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# Fish Diversity in Cibareno River, Gunung Halimun National Park: its unique assemblage, management, and conservation consideration

## (Keanekaragaman Ikan di S. Cibareno, TN. Gunung Halimun: keunikan, manajemen, dan konservasinya)

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### ABSTRACT

The study was conducted in Gunung Halimun National Park (GHNP) at water catchmen area of Cibareno River, starting from the national park to southward in May-June 2002. The objective of the study is to reveal fish diversity and it's succession from the lower part until upstream area and reveal their characteristics as a base for their management and conservation. Beside the fish collection some water quality parameters were measured. Twenty nine fish species were collected consisting of primary marine, secondary, diadromous, and primary freshwater species. The uniqueness of the fish composition, some biological characteristics, and their conservation aspects are discussed in this paper.

***Key words***: Gunung Halimun National Park, fish diversity, fish succession, fish abundance, primary marine, diadromous, secondary and primary freshwater species.

### ABSTRAK

Studi dilakukan di Taman Nasional Gunung Halimun (TNGH) pada daerah aliran Sungai Cibareno, mulai dari daerah taman nasional tersebut ke arah selatan pada bulan Mei-Juni 2002. Tujuan penelitian untuk mengetahui keanekaragaman ikan dan suksesinya dari bagian bawah sampai daerah hulu sungai, dan mengetahui ciri-ciri (sifat) ikan-ikan tersebut sebagai dasar pengelolaan dan pelestariannya. Selain koleksi ikan, dilakukan juga pengukuran beberapa parameter kualitas air. Selama penelitian telah tertangkap sebanyak 29 jenis ikan terdiri dari ikan laut utama, ikan diadromous, ikan air tawar sekunder dan ikan air tawar utama. Keunikan komposisi jenis yang ada, sifat-sifat biologi serta aspek-aspek konservasinya didiskusikan dalam paper ini.

***Kata-kata kunci***: Taman Nasional Gunung Halimun, keanekaragaman ikan, suksesi, kelimpahan ikan, ikan laut utama, diadromous, sekunder, ikan air tawar utama.

### INTRODUCTION

Gunung Halimun National Park is one of the largest remnants of forest area remaining in Java. From this conservation area a number of river systems originate i.e Cikaniki (Cisadane), Ciberang (Ciujung), Cidurian, Cisukawayana, Cimaja, Cibareno, Cidikit and Cimadur. The fish fauna study of this area revealed that this area contained 33 fish species, some of them were found to extend their range to Java such as genus *Lentipes* (Rachmatika, et al. 2001). *Rasbora aprotaenia,* a fish species endemic for Northern Java (Kottelat, et al.1993) and *Tor tambra,* a highly demanded, site specific fish were also found in this area.

Cibareno River is one of the rivers originating from Gunung Halimun National Park and flows south into the Indian Ocean, several kilometers west of the Pelabuhan Ratu. This river was distant from the Pelabuhan Ratu recreational area, and flows through the area which is relatively still pristine compared with neighbouring drainages such as Cimaja and Cisukawayana Rivers.

The objective of the study is to reveal fish diversity and its succession change from the lower part until the upstream area and to reveal their characteristics as a base for their management and conservation

## METHODS

The method of the survey and fish collection was conducted as performed by Rachmatika et al (2001). The survey was conducted in May – June 2002, coincided with the low water level at which according to Yoneda et al (2001) the lowest period of the rainfall was within April- August. In Cibareno River the localities of sampling encompassed: group of sampling sites within the national park or locality 1 (at the camp, at S.Cibentang, at S.Cidasirun), near the park or locality 2 (at S.Cisodong, at Cibareno), at Kp.Bojong or locality 3 (at the bridge connenting Kp.Bojong to Ds.Cicadas: S 6° 50' 04.7" E 106° 26' 30.7"), at Karangropong or locality 4 (the confluence of Cibareno and Cikidang: S 6°50'26.2", E 106°26 '08.8"), at Kp.Cilumayan or locality 5 (at the village: S 6° 57'50.5", E 106 ° 23'41.", at Leuwi Batu Malang), and at Kp. Pajagan Piit or locality 6. In general, these established localities followed the variety of the landscape available such as: primary forest, paddy field, agroforestry, villages, and estuary environments.

Fish specimens were fixed by using formalin 5% then deeped in alcohol 76% for MZB permanent collection. The ecological parameters such as current, depth and type of substrate at the rivers were observed. Water quality parameters such as conductivity, pH, dissolved oxygen, water temperature were observed using Kagaku Kit-Type UC Series. Informal interview was conducted with the villagers especially with those who were familiar with fishing activities.

Fish identification was based on Weber and de Beaufort (1913;1916;1936; 1953), Brittan (1954), Robert (1993), Kottelat et al. (1993), Watson and Kottelat (1994), Prince Akihito et al. (1988), Hoese and Allen (1990). Fish abundance was estimated by dividing the total number of particular species by the number of station of occurrence (Misra, 1978). The level of abundance designated was : 0 –10 for low abundance, 10 – 20 for moderate abundance, and more than 20 individual per station for high abundance categories.

## RESULT AND DISCUSSION

1. Ichthyofauna Profile

1.1. Fish Species Composisiton

There were 29 fish species found (Table 1), consisting of primary marine, estuarine, secondary and primary freshwater. These mostly belong to Gobioids (30 %), then followed by Cyprinidae (6.6%), Eleotrididae (6.6%), Syngnathidae (6.6%), Anguillidae (6.6 %). The others are Apogonidae, Carangidae, Elopidae, Mugilidae, Muraenidae, Scorpaenidae, Teraponidae, Belontidae, Channidae, Sisoridae, Poecilidae, Rhyacichthydae that each represent one species or 3.33 %. Six species (6.6 %) of the Gobioids are member of the sub family Sicydiinae ie. *Sicyopterus cyanocephalus*, *S. microcephalus*, *S.macrostatholepis*, *Sicyopus* cf. *balinense*, *Stiphodon semoni* and *Lentipes* sp. Member of Sicydiinae is known to have amphydromous or a spezialized diadromous pattern common to tropical insular stream gobioids (Ryan, 1991 in Parenti and Maciloek, 1993): a life-history pattern where they have a relatively short period of larva in the sea, then conducting up stream migration to grow and breed in the upstream area (Maciloek, 1977: Parenti and Maciloek, 1993). This group was found usually in swift-flowing water, rocky substrate (Maciloek, 1977; Parenti and Maciloek, 1993; Allen, 2001) and considered to be pioneer in fulfilling the vacant niche as they live in precipitous (noticeable gradient), pristine area which usually occur on geologically new land masses, omnivorous, lived in upstream area and usually does not co-occur with other except with the herbivorous Sicydium (Maciloek, 1977; Parenti and Maciolek, 1993); the group which usually occurs in tropical and subtropical insular and coastal streams (Parenti and Maciloek, 1993; Parenti and Maciloek 1996).

Presence of member of Sicydiinae subfamily along with primary fresh water species such as *Rasbora aprotaenia, Tor soro* and Sicydiinae in Cibareno River; *R.aprotaenia*, *Puntius binotatus* and Sicydiinae in Cisukawayana River is an unique phenomena for Cibareno and Cisukawayana River . This unique assemblage could be firstly resulted from head water capture where the northern drainages (that were already inhabited by the primary species) were captured by the southern ones as resulted from tectonic movement that occurred earlier in the area of Bayah Dome. Then subsequent collaps of this volcano resulting the Sunda Strait separating Sumatra and Java and the southern part of the mountain has subsided under the Hindian Ocean (PHKA, 1997). Then Sicydiinae invaded later as the southern drainages lack of primary species. As in common theory that Gobiidae colonize inland water via marine route (Banarescu, 1994). This group usually occurs in volcanic islands such as Japan (Akihito Prince, 1988 ), Hawai (Maciolek, 1973), Micronesia islands (Parenti and Maciolek,1993), Bali (Watson and Kottelat, 1994), Anjaauan island, Madagascar (Balon and Bruton, 1994).

1.2. Endemism and Undescribed Species

*Rasbora aprotaenia* is an endemic fish to Java North (Kottelat, et al.1993). By finding this fish in some streams flowing south i.e. in Cisukawayana and Cibareno River this fish extends its range to the southern part of the mountain. Stream capture of the northern drainages that had more access to Sundaplate in the past by the drainages occurring in the southern area accompanying the tectonic movement before Bayah Dome collaps, or extension of the range of this fish coincided with the collaps of Bayah Dome can be the explanations.

*Lentipes* sp. might represent a separate population (undescribed species) from a Bali population: *Lentipes whitenorum* (Watson and Kottelat, 1994), which was collected from Gilgit waterfall, Sungai Buleleng upstream from Singaradja. This is caused since the amphydromous pattern is hypothesized to give rise gene flow more restrictedly among the populations. This also could lead the populations to be highly regional or island-group endemism: the distributional character that prevails for Sicydiinae gobies (Parenti and Maciloek, 1993; Parenti and Maciloek, 1996).

2. Fish Species in Longitudinal Distribution

2.1. Amhpydromous/ Diadromous fishes

Up to the present it is asummed that Sicydiinae that was found in Cibareno and Cisukawsayana River GHNP were amphydromous. Sicydiinae fishes were distributed from the mouth until the up stream area (from deep pool, fast flowing water until cascade, torrential zones ) (Figure 1). However, there was a tendency that they differed each other in the upreach areas. For example, ***Sicyopus*** cf. *balinense*, and *Lentipes* sp. were found until the most up reach area (Figure 2). *Sicyopus* cf. *balinense*, which lacks of labial teeth, is considered to be the most primitive among the Sicydiinae (Maciloek, 1977; Parenti and Maciloek, 1993; Watson and Kottelat, 1994). Another amphydromous fish i.e is ***Rhyacichthys aspro***, however, reached until locality 3.

The up reach of *Anguilla marmorata* has not been determined yet. However, there was an indication that the most up reach of *A.marmorata* in this river is in the middle part of Cibareno, which has deep pool zones. For comparison, the elver of this species that was found in Tatinga River, Comoro could not reach the up stream areas as *Sicyopterus lagocephalus* did, eventhough the elvers can surmount a 300 m high waterfall (Turnbull-Kemp, 1958 in Balon and Burton, 1992).

2.2. Primary fishes

*Glyptothorax platypogon* was found from the middle until the up reach area, in line with the presence of *Lentipes* sp.(Figure 2). The interesting finding was that

*Tor tambra* (106.24 – 164.02 mm SL) was found in the lower reach of river, occurred in the same locality with *Kuhlia marginata* (107.87 – 112.57 mm SL) (Plate 1) in deep pool, fast flowing water with stony substrate habitat type. Fast flowing water zone with rocky substrate was still present at the lower part of the river. The proportion of the area of the park mostly (75.7%) constituted slope ranging from 21 to 45 % (Nijima, 1997) is attributable to the condition, where at the lower reach fast flowing water habitat with rocky substrates still occurred. This was supported by the measure of water ability to convey an electrical current (conductivity) and all dissolved ion content (salinity) at the lower reach were very low i.e 0.12 mms/cm (0.001 ms/cm) and 0.053 ppt respectively (Figure 3). The value of the parameters even at the lower reaches were very low, at the freshwater level as categorized by Reid (1978) and Boyd (1992).

Habitat of *R. aprotaenia* is confined in cascade zones with primary forest along the bank of the river, in which this occurred within the national park. The habitat preferred by this species agreed with that that was found in up stream area of Cikaniki, and Cisukawayana River (Rachmatika, 2001).

**Fig.3 Fish diversity in relation with longitudinal zone of the river**

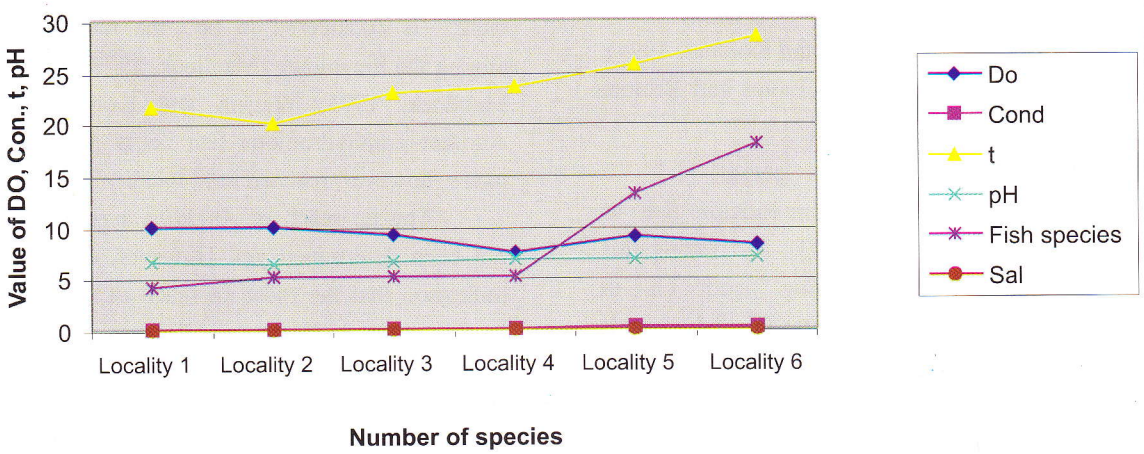

Plate 1. *Tor tambra* (106.24 mm - 164.02 mm SL) and *Kuhlia marginata* (107.87 mm - 112.57 mm SL) that were found in the same localities in the lower part of Cibareno River

Plate 2. Localities (2 a and 2 b) in the lower part of Cibareno River where *Tor tambra* and *Kuhlia marginata* were found

2.3. Secondary fishes

Poeciliid fish is distributed at the lower reach of the river and in the ponds at the middle reach of the river. This fish seems to have become established, feral populations in this river. The condition that also occurred in Cikaniki,Cidurian and Cisukawayana River where this fish spread in

water body with agricultural land, or rural settlement at the bank.

2.4. Marine Fishes

Marine fishes such as *Liza macrolepis, Caranx sexfasciatus, Microphis argulus, Microphis brachyurus, Ambassis buruensis, Vespicula depressifrons ,Megalops cyprinoides* were found only in the tidal reaches area, which stretch about 200 meter from the mouth of the river. Among these fishes, larva *Megalops cyprinoides* and juvenile of *Kuhlia marginata* were found: indicating that the lower reach is nursery ground for some marine fishes. For others such as *Liza macrolepis*, *Caranx sexfasciatus* their presence in this area might be just for occasional visit or for feeding purpose.

3. The threat identified to the continuing populations:

3.1. Poisoning for fishing and habitat fragmentation.

The use of poison was practised by some people. It was spread by the people as they were walking fast in down stream direction. The villagers came and caught the various killed fish that mostly were floating on the surface. In the lower part, people used poison for catching small shrimp. The excesive use of water for irrigation etc, as observed in Cimaja and Cisukawayana River , is apprehensive that in the dry season (i.e in April – August) the downstream areas have shortage of water or only small pools left. In line with the peak of eels larvae up stream migration, which lasts from March to September (Dr. Ridwan Affandie, a lecture of Faculty of Fisheries and Marine Sciences, IPB, pers. comm), the shortage of water or habitat disruption/fragmentation could hamper the migration of the diadromous, *Anguilla marmorata* and Sicydiinae fishes as well. However, it was reported that national park has high rainfall, which has an annual average of between 3,900 to 5,300 mm and no distinct dry season eventhough in subside period or in April to August (Yoneda, et al, 2001).

3.2.Introduced Species

Poeciliid fish in Cibareno River were found outside the park, in the habitat which were relatively already disturbed by human activity (locality 3 and 5). As they insect feeders (Mohsin and Ambak, 1983; Munro, 1990) they could be competitor for *R.aprotaenia* a native, endemic fish to the area (North Java) for food sources There has not been any study, however, from its mouth morphology this fish might feed on aquatic insect. Its close relatives such as *Rasbora lateristriata* and *R.argyrotaenia* feed mainly on insect (Hartoto and Sulastri, 1987; Welcomme, 1979).

3.3. Fishing of juvenile fishes

There was activity of fishing of juvenile fish in the lower part of Cibareno River. Initial observation indicated that fishes constituting *impun* stock were *Stiphodon* cf.*elegans ,Awaous grammepomus, Sicyopterus* spp, *Lentipes* sp. From this initial observation, juvenile of *Awaous grammepomus* constituted high portion of *impun* stock: 1 *bubu* (trap) of May contained 77 or 19.79 % juvenile of 389 total individual, and June contained 77 or 13.13 % juvenile of 389 total individual.

People catch the fishes use selective gears such as trap (*bubu*) and lifted-square net (*sirib*). Lifted-square net was operated in estuarin by following the up down of the wave ocean; while trap was operated in the lower reach of the river, which is few kilometers (2 –3 km) up from the mouth. It was informed that every month (on 25 th of islamic calendar), there is a peak of this fishing or *ngimpun* at the mouth of the river, where this practise has been conducted for long time. This activity has involved many people from surrounding areas and given additional income for them. If there is pressure to this persisting activity such as increase the effort, increase the frequency, and the shortage of water running, these would

decrease the stock and threat the continuing populations.

4. Management and conservation considerations: research and proposed activities

Segment of stream with forest at the bank (within the park and officially protected), would conserve the continuing populations of *Rasbora aprotaenia*, species whose life cycle is confined in the forested stream habitat. For other species that are amphydromous such as *Lentipes* sp., and *Sicyopus* cf. *balinense,* this habitat would conserve part of their life cycle. For outside the park (deep pools zone areas with forest on the bank) establishing small harvest reserves or fishery reserves (called "Suaka Perikanan") (Hartoto, 1999; Sukadi, 2002) along the bank where local community could manage this reservat could be performed. Activities related to this conservation habitat, controlled fishing activity or environmentally sound fishing should be encouraged.

In line with the effort to increase individual income in the area, segment of the river (for instance stretching for 10 -20 km) from the mouth of the river could function as scientific and/ or adventurous tourism. It is attributable to the fact that Cibareno River meanders throughout deep, narrow valley with a natural, beautiful landscape. Fishing angling with lisence in this area could be performed. Providing guidance, producing unique fish product from this area (such as fried *impun* that is wrapped by material available in site such as bambo- handycraft etc.) could be one of alternatives. Cultural heritage existing at the middle/upstream area could enhance the natural beauty.

A variety of research such as for *T.tambra*, valuable consummed fish should be conducted in line with the decreasing its habitat quality along its range, for instance research on genetic diversity as a base for its aquaculture and gene conservation. Kottelat et al. (1993) listed that member of genus *Tor* constituted among fishes that must be watched or monitored because of intense trading or threats: likewise Mohsin and Ambak (1983) listed them as members of the endangered species (exist in limited localities, but the factors for their survival are not favourable) among freshwater fishes which were found in Peninsular Malaysia.

Various studies on amphydromous Gobies/diadromous Anguilla also should be conducted, for instance, life history or biological development, migratory period and pattern in relation with the season, reproductive pattern, and fishing juvenile activity including the effect of this practice on the continuing populations are needed.

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Table 1.Fish species existing in Cibareno River, their distribution and biological characteristic

| No. | Species, English and Local Name | Famili | Distribution[1] and some biological characteristics |
|---|---|---|---|
| 1. | *Anguilla marmorata (Quoy and Gaimard,, 1824)*<br>Oleng, Lubang,Sidat | Anguilidae | -From East Africa to Polynesia and Ryukyus<br>-Diadromous, spawn in the deep sea, big bank (adult perish after spawnig), carnivorous<br>-Food fish |
| 2. | *Ambassis buruensis* Bleeker, 1857<br>Pempreng | Apogonide | -Sumatera, Java, Bali Sulawesi, Moluccas, Philippines, New Guinea<br>-Marine fishes occasionaly visit freshwater<br>-Food fishes |
| 3 | *Awaous grammepomus* Bleeker, 1849<br>Belosoh | Gobiidae | -Indonesia, Philippines<br>-Estuarine fishes which enter freshwater<br>- Ornamental fishes |
| 4 | *Belobranchus belobranchus* (Valenciennes, 1837)<br>Belosoh | Eleotridae | -Nias, Java, Sulawesi, Lesser Sundas, Moluccas, Philippines<br>-Estuarine fishes which enter freshwater<br>-Ornamental fishes |
| 5 | *Caranx sexfasciatus* Quoy and Gaimard, 1824<br>Bagad | Carangidae | -Indo-Pasific<br>-Marine fishes ocasionally visit fresh water<br>-Food fishes |
| 6 | *Channa gachua* Hamilton-Buchanan, 1822<br>Bogo | Channidae | -Sundaland, Bali, Indochina, India, Srilangka<br>-Freshwater fish, carnivorous[2] food fish<br>-Ornamental fishes |
| 7. | *Cyprinus carpio* (Linnaeus, 1846)<br>Ikan Mas/Lauk Mas | Cyprinidae | -Originally from Japan, China and Central Asia: introduced throughout the world<br>-Omnivorous: it is able to adjust its feeding habit to available food, high fecundity (37.826- 1.266.500)[3]<br>-Food and ornamental fish |
| 8. | *Glyptothorax platypogon* (Cuvier and Valenciennes,1842<br>Kehkel | Sisoridae | -Sumatra, Borneo, Java, Malaysia<br>-Omnivorous, low fecundity (104-920)[4]<br>-Ornamental fish |
| 9. | *Gymnothorax* sp.<br>Moa | Muraenidae | -Sumatra, Borneo, Java, Sulawesi, Moluccas, New Guinea, Palawan, Sri Lanka, Fiji<br>-Marine fish which occasionally enter freshwater, carnivorous<br>-Food and ornamental fish |
| 10. | *Kuhlia marginata* (Cuvier, 1829)<br>Corengcang | Teraponidae | -Indonesia, West Pacific, Polynesia<br>-Marine fish which occasionally enter freshwater<br>-Food fish, sport fish |
| 11. | *Liza macrolepis* Smith, 1849<br>Belanak | Mugilidae | -Indo-West Pacific<br>-Marine fish which occasionally enter estuarin<br>-Food fish |

*Table 1 (continued)...*

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|---|---|---|---|
| 12. | *Lentipes* sp.<br>Cinir Putri, Menga Kumpay | Gobiidae | -Bali, Java, New Guinea, Hawaii, Micronesia<br>-Amphydromous, high fecundity (7000-14.000)[5)]<br>-Ornamental fish |
| 13. | *Microphis argulus* (Peters, 1855)<br>Pangerek Buaya | Syngnathidae | -Java, Flores, Madagascar, Fiji, Polynesia<br>-Low fecundity, limited mobility, structure matting pattern,site fidelity as refer to seahorse in general [6)]<br>-Medicinal value |
| 14. | *Microphis brachyurus* (Bleeker, 1853)<br>Pangerek Buaya | Syngnathidae | -Sumatra, Java, Lesser Sunda, Moluccas, New Guinea, India, Philipines, Indochina, Japan, South Africa<br>-Low fecundity, limited mobility, structure mating pattern, site fidelity as refer to sea horse in general [6)]<br>-Medicinal value |
| 15. | *Oreochromis mossambicus* (Peters, 1852)<br>Mujaer/Tilapia | Cichlidae | -Africa, introduced into Sumatra, Borneo, Java, Sulawesi etc.<br>-Prolific breeding habit<br>-Cultivated in the ponds for food |
| 16. | *Puntius binotatus* Valenciennes, 1842<br>Beunteur | Cyprinidae | -Sundaland, Bali, Lombok, Phillipines, Indochina<br>-Omnivorous:feed on insects and plant[7)8)]<br>-Ornamental fish |
| 17. | *Poecilia reticulata* Peters, 1859<br>Bungkreng, Ikan Seribu | Poecilidae | -Venezuela, introduced to Sundaland, Sulawesi<br>-Insect feeder, internal fertilization:give birth of their young[9)]<br>-Mosquito control |
| 18. | *Rasbora aprotaenia* Hubbs and Brittan, 1954<br>Paray | Cyprinidae | -Java North<br>-Insect feeder<br>- Ornamental fish |
| 19. | *Rhyacichthys aspro* (Valenciennes in Cuvier and Valenciennes, 1837)<br>Nayapan | Rhyacichthydae | -Sumatra, Java, Bali, Sulawesi, Moluccas, New Guinea, Philippines, Taiwan, Solomon<br>-Freshwater fish: amphydromous[10)]<br>-Ornamental fish |
| 20. | *Sicyopterus cyanocephalus* (Cuvier and Valenciennes, 1837)<br>Menga | Gobiidae | -Java, Sulawesi, Lesser Sunda, Andaman island, Philippines, Papua New Guinea<br>-Freshwater fish:probably amphydromous<br>-Ornamental fish |
| 21. | *S.macrostatholepis* Bleeker, 1853<br>Menga | Gobiidae | -Sumatra West, Java, Bali, Lesser Sundas, Moluccas<br>-Freshwater fish:probably amphydromous<br>-Ornamental fish |
| 22 | *S.microcephalus* Bleeker, 1854<br>Menga | Gobiidae | -Java, Sulawesi, Lesser Sunda, Andaman Island<br>-Freshwater fish:probably amphydromous<br>-Ornamnetal fish |
| 23 | *Sicyopus* cf.*balinense* (Bleeker, 1857)<br>Menga | Gobiidae | -Nias, Bali, New Guinea<br>-Freshwater fish: probably amphydromous<br>-Ornamental fish |

*Table 1 (continued)...*

| | | | |
|---|---|---|---|
| 24. | *Schismatogobius marmoratus*<br>Buhung | Gobiidae | -Sulawesi, Philippines, Japan<br>-Estuarine fish which enter freshwater<br>-Ornamental fish |
| 25. | *Stiphodon semoni* Weber, 1895<br>Menga | Gobiidae | -Indonesia, Philippines, Pacific<br>-Freshwater fish:probably amphydromous<br>-Ornamental fish |
| 26. | *Tor tambra* (Valenciennes in Cuiver and Valenciennes, 1842)<br>Soro | Cyprinidae | -Sundaland<br>-Primary freshwater:plankton feeder[11],<br>possibly has low fecundity as *T.tambroides* (1995 – 7595)[12]<br>-Food fish, Ornamental, and Sport fish |
| 27 | *Trichogaster trichopterus* (Pallas,1777)<br>Sepat | Belontiidae | -Sundaland, Indochina<br>-Secondary freshwater fish, cultivated in the ponds, algae feeder[13]<br>-Food fish, Ornamental fish |
| 28 | *Vespicula depressifrons*<br>Lepu | Scorpaenidae | -Sumatra, Bali, Sulawesi, Moluccas, New Guinea,Philippines<br>-Marine fish which enter freshwater |
| 29 | *Xipophorus hellerii*,Heckel 1848<br>Paris | Poecilidae | -Mexico, introduced to Java North, Sulawesi<br>-Secondary freshwater fish<br>-Mosquito control, and ornamental fish |

1) Kottelat et al (1993)
2) Ng and Lim (1990)
3) Prameswaran et.al (1972)
4) Rachmatika (1987)
5) Maciloek (1978)
6) Lourie et al (1999)
7) Sulastri and Hartoto (1985)
8) Inger and Chin (1962)
9) Mohsin and Ambak (1983)
10) Akihito Prince et al (1988)
11) Susilawaty et al.(1972)
12) Rachmatika and Haryono (1999)
13) Mohsin and Ambak (1983)

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**Fig. 1.** Longitudinal distribution of fish communites : a case of Cibareno River

| Hill<br>annual crops<br>seasonal crops, field rice | | Hill<br>annual crops<br>seasonal crops, field rice | | Mountaneous area<br>primary forest<br>(National Park) | |
|---|---|---|---|---|---|
| Tidal area | | deep pool (until 4 m deep) and riffle zones | | cascade zone | |
| Loc.1 >>>>>>> | Loc.2 | Loc.3 | Loc.4 | Loc.5 | Loc.6 |
| Anguillidae | Cyprinidae | Anguillidae | Belontiidae | Channidae | Cyprinidae |
| Apogonidae | Eleotridae | Cyprinidae | Channidae | Cyprinidae | Gobiidae* |
| Carangidae | Gobiidae | Gobiidae* | Gobiidae* | Gobiidae* | Sisoridae |
| Eleotridae | Poecilidae | Rhyacichthydae | Poecilidae | Sisoridae | |
| Elopidae | Rhyacichthydae | Sisoridae | Sisoridae | | |
| Gobiidae | Teraponidae | | | | |
| Mugillidae | Syngnathidae | | | | |
| Ophichthidae | | | | | |
| Scorpaenidae | | | | | |
| Syngnathidae | | | | | |
| Teraponidae | | | | | |

* Sicydiinae

**Fig. 2.** Fish assemblages in longitudinal section of Cibareno River

| Locality 1 | Locality 2 | Locality 3 | Locality 4 | Locality 5 | Locality 6 |
|---|---|---|---|---|---|
| *Ambassis buruensis* | *Awaous grammepomus* | *Anguilla marmorata* | *Channa gachua* | *Channa gachua* | *G. platypogon* |
| *Anguilla marmorata* | *Belobranchus belobranchus* | *Cyprinus carpio* [1)] | *Cyprinus carpio* [2)] | *Cyprinus carpio*[2)] | *Lentipes* sp. |
| *Awaous grammepomus* | *Cyprinus carpio* | *Glyptothorax platypogon* | *Glyptothorax platypogon* | *G. platypogon* | *R.aprotaenia* |
| *Belobranchus belobranchus* | *Eleotris melanosoma* | *Lentipes* sp. | *Lentipes* sp. | *Lentipes* sp. | |
| *Sicyopuscf.balinense* | | | | | |
| *Caranx sexfasciatus* | *Kuhlia marginata* | *Puntius binotatus* | *Poecilia reticulata* | *Puntius binotatus* | |
| *Eleotris melanosoma* | *Microphis argulus* | *Rhyacichthys aspro* | *Sicyopterus macrostatholepis* | *S. macrostatholepis* | |
| *Lamnostoma* sp. | *Poecilia reticulata* | *Sicyopterus cyanocephalus* | *Trichogaster trichopterus* | | |
| *Liza macrolepis* | *Puntius binotatus* | | | | |
| *Megalops cyprinoides* | *Rhyacichthys aspro* | | | | |
| *Microphis argulus* | *Schismatogobius marmoratus* | | | | |
| *Microphis brachyurus* | *Sicyopterus cyanocephalus* | | | | |
| *Sicyopterus cyanocephalus* | *S.macrostatholepis* | | | | |
| *S.macrostatholepis* | *S.microcephalus* | | | | |
| *S.microcephalus* | *Stiphodon elegans* | | | | |
| *Schismatogobius marmoratus* | *Tor tambra* | | | | |
| *Stiphodon elegans* | | | | | |
| *Vespicula depressifrons* | | | | | |

[1)] informed by villager to occur in this area
[2)] occurred in the ponds