Socio economic valuation of demersal fisheries in Bunaken National Park – A site study report

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Socio economic valuation of demersal fisheries in Bunaken National Park – A site study report

Introduction

Bunaken National Park (BNP) is located in the province of Minahasa, North Sulawesi, Indonesia. The total area of the park is 79,056 hectares (ha) including land and sea (Mehta 1999). There are 22 villages located within the Park, with over 30000 inhabitants, and the Bunaken Park waters and reefs have been supporting subsistence fishing and farming communities for over 100 years. BNP was identified by experts from various disciplines and stakeholders to the Sulu Sulawesi Marine Ecoregion (SSME) as a priority area for conservation. It is one of the few protected areas in the center of the hotspot for global marine biodiversity.

The area was gazetted as a National Park on October 15th, 1991, (Mehta 1999) to protect the high diversity of marine and terrestrial life within the area, and the migration paths and feeding grounds for protected species such as dugongs and turtles. The 25-year management plan (required for national parks by Indonesian law) was approved in 1996, which led to the development of the Balai Taman Nasional Bunaken (BNP management authority), supported by the central government's Ministry of Forestry. Limited management effectiveness combined with increasing demands from stakeholders to be involved in management decision processes following Indonesia's decentralization process, resulted in the establishment of the BNP Management Advisory Board in December 2000.

The advisory board and other groups involved with providing support for effective management of BNP have acknowledged that one important improvement to the management would be to incorporate more ecological criteria in the revised design of the zonation plan. For example, locations and areas critical for particular live stages of endangered species such as turtles and dugong should be better protected. Also processes that ensure viable fish populations must be safeguarded to allow sustainable benefits and maintaining balanced fish community structures. Long-term and regular monitoring of the biological status of reefs and fish populations in the park and of the resource use patterns of park users will allow for adaptive management. Including some socio-economic indicators in the regular monitoring will allow for regular evaluation on how effective park management benefits users directly or indirectly.

Particular recommendations for ecologically meaningful zonation would include to turn fish spawning aggregation sites (SPAGS) that had been identified in the recent past into fully protected no take zones. However, this management strategy was likely to meet with significant objection by some of the local fishers that specifically target the high valued grouper species that tend to aggregate to reproduce at those sites. These fishers claim they depend on this fishery and have little alternative fishing grounds to turn to. Without reliable information to counterbalance these claims, the management board would have much difficulty to convince park and fisheries authorities of the larger society benefits of protection of these particular sites.

About 1.5 years ago, WWF initiated a process to create awareness on the importance of protection specific critical sites for the larger ecologic and economic benefits of society. Activities mostly involved underwater monitoring of the fish behaviour patterns and the abundance and species composition of fish aggregating at a number of potential fish spawning aggregation sites in the park. This socio-economic study needed to provide information on how many fishers had direct benefit from exploiting the SPAGS or would depend on these SPAGS for their livelihoods.

Assuming that the numbers of fishers that really depend on fishing these SPAGS was low, WWF had been motivating the management advisory board to implement a SPAGS protection strategy, which in turn would enhance the overall outcome of management of BNP. Socio-economic evidence that protection of the SPAGS would not negatively impact large numbers of community members became important in the discussions.

For this project, a general description of socio-economic characteristics of fisheries in the Bunaken National Park was generated using some of the methods described in the Socio-economic manual for coral reef management. In a separate report, funded with matching funding to this project, a study was done into the socio-economic impacts of eco-tourism in the Park. Lastly, a longer-term resource use monitoring program that had been drafted prior to this project was further improved to monitor socio-economic inputs and outputs of the park and its management.

This site study report reflects outcomes of the descriptive study into some socio-economic characteristics of demersal fisheries in the park. Another report is available that provides the outcome of the eco-tourism impact study and the protocol for resource use monitoring is also available.

Study Objective

The objective of the study was 4-fold:

- Provide the survey team with an opportunity to apply newly learned socio-economic monitoring techniques.
- Provide BNP decision makers (park authority, collaborative management advisory board and communities) with information on the socio-economic costs of protection of fish spawning aggregation sites.
- Provide an update to a similar study done in 2001 on fisheries in BNP.
- Review the application of methods described in the socio-economic manual for coral reef management for BNP long-term management.

Research Method

In line with the objective of the study, a comparative study was done of socio-economic conditions of fisher communities inside the National Park of Bunaken. The study focused on fishers that capture demersal fish. Resource use patterns were described, characteristics of the fisheries in the area and perceptions by communities on park management and resource status were gathered.

Primary and secondary data were collected. The study period was quite limited. Open interviews were conducted with 111 respondents following a list of questions that was prepared prior to the field work. This would prevent the interviewers from straying too far from the questions that needed to provide data. Secondary data was collected from literature, from a previous fisheries assessment done by WWF in 2000 and from village statistics. All data was analysed quantitatively where possible or qualitative to provide descriptions of findings.

Results

Secondary information data from literature was combined with information collected by WWF in 2000 on the fisheries in Bunaken national Park (Pet-Soede, 2001). The primary data collected applying methods described in the Socioeconomic manual for coral reef management was used to update this secondary data.

The fisheries in North Sulawesi fall in two categories that can still be considered coastal due to the fact that some of the islands have steep coastlines reaching large depths close to shore. The one contributing most to total fish production in North Sulawesi is the pelagic fishery, secondly the reef and demersal fishery is important, particularly for the small-scale operations (Table 1).

Table 1 The status of maximum sustainable yield of fishery in North Sulawesi, 1998.

Type of Fishery	MSY (ton/year)	
	Territorial Water	EEZ
Pelagic Fish	61,500	165,300
Demersal	30,800	-
Tuna	12,800	12,000
Skipjack	20,800	19,600

Source: Fisheries Agency of North Sulawesi, Annual Report 1998

Most of the total reported fish production for North Sulawesi is generated by Purse seine gear, followed closely by longlines (Figure 1).

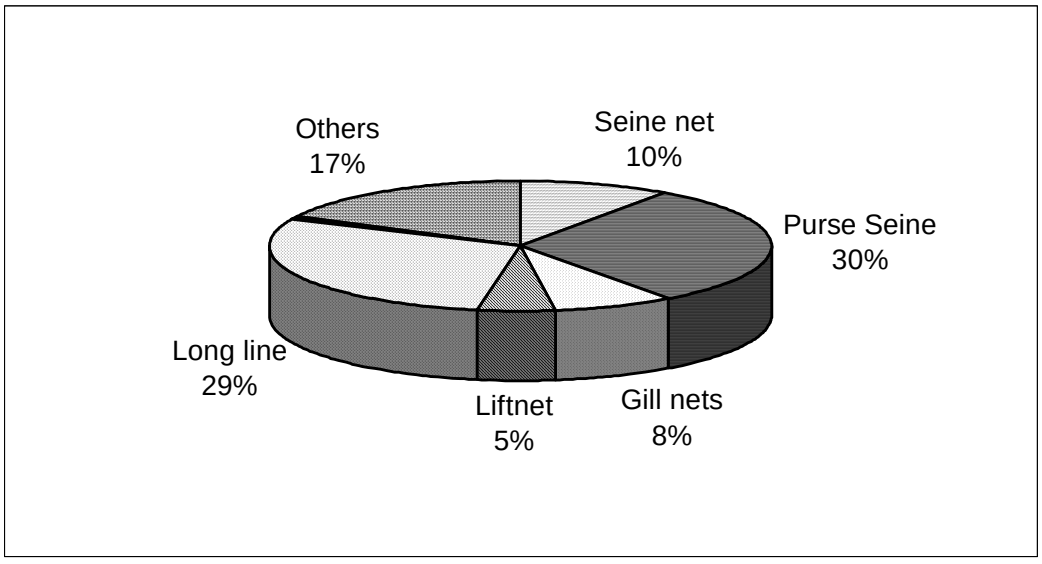


Figure 1 Marine landings by geartype for North Sulawesi.

General description of fishing gears used

In the 7 sub-districts of Bunaken National Park, the current survey team found 5 major types of fishing gear.

(1). Purse seine or “Pukat Cincin”

This gear involves a net, with a ‘ring” at the bottom that can be pulled closed and turn the net into a ‘bag” and some ropes to pull the net in an encircling way around the school of fish. Floaters are attached to the top of the net and weights at the bottom to position the net correctly in the water column. Also often a fish attracting device or FAD is used.

(2). Scad net or “Pukat Malalugis/lolosi”
This gear is more of a beach seine operated from the shore, but it has been modified to be operated at open water also, and looks quite similar as the purse seine described above.

(3). Gill net or “Jaring Insang”
There are several varieties of gill nets, those drifting freele, those set in a shallow area to the bottom substrate, those hanging in the water column but in a fixed position with anchors, a horizontally or verticallyu placed net and those with different mesh sizes at different depths of operation. Some nets are from multi-filament others from mono-filament.

(4). Hook and line or “Pancing”
There are also various hook and line gears, trolling, handlines, shallow or deep water lines, long-lines, and pole and line. Different gears also differ in whether they use bait or not and then what type of bait.

(5) Spearfishing or “Jubi-Jubi”
This is one of the most simple gears and includes a stick, some elastic band, a hook and often some rope. Fishers usually do free-diving when using this gear.

Fishing areas and seasons

Most fishers from within the National Park fish inside the park, they operate near rocks and reefs, but also near the beach. They seldomly go further than 200-1000 m from the island. Only the purse seine fishers and some of the deep water line fishers, operate further away at around 1- 3 mile from the islands, this would take about 1 -2 hours by small motor canoe.

About 54% of the people interviewed mentioned they know where fish spawn, of the ones that know where reef fish spawn, none mentioned that they fish there specifically.

Wind from the south is relevant for fishing in the park between July-September and with from the North is important for fishing around October to January. North eastern winds influence fishing between January and February and North Western winds for the remaining months. Especially the North Western winds bring most difficulty for the fisheries, but some fishers also mentioned that southern wind bothers them. The best season for fishing is May - September.

Fish species caught in Bunaken NP

Table 2 Local names of fish species caught in the park

Bahasa Indonesia	Bahasa Manado	Bahasa Satal	Bahasa Bolmomg	Bahasa Gorontalo	English name	Latrine name
Layang	Malalugis	Talang	Layang	Lajang	Scads	Decapterus spp
Kerapu	Goropa	Kuhapu	Goropa	Lumolahu	Groupers	Epinephelus spp
Tongkol	Deho	Kindaeng	Deho	Deho	Eastern little tuna	Euthynnus spp
Biji Namgka	Lomotu	Haghalu	Lolomotu	Mimia Otululo	Goat fishes	Upeneus spp
Selar	Tude	Kahekuang	Tude	Tilahu	Yellow tail	Scads
Merah bambangan	Kulindama (gora)	Dendapa	Somasi laut	Tingaluhu	Red snappers	Lutjanus spp

Lencam	Gotila	Mohonsio	Gotiila	Molamilama	Emperors	Lethrinus spp
Kakap	Somasi	Lemide	Somasi	Mangaheto	Barramundi	Lates calcarifer
Ekor Kuning	Lolosi	Tahumang/Dolosi	-	Lolosi liatu	Yellow tail f usilliers	Caesio spp
Kurisi	Sahamia	Saweba	Kuisi	Buku-eja	Treadfin-breams	Nemipterus spp
Swanggi	Bulan-bulan	Panembulang	Swanggi	Demoto	Big eye	Priacanthus spp
Pari	Nyoa	Pahi manu	Nyoa	Tumalibu Bumengo	Rays	Trigonidae
Bawal putih	Uhi	Balang	Lasi perempuan	Habo-haboko	Silver pomfret	Pampus argrnteus
Bawal hitam	Tampal bor	Ari	Nyowa	Dungo Bulongo	Black pomfret	Formia niger
Kuwe	Bobara	Sepo, Takapipi, Epese	Bobara	Wawaqa	Trevallies/Jacks	Caranx spp
Daun bamboo	Lasi	Lasi	Lasi	Andalango	Queen fishes	Charinemus spp
Tatengke	Raruhe/ Darah Itang	Letahe	Darah Itang	Botupaleo	Hardtail scade	Megalaspis cordial
Ikan terbang	Antoni	Malaluge	Anthoni	Kapia	Flying fishes	Cypselurus spp
Belanak	Guruo	Belana/Gare	Goruo	Bulalago/ anduwata	Mullets	Magil spp
Kuro	Saramia	Buhau	Tikus-tikus	Tutumbila	Tread fins	Polinemus spp
Julung-julung	Sako/Roa	Soloeng, Hola	Sako	Tambai Toli	Garfish and Half Beaks	Tylosurus spp
Japuh	Lompa	Sarading	Sardin	Muamuayo	Sardines	Dussumieris spp
Lemuru	Sardin	Sarding	Sardin	Goria	Indian oil sardinella	Sardinella longiceps
Golok-golok	Lamadang	Bawalira	-	Spa-spada	Wolf herrings	Chirocentrus spp
Kembung	Lehoma	Lehoma	Bombong	Luma-luma	Mackerels	Rastlliger spp
Layur	Sabel	Papukule	Daun bamboo	Pato-potodu	Hairtails	Trichiurus spp
Tuna	Pani	Pani	Madidihang	Kuru kuni	Tunas	Thunnus spp

Pelagic Fisheries

Most common pelagic fishing gears operated around Bunaken national park are pole and line and purse seine fisheries locally known as “Funae” and “Pajeko” respectively for tuna and other middle sized pelagic schooling fish species locally known as Deho (*Scomberomorus* sp.), Malalugis (*Decapterus* sp.), Cakalang (*Katsuwonus pelamis*), Tude (*Selar crumenophthalmus*) and Mandidihang (*Thunnus albacares*) (Table 3). Both fisheries make use of fish attacting devices or FADs. In 2001, it was estimated that there are 162 fishing Rackets in the Bunaken Park area. Navigation to and from the FADs is done using landmarks during the day ie Manado Tua, and stars at night.

Table 3: The two capture methods operating within the pelagic fishery (2001 data).

Boat Type	**Method**	**Main species (local names)**	**# men/ boat**	**travel (hrs)**	**fishing (hrs)**	**Max. catch/ day (ton)**
Funae	Pole and line (bait)	Mandidihang, Cakalang, Deho	10	6	1.5	7
Pajeko	Purse-seine nets	Deho, Malalugis, Tude, Cakalang	23	3	2	10

The Pole and Line Fishery

Pole and line fishing for tuna dates back hundreds of years and is considered one of the traditional tuna fishing methods, since the 1950s it has been increasingly replaced by purse seine gear (Hall, 1999). The boats are anchored over the seagrass beds on the south-east corner of the island adjacent to Christian sector (Kampung Christian) of Bunaken village. The "funae" is a shallow 10 to 12 m long boat, all boats use three outboard engines, of 40 hp each. The average crew on a funae counts 10 men, but can go up to 15, including captain and boat driver. During the hole season the funai fleet is fishing in the same area of the Celebes Sea, 40 km north west of Manado Tua.

Boats are launched between 22:00 and 02:00, when tidal characteristics allow enough depth for launching. Bait is collected at the Tanahwangko bait pontoons between 00:00 and 03:00. The bait is captured on a nightly basis using lift nets fixed to the bottom of the pontoon. The target species, Shorthead anchovy *(Encrasicolus hetroloba)* are attracted to the nets using artificial light. Four boats can moor to the side of the pontoon at any one time and the catch transferred live into the hull of the boat. The bait measuring 3-7cm is kept alive by circulating seawater through the hull of the boat, using a pumping facility. For between three days and one week every month when the moon is at its fullest, it is not possible for the pole and line boats to acquire bait from the lift net pontoons, due to large amounts of natural light preventing the anchovies from being attracted to the artificial light above the lift nets.

Bait fish is put into three categories by the fishermen due to its catching success. Bait No. 1, anchovies purchased from the lift nets at Tanahwangko. Bait No.2, larger Juv reef fish caught by hand over the seagrass beds. Bait No. 3, smaller Juv reef fish caught by hand over the seagrass beds. Pipefish (*choeroichthys sculptus*) are removed from the bait catch first, it is claimed that they poison the bait fish. Other bycatch in the bait catch such as cornetfish are cooked and eaten on board in coconut shells.

When no bait is available, the crew catches their own bait over seagrass beds. They use small boat seines, approximately 30m in length; the operation can take up to 4 hours and an assortment of juvenile reef and pelagic species are caught including *Pseudanthias* spp, *Cirrhilabrus* spp and small silvery pelagic species using the seagrass beds as nursery grounds. Bait caught by this method is thought to be of inferior quality by the fishermen, and more tuna are generally caught using the anchovy.

The fishing sites are reached by sunrise (05:00-05.30). Small anchored fish aggregating devices (FADs) are used for fishing, locally referred to as "rakit" deployed in waters 200-4000m deep. The presence of large pelagic fish such as tuna is strongly influenced by the presents of floating objects such as FADs (Fonteneau et al. 2000), and FADs have long been used in Indonesian fisheries (Monintja, 1993). The FADs are constructed using bamboo, and consist of simple floating rafts of 3-4m in length with palm branches attached to the anchor line, or larger rafts of 5-6m in length with a small occupied bamboo hut on the raft.

Ten men fish from the rear of the boat using 5-6m long bamboo poles with 6m of line attached to a home made plastic and feather lure with a barbless hook. The feeding characteristics of the tuna are exploited, by chumming the water directly behind the boat with live bait from a small hand held net, sprinklers are used to create the elusion of a greater number of bait fish, creating a tuna feeding frenzy. The mean catch of target species during May and June for the pole and line fishery was 675.4 kg per boat per day. The actual fishing time is separated in runs of several minutes. During one run the boatman is driving the boat slowly in a straight line near the rackit, than turns and starts another run. During the run the fishermen catch the fish at the back of the boat using fishing rods. The fishing rods are made

up of 3 m long bamboo sticks, transparent fishing rope and a hook, which is covered by self-made fake fish. To attract the fish life bait and sprinkling water is used. The bait is kept alive in the hold of the boat by a constant stream of fresh seawater. The seawater is entering the hold through holes in the bottom and pumped out again through little holes at the back of the boat, which causes the sprinkling water on the backside. Depending of the catch the captain decides to visit another rakit or to go back to land the catch.

The fishermen go out fishing 6 times a week, not on Sunday, because of religion. The fishing trips start at 10.00 pm going out to buy bait on floating houses near the coastline of Tanawangko. If there is no bait available the fishermen have to catch the bait themselves in the shallow waters round Bunaken Island. The difference between the two places is the sort of bait, Shorthead anchovy (*Encrasicolus heterolaba*) in Tanawangko and Slender rainbow sardine (*Dussumieria elopsoides*) around Bunaken Island. The fishermen prefer the Shorthead anchovy, they reckon the smell of this fish is better to attract the tuna. After reaching the fishing ground at sunrise (5.00 – 5.30), the actual fishing starts. The actual fishing time takes 2 hours, visiting one or more FADs. The catch is landed around midday (12.00 – 1.00 pm) in Tanawangko or Manado. The total trip, including selling the fish at the market, takes 12 to 17 hours.

The fishing season starts on January till the end of October. Due to bad weather and rough sea there is no fishing activity during November and December.

The Purse Seine Fishery

Purse seine oats are launched between 00:00 and 04:00, dependent on tidal characteristics. Each fishing vessel works along side as smaller “transport” boat. The transport boat is launched approximately 12 hours before fishing commences to transport the “fish eyes” to the FAD. The fish eyes are highly respected members of the crew who spend the night before fishing commences on the smaller bamboo raft FAD, keeping alight four kerosene lanterns and observing the numbers and characteristics of the target species. Fishing only commences on the order of the fish eye, when he thinks the target species aggregating under the FAD are at their maximum number.

These FADs consists of a floating house connected to a buoy, called ponton, which is anchored to the bottom of the sea and constantly occupied by one man. This man informs the fishermen by radio about presence of fish below his rakit. The main boat reaches the FAD at sunrise and on the command of the “fish eyes”, the purse seine (of less than 200m in length) is deployed by hand from the side of the boat as the boat encircles the FAD. The net is then recovered by hand and the catch sorted into boxes of corresponding species ready for sale at Manado fish market. Manado based boats operate the nets with winches, on the islands this never really was a success due to the resulting lesser need for workers.

Demersal and Reef Fisheries

Demersal fisheries occur at most of the reef flat areas and along some of the reef slopes.

Hook and line fishing

The most common hook and line methods that are deployed closer inshore and can be considered of the demersal and reef species targeting type, are a simple handline with bait, and trolling with a handline with mostly artificial bait. Further hook and line include longlines and a simple form of pole and line, often operated from the shore. Most hook and line activities occur with 1-3 crew per boat. Only the pelagic pole and line operations employ 10 or more crew per boat.

Net fishing

A large variety of nets are used and often the same nets are operated in different ways. The most common small-scale net is the gill net, which is either operated at the surface with buoys or other simple floaters, or it is operated near the substrate with weights or simple sinkers such as batteries. Some gill nets are operated during the day and others during the night. Sometimes fishers apply water beating to scare fish into the nets. Also trammel nets are used that combine 3 layers of gill nets. This way the fish is very easily entangled and retained in the net.

Another relatively common net is the beach seine. A long net is set out in the water sometimes from boats and pulled inshore by one or two teams of fishers. Catches are usually low and are composed of a large variety of smaller demersal soft bottom species. Some special beach seine net exists that particularly targets anchovies. Similarly an encircling gillnet is found to be operated that is deployed from boats and aims at catching houndsfish.

Reef gleaning[1]

Gleaning the reefs and shoreline for various edible species is the most common marine activity for women in BNP (Table 4), and occurs in all communities in the study area. The best time for gleaning is at spring or neap low tides, although it is often a daily activity for many women at low tide. It is a localised activity with all respondents gleaning the shoreline and reef flats closest to their community. The catch is normally used to supplement the household diet, apart from the communities on Mantehage and Nain who collect sea cucumbers for export overseas. There is some confusion as to where women are allowed to glean, on the reef flats or in the seagrass beds. Gleaning is particularly important during the NW monsoon season where bad weather can prevent pelagic fishing trips. It can be the only source of household protein "*when there is no fish, which can happen often*".

Table 4: Gleaning (banyare)

Communities	All sixteen communities.
Equipment	Bucket/basket to hold catch. Sharp knife *(Pisau)* or pry stick *(Galah)* to prise shells from the reef flat.
Catch	Beche de Mer (*Bia Taripang),* large cowries (*Bia Raga, Bia bilaulu),* Murex spp. *(Bia Hanga hanga),* Conch (*Bia Linsui),* Giant clam *(Bia Kima),* Spider conch *(Bia Jave),* Bivalve *(Bia Kerang Kerang),* edible seaweed and small octopus.
Destination of catch	Subsistence only apart from sea cucumbers which are dried and boiled and sold to middlemen in Manado for export to China (Rp 105,000 per kilo).
Distance to fishing ground	~ 10 to 30 minutes walk from community to reef flats and shoreline.
Average time spent	< 2 hours per day at low tide. Glean when the tide is right.

[1] Information presented here is taken from a study by Kate M. Gallop titled: The Impact of the Bunaken National Park Management Plan on Women's Access to and Utilisation of Marine Resources, North Sulawesi, Indonesia. Study for MSC degree conducted for Centre for Tropical Marine Management, Department of Marine Sciences, University of Newcastle, Newcastle, NE1 7RU.

Aquarium fishing[2]

During the survey aquarium fisheries were not found in the park area. In North Sulawesi this fishery is indeed rare but entire villages can be dependent on this fishery for their sole income. Many aquarium fish species are involved in the trade, however the following were identified by collectors as being the most commercially important in the North Sulawesi situation:

- Banggai cardinal fish (*Pterapogon kauderni*), indigenous to the area;
- Angel Batman (*Pomacanthus navarchus*);
- Letter 6 (*Paracanthurus hepatus*);
- Angel Napoleon (*Euxiphipops xanthometapon*) and
- Angel Piyama (*Euxiphipops navarchus*).

Collection of fish is moslty by using *Igi's* (fish traps constructed of bamboo or wire), hookah and weighted nets with cyanide. Collection areas tend to be within 2 km of the village with the exception of Tumbak where the collectors travel to the Banggai islands (24hrs away) specifically to collect the Banggai cardinal fish. Aquarium fish are then stored in *Karamba's* (suspended netting from bamboo rafts) until collection, which may be weekly or in some cases every three months depending upon orders from middlemen. The middlemen were located in Manado due to the proximity of the airport, and bought fish from many sources in North Sulawesi selling them onto international exporters in Bali, Jakarta or Surabaya (west Java). These international exporters then sell to countries world-wide but mainly Europe, USA and Singapore (Pers. Comm. I Cindra 2001). Smaller middlemen were also identified in the chain; they were village based, gathering fish from collectors to fulfil orders to the middlemen in Manado (Figure 2).

[2] Information presented here was taken from a study by Seran W. Davies with reference: The feasibility of certification for small-scale fisheries based on observations of th epelagic and aquariumfisheries of North Sulawesi, Indonesia. Study conducted for MSc degree for Centre for Tropical Coastal Management Studies, Department of Marine Sciences and Coastal Management, Ridley Building, University of Newcastle, Newcastle-Upon-Tyne, NE1 7RU, UK

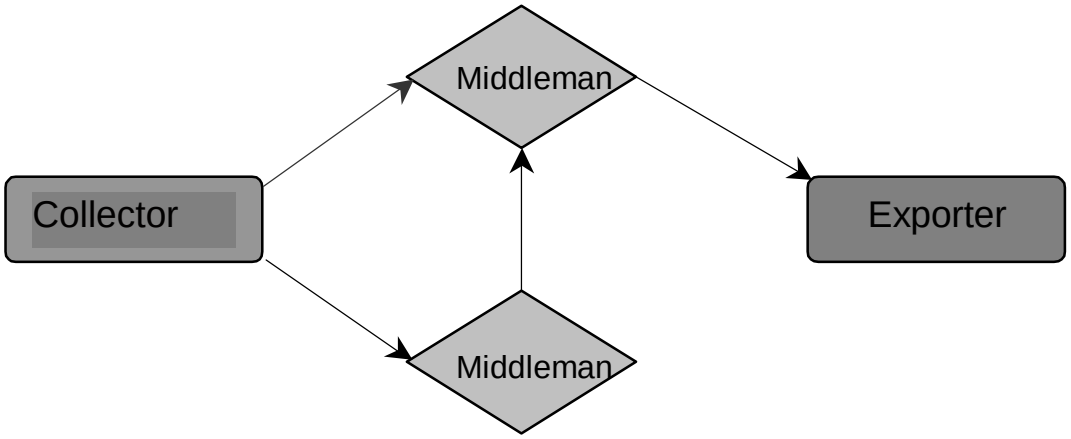


Figure 2 The chain of custody for the aquarium fishery in North Sulawesi.

Other harvesting activities[3]

Seaweed farming

Not much is investigated with respect to the seaweed farming other than the role of woemn in this activity. It is however strongly suggested to determine the cause of the "white-disease" that is ruining the harvest and that may cause fishers to return to their old activities. See also the recommendation section. A clear example of the importance of women's activities is shown in Tables 5 and 6 where women from Nain Island have switched livelihood strategies to overcome loss of income from seaweed farming.

Table 5: Seaweed farming

Communities	Buhias, Tangkasi, Bango, Bajo, Tampi, Tarente.
Equipment	Rope to grow out seaweed. Plastic water bottles to float lines. Seaweed propagules (3 different species). Small wooden dugout canoes to reach individual plots.
Species	Mainly Kappaphycus alvarezii and Euchema cotonii.
Destination of catch	All seaweed harvested is sold to the manager of *Sumber Rejeki* seaweed company before it is exported to overseas markets.
Distance to seaweed plot	~ 5 to 30 minutes travel by small dugout cane and paddle.
Average time spent	4 - 8 hours per day at low tide, this is when the seaweed floats on the water.

Farmers go to sea every day at low tide and return at high tide. Men and women are responsible for the same tasks, which include cleaning the rope and harvesting the seaweed. Equipment and some initial training is provided free of charge by *CV Sumber Rejeki* Seaweed Company. Nain Island is one of the main producers of seaweed in North Sulawesi and the financial benefits involved mean that the majority of Nain islanders are seaweed farmers.

[3] Information presented here is taken from a study by Kate M. Gallop titled: The Impact of the Bunaken National Park Management Plan on Women's Access to and Utilisation of Marine Resources, North Sulawesi, Indonesia. Study for MSC degree conducted for Centre for Tropical Marine Management, Department of Marine Sciences, University of Newcastle, Newcastle, NE1 7RU.

The seaweed takes one to two months to grow out so income is not regular. It also depends on the season and other factors such as prices set by buyers and exporters. The farmers currently receive Rp. 4600 per kilo of dried seaweed. There are also small co-operative groups set up to regulate seaweed farming from within the community. Group leaders take the harvested seaweed to the owner of *CV Sumber Rejeki* and are responsible for paying farmers. They can also advance payment to individual farmers.

However, the farmers are currently experiencing problems with whitespot or "ice-ice" disease. About 80% of the current crop is diseased which has forced many farmers to switch livelihood options. The farmers haven't received any compensation from *CV Sumber Rejeki* who suggested that cyanide fishing is causing the increase in disease. Men have returned to fishing while the women are working on handicrafts made of shells, which are collected off the coast of Mantehage Island. About thirty men, some with their wives and families, have been forced to relocate from the village of Bajo to Kwandang Island off the coast of Gorontolo in order to find other work.

4.7.3.2 Shell handicraft

Table 6: Traditional shell handicraft

Communities	Bajo
Equipment	Nylon fishing line. Small clippers to cut the tips off shells. Laundry soap to clean shells and oil to fry them, which makes the shells shiny and strong. Can to keep shells in.
Catch	Very small cowrie shells (<1cm length). One woman from Bajo collects shells from Tangkasi, Mantehage Island.
Destination of handicrafts	Sell lampshades to households in Manado (Rp. 15,000 for one)
Distance to fishing ground	2-3 hours journey one way to find shells at Tangkasi.
Average time spent	~ 8 hours per day to clean, dry, prepare shells and thread onto nylon fishing line. ~ 8 hours per day by shell supplier (travels to Tangkasi every day).

Groups of women work with hundreds of small cowrie shells preparing, cleaning, trimming and threading them onto nylon fishing line to make decorative lampshades. The shells are collected every day by one woman from Bajo, who travels 2-3 hours by dugout canoe and paddle to collect them from the seagrass at Tangkasi on Mantehage Island. Many women (>30) in the community buy these shells from her at a cost of Rp 750 for a ½ litre can. The tips are cut off every shell so they can be threaded which is time-consuming and concentrated work because the shells are so small. Each woman will prepare, thread and sell one lampshade to a group of women who act as middlemen. These women sell the lampshades at households in Manado and the producer receives Rp 15,000 per lampshade.

Socio-economic characteristics of the fisheries in BNP

The current survey team concluded that most fishing activities can still be called subsistence fisheries. At the national level many plans have been designed to improve and develop fisheries since 1970. This included: (1) credit to purchase boats and gear via coops, (2) providing boats via revolving fund systems, (3) Providing ice and salt for fish processing and to keep quality, (4) Build fish auction places and imprlve market facilities for sale of fish, (5) improve fishing gears (Hadi & Basa, 1995; Rachmat et al, 1997; Nikijuluw & Basuki, 2001), and all these activities went hand-in-hand with more general development programs for coastal communities (Nikijuluw. 2001). Many of these programs were only partially implemented or failed according to Rachmat et al. (1997 in Basuki et al, 2001).

Some demographics of the fisher communities

Education level

The survey team found that education is looked upon as very important in the fisher community, majority of people interviewed had only primary education (Table 7).

Table 7 Level of education of fishers interviewed in 6 sub-districts in BNP

No	Sub-district	Education level				Total
		Primary (SD)	Secondary (SLTP)	Highschool (SMU)	Academic (PT)	
1.	Alung Banua	13	3	1	0	17
2.	Bunaken	20	7	5	0	32
3.	Manado Tua	12	5	2	0	19
4.	Meras	6	0	0	1	7
5.	Molas	13	5	0	0	18
6.	Tongkaina	11	5	2	0	18
Total		75	25	10	1	111

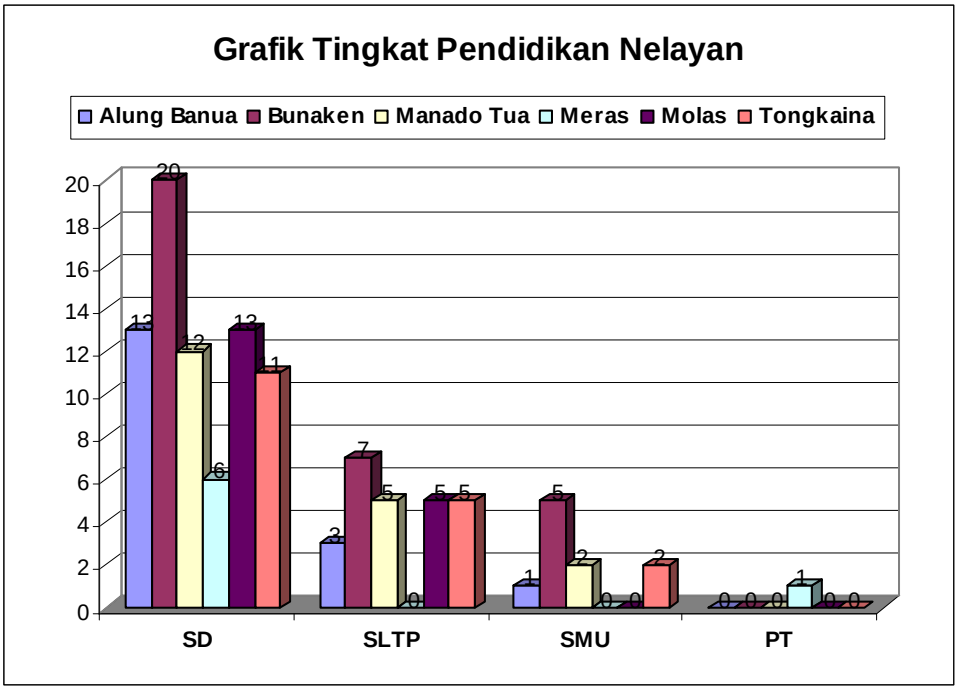


Table 8. Religious background of people interviewed

No	Sub-district	Religion					Total
		Islam	Protestant	Catholic	Hindu	Buddhist	
1.	Alung Banua	17	0	0	0	0	17
2.	Bunaken	6	26	0	0	0	32
3.	Manado Tua	0	19	0	0	0	19
4.	Meras	0	7	0	0	0	7
5.	Molas	3	15	0	0	0	18
6.	Tongkaina	6	12	0	0	0	18
Total		32	79	0	0	0	111

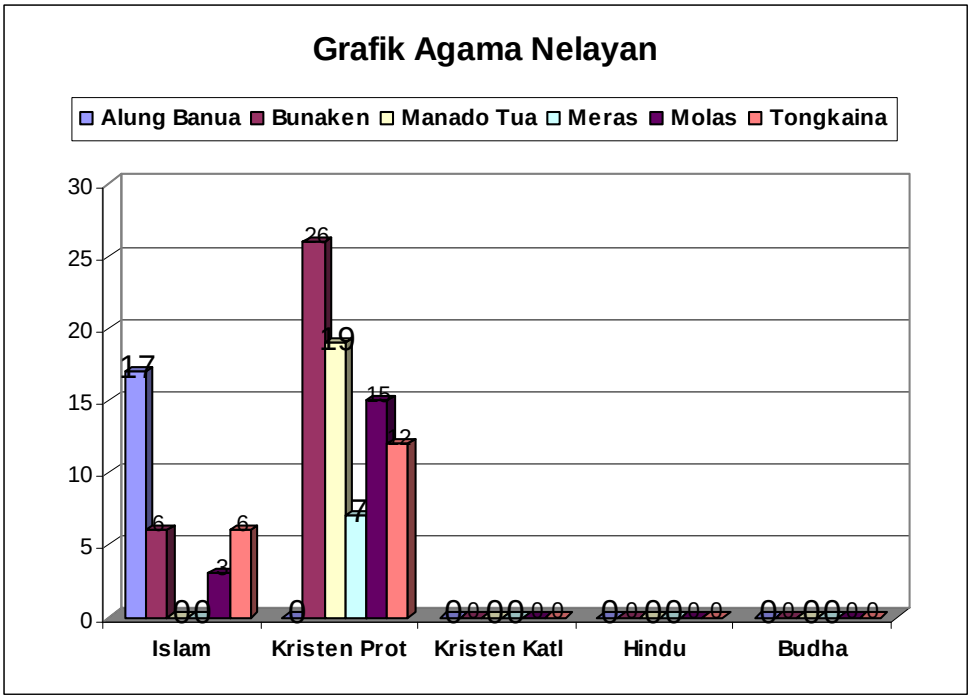


Table 9. Ethnic background of people interviewed.

No	Sub-district	Ethic group					Total
		Bolmong	Gorontalo	Sanger	Minahasa	Other	
1.	Alung Banua	0	0	16	1	0	17
2.	Bunaken	0	1	27	0	4	32
3.	Manado Tua	0	0	18	1	0	19
4.	Meras	0	0	7	0	0	7
5.	Molas	0	1	16	0	1	18
6.	Tongkaina	0	2	2	13	1	18
Total		0	4	86	15	6	111

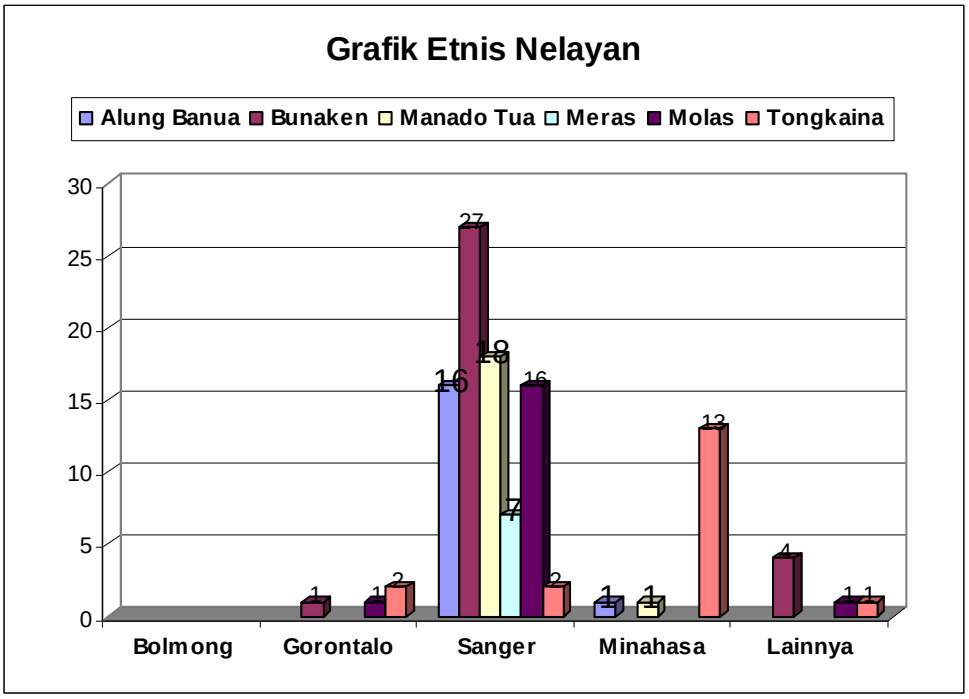
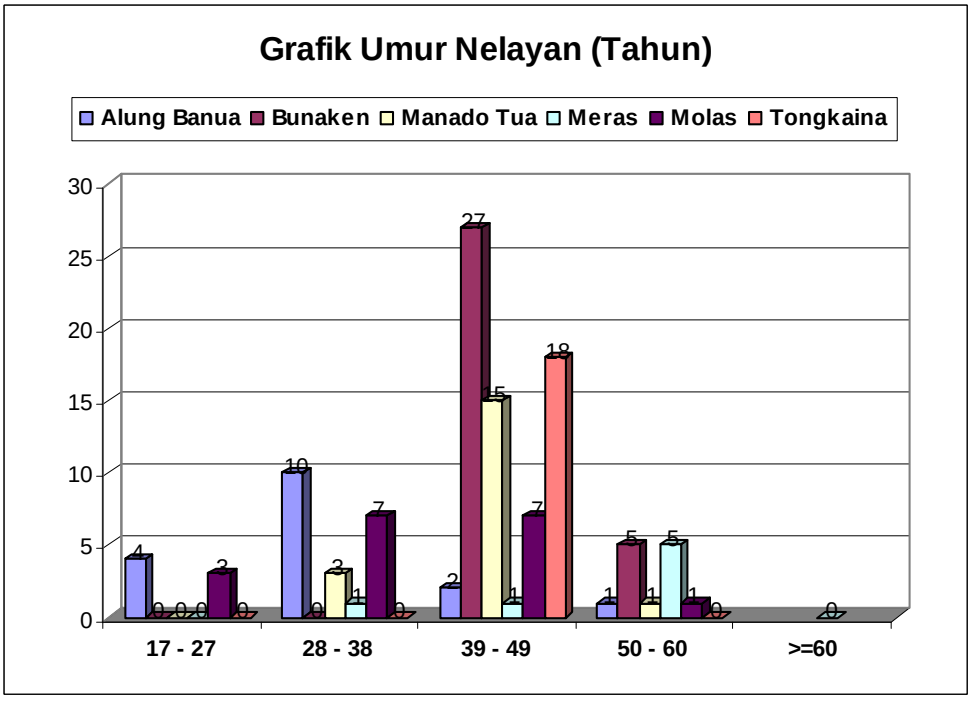


Table 10. Age distribution of fishers interviewed

No	Sub-district	Age (years)					Total
		17 - 27	28 - 38	39 - 49	50 - 60	>=60	
1.	Alung Banua	4	10	2	1	0	17
2.	Bunaken	0	0	27	5	0	32
3.	Manado Tua	0	3	15	1	0	19
4.	Meras	0	1	1	5	0	7
5.	Molas	3	7	7	1	0	18
6.	Tongkaina	0	0	18	0	0	18
Total		7	21	70	13	0	111



Income derived from fisheries in the park

Costs and revenues in fisheries households varies between the type of fisheries. The survey team calculated average individual revenue per type of fishing gear (Table 11).

Table 11. Total number of fishers owning certain gears and initial investment 9average) per gear type in 7 sub-districts of Bunaken National Park.

Sub-district	Total fishers	Fishing gear	%	Investment per gear unit (Rp)
Bunaken	5	Jaring Insang	15,62	3.050.000
	20	Pancing Ulur	62,50	2.585.000
	3	Darape	9,38	2.700.000
	3	Noru	9,38	2.525.000
	1	Pajeko	3,12	350.000.000
Jumlah	32		100.00	
Alung Banua	3	Jaring Insang	17,65	3.050.000
	2	Darape	11,76	2.700.000
	8	Pancing Ulur	47,06	2.585.000
	4	Noru	23,53	2.525.000
Jumlah	17		100.00	
Manado Tua	6	Jaring Insang	31,58	3.050.000
	1	Jaring Malalugis	5,26	3.500.000
	2	Jaring Lolosi	10,52	3.500.000
	5	Pancing Ulur	26,32	2.585.000
	5	Noru	26,32	2.525.000
Jumlah	19		100	
Meras	5	Pancing Ulur	71,42	2.585.000
	1	Noru	14,29	2.525.000
	1	Jubi	14,29	450.000
Jumlah	7		100.00	
Molas	4	Jaring Insang	22,22	3.050.000
	1	Darape	5,56	2.700.000
	8	Pancing Ulur	44,44	2.585.000
	5	Noru	27,78	2.525.000
Jumlah	18		100.00	
Tongkaina	2	Jaring Insang	11,11	3.050.000
	7	Pancing Ulur	38,89	2.585.000
	4	Darape	22,22	2.700.000
	5	Jubi	27,78	450.000
Jumlah	18		100.00	

The table shows that investments into fishing gear and boats varies between Rp.450.000,- and Rp. 350.000.000,- or about US$ 50 – 40,000. Additionally, for operations of the gear and boat, fixed and variable costs are relevant. Fixed costs include depreciation of the value of gear and boat, administration costs for fishing licenses and boat licenses, variable costs include expenses for gasoline, food, auction costs as these depend on the amount of fish caught so these are not fixed (Table).

Table 12. Expenses (fixed costs and variable costs) for different fishing gears in 7 sub-districts of Bunaken National Park.

Sub-district	Fishing gear	Fixed costs (Rp)	Variable costs (Rp)	Total Cost (TC)
Bunaken	Jaring Insang	2.287.500	2.250.000	4.537.500
	Pancing Ulur	1.901.250	1.125.000	3.026.250
	Darape	2.025.000	1.500.000	3.525.000
	Noru	1.893.750	1.125.000	3.018.750
	Pajeko	26.250.000	375.000.000	401.250.000
Alung Banua	Jaring Insang	2.287.500	2.250.000	4.537.500
	Darape	2.025.000	1.500.000	3.525.000
	Pancing Ulur	1.901.250	1.125.000	3.026.250
	Noru	1.893.750	1.125.000	3.018.750
Manado Tua	Jaring Insang	2.287.500	2.250.000	4.537.500
	Jaring Malalugis	2.625.000	2.250.000	4.875.000
	Jaring Lolosi	2.625.000	2.250.000	4.875.000
	Pancing Ulur	1.901.250	1.125.000	3.026.250
	Noru	1.893.750	1.125.000	3.018.750
Meras	Pancing Ulur	1.901.250	1.125.000	3.026.250
	Noru	1.893.750	1.125.000	3.018.750
	Jubi	337.500	750.000	1.087.500
Molas	Jaring Insang	2.287.500	2.250.000	4.537.500
	Darape	2.025.000	1.500.000	3.525.000
	Pancing Ulur	1.901.250	1.125.000	3.026.250
	Noru	1.893.750	1.125.000	3.018.750
Tongkaina	Jaring Insang	2.287.500	2.250.000	4.537.500
	Darape	2.025.000	1.500.000	3.525.000
	Pancing Ulur	1.901.250	1.125.000	3.026.250
	Jubi	337.500	750.000	1.087.500

The costs are again highests for purse seine operations. Cost benefit analysis can be done with the above data and results are presented in table 13.

Table 13. Cost benefit analysis per fishing type in Bunaken NP for 1 year

Sub-district	Fishing gear	Gross revenue per year (Rp)	Total Costs (Rp)	Nett income (Rp)
Bunaken	Jaring Insang Pancing Ulur Darape Noru Pajeko	20 kg x 5000 x 150 trip = 15.000.000 10 kg x 7500 x 150 trip = 11.250.000 15 kg x 5000 x 150 trip = 11.250.000 10 kg x 5000 x 150 trip = 7.500.000 1 ton x 5000 x 120 trip = 750.000.000	4.537.500 3.026.250 3.525.000 3.018.750 401.250.000	10.462.500 8.223.750 7.725.000 4.481.250 348.750.000
Alung Banua	Jaring Insang Darape Pancing Ulur Noru	20 kg x 5000 x 150 trip = 15.000.000 15 kg x 5000 x 150 trip = 11.250.000 10 kg x 7500 x 150 trip = 11.250.000 10 kg x 5000 x 150 trip = 7.500.000	4.537.500 3.525.000 3.026.250 3.018.750	10.462.500 7.725.000 8.223.750 4.481.250
Manado Tua	Jaring Insang Jaring Malalugis Jaring Lolosi Pancing Ulur Noru	20 kg x 5000 x 150 trip = 15.000.000 25 kg x 5000 x 150 trip = 18.750.000 25 kg x 5000 x 150 trip = 18.750.000 10 kg x 7500 x 150 trip = 11.250.000 10 kg x 5000 x 150 trip = 7.500.000	4.537.500 4.875.000 4.875.000 3.026.250 3.018.750	10.462.500 13.875.000 13.875.000 8.223.750 4.481.250
Meras	Pancing Ulur Noru Jubi	20 kg x 5000 x 150 trip = 15.000.000 10 kg x 5000 x 150 trip = 7.500.000 7,5 kg x 7500 x 150 trip = 8.437.500	3.026.250 3.018.750 1.087.500	8.223.750 4.481.250 7.350.000
Molas	Jaring Insang Darape Pancing Ulur Noru	20 kg x 5000 x 150 trip = 15.000.000 15 kg x 5000 x 150 trip = 11.250.000 10 kg x 7500 x 150 trip = 11.250.000 10 kg x 5000 x 150 trip = 7.500.000	4.537.500 3.525.000 3.026.250 3.018.750	10.462.500 7.725.000 8.223.750 4.481.250
Tongkaina	Jaring Insang Darape Pancing Ulur Jubi	20 kg x 5000 x 150 trip = 15.000.000 15 kg x 5000 x 150 trip = 11.250.000 10 kg x 7500 x 150 trip = 11.250.000	4.537.500 3.525.000 3.026.250 1.087.500	10.462.500 7.725.000 8.223.750 7.350.000

		7,5 kg x 7500 x 150 trip = 8.437.500		

Calculating the monthy result, some of the fishing gears do not even support an income that is at the regional minimum income level.

Benefit sharing system

Even while the system of sharing benefits from fisheries has been described in law UUPBH Number 16 of 1964, sharing benefit from the fishing operation is stil done following tradition. Theer are no written regulations or ruiles on this sharing system. Agreements are made between the person who owns the gear and the people who fish using the gear. The owner of the vessel and gear usually checks with various people on the boat what the yield was so that there can be no misunderstanding on what benefits were the end result. For purse seine operations, often the owner gets 60 parts of the yield, where 50 parts are for the owner and 10 parts are used to pay for costs of operation. The captain gets 40 parts which is again distributed amongst the crew accordining to different functions of crew members.

Perception of fishers interviewed about the environment and the status of fisheries in BNP

This survey team found that only 25 % of the people interviewed knew that Bunaken was a tourism destination. The people interviewed were asked specifically whether they thought that the status of the resources had changed over the past 10 years.

- Bunaken: 12.5% said status was very good, 87.5 % said status is good
- Alungbanua: 17,64 % said very good, 41.11 % good, 11.76% not good not bad, 5.88 % bad, 23.61% no comments
- Manado Tua: 10.52 % very good, 21.05 % good, 26.31 % not bad not good, 15.78 % bad, 26.34 % no comment
- Meras: 71.42 % condition good, 28.58 % not good not bad
- Molas: 44.44 % good, 16.66 % not good not bad, 38.9 % no comment
- Tongkaina: 11.11 % very good, 66.66 % good, 16.66 % not bad not good; 5.57 % no answer

Conclusions

There are many issues that need attention when aiming to develop sustainable fisheries within Bunaken national Park. However, the main reason for this assessment, looking at who depends on fishing at fish spawning aggregation sites that may need to be fully protected, was to some extend served, as none of the fishers target these SPAGS specifically or is depending on these SPAGS.

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