

Land Molluscs from the Northern Mariana Islands, Micronesia

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Abstract More than twenty-four species of land molluscs, belonging to 13 families and 20 genera were collected from the 9 islands of the northern Mariana Islands, and 22 species are recorded for the first time from the islands. Six introduced species were recognized, including *Achatina fulica* and its predators, *Euglandina rosea* and *Gonaxis kibweziensis*. Almost all of the genera are widely distributed on Micronesian islands. Only one species, *Ptychalaea* sp., may show dispersal from the northern area to the northern Marianas.

Key words: Land molluscs, *Ptychalaea*, *Achatina fulica*, northern Mariana Islands.

The northern Mariana Islands are located in the western Pacific between 16°22' and 20°32'N. Only two species of land molluscs, *Partula gibba* and "Succinea" sp., have so far been reported from the northern Mariana Islands (Kondo, 1970; Eldredge *et al.*, 1977). From May to June 1992, an expedition to the northern Mariana Islands was conducted by the Natural History Museum and Institute, Chiba (NHMIC) in cooperation with the Division of Fish and Wildlife, Department of Natural Resources (Commonwealth of the Northern Mariana Islands) and University of Guam Marine Laboratory. More than twenty-four species of land molluscs were collected on the nine islands.

Study Sites and Methods

The northern Mariana Islands consist mainly of nine islands, from south to north, Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, Maug (3 small islets) and Uracas. These islands are of Quaternary volcanic origin, and their shapes are basically high triangular. Volcanic activity occurs on Pagan and Uracas at the present time.

The main forest types on the islands are *Hibiscus tiliacea*, *Pandanus tectorius*, *Elaeocarpus joga*, *Aglaia marianensis*, *Barringtonia asiatica*, and *Ficus tinctoria* (Ohba, 1994). There are *Cocos nucifera* plantations in the lower flat coastal regions of most of the islands.

Investigations were carried out along the

survey routes (see Asakura *et al.*, 1994). Land snails were collected from litter layers, tree trunks, underside of leaves and among mosses. In one to four sites on one island, a quadrat was set on the forest floor, and soil-dwelling snails were picked up by hand-sorting.

A tentative list of collected specimens is given. Data on the materials are as follows; island, number of specimens, registration number of NHMIC with code CBM-ZM, collection site, collector and date in 1992. For general information on the sampling sites, such as A1-2, see Kurozumi (1994).

Initials of the collectors are as follows: TK = Taiji Kurozumi, SM = Shinya Miyano, HH = Hiroshi Harada, TO = Tatsuyuki Ohba, TF = Tatsuwo Furuki and AA = Akira Asakura of the NHMIC.

In this list, splash zone inhabiting molluscs, such as Assimineidae and Ellobiidae, are excluded, and they are listed separately in another report (Kurozumi and Asakura, 1994).

List of Collected Species

Class Gastropoda

Subclass Prosobranchia

Order Neotaenioglossa

Family Assimineidae

1. *Omphalotropis* sp. A

Specimens examined. SARIGAN: 15 exs., CBM-ZM-107786 & 107796, north slope, 280-

300 m alt., TK leg., 15 May; 3 exs., CBM-ZM-107799, crater, 300 m alt., TK leg., 15 May. GUGUAN: 1 ex., CBM-ZM-107777, west coast, SM leg., 18 May. ALAMAGAN: 66 exs., CBM-ZM-107826, 108040, 108048, 108049 & 108054, south west slope, 50–300 m alt., TK leg., 19 May; 2 exs., CBM-ZM-108069, south west slope, 250 m alt. (A1-2), TK leg., 19 May; 1 ex., CBM-ZM-108072, south west slope, SM leg., 19 May; 20 exs., CBM-ZM-108078, south west slope, 150–180 m alt., TK leg., 9 June; 7 exs., CBM-ZM-108086, south west coast, TK leg., 9 June; 41 exs., CBM-ZM-108090, south west coast, 5 m alt. (A1-3), TK leg., 9 June. PAGAN: 42 exs., CBM-ZM-108099, west coast, TK leg., 24 May.

2. *Omphalotropis* sp. B

Specimens examined. SARIGAN: 18 exs., CBM-ZM-107814, 107787 & 108323, north slope, 40–280 m alt., TK leg., 15 May; 2 exs., CBM-ZM-108318, north slope, 270 m alt. (S-2), TK leg., 15 May.

Subclass Pulmonata Order Archaeopulmonata Family Veronicellidae

3. *Laevicaulis alte* (Férussac)

Specimens examined. ALAMAGAN: 1 ex., CBM-ZM-108068, south west slope, 250 m alt. (A1-2), TK leg., 19 May; 3 exs., CBM-ZM-108084, south west slope, 180 m alt., TK leg., 9 June. AGRIHAN: 1 ex., CBM-ZM-108159, south coast, TK leg., 30 May.

Order Stylommatophora Family Achatinellidae

4. *Elasmias* sp.

Specimens examined. ANATAHAN: 3 exs., CBM-ZM-107730 & 107733, south west slope, 290–400 m alt., TK leg., 13 May; 1 ex., CBM-ZM-107734, south west slope, 365 m alt. (An-4), TK leg., 13 May. SARIGAN: 13 exs., CBM-ZM-107804, 107788, 107816 & 108324, north slope, 40–280 m alt., TK leg., 15 May; 4 exs., CBM-ZM-107800, crater, 300 m alt., TK leg., 15 May; 3 exs., CBM-ZM-108317, north slope, 270 m alt. (S-2), TK leg., 15 May; 6 exs., CBM-ZM-108321, center, 300 m alt. (S-3), TK leg., 15 May; 12 exs., CBM-ZM-108330, north slope, SM leg., 15 May. GUGUAN: 40 exs., CBM-ZM-107740, 107744, 107745, 107755 & 107771, south west slope,

40–220 m alt., TK leg., 17 May; 1 ex., CBM-ZM-107762, south west valley, 60 m alt. (G-1), TK leg., 17 May; 10 exs., CBM-ZM-107774, south west slope, SM leg., 17 May; 1 ex., CBM-ZM-107778, west coast, SM leg., 18 May. ALAMAGAN: 10 exs., CBM-ZM-107827, south west slope, 70–495 m alt., TK leg., 19 May; 3 exs., CBM-ZM-108074, south west slope, SM leg., 19 May. AGRIHAN: 7 exs., CBM-ZM-108136, west coast, 120 m, TK leg., 28 May; 1 ex., CBM-ZM-108141, west valley, 35 m alt. (Ag-1), TK leg., 28 May; 12 exs., CBM-ZM-108144, north coast, TK leg., 29 May; 1 ex., CBM-ZM-108152, north west slope, 220 m alt. (Ag-2), TK leg., 29 May. ASUNCION: 16 exs., CBM-ZM-108171, west slope, TK leg., 1 June.

5. *Lamellidea* spp.

Specimens examined. SARIGAN: 28 exs., CBM-ZM-107805, 107815 & 108328, north slope, 50–270 m alt., TK leg., 15 May. GUGUAN: 19 exs., CBM-ZM-107737, 107750, 107756 & 107772, south west slope, 60 m alt., TK leg., 17 May; 27 exs., CBM-ZM-107763, south west valley, 60 m alt. (G-1), TK leg., 17 May; 17 exs., CBM-ZM-107767, south west peak, 220 m alt. (G-2), TK leg., 17 May. ALAMAGAN: 26 exs., CBM-ZM-107828, 108042 & 108050, south west slope, 40–150 m alt., TK leg., 19 May; 3 exs., CBM-ZM-108079, south west slope, 150–180 m alt., TK leg., 9 June; 1 ex., CBM-ZM-108087, south west coast, TK leg., 9 June; 13 exs., CBM-ZM-108091, south west coast, 5 m alt. (A1-3), TK leg., 9 June. PAGAN: 1 ex., CBM-ZM-108109, west coast, 55 m alt. (P-1), TK leg., 24 May; 5 exs., CBM-ZM-108115, south west coast, TK leg., 25 May; 53 exs., CBM-ZM-108120, south west coast, 10 m alt. (P-3), TK leg., 25 May; 1 ex., CBM-ZM-108124, south west slope, to 200 m alt., TK leg., 25 May. AGRIHAN: 2 exs., CBM-ZM-108160, north coast, TK leg., 30 May. ASUNCION: 10 exs., CBM-ZM-108172, west slope, TK leg., 1 June; 6 exs., CBM-ZM-108178, west slope, 240 m alt., TK leg., 1 June; 1 ex., CBM-ZM-108179, west slope, 190 m alt. (As-1), TK leg., 1 June; 34 exs., CBM-ZM-108184, west slope, 50 m alt. (As-2), TK leg., 1 June. MAUG, EAST: 38 exs., CBM-ZM-108192 & 108195, west side, TK leg., 2 June; 76 exs., CBM-ZM-108204, ridge, 120 m alt. (M-1), TK leg., 2 June; 9 exs., CBM-ZM-108209, west side,

TK leg., 4 June; 1 ex., CBM-ZM-108212, west side, TK leg., 5 June; 5 exs., CBM-ZM-108219, SM leg., 5 June. MAUG, WEST: 21 exs., CBM-ZM-108220, east side, TK leg., 5 June; 78 exs., CBM-ZM-108224, ridge, 105 m alt. (M-2), TK leg., 5 June.

6. *Tornatellinops* sp.

Specimens examined. SARIGAN: 2 ex., CBM-ZM-107789, north slope, 280 m alt., TK leg., 15 May; 2 exs., CBM-ZM-107806, north slope, to 85 m alt., TK leg., 15 May. GUGUAN: 7 exs., CBM-ZM-107775, south west slope, SM leg., 17 May. ALAMAGAN: 1 ex., CBM-ZM-108061, south west slope, 300–495 m alt., TK leg., 19 May. AGRIHAN: 1 ex., CBM-ZM-108137, west coast, 120 m, TK leg., 28 May. MAUG, EAST: 5 exs., CBM-ZM-108218, SM leg., 4 June.

Family Vertiginidae

7. *Gastrocopta* (s.s.) sp.

Specimens examined. SARIGAN: 2 exs., CBM-ZM-107809, north slope, to 85 m alt., TK leg., 15 May. GUGUAN: 4 exs., CBM-ZM-107757, south west slope, 220 m alt., TK leg., 17 May.

8. *Gastrocopta* (*Sinalbinula*) spp.

Specimens examined. SARIGAN: 22 exs., CBM-ZM-107808, north slope, to 85 m alt., TK leg., 15 May; 1 ex., CBM-ZM-108334, north coast, TK leg., 16 May. GUGUAN: 32 exs., CBM-ZM-107738, 107741, 107747, 107752 & 107758, south west slope, 60–220 m alt., 17 May, TK leg.; 3 exs., CBM-ZM-107764, south west valley, 60 m alt. (G-1), TK leg., 17 May; 8 exs., CBM-ZM-107768, south west peak, 220 m alt. (G-2), TK leg., 17 May. ALAMAGAN: 2 exs., CBM-ZM-107830, south west slope, to 150 m alt., TK leg., 19 May; 1 ex., CBM-ZM-108092, south west coast, 5 m alt. (Al-3), TK leg., 9 June. PAGAN: 5 exs., CBM-ZM-108117, south west coast, TK leg., 25 May; 11 exs., CBM-ZM-108121, south west coast, 10 m alt. (P-3), TK leg., 25 May. AGRIHAN: 3 exs., CBM-ZM-108162, north coast, TK leg., 30 May. ASUNCION: 19 exs., CBM-ZM-108174, west slope, TK leg., 1 June; 24 exs., CBM-ZM-108180, west slope, 190 m alt. (As-1), TK leg., 1 June; 9 exs., CBM-ZM-108185, west slope, 50 m alt. (As-2), TK leg., 1 June; 8 exs., CBM-ZM-108188, south west coast, TK leg., 1 June. MAUG, EAST: 11 exs., CBM-ZM-108190, north west side, TK leg., 2 June; 8 exs.,

CBM-ZM-108196 & 108200, west side, TK leg., 2 June; 12 exs., CBM-ZM-108205, ridge, 120 m alt. (M-1), TK leg., 2 June; 4 exs., CBM-ZM-108210, west side, TK leg., 4 June; 26 exs., CBM-ZM-108213, west side, TK leg., 5 June. MAUG, WEST: 8 exs., CBM-ZM-108221, east side, TK leg., 5 June; 20 exs., CBM-ZM-108225, ridge, 105 m alt. (M-2), TK leg., 5 June.

9. *Ptychalaea* sp.

Specimens examined. SARIGAN: 71 exs., CBM-ZM-107807, 107817 & 107790, north slope, 80–280 m alt., TK leg., 15 May; 2 exs., CBM-ZM-107801, crater, 300 m alt., TK leg., 15 May. GUGUAN: 9 exs., CBM-ZM-107739, 107746 & 107751, south west slope, 50–202 m alt., TK leg., 17 May. ALAMAGAN: 3 exs., CBM-ZM-107829 & 108043, south west slope, 70–180 m alt., 19 May, TK leg. PAGAN: 2 exs., CBM-ZM-108100, west coast, TK leg., 24 May; 5 exs., CBM-ZM-108116, south west coast, TK leg., 25 May; 4 exs., CBM-ZM-108126 & 108130, south west slope, to 255 m alt., TK leg., 25 May; 2 exs., CBM-ZM-108135, Mt. Togari, 75 m on Palm tree, TF leg., 25 May. AGRIHAN: 20 exs., CBM-ZM-108145, north coast, TK leg., 29 May; 1 ex., CBM-ZM-107915, north coast, beach drift, TK leg., 29 May; 1 ex., CBM-ZM-108155, east slope, 215 m alt., HH leg., 29 May; 5 exs., CBM-ZM-108161, north coast, TK leg., 30 May. ASUNCION: 3 exs., CBM-ZM-108173, west slope, TK leg., 1 June. MAUG, EAST: 4 exs., CBM-ZM-108201, west side, TK leg., 2 June; 6 exs., CBM-ZM-108214, west side, TK leg., 5 June.

10. *Pupisoma* sp.

Specimens examined. GUGUAN: 5 exs., CBM-ZM-107748, south west slope, 85–220 m alt., TK leg., 17 May. ALAMAGAN: 1 ex., CBM-ZM-108095, south west coast, 5 m alt. (Al-3), TK leg., 9 June. AGRIHAN: 8 exs., CBM-ZM-108149, north coast, TK leg., 29 May.

Family Partulidae

11. *Partula gibba* Férussac

Specimens examined. ANATAHAN: 1 ex., CBM-ZM-108335, north west coast, AA leg., 11 May; 4 exs., CBM-ZM-107724, south west slope, 60 m alt., TK leg., 12 May; 14 exs., CBM-ZM-107726, 107729 & 107731, south west slope, 70 to 400 m alt., TK leg., 13 May. SARIGAN: 53 exs., CBM-ZM-107780 to 107784 & 108327,

north slope, 270 m alt., TK leg., 15 May; 2 exs., CBM-ZM-108319, north slope, 270 m alt. (S-2), TK leg., 15 May; 1 ex., CBM-ZM-108322, crater, 300 m alt. (S-3), TK leg., 15 May; 15 exs., CBM-ZM-107785, north slope, 280 m alt., TK leg., 15 May; 7 exs., CBM-ZM-107794, north slope, 300 m alt., TK leg., 15 May; 18 exs., CBM-ZM-107797, crater, 300 m alt., TK leg., 15 May; 6 exs., CBM-ZM-108331, north slope, SM leg., 15 May. ALAMAGAN: 58 exs., CBM-ZM-107820 to 107823, south west slope, 150–300 m alt., TK leg., 19 May; 13 exs., CBM-ZM-107825, south west slope, 300–450 m alt., TK leg., 19 May; 2 exs., CBM-ZM-108053, south west slope, 250 m alt., TK leg., 19 May; 8 exs., CBM-ZM-108065, south west slope, 300–495 m alt., TK leg., 19 May; 6 exs., CBM-ZM-108077, south west slope, SM leg., 19 May; 30 exs., CBM-ZM-108083, south west slope, 150–180 m alt., TK leg., 9 June; 6 exs., CBM-ZM-108098, north west slope, 200 m alt., TO leg., 9 June. PAGAN: 22 exs., CBM-ZM-108129, south west slope, 220–255 m alt., TK leg., 25 May.

Family Ferussaciidae

12. *Geostilbia* sp.

Specimens examined. SARIGAN: 1 ex., CBM-ZM-107811, north slope, to 85 m alt., TK leg., 15 May. ALAMAGAN: 1 ex., CBM-ZM-108044, south west slope, 180 m alt., TK leg., 19 May; 1 ex., CBM-ZM-108094, south west coast, 5 m alt. (Al-3), TK leg., 9 June.

Family Sublinidae

13. *Subulina octona* (Bruguère)

Specimens examined. ANATAHAN: 2 exs., CBM-ZM-107727, south west slope, 70 m alt., TK leg., 13 May. PAGAN: 12 exs., CBM-ZM-108104, west coast, TK leg., 24 May; 3 exs., CBM-ZM-108112, west coast, 55 m alt. (P-1), TK leg., 24 May.

14. *Allopeas* spp.

Specimens examined. ANATAHAN: 4 exs., CBM-ZM-107718, north west coast, TK leg., 11 May; 5 exs., CBM-ZM-107722, south west coast, TK leg., 12 May; 2 exs., CBM-ZM-107728, south west slope, 70 m alt., TK leg., 13 May. SARIGAN: 8 exs., CBM-ZM-107810, north slope, to 85 m alt., TK leg., 15 May; 4 exs., CBM-ZM-107791 & 108329, north slope, 270–280 m alt.,

TK leg., 15 May; 3 exs., CBM-ZM-107803, crater, 300 m alt., TK leg., 15 May. GUGUAN: 19 exs., CBM-ZM-107736, south west slope, 60 m alt., TK leg., 17 May; 3 exs., CBM-ZM-107742, south west slope, to 85 m alt., TK leg., 17 May; 5 exs., CBM-ZM-107759, south west slope, 220 m alt., TK leg., 17 May; 14 exs., CBM-ZM-107766, south west valley, 60 m alt. (G-1), TK leg., 17 May. ALAMAGAN: 4 exs., CBM-ZM-107831, to 150 m alt., TK leg., 19 May; 1 ex., CBM-ZM-108056, south west slope, 150–300 m alt., TK leg., 19 May; 2 exs., CBM-ZM-108062, south west slope, 300–495 m alt., TK leg., 19 May; 1 ex., CBM-ZM-108067, south west slope, 365 m alt. (Al-1), TK leg., 19 May; 1 ex., CBM-ZM-108070, south west slope, 250 m alt. (Al-2), TK leg., 19 May; 2 exs., CBM-ZM-108073, south west slope, SM leg., 19 May; 1 ex., CBM-ZM-108088, south west coast, TK leg., 9 June; 5 exs., CBM-ZM-108094, south west coast, 5 m alt. (Al-3), TK leg., 9 June. PAGAN: 26 exs., CBM-ZM-108102 & 108103, west coast, TK leg., 24 May; 12 exs., CBM-ZM-108110 & 108111, west coast, 55 m alt. (P-1), TK leg., 24 May; 6 exs., CBM-ZM-108118, south west coast, TK leg., 25 May; 25 exs., CBM-ZM-108122, south west coast, 10 m alt. (P-3), TK leg., 25 May; 6 exs., CBM-ZM-108125, south west slope, to 200 m alt., TK leg., 25 May. AGRIHAN: 30 exs., CBM-ZM-108146 & 108163, north coast, TK leg., 29 May; 1 ex., CBM-ZM-107916, north coast, beach drift, TK leg., 29 May; 1 ex., CBM-ZM-108153, north west slope, 220 m alt. (Ag-2), TK leg., 29 May; 2 exs., CBM-ZM-108150, north west coast, 10 m alt. (Ag-3), TK leg., 29 May; 1 ex., CBM-ZM-108157, south coast, TK leg., 30 May; 1 ex., CBM-ZM-108169, center, 400 m. (Ag-4), TF leg., 31 May. ASUNCION: 52 exs., CBM-ZM-108175, west slope, TK leg., 1 June; 56 exs., CBM-ZM-108181, west slope, 190 m alt. (As-1), TK leg., 1 June; 7 exs., CBM-ZM-108186, west slope, 50 m alt. (As-2), TK leg., 1 June; 18 exs., CBM-ZM-108189, south west coast, TK leg., 9 June. MAUG, EAST: 6 exs., CBM-ZM-108191, north west side, TK leg., 2 June; 5 exs., CBM-ZM-108193 & 108197, west side, TK leg., 2 June; 1 ex., CBM-ZM-108206, ridge, 120 m alt. (M-1), TK leg., 2 June; 3 exs., CBM-ZM-108211, west side, TK leg., 4 June; 6 exs., CBM-ZM-108215, west side, TK leg., 5 June. MAUG,

WEST: 7 exs., CBM-ZM-108222, east side, TK leg., 5 June; 8 exs., CBM-ZM-108226, ridge, 105 m alt. (M-2), TK leg., 5 June.

Family Achatinidae

15. *Achatina (Lissachatina) fulica* Bowdich

Specimens examined. PAGAN: 3 exs., CBM-ZM-108101, west coast, TK leg., 24 May; 21 exs., CBM-ZM-108132 & 108232, south west slope, 60–255 m alt., TK leg., 25 May; 32 exs., CBM-ZM-108229 & 108230, south west slope, TK leg., 25 May. AGRIHAN: 1 ex., CBM-ZM-108158, south coast, TK leg., 30 May; 5 exs., CBM-ZM-108231, west coast, TK leg., 28 May.

Family Streptacidae

16. *Indoenna bicolor* (Hutton)

Specimens examined. Pagan: 8 exs., CBM-ZM-108107, west coast, TK leg., 24 May.

17. *Gonaxis kibweziensis* (Smith)

Specimens examined. PAGAN: 11 exs., CBM-ZM-108105 & 108106, west coast, TK leg., 24 May; 1 ex., CBM-ZM-108113, west coast, 55 m alt. (P-1), TK leg., 24 May; 8 exs., CBM-ZM-108107, west coast, TK leg., 24 May.

Family Charopidae

18. *Semperdon* sp.

Specimens examined. MAUG, EAST: 4 exs., CBM-ZM-108202, west side, TK leg., 2 June; 24 exs., CBM-ZM-108216, west side, TK leg., 5 June; 5 exs., CBM-ZM-108207, ridge, 120 m alt. (M-1), TK leg., 2 June.

Family Succineidae

19. "*Succinea*" sp.

Specimens examined. SARIGAN: 12 exs., CBM-ZM-107812, north slope, to 85 m alt., TK leg., 15 May; 31 exs., CBM-ZM-107818, north slope, 110 m alt., TK leg., 15 May; 15 exs., CBM-ZM-107792 & 108325, north slope, 270–280 m alt., TK leg., 15 May; 28 exs., CBM-ZM-107795, north slope, 300 m alt., TK leg., 15 May; 11 exs., CBM-ZM-107798, crater, 300 m alt., TK leg., 15 May; 8 exs., CBM-ZM-108332, north slope, SM leg., 15 May. ALAMAGAN: 13 exs., CBM-ZM-107834, south west slope, to 150 m alt., TK leg., 19 May; 48 exs., CBM-ZM-107824, 108045, 108051, 108057 & 108058, south west slope, 150–300 m alt., TK leg., 19 May; 4 exs., CBM-

ZM-108063, south west slope, 300–495 m alt., TK leg., 19 May; 1 ex., CBM-ZM-103838, south west slope, TK leg., 19 May; 9 exs., CBM-ZM-108075, south west slope, SM leg., 19 May; 36 exs., CBM-ZM-108081 & 108082, south west slope, 150–180 m alt., TK leg., 9 June; 1 ex., CBM-ZM-108085, south west slope, 9 June, TK leg.; 17 exs., CBM-ZM-108097, north west slope, 200 m alt., TO leg., 9 June. PAGAN: 1 ex., CBM-ZM-108119, south west coast, TK leg., 25 May; 1 ex., CBM-ZM-108133, south west slope, 220 m alt., TK leg., 25 May. AGRIHAN: 8 exs., CBM-ZM-108164, north coast, TK leg., 30 May. MAUG, EAST: 1 ex., CBM-ZM-108194, west side, TK leg., 2 June. URACAS: 1 ex., CBM-ZM-108228, TK leg., 6 June.

Family Helicarionidae

20. *Lamprocystis* sp. A

Specimens examined. ANATAHAN: 4 exs., CBM-ZM-107715 & 107719, north west coast to 140 m alt., TK leg., 11 May; 2 exs., CBM-ZM-107720, north west valley, 165 m alt. (An-2), TK leg., 11 May; 2 exs., CBM-ZM-107721, south west coast, TK leg., 12 May; 4 exs., CBM-ZM-107725, south west slope, 60 m alt. (An-3), TK leg., 12 May; 6 exs., CBM-ZM-107732, south west slope, 400 m alt., TK leg., 13 May. SARIGAN: 36 exs., CBM-ZM-107793 & 108326, north slope, 270–280 m alt., TK leg., 15 May; 5 exs., CBM-ZM-107802, crater, 300 m alt., TK leg., 15 May; 1 ex., CBM-ZM-107813, north slope, to 85 m alt., TK leg., 15 May; 4 exs., CBM-ZM-108320, north slope, 270 m alt. (S-2), TK leg., 15 May. GUGUAN: 6 exs., CBM-ZM-107754, south west slope, 220 m alt., TK leg., 17 May; 2 exs., CBM-ZM-107761, south west slope, 220 m alt., TK leg., 17 May; 4 exs., CBM-ZM-107770, south west peak, 220 m alt. (G-2), TK leg., 17 May. ALAMAGAN: 5 exs., CBM-ZM-107832, to 150 m alt., TK leg., 19 May; 14 exs., CBM-ZM-108046, 108052 & 108059, south west slope, 150–300 m alt., TK leg., 19 May; 24 exs., CBM-ZM-108064, south west slope, 300–495 m alt., TK leg., 19 May; 16 exs., CBM-ZM-108066, south west slope, 365 m alt. (A1-1), TK leg., 19 May; 3 exs., CBM-ZM-108071, south west slope, 250 m alt. (A1-2), TK leg., 19 May; 4 exs., CBM-ZM-108076, south west slope, SM leg., 19 May; 15 exs., CBM-ZM-108080, south

west slope, 150–180 m alt., TK leg., 9 June. PAGAN: 2 exs., CBM-ZM-108123, south west coast, 10 m alt. (P-3), TK leg., 25 May; 26 exs., CBM-ZM-108128, south west slope, to 200 m alt., TK leg., 25 May; 15 exs., CBM-ZM-108131 & 108134, south west slope, 220–255 m alt., TK leg., 25 May. AGRIHAN: 1 ex., CBM-ZM-108148, north coast, TK leg., 29 May; 15 exs., CBM-ZM-108165, N edge, TK leg., 31 May. ASUNCION: 4 exs., CBM-ZM-108177, west slope, TK leg., 1 June; 1 ex., CBM-ZM-108183, west slope, 190 m alt. (As-1), TK leg., 1 June.

21. *Lamprocytis* sp. B

Specimens examined. ANATAHAN: 1 ex., CBM-ZM-107716, north west coast, TK leg., 11 May. AGRIHAN: 1 ex., CBM-ZM-108142, west valley, 35 m alt. (Ag-1), TK leg., 28 May; 3 exs., CBM-ZM-108154, north west slope, 220 m alt. (Ag-2), TK leg., 29 May; 2 exs., CBM-ZM-108151, north west coast, 10 m alt. (Ag-3), TK leg., 29 May; 2 exs., CBM-ZM-108170, center, 400 m. (Ag-4), TF leg., 31 May.

22. *Liardetia* spp.

Specimens examined. ANATAHAN: 2 exs., CBM-ZM-107717, north west coast, HH leg., 11 May; 2 exs., CBM-ZM-107723, south west coast., HH leg., 12 May. SARIGAN: 11 exs., CBM-ZM-1078119, north slope, 110 m alt., TK leg., 15 May; 2 exs., CBM-ZM-108333, north slope, SM leg., 15 May. GUGUAN: 35 exs., CBM-ZM-107735, 107743, 107749, 107753 & 107760, south west slope, 60–220 m alt., TK leg., 17 May; 6 exs., CBM-ZM-107765, south west valley, 60 m alt. (G-1), TK leg., 17 May; 3 exs., CBM-ZM-107769, south west peak, 220 m alt. (G-2), TK leg., 17 May; 6 exs., CBM-ZM-107773, south west slope, TK leg., 17 May; 2 exs., CBM-ZM-107776, south west slope, SM leg., 17 May; 1 ex., CBM-ZM-107777, west coast, SM leg., 18 May. ALAMAGAN: 1 ex., CBM-ZM-107833, south west slope, to 150 m alt., TK leg., 19 May; 3 exs., CBM-ZM-108047, south west slope, 180 m alt., TK leg., 19 May; 1 ex., CBM-ZM-108089, south west coast, TK leg., 9 June; 1 ex., CBM-ZM-108096, south west coast, 5 m alt. (Al-3), TK leg., 9 June. PAGAN: 5 exs., CBM-ZM-108108, west coast, TK leg., 24 May; 2 exs., CBM-ZM-108114, west coast, 55 m alt. (P-1), TK leg., 24 May; 1 ex., CBM-ZM-108127, south west slope, to 200 m alt., TK leg., 25 May. AGRIHAN: 6

exs., CBM-ZM-108139, west coast, 120 m alt., TK leg., 28 May; 2 exs., CBM-ZM-108156, east slope, 215 m alt., HH leg., 29 May; 1 ex., CBM-ZM-108166, north edge, TK leg., 31 May. ASUNCION: 10 exs., CBM-ZM-108176, west slope, TK leg., 1 June; 2 exs., CBM-ZM-108182, west slope, 190 m alt. (As-1), TK leg., 1 June; 10 exs., CBM-ZM-108187, west slope, 50 m alt. (As-2), TK leg., 1 June. MAUG, EAST: 10 exs., CBM-ZM-108198 & 108203, west side, TK leg., 2 June; 15 exs., CBM-ZM-108208, ridge, 120 m alt. (M-1), TK leg., 2 June; 24 exs., CBM-ZM-108217, west side, TK leg., 5 June. MAUG, WEST: 1 ex., CBM-ZM-108223, east side, TK leg., 5 June; 3 exs., CBM-ZM-108227, ridge, 105 m alt. (M-2), TK leg., 5 June.

23. *Coneuplecta* (*Durgellina*) sp.

Specimens examined. AGRIHAN: 4 exs., CBM-ZM-108138, west coast, 120 m alt., TK leg., 28 May; 5 exs., CBM-ZM-108147, north coast, TK leg., 29 May.

Family Olecinidae

24. *Euglandina rosea* (Férussac)

Specimens examined. AGRIHAN: 1 ex., CBM-ZM-108143, west coast, TK leg., 28 May; 3 exs., CBM-ZM-108167 & 108168, north edge, TK leg., 31 May.

Discussion

More than twenty-four species of land molluscs were collected during the expedition. Many introduced species were obtained, such as *Laevicaulis alte*, *Achatina fulica*, *Subulina octona* and *Indoennea bicolor*. They become to be widely distributed in tropical Pacific islands through human trading activity (Mead, 1978; Solem, 1978b). *Gonaxis kibweziensis* and *Euglandina rosea* are major biological control agents of *Achatina fulica* (Mead, 1978). These two species might have been introduced for this purpose to the northern Marianas.

Other land molluscs on the islands, excluding introduced species, are composed of minute species. These minute land snails have greater dispersal abilities than the larger ones (Vagvolgyi, 1976). The distribution areas of these species are wide throughout the Pacific islands (e.g. Baker, 1941; Cooke and Kondo, 1960; Solem, 1978b). Some genera collected in the

northern Marianas, such as *Elasmias*, *Lamelli-dea* and *Lamprocystis*, became to be distributed to the Ogasawara Islands via the Kazan (Volcano) Islands (Kuroda, 1930; Habe, 1985; Kurozumi, 1987; Tomiyama and Kurozumi, 1992).

Semperdon sp. was discovered only on the Maug Island, located at the northern edge of the island chain. This is the northern limit for this genus (see Solem, 1978b).

Living species of *Ptychalaea* are hitherto known only from the Ogasawara Islands (Zilch, 1959–60). Recently, Kurozumi (1992) found this genus on the Daito Islands, east of the Ryukyu Islands, as the second recorded locality. The northern Marianas is the third recorded locality for this genus. *Ptychalaea* may be the only genus for which dispersal occurs from the northern islands to the northern Marianas.

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