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# FISHES OF REEF LIMESTONE PLATFORM AT MAOPITOU, TAIWAN: DIVERSITY AND ABUNDANCE[1,2]

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## ABSTRACT

**Sin-Che Lee Kun-Hsiung Chang, and Wen-Lung Wu** (1977). *Fishes of reef limestone platform at Maopitou, Taiwan: Diversity and Abundance.* Bull. Inst. Zool., Academia Sinica, **16**(1): 9-21. This study provides a second evaluation of diversity and abundance of the fish assemblege of reef limestone platform at Maopitou, Southern Taiwan, six years after the first evaluation in 1969. Quantitative analyses of the fish fauna revealed a total of 194 species nearly three times higher than the 1969's evaluation. The similarity index (*s*) between these two studies was 0.38. The value of the diversity index (*H*) ranged from 2.06-6.31. The value of the evenness index (*e*) ranged from 1.49-3.70. Both diversity and evenness showed the greater value than those of the 1969's evaluation. The individual numbers of the dominant families (90.87% of total individuals) were similar to those of the 1969's (94.36% of total individuals). However, the increased number of the species evaluated are mostly due to the transient visitors.

A preliminary survey on the fish community of the rockyshore was conducted at the intertidal zone of Maopitou, the southern Taiwan by the first two authors in 1969 (Chang, *et al.*)[1]. They reported a total of 62 species (1099 fish). Later, Chang, Lee, *et al.*[2] discussed the community structure of the intertidal fishes based on the latter survey and concluded that the valuse of both diversity index (*H*) and evenness index (*e*) were high and rather constant with slight fluctuation throughout the year of 1969. Whether this intertidal fish community could maintain a long-term high stability in this tropical reef-limestone platform is not yet to be determined. The main purpose of this study is to re-evaluat the species diversity and evenness of their distribution and to compare them with the data of the 1969's survey.

## STUDY SITE

The site selected for this study is a reef-limestone platform with fossil surge channels (Figs. 1-2). The area is roughly 800 m$^2$ (40 m long by 20 m wide) and consists of two major pools A and B (Fig. 3). Surface of the platform is coverd with both green and blue-green algae. Patches of the soft corals grow at the low tide level. Bottoms of the two census pools are

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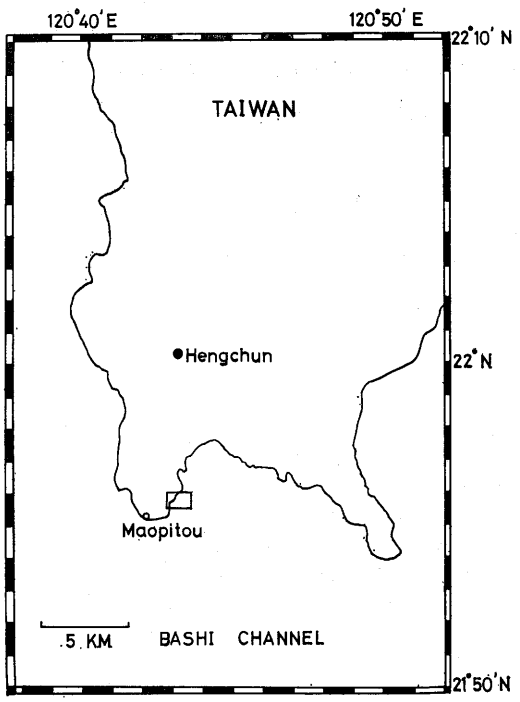


Fig. 1. Map of the southern Taiwan, showing the study site in rectangular mark.

rocky flat with patches of coarse sand and scattering blocks and boulders. Extending from the Maopitou study area toward the adjacent Hopihu Fishing Harbor, 5-20% of the substratum are covered by fringing coral reefs and 10-50% by soft corals (Jones, *et al.*)[5].

The patches of algal growths on the pool and the surface of the surrounding reef-limestone are *Sargassum* sp., *Ulva lactuca*, *Enteromorpha intestinalis*, *Amphiroa* sp., *Rhodymenia* sp., *Boodlea composita*, *Padina minor*, *Acanthophora* sp. and *Gracilaria* sp. *Sargassum* is abundant during spring and summer near the low tide level while *Ulva* is abundant during autumn and winter at the mid-intertidal zone. Distributions of the molluscs are related to the topographical features of the pools, i. e., *Cypraena annulus*, *C. errones*, *Menathais tuberosa*, *Drupa ricina* and *Lunella coronata* occur among the coarse sand and gravel area (Fig. 3). *Morula granulata*, *Engina mendicaria*, *Strigatella retusa* and *Conus textile* are associated with the algal growths. *Nerita albicilla* and *Echininus cumingii* prefer the bare rocks above the high tide line while *Tridacna maxima*

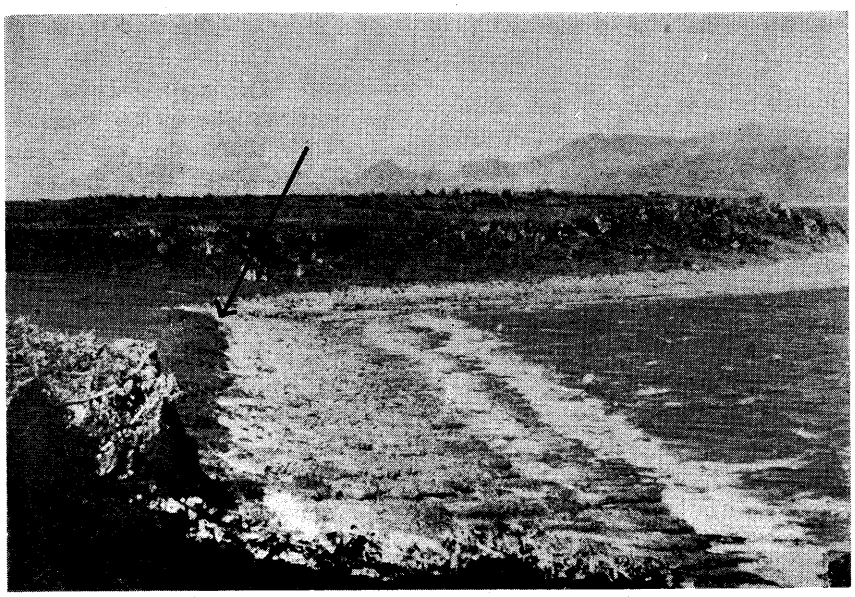

Fig. 2. Emergent limestone platform at Maopitou area, showing the study site in arrow.

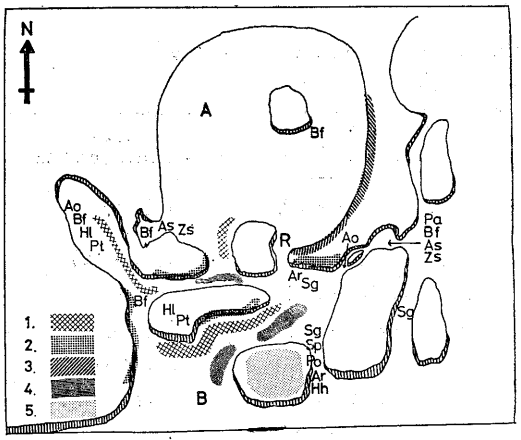


Fig. 3. Topography of census pools and distribution of fishes.
A, Census pool A; B, Census pool B; Ao, *Acentrogobius ornatus*; Bf, *Bathygobius fuscus*; Pt, *Praealticus tanegasimae*; As, *Asterropteryx semipunctatus*; Zs, *Zonogobius semidoliatus*; Ar, *Apogon robustus*; Sg, *Scorpaenodes guamensis*; Pa, *Plotosus anguillaris*; Hh, *Histrio histrio*; Po, *Pempheris vanicolensis*; 1, Coarse sand and gravel area; 2. Algal growths; 3, Bare rocks above high tide line; 4, Sandy substratum; 5, *Sargassum*.

buries in the sandy substrate of the surge channels.

## METHODS

The intertidal fish community was studied monthly during the period between January 1975 and January1976. Monthly sampling was undertaken at 1 hr. after the lowest tide level for 2 successive days in each visit. Complete removal of the fishes was attempted with repeated application of the ichthyocide NaCN. The fishes were fixed immediately in 10% formalin and later transferred to formalin of same concentration for preservation until examination. Standard length (mm) of fish was measured from tip of snout to base of caudal fin.

Similarity index $s$ (Sorenson, 1948)[8] was calculated using the formula $s=2C/(A+B)$, where $C$=number of species common to both communities, $A$ and $B$=number of species in $A$ and $B$ communities respectively. The general diversity indx $H$ (Good, 1953[4]; Pielou, 1966b[7]) was calculated using the formula $H=\ln N-1/N \sum_r n_r' (gr+d/dr \ln n_r')$, where $N$=number of individuals, $r=1, 2, 3, \ldots$ $nr'$=frequencies of species with different number of individuals (smoothed on the basis of logarithmic series), $gr=\sum_r 1/r-\gamma$, $\gamma=0.577215..$ (Euler's constant). $d=(S-1)/\log N$. The evenness index $e$ (Pielou, 1966a[6]) was calculated using the formula $e=H/\log S$, where $S$=number of species.

Surface water temperature was recorded at the point $R$ (Fig. 3) where water level is about 1 m one hour after the lowest tide level. Salinity was determined by titration of sea water taken from the above location. Identity and distribution of ecological associates including invertebrates and plants were recorded before the removal of fishes. All specimens collected, including fishes, are deposited in the museum of the Institute of Zoology, Academia Sinica.

## RESULTS

Water temperatures during the survey ranged from lows around 24°C in January 1975, to highes at 30.5°C in May 1975 (Fig.4), with a difference of only 6.5°C. Salinities ranged from an occasion of 11.77‰ in September 1975 to 34.42‰ in January 1976 (Fig. 5).

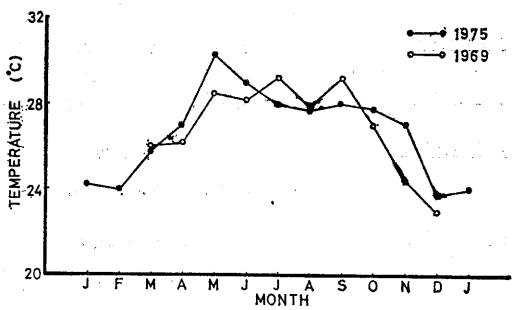


Fig. 4. Water temperatures measured at the time of field operation from January 1975 to January 1976.

TABLE 1

List of fishes collected from the intertidal zone of Maopitou in the years of 1969 and 1975.

| Family | Species | 1975 No. fish (BLmm) | 1969 No. fish (BLmm) |
|---|---|---|---|
| Moringuidae | *Moringua abbreviata* | 26 (192-890) | 1 (358) |
| Muraenidae | *Echidna nebulosa* | 252 (74-565) | 8 (91-356) |
| | *E. polyzona* | 106 (67-465) | — |
| | *E. zebra* | 14 (37-732) | 1 (650) |
| | *Gymnothorax fimbriatus* | 44 (116-645) | 2 (141-154) |
| | *G. flavimarginatus* | 34 (62-500) | 5 (185-478) |
| | *G. pictus* | 7 (119-595) | — |
| | *G. marmoratus* | 22 (87-268) | — |
| | *G. meleagris* | 11 (140-460) | — |
| | *G. undulatus* | 71 (80-870) | — |
| | *G. petelli* | 12 (156-490) | — |
| | *G. thyrsoides* | 4 (173-253) | — |
| | *Muraena pardalis* | 1 (210) | — |
| Congridae | *Conger cinereus* | 45 (79-870) | 1 (128) |
| Ophichthyidae | *Leiuranus semicinctus* | 22 (172-380) | — |
| | *Myrichthys maculosus* | 8 (100-455) | — |
| Dussumieridae | *Dussumiera acuta* | 1 (97) | — |
| | *Etrumeus micropus* | 1 (54) | — |
| Clupeidae | *Sardinella jussieu* | 4 (72-136) | — |
| Synodontidae | *Synodus variegatus* | 6 (42-122) | — |
| | *Saurida gracilis* | 1 (175) | — |
| Plotosidae | *Plotosus anguillaris* | 105 (135-180) | — |
| Belonidae | *Sp. A* | 1 (180) | — |
| Atherinidae | *Atherion elymus* | 541 (12-45) | 137 (17-40) |
| | *Atherina woodwardi* | 510 (40.5-95) | 1 (78) |
| Brotulidae | *Brotula multibarbata* | 1 (255) | — |
| | *Dinematichthys iluocoeteoides* | 24 (32.5-53) | — |
| Carapidae | *Jordanicus sagamianus* | 1 (86) | — |

TABLE 1
List of fishes collected from the intertidal zone of Maopitou in the years of 1969 and 1975. (Continued)

| Family | Species | 1975 No. fish (BLmm) | 1969 No. fish (BLmm) |
|---|---|---|---|
| Antennariidae | *Histrio histrio* | 64 (10.5-40) | 5 (12-20) |
| | *Antennarius altipinnus* | 17 (19-31) | — |
| | *Golem sp.* | 3 (73-79) | — |
| | *Sp. B* | 1 (25) | — |
| Bothidae | *Bothus mancus* | 5 (33-121) | — |
| Soleidae | *Synaptura marginata* | 1 (29) | — |
| | *Soleichthys heterohinos* | 1 (77) | — |
| | *Sp. C* | 1 (34) | — |
| Balistidae | *Balistapus aculeatus* | — | 2 (26-53) |
| Ostraciontidae | *Ostracion sebae* | 1 (134) | — |
| | *O. cubicus* | 1 (34) | — |
| | *O. meleagris* | 1 (142) | — |
| Tetraodontidae | *Canthigaster amboinensis* | 13 (21-90) | — |
| | *C. janthinopterus* | 4 (24-58) | — |
| | *C. solandri* | 1 (18) | — |
| | *C. margaritatus* | — | 1 (17) |
| | *C. valentini* | — | 2 (22-31) |
| | *C. sp.* | 1 (40) | — |
| | *Tetraodon hispidus* | 4 (26-90) | 2 (29-70) |
| | *T. meleagris* | — | 9 (11-17) |
| Diodontidae | *Diodon holacanthus* | 17 (116-225) | — |
| Holocentridae | *Holocentrus diadema* | 2 (55-94.5) | — |
| | *H. sp.* | 3 (27-29) | — |
| Fistulariidae | *Fistularia petimba* | 4 (135-218) | — |
| Syngnathidae | *Hippichthys nox* | 1 (46.5) | 1 (56) |
| | *Chaeroichthys sculptus* | 13 (44-66) | — |
| | *Syngnathus sp.* | 1 (55) | — |
| Scorpaenidae | *Scorpaenodes guamensis* | 107 (24-96) | 31 (29-93) |
| | *S. parvipinnis* | 3 (72.5-93) | — |

TABLE 1

List of fishes collected from the intertidal zone of Maopitou in the years of 1969 and 1975. (Continued)

| Family | Species | 1975 No. fish (BLmm) | 1969 No. fish (BLmm) |
|---|---|---|---|
| Scorpaenidae | *Scorpaena izensis* | 1 (45) | — |
| | *S. zanzibarensis* | 28 (32-98) | — |
| | *S. albo-brunnea* | 1 (88) | — |
| | *Scorpaenopsis gibbosa* | 2 (48-145) | — |
| | *Pterois volitans* | 1 (16) | — |
| Synanceiidae | *Synanceia verrucosa* | 19 (58-205) | 3 (71-84) |
| | *Erosa erosa* | 5 (16-26) | — |
| Mugilidae | *Liza macrolepis* | 302 (15-158) | 229 (18-114) |
| | *Liza parva* | — | 8 (17-34) |
| | *Mugil kelaartii* | — | 1 (60) |
| | *M. tade* | — | 39 (16-45) |
| | *Crenimugil crenilabis* | 52 (27-121) | 30 (28-72) |
| | *Mugil sp.* | 3 (25-36) | — |
| Sphyraenidae | *Sphyraena sp.* | 2 (42-60) | — |
| Ephippidae | *Platax orbicularis* | 7 (16-56) | — |
| | *Drepane punctata* | 1 (111) | — |
| Chaetodontidae | *Chaetodon vagabundus* | 28 (20-90) | 4 (30-45) |
| | *C. aureus* | 12 (18-92) | — |
| | *C. citrinellus* | 8 (31-87.5) | — |
| | *C. lunula* | 3 (32-89) | 1 (40) |
| | *Pomacanthus semicirculatus* | 15 (19.5-124) | 1 (62) |
| Pomacentridae | *Abudefduf sordidus* | 37 (16-98) | 16 (16-59) |
| | *A. sexfasciatus* | 12 (22-62) | 6 (18-57) |
| | *A. septemfasciatus* | 60 (20-90) | 26 (18-84) |
| | *A. vaigiensis* | 378 (12.5-79) | 70 (15-53) |
| | *A. leucozona* | 48 (18-91) | — |
| | *A. glaucus* | 58 (22-78) | — |
| | *A. uniocellata* | 28 (36-68) | — |
| | *A. biocellatus* | 7 (18-40) | 34 (15-65) |
| | *A. amabilis* | 8 (25.5-57) | — |
| | *A. leucopomus* | 56 (12.5-41) | — |
| | *A. notatus* | 7 (24-28.5) | — |

TABLE 1

List of fishes collected from the intertidal zone of Maopitou in the years of 1969 and 1975. (Continued)

| Family | Species | 1975 No. fish (BLmm) | 1969 No. fish (BLmm) |
|---|---|---|---|
| Pomacentridae | *Pomacentrus pavo* | 1 (82) | — |
| | *P. sp.* | 1 (75) | — |
| Pempheridae | *Pempheris vanicolensis* | 520 (15-99) | 104 (16-50) |
| Mullidae | *Parupeneus fraterculus* | 6 (30-49.5) | — |
| | *P. barberinus* | 2 (41-46) | — |
| | *P. indicus* | 2 (37-40) | — |
| | *Upeneus sulphureus* | — | 2 (42-45) |
| Apogonidae | *Apogon doederleini* | 2 (16-25) | 27 (15-80) |
| | *A. robustus* | 435 (15-91) | — |
| | *A. bandanensis* | 33 (19-71) | — |
| | *A. erythrinus* | 5 (19-69) | — |
| | *A. sp.* | 1 (25) | — |
| | *Apogonichthys ellioti* | 3 (17-43) | — |
| | *A. ocellatus* | 5 (19-39) | — |
| | *Cheilodipterus macrodon* | 1 (63) | — |
| Kuhlidae | *Kuhlia taeniura* | 10 (17-27) | — |
| Lobotidae | *Lobotea surinamensis* | 1 (35) | — |
| Serranidae | *Epinephelus caeruleopunctatus* | 4 (20-167) | 1 (80) |
| | *E. summara* | 1 (93.5) | — |
| | *E. merra* | 2 (93.5-115) | 1 (81) |
| | *E. megachir* | 7 (29-143) | — |
| | *Grammistes sexlineatus* | 46 (19-100) | 2 (29-71) |
| Plesiopidae | *Plesiops melas* | 10 (31-64) | 6 (34-67) |
| | *P. nigricans* | 4 (20.5-122) | — |
| Acanthoclinidae | *Belonepterygion fasciolatum* | 1 (25) | — |
| Pseudochromidae | *Dampieria ocillifera* | 17 (24-73) | — |
| | *D. spiloptera* | — | 6 (34-54) |
| | *Pseudochromis luteus* | 5 (42-46) | — |
| | *P. tapeinosoma* | 6 (26.5-46) | — |
| Cirrhitidae | *Cirrhitus pinnulatus* | 1 (35) | — |

TABLE 1

List of fishes collected from the intertidal zone of Maopitou in the years of 1969 and 1975. (Continued)

| Family | Species | 1975 No. fish (BLmm) | 1969 No. fish (BLmm) |
|---|---|---|---|
| Kyphosidae | *Girella mezina* | 6 (39.5-132) | — |
| Ambassidae | *Ambassis gymnocephalus* | — | 1 (44) |
| Gerridae | *Gerres oblongus* | — | 1 (40) |
| Lutjanidae | *Lutjanus vaigensis* | 2 (83-124) | — |
| | *L. russelli* | — | 2 (115-118) |
| | *L. monostigma* | 4 (21-93.5) | — |
| | *L. janthrinuropterus* | 3 (23-41) | — |
| | *L. fulviflamma* | 9 (88-132) | — |
| Pomadasyidae | *Scolopsis cancellatus* | 16 (26-83) | 4 (19-64) |
| | *Plectorhynchus pictus* | 2 (35-48) | — |
| Teraponidae | *Terapon jarbua* | 2 (22.5-100) | — |
| Parapercidae | *Parapercis cephalopunctatus* | 6 (37-91.5) | — |
| | *Sp. D* | 1 (43) | — |
| Trichinotidae | *Limnichthys fasciatus* | 1 (33) | — |
| Callionymidae | *Synchiropus ocellatus* | 9 (38-57) | — |
| Blenniidae | *Tripterygion etheostoma* | 13 (12-46) | — |
| | *T. inclinatum* | 2 (20-34) | — |
| | *T. fuscipectoris* | 7 (21.5-31) | — |
| | *Halmablennius dussumieris* | 5 (68-76) | — |
| | *H. lineatus* | 180 (19-119) | 18 (36-94) |
| | *Istiblennius edentulatus* | 54 (24-163) | 17 (50-108) |
| | *I. andamensis* | 3 (42-54) | 2 (57-83) |
| | *I. periophthalmus* | 1 (52) | — |
| | *Entomacrodus striatus* | 4 (40-60.5) | — |
| | *F. decussatus* | 2 (59-71) | — |
| | *Salarias fasciatus* | 2 (117-119) | — |
| | *Cirripectis reticulatus* | 1 (82) | — |
| | *Meiacanthus grammistes* | 7 (40-67) | — |
| | *Praealticus tanegasimae* | 227 (43-71) | — |
| | *Sp. E* | 4 (21-63) | — |

TABLE 1

List of fishes collected from the intertidal zone of Maopitou in the years of 1969 and 1975. (Continued)

| Family | Species | 1975 No. fish (BLmm) | 1969 No. fish (BLmm) |
|---|---|---|---|
| Clinidae | *Springeratus xanthosoma* | 50 (23-56.5) | — |
| Electoridae | *Asterropteryx semipunctatus* | 379 (14.5-40) | 48 (18-40) |
| | *Eleotris fusca* | 28 (20-57) | 4 (21-27) |
| | *Eleotroides sexguttatus* | 7 (28-72) | — |
| | *E. strigatus* | 1 (24.5) | — |
| | *Eviota abax* | 15 (14-23.5) | 1 (19) |
| | *Parioglossus dotui* | — | 3 (22-29) |
| | *Austrolethops wardi* | 5 (21-41) | — |
| Gobiidae | *Bathygobius fuscus* | 1,422 (14-87) | 77 (19-62) |
| | *B. scapulopunctatus* | 16 (34-42) | — |
| | *Acentrogobius ornatus* | 115 (18-93) | 7 (21-56) |
| | *Zonogobius semidoliatus* | 103 (16-37) | 4 (23-32) |
| | *Z. eugenius* | 20 (25-45) | — |
| | *Rhinogobius neophytus* | 36 (19-59) | — |
| | *Callogobius liolepis* | 68 (21-53) | — |
| | *C. sclateri* | 5 (42-43) | — |
| | *Pipidonia arenarius* | 5 (20.5-29) | — |
| | *Gnatholepis knighti* | 44 (22-45) | — |
| | *Amblygobius albimaculatus* | 3 (23.5-35.5) | — |
| | *Sp. F* | 1 (31) | — |
| Labridae | *Stethojulis phekadopleura* | 255 (21-123) | 36 (18-95) |
| | *S. axillaris* | 237 (18-89) | 18 (31-72) |
| | *S. trilineatus* | 1 (115) | — |
| | *S. strigiventer* | 23 (22-84) | 10 (21-43) |
| | *Halichoeres trimaculatus* | 154 (26-97) | 2 (68-95) |
| | *H. margaritaceus* | 196 (20-100) | 4 (30-36) |
| | *H. leparensis* | 7 (31-50) | — |
| | *H. marginatus* | 53 (18-123) | 1 (63) |
| | *H. poecilopterus* | 3 (28-32) | — |
| | *H. hortulanus* | 4 (26.5-67) | — |
| | *H. argus* | 2 (28-50) | — |
| | *H. scapularis* | 3 (63-84) | — |
| | *Thalassoma umbrostigma* | 8 (30-79) | — |

TABLE 1

List of fishes collected from the intertidal zone of Maopitou in the years of 1969 and 1975. (Continued)

| Family | Species | 1975 No. fish (BLmm) | 1969 No. fish (BLmm) |
|---|---|---|---|
| Labridae | *T. cupido* | 12 (67-110) | — |
| | *T. purpureum* | 1 (51) | — |
| | *T. quinquevittatus* | 2 (74-98) | — |
| | *T. hardwickei* | 7 (47.5-81) | 1 (94) |
| | *T. sp.* | 2 (45-58) | — |
| | *Hemigymus fasciatus* | — | 1 (33) |
| | *Cheilinus trilobatus* | 31 (22-92) | — |
| | *Cheilio inermis* | 19 (36.5-185) | — |
| | *Coris gaimardi* | 1 (43) | — |
| | *Xyrichthys taeniourus* | 6 (25.5-107) | — |
| | *Anampses caeruleopunctatus* | 1 (86) | — |
| Scariidae | *Scarus lepidus* | 85 (17-56) | — |
| | *S. sexvittatus* | 8 (47-98) | — |
| | *Callyodon mutabilis* | 10 (22.5-105) | — |
| | *Calotomus spinideus* | 5 (86-95) | — |
| | *Leptoscarus vaigiensis* | 1 (37) | 5 (57-122) |
| Zanclidae | *Zanclus cornutus* | 14 (56-69) | — |
| Acanthuridae | *Acanthurus triostegus* | 71 (20.5-119) | 6 (21-33) |
| | *A. dussumieri* | 1 (115) | — |
| | *A. lineatus* | 3 (43-73) | — |
| | *A. reticulatus* | 2 (40.5-43) | — |
| | *A. xanthopterus* | 4 (26-47) | — |
| | *A. sp.* | 1 (62) | — |
| | *Ctenochaetus striatus* | 8 (30-38) | — |

A total of 8,595 fish collected were identified to 194 species belonging to 53 famillies. For comparison, the species, the numbers collected and their ranges of body length (SL) from both the 1975 and 1969 surveys are compiled in Table 1. The following families: Moringuidae, Muraenidae, Congridae, Ophichthyidae, Atherinidae, Scorpaenidae, Mugilidae, Chaetodontidae, Pomacentridae, Pempheridae, Apogonidae, Blenniidae, Eleotridae, Gobiidae, and Labridae contribute 116 of 194 species (59.79%) and 7,810 of 8,595 (90.87%) individuals.

According to Thompson & Lehner (1976)[9], intertidal fishes can be categorized into 3 groups, namely primary residents, secondary residents and transients. The primary residents (or true residents) of this site are the members of the families Blenniidae, Clinidae, Eleotridae, Gobiidae. The primary residents comprise 17.53% of the total species and 32.97% of the total

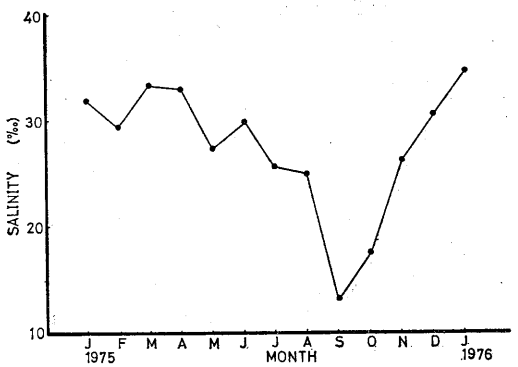


Fig .5. Salinities measured at the time of field operation from January 1975 to January 1976.

individuals. The fishes belonging to this group are mostly small, cryptic-coloured and territoral. The secondary residents (or partial residents) include the following families Moringuidae, Muraenidae, Congridae, Ophichthyidae, Synodontidae, Plotosidae, Brotulidae, Carapidae, Antennaridae, Bothidae, Soleidae, Balistidae, Ostraciontidae, Tetraodontidae, Diodontidae, Holocentridae, Fistulariidae, Sygnathidae, Scorpaenidae, Synanceiidae, Ephippidae, Chaetodontidae, Pomacentridae, Pempheridae, Mullidae, Apogonidae, Lobotidae, Serranidae, Plesiopidae, Acanthoclinidae, Pesudochromidae, Cirrhitidae, Kyphosidae, Lutjanidae, Pomadasyidae, Parapercidae, Trichinotidae, Labridae, Scariidae, Zanclidae and Acanthuridae. These families make up 76.29% of the total species and 50.49% of the total individuals. The secondary residents are basically the sublittoral fishes which breed in deeper water but their juveniles visit the pools regularly. The transients (or tidal visitors) are basically the sandy shore or pelagic fishes which occasionally visit the intertidal zones. This group include the families Dussumieridae, Clupeidae, Belonidae, Atherinidae, Mugilidae, Sphyraenidae, Kuhlidae and Teraponidae. These families compries 6.18% of the total species and 16.58% of the total individuals.

Distribution pattern of the primary residents is shown in Fig. 3. The blennies *Halmablennius lineatus* and *Praealticus tanegasimae* occupy rock cleft or holes in the alga growing shallow pool as their territory. The gobies *Asterropteryx semipunctatus*, *Zonogobius semidoliatus*, *Bathygobius fuscus* and *Acentrogobius ornatus* were found in small channel or rocky cleft during low tide. The latter two species may spread over to the algal patches while the tide rises. The secondary residents such as *Histrio histrio*, *Scorpaenodes guamensis*, *Apogon robustus*, *Pempheris vanicolensis* and *Stethojulis phekadopleura* were collected from the deeper channel with overgrown *Sargassum* during the spring-summer time. They may enter the pools on the occasion of rising tide. Morays are denizens of crevices in the sublittoral reefs, however, some of them, especially the juveniles, move toward the intertidal zone. *Plotosus anguillaris* is also a sublittoral species.

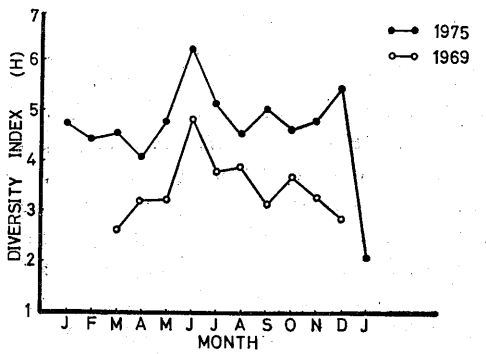


Fig. 6. General species diversity indices (H) for fish communities of 1969 (o--) and 1975 (•--).

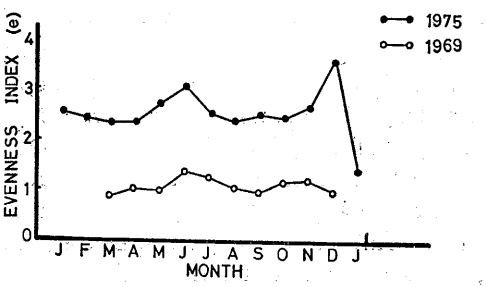


Fig. 7. Eveness indices (e) for fish communities of 1969 (o--) and 1975 (•--).

However, a school of 105 individuals ranging 135–180 mm SL, were collected while they were entering a small pool of the study site.

Species diversity index ($H$) ranged from 2.06 in January 1976 to 6.31 in June 1975. it changes very little except a sharp decline in January 1976 (Fig. 6). Fluctuation in the evenness index ($e$) ranged from 1.49 to 3.7 (Fig. 7).

## DISCUSSION

The area studies in 1969 was restricted to pool *A* while the present one was extended somewhat to low tide margin including pools *A* and *B* (Fig. 3). The comparison of the studies revealed that the $H$ value increasing number of species and increasing equilability or evenness of their distribution. The low similarity index (0.38) between the two studies may be due to the slight changes in the sampling methods (doubled ichthyocide dossage and working days) and the expansion of surveying area. The diversity value ($H$=2.06–6.31, mean 4.68) and evenness value ($e$=1.49–3.7, mean 3.4) in 1975 were much higher than those ($H$=2.61–4.9, mean 3.43; $e$=0.94–1.43, mean 1.16) in 1969, however, the relative abundance of the individuals of the dominant families (made up 90.87% of the total individuals) is not significantly different from that of 1969 (94.36%). Although the expansion of the study area and the increases of the collecting effort may increase the species diversity, the occurrences of the intertidal dominant species remain unchanged. The increase of fish species are due to mostly the transient visitors.

The fish species inhabiting at the Maopitou reef limestone platform are entirely of tropical and subtropical affinities. They have adapted to an optimal temperature range of 24–30.5°C. Neither incidence of winter kill as the case for the intertidal fish community in the Northern Gulf of California (Thompson & Lehner, 1976) [9], nor summer kill at this site were noticed. The intertidal fishes have elvolved to adapt to a wide range of thermal changes, e. g. the blenny *Istiblennius* may remain alive in shallow pool at a temperature of 41.2°C in Hawaii (Gibson, 1969) [3]. During the exposure of the tide pool at low tide period, the secondary residents usually retreat to deeper sublittoral zone. The primary residents may either retreat to the waters near low tide margin or remain in sheltered area within the pools.

It seems that salinities has no effect on the seasonal pattern of the species diversity. However, the strong wind and wave disturbance obviously influenced the species diversity as the case happened in January 1976 (Fig. 6). In stable environment such as the Maopitou reef limestone platform, the succession of fish community may be regulated by biological factors rather than by the physical and chemical factors. For example, seasonal occurrence of the sargasso fish *Histrio histrio* (Fig. 8) is probably connected with the growing season of Sargassum (Chiang, personal communication).

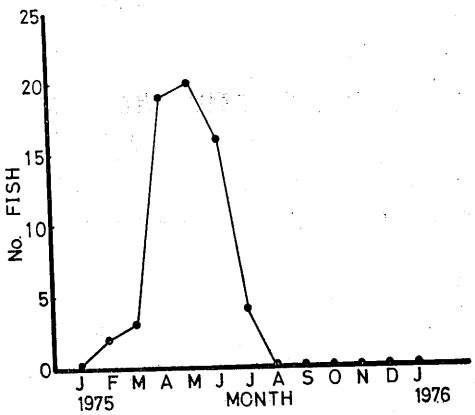


Fig. 8 Seasonal abundance of *Histrio histrio.*

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# 臺灣南端猫鼻頭石灰質珊瑚礁臺之魚類：種歧性及豐度

張崑雄　李信徹　巫文隆

本報告（1975年1月～1976年1月）爲繼1969年以來第二次估算棲息於恒春半島猫鼻頭石灰質珊瑚礁臺潮池魚類之種歧性及豐度。定量分析結果共得194種魚類，約爲1969年所獲魚種數之三倍。此可由於二年間所得甚低之種相似性係數（0.38）佐證之。種歧性係數（*H*）爲2.06～6.31，均勻係數（*e*）爲1.49～3.70，雖二者之數值均遠超1969年者，然優勢種個體數總和所佔之比例（90.87%）却與1969年者（94.36%）相近。至於新近所增加之魚種則多屬短暫棲息者（Transients）。