

ODONATA OF DINAGAT ISLAND, THE PHILIPPINES: UPDATED SPECIES LIST AND NOTES ON CONSERVATION OF SPECIES AND HABITATS

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Abstract – 69 spp. were recorded from the island in 2007-2008, raising the number of the known spp. up to 83, but 12 spp. from the 1997 list of M. Hämäläinen & R.A. Müller (*Odonatologica* 26: 249-315) were not recorded during the present survey. 7 spp. and 3 sites are con-

sidered important from conservation viewpoint.

Introduction

Dinagat Island is the third largest island in the Mindanao biogeographic sub-region. It is lo-

cated North from the northeastern Mindanao and is the home of several interesting species of flora and fauna including Odonata.

According to HÄMÄLÄINEN & MÜLLER (1997), the first dragonfly record from the island was made in 1915, when a specimen of *Amphicnemis cantuga* was collected by G. Boettcher. NEEDHAM & GYGER (1939) added another two Zygoptera species. Study of the large material in Roland A. Müller's collection, collected in the North of the island during 1988-1990, raised the number of the known species to 62, including four undetermined species: two *Amphicnemis*, an *Oligoaeschna* and a *Chlorogomphus* species (HÄMÄLÄINEN & MÜLLER, 1997).

Presently, a significant portion of the land area in eastern Mindanao and the islands North of it (Siargao, Nonok and Dinagat) are under mining concessions. In the island of Dinagat, 3 large mining companies are in place for nickel and chrome ore mines along with several groups undergoing exploratory, small-scale mining activity for the same minerals including gold and manganese. These mining firms have a land claim on almost the entire eastern half of the island while the rest of the island is categorized as mining land by the Philippine government.

Odonatological exploration of Dinagat Island is restricted to the northern part of the island, mostly around the municipality of Loreto. The southern region lacks odonatological data to date. The area in the North has a good forest cover and could still hold several undocumented species. This implies a need for further exploration while good forest cover is still present. Though the island is under mining concession, an attempt is made to characterize sites important for conservation that should be reclassified as protected zones. Selected species are also included for immediate conservation action.

The Dinagat species and locality data from R.A. Müller collection, now in Naturalis-Leiden, are also included in this paper.

Methods

The field work was conducted on an opportunistic basis visiting as many sites as possible when weather and free time permitted. The sur-

vey work started in the 1st week of October 2007 and lasted until the end of October 2008. Voucher specimens were collected of species not frequently encountered. Otherwise, species were recorded on sight or netted for identification and then released. The air-dried or acetone-dried specimens are kept in the author's personal collection.

List of localities

Localities visited by A. Buenafe during 1988-1990, all in the Loreto municipality (from R.A. Müller collection):

- (A) Bali-bali river, Esperanza
- (B) Balitbiton river, Mt. Canbinliw
- (C) Canbinliw river, Mt. Canbinliw
- (D) Danao lake
- (E) Danao lake (big)
- (F) Danao lake (small)
- (G) Maribo river
- (H) Midas river, Mt. Redondo
- (I) Mt. Canbinliw
- (J) Mt. Redondo
- (K) Mt. San Ramon, Layonggan
- (L) Mt. Tristan
- (M) Pagtabanan river
- (N) Sinayao

Localities visited during the present survey (Nos 1-59 from the Loreto municipality, the others as stated in brackets):

- (1) Rice field, Campintak, Brgy. Panamaon
- (2) Coastal creek, Campintak, Brgy. Panamaon
- (3) Coastal swamp, Campintak, Brgy. Panamaon
- (4) Settling pond, Acoje, Brgy. Panamaon
- (5) Spring, Acoje, Brgy. Panamaon
- (6) Small river, Acoje, Brgy. Panamaon
- (7) Streams and rivulets, Umasdang Daku, Acoje, Brgy. Panamaon
- (8) Streams and rivulets, Umasdang Gamay, Acoje, Brgy. Panamaon
- (9) Creeks and springs, Guintabuan, Acoje, Brgy. Panamaon
- (10) I Coastal creeks, Brgy. Panamaon
- (11) II Coastal creeks, Brgy. Panamaon
- (12) Coastal swamps, Brgy. Panamaon
- (13) Stream, Brgy. Panamaon
- (14) Creek, Brgy. Panamaon
- (15) Mini-waterfall, Brgy. Panamaon

- (16) Rivulets along the road, Brgy. Panamaon
 (17) Abandoned rice field, Layonggan, Brgy. Panamaon
 (18) Mangrove area, Layonggan, Brgy. Panamaon
 (19) Coastal pond, Layonggan, Brgy. Panamaon
 (20) River, Layonggan, Brgy. Panamaon
 (21) Midas river, Midas Brgy, Esperanza
 (22) Swamp, Midas, Esperanza
 (23) Pagtabanan river, Pagtabanan, Esperanza
 (24) Pond, Pagtabanan, Esperanza
 (25) Stream, Pagtabanan, Esperanza
 (26) Linao, Brgy. Esperanza
 (27) Creek, Sinayao, Brgy. Esperanza
 (28) Maribo river, Brgy. Esperanza
 (29) Bali-bali river, Brgy. Esperanza
 (30) Settling ponds, Chrominco mining site, Mt. Redondo
 (31) Rivulets, Chrominco mining site, Mt. Redondo
 (32) River, Chrominco mining site, Mt. Redondo
 (33) Streams, bonsai field, Chrominco mining site, Mt. Redondo
 (34) Settling pond, Naradico area bordering Chrominco, Mt. Redondo
 (35) Balitbiton river, Canbinliw, Brgy. Santiago
 (36) Canbinliw river, Canbinliw, Brgy. Santiago
 (37) Rice field, Canbinliw, Brgy. Santiago
 (38) Swamp, Canbinliw, Brgy. Santiago
 (39) Irrigation canal, Canbinliw, Brgy. Santiago
 (40) Ponds, Canbinliw, Brgy. Santiago
 (41) Mangrove, Brgy. Carmen
 (42) Rice field, Brgy. Carmen
 (43) Creek, Brgy. Carmen
 (44) Swamp, Brgy. Carmen
 (45) Stream, Brgy. Carmen
 (46) Spring, Brgy. Carmen
 (47) Loreto District Hospital ground, Brgy. Carmen
 (48) Swampy creek, Buyo, Brgy. Sta. Cruz
 (49) Rice field, Brgy. San Juan
 (50) Pond and creek, Brgy. San Juan
 (51) Road puddles, Brgy. San Juan
 (52) Rivulet, Kandiis, Brgy. San Juan
 (53) Creek, Kandiis, Brgy. San Juan
 (54) Rice field, Kandiis, Brgy. San Juan
 (55) Stream, Tabunan, Brgy. San Juan
 (56) Danao Gamay, Brgy. San Juan
 (57) Road puddles, Brgy. Ferdinand
 (58) Danao Daku, Brgy. Ferdinand
 (59) Rivulets, Brgy. Ferdinand
 (60) Rice field, Brgy. Sta. Cruz (Tubajon)
 (61) Creek, Brgy. Sta. Cruz (Tubajon)
 (62) Creeks, Brgy. Mabini (Tubajon)
 (63) Swamp, Brgy. Mabini (Tubajon)
 (64) Abandoned rice fields, Danapa, Brgy. Mabini (Tubajon)
 (65) Pond, Danapa, Brgy. Mabini (Tubajon)
 (66) Lecing river, Danapa, Brgy. Mabini (Tubajon)
 (67) Spring and stream, Danapa, Brgy. Mabini (Tubajon)
 (68) Waterfall and its surrounding areas, Bangkaw, Brgy. Diaz (Tubajon)
 (69) Ricefield, Brgy. Diaz (Tubajon)
 (70) Creek, Brgy. Diaz (Tubajon)
 (71) Mangrove, Dunggoan, Brgy. Diaz (Tubajon)
 (72) Spring, Dunggoan, Brgy. Diaz (Tubajon)
 (73) Henry river, Paragua Forest Reserve (Libjo)
 (74) Paragua 1 river, Paragua Forest Reserve (Libjo)
 (75) Creeks, Paragua Forest Reserve (Libjo)
 (76) Large pond, Paragua Forest Reserve (Libjo)
 (77) Springs, Paragua Forest Reserve (Libjo)
 (78) Rivulets, Paragua Forest Reserve (Libjo)
 (79) Spring, Albor District Hospital (Libjo)
 (80) Rice field, Tagabaka (Basilisa)
 (81) Surrounding area, Dinagat District Hospital (Dinagat)
- Annotated list of species known from Dinagat Island**
 (* new record; - ** not recorded 2007-2008)
A m p h i p t e r y g i d a e
 - *Devadatta podolestoides basilanensis* Laidlaw, 1934 (1♂) [E, 68]
 This is endemic in Mindanao subregion. It is a strict forest specialist that prefers moist, shaded ground. The species was not found at the site visited during 1988-1990.

Chlorocyphidae

- *Cyrano angustior* Hämäläinen, 1989 [A,B,H,I,J,5,7,8,23 67,68,73,74,75]

The genus is endemic in the Philippines with two representatives. The species occurs in low numbers and prefers shady habitat, perching on twigs above or at some distance from the waterways.

- *Rhinocypha colorata* (Hagen in Selys, 1869) [A,B,C,L,5,6,7,8,9,13,15,20,21,23,25,26,27,28,29,32,35,36,43,45,46,53,55,61,62,67,68,70,73,74,75,79]

Widely distributed Philippine endemic. The most frequent morph in Dinagat is similar to the Cebu and Bohol form. The species seems to tolerate relatively disturbed areas.

- *Rhinocypha turconii* Selys, 1891 [A,B,C,G,H,I,J,K,M,5,6,7,8,9,20,23,27,28,29,35,36,68,73,74,75,77]

It is a widely distributed Philippine endemic except for Palawan region. Unlike its congener, the species prefers less disturbed habitat. The individuals in the Dinagat populations are relatively smaller than those from neighboring islands.

Calopterygidae

- *Vestalis melania* Selys, 1873 [A,B,C,H,I,J,K,L,M,6,7,8,9,10,23,27,28,29,68,73,74,75]

The species is a widely distributed Philippine endemic except for Palawan region. It prefers open or partly shaded streams and rivers.

Coenagrionidae

- *Agriocnemis f. femina* (Brauer, 1868) [B,C,D,E,F,I,1,2,3,4,10,11,12,13,14,17,18,22,37,38,39,40,41,42,43,44,47,48,49,50,54,55,60,61,62,63,64,65,69,70,71,79,80,81]

The most dominant damselfly in the island, noted in open grassy areas though occurring in low numbers also in mangrove and at forest edges.

- **Agriocnemis pygmaea* (Rambur, 1842) [1,2,3,4,10,11,12,13,14,17,18,22, 37,38,39,40,41,42,43,44,47,48,49,50,54,55,60,61,62,63,64,65,69,70,71,79,80,81]

Though a widely distributed oriental species, it is recorded for the first time from the island. It has similar habitat preference as its congeners.

- **Amphicnemis* cf. *dentifer* (Needham & Gyger, 1939) [18,58,76]

Greater Mindanao (East Visayan and Mindanao subregion) endemic. It bears close resemblance to *A. dentifer* but differs in some details and could represent a new species.

- *Amphicnemis* cf. *cantuga* (Needham & Gyger, 1939) (6♂, 1♀) [B,D,H,I,M,N,43, 56,58,73] Greater Mindanao endemic. All specimens were associated with *Pandanus* plants occurring in forested areas. It closely resembles *A. cantuga* but differs in the position of R2 and IR1 from the wing illustration in NEEDHAM & GYGER (1939).

- *Amphicnemis* sp.n 1. [43,44,45,46,53,56]

The species is found at a small stream running from coconut farms to undisturbed areas. It occurs also in areas with no water other than that trapped in rock crevices and axils of some plants, suggesting a phytothelmatan habit.

The two *Amphicnemis* species listed as *Amphicnemis* sp. [(44) Balitbiton river] and [(47) Danao lake] by HÄMÄLÄINEN & MÜLLER (1997) could not be compared with the two new species. At the moment it is not known whether these are similar to our material or represent another species.

- *Amphicnemis* sp.n. 2 (5♂) [7,67,68]

It is similar to the previous species though longer and it has a reddish spot on synthorax. This is a solitary species, with a single individual occupying a suitable habitat compared to the previous species that occurs in groups.

- *Argiocnemis rubescens intermedia* Selys, 1877 [D,12,10,13,14,24,43,44,48,50,54,55,62,63,70,76,80]

- ***Ceriagrion lieftincki* Asahina, 1967 [D,E]

The record is based on several specimens collected from Danao area. This widely distributed Philippine endemic prefers pond and swampy habitats, where it hides among reeds and other tall grasses.

- *Ischnura senegalensis* (Rambur, 1842) [D,1,2,10,11,12,17,18,22,24,37,39,41,42,48,49,50,54,60,64,69,80]

- **Pseudagrion microcephalum* (Rambur, 1842) (1♂) [58]

This widely distributed oriental species was noted only once during the observation period.

– *Pseudagrion p. pilidorsum* (Brauer, 1868) [A, B, C, E, H, 2, 10, 11, 13, 14, 25, 26, 27, 33, 35, 36, 43, 45, 50, 53, 55, 58, 61, 62, 63, 70, 73, 79]

– *Teinobasis annamaijiae* Hämäläinen & Müller, 1989 (1 ♂) [B, I, J, L, 74]
Forest specialist endemic in Mindanao subregion. It occurs in low numbers in comparison with similarly preferred areas in Mindanao.

– **Teinobasis filamentum* Needham & Gyger, 1939 (5 ♂, 1 ♀) [44, 75]
Greater Mindanao endemic, noted in relatively disturbed to pristine streams with muddy substrate.

– **Teinobasis* sp.n.1 (3 ♂, 1 ♀) [18, 41]
Perhaps one of the most critically threatened species, restricted to the mangrove swamp in the town of Loreto. Most of the surrounding area is already converted to paddies and clearing of mangrove and Nipa is currently ongoing.

– **Teinobasis* sp.n.2 (8 ♂, 2 ♀) [18]
It is known from two mangrove swamps in Loreto and is the dominant damselfly in the area but faces the same threat as the preceding species.

– *Xiphiagrion cyanomelas* Selys, 1876 [D, E, I, 58, 65]
The species is noted on wings in large numbers between June and October though occurring in low numbers throughout the year.

Euphaeidae

– *Euphaea amphicyana* Ris, 1930 [A, B, C, G, H, I, J, K, L, M, N, 5, 6, 7, 8, 9, 15, 23, 68, 73, 74, 75, 77]
Greater Mindanao endemic. It has a similar habitat as *Vestalis melania*, with preference for more intact surroundings. The individuals in the Dinagat populations are distinctly smaller than those from Mindanao. The metallic wing reflection is also patterned differently.

Lestidae

– *Lestes p. praemorsus* (Selys, 1862) (1 ♂, 1 ♀) [E, 56, 76]
It occurs in very low numbers, preferring shady ponds with muddy substrate.

Megapodagrionidae

– **Rhinagrion philippina* (Selys, 1882) (6 ♂, 1 ♀) [67, 73, 74]
Lowland forest Philippine endemic. It occurs

in low numbers. Its Dinagat habitat is currently disturbed by mining operations.

Protoneuridae

– *Prodasineura integra* (Selys, 1882) [C, D, E, H, 2, 10, 11, 13, 14, 15, 20, 21, 23, 25, 26, 27, 28, 29, 35, 36, 43, 45, 46, 50, 53, 55, 58, 61, 62, 70, 72, 73, 79]
Widely distributed Philippine endemic except for Palawan region. This running water species seems to be the most tolerant to disturbance among the Philippine species that thrive in similar habitats.

Platystictidae

– *Drepanosticta lestoides* (Brauer, 1868) (4 ♂) [C, 68, 73, 74]
Greater Mindanao endemic. Unlike its congeners in the island that perch near the ground, this forest species perches a few feet above the ground in shady areas and occurs in low numbers.

– **Drepanosticta megametta* Cowley, 1936 (2 ♂) [67, 68]
Mindanao subregion endemic. The species was described nearly 70 years ago based on material collected in 1915. Since then no further material was available until now when a specimen was found 15 m from a river heavily disturbed by mining, and another teneral male from a site that was recently opened for mining.

– *Drepanosticta mylitta* Cowley, 1936 [N, 8, 25, 27, 46, 52, 67, 68, 78]

Fairly distributed species in eastern central part of the archipelago. This forest specialist is frequent on moist forest floor and at rivulets. A variable species, the Dinagat population has closer resemblance to Leyte and Biliran populations and it is distinct from the Cebu population which is much larger.

Platycnemididae

– *Coelliccia dinocerus* Laidlaw, 1925 [B, 7, 8, 9, 23, 25, 27, 57, 68, 73, 74, 75, 77]
Greater Mindanao endemic. A forest specialist able to tolerate relatively disturbed habitats as long as clear running water and partial shade are maintained.

– *Risiocnemis appendiculata* (Brauer, 1868) [B, C, I, J, 5, 7, 8, 9, 13, 15, 16, 20, 21, 23, 25, 27, 45, 46, 53, 55, 67, 68, 73, 74, 75, 77, 78, 79]
Greater Mindanao endemic. The species is a forest specialist. The genus is Philippine en-

demic with over 40 described species under two subgenera that prefer forested habitats.

- *Risio cnemis calceata* Hämäläinen, 1991 [B,7, 9,67,68,75,77]

Dinagat and Panaon islands endemic. Solitary, strict forest specialist that prefers heavily shaded habitats besides rivulets.

- *Risio cnemis flammea* (Selys, 1882) [A,B,C, E,F,I,5,7,8,9,15,16,25,27,31,45,46,53,55,67, 68,73,74,75,77,78,79]

Greater Mindanao endemic.

- *Risio cnemis fuligifrons* Hämäläinen, 1991 [B,C,H,31,45,46,74,77]

Greater Mindanao endemic.

- **Risio cnemis nigra* Gassman & Hämäläinen 2002 [7,31]

The species was previously known only from the island of Samar. It has a unique microhabitat, preferring shaded vertical surfaces of moist boulders or seepage in upland areas (>400 a.s.l.).

- *Risio cnemis praeusta* Hämäläinen, 1991 [B,C, D,E,G,H,I,J,K,L,6,7,8,9,20,21,23,25,27, 28,29,35,36,67,68,73,74,75]

It is the predominant damselfly in Dinagat Island forests and sometimes encountered several meters from the water, whereas the other members of the genus in the island occur always in the immediate vicinity of water.

- ***Risio cnemis rubripes* (Needham & Gyger, 1939)

Mindanao subregion endemic. No new material from the Dinagat is available since the type material was collected.

Aeshnidae

- **Anax guttatus* (Burmeister, 1839) (1♂, 1♀) [42,64]

The two specimens were collected from a pond formed by damming a stream for mining purposes. The small pond has muddy substrate, surrounded by secondary vegetation about a meter in height.

- *Gynacantha bayadera* Selys, 1891 (1♂, 1♀) [D, G,N,47]

- **Gynacantha subinterrupta* Rambur, 1842 (1♂) [47]

A single male was collected while attracted to light inside a building.

- **Gynacantha* sp. (1♂, 6♀) [47]

This small species lacks the T-shaped mark in the frons. Several females were collected with only 1 male. Large numbers were noted flying beside recently harvested rice fields.

- ***Oligo aeschna* sp. [D]

The record is based on a single specimen collected in Danao area.

- **Tetracanthagyna brunnea* McLachlan, 1898 [20]

No material collected. The species oviposits in moist and decaying twigs above or at some distance from the running water.

Gomphidae

- ***Heliogomphus bakeri* laidlaw, 1925 [B]

The record is based on a single specimen in the R.A. Müller collection from Dinagat Island. This widespread Philippine endemic except for Palawan region prefers forested areas with clear running water.

- **Paragomphus* sp. (1♂) [73, 74]

A single large female was collected in the Paragua Forest Reserve.

Chlorogomphidae

- ***Chlorogomphus* sp. [B]

The record is based on a single specimen in the R.A. Müller Dinagat collection.

Corduliidae

- **Epophthalmia v. vittigera* (Rambur, 1842) (2♂) [65,76]

Oriental species noted in two forested ponds now modified to fishponds for tilapia.

- ***Hemicordulia m. mindana* Needham & Gyger, 1937 [E,F]

The record is based on two specimens collected in Danao area, from R.A. Müller Dinagat material.

- *Heteronaias heterodoxa* (Selys, 1878) [A, B,C,G,I,J,M,73,74]

Monotypic endemic genus, widely distributed in the archipelago. The Dinagat population is distinctly smaller than those from neighboring islands.

- *Idionyx philippa* Ris, 1937 [B,C,K,23,73,74]

The species is a widely distributed Philippine endemic.

- ***Macromidia samal* Needham & Gyger, 1937 [J]

The record is based on a single specimen from R.A. Müller Dinagat material.

Libellulidae

- *Acisoma p. panorpoidea* Rambur, 1842 [A,3,12,17,22,42,64]
It is frequently encountered in ponds and rice fields.
- *Agrionoptera insignis* (Rambur, 1842) D,E, I,L,[2,3,10,11,12,14,18,22,43,44,51,53,56,57,58,59,66,79]
- *Brachydiplax c. chalybea* Brauer, 1868 (3♂) [D,E,F,61]
- ***Brachydiplax duivenbodei* (Brauer, 1866) [D,E]
The record is based on a few specimens collected from Danao area, in R.A. Müller Dinagat collection.
- ***Camacinia gigantea* (Brauer, 1867) [d]
The record is based on a single specimen from Danao area, in R.A. Müller Dinagat Island collection.
- *Cratilla lineate assidua* Lieftinck, 1953 [B,I, K,21,23,34,28,55]
- **Diplacina bolivari* Selys, 1882 (1♂) [23]
Widespread Philippine endemic. It is interesting to note that Dinagat streams and rivers are depauperate of *Diplacina* in comparison with the neighboring islands.
- *Diplacina nana* Brauer, 1868 (2♂) [B,45]
Widespread Philippine endemic that prefers forested habitats.
- *Diplacodes trivialis* (Rambur, 1842) [B,D,1,2,3,4,10,11,12,13,14,16,17,18,19,22,24,25,26,28,29,30,32,33,34,35,37,38,39,40,41,42,43,44,47,48,54,55,57,60,61,64,65,66,69,71,79,80,81]
- *Hydrobasileus croceus* (Brauer, 1867) (4♂) [D,64]
- *Lathrecista a. asiatica* (Fabricius, 1798) [B,D, E,2,3,10,11,12,13,14,18,22,43,48,50,51,55,57,62]
- ***Lyriothemis cleis* Brauer, 1868 [A,B,D, K,L]
The record is based on several specimens from various areas in Loreto, in R.A. Müller Dinagat collection.
- **Macrodiplax cora* (Brauer, 1867) (1♂) [18]
A single male was collected perching on a twig beside the coastal margin of a mangrove swamp.
- *Nannophya pygmaea* Rambur, 1842 [E,22,64]
- *Neurothemis r. ramburii* (Brauer, 1866) [D,2,3,4,10,13,16,18,22,24,26,35,39,44,46,48,53,55,62,65,66,69,79,80]
- *Neurothemis t. terminata* Ris, 1911 [A,B,D,E,I,1,2,3,4,10,11,12,13,17,19,21,22,23,24,25,28,30,32,33,34,35,38,39,40,42,43,44,45,48,49,50,51,53,54,55,57,60,61,62,63,69,71,79,80,81]
- **Orthetrum chrysis* (Selys, 1891) (3♂) [62,64]
Several specimens of this widespread species were encountered in swampy areas and abandoned rice fields.
- *Orthetrum pruinusum clelia* (Selys, 1878) [B, K,2,4,10,11,13,24,26,30,32,43,48,50,51,53,57,61,62,65,80]
- **Orthetrum s. sabina* (Drury, 1770) [1,2,3,4,6,10,11,12,13,14,15,17,18,19,21,22,24,25,26,27,29,30,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,49,50,51,53,54,55,56,57,60,61,62,63,64,65,66,69,70,71,73,70,80,81]
Somehow this widely distributed oriental species was overlooked by previous collectors on the island.
- *Orthetrum t. testaceum* (Burmeister, 1839) [B,2,24,57,65.]
- *Pantala flavescens* (Fabricius, 1798) [D,1,2,3,5,4,6,7,10,11,12,13,14,15,17,18,19,21,22,24,25,26,27,29,30,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,49,50,51,53,54,55,56,57,60,61,62,63,64,65,66,69,70,71,73,70,80,81]
- *Potamarcha congener* (Rambur, 1842) [D,E,2,10,11,13,23,26,27,42,45,48,51,53,55,57,65,79,81]
- *Raphismia bispina* (Hagen, 1867) [B,18,19,41]
Commonly encountered in coastal mangrove areas.
- ***Rhodothemis rufa* (Rambur, 1842) [D]
The record is based on a single specimen from the R.A. Müller Dinagat collection.
- *Rhyothemis phyllis subphyllis* Selys, 1882 [D,58]
- *Rhyothemis r. regia* (Brauer, 1867) [D,E,58]
- *Tetrathemis irregularis* Brauer, 1868 (1♂) [D,E,F,53,55]
- *Tholymis tillarga* (Fabricius, 1798) [E,I,21,22,23,26,27,39,43,47,56]
- *Tramea transmarina euryale* (Selys, 1878) [B,D,E,64]
- **Tritthemis adelpha* Selys, 1878 (1♂) [30]
A single male was noticed in a mine catch-

ment pond.

- ***Trithemis festiva* (Rambur, 1842) [E]
The record is based on a single specimen in the R.A. Müller Dinagat collection.
- **Zyxomma obtusum* Albarda, 1881 [47]
Most of the collected specimens were attracted to light inside a building.
- *Zyxomma petiolatum* Rambur, 1842 [D,47, 58]

Remarks

The present study lists a total of 69 species under 15 families and 56 genera, raising the known number of species to 83. Twenty-one species are recorded for the first time including at least four new species. Over 40% of the recorded species are zygopterans.

The ratio between Zygoptera and Anisoptera is low. Studies from other regions showed that high ratio between the two suborders indicates a landscape with little or no human disturbance (OPPEL, 2005). This suggests that most of the studied area is already disturbed, resulting in a low diversity of Zygoptera which prefer a forested or closed canopy habitats.

Endemicity is high in Zygoptera (ca 80%) compared to Anisoptera (ca 20%). The high rate of endemism among zygopterans is important especially from the point of view of conservation. Most zygopterans are forest specialists especially the endemic species, which makes them suffering from clearing and deforestation. Experience from other regions shows that up to 25% reduction in close canopy species is expected when habitat modification is caused by simple gardening (OPPEL, 2006).

The main cause of habitat modification in the island is the mining aside from the usual domestic and agricultural activities. In the island, two main means of extracting the ore are used: open-pit for nickel and “lumpy” chromite ore, and “washing” of soil for sandy-type of chromite ore. The open-pit method opens-up the canopy cover thus threatening the shade-loving species. Extraction of sandy-type ore, however, is even more destructive: not only for Odonata but for all organisms in the affected waterways. Twelve species from the 1997 list remained unrecorded during the current survey. These are probably locally rare and can easily be affected

by habitat modification or by any other threat. Most of the old sites are now moderately of heavily modified, while the missing species were collected decades ago when pristine forest still covered the island.

Species of immediate conservation importance

HÄMÄLÄINEN (2004) listed several Philippine Odonata of conservation importance. Among the *Risicnemis* species present in the island only three taxa are considered of an immediate conservation interest. *R. calceata*, known only in Panaon and Dinagat islands, is a strict forest species that requires heavy shade (75-90%). It is rare, encountered only sporadically at the sites frequently visited. *R. nigra*, known from Samar and now Dinagat Island, was recorded only from the areas that are already part of mining concessions. Most of the streams are dammed almost from the source, used for washing the chromite ore, leading to high sediment level downstream. As to *R. rubripes*, though known to occur in Surigao del Sur, (Mindanao), no information on its recent status on the island is available. Unless the species clings for survival in the denuded southern part of the island, it is likely that it is threatened with extinction on the island.

The genus *Drepanosticta* is one of the speciose genera in the country, with over 30 species (VAN TOL & MÜLLER, 2003; VAN TOL, 2005). In Dinagat, it is represented by three species, one is an Eastern Visayas endemic and the other one is a Mindanao subregion endemic. *D. megametta* is of particular interest, since only two specimens are on record since the collection of the type almost a century ago.

The genus *Teinobasis* is another speciose genus, with four representatives in the island. The two undescribed species are considered restricted to mangrove swamps. Due to land conversion, this habitat is one of the most threatened habitats, not just in Dinagat but throughout the country in general. Though a significant tract of mangrove swamps is known in the central eastern part of the island, this unfortunately suffers under the impact of heavy sedimentation caused by mining activities and it is almost devoid of aquatic life.

The genus *Amphicnemis* is represented by

four species. *A. cantuga* is recorded also from the island of Mindanao. The species is associated with *Pandanus* plants, surrounded by tall trees. Several of the surveyed areas with plenty of *Pandanus* but without the surrounding canopy cover, lack this species. The unique habitat preference makes the species at risk of habitat modification. The two other undescribed species are also considered. Though relatively distributed at least in the surrounding areas of the town of Loreto, the species are probably restricted to northern Dinagat and they are threatened.

The unidentified Anisoptera (*Oligoaeschna* sp., *Chlorogomphus* sp. and *Paragomphus* sp.) are also of concern. These species are known only from 1-2 specimens, despite extensive surveys conducted by Alex Buenafe (1988-1990) and by us. They occur in forested areas and face threat from deforestation, clearing and, importantly, from mining activities.

Site of conservation importance

The present study identifies three sites of conservation value. These areas are considered since most of the species occur there along with the site specific taxa. The habitat of *Risicnemis nigra* is also a candidate site but since it is already part of a mining concession it is not included here. It is unfortunate that the area cannot be conserved as it has one of the largest tracts of small to medium-large sized natural "bonsai" plants in the archipelago. The location of the *R. rubriceps* habitat could not be identified in the island.

The first site is a mangrove swamp in Layonggan, Brgy Panamaon Municipality of Loreto. It is a relatively small swamp (less than 20 ha) due to land conversion. The central part is characterized by thick mangrove trees with scattered *Nipa* plants. Though a large portion of its periphery is already disturbed by human activities, a significant vegetation cover is still present and the area still harbors native orchids which is not common in lowland areas these days. The site, though relatively depauperate of Odonata (21 species, mainly Anisoptera), includes 4 taxa endemic to the archipelago, and it is noted as

the habitat of two new *Teinobasis* species, both probably endemic to Dinagat Island.

The second is the karst area in Tabunan, Danao and Kandiis, between Brgy Ferdinand and Brgy San Juan Municipality of Loreto. The area is a ca 10sq km narrow strip of land, dividing the Loreto and the Tubajon coves. It is characterized by steep limestone formation with a relatively good vegetation cover. Forty species, including 9 endemic to the archipelago, were recorded in the area, among which is a new *Amphicnemis* species. Aside from Odonata, the area harbours also several other endemic animals, including the Philippine hornbill and the Dinagat flying lizard.

The third site is Paragua Forest and Wildlife Reserve in the municipality of Libjo. It is perhaps the largest of the three sites, and it is characterized by gently sloping terrain with good vegetation cover to date. The area has rich nickel, chrome and gold deposits and was subject to mining activity until declared as a forest and wildlife reserve. Thirty-three species were recorded, mainly Zygoptera with 24 endemics to the archipelago.

Though the island is categorized as mining land, the protection of its biological resources and selected sites is urgently needed.

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