



Rebuilding Management Effectiveness in Karimunjawa Marine National Park, Indonesia



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Chief Investigator: Dr. Stuart J. Campbell

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The Wildlife Conservation Society's (WCS) Asia Pacific Coral Reef Program followed guidelines of "How is Your MPA doing" to develop an integrated approach to researching the factors that influence the health of coral reef ecosystems. The following is a report of the findings of this approach which were used to develop and build management capacity through development of a management framework, monitoring plans and training programs.

Summary

The Wildlife Conservation Society's (WCS) Asia Pacific Coral Reef Program provides an integrated approach to researching the factors that influence the health of coral reef ecosystems. The specific objectives of this study have been to:

1. Work with all key stakeholder groups to develop and implement an effective management strategy based on information collected.
2. Build community support for the new management plan and increase awareness of the status and benefits of the new management strategy.
3. Monitor the effectiveness of the management plan and incorporate findings into an adaptive management system.

WCS has been working in partnership with the Balai Taman Nasional, the government authority responsible for the management and re-design of an effective management system for the coral reef ecosystems within Karimunjawa National Park (Figure 1). Karimunjawa National Park is made up of 27 islands and is inhabited by 8000 individuals in three communities. Farming, fishing, aquaculture, tourism and domestic business comprise the primary source of income for residents of Karimunjawa (Figure 2).

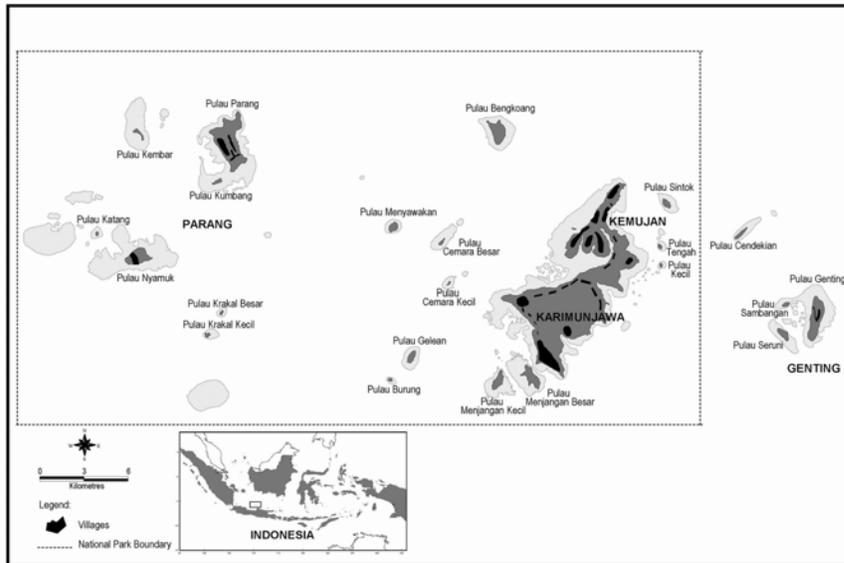


Figure 1. Location of Karimunjawa Marine National Park in central Java, Indonesia

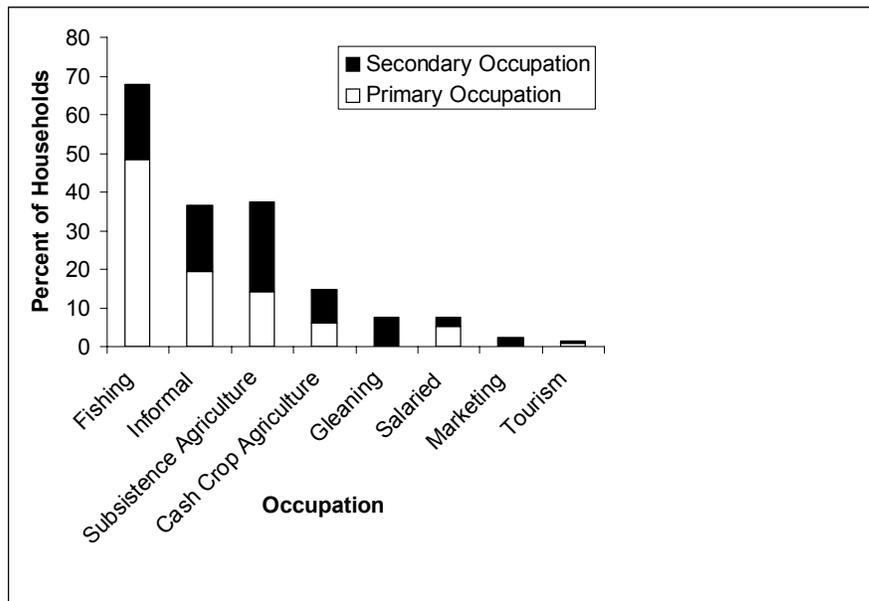


Figure 2. Percent of household primary and secondary occupations in Karimunjawa Marine National Park.

This collaborative program arose because of a lack of ecological and socio-economic data associated with the use of coral reef resources within Karimunjawa Marine National Park.

WCS Marine Program Indonesia has assessed the ecological condition of coral reef habitats, and evaluated socio-economic factors that constrain fisheries and conservation management in Karimunjawa National Park. Baseline data on Karimunjawa coral reef systems was used to define the most appropriate reef management strategies for Karimunjawa reefs. Between 2003 and 2005, this information was used by Balai Taman Nasional to re-design a zoning plan for the marine park as part of their management of marine resources. This plan has been through an extensive consultative process and was formally adopted by the park authority in March 2005. The plan has also received formal support from local district government (Kapupaten) and village leaders (Perda). In June 2005 the zoning plan was formally legislated at the national government level. Legal documents were then signed by all government sectors at the National, District and local government levels before the process was finalized. Patrols by national park rangers in collaboration with police and navy officers have been conducted since June 2005.

As part of the management plan an integrated biological and socio-economic monitoring plan was developed by WCS in cooperation with Balai Taman Nasional. The first monitoring of coral reef resources was conducted in April 2005 (time = 0) to assess resources and provide a basis to evaluate management effectiveness over the next five years. Scientific training for marine park rangers was conducted by WCS coral reef scientists. Ten marine park rangers have been fully trained and now have expertise in coral reef surveys, data management, data analysis and reporting. The technical monitoring protocols, documentation and field protocol booklets/guides are finalized in both English and Indonesian languages. The monitoring of coral reef resources using coral reef surveys of coral and fish will occur on an annual basis and was again completed in April 2006 (time = + 1 year).

Conservation Accomplishments

Objective 1. Work with all key stakeholder groups to develop and implement an effective management strategy based on information collected during phase I of the project.

Reports on biological resources of coral reef ecosystems, socio-economic information and patterns of fishing methods by local fisher communities were prepared (in English and Indonesian) and submitted to Balai Taman Nasional (Marnane et al. 2004). The reports provide data on marine ecosystem condition and anthropogenic factors that threaten these ecosystems and the data were used for marine resource planning and the re-zoning process. The main findings were that:

1. Coral reef resources were relatively homogenous throughout the park;
2. Coral reef fish abundance was generally in a depleted condition throughout the park;
3. Coral reefs were not highly diverse but were relatively healthy;
4. There was low awareness of park regulations (Table 1);
5. There was high awareness of the impacts of destructive fishing pressures (Fig. 3);
6. There was low input by communities into the previous management system;
7. There was high support from the community for some new regulations (Fig. 4).

Table 1. Percent of survey population aware of restriction types and implementing body.

Restriction	Total^a	Government	NGO	Community	Unknown	Common Answers
Spatial	13.4	6.7	0.0	3.7	3.0	Menyawakan Island, Burung Island, Geleang Island August (Navy Island), Islamic New Year
Seasonal	5.2	1.5	0.0	3.0	0.7	Turtles, Ornamental fish, Giant clams
Species	34.3	29.9	0.0	3.7	0.0	n/a
Nets	35.8	25.4	0.7	17.2	0.0	n/a
Poison	59.0	56.7	0.0	14.2	0.0	n/a
Explosives	29.9	29.1	0.7	9.7	0.0	n/a
Other Gear	2.2	1.5	0.0	0.7	0.0	Compressor, Electricity

a Percent of respondents that mentioned the specific restriction. More than one response could be chosen for the implementing body, therefore values in the Government, NGO, Community, and Unknown columns do not necessarily equal the Total column.

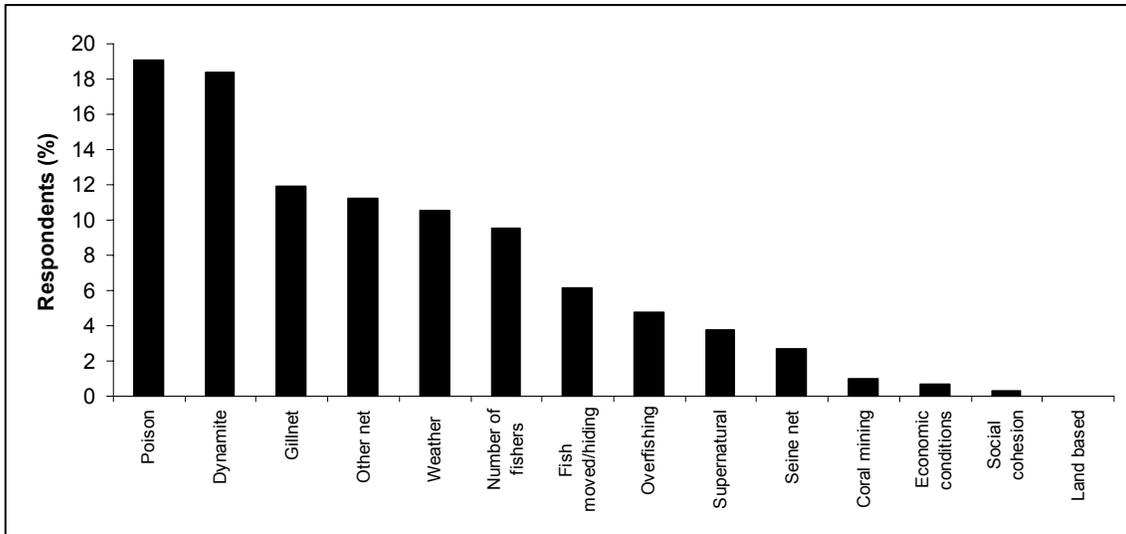


Figure 3. Percentage of respondents perceiving impacts on fisheries and reef condition

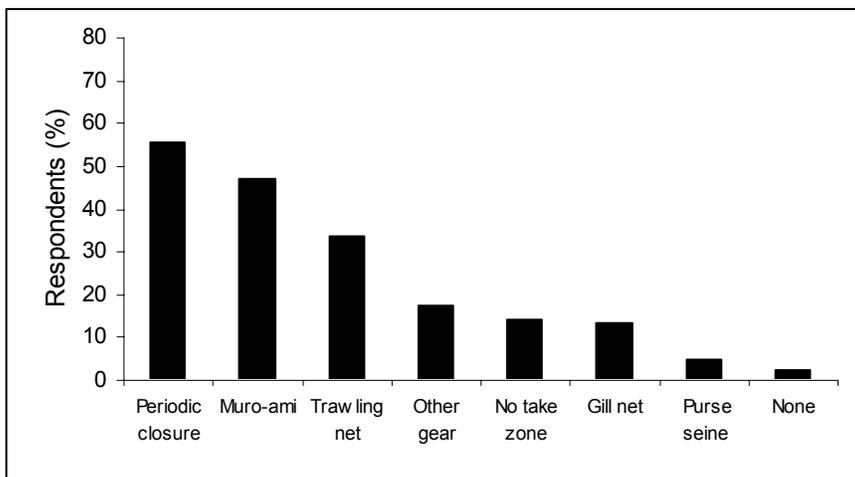


Figure 4. Percentage of respondents that support regulations on fisheries

To assist in building an integrated park management system in partnership with Balai Taman Nasional agency, WCS developed an initial zoning plan document (Fig. 5a) in accordance with National Park guidelines. This document was extensively discussed at a series of consultative workshops in 2004. An interim consultative proposal, finalized in October 2004, (Fig. 5b) was then discussed at a series of targeted consultative meetings held between government and key stakeholder groups from November 2004 to January 2005. These included village based forums and government and stakeholder meetings.

Consensus on a final plan acceptable all stakeholders was achieved in January 2005. The final document and zoning plan (Fig. 5c) were legislated in June 2005 by the national government and formally accepted by district governments in August 2005.

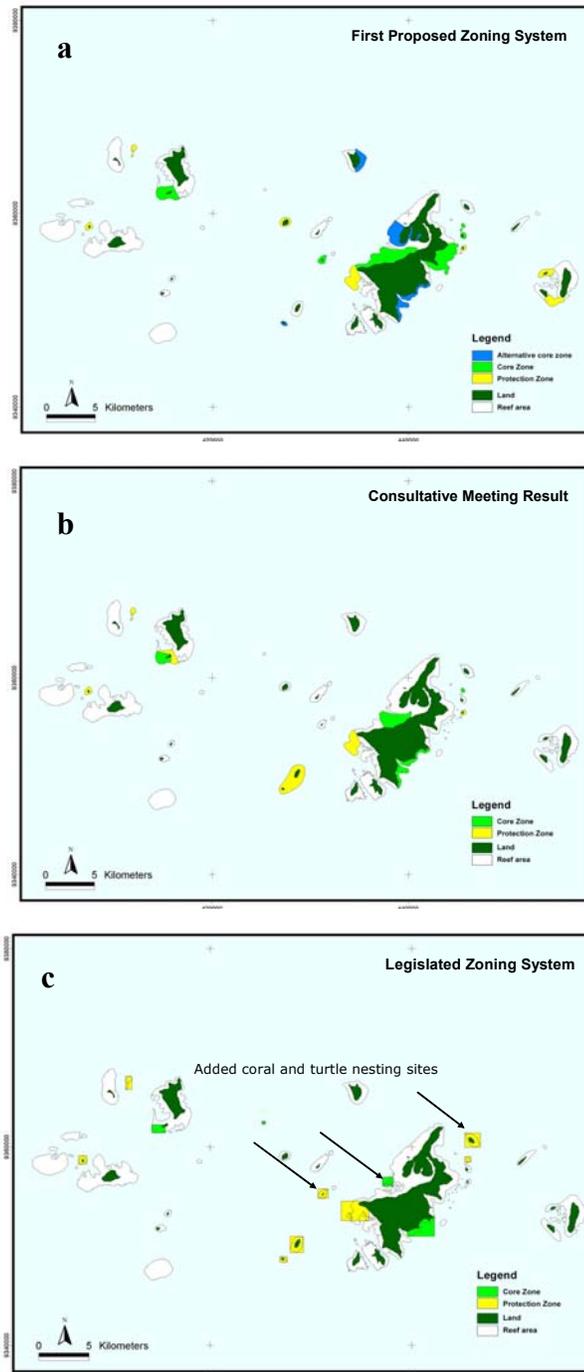


Figure 5. Zonation plans for a) initial zoning plan document, b) interim consultative proposal, finalized in October 2004 and c) final legislated zoning plan in June 2005.

The final zoning plan includes a series of zones for different uses (Fig. 6). These include Zona Inti (Core zone) where access or taking of marine resources is prohibited; Zona Perlindungan (Protection Zone) where entry is permitted but fishing is prohibited; Zona Pemanfaatan Perwisata (Tourism zone) specifically designed for tourism and where limited line fishing is permitted; Zona Pemanfaatan (Utililisation zone) where traditional fishing is permitted; Zona Pemukiman (Development zone) where communities are allowed to develop; Zona Rehabilitasi (Rehabilitation zone) designed for some rehabilitation of damaged reefs and Zona Budidaya (Aquaculture zone) where areas have been designated for aquaculture use.

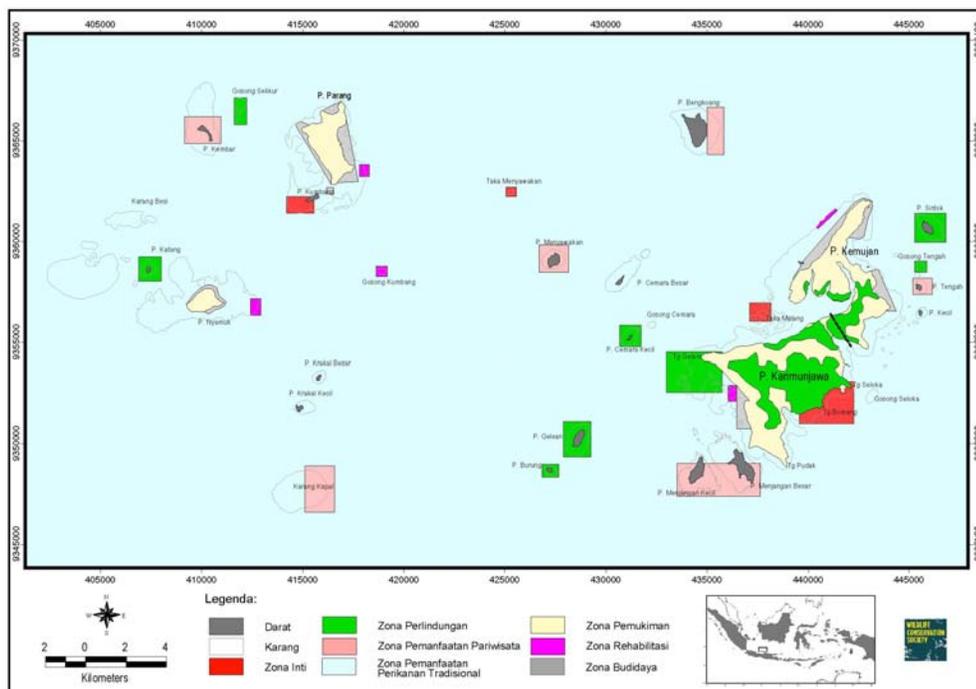


Figure 6. Final legislated zoning plan for Karimunjawa Marine National Park.

A process to re-zone the management boundaries in Karimunjawa began in January 2004 and was initiated by the central government Perlindungan Hutan and Konservasi Alam (PHKA - Department of Forestry and Conservation of Natural Resources). WCS acted as the key advisor to PHKA during this process. The process consisted of the following main steps.

1. Development of baseline information on coral reef, fisheries and socio-economic data (phase 1).
2. Development of a management strategy for the conservation and protection of coral reef resources (phase 2).
3. Community consultation approaches (meetings, household discussions, formal presentations, formal community forums) to discuss and reach consensus on a zoning strategy for the marine areas of Karimunjawa National Park.
4. Design and adoption of formal monitoring and evaluation programs to form the basis of an adaptive management strategy.

Key Accomplishments

- Legislation of zoning plan (June 2005).
- Stakeholder and government agreement on zoning plan.

Objective 2. Build community support for the new management plan and increase awareness of the status and benefits of the new management strategy.

To inform and involve communities, stakeholders and decision makers in conservation and natural resource management in Karimunjawa Marine National Park dissemination of information was initiated through a series of workshops and meetings attended by park users and managers. A zoning plan concept developed by WCS had been discussed at stakeholder meetings in order to seek feedback from communities, NGO's and government agencies on proposed management options. WCS had developed a series of communication tools (workshops, face to face meetings, brochures (Fig. 7)) to deliver outcomes of the zoning plan process to communities and other stakeholders. Through these communication channels, management options (e.g. banning of muro-ami fishing) had been discussed and a series of recommendations on re-zoning adopted by the National Park Authority and agreed to by all stakeholders.



Figure 7. Formal government and community forum discussing the process of zoning and monitoring for Karimunjawa Marine National Park (March 2004). The zoning plan document in accordance with National Park guidelines was legislated at the national level in June 2005.

Through the process of community consultation, communities have expressed willingness to become more active in ongoing management of the marine park. They have established village based community networks within each of the three villages in Karimunjawa and are represented by an umbrella organization at the provincial level. All groups have given support to the marine park zoning plan and currently community based monitoring teams are being established (see objective 3).

To inform and involve communities, 1000 posters of the new zoning regulations (Fig.8) were distributed to local communities in September. This occurred in conjunction with efforts to socialize and raise awareness among communities of the park regulations and boundaries. The posters were disseminated by local park rangers and NGO's and face to face discussions on the regulations were conducted. Simultaneously WCS conducted 120 household surveys aimed at evaluating perceptions to new park regulations. Through these communication channels the process of community consultation continues within the three villages in Karimunjawa. In June 2005 Seagrass Watch, an environmental education

program was conducted in Kemujan village school within the existing environmental school curriculum. The program aims to educate and raise awareness of marine environment and issues affecting its health to local school children.

Marine buoys have been positioned at the boundaries of new zones to inform fishers of the position of zones and patrols conducted by marine national park staff have aimed to inform fishers of the new regulations.

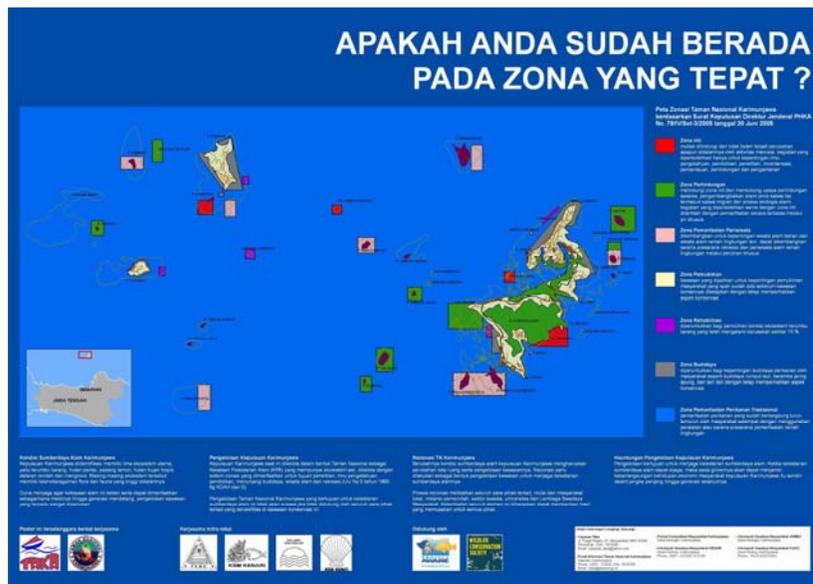


Figure 8. Community poster explaining the new zoning within Karimunjawa Marine National Park



Informal meetings and discussion groups (photos above) played pivotal roles in education and consensus on marine park regulation and compliance by local communities.

Key achievements:

- Awareness campaign started with Seagrass Watch, poster dissemination and village discussions.
- Socio-economic surveys completed and information on community perception of management regulations was used by government agencies.
- Stakeholder, government and community agreements on new management regulations.
- Establishment of key umbrella NGO in Karimunjawa to represent three community groups.

Objective 3. Monitor the effectiveness of the management plan and incorporate findings into an adaptive management system.

WCS is the primary advisor to marine park management, responsible for development and implementation of management and monitoring plans, and providing advice on enforcement and awareness programs. Discussions on an integrated monitoring plan to assess the effectiveness of new park regulations and compliance by communities took place in October-November 2004 and a fully integrated monitoring plan was developed at a workshop in March 2005. Discussions on enforcement and compliance monitoring as part of integrated monitoring of coral reef resources and community compliance took place in June 2005 and patrols by national park rangers in collaboration with police and navy officers have been conducted since June 2005. WCS staff provide on-ground training for government and non-government organizations in monitoring of marine resources (Balai Taman Nasional, Takka, NGO's). The monitoring protocols include protocols for reef fish (Fig. 9), coral (Fig. 10), invertebrates and seagrass ecosystems and are based upon a suite of monitoring objectives and indicators outlined in Table 2. The technical monitoring protocols, documentation and field protocol booklets/guides are finalized in both English and Indonesian languages.

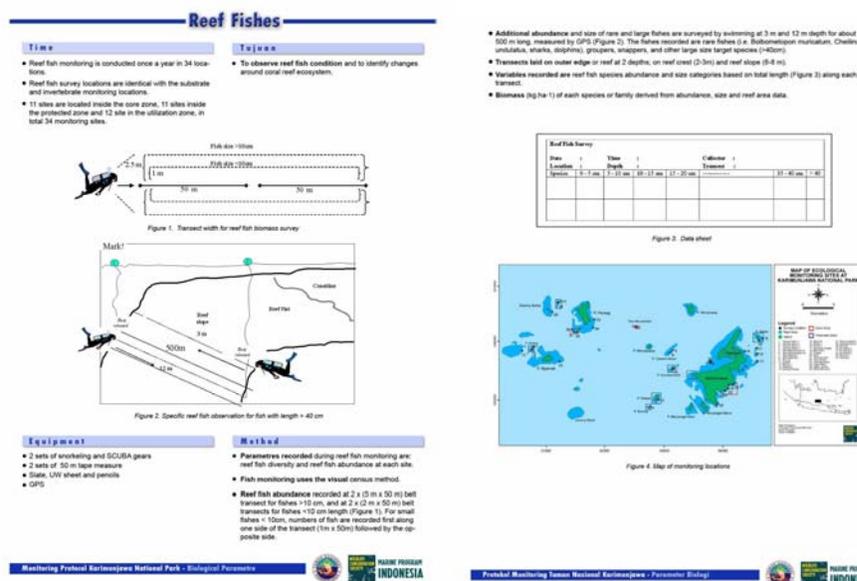


Figure 9. Monitoring protocol for Karimunjawa coral reef fish monitoring.

Coral Reef Substrate

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|--|--|
| <p>Time</p> <ul style="list-style-type: none"> • Coral reef substrate monitoring is conducted once a year in 34 locations. • Coral reef substrate survey locations are identical with the reef fish and macrobenthic monitoring locations. • 11 sites are located inside the core zone, 11 sites inside the protected zone and 12 sites in the utilization zone, in total 34 monitoring sites. | <p>Goal</p> <ul style="list-style-type: none"> • Monitor the condition of coral and other benthic substrate (e.g. algae and soft coral) and its composition as a response to the implementation of different management. • Monitor coral damage and discarded fishing gear as indicators of fishing pressure on coral reef. • Estimate coral recruitment in the different zones. |
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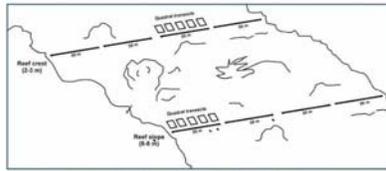


Figure 1. Coral reef substrate monitoring transect profile

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|--|--|
| <p>Equipment</p> <ul style="list-style-type: none"> • 2 sets of snorkeling and SCUBA gear • 2 sets of 50 meter tape measure • 2 sets of underwater paper and pencil • 2 sets of 50 x 50 cm PVC-Quadrat • GPS | <p>Method</p> <ul style="list-style-type: none"> • Position is located or marked using the GPS. • One hundred point counts of substrate variables (eg. hard coral, algae) are made every 50 cm, using Point Transect method, along 4000 metre transects situated on the reef crest (2-3 m) and 4000 metre transects on the reef slope (3-5 m) (Figure 1). Hard coral count record based on life form growth and genus/species. Substrate identified into several categories: soft coral, fleshy algae, turf algae, red coralline algae, calcareous algae (Halimeda), sponge and sand. The substrate at each 50 cm interval is recorded using 3 main columns (Figure 2): 1) distance along transect at 50 cm intervals, 2) Genus/species, 3) life form category. • Lifeform and other categories are adopted from English and Wilkinson (1994) (Table 1). |
|--|--|

Distance	Genus/species	Lifeform
0.5		
1.5		
2.5		
3.5		

Figure 2. Data sheet

- Recent coral damage and number of discarded fishing gear are recorded using a belt transect method at the 4 x 50m substrate transects at each depth. Three coral damage categories are used: Broken Branching Coral (BBC), Broken Plate Coral (BPC) and Up-turned Coral (UTC). Size area of damage recorded in m². On 1 m² either side of the transect (50m x 2m) discarded fishing gears are counted and area measured; the gears recorded are: lines, nets, traps and spearthrower ropes. Mesh size of nets found are measured in inches.
- COT (Crown-of-Thorns Starfish + Acanthaster planci) occurrence and coral bleaching conducted at each benthic substrate, coral damage and macrobenthic transect.
- Numbers of coral recruits using 50cm x 50cm quadrat transect placed on benthic substrate transects at 10m intervals. Coral recruits are those less than 8cm in diameter. Coral identified into genus/species level and estimate of live hard coral percent cover are also made at each quadrat.

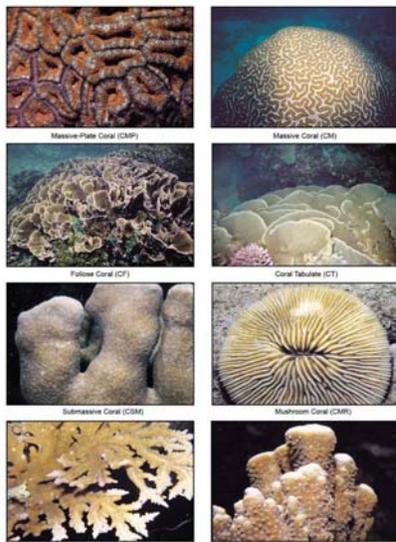
Table 1. Coral morphology subgroups used in coral reef substrate survey

Morphology	Code	Description
Ampora branching	ACB	Staghorn corals, long thin branches
Ampora tabulate	ACT	Mainly A. tabularis group
Ampora symphyse	ACC	Short branches, low bushy shape
Ampora digitae	ACD	Digitals, mainly mostly A. formosa group
Ampora tabulae	ACT	Tables, mostly A. formosa group
Ampora submassive	ACS	Columnar/plate, very stout, mainly A. pallida and A. formosa
Branching coral	CB	Branching non-Amporacean, especially Pocillopora and some other spp.
Encrusting coral	CE	Low table, other coral colonies
Massive plate coral	CMP	Plate like corals forming large massive colonies, especially Porolithothamnion, Leptothamnion
Massive coral	CM	Massive or dome like corals of all sizes
Foliose coral	CF	Foliose, either horizontal or vertical, non-Ampora especially Montipora, Echinopora
Tabulae coral (non-Ampora)	CT	Tabulae non-Ampora spp. Montipora, Melastemon or "steep" corals, sometimes columnar or mixed-massive-columnar.
Submassive coral	CSM	especially, Goniopora, Dipsasae
Massive coral	CM	Free living target corals
Milipora	CM	Vertical series of tubular cylindrical
Milipora	CM	Blue coral (cylindrical)

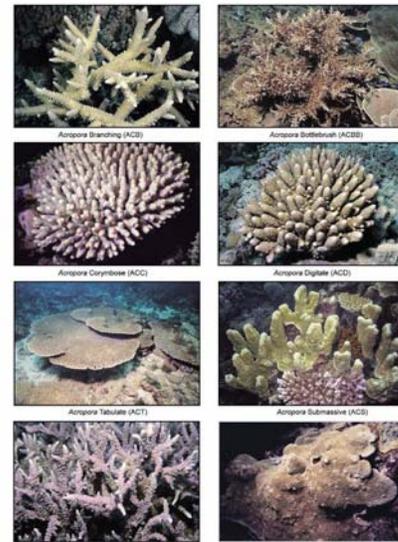


Figure 3. Map of monitoring locations

Monitoring Protocol Karimunjawa National Park - Biological Parameters



Source: Coral ID. Monitoring Protocol Karimunjawa National Park - Biological Parameter



Source: Coral ID. Monitoring Protocol Karimunjawa National Park - Biological Parameter

Figure 10. Monitoring protocol for Karimunjawa National Park marine benthic monitoring.

Table 2. Monitoring objectives, methods and indicators used in evaluating management performance in Karimunjawa Marine National Park – the basis for the integrated monitoring plan.

Indicator	Monitoring objective	Method
Fish		
All fish biomass (kg ha ⁻¹)	Increased reef fish in protected areas and surrounds	Annual coral reef surveys
All fish abundance (no. ha ⁻¹)		
Serranidae biomass		
Caesionidae biomass		
Coral		
Coral cover (%)	Increased coral cover in marine protected areas. Increase coral recruits at sites of low coral recruitment.	Annual coral reef surveys
Genera diversity		
Coral recruits		
Invertebrates		
All (no. ha ⁻¹)	Increased numbers of <i>Triadacna</i> and reduced numbers of <i>Diadema</i> in protected areas and surrounds.	Annual coral reef surveys
Tridacna (no. ha ⁻¹)		
Diadema (no. ha ⁻¹)		
Fisheries		
Fish catch (kg ha ⁻¹)	Increased reef fish catch in areas outside protected area zones. Reduction in fishing effort	Fish catch surveys every 4 months
Fishing effort outside no take areas		
Fishing effort inside no take areas		
Number of grouper caught for live		

export (kg y ⁻¹)	Reduction in fishing effort Reduction in grouper caught for live export.	
Seagrass		
Seagrass percentage cover (%)	Maintain cover of seagrass meadows	Annual surveys
Socio-economic factors		
Community knowledge of new zoning	% of community aware of, understanding and complying with zoning regulations	Household socio-economic surveys every 2 years
Community acceptance of new zoning		
Community perception of reef fish condition	% of community respondents perceiving reef and fisheries condition to be improving	
Community perception of fish catch condition		

Monitoring of biological and socio-economic indicators

In April 2005, three months prior to final legislation of zoning, WCS and park rangers conducted the first biological monitoring of 34 sites within Karimunjawa Marine National Park's newly established management zones. Ecological indicators included coral cover, invertebrate abundance, reef fish abundance, reef fish biomass and seagrass cover. Monitoring was conducted within replicated sites within each core zone (no entry, no take), protection zone (entry permitted, no take) and general use zone (artisanal fishing permitted) (Fig. 11). The annual monitoring of marine resources will be used to assess resources against baseline data collected in 2003-2005 prior to zoning regulations and provide a basis to evaluate management effectiveness over the next five years. In addition monitoring of fisheries resources at key landing sites is conducted three times per year. Socio-economic

surveys used to evaluate community perceptions and compliance with management regulations occur every two years. Data for all monitoring has been entered onto a central Access database which is available to government partners. Marine park rangers will conduct ongoing monitoring and will be responsible for database management, analysis, and reporting on the effectiveness of new management regulations.

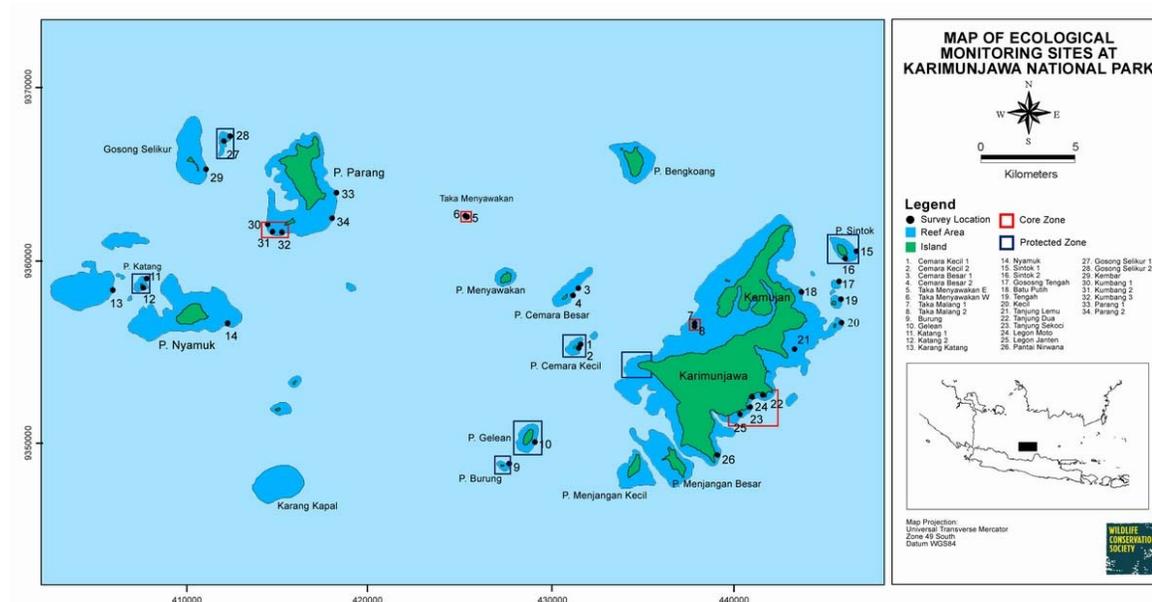


Figure 11. New zoning plan and monitoring sites in Karimunjawa Marine National Park.

Measures of key ecological indicators are assessed using a set of pre-defined scores that assess the status (very low, low, medium, high) of each indicator (Table 3). The scores are based on baseline data collected from Karimunjawa Marine National Park.

Table 3. Biological and fisheries indicator scores and assessment categories.

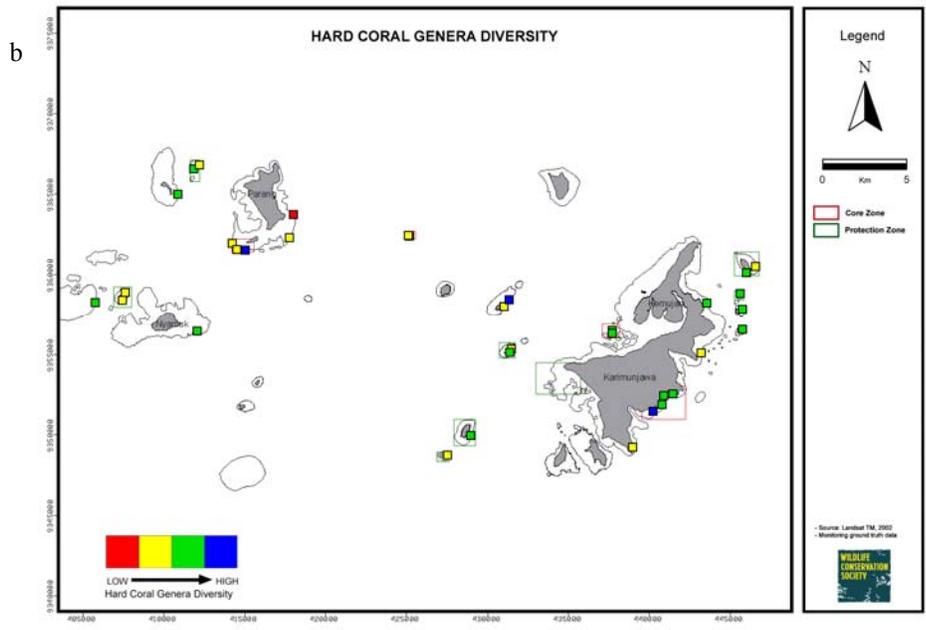
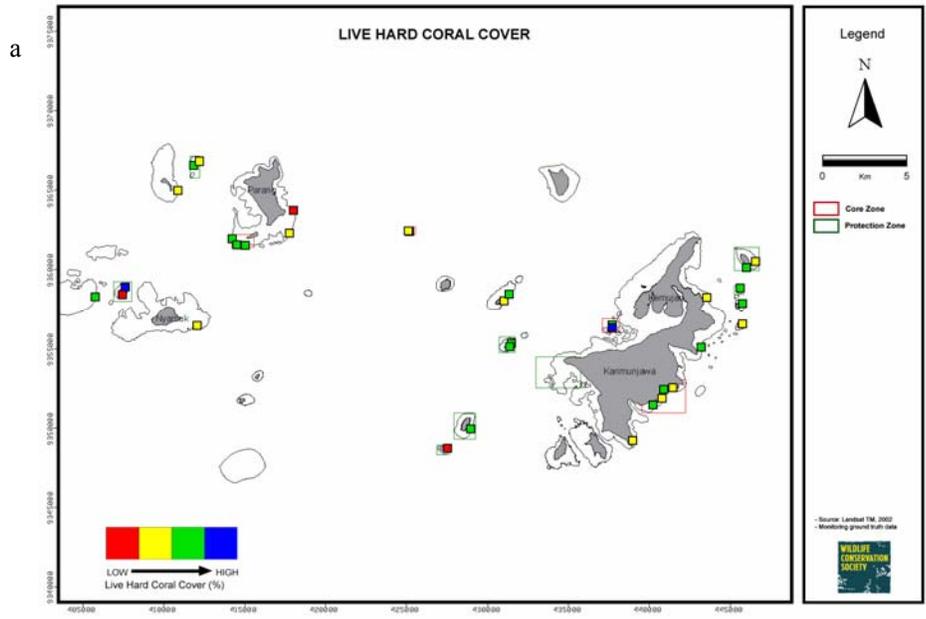
Fish	Very Low (0)	Low (1)	Med (2)	High (3)
- Biomass (kg.ha ⁻¹) all species	< 420	520	750	> 750
- Abundance (no. ha ⁻¹) all species	< 18000	20000	26000	> 26000
- Serranidae biomass (kg.ha ⁻¹)	< 3.7	7.6	16	> 16
- Caesionidae biomass (kg.ha ⁻¹)	< 16.4	60	220	> 220

Hard coral	Very Low (0)	Low (1)	Med (2)	High (3)
- Cover (%)	< 27	42	58	> 58
- Genera diversity	< 4.40	5.10	5.85	> 5.85
- Coral recruits (no. 10m ⁻²)	< 1.6	3.6	8.5	> 8.5
Invertebrate (ind.ha⁻¹)	Very Low (0)	Low (1)	Med (2)	High (3)
- Tridacna sp.	< 50	150	1500	> 1500
Invertebrate (ind.ha⁻¹)		Low (2)	Med (1)	High (0)
- <i>Diadema sp.</i>		< 500	8300	> 8300
Fisheries	Very Low (0)	Low (1)	Med (2)	High (3)
- Fish catch (kg area-1) all species	<50	50-200	200-1300	>1300
- Effort	<3	3-7	8-30	>30

The results of the April 2005 monitoring of coral reefs are shown separately for each indicator group below.

Coral indicators

Hard coral cover (%) and diversity were mainly low to medium within most core and protection zones (Fig. 12). The lowest hard coral cover within protection zones was recorded at Pulau Katang (west) and Pulau Burung (south) and the highest hard coral cover recorded for all zones was in western Karimunjawa (Pulau Katang). Coral diversity was generally medium at eastern sites and low-medium at western sites. Coral recruits were generally low to medium in number with very few coral recruits recorded at only one site (Cemara Kecil) in central Karimunjawa.



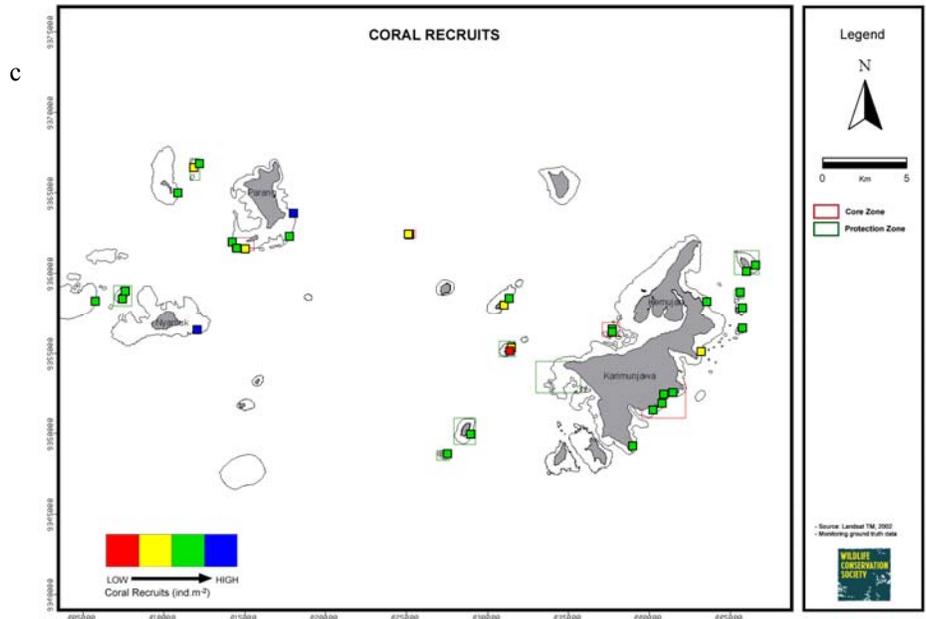


Figure 12. Coral indicators in Karimunjawa Marine National Park including a) coral cover, b) coral diversity and c) number of coral recruits.

Reef Fish indicators

Reef fish biomass was generally medium in all zones except in west Karimunjawa where three sites had very low biomass and four sites had high biomass (Fig 13). Reef fish abundance was very low in five sites in central and west Karimunjawa (including three no take zones) and one site in east Karimunjawa (Fig. 14). Sites with high biomass of reef fish were found at four sites in the central and west regions. A high abundance of reef fish was found at four sites in east Karimunjawa although biomass was low to medium, indicative of an absence of large size fishes (e.g. >40cm). At Taka Menyawakan in the centre of the park the biomass of fish was high but the abundance of reef fish was very low, indicative of large sized fish.

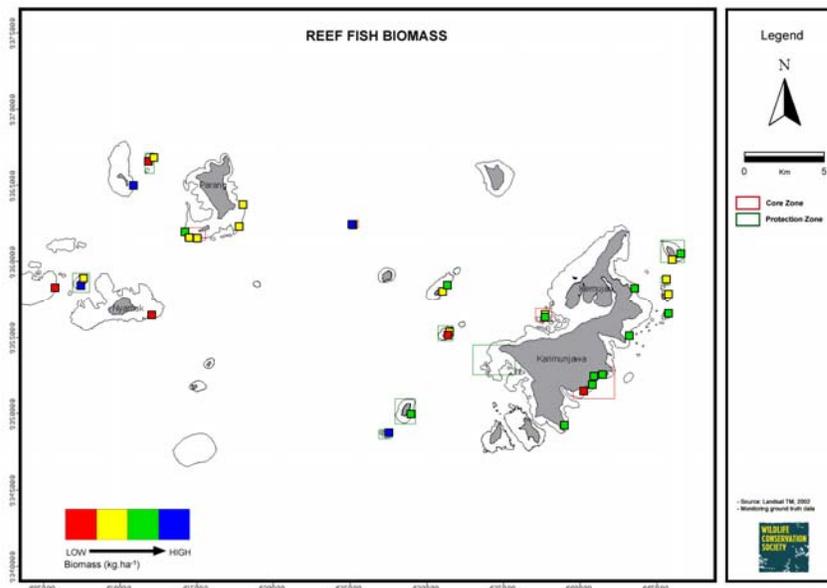


Figure 13. Coral reef fish biomass in Karimunjawa Marine National Park.

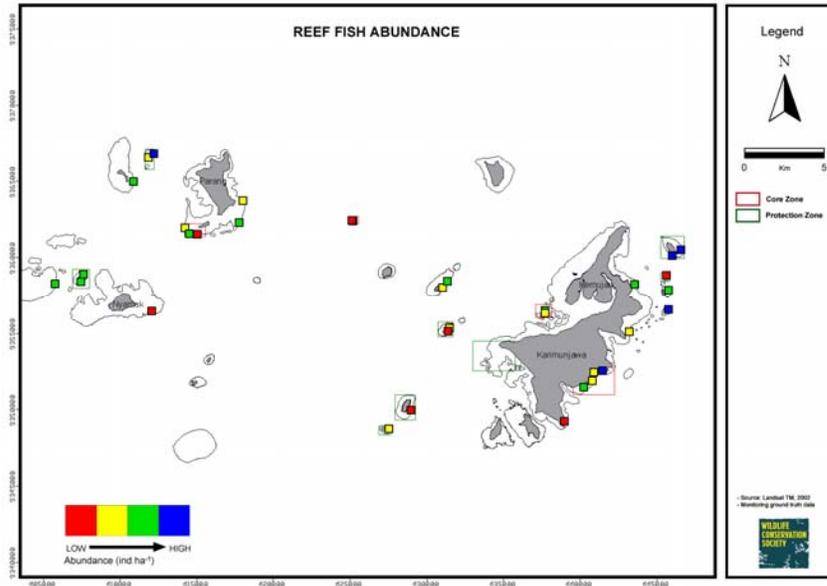


Figure 14. Coral reef fish abundance in Karimunjawa Marine National Park.

The biomass of the highly targeted groupers within the fish family *Serranidae* (Fig. 15) was medium to high at most sites in east Karimunjawa but very low to medium at most sites in central and west Karimunjawa. The biomass of *Serranidae* varied considerably within and between ‘no take’ zones and changes in this variable will be monitored closely as an indication of successful management.

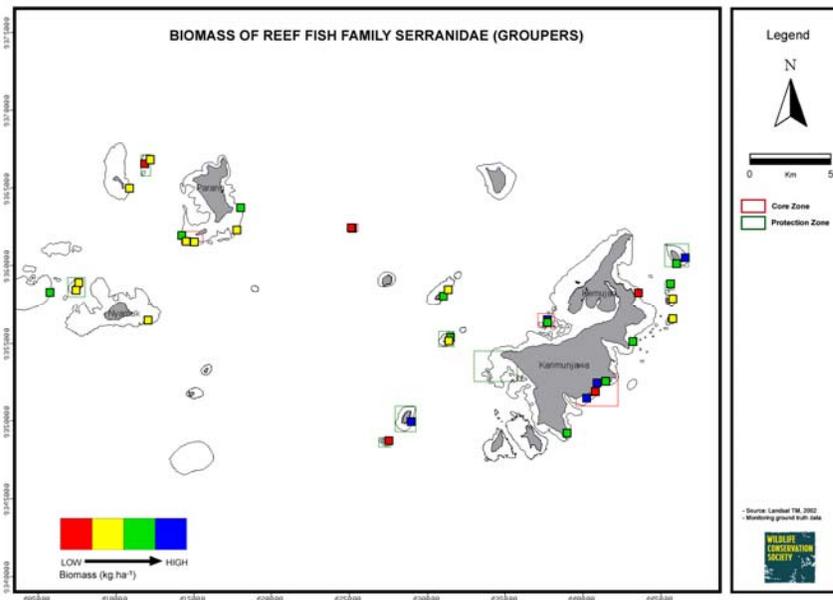


Figure 15. Biomass of the grouper *Serranidae* in Karimunjawa Marine National Park.

Invertebrates

Clam (*Tridacna sp.*) abundance was much higher in the western region of Karimunjawa compared with the eastern region where clam biomass was generally very low to low in abundance. Clam abundance within protected zones varied from very low to medium abundance, whereas in the utilization zones, *Tridacna sp.* abundance was high in some western locations (Fig. 16). Sea-urchin (*Diadema spp.*) abundance was lowest at sites in the eastern region of Karimunjawa and Kemujan compared with areas in western Karimunjawa (Katang and Taka Malang) (Fig. 16) which have turbid waters and low visibility, suitable for sea-urchin recruitment.

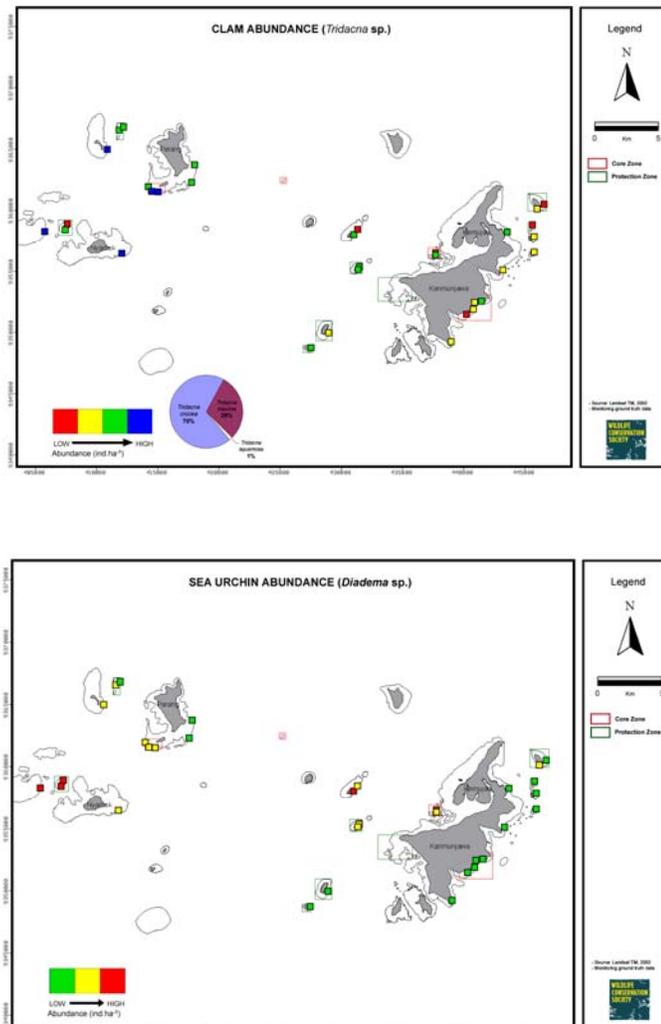


Figure 16. Abundance of clam (*Tridacna sp.* and sea urchins) in Karimunjawa Marine National Park.

Fisheries Indicators

Maps of fishing grounds and fishing catch (Figs. 17 and 18) have been produced for 2005 and provide a basis for evaluating future catch and effectiveness of marine park regulations and zones. They also provide the basis for developing additional fisheries regulations (e.g. gear usage, periodic closures) within areas of the park with support from the Department of Fisheries.

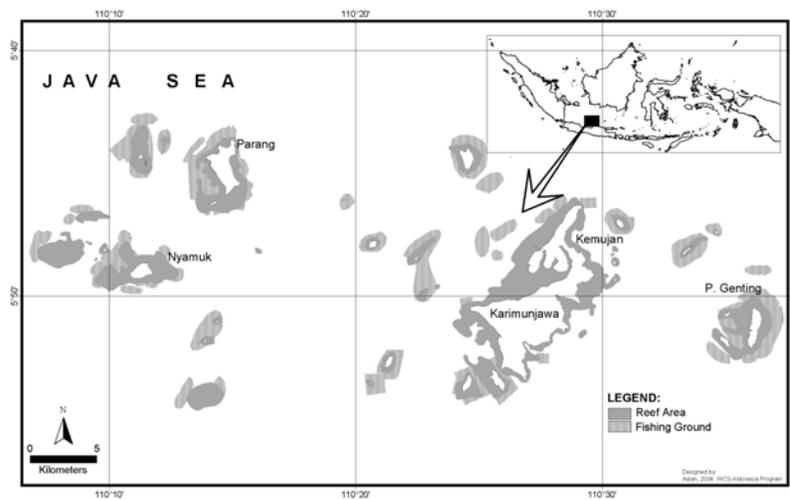


Fig. 17. Map of fishing grounds in Karimunjawa Marine National Park.

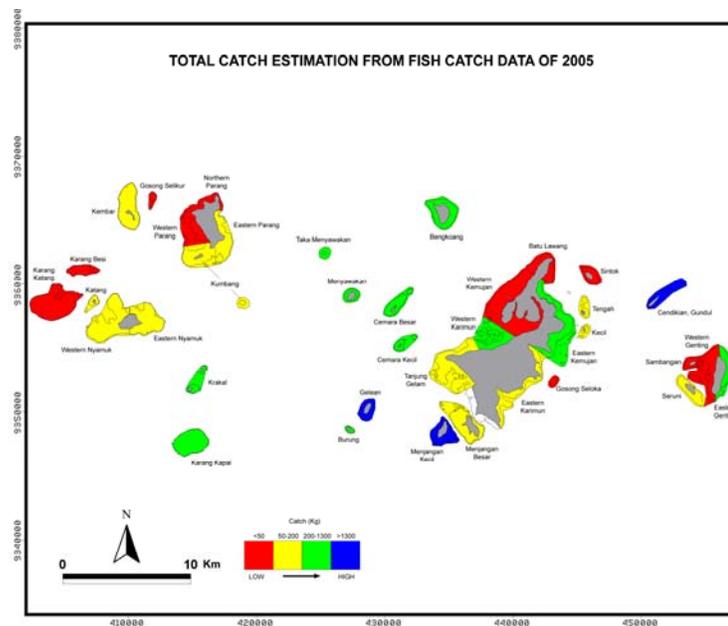


Fig. 18. Fish catch (kg ha^{-1}) at each fishing ground in Karimunjawa Marine National Park.

Socio-economic indicators

In August 2003 a randomized socio-economic household survey, representing 10% of the population, was conducted and showed a relatively low overall knowledge of existing zoning plans. Knowledge of zoning regulations varied widely among villages (25-30%) with only 13% of respondents aware of zoning regulations (Figure 19).

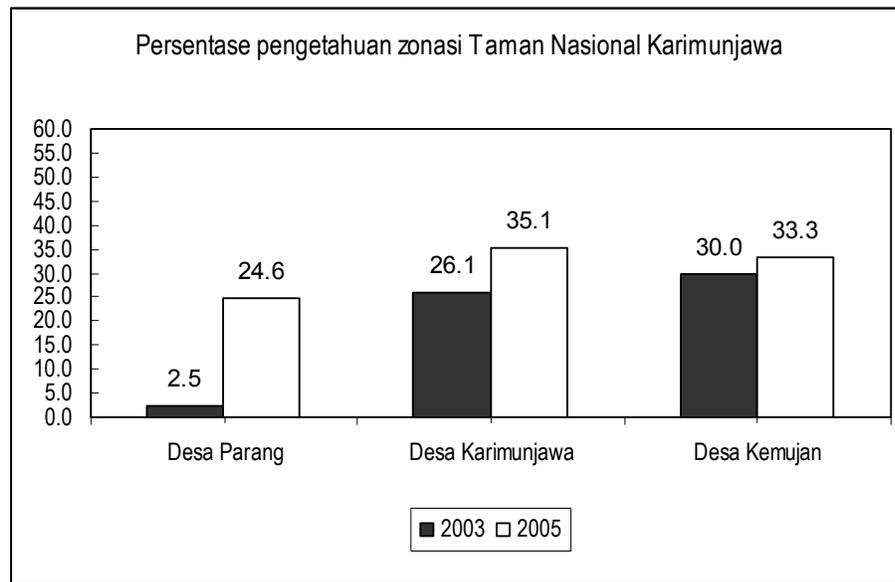


Figure 19. Community knowledge of zoning regulations in 3 villages in Karimunjawa Marine National Park in 2003 and 2005.

In August 2005 a second randomized socio-economic household survey, again representing 10% of the population, was conducted and showed an increased knowledge of zoning (Figure 20). Despite the improvement in the level of awareness of zoning regulations compared with 2003 surveys the overall awareness is still patchy and in some villages very low, highlighting the need for continued awareness and socialization programs.

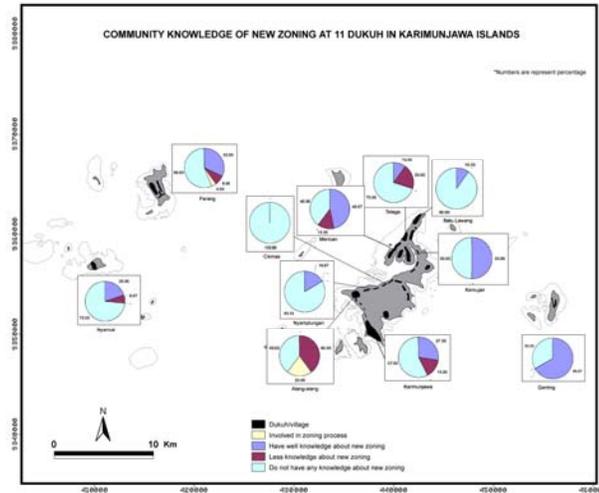


Figure 20. Community knowledge of new zoning scheme in the Karimunjawa Marine National Park.

The surveys were conducted only two months after legislation and were conducted to determine levels of support for the new regulations, particularly among fisher communities. The results suggested that improved socialization of the new zoning regulations is required. Factors responsible for the lack of knowledge included lack of education on zoning concepts and lack of interest or belief that zoning will benefit people. Awareness among fishers was higher than other community members (data not shown) as they were directly involved during the zoning consultation process. The data demonstrates the poor communication and dissemination of information from community group meetings to the broader community and the need to involve all community members in the consultative process.

Communication Strategy

To address the low awareness of management regulations WCS, government and local NGO's initiated a communication campaign immediately in September 2005 with the distribution of maps to inform local community members of the newly zone area. This approach was informal and aimed to be the first of many education and awareness sessions. Discussions with key stakeholders and key informants are ongoing to deliver collaborative

agreements that comply with marine park regulations, specifically concerning high threat issues such as cyanide fishing, muro-ami fishing inside no take areas and new management regulations. The discussions aim to raise issues of sectoral interests that threaten compliance with new regulations, and bring these concerns to the attention of the management authority.

Currently reports are being prepared to compare the April 2005 and 2006 monitoring and fisheries data with baseline data collected in 2003-2004. Initial analyses suggest there is no temporal change from 2004 to 2005 in reef fish biomass within each of the three management zones; core zone (no entry, no take); protection zone (no take), and utilization zone (artisanal fisheries permitted) (Figure 21). Legislation of the new park regulations did not occur until June 2005, and therefore we would not yet expect to see a change in fish biomass at this stage.

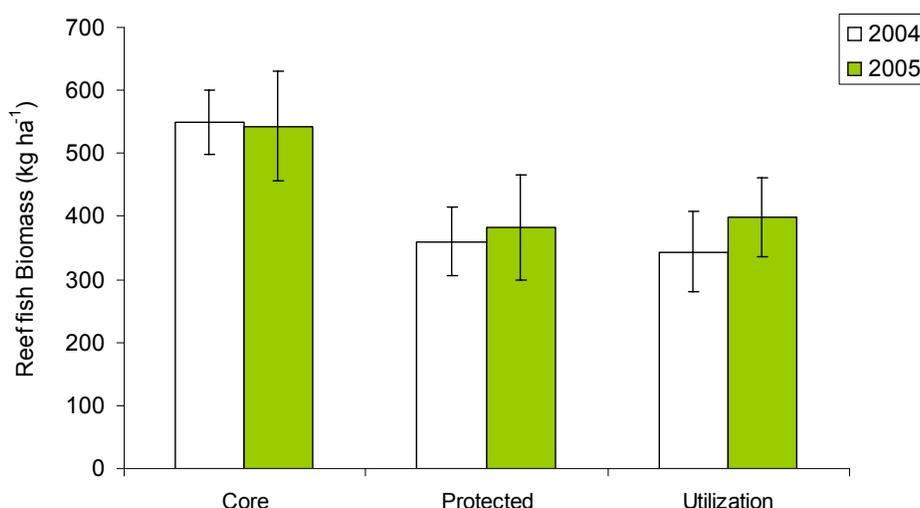


Figure 21. Comparison of reef fish biomass (kg ha⁻¹) in 2004 and 2005 within 3 management zones.

In September-October 2005 and April-May 2006 WCS implemented training for community groups in developing community fish catch and fishing compliance monitoring. The training workshops were conducted following requests from local village NGO's to involve local fishers in simple data collection and observation roles to help with park

A community manual has been produced and communities are using it as part of their fisheries catch monitoring (Fig. 23). The program has gained wide acceptance within villages and is being used to educate local fishers on the regulations of the new zoning plan. The program is being implemented by local village organizations which are also developing alternative options for fishing reefs. These have included the construction and deployment of fish aggregation devices (Fig. 24) in pelagic waters at greater than 500m from coral reefs. The village community groups are committed to active involvement in collection and analysis of fisheries information for use by management and raising local community awareness of marine park issues (Fig. 25).

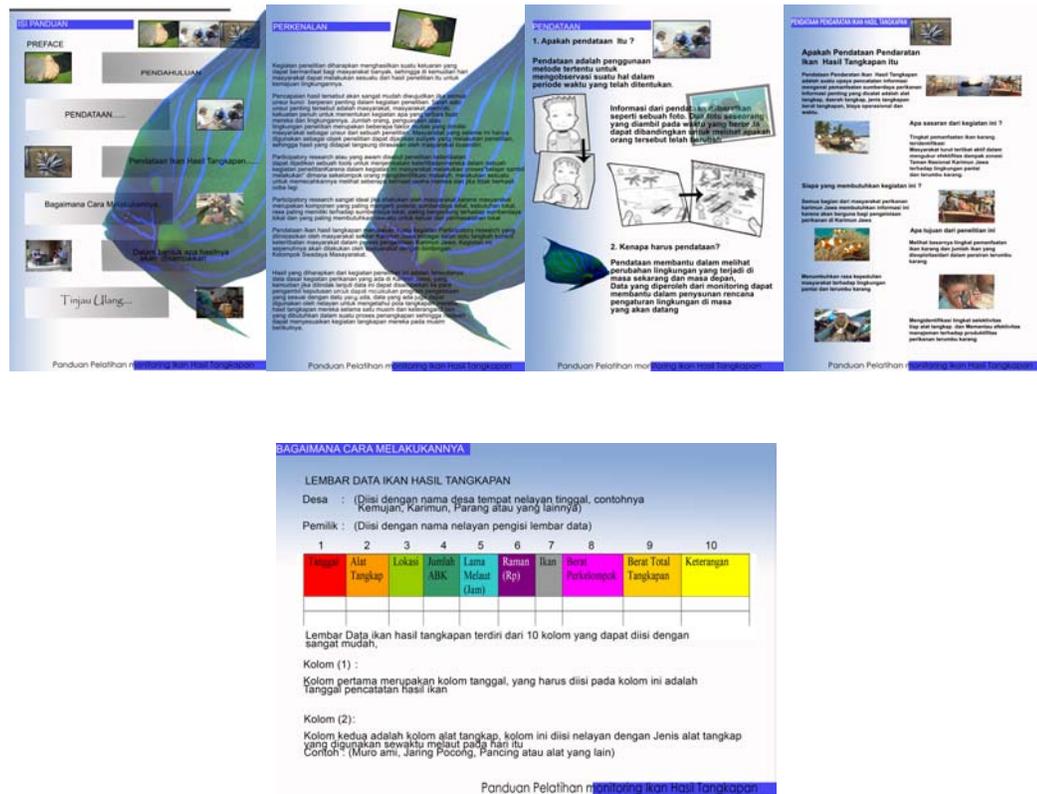


Figure 23. Community fish monitoring protocols.



Figure 24. Deployment of fish aggregating devices (March 2006).



Figure 25. Fishers assessing fisheries information and community events where education and awareness of marine park management takes place (August 2005).

Key achievements:

- Development and implementation of biological and socio-economic monitoring protocols and monitoring plan.
- Formal agreements by National Park Authority to adopt integrated approach to monitoring management effectiveness.
- Formal agreements by community NGO to participate in ongoing management (local compliance and fish catch monitoring).
- Ecological monitoring (pre-zoning: -3 months) of marine ecological indicators completed at 34 sites.
- Socio-economic monitoring (post-zoning: +3 months) conducted at 120 households.
- Fisheries catch monitoring conducted.
- Community fish catch monitoring conducted at three villages.
- Data added to central database on marine ecological data.

Objective 4. Increase the capacity of National Park staff to carry out their own management and monitoring of reefs.

To increase the capacity of national park staff to conduct marine research and monitoring, WCS staff completed ongoing training of national park and NGO staff in coral reef and seagrass monitoring techniques. In April 2005 and September 2005 staff received further training in carrying out new coral reef protocols for assessing coral reef health and also for assessment of reef fish connectivity between coral reef and seagrass meadows. Technical protocols include technical manuals of reef health survey protocols and a simple field guide for reef health survey protocols. Intensive workshops were conducted in May 2006 to train rangers and marine park staff in techniques of data analysis, interpretation, reporting and production of communication tools (newsletters, presentations, data summaries) to disseminate findings of resource monitoring to management and among stakeholders (Fig. 26).



Figure 26. Training of national park staff in data management, analysis and reporting – May 2006.

Key achievements:

- Training of ten national park staff in coral, reef fish and seagrass surveys.
- Development of draft set of field technical guides on monitoring techniques and tools.

Summary

In some villages awareness of the marine zoning plan is still low, highlighting the need for continued awareness and ongoing socialization programs conducted by government agencies. Formal agreements between community NGO's and WCS have been established to develop community based fisheries monitoring activities that will help in the evaluation of the effectiveness of new management regulations and support the communities contribution to data and management over the next five years. The program has gained wide acceptance within villages and is being used to educate local fishers on the regulations of the new zoning plan. The program is being implemented by local village organizations which are also developing alternative options for fishing reefs. This not only provides communities with sense of stewardship as part of the management process but will aid the national park agency in their capacity to assess the effectiveness of management in achieving conservation targets. These include the reduction in unsustainable fishing practices and increase in reef fish abundance. To increase the capacity of park staff to conduct marine research and monitoring WCS staff provided ongoing training of National park and NGO staff in coral reef and seagrass monitoring techniques. In April 2005 and September 2005 staff received further training in carrying out new coral reef protocols for assessing coral reef health and also assessment of reef fish connectivity between coral reef and seagrass meadows. Training for government marine park rangers in data analysis, interpretation, reporting and production of communication tools (newsletters, presentations, data summaries) have been completed, and further training will be provided.

The project has contributed to the first re-zoning of marine National Park in Indonesia using a rigorous scientific approach complemented by an exhaustive community consultation process. This achievement has culminated in the first legislation of a re-zoning plan for a Marine National Park in Indonesia and provides a model of marine resource management that can be evaluated over the next five years. The approach is unique to Indonesia and also provides lessons for adopting similar approaches in other regions. The key factors in achieving consensus were the extensive community consultation, key criteria based on representativeness and replication in the design of the MPA zones and a flexible

and open approach that allowed communities to reach consensus with management agencies on the placement and delineation of zones. Management success will be dependent on community compliance and sense of ownership of the new zoning regulations, development of alternative options to destructive and unsustainable fishing practices, the authority of stakeholders to influence and make decisions, the capacity of stakeholders to self-organize and have an influence on adaptive management, and the capacity of stakeholders to evaluate the success of management and adapt new management options if required.

Technical publications

Penatan Zonasi Taman Nasional Karimunjawa Kabupaten Jepara Provinsi Jawa Tengah. Wildlife Conservation Society 86 pp. (Indonesian and English versions). - The zoning plan document prepared by WCS and Balai Taman Nasional in accordance with government guidelines. The report outlines all regulations and justifications for re-zoning of the marine national park and maps of the zoning regulations.

A number of technical reports are being finalized in Indonesian for the Balai Taman Nasional (the Marine National Park Authority). These include reports on the ecological indicators, fisheries, socio-economic and compliance issues and a report on the use of seagrass habitats by reef fish. Cover pages of these reports are attached.

Ardiwijaya, R. L., Wibowo J. T., Mukminin A., Kartawijaya T., Herdiana Y. (2006). Laporan Monitoring: Peta kondisi ekosistem terumbu karang, pola perikanan tangkap, sosial ekonomi di Taman Nasional Karimunjawa. Laporan hasil monitoring fase I (2005). WCS Marine Program Indonesia. External report no. REP/VII/EXT/01/06/BAH. (22p)

Sabarini, E. K., Kartawijaya T. (2006). Laporan teknis survey ekosistem lamun dan komposisi ikan di Taman Nasional Karimunjawa. WCS Marine Program Indonesia. External report no. REP/VIII/EXT/02/06/BAH. (18p).

Wibowo, J. T., (2006). Laporan Monitoring: Aspek sosial ekonomi dalam pengelolaan Taman Nasional Karimunjawa. Laporan hasil monitoring fase I (2005). WCS Marine Program Indonesia. External report no. REP/IX/EXT/03/06/BAH (18p).

Mukminin, A., Kartawijaya T., Herdiana Y. (2006). Laporan Monitoring: Kajian pola perikanan tangkap di kepulauan Karimunjawa tahun 2003-2005. WCS Marine Program Indonesia. External report no. REP/X/EXT/04/06/BAH (20p).

Journal publications

Campbell, S.J. and Pardede, S. T. (2006). Reef fish structure and cascading effects in response to artisanal fishing pressure *Fisheries Research* **79**: 75-83.

Campbell, S.J., Pardede, S. T., Herdiana, Y. and Ardiwijaya, R. and Wibowo, J. and Marnane, M.J. (2006). Designing effective marine protected areas in Karimunjawa Marine National Park using an integrated biological and socio-economic approach. (Submitted to *Conservation Biology* April 2006)

Doss, N.S. Cinner, J.E., Sutton, S., and Campbell, S. J. (2006). Influence of Socio-Economic Factors on Perceptions and Awareness of Marine Ecosystems and Management in Kepulauan Karimunjawa Marine National Park, Indonesia. (Submitted to *Environmental Conservation* May 2006)

Marnane, M., Campbell, S.J., Pardede, S., Wibowo, J., Mukminin, A., Cinner, J. McClanahan, T. (2005). Evaluation of artisanal fisheries gear on species capture and selectivity of tropical reef fish in Indonesia (submitted to *Ocean Ecology and Management* February 2005).