

New Records of Butterflies (Lepidoptera) from the Eastern Caroline Islands, Micronesia¹

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Abstract: Twenty-three new locality records are presented for nine species of butterflies (Lepidoptera) from 11 islands and island groups in the eastern Caroline Islands, Micronesia. None is endemic; most occur widely in the Indo-Australian region and the islands of the western Pacific. The Lycaenidae were the most well-represented family with at least eight species. The nymphalid *Hypolimnas bolina* was the most frequently encountered species, occurring on all 11 island groups. Pakin Atoll, which was visited on two different occasions for a total of 5 days, was the only island group visited during this study where butterflies were not seen.

THE BUTTERFLY FAUNA of Micronesia has never been comprehensively assessed. Many of the specimens collected during the Insects of Micronesia Project outlined by Gressitt (1954) were apparently lost after being sent on loan overseas (S. E. Miller in Buden and Miller 2003), and no article on butterflies was ever published in the Insects of Micronesia series. Schreiner and Nafus (1997) summarized what little is known of the ecology and distribution of species among the major islands and island groups of greater Micronesia, including the Mariana Islands, Caroline Islands, and Marshall Islands. Buden and Miller (2003) augmented the list of species from Pohnpei, but the other Caroline Islands, especially the atolls, have remained largely unsurveyed. The study reported here

contributes new locality records based largely on recent collections and observations from eight different islands and island groups in the eastern Caroline Islands intermittently between November 2001 and August 2003, plus supplementary material from the Bishop Museum and a small, hitherto-unreported collection in the College of Micronesia Land Grant Office (Kolonia, Pohnpei).

Study Area

The Caroline Islands span approximately 3,200 km across the West-central Pacific Ocean from Palau eastward to and including all of the Federated States of Micronesia (FSM): Yap, Chuuk (formerly Truk), Pohnpei, and Kosrae States (Figure 1). Pohnpei (355 km², 791 m high) and Kosrae (109 km², 630 m high) are the largest of the eastern Carolines. Chuuk proper approaches atoll status and comprises 19 volcanic islands (the largest is Tol: 34.2 km², 443 m high) within a lagoon (2,130 km²) enclosed by a reef and its associated coral islets. Tropical rainforest in various stages of degradation (less degradation on Pohnpei and Kosrae, more on Chuuk) covers most of the slopes of the higher islands. Cloud forest lush in terrestrial and epiphytic mosses and ferns occurs on the highest summits and ridgelines on Pohnpei and Kosrae. Agroforest and secondary woodlands predominate at the lower elevations throughout and mangroves are common

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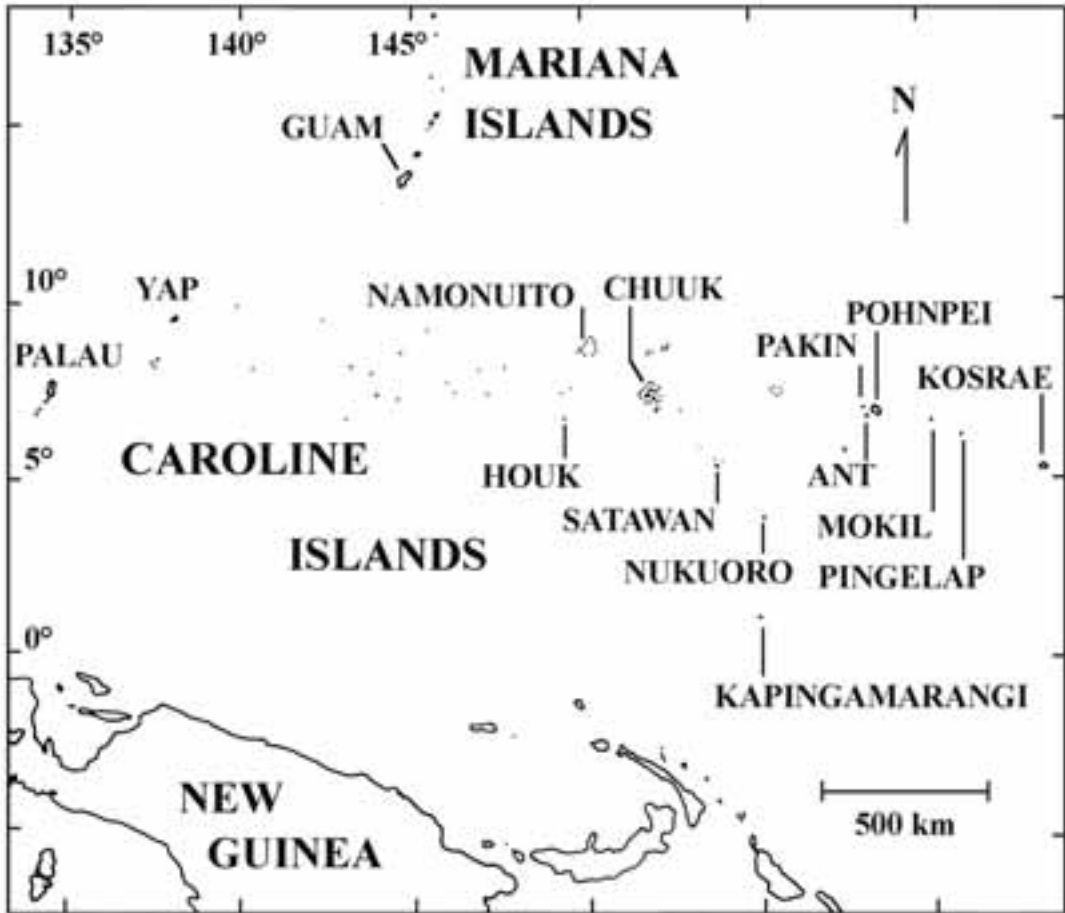


FIGURE 1. Location of the Caroline Islands.

along the shore. The average annual rainfall ranges from about 363 cm in Chuuk (Merlin and Juvik 1996) to 1,015 cm estimated in the mountains on Pohnpei (Merlin et al. 1992).

The land area on the numerous, widespread, low (1–4 m high) coralline atolls is miniscule. Satawan Atoll in the Mortlock Islands, southern Chuuk State, has the largest total land area, with 4.6 km² distributed among approximately 49 islets (Bryan 1971). Houk (= Pulusuk Atoll), a lone islet west of Chuuk Lagoon, is the largest single island (2.8 km²) among all of these outliers. Coconut (*Cocos nucifera*) and breadfruit (*Artocarpus*

spp.) are the dominant trees on all but the smallest atoll islands, where coastal scrub and strand predominate. All of the islands fall within the equatorial rain belt and are wet enough to support a mesophytic vegetation (Mueller-Dombois and Fosberg 1998). All of the atolls visited during this survey are inhabited or (in the case of Ant Atoll) have been so in the recent past. Ornamental shrubs, trees, and herbs are common in the settlements, which are usually located on one or several of the larger islets; the others are visited frequently to harvest coconuts, crabs, and other forest products used by the community.

MATERIALS AND METHODS

Butterflies were collected by D.W.B. when the opportunity arose during biological surveys of several different taxonomic groups, including birds, reptiles, odonates, and millipedes, on Chuuk Lagoon islands (20 June–2 July 2003), Onoun Island, Namonuito Atoll (3–7 January 2003), Houk Island (26 December 2002–2 January 2003), Satawan Atoll (17–26 December 2002, 7 July–1 August 2003), Pakin Atoll (7–9 August 2002, 5–7 November 2003), Ant Atoll (28–31 March and 16–18 November 2001, and 10–11 May, 7–8 September, and 6–9 November 2002), Mokil Atoll (29 July–2 August 2002), Pinge-lap Atoll (29 March–1 April and 13–16 December 2002), and Kosrae (20 June–6 July 2002). Specimens have been deposited in CSIRO Long Pocket Laboratory (Indooroopilly, Australia) and The Natural History Museum (London). Sight records are enclosed in square brackets.

SPECIES ACCOUNTS

Family PIERIDAE

Catopsilia pomona (Fabricius)

Ranges widely from Madagascar to the Solomon Islands, Vanuatu, and Fiji. It has been recorded in western Micronesia on Palau and the Mariana Islands (Schreiner and Nafus 1997), and Buden and Miller (2003) recorded it from Pohnpei in the eastern Carolines. One collected at Utwa village and another along the Utwa-Walung road on 1 July 2002, both apparently attracted to nearby *Cassia alata*, are the first reports from Kosrae. Others were observed occasionally along roadsides in different parts of the island during 20 June–6 July.

[*Catopsilia pyranthe* (Linnaeus)]

[Ranges widely from Southeast Asia southward to Indo-Australia and to as far east as Fiji (W.J.T., unpubl. data). Schreiner and Nafus (1997) recorded it in Micronesia in Palau and Yap, and Buden and Miller (2003) recorded it on Pohnpei. One seen along the Utwa-Walung road on 1 July 2002 is the only

record from Kosrae, but this sight record requires confirmation.]

Family LYCAENIDAE

Catochrysops panormus (C. Felder)

Ranges widely from India and Sri Lanka through Indonesia to eastern Australia, and in the Pacific as far east as the Society Islands (Tite 1959, Seki et al. 1991, Braby 2000). In Micronesia, it has been recorded on Guam (Parsons 1998) and Pohnpei (Buden and Miller 2003). During this study, *C. panormus* was common on Nikalap Aru Island (Ant Atoll) and on Houk, Chuuk State. It was less common on Onoun, Namonuito Atoll, where only one was collected and few others were seen. Nearly all were in coastal strand and forest edge where *Canavalia* sp. and *Vigna marina* vines were common. These are the first records from among the atolls of Micronesia.

Euchrysops cnejus (Fabricius)

Ranges from India through Southeast Asia to New Guinea, Australia, and the western Pacific islands as far east as Fiji and Tonga. Schreiner and Nafus (1997) recorded it in the western Carolines in Palau and Yap. We report it from the eastern Carolines for the first time based on three previously unreported specimens in the Bishop Museum: one from Dublon (= Tonoas) Island, Chuuk, and another from Kusaie (= Kosrae), both collected by Z. Ono in January 1936, and another from Pohnpei collected by P. A. Adams in 1950.

Jamides sp. (*bochus* group)

More than 20 names have been proposed for the *Jamides bochus* species group in the Pacific Islands, and the taxonomy and species limits within this complex are unresolved. Schreiner and Nafus (1997) recorded *J. bochus* (Stoll) in Micronesia on Palau and Pohnpei. No example of this group was found on Pohnpei during a more recent survey (Buden and Miller 2003). However, 28 collected during two different visits to Satawan Atoll (December 2002, July 2003) are the first reports for Chuuk State. They were in open,

weedy areas and nearly always on or in close proximity to the vine *Vigna marina*.

Lampides boeticus (Linnaeus)

Ranges widely from Africa and Europe to the Orient, Hawai'i, Indo-Australia, and the Pacific Islands as far east as Fiji and Tonga. Schreiner and Nafus (1997) recorded it in Micronesia only as far east as Chuuk, but Sugarman (1979) recorded *Lampides* sp. from Kwajalein Atoll in the Marshall Islands, and Samuelson and Nishida (1987:165) referred to this record as "probably *L. boeticus*." Only two were encountered during this survey: one collected on Tonoas, Chuuk Lagoon, on 27 June, and the other on Ta Island, Satawan Atoll, on 16 July 2003.

Zizula hylax (Fabricius)

Widespread in the Pacific and previously recorded in Micronesia as far east as Pohnpei (Buden and Miller 2003). Eight specimens collected on Kosrae during this study are new island locality records, and three from Satawan are the first reported from an eastern Carolines atoll.

Family NYMPHALIDAE
Subfamily DANAINAE

Danaus plexippus (Linnaeus)

Ranges widely in tropical and temperate zones throughout the world, excluding Africa. Schreiner and Nafus (1997) recorded it on nearly all major islands and island groups in Micronesia. Kosrae was not included in the body of their work, although it was included, with an unexplained question mark, in a tabulated list. Aside from acknowledging a report from Pohnpei by Walker (1914), *D. plexippus* was not reported from the Carolines by Ackery and Vane-Wright (1984). The Bishop Museum has two specimens from "Kusaie," one collected by Z. Ono on 24 January 1936 and another by H. K. Townes on 19 August 1946. During this study, *D. plexippus* was encountered regularly (up to four to five sightings per day) in the settlements on Kosrae, mainly along the eastern shore and on Lelu Island, which is connected to the main island by a causeway. The time

and mode of its initial arrival and colonization of Kosrae (and elsewhere in the Pacific) is unknown, but the species is known to have spread across the whole of the Pacific from about the 1840s (Vane-Wright 1993). It may have reached Pohnpei via a ship from Hawai'i, as suggested by Scudder (1875), or as a direct result of its migrating ability in tracking the spread of *Asclepias* (milkweed) host plants brought through trade (Vane-Wright 1993).

One seen on Deke Island, Pingelap Atoll, on 30 March 2002 (D.W.B.) is the only record for an eastern Carolines atoll. It flew among coastal shrubs and small trees on this uninhabited islet, alighting on the foliage briefly from time to time over several minutes before disappearing from view. No potential host plants were seen in the area. In all probability it was a vagrant from one of two adjacent high islands, Pohnpei (where it is now resident) or Kosrae (where it is presumed to be resident).

Subfamily NYMPHALINAE

Hypolimnas bolina (Linnaeus)

Ranges widely from Madagascar to New Zealand and numerous, small islands of the Pacific, including all the high islands and many atolls of Micronesia (Schreiner and Nafus 1997). It has reached as far east as Henderson and Pitcairn Islands and is often the only butterfly species recorded from some remote Pacific islands. It was the most frequently encountered species during this study and was absent only from Pakin Atoll, where no butterflies were observed on two separate visits. It was usually seen in ruderal habitats, most often among species of Asteraceae. The records for Nukuoro and Kapingamarangi Atolls are based on specimens collected by Dr. Nelson Esguerra in December 1987 and are a part of a small collection of insects at the College of Micronesia Land Grant Office in Kolonia. Niering's (1956:18) statement that "in the more open areas [on Kapingamarangi] a larger lepidopteran (butterfly) is relatively common" probably also refers to this species. The insects collected on Kapingamarangi during the expedition in which Niering par-

anticipated were to have been deposited in the USNM (Niering 1963), but none could be found in the museum collections, and there is no evidence to indicate that the specimens were ever deposited (R. Robbins, pers. comm.).

DISCUSSION

Of the 18 species of butterflies in five different families recorded in the eastern Caroline Islands (Table 1), eight (44%) are Lycaenidae (there are 19 species [nine lycaenids] if the occurrence of *Catochrysops amasea* Water-

house & Lyell on Chuuk reported by Schreiner and Nafus [1997] is not based on misidentified material). Four of the lycaenids (*Catochrysops panormus*, *Jamides* sp. [*bochus* group], *Lampides* sp., and *Zizula hylax*) and the nymphalid *Hypolimnas bolina* are the only resident or presumed resident species recorded on the atoll islands; a lone Monarch seen on Pingelap was probably a waif. The lycaenids were most numerous in strand vegetation, especially among the legume vines *Vigna marina* and *Canavalia* sp. The family Nymphalidae is represented by five species in the eastern Carolines, the Pieridae by three,

TABLE 1
Butterfly Species Recorded from the Eastern Caroline Islands

Species	Chuuk Lagoon Islands	Chuuk State Atolls ^a			Pohnpei State Atolls ^b					Pohnpei	Kosrae
		Nam	Hou	Sat	Ant	Nuk	Kap	Mok	Pin		
Hesperiidae											
<i>Badamia exclamationis</i> (Fabricius)										+	
Papilionidae											
<i>Papilio xuthus</i> (Linnaeus)											+
Pieridae											
<i>Catopsilia pomona</i>										+	+*
<i>Catopsilia pyranthe</i>										+	SR ^c
<i>Eurema becabe</i> (Linnaeus)	+										+
Lycaenidae											
<i>Acytolepis puspa</i> (Horsfield)										+	
<i>Catochrysops panormus</i> ^d	+*	+*	+*		+*					+	
<i>Euchrysops cnejus</i>	+*									+*	+*
<i>Jamides</i> sp. (<i>bochus</i> group)										+	
<i>Lampides boeticus</i>	+										+*
<i>Megisba strongyle</i> Felder	+										
<i>Zizina otis</i> (Fabricius)	+									+	
<i>Zizula hylax</i>	+									+	+*
Nymphalidae											
Danainae											
<i>Danaus plexippus</i>	+									SR ^c	+
Nymphalinae											
<i>Hypolimnas bolina</i>	+	+*	+*	+*	+*	+*	+*	+*	+*	+	+
<i>Hypolimnas pitheoeka</i> Kirsh										+	+
<i>Junonia villida</i> (Fabricius)	+									+	
Satyrinae											
<i>Melanitis leda</i> (Linnaeus)	+									+	+

Sources: Schreiner and Nafus (1997) for Chuuk and Kosrae; Buden and Miller (2003) for Pohnpei.

^a Nam, Namonuito; Hou, Houk; Sat, Satawan.

^b Nuk, Nukuoro; Kap, Kapingamarangi; Mok, Mokil; Pin, Pingelap.

^c SR (sight record) only.

^d The report of *C. amasea* in the Caroline Islands by Schreiner and Nafus (1997) may be based in part or in whole on misidentified *C. panormus*, which was not listed in their work. In the absence of confirmed documentation, *C. amasea* is omitted from the list.

* First report, this study.

and the Hesperidae and Papilionidae by one each. However, *Papilio xuthus* may be extirpated throughout its Micronesian range thus leaving papilionids currently unrepresented (Schreiner and Nafus 1997).

All the species recorded in the eastern Carolines are widely distributed among the islands of Oceania and within the larger landmasses of Southeast Asia and Indo-Australia to the west, geographically the most likely sources for Micronesian populations. Munroe (1996:276) considered the tropical Asian and Indo-Australian regions as the primary "ultimate sources of the lepidopteran fauna for the vast Pacific area." The Micronesian islands exhibit progressive diminution in butterfly species number eastward into the more remote regions of the Pacific—43 in the western Carolines (Palau and Yap), at least 18 in the eastern Carolines (Chuuk, Pohnpei, Kosrae), and only five in the Marshall Islands. Adler and Dudley (1994:159) stated that "isolation generally is the most important [geographic variable] in explaining butterfly species richness among tropical Pacific islands," and Munroe (1996:293) similarly regarded "the proximity to source of recruitment" as a particularly important factor in determining the numbers of indigenous pyraloid moth species in Micronesia. The broad distribution of Micronesian butterflies, however, impedes assessment of patterns of origin and distribution for specific island groups such as the Carolines. Colonization may have been more complex than a progressive attenuation of species west to east across "stepping-stone" islands into the more distant areas of the Pacific. Regarding pyraloid moths of the Carolines, for example, Munroe (1996:293) stated "Philippine, Micronesian, and especially Papuan elements" are important components of the Palauan fauna, but "the picture is not so clear" for the FSM states, where "there are species of Micronesian, Central Pacific, and Philippine derivation, but the majority are of indeterminate origin."

The low number of species (five) for the Marshall Islands (all of which are atolls or low, single islets) is in large measure likely a combined distance/area effect (see, e.g., Mac-

Arthur and Wilson 1967). However, the species assemblage found in the Marshalls differs from that of the atolls of the eastern Carolines. *Hypolimnas bolina* is the only species confirmed as common to both areas. Three Marshall Islands species (*Badamia exclamatoris*, *Danaus plexippus*, and *Junonia villida*) occur on one or more of the high islands of the eastern Carolines but not on the atolls, and lycaenids, a major component of the Caroline atolls fauna, are seemingly scarce in the Marshalls; none was recorded by Schreiner and Nafus (1997), although Sugarman (1979) recorded *Lampides* sp. on Kwajalein. To what extent these geographic differences in species assemblages and number are real or a reflection of incomplete surveys and sampling bias is uncertain.

The apparent absence of butterflies on Pakin Atoll, Pohnpei State, on two different visits is unexpected and very likely an artifact of sampling. The flora of Pakin is typical of that of other low islands in this region, and the atoll is in close proximity to Pohnpei, which has the largest number of butterfly species of any island in the eastern Carolines. Rain and strong winds during much of the first visit doubtlessly contributed to the lack of records, though sunshine and windless conditions prevailed during the second.

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