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Grand challenges in feather mite biology*

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In the 26 years since Gaud and Atyeo (1996) published their seminal work "*Feather Mites of the World*", remarkable progress has been made in increasing the number of described feather mite species and host-mite records. Advances in molecular genetic methods are shedding light on relationships both among higher taxa and within species. Nevertheless, there are aspects of these research areas that need further study, as well as many other important areas of feather mite biology that have been almost unexplored since the works of V.B. Dubinin in the 1950's (*e.g.*, Dubinin, 1951). In this presentation I outline what I feel are desirable targets for future feather mite studies, some of which will be more challenging to achieve than others. These research topics include:

- inventories and new taxon descriptions of feather mites from geographical areas and bird taxa that have been poorly explored;
- expanded assessment of phylogenetic relationships among feather mite taxa using molecular tools;
- more tests of host-mite co-diversification at both micro- and macroevolutionary scales;
- continued investigation of factors that affect feather mite richness and abundance on hosts, *e.g.*, diversity of host feather morphology, local climate, host migratory behaviour, *etc.*;
- manipulative experiments to determine effects of adding/removing feather mites on feather condition and microbe load, and on host condition and reproductive success;
- more scrutiny of feather mite diet including whether they actually consume uropygial oil;
- evaluation of composition of secretions of feather mite oil glands;
- observations of live mites on feathers during both day and night;
- functional morphology of feather mite genitalia and non-genitalic contact structures;
- function and control of male polymorphism;
- in-vitro culturing! The ability to culture feather mites off their hosts would allow propagation of mites for experimental manipulation of host loads, close observation of interactions within and between the sexes and between life-history stages (including oviposition), details of feeding behaviour, and interactions between species that share the same feathers.

Contribution to any of these research areas would greatly enhance our understanding of the evolution and ecology of feather mites. With increasing capacity to sequence whole genomes of tiny organisms, improvements in 3-D printing of biological objects (*e.g.*, feathers), and other technological advances, many of the grand challenges in feather mite biology that seem unattainable now may soon be within reach.

Keywords: Analgoidea, Pterolichoidea, feather mites, ecology, evolution, functional morphology

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