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Zoogeography of Fishes of the Mariana, Ogasawara and Izu Islands: A Preliminary Assessment

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Abstract The zoogeographical relationships of the fishes of the Mariana, Ogasawara, and Izu Islands, all part of a single major archipelago located along the Pacific-Philippine plate and Pacific-Eurasian plate margins were examined. The Mariana Islands were further partitioned into the Northern Marianas, of recent volcanic origin, and the Southern Marianas, of older volcanic origin with considerable coralline limestone development. The Iwou, or Volcano Islands, located between the Northern Marianas and the Ogasawara was excluded from the analysis. Levels of species richness, family richness, endemicity, and faunal similarity and latitudinal affinity were compared. Species richness was highest in the Marianas, followed by the Ogasawaras and the Izus. The N. Mariana Islands fauna had the lowest species richness when partitioned, however. Family richness was greatest in the Marianas and least in the Ogasawara. Partitioning the N. Marianas resulted in this group having the lowest family richness. Family richness in the Izus likely benefited from the inclusion of taxa not found in the tropics. Endemicity was low at all localities. Cluster analyis of similarity index values resulted in two distinct clusters: N. Marianas–S. Marianas, and Izus–Ogasawaras. Latitudinal faunal affinities at all localites were strongly tropical.

Key words: Distribution, fauna, endemism, similarity, species richness, temperate, tropical.

The Izu, Ogasawara, and Mariana Islands, all part of the Izu–Mariana Archipelago, which also includes the Iwou or Volcano Islands, extend southward in an arc from central Honshu, Japan, along the margin of the Pacific and Philippine plates to within 13 deg of the equator. These islands are remarkable in that many are of recent volcanic origin, and include active volcanos, but also include, at the southern end of the arc, islands of raised limestone on older volcanics. Further, the arc consists of both temperate and tropical faunas, with the former, in the Izus, influenced seasonally by the Kuroshio Current. Interestingly, temperate inshore species occur as far south as the volcanic northern Marianas while tropical species have successfully colonised warm temperate waters of the northern-most Izu Islands.

Habitat differences also likely affect the composition of species at a given locality. For example, the southern Mariana Islands have well-developed reef flats and coral reefs, while most of the northern volcanic Marianas consists of volcanic rock, steep slopes, and limited coral development. Exceptions to this "rule" include portions of Anatahan, Sarigan and Pagan which support some surprisingly well developed reefs in deeper (>25 m) waters (pers. obs.). Similarily, Miyake-jima (34°5′N, 139°30′E), mid-way up the Izu Islands chain, where surface water temperatures may range from 13°C in February to 29.5°C in August, supports one of two the most northerly coral communities in the world (Moyer, 1980). The Ogasawaras, located at the northeastern margin of the Philippine plate, has surface temperatures ranging from 20–27°C depending upon season. Coral and rocky reef habitats are developed variously within the group.

The fishes of the Izu–Ogasawara–Mariana Islands are variable in their origins. Fishes of the Izu Islands are characterised as being of

either cold temperate origin, warm temperate endemics of tropical origin, established tropical species, and non-established tropical species (Moyer, 1980). Establishment requires survival of winter water temperatures (Moyer, 1980) which undoubtedly varies both with latitude and with proximity to the Kuroshio Current. Freshwater and estuarine species remain to be examined closely. Fishes of the Ogasawara Islands are largely tropical in origin, although a number also occur in warm temperate waters of Japan (Pyle, unpubl. ms; Randall and Pyle, unpubl. ms). Fishes of the Mariana Islands have largely tropical origins, including colonists from the Philippines, Belau and the Caroline Islands (Myers, 1989) with low endemism (Randall, 1992). Shallow offshore banks and seamounts to the west and southwest remain to be adequately sampled. Estuarine and freshwater species are developed only on Guam, and to a much lesser extent, on Rota and Saipan (Myers, 1988; pers. obs.).

The patterns of distribution of fishes in these islands groups, as elsewhere in the Indo-Pacific region, are dependent upon a number of factors, including local and regional current patterns (Lobel, 1989), plate tectonics (Springer, 1982; Myers, 1989), fluctuating sea levels (Woodland, 1983; Donaldson, 1986; Myers, 1989), annual and seasonal surface water temperature fluctuations (Moyer, 1980), habitat type and availability (e. g., Bell and Galzin, 1984), reproductive ecology (Thresher and Brothers, 1985), spawning mode (Thresher, 1991), pelagic duration (Brothers and Thresher, 1985; Thresher, 1991), and community processes (Ebeling and Hixon, 1991; Hixon, 1991; Sale, 1980, 1991; Williams, 1991). The extent to which each of these factors operates within and between island groups will require much additional work.

This paper assesses the relationships between fish faunas of the Izu, Ogasawara, and Mariana islands. The assessment is a preliminary one, since the fauna of the Izu Islands has not been adequately examined. The same is true of the Iwou Islands, which stand between the northern Mariana and Ogaswara islands, and which will be omitted here. Still, our assessment should provide a framework for further examination of patterns of species distribution and endemism. To this end, checklists of families and species known from the Mariana appear in Appendix I and II, respectively. Freshwater fishes are included here and in the analysis below since all species have a marine component in their life history. Checklists of fishes from the Ogasawara Islands (Randall and Pyle, unpubl. ms.) and Izu Islands (Matsuura and Moyer, in prep.) will appear elsewhere.

Study Sites, Materials and Methods

Field studies

Fishes of the northern Mariana Islands were surveyed during the Natural History Museum and Institute, Chiba-Northern Mariana Islands Expedition (May–June, 1992), conducted in cooperation with the Commonwealth of the Northern Mariana Islands Division of Fish and Wildlife and the University of Guam Marine Laboratory. Visual surveys were conducted by scuba diving or snorkelling in selected habitats at each locality. Fishes were identified to species and recorded on underwater paper. Additional observations of fishes and their habitats were made with underwater still and video photography. T. J. Donaldson and P. Schupp conducted the surveys on the first leg of the cruise (Anatahan, Sarigan, Guguan, and Alamagan). P. Schupp, T. Pitlek and J. E. Gourley conducted the surveys at the remaining localities. These surveys were scheduled to include daylight time periods at all localities, and additionally, dusk time periods at Anatahan, Sarigan, Guguan and Alamagan. The number of surveys at each locality varied because of local conditions, nitrogen limitations, time spent at each locality, and shark activity. Depths surveyed ranged from 0.1 m to 65 m.

Collections of materials were also made by hook and line, spear, quinaldine, and rotenone. These specimens are deposited at the Natural History Museum and Institute, Chiba.

Data on southern Mariana Islands fishes has been collected over several years by a number of workers (e.g., Kami 1971; Kami *et al.*, 1968; Myers and Shepard, 1980; Shepard and Myers, 1980; Myers, 1988), the results summarised in Myers (1989). Additional new records (Myers and Donaldson, in press) have been obtained by

visual observations, underwater photography, fish market inspections, and collections, principally by R. F. Myers and T. J. Donaldson.

Izu Islands fishes not reported from the literature (see below) have been observed primarily by J. T. Moyer and co-workers over the past several years (1972–present). The Tatsuo Tanaka Memorial Biological Station at Miyake-jima, although specializing in research on ecology and behavior, conducted thorough surveys of seven families of reef fishes at Miyake-jima. These families were: Apogonidae, Callionymidae, Chaetodontidae, Labridae, Pomacanthidae, Pomacentridae, and Tripterygidae. Also, additional observations have been made with scuba and underwater photography by T. J. Donaldson and R. F. Myers.

Literature surveys

A list of fishes of the Mariana Islands was generated from Shepard and Myers (1980), Myers (1988, 1989, in press), with additional materials gleaned from Donaldson and Myers (1988), Myers and Donaldson (in press), and Randall and Heemstra (1991). Partitioning the list between the Southern and Northern Mariana Islands followed Myers (1989), supplemented with personal observations.

The Ogasawara Islands list followed Randall and Pyle (unpubl. ms), with minor additions from Masuda *et al.* (1984), Randall and Ida (1993), and J. T. Moyer and K. Matsuura (pers. obs.). Pyle (unpubl. ms) cited 754 species but Randall and Pyle (unpubl. ms) noted that some citations are suspect. Because of this, we have chosen a conservative number in this study.

A preliminary checklist of fishes of the Izu Islands was derived primarily from Ida and Moyer (1974), Shepard and Randall (1976), Shepard and Moyer (1980), Masuda *et al.* (1985), Zaiser and Fricke (1985), Moyer (1991), and Fricke and Zaiser Brownell (1993). The list was also supplemented with species reported incidentally, usually in the behavior literature (e.g., Moyer, 1979, 1984, 1987, 1991; Moyer and Zaiser, 1981; Moyer and Yogo, 1982), and with personal observations. This compiliation was particularly tasking since the fish fauna of the islands is still poorly known, and patterns of temperate and tropical species distributions, including the occurence of seasonal waifs, remain uncertain. For example, the fishes of northerly Oshima likely differ remarkably from those found in the warmer waters of Miyake-jima and Hachijo-jima. Therefore, certain species likely to occur in the Izus were placed in the list. The reasoning was relatively simple. Warm temperate species occurring in central Honshu, including sagami Bay, Suruga Bay, Tokyo Bay, and the Izu Peninsula, were deemed likely to occur at least at Oshima. Species with strong continental affinities were not included, however. Tropical species reported from the above localities, but also occurring in the Ogasawara, were also included in many instances. The margin for error is likely significant and the list will doubtless require considerable improvement. Nevertheless, a working list of this type will provide some basis for comparative assessment, and for future hypothesis testing.

Analyses

The following parameters were examined: species richness, the number of species occurring at each locality; family richness, the number of families occurring at each locality; endemicity, the proportion of endemic species at each locality; a ranking of the number of species per family at each locality; and a ranking of the ten most speciose families at each locality. An estimate of the proportion of the assemblage belonging to cold temperate, warm temperate, warm temperate of tropical origin, and tropical faunas, was also calculated for each locality. This measure assumed that species observed was established in at least part of the latitudinal range of the locality. Latitudinal faunal affinity was assigned on the basis of descriptions in the literature (Masuda *et al.*, 1984; Myers, 1989; Kuiter, 1992; Michael, 1993) or from personal observations.

Three localities were specified: the Izu Islands, the Ogaswara Islands, and the Mariana Islands. Further partitioning was made for the Mariana Islands, separating the volcanic Northern Mariana Islands from the limestone Southern Mariana Islands (Table 1).

Species richness, family richness, endemicity, and faunal affinity were analysed

Table 1. Partitioning of the Mariana Islands into the volcanic Northern Marianas and the limestone Southern Marianas.

Southern Mariana Islands	Northern Mariana Islands
Galvez Banks	Anatahan
Guam	Sarigan
Rota	Guguan
Aguijan (Goat Island)	Alamagan
Tinian	Pagan
Saipan	Agrihan
Marpi Reef	Asuncion
Farallon de Mendinilla	Maug
	Farallon de Pajaros (Uracas)

Islands are arranged from south to north. The seamounts and banks to the west are not included. All of the Northern Mariana Islands but Sarigan and Maug are currently or recently volcanically active.

with chi square tests. The null hypothesis stated that there was no significant difference between localities in species richness, family richness, endemicity, or faunal affinity.

The relationship between the number of families and the number of species in all localities was examined by calculation of Pearson product-moment correlation analysis.

Similarities between island groups in their faunal composition were estimated by pairwise calculation of Sorenson's Qualitative Similarity Index (Magurran, 1988). This index analyzed presence-absence data from each locality. While this index was less satisfactory than quantitative measures, it is considered the most robust of qualitative measures (Smith, 1986, cited in Magurran, 1988). The values ideally range from 0 (no similarity between pairs of localities) to 1 (complete similarity). A matrix of index values was assembled from the pairwise comparisons. This matrix was subjected to cluster analysis (CLUSTER: Norusis and SPSS, Inc., 1990) to determine relationships between localities in faunal composition.

Results

Species, family richness and endemicity

Species richness increased from north to south between the Izu, Ogasawara, and Mariana Islands (Table 2). Differences between these three groups were highly significant. Partitioning the N. and S. Mariana Islands produced similar results. Species richness increased with decreasing latitude (Table 2) with highly significant differences between groups (Table 3). A minor exception existed when the partitioned S. Mariana fauna was compared against the entire Marianas fauna. Although species richness was greater in the latter, there was no significant difference between the two (Table 3).

Table 2. Species richness, family richness and endemicity of fishes from the Izu Islands (IZU), Ogasawara Islands (OGW), Mariana Islands (MI), Northern Mariana Islands (NMI), and Southern Mariana Islands (SMI).

Parameter	Locality				
	IZU	OGW	MI	NMI	SMI
Species richness	568	745	943	463	923
Family richness	100	92	112	72	100
Endemicity (%)	<1.0	1.3	<1.0	<1.0	<1.0

Endemic species for the partitioned Mariana Islands are those of combined islands which occur in either or both partitions.

Table 3. Chi-square values for pairwise comparisons of species richness (upper diagonal) and family richness (lower diagonal).

	IZU	OGW	MI	SMI	NMI
IZU	—	23.9***	93.1***	84.5***	10.7**
OGW	0.3	—	23.2***	9.5**	87.2***
MI	0.6	1.8	—	<0.21	163.0***
SMI	0.5	1.6	<0.01	—	152.7***
NMI	4.6*	2.4	60.4***	7.9**	—

$df = 1$, ***$P < 0.001$, **$P < 0.01$, *$P < 0.05$.

The pattern of family richness between island groups did not mirror that of species richness (Table 2). Family richness was greatest in the Mariana Islands and least in the Ogasawara Islands. Family richness in the Izu Islands was quite high, having only 12 fewer families than the Mariana Islands. Partitioning of the Marianas resulted in the S. Mariana Islands having one less family than the entire Marianas with the N. Mariana Islands the least of all island groups. Differences in comparisons between island groups were significant in only three instances (Table 3), all of which involved

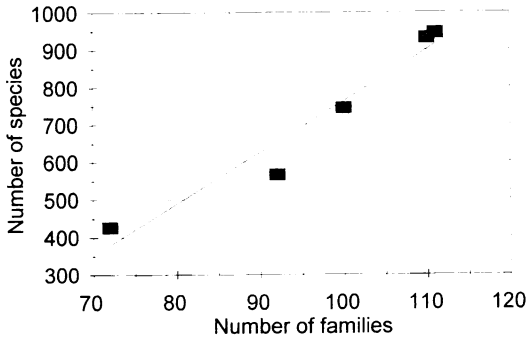

Fig. 1. Relationship between the number of families at a locality and the number of species. Correlation $r=0.94$, $P<0.05$.

subsets partitioned from the Mariana Islands: Izu Islands vs N. Mariana Islands; S. Mariana Islands vs. N. Mariana Islands; and, Mariana Islands vs N. Mariana Islands.

There was a strong positive correlation ($r=0.94$, $df=3$, $P<0.05$) between family richness and species richness (Fig. 1).

The ten most speciose families of each island group are listed in Table 4. Individually, the Gobiidae had the most families in the Marianas. The Labridae dominated both the Ogasawara and Izu Islands. Of the families listed, most were common to all three major island groups. For example, the Gobiidae, Labridae, Serranidae, and Pomacentridae placed in the top five for each island group. Rounding out the top five were the Muraenidae (Mariana Islands) and the Chaetodontidae (Ogasawara and Izu Islands). The lower five counted the Acanthuridae, Apogonidae and Carangidae among all three island groups. The remaining families differed between groups. These included the Blenniidae and Holocentridae in the Mariana Islands, the Tetraodontidae and Lutjanidae in the Ogasawara Islands, and the Scorpaenidae and Pomacanthidae in the Izu Islands.

A comparison between the ten most speciose families of Northern and Southern Mariana Islands (Table 5) gave somewhat similar results, although the order of importance differed to some extent. The Gobiidae dominated the S. Marianas while the Labridae, although having a lesser number of species than the south, dominated the N. Marianas. The Serranidae and Pomacentridae, and to a lesser extent, the Blenniidae, Carangidae, Chaetodontidae, and Holocentridae, were important to both islands groups. The Lutjanidae and Balistidae were more important in the north, and the Muraeni-

Table 5. The ten most speciose families of the Northern and Southern Mariana Islands.

Northern Mariana Islands	Southern Mariana Islands
Labridae (50)	Gobiidae (84)
Serranidae (39)	Labridae (68)
Pomacentridae (30)	Serranidae (50)
Acanthuridae (29)	Muraenidae (47)*
Chaetodontidae (23)	Pomacentridae (46)
Lutjanidae (19)	Blenniidae (39)
Blenniidae (17)	Apogonidae (35)
Carangidae (16)*	Acanthuridae (34)
Holocentridae (16)*	Chaetodontidae (31)
Balistidae (14)	Holocentridae (25)*
	Scorpaenidae (25)*
	Carangidae (23)*

Species number is given in parentheses. *denotes tie.

Table 4. The ten most speciose families at each locality.

Mariana Islands	Ogasawara Islands	Izu Islands
Gobiidae (86)	Labridae (70)	Labridae (76)
Labridae (71)	Serranidae (60)	Pomacentridae (38)
Serranidae (52)	Gobiidae (46)	Serranidae (36)
Pomacentridae (47)*	Chaetodontidae (35)	Chaetodontidae (32)
Muraenidae (45)	Pomacentridae (33)	Gobiidae (24)
Blenniidae (39)	Tetraodontidae (31)	Acanthuridae (21)
Apogonidae(35)	Acanthuridae (26)*	Scorpaenidae (20)
Acanthuridae (34)	Carangidae (26)*	Apogonidae (18)*
Chaetodontidae (32)	Lutjanidae (26)*	Carangidae (18)*
Holocentridae (25)	Apogonidae (23)	Pomacanthidae (17)

Species number is given in parentheses. *denotes tie.

dae, Apogonidae, and Scorpaenidae were so in the south. The Gobiidae were of diminished importance in the N. Mariana Islands. This may be a consequence of a reduction in habitat diversity, but may also be a result of sampling bias. The S. Marianas have been sampled extensively compared to the N. Marianas. Cryptic or less visible species, such as the gobiids, may have easily gone undetected in the seldom-visited north. This bias may extend in varying degrees to the Ogasawaras and Izus as well. A list of families occurring at each locality, including the number of species per family, is given in Appendix I.

Endemicity was very low at all localities (Table 2), usually slighty more or less than 1% of the total fauna. Differences were not significant. Endemicity values are low partly because of the inclusion of epipelagic species in each locality's faunal assemblage, of incomplete sampling at some localities and at depths greater than 80 m, and because of each locality's geographic proximity to the highly speciose Philippines–Indo–Malayan region (see Discussion below). This region likely supplied numerous species historically without much interuption in gene flow. Endemic species are given in Table 6.

Table 6. Endemic species of the Izu–Ogasawara–Marianas archipelago.

Locality and species	Number of species
Izu Islands	8
Callionymus curvispinis (Callionymidae)	
C. persicus izuensis (Callionymidae)	
Synchiropus kiyoae (Callionymidae)	
*S. moyeri** (Callionymidae)	
Gorgasia japonica (Congridae)	
Macropharyngodon moyeri (Labridae)	
Chromis notatus miyakensis (Pomacentridae)	
Enneapterygius sp. (Tripterygidae)	
Ogasawara Islands	10
Synodus n. sp. (Synodontidae)	
Campichthys n. sp. (Syngnathidae)	
Pseudamia rubra (Apogonidae)	
Halichoeres n. sp. (Labridae)	
Pteragogus n. sp. (Labridae)	
Xyrichthys n. sp. (Labridae)	
Scarus obishime (Scaridae)	
Parapercis n. sp. (Pinguipedidae)	
Cabillus n. sp. (Gobiidae)	
Ammodytoides kimurai (Ammodytidae)	
Mariana Islands	7
Pseudoanthias sp. (Serranidae)	
Chaetodon flavocoronatus (Chaetodontidae)	
Enneapterygius nanus (Tripterygidae)	
Lepadichthys minor (Gobiosocidae)	
Synchiropus circularis (Callionymidae)	
Synchiropus sp. (Callionymidae)	
Xenobalistes tumidipectoris (Balistidae)	
Endemic to the Mariana and Ogasawara Islands	2
*Centropyge shepardi** (Pomacanthidae)	
Pomachromis guamensis (Pomacentridae)	

Data are from Myers (1989), Fricke and Zaiser Brownell (1993), and Randall and Pyle (unpubl. ms), with modification. *denotes recently seen outside of its reported range (see text).

Similarities and faunal affinities

The fish faunas of the Izu, Ogasawara, and Mariana Islands were generally less than moderately similar to one another in composition (Table 7). Of major groups, the Izus and Ogasawaras were most similar to one another but at only just slightly more than 50%. Partitioning the Marianas into northern and southern components yielded the greatest degree of similarity, about 61%, which was between the two subsets. There was an apparent latitudinal effect from north to south in faunal similarity. The Marianas, and both partitioned subsets, were least similar to the Izus, and then the Ogasawara, in that order.

Cluster analysis of similarity values for the Izu, Ogasawara, N. Mariana, and S. Mariana fish faunas yielded a dendrogram depicting the relationships between these localities (Fig. 2). There are two clusters, with clear definition between the Marianas, at the margin of the Pacific and Philippine plates to the south, and the Ogasawara and Izu Islands, along the northern edge of the Pacific Plate-Philippine Plate and Pacific-Plate Eurasian Plate boundaries, respectively. The Izu–Ogasawara cluster is indicative of a continental margin associated fauna; the Marianas cluster of a transitional insular fauna more, strongly associated with the Pacific Plate-Philippine Plate boundary.

A preliminary analysis of faunal affinities on

Table 7. Matrix of Sorenson Qualitative Similarity Index values for pairwise comparisons of fish faunas recorded for the Izu Islands (IZU), Ogasawara Islands (OGW), Mariana Islands (MI), Northern Mariana Islands (NMI), and Southern Mariana Islands (SMI).

	IZU	OGW	MI	NMI	SMI
IZU	—				
OGW	0.5327	—			
MI	0.3582	0.4931	—		
NMI	0.3793	0.4848	*	—	
SMI	0.3611	0.4906	*	0.6681	—

*not calculated.

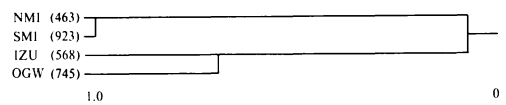

Fig. 2. Dendrogram generated from cluster analysis of Sorenson Qualitative Similarity Index values in pairwise calculations. 0=no similarity; 1.0=complete similarity. NMI—Northern Mariana Islands, SMI—Southern Mariana Islands, IZU—Izu Islands, and OGW—Ogasawara Islands. Number of species at each locality is given in parentheses.

the basis of latitudinal criteria described previously showed a very strong tropical component at all localities (Table 8). Fishes described as circumtropical and warm temperate were the second most common, followed by warm temperate species of tropical origin, insular freshwater species, warm temperate species, cold temperate species, and continental freshwater species. Significant differences between localities existed for each class except for cold temperate, circumtropical and warm temperate, and continental freshwater species (Table 8). A more detailed analysis, which will consider regional affinities, is in preparation.

The Izu Islands fish fauna was dominated (71.4%) by tropical species, followed in order by warm temperate of tropical origin, warm temperate, circumtropical and warm temperate, cold temperate and continental freshwater (tie), and insular freshwater species. This order may be biased since their was sharp division in faunal composition between Oshima and islands south (see Moyer, this volume), and because the fish fauna of Miyake-jima, largely tropical in composition, is better known than those of other islands in the group.

The Ogasawara Islands fish fauna was also dominated (86.8%) by tropical species. Warm temperate of tropical origin species comprise the second largest component, followed in order by circumtropical and warm temperate and warm temperate species. Cold temperate, continental freshwater, and insular freshwater species follow with just one species each.

Predictably, tropical species dominated the Marianas fish fauna (94.6%), including the N.

Table 8. Faunal affinities of fishes. Class: (1) cold temperate, (2) warm temperate, (3) warm temperate of tropical origin, (4) tropical, (5) circumtropical and warm temperate, (6) continental freshwater, and (7) insular freshwater.

Lcality		Class						
	N	1	2	3	4	5	6	7
Izu	568	3	31	97	406	27	1	3
		(0.5)	(5.3)	(17.1)	(71.6)	(4.8)	(0.2)	(0.5)
Ogasawara	745	1	19	45	647	29	1	1
		(0.1)	(2.6)	(6.0)	(86.8)	(3.9)	(0.1)	(0.1)
Mariana	943	4	2	7	875	26	0	16
		(0.4)	(0.2)	(0.7)	(94.2)	(2.8)	(0)	(1.7)
N. Mariana	463	1	1	7	436	18	0	0
		(0.2)	(0.2)	(1.5)	(94.2)	(3.9)	(0)	(0)
S. Mariana	923	3	2	7	870	26	0	15
		(0.3)	(0.2)	(0.8)	(94.3)	(2.8)	(0)	(1.6)
χ^2		3.0	66.6	152.3	315.8	2.8	3.0	35.2
df		6	6	6	6	6	6	6
P<		ns	0.001	0.001	0.001	ns	ns	0.001

N=number of species at that locality. Percentage of total number of species at a given locality is given in parentheses.

Marianas (93.7%) and S. Marianas (94.7%). Warm temperate and warm temperate of tropical origin were poorly represented in the Mariana Islands and its partitioned subsets, and continental freshwater species were absent. A single cold temperate species, a pelagic shark (*Isurus oxyrhynchus*) often found in warm temperate waters, occurred in the N. Marianas. Insular freshwater species occurred only in the Southern Marianas, and virtually all were confined to the islands of Guam and Rota (pers. obs.).

Discussion

There is a tendency for species richness to increase with decreasing latitude along either side of the margin between the Pacific, Philippine, and Eurasian plates (Myers, 1989: Figs. 6 and 7). This was true to only some degree in the Izu–Ogasawara–Marianas archipelago. Species richness increased from north to south along this arc. Partitioning of the Marianas into two geologically distinct subsets however, resulted in a dramatic decrease in the number of species found in the N. Marianas, about half the number of the S. Marianas, but also 39% less than the Ogasawaras and 19% fewer species than found in the Izus to the north. This reduction in the N. Marianas may be a function of the lack of habitat complexity in relatively young and steep sloped islands such as Alamagan, Anatahan, Guguan, Pagan and Sarigan (1–1.5 myr), compared with Saipan and Guam (35–45 myr), although coral reef development in the southern and southwestern leeward coasts of Sarigan and Anatahan is surprisingly rich below 25 m (pers. obs.). Habitat complexity may be greater in the Ogasawaras, at least at Chichi-jima, and in some of the Izus (e.g., Miyake-jima and Hachijo-jima), although this complexity need not be manifested in terms of coral reef development alone. Rocky reefs and algal meadows (see Moyer, 1991) may be surprisingly rich in species. A comparison between the N. Marianas fauna and that of similarily young and steep-sloped Iwou (Volcano) Islands, is highly desirable. The presence of freshwater habitats, and hence, a secondarily-derived freshwater fish fauna, further contributed to species richness at least in the S. Mariana Islands, and particularly in Guam. Freshwater habitats containing native fishes are non-existent in the N. Marianas (pers. obs.), and data for the Izus (particularly Mikura-jima) and Ogasawaras, are wanting.

Similar differences were evident in family richness. The Marianas had the greatest number (112), followed by the S. Marianas, Izus, Ogasawaras and N. Marianas. The difference in number between the tropical Marianas and Marianas, and the warm temperate Izus was only 12 families. The Izus had eight more families than the Ogasawaras, as well. The fauna of the Izus likely benefited from the inclusion of contintental and non-tropical families, and also from the inclusion of warm temperate species from families of tropical origin which would otherwise be absent, and likely are so as far north as Oshima. Remarkably, all island groups in this analysis shared several of the ten most speciose families. This is likely indicative of the relatively high degree of speciation within these families and their success at colonizing different island groups, compared to other taxa.

Endemism, generally around 1%, was low compared to various island groups to the east or far south, e.g., the Society, Tuamotu and Austral Islands (2%), Rapa (5%), Lord Howe Island-Norfolk Island (7.2%), the Marquesas (10%), and quite low compared to the relatively isolated Easter Island (23.3%) and Hawaiian Islands (25%) (Randall, 1992). These other measures are based upon the inclusion of shore fishes alone in the analysis. Doubtless some localities will, with the inclusion of epipelagics and freshwater species, have lower levels of total endemism, but the differences in at least three of these having the greatest levels of endemism for shorefishes will not be significant.

Some islands within the Izu–Ogasawara–Marianas appeared to have high levels of endemism relative to others in their respective groups. For example, Miyake-jima in the Izus had eight endemics species, and a remarkably well developed dragonet (Callionymidae) fauna as well (Zaiser and Fricke, 1985; Fricke and Zaiser Brownell, 1993). Randall (1992) noted that almost all of the island groups of Oceania

with relatively high levels of endemism were located at subtropical latitudes. Miyake-jima, located in a warm temperate latitude but possessing a large tropical fauna, fits this pattern. Elsewhere tropical Guam, the largest of the Marianas, and having the greatest habitat complexity within the group, has seven endemic species (Myers, 1989), and shares an additional two species, *Centropyge shepardi* (Pomacanthidae) and *Pomachromis guamensis* (Pomacentridae) with the Ogasawaras.

Endemism should be low relative to other more isolated eastern and southeastern localities. The Izu–Ogasawara–Marianas archipelago sits at the juncture of three separate zoogeographical regions and appears to collect allopatric species which originate elsewhere without much chance of interupted gene flow, and hence, speciation. (Myers, 1988; Pyle, unpubl. ms; pers. obs.). Historically, endemism has had little opportunity to develop (Myers, 1988), except in the Izu (Moyer, unpubl. ms).

The problem with endemic species is that many may not be so. Greater sampling effort in localities outside the range of endemicity, particularly isolated ones, or at greater depths, may reduce the number of endemic species claimed. For example, *Centropyge shepardi* (and not *C. ferrugatus*) has been observed recently from the Southwest Palau Islands (Donaldson, unpubl. ms). This island group is distant and well isolated from this species known range, and relatively close to the highly speciose islands of northern Indonesia, part of the Philippines–Indo–Malayan area, and an area warranting greater attention. Similarily, *Synchiropus moyeri* (Callionymidae), an endemic of Miyake-jima, Izu Islands, has recently been observed in the southern Ryukyu Islands.

Granted, isolated localities such as the Hawaiian Islands, Easter Island, the Marquesas, Lord Howe Island-Norfolk Island, and Rapa will stand as prime examples of high levels of endemism and the potential for speciation in relatively depauperate faunas. Miyake-jima, in the Izu Islands, seemingly unique in the juxtaposition of both tropical and temperate influences, has a well developed endemic fauna. Other island groups may not be so fortunate. An analysis of larval duration in endemic species having pelagic larvae, compared with larval durations of congenerics (e.g. Brothers and Thresher, 1985), coupled with measures of genetic similarity, may provide a test of hypotheses regarding the potential for endemicity at non-isolated localities in the Central and Western Pacific.

We feel it essentital to state an important point: measure of endemism, as a percentage of total fauna, are not important from a conservation standpoint. Knowing how many endemic species are present at a given locality is considerably more important since this provides an indication of relative uniqueness and the presence of possible "hotspots". Further considerations of endemism should be made in this direction.

Comparisons of faunal composition with other localities on the Pacific Plate, the Indo-West Pacific, and the Indian Ocean are tricky at this point, partly because studies of these regions (e.g., Springer, 1982; Thresher, 1991) tend to address reef or shore species only rather than a broader faunal spectrum. Other difficulties arise because of a simple lack of effective sampling at half of the localities examined here.

The faunas of the S. Mariana and Ogasawara islands are fairly well known. Myers (1988) looked at regional affitinities in the fauna of the Mariana Islands and found that species were distributed in the following fashion: 1) wide spread Indo-Pacific (73%), Indo-West Pacific (12%), Pacific-Philippine plate (4.2%), Pacific-Philippine plate and insular eastern Indian Ocean (2.5%), circumtropical (5%), Marianas and adjacent regional endemics (2.1%), and Mariana Islands endemics (1%, slightly larger than the current figure). Employing different classifications, Pyle (unpubl. ms) found that 34% of known Ogasawara species occurred at localities south of the group, 9% were restricted to more northern waters, 52% occurred both north and south of the group, 4% had anti-equatorial distributions, and 1.3% were endemic. Further, he found that 67% of known species occurred non-marginally on the Pacific Plate and in the Indo-West Pacific, 32% were restricted to the Indo-West Pacific, and 3% were restricted to the Pacific Plate and to its

margins.

The faunas of the N. Mariana and the Izu Islands, on the other hand, are not so well known. This difference is especially ironic since the former are geographically and historically isolated from most contact, while the latter are within relatively close proximity to a densely populated land mass. Further, virtually all sampling has been confined to the upper 75 m in depth because of diver safety limitations and ineffective collecting gear. Recent surveys (Thresher and Colin, 1986; Myers, 1989; R. Pyle, pers. comm.) have utilised submersibles or mixed gas diving in an attempt to overcome this depth related bias but such efforts are limited because of logistical difficulties or expense. The latter method does show considerable promise for surveying species as deep as 120 m, however.

The similarity in faunal composition between localities is dependent upon sampling effort, as described above. Nevertheless, comparisons between localities provides a basis for determining the origin of faunal components.

Species are distributed as a function of latitudinal effects, mainly in water temperature (at least above the thermocline), currents and oceanic eddies (e.g., Myers, 1989, Fig. 1 in the Introduction; Lobel, 1989; Lobel and Robinson, 1983), spawning modes (Thresher, 1991), larval duration (Brothers and Thresher, 1985; Thresher and Brothers, 1989), and vicariance, including plate tectonics (Springer, 1982; Myers, 1989), as they relate to patterns of dispersal and speciation. The presence of even marginally suitable habitats has further importance once fishes arrive at a given locality, but habitat availability cannot adequately explain distribution patterns as a whole (Thresher, 1991). Similarily, patterns of extinction likely have only local importance since evidence of large-scale extinctions, at least in central pacific fishes, is wanting (Springer, 1982; but see Thresher, 1991) although evidence from the molluscan fossil record supports this hypothesis (Vermeij, 1986). Thus, no single factor explains the composition of fishes at a given locality and there is likely a considerable amount of covariance between factors, even within localities.

The similarity between faunas of the S. Marianas and N. Marianas (61%) is instructive considering the close proximity of the two island groups. Less than one percent of species occurring in the north are absent in the south. Endemism very low, although the level, like the Ogasawara, is, as a whole, higher than that of the Belau (Palau), eastern Caroline, and Marshall Island (Myers, 1989). The Marianas are not oceanographically isolated from continental margin localities to the west. Historically, they appear to have received much of their species via a Balau–Carolines–Marshalls conduit from the Philippines–Indo–Malayan area (Springer, 1982; Myres, 1989), by dispersal across the Philippine Sea (Myers, 1989: Fig. 7 in the Introduction), or from the Pacific Plate (Springer, 1982; Myers, 1989). These fishes are largely tropical in affinity.

Similarities between the fish faunas of the Ogasawara and Izu islands suggests that both received a large component of continental margin species. The Ogasawara probabaly received these via dispersal across the Philippine Sea, as does the Marianas, and the bulk of the species have tropical affinities. The Izus likely received tropical species via the Kuroshio Current, and secondarily via the Ogasawaras (see Myers, 1989; Fig. 7 in the Introduction). Non-tropical continental margin species might have arrived, with variable success, during seasonal or annual fluctuations in the path of the Kuroshio, or by step-wise colonisation from Oshima southward via localised currents (more likely for those island close to Oshima if at all). Both island groups also received species from the Pacific Plate to some extent, although a sharp boundary exists in the Izus between Oshima and the islands further south (Moyer and Donaldson, in prep.).

The accuracy of describing faunal relationships between localities within the archipelago will doubtless improve with increased sampling, particularly in isolated or overlooked areas, and at greater depths. Measurement and analysis of faunal similarities between localities will provide a good picture of how island groups relate to one another, but they will not provide a historical basis for these relationships. The application of phylogenetic methods

(e.g., Brooks and McLennann, 1991) can address this vital aspect of zoogeography. Unfortunately, these methods require considerable knowledge of the phylogenetic relationships between species at a given taxonomic level, and much of it has yet to be learned.

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Appendix I. List of families occurring in the Izu Islands (IZU), Ogasawara Islands (OGW), Mariana Islands (MI), Northern Mariana Islands (NMI), and Southern Mariana Islands (SMI). The number of species per family is indicated. Arrangement follows Myers (1989) with modification from Randall and Pyle (unpubl. ms).

FAMILY	SMI S/F	NMI S/F	MIS S/F	OGW S/F	IZU S/F
RHINIODONTIDAE	1	0	1	0	
HETERODONTIDAE	0	0	0	2	1
SCYLIORHINIDAE					1
ORECTOLOBIDAE	1	1	1	1	1
TRIAKIDIDAE					1
HEMIGALEIDAE	1	1	1	1	
CARCHARHINIDAE	8	5	8	0	3
SPHYRNIDAE	1	0	1	0	1
ODONTASPIDIDAE	0	0	0	1	2
PRISTIOPHORIDAE	0	0	0	1	
LAMNIDAE	1	0	1	0	3
ALOPIDAE	1	1	1	0	
RHINOBATIDAE	1	0	1	0	2
SQUATINIDAE					1
DASYATIDIDAE	3	2	3	5	1
GYMNURIDAE					1
MYLIOBATIDAE	1	1	1	3	1
MOBULIDAE	1	1	1	2	
ANGUILLIDAE	2	0	2	0	2
MURAENIDAE	45	10	45	21	9
CHLOPSIDAE	1	1	2	0	
CONGRIDAE	5	1	5	3	2
MORINGUIDAE	1	0	3	0	
MURAENESOCIDAE	1	0	1	0	
OPHICHTHIDAE	12	1	13	4	1
MEGALOPIDAE	1	0	1	0	
ALBULIDAE	1	0	1	1	
CHANIDAE	1	0	1	0	
ENGRAULIDAE	5	0	5	1	1
CLUPEIDAE	2	1	2	3	1
PLOTOSIDAE	0	0	0	1	1
SYNODONTIDAE	5	4	5	10	4
BREGMACEROTIDAE	1	0	1	0	
LAMPRIDAE	1	1	1	0	1
OPHIIDIIDAE	1	1	1	2	1
BYTHITIDAE	2	1	2	0	
CARAPODIDAE	5	0	5	1	
GOBIESOCIDAE	2	0	2	1	2
ANTENNARIIDAE	8	2	8	4	2
OGCOCEPHALIDAE	0	0	0	0	1
ATHERINIDAE	4	0	4	3	
BELONIDAE	5	3	5	5	5
HEMIRAMPHIDAE	7	2	7	3	3
EXOCOETIDAE	10	2	11	0	6
ANAMOLOPIDAE	2	0	2	0	
MONOCENTRIDAE	0	0	0	1	1
HOLOCENTRIDAE	25	16	25	21	3
AULOSTOMIDAE	1	1	1	1	1
FISTULARIIDAE	1	1	1	2	2
SOLENOSTOMIDAE	1	0	1	0	
SYNGNATHIDAE	18	5	19	6	5
PEGASIDAE	1	0	1	0	1
DACTYLOPTERIDAE	2	0	2	2	1

Appendix I. (continued)

FAMILY	SMI S/F	NMI S/F	MI S/F	OGW S/F	IZU S/F
PLATYCEPHALIDAE	2	2	2	1	2
CONGIOPODIDAE					2
CARACANTHIDAE	2	2	2	2	
APLOACTINIDAE	0	0	0	0	1
SCORPAENIDAE	25	9	0	14	20
PERCICTHYIDAE	0	0	0	0	1
SERRANIDAE	50	39	52	60	36
CALLANTHIIDAE	2	0	2	0	
PLESIOPIDAE	3	0	3	2	3
PSEUDOCHROMIDAE	4	2	5	2	
CIRRHITIDAE	9	8	9	10	4
CHEILODACTYLIDAE	0	0	0	3	3
AMBASSIDAE	1	0	1	0	1
APOGONIDAE	35	13	35	23	18
KUHLIIDAE	3	3	3	3	
TERAPONIDAE	0	0	0	2	1
PRIACANTHIDAE	5	2	5	5	
MALACANTHIDAE	3	1	3	1	1
SCOMBROPIDAE					1
RACHYCENTRIDAE	0	0	0	1	1
ECHENEIDAE	3	2	3	0	1
CARANGIDAE	22	15	22	26	18
CORYPHAENIDAE	2	1	2	0	2
LEIOGNATHIDAE	3	0	3	0	
EMMELICHTHTIDAE	2	0	2	0	
LOBOTIDAE	1	0	1	1	1
GERREIDAE	2	0	2	3	1
LUTJANIDAE	23	19	22	26	12
SYMPHYSANODONTIDAE	1	1	2	0	
CAESIONIDAE	4	3	4	7	2
HAEMULIDAE	6	2	6	8	5
SPARIDAE	0	0	0	2	2
NEMIPTERIDAE	2	1	2	3	3
LETHRINIDAE	16	7	16	10	3
MULLIDAE	13	8	14	14	10
PEMPHERIDAE	1	1	1	0	3
GIRELLIDAE	0	0	0	3	3
KYPHOSIDAE	3	3	3	3	2
LABRACOGLOSSIDAE	0	0	0	1	1
SCORPIDIDAE	0	0	0	1	1
MONODACTYLIDAE	1	0	1	0	
CHAETODONTIDAE	32	21	32	35	32
POMACANTHIDAE	16	8	16	19	17
PENTACEROTIDAE	0	0	0	3	2
OPLEGNATHIDAE	0	1	1	2	2
POMACENTRIDAE	46	30	46	33	38
MUGILIDAE	5	4	5	4	1
POLYNEMIDAE	1	0	1	2	0
LABRIDAE	68	50	71	69	76
ODACIDAE	1	1	1	1	1
SCARIDAE	22	10	22	16	6
AMMODYTIDAE	0	0	0	1	1
PINGUIPEDIDAE	3	1	0	1	4
TRICHONOTIDAE	1	0	1	2	0
CREEDIDAE	1	1	1	2	1
URANOSCOPIDAE	2	0	2	0	1

Appendix I. (continued)

FAMILY	SMI S/F	NMI S/F	MI S/F	OGW S/F	IZU S/F
TRIPTERYGIIDAE	7	0	7	10	3
BLENNIIDAE	40	17	40	20	13
CALLIONYMIDAE	6	0	6	3	10
ELEOTRIDAE	2	0	2	1	0
XENISTHMIDAE	0	1	1	0	0
MICRODESMIDAE	10	6	11	4	0
GOBIIDAE	84	12	86	46	24
KRAEMERIIDAE	1	0	1	0	0
SIGANIDAE	6	0	6	4	2
ZANCLIDAE	1	1	1	1	1
ACANTHURIDAE	34	29	34	26	21
CENTROLOPHIDAE	0				1
EPHIPPIDAE	1	1	2	1	1
SPHYRAENIDAE	6	2	6	1	2
XIPHIIDAE	1	1	1	1	1
SCOMBRIDAE	9	9	9	12	11
ISTIOPHORIDAE	5	5	5	0	3
NOMEIDAE	1	0	1	0	1
BOTHIDAE	4	1	4	4	0
SOLEIDAE	2	1	2	1	0
TRIACANTHODIDAE	1	0	1	0	12
BALISTIDAE	16	15	17	16	10
MONACANTHIDAE	9	7	10	11	0
ARACANIDAE	0	0	0	1	5
OSTRACIIDAE	5	5	5	6	0
TRIODONTIDAE	1	1	1	0	9
TETRAODONTIDAE	16	9	16	14	4
DIODONTIDAE	2	2	3	4	
MOLIDAE	3	3	3	0	0
Total no. families	112	72	111	92	100

Appendix II. Checklist of fishes recorded from the Mariana Islands (MI), including the Northern Mariana Islands (NMI) and Southern Mariana Islands (SMI). Order largely follows Myers (1989), with modification from Myers and Donaldson (in press), and Randall and Pyle (unpubl. ms). Code refers to the faunal affinity type: 1) cold temperate, 2) warm temperate, 3) warm temperate of tropical origin, 4) tropical, 5) circumtropical and warm temperate, 6) continental freshwater, and 7) insular freshwater. *Introduced.

FAMILY/SPECIES	CODE	SMI	NMI	MI
RHINIODONTIDAE				
Rhiniodon typus	5	1		1
HETERODONTIDAE				
Heterodontus japonicus	2			
H. zebra	2			
SCYLIORHINIDAE				
Cephaloscyllium umbratile	1			
ORECTOLOBIDAE				
Nebrius concolor	4	1	1	1
Orectolobus japonicus	3			
TRIAKIDIDAE				
Mustelus griseus				
HEMIGALEIDAE				
Triaenodon obesus	4	1	1	1
CARCHARHINIDAE				
Carcharhinus albimarginatus	5	1	1	1
C. amblyrhynchos	4	1	1	1
C. falciformis	5	1		1
C. galapagensis	4	1		1
C. longimanus	5	1	1	1
C. melanopterus	5	1	1	1
C. plumbeus	5			
Galeocerdo cuvier	5	1	1	1
Prionace glauca	5	1		1
Rhizoprionodon acutus	5			
SPHYRNIDAE				
Sphyrna lewini	5	1		1
S. zygaena	5			
ODONTASPIDIDAE				
Odontaspis taurus	5			
O. ferox	5			
PRISTIOPHORIDAE				
Pristiophorus japonicus	1			
LAMNIDAE				
Carcharodon carcharias	2			
Isurus oxyrhynchus	2	1		1
Lamna ditropis	2			
ALOPIDAE				
Alopias pelagicus	5	1	1	1
RHINOBATIDAE				
Rhinchobatus djiddensis	4	1		1
R. schlegelii	3			
SQUATINIDAE				
Squatina japonica	1			
DASYATIDAE				
Dasyatus akajei	3			
D. kuhlii	2	1		1
D. ushiei	2			
Taeniura melanospilos	3	1	1	1
T. meyeni	4			
Urogymnus africanus	4	1	1	1

FAMILY/SPECIES	CODE	SMI	NMI	MI
GYMNURIDAE				
Gymnura japonica	3			
MYLIOBATIDAE				
Aetobatis narinari	5	1	1	1
Myliobatus tobijei	3			
RHINOPTERIDAE				
Rhinoptera javanica	3			
MOBULIDAE				
Manta birostris	4	1	1	1
Manta sp.	3			
Mobula japanica	3			
ANGUILLIDAE				
Anguilla blcolor	7	1		1
A. japonica	6			
A. marmorata	7	1		1
MURAENIDAE				
Anarchias allardicei	4	1		1
A. seychellensis	4	1		1
Echidna leucotaenia	4	1		1
E. nebulosa	4	1	1	1
E. polyzona	4	1		1
Echidna unicolor	4	1		1
Enchelycore bayeri	4	1		1
E. bikiniensis	4	1	1	1
E. lichenosa	3			
E. pardalis	3			
E. schismatorhynchus	4	1		1
E. canina	4	1		1
Gymnomuraena zebra	4	1		1
Gymnothorax berndti	4	1		1
G. buroensis	4	1	1	1
G. chilospilus	4			
G. elegans	4	1		1
G. enigmaticus	4	1	1	1
G. eurostus	4			
G. fimbriatus	4	1		1
G. flavimarginatus	4	1	1	1
G. fuscomaculatus	4	1		1
G. gilberti	4			
G. gracilicaudus	4	1		1
G. hepaticus	4	1		1
G. javanicus	4	1	1	1
G. kidako	3			
G. leucostigma	3			
G. margaritophorus	4	1	1	1
G. marshallensis	4	1	1	1
G. melanospilus	3			
G. melatremus	4	1		1
G. meleagris	4	1	1	1
G. monostigmus	4	1		1
G. neglectus	4	1		1
G. nudivomer	4	1		1

Appendix II. (continued)

FAMILY/SPECIES	CODE	SMI	NMI	MI
G. pescadoris	4			
G. pindae	4	1		1
G. richardsoni	4	1		1
G. rueppelliae	4	1		1
G. thyrsoideus	4			
G. undulatus	4	1		1
G. ypsilon	4			
G. zonipectus	4	1		1
Gymnothorax sp. '*johnsoni*'	4			
Rhinomuraena quaesita	4	1		1
Scuticaria tigrinus	4	1		1
Sideria picta	4	1	1	1
S. prosopeion	4	1		1
S. thyrsoidea	4			
Strophidon sathete	4	1		1
Pseudechidna brummeri	4	1		1
Uropterygius concolor	4	1		1
U. macrocephalus	4	1		1
U. mannoratus	4	1		1
U. micropterus	4	1		1
U. supraforatus	4	1		1
U. xanthopterus	4	1		1
CHLOPSIDAE				
Kaupichthys atronasus	4		1	1
K. hyoproroides	4	1		1
CONGRIDAE				
Conger cinereus	4	1	1	1
C. japonicus	3			
C. sp. cf *macrocepalus*	4	1		1
C. myriaster	2			
Gorgasia preclara	4	1		1
Gorgasia n. sp.	4	1		1
G. japonica	3			
Heteroconger hassi	4	1		1
MORINGUIDAE				
Moringua ferruginea	4	1		1
M. javanica	4	1		1
M. microchir	4	1		1
MURAENESOCIDAE				
Muraenosox cinereus	4	1		1
OPHICHTHIDAE				
Ichthyapus vulturis	4			
Muraenichthys laticudata	4	1		1
M. macropterus	4	1		1
Brachysomophis sauropsis	4	1		1
Caecula polyophthalmus	4	1		1
Callechelys catostomus	4	1		1
C. marmorata	4	1		1
Leiuranus semicinctus	4	1		1
Myrichthys colubrinus	4	1		1
M. maculosus	4	1		1
Ophichthus erabo	4			
O. cephalozona	4	1		1
Ophichthus n. sp?	4	1		1
MEGALOPIDAE				
Megalops cyprinoides	4	1		1
ALBULIDAE				
Albula glossodonta	4	1		1
CHANIDAE				
Chanos chanos	4	1		1
ENGRAULIDIDAE				
Engralis japonicus	3			
Thryssa baelama	4	1		1
Enchrasicholina punctifer	4	1		1
E. devisi	4	1		1
S. indicus	4	1		1
S. pacificus	4	1		1
CLUPEIDAE				
Dussumieria sp. B	4	1		1
Herklotsichthys quadrimaculatus	4			
Sardinella melanura	3			
S. zunasi	3			
Spratelloides delicatulus	4	1	1	1
PLOTOSIDAE				
Plotosus lineatus	4			
SYNODONTIDAE				
Saurida gracilis	4	1	1	1
S. nebulosa	4	1		1
S. undosquamis	3			
Synodus binotatus	4	1	1	1
S. dermatogenys	4	1	1	1
S. englemanni	4	1		1
S. hoshinonis				
S. jaculum	4			
S. ulae	4			
S. variegatus	4	1	1	1
Synodus sp. 1	4			
Synodus sp. 2	4			
Trachinocephalus myops	5			
BREGMACEROTIDAE				
Bregmaceros nectabanus	4	1		1
LAMPRIDAE				
Lampris guttatus	5	1	1	1
OPHIDIIDAE				
Brotula multibarbata	4	1	1	1
Ophiodon sp.	4			
BYTHITIDAE				
Brosmophyciops pautzkei	4	1		1
Dinematichthys iluocoetenoides	4	1	1	1
Dinematichthys sp.	4			
CARAPODIDAE				
Carapus mourlani	4	1		1
C. parvipinnis	4	1		1
Encheliophis gracilis	4	1		1
E. homei	4	1		1
E. sagamianus	4			
E. vermicularis	4	1		1
GOBIESOCIDAE				
Diademichthys lineatus	2			
Lepadichthys frenatus	3			

Appendix II. (continued)

FAMILY/SPECIES	CODE	SMI	NMI	MI
L. minor	4	1		1
Liobranchia stria	4	1		1
Propherallodus briggsi	2			
ANTENNARIIDAE				
Antennarius coccineus	4	1		1
A. commersonii	4	1		1
A. dorehensis	4	1		1
A. nummifer	4	1		1
A. maculatus	4	1		1
A. pictus	4	1		1
A. striatus	4			
Antennatus tuberosus	4	1		1
Histrio histrio	5	1		1
OGCOCEPHALIDAE				
Dibranchus japonicus	2			
ATHERINIDAE				
Atherion elymus	4	1		1
A. insularum whitei	4	1		1
A. lacunosus	4	1		1
Hypoatherina bleekeri	4			
H. ovalaua	4	1		1
BELONIDAE				
Ablennes hians	5	1		1
Platybelone argala	4	1	1	1
Strongylura anastomella	3			
S. incisa	4	1	1	1
S. leiura	4	1		1
Tylosurus acus melanotus	4	1		1
T. crocodilis	5	1	1	1
HEMIRAMPHIDAE				
Euleoptorhamphus viridis	4	1		1
Hemiramphus archipelagicus	4	1		1
H. lutkel	4	1	1	1
Hyporhamphus acutus	4	1		1
H. affinis	4	1		1
H. dussumieri	4	1		1
*H. sajorri**	3			
Oxyporhamphus micropterus	4	1	1	1
Zenarchopterus dispar	4	1		1
EXOCOETIDAE				
Cheilopogon spilonopterus	4	1		1
C. spilopterus	4	1		1
C. unicolor	4	1		1
Cypselurus angusticeps	4	1		1
*C. atrisignis**	3			
*C. monocirrhus**	3			
C. pinnatibarbatus japonicus	3			
C. poecilopterus	4	1	1	1
C. speculiger	4	1		1
Exocoetus volitans	4		1	1
Parexocoetus brachypterrus	4	1		1
P. mento mento	4	1		1
Prognichthys albimaculatus	4	1		1
P. sealei	4	1		1
ANAMOLOPIDAE				
Anamolops katoptron	4	1		1
Photoblepheron palpebratus	4	1		1
MONOCENTRIDAE				
Monocentrus japonica	2			
HOLOCENTRIDAE				
Myrpristis adustus	4	1	1	
M. amaneus	4	1	1	1
M. bemdti	4	1	1	1
M. chryseres	4	1	1	1
M. kuntee	4	1	1	1
M. melanaosticta	4			
M. murdjan	4	1	1	1
M. pralinia	4	1	1	1
M. violacea	4	1		1
M. vittata	4	1		1
M. woodsi	4	1		1
Mypristis sp.	4			
Neoniphon argenteus	4	1		1
N. aurolineatus	4	1		1
N. opercularis	4	1		1
N. sammara	4	1	1	1
Ostichthys archiepiscopus	4			
O. brachygnathus	4	1		1
O. japonicus	4			
O. kaianus	4	1		1
Plectrypops lima	4	1	1	1
Sargocentron caudimaculatum	4	1	1	1
S. diadema	4	1	1	1
S. ittodal	4			
S. melanospilos	4			
S. microstoma	4	1	1	1
S. praslin	4	1	1	1
S. punctatissium	4	1	1	1
S. rubrum	3			
S. spiniferum	4	1	1	1
S. spinosissimus	4			
S. tiere	4	1	1	1
S. tieroides	4	1		1
AULOSTOMIDAE				
Aulostomus chinensis	4	1	1	1
FISTULARIIDAE				
Fistularia commersoni	4	1	1	1
F. petimba	4			
SOLENOSTOMIDAE				
Solenostomus cyanopterus	4	1		1
SYNGNATHIDAE				
Hippocampus hystrix	4	1		1
C. equula	4			
C. ferdau	4	1	1	1
C. orthogrammus	4	1	1	1
C. plagiotaenia	4	1	1	1
C. talamparoides	4	1		1
Caranx ignobilis	4	1	1	1
C. lugubris	4	1	1	1
C. papuensis	4	1		1
C. melampygus	4	1	1	1

Appendix II. (continued)

FAMILY/SPECIES	CODE	SMI	NMI	MI
C. sexfasciatus	4	1	1	1
Decapterus akaadsi	4			
D. macarellus	4	1	1	1
D. macrosoma	4	1		1
D. maruadsi	4	1		1
D. russelli		1		1
Gnathanodon speciosus	4	1	1	1
Longirostrum delicatissimus?	3			
Naucrates ductor	4	1		
Parastromateus niger	4			
Pseudocaranx dentax	4			
Sarda orientalis	4			
Selar crumenopthalmus	4	1	1	1
Campichthys n. sp.	4			
Choeroichthys brachysoma	4	1		1
C. sculptus	4	1		1
Corythoichthys flavofasciatus	4	1		1
C. haematopterus	3			
C. intestinalis	4	1		1
C. nigripectus	4	1		1
Cosmocampus banneri	4			
C. darrosanus	4	1		1
Doryramphus ecxisus	4	1	1	1
D. dactyliophorus	4	1	1	1
*D. melanopleura**	3			
Halicamapus brocki	4	1		1
H. mataaffae	4	1		1
Hippichthys spicifer	4	1		1
Micrognathus andersonii	4	1		1
M. brevirostris pygmaeus	4	1		1
Minyichthys myersi	4	1		1
Phoxocamphus diacanthus	4	1		1
Syngnathoides biaculeatus	4	1		1
Sygnathus schlegeli	4			
Trachyramphus bicoarctata	4	1	1	1
PEGASIDAE				
Eurypegasus draconis	4	1		1
*Zalises draconis**	3			
DACTYLOPTERIDAE				
Chelidonichthys spinosus?	2			
Dactyloptena orientalis	4	1		1
D. petersoni	4	1		1
PLATYCEPHALIDAE				
*Inegocia spinosa**	3			
Thysanophrys arenicola	4	1	1	1
T. chiltonae	4	1		1
T. indicus	3			
T. otaitensis				
CONGIOPODIDAE				
Hypodytes rubipinnis	2			
Amblyapistus taenianotus	2			
CARACANTHIDAE				
Caracanthus maculatus	4	1	1	1
C. unipinna	4	1	1	1

FAMILY/SPECIES	CODE	SMI	NMI	MI
APLOACTINIDAE				
Cocotropus masudai	3			
SCORPAENIDAE				
Inimicus japonicus	3			
Neosebastes entaxis	3			
Parascorpaena mossambica	4	1		1
Pontinus macrocephalus	4	1		1
Pontinus sp. cf. *nigerimum*	4	1		1
Rhinopios sp.	3			
Scorpaena hatizyoensis	3			
S. neglecta neglecta?	3			
S. picta	3			
Scorpaenodes kelloggi	4	1		1
S. littoralis	4			
S. minor	4	1		1
S. parvipinnis	4	1		1
S. varipinnis	4	1		1
S. guamensis	4	1	1	1
Scorpaenopsis brevifrons	4			
S. cirrhosa	3			
S. diabolis	4	1	1	1
S. macrochir	4	1		1
S. fowleri	4	1		1
S. oxycephala	4	1		1
S. papuaensis	4	1		1
Scorpaenodes n. sp.	4	1		1
Sebastapistes cyanostigma	4	1	1	1
S. galactacma	4	1		1
S. mauritiana	4	1		1
S. strongia	4	1	1	1
S. tinkhami	4			
*Sebastes albofasciatus**	2			
S. inermis	2			
S. joyneri?	2			
S. pachycephalus?	2			
Sebasticus albofasciatus	2			
S. marmoratus	2			
Taenianotus triacanthus	4	1	1	1
Synanceia verrucosa	4	1		1
Dendrochirus biocellatus	4	1	1	1
D. brachypterus	4	1		1
D. zebra	3			
Pterois antennata	4	1	1	1
P. lunulata	3			
P. radiata	4	1	1	1
P. volitans	4	1	1	1
PERCICTHYIDAE				
Doederlinia berycoldes	3			
SERRANIDAE				
Holanthias borbonius	4	1		1
H. flagris	4			
H. katayamai	4	1		1
H. unimaculatus	4			
Plectranthias fourmanoiri	4	1	1	1
P. kamii	4	1		1
P. kelloggi	4			

Appendix II. (continued)

FAMILY/SPECIES	CODE	SMI	NMI	MI
P. longimanus	4			
P. nanus	4	1		1
P. rubrifasciatus	4	1		1
P. altipinnis	3			
Pseudanthias cooperi	4	1		1
P. pleurotaenia	4	1	1	1
P. caudalis	3			
P. leucozonus	3			
P. fasciatus?	3			
Pseudanthias sp.	4	1		1
P. pascalus	4	1	1	1
P. squamipinnis	4			
P. taira	4			
P. thompsoni	4			
*P. truncatus**	3			
P. ventralis ventralis	4	1	1	1
Pseudoanthias sp. 1	4			
Pseudoanthias sp. 2	4			
Selenanthias n. sp. "*myersi*"	4	1		1
Serranocirrhitus latus	4			
Aethaloperca rogaa	4	1	1	1
Anyperodon leucogrammicus	4		1	1
Caprodon schlegeli	3			
Aulacocephalus temminckii	4			
Cephalopholis argus	4	1	1	1
C. aurantia	4	1		1
C. boenack	4			
C. igarashiensis	4	1	1	1
C. leopardis	4	1	1	1
C. miniata	4	1	1	1
C. polleni	4	1	1	1
C. sexmaculata	4	1	1	1
C. sonnerati	4	1	1	1
C. spiloparaea	4	1	1	1
C. urodeta	4	1	1	1
Cromileptes altivelis	4	1	1	1
Gracilia albomarginata	4	1	1	1
Epinephelus akaara	3			
E. areolatus	4			
E. awaoora	4			
E. brunneus	4			
E. caeruleopunctatus	4			
E. chlorostigma	4			
E. corallicola	4	1	1	1
E. cyanopodus	4			
E. episticus	4			
E. fasciatus	4	1	1	1
E. fuscoguttatus	4	1	1	1
E. hexagonatus	4	1	1	1
E. howlandi	4	1	1	1
E. lanceolatus	4	1	1	1
E. latifasciaitus	4			
E. macrospilos	4			
E. maculatus	4	1	1	1
E. merra	4	1	1	1
E. morrhua	4	1	1	1
E. ongus	4			
E. octofasciatus	4	1	1	1
E. poecilonotus	4			
E. polyphekadion	4	1	1	1
E. radiatus	4			
E. retouti	4			
E. rivulatus				
E. socialis	4		1	1
E. stictus	4			
E. tauvina	4	1	1	1
E. trimaculatus	4			
Plectropomus laevis	4	1	1	1
*P. leopardus**	4			
Sacura margaritacea	2			
Saloptia powelli	4	1	1	1
Triso dermopterus	4			
Variola albimarginata	4	1		1
V. louti	4	1	1	1
Liopropoma japonicum	4			
*L. lineata**	4			
L. lunulatum	4	1		1
L. maculatum	4			
L. mitratum	4			
L. pallidum	4	1	1	1
L. susumi	4			
L. tonstrinum	4	1		1
GRAMMISTINAE				
Belonoperca chaubanaudi	4	1	1	1
Grammistes sexlineatus	4	1	1	1
Grammistops ocellata	4	1		1
Pogonoperca punctata	4	1	1	1
Aporops bilinearis	4	1		1
Pseudogramma polyacantha	4	1		1
CALLANTHIIDAE				
Grammatonotus sp. 1	4	1		1
Grammanototus sp. 2	4	1		1
PLESIOPIDAE				
Acanthoplesiops hiatti	4			
Calloplesiops altivelis	4	1		1
Plesiops caeruleolineatus	4	1		1
P. corallicola	4	1		1
P. nakaharae	4			
PSEUDOCHROMIDAE				
Pseudochromis cyanotaenia	4	1	1	1
P. fuscus	4			
P. marshallensis	4			
Pseudoplesiops revellei	4	1		1
P. rosae	4	1		1
Pseudoplesiops sp.	4	1		1
CIRRHITIDAE				
Amblycirrhitus bimacula	4	1	1	1
Cirrhitichthys aprinus	4			
C. falco	4	1	1	1
C. oxycephalus	4	1	1	1
Cirrhitops hubbardi	4			
Cirrhitus pinnulatus	4	1	1	1

Appendix II. (continued)

FAMILY/SPECIES	CODE	SMI	NMI	MI
Cyprinocirrhtes polyactis	4			
Neocirrhitus armatus	4	1	1	1
Oxycirrhites typus	4	1		1
Paracirrhites arcatus	4	1	1	1
P. forsteri	4	1	1	1
P. hemistictus	4	1	1	1
CHEILODACTYLIDAE				
Cheilodactylus quadricornis	3			
C. zebra	3			
C. zonatus	3			
AMBASSIDAE				
Ambassis buruensis	4	1		1
APOGONIDAE				
Apogon apogonoides	4			
A. aureus	4			
A. bandanensis	4			
A. caudicinctuus	4			
A. coccineus	4	1	1	1
A. crassiceps	4			
A. doederleini	4			
A. doryssa	4	1	1	1
A. endekataenia	4			
A. erythrinus	4			
A. fukuii	4			
A. angustaus	4	1	1	1
A. cyanosoma	4	1	1	1
A. fuscus	4	1		1
A. guamensis	4	1		1
A. jordani	4	1		1
A. lateralis	4	1		1
A. lineatus	4			
A. mydrus	4	1		1
A. nigrofasciatus	4	1	1	1
A. notatus	4			
A. novemfasciatus	4	1		1
A. semilineatus	4	1		1
A. semiornatus	4			
A. taeniophorus	4	1	1	1
A. trimaculatus	4	1		1
A. leptacanthus	4	1		1
A. exostigma	4	1		1
A. fraenatus	4	1	1	1
A. kallopterus	4	1	1	1
A. taeniopterus	4	1	1	1
Apogon sp.	4			
Apogon n. sp. "*cyanosoma*"	4	1		1
Apogonichthys ocellatus	4	1		1
A. perdix	4	1		1
Archamia biguttata	4	1		1
A. dispilus	4			
A. fucata	4	1		1
Foa brachygramma	4	1		1
Fowleria aurita	4	1		1
F. isostigma	4	1		1
F. marmorata	4	1		1
F. variegata	4	1		1
Cheilodipterus artus	4	1		1
C. lineatus	4	1	1	1
C. macrodon	4	1	1	1
C. quinquelineata	4	1	1	1
Siphamia fistulosa	4	1		1
S. majimai	4			
S. versicolor	4	1		1
Siphamia sp.	4			
Sphaeramia orbicularis	4	1		1
Gymnapogon urospilotus	4	1		1
Pseudamia amblyuropterus	3			
P. rubra	4			
Pseudamiops gracilicauda	4	1		1
Pseudamiops n. sp.	4			
Rhabdamia cypselura	3			
KUHLIIDAE				
Kuhlia boninensis	4			
K. marginata	4	1		1
K. mugil	4	1	1	1
K. rupestris	4	1		1
TERAPONIDAE				
Pelates quadrilineatus	3			
Terapon theraps	3			
PRIACANTHIDAE				
Heteropriacanthus cruentatus	4	1	1	1
Cookeolus japonicus	4	1		1
Priacanthus alalaua	4	1		1
P. hamrur	4	1	1	1
P. macrocanthus	4			
P. sagittarius	3			
P. zaiseri	3			
Pristigenys meyeri	4	1		1
P. multifasciata	3			
P. niphonia	4			
MALACANTHIDAE				
Hoplolatilus starcki	4	1		1
Malacanthus brevirostris	4	1	1	1
M. latovittatus	4	1		1
SCOMBROPIDAE				
Scombrops boops	3			
RACHYCENTRIDAE				
Rachycentron canadum	3			
ECHENEIDAE				
Echeneis naucrates	4			
Phtheirichthys lineatus	4	1	1	1
Remora albescens	4			
R. remora	4	1	1	1
Rhombochiirus osteochir	4	1		1
CARANGIDAE				
Alectis ciliaris	4	1		1
Atropus atropus	4			
Carangoides caeruleopinnatus	4	1		1
Schultzidia johnstonensis	4		1	1
Urapsis helvolus	4	1		1
Elagtis bipinnulatus	4	1	1	1

Appendix II. (continued)

FAMILY/SPECIES	CODE	SMI	NMI	MI
Scomberoides lysan	4	1	1	1
S. tol	4			
Seriola dumerili	4	1	1	1
S. lalandi	4			
S. quinqueradiata	4			
S. rivoliana	4	1	1	1
Trachinotus ballioni	4	1	1	1
T. blochii	4	1		1
T. japonicus	4			
CORYPHAENIDAE				
Coryphaena equiselis	5	1		1
C. hippurus	5	1	1	1
LEIOGNATHIDAE				
Gazza achlamys	4	1		1
Leiognathus equulus	4	1		1
L. stercorarius	4	1		1
EMMELICHTHTIDAE				
Emmelichthys kamellai	4	1		1
Erythrocles scintillans	4	1		1
LOBOTIDAE				
Lobotes surinamensis	5	1		1
GERREIDAE				
Gerres acinaces	4			
G. argyreus	4	1		1
G. japonicus	4			
G. oblongus	4	1		1
G. oyena	4			
LUTJANIDAE				
Aphareus furcatus	4	1	1	1
A. rutilans	4	1	1	1
Aprion virescens	4	1	1	1
Etelis carbunculus	4	1	1	1
E. corsucans	4	1	1	1
Paracaesio caeruleus	4			
P. kusakarii	4			
P. sordidus	4	1	1	1
P. xanthurus	4	1	1	1
Pristipomoides amoenus	4	1	1	1
P. argyrogrammicus	4	1	1	1
P. auricila	4	1	1	1
P. filamentosus	4	1	1	1
P. flavipinnis	4	1	1	1
P. seiboldi	4	1	1	1
P. zonatus	4	1	1	1
Randallichthys filamentosus	4	1		1
Macolor niger	4	1	1	1
M. macularis	4	1		1
Lutjanus argentimaculatus	4	1		1
L. fulviflamma	4			
L. bohar	4	1	1	1
L. fulvus	4	1	1	1
L. gibbus	4	1	1	1
L. kasmira	4	1	1	1
L. monostigma	4	1	1	1
L. rivulatus	4	1		1
L. russelli	4			

FAMILY/SPECIES	CODE	SMI	NMI	MI
L. sebae	4			
L. stellatus	4			
SYMPHYSANODONTIDAE				
Symphysanodon maunaloa	4		1	1
S. typus	4	1		1
CAESIONIDAE				
Caesio caerulaurea	4	1	1	1
C. cuning	4			
*C. diagramma**	4			
C. lunaris	4			
C. teres	4	1	1	1
Pterecaesio chrysozonus	4			
P. marri	4	1		1
P. tile	4	1	1	1
HAEMULIDAE				
Diagramma pictum	4			
Hapalogenys macronatus	4			
Plectorhinchus albovittattus	4	1		1
P. chaetodonoides	4			
P. cinctus	4			
P. gibbosus	4	1		1
P. lessonii	4			
P. obscurus	4	1		1
P. orientalis	4	1	1	1
P. pictus	4			
P. picus	4	1	1	1
P. schotaf	4	1		1
SPARIDAE				
Acanthopargrus latus	2			
Dentex tumifrons	2			
NEMIPTERIDAE				
Parascolopsis inermis	3			
Pentapodus caninus	4	1		1
P. nagasakiensis	4			
Scolopsis bilineata	4			
S. lineata	4	1	1	1
LETHRINIDAE				
Gnathodentex aurolineatus	4	1	1	1
Gymnocranius euanus	4	1	1	1
G. grandoculis	4	1		1
G. griseus	4	1	1	1
G. japonicus	4	1	1	1
G. microdon	4	1		1
Gymnocranius sp.	4	1		1
Lethrinus amboinensis	4	1		1
L. atkinsoni	4	1		1
L. erythracanthus	4	1		1
L. elongatus?	4			
L. harak	4	1	1	1
L. heamatopterus	4			
L. kallopterus?	4			
L. lentjan	4			
L. mahsenoides?	4			
L. miniatus	4			
L. nebulosus	4			
L. obselotus	4	1	1	1

Appendix II. (continued)

FAMILY/SPECIES	CODE	SMI	NMI	MI
L. olivaceus	4	1		1
L. reticulatus	4			
L. rubrioperculatus	4	1	1	1
L. xanthochilus	4	1		1
Monotaxis grandoculus	4	1		1
Wattsia mossambicus	4	1		1
MULLIDAE				
Mulloidichthys flavoliineatus	4	1	1	1
M. pflugeri	4	1		1
M. vanicolensis	4	1	1	1
Parupeneus barbemoides	4			
P. barberinus	4	1	1	1
P. bifasciatus	4	1	1	1
P. chrysopleuron	4			
P. ciliatus	4	1		1
P. cyclostomus	4	1	1	1
P. heptacanthus	4	1		1
P. indicus	4			
P. ischyrus	4			
P. moffiti	4	1		1
P. multifasciatus	4	1	1	1
P. pleurostigma	4	1		1
*P. pleurotaenia**	4			
P. spilurus	4			
*P. trifasciatus**	4			
Upeneus japonicus	4			
U. moluccensis	4			
U. taeniopterus	4	1		1
U. vittatus	4	1		1
PEMPHERIDAE				
Parapriacanthus ransonneti	4			
Pempheris oualensis	4	1	1	1
P. xanthoptera				
GIRELLIDAE				
Girella melanichthys	3			
G. mezina	3			
G. punctata	3			
KYPHOSIDAE				
Kyphosus bigibbus	4	1	1	1
K. cinerascens	4	1	1	1
K. lembus	4			
K. vaigensis	4	1	1	1
LABRACOGLOSSIDAE				
Labracoglossa argentiventris	3			
SCORPIDIDAE				
Microcanthus strigatus	4			
MONODACTYLIDAE				
Monodactylus argenteus	4	1		1
CHAETODONTIDAE				
Chaetodon argentatus	4			
C. auriga	4	1	1	1
C. auripes	4			
C. baronessa	4	1		1
C. bennetti	4	1	1	1
C. citrinellus	4	1	1	1
C. daedalma	3			

FAMILY/SPECIES	CODE	SMI	NMI	MI
C. ephippium	4	1	1	1
C. guentheri	4			
C. flavocoronatus	4	1		1
C. kleinii	4	1		1
C. lineolatus	4	1	1	1
C. lunula	4	1	1	1
C. melannotus	4	1		1
C. mertensii	4	1	1	1
C. modestus	4	1		1
C. nippon	3			
C. omatissimus	4	1	1	1
C. plebius	4			
C. punctatofasciatus	4	1	1	1
C. quadrimaculatus	4	1	1	1
C. reticulatus	4	1	1	1
C. selene	3			
C. semeion	4	1		1
C. speculum	4			
C. trifascialis	4	1	1	1
C. trifasciatus	4	1	1	1
C. ulietensis	4	1	1	1
C. unimaculatus	4	1		1
C. vagabundus	4	1	1	1
C. xanthurus	4			
Coradion altivelis	4			
C. chrysozonus	4			
Forcipinger flavissimus	4	1	1	1
F. longirostris	4	1	1	1
Hemitaurichthys polylepis	4	1	1	1
H. thompsoni	4	1		1
Hemiochus acuminatus	4	1		1
H. chrysostomus	4	1	1	1
H. diphreutes	4	1		1
H. monoceros	4	1		1
H. singularis	4	1		1
H. varius	4	1		1
Parachaetodon ocellatus	4			
POMACANTHIDAE				
Apolemichthys trimaculatus	4	1		1
Centropyge bicolor	4	1		1
C. bispinosus	4	1	1	1
C. colini	4	1		1
C. ferrugatus	4			
*C. fisheri**	4			
*C. flavicauda**	4			
C. flavissimus	4	1	1	1
C. heraldi	4	1	1	1
C. interruptus	4			
C. loriculus	4	1		1
C. multifasciatus	4	1		1
C. nigrocellus	4	1		1
C. shepardi	4	1	1	1
C. tibicen	4			
C. vrolicki	4	1		1
Chaetodontoplus septentrionalis	4			

Appendix II. (continued)

FAMILY/SPECIES	CODE	SMI	NMI	MI
C. chrysocephalus	4			
C. melanosoma	4			
Genicanthus bellus	4	1		1
G. melanospilos	4	1		1
G. semifasciatus	4			
G. watanabei	4	1		1
Genicanthus n. sp.	4			
Holocanthtus venustus	3			
Pomacanthus imperator	4	1	1	1
P. semicirculatus	4			
Pygoplites diacanthus	4	1	1	1
PENTACEROTIDAE				
Evistias acutirostris	2			
Pentaceros japonicus	2			
Pseudopentaceros wheeleri	2			
OPLEGNATHIDAE				
Oplegnathus fasciatus	2			
O. punctatus	2	1	1	1
POMACENTRIDAE				
Amphiprion chrysopterus	4	1	1	1
A. clarki	4	1	1	1
A. frenatus	4			
A. melanopus	4	1		1
A. peridaeraion	4	1	1	1
Chromis acares	4	1	1	1
C. agilis	4	1	1	1
C. albomaculata	4			
C. alleni	4			
C. alpha	4	1		1
C. amboinensis	4	1		1
C. analis	4	1		1
C. atripectoralis	4	1		1
C. atripes	4			
C. chrysura	4			
C. elerae	4	1		1
C. flavomaculata	4			
C. fumeus	3			
C. lepidolepis	4	1		1
C. margaritifer	4	1	1	1
C. mirationis	3			
C. notatus miyakeensis	3			
C. ovatiformis	4			
C. ternatensis	4	1		1
C. vanderbilti	4	1	1	1
C. viridis	4	1	1	1
C. weberi	4			
C. xanthura	4	1	1	1
Dascyllus aruanus	4	1	1	1
D. reticulatus	4	1	1	1
D. trimaculatus	4	1	1	1
Lepidozygus tapienosoma	4	1	1	1
Abudefduf notatus	4			
A. septemfasciatus	4	1	1	1
A. sexfasciatus	4	1	1	1
A. sordidus	4	1	1	1
A. vaigiensis	4	1	1	1

FAMILY/SPECIES	CODE	SMI	NMI	MI
Amblygliphididon aureus	4	1		1
A. curacao	4	1	1	1
Chrysiptera biocellata	4	1	1	1
C. caeruleolineata	4	1		1
C. glauca	4	1	1	1
C. leucopoma	4	1	1	1
C. rex	4			
C. starcki	4			
C. traceyi	4	1		1
C. tricincta	4			
Hemiglyphididon plagiometapor	4			
Neoglyphididon nigroris	4			
Neopomacentrus violascens	4	1		1
Plectroglyphididon dickii	4	1	1	1
P. imparipennis	4	1	1	1
P. johnstonianus	4	1	1	1
P. lacrymatus	4	1	1	1
P. leucozona	4	1	1	1
P. phoenixensis	4	1	1	1
Pomacentrus amboinensis	4	1		1
P. bankanensis	4			
P. chrysurus	4			
P. coelestis	4			
P. nagasakiensis	3			
P. pavo	4	1		1
P. vaiuli	4	1	1	1
Pomachromis guamensis	4	1	1	1
P. richardsoni	4			
Stegases albifasciatus	4	1		1
S. altus	4			
S. fasciolatus	4	1	1	1
S. lividus	4	1		1
S. nigricans	4	1		1
MUGILIDAE				
Chaenomugil leuciscus	4	1		1
Crenimugil crenilabris	4	1	1	1
Liza vaigiensis	4	1	1	1
Moolgardi seheli	4			
Mugil cephalus	5			
Neomyxus leuciscus	4			
Valamugil engeli	4	1	1	1
V. seheli	4	1		1
POLYNEMIDAE				
Polydactlus plebeius	4			
P. sexfilis	4	1		1
LABRIDAE				
Bodianus anthioides	4	1	1	1
B. axillaris	4	1	1	1
B. bilunulatus	3			
B. diana	4			
*B. izuensis***	3			
B. loxozonus	4	1		
*B. masudai***	3			
B. mesothorax	3			
B. oxycephalus	3			

Appendix II. (continued)

FAMILY/SPECIES	CODE	SMI	NMI	MI
B. perditio	3			
B. tanyokidus	4	1		1
Choerodon anchorago?	4		1	1
C. azurio	3			
Polylepion russelli	4		1	1
Pseudodax moluccanus	4	1	1	1
Semicossyphus reticulatus	2			
Chellinus chlorourus	4	1		1
C. fasciatus	4	1	1	1
C. oxycephalus	4	1	1	1
C. trilobatus	4	1	1	1
C. undulatus	4	1	1	1
Oxycheilinus arenatus	4	1		1
O. bimaculatus	4	1		1
O. diagrammus	4	1		1
O. orientalis	4	1		1
O. unifasciatus	4	1	1	1
Epibulus insidiator	4	1	1	1
Wetmorella albofasciata	4		1	1
W. nigropinnata	4	1	1	1
Cymolutes praetextatus	4	1	1	1
C. torquatus	4			
Novaculichthys macrolepidotus	4	1		1
N. taeniourus	4	1	1	1
Xyrichtys aneitensis	4	1		1
X. celebicus	4	1		1
*X. dea**	3			
X. geisha	4	1		1
X. melanopus	4	1		1
X. pavo	4	1		1
X. pentadactylus	4			
Xyrichthys n. sp.	4			
Cirrhilabrus cyanopleura	4			
C. exquisitus	4			
C. katherinae	4	1		1
C. lunatus	4			
C. rubriomarginatus	4			
C. temminckii	4			
Pseudocheilinus evanidus	4	1		1
P. hexataenia	4	1	1	1
P. octotaenia	4	1	1	1
P. tetrataenia	4	1		1
Pseudocheilinus n. sp.	4	1		1
Pseudocheilinus n. sp.	4			
Pterogogus cryptus	4	1		1
P. enneacanthus	4	1		1
P. flagillifera	4			
Pterogogus n. sp.	4			
Anampses caeruleopunctatus	4	1	1	1
*A. geographicus**	4			
A. meleagrides	4	1		1
A. melanurus	4			
A. neoguinaicus	4			
A. twisti	4	1	1	1
Coris aygula	4	1	1	1

FAMILY/SPECIES	CODE	SMI	NMI	MI
C. batuensis	4			
C. dorsomaculata	4			
C. gaimardi	4	1	1	1
C. picta	4			
Gomphosus varius	4	1	1	1
Halichoeres biocellatus	4	1	1	1
*H. chrysus**	4			
H. hortulanus	4	1	1	1
H. margaritaceus	4	1	1	1
H. marginatus	4	1	1	1
H. melanurus	4			
H. melanochir	4			
H. melasmopomus	4	1		1
H. nebulosus	4			
H. ornatissimus	4	1		1
*H. poecilopterus**	4			
*H. tenuspinus**	4			
H. trimaculatus	4	1	1	1
H. zeylonicus	4	1		1
Halichoeres sp.	4			
Hemigymnus fasciatus	4	1	1	1
H. melapterus	4	1	1	1
H. taeniuurus	3			
Hologymnosus annulatus	4	1	1	1
H. doliatus	4	1	1	1
Macropharyngodon meleagris	4	1	1	1
M. moyeri	4			
M. negrosensis	4			
Novaculops woodi	4			
Parajulis poecilopterus	4			
Pseudocoris aurantiofasciatus	4			
P. yamashiroi	4			
Pseudojuloides atavai	4	1		1
P. cerasinus	4	1		1
P. elongatus	4			
Pseudolabrus japonicus	4			
Stethojulis bandanensis	4	1	1	1
S. interrupta	4			
S. maculata	4			
S. strigiventor	4	1	1	1
Suezichthys arquatus	4			
S. gracilis	4			
S. soelae	4			
Thalassoma amblycephalum	4	1	1	1
T. cupido	4			
T. hardwicke	4	1	1	1
T. janseni	4	1		1
T. lunare	4			
T. lutescens	4	1	1	1
T. purpureum	4	1	1	1
T. quinquevittatum	4	1	1	1
T. trilobatum	4	1	1	1
Labrichthys unilineatus	4	1		1
Labroides bicolor	4	1	1	1
L. dimidiatus	4	1	1	1

Appendix II. (continued)

FAMILY/SPECIES	CODE	SMI	NMI	MI
L. pectoralis	4	1	1	1
Labropsis manabei	4			
L. micronesica	4	1	1	1
L. xanthonota	4	1		1
ODACIDAE				
Cheilio inermis	4	1		1
SCARIDAE				
Calatomus carolinus	4	1	1	1
C. japonicus	3			
C. spinidens	4	1		1
Leptoscarus vaigiensis	4	1		1
Bolbometapon muricatum	4	1	1	1
Cetoscarus bicolor	4	1		1
Hippsoscarus longiceps	4	1		1
Scarus altipinnis	4	1		1
S. festivus	4	1		1
S. forsteni	4	1	1	1
S. frenatus	4	1	1	1
S. frontalis	4	1	1	1
S. ghobban	4	1		1
S. gibbus	4	1	1	1
S. globiceps	4	1		1
S. microrhinos	4	1	1	1
S. niger	4			
S. obishime	4			
S. oviceps	4	1	1	1
S. ovifrons	4			
S. psittacus	4	1		1
S. rubrioviolaceus	4	1	1	1
S. schlegeli	4	1	1	1
S. sordidus	4	1	1	1
S. spinus	4	1		1
Scarus n. sp.	4	1		1
AMMODYTIDAE				
Ammodytoides kimurai	4			
PINGUIPEDIDAE				
Parapercis clathrata	4	1	1	1
P. kamoharoae				
P. millipunctata	4	1	1	1
P. multiplicata	4	1		1
P. polyophthalma	4			
P. synderi	4			
Parapercis n. sp.	4			
TRICHONOTIDAE				
Trichonotus filamentosus	4			
T. setiger	4			
Trichonotus n. sp.	4	1		1
CREEDIDAE				
Chalixodytes tauensis	4	1	1	1
Limnichthys donaldsoni	4			
L. fasciatus	4			
URANOSCOPIDAE				
Uranoscopus japonicus	3			
Uranoscopus sp. 1	4	1		1
Uranoscopus sp. 2	4	1		1

FAMILY/SPECIES	CODE	SMI	NMI	MI
TRIPTERYGIIDAE				
Ceratobregma helenae	4	1		1
Enneapterygius etheostoma	4			
E. hemimelas	4	1		1
E. miyakensis	4			
E. nanus	4	1		1
E. tutuilae	4			
Enneapterygius sp. 1	4			
Enneapterygius sp. 2	4			
Helcogramma capidata	4	1		1
H. chica	4	1		1
H. hudsoni	4			
H. obtusirostris	4			
H. striata	4			
Helcogramma n. sp.	4			
Norfolkia brachylepis	4	1		1
*Tripterygion bapturum**	3			
Ulca n. sp.	4	1		1
BLENNIIDAE				
Alticus orientalis	4			
A. saliens	4	1	1	1
Cirripectes castaneus	4	1		1
C. imitator	4			
C. fuscoguttatus	4	1		1
C. perustus	4	1		1
C. polyzona	4	1	1	1
C. quagga	4	1		1
C. variolosus	4	1	1	1
Ecsenius bicolor	4	1		1
E. lineatus	4			
E. opsifrontalis	4	1		1
E. stellifer	4	1		1
Entomacrodus caudofasciatus	4			
E. decussatus	4	1		1
E. niuafooensis	4	1		1
E. sealei	4	1		1
E. stellifer stellifer	4	1		1
E. striatus	4	1	1	1
E. thalassinus	4	1		1
Exalias brevis	4	1	1	1
Glyptoparus delicatulus	4	1		1
Istiblennius bellus	4	1		1
I. caudolineatus	4	1		1
I. chrysospilos	4	1	1	1
I. cyanostigma?	4			
*I. enosimae**	4			
I. endentulus	4	1	1	1
I. gibbifrons rodenbaughi	4	1		1
I. lineatus	4	1	1	1
I. paulus	4	1	1	1
I. periophthalmus?	4			
Mimoblennius atrocinctus	4			
Prealticus labrovittatus	4	1	1	1
P. poptae	4	1	1	1
P. tanegashimae	4			

Appendix II. (continued)

FAMILY/SPECIES	CODE	SMI	NMI	MI
Rhabdoblennius ellipes	4	1		1
R. snowi	4	1	1	1
Salarius fasciatus	4	1		1
*S. luctuosus**	4			
Stannulus seychellensis	4	1		1
S. talboti	4			
Enchelyurus kraussi	4	1		1
Omobranchus elongatus	4	1		1
O. rotundiceps obliquus	4	1		1
Parenchelyrus hepburni	4	1		1
Aspiodontus dussumieri	4			
Aspiodontus taeniatus	4	1		1
Meiacanthus atrodorsalis	4	1		1
M. grammistes	4			
M. kamohoral	4			
Petroscirtes breviceps	4			
P. mitratus	4	1		1
P. springeri	4			
P. xestus	4	1		1
Plagiotremus laudandus	4	1		1
P. rhinorhynchos	4			
P. tapienosoma	4	1	1	1
Xiphasia matsubarai	4	1	1	1
CALLIONYMIDAE				
Anaora tentaculata	4	1		1
Callionymus beniteguri	3			
C. corallinus	3			
C. curvispinis	3			
C. persicus izuensis	3			
C. simplicornis	4	1		1
Diplogrammus goramensis	4	1		1
D. xenicus	4			
Synchiropus circularis	4	1		1
S. ijimae	3			
S. kiyoae	3			
S. morrisoni	4	1		1
S. moyeri	4			
S. ocellatus	3			
Synchiropus sp. 1	4	1		1
Synchiropus sp. 2	4			
ELEOTRIIDAE				
Calumia godeffroyi	4	1		1
Eleotris acanthopoma	7	1		1
XENISTHMIDAE				
Xenisthmus polyzonatus	4		1	1
MICRODESMIDAE				
Gunnellichthys monostigma	4	1		1
G. pleurotaenia	4	1		1
G. viridescens	4	1		1
Nemateleotris helfrichi	4	1		1
N. magnifica	4	1	1	1
Paraglossus philippinus	4	1		1
Ptereleotris evides	4	1	1	1
P. heteroptera	4	1	1	1
P. lineopinnis	4	1		1
P. microlepis	4	1	1	1
P. zebra	4	1	1	1
GOBIIDAE				
Amblyeleotris fasciata	4	1	1	1
A. guttata	4	1		1
A. ogasawaraensis	4			
A. periopthalma	4			
A. steinitzi	4	1		1
A. wheeleri	4			
Cryptocentrus caruleomaculatus	4	1		1
C. fillifer	4			
C. koumansi	4	1		1
C. strigilliceps	4	1		1
Ctenogobiops feroculus	4	1		1
C. pomastictus	4	1		1
C. tangarorai	4	1		1
Lotilla graciliosa	4	1		1
Mahidolia mystacina	4	1		1
Vanderhorstia ambanoro	4	1		1
V. mertensi	4			
V. omatissima	4	1		1
Vanderhorstia n. sp.	4	1		1
Amblygobius nocturnus	4	1		1
A. phalaena	4	1		1
Oplopomus oplopomus	4	1		1
Valenciennea helsdingeni	4			
V. puellaris	4	1		1
V. strigatus	4	1	1	1
Asterropteryx semipunctatus	4	1		1
Austrolethops wardi	4	1		1
Awaous guamensis	4	1		1
A. ocellaris	4			
Bathygobius cocosensis	4	1		1
B. cotticeps	4	1		1
B. fuscus fuscus	4	1	1	1
B. padangensis	4			
Bathygobius sp.	4			
Bryanops amplus	4	1		1
B. erythrops	4	1		1
B. natans	4	1		1
Cabillus sp.	4			
C. plumatus	4	1		1
C. sclateri	4	1		1
C. tanegasimae	4			
Clariger exilis	3			
Eviota abax				
E. afelei	4	1		1
E. albolineata	4	1		1
Eviota n. sp.	4	1		1
E. distigma	4	1		1
E. epiphanes	4			
E. fasciola	4	1	1	1
E. guttata	4			
E. lachdebrerei	4	1		1
E. melasma	4			
E. nebulosa	4	1		1

Appendix II. (continued)

FAMILY/SPECIES	CODE	SMI	NMI	MI
E. pellucida	4	1		1
E. prasina	4			
E. prasites	4			
E. saipanensis	4	1		1
E. smaragdus	4	1		1
E. storthynx	4			
E. zonura	4	1	1	1
Eviota sp.	4	1	1	1
Eviota sp. 1	4			
Eviota sp. 2	4			
Eviota sp. 3	4			
Eviota sp. 4	4			
Exyrias belissimus	4	1		1
E. puntang	4	1		1
Fusiogobius duospilus	4			
F. longispinus	4	1		1
F. neophytus	4	1	1	1
Fusiogobius sp. 2	4			
Glossogobius biocellatus	7	1		1
Gnatholepis anjerensis	4	1	1	1
G. scapulostigma	4	1		1
Gnatholepis sp. 2	4	1		1
Gobiodon atrangulatus	4			
G. citrinus	4	1		1
G. multilineatus	4			
G. oculolineatus	4			
G. quinquestrigatus	4	1		1
G. rivulatus	4	1		1
Gopiopsis arenaria	4			
Hazeus otakii	2			
Hetereleotris poecila	4			
Istigobius campbelli	3			
I. decoratus	4	1		1
I. hoshinonis	4			
I. ornatus	4	1		1
Luciogobius grandia	2			
L. elongatus	2			
Kelloggella cardinalis	4	1		1
Mugilogobius cavifrons	7	1		1
M. tagala	7	1		1
M. villa	7	1		1
Oligolepis acutipennis	7			
Oxyurichthys guibei	7	1		1
O. ophthalmonema	7	1		1
O. papuensis	7	1		1
Paragobiodon echinocephalus	4	1		1
P. lacunicolus	4	1		1
Periophthalmus koelreuteri	4	1		1
Pleurosicya bilobata	4	1		1
P. coerulea	4	1		1
P. muscarum	4	1		1
Priolepis boreus	4			
P. cincta	4		1	1
P. inhaca	4	1		1
P. semidoliatus	4	1		1
Priolepis sp.	4			
Pseudogobius masago	4			
Redigobius bikolanus	7	1		1
Sicyopus leprurus	7	1		1
Sicyopterus macrostetholepis	7	1		1
Sueviota lachneri	4			
Stiphidon elegans	7	1		1
Taenoides limicola	7	1		1
Tomiyamaichthys oni	2			
Trimma caesiura	4	1		1
T. naudei	4	1	1	1
T. okinawae	4			
T. tevegae	4	1		1
T. taylori	4	1		1
Trimma sp.	4	1	1	1
Trimmatom evitops	4		1	1
KRAEMERIIDAE				
Kraemeria samoensis	4	1		1
SIGANIDAE				
Siganus argenteus	4	1		1
S. corallinus	4			
S. fuscescens	4			
S. punctatus	4	1		1
S. randalli	4	1		1
S. spinus	4	1		1
S. unimaculatus	4			
S. vermiculatus	4	1		1
S. virgatus	4			
ZANCLIDAE				
Zanclus cornutus	4	1	1	1
ACANTHURIDAE				
Acanthurus achilles	4	1	1	1
A. blochii	4	1	1	1
A. dussumieri	4	1	1	1
A. guttatus	4	1	1	1
A. japonicus	4			
A. leucopareius	4	1	1	1
A. lineatus	4	1	1	1
A. lopezi	4			
A. mata	4		1	1
A. nigricans	4	1	1	1
A. nigricauda	4	1	1	1
A. nigrofuscus	4	1	1	1
A. nigoris	4	1	1	1
A. nubilus	4	1		1
A. olivaceus	4	1	1	1
A. pyroferus	4	1	1	1
A. thompsoni	4	1	1	1
A. triostegus	4	1	1	1
A. xanthopterus	4	1		1
Ctenochaetus binotatus	4	1		1
C. hawaiiensis	4	1	1	1
C. striatus	4	1	1	1
C. strigosus	4	1		1
Paracanthurus hepatus	4	1	1	1
Prionurus microlepidotus	3			
P. scalprum	3			

Appendix II. (continued)

FAMILY/SPECIES	CODE	SMI	NMI	MI
Zebrasoma flavescens	4	1	1	1
Z. scopas	4	1		1
Z. veliferum	4	1		1
Naso annulatus	4	1	1	1
N. brachycentron	4	1	1	1
N. brevirostris	4	1	1	1
N. caesius	4	1	1	1
N. hexacanthus	4	1	1	1
N. lituratus	4	1	1	1
N. maculatus	4			
N. thynnoides	4	1		1
N. tuberosus	4	1	1	1
N. unicomis	4	1	1	1
N. vlagmingii	4	1	1	1
EPHIPPIDAE				
Platax orbicularis	4	1	1	1
P. tiera	4			
CENTROLOPHIDAE				
Hyperoglyphe japonica	2			
SPHYRAENIDAE				
Sphyraena acutipinnis	4	1		1
S. barracuda	4	1	1	1
S. forsteri	4	1	1	1
S. genie	4	1		1
S. japonica	4			
S. novaehollandiae	4	1		1
S. obtusata	4	1		1
XIPPHIIDAE				
Xiphias gladius	5	1	1	1
SCOMBRIDAE				
Acanthocybium solandri	4	1	1	1
Auxis rochei	5			
A. thazard	5	1	1	1
Euthynnus affinis	4	1	1	1
Grammatocynus bilineatus	4	1		1
Gymnosarda unicolor	4	1	1	1
Katsuwonus pelamis	5	1	1	1
Scomber australasicus	4			
S. japonicus	5			
Thunnus alalunga	5	1	1	1
T. albacares	5	1	1	1
T. obesus	5	1	1	1
T. thynnus	5			
ISTIOPHORIDAE				
Istiophorus platypterus	3	1	1	1
Makaira indica	3	1	1	1
M. mazara	3	1	1	1
M. nigricans	3			
Tetrapterus angustirostris	3	1	1	1
T. audax	3	1	1	1
NOMEIDAE				
Psenes cyanophrys	5	1		1
BOTHIDAE				
Asterorhombus intermedus	4	1		1
Bothus mancus	4	1		1
B. pantherinus	4	1	1	1
Crossorhombus kobensis	3			
Engyprosopan sp.	4	1		1
Engyprosopan sp. 1	4			
Engyprosopan sp. 2	4			
SOLEIDAE				
Aseraggodes melanostictus	4	1		1
A. whitakeri	4			
Soleichthys heterohinos	4	1		1
TRIACANTHODIDAE				
Halimochirurgus alcocki	4	1		1
BALISTIDAE				
Abalistes stellatus	3			
Balistapus undulatus	4	1	1	1
Balistoides conspicillum	4	1	1	1
B. viridescens	4	1	1	1
Canthidermis maculatus	4	1	1	1
Melichthys niger	4	1	1	1
M. vidua	4	1	1	1
Odonus niger	4	1	1	1
Pseudobalistes flavimarginatus	4	1		1
P. fuscus	4	1		1
Rhinecanthus aculeatus	4	1	1	1
R. rectangulus	4	1	1	1
R. verrucosus	4			
Sufflamen bursa	4	1	1	1
S. chrysoptera	4	1	1	1
S. freanatus	4	1	1	1
Xanthichthys auromarginatus	4	1	1	1
X. careuleolineatus	4	1		1
X. lineopunctatus	4			
X. mento	4			
Xenobalistes tumidipectoris	4		1	1
MONACANTHIDAE				
Aluterus monoceros	5		1	1
A. scriptus	5	1	1	1
Amanses scopas	4	1	1	1
Cantherhines dumerilii	4	1	1	1
C. fronticinctus	4	1		1
C. pardalis	4	1	1	1
*Navodon modestus**	3			
Oxymonacanthus longirostris	4	1	1	1
Paraluteres prionurus	4	1	1	1
Paramonacanthus japonicus	4			
Pervagor janthinosoma	4	1		1
P. melanocephalus	4			
Pseudalutarias nasicornis	4	1		1
Stephanolepis cirrhifer	2			
Thamnaconus modestoides	4			
T. tessellatus	3			
ARACANIDAE				
Kentrocapros aculeatus	2			
OSTRACIIDAE				
Lactora cornuta	4	1	1	1
L. diaphana	4	1	1	1

Appendix II. (continued)

FAMILY/SPECIES	CODE	SMI	NMI	MI
L. fornasini	4	1	1	1
Ostracion cubicus	4	1	1	1
O. immaculatus	3			
O. meleagrides	4	1	1	1
Rhynchostracion rhynorhynchus	4			
TRIODONTIDAE				
Triodon macropterus	4	1	1	1
TETRAODONTIDAE				
Arothron hispidus	4	1		1
A. manilensis	4	1		1
A. mappa	4	1		1
A. meleagris	4	1	1	1
A. nigropunctatus	4	1	1	1
A. stellatus	4	1		1
Canthigaster amboinensis	4	1	1	1
C. bennetti	4	1	1	1
C. compressa	4	1		1
C. coronata	4	1	1	1
C. epilampra	4	1		1
C. janthinoptera	4	1	1	1
C. leoparda	4	1		1
C. rivulata	4	1		1
C. solandri	4	1	1	1
C. valentini	4	1	1	1
Chelonodon patoca	4			
Fugu poecilonotum	2			
F. xanthropterus	2			
Lagocephalus lagocephalus	3	1		1
L. sceleratus	4			
Sphoeroides pachygaster	2			
DIODONTIDAE				
Chilomycterus affinis	5			
C. reticulatus	4		1	1
Diodon holocanthus	5			
D. hystrix	5	1		1
D. liturosus	4			
MOLIDAE				
Mola mola	5			
Total species		933	427	946

ERRATA for Appendix II in "Zoogeography of fishes of the Mariana, Ogasawara and Izu Islands: a preliminary assessment", by T.J. Donaldson, R.F. Myers, J.T. Moyer and P. Schupp. Natural History Research, Special Issue, No.1:303-332.

				FAMILY/SPECIES	CODE	SMI	NMI	MI
P.318	Left column	L.12	For	*Mustelus griseus*				
			Read	*Mustelus griseus*	1			
P.319	Left column	between L.54 and L.55	Insert	*Schultzidia johnstonensis*	4		1	1
P.319	Right column	L.27	Delete	*S. englemanni*	4	1		1
P.319	Right column	L.49	Delete	*C. parvipinnis*	4	1		1
P.320	Left column	L.5	For	*Antennarius coccineus*	4	1		1
			Read	*Antennarius coccineus*	4	1	1	1
P.320	Left column	between L.11 and L.12	Insert	*Antennarius* sp.	4		1	1
P.320	Left column	L.18	Delete	*A. insularum whitei*	4	1		1
P.320	Left column	L.27	For	*S. leiura*	4	1		1
			Read	*S. leiura*	4			
P.320	Left column	L.32	For	*Hemiramphus archipelagicus*	4	1		1
			Read	*Hemiramphus archipelagicus*	4			
P.320	Right column	L.5	For	*Myrpristis adustus*	4	1	1	
			Read	*Myrpristis adustus*	4	1	1	1
P.321	Left column	L.6	For	*D. russelli*				
			Read	*D. russelli*	4			
P.321	Left column	L.10	For	*Naucrates ductor*	4	1		
			Read	*Naucrates ductor*	4	1		1

Data from *C. equula* (P.320, right column, L.48) to *Selar crumenopthalmus* (P.321, left column, L.14) should be moved to the line after *Carangoides caeruleopinnatus* (P.323, right column, L.53).

P.321	Left column	between L.21 and L.22	Insert	*Corythoichthys* sp.A	4		1	1
				Corythoichthys sp.B	4		1	1
P.321	Left column	L.39	Delete	*Zalises draconis**	3			
P.321	Left column	L.47	For	*T. chiltonae*	4	1		1
			Read	*T. chiltonae*	4	1	1	1
P.321	Left column	L.49	For	*T. otaitensis*				
			Read	*T. otaitensis*	4			
P.322	Right column	L.7	For	*E. rivulatus*				
			Read	*E. rivulatus*	4			
P.322	Right column	L.17	For	*Variola albimargonata*	4	1		1
			Read	*Variola albimargonata*	4	1	1	1
P.322	Right column	between L.46 and L.47	Insert	*Pseudoplesiops multisquamatus*	4		1	1
P.323	Left column	L.26	For	*A. cyanosoma*	4	1	1	1
			Read	*A. cyanosoma*	4			
P.323	Left column	L.29	For	*A. jordani*	4	1		1
			Read	*A. evermanni*	4	1		1
P.323	Left column	L.32	For	*A. mydrus*	4	1		1
			Read	*A. mydrus*	4			
P.323	Left column	L.41	For	*A. exostigma*	4	1		1
			Read	*A. exostigma*	4	1	1	1
P.323	Left column	L.46	For	*Apogon* n.sp. "*cyanosoma*"	4	1		1
			Read	*Apogon* n.sp. "*cyanosoma*"	4	1	1	1
P.323	Right column	L.2	For	*C. lineatus*	4	1	1	1
			Read	*C. lineatus*	4			
P.323	Right column	L.17	For	*Kuhlia boninensis*	4			
			Read	*Kuhlia boninensis*	4		1	1
P.323	Right column	L.20	For	*Kuhila rupestris*	4	1		1
			Read	*Kuhila rupestris*	4	1	1	1

				FAMILY/SPECIES	CODE	SMI	NMI	MI
P.323	Right column	L.54	Delete	*Schultzidia johnstonensis*	4		1	1
P.324	Left column	L.24	Delete	*G. argyreus*	4	1		1
P.324	Left column	L.38	For	*Pristipomoides amoenus*	4	1	1	1
			Read	*Pristipomoides amoenus*	4			
P.324	Right column	L.25	Delete	*P. pictus*	4			
P.324	Right column	L.42	For	*G. japonicus*	4	1	1	1
			Read	*G. japonicus*	4			
P.325	Left column	L.5	For	*Monotaxis grandoculus*	4	1		1
			Read	*Monotaxis grandoculus*	4	1	1	1
P.325	Left column	L.23	For	*P. pleurotaenia**	4			
			Read	*P. pleurotaenia**	4		1	1
P.325	Right column	L.20	Delete	*C. trifasciatus*	4	1	1	1
P.325	Right column	L.34	For	*H. monocerous*	4	1		1
			Read	*H. monocerous*	4	1	1	1
P.326	Left column	L.15	For	*Pseudopentacerous wheelweri*	2			
			Read	*Pseudopentacerous wheelweri*	2		1	1
P.326	Left column	L.38	For	*C. lepidolepis*	4	1		1
			Read	*C. lepidolepis*	4			
P.326	Right column	L.14	For	*Neopomacentrus violascens*	4	1		1
			Read	*Neopomacentrus violascens#*	4	1		1
P.326	Right column	L.36	For	*Chaenomugil leuciscus*	4	1		1
			Read	*Chaenomugil leuciscus*	4	1	1	1
P.327	Left column	L.40	For	*Pseudocheilinus evanidus*	4	1		1
			Read	*Pseudocheilinus evanidus*	4	1	1	1
P.327	Left column	L.43	For	*P. tetrataenia*	4	1		1
			Read	*P. tetrataenia*	4	1	1	1
P.327	Right column	L.13	For	*H. melasmopomus*	4	1		1
			Read	*H. melasmopomus*	4	1	1	1
P.327	Right column	L.24	For	*Hologymnosus annulatus*	4	1	1	1
			Read	*Hologymnosus annulatus*	4		1	1
P.327	Right column	L.34	For	*Pseudojuloides atavai*	4	1		1
			Read	*Pseudojuloides atavai*	4	1	1	1
P.328	Left column	L.4	For	*L. xanthonota*	4	1		1
			Read	*L. xanthonota*	4	1	1	1
P.328	Left column	between L.15 and L.16	Insert	*S. atripectoralis*	4	1		1
P.328	Left column	L.21	Delete	*S. gibbus*	4	1	1	1
P.328	Right column	L.18	For	*Ulca* n.sp.	4	1		1
			Read	*Ulca* new genus and n.sp.	4	1		1
P.328	Right column	L.21	For	*Cirripectes castaneus*	4	1		1
			Read	*Cirripectes castaneus*	4			
P.328	Right column	L.30	For	*E. opsifrontalis*	4	1		1
			Read	*E. opsifrontalis*	4	1	1	1
P.328	Right column	L.40	For	*Exalias brevis*	4	1	1	1
			Read	*Exallias brevis*	4	1	1	1
P.329	Left column	L.13	For	*Meiacanthus atrodorsalis*	4	1		1
			Read	*Meiacanthus atrodorsalis*	4	1	1	1
P.329	Left column	L.21	For	*P. rhynorhynchos*	4			
			Read	*P. rhynorhynchos*	4	1	1	1
P.329	Left column	L.52	For	*Paraglossis philippinus*	4	1		1
			Read	*Paraglossis philippinus**	4	1		1
P.329	Right column	L.41	Delete	*Cabillus* sp.	4			
P.329	Right column	between L.41 and L.42	Insert	*Cabillus tongarevae*	4	1		1
				Callogobius maculipinnis	4	1		1

				FAMILY/SPECIES	CODE	SMI	NMI	MI
P.329	Right column	L.46	For	*Eviota abax*				
			Read	*Eviota abax*	4			
P.330	Left column	L.18	For	*Fusiogobius* sp.2	4			
			Read	*Fusiogobius signipinnis*	4	1		1
P.330	Right column	between L.15 and L.16	Insert	*T. unisquamis*	4	1		1
P.330	Right column	L.20	For	*S. corallinus*	4			
			Read	*S. corallinus*	4	1		1
P.330	Right column	L.39	For	*A. mata*	4		1	1
			Read	*A. mata*	4			
P.330	Right column	L.49	For	*A. xanthopterus*	4	1		1
			Read	*A. xanthopterus*	4	1	1	1
P.330	Right column	L.50	For	*Ctenochaetus binotatus*	4	1		1
			Read	*Ctenochaetus binotatus*	4	1	1	1
P.331	Left column	L.35	For	*Grammatocynus bilineatus*	4	1		1
			Read	*Grammatocynus bilineatus*	4	1	1	1
P.331	Left column	L.48	Delete	*M. nigricanus*	3			
P.331	Right column	L.31	For	*X. careuleolineatus*	4	1		1
			Read	*X. careuleolineatus*	4	1	1	1
P.332	Left column	L.15	For	*A. stellatus*	4	1		1
			Read	*A. stellatus*	4	1	1	1
P.332	Right column	L.12	Delete	*Chilomycterus affinis*	5			
P.332	Right column	L.13	For	*C. reticulatus*	4	1		1
			Read	*Chilomycterus reticulatus*	4	1		1
P.332	Right column	between L. 18 and 19	Insert	*Masturus lanceolatus*	5	1	1	1
				Runzania laevis	5	1	1	1
P.332	Right column		For	Total species		933	427	946
			Read	Total species		923	466	943