Odonata (Dragonflies and Damselflies) of the Nakanai Mountains, East New Britain Province, Papua New Guinea

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Chapter 3

Odonata (dragonflies and damselflies) of the Nakanai Mountains, East New Britain Province, Papua New Guinea

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SUMMARY

Odonatological results of a biodiversity assessment of the Nakanai Mountains, East New Britain Province, Papua New Guinea in April 2009 are presented. Thirty-two species of Odonata were collected at three different elevations (200-1,700 m) in the Nakanai Mountains and, to a minor extent, on the coastal fringe of Jacquinot Bay. Ten species are recorded from New Britain island for the first time. An undescribed species of *Pseudagrion* Selys and a species or subspecies of *Tetrathemis* Brauer new to science were found. Eleven odonate taxa appear to be endemic to the island and some species were only found at particular elevations suggesting that more odonate species await discovery on the island.

Due to the karst topography of the Nakanai Mountains, surface water that is essential for the development of odonate larvae is very scarce in the region. Natural forest cover is crucial for the survival of forest-dwelling habitat specialists, particularly those occupying the limited above-ground aquatic habitats that do exist. The designation of a World Heritage Area in the Nakanai Mountains will be an important first step to protect New Britain's unique aquatic invertebrate fauna from extinction.

INTRODUCTION

Despite several major contributions to knowledge about the dragonfly fauna of New Britain and the Bismarck Archipelago since the end of the 19th century, the odonate fauna of these islands remains poorly known. F. Ris (1898, 1900) published two papers based largely on the collections of F. Dahl, a German zoologist who spent about a year at a research station at Ralum on Blanche Bay (northern Gazelle Peninsula). Dahl used Ralum as a base from which to travel the surrounding areas collecting zoological specimens (Frodin 2007, Groeben 2004). His collection survived the course of time and is currently housed in the Berlin Museum (Dr. M. Ohl, pers. comm.). In 1919 the British zoologist H. Campion published a short note on a collection of New Britain Odonata obtained by A. Willey and deposited in the Cambridge Museum of Zoology (UK). The most recent synopsis of the Odonata of the Bismarck Archipelago (and the Solomons) was provided by Dutch odonatologist M. A. Lieftinck (1949a) who examined specimens in various collections.

Since the summary of Lieftinck (1949a) knowledge of the New Britain odonate fauna has resulted mostly from a few expeditions with broad zoological and botanical targets that did not have a special focus on Odonata. An important example is the Danish Noona Dan Expedition which visited the Bismarck Archipelago in 1962. This expedition had a broad focus on entomology and yielded dragonfly specimens from New Britain's Gazelle Peninsula including samples from an elevation of about 1000 m at Yalom and Komgi villages (Petersen 1966).

Recent advances include the works of Donnelly (1993) who erected two new genera of Isostictidae, each with a single species, from New Britain, Theischinger and Richards (2005) who described the only platystictid damselfly currently known from New Britain based on

collections inland from Wide Bay, and a trip by the first author to the Gazelle Peninsula and north-central New Britain (Gassmann 1999, in prep).

Lieftinck (1949a) listed 22 (possibly 23, if one uncertain record is included) species for the island of New Britain. However if we correct for some errors and omissions in that list and include taxa reported in the more recent literature, the number of species currently known from New Britain amounts to 43 species, two of them identified to family level only. Ten species are considered endemic to the island. Of the 16 odonate families known from mainland New Guinea only three have so far not been recorded from New Britain: the Lestoideidae, the Gomphidae, and the Synthemistidae.

Generally, the New Britain dragonflies constitute a depauperate subset of the New Guinean mainland fauna, with roughly 10% of the diversity reported from the mainland (Lieftinck 1949a,b). However the New Britain fauna includes a number of endemic genera and species that are of great evolutionary interest and that may be of conservation concern. This chapter presents findings of a study conducted in April 2009 to assess the diversity and endemism of Odonata in the Nakanai Mountains in East New Britain Province.

MATERIALS AND METHODS

Odonate specimens were collected in and around three camps at different elevations in the Nakanai Mountains, East New Britain Province, Papua New Guinea between April 3 and April 26, 2009. Major sites were:

1. Lamas (05°36.853'S 151°24.483'E; 200 m), lowland forest, with access to muddy pools and streams, and short stretch of clear stream

2. Vouvou (05°26.740'S 151°27.842'E; 859 m), hill forest with access to clear stream, and range of temporary and permanent forest and open pools

3. Tompoi (05°20.623'S 151°18.875'E; 1590 m), montane, extremely wet forest, water bodies absent around camp

Additional opportunistic samples were obtained from streams near Palmalmal, Irena and Marmar Villages (all adjacent or close to Jacqinot Bay, East New Britain); and at several sites in and around Goroka, Eastern Highlands Province, Papua New Guinea following completion of the survey (See Appendices 3.1 and 3.2 for more detailed descriptions of sites and schedule). Specimens from mainland New Guinea are treated separately in this report. Most specimens were caught with the aid of a long-handled net. A small number of anisopteran specimens were caught when they were attracted to lights in the field camps. Collecting activities were concentrated during daylight hours but some anisopterans were caught at dusk. Larval specimens were sampled by scooping with a sieve in small ponds.

Most specimens were treated with acetone for about 12 hours, quickly sun-dried, and subsequently placed into envelopes. A small number of specimens were preserved in 90% ethanol for molecular and histological studies. All larval specimens were preserved in ethanol.

RESULTS AND DISCUSSION

Thirty-two species of Odonata were documented during this survey in the Nakanai Mountains and adjacent coastal regions, with approximately 300 vouchers, including 266 adult specimens (35 of them in alcohol) and circa 31 larval specimens collected. Among them were 19 species of dragonflies (Anisoptera) and 13 species of damselflies (Zygoptera) (Table 3.1). A further six odonate species (four Anisopterans and two Zygopterans) were collected in the vicinity of Goroka, Eastern Highlands Province following the survey (Table 3.2), making a total of 38 species collected during the entire expedition.

The RAP survey documented 10 species previously not recorded with certainty from New Britain, increasing the known odonate fauna of the island by about 24% from 42 to 52 species. Two species newly documented during the survey, an undescribed *Pseudagrion* and a possibly new subspecies of *Tetrathemis* may be endemic to New Britain. In addition two of the new records for the island are found outside New Britain only in the neighbouring Solomon Islands archipelago (see below).

Based on our findings the number of odonate species known or expected to be endemic to New Britain has increased to nine, with a further three (potential) subspecies endemic to the island. We will not deal here with the concept of subspecies or investigate whether the taxa deserve specific or sub-specific rank. Instead, we follow the tradition of previous investigators. Final taxonomic decisions are pending, following further morphological or molecular studies.

The odonate taxa endemic to New Britain are:

Diplacina fulgens, *Huonia moerens*, *Nannophlebia imitans imitans*, *Orthetrum villosovittatum bismarckianum,* the new (sub) species of *Tetrathemis*, *Argiolestes aurantiacus, Cnemisticta angustiloba, Drepanosticta antilope, Idiocnemis kimminisi Nososticta commutata*, *Pseudagrion* new spec., and *Tanymecosticta filiformis.*

Two zygopteran families, the Lestidae and the Corduliidae were previously each known only by a single species of uncertain identity (Lieftinck 1949b). Our report helps to clarify the taxonomic situation (Table 3.1).

SIGNIFICANT SPECIES

1. New taxa

Zygoptera

Coenagrionidae: *Pseudagrion*. Selys, 1876.

An hitherto undescribed yellow species of *Pseudagrion* Selys was collected during the expedition. It had been collected previously elsewhere in New Britain by the first author, and may be widespread on the island. It is surprising that this species has not been described before. Ris (1900) examined a male *Pseudagrion* specimen from New Britain which was lacking the terminal appendages (which usually bear important taxonomic characters) and considered it to belong to *P. ustum* (Selys, 1876), previously only known from the Moluccas and Sulawesi. Lieftinck (1949a) doubted Ris' identification and further speculated on the subject when describing a new species from the Solomon Islands (Lieftinck 1949a). Ris' description of that male from 'Matanata River' matches our specimens and is probably conspecific. The status of the new species has been confirmed by comparison with other yellow *Pseudagrion* species including *P. civicum* and *P. silaceum* from the mainland of New Guinea and *P. incisurum* from the Solomons (to which it is most similar). The new species is clearly distinguishable from all other yellow species by structural characters of the male appendages (Gassmann, submitted).

Anisoptera

Libellulidae: *Tetrathemis* Brauer, 1868.

A single male specimen in our alcohol collection and a field photograph of the presumed female of this species not only represent the first record of this archaic forest-haunting genus from New Britain but appear to differ from all subspecies of *T. irregularis* currently known from the region. We preliminarily consider our specimen to belong to a new

Table 3.1. Checklist of Odonata documented in the Nakanai Mountains, East New Britain Province, Papua New Guinea in April 2009.

Species	Lamas (200 m)	Vouvou (859 m)	Tompoi (~1,600 m)	South coast nr. Palmalmal	IUCN Category*	New Record for New Britain?
ANISOPTERA						
Aeshnidae						
Agyrtacantha dirupta	X	X			N/A	**N**
Anax maclachlani		X			N/A	**N**
Gynacantha kirbyi	X	X			N/A	**Y**
Corduliidae						
Hemicordulia hilaris		X		X	N/A	**Y**
Hemicordulia cyclopica		X			N/A	**Y**
Macromiidae						
Macromia lachesis		X			N/A	**N**
Libellulidae						
Agrionoptera insignis similis	X			X	LC	**N**
Agrionoptera longitudinalis dissoluta	X	X			LC	**N**
Diplacina fulgens	X				N/A	**N**
Diplacodes trivialis		X			N/A	**N**
Huonia moerens	X	X			DD	**N**
Nannophlebia imitans imitans	X				N/A	**N**
Neurothemis stigmatizans bramina	X	X		X	N/A	**N**
Orthetrum serapia		X			LC	**Y**
Orthetrum villosovittatum bismarckianum	X	X	X		N/A	**N**
Pantala flavescens		X			LC	**N**
Protorthemis coronata	X				N/A	**N**
Tetrathemis irregularis ?irregularis	X					**Y**
Zyxomma multinervorum		X			N/A	**Y**

table continued on next page

Table 3.1. *continued*

Species	Lamas (200 m)	Vouvou (859 m)	Tompoi (~1,600 m)	South coast nr. Palmalmal	IUCN Category*	New Record for New Britain?
ZYGOPTERA						
Chlorocyphidae						
Rhinocypha liberata	X	X			DD	**Y**
Coenagrionidae						
Archibasis mimetes		X			N/A	**N**
Mortonagrion martini				X	N/A	**N**
Pseudagrion new spec.	X	X		X	N/A	**Y**
Teinobasis rufithorax	X	X		X	N/A	**N**
Xiphiagrion cyanomelas		X			N/A	**N**
Isostictidae						
Cnemisticta angustiloba		X			N/A	**N**
Tanymecosticta filiformis	X				N/A	**N**
Lestidae						
Lestes pertinax		X			N/A	**Y**
Megapodagrionidae						
Argiolestes aurantiacus	X	X			N/A	**N**
Platycnemididae						
Idiocnemis kimminsi	X	X			N/A	**N**
Protoneuridae						
Nososticta commutata	X			X	N/A	**N**
Nososticta africana	X	X		X	N/A	**Y**

*N/A = Not assessed; LC = Least Concern; DD = Data Deficient

subspecies of *T. irregularis*. Further investigation is needed to clarify the taxonomic rank of the new discovery, which looks more similar to the nominal subspecies, *T. i. irregularis* from the Philippines, than to other regional subspecies.

2. Other new records for New Britain

Zygoptera

Chlorocyphidae: *Rhinocypha* Rambur, 1842.

The *Rhinocypha* species found in the Nakanai Mountains represents the first record of *R. liberata* Lieftinck, 1949, for New Britain. This identification has been confirmed by examination of the colour pattern and by scanning electron microscopy of the male ligula (Gassmann and Richards, in prep.). R. *liberata* was previously known from two poorly preserved male specimens from the south-eastern Solomon Islands that are in the Leiden collection and a record from Guadalcanal and Ugi islands by Polhemus et al. (2008). Together with another new record from the RAP, i.e. *Nososticta africana* (Schmidt 1944; see below), this species represents an interesting and previously unsuspected biogeographical link between odonates of New Britain and the Solomon Islands. Previously only *Rhinocypha tincta semitincta*, a species from mainland south-eastern New Guinea was known from New Britain and this discovery raises new questions about West-Pacific odonate biogeography. We observed a male *Rhinocypha liberata* displaying to females with its beige-coloured tibiae as well as females ovipositing in wood just below the water surface.

Lestidae: *Lestes* Leach, 1815.

Two male specimens from Vouvou Camp are clearly conspecific with *L. pertinax*, a species described by Lieftinck (1932) from northern New Guinea (Jayapura area). This confirms Lieftinck's (1949) suggestion that the male from New Britain examined by Ris (1900) and listed as *L. praemorsa* could actually be conspecific with *L. pertinax*.

Protoneuridae: *Nososticta* Selys, 1860.

Careful examination of *Nososticta* specimens in our collection revealed two species: *N. commutata* (Lieftinck, 1938), and *N. africana* (Schmidt, 1944). The latter species was

Table 3.2. Checklist of Odonata documented in the surroundings of Goroka, Eastern Highlands Province, Papua New Guinea from April 30 to May 2, 2009.

Species	Mt. Gahavisuka	Gharegepauko	Goroka	IUCN status*
ANISOPTERA				
Corduliidae				
Procordulia astridae	X			NA
Libellulidae				
Diplacina hippolyte	X	X		NA
Lanthanusa sufficiens		X		NA
Orthetrum villosovittatum villosovittatum	X		X	NA
ZYGOPTERA				
Coenagrionidae				
Ichnura acuticauda		X		LC
Papuagrion digitiferum	X	X		NA

*NA = Not Assessed, LC = Least Concern

described as native to Africa due to a misinterpreted label of the type specimen in the Berlin Museum collection. According to Pinhey (1962), *N. africana* occurs in the Solomon islands.

As in the case of *Rhinocypha liberata*, our New Britain record of *N. africana* represents an interesting geographical range extension. Our material has also provided the opportunity to identify characters useful for distinguishing between *N. africana* and *N. salomonis*, a species thought to be widespread in mainland New Guinea, New Britain and the Solomons. We suspect that *N. salomonis* has been confused with the quite similar *N. africana* by previous researchers and that it probably doesn't occur in New Britain at all. The occurrence there of *N. nigrofasciata* (Lieftinck, 1932), the fourth *Nosoticta* species reported from New Britain, is also suspect and requires confirmation through collection of voucher material.

Anisoptera

Aeshnidae:

Gynacantha kirbyi

Species of the genus *Gynacantha* are crepuscular insects which fly after dusk and before sunrise (Silsby 2001). At least two of the specimens in our collection were caught at dark when they were attracted by the camp lights at Lamas and Vouvou.

Corduliidae: *Hemicordulia* Selys, 1870.

The single male specimen of *Hemicordulia cyclopica* collected near Vouvou Camp represents the first New Britain record of that species, which is otherwise only known from the Cyclops Mountains in northern mainland New Guinea (Lieftinck 1942).

The second *Hemicordulia* species in our collection is *H. hilaris*, which was previously known only from New Caledonia and Vanuatu (New Hebrides; Lieftinck 1975). Its documentation at Palmalmal and Vouvou therefore represents a considerable range extension. Lieftinck (1975) considered Fiji and Samoa likely to be part of this species' distribution and our data confirm that this species is quite widespread in the south-western Pacific. Surprisingly *H. oceanica*, a species known from the Solomons and doubtfully reported from New Britain by Lieftinck (1975) based on the examination of a single female specimen, was not encountered during this survey. In the Palmalmal area, the brilliantly green shiny metallic *H. hilaris* was seen perching on twigs not far from small streamlets.

Libellulidae: *Orthetrum*

***Orthetrum serapia* Watson, 1984**

Described as recently as 1984, *O. serapia* had not previously been recorded from New Britain. With *O. villosovittatum*, there are now two *Orthetrum* species known from the island.

***Zyxomma multinervorum* Carpenter, 1897**

Habitat requirements of this species appear to be largely unknown (Theischinger and Hawking 2006). A single male specimen was captured in the surroundings of Vouvou Camp.

Larval specimens

Our collection of odonate larvae will provide life-history data for a number of species. These specimens have not yet been examined thoroughly, except for the hemicorduliine larvae (typical high-altitude odonates) from Tompoi. The collection includes several libellulid and hemicorduliine larvae, and one aeshnid larva (genus *Anax*).

Other sightings and observations

At all three sites we observed anisopteran species that could not be collected, and the species total for each site is probably somewhat higher than presented here (Table 3.1). For

example at Tompoi Camp where we collected only an adult specimen of *Orthetrum villosovittatum* and some hemicorduliine larvae various team members reported seeing a conspicuous dragonfly flying through the camp(~1,600 m). The description given does not match any other dragonfly species sampled during the survey. Our brief encounters with another anisopteran species hawking around the helipad indicate (and therefore appear to confirm) the presence of corduliids,which are typically represented among high-altitude odonate assemblages in New Guinea.

At Lamas Camp fast-flying dragonflies, probably *Anax maclachlani*, became active as soon as the afternoon rain started, and appeared to be laying their eggs in small temporary ditches which quickly filled with rain water.

Sampling effects

Because of the paucity of surface water at all Nakanai camps and the average time of 6.3 days available for sampling at the three sites, it was possible to get a relatively comprehensive overview of the odonate fauna at accessible aquatic habitats at each camp. Despite this, suspected differences in phenology and observed differences in species abundance suggest that the spectrum of species observed and sampled is far from being complete. This is particularly likely for the Palmalmal area, where only two days were available for collecting. The comparatively species rich lowland creeks around Palmalmal were not originally scheduled for sampling due to the focus on more mountainous regions, and further studies in the southern lowlands should be rewarding. Sampling efforts in the Eastern Highlands also were restricted by time (2 days) and logistical constraints.

Comparison between sites

Zygoptera diversity was similar at Lamas and Vouvou (8 species and 10 species respectively) but no damselflies were found at Tompoi. A similar pattern was observed in the Anisoptera, with 11 species and14 species at Lamas and Vouvou respectively. Two anisopteran species were documented at Tompoi and at least one other unidentified species was observed there. Thus in total 19 species were identified at Lamas, 24 at Vouvou and 2 at Tompoi (Table 3.1). These results are only partially consistent with odonatological studies along altitudinal gradients elsewhere which generally show a steady decrease in species diversity from the lowlands to mid-elevations with species numbers decreasing exponentially from an altitude of 1,400 m upwards (Samways 1989). In our study, the higher species numbers at mid-elevation compared with the lower site is probably due to the somewhat more diverse range of aquatic habitats found near Vouvou Camp. However additional studies are needed to get a better insight into altitudinal patterns in odonate diversity in this poorly-known region.

Biogeography

With two new records of species formerly known only from the Solomon Islands Archipelago (*Nososticta africana*, *Rhinocypha liberata*), our results reveal an interesting biogeographical link between the Bismarck Archipelago and the Solomon Islands. As stated above, we also suspect that New Britain populations of '*Nososticta salomonis*', a species recorded from New Britain, the Solomons and the mainland of New Guinea (Lieftinck, 1949a) may actually be *N. africana*.

It is surprising that the colourful and conspicuous *Rhinocypha liberata* has not been reported previously from New Britain. Our discovery supplements the known record of *Rhinocypha tincta semitincta* from this island. It is possible that *Rhinocypha liberata* prefers higher altitudes than *R. tincta semitincta* and therefore was not encountered by previous collectors.

CONSERVATION ISSUES AND RECOMMENDATION

Although depauperate compared with the mainland New Guinea fauna, the odonates of New Britain include several noteworthy endemics, both among the Anisopterans and the Zygopterans (see Results section). Two of our new records, *Nososticta africana* and *Rhinocypha liberata*, are currently known only from New Britain and the Solomons. Given that the dragonfly fauna of New Britain is still poorly known, and since habitats similar to those investigated here occur in other mountain ranges like the Whiteman Range, it is possible that these two species occur more widely on the island.

The freshwater ecosystems of New Britain in general are an important target for conservation. Although the Nakanai Mountains as well as other New Britain mountain ranges have comparatively little surface water, they harbour a distinct odonate fauna. These ecosystems face threats from climate change which will change flow regimes and water availability in scarce freshwater habitats. Among other possible human impacts in the lower areas of New Britain in general and the Nakanai mountains in particular, are logging and forest clearing for plantation. According to satellite imagery (remote sensing), 12 % of the forest cover of the island has disappeared between 1989 and 2000, mainly in the process of clearing rainforest areas for oil palm plantations (Buchanan et al. 2007).

Although the steep mountain areas of New Britain have been less affected by logging than the lowlands, we expect that the pressure on the mountain forest will increase in the future. Only intact forest cover will help to preserve the fragile freshwater ecosystems in New Britain and the invertebrate fauna associated with them, and designation of the Nakanai Mountains as a World Heritage Area will be a vital first step in providing this critical protection.

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Appendix 3.1. Characteristics of sites sampled for odonates during the 2009 Nakanai Mountains RAP survey.
N/A = Not available (information not recorded).

Locality	Habitat	Dates	Coordinates	Elevation (m asl)
Lamas Camp	Lowland forest	April 3-8, 2009	05°36.853'S 151°24.483'E	200
Lamas Site 1	Several small pools in a narrow stream bed directly adjacent to the camp site. Substrate muddy, with considerable accumulated leaflitter. Partly sheltered by overhanging vegetation.	April 3-8, 2009	05°36.847'S 151°24.485'E	200
Lamas Site 2	Broad streambed ~ 100 m from Camp with much larger remnant pools than at Site 1	April 3-8, 2009	N/A	N/A
Lamas Site 3	Rocky stream with shallow stagnant areas surrounded by forest.	April 3-8, 2009	N/A	N/A
Stream between Irena Village and coast	Moderately fast flowing small sun-exposed river with stony banks and floating macrovegetation	April 8, 2009	N/A	N/A
Western banks of Matali River mouth, Jacquinot Bay between Marmar and Pomio	Partially shady banks with dense vegetation	April 10, 2009	N/A	0
Vouvou Camp	Hill forest	April 10-18, 2009	05°26.740'S 151°27.842'E	859
Vouvou Site 1	Partially shady pools in muddy streambed, leaf litter substrate.	April 10-18, 2009	N/A	~ 859
Vouvou Site 2	Small pond at edge of old logging road at Camp 2. Substrate muddy, partially covered by leaflitter and with algae slick.	April 10-18, 2009	05°26.776'S 151°27.856'E	~ 859
Vouvou Site 3	Large, deep pond in forest with steep banks. Thick layers of leaf litter, and floating macrovegetation and treetrunks.	April 10-18, 2009	05°26.572'S 151°27.994'E	N/A
Vouvou Site 4	Medium-sized pond, smaller than but otherwise similar to Site 3.	April 10-18, 2009	05°26.742'S 151°27.944'E	N/A
Tompoi Camp	Wet montane forest	April 19-25	05°20.623'S 151°18.875'E	1,590
Tompoi Site 1	Helipad on ridge above Tompoi Camp. No free-standing water	April 19-25	05°20.630'S 151°18.696'E	1,675
Tompoi Site 2	Small pools with semi-solid (karst or sedimental) substrate, mostly open and clear except for partial coverage by moss layers. Some muddy areas.	April 19-25	05°20.683'S 151°18.846'E	N/A
Tompoi Site 3	Dry stream bed a few metres wide with small puddles separated by rocky and coarse gravel stretches. Many broken tree trunks and quite dense riparian vegetation.	April 21	05°20.381'S 151°18.980'E	1,475
Palmalmal area 1st stream	Rocky, fast flowing stream	April 25	N/A	0
Palmalmal area 2nd stream	Rocky, fast flowing stream and associated trickles. Similar to but with more stagnant areas than 1st stream	April 26	05°38.891'S 151°30.577'E	0

Appendix 3.2. Characteristics of sites sampled for odonates around Goroka in Eastern Highlands Province following the 2009 Nakanai Mountains RAP survey. Goroka is at ~1,600 m elevation; remaining sites ~2,200-2,400 m.
N/A = Not available

Locality	Habitat	Dates	Coordinates
Gharegepauko	A few small streams and trickles	April 30, 2009	05°59.346'S 145°22.871'E
Mt. Gahavisuka Site 1*	Fast flowing small, shady mountain stream	May 1, 2009	N/A
Mt. Gahavisuka Site 2*	A large pond in swampy area close to lookout	May 1, 2009	N/A
Mt. Gahavisuka Site 3	Sample site at the road to Mount Gahavisuka Provincial Park below park entrance. Dense vegetation to either side of the track where sounds indicated a nearby river or creek.	May 1, 2009	06°01.23833'S 145°24.58667'E
Goroka	A fast flowing mountain stream running through the Pacific Estate compound.	May 2, 2009	N/A

*No dragonfly specimens collected, but listed here as a potential habitat