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Fifteen from one: a revision of the *Galaxias olidus* Günther, 1866 complex (Teleostei, Galaxiidae) in south-eastern Australia recognises three previously described taxa and describes 12 new species

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Abstract

The systematics of the *Galaxias olidus* hyper-species complex from freshwater habitats in south-eastern, mainland Australia is revised. *Galaxias olidus* Günther 1866 is redescribed, *Galaxias fuscus* Mack 1936 and *Galaxias ornatus* Castelnau 1873, previously synonymised with *G. olidus* (*sensu lato*), are reinstated as valid taxa and redescribed, and 12 taxa are described as new: *Galaxias aequipinnis* **sp. nov.**, *Galaxias arcanus* **sp. nov.**, *Galaxias brevissimus* **sp. nov.**, *Galaxias gunaikurnai* **sp. nov.**, *Galaxias lanceolatus* **sp. nov.**, *Galaxias longifundus* **sp. nov.**, *Galaxias mcdowalli* **sp. nov.**, *Galaxias mungadhan* **sp. nov.**, *Galaxias oliros* **sp. nov.**, *Galaxias supremus* **sp. nov.**, *Galaxias tantangara* **sp. nov.**, and *Galaxias terenasus* **sp. nov.** These species are morphologically similar and, whilst there is extensive overlap in meristic counts and morphometric characters, each can be diagnosed by unique combinations of characters, including allozyme loci and colour pattern; morphological diagnosis is improved greatly if based on freshly formalin-fixed material. *Galaxias schomburgkii*

Peters 1868, *Galaxias bongbong* Macleay 1881, *Galaxias kayi* Ramsay & Ogilby 1886 and *Galaxias oconnori* Ogilby 1912 are retained as junior synonyms of *G. olidus* (*sensu stricto*). The types for *Galaxias findlayi* Macleay 1882 are lost and no specimens matching its description were collected or examined from the Mt. Kosciuszko region; it is also currently retained as a junior synonym of *Galaxias olidus* s.s. The species *G. terenasus* **sp. nov.** and *G. arcanus* **sp. nov.** are the most morphologically specialised in the complex and *G. olidus* s.s remains the most morphologically variable species. It also remains the most widespread taxon, though its previously known distribution is reduced, particularly in the south-west of its range. Nine species are narrow-range endemics, known from one, or only a few, locations, and these restricted distributions most probably reflect the fragmentation and reduction of former ranges caused by the effects of alien salmonids. Eleven species are of conservation concern, most are considered critically endangered.

Key words: Galaxiinae, systematics, sympatric, cryptic species, salmonid impacts, threatened species, endemic fishes, freshwater.

Introduction

The Galaxiidae is arguably the most widespread freshwater fish family of southern-temperate affinity in terms of geographic spread across continents (South America, South Africa, Australia, New Caledonia and New Zealand) and altitudinal range, occurring from sea level to more than 2000 m above sea level (m asl) (McDowall 1990, Raadik & Kuiter 2002, Berra 2007). With 50 valid extant species world-wide in two subfamilies (47 species in Galaxiinae and three in Aplochitoninae), galaxiids have reached a particularly high level of species richness in Australia (McDowall & Frankenberg 1981) and New Zealand (McDowall 1970a, 2000), with 20 endemic species each, and sharing two additional taxa (Allen *et al.* 2003, McDowall 1970b, 2010). *Galaxias fuscus* Mack, 1936, currently a synonym of *Galaxias olidus* Günther (see McDowall & Frankenberg 1981) is considered a valid species by some authors, though it has not been formally re-elevated to species status. It is therefore excluded here. Eight species have so far been described from fossil remains in New Zealand (Stokell 1945, Whitley 1956a, Lee *et al.* 2007, Schwarzhans *et al.* 2012).

A relatively morphologically conservative family (Wishart *et al.* 2006), galaxiids have undergone traditional taxonomic revision a number of times (Stokell 1966, McDowall 1968, Scott 1968, McDowall 1970a, 1971, 1973a,b,c, 1976, 1978a, McDowall & Fulton 1978a, McDowall & Frankenberg 1981), leading to a number of previously valid species being synonymised and a period of relative stability in galaxiid nomenclature. Recent genetic analyses, however, provide considerable additional insight into species-level diversity in the Galaxiidae.

For example, a morphological revision placed a number of similar described taxa in New Zealand into a single, widespread, and rather variable species, the Common River Galaxias, *Galaxias vulgaris* Stokell, 1949 (McDowall 1970a). Subsequent genetic analyses revealed the presence of substantial cryptic diversity in this nonmigratory member of the *Galaxias brevipinnis* species group (Allibone 1991, Allibone & Wallis 1993, Allibone *et al.* 1996), suggesting that *G. vulgaris* was a species complex. A combined molecular and morphological focus on this species complex has reinterpreted its taxonomy to include six species, four of which are new (McDowall & Wallis 1996, McDowall 1997a, McDowall & Chadderton 1999, McDowall 2006b). Four additional genetic lineages are still awaiting taxonomic delineation (McDowall & Wallis 1996, Waters & Wallis 2000, 2001a,b, Waters *et al.* 2001a,b, McDowall 2006b, Burridge *et al.* 2007, Crow *et al.* 2009). A similar case is also being observed in South Africa for the nonmigratory Cape Galaxias, *Galaxias zebratus* (Castelnau, 1861), where ten deeply divergent genetic lineages flag an unresolved species complex (Waters & Cambray 1997, Wishart 2002, Wishart *et al.* 2006, Chackona *et al.* 2011, 2013).

In the Australian Galaxiidae, significant genetic divergence has been identified in two nonmigratory species suggesting the presence of additional morphologically similar taxa (cryptic species, *sensu* Bickford *et al.* 2007; p. 149): Western Galaxias, *Galaxias occidentalis* Ogilby, 1899 (Watts *et al.* 1995, Morgan *et al.* 2010, Murphy 2010), and Dwarf Galaxias, *Galaxiella pusilla* (Mack, 1935) (Coleman *et al.* 2010, Unmack *et al.* 2012). More recently, significant levels of genetic diversity were discovered in the Mountain Galaxias, *Galaxias olidus* Günther, 1866 in which 15 deeply divergent, distinctive, genetically defined candidate species (*sensu* Vences *et al.* 2005) were diagnosed (Raadik 2011, Adams *et al.* 2014).

Substantial genetic subdivision in *G. olidus* sensu lato (s.l.) is not surprising. It is globally the most widespread, nonmigratory, obligate freshwater species of galaxiid, recorded from an estimated area of 890,000 km^2 in south-eastern, mainland, Australia (see fig. 9 in McDowall & Frankenberg 1981). This distribution far exceeds that of the next most-widespread nonmigratory galaxiid, the Patagonian Puye Grand (*Galaxias platei*) of South America (McDowall 1971, Cussac *et al.* 2004). Given this broad geographic range across discrete river systems and biogeographic provinces (Unmack 2001, 2013) isolated by mountain ranges, lack of migration and restriction to freshwater (Raadik 2011), suggests it is highly vulnerable to isolation in an evolutionary context and therefore could harbour species-level genetic divergence. Additionally, considerable environmental heterogeneity at large (climate zones such as alpine, lowland etc.) and fine (riffles, pools, springs, lakes) scales, and short (seasonal and perennial flow regimes) and longer term (ice-age cycles of drainage connectivity, earth history events) temporal variability could also promote ecological specialisation and speciation (see Hammer *et al.* 2013, Unmack 2013).

Galaxias olidus s.l. has received little taxonomic attention over the last 33 years since being subjected to a morphologically-based systematic revision (McDowall & Frankenberg 1981). This is despite one species (*Galaxias fuscus* Mack, 1936) synonymised with *G. olidus* s.l. being informally resurrected by some, and the identification of additional morphologically distinct forms (Raadik *et al.* 1996, Raadik 2001, Allen *et al.* 2003, Raadik *et al.* 2010, Raadik unpubl. data). The 15 genetically-defined candidate taxa in *G. olidus* s.l. were also found to be diagnosable from each other, following a detailed morphological analysis. Based on multiple lines of evidence, they were consequently defined as a hyper-cryptic species complex of distinct species, all valid under multiple species concepts (Raadik 2011, Adams *et al.* 2014). This grouping of taxa is herein referred to as the '*Galaxias olidus* complex', or upland galaxiids.

In light of the above the taxonomy of *Galaxias olidus* s.l. is herein revised, with descriptions of new species and valid taxa redescribed. A key to all species in the *G. olidus* complex, and revised keys to genera of Australian Galaxiidae, and species of *Galaxias* in eastern, mainland Australia, are also provided, with the status and conservation of species within the context of the new taxonomic framework discussed.

Historical background

Early Australian galaxiid taxonomy consisted primarily of descriptions of new species, with the first discovered (*Galaxias truttaceus* Valenciennes, 1846 and *Galaxias scriba* Valenciennes, 1846 [= *Galaxias maculatus* (Jenyns, 1842)] described in 1846, 30 years after the genus *Galaxias* was defined (Cuvier 1816, Valenciennes 1846). The third Australian species was *Galaxias olidus* Günther, 1866, which was followed by descriptions of 25 additional species to 1900 (Hoese *et al.* 2006).

The current taxonomy of *Galaxias olidus* s.l. was defined by McDowall & Frankenberg (1981), who synonymised seven previously valid and morphologically similar taxa, with that species: *Galaxias schomburgkii* Peters, 1868, *Galaxias ornatus* Castelnau 1873, *Galaxias bongbong* Macleay, 1881, *Galaxias findlayi* Macleay, 1882, *Galaxias kayi* Ramsay & Ogilby, 1886, *Galaxias oconnori* Ogilby, 1912, and *Galaxias fuscus* Mack, 1936 (Table 1). To progress with a reinterpretation of *G. olidus* s.l., it is important to understand the taxonomic treatment of these various taxa that have been associated with it from an historical perspective and to document the various taxonomic decisions leading to the currently accepted taxonomy. The text from the original descriptions for the above eight taxa is provided in Appendix 1.

Macleay (1881) was the first to provide a list of all Australian galaxiids known, including *G. olidus*, *G. bongbong* and *G. ornatus*, though Ogilby (1896) was the first to critically comment, albeit briefly, on overall galaxiid systematics with a number of proposed corrections and suggestions. Ogilby (1896) provided a list of the 32 species of *Galaxias* known world-wide to date and noted that many were probably junior synonyms. More importantly he was the first to recognise problems with the degree of morphological variation in some members of the family, commenting that, to delimit species satisfactorily, "…a full series of each variety or subspecies..." and "...local variation in the same form..." needed to be brought together for examination (Ogilby 1896, p. 70). Pertinent to the current study, Ogilby (1896, p. 69 & 71) stated that *G. olidus* was not from Australia (Table 1), though he did not base this decision on an examination of the holotype, and he did not associate any of the morphologically similar species with it or with each other. Ogilby (1896, p. 71) also (incorrectly) suggested that *G. schomburgkii* and *G. kayi* were 'varieties' of *Galaxias waterhousei* [= *Galaxias maculatus*].

Regan (1906) was the first to undertake an intensive and critical review of the entire family and his work is an important, first taxonomic synthesis. Unfortunately he was unable to examine all type material, substituting topotypical material where possible, or relying on original descriptions which were sometimes lacking in detail. He also worked on material available in the collection of the British Museum and material donated or loaned to him by other institutions and so was also hampered by a lack of freshly collected specimens. With respect to *G. olidu*s and five of the morphologically similar species described up to that time, he retained four and synonymised two, one each with *G. olidus* and *G. findlayi* (Table 1). He also rejected the earlier suggestion by Ogilby (1896) that *G. olidus* was a New Zealand species.

TABLE 1. Chronological summary of proposed valid species and taxonomic changes in the *Galaxias olidus* species group. Significant revisions are marked with an asterisk. Junior synonyms are indented below valid species names.

Ogilby (1896) *Galaxias olidus* Günther, 1866, from New Zealand, not Australia.

Regan (1906)*

- *Galaxias findlayi* Macleay, 1882.
    - *Galaxias bongbong* Macleay, 1881.
- *Galaxias olidus* Günther, 1866.
    - *Galaxias kayi* Ramsay & Ogilby, 1886.
- *Galaxias ornatus* Castelnau, 1873.
- *Galaxias schomburgkii* Peters, 1868.

McCulloch (1929)

- *Galaxias bongbong* Macleay, 1881.
- *Galaxias findlayi* Macleay, 1882.
- *Galaxias oconnori* Ogilby, 1912.
- *Galaxias olidus* Günther, 1866.
    - *Galaxias kayi* Ramsay & Ogilby, 1886.
- *Galaxias ornatus* Castelnau, 1873.
- *Galaxias schomburgkii* Peters, 1868.

Mack (1936)

- *Galaxias ornatus* Castelnau, 1873.
    - *Galaxias findlayi* Macleay, 1882.
- *Galaxias fuscus* sp. nov.

Stokell (1947)

- *Galaxias olidus* Günther, 1866, from New Zealand, not Australia and possibly invalid.
- *Galaxias kayi* Ramsay & Ogilby, 1886.

Whitley (1957b)

- *Galaxias bongbong* Macleay, 1881.
- *Galaxias findlayi* Macleay, 1882.
- *Galaxias fuscus* Mack, 1936.
- *Galaxias kayi* Ramsay & Ogilby, 1886.
    - *Galaxias oconnori* Ogilby, 1912.
- *Galaxias ornatus* Castelnau, 1873.
- *Galaxias schomburgkii* Peters, 1868.

Frankenberg (1969)*

- *Galaxias olidus olidus* Günther, 1866.
    - *Galaxias bongbong* Macleay, 1881.
    - *Galaxias kayi* Ramsay & Ogilby, 1886.
    - *Galaxias oconnori* Ogilby, 1912.
    - *Galaxias ornatus* Castelnau, 1873.
    - *Galaxias schomburgkii* Peters, 1868.
- *Galaxias olidus findlayi* (Macleay, 1882).
- *Galaxias olidus fuscus* (Mack, 1936).
- *Galaxias olidus johnstoni* (Scott, 1936).

McDowall & Frankenberg (1981)*

- *Galaxias olidus* Günther, 1866.
    - *Galaxias bongbong* Macleay, 1881.
    - *Galaxias findlayi* Macleay, 1882.
    - *Galaxias fuscus* Mack, 1936.
    - *Galaxias kayi* Ramsay & Ogilby, 1886.
    - *Galaxias oconnori* Ogilby, 1912.
    - *Galaxias ornatus* Castelnau, 1873.
    - *Galaxias schomburgkii* Peters, 1868.

McCulloch (1929), in his check-list of Australian fishes, included the newly described *Galaxias oconnori* Ogilby, 1912 as a valid species and followed the taxonomic decisions of Regan (1906), apart from re-elevating *Galaxias bongbong* Macleay, 1881 to full species status. Mack (1936) restricted his attention to galaxiids in the state of Victoria, describing as new *Galaxias fuscus* but placed *G. findlayi* in a synonymy with *G. ornatus* (Table 1). Stokell (1947) agreed with Ogilby (1896), though for different reasons, stating that *G. olidus* was not from Australia but possibly from New Zealand; even suggesting it may be an invalid name (Table 1). He based this on "...certain circumstances noted…" during his early work on the New Zealand Galaxiidae, but did not elaborate further (Stokell 1947 p. 671). Stokell only examined an X-ray of the holotype of *G. olidus*, and was confused by a second, though headless, specimen found in the same jar as the holotype at the British Museum. To clarify this point, the headless specimen, still in the same jar as the holotype along with its detached head, was borrowed and examined by the current author and found to conform to *Galaxias brevipinnis* Günther, 1866. As this additional specimen is not involved in the description of *Galaxias olidus* Günther, 1866, it has no relevance to its taxonomic validity. Stokell (1947) also reversed a taxonomic decision of Regan (1906) by recognising *G. kayi* as a valid species, based on a comparison of three specimens of *G. kayi* (probably not from the type series) and the description and X-ray of *G. olidus.*

Whitley (1956b) listed all seven taxa as valid, yet then followed Ogilby (1896) and omitted *G. olidus* from his list of Australian Galaxiidae (Whitley 1957a) (Table 1), as did some later workers (Munro 1957, Lake 1971). Confusingly, he also synonymised *G. olidus* with *G. kayi* (Whitley 1957b). Whitley (1957a) retained six of the remaining seven morphologically similar taxa as valid species, though synonymised *G. oconnori* with *G. kayi*. The above publications, except for Regan (1906), are not considered to constitute detailed revisions but are general or cursory assessments. They were based on a mix of species descriptions taken from the literature, the examination of a limited number of type specimens (very few studies), and the study of small collections of additional museum material, many of which appear to have been incorrectly identified and the majority which appear to have not been freshly collected. Apart from Regan (1906) justification were rarely provided for taxonomic changes (e.g. McCulloch 1929, Whitley 1957a).

Next, Frankenberg (1969) examined Australian galaxiids using morphometric, meristics and osteological techniques, undertook taxonomic revisions and defined species-groups. Importantly, he attempted to view type material and also undertook extensive collecting for fresh comparative material. He reinterpreted the taxonomy of the *Galaxias olidus* species-group, retaining *G. olidus* as valid though with three subspecies (*Galaxias olidus findlayi*, *G. o. fuscus* and *G. o. johnstoni*), and synonymised the remaining five morphologically similar taxa under *G. olidus* (Table 1). Significantly, he added *Galaxias johnstoni* Scott, 1936 from Tasmania as one of the subspecies based on morphology, the first non-mainland taxon in the group. Frankenberg's work remained unpublished but was later synthesized into a more detailed revision of the Australian Galaxiidae completed in the mid-1970s (McDowall & Frankenberg 1981). The latter differed from the former in recognising *G. johnstoni* as a valid species outside of the *G. olidus* species-group and in synonymising all other nominal species with *G. olidus* Günther, with no subspecies (Table 1).

Whilst not stated, McDowall & Frankenberg (1981) appear to have grouped all species in the genus *Galaxias* into phylogenetic species-groupings based on morphological similarity, with *G. olidus* placed in a group with *Galaxias brevipinnis*, *Galaxias johnstoni*, *Galaxias pedderensis* Frankenberg, 1968, and *Galaxias fontanus* Fulton, 1978(a), the last three taxa confined to Tasmania. This particular complex had been suggested earlier by some authors (Frankenberg 1969, Andrews 1976, Fulton 1978a, McDowall 1980). Following further morphological/ meristic work on Tasmanian galaxiids, using the mainland *G. olidus* as an outgroup, Johnson *et al.* (1983) found little support for this species-grouping. Instead, their work somewhat supported a group consisting of *G. brevipinnis*, *G. fontanus*, *G. johnstoni*, and *G. pedderensis* and was inconclusive about a relationship between *G. olidus* and the Tasmanian *G. parvus* Frankenberg, 1968.

Recent molecular work provides an alternative perspective on the species-grouping of McDowall & Frankenberg (1981), but does indicate a close affinity between the mainland *Galaxias olidus* and Tasmanian *Galaxias parvus* (Waters 1996, Waters *et al.* 2000a, Burridge *et al.* 2012). It also suggests both species may be more closely related to the endemic Tasmanian Galaxiinae genus *Paragalaxias* than to the other taxa in the genus *Galaxias*, although these relationships require further investigation. The above relationships are not supported by detailed osteological/ morphological analysis (McDowall & Burridge 2011), though the study focussed on higher level relationships.

Lastly, the treatment of the Mountain galaxias (*Galaxias olidus*) complex by Kuiter (2013) is confusing and does not contribute to the taxonomic clarification within this group of fishes. It is not based on genetic data nor detailed morphological study of a large amount of comparative material, and identifies many putative new taxa (albeit without formal taxonomic description) based mainly on visual differences between a very small number of individuals from particular populations (usually only the specimens used for the images). Where putative new taxa of Kuiter (2013) agree with those of Raadik (2011), they do so as Kuiter was aware of the work of Raadik (2011), as he undertook much of the photography of Raadik's study material, including new species, many of which are reproduced in Kuiter (2013). Those putative new taxa which do not agree with the findings of Raadik (2011) are additional populations of two widespread species, though exhibiting different body patternation and slight morphological differences: all had been analysed by Raadik (2011) and found not to warrant recognition as new taxa. Further, some species treatments of Kuiter (2013) include putative hybrid individuals, which were only later (after being photographed) identified as such by Raadik (2011) using genetic analysis.

Brief overview of *Galaxias olidus* s.l.

Commonly called the Mountain Galaxias, *Galaxias olidus* s.l., as defined by McDowall & Frankenberg (1981), has a broad distribution on both sides of the Great Dividing Range (GDR) on mainland Australia (~ 27º 58′-38º 50′ S, 137º 01′-153º 10′ E), extending from near Toowoomba in southern Queensland, through New South Wales and Victoria, to Kangaroo Island in South Australia (McDowall & Fulton 1996, McDowall 2006a). A small species (<

135 mm in length), it occupies freshwater streams and larger rivers, commonly in foothill and montane areas and extending into alpine reaches, though it is also found in lowland zones (McDowall & Fulton 1996). *G. olidus* s.l. completes its entire life-cycle in freshwater (Cowden 1988, Drayson 1989, O'Connor & Koehn 1991, Close 1995) and is the most widespread species of non-diadromous galaxiid in Australia. Many populations are severely impacted by negative interactions with the predatory alien species Brown Trout (*Salmo trutta*) and Rainbow Trout (*Oncorhynchus mykiss*), leading to localised extirpations and fragmentation and geographic isolation of remaining populations (Frankenberg 1966, Tilzey 1976, Cadwallader 1979, Raadik 1995a, Cadwallader 1996, Closs 1996, Closs & Lake 1996, Raadik et al. 1996, Lintermans 2000a, Lintermans & Raadik 2003, McDowall 2006a, Green 2008). Though less severe, populations can also be affected by landuse changes which lead to instream sedimentation, loss of habitat and increased water salinity, and from alteration to flow regimes.

Materials and methods

Institutional codes follow Leviton *et al.* 1985, except **TMAG**—Tasmanian Museum and Art Gallery, Hobart.

The following abbreviations are used in the text: **ACT**—Australian Capital Territory; **DD**—Drainage Division; **d/s**—downstream; **LHS**—left hand side; **m asl—**metres above sea level; **MDB**—Murray–Darling Basin drainage division; **mtDNA**—mitochondrial DNA; **NEC**—North-east Coast drainage division; **N.P.**—National Park; **NSW**—New South Wales (the Australian state of); **NZ**—New Zealand; ***partim***—Latin, in part, partly; **QLD**—Queensland (the Australian state of); **RB**—River Basin; **SA**—South Australia (the Australian state of); **RHS**—right hand side; **SAG**—South Australian Gulf drainage division; **SEC**—South-east Coast drainage division; **s.l.**—Latin, *sensu lato*, in the broad sense; **s.s.**—Latin, *sensu stricto*, in the strict sense; **TAS**—Tasmania (the state of); **trib.**—tributary; **u/s**—upstream; **VIC**—Victoria (the Australian state of); **WA**—Western Australia (the Australian state of).

Study material

To adequately undertake a systematic revision of the morphologically conservative *Galaxias olidus* s.l. complex required detailed examination of a large amount of comparative material from throughout its extensive geographical range, including material representing previously identified morphotypes. This was particularly important to maximise the chance of locating previously unrecognised taxa, particularly narrow-range endemics, which could potentially be missed in broader-scale collecting. Key steps in compiling a comprehensive comparative dataset of specimens were: collation of existing location data and specimens; evaluation of suitability of existing specimens for morphological examination; and intensive field collection of fresh voucher material.

This dataset was extensively used in this taxonomic revision, and earlier in the genetic and morphological study by Raadik (2011) and Adams *et al.* (2014). Its scope and compilation is detailed below.

Location data. The extensive distribution of *Galaxias olidus* s.l. (see McDowall & Frankenberg 1981, figure 9), was largely defined in approximately 1978 (see McDowall 1979) based on substantiated locality records from field collections and museum material. To update this dataset from 30+ years ago, a search was made for additional distributional records, sourced from published and grey literature, state fisheries authorities, universities, consultants and private collectors. A search was also conducted for collections of Galaxiidae in Australian and international museums during 2001–2009 via the FishBase collection search function (see Froese & Pauly 2009, Eschmeyer & Fricke 2013), online collection databases or by e-mail contact with various museums without online data search facilities (Appendix 2). The final dataset consisted of 2650 records (not shown), within the previously known distribution, though extending slightly farther north along the coast into southern QLD (Terzis 1986). The earliest confirmed record of the taxon was the specimen (holotype) sent to England by Gerard Krefft and formally described as *Galaxias olidus* in 1866 (Günther 1866).

This distribution covers four discrete hydrological drainage divisions (DD), North-east Coast, South-east Coast, Murray–Darling Basin and South Australian Gulf, which each contain a number of river drainages (or basins (RB)) (AWRC 1976). Drainage systems within each division are geographically isolated from those in adjacent divisions usually by mountain ranges (Fig. 1). This broad area includes three major biogeographical provinces proposed for Australian freshwater fish (Murray-Darling, Eastern and Bass), and 10 biogeographical regions within these provinces (Unmack 2001).

Assessment of existing comparative material. Where possible, the identification of museum specimens was confirmed by direct examination or from high definition images. Previously unidentified *Galaxias* specimen lots were identified, and specimen lots of other *Galaxias* species, occupying similar distributions (e.g. *Galaxias brevipinnis*, *Galaxias maculatus*, *Galaxias rostratus* Klunzinger, 1872 and *Galaxias truttaceus*), were checked for misidentifications (seven lots previously identified as *Galaxias olidus* s.l. were reassigned to other taxa and eight additional lots were re-determined as *G. olidus* s.l.; Appendix 3).

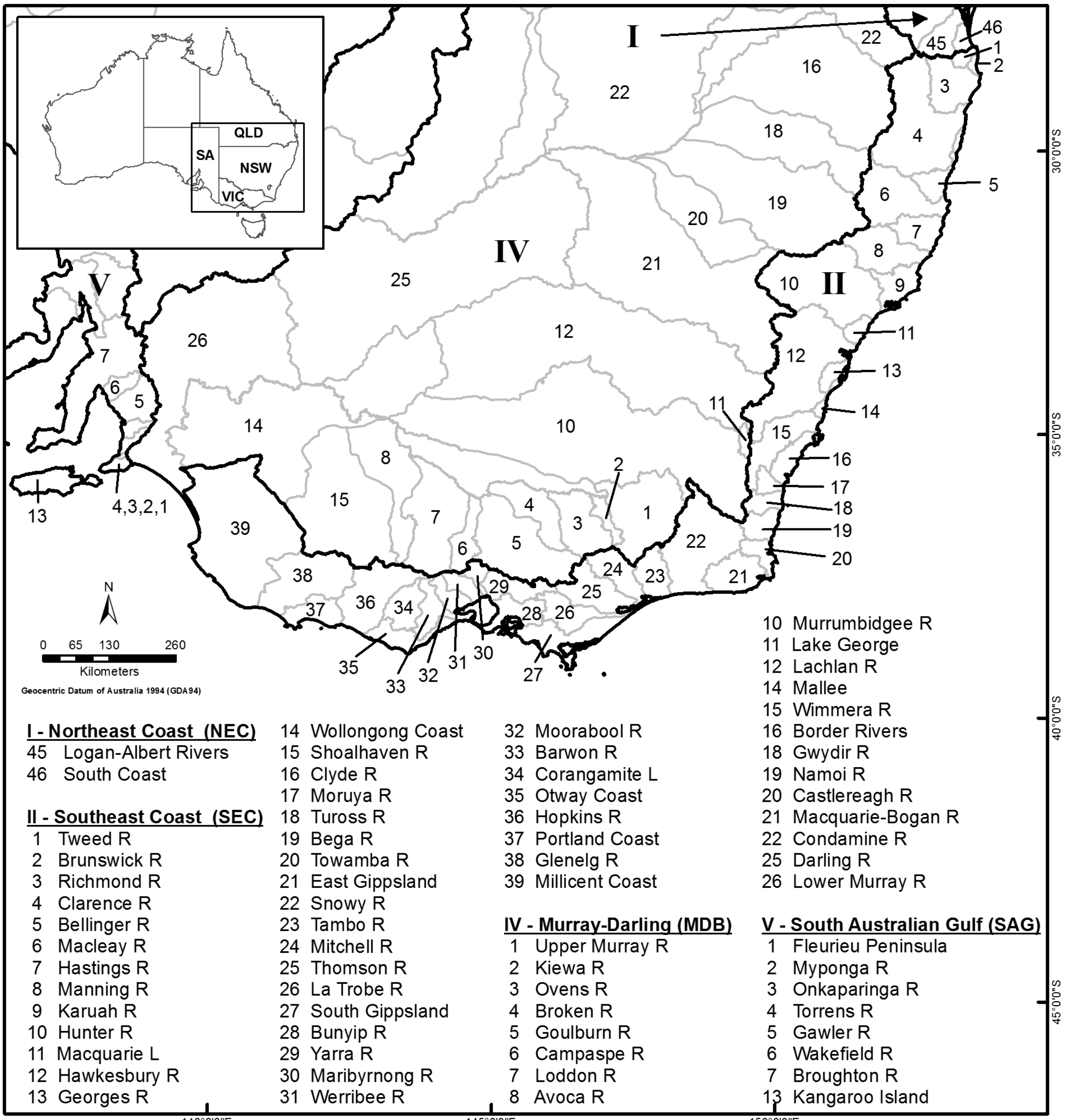

FIGURE 1. Codes and names of Drainage Divisions (bold) and River Basins of interest in the area of this study in southeastern Australia. Drainage Divisions and River Basins as defined by the AWRC (1976).

Specimen lots examined by McDowall & Frankenberg (1981) were used as a baseline from which to start and expand the collection of comparative material for this study. They examined approximately 285 specimen lots from ~201 sites (McDowall 1979), representing a good coverage of the distribution and almost 50 % of the *Galaxias olidus* s.l. locations known at that time (pre 1978). However, the following issues, which potentially constrained their findings, should be noted: only 62 specimen lots were examined in detail, from which morphometric and/or meristics data were taken; none were from the MDB side of the Adelaide Hills in SA; only one population of *Galaxias fuscus* Mack, 1936 was morphologically examined and, of extant type specimens, the type for *Galaxias ornatus* Castelnau, 1873 was not seen (McDowall & Frankenberg 1981). In addition, specimens from the following river basins were not available: Genoa and Glenelg River systems (SEC, RB 21 and 38 respectively), Wimmera and Lower Murray systems (MDB, RB 15 and 26 respectively), and Kangaroo Island in South Australia (SAG, RB 13) (Fig. 1).

Overall, 1132 lots of spirit-preserved specimens, referrable to *Galaxias olidus* s.l., were identified. Of these about 78 % were in state or international museum collections (Appendix 4), of which approximately 97 % were housed in mainland Australian institutions. Australian museum material, which could be located (some lots were missing), was initially examined during visits to these institutions or via specimen loan. A small number of specimens were also borrowed from overseas institutions or examined from digital images if loans could not be arranged. Type material for *G. olidus* Günther, and for the species considered by McDowall & Frankenberg (1981) to be junior synonyms, was also examined, either directly or via digital images. A small number of preserved lots of fish were also donated from private collectors or state fisheries agency staff during the early part of the study. These were added to a large collection consisting of about 250 lots, mainly from across VIC, accumulated over a 10 year period by the author before the study commenced.

Preserved specimens varied widely in their condition, and therefore in their suitability for morphological analysis. Older samples (pre 1950) were usually distorted due to bending, twisting and shrinkage, as were much of the more recent material (pre 1980). Therefore the majority of the available spirit preserved specimens (those poorly to moderately poorly preserved) were considered unsuitable, due to distortion from swelling, shrinkage, twisting or bending, as comparative material for fine-scale morphometric analysis (e.g. Valentin *et al.* 2008), and hence avoided (though later examined and compared with the new species descriptions and assigned to new taxa if needed). Furthermore, the geographic coverage of existing specimens was sparse in many collected areas and also contained large datagaps within the known distribution. Finally, many specimen lots were represented by only a few individuals. The bulk of this material was, however, suitable for additional meristic analysis and valuable for general comparisons and species location records, with some material valuable for the identification of potentially distinctive forms.

Field sampling. Targeted, intensive field sampling, guided by the previously compiled distributional dataset, was undertaken to collect fresh specimens suitable for morphological comparison and taxonomic description across the documented range of *Galaxias olidus* s.l., except in the MDB portion of NSW. Here sampling was restricted to areas likely to harbour resident populations of *G. olidus* s.l. in medium to higher elevation areas generally east of the Newell Highway, but including the area of higher elevation extending westward between Peak Hill and Coonabarabran. Sampling also involved an increase in effort in catchments identified as potentially having a diversity of morphotypes or additional sampling if populations were hard to find or fish numbers were low.

Fish were collected during daylight hours using a portable, battery powered Smith-Root® Model 12B electrofishing unit. Selected galaxiids were euthanased in a bath of anaesthetic (Cove oil, 40 mg/L for 10 minutes) and species/morphotype identifications were double-checked before fixation. Whole fish were fixed in a 10 % solution of neutral buffered formalin, in a sufficiently large plastic container to avoid bending fish or fins. After five to seven days (depending on fish size) samples were washed in freshwater to remove excess formalin and were transferred into 70 % ethanol for long term storage.

A total of 1187 sites were visited between March 2001 to December 2005, and *Galaxias olidus* s.l. was recorded from 453 sites across its previous distribution, except from the NEC DD in south-east Queensland where it had previously been recorded (Terzis 1986). Locations ranged in altitude from 50 m asl near the coast in the Glenelg system (SEC, basin 38) to 1940 m asl on Mount Kosciuszko (SEC, basin 22) (Fig. 1). Within its known range, sampling failed to record the taxon in previously identified datagap areas, except for the Hastings River basin in coastal northern NSW (SEC, basin 07) and the Tuross River basin in southern coastal NSW (SEC, basin 18), from which it was recorded for the first time. Furthermore, McDowall & Frankenberg (1981) stated the taxon was absent from "...between the Macleay and Hawkesbury Rivers..." (p. 489) but this was in error as they were aware of a record from the Hunter River system (Omadale Brook, AMS IB.743, registered 1909). *G. olidus* s.l. was sampled during this study from an additional seven sites in the Hunter River system, confirming its presence in that catchment.

Specimens were retained from 395 sites, with the number of individuals per lot ranging from one to 40. The final morphological collection consisted of 645 lots (freshly and recently collected) of fixed and preserved whole specimens, and approximately 879 suitable specimen lots available in museum collections for general comparison.

Morphology

Species descriptions and re-descriptions are based on a conventional suite of morphometric and meristic characters (Hubbs & Lagler 1958). These have been modified and include additional characters previously found to be informative for taxonomic studies of galaxiid fishes (e.g. Frankenberg 1969, McDowall 1970a). These characters, and the methods for measurement (morphometric) or counts (meristic), generally follow procedures described by Frankenberg (1969), McDowall (1970a), (2001); McDowall & Frankenberg (1981) and McDowall & Wallis (1996). However, whilst documented, many of the characters and their measurement were originally poorly defined, or have become further modified, and are therefore difficult to apply. In addition, new characters, important for discrimination in the *Galaxias olidus* complex, have been developed for this study. To improve precision, aid comparison, and to provide a sound methodology for future galaxiid work, the morphological characters and the methods to obtain them, including modified or new characters, are here re-defined.

Measurements and counts were conducted on fish 50 mm or greater in length (LCF) (except for a diminutive taxon), considered to represent adult fish, however, meristic counts were also taken from smaller individuals when needed. To improve the accuracy of dimension measurements (McDowall & Wallis 1996, McDowall & Hewitt 2004), the majority of specimens measured were those which had been relatively recently collected by the author and preserved in a systematic fashion, and a smaller amount of well-preserved existing museum material.

Suspected hybrid individuals (morphologically anomalous individuals from populations from which presumptive hybrids were allozymically identified (Raadik 2011, Adams *et al.* 2014)) were excluded. Morphological analysis was undertaken on a suite of morphometric and meristic characters, including objective comparisons of additional characters (see below) to determine which characters provided discrimination between taxa, followed by species diagnoses. Details of this methodology, which generally followed Horner (2007), and results are presented in Raadik (2011) and Adams *et al.* (2014).

Morphometric characters. Length measurements were taken to the nearest 0.1 mm with needlepoint digital vernier calipers, with the aid of a 3 x illuminated magnifier (Maggylamp—Redbank Instruments), or under a dissecting stereomicroscope. Readings were transferred, as they were taken, directly to an electronic spreadsheet via a digital adaptor (GaugeLink™). Measurements, particularly the establishment of consistent dimension reference points, were defined from a preliminary investigation and adhered to throughout the measuring phase of the study.

The morphometric character suite comprised the following 26 measured characters (Figs. 2–3), including one calculated character: **AL** (anal fin length)—distance from anterior end of anal fin base to posteriormost extremity of longest fin ray; **BDPec** (body depth at pectoral fin base)—vertical depth of body through pectoral fin base; **BDV** (body depth at vent)—vertical depth of body above vent; **CFFL** (caudal fin fork length)—calculated measurement (LCF—SL); **DCP** (depth of caudal peduncle)—vertical depth of caudal peduncle at posterior end of anal fin base; **DF–AF—**direct measure of the horizontal distance between two vertical lines, drawn through the origin of the dorsal fin and the anal fin; **DL** (dorsal fin length)—distance from dorsal fin origin to posteriormost extremity of longest fin ray; **ED** (eye diameter)—greatest horizontal distance between anterior and posterior margins of orbit; **GW** (gape width)—direct distance between junction of lower and upper jaws on each side of head, measured from ventral surface; **HD** (head depth)—maximum vertical depth measured from above middle of eye; **HL** (head length)—direct distance from tip of snout to most posterior extent of fleshy portion of gill cover above pectoral fin base; **HW** (head width)—maximum horizontal width measured at preopercular margin; **IOW** (interorbital width)—distance between mid-dorsal margins of eyes; **LAB** (length of anal fin base)—length of the fin base; **LCF** (length to caudal fork)—horizontal distance from tip of snout to caudal fin fork; **LCP** (length of caudal peduncle)—oblique distance measured from posterior end of base of last anal fin ray to midposterior edge of hypural joint; **LDB** (length of dorsal fin base—length of the fin base; **LJL** (lower jaw length—distance from tip of lower jaw to posterior margin; **PecL** (pectoral fin length—distance from middle of fin base to posterior end of longest fin ray; **PecPel** (pectoral fin to pelvic fin length—direct distance from middle of pectoral fin base to origin of pelvic fin; **PelAn** (pelvic fin to anal fin length—direct distance from origin of pelvic fin base to origin of anal fin; **PelL** (pelvic fin length)—distance from dorsal origin of fin to proximal tip of longest fin ray; **PoHL** (post-orbital head length)—distance from posterior end of eye (orbit) to posteriormost extent of fleshy portion of gill cover above pectoral fin base; **PreA** (pre-anal fin length)—direct distance from tip of snout to anal-fin origin; **PreD** (pre-dorsal fin length—direct distance from tip of snout to dorsal-fin origin; **PrePel** (pre-pelvic fin length)—direct distance from tip of snout to origin of pelvic fin; **SL** (standard length)—horizontal distance from tip of snout to midposterior edge of hypural joint; **SnL** (snout length)—direct distance from tip of snout to anterior margin of eye; **UJL** (upper jaw length)—distance from tip of snout to posterior extent of upper jaw.

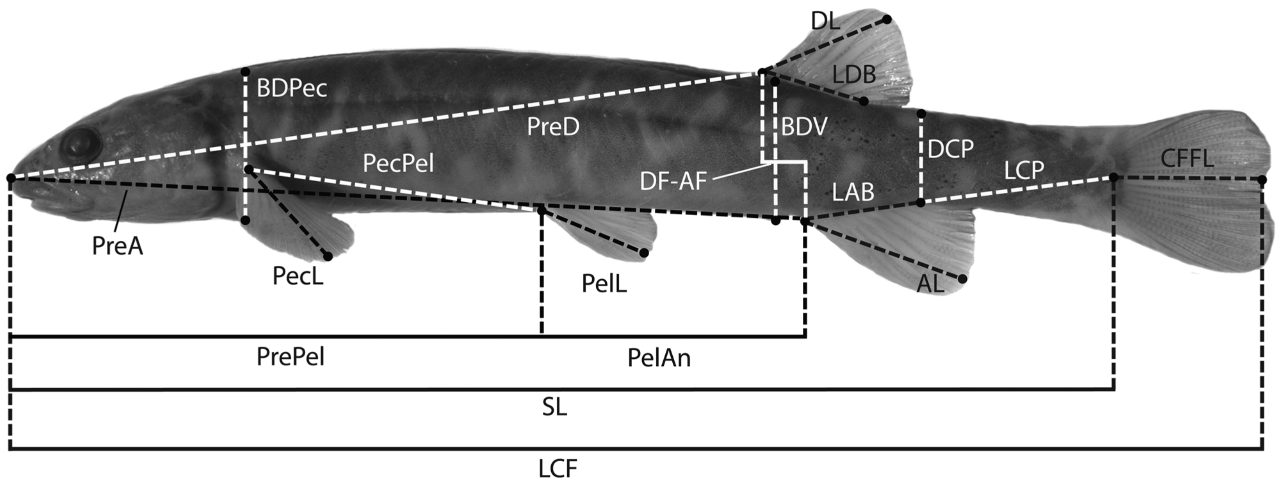

FIGURE 2. *Galaxias* body and fin morphometric measurements. AL—anal fin length; BDPec—body depth at pectoral fin origin; BDV—body depth at vent; CFFL—caudal fin fork length; DCP—caudal peduncle depth; DF–AF—anal fin setback; DL—dorsal fin length; LAB—anal fin base length; LCF—length to caudal fork; LCP—caudal peduncle length; LDB—dorsal fin base length; PecL—pectoral fin length; PelL—pelvic fin length; PelAn—distance between pelvic and anal fin bases; PecPel—distance between pectoral and pelvic fin bases; PreA—pre-anal fin length; PreD—pre-dorsal fin length; PrePel—pre-pelvic fin length; SL—standard length.

The calculated measurement CFFL gave a measure of the length of the middle rays of the emarginate caudal fin, and BDPec defined the depth of the body towards its anterior end (Fig. 2) and unlike BDV, was considered a surrogate for maximum body depth. Importantly, BDPec was independent of the degree of distension of the ventral body wall due to stomach fullness or gonad development as it was well forward of these areas. HD in galaxiids is an uncertain measurement and is usually taken at the posterior margin of the cranium (McDowall 1970a), though it has also been taken at a vertical above the isthmus (McDowall & Frankenberg 1981). In galaxiids, the greatest HD is at the posterior end of the head and reduces anteriorly, often with the greatest reduction from the posterior margin of the cranium anteriorly across the nape. Consequently a HD measurement taken posteriorly is unrepresentative of the depth of the head along its length and is almost identical to a measure of anterior body depth, which is already recorded (BDPec). Therefore HD was taken at a vertical measured through the middle of the eye (Fig. 2) to reflect a measure of average head depth along its length. Similarly, HW, usually recorded at or near the posterior margin of the head, was taken at a more representative position, at the most posterior edge of the preopercular margin which is defined by an indent on the gill cover (Fig. 3a).

Occasionally, determining the anterior point of origin of the dorsal fin is difficult as the fin base in some individuals can extend varying distances anteriorly from the first segmented ray. A portion of the fin in this area is underlain by procurrent rays but the fin base can extend farther anteriorly as a low ridge of tissue, unsupported by rays. Usually the most anterior procurrent ray is defined by a small notch and groove in the fin base, with the groove curving posterio-ventrally a short distance onto the lateral surface of the fin base. This notch and groove, which provide flexibility for fin movement, were defined as the origin of the dorsal fin in this study.

The relative position of the origin of the anal fin with respect to that of the dorsal fin is a diagnostic character for some species in the Galaxiidae (McDowall 1970a, McDowall & Frankenberg 1981). The method of determining its position, developed by Frankenberg (1969), consists of a ratio derived from the morphometric characters PreD—PreA / LDB, expressed as a percentage (Fig. 2). However, the measurements PreD and PreA can be influenced by the depth of the trunk (BDV), resulting in the distances seeming to be longer (fins placed farther back) in deeper bodied specimens, though the relative position of the origin of each fin to the other remain similar between specimens. These length measurements can also be influenced by body distortion, and as the setback of the anal fin from the origin of the dorsal is relatively small (usually < 10mm), a small amount of error in PreD or PreA can significantly influence the above equation, particularly as LDB is also a relatively short measurement. A more precise measurement, defined as DF–AF (Fig. 2), is a direct measure of the horizontal distance between the origin of each fin base. With the specimen on its side and horizontal, the measurement is taken by placing the arms of a set of calipers at a right angle across the trunk of the specimen so that the inside edge of each arm intersects the origin of a fin base (i.e. edge of anterior arm at the dorsal fin origin and posterior arm at anal fin origin). As fin bases can be fleshy, sometimes with procurrent rays and raised fleshy ridges, care must be taken to accurately establish the point of origin of each fin base and to do this consistently between taxa. This is best undertaken under a dissecting microscope. This character was specifically assessed for its degree of discrimination amongst taxa in the *Galaxias olidus* complex (see Results).

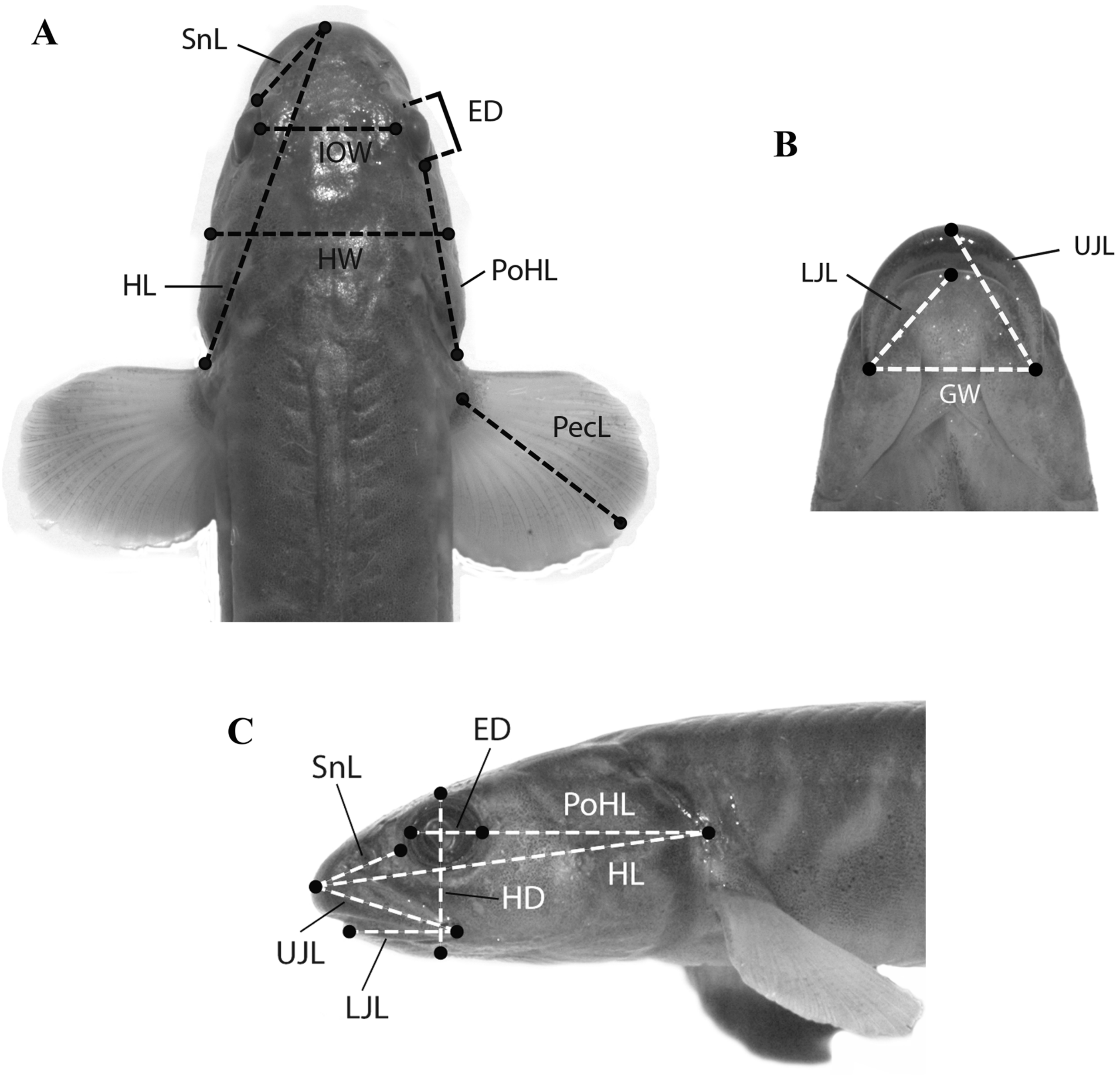

FIGURE 3. *Galaxias* head morphometric measurements: A) dorsal; B) ventral; C) lateral. ED—eye diameter; GW—gape width; HD—head depth; HL—head length; HW—head width; IOW—inter-orbital width; LJL—lower jaw length; PecL—pectoral fin length; PoHL—post-orbital head length; SnL—snout length; UJL—upper jaw length.

Meristic characters. The following 17 serially-repeated meristic characters were enumerated: **Dorsal Rays (T)** (dorsal fin rays—total)—number of segmented rays; last ray, if bifurcated at base, counted as a single element;

Dorsal Rays (B) (dorsal fin rays—branched)—number of segmented branched rays; **Dorsal Rays (S)** (dorsal fin rays—unbranched)—number of segmented but unbranched rays; last ray, if bifurcated to near the base, counted as a single element; **Anal Rays (T)** (anal fin rays—total)—number of segmented rays; last ray, if bifurcated at base, counted as a single element; **Anal Rays (B)** (anal fin rays—branched)—number of segmented branched rays; **Anal Rays (S)** (anal fin rays—unbranched)—number of segmented but unbranched rays; last ray, if bifurcated to near the base, counted as a single element; **Caudal Rays** (caudal fin rays)—principal caudal fin ray count (branched segmented rays plus one unbranched segmented ray above and below branched rays); **Pectoral Rays (T)** (pectoral fin rays—total)—number of segmented rays; **Pectoral Rays (B)** (pectoral rays—branched)—number of segmented branched rays; **Pectoral Rays (S)** (pectoral rays—unbranched)—number of segmented unbranched rays; **Pelvic Rays (T)** (pelvic fin rays—total)—number of segmented rays; **Pelvic Rays (B)** (pelvic fin rays—branched)—number of segmented branched rays; **Pelvic Rays (S)** (pelvic fin rays—unbranched)—number of segmented unbranched rays; **Gill Rakers (T)** (gill rakers—total)—number of gill raker elements on lower and upper limb of first gill arch, including any vestigial anterior rakers. Raker in bend of arch included in lower limb count. Counts made separately for each limb and total count derived by addition; **Gill Rakers (L)** (gill rakers—lower)—number of gill raker elements on lower limb of first gill arch, including any vestigial anterior rakers; **Gill Rakers (U)** (gill rakers—upper)—number of gill raker elements on upper limb of first gill arch, including any vestigial anterior rakers; **Vertebrae**—number of vertebral centra, excluding the hypural centrum (Fig. 4).

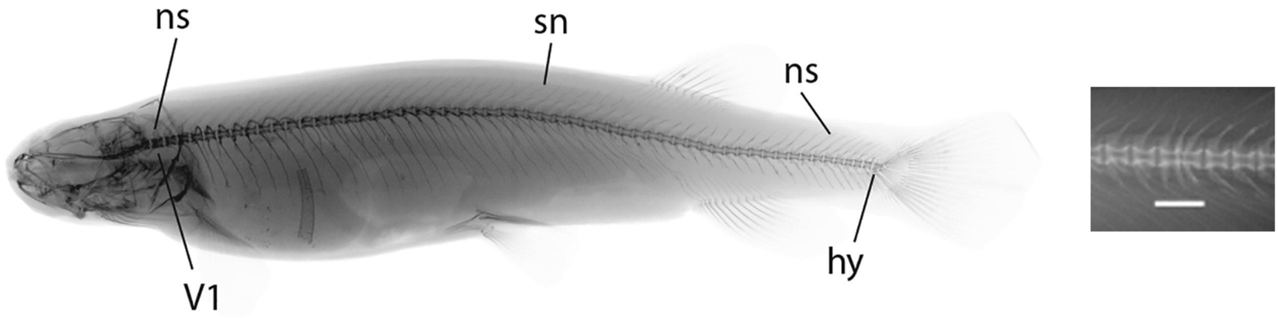

FIGURE 4. Positive radiograph of an individual of *Galaxias olidus* s.l. showing vertebral column and (inset) three fused vertebrae (underlined). hy—hypural; ns—neural spine; sn—supra neural; v1—first vertebra.

For all species the anterior segmented rays in the dorsal and anal fins were unbranched, as were the outer segmented rays in the caudal fin. The outer (or first) ray in the pelvic fin, and the upper or most forward rays, depending on fin orientation, in the pectoral fin were unbranched; the last 1–2 small rays in the pectoral fin often appear unbranched and were counted as such in this study. An unbranched, unsegmented splint ray is present in the pelvic fin and was not counted.

Fin ray counts were made on the LHS of the specimen, under a dissecting stereomicroscope. The rays were viewed with reflected or backlight only (shining up through the fin) to more clearly define the ray structure. On specimens where the dorsal or anal fin was covered by thick skin and/or the base was swollen, a horizontal incision was made along the base of the fin on the RHS and the skin peeled back to expose the rays. Similarly, the ventral surface of the pelvic fin was cut at the fin base, the skin loosened by careful insertion of a scalpel blade posteriorly between the skin and the rays, and the skin peeled back to expose the rays to their bases. This allowed greater light transmission through each fin and definition of the ray structure, particularly in smaller posterior or medial rays where it was often difficult to discern between unsegmented procurrent and segmented fin rays. These procedures also enabled accurate inspection of the last dorsal and anal fin rays to verify if they each consisted of a bifurcated ray, which articulated with a single pterygiophore (= 1 ray), or were two, very close but independent, rays, each articulating with a separate pterygiophore. Accurate enumeration of fin rays is important in the Galaxiidae as they may be informative, yet subtle, characters useful for taxonomic discrimination in a group of morphologically conservative fishes. Procurrent rays, present in the dorsal, anal and caudal fins, anterior to segmented rays, were not enumerated (a modification to McDowall & Frankenberg 1981), nor was the small, unsegmented procurrent ray very occasionally present at the medial border of the pectoral and pelvic fins.

Gill rakers, including small rudimentary or vestigial rakers present at the ends of each limb, were counted *in* *situ* on the first branchial arch on the LHS of the specimen and included all elements on the lower (L) limb or ceratobranchial, including the raker straddling the angle of the arch, and elements on the upper (U) limb, or epibranchial, to provide three counts (L, U, and Total (= L+U)). This usually required manipulation of the specimen to allow sufficient light penetration into the opened gill cavity, removal of mucus and/or fine particles, and moving of the arch to expose any vestigial rakers in profile for detection. Occasionally, upper rudimentary rakers extended off the centre-line of the gill raker and slightly onto the lateral face. These were also counted.

Vertebral counts. Vertebral counts of preserved specimens were enumerated from black and white radiographs. Wet specimens were laid on their sides (or on their backs if laterally bent) on a light and water proof, thin, cardboard cartridge holding a 203 x 254 mm sheet of industrial X-ray film (AGFA® Structrurix D4 FW). Each cartridge was exposed for 30 seconds at 25 to 28 kV of power, depending on average specimen thickness, in a Faxitron® X-ray machine. The X-ray film was then developed in a photographic darkroom, allowed to dry, and scanned at 600 dpi on a Microtec® ScanMaker i800, producing an approximately 27 MB Tagged Image File Format (TIFF) electronic file. Image files were electronically modified to improve contrast and clarity, when required, using image editing software (Adobe Photoshop® CS4 v. 11.0), enlarged to between 200–300X magnification on a computer screen using image viewing software (ACDSee® 4.0) and vertebrae counted.

Vertebrae, with a strong articular facet at each end, were counted anteriorly from the first vertebral centrum following the occipital condyle of the cranium (Fig. 4), posteriorly and excluding the hypural vertebra (designated 'pu1 + u1' in fig. 1 of McDowall 1999), which tends to have an articular facet anteriorly and to taper to a slightly upwardly turned point posteriorly (McDowall 1999). The precaudal and caudal vertebrae were not distinguished. The first vertebral centrum supports a flattened and broad dorsal neural spine (ns, see Fig. 4) with a broad supraneural attached to the upper end. This structure was used to locate the first centrum when an intervertebral gap was not clearly present between it and the occipital condyle.

Compressed vertebrae occasionally appeared as a single, normal or aberrant-sized vertebra with two or more neural spines and extremely faint or absent intervertebral gaps (see inset, Fig. 4). These were enumerated according to the number of neural spines present, with each neural spine counted as representing a single vertebra.

Additional characters. Additional morphological characters important for taxon discrimination, not captured by the morphometric measurements, were objectively recorded (see Adams *et al.* 2014). All varied in their occurrence between, but also to a degree within, taxa, and therefore are not considered robust, stable primary taxonomic characters. Some characters also varied in their degree of development. The characters included maximum size, shape of the dorsal and ventral trunk profiles, cross-section trunk shape, presence of a fleshy snout, shape of the lateral profile of the head and snout, and aspects of colour pattern morphology. Details of the six most prominent characters are given below.

Pyloric caecae. Pyloric caecae, blind sacs located at the posterior of the stomach, are known to vary in presence, number and length between galaxiid genera and species, (McDowall & Frankenberg 1981: figs. 45 & 46). A shallow incision was made along the ventral midline of the body from just in front of the pelvic girdle to the isthmus, anterior of the pectoral fin bases. Fine forceps were inserted over and down the sides of the heart into the body cavity and the heart and liver were removed by a quick upward, posterior motion. The exposed oesophagus, lying at the top of the cavity, was cut with long-nosed scissors and the stomach, duodenum and intestine were lifted out of the body cavity. The sides of the duodenum, posterior to the pylorus, were examined for pyloric caecae, which were considered present if there was one or more distinct, independent structures, longer than 0.1 mm in length, protruding outward. Often the duodenum was much wider than the pylorus and appeared swollen at the junction between the two. As this swelling did not constitute independent structures, and extended along the entire circumference of the pylorus, it was not considered a pyloric caecum. All caecae present were counted and length was measured from the tip to a line formed between the inner and outer sides of the caecum at the junction with the duodenum/pyloric arm of the stomach (adapted from McDowall & Wallis 1996, fig. 2.). This provided a more accurate length measurement, particularly where caecae were very short but had a wide base (> than the length). Where present, caecal length was expressed as a percentage of the standard length (SL) of the individual specimen. Where two caecae were present, they were always of unequal length and only the length of the longest was recorded.

Sensory pores and papillae, and accessory lateral line. The disposition of cephalic sensory pores, namely distinct openings in the epidermis of the head associated with an underlying canal of the lateral line system (see Nelson 1972, Lagler *et al.* 1977), was determined by visual examination of specimens under a dissecting microscope. Fish were blotted dry, examined and the number and location of cephalic papillae/pitlines recorded. A sensory papillus was defined as a raised structure embedded in the surface of the dermis, consisting of a cluster of receptor cells forming a neuromast organ. On the head this structure was usually overlain by dermal tissue located in a depression or by a small pit extending through the epidermis to the outer surface. Often a number of closely spaced papillae/pits formed a discrete, curved or straight, linear series and was called a pitline. The presence of accessory lateral line papillae was also noted. If papillae were obscure, or appeared to be lacking from a particular area, a scalpel blade was used to carefully scrape back the epidermis to expose the outer dermal layer below to check for the presence of an underlying neuromast organ. The primary trunk lateral line papillae were ignored as the lateral line is a stable character in *Galaxias*, though varying slightly in definition (McDowall 1970a).

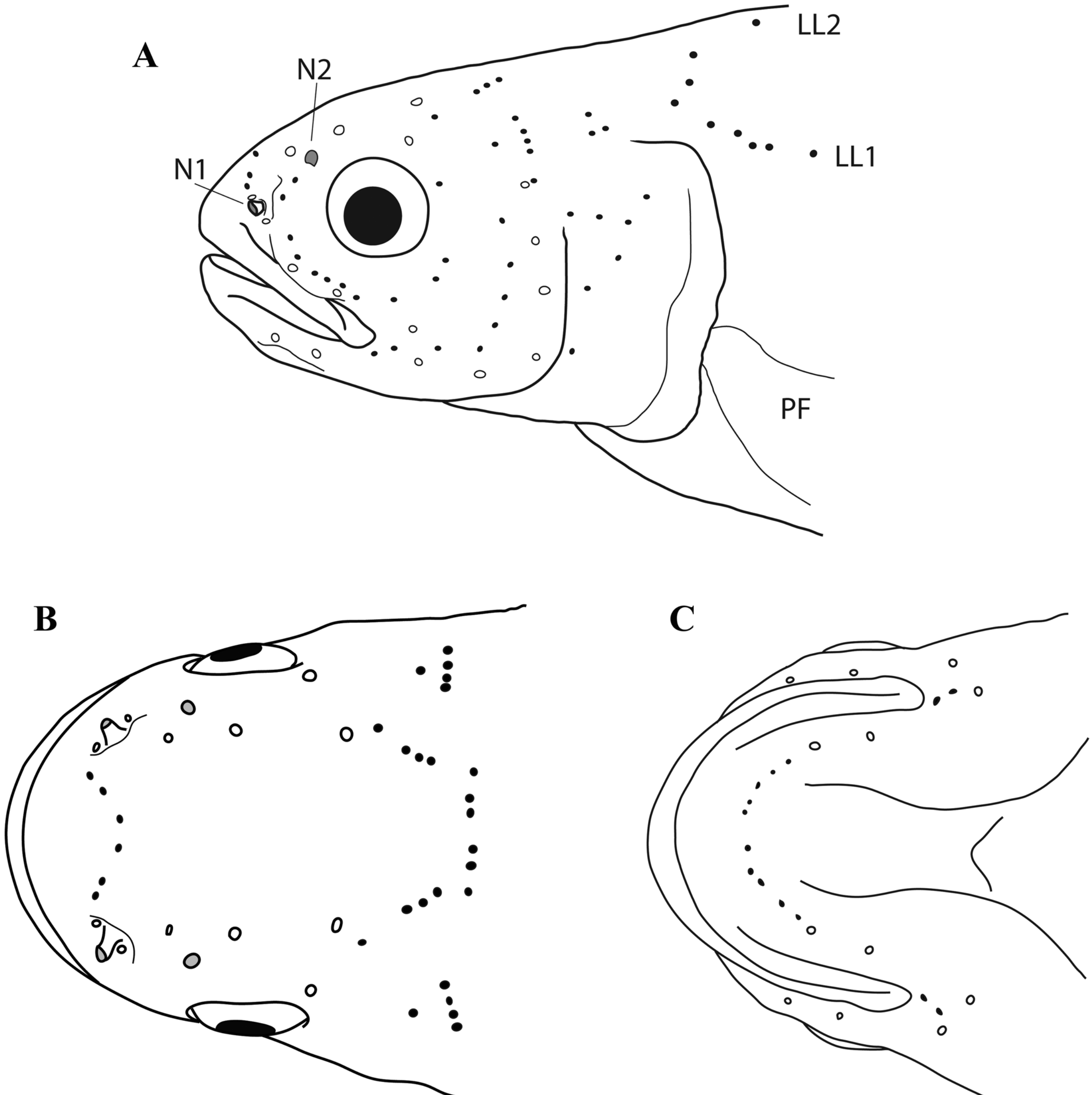

FIGURE 5. Cephalic sensory pore system (open) and cutaneous sensory papillae (closed) of *Galaxias* spp.; a. lateral view; b. dorsal view; c. ventral view. LL1—lateral line papillae; LL2—accessory lateral line papillae; N1—anterior nostril; N2—posterior nostril; PF—pectoral fin base.

Paired fin ray lamellae. The presence of fin ray lamellae, a raised thin layer of skin forming a strong, backward facing longitudinal ridge of tissue along the ventral surface of a fin ray, also known as rugosities (McDowall 2006a), has been documented on the anterior rays of the paired fins in *Galaxias brevipinnis* from Australia and New Zealand, and from a number of other New Zealand species (McDowall 2003b). These structures assist the fish when out of water in 'climbing' up the surface of wet rocks using water surface tension. Similar, distinctive raised lamellae were found for the first time on the ventral surface of anterior rays of the pectoral and pelvic fins in a number of species in the *Galaxias olidus* complex. The occurrence and degree of development of raised lamellae varied widely and appeared to have no consistent pattern of occurrence within a taxon. They tended to be strongly developed and found more frequently on younger individuals than on older fish, where if present, they were more frequently poorly developed.

The presence of raised lamellae was relatively easy to detect under a dissecting microscope, with the individual fish laid on its back, the paired fin spread out fully and the ventral surface of the rays viewed with reflected or backlight only (shining up through the fin), to more clearly define the ray structure. Fin lamellae were considered present if there was a distinctive raised layer of skin forming a longitudinal ridge on the distal end of any fin ray. Lamella ranged from weak (raised ridge) to strongly developed (raised and back-ward extending ridge with sharpened edge, often extending over the adjacent ray which lacked a lamella). On branched segments of rays, the most anterior ray carried the raised lamella.

Lateral canines. Distinctly enlarged, conical, teeth are present laterally in opposing groups on the jaws in many species of galaxiids (e.g. *Galaxias brevipinnis*, *Galaxias truttaceus*), and are defined as enlarged canines (McDowall 1970a, McDowall & Frankenberg 1981). They have been reported as present in the *Galaxias olidus* complex: present in *Galaxias fuscus* (Allen 1989, Armstrong 1993) and absent or weakly developed in *G. olidus* s.l. (Frankenberg 1969, McDowall & Frankenberg 1981). Both jaws were examined under a dissecting microscope for the presence of enlarged teeth, and this usually involved gently prising open the mouth by pulling down the lower jaw and inspecting teeth on each side.

Mid-lateral bars. Colour and pattern (e.g. blotches, speckles and bars) can vary greatly in *Galaxias* (McDowall 1970a, McDowall & Frankenberg 1981, McDowall 2000), particularly in *Galaxias olidus* s.l. (McDowall & Frankenberg 1981). A distinctive character in this species complex, although not universally present, is a series of distinct, short, vertical, usually black, bars, often relatively uniform in shape and located over or very close to the mid-lateral region of the trunk. These are in contrast to blotches, dark grey to brownish markings, irregular in shape and with a more diffuse border, which are commonly also found on the dorsal surface or widespread over the lateral surface of the trunk, and tend to be paler in colour and often coalesce with other blotches. When present, bars varied in distinctiveness, colour, shape, size, number, disposition (spacing between bars) and frequency of occurrence between species. Within species, these bars were relatively stable, although visual inspection of individuals from a number of populations was often necessary before a bar-pattern trend could be determined.

Anterior nostril length. The length of the anterior tubular nostril varies between galaxiid genera (McDowall 1970a) and elongated nostrils have previously been recorded in two Australian galaxiids, *Galaxias parvus* and *Neochanna cleaveri* (McDowall & Frankenberg 1981). Whilst not specifically measured, the comparative length of the tubular anterior nostril was noted.

Genetic analysis

Molecular analysis, using both nuclear and matrilineal markers, of the *Galaxias olidus* complex, including methods and specimens used, are presented by Adams *et al.* (2014). They present allele frequencies from 54 allozyme loci and *CytB* sequence analysis, and use the following codes for the 15 diagnosed candidate taxa: AR, BA, DA, FU, GE, JI, KO, OL, OR, RF, RI, RO, SH, ST, TA. These data are summarised below (see Systematics section) where they are assigned to individual species.

Results

The taxa taxa codes in the following section are those used those used by Adams *et al.* (2014), and are assigned to particular species in the Systematics section (see below).

Anal fin origin. The majority of candidate species (Adams *et al.* 2014) varied widely in the position of the anal fin origin with respect to the origin of the dorsal fin, with broad overlap between all taxa (Table 2), though on average, the anal fin origin was < 40 % posterior in all candidate species. The setback in 60 % of candidate species was under approximately 60 % or greater along the dorsal fin base (BA, DA, FU, JI, KO, OL, SH, ST, and TA), with the average setback in FU, JI, KO, SH and TA > 70 %. KO was distinctive, with the greatest setback overall (84.6 % along the dorsal fin base), followed by JI with a setback of 77.5 %. The smallest average setback was recorded in GE and RF (< 45 % along the dorsal fin base), followed by OR at 46.8 % (Table 2). The sample size was low for JI and SH and consequently the average setback for these taxa may be found to change if re-analysed with additional data.

The taxonomic value of the position of the anal fin origin to that of the dorsal fin origin in this species complex is compromised by the high level of intraspecific and interspecific variation. Some interspecific differences could be observed, with GE, RF and OR on average with the least setback and FU, JI and KO, SH and TA with the greatest. Consequently this character has some diagnostic importance.

Assessment of additional characters

The majority of additional morphological characters investigated provided a level of further taxon discrimination in the *Galaxias olidus* complex (Adams *et al.* 2014), though the degree of usefulness varied between characters, often related to the degree of intraspecific variation in that character.

TABLE 2. Summary statistics for the position of the origin of the anal fin as a proportional setback from the origin of the dorsal fin, from the direct measurement DF–AF. Values expressed as percentages. Taxon codes are from Adams *et al.* 2014: see 'Systematics' section for species names).

Taxon	Mean	Median	Std. dev.	Std. Err.	Minimum	Maximum	N
AR	56.7	59.1	8.37	1.75	38.7	70.5	24
BA	63.3	62.8	12.36	0.95	34.7	102.2	171
DA	61.6	61.0	12.86	2.88	41.1	96.1	21
FU	70.5	70.0	9.73	0.84	51.7	114.4	136
GE	41.6	42.6	9.81	1.23	19.8	69.7	65
JI	77.5	74.7	8.00	3.58	68.4	88.9	6
KO	84.6	83.0	10.00	1.88	66.0	121.3	30
OL	67.8	68.1	12.67	0.59	20.8	114.3	464
OR	46.8	46.2	10.42	1.11	19.2	72.6	89
RF	43.4	43.9	9.92	1.06	18.3	65.6	89
RI	58.3	58.9	7.62	3.49	45.3	73.0	11
RO	52.5	52.6	8.33	1.78	34.9	64.6	23
SH	73.9	73.4	8.72	4.36	63.9	86.8	5
ST	65.6	66.0	8.07	2.16	51.0	83.5	15
TA	73.4	73.7	7.77	2.08	60.3	88.9	15

Pyloric caecae. Pyloric caecae are an additional means to discriminate between species, although their presence or absence, number and mean length were found to vary across taxa and also within taxa (Table 3). Five groups of taxa (see below) could be identified based on the presence/ or absence of caecae and, when present, the number of caecae (Table 3). A sixth group with 0–2 caecae, consisting of BA, FU, OL, OR, RF and RI, was initially evident, but FU, OR and RF could be considered to belong to Group 2 (individuals with 0 or 1 caecum) as < 8 % of individuals possessed two caecae, and BA, and OL could be considered to belong to Group 4 (individuals with 1 or 2 caecae) as < 8 % of individuals lacked caecae. RI was also considered to belong to Group 4, though a slightly higher number of individuals lacked caecae (12 %). In addition, ST was considered to belong to Group 1 with the majority (95 %) of individuals lacking caecae, SH to group 4 with 96 % of individuals with 1–2 caecae and TA to group 5 with 93 % of individuals with two caecae.

- Group 1 (0 caecae): AR, RO and ST;
- Group 2 (0 or 1 caecae): DA, FU, OR and RF;
- Group 3 (1 caecum): JI;
- Group 4 (1 or 2 caecae): BA, KO, OL, RI, and SH; and,
- Group 5 (two caecae): GE and TA.

Of those in Group 2, the majority of individuals in DA and RF (52 % and 58 % respectively) lacked pyloric caecae.

For taxa possessing pyloric caecae, the mean length of the longest caecum varied from 0.7–5.1 % of SL between taxa. GE and TA had the longest mean length of caecae (5.1 and 4.7 % SL respectively), with DA, FU, OR and RF with the shortest (from 0.7 to 1.2 % SL). When present, caecae in DA were usually the shortest, averaging 0.7 % of SL. In comparison, BA, OL, RI and SH possessed caecae of moderate length (2.0 –3.1 % SL), that of KO was moderately long (4.6 %SL), and that of JI moderately short (1.7 % SL). Shape of pyloric caecae was noted to vary considerably between and within species, and was considered a minor diagnostic character.

Sample sizes for some taxa were low (e.g. JI). Therefore, additional data may further refine the mean length of caecae or group membership based on number of caecae, and the importance of this character in taxon discrimination.

TABLE 3. Summary of the mean and range (expressed as % SL) of length of pyloric caecae between candidate species, including % frequency of number of caecae. (*N*—number of pyloric caeca or individuals examined. Taxon codes are from Adams *et al.* 2014: see 'Systematics' section for species names).

Taxon	Length of pyloric caecae	Frequency of pyloric caecae (%)			N
	(% SL; mean (range) (*N*))	0	1	2	
AR	0	100	0	0	24
BA	2.3 (0.3–5.5) (132)	7	53	40	141
DA	0.7 (0.1–1.6) (23)	52	48	0	48
FU	1.0 (0.6–3.2) (53)	43	55	2	114
GE	5.1 (3.6–7.8) (24)	0	0	100	28
JI	1.7 (1.2–2.4) (9)	0	100	0	9
KO	4.6 (2.7–7.9) (22)	0	18	82	22
OL	3.1 (0.4–7.2) (487)	3	39	58	500
OR	1.2 (0.1–3.3) (169)	31	62	7	236
RF	1.0 (0.4–2.6) (39)	58	40	2	103
RI	2.2 (0.8–4.8) (15)	12	53	35	17
RO	0	100	0	0	26
SH	2.0 (0.8–3.6) (22)	4	74	22	23
ST	0.8 (1)	95	5	0	19
TA	4.7 (3.7–6.1) (15)	0	7	93	15

Sensory pores and papillae, and accessory lateral line. Sensory pores were found to conform to the number and arrangement of pores previously reported for most Australian species of *Galaxias* (McDowall & Frankenberg 1981: fig. 47a). Abnormalities were very rare and usually consisted of the absence or addition of a pore on individual fish.

The general disposition of cephalic sensory papillae also did not vary across species in the *G. olidus* complex, and is therefore not diagnostically important. However, individual cutaneous sensory papillae have not been documented in detail on the cephalic region of *Galaxias*, except those in pitlines composed of a row of papillae, on the primary and accessory lateral lines in the Galaxiidae (McDowall 1970a, 1997b). Consequently, the number and disposition of sensory papillae in the *G. olidus* complex is herein defined (Fig 5a,b,c).

Sensory papillae extended broadly over the lateral cephalic region, connecting across the snout and nape, extending posteriorly to the lateral and accessory lateral lines, and were restricted ventrally to the lower jaw. There was slight variation in the exact position of papillae or the number of papillae on some pitlines, but these also varied intraspecifically between individuals or populations. The absence of any particular papillus could not always be accurately determined and was related to the degree of development. Often the usual structure of a sensory papillus, consisting of a raised and unpigmented cluster of receptor cells in the dermal surface with an overhead shaft (or pit) extending through the epidermal layer, appeared to be lacking. On closer inspection, the epidermal shaft was usually absent or represented by a very slight indentation in the surface of the epidermis, and the cluster of receptor cells could be absent, slightly or greatly reduced in size, or occasionally pigmented.

The existence of an accessory lateral line in the Galaxiidae has long been known but poorly documented (McDowall 1970a, 1997b), and it is often difficult to visually discern. Within the *G. olidus* complex its presence was widespread across species (lacking in one species only) but appeared to vary between individuals within taxa, often necessitating inspection of individuals from a number of populations to confirm presence or absence.

Paired fin ray lamellae. Distinct raised lamellae were found on the ventral surface of anterior rays of the pectoral and pelvic fins in a number of candidate species. Whilst this character varied widely in occurrence amongst individuals within populations, and also in the degree of development, it appeared to be absent in GE, JI and TA, though low numbers of available specimens in the latter two taxa (9 and 15 respectively) may have biased results. Whilst recorded in OR, the frequency of occurrence was very low and raised lamellae were never strongly developed. Raised lamellae were recorded on the paired fins of individuals in all other species.

Within a taxon, there was no consistent pattern of occurrence, though lamellae tended to be strongly developed and found more frequently on younger individuals than on older fish, where if present, they were more frequently poorly developed. Consequently, paired fin lamellae are regarded as of minor diagnostic value.

Lateral canines. Enlarged lateral canines, as previously identified in *Galaxias brevipinnis* and *Galaxias truttaceus* (McDowall & Frankenberg 1981) were not found in individuals of any species and all teeth (premaxillar, mandibular, basihyal, mesopterygoidal) were as described for *Galaxias* and for *Galaxias olidus* s.l. (McDowall & Frankenberg 1981). They are therefore of no diagnostic value in this complex. The enlarged lateral canines reported in *Galaxias fuscus* (= taxon FU of Adams *et al.* 2014) (Allen 1989, Armstrong 1993) could not be found in 188 specimens examined from all known populations. They are therefore considered absent from this species.

Mid-lateral bars. Distinct, small to large dark vertical bars were present along the lateral midline in FU, OL and OR, and occasionally in BA, KO, RI, SH and ST, being absent in all other species. Bars were always present on FU, but varied in occurrence on individuals of the other taxa, only occurring infrequently on BA, KO, RI, SH and ST, where they were small, black, round to ovoid and occasionally present on only a few individuals per population. Within FU, OL and OR, general bar shape, size and distribution differed between these taxa but, when present, was relatively stable within taxa. Consequently, this character is considered of secondary diagnostic importance in the *G. olidus* complex, particularly important for the diagnosis of FU, when present, secondarily important in the diagnosis of OL and OR and of limited value for BA, KO, RI, SH and ST. See the Systematics section for a description of the bars for each species.

In addition, dark markings, termed blotches, were present near or on the lateral midline in other taxa, such as RO and SH. These differed to distinct bars by being irregular in shape and with a more diffuse border. They were commonly found on the dorsal surface or widespread over the lateral surface of the trunk, and tended to be paler and often coalescent with other blotches.

Anterior nostril length. The comparative length of the tubular anterior nostril did not vary in nearly all of the species and was similar to that of the majority of other species of Australian *Galaxias* (*cf.* McDowall & Frankenberg 1981: figure 47). However, this character was distinctive in GE, being noticeably slightly longer and usually extending anterio-dorsally to near the anterior margin of the upper lip.

Other morphological characters were noted and these occasionally provided a degree of differentiation between some taxa in the *Galaxias olidus* complex.

Trunk profile and shape. The shape of the dorsal and ventral trunk profiles in the majority of species tended to be evenly arched. In RF the dorsal was arched and the ventral profile straight. However, only GE appeared to be relatively distinct, displaying a tubular trunk with both profiles straight and parallel to each other. Further, the majority of species were roughly oval in cross section throughout the trunk, extending anteriorly to the start of the caudal peduncle. In contrast, OR tended to be partly or distinctly laterally compressed on the trunk, with the compression extending posteriorly from just above the pelvic in base.

Body length. The length of individuals of all species was similar, with the majority between 80 and 100 mm in

LCF, and maximum recorded size of taxa between 110 and 150 mm LCF. However, GE appears to be a diminutive taxon, with average body length between 45–55 mm LCF and the maximum recorded size to 69.8 mm LCF.

Fleshy snout. The upper lip in RF was fleshy and extended anteriorly, making the upper jaw seem longer than the lower. This altered the shape of the snout, compared with all other taxa, when viewed from the front, above or from below. This distinctive fleshy snout appears unique amongst the Galaxiidae.

Snout profile. The lateral profile of the head, including the snout and mouth, tended to be rounded in GE, more so than in the other species examined. This appeared to be due to the vertical depth of the head and snout not decreasing greatly from the vertical depth of the trunk, leading to a deeper snout and the lower jaw angling upwards at a steep angle.

Systematics

Material examined is included under each description (listed by state or territory, then by drainage division, and river basin within each division, and alphabetically within river basins), with additional, non-type material examined, but not measured, provided in Appendix 5. Length measurements are provided in two forms, LCF (length to caudal fork), followed in parentheses by the traditional SL (standard length). SL excludes the length of the caudal fin and is measured to the posterior edge of the hypural plate, which can be difficult to accurately locate without an X-ray. However, LCF can be easily and accurately defined and provides a measure of the length of the individual. It therefore has more relevance to biologists/ecologists and resource managers. LCF and SL provide the length of individuals examined in each specimen lot.

Common collector names are abbreviated as follows, except in the description of type material: JPO - Justin P. O'Connor; MH—Michael Hammer; PJU - Peter J. Unmack; TAR - Tarmo A. Raadik.

Type material for new species has been lodged in the collections of the following institutions (see 'Species Treatments' for specific locations): AUSTRALIA - Australian Museum, Sydney (AMS), Museum Victoria, Melbourne (NMV), South Australian Museum, Adelaide (SAMA), Tasmanian Museum and Art Gallery, Hobart (TMAG); NEW ZEALAND—Te Papa, National Museum of New Zealand, Wellington (NMNZ).

Order Galaxiiformes

(as supported by Li et al. 2010).

Family Galaxiidae Müller, 1846.

Diagnosis (modified from McDowall & Frankenberg 1981). Distinguished by the following combination of characters: small to medium sized (39–580 mm); body elongate, generally cylindrical to laterally compressed, scale-less; primary trunk lateral line as a series of closely-spaced superficial neuromasts within a mid-lateral crease, accessory lateral line present in some species as a bilateral linear series of superficial, widely-space neuromasts along the dorso-lateral trunk; laterosensory pores and cutaneous sensory papillae present on head; nostrils well developed, anterior one set in a small depression and tubular, posterior one a simple aperture; maxilla usually partly included in gape but toothless (excluded in *Lovettia*); teeth usually conical, uniserial on premaxilla and dentary uniserial; mesopterygoidal, basihyal and pharyngeal teeth developed (reduced or absent in *Neochanna*); vomer shafted but toothless and palatine toothless; enlarged laterally opposing canine teeth in many species; sexes usually similar; both gonads well developed, though left sometimes larger than right, urogenital aperture generally on a papilla in a post-anal depression (protruding in *Lovettia*).

All fins lacking spines; dorsal fin originates either above and slightly posterior to pelvic fin base (Aplochitoninae) or well back on trunk above, slightly forward or behind vent, 5–19 segmented fin rays; anal fin originates well back on trunk, behind vent, 6–19 segmented fin rays; caudal fin emarginate to truncate, less often forked or rounded, 11–19 principal rays, usually 16 (14 branched); pectoral fins inserted just posterior to head, most anterior extent of fin base usually below ventral margin of eye (except in *Brachygalaxias* and *Galaxiella*), 9–18 segmented fin rays; pelvic fins abdominal, occasionally absent, 4–9 segmented rays, usually 6–7; procurrent rays usually moderately developed along caudal peduncle, also anterior to dorsal and anal fins; adipose fin generally absent (except in Aplochitoninae); 0–6 pyloric caecae, usually 0–2; vertebrae 36–73; gill rakers (on first arch) 6–21.

Subfamily Galaxiinae

Key to Australian genera of Galaxiinae

1 Dorsal fin origin well forward, above pelvic fin bases . . . . *Paragalaxias*
- Dorsal fin origin distinctly posterior to pelvic fin bases and closer to anal fin origin 2
2 Dorsal fin origin distinctly posterior to anal fin origin; no laterosensory pores below lower jaw; fewer than 16 principal caudal rays, usually 13–14 . . . . *Galaxiella*
- Dorsal fin origin usually above or slightly anterior to anal fin origin; laterosensory pores below lower jaw; usually 16 principal caudal rays. 3
3 Distinctly long anterior, tubular nostrils; very small eye; pelvic fins small; pectoral fins oriented laterally with first ray of fin towards lateral line; caudal flanges well developed, extending almost to the rear of the anal fin base; dorsal and anal fins relatively low and appear long based and 'swept back' . . . . *Neochanna*
- Anterior, tubular nostrils usually short (except in *Galaxias parvus*); eye and pelvic fins moderate to large; pectoral fins oriented latero-ventrally to ventrally with first ray of fin oriented away from the trunk; caudal flanges weakly to moderately developed, usually only extending as far as rear margin of adpressed anal fin; dorsal and anal fins not as above . . . . *Galaxias*

Genus *Galaxias* Cuvier

Gender: masculine.

Galaxias Cuvier, 1816: 183. Type species: *Esox truttaceus* Cuvier, 1816 by monotypy. Cuvier's species is named only in a footnote to the definition of the genus *Galaxias* and was suggested by Stokell (1966) to be a *nomen nudum*. McDowall (1970b) proposed *Galaxias fasciatus* Gray, 1842 as the type-species for the genus by subsequent monotypy though later reverted to Cuvier's species (McDowall 1984). Cuvier's species is considered tied to the description in the text and therefore valid.

Mesites Jenyns, 1842: 118. Type species: *Mesites attenuatus* Jenyns, 1842 by subsequent designation of Jordan, 1919: 212. Preoccupied in Insecta, Coleoptera.

Austrocobitis Ogilby, 1899: 158. Type species: *Mesites attenuatus* Jenyns, 1842 by subsequent designation of Whitley, 1956c: 34.

Agalaxias Scott, 1936: 105. Type species: *Cobitis zebrata* Castelnau, 1861 by original designation.

Nesogalaxias Whitley, 1935: plate 3 legend. Type species: *Galaxias neocaledonicus* Weber & de Beaufort, 1913 by original designation.

Lyragalaxias Whitley 1935: plate 3 legend. Type species: *Galaxias oconnori* Ogilby, 1912 by original designation.

A genus of 46 non-fossil species (includes those treated herein) native to the Southern Hemisphere, including southern Africa, Australia (including Tasmania and Lord Howe Island), New Caledonia, New Zealand (and offshore islands) and South America (Chile, Argentina, Falkland Islands).

Diagnosis (modified from McDowall & Frankenberg 1981). A genus of the family Galaxiidae distinguished by the following combination of characters: small to medium sized (50–580 mm LCF); trunk cylindrical to a little dorsally and/or laterally compressed; laterosensory pores on head usually typical of family, though reduced or slightly modified in some species; maxilla included in gape but toothless; teeth usually conical, uniserial on premaxilla and dentary; more than half of species lacking enlarged lateral canines, others with weakly to well-developed canine teeth; mesopterygoidal teeth well developed, uniserial; lingual teeth biserial. Median supraethmoid and ventral ethmoid present; postcleithrum present or absent; epipleural and epineural ribs present. Dorsal fin origin posterior, about above vent, 6–13 segmented fin rays; anal fin with 7–19 segmented fin rays; caudal fin emarginate to truncate, less often forked or rounded, 13–18 principal rays, usually 16 (14 branched); pectoral fins with 9–18 segmented rays, usually positioned anterio-ventrally to ventrally, less often laterally, with raised lamellae (callus-like ridges) present along fin rays on ventral surface in some species; pelvic fins present, 4–9 segmented rays, usually 7; procurrent rays usually moderately developed along caudal peduncle, also sometimes anterior to dorsal and anal fins; adipose fin absent; 0–6 pyloric caecae, usually 0–2; vertebrae 36–66; gill rakers (on first arch) 6–21, short and stout to long and slender.

McDowall (1978a) removed *Galaxias pusillus* Mack, 1936, and *Galaxias nigrostriatus* Shipway, 1953, from *Galaxias*, placing them into a new genus, *Galaxiella* McDowall, 1978(a). More recently, McDowall (1997c, 2004) removed *Galaxias cleaveri* Scott, 1934, and *Galaxias rekohua* Mitchell, 1995, from *Galaxias*, placing them into

Neochanna. Further, Waters *et al.* (2000a), based on genetic data, recommended *Nesogalaxias neocaledonicus* (Weber & de Beaufort, 1913), be restored to *Galaxias*, and concluded that *Galaxias* is not monophyletic. The paraphyly of *Galaxias* is further supported by Burridge *et al.* (2012).

Key to differentiating the *Galaxias olidus* complex from south-east mainland Australian species of *Galaxias*

(adapted from McDowall & Fulton 1996)

1 Anal fin origin directly below dorsal fin origin; caudal fin forked; eye large 2
- Anal fin origin slightly to distinctly posterior to dorsal fin origin; caudal fin truncated, emarginate or slightly forked; eye small to moderately large 3
2(1) Mouth large, reaching back to well below eyes; head moderately long and flattened dorsally; snout flattened and slender, moderately pointed; anterior extent of pectoral fin base above level of posterior extent of mouth. . . . . *Galaxias rostratus*
- Mouth small, reaching back to near front of eyes; head short to moderate length, not flattened dorsally; snout bluntly pointed; anterior extent of pectoral fin base level with posterior extent of mouth . . . . *Galaxias maculatus*
3(1) Anal fin origin only slightly posterior to dorsal fin origin (below < 15 % distance posteriorly along dorsal fin base); jaws usually with moderately developed to enlarged lateral canine teeth 4
- Anal fin origin usually distinctly posterior to dorsal fin origin (below > 20 % distance posteriorly along dorsal fin base); jaws lacking canine teeth. . . . . *Galaxias olidus* complex
4(3) Lower jaw distinctly shorter than upper; lateral canine teeth enlarged; usually 2 long pyloric caecae; fins without dark margins; no stripe through eye or spots surrounded by halos on body; one blue-black blotch at base of pectoral fin (may be absent from fish from the upper Murray River system . . . . *Galaxias brevipinnis*
- Jaws about equal; lateral canine teeth moderately developed; usually 2 vestigial pyloric caecae; dorsal, anal and pelvic fins with grey-black margins; distinct diagonal stripe passing back and down through eyes; trunk with numerous round spots each surrounded by a thin pale halo; two distinct blue-black blotches above pectoral fin base . . . . *Galaxias truttaceus*

Galaxias olidus complex

Diagnosis. Anal fin origin posterior to that of dorsal fin and usually set back under 40 % or more of length of dorsal fin base; body moderately thick to stout; caudal peduncle always longer than deep; accessory lateral line usually present; head moderately wide to broad, wider than deep; interorbital broad and usually flat, about twice eye diameter or greater; snout profile from above and below evenly rounded without obvious inflections; mouth usually reaching under first third to middle of eye, occasionally to anterior margin, and regularly > 0.5 eye diameter below eye; dorsal and anal fin bases usually fleshy and fins usually of similar length, anal fin base usually longer; pectoral fin always longer than pelvic fin, oriented anterio-ventrally to ventrally, pectoral fin base about level with posterior extent of mouth; caudal fin usually emarginate, occasionally truncate or weakly forked, fin lobes rounded; caudal peduncle flanges often reach at least to adpressed anal fin rays; gill rakers usually stout and short to moderate length, always shorter than diameter of eye; pyloric caecae, when present usually stout.

Description. Members of the *Galaxias olidus* complex, which includes *Galaxias olidus* s.s., *Galaxias fuscus* and *Galaxias ornatus*, and the 12 species described below, are distinguished by the following combination of characters: relatively small (70–165 mm LCF); body of moderate length to elongate, usually ovoid in cross-section, but often a little dorsally compressed, less often laterally, and moderately thick to stout (10–16 % SL), with depth through the pectoral fin base almost equal to, or usually greater (108–137 % BDV) than, that through the vent; standard length from 88–90 % of caudal fork length; dorsal and ventral profiles of body usually relatively evenly arched from snout to anal fin, though ventral occasionally straight; body tapering back to a moderate to relatively long (11–16 % SL) and deep (7.0–9.0 % SL) caudal peduncle, the peduncle always longer than deep; belly deepened in maturing individuals. Lateral line mid-lateral; accessory lateral line usually present, often indistinct, extending along dorso-lateral margin to near dorsal fin base.

Head moderately long (20–24 % SL) and deep (35–47 % HL), usually about 90–93 % of the Pelvic-Anal (PelAn) distance though sometimes shorter or longer, moderately wide to broad (55–69 % HL) and distinctly wider than deep (133–171 % of HD), lateral profile rounded or bulbous to wedge shaped, sometimes distinctly flattened dorsally; eyes relatively small to moderate size (16–21 % HL), oriented laterally, situated moderately high on head, at or just below dorsal head profile, interorbital broad (35–42 % HL) and flat, occasionally slightly concave or convex, usually greater than twice diameter of eye; snout short to moderate length (25–31 % HL), 1.2–1.5 times diameter of eye, lateral profile rounded to pointed, profile from above and below evenly rounded without obvious inflections, most anterior extent of snout usually level with middle of eye; posterior opercular margin usually extending as a fleshy flap onto pectoral fin base, occasionally reaching base of fin. Mouth moderately long (27–39 % HL), usually reaching back below first third to middle of eyes, though sometimes to front of eye or farther back, regularly 0.6–0.8 ED below ventral margin of eye, wider than long, cleft usually oblique, anterior tip of upper lip usually about level with ventral margin of eye or higher; gape moderate to relatively broad (31–45 % HW). Jaws either relatively equal, with lower very slightly shorter, or subequal and lower distinctly shorter than upper (73–95 % UJL); single row of conical teeth in jaws, without enlarged canines; mesopterygoidal teeth moderately strong.

Pyloric caecae absent, 1 or 2, if present ranging from very short to moderately long (1.0–5.1 % SL); if two caecae present, one usually shorter. Gill rakers (total count usually 11–16) short to moderately long and typically stout, always less than diameter of pupil, rounded to bluntly or sharply pointed, usually 8–11 along lower arch (including raker in angle of arch) and 2–5 on upper arch. Vertebral count usually from 49–58. Disposition of laterosensory pores on head as in most *Galaxias* (see McDowall 1970a, 1997a, McDowall & Frankenberg 1981); disposition of sensory papillae defined in Fig 5.

Fins generally fleshy at bases and extending across about 0.5 of fin surface; dorsal fin (usually 8–11 segmented rays) and anal fin (9–13 segmented rays) similar and usually with two (range 1–3) unbranched, segmented rays anteriorly, bases of fins of moderate size, anal fin base usually longer than dorsal fin base, fins short to moderate length and rounded, middle rays usually longest; anal fin origin posterior to that of dorsal fin, set back under 40–85 % (range 18–120 %) of length of dorsal fin base. Pelvic fins usually with 7 segmented rays, some species with 8, of moderate size (9–12 % SL), origin at about mid-point of standard length, distinctly shorter than pectoral fins (74–92 % PecL); pectoral fin usually with 12–16 segmented rays, moderately large (11–15 % SL) and typically paddle-shaped, with two, occasionally 1 or 3, unbranched segmented rays anteriorly, relatively low on body, most dorsal extent of fin base usually level with posterior extent of mouth, well below lateral midline of head and below ventral margin of eye; laminae of paired fins oriented anterio-ventrally to ventrally, often with weakly to well-developed raised lamellae on ventrally facing surface along the distal end of the first few rays. Caudal fin with 16 principal caudal rays, rarely 15 or 17, usually emarginate, occasionally truncate to almost forked, fin lobes rounded, length to caudal fork 11.5–15.0 % SL; caudal peduncle flanges usually moderately developed, either short to long along caudal peduncle, just reaching or extending anteriorly past adpressed anal fin.

Morphological key to species in the *Galaxias olidus* complex

Due to morphological conservatism in this complex, and the degree of within-species variation of various morphological characters, ambiguities in some identifications will remain using the following key. The accuracy of specimen identification can be improved by examination of combinations of multiple characters and careful and detailed comparison with all characters in the species diagnoses and descriptions. This includes external characters, but importantly, also the internal characters of pyloric caecae and gill rakers. Identification can be further improved by inclusion of the geographical location of the collection site, if known, to reduce the potential list of possible species, as many taxa are allopatrically distributed. The combination of multiple, relatively indiscrete external characters, and use of internal characters, will make field identification difficult, and in many instances will require collection of 10 % formalin fixed voucher material for later verification in the laboratory and a lateral profile image of live specimens.

Ethanol preserved material is unsuitable for identification of the majority of species within this complex as most of the subtly differing morphometric features are affected by shrinkage, which significantly increases the chance of error in correct identification. Further, accurate counts of fin rays can be difficult following ethanol preservation as fins usually collapse and shrink and become brittle and difficult to ‘fan’ open.

The key is designed for use primarily with adult specimens as morphometric characters may differ in the juvenile stage. A minimum length is not provided as one species is diminutive, with the length of younger adult fish falling below what would usually be considered an appropriate minimum length (50 mm LCF). The majority of couplets in the key are based on combinations of characters which increase the accuracy of the key. Characters are separated in the text by a semi-colon, are not hierarchical, and consequently their order is not relevant.

Based on a significant, but only partially diagnostic character, two species appear twice in the following key.

1 One or more distinct, black, very dark grey or dark brown, elongate vertical bars (as opposed to diffuse and irregular shaped brown, brownish grey to dark brown blotches), usually much longer than wide and not centred inside a mid-lateral blotch, present along the lateral midline . . . 2

\- Mid-lateral bars not as above, or if present, usually small and black, circular or slightly ovoid (as opposed to medium or large, distinct and elongate) . . . 4

2(1) Mid-lateral bars large, black, generally long and wide, ovoid to inverted tear-drop shape, often surrounded by a lighter halo, relatively widely spaced and located between the pectoral and pelvic fin bases; pattern usually lacking from dorsal surface of trunk; gape wide (> 41 % HL); head length typically greater than PelAn distance (HL/PelAn ratio usually > 106 %); body often orange, orange-red or orange-brown. . . . *Galaxias fuscus* Mack, 1936

\- Mid-lateral bars not as above; pattern usually often present on dorsal surface of trunk; gape width < 41 % HL; head length typically shorter than PelAn distance (HL/PelAn ratio usually < 106 %); body usually brown to yellow . . . 3

3(2) Mid-lateral bar shape variable, from elongate and very narrow, ovoid to almost round, small to moderate sized, becoming paler (and grey or brown) posteriorly, bars often closely spaced and extending posteriorly well past pelvic fin base; LDB/LAB ration > 85 %; DL/AL ratio > 90 %; anal fin origin typically under > 55 % distance posteriorly along dorsal fin base; 1, more often 2, pyloric caeca of moderate length . . . *Galaxias olidus* Günther, 1866 (in part)

\- Bars very short and narrow, usually restricted to anterior portion of lateral midline between the pectoral and pelvic fin bases, typically on or within lighter bars; LDB/LAB ration < 80 %; DL/AL ratio < 90 %; anal fin origin typically under < 55 % distance posteriorly along dorsal fin base; usually a single, short pyloric caecum, often absent. . . . *Galaxias oliros* **sp. nov.** (in part)

4(1) Mouth distinctly subterminal (lower jaw shorter than upper). . . . 5

\- Mouth usually terminal or nearly so (jaws about equal or lower slightly shorter than upper) . . . 7

5(4) Snout and upper lip extended anteriorly as thick and fleshy protrubence; lower jaw distinctly shorter than upper; ventral profile of body straight; usually 7 segmented pelvic fin rays; caudal peduncle long (mean of 16.4 % SL); anal fin origin usually under 0.4 distance posteriorly along dorsal fin base (known from the upper Murray River and tributaries in inland VIC and southern NSW). . . . *Galaxias arcanus* **sp. nov.**

\- Snout and upper lip not as above; lower jaw not as above but shorter than upper; ventral profile of body arched; usually 8 segmented pelvic fin rays; caudal peduncle of moderate length (mean < 13.5 % SL); anal fin origin under 0.5 or greater distance posteriorly along dorsal fin base . . . 6

6(5) Pyloric caecae absent; body depth at vent moderate (12.7 (11.2–14.3) % SL); anal fin long based (11.7 (11.0–12.5) % SL); segmented pectoral fin rays usually 14, sometimes 15; anal fin origin usually under 0.5 distance posteriorly along dorsal fin base; usually 55 or fewer vertebrae (known from the upper Roger River, lower Snowy River system East Gippsland, coastal VIC). . . . . *Galaxias mcdowalli* **sp. nov.**

\- Usually 2 pyloric caecae, occasionally 1; body depth at vent shallow (10.1 (8.4–12.4) % SL); anal fin based of moderate length (9.9 (8.7–10.9) % SL); segmented pectoral fin rays usually 15 or more; anal fin origin usually under 0.8 distance posteriorly along dorsal fin base; usually 57 vertebrae (known from upper tributaries of the Snowy River on Mount Kosciuszko, Snowy River system, NSW) . . . *Galaxias supremus* **sp. nov.**

7(4) Caudal peduncle, caudal fin and pectoral fins short, usually < 12 % SL (known from the upper Tuross River system in coastal SE NSW). . . . *Galaxias brevissimus* **sp. nov.**

\- Caudal peduncle, caudal fin and pectoral fins usually > 12 % SL (found outside of the Tuross River system) . . . 8

8(7) Length of dorsal fin base usually equal or greater than length of anal fin base . . . 9

\- Length of dorsal fin base usually less than (< 97 %) length of anal fin base . . . 11

9(8) PelAn distance > 24.5 % SL; anal fin base usually < 10 % SL; dorsal fin length usually < 14.5 % SL; dorsal and anal fins set back along body usually at > 71 and > 76 % SL respectively; head depth < 38.5 % HL; postorbital head length > 58 % HL; usually 53 (52–53) vertebrae (known from the upper Dargo River system in the coastal Gippsland region of VIC) . . . *Galaxias mungadhan* **sp. nov.**

\- PelAn distance < 24.5 % SL; anal fin base usually > 10 % SL; dorsal fin length usually > 14.5 % SL; dorsal and anal fins set back along body usually at < 71 and < 76 % SL respectively; head depth > 38.5 % HL; postorbital head length < 58 % HL; usually 54 (54–55) vertebrae . . . 10

10(9) Usually 1, less often 2, pyloric caecae; dorsal and anal fin bases long, > 11.0 % SL; eye diameter relatively small (< 17.5 % HL) and < 48 % IOW; gape relatively narrow (< 35.5 % HL); gill rakers moderately long; usually 9–10 segmented dorsal fin rays and 14 segmented pectoral fin rays; (known from a tributary of the lower La Trobe River system in the coastal Gippsland region of VIC). . . . *Galaxias longifundus* **sp. nov.**

\- Pyloric caecae usually absent; dorsal and anal fin bases short, < 11.0 % SL; eye diameter relatively large (< 17.5 % HL) and > 48 % IOW; gape relatively broad (> 35.5 % HL); gill rakers short; usually 10–11 segmented dorsal fin rays and 15 segmented pectoral fin rays; (known from a tributary of the lower Thomson River system in the coastal Gippsland region of VIC) . . . *Galaxias lanceolatus* **sp. nov.**

11(8) Body stocky and deep, depth at vent > 13.5 % SL, depth through pectoral fin base > 15.5 % SL; typically 10 gill rakers on first gill arch; caudal peduncle depth usually > 8.8 % SL; gape width > 43 % HL and > 64 % HW (restricted to the very upper Murrumbidgee River system in inland NSW) . . . *Galaxias tantangara* **sp. nov.**

\- Body elongate and shallow to moderately deep, depth at vent < 13.5 % SL, depth through pectoral fin base < 15.5 % SL; usually 12 or more gill rakers on first gill arch; caudal peduncle depth usually < 8.8 % SL; gape width < 43 % HL and < 64 % HW . . . 12

12(11) Snout relatively long, > 29.5 % HL and > 157 % ED. . . . 13

\- Snout short or of moderate length, < 29.5 % HL and < 157 % ED . . . 14

13(12) Segmented pelvic fin rays 8; typically 11 segmented anal fin rays; gill rakers on first arch 14 (13–15); pyloric caecae absent;

nostrils normally just visible from ventral view (known from the Arte River, Bemm River system, East Gippsland, in coastal VIC). . . . . *Galaxias aequipinnis* **sp. nov.**

\- Segmented pelvic fin rays 7; typically 10 segmented anal fin rays; gill rakers on first arch 12 (11–12); usually 1, sometimes 2, pyloric caecae; nostrils not visible from ventral view (known from an upper tributary in the Macalister River system, Gippsland, in coastal VIC) . . . . *Galaxias gunaikurnai* **sp. nov.**

14(12) Accessory lateral line absent; dorsal and ventral trunk profiles straight or nearly so; anterior nostrils long and visible from ventral view; segmented pectoral fin rays 13; eye large, > 20 % HL and ED/HD and ED/IOW ratios > 50 and > 55 % respectively; pelvic fins small (< 9.8 % SL) and PelL/PecL ratio < 80 %; mean vertebral count 51 (diminutive species, average size 45–55 mm LCF; known from the Genoa/Wallagaraugh, Cann, and mid-Snowy River systems East Gippsland, coastal VIC/NSW). . . . . *Galaxias terenasus* **sp. nov.**

\- Accessory lateral line present; dorsal and ventral trunk profiles relatively evenly arched; anterior nostrils short to moderately long and not visible from ventral view; segmented pectoral fin rays 14 or more; eye moderate, < 20 % HL and ED/HD and ED/IOW ratios < 50 and < 55 % respectively; pelvic fins moderate (> 9.8 % SL) and PelL/PecL ratio > 80 %; mean vertebral count usually > 52; (average size 60–90 mm LCF; distribution not as above). 15

15(14) Interorbital width < 40.5 % HL; DCP/LCP ratio > 61 %; caudal peduncle length < 13 % SL; rakers on first gill arch usually 12 and typically 15 segmented pectoral fin rays; 1–2 pyloric caecae of moderate length. . .*Galaxias olidus* Günther, 1866 (in part)

\- Interorbital width > 40.5 % HL; DCP/LCP ratio < 61 %; caudal peduncle length > 13 % SL; rakers on first gill arch usually 13 or more and typically 14 segmented pectoral fin rays; usually 1 pyloric caecum or caecae absent, if present, short to moderate length. 16

16(15) Anal fin base long (> 11.0 % SL), distinctly longer than dorsal fin base (LDB/LAB ratio < 83 %); BDPec/BDV ratio < 114 %; anal fin origin typically under < 55 % distance posteriorly along dorsal fin base; AL/LAB ratio < 147 %; Pel/PelAn ratio > 48 %; LJL/GW ratio > 90 %; usually 1 very short pyloric caecum, less often absent; typically 14 gill rakers on first arch with 9 segmented dorsal fin, and 12 segmented anal fin rays; caudal fin emarginate to weakly forked (found north of the Great Dividing Range, and west of the Otway Coast basin in coastal VIC, extending into SA) . . . .*Galaxias oliros* **sp. nov.** (in part)

\- Anal fin base of moderate length (< 11.0 % SL), usually slightly longer than dorsal fin base (LDB/LAB ratio > 83 %); BDPec/BDV ratio > 114 %; anal fin origin typically under > 55 % distance posteriorly along dorsal fin base; AL/LAB ratio > 147 %; Pel/PelAn ratio < 48 %; LJL/GW ratio < 90 %; pyloric caecae usually absent, less often 1 present, moderately long; typically 13 gill rakers on first arch with 10 segmented dorsal fin, and 11 segmented anal fin rays; caudal fin emarginate (known from catchments draining to the middle of Bass Strait in central, coastal VIC) . . . .*Galaxias ornatus* Castelnau, 1873

Species Treatments

See Tables 4–9 for the entire range of frequencies in counts for rays in the dorsal, anal, caudal, pectoral and pelvic fins, gill rakers and vertebrae for all species in the *Galaxias olidus* complex. Summarised counts and morphometric variation are provided separately under each species treatment. In each species description meristic character values are presented as a mode and value range for 90 % of specimens, holotype indicated as * if different to the modal count, [ ] if within or outside of range. Diagnostic allozyme loci (see Adams *et al.* 2014) are also provided for each species.

TABLE 4. Frequency distribution of segmented dorsal fin ray counts in species in the *Galaxias olidus* complex (total—branched + unbranched rays; *—holotype). Taxon codes following species names are from Adams *et al.* 2014.

Number of elements																			
	Total							Branched								Unbranched			
	6	7	8	9	10	11	12	4	5	6	7	8	9	10	11	1	2	3	4
Galaxias aequipinnis AR	-	-	-	5	24*	2	-	-	-	-	1	26*	4	-	-	7	23*	1	-
Galaxias arcanus RF	1	-	44	193*	82	2	-	-	1	33	194*	90	4	-	-	38	270	14*	-
Galaxias brevissimus JI	-	-	-	8*	1	-	-	-	-	-	3	6*	-	-	-	5*	4	-	-
Galaxias fuscus FU	-	-	2	52	109*	23	1	-	-	6	44	118*	17	1	-	11	124*	49	3
Galaxias gunaikurnai SH	-	-	2	8	8*	-	-	-	-	1	5	11*	-	-	-	2	14*	-	-
Galaxias lanceolatus ST	-	-	-	1	11	8*	-	-	-	-	1	10	9*	-	-	4	13*	3	-
Galaxias longifundus RI	-	-	-	8*	6	3	-	-	-	-	6	9*	2	-	-	2*	14	1	-
Galaxias mcdowalli RO	-	-	1	1	16*	7	1	-	-	2	1	11	11*	1	-	3	23*	-	-
Galaxias mungadhan DA	-	-	-	7	14*	2	-	-	-	-	7	14	4*	-	-	2*	23	-	-
Galaxias olidus OL	-	4	100	790*	803	156	9	1	2	43	609	982*	213	11	1	443*	1338	80	1

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TABLE 4. (Continued)

Number of elements	Total							Branched								Unbranched			
	6	7	8	9	10	11	12	4	5	6	7	8	9	10	11	1	2	3	4
Galaxias oliros OR	-	2	86	365*	116	4	-	-	4	59	333*	173	4	-	-	108	437*	28	-
Galaxias ornatus BA	-	-	12	173	227*	44	2	-	-	11	146	237	61*	2	-	75*	353	29	-
Galaxias supremus KO	-	-	-	9	16*	7	-	-	-	-	7	13*	11	1	-	10	20*	2	-
Galaxias tantangara TA	-	-	1	4	8*	2	-	-	-	1	3	8	3*	-	-	2*	13	-	-
Galaxias terenasus GE	-	-	10	69*	25	1	-	-	-	16	63*	26	-	-	-	6	86*	13	-

TABLE 5. Frequency distribution of segmented anal fin ray counts in species in the *Galaxias olidus* complex (total—branched + unbranched rays; *—holotype).

Number of elements	Total							Branched							Unbranched			
	8	9	10	11	12	13	14	6	7	8	9	10	11	12	1	2	3	4
Galaxias aequipinnis	-	-	1	24*	5	1	-	-	-	1	15	14*	1	-	10	20*	1	-
Galaxias arcanus	1	5	119	180*	18	-	-	-	16	136*	159	12	-	-	7	267	49*	-
Galaxias brevissimus	-	-	2	4	2*	-	-	-	-	3*	4	3	-	-	-	9*	-	-
Galaxias fuscus	-	1	64*	102	20	-	-	1	11	83*	74	18	-	-	11	124*	49	3
Galaxias gunaikurnai	-	1	12*	5	-	-	-	-	-	13*	5	-	-	-	5	13*	-	-
Galaxias lanceolatus	-	-	4	12	4*	-	-	-	-	2	12	6*	-	-	4	16*	-	-
Galaxias longifundus	-	1	8	8*	-	-	-	-	1	10*	6	-	-	-	1	13	3*	-
Galaxias mcdowalli	-	-	-	13*	13	-	-	-	-	-	10*	16	-	-	3	23*	-	-
Galaxias mungadhan	2	1	14*	10	-	-	-	-	1	16*	8	-	-	-	-	24*	1	-
Galaxias olidus	2	108	703	838*	199	10	1	1	66	632	931*	223	8	-	325	1388*	146	3
Galaxias oliros	-	2	30	199	269*	72	3	-	2	49	231	256*	34	3	10	467*	68	-
Galaxias ornatus	-	30	123*	177	117	10	1	-	21	129	183*	114	9	1	60*	346	49	2
Galaxias supremus	1	-	10	14*	7	-	-	-	1	7	14*	9	1	-	8	24*	-	-
Galaxias tantangara	-	-	4	7*	3	-	-	-	-	3	8*	2	1	-	3	10*	1	-
Galaxias terenasus	-	-	17	59*	28	1	-	-	1	25*	63	16	-	-	3	75	27*	-

TABLE 6. Frequency distribution of segmented pectoral fin ray counts in species in the *Galaxias olidus* complex (total—branched + unbranched rays; *—holotype).

Number of elements	Total								Branched									Unbranched				
	11	12	13	14	15	16	17	18	9	10	11	12	13	14	15	16	17	1	2	3	4	5
Galaxias aequipinnis	-	-	-	5*	21	5	-	-	-	-	-	4*	19	6	2	-	-	10	20*	1	-	-
Galaxias arcanus	-	12	44	172	85*	10	-	-	-	13	45	160	91*	-	-	-	-	18	298*	7	-	-
Galaxias brevissimus	-	-	1	3*	4	1	-	-	-	-	1	3*	4	1	-	-	-	-	9*	-	-	-
Galaxias fuscus	-	-	-	20	97*	65	5	-	-	-	-	21	88*	62	6	-	-	6	163*	18	-	-
Galaxias gunaikurnai	-	-	-	10	6*	2	-	-	-	-	-	10	6*	2	-	-	-	-	18*	-	-	-
Galaxias lanceolatus	-	-	-	3	13*	4	-	-	-	-	-	4	12*	4	-	-	-	-	19*	1	-	-
Galaxias longifundus	-	1	3	10*	3	-	-	-	-	1	3	10*	3	-	-	-	-	-	17*	-	-	-
Galaxias mcdowalli	-	-	-	14*	9	3	-	-	-	-	2	12*	19	3	-	-	-	-	23*	3	-	-
Galaxias mungadhan	-	-	-	10	15*	-	-	-	-	-	-	10	15*	-	-	-	-	-	25*	-	-	-
Galaxias olidus	-	14	131	662	739*	277	38	2	2	20	151	628	690*	259	48	4	1	97	1598*	101	6	1

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TABLE 6. (Continued)

Number of elements	Total								Branched									Unbranched				
	11	12	13	14	15	16	17	18	9	10	11	12	13	14	15	16	17	1	2	3	4	5
Galaxias oliros	-	9	147	280	127*	11	-	-	2	28	147	249	106*	13	-	-	-	10	467*	68	-	-
Galaxias ornatus	1	3*	64	196	165	24	1	-	2	3*	68	184	153	42	5	-	-	41	400*	14	2	-
Galaxias supremus	-	-	-	3	17*	11	2	-	-	-	-	6*	15	10	2	-	-	-	29	4*	-	-
Galaxias tantangara	-	-	4	9*	2	-	-	-	-	-	4	8*	3	-	-	-	-	1	14*	-	-	-
Galaxias terenasus	1	25	56*	15	4	-	-	-	1	27	51*	19	3	-	-	-	-	9	86*	3	3	-

TABLE 7. Frequency distribution of segmented pelvic fin and principal caudal fin ray counts in species in the *Galaxias olidus* complex (total—branched+unbranched rays; *—holotype).

Number of elements	Pelvic Total					Branched					Unbranched				Principal Caudal							
	5	6	7	8	9	4	5	6	7	8	0	1	2	3	12	13	14	15	16	17	18	19
Galaxias aequipinnis	-	-	1	30*	-	-	-	1	30*	-	-	31*	-	-	-	-	-	3	27*	1	-	-
Galaxias arcanus	-	5	317*	1	-	-	5	317*	1	-	-	323*	-	-	-	1	1	16	303*	2	-	-
Galaxias brevissimus	-	-	9*	-	-	-	-	9*	-	-	-	9*	-	-	-	-	-	-	8*	1	-	-
Galaxias fuscus	-	3	161*	23	-	-	3	161*	23	-	-	187*	-	-	-	-	1	7	171	7*	1	-
Galaxias gunaikurnai	-	-	17	1*	-	-	-	17	1*	-	-	18*	-	-	-	-	2	-	16*	-	-	-
Galaxias lanceolatus	-	1	18*	1	-	-	1	18*	1	-	-	20*	-	-	-	-	-	1	19*	-	-	-
Galaxias longifundus	-	-	16*	1	-	-	-	16*	1	-	-	17*	-	-	-	-	1*	-	16	-	-	-
Galaxias mcdowalli	-	-	1	25*	-	-	-	2	24*	-	-	25*	1	-	-	-	-	-	25*	1	-	-
Galaxias mungadhan	-	-	23	2*	-	-	-	23	2*	-	-	25*	-	-	-	-	-	3	20*	-	-	-
Galaxias olidus	2	26	1640*	192	3	2	40	1627*	191	3	2	1845*	15	1	-	1	16	86	1685*	66	7	1
Galaxias oliros	-	4	563*	7	-	-	7	560*	7	-	-	571*	3	-	1	-	6	16	547*	5	-	-
Galaxias ornatus	-	9	430*	19	-	-	14	424*	19	-	-	452*	5	-	-	1	4	24	422*	5	-	1
Galaxias supremus	-	-	1	31*	1	-	-	1	31*	1	-	33*	-	-	-	-	1	3	29*	-	-	-
Galaxias tantangara	-	-	15*	-	-	-	-	15*	-	-	-	15*	-	-	-	-	-	1	14*	-	-	-
Galaxias terenasus	-	-	93*	9	-	-	-	93*	9	-	-	102*	-	-	-	-	-	-	99*	6	-	-

TABLE 8. Frequency distribution of gill raker number in species in the *Galaxias olidus* complex (total—all rakers on first gill arch; lower—rakers on lower limb + raker in angle; upper—rakers on upper limb; *—holotype).

Number of elements	Total										Lower								Upper						
	8	9	10	11	12	13	14	15	16	17	6	7	8	9	10	11	12	13	1	2	3	4	5	6	7
G. aequipinnis	-	-	-	-	3	8	12*	6	2	-	-	-	1	6	22*	2	-	-	-	-	7	17*	5	2	-
G. arcanus	1	2	9	44	123	39*	106		17	1	1	2	53	162*	106	18	-	-	-	12	167	145*	17	1	-
G. brevissimus	-	-	2	2*	4	1	-	-	-	-	-	-	2	6*	1	-	-	-	-	4*	5	-	-	-	-
G. fuscus	-	2	7	40	53	50*	23	6	4	-	-	7	61	86*	26	5	-	-	-	8	81	76*	19	1	-
G. gunaikurnai	-	-	-	5*	11	2	-	-	-	-	-	-	2	15*	1	-	-	-	-	3*	14	1	-	-	-
G. lanceolatus	-	-	-	-	9	2	6*	3	-	-	-	-	-	9	8*	3	-	-	-	-	11	9*	-	-	-
G. longifundus	-	-	-	9*	6	2	-	-	-	-	-	-	-	8*	9	-	-	-	-	1	14*	2	-	-	-
G. mcdowalli	-	-	-	2	13	10*	1	-	-	-	-	-	1	14*	11	-	-	-	-	1	24*	1	-	-	-
G. mungadhan	-	-	-	4	11	10*	-	-	-	-	-	-	5	18*	2	-	-	-	-	-	16	9*	-	-	-
G. olidus	4	4	44*	268	727	571	203	37	5	-	-	20*	299	1151	360	33	-	-	7	112	1020*	688	33	3	-
G. oliros	-	-	1	11	94	163	213*	65	22	4	-	1	13	174	324*	57	3	1	-	6	189	315*	56	6	1

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TABLE 8. (Continued)

Number of elements	Total										Lower								Upper						
	8	9	10	11	12	13	14	15	16	17	6	7	8	9	10	11	12	1	1	2	3	4	5	6	7
G. ornatus	-	2	7	11	140	163	82	9	-	-	-	6	57	261	127	6	-	-	1	17	262	197	16	-	-
G. supremus	-	-	2	5*	11	14	1	-	-	-	-	-	2	18*	3	-	-	-	-	8*	21	4	-	-	-
G. tantangara	-	2	8	4*	1	-	-	-	-	-	-	1	10	4*	-	-	-	-	1	12*	2	-	-	-	-
G. terenasus	-	-	4	29	47*	18	2	-	-	-	-	5	42	47*	10	-	-	-	-	-	69*	31	-	-	-

TABLE 9. Frequency distribution of vertebrae and pyloric caecae counts in species in the *Galaxias olidus* complex (*—holotype).

Number of elements	Vertebrae														Pyloric Caecae		
	47	48	49	50	51	52	53	54	55	56	57	58	59	60	0	1	2
Galaxias aequipinnis	-	-	-	-	-	1	11	16	3*	1	-	-	-	-	24*	-	-
Galaxias arcanus	1	1	6	46	100	63*	26	1	1	-	-	-	-	-	60	41*	2
Galaxias brevissimus	-	-	-	-	1	8*	-	-	-	-	-	-	-	-	-	9*	-
Galaxias fuscus	-	-	-	-	1	31	48*	62	33	10	-	-	-	-	49	63	2
Galaxias gunaikurnai	-	-	-	-	-	10*	16	7	2	-	-	-	-	-	1	17	5*
Galaxias lanceolatus	-	-	-	-	-	-	2	11	8*	-	-	-	-	-	18*	1	-
Galaxias longifundus	-	-	-	-	-	4*	6	7	-	-	-	-	-	-	2	9*	6
Galaxias mcdowalli	-	-	-	-	-	-	-	8	16*	4	-	-	-	-	26*	-	-
Galaxias mungadhan	-	-	-	1	5	13*	16	4	2	-	-	-	-	-	25	23*	-
Galaxias olidus	-	-	9	97	282*	321	286	209	155	49	21	7	3	2	14	197*	289
Galaxias oliros	-	-	-	1	12	68	160*	136	45	3	-	-	-	-	73*	146	17
Galaxias ornatus	-	-	2	13	52	117*	121	30	8	-	-	-	-	-	10	75	56
Galaxias supremus	-	-	-	-	-	1	3	7	5	7	13	7*	1	-	-	4	18*
Galaxias tantangara	-	-	-	-	-	-	3	8	3*	1	-	-	-	-	-	1	14*
Galaxias terenasus	-	-	3	21	44*	30	15	-	-	-	-	-	-	-	-	-	28*

Galaxias aequipinnis, new species

East Gippsland Galaxias

Tables 4 to 11; Figs. 6 & 7

Galaxias olidus (non *G. olidus* Günther, 1866)—Cadwallader & Backhouse, 1983: 69 (*partim*); Raadik, 1995b: 55, fig A4.7 (*partim*).
Galaxias sp. 4—DSE, 2013: 17; Lieschke *et al.* 2013a,b.
Galaxias sp. 17—Kuiter, 2013: 80.

Conforms to the allozymically defined and morphologically diagnosed taxon 'AR' of Adams *et al.* (2014) and 'arte' of Raadik (2011).

Material Examined.

Holotype. NMV A.30565-2, 79.8 mm LCF, (70.8 mm SL), female, Arte River, at bridge on Glen Arte Road, west of Club Terrace, Murrungower State Forest, Victoria, 37° 34' 4"S 148° 45' 14"E, T.A. Raadik, 25 February 2002.

Paratypes. VIC: AMS I.44922-001 (2), 64.3–72.6 mm LCF (56.7–63.6 mm SL), NMNZ P.045752 (2), 68.5–71.1 mm LCF (60.5–62.8 mm SL) and NMV A.30565-1 (10), 64.2–85.7 mm LCF (56.3–75.8 mm SL), collected with holotype; NMV A.30567-1 (3), 69.8–89.7 mm LCF (62.0–79.4 mm SL), Arte River, at type locality, T.A. Raadik, 28 May 1992; NMV A.30563-1 (6), 62.9–85.2 mm LCF (55.9–76.0 mm SL), Arte River, at bridge on Arte Road, west of Club Terrace, Murrungower State Forest, 37° 32'53"S 148° 47' 55"E, T.A. Raadik, 28 May 1992.

Non-type material. VIC: NMV A.30567-2 (9), Arte R, collected with NMV A.30567-1.

Diagnosis. *Galaxias aequipinnis* **sp. nov.** differs from all other species within the *Galaxias olidus* complex by a combination of the following characters: segmented pelvic fin rays 8; pyloric caecae absent; head length relatively long (21.6–24.5 % SL), its length about as long as PelAn distance; nostrils of moderate length, usually just visible anterio-laterally from ventral view; mouth slightly subterminal and lower jaw shorter than upper; distinctive 'blunt' profile of snout; long anal fin base (10.4–12.9 % SL); short AL/LAB ratio, long pelvic fins which are about 0.9 of the pectoral fin length; a relatively long snout (27.2–32.0 % HL); a broadly flat dorsal midline anteriorly from above pelvic fin bases; raised lamellae rarely present on ventral surface of paired fins, if so, weakly developed; anal fin origin usually under 0.6 distance posteriorly along dorsal fin base; and, lack of black bars along lateral line.

Description. As for the genus and members of the *G. olidus* complex, except as indicated below, based on 24 specimens, 55.9–79.4 mm SL, and eight additional, non-type specimens for meristics. See Tables 4 to 9 for frequencies of meristic values and Table 10 for a summary of meristic variation. Segmented dorsal fin rays 10 (9–10), of these 8 (8–9) branched and 2 (1–3) unbranched; segmented anal fin rays 11 (11–12), of these 9 (9–10*) branched and 2 (1–2) unbranched; caudal fin rays 16; segmented pectoral fin rays 15 (14*–16), of these 13 (12*–14) branched and 2 (1–2) unbranched; pelvic fin rays 8, of these 7 branched and one unbranched; gill raker total count (lower limb and upper limb) 14 (12–15), lower arch with 10 (9–10) and 4 (3–5) on upper, variation on first gill arch 8+4 (1), 9+3 (2), 9+4 (3), 9+5 (1), 10+3 (5), 10+4 (11*), 10+5 (4), 10+6 (2), 11+4 (2); vertebrae 54 (52–56); pyloric caecae absent.

See Table 11 for comparative value ranges of morphometric characters. Body moderately stout and elongate, dorsal midline usually broadly flat anteriorly from above pelvic fin bases, depth through pectoral base 1.2 (1.0–1.2) that through vent, trunk with dorsal and ventral profiles evenly arched from snout to dorsal fin, somewhat depressed on head, with upper surface flattish, body tapering back to a moderately short, 7.9 (7.3–8.8) in SL, and deep, 11.6 (10.4–13.0) in SL, caudal peduncle, the peduncle depth 1.5 (1.2–1.7) in its length; accessory lateral line present. Head of moderate length, 4.4 (4.1–4.6) in SL, and similar to PelAn distance (0.9–1.1), of moderate depth and width, 2.4 (2.2–2.6) and 1.6 (1.4–1.7) in HL respectively, distinctly wider than deep (depth 1.6 in HW), lateral profile wedge-shaped and flattened dorsally; eyes of moderate size, 5.4 (4.9–6.3) in HL, 2.3 (1.9–2.7) in HD, situated high on just below dorsal head profile, interorbital slightly convex, of moderate width, 2.5 (2.2–2.7) in HL and 2.2 (2.2–2.3) times ED; cheeks expanded little below eyes, eye profiles usually visible laterally from ventral view; snout relatively long, 3.3 (3.1–3.7) in HL and 1.6 (1.3–1.9) times ED, lateral profile bluntly pointed as anterior portion of upper lip little rounded and almost vertical; post-orbital head length of moderate length, 1.9 (1.8–2.0) in HL; nostrils moderately long and usually just visible anterio-laterally from ventral view; mouth slightly subterminal, moderately large, 2.6 (2.4–2.8) in HL, posterior extent reaching back to below anterior 0.3–0.5 of diameter of eyes and 0.7 (0.6–0.8) ED below ventral margin of eye, cleft moderately oblique, most anterior tip of upper lip about level with ventral margin of eye, gape moderately narrow, 2.5 (2.0–2.9) in HL, width about equal to length of upper jaw and 1.6 (1.4–1.7) in HW. Jaws subequal, lower a little shorter (1.1–1.3 in UJL). Pyloric caecae absent; gill rakers moderately short, stout and bluntly pointed.

TABLE 10. Summary of meristic variation in *Galaxias aequipinnis* **sp. nov.** (T—total; B—branched; L—lower limb; S—single; U—upper limb). Range in 90 % and 100 % of specimens.

Character	Mode	Mean	SD	SE	Range 90 %	Range 100 %	N
Dorsal Rays (T)	10	9.9	0.48	0.09	9–10	9–11	31
Dorsal Rays (B)	8	8.1	0.40	0.07	8–9	7–9	31
Dorsal Rays (S)	2	1.8	0.48	0.09	1–2	1–3	31
Anal Rays (T)	11	11.2	0.55	0.10	11–12	1–13	31
Anal Rays (B)	9	9.5	0.63	0.11	9–10	8–11	31
Anal Rays (S)	2	1.7	0.52	0.10	1–2	1–3	31
Caudal Rays	16	15.9	0.37	0.07	15–16	15–17	31
Pectoral Rays (T)	15	15.0	0.56	0.10	14–16	14–16	31

......*continued on the next page*

TABLE 10. (Continued)

Character	Mode	Mean	SD	SE	Range 90 %	Range 100 %	N
Pectoral Rays (B)	13	13.2	0.73	0.13	12–14	12–15	31
Pectoral Rays (S)	2	1.8	0.41	0.07	1–2	1–2	31
Pelvic Rays (T)	8	8.0	0.18	0.03	8	7–8	31
Pelvic Rays (B)	7	7.0	0.18	0.03	7	6–7	31
Pelvic Rays (S)	1	1.0	0.00	0.00	1	1	31
Gill Rakers (T)	14	13.9	1.07	0.20	12–15	12–16	31
Gill Rakers (L)	10	9.8	0.61	0.11	9–10	8–11	31
Gill Rakers (U)	4	4.1	0.83	0.15	3–5	3–6	31
Vertebrae	54	53.8	0.80	0.14	53–55	52–56	32

TABLE 11. Morphometric variation in *Galaxias aequipinnis* **sp. nov.** (values are percentages of denominators in ratios, except for LCF and SL).

	Holo-	Paratypes (N = 23)			
Character	type	Mean	Min.	Max.	S.D.
LCF (mm)	79.8	71.3	62.9	89.7	
SL (mm)	70.8	63.1	55.9	79.4	
SL / LCF	88.7	88.4	87.6	89.1	0.46
BDV / SL	12.6	12.7	11.3	14.4	0.76
BDPec / SL	15.0	14.7	13.3	16.1	0.81
BDPec / BDV	118.9	116.0	99.9	125.3	7.45
LCP / SL	12.7	12.6	11.4	13.7	0.70
DCP / SL	9.0	8.6	7.7	9.6	0.51
DCP / LCP	71.1	68.3	58.9	82.4	6.04
CFFL / SL	12.7	13.1	12.2	14.2	0.60
LCP/CFFL	99.8	96.3	83.5	110.3	7.37
PreD / SL	71.0	71.1	69.3	72.7	1.12
PreA / SL	75.7	75.0	72.7	76.3	0.97
PreD / PreA	93.9	94.8	92.6	98.6	1.50
DF–AF / LDB	70.5	56.1	38.7	67.0	8.01
LDB / SL	9.7	10.4	9.1	11.8	0.76
LAB / SL	11.4	11.6	10.4	12.9	0.66
LDB / LAB	85.6	89.3	79.3	98.5	5.66
DL / LDB	158.6	144.8	127.8	164.0	10.07
AL / LAB	145.3	134.6	123.2	148.1	6.92
DL / SL	15.4	14.9	13.6	16.2	0.61
AL / SL	16.5	15.6	14.6	16.5	0.52
DL / AL	93.4	95.8	89.0	105.5	4.23
PecL / SL	13.1	12.3	10.8	13.3	0.58
PelL / SL	11.6	11.3	10.1	12.5	0.62
PelL / PecL	89.0	91.7	80.9	105.7	4.92
PrePel / SL	51.1	52.8	50.5	54.3	1.16

......*continued on the next page*

TABLE 11. (Continued)

Character	Holo-type	Paratypes (N = 23) Mean	Min.	Max.	S.D.
PecPel / SL	30.1	31.4	29.4	33.5	1.12
PelAn / SL	22.9	22.9	21.0	24.8	1.00
PecL / PecPel	43.5	39.1	34.4	43.8	2.33
PelL / PelAn	50.7	49.3	43.2	56.0	3.45
HL / SL	22.8	22.9	21.6	24.5	0.77
HL / PelAn	99.4	100.3	90.6	109.8	5.42
HW / HL	64.1	63.6	59.6	70.7	2.91
HD / HL	40.1	42.1	37.6	45.1	1.75
HW / HD	160.1	150.9	140.2	164.7	6.15
SnL / HL	29.7	30.1	27.2	32.0	1.35
SnL / ED	156.5	164.3	133.3	193.5	13.66
ED / HL	18.9	18.4	15.8	20.5	1.10
ED / HD	47.3	43.8	36.8	52.7	3.43
PoHL / HL	56.8	53.7	50.1	56.3	1.75
IOW / HL	41.1	40.4	36.7	44.8	1.90
ED / IOW	46.1	45.8	35.3	51.6	3.75
UJL / HL	38.4	38.5	35.1	42.4	1.70
LJL / HL	32.7	33.9	29.9	37.1	1.87
GW /HL	38.5	39.2	34.9	48.8	3.32
LJL / UJL	85.2	87.9	78.8	94.8	3.28
LJL / GW	84.9	86.7	74.9	97.6	7.00
GW / HW	60.0	61.6	58.6	69.0	2.71
SnL/UJL	77.3	78.4	70.0	85.0	4.47

Fins moderately fleshy at bases, with thickening extending distally over approximately 0.5 of fin area, extending farther between fin rays, dorsal fin base usually 1.1 (1.0–1.3) times length of anal fin base, fins rounded and moderately high, anal fin longer than dorsal fin, middle rays longest; anal fin origin usually under 0.6 (0.4–0.7) distance posteriorly along dorsal fin base. Pelvic fins moderately long, 8.8 (8.0–9.9) in SL, 0.9 of pectoral fin length, usually inserted at, or just posterior to, mid-point of standard length and extending about 0.5 distance to anal fin base; pectoral fin moderately large and paddle-shaped, 8.1 (7.5–9.2) in SL, extending just over 0.4 distance to pelvic fin base, low on body with dorsal end of fin base level with, or slightly above, posterior extent of mouth, lamina of paired fins oriented anterio-ventrally, raised lamellae rarely present, if so, weakly developed on ventral surface of rays, mainly on the distal end of the first few rays. Caudal fin of moderate length, 7.6 (7.0–8.2) in SL, emarginate, equal to, or very slightly longer than, caudal peduncle, vertical width of expanded rays greater than body depth through pectoral fin base, flanges low and well developed along caudal peduncle, reaching anteriorly to just past distal end of adpressed anal fin rays, usually farther, occasionally almost to anal fin base.

Size. Recorded to 110 mm LCF and 12.9 g; commonly to 70–80 mm LCF.

Colour in life. Body predominantly brown on back and upper sides above lateral line, extending onto top and sides of head and snout, and lateral sides of trunk posterior to anal fin, becoming light brown to cream ventrally, belly almost silvery white. Overlain by small to moderate sized dark brown to black, irregular shaped blotches, some coalescing to form irregularly shaped vertical bands; gill cover translucent with small golden patch; wide, diffuse and pale, mid-lateral band of copper flecks, becoming more noticeable on caudal region. Iris silvery gold; fins generally brown, light brown or pale orange. Gravid females with fine black to dark grey stippling along ventro-lateral surface of trunk between the pectoral fin base and vent. See below for more detailed comments on body pattern.

TABLE 12. Details of diagnostic allozyme loci among the 15 species in the *Galaxias olidus* complex treated in this revision. Lower left triangle = total number of pairwise fixed differences for the 54 loci analysed by Adams *et al.* (2014); upper right triangle = list of the individual loci found to be diagnostic for each species pair (code used:—1 = *Acon1*;2 = *Acon2*;3 = *Acp1*;4 = *Acp1*;5 = *Ada*;6 = *Adh*;7 = *Ak*;8 = *Ald1*;9 = *Ald2*;10 = *Ap1*;11 = *Ap2*;12 = *Ca*;13 = *Ck*;14 = *Enol1*;15 = *Enol2*;16 = *Fdp*;17 = *Fum*;18 = *G6pd*;19 = *Gapd*;20 = *Gda*;21 = *Glo*;22 = *Got1*;23 = *Got2*;24 = *Gp*;25 = *Gpi1*;26 = *Gpi2*;27 = *Gsr*;28 = *Idh1*;29 = *Idh2*;30 = *Ldh1*;31 = *Ldh2*;32 = *Mdh1*;33 = *Mdh2*;34 = *Me1*;35 = *Me2*;36 = *Mpi*;37 = *Ndpk1*;38 = *Ndpk2*;39 = *Np*;40 = *Pgam*;41 = *6Pgd*;42 = *Pgm1*;43 = *Pgm2*;44 = *Pk1*;45 = *Pk2*;46 = *PepA2*;47 = *PepB*;48 = *PepD*;49 = *PepA1*;50 = *Sod*, 51 = *Sordh*;52 = *Tpi1*;53 = *Tpi2*;54 = *Ugpp*); see Table 4 for species names.

Taxon	AR	BA	DA	FU	GE	JI	KO	OL	OR	RF	RI	RO	SH	ST	TA
AR	–	5,25,32, 47,51,53, 54	5,20,25, 41,42,47, 51,53	5,18,20, 25,42,47, 48,51,53	1,2,5,19, 20,25,39, 45,46,47, 51,53	5,26,27, 33,39,42, 43,51,53	5,25, 32,53	5,25,32, 39,43,47, 51,53	5,15,19, 25,39,42, 47,50, 51,53	4,5,18, 25,35,42, 48,51,53	5,20,25, 32,34,39, 41,42,43, 46,47,51, 53	5,15,22, 23,28,34, 53	2,5,20, 25,27,32, 39,46,47, 51,53,54	3,5,20, 23,25,27, 39,42,47, 50,51,53	5,25,34, 36,39,48, 51,53
BA	7	–	5,20,32, 41,42,47, 54	18,20,32, 51,54	1,2,5,19, 32,45,46, 47,54	26,27,32, 33,43,47, 51,54	47,54	43,54	19,54	4,5,18, 32,35,47, 54	34,41,42, 43,46,47, 53,54	5,15,22, 25,28,32, 34,47,51, 54	2,20,27, 46,47,54	3,5,20, 27,32,42, 47,50,54	5,32,34, 36,47,54
DA	8	7	–	5,18,20, 41,42,47, 48,51	1,2,5,19, 20,41,42, 45,46,47	5,20,26, 27,33,41, 42,43,47, 51	5,20,32, 41,42,47	5,20,32, 41,42,43, 47	5,15,19, 20,41,42, 47,50	4,5,18, 20,35,41, 42,47,48	5,20,32, 34,41,42, 43,46,53	5,15,20, 22,23,25, 28,34,41, 42,47,51	2,5,20, 27,32,41, 42,46,54	3,20,23 27,41,50	5,20,34, 36,41,42, 47,48
FU	9	5	8	–	1,2,5,18 20,42,45, 46,47,48, 51	5,18,20, 26,27,33, 47,48	5,18,20, 32,42,47, 48,51	18,20,32, 43,48	15,18,20, 47,48,50, 51	4,5,20, 35,47,51	18,20,32, 34,41,42, 43,46,47, 48,51,53	5,15,18, 20,22,23, 25,28,34, 42,47,48, 51	2,18,27, 32,42,46, 47,48,51, 54	3,5,18, 23,27,42, 47,48,50, 51	5,18,20, 34,36,42, 47,51
GE	12	9	10	11	–	1,2,5,19, 20,26,27, 33,42,45, 46,47,51	1,2,5,19, 20,32,45, 46,47	1,2,5,19, 32,43,45, 46,47	1,2,5,15, 20,39,42, 45,46,47, 50	1,2,18,19, 20,35,42, 45,46,47, 48	1,2,5,19, 32,34,39, 41,42,43, 45,46,47, 53	1,2,5,15, 19,20,22, 23,25,28, 34,39,45, 46,47,51	1,5,19, 20,27,32, 39,45,46, 47,54	1,2,3,5, 19,20,23, 27,39,42, 45,46,47, 50	1,2,5, 19,20,36, 45,46,47, 48
JI	9	8	10	8	13	–	26,27,32, 33,42,43, 51	5,26,27, 32,33,43, 47	5,15,19, 26,27,39, 47,50,51	4,5,18, 26,27,33, 35,43,48, 51	5,20,26, 27,32,33, 34,39,41, 42,43,46, 47,51,53	5,15,22, 23,26,27, 28,33,34, 39,42,43, 51	2,5,20, 26,27,32, 33,39,42, 43,46,47, 51,54	3,5,20, 23,26,27, 33,39,42, 43,47,50, 51	5,26,27, 33,34,36, 42,43,48, 51

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TABLE 12. (Continued)

Taxon	AR	BA	DA	FU	GE	JI	KO	OL	OR	RF	RI	RO	SH	ST	TA
KO	4	2	6	8	9	7	–	5,47	5,15,19,39,42,47,50	4,5,18,32,35,42,48	5,20,34,39,41,42,46,47,53	5,15,22,25,28,32,34	2,5,20,27,39,46,47,54	3,5,20,27,32,39,42,47,50	5,32,34,36,48
OL	8	2	7	5	9	7	2	–	19,47	4,5,18,32,35,43,47,48	34,39,41,42,47,53	5,15,22,23,25,28,32,34,39,43,47,51	2,20,43,47	3,5,20,23,27,32,42,43,47	5,32,36,47,48
OR	10	2	8	7	11	9	7	2	–	4,5,15,18,19,35,47,48,50	15,19,20,34,39,41,42,46,47,50,53	5,19,22,23,25,28,34,39,42,47,50,51	2,15,19,27,42,47,50,54	3,5,15,19,20,23,27,42,47	5,15,19,34,36,39,42,47,48,50
RF	9	7	9	6	11	10	7	8	9	–	4,5,18,20,32,34,35,41,42,46,47,48,53	4,5,15,18,22,23,25,28,34,35,42,48,51	2,4,5,18,20,27,32,35,42,46,47,48,54	3,4,5,18,20,23,27,35,42,47,48,50	4,5,18,34,35,36,42
RI	13	8	9	12	14	15	9	6	11	13	–	5,15,20,22,23,25,28,32,34,39,41,42,43,46,47,51,53	2,20,27,34,39,41,42,43,53,54	3,5,20,23,27,32,34,39,41,42,43,46,50,53	5,20,32,36,39,41,42,46,47,48,53
RO	7	10	12	13	16	13	7	12	12	13	17	–	2,5,15,20,22,23,25,27,28,32,34,39,46,47,51,54	3,5,15,20,22,25,27,28,34,39,42,47,50,51	5,15,22,23,25,28,34,36,39,48,51
SH	12	6	9	10	11	14	8	4	8	13	10	16	–	2,3,5,23,27,32,42,46,50,54	2,5,20,27,32,34,36,39,46,47,48,54
ST	12	9	6	10	14	13	9	9	9	12	14	14	10	–	3,5,20,23,27,34,36,39,42,47,48,50
TA	8	6	8	8	10	10	5	5	10	7	11	11	12	12	–

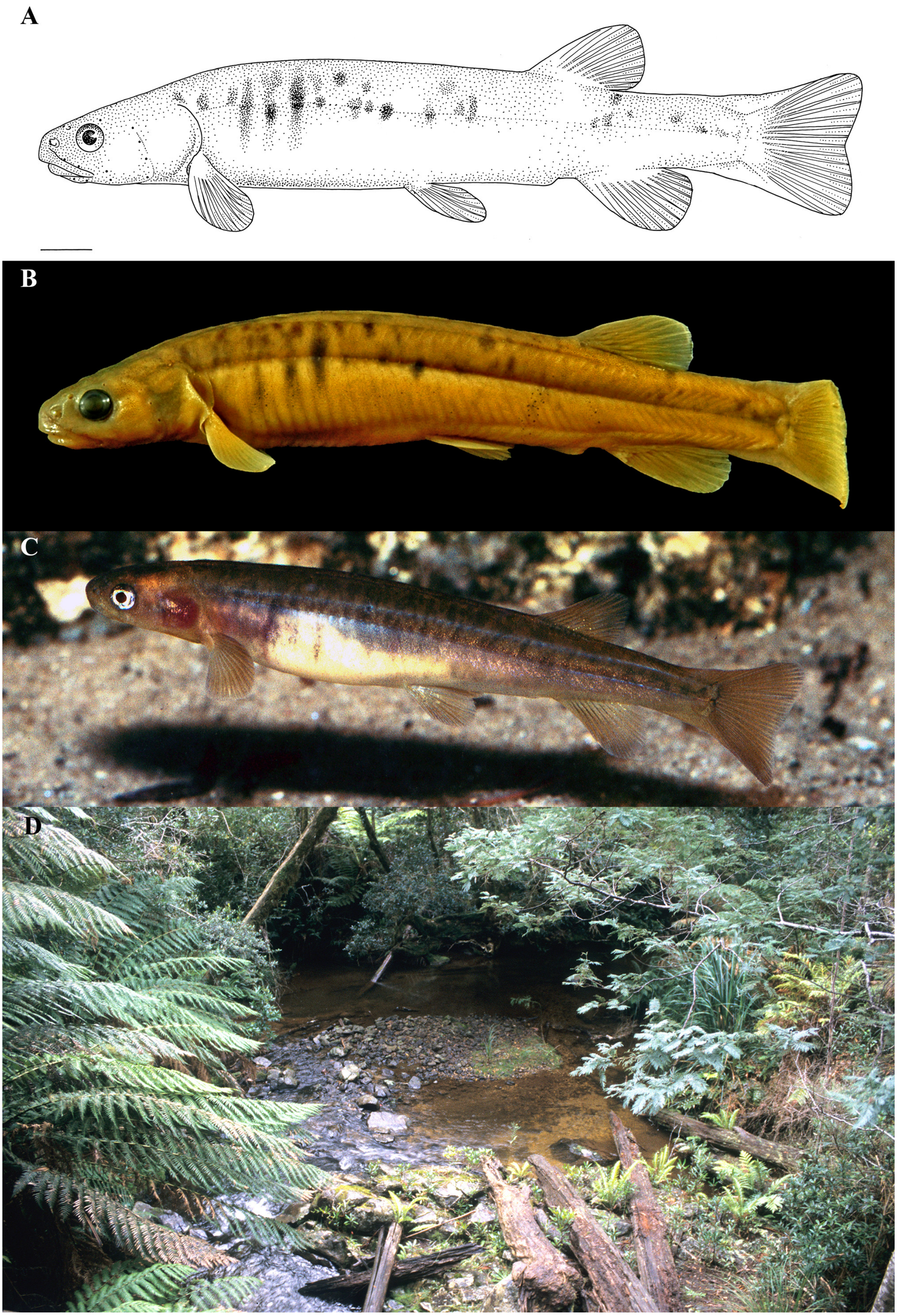

FIGURE 6. A–B: *Galaxias aequipinnis* **sp. nov.** holotype, NMV A.30565-2, 79.8 mm LCF, Arte River, Glen Arte Road, west of Club Terrace, Murrungower State Forest, Victoria, A) line drawing (R. Plant), B) image of preserved specimen (note: distal end of caudal fin is bent to the left in the horizontal plane) (T.A. Raadik); C) *Galaxias aequipinnis*, collected at the type locality with the holotype, 25 February 2002; ~ 70 mm LCF. (R. Kuiter); D) Arte River, at type locality of *Galaxias aequipinnis*, facing downstream, 25 February 2002 (T.A. Raadik). Scale bar = 5 mm.

Colour of preserved material. Base colour of head and body light tan to pale creamy brown. Dorsal surface of head and trunk usually with dusky shading composed of very fine brown stippling, darker dorsally and fading down sides but extending onto ventral surface. Irregularly shaped, small and large, brown blotches tending to diffuse bars, reminiscent of flecks, randomly dispersed on dorsal and lateral surfaces, extending down sides to below lateral line, occasional larger, vertical, blotches, centred on lateral line, usually darker brown, contrasting in tone to nearby paler blotches and shading. Dusky shading extending onto head as fine brown stippling, darker on dorsal surfaces, fading down sides and light on ventral surface. Some medium to fine, black or brown spotting inside operculum and dark fine spotting at base and along gill filaments.

Eye grey to black, pupil translucent pale orange-yellow. Teeth translucent pale orange-yellow, tips orange to orange-red; gill rakers pale cream. Fins pale cream to tan, becoming more translucent on posterior margins, finer body pattern and shading extending onto fleshy bases of dorsal, anal and pectoral fins, and onto base of caudal fin. Fin rays translucent, external edges of rays highlighted with very fine black lines, first few rays generally darker.

Etymology. From the Latin *aequalis*, meaning like or same and *pinna*, meaning fin, in reference to the almost equal size, on average, of the pectoral and pelvic fins in this species, which are the most equal of all members within the *G. olidus* complex. Suggested vernacular name as the 'East Gippsland Galaxias'.

Genetics. Allozyme and mtDNA analysis of this species can be found in Adams *et al.* (2014; taxon code AR). Diagnostic allozyme loci (4–13) between this taxon and the other species in the *Galaxias olidus* complex are provided in Table 12.

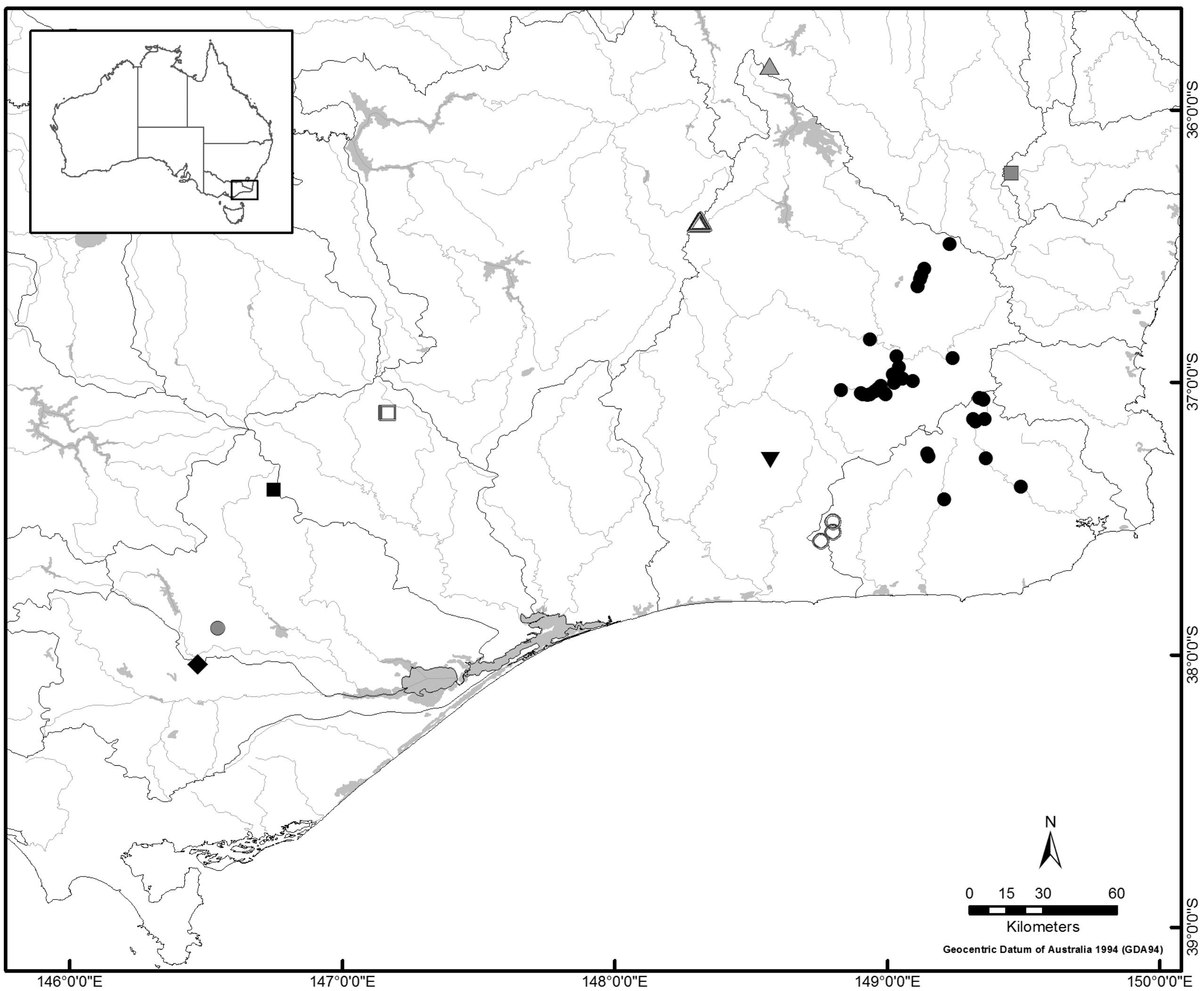

FIGURE 7. Distribution of *Galaxias aequipinnis* (open circles), *Galaxias brevissimus* (grey square), *Galaxias gunaikurnai* (black square), *Galaxias lanceolatus* (grey circle), *Galaxias longifundus* (black diamond), *Galaxias mcdowalli* (inverted black triangle), *Galaxias mungadhan* (open squares), *Galaxias supremus* (open triangle), *Galaxias tantangara* (grey triangle), and *Galaxias terenasus* (black circles) (river basins shown—refer to Fig. 1).

Distribution. See Fig 7. Known from the Arte River system, a tributary of the Goolengook River, Bemm River catchment, in the coastal East Gippsland region of Victoria, at an elevational range of 250– > 390 m asl. Recorded downstream in the Arte River to Arte Road near Pikes Hill Track, and from the mid reaches of the Little Arte River, which joins farther downstream, though its distribution in intervening waters is unknown. Therefore, currently known from the headwater section of the Arte River extending 13 km from the source, and from a section of the Little Arte River extending 7 km from the source, with a combined catchment area of 46 km^2 (27 km^2 and 19 km^2 respectively).

Sympatry. Only species in the *Galaxias olidus* complex found within its range (however, see Remarks, below), although *G. brevipinnis* and *G. maculatus* are also known from the Bemm River system.

Habitat. Recorded from small to moderately large (1.5–6.0 m average width and 0.15–0.40 m in average depth), well-shaded and cool, clear to slightly tannin-stained streams, flowing through densely forested catchments, consisting of pools, glides and riffles, with smaller amounts of rapids and backwater areas. Substrate consisted predominantly of bedrock with boulder and cobble, with smaller amounts of gravel and coarse sand, and relatively large areas of silt deposits. Instream cover was provided predominantly by rock, vegetation overhang and timber debris, with smaller areas of aquatic vegetation, and pools averaged 0.6–0.8 m in depth.

Conservation status. Endangered (DSE 2013).

General Biology. Confined to freshwater and considered not to undertake diadromous migrations. Recorded at a density of 0.10–0.28 fish/m^2 and collected with the native species Shortfinned Eel (*Anguilla australis*), Broadfinned Galaxias (*Galaxias brevipinnis*), East Gippsland Spiny Crayfish (*Euastacus bidawalus*), Gippsland Spiny Crayfish (*Euastacus kershawi*) and Common Freshwater Shrimp (*Paratya australiensis*). The predatory alien species Brown Trout (*Salmo trutta*) is present farther downstream in the Goolengook River system. Spawning period is possibly during winter to spring, but may be variable. Fish collected in late February 2002 (late summer) were at an early stage of gonad development but in late May 1992 (end of autumn) were at an advanced stage, with males running ripe and female gonads well developed and generally in a ripe stage. The majority of fish recorded in late May were > 54 mm LCF, with the smallest sexually developing individual 54.8 mm LCF. Confusingly, three individuals also collected in late May were juveniles (37.0, 39.5 and 41.4 mm LCF respectively), considered of 0+ age, possibly indicating a late spawning with a possible November-December hatching. One individual found to be infected with a short, thin, white worm, coiled and pointed at both ends, from amongst fat deposits around stomach in the body cavity.

Remarks. Raised lamellae on paired fins were infrequently encountered, and were also poorly developed. If present, they were characterised as very short in length along the rays, small thickenings on the distal end of the first few rays of the pectoral fins only, and difficult to distinguish.

Brown Trout have not been recorded from the Arte River system at the above sites, but are abundant in the Goolengook River approximately 4 km downstream from the junction with the Little Arte River, which is 7 km downstream from the collection site for *Galaxias aequipinnis* in the Arte River, and 4 km downstream from the collection site in the Little Arte River. Their presence in the lower Arte River, and possibly Little Arte River, is strongly suspected, which would limit the current downstream distribution of *G. aequipinnis*, which is considered to have been historically more widespread, possibly occupying the majority of the Goolengook River system.

Individuals belonging to the *Galaxias olidus* complex, have been collected from farther north-east in the Bemm River system (NMV A.30646-1 (5), Shady Creek, a tributary of the Errinundra River), though their identity has not been determined due to a lack of suitably preserved specimens. No fresh material was collected during extensive sampling for this study. The available individuals, collected in 1992, are small (< 53 mm LCF) but superficially resemble *Galaxias aequipinnis*, though initial examination has detected some morphological differences between the taxa, and with all other species within the complex in nearby catchments. This suggests the possibility of further undescribed species diversity in the upper Bemm River system and additional survey effort in this area is required to locate material and resolve this issue.

***Galaxias arcanus*, new species**

Riffle Galaxias

Tables 4 to 9, 12 to 14; Figs. 8 to 11

Galaxias olidus (non *G. olidus* Günther, 1866)—Koehn, 1987: 3; Morison & Anderson, 1991 (*partim*); Lintermans, 1998: sites

36 and 47 (*partim*) and 57; Raadik *et al.*, 2001: 115, 116–117 (*partim*), 122 (*partim*), 123, 124 (*partim*), 125, 126 (*partim*); Koehn, 2002 (*partim*); Pollino *et al.*, 2004 (*partim*); Lintermans, 2007: 44 (*partim*).
Galaxias sp. nov.–Raadik, 2001: 785, top image p. 786.
Galaxias sp. 2—Sowersby, 2007; Davies *et al.*, 2008: 338; Gilligan *et al.*, 2010: 7, Lieschke *et al.,* 2013a,b.
Galaxias sp. 3—Kuiter, 2013: 44.

Conforms to the allozymically defined and morphologically diagnosed taxon 'RF' of Adams *et al.* (2014), and 'riffle' of Raadik (2011).

Material Examined.

Holotype. NMV A.30568-3, 86.3 mm LCF (74.9 mm SL), female, Wheelers Creek, just upstream of bridge on Wheelers Creek Logging Road and junction with Zulu Creek, upstream of O'Hagens Campsite, south of Staceys Bridge, Victoria, 36° 32' 23"S 147° 49' 44"E, T.A. Raadik and J. Lyon, 1 April 2008.

Paratypes. NSW: AMS I.32711-002 (4), 50.3–71.2 mm LCF (44.7–62.6 mm SL), Murray River, off Murray River Road, just upstream from junction with Corryong Creek, upstream from Tintaldra, 36° 05' 23"S 147° 59' 00"E, M. Lintermans, 12 March 1992; NMV A.30464-1 (1) 81.7 mm LCF (74.5 mm SL), Murray River, 50 m upstream from The Poplars campsite at end of Limestone Creek Track, Alpine National Park, 36° 46' 42"S 148° 06' 25"E, T.A. Raadik and V. Caracher, 22 March 2005. **VIC:** AMS I.44935-001 (3), 60.3–63.4 mm LCF (52.1–55.5 mm SL), NMV A.30393-5 (12), 56.3–77.3 mm LCF (50.0–68.2 mm SL), Corryong Creek, at bridge on Briggs Gap Road, north-west of Corryong, 36° 10' 28"S 147° 51' 52"E, T.A. Raadik, 18 March 2002; NMV A.30420-1 (18), 55.3–77.7 mm LCF (48.3–67.7 mm SL), Corryong Creek, same location as NMV A.30393-5, T.A. Raadik, 11 September 2002; NMV A.30463-2 (3), 54.2–85.0 mm LCF (47.4–75.3 mm SL), Snowy Creek, behind hotel, Mitta Mitta township, 36° 32' 09"S 147° 22' 40"E, T.A. Raadik, 19 March 2002; AMS I.44923-001 (2), 62.3–66.3 mm LCF (54.2–58.4 mm SL) and NMV A.30568-1 (5), 60.3–79.8 mm LCF (52.5–70.0 mm SL), collected with holotype; AMS I.44933-001 (2), 69.7–71.9 mm LCF (61.6–62.8 mm SL), NMV A.30453-2 (6), 67.8–72.5 mm LCF (59.0–63.8 mm SL) and SAMA F.12142 (2), 64.8–67.5 mm LCF (56.7–59.7 mm SL), Kiewa River, east branch, at bridge on East Kiewa Road, north of Mount Beauty, 36° 43' 29"S 147° 10' 46"E, T.A. Raadik, 20 March 2002; AMS I.44934-001 (3), 58.5–63.8 mm LCF (51.1–55.4 mm SL), and NMV A.30462-2 (12), 57.1–65.4 mm LCF (50.0–57.6 mm SL), Ovens River, off end of track in Braithwaite Plantation, downstream of Porepunkah, 36° 40' 54"S 146° 52' 46"E, T.A. Raadik, 21 March 2002; NMV A.30456-2 (5), 58.3–64.6 mm LCF (50.4–56.3 mm SL), Ovens River, at Nimmo Bridge on Buffalo River Road, Myrtleford, 36° 34' 09"S 146° 42' 57"E, T.A. Raadik, 26 June 2002; NMV A.30457-2 (4), 59.9–80.3 mm LCF (51.6–71.3 mm SL), Acheron River, at bridge on Glendale Lane, between Taggerty and Buxton, 37° 21' 10"S 145° 42' 25"E, T.A. Raadik and B. Cant, 22 May 2001; NMV A.30466-2 (5), 58.9–70.8 mm LCF (51.0–61.7 mm SL), Little River, off Maroondah Highway at Taggerty, 37° 19' 26"S 145° 42' 46"E, T.A. Raadik and B. Cant, 25 May 2001; NMV A.30467-2 (4), 59.4–74.6 mm LCF (51.7–66.6 mm SL), Little River, at bridge on Cathedral Lane, south-east of Taggerty, 37° 20' 05"S 145° 44' 28"E, T.A. Raadik and B. Cant, 23 May 2001.

Non-type material. NSW: AMS I.32711-006 (6), 41.0–45.3 mm LCF (36.1–39.8 mm SL), Murray River, collected with AMS I.32711-002; NMV A.30440-1 (4), 46.6–71.6 mm LCF (41.2–63.7 mm SL), Murray River, Clarke Lagoon Reserve, downstream from Tintaldra, 36° 01' 29"S 147° 54' 49"E, TAR, 18 March 2002. **VIC:** NMNZ P.045755 (3), 55.8–59.0 mm LCF (49.6–52.1 mm SL), NMV A.30393-4 (37), 36.7–56.3 mm LCF (32.1–48.6 mm SL) and SAMA F.12143 (3), 54.3–56.4 mm LCF (48.0–49.9 mm SL), Corryong Creek, collected with NMV A.30393-5; NMV A.30420-3 (4), 53.2–57.0 mm LCF (45.9–50.1 mm SL) and TMAG D.3833 to 5 (3), 57.2–59.5 mm LCF (49.2–52.3 mm SL), Corryong Creek, same location as NMV A.30393-5, TAR, 11 September 2002; NMV A.30430-1 (10), 49.5–67.3 mm LCF (43.2–58.7 mm SL), Mitta Mitta River, caravan park of Omeo Highway, Mitta Mitta, 36° 32' 12"S 147° 22' 08"E, TAR, 21 June 1992; NMV A.30474-1 (4), 54.5–71.3 mm LCF (48.5–62.0 mm SL), Nariel Creek, Stacey Bridge on Benambra/Corryong Road, A.F. Baxter and S. Vallis, 7 March 1978; NMV A.30439-1 (4), 67.2–83.3 mm LCF (58.7–73.7 mm SL), Simpsons Creek, Grapolite Gully Track, east of Carmody's Road, 36° 23' 48"S 147° 47' 04"E, J. Lieschke, 30 March 2005; NMV A.30463-1 (7), 40.5–53.4 mm LCF (35.5–46.0 mm SL), Snowy Creek collected with NMV A.30463-2; NMV A.30446-1 (3), 50.2–63.9 mm LCF (44.2–55.6 mm SL), Snowy Creek, off Omeo Highway, 6.6 km upstream from junction with Mitta Mitta River, south-east of Mitta Mitta, 36° 33' 52"S 147° 24' 30"E, D.J. Harrington, 19 May 1992; NMV A.30422-1 (1), 67.7 mm LCF (59.0 mm SL), Snowy Creek, Lightning Creek track, south-east of Mitta Mitta, 36° 40' 55"S 147° 26'

38”E, TAR, 20 October 1997; NMV A.30458-1 (5), 50.6–63.8 mm LCF (43.9–55.5 mm SL), Snowy Creek, same location as NMV A.30422-1, TAR, 19 March 2002; NMV A.30529-1 (1), 56.3 mm LCF (49.0 mm SL), Snowy Creek, west branch, West Branch Track, south-west of Granite Flat, 36° 36' 42”S 147° 22' 38”E, D. Stoessel, 12 March 2008; NMV A.30568-2 (13), 40.2–59.3 mm LCF (35.0–51.6 mm SL), Wheelers Creek, collected with holotype; NMV A.30426-1 (2), 52.4–78.7 mm SL (46.1–67.0 mm SL), Zulu Creek, Zulu Creek Track, 36° 32' 25”S 147° 49' 44”E, JPO, 21 May 1997; NMV A.30451-1 (3), 60.9–62.4 mm LCF (53.6–54.6 mm SL), Kiewa River, east branch, East Kiewa (Damm's) Road, north of Mount Beauty, 36° 43' 28”S 147° 10' 46”E, JPO, 24 February 1998; NMV A.30450-1 (3), 48.2–60.8 mm LCF (42.3–53.2 mm SL), Kiewa River, Ang’s tobacco farm, off Damm’s Road, north of Mount Beauty, 36° 42' 52”S 147° 09' 29”E, JPO, 25 February 1998; NMV unregistered (4), 63.7–74.4 mm LCF (56.0–66.2 mm SL), Kiewa River, same location as NMV A.30450-1, P.S. Fairbrother and W. Koster, 6 March 2007; NMV A.30453-1 (30), 39.9–59.2 mm LCF (34.8–51.6 mm SL), Kiewa River east branch, collected with NMV A.30453-2; NMV A.8933 (5), 70.9–78.8 mm LCF (63.7–69.8 mm SL), Buckland River, east branch, off Buckland River Road, 36° 52' 31”S 146° 52' 19”E, A.F. Baxter and S. Vallis, 27 March 1990; NMV A.30537-1 (6), 37.8–68.5 mm LCF (33.6–60.3 mm SL), Buckland River, track off Buckland River Road, upstream from Buckland, 36° 50' 23”S 146° 51' 09”E, R.J. Strongman, 16 January 1996; NMV A.30425-1 (2), 55.0–59.0 mm LCF (48.5–52.2 mm SL), Buffalo River, at junction with Dandongadale River, 36° 47' 42”S 146° 39' 53”E, D.J. Harrington, 31 March 1992; NMV A.30434-1 (7), 56.4–75.5 mm LCF (49.7–67.5 mm SL), German Creek, off Tawonga Gap Road, east from Germantown, 36° 43' 47”S 147° 02' 56”E, A.F. Baxter and S. Vallis, 8 February 1994; NMV A.30449-1 (1), 51.0 mm LCF (43.5 mm SL), King River, Burnt Track, Pineapple Flat, north-east from Mt. Stirling, 37° 03' 58”S 146° 29' 54”E, JPO, 18 April 1997; NMV A.30421-1 (2), 70.3–77.9 mm LCF (61.4–68.1 mm SL), King River, Speculation Road, west of Mt. Speculation, Alpine National Park, 37° 06' 12”S 146° 34' 23”E, P. Tinkler, 22 February 2007; NMV A.30469-1 (11), 45.2–63.0 mm LCF (39.6–55.0 mm SL), King River, at old bridge, Cheshunt, 36° 47' 51”S 146° 25' 33”E, TAR, 17 May 2001; NMV A.30462-1 (15), 33.9–56.3 mm LCF (29.5–48.9 mm SL), Ovens River, collected with NMV A.30462-2; NMV A.30456-1 (10), 44.8–56.2 mm LCF (38.2–49.0 mm SL), Ovens River, collected with NMV A.30456-2; NMV A.30423-1 (7), 46.5–64.0 mm LCF (40.3–56.0 mm SL), Ovens River, same location as NMV A.30462-2, B. Zampatti, 23 February 2000; NMV A.30454-1 (10), 51.9–70.5 mm LCF (45.6–61.3 mm SL), Ovens River, same location as NMV A.30462-2, B. Zampatti, 4 March 2002; NMV A.30424-1 (4), 49.9–70.9 mm LCF (44.0–62.1 mm SL), Rose River, off Rose River Road upstream of junction with Dandongadale River, 36° 48' 20”S 146° 37' 43”E, D.J. Harrington, 19 March 1992; NMV A.30457-1 (10), 36.6–54.1 mm LCF (31.5–47.5 mm SL), Acheron River, collected with NMV A.30457-2; NMV A.8197 (1), 64.8 mm LCF (56.9 mm SL), Acheron River, Taggerty, 37° 19' 15”S 145° 42' 41”E, P.S. Lake, April 1985; NMV A.9246 (1), 52.2 mm LCF (45.1 mm SL), and NMV A.8136 (1), 49.8 mm LCF (43.0 mm SL), Acheron River, 4 km north of Taggerty off Keenes Road, 37° 17' 08”S 145° 43' 04”E, P.S. Lake, November 1985; NMV A.1040 (2), 64.9–72.7 mm LCF (56.6–63.6 mm SL), Acheron River, T.J. Doeg, 17 October 1988; NMV A.30480-1 (15), 62.0–90.8 mm LCF (55.3–80.1 mm SL), Big River, Reefton Logging Road, 37° 31' 16”S 146° 04' 42”E, D.J. Harrington, 28 February 1990; NMV A.30444-1 (3), 55.8–63.2 mm LCF (48.9–55.9 mm SL), Black River, River Track, 37° 31' 13”S 146° 18' 38”E, JPO, 9 December 1997; NMV A.30447-2 (3), 73.8–80.2 mm LCF (66.0–71.5 mm SL), Goulburn River, east of Acheron, 37° 14' 28”S 145° 44' 59”E, R.J. Strongman, 7 May 1996; NMV A.30478-1 (2), 71.3–74.2 mm LCF (62.3–65.5 mm SL), and NMV A.30471-1 (4), 50.3–55.5 mm LCF (43.9–48.6 mm SL), Howqua River, off Howqua Road, upstream from Howqua, 37° 13' 38”S 146° 12' 35”E, A.F. Baxter and S. Vallis, 18 April 1978; NMV A.30526-1 (6), 70.1–86.9 mm LCF (62.6–77.7 mm SL), Howqua River, Tunnel Bend, upstream from Sheepyard Flat, 37° 11' 16”S 146° 22' 12”E, R.J. Strongman, 31 January 1996; NMV A.30433-1 (6), 70.1–86.9 mm LCF (62.2–77.7 mm SL), Howqua River, Tobacco Flat, 37° 13' 04”S 146° 18' 24”E, R.J. Strongman, 31 January 1996; NMV A.30532-1 (12), Howqua River, same location as NMV A.30433-1, R.J. Strongman, 16 January 2001; NMV A.14018 (1), 75.8 mm LCF (66.9 mm SL), Jamieson River, upstream from Jamieson, 37° 17' 31”S 146° 10' 31”E, R. Gibb, 18 April 1978; NMV A.30535-1 (1), 55.9 mm LCF (49.1 mm SL), Jamieson River, south branch, off Silvermine Spur Road, 37° 20' 36”S 146° 22' 21”E, JPO, 16 April 1997; NMV A.30466-1 (5), 35.1–35.4 mm LCF (31.1–48.7 mm SL), Little River, collected with NMV A.30466-2; NMV A.30467-1 (3), 32.1–44.6 mm LCF (27.9–39.5 mm SL), Little River, collected with NMV A.30467-2; NMV A.30452-1 (1), 59.1 mm LCF (51.4 mm SL), Little River, same location as NMV A.30467-2, J. Lieschke, 2 March 1999; NMV A.30648-2 (5), 41.5–53.6 mm LCF (36.3–47.2 mm SL), Little River, in reserve, upstream of Maroondah Highway, Taggerty, 37° 19' 27”S 145° 42' 48”E, TAR, 18 December

2001; NMV A.30472-1 (2), 89.2–98.1 mm LCF (78.6–87.2 mm SL), Rubicon River, access track, Rubicon, 37° 17' 23"S 145° 49' 34"E, J. Lieschke, 1 March 2000; NMV A.30477-1 (3), 53.9–80.9 mm LCF (47.3–71.2 mm SL), Rubicon River, same location as NMV A.30472-1, P. Close and G. Aland, March 2001; NMV A.30432-1 (3), 46.7–56.8 mm LCF (39.9–48.2 mm SL), Rubicon River, same location as NMV A.30472-1, TAR, 24 May 2001; NMV A.30470-1 (13), 57.9–72.9 mm LCF (51.0–65.0 mm SL), Rubicon River, 'Tumbling Waters' picnic area, south of Thornton, 37° 16' 47"S 145° 47' 58"E, R.J. Strongman, 22 February 2002; NMV A.30431-1 (2), 68.0–89.9 mm LCF (60.4–80.4 mm SL), Snobs Creek, Snobs Creek Hatchery, 37° 15' 49"S 145° 52' 24"E, J. Douglas, 17 March 1995; NMV A.30539-1 (1), 53.1 mm LCF (45.4 mm SL), Snobs Creek, Goulburn Valley Highway, 37° 15' 32"S 145° 52' 24"E, TAR, 29 March 2001; NMV A.30455-1 (2), 44.5–73.3 mm LCF (38.5–64.5 mm SL), Steavenson River, downstream from Buxton/Marysville Road, north of Marysville, 37° 27' 53"S 145° 44' 01"E, TAR, 22 May 2001; NMV A.30436-1 (2), 68.8–79.9 mm LCF (60.7–70.9 mm SL), Steavenson River, upstream of Buxton/Marysville Road, north of Marysville, 37° 28' 56"S 145° 45' 05"E, TAR, 22 May 2001; NMV A.30438-1 (1), 72.0 mm LCF (63.9 mm SL), Steavenson River, at Buxton/Marysville Road, north of Marysville, 37° 27' 55"S 145° 44' 08"E, J. Lieschke, 2 October 2002.

Additional material examined (not measured): see Appendix 5.

Diagnosis. *Galaxias arcanus* **sp. nov.** is one of the most morphologically distinctive species in the *Galaxias olidus* complex and differs from all others by a combination of the following characters: shallow body with a straight ventral profile; long and shallow caudal peduncle, the peduncle length greater than the caudal fin length; caudal peduncle flanges poorly developed; a distinctive snout which extends anteriorly from the thick and fleshy upper jaw as a fleshy protrubence, bulbous in lateral profile; nostrils of moderate length, usually not visible from ventral view; subterminal mouth and lower jaw 81.5 (72.9–99.4) % of length of upper jaw; most anterior tip of snout level with about lower 0.3 of eye diameter; head wide and shallow; short PrePel, PecPel and PoHL dimensions; large, ventrally oriented pectoral and pelvic fins (12.1–16.7 and 9.2–13.0 % SL respectively); low mean vertebral count of 51, though range broad (47–55); 0–1 pyloric caecae, short (1.0 % SL) and wide when present; gill rakers of moderate length, thin and sharply pointed; anal fin origin usually under 0.4 distance posteriorly along dorsal fin base; distinctive cryptic colouration; and, lack of black bars along lateral line.

Description. As for the genus and members of the *Galaxias olidus* complex, except as indicated below, based on 92 specimens, 44.7–75.3 mm SL, and 250 additional, non-type specimens for meristics. See Tables 4 to 9 for frequencies of meristic values and Table 13 for a summary of meristic variation. Segmented dorsal fin rays 9 (8–10), of these 7 (6–8) branched and 2 (1–3*) unbranched; segmented anal fin rays 11 (10–12), of these 9 (7–9; [8*]) branched and 2 (2–3*) unbranched; caudal fin rays 16 (15–16); segmented pectoral fin rays 14 (13–15*), of these 12 (11–13*) branched and 2 (1–2) unbranched; pelvic fin rays 7, of these 6 branched and one unbranched; gill raker total count (lower limb and upper limb) 13 (11–16), lower arch with 9 (8–11) and 3 (3–5; [4*]) on upper, variation on first gill arch 6+3 (1), 7+3 (2), 8+2 (2), 8+3 (37), 8+4 (11), 8+5 (1), 9+2 (6), 9+3 (81), 9+4 (63*), 9+5 (5), 10+2 (4), 10+3 (34), 10+4 (53), 10+5 (7), 11+3 (4), 11+4 (8), 11+5 (2), 11+6 (1); vertebrae 51 (50–53; holotype 52); 0–1* pyloric caecae on stomach.

See Table 14 for comparative value ranges of morphometric characters. Body slender and elongate, body depth through pectoral fin base 8.1 (6.8–9.7) in SL, slightly laterally compressed and dorsal midline sometimes flattened anteriorly between pelvic and pectoral fin bases, depth through pectoral base 1.1 (1.0–1.2) that through vent, dorsal profile evenly arched from snout to dorsal fin, ventral profile straight from snout to anal fin, generally flat anterior to pelvic fins; belly only slightly deepened in maturing individuals, body tapering back to a long, 6.2 (5.3–12.8) in SL, and shallow, 14.1 (8.6–16.7) in SL, caudal peduncle, the peduncle depth about 2.3 in its length; accessory lateral line present. Head of moderate length, 4.6 (4.2–5.0) in SL, and shorter (0.9) than the PelAn distance, shallow and wide, 2.8 (2.3–3.5) and 1.6 (1.4–1.8) in HL respectively, distinctly wider than deep (depth 1.7 (1.6–1.9) in HW), upper profile of head curved, slightly depressed, ventral straight, lateral profile wedge-shaped; eyes moderate, 5.5 (4.8–6.9) in HL and 2.0–2.1 in HD, situated high on head at or slightly protruding above dorsal head profile, interorbital flat, of moderate width, 2.6 (2.4–3.0) in HL and 2.1 (2.0–2.3) times ED; cheeks expanded below eyes, eye profiles usually visible laterally from ventral view, less so in larger individuals; snout of moderate length, 3.4 (3.0–4.1) in HL and 1.6 (1.2–2.1) times ED, extending anteriorly from jaw as a fleshy protrubence and distinctly narrow anteriorly from in front of eyes in dorsal view, lateral profile dorsally bulbous and anteriorly rounded to bluntly pointed; post-orbital head length short, 1.9 (1.7–2.2) in HL; nostrils moderately long, not visible anterio-laterally from ventral view; mouth subterminal, moderately long, 2.6 (2.3–3.0) in HL, posterior extent reaching back to under about 0.5 ED and 0.6 (0.4–1.0) ED below ventral margin of eye, appears subterminal due to extended snout, cleft slightly oblique, most anterior tip of upper lip level with about 0.3 of ED above ventral margin of eye, gape of moderate width, 2.6 (2.2–3.1) in HL, width about equal to length of upper jaw and 1.6 (1.5–1.7) in HW. Jaws distinctly subequal, lower 0.8 (0.7–0.9) of UJL, upper jaw strongly expanded into a thick, fleshy lip (Figs. 8c,d, and 9a,b), thickening extending laterally from premaxilla onto maxilla and broader than snout in anterior view, lower also fleshy but less so, and distinctly wider than deep. Fleshy anterior extension of upper lip increasing anterior extension of snout forward of jaw, no distinct fold separating extent of upper jaw from snout. Pyloric caecae short, usually 1.0 % SL (0.4–2.6 %), wide; gill rakers of moderate length, thin and sharply pointed.

TABLE 13. Summary of meristic variation in *Galaxias arcanus* **sp. nov.** (T—total; B—branched; L—lower limb; S—single; U—upper limb). Range in 90 % and 100 % of specimens.

Character	Mode	Mean	SD	SE	Range 90 %	Range 100 %	N
Dorsal Rays (T)	9	9.1	0.66	0.04	8–10	8–11	322
Dorsal Rays (B)	7	7.2	0.64	0.04	6–8	5–9	322
Dorsal Rays (S)	2	1.9	0.40	0.02	1–2	1–3	322
Anal Rays (T)	11	10.6	0.62	0.03	10–12	8–12	323
Anal Rays (B)	9	8.5	0.65	0.04	7–9	7–10	323
Anal Rays (S)	2	2.1	0.40	0.02	2–3	1–3	323
Caudal Rays	16	15.9	0.30	0.02	15–16	13–17	323
Pectoral Rays (T)	14	14.1	0.81	0.05	13–15	12–16	323
Pectoral Rays (B)	12	12.1	0.86	0.05	11–13	10–13	323
Pectoral Rays (S)	2	2.0	0.28	0.02	1–2	1–3	323
Pelvic Rays (T)	7	7.0	0.14	0.01	7	6–8	323
Pelvic Rays (B)	6	6.0	0.14	0.01	6	5–7	323
Pelvic Rays (S)	1	1.0	0	0	1	1	323
Gill Rakers (T)	13	12.7	1.18	0.07	11–16	8–17	342
Gill Rakers (L)	9	9.2	0.81	0.05	8–11	6–11	342
Gill Rakers (U)	3	3.5	0.66	0.04	3–5	2–6	342
Vertebrae	51	51.2	1.08	0.07	50–53	47–54	245

TABLE 14. Morphometric variation in *Galaxias arcanus* **sp. nov.** (values are percentages of denominators in ratios, except for LCF and SL).

	Holo-	Paratypes (N = 88)			
Character	type	Mean	Min.	Max.	S.D.
LCF (mm)	86.3	64.9	50.5	85.0	6.96
SL (mm)	74.9	57.0	44.7	75.3	6.31
SL / LCF	86.8	87.7	86.2	89.5	0.70
BDV / SL	12.6	10.9	9.2	12.9	0.74
BDPec / SL	14.8	12.3	10.3	14.6	0.82
BDPec / BDV	118.3	113.8	102.9	123.4	4.96
LCP / SL	16.4	16.3	12.9	18.9	1.00
DCP / SL	8.4	7.0	6.0	8.0	0.46
DCP / LCP	51.1	43.2	33.9	55.5	4.07
CFFL / SL	15.2	14.0	11.7	16.0	0.91
LCP/CFFL	107.7	116.9	93.6	138.6	10.19

......continued on the next page

TABLE 14. (Continued)

Character	Holo-type	Paratypes (N = 88) Mean	Min.	Max.	S.D.
PreD / SL	69.8	68.7	65.5	71.7	1.22
PreA / SL	73.2	72.0	69.5	75.1	1.25
PreD / PreA	95.3	95.4	91.7	98.6	1.41
DF–AF / LDB	48.0	43.4	18.3	65.6	9.92
LDB / SL	7.9	8.8	7.0	11.1	0.77
LAB / SL	10.1	10.9	9.5	12.4	0.73
LDB / LAB	77.4	80.5	68.1	96.5	6.05
DL / LDB	166.3	164.4	119.3	204.8	15.34
AL / LAB	151.1	142.4	118.9	160.3	9.67
DL / SL	13.1	14.4	12.5	16.6	0.91
AL / SL	15.3	15.5	13.1	17.6	0.91
DL / AL	85.2	92.7	78.9	107.3	5.32
PecL / SL	14.2	14.4	12.1	16.7	0.94
PelL / SL	10.9	11.8	9.2	13.0	0.67
PelL / PecL	76.4	82.0	66.4	92.5	5.15
PrePel / SL	48.4	47.9	44.3	52.4	1.30
PecPel / SL	27.8	27.2	24.4	32.7	1.27
PelAn / SL	24.8	23.8	21.1	27.3	1.27
PecL / PecPel	51.2	53.0	37.0	63.8	4.54
PelL / PelAn	43.8	49.5	34.6	60.4	4.23
HL / SL	21.8	21.7	20.0	23.7	0.80
HL / PelAn	87.8	91.3	76.9	110.4	7.01
HW / HL	68.5	60.7	54.7	68.9	2.82
HD / HL	40.6	35.5	28.5	43.3	2.85
HW / HD	168.8	171.6	145.4	203.2	10.89
SnL / HL	31.2	29.0	23.9	33.1	2.01
SnL / ED	171.1	161.3	121.7	210.8	19.15
ED / HL	18.2	18.1	14.5	20.9	1.40
ED / HD	44.9	51.3	39.4	66.0	5.39
PoHL / HL	53.6	51.4	45.6	58.2	2.01
IOW / HL	39.0	37.6	32.9	41.7	1.91
ED / IOW	46.8	48.3	37.8	61.5	4.49
UJL / HL	38.1	38.2	26.5	43.8	2.22
LJL / HL	31.1	31.5	26.4	36.2	1.93
GW /HL	42.2	38.6	32.6	45.4	2.83
LJL / UJL	81.5	82.5	72.9	99.4	4.90
LJL / GW	73.6	82.0	66.4	100.0	7.20
GW / HW	61.7	63.5	56.5	74.0	3.74
SnL/UJL	81.9	76.0	61.6	90.2	5.49

Median fins relatively thin and slightly fleshy at bases, paired fins less so, with thickening extending distally over 0.2–0.3 of fin area, extending farther between fin rays, dorsal and anal fin bases of moderate length, dorsal base usually 0.9 in length of anal base, fins of moderate length, anal fin slightly longer, 2nd or 3rd branched ray usually longest, distal tip rounded but posterior margin of fin distinctively straight or slightly convex; anal fin origin usually under 0.43 (0.18–0.66) distance posteriorly along dorsal fin base. Pelvic fins relatively long, 8.5 (7.7–10.8) in SL, paddle-shaped, usually 0.8 (0.7–1.0) of pectoral fin length inserted at about mid-point of standard length and extending about 0.5 distance to anal fin base; pectoral fin large, long and rounded to paddle-shaped, 6.9 (6.0–8.3) in SL, usually extending just over 0.5 distance to pelvic fin base, low on body with dorsal end of fin base level with posterior extent of mouth, lamina of paired fins oriented ventrally, raised lamellae usually present on ventral surface of rays, usually weakly to moderately developed though occasionally strong. Caudal fin of moderate length, 7.1 (6.2–8.5) in SL, emarginate, distinctly shorter 1.2 (0.9–1.4) than caudal peduncle, vertical width of expanded rays usually greater than body depth through pectoral fin base, flanges low and moderately developed, short, usually extending about 0.6–0.9 distance along caudal peduncle to distal margin of rays of adpressed anal fin, occasionally reaching rays.

Size. Recorded to 98 mm LCF and 6 g; commonly to 60–75 mm LCF.

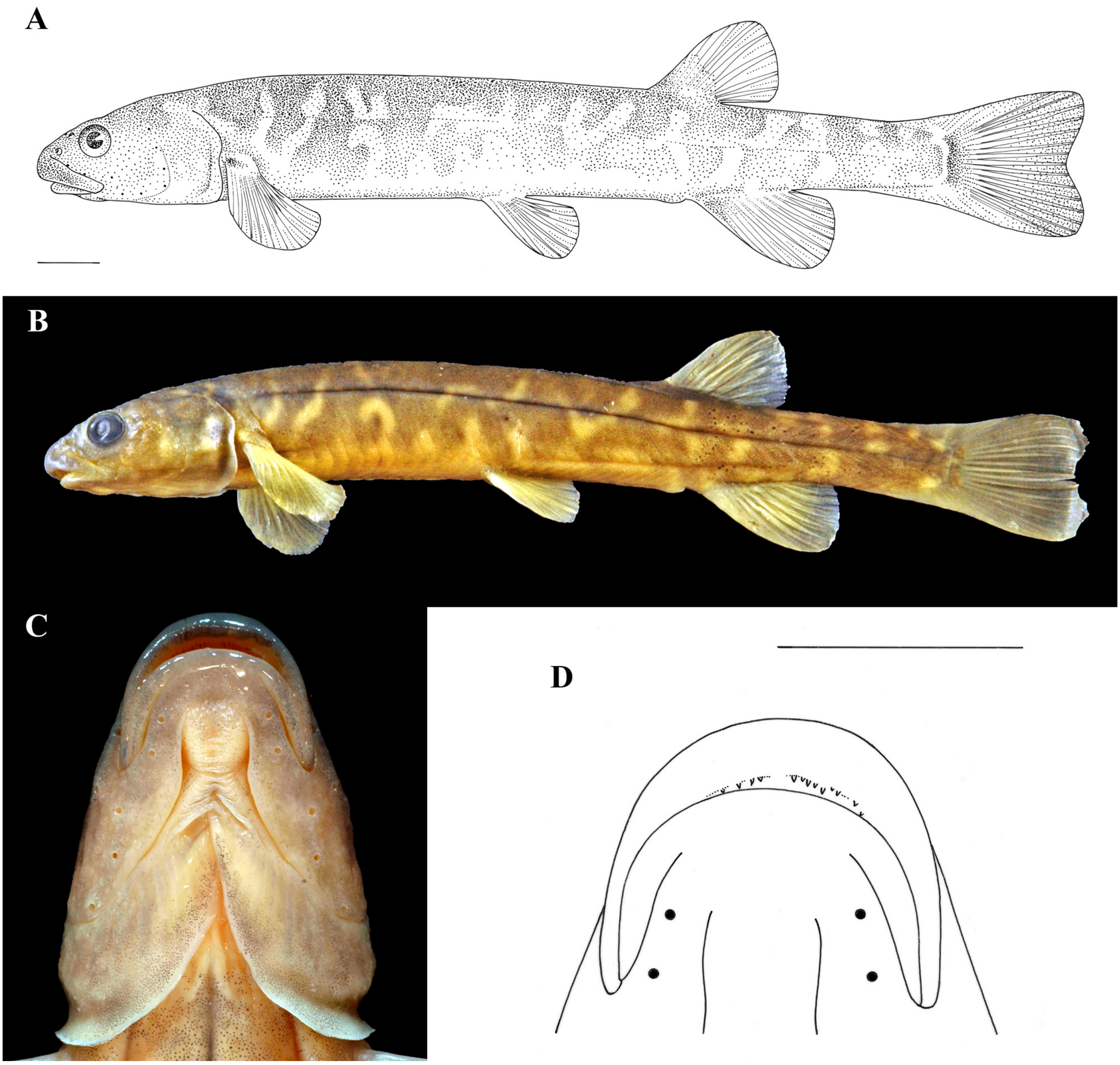

FIGURE 8. *Galaxias arcanus* **sp. nov.** holotype, NMV A.30568-3, 86.3 mm LCF, Wheelers Creek, Wheelers Creek Logging Road, south of Stacey's Bridge, Victoria: A) line drawing; B) image of preserved specimen (T.A. Raadik); and detail of ventral surface of C) head (T.A. Raadik), and D) jaws (R. Plant). Scale bar = 5 mm.

Colour in life. Body overall olive-brown to beige, becoming silvery white on belly, overlain by dark grey, dark brown or almost black, irregularly shaped blotches forming patches or usually coalescing to form irregular shaped bands or marbling, often overlain with shading formed by minute, closely spaced, dark grey spots. Pattern extends over dorsal and lateral surfaces of trunk, caudal peduncle and head, extending onto fin bases and sometimes onto the underside of the head. Head usually darker, with snout and lips often quite dark grey. Trunk with broad, relatively diffuse mid-lateral horizontal band of copper and gold flecks extending from above pectoral fin base onto caudal peduncle; snout and upper lip sometimes with copper and gold flecks, also diffusely scattered over head; sometimes a thin double band of gold flecks mid dorsally, extending from nape to base of dorsal fin and often onto caudal peduncle. Gill cover olive-brown with a small gold patch; fins translucent, yellowish brown, sometimes greyish; iris coppery gold. When stressed, adults can become almost uniformly dark grey to black (see upper image on page 786 in Raadik 2001); occasionally adults may lack dark body pattern.

Juvenile colouration distinct from that of adults (Fig. 9c), with paler and less profuse dark patterning over body and head, little body shading, larger gold patch on gill cover, and trunk pattern absent from latero-ventral region. See below for more detailed comments on body pattern.

FIGURE 9. A–B: Anterior view of the unique snout of *Galaxias arcanus* **sp. nov.**, A) jaws closed and B) jaws open, showing fleshy upper lip; C) juvenile colour pattern and propping; and, D) adult propping on a rock. (T.A. Raadik).

Colour of preserved material. Base colour of head and body pale lemon-yellow, tan or creamy yellow. Dorsal surface of head and trunk usually overall dark brown, dark grey or black, darkest mid-dorsally, on body fading down sides and occasionally on ventro-lateral surface as light duskiness, belly light cream to creamy yellow, lacking duskiness. Bold cryptic patterning of large, irregularly shaped joined blotches interspersed by contrasting light pale cream spots or thin, separated or connected, irregularly-shaped narrow bands, darker on top and fading down sides, extending over entire dorsal and lateral surface of head and body, absent from ventral surface. Dorsal portion of nape, head, snout, and anterior-dorsal portion of upper jaw with dark grey colouration, becoming paler laterally and extending onto lower jaw, below eyes, cheeks and gill covers, ventral surface of head sometimes also dusky and with patches of fine black spots. Duskiness produced by profuse, very fine pale black spotting. Often minute black spotting also inside operculum and on base of gill filaments.

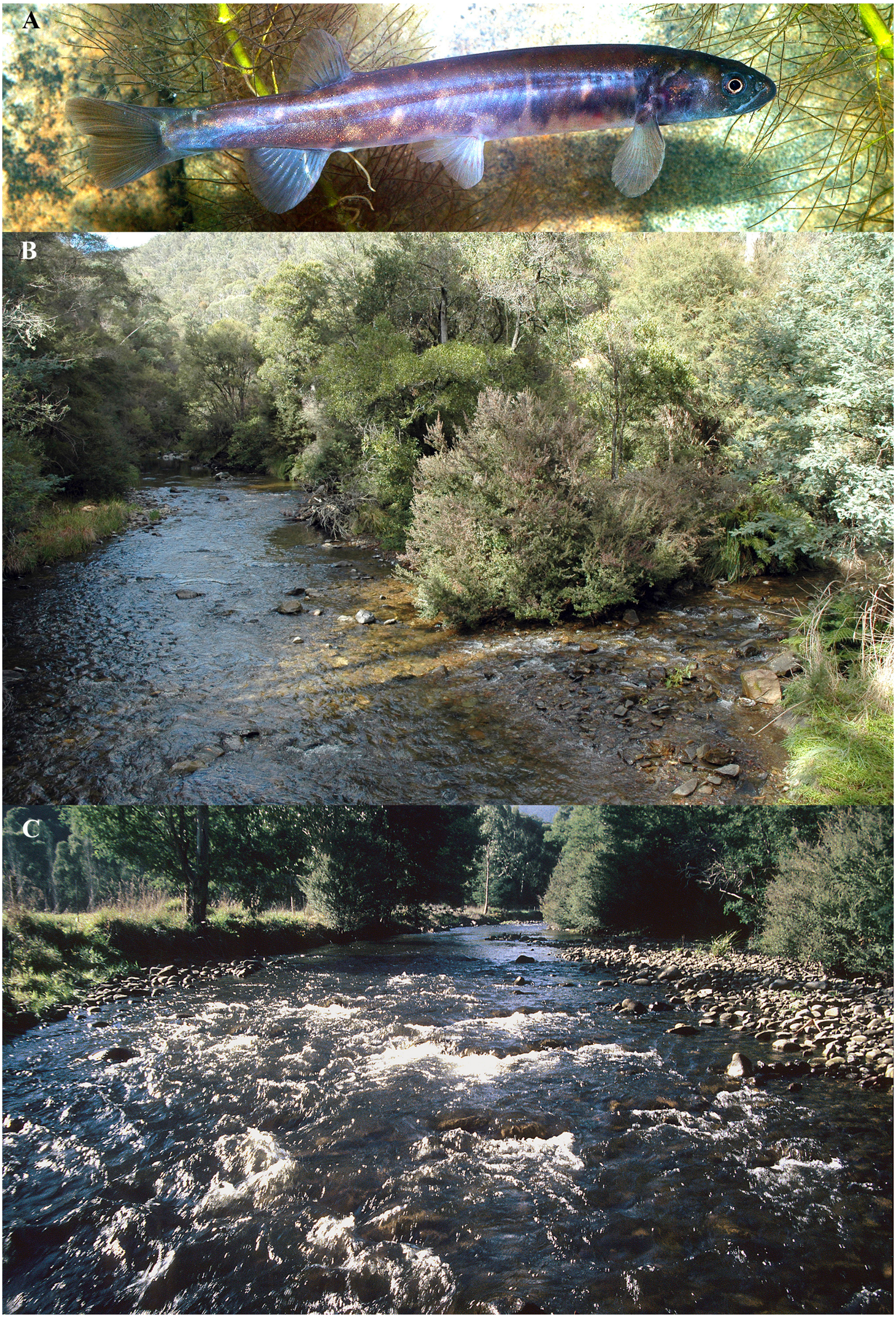

FIGURE 10. A) *Galaxias arcanus* **sp. nov.**, adult, collected from type locality, ~ 85 mm LCF March 2008; B) Wheeler Creek, at type locality, 1 April 2008. Zulu Creek inflow on right; C) typical habitat of *Galaxias arcanus*, amongst cobbles in a fast-flowing riffle, Steavenson River downstream from Marysville, 22 May 2001. (T.A. Raadik).

Colour pattern of juveniles creamy yellow to light tan base colour with dorsal surface and top of head covered with relatively large irregular, discrete or connected dark brown blotches composed of dense fine spots, extending down sides to near ventral surface and onto gill covers and snout, snout cheeks and upper and lower lips with dusky hue.

Eye black, pupil translucent pale orange-yellow or brownish yellow. Teeth translucent yellow to pale orange–yellow, tips orange to orange–red; gill rakers creamy white to pale yellow. Fins generally dusky pale yellow, becoming more translucent on posterior margins, fleshy bases of pelvic and pectoral fins cream. Fin rays translucent, external edges of rays highlighted with very fine black lines, first few rays generally darker; duskiness and patches of fine black spots on dorsal, anal and pectoral fin bases. Base of caudal fin usually with narrow, vertical, diffuse and dark to relatively pale grey band.

Etymology. From the Latin *arcanus*, meaning cryptic, secret, mysterious, in reference to the cryptic habitat occupied by this species (amongst boulder and cobbles on the stream bed), and its cryptic colouration. Commonly referred to as the 'Riffle Galaxias'.

Genetics. Allozyme and mtDNA analysis of this species can be found in Adams *et al.* (2014**;** taxon code RF). Diagnostic allozyme loci (6–13) between this taxon and the other species in the *Galaxias olidus* complex are provided in Table 12. Two genetically distinct subpopulations were identified, with fish in the Goulburn River basin differing by one diagnostic allozyme locus from those in the Upper Murray to the Ovens River basins (Raadik 2011). Morphological variation between these subpopulations was not investigated.

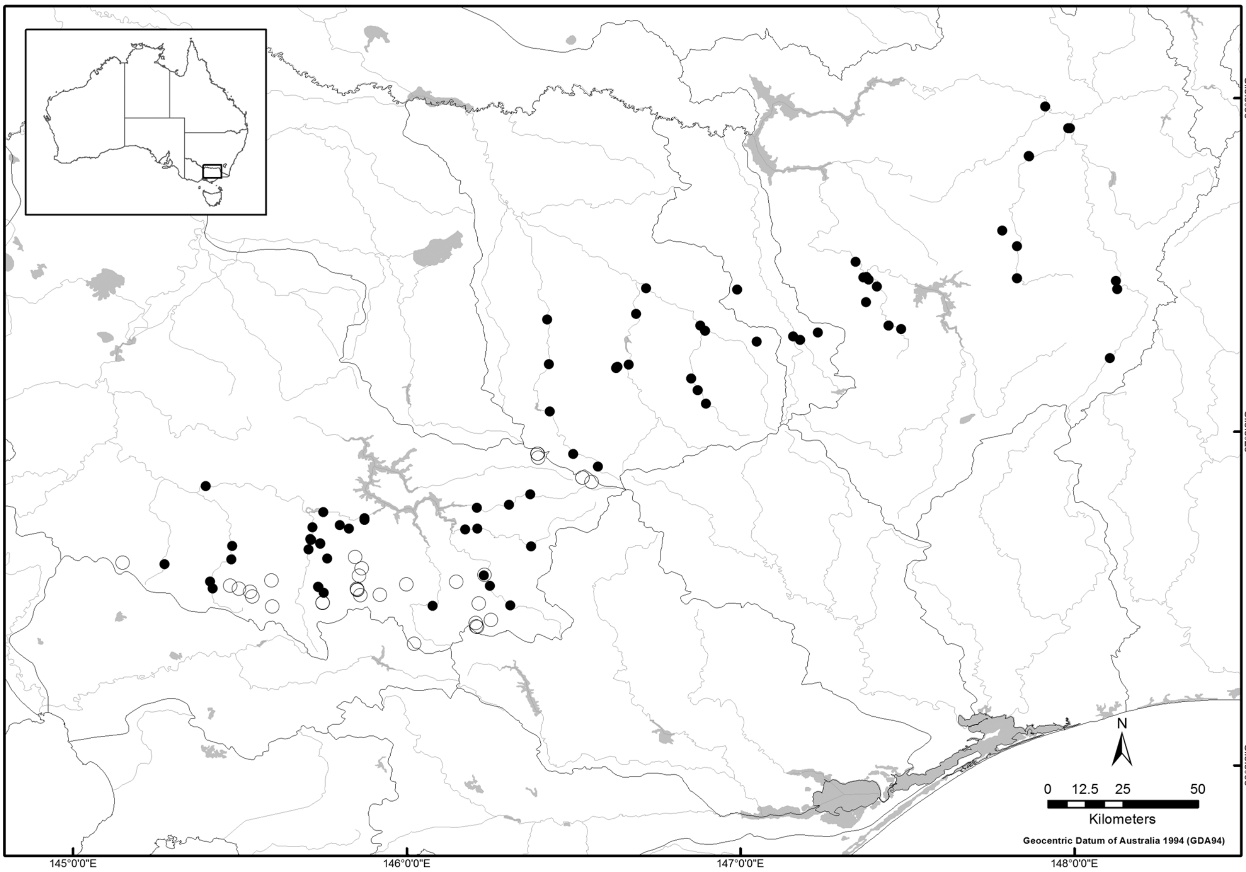

FIGURE 11. Distribution of *Galaxias arcanus* **sp. nov.** (black circles) and *Galaxias fuscus* (open circles). (river basins shown—refer to Fig. 1).

Distribution. See Fig. 11. Restricted to a thin band on the north of the Great Dividing Range in north-eastern Victoria, including the upper Murray River from near its headwaters and extending westward to the Goulburn River system, at an elevation of between 150–880 m asl. Not known as yet from the Broken River system but may be present, but restricted in range, to the cooler and faster-flowing upland reaches. Currently not recorded from the Murray River downstream from about Albury, or from tributaries of the upper Murray River in NSW. May be restricted in range to steeper-gradient streams in foothill to upland reaches by specific habitat requirements, such as diverse substrates and fast-flows.

Sympatry. Found with other members of the *Galaxias olidus* complex, primarily with *G. olidus* and *Galaxias. oliros* sp. nov, and considered to have been sympatric with *Galaxias fuscus* in the Goulburn River system, before alien trout substantially altered distributional patterns. Also found with *Galaxias rostratus* at the lower elevations within its range, and with *Galaxias brevipinnis* which has colonised the upper Murray and tributaries.

Habitat. Recorded from cold to relatively cool, clear water in flowing creeks to large rivers (1.0–20.0 m average width), usually in shallow (0.1–0.4 m average depth), fast-flowing and high energy riffles and runs (Fig. 10c), though juveniles have been recorded moving upstream through slow water along the shallow edges of pools. Substrate in riffles and runs consists predominantly of a complex of abundant cobbles and pebbles, with smaller amounts of bedrock, boulder, gravel and coarse sand. Fish are typically found within the diverse substrate, either amongst or under rocks on the stream bed, or deeper in the interstitial spaces of the substratum. Usually not associated with aquatic vegetation, but have been found amongst small and large timber debris.

General Biology. Confined to freshwater. Collected at a density ranging from < 0.01–0.80 fish/m^2 though, as individuals are usually hidden amongst or within the substrate in fast-flowing areas (Fig. 10c) which are difficult to sample, these values are considered a gross underestimate of relative abundance. Usually collected with the native species Two-spined Blackfish (*Gadopsis bispinosus*), *Galaxias olidus* s.s., Murray Spiny Crayfish (*Euastacus armatus*), Alpine Spiny Crayfish (*Euastacus crassus*) and shrimp (Atyidae) and including the alien species Brown Trout and Rainbow Trout (*Oncorhynchus mykiss*), and less often with the native species Obscure Galaxias (*Galaxias oliros* **sp. nov.**) and Broadfinned Galaxias. Spawning period is probably spring to summer (October–December and possibly extending into January): adult fish collected from Corryong Creek in the Upper Murray system in early November, and from the Acheron and Little rivers (Goulburn River system) in mid-October to mid-November, were ripe to running ripe, whilst all fish collected post mid-December were at earlier stages of development and usually with their body cavity full of fat deposits through January to March; juvenile 0+ age fish < 38 mm LCF have been recorded in all months from December to May; and, the smallest 0+ age individuals recorded have been 16.7 mm LCF in early February (Ovens River system) and 27.9 mm LCF in late May (Goulburn River system). Males mature earlier, with a ripe individual recorded from the Goulburn River in early May (late autumn) and a running ripe male from the Ovens River in late June 2002. Confusingly, some females have been recorded as running ripe in late June 1992 in the upper Murray catchment, and almost ripe in the Goulburn River system in May 2001. The smallest fish which could be reliably sexed were a female at 49.5 mm LCF (Corryong Creek, Upper Murray) and a male at 41.5 mm LCF (Little River, Goulburn River system).

Adults usually solitary; juveniles and younger adults observed in loose shoals of 50+ individuals, moving upstream during the day in shallow, slow-flowing water along the edge of pools, between riffle habitats: fish 38–66 mm LCF recorded moving upstream in the Acheron River and individuals < 50 mm LCF observed along the edge in the Steavenson River (Goulburn system) in late May 2001; and, individuals 49–67 mm LCF collected moving upstream along the edge of a long pool in the Mitta Mitta River (upper Murray system) in late June 2002. This suggests active upstream dispersal by younger age-classes of fish. Individuals from the Steavenson River, downstream from Marysville, found with cysts, possibly trematode metacercariae, embedded in the skin of the trunk and fins. Also see Sowersby (2007).

Variation. As noted above, the species is extremely variable in colour pattern, differing between juveniles and adults (*cf.* Figs. 9c and 10a). Colour and pattern changes are also evident between populations, and between individuals within populations, and can also rapidly change from the usual strongly patterned colouration to a plain light grey or almost black, depending on the stress level of individual fish. Also exhibits a relatively high amount of variation in meristic characters across its range, particularly in dorsal, anal and pectoral fin ray number, and number of gill rakers and vertebrae.

Remarks. First recognized as an unidentified species in 1986 when a specimen, collected from a riffle in the Acheron River during an aquatic macroinvertebrate 'kick' sample, was received by the author. No additional specimens were found in museum collections, except in the unregistered wet specimen collection at the Arthur Rylah Institute in Victoria, which were subsequently deposited at the Museum Victoria (NMV A.10017, NMV A.30474-1). These represented the first recorded collections of the species, in early March 1978. The high-energy habitat usually occupied by *Galaxias arcanus*, and its crypto-benthic nature, may explain its late discovery.

The unique morphology of *Galaxias arcanus*, which includes a straight ventral profile, long, low caudal peduncle, a downturned, subterminal mouth and a bulbous nose, suggests an adaptation to a benthic existence within a diverse substrate in a high energy environment. In particular, the subterminal mouth and straight ventral profile may be an advantage for feeding off the substrate or rocks, the bulbous extension to the snout may play a sensory role in prey detection within the substrate, and the overall low body profile may enable easier movement amongst the substrate and in keeping in the quieter water on the stream bed just below the level of fast or turbulent flow.

Galaxias arcanus often lie in a characteristic manner when motionless on the substrate, with the body slightly curved in the horizontal plane when viewed from above. They are also often found propped on the substrate (gravel, rock or timber), with the pectoral and pelvic fins expanded ventrally, supporting and raising the head and front of the body higher than the tail (Fig. 9c,d), or propping on the pelvic, pectoral and anal fins. In this position the head can be moved slightly laterally or tilted to some extent downwards, presumably to look for prey. Often found in streams with high densities of alien trout (*Salmo trutta* and *Oncorhynchus mykiss*), they are presumably able to avoid predation by occupying high energy riffle habitats which may be marginal for trout, and also by their disruptive colouration and remaining hidden amongst habitat on or within the stream bed. Flow regulation, whereby riffle areas can be dewatered or, alternatively, submerged for longer periods than during natural floods, may be a key threat to this species by reducing habitat availability and allowing predators to gain access when riffles are drowned out.

The use of interstitial spaces within the substrate of the streambed may also act as refugia during times of low flow (*sensu* Dunn & O'Brien 2006) and also provides usable habitat in areas with very low flow. *Galaxias arcanus* were found within a bank of pebbles (30–50 mm in diameter), in Corryong Creek, which was covered by only 10 mm of water and they could not be depleted from a 2 m^2 area following 60 minutes of electrofishing: individuals kept emerging from amongst the pebbles on each successive pass.

***Galaxias brevissimus*, new species**

Short-tail Galaxias

Tables 4 to 9, 12, 15 to 16; Figures 7 & 12

Conforms to the allozymically defined and morphologically diagnosed taxon 'JI' of Adams *et al.* (2014), and 'jibolaro' of Raadik (2011).

Material Examined.

Holotype. NMV A.30559-3, 77.2 mm LCF, (69.6 mm SL), female, Jibolaro Creek, at bridge on Tuross Rd, north-west of Kybeyan, New South Wales, 36° 14' 01"S 149° 27' 10"E, T.A. Raadik, 14 March 2002.

Paratypes. NSW: AMS I.44914-001 (1), 79.8 mm LCF (71.3 mm SL) and NMV A.30559-1 (4), 71.9–95.5 mm LCF (64.2–86.7 mm SL), collected with holotype.

Non-type material. NSW: NMV A.30559-2 (3), 49.4–55.9 mm LCF (44.0–49.9 mm SL), collected with holotype.

Diagnosis. *Galaxias brevissimus* **sp. nov.** differs from all other species within the *Galaxias olidus* complex by a combination of the following characters: short caudal peduncle (10.3–12.0 % SL) and caudal fin length (10.1–12.2 % SL); anal fin and pelvic fins set far back at about 76 and 53 % SL respectively; anal and dorsal fin lengths short and dorsal fin base short (8.0–9.6 % SL); small pectoral fin (9.6–12.0 % SL); dorsal midline of trunk usually flattened anteriorly from above midpoint between pectoral and pelvic fin bases; head quite narrow (55.9–59.6 % HL) and eye relatively large (18.3–21.0 % HL); nostrils moderately long, not visible from ventral view; gape about as wide as length of lower jaw; often a single, sometimes two, unbranched, segmented rays in the dorsal fin (versus usually 2); low mean number of vertebrae (52); raised lamellae on the ventral surface of paired fins appear to be absent; caudal peduncle flanges relatively short, occasionally just reaching adpressed anal fin; single, moderately short (1.7 % SL) and thin pyloric caecum; anal fin origin usually under 0.8 distance posteriorly along dorsal fin base; gill rakers sharply pointed; and, lack of black bars along lateral line.

Description. As for the genus and members of the *Galaxias olidus* complex, except as indicated below, based on 6 specimens, 64.2–86.7 mm SL, and 3 additional, non-type specimens for meristics. See Tables 4 to 9 for frequencies of meristic values and Table 15 for a summary of meristic variation. Segmented dorsal fin rays 9 (9–10), of these 8 (7–8) branched and 1 (1–2) unbranched; segmented anal fin rays 11 (10–12*), of these 9 (8*–10) branched and 2 unbranched; caudal fin rays 16 (16–17); segmented pectoral fin rays 15 (13–16; [14*]), of these 13 (11–14; [12*]) branched and 2 unbranched; pelvic fin rays 7, of these 6 branched and one unbranched; gill raker total count (lower limb and upper limb) 12 (10–13; [11*]), lower arch with 9 (8–10) and 3 (2–3) on upper, variation on first gill arch 8+2 (2), 9+2 (2*), 9+3 (4), 10+3 (1); vertebrae 52 (51–52); one pyloric caeca on stomach.

See Table 16 for comparative value ranges of morphometric characters. Body moderately elongate and shallow, dorsal midline usually flattened anteriorly from above midpoint between pectoral and pelvic fin bases, depth through pectoral base about 1.2 that through vent, trunk with dorsal and ventral profiles slightly but evenly arched from snout to dorsal fin, body tapering back to a short, 9.1 (8.3–9.7) in SL, caudal peduncle of moderate depth, 12.5 (12.0–13.0) in SL, the peduncle depth 1.4 (1.3–1.6) in its length; accessory lateral line present. Head of moderate depth, 2.3 (2.1–2.4 in HL) and length, 4.5 (4.3–4.8 in SL), length 1.1 (1.0–1.3) in PelAn length, narrow, 1.7–1.8 in HL, and distinctly wider than deep (depth 1.3 in HW), lateral profile wedge-shaped, flattened dorsally; eyes of moderate size, 5.1 (4.8–5.5) in HL and 2.2 (2.1–2.3) in HD, situated high on head just below dorsal head profile, interorbital flat to slightly convex, of moderate width, 2.6–2.7 in HL and 1.9–2.0 times ED; cheeks expanded only very slightly below eyes, eye profiles clearly visible laterally from ventral view; snout of moderate length, 3.4 (3.2–3.6) in HL and 1.5–1.7 times ED, lateral profile slightly blunt; post-orbital head length of moderate length (1.8 in HL); nostrils moderately long, not visible anterio-laterally from ventral view; mouth generally terminal, of moderate length, 2.7 (2.6–2.9) in HL, posterior extent reaching under anterior 0.3 of eyes and about 0.64 (0.59–0.69) of ED below ventral margin of eye, most anterior tip of upper lip usually just above level with middle of eye, gape of moderate width, 2.8 (2.7–3.0) in HL, width 0.9–1.0 that of length of upper jaw and 1.6–1.7 in HW. Jaws subequal, lower a little shorter (1.0–1.1 in UJL). Pyloric caeca moderately short, averaging 1.7 % SL (1.2–2.4 %), thin and rounded on the end; gill rakers short and stout, sharply pointed.

Fins relatively thin, slightly fleshy at bases, paired fins less so, with thickening extending distally over 0.3–0.5 of fin area, extending farther between fin rays; dorsal and anal fins bases of moderate length, dorsal base usually 1.0–1.2 times length of anal base, fins short and rounded, usually of similar length though anal sometimes slightly longer, middle rays the longest, anal fin origin usually set back under 0.77 (0.68–0.89) distance along dorsal fin base. Pelvic fins small, 10.6 (10.1–11.1) in SL, usually 0.84 of pectoral fin length, inserted just posterior to mid-point of standard length (0.52–0.55 of SL) and extending about 0.4 (0.34–0.45) distance to anal fin base; pectoral fin small and paddle-shaped, usually 8.8 (8.3–10.4) in SL, extending just over 0.35 distance to pelvic fin base, low on body with dorsal extent of fin base usually level with posterior extent of mouth, lamina of paired fins tending to face ventrally, raised lamellae not present on ventral surface of rays. Caudal fin short, 8.8 (8.2–9.9) in SL, emarginate, about same length as caudal peduncle, vertical width of expanded rays greater than body depth through pectoral base, flanges low and moderately developed along caudal peduncle, extending only slightly anteriorly, occasionally reaching distal end of adpressed anal fin rays.

TABLE 15. Summary of meristic variation in *Galaxias brevissimus* **sp. nov.** (T—total; B—branched; L—lower limb; S—single; U—upper limb).

Character	Mode	Median	SD	SE	Range	N
Dorsal Rays (T)	9	9.1	0.33	0.11	9–10	9
Dorsal Rays (B)	8	7.7	0.50	0.17	7–8	9
Dorsal Rays (S)	1	1.4	0.53	0.18	1–2	9
Anal Rays (T)	11	10.9	0.78	0.26	10–12	9
Anal Rays (B)	9	8.9	0.78	0.26	8–10	9
Anal Rays (S)	2	2.0	0.00	0.00	2	9
Caudal Rays	16	16.1	0.33	0.11	16–17	9
Pectoral Rays (T)	15	14.6	0.88	0.29	13–16	9
Pectoral Rays (B)	13	12.6	0.88	0.29	11–14	9
Pectoral Rays (S)	2	2.0	0.00	0.00	2	9
Pelvic Rays (T)	7	7.0	0.00	0.00	7	9

......*continued on the next page*

TABLE 15. (Continued)

Character	Mode	Median	SD	SE	Range	N
Pelvic Rays (B)	6	6.0	0.00	0.00	6	9
Pelvic Rays (S)	1	1.0	0.00	0.00	1	9
Gill Rakers (T)	12	11.4	1.01	0.34	10–13	9
Gill Rakers (L)	9	8.9	0.60	0.20	8–10	9
Gill Rakers (U)	3	2.6	0.53	0.18	2–3	9
Vertebrae	52	51.9	0.33	0.11	51–52	9

TABLE 16. Morphometric variation in *Galaxias brevissimus* **sp. nov.** (values are percentages of denominators in ratios, except for LCF and SL).

	Holo-	Paratypes (N = 5)			
Character	type	Mean	Min.	Max.	S.D.
LCF(mm)	79.8	81.2	71.9	95.5	
SL(mm)	71.3	73.0	64.2	86.7	
SL / LCF	89.3	89.9	89.1	90.9	0.67
BDV / SL	11.7	11.7	11.1	12.2	0.40
BDPec / SL	14.1	13.7	12.9	14.5	0.59
BDPec / BDV	119.9	117.2	109.3	125.8	6.76
LCP / SL	12.0	11.0	10.3	11.5	0.49
DCP / SL	7.7	8.0	7.7	8.3	0.26
DCP / LCP	64.4	72.5	66.8	79.9	4.89
CFFL / SL	12.0	11.3	10.1	12.2	0.83
LCP/CFFL	99.8	98.5	89.0	114.5	9.98
PreD / SL	71.2	71.4	70.1	72.7	0.99
PreA / SL	76.6	76.4	74.5	77.6	1.25
PreD / PreA	92.9	93.5	90.4	95.4	1.90
DF–AF / LDB	73.0	78.4	68.4	88.9	8.58
LDB / SL	8.9	8.7	8.0	9.6	0.73
LAB / SL	9.9	10.0	9.5	10.7	0.50
LDB / LAB	89.8	87.4	82.2	96.9	5.84
DL / LDB	164.5	162.1	130.8	179.8	19.80
AL / LAB	146.5	141.4	128.2	153.6	10.42
DL / SL	14.7	14.1	12.5	14.7	0.88
AL / SL	14.6	14.1	13.2	14.8	0.62
DL / AL	100.9	99.7	94.9	107.1	4.69
PecL / SL	11.7	11.3	9.6	12.0	0.99
PelL / SL	9.2	9.4	9.0	9.9	0.34
PelL / PecL	78.6	84.0	79.1	94.2	6.07
PrePel / SL	52.8	53.2	51.7	54.8	1.43
PecPel / SL	31.7	32.6	30.8	34.1	1.58
PelAn / SL	23.4	24.2	22.1	26.2	1.83

......*continued on the next page*

TABLE 16. (Continued)

Character	Holo-type	Paratypes (N = 5) Mean	Min.	Max.	S.D.
PecL / PecPel	37.0	34.6	31.0	38.6	2.75
PelL / PelAn	39.5	39.3	34.4	45.1	4.32
HL / SL	22.5	22.0	20.7	23.0	0.88
HL / PelAn	96.4	91.5	79.1	104.3	9.56
HW / HL	57.6	57.5	55.9	59.6	1.53
HD / HL	42.1	43.2	41.4	46.4	1.91
HW / HD	136.9	133.2	128.4	136.5	3.67
SnL / HL	30.5	29.0	27.9	31.6	1.47
SnL / ED	166.9	149.1	146.4	150.7	1.80
ED / HL	18.3	19.5	18.5	21.0	0.92
ED / HD	43.4	45.1	43.1	46.8	1.31
PoHL / HL	53.8	55.0	54.3	55.7	0.57
IOW / HL	39.0	37.5	36.7	39.0	0.91
ED / IOW	46.8	51.9	50.5	53.8	1.31
UJL / HL	36.9	37.2	34.4	38.7	1.75
LJL / HL	35.3	34.4	33.7	36.0	0.94
GW /HL	33.9	35.2	33.4	36.9	1.61
LJL / UJL	95.6	92.4	88.5	98.7	3.89
LJL / GW	104.2	97.8	91.2	103.8	5.55
GW / HW	58.8	61.3	57.9	66.1	3.06
SnL/UJL	82.6	78.0	75.1	82.6	3.75

Size. Recorded to 95 mm LCF and 7 g; commonly to 70–75 mm LCF.

Colour in life. Body predominantly brown on back and upper sides above lateral line, extending onto top and sides of head and snout, becoming lighter brown on lower lateral sides of trunk to light brown or cream ventrally. Overlain by small to moderately large, irregularly shaped dark brown to almost black profuse blotches and spots, some coalescing to form larger patches, Gill cover translucent, brownish; iris coppery; fins dusky. See below for more detailed comments on body pattern.

Colour of preserved material. Base colour of head and body light brown to tan. Small to moderately large, irregularly shaped and faded spots, blotches and bands densely spaced on dorsal surface of trunk, extending down sides to below lateral line, also extending across entire depth of caudal peduncle, very faded to absent from head. Trunk patterning overlain by very fine, pale brown stippling, also extending downs sides and onto head.

Eye dark grey to black, pupil translucent pale orange-yellow. Teeth translucent yellow to pale orange-yellow, tips orange to orange-red; gill rakers cream. Fins generally pale tan to cream, becoming more translucent on posterior margins. Fin rays translucent.

Etymology. Latin *brevissimus*, meaning shortest, small, in reference to this species having the shortest caudal peduncle and caudal fin compared with other members of the *Galaxias olidus* complex. Suggested vernacular name as the 'Short-tail Galaxias'.

Genetics. Allozyme and mtDNA analysis of this species can be found in Adams *et al.* (2014**;** taxon code JI). Diagnostic allozyme loci (7–15) between this taxon and the other species in the *Galaxias olidus* complex are provided in Table 12.

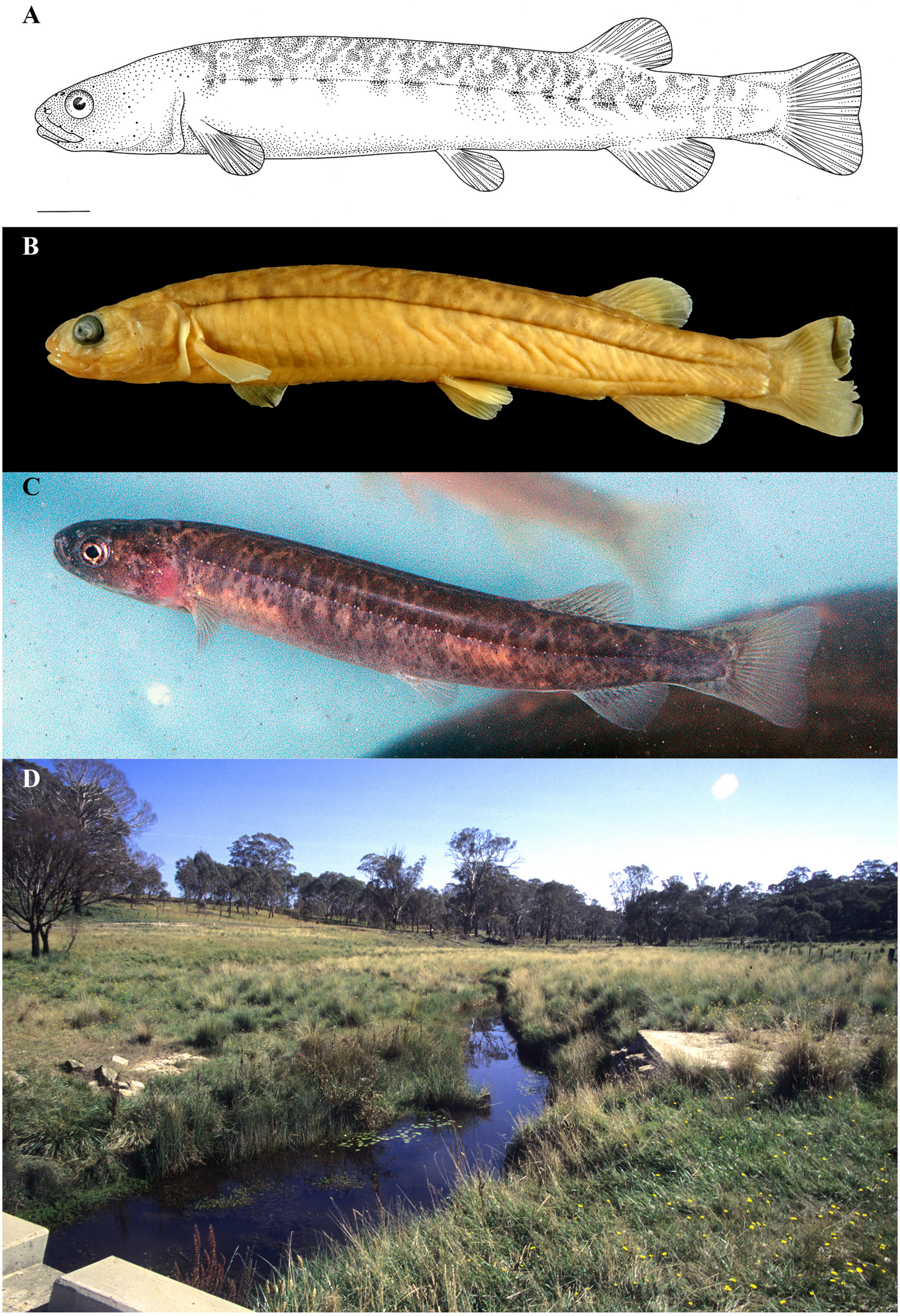

FIGURE 12. A–B: *Galaxias brevissimus* **sp. nov.** holotype, NMV A.30559-3, 77.2 mm LCF, Jibolaro Creek, Tuross Rd, north-west of Kybeyan, New South Wales, A) line drawing (R. Plant), B) image of preserved specimen (T.A. Raadik); C) *G. brevissimus* **sp. nov.**, collected at the type locality with the holotype, 14 March 2002; ~ 80 mm LCF (R. Kuiter); D) Jibolaro Creek, at type locality, 14 March 2002 (T.A. Raadik). Scale bar = 5 mm.

Distribution. See Fig. 7. Only known from the type locality in the headwaters of Jibolaro Creek, a tributary in the very upper reaches of the Tuross River system in southern, coastal New South Wales, at an elevation of 950 m asl. The location is approximately 12 km (river distance) from the source, which is at 1190 m asl, in a catchment of approximately 27 km^2. Downstream distribution unknown; considered to have been historically more widespread, extending a considerable distance farther downstream before predatory trout reduced and fragmented its range.

Sympatry. Only species of *Galaxias* found within its restricted range. However *Galaxias brevipinnis* is known from lower to mid reaches of the Tuross River system, farther downstream. Also see under 'Remarks'.

Habitat. Recorded from a clear and gently flowing, unshaded, narrow and shallow (1.0 m average width and 0.3 m average depth) creek, consisting predominantly of pools connected by very short sections of shallow riffles. Substrate consisted of clay overlain by fine and coarse sand, with areas of silt, and riparian vegetation had been cleared and consisted of pasture and tussock grass. Instream cover was provided by rock, aquatic vegetation and overhanging grasses and maximum pool depth was 0.9 m. The general catchment of the creek at the type locality was disturbed, having been previously cleared for grazing. At the time of sampling (0900 hrs, 14 March 2002) the instream dissolved oxygen (DO) concentration was relatively low (4.2 mg/L) and the majority of fish were captured in the shade under the bridge at the head of a pool where, presumably, water of higher DO concentration was flowing in over a short riffle section.

General Biology. Confined to freshwater and considered not to undertake diadromous migrations. Recorded at a relatively high density of 2.15 fish/m^2, though this was probably elevated above normal levels encountered in an undisturbed stream due to fish congregating in shade and accessing higher quality water (see above). Collected with a native species of freshwater crayfish (*Euastacus* sp.), the native Common Freshwater Shrimp and the translocated native Common Yabby (*Cherax destructor*). Spawning period unknown, though all mature fish examined in mid-March were in an early stage of gonad development, with gonads filling from 25–50 % of the body cavity, and the smallest fish collected measuring 49.4 mm LCF, suggesting spawning during late winter/early spring. One individual found with small white cysts, possibly trematode metacercariae, embedded in tissue on the inside of both gill covers.

Conservation status. Considered critically endangered based on IUCN criteria (ISPS 2013): A2e; B1+2abc; C2a(i)—one location/population, EOO and AOO estimated at 2.7 km^2.

Remarks. Raised lamellae on the paired fins in this species appear to be absent, though only nine individuals were available for examination. Consequently, examination of additional material is required to confidently confirm their absence. Until collected during this study in 2002, galaxiids from the *Galaxias olidus* complex had not been recorded from the Tuross River system. More recently, additional specimens from the *G. olidus* complex have been recorded by NSW Fisheries staff from two locations at lower elevations in the Tuross River catchment (Wadbilliga River and New England Creek). These samples, preserved in ethanol and therefore only partially suitable for morphological examination due to shrinkage, have been initially identified as *G. olidus* based on mtDNA analysis (C. Burridge, pers. comm. 2011). Collection of fresh material is required for a detailed nuclear DNA and taxonomic appraisal.

Galaxias fuscus Mack, 1936

Barred Galaxias

Tables 4 to 9, 12, 17 to 18; Figures 11, 13 to 14

Galaxias fuscus Mack, 1936: 100 (holotype: NMV A.96; paratype (1) NMV A.99; type locality: Rubicon River, Victoria) [see Appendix 1 for text of original description];—Whitley, 1956b: 39; 1956c: 34, fig. 1; Munro, 1957: 17; Whitley, 1957a: 7; Whitley, 1964: 35; Lake, 1971: 20; Dixon, 1972: 121; McDowall & Frankenberg, 1981: 472; Cadwallader & Backhouse, 1983: 64, plate p. 190; Ealey *et al*., 1983: 44 (*partim*); Merrick & Schmida, 1984: 85 (*partim*); Schmida, 1985; 149; Rich, 1986: 21 (*partim*); Leggett & Merrick, 1987: 93 (image); Allen, 1988: 3; Allen, 1989; 37, plate 55; Shirley, 1991; Armstrong, 1993; Wager & Jackson, 1993; Raadik, 1995a; Raadik *et al*., 1996: 108; Raadik, 1999; Shirley & Raadik, 1997; Raadik, 2000; Raadik, 2001: second image from bottom p. 787; Raadik, 2002; Allen *et al.,* 2003: 99; Kuiter, 2003: 976 and images; Raadik, 2006a; Raadik, 2006b: 138; Lintermans, 2007: 40; Davies *et al*., 2008: 338; Schmida, 2008: image on contents page; Raadik *et al*., 2010; Ayres *et al*., 2012a; 2012b: 1; Stoessel *et al*., 2012: 1; DSE, 2013: 17; Kuiter, 2013: 46; Lieschke *et al.,* 2013a,b; Raadik & Nicol, 2013: 1.

Galaxias ornatus (non *G. ornatus* Castelnau, 1873)—Butcher, 1946: 9 (*partim*).

Galaxias olidus fuscus (Mack, 1936)—Frankenberg, 1969: 171; Terzis, 1986: 1.

Galaxias olidus (non *G. olidus* Günther, 1866)—McDowall, 1980: 57 (*partim*); McDowall & Frankenberg, 1981: 469 (*partim*); Rich, 1986: 21 (*partim*); McDowall & Fulton, 1996: 55 (*partim*); McDowall, 2003b: 364 (*partim*).
Galaxias olidus var. *fuscus*—Koehn & Raadik, 1995: 1.

Conforms to the allozymically defined and morphologically diagnosed taxon 'FU' of Adams *et al.* (2014), and 'fuscus' of Raadik (2011).

Material Examined.

Holotype. NMV A.96, 74.9 mm LCF, (65.3 mm SL) [dried out], Rubicon River, Victoria, (?)37° 19' 37"S 145° 51' 39"E, A.C. Payne, 1935.

Paratype. NMV A.99 (1), 83.1 mm LCF (73.5 mm SL) [dried out], collected with holotype.

Non-type material. VIC: NMV A.30247-1 (2), 70.6–74.7 mm LCF (61.8–64.7 mm SL), Criss Cross Creek, off Criss Cross Road, Toolangi State Forest, 37° 27' 39"S 145° 28' 13"E, TAR, 10 September 1998; NMV A.30243-1 (1), 85.2 mm LCF (75.0 mm SL), Criss Cross Creek, same location as NMV A.30247-1, TAR, 18 June 2002; NMV A.30267-1 (4), 94.2–114.6 mm LCF (82.8–100.1 mm SL), Falls Creek, Bindaree Road, below Bindaree Falls, Mt. Stirling, 37° 09' 04"S 146° 33' 12"E, TAR, 15 May 2001; NMV A.30249-1 (3), 93.3–118.4 mm LCF (81.4–104.1 mm SL), Gaffneys Creek, Woods Point/Jamieson Road, Knockwood, 37° 25' 42"S 146° 13' 55"E, D.J. Harrington and J.A. McKenzie, 12 June 1985; NMV A.30242-1 (3), 60.6–95.2 mm LCF (52.2–84.9 mm SL), Kalatha Creek, Kalatha Road, Toolangi State Forest, 37° 29' 36"S 145° 32' 12"E, TAR, 18 September 1998; AMS I.44803-001 (1), 80.9 mm LCF (71.1 mm SL) , Kalatha Creek, same location as NMV A.30242-1, TAR, 18 June 2002; NMV A.30254-1 (2), 59.9–92.9 mm LCF (50.8–79.4 mm SL), Keppel Hut Creek, tributary, Upper Taggerty Road, Lake Mountain, Yarra Ranges National Park, 37° 28' 36"S 145° 51' 02"E, JPO and J.A. McKenzie, 28 November 1990; NMV A.30268-1 (7) 53.2–109.0 mm LCF (45.4–93.0 mm SL), Keppel Hut Creek, same location as NMV A.30254-1, PJU and TAR, 5 February 1991; NMV A.30257-1 (4), 95.4–101.4 mm LCF (81.4–88.0 mm SL), Keppel Hut Creek, north tributary, at Upper Taggerty Road, Lake Mountain, Yarra Ranges National Park, 37° 28' 13"S 145° 51' 02"E, PJU, 10 February 1991; NMV A.30245-1 (3), 73.4–89.8 mm LCF (64.4–79.1 mm SL), Luke Creek, Klondyke Road, Toolangi State Forest, 37° 28' 13"S 145° 29' 46"E, TAR, 10 September 1998; AMS I.44802-001 (1), 87.9 mm LCF (76.6 mm SL), Luke Creek, same location as NMV A.30245-1, TAR, 18 June 2002; NMV A.7854 (27), 48.0–132.2 mm LCF (42.4–114.9 mm SL), NMV A.7858 (2), 71.7–83.3 mm LCF (62.5–73.1 mm SL), and NMV A.7870 (1), 73.8 mm LCF (63.4 mm SL), Mountain Creek, 1 mile east of Kinglake, (?)37° 31' 50"S 145° 21' 06"E, R.S. Frankenberg, P. Holbeche, P. Rogan, 6 May 1966; NMV A.30258-1 (5), 62.4–115.5 mm LCF (52.9–100.0 mm SL), Perkins Creek, Perkins Creek track, north-west of Woods Point, 37° 34' 22"S 146° 12' 22"E, JPO and J.A. McKenzie, 20 November 1990; NMV A.30252-1 (1), 98.5 mm LCF (86.2 mm SL), Keppel Hut Creek, same location as NMV A.30258-1, TAR, 8 April 2003; NMV A.7935 (17), 51,0–106.1 mm LCF (43.4–92.2 mm SL), Pheasant Creek, Bartlett Track, west of Woods Point, 37° 35' 02"S 146° 12' 25"E, F. Seymour, N. Armstrong, R.H. Kuiter and B. Crockford, February 1982; NMV A.30261-1 (7), 48.5–110.8 mm LCF (41.3–96.2 mm SL), Pheasant Creek, same location as NMV A.7935, W.G. O'Connor and J.D. Koehn, 8 December 1987; AMS I.44804-001 (1), 79.2 mm LCF (69.4 mm SL) and NMV A.30264-1 (7), 41.8–98.9 mm LCF (35.9–86.9 mm SL), Pheasant Creek, same location as NMV A.7935, JPO and J.A. McKenzie, 20 November 1990; NMV A.30251-1 (2), 102.9–118.1 mm LCF (88.2–102.3 mm SL), Plain Creek, Plain Creek Track, north of Mirimbah, 37° 03' 59"S 146° 23' 30"E, S.R. Saddlier, 9 December 1998; NMV A.30238-1 (1), 57.8 mm LCF (48.5 mm SL), Plain Creek, tributary, Plain Creek Track, north of Mirimbah, 37° 04' 41"S 146° 23' 37"E, S.R. Saddlier, 9 December 1998 ; NMV A.30246-1 (2), 113.8–118.9 mm LCF (100.6–103.6 mm SL), Plain Creek, same location as NMV A.30251-1, TAR, 16 May 2001; NMV A.30241-1 (1), 46.9 mm LCF (40.7 mm SL), Plain Creek, same location as NMV A.30251-1, P.S. Fairbrother, 3 December 2002; NMV A.4848 (2), dried, Quartz Creek, above falls, upstream of Quartz Creek Road, south of Rubicon, 37° 24' 34"S 145° 51' 51"E, J.P. Beumer, 26 January 1980; NMV A.30244-1 (2), 94.2–104.8 mm LCF (92.8–92.0 mm SL), Robertson Gully, Falls Road, Marysville, 37° 30' 54"S 145° 44' 58"E, TAR, 11 December 1998; NMV A.30263-1 (3), 72.5–91.7 mm LCF (63.2–81.2 mm SL), Robertson Gully, Kings Road, Marysville, 37° 30' 49"S 145° 44' 51"E, TAR, 11 December 1998; NMV A.30266-1 (12), 57.0–119.9 mm LCF (49.1–105.6 mm SL), Rubicon River, Quartz Link Track, 37° 25' 53"S 145° 51' 21"E, TAR, 20 February 1995; NMV A.30255-1 (8), 64.5–109.0 mm LCF (56.1–94.5 mm SL), Rubicon River, same location as NMV A.30266-1, TAR, 18 May 1995; NMV A.30256-1 (7), 46.3–92.9 mm LCF (40.1–82.1 mm SL), Rubicon River, same location as NMV A.30266-1, TAR, 24 May 2001; NMV A.30239-1 (5), 43.9–105.9 mm LCF (37.7–93.2 mm SL), S Creek, Ash Creek track, north-east of Narbethong, 37° 26' 44"S 145° 35' 40"E, JPO, 6 March 1997; NMV A.30259-1 (3), 42.6–98.7 mm LCF (37.7–85.4 mm SL), S Creek, same location as NMV A.30239-1, TAR, 6 August 1997; NMV A.30240-1 (8), 76.9–131.8 mm LCF (66.7–116.1 mm SL), Stanley Creek, Circuit Road, Mt. Stirling, 37° 08' 18"S 146° 31' 35"E, PJU, 24 April 1992; NMV A.30262-1 (5), 68.7–108.0 mm LCF (59.4–94.4 mm SL), Stanley Creek, same location as NMV A.30240-1, TAR, 15 May 2001; NMV A.30265-1 (1), 123.4 mm LCF (105.5 mm SL), Stony Creek, Plantation Road, west-north-west of Narbethong, 37° 31' 24"S 145° 35' 48"E, TAR, S.R. Saddlier, 18 September 1998; NMV A.30263-1 (5), 63.3–107.9 mm LCF (54.9–94.6 mm SL), Sunday Creek, Main Mountain Road, east of Wallan, Mount, Disappointment State Forest, 37° 23' 36"S 145° 08' 56"E, J. Lieschke, 28 November 2005; NMV A.30248-1 (11), 65.7–110.1 mm LCF (56.4–96.4 mm SL), Sunday Creek, same location as NMV A.30263-1, TAR, 7 December 2005; NMV A.30260-1 (2), 104.6–105.9 mm LCF (91.4–92.2 mm SL), Taggerty River, Upper Taggerty Road, Lake Mountain, Yarra Ranges National Park, 37° 29' 23"S 145° 51' 37"E, JPO and J.A. McKenzie, 28 November 1990; NMV A.30253-1 (7), 67.0–103.6 mm LCF (57.3–89.6 mm SL), Taggerty River, same location as NMV A.30260-1, TAR, 5 February 1991; NMV A.30250-1 (5), 65.7–141.4 mm LCF (55.9–123.2 mm SL), Torbreck River, tributary of south branch, Lower (South) Torbreck Road, east of Lake Mountain, 37° 29' 18"S 145° 55' 10"E, TAR and PJU, 26 February 1991; NMV A.8126 (3), 77.3–92.3 mm LCF (67.3–79.4 mm SL), Whitehouse Creek, Lady Talbot Drive, north-east of Marysville, Yarra Ranges National Park, 37° 28' 09"S 145° 48' 57"E, N.A. O'Connor and P.S. Lake, 19 February 1986.

Additional material examined (not measured): see Appendix 5.

Diagnosis. *Galaxias fuscus* differs from all other species within the *Galaxias olidus* complex by a combination of the following characters: a distinctive overall colour ranging from dull to moderately bright orange, yellow-orange to reddish orange; body pattern generally absent except sides of trunk with a series of large, distinctive, dark bars surrounded by halos present, generally centred on the lateral line, relatively widely spaced and extending from above the pectoral fin base to above the pelvic fin base, very rarely faint blotches also on dorsal surface; dorsal surface of trunk broadly flattened anteriorly from above pelvic fin bases; caudal peduncle very deep (7.2–10.4 % SL); long caudal fin (12.1–19.2 % SL), much longer than caudal peduncle; long anal fin (14.2–18.6 % SL); large pectoral and pelvic fins (11.4–17.6 and 9.5–16.2 % SL, respectively); pelvic fins set far back (pre pelvic length 53.4 % SL); large bulbous head, length 21.0–26.7 % SL and longer than PelAn distance, relatively wide and deep (56.7–75.6 and 35.5–53.3 % HL); nostrils short, not visible from ventral view; mouth large, with long upper and lower jaws (33.9–46.7 and 30.2–43.6 % HL respectively) and wide gape (34.3–53.9 % HL); most posterior extent of mouth about 0.8 ED below ventral margin of eye; 0–1 pyloric caecae, short (1.0 % SL) when present; and, anal fin origin usually under 0.78 distance posteriorly along dorsal fin base.

Description. As for the genus and members of the *Galaxias olidus* complex, except as indicated below, based on 137 specimens, 48.5–123.2 mm SL, and 50 additional, non-type specimens for meristics. Holotype and paratype examined; as they have dried out, no morphometric measurements were undertaken though all meristic counts could be made except number of pyloric caecae. See Tables 4 to 9 for frequencies of meristic values and Table 17 for a summary of meristic variation. Segmented dorsal fin rays 10 (9–11), of these 8 (7–9) branched and 2 (1–3) unbranched; segmented anal fin rays 11 (10*–12), of these 8 (7–10; [8*]) branched and 2 (1–3) unbranched; caudal fin rays 16 [17*]; segmented pectoral fin rays 15 (14–16), of these 13 (12–14; [13*]) branched and 2 (2–3) unbranched; pelvic fin rays 7 (7–8), of these 6 (6–7) branched and one unbranched; gill raker total count (lower limb and upper limb) 12 (11–14; [13*]), lower arch with 9 (8–10) and 3 (3–5; holotype 4) on upper, variation on first gill arch 7+2 (2), 7+3 (4), 7+4 (1), 8+2 (3), 8+3 (37), 8+4 (19), 8+5 (2), 9+2 (2), 9+3 (33), 9+4 (42*), 9+5 (9), 10+2 (1), 10+3 (6), 10+4 (13), 10+5 (5), 10+6 (1), 11+3 (1), 11+4 (1), 11+5 (3); vertebrae 54 (52–56; holotype 53); 0–1 pyloric caecae on stomach.

See Table 18 for comparative value ranges of morphometric characters. Body large, elongate and deep, dorsal surface usually broadly flattened anteriorly from above pelvic fin bases, depth through pectoral base 1.2 (1.0–1.3) that through vent, trunk with dorsal and ventral profiles evenly arched from snout to dorsal fin, dorsal profile sometimes less so, occasionally almost straight, body tapering back to a moderately long, 7.4 (6.3–9.1) in SL, and deep, 11.1 (9.6–13.9) in SL, caudal peduncle, the peduncle depth 1.5 in its length; accessory lateral line present. Head distinctly large, long, 4.2 (3.7–4.8) in SL, usually similar to PelAn distance (0.8–1.3), relatively deep and wide, 2.3 (1.9–2.8) and 1.5 (1.3–1.8) in HL respectively, distinctly wider than deep (depth 1.5 (1.4–1.6) in HW), lateral profile obtuse to bulbous, particularly in larger individuals; eyes of moderate size to smallish, 5.5 (4.6–7.2) in HL and 2.4 (1.7–3.4) in HD, situated relatively high on head but distinctly below dorsal head profile, interorbital convex, wide, 2.5 (2.1–3.1) in HL and 2.2–2.3 times ED, very broad in larger individuals; cheeks expanded below eyes, eye profiles usually not visible laterally from ventral view; snout of moderate length, 3.4 (2.1–4.2) in HL and 1.6 (1.2–2.9) times ED, lateral profile bluntly rounded; post-orbital head length of moderate length, 1.9 (1.7–2.2) in HL; nostrils usually short and not visible anterio-laterally from ventral view; mouth generally terminal, large, 2.5 (2.1–2.9) in HL, posterior extent reaching back to below middle of eyes or farther and 0.8 (0.5–1.2) ED below ventral margin of eye, most anterior tip of upper lip level with middle of eye, gape wide, 2.3 (1.8–2.9) in HL, width always greater than length of upper jaw and 1.5 (1.4–1.6) in HW. Jaws subequal, lower slightly shorter (1.1 in UJL). Pyloric caecae short, usually 1.0 % SL (0.6–3.2 %); gill rakers stout, short to moderately long and bluntly to sharply pointed.

Median fins fleshy at bases, paired fins less so, with thickening extending distally over 0.3–0.5 of fin area, extending farther between fin rays, dorsal and anal fin bases relatively long, dorsal base usually 0.9 in length of anal base, fins rounded and relatively long, middle rays longest, about equal in length; anal fin origin usually under 0.7 (0.5–1.1) distance posteriorly along dorsal fin base. Pelvic fins large, 8.1 (6.2–10.5) in SL, paddle shaped and 0.8–0.9 of pectoral fin length, usually inserted just posterior to mid-point of standard length and extending about 0.54 (0.39–0.67) distance to anal fin base; pectoral fins large, long, 7.2 (5.7–8.8) in SL, broad and rounded, extending about 0.45 distance to pelvic fin base, low on body with dorsal extent of fin base level with posterior extent of mouth, lamina of paired fins oriented ventrally, raised lamellae present on ventral surface of rays, usually strongly developed. Caudal fin long, 6.7 (5.2–8.3) in SL, weakly to strongly emarginate, occasionally truncate, 1.1–1.2 times length of caudal peduncle, vertical width of expanded rays greater than body depth through pectoral fin base, flanges moderately high and developed along caudal peduncle, relatively long but variable in length, reaching to distal end of adpressed anal fin rays or further anteriorly, often almost to fin base.

Size. Recorded to 165 mm LCF and 30 g; commonly to 80–105 mm LCF.

Colour in life. Base colour of head and body a dull to moderately bright yellow-orange, red-orange to orange, becoming lighter ventrally; belly light yellow-orange to cream. Head and upper portion of body usually overlain by a dusky shading of very fine pale dark brown to dark grey stippling, usually extending down sides to near lateral line and becoming paler; lips usually light grey, sometimes dark grey.

TABLE 17. Summary of meristic variation in *Galaxias fuscus* (T—total; B—branched; L—lower limb; S—single; U—upper limb). Range in 90 % and 100 % of specimens.

Character	Mode	Mean	SD	SE	Range 90 %	Range 100 %	N
Dorsal Rays (T)	10	9.8	0.66	0.05	9–11	8–12	187
Dorsal Rays (B)	8	7.8	0.68	0.05	7–9	6–10	187
Dorsal Rays (S)	2	2.0	0.44	0.03	1–3	1–3	187
Anal Rays (T)	11	10.8	0.64	0.05	10–12	9–12	187
Anal Rays (B)	8	8.5	0.77	0.06	7–10	6–10	187
Anal Rays (S)	2	2.2	0.58	0.04	1–3	1–4	187
Caudal Rays	16	16.0	0.34	0.03	16	14–18	187
Pectoral Rays (T)	15	15.3	0.69	0.05	14–16	14–17	187
Pectoral Rays (B)	13	13.2	0.76	0.06	12–14	12–15	187
Pectoral Rays (S)	2	2.1	0.35	0.03	2–3	1–3	187
Pelvic Rays (T)	7	7.1	0.36	0.03	7–8	6–8	187
Pelvic Rays (B)	6	6.1	0.36	0.03	6–7	5–6	187
Pelvic Rays (S)	1	1.0	0	0	1	1	187
Gill Rakers (T)	12	12.4	1.32	0.10	11–14	9–16	185
Gill Rakers (L)	9	8.8	0.83	0.06	8–10	7–11	185
Gill Rakers (U)	3	3.6	0.75	0.06	3–5	2–6	185
Vertebrae	54	53.7	1.13	0.08	52–56	51–56	185

TABLE 18. Morphometric variation in *Galaxias fuscus* (values are percentages of denominators in ratios, except for LCF and SL). Excludes selected measurements for the holotype, and all those of the paratype, which have been affected by shrinkage.

Character	Holo-type	Non-Types (N = 136) Mean	Min.	Max.	S.D.
LCF (mm)	74.9	93.2	57.8	141.4	
SL (mm)	65.3	81.1	48.5	123.2	
SL / LCF	87.2	87.0	83.9	89.2	0.97
BDV / SL	-	13.2	10.1	16.5	1.10
BDPec / SL	-	15.3	11.1	18.9	1.31
BDPec / BDV	-	116.0	97.1	132.1	7.71
LCP / SL	14.9	13.5	11.0	15.8	0.93
DCP / SL	-	9.0	7.2	10.4	0.69
DCP / LCP	-	67.2	48.9	90.0	7.30
CFFL / SL	14.6	15.0	12.1	19.2	1.29
LCP/CFFL	101.5	90.6	57.3	116.8	10.59
PreD / SL	-	69.0	66.1	72.2	1.16
PreA / SL	-	75.5	71.0	78.5	1.50
PreD / PreA	-	91.4	87.1	97.6	1.96
DF–AF / LDB	65.4	70.5	51.7	114.4	9.73
LDB / SL	8.8	10.6	7.3	12.8	0.87
LAB / SL	10.1	11.2	8.0	13.7	0.74
LDB / LAB	87.3	95.0	72.7	120.1	7.33
DL / LDB	173.7	152.9	122.7	231.9	11.99
AL / LAB	182.9	147.0	121.3	195.7	10.29
DL / SL	15.3	16.2	13.4	18.3	0.95
AL / SL	18.4	16.4	14.2	18.6	0.83
DL / AL	82.9	98.7	83.9	116.9	6.24
PecL / SL	15.1	13.9	11.4	17.6	1.05
PelL / SL	12.7	12.3	9.5	16.2	0.95
PelL / PecL	84.0	88.5	71.5	118.7	7.14
PrePel / SL	-	53.4	47.9	58.0	1.71
PecPel / SL	-	31.2	26.2	37.1	1.93
PelAn / SL	-	23.1	19.2	27.7	1.64
PecL / PecPel	-	44.9	30.6	60.7	4.92
PelL / PelAn	-	53.6	38.6	67.3	5.73
HL / SL	23.5	23.8	21.0	26.7	1.11
HL / PelAn	-	103.6	82.7	128.7	10.28
HW / HL	-	66.1	56.7	75.6	3.58
HD / HL	-	43.3	35.5	53.3	3.40
HW / HD	-	153.3	125.9	178.3	9.19
SnL / HL	-	29.2	24.0	47.4	2.52
SnL / ED	-	164.4	120.6	290.7	23.20
ED / HL	-	18.0	13.8	21.7	1.63
ED / HD	-	41.9	29.1	58.5	5.53

...... *continued on the next page*

TABLE 18. (Continued)

Character	Holo-type	Non-Types (N = 136) Mean	Min.	Max.	S.D.
PoHL / HL	-	53.6	46.0	59.0	2.24
IOW / HL	-	40.2	31.8	48.1	3.00
ED / IOW	-	45.0	30.9	64.8	6.18
UJL / HL	-	39.2	33.9	46.7	2.24
LJL / HL	-	36.0	30.2	43.6	2.29
GW /HL	-	44.2	34.3	53.9	4.20
LJL / UJL	-	91.7	79.8	102.2	4.02
LJL / GW	-	82.0	66.3	111.0	8.18
GW / HW	-	66.8	56.7	83.6	4.24
SnL/UJL	-	93.2	57.8	141.4	16.76

Most distinctive feature is a series of large, vertical, variably shaped, roughly ovoid to elongate bars (Figs. 13d, 14) located mid-laterally and extending above and below the lateral line. The number, shape, size and location of bars vary within and between populations and between the two sides of individual fish. Bars are deep black to rich burgundy black, usually solid though some are occasionally slightly faded, surrounded by a narrow, light halo composed of the base body colour without a dusky hue. Halos of adjacent bars are usually separated though may partially join when bars are closely spaced. Bars are usually wider with a rounded end above the lateral line, becoming narrower and pointed below (inverted 'tear-drop' shape), or widest at the lateral line. From 0 to about 10 bars can be present, usually 7 or less, fully formed or partial; partial bars usually short but generally as wide as full bars, circular to ovoid, situated on the upper sides and extending down to the lateral line. Bars always located between the upper margin of the opercle, above and forward of the pectoral fin base, extending posteriorly to just before the dorsal fin base. Occasionally very faint, widely spaced, grey blotches extend farther posteriorly, onto the caudal peduncle. Bars, blotching or spotting absent from dorsal surface, except rarely when large, faint, discrete roundish blotching present, extending posteriorly from posterior edge of nape to about above pelvic fin base, interspersed in areas between lateral bars, some extending over dorso-lateral margin onto very upper lateral surface, again dispersed between lateral bars. Pattern and bars absent from head.

Mid-dorsal surface of trunk usually with thin, single to double, row of gold flecks extending from nape posteriorly to dorsal fin base; dorsal and dorso-lateral surface of trunk also with moderate sprinkling of gold flecks, extending down sides to top of lateral bars, occasionally also extending onto top of head and snout and onto cheeks; sides of caudal peduncle sometimes with wash of gold flecks. Gill cover translucent, sometimes with a small golden patch; iris golden. Fins usually translucent light grey, yellowish grey to pale orange. Fish smaller than about 50–55 mm LCF usually lack bars and are a dull grey to grey-brown overall.

Colour of preserved material. Head and body fade to an overall pale lemon yellow to tan base colour, overlaid by a dusky light to moderately dark, grey to black hue, darkest mid-dorsally, gradually lightening down the sides. Ventral surface light cream to creamy yellow, lacking duskiness. Dorsal portion of nape, head and snout, and dorso-anterior portion of upper jaw with dusky hue, becoming paler ventrally and extending downward onto preopercle, opercle, lower jaw and below eyes.

Eye black, pupil translucent pale orange-yellow or brownish yellow. Teeth translucent yellow to pale orange-yellow, tips orange to orange-red; gill rakers creamy white to pale yellow. Fins generally translucent yellow, becoming transparent to clear on posterior margins, fleshy bases of pelvic and pectoral fins light lemon yellow. Fin rays transparent, anterior edges of first few rays edged with brown. Most distinctive marking, present even on faded specimens, is the series of large black bars along mid-lateral portion of the body (see Colour in life, above).

Dried out specimens (i.e. holotype and paratype) orange-brown to dark brown, slightly lighter ventrally. Caudal peduncle yellow brown and partially translucent. Eye black to blackish purple, bars on sides black, partially faded, fins clear to slightly yellowish (see Fig. 13a).

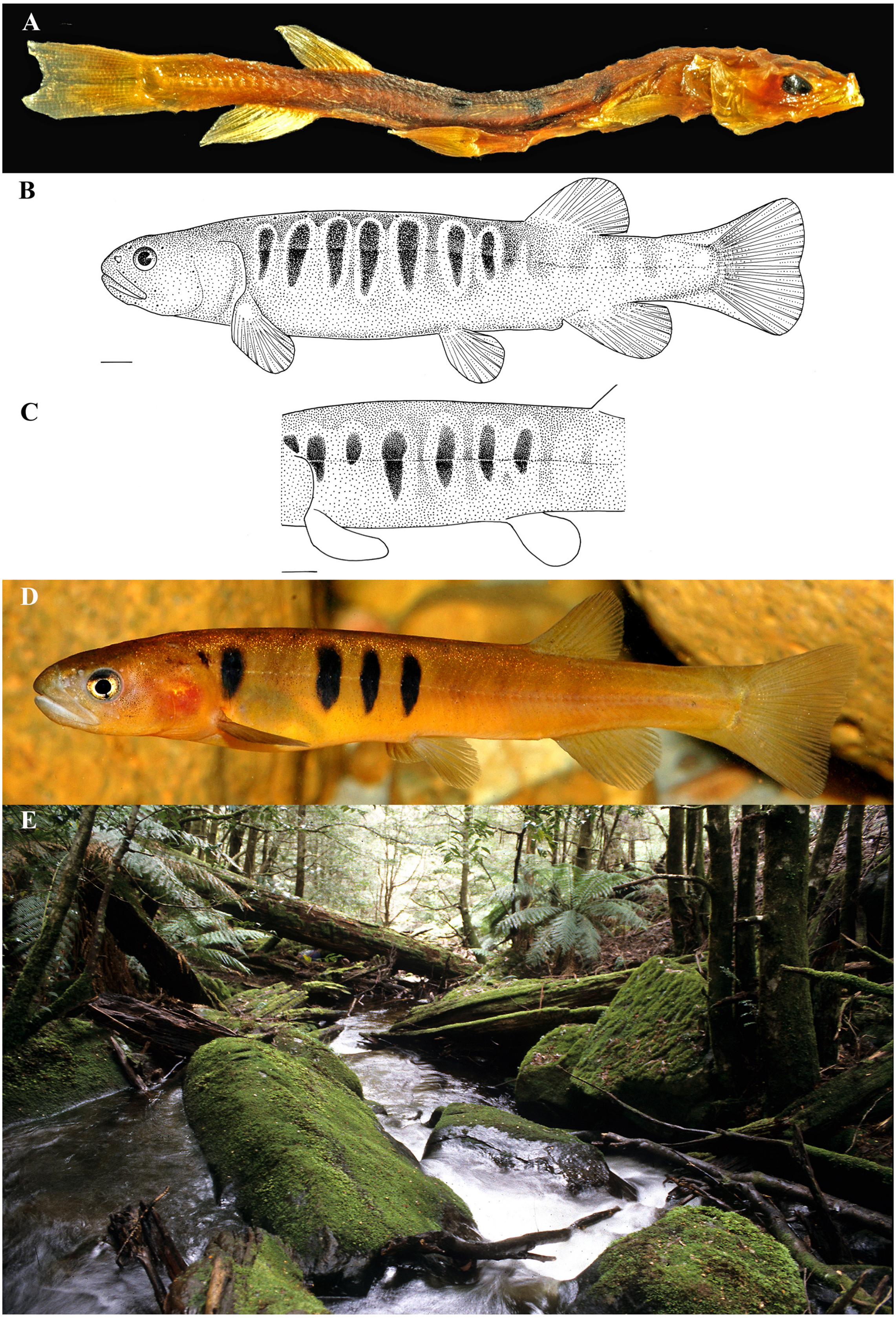

FIGURE 13. A) *Galaxias fuscus* holotype (NMV A.96), right side (T.A. Raadik); B) *G. fuscus* Rubicon River (NMV A.30266-1), female, usual bar pattern, and C) *G. fuscus* Keppel Hut Creek (NMV A.30257-1), female, alternate bar pattern showing some partial bars (R. Plant); D) *G. fuscus*, Falls Creek, Mount Stirling, 21 February 2007; ~ 85 mm LCF (T.A. Raadik); and E) habitat of *G. fuscus*, Keppel Hut Creek, Lake Mountain, June 1992 (T.A. Raadik). Scale bar = 5 mm.

FIGURE 14. Variation in bar pattern in *Galaxias fuscus* from across their range. Clockwise from top left: Plain Creek (Delatite system); Brewery Gully (Goulburn system); Torbreck River tributary, (Big system); Keppel Hut Crk and Robertsons Gully (Leary's Creek) (Steavenson system); Luke Crk (Yea River system); All images by T.A. Raadik, except Torbreck R (M. Shirley).

Etymology. The species name is derived from the Latin, *fusc*, meaning brown, dark, dusky or tawny. Mack (1936; p. 101) described the colour of the holotype and paratype as greenish brown, but this is similar to the colouration of the many preserved individuals within the *Galaxias olidus* complex. Possibly Mack was referring to the distinctive and dark bars on the sides of the body which he referred to as "..prominent dark oval blotches..". The live colouration of the majority of *Galaxias fuscus* is a dusky orange-brown, and the type material is currently also a tawny colour, hence the species name is apt.

Genetics. Allozyme and mtDNA analysis of this species can be found in Adams *et al.* (2014**;** taxon code FU). Diagnostic allozyme loci (5–13) between this taxon and the other species in the *Galaxias olidus* complex are provided in Table 12.

Distribution. See Fig. 11. Endemic to the Goulburn River system in central Victoria, on the Murray–Darling Basin side of the Great Dividing Range. Now restricted to a small upland area extending along the south-eastern portion from the Delatite River system in the north-east, southward to the upper reaches of the Goulburn River near Woods Point, and then westward to a hybrid population (see Ayres *et al.* 2012b) in the Sunday Creek system near Mount Disappointment, just north of Melbourne (Raadik *et al.* 2010), at an elevation between 400–1600 m asl. Now extinct in the lower Rubicon River (Rubicon), Gaffneys Creek (A1 Mine Settlement), Whitehouse Creek (NE Marysville), and Mountain Creek (Kinglake).

Sympatry. Found with *Galaxias olidus* at one site (Raspberry Creek, Woods Point) though considered to have been sympatric with other populations before alien trout severely fragmented populations and substantially altered distributional patterns. Also considered to have been historically found with *Galaxias arcanus* **sp. nov.**, and very possibly with *Galaxias oliros* **sp. nov.** at the very downstream extent of its range.

Habitat. See Raadik *et al.* (2010) for detailed description. Briefly, found in small to medium-sized (0.7–11.0 m average width), moderately to fast flowing, steep gradient, shallow (0.1–0.4 m average depth), creeks and rivers, all typically cool to cold. Stream substrate consists of bedrock, boulder, cobble, with smaller amounts of pebble, gravel and sand, and streams are usually well shaded by dense overhanging riparian vegetation. Instream habitat usually consists of accumulations of large and small timber debris, rocks and tree roots in undercut banks.

General Biology. Relatively well covered by Raadik *et al.* (1996, 2010), Shirley and Raadik (1997) and Stoessel *et al.* (2012). In brief, non-migratory and completes its entire life cycle in freshwater and collected at a density ranging from 0.1–1.2 fish/m^2 in the absence of trout. Diet consists mostly of aquatic and terrestrial insects, with fish foraging off the bottom and mid water in pools and at the end of riffle/glide sections. Often the only freshwater native fish in the systems it occupies and usually found with Central Highlands Spiny Crayfish. Very occasionally also recorded with the native species *Galaxias olidus* and *Gadopsis bispinosus*. Spawning occurs from late September to early October, though males can be running ripe from about April, and females ripe from mid-June. Fecundity is low (mean approx. 500 eggs); eggs are adhesive, about 2.2 mm diameter, and laid on the side or underneath large rocks in fast-flowing, shallow water. Hatching occurs after about a month, and newly-hatched larvae are about 8–12 mm in length. Growth rates are slow, and adults live to about 15 years of age. Able to survive in very cold water (< 3 ºC) during winter, with populations at higher elevations in streams draining catchments which are usually covered by snow for varying periods of time. Populations between Marysville and Sunday Creek found to be infected with small dark brown to black cysts, possibly trematode metacercariae, embedded in the skin, fins, and sometimes in the eyes.

Variation. Mid-lateral bars vary geographically (Fig. 14), and are very occasionally absent, though this is extremely rare. Bars on fish from around Lake Mountain are the largest. Putative hybridisation with *Galaxias olidus* can cause difficulties in the identification of some individuals (see below).

Conservation status. Endangered (DSEWPC 2013), critically endangered (IUCN 2012, DSE 2013); protected under the national *Environment Protection Biodiversity Conservation Act* 1999 and Victorian *Flora and Fauna Guarantee Act* 1988.

Remarks. This species has the most distinctive colour pattern of all taxa in the *Galaxias olidus* complex: black, generally long and wide, ovoid to inverted tear-shaped, and restricted to an area extending from the rear of the operculum to about the origin of the pelvic fin.

Previously considered a junior synonym of *Galaxias olidus* Günther, 1866 (McDowall & Frankenberg 1981). Originally described from two specimens in poor condition from the Rubicon River (Mack 1936), the holotype and paratype were noted to be "...completely dehydrated...' by McDowall & Frankenberg (1981: 475) and are currently in very poor condition (shriveled). The length of the Holotype was listed as 84 mm TL when described (Mack 1936) (see Appendix 1) but is now 74.9 mm LCF, possibly having dried out or deteriorated further over time. Contrary to McDowall & Frankenberg (1981), who stated the types were useless, the prominent bar pattern is still visible on each and specimen condition is sufficient to enable counts to be made of fin rays and gill rakers.

In an unpublished revision of Australian Galaxiidae, Frankenberg (1969) was unable to find additional specimens for comparison from the type locality but located a second population at Kinglake, approximately 50 km south-west. Based on comparison of the new material with *Galaxias olidus* s.l., the nominal species *Galaxias fuscus* was retained as a subspecies of *G. olidus* s.l. (Frankenberg 1969). A subsequent, more detailed revision (McDowall & Frankenberg 1981) considered *G. fuscus* a colour pattern variant of *G. olidus* s.l., rejected its status as a distinct species or subspecies and considered it a junior synonym of *Galaxias olidus* Günther, 1866.

The '*fuscus*' form of *Galaxias olidus* s.l. was re-discovered in 1980 near Woods Point (Armstrong 1993), approximately 35 km south-east of the original type locality and additional survey work in the late 1980s to early 1990s located additional sites. Considered extinct from its type locality, it was rediscovered in headwater reaches of the Rubicon River in the mid 1990s.

Whilst dried out, the holotype could still be adequately compared with recent material as all but one meristic character could be enumerated and it retains a number of additional distinctive characteristics (large fins, distinctive colouration, dark bars, etc.). *Galaxias fuscus* is known to hybridise with *Galaxias olidus* with putative hybrid fish identified from amongst both parents in Raspberry Creek and the entire population at Sunday Creek appears to be composed of hybrids. Suspected putative hybrid individuals range in colour from the typical orange to a dull yellow and appear to possess obvious or pale blotching on the dorsal surface of the trunk. Black bars are present along the sides but these are smaller (narrower and shorter), and often more bars are present extending farther posteriorly, sometimes onto the caudal peduncle; bars usually fade in intensity posteriorly.

A cold-adapted fish, usually found in very heavily shaded streams which rarely exceed 15 ºC during summer and usually reach 1–3 ºC during winter. This species is considered to have previously occupied larger, deeper and more moderate gradient river systems at lower altitudes (down to about 300 m elevation), with a coarser substrate and larger accumulations of timber debris. The enlarged lateral canine teeth reported in this species (Allen 1989, Armstrong 1993) could not be confirmed from 188 specimens examined from all populations. They are therefore considered absent. The distinctive mid-lateral bars differ to those on the conspecific *Galaxias olidus* by being wider and longer (up to 4 mm wide, 10 mm long), fewer in number and more widely spaced, and restricted along sides to between the posterior end of the head and the origin of the dorsal fin base (extend farther in *G. olidus*). Fish in captivity have been reported to rapidly alter the number of bars (P.L. Cadwallader, pers. comm. 1993; G.N. Backhouse, pers. comm. 2004), though this has not been observed in over 10 years of keeping captive fish from a much larger number of individuals and populations. This anomalous report may have been due to confusing poorly identified individual fish.

The original specimens, which were described as *Galaxias fuscus* in 1936, were in poor condition when they were received at the Museum of Victoria (Mack 1936) and an attempt was made to secure more from the collector. Reproduced below is a transcript of a copy of a letter written by George Mack, Curator, National Museum of Victoria, to A.C. (Archibald) Payne who collected the specimens and donated them on 18 April 1935. This copy was located in the historical letter file of the Department of Ichthyology, Museum Victoria in 1986; original copy and letter file now missing.

Mr A. C. Payne

April 27th 1935

Tin Hut,
Rubicon,
Victoria

Dear Sir,
The two small fishes forwarded by you for identification, through Mr C. French, are referable to the genus Galaxias, but they appear to differ from the known species. Both examples were in poor condition when received and to permit a definite determination to be made it would be necessary to have additional fresh specimens. If you could undertake to obtain some we would be greatly obliged, and we would send you one or two small bottles containing proper preserving fluid. Before forwarding these we would be pleased to hear from you, and an envelope, stamped and addressed, is enclosed for your reply.

We are always prepared to pay postage charges on specimens forwarded.

Yours truly,
G. Mack

It appears that Archie Payne did not send additional specimens and it is unknown if he received or replied to Mack's letter. The description of *Galaxias fuscus* was published the following year, based on the two original 'poor' specimens. The actual state of the specimens is difficult to determine, as Mack provides little detail, and confusingly, his line drawing of the holotype suggests a specimen in relatively good condition. Mack may have used artistic licence to depict the holotype as he thought it may have been when alive. Whether the specimens were as dried as they are now (see Fig. 13a), or dried to this extent later, is unknown.

The type locality is given as 'Rubicon River' (Mack 1936) and this information may have been supplied by the collector, Archie Payne, or inferred by Mack from the postal address for Payne ('Tin Hut, Rubicon'). Tin Hut is the local name for the original Rubicon Township which was situated at the junction of the Rubicon River and its main tributary, the Royston River. The exact location of collection will never be known, but may have been at Tin Hut in the Rubicon or Royston rivers, in Flea Creek which ran through the old township, or elsewhere in the catchment, as Archie Payne is known to have lived farther upstream in the mid reaches of the Rubicon River system, at the original Lumber Co. mill site (Evans 1994), which was located just upstream of the existing Royston Power

Station. Archie Payne died in the Black Friday fires on 10 January 1939, defending timber mill machinery on a ridge near a tributary of the Rubicon River (Evans 1994). Unlike its discoverer, *Galaxias fuscus* survived the 1939 fires, and those of 2006-7 in the east of its range and the large fires of February 2009 which re-burnt the Rubicon River catchment 70 years on.

***Galaxias gunaikurnai*, new species**

Shaw Galaxias

Tables 4 to 9, 12, 19 to 20; Figures 7 & 15

Galaxias olidus olidus (non *G .olidus* Günther, 1866)—Frankenberg, 1969: 170 (*partim*).

Galaxias olidus (non *G. olidus* Günther, 1866)—Dixon, 1976: 108; McDowall & Frankenberg, 1981: 469 (*partim*); Cadwallader & Backhouse, 1983: 69 (*partim*); McDowall, 2003a: 364 (*partim*).

Galaxias findlayi (non *G. findlayi* Macleay, 1882)—Dixon, 1976: 108.

Galaxias sp. 7—DSE, 2013: 17.

Galaxias sp. 14—Kuiter, 2013: 72.

Conforms to the allozymically defined and morphologically diagnosed taxon 'SH' of Adams *et al.* (2014), and 'shaw' of Raadik (2011).

Material Examined.

Holotype. NMV A.30573-2, 94.6 mm LCF, (83.5 mm SL), female, Shaw Creek, at walking track off Howitt Road at the Gorge, Bennison High Plains, Alpine National Park, Victoria, 37° 23' 39"S 146° 44' 51"E, T.A. Raadik, 28 February 2002.

Paratypes. AMS I.44915-1 (1), 91.7 mm LCF (82.0 mm SL) and NMV A.30573-1 (3), 88.6–98.9 mm LCF (78.9–88.4 mm SL), collected with holotype.

Non-type material. all VIC: NMV A.30640-1 (12), 51.6–82.3 mm LCF (45.4–72.4 mm SL), Shaw Creek, at type locality, JPO, 23 March 1998; NMV A.26403-1 (5), 95.3–98.9 mm LCF (84.1–88.0 mm SL), Shaw Creek, at type locality, P.S. Fairbrother and M. Nicol, 17 April 2008; NMV A.9922 (11), 31.6–79.5 mm LCF (26.9–69.8 mm SL), and NMV A.10381 (4), 55.7–75.0 mm LCF (63.3–66.7 mm SL), Shaw Creek, Bennison High Plains, P.A. Rhodes, 1 April 1960.

Additional material examined (not measured): see Appendix 5.

Diagnosis. *Galaxias gunaikurnai* **sp. nov.** differs from all other species within the *Galaxias olidus* complex by a combination of the following characters: dorsal fin set far back (PreD about 70.4–74.1 % SL); distance between pectoral and pelvic fin bases long (30.8–33.8 % SL); caudal fin shorter than caudal peduncle length and vertical width of expanded caudal fin rays about the same as the body depth through the pectoral fin base; caudal peduncle flanges just reaching adpressed anal fin rays; head short (20.0–20.7 % SL), distinctly shorter than PelAn distance, but wide (66.2–71.2 % HL) and deep (44.2–49.9 % SL); snout long (29.2–32.0 % HL); nostrils short, not visible from ventral view; eye relatively small (16.6–17.8 % HL); inter-orbital gap broad (39.2–41.2 % HL); most posterior extent of mouth usually 0.8 ED below ventral margin of eye; dorsal and anal fin bases short (8.3–10.1 and 8.8–10.7 % SL), with AL/LAB ratio high (147–163 %); anal fin origin usually under 0.74 distance posteriorly along dorsal fin base; anal fin segmented ray count usually 10; gill rakers moderately long and usually pointed; usually 1, sometimes 2 stout and wide pyloric caecae of moderate length (2.0 % SL); and, lack of black midlateral bars.

Description. As for the genus and members of the *Galaxias olidus* complex, except as indicated below, based on five specimens, 78.9–88.4 mm SL, and 30 additional, non-type specimens for meristics. See Table 4 to 9 for frequencies of meristic values and Table 19 for a summary of meristic variation. Segmented dorsal fin rays 9 (8–10*), of these 8 (7–8) branched and 2 (1–2) unbranched; segmented anal fin rays 10 (10–11), of these 8 (8–9) branched and 2 (1–2) unbranched; caudal fin rays 16 (14–16); segmented pectoral fin rays 14 (14–16; [15*]), of these 12 (12–14; [13*]) branched and 2 unbranched; pelvic fin rays 7 [8*], of these 6 [7*] branched and one unbranched; gill raker total count (lower limb and upper limb) 12 (11*–13), lower arch with 9 (8–9) and 3 (2*–4) on upper, variation on first gill arch 8+3 (2), 9+2 (5*), 9+3 (9), 9+4 (1), 10+3 (1); vertebrae 53 (52*–55); usually one, sometimes two*, pyloric caecae on stomach.

See Table 20 for comparative value ranges of morphometric characters. Body stout and moderately elongate, dorsal midline usually broadly flattened anteriorly from above pelvic fin bases, depth through pectoral base 1.1–1.2

that through vent, trunk with dorsal and ventral profiles evenly arched from snout to dorsal fin origin; body tapering back to a caudal peduncle of moderate depth, 11.9 (11.4–12.8) in SL, and length, 7.1 (6.9–7.3 in SL), the peduncle depth 1.6–1.7 in its length; accessory lateral line present. Head short 4.9 (4.8–5.0 in SL), shorter (0.8–0.9) than PelAn distance, but wide, 1.45 (1.40–1.50) in HL, and deep, 2.1 (2.0–2.3) in HL, distinctly wider than deep (depth 1.46 (1.43–1.50) in HW), lateral profile slightly wedge-shaped, dorsal profile distinctly flat anterior to nape; eyes moderately small, 5.8 (5.6–6.0) in HL and 2.7–2.8 in HD, situated high on head, distinctly below dorsal head profile, interorbital flat to convex, moderately broad, 2.5 (2.3–2.5) in HL and 2.3–2.4 times ED; cheeks expanded below eyes, eye profiles not visible laterally from ventral view; snout long, 3.3 (3.1–3.4) in HL and 1.7–1.8 times ED, lateral profile rounded; post-orbital head length moderately short, 1.9 in HL; nostrils relatively short, just extending to posterior edge of upper lip or less, not visible from ventral view; mouth generally terminal, moderately long, 2.6–2.7 in HL, posterior extent reaching back to under anterior 0.25–0.50 of eyes, and about 0.8 (0.7–1.0) ED below ventral margin of eye, most anterior tip of upper lip level with middle of eye, gape moderately wide, 2.4 (2.2–2.6) in HL, width 1.1 (1.0–1.1) that of length of upper jaw and 1.7 (1.6–1.7) in HW. Jaws subequal, lower 0.9 times length of upper. Pyloric caecae of moderate length, longest averaging 2.0 % SL (0.8–3.6 %), stout, wide at base and blunt; gill rakers moderately long, stout and usually pointed.

Fins fleshy at bases, median fins more so, with thickening extending distally over 0.5 of fin area, extending to about 0.9 distance distally between fin rays; dorsal and anal fin bases short, usually 11.0 (10.3–12.0) and 10.5 (9.5–11.4) in SL respectively, dorsal fin base usually 0.9 of length of anal fin base, fins of moderate length, rounded, usually equal though anal sometimes slightly longer (1.0–1.1 times DL), middle rays longest; anal fin origin usually under 0.74 (0.64–0.87) distance posteriorly along dorsal fin base. Pelvic fins of moderate length, 9.2 (8.5–9.7) in SL, usually 0.9 of pectoral fin length, inserted at about mid-point of standard length and usually extending to 0.45 (0.43–0.49) distance to anal fin base; pectoral fin of moderate length and paddle-shaped, 8.1 (7.8–8.5) in SL, extending less than 0.4 distance to pelvic fin base, low on body with dorsal end of fin base level with posterior extent of mouth, lamina of paired fins oriented anterio-ventrally to ventrally, raised lamellae on ventral surface of rays usually present and strongly developed. Caudal fin moderately short, 8.1 (7.6–8.5) in SL, emarginate, shorter than caudal peduncle, vertical width of expanded rays about same as body depth through pectoral fin base, flanges moderately developed along caudal peduncle, just reaching adpressed anal fin rays.

TABLE 19. Summary of meristic variation in *Galaxias gunaikurnai* **sp. nov.** (T—total; B—branched; L—lower limb; S—single; U—upper limb). Range in 90 % and 100 % of specimens.

Character	Mode	Mean	SD	SE	Range 90 %	Range 100 %	N
Dorsal Rays (T)	9	9.3	0.69	0.16	8–10	8–10	18
Dorsal Rays (B)	8	7.6	0.62	0.15	7–8	6–8	18
Dorsal Rays (S)	2	1.8	0.43	0.10	1–2	1–2	18
Anal Rays (T)	10	10.2	0.55	0.13	10–11	9–11	18
Anal Rays (B)	8	8.3	0.46	0.11	8–9	8–9	18
Anal Rays (S)	2	1.9	0.54	0.13	1–2	1–2	18
Caudal Rays	16	15.8	0.65	0.15	14–16	14–16	18
Pectoral Rays (T)	14	14.6	0.70	0.17	14–16	14–16	18
Pectoral Rays (B)	12	12.6	0.70	0.17	12–14	12–14	18
Pectoral Rays (S)	2	2.0	0.00	0.00	2	2	18
Pelvic Rays (T)	7	7.1	0.24	0.06	7	7–8	18
Pelvic Rays (B)	6	6.1	0.24	0.06	6	6–7	18
Pelvic Rays (S)	1	1.0	0.00	0.00	1	1	18
Gill Rakers (T)	12	11.8	0.62	0.15	11–13	11–13	18
Gill Rakers (L)	9	8.9	0.42	0.10	8–9	8–10	18
Gill Rakers (U)	3	2.9	0.47	0.11	2–3	2–4	18
Vertebrae	53	53.0	0.86	0.14	52–55	52–55	35

TABLE 20. Morphometric variation in *Galaxias gunaikurnai* **sp. nov.** (values are percentages of denominators in ratios, except for LCF and SL).

Character	Holo- type	Paratypes (N = 4) Mean	Min.	Max.	S.D.
LCF (mm)	92.3	93.5	88.6	98.9	
SL (mm)	81.5	83.2	78.9	88.4	
SL / LCF	88.3	89.0	88.3	89.4	0.50
BDV / SL	15.8	12.6	11.2	13.4	1.01
BDPec / SL	16.3	14.5	13.6	14.8	0.60
BDPec / BDV	103.5	114.9	110.0	121.0	5.22
LCP / SL	14.2	14.0	13.6	14.5	0.39
DCP / SL	9.9	8.4	7.8	8.8	0.48
DCP / LCP	70.0	60.1	56.1	64.0	4.39
CFFL / SL	13.3	12.3	11.8	13.2	0.64
LCP/CFFL	106.6	113.5	104.6	117.7	6.02
PreD / SL	72.2	72.3	70.4	74.1	1.69
PreA / SL	74.8	75.1	72.8	76.4	1.60
PreD / PreA	96.5	96.2	94.1	97.0	1.39
DF–AF / LDB	63.9	76.4	68.6	86.8	7.72
LDB / SL	10.1	9.1	8.3	9.7	0.61
LAB / SL	10.7	9.5	8.8	10.5	0.71
LDB / LAB	94.3	96.0	89.6	102.7	5.54
DL / LDB	139.4	161.3	154.8	166.7	5.32
AL / LAB	147.0	158.6	153.0	163.0	4.27
DL / SL	14.1	14.7	13.7	15.7	0.87
AL / SL	15.7	15.1	14.4	16.6	1.02
DL / AL	89.4	97.5	94.6	103.9	4.37
PecL / SL	13.2	12.3	11.7	12.8	0.51
PelL / SL	11.7	10.9	10.3	11.2	0.39
PelL / PecL	88.7	88.9	80.8	95.3	6.14
PrePel / SL	51.3	51.4	50.6	52.2	0.76
PecPel / SL	32.1	32.6	30.8	33.8	1.25
PelAn / SL	23.7	24.3	23.8	25.1	0.53
PecL / PecPel	41.0	37.8	35.7	39.0	1.45
PelL / PelAn	49.4	44.9	43.4	46.0	1.17
HL / SL	21.2	20.2	20.0	20.7	0.33
HL / PelAn	89.6	83.2	79.7	86.1	2.71
HW / HL	66.2	69.1	67.1	71.2	1.96
HD / HL	44.2	47.4	46.0	49.9	1.71
HW / HD	149.7	145.9	142.7	149.8	3.49
SnL / HL	30.3	30.3	29.2	32.0	1.31
SnL / ED	170.1	176.8	164.1	192.5	11.71

...... continued on the next page

TABLE 20. (Continued)

Character	Holo-type	Paratypes (N = 4) Mean	Min.	Max.	S.D.
ED / HL	17.8	17.2	16.6	17.8	0.51
ED / HD	40.3	36.3	33.4	38.7	2.22
PoHL / HL	53.0	52.8	51.4	53.5	0.95
IOW / HL	43.1	40.3	39.2	41.2	0.99
ED / IOW	41.4	42.6	40.4	43.7	1.48
UJL / HL	39.4	37.8	37.3	38.4	0.46
LJL / HL	35.0	33.6	32.6	35.9	1.56
GW /HL	40.9	41.6	38.4	44.4	2.65
LJL / UJL	88.7	88.9	86.2	93.6	3.26
LJL / GW	85.6	81.1	74.8	88.7	6.83
GW / HW	61.7	60.1	57.3	63.1	2.38
SnL/UJL	76.9	80.3	76.0	85.9	4.41

Size. Recorded to 104 mm LCF and 11 g; commonly to 65–70 mm LCF.

Colour in life. Body predominantly grey-brown to grey-tan on back and upper sides above lateral line, extending onto top and sides of head and snout, becoming light tan to creamy brown on lower lateral sides of trunk to cream or white ventrally. Dorsal surface of trunk and head, and upper surface of sides, also overlain by dusky grey shading, with grey-brown to dark grey, almost black, irregularly shaped blotches and stripes (very occasionally tending to a diffuse black bar), some extending ventrally across lateral line; gill cover translucent with golden patch; iris coppery gold; fins translucent, slightly pale yellow to dusky. See below for more detailed comments on body pattern.

Colour of preserved material. Base colour of head and body pale creamy yellow to tan, with overlying very light stippling of grey on dorsal and dorso-lateral surface. Dorsal surface of trunk with small to medium sized, irregular shaped dark brown to grey brown spots or blotches, more dense dorsally, extending down sides and coalescing on some individuals to form larger blotches and elongate, narrow and irregular shaped, vertical, mid-lateral bars, roughly centred on the lateral line. Trunk pattern extends down sides to near ventro-lateral region well below lateral line; lateral trunk pattern widely spread over caudal peduncle, except on ventral and ventro-lateral surfaces. Dorsal trunk pattern extends across the nape and inter-orbital region to the snout, behind and below eyes and onto upper opercular region, with rest of lateral surfaces of head slightly dusky grey; upper jaw and anterior portion of lower lip slightly dusky. Ventral surface of head pale cream to tan, with fine stippling along posterior lateral and ventral edges of gill covers; fine to medium black and brown spotting inside opercula, with fine, grey spotting at base of, and along, gill filaments.

Eye grey, pupil translucent pale orange to brown. Teeth translucent yellow to pale orange–yellow, tips orange to orange–red; gill rakers pale cream. Fins pale creamy yellow, becoming slightly more translucent on posterior margins, fleshy bases of dorsal fin with fine brown. Fin rays slightly opaque, external edges of rays highlighted with fine pale brown spots forming thin lines.

Etymology. The specific name gunaikurnai, named after the Gunai/Kurnai indigenous nation, the traditional inhabitants of the Gippsland region of Victoria. *Galaxias gunaikurnai* is found within the country of the Brayakuloong people, one of the five major clans. A noun in apposition. Suggested vernacular name 'Shaw Galaxias'.

Genetics. Allozyme and mtDNA analysis of this species can be found in Adams *et al.* (2014**;** taxon code SH). Diagnostic allozyme loci (4–16) between this taxon and the other species in the *Galaxias olidus* complex are provided in Table 12.

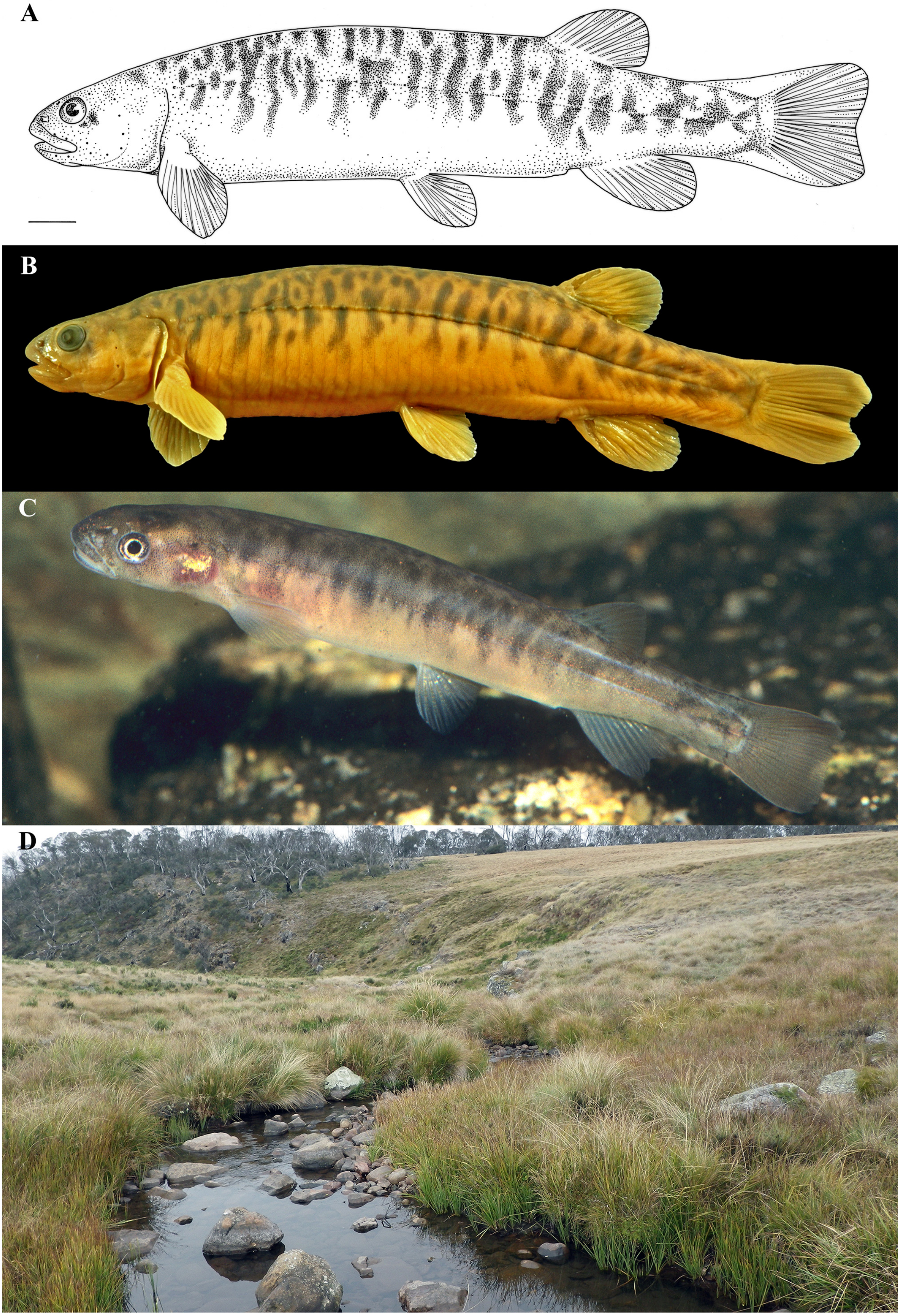

FIGURE 15. A–B: *Galaxias gunaikurnai* **sp. nov.** holotype, NMV A.30573-2, 94.6 mm LCF, Shaw Creek, off Howitt Road, Bennison High Plains, Alpine National Park, Victoria, A) line drawing (R. Plant), B) image of preserved specimen (T.A. Raadik); C) *G. gunaikurnai* **sp. nov.**, collected at the type locality with the holotype, 28 February 2002; ~ 80 mm LCF. (R. Kuiter); D) Shaw Creek, at the type locality of *G. gunaikurnai* **sp. nov.**, 16 April 2013 (T.A. Raadik). Scale bar = 5 mm.

Distribution. See Fig. 7. Currently only known from the type locality in the headwaters of Shaw Creek, a tributary of the Caledonia River (Macalister River catchment) in the coastal Gippsland region of Victoria, at an elevation of 1470 m asl. The location is approximately 4 km (river distance) from the source, which is at 1580 m asl, in a catchment of approximately 8 km^2. Historical data indicates a more extensive distribution in this system, previously extending farther downstream (at least 12 km in the mid 1960s). The alien predatory species Brown Trout was recorded as abundant, and galaxiids absent, 400 m farther downstream from this site in 2002, below a small instream barrier. By 2012 Brown Trout had colonised upstream past this barrier to the source of the stream, eliminating *Galaxias gunaikurnai* from the majority of its small distribution and essentially restricting it to a single side tributary (see below).

Habitat. In 2002 recorded from a small (0.6–1.4 m average width and 0.15–0.20 m in average depth), cool, clear, alpine creek, flowing through a grassy plain, consisting of pools, glides and riffles, with smaller amounts of small cascades, and with very little shading except that provided by grasses (Fig. 15d). During winter the catchment is usually covered by snow for varying periods of time. Substrate consisted of bedrock, boulder and cobble, with smaller amounts of pebble, gravel and coarse sand. Instream cover was provided predominantly by rock and from bank and vegetation (alpine grasses) overhang, and pools averaged 0.5 m in depth.

General Biology. Confined to freshwater and considered not to undertake diadromous migrations. Recorded at densities of 0.05–0.18 fish/m^2 and is the only native fish species so far recorded from within its range. Spawning period unknown, though possibly winter to early spring: fish collected in late February were at an early stage of gonad development, with the majority of the body cavity full of fat deposits (though one female was significantly advanced in development), those collected in mid-April (NMV A.26403-1) and had gonads filling 50–60 % of the body cavity and males collected in early May 2013 were running ripe and females were at a ripe stage. The smallest presumed 0+ age fish recorded in April 1960 and May 2012 was 32 mm LCF with the smallest fish collected in mid-April 2008 measuring 40 mm LCF and 70 % of 95 individuals ranging in length from 40–60 mm LCF. Able to survive in very cold water (< 5 ºC) during winter.

Conservation status. Critically endangered (DSE 2013). Brown Trout had invaded the upper Shaw Creek between 2010 and 2011 when high flows appear to have eroded the instream barrier which previously excluded them. In May 2012 *Galaxias gunaikurnai* had disappeared from the entire 4 km of main stream length in their habitat, declining from a fish density of 0.18 fish/m^2 recorded in April 2008 (Raadik unpubl. data). Approximately 150 fish remained in three small pools in a sphagnum bog in a 300 m long section of the headwaters of a 0.3 m wide side tributary, and a single adult was recorded from the headwaters of a separate, small, side tributary.

Remarks. The morphometric description of *Galaxias gunaikurnai* is based on only five, large, specimens. Consequently, examination of additional, moderately sized individuals is required to further define the morphometric variation within this species. This can only be undertaken once population size increases so that collection of additional individuals does not affect population viability. Of great concern is the incursion of Brown Trout into this small population. An instream barrier has been constructed and trout removal from the upstream 'galaxiid-zone' has commenced (2012) and is planned to occur until all trout are removed.

This species is considered to have been historically more widespread, at least extending throughout the Shaw Creek system and probably downstream into the mid-reaches of the larger Caledonia River system. Systematic survey effort, focussing on headwater sections of smaller streams in the upper reaches of the Macalister River catchment, and the headwater reaches of the adjacent Wonnangatta River catchment, is required to determine if additional, remnant populations remain, to accurately delineate the small distribution of this species and to search for suitable potential translocations sites within its presumed former range. A population of galaxiids, referrable to the *Galaxias olidus* complex, could not be relocated from the headwaters of Pieman Creek, Bryces Plain (Mitchell River system) (NMV A.490), approximately 14 km farther north from the type locality of *Galaxias gunaikurnai*, and hence its identity could not be determined.

***Galaxias lanceolatus*, new species**

Tapered Galaxias

Tables 4 to 9, 12, 21 to 22; Figures 7 & 16

Galaxias olidus (non *G. olidus* Günther, 1866)—Raadik *et al.,* 2001: 73.

Galaxias sp. 8—DSE, 2013: 17; Raadik & Nicol, 2013: 1.
Galaxias sp. 15—Kuiter, 2013: 74.

Conforms to the allozymically defined and morphologically diagnosed taxon 'ST' of Adams *et al.* (2014), and 'stoney' of Raadik (2011).

Material Examined.

Holotype. NMV A.30552-3, 74.5 mm LCF, (66.5 mm SL), female, Stoney Creek, at ford on Stoney No. 5 Track, west of Seaton, Victoria, 37° 54' 10"S 146° 32' 32"E, T.A. Raadik, 27 February 2002.

Paratypes. AMS I.44916-001 (2), 68.7–74.8 mm LCF (60.6–65.8 mm SL) and NMV A.30552-2 (12), 67.1–76.9 mm LCF (59.4–67.9 mm SL), collected with holotype.

Non-type material. VIC: NMV A.30552-1 (6), 43.0–68.1 mm LCF (42.1–60.5 mm SL), collected with holotype.

Additional non-type material examined (not measured): see Appendix 5.

Diagnosis. *Galaxias lanceolatus* **sp. nov.** differs from all other species within the *Galaxias olidus* complex by a combination of the following characters: trunk with dorsal and ventral profiles evenly arched from snout to dorsal fin; dorsal and anal fin lengths, and fin base lengths, about equal; snout and upper lip slightly anteriorly expanded and fleshy; dorsal midline usually broadly flattened anteriorly; dorsal profile of head distinctly flat anterior to nape; mouth cleft moderately oblique; nostrils short, not visible from ventral view; caudal peduncle flanges high and long, usually extending to near anal fin base, and also extending along outer rays onto caudal fin; caudal fin length usually just shorter than caudal peduncle length; pyloric caecae usually absent; anal fin origin usually under 0.66 distance posteriorly along dorsal fin base; and, lack of black bars along lateral line.

Description. As for the genus and members of the *Galaxias olidus* complex, except as indicated below, based on 15 specimens, 59.4–67.9 mm SL, and six additional, non-type specimens for meristics. See Tables 4 to 9 for frequencies of meristic values and Table 21 for a summary of meristic variation. Segmented dorsal fin rays 10 (10–11*), of these 8 (8–9*) branched and 2 (1–3) unbranched; segmented anal fin rays 11 (10–12*), of these 9 (8–10*) branched and 2 (1–2) unbranched; caudal fin rays 16; segmented pectoral fin rays 15 (14–16), of these 13 (12–14) branched and 2 unbranched; pelvic fin rays 7, of these 6 branched and one unbranched; gill raker total count (lower limb and upper limb) 13 (12–15; [14*]), lower arch with 9 (9–11; [10*]) and 3 (3–4*) on upper, variation on first gill arch 9+3 (6), 9+4 (3), 10+3 (4), 10+4 (4*), 11+3 (1), 11+4 (2); vertebrae 54 (53–55*); pyloric caecae usually absent.

See Table 22 for comparative value ranges of morphometric characters. Body moderately slender and elongate, dorsal midline usually broadly flattened anteriorly from above pelvic fin bases, depth through pectoral base 1.1 (1.0–1.2) depth that through vent, trunk with dorsal and ventral profiles evenly arched from snout to dorsal fin, slightly depressed on head; body tapering back to a caudal peduncle of moderate length, 7.5 (7.0–8.0) in SL, and depth, 13.0 (11.9–13.9) in SL, the peduncle depth 1.7 (1.6–1.8) in its length; accessory lateral line present. Head of moderate length, 4.7 (4.5–4.8) in SL and usually shorter (0.9) than PelAn distance, of moderate depth, 2.5 (2.4–2.8) in HL, and width (1.6 in HL), and distinctly wider than deep (depth 1.6 in HW), depressed dorsally and lateral profile wedge-shaped, dorsal profile distinctly flat anterior to nape; eyes of moderate size, 5.3 (5.0–5.5 in HL; 2.1 (1.8–2.3) in HD), situated high on head, just below dorsal head profile, interorbital flat, of moderate width, 2.6 (2.4–2.8) in HL and 2.0 (1.8–2.1) times ED; cheeks slightly expanded below eyes, eye profiles just visible laterally from ventral view; snout moderately long, 3.4 (3.2–3.6) in HL and 1.5 (1.4–1.6) times ED, lateral profile dorsally slightly bulbous and anteriorly rounded to bluntly pointed as upper lip anteriorly expanded and fleshy; post-orbital head length of moderate length (1.8 in HL); nostrils relatively short, just extending to posterior edge of upper lip or less, not visible from ventral view; mouth generally terminal, of moderate length, 2.8 (2.6–3.0) in HL, posterior extent reaching back to under anterior 0.3–0.5 of eyes, and about 0.6 (0.5–0.7) ED below ventral margin of eye, cleft moderately oblique, most anterior tip of upper lip about level with middle of eye, gape of moderate width, 2.7 (2.6–2.8) in HL, width slightly longer than length of upper jaw and 1.7 (1.6–1.8) in HW. Jaws subequal, lower about 0.9 length of upper. Gill rakers short to moderate length, stout, bluntly rounded to sharply pointed.

Size. Recorded to 84 mm LCF and 6 g; commonly to 65–70 mm LCF.

Colour in life. Body predominantly brown to grey-brown on back and upper sides above lateral line, extending onto top and sides of head and snout, becoming brown to tan on lower lateral sides of trunk to light brown or cream ventrally. Overlain by diffuse, pale brown, dark brown or almost black blotches, or elongate and narrow vertical to chevron bars, extending down sides to lower lateral surface; some individuals occasionally with one or two, small, slightly diffuse, black circles or ovoid bars on lateral midline. Faint mid-lateral band of gold flecks visible posteriorly, and dorsal midline sometimes with a thin row of gold flecks extending from nape to dorsal fin origin. Gill cover translucent with small golden patch; iris copper; fins translucent grey. See below for more detailed comments on body pattern.

TABLE 21. Summary of meristic variation in *Galaxias lanceolatus* **sp. nov.** (T—total; B—branched; L—lower limb; S—single; U—upper limb). Range in 90 % and 100 % of specimens.

Character	Mode	Mean	SD	SE	Range 90 %	Range 100 %	N
Dorsal Rays (T)	10	10.4	0.59	0.13	10–11	9–11	20
Dorsal Rays (B)	8	8.4	0.60	0.13	8–9	7–9	20
Dorsal Rays (S)	2	2.0	0.60	0.14	1–3	1–3	20
Anal Rays (T)	11	11.0	0.65	0.15	10–12	10–12	20
Anal Rays (B)	9	9.2	0.62	0.14	8–10	8–10	20
Anal Rays (S)	2	1.8	0.41	0.09	1–2	1–2	20
Caudal Rays	16	16.0	0.22	0.05	16	15–16	20
Pectoral Rays (T)	15	15.1	0.60	0.14	14–16	14–16	20
Pectoral Rays (B)	13	13.0	0.65	0.15	12–14	12–14	20
Pectoral Rays (S)	2	2.1	0.22	0.05	2	2–3	20
Pelvic Rays (T)	7	7.0	0.32	0.07	7	6–8	20
Pelvic Rays (B)	6	6.0	0.32	0.07	6	5–7	20
Pelvic Rays (S)	1	1.0	0	0	1	1	20
Gill Rakers (T)	13	13.2	0.99	0.22	12–15	12–15	20
Gill Rakers (L)	9	9.7	0.73	0.16	9–11	9–11	20
Gill Rakers (U)	3	3.5	0.51	0.11	3–4	3–4	20
Vertebrae	54	54.3	0.64	0.14	53–55	53–55	21

TABLE 22. Morphometric variation in *Galaxias lanceolatus* **sp. nov.** (values are percentages of denominators in ratios, except for LCF and SL).

	Holo-	Paratypes (N = 14)			
Character	type	Mean	Min.	Max.	S.D.
LCF (mm)	74.5	71.9	67.1	76.9	
SL (mm)	66.5	63.6	59.4	67.9	
SL / LCF	89.2	88.5	87.9	89.7	0.45
BDV / SL	11.8	12.4	11.6	13.6	0.52
BDPec / SL	13.7	14.0	12.8	15.8	0.82
BDPec / BDV	115.8	112.9	101.9	125.9	6.17
LCP / SL	13.7	13.4	12.5	14.3	0.56
DCP / SL	7.4	7.7	7.2	8.4	0.29
DCP / LCP	54.0	57.8	54.7	63.4	2.68
CFFL / SL	12.1	13.0	11.5	13.8	0.57
LCP/CFFL	113.6	103.6	90.6	116.7	6.20
PreD / SL	68.5	69.9	69.0	71.1	0.66
PreA / SL	74.5	74.9	73.0	76.3	1.00
PreD / PreA	91.9	93.4	92.2	95.4	0.87
DF–AF / LDB	72.1	65.1	51.0	83.5	8.16

...... *continued on the next page*

TABLE 22. (Continued)

Character	Holo-type	Paratypes (N = 14) Mean	Min.	Max.	S.D.
LDB / SL	9.8	10.5	8.8	11.4	0.60
LAB / SL	10.8	10.6	9.5	11.5	0.62
LDB / LAB	90.5	100.1	82.7	109.7	8.03
DL / LDB	145.3	147.8	136.7	170.5	9.28
AL / LAB	143.9	146.5	135.1	168.5	9.59
DL / SL	14.2	15.5	14.9	16.6	0.44
AL / SL	15.5	15.4	14.4	16.0	0.48
DL / AL	91.4	100.8	94.4	105.7	3.42
PecL / SL	12.5	12.6	11.6	13.5	0.54
PelL / SL	9.8	10.5	9.7	11.1	0.37
PelL / PecL	79.1	83.3	79.0	88.9	2.82
PrePel / SL	49.2	51.1	49.1	53.3	1.27
PecPel / SL	30.4	31.5	30.1	35.0	1.28
PelAn / SL	23.5	23.1	21.5	24.5	0.86
PecL / PecPel	40.9	40.1	34.1	43.1	2.59
PelL / PelAn	41.9	45.6	41.0	49.8	2.48
HL / SL	20.0	21.3	20.6	22.4	0.52
HL / PelAn	85.3	92.5	86.2	100.0	4.13
HW / HL	64.7	63.6	60.7	67.2	1.98
HD / HL	38.8	39.3	35.8	41.7	1.84
HW / HD	166.7	162.3	155.7	179.4	6.35
SnL / HL	30.0	29.1	27.4	30.7	1.00
SnL / ED	150.4	153.7	139.3	164.4	8.30
ED / HL	20.0	19.0	18.2	19.8	0.63
ED / HD	51.5	48.4	43.8	53.9	2.83
PoHL / HL	54.2	53.8	50.9	56.0	1.50
IOW / HL	39.0	38.0	36.0	40.9	1.39
ED / IOW	51.2	50.0	46.4	53.8	2.21
UJL / HL	35.1	35.7	33.1	38.4	1.47
LJL / HL	32.0	31.9	29.5	34.9	1.74
GW /HL	38.5	37.2	35.1	39.1	1.31
LJL / UJL	91.2	89.2	85.7	94.2	2.71
LJL / GW	83.2	85.8	81.3	96.5	4.31
GW / HW	59.5	58.4	55.3	62.6	1.68
SnL/UJL	85.5	81.7	73.0	90.7	4.27

FIGURE 16. A–B: *Galaxias lanceolatus* **sp. nov.** holotype, NMV A.30552-3, 74.5 mm LCF, female, Stoney Creek, Stoney No. 5 Track, west of Seaton, Victoria, A) line drawing (R. Plant), B) image of preserved specimen (T.A. Raadik); C) *G. lanceolatus* **sp. nov.** female, collected at the type locality, ~ 75 mm LCF, 1 May 2012. (T.A. Raadik); D) Stoney Creek, at type locality of *G. lanceolatus* **sp. nov.**, 1 May 2012 (T.A. Raadik). Scale bar = 5 mm.

Colour of preserved material. Base colour of head and body pale cream to creamy yellow. Dorsal surface of head (including snout) and trunk overall tan to light brown, darkest mid dorsally, fading rapidly dorso-laterally, and then gradually down the sides, extending ventrally past lateral line almost to ventral surface as sparse, fine stippling. Sides with a distinctive series of diffuse, pale brown to grey, elongate and narrow, closely to moderately space, vertical to chevron bars, centred on the lateral line and extending dorsally and ventrally, extending from above and slightly posterior to pectoral fin base posteriorly to caudal peduncle; occasionally, smaller, diffuse blotches located above lateral line, though much fainter, otherwise sides free of patterning. Nape, interorbital, snout and upper lip grey-brown, extending onto cheeks and opercles as fine brown stippling. Some brown spotting inside operculum and dark brown to very spots on base of gill filaments.

Eye black to dark grey, pupil translucent pale orange yellow. Teeth translucent yellow to pale, tips pale orange–yellow; gill rakers pale creamy yellow. Fins generally pale cream, becoming more translucent on posterior margins, caudal with slight dusky hue. Fleshy bases of dorsal, anal, pelvic and pectoral fins cream.

Etymology. From the Latin *lanceolatus*, meaning lance-like, in reference to the comparatively elongate body shape of this species with relatively evenly arched dorsal and ventral profiles, except when close to spawning. Suggested vernacular name as the 'Tapered Galaxias'.

Genetics. Allozyme and mtDNA analysis of this species can be found in Adams *et al.* (2014**;** taxon code ST). Diagnostic allozyme loci (6–14) between this taxon and the other species in the *Galaxias olidus* complex are provided in Table 12.

Distribution. See Fig. 7. Only known from the headwater reaches of Stoney Creek, a tributary of the Thomson River in west Gippsland, Victoria, at an elevational range of 340–545 m asl. Confined to a 10 km reach of stream (~ 0.75 m average width) commencing about 1.5 km (river distance) downstream from the source, which is at 690 m asl, draining a catchment area of approximately 26 km^2. Downstream distribution unknown, though not recorded a farther 8 km (river distance) downstream where the alien species Brown Trout were present, or elsewhere in adjacent catchments (e.g. Glenmaggie Creek) (Raadik & Nicol 2013).

Sympatry. Only species in the *Galaxias olidus* complex found within its restricted range. Found in the same river basin as *Galaxias gunaikurnai* **sp. nov.**, which is geographically isolated in the upper reaches of a headwater tributary of the Macalister River, approximately 70 km farther north-east.

Habitat. Recorded from a cool, small (0.5–1.5 m), shallow (0.1–0.5 m), clear and slow-flowing, partly shaded freshwater creek in a forested catchment. Substrate consisted predominantly of cobbles, with some gravel, bedrock and sand, and instream cover was provided mostly by rock, and by small amounts of undercut banks, timber debris and vegetation overhang.

General Biology. Confined to freshwater and considered not to undertake diadromous migrations. Recorded at densities of 0.01–0.9 fish/m^2 and collected with the native species Broadfinned Galaxias, Shortfinned Eel, Central Highlands Spiny Crayfish, Gippsland Spiny Crayfish and Common Freshwater Shrimp. Spawning period unknown, though possibly late winter to spring: the majority of fish collected in early May were at a mature stage of gonad development (gonads filling nearly entire body cavity) with some males running ripe (Raadik & Nicol 2013), the smallest presumed 0+ age fish recorded in early November 1998 was 23 mm LCF (9 fish in length range 23–26 mm LCF), and the smallest fish collected in late February 2002 was 43.0 mm LCF (NMV A.30552-1). One individual recorded with a short, thin, white worm (nematode?), coiled and pointed at both ends, from amongst fat deposits around the stomach in the body cavity.

Conservation status. Critically endangered (DSE 2013).

Remarks. One individual, cited as *Galaxias olidus* (s.l.), was recorded from nearby in Glenmaggie Creek in January 1988 (Hall 1989). The specimen was not retained, and assuming that its identification at the time was correct (to the *olidus* group given *Galaxias brevipinnis* is abundant further upstream), the specific identity of the presumed population in this system requires clarification. Therefore, systematic survey effort, focussing on headwater sections of smaller streams in the Thomson River catchment, is required to determine if additional, remnant populations remain and to accurately delineate the small distribution of *Galaxias lanceolatus*. Considered to have been historically more widespread, throughout the entire Stoney Creek system and within portions of the Thomson River, including the Deep Creek system, and may have ranged into the lower Macalister River system.

***Galaxias longifundus*, new species**

West Gippsland Galaxias

Tables 4 to 9, 12, 23 & 24; Figures 7 & 17

Galaxias olidus olidus (non *G. olidus* Günther, 1866)—Frankenberg, 1969: 170 (*partim*).

Galaxias olidus (non *G. olidus* Günther, 1866)—McDowall & Frankenberg, 1981: 469 (*partim*); Cadwallader & Backhouse, 1983: 69 (*partim*); Raadik *et al.* 2001: 78; McDowall, 2003a: 364 (*partim*).

Galaxias sp. 9—DSE, 2013: 17; Raadik & Nicol, 2013: 1.

Galaxias sp. 13—Kuiter, 2013: 70.

Conforms to the allozymically defined and morphologically diagnosed taxon 'RI' of Adams *et al.* (2014), and 'rintoul' of Raadik (2011).

Material Examined.

Holotype. NMV A.30575-2, 81.0 mm LCF, (71.2 mm SL), female, Rintoul Creek, east branch, at ford on C12 Track, north of Tyers, Victoria, 38° 02' 09"S 146° 28' 09"E, T.A. Raadik, 28 February 2002.

Paratypes. AMS I.44921-001 (2), 67.8–78.8 mm LCF (59.4–69.9 mm SL) and NMV A.30575-1, (8), 66.8–98.7 mm LCF (58.4–87.4 mm SL), collected with holotype.

Non-type material. VIC: NMV A.30590-1 (19), Rintoul Creek, at type locality10 December 1998; NMV A.9861 (6) and NMV A.12675 (32), Jeeralong Creek, S of Traralgon, January 1918.

Diagnosis. *Galaxias longifundus* **sp. nov.** differs from all other species within the *Galaxias olidus* complex by a combination of the following characters: long dorsal and anal fin bases (11.2–12.4 and 10.6–12.1 % SL, respectively); long dorsal and anal fins, with dorsal fin and base lengths longer than that of anal fin; eye relatively small (14.9–18.4 % HL); gape narrow (50.6–63.7 % HW); body depth through pectoral fin base only slightly greater (108.7 %) than depth through vent; nostrils moderately long, usually just visible anterio-laterally from ventral view; eyes well below dorsal head profile; most posterior extent of mouth usually 0.9 ED below ventral margin of eye; caudal peduncle flanges distinctive, long and also extend along outer rays onto caudal fin; caudal fin emarginate to almost truncate; usually 10 segmented anal fin rays and only 11 total gill rakers on first arch; gill rakers moderately long; often 1, sometimes 2, thin and pointed pyloric caecae of moderate length (2.2 % SL), very occasionally absent; anal fin origin usually under 0.58 distance posteriorly along dorsal fin base; and, lack of black bars along lateral line.

Description. As for the genus and members of the *Galaxias olidus* complex, except as indicated below, based on 11 specimens, 58.4–87.4 mm SL, and 6 additional, non-type specimens for meristics. See Tables 4 to 9 for frequencies of meristic values and Table 23 for a summary of meristic variation. Segmented dorsal fin rays 9 (9–11), of these 8 (7–8) branched and 2 (1–2) unbranched; segmented anal fin rays 10 (10–11*), of these 8 (8–9) branched and 2 (2–3*) unbranched; caudal fin rays 16 [14*]; segmented pectoral fin rays 14 (13–15), of these 12 (11–13) branched and 2 unbranched; pelvic fin rays 7, of these 6 branched and one unbranched; gill raker total count (lower limb and upper limb) 11 (11–12), lower arch with 9 (9–10) and 3 (3–4) on upper, variation on first gill arch 8+3 (8*), 9+2 (1), 9+3 (6), 9+4 (2); vertebrae 54 (52–54); two, more often one*, pyloric caecae on stomach, occasionally absent.

See Table 24 for comparative value ranges of morphometric characters. Body moderately deep and long, dorsal midline usually flattened anteriorly from above or slightly posterior to pectoral fin bases, depth through pectoral base 1.1 (1.0–1.2) that through vent, trunk with dorsal profile arched from snout to dorsal fin (ventral profile less so), upper surface of head straight to slightly arched, body tapering back to a relatively narrow (12.3 (11.4–13.5) in SL) caudal peduncle of moderate length, 7.5 (6.8–7.9) in SL), the peduncle depth 1.6 (1.5–1.9) in its length; accessory lateral line present. Head of moderate length, 4.6 (4.4–4.7) in SL, and usually slightly shorter (1.1 (0.9–1.2) than PelAn distance, of moderate depth and width (2.3–2.6 and 1.5–1.7 in HL respectively), distinctly wider than deep (depth 1.4–1.6 in HW), lateral profile wedge-shaped; eyes of moderate size, 5.9 (5.4–6.7) in HL, situated reasonably high on head though well below dorsal head profile, interorbital flat to slightly convex, moderately broad, 2.6 (2.4–2.9) in HL and 2.2 (1.9–2.8) times ED; cheeks expanded slightly below eyes, eye profiles visible laterally from ventral view in small to medium-sized individuals, obscured in larger, older specimens; snout moderately long, about 3.4 in HL and 1.8 (1.6–2.0) times ED, lateral profile bluntly rounded; post-orbital head length of moderate length, 1.8 (1.7–1.9) in HL; nostrils relatively long and just visible anterio-laterally from ventral view; mouth terminal, of moderate length, 2.7 (2.5–2.9) in HL, posterior extent reaching back to below anterior 0.1–0.5 of eyes and 0.9 (0.7–0.9) ED below ventral margin of eye, most anterior tip of upper lip level with about middle of eye, gape moderately narrow, 2.9 (2.4–3.2) in HL, width usually 0.9 of length of upper jaw and 1.8 (1.6–2.0) in HW. Jaws subequal, lower usually a little shorter (1.1 (1.0–1.2) in UJL). Pyloric caecae of moderate length, longest usually 2.2 % SL (0.8–4.8 %), thin and pointed to rounded; gill rakers moderately long, stout and pointed.

TABLE 23. Summary of meristic variation in *Galaxias longifundus* **sp. nov.** (T—total; B—branched; L—lower limb; S—single; U—upper limb). Range in 90 % and 100 % of specimens.

Character	Mode	Mean	SD	SE	Range 90 %	Range 100 %	N
Dorsal Rays (T)	9	9.7	0.77	0.19	9–11	9–11	17
Dorsal Rays (B)	8	7.8	0.66	0.16	7–8	7–9	17
Dorsal Rays (S)	2	1.9	0.43	0.10	1–2	1–3	17
Anal Rays (T)	10	10.4	0.62	0.15	10–11	9–11	17
Anal Rays (B)	8	8.3	0.59	0.14	8–9	7–9	17
Anal Rays (S)	2	2.1	0.49	0.12	2–3	1–3	17
Caudal Rays	16	15.9	0.49	0.12	16	14–16	17
Pectoral Rays (T)	14	13.9	0.78	0.19	13–15	12–15	17
Pectoral Rays (B)	12	11.9	0.78	0.19	11–13	10–13	17
Pectoral Rays (S)	2	2.0	0.00	0.00	2	2	17
Pelvic Rays (T)	7	7.1	0.24	0.06	7	67–8	17
Pelvic Rays (B)	6	6.1	0.24	0.06	6	6–7	17
Pelvic Rays (S)	1	1.0	0.00	0.00	1	1	17
Gill Rakers (T)	11	11.6	0.71	0.17	11–12	11–13	17
Gill Rakers (L)	9	8.5	0.51	0.12	9–10	9–10	17
Gill Rakers (U)	3	3.1	0.43	0.10	3–4	2–4	17
Vertebrae	54	53.2	0.81	0.20	52–54	52–54	17

TABLE 24. Morphometric variation in *Galaxias longifundus* **sp. nov.** (values are percentages of denominators in ratios, except for LCF and SL).

Character	Holo-type	Paratypes (N = 10) Mean	Min.	Max.	S.D.
LCF (mm)	81.0	77.0	66.8	98.7	
SL (mm)	71.2	67.9	58.4	87.4	
SL / LCF	87.9	88.0	86.8	89.3	0.77
BDV / SL	12.7	12.9	11.9	13.9	0.72
BDPec / SL	14.0	14.1	12.9	16.0	1.05
BDPec / BDV	110.3	108.7	103.3	117.5	4.18
LCP / SL	13.5	13.4	12.6	14.6	0.65
DCP / SL	8.1	8.1	7.4	8.7	0.45
DCP / LCP	60.3	60.8	51.2	66.5	5.03
CFFL / SL	13.8	13.6	11.9	15.2	0.99
LCP/CFFL	98.0	98.8	87.7	114.7	8.55

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TABLE 24. (Continued)

Character	Holo-type	Paratypes (N = 10) Mean	Min.	Max.	S.D.
PreD / SL	70.0	70.4	69.3	71.5	0.58
PreA / SL	72.9	74.8	73.5	76.4	0.79
PreD / PreA	96.0	94.2	92.8	95.6	0.87
DF–AF / LDB	59.2	58.2	45.3	73.0	8.03
LDB / SL	11.2	11.8	11.3	12.4	0.33
LAB / SL	12.1	11.5	10.6	12.0	0.41
LDB / LAB	92.0	102.8	94.9	114.6	5.08
DL / LDB	152.6	139.6	131.5	148.0	6.11
AL / LAB	129.0	139.6	129.2	147.7	6.34
DL / SL	17.0	16.4	15.1	17.2	0.71
AL / SL	15.6	16.0	14.3	17.2	1.00
DL / AL	108.9	102.8	95.6	110.4	4.80
PecL / SL	13.5	13.0	10.7	14.3	1.12
PelL / SL	11.2	11.6	9.7	12.3	0.87
PelL / PecL	82.9	89.4	85.0	93.7	3.03
PrePel / SL	50.6	51.2	49.9	53.0	0.88
PecPel / SL	30.4	31.2	30.1	33.6	1.19
PelAn / SL	22.2	23.5	20.0	26.1	1.60
PecL / PecPel	44.3	41.8	31.9	45.4	4.21
PelL / PelAn	50.4	49.7	37.1	61.7	6.36
HL / SL	21.3	21.9	21.1	22.9	0.48
HL / PelAn	95.9	93.7	81.0	114.5	8.55
HW / HL	63.6	61.0	58.4	68.4	2.90
HD / HL	40.8	40.7	38.1	43.3	1.39
HW / HD	156.1	149.9	142.1	157.9	5.06
SnL / HL	27.6	29.6	28.5	30.5	0.58
SnL / ED	177.9	176.8	161.9	198.2	12.60
ED / HL	15.5	16.8	14.9	18.4	1.09
ED / HD	38.1	41.4	34.4	45.7	3.50
PoHL / HL	58.1	55.9	52.6	58.9	2.43
IOW / HL	40.0	38.2	34.5	42.1	2.51
ED / IOW	38.8	44.3	35.9	53.3	4.99
UJL / HL	36.7	36.7	34.4	39.3	1.66
LJL / HL	32.0	33.3	31.9	35.7	1.27
GW /HL	35.6	34.5	30.7	41.3	3.31
LJL / UJL	87.2	90.9	83.7	95.9	3.78
LJL / GW	90.0	97.3	82.0	109.9	9.76
GW / HW	56.0	56.6	50.6	63.7	4.19
SnL/UJL	75.2	80.8	75.8	85.6	3.31

FIGURE 17. A–B: *Galaxias longifundus* **sp. nov.** holotype, NMV A.30575-2, 81.0 mm LCF, Rintoul Creek, C12 Track, north of Tyers, Victoria, A) line drawing (R. Plant), B) image of preserved specimen (note: tail curved slightly to the left in horizontal plane) (T.A. Raadik); C) *G. longifundus* **sp. nov.**, female, 65 mm LCF, collected at the type locality, 30 April 2012 (T.A. Raadik); D) Rintoul Creek, at type locality of *G. longifundus* **sp. nov.**, 30 April 2012 (T.A. Raadik). Scale bar = 5 mm.

Fins fleshy at bases, paired fins less so, with thickening extending distally over 0.3–0.5 of fin area, extending farther between fin rays, dorsal and anal fin bases relatively long and usually equal in length or dorsal slightly longer, fins rounded and relatively long, dorsal a little longer than anal, middle rays longest; anal fin origin usually under 0.58 (0.45–0.73) distance posteriorly along dorsal fin base. Pelvic fins of moderate length, 8.6 (8.1–10.3) in SL, 0.9 of pectoral fin length, inserted at about mid-point of standard length and extending 0.5 distance to anal fin base; pectoral fin of moderate length and paddle-shaped, 7.7 (7.0–9.3) in SL, extending 0.4 distance to pelvic fin base, low on body with dorsal end of fin base level with posterior extent of mouth, lamina of paired fins oriented anterio-ventrally, raised lamellae usually present and strongly developed on ventral surface of rays. Caudal fin of moderate length, 7.3 (6.6–8.4) in SL, emarginate to almost truncate, similar in length to caudal peduncle, upper rays sometimes longer than lower, vertical width of expanded rays equal to or slightly greater than body depth through pectoral fin base, flanges distinctive, moderately low but strongly developed along caudal peduncle, long, reaching anteriorly past distal margin of adpressed anal fin, usually more than 0.6 distance to anal fin base, profile of ventral flange usually straight (sometimes slightly curved) across peduncle/caudal fin boundary, that of dorsal flange usually with a slight inflection, flanges extend posteriorly on caudal fin to near outer rays.

Size. Recorded to 97 mm LCF and 11 g; commonly to 65–80 mm LCF.

Colour in life. Body predominantly olive-brown on back and upper sides above lateral line, extending onto top and sides of head and snout, becoming light brown on lower lateral sides of trunk to cream ventrally. Overlain by small to moderate sized, relatively diffuse, dark brown to black, spots and blotches, some coalescing to form irregularly shaped bars; wide and usually faint mid-lateral band of gold flecks becoming iridescent posteriorly, and dorsal midline with thin row of gold or copper flecks extending from nape to dorsal fin origin. Some individuals occasionally with a few, small, slightly diffuse, black circles or ovoid bars on lateral. Gill cover translucent with small golden patch; iris golden; fins translucent olive-grey. See below for more detailed comments on body pattern.

Colour of preserved material. Base colour of head and body light brown to creamy tan. Small, round to elongate, pale and slightly diffuse brown spots to blotches on dorsal surface of trunk, extending down sides and slightly ventrally past lateral line; absent from ventro-lateral and ventral surface; greatest density on dorsal surface. A band consisting of a series of irregular shaped, small to large, dark grey blotches, sometimes 2–3 deep, along middle of sides, extending from just posterior to gill cover and onto caudal peduncle; blotches occasionally tending to very small, thin, elongate, vertical bars, some becoming quite dark brown, contrasting in tone to others. Distinctive dark grey, narrow, vertical lateral band located at posterior end of caudal peduncle, at the base of the caudal rays. Top and sides of head slightly grey-brown with fine black to brown-grey stippling. Some black fine spotting inside operculum and on base of gill filaments.

Eye black to grey, pupil translucent pale orange-yellow. Teeth translucent yellow to pale orange-yellow, tips orange to orange-red; gill rakers creamy to pale yellow. Fins generally pale creamy yellow to pale tan, becoming more translucent on posterior margins, fleshy bases of dorsal, anal, pelvic and pectoral fins cream to tan, usually with light grey, fine stippling. Base of caudal fin with a diffuse, pale grey, vertical blotch or bar.

Etymology. From the Latin *longus*, meaning long and *fundus*, meaning base, bottom, in reference to the relatively long dorsal and anal fin bases in this species compared with other members of the *Galaxias olidus* complex. Suggested vernacular name as the 'West Gippsland Galaxias'.

Genetics. Allozyme and mtDNA analysis of this species can be found in Adams *et al.* (2014**;** taxon code RI). Diagnostic allozyme loci (6–17) between this taxon and the other species in the *Galaxias olidus* complex are provided in Table 12.

Distribution. See Fig. 7. Currently only known from the headwaters of Rintoul Creek east branch, a tributary of the La Trobe River in Victoria, at an elevational range of 195–275 m asl. Known from a 4 km reach of stream (~0.75 m average width), commencing approximately 1.4 km (river distance) from the source, which is at 420 m asl, draining a catchment area of approximately 18 km^2. Downstream distribution unknown, though not recorded 2 km (river distance) farther downstream (March 2010), 18 km downstream in the main stem of Rintoul Creek (W4 Track) where the alien species Brown Trout was present (1998, 2002, 2006, 2010), or elsewhere in adjacent catchments (e.g. Tyers River, Eaglehawk Creek, Fells Creek). Comparison with museum specimens suggests that this species was historically more widely distributed in the lower La Trobe River catchment, being recorded from Jeeralang [sic] (= Jeeralong) Creek catchment in 1918, and possibly extending further upstream in the La Trobe River from Traralgon, before trout reduced their range.

Sympatry. Only species of the *Galaxias olidus* complex found within its restricted range, and in the La Trobe

River system, though *Galaxias gunaikurnai* **sp. nov.** and *Galaxias lanceolatus* **sp. nov.** are known from the Macalister River system, which drains into the Thompson River system, a tributary of the La Trobe River. Also recorded with *Galaxias brevipinnis*.

Habitat. Recorded from a moderately shaded, gently flowing, small and shallow (2.0 m average width and 0.5 m average depth) creek, consisting predominantly of pools with smaller areas of shallow riffle (0.05 m average depth). Substrate consisted of boulder, cobble and pebble, with small amounts of gravel, sand and clay. Instream cover was provided predominantly by rock with smaller amounts of logs, branches and bank/vegetation overhang, and pools averaged 0.9 m (0.6–1.1 m) in depth.

General Biology. Confined to freshwater and considered not to undertake diadromous migrations. Recorded at a density of 0.27 fish/m^2 in 2002, and 0.004–0.01 fish/m^2 in 2012 (Raadik & Nicol 2013). Collected with the native species Shortfinned Eel, Broadfinned Galaxias, Gippsland Spiny Crayfish, a species of burrowing crayfish (*Engaeus* sp.) and Common Freshwater Shrimp. Spawning period unknown, though probably during spring: about 50 % of fish collected in early December (1998) were between 28–38 mm LCF and considered of 0+ age, suggesting a late November hatching and possibly October spawning. Found to be infected by metacercarial cysts embedded in the skin or fins, and one individual recorded with a short, thin, white worm, coiled and pointed at both ends, from amongst fat deposits around stomach in the body cavity.

Conservation status. Critically endangered (DSE 2013). Of concern is the dramatic decline in fish density to < 0.01 fish/m^2 recorded in 2012, which is 1.7% of the densities recorded in 2002 (Raadik & Nicol 2013). Whilst trout have historically reduced the abundance of this species, it appears that instream sedimentation following fire in the upper Rintoul Creek catchment may currently be responsible for this recent further decline in abundance (Raadik & Nicol 2013). This demonstrates the high risk of extinction from stochastic events once a species has been reduced to a single, small population.

Remarks. One gravid female was collected from Jerralong Creek outside of the probable spawning period for this species (see above) in January 1918 (NMV A.12675), though this date is highly likely to be the date of accession into the museum collection rather than a collecting date. Additional efforts should be made to locate fish from Jeeralang Creek, or nearby in the rivers draining to the north from the Strezelecki Ranges, in order to confirm their identity as *Galaxias longifundus*.

A school of galaxiids was observed swimming near cover in a pool in the headwaters of the Tanjil River (east branch), behind the Mt. Baw Baw Ski Club in the Mount Baw Baw Alpine Village in February 1974 (T.A. Raadik, personal observation). Given the elevation of this location these fish are considered to belong to the *Galaxias olidus* complex and represent only the third recorded locality for this complex in the La Trobe River catchment. Unfortunately no specimens were retained, and additional sampling in 2002 and 2011 at the site, farther downstream, below the village, at 'The Morass' and elsewhere on the plateau, failed to relocate them, or to record any species of fish (Raadik 2011, Raadik & Nicol 2013). Consequently the identity of this member of the *Galaxias olidus* complex remains unresolved and additional sampling on the Baw Baw Plateau, and elsewhere in headwater reaches of the La Trobe River catchment, is urgently required.

***Galaxias mcdowalli*, new species**

McDowall's Galaxias

Tables 4 to 9, 12, 25 & 26; Figures 7, 18 & 19

Galaxias olidus (non *G. olidus* Günther, 1866)—Cadwallader & Backhouse, 1983: 69 (*partim*); Koehn *et al.*, 1991: 19; Raadik, 1992a: 51; Raadik, 1992b: fig. 16 (*partim*); Raadik, 1995b: 51, fig A4.7 (*partim*).
Galaxias sp. 5—DSE, 2013: 17.
Galaxias sp. 12—Kuiter, 2013: 69.

Conforms to the allozymically defined and morphologically diagnosed taxon 'RO' of Adams *et al.* (2014), and 'rodger' of Raadik (2011).

Material Examined.

Holotype. NMV A.30572-2, 74.2 mm LCF, (65.6 mm SL), male, Rodger River, at bridge on Waratah Flat Road, Waratah Flat, Snowy River National Park, Victoria, 37° 17' 01"S 148° 34' 12"E, T.A. Raadik, 27 February 2002.

Paratypes. AMS I.44918-001 (2), 70.2–84.0 mm LCF (62.1–74.1 mm SL), NMNZ P.045749 (2), 73.6–75.1 mm LCF (65.7-66.1 mm SL) and NMV A.30572-1 (10), 69.0–78.2 mm LCF (61.2–69.4 mm SL), collected with holotype; NMV A.30574-1 (8), 60.0–82.5 mm LCF (53.1–73.3 mm SL) Rodger River, type locality, TAR, 4 March 1993.

Non-type material. VIC: NMV A. 30572-3 (2), collected with holotype; NMV A.30574-2 (3), Rodger R, collected with NMV A.30574-1.

Diagnosis. *Galaxias mcdowalli* **sp. nov.** differs from all other species within the *Galaxias olidus* complex by a combination of the following characters: 8 segmented pelvic fin rays; high vertebral count of 55; head length about as long as PelAn distance; dorsal and anal fin bases relatively long (9.9–13.0 and 11.0–12.5 % SL); snout long (27.0–33.7 % HL) and post-orbital head length short (48.9–55.2 % HL); inter-orbital relatively wide (38.6–44.8 % HL); nostrils of moderate length, not visible from ventral view; pelvic fins moderately short (8.9–10.8 % SL); caudal peduncle relatively shallow (7.2–8.1 % SL), longer than length of caudal fin and flanges moderately developed and longish, reaching to or anteriorly past distal end of adpressed anal fin rays; dorsal midline usually quite broadly flat anteriorly from above pelvic fin bases; raised laminae on ventral surface of paired fins sometimes evident though not strongly developed; gill rakers short and stout; pyloric caecae absent; anal fin origin usually under 0.53 distance posteriorly along dorsal fin base; and, lack of distinct black bars along lateral line.

Description. As for the genus and members of the *Galaxias olidus* complex, except as indicated below, based on 23 specimens, 61.2–74.1 mm SL, and 5 additional, non-type, specimens for meristics. See Tables 4 to 9 for frequencies of meristic values and Table 25 for a summary of meristic variation. Segmented dorsal fin rays 10 (9–12), of these 8 or 9* (6–10) branched and 2 (1*–3) unbranched; segmented anal fin rays 11* or 12, of these 9* or 10 branched and 2 (1–2) unbranched; caudal fin rays 16; segmented pectoral fin rays 14 (14–16), of these 12 (11–14) branched and 2 (2–3) unbranched; pelvic fin rays 8, of these 7 (6–7) branched and one unbranched; gill raker total count (lower limb and upper limb) 12 (11–13*), lower arch with 9 (9–10*) and 3 (2–4) on upper, variation on first gill arch 8+2 (1), 9+2 (2), 9+3 (13), 10+3 (10*), 10+4 (1); vertebrae 55 (54–56); no pyloric caecae on stomach.

See Table 26 for comparative value ranges of morphometric characters. Body moderately deep and long, dorsal midline usually quite broadly flat anteriorly from above pelvic fin bases, body depth through pectoral base 1.25 (1.0–1.3) that through vent, trunk with dorsal and ventral profiles evenly arched from snout to dorsal fin, dorsal arched slightly more than ventral, laterally compressed posteriorly from about above pelvic fin bases; body tapering back to a caudal peduncle of moderate length, 7.5 (6.8–9.0) in SL and depth, 13.1 (12.3–13.9) in SL, the peduncle depth 1.7 (1.5–1.8) in its length; accessory lateral line present. Head of moderate length, 4.5 (4.1–4.7) in SL and similar to PelAn distance (0.9–1.1), moderately deep, 2.4 (2.2–2.8) in HL, and wide, 1.6 (1.5–1.7) in HL, distinctly wider than deep (depth 1.5–1.7 in HW), lateral profile weakly wedge-shaped and slightly depressed and flattened dorsally; eyes moderate, 5.3 (4.8–5.8) in HL, situated high on head, just below dorsal head profile, interorbital usually flat but occasionally convex, broad, 2.4 (2.2–2.6) in HL and 2.2 (1.9–2.6) times ED; cheeks expanded slightly below eyes, eye profiles just visible laterally from ventral view; snout long, 3.2 (3.0–3.7) in HL and 1.6 (1.4–1.9) times ED, lateral profile rounded to slightly pointed; post-orbital head length short, 1.9 (1.8–2.0) in HL; nostrils of moderate length, just extending to posterior edge of upper lip, not visible from ventral view; mouth subterminal, of moderate length, 2.7 (2.4–3.1) in HL, posterior extent reaching back to under anterior 0.3 of eyes, and 0.7 (0.56–0.74) ED below ventral margin of eye, most anterior tip of upper lip usually level with about middle of eye, gape moderately wide, 2.5 (2.3–2.7) in HL, width 1.1 times length of upper jaw and 1.6 (1.4–1.8) in HW. Jaws subequal, lower usually 1.1 in upper, upper jaw relatively thick and fleshy. Gill rakers short, stout and bluntly pointed.

Fins moderately fleshy at bases, median fins more so, with thickening extending distally over 0.3–0.5 of fin area, extending farther distally between fin rays; dorsal and anal fin bases long and about equal in length, though dorsal base sometimes very slightly shorter, fins moderately long and rounded, usually of equal length (0.9–1.1), middle rays longest; anal fin origin usually under 0.52 (0.35–0.65) distance posteriorly along dorsal fin base. Pelvic fins relatively short, 10.2 (9.2–11.2) in SL, 1.2 in pectoral fin length, inserted at about mid-point of standard length and extending to just under 0.5 distance to anal fin base; pectoral fin moderately short and paddle-shaped, 8.5 (7.9–9.2) in SL, extending about 0.4 distance to pelvic fin base, low on body with dorsal end of fin base at, or just above, level of posterior extent of mouth, lamina of paired fins oriented anterio-ventrally to ventrally, raised lamellae on ventral surface of rays sometimes present though not strongly developed. Caudal fin of moderate length, 7.7 (7.3–8.5) in SL, emarginate, about as long as caudal peduncle, vertical width of expanded rays greater than maximum body depth, flanges moderately well-developed along caudal peduncle, reaching anteriorly past distal end of adpressed anal fin rays.

TABLE 25. Summary of meristic variation in *Galaxias mcdowalli* **sp. nov.** (T—total; B—branched; L—lower limb; S—single; U—upper limb). Range in 90 % and 100 % of specimens.

Character	Mode	Mean	SD	SE	Range 90 %	Range 100 %	N
Dorsal Rays (T)	10	10.2	0.76	0.15	10–11	8–12	26
Dorsal Rays (B)	8	8.3	0.93	0.18	7–9	6–10	26
Dorsal Rays (S)	2	1.9	0.48	0.09	1–3	1–3	26
Anal Rays (T)	11–12	11.5	0.51	0.10	11–12	11–12	26
Anal Rays (B)	10	9.6	0.50	0.10	9–10	9–10	26
Anal Rays (S)	2	1.9	0.33	0.06	1–2	1–2	26
Caudal Rays	16	16.0	0.20	0.04	16	16–17	26
Pectoral Rays (T)	14	14.6	0.70	0.14	14–16	14–16	26
Pectoral Rays (B)	12	12.5	0.76	0.15	11–14	11–14	26
Pectoral Rays (S)	2	2.1	0.33	0.06	2–3	2–3	26
Pelvic Rays (T)	8	8.0	0.20	0.04	8	7–8	26
Pelvic Rays (B)	7	6.9	0.27	0.05	7	6–7	26
Pelvic Rays (S)	1	1.0	0.20	0.04	1	1–2	26
Gill Rakers (T)	12	12.4	0.70	0.14	12–13	11–14	26
Gill Rakers (L)	9	9.4	0.57	0.11	9–10	8–10	26
Gill Rakers (U)	3	3.0	0.28	0.06	3	2–4	26
Vertebrae	55	54.9	0.65	0.12	54–56	54–56	28

TABLE 26. Morphometric variation in *Galaxias mcdowalli* **sp. nov.** (values are percentages of denominators in ratios, except for LCF and SL).

Character	Holo-type	Paratypes (N =22) Mean	Min.	Max.	S.D.
LCF (mm)	74.2	73.5	60.0	84.0	
SL (mm)	65.6	65.2	53.1	74.1	
SL / LCF	88.4	88.6	87.9	89.5	0.44
BDV / SL	12.2	12.7	11.2	14.3	0.87
BDPec / SL	15.2	14.3	13.1	16.3	0.79
BDPec / BDV	124.9	112.8	101.3	127.0	6.98
LCP / SL	13.9	13.3	11.1	14.6	0.86
DCP / SL	8.0	7.6	7.2	8.1	0.24
DCP / LCP	57.6	57.3	50.4	69.8	4.35
CFFL / SL	13.1	12.9	11.8	13.7	0.55
LCP/CFFL	105.9	103.6	83.2	117.0	7.31
PreD / SL	70.9	70.0	67.4	72.1	1.19
PreA / SL	75.3	74.0	72.4	75.5	0.86
PreD / PreA	94.2	94.6	91.2	97.1	1.58
DF–AF / LDB	56.6	52.3	34.9	64.6	8.48
LDB / SL	11.2	11.5	9.9	13.0	0.76
LAB / SL	11.5	11.7	11.0	12.5	0.42
LDB / LAB	96.8	97.8	86.7	106.8	4.84
DL / LDB	140.0	134.5	115.6	154.9	9.48

...... *continued on the next page*

TABLE 26. (Continued)

Character	Holo-type	Paratypes (N =22) Mean	Min.	Max.	S.D.
AL / LAB	133.7	133.5	121.0	144.1	6.46
DL / SL	15.6	15.4	13.9	16.4	0.63
AL / SL	15.4	15.6	14.5	16.9	0.70
DL / AL	101.4	98.4	87.4	108.7	4.63
PecL / SL	12.4	11.8	10.9	12.7	0.58
PelL / SL	9.8	9.8	8.9	10.8	0.42
PelL / PecL	79.0	83.4	75.7	90.7	4.20
PrePel / SL	52.7	51.4	49.7	53.2	0.80
PecPel / SL	30.7	30.9	28.6	33.7	1.26
PelAn / SL	21.8	22.2	20.3	23.9	1.07
PecL / PecPel	40.3	38.2	34.4	40.9	1.94
PelL / PelAn	44.9	44.3	39.5	51.3	3.21
HL / SL	24.4	22.4	21.4	23.4	0.50
HL / PelAn	112.0	101.1	92.4	113.7	6.04
HW / HL	63.0	63.9	59.8	68.1	2.39
HD / HL	41.9	41.3	36.0	45.7	2.59
HW / HD	150.2	154.9	142.9	168.7	6.53
SnL / HL	30.0	30.8	27.0	33.7	1.70
SnL / ED	165.5	162.7	141.8	186.0	10.89
ED / HL	18.1	19.0	17.2	20.7	0.92
ED / HD	43.2	46.0	42.6	51.1	2.88
PoHL / HL	52.5	51.6	48.9	55.2	1.62
IOW / HL	39.4	41.2	38.6	44.8	1.49
ED / IOW	46.0	46.1	39.1	51.4	2.69
UJL / HL	35.9	36.7	32.7	40.9	1.78
LJL / HL	31.2	32.4	28.7	36.0	1.61
GW /HL	39.8	40.6	36.4	43.5	2.27
LJL / UJL	86.9	88.5	77.0	92.7	3.53
LJL / GW	78.3	80.1	71.1	96.5	6.54
GW / HW	63.2	63.6	56.4	70.8	3.82
SnL/UJL	83.6	84.1	74.6	92.6	4.45

Size. Recorded to 84 mm LCF and 6 g; commonly to 65–75 mm LCF.

Colour in life. Body predominantly olive-brown on back and upper sides above lateral line, extending onto top and sides of head and snout, and lateral sides of trunk posterior to anal fin, becoming light brown to cream ventrally, belly almost white. Overlain by small to moderate sized dark brown to black, irregular shaped blotches or flecks, some coalescing to form irregularly shaped vertical bands; wide mid-lateral band of gold flecks present, becoming iridescent posteriorly, and dorsal midline with thin row of gold flecks extending from nape to dorsal fin origin. Gill cover translucent with large golden patch; iris golden, fins translucent grey to light brown or olive-grey. See below for more detailed comments on body pattern.

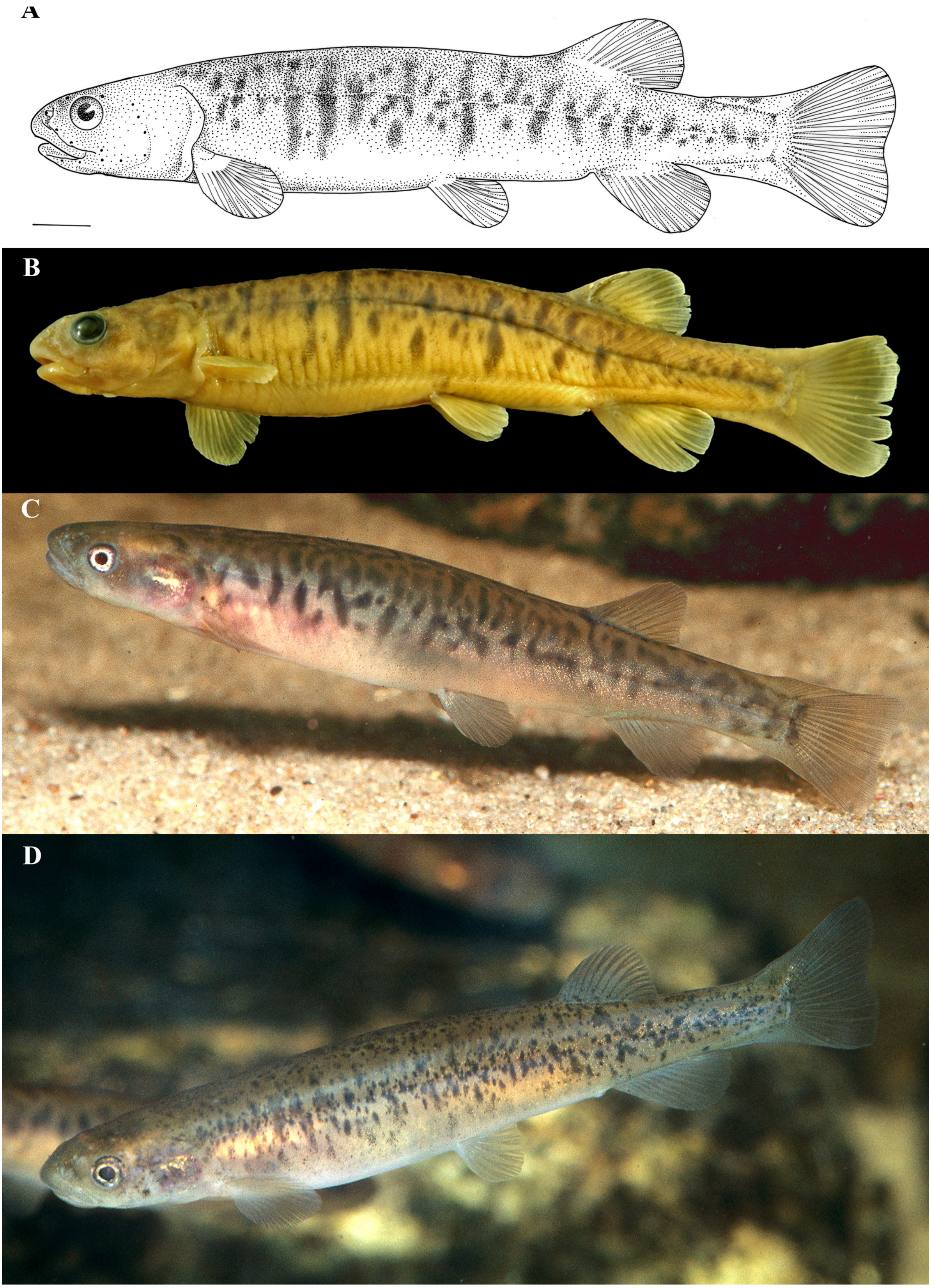

FIGURE 18. A–B: *Galaxias mcdowalli* **sp. nov.** holotype, NMV A.30572-2, 74.2 mm LCF, Rodger River, Waratah Flat Road, Waratah Flat, Snowy River National Park, Victoria, A) line drawing (R. Plant), B) image of preserved specimen (T.A. Raadik); C–D *G. mcdowalli* **sp. nov.** collected at the type locality with the holotype, 27 February 2002, C) ~ 80 mm LCF. (R. Kuiter), D) showing different pattern, collected at the type locality with the holotype, 27 February 2002; ~ 85 mm LCF (R. Kuiter). Scale bar = 5 mm.

FIGURE 19. Rodger River, at the type locality of *G. mcdowalli* **sp. nov.**, 27 February 2002 (T.A. Raadik).

Colour of preserved material. Base colour of head and body pale creamy tan, darker brownish dorsally, generally above lateral line. Dorsal surface of trunk with irregular shaped medium-size, diffuse, dark brown spots or flecks and small to medium sized diffuse to distinct blotches, particularly abundant on sides, extending well below lateral line and onto ventro-lateral surface, some almost reaching pelvic fin base; very fine, sparse, brown stippling extending onto ventral surface. A few blotches coalesce to form diffuse vertical bars near, or centred on, the lateral line, and some spots or blotches become much darker brown to almost black in the area of the lateral line. Dorsal and lateral surfaces of head brown, darker dorsally, behind eye and on upper opercle, extending onto ventral surface as fine, sparse, brown stippling. Fine black spotting inside operculum and at base of, and along, gill filaments. Trunk with very fine, light coloured lines following myomeres, etched across body pattern.

Eye grey-black, pupil translucent pale brownish yellow. Teeth translucent yellow to pale orange–yellow, tips orange to orange–red; gill rakers pale cream. Fins creamy white, becoming more translucent on posterior margins, finer body stippling extending onto fleshy bases of dorsal, anal and pectoral fins. Fin rays translucent, external edges of rays highlighted with very fine black lines or row of fine spots.

Etymology. Named for the late Dr Robert (Bob) Montgomery McDowall (1939–2011), for his long and valuable contribution to galaxioid systematics. Suggested vernacular name as 'McDowall's Galaxias'.

Genetics. Allozyme and mtDNA analysis of this species can be found in Adams *et al.* (2014**;** taxon code RO). Diagnostic allozyme loci (7–17) between this taxon and the other species in the *Galaxias. olidus* complex are provided in Table 12.

Distribution. See Fig. 7. Currently known from the type locality in the headwaters of the Rodger River, a tributary of the Snowy River in the coastal East Gippsland region of Victoria, at an elevation of 680 m asl. The location is approximately 10 km (river distance) from the source, which is at 1140 m asl, in a catchment of approximately 30 km^2. Not recorded from elsewhere in the catchment and alien Brown Trout are present throughout the lower and mid reaches of the Rodger River, extending upstream at least to the Deddick Track which is approximately 15 km (river distance) downstream of the type locality. Presumably an instream barrier is present between the type locality and the Deddick Track, which has prevented the colonisation of trout farther upstream.

Sympatry. Only species of *Galaxias* found within its restricted range. *Galaxias brevipinnis*, *Galaxias maculatus* and *Galaxias truttaceus* are found farther downstream and their ranges may have historically overlapped with that of *Galaxias mcdowalli* before trout disrupted and reduced distributional ranges. An unidentified species of *Galaxias* has been recorded from the lower to mid Rodger River system, in the Yalmy River and Serpentine Creeks, though its identity has not been established (see Remarks).

Habitat. Recorded from a cool, clear flowing, heavily shaded and shallow (0.5 m) freshwater river, 3–5 m wide, with a substrate of sand, silt and clay, and areas of cobble and pebble. Instream cover was provided by logs, branches and bank and vegetation overhang, and pools ranged from 1–2 m in depth.

General Biology. Confined to freshwater and considered not to undertake diadromous migrations. Recorded at densities of 0.15–0.18 fish/m^2 and collected with the native species Shortfinned Eel and East Gippsland Spiny Crayfish. Spawning period unknown, though possibly late spring to summer: fish collected in late February/early March were at an early stage of gonad development, though a male (74.2 mm LCF) appeared to be almost ripe (NMV A.30572-2), and the smallest presumed 0+ age fish recorded (33.9 mm LCF) was collected in early March (NMV A.30574-1). One individual recorded with a short, thin, white worm, coiled and pointed at both ends, from amongst fat deposits around the stomach in the body cavity.

Conservation status. Critically endangered (DSE 2013).

Remarks. Considered to have been historically more widespread before trout reduced their range, possibly extending into the Snowy and lower Buchan River systems, and into adjacent catchments (e.g. Mountain and New Country creeks). A few *Galaxias* individuals, belonging to the *Galaxias olidus* complex, and superficially similar to *Galaxias mcdowalli*, have been recorded at lower elevation farther downstream in the Yalmy River and Serpentine Creek (NMV A.30569-2) in the Rodger River system, and at higher elevations to the north-west in the Suggan Buggan River (NMV A.12415 and A.30615-1) and headwaters of the Buchan River (AMS I.17994-001 and I.19262-001; NMV A.9920) which includes Native Dog Creek (NMV A.10419). The identities of these populations have not been determined due to a lack of suitably preserved fresh material, the rarity of individuals (Serpentine Creek, Suggan Buggan and Yalmy rivers), and the apparently recent possible extinction of the population in the Buchan River headwaters following upstream invasion and colonisation of Brown Trout (Raadik unpubl. Data). Extensive sampling in these areas for this study failed to locate any individuals and therefore additional, targeted sampling is strongly recommended to locate fresh material for taxonomic study.

***Galaxias mungadhan*, new species**
Dargo Galaxias
(Tables 4 to 9, 12, 27 & 28; Figures 7 & 20)

Galaxias olidus olidus Günther, 1866—Frankenberg, 1969: 170 (*partim*).
Galaxias olidus (non *G. olidus* Günther, 1866)—Dixon, 1976: 111; McDowall & Frankenberg, 1981: 469 (*partim*); Cadwallader & Backhouse, 1983: 69 (*partim*); McDowall, 2003a: 364 (*partim*).
Galaxias findlayi (non *G. findlayi* Macleay, 1882)—Dixon, 1976: 111.
Galaxias sp. 6—Raadik & Nicol, 2012; 1; DSE, 2013: 17; Raadik & Nicol, 2013:1.
Galaxias sp. 16—Kuiter, 2013; 76.

Conforms to the allozymically defined and morphologically diagnosed taxon 'DA' of Adams *et al.* (2014), and 'dargo' of Raadik (2011).

Material Examined.

Holotype. NMV A.30550-3, 104.5 mm LCF, (94.2 mm SL), female, Lightbound Creek, on Dargo High Plains Road, Lankey's Plain, Dargo High Plains, Alpine National Park, Victoria, 37° 06' 33"S 147° 09' 40"E, T.A. Raadik, 20 March 2002.

Paratypes. AMS I.44913-1 (2), and NMV A.30550-2 (8), 64.2–90.9 mm LCF (56.8–80.9 mm SL), collected with holotype; NMV A.30588-1 (10), 62.3–88.6 mm LCF (55.0–78.1 mm SL), Lightbound Creek, at type locality, R.H. Parrish, 10 December 1963.

Non-type material. NMV A.30550-1 (7), collected with holotype; NMV A.12682 (23), Lightbound Creek, collected with NMV A.30588-1; NMV A.12405 (5), Lightbound Creek, at type locality, 9 May 1962; NMV A.12674 (57), Lightbound Creek, at type locality, 10 December 1963; NMV A.486 (4), Lightbound Creek, at type locality, 9 November 1974; NMV A.488 (1), Lightbound Creek, at type locality, 10 November 1974; NMV A.487 (7), Lightbound Creek, at type locality, 11 November 1974; NMV A.26402-1 (5), Lightbound Creek, at type locality, 16 April 2008.

Diagnosis. *Galaxias mungadhan* **sp. nov.** differs from all other species within the *Galaxias olidus* complex by a combination of the following characters: distance between pelvic and anal fin bases long (22.4–27.7 % SL); head shallow (30.0–42.6 % HL) and post-orbital head length long (54.7–62.4 % HL); inter-orbital narrow (35.1–40.4 % HL); nostrils of moderate length, not visible from ventral view; dorsal and anal fin origins set far back along trunk (70.5–74.5 and 74.4–79.9 % SL, respectively); body depth through pectoral fin base greater (121.2 % SL) than that through vent; anal fin base short (9.0–10.7 % SL), usually shorter than dorsal fin base; dorsal fin short (13–15 % SL) and anal fin moderately short (13.2–15.6 % SL); lower jaw length much shorter (67.8–89.0 %) than width of gape; expanded rays of caudal fin equal to or less than body depth through pectoral fin base; dorsal midline usually flattened anteriorly from above or slightly posterior to pectoral fin bases; usually 10 segmented anal fin rays; posterior extent of mouth about 0.8 ED below ventral margin of eye; pyloric caecae either present or absent, if present, as a single, wide and blunt, short (0.7 % SL) caecum; gill rakers short and stout; anal fin origin usually under 0.61 distance posteriorly along dorsal fin base; lack of distinct black bars along lateral line; and, usually a dark chocolate brown overall when alive.

Description. As for the genus and members of the *Galaxias olidus* complex, except as indicated below, based on 21 specimens, 55.0–94.2 mm SL, and 18 additional, non-type, specimens for meristics. See Tables 4 to 9 for frequencies of meristic values and Table 27 for a summary of meristic variation. Segmented dorsal fin rays 10 (9–11), of these 8 (7–9*) branched and 2 (1*–2) unbranched; segmented anal fin rays 10 (10–11), of these 8 (8–9) branched and 2 unbranched; caudal fin rays 16 (15–16); segmented pectoral fin rays 15 (14–15), of these 13 (12–13) branched and 2 unbranched; pelvic fin rays 7 (7–8*), of these 6 (6–*7) branched and one unbranched; gill raker total count (lower limb and upper limb) 12 (11–13*), lower arch with 9 (8–9) and 3 (3–4*) on upper, variation on first gill arch 8+3 (4), 8+4 (1), 9+3 (10), 9+4 (8*), 10+3 (2); vertebrae 52 (52–55); 0–1* pyloric caecae on stomach.

See Table 28 for comparative value ranges of morphometric characters. Body moderately deep and long, dorsal midline usually flattened anteriorly from above or slightly posterior to pectoral fin bases, depth through pectoral base 1.2 (1.1–1.3) that through vent, trunk with dorsal profile relatively flattish and somewhat depressed on head and ventral profile evenly arched from snout to anal fin; body tapering back to a caudal peduncle of moderate length, 8.0 (7.2–9.4 in SL), and depth, 12.8 (11.7–13.5), the peduncle depth 1.6 (1.3–1.8) in its length; accessory lateral line present. Head of moderate length (4.2–4.7 in SL) and 1.1–1.2 in PelAn distance, relatively shallow, 2.7 (2.3–3.3) in HL, moderately wide, 1.6 (1.5–1.8) in HL, distinctly wider than deep (depth about 1.7 in HW), lateral profile obtuse with dorsal profile distinctly flat anterior to nape; eyes of moderate size, 5.5 (5.0–6.1) in HL and 2.0 (1.6–2.5) in HD, situated high on head, just below dorsal head profile, interorbital flat and relatively narrow, 2.7 (2.5–2.8) in HL and 2.0 (1.9–2.3) times ED; cheeks expanded below eyes, eye profiles usually not visible laterally from ventral view; snout shortish, 3.6 (3.4–4.0) in HL and 1.5 (1.2–1.8) times ED, lateral profile rounded, profile from above and below evenly rounded without obvious inflections; post-orbital head length long, 1.7 in HL; nostrils of moderate length, just extending to posterior edge of upper lip, not visible from ventral view; mouth usually terminal or very slightly subterminal, of moderate length, 2.8 (2.6–3.1) in HL, posterior extent reaching back to under anterior 0.3 of eyes, and about 0.7 (0.6–1.0) ED below ventral margin of eye, most anterior tip of upper lip level with about middle of eye, gape moderately wide, 2.5 (2.3–3.1) in HL, width 1.1 times length of upper jaw and 1.6 (1.4–1.8) in HW. Jaws subequal, lower 1.1 in length of upper, upper jaw relatively thick and fleshy. Pyloric caecum, if present, short, averaging 0.7 % SL (0.1–1.6 %), wide and bluntly rounded; gill rakers short, stout and rounded to bluntly pointed.

Fins fleshy at bases, median fins more so, with thickening extending distally over 0.3–0.5 of fin area, extending farther between fin rays; dorsal and anal fin bases of moderate length and usually equally long, fins short and rounded, of equal length or dorsal very slightly shorter, middle rays longest; anal fin origin usually under 0.62 (0.41–0.96) distance posteriorly along dorsal fin base. Pelvic fins of moderate length, 9.1 (8.2–9.8) in SL, 1.2 (1.1–1.4) in pectoral fin length, inserted at about mid-point of standard length and usually extending to 0.4 distance to anal fin base; pectoral fin longish and paddle-shaped, 7.5 (6.7–8.3) in SL, usually extending 0.45 distance to pelvic fin base, low on body with dorsal end of fin base level with posterior extent of mouth, lamina of paired fins oriented anterio-ventrally to ventrally, raised lamellae on ventral surface of rays usually present and moderately to strongly developed. Caudal fin of moderately length, 7.6 (6.7–8.3) in SL, emarginate, usually 1.1 times length of caudal peduncle, vertical width of expanded rays equal to or less than body depth through pectoral fin base, flanges low and well developed along caudal peduncle and long, reaching anteriorly past distal end of adpressed anal fin rays to near fin base.

TABLE 27. Summary of meristic variation in *Galaxias mungadhan* **sp. nov.** (T—total; B—branched; L—lower limb; S—single; U—upper limb). Range in 90 % and 100 % of specimens.

Character	Mode	Mean	SD	SE	Range 90 %	Range 100 %	N
Dorsal Rays (T)	10	9.8	0.65	0.13	9–11	9–11	25
Dorsal Rays (B)	8	7.9	0.67	0.13	7–9	7–9	25
Dorsal Rays (S)	2	1.9	0.28	0.06	2	1–2	25
Anal Rays (T)	10	10.4	0.57	0.11	10–11	9–11	25
Anal Rays (B)	8	8.3	0.54	0.11	8–9	7–9	25
Anal Rays (S)	2	2.1	0.28	0.06	2	2–3	25
Caudal Rays	16	15.9	0.33	0.07	15–16	15–16	25
Pectoral Rays (T)	15	14.6	0.50	0.10	14–15	14–15	25
Pectoral Rays (B)	13	12.6	0.50	0.10	12–13	12–13	25
Pectoral Rays (S)	2	2.0	0.00	0.00	2	2	25
Pelvic Rays (T)	7	7.1	0.28	0.06	7	7–8	25
Pelvic Rays (B)	6	6.1	0.28	0.06	6	6–7	25
Pelvic Rays (S)	1	1.0	0.00	0.00	1	1	25
Gill Rakers (T)	12	12.2	0.72	0.14	11–13	11–13	25
Gill Rakers (L)	9	8.9	0.53	0.11	8–9	8–10	25
Gill Rakers (U)	3	3.4	0.49	0.10	3–4	3–4	25
Vertebrae	53	52.6	1.07	0.17	51–55	50–55	41

TABLE 28. Morphometric variation in *Galaxias mungadhan* **sp. nov.** (values are percentages of denominators in ratios, except for LCF and SL).

Character	Holo-type	Paratypes (N = 20) Mean	Min.	Max.	S.D.
LCF (mm)	104.5	76.8	62.3	95.2	
SL (mm)	94.2	67.8	55.0	84.1	
SL / LCF	90.1	88.3	87.1	89.2	0.59
BDV / SL	11.3	11.7	11.0	12.8	0.47
BDPec / SL	13.4	14.2	12.7	15.6	0.72
BDPec / BDV	119.2	121.2	112.5	131.5	5.91
LCP / SL	13.2	12.4	10.6	13.8	1.03
DCP / SL	7.6	7.8	7.4	8.5	0.32
DCP / LCP	57.9	63.6	53.9	75.6	7.51
CFFL / SL	11.0	13.2	12.1	14.8	0.76
LCP/CFFL	120.3	94.5	71.5	113.7	12.61
PreD / SL	74.0	72.6	70.5	74.5	1.37
PreA / SL	76.7	77.2	74.4	79.9	1.86
PreD / PreA	96.5	94.0	91.8	95.5	1.02
DF–AF / LDB	61.0	61.6	41.1	96.1	13.20
LDB / SL	9.3	9.9	9.0	11.3	0.63
LAB / SL	9.2	9.6	9.0	10.7	0.48
LDB / LAB	100.7	102.7	87.9	117.8	6.05
DL / LDB	150.9	142.8	128.2	155.7	7.60
AL / LAB	156.0	151.6	142.6	162.0	5.13
DL / SL	14.0	14.1	13.0	15.0	0.57
AL / SL	14.4	14.6	13.2	15.6	0.66
DL / AL	97.4	96.6	86.3	104.5	4.58
PecL / SL	12.3	13.4	12.0	15.0	1.06
PelL / SL	10.6	11.0	10.2	12.2	0.57
PelL / PecL	86.3	81.8	72.9	89.9	5.00
PrePel / SL	50.8	51.3	46.7	55.1	2.64
PecPel / SL	31.6	30.0	26.5	34.8	2.58
PelAn / SL	26.7	25.0	22.4	27.7	1.40
PecL / PecPel	38.8	44.8	39.3	52.0	3.28
PelL / PelAn	39.8	44.0	37.4	48.8	3.07
HL / SL	21.3	22.4	21.2	23.9	0.70
HL / PelAn	79.8	90.0	78.5	101.1	5.52
HW / HL	64.5	62.3	54.5	65.9	2.94
HD / HL	38.8	37.2	30.0	42.6	3.30
HW / HD	166.5	168.2	148.2	184.1	10.52
SnL / HL	28.3	27.6	24.9	29.7	1.74
SnL / ED	178.5	153.6	125.2	178.5	15.66

...... *continued on the next page*

TABLE 28. (Continued)

Character	Holo-type	Paratypes (N = 20) Mean	Min.	Max.	S.D.
ED / HL	15.8	18.0	16.3	20.1	1.14
ED / HD	40.9	48.9	39.8	61.5	6.04
PoHL / HL	57.5	58.0	54.7	62.4	2.17
IOW / HL	36.7	36.9	35.1	40.4	1.48
ED / IOW	43.1	48.9	43.3	55.9	3.69
UJL / HL	37.2	35.1	32.3	37.7	1.60
LJL / HL	33.7	31.0	29.2	33.7	1.29
GW /HL	45.9	39.5	34.9	43.5	2.12
LJL / UJL	90.6	88.5	83.4	95.8	3.31
LJL / GW	73.5	78.7	67.8	89.0	5.43
GW / HW	71.1	63.5	55.1	70.0	4.35
SnL/UJL	76.0	78.7	70.2	91.0	4.98

Size. Recorded to 110 mm LCF and 11 g; commonly to 70–80 mm LCF.

Colour in life. Body dark brown overall, usually darker above lateral line, extending onto top and sides of head and snout, becoming brown ventrally, belly sometimes light brown. Overlain by small to moderate sized dark brown to black, irregular shaped, rather diffuse blotches, more densely spaced above lateral line. Gill cover brown; iris silvery to coppery gold. Mid-dorsal surface of trunk usually with a moderately wide band composed of gold spots or flecks extending from nape to dorsal fin base, sometimes extending over head to snout; head broadly scattered with small gold flecks, and broad, diffuse band of golden spots usually extending from near base of pectoral fin onto caudal peduncle, usually mostly below lateral line and quite distinct posteriorly. Fins translucent yellowy brown. See below for more detailed comments on body pattern.

Colour of preserved material. Base colour of head and body tan to light brown. Fine to medium-size, irregularly shaped, diffuse brown, dark grey to black blotches densely spaced on dorsal surface of trunk, extending down sides to lateral line, also extending onto top of head. Prominent trunk patterning ends abruptly at lateral line, continuing below but extremely pale, conferring a two-tone pattern, darker on top. Trunk patterning overlain by light shading of fine brown stippling, distinctly darker above lateral line and fading ventrally, merging well below lateral line with faint trunk pattern. Dorsal trunk pattern extends over dorsal surface of head to snout and upper lip, though pale, also extending laterally onto cheeks and behind eye.

Eye grey to black, pupil translucent pale orange-yellow. Teeth translucent yellow to pale orange–yellow, tips orange to orange–red; gill rakers cream to pale yellow. Fins pale creamy yellow, becoming more translucent on posterior margins, fleshy bases of dorsal, anal, pelvic and pectoral fins with fine brown stippling, trunk pattern just extending onto base of caudal fin. Fin rays opaque, external edges of rays highlighted with fine brown spots forming thin lines, first few rays generally darker.

Etymology. The specific name mungadhan, from 'munga' meaning from, and 'dhan' meaning frost or snow, in reference to its distribution at high elevations on the Dargo High Plains which are usually covered by snow during winter. From the language of the Gunai/Kurnai indigenous nation, the traditional inhabitants of the Gippsland region of Victoria (Gardner 1996). Suggested vernacular name as the 'Dargo Galaxias'.

Genetics. Allozyme and mtDNA analysis of this species can be found in Adams *et al.* (2014**;** taxon code DA). Diagnostic allozyme loci (6–12) between this taxon and the other species in the *Galaxias olidus* complex are provided in Table 12.

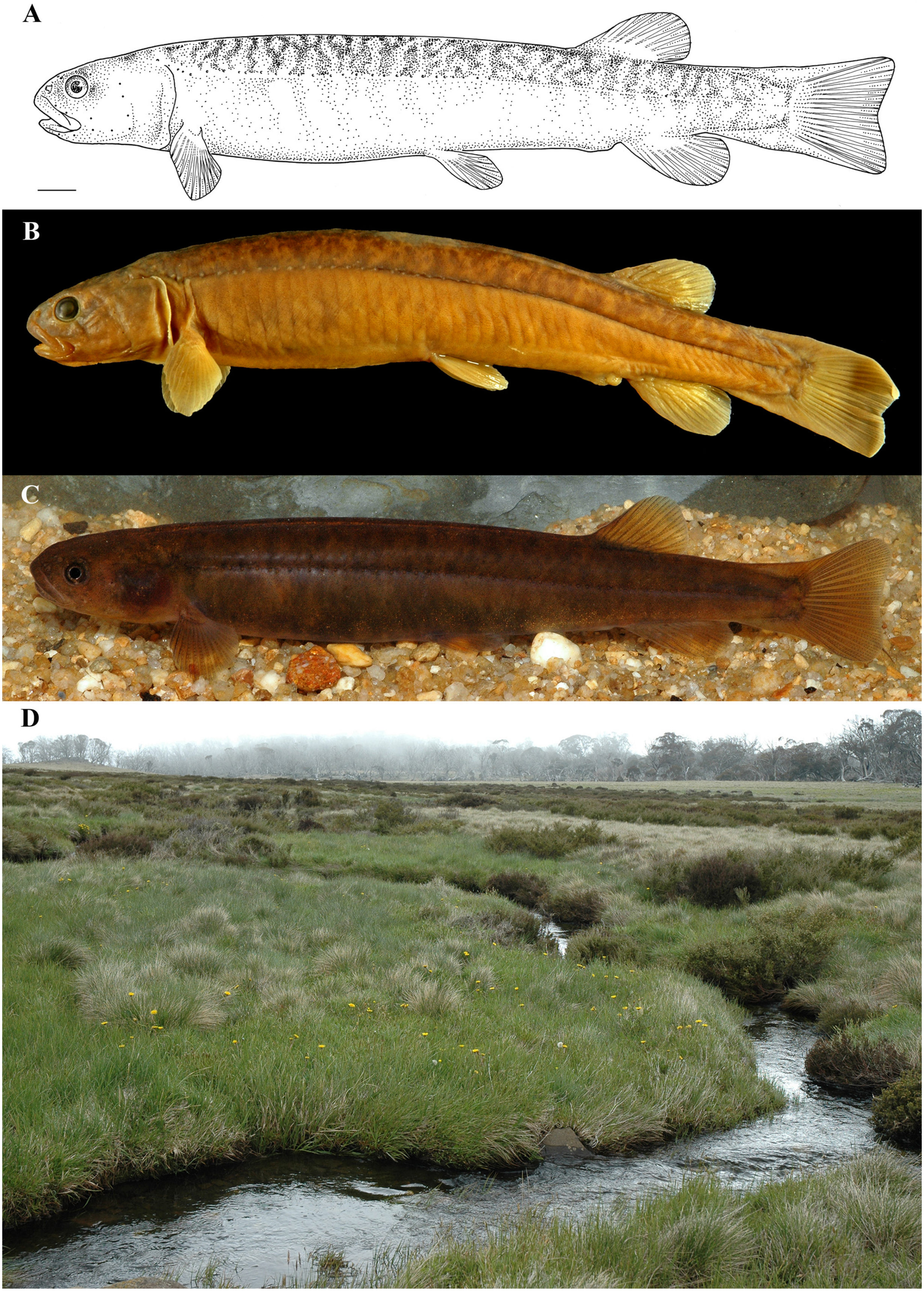

FIGURE 20. A–B: *Galaxias mungadhan* **sp. nov.** holotype, NMV A.30550-3, 104.5 mm LCF, Lightbound Creek, Dargo High Plains Road, Lankey's Plain, Alpine National Park, Victoria, A) line drawing (R. Plant), B) image of preserved specimen (T.A. Raadik); *G. mungadhan* **sp. nov.**, collected from the type locality, 5 April 2011; ~ 90 mm LCF. (T.A. Raadik); D) Lightbound Creek, at type locality of *G. mungadhan* **sp. nov.**, 16 November 2010 (T.A. Raadik). Scale bar = 5 mm.

Distribution. See Fig. 7. Only known from a short section of creek extending from 700 m downstream of the type locality to the top of the catchment, in the headwaters of Lightbound Creek, a tributary of the Dargo River, Mitchell River system in the coastal Gippsland region of Victoria, from an elevation of 1550 m asl. The population is known to extend over approximately 2 km (river distance) from the source, which is at 1620 m asl, in a catchment of approximately 4 km^2. Downstream distribution unknown, though waterfalls are present 2 km farther downstream at Devils Hollow, which are located 2 km upstream from the junction with the Dargo River. Alien trout are abundant throughout the Dargo River system, and possibly within the lower Lightbound Creek upstream to the falls, possibly restricting the distribution of *Galaxias mungadhan* to a 4 km length of creek in a catchment of 9 km^2. Historical distribution unknown, though suspected, based on anecdotal records, to have been more widespread, possibly throughout the majority of the upper Dargo River system before trout reduced their range.

Sympatry. Only species of *Galaxias* found within its current restricted range, though considered to have been historically found with *Galaxias olidus*, which is present nearby. Alien trout have substantially altered distributional patterns in the last 150 years and fragmented and reduced the distributional range of galaxiids and their populations. *Galaxias brevipinnis*, *Galaxias maculatus* and *Galaxias truttaceus* are found farther downstream in the Dargo River system and their ranges may also have historically overlapped with that of *Galaxias mungadhan*.

Habitat. Recorded from a small (0.5–1.3 m average width and 0.05–0.40 m in average depth), cool, clear, alpine creek, flowing through a grassy plain, consisting predominantly of riffles and pools, and with very little shading except that provided by grasses. During winter the catchment is often covered by snow for varying periods of time. Substrate consisted predominantly of bedrock with some loose boulders, with smaller amounts of pebble, gravel, sand and clay, overlain in backwaters by silt. Instream cover was provided by rock and by bank and vegetation (alpine grasses) overhang, and pools averaged 0.5 m in depth.

General Biology. Confined to freshwater and considered not to undertake diadromous migrations. Recorded at densities of 4.2–6.4 fish/m^2 and is the only native fish species so far recorded from within its range. Spawning period unknown and possibly annually variable depending on conditions. Adult fish sampled in mid-November (2010) and mid-December (1963) were full of fat deposits and their gonads were in an early stage of development, whereas those collected in mid-April (2008) were at an advanced stage of development, with many females ripe to nearly ripe and with large eggs which were beginning to separate. The smallest presumed 0+ age fish recorded in mid-November (1974) was 27 mm LCF, and 38 mm LCF in mid-December 1963, with approximately 30 % of fish collected in late March (2002) less than 50 mm LCF (smallest 27 mm LCF) and in mid-April (2008) 75 % of 100 fish collected less than 40 mm LCF, with 94 % < 50 mm LCF, all considered of 0+ age. This suggests an extended spawning period possibly from late winter to spring, though a 0+ age fish of 18.1 mm LCF, still possessing a mid-ventral larval keel, was collected in early May (1962), suggesting a late March to April (autumn) spawning. Able to survive in very cold water (< 5 ºC) during winter.

Conservation status. Critically endangered (DSE 2013).

Remarks. Pyloric caecae are usually absent and the anterior portion of the intestine is usually relatively evenly swollen around its circumference, and much wider in diameter than the posterior end of the stomach. Occasionally, a rudimentary caecum were considered present if there was a small but distinctive distension to this swelling, usually at right angles.

A dark galaxiid was observed (but not caught) amongst trout in the very upper reaches of the Dargo River system, off the very northern section of the Dargo High Plains Road, in 1963, and 'minnows' (= *Galaxias* sp.) were reported to be present in 1961 above a set of falls (with trout below) in the upper reaches of a tributary flowing between Mt. Blowhard and Little Mount Baldy, though they were not recorded in March 1963 (R. Frankenberg, pers. comm. 2011). Recent surveys in nearby tributaries to Lightbound Creek (Twenty Five Mile Creek, Thirty Mile Creek, Little Dargo River, and small eastern tributaries of the Dargo River) have failed to record *Galaxias mungadhan*, at additional locations, though *Galaxias olidus* were located in some catchments (Raadik & Nicol 2012).

Systematic survey effort, focussing on headwater sections of smaller streams in the upper reaches of the Dargo River system, and the headwater reaches of the adjacent Wonnangatta and Wongungarra river systems, is required to determine if additional, remnant populations of *Galaxias mungadhan* remain, to accurately delineate the distribution of this species, to search for suitable potential translocation sites within its presumed former range, and to determine if other potentially novel species in the *Galaxias olidus* complex are present.

Galaxias olidus Günther, 1866

Mountain Galaxias

Tables 4 to 9, 12, 29 & 30; Figures 21 to 24

Galaxias olidus Günther, 1866: 209 (holotype: BMNH.2.13.24; type locality: ? Queensland) [see Appendix 1 for text of original description];—Krefft, 1871: 768; Macleay, 1880: 46; Macleay, 1881: 230; 1885; Ogilby, 1886: 54; Helms, 1890: 12 (*partim*); Ogilby, 1896: 66 (*partim*); Regan, 1906: 381; Zeitz, 1908: 297 (*partim*); Waite, 1921: 41 (*partim*); Waite, 1923; 62 (*partim*); McCulloch, 1922: 18; Waite, 1924: 483 (*partim*); McCulloch & Whitley, 1925: 133; McCulloch, 1927: 18; Hale, 1928: 25 (*partim*); McCulloch, 1929: 48; Johnson & Mawson, 1940; 1944; Stokell, 1947: 671; Whitley, 1956b: 39; 1956c: 34; Frankenberg, 1966: 23; Greenham, 1967; Morrissy, 1967; Greenham, 1968; Frankenberg, 1969: 170 (*partim*); Harasymiw, 1970; Andrews, 1973: 105; Pollard, 1974: 117; Dixon, 1976: 111; Grant, 1975: 564; Andrews, 1976: 318: Jackson, 1976: 14; Tilzey, 1976; Bishop, 1977: 53; Bishop & Tilzey, 1978: 14; Cadwallader, 1978; Lake, 1978: 24, image p. 105; Bishop, 1979; Cadwallader, 1979 (*partim*); Fletcher, 1979 (*partim*); Cadwallader *et al.*, 1980: 257 (*partim*); McDowall, 1980: 57 (*partim*); McDowall & Frankenberg, 1981: 469 (*partim*); Cadwallader & Backhouse, 1983: 69 (*partim*); Ealey *et al*., 1983: 44 (*partim*); Llewellyn, 1983: 11 (*partim*); Merrick & Schmida, 1984: 85 (*partim*); Rimmer & Merrick, 1984; Blyth & Jackson (1985) (*partim*); Campbell *et al.*, 1986: 95 (*partim*); Lloyd & Walker, 1986 (*partim*); Rich, 1986 (*partim*); Terzis, 1986 (*partim*); Leggett & Merrick, 1987: 92 (*partim*); Morison & Anderson, 1987: 7 (*partim*); Allen, 1988: 3; Cowden, 1988; Allen, 1989: 39, plate 18 (*partim*); Drayson, 1989; Marshall, 1989: image p. 223; Jones *et al.*, 1990; Lintermans & Rutzou, 1990; Lintermans *et al.*, 1990: 11; Morison & Anderson (1991) (*partim*); Wager, 1993: 6, 16; Green & Osbourne, 1994: 124 (*partim*); Rutzou *et al.*, 1994; Close, 1995; Brinkley, 1996; McDowall & Fulton, 1996: 55 (*partim*); Schiller *et al.*, 1997: 75 (*partim*); Turvey & Merrick, 1997: 134; Cashner *et al.* (1999); Laws, 1999; Bromhead *et al.*, 2000: 732; Lintermans, 2000a,b; McDowall, 2001: 396 (partim); O'Connor *et al.*, 2001; Raadik, 2001: 785 (*partim*), bottom and two uppermost images p. 785, second bottom image p. 786, bottom and top two images p. 787, lower two images p. 788; Raadik *et al.*, 2001 (*partim*); Koehn (2002) (*partim*); Lintermans, 2002: 24; Raadik & Kuiter, 2002: 830 (*partim*); Waters *et al.,* 2002b; 51 (*partim*); Allen *et al.*, 2003: 103 (*partim*); Lintermans & Osbourne, 2002; 26; McDowall, 2003a: 364 (*partim*); Kuiter 2004; Pollino *et al.* 2004 (*partim*); Coughran, 2005: 43; Raadik, 2005; 104, 105 (*partim*): Green, 2006: 14; Lintermans, 2007: 44 (*partim*); Davies *et al.*, 2008: 338; Green, 2008: (*partim*); Hammer *et al.*, 2009; 93 (*partim*); Howell & Creese, 2010: 14; Kuiter, 2011: 618; Lieschke *et al.* 2013a,b.

Galaxias schomburgkii Peters, 1868: 455 (syntypes: (2) ZMB 6788; type locality: Adelaide district, South Australia) [see Appendix 1 for text of original description];—Macleay, 1880: 47; Ogilby, 1896: 69; Regan, 1906: 382; McCulloch, 1929: 49; Stokell, 1947: 671; Whitley, 1956b: 39; Whitley, 1956c: 34; Munro, 1957: 16; Whitley, 1957a: 7; 1964: 35; Lake, 1971: 20; Scott *et al.*, 1974: 78; McDowall & Frankenberg, 1981: 469.

Galaxias bongbong Macleay, 1881: 233 (original syntypes: (10) MAMU F.82; now lectotype: (1) AMS I.16258-002; paralectotypes: (6) AMS I.16258-001, 3 missing; type locality: Moss Vale and rivers at Bong-bong, New South Wales) [see Appendix 1 for text of original description];—Tenison-Woods, 1882: 22; Ogilby, 1886: 55; Ogilby,1896: 60; Waite, 1904: 17; Regan, 1906: 382: McCulloch, 1921: 28; McCulloch, 1922: 18; McCulloch, 1927: 18; McCulloch & Whitley, 1927: 18; McCulloch, 1929: 49; Whitley, 1934: 668; Whitely, 1939: 268 (*partim*); Whitley, 1941: 4, plate i, fig. 4; Whitley, 1954: 29; 1956b: 39; 1956c: 34; Munro, 1957: 16; Whitley, 1957a: 7; 1964: 35; Greenham, 1967, Lake, 1967a: 14; Lake, 1967b: 196; Greenham, 1968: 846; Stanbury, 1968: 205; Llewellyn, 1969: 16; Dick, 1971; Lake, 1971: 20; Llewellyn, 1971: 3; Berra, 1973: 363; McDowall & Frankenberg, 1981: 472.

Galaxias findlayi Macleay, 1882: 107 (syntypes: (2) MAMU (unregistered) lost; type locality: Mount Kosciuszko, New South Wales) [see Appendix 1 for text of original description];—Tenison-Woods, 1882: 107; Ogilby, 1886: 55; 1896: 66 (*partim*); Waite, 1904: 17; Regan, 1906: 382; Stead, 1906: 50; McCulloch, 1914: 328; Gale, 1915: 16; McCulloch, 1921: 28; McCulloch, 1922: 18; McCulloch, 1927: 18; McCulloch, 1929: 49; Walford, 1940: 234; Stokell, 1945: 124; Costin, 1954: 97; Whitley, 1956b: 39; McCulloch, 1956c: 34; Munro, 1957: 17; Whitley, 1957a: 7; 1964: 35; Frankenberg, 1969: 329; Tilzey, 1970: 13; Lake, 1971: 20; Thomson, 1974: 151; Baker, 1978: 822; McDowall & Frankenberg, 1981: 472; Raadik & Kuiter, 2002: 830 (*partim*).

Galaxias kayi Ramsay & Ogilby, 1886: 6 (syntypes: (6) AMS I.5–7; (2) BMNH 1905.7.29.31 (originally AMS I.3); (1—originally 2, 1 now lost) MCZ.27560 (originally AMS I.4); type locality: Fifth Creek, South Australia) [see Appendix 1 for text of original description];—Ogilby, 1896: 70; Regan, 1906: 381, plate XI fig. 3; McCulloch, 1929: 48; Stokell, 1945: 25; 1947: 671; Whitley, 1956b: 34; Whitley, 1957b: 57, 58 fig. 2; Whitley, 1957a: 7; Munro, 1957: 17; Scott, 1962: 68; Whitley, 1964: 35; Lake, 1971: 20; Scott *et al.*, 1974: 77; McDowall & Frankenberg, 1981: 472.

Galaxias findlayi (non *G. findlayi* Macleay, 1882)—Ogilby, 1896: 66 (*partim*) [see Appendix 1 for text of revision]; Regan, 1906: 382, plate XIII fig. 3 (*partim*); Tadgell, 1930; 230; Whitley, 1959: 136; Littlejohn, 1962: 311.

Galaxias oconnori Ogilby, 1912: 33 (holotype: QM I.321; type locality: Lyra, near Stanthorpe, Queensland) [see Appendix 1 for text of original description];—McCulloch & Whitley, 1925: 133; McCulloch, 1929: 49; Duhig, 1930: xvi; Whitley, 1933: 61, plate xii, fig. 3; Whitley, 1955: 154, fig. 2; Whitley, 1956b: 39; Whitley, 1956c: 7; Whitley, 1957a: 34; Munro, 1957: 17; Lake, 1971: 20; McDowall & Frankenberg, 1981: 472; Raadik & Kuiter, 2002: 830 (partim).

Galaxias coxii (non *Galaxias coxii* Macleay, 1881)—Walford, 1928: 274; Gray, 1929: 140; Whitley, 1935: 51; Walford, 1941: 234; 1942: 56; Whitley 1957c: 10; Garnet, 1959: 213; Littlejohn, 1962; Breder & Rosen, 1966: 132; Tilzey, 1974: 7.

Galaxias ornatus (non *G. ornatus* Castelnau, 1873)—Butcher, 1946: 9 (*partim*).

Lyragalaxias oconnori—Whitley, 1935: plate III fig. 5; Scott, 1966: 250.
Galaxias olidus findlayi (Macleay, 1882)—Frankenberg, 1969: 171 (*partim*).

*Galaxias schomburghii—*Lake, 1971: 20 (mis-spelling of *Galaxias schomburgkii* Peters, 1868).
Galaxias brevipinnis (non *G. brevipinnis* Günther, 1866)—Lake, 1978: image p. 106; Green, 1979: 230.
Galaxias sp.—Kuiter, 2004: 70 (images).
Galaxias sp. 4—Kuiter, 2013: 48.
Galaxias sp. 5—Kuiter, 2013: 52.
Galaxias sp. 6—Kuiter, 2013: 54.
Galaxias sp. 7—Kuiter, 2013: 56.
Galaxias sp. 8—Kuiter, 2013: 58.
Galaxias form G–Raadik, 2005; 104.
Galaxias form H–Raadik, 2005; 104.

Conforms to the allozymically defined and morphologically diagnosed taxon 'OL' of Adams *et al.* (2014), and 'olidus' of Raadik (2011).

Material Examined.

Holotype. BMNH 1866.2.13.24 (1), 101.6 mm LCF (88.5 mm SL), sex undetermined, ? Queensland, G. Krefft, ca. 1866.

Other type material. AMS I.5–7 (6), BMNH 1905.7.29.31 (3) (digital image seen), and MCZ.27560 (1) (digital image seen), syntypes of *Galaxias kayi*, Fifth Creek, SA; AMS I.16258-002 (1), lectotype, and AMS I.16258-001 (6), paralectotype, of *Galaxias bongbong*, Moss Vale and rivers at Bong Bong, NSW; QM I.321 (1) [disintegrated], holotype of *Galaxias oconnori*, Lyra, near Stanthorpe, QLD ; ZMB 6788 (2), syntypes of *Galaxias schomburgkii* (digital images seen), Adelaide district, SA;

Non-type material. ACT: NMV A.30088-1 (15), 78.7–100.0 mm LCF (70.1–89.1 mm SL), Gibralter Creek, just above Gibralter Falls, off Corin Dam Road, 35° 29' 16"S 148° 56' 04"E, TAR and M. Lintermans, 12 March 2002; NMV A.30159-1 (16), 69.8–96.2 mm LCF (61.2–85.0 mm SL), Kangaroo Creek, Corin Dam Road, Namadgi National Park, upstream of reservoir, 35° 32' 18"S 148° 52' 10"E, TAR and M. Lintermans, 11 March 2002; NMV A.30115-1 (15), 67.9–99.3 mm LCF (60.0–88.5 mm SL), Naas Creek, Mount Clear campsite, downstream of Boboyan Road, Namadgi National Park, 35° 51' 51"S 149° 00' 41"E, TAR and M. Lintermans, 11 March 2002**;** NMV A.30073-1 (16), 46.5–74.1 mm LCF (40.5–65.5 mm SL), Pierces Creek, Concrete Crossing, Vanity's Crossing Road, 35° 20' 21"S 148° 54' 54"E, TAR and M. Lintermans, 12 March 2002. **NSW: (II, 03)** NMV A.30097-1 (15), 49.5–71.7 mm LCF (43.8–63.8 mm SL), Brindle Creek, Brindle Creek Road, Border Ranges N.P., World Heritage Area, 28° 22' 40"S 153° 04' 08"E, TAR, 9 December 2001; **(II, 04)** NMV A.30092-2 (6), 59.7–70.9 mm LCF (53.1–63.1 mm SL), Aberfoyle River, Wards Mistake Road, E of Guyra, 30° 11' 25"S 151° 46' 37"E, TAR, 5 December 2001; NMV A.30052-1 (4), 63.1–74.7 mm LCF (55.5–66.3 mm SL), Backwater Creek, Backwater Road, NE of Guyra, 30° 03' 59"S 151° 53' 02"E, TAR, 6 December 2001; NMV A.30147-1 (6), 71.9–78.4 mm LCF (63.8–69.6 mm SL), Barney Downs Creek, Billarimba Road, E of Tenterfield, 29° 05' 26"S 152° 05' 34"E, TAR, 7 December 2001; NMV A.30114-1 (6), 50.8–56.8 mm LCF (45.1–50.3 mm SL), Basket Swamp Creek, Basket Swamp Falls, Boonoo State Forest, 28° 54' 40"S 152° 10' 32"E, TAR, 5 October 2001; NMV A.30155-1 (4), 52.0–55.4 mm LCF (46.3–49.6 mm SL), Bielsdown River, off Billings Road, at junction with Matthews Creek, 30° 18' 11"S 152° 42' 42"E, TAR, 27 June 2005; NMV A.30068-1 (3), 52.2–55.1 mm LCF (46.3–49.0 mm SL), Bielsdown River, Coramba/Dorrigo Road, E of Dorrigo, d/s of Dangar Falls, 30° 18' 22"S 152° 42' 53"E, TAR, 9 December 2001; NMV A.30041-1 (10), 64.8–79.2 mm LCF (57.0–70.6 mm SL), Bielsdown River, Shepherds Road, SW of Dorrigo, 30° 21' 27"S 152°309' 27"E, TAR, 13/9/2003; NMV A.30117-1 (5), 63.3–89.8 mm LCF (56.2–80.3 mm SL), Bielsdown River, same loc. as NMV A.30041-1, TAR, 28 June 2005; NMV A.30070-1 (13), 58.2–71.9 mm LCF (51.6–64.3 mm SL), Blicks River, Armidale/Grafton Road, Dundurrabin, 30° 11' 39"S 152° 32' 42"E, 10 October 2001; NMV A.30072-1 (1), 64.0 mm LCF (56.2 mm SL), Boonoo Boonoo River, Mount Lindsay Highway, N of Tenterfield, 28° 52' 46"S 152° 06' 14"E, TAR, 5 October 2001; NMV A.30036-1 (6), 55.1–68.4 mm LCF (49.7–60.4 mm SL), Borra Creek, off track off Borra Creek Road, S of Bostobrick, 30° 18' 50"S 152° 36' 60"E, TAR, 11 September 2003; NMV A.30096-1 (12), 69.3–82.6 mm LCF (61.4–73.6 mm SL), Borra Creek, McInodes Road, NE of Deer Vale, 30° 19' 57"S 152° 33' 54"E, TAR, 11 September 2003; NMV A.30098-1 (5), 54.2–56.0 mm LCF (47.2–49.7 mm SL), Charon Creek, Sheep Station Road, W of Dundurrabin, 30° 11' 37"S 152° 32' 13"E, TAR, 10 October 2001; NMV A.30009-1 (1), 46.8 mm LCF

(41.4 mm SL), Chinamans Creek, Sheep Station Creek Road, W of Dundurrabin, 30° 11' 40”S 152° 32' 21”E, I. Wooden, 2000; NMV A.30045-1 (4), 46.1–56.2 mm LCF (40.5–49.4 mm SL), Coopernook Creek, Dorrigo/ Coramba Road, W of Megan, Dorrigo N.P., 30° 17' 33”S 152° 49' 44”E, TAR, 16 September 2004; NMV A.30007-1 (5), 50.2–64.0 mm LCF (44.0–56.9 mm SL), Coopernook Creek, same loc. as NMV A.30045-1, 28 June 2005; NMV A.30577-1 (1), 48.8 mm LCF (42.6 mm SL), Eve Creek, Coramba Road, W of Brooklana, 30° 16' 34”S 152° 50' 20”E, TAR, 12 September , 2003; NMV A.30102-1 (18), 74.3–103.9 mm LCF (65.8–93.1 mm SL), Guy Fawkes River, Armidale/Grafton Road, Ebor, u/s of Ebor Falls, 30° 24' 15”S 152° 20' 51”E, TAR, 10 October 2001; NMV A.30051-1 (5), 56.7–64.9 mm LCF (50.1–57.2 mm SL), Little Murray River, Deer Vale Road, W of Dorrigo, 30° 19' 29”S 152° 38' 07”E, TAR, 11 September 2003; NMV A.30008-1 (2), 49.6–57.3 mm LCF (43.4–49.3 mm SL), Little Nymboida River, Lowanna Road, Lowanna, 30° 12' 46”S 152° 54' 07”E, TAR, 12 September 2003; NMV A.30193-1 (3), 56.4–66.2 mm LCF (50.0–58.6 mm SL), Little Plain Creek, Dorrigo/North Dorrigo Road, North Dorrigo, 30° 17' 41”S 152° 41' 07”E, TAR, 17 September 2004; NMV A.30066-1 (3), 63.5–69.4 mm LCF (56.4–61.3 mm SL), Mann River, Streeter Road, E of Ben Lomond, d/s of Lake Llanglothlin, 30° 02' 03”S 151° 44' 16”E, TAR, 6 December 2001; NMV A.30153-1 (1), 58.1 mm LCF (51.8 mm SL), Oban River, Backwater Road, Oban, 30° 07' 10”S 151° 51' 24”E, TAR, 6 December 2001; NMV A.30044-1 (7), 47.4–53.0 mm LCF (42.2–46.8 mm SL), Rocky Creek, road past rubbish tip, Dorrigo, 30° 20' 19”S 152° 44' 01”E, TAR, 17 September 2004; NMV A.30075-1 (15), 51.4–63.9 mm LCF (45.4–54.9 mm SL), Rocky Creek, Dorrigo/ Bellingen Road, S of Dorrigo, 30° 21' 56”S 152° 43' 16”E, TAR, 9 October 2001; NMV A.30152-1 (1), 55.8 mm LCF (49.8 mm SL), Ropers Gully, road to Boonoo Boonoo Falls, Boonoo Boonoo N.P., 28° 51' 54”S 152° 08' 35”E, TAR, 7 December 2001; NMV A.30229-1 (15), 48.0–57.5 mm LCF (42.9–50.8 mm SL), Snowy Creek, trib., off Round Mountain Road, Cathedral Rock N.P., 30° 26' 17”S 152° 17' 09”E, TAR, 17 September 2004; NMV A.30154-1 (2), 60.9–62.6 mm LCF (54.0–55.9 mm SL), Swamp Oak Creek, Billarimba Road, E of Tenterfield, 29° 05' 41”S 152° 07' 21”E, TAR, 7 December 2001; NMV A.30144-1 (13), 63.9–74.8 mm LCF (56.5–66.7 mm SL), Wallaby Creek, border with Tooloom N.P., off Wallaby Creek fire trail, 28° 28' 33”S 152° 26' 06”E, TAR, 4 October 2001; **(II, 06)** NMV A.30166-1 (8), 66.2–86.8 mm LCF (59.1–77.0 mm SL), Apsley River, off Walcha/ Brackendale Road, S of Walcha, 31° 09' 59”S 151° 37' 35”E, TAR, 14 September 2003; NMV A.30219-1 (5), 68.9–81.5 mm LCF (61.4–71.7 mm SL), Gara River, Herbert Park Road, Herbert Park, 30° 24' 32”S 151° 49' 21”E, TAR, 10 October 2001; NMV A.30156-1 (1), 63.4 mm LCF (56.2 mm SL), Gara River, Ebor/Guyra Road, E of Guyra, upstream of Malpas Dam, 30° 12' 41”S 151° 43' 40”E, TAR, 11 October 2001; NMV A.30223-1 (15), 69.6–83.9 mm LCF (61.9–74.8 mm SL), Oaky River, road in Cathedral N.P., SW of Ebor, 30° 26' 40”S 152° 16' 09”E, TAR, 10 December 2001; NMV A.30027-1 (1), 60.7 mm LCF (53.5 mm SL), Oaky River, same loc. as NMV A.30223-1, TAR, 17 September 2004; NMV A.30576-1 (1), 55.9 mm LCF (50.8 mm SL), Styx River, Jeogla stream gauge, Lower Creek Road, 30° 35' 42”S 152° 09' 48”E, C. Gallen and M. Rogers, 27 May 2003; NMV A.30217-1 (15), 49.5–81.8 mm LCF (43.8–72.7 mm SL), Styx River, bridge on walking track at 'Tom's Cabin', on road to Point Lookout, New England N.P., 30° 29' 48”S 152° 23' 53”E, TAR, 27 June 2005; NMV A.30211-1 (11), 58.1–73.6 mm LCF (51.3–64.6 mm SL), Warnes River, Kangaroo Flat Road, E of Yarrowitch, 31° 13' 05”S 152° 05' 27”E, TAR, 11 December 2001; **(II, 07)** NMV A.30157-1 (5), 58.1–61.4 mm LCF (51.1–54.7 mm SL), Fenwicks Creek, Oxley Highway, SE of Yarrowitch, 31° 17' 56”S 151° 58' 44”E, TAR, 11 December 2001; NMV A.30150-1 (1), 77.0 mm LCF (68.4 mm SL), Mooraback Creek, track past Mooraback Field Study Centre, Werrikimbe N.P., 31° 08' 45”S 152° 13' 12”E, TAR, 11 December 2001; **(II, 12)** NMV A.30203-1 (8), 64.3–85.0 mm LCF (56.6–75.9 mm SL), Coxs River, Coxs River Road, S of Lithgow, 33° 37' 05”S 150° 09' 42”E, TAR, 6 September 2002; NMV A.30202-1 (14), 59.6–100.8 mm LCF (52.3–89.8 mm SL), Govetts Creek, off Mount Street, Leura, Blue Mountains, 33° 41' 56”S 150° 20' 02”E, TAR, 5 September 2002; NMV A.30216-1 (15), 44.2–72.2 mm LCF (38.5–63.9 mm SL), Jamieson Creek, off end of William Avenue, Wentworth Falls, upstream of the falls, 33° 42' 47”S 150° 22' 27”E, 5 September 2002; NMV A.30213-1 (17), 65.1–82.7 mm LCF (57.3–73.1 mm SL), Katoomba Creek, u/s of the cascades, in Katoomba Park, Katoomba, 33° 43' 28”S 150° 18' 17”E, TAR, 5 September 2002; NMV A.30192-1 (1), 76.5 mm LCF (67.8 mm SL), Leura Falls Creek, Leura Cascades, off Cliff Drive, Leura, 33° 43' 09”S 150°19' 23”E, TAR, 5 September 2002; NMV A.30212-1 (12), 31.9–77.6 mm LCF (27.8–68.2 mm SL), Little River, Tourist Road, Mount Murray, 34° 32' 42”S 150° 37' 09”E, TAR, 4 September 2002; NMV A.30208-1 (7), 56.5–63.0 mm LCF (50.1–55.6 mm SL), Nepean River, Moresby Hill Road, 34° 32' 35”S 150° 34' 57”E, TAR, 18 September 2003; NMV A.30201-1 (16), 61.3–100.0 mm LCF (54.5–90.4 mm SL), Pulpit Hill Creek, Blackheath Glen Reserve, off Megalong Valley Road, upstream of Megalong, 33° 40' 31”S 150°

16' 08”E, TAR, 6 September 2002; NMV A.30204-1 (4), 63.7–78.2 mm LCF (55.7–68.9 mm SL), Reedy Creek, Ferndale Road, W of Bundanoon, 34° 38' 52”S 150° 16' 51”E, TAR, 4 September 2002; NMV A.30205-1 (11), 42.9–67.2 mm LCF (37.5–58.9 mm SL), Wingecarribee River (Caalang Crk), off end of Burrawang Street, Robertson, 34° 35' 13”S 150° 35' 25”E, TAR, 18 September 2003; NMV A.30200-1 (7), 61.3–80.7 mm LCF (53.7–71.7 mm SL), Wollondilly Rive, Roslyn Road, SE of Crookwell, 34° 27' 51”S 149° 33' 25”E, TAR, 4 September 2002; **(II, 14)** NMV A.30148-1 (14), 41.1–80.1 mm LCF (35.9–71.3 mm SL), Macquarie Rivulet, Illawarra Highway, S of Mount Murray, Illawarra Range, 34° 34' 45”S 150° 37' 44”E, TAR, 4 September 2002; **(II, 15)** NMV A.30215-1 (9), 53.2–94.1 mm LCF (46.5–83.8 mm SL), Barrengarry Creek, Belmore Falls Road, u/s of Belmore Falls, S of Robertson, 34° 36' 14”S 150° 35' 06”E, TAR, 4 September 2002; NMV A.30132-1 (15), 43.2–73.5 mm LCF (37.7–65.1 mm SL), Gillamatong Creek, Boppings Crossing Road, Braidwood, 34° 26' 30”S 149° 46' 46”E, TAR, 13 March 2002; NMV A.30194-1 (1), 55.2mm LCF (49.4 mm SL), Jerrabattgulla Creek, Hereford Hall Road, Kain, 35° 43' 56”S 149° 34' 15”E, 13 March 2002; NMV A.30207-1 (1), 59.5 mm LCF (51.6 mm SL), Sandy Creek, Meryla Road, Morton N.P., S of Moss Vale, 34° 40' 14”S 150° 22' 57”E, TAR, 4 September 2002; NMV A.30130-1 (11), 43.0–53.3 mm LCF (38.6–47.7 mm SL), Shoalhaven River, Warri Bridge, Kings Highway, NW of Braidwood, 35° 20' 33”S 149° 44' 17”E, TAR, 13 March 2002; NMV A.30214-1 (12), 56.2–63.9 mm LCF (50.3–56.6 mm SL), Witts Creek, Krawarree Road, N of Toggannaggra, 35° 36' 34”S 149° 37' 02”E, P. Close and G. Aland, 20 June 2001; NMV A.30133-1 (7), 54.0–66.7 mm LCF (47.5–59.0 mm SL), Witts Creek, same loc. as NMV A.3021401, TAR, 13 March 2002; **(II, 17)** NMV A.30209-1 (10), 51.0–74.8 mm LCF (45.2–67.0 mm SL), Majors Creek, Braidwood/Majors Creek Road, just N of Majors Creek, 35° 33' 27”S 149° 45' 09”E, TAR, 13 March 2002; NMV A.30134-1 (15), 51.7–82.7 mm LCF (45.6–72.7 mm SL), Stony Creek, Araluen North/Braidwood Road, SE of Majors Creek, 35° 35' 05”S 149° 48' 14”E, TAR, 13 March 2002; **(IV, 01)** NMV A.30026-1 (2), 75.7–90.9 mm LCF (67.3–80.3 mm SL), Bogong Creek, d/s of diversion weir, at end of Bourkes Gorge Road, Kosciuszko N.P., 36° 15' 11”S 148° 15' 33”E, G. Gillespie, 12 February 1994; NMV A.29978-1 (15), 69.5–98.7 mm LCF (61.0–86.9 mm SL), Bogong Creek, same loc. as NMV A.30026-1, TAR, 17 March 2002; NMV A.30010-1 (2), 62.8–92.6 mm LCF (54.7–80.2 mm SL), Cootapatamba Lake, outlet from lake, Mt. Kosciuszko N.P., 36° 27' 59”S 148° 15' 50”E, K. Green, 9 January 2006; NMV A.30164-1 (20), 65.5–105.7 mm LCF (58.1–95.0 mm SL), Deep Creek, end of track off Khancoban/Cabramurra Road, at Snowy Mountains Hydroelectric Scheme adit, Kosciuszko N.P., 36° 00' 34”S 148° 20' 34”E, TAR, 16 March 2002; NMV A.30025-1 (5), 45.7–91.3 mm LCF (39.7–80.6 mm SL), Murray River, Cowombat Flat Track, Cowombat Flat, Alpine N.P., 36° 47' 42”S 148° 10' 18”E, TAR, 23 March 2005; NMV A.29960-1 (21), 58.4–126.1 mm LCF (51.3–113.7 mm SL), Three Rocks Creek, Three Rocks Creek diversion weir, Kosciuszko N.P., 36° 20' 18”S 148° 19' 06”E, TAR, 17 March 2002; NMV A.30221-1 (4), 88.2–104.2 mm LCF (77.8–92.4 mm SL), Two Mile Creek, Yarara/Coppabella Road, W of Coppabella, 35° 44' 07”S 147° 42' 28”E, TAR, 2 September 2002; **(IV, 10)** NMV A.30118-1 (6), 66.0–97.3 mm LCF (58.7–86.8 mm SL), Bombowlee Creek, tributary, Billo Road, 35° 14' 60”S 148° 23' 49”E, TAR, 2 September 2002; NMV A.30065-1 (15), 46.0–54.8 mm LCF (40.9–48.9 mm SL), Bredbo River, Capperwidgee Road, E of Bredbo, 35° 59' 43”S 149° 12' 30”E, TAR, 15 March 2002; NMV A.30120-1 (20), 66.5–93.0 mm LCF (59.2–82.5 mm SL), Burns Creek, Khancoban/Cabramurra Road, near Bradley's Hut, Kosciuszko National Park, 36° 00' 49”S 148° 22' 50”E, TAR, 16 March 2002; NMV A.30040-1 (17), 51.3–93.0 mm LCF (45.3–82.2 mm SL), Flea Creek, Powerline Road, Brindabella National Park, 35° 17' 15”S 148° 47' 27”E, TAR, 2 September 2002; AMS I.43384-001 (3), 49.2–61.2 mm LCF (42.7–54.5 mm SL), Kybeyan River, "The Avenue", SE from Cooma, 36° 19' 26”S 149° 24' 19”E, K. Pogonoski and R. Farragher, 22 June 2004; NMV A.29984-2 (11), 57.6–110.7 mm LCF (50.2–98.8 mm SL), Morris Creek, Snowy Mountains Highway, N of Talbingo, 35° 31' 52”S 148° 17' 35”E, TAR, 16 March 2002; NMV A.29981-2 (13), 51.9–76.7 mm LCF (46.1–67.6 mm SL), Mountain Creek, Sawyers Gully Road, E of Wee Jasper, 35° 04' 44”S 148° 48' 16”E, TAR, 2 September 2002; NMV A.30064-1 (5), 60.4–82.1 mm LCF (52.7–72.3 mm SL), Murrumbateman Creek, Kiers Road, E of Murrumbateman, 34° 57' 23”S 149° 04' 38”E, TAR, 3 September 2002; NMV A.10385 (20), 56.6–71.3 mm LCF (50.7–63.9 mm SL), Tibeaudo Creek (Happy Jacks Creek), Happy Jacks Road, 1.3 km NW of McKeahnies Creek, Kosciuszko National Park, 36° 03' 21”S 148° 29' 45”E, R.J. Frankenberg, 9 March 1966; NMV A.30043-1 (9), 62.3–76.9 mm LCF (54.0–67.8 mm SL), Yass River, Yass River Road, W of Bellmount Forest, 34° 55' 15”S 149° 10' 21”E, TAR, 3 September 2002; **(IV, 11)** NMV A.30063-1 (16), 41.2–97.0 mm LCF (36.0–85.2 mm SL), Butmaroo Creek (Deep Creek), Kings Highway, E of Bungendore, 35° 15' 24”S 149° 32' 11”E, TAR, 12 March 2002; **(IV, 12)** NMV A.30034-1 (17), 52.5–78.1 mm LCF (45.8–68.3 mm SL), Abercrombie River, Oberon/Goulburn Road, S of Paling Yards, 34° 11' 38"S 149° 44' 15"E, TAR, 3 September 2002; NMV A.30091-1 (3), 70.6–78.6 mm LCF (61.6–68.8 mm SL), Belubula River, off track at Carcoar, downstream of Lake Carcoar, 33° 36' 44"S 149° 08' 24"E, TAR, 10 September 2002; NMV A.30042-1 (17), 54.3–70.9 mm LCF (47.9–62.1 mm SL), Bolong Creek, Golspie Road, NE of Laggan, 34° 17' 50"S 149° 37' 35"E, TAR, 3 September 2002; NMV A.30112-1 (1), 87.2 mm LCF (77.2 mm SL), Burrangong Creek, Lirambenda Lane, NNW of Young, 34° 05' 13"S 148° 09' 51"E, TAR, 10 September 2002; NMV A.30067-1 (5), 60.8–74.1 mm LCF (54.0–74.1 mm SL), Cadiangullong Creek, Panuara Road, 33° 30' 39"S 148° 58' 48"E, TAR, 9 September 2002; NMV A.30109-1 (17), 53.2–96.3 mm LCF (46.0–85.6 mm SL), Mandagery Creek, Sullivans Road, N of Manildra, 33° 08' 21"S 148° 43' 16"E, TAR, 9 September 2002; NMV A.30101-1 (1), 72.1 mm LCF (62.9 mm SL), Murringo Creek, Fishers Lane, off Chews Lane, Murringo Gap, 34° 13' 47"S 148° 28' 43"E, TAR, 10 September 2002; NMV A.30053-1 (13), 53.1–85.7 mm LCF (44.9–75.5 mm SL), Terarra Creek, 1.0 km downstream from Dripping Rock, on Terarra Creek Track, Nangar N.P., 33° 25' 08"S 148° 30' 11"E, TAR, 9 September 2002; **(IV, 16)** NMV A.30033-1 (15), 49.0–72.8 mm LCF (43.0–64.8 mm SL), Deepwater River, Ten Mile Road, E of Deepwater, 29° 26' 28"S 152° 00' 38"E, TAR, 7 December 2001; NMV A.30069-1 (10), 66.4–89.6 mm LCF (58.6–79.6 mm SL); Five Mile Creek, Spiraby Road, Copoompeta N.P., S of Sandy Flat, 29° 20' 41"S 152° 02' 25"E, TAR, 7 December 2001; NMV A.30035-1 (6), 84.2–92.2 mm LCF (75.4–82.5 mm SL); Macintyre River, Elsmore Road, near Paradise Creek, SE of Inverell, 29° 53' 60"S 151° 24' 09"E, TAR, 6 December 2001; NMV A.30055-1 (7), 66.3–79.9 mm LCF (58.4–70.7 mm SL); MacIntyre River, same loc. as NMV A.30035-1, , TAR, 10 September 2003; NMV A.30106-1 (11), Mayboll Creek, Glen Innes/Maybole Road, N of Ben Lomond, 29° 53' 25"S 151° 37' 36"E, TAR, 11 October 2001; NMV A.30095-1 (2), 79.1–83.9 mm LCF (70.8–75.4 mm SL), Mayboll Creek, same loc. as NMV A.30106-1, TAR, 10 September 2003; NMV A.30105-1 (2), 74.9–78.5 mm LCF (66.6–70.3 mm SL), Severn River, Morvern Road, E of Dundee, 29° 35' 19"S 151° 58' 01"E, TAR, 11 October 2001; NMV A.30090-2 (6), 61.9–80.6 mm LCF (55.2–72.9 mm SL), Tenterfield Creek, Scrub Road, upstream of Tenterfield, 29° 05' 44"S 152° 02' 07"E, TAR, 5 October 2001; **(IV, 18)** NMV A.30093-1 (10), 65.7–94.5 mm LCF (58.9–84.5 mm SL), Abington Creek, Boorlong Road, W of Guyra, 30° 20' 00"S 151° 26' 31"E, TAR, 5 December 2001; NMV A.30082-1 (3), 77.7–86.5 mm LCF (69.7–77.9 mm SL), Forest Creek, Gulf Creek Road, SW of Gulf Creek, 30° 13' 23"S 150° 43' 06"E, TAR, 10 September 2003; NMV A.30058-2 (15), 72.8–94.0 mm LCF (64.8–83.4 mm SL), Georges Creek, Guyra/Tingha Road, S of Wandsworth, 30° 06' 15"S 151° 31' 44"E, TAR, 5 December 2001; NMV A.30039-1 (7), 69.5–86.6 mm LCF (61.1–76.2 mm SL), Horton River, off Cotswald Road, upstream of Horton Falls, Nandewar Range, 30° 19' 37"S 150° 16' 49"E, TAR, 10 September 2003; NMV A.30047-1 (6), 48.8–67.3 mm LCF (42.6–59.6 mm SL), Molong Creek, Balala/Bendemeer Road, W of Uralla, 30° 39' 56"S 151° 16' 59"E, TAR, 4 December 2001; **(IV, 19)** NMV A.30038-1 (6), 54.5–76.6 mm LCF (48.1–67.3 mm SL), Borah Creek, Major Road, W of Upper Manilla, 30° 37' 08"S 150° 30' 54"E, TAR, 3 December 2001; NMV A.30094-1 (2), 73.4–74.0 mm LCF (65.4–66.0 mm SL), Corbrabald Creek, Walcha/Nowendoc Road, S of Walcha, 31° 10' 06"S 151° 34' 49"E, TAR, 14 September 2003; NMV A.30084-1 (14), 56.3–94.1 mm LCF (52.1–84.2 mm SL), Halls Creek, off Manilla/Bendemeer Road, W of Bendemeer, 30° 50' 56"S 151° 01' 59"E, TAR, 4 December 2001; NMV A.30061-1 (14), 61.5–93.4 mm LCF (55.1–83.8 mm SL), MacDonald River, Walcha/Nowendoc Road, S of Walcha, 31° 20' 57"S 151° 32' 03"E, TAR, 14 September 2003; NMV A.30122-1 (2), 54.4–101.8 mm LCF (48.0–91.4 mm SL), Peel River, Wallabadah/Nundle Road, SW of Nundle, 31° 29' 53"S 151° 05' 36"E, TAR, 14 September 2003; NMV A.30086-1 (13), 54.4–101.8 mm LCF (48.0–91.4 mm SL), Peel River, Head of Peel Road, S of Nundle, 31° 35' 12"S 151° 07' 43"E, TAR, 19 September 2004; **(IV, 20)** NMV A.30031-1 (1), 47.2 mm LCF (40.9 mm SL), Castlereagh River, John Renshaw Parkway, W of Coonabarabran, 31° 16' 37"S 149° 05' 54"E, TAR, 12 October 2001; NMV A.30059-1 (9), 53.7–78,6 mm LCF (47.5–69.1 mm SL), Castlereagh River, off John Renshaw Parkway, W of Coonabarabran, 31° 16' 51"S 149° 05' 28"E, 3 December 2001; NMV A.30056-1 (11), 44.4–52.0 mm LCF (38.7–45.5 mm SL), Shawns Creek, off track off John Renshaw Parkway, W of Coonabarabran, 31° 15' 35"S 149° 06' 39"E, TAR, 3 December 2001; **(IV, 21)** NMV A.30104-1 (1), 58.8 mm LCF (52.6 mm SL), Clear Creek, Clear Creek Road, NE of Bathurst, 33° 19' 37"S 149° 43' 10"E, TAR, 17 September 2003; NMV A.30143-1 (11), 52.5–76.2 mm LCF (46.8–68.4 mm SL), Duckmaloi River, Burroughs Crossing, NW of Edith, 33° 46' 14"S 149° 54' 06"E, TAR, 6 September 2002; NMV A.30085-1 (12), 58.1–77.8 mm LCF (51.5–68.2 mm SL), Fish River, off Tarana Road, W of Tarana, 33° 31' 09"S 149° 51' 36"E, TAR, 6 September 2002; NMV A.30081-1 (10), 48.2–97.3 mm LCF (42.6–86.2 mm SL), Frying Pan Creek, Porters Lane, Yetholme, 33° 26' 51"S 149° 48' 59"E, TAR, 17 September 2003; NMV A.30087-1 (2), 68.7–88.7 mm LCF

(60.0–77.5 mm SL), Gulf Stream, u/s of Winburndale Dam, Winburndale Nature Reserve, 33° 23' 18"S 149° 47' 01"E, TAR and I.B. McArtney, 17 September 2003; NMV A.30149-1 (2), 62.5–85.6 mm LCF (54.7–76.0 mm SL), Meadow Flat Creek, old Bathurst Road, next to Great Western Highway, W of Meadow Flat, 33° 25' 56"S 149° 55' 16"E, TAR, 17 September 2003; NMV A.30060-1 (13), 48.2–107.7 mm LCF (42.0–96.7 mm SL), Mitchells Creek, junction with Kirconnell Creek, Sunny Corner State Forest, N of Kirconnell, 33° 23' 23"S 149° 50' 21"E, TAR, 17 September 2003; NMV A.30145-1 (1), 95.9 mm LCF (83.9 mm SL), Molong Creek, road to Mount Canobolas, upstream of Canobolas Lake, Orange, 33° 06' 33"S 149° 09' 40"E, TAR, 10 September 2002; NMV A.30139-1 (7), 72.8–89.2 mm LCF (64.3–78.7 mm SL), Native Dog Creek, Sewells Creek Road, W of Oberon, 33° 43' 24"S 149° 41' 25"E, TAR, 6 September 2002; NMV A.30141-1 (7), 64.4–80.0 mm LCF (56.5–71.6 mm SL), Norah Creek, Cumnock/Molong Road, NW of Molong, 33° 00' 46"S 148° 47' 42"E, TAR, 14 December 2001; NMV (un reg.) (20), 35.2–90.2 mm LCF (30.5–79.8 mm SL), Norfolk Island Creek, Hildegrad Road, Coolah Tops N.P., 31° 44' 54"S 150° 01' 26"E, TAR, 13 December 2001; AMS IB.7571 (4), 52.6–77.4 mm LCF (45.4–68.0 mm SL), Saint Anthonys Creek, Napoleans Reef, E of Bathurst, 33° 24' 52"S 149° 44' 51"E, I.B. McCartney, 1966; NMV A.30146-1 (2), 52.6–77.4 mm LCF (45.4–68.0 mm SL), Saint Anthonys Creek, same loc. as AMS IB.7571, TAR, 17 September 2003; NMV A.30029-1 (3), 68.7–79.0 mm LCF (59.4–69.2 mm SL), Tindales Flat Creek, Sunny Corner Road, Sunny Corner State Forest, 33° 22' 35"S 149° 51' 56"E, TAR, 17 September 2003; NMV A.25253-2 (3), 55.0–60.8 mm LCF (47.6–52.0 mm SL), Turon River, Sofala Road, Sofala, 33° 04' 49"S 149° 41' 17"E, PJU, 4 December 2002; NMV A.30080-1 (1), 75.6 mm LCF (66.6 mm SL), Winburndale Rivulet, just below Winburndale Dam wall, Winburndale Nature Reserve, 33° 23' 25"S 149° 46' 33"E, TAR and I.B. McArtney, 17 September 2003. **QLD:** **(IV, 16)** NMV A.30119-1 (1), 78.8 mm LCF (70.1 mm SL), Accommodation Creek, Pyramids Road, near Girraween N.P, Wyberba, 28° 51' 29"S 151° 52' 26"E, TAR, 4 October 2001; NMV A.30054-1 (3), 66.4–73.6 mm LCF (59.8–65.3 mm SL), Paling Yard Creek, track in Girraween N.P., E of Lyra, 28° 50' 38"S 151° 59' 45"E, TAR, 7 December 2001; **(IV, 22)** NMV A.30100-1 (13), 57.0–93.3 mm LCF (50.7–82.9 mm SL), Browns Creek, on road to Queen Mary Falls, u/s of Killarney, 28° 21' 12"S 152° 20' 44"E, TAR, 2 October 2001; NMV A.30083-1 (9), 59.2–83.7 mm LCF (52.3–74.2 mm SL), Condamine R, eighth crossing on Condamine River Road, u/s of Killarney, 28° 17' 42"S 152° 21' 27"E, TAR, 2 October 2001; NMV A.30099-1 (7), 57.1–78.4 mm LCF (50.6–69.2 mm SL), Condamine River, tenth crossing upstream on Condamine River Road, u/s of Killarney, 28° 17' 36"S 152° 22' 18"E, TAR, 2 October 2001; NMV A.30077-1 (16), Dalrymple Creek, end of track in Goomburra State Forest Park, 27° 58' 49"S 152° 20' 51"E, TAR, 3 October 2001; NMV A.30049-1 (15), 66.1–95.1 mm LCF (59.0–84.3 mm SL), Farm Creek, Bakers Road, Mount Colliery, 28° 16' 54"S 152° 17' 12"E, TAR, 2 October 2001; NMV A.30103-1 (5), 38.3–82.5 mm LCF (33.1–72.8 mm SL), Gap Creek, off Cunningham Highway, u/s of Tregany, near rest area, 28° 03' 41"S 152° 21' 91"E, TAR, 2 October 2001; NMV A.30079-1 (7), 64.7–73.6 mm LCF (57.2–65.6 mm SL), Spring Creek, near Wilsons Peak, off Spring Creek Road, 28° 14' 32"S 152° 28' 28"E, TAR, 3 October 2001. **SA:** **(IV, 26)** NMV A.30057-1 (15), 58.5–70.1 mm LCF (51.0–61.8 mm SL), Meadows Creek, Wickhams Hill Road, Prospect Hill, 35° 12' 38"S 138° 41' 44"E, TAR and MH, 17 May 2002; NMV A.30032-1 (6), 69.2–87.1 mm LCF (60.2–76.8 mm SL), Nangkita Creek, off Nangkita Road, 35° 20' 37"S 138° 39' 49"E, TAR and MH, 17 May 2002; **(V, 01)** NMV A.30178-1 (7), 69.7–97.0 mm LCF (61.3–86.2 mm SL), Yankalilla River, S branch, Parawa Road, 35° 22' 22"S 138° 22' 47"E, TAR and MH, 17 May 2002; **(V, 02)** NMV A.30179-1 (4), 63.7–75.8 mm LCF (56.0–66.9 mm SL), Glenshera Swamp, tributary, off Lawless Road, in reserve, SW of Mount Compass, 35° 22' 13"S 138° 32' 49"E, TAR and MH, 27 November 2002; NMV A.30222-1 (15), 45.9–102.9 mm LCF (39.6–92.2 mm SL), **(V, 03)** Aldgate Creek, Euston Road, Aldgate, 35° 00' 52"S 138° 44' 03"E, TAR and MH, 16 May 2002; NMV A.30182-1 (16), 65.4–104.4 mm LCF (57.4–93.1 mm SL), Cox Creek, Mount Barker Road, Bridgewater, 35° 00' 35"S 138° 45' 30"E, TAR and MH, 16 May 2002; NMV A.30237-1 (10), 65.2–77.5 mm LCF (57.9–67.8 mm SL), Onkaparinga River, W branch, Western Branch Road, SSW of Lobethal, 34° 55' 52"S 138° 51' 45"E, TAR and MH, 14 May 2002; NMV A.30176-1 (1), 61.5 mm LCF (53.7 mm SL), Onkaparinga River, tributary, Ableside Road, Handorf, 35° 01' 17"S 138° 48' 21"E, TAR and MH, 16 May 2002; NMV A.30225-1 (5), 63.9–77.5 mm LCF (56.2–68.1 mm SL), Scott Creek, tributary, Allamanda Mine, Dorset Vale Road, Scott Creek Conservation Park, Dorset Vale, 35° 05' 02"S 138° 40' 29"E, TAR and MH, 16 May 2002; **(V, 04)** NMV A.30078-1 (11), 61.2–80.2 mm LCF (58.8–71.4 mm SL), Brownhill Creek, end of Brownhill Creek Road, Brownhill Creek Recreation Reserve, 34° 59' 36"S 138° 39' 17"E, TAR and MH, 18 May 2002; NMV A.30233-1 (15), 49.5–66.5 mm LCF (42.7–58.6 mm SL), First Creek, off Waterfall Gully Road, Waterfall Gully, 34° 56' 55"S 138° 40' 06"E, TAR and MH, 14 May 2002; NMV A.30172-1 (2), 73.8–86.8 mm

LCF (64.8–76.7 mm SL), Millers Creek, Checker Hill Road, N of Gumeracha, 34° 48' 05"S 138° 53' 41"E, TAR and MH, 14 May 2002; NMV A.30174-1 (15), 65.1–97.7 mm LCF (56.8–86.3 mm SL), Second Creek, Michael Perry Reserve, Stonyfell, 34° 56' 08"S 138° 40' 10"E, TAR and MH, 14 May 2002; **(V, 05)** NMV A.30184-1 (10), 65.0–99.4 mm LCF (57.1–88.9 mm SL), Jacobs Creek, Barossa Valley Highway, Moorooroo, 34° 33' 53"S 138° 56' 26"E, TAR and MH, 15 May 2002. **VIC: (II, 23)** NMV A.30107-1 (1), 99.8 mm LCF (91.8 mm SL), Bluestone Creek, Nunniong Plains Track, Emu Plains, 37° 07' 36"S 147° 56' 18"E, TAR, 17 April 2002; NMV A.10414 (1), 102.9 mm LCF (91.8 mm SL), Wild Dog Creek, Bentley Plain Road, 37° 16' 54"S 147° 53' 29"E, G.A. Apps, 10 November 1975; NMV A.30108-1 (1), Wild Dog Creek, same loc. as NMV A.10414, TAR, 17 April 2002, **(II, 24)** NMV A.489 (1), 59.5 mm LCF (50.6 mm SL), Twenty Five Mile Creek, White Timber Spur Track, Gow Plain, Dargo High Plains, off Dargo High Plains Road, 37° 07' 53"S 147° 10' 52"E, P. Menkhorst, 10 November 1974; **(IV, 01)** NMV A.29967-1 (5), 88.9–100.7 mm LCF (78.3–88.9 mm SL), Bluff Creek, below Bluff Creek falls, Burrowa-Pine N.P., 36° 07' 19"S 147° 45' 32"E, TAR, 17 March 2002; NMV A.29980-1 (21), 62.1–105.6 mm LCF (64.7–94.4 mm SL), Bulley Creek, Cowombat Flat Track, W of Moscow Peak, Alpine N.P., 36° 51' 13"S 148° 06' 34"E, TAR, 16 April 2002; NMV A.30006-1 (9), 60.0–84.7 mm LCF (52.3–74.8 mm SL), Cottontree Creek, Webb Lane, on border of Mt. Granya State Park, Granya, 36° 06' 54"S 147° 18' 23"E, TAR, 24 June 2002; NMV A.29959-1 (5), 63.2–85.0 mm LCF (54.9–74.2 mm SL), Middle Creek, tributary, on Bogong High Plains, Alpine N.P., S of Falls Creek, 36° 55' 49"S 147° 18' 09"E, TAR, 20 March 2002; NMV A.29961-1 (1), 71.0 LCF (62.0 mm SL), Mitta Mitta River, 400 m d/s of Hinnomunjie Bridge, W of Benambra, 36° 56' 38"S 147° 36' 40"E, TAR, 19 March 2002; NMV A.30173-1 (10), 48.4–90.7 mm LCF (42.6–80.8 mm SL), Morass Creek, Tableland Road, d/s of Uplands, 36° 51' 33"S 147° 42' 14"E, D.J. Harrington, 27 February 1993; NMV A.30022-1 (1), 56.0 mm LCF (49.2 mm SL), Morass Creek, same loc. as NMV A.30173-1, TAR, 19 March 2002; NMV A.482 (3), 65.0–80.8 mm LCF (57.2–70.4 mm SL), Mount Murphy Creek, 1.6 km from mining huts, NE from Benambra, 36° 43' 09"S 147° 59' 35"E, G. Stroud, 10 January 1975; NMV A.480 (2), 68.7–76.0 mm LCF (60.1–67.2 mm SL), Mount Murphy Creek, same loc. as NMV A.482, G. Stroud, 1 September 1975; NMV A.29979-1 (24), 51.2–98.7 mm LCF (44.5–87.4 mm SL), Nine Mile Creek, The Knockers Track, W of Benambra, 36° 54' 54"S 147° 33' 42"E, TAR, 19 March 2002; NMV A.30183-1 (9), 49.1–97.4 mm LCF (43.2–87.2 mm SL), Reedy Creek, off Mount Battery Track, u/s of junction with Cobungra River, 37° 03' 11"S 147° 23' 33"E, D.J. Harrington, 3 March 1993; NMV A.30019-1 (27), 61.5–96.0 mm LCF (53.0–85.8 mm SL), Swindlers Creek, u/s of weir at end of Davenport Access Track, Mount Hotham, Alpine N.P., 36° 58' 33"S 147° 08' 59"E, TAR, 20 March 2002; **(IV, 02)** NMV A.30180-1 (4), 67.8–96.4 mm LCF (59.2–84.5 mm SL), 3McKay Creek, off track, Aine N.P., 36° 52' 15"S 147° 15' 50"E, J. Reed, 19 January 1994; NMV A.30062-1 (15), 71.5–111.0 mm LCF (62.6–98.3 mm SL), McKay Creek, off track running along McKay Creek, Falls Creek, Alpine N.P., 36° 52' 15"S 147° 15' 50"E, TAR, 17 April 2002; NMV A.30030-1 (13), 75.0–114.0 mm LCF (65.1–101.2 mm SL), Pretty Valley Creek, tributary, on Fainter Fire Track, E of Pretty Valley Pondage, Alpine National Park, 36° 53' 44"S 147° 14' 52"E, TAR, 17 April 2002; **(IV, 03)** NMV A.30170-1 (8), 84.2–114.7 mm LCF (73.6–101.5 mm SL), Bakers Gully Creek, off Bakers Gully Road at junction with Walkers Mine Road, 36° 45' 20"S 146 57' 19"E, TAR, 20 September 1995; NMV A.30076-1 (15), 74.3–95.8 mm LCF (64.9–83.9 mm SL), Bakers Gully Creek, same loc. as NMV A.30170-1, TAR, 21 March 2002; NMV A.30017-1 (15), 72.5–110.3 mm LCF (63.6–98.2 mm SL), Buffalo Creek, above Rollasons Falls, off Mount Buffalo Road, Mount Buffalo N.P., 36° 41' 29"S 146° 49' 12"E, TAR, 21 March 2002; NMV A.29972-1 (2), 84.6–89.3 mm LCF (74.5–76.9 mm SL), Buffalo River, off Dandongadale/ Abbeyard Road, near junction with Four Mile Creek, 36° 51' 24"S 146° 40' 54"E, D.J. Harrington, 1 April 1992; NMV A.30181-1 (11), 62.2–94.8 mm LCF (54.3–83.0 mm SL), Four Mile Creek, at junction with Buffalo River, on Abbeyards Road, Buffalo State Forest, 36° 51' 24"S 146° 40' 54"E, TAR, 26 June 2002; NMV A.30020-1 (17), 63.7–102.6 mm LCF (56.3–90.1 mm SL), King River, west branch, DSM Road, upstream of King Falls, 36° 57' 45"S 146° 20' 02"E, TAR, 16 May 2001; NMV A.30162-1 (7), 61.8–103.6 mm LCF (53.5–91.5 mm SL), Mine Creek, Mine Creek Road, 37° 04' 00"S 146° 25' 39"E, TAR, 14 May 2001; NMV A.30004-1 (10), 59.0–88.1 mm LCF (51.1–78.0 mm SL), Running Jump Creek, Mount Buffalo Road, u/s of Dicksons Falls, Mount Buffalo N.P., 36° 46' 06"S 146° 46' 32"E, TAR, 21 March 2002; NMV A.29962-1 (19), 58.3–114.0 mm LCF (51.2–101.4 mm SL), Stony Creek, tributary, Paradise Falls Road, 36° 52' 14"S 146° 27' 51"E, TAR, 17 May 2001; **(IV, 04)** NMV A.29971-1 (1), 84.2 mm LCF (75.3 mm SL), Broken River, behind tennis courts, Lima South, 36° 48' 47"S 146° 00' 51"E, J. Douglas, 3 October 1995; NMV A.29964-1 (17), 64.2–113.3 mm LCF (56.1–101.5 mm SL), Five Mile Creek, Chapmans Road, E of Boho South, Strathbogie Ranges State Park, 36° 46' 46"S 145° 49' 12"E, TAR, 27

June 2002; NMV A.30023-1 (19), 66.5–118.7 mm LCF (58.1–106.7 mm SL), Middle Creek, Madhouse Road, N of Tolmie, 36° 50' 27"S 146° 15' 04"E, TAR, 18 May 2001; NMV A.30013-1 (12), 64.0–89.5 mm LCF (55.7–78.5 mm SL), Parlours Creek, Lima East Road, Strathbogie Ranges, 36° 50' 58"S 145° 54' 46"E, TAR, 27 June 2002; NMV A.29963-1 (15), 65.8–96.7 mm LCF (57.1–85.8 mm SL), Watchbox Creek, Watchbox Creek Track, Toombullup State Forest, 36° 43' 49"S 146° 11' 47"E, TAR, 27 June 2002; **(IV, 05)** NMV A.30790-1 (17), 63.6–111.8 mm LCF (54.6–98.9 mm SL), Bakers Creek, Buttercup Jeep Track, 37° 03' 19"S 146° 17' 40"E, TAR, 15 May 2001; NMV A.29977-1 (5), 70.9–93.7 mm LCF (62.5–83.0 mm SL), Cerberus Creek, South Cathedral Lane, 37° 24' 14"S 145° 43' 31"E, TAR, 25 May 2001; NMV A.30125-1 (3), 64.7–73.6 mm LCF (56.9–64.4 mm SL), Cerberus Creek, same loc. as NMV A.29977-1, TAR, 15 August 2002; NMV A.30249-2 (1), 82.5 mm LCF (72.3mm SL), Gaffneys Creek, Woods Point/Jamieson Road, Knockwood, 37° 25' 42"S 146° 13' 55"E, D.J. Harrington and J. McKenzie, 12 June 1985; NMV A.29958-1 (9), 71.1–96.6 mm LCF (61.4–85.3 mm SL), Glen Creek, Ferraris Track, Strathbogie Ranges State Forest, 36° 56' 45"S 145° 56' 29"E, TAR, 27 June 2002; NMV A.29973-5 (10), 72.3–99.0 mm LCF (63.6–87.9 mm SL), Godfrey Creek, u/s of weir, u/s of Woods Point/Jamieson Road, 37° 30' 30"S 146° 12' 43"E, TAR, 6 February 2002; NMV A.29973-1 to 4 (4), 93.9–105.9 mm LCF (82.6–94.0 mm SL), Godfrey Creek, same loc. as for NMV A.29973-5, TAR, 4 February 2002; NMV A.30137-1 (1), 76.1 mm LCF (67.7 mm SL), Godfrey Creek, same loc. as for NMV A.29973-5, TAR, 4 February 2002; NMV A.30160-1 (9), 56.1–91.8 mm LCF (48.8–81.0 mm SL), Harpers Creek, Engine Camp Road, Mt. Disappointment State Forest, 37° 23' 38"S 145° 08' 05"E, TAR and P.S. Fairbrother, 7 December 2005; NMV A.30015-1 (12), 66.9–108.2 mm LCF (58.3–96.3 mm SL), Howqua River, tributary, off unnamed track, Alpine N.P., 37° 10' 40"S 146° 34' 00"E, TAR, 14 December 1994; NMV A.30016-1 (3), 74.3–86.8 mm LCF (66.9–77.5 mm SL), Little River, Blue Range Road, Cathedral Range State Park, 37° 23' 27"S 145° 48' 32"E, 4 May 1989; NMV A.30014-1 (2), 85.7–93.5 mm LCF (77.1–83.2 mm SL), Little River, same loc. as NMV A.30016-1, TAR, 6 December 2002; NMV A.29970-1 (2), 90.5–93.7 mm LCF (80.2–83.2 mm SL), Little River, Ruoaks Road, 37° 25' 02"S 145° 49' 09"E, TAR, 7 September 1994; NMV A.30021-1 (14), 69.2–112.0 mm LCF (60.5–99.3 mm SL), Piccanini Creek, u/s from old water supply weir, u/s from Gaffneys Creek, 37° 28' 36"S 146° 11' 50"E, TAR, 9 April 2002; NMV A.30123-1 (10), 60.1–85.6 mm LCF (53.0–75.8 mm SL), Ponkeen Creek, off Longwood/Tarcombe Road, 1.5 km N of Tarcombe, 36° 57' 51"S 145° 24' 37"E, TAR, 14 August 2002; NMV A.29969-1 (2), 76.3–96.0 mm LCF (67.0–85.0 mm SL), Raspberry Creek, 600 m d/s from Godfrey Creek, 37° 30' 15"S 146° 12' 40"E, TAR, 1 February 1995; NMV A.30011-1 (13), 65.9–102.9 mm LCF (58.1–90.6 mm SL), Raspberry Creek, same loc. as NMV A.29969-1, TAR, 28 March 1995; NMV A.30012-1 (11), 53.3–117.1 mm LCF (45.5–103.7 mm SL), Raspberry Creek, just d/s of Godfrey Creek, 37° 30' 28"S 146° 12' 46"E, TAR, 2 May 2000; NMV A.29974-5 (9), 55.7–95.3 mm LCF (47.5–83.7 mm SL), Raspberry Creek, off Woods Point/Jamieson Road u/s to junction with south and east branches, 37° 30' 52"S 146° 12' 57"E, TAR, 6 February 2002; NMV A.29974-4 (1), 113.3 mm LCF (99.6 mm SL), and NMV A.29974-1 (1), 97.4 mm LCF (85.6 mm SL), Raspberry Creek, same loc. as NMV A.29974-5, TAR, 6 February 2002; NMV A.12601 (1), 64.3 mm LCF (56.6 mm SL), Snobs Creek, off Snobs Creek Road, u/s of falls, 37° 18' 21"S 145° 53' 21"E, R.S. Frankenberg, 2 April 1962; NMV A.11490 (2), 65.4–66.2 mm LCF (58.1–58.3 mm SL), Snobs Creek, same loc. as NMV A.12601, L. Ashburner, 7 March 1966; NMV A.30089-1 (9), 60.0–87.3 mm LCF (52.6–76.8 mm SL), South Creek, dam u/s of Granton Road, Granton, 37° 32' 22"S 145° 42' 28"E, TAR, 14 October 1999; NMV A.30161-1 (15), 50.3–93.1 mm LCF (43.7–82.4 mm SL), Springs Creek, fire dam off Yelland Track, 37° 37' 30"S 146° 08' 30"E, TAR, 4 May 2000; NMV A.30136-1 (7), 62.2–105.8 mm LCF (57.6–95.0 mm SL), Steavenson River, tributary, d/s of Yellow Dog Road, u/s of Steavensons Falls 37° 31' 53"S 145° 48' 32"E, TAR and PJU, 5 February 1991; NMV A.13902 (3), 93.9–112.1 mm LCF (82.4–99.5 mm SL), Steavenson River, 30 m u/s of Steavenson Falls, 37° 32' 00"S 145° 46' 29"E, PJU and T. Messerle, 14 January 1994; NMV A.30127-1 (8), 68.7–88.0 mm LCF (59.6–78.1 mm SL), Steavenson River, Olsens Road, u/s of Steavensons Falls, 37° 32' 49"S 145° 48' 05"E, TAR, 14 October 1999; NMV A.29976-1 (2), 62.5–68.3 mm LCF (54.4–60.2 mm SL), Steavenson River, same loc. as NMV A.30127-1, TAR, 21 May 2001; NMV A.29975-1 (2), 66.9–94.9 mm LCF (58.2–84.8 mm SL), Steavenson River, same loc. as NMV A.30127-1, TAR, 6 December 2002; NMV A.30037-1 (15), 57.6–109.2 mm LCF (50.5–98.0 mm SL), Strath Creek, Flowerdale Road, Mt. Disappointment State Forest, u/s of Strath Falls, 37° 19' 27"S 145° 11' 27"E, TAR, 19 February 2002; NMV A.30028-1 (4), 84.5–94.8 mm LCF (78.8–83.8 mm SL), Trawool Creek, below Trawool Reservoir, u/s of Granite, 37° 07' 17"S 145° 11' 41"E, TAR, 20 February 2002; NMV A.30129-1 (7), 67.6–94.9 mm LCF (59.2–84.4 mm SL), Watch Box Creek, Euroa/Mansfield Road, E of Gooram, Strathbogie Ranges, 36° 54'

30"S 145° 38' 17"E, TAR, 13 August 2002. **(IV, 06)** NMV A.30138-1 (19), 45.7–109.9 mm LCF (39.8–97.7 mm SL), Campaspe River, Ashbourne Road, Ashbourne, 37° 23' 12"S 144° 27' 04"E, TAR, 27 July 2001; NMV A.30116-1 (6), 67.6–86.3 mm LCF (59.5–75.8 mm SL), Five Mile Creek, Calder Highway, Woodend, 37° 21' 16"S 144° 31' 51"E, TAR, 27 July 2001; NMV A.30071-1 (10), Little Coliban River, Tylden/Woodend Road, Tylden, 51.0–82.5 mm LCF (44.8–71.9 mm SL), 37° 19' 48"S 144° 24' 60"E, TAR, 27 July 2001; **(IV, 07)** NMV A.30195-1 (4), 64.5–72.2 mm LCF (57.6–64.1 mm SL), Loddon River, Bridge Road, Wombat State Forest, 37° 20' 27"S 144° 15' 31"E, JPC, 5 March 1999; NMV A.30158-1 (16), 59.7–90.2 mm LCF (53.0–80.3 mm SL), Loddon River, same loc. as NMV A.30195-1, TAR, 3 June 2002.

Additional non-type material examined (not measured): see Appendix 5.

Diagnosis. *Galaxias olidus* is the least morphologically specialised species in the complex. It is generally intermediate to all other species in the complex with respect to morphometric and meristic values, however, also displays the highest amount of morphological variation in some characters. It can be distinguished by a combination of the following characters and careful comparison with the diagnoses, descriptions and geographical distributions of the other species. Some populations, or individuals within a population, with a series of small, closely-spaced and short, distinct mid-lateral black bars, usually extending from near the pectoral fin base posteriorly to past the pelvic fin base, though equally as often, absent; body depth at vent moderately shallow (8.3–16.9 % SL); caudal peduncle length similar to that of caudal fin, relatively shortish, but moderately deep; dorsal midline usually partly flattened anteriorly from above pelvic fins; trunk with dorsal and ventral profiles relatively gently and evenly arched; interorbital usually relatively flat though sometimes slightly to strongly convex; nostrils short to moderately long, usually not visible from ventral view; mouth generally terminal, occasionally slightly sub-terminal; lower jaw shorter than upper; caudal peduncle flanges usually low and long, generally reaching to, or near, anal fin base; anal fin origin usually under 0.68 (0.21–1.14) distance posteriorly along dorsal fin base; 1, more often 2, pyloric caecae of moderate length (mean length of 3.1 % SL); gill rakers variable, short to moderately long and stout to moderately thin; expanded caudal fin rays usually equal to body depth through pectoral fin base, occasionally wider or narrower; lamina of paired fins oriented anterio-ventrally to ventrally; and, raised lamellae can be present on ventral surface of rays, and if so, weakly to strongly developed.

Galaxias olidus is morphologically most similar to *Galaxias ornatus*, but can be distinguished from it by the characters listed in the diagnosis for that species, and the geographical ranges of the two species are separated by the Great Dividing Range, except for an anomalous population of *G. ornatus* in the southern Goulburn River system. *Galaxias olidus* can also be confused with *Galaxias oliros* **sp. nov.**, with which it can be found sympatrically, but can be distinguished from it by characters listed in the diagnosis of that species.

Description. As for the genus and members of the *Galaxias olidus* complex, except as indicated below, based on 467 specimens, 43.8–106.7 mm SL, and 1396 additional specimens for meristics. Holotype examined. See Tables 4 to 9 for frequencies of meristic values and Table 29 for a summary of meristic variation. Segmented dorsal fin rays 10 (8–11; [9*]), of these 8 (7–9) branched and 2 (1*–2) unbranched; segmented anal fin rays 11 (9–12), of these 9 (8–10) branched and 2 (1–3) unbranched; caudal fin rays 16 (15–16); segmented pectoral fin rays 15 (13–16), of these 13 (11–14) branched and 2 (1–3) unbranched; pelvic fin rays 7 (7–8), of these 6 (6–7) branched and one unbranched; gill raker total count (lower limb and upper limb) 12 (11–14; [10*]), lower arch with 9 (8–10; [7*]) and 3 (2–4) on upper, variation on first gill arch 7+1 (4), 7+2 (3), 7+3 (13*), 8+1 (1), 8+2 (29), 8+3 (201), 8+4 (67), 8+5 (1), 9+1 (2), 9+2 (67), 9+3 (647), 9+4 (421), 9+5 (13), 9+6 (1), 10+2 (13), 10+3 (149), 10+4 (180), 10+5 (16), 10+6 (2), 11+3 (10), 11+4 (20), 11+5 (3); vertebrae 52 (50–56); usually two, less often one* pyloric caecae on stomach.

See Table 30 for comparative value ranges of morphometric characters. Body relatively morphologically variable, usually elongate and moderately shallow though shallow or moderately long and deep, dorsal midline usually partly flattened anteriorly from above pelvic fins, depth through pectoral base usually 1.3 that through vent, trunk with dorsal and ventral profiles relatively gently and evenly arched from snout to caudal peduncle or ventral slightly less so, belly a little deepened and laterally expanded in maturing individuals, body tapering back to a shortish, 7.8 (6.2–10.4) in SL, caudal peduncle of moderate depth, 12.2 (9.9–15.9) in SL, the peduncle depth 1.5–1.6 in its length; accessory lateral line present. Head of moderate length, 4.5 (3.8–5.3) in SL, and usually slightly shorter than PelAn distance, 0.9 (0.8–1.2) in PelAn, of moderate depth and width, 2.3 (1.9–2.8) and 1.6 (1.3–1.8) in HL respectively, distinctly wider than deep (depth 1.4–1.5 in HW), profile weakly wedge-shaped to obtuse and generally straight dorsally, sometimes bulbous, becoming quite fleshy in older individuals; eyes of moderate size, 5.2 (3.8–7.0) in HL, situated moderately high on head near dorsal head profile, interorbital usually relatively flat though sometimes slightly to strongly convex, of moderate width, 2.5 (2.1–3.1) in HL and 2.1 (1.8–2.3) times ED; cheeks usually expanded slightly below eyes and eye profiles usually obscured or just visible laterally from ventral view; snout moderate, 3.5 (2.9–4.7) in HL and 1.5 (1.3–1.5) times ED, lateral profile moderately deep and rounded to bluntly pointed; post-orbital head length of moderate length, 1.8 (1.6–2.1) in HL; nostrils short to moderate length and not visible anterio-laterally from ventral view; mouth terminal, occasionally slightly subterminal, of moderate length, 2.7 (2.2–3.2) in HL, posterior extent usually reaching to under anterior 0.3–0.5 of eyes, or farther, and usually 0.6 (0.4–0.9) ED below ventral margin of eye, anterior tip of upper lip level with about middle of eye, gape of moderate width, 2.5 (1.7–3.6) in HL, usually wider than length of upper jaw though sometimes shorter, and about 1.6–1.9 in HW. Jaws subequal, lower 0.9 times length of upper. Pyloric caecae of moderate length, longest usually 3.1 % of SL (0.4–7.2 %); gill rakers variable, short to moderately long, stout to moderately thin, and bluntly rounded to sharply pointed.

Median fins usually moderately to heavily fleshy at bases, paired fins less so, with thickening extending distally over 0.5 of fin area, extending farther between fin rays; anal fin base of moderate length, that of dorsal fin shortish and 0.9 times anal fin base length, fins rounded and moderately long, anal fin slightly longer than dorsal, middle rays longest, anal fin origin usually under 0.68 (0.21–1.14) distance posteriorly along dorsal fin base. Pelvic fins of moderate length, 9.2 (7.6–11.5) in SL, 0.9 (0.7–1.2) of pectoral fin length, inserted just posterior to mid-point of standard length and extending about 0.5 distance to anal fin base; pectoral fin of moderate length and rounded to paddle-shaped, 8.1 (6.4–10.7) in SL, extending about 0.4 distance to pelvic fin base, low on body with dorsal end of fin base level with posterior extent of mouth, lamina of paired fins oriented anterio-ventrally to ventrally, raised lamellae can be present on ventral surface of rays, and if so, weakly to strongly developed. Caudal fin of moderate length, 7.7 (5.6–9.8) in SL, emarginate, as long or slightly longer than caudal peduncle (1.0–1.1times LCP), vertical width of expanded rays usually equal to body depth through pectoral fin base, occasionally wider or narrower, flanges low and moderately to well-developed along caudal peduncle, variable in length though usually reaching anal fin base, sometimes as a low, long ridge, or reaching 0.5 distance anteriorly along length of rays in adpressed anal fin: occasionally just reaching distal end of adpressed anal fin.

Also see line drawing in McDowall & Frankenberg (1981) for general body shape.

TABLE 29. Summary of meristic variation in *Galaxias olidus* (T—total; B—branched; L—lower limb; S—single; U—upper limb). Range in 90 % and 100 % of specimens.

Character	Mode	Mean	SD	SE	Range 90 %	Range 100 %	N
Dorsal Rays (T)	10	9.6	0.75	0.02	8–11	7–12	1862
Dorsal Rays (B)	8	7.7	0.72	0.02	7–9	4–11	1862
Dorsal Rays (S)	2	1.8	0.50	0.01	1–2	1–4	1862
Anal Rays (T)	11	10.6	0.78	0.02	9–12	8–14	1861
Anal Rays (B)	9	8.7	0.74	0.02	8–10	6–11	1862
Anal Rays (S)	2	1.9	0.50	0.01	1–3	1–4	1862
Caudal Rays	16	16.0	0.37	0.01	15–16	13–19	1862
Pectoral Rays (T)	15	14.7	0.92	0.02	13–16	12–18	1863
Pectoral Rays (B)	13	12.7	0.98	0.02	11–14	9–17	1803
Pectoral Rays (S)	2	2.0	0.36	0.01	1–3	1–5	1803
Pelvic Rays (T)	7	7.1	0.35	0.01	7–8	5–9	1863
Pelvic Rays (B)	6	6.1	0.36	0.01	6–7	4–8	1863
Pelvic Rays (S)	1	1.0	0.11	0.00	1	0–3	1863
Gill Rakers (T)	12	12.4	1.05	0.02	11–14	8–16	1863
Gill Rakers (L)	9	9.0	0.68	0.02	8–10	7–11	1863
Gill Rakers (U)	3	3.3	0.64	0.01	2–4	1–6	1863
Vertebrae	52	52.7	1.74	0.05	50–56	49–60	1441

TABLE 30. Morphometric variation in *Galaxias olidus* (values are percentages of denominators in ratios, except for LCF and SL).

	Holo-	Non-Types (N = 466)			
Character	type	Mean	Min.	Max.	S.D.
LCF (mm)	101.6	78.5	49.5	118.7	
SL (mm)	88.5	69.5	43.8	106.7	
SL / LCF	87.1	88.5	85.0	90.7	0.78
BDV / SL	16.9	11.0	8.3	14.7	1.07
BDPec / SL	18.9	14.4	11.0	18.9	1.19
BDPec / BDV	112.1	116.7	87.1	147.6	8.87
LCP / SL	12.4	12.8	9.6	16.0	1.02
DCP / SL	9.7	8.2	6.3	10.1	0.70
DCP / LCP	78.3	64.2	46.1	88.9	7.47
CFFL / SL	14.8	13.0	10.2	17.7	1.01
LCP/CFFL	83.4	98.8	66.2	135.6	11.04
PreD / SL	71.8	71.4	67.6	75.9	1.36
PreA / SL	75.7	75.8	69.6	79.9	1.46
PreD / PreA	94.8	94.2	89.6	99.4	1.79
DF–AF / LDB	71.4	67.8	20.8	114.3	12.67
LDB / SL	10.4	9.5	6.9	13.7	0.86
LAB / SL	9.9	10.6	8.1	16.0	0.95
LDB / LAB	105.5	90.3	69.7	120.5	7.39
DL / LDB	156.3	154.6	108.7	217.6	13.22
AL / LAB	159.8	146.6	106.6	185.1	12.26
DL / SL	16.3	14.7	9.5	17.5	1.17
AL / SL	15.8	15.4	12.2	18.4	1.02
DL / AL	103.1	95.3	61.2	117.7	7.30
PecL / SL	13.8	12.3	9.3	15.5	0.96
PelL / SL	11.0	10.9	8.7	13.2	0.86
PelL / PecL	80.0	88.7	72.4	116.7	6.04
PrePel / SL	50.5	51.9	47.7	57.2	1.51
PecPel / SL	31.7	31.4	26.5	37.1	1.75
PelAn / SL	22.6	23.7	19.2	27.2	1.24
PecL / PecPel	43.4	39.2	26.0	52.3	3.96
PelL / PelAn	48.6	46.1	35.1	60.9	4.45
HL / SL	22.7	22.0	18.7	26.4	1.15
HL / PelAn	100.3	93.4	76.3	122.6	1.15
HW / HL	68.1	64.0	54.1	75.2	3.93
HD / HL	51.4	43.1	35.5	52.6	3.14
HW / HD	132.4	148.9	124.7	177.2	8.81
SnL / HL	26.4	28.7	21.2	34.7	1.94
SnL / ED	146.0	152.1	87.1	207.4	19.54

...... continued on the next page

TABLE 30. (Continued)

Character	Holo-type	Non-Types (N = 466) Mean	Min.	Max.	S.D.
ED / HL	18.1	19.1	14.3	26.5	2.04
ED / HD	35.1	44.5	31.0	68.1	6.24
PoHL / HL	54.0	54.3	47.0	60.9	2.38
IOW / HL	37.7	39.4	32.4	47.9	2.37
ED / IOW	47.9	48.7	35.1	70.3	5.90
UJL / HL	46.3	37.5	31.0	46.3	2.68
LJL / HL	38.6	34.0	27.0	45.6	2.64
GW /HL	41.4	39.4	27.8	57.1	4.69
LJL / UJL	83.3	90.7	77.7	103.3	3.89
LJL / GW	93.3	87.1	64.5	112.6	9.22
GW / HW	60.7	61.5	46.2	78.2	5.27
SnL/UJL	57.0	76.7	56.0	93.6	5.91

Size. Recorded to 126 mm LCF and 25 g; commonly to 55–80 mm LCF.

Colour in life. Extremely variable in base colouration and body pattern between populations across its geographic range (Fig. 23), less so within populations. Body predominantly tan, light brown to brown or olive, sometimes orange-brown, on back and sides, extending over head and snout, becoming lighter below lateral line, belly usually cream, occasionally almost white. Overlain by extremely variable pattern consisting of dark brown or grey, grey-brown or almost black spots, irregularly shaped blotches, patches, flecks and bands, and reticulations, or various combinations of these, with blotches, patches and large spots often coalescing to form irregularly shaped vertical bands. Trunk pattern usually most dense on dorsal surface, also extending down sides past lateral line, sometimes to ventro-lateral margin, also extending onto top of head and often down sides and onto snout. Body pattern sometimes quite pale or almost absent in some individuals or populations, or pattern also overlain by shading formed by profuse tiny grey spots. Typically, a series of small to moderately large, usually thin and elongate, sometimes ovoid to almost circular, closely-spaced black to very dark brown bars present along the lateral line, extending posteriorly from just above the pectoral fin base, often to the caudal peduncle, with posterior bars often paler or grading into diffuse blotches; bars may be very pale or absent in some populations. When present, bars always narrower, more closely-spaced, variable in shape and numerous than those in *Galaxias fuscus*, and also extend farther posteriorly, usually to at least origin of anal fin or farther.

FIGURE 21. *Galaxias olidus* holotype (BMNH 1866.2.13.24), showing encysted metacercariae (as small spots) embedded in the skin of the trunk and head, and in the fins (note: head curved to the right in horizontal plane) (T.A. Raadik).

Mid-dorsal surface of trunk often with a moderately thick single or double row of gold spots extending from nape to dorsal fin base; top of head and snout sometimes with diffuse scattering of small gold flecks; trunk often with broad diffuse band of golden to coppery spots or flecks usually extending from near base of pectoral fin onto caudal peduncle, usually centred along lateral line. Gill cover translucent, often with a small to moderately large golden patch; iris golden to coppery gold. Fins usually translucent light grey, olive or pale yellow. Gravid females with fine black to dark grey stippling along ventro-lateral surface of trunk between the pectoral fin base and vent. See below for more detailed comments on body pattern.

Occasionally, snout and anterior portion of head including, the nape, noticeably an almost transparent pale lime-green (also found sporadically in *Galaxias oliros* **sp. nov.** and *Galaxias ornatus*), though the reason is unknown.

Colour of preserved material. Base colour of head and body pale yellowish brown. Configuration, degree and extent of body patterning highly variable, with some populations lacking any pattern. Generally, dorsal surface of trunk with dense pattern of small to moderately sized, closely-spaced, brown to dark brown, single or coalescing, irregularly shaped blotches or spots, sometimes vermiculations, often extending onto head to tip of snout, and laterally onto head. Dorsal pattern usually extending onto lateral surface of trunk, posteriorly from pectoral fin base, as more discrete and widely spaced, irregularly shaped, thin to moderately wide, vertical to near-vertical stripes and blotches, some coalescing, reaching ventrally past lateral line to about level with pectoral fin base, sometimes farther, extending almost to ventral-lateral margin posteriorly from pelvic fin base, also extending over entire caudal peduncle area; ventral surface of trunk pale yellowish brown to cream. Bars, stripes and blotches usually distinctive and bold on sides, usually darker than dorsally, often darkest, almost black, on and around lateral line; pattern sometimes light brown or very faded and indistinct, though usually only on a few individuals within a population. Fine, dark brown stippling usually present on sides and ventral surface of lower jaw, and along posterior fleshy extension of operculum. Usually brown to black spots at base of, and along gill filaments, also on gill rakers, and brown spotting inside gill cover.

Eye usually dark grey to black, pupil translucent pale orange or yellow. Teeth translucent yellow to pale orange–yellow, tips orange to orange–red; gill rakers pale yellowish brown. Fins pale brown or yellow, becoming translucent at about 0.5 to 0.7 distance along fin length, fleshy bases of dorsal, anal and pectoral fins sometimes with fine brown stippling, sometimes also extending onto base of caudal fin and caudal peduncle flanges. Fin rays opaque to translucent, external edges of rays highlighted with fine brown spots forming thin lines.

Etymology. Whilst not elaborated upon in the original description (Günther 1867), the specific epithet is derived from the Latin, *olida*, *olid* or *olidum*, meaning to smell or foul smelling, stinking. The reason for the name remains unclear as live or freshly preserved *Galaxias olidus* are not known to impart a distinctive odour, and the holotype currently smells only of preservative. Possibly the liquid the holotype was originally preserved in, or later transferred to, may have had a distinctive odour at the time the description was made, but this is purely conjecture.

Genetics. Allozyme and mtDNA analysis of this species can be found in Adams *et al.* (2014**;** taxon code OL). Diagnostic allozyme loci (2–12) between this taxon and the other species in the *Galaxias olidus* complex are provided in Table 12.

Distribution: see Fig. 22. Widespread in south-eastern Australia, found on both sides of the GDR from southern QLD, southward through NSW and the ACT, south-west across northern VIC, with a disjunct population straddling the Mont Lofty Ranges in SA. Within this distribution, occupy an extensive elevational range from near sea level in SA, up to over 2000 m asl on Mount Kosciuszko. Specifically, found in coastal southern Queensland from about Canungra Creek in the MacPherson Range (Logan-Albert system), to the Moruya catchment in southern NSW though appear to be absent from the small South Coast catchment in southern QLD, and from the Tweed, Brunswick, Manning, Karuah, Macquarie Lakes, St Georges, and Tuross catchments in NSW. Also found in the upland portion of the Snowy River catchment in southern NSW, and in the Tambo and Mitchell river catchments in southern coastal VIC.

Inland (Murray-Darling drainage division) distribution extends from Dalrymple Creek in the upper Condamine catchment in southern QLD, southward along the GDR through the Border Rivers, Gwydir, Namoi, Castlereagh, Macquarie and Lachlan catchments to the Murrumbidgee and Murray catchments in southern NSW, and westward in VIC tributaries of the Murray River from the Upper Murray catchment to the Loddon River catchment. Typical distribution in inland NSW considered confined generally to east of the Newell Highway, with previous records from Balranald (AMS IB.3676), Condobolin (AMS IB.2892 and IB.2893), Berringaga (?=Bringagee; AMS

IB.754), Walgett (AMS IB.575 and IB.755) and downstream of Narrandera (AMS I.17993-001 and I.19315-001) considered to represent individuals washed downstream during wetter periods from more permanent populations at higher elevations.

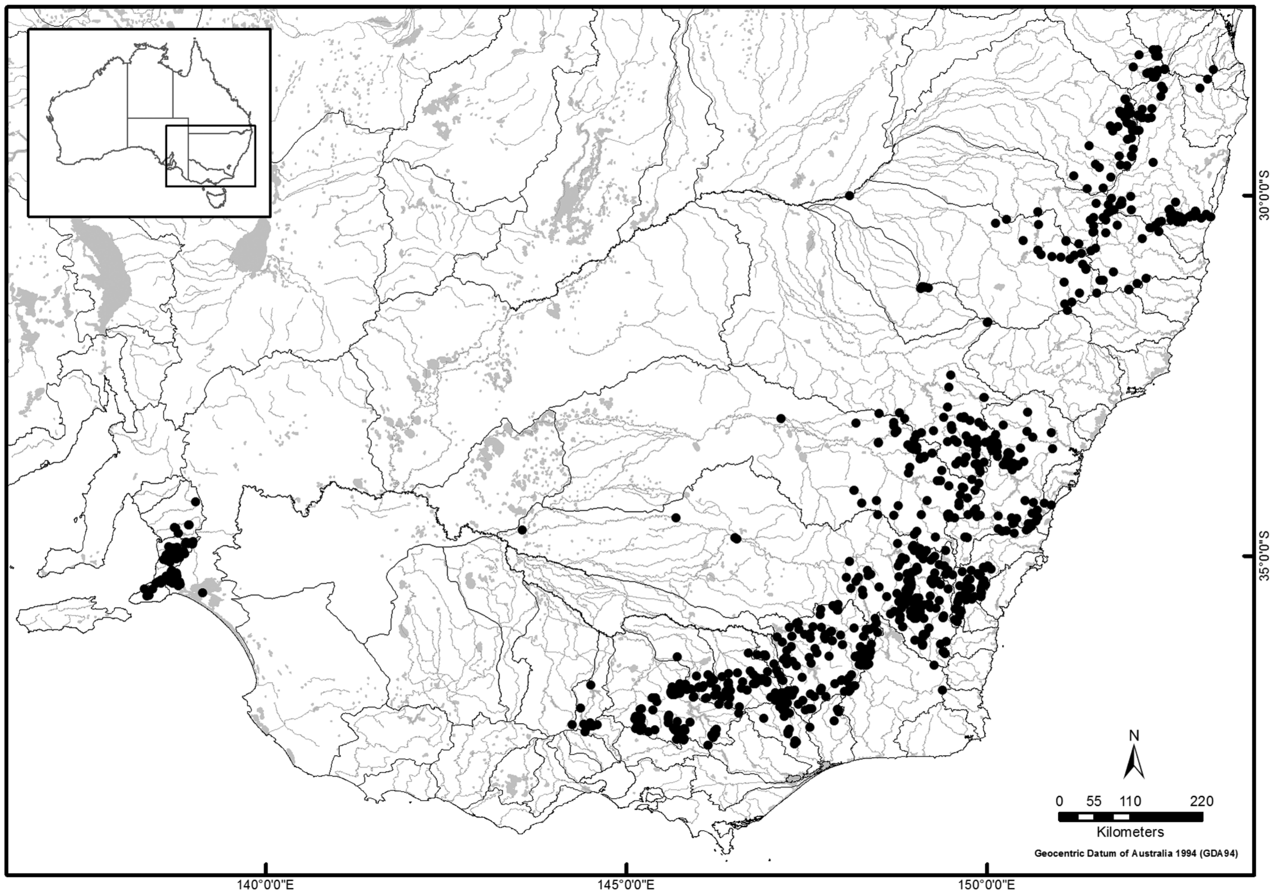

FIGURE 22. Distribution of *Galaxias olidus* in south-eastern Australia (river basins shown—refer to Fig. 1).

In SA, found in two tributaries of the lower Murray River system draining the eastern Mt. Lofty Ranges (Finnis and Tookayerta), and in the Yankalilla, Carrickalinga, Myponga, Onkaparinga, Torrens and Gawler catchments draining the west of the Mt. Lofty Ranges (South Australian Gulf drainage division). Previously also known from Kangaroo Island, and possibly the Yorke Peninsula, but now considered extinct.

The minimum elevational range in northern parts of its distribution (northward from mid-NSW) is higher than farther south, with most populations confined to more cooler, upland areas along the GDR or other mountain ranges, usually above 400–500 m asl.

Sympatry. Only species in the *Galaxias olidus* complex found within its range in the Murray–Darling Basin northwards from the Murrumbidgee River system, and in coastal catchments northward from the Moruya River catchment in NSW. Possibly historically sympatric with *Galaxias mungadhan* **sp. nov.** in the Mitchell River catchment in coastal Victoria. Found in sympatry with *Galaxias oliros* **sp. nov.** and *Galaxias arcanus* **sp. nov.** in the Murray River and tributaries in north-eastern Victoria and southern NSW (Upper Murray, Kiewa, Ovens, Broken and Goulburn River basins), and with *Galaxias fuscus* in the Goulburn River system; in sympatry to parapatry with *G. oliros* **sp. nov.** in the very upper Campaspe and Loddon River systems; and, in broad sympatry (separate catchments) with *G. oliros* **sp. nov.** in the Eastern Mount Lofty Ranges in SA. Recorded from river systems with *Galaxias brevipinnis*, *Galaxias maculatus* and *Galaxias truttaceus* in coastal catchments, and with *G. brevipinnis* and *Galaxias rostratus* in north-east Victoria and the Murray River; also historically with *G. rostratus* from tributaries of the Murray and Darling rivers in inland NSW and possibly in swamps of the lower Murray River in SA.

Habitat. Found in a wide range of freshwater aquatic habitats at low to high elevations (lowland to montane reaches), ranging from slow to moderately flowing, clear to turbid, medium to larger rivers (4–20 m average width), and moderately to fast flowing, small to medium sized creeks, (0.5–5 m average width). Also found in some lowland wetlands and billabongs in VIC to central and northern NSW, onstream farm dams, upland wetlands (e.g. alpine bogs), and occasionally in upland lakes (e.g. Lake Cootapatamba) and disconnected pools in drying water courses. Usually found in shallow riffle areas or moderately deep runs, particularly when instream predators are present, to deeper (0.3–> 1.2 m average depth), habitats in pools. Usually found near the substrate or amongst dense aquatic vegetation, rocks, large and small timber debris and within undercut banks, though also occasionally found in the open in midwater, particularly in the absence of instream predators. Can survive in refuge pools in ephemeral creeks, but often only those with a small but sustained freshwater inflow (e.g. freshwater spring).

General Biology. Confined to freshwater and considered to not undertake migration as part of its life cycle. General biology covered by Harasymiw (1970), Cowden (1988), Drayson (1989), O'Connor *et al.* (2001), Close (1995), Brinkley (1996), though all but one study were conducted in a few tributaries of the Murrumbidgee River in the ACT. Consequently many aspects of biology and ecology may not be applicable to populations in other areas of their range, and this knowledge is therefore considered poor for this species. Some additional information is presented below.

Usually recorded at densities up to 0.5–1.5 fish/m^2, though can be abundant in isolated pools (> 2.0 fish/m^2) in the absence of instream predators. Often the only fish species present in upland streams, but in lower to mid reaches collected with a diverse range of fish and decapod crustacea (shrimp, prawns and crayfish). Some populations at higher elevations along the GDR in VIC, NSW and southern QLD in streams within catchments which are usually covered by snow for varying periods of time during winter. In particular, found in VIC and southern NSW well above the winter snowline in streams which may freeze over and are covered by snow for 2–3 months. Whitley (1959) incorrectly commented that '…*Galaxias findlayi* [? = probably *Galaxias olidus* and *Galaxias supremus* **sp. nov.**—see below] enjoys life above the snowline but swims to lower warmer levels during the winter.' (p. 136).

Spawning period poorly defined across its broad geographical range but appears to extend from about early May to June in SA, May to August in VIC and very southern NSW, and August to October in northern NSW and southern QLD. Unshed, mature oocytes are from 1.0–1.3 mm in diameter, roughly spherical, and orange to pale orange. Fecundity is moderate, with 560 to 1275 mature oocytes recorded from two females 62.0 and 84.7 mm LCF respectively. Juveniles reach a length of about 35–40 mm LCF in their first year.

Found to be infected with the parasitic copepod *Lernaea cyprinoides* (?), and can be lightly to heavily infected with small red, brown, grey or black cysts, possibly trematode metacercariae, embedded in the skin of the head or trunk, or in fins (e.g. see Fig. 21). Some individuals recorded with one to two short, thin, white worms, coiled and pointed at both ends, from amongst fat deposits around the stomach in the body cavity. Also recorded with deformities of fins (dorsal, pectoral, pelvic), complete absence of pelvic fins, deformities/damage of the jaws, bulging eyes, large, single cyst embedded under the skin on the head or body, some with curvature of the spine, and also being attacked by a leech (Cadwallader 1978).

Variation. Has the highest range in variation in morphological characters, particularly meristic values and colour pattern, in the species complex. Consequently many populations, including those that are close or adjacent to each other, can look superficially different. Body pattern can vary greatly (Fig. 23), ranging from densely and boldly marked to almost plain, and with distinct mid lateral bars or without. Putative hybridisation with *Galaxias fuscus*, *Galaxias oliros* **sp. nov.** and *Galaxias supremus* **sp. nov.**, can add further to difficulties in taxon discrimination.

Remarks. The holotype was examined in detail. Its condition is good for its age (145+ years), though the head, including the jaws, are bent, possibly from having previously been squeezed into a smaller jar, and the viscera are soft and partially degraded. Of particular note, and which was not detailed by Günther (1866) in his original description, or by Regan (1906) in his revision of the Galaxiidae, is that the body is very deep for its length and the fish therefore appears to be slightly stunted (i.e. should be longer for its depth). This is supported by Stokell (1947) who examined the vertebrae and found that the specimen had a low vertebral count with many fused vertebrae (also confirmed in this study).

Also not previously noted (Günther 1866, Ogilby 1896, Regan 1906, Stokell 1947, McDowall & Frankenberg 1981) is that the holotype has a single pyloric caecum, the anal fin origin commences under the 7th (third last) segmented dorsal fin ray, the mouth is deformed, extending posteriorly to under about the middle of the eye on the right side and to past the posterior margin of the eye on the left side, and that sex could not be confidently determine as gonads were difficult to locate due to the poor condition of the viscera, either being in a very early stage of development, or having been removed. Further, the body, head, fins and gill arches are covered in small, reddish brown, embedded metacercarial cysts which Günther (1866) erroneously referred to as "…thick black dots…" (p. 209).

The body depth at the vent (as a proportion of its standard length) of the holotype is greater than recorded elsewhere across the range of *Galaxias olidus* or within all other taxa in the complex (compare morphometric variation between taxa—this study). The abdominal cavity appears distended, yet the stomach, which is large and full, does not fill the cavity, and fat deposits or large gonads are not present, possibly having been previously removed, though it is difficult to tell.

The validity of *Galaxias olidus* Günther, 1866 as an Australian species, was raised by Ogilby (1896) who stated it was from New Zealand but did not provide evidence for his decision. Later, Stokell (1947) upheld this view, but was also confused by a headless second specimen in the same jar as the holotype (not noted by Günther (1866) or Regan (1906)). The headless specimen was examined during this study, along with its head which was also in the jar, and found to conform in colour pattern, morphometric and meristic characters to *Galaxias brevipinnis* (e.g. distinctive colouration, head broad and flat, two long pyloric caecae, much shorter lower jaw, large paired fins, short but deep caudal peduncle and anal fin origin is only slightly rearward from that of the dorsal fin origin). Despite having vertebral abnormalities, which was also noted amongst other specimens of *Galaxias olidus* during this study, the morphology of the holotype was found to conform to that of other samples collected across the range of the taxon in south-eastern Australia and is therefore considered an Australian species.

Galaxias findlayi Macleay, 1882 was described from Mount Kosciuszko, from where *Galaxias olidus* and *Galaxias supremus* **sp. nov.** are also known. The type specimens of *G. findlayi* have been lost, but, based on comparison with the published description (see Appendix 1), significant differences exist in the morphology between *G. findlayi* and *Galaxias supremus* **sp. nov.**, particularly the pelvic fin ray count. Less differences exists between *G. findlayi* and *G. olidus*, though detailed comparison is hampered by the loss of type specimens and lack of fresh comparative material. The taxonomic status of *G. findlayi* could therefore not be resolved and its current placement as a junior synonym of *Galaxias olidus* is upheld.

Ogilby (1896) redescribed *Galaxias findlayi* from a series of specimens collected from Mount Kosciuszko (Raadik and Kuiter 2002), which cannot be located with certainty (see Appendix 1). Comparison of his redescription with Macleay's original description, and with material from *Galaxias olidus* and *Galaxias supremus* **sp. nov.**, strongly suggests that Ogilby's redescription is based on individuals representing multiple species, and consequently is of little taxonomic value. Of additional note is the reference by Frankenberg (1969) and McDowall & Frankenberg (1981) to a distinctive colour pattern in *G. findlayi*, typified as dark, irregular blotches, grading into a speckled or vermiculated pattern. This pattern differs to that in Macleay's (1882) original description and is based on collection of presumed topotypical material (Frankenberg 1969) and possibly on the (inaccurate) revised description of *Galaxias findlayi* by Ogilby (1896) (see above). Given the taxonomic confusion regarding the genus *Galaxias* in the upper Snowy River system, it is difficult to determine to which species the description of colour pattern by Ogilby (1896) and Frankenberg (1969) refer.

The revision of *Galaxias findlayi* by Regan (1906) is far more confusing and should be disregarded. He studied two specimens collected by Ogilby and five provided from the Australian Museum from the Australian Alps (see issues above, plus also multiple or different species), and included specimens from the Richmond River and near Colo Vale which are now known to be *Galaxias olidus*

Further, as the identity and distribution of galaxiids in the upper Snowy River are poorly known, historical records should be treated with caution (e.g. Helms 1890, etc.), particularly where voucher specimens are unavailable or collection locality information is imprecise. These records may be referable to *Galaxias olidus*, *Galaxias supremus* **sp. nov.**, to additional undescribed species, or combinations of species. Additional, detailed assessment of the genetic and morphological variation of galaxiids is therefore urgently required, based on systematic collection of fresh material, to resolve the systematics of the genus in the upper Snowy River system, upstream of Dalgety, and to define distributions.

The name *Galaxias guttatus*, attached to one specimen lot (NMW 78274), has no validity as it is an unpublished name. The specimens were examined and found to conform to *G. olidus* (Appendix 6). Further, a large number of *Galaxias*, weighing approximately 101.6 kg (224 lbs), were mistakenly sent to London in 25 wool bales from Midgeon Station near Narrandera (NSW) in about 1888–9 (Neill 1890). These fish came from Lake Midgeon or nearby and inadvertently entered the bales via water which was used to wash the wool. Eighty-five fish were returned to Australia and exhibited at a meeting of the Royal Linnean Society of New South Wales (Neill 1890), but their current location is unknown. The fish may have been *Galaxias olidus* or *Galaxias rostratus*, or a mix of both, as both have been recorded from the area. A further novelty report of what is presumed to be referrable to *G. olidus* is of a specimen found coming through a tap in Katoomba, NSW (Frankenberg 1966). The identity of the *Galaxias* sp. from the upper Murrumbidgee River, purported to be a new species (Macleay 1885), could not be defined as no specimens could be located. Based on the area of collection, this record may be attributable to *G. olidus*

Within the known range of *Galaxias olidus*, as defined by McDowall & Frankenberg (1981), the species has now been recorded from previously defined datagap areas in the Hastings and Tuross river systems in northern and southern coastal NSW respectively, from the Broken and Avoca river systems in northern VIC, and from the Castlereagh River system in inland NSW. McDowall & Frankenberg (1981) also implied the species was not present in the Hunter River system in coastal NSW as they stated that the taxon was absent from "...between the Macleay and Hawkesbury Rivers..." (p. 489), but this was in error as they were aware of a record from the Hunter River system (Omadale Brook, AMS IB.743). *Galaxias olidus* was sampled during this study from an additional seven sites in the Hunter River system, confirming its presence in that catchment. Of note is that two distinct mtDNA lineages were identified amongst these samples (Adams *et al.* 2014), one conforming to *G. olidus*, and the other possibly representing an additional new candidate taxon. Allozymic and detailed morphological study of additional material is required to resolve species boundaries within this catchment.

Other significant changes in the previously known distribution of *Galaxias olidus* s.l. is its absence from coastal catchments south of the Great Dividing Range in southern NSW and VIC (between the Tuross River system, NSW, and the eastern Mount Lofty Ranges in SA), except for the upper reaches of the Snowy River system (upstream of about Eucumbene), and the Tambo and Mitchell River systems draining to the Gippsland Lakes in VIC. Previous records of *G. olidus* s.l. in this region (besides those areas listed above) are referrable to other species defined in this study in the *G. olidus* complex (see under the separate species treatments). Further, previous records of *G. olidus* s.l. in the Red River in East Gippsland (VIC) are considered erroneous, and referrable to *Galaxias brevipinnis* (Tunbridge 1983, Raadik 1992a: 29, 38, 1992b fig. 16 *partim*).

The highest recorded population is in Lake Cootapatamba (at approx. 2030 m asl) (Green 2006) and makes *Galaxias olidus*, along with *Galaxias supremus* **sp. nov.**, the highest occurring galaxiids in the family Galaxiidae. They are found 600+ m higher than *Galaxias brevipinnis*, the second highest occurring galaxiid, which has been recorded to 1390 m asl in New Zealand (NZ Freshwater Fish Database, NIWA, accessed 2010).

The most northern record in coastal catchments for *Galaxias olidus* appears to be from the upper Canungra Creek near O'Reilly's Guest House in the MacPhearson Ranges, south-eastern QLD. One specimen was collected by Terzis (1986) but is now in very poor condition (AMS I.29429-001). The exact collecting locality is unknown, and there was confusion for a while regarding the stream of capture (Canungra Creek or the adjacent Morans Creek immediately to the south) (Themo Terzis, pers. comm. 2001, 2003), though the specimen was dipnetted, with difficulty, from a pool from amongst overhanging vegetation. Additional, though anecdotal, evidence for the species being in Canungra Creek exists, with the species being previously noted in the system (Woo O'Reilly pers. comm. 2004), and on fish observed in February 1990 in a pool downstream of Elebana Falls, swimming through a splash of light (Martyn Robinson pers. comm. 2004). The species may also have been observed by Peter O'Reilly a long time ago in Morans Creek, before a trout introduction event about 40 years ago (Woo O'Reilly pers. comm. 2004). Repeat visits to these systems in 2001 and 2004 failed to locate the species and additional sampling in the headwaters of the streams in Lamington National Park, between Canungra Creek and the NSW/QLD border to the south, is required to define the distribution of *G. olidus* in this area.

Paired fin ray lamellae, which aid climbing out of water over damp rocks in *Galaxias brevipinnis* and some other *Galaxias* spp. (McDowall 2003b), are quite frequently present on *Galaxias olidus* throughout their range. Climbing in *G. olidus* has been recorded in Dicky Cooper Creek on Mount Kosciuszko (Green 1979; incorrectly identified as *G. brevipinnis*), regularly during late November/early December to early January up a 20 m high wall on Winburndale Dam (near Bathurst, NSW), anecdotally extending back to 1938 (Ian McCartney, pers. comm. 2004–2006), up a waterfall in Dalrymple Creek, QLD (Harry Hines, pers. comm. 2001), and up a moist rock wall in the upper Bogong Creek, VIC (Graeme Gillespie, pers. comm. 2002). This climbing ability infers a greater capacity and propensity for movement, particularly within the steep gradient streams in which this species is often found. It also provides a mechanism for broader dispersal, particularly between adjacent catchments, via low catchment divides during extended wet periods.

FIGURE 23. Examples of colour pattern variation in *Galaxias olidus*. Clockwise from top left: II,04 Coopernook Creek, NSW (RK); II,14 Macquarie Rivulet, NSW (TAR); II,23 Bluestone Crk, VIC (NA); II,24 Wentworth R, VIC (NA); IV,01 Swindlers Crk, VIC (TAR); IV,02 Kiewa R, Bogong, VIC (RK); IV,03 Musk Crk, Whitfield, VIC (NA); IV,05 Steavenson R, VIC (NA); IV,07 Loddon R, VIC (TAR); IV,10 Kangaroo Crk, ACT (NA); IV,19 Peel R, NSW (TAR); IV,21 Grattai Crk, NSW (TAR) (refer to FIGURE 1 for drainage division and river basin locations). (RK—Rudie Kuiter; NA—Neil Armstrong; TAR—Tarmo Raadik).

FIGURE 24. Diversity of aquatic habitats occupied by *Galaxias olidus* (clockwise from top left): I,46 Canungra Crk, O'Reilly's, QLD; II,04 Bielsdown R, Dorrigo, NSW; II,04 Coopernook Crk, NSW; II,04 Snowy Crk trib., Cathedral N.P., NSW; II,10 Oaky Crk, NSW; II,24 Twenty Five Mile Crk, Dargo High Plains, VIC; IV,01 Murray R, Jingellic NSW; IV,02 McKay Crk, Bogong High Plains, VIC; IV,16 MacIntyre R, Paradise, NSW; IV,19 upper Peel R, NSW (T.A. Raadik) (refer to FIGURE 1 for drainage division and river basin locations).

Specimens of *Galaxias*, belonging to the *Galaxias olidus* complex, and superficially similar to *Galaxias olidus*, have been recorded at lower elevation in the lower to mid western portion of the Snowy River catchment in Victoria, farther upstream from the distribution of *Galaxias mcdowalli* **sp. nov.** and downstream of *Galaxias terenasus* **sp. nov.** and *Galaxias supremus* **sp. nov.**: Suggan Buggan River (NMV A.12415 and A.30615-1); and, headwaters of the Buchan River (AMS I.17994-001 and I.19262-001; NMV A.9920) which includes Native Dog Creek (NMV A.10419). These specimens superficially differ morphologically from *G. olidus* and *Galaxias mcdowalli* **sp. nov.** (see above) but their identity has not been determined due to a lack of suitably preserved fresh material for morphological and genetic analysis, hampered in part by their rarity and the recent possible extinction of the population in the Buchan River headwaters following upstream invasion and colonisation of alien Brown Trout post 2003.

Potentially hybridise with *Galaxias fuscus*, *Galaxias oliros* **sp. nov.** and *Galaxias supremus* **sp. nov.** (see under specific species treatments) with putative hybrid fish identified from a small number of systems.

Five collection localities, based on seven specimen lots at the Australian Museum, Sydney, are found west of the main distribution of *Galaxias olidus*: Murrumbidgee system near Balranald (AMS IB.3676), Beringaga (? = Bringagee) (AMS IB.754) and Narrandera (AMS I.19315-001 and I.17993-001); Lachlan system near Condobolin (AMS IB.2892 and IB.2893); and Namoi system at Walgett (AMS IB.755 and IB.575). These specimen lots were reviewed by McDowall & Frankenberg (1981) and confirmed as *Galaxias olidus* s.l. but only four of these lots could be located and verified as *Galaxias olidus* in the current study (AMS IB.3676, IB.2892, IB.2893 and I.19315-001). AMS IB.754 was destroyed in 1976 and the others could not be found in the collection. If the identification of the missing specimen lots by McDowall & Frankenberg (1981) is presumed correct, then these five western locations for *G. olidus* in inland NSW are valid. Due to the paucity of collection records west of the Newell Highway, these locality records may represent atypical occurrences for the species, of individuals washed downstream during wetter periods from more typical population centres at higher elevations. This is supported by the lack of additional or recent collection records (Llewellyn 1983, Swales and Curran 1995, Roberts and Sainty 1996, Harris and Gehrke 1997, Schiller *et al.* 1997, Copeland *et al.* 2003, Baumgartner 2005, Gilligan 2005a, b, Kerezsy 2005, Baumgartner 2007, Davies *et al.* 2008, Unmack unpubl. data.). Consequently, due to time and budget restrictions and logistical constraints (large geographic area, low probability of relocating transitory populations), sampling for specimens in the *G. olidus* complex was not undertaken in this area.

Similarly, *Galaxias olidus* has also not been recorded from Kangaroo Island in SA (SAG, basin 13) since its original collection from one site in 1883 (SAMA F.1115—specimen seen and identification confirmed; Glover 1979), despite intensive sampling of approximately 80 sites during 2002–2007 (Hammer *et al.* 2009, M. Hammer, pers. comm. 2010). Therefore this area was also not resampled. A further outlying record from SA, of one specimen collected from the 'southern Yorke Peninsula' in 1934 (SAMA F.1791) (SAG, basin 07), could not be verified as it was noted as destroyed by the South Australian Museum in 1973. Based on verified records, only *Galaxias brevipinnis* and *Galaxias maculatus* have been recorded from the Yorke Peninsula or farther westward (Hammer *et al.* 2009, SAMA F.1098). Further, the listing of *Galaxias olidus* from two sites in the Broughton River (SAG, basin 07) is considered to be invalid (Hicks & Sheldon 1999). These records are considered mis-identifications, most probably referrable to *G. maculatus*, which is abundant in the system, yet was not recorded during their survey.

***Galaxias oliros*, new species**

Obscure Galaxias

Tables 4 to 9, 31 & 32; Figures 25 to 28

Galaxias olidus olidus Günther, 1866—Frankenberg, 1969: 170 (*partim*).

Galaxias olidus (non *G. olidus* Günther, 1866)—Zeitz, 1908: 297 (*partim*); Waite, 1921: 41 (*partim*); Waite, 1923; 62 (*partim*); Waite, 1924: 483 (*partim*); Hale, 1928: 25 (*partim*); Cadwallader, 1976: 18; Jackson, 1978; Cadwallader, 1979 (*partim*); Hume, 1979; Cadwallader *et al.*, 1980: 257 (*partim*); McDowall & Frankenberg, 1981: 469 (*partim*); Cadwallader & Backhouse, 1983: 69 (*partim*); Jackson & Davies, 1983; Johnson *et al.* 1983: 51; Lloyd & Walker, 1986 (*partim*); Rich, 1986 (*partim*); Terzis, 1986 (*partim*); Morison & Anderson, 1987: 7 (*partim*); Langdon, 1989; Langdon, 1990; Hall & Harrington, 1991; Koehn *et al.* 1991: 9 (*partim*), 11, 13, 15, 39, 43; Morison & Anderson, 1991 (*partim*); O'Connor, 1993; McDowall & Fulton, 1996: 55 (*partim*); Waters, 1996; McDowall, 1997b: 218; 1999: 936; Arisuryanti, 2000; Waters *et al.* 2000a: 785, appendix 1; McDowall, 2001: 396 (*partim*); Raadik, 2001: bottom image p. 786, top image p. 788; Raadik *et* *al.* 2001: 103–104, 105 (*partim*), 108 (*partim*), 109–112, 114 (*partim*), 121 (*partim*), 127 (*partim*), 128; Koehn, 2002 (*partim*); Waters *et al.*, 2002b: 51 (*partim*); Allen *et al.*, 2003: 103, lower plate (*partim*); Bond & Lake, 2003: 611; McDowall, 2003b: 364 (*partim*); Bond, 2004; McMaster, 2004; Pollino *et al.*, 2004 (*partim*); Bond & Lake, 2005; Lintermans, 2007: 44 (*partim*); McMaster and Bond, 2008: 178; Hammer *et al.*, 2009: 93 (*partim*); Bond *et al.*, 2010: 2003; McDowall & Burridge, 2011: 95 (*partim*); Dexter *et al.*, 2013: 225.

Galaxias rostratus (non *G. rostratus* Klunzinger, 1872)—Allen, 1989; 84 (plate 18).

Galaxias sp. 1—Sowersby, 2007; Davies *et al.*, 2008: 338; Humphries, 2009: 100; Gilligan *et al.*, 2010: 7; Kuiter, 2013: 40; Lieschke *et al.* 2013a,b.

Galaxias sp. 4—Kuiter, 2013: 51 (*partim*).

Galaxias sp. 10—Kuiter, 2013: 66.

Galaxias sp. 11—Kuiter, 2013: 68.

Conforms to the allozymically defined and morphologically diagnosed taxon 'OR' of Adams *et al.* (2014), and 'oliros' of Raadik (2011).

Material Examined.

Holotype. NMV A.30580-2, 106.9 mm LCF (93.4 mm SL), female, Avoca River, Mount Lonarch Road, south-south-east of Mount Lonarch, Victoria, 37° 16' 47"S 143° 21' 40"E, J.P. O'Connor, M. Jones and L. Grgat, 14 April 1999.

Paratypes. VIC: AMS I.44927-001 (2), 69.6–77.3 mm LCF (59.3–67.2 mm SL), NMV A.30298-1 (9), 72.4–86.4 mm LCF (62.9–75.5 mm SL) and SAMA F.12105 (2), 74.9–78.3 mm LCF (64.5–68.8 mm SL), Springdallah Creek, at culvert on Graded Road, off Linton/Piggoreet Road, Happy Valley, south-east of Linton, Victoria, 37° 42' 22"S 143° 35' 53"E, T.A. Raadik, 27 August 2002; NMV A.30297-1 (3), 87.9–111,8 mm LCF (77.3–99.7 mm SL), Mason Creek, at bridge on Masons Road, Mafeking, Victoria, 37° 23' 21"S 142° 36' 03"E , T.A. Raadik, 22 May 2002; AMS I.44930-001 (2), 67.3–69.2 mm LCF (58.5–60.7 mm SL), NMV A.30283-1 (6), 64.8–78.0 mm LCF (56.7–68.1 mm SL) and SAMA F.12106 (2), 69.7–74.8 mm LCF (60.6–65.7 mm SL), Mosquito Creek, at bridge on Apsley/Langkoop Road, Langkoop, Victoria, 37° 06' 09"S 141° 02' 09"E, T.A. Raadik, 20 May 2002; AMS I.44928-001 (2), 60.1–63.2 mm LCF (51.8–55.7 mm SL) and NMV A.30406-1 (7), 58.8–90.9 mm LCF (51.0–80.6 mm SL), Cudgewa Creek, at bridge on Murray Valley Highway, just west of Tintaldra, Victoria, 36° 02' 47"S 147° 54' 37"E, T.A. Raadik, 18 March 2002; NMV A.30580-1 (5), 92.2-108.1 mm LCF (81.3–94.7 mm SL), collected with holotype; AMS I.44929-001 (2), 81.2–102.9 mm LCF (79.8–99.5 mm SL), and NMV A.30366-1 (8), 69.9–105.9 mm LCF (68.4–103.5 mm SL), Spring Creek, at Parsons Lane, downstream of Fawcett, Victoria, 37° 07' 22"S 145° 41' 25"E, T.A. Raadik, 18 May 2001; AMS I.44925-001 (2), 84.5–90.1 mm LCF (73.1–78.7 mm SL), NMV A.30373-1 (11), 70.9–101.4 mm LCF (61.4–89.5 mm SL) and SAMA F.12103 (2), 79.7–81.6 mm LCF (68.7–71.3 mm SL), Myrtle Creek, at bridge on Bendigo/Sutton Grange Road, Sutton Grange, Victoria, 36° 59' 13"S 144° 21' 31"E, T.A. Raadik, 4 June 2002; AMS I.44926-001 (2), 80.0–89.8 mm LCF (70.6–79.6 mm SL), NMV A.30345-1 (7), 83.3–97.4 mm LCF (73.5–86.5 mm SL) and SAMA F.12104 (2), 79.4–87.3 mm LCF (70.0–77.6 mm SL), Hickman Creek, at water supply weir off McGee Road, 300 m from junction with Mill Track, Mount Cole State Forest, Victoria, 37° 13' 29"S 143° 14' 02"E, T.A. Raadik, 6 June 2002. **SA:** AMS I.44924-001 (2), 97.0–104.5 mm LCF (85.0–93.1 mm SL), NMNZ P.045753 (1), 96.6 mm LCF (84.5 mm SL), NMV A.30395-1 (10), 86.7–117.8 mm LCF (76.2–102.7 mm SL) and SAMA F.12102 (2), 82.0–109.8 mm LCF (72.3–96.9 mm SL), Mount Barker Creek, at bridge on Adelaide Road, Mount Barker, South Mount Lofty Ranges, South Australia, 35° 04' 11"S 138° 51' 28"E, T.A. Raadik and M. Hammer, 16 May 2002.

Non-type material. NSW: NMV A.30440-4 (3), 50.0–59.9 mm LCF (44.0–51.8 mm SL), Murray River, off track at Clarke Lagoon Reserve, downstream of Tintaldra, 36° 01' 30"S 147° 54' 50"E, TAR, 18 March 2002. **SA:** NMV A.30308-1 (15), 72.1–92.3 mm LCF (62.4–80.5 mm SL), Angas River, Searle Road, Macclesfield, 35° 10' 20"S 138° 50' 06"E, TAR and MH, 17 May 2002; NMV A.30404-1 (5), 89.3–109.6 mm LCF (78.4–96.1 mm SL), Bremer River, Harrogate, 34° 57' 01"S 139° 00' 48"E, TAR and MH, 16 May 2002; NMV A.30306-1 (6), 73.9–81.3 mm LCF (65.5–71.2 mm SL), Marne River, Jutland Road, 34° 40' 05"S 139° 09' 49"E, TAR and MH, 16 May 2002. **VIC:** NMV A.30401-1 (5), 74.3–120.2 mm LCF (64.8–106.0 mm SL), Kuruc-A-Ruc Creek, Dereel-Mount Mercer Road, 37° 48' 01"S 143° 47' 23"E, JPO, 31 March 1999; NMV A.30275-1 (6), 50.8–61.4 mm LCF (43.8–52.8 mm SL), Kuruc-A-Ruc Creek, Ferrers Road, SW of Dereel, 37° 50' 09"S 143° 48' 01"E, TAR, 25 July 2002; NMV A.30274-1 (3), 47.5–56.8 mm LCF (41.6–49.4 mm SL), Smythes Creek, Whites Road, Smythesdale, 37° 38' 06"S 143° 41' 23"E, JPO, 15 March 1999; NMV A.30298-2 (1), 61.2 mm LCF (52.8 mm SL), Springdallah

Creek, collected with NMV A.30298-1; NMV A.30292-1 (4), 59.6–64.9 mm LCF (52.0–57.1 mm SL), Fiery Creek, Beaufort/Elmhurst Road (Raglan Church Road), Raglan, 37° 21' 53"S 143° 20' 31"E, TAR, 29 August 1995; NMV A.30290-1 (7), 65.7–74.7 mm LCF (64.9–73.7 mm SL), Fiery Creek, Yalla-Y-Pooka Road, S of Buangor, 37° 28' 51"S 143° 05' 60"E, TAR, 7 June 2002; NMV A.30278-1 (9), 61.5–88.4 mm LCF (53.8–78.8 mm SL), Mason Creek, Watgania/Maroona Road, 37° 25' 36"S 142° 38' 29"E, TAR, 16 August 1995; NMV A.30294-1 (2), 94.7–106.8 mm LCF (83.1–94.4 mm SL), Mason Creek, Moyston/Dunkeld Road, 37° 24' 43"S 142° 38' 03"E, TAR, 16 August 1995; NMV A.30293-1 (4), 57.3–87.6 mm LCF (50.5–77.0 mm SL), Middle Creek, Fern Tree Waterfalls Road, 37° 18' 56"S 143° 14' 28"E, TAR, 4 March 1999; NMV A.30286-1 (8), 58.2–91.8 mm LCF (50.3–80.2 mm SL), Mustons Creek, Hamilton/Chatsworth Road, Woodhouse, 37° 47' 30"S 142° 24' 31"E, TAR, 24 July 2002; NMV A.30285-1 (10), 53.4–87.4 mm LCF (46.3–77.2 mm SL), Trawalla Creek, end of unnamed track off Chute/Waterloo Road, upstream of Waterloo, 37° 21' 32"S 143° 24' 59"E, TAR, 29 August 1995; NMV A.30288-1 (6), 86.9–117.4 mm LCF (76.4–103.6 mm SL), Trawalla Creek, end of track, just off Trawalla Creek Track, 37° 19' 35"S 143° 22' 13"E, TAR, 14 April 1999; NMV A.30277-1 (3), 61.3–68.1 mm LCF (53.3–60.0 mm SL), Breakaway Creek, Boundary Road, 38° 00' 47"S 141° 46' 29"E, TAR, 11 September 2001; NMV A.30309-1 (6), 62.5–80.6 mm LCF (53.6–70.6 mm SL), Fitzroy River, T & W Road, Cobboboonee State Forest, 38° 04' 33"S 141° 25' 44"E, JPC, 11 May 1999; NMV A.30289-1 (6), 69.5–92.9 mm LCF (61.7–81.8 mm SL), Fitzroy River, same loc. as NMV A.30309-1, TAR, 21 May 2002; NMV A.30271-1 (5), 63.4–83.7 mm LCF (55.1–73.3 mm SL), Branch Creek, Bullawin Road, Grampians National Park, 37° 25' 09"S 142° 15' 386"E, TAR, 13 May 1999; NMV A.30284-1 (4), 95.2–103.8 mm LCF (84.5–92.6 mm SL), Cawker Creek, Glenelg Highway, west of Casterton, 37° 38' 38"S 141° 15' 27"E, TAR, 21 May 2002; NMV A.30270-1 (2), 64.9–72.2 mm LCF (56.8–64.4 mm SL), Glenelg River, off Harrow/Casterton Road, Harrow, upstream of Glenferrie Road, 37° 10' 15"S 141° 35' 25"E, TAR, 25 May 1999; NMV A.30273-1 (5), 44.1–55.8 mm LCF (38.4–48.2 mm SL), Kangaroo Creek, Morven Road, NE of Hotspur, 37° 52' 55"S 141° 40' 13"E, TAR, 1 May 1999; NMV A.30280-1 (3), 55.4–99.9 mm LCF (48.4–88.1 mm SL), Palmers Creek, Portland/Casterton Road, Merino, 37° 43' 19"S 141° 32' 49"E, TAR, 21 May 2002; NMV (un reg.) (14), 51.4–94.6 mm LCF (44.7–83.5 mm SL), Rose Creek, Philip Island Track, Grampians National Park, 37° 09' 07"S 142° 22' 57"E, TAR, 20 May 2002; NMV A.30310-1 (6), 71.1–100.4 mm LCF (62.1–89.4 mm SL), Wannon River, Victoria Valley Road, near Dunkeld, 37° 37' 51"S 142° 20' 10"E, TAR, 3 May 1996; NMV A.30279-1 (4), 92.8–110.6 mm LCF (82.2–97.3 mm SL), Wannon River, North Boundary Road, NE of Dunkeld, 37° 36' 02"S 142° 22' 42"E, TAR, 22 May 2002; NMV A.30304-1 (1), 59.8–62.7 mm LCF (52.7–55.2 mm SL), Mosquito Creek, N branch, Poolaijelo/Edenhope Road, 37° 08' 01"S 142° 09' 33"E, TAR, 21 April 1994; NMV A.30282-1 (1), 77.6 mm LCF (68.2 mm SL), Mosquito Creek, Apsley/Langkoop Road, Langkoop, 37° 06' 10"S 142° 02' 10"E, TAR, 10 September 2001; NMV A.30283-3 (1), 56.1 mm LCF (48.7 mm SL), Mosquito Creek, collected with NMV A.30283-1; NMV A.30393-2 (6), 52.0–67.7 mm LCF (45.1–58.8 mm SL), Corryong Creek, Briggs Gap Road, NW of Corryong, 36° 10' 28"S 147° 51' 54"E, TAR, 18 March 2002; NMV A.30420-2 (3), 65.3–74.0 mm LCF (56.7–64.0 mm SL), Corryong Creek, same loc. as NMV A.30393-2, TAR, 11 September 2002; NMV A.30396-1 (2), 68.7–69.4 mm LCF (59.6–59.6 mm SL), Corryong Creek, end of Thomas Lane, NE of Corryong, 36° 10' 10"S 147° 53' 47"E, TAR, 1 April 2008; NMV A.29968-1 (1), 114.8 mm LCF (102.9 mm SL), Cudgewa Creek, junction with Reedy Creek, off Lucyvale Road, 36° 16' 49"S 147° 37' 20"E, D.J. Harrington, 1 May 1993; NMV A.30406-3 (4), 57.3–58.9 mm LCF (50.0–51.1 mm SL), Cudgewa Creek, collected with NMV A.30406-1; NMV A.29957-1 (4), 65.0–104.3 mm LCF (56.2–92.3 mm SL), Cudgewa Creek, Murray Valley Highway, W of Tintaldra, 36° 02' 48"S 147° 37' 20"E, TAR, 11 September 2002; NMV A.30392-1 (2), 53.1–57.8 mm LCF (44.9–49.3 mm SL), Mitta Mitta River, 4 km downstream from Lake Banimboola, upstream from Mitta Mitta, 36° 30' 48"S 147° 26' 11"E, TAR and J. Lyon, 2 April 2008; NMV A.30474-2 (2), 57.3–58.6 mm LCF (50.0–50.3 mm SL), Nariel Creek, Stacey Bridge on Benambra/Corryong Road, 36° 26' 35"S 147° 49' 45"E, A.F. Baxter and S. Vallis, 7 March 1978; NMV A.30287-1 (13), 60.2–97.4 mm LCF (58.6–87.1 mm SL), Spring Creek, off Spring Creek Road, 0.9 km downstream from first bridge upstream of Yabba Road, east of Tallangatta, 36° 15' 01"S 147° 17' 16"E, TAR, 19 March 2002; NMV A.30408-1 (6), 69.6–100.7 mm LCF (68.7–99.3 mm SL), Gap Creek, Kiewa Valley Highway, Kergunyah, 36° 19' 45"S 147° 01' 36"E, TAR, 25 June 2002; NMV A.30402-1 (1), 84.4 mm LCF (73.5 mm SL), Gap Flat Creek, Gap Flat Road, E of Allans Flat, 36° 17' 47"S 147° 15' 47"E, TAR, 25 June 2002; NMV A.30400-1 (2), 64.8–65.2 mm LCF (55.5–55.6 mm SL), Glen Creek (Swamp Crk), Kiewa Valley Highway, NW of Dederang, 36° 27' 12"S 147° 59' 57"E, TAR, 25 June 2002; NMV A.30299-1 (1), 70.8 mm LCF (62.5 mm SL), Kiewa River, downstream of Boyd Road, Gundowring, 36° 25' 32"S 147° 02' 47"E, B.

Zampatti, 12 April 2000; NMV A.30413-1 (1), 96.5 mm LCF (84.4 mm SL), Kiewa River, Mongans Bridge, downstream of Coral Bank, 36° 35' 05"S 147° 05' 34"E, D. O'Mahoney, 9 October 2002; NMV A.30412-1 (2), 74.4–74.4 mm LCF (64.6–64.9 mm SL), Yackandandah Creek, Osbornes Flat Road, Allans Flat, 36° 16' 10"S 146° 54' 23"E, TAR, 25 June 2002; NMV A.30792-1 (9), 81.7–125.4 mm LCF (80.7–123.4 mm SL), Happy Valley Creek, tributary, Happy Valley Road, E of Rosewhite, 36° 35' 13"S 146° 54' 36"E, TAR, 25 June 2002; NMV A.30469-2 (1), 65.9 mm LCF (57.4 mm SL), King River, old bridge, Cheshunt, 36° 47' 54"S 146° 25' 34"E, TAR, 17 May 2001; NMV A.?? (8), 53.4–106.5 mm LCF (46.4–94.0 mm SL), King River, anabranch, King Valley Road, Cheshunt, 36° 47' 55"S 146° 25' 35"E, TAR, 17 May 2001; NMV A.30305-1 (9), 65.9–89.6 mm LCF (64.8–87.7 mm SL), Meadow Creek, off Meadow Creek Road, Meadow Creek, 36° 34' 50"S 146° 26' 45"E, TAR, 26 June 2002; NMV A.30295-1 (8), 84.1–102.8 mm LCF (64.8–87.7 mm SL), Black Springs, dam on spring just upstream of Nightjar Track, Warby Ranges State Park, 36° 19' 53"S 146° 10' 58"E, TAR, 27 June 2002; NMV A.30457-3 (1), 59.6 mm LCF (51.3 mm SL), Acheron River, Glendale Lane, between Taggerty and Buxton, 37° 21' 10"S 145° 42' 25"E, TAR, 22 May 2001; NMV A.30365-1 (5), 82.1–98.2 mm LCF (71.8–95.7 mm SL), Branjee Creek, Pranjip Road, 36° 42' 56"S 145° 23' 11"E, TAR, 13 August 2002; NMV A.30361-1 (10), 69.2–88.2 mm LCF (68.0–87.0 mm SL), Branjee Creek, Drysdale Road, N of Longwood, 36° 45' 09"S 145° 26' 04"E, TAR, 22 September 2004; NMV A.30370-1 (1), 74.9 mm LCF (65.7 mm SL), Creightons Creek, tributary, Creightons Creek Road, S of Creightons Creek, Strathbogie Ranges, 36° 53' 41"S 145° 31' 43"E, TAR, 14 August 2002; NMV A.30364-1 (1), 77.8 mm LCF (67.8 mm SL), Honeysuckle Creek, off Crocus Street, Violet Town, 36° 38' 08"S 145° 43' 32"E, TAR, 28 June 2002; NMV A.30303-1 (11), 51.2–88.1 mm LCF (44.0–77.2 mm SL), Kurkurac Creek, tributary, Forbes/Moranding Road, W of Kilmore, 37° 13' 47"S 144° 53' 15"E, TAR, 12 August 2002; NMV A.30648-2 (1), 64.8 mm LCF (56.3 mm SL), Little River, reserve upstream of bridge on Maroondah Highway, Taggerty, 37° 19' 26"S 145° 42' 48"E, TAR, 18 December 2001; NMV A.30415-1 (19), 56.4–105.8 mm LCF (48.9–93.1 mm SL), Muddy Creek (Pranjip Creek), downstream from syphon on Goulburn Main Channel, E of Murchison, 36° 37' 15"S 145° 18' 25"E, TAR, 13 August 2002; NMV A.30362-1 (6), 66.3–94.3 mm LCF (64.9–92.7 mm SL), Pranjip Creek, James Road, S of Longwood, 36° 51' 37"S 145° 24' 29"E, TAR, 28 June 2002; NMV A.30468-1 (15), 40.1–84.8 mm LCF (33.9–74.2 mm SL), Seven Creeks, below fishway at Euroa, 36° 450' 07"S 145° 34' 26"E, TAR, 9 December 2002; NMV A.30366-2 (5), 60.5–82.6 mm LCF (59.7–80.7 mm SL), Spring Creek, collected with NMV A.30366-1; NMV A.30129-2 (1), 79.5 mm LCF (68.8 mm SL), Watch Box Crk, Euroa/Mansfield Rd, E of Gooram, Strathbogie Ranges, 36° 54' 28"S 145° 38' 16"E, TAR, 13 August 2002; NMV A.30435-2 (1), 66.9 mm LCF (57.5X mm SL), Yea River, Melba Highway, Devlins Bridge, 37° 22' 58"S 145° 28' 26"E; NMV A.30388-1 (1), 73.1 mm LCF (63.7 mm SL), Axe Creek, Patons Road, W of Eppalock, 36° 50' 27"S 144° 22' 33"E, TAR, 30 September 1999; NMV A.30418-1 (5), 62.6–84.6 mm LCF (53.8–73.7 mm SL), Emu Creek, Bendigo/Sutton Grange Road, S of Sedgwick, 36° 54' 40"S 144° 19' 01"E, TAR, 4 June 2002; NMV A.30302-1 (6), 66.8–84.6 mm LCF (58.0–73.9 mm SL), Jews Harp Creek, tributary, Kyneton/Baynton Road, NE of Pastoria East, 37° 11' 09"S 144° 36' 12"E, TAR, 27 July 2001; NMV A.30381-1 (2), 36.0–51.3 mm LCF (31.8–45.1 mm SL), McIvor Creek, on Warrwitue Forest Road, upstream of Heathcote, 36° 57' 03"S 144° 44' 31"E, TAR, 17 November 2000; NMV A.30374-1 (6), 81.3–108.6 mm LCF (78.3–95.8 mm SL), McIvor Creek, Northern Highway, 2 km NW of Tooborac, 37° 01' 43"S 144° 44' 31"E, TAR, 12 August 2002; NMV A.30391-1 (2), 92.7–105.7 mm LCF (81.8–92.8 mm SL), Myrtle Creek, Carnochans Back Road, 36° 57' 19"S 144° 22' 43"E, TAR, 30 September 1999; NMV A.30407-1 (4), 84.3–97.3 mm LCF (73.8–84.4 mm SL), Pipers Creek, old bridge on track off Pipers Creek Road, Pipers Creek, 37° 15' 04"S 144° 32' 22"E, TAR, 16 September 1999; NMV A.30336-1 (5), 87.7–113.2 mm LCF (76.1–99.6 mm SL), Beckworth Creek, Pickfords Road, 37° 17' 14"S 143° 43' 34"E, JPC, 3 March 1999; NMV A.30342-1 (9), Beckworth Creek, same loc. as NMV A.30336-1, TAR, 5 June 2002; NMV A.30399-1 (15), 42.3–92.5 mm LCF (36.8–81.8 mm SL), Birchs Creek, end Nicholson's Road, E of Clunes, 37° 18' 00"S 143° 52' 06"E, TAR, 15 December 2004; NMV A.30411-1 (8), 82.4–101.3 mm LCF (71.8–88.7 mm SL), Bullarook Creek, Midland Highway, Newlyn North, 37° 24' 1"S 143° 59' 38"E, TAR, 3 June 2002; NMV A.30419-1 (5), 76.6–96.1 mm LCF (75.2–94.6 mm SL), Bullock Creek, off Calder Alternative Highway, Lockwood South, 36° 50' 24"S 144° 09' 17"E, TAR, 4 June 2002; NMV A.30360-1 (10), 84.2–110.5 mm LCF (72.4–96.0 mm SL), Creswick Creek, Clunes/Creswick Road, Clunes, 37° 17' 46"S 143° 47' 23"E, TAR, 5 June 2002; NMV A.30403-1 (10), 73.5–98.2 mm LCF (63.9–85.5 mm SL), Stony Creek, Old Ballarat Road, NE of Evansford, 37° 13 59"S 143° 40' 55"E, TAR, 5 June 2002; NMV A.30398-1 (10), 58.8–109.1 mm LCF (51.1–96.5 mm SL), Tullaroop Creek, Six Mile Bridge, on Mount Cameron/Glengower Road, Glengower, 37° 13' 38"S 143°

50' 05"E, TAR, 13 December 2004; NMV A.30353-1 (5), 85.5–106.9 mm LCF (74.2–93.9 mm SL), Amphitheatre Creek, Mills Road, W of Amphitheatre, 37° 11' 40"S 143° 21' 51"E, TAR, 6 June 2002; NMV A.30351-1 (2), 98.3–99.8 mm LCF (85.7–87.8 mm SL), Avoca River, off Back Mount Lonarch Road, Mount Lonarch, 37° 14' 59"S 143° 22' 47"E, TAR, 5 June 2002; NMV A.30346-1 (19), 54.1–100.6 mm LCF (46.7–89.0 mm SL), Middle Creek, tributary, Warrenmang/Glenlofty Road, at Warrenmang, 37° 01' 56"S 143° 19' 06"E, TAR, 10 March 2000; NMV A.30354-1 (4), 67.6–86.2 mm LCF (59.2–76.3 mm SL), Middle Creek, Hardys Lane, Warrenmang, 37° 02' 06"S 143° 17' 21"E, TAR, 6 June 2002; NMV A.30337-1 (2), 86.4–86.6 mm LCF (75.3–75.9 mm SL), Mountain Creek, off Stawell/Avoca Road, Moonambell, 36° 59' 13"S 143° 18' 02"E, TAR, 5 June 2002; NMV A.30385-1 (1), 84.5 mm LCF (74.7 mm SL), Glenpatrick Creek, Kearns Road, upstream from Elmhurst, 37° 09' 35"S 143° 16' 58"E, TAR, 11 February 2000; NMV A.30382-1 (1), 69.9 mm LCF (61.0 mm SL), Goulton Creek, Mount Zero Road, Grampians National Park, 36° 55' 17"S 142° 25' 47"E, T. Doeg, 16 November 1994; NMV A.30359-1 (6), 66.0–106.2 mm LCF (64.7–104.82 mm SL), Mackenzie River, Grampians Road, Wartook, 37° 02' 02"S 142° 20' 25"E, TAR, 20 May 2002; NMV A.30349-1 (2), 109.8–110.6 mm LCF (97.8–98.0 mm SL), Mount William Creek, Howards Bridge, Ledcourt, 36° 58' 07"S 142° 30' 25"E, TAR, 19 May 2002; NMV A.30390-1 (3), 49.3–65.7 mm LCF (42,3–57.1 mm SL), Reservoir Creek, track off Mafeking Road, downstream of diversion weir, Grampians National Park, 37° 20' 48"S 142° 37' 19"E, TAR, 16 August 1995; NMV A.30358-1 (2), 78.4–90.1 mm LCF (68.6–84.5 mm SL), Reservoir Creek, Mount William Picnic Ground Road, Grampians National Park, 37° 20' 26"S 142° 40' 15"E, TAR, 16 August 1995; NMV A.30307-1 (7), 69.6–99.6 mm LCF (60.4–87.7 mm SL), Troopers Creek, off Roses Gap Road, 3.0 km upstream from Halls Gap/Mount Zero Road, Grampians National Park, 36° 58' 36"S 142° 26' 06"E, TAR, 19 May 2002; NMV A.30339-1 (12), 61.2–94.5 mm LCF (53.2–83.3 mm SL), Troopers Creek, same loc. as NMV A.30307-1, TAR, 28 November 2002.

Additional non-type material examined (not measured): see Appendix 5

Diagnosis. *Galaxias oliros* **sp. nov.** differs from all other species within the *Galaxias olidus* complex by a combination of the following characters: trunk usually laterally compressed posteriorly from about above the pelvic fin base; caudal fin emarginate to weakly forked; usually 12 segmented rays in anal fin (range 9–14), and always more than in the dorsal fin, which usually has about 9 segmented rays; length of anal fin base long (9.8–14.1 % SL) and that of dorsal fin short (7.4–10.8 % SL) and anal fin long (14.3–19.7 % SL); distinctive body pattern, particularly on sides, and gill cover often with a large turquoise or gold patch and belly often distinctly silvery or white; caudal peduncle somewhat shallow (6.5–9.0 % SL); pelvic fins moderately large, about 91 % of length of pectoral fins; lateral profile of head slightly to moderately wedge-shaped and snout rounded; inter-orbital wide (36.0–46.4 % HL) and eye moderately large (16.4–23.9 % HL); nostrils of moderate length, usually not visible from ventral view; anterior tip of upper lip level with about 0.6 ED above ventral margin of eye; raised lamellae usually absent from ventral surface of rays of paired fins, very occasionally present but weakly developed; anal fin origin usually under 0.47 distance posteriorly along dorsal fin base, often much less; usually a single, short (1.2 % SL) pyloric caecum though often absent; gill rakers variable, of moderate length to long and stout to thin; and, distinct black bars along lateral line usually absent, though occasionally some individuals with darker mid-lateral dark brownish blotches between the pectoral and pelvic fin bases, or a single, to a series of, very narrow and short faint brown to greyish dark brown mid-lateral bars anteriorly behind the pectoral fin base.

Description. As for the genus and members of the *Galaxias olidus* complex, except as indicated below, based on 89 specimens, 51.0–102.7 mm SL, and 485 additional, non-type specimens for meristics. See Tables 4 to 9 for frequencies of meristic values and Table 31 for a summary of meristic variation. Segmented dorsal fin rays 9 (8–10), of these 7 (6–8) branched and 2 (1–2) unbranched; segmented anal fin rays 12 (10–13), of these 10 (8–11) branched and 2 (1–3) unbranched; caudal fin rays 16; segmented pectoral fin rays 14 (13–15*), of these 12 (10–13*) branched and 2 (2–3) unbranched; pelvic fin rays 7, of these 6 branched and one unbranched; gill raker total count (lower limb and upper limb) 14 (12–15), lower arch with 10 (9–11) and 4 (3–5) on upper, variation on first gill arch 7+3 (1), 8+3 (7), 8+4 (6), 9+2 (4), 9+3 (86), 9+4 (74), 9+5 (8), 9+6 (2), 10+2 (2), 10+3 (89), 10+4 (199*), 10+5 (31), 10+6 (2),10+7 (1), 11+3 (6), 11+4 (32), 11+5 (17), 11+6 (2), 12+4 (3), 13+4 (1); vertebrae 53* (52–55); usually one [0*] pyloric caecae on stomach, or caecae less often absent.

See Table 32 for comparative value ranges of morphometric characters. Body moderately deep and long, laterally compressed posteriorly from about above the pelvic fin base, dorsal midline generally not flattened, body depth through pectoral base 1.1 (0.8–1.3) that through vent, trunk with dorsal profile evenly arched from nape to origin of dorsal fin, somewhat depressed on head forward of nape, ventral profile of trunk and head follows dorsal profile, though less arched, belly deepened and laterally expanded in maturing individuals, particularly so in fish approaching spawning. Body tapering back to a moderately shallow, 13.1 (11.1–15.4) in SL, caudal peduncle of moderate length, 7.5 (6.5–9.3) in SL, strongly laterally compressed, the peduncle depth 1.6–1.8 in its length; accessory lateral line present. Head of moderate length, 4.7 (4.4–5.4) in SL, and slightly shorter than, 0.9 (0.8–1.1) PelAn distance, of moderate depth and width, 2.3 (2.0–2.6) and 1.6 (1.5–1.8) in HL respectively, distinctly wider than deep (depth 1.4 in HW) and can appear weakly to moderately laterally compressed in some individuals, with sides almost parallel from dorsal view, lateral profile slightly to moderately wedge-shaped, dorsal profile straight and inclined anteriorly; eyes moderately large, 5.1 (4.2–6.1) in HL, situated moderately high on head, distinctly below dorsal head profile, interorbital generally flat to slightly convex, wide, 2.4 (2.1–2.8) in HL and 2.1 (1.9–2.2) times ED; cheeks not expanded below eyes, eye profiles visible laterally from ventral view except in some larger individuals; post-orbital head length of moderate length, 1.9 (1.7–2.1) in HL; snout of moderate length, 3.5 (3.0–3.8) in HL and 1.5 (1.4–1.6) times ED, lateral profile usually rounded; nostrils of moderate length, usually extending to anterior edge of upper lip and usually not visible anterolaterally from ventral view; mouth generally terminal, moderately long, 2.7 (2.4–3.2) in HL, posterior extent usually reaching to under anterior 0.3–0.5 of eyes and 0.55 (0.32–0.76) ED below ventral margin of eye, anterior tip of upper lip level with about 0.6 ED above ventral margin of eye, gape moderate, 2.8 (1.8–3.7) in HL, usually narrower than length of upper jaw and 1.7–2.0 in HW. Jaws subequal, lower slightly shorter. Pyloric caecae short, usually 1.2 % SL (0.1–3.3 %); gill rakers variable, from moderate length to relatively long and stout to thin, usually sharply pointed though occasionally rounded.

Median fins moderately fleshy at bases, paired fins much less so, with slight thickening extending distally over 1/3–1/2 of fin area, with thickening extending slightly farther distally between fin rays, anal fin base long, 8.4 (7.1–10.2) in SL, dorsal fin base short, 11.2 (9.2–13.5) in SL and 0.7 (0.6–0.9) of LAB, dorsal base sometimes extending anteriorly as a low fleshy ridge not underlain by procurrent rays, fins rounded, dorsal fin of moderate length and anal fin long, 5.9 (5.1–7.0) in SL and 1.1–1.2 times length of dorsal fin, middle rays longest, anal fin origin usually under 0.47 (0.19–0.73) distance posteriorly along dorsal fin base. Pelvic fins moderately large, 8.6 (7.5–10.3) in SL, 0.9 (0.8–1.1) of pectoral fin length, usually inserted just posterior to mid-point of standard length and about 0.5 distance to anal fin base; pectoral fin of moderate length and rounded to paddle-shaped, 7.9 (6.6–10.2) in SL, extending about 0.4 distance to pelvic fin base, low on body with dorsal end of fin base usually level with, or very slightly higher than, posterior extent of mouth, lamina of pectoral and pelvic fins oriented anterio-ventrally to ventrally and ventrally respectively, raised lamellae usually absent from ventral surface of rays. Caudal fin moderately long, 7.0 (5.8–9.3) in SL, emarginate to weakly forked, usually longer than caudal peduncle (1.0–1.2 in LCP), vertical width of expanded rays usually equal to or slightly greater than body depth through pectoral fin base, though much greater in individuals < 60 mm SL, flanges moderately high, long and moderately well-developed along caudal peduncle, usually almost reaching anteriorly past the distal end of adpressed anal fin to anal fin base as a low ridge.

Size. Recorded to 133 mm LCF and 33 g; commonly to 75–90 mm LCF.

Colour in life. Body predominantly olive to grey-brown on back and sides, extending over head and snout, becoming cream to white or silvery below lateral line, belly usually silvery. Overlain by small to moderate sized dark brown to grey brown, irregular shaped blotches, flecks and patches, many coalescing to form irregularly shaped vertical bands; blotches and patches more densely distributed over dorsal surface of trunk and on to nape, absent from head and snout. Trunk pattern extending down sides usually as moderately widely spaced bands, reaching to just below lateral line, extending from behind pelvic fin base to the caudal fin. Body pattern sometimes very faint. Distinct, small to medium sized, thin to very thin, intermittently or closely-spaced series of black to dark brown bars (sometimes faded) occasionally present along anterior portion of lateral line posterior to end of operculum; bars often located within coalescing lighter blotches or banding where it crossed the lateral line. Bars often extend to caudal peduncle as faded brown blotches, frequently located within vertical bands, though often faded and indistinct or absent.

Mid-dorsal surface of trunk sometimes with a moderately thick row of coppery or gold spots extending from nape to dorsal fin base; top of head and snout sometimes with diffuse scattering of small gold flecks; and trunk often with broad diffuse band of golden to coppery spots or flecks usually extending from near base of pectoral fin onto caudal peduncle. Gill cover translucent, with a large turquoise, silvery or golden patch; iris silver or silvery gold. Fins usually translucent light grey to olive. Gravid females with fine black to dark grey stippling along ventro-lateral surface of trunk between the pectoral fin base and vent. See below for more detailed comments on body pattern.

TABLE 31. Summary of meristic variation in *Galaxias oliros* **sp. nov.** (T—total; B—branched; L—lower limb; S—single; U—upper limb). Range in 90 % and 100 % of specimens.

Character	Mode	Mean	SD	SE	Range 90 %	Range 100 %	N
Dorsal Rays (T)	9	9.1	0.63	0.03	8–10	7–11	573
Dorsal Rays (B)	7	7.2	0.65	0.03	6–8	5–9	573
Dorsal Rays (S)	2	1.9	0.47	0.02	1–2	1–3	573
Anal Rays (T)	12	11.7	0.79	0.03	10–13	9–14	575
Anal Rays (B)	10	9.5	0.77	0.03	8–11	7–12	575
Anal Rays (S)	2	2.2	0.57	0.02	1–3	1–4	575
Caudal Rays	16	16.0	0.32	0.01	16	12–17	575
Pectoral Rays (T)	14	14.0	0.79	0.03	13–15	12–16	574
Pectoral Rays (B)	12	11.9	0.88	0.04	10–13	9–14	545
Pectoral Rays (S)	2	2.1	0.36	0.02	2–3	1–3	545
Pelvic Rays (T)	7	7.0	0.14	0.01	7	6–8	574
Pelvic Rays (B)	6	6.0	0.16	0.01	6	5–7	574
Pelvic Rays (S)	1	1.0	0.07	0.00	1	1–2	574
Gill Rakers (T)	14	13.5	1.12	0.05	12–15	10–17	573
Gill Rakers (L)	10	9.8	0.70	0.03	9–11	7–13	573
Gill Rakers (U)	4	3.8	0.69	0.03	3–5	2–7	573
Vertebrae	53	53.3	1.00	0.05	52–55	50–56	425

TABLE 32. Morphometric variation in *Galaxias oliros* **sp. nov.** (values are percentages of denominators in ratios, except for LCF and SL).

	Holo-	Paratypes (N = 88)			
Character	type	Mean	Min.	Max.	S.D.
LCF (mm)	107.0	82.7	58.8	117.8	
SL (mm)	93.5	72.5	51.0	102.7	
SL / LCF	87.4	87.6	85.4	90.3	0.83
BDV / SL	14.0	12.7	10.6	15.5	1.07
BDPec / SL	15.8	14.3	12.2	16.6	1.00
BDPec / BDV	112.8	112.9	82.6	133.1	9.26
LCP / SL	12.3	13.4	10.7	15.3	0.91
DCP / SL	8.0	7.6	6.5	9.0	0.49
DCP / LCP	65.1	57.2	45.6	75.6	5.57
CFFL / SL	14.4	14.2	10.7	17.1	1.08
LCP/CFFL	84.9	95.0	68.8	124.1	9.66
PreD / SL	71.8	70.8	68.3	73.0	1.16
PreA / SL	73.5	73.3	70.9	76.7	1.12
PreD / PreA	97.7	96.6	93.4	100.3	1.50
DF–AF / LDB	47.4	46.8	19.2	72.6	10.48

...... *continued on the next page*

TABLE 32. (Continued)

Character	Holo-type	Paratypes (N = 88) Mean	Min.	Max.	S.D.
LDB / SL	10.0	8.9	7.4	10.8	0.76
LAB / SL	14.1	11.9	9.8	14.1	1.08
LDB / LAB	70.7	74.6	63.1	86.1	4.58
DL / LDB	147.6	166.6	138.6	193.7	12.01
AL / LAB	130.5	141.9	118.0	165.8	8.65
DL / SL	14.7	14.7	12.8	16.6	0.94
AL / SL	18.4	16.8	14.3	19.7	1.18
DL / AL	80.0	87.5	77.4	98.5	4.84
PecL / SL	12.8	12.7	9.8	15.2	0.95
PelL / SL	11.7	11.5	9.7	13.3	0.73
PelL / PecL	91.4	90.7	81.0	115.2	5.69
PrePel / SL	49.7	50.7	48.2	54.4	1.17
PecPel / SL	29.6	30.9	28.0	34.2	1.61
PelAn / SL	22.7	23.0	20.5	26.0	1.08
PecL / PecPel	43.1	41.3	29.4	50.8	3.98
PelL / PelAn	51.4	50.2	40.0	59.4	4.24
HL / SL	22.3	21.1	18.6	22.9	0.99
HL / PelAn	98.0	92.0	78.8	105.8	6.64
HW / HL	61.0	61.2	55.0	66.8	2.83
HD / HL	43.6	43.1	38.1	48.8	2.31
HW / HD	140.1	142.2	125.0	160.7	5.95
SnL / HL	28.1	28.9	26.1	33.1	1.48
SnL / ED	153.1	148.8	110.4	187.8	15.83
ED / HL	18.4	19.6	16.4	23.9	1.59
ED / HD	42.2	45.6	35.0	60.9	4.90
PoHL / HL	50.5	53.2	46.9	57.8	2.06
IOW / HL	40.4	41.0	36.0	46.4	2.30
ED / IOW	45.4	47.9	37.0	63.5	5.31
UJL / HL	38.7	37.2	30.9	42.0	1.94
LJL / HL	35.9	34.3	27.7	39.9	2.32
GW /HL	39.2	36.2	26.9	54.9	3.81
LJL / UJL	92.9	92.0	81.9	100.0	3.74
LJL / GW	91.7	95.5	56.9	140.8	10.12
GW / HW	64.2	59.1	48.9	84.8	4.89
SnL/UJL	72.8	77.8	66.1	92.0	5.09

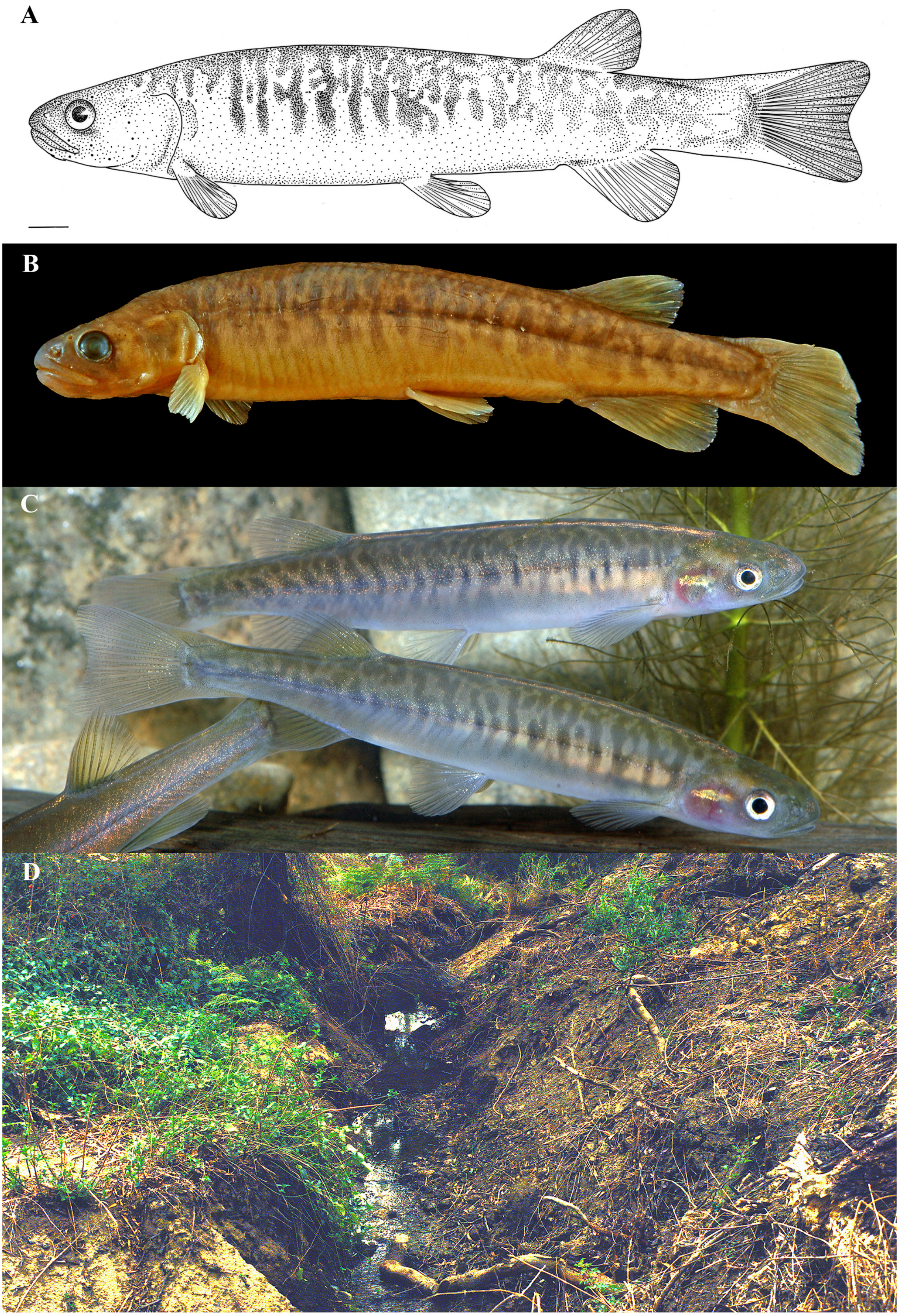

FIGURE 25. A–B: *Galaxias oliros* **sp. nov.** holotype, NMV A.30580-2, 106.9 mm LCF, female, Avoca River, Mount Lonarch Road, south-south-west of Mount Lonarch, Victoria; A) line drawing (R. Plant), B) image of preserved specimen (note: tail curved to left in horizontal plane) (T.A. Raadik); C) *G. oliros* **sp. nov.**, Corryong Creek, north-east Victoria, 1 April 2008, ~ 90 mm LCF (T.A. Raadik); D) Avoca River, at type locality of *G. oliros* **sp. nov.**, 14 April 1999 (J.P. O'Connor). Scale bar = 5 mm.

FIGURE 26. A) *Galaxias oliros* **sp. nov.**, Avoca River, Amphitheatre, Victoria, 18 November 2005, ~ 95 mm LCF (T.A. Raadik); B) *G. oliros*, Hewitt Creek, Glenelg River system, Victoria, 7 April 2005, ~ 90 mm LCF (R. Kuiter).

Occasionally, snout and anterior portion of head, including the nape, noticeably an almost transparent pale lime-green (also found sporadically in *Galaxias olidus* and *Galaxias ornatus*), although the reason is unknown.

Colour of preserved material. Base colour of head and body pale cream to tan, with overlying light dusky shading of fine brown-black stippling, particularly on dorsal and dorso-lateral surfaces. Dorsal and lateral surfaces of trunk with distinctive bold pattern of very closely spaced, irregular shaped, dark brown spots and blotches, smaller on dorsal surface and coalescing to form distinct, larger, elongate, vertical patches or bars on sides, ranging from the pectoral fin base posteriorly to the caudal fin. Lateral patches and bars centred on lateral line, largest usually located in anterior to mid-trunk region, most distinctive with darker brown regions on midline contrasting with intervening lighter base colour areas. Lateral trunk pattern extends below lateral line, fading before reaching ventro-lateral region merging with overlying shading light shading. Dorsal trunk pattern extends onto nape; interorbital, snout, lateral regions of head and upper and lower jaws with dark brown to grey-brown shading. Sparse stippling of fine brown spots extending onto ventral region of head, and along ventro-posterior margin of gill cover. Brown to black stippling inside gill cover, and black spotting at base of, and along gill filaments, also on gill rakers.

Eye grey to black, pupil translucent pale orange yellow. Teeth translucent yellow to pale orange–yellow, tips orange to orange–red; gill rakers cream to pale yellow. Fins pale creamy yellow, becoming translucent at about half way along fin length, fleshy bases of dorsal, anal and pectoral fins with fine brown stippling, also just extending onto base of caudal fin. Fin rays opaque to translucent, external edges of rays highlighted with fine brown spots forming thin lines, first few rays generally darker; dorsal, anal and caudal fins rays often stippled with fine brown spots along centre of first third to one half of fin ray.

Etymology. The specific name *oliros* is derived from a combination of the first three letters of the species names of *Galaxias olidus* and *Galaxias rostratus*. It was first used as a field code for what appeared to be a distinct morphological form intermediate between, and sharing morphological characteristics with, both taxa, particularly juvenile to young adult stages. Suggested vernacular name as the 'Obscure Galaxias', in reference to it being a relatively widespread and common species which has remained in obscurity until now, and to its relatively indistinct or subtle morphological features which separate it from the morphologically similar sister taxon *G. olidus*. The two species can be found in sympatry and occasionally produce putative hybrid offspring, which can further add to confusion.

Genetics. Allozyme and mtDNA analysis of this species can be found in Adams *et al.* (2014**;** taxon code OR). Diagnostic allozyme loci (2–12) between this taxon and the other species in the *Galaxias olidus* complex are provided in Table 12.

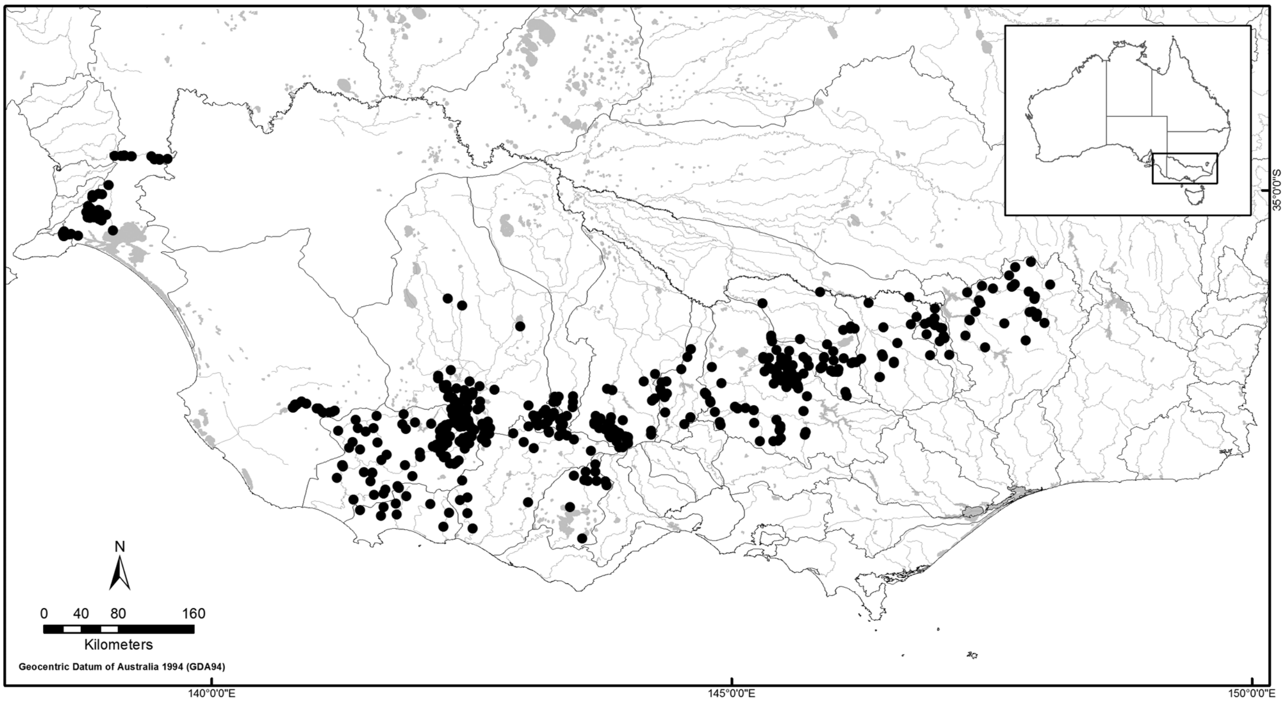

FIGURE 27. Distribution of *Galaxias oliros* **sp. nov.** in south-eastern Australia (river basins shown—refer to Fig.1).

Distribution. See Fig. 27. Widespread in the Murray River system and tributaries, and also found south of the GDR in western VIC; occupy an extensive elevational range from 0–600 m asl. Specifically, found in the Murray River from the Upper Murray Basin in southern NSW and northern VIC westward, including all VIC tributaries and the endorheic Wimmera River system, in several tributaries of the Lower Murray draining the eastern Mount Lofty Ranges (SA), and in coastal Victoria in the endorheic Corangamite Basin, and westward from, and including the Hopkins River basin to Mosquito Creek in the Bool Lagoon drainage in SA. Found very close to the coast in the Merri River and Darlot/Fitzroy River systems in coastal western VIC, and appears to be absent from the Murray River main channel downstream from about Barmah to Mannum. Known from a single catchment in the SA Gulf Drainage Division (Hindmarsh River) (Hammer *et al.* 2012).

Sympatry. Only species in the *Galaxias olidus* complex found within its range south of the GDR in coastal western Victoria (Corangamite Basin to Glenelg River system) and south-east portion of South Australia. Also only species in the complex known from north of the Great Dividing Range in north-west Victoria (Avoca to Wimmera basins), but may overlap with *G. olidus* in the very upper reaches of the Campaspe and Loddon River system. Also found with *Galaxias arcanus* **sp. nov.** and *G. olidus* in north-eastern VIC and south-eastern NSW (Upper Murray basin to Goulburn River system) and with *G. olidus* in the eastern portion (Murray River catchment) of the

Adelaide Hills in South Australia (broad sympatry in different catchments). Recorded with *Galaxias brevipinnis*, *Galaxias maculatus* and *Galaxias truttaceus*, *Galaxiella pusilla* and *Neochanna cleaveri* in some coastal catchments, and with *G. brevipinnis*, *G. maculatus*, *Galaxias rostratus* and *G. truttaceus* in north-east Victoria and the Murray River; also with *G. maculatus* and historically with *G. rostratus* in the lower Murray River in South Australia.

Habitat. Generally found at low to moderate elevations (lowland to foothill reaches) in a diversity of stream types, ranging from slower-flowing, clear to turbid, medium to larger rivers (4–20 m average width), gently or moderately fast flowing smaller creeks (0.5–4.0 m average width), and also in anabranches, billabongs and some wetlands, including disconnected pools in drying water courses. Recorded from shallow riffle areas along the edge of pools as juveniles, to deeper (0.1–> 1.2 m average depth), more open water habitats in pools as adults, though often also in glides. Usually found amongst dense aquatic vegetation and timber debris, though also occasionally found in the open in midwater or just under the surface.

General Biology. Confined to freshwater and considered not to undertake diadromous migrations. Usually recorded at densities up to 0.7–1.6 fish/m^2, though can be very abundant in swamps, billabongs and isolated pools (up to 8.0 fish/m^2). Collected with a diverse range of fish and decapod crustacea, though commonly with *Galaxias olidus*, *Galaxias arcanus* **sp. nov.**, River Blackfish (*Gadopsis marmoratus*), Southern Pygmy Perch (*Nannoperca australis*), Australian Smelt (*Retropinna* spp.), Flatheaded Gudgeon (*Philypnodon grandiceps*), Common Freshwater Shrimp and Common Yabby. Appear to have high physico-chemical tolerance as recorded from isolated pools with high water turbidity or salinity levels (e.g. Wimmera and Glenelg river systems), or stagnant, refuge pools with high loads of dissolved organic carbon from leachates from *Eucalyptus* leaves (e.g. Marne River (this study) and upper Avoca River system, also see McMaster & Bond (2008)).

Spawning period usually extends from about late May to early July, though can extend into August, with adults ripe and close to spawning in early May and with the body cavity full of fat deposits, and gonads in an early stage of development, by September. The smallest fish recorded in mid-May was 34.9 mm LCF (possibly from a late spawning) with the smallest fish recorded in early November measuring 23.7 mm LCF. The smallest female that could be confidently sexed was 51.3 mm LCF. Fecundity is relatively high within the species complex, with a 105.6 mm LCF ripe female recorded with 2057, relatively small (mean of 1.1 mm, range 0..9–1.4 mm diameter), roughly circular and orange, unshed mature ova in mid-May (NMV A.11683). A relatively good swimmer, and considered more pelagic and mobile than most other members in the *Galaxias olidus* complex, often seen swimming in small schools, though larger individuals more solitary. Possibly also undertakes defined upstream movements as juveniles (< 50 mm LCF) as large numbers of juveniles were recorded moving upstream through the fishway on Seven Creeks (Euroa) during late December 2000 and early December 2002 (Raadik, unpubl. data).

Found to be infected with the parasitic copepod *Lernaea cyprinoides* (see Bond 2004), and can be lightly to heavily infected with small grey to black cysts, possibly trematode metacercariae, embedded in the skin of the head or trunk, or in fins. A small number of fish recorded with a short, thin, white worm, coiled and pointed at both ends, from amongst fat deposits around the stomach in the body cavity, others with small ulcers on the body. Also recorded with deformities of fins (dorsal, pectoral, and pelvic), deformities of the jaws and posterior margin of the gill cover, and some with curvature of the spine.

Variation. Has the second widest range in variation of morphological characters in the *Galaxias olidus* complex. Consequently close or adjacent populations can sometimes look superficially different or resemble *Galaxias olidus*, particularly at higher elevations and also in catchments of the coastal southwest of VIC. In particular, the morphology of the head and size of the pectoral fins can vary, with some individuals or populations possessing smaller pectoral fins than usual or heads which appear more similar to those of *G. olidus* (e.g. smaller, less laterally compressed, etc.). In these fish, other diagnostic characters are usually still distinct, such as the relatively larger size of the eye and mouth, lateral compression of the body, and in particular, the disparity in the length of the bases of the dorsal and anal fins. Putative hybridisation with *G. olidus* can also cause difficulties in the identification of some individuals (see below).

Remarks. A hardy species, able to survive relatively well during drought in lowland to foothill areas. Has a remarkably broad tolerance of salinity, being recorded from clear, fresh (< 0.1 g/L salinity) and flowing water in the Upper Murray catchment, and also from an isolated, turbid and still pool in Dwyer Creek in the Grampians (south-western VIC) with a salinity of 13.4 g/L. *Galaxias oliros* is also the main species, previously known as *G.*

olidus s.l., which can persist in the presence of alien trout, possibly partly as the areas it occupies are warm and therefore marginal for salmonid survival, and habitat and niche overlap may not be as strong as it is between trout and other members in the *G. olidus* complex.

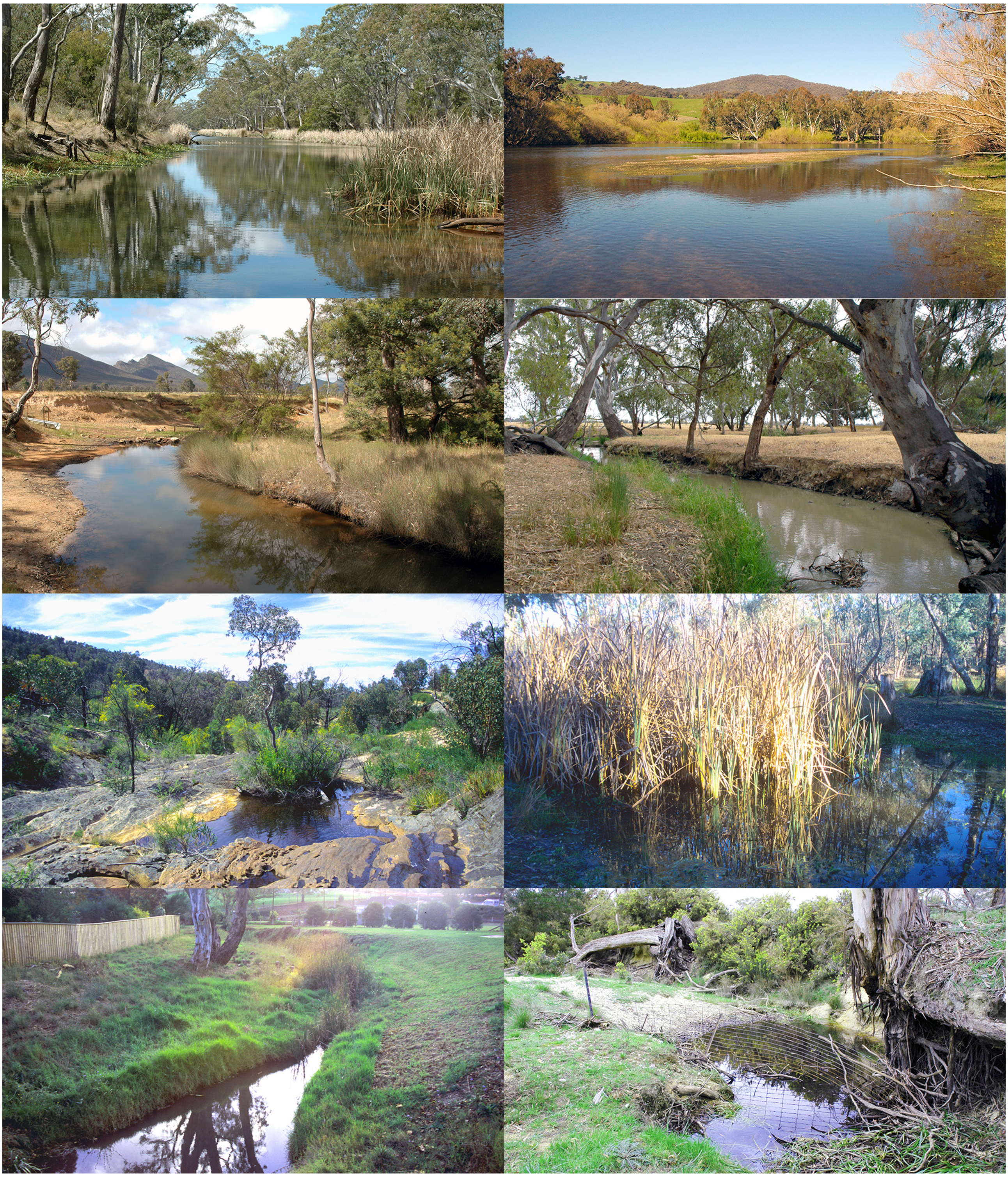

FIGURE 28. Diversity of aquatic habitats occupied by *Galaxias oliros* **sp. nov.**, (clockwise from top left): II,38 Glenelg River, Balmoral, coastal VIC; IV,01 Murray River, Jingellic, NSW; IV,04 Broken Creek, Tungamah, inland VIC; IV,04 Black Springs swamp, Warby Ranges, inland VIC; II,34 Springdallah Creek, Linton, coastal VIC; IV,26 Mount Barker Creek, SA; IV,15 Troopers Creek, Grampians, inland VIC; II,38 Dwyer Creek, Grampians, coastal VIC (T.A. Raadik) (refer to FIGURE 1 for drainage division and river basin locations).

Potentially hybridise with *Galaxias. olidus*, with putative hybrid fish identified from a small number of systems (Ovens River basin: Musk Creek near Whitfield; Broken River basin: Broken River north of Mansfield; Goulburn River basin: Hayfield Creek (Brankeet Creek system) and Trawool Creek near Granite). Suspected putative hybrids often morphologically intermediate, usually with a larger, silvery eye, long gill rakers and sometimes with larger fins or longer caudal peduncle. Occasionally quite similar to *Galaxias olidus*, with only very subtle differences in characteristics. Putative hybrid morphology requires detailed study.

Galaxias oliros **sp. nov.**, incorrectly referenced as *Galaxias olidus* (s.l.), has been used in previous genetic (Waters 1996, Waters *et al.* 2000a, 2002a) and morphological studies (Johnson *et al.* 1983, McDowall 1997b, 1999, 2001, 2003a, and McDowall & Burridge 2011), with Waters *et al.* (2000a) proposing a close relationship with the Tasmanian *G. parvus*. The identity of the species of *Galaxias* in Mack (1918) could not be established, but may possibly be referable to *Galaxias oliros* **sp. nov.**

***Galaxias ornatus* Castelnau, 1873**

Ornate Galaxias

Tables 4 to 9, 33 & 34; Figures 29 to 32 [Line drawing of holotype figured in Whitley (1955)]

Galaxias ornatus, Castelnau, 1873: 153 (holotype: MNHN A.5225; paratype: (1) MNHN A.6914; type locality: Cardinia Creek, Victoria) [see Appendix 1 for text of original description];—Macleay, 1881: 237; Lucas, 1890: 36; Ogilby, 1896: 69; Regan, 1906: 381; Ogilby, 1912: 33; McCulloch, 1929: 48; Whitley, 1939: 268 (*partim*); Scott, 1942: 56; Butcher, 1946: 9 (*partim*); Bertin & Esteve, 1950: 3; Whitley, 1955: 154, fig. 1; Whitley, 1956b: 39; Whitley, 1956c: 34; Munro, 1957: 17; Whitley, 1957a: 7; Whitley, 1964: 35; Frankenberg, 1967: 227; Lake, 1971: 20; McDowall & Frankenberg, 1981: 469; Kuiter, 2013: 60.

Galaxias olidus olidus (non *G. olidus* Günther, 1866)—Frankenberg, 1969: 170 (*partim*).

Galaxias olidus (non *G. olidus* Günther, 1866)—Renowden, 1968; Jackson, 1975; Atkins, 1979: 411; Fletcher, 1979 (*partim*); Jackson & Williams, 1980; McDowall, 1980b: 57 (*partim*); McDowall & Frankenberg, 1981: 469 (*partim*); Cadwallader & Backhouse, 1983: 69 (*partim*); Hortle & Lake, 1983; Closs, 1984; Campbell *et al.*, 1986: 95 (*partim*); Koehn, 1986: 7; Rich, 1986 (*partim*); Hall & Tunbridge, 1988; Tunbridge & Glenane, 1988: 48; McKenzie & O'Connor, 1989; Koehn & O'Connor, 1990; Closs, 1991; Koehn *et al.*, 1991 (*partim*); O'Connor & Koehn 1991: 113; Closs, 1994; McDowall & Fulton, 1996: 55 (*partim*), plate p. 56; Closs, 1996; Closs & Lake, 1996; Raadik, 2001; image second from bottom p. 785; Raadik *et al*., 2001; 85, 88–102, 105 (*partim*), 106-107, 108 (*partim*); Allen *et al.*, 2003: 103, upper plate (*partim*); McDowall, 2003b: 364 (*partim*); Raadik, 2006b: 138; Schmida, 2008: lower image p. 31; Lieschke *et al.* 2013 a,b.

Galaxias ornatus var. Yarra—Kuiter, 2013: 62.

Galaxias sp. 9—Kuiter, 2013: 64.

Conforms to the allozymically defined and morphologically diagnosed taxon 'BA' of Adams *et al.* (2014), and 'bass' of Raadik (2011).

Material examined.

Holotype. MNHN A.5225 (1), 101 mm LCF (89.9 mm SL), female, Cardinia Creek, Victoria, F. de Castelnau, ca. 1873 [digital images and X-ray seen];

Paratypes. MNHN A.6914 (1), 90 mm TL, collected with holotype. [digital images and X-ray seen].

Non-type material. all VIC: NMV A.30741-1 (8), 63.3–73.6 mm LCF (56.3–64.8 mm SL), Moonlight Creek, off Allambee Estate Road, Mount Worth State Park, Strezelecki Ranges, 38° 16' 53"S 146° 00' 35"E, TAR, 17 June 2002; NMV A.30734-1 (5), 65.6–83.1 mm LCF (64.6–82.2 mm SL), Bessie Creek, at Twin Creeks Road, Nar Nar Goon North, 38° 00' 29"S 145° 33' 18"E, JPC, 16 December 1998; NMV A.30740-1 (5), 52.8–65.6 mm LCF (45.7–57.8 mm SL), Bessie Creek, same loc. as NMV A.30734-1, TAR, 21 June 2001; NMV A.30681-1 (3), 68.3–68.8 mm LCF (60.0–60.1 mm SL), Cardinia Creek, tributary, off Old Beaconsfield Road, Emerald, 37° 56' 44"S 145° 26' 54"E, TAR, 5 February 2001; NMV A.30688-1 (6), 66.8–81.0 mm LCF (58.7–70.7 mm SL), Cardinia Creek, same loc. as NMV A.30681-1, TAR, 19 June 2001; NMV A.30738-1 (3), 59.0–72.6 mm LCF (50.3–63.8 mm SL), Cardinia Creek, same loc. as NMV A.30681-1, TAR, 21 June 2001; NMV A.30693-1 (3), 73.5–105.1 mm LCF (64.5–92.7 mm SL), Ryson Creek, Forest Road, Bunyip State Forest, 37° 58' 27"S 145° 49' 23"E, TAR, 17 June 2002; NMV A.30736-1 (15), 74.5–108.8 mm LCF (65.6–96.0 mm SL), Tarago River, Phasmid Ridge Track, Tarago State Forest, 37° 56' 26"S 145° 48' 57"E, TAR, 24 July 2001; NMV A.30513-1 (8), 57.0–79.7 mm LCF (50.2–69.5 mm SL), Tarago River, same loc. as NMV A.30736-1, TAR, 17 June 2002; NMV A.30698-1 (6), 54.4–77.6 mm LCF (47.2–68.5 mm SL), Badger Creek, downstream from Coranderrk Homestead, Healesville, 37° 41' 24"S 145° 30' 35"E, Koehn, J.D., 2 May 1984; NMV A.30737-1 (4), 54.3–74.6 mm LCF (46.9–65.9 mm SL), Badger Creek, same loc. as NMV A. 30698-1, O'Connor, W.G., 12 December 1984; NMV A.30697-1 (4), 60.1–71.2 mm LCF (53.5–62.1 mm SL), Badger Creek, Badger Creek Road, Healesville, 37° 40' 56"S 145° 32' 09"E, TAR, 23 July 2001; NMV A.30699-1 (5), 53.2–60.7 mm LCF (50.0–53.4 mm SL), Badger Creek, Dalry Road, S of Healesville, 37° 41' 21"S 145° 31' 07"E, TAR, 18 June 2002; NMV A.30509-1 (3), 54.0–72.4 mm LCF (47.3–63.9 mm SL), Cockatoo Creek, trib., Mountain Road, Cockatoo, 37° 55' 24"S 145° 30' 11"E, TAR, 1 February 1993; NMV A.30527-1 (3), 56.5–86.4 mm LCF (48.9–75.0 mm SL), Diamond Creek, Haleys Gully Road, 37° 386' 15"S 145° 11' 29"E, TAR, 14 April 1992; NMV A.30735-1 (10), 64.6–96.1 mm LCF (56.6–85.0 mm SL) and NMV A.30520-1 (5), 49.9–100.1 mm LCF (43.2–88.5 mm SL) Diamond Creek, upstream of Ninks Road, Kinglake N.P., 37° 32' 22"S 145° 19' 32"E, TAR, 15 April 1992; NMV A.30732-1 (3), 42.7–96.3 mm LCF (37.6–84.0 mm SL) Diamond Creek, upstream of Ninks Road, Kinglake N.P., 37° 32' 22"S 145° 19' 32"E, TAR, 18 June 2001; NMV A.30518-1 (2), 56.5–61.2 mm LCF (49.4–53.0 mm SL), Dixons Creek, off Melba Highway, Dixons Creek, 37° 36' 11"S 145° 25' 22"E, TAR, 17 October 2000; NMV A.30733-1 (4), 57.2–64.3 mm LCF (50.3–55.3 mm SL), Grace Burn, Wallace Parade, Healesville, 37° 39' 12"S 145° 32' 21"E, TAR, 18 June 2002; NMV A.30514-1 (3), 82.2–97.4 mm LCF (72.3–84.7 mm SL), Hoddles Creek, Prices Road, 37° 51' 31"S 145° 37' 35"E, TAR, 21 June 2001; NMV A.30687-1 (5), 54.7–61.5 mm LCF (48.2–54.6 mm SL), Little Yarra River, footbridge on Doon Road, W of Yarra Junction, 37° 46' 32"S 145° 35' 31"E, TAR, 21 June 2002; NMV A.30689-1 (15), 43.4–84.2 mm LCF (38.1–75.3 mm SL), Myers Creek, Myers Creek Road, 37° 36' 20"S 145° 31' 09"E, TAR, 18 June 2001; NMV A.30690-1 (9), 93.7–102.0 mm LCF (91.6–100.4 mm SL), Olinda Creek, Falls Road, Olinda, above Olinda Falls, Mount Dandenong, Dandenong Ranges National Park, 37° 50' 07"S 145° 22' 03"E, TAR, 19 June 2002; NMV A.30694-1 (12), 51.0–91.8 mm LCF (44.5–80.4 mm SL), Plenty River, west branch, Halls Road, north of Glenvale, 37° 27' 17"S 145° 06' 31"E, TAR, 20 June 2002; NMV A.30685-1 (13), 55.2–69.5 mm LCF (47.8–60.9 mm SL), Running Creek, off Boundary Track, upstream of Mason Falls, Kinglake National Park, 37° 29' 31"S 145° 15' 03"E, TAR, 19 February 2002, NMV A.30691-1 (10), 71.5–96.4 mm LCF (70.5–94.5 mm SL), Scotchman Creek, off Scotchmans Creek Road, Warburton, 37° 45' 29"S 145° 40' 55"E, TAR, 23 July 2001; NMV A.30561-1 (2), 69.9–91.3 mm LCF (61.2–80.8 mm SL), Scotchman Creek, same loc. as NMV A.30691-1, TAR, 19 June 2002; NMV A.30696-1 (7), 70.2–78.9 mm LCF (61.0–69.2 mm SL), Stringybark Creek, Clegg Road, Wandin, 37° 46' 57"S 145° 24' 34"E, TAR, 20 June 2001; NMV A.30692-1 (10), 56.6–94.5 mm LCF (48.8–82.9 mm SL), Stringybark Creek, end of Channel Road, Silvan, 37° 48' 46"S 145° 24' 47"E, TAR, 20 June 2001; NMV A.30488-1 (4), 43.4–82.6 mm LCF (38.1–73.3 mm SL), Watts River, Road 4, Upper Yarra Closed Catchment, 37° 36' 52"S 145° 37' 34"E, TAR, 27 March 1997; NMV A.30682-1 (9), 55.6–73.9 mm LCF (47.4–65.1 mm SL), Yankee Jim Creek, end of Wylie Street, Warburton, 37° 466' 08"S 145° 38' 58"E, TAR, 19 June 2002; NMV A.30521-1 (2), 75.0–82.9 mm LCF (66.5–73.4 mm SL), Yarra River, P.D. Jackson, 29 August 1973; NMV A.30487-1 (2), 46.8–83.4 mm LCF (40.4–72.7 mm SL), Yow Yow Creek, off Yow Yow Creek Road, 37° 35' 41"S 145° 17' 34"E, TAR, 18 June 2001; NMV A.30530-1 (15), 66.7–93.4 mm LCF (59.0–82.7 mm SL), Barringo Creek, off Wooling Road, east of Macedon, 37° 25' 15"S 144° 37' 03"E, TAR, 26 July 2001; NMV A.30519-1 (13), 61.9–84.5 mm LCF (54.6–75.0 mm SL), Bolinda Creek, Mullayes Road, Bolinda, 37° 25' 54"S 144° 44' 09"E, TAR, 26 July 2001; NMV A.30515-1 (3), 66.7–70.6 mm LCF (66.1–69.1 mm SL), Jacksons Creek, Settlement Road, Clarkefield, 37° 29' 24"S 144° 44' 21"E, TAR, 26 July 2001; NMV A.30506-1 (12), 54.8–90.2 mm LCF (53.9–88.9 mm SL), Monument Creek, Frankenburgs Lane, 37° 19' 49"S 144° 39' 49"E, TAR, 26 July 2001; NMV A.30510-1 (2), 62.1–69.8 mm LCF (54.7–61.8 mm SL), Sandy Creek, Black Range Road, Monegeetta North, 37° 23' 34"S 144° 44' 45"E, TAR, 26 July 2001; NMV A.30494-1 (15), 70.3–100.5 mm LCF (62.0–90.0 mm SL), Dale Creek, Darcey Track, near Greendale Hill, 37° 33' 16"S 144° 17' 37"E, TAR, 18 February, 2002; NMV A.30524-1 (17), 70.2–71.9 mm LCF (61.8–63.7 mm SL), Goodman Creek, Seerery Road, west of Coimadai, 37° 36' 25"S 144° 27' 05"E, TAR, 16 November 1994; NMV A.30495-1 (17), 59.7–84.6 mm LCF (61.8–63.7 mm SL), Goodman Creek, No. 1 Firebreak Track, Lerderderg State Park, west of Bullengarook, 37° 31' 47"S 144° 27' 47"E, TAR, 3 June 2002; NMV A.30522-1 (3), 44.0–73.3mm LCF (38.1–63.9 mm SL), Lerderderg River, Roach Road, Wombat State Forest, 37° 40' 53"S 144° 14' 01"E, TAR, 3 June 2002; NMV A.30508-1 (15), 62.6–83.2 mm LCF (55.2–73.2 mm SL), Werribee River, Ballan/Greendale Road, Ballan, 37° 35' 53"S 144° 13' 50"E, TAR, 18 February 2002; NMV A.30497-1 (15), 62.0–81.6 mm LCF (53.9–72.6 mm SL), Lal Lal Creek, Old Melbourne Road, south of Bungaree, 37° 34' 48"S 144° 00' 36"E, TAR, 18 February 2002; NMV A.30496-1 (15), 74.4–102.7 mm LCF (66.1–91.3 mm SL), Lynch's Creek, Brickhouse Road, Wombat State Forest, 37° 27' 57"S 144° 06' 49"E, TAR, 18 February, 2002; NMV A.30504-1 (15), 63.5–77.3 mm LCF (56.3–69.2 mm SL), Moorabool River, west branch, Old Melbourne Road, Millbrook, 37° 35' 25"S 144° 03' 23"E, TAR, 18 February 2002; NMV A.30492-1 (8), 43.8–80.9 mm LCF (38.1–71.7 mm SL), Barwon River, east branch, downstream Elizabeth Lake, 38° 33' 08"S 143° 440' 54"E, TAR, 21 January 1988; NMV A.30482-1 (3), 52.0–69.4 mm LCF (45.1–59.7 mm SL), Callahans Creek, south branch, Goat Track, 38° 30' 34"S 143° 46' 16"E, TAR, 27 April 1999; NMV A.30501-1 (6), 60.5–80.4 mm LCF (53.7–70.4 mm SL), Cargerie Creek, Mount Mercer/Meredith Road, west of Meredith, 37° 50' 43"S 143° 56' 55"E, TAR, 26 July 2002; NMV A.30505-1 (2), 75.3–79.3 mm LCF (66.2–69.7 mm SL), Gong Gong Creek, off Springs Road, 37° 32' 11"S 143° 54' 56"E, TAR, 27 August 2002; NMV A.30493-1 (12); 65.1–90.9 mm LCF (58.1–80.3 mm SL), Winter Creek, Bells Road, SW of Ballarat, 37° 36' 44"S 143° 48' 36"E, TAR, 27 August 2002; NMV A.30507-1 (8), 53.8–76.0 mm LCF (47.2–67.7 mm SL), Woodbourne Creek, Glenetive Road, Bamganie, 37° 54' 60"S 144° 00' 06"E, TAR, 26 July 2002; NMV A.30503-1 (15), 53.7–81.9 mm LCF (47.3–72.7 mm SL), Asplin Creek, Asplin Track, Otway Ranges, 38° 34' 15"S 143° 37' 36"E, W.G. O'Connor, 20 January 1988; NMV A.30490-1 (5), 64.7–74.5 mm LCF (63.8–72.8 mm SL), Chapple Creek, south branch, at swimming pool on Morris Track, Lavers Hill, 38° 40' 35"S 143° 23' 18"E, TAR, 23 July 2002; NMV A.30489-1 (10), 57.3–85.2 mm LCF (50.5–75.6 mm SL), Clearwater Creek, upstream of Redwater Creek, Otway Ranges, 38° 43' 40"S 143° 30' 44"E, W.G. O'Connor, 20 January 1988; NMV A.30595-1 (11), 66.4–85.8 mm LCF (57.7–75.2 mm SL), Clearwater Creek, Robertsons Track, Aire Valley Plantation, Otway Ranges, 38° 41' 46"S 143° 35' 03"E, TAR 22 July 2002; NMV A.30486-1 (3), 57.1–60.1 mm LCF (50.6–52.2 mm SL), Ford River, east branch, Number Nine Ridge Track, Otway State Forest, 38° 42' 44"S 143° 26' 59"E, TAR, 10 February 1999; NMV A.30491-1 (18), 40.9–84.8 mm LCF (35.9–75.5 mm SL), Ford River, same loc. as NMV A.30486-1, TAR, 23 July 2002; NMV A.30498-1 (1),61.8 mm LCF (55.0 mm SL), Gellibrand River, off Sawyers Track, Otway Ranges, ESE of Gellibrand, 38° 32' 36"S 143° 36' 22"E, TAR, 16 December 2002; NMV A.30485-1 (5), 52.9–57.5 mm LCF (46.3–50.6 mm SL), Lardners Creek, east branch, Jackson Track, 38° 33' 07"S 143° 34' 07"E, W.G. O'Connor, 20 January 1988; NMV A.30484-1 (1), 54.8 mm LCF (47.8 mm SL), Parker River, Sandy Ridge Track, 38° 48' 03"S 143° 33' 18"E, W.G. O'Connor, 19 January 1988; NMV A.30500-1 (2), 72.8–74.3 mm LCF (64.1–65.8 mm SL), Parker River, tributary, Maits Rest, Otway National Park, 38° 35' 19"S 143° 33' 19"E, TAR, 23 July 2002. **Murray-Darling Basin**: NMV A.30135-1 (16), 63.6–89.0 mm LCF (54.5–78.7 mm SL), Hirts Creek, horse trail, upstream of Wombelano Falls, off Captain Creek Road, north of Kinglake, 37° 28' 43"S 145° 20' 35"E, TAR, 19 February 2002.

Additional non-type material examined (not measured): see Appendix 5.

Diagnosis. *Galaxias ornatus* is one of the least morphologically specialised species in the *Galaxias olidus* complex, differing only slightly from the typical '*olidus*' morphology, but can be distinguished from all other species within the *G. olidus* complex by a combination of the following characters (and careful comparison with the description of the other species): interorbital usually convex, very wide (35.5–53.8 % HL); nostrils of moderate length, not visible from ventral view; dorsal midline usually flattened anteriorly from above pelvic fin bases; caudal peduncle flanges long, almost reaching anal fin base; length of caudal fin about same as that of caudal peduncle; anal fin origin usually under 0.63 distance posteriorly along dorsal fin base; 1–2 moderately long (2.3 % SL) pyloric caecae, very occasionally absent; gill rakers short to moderately long, stout and sharply pointed; and, lack of distinct black bars along lateral line.

Description. As for the genus and members of the *Galaxias olidus* complex, except as indicated below, based on 172 specimens, 48.2–105.7 mm SL, and 286 additional specimens for meristics. Holotype and paratype were not able to be directly examined, though digital images and X-rays were seen: morphometric measurements were taken from images, some fin ray counts from X-rays, counts for pectoral and pelvic fins from the original description, but a request for counts of gill rakers and rays in paired fins, including examination of pyloric caecae, could not be met by the host institution. See Tables 4 to 9 for frequencies of meristic values and Table 33 for a summary of meristic variation. Segmented dorsal fin rays 10* (9–11), of these 8 (7–9*) branched and 2 (1*–3) unbranched; segmented anal fin rays 11 (9–12; [10*]), of these 9* (7–10) branched and 2 (1*–3) unbranched; caudal fin rays 16* (15–16); segmented pectoral fin rays 14 (13–16; [12*]), of these 12 (11–14; [10*]) branched and 2* (1–2) unbranched; pelvic fin rays 7*, of these 6* branched and one* unbranched; gill raker total count (lower limb and upper limb) 13 (12–14), lower arch with 9 (8–10) and 3 (3–4) on upper, variation on first gill arch 7+2 (1), 7+3 (5), 8+1 (1), 8+2 (2), 8+3 (45), 8+4 (8), 8+5 (1), 9+2 (9), 9+3 (127), 9+4 (117), 9+5 (8), 10+2 (5), 10+3 (45), 10+4 (70), 10+5 (7), 11+3 (4), 11+4 (2); vertebrae 53 (51–54; [52*]); 1–2 pyloric caecae on stomach.

TABLE 33. Summary of meristic variation in *Galaxias ornatus* (T—total; B—branched; L—lower limb; S—single; U—upper limb). Range in 90 % and 100 % of specimens.

Character	Mode	Mean	SD	SE	Range 90 %	Range 100 %	N
Dorsal Rays (T)	10	9.7	0.70	0.03	9–11	8–12	459
Dorsal Rays (B)	8	7.8	0.72	0.03	7–9	6–10	458
Dorsal Rays (S)	2	1.9	0.47	0.02	1–3	1–3	458
Anal Rays (T)	11	10.9	0.94	0.04	9–12	9–14	459
Anal Rays (B)	9	8.9	0.90	0.04	7–10	7–12	458
Anal Rays (S)	2	2.0	0.51	0.02	1–3	1–4	458
Caudal Rays	16	15.9	0.37	0.02	15–16	13–19	458
Pectoral Rays (T)	14	14.3	0.83	0.04	13–16	11–17	459
Pectoral Rays (B)	12	12.4	0.94	0.04	11–14	9–15	458
Pectoral Rays (S)	2	1.9	0.37	0.02	1–2	1–4	458
Pelvic Rays (T)	7	7.0	0.25	0.01	7	6–8	459
Pelvic Rays (B)	6	6.0	0.27	0.01	6	5–7	458
Pelvic Rays (S)	1	1.0	0.10	0.00	1	1–2	458
Gill Rakers (T)	13	12.6	1.05	0.05	12–14	9–15	458
Gill Rakers (L)	9	9.2	0.70	0.03	8–10	7–11	458
Gill Rakers (U)	3	3.5	0.64	0.03	3–4	1–5	458
Vertebrae	53	52.4	1.07	0.06	51–54	49–55	344

TABLE 34. Morphometric variation in *Galaxias ornatus* (values are percentages of denominators in ratios, except for LCF and SL).

	Holo-	Non-Types (N = 171)			
Character	type	Mean	Min.	Max.	S.D.
LCF (mm)	101.0	77.1	54.7	119.8	
SL (mm)	89.9	68.0	48.2	105.7	
SL / LCF	89.0	88.2	86.0	89.8	0.72
BDV / SL	13.0	12.3	8.8	15.2	1.39
BDPec / SL	15.0	14.2	11.5	16.9	1.18
BDPec / BDV	116.0	116.4	97.2	153.9	8.67
LCP / SL	13.3	13.4	10.8	16.4	0.95
DCP / SL	8.3	7.8	5.9	9.6	0.75
DCP / LCP	62.2	58.6	39.8	86.1	7.40
CFFL / SL	12.3	13.4	11.3	16.3	0.93
LCP/CFFL	107.9	100.2	75.9	127.8	9.72
PreD / SL	71.0	70.7	67.3	74.1	1.20
PreA / SL	78.2	74.8	69.9	79.6	1.38
PreD / PreA	90.9	94.6	90.3	99.4	1.80
DF–AF / LDB	93.6	63.3	34.7	102.2	12.36
LDB / SL	8.5	9.6	7.1	12.4	1.05
LAB / SL	9.5	10.5	7.1	13.5	1.32

...... continued on the next page

TABLE 34. (Continued)

Character	Holo-type	Non-Types (N = 171) Mean	Min.	Max.	S.D.
LDB / LAB	89.6	92.7	71.8	124.3	9.24
DL / LDB	149.5	158.5	132.3	209.5	14.73
AL / LAB	149.4	152.8	125.4	194.5	15.99
DL / SL	12.8	15.1	12.8	17.7	1.01
AL / SL	14.2	15.8	12.7	19.4	1.06
DL / AL	89.7	96.0	81.7	112.0	5.78
PecL / SL	13.7	12.1	10.1	14.6	0.93
PelL / SL	11.8	10.6	8.9	12.7	0.80
PelL / PecL	86.2	88.1	71.8	112.8	6.13
PrePel / SL	52.6	50.6	47.7	55.1	1.36
PecPel / SL	31.7	30.5	26.5	34.7	1.52
PelAn / SL	27.5	23.3	19.8	26.2	1.21
PecL / PecPel	43.2	39.8	32.1	50.7	3.55
PelL / PelAn	42.8	45.8	35.5	58.7	4.73
HL / SL	19.4	21.4	19.1	23.8	1.03
HL / PelAn	70.6	92.0	75.2	116.5	7.37
HW / HL	60.6	63.2	55.3	70.6	3.19
HD / HL	47.9	43.0	35.9	50.0	3.00
HW / HD	126.6	147.2	126.5	170.4	7.97
SnL / HL	30.0	29.0	24.0	34.4	2.29
SnL / ED	159.6	154.1	108.3	210.1	20.69
ED / HL	18.8	19.0	14.2	25.1	2.24
ED / HD	39.3	44.5	31.0	62.2	6.37
PoHL / HL	54.9	53.7	44.9	60.2	2.31
IOW / HL	43.0	41.8	35.5	53.8	2.95
ED / IOW	43.8	45.7	32.8	61.7	5.88
UJL / HL	38.6	37.0	32.0	42.1	1.91
LJL / HL	33.8	33.8	28.9	39.6	2.20
GW /HL	30.9	39.9	28.9	51.6	3.70
LJL / UJL	87.4	91.4	81.4	103.4	4.06
LJL / GW	109.3	85.4	62.5	121.6	8.45
GW / HW	50.9	63.0	51.5	81.8	4.82
SnL/UJL	77.8	78.5	63.4	100.7	6.50

See Table 34 for comparative value ranges of morphometric characters. Body of moderate depth and elongate, slightly laterally compressed and dorsal midline usually flattened anteriorly from above pelvic fin bases, depth through pectoral base 1.1 that through vent, trunk with dorsal and ventral profiles relatively evenly arched from snout to caudal peduncle or ventral slightly less so, belly a little deepened and laterally expanded in maturing individuals, body tapering back to a caudal peduncle of moderate length, 7.5 (6.1–9.2) in SL, and depth, 12.8 (10.4–16.9), the peduncle depth 17–1.8 in its length; accessory lateral line present. Head of moderate length, 4.7 (4.2–5.2) in SL, and usually slightly shorter than PelAn distance, 0.9 (0.7–1.1) in PelAn, of moderate depth and width, 2.3 (2.0–2.8) and 1.6 (1.4–1.8) in HL respectively, distinctly wider than deep (depth 1.5 in HW), lateral profile weakly wedge-shaped and slightly flattened dorsally, becoming quite fleshy in older individuals; eyes moderate, 5.3 (4.0–7.0) in HL, situated moderately high on head slightly below dorsal head profile, interorbital usually convex, very wide, 2.4 (1.9–2.8 in HL) and 2.2 (2.1–2.5) times ED; cheeks slightly to moderately expanded below eyes, eye profiles usually clearly or partially visible laterally from ventral view, or obscured; post-orbital head length of moderate length, 1.9 (1.7–2.2) in HL; snout of moderate length, 3.4 (2.9–4.2) in HL and 1.5 (1.4–1.7) times ED, lateral profile deep and usually rounded; nostrils moderately long and usually not visible anterio-laterally from ventral view; mouth terminal, of moderate length, 2.7 (2.4–3.1) in HL, posterior extent usually reaching to under anterior 0.4–0.5 of eyes and usually 0.6 ED below ventral margin of eye, most anterior tip of upper lip level with middle of eye, gape moderately wide, 2.5 (1.9–3.5) in HL, usually wider than length of upper jaw and 1.6 (1.4–1.9) in HW. Jaws subequal lower 0.9 of upper jaw length. Pyloric caecae of moderate length, longest usually 2.3 % SL (0.3–5.5 %); gill rakers shortish to moderate length, reasonably stout and sharply pointed, occasionally rounded.

Median fins fleshy at bases, paired fins moderately fleshy, with thickening extending distally over 0.5 of fin area, extending farther between fin rays, dorsal and anal fin bases of moderate length, dorsal base slightly shorter than anal base, fins rounded and of moderate length, anal a little longer than dorsal, middle rays longest, anal fin origin usually under 0.63 (0.35–1.00) distance posteriorly along dorsal fin base. Pelvic fins moderately long, 9.4 (7.9–11.2) in SL, 0.9 of pectoral fin length, usually inserted at about mid-point of standard length and extending about 0.46 distance to anal fin base; pectoral fin of moderate length and usually paddle-shaped, 8.3 (6.8–9.9) in SL, extending about 0.4 distance to pelvic fin base, low on body with dorsal end of fin base level with posterior extent of mouth, lamina of paired fins oriented anterio-ventrally to ventrally, raised lamellae infrequently present on ventral surface of rays, but when present, relatively well developed. Caudal fin of moderate length, 7.5 (6.1–8.8) in SL, emarginate, about same length as caudal peduncle, vertical width of expanded rays about equal to or greater than body depth through pectoral fin base, flanges low and moderately developed along caudal peduncle, long, almost reaching anal fin base, if shorter, then reaching anteriorly past distal margin of adpressed anal fin rays.

Size. Recorded to 110 mm LCF and 12 g; commonly to 55–75 mm LCF.

Colour in life. Body predominantly tan, light brown or brown on back and sides, extending over head and snout, becoming cream ventrally, belly creamy white. Overlain by small to moderate sized, relatively closely spaced, dark brown to grey-brown, irregular shaped blotches, flecks and patches, many coalescing to form irregularly shaped vertical bands; pattern densely distributed over dorsal surface of trunk and on to top and sides of head, extending down sides of trunk usually as bands which reach well below lateral line; blotches and bands usually darkest where they cross lateral line. Mid-dorsal surface of trunk sometimes with a thin row of gold spots extending from nape to dorsal fin base and broad, diffuse band of golden to coppery spots usually extending from near base of pectoral fin onto caudal peduncle, usually mostly below lateral line and quite distinct posteriorly. Gill cover translucent, with a moderately large golden patch; iris golden. Fins usually translucent light grey to yellowish brown, occasionally olive. Gravid females with fine black to dark grey stippling along ventro-lateral surface of trunk between the pectoral fin base and vent. See below for more detailed comments on body pattern.

Occasionally, snout and anterior portion of head including, the nape, noticeably an almost transparent pale lime-green (also found sporadically in *Galaxias olidus* and *Galaxias oliros* **sp. nov.**), though the reason is unknown.

Colour of preserved material. Base colour of head and body pale yellowish brown. Dorsal surface of trunk with distinctive bold pattern of closely spaced, irregular shaped, brown to dark brown blotches (still visible on holotype: Fig. 29a), sometimes coalescing into an almost completely enveloping brown shading, extending onto the dorsal surface of the head to tip of snout and laterally on head to about level with pectoral fin base. Fine, dark brown stippling usually present on sides and ventral surface of lower jaw, and along posterior fleshy extension of operculum. Dorsal trunk pattern extending onto lateral surface of trunk, posteriorly from pectoral fin base, as more discrete and widely spaced, irregularly shaped, thin to moderately wide, vertical to near-vertical bars or stripes and blotches, some coalescing, reaching ventrally past lateral line to about level with pectoral fin base, extending almost to ventral-lateral margin posteriorly from the pelvic fin base, also extending over entire caudal peduncle area; ventral surface of trunk pale yellowish brown. Bars, stripes and blotches usually distinctive and bold on sides, usually darker than dorsally, often darkest, almost black, on and around lateral line; pattern sometimes light brown or very faded and indistinct, though usually only on a few individuals within a population. Occasionally sparse brown to black spots at base of, and along, gill filaments, also on gill rakers. When present verticle bars usually small, occasionally medium size, often irregular in shape or round/ovoid, centred along lateral midline and more distinct anteriorly.

FIGURE 29. *Galaxias ornatus*: A) holotype (MNHN A.5225), a 90 mm TL female, and B) paratype (MNHN A.6915) (Muséum National D'Histoire Naturelle, Paris); C) Badger Creek; usual colour pattern (R. Kuiter); D) Lynches Creek at Brickhouse Road, 18 February, 2002; more stippled colour pattern (N. Armstrong).

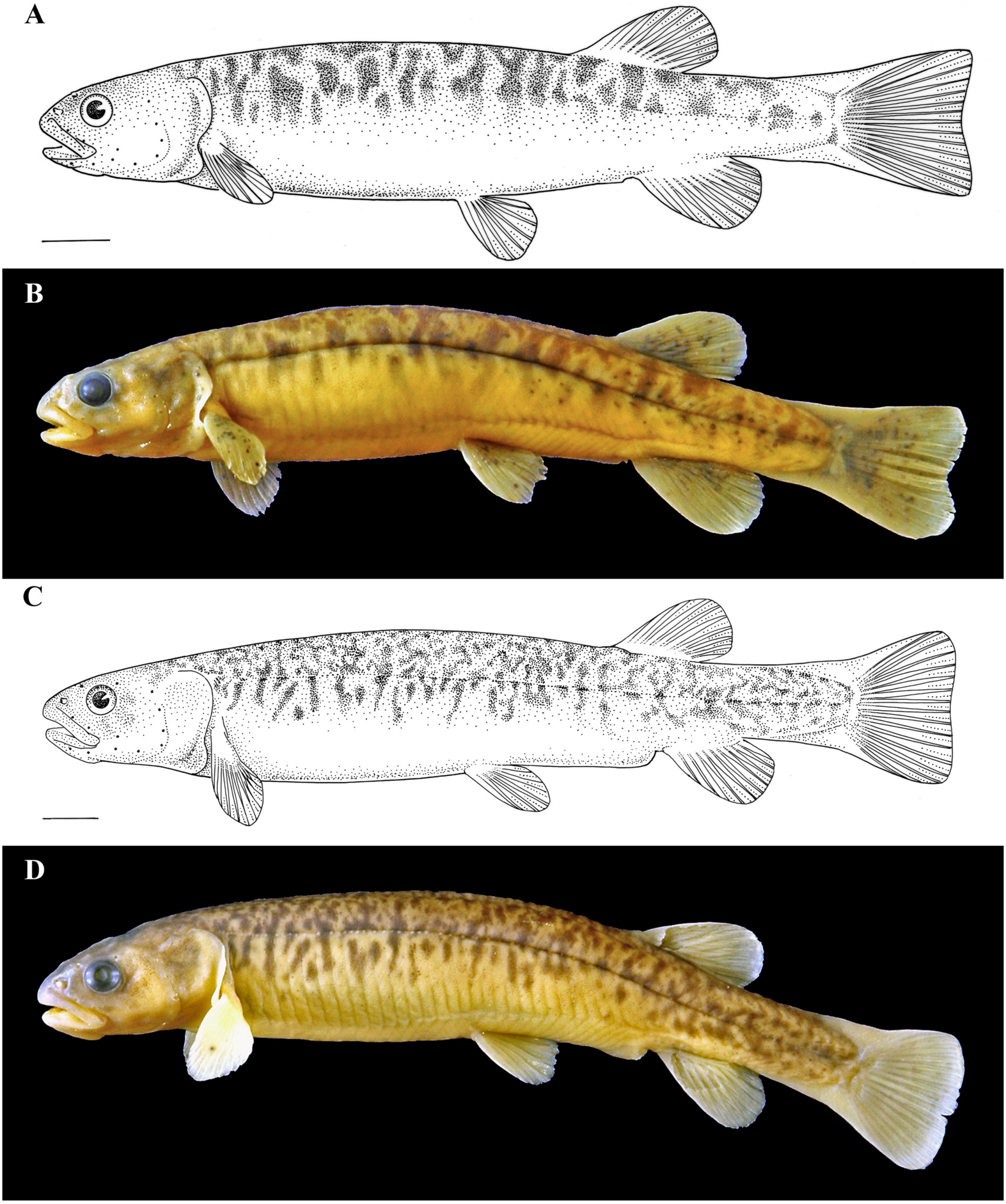

FIGURE 30. *Galaxias ornatus*, A–B: Cardinia Creek (NMV A.30688-1), A) line drawing (R. Plant), B) image of preserved specimen (T.A. Raadik); C–D: Clearwater Creek, Otway National Park (NMV A.30595-1), female:, C) line drawing (R. Plant), D) image of preserved specimen (T.A. Raadik). Scale bar = 5 mm.

Eye dark grey to black, pupil translucent pale orange. Teeth translucent yellow to pale orange–yellow, tips orange to orange–red; gill rakers pale yellowish brown. Fins pale creamy yellow, becoming translucent at about two-thirds distance along fin length, fleshy bases of dorsal, anal and pectoral fins with fine brown stippling, also just extending onto base of caudal fin and caudal peduncle flanges. Fin rays opaque to translucent, external edges of rays highlighted with fine brown spots forming thin lines.

Etymology. From the Latin, *ornatus*, meaning decorated, adorned, most probably in reference to the often bold and ornate colour pattern exhibited in this species.

Genetics. Allozyme and mtDNA analysis of this species can be found in Adams *et al.* (2014**;** taxon code BA). Diagnostic allozyme loci (2–10) between this taxon and the other species in the *Galaxias olidus* complex are provided in Table 12. Three genetically distinct subpopulations were identified, differing from each other by one diagnostic allozyme locus (Raadik 2011). One subpopulation ranges from the Tarwin River basin in the east to the Maribyrnong River basin, a second from the Werribee River basin to the west of Melbourne extending into the Otway Ranges, and the third, located in the Otway Ranges in the upper Calder River system. Morphological variation between these subpopulations was not investigated.

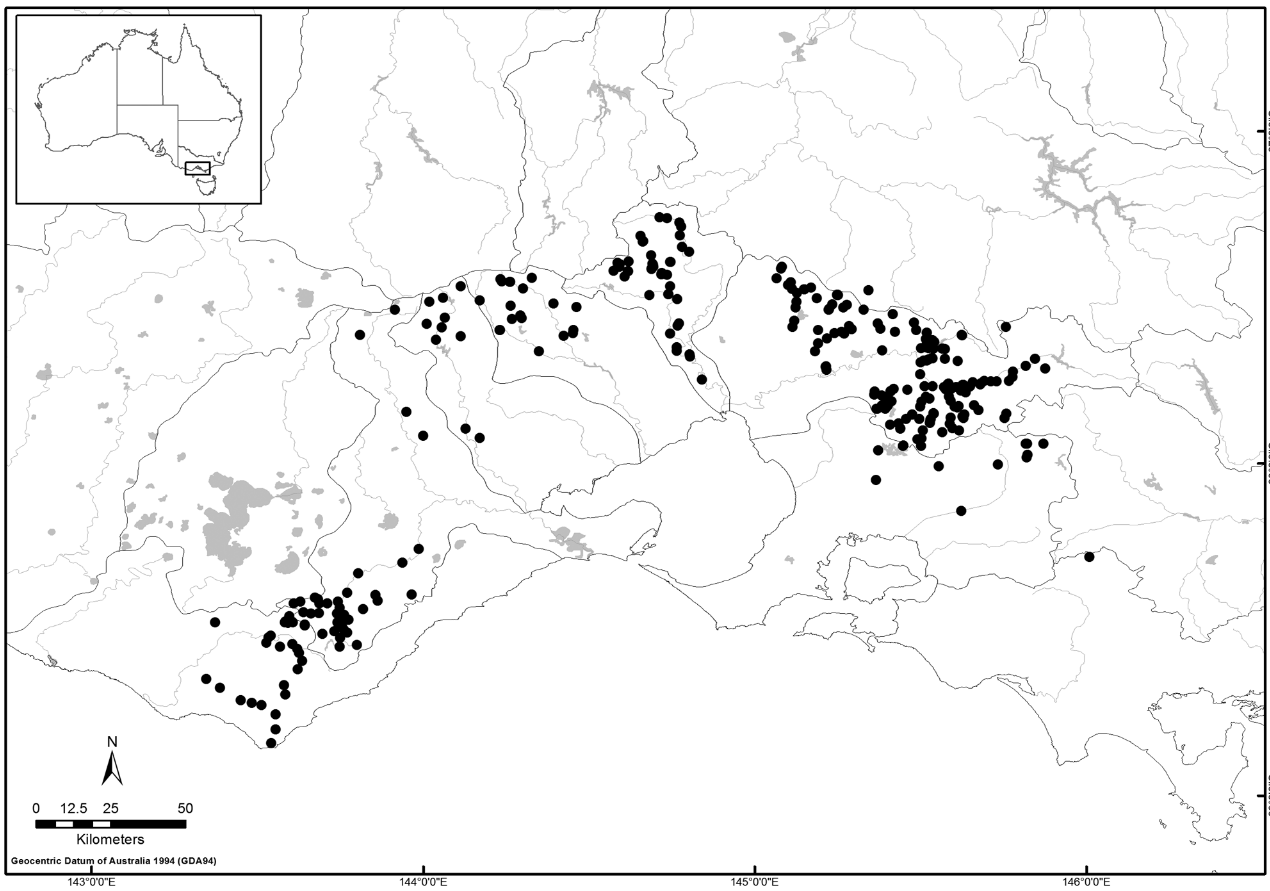

FIGURE 31. Distribution of *Galaxias ornatus* in central coastal Victoria (river basins shown—refer to Fig.1).

Distribution. See Figure 31. Broadly distributed south of the Great Dividing Range in coastal, central Victoria between Wilsons Promontory and Cape Otway at an elevation of between 35–800 m asl, though probably found up to 1000 m asl. Recorded from the upper reaches of the west Tarwin River in South Gippsland and throughout catchments westward from the Tarago River system in the Bunyip River catchment to the Gellibrand River system in the Otway Ranges, excluding the endorheic Corangamite Lakes catchment. Absent from French and Phillip islands in Western Port, including the Lang Lang and Bass river systems draining the eastern shore of Western Port, and the streams on the Mornington Peninsula. Also absent from the Little River system draining the Brisbane Ranges near Geelong, and from the short coastal streams along the Otway Ranges between the Barwon and the Parker river systems (Koehn and O'Connor 1990). Also appear to be absent from lower elevations in larger river systems (e.g. Yarra, Barwon, Werribee rivers), though historically may have been found much closer to the coast. See also Hortle and Lake (1983) and Closs (1984), which are referrable to *Galaxias ornatus*.

A small population is also present outside of this distribution, north of the GDR, upstream of a waterfall on a small creek in the upper reaches of the Yea River system Goulburn River basin).

Sympatry. Only species in the *Galaxias olidus* complex found within its range. Recorded in sympatry with *Galaxias brevipinnis*, *Galaxias maculatus* and *Galaxias truttaceus*, and historically possibly with *Galaxiella pusilla* and *Neochanna cleaveri*.

Habitat. Recorded from cool, well-shaded and clear-flowing, small upland creeks and moist gullies along mountain ranges (e.g. Dandenong Ranges, GDR, Otway Ranges), larger, forested foothill streams to larger rivers at lower elevation. Streams occupied usually range in size from 0.5–8.0 m in width (up to 20 m), 0.05–0.30 m average depth, with pools 0.3–> 1.2 m in depth, with a complex instream substrate ranging from clay and sand to bedrock, boulder and cobble. Instream cover is usually relatively plentiful, consisting of rock, large and small timber debris, aquatic vegetation, and vegetation and bank overhang. Also known from drier river systems, including ephemeral tributaries, to the north-west and west of Melbourne (e.g. Plenty, Maribyrnong, and Werribee rivers), where they are able to persist in small and large, isolated and sometimes stagnant pools. Also able to persist in small streams within upland catchments in the north-east of their range (e.g. upper Yarra River system) which are often covered by snow for varying periods of time during winter.

General Biology. Previous studies on *Galaxias olidus* s.l. spawning biology (O'Connor and Koehn 1991), diet and feeding (Fletcher 1979 (in part), Closs 1994), impacts on aquatic invertebrate communities (Closs 1991, 1996), and interaction with predatory salmonids (Closs 1991, Closs & Lake 1996), are all referrable to *Galaxias ornatus.* Confined to freshwater and considered not to undertake diadromous migrations. Usually recorded at densities up to 04–1.5 fish/m^2, though can be very abundant in isolated pools (up to 3.0 fish/m^2). Often the only fish species present in upper reaches, but in lower to mid reaches collected with a diverse range of fish and decapod crustacea, though commonly with Shortfin Eel, Broadfinned Galaxias, River Blackfish, Southern Pygmy Perch, Australian Smelt, Common Freshwater Shrimp, Central Highlands Spiny Cray, Southern Victorian Spiny Cray (*Euastacus yarraensis*) and Common Yabby. Also often found with the alien species Brown Trout.

Spawning period, fecundity and other aspects of biology have been reported by O'Connor and Koehn (1991) from one population and spawning event (early August to late October and up to 384 eggs). Based on material examined from across its range between 1988 and 2002, spawning was found to extend from about June to early August, with adults ripe and close to spawning from about mid-April, and with the body cavity full of fat deposits, and gonads in an early stage of development by August. Consequently, the spawning period may be quite long (June–October), or flexible between years depending on environmental conditions. Fecundity was also found to be slightly higher, with 492 mature oocytes (mean diameter of 1.2 mm) recorded from a 66.1 mm LCF female collected in late July. The smallest fish which could be confidently sexed was a male at 50.9 mm LCF and a female at 51.7 mm LCF, though O'Connor and Koehn (1991) recorded 42 and 47 mm LCF respectively. The smallest fish length per month is confusing with respect to the spawning period and size at age. Fish approaching length at maturity can be present at the end of March (43.4 mm LCF) and most fish by June are > 43 mm LCF, though some fish 30.8–37.0 LCF have also been recorded in June and late August. The smallest fish collected to date (25.0–28.9 mm LCF) were recorded in February, and fish > 40 mm LCF have been recorded in January–March, June, August and December.

Many populations and individuals found to be heavily infected with small to moderate-sized grey, black or brown cysts, possibly trematode metacercariae, embedded in the skin of the head or trunk, fins and eyes. A small number of fish recorded with a short, thin, white worm, coiled and pointed at both ends, from amongst fat deposits around the stomach in the body cavity, some with white cysts embedded in the liver, and one female from Stringybark Creek (Yarra catchment) recorded with glochidia, a parasitic life-history stage of a native freshwater mussel (Hyriidae), attached to the gills (three in the left cavity and one in the right). This has previously been reported from fish from the Bunyip River system (Atkins 1979). *Galaxias ornatus* also recorded with deformities, damage or absence of some fins, deformities of the snout (snub-nose) and some with curvature of the spine.

Variation. Has a relatively high amount of variation in morphometric and meristic characters across its range. Consequently close or adjacent or widely separated populations can look superficially quite different or resemble the morphologically similar *Galaxias olidus* In particular, colour pattern varies considerably, with populations east of Melbourne usually with a distinct and striking pattern, those in the west less so, and some populations just west of Melbourne (e.g. Maribyrnong, and Werribee catchments) quite pale or almost lacking in pattern.

Remarks. Previously considered a junior synonym of *Galaxias olidus* Günther, 1866 (McDowall & Frankenberg 1981), with which it is morphological very similar. Fish from some populations are very strikingly and boldly coloured with intense and contrasting patterns (e.g. Hoddles and Stringybark creeks in the Yarra River catchment, and Clearwater Creek in the Otway Ranges). The distribution is centred on catchments which drain to Bass Strait between Cape Otway and Wilson's Promontory, though it has also been able to colonise farther westward into the Gellibrand, and Aire/Ford/Calder river systems which drain into the Southern Ocean.

FIGURE 32. Diversity of aquatic habitats occupied by *Galaxias ornatus* (clockwise from top left): II,31 Goodman Crk, Coimadai; II,35 Youngs Crk, Otway Ranges; II,29 Little Yarra R, Yarra Junction; II,29 McCrae Crk, Water Mill Trk; II,30 Maribyrnong R, Sydenham; II,31 drying pool in Lerderderg R, Lerderderg Gorge; II,29 stagnant pool, Plenty R, east branch, Wildwood Rd; II,29 Jerusalem Crk, mid Yarra River system. (All images by T.A. Raadik) (refer to FIGURE 1 for drainage division and river basin locations).

Genetically defined population substructure was evident across the range of *Galaxias ornatus* with three distinct subpopulations identified (Raadik 2011). One ranges from the Tarwin River basin in the east to the Maribyrnong River basin, a second from the Werribee River basin to the west of Melbourne extending into the

Otway Ranges, and the third, located in the Otway Ranges in the upper Calder River system. Morphological variation between these subpopulations was not investigated.

A population was identified outside of the usual range of the taxon, north of the GDR in Hirts Creek. This population persists above a natural waterfall and the species was not found farther downstream where alien Brown Trout are abundant. The origin of this population is unknown, and may represent a remnant, isolated population from a former, more widespread range, a more recent, natural colonisation across the catchment divide, or a very recent anthropogenic translocation (possibly bait-bucket transfer of live bait from recreational angling). Further genetic investigation with highly variable markers could help to elucidate the origin.

Type specimens were not able to be borrowed and therefore could not be directly examined, though counts and measurements were made, where possible, from digital images and X-rays. Pectoral and pelvic total ray count (and number of branched and unbranched rays), including the gill raker count and number and shape of pyloric caecae, remain to be verified or determined. Whitley (1955) gave the length of the holotype as 95 mm SL, though was measured in this study as 89.9 mm SL from a digital image.

Able to persist in the presence of alien trout to some degree, though interactions can be complex (Closs & Lake 1996), can also be mediated to some degree by increased habitat complexity, and salmonids can still significantly impact on some populations (e.g. Fletcher 1979) leading to localised extinctions.

***Galaxias supremus*, new species**
Kosciuszko Galaxias
Tables 4 to 9, 35 & 36; Figures 7, 33 & 34

Galaxias olidus olidus (non *G. olidus* Günther, 1866)—Frankenberg, 1969: 170 (*partim*).
Galaxias olidus (non *G. olidus* Günther, 1866)—Helms, 1890 (*partim*): 12; McDowall & Frankenberg, 1981: 469 (*partim*); Campbell *et al.*, 1986: 95 (*partim*); Terzis, 1986 (*partim*); Green & Osbourne, 1994: 124 (*partim*); Green, 2002: 37; McDowall, 2003a: 364 (*partim*); Green, 2008: (*partim*).
Galaxias findlayi (non *G. findlayi* Macleay, 1882)—Ogilby, 1896: 66 (*partim*) [see Appendix 11 for text of revision]; Frankenberg, 1969: 329; Timms, 1980: 123; Hebert, 1977: 391; Raadik & Kuiter, 2002: 831 *(partim)*.
Galaxias sp. 1–Raadik & Kuiter, 2002: 831.

Conforms to the allozymically defined and morphologically diagnosed taxon ‘KO’ of Adams *et al.* (2014), and ‘kosciusko’ of Raadik (2011).

Material Examined.

Holotype. NMV A.30571-3, 86.6 mm LCF, (77.0 mm SL), female, Carruthers Creek, on Main Range Track, south-east of Blue Lake, Mount Kosciuszko National Park, New South Wales, 36° 24' 37”S 148° 18' 20”E, T.A. Raadik, 15 March 2002.

Paratypes. NSW: AMS I.44919-001 (3), 72.8–84.3 mm LCF (64.2–74.8 mm SL), NMNZ P.045750 (1), 75.2 mm LCF (66.0 mm SL) and NMV A.30571-1, (10), 77.0–96.1 mm LCF (68.63–85.4 mm SL), collected with holotype; AMS I.44920-001 (3), 71.3–87.5 mm LCF (62.9–76.6 mm SL), NMNZ P.045751 (2), 82.2–83.0 mm LCF (72.3–73.5 mm SL) and NMV A.30570-1 (10), 60.9–94.0 mm LCF, (53.8–83.3 mm SL), Blue Lake, west shore and inflowing tributary, off Blue Lake walking track, Mount Kosciuszko National Park, 36° 24' 20”S 148° 18' 48”E, T.A. Raadik, 15 March 2002.

Non-type material. NSW: NMV A.30571-2 (1), Carruthers Creek, collected with holotype; NMV A.30570-2 (16), Blue L., collected with NMV A.30570-1.

Diagnosis. *Galaxias supremus* **sp. nov.** differs from all other species within the *Galaxias olidus* complex by a combination of the following characters: 8 segmented pelvic fin rays; very high mean vertebral count of 57, though range broad (52–59); mouth distinctly subterminal; dorsal, anal and pelvic fin origins set far back along trunk (70.4–75.1, 74.8–80.2 and 49.7–55.6 % SL respectively); distance between pectoral and pelvic fin bases long (27.8–35.7 % SL); body depth shallow (8.4–12.4 % SL) and much greater through pectoral fin base (11.8–16.4 % SL) than that through vent; caudal peduncle very short and shallow (10.0–12.7 and 6.3–8.9 SL respectively) and caudal fin much longer (120 %) than caudal peduncle; snout long (26.7–34.9 % HL) and eye small (13.1–20.7 % HL); nostrils short, not visible from ventral view; anal fin base short (8.7–10.9 % SL); dorsal and anal fins short (12.6–15.9 and 13.1–15.9 % SL respectively); dorsal midline usually flattened anteriorly from above or slightly posterior to pectoral fin bases; posterior extent of mouth about 0.8 ED below ventral margin of eye; usually 2, occasionally 1, pyloric caecae of moderate length (4.6 % SL); gill rakers short to moderately long; anal fin origin usually under 0.85 distance posteriorly along dorsal fin base, the greatest setback in all members of the species complex; lack of distinct black bars along lateral line though, very occasionally, dark patches on dorsal midline may have a very small, black bar in the centre; and, distinctive, mottled colour pattern.

Description. As for the genus and members of the *Galaxias olidus* complex, except as indicated below, based on 29 specimens, 53.8–85.4 mm SL, and 15 additional, non-type specimens for meristics. See Tables 4 to 9 for frequencies of meristic values and Table 35 for a summary of meristic variation. Segmented dorsal fin rays 10 (9–11), of these 8 (7–9) branched and 2 (1–3) unbranched; segmented anal fin rays 11 (10–12), of these 9 (8–10) branched and 2 (1–2) unbranched; caudal fin rays 16 (15–16); segmented pectoral fin rays 15 (14–16), of these 13 (12*–15) branched and 2 (2–3) unbranched; pelvic fin rays 8 (7–9), of these 7 (6–8) branched and one unbranched; gill raker total count (lower limb and upper limb) 13 (10–13; [11*]), lower arch with 9 (8–10) and 3 (2*–4) on upper, variation on first gill arch 8+2 (2), 9+2 (5*), 9+3 (10), 9+4 (3), 10+2 (1), 10+3 (11), 10+4 (1); vertebrae 57 (53–58); usually two*, occasionally one, pyloric caecae on stomach.

See Table 36 for comparative value ranges of morphometric characters. Body moderately long but shallow, relatively shallow at vent and of moderate depth through pectoral base, dorsal midline usually flattened anteriorly from above or slightly posterior to pectoral fin bases, depth through pectoral base much greater than that through vent, 1.3 (1.2–1.6) times BDV, trunk with dorsal profile evenly arched from snout to dorsal fin, ventral less arched from snout to anal fin, body tapering back to a relatively short, 8.8 (7.0–10.0) in SL, and shallow, 13.5 (11.2–15.9) in SL, caudal peduncle, the peduncle depth 1.5 (1.3–1.9) in its length; accessory lateral line present. Head of moderate length and shorter, 0.9 (0.8–1.1) than PelAn distance, of moderate depth and width, 2.5 (2.0–2.7) and 1.6 (1.5–1.7) in HL respectively, distinctly wider than deep (depth 1.6 (1.4–1.7) in HW), dorsally compressed and lateral profile wedge-shaped; eyes small, 6.0 (4.8–7.6) in HL, 2.4 (2.0–3.0) in HD, situated at or just below dorsal head profile, interorbital flat to very slightly convex, relatively broad, 2.6 (25–2.9) in HL and 2.3 (1.8–2.8) times ED; cheeks expanded below eyes, eye profiles usually not visible laterally from ventral view; snout relatively long, 3.3 (2.9–3.7) in HL and 1.9 (1.4–2.5) times ED, lateral profile usually pointed; post-orbital head length of moderate length, 1.9 (1.7–1.9) in HL; nostrils short and not visible anterio-laterally from ventral view; mouth subterminal, of moderate length, 2.7 (2.4–3.2) in HL, posterior extent reaching to below middle of eyes or slightly farther and usually 0.8 (0.6–1.1) of ED below ventral margin of eye, most anterior tip of upper lip level with about middle of eye, occasionally just lower, gape of moderate width, 2.6 (2.3–3.0) in HL, wider than length of upper jaw and about 1.6 in HW. Jaws subequal, 1.1–1.2 times length of lower. Pyloric caecae moderately long, longest averaging 4.6 % (2.7–7.9 %) of SL; gill rakers stout, short to moderately long and rounded to bluntly pointed.

Median fins moderately fleshy at bases, paired fins less so, with thickening extending distally over about 0.5 of fin area, extending farther between fin rays, dorsal fin base usually slightly shorter than anal fin base, dorsal and anal fins rounded and relatively short, anal longer than dorsal, middle rays longest; anal fin origin usually under 0.85 (0.66–1.21) distance posteriorly along dorsal fin base. Pelvic fins relatively long, 8.7 in SL, 0.9 of pectoral fin length, inserted just posterior to mid-point of standard length and extending just under 0.5 distance to anal fin base; pectoral fin of moderate length and paddle-shaped, 7.6 in SL, extending abut 0.4 distance to pelvic fin base, low on body with dorsal extent of fin base level with posterior extent of mouth, lamina of paired fins oriented distinctly ventrally, raised lamellae on ventral surface of rays usually present and strongly developed. Caudal fin of moderate length, 7.5 (6.4–8.3)in SL, emarginate, 1.2 times length of caudal peduncle, vertical width of expanded rays greater than maximum body depth, flanges low and moderately well-developed along caudal peduncle, reaching to distal end of rays of adpressed anal fin as a low ridge, or slightly farther.

Size. Recorded to 96 mm LCF and 8 g; commonly to 80–85 mm LCF.

Colour in life. Body and head light brown to tan overall, body usually slightly lighter below lateral line, belly lighter. Overlain by moderate to large sized brown to dark brown, sometimes dark grey to almost black, irregularly shaped blotches usually coalescing to form irregular shaped bands, more densely spaced above lateral line, extending down sides and reaching about mid-laterally, sometimes overlain with shading formed by minute, closely spaced, dark grey spots. Blotches centred along lateral line darkest and blotches/bands more widespread laterally on caudal peduncle: very occasionally tiny black bars present, located around the centre of the trunk and interspersed amongst the blotches and bands. Gill cover light brown, with a moderately large gold blotch; iris gold. Mid-dorsal surface of trunk sometimes with a thin band composed of gold spots extending from nape to dorsal fin base; head broadly scattered with diffuse small gold flecks, and broad, diffuse band of golden to coppery spots usually extending from near base of pectoral fin onto caudal peduncle, usually mostly below lateral line and quite distinct posteriorly, though can extend dorsally to above lateral line along flanks of trunk. Fins translucent lemon to light brown. See below for more detailed comments on body pattern.

TABLE 35. Summary of meristic variation in *Galaxias supremus* **sp. nov.** (T—total; B—branched; L—lower limb; S—single; U—upper limb). Range in 90 % and 100 % of specimens.

Character	Mode	Mean	SD	SE	Range 90 %	Range 100 %	N
Dorsal Rays (T)	10	9.9	0.72	0.13	9–11	9–11	32
Dorsal Rays (B)	8	8.2	0.82	0.15	7–9	7–10	32
Dorsal Rays (S)	2	1.8	0.57	0.10	1–3	1–3	32
Anal Rays (T)	11	10.8	0.90	0.16	10–12	8–12	32
Anal Rays (B)	9	9.1	0.88	0.16	8–10	7–11	32
Anal Rays (S)	2	1.8	0.44	0.08	1–2	1–2	32
Caudal Rays	16	15.8	0.44	0.08	15–16	14–16	33
Pectoral Rays (T)	15	15.4	0.74	0.13	14–16	14–17	33
Pectoral Rays (B)	13	13.2	0.83	0.14	12–15	12–15	33
Pectoral Rays (S)	2	2.1	0.33	0.06	2–3	2–3	33
Pelvic Rays (T)	8	8.0	0.25	0.04	8	7–9	33
Pelvic Rays (B)	7	7.0	0.25	0.04	7	6–8	33
Pelvic Rays (S)	1	1.0	0	0	1	1	33
Gill Rakers (T)	13	12.2	0.96	0.17	10–13	10–14	33
Gill Rakers (L)	9	9.3	0.60	0.10	8–10	8–10	33
Gill Rakers (U)	3	2.9	0.60	0.10	2–4	2–4	33
Vertebrae	57	56.0	1.71	0.26	53–58	52–59	44

TABLE 36. Morphometric variation in *Galaxias supremus* **sp. nov.** (values are percentages of denominators in ratios, except for LCF and SL).

	Holo-	Paratypes (N = 29)			
Character	type	Mean	Min.	Max.	S.D.
LCF (mm)	86.6	81.1	60.9	96.1	
SL (mm)	77.0	71.5	53.8	85.4	
SL / LCF	88.9	88.2	86.5	89.2	0.58
BDV / SL	10.2	10.1	8.4	12.4	0.86
BDPec / SL	13.2	13.6	11.8	16.4	1.28
BDPec / BDV	129.3	134.3	120.2	157.5	9.48
LCP / SL	11.5	11.4	10.0	12.7	0.69
DCP / SL	7.5	7.4	6.3	8.9	0.61
DCP / LCP	65.4	65.0	52.5	78.4	5.61
CFFL / SL	12.5	13.4	12.1	15.7	0.74
LCP/CFFL	92.1	85.1	71.6	101.0	7.63
PreD / SL	71.8	72.5	70.4	75.1	1.10
PreA / SL	76.8	77.5	74.8	80.2	1.41
PreD / PreA	93.5	93.7	90.1	96.5	1.71

...... *continued on the next page*

TABLE 36. (Continued)

Character	Holo-type	Paratypes (N = 29) Mean	Min.	Max.	S.D.
DF–AF / LDB	72.9	85.0	66.0	121.3	9.93
LDB / SL	10.7	9.4	7.6	11.4	0.86
LAB / SL	10.1	9.9	8.7	10.9	0.58
LDB / LAB	106.3	95.4	79.8	108.7	7.58
DL / LDB	135.0	149.7	123.8	181.8	13.12
AL / LAB	136.0	144.1	128.1	169.4	8.39
DL / SL	14.4	14.0	12.6	15.9	0.79
AL / SL	13.7	14.2	13.1	15.9	0.69
DL / AL	105.5	98.7	87.4	110.9	4.91
PecL / SL	13.1	13.1	11.5	14.6	0.68
PelL / SL	11.1	11.5	10.2	13.2	0.63
PelL / PecL	85.2	87.5	79.7	96.6	4.69
PrePel / SL	51.5	53.2	49.7	55.6	1.45
PecPel / SL	31.4	32.1	27.8	35.7	2.03
PelAn / SL	26.7	24.4	21.4	26.7	1.39
PecL / PecPel	41.6	41.0	35.7	48.4	3.13
PelL / PelAn	41.6	47.0	39.7	56.5	3.61
HL / SL	21.9	22.3	21.0	24.3	0.80
HL / PelAn	81.9	91.5	78.5	109.9	7.24
HW / HL	62.5	63.0	59.4	67.5	1.94
HD / HL	38.2	40.4	36.5	49.1	2.89
HW / HD	163.5	156.6	136.9	174.4	8.98
SnL / HL	28.4	30.2	26.7	34.9	1.72
SnL / ED	197.1	186.0	138.0	251.1	31.11
ED / HL	14.4	16.6	13.1	20.7	2.28
ED / HD	37.7	41.0	33.2	49.0	4.19
PoHL / HL	55.0	55.6	52.4	58.5	1.75
IOW / HL	35.0	38.0	34.1	40.2	1.39
ED / IOW	41.2	43.6	35.9	56.5	5.98
UJL / HL	35.3	37.0	31.6	42.1	1.99
LJL / HL	30.4	32.3	28.3	35.3	1.67
GW /HL	38.3	38.4	33.0	42.9	2.54
LJL / UJL	86.1	87.4	81.2	93.0	3.02
LJL / GW	79.4	84.5	76.6	93.3	4.65
GW / HW	61.3	61.0	50.7	67.0	3.99
SnL/UJL	80.4	81.5	72.1	89.8	3.80

FIGURE 33. *Galaxias supremus* **sp. nov.**, A–B: holotype, NMV A.30571-3, 86.6 mm LCF, female, Carruthers Creek, Main Range Track, south-east of Blue Lake, Mount Kosciuszko National Park, New South Wales, A) line drawing (R. Plant), B) image of preserved specimen (T.A. Raadik); C), collected at the type locality with the holotype, 15 March 2002; ~ 80 mm LCF. (R. Kuiter); D), collected from Blue Lake, 15 March 2002; ~ 70 mm LCF. (R. Kuiter). Scale bar = 5 mm.

FIGURE 34. A) Carruthers Creek, at type locality of *G. supremus* **sp. nov.**, 15 March 2002 (T.A. Raadik); B) habitat of *G. supremus* **sp. nov.**, Blue Lake and inflowing tributary, Mount Kosciuszko National Park, 15 March 2002 (T.A. Raadik).

Colour of preserved material. Base colour of head and body pale cream to creamy yellow, with overlying light dusky shading of fine brown-black stippling, particularly on dorsal and latero-ventral surface. Dorsal and lateral surfaces of trunk with distinctive bold pattern of closely spaced, irregular shaped, dark brown to grey spots and blotches, smaller on dorsal surface and coalescing to form distinct broad patches, sometimes crisply outlined, centred on the lateral line, ranging from pectoral fin base posteriorly to caudal fin; with dark brown to black regions on lateral line. Mid-lateral bars rarely present, if so, tiny and black, located around centre of trunk and usually within other diffuse dark brown bars and larger blotches. Lateral trunk pattern extends below lateral line to ventro-lateral region, fading rapidly and merging with overlying ventro-lateral stippling. Dorsal trunk pattern extends onto nape, behind eyes and upper opercular region, with rest of dorsal surface of head and snout, including lateral surfaces of head, dusky grey. Fine, sparse black stippling extends onto ventral surface of head, and fine to medium black and brown spotting inside operculum, with black spotting at base of, and along, gill filaments.

Eye grey to black, pupil translucent pale orange yellow. Teeth translucent yellow to pale orange–yellow, tips orange to orange–red; gill rakers cream to pale yellow. Fins pale creamy yellow, becoming more translucent on posterior margins, fleshy bases of dorsal, anal and pectoral fins with fine brown stippling, also just extending onto base of caudal fin. Fin rays opaque, external edges of rays highlighted with fine brown spots forming thin lines, first few rays generally darker.

Etymology. From Latin *supremus*, meaning highest, uppermost, in reference to this species being the galaxiid found at the highest elevation of all the Galaxiidae, occurring at over 2000 m asl on Mount Kosciuszko, Australia's highest mountain. Suggested vernacular name as the 'Kosciuszko Galaxias'.

Genetics. Allozyme and mtDNA analysis of this species can be found in Adams *et al.* (2014**;** taxon code KO). Diagnostic allozyme loci (2–9) between this taxon and the other species in the *Galaxias olidus* complex are provided in Table 12.

Distribution. See Fig. 7. Poorly known. Confirmed records only from Blue Lake and type locality in the upper reaches of Carruthers Creek, headwaters of the Blue Lake Creek system in the upper Snowy River on Mount Kosciuszko, Mount Kosciuszko National Park in NSW, at an elevation of 1900 to 1950 m asl. The Carruthers Creek location is approximately 1.3 km (river distance) from the source, which is at 2100 m asl, in a catchment of approximately 3.5 km^2, and that of Blue Lake approximately 1.6 km (river distance) from the source (at 2150 m asl), in a catchment of approximately 5.5 km^2. Alien trout are abundant in the Snowy River approximately 2 km downstream from the Carruthers Creek and Blue Lake locations, and therefore the populations of *Galaxias supremus* are considered to be currently restricted to the upper reaches of each system; within the Blue Lake Creek possibly to upstream of Hedley Tarn which is just over 1 km upstream from the Snowy River. The identity of galaxiids in many nearby waters in the upper reaches of the Snowy River system on Mount Kosciuszko (e.g. Snowy River, Thredbo River, Club Lake, Merritts, Spencers, Betts, Perisher, Pipers and Diggers creeks, etc.) are unconfirmed (see Remarks). Consequently, changes to historical distributions are currently unknown.

Sympatry. Considered to have been sympatric with *Galaxias olidus*, though alien trout have substantially altered distributional patterns in the last 150 years and fragmented and reduced galaxiid populations.

Habitat. Collected from cold and clear water in small flowing creeks (0.6–1.1 m average width, 0.1–0.2 m average depth, 0.5–0.6 m maximum depth) and from an on-stream lake (Blue Lake). During winter all sites are covered by snow and ice for an extended period of time. Substrate consisted of bedrock, boulder, cobble, gravel and sand in the creeks, and cobble, pebble, gravel and silt in the lake, with fish collected from amongst rock, undercut banks and overhanging grasses in the creeks, mainly from pools. In Blue Lake, fish were collected from amongst small cobbles and from within 2 m of the shoreline; fish location and habitat in deeper water is unknown. All sites lacked emergent or submerged aquatic vegetation or overhead shading.

General Biology. Confined to freshwater and considered not to undertake diadromous migrations. Collected at a density of 4.5 fish/m^2 in Carruthers Creek, 2.5 fish/m^2 along the edges of Blue Lake, and 1.5 fish/m^2 in an inflowing tributary to Blue Lake, and is the only native fish species so far recorded from within its range, though *Galaxias olidus* is presumed to be present nearby. Collected in Carruthers Creek with an unidentified native spiny crayfish *Euastacus* sp. (possibly *E. rieki*). Spawning period unknown, though possibly very late spring to early summer: adult fish collected in mid-March were from early to mid-stage of gonad development, and the smallest presumed 0+ age fish recorded was 34.1 mm LCF; and, an additional 13 fish between 35.0–49.4 mm LCF were also collected in mid-March (NMV A.30570-2). Able to withstand very cold water (< 2 ºC) for extended periods, as Blue Lake, and possibly the creeks, ice over during winter; Green (2000) reported an active fish lying on the ice of Blue Lake in October 1977.

Variation. Individuals from Carruthers Creek differ slightly in overall morphology to those from Blue Lake, being shallower in body and head depth, the posterior end of the mouth is positioned slightly lower below the eyes, and the body pattern is more intense and extends farther down the sides to cross the lateral line. Juvenile fish (< 55 mm LCF) from Blue Lake had a larger eye than similar sized individuals from Carruthers Creek. In addition, one individual from Blue Lake lacked the typical large dark brown blotches along the mid-lateral region of the trunk, which were replaced by a lateral series of closely spaced, small (1.1–1.2 mm wide x 1.6–1.8 mm long), relatively diffuse black bars, extending from the pectoral fin base to above the pelvic fin base. Putative hybridisation with *G. olidus* is not considered to cause difficulties in identification (see below).

Conservation status. Considered critically endangered based on IUCN criteria (ISPS 2013): A2e; B1+2abc; C2a(i)—two locations/populations, estimated EOO of 6 km^2 and AOO of 1.4 km^2.

Remarks. Potentially hybridise with *Galaxias olidus*, with putative hybrid fish genetically identified from Sawpit Creek. These individuals were morphologically similar to *G. olidus*, with only very subtle differences in characteristics. The degree of putative hybridisation, and hybrid morphology, requires detailed study.

Galaxias supremus is recorded from a similar location to the poorly defined type locality for *Galaxias findlayi* Macleay, 1882 from near Mount Kosciuszko (see Appendix 1). The type specimens for *G. findlayi* have been lost and could not be examined, but, based on comparison with the published description, significant differences exist in the morphology of both taxa, particularly the pelvic fin ray count. Consequently it is considered that *G. findlayi* is not referrable to *Galaxias supremus*. The taxonomic status of *G. findlayi* could therefore not be resolved and its placement as a junior synonym of *Galaxias olidus* Günther is upheld.

Galaxias supremus is probably more widespread than currently known and is highly likely to be the galaxiid found in the upper Snowy River near the summit of Mount Kosciuszko, at an elevation of ~2100 m (Green 2002). It is also probably the species present in nearby Club Lake. Many additional populations of galaxiids in the *Galaxias olidus* complex, are known throughout the upper headwaters of the Snowy River system (e.g. Munyang, Snowy, and Thredbo rivers, and Betts, Diggers, Four Mile, Merritts, Perisher, Pipers, Racecourse, Rawsons, Spencers, creeks), and have been fragmented by alien trout (Green 2008). Given the possibility for unrecognised species in the catchment (e.g. *Galaxias findlayi* or new taxa), that putative hybrids have been identified between *Galaxias supremus* and *Galaxias olidus*, and that many populations of galaxiids remain to be identified, detailed assessment of the genetic and morphological variation of galaxiids in the upper Snowy River system, upstream of Dalgety, is urgently required, based on systematic collection of fresh material, to resolve the systematics of the species complex and to define distributions.

***Galaxias tantangara*, new species**

Stocky Galaxias

Tables 4 to 9, 37 & 38; Figures 7 & 35

Conforms to the allozymically defined and morphologically diagnosed taxon 'TA' of Adams *et al.* (2014), and 'tantangara' of Raadik (2011).

Material Examined.

Holotype. NMV A.30578-2, 86.3 mm LCF, (75.7 mm SL), female, Tantangara Creek, tributary, above falls 200 m upstream of ford on Alpine Creek Fire Trail, Kosciuszko National Park, upstream of Tantangara Reservoir, New South Wales, 35° 50' 23"S 148° 34' 04"E, T.A. Raadik, 16 March 2002.

Paratypes. AMS I.44917-001 (3), 79.6–86.7 mm LCF (70.5–76.0 mm SL) and NMV A.30578-1 (11), 74.6–102.7 mm LCF (65.5–91.5 mm SL), collected with holotype.

Non-type material examined (not measured): see Appendix 5.

Diagnosis. *Galaxias tantangara* **sp. nov.** differs from all other species within the *Galaxias olidus* complex by a combination of the following characters: low mean total gill raker count of 10; body distinctly stocky and deep through vent and pectoral fin base (12.6–15.6 and 14.9–17.9 % SL); caudal peduncle deep (8.5–10.2 % SL); head obtuse to slightly bulbous in lateral profile, moderately deep (41.4–48.2 % HL) but wide (63.4–72.8 % HL); gape wide (40.2–51.0 % HL and 59.6–72.2 % HW); eye profiles usually not visible laterally from ventral view; nostrils short, not visible from ventral view; caudal fin weakly emarginate to truncate, about as long or slightly longer than caudal peduncle, vertical width of expanded rays usually equal to body depth through pectoral fin base; caudal peduncle flanges long, reaching more than half distance to anal fin base; anal fin long (16.3 % SL); most posterior extent of mouth 0.8 ED below ventral margin of eye; dorsal midline usually flattened anteriorly from above or slightly posterior to pectoral fin bases; raised lamellae absent from ventral surface of rays of paired fins; anal fin origin usually under 0.73 distance posteriorly along dorsal fin base; usually 2, occasionally 1, relatively thin and long (4.7 % SL) pyloric caecae; gill rakers short to very short; and, lack of distinct black bars along lateral line.

Description. As for the genus and members of the *Galaxias olidus* complex, except as indicated below, based on 15 specimens, 75.7–91.5 mm SL. See Tables 4 to 9 for frequencies of meristic values and Table 37 for a summary of meristic variation. Segmented dorsal fin rays 10 (8–11), of these 8 (6–9*) branched and 2 (1*–2) unbranched; segmented anal fin rays 11 (10–12), of these 9 (8–11) branched and 2 (1–3) unbranched; caudal fin rays 16 (15–16); segmented pectoral fin rays 14 (13–15), of these 12 (11–13) branched and 2 (1–2) unbranched; pelvic fin rays 7, of these 6 branched and one unbranched; gill raker total count (lower limb and upper limb) 10 (9–12; [11*]), lower arch with 8 (7–9*) and 2 (1–3; [2*]) on upper, variation on first gill arch 7+2 (1), 8+1 (1), 8+2 (8), 8+3 (1), 9+2 (3*), 9+3 (1); vertebrae 54 (53–56; [55*]); two*, very occasionally one, pyloric caecae on stomach.

See Table 38 for comparative value ranges of morphometric characters. Body stout, moderately long but deep, body depth through pectoral fin base 5.7 (5.6–6.7) in SL, dorsal midline usually flattened anteriorly from above or slightly posterior to pectoral fin bases, depth through pectoral base 1.2 (1.1–1.3) that through vent, with dorsal profile evenly arched from snout to dorsal fin, ventral profile flattish to slightly arched from snout to anal fin; body tapering back to a deep, 11.1 (10.3–11.7) in SL, caudal peduncle of moderate length, 7.9 (7.0–8.8) in SL, the peduncle depth 1.4 (1.2–1.6) in its length; accessory lateral line present. Head of moderate length, 4.6 (4.4–4.8) in SL, and depth, 2.2 (2.1-2.4) in HL, just shorter than PelAn distance, relatively wide, 1.5 (1.4–1.6) in HL, distinctly wider than deep, depth 1.5 (1.4–1.6) in HW, lateral profile obtuse to slightly bulbous, with dorsal and ventral profiles sloping slightly anteriorly; eyes moderate, 5.3 (4.9–5.7) in HL, situated well below dorsal head profile, interorbital flat to convex, of moderate width, 2.7 (2.4–2.9) in HL and 2.0 (1.8–2.3) times ED; cheeks expanded below eyes, eye profiles usually not visible laterally from ventral view; snout moderately long, 3.5 (3.2–3.8) in HL and 1.5 (1.3–1.7) times ED, lateral profile bluntly rounded; post-orbital head length of moderate length, 1.8 (1.7–1.9) in HL; nostrils short, not visible anterio-laterally from ventral view; mouth usually terminal to very slightly subterminal, moderately long, 2.6 (2.3–2.8) in HL, posterior extent reaching back to under about 0.3 (0.2–0.4) ED and 0.8 (0.7–0.9) ED below ventral margin of eye, most anterior tip of upper lip level with middle of eye or occasionally slightly lower, gape wide, 2.2 (2.0–2.5) in HL, about 1.2 times wider than length of upper jaw and 1.5 (1.4–1.7) in HW. Jaws subequal, lower slightly to distinctly shorter than upper, 0.9 (0.8–0.9 of UJL). Pyloric caecae long, longest averaging 4.7 (3.7–6.1) % SL, relatively thin and rounded to bluntly pointed; gill rakers usually short, or occasionally very short, stout and rounded to bluntly pointed.

Median fins moderately fleshy at bases, paired fins less so, with thickening extending distally over 0.3–0.5 of fin area, extending farther between fin rays, dorsal fin base usually 0.9 (0.8–1.0) in length of anal fin base, fins rounded and relatively low, middle rays longest, anal fin relatively high, 6.1 (5.8–6.9) in SL, longer than dorsal fin; anal fin origin usually under 0.7 (0.6–0.9) distance posteriorly along dorsal fin base. Pelvic fins of moderate length, 9.3 (8.8–10.0) in SL, usually 0.8 (0.8–0.9) of pectoral fin length, inserted at about mid-point of standard length and extending about 0.46 distance to anal fin base; pectoral fin moderately long and paddle-shaped, 7.8 (7.2–8.9) in SL, extending 0.4 distance to pelvic fin base, low on body with dorsal end of fin base level with posterior extent of mouth, lamina of paired fins oriented anterio-ventrally, raised lamellae absent from ventral surface of rays. Caudal fin moderately long, 7.5 (7.1–8.2) in SL, weakly emarginate to truncate, about as slightly longer (1.0–1.1) than caudal peduncle, vertical width of expanded rays usually equal to body depth through pectoral fin base, flanges moderately low and well developed along caudal peduncle, long, reaching anteriorly to more than half distance to fin base along adpressed anal fin rays.

Size. Recorded to 103 mm LCF and 13 g; commonly to 75–85 mm LCF.

Colour in life. Body predominantly dark olive-brown on back and upper sides above lateral line, extending onto top and sides of head and snout, and lateral sides of trunk posterior to anal fin, becoming lighter brown to cream ventrally. Profusely overlain by dark brown to almost black spots and flecks coalescing into small or moderately large, irregular shaped, blotches, particularly widespread on head, extending to snout, under lower jaw, and to near the latero-ventral margin of the gill covers. Gill cover translucent, dusky grey-brown; iris golden; fins translucent dusky grey. See below for more detailed comments on body pattern.

TABLE 37. Summary of meristic variation in *Galaxias tantangara* **sp. nov.** (T—total; B—branched; L—lower limb; S—single; U—upper limb).

Character	Mode	Mean	SD	SE	Range	N
Dorsal Rays (T)	10	9.7	0.80	0.21	8–11	15
Dorsal Rays (B)	8	7.9	0.83	0.22	6–9	15
Dorsal Rays (S)	2	1.9	0.35	0.09	1–2	15
Anal Rays (T)	11	10.9	0.73	0.20	10–12	14
Anal Rays (B)	9	9.1	0.83	0.22	8–11	14
Anal Rays (S)	2	1.9	0.53	0.14	1–3	14
Caudal Rays	16	15.9	0.26	0.07	15–16	15
Pectoral Rays (T)	14	13.9	0.64	0.17	13–15	15
Pectoral Rays (B)	12	11.9	0.70	0.18	11–13	15
Pectoral Rays (S)	2	1.9	0.26	0.07	1–2	15
Pelvic Rays (T)	7	7.0	0	0	7	15
Pelvic Rays (B)	6	6.0	0	0	6	15
Pelvic Rays (S)	1	1.0	0	0	1	15
Gill Rakers (T)	10	10.3	0.80	0.21	9–12	15
Gill Rakers (L)	8	8.2	0.56	0.14	7–9	15
Gill Rakers (U)	2	2.1	0.46	0.12	1–3	15
Vertebrae	54	54.1	0.83	0.22	53–56	15

TABLE 38. Morphometric variation in *Galaxias tantangara* **sp. nov.** (values are percentages of denominators in ratios, except for LCF and SL).

	Holo-	Paratypes (N = 14)			
Character	type	Mean	Min.	Max.	S.D.
LCF (mm)	86.3	86.6	74.6	102.7	
SL (mm)	75.7	76.5	65.5	91.5	
SL / LCF	87.7	88.3	87.7	89.1	0.51
BDV / SL	15.1	14.1	12.6	15.6	0.85
BDPec / SL	17.4	16.6	14.9	17.9	0.73
BDPec / BDV	115.7	117.8	110.8	126.4	4.50
LCP / SL	14.0	12.7	11.3	14.2	0.79
DCP / SL	10.2	9.0	8.5	9.7	0.41
DCP / LCP	72.7	71.0	61.1	83.0	5.87
CFFL / SL	14.0	13.3	12.2	14.1	0.65
LCP/CFFL	99.9	95.8	81.0	107.6	6.91
PreD / SL	70.8	71.4	69.8	73.2	0.78
PreA / SL	75.3	75.7	74.4	76.9	0.68
PreD / PreA	94.0	94.3	92.3	96.5	1.28
DF–AF / LDB	69.4	45.0	25.9	84.2	14.29
LDB / SL	11.1	9.9	9.0	10.9	0.57
LAB / SL	10.9	10.9	9.8	12.1	0.65
LDB / LAB	101.8	91.2	79.9	100.0	6.55

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TABLE 38. (Continued)

Character	Holo-type	Paratypes (N = 14) Mean	Min.	Max.	S.D.
DL / LDB	141.2	156.5	140.7	166.9	7.70
AL / LAB	150.2	149.7	136.0	171.7	10.25
DL / SL	15.6	15.5	14.1	16.1	0.64
AL / SL	16.3	16.3	14.5	17.3	0.75
DL / AL	95.7	95.3	89.5	98.0	2.69
PecL / SL	13.4	12.8	11.2	13.8	0.88
PelL / SL	11.8	10.7	10.0	11.4	0.40
PelL / PecL	87.6	84.2	75.8	91.7	4.86
PrePel / SL	53.5	51.7	49.5	54.2	1.52
PecPel / SL	33.8	31.9	30.4	35.2	1.46
PelAn / SL	23.2	23.5	21.7	26.3	1.17
PecL / PecPel	39.8	40.0	36.4	45.6	2.60
PelL / PelAn	50.8	45.7	41.1	52.4	3.19
HL / SL	23.5	21.7	20.6	22.7	0.69
HL / PelAn	101.6	92.9	79.3	103.1	6.05
HW / HL	65.9	68.3	63.4	72.8	2.70
HD / HL	45.4	44.7	41.4	48.2	2.11
HW / HD	145.3	152.9	142.8	165.3	6.00
SnL / HL	27.4	28.5	26.4	31.5	1.52
SnL / ED	148.8	153.1	129.1	174.8	11.42
ED / HL	18.4	18.7	17.5	20.5	0.95
ED / HD	40.6	41.8	37.0	49.0	2.86
PoHL / HL	54.5	55.9	51.3	58.0	1.86
IOW / HL	37.4	37.5	34.6	40.9	1.62
ED / IOW	49.2	49.9	43.5	55.7	3.23
UJL / HL	40.9	38.1	35.4	42.7	1.96
LJL / HL	33.7	33.8	31.5	38.3	1.74
GW /HL	41.1	44.7	40.2	51.0	3.01
LJL / UJL	82.3	88.8	83.5	94.4	2.71
LJL / GW	82.0	75.8	67.8	82.4	3.72
GW / HW	62.4	65.4	59.6	72.2	3.20
SnL/UJL	66.9	74.9	71.1	86.1	4.66

Colour of preserved material. Base colour of head and body pale cream to creamy yellow, with dusky shading on dorsal surface extending downward onto lateral and ventrally surfaces as fine to moderately size, sparse black stippling. Dorsal surface of trunk with bold pattern of closely spaced, grey to dark grey spots and flecks coalescing into small or moderately large, irregular shaped, blotches, extending laterally onto sides; pattern extends across entire caudal peduncle region and flanges, though generally restricted down sides of trunk o just below lateral line, fading abruptly, and extending to ventro-lateral region as faint, light grey blotches. Few very small, almost black vertical bars present along lateral line, more prevalent in anterior trunk region. Spots, blotches and flecks slightly diffuse in outline. Bold trunk pattern extends over dorsal and lateral surfaces of head, extending down cheeks, gill covers, snout and upper jaw onto ventral surface, including underneath anterior portion of lower jaw. Fine to medium, black and brown spotting inside operculum, with fine black spotting on base of and on gill filaments and rakers.

FIGURE 35. A–B: *Galaxias tantangara* **sp. nov.** holotype, NMV A.30578-2, 86.3 mm LCF, female, Tantangara Creek, tributary, above falls 200 m upstream Alpine Creek Fire Trail, Kosciuszko National Park, New South Wales, A) line drawing (R. Plant), B) image of preserved specimen (note: head and tail curve to right in horizontal plane) (T.A. Raadik); C) detail of head pattern (right hand side) of *G. tantangara* **sp. nov.** holotype (T.A. Raadik); D) Tantangara Creek, tributary, facing upstream to type locality of *G. tantangara* **sp. nov.**, which is above the waterfall, 16 March 2002 (T.A. Raadik). Scale bar = 5 mm.

Eye grey to black, pupil translucent pale orange yellow. Teeth translucent yellow to pale orange–yellow, tips orange to orange–red; gill rakers cream to pale yellow. Fins pale creamy yellow, becoming more translucent on posterior margins, fleshy bases of dorsal, anal, and pectoral fins with sparse fine black stippling; faint body pattern extending onto base of caudal fin. Fin rays opaque to translucent, external edges of rays highlighted with very fine black lines or row of fine spots.

Etymology. The specific name tantangara is taken from the small alpine stream from which the type specimens were collected, a tributary of the upper Murrumbidgee River draining from Mount Tantangara. A noun in apposition. Suggested vernacular name as the 'Stocky Galaxias'.

Genetics. Allozyme and mtDNA analysis of this species can be found in Adams *et al.* (2014**;** taxon code TA). Diagnostic allozyme loci (5–12) between this taxon and the other species in the *Galaxias olidus* complex are provided in Table 12.

Distribution. See Fig. 7. Only known from the type locality, in the headwaters of Tantangara Creek, upstream of Tantangara Reservoir, NSW, at an elevation of 1360 m asl. Restricted by the presence of trout to a small creek above a waterfall, approximately 4 km (river distance) from the source, which is at 1630 m asl, in a catchment of approximately 4 km^2.

Sympatry. Only species of *Galaxias* found within its restricted range. Possibly was historically found with *Galaxias olidus*, which is present farther downstream in the upper Murrumbidgee River system, before alien trout substantially altered distributional patterns in the last 150 years and fragmented and reduced galaxiid populations.

Habitat. Recorded from a small (0.8 m average width and 0.1 m in average depth), cold, clear and fast flowing alpine creek, flowing through an open forest of Eucalypts, low shrubs and tussock grass, which is often snow-covered during winter. Flow consisted predominantly of riffle and glide, with smaller amounts of cascades, and substrate was composed of bedrock, boulder, and cobble, with smaller amounts of pebble and gravel, and sections of silt. Instream cover was provided predominantly by rock and by bank and vegetation overhang, and pools averaged 0.3 m in depth.

General Biology. Confined to freshwater. Recorded at a density of 1.8 fish/m^2 and is the only native fish species so far recorded from within its range. Spawning period unknown, though probably winter: fish collected in mid-March were predominantly at an intermediate stage of gonad development (gonads filling approximately 50 % body cavity), though one male was almost running ripe and one female was close to ripe (gonads filling 75 % of body cavity). Interestingly no juvenile fish were sampled from a 60 m reach of stream during mid-March, with the smallest individual 74.6 mm LCF. Holotype recorded with a short, thin, white worm in the mouth and another from amongst fat deposits around stomach in the body cavity. Able to survive in very cold water (< 5 ºC) during winter.

Conservation status. Considered critically endangered based on IUCN criteria (ISPS 2013): A2e; B1+2abc; C2a(i)—one location/population, EOO and AOO estimated at 1.7 km^2.

Remarks. Appear to lack paired fin ray lamellae, a characteristic typical of most species within the *Galaxias olidus* complex found at high elevations in steep gradient streams with many natural instream barriers. Lamellae may possibly be present in smaller, younger aged fish. A 70 mm SL specimen (AMS IB.745), possibly registered in 1905 and collected from 'Fantangara Creek [= Tantangara Creek?], Murrumbidgee River, Snowy Mountains, NSW', may be referable to this species, but is almost completely dried. Another old individual (BMNH 1914.80.20.75), collected from 'Tantangara Creek, New South Wales' and examined from a digital image also appears to be referable to this species. Considered to be impacted by alien salmonids, with Brown Trout found immediately below the falls on this system and galaxiids absent from this section. Additional sampling in other headwater tributaries of the Murrumbidgee River, upstream of Tantangara Reservoir, is urgently needed to define the overall distribution and abundance of this apparently rare species, particularly concentrating on small tributary streams above instream barriers which may protect populations from predatory trout. Considered to have been historically more widespread throughouty the upper Murrumbidgee River system before trout reduced their range.

***Galaxias terenasus*, new species**

Roundsnout Galaxias

Tables 4 to 9, 39 & 40; Figures 7, 36 to 38

Galaxias bongbong (non Macleay, 1881)—Whitley, 1939: 268 (*partim*).
Galaxias olidus olidus Günther, 1866—Frankenberg, 1969: 170 (*partim*).

Galaxias olidus (non *G. olidus* Günther, 1866)—McDowall & Frankenberg, 1981: 469 (*partim*); Koehn *et al.*, 1991: 17; Raadik, 1992a: 19, 21; Schiller *et al.*, 1997: 75 (*partim*); Lintermans, 1998: site 73 and 83; McDowall, 2003a: 364 (*partim*).

Galaxias sp. 2—Kuiter, 2013: 42.

Galaxias sp. 3—DSE, 2013: 17; Lieschke *et al.* 2013a,b.

Conforms to the allozymically defined and morphologically diagnosed taxon 'GE' of Adams *et al.* (2014), and 'genoa' of Raadik (2011).

Material Examined.

Holotype. NMV A.30592-3, 65.4 mm LCF (58.6 mm SL), female, Maclaughlin River, at Allen Caldwell Bridge on Ando (Dalgety/Bombala) Road, north-north-west of Bombala, New South Wales, 36° 38' 50"S 149° 06' 40"E, T.A. Raadik, 14 March 2002.

Paratypes. NSW: AMS I.44931-001 (3), 56.2–65.0 mm LCF (49.9–58.2 mm SL), NMNZ P.045754 (2), 56.1–59.5 mm LCF (50.0–53.4 mm SL) and NMV A.30592-2 (9), 52.0–69.4 mm LCF (46.8–62.2 mm SL), collected with holotype; NMV A.9897-1 (12), 45.3–53.4 mm LCF (39.8–46.4 mm SL), Church Creek, at bridge on Bombala/Delegate Road, east of Delegate, 37° 02' 18"S 148° 59' 17"E, R.S. Frankenberg, 8 March 1966; NMV A.30557-1 (4), 57.9–64.0 mm LCF (51.3–57.0 mm SL), Church Creek, at bridge on Bombala/Delegate Road, east of Delegate, 37° 02' 18"S 148° 59' 17"E, T.A. Raadik, 17 December 2003; NMV A.30591-2 (10), 51.7–62.7 mm LCF (45.6–55.2 mm SL), Genoa River, at bridge on Monaro Highway, Rockton, 37° 08' 03"S 149° 18' 50"E, T.A. Raadik, 16 December 2003; NMV A.30584-2 (2), 53.3–64.9 mm LCF (47.1–57.4 mm SL), Genoa River, as for NMV A.30591-2, T.A. Raadik, 26 February 2002; NMV A.30554-1 (6), 54.2–66.1 mm LCF (47.4–58.3 mm SL), White Rock River, downstream of culvert on Southern Access Road, upstream of Nalbaugh Falls, north-east of Rockton, Nalbaugh State Forest, 37° 03' 21"S 149° 20' 10"E, T.A. Raadik, 26 February 2002; AMS I.44932-001 (3), 52.4–58.2 mm LCF (46.3–51.5 mm SL) and NMV A.30542-2 (6), 57.6–62.0 mm LCF (51.2–54.7 mm SL), White Rock River, location as for NMV A.30554-1, T.A. Raadik, 16 February 2003; NMV A.30560-1 (5), 48.9–56.9 mm LCF (47.1–50.4 mm SL), White Rock River, at bridge on track to Nalbaugh Falls, Nalbaugh State Forest, 37° 03' 33"S 149° 20' 50"E, T.A. Raadik, 16 December 2003; **VIC:** NMV A.30548-1 (2), 45.1–47.2 mm LCF (39.2–41.1 mm SL), Back Creek, at bridge on Back Creek Track, Noorinbee North, 37° 25' 41"S 149° 12' 32."E, TAR, 5 May 1993.

Non-type material. NSW: NMV A.30592-1 (9), 43.1–60.0 mm LCF (38.6–54.7 mm SL), Maclaughlin River, collected with holotype; NMV A.9897-2 (60), 20.7–43.9 mm LCF (18.0–37.8 mm SL), Church Creek, collected with NMV A.9897-1; AMS I.40037-001 (2), Delegate River, Delegate, (37.1–37.5 mm LCF), 13 April 1999; NMV A.30591-1 (10), 19.1–34.6 mm LCF (16.5–30.8 mm SL), Genoa River, collected with NMV A.30591-2; NMV A.30584-1 (4), 43.7–47.8 LCF (38.7–42.0 SL), Genoa River, collected with NMV A.30584-2; NMV A.11622 (6), 49.6–57.3 mm LCF (43.5–50.6 mm SL), Genoa River, location as for NMV A.30591-2, PJU and C. Brumley, 19 January 1993; NMV A.11621 (4), 23.7–35.1 mm LCF (20.8–30.9 mm SL), White Rock River, at Imlay Road, east of Rockton, 37° 08' 05"S 149° 21' 22"E, PJU and C. Brumley, 19 January 1993; NMV A.30542-1 (9), 36.9–46.5 mm LCF (31.9–40.1 mm SL), White Rock River, collected with NMV A.30542-2; NMV A.30560-2 (1), 43.6 mm LCF (38.6 mm SL), White Rock River, collected with NMV A.30560-1. **VIC:** NMV A.30548-2 (5), 32.3–37.4 mm LCF (28.6–32.1 mm SL), Back Creek, collected with NMV A.30548-1; NMV A.30549-1 (8), 18.4.0–48.5 mm LCF (16.7–41.8 mm SL), Back Creek, location as for NMV A.30548-1, TAR, 15 December 2003.

Additional non-type material examined (not measured): see Appendix 5.

Diagnosis. *Galaxias terenasus* **sp. nov.** is the most distinctive species in the *Galaxias olidus* complex and differs from the other species by a combination of the following characters: diminutive size; long anterior nostrils, usually visible anterio-laterally from ventral view; distinctive body colour pattern and thin fins; low mean total pectoral fin segmented ray count of 13; low mean vertebral count of 51; dorsal and ventral trunk profiles straight or nearly so; lateral snout profile usually rounded; body depth shallow through pectoral fin base (11.2–14.3 % SL); dorsal midline usually distinctly flattened anteriorly from dorsal fin base; mouth small, usually reaching back to anterior margin of eye with posterior extent of mouth about 0.4 ED below ventral margin of eye; head and inter-orbital narrow (49.8–64.0 and 31.4–40.5 % HL respectively) but head length greater than PelAn distance; eye large (17.5–27.7 % HL and 45.7–73.3 % HD); gape narrow (26.4–34.4 % HL and 48.7–64.2 % HW); snout, upper and lower jaws short (17.6–29.8, 24.4–29.9 and 21.2–29.2 % HL respectively); lower jaw about 95 (82.9–100.0) %

length of upper; caudal peduncle moderately long and longer than length of caudal fin; caudal peduncle flanges moderately developed but short, usually not reaching to adpressed anal fin; dorsal fin base short (7.1–11.6 % SL); distance between pelvic and anal fins short (17.8–24.6 % SL); pelvic fin very short (6.3–11.2 % SL), only about 74.4 % of length of pectoral fin; raised lamellae absent from ventral surface of rays of paired fins; accessory lateral line absent; anal fin origin usually under 0.42 distance posteriorly along dorsal fin base; 2 thin to moderately thick and long (5.1 % SL) pyloric caecae; gill rakers short and stout; and, lack of distinct black bars along lateral line.

Description. As for the genus and members of the *Galaxias olidus* complex, except as indicated below, based on 64 specimens, 39.9–62.2 mm SL, and 51 additional, non-type specimens for meristics. See Tables 4 to 9 for frequencies of meristic values and Table 39 for a summary of meristic variation. Segmented dorsal fin rays 9 (8–10), of these 7 (6–8) branched and 2 (1–3) unbranched; segmented anal fin rays 11 (10–12), of these 9 (8*–10) branched and 2 (2–3*) unbranched; caudal fin rays 16; segmented pectoral fin rays 13 (12–14), of these 11 (10–12) branched and 2 (1–3) unbranched; pelvic fin rays 7 (7–8), of these 6 (6–7) branched and one unbranched; gill raker total count (lower limb and upper limb) 12 (11–13), lower arch with 9 (7–10) and 3 (3–4) on upper, variation on first gill arch 7+3 (4), 7+4 (1), 8+3 (28), 8+4 (14), 9+3 (33*), 9+4 (14), 10+3 (4), 10+4 (2); vertebrae 51 (49–53); two* pyloric caecae on stomach.

See Table 40 for comparative value ranges of morphometric characters. Body elongate and relatively shallow, dorsal midline usually distinctly flattened anteriorly from dorsal fin base, depth through pectoral base 1.1 (1.0–1.4) that through vent, trunk with dorsal and ventral profiles near parallel from head to tail, dorsal profile very slightly arched; PelAn distance short, 4.7 (4.1–5.6) in SL; body tapering back to a moderately long, 6.9 (5.8–8.9) in SL, and shallow, 13.1 (11.1–14.7) in SL, caudal peduncle, the peduncle depth 1.9 in its length; accessory lateral line appears to be absent. Head of moderate length, 4.6 (4.2–5.1) in SL, and similar to PelAn distance (0.9–1.3), quite narrow, 1.8 (1.6–2.0) in HL, and relatively shallow, 2.6 (2.2–3.0) in HL, distinctly wider than deep (depth 1.4–1.5 in HW), lateral profile weakly wedge-shaped and rounded to obtuse, dorsal profile anterior to nape flattish; eyes large, 4.7 (3.6–5.7) in HL and 1.8 (1.4–2.2) in HD, situated high on head slightly below dorsal head profile, interorbital flat to slightly convex, narrow, 2.8 (2.5–3.2) in HL and 1.7 (1.5–1.8) times ED; cheeks not expanded below eyes, eye profiles visible laterally from ventral view; snout short, 4.0 (3.3–5.7) in HL and 1.2 (0.7–1.5) times ED, lateral profile usually rounded to blunt; post-orbital head length of moderate length, 1.9 (1.7–2.1) in HL; nostrils long and just visible anterio-laterally from ventral view; mouth terminal, short, 3.7 (3.3–4.1) in HL, posterior extent reaching anterior border of eyes and 0.4 (0.3–0.5) of ED below ventral margin of eye, most anterior tip of upper lip usually level with 0.6 ED above ventral margin of eyes, gape narrow, 3.2 (2.9–3.8) in HL, 1.1 times wider than length of upper jaw and 1.8–1.9 in HW. Jaws usually subequal, lower a little shorter (1.0–1.1 in UJL). Pyloric caecae thin to moderate thickness and long, longest averaging 5.1 % SL (3.6–7.8 %), usually rounded on end; gill rakers short, stout and bluntly rounded.

Median fins moderately fleshy at bases, paired fins less so, with thickening extending distally over 0.3–0.5 of fin area, extending farther between fin rays, dorsal and anal fin bases of moderate length, dorsal fin base usually 1.2 in length of anal fin base and sometimes noticeably extended anteriorly as a low ridge supported by short procurrent rays, fins rounded and relatively low, anal usually a little longer than dorsal, middle rays longest; anal fin origin usually under 0.4 (0.2–0.7) distance posteriorly along dorsal fin base. Pelvic fins small, 10.7 (8.9–15.9) in SL, 0.7 of pectoral fin length, usually inserted just posterior to mid-point of standard length and extending just over 0.45 distance to anal fin base; pectoral fin of moderate length and paddle-shaped, 7.9 (6.7–10.3) in SL, extending just over 0.43 distance to pelvic fin base, low on body with dorsal extent of fin base usually level with posterior extent of mouth, lamina of paired fins oriented anterio-ventrally to ventrally, raised lamellae absent from ventral surface of rays. Caudal fin of moderate length, 7.5 (6.1–9.6) in SL, emarginate, shorter than caudal peduncle (1.1 in LCP), vertical width of expanded rays greater than body depth through pectoral fin base, flanges moderately developed along caudal peduncle, not reaching distal end of rays in adpressed anal fin.

Size. Recorded to 70 mm LCF and 3 g; commonly to 45–55 mm LCF. Males do not grow as large as females.

Colour in life. Body predominantly olive-brown on back and upper sides above lateral line, extending onto top and sides of head and snout, and lateral sides of trunk posterior to anal fin, becoming lighter ventrally, belly silvery white, lips usually slightly dusky. Overlain by small brown, dark brown to grey-brown, irregularly shaped blotches relatively densely space on dorsal and lateral surfaces of trunk and extending onto the head and snout, less so in juveniles, many coalescing to form irregular shaped vertical bands. Blotches and bands sometimes obscured by fine dark stippling. Gill cover translucent with a small golden patch; iris coppery gold. Fins clear to translucent light brown. Gravid females usually with profuse, fine, black to dark grey stippling along ventro-lateral surface of trunk between the pectoral fin base and vent, sometimes extending almost to mid-lateral region. See below for more detailed comments on body pattern.

TABLE 39. Summary of meristic variation in *Galaxias terenasus* **sp. nov.** (T—total; B—branched; L—lower limb; S—single; U—upper limb). Range in 90 % of values.

Character	Mode	Mean	SD	SE	Range 90 %	Range 100 %	N
Dorsal Rays (T)	9	9.2	0.59	0.06	8–10	8–11	105
Dorsal Rays (B)	7	7.1	0.63	0.06	6–8	6–8	105
Dorsal Rays (S)	2	2.1	0.42	0.04	1–3	1–3	105
Anal Rays (T)	11	11.1	0.68	0.07	10–12	10–13	105
Anal Rays (B)	9	8.9	0.65	0.06	8–10	7–10	105
Anal Rays (S)	2	2.2	0.49	0.05	2–3	1–3	105
Caudal Rays	16	16.1	0.23	0.02	16–17	16–17	105
Pectoral Rays (T)	13	13.0	0.77	0.08	12–14	11–15	101
Pectoral Rays (B)	11	11.0	0.79	0.08	10–12	9–13	101
Pectoral Rays (S)	2	2.0	0.49	0.05	1–3	1–4	101
Pelvic Rays (T)	7	7.1	0.29	0.03	7–8	7—8	102
Pelvic Rays (B)	6	6.1	0.29	0.03	6–7	6–7	102
Pelvic Rays (S)	1	1.0	0	0	1	1	102
Gill Rakers (T)	12	11.9	0.83	0.08	11–13	10–14	100
Gill Rakers (L)	9	8.5	0.69	0.07	7–10	7–10	100
Gill Rakers (U)	3	3.3	0.46	0.05	3–4	3–4	100
Vertebrae	51	51.3	1.04	0.10	49–53	49–53	115

TABLE 40. Morphometric variation in *Galaxias terenasus* **sp. nov.** (values are percentages of denominators in ratios, except for LCF and SL).

	Holo-	Paratypes (N = 64)			
Character	type	Mean	Min.	Max.	S.D.
LCF (mm)	65.5	56.1	45.1	69.5	
SL (mm)	58.6	49.5	39.2	62.2	
SL / LCF	89.5	88.2	86.0	90.6	0.94
BDV / SL	12.0	11.3	9.6	13.4	0.71
BDPec / SL	13.2	12.7	11.2	14.3	0.71
BDPec / BDV	110.2	112.3	97.1	139.2	7.63
LCP / SL	14.4	14.4	11.2	17.3	1.41
DCP / SL	8.0	7.6	6.8	9.0	0.48
DCP / LCP	55.5	53.5	41.9	75.5	6.83
CFFL / SL	11.7	13.3	10.4	16.3	1.21
LCP/CFFL	122.9	108.7	74.5	140.5	14.36
PreD / SL	70.7	70.4	66.6	74.4	1.88
PreA / SL	73.7	73.7	70.8	77.2	1.62
PreD / PreA	95.9	95.5	91.0	99.6	1.73

...... *continued on the next page*

TABLE 40. (Continued)

Character	Holo-type	Paratypes (N = 64) Mean	Min.	Max.	S.D.
DF–AF / LDB	54.6	41.4	19.8	69.7	9.75
LDB / SL	8.6	8.8	7.1	11.6	1.16
LAB / SL	9.7	10.2	8.5	13.8	1.06
LDB / LAB	88.5	86.3	69.5	100.0	7.80
DL / LDB	150.0	166.0	122.9	218.2	21.22
AL / LAB	139.3	150.6	124.5	179.5	12.65
DL / SL	12.9	14.4	12.0	17.8	1.09
AL / SL	13.5	15.2	12.3	17.5	1.15
DL / AL	95.3	94.6	82.1	111.6	6.94
PecL / SL	12.1	12.6	9.7	15.0	1.17
PelL / SL	8.0	9.3	6.3	11.2	1.04
PelL / PecL	66.4	74.4	60.4	85.5	5.07
PrePel / SL	52.4	51.2	48.3	54.9	1.58
PecPel / SL	32.7	29.6	25.8	33.2	1.79
PelAn / SL	23.2	21.2	17.8	24.6	1.38
PecL / PecPel	37.0	42.6	32.6	52.3	5.14
PelL / PelAn	34.6	44.5	29.2	59.8	6.56
HL / SL	21.0	21.9	19.6	23.6	0.74
HL / PelAn	90.8	104.2	88.5	127.3	8.76
HW / HL	57.8	55.6	49.8	64.0	2.94
HD / HL	36.2	38.3	32.7	46.1	2.63
HW / HD	159.9	145.6	127.8	171.7	9.02
SnL / HL	23.9	24.9	17.6	29.8	2.51
SnL / ED	122.4	117.9	74.7	146.7	16.43
ED / HL	19.5	21.3	17.5	27.7	1.76
ED / HD	54.0	55.7	45.7	73.3	5.20
PoHL / HL	55.1	53.2	47.9	58.0	2.28
IOW / HL	35.3	35.4	31.4	40.5	2.33
ED / IOW	55.4	60.2	49.7	76.8	5.33
UJL / HL	26.5	27.1	24.4	29.9	1.38
LJL / HL	26.4	25.7	21.2	29.2	1.74
GW /HL	34.7	30.8	26.4	34.4	1.98
LJL / UJL	99.4	94.9	82.9	100.0	5.11
LJL / GW	75.9	83.7	68.9	96.4	5.94
GW / HW	60.0	55.5	48.7	64.2	3.72
SnL/UJL	90.2	91.9	64.5	110.0	10.36

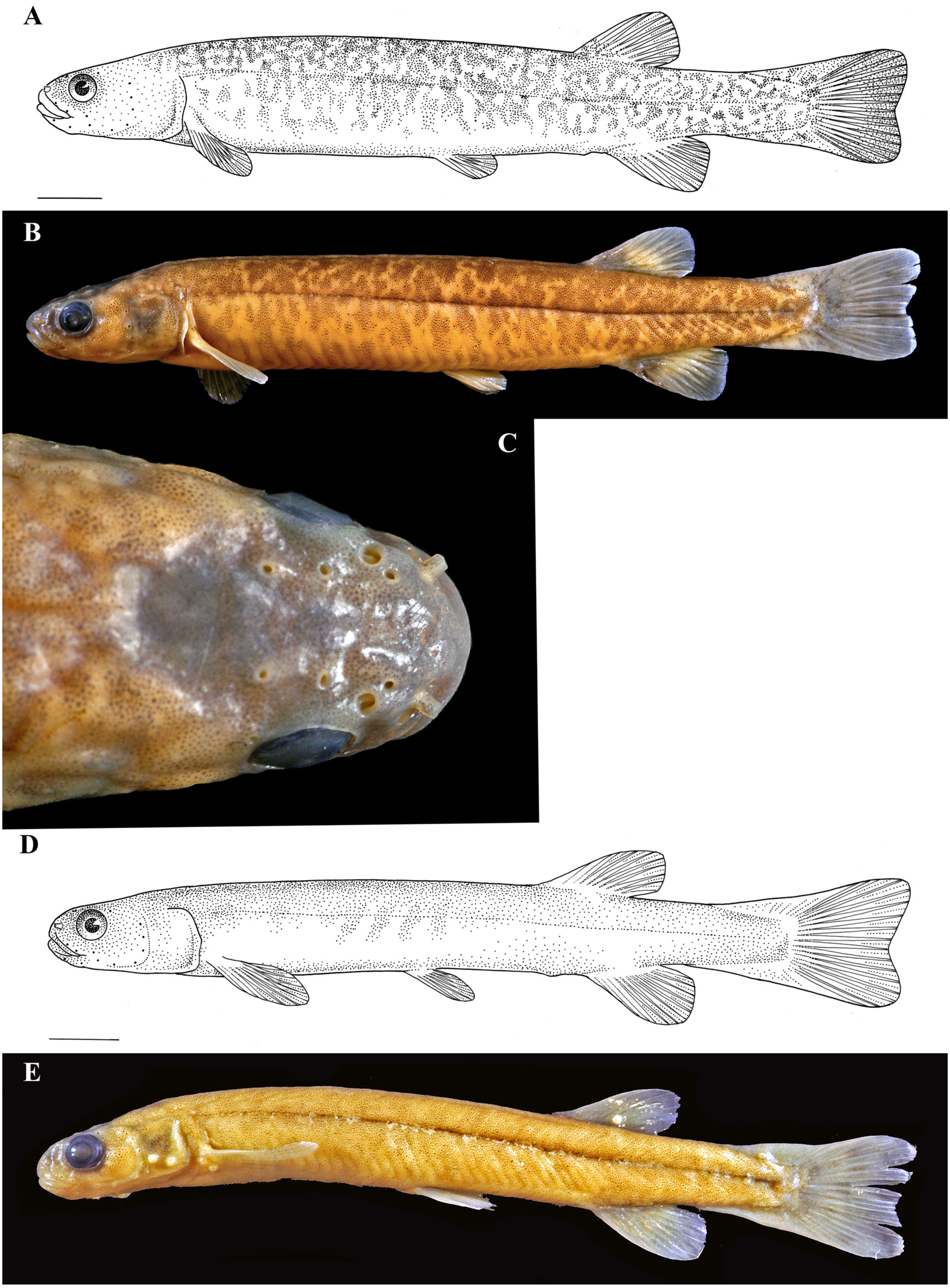

FIGURE 36. *Galaxias terenasus* **sp. nov.**, A–C: holotype, NMV A.30592-3, 65.4 mm LCF, female, Maclaughlin River, Allen Caldwell Bridge on Ando Road, north-north-west of Bombala, New South Wales, A) line drawing (R. Plant), B) image of preserved specimen (T.A. Raadik), C) dorsal view of head showing anterior, elongate, tubular nostril (T.A. Raadik); D–E: paratype, NMV A.30542-2, 62.0 mm LCF, White Rock River, Southern Access Road, NE of Rockton, D) line drawing (R. Plant), E) image of preserved specimen (T.A. Raadik). Scale bar = 5 mm.

FIGURE 37. *Galaxias terenasus* **sp. nov.** A) Church Creek, east of Delegate, 17 March 2003; ~ 50 mm LCF (T.A. Raadik); B) Genoa River at Rockton, 16 December 2003; ~50 mm LCF (R.H. Kuiter).

Colour of preserved material. Base colour of head and body pale cream to creamy yellow, overlain with a very faint shading of fine, sparse, brown stippling, fading ventrally. Surface of trunk typically with dense and diffuse pattern of irregular shaped, medium-size, relatively faint brown blotches, more densely spaced and darker on dorsal surface, extending laterally down sides, just reaching ventral surface, and extending onto caudal peduncle flanges; pattern fades gradually down sides of trunk. Dorsal trunk pattern extends onto nape and upper opercular region of head, with rest of dorsal head region densely stippled dark brown; stippling extending onto upper and lower lips, down sides of head and onto ventral surface; relatively dense stippling along posterior and ventral margin of gill cover. Dense dark brown to black spotting inside operculum and black spotting at base of, and along, gill filaments. Trunk and head pattern appears to be absent from most fish in the Genoa River system, and overlying shading is stronger, consisting of closely spaced brown to dark brown stippling, darkest on the dorsal surface and fading laterally.

Eye grey to black, pupil translucent pale orange yellow or brownish yellow. Teeth translucent yellow to pale orange–yellow, tips orange to orange–red; gill rakers cream. Fins pale creamy yellow to dusky grey, becoming more translucent on posterior margins, fleshy bases of dorsal and anal fins with fine brown stippling extending to about half distance of fin length, generally restricted to pectoral fin base; body pattern and fine shading extending onto caudal fin base to about one third to one half of fin length. Fin rays translucent, external edges of rays highlighted with very fine brown to black lines.

Etymology. From the Latin *teres*, meaning rounded or smooth, and *nasus*, meaning nose, in reference to the rounded snout of this species. Suggested vernacular name as the 'Roundsnout Galaxias'.

Genetics. Allozyme and mtDNA analysis of this species can be found in Adams *et al.* (2014**;** taxon code GE). Diagnostic allozyme loci (9–16) between this taxon and the other species in the *Galaxias olidus* complex are provided in Table 12. Two genetically distinct subpopulations were identified, with individuals in the Genoa River (and presumably Cann River) differing by two diagnostic allozyme loci from those in the Snowy River system (Raadik 2011). Morphological variation between these subpopulations was not quantitatively investigated.

Distribution. See Figure 7. Found in the very south-east corner of southern NSW and East Gippsland, Victoria, in the mid Snowy River, Cann River and Genoa River systems. In the Snowy River, recorded from Burnt Hut Crossing (approximately 500 m asl), Maclaughlin River system (to 780 m asl) and widespread in the Delegate/ Bombala River systems (760 and 785 m asl respectively). Known from the mid to upper reaches of the Genoa River system (250–680 m asl), predominantly in NSW, and also recorded from at least one confirmed location in the mid Cann River system in Victoria; possibly more widespread in this catchment. Apparently absent from the very upper, headwater reaches of all these systems. Historical data generally lacking, except for a record from Curry Flat, Nimmitabel (possibly Bobundara Creek system) c. 1914 (BMNH 1914.8.20.67–68), near Bombala in 1938 (AMS IA.7904 to IA.7906) and from Church Creek near Delegate in 1965–6 (NMV A.9897 and NMV A.30581-1); the species was reconfirmed from the Bombala and Church Creek systems in 2002–3.

Sympatry. Currently the only species in the *Galaxias olidus* complex, found throughout its restricted range, though probably historically found with *Galaxias olidus* in the mid reaches of the Snowy River in NSW. Recorded with *Galaxias brevipinnis* (Genoa and Cann river systems), and possibly also occurs with *Galaxias maculatus* in the mid-reaches of the Genoa River in Victoria.

Habitat. Typically recorded from clear water in slow to moderately flowing creeks to large rivers (1.0–12.0 m average width and 0.1–0.6 m average depth), flowing through light to heavily forested (and shaded) catchments, consisting predominantly of pools, glides and riffles with smaller areas of still backwaters. Also recorded from modified streams in areas almost completely cleared for grazing. Substrate usually consists of bedrock, boulder, cobble and coarse sand with smaller amounts of pebble, gravel and silt and instream cover is typically provided predominantly by rock, timber debris, and smaller amounts of aquatic vegetation, leaf litter and bank and vegetation overhang. Average pool depth ranged from 0.2–1.8 m.

General Biology. Confined to freshwater and considered not to undertake diadromous migrations. Collected at densities ranging from < 0.1–1.5 fish/m^2 and found with the native fish species Shortfinned Eel, Longfinned Eel (*Anguilla reinhardtii*), Eastern Smelt (*Retropinna* sp.), and River Blackfish (also see 'Sympatry' above), the native decapod crustaceans Common Freshwater Shrimp, East Gippsland Spiny Crayfish and Variable Spiny Crayfish (*Euastacus yanga*), and a native bivalve mollusc (*Hyridella* sp.). Also recorded with the alien species Brown Trout, though probably occupies a discrete micro-habitat.

Spawning period unknown, though possibly spring to early summer, or earlier in the Snowy River catchment: an adult female collected in mid-September from Back Creek was gravid and close to spawning (swollen vent) and fish from White Rock River were spawning in the middle of December, though both sexes from the Delegate River system were well developed to ripe in June; fish were at an early stage of gonad development during January–February; the smallest presumed 0+ age fish recorded (16.7 mm LCF) was collected from Back Creek in mid-December; and, juvenile fish 20.2–24.7 mm LCF were recorded from Church Creek in November; 23.7 mm LCF from White Rock River in mid-January, and 26.4 mm LCF from Maclaughlin River in February. Fish in the length range 16.7–24.8 had a keel present on the ventral midline, extending from the pectoral fin based posteriorly to anus. The smallest fish which could be reliably sexed were a female at 35.1 mm LCF (White Rock River, Genoa catchment) and a male at 42.4 mm LCF (Little River, Goulburn River system), though males, as in other species of *Galaxias*, are considered to mature at a smaller size than females. *Galaxias terenasus* is therefore considered to become sexually mature at about 30–35 mm LCF. Fecundity is low; gravid females (52–63 mm LCF) recorded with 220–240, relatively small (1.2 mm average diameter), unshed eggs.

FIGURE 38. Habitat of *Galaxias terenasus* **sp. nov.** A) Genoa River, Monaro Highway, Rockton, 26 February 2002; B) Church Creek, east of Bombala (Snowy River catchment), 17 December 2003; C) White Rock River, Southern Access Road (Genoa River system), 16 February 2003 (T.A. Raadik).

Larger adults usually solitary, but younger fish typically found in loose shoals amongst habitat near the substrate; occasionally in midwater close to habitat. Fish from the Genoa River system are heavily infected with large, white to cream cysts, possibly trematode metacercariae, embedded in the skin, fins, and eyes. *Galaxias terenasus* also found to be infected by the parasitic copepod Anchor Worm *Lernaea cyprinacea* (?), and one individual recorded with a short, thin, white worm, coiled and pointed at both ends, from amongst fat deposits around the stomach in the body cavity.

Variation. Populations in the Genoa and Cann River catchments differ slightly in morphology to those in the Snowy River catchment (see Fig. 36), with the dorsal fin extending anteriorly as a low ridge, underlain by a number (~4–5+) short, procurrent rays (lacking, or much shorter, with 1–2 procurrent rays, in the Snowy catchment), the snout is more rounded, and colour pattern is often less pronounced. The population level (within species) differences are also supported by molecular data.

Conservation status. Critically endangered in Victoria (DSE 2013).

Remarks. The only diminutive species in the *G. olidus* complex, and outside of the diminutive genus *Galaxiella* in Australia, being much smaller than all other members in the genera *Galaxias* and *Neochanna* on the mainland and in Tasmania. *Galaxias terenasus* is also the most morphologically distinctive taxon in the complex, differing from all other members by the lack of an accessory lateral line, lack of paired fin ray lamellae (except for *Galaxias brevissimus* **sp. nov.** and *Galaxias tantangara* **sp. nov.**), elongate anterior nostrils, dorsal and ventral trunk profiles straight or nearly so, low pectoral fin ray count, and long pyloric caecae. It also shares a number of morphological characters with *Galaxias parvus* from Tasmania: relatively elongate tubular, anterior nostrils; a tubular trunk; small mouth with jaws of relatively equal length; a low ridge in front of the dorsal fin; the relatively small setback of the anal fin origin from that of the dorsal fin origin; small pectoral fins with a low ray count; and, short gill rakers. Investigation of the evolutionary relationship between the taxa within the *Galaxias olidus* complex, and with non-diadromous galaxiids from Tasmania, would be of value in understanding Australian galaxiid phylogeny.

Galaxias terenasus are able to survive amongst populations of alien trout in the Genoa, Cann and Snowy river systems, though the mechanisms of predator-avoidance are unknown but may include occupying habitat marginal to trout; the majority of *G. terenasus* collected from the Maclaughlin River were located in shallow riffle areas about 0.1 or less in depth (and not in pools). Additionally, instream habitat complexity in Back Creek is high as the stream is not sand impacted, and areas of the Genoa River may be marginal for trout due to degradation and higher water temperatures. Additional sampling in the mid Snowy River system, the upper Cann River catchment, and the Wallagaraugh and upper Genoa River systems, is required to more accurately define the specific distribution of this species.

Discussion

The fifteen taxa designated from within a previously accepted, and reasonably well studied, single species, are the outcome of a targeted, intensive study (Raadik 2011, Adams *et al.* 2014). These species are all closely related and diverged relatively recently in evolutionary time (Adams *et al.* 2014) and share a similar morphology. Consequently, whilst able to be discriminated from one another using the ‘traditional’ morphological characters of morphometric measurements and meristic counts, taxon diagnosis is greatly improved by the addition of a range of diagnostic genetic characters, particularly allozyme loci.

No previous study has investigated any member of the Galaxiidae in as much detail genetically, nor morphologically (>4200 specimens, entire species range, 54 genetic markers and 46 morphological characters). This is also the most comprehensive molecular plus morphological assessment of any Australian freshwater fish to date. Another critical aspect, was the focus on spatially-dense sampling within the geographical range of *Galaxias olidus* s.l. that revealed cryptic speciation in small and isolated ranges. Consequently this study has dramatically increased our understanding of levels of speciation in nonmigratory galaxiids and the Australian freshwater fish fauna.

Despite intensive sampling across the range of *Galaxias olidus* s.l. the localised distributions of several newly described species strongly suggests areas remain in which additional sampling may discover new, highly divergent lineages, particularly in the south-eastern corner of Australia. Principal catchments for further investigation include the Manning, Hunter and lower Bellinger river systems (north-central coastal NSW), the Clyde, Moruya, Tuross, Bega and Towamba river basins in coastal southern NSW, coastal East Gippsland (particularly the mid to upper Snowy River and Bemm River systems, including the Mount Kosciuszko area), the mid to upper Mitchell, Thomson and La Trobe river basins in the coastal Gippsland region of VIC, and the upper Murrumbidgee system in inland, south-eastern NSW.

Previously only two nondiadromous species of *Galaxias* were known from freshwaters in the eastern portion of mainland Australia (*Galaxias olidus* s.l., *Galaxias rostratus*; Allen *et al.* 2003). As all taxa in the *G. olidus* complex are considered not to migrate for spawning, the number of nondiadromous galaxiids is now increased to 16.

Based on general body shape all species in the *G. olidus* complex can be placed into one of a number of groups:

1. Diminutive and tubular: *Galaxias terenasus* **sp. nov.**;
2. Relatively slender and elongate: *Galaxias arcanus* **sp. nov.**, *Galaxias supremus* **sp. nov.**;
3. Moderately stout: *Galaxias aequipinnis* **sp. nov.**, *Galaxias brevissimus* **sp. nov.**, *Galaxias lanceolatus* **sp. nov.**, *Galaxias longifundus* **sp. nov.**, *Galaxias mcdowalli* **sp. nov.**, *Galaxias olidus*, *Galaxias ornatus*;
4. Moderately stout and elongate: *Galaxias mungadhan* **sp. nov.**, *Galaxias oliros* **sp. nov.**; and,
5. Stout: *Galaxias fuscus*, *Galaxias gunaikurnai* **sp. nov.**, *Galaxias tantangara* **sp. nov.**

The greatest number of species (80 %) were relatively thickset (moderately stout to stout), conforming to the general body shape defined for *Galaxias olidus* s.l. (McDowall & Frankenberg 1981). However, the three most morphologically distinctive species (*Galaxias arcanus* **sp. nov.**, *Galaxias supremus* **sp. nov.** and *Galaxias terenasus* **sp. nov.**) did not conform to this body plan, being smaller or more slender.

Raised fin ray lamellae on the paired fins, previously only known in *Galaxias brevipinnis* in Australia and New Zealand (McDowall 2003b), were found to be present in all species in the *Galaxias olidus* complex except for *Galaxias brevissimus* **sp. nov.**, *Galaxias tantangara* **sp. nov.** and *Galaxias terenasus* **sp. nov.** That this structure has been overlooked in *Galaxias olidus* s.l. is surprising considering the amount of previous morphological work on the taxon (Frankenberg 1989, McDowall & Frankenberg 1981, Rich 1986), and how widely the lamellae are found among the species in the complex. Whilst not as well developed or as distinctive as in *G. brevipinnis*, raised lamellae, when present, are usually located on the first 2–3 anterior rays of the pectoral and pelvic fins, either poorly developed as a slight thickening present towards the distal end of the ray, or well defined and extending along the distal half of each ray.

As in *Galaxias brevipinnis*, the raised lamellae are presumably used to aid climbing out of water over damp rocks by increasing the surface area of the ventrally facing fins to maximise the use of surface tension of the water for grip. This type of climbing has been recorded in *Galaxias olidus* s.l. (incorrectly identified as *G. brevipinnis*) near Mt Kosciuszko (Green 1979), and in *Galaxias olidus* climbing waterfalls and artificial instream barriers such as a large dam (see under 'remarks' in the *G. olidus* species treatment, above). If the raised lamellae on the other species in the *G. olidus* complex also facilitate climbing, this infers a greater capacity for local movement in these upland galaxiids, particularly in steep gradient streams in which they are commonly found. Climbing also presumably provides a mechanism for broader dispersal, particularly between adjacent catchments via low catchment divides during extended wet periods, facilitated by the presence of the galaxiids in headwater tributaries. This presents an alternative hypothesis to tectonic drainage rearrangement or increased connectivity on the continental shelf between adjacent drainages during periods of lowered sea-level (Unmack 2001) to explain the distribution of obligate freshwater galaxiid species which straddle significant drainage divides (e.g. Great Dividing Range). In particular, the more widespread *Galaxias olidus*, *Galaxias oliros* **sp. nov.**, and *Galaxias terenasus* **sp. nov.** would be suitable species to test alternative theories for dispersal across catchment boundaries (*sensu* Waters *et al.* 2001a, Burridge *et al.* 2007, 2008).

Given this climbing ability in the upland galaxiids, the vernacular name 'Climbing Galaxias', commonly used in Australia for *Galaxias brevipinnis*, is a misnomer, as climbing ability is not restricted to this species, though it may not be as obvious or as dramatic in the *Galaxias olidus* complex. The alternative vernacular name of 'Broadfinned Galaxias' for *G. brevipinnis*, referring to the distinctly enlarged pectoral and pelvic fins in this species, appears more appropriate.

The concentration of the majority of the species within the *Galaxias olidus* complex is located in a relatively small area of the very south-east corner of mainland Australia, ranging from the Tuross River basin in coastal NSW, south-westward to the La Trobe River system in VIC and including the very upper, inland, Murrumbidgee River system. This small region, approximately 450 km long and averaging ~100 km wide, is significant as it contains the entire distributions of 10 (67 %) of the species in the *G. olidus* complex, nine of which are now found in a few very small and isolated, (presumed) allopatric populations. The distribution of *Galaxias terenasus* **sp. nov.** is more widespread within this region, and *Galaxias olidus* is also present, relatively widespread in the upper catchment of the Murrumbidgee River basin, but restricted in the coastal portion to the Tambo River and Mitchell River basins. Including the non-diadromous Dwarf Galaxias (*Galaxiella pusilla*) and the diadromous *Galaxias maculatus*, *Galaxias brevipinnis* and *Galaxias truttaceus* (Cadwallader & Backhouse 1983, Raadik 1992a,b, 1995b), this south-east mainland region of Australia contains potentially 15 species of galaxiids.

While such high and geographically concentrated galaxiid species richness may seem unlikely at first glance, it is equivalent to that displayed by the Tasmanian galaxiid fauna, where 14 species have been recorded from northern Tasmania (north of latitude 42.2^0 S) in a geographic area of comparable size (Fulton 1990). The south-east corner of Australia is therefore significant for a number of reasons: with respect to Australian freshwater cool-temperate fish evolution, as no other comparable region contains such a high concentration of restricted, narrow-range endemic obligate freshwater fish species; for the diversity and evolution of galaxiid fishes; and, for the high diversity of nonmigratory *Galaxias* species. This high regional diversity of non-migratory galaxiids far exceeds that recorded elsewhere across the global range of the Galaxiidae, including a similar area of the very southern portion of the South Island of New Zealand (south of approx. Haast–Palmerston) where six non-migratory species are currently found (McDowall 2000).

The Galaxiidae (revised)

The taxonomy and systematics of the Galaxiidae is undergoing revision with a number of recent and ongoing studies on Australian, New Zealand and South African species (Watts *et al.* 1995, Waters & Cambray 1997, Waters & Wallis 2000, 2001a, Coleman *et al.* 2010). There is also continuing debate whether the Western Australian Salamanderfish, *Lepidogalaxias salamandroides* Mees, 1961, is distinct or part of this family (Waters *et al.* 2000a, Li *et al.* 2010, Burridge *et al.* 2012). There is also debate about higher level relationships (Johnson & Patterson 1996, Waters *et al.* 2000a, Waters & McDowall 2005, Li *et al.* 2010). Based on morphological analyses, galaxiids have been historically placed in the order Salmoniformes (Northern Hemisphere salmons, trouts, chars, etc.), and more recently, based on molecular analyses, to the order Osmeriformes (Northern Hemisphere smelts) (Johnson & Patterson 1996, Waters *et al.* 2000a, Hoese *et al.* 2006, Nelson 2006, Burridge *et al.* 2012). Higher level relationships have been further refined with more detailed and broader genetic analysis suggesting that galaxiids comprise the distinctive Order Galaxiiformes, which is basal to the Osmeriformes and Salmoniformes (Li *et al.* 2010, Burridge *et al.* 2012).

Following the revision of *Galaxias olidus* s.l. (this study), the Galaxiidae, or 'galaxiids' (incorrectly referred to as 'minnows' or 'jollytails'), remain a moderately small freshwater family of seven genera but with 64 extant species in two subfamilies (Galaxiinae and Aplochitoninae) (Table 41). Eight species have so far been described from fossil remains in New Zealand, extending the known age of the family to the Miocene (Stokell 1945, Whitley 1956a, Lee *et al.* 2007, Schwarzhans *et al.* 2012).

The subfamily Galaxiinae is the larger and now contains 61 extant species in five genera, with *Galaxias* the most speciose, with 46 extant species. The greatest diversity of the Galaxiinae is found in Australia and New Zealand, which have 33 and 28 endemic species each respectively, and share two (*Galaxias brevipinnis* and *Galaxias maculatus*) (Table 41). *Galaxias* is the most geographically widespread and diverse genus, with 45 extant, valid species recognised worldwide. Australia also has a high degree of endemism within this family with 34 species not found elsewhere (Table 42). Nineteen of these are endemic to the mainland and 11 are endemic to Tasmania, which also has the endemic genus *Paragalaxias*.

Salmonid impacts on the *Galaxias olidus* complex

The ongoing impact on the Galaxiidae by predatory, alien trout (*Salmo trutta* and *Oncorhynchus mykiss*) has been recognised globally (McDowall 2006a), with many nonmigratory galaxiid species reduced in abundance and populations highly fragmented and reduced in geographical range. Prior to the current study, salmonids were conclusively known to negatively impact *Galaxias fuscus* (Raadik *et al.* 2010) and were implicated in the general decline in range and/or fragmentation of *Galaxias olidus* s.l., though the degree of impact or specific process of interaction was unclear (Tilzey1976, Cadwallader 1996, Lintermans 2000a). Consequently the impact on nonmigratory galaxiids by salmonids in Australia has been considered to be moderate at most (Jackson *et al.* 2004), only seriously affecting one species (*G. fuscus*) in a very small proportion of the range of *G. olidus* s.l. in south-eastern Australia.

TABLE 41. Valid species of extant and fossil (†) Galaxiidae, including authority and distribution. AUS—Australia (only mainland; Tas—only Tasmania; &Tas—mainland and Tasmania); NZ—New Zealand; SAm—South America (includes country); SAfr—South Africa.

SUBFAMILY and Scientific Name	**Authority**	**Country**
GALAXIINAE		
Brachygalaxias bullocki	(Regan, 1908)	SAm (Chile)
Brachygalaxias gothei	Busse, 1982	SAm (Chile)
Galaxias aequipinnis **sp. nov.**	Raadik (this paper)	AUS
†*Galaxias angustiventris*	Schwarzhans, 2012	NZ
Galaxias anomalus	Stokell, 1959	NZ
Galaxias arcanus **sp. nov.**	Raadik (this paper)	AUS
Galaxias argenteus	Gmelin, 1789	NZ
Galaxias auratus	Johnston, 1883	AUS (Tas)
†*Galaxias bobmcdowalli*	Schwarzhans, 2012	NZ
†*Galaxias brevicaudus*	Schwarzhans, 2012	NZ
Galaxias brevissimus **sp. nov.**	Raadik (this paper)	AUS
Galaxias brevipinnis	Günther, 1866	AUS (& Tas), NZ
Galaxias cobitinis	McDowall & Waters, 2002	NZ
Galaxias depressiceps	McDowall & Wallis, 1996	NZ
Galaxias divergens	Stokell, 1959	NZ
†*Galaxias effusus*	Lee, McDowall & Lindqvist, 2007	NZ
Galaxias eldoni	McDowall, 1997	NZ
Galaxias fasciatus	Gray, 1842	NZ
Galaxias fontanus	Fulton, 1978	AUS (Tas)
Galaxias fuscus	Mack, 1936	AUS
Galaxias globiceps	Eigenmann, 1928	SAm (Chile)
Galaxias gollumoides	McDowall & Chadderton, 1999	NZ
Galaxias gracilis	McDowall, 1967	NZ
Galaxias gunaikurnai **sp. nov.**	Raadik (this paper)	AUS
Galaxias lanceolatus **sp. nov.**	Raadik (this paper)	AUS
Galaxias longifundus **sp. nov.**	Raadik (this paper)	AUS
Galaxias johnstoni	Scott, 1936	AUS (Tas)
†*Galaxias kaikorai*	Whitley, 1956	NZ
Galaxias macronasus	McDowall and Waters, 2003	NZ
Galaxias maculatus	(Jenyns, 1842)	AUS (& Tas), NZ, SAm (Chile, Argentina, Falkland Islands)
Galaxias mcdowalli **sp. nov.**	Raadik (this paper)	AUS
Galaxias mungadhan **sp. nov.**	Raadik (this paper)	AUS

...... continued on the next page

TABLE 41. (Continued)

SUBFAMILY and Scientific Name	Authority	Country
Galaxias neocaledonicus	Weber & de Beaufort, 1913	New Caledonia
Galaxias niger	Andrews, 1985	AUS (Tas)
Galaxias occidentalis	Ogilby, 1899	AUS
Galaxias olidus	Günther, 1866	AUS
Galaxias oliros **sp. nov.**	Raadik (this paper)	AUS
Galaxias ornatus	Castelnau, 1873	AUS
†*Galaxias papilionis*	Schwarzhans, 2012	NZ
†*Galaxias parvirostris*	Schwarzhans, 2012	NZ
Galaxias parvus	Frankenberg, 1968	AUS (Tas)
Galaxias paucispondylus	Stokell, 1938	NZ
Galaxias pedderensis	Frankenberg, 1968	AUS (Tas)
Galaxias platei	Steindachner, 1898	SAm (Chile, Argentina, Falkland Islands)
Galaxias postvectis	Clarke, 1899	NZ
Galaxias prognathus	Stokell, 1940	NZ
Galaxias pullus	McDowall, 1997	NZ
Galaxias rostratus	Klunzinger, 1872	AUS
Galaxias supremus **sp. nov.**	Raadik (this paper)	AUS
†*Galaxias tabidus*	Schwarzhans, 2012	NZ
Galaxias tantangara **sp. nov.**	Raadik (this paper)	AUS
Galaxias tanycephalus	Fulton, 1978	AUS (Tas)
Galaxias terenasus **sp. nov.**	Raadik (this paper)	AUS
Galaxias truttaceus	Valenciennes, 1846	AUS (& Tas)
Galaxias vulgaris	Stokell, 1949	NZ
Galaxias zebratus	(Castelnau, 1861)	SAfr
Galaxiella munda	McDowall, 1978	AUS
Galaxiella nigrostriata	(Shipway, 1953)	AUS
Galaxiella pusilla	(Mack, 1936)	AUS (& Tas)
Neochanna apoda	Günther, 1867	NZ
Neochanna burrowsius	(Phillips, 1926)	NZ
Neochanna cleaveri	(Scott, 1934)	AUS (& Tas)
Neochanna diversus	Stokell, 1949	NZ
Neochanna heleios	Ling & Gleeson, 2001	NZ
Neochanna rekohua	(Mitchell, 1995)	NZ (Chatham Is.)
Paragalaxias dissimilis	(Regan, 1906)	AUS (Tas)
Paragalaxias eleotroides	McDowall & Fulton, 1978	AUS (Tas)
Paragalaxias julianus	McDowall & Fulton, 1978	AUS (Tas)
Paragalaxias mesotes	McDowall & Fulton, 1978	AUS (Tas)
APLOCHITONINAE		
Aplochiton taeniatus	Jenyns, 1842	SAm (Chile, Argentina)
Aplochiton zebra	Jenyns, 1842	SAm (Chile, Falkland Islands)
Lovettia sealii	(Johnston, 1883)	AUS (& Tas)

TABLE 42. Australian Galaxiidae, including Australian, mainland and Tasmanian endemism. (Y = yes; m—mainland Australia; T—Tasmania).

Species	Endemic	Distribution	Comment
Galaxias aequipinnis **sp. nov.**	Y	m	Restricted to VIC.
Galaxias arcanus **sp. nov.**	Y	m	Found in NSW and VIC.
Galaxias auratus	Y	T	
Galaxias brevissimus **sp. nov.**	Y	m	Restricted to NSW.
Galaxias brevipinnis		m&T	Found in SA, VIC, NSW and TAS; also in NZ.
Galaxias fontanus	Y	T	
Galaxias fuscus **sp. nov.**	Y	m	Restricted to VIC.
Galaxias gunaikurnai **sp. nov.**	Y	m	Restricted to VIC.
Galaxias johnstoni	Y	T	
Galaxias lanceolatus **sp. nov.**	Y	m	Restricted to VIC.
Galaxias longifundus **sp. nov.**	Y	m	Restricted to VIC.
Galaxias maculatus		m&T	Found in WA, SA, TAS, VIC, NSW, and QLD; also in NZ and South America.
Galaxias mcdowalli **sp. nov.**	Y	m	Restricted to VIC.
Galaxias mungadhan **sp. nov.**	Y	m	Restricted to VIC.
Galaxias niger	Y	T	Possibly a synonym of *G. brevipinnis*.
Galaxias occidentalis	Y	m	Restricted to WA.
Galaxias olidus	Y	m	Found in QLD, NSW, VIC, ACT and SA.
Galaxias oliros **sp. nov.**	Y	m	Found in NSW, VIC and SA.
Galaxias ornatus **sp. nov.**	Y	m	Restricted to VIC.
Galaxias parvus	Y	T	
Galaxias pedderensis	Y	T	
Galaxias rostratus	Y	m	Found in NSW, VIC and SA.
Galaxias supremus **sp. nov.**	Y	m	Restricted to NSW.
Galaxias tantangara **sp. nov.**	Y	m	Restricted to NSW.
Galaxias tanycephalus	Y	T	
Galaxias terenasus **sp. nov.**	Y	m	Found in NSW and VIC.
Galaxias truttaceus	Y	m&T	Found in SA, VIC, and TAS.
Galaxiella munda	Y	m	Restricted to WA.
Galaxiella nigrostriata	Y	m	Restricted to WA.
Galaxiella pusilla	Y	m&T	Found in SA, VIC and TAS.
Neochanna cleaveri	Y	m&T	Found in SA, VIC and TAS.
Paragalaxias dissimilis	Y	T	
Paragalaxias eleotroides	Y	T	
Paragalaxias julianus	Y	T	
Paragalaxias mesotes	Y	T	
Lovettia sealii	Y	m&T	Found in TAS and VIC.
Total	34	25 m / 17 T	

This study demonstrates the degree of salmonid impact on biodiversity in Australian non-migratory galaxiids has been seriously under-estimated due to the lack of taxonomic resolution in the *Galaxias olidus* complex. Significantly, trout are implicated in the decline and/or fragmentation in range of 10 of the 15 species within the complex (with at least regional/localised impacts documented/predicted in the remaining five), all of which occur in habitats which are now considered to have highly modified biotas which reflect relictual distributions as a result of recent and local extirpations. Significantly this is often in otherwise pristine or little modified upland habitat. Surviving populations of many of these new species are small and found above instream barriers that have prevented the upstream colonisation of trout (e.g. *Galaxias gunaikurnai* **sp. nov.**, *Galaxias mcdowalli* **sp. nov.**, *Galaxias mungadhan* sp. nov and *Galaxias tantangara* **sp. nov.**). These are at high risk of extinction from the genetic consequences of reduced population size and stochastic events such as drought (dewatering) or floods (extensive post-fire sedimentation or facilitation of further salmonid expansion) and the general effects of catchment and climate change (increasing water temperature, altered seasonality of flows, salinity etc.). Other species occur in multiple rivers but occupy specific habitat niches in streams with predators (e.g. *Galaxias arcanus* **sp. nov.**, *Galaxias terenasus* **sp. nov.**), and loss of genetic diversity within these, and more widespread species (e.g. *G. olidus*, *Galaxias oliros* **sp. nov.**), may be occurring through reduction or elimination of local populations by salmonids singly or in concert with other threatening processes such as flow regulation and riparian habitat loss. These new species provide additional opportunities to investigate the specifics of trout-galaxiid interactions in Australia at multiple scales across the landscape, and to refine and implement appropriate scale conservation management strategies to further protect or expand galaxiid populations and build resistance and resilience to cope with stochastic change.

Of great significance is the possibility that additional lineages, sufficiently diverged to have similarly warranted recognition as candidate species, and therefore probably representing valid species, may have already been extirpated by salmonids. For example, phenotypically different populations of *Galaxias olidus* s.l., previously recorded from the headwaters of the Buchan River (Snowy River system) and Pieman Creek (Mitchell River system) (Frankenberg 1969, McDowall & Frankenberg 1981), have been replaced by salmonids in the past 30 years and are now presumed extinct (T.A. Raadik, unpublished data). Other areas which may have similarly lost valid species are the Mount Baw Baw Plateau, the upper Snowy, Thredbo and Murrumbidgee river systems, and widespread reaches in the mid to upper portions of the La Trobe, Macalister, Mitchell and Tambo river catchments.

This historically unrecorded potential loss, and the continuing threat of rapid loss, of species-level diversity in non-migratory galaxiids in south-eastern Australia will prevent true levels of global species diversity in the Galaxiidae being defined; species probably have, and will continue to be lost before they are discovered. This reduces the overall success of global freshwater fish conservation efforts as the impact of salmonid predation on non-migratory galaxiids is widespread in the Southern Hemisphere and is currently being poorly addressed (McDowall 2006a). Locally, it also confounds our knowledge of true levels of species diversity in upland regions of Australian freshwater environments. Now that the breadth of salmonid impacts has been redefined in the galaxiids of south-eastern Australia this should drive the acceptance of salmonid predation as a credible and major risk, where urgent implementation of effective conservation management strategies is required.

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Whitley, G.P. (1959) The freshwater fishes of Australia. *In*: Keast, A., Crocker, R.L., Christian, C.S. (Eds.), *Biogeography and Ecology in Australia*. Dr. W. Junk: Den Haag, pp. 136–149.

Whitley, G.P. (1964) Presidential Address: A survey of Australian Ichthyology. *Proceedings of the Linnean Society of New South Wales*, 89 (1), 11–127.

Wishart, M.J. (2002) *A comparative phylogenetic approach toward defining functional units for the conservation of biodiversity in lotic systems*. PhD Thesis, Griffith University, Brisbane, 156 pp.

Wishart, M., Hughes, J., Stewart, B. & Impson, D. (2006) Extreme levels of intra-specific divergence among Cape Peninsula populations of the Cape galaxias, *Galaxias zebratus* Castelnau 1861, reveals a possible species complex. *African Journal of Aquatic Science*, 31 (1), 99–106.

Zeitz, A.H.C. (1908) A synopsis of the fishes of South Australia. Part II. *Transactions of the Royal Society of South Australia*, 32, 294–299.

APPENDIX 1. Text of original descriptions for species of *Galaxias* in the *Galaxias olidus* species complex, including the redescription of *Galaxias findlayi* Macleay 1882, by Ogilby (1896).

Transcribed original text, except where translated. Original proportionate measurements expressed as percentages (in parentheses) to aid in interpretation and comparisons.

Galaxias olidus Günther, 1866

Günther, A. (1866) Fam. 9. Galaxiidae. Catalogue of the fishes of the British Museum. London: British Museum Vol. 6, 208–213.

Original description:
Page 209.
3. Galaxias olidus.
D. 11. A. 13. P. 14. V. 7.
Body stout: head thick, its length being about equal to the height of the body, and two-ninths (22.2 %) of the total (without caudal). The lower jaw a little shorter than the upper; cleft of the mouth of moderate width, the maxillary not quite extending to below the middle of the eye. Eye rather small, less than one-sixth (16.7 %) of the length of the head, and much shorter than the snout. The length of the pectoral fin is less than one-half (< 50 %) of the distance of its root from the ventral, and the ventral fin terminates at a considerable distance from the vent; anal fin, if laid backwards, scarcely extending to the base of the caudal. The least depth of the tail is one-half (50 %) of the distance between caudal and dorsal fins. Brownish red above, yellowish red below; all the fins and the opercles with thick black dots; a few scattered similar dots on the side of the tail.
? Queensland.
a. Four inches long. From Mr. G. Krefft's Collection.

Galaxias schomburgkii Peters, 1868

Peters, W.C.H. (1868) Über eine neue Nagergattung *Chiropodomys penicillatus*, so wie über einige neue oder weniger bekannte Amphibien und Fische. *Monatsberichte der Koniglich Preussischen Akademie der Wissenschaften zu Berlin*, 1868, 448–460.

Original description: [Original text in German. English translation by I.L. Raadik]
Pages 455—456.
7. *Galaxias Schomburgkii* n. sp.
D. 9; V. 7; A. 10.
Body depth to total length as 1: 6 ½ (15.4 %), head length to total length 1: 5 ½ (18.2 %). The eye lies in the second quarter of the head length. The pectoral fin is longer than half the distance of its base from the pelvic fin. The latter do not reach the anal opening. The depressed anal fin does not reach to the caudal fin and starts almost before the end of the dorsal fin. The distance of the dorsal fin from the caudal fin is twice as great as the smallest height of the tail. Colourless, viewed through the magnifier, tightly compressed [?] and very finely punctuated.
Two examples, 50 mm long. From a mountain stream near Adelaide via Mr Rich. Schomburgh.

Comments
Type Locality: Adelaide district, South Australia.
Type specimens: Museum für Naturkunde, Humbolt Universitat, Berlin. Syntypes ZMB 6788 (2 specimens) [see Fig. A1, below].

FIGURE A1. *Galaxias schomburgkii* (Syntypes ZMB 6788) (Museum für Naturkunde, Berlin).

Galaxias ornatus Castelnau, 1873

Castelnau, F.L. de (1873) Contribution to the ichthyology of Australia. 9. New sorts for the Victorian fauna. *Proceedings of the Zoological and Acclimatisation Society of Victoria*, 2, 150–153.

Original description:
Page 153.
GALAXIAS ORNATUS
Body elongate; its height contained seven times (14.3 %) in the total length; head (14.3 %) as long as the height of the body; lower jaw rather longer than the upper one; eye rather shorter than the snout, and contained four times (25 %) in the length of the head; the dorsal of ten rays, the first of which is very short; this fin is inserted at a distance from the snout double to the one up to the base of the caudal; this last strongly emarginated; anal placed a little behind the dorsal of eleven rays; the ventrals are inserted at an equal distance to the base of the pectorals and to the one of the anal; they have seven rays; the pectorals are as long as the space between the posterior edge of the eye and the extremity of the operculum; they have twelve rays.

The colour of the living specimen was of a light green, with the lower parts of a golden yellow; the back has numerous transverse bands, rather narrow, but well defined, of an obscure green. These bands are not agglomerations of fine points, as in many other species; eyes yellow; fins of a light yellow.
The largest of my specimens measures four and a half inches.

Comments
Type Locality: Cardinia Creek, Victoria.

Galaxias bongbong Macleay, 1881

Macleay, W. (1881) Descriptive catalogue of the fishes of Australia. Part 4. *Proceedings of the Linnean Society of New South Wales*, 1881 (1)6(2), 202–387.

Original description:
Page 233.
GALAXIAS BONG-BONG, *n. sp.*
The greatest height of the body is one-fifth (20 %) of the length (without caudal); the length of the head the same (20 %). The snout is rounded in front; the maxillary reaching to below the anterior third of the eye. The length of the pectoral fin is nearly one-half (50 %) the distance of its root from the ventral, and that of the ventral is quite half (50 %) the length of the space between the root of the ventral and the anal. Caudal fin very slightly emarginate, its membrane extending very considerably on to the upper and lower portions of the tail, and almost continuous with the anal fin. The colour in spirits is red, more or less densely spotted and clouded with black, the vertical fins slightly tinged with blackish. Length three inches.

Moss Vale and rivers at Bong-bong.

Comments

Type specimens: Lectotype AMS I.16258-002 (1 specimen) [see Fig. A2, below]; Paralectotypes: AMS I.16258-001 (6 specimens). Whitley (1941) designated the lectotype (1 specimen 63 mm long), and stated that all co-types were in the Macleay Museum, University of Sydney (MMS F.82). The original type series contained 10 specimens (Stanbury 1968) and currently contains 7 specimens (see above). Three appear to have been lost since the audit by Stanbury (1968). Co-types were moved on permanent loan to the collection of the Australian Museum c. 1969 (Paxton & McGrouther 1997).

FIGURE A2. *Galaxias bongbong* lectotype (AMS I.16258-002) (T.A. Raadik).

Galaxias findlayi Macleay, 1882

Macleay, W. (1882) On a species of *Galaxias* found in the Australian Alps. *Proceedings of the Linnean Society of New South Wales*, (1)7(1), 106–109.

Original description:

Page 107.

Galaxias Findlayi, *n. sp.*

D. 9, A. 12, P. 14, V. 7, C. 16.

The height of the body is about one-tenth (10 %) of the total length, and the length of the head about one-fifth (20 %) of the same. Head blunt and rounded in front, the space between the eyes broad and nearly flat; eyes small; the cleft of the mouth reaching to beneath the front margin of the eye; teeth minute in the jaws, and two rows of similar small teeth on each side of the vomerine ridge. There are numerous pores on the head. The length of the pectoral fin is less than the distance between its extremity and the ventral fin, and the length of the ventrals is less than their distance from the vent; the dorsal fin is situated almost entirely in front of the anal; the caudal is rather long and emarginate, a fold of skin joining it above and below to the body—the upper fold largest, but in neither case extending to the vertical fins, which are distant from the tail. A distinct anal papilla. Colour in spirits yellowish brown, the back densely speckled with very minute brownish dots, taking the form of very distinct fasciæ.

Both specimens are small—the largest not exceeding three inches in length, and are evidently immature.

Comments

Collected by S. Findlay, Esq., J.P., in 1882, and similar fish previously noted in the Snowy Mountains by Baron von Mueller during his trips in 1853–4, 1855, and in 1874.

Type Locality: '.. the icy ponds of the snowy range in the neighbourhood of Mt. Kosciusko'.

Type specimens: Originally in the private collection of William Macleay and then presumably donated to the University of Sydney at the establishment of the Macleay Museum, unregistered syntypes, 2 specimens—current location unknown, presumed lost. Additional effort was made to locate types at the Macleay Museum, Sydney, but was unsuccessful (Elizabeth Jeffrys, Curator of Natural History, Macleay Museum, *pers. comm*. 2008; Tony Gill, Curator of Natural History, Macleay Museum, *pers. comm*. 2012).

Galaxias kayi Ramsay & Ogilby, 1886

Ramsay, E.P. & Ogilby, J.D. (1886) Description of some new Australian fishes. *Proceedings of the Linnean Society of New South Wales*, (2)1(1), 4–7.

Original description:
Page 6.
Galaxias kayi *sp. nov.*
D. 10: A. 11: V. 8: P. 14: C. 16: Vert 33/20.
Length of head 5 ¾ (17.4 %), of caudal fin 7 $^{2}/_{5}$ (13.5 %), height of body 6 (16.7 %) in the total length. Diameter of eyes $^{2}/_{9}$ (22.2 %) of the length of the head, $^{5}/_{7}$ (71.4 %) of that of the snout, and ⅔ (66.7 %) of the interorbital space, which is flat. The breadth of the head is equal to its height, and to the length behind the middle of the eye. Jaws equal; maxilla reaches to beneath the middle of the eye. Each jaw with a single row of subulate teeth; edge of the tongue with several larger recurved teeth; palatine teeth shorter and blunter in a narrow row on the inner margin of the bones. The length of the interspace between the dorsal and anal fins is equal to the distance between the front margin of the eye and the base of the pectoral fin; that between the anal and caudal equal to the head in front of the hind margin of the eye; anal commences beneath the seventh dorsal ray: the length of the pectoral is two-fifth (40 %) of the distance of its root from the ventral, which latter terminates more than its own length from the vent. *Colours*, olive green above the lateral line, yellow below; generally some short fasciæ depending from the former colour.

Several specimens of this handsome *Galaxias* have been forwarded to us for identification by our esteemed correspondent, Mr Robert Kay, General Director and Secretary of the Adelaide Museum, after whom we have named it; they were taken in Fifth Creek, S. Australia; the largest measures 3 and three-quarter inches, and is registered, I. 3.

Comments
Type specimens: Australian Museum, Sydney. Syntypes: AMS I.5 to 7 (6) (Fig. A3); BMNH 1905.7.29.31 (2) ex AMS [originally as AMS I.3] (Fig. A4); MCZ 27560 (2 [1 missing]), ex AMS [originally as AMS I.4] (Fig. A5). Whilst not stated, the original type series at the AMS consisted of 10 individuals respectively registered as AMS I.3 to 7. Whitley (1957d) referred (in error) to a cotype AMS I.8 and omitted AMS I.4 from Fifth Creek. Examination of the relevant specimen register indicated that AMS I.8 is from Mount Compass (2 individuals) and came on exchange from SAMA at the same time as AMS I.3 to 7, and did not form part of the type series as all type material for *G. kayi* is from Fifth Creek, SA (see above); Whitley's inclusion of AMS I.8 for the type series is in error, as is, therefore, his omission of AMS I.4.

Hoese *et al.* (2006: 406) incorrectly include BMNH 1866.2.13.24 as a syntype of *Galaxias kayi*. This is the holotype of *Galaxias olidus* Günther, 1866. Further, the syntype information given is also partially incorrect.

FIGURE A3. *Galaxias kayi* syntype (AMS.I.7) (Australian Museum, Sydney). Note encysted metacercariae on pectoral and caudal fins.

FIGURE A4. *Galaxias kayi* syntype (BMNH 1905.7.29.31) (British Museum of Natural History, London).

FIGURE A5. *Galaxias kayi* syntype (MCZ.27560) (Museum of Comparative Zoology, Massachusetts). Note encysted metacercariae on anal and caudal fins.

Galaxias oconnori Ogilby, 1912

Ogilby, J.D. (1912) On some Queensland fishes. *Memoirs of the Queensland Museum*, 1, 26–65.

Original description:

Page 33.

GALAXIIDÆ

GALAXIAS O'CONNORI sp. nov.

Queensland Mountain Trout

Depth of body 7.33 (13.6 %), length of head 4.52 (22.1 %) in length of body. Diameter of eye 1.21 (82.6 %) in length of snout and 4.42 (22.6 %) in that of the head; width of interorbit 4.87 (20.5 %) in the head. Lower jaw slightly projecting; maxillary extending to below the anterior border of the eye. Dorsal 2+8; space between origin of dorsal and root of caudal 3.62 (27.6 %) in the length of the body. Anal 3+9, originating below the last third of the dorsal and not extending to the caudal when depressed. Pectoral extending four ninths (44.4 %) of the distance between its origin and the ventral. Ventral 7-rayed, originating one eight (12.5 %) nearer to the root of the caudal than to the tip of the snout, extending half the distance between its origin and the anal. Caudal emarginate; caudal peduncle three fifths (60 %) longer than deep. Light brown, profusely spotted with darker brown; fins immaculate. Our single specimen comes from Lyra, near Stanthorpe, and measures 77 millim. Reg. No. I.421.

Comments

Whitley (1955) provided a line drawing of a purported *Galaxias oconnori*. This is in error as his specimen came from Rylstone, NSW (AMS IB.3278), which is considered to represent *Galaxias olidus* s.s.

Type specimens: The holotype (QM I.421) was noted previously to have '..disintegrated..' by McDowall & Frankenberg (1981: 474) and is now virtually unusable except for osteological examination (see Fig. A6). A co-type (AMS I.11161) was listed by Whitley (1957d), though this is in error as Ogilby stated that he had only one specimen (see description above), and AMS I.11161 could not be located in 2006.

FIGURE A6. Detailed view of remains of *Galaxias oconnori* holotype (QM I.421) in January 2003 (T.A. Raadik).

Galaxias fuscus Mack, 1936

Mack, G. (1936) Victorian species of the genus *Galaxias*, with descriptions of two new species. *Memoirs of the National Museum*, 9, 98–101.

Original description:

Page 100—101.

Galaxias fuscus sp. nov.

B.8; D.12; A.12; V.7; P.15; C.18.

Head, 5.6 (17.9 %), depth of body, 8.4 (11.9 %), in total length. Snout longer (> 100 %) than diameter of eye, 3.7 (27.0 %) in head. Eye 1.5 (66.7 %) in interorbital width and 4.2 (23.8 %) in head. Jaws equal, maxillary extending to below middle of eye. Gill-rakers short, slender, 9 on lower part of anterior arch. Teeth in jaws subequal.

Distance from origin of dorsal to base of caudal 3.5 (28.6 %) in total length. Anal commencing slightly in advance of the vertical from posterior end of base of dorsal. Pectoral extending two-fifths (40 %) the distance from its base to base of ventrals. Ventrals originating at a point about equidistant between snout and base of caudal, extending half (50 %) the distance from their base to origin of anal. Caudal emarginate, 7.6 (13.2 %) in total length; its length equal (100 %) to length of caudal peduncle which is twice (200 %) as long as deep.

Colour in spirit greenish brown, with four prominent dark oval blotches on each side between base of pectoral and origin of dorsal.

Described from a specimen (A.96, Nat. Mus. Victoria) measuring 84 mm. in total length, one of two examples from the Rubicon River, Victoria.

Text of redescription of *Galaxias findlayi* Macleay 1882, by Ogilby (1896).

Original proportionate measurements expressed as percentages (in parentheses) to aid in interpretation and comparisons.

Ogilby, J.D. (1896) On a *Galaxias* from Mount Kosciusko. *Proceedings of the Linnean Society of New South Wales,* 21(1), 62–73.

Original description:
Page 66.
GALAXIAS FINDLAYI.
Galaxias findlayi, Macleay, Proc. Linn. Soc. N.S. Wales, 1882, vii. P. 107.
B. ix. D. 12–13. A. 11–1[1]2. V. 9. P. 16. C. 16. Vert. 37–38/23.
Body stout to slender, the head broad and depressed. Length of head $4\,^{3}/_{4}$ to $5\,^{1}/_{2}$ (18.2–21.0 %), depth of body $5\,^{1}/_{5}$ to 8 (12.5–19.2 %) in the total length; width of body equal to or a little less than its depth, 1 ⅓ to 1 ¾ (125.0–133.3 %), of interorbital region $2\,^{4}/_{5}$ to $3\,^{1}/_{5}$ (31.2–35.7 %), diameter of eye 4 to $5\,^{2}/_{5}$ (18.5–25 %)in the length of the head; snout obtuse, from $^{3}/_{8}$ to $^{3}/_{4}$ (37.5–75.0 %) of a diameter longer than the eye, which is very small. Lips thick and fleshy; the maxillary reaches to the vertical from the middle of the eye or not quite so far; lower jaw included. Seven or eight gill-rakers on the lower branch of the anterior arch. Jaws with a single series of moderate hooked teeth of somewhat irregular size; palatines with a similar series along their inner border directed inwards and backwards; a series of five strong hooked teeth on each side of the tongue and a single median tooth in front; vomer toothless. Dorsal fin obtusely po[2]inted or rounded, the space between its origin and the base of the caudal 2 and two-fifths to 2 and three-fifths (38.5–41.7 %) in its distance from the extremity of the snout; the fourth and fifth rays are the longest, one and four-fifths to two (50.0–55.5 %) in the length of the head; the base of the fin is one and one-tenth to one and one fifth in its height (83.3–90.9 %) and $1\,^{1}/_{2}$ to $1\,^{3}/_{5}$ (62.5–66.7 %) in the space between its origin and that of the anal: the anal fin is similar in shape to and originates beneath the last fourth (25 %) of the dorsal; the fifth and sixth rays are the longest, as long as or a little longer than the dorsal rays; its base is $1\,^{1}/_{10}$ to $1\,^{1}/_{5}$ (83.3–90.9 %) in its height, and 1 to $1\,^{1}/_{4}$ (80–100 %) in its distance from the caudal: ventral inserted nearer to the anal than to the base of the pectoral, not reaching to beneath the dorsal fin; the distance between its origin and the base of the caudal is $1\,^{1}/_{10}$ to $1\,^{1}/_{4}$(83.3–90.9 %) in its distance from the tip of the snout; the middle rays are the longest, 1 ½ to 1 ¾ (57.1–66.7 %) in the length of the head and 2 to 2 ¼ (44.4–50 %) in the distance between its origin and the anal: pectoral cuneiform, $1\,^{1}/_{5}$ to 1 ½ (66.7–83.3 %) in the head and $2\,^{1}/_{8}$ to 2 ⅔ (37.5–47.0 %) in the space between its origin and the ventral: caudal slightly emarginate with the lobes rounded, $1\,^{1}/_{5}$ to 1 ⅓ (75.0–83.3 %) in the length of the head, the peduncle rather slender and compressed, its depth $2\,^{2}/_{5}$ to $3\,^{1}/_{5}$ (31.2–41.7 %) in its length.

Colours variable: from dark greenish brown above and yellowish brown below, the sides with more or less distinct darker markings, which may take the form of irregular transverse bands, or of minute spots, which again may be concurrent so as to form blotches or may be distributed also as to almost obliterate the ground-colour, generally with a more or less well defined series of dark spots along the middle of the body, with the fins shading from yellowish brown basally to orange distally; to golden with regular transverse bands or large blotches of a black or dark chestnut colour, with the fins yellow. Irides silvery.

In addition to the above, the Rev. Mr. Curran tells me that there is in the living fish "over the eye a crescent-shaped area coloured reddish like metallic copper"; that the opercles "are metallic gold and green," and that the sides are irradiated with "peacock hues." ….. .

Distribution: Streams and tarns on Mount Kosciusko and the neighbouring uplands, including the head waters of the Snowy River and its tributary, the Crackenback, where they were obtained by Messers. Curran and Hedley. Later on the former gentlemen obtained specimens from the streams draining the northern and western slopes of

1. The small rod-like rays in front being variable in number are not included, the computation being made from the first normally articulated ray.
2. In the largest example all the fins are rounded except the caudal.

Kosciusko and flowing into the Murrumbidgee. Spawning in February.

Eleven specimens measuring from 63 to 105 millimeters were utilised in drawing up the above description.

Comments

Ogilby's redescription is possibly based on more than one species as exact collecting locations are unknown and a number of species, including *Galaxias olidus* Günther, 1866 and *G. supremus* sp. nov. are also present on Mt. Kosciuszko. Importantly, the redescription may not include *Galaxias findlayi* Macleay, 1882, as some meristic counts are quite high. Consequently the taxonomic value, or significance, of Ogilby's redescription cannot be evaluated without locating and examining his series of fish.

Confusion surrounds the location of the fish Ogilby examined, and he was not specific as to where they were collected. An unknown number of specimens of *Galaxias* were collected by Mr. Richard Helms from streams flowing into the Snowy River, in autumn 1889 and presented to J.D. Ogilby at the Australian Museum. The specimens were not examined and were subsequently lost (misplaced?). In January 1896 two to three specimens were collected by Rev. J.M. Curran and Mr. C. Hedley from Mount Kosciuszko and deposited at the Australian Museum. These were unavailable to J.D. Ogilby as he had been discharged from the Museum by this time. Later in 1896 Rev. Mr. Curran made a second trip to Mount Kosciuszko and collected sixteen specimens, which he gave to J.D. Ogilby to examine. Ogilby also secured an additional 11 specimens afterwards (time frame and collecting location not specified). Therefore, the above redescription is possibly based on a series of 27 specimens, from two collections, though exact collecting localities are unknown (Raadik and Kuiter 2002).

The following specimen lots have been located which are, or are possibly, attributable to Ogilby, and may contain the material he used in his redescription:

- The British Museum collection contains three lots of specimens [digital images seen]: a lot of three fish collected from Mount Kosciuszko (BMNH 1912.3.1.18–20), possibly sent by Ogilby; a lot of 2 fish sent on exchange from the Australian Museum from Mount Kosciuszko (BMNH 1897.10.27.33–34; see Fig. A7a, below); and, a lot of five fish from the 'Australian Alps', also on exchange from the AMS (1905.7.29.12–15). The last two lots were previously examined by Regan (1906).
- Smithsonian Institute Ichthyological Collection has three specimens designated. *Galaxias findlayi*, collected from upland streams of Mt. Kosciuszko, with J.D. Ogilby listed as the collector (USNM 00048823, Acc. No. 033031; see Fig. A7aA, below) [digital images seen].
- The Queensland Museum ichthyological collection contains two lots collected on Mount Kosciuszko (QM I.246 and 9019; see Fig. A7aA, below) [examined]. The two specimens in I.246, collected by J. Ogilby and registered 15/02/1912, are currently in the same jar as the four specimens in I.9019, which were not registered till the 1960s and which may be from the same, or similar, series as I.246.
- The Australian Museum collection contains 5 fish listed as collected by J. Ogilby from Mount Kosciuszko in 1896 (AMS I.3477) [examined], and 3 fish collected in 1895 from the 'Australian Alps' at 1714–2026 m (5500–6500 ft) (AMS I.9290) which were sent on exchange to the Melbourne Museum [sic] (= Museum Victoria) [now lost].

FIGURE A7. Specimens possibly from the series examined b Ogilby (1896): A) *Galaxias* sp. BMNH 1897.10.27.33-4 (British Museum, London); B) *Galaxias* sp. USNM 048823 (S.J. Raredon, Smithsonian Institute); C) *Galaxias* sp. QM I.9019, in same jar as QM I.246 from Mount Kosciuszko collected by J. Ogilby (T.A. Raadik).

APPENDIX 2. Museum collections consulted regarding holdings of Galaxiidae material.
C—Galaxiidae collection examined, E—e-mail correspondence regarding Galaxiidae in collection, I —images of *Galaxias* specimens in collection examined, L—loan of *Galaxias* specimens, O—online institutional collection search for Galaxiidae specimens.

Country, Institute Code, Institution and Interaction
AUSTRALIA
AMS Australian Museum, Sydney—C, L
MMS Macleay Museum, Sydney—E
MQU Macquarie University, Biological Sciences Museum, Sydney—O
NMV Museum Victoria, Melbourne—C
QM Queensland Museum, Brisbane—L, C
SAMA South Australian Museum, Adelaide—L, C
WAM Western Australian Museum, Perth—E, L
NTM Northern Territory Museum and Art Gallery, Darwin—E
TMAG Tasmanian Museum and Art Gallery, Hobart—E
QVMT Queen Victoria Museum and Art Gallery, Launceston—E
AUSTRIA
NMW Naturhistorisches Museum, Vienna—E, I, L
BELGIUM
IRSNB Institut Royale des Sciences Naturales de Belgique, Brussels—O
BRAZIL
MNRJ Universidade do Rio Janeiro, Museu Nacional, Rio de Janeiro—O
CANADA
ROM Royal Ontario Museum, Department of Natural History, Toronto—O
UAMZ University of Alberta Museums, Edmonton, Alberta —O
UBC University of British Columbia, Cowan Vertebrate Museum, Vancouver—O
DENMARK
ZMUC Zoological Museum, University of Copenhagen—O
ENGLAND
BMNH British Museum of Natural History, London—E, I, L, O
FRANCE
MNHN Muséum National D'Histoire Naturelle, Paris—E, I, L, O
GERMANY
SMF Natur-Museum und Forschungs-Institut Senkenberg, Frankfurt-am-Main—O
SMNS Staatliches Museum für Naturkunde, Stuttgart—E, L
ZMB Museum für Naturkunde, Humbolt Universitat, Berlin—E, I
ZMH Zoologisches Institut und Museum, Universitat Hamburg—O
ZSM Zoologi Staatssammlung, Munchen—E
NEW ZEALAND
NMNZ National Museum of New Zealand Te Papa, Wellington—E, L
OM Otago Museum, Dunedin—E
SOUTH AFRICA
SAIAB South African Institute for Aquatic Biodiversity, Grahamstown (formerly **RUSI** J.L.B. Smith Institute of Ichthyology collection)—O
SAM South African Museum, Cape Town (freshwater fish collection on loan to **SAIAB**)—O
SWEDEN
NRM Swedish Museum of Natural History, Stockholm—O
SWITZERLAND
NMBA Naturhistorisches Museum, Basel—O
NMBE Naturhistorisches Museum der Burgergemeinde, Bern—E
USA
AMNH American Museum of Natural History, New York—E
ANSP Academy of Natural Sciences, Philadelphia—O
CAS California Academy of Sciences, San Francisco—E, I, O
CU Cornell University, Museum of Vertebrates, New York—E, I, O
FMNH Field Museum of Natural History, Chicago—O

INHS University of Illinois, Champaign, Illinois—O
KU University of Kansas, Museum of Natural History, Kansas—O
LACM Natural History Museum of Los Angeles County, California—O
MCZ Museum of Comparative Zoology, Harvard University, Massachusetts—E, I, O
SIO Scripps Institution of Oceanography, Marine Vertebrate Collection, California—O
SU Stanford University, California (housed at **CAS**)—O
TNHC Texas Memorial Museum, Texas Natural History Collection, Austin, Texas—O
UF-FSU (FLMNH) Florida Museum of Natural History, University of Florida, Gainesville—O
UMMZ University of Michigan, Museum of Zoology, Ann Arbour, Michigan—O
USNM National Museum of Natural History, Smithsonian Institution, Division of Fishes, Washington—E, I, O
UW University of Washington, College of Fisheries, Washington—O
YPM Yale Peabody Museum of Natural History, Yale University, New Haven—O

APPENDIX 3. Corrections to identifications of museum material examined.

Specimens lots incorrectly identified as *Galaxias olidus* s.l.: NMNZ P.20630, Bellinger River system, NSW = *Galaxias maculatus*; AMS I.19004-001, Wollongong Coast, NSW = *Galaxias brevipinnis*; AMS I.38968-002, Towamba River system, NSW = *Retropinna* sp.; AMS I.17920-001 and AMS I.30377-003, Snowy River system, NSW = *Galaxias brevipinnis*; AMS I.42550-002, Upper Murray system, NSW?; and, NMV A.9980, Broken River system, VIC = *Galaxias brevipinnis*.

Specimen lots re-identified as *G. olidus* s.l.: AMS I.40043-002 Mongarlowe River, NSW; AMS I.400037-001 and 40028-001 Delegate River, NSW; BMNH 1914.8.20.50, Glen Innes, NSW; NMV A.14018 Jamieson River, VIC; NMV A.12200 and NMV A.16289, Upper Murray system; and, NMV A.21286, Jews Harp Creek tributary, VIC.

APPENDIX 4. The number of specimen lots referrable to *G. olidus* s.l. located in Australian and international museums.

Australia—NMV (462), AMS (311), SAMA (46), QM (32), TMAG (1); International—BMNH, England (21), MNHN, France (2), CU, UMMZ and USNM, America (5) and ZMB, Germany (2).

APPENDIX 5. Additional non-type material examined but not measured (see FIGURE 1 for location of Drainage Divisions and River Basins).

***Galaxias arcanus* sp. nov.**

VIC: NMV A.30479-1 (1), Buckwong R, Davies Plain Trk, 16 May 1990; NMV A.30427-1 (4), Lightning Crk, track off Razorback Trk, 30 November 1998; NMV A.16289 (1), Mitta Mitta R, Lords Cutting, 20 May 1992; AMS I.32714-001 (4), Murray R, off Tom Groggin Trk, 22 February 1992; NMV A.10017 (2), Nariel Crk, same location as NMV A.30474-1, 7 March 1978; NMV A.30429-1 (5), Snowy Crk, off Omeo Hwy, 1.5 km upstream Mitta Mitta R, 26 March 1992; NMV A.30538-1 (5), Snowy Crk, Lightning Creek Trk, 25 March 1992; NMV (unreg.) (1), Wheelers Crk, at type locality, 21 May 1997; NMV A.30450-2 (4), Kiewa R, same location as NMV A.30450-1, 25 February 1992; NMV A.30483-1 (3), Buckland R, old bridge on Porepunkah/Mount Buffalo Rd, 4 April 1991; NMV A.30536-1 (2), Buckland R, west brnch, Buckland River Rd, 7 October 1997; NMV A.30465-1 (1), Buckland R, east brnch, access trk off Buffalo River Rd, 20 February 2007; NMV A.10008 (5), Dandongadale R, 1.5 km upstream of Rose R, 9 December 1997; NMV A.30475-1 (1), King R, Edi Cutting, 5 February 1992; NMV A.12471 (2), King R, east brnch, Sandy Flat Trk, 8 April 1978; NMV A.30481-1 (2), Gaffneys Crk, 1 km upstream Goulburn R, 4 April 1981; NMV A.30459-1 (2), Goulburn R, upstream of Yea R, 30 May 1991; NMV A.30473-1 (1), Goulburn R, Lazarini Spur Trk, 14 February 1990; NMV A.30526-1 (2), Howqua R, Tunnel Bend, 31 January 1996; NMV A.(unreg.) (3), Jamieson R, trk to Grannies Flat, 16 April 1997; NMV A.(unreg.) (1), Little R, Little River Rd, 2 March 1999; NMV A.30455-1 (1), Yea R, upstream of Nash's Rd, 14 April 1992; NMV A.30476-1 (2), Yea R, near Island Creek, 14 March 1990.

Galaxias fuscus

VIC: NMV A.4848 (2), Quartz Crk, above falls, at Quartz Creek Rd, 26 January 1980.

***Galaxias gunaikurnai* sp. nov.**

VIC: NMV A.12407 (1), Shaw Crk, trib., Bennison High Plains, 1 December 1962; NMV A.10209 (1), Shaw Crk, Bennison High Plains, June 1960; NMV A.12417 (2), Bennison High Plains, 10 May 1970; NMV A.478 (2), The Valley, Howitt Road, Bennison High Plains, 1 December 1974.

***Galaxias lanceolatus* sp. nov.**

VIC: (10) Stoney Creek, at type locality, 10 November 1998.

***Galaxias olidus* s.s.**

ACT: (IV, 10) AMS I.40677-001 (15), Tanners Flat Crk, 1985; AMS I.36078-001, Queanbeyan, 20 February 1995. **NSW: (II, 03)** AMS I.7419 (3), Richmond R, 1885; BMNH 1905.7.29.24-26 (3), Richmond R; NMV A.7843 (1), Brindle Crk, Brindle Creek Road, Border Ranges N.P., McPherson Range, World Heritage Area, 28 March 1981; **(II, 04)** AMS I.34231-001 (7), Basket Swamp, Boonoo Boonoo State Forest, 25 September 1993; AMS I.38978-001 (3), Blicks R, Armidale Rd, Dundurrabin, 24 January 1995; AMS I.34232-001 (2), Boonoo Boonoo R, top Swimming hole, Boonoo Boonoo Falls, Boonoo Boonoo N.P., 25 September 1993; NMV A.7841 (1), Boundary Crk, Dorrigo/Ebor Rd, 13 September 1981; NMV A.7842 (1), Brimbin Crk, Coramba/Dorrigo Rd, 10 September 1981; AMS I.44213-001 (6), Cataract R, Sandy Hill, 18 February 2004; AMS IB.2755 (1), Clouds Crk, Clouds Creek/Dundurrabin Rd, Clouds Creek, 27 October 1964; NMV A.12620 (4), Cockatoo Crk, 1 km NE of Dundarrabin, on Dundurrabin/Clouds Creek Rd, 27 October 1964; AMS I.43449-001 (1), Guy Fawkes R. The Common, near Ebor, 21 September 2004; NMV A.30626-1 (1), Kalumbundah Crk, Upper Bo Bo Rd, S of Ulong, 9 December 2001; AMS I.29683-006 (31), Karinga Crk, Mountain west of Coffs Harbour, 19 August 1977; CU 72827 (10), Little Murray R, 12 km NE from Dorrigo, 28 April 1991; USNM 00084385 (11), Majors Crk(?), Ebor, 52 miles E from Armidale, 15 February 1921; NMV A.7840 (2), Mann R, at junction with Waratah Crk and Dandahra Crk [doubtful], 3 April 1981; AMS I.41487-002, Morgans Crk, off Morgans Creek Rd, NE of Boorook, 16 April 2002; AMS I.28799-001, Nymboida R, Booma's Farm, 1998; AMS I.38797-001, Nymboida R, 7km SW Bostobrick, 1 July 1991; AMS I.18913-001 (27), Oban R, Ann River, just d/s from Oban, 20 April 1975; AMS I.34233-001 (2), Ropers Gully, trib., Boorook State Forest, 25 September 1993; AMS IB.6332 to 3 (6), Wallaby Crk, Tooloom, 9 December 1962; AMS I.40647-001 (20), Wallaby Crk, 12 km WSW of Urbenville, 1985; AMS I.40660-001 to 002, (43), Mt. Dorrigo, 1985; **(II, 05)** SMNS 5951 (1), AMS I.35608-001 (1), AMS I.35608-006 (1) and AMS I.35727-008 (3), Coffs Harbour, 19 August 1977; AMS I.29683-001 (31), mountains west of Coffs Harbour and Karinga Crk, 9 August 1977; **(II, 06)** QM I.33115 (3), Gara R, Guyra/Ebor Rd, 5 km E of Guyra, 18 March 1990; AMS I.38975-001 (1), Gara R, Herbert Park Rd, Herbert Park, 21 January 1995; NMV (unreg.) (3), Gara R (Ryanda Crk), New England Hwy, N of Llangothlin, 6 December 2001; AMS I.18959-001 (2), Oaky R, Round Mountain drain, 1 October 1975; NMV A.30224-1 (2), Salisbury Waters, Uralla/Walcha Rd, SE of Uralla, 10 December 2001; AMS I.3666 (5), Armidale; BMNH 1914.8.20.77 (1), Guyra; **(II, 07)** NMV A.7844 (1), Fenwicks Crk, Yarrowitch, 23 September 1981; **(II, 12)** AMS I.18993-001 (5), Avon R, below Dam, 10 December 1975; NMV (unreg.) (1), Bowens Crk, Mount Irvine/Bilpin Rd, Blue Mountains, 20 September 2004; NMV A.12430 (28), Cordeaux Crk, 2 miles N of Berrima, Hume Hwy, 18 August 1962; NMV A.10210 (19), Cordeaux Crk, 2 miles N of Berrima, Hume Hwy, 19 August 1962; NMV A.12427 (11), Cordeaux Crk, 2 miles N of Berrima, 25 August 1962; AMS I.6258-001, Cordeaux River; AMS I.36408-009 (5), Coxs R, near River Lett , 25 October 1996; AMS I.36406-005 (1), Coxs R, below Lyell Dam, Lithgow, 25 October 1996; AMS I.39457-001 (1), Coxs R, u/s of Lyell Reservoir, 10 March 1999, NMV A.30232-1 (3), Coxs R, Coxs River Rd, W of Blackheath, 15 June 2001; AMS I.18994-001 (22), Donald's Castle Crk, track, S of Wilton, 10 December 1975; NMV A.27584-1 (13), Farmers Crk, The James Kirkwood Bridge on Coorwull Rd, Lithgow, 14 June 2001; QM I.9018 (7), Lithgow; AMS I.15344-001 (6), Gordon Crk, Gordon Falls, Leura, 12 January 1969; AMS I.19314-001 (1), Gordon Crk, falls below Leura, 1976; AMS IB.4218 (6), Jamieson Crk, Wentworth Falls, 3 February 1959; NMV A.12424 (30), Jaunter Crk, near Jaunter, 23 February 1907; AMS I.40648001 (25), Katoomba Crk, 1985; AMS IA.3589 (57), Megalong Crk, 5 km from Katoomba, 15 January 1928; AMS I.38952-001 (1), creek, Katoomba Falls, on Katoomba Falls Rd, 8 August 1998; AMS IA.3705 (66), Megalong Crk, Blue Mountains, 3 November 1928; AMS IA.3764 (6), Megalong Crk, Blue Mountains, 1929; AMS I.18958-001 (2), Megalong Crk, 29 August 1975; NMV A.30227-1 (10), Middle R, small dam, in military reserve, NE of Marrangaroo, 14 June 2001; AMS I.18997-001 (34), Mittagong Crk, Bowral, 6 January 1976; AMS I.18998-001 (34), Paddys Crk, Penrose, 6 January , 1976; AMS IA.3566 (4), Pulpit Hill Crk, Megalong Valley, 30 October 1927; AMS I.38951-001 (2), Pulpit Hill Crk, Blackheath Glen Reserve, Megalong Rd, 8 August 1998; AMS I.40663-001, Reedy Crk, Bundanoon, 21 November 1984; AMS I.36409-004 (1), River Lett, u/s of Coxs R, 25 October 1996; AMS IB.3707 (1), Thirlmere Lakes (Picton Lakes), SW of Thirlmere, 1957; AMS IB.3724 (2), Thirlmere Lakes (Picton Lakes), SW of Thirlmere, 1957; NMV A.12425 (1), Whites Crk, Moss Vale, 25 August 1962; AMS I.31231-001 (29), Wingecarribee R, anabranch, u/s of Greenstead Homestead, 11 January 1989; AMS I.19172-001 (2), Wollondilly R, Goulburn, 1905; AMS I.15920-001 (1), Wollondilly R, Marsden Weir, Goulburn, 16 February 1971; AMS I.15362-001 (1), Woolshed Crk, 4 miles from Taralga, 26 January 1969; AMS IB.636 (1), Moss Vale (Bongbong);

AMS IA.4657 (1), Blue Mountains, 1930; AMS IA.3561 (1), Katoomba, 1927; **(II, 14)** AMS I.19002-001 (313), Macquarie Rivulet, 7 January 1976; NMV A.7694 (7), Macquarie Rivulet, near Wollongong, January 1984; **(II, 15)** NMV A.12611 (12), Back Creek(?), trib., 3.3 miles from Majors Crk on road to Tallaganda (Berlang Forest Road), 14 November 1965; AMS I.19003-001 (53), Barrengarry R, above Belmore Falls, Belmore Falls Rd, S of Robertson, 8 January 1976; AMS I.18988-001 (2), Bobs Crk, Charleys Forest Rd, NE of Mongarlowe, 25 November 1975; AMS I.25582-001 (1), Bombay Crk, Braidwood/Hoskinstown Rd, near Little Bombay, 13 January 1981; AMS I.18984-001 (380), Boro Crk, Mayfield Rd, N of Mayfield, 23 November 1975; AMS I.18982-001 (24), Currambene Crk, 22 November 1975; NMV A.30230-2 (29), Currambene Crk, Snowball Rd, SW of Krawarree, 20 June 2001; AMS I.40675-001 (30), Durran Durra Crk, 1985; AMS I.18981-001 (32), Fairfield Crk, Krawarre Rd, Fairfield, 22 November 1975; AMS I.19066-001 (18), Feagens Crk, Half Moon Rd(?), N of Mongarlowe, 20 November 1975; AMS I.18990-001 (84), Gillamatong Crk, Braidwood, 26 November 1975; NMV A.30188-1 (45) and NMV A.30188-2 (24), Gillamatong Crk, Boppings Crossing Rd, W of Braidwood, 21 June 2001; AMS I.18980-001 (19), Jerrabattgulla Crk, 22 November 1975; NMV A.30206-1 (30), Jerrabattgulla Crk, Jerrabattgulla Rd, N of Kain, 22 June 2001; AMS I.18865-002 (372), Mongarlowe R, 1 mile d/s of bridge at Charlyong, 18 January /1975; AMS I.18975-001 (4), Mongarlowe R, ear Charleyong, 18 November 1975; AMS I.18976-001 (7), Mongarlowe R, junction with Shoalhaven R, 20 November 1975; AMS I.18978-002 (8), Mongarlowe R, near Mongarlowe, 21 November 1975; AMS I.18991-001 (262), Mongarlowe R, 26 November 1975; AMS I.40043-002 (5), Mongarlowe R, 23 April 1978; AMS I.40028-001 (6), Mongarlowe R, 8 February 1999; AMS I.40040-003 (4), Mongarlowe R, Charleygong, 4 November 1999; NMV A.27590-1 (27), Mongarlowe R, Northangera Rd, S of Mongarlowe, 19 June 2001; NMV A.27578-1 (18), Mongarlowe R, Old River Rd, Monga N.P., 21 June 2001; AMS I.18979-001 (40), Northangera Crk, Kings Hwy, Northangera(?), 21 November 1975; AMS I.18986-001 (95), Reedy Crk, 24 November 1975; NMV A.12511 (9), Reidsdale Crk, Monga La., 2.2 miles E of Araluen/Braidwood Rd, near Reidsdale, 14 November 1965; NMV A.12624 (10), Shoalhaven R, trib., 3.3 miles from Majors Creek on road to Tallaganda, 14 November 1965; AMS I.18976-001 (7), Shoalhaven R, junction with Mongarlowe R, 20 November 1975; AMS I.18985-001 (57), Shoalhaven R, 24 November 1975; AMS I.18987-001 (19), Shoalhaven R, Oallen Bridge, 25 November 1975; AMS I.18989-001 (160), Shoalhaven R, Warri Bridge, Kings Hwy, 26 November 1975; NMV A.11619 (12), Shoalhaven R, Warri Bridge, Kings Hwy, 17 January 1993; **(II, 17)** NMV A.12399 (28), Sheep Station Crk, 11 miles S of Braidwood, 14 November 1965; **(IV, 01)** NMV A.30010-1 (2), Cootapatamba Lake, outlet Mt. Kosciuszko N.P., 9 January 2006; NMV A.30187-1, Hell Hole Crk, Hell Hole Creek Fire Trail, Kosciuszko N.P., 23 March 2005; NMV A.30220-1 (1), Mannus Crk, Tumbarumba/Rosewood Rd, Glenroy, 2 September 2002; NMV A.30397-1 (13), Mannus Crk, Tumbarumba Road SE of Rosewood, 24 March 2005; NMV A.30168-1, Mannus Crk, Tumbarumba Road, SE of Rosewood, 31 March 2008; AMS IB.2763, (1), Murray R, 60 miles u/s from Albury, 12 February 1952; NMV A.9029 (6), Murray R (Indi R), about 10 km from Limestone Crk, on Tin Mine Trk, 9 December 1963; NMV A.7868 (4), Murray R, Cowambat Flat, 1975(?); NMV A.30025-2 (2), Murray R, Cowombat Flat Trk, Cowombat Flat, Alpine N.P., 23 March 2005; AMS I.32712-001 (2), Swampy Plains R, Alpine Way, 26 February 1992; NMV A.30218-1, Swampy Plains R, off Alpine Way, 2 April 2008; AMS I.18891-001 (15), Tooma R, 10 km from Tooma Dam 28 February 1975; AMS I.18890-001 (11), Yellow Bog Crk, 28 February 1975; AMS I.30317-001 (2), Dora Dora (proposed) National Park, near Albury, 15 January 1979; **(IV, 10)** NMV A.12617 (10), Bombowlee Crk, trib., Billapoola Rd, Billapoola State Forest (Billapaloola Forestry Camp, Snowy Mountains), 3 November 1962; NMV A.12683 (23), Burra Crk, (?)Homestead Road, N of Burra (Old London Bridge Rd), 5 December 1961; AMS IB.3819 (4), Cooma Back Crk, Cooma, 18 September 1957; BMNH 1914.8.20.72 (1), Honeysuckle Crk, Tumut; NMV A.12602 (18), Little Peppercorn Crk, Long Plain Rd (Rules Point Rd), above falls, Little Peppercorn Flat, 19 miles south from Brindabella (Post Office), 31 May 1962; NMV A.9915 (3), Little Peppercorn Crk, same loc. as NMV A.12602, 31 May 1967; AMS I.44214-001 (3), Log In Hole Crk, Log In Hole, 14 February 2007; NMV A.30763-1 (1), Mantons Crk, Lucerne Vale Rd, E of Yass, 3 September 2002; QM I.9009 (1), Murrumbidgee R, Gundagai; AMS I.19315-001 (1), Murrumbidgee R, below Narrandera, 1976; AMS IB.754 (10), Murrumbidgee R, Bringagee; AMS IB.3676 (3), Murrumbidgee R, sky tank north of Balranald, 1956; AMS I.44204-002 (1), Murrumbidgee R, Mittagang/Shannons Flat Rd, NNW of Cooma; AMS I.44208-001 (1), Murrumbidgee R, Cooma weir pool, 26 ay 2003; NMV A.12426 (15), Roberts Crk, East Tinderry Fire Trail, Round Flat, 12 December 1961; AMS I.15819-001 (40), Tanners Flat Crk, 1.6 km south of Tidbinbilla, March 1970; AMS I.41312-001 (2), Tarcutta Crk, Taradale Rd, 9 April 2002; NMV A.12621 (12), Towneys Crk, Bredbo/Jerangle Rd, SW of Anembo, 1962; AMS I.18874-

001 (57), Tumut Crk, 11 February 1975; AMS I.21051-001 (1), Tumut State Forest, May 1979; NMV A.12510 (12), 1 mile NE of Kybeyan, 15 November 1965; NMV A.10314 (9), crk 7 miles E of Numeralla, 15 November 1965; **(IV, 11)** NMV A.9898 (11), Lake George, 8 March 1958; BMNH 1914.8.20.73-74 (2), Collector Crk, Collector; AMS IB.3933 (82), Butmaroo Crk (Deep Crk), Bungendore side of lake, 8 March 1958; AMS IB.3378 (1), Turallo Crk (?), small creek at south end, 1955; AMS I.38762-001 (3), Lake George, Lake George, April 1998; **(IV, 12)** NMV A.11644 (11), Abercrombie R, Oberon/Goulburn Rd, near Paling Yards, 17 January 1993; AMS I.44211-001 (8), Abercrombie R, The Levels, 9 November 2006; AMS I.35490-001 (6), Belubula R, Allonby, S of Blaney, 6 December 1994; AMS I.44386-001 (1), Blakneys Crk, Pudmans La., 3 July 2006; NMV A.30766-1 (3), Boorowa R, Scott St, Boorowa, 10 September 2002; AMS I.38965-004 (3), Boorowa R, 24 January 1996; AMS IB.3927 (1), Boree Crk(?), near Cudal, February 1958; NMV A.30765-1 (17), Flyers Crk, Panuara Rd, NW of Eurrowanbang, 9 September 2002; AMS IB.7064 (1), Goobang Crk(?), Parkes, 1964; AMS I.44212-001 (1), Grabbin Gully(?), Upper Grabbin Gully, 6 May 2003; NMV A.30764-1 (2), Kiamma Crk, Saleyards Rd, Crookwell, 3 September 2002; NMV A.30770-1 (4), Lachlan R, Gunning/Crookwell Rd, NE of Gunning, 3 September 2002; AMS I.19043-001 (2), Lachlan R, Narrawa, 10 May 1975; AMS IB.2892 (1) and AMS IB.2893 (6), Lachlan R(?), Condobolin, 1949; AMS I.41332-001 (5), Mandagery Crk, Sullivans Rd, 10 km from Manildra, 22 April 2002; NMV A.30762-1 (9), Milburn Crk, Padua Bridge on Reg Hailstone Way, S of Woodstock, 10 September 2002; AMS I.44387-001 (1), Mulgowrie Crk, Caithness, 3 February 2006; AMS I.35489-002 (6), Retreat R, SE from near Black Springs, 4 December 1994; AMS I.38138-001 (5), Terarra Crk, trib., Nangar National Park, 1 April 1997; AMS I.38137-001 (2), Terarra Crk, Dripping Rock, Nangar N.P., near Eugowra, 27 March 1997; AMS I.19172-001 (2), Goulburn, 1905; **(IV, 16)** AMS IB.3670 to 3671 (3), Beardy R, 1956; AMS I.44435-002, Bluff R, Craignook Causeway, on Bluff River Rd, 7 April 2005; QM I.33113 (1), Bluff R, 17 km S of Tenterfield at New England Hwy, 19 March 1990; AMS I.19032-001 (88), Camerons Crk, Strathbogie Rd, NW of Glen Innes, 16 March 1976; AMS IB.3163 (2), Crooked Crk, off Bruxner Highway, 38km E of Tenterfield, 21 December 1953; AMS I.17925-001 (21), Crooked Crk, off Bruxner Hwy, 38km E of Tenterfield, 5 July 1974; QM I.33114 (7), Deepwater R, New England Hwy, near Deepwater, 19 March 1990; BMNH 1914.8.20.50 (1), Rocky Ponds Crk(?), Glen Innes; NMV A.10477 (1), Severn R, New England Hwy, Dundee, 6 April 1991; AMS I.18912-001 (3), Swan Brook, Kings Plains Rd, NE of Inverell, 17 April 1975; AMS I.3730, Tenterfield Crk, 1898; NMV A.11060 (8), Tenterfield Crk, Washpool Creek Rd, N of Tenterfield, 8 October 1991; **(IV, 18)** AMS I.24666-001 (10), Abington Crk, farm dam, 18 miles NW of Armidale, 1 April 1971; AMS I.18963-001 (128), Back Crk, 3 October 1975; NMV A.30605-1 (1), Boorolong Crk, off Boorolong Rd, NW of Black Mountain, 18 March 2008; NMV A.30769-1 (4), Tea Tree Crk, Armidale/Bundarra Rd, W of Armidale, 5 December 2001; NMV A.30772-1 (22), Toms Crk, Warrane Rd, W of Warrane, 5 December 2001; AMS IB.3686 (1), Kentucky, N. Line, 1957; **(IV, 19)** AMS IB.7908 (3), Black Mountain Crk, below Mt Coryah, Mount Kaputar N.P., 13 May 1967; NMV A.30760-1 (3), Burrows Crk, Nowendoc/Nundle Rd, u/s of Burrows Falls, 14 September 2003; AMS I.41334-003 (2), Greenhatch Crk, Coates La., SE of Manilla, 23 April 2002; AMS I.18962-001 (5), Iron Bark Crk(?), East of Barraba, 3 October 1975; NMV A.8178 (1), MacDonald R, Bendemeer, 30 April 1981; AMS IB.6677 (1), Namoi R, Manilla, November 1957; AMS IB.755 (2), Namoi R, junction with Barwon River, Walgett, 1919; AMS IB.757, Namoi R, junction with Barwon River, Walgett; NMV A.30773-1 (1), Rocky Gully, New England Hwy, NE of Bendemeer, 4 December 2001; NMV A.30756-1 (2), Spring Crk, Attunga/Halls Creek Rd, 4 December 2001; **(IV, 20)** AMS I.40347-002 (6), Shawns Crk, off road to telescope, W of Coonabarabran, 19 November 1999; **(IV, 21)** AMS I.18974-001 (2) and AMS I.18996-001 (5), Campbells R, trib., 2 November 1975; NMV A.10533 (23), Cudgegong R, Gulgong/Mudgee Rd, Galambine, 11 October 1990; BMNH 1914.8.20.69-71 (3), Cudgegong R, Rawdon, Rylstone; AMS IB.3278 (1) and AMS I.13459 (1), Cudgegong R, Rylstone, 18 December 1911; AMS IB.756 (6), Cudgegong R, Rawdon, Rylstone, 18 December 1911; NMV A.11614 (2), Cudgegong R, Rylstone, 17 January 1993; AMS IA.6367 to 8 (5), Duckmaloi R, trib., 1935; AMS I.35486-001 (7), Duckmaloi R, Edith, 3 December 1994; AMS I.17287-001 (8), Fish R, Oberon, 1973; AMS I.27497-001 (1), Fish R, Oberon, 1988; NMV A.30759-1 (11), Grattai Crk, Hargraves Creek Rd, SW of Mudgee, 9 September 2002; AMS I.18937-002 (4), Jews Crk, Molong/Cumnock Rd, NW of Molong, 12 June 1975; NMV A.10537 (3), Macquarie R, near Great Western Hwy, Bathurst, 10 November 1990; NMV A.30768-1 (6), Macquarie R, Ranen Bridge, Bathurst, 6 September 2002; AMS I.20686-001 (14), Molong Crk, Lake Canobolas, Canobolas, 3 August 1972; NMV A.30771-1 (4), Pyramul Crk, Hargrave/Hill End Rd, S of Hargrave, 9 September 2002; AMS I.18899-001 (17), Rocks Crk, Mitchell Hwy, W of Bathurst, 31 March 1975; AMS I.37848-001 (1), Rocky Ponds Crk, Goobang N.P., 6 March

1997; NMV A.30776-1 (8), Stony Crk, The Bridle Trk, N of Bathurst, 6 September 2002; NMV A.24912-4 (1), Turon R, The Bridle Trk, S of Hill End, 4 December 2003; AMS I.38944-001 (7), Turon R, Hill End Rd, W of Sofala, 18 January 1996; AMS I.38503-001 (11), Turon R, 6 km SSW of Capertee, 2 December 1997; NMV A.30774-1 (15), Turon R, off Upper Turon Rd, E of Sofala, 7 September 2002; AMS I.14375 (39), Yetholme, near Bathurst, March 1918; AMS IB.1355 (7), Yetholme, near Bathurst (near Molybdenite mines), 1944; AMS IB.3899 (1), Molong, 1957; AMS I.17893-001 (1), Orange, June 1966; AMS IB.7579 (9), Orange area(?), 1966. **QLD: (IV, 16)** QM I.10190 (1), Accomodation Crk, trib.(?), Wyberba, in cave 7 January 1972; AMS I.11494 (3), AMS I.11495 (3), AMS I.11496 (3), AMS I.11497 (3) and AMS I.11498 (3), Accomodation Crk, Wallangarra, June 1911; AMS I.11161 (1), Accomodation Crk, Wallangarra, 1910; QM I.7708 (6), Accomodation Crk, Wallangarra, 24 September 1946; AMS I.12440 to 12448 (9), Accomodation Crk(?), Lyra 1912; QM I.18418 (1), Bald Rock Crk, Girraween N.P., 26 November 1980; QM I.26561 (1), McKenzie Crk, Eukey, 16 April 1990; QM I.12848 (1), Paling Yard Crk, track in Girraween N.P., E of Lyra, 19 April 1972; QM I.31470 (3), Racecourse Crk, E brnch, SW of Girraween N.P., 21 October 1999; QM I.4668 to 4677, Severn R(?), Stanthorpe, 12 May 1930; QM I.4673 to 4677 (4), Stanthorpe, 13 June 1930; **(IV, 22)** QM I.18418 (1), Bald Rock Crk, Girraween N.P., 26 November 1980; AMS I.40348-001 (40), Browns Crk, road to Queen Mary Falls, u/s of Killarney, 26 November 1999; AMS I.40334-001 (31), Condamine R, eighth crossing on Condamine River Rd, u/s of Killarney, 26 November 1999; QM I.11835 (4), Dalrymple Crk, Goomburra, near Warwick, 11 October 1956; QM I.20633 (4), Dalrymple Crk, N brnch, near Goombura, Goomburra Forest, 27 November 1983; QM I.13285 (14), Farm Crk, near Kilarney, 22 June 1975; QM I.20943 (6), Farm Crk, Bald Mountain, 21 April 1984; QM I.33105 (1), Farm Crk, Yangan/ Killarney Rd, Tannymorel, 20 March 1990; NMV A.11643 (10), Farm Crk, same loc. as QM I.33105, 5 April 1991; QM I.26561 (1), McKenzie Crk, Eukey, near Stanthorpe, 16 April 1990; QM I.12848 (1), Paling Yard Crk, Girraween, 19 April 1972; QM I.31470 (3), Racecourse Crk, E brnch, SW Girraween N.P., 20 January 1999; QM I.32656 (1) and QM I.32538 (1), Spring Crk, road crossing west of Teviot Gap, 19 October 2000; AMS I.33777 to 8, Goomburra, Warwick District; AMS IB.3777 to 8 (4), Warwick District, 1957; QM I.4673 to 7 (5), Stanthorpe, 13 June 1930; QM I.7708 (6), Wallangarra, 24 September 1946. **SA: (IV, 26)** SAMA F.7475 (23), Finnis R, John Bradford's dairy, 3 February 1992; SAMA F.6974 (1), McHargs Crk, trib., between Meadows and Strathalbyn, December 1978; SAMA F.7451 (18), Meadows Crk, 14 October 1993; SAMA F.10108 (30), Murray R, Point Macleay Jetty, 22 March 1886; SAMA F.10269 (8), Nangkita Crk, Willowbend Rd, Willowbend, 27 March 2004; SAMA F.5040 (2), Yundi, 27 February 1983; AMS I.8 (2), Mount Compass, 1886; SAMA F.3585 (1), Bungala R (?), Normanville May 1963; **(V, 01)** NMV A.14148 (14) and AMS I.34819001 (15), Yankalilla R, Parawa Rd, near Torrens Vale, 30 April 1994; **(V, 02)** SAMA F.3585 (1), Normanville, May 1963; NMV A.14131 (1) and AMS I.34820-001 (2), Myponga R, Dodd Rd, N of Pages Flat, 30 April 1994; SAMA F.3558 (5), Myponga R, upstream of reservoir, March 1964; **(V, 03)** SAMA F.3560 (10), Aldgate Crk, trib., near Aldgate(?); AMS I.34808-001 (9) and NMV A.14145 (11), Cock Crk, W brnch, Swamp Rd, near Lenswood, 23 April 1994; SAMA F.7796 (3), Cox Crk, Bridgewater Mill, off Mount Barker Rd, Bridgewater, 20 January 1996; NMV A.14137 (2) and AMS I.34810-001 (2), Inverbrackie Crk, Woodside/Nairne Rd, near Woodside, 23 April 1994; NMV A.14132 (6), AMS I.34809-001 (7), Onkaparinga R, W brnch, Western Branch Rd, NW of Woodside, 23 April 1994; SAMA F. 3743 (23), overflow of pool of a dam, Forest Range, (registered) January 1974; NMV A.14136 (10) and AMS I.34807-001 (9), Camac Rd, near Balhannah, 23 April 1994; NMV A.14155 (3) and AMS I.34806-001 (3), Beaumont Rd, NE of Verdun, 23 April 1994; **(V, 04)** SAMA F.7260 (11), Brownhill Crk, 19 December 1992; SAMA F.1112 (42), Brownhill Crk, 1928; NMV A.14149 and AMS I.34805-001, Fifth Crk, near Mautacute and Marble Hill Rds, 23 April 1994; SAMA F.1112 (42), Fifth Crk, 1928; SAMA F.1109 (48), First Crk, Waterfall Gully, 16 November 1928; NMV A.14127 (6) and AMS I.34794-001 (6), First Crk, Waterfall Gully Rd, 27 February 1994; SAMA F.1117, Fourth Crk, Morialta Falls, ?Glen Stuart, 1928; SAMA F.7259 (28), Fourth Crk, Morialta, 9 December 1992; NMV A.14124 (6) and AMS I.34798-001 (6), Millers Crk, Checker Hill Rd, N of Gumeracha, 4 April 1994; SAMA F.1108 (15), Minnow Crk, upstream of reservoir, Belair NP, November 1928; SAMA F.113 (28), Second Crk, Slapes Gully Rd, Stonyfell, 18 January 1894; NMV A.9908 (2), Sixth Crk, trib., 22 November 1966; SAMA F.3559 (67), Sturt R, Sturt Gorge; AMS IA.6 (13), Sturt R, Adelaide, 1920; SAMA F.? (15), Sturt R, 1896; SAMA F.7473 (1), Torrens R, Windsor Gardens, 4 March 1882; SAMA F.4917 (1), creek east of Mount Lofty, near Stirling; BMNH 1905.7.29.29-30 (2), Adelaide; USNM 00087368 (13), Adealide, 28 February 1920; **(V, 13)** SAMA F.1115 (1), Kangaroo Island, 1883; **VIC: (II, 23)** NMV A.7867 (11), Stony Crk, Nunniong Rd, Nunniong State Forest; **(IV, 01)** NMV A.30226-1 (4), Benambra Crk; NMV A.10308 (1), Bethanga; NMV A.29967-1 (3), Bluff Crk, Bluff Crk falls, Burrowa-Pine N.P., 17 March 2002; NMV A.9829 (6), Bulley Crk, Tin Mine Track, 19 February 1963; NMV A.9854 (7), Bulley Crk, Cowombat Flat Trk (Tin Mine Hut Rd), Cobberas Wilderness Area; NMV A.30668-1 (1), Bulley Crk, above falls, u/s of Murray R, 16 December 1997; NMV A.484 (9), Charlie Crk, Charlies Creek Plain, along Davies Plains Rd, 11 October 1975; NMV A.12409 (9), Cobungra R, 1 mile SE of Mount Loch, NE of Mount Hotham, 10 May 1962; NMV A.11681 (29), Cottontree Crk, off Webb Lane, 27 March 1990; NMV A.11694 (25), Cudgewa Crk, trib., Dogman Trk, 28 May 1990; NMV A.491 (3), Davies Plain Crk, Kings Flat, Davies Plain, 31 January 1975; NMV A.12428 (12), Davies Plain Crk, Davies Plain; NMV A.12685 (6), High Plains Crk, above aqueduct near Mt Jim, Bogong High Plains, 11 January 1963; NMV A.11703 (68), Jimmey Crk, Mount Lawson Trk (Wallaces Rd), 29 May 1990; NMV A.11692 (3), Jones Crk, u/s junction with Burrowye Crk, 29 March 1990; NMV A.30171-1 (7), Koetong Crk, Mount Lawson Rd, 11 September 2002; NMV A.12605 (11), Middle Crk, near Langfords Gap, Bogong High Plains, 7 April 1962; NMV A.10307 (6), Middle Crk, 5.5 km W of Omeo, 4 December 1965; NMV A.30003-1 (1), Middle Crk, trib., Bogong High Plains, Alpine N.P., 18 February 2003; NMV A.11704 (69), Pine Mountain Crk, off Pine Mountain Rd, d/s of falls, 30 May 1990; NMV A.30163-1 (4), Reedy Crk, E brnch, off Black Jack Trk, 20 May 1997; NMV A.481 (4), Rough Crk, trib., Davies Plain Trk, King Flat, 10 January 1975; NMV A.479 (3), Sandy Crk, 5.4 miles along Limestone Rd (Beloka Rd) from Benambra, 8 January 1975; NMV A.11707 (26), Stockyard Crk, Stockyard Creek Trk, S of Thologolong, 29 May 1990; NMV A.11682 (6), Stony Crk, Dogman Trk, W of Cudgewa North, 28 May 1990; NMV A.12612 (2), Stony Crk, trib., Cowombat Flat Trk (Tin Mine Trk), 9 December 1961; NMV A.10240 (2), Stony Crk, 4.8 miles E of Limestone Crk, Cowombat Flat, 18 February 1963; NMV A.9820 (9), Cowombat Flat Trk, 18 February 1963; NMV A.30165-1 (14), Stony Crk, Cowombat Flat Trk, Alpine N.P., 16 April 2002; NMV A.30185-1 (6), Tallangatta Crk, off Tallangatta Crk Rd near Mt. Cravensville, 8 February 1993; NMV A.30167-1, Walwa Crk, off Shelley/Walwa Rd, u/s Walwa, 29 March 2005; NMV A.11683 (26), Whiteheads Gap Rd, Towong Upper, 15 May 1990; NMV A.12431 (8), 8 km from Omeo on the road to Hotham, 10 January 1963; NMV A.7855 (9), 16 miles SW of Walwa, 3 October 1964; **(IV, 02)** NMV A.30231-1 (4), Back Crk, Back Creek Rd, S of Yackandandah, 13 November 1997; NMV A.11690 (135), Cherry Tree Crk, trib., Ben Valley La., SE of Yackandandah, 31 May 1990; NMV A.30110-1 (3), Cherry Tree Crk, track off Ben Valley La., SE of Yackandandah, 13 November 1997; NMV A.10418 (2), Cope Crk, near Cope Trk, Bogong High Plains, 13 December 1962; NMV A.12517 (10), Cope Crk, Pretty Valley, Bogong High Plains, 7 September 1962; NMV A.10312 (8), Cope Crk, Pretty Valley, Bogong High Plains, 25 February 1963; NMV A.10373 (25), Cope Crk, Pretty Valley, Bogong High Plains, 24 March 1963; NMV A.10309 (6), Cope Crk, near Cope Track, Bogong High Plains, 18 December 1967; NMV A.10379 (4), Cope Crk, pool near top, 11 February 1968; NMV A.10433 (29), Cope Crk, Bogong High Plain, 24 February 1971; NMV A.12469 (17), Cope Crk, Alpine Walking Track, near Mount Cope, 20 February 1978; NMV A.10318 (11), Cope Crk, trib., near Mount Cope, Bogong High Plains, 20 March 1978; NMV A.10375 (8), Diamantina R, off walking track off Great Alpine Road, 0.5 km north of old Diamantina Hut, Mount Hotham, 8 May 1962; NMV A.12676 (17), Grandaddy Crk, Pretty Valley, 7 May 1962; NMV A.10315 (5), Grandaddy Crk, Pretty Valley, 25 March 1963; NMV A.30197-1 (1), McKay Crk, trib., off track, Falls Creek, Bogong National Park, 19 January 1994; NMV A.12416 (4), Morgan Crk, trib., approx. 4 km (2.5 miles) SW of Kancoona South, 18 January 1966; NMV A.10313 (22), Mount Cope Crk, Pretty Valley, Bogong High Plains, 26 February 1963; NMV A.30186-1 (2), Nelse Crk, trib., off Big River Firetrail, Bogong High Plains, 2 February 1994; NMV A.12473 (3), Pretty Valley Crk, Pretty Valley (gauge), 9 July 1962; NMV A.10376 (2), Pretty Valley Crk, Pretty Valley pumping station, Bogong High Plains, 14 August 1962; NMV A.12514 (3), Pretty Valley Crk, Pretty Valley pumping station, 11 January 1963; NMV A.12508 (12), Pretty Valley Crk, 2 miles S of Mount McKay, Bogong High Plains, 24 February 1971; NMV A.30175-1 (1), Tawonga Hut Crk, Tawonga Hut, on Fainter Fire Trail, Alpine National Park, 18 March 2003; NMV A.12679 (23), SE side of Rocky Valley Dam, Bogong High Plains, 19 January 1966; **(IV, 03)** NMV A.7865 (45), Boulder Crk, trib., 1 mile SW of the Tatra Hut Inn, Mt. Buffalo N.P., 7 May 1967; NMV A.7859 (6), Buffalo Crk, Mount Buffalo, 24 April 1978; NMV A.12623 (2), Hospice Crk, 0.25 miles (400 m) SW of Mount Smythe, 10 May 1962; NMV A.22483-2 (1), King R, anabranch, King Valley Rd, Cheshunt, 17 May 2001; NMV A.30196-1 (6), King R, W brnch, DSM Rd, u/s of King Falls, 17 April 1997; NMV A.10271 (5), King R, trib., W brnch, DSM Rd, 29 May 1990; NMV A.9996 (7), Middle Crk, Madhouse Rd, N of Toombullup, 16 January 1989; NMV A.30190-1 (1), Mine Crk, Mine Creek Rd, 19 April 1994; NMV A.30189-1 (13), Simmons Crk, Harrietville, u/s water supply weir, 15 November 1994; NMV A.12614 (2), Stockyard Crk, off Top Crossing Trk, 26 November 1967; NMV

A.7866 (6), Stony Crk, d/s of Big Paradise Falls, S of Cheshunt, 29 October 1975; NMV A.7861 (6), Stony Crk, trib., Paradise Falls Road, S of Cheshunt, 29 October 1975; NMV A.9844 (4), near Bright, 11 July 1906; NMV A.7860 (2), 6.1 miles from Hotham turnoff at Harrietville, along west branch of Ovens River; NMV A.12622 (20), Bright; NMV A.9826 (1), Whitfield; **(IV, 04)** NMV A.10354 (6), Bridge Crk, Mansfield/Whitfield Rd, u/s of Bridge Creek, 18 December 1989; NMV A.10299 (8), Broken R, trib., Midland Hwy, N of Lima South, 29 May 1990; NMV A.20416 (15), Five Mile Crk (Baddaginnie Crk), D Rd, Warrenbayne Pine Plantation, E of Boho South, 30 May 1994; NMV A.10514 (5), Hollands Crk, trib., Mansfield/Whitfield Rd, Tolmie, 13 February 1990; NMV A.10269 (4), Hollands Crk, off Mansfield/Whitfield Rd, 29 May 1990; NMV A.30177-1 (11), Middle Crk, Madhouse Rd, N of Tolmie, 18 March 1997; NMV A.10729 (1), Sam Crk, Molyullah/Tatong Rd, NW of Molyullah, 7 October 1990; NMV A.10275 (8), Samaria Crk, trib., Schoolhouse Rd, Samaria, 5 May 1990; NMV A.30048-1 (27), Samaria Crk, trib., ford adjacent to picnic ground, off Mount Samaria Rd, E of Lima South, 20 March 1997; NMV A.30140-1 (7), Samaria Crk, Browns Rd, Mount Samaria State Park, 27 June 2002; NMV A.10239 (6), Watchbox Crk, Watchbox Creek Rd, S of Molyullah, 24 February 1990; NMV A.30142-1 (21), Watchbox Crk, Triangle Rd, SE of Tatong, 19 March 1997; NMV A.10736 (5), at Yin Barun Rd, Yin Barun, 8 October 1990; **(IV, 05)** NMV A.30121-1 (3), Ault Beeac Crk, Ingram Rd (Ault Beeac Rd), 13 October 1999; NMV A.30191-1 (4), Ault Beeac Crk, same loc. as NMV A.30121-1, 23 May 2001; NMV A.30126-1 (7), Bakers Crk, Buttercup Jeep Trk, 17 March 1997; NMV A.7699 (1), Boggy Crk, Glenburn, 8 January 1989; NMV A.9352 (26), Chryser Crk, Arthurs Rd, 24 April 1990; NMV A.10518 (9), Dabyminga Crk, Broadford/Flowerdale Rd, Tyaak, 11 February 1990; NMV A.16278 (4), Falcon Vale Crk, Falcon Vale homestead, 11 May 1993; NMV A.7945 (15), Godfrey Crk, junction with Raspberry Crk, 1 June 1986; NMV A.29966-1 (7), Howqua R, trib., off unnamed track, Alpine N.P., 15 May 2001; NMV A.8621 (5), Jerusalem Crk, Mallet's Creek Trk, 19 November 1989; NMV A.10283 (16), Little R, Blue Range Rd, 7 June 1990; NMV A.12606 (2), Little Steavenson R, Buxton, 3 December 1965; NMV A.30024-1 (2), Mill Crk, Mill Creek Rd, 5 March 1997; NMV A.7872 (2), Old Hut Crk, 18 November 1976; NMV A.30131-1 (7), Raspberry Crk, A1 Mine Settlement Weir, 1 May 2000; NMV A.30669-1 (26), Raspberry Crk, junction with Godfrey Crk, N of Woods Point, 8 April 2003; NMV A.10412 (22), Reedy Crk, trib., Flowerdale Rd, 17 January 1966; NMV A.9906 (9), Reedy Crk, near Broadford; NMV A.30018-1 (10), Reedy Crk, Reedy Creek Rd, South Reedy Creek, 14 August 2002; NMV A.12411 (23), Scrubby Crk, 2 dams, near Alexandra, 6 May 1962; NMV A.30005-1 (3), Scrubby Crk, Boundary Rd, Black Range State Forest, 3 March 1997; NMV A.30050-1 (12), Scrubby Crk, Wherretts Trk, off Black Range Rd, 23 May 2001; NMV A.7869 (5), Seven Crks, 18 November 1977; NMV A.8286 (60), Seven Crks, 25 January 1978; NMV A.30169-1 (7), Seven Crk, 7 March 1968; NMV A.30198-1 (1), South Crk, dam, Granton Rd, Granton, 7 September 1992; NMV A.8198 (25), Springs Crk, trib., dam Yelland Trk, between Oaks Trk and Saint Clair turnoff , 16 August 1986; NMV A.13906 (9), Steavenson R, trib., off Retreat Rd, SE of Buxton 14 January 1994; NMV A.13477 (2), Steavenson R, trib., off Olsen Rd, u/s of falls, 14 December 1991; NMV A.10523 (1), Strath Crk, at Strath Creek, 11 February 1990; NMV A.7853 (125), Strath Crk, falls, 5 miles SSW of Strath Creek, 1 January 1966; NMV A.10302 (7), Strath Crk, above Murchison Falls, 17 November 1973; NMV A.30074-1 (3), Tin Crk, Mill Creek Rd, 3 km W of Buxton, 4 March 1997; NMV A.12619 (12), Watch Box Crk, 11 May 1977; NMV A.10377 (26), Watch Box Crk, u/s of falls, 13 January 1978; NMV A.9836 (28), Watch Box Crk, Strathbogie Ranges, above waterfall, 12 April 1978; NMV A.30228-1 (2), near Ghin Ghin, December 2000; **(IV, 06)** NMV A.12474 (9), Campaspe R, January 1940; NMV A.12512 (1), Five Mile Crk, Kyneton, 24 October 1963; NMV A.30670-1 (3), Five Mile Crk, Calder Highway, Woodend, 16 September 1999.

***Galaxias oliros* sp. nov.**

NSW: NMV A.13146 (1), Coppabella Crk, Coppabella Rd (Maginnitys Gap Rd), Coppabella, 22 December 1992; NMV A.13159 (1), Home Flat Crk, end track on private property, off River Rd, Dora Dora, 21 December 1992; NMV A.30416-1 (2), Horse Crk, Jingellic/Ournie Rd, Jingellic, 21 September 2004; NMV A.12200 (5), Horse Crk, off track, NE of Jinjellic, 22 December 1992; NMV A.13151 (3), Jingellic Crk, River Rd, W of Jingellic, 22 December 1992; NMV A.13160 (2), Lankeys Crk, Lankeys Creek Rd, Lankeys Creek, 22 December 1992; NMV A.30414-1 (1), Ournie Crk, Jingellic/Ournie Rd, Ournie, 21 September 2004; NMV A.13150 (12), Seven Mile Crk, River Rd, Talmalmo, 21 December 1992; NMV A.13155 (7), Wagra Crk, Bowna/Wymah Rd, N of Wymah, 21 December 1992; NMV A.11045 (3), Murray R, Red Bank Beach, off Murray Trk, 10 January 1991. **SA:** AMS I.34816-002 (1), Angas R, South Terrace (Callington/Goolwa Rd), Strathalbyn, 25 April 1994; AMS I.34812-001

(4), Angas R, Searle Street, Macclesfield, 25 April 1994; NMV A.30376-1 (2), Currency Crk, Victor Harbor Rd, S of Mount Compass, 18 May 2002; NMV A.14133 (1) and AMS I.34821001 (2), Currency Crk, Sneyd Rd, upstream of Mosquito Flat 14 May 1994; SAMA F.9269 (1), Dawson Crk, Dog Trap Rd, W of Strathalbyn, May 1999; SAMA (unreg.) (1), Middle Crk, Paris Creek Rd, Strathalbyn, 23 January 1989; SAMA F.9332 (3), Mount Barker Crk, Mount Barker, 10 January 2000; SAMA F.7461 (13), Angas R, near Flaxley, 8 October 1993; SAMA F.1110 (22), Scotts Crk, Dawesley, March 1887. **VIC:** NMV A.9918 (4), Woady Yaloak R, Cape Clear, SW of Ballarat, 14 May 1964; NMV A.30558-1 (1), Hopkins R, Warrak Road, E of Ararat, 6 June 2002; NMV A.30291-1 (3), Spring Crk, Bromfields La., Woolsthorpe, 20 November 1996; NMV A.10630 (3), Moyne R, Moyne Falls/Hawkesdale Rd, W of Hawksdale, 10 October 1989; NMV A.30660-1 (6), Sunday Crk, Noskes Rd, 10 May 1999; NMV A.30276-1 (1), Branch Crk, Bullawin Road, Grampians NP, 13 May 1999; NMV A.7943 (5), Crawford R, trib., Blackwoods Rd, Hotspur, 20 February 1986; NMV A.30269-1 (5), Cultivation Crk, Harrop Trk, Grampians NP, 2 May 1996; NMV A.8177 (3), Dwyer Crk, Grampians Rd (Halls Gap/Dunkeld Rd), 35km SSW of Halls Gap, 26 May 1982; NMV A.30657-1 (4), Dwyer Crk, J. Pearson Rd, 14 May 1999; NMV A.12509 (2), Gap Crk, Bullawin Rd, 12 August 1974; NMV A.7944 (17), Honeysuckle Crk, Harrop Trk, Grampians NP, 30 March 1986; SAMA F.5709 (1), drain from Moora Moora Res., 9 December 1981; NMV A.10384 (1), Moora Moora Crk, Rosea Trk, 8 August 1974; NMV A.13120 (15), No. 1 Crk, off Harrops Trk, 12 August 1974; NMV A.13118 (6), Rose Crk, Burrong (Rose Creek) Falls, off Rose Creek Rd, 7 August 1974; NMV A.12412 (9), Scott Crk, Harrops Track, Grampians NP, 22 April 1964; NMV A.21277 (9), Stokes R, Portland/Casterton Rd, N of Digby, 7 January 2000; SAMA F. 6867 (20), S of Brimbool, Glenelg Hwy, 23 February 1990; NMV A.21303 (22), Wannon R, Victoria Valley Rd, N of Dunkeld, 6 January 2000; NMV A.11709 (1), Biggara Crk, track off Werrits Trk, W of Biggara, 15 May 1990; NMV A.11697 (5), Kangaroo Crk, track off Hindleton Rd, NNE of Bullioh, 29 May 1990; NMV A.30386-1 (1), Koetong Crk, off Running Creek Rd, Mount Lawson State Park, 17 May 1995; NMV A.30310-1 (2), Mitta Mitta R, Peters Bridge on Omeo Hwy, NE of Tallandoon, 17 March 2008; NMV A.30272-1 to 5, (10), Thowgla Crk, South Hamiltons La., NE of Corryong, 31 March 2005; NMV A.11702 (76), Basin Crk, off Basin Creek Rd, NE of Yackandandah, 31 May 1990; NMV A.30409-1 (1), Flaggy Crk. Wodonga/Dederang Rd, Bruarong, 25 June 2002; NMV A.11705 (7), Gap Crk, Lumby La., W of Kergunyah, 1 June 1990; NMV A.30301-1 (1), Kiewa R, South of Kergunyah South, 9 March 2006; NMV A.10458 (22), Yackandandah Crk, Alans Flat Rd, NE of Yackandandah, 8 April 1962; NMV A.12677 (13), Burgoigee Crk, Alpine Way, approx. 27.7 km SE of Wangaratta, N of Whorouly, 6 December 1963; NMV A.8928 (4), Fifteen Mile Crk, Wangaratta/Kilfeera Rd, E of Greta South, 30 November, 1989; NMV A.9124 (2), Hurdle Crk, upstream from Carboor Upper, 27 March 1990; NMV A.9774 (2), Reedy Crk, Rankines Rd, off Beechworth/Wodonga Rd, Wooragee, 8 April 1962; NMV A.30296-1 (1), Scrubby Crk, Lake Buffalo/Carboor Rd, Carboor East, 26 June 2002; NMV A.10264 (6), Baddaginnie Crk (Five Mile Crk), Terrett Rd, 29 April 1990; NMV A.10249 (7), Blue Range Crk, Blue Range Rd, N of Bridge Creek, 18 December 1989; NMV A.10250 (7), Boosey Crk, Thoona, 24 February 1990; NMV A.10214 (5), Broken R, bridge near Bridge Creek, 18 December 1989; NMV A.10643 (1), Broken R, Shepparton, 28 April 1990; NMV A.9347 (1), Broken R, downstream from Gowangardie Weir, 3 March 1990; NMV A.10641 (8), Castle Crk, Castle Hill Rd, NNE of Swanpool, 5 May 1990; NMV A.10642 (3), Five Mile Crk (Baddaginnie Crk), Macks Rd, ESE of Baddaginnie, 29 April 1990; NMV A.20412 (1), Five Mile Crk (Baddaginnie Crk), off Davies Road, 27 May 1994; NMV A.10350 (5), Moonee Crk, Swanpool/Lima Rd, W of Swanpool, 18 December 1989; NMV A.10324 (5), Parkes Crk, Lima Road, 5 May 1990; NMV A.10248 (5), Sam Crk, Odea Rd, Molyullah, 24 February 1990; NMV A.10640 (1), Swanpool Crk, Castle Hill Rd, E of Swanpool, 5 May 1990; NMV A.10653 (5), unnamed, tributary, at Swanpool Rd, 7 October 1990; NMV A.30417-1 (1), Benalla L., bottom end of lake, 31 January 2001; NMV A.10252 (5), Boggy Crk, near Glenburn, 28 January 1990; NMV A.13514 (3), Castle Crk, Murchison/Violet Town Rd, 18 September 1993; NMV A.7990 (65), Creightons Crk, Mansfield Rd, 18 April 1985; NMV A.10235 (1), Falls Crk, Goulburn Valley Hwy, 11 February 1990; NMV A.10516, Katy Crk, Melba Hwy, 28 January 1990; NMV A.30375-1 (1), Kurkurac Crk, Willowmavin Rd, W of Kilmore, 12 August 2002; NMV A.10257 (6), Limestone Crk, near Turnbull Hill, 28 January 1990; NMV A.8620 (2), Major Crk, South Costerfield/Graytown Rd, , SW of Graytown, 24 November 1989; NMV A.30124-1 (1), Merton Crk, Merton/Strathbogie Rd, E of Merton, 13 August 2002; NMV A.10247, Mill Crk, Upper Goulburn Rd (Tallarook/Trawool Rd), E of Tallarook, 11 February 1990; NMV (unreg.), (3), Mollison Crk, Racecourse La., SE from Pyalong, 8 June 1989; NMV A.8287 (70), Old House Crk, at Old House Creek, 16 February 1978; NMV A.10510 (5), Pheasant Crk, Yea Rd, 11 February, 1990; NMV A.30369-1 (2), Pranjip Crk, Geodetic Rd, Longwood, 14 August 2002; NMV

A.11025 (5), Rellimeigga Crk, Melba Hwy, S of Yea, 28 January 1990; NMV A.30394-1 (13), Seven Crks, Pine Lodge Rd (Leckies Rd), Miepoll South, 29 January 2001; NMV A.10296 (1), Strath Crk, Strath Creek township, 11 February 1990; NMV A.30410-1 (8), Sugarloaf Crk, Pyalong/Tallarook Rd, W of Tallarook, 14 August 2002; NMV A.10277 (1), Sunday Crk, Sharp and Taylor Rd, W of Tallarook, 11 February 1990; NMV A.11002 (6), Yea R, N of highway, near Yea, 16 November 1991; NMV A.30666-1 (2), Coliban R, junction with Spring Creek, Taradale, 7 February 1994; NMV A.30667-1 (10), Emu Crk, Storys Rd, 30 September 1999; NMV A.10310 (13), Forest Crk, Northern Hwy, 10.4 km from Tooborac, just SE of Heathcote, 5 May 1965; NMV A.9926 (2), Barkers Crk, 1946; NMV A.30551-1 (4), Birchs Crk, Nelsons Bridge on Daylesford/Clunes Rd, Clunes, 20 February 2002; NMV A.12515 (10), Blackjack Crk, Harcourt, 1965; NMV A.10409 (3), Jim Crow Crk, Hepburn Lake; NMV A.30341-1 (3), Joyces Crk, Deep Creek Rd, Campbelltown, 15 December 2004; AMS I.32509-001 (2), Loddon R, October 1983; NMV A.30553-1 (4), McCallum Crk, Maryborough/Ballarat Rd, Dunach, 4 June 2002; AMS I.40327-001 (9), McCallum Crk, Talbot/Mount Greenock Rd, Mount Glasgow, 7 November, 1999; NMV A.30555-1 (15), Slaty Crk, Bush Inn Rd, E of Creswick, 7 June 2002; NMV A.30405-1 (1), Tullaroop Crk, Mulins Bridge on Mullins Road, 14 December 2004; NMV A.12618 (1), unnamed (?Talbot Crk), Talbot; NMV A.30380-1 (4), Burnt Crk, Hickeys Road, upstream of Wonwondah East, 8 February, 2000; NMV A.30658-1 (4), Mount Cole Crk, on Allenders Rd, downstream from Warrak, 12 April 2000; NMV A.8081 (5), Mount William Crk, trib., 7 Km west of Moyston, 19 September 1989; NMV A.8082 (3), Mount William Crk, trib., 11 km WSW of Moyston, 19 September 1989; SAMA F.5720 (1), Mount William Crk, Lady Somers Bridge on Ararat/Pomonal Rd, 6 km SE of Pomonal, 8 December 1981; NMV A.30384-1 (12), Nowhere Crk, track off Nowhere Creek Rd, 13 April 2000; NMV A.12472 (5), Potter Crk, 3.2 km S of Mount Zero, Winfields Rd, 15 August 1974; NMV A.30663-1 (1), Wimmera R, off Giles River Road, Southbank, 10 February 2000; NMV A.30665-1 (15), Wimmera R, Crowlands/Eversley Rd, 11 April 2000; NMV A.30650-1 (7), Wimmera R, Clarke Street, Elmhurst,12 April 2000; NMV (unreg.) (1), Mackenzie R, Tatlocks Bridge, Laharum/Brimpaen Rd, Wartook, 20 May 2002; NMV A.8069 (4), Mackenzie R, Burnt Creek diversion weir, Distribution Heads, 21 September 1989; NMV A.8082 (3), Mount William Crk, trib., 11 km WSW of Moyston, 19 September 1989; SAMA F.5720 (1), Mount William Crk, Lady Somers Bridge, Ararat/Pomonal Rd, 6 km SE of Pomonal, 8 December 1981.

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VIC: NMV A.7978, Backstairs Crk, Warburton, 20 March 1986; NMV A.30697-1 (45), Badger Crk, Badger Creek Rd, Healesville, 23 July 2001; NMV A.8196 (4), Badger Crk, Coranderrk Homestead, 24 February, 1986; NMV A.8135 (1), Badger Crk, Coranderrk Homestead, 1987; NMV A.7979 (33), Badger Crk, Coranderrk weir, 19 April 19986; NMV A.7936 (3), Badger Crk, Coranderrk, 27 February 1982; NMV A.10026 (6), Braham Crk, Lyrebird Rd, 21 May 1973; NMV A.9845 (1), Chum Crk, Healesville, 1986; NMV A.30509-1 (9), Cockatoo Crk, trib., Mountain Rd, Cockatoo, 1 February 1993; NMV A.30739-1 (2), Diamond Crk, upstream of Ninks Rd, Kinglake N.P., 19 February 2002; NMV A.30517-1 (10), Diamond Crk, Mittons Bridge Rd and Cottlesbridge Rd, 15 April 1992; NMV A.30511-1 (1), Donnellys Crk, Donnelly Weir Rd, 18 June 2002; NMV A.10219 (3), Frenchmans Crk, Gairns Rd, W of Wesburn, 25 February 1990; NMV A.10228 (3), Hoddles Crk, Launching Place, 25 February, 1990; NMV A.30680-1 (2), Jerusalem Crk, just downstream Jerusalem Creek Trk, 3 November 2004; NMV A.10637 (3), Macclesfield Crk, Yellingbo State Nature Reserve, 14 November 990; NMV A.30695-1 (10), Menzies Crk, Emerald/Monbulk Rd, 29 January 1998; NMV A.30512-1 (2), Olinda Crk, Road 19, Olinda, 20 June 2001; NMV A.10181 (4), Olinda Crk, Silvan Reservoir outlet, 6 December 1990; NMV A.10236 (5), Olinda Crk, outflow from Silvan Dam, 25 February 1990; NMV A.12401 (3), Stony Creek ?), Warrandyte, 26 December 1945; NMV A.13158 (14), Stony Crk, "The Chase", Floods Rd , Warrandyte Nth, 30 December 1992; NMV A.30577-1 (6), Tomahawk Crk, Gembrook/Launching Place Rd, 11 February 1998; NMV A.10218 (5), Wandin Yallock Crk, off Wandin/Monbulk Rd, Seville, 25 February 1990; NMV A.11041 (30), Yankee Jim Crk, trib., Edward St, Wesburn, 1 March 1992; NMV A.8935 (3), Yarra R, Launching Place to Millgrove, 19 March 1990; NMV A.12513 (1), Yarra R, upper, 16 January 1871; NMV A.12519 (1), Yarra R, upper, 4 July 1877; NMV A.30487-1 (2), Yow Yow Crk, Yow Yow Crk Rd, 18 June 2001; NMV A.10046 (6), Jacksons Crk, Sunbury/Riddells Creek Rd, 10 December 1979; NMV A.8110 (4), Main Crk, trib., Kent Rd, 12 September 1984; NMV A.30686-1 (1), Maribyrnong R, Keilor North, 23 January 2002; NMV A.10602 (1), Monument Crk, Lancefield/Woodend Rd, 24 October 1989; NMV A.12507 (32), Clearwater Gully, Lerderderg Gorge, Lerderderg State Park, 2 April 1962; NMV A.30684-1 (5), Korjamnunnip Crk, Binks Road, 30 March 1999; NMV A.30522-1 (4), Lerderderg R, Roach

Rd, Wombat State Forest, 3 June 2002; NMV A.30499-1 (2), Werribee R, 11.5 km NNW of Ballan, 14 May 1982; AMS IA.3622, (2), Devils Crk, W of Ballarat, 9 January 1928; NMV A.30492-1 (4), Barwon R, E brnch, downstream Elizabeth L., 21 January 1988; NMV A.10411 (3), Barwon R, downstream Barwon Downs, 17 January 1968; NMV A.10301 (1), Barwon R, E bnch, Birregurra/Forrest Rd, 17 January 1968; NMV A.30502-1 (9), Dewing Cr, Griffins Rd, E of Barwon Downs, 27 April 1999; NMV A.10303 (8), Retreat Crk, East Otways Plantation, 28 March 1974; NMV A.13116 (15), Seymour Crk, off Hayden , 24 March 1974; NMV A.10306 (4), Aire R, beside Aire Valley Rd, Otway Ranges, 29 March 1974; NMV A.30503-1 (6), Asplin Crk, Asplin Trk, Otway Ranges, 20 January, 1988; NMV A.12468 (8), Chapple Crk, Junction Trk, NW Lavers Hill, 26 April 1974; NMV A.10429 (15), Charlie Crk, at Charlie Creek, 1974; NMV A.12616 (8), Lardners Crk, E bnch, Webster Hill Plantation, 19 August 1975; NMV A.12414 (7), Parker R, Blanket Bay Rd, 19 January 1968; NMV A.30579-1 (1), Porcupine Crk, Pipeline Trk, 26 August 2002; NMV A.30679-2 (8), Yahoo Crk, Yahoo Creek Trk, Kawarren, 19 February 1999.

***Galaxias tantangara* sp. nov.**
NSW: AMS IB.745 (1), Tantangara Crk, Snowy Mountains, October 1905; BMNH 1914.80.20.75 (1), Tantangara Crk, Murrumbidgee River.

***Galaxias terenasus* sp. nov.**
NSW: AMS IA.7904–7906 (3), [Bombala R (?)], near Bombala, 1938; BMNH 1914.8.20.67–68 (2), [Curry Flat Crk?] Curry Flat, Nimmitabel, c. 1914 (digital image seen); NMV A.30581-1 (8), Church Crk, Bombala/Delegate Rd, E of Delegate, 15 November 1965.

APPENDIX 6. *Galaxias 'guttatus'*

Six specimens registered as *Galaxias guttatus* (NMW 78274) from South Australia ('Süd Australien') were located in the collection of the Naturhistorisches Museum, Vienna. The specimens were requested on loan, examined and found to conform to *Galaxias olidus* Günther, 1866. The specimen label attributes the species to (possibly) Mc Clelland ('Mc. Cl.'), contains the date 1886, the number 31 or 32, and the name 'Schneider', who may possibly have collected or identified the specimens.

The history of this specimen lot is unknown and no published reference has been found to the specific name 'guttatus' in Galaxiidae nomenclature (Eschmeyer & Frike 2013). The specimens are unlikely to have been confused with the cyprinid *Barbus guttatus* McClelland, 1839, from Bhutan, a synonym of *Schizothorax richardsonii* (Gray 1832). The specific name is possibly from an unpublished manuscript or a complete error and the identity of 'Mc Cl.' remains unknown. Consequently the name is considered invalid and has no taxonomic significance.