ECOSYSTEM-BASED MANAGEMENT OF THE BIRD'S HEAD SEASCAPE

A joint initiative of Conservation International, The Nature Conservancy, and WWF-Indonesia
Funded by the David and Lucille Packard Foundation

Stretching from Teluk Cenderawasih in its eastern reaches to the Raja Ampat archipelago in the west, the Bird's Head Seascape in NW Papua sits firmly in the epicenter of the "Coral Triangle", the area of the world's highest marine biodiversity. Recent surveys in the Raja Ampat archipelago, an area encompassing over 4.5 million hectares and nearly 1500 islands and submerged reefs, have recorded over 1,000 species of coral reef fishes and nearly 540 species of scleractinian coral (roughly 70% of the world's total) – the highest coral reef biodiversity recorded for an area of this size anywhere in the world. Though the surrounding seascape is not nearly as well-known as Raja Ampat, it is clear that these areas harbor equally impressive marine ecosystems – including the largest Pacific Leatherback Turtle nesting site in the world in Jamursbamedi.

The area's incredible marine biodiversity and rich marine resources make it both a global marine conservation priority while at the same time a target for development of economic sectors ranging from fisheries to marine tourism to oil and gas. The local governments in the Bird's Head Seascape (including Sorong, Sorong Selatan, Raja Ampat, Manokwari,

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Teluk Wondama, Biak Numfor, Yapen, Supiori, Nabire, Waropen, and the neighboring regencies of Teluk Bintuni, FakFak and Kaimana) are now facing very important decisions on how to balance between sustainable economic development of rich marine resources and conservation of globally-significant marine diversity. The future prosperity of the people living in the Bird's Head Seascape (and their grandchildren) urgently depends upon responsible, well-informed policies that allow for sustainable development while preventing the environmental destruction that has occurred in many other areas of Indonesia, including severe overfishing and illegal logging of forests that protect vital watersheds. To be most effective, these policies must be coordinated with neighboring local governments, as many ecological and economic processes within the Bird's Head Seascape are strongly "connected" and operate across administrative boundaries.

In order to assist in developing these environmentally-sound development policies, three environmental NGO partners (Conservation International, The Nature Conservancy's Southeast Asia Center for Marine Protected Areas, and WWF-Indonesia) have begun a science-based initiative to explore (in partnership with local stakeholders representing the government, civil society, academia and the private sector) the ecological, socioeconomic, and governmental processes that are most important to understand and include in management decisions in the Bird's Head. Increasingly, scientists and fisheries/natural resource managers around the world are recognizing that an "ecosystem-based management" (EBM) approach that takes into account the effects of interactions among the living organisms, the physical and biotic environment, and the human actors in an ecosystem is necessary to achieve truly sustainable use of marine resources (see the full definition of EBM at the end of this fact sheet).

This EBM initiative will conduct a series of thirteen separate studies (each described in their own separate fact sheet) over a two-year period that will help elucidate those processes and factors most critical to designing ecosystem-based management plans for the regencies and cities in the Bird's Head Seascape. The results of this comprehensive set of studies will be used to develop and refine a synthesis ecosystem model which will be used to assess the consequences of a range of different management scenarios that attempt to balance conservation and sustainable economic development. Results from this extensive modeling exercise will be used to develop a comprehensive ecosystem-based management plan for the coastal and marine resources in Raja Ampat Regency as a first "test-case". Though the first iteration of this ecosystem-based management planning will focus on the Raja Ampat Regency, the data collected in the 13 studies will be valuable to ALL of the local governments in the Seascape, and the implementing partners are committed to involving government and local stakeholders from all the kabupaten/kota in the Seascape in this process and sharing all data collected. If this approach proves successful for Raja Ampat, we will strive to assist each of the other kabupaten/kota in designing similar EBM plans for their areas of the Seascape.

Addendum: Working Definition of Ecosystem-Based Management used in the bird's head Seascape EBM initiative:

We define Ecosystem-Based Management as a management regime in which decisions explicitly take into account the effects and values of interactions among the living organisms, the physical and biotic environment, and the human actors1 in an ecosystem. Measuring, evaluating, and forecasting the dynamics of these interactions constitute the science that underpins EBM. EBM for the marine environment aims to create a sustainable relationship between humans and marine resources by: (1) maintaining or restoring the structure, function, resiliency, biodiversity and ecosystem services of the Seascape; (2) recognizing that human use and values, and the health of human communities are dependent on marine resources; (3) recognizing that ecosystems are dynamic, interrelated, and respond to changing natural and anthropogenic factors; (4) reflecting a shared vision, a common perception that is based on "real evidence" (such as monitoring and scientific surveys), and working toward mutually agreed upon objectives among stakeholders; and (5) implementing adaptive management based on the best scientific knowledge, and reconciling short-term losses brought about by restrictive management with long-term benefits (adapted from Ward et al. 2002).

Ward T, Tarte D, Hegerl E, and Short K. (2002). Policy proposals and operational guidance for ecosystem-based management of marine capture fisheries. World Wide Fund for Nature, Sydney, Australia. 80pp.

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Genetic Connectivity of Marine Ecosystems in the Bird's Head

Introduction

The majority of fishes, corals and other marine organisms do not give birth, but rather release eggs into the water that hatch as tiny larvae. These larvae then swim or drift in the currents for periods ranging from several days to several months before they transform into juveniles and settle to the bottom, during which time they may move great distances of up to hundreds of kilometers or more. Alternatively, if the ocean currents are weak or move in gyres, they may not move very far at all from their place of origin before settling.

Photo © Mark V. Erdmann

The extent to which larval marine organisms move between reefs in the Bird's Head Seascape determines the amount of "connectivity" between these reefs – which is very important for managers to understand. For example, tuna larvae from Biak may be carried by currents and settle on reefs in Yapen, Manokwari, or even Raja Ampat. Obviously, if the adult tuna in Manokwari all come from Biak, it is important for the Manokwari government to work closely with the Biak government to ensure a future supply of larval tuna for the fishermen in Manokwari!

This same principle applies to corals, lobster, and many other marine organisms of importance in the Bird's Head. For instance, if all of the reefs in Teluk Wondama are bombed, they may depend on new coral larvae from Waropen or even FakFak to recover. As another example, the villagers who catch lobster in Raja Ampat might be dependent upon Supiori as the source of new larval lobsters to renew their stock. Results of initial studies in the Bird's Head show that there is indeed a high degree of connectivity between the reefs there, but there is still much work to be done.

Objective

The examples above demonstrate why it is extremely important to understand the patterns of connectivity between the marine ecosystems in the Bird's Head Seascape. This study will elucidate the patterns of connectivity for a wide range of important marine organisms in the Seascape in order to allow local governments to set policies that will ensure the long-term sustainability of their reefs and fisheries, including development of MPAs that protect reefs that are vitally important as sources of larvae for other reefs in the region.

Methods

This study will use cutting-edge genetic analysis techniques to determine the patterns of connectivity of a range of different marine organisms in the Seascape, including corals, tuna, grouper, rabbitfish, fusiliers, Spanish mackerel, coral shrimps, giant clams, and even worms and starfish. This involves taking small tissue samples from each of these organisms from reefs throughout the Seascape (from Biak to Kaimana) and using genetic analysis to determine connectivity between the reefs. The results of these analyses will be used to construct maps that show patterns of connectivity within the seascape for each species, and these will be shared with
our primary governmental, academic and civil society partners in order to inform fisheries and natural resource use policies that are based upon the principles of ecosystem-based management.

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FACTSHEET

Satellite Tagging of Hawksbill and Green Turtles

Introduction

Of the seven sea turtle species known worldwide, six are found in Indonesian waters. These include the **Loggerhead turtle, (*Caretta caretta*), Green turtle, (*Chelonia mydas*), Hawksbill turtle, (*Eretmochelys imbricata*), Olive ridley, (*Lepidochelys olivacea*), Flatback turtle, (*Natator depressus*) and the Leatherback turtle, (*Dermochelys coriacea).*** The distributions of these turtles are closely linked to their life cycles, whereby the juvenile and adult turtles often utilize different habitats. After hatching and entering the sea, the juveniles of many turtle species may reside in a specific area for a number of years while developing into adults, though we know very little about this part of their life cycle. Once they are grown, the adults generally spend their time foraging in coastal areas (especially around coral reefs and in seagrass beds), but then may move great distances to specific nesting beaches where they lay their eggs.

Turtle tagging programs allow researchers to track the movements of turtles over periods of months or even years. Results from tagging studies in the western Pacific region show that while adults have specific nesting beaches, they later will travel to common foraging grounds along with turtles that nest in many different areas. For example, turtles that have been tagged on nesting beaches in Australia have been shown to later return to their foraging grounds around the Aru Islands in eastern Indonesia, where they join foraging adult turtles that nest in other areas.

The Bird's Head Seascape encompasses a wide variety of habitats, many of which are used by sea turtles for both foraging and nesting – including the largest remaining nesting areas for Pacific Leatherback turtles in the world. Recent surveys conducted in the Raja Ampat Archipelago have shown that both green and hawksbill turtles use this area for both foraging and nesting, with particular abundances noted around South East Misool, Sayang Island and Piai Island. Both of these turtle species are considered endangered and face a variety of threats within the Bird's Head Seascape, including egg collection and poaching of adults. While we do know quite a bit about these species feeding habits in general (the green is a herbivore, feeding on seagrasses and seaweeds, while the hawksbill is an omnivore that feeds on coral reef organisms like sponges, tunicates and mollusks), tagging studies will provide detailed information on their specific foraging and nesting movements within the Bird's Head Seascape.

Objective

The aim of this study is to understand the migration and dispersal of the green and hawskbill turtles in their habitats within the Raja Ampat Archipelago and the greater Bird's Head Seascape.

Methods

This study will be conducted by attaching satellite transmitters to 5 green and 5 hawksbill turtles captured while nesting or feeding in Raja Ampat. The turtles are released immediately, and data will be collected on their movements for at least a year, providing information that is critical to formulating a management strategy to protect the remaining, but threatened stocks in the Bird's Head.

Satelite transmitter (+ sonic tag) attached to a male hawksbill turtle of approx. 60 kg, in Mona Island, Puerto Rico, 2003.
Foto © Geoffrey Gearheart

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Sea Surface Temperature Monitoring

Introduction

Sea surface temperature is one of the most important physical factors influencing the growth, health, and distribution of marine organisms in the Bird's Head Seascape. Many reef organisms are adapted to the normal temperature ranges on the reefs where they occur, and if the water temperature becomes much cooler or hotter than normal, they may become unhealthy or even die. Especially with organisms like corals that cannot move to warmer or cooler waters like fishes, large temperature changes can cause widespread bleaching and death.

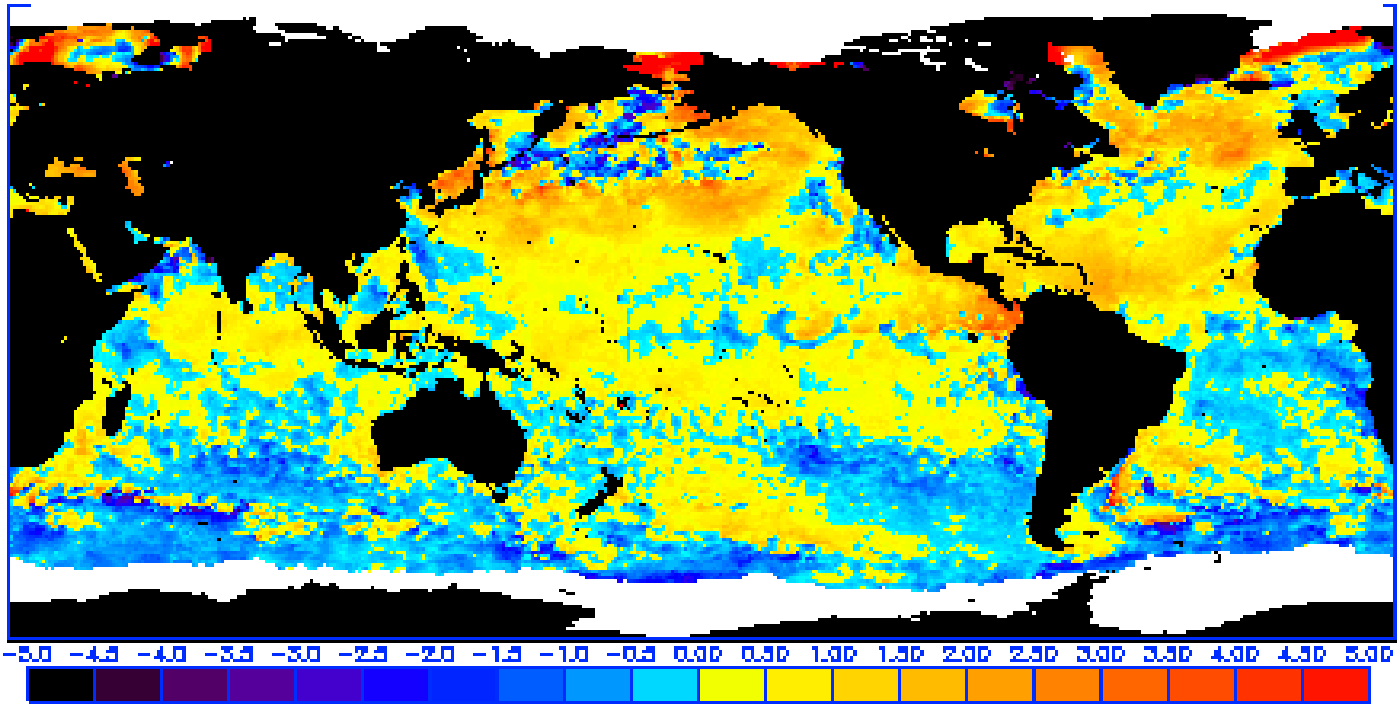
With the onset of global climate change, reef organisms are increasingly subject to more extreme temperatures, often much warmer ones than they can tolerate. Many reefs around Indonesia and the world have experienced severe bleaching and degradation due to unusually warm waters, and these degraded reefs are much less productive for fisheries.

However, scientists have noticed that some reefs are more resilient to coral bleaching than others and recover much more quickly; these reefs are often either subject to cold-water upwellings from nearby deep water or are previously adapted to warmer temperatures due to their physical location in areas normally exposed to warm, still water. Most scientists now believe that we should specially protect these resilient reefs in MPAs in order that they can function as larval sources of corals, fish and other organisms for other less resilient reefs in the seascape that might suffer severe degradation from global warming and need larvae from these source reefs to ensure recovery.

Objective

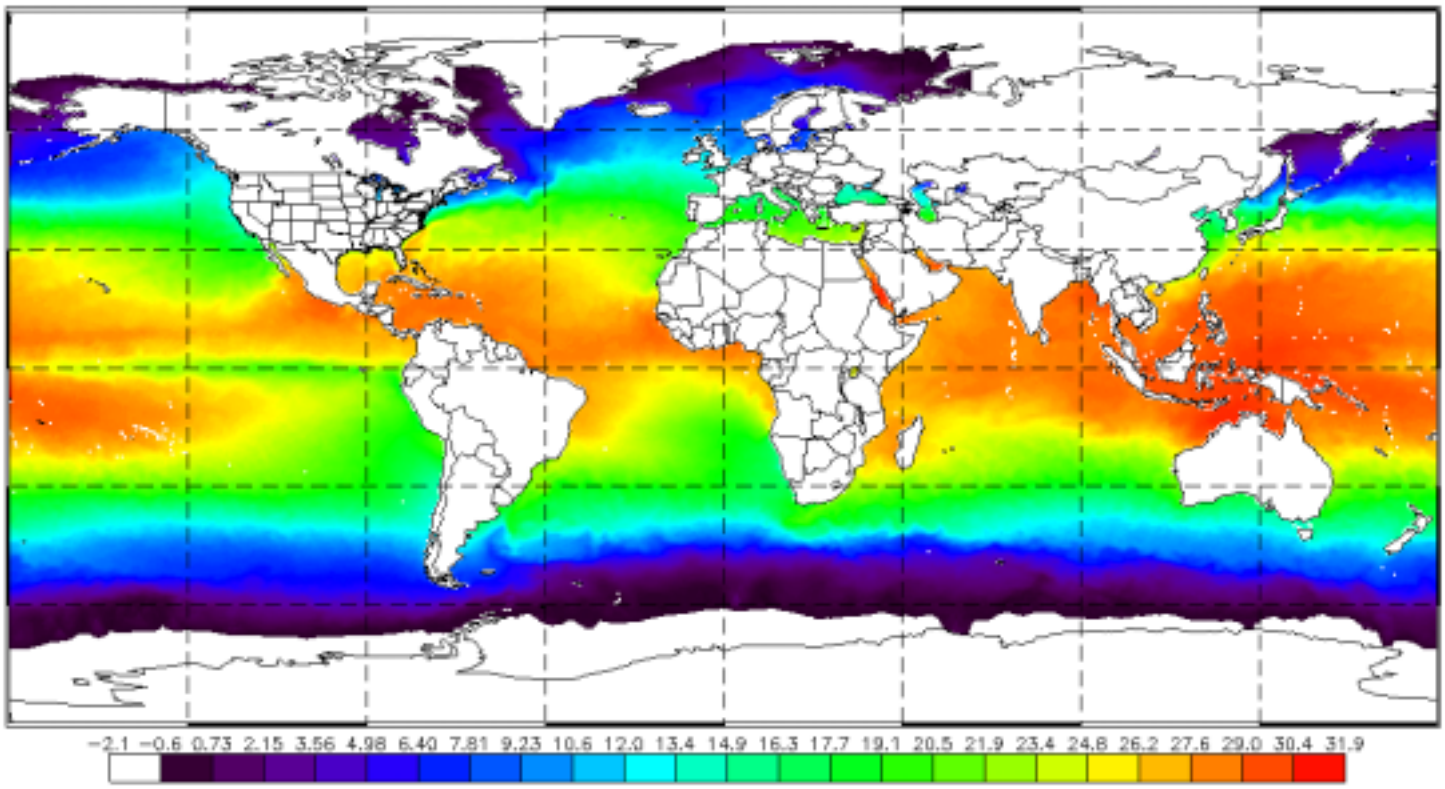
The purpose of this study is to uncover sea surface temperature patterns from a wide variety of reef areas and oceanographic conditions throughout the Bird's Head Seascape. By doing this, we can identify important areas of cold-water upwellings (that are important for both fisheries and for identifying reefs that are resilient to global warming) and also areas which are normally subject to very warm waters and might have corals and fishes that are adapted to tolerate global warming. Identifying these important areas will allow governments to better plan a network of MPAs that are resilient to global climate change and can thereby

NOAA Current SST Anomalies (C), 8/13/2005



Sea Surface Temperature Monitoring

Monthly Mean Satellite - only Nighttime SST for November 1998



insure long-term sustainability of coral reefs and the fisheries and tourism that depend on them.

Methods

This study will collect and analyze data from 60 miniature electronic temperature loggers that will be installed at a series of sites throughout the Bird's Head Seascape. Loggers will be installed at either 1, 3, or 20m depth and will record temperature every 30 minutes for a two year period. The sites that have been chosen were selected to represent a wide range of different oceanographic conditions, including reefs that are thought to be exposed to cold-water upwelling and those that are inside shallow enclosed bays that are routinely exposed to very warm water. Temperature data will be downloaded from these loggers every 6-12 months and used to produce maps of sea surface temperature variations across the seascape that will be shared with all primary partners in the Bird's Head.

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FACTSHEET

Fisher Surveys to Locate Spawning Aggregation Sites

Photo © Mark V. Erdmann

Introduction

A number of the macro carnivorous reef fishes (including groupers and Napoleon wrasse) are severely threatened by over-exploitation, because these species are so commercially valuable, slow growing, and easy to catch. Examples of such species include tiger grouper *Epinephelus fuscoguttatus*, marbled grouper *E. polyphekadion*, squaretail coralgrouper *Plectropomus areolatus*, and Napoleon wrasse *Cheilinus undulatus* all of which form seasonal spawning aggregations that occur every year at the same site.

Spawning aggregations comprise a large part of the adult population from an area that is much larger than the spawning aggregation site itself. Hence, fishers who exploit those aggregations actually affect the reef fish assemblages of a much larger area. Throughout the world, species that form spawning aggregations have already been severely depleted, and many spawning aggregations have been extirpated.

If the location and processes of fish spawning particularly for these highly targeted fish could be protected, the long term sustainability of the fish population and related fisheries can become reality. If these locations are left to over-exploitation, these fish will disappear from the reefs and seize to provide income to fishers.

Objective

From interviews, researchers will aim to determine locations and characteristics of fish spawning aggregation sites for a number of target species. Information on levels of exploitation and potential support for protection of these locations will be collected at the same time.

Methods

A semi-structured interview will be used and integrated with other socio-economic assessments in the birds head region. Fishers known to specifically target the selected species will be interviewed primarily, and other fishers will be included in the same to establish some understanding on the level of knowledge about spawning processes and link with sustainability and to allow for some awareness activities relating to potential future protection of SPAGS.

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Monitoring of Reef Fish Spawning Aggregation Sites

What are reef fish spawning aggregations?

A reef fish spawning aggregation is a grouping of a single species of reef fish that has gathered in greater densities than normal for spawning. Examples of fishes that form spawning aggregations are certain species of grouper, snapper, surgeonfish, rabbitfish, parrotfish and wrasse. Aggregations vary widely between reef fish species. Some species, such as Napoleon wrasse Cheilinus undulatus, form only small aggregations of few individuals, whereas other species form aggregations that number hundreds or thousands of fish. Some species migrate hundreds of kilometers to reach an aggregation site, whereas aggregation sites for other species may only be a short distance from their home reef.

Large aggregations usually form during part of the year, whereas small aggregations may form every month. Often, aggregations form just before full moon or new moon. Spawning usually takes place during one or two nights, after which the aggregation rapidly dissolves. Various fish species may use the same site on a reef to aggregate for spawning. An example from the Asia-Pacific of a species assemblage that often aggregate at the same site, during the same season, and during the same moon phase, are the commercially important squaretail coraltrout Plectropomus areolatus, tiger grouper Epinephelus fuscoguttatus, and camouflage grouper E. polyphekadion. Reef fishers often know where and when these species aggregate.

Why are reef fish spawning aggregations important?

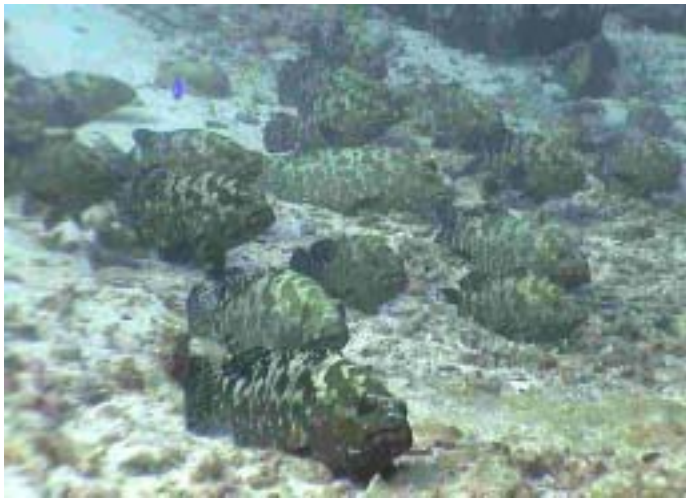
Spawning aggregations are important because they are essential for the survival of aggregating species. Commercial or subsistence fisheries on aggregating species can only exist if there are aggregation sites where these fish can spawn. Spawning aggregations of commercial species are extremely vulnerable to over-fishing, because fishers can predict when and where fish aggregate for spawning. A spawning aggregation concentrates a large part of the fish population in time and space, and thus fish become readily accessible to the fishery. With the development of a strong domestic and foreign market for aggregating species (notably groupers and Napoleon wrasse), the catch from spawning aggregation sites far exceeds what nature can produce. As a result, populations of many aggregating species have dwindled, and fisheries that depend on these populations can no longer sustain local livelihoods. For this reason, spawning aggregations need protective management.

Why monitoring reef fish spawning aggregations?

For generations, traditional communities throughout the Asia-Pacific have implemented protective management for spawning aggregations. However, traditional management systems have become less effective with population growth, increasing socio-political dynamics, and increasing domestic and foreign demand for reef fish. Modern protected area management systems, which comprise government agencies as well as representatives of local communities, may help to protect spawning aggregations for the benefit of present and future generations. Such systems, however, require accurate knowledge on the location and status of spawning aggregations. Fortunately, methodologies have been developed to monitor spawning aggregation sites, and results from monitoring programs can be used to support management.

Monitoring of spawning aggregation sites in the Bird's Head Seascape

Field teams of Conservation International, The Nature Conservancy and WWF Indonesia have already started to interview fishers on locations of spawning aggregating sites and on seasonality in spawning. Over the coming two years, monitoring teams will dive every month at 2-4 sites in the Bird's Head Seascape to take observations on species composition, numbers and sizes of aggregating fish, and on seasonality in aggregating behavior. Furthermore, a study will be conducted to describe how fertilized eggs disperse from the aggregation site. Monitoring results will be used to inform local government agencies and co-managing community members how to manage aggregation sites for the benefit of the people from the Bird's Head Seascape.



Aggregating camouflage grouper in Palau. Photo by Andrew Smith

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Biomass Assessments of Coral Reef Fish Functional Groups

Functional groups of reef fishes

Ecosystem-based management (EBM) is a management regime that takes into account interactions among the living organisms, the physical and biotic environment, and the human actors in an ecosystem. The Bird's Head research program aims to provide the scientific basis for EBM by constructing a holistic simulation model of the coastal and marine ecosystems in the Bird's Head Seascape.

With this model, consequences of management interventions on all major components of the ecosystem can be simulated. A quantitative understanding of the reef ecosystem's food web is essential for the construction of this model. Describing the ecosystems of the mega-diverse Bird's Head Seascape in terms of species composition is unpractical – a better approach is to use functional groups.

Functional groups are assemblages of species that affect major ecosystem processes in similar ways. An example of a functional group is the group of large carnivores, which includes amongst others groupers, snappers and trevallies. Another example is the group of bio-eroders, which includes parrotfishes.

Biomass assessments

To understand how functional groups interact with each other, and to understand how management of one functional group may affect another group, it is necessary to assess the spatial distribution in the biomass of each functional group. In this research program, the spatial distribution in biomass of functional groups will be studied using Underwater Visual Census. Small teams of SCUBA divers will receive training to assess numbers and body size distribution of fish observed during timed swims at hundreds of sites in the western part of the Bird's Head Seascape.

Management implications

Besides providing baseline data for the ecosystem simulation model, results from this study will also be used to assess the exploitation status of fish populations.

Reefs in the Bird's Head Seascape are extremely diverse. To describe interaction in these complex reef ecosystems, scientists group species in functional groups.
Photo by Shimlock/Jones, Secret Sea

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Marine resource utilization surveys

The need for understanding patterns in resource use

Ecosystem-based management (EBM) is a management regime that takes into account interactions among the living organisms, the physical and biotic environment, and the human actors in an ecosystem. The Bird's Head research program aims to provide the scientific basis for EBM by constructing a holistic simulation model of the coastal and marine ecosystems in the Bird's Head Seascape. With this model, consequences of management interventions on all major components of the ecosystem can be simulated. A quantitative understanding of the effects of fishery and other resource uses on fish populations and habitats is essential for the construction of this model.

Whereas information on some aspects of resource utilization can be obtained by village surveys and through fishery statistics, a more comprehensive description of marine resource utilization patterns in the area can only be obtained through direct observations on the fishery in the field. A study of who is doing what, where, when and how, combined with direct observations on catch quantity and composition is analogous to a study of the feeding behavior of apex predators. As such, the information obtained during this survey can directly be used to inform the holistic ecological model of the Bird's Head Functional Seascape.

Survey methods

This research will be conducted through a frame survey, which aims to determine how fishing effort is distributed throughout the Seascape, in combination with a catch assessment survey, which describes catch composition and volume as well as which gears are used. The catch assessment survey will be based on a sample of fishing operations encountered in the field. These surveys will be repeated at least four times to cover different phases of the lunar cycle and take account of the two primary monsoon seasons in the area (both of which factors have a strong temporal impact on resource utilization patterns).

One of the challenges for this survey is the large size of study area: ca. five million ha. Obviously, it would be very expensive to do observations from a speed boat, whereas surveying from a more fuel-efficient vessel would be too time-consuming. Therefore, part of this survey may have to be done from a small airplane, where observers take notes on fishing operations while flying at low altitude and low speed over the area-of-interest.

Management implications

Besides informing the ecosystem simulation model, results from this survey will also be used as input for the design of a network of protected areas. This network will preserve the Seascape's unique biodiversity and it will sustain fisheries for present and future generations.

Double-outrigger canoes are commonly used by fishers in Raja Ampat.
Photo by TNC SEACMPA

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Historical Ecology of the Bird's Head Seascape

Introduction

Over the past decade, scientists and resource managers have realized the dangers of the "shifting baseline" phenomenon, whereby our perspective of "what is natural and pristine" is blurred by the increasing overexploitation of reefs over the last half-century. We have "forgotten" what a truly healthy reef or fish stock looks like; a reef that today seems healthy and dense with fish may actually be only a vestige of its former self. A "good catch" for a fisherman using a motorized dugout canoe today might actually be tiny compared to what a fisher used to be able to catch twenty years' ago by simply fishing from the beach. Accounts from the 1800's which mention seas swarming with big fish and beaches packed with turtles are nowadays hard to believe, though we are coming to understand that this really was the way that reefs naturally existed - but sadly we have greatly reduced the numbers of most large marine life over the past 100 years.

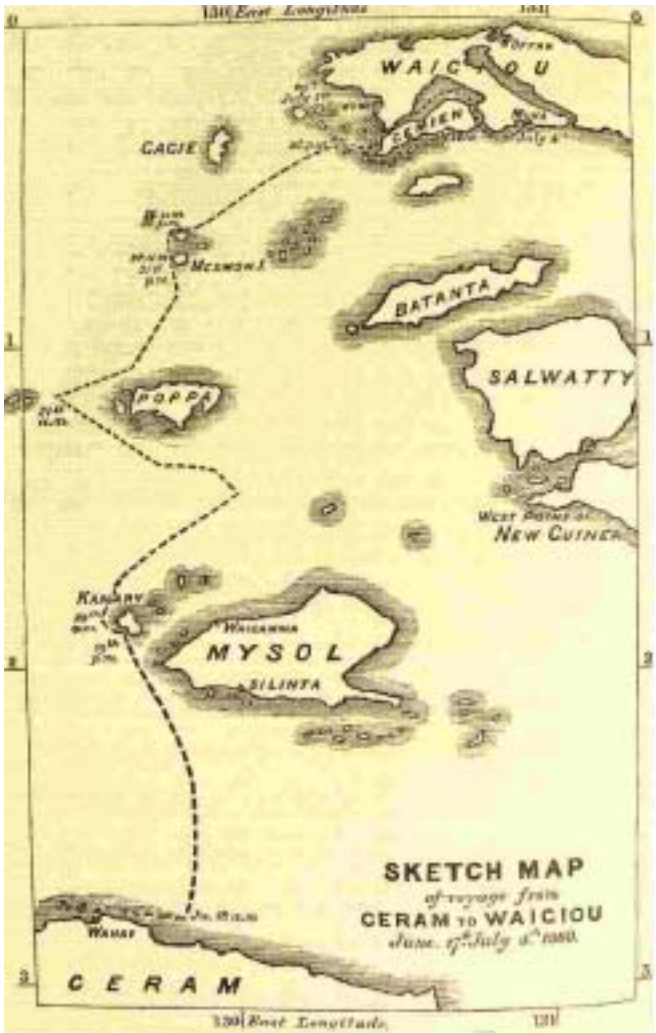
In order to set appropriate management targets for maintenance and restoration of fish stocks and ecosystem integrity in the Bird's Head Seascape, it is imperative to reconstruct, as best we can, what these fish stocks and ecosystems looked like in their "pristine" state before the onset of commercial fishing and logging. Fortunately, the Bird's Head Seascape was the focus of at least five major naturalist expeditions in the early to mid 1800's, including the French ships L'Uranie (1818-1819), La Coquille (1823), and L'Astrolabe (1826), the Dutch ichthyologist Peter Bleeker's comprehensive studies on Indonesia's fish fauna throughout the 1860's, and the travels of Alfred Russel Wallace (1860-1861). The area was again visited by the Dutch Snellius Expedition in the late 1920's. Additionally, there is a wealth of information collected by Dutch colonial administrators (recording volumes of fisheries products landed and traded, etc) and the Allied Forces during WWII, all of which can be mined for information on the original state of the fish stocks and reefs in the Bird's Head Seascape.

Objective

The main objective of this study is to reconstruct, to the extent possible, a broad picture of the original status of the living marine and coastal resources of the Bird's Head Seascape prior to the onset of commercial fishing and logging. This data will be used to create management targets for fish biomass and other stock densities, as well as overall ecosystem condition (ie, establish the "historical baseline conditions" which resource managers will strive to return Bird's Head marine ecosystems to).

Methods

This study will contract several of the world's foremost experts on historical ecological baseline reconstruction from the University of British Columbia in Canada. These researchers will collect data from the various reports and field notes of the early European expeditions mentioned above (many of which are in various museums around Europe) and also comb through local archives in Papua and Jakarta to extract any useful data on the status of marine resources in the Bird's Head during the period of 50-200 years ago. This data will be compiled into a comprehensive report and used to provide target inputs to the overall synthesis ecosystem model being prepared for the EBM project. The final report and collated data will be made available to all stakeholders from the Bird's Head.



Historical Ecology © Alfred Russel Wallace

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Monitoring of Knowledge, Attitudes and Practices Among Resource Users and Policy Makers in the Bird's Head Seascape

Measuring knowledge, attitudes and practices (KAP)

Resource users, especially fishers, are an integral part of the Bird's Head Seascape, and their practices co-determine ecosystem dynamics. As their practices are influenced by their knowledge and attitudes, achieving change of behavior through management interventions requires an assessment of these three attributes. At the other end of the stakeholder spectrum are local policymakers and officials, who co-determine behavior of resource users by through design and enforcement of new regulations. Therefore, it is important to also measure their knowledge, attitudes and practices (KAP) on marine resource use and marine conservation. Ultimately, KAP assessments will not only inform ecosystem-based management, they will also measure the effectiveness of on-going awareness programs.

Objectives of KAP monitoring

KAP monitoring will allow managers to become better acquainted with knowledge attitudes, perceptions and practices in the communities residing in and interacting with protected areas. This monitoring program will: a) produce qualitative and quantitative data portraying the community's knowledge, attitudes and practices concerning the environment in general, and concerning (planned) protected areas where they live; b) identify cultural and socioeconomic factors that may either obstruct or facilitate the adoption of more environmentally responsible practices; c) become a source of information to ascertain the types of management interventions that are more likely to have a noticeable impact on people's attitudes and practices. This program will also provide baseline information to monitor trends in the communities' perceptions on management effectiveness and the state of natural resources for the duration of the program intervention.

Methods

KAP monitoring will be implemented through village surveys that focus on the Raja Ampat regency but that also include a sample of other villages throughout the Bird's Head Seascape. A total of 120 villages will be surveyed by field staff, supported by TNC SEACMPA Bali and experts from Johns Hopkins University. It is likely that knowledge, attitudes and practices will change over time as Conservation International, The Nature Conservancy and WWF Indonesia are expanding their awareness programs. Therefore, local KAP will be measured at least once a year.

Measuring knowledge, attitudes and practices on marine resource use is mostly done by interviewing. Photo by TNC SEACMPA

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Institutional Mapping and Assessment of Marine Tenure Systems in the Bird's Head

Introduction

An ecosystem-based management approach, by its nature, requires broad involvement of all primary stakeholders in the region that play a part in or are affected by natural resources management policies. Moreover, ecosystem-based management requires a decision-making framework that takes into account both the formal and informal institutions that play a role in determining natural resources management policies and/or influence stakeholder decisions in their resource utilization patterns. Such institutions may range from the local fisheries or forestry department to the Camat, the Dewan Adat, religious figures or even influential families in a particular village – all of which play an important role in setting regulations and practices governing resource use. In some cases, it is common that national or even international institutions or organizations play a role – a powerful Malaysian logging company, for example, may be extremely influential in setting local forest use policy!

In Papua, it is also imperative to understand the nature and role of traditional tenure systems (hak ulayat), which may often be more important in the daily lives of local villagers than kabupaten, provincial or national laws governing resource use. The extremely important role of these traditional tenure systems should fit in very well with an ecosystem-based management approach, but it is necessary to better understand and eventually map these tenure claims in order to ensure that they are accommodated in any broader management scheme.

These two related activities – institutional mapping and assessment of traditional tenure systems – will provide data that is essential in transitioning towards ecosystem-based management – as EBM does not require any new institutions for implementation, but rather relies on implementation through the formal and informal institutions that currently play a role in setting natural resource use policy and practice.

Objective

The objective of this study is to first conduct an institutional mapping exercise to thoroughly understand the local context and primary institutions (from the village up to the provincial, national, and even international level) that act as either formal decision-makers or influential actors in marine and coastal management in the Bird's Head Seascape. At an even more detailed level, this study will focus in on understanding and possibly mapping the traditional marine and coastal tenure systems that currently exist in select areas of the Bird's Head.

Methods

This study will involve local experts with a social sciences background to conduct the institutional mapping and design a culturally-sensitive assessment of traditional marine and coastal tenure. Because the tenure assessment will be very labor-intensive, it will focus first on the villages in Kabupaten Raja Ampat. The data collected will be compiled into a comprehensive report and associated maps that will be invaluable for designing the most effective ecosystem-based management framework for the Bird's Head.

Photo © Jennifer Jeffers

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FACTSHEET

Design of Effective Framework for Collaborative Ecosystem-Based Management of Bird's Head Seascape

Introduction

Ecosystem-based management often relies upon a collaborative management approach to implementation, whereby all the primary stakeholders that play a part in or are affected by natural resources management policies are involved in making these decisions. A collaborative-management framework can take many different forms, depending upon the number and kinds of stakeholders involved, the relative influence that each stakeholder group currently has in effecting policy decisions, the effectiveness of formal and informal decision-making institutions, and simply the local culture.

For instance, in a remote area where the only stakeholders are local villagers and the Kecamatan government, a collaborative-management framework may already be in place, whereby the Camat works closely with the village chief and adat leaders to make decisions on natural resource management.

In more complex situations with many more stakeholder groups, including local villagers and adat leaders, kecamatan, kabupaten and provincial government agencies and local parliaments, private sector actors, local NGO's, and academia, a collaborative management framework may require the development of a multi-stakeholder advisory body to accurately represent the full range of stakeholder needs and perspectives to decision-makers. In Raja Ampat, the Forum Bersama Membangun Raja Ampat (FORBES) is a good example of this, whereby all primary stakeholders are represented in a single forum where important natural resource management issues can be discussed openly and recommendations based upon consensus from all stakeholder groups presented to decision-makers.

Objective

The objective of this study is to thoroughly examine the current stakeholder situation in the various areas of the Bird's Head and, based upon this assessment and the results of the related studies on institutional mapping and traditional tenure assessment, design an effective framework for collaborative, ecosystem-based management of the Bird's Head Seascape.

Methods

Because of the complex nature of this study and its reliance upon the results of many of the other studies in this EBM initiative, we anticipate that this study will require the full two years for completion. The study will be conducted by a post-graduate Indonesian researcher with a strong background in social sciences and natural resources management, and will work closely with all stakeholder groups in the Bird's Head Seascape to design a comprehensive and effective collaborative management framework that will benefit all.

Photo © Muhammad Farid

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FACTSHEET

Valuation of Ecosystem Services and Assessment of Current Livelihood Sectors in Raja Ampat

Introduction

Throughout the world, local governments often make important and far-reaching policy decisions based upon incomplete economic data that strongly favors short-term gains from exploitation of natural resources. The Bird's Head region of Papua is certainly no exception; many of the economic development plans currently being considered throughout Papua are heavily focused on exploitation of natural resources through forestry, mining, commercial fishing, and oil and gas extraction.

Unfortunately, these decisions rarely are based upon a complete cost-benefit analysis that takes into account the "ecosystem services" that are lost or diminished after resource exploitation begins. For instance, though cutting down a forest can produce large revenues for villagers and government alike through sale of the timber, it is important to note that this forest will no longer provide the services it once did such as provision of rainwater for drinking, protection from erosion and landslides, and production of non-timber forest products like honey or fruits or nuts that may be very important to local villagers.

Additionally, governmental decisions to promote large-scale investments in natural resource exploitation sectors often overlook the potential impacts these may have on current livelihoods of local villagers. For example, a national policy to promote intensive commercial fisheries in an area may have a severe negative impact on local artisanal fishers when fish stocks are quickly depleted and they can no longer feed their families. Similarly, a mining concession in an area may provide large revenues to the government, but if it also pollutes the water so severely that local people can no longer fish, it may overall be more costly than beneficial.

Objective

The objective of this study is to provide governmental decision-makers in the Bird's Head with a much more complete understanding of the current economic values of the natural resources in their regencies and the role they play in supporting the livelihoods of local villagers. Once this full picture of the current economic situation in an area is obtained, decision-makers can make a more accurate cost-benefit analysis when considering possible new large-scale investments in natural resource exploitation sectors.

Methods

This study will be conducted in the first year of the EBM initiative in order to quickly provide governmental decision-makers with the data they need to make more informed decisions on natural resource use policy. It will utilize current state-of-the-art natural resource valuation methods, as well as intensive field surveys in select villages to gain a comprehensive understanding of the current livelihoods of local villagers and how dependent these are on intact and healthy ecosystems such as productive coral reefs and coastal forests. These data will be provided to governments throughout the Bird's Head, and will also be used in the overall EBM synthesis model that tests best scenarios for sustainable development in the Bird's Head.

Photo © Mark V. Erdmann

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FACTSHEET

Raja Ampat Sustainable Development Options Study

Introduction

A primary concern of each of the kabupaten governments in the Bird's Head Seascape is to plan the best course for sustainable economic development in their kabupaten – one which maximizes governmental revenues (PAD) while ensuring the long-term welfare of the local people living within their borders. Indeed, the primary objective of increasing governmental revenues is to enable local governments to provide more efficient and effective services for their constituents and generally improve their lives.

Unfortunately, many economic development decisions are made with a very strong focus on increasing local governmental revenues, without consideration of the much broader and more important goal of improving the welfare of the local people the government serves. For instance, governments may eagerly pursue the development of a mining concession in their area based upon projected revenues to be generated, without fully taking into account the broader impact on their constituents' livelihoods. If the development of such a mining concession provides not only government revenue but also significant local employment and other development benefits and has environmental safeguards to prevent contamination of drinking water supplies and fisheries, then it might be a very good development option for a local government. However, if the mine employs mostly outside labor and severely contaminates local drinking water supplies and destroys important fisheries, then it cannot be considered a truly sustainable development option. Government decision-makers must very carefully take into account the full impact of a particular development option on local people's livelihoods before enthusiastically approving it based only on large projected revenues.

Objective

The primary objective of this study is to provide local governments within the Bird's Head Seascape with a full range of sustainable economic development options that explicitly take into account the economic, environmental, and social implications of each development option. The results of this study should prove invaluable to local decision-makers who are aiming to improve the welfare of their constituents, and will also be used in the overall synthesis model that is being developed to evaluate the most optimal ecosystem-based management framework for the Bird's Head.

Photo © Mark V. Erdmann

Methods

This study will draw heavily from the results of the related study that is conducting a valuation of the natural resources and environmental services in the Bird's Head and assessing the degree to which local people currently rely on natural resources for their livelihoods. The study will be led by one of the top environmental economics researchers in the world, and will use cutting edge modeling techniques to provide local governments with a range of development options that maximize the long-term welfare of the people living within the Bird's Head and the sustainable use of the rich coastal and marine resources included within the Seascape.

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FACTSHEET

Development of a marine ecosystem model of the western part of the Bird's Head Seascape (Raja Ampat)

Ecosystem modeling and ecosystem-based management

Ecosystem-based management (EBM) is a management regime that takes into account interactions among the living organisms, the physical and biotic environment, and the human actors in an ecosystem. The Bird's Head research program aims to provide the scientific basis for EBM by constructing a holistic simulation model of the coastal and marine ecosystems in the Bird's Head Seascape. With this model, consequences of management interventions on all major components of the ecosystem can be simulated. Ecosystem modeling is one way to integrate knowledge on various components of the ecosystem – modeling is a very explicit way to ensure that results from individual studies contribute to a better understanding of the entire ecosystem, including the human component.

This 2-year postdoctoral study will draw upon the results of other studies constituting the EBM Bird's Head research program to develop a spatially-explicit ecosystem model of Raja Ampat and the surrounding Seascape that will then be used to elucidate the consequences of a range of management scenarios for the Seascape. These simulations will be shared with regency policymakers to obtain valuable feedback that will be used to draft a strategic management plan for the Seascape.

This study is implemented by the University of British Columbia's Fisheries Centre, in close cooperation with Conservation International, The Nature Conservancy and WWF-Indonesia.

Modeling methodology

Whole-ecosystem modeling will be performed using the Ecopath-with-Ecosim (EwE) technique. This type of modeling is a compromise between the oceanographic and ecological realism of highly complex biogeochemical models and the practical need to quickly evaluate outcomes of management scenarios. By parameterizing operating costs, prices and profits, employment characteristics of the fisheries and exploited organisms in the ecosystem, and by restricting fisheries access to certain areas and functional groups, scenarios can explore a range of ecosystem-based management objectives that relate to both people and fish. A search interface enables us to explore scenarios towards objectives that relate to risk of local extinction, socio-economics (profit or jobs), or mixture of the above. The spatial version of EwE (Ecospace) will be used to explore the costs and benefits of connected networks of MPAS.

EwE models are not the most complex that can be devised for this task, but they are the only ecosystem models that can be progressively improved from simple, approximate forms to versions that better approximate reality. While far from universally accepted, EwE modeling has recently received a wide support from the researchers. This study is an opportunity to further test this cutting-edge methodology in a management context.

Coastal communities depend on the complex near-shore ecosystems for their livelihoods. In the ecosystem model that will be developed during this study, man-nature interactions are explicitly included. Photo by Andreas Muljadi, TNC SEACMPA

Early in the project, preliminary ecosystem models will be constructed using information from the literature, from databases and diet records, and form nearby tropical marine ecosystems. Later in the project, field sampling will enrich the model structure and improve parameter values. For example, sampling led by biodiversity concerns understandably tends to focus on large charismatic organisms, but often the principle model uncertainty, critical for the credibility of management scenarios, lies in small forage fish, euphausiids (Crustaceans that live in the water column) or jellies that drive important linkages across the ecosystem.

Implications for management, dissemination of results

Dealing in practical fashion with the perceptions of fishers and the flexibility and willingness of institutions to receive ecosystem–based advice will be essential to engender support from local constituencies for EBM regulations. Shaping the explored model scenarios and MPA designs to what is feasible in the Bird's Head Seascape a critical task for the project. A final workshop to produce a draft strategic ecosystem-based management plan for the Seascape will be held to integrate inputs from scientists, local government agencies and local communities.

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