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Systematics of tiny black acalyptrate flies as case studies for challenges in Australian biodiversity research.

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Flies (Diptera) are among the most poorly known Australian insects. These ecologically labile, fragile insects need specialised techniques to collect and preserve. While technological advances in sequencing and artificial intelligence will streamline aspects of biodiversity characterisation, shifts in researcher mindset and education policy are needed to circumscribe Australia's flies. 1. Tertiary education should renew emphasis on organismal biology to inspire and empower new researchers. 2. Standardised fieldwork methods should be developed to ethically maximise specimen volume and utility. 3. Laboratories should process and share samples more widely. A new Australian Biological Resources Study funded study on scale parasitoid *Cryptochetum* flies will be used as an example. To clarify higher-level groups, a phylogeny based on analyses of 160 taxa and 3000 markers yielded compelling hypotheses, clarifying the position of enigmatic Braulidae and Librella. *Cryptochetum* and Drosophilidae are sister groups and Librella and Braula are inside Drosophilidae subfamily Steganinae. This is supported by newly examined genitalic characters. Comprehensive sampling and character selection in hyperdiverse clades are critical. This project provides the impetus and foundation comprehensively revise Australian cryptochetids, a group in which biocontrol projects deployed species of unclear identities. Numerous new species will be described in concert with museomics illuminating parasitoid host records.

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