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CORAL REEF MANAGEMENT IN TAKA BONERATE MARINE NATIONAL PARK, SOUTH SULAWESI (A CASE STUDY FOR THE ALTERNATIVE TO DESTRUCTIVE FISHING PRACTICES ON CORN REEFS)

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ABSTRACT

The c*oral reef is the most productive marine ecosystem in coastal waters. The primary productivity may reach up to more than 10 kg C/m^2/year. This resulted in a high number of fisheries production, such as fishes, shrimps, lobster, mollusc (shellfish), turtle, and others. Unfortunately, this condition has already suffered from non-sustainable human use including destructive fishing practices (bombing and cyanide), coral mining, over fishing, settlement pollution and uncontrolled tourism development. These affected the production of those fisheries resources in coral reefs. In order to manage those resources, such alternative to destructive use need to be studied.*

This paper reports alternatives to destructive fishing practices on coral reefs. The study had been carried out at Taka Bonerate Marine National Park, the District of Selayar, South Sulawesi province, for about 3 weeks, 7-26 November 2000. Survey method was used during the study. The data were collected using ***Participatory Rapid Appraisal (PRA)****'s method, with members of fisher group as the participants.*

Three kinds of reef fish groups are identified at the Taka Bonerate Islands waters, i.e. major group, target group, and indicator group. These include ornamental and consumption fishes. These were caught with several fishing gears, while some of them are identified as destructive fishing practices, e.g. bomb, cyanide fishing. However, some of them can be recommended as sustainable fishing technologies, i.e. (1) pancing cumi-cumi, (2) pancing tonda, and (3) samba/kulambi.

Key words: Coral reefs management, Destructive Fishing

INTRODUCTION

The coral reef is the most productive marine ecosystem in coastal waters. The primary productivity may reach up to more than 10 kg C/m^2/year. It is higher compared to the primary productivity in the open seas, which is usually only around 50-100 g C/m^2/year. This condition resulted in the gathering of varieties of species of animals. Therefore the secondary productivity, e.g. fishes, shrimps, lobster, mollusk (shellfish), turtle, and others, is also high in this system. The maximum sustainable yield (MSY) potential of fishes in Indonesian marine waters is estimated about 80,000 tons/year (Directorate General of Fisheries, 1991). With the total area of Indonesian coral reefs of about 50,000 km^2, the MSY of reef fishes resources is estimated around 1.6 tons/year in Indonesia. This contributes

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significantly to the national economy. Salm (1984) reported that the exports of reef–associated fish species from Indonesia earned more than US$ 97 million, or 16% of the total earnings from fish exports in 1979.

Coral reefs also provide opportunities for tourism development and other economic and financial returns that can be used to improve the welfare of coastal communities. However, the condition of coral reefs in Indonesia has already suffered from non-sustainable human use including destructive fishing practices (bombing and cyanide), coral mining, over fishing, settlement pollution and uncontrolled tourism development. If the destructive uses continue they will result in further deterioration of coral reefs in Indonesia with long-term adverse consequences locally for the welfare of coastal communities and nationally through knock-on effects. Regarding these problems, in order to protect, rehabilitate and achieve sustainable use of coral reefs and associated ecosystems in Indonesia, and, in turn, enhance the welfare of coastal communities, a sustainable alternative to fishing technology and other practices on coral reefs has to be found.

The objective of the present study is to obtain alternatives to destructive fishing practices on coral reefs at Taka Bonerate Marine National Park (TN-TBR), the District of Selayar, South Sulawesi province, which used to be one of the COREMAP (Coral Reef Management and Planning Program)'s sites.

METHODS

Sampling Technique

The study used the survey method. Two kinds of data were collected, i.e. the primary and secondary data. Primary data were collected using **Participatory Rapid Appraisal (PRA)**'s technique**.** Participants were members of fisher groups, comprising all strata of fishermen, i.e. "punggawa" (informal leader/collectors or seller), "juragan" (fishing gears and fishing boat's owner), "pandega" (fishers) and "sawi" (assistant fishers) They were chosen proportionally according to their number in the fisher population. In addition, these participants were representatives from the three villages in inner and outer Taka Bonerate Islands. Meanwhile, the secondary data were collected from the related departments, e.g. COREMAP office, the Fisheries Services.

Location and Duration of the Study

The survey was carried out at three villages, included two villages inside TN-TBR, i.e. Ranjuni and Tarupa, and one village outside TN-TBR, namely Kayuadi village (**Figure 1**). This was conducted for about 3 weeks, between 7-26 November 2000.

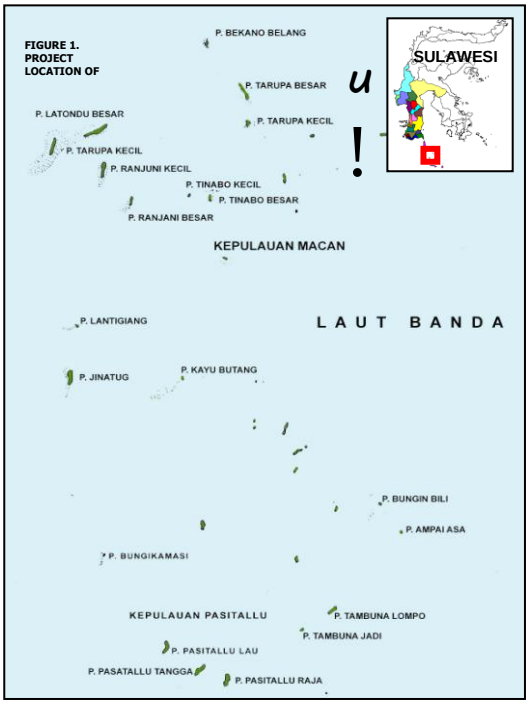

Figure 1. Project Location of Taka Bonerate

Data Analyses

The data, the fishing technologies used by the fishers, were selected by using Analytical Hierarchy (Saaty, 1986). This was used to select the most suitable fishing technology to be further developed, as well as the most destructive fishing practices to be curbed. A selection analysis based on environmental friendliness and sustainability principles was applied to the fishing technologies mentioned before. The technology finally selected was:

(1) highly selective with regard to the fish caught;
(2) non destructive to fish habitat;
(3) harmless to the operator (s) as well as to the consumers;
(4) able to produce good fish quality; In addition it had also
(5) provided minimum discard quality
(6) had minimum impact to bio-diversity
(7) prevented the catching of endangered species;
(8) shown socially acceptable attributes;
(9) ensured that the target species were still under the TAC (Total Allowable Catch);
(10) guaranteed profitability;
(11) needed low investment
(12) required low energy consumption;
(13) met legal requirements

Paired comparison matrices, scorings based on the available data and information, combined with expert judgment were applied to reveal the best options.

RESULT AND DISCUSSION

General Description of Taka Bonerate Marine National Park

Taka Bonerate Islands are located between 06°20'- 07°10' South Latitude and 120°55' - 121°25' East Longitude. It is located in the Flores Sea, east of the southern tip of Selayar Island, or halfway between Sulawesi and Flores. Taka Bonerate is the largest atoll (220,000 ha) in Indonesia and the area supports a high diversity of reef corals and invertebrate (Salm 1982; Usher, 1984). Therefore, the PHPA proposed this area as a strict nature reserve (Abdullah, 1986). Then, this was established as strict nature reserve through the Decree of the Minister of Forestry No. 100/Kpts-II/1989 dated 10 February 1989. Moreover, through the Decree of the Minister of Forestry No. 280/Kpts-II/1992 dated 26 February 1992 the Taka Bonerate was stated as Marine National Park, with the total area is 530,765 ha.

The Taka Bonerate Marine National Park (TN-TBR) covers Taka Bonerate Islands and surrounding islands in the District of Selayar, South Sulawesi with a total area of around 530,765 hectares. This park includes 21 islands, seven of which, namely Rajuni Besar, Rajuni Kecil, Tarupa Kecil, Latondu, Jinato, Pasitalu Tengah and Pasitalu Timur, have already permanent inhabitants. This park covers administratively two kecamatans (sub-districts), namely Kecamatan Passimasungu for North Taka Bonerate and Kecamatan Passimaranu for South Taka Bonerate.

The majority of the people (almost 90%) in TN-TBR engage in several marine related activities such as fishing, fishing boats industries, fish marketing , fish processing, and others. Most fishers in the area are small-scale fishermen using traditional fishing gears and fishing techniques such as hook and lines, nets, traps, and others The fishing ground is located around 1.5 to 2.0 km from the island. The fishermen usually use traditional fishing boats called the "Jarangka" (sampan), and "jolor" (bigger than "Jarangka" without board motor), with the total vessel capacity around 2-3 tons and 2-3 crewmen. The fishing boats are generally equipped with a motorized engine to reach fishing ground areas, which are relatively far from their homes.

Existing Coral Reefs Condition

Reef Corals Condition

Taka Bonerate Islands have a luxuriant coral diversity. The results of Marine Expeditions in Taka Bonerate Islands showed that at least 233 species were recorded in these areas (Bakosurtanal and P3O-LIPI, 1995). These genera are derived from 69 genera and 16 families. These families are distributed in all areas, but some of them tend to be more abundant, i.e. Acroporidae, Faviidae, and Fungiidae. While the dominant genus are *Acropora* (43) *Montipora* (23), *Fungia* (13), *Favites* (11), *Favia* (8), *Pavona* (7), and *Porites* (6). The branching corals, either genera *Acropora* or non-*Acropora*, tend to grow at any depth between 3 m to 10 m, while the massive and sub massive corals grow in deeper waters (10 m). These corals cover an average of about 24% and 20% of the total reef area respectively in the depth of between 3 and 10 m .

Reef Fishes Condition

At least 293 species with 43 families of reef-fish had been observed in Taka Bonerate waters during a marine expedition that took place during 25 September - 2 November 1995 (Bakosurtanal and P3O-LIPI, 1995). These fish are divided into three groups, i.e. major group, target group, and indicator group. The major group consists of 29 families with 178 species. They comprise a variety of size, from small, which are usually ornamental fish, to the bigger size, which are likely fish as food. The dominant species of the group are belong to the species of *Chromis ternatensis, Dascyllus reticulatus, Pomacentris coelestis, P. lepidogenis, P. retrofasciatus,* and *Acanthochromis polycanthus*. The target group consists of 13 families with 87 species. The majority are fish for consumption, most of which are economically important. The dominant species of the group are *Lutjanus decussatus, L. bohar, L.gibbus, Siganus virgatus,* and *Caesio trilineatus*. The indicator group consists of one family with 28 species. This group is likely dominated by the family Chaetodontidae, i.e. *Chaetodon kleini, C. trifasciatus*, and *C. vagabundus*.

Existing Fishing Technology

Bakosurtanal and P3O-LIPI (1995) reported that some destructive fishing practices may have occurred in the study site. It is reported that about 63 women fishers collected octopus in Pulau Tarupa Kecil. They used small spears (1m length, 0.4 cmϕ), wading or snorkeling to catch mostly octopus, from the genus *Cyanea*.

It is also reported that about 325 fish species were collected. These include 28 reef fishes indicator species, 87 target species (fish as food) and 210 species of mostly ornamental fishes. High fish bio-diversity are recorded in Jinatu waters, including the occurrence of Napoleon wrasse (*Cheilinus undulatus*) and the tiger kembang (*Balistoides couspicillum*). These fishes are usually captured by using variety of fishing gear and techniques. The daily catch of these fishes was about 2 to 3 Kilograms, with the price depending on the species, such as the live sunu merah super (size about 1.2 Kg/each) which was reported to reach about Rp 80,000.00/each. According to the fishermen the present catch was lower, compared with previous years, that was about 10 Kg/ day. In addition, it is reported that there is no limitation yet or Total Allowable Catch for the fisheries in Taka Bonerate, except for size limitation which is $\leq$ 3 Kg/each. This regulation suggested that fish caught with a size larger that 3 Kg, had to be released. However, according to the fishermen, it was not very common for the fishermen to

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release their catch. It was usually not sold, but consumed by their families. The fishing gear used in TN-TBR is presented in **Table 1** and **Figure 2**.

Table 1. Fishing Method and Gear in TN-TBR In 1999

No.	Village	Fishing Gears				
		Hook *)	Net **)	Compressor	Cage	T o t a l
1.	Rajuni	143	60	6	-	208
2.	Latondu	75	12	12	1	100
3.	Tarupa	110	8	12	1	131
4.	Jinato	165	46	12	9	232
5.	Pasitallu	172	35	-	-	202
T o t a l		665	161	36	11	853

*) Used to catch sunu, kerapu and Shark
**) Used to catch katamba, baronang, simbula (Sardine), and Shark

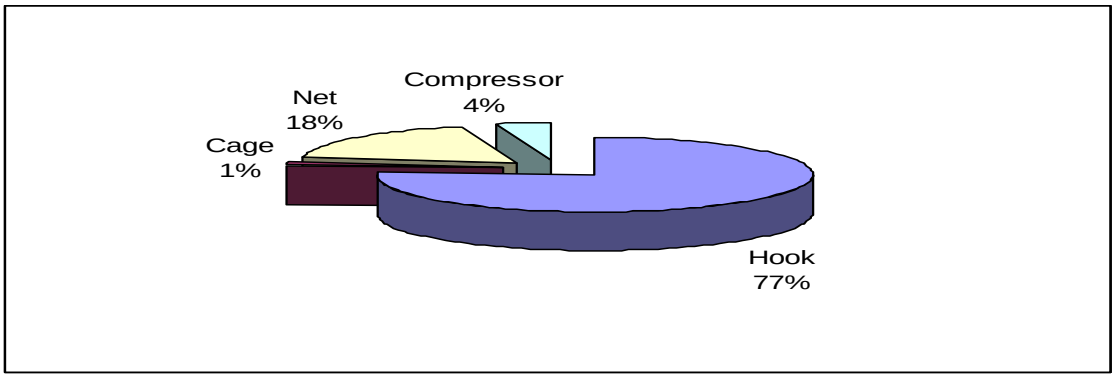

Figure 2. Benchmark Indicator on Fishing Gear Used by the Taka Bonerate Community in 1999

Destructive Fishing Activities

Indication of destructive fishing practices is given in **Table 2** and Table **3. Table 2** shows the relative comparison among the fishing gear: bamboo trap, diving with compressor, cyaniding and blast fishing are classified as destructive fishing gear. The light fishing (bagan) is also considered destructive, since it collected larvae, post larvae and juveniles, especially in relatively calm waters. Species identified are *Sardinella* sp., Atherinidae, Spheraenidae, *Siganus* spp and Lethrinidae. It was also reported that some evident of destructive fishing, e.g. bomb, cyanide, occurred in TN-TBR, mainly in the southern part of the groups of islands, e.g. Pasitallu Tengah, Pasitallu Timur, Rajuni Kecil, Jinato, and Taka Silebu (Statistik Taman Nasional Taka Bonerate, 2000). These majority of the actions were executed by fisherrmen from surrounding areas, e.g. Kayuadi, Pasitallu, Kabaena, Kupang, Rajuni, Jinato. The evidence of destructive fishing practices in these areas is presented in **Table 3**. In relation to the ban of operation Gae or Pagae (purse seine), according to Pusat Studi Terumbu Karang UNHAS (2001) this is actually based on conflict of the Bajonese who did not agree on allowing the use of Pagae by the fishermen from out side Taka Bonerate in collaboration with the Bugenese.

Table 2. Benchmark Qualitative Indicator on Existing Type of Fishing Technology in Taka Bonerate in 1999

Local Name	Classification	Destructive/ Sustainable	Target species	Location
A. Net Fisheries				
a. *Pukat Katamba*	Bottom gillnet	Sustainable	Demersal fish	Rajuni, Tarupa
b. *Pukat Pari*	Bottom gillnet	Sustainable	Rays	Bungin Belle
c. *Pukat Hiu*	Drift gillnet	Sustainable	Sharks	Pasitallu Tengah
d. *Lanra*	Drift gillnet	Sustainable	Sardines	Jinato, Pasitallu
e. *Pukat Ketombang*	Drift gillnet	Sustainable	Scot and others small Pelagic fish	Jinato, Pasitallu
B. Hook Fisheries				
a. *Pancing Sunu*	Hand line	Sustainable	Groupers	Pasitallu Timur, Tarupa, Rajuni
b. *Pancing Rawai*	Bottom long line	Sustainable	Demersal fish	Rajuni, Tarupa
c. *Pancing Tonda*	Troll line	Sustainable	Scot, little tuna, and Skipjack	Tarupa, Rajuni
d. *Pancing Hiu*	Surface long line	Sustainable	Sharks	Pasitallu Timur
C. Trap Fisheries				
a. *Bubu*	Bamboo trap	Destructive	Reef-fish	Bungin Belle, Rajuni, Tarupa
D. Diving Apparatus				
Diving apparatus and compressor	Diving	Destructive	Sea cucumber	Pasitallu Tengah, Tambuna Besar, Bungin Belle
E. Apotas and Bomb	Cyanide and Blast Fishing	Destructive	Reef-fish, pelagic fish	Unrecorded (but still exist)
F. Bagan	Floating lift net	Destructive	Anchovy, Squid	Rajuni Kecil, Jinato, Pasitallu Timur

Table 3. Destructive fishing practices evident in Taka Bonerate Marine National Park in 2000

No.	Type of Destruction	Time Evident	Location	Origin of Executor
1	Explosive	06/01	Pasitallu Tengah	Kayuadi
2	Explosive	30/01	Pasitallu Tengah	None (Sidik Cs)
3	Explosive	½	Pasitallu Tengah	None (Sidik Cs)
4	Explosive	--/02	Pasitallu Timur	Pasitallu
5	Explosive	14/03	Pasitallu Timur	Pasitallu
6	Explosive	09/04	Pasitallu Tengah	Kabaena
7	Explosive	19/04	Pasitallu Tengah	Kupang
8	Explosive	20/04	Pasitallu Timur	Pasitallu
9	Explosive	26/04	Pasitallu Tengah	Kabaena
10	Explosive	04/08	Rajuni Kecil	Noee (Pardi Cs)
11	Explosive	18/09	Rajuni Kecil	Rajuni
12	Explosive	20/09	Jinato	Jinato
13	Explosive	05/10	Rajuni Kecil	Rajuni
14	Narcoses	27/06	Tal Silebu	Inner Park
15	Operational Gae	--/04	Tarupa	Sinjai
16	Operational Gae	10/04	Tinabo	None (Motor Boat)
17	Operational Gae	25/04	Pasitallu Tengah	Kodingareng
18	Operational Gae	25/04	Jinato	Outside Park
19	Operational Gae	27/04	Rajuni Kecil	None (Wahyuddin)
20	Operational Gae	28/04	TakaTumbor	Sinjai
21	Operational Gae	--/05	Tarupa	Rajuni
22	Operational Gae	09/05	Taka Tumbor	Rajuni
23	Operational Gae	21/05	Pasitallu Tengah	Sinjai
24	Operational Gae	25/05	Rajuni Kecil	Outside Park
25	Operational Gae	27/05	Rajuni Besar	Rajuni
26	Operational Gae	10/06	Rajuni Besar	Sinjai
27	Operational Gae	23/06	Rajuni Besar	Sinjai
28	Operational Gae	22/07	Taka Lasilimu	Tinabo
29	Operational Gae	--/08	Jinato	Sinjai
30	Operational Gae	21/08	Tinabo	None (H.M.Tang)
31	Operational Gae	15/09	Taka Lasilimu	Inner park
32	Operational Gae	--/10	Rajuni Kecil	Rajuni
33	Operational Gae	--/10	Tinabo	Inner park
34	Operational Gae	--/10	Jinato	Sinjai

Source: Anonimus (2000)

Selected Fishing Technology

In order to maintain the coral reef in Taka Bonerate, such destructive fishing activities in these areas have to be curbed. Therefore, the existing fishing practices in the site should be analyzed to indicate the most suitable technologies for the fisheries.

During the field survey a total of 12 fishing gears and methods used by the local fishers in Taka Bonerate were identified. They included:

(1) *Samba* or *kulambi*: small size drive-in net, to catch coral fish around coral reefs. The catch ranged from a minimum of 10 kg to a maximum of 200 kg per trip.
(2) *Pancing cumi-cumi*: squid jig, for squid fishing. About 20 kg of squid were reported caught per trip on the average.
(3) *Pancing dasar*: hand line, applied to catch the "sunu" and groupers alive.
(4) *Bagang perahu*: boat lift net, for catching pelagic fish, among other the anchovy squid.
(5) *Pekang Rinto*: to catch small pelagic fish to be used as baits for hand lining.
(6) *Pukat simbulak*: small size drift gillnet for lemuru or Indian Oil sardine fishing. The unit is reported to catch an average of 100 kg of sardines per trip.
(7) *Pukat mangihang*: drift gillnet for shark fishing.
(8) *Pukat tallang*: bottom gillnet for catching demersal fish
(9) *Pekang mangihang*: to catch demersal fish
(10) *Pekang tonra (Pancing Tonda)*: troll line, for skipjack fishing
(11) Cyaniding: for coral reefs fishing
(12) Blast fishing: for coral reefs fishing

Using the Analytical Hierarchy Process introduced by Saaty (1986), it resulted in the selection of sustainable fishing technologies (**Table 4).** This table shows that pancing tonda, pancing cumi-cumi, samba/kulambi, pancing dasar and pukat simbulak are among the highest priority revealed by the analysis. From those nominated fishing technologies, pancing dasar (hand line) is not recommended to be further developed since its target species are reported to be at the declining stage. Consequently, the vertical long line would also be dropped, since its target species are the bait fish for the hand lining. Pukat simbulak (small size drift gillnet) is also not recommended at the moment since the species has not got a proper price at the local market. The bagan perahu (boat lift net) needs quite high capital investment , and most likely will endanger the bio-diversity if operated around the coral reefs. On the basis of the considerations mentioned above, the selected fishing **technologies to be developed, are: (1) pancing tonda (troll line), (2) pancing cumi-cumi (squid jig), and (3) samba/kulambi (small size drive-in net)**. It is recommended that these three fishing units be socialized to the fishermen at Taka Bonerate Islands.

Table 4. Scoring Matrix for Fishing Technology Selection (Taka Bonerate)

Fishing Technology (*)	Criterions (**)															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Final Score	Priority
1	0,08 (0,14)	0,1 (0,14)	0,09 (0,13)	0,1 (0,04)	0,09 (0,05)	0,1 (0,03)	0,08 (0,1)	0,11 (0,12)	0,18 (0,03)	0,15 (0,04)	0,1 (0,02)	0,07 (0,02)	0,08 0,02)	0,1 (0,12)	0,0884	3
	0,01	0,01	0,01	0,004	0,005	0,003	0,008	0,01	0,0054	0,006	0,002	0,001	0,002	0,012		
2	0,15 (0,14)	0,1 (0,14)	0,12 (0,13)	0,12 (0,04)	0,09 (0,05)	0,1 (0,03)	0,14 (0,1)	0,11 (0,12)	0,09 (0,03)	0,12 (0,04)	0,08 (0,02)	0,15 (0,02)	0,14 (0,02)	0,1 (0,12)	0,1198	2
	0,02	0,01	0,02	0,0048	0,005	0,003	0,01	0,01	0,003	0,005	0,002	0,003	0,003	0,012		
3	0,09 (0,14)	0,1 (0,14)	0,1 (0,13)	0,13 (0,04)	0,09 (0,05)	0,1 (0,03)	0,12 (0,1)	0,08 (0,12)	0,12 (0,03)	0,07 (0,04)	0,11 (0,02)	0,14 (0,02)	0,07 (0,02)	0,1 (0,12)	0,0878	4
	0,01	0,01	0,01	0,005	0,005	0,003	0,01	0,01	0,004	0,0028	0,002	0,003	0,001	0,012		
4	0,06 (0,14)	0,1 (0,14)	0,1 (0,13)	0,12 (0,04)	0,09 (0,05)	0,1 (0,03)	0,06 (0,1)	0,09 (0,12)	0,07 (0,03)	0,07 (0,04)	0,08 (0,02)	0,04 (0,02)	0,07 (0,02)	0,1 (0,12)	0,0764	8
	0,008	0,01	0,01	0,0048	0,004	0,003	0,006	0,01	0,002	0,0028	0,002	0,0008	0,001	0,012		
5	0,07 (0,14)	0,1 (0,14)	0,1 (0,13)	0,09 (0,04)	0,09 (0,05)	0,1 (0,03)	0,08 (0,1)	0,09 (0,12)	0,07 (0,03)	0,08 (0,04)	0,04 (0,02)	0,15 (0,02)	0,14 (0,02)	0,1 (0,12)	0,0826	6
	0,01	0,01	0,01	0,0036	0,004	0,003	0,008	0,01	0,002	0,004	0,002	0,003	0,003	0,012		
6	0,11 (0,14)	0,1 (0,14)	0,1 (0,13)	0,03 (0,04)	0,09 (0,05)	0,1 (0,03)	0,09 (0,1)	0,1 (0,12)	0,11 (0,03)	0,08 (0,04)	0,02 (0,02)	0,07 (0,02)	0,07 (0,02)	0,1 (0,12)	0,0875	5
	0,02	0,01	0,01	0,0001	0,004	0,003	0,009	0,01	0,003	0,003	0,0004	0,001	0,001	0,012		
7	0,09 (0,14)	0,1 (0,14)	0,06 (0,13)	0,07 (0,04)	0,09 (0,05)	0,1 (0,03)	0,07 (0,1)	0,08 (0,12)	0,07 (0,03)	0,08 (0,04)	0,04 (0,02)	0,04 (0,02)	0,07 (0,02)	0,1 (0,12)	0,0756	9
	0,01	0,01	0,008	0,002	0,004	0,003	0,007	0,01	0,002	0,003	0,002	0,0008	0,001	0,012		
8	0,07 (0,14)	0,1 (0,14)	0,1 (0,13)	0,07 (0,04)	0,09 (0,05)	0,1 (0,03)	0,07 (0,1)	0,08 (0,12)	0,07 (0,03)	0,08 (0,04)	0,04 (0,02)	0,07 (0,02)	0,07 (0,02)	0,1 (0,12)	0,0769	7
	0,01	0,01	0,01	0,002	0,004	0,003	0,007	0,01	0,002	0,003	0,002	0,0001	0,001	0,012		
9	0,08 (0,14)	0,1 (0,14)	0,06 (0,13)	0,07 (0,04)	0,09 (0,05)	0,1 (0,03)	0,07 (0,1)	0,09 (0,12)	0,07 (0,03)	0,08 (0,04)	0,08 (0,02)	0,04 (0,02)	0,07 (0,02)	0,1 (0,12)	0,0756	9
	0,01	0,01	0,008	0,002	0,004	0,003	0,007	0,01	0,002	0,003	0,002	0,0008	0,001	0,012		
10	0,17 (0,14)	0,1 (0,14)	0,11 (0,13)	0,13 (0,04)	0,09 (0,05)	0,1 (0,03)	0,16 (0,1)	0,13 (0,12)	0,11 (0,03)	0,14 (0,04)	0,08 (0,02)	0,16 (0,02)	0,07 (0,02)	0,1 (0,12)	0,1200	1
	0,02	0,01	0,01	0,005	0,005	0,003	0,02	0,02	0,003	0,006	0,002	0,003	0,001	0,012		
11	0,02 (0,14)	0,02 (0,14)	0,03 (0,13)	0,04 (0,004)	0,05 (0,05)	0,02 (0,03)	0,03 (0,1)	0,02 (0,12)	0,02 (0,03)	0,02 (0,04)	0,13 (0,02)	0,04 (0,02)	0,07 (0,02)	0,1 (0,12)	0,0494	10
	0,002	0,003	0,004	0,002	0,002	0,0006	0,003	0,002	0,006	0,0008	0,003	0,008	0,001	0,012		
12	0,02 (0,14)	0,02 (0,14)	0,02 (0,14)	0,04 (0,04)	0,05 (0,05)	0,02 (0,03)	0,02 (0,1)	0,02 (0,12)	0,02 (0,03)	0,2 (0,04)	0,19 (0,02)	0,04 (0,02)	0,07 (0,02)	0,1 (0,12)	0,0484	11
	0,002	0,003	0,003	0,002	0,002	0,0006	0,002	0,002	0,006	0,0008	0,004	0,008	0,001	0,012		

(*) 12 Types of fishing technologies as aforementioned
(**) 14 Criterions of environmental friendliness and sustainability as aforementioned

CONCLUSION

Considering the results of the study, these are the conclusions:

1. Three groups of reef fishes, i.e. major, target, and indicator groups, are recorded at the study site. These fishes are ornamental fishes and fishes as food, particularly the target group of fishes used to be fishes as food, which used to be consumed as live, fresh and dry fishes.
2. The dominant reef fishes species are (a) Major group : *Chromis ternatensis, Dascyllus reticulatus, Pomacentris coelestis, P. lepidogenis, P. retrofasciatus,* and *Acanthochromis polycanthus*, (b) The Target Group : *Lutjanus decussatus, L. bohar, L.gibbus, Siganus virgatus,* and *Caesio trilineatus*, and (c) The Indicator Group : *Chaetodon kleini, C. trifasciatus,* and *C. vagabundus*. These fishes were observed from small to bigger size (around 30 cm) at the study sites. Some of them, such as *Plectropomus* and *Cheilinius*, were caught live as food consumption by the fishermen. The Napoleon wrasse (*Cheilinus undulatus*) and the tiger kembang (*Balistoides couspicillum*) were sold at about Rp 80,000.00/fish (about 1.2 Kg/fish). They were able to catch 3-10 fishes a day.
3. Fishing gears used by the fishers at Taka Bonerate Islands include hook and line, gillnets, arrow, and spear.
4. Some fishing technologies used are suspected assumed to be dangerous to coral reefs. At least 36 evidences of human activities, mainly "explosive" fishing, were collected at Taka Bonerate in year 2000.
5. Three sustainable fishing technologies are identified at Taka Bonerate, i.e. (1) pancing cumi-cumi (squid jig), for squid fishing), (2) pancing tonda (troll line), for skipjack fishing, (3) samba/ kulambi (small size drive-in net), to catch reef fishes around coral reefs.

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