Diversity and Status of Butterflies in Dinagat Island, Philippines

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Abstract

This study aimed to provide information on the diversity and status of butterflies in the three habitat types of Dinagat islands, Mindanao. Belt transect, light, malaise traps and time constraint samplings were employed in the study on three Mountains namely: Mt. Paragua, Mt. Redondo and Mt. Kambinliw. Data revealed 108 species of butterflies documented. Of these, 27 or 26% were endemic. Four were rare Philippine endemic, 12 common Philippine endemic, 2 very rare Philippine endemic, 1 rare Mindanao endemic, 1 common endemic and 3 Site or Dinagat Island endemic. Three of the species are new record to the Philippines, 5 new record to Mindanao, 58 new record to Dinagat Island and 28 previously recorded species in Dinagat islands. The 101 species with 25% endemism and the presence of newly recorded species are noteworthy for conservation. More than 50% of the species found in each habitat types are disconcordant, most of the endemic species listed were found in the forests habitats. This simply suggests that forests are important in sustaining the lives of the endemic butterflies in the area.

Keywords: butterflies, status, Dinagat island Mindanao Philippines

1. INTRODUCTION

The island of Dinagat lies off the northeastern part of peninsula of Mindanao and has a total area of 66,300 has. It is located 10º 12'35 E. The Peak is 936 masl (Mallari, Tabaranza & Crosby, 2001). Small scale and open pit mining is operating on large scale in Dinagat island. Yet study on butterflies as habitat quality indicators was not yet done. Dinagat island has a very good quality forests and seashores. A dipterocarp forest is so vast starting from Albor to about 45 minutes ride going to the dipterocarp part of Loreto. There were many bird species observed though, disturbed with ongoing mining testing activities.

Mt. Redondo, along the Dinagat mining has hectares montane forest. To its peak, are colonies of different species of *Nepenthes* spp., iron woods or magkono, and other interesting species of flowering and fruiting plants that makes the forest favorable shelter of most fauna. Trekkers observed squirrel, rodents sometimes in chains of 6-12 rats playing inside the forest and V*aranus salvator* along the mining road. Dr. Vic B. Amoroso recorded a new species of *Nepenthes* in the area. Potential economic plants and food for civet cat are found in Dinagat. Orchid plants are also plenty in the area. Two of the noteworthy orchids are the fire orchid and the yellow and small violet colored ground orchids. The water collected during rainy days are drained at the river with the same slope of Redondo at the Kambinlio side. They call this river "hydro" because it is where the people attempt to generate electrical current. Water is a problem on the montane forest of Mt. Redondo.

The pygmy forest is so vast and it serves as a good habitat of several wildlife species in the area. The whole landscape is a good site for ecotourism. It is full of scenic views from mountain top to sea shore. The islets are the abode possible new *Cycas sp.* endemic to the

area. As haven for wildlife, thousands of roosting bats can be observed in some mangrove areas (Tubajon). There were about 14 species of cicadas songs heard by experts (Dave Marshall & Kathy Hill) and some could be possibly new. Most of them were heard from the pygmy forests. Water sources is wanting in Mt. Redondo but a river with clear water was observed in Kambinlio and in Paragua.

Investigating the diversity and status of butterflies is a good passion. Mohagan & Treadaway (2010) recorded 142 species of butterflies in Mt. Hamiguitan Wildlife Sanctuary in Davao Oriental; 81 in Mt. Timpoong (Toledo & Mohagan, 2011) and 104 species in the dipterocarp forest and agroecosystem of Maitum, Tandag, Surigao del Sur (Ramirez and Mohagan, 2012) and 247 species were listed in the 4 Key Biodeversity Area's (KBA's) in Mindanao (Mohagan, Mohagan, & Tambuli, 2011) but there were no documents to show on the butterfly fauna in Dinagat island. Thus, this paper aimed to provide information on the species composition, diversity and status of butterflies in the three habitat types of Dinagat islands.

2. METHODS

2.1. Entry Protocol

The National Gratuitous Permit (GP) for Mt. Redondo sampling was secured from Protected Areas and Wildlife Bureau (PAWB) which transport and fieldworks have benefited the fund from National Science Foundation of America through Dr. Chris Simon of the University of Connecticut (GP.No.206). Prior to sampling, courtesy visits were conducted to LGU's which has jurisdiction over the three mountains selected for study.

2.2. Study Stations

Three vegetation types were identified for butterfly sampling: dipterocarp, montane and pygmy forests. The dipterocarp forests chosen were the disturbed dipterocarp forest in Albor and in seemingly less disturbed dipterocarp forest of Kambinlio. Montane and pygmy forests were chosen in Mt. Redondo.

2.3. Butterfly collection and Sampling Techniques Employed

Butterflies were collected using belt transect, time constraint, malaise traps and light traps were included in the study. Insect nets were employed to collect butterflies, samples were preserved with mothballs and stored in Central Mindanao University (CMU) museum.

2.4. Diversity and Status Assessment

Diversity assessment was analysed using BIOPRO Software. Status assessment was based on Treadaway's list (1995) and was done by matching the local list of species with National listing of Treadaway.

3. RESULTS and DISCUSSION

3.1. Species Composition

Data revealed 108 species of butterflies documented across vegetation types of Dinagat Island. These belong to five families: Hesperiidae, Lycaenidae, Papilionidae, Pieridae and Nymphalidae of butterflies in 70 genera (Tables 1 & 2). Twelve were Papilionidae, 12 Pieridae, 19 Hesperiidae , 26 Lycaenidae and 35 Nymphalidae. This data is higher than the composition of butterflies in Mt. Malindang environs (42 species) (Ballentes, Mohagan, Espallardo, Zarcilla, & Gapud, 2006 ; Hansel et al., 2006) it is quite higher than the species in Mt. Timpoong and Mt. Hibok-hibok of Camiguin.

Agroecosystem had higher species composition (Toledo & Mohagan, 2011). But this result is lower by 3 species of butterflies found in the dipterocarp forest and agro-ecosystem of Maitum, Tandag Surigao del

Sur (104 species) (Ramirez & Mohagan, 2012) where butterfly species was higher in Dipterocarp forest. Mohagan & Treadaway (2010) reported 143 species of butterflies with highest record in the mountane forest. Mt. Kitanglad had 148 species, Mt. Apo with 104 species and Mt. Musuan had 116 species.

The neighboring KBA's had close similarity of species composition. These (6 and 7%), suggest specificity of butterflies in terms

Table 1. Species list and its status of butterflies under Family Papilionidae, Pieridae & Hespiriidae of Dinagat Island

Family/Species	**Status**
Family Papilionidae	
1. Achillides palinurus Daedalus Felder & Felder 1861	Common endemic
2. Arisbe decolor tigris Semper 1893	Rare
3. Arisbe eurypilus gordion Felder &Felder 1864	Common
4. Graphium agamemnon agamemnon Linnaeus 1758	Common
5. Graphium sarpedon sarpedon Linnaeus 1758	Common
6. Lamproptera meges decius Felder & Ferder 1862	Common
7. Menelaides deiphobus rumanzivia Frushtorfer 1908	Common endemic
8. Menelaides helenus hystaspes Felder & felder 1862	Common endemic
9. Menelaides polytes ledebouria Esch.1821	Common
10. Pachleopta kotzebuea philippus Semper 1891	Common
11. Papilio demolius lebanius Frustorfer 1908	Common
12. Troides rhadamantus Lucas 1835	Common endemic
Family Pieridae	
13. Appias olferna peducaea Frushtorfer 1910	Common
14 Appias aegis aegis Felder & Felder 1861	Rare
15. Catopsilia pyranthe pyranthe Linnaeus 1758	Common
16. Catopsilia scylla asema Staudinger 1885	Common
17. Delias hyparete mindanaensis MITIS 1893	Common
18. Eurema alitha alitha C&R Felder 1862	Common Mindanao endemic
19. Eurema blanda vallivolans Butler 1883	Common
20. Eurema hecabe tamiathis Frustorfer 1910	Common
21. Eurema sarilata sarilata Semper 1890	Rare endemic
22. Eurema sarilata rosario Schroedr, Treadaway & Nuyda 1990	Rare (Homonhon record only)
23. Gandaca harina mindanaensis Frustorfer 1910	Common
24. Hebemoia glaucippe iliaca Frustorfer 1911	Common
25. Leptosia nina terentia Frustorfer 1910	Common
26. Udiana sp	Rare
27. Pareronia boebera trinobantes Frustorfer 1911	Common
Family Hesperiidae	
28. Aeromacus musca Mabile 1876	Rare endemic
29. Aeromacus plumbiola Felder 1867	Common endemic
30. Ancistroides nigrita fumatus Mabile 1876	Common
31. Caltoris cormasa Hewitson 1876	Rare
32. Cephrenes acalle chrysozona Plotz 1883	Common
33. Erionata surprisa de Jong & Treadaway,1992	Common
34 Halpe luteisquama Mabille 1877	Common endemic
35. Hyarotis iadera de Niceville 1895	Very Rare endemic; new record in Mindanao
36. Notocrypta paralysos volux Mabille 1883	Common endemic
37. Odina cuneiformis Semper 1892	Rare endemic
38. Parnara bada borneana Chiba & Eliot 1991	Rare
39. Parnara kawazoei Chiba & Eliot 1991	Common
40. Pelopidas conjuncta conjuncta Herrisch & Schafer,1869	Common
41. Potanthus mingo mingo Edwards 1866	Common
42. Tagiades gana elegans Mabille, 1877	Common endemic
43. Tagiades japitus titus Plotz,1834	Common
44. Taractrocera luzonensis luzonensis Staudinger 1889	Common
45. Telicota ancilla minda Evans1934	Common
46. Telicota colon vaja Corbet 1942	Rare

Table 2. Species list and its status of butterflies under Family Lycaenidae & Nymphalidae of Dinagat Island

Family/Species	**Status**
Family Lycaenidae	
47 Allotinus fallax aphacus Frustorfer 1913	Common
48. Allotinus nivalis felderi Semper 1989	Rare
49. Arhopala abseus amplea C&R Felder 1865	Common
50. Arhopala aedias oenotria Hewitson,1869	Rare
51. Arhopla anthelus paradisii Schroeder &Treadaway,1990	Rare
52 Arhopola corinda corinda Hewitson,1869	Common endemic
53. Catochrysops panormus exiguous Distant1886	Common
54.Catochrysops strabo luzpnensis Tite 1959	Common
55. Drupadia theda pekas Takanami 1982	Common
56. Eooxylides meduana Hewitson 1869	Common endemic
57. Euchrysops cnejus cnejus Fabricius 1798	Common
58. Hypolycaena erylus orsiphantus Frustorfer 1912	Rare
59. Hypolycaena shirozui Hayashi1981	Rare endemic
60. Hypolycaena sipylus tharrytas Felder &Felder 1862	Common
61. Jamides bochus pulchrior Grose-Smith 1895	Common
62. Jamides callistus callistus Raber 1886	Rare
63. Jamides celeno lydanius Frushtorfer 1910	New record
64. Jamides cleodus cleodus Felder & felder,1865	Common
65. Jamides cyta raddatzi Schroeder & Treadaway,1984	Rare
66. Lampides boeticus Linnaeus 1767	Common
67. Leptotes plinius leopardus Schultze 1910	Rare
68. Logania marmorata faustina Frustorfer 1914	Common
69. Miletus bazilanus Frushtorfer 1913	Rare endemic
70. Rapala masara Osada 1987	Very Rare endemic
71. Tajuria jalajala jalajala Felder 1862	Common endemic
72. Zizina otis oriens Butler 1883	Common
Family Nymphalidae	
73. Acropthalmia leto ochine Semper,1887	Rare Mindanao endemic
74. *Anosia melanipus edmondii* Lesson 1837	Common
74. Athyma kasa gordia Felder & Ferder, 1863	New record
75. Cirrochroa menones Semper 1888	Common
76. Doleschallia bisaltide philippensis Frustorfer 1899	Common
77. Elymnas beza besa Hewitson 1877	Common Mindanao endemic
78. Euploea mulciber dinagatensis Tsukada and Nishiyama 1979	Site endemic
79. Euthalia alpheda cusama Frustorfer , 1913	Rare
80. Euripus nyctelius nysea Semper 1887	
81. Faunis sappho dinagatensis Aoki &Uemura 1982	Site endemic
*82. Hyplimnas anomala anomala*Wallace 1869	Common
83. Hypolimnas bolina philippensis Butler 1874	Common
84. Idea leuconnoe obscura Staudinger,1889	Common
85. Idiopsis juventa manilana	
86. Junonia almana almana	Common
87. Junonia orithya leucasia Frushtorfer, 1912	Common
88. Lassipa ebusa laetitia Frushtorfer, 1908	Common
89. Lethe chandica byzaccus Frushtorfer 1911	Common
90. Lexias panopus vistrica Frushtorfer,1913	Rare
91. Logania marmorata Frushtorfer 1914	Common
92. Melanitis atrax lucillus Frushtorfer,1908	Common
93. Melanitis leda leda Linnaeus, 1758	Common
94 Moduza pintuyana gahiti	Rare
95 Mycalesis felderi felderi Butler, 1868	Common
*96. Mycalesis jardana micromede*Fruhstorfer,1900	Common
97 Mycalsis frederici Aoki & Ketmura, 1982	Rare endemic
98. Neptis cymela nitetus Hewitson, 1868	Common
99 Neptis mindorana nosba Frushtorfer,1913	common
100. Orsotriaena medus medus Fabricius,1775	Common
101. Pantoporia cyrilla athenais Felder &Ferder,1863	Common
102. Pantoporia dama commixta Frushtorfer,1908	Common
103. Rhinopalpa polynice validice Frushtorfer,1912	Common
104. Tanaecia leucotaenia exul Tsukada & Nishiyama, 1980	Site endemic
105. Terinos clarissa lucilla Butler 1870	Rare
106. Vindula dejone dejone Erichson, 1834	Common
107.Ypthima sempera chaboras Frushtorfer 1910	Rare
108. Ypthima stellera stellera Esch.1821	Common endemic

of habitat (Mohagan, et al, 2011). More butterfly species were observed in habitats with varied plant composition, in mountains or KBA's of the same geographic location and differ in KBA's across islands. These, further suggest that availability of food plants and nectar host plants and probably microhabitats largely influence butterfly occurrences. The varied vegetation in Dinagat provided an array of food plants for butterflies in Dinagat. This observation is consistent with floral diversity in which many rare plants were observed in Dinagat that are discordant in the area like *Cycas* sp. and other undetermined plants.

3.2. Diversity

Sampling requirement was met in dipterocarp forest. Additional sampling is required for montane and mossy. Highest species richness was observed in Dipterocarp forest H' 1.692 (86 species), followed by montane H'1.394 (78 species) and pygmy H'1.363 (33 species) (Table 2). This may be due to the presence of water sources in the dipterocarp forest. Montane and pygmy forests in Dinagat have no water bodies. It is very dry with strong wind current. There are few species of butterflies observed in pygmy but these were rare. The butterfly diversity in Dinagat island is fair in dipoterocarp forest. It was low in montane and pygmy forests. This observation is consistent with Mohagan and Treadaway (2010) in Mt. Hamiguitan Wildlife Sanctuary where the vast pygmy forest hosted only few species of butterflies. is consistent with Mohagan & Treadaway (2010) in Mt. Hamiguitan Wildlife Sanctuary where the vast pygmy forest hosted only few species of butterflies. Most of them are habitat specific. Species richness trend across vegetation types decreased with elevation from dipterocarp 86<montane 78< pygmy 33. This observation slightly differ from the Mt. Hamiguitan and Mt. Timpoong butterfly species composition and diversity level in which montane forest had the higher species followed by dipterocarp forest (Mohagan & Treadaway, 2010; Toledo & Mohagan, 2011). This can be accounted to the presence of water bodies that permitted varied food-plants and nectar host-plants thriving along the river banks and streams of Dipterocarp forests.

Water is the problem for the montane and pygmy forests in Dinagat island. These results may suggest that butterfly composition is a property of a mountain/KBA or an island which further suggests that further studies on the diversity of butterflies across islands, KBAs' and other gradients can be used in indexing the quality of the habitat or environment.

Ramirez & Mohagan (2012) also observed that in Maitum Village of Tandag Surigao del Sur, dipterocarp forest sheltered 89 species of butterflies which was greater than these found in agro ecosystem (51 species). This result would show that human disturbance and habitation could modify the environment and affect species composition of butterflies.

Figure 1 shows that species composition in the three vegetation types are unique in each habitat with less than 20%

Table 2. Summary table for the diversity of butterflies across the vegetation types of Dinagat Island.

Sample	Mean Individuals	Variance	Standard Deviation	Shannon Weiner Index	Total Individuals	Total Species
Dipterocarp	19.614	576.919	24.019	1.692	1981	86
Montane	1.931	20.785	4.559	1.394	195	78
Pygmy	0.386	0.659	0.812	1.363	39	33

species composition across habitats. This suggests the importance of conserving the forests habitats regardless of its type.

3.3. Status

The butterflies species 27 or 26 % were endemic. Four were rare Philippine endemic, 12 common Philippine endemic, 2 very rare Philippine endemic, 2 rare Mindanao endemic, 2 common Mindanao endemic, 3 site or Dinagat Island endemic. Three of the species are new record to the Philippines, 4 new record to Mindanao, 58 new record to Dinagat Islands and 28 re-listed species and one possible new to Science (*Udiana* sp). The disparity between the old and the new list is probably due to sampling intensity. This endemism is lower as compared to Mt. Apo 42%, Mt. Timpoong and 27.8% but higher than in Mt. Kitanglad 19.6% and Mt. Musuan 1.2% (Mohagan et al, 2012, Salmoy-Toledo & Mohagan, 2011). This may be due to sampling intensity.

Sampling effort is needed for the whole site to collect more possible new species and endemic species. There are lots of sites to be explored in Dinagat especially the islets. There were species observed in the islets that cannot be observed in the main island. The highest endemism observed so far is in Mt. Apo 42%. This could be attributed to food plants & nectar host plants availability and elevation. Mt Apo as the highest mountain sampled which has the unique species composition. Many of which were discordant species and differently colored from the Mt. Kitanglad and Mt. Hamiguitan species (Mohagan & Mohagan, 2012).

4. CONCLUSION

The 108 species with 25% endemism and the presence of newly recorded species and the one possible new to Science are noteworthy for conservation. More than 50% of the species found in each habitat type is discordant, most of the endemic species. They were found in the forest habitats. Mining should be regulated especially at the Bonsai Forest of Mt. Redondo. Molecular studies on butterflies are needed to determine whether polymorphs are just variants or they can be subspecies.

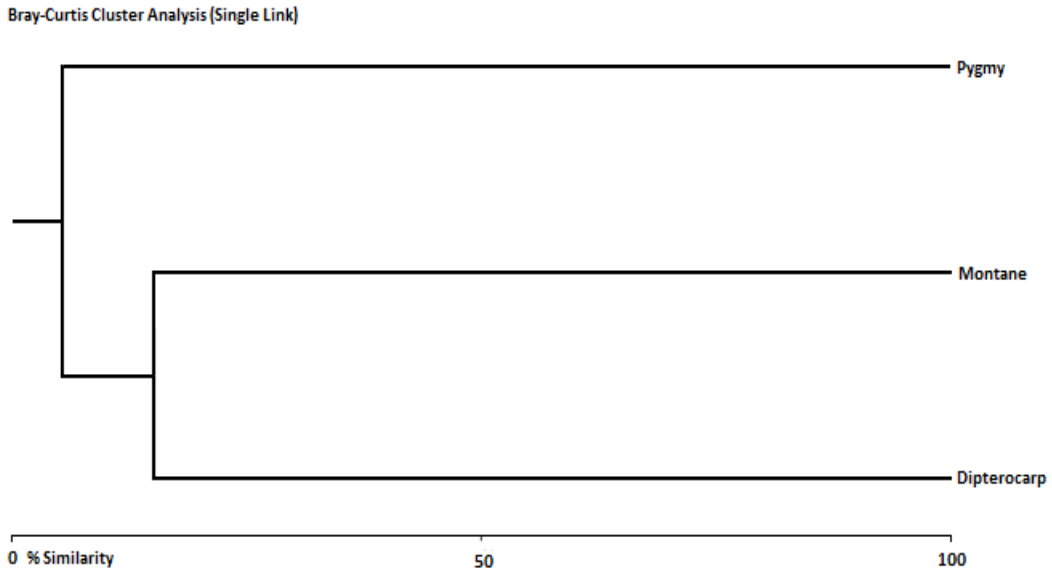

Fig.1. Dendrogram of Similarity of Species Composition of Butterflies across vegetation types of Dinagat island

REFERENCES

Ballentes, M., Mohagan, A., Espallardo, M., Zarcilla, M., & Gapud, V. (2006). *Arthropod Faunal Diversity and Relevant Interrelationships of Critical Resources in Mt. Malindang, Misamis Occidental* (Technical Report) (pp. 1–166). Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA): Biodiversity Research Programme for Development in Mindanao: Focus on Mt. Malindang and Environs.

Hansel, C., Gorospe-Villarino, A., Mohagan, A., Nacua, S., Poblete, T., Roa, E., … Bacaltos, D. (2006). *Assessing the headwaters of Layawan River: Linkage between the terrestrial and aquatic ecosystem in Mt. Malindang, Misamis Occidental* (Technical Report) (pp. 1–62). SEAMEO SEARCA, College, Laguna, Philippines: Biodiversity Research Programme (BRP) for Development in Mindanao: Focus on Mt. Malindang and Environs. Retrieved from http://www.searca.org/brp/pdfs/monographs/Assessing%20the%20Headwaters%20of%20Layawan%20River.pdf.

Mallari, N., Tabaranza, B., & Crosby, M. (2001). *Key conservation sites of the Philippines*. Makati City: Bookmark Inc.

Mohagan, A., & Treadaway, C. (2010). Diversity and status of butterflies across vegetation types of Mt. Hamiguitan, Davao Oriental, Philippines. *Asian Journal of Biodiversity, 1*(1), 1–24.

Mohagan, A., Mohagan, D. (2012). Status of Butterflies in Dinagat Islands, Philippines [Abstract]. *Transactions of the National Academy of Science & Technology. 34(1)*: p65.

Mohagan, A., Mohagan, D., & Tambuli, A. (2011). Diversity of butterflies in the selected key biodiversity areas of Mindanao, Philippines. *Asian Journal of Biodiversity*, *2*, 121–148. doi:http://dx.doi.org/10.7828/ajob.v2i1.95

Ramirez, R., & Mohagan, A. (2012). Diversity and status of butterflies in Maitum Village, Tandag, Surigao del Sur,Philippines. *Asian Journal of Biodiversity*, *3*, 74–112. doi:http://dx.doi.org/10.7828/ajob.v3i1.84

Toledo, J., & Mohagan, A. (2011). Diversity and Status of Butterflies in Mt. Timpoong and Mt. Hibok-hibok, Camiguin Island, Philippines. *Philippine Association of Institution for Research, Inc., 6*(1). 103-116. doi:http://dx.doi.org/10.7719/jpair.v6i1.139

Treadaway, C. (1995). Checklist of butterflies in the Philippine Islands (Lepidoptera: Rhopalocera). *Nachricten des Entomologischen Vereins Apollo, Suppl. 14:* 7-118. Frankfurt, Germany.

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