Reef Fish Community of Pamuteran and Sumber Kima Waters, Buleleng, Bali

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Abstrak

Distribusi dan kelimpahan komunitas ikan karang sangat dipengaruhi oleh faktor biologis dan fisik seperti paparan gelombang, beban sedimen, kedalaman air serta kompleksitas topograhical dari substrat karang. Penelitian ini ditujukan untuk memberikan gambaran pada struktur komunitas ikan karang di Sumber Kima dan perairan Pemuteran, Buleleng, Bali Utara. Pengambilan sampel dengan transek dari 100 meter panjang garis lurus, mengikuti kontur kedalaman dan meletakkan sejajar dengan bagian depan karang. komunitas ikan karang dipelajari dengan siang hari di bawah air visual yang metode sensus transek ikan dari 100 x 5 m mendata spesies ikan dan kelimpahannya. sensus ikan dilakukan tiga kali per situs. Ikan diidentifikasi untuk tingkat spesies. Kelimpahan ikan yang dikumpulkan dari data dari lokasi pengambilan sampel dari setiap lokasi dianalisis menggunakan indeks struktur masyarakat. dari total 7.966 ikan yang disensus dari sembilan situs permanen selama periode penelitian. Ada 78 spesies milik 24 keluarga ditemukan di Pamuteran dan 65 spesies dari 24 keluarga di Sumber Kima Waters. Pomacentridae adalah keluarga yang paling melimpah di kedua lokasi pengambilan sampel terdiri dari 14 spesies di perairan Pamuteran dan 12 spesies di perairan Sumber Kima, Diikuti oleh Chaetodontidae terdiri dari 10 spesies di perairan Pamuteran dan sumber perairan Kimas

Kata kunci : *ikan karang, Pamuteran, Sumber Kima, Bali*

Abstract

The distribution and abundance of the coral reef fish community is strongly influenced by biological and physical factors like wave esposure, sediment loads, water depth as well as topograhical complexity (rugosity of the coral substrate. This study was aimed to provide description on the structure of reef fish communities in Sumber Kima and Pemuteran waters, Buleleng, North of Bali. The transect of 100 meter length line were straight, following the depth contour and were laid down parallel to the reef front.The reef fish community was studied with daytime underwater visual census method on fish transect of 100 x 5 m recording the fish species and their abundances.The fish census was done three times per site. Fish were identified to species level. The pooled fish abundance data from sampling sites of each location were analysed using community structure indices. Of total 7966 fishes were censused from 9 permanent sites during study period.There were 78 species belong to 24 families found at Pamuteran and 65 species of 24 families at Sumber Kima Waters. Pomacentridae was the most abundant family at both sampling sites consisted of 14 species in Pamuteran waters and 12 species in Sumber Kima waters, followed by Chaetodontidae consisted of 10 species in Pamuteran waters and Sumber Kimas waters.

Keywords :reef fish, Pamuteran, Sumber Kima, Bali

INTRODUCTION

Coral reefs support a high diversity of fishes by providing food, shelter and living space. as happened worldwide, coral reefs face degradation caused by a variety of perturbations, including bleaching and predation by crown-of-thorns

starfish; as well as anthropogenic (e.g. overfishing, sedimentation, pollution) disturbances (Pandolfi et al. 2003). There is increasing evidence that these disturbances can have a substantial effect on the structureof fish assemblages associated with coral reefs (Jones et al. 2004, Munday 2004b).

The distribution and abundance of the coral reef fish community is strongly influenced bybiological and physical factors like wave esposure, sediment loads, water depth as well as topograhical complexity (rugosity of the coral substrate (Chabanet et al., 1997). Additionally, weather and curent waere founds to influence reef fish composition (Walsh, 1983). In certain family of fishes, the living Scleractinian corals, food diversity and reproductiive behaviour seen also to affect their diversity (Galzin et al., 1994).

Sumber Kima and Pamuteran waters are in Buleleng Regency of North Bali. Coral reef fisheries in both area plays an important role as community livelihood. Beside fisheries, fishing sport and tourism activities are also increasing in the such area. During Workshop coral reef fisheries management, Sutrisna (2015, http://reefcheck.or.id/ 2015/09/03/lokakarya-pengkajian-stok-ikan-karang #stash.vxyaSLhf.dpuf) reported that fishing activities in the both waters are still undercontrolled but in the near future with increasing demand of coral fishes coral reef fish will lead to overexploited. But Russ (1991) reported that fishing activities cause habitat modification, thereby affecting fish populations and communities level of reef fishes. Therefore this study was aimed to provide description on the structure of reef fish communities in Sumber Kima and Pemuteran waters, Buleleng, North of Bali.The information will be useful as a reference for the proper management of tourism and fisheries.

MATERIALS AND METHODS

The research material are fishes found in Sumber Kima and Pamuteran Waters, Buleleng Regency of North Bali. There are 9 sites chosen, ie 5 site in Pamuteran and 4 sites in Sumber Kima Waters. The transect of 100 meter length line were straight, following the depth contour and were laid down parallel to the reef front. The reef fish community was studied with daytime underwater visual census method (Adrim, 1995; English et al., 1994; Samoilys and Carlos, 2000) on fish transect

of 100 x 5 m recording the fish species and their abundances.The fish census was done three times per site. Fish were identified to species level based on Burgess and Axelrod (1972), Masuda et al. (1984). Allen and Steene (1987), Kuiter (1992), Lieske and Myers (1997) and Alen (1999). The pooled fish abundance data from sampling sites of each location were analysed using the Shannon diversity index (Magurran, 1988). The homogeneity of the reef fish community was measured by Pielou's evennessindex (Clarke and Warwick, 1994) and dominance indices (Odum, 1971) see Table 1.

RESULTS AND DISCUSSION

Sumber Kima and Pemuteran waters located in Gerokgak area of Buleleng, North Bali. There are fringing reef in both waters up to the depth of 12 m. Several reef patch were foundin Pamuteran and there is sand dune in Sumber Kima waters gave better protection from the waves. At a depth of 10 m, the percent coral cover of Sumber Kima was higher (19,34 - 93,42%) than Pamuterans waters (5,60-29,30%). In both area, the fishermen catch ornamental fish as their livelihood.

Of total 7966 fishes were censused from 9 permanent sites during study period. There were 78 species belong to 24 families found at Pamuteran and 65 species of 24 families at Sumber Kima Waters (Table 2). Compare to Bunaken National Park, the abundance of reef fishes species of Pamuteran and Sumber Kima is lower. Setiawan *et al* (2013) found of total 368 species belong to 46 family reef fishes consist of 30 species indicator fish (Chaetodonthidae), 238 major fish species (32 family), and 100 species of target fish (15 family) in Bunaken National Park.

Diversity index (H') of reef fish in Pemuteran waters was 3.99 , eveness index (E) was 0.63 and dominance index (C) was 0.13. In Sumber Kima waters the diversity index (H') , reef fish amounted to 2.37% , the eveness index (E) was 0.39 and dominance index (C) of 0.45 % (Table 2). The value of community similarity index between two locations (Pemuteran and Sumber Kima) as calculated by the formula Community Similarity Index (Odum , 1971) was 62,94%. This fair value due to different ecosystem. There was sun dune in Sumber Kima make the environment more close than Pamuteran Waters.

Table 1. Potensial resources in Pamuteran and Sumber Kima Waters

No.	Item	Pemuteran	Sumber Kimia
1	Coral cover (%)	5,60 - 29,30	19,34 - 93,42
2	Coral type	Fringing reef	Fringing reef
3	Reef Fishes		
	a. Number censused	3419	4547
	b. Number of family	24	24
	c. Number of spesies	78	65
5	Indeces of reef fish community		
	a. Diversity	3,99	2,37
	b. Evenness	0,63	0,39
	c. Dominance	0,13	0,45
	d. Community evenness	62,94%	
6	Mangrove existance	none	exist
7	Coastline	Bay	Bay with sand dune

A number of 3419 reef fishes belong to 24 families has been found in Pamuteran watres and was dominated by family Pomacentridae (relative abundance of 15,62%) (Table 2). Other families, such as Chaetodontidae, Caesonidae, Pseudochromidae etc existed in lower number with relative abundance less than 3%. In Sumber Kimia watres there were 4547 individus reef fishes cencused belong to 24 families. Apogonidae has highest relative abundance (66,81%), followed Family of Centricidae and Caesionidae has third and fourth relative abundance i.e. 5,81% and 3,41%, others was less than 3% (Table 2).

In general Pomacentridae was the most abundant family at both sampling sites consisted of 14 species in Pamuteran waters and 12 species in Sumber Kima waters, followed by Chaetodontidae consisted of 10 species in Pamuteran waters and Sumber Kimas waters. Pomacentrids are the most common fishes in tropical and subtropical seas.

Coral reef fish species vary in the degree to whichthey are reliant on characteristics of the underlying substratum (Syms & Jones 2000). Coral-associated fish communities comprise a variety of species, representing the full spectrum of coral dependency, fromextreme habitat specialists (Munday, 2001) to specieswith highly flexible habitat requirements (Guzman &Robertson, 1989). Species-specific differences in livecoral dependence are likely to influence how fish assemblages respond to live coral loss (Munday,2004b). Fish species with a strong preference for, or an obligate association with, live coral are likely to decline in both abundance and diversity in response to increased mortality of their host corals (Shibuno et al.,1999). Degradation of live coral may also influence both the movement and recruitment of species that utilise non-living coral substrata, such as dead corals or rubble (Jones & Syms ,1998). Furthermore, seaweeds typically colonise recently disturbed habitats (Hughes,1994), thereby increasing the availability of benthic algal resources. An increase in algal resources generally results in an increase in both the abundance and diversity of herbivores, detritivores and mobile invertebrate feeding fishes (McClanahan et al. 2002).

The abundance of species with an obligate association with live coral differed among coral health categories. Average total abundance of all fish species was lowest in algalcovered colonies of both coral species and these assemblages were dominated by species that are not closely associated with live coral. Lower fish abundance on algal-covered colonies was largely due to the low number of small size classes (new recruits and juveniles). This study suggests that habitat health may play an important role in structuring coral-associated fish assemblages (Feary et al., 2007).

This present work revealed that abundance of family Pomacentrids was the highest in both location, i.e. 2317 and 668 individus (Tabel 2).

Pomacentridae were found to be diurnal fishes, remaining by day either near the bottom or for aging in the water column above their home range (Fricke, 1977). This bottom-living species were defined as those remaining within 50 cm of the substrate; mid water species ascend higher. Stomach analysis of all species showed the pomacentrids of the Gulf of Aqaba to be herbivorous, omnivorous or plankton-carnivorous. Home-and-shelter-site select-ion of Pomacentrids revealed that the substrate of the home-and-shelter-site was determined.

This is occupied by night, and during resting periods by day, it is also used to excape from predator attacks or in response to other alarm stimuli. The selection of substrate was classified as either specialized or unspecialized. Specialization exists when a species exhibits habitat preference. *Chromis caeruleus, D. aruanus* and *D. marginatus* are coral-dwelling species; *Amphiprion* species inhabit sea anemones. All other species are able to live on various substrates, that is, they are unspecialized.

Table 2. Reef fishes family found in Pemuteran and Sumber Kima Waters

No.	Family	Number of species		Abundance (Inds.)		Relative abundance (%)	
		Pamuteran	Sumber Kima	Pamuteran	Sumber Kima	Pamuteran	Sumber Kima
1	Acanthuridae	4	2	54	13	1,58	0,29
2	Apogonodae	-	2	-	3038	0,00	66,81
3	Balistidae	2	1	3	1	0,09	0,02
4	Bleniidae	4	2	33	6	0,97	0,13
5	Caesionidae	2	2	100	155	2,92	3,41
6	Callionymidae	1	1	7	2	0,20	0,04
7	Carangidae	-	1	-	4	0,00	0,09
8	Centriscidae	1	1	4	264	0,12	5,81
9	Chaetodontidae	10	8	102	74	2,98	1,63
10	Cirrihitidae	1	2	6	11	0,18	0,24
11	Ephippidae	1	1	2	1	0,06	0,02
12	Gobiidae	7	6	25	65	0,73	1,43
13	Haemolidae	-	1	-	2	0,00	0,04
14	Holocentridae	-	1	-	6	0,00	0,13
15	Labridae	9	5	534	110	15,62	2,42
16	Lutjanidae	1	3	2	7	0,06	0,15
17	Microdemidae	3	-	16	-	0,47	0,00
18	Monacanthidae	1	-	1	-	0,03	0,00
19	Mullidae	1	3	7	6	0,20	0,13
20	Ostraciidae	1	-	1	-	0,03	0,00
21	Pomacanthidae	3	1	48	2	1,40	0,04
22	Pomacentridae	14	12	2317	668	67,77	14,69
23	Pseudochromidae	1	1	68	47	1,99	1,03
24	Scorpaenidae	1	-	2	-	0,06	0,00
25	Serranidae	5	4	43	40	1,26	0,88
26	Siganidae	3	3	20	21	0,58	0,46
27	Syngnathidae	-	1	-	2	0,00	0,04
28	Tetraodontidae	1	-	8	-	0,23	0,00
29	Zanclidae	1	1	16	2	0,47	0,04
	Total	78	65	3419	4547	100	100

Tabel 3.Abundaces, Minimum length (Lm), maximum length (Lx) and average length (La) of haetodonthidae and Pomacentridae Fish in Pamuteran and SumberKima Waters.

Family/Species	Pemuteran Waters				Sumber Kima waters			
	Number	Lmin	Lmax	Lav	Number	Lmin	Lmax	Lav
Chaetodonthidae								
1. *Chaetodon kleini*	4	9	9	9,00	-	-	-	-
2. *C. bennetti*	-	-	-	-	1	1	1	1,00
3. *C. Melanotus*	4	2	7	4,75	2	5	5	5,00
4. *C. Mesoleucus*	2	3	3	3,00	3	3	10	6,00
5. *C. Speculum*	2	5	5	5,00	-	-	-	-
6. *C. trifasciatus*	11	3	9	5,73	12	1	6	4,58
7. *C. vagabundus*	5	3	9	6,2	11	4	9	5,27
8. *Chelmon rostratus*	7	3	10	5,43	2	3	5	4,00
9. *Coradion chrysozonus*	1	5	5	5,00				
10. *Hemitaurichthys polylepis*	61	1	4	3,72	35	2	3	2,63
11. *Heniocus varius*	5	3	5	3,80	8	2	5	3,13
Pomacentridae								
1. *Chromis retrofasciata*	-	-	-	-	12	1	1	1,00
2. *C. viridis*	1030	1	5	2,98	274	2	2	2,00
3. *Chrysiptera cyanea*	30	4	5	4,33	-	-	-	-
4. *C. margaritifer*	30	5	7	5,67	-	-	-	-
5. *C. rollandi*	5	3	3	3,00	-	-	-	-
6. *C. leucapma*	-	-	-	-	16	2	2	2,00
7. *C. talboti*	184	1	3	1,94	56	1	3	1.82
8. *Dascyllus auanus*	31	2	5	3,32	6	1	1	1,00
9. *D. melanurus*	54	2	3	2,83	5	1	2	1,20
10. *D. prosopotaenia*	7	2	3	2,29	3	1	1	1,00
11. *D. reticulatus*	107	1	5	2,62	41	1	2	1,12
12. *D. trimaculatus*	88	1	4	2,4	32	1	3	2,38
13. *Neopomacentrus azysron*	10	5	5	5,00	-	-	-	-
14. *Pomacentrus caeruleus*	320	2	4	3,00	23	2	2	2,00
15. *P. coelestris*	162	2	4	2,77	25	2	2	2,00
16. *P. molluccensis*	259	1	4	1,88	175	1	4	1,89

The life cycle of most reef fish can be divided into three phases i.e. pelagic larval, juvenile, and adult stage. During the pelagic phase, eggs and/or larvae float in the open water as a component of marine plankton. Juvenile phase begins when the young age of the fish settled on reefs in a process.

Adult phase is marked by the commen cement of sexual maturity. For most reef fish, adult stage gets more attention, and relatively recently the importance of the ecology of the larvae and the rate of juvenile known (Doherty, 1991; Jones , 1991; Leis , 1991a ; Richards , 1982; McFarland , 1985; Hallacer , 2003).

The size of minimum length (Lm), maximum length (Lx) and average length (La) of Chaetodonthidae and Pomacentridae fish could be seen in Table 3. It seems that they are recruit fish in the reef ecosystem of Pamuteran and Sumber Kima Waters.

Reef fish tend to have high fecundity. They release a bunch of eggs daily, weekly , monthly or less frequently. Group of eggs are released also vary in size from start small number, hundreds or even thousands. Young fishes live settle after experiencing the pelagic phase of experiencing mortality varied from low to high once weekly over a period of coral reef environment (Hutomo , 1995).

Understanding the food ecology of coral reef fish is important for several reasons. To survive, fish need their feed. Predation on fish can have great impact on reef fish communities as a whole. When the unitary arrangement of foods from a set multispecies reef fish are evaluated, these data provide knowledge about the energy that flows through the coral reef communities (Hallacher, 2003). Although there are several reef fish family that includes members of herbivore, which have appeared only four family, i.e. Acanthuridae (76 species), Siganidae (25 species), Scaridae (79 species) and Pomacentridae (159 species) (Table 2) (Choat, 1991). Another significant herbivore groups was blennies (Blenniidae), although it need more study (Choat, 1991).

Because of diurnal planktivora consume large quantities of plankton of open sea, it has long been said that the fish planktivora is a major food chain between the reef and the open ocean (Emery 1986 and Birdsong, 1973, in Hallacher, 2003). There are three ways how energy may be taken or released between planktivora fish and coral reefs. First, some planktivora may be consumed by fish big piscivora (Choat, 1986; Hartline et al., 1972 and Polovina, 1984 in Hallacher, 2003). Second, the main energy flow during the day planktivora to coral reef organisms is through their feces (Hobson, 1991). Planktivora produce large amounts of feces (sometimes accompanied by many zooplankton, undigested) were "showered" coral reefs and consumed by other fish such as benthos herbivore and detrivora (Hobson, 1991; Robertson, 1982 in Hallacer, 2003). Third way in which the diurnal planktivora possible to transfer energy is through the death of coral reefs and then decay (Hallacher, 2003).

Carnivorous species of reef fish are more common on coral reefs than herbivores or planktivores. Jones et al. (1991) in their review of predation and its inhabitants, evaluate from seven studies on diet reef fish (Goldman and Tallbot, 1976; Hobson, 1974; Willams and Hatcher, 1983; Sano et al., 1984; Thresher and Colin, 1986) , and calculate the portion of the reef fish species feeding on different categories. Carnivore species, piscivora and benthic invertebrate feeders, excluding planktivora speciesis the most common which ranged from 68% to 41% . Herbivores ranged from 25% to 7% of existing species , planktivora ranged from 38 % till 4% and omnivore ranged from 19% to 4%.

Overall the number of reef fish species found in the Pemuteran and Sumber Kima waters are 98 species belong to 29 family (Table 2). This result was lower than study of Allen (2002) who observed coral fish Raja Ampat Papua island. The results of this study stated that Raja Ampat Islands are a the richest with highest fish species in the world , at least 970 species. Gobies (Gobiidae), damselfish (Pomacentridae), and Labridae are the dominant group in the Raja Ampat Islands (110, 109 and 98 number of species respectively) (Alllen, 2002).

The coral cover of Pemuteran waters was 5.60-29.30%. This is a smaller than coral cover in Sumber Kima watersi.e. 19.34-93.42% (Table 1). But it was not for their abundance of reef fish species. Data from census visual observations of the abundance of reef fish species in Pemuteran waters showed richer (78 species) than Sumber Kima waters (65 species). It may be influenced by the presence of algae which was quite abundant in these waters as source of food of reef fish. According Widjojodharmo (2002) in the waters of Pemuteran mostly dead coral and coral fragments (rubble) has been overgrown by algae. It is reinforced by data showing that in Pemuteran many as 1236 (36.15% of the total people) fish in 28 species of algae turned out to incorporate in their food preferences.

An abundance of reef fish in the Pemuteran waters was dominated by Pomacentridae consisted of 14 species with relative abundance of 67.77 % (Table 3). Research on the structure of reef fish communities by visual census methods conducted by Manthachitra and Sudara (2002) on reef Gulf of Thailand found 29 family consisting of 83 species with an abundance of reef fish were also dominated by Pomacentridae consisting of 13 species with

abundance by 40 %. Then, the study of Ackerman and Bellwood (2000) on the Northern Pionneer Bay, Orpheus Island Great Barrier Reef Australia found 146 species of Pomacentridae moluccensis has nearly 50 % of all individual fish recorded in Pioneer Bay. Pomacentridae (Damselfishes) is one of the most abundant reef fish, about 320 species can be found in the world (Randall et al., 1997).

In contrast with Pemuteran waters, in Sumber Kima waters Pomacentridae occupy second largest after Apogonodae (Table 4). According to Nybakken (1992), high diversity of species on reefs due to variation of reef habitats. Coral reefs are not just made up of coral, but also a sandy area, various bays and crannies, algae, as well as shallow and deep waters as well as the different zones across the reef (Nybakken, 1992) . Based on these reasons , the difference in the condition of waters including coral cover or shape of Pemuteran beach and Sumber Kima (more covered by a san dune) can be influences the family composition of reef fish .

Chromis viridis of Pomacentridae was the most abundant fishes in the Pemuteran waters (1030 fishes or 30.13% of the total individuals) (Table 2). This species feeds on phytoplankton (Fish Base, 2000). Planktivora depends on the flow of water that supply them with food. It is well known that the flow is important for planktivorous in getting food (Stevenson, 1972; Hobson, 1991). Pemuteran bay is relatively more open than Sumber Kima waters. Such conditions allow the water flow easier than Pemuteran bay. Besides this species in not fish target of fishermen.

Reef fish of Sumber Kima waters was dominated by *Archamia fucata* (family Apogonidae) with a very high abundance as many as 3018 fishes (66.81%). This species is found in large groups and look like they were resting quietly on the sidelines of branching corals. Family Apogonidae was a nocturnal feeder (McConnell, 1987), in their evening go out from a resting place for foraging (Randall et al., 1997). The existance of *Archamia fucata* in Sumber Kima waters may be related to its more sheltered bays. According to Fish Base (2000), *Archamia fucuta* found live in lagoon patch reef, and usually form dense groups in caves or among branching corals. Same as *Chromis viridis*, *Archamia fucata* was not a favorite species for fishermen.

Research on the effects of fish capture on the structure of reef fish communities conducted by Tissot and Hallacher (2003) by comparing the abundance of ornamental fish species and control area) in Kona Hawaii showed that 7 and 10 ornamental species showed a decrease in the numbers significantly. Abundance of ornamental species fish at the capture site ranged from 38% (*Chaetodon multicinctus*) to 75% (*C. quadrimaculatus*) lower.

Widjojodharmo (2002) took samples of ornamental fish catch data for 6 months of a fisherman who catch fish in the Pemuteran and Sumber Kima waters found that their preference for the 65 species of reef fish. *Labroides dimidiatus* is a species with the highest frequency of catch compared to other species that with the percentage 16.77 % of the total fish followed by *Cirhilabrus cyanopleura* (7.95), *Pseudochromis paccagnellae* (6.82%) and the other in a smaller percentage. In the waters of Pemuteran, the abundance of *Labroides dimidiatus* was small (1.08% or 37 indv.) with an average body length was 3.08 cm (Table 3) while in the Sumber Kima Watres was 0.44% (20 indv.) with an average body length of 3.95 cm (Table 3) .

Body length of *Labroides dimidiatus* found in the research locations was 5 cm (Table 3). According to Randall et al., (1997) *Labroides dimidiatus* species can reach a length of 11.5 cm in the Great Barrier Reef. If it is assumed that growth parameters and mortality were similar on that different geographic location,it is possible that the fishing activities in Pemuteran and Sumber Kima waters were very high and caused the loss of species. Russ (1991) compared the coral reefs in Haiti which is the subject of the exploitation of fishing with different levels. They showed that the length of the body of Scaridae and Chaetodonidae (group most captured) turned out to be shorter in areas that experienced more severe exploitation.

CONCLUSION

Of total 7966 fishes were censused from 9 permanent sites during study period. There were 78 species belong to 24 families found at Pamuteran and 65 species of 24 families at Sumber Kima Waters. Pomacentridae was the most abundant family at both sampling sites consisted of 14 species in Pamuteran waters and 12 species in Sumber Kima waters, followed by Chaetodontidae consisted of 10 species in Pamuteran waters and Sumber Kimas waters.

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