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COMMUNITY ECOLOGY OF THE MARINE FISHES ON LUTAO ISLAND, TAIWAN[1]

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Kun-Hsiung Chang, Rong-Quen Jan and Kwang-Tsao Shao (1983) Community ecology of the marine fishes on Lutao Island, Taiwan. *Bull. Inst. Zool., Academia Sinica* **22**(2): 141-155. Lutao Island (121°29′E, 22°40′N) is a 16 km² offshore islet located 33 km southeast of Taitung, Taiwan. Survey on marine fishes at six study sites around this islet were made during 1979-82 period. A total of 294 species belonging to 52 families was censused. Among them Labridae was the largest family which consisted of 49 species. It was followed in order by Pomacentridae, 43 species; Chaetodontidae, 20 species; Acanthuridae, 19 species; Blenniidae, 14 species, etc. UPGMA (unweighted pair-group method using arithmetic averages) is used to treat dissimilarity coefficients between faunas to show two main clusters existing among six sampling sites—one pertaining to northern coast of this islet, and the other pertaining to both western and eastern coasts.

Located 75 km north of Lanyu Island and 33 km southeast of Taitung, Taiwan, Lutao (121°29′E, 22°40′N) is a 16 km² offshore islet. While fish fauna of adjacent islands of Taiwan has not yet been fairly well investigated, that of Lutao Island is far less assessible and consequently poorly known. Only a few species of fishes has been miscellaneously recorded from this islet, and as a result a study pertaining to local marine fish community is therefore triggered.

MATERIALS AND METHODS

In present study visits to Lutao were made in June, September 1979; March, June 1980; January 1981; and June 1982. Fish composition at six study sites (Fig. 1; Table 1) around this islet was censused during each visit. The non-cryptic fish species were counted by diver transect method. Two divers swam along each isobathic transect at 3 m depth for 40 minutes. Their results were kept on water-resist notebooks and were compared. The relative abundance of a species was noted under four grades, viz., *A* (Abundant), $\bar{C}$ (Common), *O* (Occasional), and *R* (Rare). Criterion on which the four grades based is noted in Table 2. The cryptic fish fauna was examined by intensive diver survey and frequently by the use of rotenone. In addition to visual counts, underwater photography helped recording uncommon specimens when collection was inavailable. Verification of species in photographs was accepted only when it was clear enough to distinguish small diagnostic characters.

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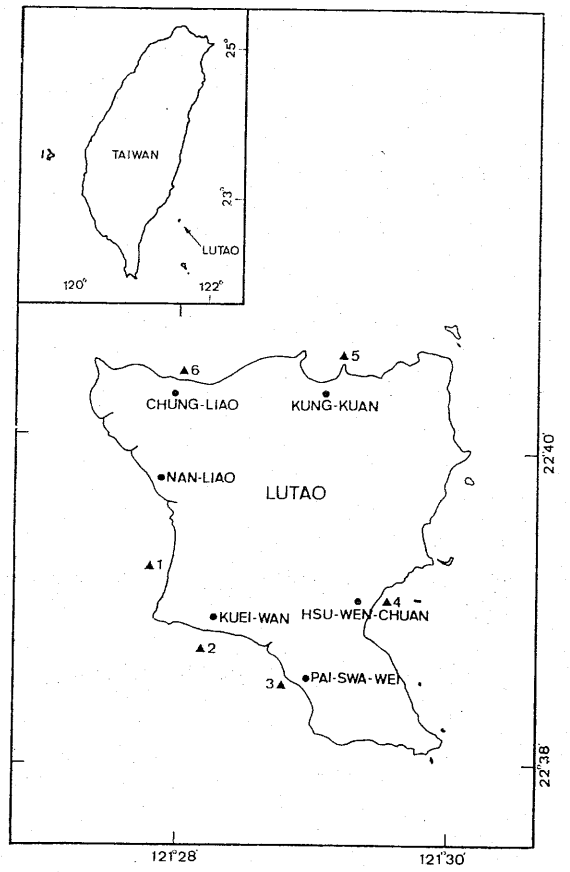

Fig. 1. Map of Lutao Island, showing the study sites.

Jaccard's coefficient (*Jc*) for similarity (Sneath and Sokal, 1973) was used to express the association between faunas found in every two study sites. When the dissimilarity index is expressed as 1-*Jc*, a dendrogram is derived from the clustering of the matrix of the index for every two fish faunas by using the UPGMA (unweighted pair-group method using arithmetic averages) given by Sneath and Sokal (1973).

RESULTS

Fishes encountered, and verified by specimen examination or underwater observation supplemented with fish pictures, are shown with estimate abundance in Table 2. Among them *Corythoichthys flavofasciatus* (Rüppell) is a newly recorded fish from Taiwan and was published elsewhere (Lee, 1983). Pictures of some uncommon species were also presented elsewhere (Chang *et al.*, 1980). Estimations of fish abundance are subjective and have been taken with caution. Since the abundance of a species might change seasonally, the upper grades of abundance for each species are listed in Table 2. Fishes belonging to 294 species in 52 families were found around Lutao Island during the study period. Among the study sites, both Pai-Sha-Wei (白砂尾; 3) and Chung-Liao (中寮; 6) got the largest number of species (146), whereas Kung-Kuan (公館; 5) got 78 species only (Table 2).

For the whole study area, an order of importance of the fish family is listed by considering each of them the number of species firstly, then supplemented with their estimate abundance. The families Labridae (49 species; 6*C*, 28*O*, 125*R*) and Pomacentridae (43 species; 4*A*, 12*C*, 50*O*, 80*R*) are the two major components of the community. We find next, in order of decreasing importance: Chaetodontidae (20 species; 4*O*, 62*R*) and Acanthuridae (19 species; 2*C*, 13*O*, 38*R*), Blenniidae (14 species; 1*O*, 30*R*), etc. A few families tended to dominate the fauna. For example, among all families found, the five major families constitute a total of 145 species, a number nearly equal to half of the whole fauna, viz., 294 species. If we consider the fauna at each site seperately, the ratios of the number of species belonging to the five major families to the total number of species in a particular site vary slightly (*i.e.*, 0.53-0.69). These ratios are slightly higher than the ratio, namely, 0.49, as the fauna of Lutao treated as a whole (Table 3).

Among fishes found, those rarely or occasionally appeared represented the major part of the fauna. Fishes occurred with an estimate abundance over *C* grade seemed much conspicuous, and nearly all these fishes belonged to the five major families. Furthermore, pomacentrids *Plectroglyphidodon imparipennis*, and *P. leucozona*, which distribute widely from intertidal flat to surge zone, are by far the most abundant species found around this islet.

TABLE 1
Description of the study sites

Study sites	Characteristics
1. Nan-Liao 南 寮	Located at western coast, with a wide intertidal terrace. Sea bottom slanting grandually with flourishing branching coral growth. Coral debris accumulation occurs sporadically.
2. Kuei-Wan 龜 灣	Located at southwestern coast. Large rocks scattering on the shallow water near shoreline. Deeper than 15 meters, sea bottom tends to be less undulated. Branching corals also abundant here.
3. Pai-Sha-Wei 白 砂 尾	Located at west side of southern tip of this islet. It is a site meeting Kuroshio directly. Shoreline is characterized by a sandy beach neighboring angular rocks. Subtidal zone full of irregular reefs.
4. Hsu-Wen-Chuan 旭 溫 泉	Adjacent to a cove and located at eastern coast. Windward to northeast monsoon. Cracks spreading on the intertidal area. Sea bottom slopes gently downward from the surging zone. Subtidal zone full of irregular reef outcrops.
5. Kung-Kuan 公 館	Located at northern coast. Windward to northeast monsoon. Reef outcrops occur heavily in the waters. A rich variety of corals covers the sides of the buttress.
6. Chung-Liao 中 寮	Located at north coast. Windward to northeast monsoon. Coral reef flat, extending out of shoreline, constitutes the intidal area. Under low tide level many encrusting patches of corals are found on outcrops of reefs in the shallow water, and small clumps of staghorn coral occur occasionally on reef surface.

TABLE 2
List of fishes occurred around Lutao Island. Occurrence+ and the relative abundance++ of each species are indicated

Families and species	Study sites					
	1	2	3	4	5	6
Family Acanthuridae						
Acanthurus japonicus		R	R		R	
A. leucopareius			R			
A. lineolatus	R	R	O	O	R	R
A. nigrofuscus			R			
A. olivaceus		R	R		R	R
A. pyroferus	R		R			
A. triostegus			R			
A. sp. 1.			R			
A. sp. 2.	O	C		O	O	C
Axinurus thynnoides	R	R				
Ctenochaetus strigatus			R			
Naso brevirostris			R			
N. hepatus		R	R			R(1)
N. hexacanthus		R	O	R		

TABLE 2
List of fishes occurred around Lutao Island. Occurrence[+] and the relative abundance[++] of each species are indicated (continued)

Families and species	Study sites					
	1	2	3	4	5	6
N. lituratus		R	R	O	O	R
N. unicornis	R	O	R	O	R	R[(1)]
Zebrassoma flavescens	R					
Z. scopas	R	O	R			
Z. veliferum	O	R	R	O		
Family Antennariidae						
Antennarius coccineus		R				
Family Apogonidae						
Apogon angustatus		R				
A. bandanensis		R				
A. coccineus		R				
A. ocellatus						R
A. robustus		R			R	R
A. sp.						R
Cheilodipterus macrodon	R					
Pseudamia gracilicauda	R					
Family Atherinidae						
Atherion elymus	R	O		R	O	R
Pranesus insularum						R
Family Aulostomidae						
Aulostomus chinensis			R			
Family Balistidae						
Balistapus undulatus	R	R			R	
Balistoides conspicillum				R		R
Odonus niger				R	O	
Pseudobalistes flavimarginatus			R			O
Rhinecanthus aculeatus	R		R			
R. rectangulus					R	
R. verrucosus		R				R
Sufflamen chrysopterus	R	R		R		R
S. fraenatus		O		R		O
Family Blenniidae						
Cirripectus sebae		R	R		R	R
C. variolosus	R	R	R			R
C. sp.	R				O	
Ecsenius namiyei			R			
E. oculus				R		
E. yaeyamaensis			R			
Entomacrodus caudofasciatus	R			R		R
E. decussatus	R		R	R		
E. striatus			R	R		R
Exallias brevis		R	R			

TABLE 2
List of fishes occurred around Lutao Island. Occurrence[+] and the relative abundance[++] of each species are indicated (continued)

Families and species	Study sites					
	1	2	3	4	5	6
Istiblennius periophthalmus	R					
Meiacanthus grammistes		R	R		R	
M. kamoharai					R	
Plagiotremus rhinorhynchus			R		R	
Family Bothidae						
Bothus sp.				R		
Family Caesionidae						
Caesio xanthonotus				O	O	O
Pterocaesio diagramma				R	R	R
P. tile				O	O	C
Family Carangidae						
Elagatis bipinnulata						R
Family Chaetodontidae						
Chaetodon argentatus	O	R	R	R	O	R
C. aureus	R	R	R		R	R
C. auriga		R	R	R		
C. bennetti		R	R			
C. citrinellus	R	R	R	R	R	R
C. ephippium			R	R		
C. kleinii		O	R			R
C. lunula		R	R		R	
C. mellannotus					R	R
C. miliaris			R			
C. plebeius			R			
C. punctatofasciatus	R	R				
C. speculum	R		R	R	R	R
C. trifasciatus	R	R	R	R		
C. unimaculatus		R	O		R	R
C. vagabundus	R	R	R	R	R	R
Forcipiger flavissimus	R[1]				R	
Gonochaetodon triangulum		R		R		
Heniochus chrysostomus		R	R	R		
Megaprotodon trifascialis	R	R	R	R		
Family Cirrhitidae						
Cirrhitichthys falco						O
C. serratus						R
Cirrhitus pinnulatus						R
Paracirrhites arcatus		O		R		R
P. forsteri	R	R	R	R	R	R
Family Congridae						
Conger cinereus						R
Family Diodontidae						
Diodon holocanthus						R

TABLE 2
List of fishes occurred around Lutao Island. Occurrence+ and the relative abundance++ of each species are indicated (continued)

Families and species	Study sites					
	1	2	3	4	5	6
D. liturosus			R			
Family Eleotridae						
Eleotriodes strigatus						R
Nemateleotris magnificus	O					
Pogonoculius zebra						O
Ptereleotris evides	O	O	O	O		O
Family Excoetidae						
Hemiramphus sp.						R
Family Gerreidae						
Gerres oyena					R	R
Family Gobiesocidae						
Lepadichthys frenatus				R		
Family Gobiidae						
Bathygobius fuscus				R		
Family Grammistidae						
Grammistes sexlineatus			R			R
Family Holocentridae						
Adioryx andananensis						R
A. caudimaculatus	R(1)					
A. ittodae	R					
Flammeo sammara		R(1)				
Myripristis murdjan	O(1)	R		R		
M. pralinius		R				
Family Kyphosidae						
Girella sp.	R	R				
Kyphosus lembus						R
Family Labridae						
Anampses caeruleopunctatus	R	R		R		
A. geographicus			R			
A. meleagrides		R		R		
A. twistii	R	R	R	R		
A. sp.						R
Bodianus axillaris		R				
B. diana			R			R
B. mesothorax	R			R		
Cheilio inermis			R			R(1)
Chelinus rhodochrous	R	R	R	R	R	R
Cirrhilabrus cyanopleura		R	R			
Coris aygula		R	R			
C. gaimard	R					R
C. variegata		R				R
Gomphosus varius	R	O	R	R	R	R
Halichoeres centiquadrus	R	O	R		R	R

TABLE 2
List of fishes occurred around Lutao Island. Occurrence[+] and the relative abundance[++] of each species are indicated (continued)

Families and species	Study sites					
	1	2	3	4	5	6
H. margaritaceus	R	R	R	O		R
H. marginatus	R	O	O	R	R	R
H. melanurus	O		R			
H. nebulosus						R
H. poecilopterus			R			
H. scapularis		R				R
H. trimaculatus	R	R	C	R	R	R
H. sp.	R					R
Hemigymnus fasciatus						R
H. melapterus				R		
Hemipteronotus taeniurus						R
Hologymnosus semidiscus	R	R	R			
Labroides bicolor		R				
L. dimidiatus	R	R	R	R	R	R
Leptojulis sp.						R
Lienardella fasciata		R	R	R(1)		
Macropharyngodon meleagris	R					R
Pseudocheilinus hexataenia	O		R	O	R	
Stethojulis bandanensis	R	O	R		R	R
S. interrupta	R	R	O		R	R
S. trilineatus	R	R		R		R
S. sp. 1.						R
S. sp. 2.					R	
Thalassoma amblycephalus	C	O	O	O	C	O
T. cupido	R	R	R			
T. fuscum	R	R	R	R	R	R
T. hardwickii	C	C	O	O	R	O
T. janseni	O	O	O	O	R	O
T. lunare		R	R	R	R	R
T. lutescens	C	O	R	O	R	O
T. purpureum	R	R	R	R	R	R
T. quinquevittatus	O	O	R	R	O	R
T. sp.	R			R		
Family Lutjanidae						
Lutjanus decussatus			R			
L. fulvus		R	R			
L. janthinuropterus	R(1)					
L. monostigma			R			
L. rivulatus		R				
L. sp.	R				R	
Family Monacanthidae						
Aluterus scriptus	R					
Amanses scopas	R					
Cantherhines pardalis		R				
Melichthys vidua	R	R				

TABLE 2
List of fishes occurred around Lutao Island. Occurrence[+] and the relative abundance[++] of each species are indicated (continued)

Families and species	Study sites					
	1	2	3	4	5	6
Oxymonacanthus longirostris				R		
Family Monotaxidae						
Gnathodentex aurolineatus	R		R			
Gymnocranius sp.		R				
Monotaxis grandoculis	R					
Family Mugilidae						
Crenimugil crenilabis	R		R		R	
Liza sp.						R
Family Mugiloididae						
Parapercis cephalopunctata	O	R		R	R	R
P. clathrata			R			
P. polyophthalma		R	R		R	R
Family Mullidae						
Mulloidichthys flavolineatus				R		
M. samoensis	R	R				
Parupeneus bifasciatus	R	R				
P. cycyostomus	R	R		R		
P. fraterculus						R
P. indicus		R				R
P. trifasciatus	R	R	O	R	O	R
P. sp.						R
Family Muraenidae						
Echidna nebulosa						R
E. polyzona			R			
Gymnothorax flavimarginatus			R			
G. meleagris	R				R	
G. thyrsoideus			R			R
G. sp.						R
Uropterygion micropterus	R					R
Family Nemipteridae						
Scolopsis bilineatus	O	R	R			R
S. cancellatus	O	R	R			R
Family Ophichthidae						
Myrichthys aki					R	
Family Ophiidae						
Dinematichthys ilucoeteoides		R				
Family Ostraciontidae						
Ostracion cubicus			R			R
O. meleagris	R	R	R	R		
Famiy Pempheridae						
Pempheris oualensis			R	R		
P. vanicolensis	R			R		

TABLE 2
List of fishes occurred around Lutao Island. Occurrence[+] and the relative abundance[++] of each species are indicated (continued)

Families and species	Study sites					
	1	2	3	4	5	6
Family Platacidae						
Platax pinnatus						R
Family Plesiopidae						
Assesor macneilli				R		
Plesiops nigricans	R					
Family Plotosidae						
Plotosus anguillaris						C
Family Pomacanthidae						
Centropyge heraldi	R					
C. vrolicki	R	O	O			
Cheatodontoplus septentrionalis		R				
Holacanthus trimaculatus			R			
Pomacanthus imperator	R	R				R
P. semicirculatus	O(1)	R	R			
Pygoplites diacanthus	R					R
Family Pomacentridae						
Abudefduf notatus		R			O	
A. sexfasciatus	R	R	R	R	R	O
A. sordidus		R(1)	R		R	R
A. vaigiensis	R	R	R	O	O	R
Amphiprion clarkii	R		R	R		R
A. frenatus	R		R	O		
A. ocellaris						R(1)
Chromis caerulea		R	O			R
C. flavomaculata	O		O	O		O
C. isharai	O	R	R	O		
C. lepidolepis	R	O	R	R		R
C. margaritifer	O	C	O		C	O
C. ternatensis	R					
C. vanderbilti	R	O	O		O	R
C. weberi		R	R		R	
C. xanthochir				R		
C. sp.		R				
Dascyllus reticulatus	R	C	O			
D. trimaculatus	C	O	O			
Glyphidodontops biocellatus					R	R
G. glaucus		R			R	R
G. leucopomus	R	O	C		R	C
G. rex		R		R		O
G. uniocellatus	R	C(1)	C		R	C
Paraglyphidodon melas	R		O	R	R	O
P. xanthurus						R
Plectroglyphidodon dickii	O	O	C	O	R	C
P. imparipennis	A	A(1)	A	R		R

TABLE 2
List of fishes occurred around Lutao Island. Occurrence[+] and the relative abundance[++] of each species are indicated (continued)

Families and species	Study sites					
	1	2	3	4	5	6
P. johnstonianus	R	R	R			
P. lacrymatus	R	R	O	R		
P. leucozona	A	O	R	O		
Pomacentrus bankanensis	R	R	R	R		R
P. coelestis						O
P. flavicauda						O
P. lepidogenys			O	R		
P. philippinus	R			R		R
P. vaiuli						R
Pomachromis richardsoni		O	O	O	R	
Stegastes albifasciatus		O(1)	O		R	R
S. fasciolatus		R	O			O
S. nigricans		R	O			R
S. sp. 1.	O	O	O		O	O
S. sp. 2.	O	O	R	C		
Family Pomadasyidae						
Gaterin goldmanni						R
G. orientalis			R			
Family Priacanthidae						
Priacanthus hamrur	R					
Family Pseudochromidae						
Dampieria melanotaenia	R		R	R	R	R
Pseudochromis aureus	O		R			R
P. cyanotaenia	R		R	R		
P. xanthochir	R		R			R
Family Scaridae						
Cetoscarus bicolor			R			
Leptoscarus vaigiensis		R				
Scarops rubroviolaceus		R	R			
Scarus bowersi		R				
S. frenatus			R			
S. gibbus			R			
S. scaber			R			
S. venosus		R		R		
S. sp.	R	R	R	R(1)		
Ypsiscarus ovifrons					R	
Family Scorpaenidae						
Scorpaena zanzibarensis		R	O			R
S. sp.						R
Family Serranidae						
Anthias squamipinnis	R	R			R	O(1)
Cephalopholis argus				R		
Epinephelus caeruleopunctatus						R

TABLE 2
List of fishes occurred around Lutao Island. Occurrence[+] and the relative abundance[++] of each species are indicated (continued)

Families and species	Study sites					
	1	2	3	4	5	6
E. fario						R
E. fasciatus						R
E. hexagonatus						R
E. melanostigma		R				
Variola louti				R		
Family Siganidae						
Siganus javus						O
S. spinus		O				O
Family Syngnathidae						
Corythoichthys flavofasciatus						R(2)
Doryrhamphus melanopleura		O				
Family Synodontidae						
Saurida gracilis	R					
Synodus variegatus						R
Family Tetraodontidae						
Canthigaster amboinensis			R		R	R
C. bennetti			R			R
C. coronatus						R
C. janthinopterus	R		R			
C. valentini	R				R	
Tetraodon hispidus						R
T. nigrofuscus	R	R	R	R		
Family Tripterygiidae						
Tripterygion etheostoma	R					
T. minutum		R	R			R
T. quadrimaculatus	R	R	R		R	R
T. sp.			R			
Family Zanclidae						
Zanclus cornutus	R	O	R	Q	O	R

[+]: Location of occurrence indicated as follows:
1. Nan-Liao 2. Kuei-Wan
3. Pai-Sha-Wei 4. Hsu-Wen-Chuan
5. Kung-Kuan 6. Chung-Liao

[++]: Relative abundance indicated as follows:
A (Abundant): A species that is found nearly at all locations within the biotope.
C (Common): A species that can generally be found at some but not all locations within the biotope.
O (Occasional): A species that may or may not be found within all the possible localities of a given biotope and, when present, is usually found only in specific localities.
R (Rare): A species known only from one or two specimens or observations from the entire study area.

(1): Fish pictures presented in Chang *et al.* (1980).
(2): Specimen examined in Lee (1983).

Jaccard's similarity indices show that the index values between fish fauna in every two study sites vary in a range between 0.26 to 0.46 (Fig. 2). When dissimilarity index is treated, a dendrogram was derived from clustering of these indices by UPGMA method (Fig. 3). It is found that fish faunas of Study Sites 2, and 3 are more similar than those at every two other sites. The dendrogram consequently shows that two seperate clusters of fish fauna exist—one pertaining to the assemblages in Study Site 1, 2, 3, and 4, and the other pertaining to those in Study Sites 5 and 6.

2	0.41				
3	0.39	0.46			
4	0.38	0.35	0.33		
5	0.31	0.33	0.31	0.27	
6	0.30	0.34	0.33	0.26	0.34
Site	1	2	3	4	5

Fig. 2. Jaccard's similarity index between fish faunas of every two study sites.

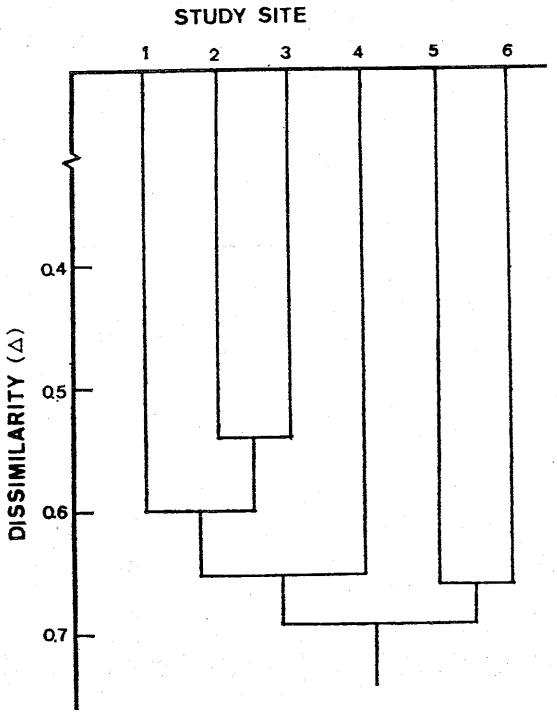

Fig. 3. Dissimilarity between fish fauna at different study sites, shown with UPGMA method.

TABLE 3

Number of fish species attributing to the total 52 families around Lutao.

Order of family importance	Family	Study sites						
		Around island	1	2	3	4	5	6
1	Labridae	49	28	30	29	23	18	31
2	Pomacentridae	43	24	29	30	19	16	28
3	Chaetodontidae	20	9	14	16	10	9	8
4	Acanthuridae	19	8	11	16	6	6	6
5	Blenniidae	14	5	4	9	4	5	4
1-5	Total* 1 (T1)	145	74	88	100	62	54	77
6-51	Total* 2 (T2)	149	52	51	46	32	24	69
1-51	Total* 3 (T3)	294	126	139	146	94	78	146
	T1/T3	0.49	0.59	0.63	0.68	0.66	0.69	0.53

* Total number of species.

DISCUSSION

The five major fish families found on Lutao listed in sequence of decreasing number of species are Labridae, Pomacentridae, Chaetodontidae, Acanthuridae and Blenniidae. Ecological survey on fish fauna around Taiwan has been made occasionally before. In Nanwan Bay (21°57′N), 60 species of labrids were found, comprising 23.3 percent of local fish

fauna studied during a one-year period (Su *et al.*, 1980). In the leeward area of Tai-pin Island (Itu Aba Island) (114°22′E, 10°22′N), Labridae, which consisted of 37 species and occupied 21.4 percent of the total fishes recorded, was also the most dominant family there (Chang *et al.*, 1981.) Therefore family Labridae might generally get the top rank in hierarchy of dominant families in fish fauna of tropical coral reef areas around Taiwan.

It is striking that on Lutao the number of pomacentrid species was only slightly less than that of labrid (43 species *vs.* 49 species). Number of pomacentrid species on Lutao is higher than that of the same family reported in other areas around Taiwan (Jones *et al.*, 1972, 38 species in southern Taiwan; Yang and Chung, 1978, 25 species in Hsiao-Liuchiu; Lee, 1980a, 9 species in intertidal pools of Sansientai, eastern Taiwan; Lee, 1980b, 15 species in intertidal zone of Lanyu). Pomacentrids are well-known for their highly habitat-associated behaviors. If the communities are stable then the comparatively abundant pomacentrids may imply either, that the local substratum on Lutao provides more niches for the fishes, or geographical differences exists between Lutao and Taiwan. Among pomacentrids found around Lutao, the heavy occurrence of *Plectroglyphidodon imparipennis* in the intertidal flats on Nan-Liao, Kue-Wan, and Pai-Sha-Wei is uncommon; since, except for Lanyu (Lee, 1980b), this species is seldom found in other coastal regions in Taiwan. A pomacentrid, *P. leucozona*, a widespread species around Taiwan and its adjacent islands, was also found abundant at Nan-Liao, sharing the habitat with *P. imparipennis*. Besides, other species such as *Lienardella fasciata* (Labridae), *Chromis flavomaculata*, *Stegastes albifasciatus* (Pomacentridae), *Parupeneus cyclostomus* (Mullidae), *Zebrassoma veliferum* (Acanthuridae), etc., are also found commonly around Lutao but rarely in Taiwan. The distributions of the foregoing species limiting to Lanyu and Lutao seem not only due to local environmental effect but also to a widescale geographical effect. However, in the absence of detailed comparative data the elucidation on zoogeography of the above mentioned reef species remains unmature.

The ratio of number of species belonging to the five major families to the total number of species for each study site was higher than the ratio of the whole fauna around Lutao. This indicates that fishes of the five major families are more common to the study sites than those of other families are. That is, fishes of some rare families may occur subordinately associated with specific habitats so that increasing sampling sites tends to encounter them, therefore lowers the ratio presented.

In present study, Jaccard's similarity indices shed some light on comparison of similarity between fish faunas. For example, fish faunas between Study Sites 2 and 3 are found more similar than those between every two other study sites. UPGMA method further seperates the six faunas into many clusters (Fig. 3).

When faunas are clustered, it is found that in each cluster the faunas are neighboring ones. For example, faunas in Study Sites 2, 3 and 1 which located on the western coast, are allocated in a cluster, whereas those in northern coast, namely, Sites 5 and 6 are allocated in another cluster. This result suggests that the contiguous fauna around Lutao varys in gradient, and two gaps, if any, exist between Sites 1 and 6, and between Sites 4 and 5. In considering factors affecting the disposition of the local fish fauna around Lutao, both topography of sea bottom and water current seem to play important roles on this phenomenon. Texture of sea bottom is reported to contribute to habitation of some proper species (Vivien, 1973; Chang *et al.*, 1981). Owing to insufficient data on coordination between fish and its habitat, further discussion is therefore reserved.

Kuroshio current with its temperature warmer than the surrounding waters runs northward along the east coast of Taiwan. The flow of this current is neither always stable, nor is its path even approximately straight,

Lutao is always on its path (Chu, 1965; Chu, 1974). The current meets Lutao at its southernmost tip then divided into two flow and pass by way of offshore areas of this islet. In present study, Study Sites 2, 3 and 1 are located on the western coast and Study Site 4 on the east. Dissimilarity exists between faunas of both sides of the islet (Fig. 2). Still, faunas of both easternes and western sides where the current passes by are members of a main cluster. Whereas faunas on the northern coast form another main cluster. This may be due to the facts that Kuroshio current has similar influence on the eastern and western sides of this islet as it passes along and disturbance may spring to the northern waters, to establish an environment differing from those at either eastern or western waters as this current flows northward away from Lutao Island.

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綠島之沿海魚類羣聚

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本報告係作者等於 1979 年至 1982 年間在綠島南寮、龜灣、白砂尾、旭溫泉、公館及中寮等沿海六個測站中所做魚類相調查的結果。調查是以潛水記錄、水中攝影，以及標本採集等方式進行。於調查期間在此六個測站內共記錄了 51 科 254 種魚類；在此魚類相中以隆頭魚科 (Labridae) 的 49 種魚所占最多，其次依次爲雀鯛科 (Pomacentridae) 的 43 種，蝶魚科 (Chaetodontidae) 的 20 種，粗皮鯛科 (Acanthuridae) 的 19 種，鰷科(Blenniidae) 的 14 種等等。當 dissimilarity coefficient 以1-Jaccard's similarity coefficient 表示，並經以 UPGMA (Unweighted pair-group method using arithmetic averages) 法將六個測站中的魚類羣聚加以分羣的結果，顯示公館、中寮這兩個位於北岸的測站內的魚類羣聚屬於同一近似的羣，而在南寮、龜灣、白砂尾、旭溫泉等這些位於西岸或東岸的魚類羣聚則屬於另一近似的羣。