FISHERS' PERCEPTIONS ON THE SEAHORSE FISHERY IN CENTRAL PHILIPPINES: INTERACTIVE APPROACHES AND AN EVALUATION OF RESULTS

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ABSTRACT

We conducted a study in coastal communities in the central Philippines designed to involve seahorse fishers in research and conservation initiatives. The study comprised (i) an initial scoping survey to obtain data on the fishers and their fishery, including effort and habitat quality, and (ii) community meetings conducted as focus group discussions, in which results from the scoping study were fed back to the communities, questions were repeated, and information on fishers' knowledge and opinions with respect to the seahorse fishery, the state of their fishing grounds, and the condition of their livelihood were collected. Discussions on marine resource management were also held. Participatory methods using visual aids were designed to facilitate communication and discussion. The scoping survey collected information from 173 seahorse fishers in 19 communities on location and quality of fishing grounds, and fishing effort while the community meetings collected information from 117 fishers in 10 focal communities. Average effort was reported in the scoping survey and community meetings as 111 and 192 trips (nights) per fisher per year and 334 and 894 trips per fishing ground per year, respectively. Habitat quality of fishing grounds was generally assessed as good in the scoping survey and community meetings but live coral was not commonly perceived as the dominant habitat type. Responses differed markedly from independent ecological surveys of the same fishing grounds. A comparison of the answers provided by fishers in the scoping study and community meetings indicated that although absolute values differed, relative estimates of fishing effort per fishing ground and effort per fisher corresponded well across the two surveys. Fishers consistently described seahorse abundance, habitat quality and their livelihoods as in decline, and proposed a number of solutions. Through our participatory approach, seahorse fishers are playing a role in designing applied fisheries research, and in developing management plans for their fishery.

INTRODUCTION

Stakeholder involvement in the planning and implementation of conservation initiatives is considered fundamental to the achievement of resource management objectives (Akimichi 1978; Johannes 1981, 1982; Polunin 1983, 1984; Wright 1985; Zann 1985; Johannes 1989; Bailey and Zerner 1992; Ruddle *et. al.* 1992; Ruddle, 1994; Jennings and Polunin, 1996; Walters *et. al.* 1998; Neis *et. al.* 1999; White and Vogt 2000). Participatory approaches to resource management have a number of benefits: (1) stakeholders may have specialized knowledge relevant to resource management that is accessible only through collaborative approaches; (2) the process transfers knowledge and builds stakeholder management capacity; and (3) compliance with resource management decisions is more likely if stakeholders participated in their establishment. There are a number of examples of stakeholder involvement in the management of tropical marine ecosystems. Local knowledge of fish behaviour has been harnessed in the management of South Pacific fisheries (Johannes 1981, 1982; Jennings and Polunin 1996; Cooke *et. al.* 2000). Capacity building lies at the heart of community-based resource management initiatives in the Philippines (White 1988; Vincent and Pajaro 1997; Walters *et. al.* 1998; Alcala 1998, 1999; White and Vogt 2000; Alcala 2001). The integrity of community-based marine protected areas relies heavily on stakeholder compliance that in turn increases with understanding and agreement based on involvement in the process of establishing these areas (Johannes 1982, 1989; Gulayan *et. al.* 2000; Pajaro *et. al.* 2000; Alcala 2001).

Interest in participatory approaches in resource management in part reflects the failure of top-down, centralized approaches to manage natural resources alone (Murdoch and Clark 1994; Agrawal 1995; Maguire *et. al.*, 1995; McClanahan *et. al.* 1997; Sillitoe 1998; White and Vogt 2000). Bottom-up, community-based approaches (BOBP 1990; Walters *et. al.* 1998), involving stakeholders may be more appropriate where resource exploitation is diffuse as is typically the case with subsistence fisheries (Pauly 1997), and

where human and financial resources are limited (White and Vogt 2000).

As part of a seahorse conservation program (Project Seahorse, www.projectseahorse.org) we initiated a participatory research-focused fisheries project in 1999. Our study focused on the seahorse fishery of Danajon Bank, Bohol, central Philippines (Fig. 1, overleaf). Danajon Bank is a double barrier reef stretching approximately 145 km along the northwest coast of Bohol (Pichon 1977). The reef system is shallow (approximately $\leq$ 10m), silty, and composed of scattered and patchy coral reefs interspersed with *Sargassum* and seagrass (pers. obs.). Fishing is the primary source of income for communities located on islands in this system. Seahorse fishing began in the 1960s as part of a subsistence food / cash income fishery termed the lantern fishery. Fishers free dive at night on shallow (1-5m) fishing grounds, using a kerosene lantern strapped to the front of their small boat (4 m outrigger canoes called *bancas*) to illuminate prey items (see also Mangahas, this vol). They spear fish, catch crabs and hand pick seahorses and holothurians (sea cucumbers) that they find. This is the primary method used to collect seahorses in this region (Vincent and Pajaro 1997), though not all lantern fishers collect seahorses. Hookah divers also catch a limited number of seahorses incidentally.

We developed a participatory approach that involved the exchange of information about marine resources on Danajon Bank between lantern fishers and researchers, and among fishers. Stakeholder inclusion was incorporated in the fisheries research program to achieve three goals: (1) obtain information about habitat quality of fishing grounds and fishing effort to aid in the design of the research component of the program; (2) increase fisher awareness about marine conservation issues to build stakeholder resource management capacity; and (3) develop an understanding of what fishers believe to be key marine conservation concerns and appropriate strategies for resolving them. Our participatory approach was unusual in that it was also designed to allow assessment of the information collected on fishing grounds in order to evaluate its accuracy and consistency. We did this by comparing two interview methods and by comparing fishers' perceptions of fishing ground habitat quality with ecological measures from underwater transects (Samoilys *et. al.* 2001) conducted on a subset of the fishing grounds. This analysis evaluated the degree of correspondence between fishers' perceptions and ecological measures of habitat quality.

Methods

The study consisted of two components: (i) an initial scoping survey; (ii) community meetings which involved a) sessions in which the results of the scoping survey were fed back to the fishers and the survey was repeated, and (b) marine resource management discussions to collect information on fishers' knowledge, opinions and actions in relation to their fishery resources. The scoping survey was done by one community organiser (CO), who was then replaced for the community meetings by a second CO (JE). Community organizers are trained social workers that focus on community level social issues as opposed to family or individual level issues. They are an integral part of many community-based resource management programmes in the Philippines (Third World Center 1990). The presence of a Filipino CO, who was fluent in the national language and supported by a local assistant fluent in the local language, was pivotal to the research methods.

1. Scoping survey

The scoping survey was conducted from March to May, 1999, and was designed to: (i) determine the number of fishers involved in the seahorse lantern fishery on Danajon Bank and their distribution among villages, (ii) identify the number of fishing grounds exploited in the seahorse lantern fishery, (iii) quantify fishing effort per fisher and per ground, and (iv) assess habitat quality on the fishing grounds. This information was subsequently used to identify 28 coralline fishing grounds for the ecological research project (Samoilys *et. al.* 2001).

The CO visited 19 seahorse fishing communities in the municipalities of Getafe, Talibon, Bien Unido, Carlos P. Garcia, Ubay, and Tubigon in northern Bohol, Central Philippines (Table 1, Fig 1). In each fishing community, the CO first contacted village leaders to explain the project and ask permission to work in the community. Lantern fishers in the community were then identified, frequently by village leaders, and interviews requested. All fishers asked to participate agreed to do the interview, a total of 199 fishers, 9.1 ± 7.7 (s.d.) fisher per village (Table 1, overleaf).

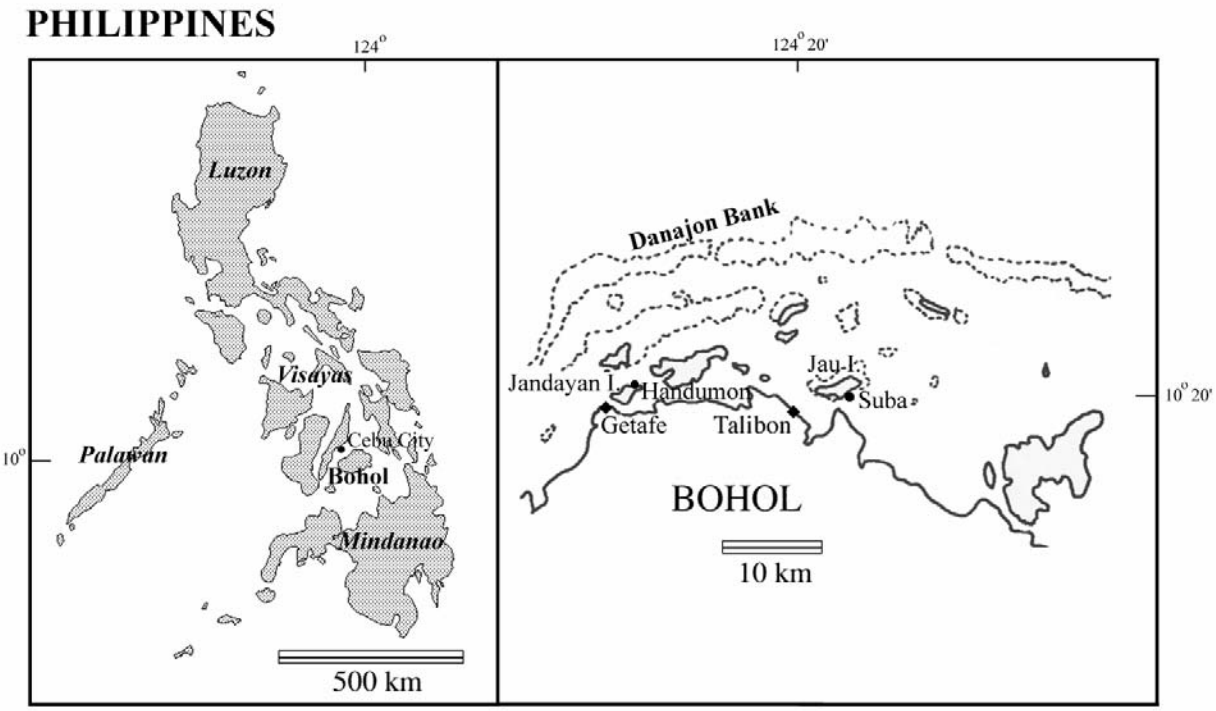

Fig. 1. Map of the Philippines showing the study area of Danajon Bank in northern Bohol, central Visayas.

Table 1. List of villages participating in the scoping and community meetings. Communities in bold participated in both components; others only in the scoping study. CPG = Carlos P. Garcia municipality.

Village	Municipality	Gears	#fishers interviewed	#lantern fishers	#fishing grounds/ village	#lantern fishing grounds/ village
Alumar	Getafe	lantern and hookah	8	6	11	11
Banacon	Getafe	lantern and hookah	6	5	7	7
Bansaan	Talibon	lantern only	8	8	19	19
Batasan	Tubigon	lantern and hookah	20	9	16	6
Calituban	Talibon	lantern and hookah	4	3	3	3
Cataban	Talibon	lantern only	15	15	7	7
Guindacpan	Talibon	lantern only	13	13	9	9
Handay-Norte	Getafe	lantern only	5	5	22	22
Handumon	Getafe	lantern only	33	33	46	46
Jagoliao	Getafe	lantern only	14	14	13	13
Nasingin	Getafe	lantern and hookah	9	3	21	18
Nocnocan	Talibon	hookah only	5	0	2	0
Paraiso	CPG	lantern only	11	11	7	7
Pinamgo	Bien Unido	lantern only	4	4	4	4
Sagasa	Bien Unido	lantern only	3	3	2	2
Sagisi	CPG	lantern only	4	4	5	5
Sinandingan	Ubay	lantern only	20	20	22	22
Suba	Talibon	lantern only	11	11	2	2
Lipata	CPG	lantern only	6	6	6	6
Total			199	173	11.79	11.00

Each interview consisted of a brief questionnaire administered verbally to fishers. Limited information on the fisher (name, number of children) and gear (lantern *vs*. hookah, and paddled *vs*. motored boat) was collected. Fishers were then asked to list all of the fishing grounds they visit. For each of these fishing grounds, they told us the number of hours spent fishing per trip, the number of trips per week, weeks per month, and months per year that they fished the ground. This information allowed the calculation of perceived annual total fishing effort (hours per year) for each fisher for each fishing ground. To indicate the total fishing pressure over time and current levels, fishers also indicated the year they began fishing each ground and the last year that they went there, if they no longer fished it. With respect to the habitat quality of these largely coralline fishing grounds, fishers were asked to: indicate whether the site was "good" (*ma'ayo*) or "bad" (*guba*), identify the major habitat types, and rank all of the sites they fished from best (=1) to worst (= number of sites identified). For each site, we then calculated the following fishing ground indices:

1. % good = the % of fishers that identified each fishing ground as "good";
2. % coral = the % of fishers that identified live coral as the dominant habitat component of a particular fishing ground;
3. fishers' relative rank (FRR) = the average of the rank each fisher gives the fishing ground. Each rank is relative to the total number of fishing grounds ranked by a fisher (e.g. 4th of 10 sites gives a relative rank of 0.4).

All three indices range from 0 to 1, where 1 indicates a good site (e.g. all fishers think it is good, or all fishers identify live coral as the dominant habitat component or it ranks at the top of their lists), and 0 indicates a poor site (e.g. no fishers think it is good or no fishers identify live coral as the dominant habitat component or it ranks at the bottom of their lists).

2a. Community-based meetings: feedback sessions

Community-based meetings were held from June to September 2000, except for one village (Alumar) which was visited in February 2001. Meetings were held with fishers in 10 target villages for the feedback sessions (Table 1) and 9 villages for the marine resource management discussions. These villages included those with the greatest number of lantern fishers (average of 12.6 fisher/village). The community meetings involved focus group discussions using highly visual but low cost methods developed by one of the authors (JE) based on the Reflect method of community interviews. Such methods were necessary given the low level of literacy among fishers and the need to engage their interest for 1-2 day periods. The approach also allowed open-ended questions, a key characteristic for areas in which the researchers had little existing information. The community-based meetings also encouraged fishers to express and formulate their ideas on marine conservation and fisheries management, and engaged fishers in the research process. The gathering of data used graphical symbols, such as cut-outs of seahorses and crabs of various sizes to indicate abundance. Fishers posted these symbols on large gridded sheets with columns for each fisher (Fig. 2). Throughout the meetings, fishers shared or validated information either individually using fishers' worksheets or through group activities using graphic symbols and large gridded sheets. In the group interactions, individual responses could still be tracked as graphic cards were uniquely numbered for each fisher.

The goals of the feedback sessions were to: (i) share and validate the data collected in the scoping survey; and (ii) repeat the scoping survey, gather additional data, and add fishers who were unable to participate in the scoping survey. The structure of the feedback sessions in each village is given in Fig. 3a. To repeat the questions in the scoping survey, a mixture of individual questionnaires and focus group discussions were used. The latter were used to solicit information on the lantern fishing grounds, in terms of habitat type (first identified in the scoping survey) and quality (Fig. 3b).

2b. Community-based meetings: marine resource management discussions

The goals of the marine resource management discussions were to collect the fishers' views on: (i) the relative importance of various marine resources; (ii) the status of marine resources in the past, present and future; and (iii) the causes of resource degradation and their relative importance. In this component of the meetings, fishers were asked to rank the six marine resources identified in the scoping survey in terms of their general economic importance to the fishers, both as a source of cash and food. These resources were grouped by fishers under widely differing taxonomic divisions, including order, family and genus: (i) crabs and other crustacea, (ii) fish, (iii) sea cucumbers, (iv) seahorses, (v) seaweed, and (vi) shells.

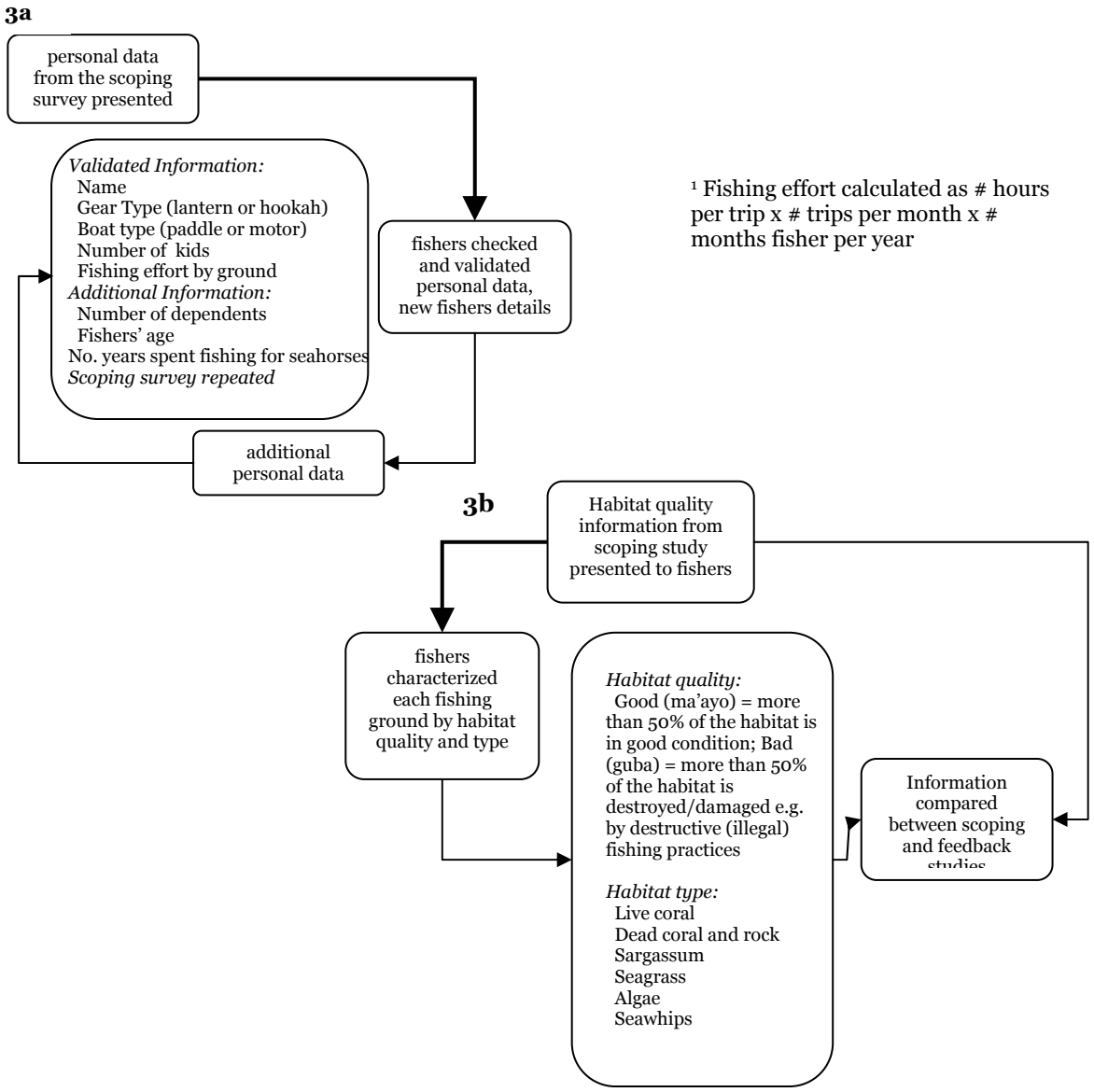

Fig. 2. Structure of a) feedback sessions to validate personal and fishing effort data and repeat scoping survey for catch and effort data, b) focus group discussions on fishing ground habitat type and quality.

Fishers were also asked to provide information for the past (1990), present (2000) and future (2010), on three main topics: the status of their livelihood as fishers, the seahorse fishery, and the fishing grounds. Fishers were asked to assign their answers into categories. Fishing grounds were described as Good (>50% of habitat is in good condition), Mixed (~ 50% of habitat is in good condition), or Bad (> 50% of habitat has been damaged or destroyed). Seahorse populations were described as many, average, or few. Fishers' livelihood was described as Good (income from fishing is sufficient to support the family - includes food, education and recreation), Bad (income from fishing is barely enough to support basic necessities such as food), Very Bad (income is not sufficient to support the basic necessities). Collective discussions were then held to ask fishers for possible reasons for the trends and possible solutions, and to rank both reasons and solutions. The marine resource discussions also consisted of several sessions covering a range of topics such as destructive fishing, particularly blast fishing, and how it affects their fishing grounds. Management options such as protected areas or sanctuaries were also discussed.

In most villages, the CO acted as facilitator for the entire group. However, for villages with more than 12 participants, fishers were subdivided into 2-3 groups with 5-6 members each and groups were assigned different topics. A local facilitator was used for each sub-group, with the CO overseeing all groups. At the end, each sub-group reported and discussed their results with the whole group of fishers.

Data Analysis

The feedback sessions provided an opportunity to evaluate the accuracy and consistency of answers provided by fishers in the scoping survey. The two surveys differed both in terms of the fishers participating and the number of fishing grounds they considered. We analysed similarities between the two surveys for: (i) all fishers and fishing grounds in the scoping survey (173 fishers and 67 fishing grounds, see fishing effort below) *vs.* 117 fishers and 25 fishing grounds in the feedback survey, and (ii) using only those fishers and fishing grounds common to both surveys. Seventy-one fishers and 25 fishing grounds were common to both the scoping and feedback surveys.

The fishers' ranking of fishing grounds by habitat quality was compared to ecological survey data from underwater transects (Samoilys *et. al.* 2001) conducted on a subset of these fishing grounds.

RESULTS

The ability to attract fishers was essential to the success of the community meetings. 117 fishers, 68% of all lantern fishers in 10 villages, participated in the feedback sessions. 114 lantern fishers in 9 villages participated in the marine resource management discussions. Feedback sessions were done in the morning with the resource management discussions in the afternoon, with 97 % attendance throughout the day's meeting. This high participation rate was attributed to the popular highly visual and graphic methods used by the CO.

Profile of Danajon Bank lantern fishers

Of the 199 fishers interviewed from 19 villages across the Danajon Bank region, 87% were exclusively lantern fishers (Table 1). In most villages, lantern gear was used exclusively, though hookah gear was also used. On average there were 9 lantern fishers per village, accessing 11 lantern fishing grounds per village (Table 1). Fishing grounds were common to several villages. Sixty percent of the lantern fishers in the scoping survey and 53% of fishers participating in the feedback sessions still used non-motorised paddle boats. The average number of children per fisher from the scoping survey was 4.1±2.4 (s.d.), and the average number of dependents from the feedback sessions was 5.2±3.0 (sd). On average, the number of children per fisher was 80.5%±35.4 (sd, n=70) of the total number of dependents. This relatively low number of children for the region probably reflects the relatively young age of the fishers: 33.6±10.8 (sd) years.

Fishers participating in the community meetings ranged from those who started fishing seahorses in 1961 to those who started in 2000. Nineteen of the fishers had stopped fishing seahorses between 1990 and 1999, the rest were still actively fishing.

Fishers gave names for 147 fishing grounds. However, reference to a map of the area indicated that these names represented 92 distinct fishing grounds, of which 73% were dominantly used by lantern fishers (>95% of the total effort per ground from lantern fishers), 16% were used by both lantern and hookah fishers, and 11% were exclusively used by hookah fishers. Nine fishing grounds were exploited in 1961, increasing to 67 in 1999 with the most rapid expansion occurring in the early 1970's (Fig. 4).

Only two grounds had been entirely abandoned in 1999. On average, fishing grounds had been exploited for 14.5 years ± 5.7 (s.d.) (range 3-39).

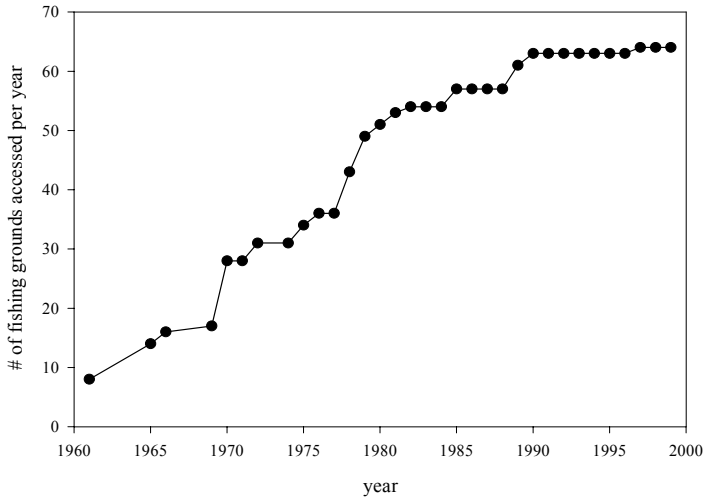

Fig. 4. The number of grounds fished per year on Danajon Bank, Bohol

Fishing Effort

Reported annual fishing effort per fisher and per fishing ground differed markedly between the scoping and feedback studies (Table 2). Considering the 67 grounds on which lantern fishing comprised at least 95% of total annual effort, fishers in the scoping survey reported they were spending around 30% of their nights fishing (111 fishing trips per year, Table 2). On average, each fishing ground was fished almost one trip per night for every night of the year (Table 2). In contrast, fishers in the feedback survey reported that they were spending up to 50% of their nights fishing on the 25 lantern fishing grounds considered (Table 2). Furthermore, these grounds were fished on average 2.5 trips per night for every night of the year.

Considering the subset of data for fishers and fishing grounds common to both studies, fishers in the feedback sessions reported total annual effort 2.6 times greater than that reported by the same fishers for the same grounds in the scoping study (45,665 hrs·yr^{-1} vs. 17,513 hrs·yr^{-1}, respectively). Annual effort per fisher within the overlapping group was significantly greater in the feedback group than in the scoping group (paired t-test, df=70, $p<0.0005$). Reported effort per fishing ground was also significantly greater in the feedback group than in the scoping group (paired t-test, df=21, $p=0.027$). Despite the absolute difference between the two groups, error estimates were relatively consistent, both by fisher (Fig 5a) and by ground (Fig 5b). Note that there was no correspondence between the estimates from fishers in Alumar and Bansaan villages, and these two outliers were therefore excluded from the analyses.

Fishing ground habitat quality

Habitat quality on the lantern fishing grounds was generally considered to be good by fishers in both the surveys. 78% of fishers (± 28% s.d., range 0-100%, n=67 sites) said the fishing grounds were in good condition in the scoping survey, and 75% of fishers (± 35% s.d., range 0-100%, n=25 sites) said the fishing grounds were in good condition in the feedback sessions. If the group of fishers and grounds common to both studies are considered, 77.3%±6.7% and 81.4±7.4% of the fishing grounds were described as "good" by fishers in the scoping and feedback groups, respectively. No significant differences could be detected and indeed, when considering the responses of each fisher for each fishing ground (n=128), 76% of the answers were consistent between the two studies.

Table 2. Annual lantern fishing effort on Danajon Bank as reported by fishers from the scoping and feedback surveys. Figures in parentheses are standard deviations. Fishing trip duration was not asked in the scoping survey: the value is an approximation. n refers to the number of fishers interviewed.

	Fishing trip duration	**Total fishing effort**		**Fishing effort per fisher**		**Fishing effort per ground**	
	Hours	**Trips**	**Hours**	**Trips**	**Hours**	**Trips**	**Hours**
Scoping survey (n=173)	~4	19,141	76,562	111 (82)	444	334 (539)	1,334
Feedback sessions (n=117)	3.5 (1.8)	21,653	75,114	192 (148)	671 (519)	894 (1,254)	3,129

The Fishers Relative Ranking allowed sites to be ranked from high (FRR near 0) to low quality (FRR near 1). Although fishers' assessments varied both qualitatively and as a function of the number of fishing grounds fished, there was sufficient consistency to allow fishing grounds to be distinguished (Fig. 6).

The assessment of habitat type was more problematic. In the scoping survey, on average, 45% of fishers (± 31% s.d., range 0-100%, n=67 sites) said that the fishing grounds were dominated by live coral, as opposed to 26% of fishers (± 31% s.d., range 0-100%, n=25 sites) in the feedback survey. Using the same group of fishers and fishing grounds common to both studies, 49.2±6.5% of fishers described fishing grounds as dominated by live coral in the scoping study, whereas only 22.1±6.8% of fishers described the same fishing grounds as dominated by live coral in the feedback sessions. This difference was significant (paired t-test, n=25, p=0.007). When considering the responses of each fisher for each fishing ground (n=128), only 20.9% of responses were consistent between the two studies.

Fishers' assessments of habitat quality generally did not correlate with any formal measurements of habitat composition (e.g. % live coral, % *Sargassum*, % dead coral etc.) as measured by a biologist (Samoilys *et. al.* 2001) using the line intercept method (English *et. al.* 1994). The only significant relationship was that between the % of fishers indicating that a fishing ground was "good" and % rubble cover (Fig. 7). The fishers' assessment of habitat quality was significantly negatively correlated with % rubble cover for both surveys.

Resource management discussions

Food fish were ranked as the most economically important resource (mean rank = 1.61 (±0.11s.e.) followed by sea cucumbers (2.81±0.11), seahorses (3.04±0.16), crabs (3.60±0.11), seaweed (4.28±0.13) and shells (5.24±0.10). Notably, one seahorse genus (*Hippocampus*), ranked third among orders and families of other organisms. The fishers' assessment of seahorse populations, fishing ground habitat quality and their livelihood indicates that these were largely healthy in the past (10 years ago), but conditions are felt to have deteriorated to the present with a poor outlook for the future (Fig. 8).

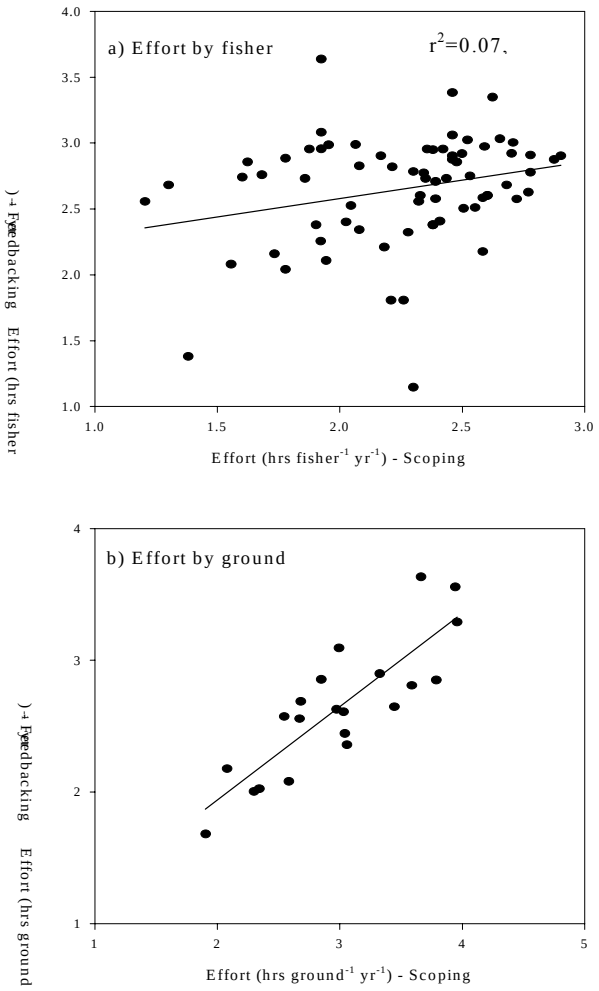

Figure 5. Correlations of effort by a) fisher and b) fishing ground in the group of overlapping fishers (n= 71) and grounds (n=25) for the Scoping (S) and Feedback (F) studies.

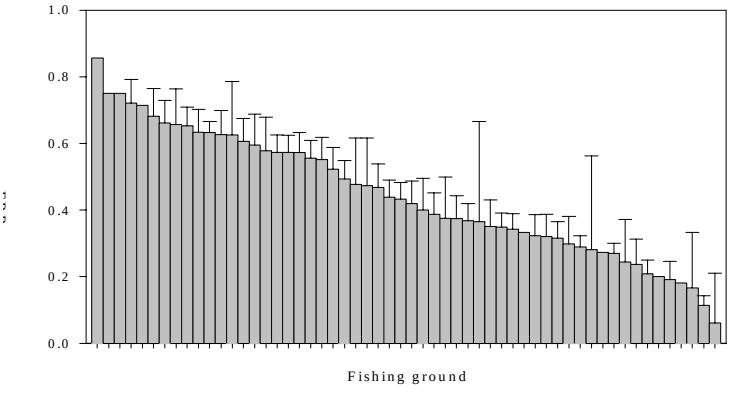

Figure. 6. Mean fisher's relative ranking (FRR) of habitat quality by fishing ground; error bars indicate standard errors.

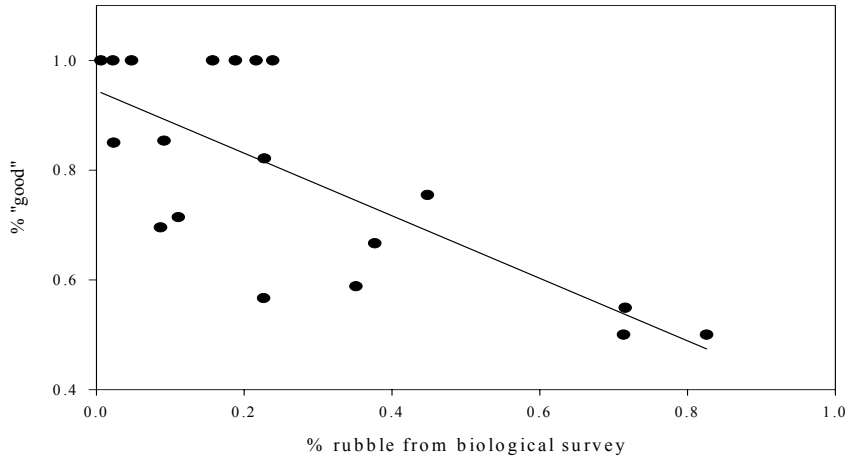

Fig. 7. Correlation between % of fishers indicating a site is "good" and % rubble cover measured on ecological surveys (points shown are from scoping survey)

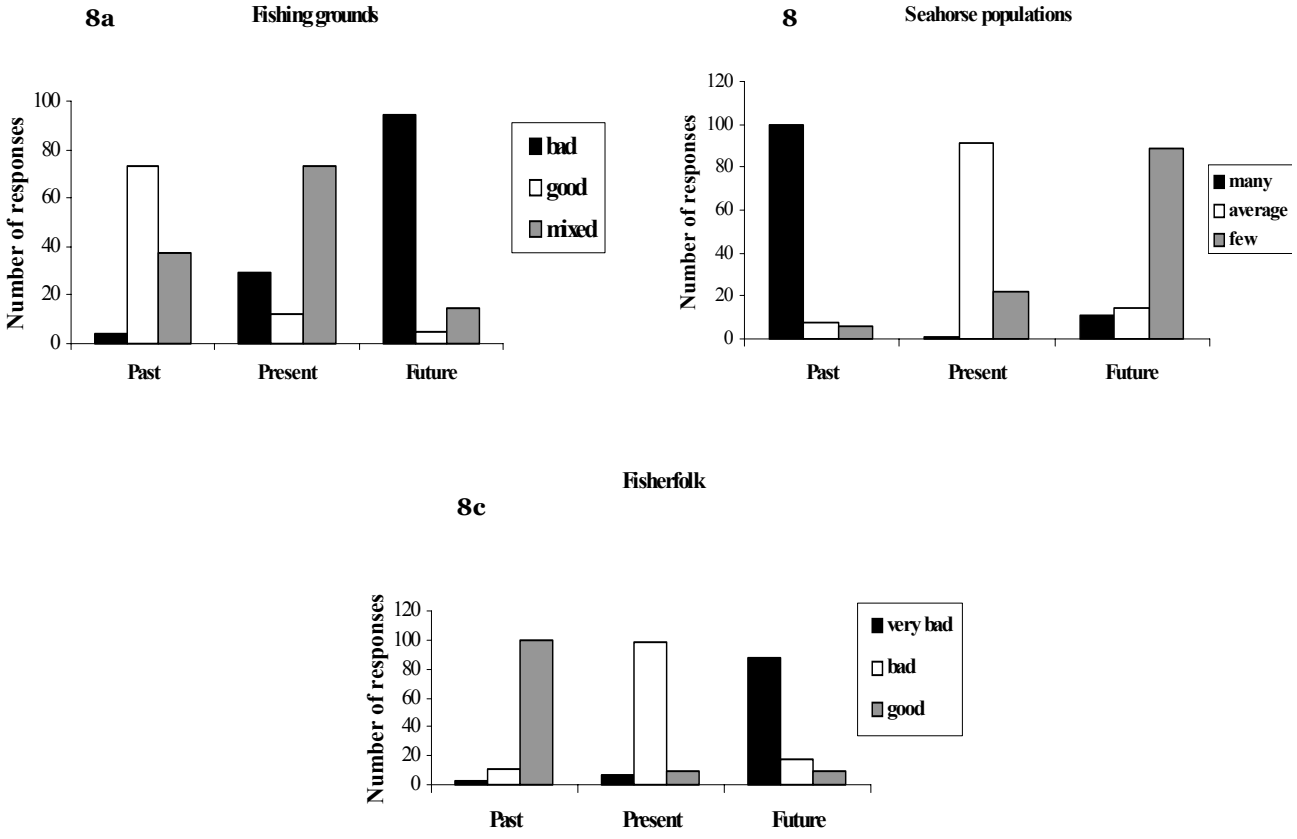

Fig. 8: Trends in status of a) fishing ground condition , b) seahorse populations and c) fishers' livelihood assessed by fishers from Past (1990), Present (2000) to Future (2010).

Reasons for the negative trends in fishing grounds, seahorse populations, and fishers' quality of life were proposed and ranked, and suggestions for improvements were given (Tables 3-5). Fishers in all villages listed destructive (generally illegal) fishing as the most important reason for the poor condition of the fishing grounds. Dynamite ("blast" fishing), cyanide and *tubli*, a local plant poison, were the major illegal gears used (Table 3).

Commercial fishing, primarily trawling and Danish seining (*liba liba*), was cited as the second most important reason for the degradation of fishing grounds. Both trawling and Danish seining are illegal within municipal waters. Fishers frequently used the terms commercial fishing and destructive fishing synonymously. Beach seining (*baling*), though legal in some municipal waters, was also cited as a destructive fishing method. Fishers stated strongly that the fishing grounds were likely to deteriorate further due primarily to continuing illegal and destructive fishing, and also increasing numbers of fishers and a lack of concern regarding protection of the seas from fishers and government (Table 3). Fishers in some villages stated that illegal fishing would continue because there was either no will on the part of government to enforce fishery laws, and/or that government officials were conniving with illegal fishers. Fishers in all villages listed the stopping of destructive and illegal fishing as the highest-ranking solution to the deterioration of their fishing grounds (Table 3). They suggested this should be done through strict and proper enforcement of fishery laws by local government units (village and municipal level), through involvement of non-government organisations (NGOs) in fishery law enforcement, and through appointing more fish wardens.

Reasons for perceived declines in seahorse populations were more variable (Table 4). Fishers perceived the taking of pregnant seahorses and habitat destruction as primary reasons for the decline. Increased effort was also listed and was ascribed to an increase in the number of fishers, partly due to fishers switching from other fishery resources (e.g. fin fish) that had declined. Fishers felt declines in seahorses are likely to continue due to insufficient numbers of adult seahorses, deteriorating habitat quality, and a lack of juveniles (Table 4). To halt declines in seahorse populations, fishers most frequently suggested stopping destructive fishing and protecting pregnant seahorses (Table 4).

Table 3: Results of marine resource discussions on the destruction of fishing grounds. The number of villages that ranked each reason or solution from most important (rank = 1) to least important (rank = 5) is indicated. Destructive fishing included both methods destructive to the habitat and illegal fishing such as trawling and seining in municipal waters. Total villages = total number of villages providing each reason/solution.

	Rank					Total Villages
	1	2	3	4	5	
Reasons for the destruction of fishing grounds						
Destructive (illegal) fishing	9					9
Commercial fishing		8				8
Typhoons			3			3
Coral collecting				1		1
Increasing # of fishers				1		1
Increasing # of outside fishers					1	1
Reasons destruction will continue in the future						
Continuing destructive fishing	7		1			8
Increasing # of fishers	1	5	2			8
Lack of concern in protecting the sea (fishers and/or government)	1	2				3
Increasing effort per fisher		1	1	1		3
Improved fishing methods				1		1
Solutions to arrest the destruction of fishing grounds						
Stop destructive and commercial fishing	9					9
Establish more MPAs		4	2			6
Stop buying destructively bought fish		1	1			2
Educate and inform fishers		1	1			2
Maintain own MPA		1				1
Alternative livelihoods for fishers			1			1
Stop outside fishers		1				1
Organize fishers			1			1

Table 4: Results of marine resource discussions on declines in seahorse populations. The number of villages that ranked each reason or solution from most important (rank = 1) to least important (rank = 7) is indicated. Total villages = total number of villages providing each reason/solution. MPA = marine protected area or sanctuary implemented and managed at the village level.

	Rank							Total Villages
	1	2	3	4	5	6	7	
Reasons for declines in seahorse populations								
Taking pregnant seahorses	3	3	1					7
Habitat destruction	3	2	1	1				7
Catching juveniles		2	2					4
Destructive fishing		1	2					3
Increased fishing effort	3		2	1				6
Weather		1	1	1	1			4
Indiscriminant catching				1				1
Catch during spawning season						1		1
Pollution							1	1
Reasons declines will continue in the future								
Few adults for reproduction	3	1						4
Continuing habitat destruction	3	1	1					5
Lack of good habitat (destroyed)	2	3	1					6
Few juveniles		2						2
Increasing effort	1	1	2					4
Catching pregnant seahorses		2						2
Solutions to arrest declines in seahorse populations								
Stop destructive fishing	4							4
Stop catching of pregnant seahorses	4	2						6
Caging of pregnant seahorses		2		1				3
Stop fishing juveniles	1	2	1					4
Establish sanctuaries		1	1					2
Moratorium on seahorse fishing		1	2					3
Regulation of trade and catch			2	1				3
MPA management			1					1
Protect habitat		1						1
Seasonal closures		1						1
Fishers to cooperate with LGU, NGO		1						1

Reasons for the poor condition of fishers' livelihood and why their situation would be very bad in the future were varied, and there was less consistency across villages (Table 5). Less income was cited as the main reason for the poor situation of fishers today, that is, less income derived from fishing which results in less disposable income for recreation. Secondarily, fishers cited an increase in the costs of living and fishing as significant factors. They also listed a lack of alternative livelihoods to fishing. The reasons for the continuing decline in quality of life were rooted in the status of the fishing grounds, with destructive fishing cited as the main reason, followed by less catch and more fishing effort. Alternative livelihoods were perceived as the most important tool to improve the fishers' situation with the need to stop destructive fishing as the second most important solution (Table 5).

Table 5: Results of marine resource discussions on the status of fishers' livelihoods. The number of villages that ranked each reason or solution from most important (rank = 1) to least important (rank = 6) is indicated. Total villages = total number of villages providing each reason/solution. MPA = marine protected area or sanctuary implemented and managed at the village level.

	Rank						Total Villages
	1	2	3	4	5	6	
Reasons for deterioration of fishers' livelihoods							
Less income	5	1			1		7
Increased price of commodities		2	3				5
Increased operating costs	1	1	1				3
No alternative livelihoods		1	1				2
Difficulty meeting basic food needs	1	1	1	3			6
Inability to improve gear technology			3		1		4
Difficulty funding kids' schooling		1		1			2
Bad weather	1	1					2
Travel further to fishing grounds				1			1
Reasons livelihood deterioration will continue							
Destructive fishing	6						6
Less catch	1	3	1	1			6
Increased # of fishers	1	1	2	1			5
Increased operating costs	1		1		1		3
Bad weather							0
Travel further to fish		1					1
No alternative livelihoods			1				1
Destroyed fishing grounds		1					1
Commercial fishing							0
Solutions to arrest the deterioration of fishers' livelihoods							
Alternative livelihood	5	3					8
Stop destructive fishing	3	1					4
Alternative income		2	1				3
Fishers' cooperative		2					2
Improve technology			3				3

DISCUSSION

The participatory approaches of the focus group discussions generated a lot of interest among the lantern fishers of Danajon Bank. The highly visual, graphical methods of conveying data were very effective in engaging the fishers and soliciting responses. The method is particularly well suited to fishers who are semi – literate. For example, only 11% complete elementary school in Handumon village (Buhat *et. al.* in prep.). High participation rates indicated this element of the program was successful.

One issue in the focus group discussion approach is the validity of the responses obtained from the group. Bias towards answers provided by dominating fishers which other fishers copy is likely. In the present study we were able to examine this by comparing reported fishing effort data obtained from the conventional questionnaire–based approach (the scoping survey) with the focus group discussions of the feedback survey. Although there were differences in the absolute values obtained, trends in fishing effort among fishing grounds were significantly correlated between the two surveys. Similarly,

there were no significant differences in the description of the overall quality of the fishing grounds between the two methods.

Most of the fishing communities of Danajon Bank that we visited had not been involved in our conservation program and therefore this study served to integrate the CO into the communities and to engage the fishers in our research and management initiatives.

One objective of the study was to generate discussions on resource management, and though at times dominated by key members in the fisher communities, group discussions served as opportunities for sharing ideas particularly between the CO and the communities. This step of educating, informing and agitating fishers (called "conscientization", in Filipino CO terminology) is vital in the community organising process (Third World Studies Center 1990). It is also fundamental to stakeholder involvement in conservation and management

initiatives (Ruddle 1994; Walters *et. al.* 1998; Alcala 1999; Cooke *et. al.* 2000; White and Vogt 2000).

A much higher estimate of fishing effort was obtained from the feedback survey compared with the scoping survey. This may reflect bias from the group discussions or the difference in sample size. There were 67 fishing grounds included in the scoping survey and only 25 in the feedback survey. However, with a change in CO during the feedback survey, we found that not all fishers had responded to the questions of fishing effort during the scoping survey, and that estimates per village were in fact based on only around 2 fishers. Therefore it is likely that the feedback survey, which collected effort estimates from each fisher in each village (mean = 9 fishers per village), provides a more accurate estimate of fishing effort. An average of 2.5 fishing trips per night per lantern fishing ground throughout the year was recorded, which is high considering the fishing grounds were less than 1km^2 in size (Samoilys *et. al.* 2001) and fishing trips lasted for 3.5 hours.

Estimates of fishing effort from interviews with fishers are renowned for their inaccuracy in terms of absolute value (Rawlinson 1993, Die 1997). However they provide useful relative estimates, and can be used to plot trends over time. This is well demonstrated in the present study. Highly consistent relative estimates of fishing effort per fishing ground were obtained between the two surveys. Effort per fisher was less consistent, therefore presumably less reliable, but still significantly correlated between the two surveys.

We suggest that long term blast fishing and other destructive fishing methods in this region means that fishers' perceptions of a healthy fishing ground have changed and now differ markedly from ours. Fishers described their fishing grounds to be in good condition in the scoping and feedback surveys. In contrast, independent transect surveys revealed average % live coral cover of 15% and % rubble/dead coral cover (an indication of blast fishing damage) to be 37% for the same fishing grounds (Samoilys *et. al.* 2001), suggesting the fishing grounds are in poor condition. This discrepancy indicates fishers and ecologists are using different criteria to assess fishing ground habitat quality. There is a difference in threshold, or a shift in baseline (Pauly 1995 and 1996), for perception of a healthy habitat, with the fishers' threshold being substantially lower. Fishers may use the extent of rubble cover as an indication of habitat quality since the relationship between fishers' perceptions of good habitat was significantly negatively correlated with % rubble cover from independent surveys. A fishing ground was not considered to be in bad condition by fishers until rubble cover exceeded 50%, a value that would be considered very high by ecologists (Gomez *et. al.* 1994; Chou 2000).

Our results highlighted potential difficulties in composing suitable questions when interviewing fishers. Fishers may interpret questions quite differently from how they were intended by the interviewer, and results can be easily misinterpreted. This is a common problem when conducting interviews and focus group discussions with subsistence fishers (Baird, this vol). In our study the definition of habitat "quality" was poorly defined, and was open to many interpretations. This may explain why the fishers described their fishing grounds to be in poor condition when asked during the marine resource status discussions. Such questions need to be defined very specifically, so that fishers' knowledge can be accurately interpreted.

The marine resource discussions revealed that 20 year trends (1990-2010) in the status of the fishing grounds, seahorse populations and the fishers' livelihood as lantern fishers were all negative. In many cases there was strong consensus across villages for the reasons and for the solutions to these trends. For example, illegal fishing (primarily blast fishing) was cited as the primary cause of the poor state of the fishing grounds, with its corollary of stopping illegal fishing as the primary solution. In other cases there was less consensus amongst fishers. For example, fishers assessed their livelihood as being bad for a number of different reasons, though most of these did relate to an increasing need for cash which their livelihood could not provide. In all cases it was clear that fishers recognized their problems and had informed ideas on how to alleviate them, though perceived themselves to be largely powerless to effect change. It was overwhelmingly clear that stopping illegal fishing, especially blast fishing, and finding alternative livelihoods for the fishers were key solutions to the problems in the Danajon Bank lantern fishery. These results provide us with useful backing when directing our conservation efforts, though neither result is surprising. The prevalence and problem of blast fishing in the Philippines is well recognised (Alcala and Gomez 1987, Yap and Gomez 1988, Bryant *et. al.* 1998, Chou 2000). Furthermore, the lantern fishers of Danajon Bank are marginalized, comprising a relatively small proportion (nine fishers per village) of the total

village population, with the lowest average income in the region, living well below the national poverty level (Buhat *et. al.* in prep.). Considering the fact that they fish for up to 50% of their nights in arduous conditions, using paddle canoes and spending on average 3.5 hours in the water per night with no protection, it is not surprising that they would gladly welcome a supplemented livelihood.

The fishers' views are guiding us in our fishery management planning with various stakeholders (Martin-Smith *et. al.* In prep.), The fishers demonstrated a good understanding that gravid seahorses are important for population sustainability, citing the taking of pregnant seahorses as the primary cause of population depletion, and that the ensuing lack of adults and juveniles will contribute to further decline. It was not clear whether they knew that the pregnant seahorses were males (Vincent 1994), however the option of protecting pregnant seahorses through fishery regulations is clearly understood (Martin-Smith *et. al.* in prep.). Fishers also linked population decline directly to habitat destruction. Fishers from the village of Handumon, where Project Seahorse has been active since 1995 (Vincent and Pajaro 1997), provided the same range of reasons and solutions to their problems as other villages. One village, Guindacpan, consistently provided more answers and appeared more informed. The reasons for some of the differences between villages require further study.

Fishers' knowledge can guide conservation initiatives. We are acting on their knowledge and formalising it. The lantern fishers demonstrated that they are aware of conservation and management issues, are concerned about their marine resources and their livelihoods, recognise the negative trends, and know the reasons for their demise. However, they feel powerless to do anything about it, and see the government as being responsible but ineffective. These results have been instrumental in our initiatives to introduce supplementary livelihoods, and to facilitate the formation of a fishers' alliance across Danajon Bank to provide seahorse fishers with their own institution with which they can effect change.

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QUESTIONS

Ian Baird: I have a comment regarding the apparent inconsistencies in the fishers' answers regarding the conditions of seahorse habitat. There can be explanations for these inconsistencies. For example, since you mentioned that there has been dynamite fishing for a long time, the habitat may have been in even worse condition than it is now, and people perceive it relative to the way it was before. They could also be comparing the habitat to adjacent places that are in even worse condition. It may not be as much of an inconsistency as it looks like initially. What you should do is go back to the fishers and tell them what you told us, and ask why there may be such inconsistencies.

Melita Samoilys: That's the next step in the project, to take our results back to the fishers and show them what we got and to ask fishers about the conditions of the fishing ground. They could be relating it to how it is doing compared to seahorses and not the habitat itself. We have to be careful.

Willard Sparrow: How do you deal with cultural understandings?

Melita Samoilys: We were fortunate in that Joel Erediano, who is in the project, is Filipino so he speaks the language. There's difficulty in translating it back to English, and it is hard for someone like myself to interpret the results.