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# INTERTIDAL FISHES OF A ROCKY POOL OF THE SANHSIENTAI, EASTERN TAIWAN[1]

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**Sin-Che Lee** (1980) Intertidal fishes of a rocky pool of the Sanhsientai, eastern Taiwan. *Bull. Inst. Zool., Academia Sinica* **19**(1): 19-26. The intertidal fish community from a rocky tidal pool of the Sanhsientai in the vicinity of Chengkong, Taiwan was studied. A total of 1105 specimens collected were both belonging to tropical or subtropical fishes. The 38 families, 124 species were recognized. Among them, *Spratelloides delicatulus*, *Belone persimilis*, *Tylosurus incisus*, *Andamia pacifica* and *Parenchelyurus hepburni* are the first record from Taiwan. The family Labridae was the most diversified group consisting of 13.7% (17 out of 124) of all species. The family Pomacentridae was the most abundant with 22.17% (245 out of 1105) of total individuals collected. The dominance (*c*), variety (*d*), evenness (*e*) and Shannon general diversity indices ($\bar{H}$) obtained from the collections I, II, III and IV, respectively were as follows: $c$=0.0393, 0.0435, 0.0819 and 0.0524; $d$=28.7097, 27.3648, 17.9195 and 25.2855; $e$=2.0687; 2.0129, 1.8771 and 1.9531; $\bar{H}$=3.804, 3.774, 2.986 and 3.486.

Since most of the coastal line in eastern Taiwan is very steep where the mountain range preciptiously drop into the Pacific Ocean, it is difficult to find a suitable pool to elucidate the faunal characteristic of intertidal fishes. Sanhsientai, a small islet, separated by a 200 m wide channel from the coastal village of Paishoulien and about 4 Km east of Chengkong (Fig. 1), was chosen for this survey. Sanhsientai has a total area of 1.1 hectres and the hill at the centre of the islet is about 10 m in height. The islet is surrounded by reefs. The census pool covers an area of about 20 m × 20 m with 0.5 m-2 m in depth at low tide. The bottom of the pool is rocky with large boulders, coral colonies and patches of algae. Monthly mean sea surface temperatures of the Chengkong area for 1978 were ranged from 22.2°C (February, 1978) to 29.2°C (September, 1978).

Sanhsientai was chosen for the present survey simply that the islet has been undisturbed and isolated which could obtain a more sufficient and accurate information on tropical fish fauna.

## MATERIALS AND METHODS

The intertidal fishes were sampled in May, July, October 1978 and February 1979 (designated as the collections I, II, III and IV, respectively). Sampling was undertaken at 1 hour after the lowest tide level for 2 successive days in each visit except October 1978 for 1 working day because of bad weather. Fishes were collected from the pool immediately after the application of 3 pounds ichthyocide NaCN on each sampling. Specimens were then fixed and preserved in 10% formalin and they are deposited in the Museum of the Institute of Zoology, Academia Sinica.

Dominance index (*c*) was calculated from $c=\sum\left(\frac{ni}{N}\right)^2$. Variety index (*d*) was calculated from $d=\frac{S-1}{\log N}$. Evenness index (*e*) was

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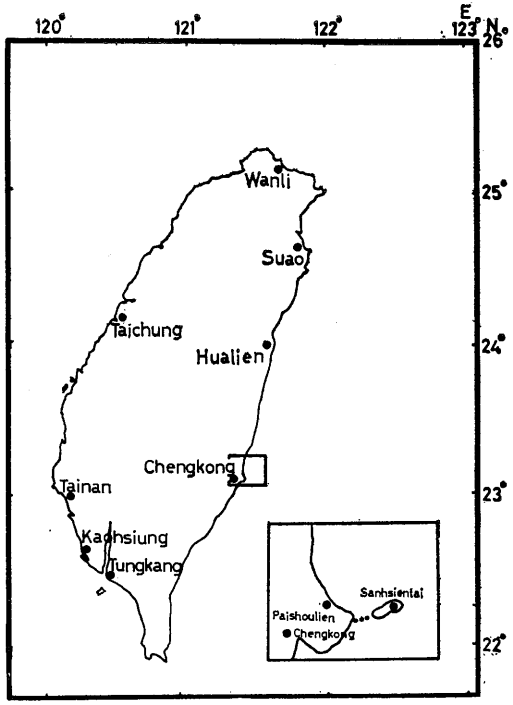


Fig. 1. Map of Taiwan showing the location of study site.

calculated from $e=\frac{\bar{H}}{\log S}$. Shannon general diversity index ($\bar{H}$) was calculated from $\bar{H}=-\sum\left(\frac{ni}{N}\right)\ln\left(\frac{ni}{N}\right)$. "*ni*" represents individual numbers of one particular species, "*N*" the total numbers of individual collected and "*S*" represents the numbers of species.

## RESULTS

A total of 1105 specimens were collected, 124 species, 38 families were recognized (Table 1). Among them, *Spratelloides delicatulus*, *Belone persimilis*, *Tylosurus incisus*, *Andamia pacifica* and *Parenchelyurus hepburni* are new records from Taiwan.

Species composition based on the percentage of 124 species, Labridae was the largest family which accounted for 13.7% of all species (17 species), and followed in the order of Blenniidae (10.48%, 13 species), Gobiidae (9.68%, 12 species), Muraenidae (8.06%, 10 species) and Pomacentridae (7.26%, 9 species). The 14 families, including Clupeidae, Atherinidae, Belonidae, Holocentridae, Scorpaenidae, Serranidae, Pseudochromidae,

TABLE 1

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

| Family and species | Collections | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| Moringuidae | | | | |
| 1. *Moringua abbreviata* | 1(195) | | | 2(163-260) |
| Muraenidae | | | | |
| 2. *Echidna nebulosa* | | 1(160) | 2(138-170) | 7(68-273) |
| 3. *E. polyzona* | 4(80-155) | 1(355) | | 1(67) |
| 4. *Gymnothorax fimbriatus* | 1(245) | 1(115) | | |
| 5. *G. flavimarginatus* | 5(75-245) | 7(182-417) | 2(71-222) | 2(265-353) |
| 6. *G. meleagris* | 1(305) | | | |
| 7. *G. petelli* | | 1(90) | | 2(194-455) |
| 8. *G. pictus* | | 1(135) | | |
| 9. *G. thyrsoideus* | | | | 3(196-360) |
| 10. *G. undulatus* | 9(170-275) | 1(175) | 4(46-79) | |
| 11. *Uropterygius micropterus* | | 1(302) | | |
| Congridae | | | | |
| 12. *Conger cinereus* | | 1(155) | | 3(57-709) |

TABLE 1 (continued)

| Family and species | Collections | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| Ophichthidae | | | | |
| 13. *Myrichthys maculosus* | 1(235) | | 1(160) | |
| Clupeidae | | | | |
| 14. *Herklotsichthys quadrimaculata* | | | 1(100) | |
| *15. *Spratelloides delicatulus* | | 42(26-53.5) | | |
| Engraulidae | | | | |
| 16. *Thryssa kammalensis* | 1(101) | | | |
| Ophidiidae | | | | |
| 17. *Dinematichthys iluocoeteoides* | | 8(35-75) | | 1(48) |
| Atherinidae | | | | |
| 18. *Allanetta woodwardi* | 1(29) | 6(28-42) | 6(44-75) | |
| 19. *Atherion elymus* | 4(20-25) | 1(26) | | |
| Belonidae | | | | |
| *20. *Belone persimilis* | 1(380) | | | |
| *21. *Tylosurus incisus* | 1(163) | | | |
| Holocentridae | | | | |
| 22. *Adioryx ruber* | | | | 1(127) |
| 23. *Flammeo sammara* | | | 1(47) | |
| Fistulariidae | | | | |
| 24. *Fistularia petimba* | | 1(141) | | |
| Syngnathidae | | | | |
| 25. *Choeroichthys sculpus* | 1(62) | | | |
| Scorpaenidae | | | | |
| 26. *Pterois radiata* | 1(85) | | | |
| 27. *Scorpaena albobrunnea* | | | | 1(25.5) |
| 28. *Scorpaenodes guamensis* | 4(32-85) | 7(24-86) | 1(31) | 1(53) |
| 29. *Scorpaenopsis cirrhosa* | 1(93) | 2(85-103) | | |
| 30. *S. diapolus* | | | | 1(61) |
| Serranidae | | | | |
| 31. *Cephalopholis argus* | | | | 2(44-57) |
| 32. *Epinephelus caeruleopunctatus* | | 8(28-202) | 2(59-72) | 1(106) |
| 33. *E. hexagonatus* | 1(121) | 3(115-132) | 1(61) | |
| 34. *E. tauvia* | | | | 1(102) |
| Grammistidae | | | | |
| 35. *Grammistes sexlineatus* | 3(39-73) | 10(29-92) | 2(25-38) | 2(20-55) |
| Pseudochromidae | | | | |
| 36. *Dampieria melanotaenia* | 3(37-113) | | | |
| 37. *Pseudochromis tapeinosoma* | 1(37) | | | |
| Plesiopidae | | | | |
| 38. *Plesiops coeruleolineatus* | | 7(31-73) | | 1(33) |
| 39. *P. melas* | | | | 2(28) |
| 40. *P. nigricans* | | 2(113-116) | | 6(50-111) |

TABLE 1 (continued)

| Family and species | Collections | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| Acanthoclinidae | | | | |
| 41. *Belonepterygion fasciolatum* | 1(36) | | | |
| Apogonidae | | | | |
| 42. *Apogon angustatus* | 1(92) | 3(53-80) | | 7(50-70) |
| 43. *A. coccineus* | 3(33-47) | 3(25-27) | | 3(36-45) |
| 44. *A. nubilis* | 2(20-24) | | | |
| 45. *A. robustus* | 23(33-83) | 52(16-57) | 18(27-69) | 1(61) |
| 46. *Fowleria isostigma* | 1(17) | | | |
| Lutjanidae | | | | |
| 47. *Lutjanus monostigma* | 1(105) | 8(28-77) | | 1(76) |
| Nemipteridae | | | | |
| 48. *Scolopsis cancellatus* | 3(32-41) | | | 1(62) |
| Mullidae | | | | |
| 49. *Parupeneus barberinus* | 2(35-37) | | | |
| 50. *P. fraterculus* | 2(38-42) | | | |
| Chaetodontidae | | | | |
| 51. *Chaetodon adieregastos* | | 1(21) | | |
| 52. *C. auriga* | | 3(24-42) | | 1(64.5) |
| 53. *C. citrinellus* | 1(91) | 3(36-81) | 1(55) | |
| 54. *C. lunula* | | | 1(48) | |
| 55. *C. vagabundus* | 1(23) | | 1(18) | |
| 56. *Pomacanthus semicirculatus* | 2(22-26) | 10(12-48) | 1(44) | 1(38) |
| Pomacentridae | | | | |
| 57. *Abudefduf coelestinus* | 2(26-27) | | | 1(60) |
| 58. *A. notatus* | 2(19-21) | | | 1(64) |
| 59. *A. septemfasciatus* | 1(19) | 2(37-42) | 1(68) | 3(54-63) |
| 60. *A. sordidus* | | 1(29) | | 1(25) |
| 61. *A. vaigiensis* | 16(20-62) | 30(14-65) | 21(15-56) | 14(16-68) |
| 62. *Glyphidodontops glaucus* | 1(30) | 12(27-79) | 1(66) | 11(27-68) |
| 63. *G. leucopomus* | 5(20-23) | 42(14-47) | 2(21-33) | 6(21-46) |
| 64. *G. uniocellatus* | | 22(38-58) | 4(37-41) | 6(33.5-57) |
| 65. *Plectroglyphidodon leucozona* | 18(27-123) | 5(26-82) | | 4(38-44) |
| Mugilidae | | | | |
| 66. *Liza macrolepis* | | 7(20-35) | 19(79-99) | |
| Labridae | | | | |
| 67. *Anampses caeruleopunctatus* | | 1(43) | | |
| 68. *Cheilinus trilobatus* | 3(85-122) | | | |
| 69. *Halichoeres leparensis* | 6(52-56) | 1(31) | 1(75) | 2(41-42) |
| 70. *H. margaritaceus* | | 12(36-60) | | 14(25-62) |
| 71. *H. marginatus* | 4(26-87) | 9(20-45) | 2(39-48) | 5(32-70) |
| 72. *H. miniatus* | | 3(65-77) | | |
| 73. *H. nebulosa* | | 1(85) | 1(67) | |

TABLE 1 (continued)

| Family and species | Collections | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| 74. *H centiquadrus* | 2(24-82) | | | |
| 75. *Hemigymnus melapterus* | | 1(47) | | |
| 76. *Labroides dimidiatus* | | 1(37) | | |
| 77. *Macropharyngodon meleagris* | 4(65-104) | | | |
| 78. *Stethojulis bandanensis* | 5(40-90) | 10(31-64) | | |
| 79. *S trilineata* | 1(28) | 8(27-59) | | 1(94) |
| 80. *Thalassoma amblycephalus* | | 1(33) | | 2(20.5-30.5) |
| 81. *Th. hardwickei* | 3(85-96) | 1(79) | 1(37) | |
| 82. *Th. purpureum* | | 1(32) | | |
| 83. *Th. quinquevittata* | | | | 1(60) |
| Scaridae | | | | |
| 84. *Scarus lepidus* | 1(24) | | | |
| Mugiloididae | | | | |
| 85. *Parapercis cephalopunctatus* | 2(58-82) | 2(80-84) | | |
| Blenniidae | | | | |
| *86. *Andamia pacifica* | | 1(35) | | 2(45-47) |
| 87. *Cirripectes sebae* | 2(27-44) | 2(41-51) | | |
| 88. *Entomacrodus caudofasciatus* | | | | 1(52) |
| 89. *E. decussatus* | 1(82) | 2(53-130) | | 5(37-89) |
| 90. *E. striatus* | 2(52-61) | | | |
| 91. *Istiblennius bilitonensis* | | 1(71) | | 8(27-81) |
| 92. *I. edentulus* | 1(69) | 22(40-106) | 9(51-109) | 38(32-88) |
| 93. *I. lineatus* | 16(31-90) | 17(35-93) | | 3(56-78) |
| 94. *I. periophthalmus* | | 3(39-59) | | |
| 95. *Istiblennius* sp. | | | 1(23) | 2(39-51) |
| *96. *Parenchelyurus hepburni* | | | 1(30) | |
| 97. *Praealticus tanegasimae* | | 2(62-65) | | |
| 98. *Salarias fasciatus* | 1(89) | 3(39-55) | | |
| Tripterygiidae | | | | |
| 99. *Tripterygion fuscipectoris* | 1(20) | | | 1(28) |
| 100. *T.* sp. | | 2(29-31) | | |
| Clinidae | | | | |
| 101. *Springeratus xanthosoma* | 1(34) | | | |
| Gobiidae | | | | |
| 102. *Acentrogobius ornatus* | 13(44-84) | 6(21-70) | 1(73) | 4(39.5-56) |
| 103. *Asterropteryx semipunctatus* | | 3(22-31) | 1(22) | 2(34-38) |
| 104. *Bathygobius fuscus* | 7(15-54) | 35(26-58) | 6(22-33) | 15(24-44) |
| 105. *Callogobius sclateri* | 8(36-51) | 4(22-42) | 1(43) | 4(35-41) |
| 106. *Eviota abax* | | 1(14) | | 1(20) |
| 107. *Fusigobius neophytus* | 2(31-51) | 1(33) | | 1(46) |
| 108. *Gnatholepis knighti* | 1(37) | 1(27) | | |
| 109. *Parioglossus dotui* | | | 1(15) | |
| 110. *Riukiuia* sp. | | | 1(18) | |
| 111. *Zonogobius eugenius* | | | | 1(33) |

TABLE 1 (continued)

| Family and species | Collections | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| 112. *Z. semidoliatus* | 6(17-33) | 9(14-31) | 1(22) | 4(18-21) |
| 113. Gobiidae sp. | 1(45) | | | |
| Acanthuridae | | | | |
| 114. *Acanthurus lineatus* | 1(120) | 1(56) | | 1(74) |
| 115. *A. nigrofuscus* | 1(102) | | 2(38-40) | |
| 116. *A. triostegus* | | 11(22-63) | 8(23-31) | 4(56-84) |
| 117. *A. xanthopterus* | 1(42) | | | |
| 118. *Ctenochaetus striatus* | | | | 1(112) |
| Siganidae | | | | |
| 119. *Siganus spinus* | | 7(59-67) | | |
| Bothidae | | | | |
| 120. *Bothus mancus* | | | | 1(92) |
| Balistidae | | | | |
| 121. *Rhineacanthus verrucosus* | | 1(31) | | |
| Tetraodontidae | | | | |
| 122. *Canthigaster benetti* | | 1(77) | | |
| 123. *Tetraodon hispidus* | | | 1(15) | |
| Diodontidae | | | | |
| 124. *Diodon holacanthus* | 1(120) | 2(150-155) | | |
| Total numbers of individual | 231 | 506 | 132 | 236 |

Plesiopidae, Apogonidae, Mullidae, Chaetodontidae, Tripterygiidae, Acanthuridae and Tetraodontidae had 2 to 6 species. The remaining 19 families excluded from above had only single species.

Among 124 species collected, *Apogon robustus* (94 out of 1105 individuals), *Abudefduf vaigiensis* (81), *Istiblennius edentulus* (70), *Bathygobius fuscus* (63) and *Glyphidodontops leucopomus* (55) were considered to be dominant species in the tidal pool. Regarding the numbers of individual in each family, Pomacentridae was the most abundant (245 fishes, 22.17% of total individuals) and followed in the order of Blenniidae (13.21%, 146), Gobiidae (12.85%, 142), Apogonidae (10.59%, 117), and Labridae (9.77%, 108).

The fishes collected may be classified into three categories based on their littoral status[12]. Primary residents including Blenniidae, Clinidae, Gobiidae and Tripterygiidae made up 22.58% of total species and 26.52% of total individualas. All of them complete their life cycle within the pool. Secondary residents including Moringuidae, Muraenidae, Congridae, Ophichthidae, Ophidiidae Holocentridae, Fistulariidae, Syngnathidae, Scorpaenidae, Serranidae, Grammistidae, Pseudochromidae, Plesiopidae, Acanthoclinidae, Apogonidae, Lutjanidae, Nemipteridae, Chaetodontidae, Pomacentridae, Labridae, Scaridae, Mugiloididae, Acanthuridae, Siganidae, Bothidae, Balistidae, Tetraodontidae and Diodontidae made up 70.97% of total species and 65.34% of toal individuals. Most of them were juveniles but some species including *Pseudochromis tapeinosoma, Apogon robustus, Halichoeres leparensis, H. marginatus, Macropharyngodon meleagris, Stethojulis bandanensis, Thalassoma hardwickei* and *Acanthurus nigrofuscus* were found to spawn in the deeper part of the pool. Transients including Clupeidae, Engrauli-

TABLE 2
Dominance ($c$), variety ($d$), evenness ($e$) and Shannon general diversity indices ($\bar{H}$) of the collections I, II, III and IV

| Indices | Collections | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| $c$ | 0.0393 | 0.0435 | 0.0819 | 0.0524 |
| $d$ | 28.7697 | 27.3648 | 17.9195 | 25.2855 |
| $e$ | 2.0687 | 2.0129 | 1.8771 | 1.9531 |
| $\bar{H}$ | 3.8040 | 3.7743 | 2.9867 | 3.4868 |

dae, Atherinidae, Belonidae and Mugilidae made up 6.45% of total species and 8.14% of total individuals. They were entirely juveniles.

Diversity index ($\bar{H}$=2.9867), variety index ($d$=17.9195) and evenness index($e$=1.8771) shown in Table 2 had lowest level in October and highest in May while the dominance index($c$) had the highest level in October and lowest in May.

## DISCUSSION

The tidal pool of Sanhsientai is a typical example of the habitat for tropical marine fishes mostly with small size and bright color. Generally, the species collected from Sanhsientai were also reported from other tidal pools of rocky shore at Maopitou[2], Nanwan[13], Liuchiu Island[14], Wanli[8] and other sea coasts in Taiwan[3] except few newly recorded species. Regarding the species composition, Labridae has the highest numbers at Maopitou (23 species), Nanwan (18), Liuchiu Island (19), Chengkong (Sanhsientai, 17) and Wanli (20). Pomacentridae has the highest in abundance at all localities except which is replaced by Labridae at Wanli and Gobiidae at Maopitou. The slight difference in the occurrence of the dominant fish groups may be caused by different topography and range of collecting area at each locality.

Taiwan is situated within a range of tropics or subtropics with a narrow range in the temperature. Thus, differences in fish fauna were hardly observed among the above localities. Water temperatures at Chengkong range between 22-29°C, winterkill and summerkill are never occurred. Seasonal variations in the species composition and diversity are almost unnoticeable. The lower diversity index ($\bar{H}$=2.9867) appeared in October 1978 was simply a result of rough sea condition at the time of visit when strong waves diluted the ichthyocide too rapidly and interruption of the collection.

The intertidal fish fauna of eastern Taiwan from Taitung County to Ilan County is basically the Indo-west-Pacific affinities with slight variation. Among 124 species collected, 101 species (81.45%) were in common with those of Philippines[7], 89 species (71.77%) with those of southern Japan[9], 56 species (45.16%) with those of India-Ceylon[10,4], 37 species (29.84%) with those of eastern Australia[1] and 36 species (29.03%) with those of Hawaii[6]. There are no common species with those of the Okhostsk Sea[11] and the New Zealand[5].

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# 臺灣東部三仙臺之岩礁潮間帶魚類

李　信　徽

本報告係根據 1978 年 5 月、7 月、10月及 1979 年 2 月等四次在臺灣東部成功附近之小島三仙臺之潮池所作之魚類相調查結果。所得 1105 尾之標本經分類爲 38 科 124 種，其中依序以 *Apogon robustus, Abudefduf vaigiensis, Istiblennius edentulus, Bathygobius fuscus* 及 *Glyphidodontops leucopomus* 等五種較爲常見，又 *Spratelloides delicatulus, Belone persimilis, Tylosurus incisus, Andamia pacifica* 及 *Parenchelyurus hepburni* 等五種則爲臺灣新紀錄種。在38科魚類中，隆頭魚科所含之種類數最多 (17種，佔 13.7%)，尾數則以雀鯛科 (245 尾，22.17%) 爲最多。在上述之四次調查中，其潮間帶魚類羣聚中魚種結構之各種指數分別爲優勢性指數 (*c*) 0.0393, 0.0435, 0.0819 及 0.0524；變異性指數 (*d*) 爲 28.7097, 27.3648, 17.9195 及 25.2855；均衡性指數 (*e*) 爲 2.0687, 2.0129, 1.8771 及 1.9531；一般岐異性指數 ($\bar{H}$) 則爲 3.804, 3.7743, 2.9867 及 3.4868。