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INTERTIDAL FISHES OF THE ROCKY POOLS AT LANYU (BOTEL TOBAGO), TAIWAN

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Sin-Che Lee (1980) Intertidal fishes of the rocky pools at Lanyu, Taiwan. *Bull. Inst. Zool., Academia Sinica* **19**(2): 1-13. Lanyu Island (22°N, 121°36′E) is located some 91 km off the southeastern coast of Taiwan. The island coast is mostly raised coral reef with well developed coral commmunity. Collections of intertidal fishes were made in August, October 1978 and April and June 1979. A total of 4162 specimens collected were assigned to 177 species in 46 families. Thirteen species, namely *Enchelynassa canina, Anarchias allardicei, Histiophryne bougainvilli, Anomalopsis kataptron, Epinephelus melanostigma, Pogonoperca puncata* (young), *Gymnapogon annona, Calotomus sandwicensis, Praealticus margaritarius, Stanulus seychellensis, Bathygobius petrophilus, Acanthurus leucopareius* and *Siganus argenteus* are new records from Taiwan.

Labridae is the largest family which consists 12.99% (23) of the total 177 species, while in analysis of the composition of individuals of the collection, those belonging to the Family Pomacentridae are most abundant and up to 31.31% (1303) of the total individuals. Among the 177 species, *Acanthurus triostegus* is the most abundant species. The intertidal community at Lanyu is predominately resident species including both primary and secondary residents. Of which the secondary residents constitutes 74.01% (131) of total species and 75.06% (3124) of total individuals. The primary residents constitutes 22.60% (40) of total species and 19.87% (827) of total individual. The remaining 3.39% (6) of total species and 5.07% (211) of total individuals are the transients.

A higher similarity index (0.55) shown between the intertidal fishes of Lanyu and the near by Chengkong (Sanhsientai), southeastern Taiwan than that between Lanyu and Wanli, north Taiwan (0.35), was probably due to the higher proportion of subtropical affinities in the northern Taiwan. The rocky pool fish community at Lanyu exhibited very low dominance (*c*), a general characteristic of a tropical fish community. Indices of Shannon's general diversity, variety and evenness are also calculated.

Lanyu is an offshore tropical island, located at lattitude 22°N and longitude 121°36′E, some 91 km southeast of Taitung, Taiwan (Fig. 1). The island is approximately 13 Km in length and 7.3 km across the widest point with a total surface area of 45.7 Km². It is surrounded by reef limestones and dissected with sand beach confining to the bays. Despite the narrow lowland along the shoreline, the island is generally mountaneous rising to an elevation of maximal 548 m in height.

The air temperatures of the island measured in January 1978 was 18.1°C and 26.7°C in July, 1978. No systematic water temperatures have been measured at Lanyu, however, the mean monthly surface temperatures recorded from the neighbouring Lutao Island varying 20.6°C

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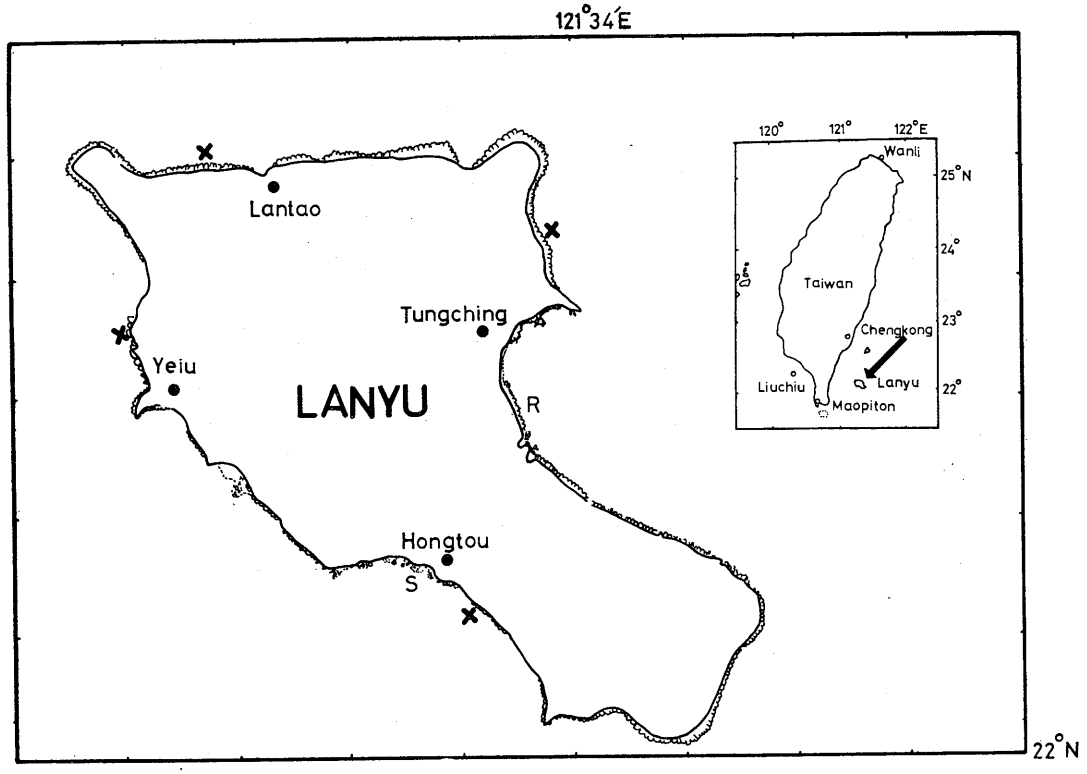

Fig. 1. Map of Lanyu showing the locations of the stations Yeiu, Lantao, Hongtou and Tungching.

(February, 1978) and 29.9°C (September, 1978). The water temperatures measured (at 1 m depth) at the time of each visit were 29.5°C, 25.5°C, 28.5°C and 29.5°C in August, October 1978 and April and June 1979, respectively. Total rainfall recorded for the year of 1978 were 3542.5 mm. It has stronger wave surges due to the influence of the northeast moonson during the winter and the southeast moonson during the summer.

The shore fish resources of the island have been little exploited in the past due to the isolation from Taiwan and the lack of fishery facilities. Consequently, the information on shore fish of the island was scarce. Kano[7] photographed some 100 food fishes in his ethnological studies of the Yamei aborgines. Later, Chen[4] reported 8 gobioids and Chang[2] subsequently listed 69 species from the island. None has ever been recorded in the literatures since 1960. Thus, an extensive study of the Lanyu fishes is urgently needed for the surrounding waters of the island is generally known as the best fishing ground.

In order to carry on this work, the author made four visits to the island in August, October 1978 and April and June 1979. As a result, a total of 4162 specimens (46 families and 177 species) were collected. They were deposited in the Museum of the Institute of Zoology, Academia Sinica.

MATERIALS AND METHODS

Fishes were sampled in August, October 1978 and April and June 1979. Sampling was undertaken at 1 hour after the lowest tide level at the stations Yeiu, Lantao, Hongtou and Tungching (Figs. 1-5). Fishes were collected from the pool immediately after the application

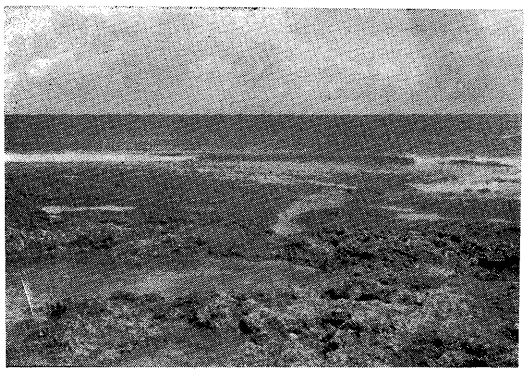

Fig. 2. Tide pool at Yeiu Station.

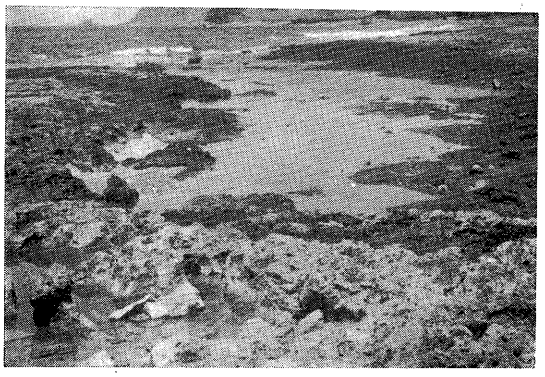

Fig. 3. Tide pool at Lantao Station.

Fig. 4. Tide pool at Hongtou Station.

Fig. 5. Tide pool at Tungching Station.

of 3 pounds ichthyocides NaCN on each sampling. Specimens were fixed and preserved in 10% formalin and they were deposited in the Institute of Zoology, Academia Sinica.

Dominance (*c*), variety (*d*), evenness (*e*) and Shannou's general diversity indices ($\bar{H}$) were calculated from the formulae appeared in the previous paper.[9] Similarity index was calculated from $S=2C/(A+B)$, where A=number of species in A community; B=number of species in B community; C=number of species common to both communities.

RESULTS

Of 4162 specimens collected during August, 1978 and June, 1979 from 4 stations at Lanyu were assigned to 177 species in 46 families. Among them, 13 species, namely *Enchelynassa canina, Anarchias allardicei, Histiophryne bougainvilli, Anomalopsis kataptron, Epinephelus melanostigma, Pogonoperca punctata* (young), *Gymnapogon annona, Calotomus sandwiciensis, Praealticus margaritarius, Stanulus seychellensis, Bathygobius petrophilus, Acanthurus leucopareius* and *Siganus argenteus* are new records from the Taiwan area and they will be described later in a separate paper. For comparison, the species, the numbers collected and their ranges of body length (SL) from each station are compiled in Table 1.

Species composition

Among 46 families, 5 families had 10 species or more, 4 families had 6-9 species, 14 families had 2-5 species and the remaining 23 families had 1 species.

Regarding the number of species in the family, Labridae was the highest with 23 species (12.99%) and followed in the order of Blenniidae with 22 species (12.43%), Pomacentridae with 15 species (8.47%), Muraenidae with 14 species (7.91%) and Acanthuridae with 10

TABLE 1

List of species and its number of individuals collected and ranges of body length in mm (in parentheses) for each species

Families and species	Stations			
	Yeiu	Lantao	Hongtou	Tungching
Moringuidae				
1. *Moringua abbreviata*		1(316)		
Muraenidae				
*2. *Anarchias allardicei*	1(122)			
3. *Echidna nebulosa*	18(85-270)	5(163-374)	8(195-378)	2(115-163)
4. *E. polyzona*	1(320)			
5. *E. zebra*		1(570)	1(698)	
*6. *Enchelynassa canina*		1(550)		
7. *Lycodontis buroensis*	1(246)	3(187-235)		
8. *L. flavimarginatus*	4(135-275)	2(149-168)	1(192)	
9. *L. marmorata*	2(211-265)			
10. *L. meleagris*		1(70)	3(125-358)	
11. *L. peteli*	2(135-370)	3(102-283)	1(270)	2(114-185)
12. *L. pictus*	1(102)			
13. *L. thyrsoideus*	4(132-240)	10(181-292)		8(104-255)
14. *L. undulatus*	7(123-265)	8(87-1327)	2(94-565)	6(215-760)
15. *Uropterygion micropterus*				4(217-282)
Congridae				
16. *Conger cinereus*	2(224-275)	3(105-320)	1(189)	1(250)
Ophichthidae				
17. *Myrichthys maculosus*		2(220-302)		
Synodontidae				
18. *Saurida gracilis*		1(52)		
Ophiidae				
19. *Brotula multibarbata*				1(146)
20. *Dinematichthys ilucoeteoides*	8(38-57)	9(40-61)	5(25-50)	13(30-71)
Antennarridae				
21. *Antennarius altipinnis*		1(19)		
*22. *Histiophyrne bougainvilli*		2(84-95)		
Excoetidae				
23. *Hemirhamphus dussumieri*		1(135)		
Belonidae				
24. *Eurycaulus persimilis*			1(322)	
Atherinidae				
25. *Atherion elymus*	19(17-40)	16(20-45)	92(14-39)	47(21-48)
26. *Pranesus insularum*			19(47-69)	4(75-98)
Anomalopidae				
*27. *Anomalopsis kataptron*				1(91)
Holocentridae				
28. *Adioryx diadema*		1(92)		
29. *A. lacteoguttatus*	14(42-87)	11(42-86)	3(41-50)	5(53-92)
30. *A. ruber*			1(166)	

TABLE 1 (Continued)

Families and species	Stations			
	Yeiu	Lantao	Hongtou	Tungching
Scorpaenidae				
31. *Scorpaena albobrunnea*	3(60-68)	17(41-72)	3(13-74)	6(66-81)
32. *S. zanzibarensis*	2(36-65)	2(33-47)		2(25-63)
33. *Scorpaenodes guamensis*	11(27-140)	9(38-82)	12(46-92)	7(36-80)
34. *Scorpaenopsis cirrhosa*	3(96-171)			
35. *S. diabolus*	2(22-71)	1(81)		1(55)
Synanceidae				
36. *Synanceia verrucosa*			1(132)	
Serranidae				
37. *Cephalopholis argus*				1(107)
38. *Epinephelus caeruleopunctatus*			2(152-190)	
39. *E. hexagonatus*		5(23-117)		3(32-85)
*40. *E. melanostigma*			5(57-125)	2(22-85)
41. *E. merra*	1(30)		3(25-29)	
42. *E. tauvina*		5(107-145)	3(152-220)	2(70-177)
Grammistidae				
43. *Grammistes sexlineatus*	11(21-76)	26(22-87)	4(27-82)	7(22-81)
*44. *Pogonoperca punctata* (young)			1(13)	
Pseudochromidae				
45. *Labracinus lineatus*	3(40-102)	8(45-108)	37(26-141)	8(36-104)
46. *Pseudochromis aureus*	1(41)		1(44)	
47. *P. cyanotaenia*	2(32-39)	1(36)	2(34)	9(29-41)
48. *P. tapeinosoma*	3(27-36)	30(12-43)	16(20-37)	7(22-30)
Pseudogrammidae				
49. *Aporops bilinearis*	1(47)		1(75)	1(46)
Plesiopidae				
50. *Plesiops coerulineatus*		1(38)		
51. *P. nigricans*	2(90-123)			
Acanthoclinidae				
52. *Belonepterygion fasciolatum*				1(18)
Kuhlidae				
53. *Kuhlia tainiura*		15(35-85)		16(24-69)
Apogonidae				
54. *Apogon angustatus*			2(65-79)	
55. *A. coccineus*	8(21-39)	5(21-36)	4(33-36)	1(35)
56. *A. robustus*	7(25-51)	30(19-76)	18(21-84)	17(26-85)
*57. *Gymnapogon annona*			1(29)	
Carangidae				
58. *Caranx lessoni*			1(103)	
Lutjanidae				
59. *Lutjanus janthinuropterus*			7(65-121)	
60. *L. monostigma*	3(92-140)	3(73-110)	4(60-160)	
Nemipteridae				
61. *Scolopsis cancellatus*	1(77)			

TABLE 1 (Continued)

Families and species	Stations			
	Yeiu	Lantao	Hongtou	Tungching
Mullidae				
62. *Parupeneus fraterculus*		1(45)	1(80)	
Pempheridae				
63. *Pempheris oualensis*				2(117-128)
Chaetodontidae				
64. *Chaetodon argentatus*		5(33-66)	1(46)	
65. *C. aureus*		2(127-131)		1(131)
66. *C. auriga*	1(29)	3(21-29)	3(23-36)	
67. *C. citrinellus*	3(50-90)	10(25-92)	7(27-94)	
68. *C. ephippium*		1(149)		
69. *C. lunula*		3(22-52)	3(51-99)	
70. *C. vagabundus*	4(19-46)	1(48)	13(18-37)	
71. *Pomacanthus semicirculatus*	5(39-74)	19(21-115)	4(37-50)	5(14-53)
Pomacentridae				
72. *Abudefduf notatus*		2(32-58)	1(101)	3(36-80)
73. *A. septemfasciatus*	12(37-71)	31(28-77)	18(38-97)	3(47-82)
74. *A. sordidus*		10(32-59)	3(55-150)	17(35-85)
75. *A. varigiensis*	29(21-59)	40(18-54)	37(17-61)	20(20-55)
76. *Chromis margaritifer*	2(51-52)			
77. *Eupomacentrus fasciolatus*	56(12-74)	31(29-85)	20(27-80)	37(23-87)
78. *E. nigricans*			2(46-52)	
79. *Glyphidodontops glaucus*	93(20-83)	40(31-72)	195(20-82)	10(40-59)
80. *G. leucopomus*	31(22-55)	52(15-56)	48(11-53)	33(23-57)
81. *G. rex*			1(44)	
82. *G. uniocellatus*	6(35-49)		58(36-62)	
83. *Plectroglyphidodon dickii*	4(47-62)			
84. *P. imparipennis*	44(31-45)	19(28-40)	28(26-45)	44(24-44)
85. *P. leucozona*	21(26-79)	101(19-75)	31(28-70)	63(13-93)
86. Pomacentridae sp.	5(20-28)	2(29-77)		
Cirrhitidae				
87. *Cirrhitus pinnulatus*	1(170)	4(49-130)		
Mugilidae				
88. *Crenimugil crenilabis*	5(72-91)	4(81-124)	1(70)	1(64)
Labridae				
89. *Anampses caeruleopunctatus*				1(73)
90. *Cheilinus rhodochrous*	1(57)			
91. *C. trilobatus*	1(98)	1(26)		
92. *Coris aygula*		4(48-155)	2(63-86)	
93. *C. gaimardi*		2(26-86)	1(55)	1(55)
94. *Halichoeres argus*	1(63)			
95. *H. centiquadrus*		4(22-94)	1(52)	
96. *H. margaritaceus*	32(33-81)	60(25-89)	18(33-81)	6(51-80)
97. *H. marginatus*		39(18-102)	3(35-46)	8(17-58)
98. *H. scapularis*		2(64-171)		
99. *H. trimaculatus*	4(57-86)	2(51-97)	7(40-100)	
100. *Labroides dimidiatus*	2(37-63)	1(44)	1(44)	

TABLE 1 (Continued)

Families and species	Stations			
	Yeiu	Lantao	Hongtou	Tungching
101. *Stethojulis bandanensis*	5(28-76)	25(18-76)	13(15-64)	2(29-45)
102. *S. interrupta*		3(38-47)	1(33)	
103. *S. trilineata*	6(37-87)	22(33--106)	32(26-102)	9(45-91)
104. *Thalassoma amblycephalus*	2(22-31)	3(32-49)	1(53)	
105. *Th. fuscum*				1(126)
106. *Th. hardwickei*	5(39-108)	2(29-48)	10(40-72)	2(32-49)
107. *Th. janseni*	5(56-75)	5(48-87)	1(52)	
108. *Th. lutscenes*		1(60)		1(60)
109. *Th. purpureum*	2(44-96)	27(24-108)	2(28-78)	24(25-96)
110. *Th. quiquevitta*	14(48-110)	5(47-64)	4(56-69)	5(45-68)
111. *Th.* sp.	1(56)			
Scariidae				
112. *Scarus lepidus*		1(42)		
*113. *Calotomus sandwicensis*		1(114)		
114. Scaridae sp. A.	1(87)			
115. Scaridae sp. B.	1(83)	2(68-165)	1(59)	
Mugiloididae				
116. *Parapercis cephalopunctata*	6(45-120)	2(73)	1(61)	
Blenniidae				
117. *Cirripectes fuscoguttatus*				4(70-91)
118. *C. sebae*	33(29-85)	50(19-75)	8(37-58)	65(25-88)
119. *C. variolosus*		1(62)		
120. *Ecsenius oculus*		2(18-26)	1(30)	
121. *Entomacrodus caudofasciatus*	2(47)	1(45)		8(34-45)
122. *E. decussatus*	20(40-140)	5(86-117)	2(79-131)	50(49-132)
123. *E. striatus*	12(45-77)	4(25-48)	2(64-74)	47(29-74)
124. *Exallias brevis*				3(65-86)
125. *Istiblennius bilitonensis*		2(69-71)	2(51-69)	
126. *I. cyanostigma*	6(40-71)		1(50)	1(64)
127. *I. edentulus*	33(34-109)	48(48-117)	35(50-119)	23(39-96)
128. *I. enosimae*				3(70-82)
129. *I. lineatus*	16(38-106)	5(83-96)	7(61-114)	2(64-78)
130. *I. meleagris*	1(83)			4(82-111)
131. *I. periophthalmus*	40(50-112)	14(39-92)	39(45-100)	3(71-108)
132. *I.* sp. A.	2(73-84)			
133. *I.* sp. B.	1(35)	1(18)		
134. *I.* sp. C.	1(48)	2(50-65)	4(41-50)	2(36-63)
135. *I.* sp. D.	1(29)		5(35-76)	
*136. *Praealticus margaritarius*	2(34-46)	5(27-52)	2(39-52)	13(35-64)
137. *P. tanegasimae*			1(56)	
*138. *Stanulus seychellensis*		1(25)		
Tripterygiidae				
139. *Tripterygion bapturum*			8(16-21)	
140. *T. etheostoma*		2(16-19)	19(19-36)	1(24)
141. *T. fulgicauda*			1(24)	
142. *T. fuscipectoris*	1(20)	1(24)	15(21-25)	

TABLE 1 (Continued)

Familise and species	Stations			
	Yeiu	Lantao	Hongtou	Tungching
143. *T. inclinatum*		2(21-25)		1(18)
144. *T. minutus*			16(13-22)	
145. *T. quadrimaculatum*		2(22-24)	22(16-25)	
146. *T.* sp. A.		2(20-23)		1(23)
147. *T.* sp. B.		1(14)		
Callionymidae				
148. *Synchirops ocellatus*		1(61)		
Gobiidae				
149. *Acentrogobius ornatus*			3(41-53)	
150. *Bathygobius fuscus*	16(25-80)	2(29-34)	26(19-67)	4(32-44)
*151. *B. petrophilus*				6(45-74)
152. *Calliogobius liolepis*	1(39)			
153. *Eviota abax*	2(13-18)		2(14-21)	4(11-17)
154. *E.* sp.			1(17)	
155. *Zonogobius eugenius*		7(27-42)	1(32)	2(29-37)
156. *Z. semidoliatus*	1(22)	2(18-20)	1(26)	
157. Gobiidae sp.				3(13-24)
Acanthuridae				
*158. *Acanthurus leucopareius*		4(63-89)	3(86-100)	
159. *A. lineatus*	5(33-110)	5(29-93)	14(29-124)	8(30-161)
160. *A. maculiceps*			4(40-111)	
161. *A. nigrofuscus*	35(35-71)	12(36-57)	63(22-124)	1(44)
162. *A. olivaceus*	1(160)			
163. *A. triostegus*	58(21-77)	116(23-86)	184(22-75)	15(30-75)
164. *A. xanthopterus*			3(72-79)	
165. *Ctenochaetus striatus*	6(34-64)	2(34-43)	37(31-78)	
166. *Naso unicornis*		1(88)		
167. *Zanclus cornutus*	2(69-86)	2(114-119)		
Siganidae				
168. *Siganus spinus*	2(88-90)	4(85-136)	4(47-72)	
*169. *S. argenteus*		1(33)		
Bothidae				
170. *Bothus mancus*		3(123-168)		
Soleidae				
171. *Aesopia heterorthinos*		1(38)		
Balistidae				
172. *Cantherhines pardalis*	1(100)			
173. *Rhineacanthus rectangulus*	2(102-114)			
Ostraciontidae				
174. *Ostracion meleagris*		1(31)		
Tetraodontidae				
175. *Canthigaster benetti*	2(76-94)	6(48-88)	1(87)	1(75)
Diodontidae				
176. *Diodon holocanthus*	1(160)	1(260)	1(135)	1(150)
177. *D. liturosus*			1(252)	
Total numbers of individual	865	1157	1383	757

species (5.65%). The hierachy of dominant families at each station were Labridae, Blenniidae and Pomacentridae at the stations Yeiu, Lantao and Hongtou; Blenniidae, Labridae and Pomacentridae at the station Tungching.

Considering the number of individuals included in each family among the total 4162 specimens collected, Pomacentridae was the most abundant family with 1303 (31.31%) and followed by Blennidae with 648 (15.57%), Acanthuridae with 581 (13.96%) and Labridae with 447 (10.74%). The above 4 families alone cons tituted 71.58% of total catches. As the records from each station were concerned, Pomacentridae remained the most abundant among all stations, and the ranking order of families varied slightly among stations.

As far the abundance of individual species concerned, the species collected more than 100 were ranked in the order of the followings: *Acanthurus triostegus* (373), *Glyphidodontops glaucus* (338), *Plectroglyphidodon leucozonus* (216), *Atherion elyntus* (174), *Glyphidodontops leucopomus* (164), *Cirripectes sebae* (156), *Eupomacentrus fasciolatus* (144), *Istiblennius edentulus* (139), *Plectroglyphidodon imparepennis* (135), *Abudefduf vaigiensis* (126), *Halichoeres margaritaceus* (116) and *Acanthurus nigrofuscus* (111). All the above 12 species constituted 52.67% of total individuals. The remaining 165 species were 47.33% of total individuals.

Seasonal variation of species composition

The occurrecce and abundance of some species exhibited somewhat seasonal changes. In August 1978, the three dominant species were in the order of *Acanthurus triostegus* (8.03% of total individuals caught in the month, 97 individuals), *Plectroglyphidodon leucozona* (7.37%, 89) and *Cirripectes sebae* (6.71%, 81). In October 1978, *Glyphidodontops glaucus* (15.8%, 152) was ranked first and followed by *Acanthurus triostegus* (11.54%, 111) and *Halichoeres margaritaceus* (5.3%, 51). In April 1979, *Plectroglyphidodon leucozona* (8.6%, 46) was the first and followed by *Eupomacentrus fasciolatus* (7.85%, 42) and *Istiblennius edentulus* (6.73%, 36). In June 1979, *Acanthurus triostegus* (10.75%, 157) was the most abundant species and follwed by *Glyphidodontops glaucus* (7.73%, 113) and *Acanthurus nigrofuscus* (5.21%, 76).

Total number of species collected in August, October 1978 and April and June 1979 were 118, 100, 88 and 110, respectively. The unusual lower number in April 1979 was probably due to the cancellation of operation at the Hongtou Station. Therefore, the lowest species number obtained may be actually in October 1978. A further consideration of the primary residents alone during the four collections, the number of species collected were 25, 16, 22 and 25, respectively. It was lowest in October 1978. The fact coincided with the strong wave disturbances at the Tungching Station. On the contrary, the numbers of species collected in April, 1979, were higher than those in October, 1978.

Littoral status of the component species group

The intertidal fish community composes the primary, secondary residents and the transients according to Thompson and Lehner[11]. The primary residents including the members of blenniids, tripterygiids and gobiids contributed 22.60% (40 out of 177 species) and 19.87% (827 out of 4162 individuals). The secondary residents consisting of the members of families other than the primary resident and transient families made up 74.01% (131 out of 177 species) and 75.06% (3124 out of 4162 individuals). Both the primary and secondary resident species comprised 96.61% of total individuals. Transients including the members of exocoetids, belonids, carangids and mugilids, contributed only 3.39% (6 out of 177 species) and 5.07% (211 out of 4162 individuals). (Table 2)

Analysis of species structure in community

At the Lantao and Tungching Stations, the index of dominance (*c*) was lowest in April. At the Yeiu Station, it was highest in April and lowest in August. At the Hongtou Station, it was highest in April and lowest in June (Table 3).

TABLE 2

% composition based on littoral status of the fish community from different rocky tide pools of Taiwan

Littoral status \ Locality		Lanyu	Maopitou	Wanli	Sanhsientai
Primary r.	% sp.	22.60	17.53	18.99	23.02
	% indiv.	19.87	32.97	—	26.52
Secondary r.	% sp.	74.01	76.29	75.98	69.84
	% indiv.	75.06	50.49	—	65.34
Transients	% sp.	3.39	6.18	5.03	7.14
	% indiv.	5.07	16.58	—	8.14

TABLE 3

Indices of dominance (*c*), Shannon's general diversity ($\bar{H}$), variety (*d*) and evenness (*e*) measured from the collections at the Lanyu Island

Index	Stations	1978		1979	
		August	October	April	June
c	Yeiu	0.0471	0.0731	0.0904	0.0622
	Lantao	0.0542	0.0641	0.0394	0.0731
	Hongtou	0.1146	0.0720	—	0.0554
	Tungching	0.0564	0.0764	0.0510	0.0581
$\bar{H}$	Yeiu	3.4392	3.2242	2.8241	3.2861
	Lantao	3.5074	3.1800	3.7063	3.0503
	Hongtou	2.8283	3.2747	—	3.3948
	Tungching	3.2940	2.8902	3.2518	3.2415
d	Yeiu	23.1764	20.5398	13.8827	20.3418
	Lantao	27.4193	20.8969	29.0132	21.0442
	Hongtou	16.4262	23.0262	—	26.0864
	Tungching	19.6632	13.3045	17.1493	18.8319
e	Yeiu	1.9503	1.8977	1.8763	1.9763
	Lantao	1.9074	1.8627	1.9955	1.7607
	Hongtou	1.7536	1.8416	—	1.8050
	Tungching	1.9291	1.9927	2.1233	1.9607

The indices of similarity (S) were almost same between stations Yeiu, Lantao, Hongtou and Tungching, those between Tungching and other three stations were slightly lower (Fig. 6).

The indices of general diversity, evenness and variety showed slight differences among stations (Table 3). Shannon index and variety index showed a similar trend with an unusual drop in October at the Tungching Station and in April at the Yeiu Station. Evenness index showed a reverse pattern.

DISCUSSION

The preliminary results of this investigation on the Lanyu intertidal fishes, there were no endemic species. The great majority of the

	Yeiu	Lantao	Hongtou
Lantao	0.66		
Hongtou	0.65	0.69	
Tungching	0.58	0.61	0.57

Fig. 6. Species similarity indices (S) among stations Yeiu, Lantao, Hongtou and Tungching at the Lanyu Island.

intertidal fishes of Lanyu are common with those fishes in the Western Pacific Region. Among 177 species listed in the text, 64.97% (115 species) are common with those fishes of the Southern Japan[10] and 63.84% (113) with those fishes of Philippines[6]. Nevertheless, the fish fauna of Lanyu has lower similarity with that of the Hawaii (24.86%, 44 species)[5] and Lord Howe Islands (27.68%, 49 species)[1].

With a relatively short distance from the coast of Taiwan, a great faunistic dissimilarity is not expected between Lanyu and Taiwan (*i. e.* 86.52% of Lanyu fishes are common with those of Taiwan). However, the species similarity index (0.55) was shown between Lanyu and the near by Chengkong, southeast Taiwan, whereas the index of 0.35 was shown between Lanyu and Wanli, north Taiwan. (Fig. 7).

Since the Lanyu fish community is mostly a tropical affinity while that of Wanli is partially a subtropical. A gradient of dissimilarity between these two fish communities are anti-

	Lanyu	Sanhsientai	Maopitou	Liuchiu
Sanhsientai	0.55			
Maopitou	0.51	0.52		
Liuchiu	0.45	0.46	0.46	
Wanli	0.35	0.42	0.46	0.37

Fig. 7. The species similarity indices (S) among Lanyu, Sanhsientai, Maopitou, Liuchiu and Wanli.

cipated. *Luciogobius saikainensis*, *Istiblennius striatomaculatus* and *Girella melanichthys* are recorded only in northern Taiwan[8]. The mullet, *Liza macrolepis* is rather abundant at Wanli and Maopitou in Taiwan, however, it is rather few or even absent from the offshore Liuchiu Islands[12] as well as Lanyu. *Pempheris vanicolensis* is numerous at Wanli, Maopitou and Liuchiu, on the contrary, it was not caught from Lanyu. *Asterropteryx semipunctatus* is very abundant at Liuchiu while it was not obtained from Lanyu. Whether these are a real or just an occasional event, a further investigation is needed. Among 13 new records obtained from Lanyu, *Enchelyassa canina*, *Anarchias allardicei*, *Anomalopsis kataptron*, *Epinephelus melanostigma*, *Pogonoperca punctata*, *Gymnapogon annona*, *Calotomus sandwiciensis*, *Stanulus seychellensis* and *Acanthurus leucopareius* were not found from the tide pools in Taiwan, but they do occur elsewhere in the neighbouring Pacific. It is worth noting that the ranges of *Acanthurus leucopareius* and *Enchelynassa canina* extends as far as the Hawaiian Islands and *Anarchias allardicei* extends to Samoa.

Despite the minor variation in fish species, the family Labridae has the largest number of species among the rocky pools in Taiwan. As far as the abundance concerned, the family Labridae is the most abundant at Wanli and family Gobiidae at Maopitou, Southern Taiwan, while the family Pomacentridae is the most abundant family at the Island of Lanyu and at Chengkong and Liuchiu, Southern Taiwan. These differences may attribute to topographical differences. The fish community components of rocky pools at Lanyu (this paper), Wanli[8], Maopitou[3], Liuchiu[12] and Chengkong[9] are predominately secondary resident. (Table 2) Only few primary residents stay within the pool throughout the entire life span due to their evolutionary accomodation to the environments.

Diversity indices have long been applicable to measure the fish community structure by ecologssts. The effects of physical factors including temperatures, rainfall, wind force and some biological factors on fish community may

be predicated from the changes of these parameters. The dominance (*c*), variety (*d*), evenness (*e*) and Shannon's general diversity indices ($\bar{H}$) obtained from each station at Lanyu are almost same as those at Chengkong[9]. All the indices at each station at Lanyu slightly varied under the same warm thermal regime. However, a sudden drop at a station at particular time may be a result of wind disturbance which might cause the interruption in the collection as the ichthyocides were diluted rapidly. Since the surface water temperatures in the adjourning waters ranged between 20.6-29.9°C, neither winterkill nor summer-kill occurred, at least during the study period. The low dominance index (*c*) both at Lanyu and Chengkong is a general characteristic of the tropical and subtropical fish communities. On the contrary, it is rather high in the temperate and cold fish communities in which the numbers of species are low.

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蘭嶼之潮間帶魚類

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本報告係根據作者在 1978 年 8 月，10 月及 1979年 4 月，及 6 月在蘭嶼島之椰油，朗島、紅頭及東清等四個村落附近之岩礁潮池所作之魚相調查結果。在所獲之 46 科，177 種及 4162 尾標本中，下列之：

Enchelynassa canina, Anarchias allardicei, Histiophryne bougainvilli, Anomalopsis kataptron, Epinephelus melanostigma, Pogonoperca punctata, Gymnapogon annona, Calotomus sandwiciensis, Praealticus margaritarius, Stanulus seychellensis, Bathygobius petrophilus, Acanthurus leucoparius 及 *Siganus argenteus* 等 13 種魚類爲臺灣之新紀錄種。

隆頭魚 (Labridae) 爲魚種數 (23 種，12.99%) 最多之一科，雀鯛 (Pomacentridae) 爲尾數最多之一科，天狗鯛科 (Acanthuridae) 之 *Acanthurus triostegus* 爲數量最多之一種。蘭嶼島潮間帶魚類羣社之主要組成份子爲棲息者 (residents) 佔總數之 96.61%（其中初級棲息者 Primary residents 佔 74.01%，次級棲息者 Secondary residents 佔 22.6%）及總漁獲尾數之 94.93%（其中初級棲息者 75.06%，次級棲息者 19.87%），偶現者 (transients) 則只佔總種數之 3.39%及總尾數之 5.07%。

蘭嶼潮間帶魚類與隣近之成功（三仙台）間之相似性係數 (0.55) 較蘭嶼與北部之萬里間 (0.35) 者略高，此項事實或與北部含有較高比例之亞熱帶魚種有關。其餘之一般分岐係數，顯著性係數，均勻係數及變異係數亦均記錄於本文中，可供作日後比較不同地理區域魚類羣社之參考，例如蘭嶼島潮間帶魚類所呈現之極低之顯著性係數，可反映出熱帶魚類羣社之通性，換言之，熱帶地區之魚種數較溫帶或寒帶者爲多。