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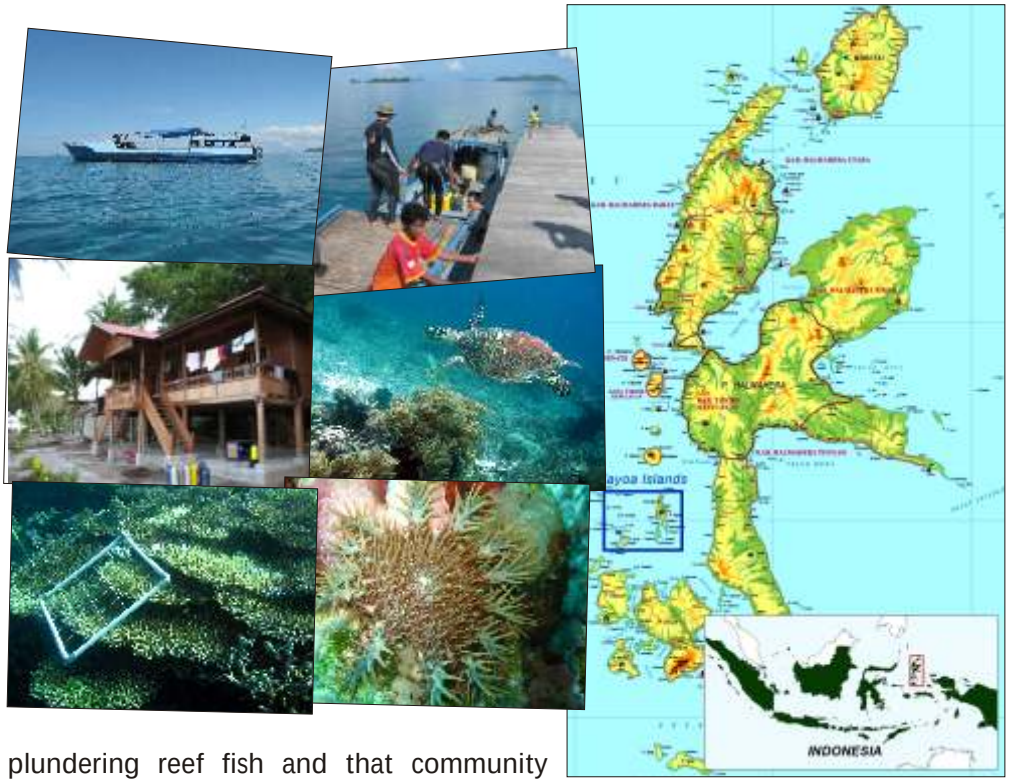
Halmahera : surveying the Last frontier in the Coral Triangle

Stuart Campbell



In December 2007, WCS Indonesia conducted a detailed coral reef survey of the Kayoa Islands in the Halmahera Seascape, in the heart of the Coral Triangle. The area is located 90 km south of Ternate, the capital of Maluku Utara. Importantly it has existing traditional fishing rules that local fishers follow and it is also one of few conservation areas in Halmahera dedicated to tourism. Local fishers use hand lines, traps and other simple forms of fishing gear, and have placed bans on their communities from using nets on the reefs. Fishers who live outside Kayoa Islands pose the greatest ongoing threat to the 'progressive' local rules set up by local fishers. Prohibitions on net fishing are commonly disregarded by outside fishers and threaten the fisheries management in place that has been established in the absence of formal government management. The rules adopted by the Kayoa fishers are tacit recognition that netting is capable of plundering reef fish and that community high. Alternatives to fishing from tourism may support for "progressive" fishing practices is also reduce impacts on reefs, yet our encounters with fishers demonstrated a willingness to continue fishing and adopt fisheries practices that prohibit destructive techniques and limit use of gears that are simply harvest too many fish too efficiently.

The surveys' key findings were the presence of high densities of reef fish including the functionally important bumpheaded parrotfish which can facilitate coral recruitment and recovery after disturbance. Areas of high coral and habitat diversity were also found, along with potentially new species of coral. Information from the surveys has been added to the Indonesian Coral Reef Resilience Database (www.konservasi-laut.net) to help identify areas most resilient to future impacts from climate change. The primary disturbances in the area had resulted from outbreaks of the crown of thorn starfish, causing widespread damage to some of the reefs surveyed. However, it should also be noted that macro-algal cover was also relatively high, which, given the reasonable density of herbivores suggests nutrient levels may be high and that resilience of these systems is being eroded by poor water quality.

Scaling up protected area design in the Coral Triangle

Tasrif Kartawijaya, Irfan Yulianto, Rian Prasetia

Aligned to the spirit of protecting one of the greatest marine biodiversity hotspots on the planet, the Indonesian Department of Marine Affairs and Fisheries (DKP) have begun the process of scaling up to declare marine conservation areas in the Coral Triangle. Two areas have recently received attention, Morotai Island located in northern Halmahera and Lombok Tengah district located in central Lombok in West Nusa Tenggara. Recent surveys have been conducted by DKP, with support from WCS to identify areas of ecological interest that have social and governance support for marine protected area development. Partnerships between national government agencies, international NGOs, district governments and local communities are not unique but certainly can give impetus for ensuring that protected area rules being developed have bottom up and top down support.

Since the ratification of two key laws pertaining to the protection of marine natural resources (Law No. 31/2004 concerning Fisheries

and Law No. 32/2004 concerning Local Governance) a new new paradigm has emerged in the management of coastal resources and in particular in the development of marine protected areas (MPA) in Indonesia. The laws essentially provide support for local government to have important roles in the development and management of marine protected areas where previously this was not the case. The legislation goes beyond mere semantics as it gives opportunity to local governments to have control over marine resources with national government support and the resources and help that can follow. All things being equal the potential benefits to the protection of Indonesia's marine resources are tangible but it does require adequate resources from national government to ensure that those charged with managing these areas can do so without compromise.

Developing Marine Protected Area Guidelines for Indonesia's Coral Triangle

Pursuant to the Government of Indonesia's regulation No. 60 / 2007, as executor of Law No. 31/ 2004, the Department of Marine Affairs and Fisheries (DKP) is currently compiling a guideline to identify new MPAs for Indonesia. WCS has been asked by the DKP to provide input into developing the guideline. The objective of the guideline is to build a common perception and action among technical executors, decision makers and stakeholders in the identification and inventory of critical areas to be proposed as MPAs.The guidelines will detail the data acquisition and identification of marine natural resources that are key to ensuring future resilience of coral reefs. The WCS Marine team is providing expert input into the planning processes necessary to achieve compliance, support and progressive actions to conserve threatened marine resources. The guideline will assist the scaling up of MPAs of eastern Indonesian through a process of 1) identifying and zoning areas of ecological interest, 2) public consultation and 3) facilitating legal processes for the development of marine protected areas at the district level with community support.

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Ecological identification for KKLD candidate in Morotai, Northern Halmahera

In early May 2008, Tasrif Kartawijaya and Rian Prasetia (WCS Staff) supported the Department of Marine Affairs and Fisheries to survey the coral reefs of Morotai Islands, North Halmahera District, as a part process to develop KKLD (Kawasan Konservasi Laut Daerah or District Marine Management Area). Morotai is an island of North Halmahera District and at the centre of the Coral Triangle Seascape which encompasses 5.7 million square kilometers of diverse marine ecosystems. The survey aimed to decide the type of KKLD that would be chosen by government and stakeholders for this area, whether a Marine National Park, Marine Tourism Area, Natural Marine Reserve or Fisheries Sanctuary. The size of this area is likely to be 600 thousand hectares.

Ecological identification for KKLD candidate in West Lombok, NTB

Rian and Tasrif (WCS) also accompanied DKP staff in June to survey sites for future MPA inclusion in the District of Lombok Tengah, within West Nusa Tenggara Province, in central region of Lombok Island. The area is beset with beautiful seascapes and a wealth of marine natural resources that support tourism and fisheries industries. Tourism activities in Central Lombok include the beach activities in Kuta and Teluk Aan beaches, surfing in Gerupuk and Ekas Bays. Most fishers use traditional fishing methods such as hand lines from small boats (ketinting) while other activities include seaweed and lobster farming in Gerupuk and Awang Bays respectively.

Currently the national government through DKP are investigating management options for the marine natural resources of Central Lombok, identifying local communities and their customs (eg. including local knowledge or wisdom known as Awig-Awig) to manage natural resource use, including fisheries resources.

The Morotai and Lombok ecological surveys are part of DKP's target to conserve 10 million hectares of marine areas in Indonesia by 2010. Until the end of 2007, DKP has claimed 24 sites of KKLD which cover 3,155,572.40 hectares and 19 sites of pre-KKLD declaration which cover 13,591,406.15 hectares. Areas under the Department of Forestry cover 5,426,092.85 hectares. Until the end of 2007, Marine Management Areas in Indonesia totalled 22,175,610.53 hectares (Lestari et al., 2007[1]).

[1] *Lestari RIP, Setiono, A. Nurhakim, A. Rojayati, R. Sudarisman. 2007. Informasi Kawasan Konservasi Perairan di Indonesia. Direktorat KTNL, Ditjen KP3K, Departemen Kelauran dan Perikanan Indonesia. Jakarta.*

'Reefs for the future', spirit of the 11th International Coral Reef Symposium. Do reefs really have a future? What can we do about it?

Yudi Herdiana and Stuart Campbell

Yudi and Rizya (first and third from left) from WCS, after giving presentation in the ICRS 11th, 2008

Do reefs have a future? This was one of the questions that the 11th International Coral Reef Symposium (ICRS) aimed to answer. The 11th ICRS was held in Fort Lauderdale, Florida, USA on 7-11 of July 2008, as part of a chain of international meetings once every four years. About 2500 scientists, managers, and publics participated in this Olympic sized meeting; divided into 26 mini-symposiums to discuss 26 different aspects of coral reef, current issues and strategy for future reefs.

Coral reefs are in crisis! Coral reefs face human and natural threats, including global warming, overfishing, coastal pollution, disease; and they are dying in alarming numbers these were some of the alarming messages given. Scientists estimated that 60% of coral reefs may disappear before 2050!

According to these predictions the reefs seem to only have a short time on this planet as global warming will increase sea water temperatures by 1-2oC causing mass bleaching to corals and resulting in mass coral mortality. Some scientists believe in this 'doomsday' scenario that 100 years from now none of our grand children will see coral reefs in their natural habitat, and ironically it is because of us! Scientists and managers want the world to be aware of this, that we are facing a very serious problem.

The doomsday scenario

This is based on the idea that oceans are not able to absorb some of the carbon dioxide associated with greenhouse gas emissions, and it emerged the extra CO_2 was making the world's oceans more acidic, causing corals to crumble and deteriorate, and impeding new growth. Such a view would have it that coral reefs have reached the point of no return and that 500 parts per million of Co_2 will occur within half a century - and when that happens, most reefs will die. The effect of CO_2 on the global temperature will cause thermal stress, mass bleaching events, acidification of the oceans which reduce concentrations of calcium carbonate - the building blocks for the limestone skeletons that corals produce. The theory refutes the belief that coral reefs can adapt to the earth's changing climate, with evolution unable to keep pace with rapid shifts in ocean acidity and temperatures at 100 to 1,000 times faster than the Ice Age transitions. The proponents of the "doomsday scenario" say that evolution takes time, and what we are seeing "is a mismatch between the rate at which evolution can adapt to change, and the rate of change". "Coral reefs can't keep up, and we're seeing an increased rate of coral degradation as a result," says one of its proponents, Dr. Ove Hoegh-Guldberg from the University of Queensland, Australia.

The anti-doomsday scenario

In contrast, Professor Terry Hughes, the recipient of this year's Darwin Medal and head of the Centre of Excellence for Coral Reef Studies, James Cook University, Australia, gave a different viewpoint in his keynote address to the 11th International Coral Reef Symposium in Florida. Professor Hughes argued that the world's coral reefs are not doomed, provided that governments and communities take the urgent and necessary actions to preserve them. He claimed that our coral reef crisis was "a crisis in governance", as we have identified the factors that are contributing to coral reef decline we now need proactive, forward looking governance that builds the resilience of coral reefs. In developing countries such as Indonesia this requires meaningful "bottom up" approaches to implement progressive fisheries regulations, reduce nutrient runoff and halt destructive practices. So the argument posed by this "progressive" perspective is that corals have the ability to bounce back, we cannot "climate proof" reefs but we can postpone by a few decades collapse due to overfishing and nutrients and in doing so build resilience. In the meantime governments around the world need to tackle the threat of climate that will limit rises in seawater temperature.

To support these arguments several studies have shown that coral reefs have the ability to adapt to water temperature rises or anomalies, but not all reefs have this ability. McClanahan et al. (2007) studied the impact of temperature variation on coral bleaching and mortality, and concluded that reefs that experienced high temperature variability tend to have higher ability to adapt and survive to temperature changes. These reefs may represent refugia where corals acclimate and adapt to environmental variation, which better prepares them for rising temperature and anomalies. Other studies showed for the first time that thermal tolerance in some corals have an underlying genetic component, suggesting a capacity to adapt to rising sea water temperatures. From a management point of view, these reefs should be selected as conservation priorities, targeted for management and further ecological research done in order to understand their acclimation, adaptation, and resilience to climate change.

Its up to us - coral reefs may have a chance to survive global warming - but human help is required. NGO's in developing countries are at the sharp end of these efforts.

Take home message

Its up to us - coral reefs may have a chance to survive global warming - but human help is required. NGO's, government and communities in developing countries are at the sharp end of these efforts.

Further reading: McClanahan T.R., M. Atewebarhan, C. A., Muhando, J. Maina. 2007. Effects of climate and seawater temperature variation on coral bleaching and mortality. Ecological Monographs, 77(4), 2007, pp. 503–525 2007 by the Ecological Society of America.

Fishing at sunset: are we missing the full story?

By Dr Richard Unsworth, Fisheries Biologist at the Department of Primary Industries, Carins, Australia

Picture - Bajo 'sea gypsy' children collecting urchins and porcupine fish at low tide in the seagrass. These people live on stilted houses often over the seagrass and are intricately associated to the marine world, particularly seagrass beds.

Across the Asia-Pacific the general public and scientists are routinely bombarded by an increasing body of evidence documenting the sad and disastrous decline of coral reefs, but in all this furore are we as conservationists missing the full picture and forgetting other valuable habitats such as seagrass beds that may also be in danger? Seagrass beds are comprised of flowering plants that are more closely related to terrestrial lilies and gingers than to true grasses. They live entirely submersed in coastal marine waters and create habitats that can be 100's of kilometres in length, and contain a plethora of rich and diverse fauna. Despite the importance of seagrass beds in supplying ecosystem services such as nutrient cycling, critical nursery habitats, and food supply, there is growing evidence that they are experiencing an unprecedented level of damage, deterioration and overexploitation, mostly attributed to human activities. Degradation of seagrass beds has been commonly associated with man made problems such as nutrient run-off, sedimentation, physical degradation and pesticide leaching. However, in many areas of the world seagrass beds are increasingly threatened by another lesser-documented factor; over-exploitation of their productive fish and invertebrate assemblages.

The next time you are on holiday by the coast somewhere around the Indo-Pacific, wait for the full moon and go for a low tide stroll. Chances are that in many places you'll find seagrass beds, and amongst them countless fishers out collecting invertebrates, trapping fish stranded in tide pools, or bringing in their net laden with fish from when the tide went out. Much of this fishing is not large-scale commercial activity, it's mostly a subsistence activity, but also includes small family fishing collectives earning a basic livelihood selling excess catch.

This exploitation remains largely undocumented, but is thought to be increasing in areas of rapid human population growth. Although low intensity fishing may be of no risk to the environment, increasing intensity may alter the trophic structure of the habitat and cause the removal of particular slow developing species.

Whilst many people are aware of coral reef fisheries as a key concern in tropical habitats, fisheries in other habitats are often forgotten about. Seagrass beds make ideal fishing grounds, they contain abundant fish and invertebrates whilst their location in shallow water means that they are readily accessible and that they can usually be exploited in all weather conditions. In contrast, reefs are often further from the shore making them less easily accessible during poor weather conditions, they are also more difficult habitats for net fishing due to the possibility of net snagging. Throughout many tropical regions, seagrass beds are commonly harvested at low tide for subsistence foodstuffs such as small molluscs, clams and urchins; and for commercial species such as octopus and sea cucumber. In some areas the seagrass itself can also be directly harvested as emergency foodstuffs, or as fodder for cattle and captured turtles. Due to their clear economic and ecological importance, and the fact that seagrass beds are becoming increasingly degraded, management of these habitats should increasingly be considered in local conservation efforts and as an economically vital habitat, particularly in areas where over-exploitation is widespread.

Conservation of seagrass beds has additional consequences for the coral reefs that are located adjacent to them. In the Wakatobi Marine National Park in SE Sulawesi, seagrass beds are coming under increasing pressure from hundreds of large tidal fishing nets (locally referred to as Sero) that are laid for up to 100m across the seagrass and catch all fish moving with the tide. Fish caught are often from families such as Emperor, Rabbitfish and Parrotfish that migrate between reef, mangrove and seagrass, and play important ecological roles on the reef. As well as the adult fish, large numbers of juvenile fish are caught, such as young Grouper, Snapper and Wrasse that utilise the abundant food sources within seagrass.

In a world of changing climate, exponential human population growth, mass extinctions and large scale habitat loss the ability of governments and conservation organisations to prioritise fisheries and conservation measures is an enormously difficult job. Seagrass beds are not an aesthetically pleasing habitat, they don't immediately stand out as colorful wonders of the world in magazines, newspapers or on wildlife documentaries, but they are undoubtedly an important economic and ecological resource, and they need to be conserved and managed for the future of the people who use them, and for the future of the biodiverse and colorful reefs that they are intricately associated with.

Mass spawning of corals in Indonesia

Dr Andrew H Baird ARC Centre of Excellence for Coral Reef Studies, JCU Townsville

One of the many issues explored by the world's leading coral scientists at the International Coral Research Symposium (ICRS) in Fort Lauderdale, Florida (July 7-11) was that of spawning synchrony in corals. Data gathered from over 20 locations within the Indo-Pacific, including many sites within Indonesia, has shown that the world's biggest orgasm - the synchronized mass-spawning of corals - is far more widespread than previously thought. Prior to this research, mass spawning events were believed to be confined to a few major reef systems such as Australia's Great Barrier Reef and Ningaloo but not more tropical reefs like in the Coral Triangle. However new research is revealing these mass spawning events occur throughout the Indo-Pacific - from French Polynesia to the Red Sea - wherever there large numbers of coral species present.

For example, in Indonesia, the majority of reproductive output is concentrated in brief periods following full moons at the beginning and end of the monsoon. In many places there are two peaks in spawning activity with the intensity of the peaks varying between locations, and among years. On the reefs off Manado, Tanjung Pinang and Aceh spawning occurs mainly in March and April, whereas on reefs off Bali, Padang and Makassar most spawning occurs in October and November. While the exact cues which prompt many different coral species to spawn together remain unclear it seems that changes in water temperature associated with the changes in wind direction and strength associated with the monsoon are a significant factor.

This is one of the many paradigms about coral biology that has changed with the wider geographic focus of recent research, and it is evoking great scientific interest as we come to grips with the implications. For example, one concern arising from these findings is that the water temperature changes driving spawning synchrony are likely to change as a consequence of climate change raising the risk that corals will become confused and start spawning at different times, reducing spawning synchrony, reducing fertilization success with the result that rates of replenishment of coral populations will be reduced. The failure of reefs to regenerate properly - as has been the case in the Caribbean - makes them less resilient to human impacts such as overfishing and pollution or climatic impacts such as hurricanes or bleaching.

However, the most significant finding of this research is that, at a large scale, the timing of coral spawning is highly predictable. This is very important knowledge for reef managers who can work to minimise activities, such as dredging, which may affect reproductive success at times of year when the corals are known to be spawning. This information can also be combined with seasonal patterns of water movement to determine source sink relationships among reefs. Documenting the patterns of connectivity among reefs is important when designing effective Marine Protected Areas.

Clues to whale shark migration patterns in Indonesia

Shinta T. Pardede dan Rachel Graham

The Whale Shark (*Rhincodon typus*) is the biggest fish in the sea, a charismatic marine megafauna that brings excitement and adventure to dive enthusiasts as supports thriving tourism industries in Ningaloo Marine Park in Australia, Belize, Philippines, Mexico, Seychelles, and Christmas Island.

Unfortunately, the planet's largest fish is on the verge of extinction. Whale sharks are extremely vulnerable to over exploitation by man for several reasons. They have a slow growth rate, only reaching maturity at around 30 years old and living as long as 60 - 100 years. Their reproduction rate is also very slow - long intervals between pregnancies and producing around a few hundred pups at one time. In Taiwan and India documented catches have declined from the 1980's to 2000's. In Indonesia, sightings of whale sharks have also declined significantly at sites including West Papua; North Sulawesi; North Kalimantan; Nusa Tenggara Timur; East Lombok; Bali; East Java, Karimunjawa Islands; Ciamis; Riau Islands; Aceh and Cenderawasih Bay. Few data are available on the exact time, the appearance, the size, numbers and behavior let alone the environmental factors (eg. tuna feeding, coral spawning, fish spawning) that may be causal factors to their appearance.

Based on the limited sources of information, in West Papua, local people find regular appearances of up to 4 whale sharks up to 10m in length almost all year round. These sharks are very tame and allow people to swim close while they consume fishes from fishponds. Other regular sightings of whale sharks have been recorded in waters between Indonesia and Australia. Various records showed that whale sharks made their appearances along the southern coast of West Java to the Timor Sea from January to October. Ten individuals were recorded separately from 2002 to 2008 with sizes ranged from about 5m-12m in length. The appearance strengthens the hypothesis about the migration paths of whale sharks from Ningaloo in Australia and northeast towards southern Indonesian waters.

Some sources indicate that these sharks may make their way up north to Sulawesi and Kalimantan through the straits between islands of Java, Bali, Lombok, and Nusa Tenggara Timur. It may also be possible that the sharks migrate from Ningaloo in Australia via Suamtra, Indonesia and into the Indian Ocean. Whale shark sightings have also been recorded in other areas in central and northern Indonesia, namely the Karimunjawa Islands in the Java Sea, Northern Kalimantan, Anambas Island, and Weh Island in Aceh. Records on these sightings were mostly associated to feeding behavior as the sharks appeared in the waters where seasonal aggregation of shrimps or plankton form as well as spawning aggregation of various species of reef fish and migratory tuna stocks. Attention to the management of these sites is needed especially as reports from these sites are of whale sharks that have been captured dead, are landed by shark processors or eaten by the locals.

One of the most infamous whale sharks 'slaughters' occurred in the waters of Lembeh Strait, North Sulawesi from 1996 to1997. The international community were outraged and the media called the incident the "Manado Walls of Death", where 18 whale sharks were caught by tiger mesh trap nets near the Tangkoko Nature Reserve, set up across the pelagic migratory channel by Taiwanese fishermen, together with 1424 manta rays, 789 marlin, 577 pilot whales, 257 dolphins, 84 green turtles, and 9 dugongs during a year of operation (http://darwin.bio.uci.edu/ ~sustain/bio65/indonesia/indon97e.htm). Anticipation and protective action were implored from the Indonesian government to stop the activity who then banned the net from being operated in Indonesia, thus to conserve whale shark, marine mammals, and sea turtles, endangered species under the Convention on Inbternational Trade of Endangered Species.

As part of the development of a marine protected area network in northern Aceh, Sumatra the WCS team is focusing on reports of whale shark sightings so that marine protected area planning will take their movements and behaviour into account. Sightings on Weh Island from 1990 to 1997 and from 2000 to 2008 during the months of September to April were of animals sized between 3 and 12 metres. There are some indications that in the 1990s, whale shark sightings were more frequent than the recent years of 2000s. As a preliminary study, this sighting information is basic to observations on whale shark ecology and movement in the region and may provide clues where these animals come from and where they travel to.

Karimunjawa National Park, its people and 3 years into a new zoning system

Stuart Campbell

The re-zoning of Karimunjawa Marine National Park was finalised under national legislation in August 2006 by a Decree of the Director General of PHKA, No. SK. 79/IV/Set-3/2005. Following a process that ranked sites according to ecological (eg. habitat diversity, replication and representation), socioeconomic (eg. fishing impact, community management, community perceptions) and governance criteria (zoning requirements, local government rules) criteria, a recommended series of replicate zones across the marine national park went through an exhaustive stakeholder consultation process over 18 months. Numerous draft revisions of the zoning plan were produced until the final draft was recommend with government and community support. It is clear that the process in Karimunjawa was influenced by the perceptions of local fishers who for the most part were not willing to accept large no-take areas as a tool for fisheries management as availability to fish as source of protein is seen as an issue of equity above all else.

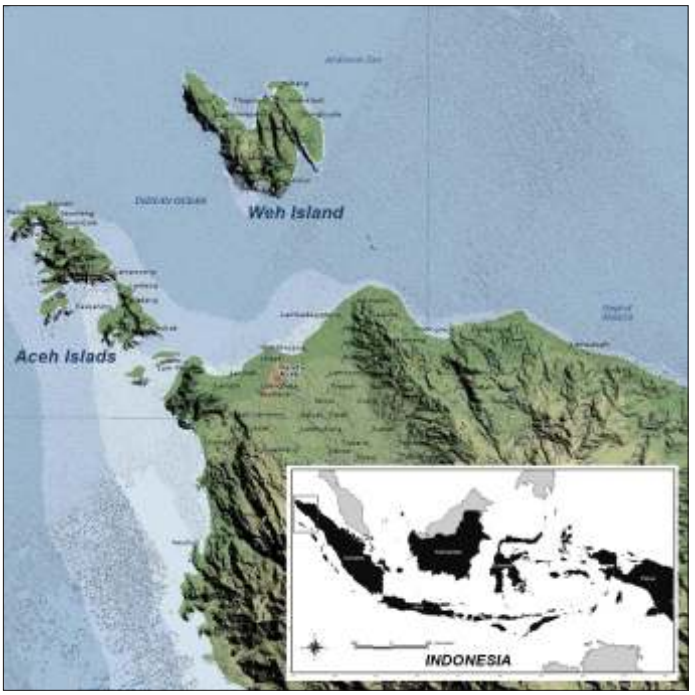
For Karimunjawa village stakeholder meetings were critical to the process of choosing sites from a range of options for this marine protected area (~1100 km2). Choices of where to site no take zones were reached through discussion of scientific data, stakeholder knowledge of marine resources, use and community needs and perceptions at the village scale attempted to allow stakeholders to have direct input into the planning process and design a consensus based network of MPAs that accounted for multiple species, habitats, oceanographic factors, resource uses..

The general achievement of about 15% of no take zones throughout the park, in theory should protect mid- and large-size commercial fishes from over-exploitation, but as with many areas in Indonesia these MPAs have not been fully enforced. The initial focus of national park management has been to enforce the prohibition of illegal fishing practices rather than all fishing within no take zones, and promote sustainable multiple uses (eg. seaweed farming, tourism, fishing), rather than enforce compliance within all permanent area closures. The adaptive management procedures allowed for by the Karimunjawa National Park Authority may result in changes in the zoned regulations in response to their success or failure after 5 years of evaluation, and responses of other management agencies and stakeholders. In the end it will be socially flexible and acceptable management interventions, meaningful community participation in management and stronger governance at local levels that will protect fisheries and coral reefs of Karimunjawa rather than any strict adherence to zoning plans.

From Italy to Indonesia

Camilla Novaglio & Claudia Meneghesso

Once we finished our Bachelor Degrees in Marine Biology in Italy, a strong will pushed us to stop for a while and transform the acquired knowledge into practice. A strong desire to explore the world led us to help with programs at WCS Indonesia Marine Program. We were kindly offered the opportunity to share our knowledge and experiences and provide some on site training to WCS staff.



We arrived in Indonesia and could never have expected something better! It was easy to adapt to this fantastic new country, considering all the many aspects that it involves, from the different religion, to the different ethics, the challenges in language, the food and the mandi! Once on Weh Island, the training area, we were amazed to work in such as spectacular sea covered by wonderful species of corals inhabited by fascinating creatures (A lot of subjects to be studied!). Impressive was the way in which the villagers welcomed and supported us in our experience!

Of remarkable interest for our knowledge was the direct observation of the fishermen daily-life activity, the intra- and inter- self-organization in the villages, and the sharing of different aspects about the fishes life-history, patterns and behaviours, between the scientific and practical points of view.

Marine ornamental fish preliminary survey in Beurawang village Pulau Weh, Indonesia (Camilla Novaglio)

The aim of this training project was the direct observation of the Aquarium trade organisation, including the fishing technique, the collectors and traders handling and transportation procedure, and the investigation of the main species exported.

During the 2 months of the training project WCS staff spoke with the fisherman and traders both in Beurawang and Banda Aceh, joining the fishing activity and the various trips to the traders, observing the packing procedure and counting the diverse species of fishes at the landing site. Many problems were found in particular during the fish handling and transportation, including incorrect handling and transportation techniques that caused high after capture mortality due to overstress.

Approximately 24 different species of aquarium fish were recorded: 6 species of Acanthuridae, 1 species from Zanclidae family, *Zanclus cornutus*, 6 species of Chaetodontidae, 6 species of Pomacanthidae, 2 species of Pomacentridae and 3 species of Labridae; 17 fishing sites for aquarium fish collection around the island were reported.

The most fished species was *Acanthurus leucosternon* (Acanthuridae), followed by *Naso lituratus* (Acanthuridae). Fisher knowledge revealed that over the past ten years, the most harvested species was *Paracanthurus hepatus*, witch is also one of the most requested and expensive on the market.

During the work it was discovered with pleasure that all fishermen were pleased to give not only the information needed for the project but also brief particulars of their life and were curious about aspects of ours.

We would like to thank all the WCS Indonesia Marine Program staff for having supported us during this unforgettable experience, and also all the fishermen and divers that contributed to these projects.

From top left (clockwise):
Achanturus leucosternon inside separated baskets; Camilla training local fisher to record harvest data; plastic packing; fishes inside plastic bag; ready to ship; Camilla gives presentation of study result to the fishers.

Indonesia: An Investigation on the Reproductive Biology of The Coral Hind Grouper, *Cephalopolis miniata*. (Claudia Meneghesso)

During this training, samples of the Coral Hind Grouper (*Cephalopolis miniata*) were collected at sites around the island, directly from the fishermen at the landing sites, and at the markets. Considering the fact that the many groupers are protogynius hermaphroditic species, so they are easily susceptible to a fast over-exploitation by the fishing activity, there was noted a large removal of males and spawners. There was a necessity to investigate the size at first maturity and size of sex change-reversal to find information that could be used to avoid a rapid decrease in the population. To reach this target the gonad samples were analysed and the sizes values were calculated through the "Gonad-somatic Index".

Another characteristic of the life-history that make the groupers vulnerable is their behaviour of aggregating in big numbers, in fixed sites and moon phases, during the spawning time. That spawning aggregations are heavily targetted all over the world by fishers as they are a source of large quantities of fishes. Information about the possible spawning aggregation sites on Weh Island were collected through interviews with fishers and divers, with the purpose of discovering where main spawning sites occur.

Once all the necessary information is gathered to predict the seasonality and location of the spawning aggregations it will be possible to propose to the Government Authorities options to manage the fishing effort, and in so doing avoid the overexploitation of the Coral Hind Grouper.

Claudia Meneghesso training WCS staff Effin Muttaqin in techniques to collect information on fish spawning

Dugongs and Dragons

Stuart Campbell

Constrained on their landward edge by mangroves which lay at the base of one of the most intriguing landscapes in Indonesia, and at their seaward edge by coral reefs that provide economic value to local communities of Komodo National Park, lie the seagrass meadows of Komodo Island - some of the most extensive, diverse and finest habitats of seagrass to be found in Indonesia. In June 2008, The Nature Conservancy with help of WCS undertook some of the most detailed surveys of seagrass meadows in Komodo National Park, in an attempt to map their distribution for future marine resource management planning. The work will identify areas most important to these forgotten and rarely seen marine mammals that inhabit the underwater marine habitats of Komodo and beyond. In muddy sediments abutting mangrove forests grow the fibrous and largest of the species found, *Enhalus acoroides*, a perfect habitat for juvenile coral reef fish. In small embayments where light penetration is 'dungeon like' the conditions were perfect for the growth of the smallest of seagrasses, *Halophila ovalis* a nutritious species, highly concentrated with amino acids and carbohydrates, and low in fibre, and so favoured by dugong.

Extensive *Thalassia hemprichii* beds stretching out to meet the coral reefs provide food for turtle species. These areas lie underwater adjacent to where the Komodo Dragon lives and support some of the last populations of dugong in the Indonesian archipelago. Less than a 1000 individuals likely remain in Indonesia but data on their distribution is poor. Dugong teeth are still used for ceremonial purposes in fishing villages across Indonesia although this practice is illegal. A dugong was encountered during the survey in waters off Komodo Island.

This newsletter informs about the lastest findings, result, and plans from WCS Indonesia's Marine Conservation Science Program and its team. On a quarterly basis contributors will provide updates about exciting discoveries, progress in our monitoring work, our training programs and scientific collaboration with other marine science institutions. We will update you on the exciting and important work being done in Indonesia and how we are contributing to the conservation of some of the most diverse coral reefs in the world. This newsletter is made possible by the generous support of the American people through Packard Foundation, the National Oceanic Atmospheric Administration (NOAA), Kerzner Foundation, Tiffany Foundation, the International Union of Conservation Nature, and all potograph contributors. The content are the responsibility of the Wildlife Conservation Society and do not reflect the views of the United States government. We hope you find information useful and inspiring.

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