

## ***Thitarodes namnai* sp. nov. and *T. caligophilus* sp. nov. (Lepidoptera: Hepialidae), hosts of the economically important entomopathogenic fungus *Ophiocordyceps sinensis* in Bhutan**

NORBERT MACZEY<sup>1</sup>, KUENZANG DHENDUP<sup>2</sup>, PAUL CANNON<sup>1,4</sup>,  
NIGEL HYWEL-JONES<sup>3</sup>, & TEK BAHADUR RAI<sup>2</sup>

<sup>1</sup>CABI Europe-UK, Bakeham Lane, Egham, Surrey TW20 9TY, United Kingdom. E-mail: n.maczey@cabi.org

<sup>2</sup>Renewable Natural Resources Research Centre, Yusipang, Bhutan

<sup>3</sup>Mycology Laboratory, National Center for Genetic engineering and Biotechnology, Science Park, Pathum Thani 12120 Thailand

<sup>4</sup>Jodrell Laboratory, Royal Botanic Gardens, Kew, Richmond, Surrey TW93AB, United Kingdom

### **Abstract**

Two new species of *Thitarodes* Viette (Lepidoptera: Hepialidae) are described from specimens collected in alpine grassland habitats of north-west Bhutan. The new species are compared with their closest relatives from Nepal and neighbouring parts of China and Japan. Male and female adults and genitalia are illustrated.

**Key words:** *Cordyceps*, Ghost moth, grassland, Himalaya, new species

### **Introduction**

*Cordyceps* ('yartsa guenbub' in Bhutan or 'chongchao' in China) is a valuable commodity, collected intensively throughout alpine grasslands of the Eastern Himalayas and parts of the Tibetan Plateau. This component of traditional Chinese medicine consists of dried fruiting bodies of the entomopathogenic fungus *Ophiocordyceps sinensis* (Berk.) G.H. Sung, J.M. Sung, Hywel-Jones & Spatafora and cuticular remains of its insect host, which still preserve the distinct shape of the caterpillar (Cannon *et al.* 2009).

As the only known hosts for *Ophiocordyceps sinensis*, members of the ghost moth genus *Thitarodes* Viette play a significant role in the ecological system at the heart of harvest and trade of 'yartsa guenbub'. Caterpillars of this genus are subterranean root-feeders living polyphagously on alpine forbs and sedges (Yang *et al.* 1996). Larvae take 2–6 years to reach maturity depending on species and environmental conditions (Chen *et al.* 2002, Yin *et al.* 2004). It is assumed that caterpillars of this genus are infected by spores of the *Ophiocordyceps* fungus during early life stages when they stay dormant for a considerable time. Death occurs in the final larval instar prior to pupation with the host being consumed by growing mycelium, turning it into a solid 'mummy'. An elongate fruiting body emerges after snow melt in spring from behind the head capsule of the former caterpillar and the combined feature is intensively collected at this time of the year. Every year, from Bhutan alone, millions of these 'chinese caterpillars' are exported as part of a worldwide multimillion-dollar trade in this commodity. Despite being of such high ecological and economic importance, for large parts of the collecting area, the taxonomic identity of the host moths remains unclear (Cannon *et al.* 2009).

The type species of *Thitarodes* was first described as *Hepialus armoricanus* Oberthür in 1909. Viette (1968) proposed the genus *Thitarodes* whilst describing three new species from Nepal. The genus seems to be restricted to eastern parts of Asia with a geographical range stretching from Nepal in the west, southwards into Myanmar, and towards the east into Taiwan, Japan, and northeastern parts of Russia.

The most recent inventory of the Hepialoidea (Nielsen *et al.* 2000) lists 51 species belonging to *Thitarodes*, the majority of which have only relatively recently been described from China, particularly