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Summary Papers

Session I: Geological History of the Island Arc and Latitudinal Gradient in Terrestrial Biota

Geological History of the Izu-Ogasawara-Mariana Arc: Review

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The Izu-Ogasawara-Mariana Arc is an oceanic island arc formed at the east end of the Philippine Sea by subduction of the Pacific Plate. It consists of several ridges and troughs, and there are two major constituents in the ridges. One is old island arcs formed by volcanism already finished in the Eocene (Ogasawara Islands, Southern Mariana Islands), and the other is new island arcs with recent brisk volcanic activity (Izu Islands, Iwo Islands, Northern Mariana Islands). The former are located more peripherally in the arc than the latter.

The geological history of the Izu-Ogasawara-Mariana Arc is related to the formation process of the Philippine Sea. Since the formation of "the Old Izu-Ogasawara-Mariana Arc" in the Eocene, the west Philippine sea basin, the Parece Vela basin, the Shikoku basin and the Mariana trough have grown intermittently. Theories of the extension process of the basins can be divided mainly into the "trench fix" and "trench retreat" models. In the former, the position of the Izu-Ogasawara-Mariana Arc (east-west direction) remains unchanged during the extension process, whereas in the latter, it was located at a far western position in the Eocene, and then has moved eastwards. Recent paleomagnetic studies support the latter model, and also suggest northward movement of the Izu-Ogasawara-Mariana Arc (the whole of the Philippine Sea) from the Eocene to Recent.

Distribution Patterns of Hepatics in the Izu-Mariana Arc

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The hepatics recognized in the Izu-Mariana Arc may be grouped into the following geographical elements. The numbers of these elements in the Arc are shown in Tables 1 and 2.

1. Endemic species. 2. East Asia element: distributed in China, Japan and adjacent regions. 3. Tropical Asia element: distributed in India, Malaya and New Guinea. 4. Asia-Pacific ocean element: distributed in Asia and the Pacific Ocean islands. 5. Pantropical element: in tropical zone worldwide. 6. Asia-Southern hemisphere element: in Asia, Australia, New Zealand and South America. 7. Northern hemisphere element: in cool-temperate zone of the northern hemisphere.

Table 1. Numbers of hepatic taxa in the Izu-Mariana Arc.

Island chain	No. of families	No. of genera	No. of species	No. of unident.
Izu	29	53	113	0
Ogasawara	19	31	79	4
Volcano	14	17	31	2
N. Mariana	16	26	58	9

Table 2. Geographical elements in the Izu-Mariana Arc.

Island chain	Endemic	East Asia	Trop. Asia	Asia-P. Ocean	Pan Trop.	Asia-S. Hemi.	N. Hemi
Izu	0	60	23	12	1	2	15
Ogasawara	4	21	15	22	6	2	5
Volcano	0	5	6	10	6	3	2
N. Mariana	1	2	8	24	8	4	2

Distribution Patterns of the Terrestrial Flora and Vegetation of the Izu-Mariana Arc

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Mainland Japan to Mariana Islands situate over 20 degree length of latitude. In this area can be distinguished a lot of floral and vegetational boundaries. On these boundaries reflex present and past natural enviroments of the respective islands. From view points or principles of the floral zonings are recognized different biogeological boundaries in same area. In almost area can be distinguished indigenous climax plant communities and cosmopolitan weed communities. Endemic and cosmopolitan each plant communities has different distribution sizes and patterns respectively.

Shape effect of vegetational zonation of oceanic islands:

In the Izu-Mariana Arc can be distinguished three latitudinal vegetational zones in almost island as Coastal-, Inland- and Summit-zone. The summit area of each island has more characteristic flora and vegetation as other vegetational zones. The summit vegetation has two tendencies, dry and wet. These diverge of moisture conditions can explain folowing shape effect hypothesis. 1. The moisture of summit area relate total volume of ascending current and total area of summit. 2. Sharp peaked summit has wet type vegetation. 3. High elevational summit always has wet type vegetation. 4. Flat and low elevational (ca. under 500 m elv.) summit has dry type vegetations.

Vegetational boundary of the Izu-Mariana Arc:

Distribution of main vegetation classes of Boso-, Izu-Mariana area is shown in Table 1.

There is two clear vegetation boundaries. The first boundary is located between Izu- and Ogasawara Islands, and the second between Volcano- and the northern Mariana-Islands. These discrepancy of vegetational boundary observed between Japan mainland and Ryukyu-Islands. Slant way boundary can solve this question.

Table 1. Distribution of main classes of Boso-, Izu-Mariana area.

	Boso-Pen.	Izu-Isl.	Ogasawara-Isl.	Volcano-Isl.	N-Marianas	S-Marians
1. Coastal-Zone						
Cliff	Crepidiastro-Dendranthemetea		Hedyotido-Limonietea →		Scaevolo-Ipomoetea	
Sand Dune	Glehnietea littoralis. →		Scaevolo-Ipomoetea →			
Salt Narsh	Juncetea mariti →		—	—	Avicenio-Sonneratietea	
Low forest	Camellietea japonicae →		Terminalio-Calophylletea →			
Forest	Camellietea japonicae →		Hibisco-Pandanetea →			
2. Innland-Zone						
Forest	Camellietea japonicae →				Elaeocarpetea jogae	
Mantle	Rosetea multiflorae →				Colubrinetea asiaticae	
3. Summit-Zone						
Scrub				Eurya japonica →		
Grassland	Miscanthetea sinensis →			? ←	Miscanthetea condensati	

Distribution Patterns of Land Molluscs on the Izu, Ogasawara and Mariana Islands

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The Izu-Mariana Arc is a large arc composed of the Izu, Ogasawara, Kazan, and Northern and Southern Mariana Islands. On the basis of field surveys and previous literature, the land molluscan faunas of these islands were investigated. There were more than 60 species on the Boso Peninsula, Ogasawaras and S. Marianas, more than 50 on the Izu, and less than 20 on the N. Marianas and Kazan Islands. Endemic rates were conspicuously high on the Ogasawaras (ca. 90%) and S. Marianas (ca. 80%), but lower than 30% in the other regions. The dominant groups in each region were Clausiliidae and Bradybaenidae on the Boso and Izu, Helicinidae, Orthurethra and Camaenidae on the Ogasawaras, Orthurethra on the Kazan and N. Marianas and Assimineidae on the S. Marianas. In comparison with the land molluscan fauna of continental islands, that of oceanic islands such as the Ogasawaras and Marianas were disharmonious. Although Boso and Izu had large species with shell sizes exceeding 32 mm, other regions did not have such large species. On the Ogasawaras and S. Marianas, polytypic genera composed of more than 10 species were recognized, and most of these genera showed radiation and were endemic. The suspected dispersal routes of land molluscs in the Izu-Mariana Arc are discussed.

Session II: Latitudinal Gradient in Marine Biota

Taxonomy and Biogeography of Ogasawara (Bonin) Islands Seaweeds

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The marine benthic flora of the Ogasawara (Bonin) Islands has been studied taxonomically and biogeographically. The present study revealed 70 genera and 99 species of marine algae occuring in this area. Of these, 22 genera and 38 species belong to the Chlorophyceae, 14 genera and 22 species to the Phaeophyceae, and 34 genera and 39 to the Rhodophyceae. Fourteen species are reported for the first time from the Ogasawara Islands. The marine flora was compared with the floras of some other regions along the Pacific coast of Japan and northern Pacific regions using by various indices, such as C/P ratio and I/H ratio. The results indicate that Ogasawara Islands have a marine flora represented by subtropical elements, having considerable similarity to regions such as the Ryukyu Islands and southern part of Japan.

Latitudinal Gradient of Species Diversity in Rocky Shore Animal Communities on Islands along the Izu-Mariana Arc

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The Izu-Mariana Arc is a long chain of islands, extending ca. 3000 km from the warm temperate to tropical regions. Species diversities were measured in rocky intertidal animal communities on the islands along the Arc. Study sites were, from north to south, Miyakejima and Hachijyo-jima of the Izu Islands, Chichijima and Hahajima of the Ogasawara Islands, and Uracas, Maug, Asuncion, Agrihan, Pagan, Alamagan, Guguan, Sarigan, and Anatahan of the northern Mariana Islands. This presentation is partly based on data published by Asakura and the co-author (Asakura *et al.*, 1990, 1991, 1993) and unpublished one on the northern Marianas. All of the islands investigated are high, volcanic islands, unlike most subtropical or tropical islands, which are generally low, raised limestone islands with well-developed coral reefs.

Species compositions and diversities were measured by the line transect and quadrat methods, and land profiles were also determined. Species diversities in terms of number of species, Shannon-Weaver's Function and Pielou's evenness became higher toward the north. This is opposite to general species diversity gradient pattern, in which species diversity is high in tropical areas. Parallel species displacement was seen for many taxa, indicating that closely related species occupy the same niche in neighboring biogeographical regions.

High species diversity in temperate areas may indicate that the animals inhabiting volcanic substrata have evolutionally originated from temperate areas.

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Breeding Distribution of Seabirds in the Izu-Ogasawara Islands

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Of 38 species of seabirds known to breed in the Japanese Islands, more than half (21 species) breed or bred in the Izu-Ogasawara Islands. Although these seabirds, except a few species, are not abundant in this region, the number of species breeding there is comparable to that in the Hawaiian Archipelago and a little larger than in the Mariana Islands. The Izu Islands in the north of the region provide the nesting sites for 10 species and the Ogasawara Islands in the south for 16 species (two of them became locally extinct). In the Izu Is. *Calonectris leucomelas* is the most abundant and has the widest breeding distribution. Recently, it seems that the species began an invasion into Kitanoshima in the northernmost of the Ogasawara Is. It is interesting that six species nest on a very small reef off Hachijyo Island, where the summer breeding *Bulweria bulwerii* uses the nesting crevices of *Synthliboramphus wumizusume* or the burrows of *Oceanodroma tristrami*, both the winter to spring breeders. On Torishima in the Izus, *Diomedea albatrus* and *D. nigripes* are increasing their numbers after the feather exploitation. In the Ogasawara Is. the most abundant and widespread species is *Sula leucogaster*. On the outlying islets, such as Nishinoshima, Kitanoshima and Minami-Iwojima, many species breed, i.e. 8, 7 and 6, respectively. On a tiny reef just off Mukojima, five species breed, including two species of albatrosses. The vegetations of the Ogasawara Islands were seriously modified by grazing of the introduced goat. It is evident that the goats are also affecting the breeding distribution on seabirds. The rats introduced may be affecting the breeding distributions, too, especially of small seabirds.

Session III: Island Biology—History and Perspective

History of Island Biology

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From a general viewpoint, modern island biology originated from the works of C. Darwin and A. R. Wallace, whose experiences with insular biota inspired them to formulate the theory of evolution. As such, studies of insular biota have had great impact on evolutionary biology. Within the disciplines of ecology, R. H. MacArthur and E. O. Wilson's seminal works on island biogeography encouraged both theoretical and empirical studies of ecological communities. Although themes they deat with centered mainly on insular biota, application of their theories is not confined exclusively to island biology. The more ecologists appreciate the applicability of these theories to general issues of ecology, the less conspicuous empirical studies of insular biota become. Here, I review the themes that island biology considered and neglected, or little studied, before and after the publication of a MacArthur and Wilson's book, and then discuss what insular biota tell us about new ideas or concepts in ecology. As a representative theme in island biology, I will focus on the micro-evolution of insular food web structures on the Izu Islands.

Perspective and Application of Island Biology

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Island biologists compare species composition, morphology, ecology, and behavior of animals and plants between one island and another, or between island and mainland areas. An island is surrounded by the sea, and constitutes a clear-cut geographical unit. Therefore, it is easy to show the number of species and the characteristics of morphology and ecology of organisms living on islands. As a consequence, island biology research has had great success in the fields of biogeography, speciation, and community ecology.

Recently, the theory of island biology has been applied to understand the biota and ecology of habitat islands in mainland or continental areas. For example, small woodlands isolated by economic developments are habitat islands surrounded by the sea of human habitations, and the number of animal and plant species is determined by the size and degree of isolation of the woodlands. Shapes and sizes of nature reserves and parks can be designed using the methods and theory of island biogeography. This kind of research will become increasingly important from now on.

On the other hand, conservation issues on true islands are also becoming more important. Many endangered species live on islands, and because the size of most islands is small, the population of island species is also small. Island species are highly specialized to use these small natural habitats, so habitat destruction can easily decrease their small populations. Also, the introduction of alien species may cause a big impact on the native species. In order to conserve the native species, we must fully consider their ecological characteristics and relationships with island habitats.

Poster session

Late Holocene Plant Fossil Assemblage from the Kozu Island

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We obtained a plant fossil assemblage including wood, seed and pollen from paleosols covered by pyroclastic materials in the valley south of Mt. Kobe, in the northern part of Kozu Island. The radiocarbon age of the paleosol was 1680±110 yr B.P. (Gak-16263) and that of the wood in the paleosol was 1310±90 yr B.P. (Gak-15253). These ages indicate that the fossil assemblages were formed just before the eruption of the Tenjosan volcano, that dated at AD 838 by Issiki (1982).

All the wood fossils were rootwood and consisted of *Mallotus japonicus* and *Morus* sp. Seed fossils in the paleosol were composed of 10 woody and 6 herbaceous taxa. Among the woody taxa, *Stachyurus praecox* (seeds), *Aralia elata* (stones), *Rubus* sp. (stones), and *Mallotus japonicus* (seeds) were abundant in the fossil assemblage. Among the herbaceous taxa, Chenopodiaceae (seeds), *Corydalis heterocarpa* var. *japonica* (seeds) and Compositae (fruits) were abundant. The pollen assemblage in the uppermost part of the paleosol was dominated by *Pinus*-type pollen (66.5% of total arboreal pollen), followed by *Mallotus* pollen (26.8%). Among non-arboreal taxa, monolete-type fern spores accounted for 35.6% of the total (including all the identified and unidentified pollen and spores).

The paleovegetation around the study site reconstructed from the plant macrofossils (wood and seeds) was deciduous broad-leaved scrub consisting of *Mallotus japonicus*, *Morus* sp., *Stachyurus praecox*, *Aralia elata*, and *Rubus* sp.

Cup Fungi of Ani-jima, the Bonin Islands

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Five species were newly collected in the litter layer of *Livistona chinensis* R. Br. var. *boniensis* community around Mt. Kita-hutago of Ani-jima. *Anthracobia* sp. was collected from the south-east community of Mt. Kitahutago. Diameter of disc was 5 mm and astipitate. Color of apothecium was bright yellow. Ascospores were 6–8 μm. *Dicephalospora rufocornea* (Berk. et Br.) Spooner was collected on decayed branch from the north-west community of Mt. kita-hutago. Apothecium was small, stipitate and dark red. Thin black subepidermal line was formed around stalk. Ascospores were hyaline, smooth, and capped with a small, obconical gelatinous collar. *Lachnum* sp. was collected on the decayed leaves and stalks of Ogasawara-biro (*L. chinensis* var. *boniensis*) from the south-east community around Mt. Kita-hutago. Apothecium was small and stipitate. Hairs were completely granulate. Hymenium was bright yellow to bright red. Ascospores were 42–56 μm $\times$ 2 μm. *Orbilia* sp. was collected on decayed leaves of Ogasawara-biro from the south-east community around Mt. Kita-hutago. *Puluvinula* sp. was collected on the ground of camellia (*Schima mertensiana* (Sieb. et Zucc.) Koidz.) community situated from north-west of Mt. Kita-hutago. Apothecium was astipitate and beige. Ascospores were round. Paraphyses were slightly curved at the apices. *Lophodermium* sp. was collected on dead leaves of *Pinus luchuensis* Mayer. Specimens of *Lophodermium* sp. were also collected in Chichi-jima and Haha-jima, the Bonin Island, but apothecium was immature to determine the species.

Lichens of the Northern Mariana Islands

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Among about 700 specimens of lichens collected in the northern Mariana Islands during the biological expedition in 1992, 134 taxa are recognized. These include 37 macrolichen taxa, which are obviously fewer than those on the Ogasawara Islands (where 63 macrolichen taxa are known).

Remarks are made about a few noteworthy lichens. (1) Although *Pannaria mariana* and *P. stylophora* are both abundant in the Ogasawara Islands, only *P. stylophora* was found in the northern Marianas. This is in accord with a phenomenon well known in the Parmeliaceae, that is, isidiate species are, in general, more widely distributed than NIS (non-isidiate nor sorediate) counterpart species (in this case *P. mariana* is a NIS species and *P. stylophora* is isidiate). (2) In the northern Marianas, *Coccocarpia smaragdina* was found in addition to *C. erythroxyli*, *C. palmicola*, and *C. pellita*, which are common in the Ogasawara Islands and also on mainland Japan, and are widely distributed in tropics. This species has been recorded from the Indo-Pacific tropics, and the northern Marianas are located at the northernmost distributional range of this species. (3) A species of the genus *Trichothelium* growing on the leaves of a fern is recognized as new to science.

A Taxonomic Study of the Orchis from Alamagan, the Northern Mariana Islands, Micronesia

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Malaxis sp. (Orchidaceae) from Isl. Alamagan, the northern Mariana Islands is taxonomically described. New name *Malaxis alamaganensis* is given, connected with a new distribution place, and description, illustration, habitat are also provided. The species is recognized as closely related to *Malaxis boninensis* from Isl. Chichijima, Ogasawara Islands, now worried about its extinction. For make a comparison with two *Malaxis* species (*M. alamaganensis*: *M. boninensis*), key to the species are also given.

Hybridization of *Rubus* (Rosaceae) on Kozu Island

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On Kozu Isl. of Izu Isls., we discovered plants which were presumed to be hybrids with putative parents thought to be *Rubus trifidus* Thumb. and *R. ribisoideus* Matsum.

R. trifidus has a hairy receptacle. Its stamens spread at flowering and wither soon later. *R. ribisoideus* has a glabrous receptacle. Its stamens erect at flowering and are still alive after that time.

On the other hand, those hybrids with hairy receptacles have stamens which erect at flowering and are still alive after that. The other, with the glabrous receptacle, has stamens which spread at flowering and wither soon later.

Style length of the hybrids is intermediate between *R. trifidus* and *R. ribisoideus* and their pollen stainability is lower than 10%.

Hermatypic Scleractinia of Chichijima Islands, Ogasawara Islands, Japan

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Faunistic sutudies on the hermatypic scleractinia of Chichijima Islands, Ogasawara Islands, have been conducted since 1990. Though species-level identifications have not been completed in several genera, about 200 species belonging to 49 genera in 15 families are recognized up to now. The followings are some characteristics of hermatypic scleractinian fauna of Chichijima Islands in comparison with those of Okinawa Islands and southern coast of Honshu, main islands of Japan.

- Chichijima Isl. lack *Seriatopora*, *Stylophora* and branching *Porites* which are very common in Okinawa Is. There are only three genera of Fungiidae in Chichijima Is., namely *Cycloseris*, *Diaseris* and *Fungia*.
- Several genera, such as *Lithophyllon*, *Physophyllia*, *Pectinia* and *Blastomussa*, found in Okinawa Is. and southern coast of Honshu, do not distribute in Chichijima Is.
- *Galaxea*, *Merulina*, *Scapophyllia* and *Leptoria* are found in Chichijima Is. as well as Okinawa Is., but do not distribute in southern coast of Honshu.

These characteristics seem to be the reflection of the lack of strong warm current system around Ogasawara Is. and paucity of lagoonal environment of the Chichijima Is.

A New Species of the genus *Goera* (Trichoptera, Goeridae) from the Ogasawara Islands

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In the Ogasawara Islands, there occur 55 taxa of aquatic and semiaquatic insects including 23 endemic ones. Tomokuni and Sato (1978) described larvae of *Goera* sp. that were collected on Chichi-jima in the Ogasawaras. However, the taxonomic position of this species has remained unclear until now. In order to compare related species, it is necessary to examine not only larval but also adult morphology. In the course of the Izu-Mariana biological survey conducted by our museum, Dr. S. Miyano obtained adults (3 males) of the genus *Goera* with 2 pupae and 10 larvae on 19 June 1991 at a small streamlet, in the upper reaches of the Hatsuse-gawa river, Chichi-jima. After close examination, this species was considered closely allied to *Goera japonica* Banks and *G. squamifera* Martynov, judging from the shape of the male genitalia, and is new to science.

Marine Gastropoda (Mollusca) of the Ogasawara (=Bonin) Islands

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The marine mollusks of the Ogasawara (= Bonin) Islands were investigated by several authors since the early age of the 19th Century and a number of species were described as new from the Islands. The Ogasawaras are located in the central part of the island chain of the Izu —Mariana Arc. Vermeij *et al.* (1983) reported the molluscan fauna of the northern Mariana Islands lying the south of the Ogasawaras, and

compared it with those of the southern Marianas and Hawaii. They indicated that the major difference of fauna exists between these Islands and it is caused by "the ocean barrier" which selects against the dispersal of mollusks. They also mentioned that the habitat which is characteristic of the volcanic islands yields the species restricted to them. These faunistic differences might be also found within the Izu-Ogasawara island chain, and the occurrence of the characteristic species in the Ogasawaras is expected. However, the study on this viewpoint is poorly done in this district.

In this study, two subclasses, 15 orders, 107 families and over 750 species of the marine Gastropoda were recognized in the Islands. Among them, ca. 300 species are new to Ogasawara, ca. 100 new to Japan, and ca. 30 apparently unnamed and undescribed species. About 30 species are regarded as endemic and most of them belong to the Archaeogastropoda and the Opisthobranchia. Some family-groups (*e.g.* Angariinae, Vasidae) commonly found in the other districts are not distributed. The sedimental bottom species of some families (*e.g.* Strombidae, Naticidae) in the shallow sea are uncommon. The brackish-water gastropods (some species of Neritidae, Littorinidae and Ellobiidae) often temporarily colonize and settle, but they seem to be extinct shonly after their immigration. Thus, the composition of the fauna appears to be changeable.

Shrimp Fauna of the Hachijyo-jima Island in the Izu Islands (Stenopodidean and Caridean Species)

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The Hachijyo-jima Island in the Izu Islands is situated between 33°20′–33°30′N and 134°43′–134°50′E. Although the island is located at such higher latitude, many subtropical or tropical organisms occur in its shallow water by the influence of warm oceanic current "Kuroshio", which flows around the island constantly.

The shrimp fauna of the island has been poorly investigated. Since 1990, I have been studying shrimp fauna of the island based on the specimens collected by skin or SCUBA diving. To date, I have collected 19 species of shrimps, which include 2 stenopodids, 4 rhynchocinetids, 5 palaemonids, 1 gnathophyllids, 3 hippolytids and 4 alpheids. Among these, 15 species are widely distributed in subtropical and tropical waters of the Indo-West Pacific, 3 species are found in the intertidal zones of the temperate Pacific coast of Honshu, the mainland of Japan, and the remaining one is unidentified species of the Alpheidae, now being studied in detail. This species composition suggests that the shrimp fauna of the Hachijyo-jima Island shows transitional characteristics between tropical and temperate areas.

Some Ecological Observations on Social Wasps in the Northern Mariana Islands

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Twenty-six nests of three social wasp species were collected with nearly all their adult members and all immatures in the northern Mariana Islands. *Ropalidia marginata sundaica* and *Polistes stigma* were inferred to have an asynchronous life cycle, whereas *Polistes olivaceus* was to have a synchronous life cycle. Solitary colony founding was ascertained in all three species. Each colony of *R. marginata sundaica* had only one female with a well developed ovary, which was presumably an egg-layer, except for two large colonies, although about half of the females in each colony were inseminated. Females with developed ovaries were significantly larger than those with undeveloped ovaries, but there was no significant size difference between inseminated and uninseminated females which had undeveloped ovaries. In *P. olivaceus*, there was a marked difference in body proportion between founding queens and first daughters, but this difference can be explained by allometric growth, and is not considered to be a morphologically discrete caste difference.

Correlate of Shell Color on Life History of the Land Snail *Euhadra periomphara shimodae* on Nii-jima Island

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The land snail, *Euhadra periomphara shimodae*, living on Niijima island, the Izu islands, shows sympatric polymorphism in its shell coloration, *i.e.*, snails with dark (dark brown- or brown-colored) shells are dominant in the south part of the island, pale (white) in the north, and two color types coexist in the central part. In this study, we looked at differences in the life history of the snails as functions of the shell coloration. Shell coloration and diameter were investigated in snails inhabiting concrete walls along a road running through woods in the central part of Niijima in June '92 and from April '93 to the present, and 325 snails were recorded. Numbers of snails found in a given census increased from April to September '93, and then decreased. Percentages of pale-colored shells was higher than dark from June to August '93 (max. 83%), and decreased from September to November (min. 53%). The seasonal change in size distributions differed markedly between the two color morphs. The pale-colored snails showed constant apparent peaks in size distribution, and continuous growth was detected for each cohort. In contrast, the size distributions of the dark snails changed month by month. Especially in summer, it was observed that the number of the dark-colored snails with 10 to 20 mm in diameter decreased, and then increased in autumn with growth in size. Thus it was suggested that in summer snails with pale-colored shells became abundant in open microhabitat (concreate walls) due to difference in suitable habitats between color morphs, and thus producing a difference in size structure in relation to shell coloration.

Ecological Release of the Snake-eye Skink, *Cryptobrepharus boutonii*, on the Outpost Islands

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Habitat, microhabitat, density and body size of the snake-eye skink, *Cryptobrepharus boutonii nigropunctatus*, were studied on the Ogasawara Islands where this species is the only indigenous diurnal lizard. Field studies of diurnal lizard assemblages on the islands of Micronesia (Marianas, Yap, Palau, Tuuk, Pohnpei) and literature surveys suggested that *Cryptobrepharus* skinks are absent or confined to narrow ecological niches on the species rich islands, but have extended ranges of habitat on solitary islands. For example, on Chichi-jima, in the Ogasawara Islands, *C. b. nigropunctarus* occupies various habitats from beach forest and dry rocky outcrops to mesic forest in the middle of the island, shows both terrestriality and arboreality, and attains a maximum snout-vent length (SVL) of 65 mm. However, on the Palau Islands, the lizards occur mainly in open beach forests, are strictly arboreal, and attain a maximum SVL of only 40 mm. Moreover, literature surveys revealed an inverse correlation between body size of *Cryptobrepharus* skinks and the number of sympatric diurnal lizards. These phenomena suggest that *Cryptobrepharus* skinks show ecological release on the isolated, species-poor islands.

Typical Sound Environment of the Miyake-jima Island (An Exhibition of Sound and Sonagraphy)

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The Miyake-jima Island is a volcanic island in the Pacific Ocean, located approximately 150 km south of the main island of Japan. It is the third largest of the Izu Seven Islands with the area of approximately 55 km^2 and circumference of approximately 35 km. Including the eruption in October 1983, Mt. Oyama (814 m a.s.l.) repeatedly erupted to impose catastrophic effects upon vegetation and topography, frequently turning extensive areas to

lava rocks. Oceanic waves and winds further add variability in the coastline structure ranging from sandy shore to rocky cliff. Further, the island developed rich natural environment like deep forests as represented by the wilderness of laurel forest around the Tairo-ike Pond. In the present study, diverse natural environment of the island is considered in the aspect of natural sounds. In order to make clear the structure of unique sound environment, acoustic activities of living organisms and physical phenomena were monitored for classification of typical sound environment. Field works were carried out in March and May, 1991. The sound environment was recorded at different locations covering varieties of coastline, lava rocks, grassland, and forests. Recordings were analysed by sonagraphy for further visual examination. In particular, a comparison was attempted for the sound environment of Tairo-ike Pond before and after 1983 eruption, using 1959 and 1976 recordings made by Tsuruhiko Kabaya.

Calving Intervals of the Humpback Whale (*Megaptera novaeangliae*) off the Ogasawara Islands, Japan

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Waters off the Ogasawara (Bonin) Islands (27°N, 142′E) have been known one of the winter breeding ground for humpback whales (*Megaptera novaeangliae*) in the Western North Pacific. Over 400 individual humpback whales have been photographically identified in nearshore waters off the Ogasawara Islands from 1987 through 1993. A total of 45 identified cows were associated with 55 calves during the 7 research seasons. Nine cows were recorded with a calf in differnt two or three seasons. Observed mean resighting interval of identified cows with calves was 2.3 years ($n=10$, SD=0.78); 1 year ($n=1$), 2 years ($n=6$), 3 years ($n=2$), 4 years ($n=1$). This means that calving interval existed around the interval above. Two of identified 12 calves were resignted in the subsequent year, and one of them still stayed with its cow. This may indicate a suckling period of the group.

Dispersal of the Major Coffee Pest, *Hypothenemus hampei*, (Coleoptera: Scolytidae) in New Caledonia

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The coffee berry borer (CBB), *Hypothenemus hampei*, is the major insect pest of coffee in New Caledonia, as in most parts of the world. All stages of the borer live within and feed upon the berries, apparently only emerging for their dispersal to uninfested fruits. Only females contribute significantly to the dispersal of the species as males are apterous. Endosulfan is the most commonly used insecticide for CBB control; the first reported case of CBB resistance to this compound arose in 1987 in New Caledonia. In a previous study, the distribution of resistance in borers in treated fields showed a cline over a short distance, with the highest resistance frequency near the point of spray application. This finding and the aggregated distribution of the pest suggested little movement between generations. Release-recapture experiments were undertaken to quantify dispersal. Insects release in uninfested fields show an average migration range of less than 20 meters. We report on results obtained using a newly developed trap in a heavily infested field; this trap offers promise as a tool for further dispersal studies. Borer movement is an essential parameter for an ongoing project to model population dynamios of the pest including resistant strains, with the aim of describing and predicting the spread of resistance within a field or region.

Resistance is an evolutionary phenomenon driven by selection conditions created by modern agriculture. A better understanding of the spread of resistance is of interest both as an example of evolution and in contributing to strategies for Integrated Pest Management.