

Conservation of Odonata in the South Pacific and Australasia

Richard J. Rowe

School of Tropical Biology, James Cook University, Townsville 4811, Australia.

<Richard.Rowe@jcu.edu.au>

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ABSTRACT

The conservation status of Odonata in the South Pacific Region and in Australasia is reviewed. Australian and New Zealand faunas have recently been monographed, for the rest of the region lack of data is the major handicap to concrete planning. The taxonomic status of the different island faunas and the state of habitat modification on land masses are indicated.

REGIONAL DEFINITION

Australasia and associated regions together with the South Pacific Ocean and its islands make up about a sixth of the globe. The region is bounded to the north and north west by Indonesia and South East Asia, to the north by the islands of Micronesia, to the east by South America, to the south by the sub-Antarctic, and to the west by the Indian Ocean. Including visitor contributions the whole area is serviced by fewer than five odonatologists.

The area considered here are the islands in the South Pacific Ocean and of Australasia, excluding the Australian continent, which is covered by Hawking & Theischinger (2004). There will be overlaps between the reports in general and biogeographic considerations.

Because the landmasses of the region support different faunas and represent different problems they are treated separately in the following.

SIGNIFICANCE OF REGION

Fortunately much of the area is salt water, unfortunately it is also an area with significant endemism, numerous relicts and local radiations, and in key respects with little commonality with other areas of the globe.

Geologically the region has been created through the break up of Gondwana and the development of the Pacific Ocean. Tectonic events have spread continental land masses and generated high volcanic islands. The Pacific Ocean is also dotted with

low-lying island archipelagos. The ocean influence has largely moderated the climate of the region, however Australia, the largest land mass, has dried as it moved north, and New Zealand was subjected to extensive glaciation during the Pleistocene.

The popular perception is that the South Pacific and Australia are pretty much untouched by human impacts – an area of forests, wide lands, swaying palms, rain-forests, Gauguin, musicals. Unfortunately this perception is not true.

Because of the paucity of odonatologists, and more importantly of resident odonatologists, the core problem in defining the conservation status of faunal elements is absence of data. Except for the island of New Guinea in all likelihood the vast majority of species have names. Unfortunately that often is the limit of our objective and defensible knowledge. Much, if not most, research across the area has been conducted by ‘expeditions’, in consequence there is very limited knowledge of microhabitat use or of seasonality. A species declared as ‘rare’ may occur naturally in unsearched microhabitats, be active at unanticipated times of day, or have a seasonal pattern that is a mismatch with expedition activity.

Regional endemics at family or subfamily level are the Hemiphlebiidae, Isostictidae, Lestoideidae, Synthemistidae, Diphlebiinae, and Cordulephyinae; note usage varies - Lestoideidae is here restricted to *Lestoidea*, and is not the ‘Lestoideidae’ of Novelo-Gutierrez (1995); cf. van Tol (1995). Seven of 11 extant petalurid species occur in the region (see also Hawking & Theischinger 2004). There is a faunal linkage with South America (Neopetaliidae) and another with South Africa (Synlestidae), largely associated with what are identified as ‘relict’ lineages. There are numerous radiations at generic level, some ancient, others representing recent evolutionary events. A number of groups are ‘problematic’ including the Australian Megapodagrionidae, *Lestoidea*, *Chorismagrion*, *Hemiphlebia*, and the ‘Australian Gomphidae’. The number of monotypic genera is a cause for concern, and work needs to be done on relationships of forms within the fauna. Not all monotypic genera are of equal concern from a conservation perspective.

The region is also notable for the occurrence of larval terrestriality in Australia, New Caledonia, and perhaps in the Solomons. Terrestrial larvae are known from the Megapodagrionidae, Gomphomacromiinae and Synthemistidae; facultative quasi-terrestriality is widespread among the Australian brachytronine Aeshnidae, and may occur elsewhere in the region. Elsewhere terrestrial larvae seem to occur only in the Hawaiian *Megalagrion*.

Notes on the species previously listed by IUCN

For the whole South Pacific and Australasian region excluding Australia one species for New Zealand has been listed in Red Lists of threatened species (Moore 1997; IUCN 2003):

lower risk [LR]:

Antipodochlora braueri (Selys, 1871) from New Zealand.

This species is widely distributed in forests, is locally common in places, but is less frequently encountered, being active at dusk and sometimes under heavy cloud.

NEW ZEALAND

New Zealand is a continental remnant of Gondwana that has undergone extensive geological working over the past 80 million years. Over the past 10 million years there has been extensive tectonic land building and volcanism. The ecosystem was heavily impacted by pleistocene glaciations, with no real prospect of latitudinal retreat. During the last glacial maximum massive volcanic eruptions occurred in the northern refuge areas.

Studies on taxonomy, ecology and biodiversity

Original collections were made by Alexander Sinclair, who recorded most of the fauna. The country has since been actively surveyed by a number of competent resident odonatologists – R.J. Tillyard, J.S. Armstrong, R.J. Rowe, W.J. Crumpton and W.J. Winstanley – supported by a large network of active freshwater ecologists. The fauna is taxonomically well-known. Cryptic species may still await discovery within the endemic coenagrionid genus *Xanthocnemis*.

In evolutionary terms the coenagrionid genus *Xanthocnemis* represents the most interesting aspect of the New Zealand fauna. Two species were originally described – *X. zealandica* (McLachlan, 1873) and *X. sobrina* (McLachlan, 1873) – however *sobrina* was subsequently ‘lost’ by local biologists who were only familiar with the smaller *zealandica*. Presently four species are recognised: *X. zealandica*, *X. sobrina*, *X. sinclairi* Rowe, 1987, and *X. tuanuii* Rowe, 1981. *X. zealandica* is everywhere – in Tony Watson’s words it is ‘too ubiquitous’ (J.A.L. Watson comment in passing 1980). *X. sobrina* is associated with heavy forest in the North Island, as the forest went it stopped being collected, but it is still there in low gradient, heavily-shaded, bush-surrounded streams. *X. sinclairi* is an alpine form, found in alpine tarns in the South Island. Recent collections have extended its known range, and my original supposition that it has a similar distribution to the Mountain black butterfly *Erebiola butleri*, seem to be being borne out (e.g. Moore 1989). *X. tuanuii* is a Chatham Island endemic. Pacific Island coenagrionids are well-known for their radiations. The expectation is that *Xanthocnemis* remains a problem. The guess is that *Xanthocnemis* will eventually be found to parallel the cluster of New Zealand parakeets in *Cyanoramphus*, and that habitat destruction and gross habitat modification has led to the very recent expansion of an open-country species, *X. zealandica*, into all available locales.

On the basis of some ‘funny’ sets of male appendages that have turned up on SEMs I expect other forms are currently ‘hanging on’ in pockets, or are still in the process of being swamped/assimilated by the widespread species.

Identification guides and faunal lists

A review of the odonate fauna including keys to identification is given by Rowe (1987).

Species to be considered

There are ten endemic species recognised in three (perhaps four) endemic genera; the generic position of '*Procordulia*' *grayi* (Selys, 1871) is suspect. Three of these species are forest-associated: the petalurid *Uropetala carovei* (White, 1843), the enigmatic crepuscular corduliid *Antipodochlora braueri* (Selys, 1871) and the coenagrionid *Xanthocnemis sobrina* (McLachlan, 1873). So long as there are appropriate forest remnants and reasonable riparian strips preserved these species are secure. The other species are associated with open country, swamps, ponds and lakes and are secure.

Critical sites and threats and conservation priorities and recommendations

A thousand years ago New Zealand was forested; even 120 years ago significant parts of the country were forested. They aren't now. Despite the 'green' claims of the Government, even in the past 40 years large areas of forest have gone, replaced by pasture or plantations of exotic pines.

Recommendations:

survey *Xanthocnemis* for cryptic species and for genetic patterns. This is an act of record, it is infeasible to protect any relict populations from swamping, i.e. replacement or genetic assimilation by introgression, by the all pervasive *X. zealandica*.

PACIFIC ISLANDS

The large continental islands - New Guinea, The Solomons, and New Caledonia - and the smaller volcanic high islands, such as Viti Levu (Great Fiji), Samoa, and Tahiti, have a wide variation in climate, fertility and vegetation. The low, generally atoll-derived, islands have no geographically-generated climatic variation, low fertility, and limited vegetation. Many of these latter islands have limited, or even no, free water and no breeding odonate fauna.

The odonate fauna of the Pacific Ocean Islands can be divided into two distinct components: a widely dispersed fauna capable of considerable trans-oceanic movement and local endemics. The widely dispersed fauna consists of elements such as the anisopterans *Pantala flavescens* (Fabricius, 1798), various *Tramea*, *Tholymis*, *Rhyothemis*, *Macrodiplax*, *Orthetrum*, *Diplacodes*, *Hemicordulia*, *Anax*, *Anaciaeschna*, *Gynacantha* species and among the Zygoptera *Agriocnemis* species and *Ischnura aurora* (Brauer 1865); whereas the endemics are either (recent) island derivatives in the widely dispersed genera or endemic coenagrionids. The vagrant species are associated with lowland still-water habitats and with open country, whereas the endemics are usually associated with forest streams. In contrast to the oceanic islands, New Guinea, The Solomons and New Caledonia have rich and diverse endemic faunas, potentially of great antiquity.

All islands have in common, that habitat destruction is a growing problem and that more surveys are needed to give a satisfying report on the odonate fauna.

Fiji

Fiji comprises two kinds of habitat: the high ancient volcanic islands with good rainfall and a dissected terrain, originally, and still largely, forest-covered; and low-lying atoll-derived habitats with limited water and limited vegetation. The high islands have an interesting endemic fauna, whereas the low islands have a typical Pacific vagrant fauna.

The Fijian fauna has been surveyed by a succession of workers, originally by visitors, then by long term resident expatriates, and latterly by another succession of visitors. A first review of the odonate fauna was given by Tillyard (1924). A new genus was described by Donnelly (1984).

The Fijian odonate fauna is most noted for its extensive radiation within the coenagrionid genus *Nesobasis* and its sister genus *Melanesobasis*, these animals fill a variety of roles and have many superficial similarities to the taxonomically distinct ecological equivalents of other places.

The high islands of Fiji have maintained a terrestrial habitat for about 40 million years. In the 1980s the opening of a road to the central plateau of Viti Levu in conjunction with development of a hydropower scheme markedly changed the access to this region, however steep hillsides provide long term refuge.

Samoa

Politically Samoa comprises the independent nation of Western Samoa and the US dependency of Eastern Samoa. Biogeographically it represents a single region. Geologically Samoa was created by a series of volcanic events over the past seven million years.

The naturalist J.S. Armstrong was resident in Samoa for several years in the 1920s and again for several years early in the 1950s. Armstrong's observations in the 1950s were focussed on the Odonata and his MS notebooks survive (a transcript is held by the author).

The odonate fauna comprises mostly widespread Pacific elements and also two endemic, apparently *Ischnura*-derived, genera: *Pacificagrion* and *Amorphostigma*, each with two recognised species. Further species in these genera continue to be found (N. Donnelly pers. comm.). From Armstrong's field notebooks it is clear that even in the 1950s these endemic species were localised. Four endemic species of *Ischnura* are described as well as an endemic *Gynacantha* and a *Hemicordulia*. A review of the odonate fauna was given by Fraser (1927, 1953).

Conservation problems are habitat modification, especially loss of primary forest, where species distributions and requirements are unknown

Tahiti / French Polynesia

French Polynesia comprises high volcanic islands (e.g. Tahiti, Moorea) and low coral atolls. The high islands are known for their endemic radiations in groups such as land snails. This does not seem to be paralleled in the odonate fauna where collections are dominated by the Pacific vagrant fauna.

New Caledonia

The island is a gondwanan remnant associated with the New Zealand land mass and has a continuous terrestrial history. Habitat threats are associated with nickel mining and development projects creating some general habitat degradation.

New Caledonia has been well-surveyed, initially by Bernice P. Bishop Museum surveys and laterly through visits by a range of odonatologists.

Approximately 55 species are recorded from the island. The fauna is notable for radiations in the Megapodagrionidae, Isostictidae and Synthemistidae, and for the evolution of larval terrestriality in representatives of both Megapodagrionidae and Synthemistidae.

A review of the odonate fauna is given by Lieftinck (1975) and Davies (2002). New species were recently described by Vick & Davies (1990), while Winstanley (1983) gives an account of the terrestrial Odonata larvae from New Caledonia.

Vanuatu

Vanuatu comprises a series of volcanic islands with a steep topography. It was formerly administered as a British-French condominium, 'The New Hebrides', under which most expedition work was categorised. Work on the Odonata fauna has been confined to alpha taxonomy. A review of the odonate fauna is given by Kimmins (1958).

Kiribati & Tuvalu

Kiribati and Tuvalu comprise a scattering of low-lying islands with a small and not well-characterised fauna of vagrant species.

Solomons

Situated to the east of New Guinea, the Solomons comprise an arc of rugged, high-rising, islands with extraordinarily steep landscapes and rapid climatic transitions. Knowledge of the Solomons fauna is restricted largely to surveys by visitors.

Amateur collections made during 1939-1945 – the Solomons were the site of some of the bloodiest campaigns in that war – existed into the 1960s but mostly disappeared later, not being deposited into institutions.

Bougainville, which is politically a part of Papua New Guinea, but biogeographically part of the Solomons, has had some freshwater ecology work done. The unfortunate civil war that erupted in the province in the early 1990s terminated field work on Cathy Yule's PhD, however we know something of the habitat of the *Lieftinckia* species, and we are faced with the likelihood of a terrestrial aeshnid larva – only the first few larval instars were ever taken in streams in over two years of intensive sampling (Yule 1993).

The fauna is rich with interesting endemism. *Lieftinckia*, a biogeographically anomalous 'platycnemidid' genus, are, on the larval characters of the three species examined, Australian megapodagrionids.

A review of the odonate fauna is given by Lieftinck (1963) and Kimmins (1957). The political situation on the islands has been troublesome. There were stories of damage by Malaysia-based timber extraction companies but all commercial activity ceased during a protracted disturbance. This disturbance now seems to have halted, which would allow extractive industries to resume.

New Guinea

Politically New Guinea comprises the independent nation of Papua New Guinea and the Indonesian province of West Papua. Biogeographically these represent a single area, noted both for its special bird fauna and for its special Austro-papuan mammal inheritance, including marsupials and monotremes.

New Guinea is a relatively recent island, generated by tectonic activity. It is big and rugged. It has frequently been attached to northern Australia, the last land bridge being submerged around ten thousand years ago.

Knowledge of the New Guinea fauna is largely due to surveys by visitors. The most comprehensive work was that associated with Maurits Lieftinck who was resident in the Indonesian Archipelago in the 1930s and early 40s. The fauna can be divided into upland and lowland biotas.

The extremely rich fauna appears dominated by northern forms which have crossed Wallace' line from South East Asia. There are also some Australian elements (Houston & Watson 1988). There is endemism at species and generic level. Some elements of the fauna are 'exotic'. No detailed work has been done on the biology or in characterising relationships within the fauna. Some material is likely 'to be in the wrong drawer'. A review of the odonate fauna is given by Lieftinck (1942, 1949).

Conservation efforts in New Guinea are likely to be dominated by interest in the charismatic avifauna. Any Bird of Paradise habitat protection will help Odonata. Recommendations are to collate current information, identify patterns and gaps and attempt to interest fauna survey teams in the Odonata; these units are doing environmental impact studies on behalf of, and with the logistical resources of, mining companies. It is infeasible to try to survey the Odonata in the remote areas. Maintain a watching brief on any habitat protection proposals for Birds of Paradise.

Summary islands

The island groups of the South Pacific represent a diversity of habitats and an interesting Odonata fauna. There is both significant endemism and a number of evolutionarily fascinating radiations. The biological richness and vulnerability of the Hawaiian Islands *Megalagrion* are paralleled several times over, but with extra pressures because of the smaller sizes of the land masses and low awareness or priority in the local scheme of things. Development of agriculture and timber extraction, and adventures in sugar cane, pose dangers as they involve large scale habitat modification ... and many of the odonate habitats may be small. On the volcanic islands steepness of the landscape and rain regimes protect the stream

fauna, but these habitats are vulnerable to massive erosion if forest cover is disrupted or if mine tailings are released (as in high rainfall areas they invariably must be) into watercourses. The general richness and diverse phylogenetic positioning of the fauna of the Australasian and South Pacific region stands in contrast to the relatively cosmopolitan fauna of the northern Pacific (e.g. Lieftinck 1962).

OVERVIEW

What can be done ... very little in reality. For the most part the local communities are operating subsistence economies, with rapidly expanding populations, and exist little above true poverty. In the short term conservation is helped by population drift to the towns – the long-term outcome will all depend on appropriate economic development and efficient land use. In most communities people are acutely aware of the finiteness of resources, however Odonata do not stand high in their lists of priorities. We must hope, but a little helpful education might go a long way as damage by local peoples is most likely to be done in ignorance or in financial desperation.

Externally derived exploitation in terms of mining industries and timber extraction, historically with meagre returns to the local communities and an unhealthy disregard for the long term impact on the local environment, are the greatest sources of acute damage. The repugnant trade policies of major first world trade blocs (most especially of the EU) are inimical to an honest and sustainable development of these communities and nations. The IUCN, and the Odonata SSG, are overwhelmingly representative of societies which exploit these vulnerable areas. For conservation to be effective it must be stable. For conservation to be stable it must be endemic to the communities resident in the areas of concern. The Odonata SSG should encourage such structures by seeking resident or genuinely regional representation rather than relying on ‘fly-in, fly-out’ expertise.

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