

# Channel Islands National Marine Sanctuary

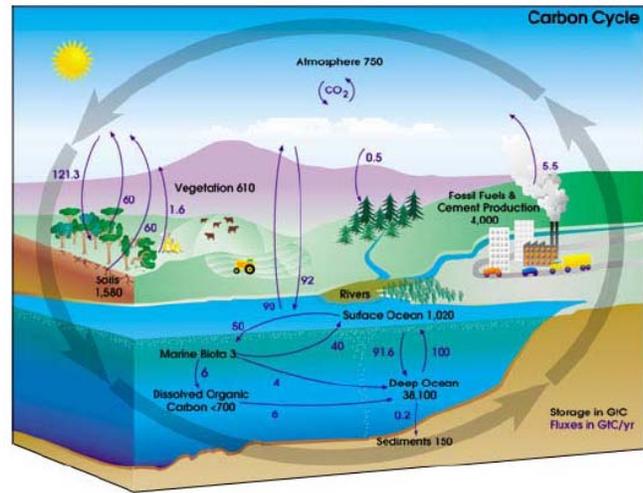
## Climate Change

### Management Issue

To effectively manage the Channel Islands National Marine Sanctuary (CINMS or Sanctuary), it will be important to understand the extent to which climate change affects resources, and be able to differentiate between those effects and those caused by activities that can be managed in a more immediate way.

### Description

The Channel Islands sanctuary will certainly manifest the consequences of global climate change. The Channel Islands are at a transition zone between cold northern currents and warm southern currents. Geographic position and variability in this transition are important drivers of community structure and changes in that boundary driven by large-scale climate alteration can be expected to have correlated large impacts in the marine community. Community-level changes may occur as a result of habitat changes and shifts in species ranges; the Channel Islands are a northern and southern range limit for many species. In addition, many local species have multiple, different habitat requirements within their life-histories making access to the diversity of conditions seen in the Sanctuary a critical component of ecosystem health. Upwelling variability is an important driver of zooplankton productivity and food web integrity on the scale of the California Current (Barth et al., 2007). Changes in upwelling driven by climatic alteration, such as changes in jet stream intensity and trajectory (Archer and Caldiera 2008), can therefore, be expected to have a direct impact on ecosystem health in the Channel Islands Sanctuary. Other possible threats from climate change include changes in ocean chemistry and sea level rise. These impacts are expected to be intense and wide-spread – particularly at the bottom of the food web where trophic process is so tightly coupled to environmental chemistry (Hays et al. 2005; Fabry et al 2008).



Concept Carbon Cycle – numbers are global estimate in Gigatons for storage and Gigatons/year for exchange rates (from NASA Earth Science Enterprise)

To effectively manage the sanctuary, it will be important to understand the extent to which climate change affects resources. First, a carbon budget of the sanctuary is needed to characterize the human carbon inputs to the sanctuary. Furthermore, a study of species and their ranges, along with a modeling effort, could present scenarios of changes that may occur as a result of climate change. This effort could also lead to the identification of indicator species that are relatively easy to sample and could provide early indications of climate shifts.

### Questions and Information Needs

- 1) What are the human carbon inputs to the Sanctuary?
- 2) What is the net carbon budget for the Sanctuary?
- 3) How will resources of the sanctuary be affected by climate change?
- 4) What is the spatial extent of the aragonite solubility surface and how is that changing?
- 5) How would sea level change affect Sanctuary resources?
- 6) How will changes in ocean chemistry affect resources?
- 7) What results will global climate change have throughout biological communities?

### Scientific Approach and Actions

- Systematic monitoring survey of marine chemistry across the Sanctuary to determine the spatial distribution of the aragonite solubility surface

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For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>

- Analysis of carbon flux – net inputs and sinks
- Mathematical modeling of mass flux (water, solutes, carbon, etc) through CINMS
- Analysis of species ranges, potential sea level change, and trophic relationships
- Analysis of potential effects of ocean chemistry changes
- Establishment of sentinel sites

### **Key Partners and Information Sources**

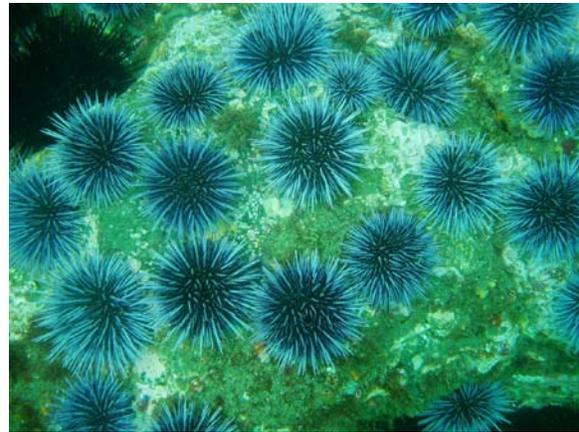
UC Santa Barbara, National Center for Ecological Analysis and Synthesis, National Center for Coastal Ocean Science, National Weather Service, National Marine Fisheries Service, National Aeronautic and Space Administration

### **Management Support Products**

- A carbon budget of the Sanctuary is needed to characterize the human carbon inputs to the Sanctuary. This will eventually be part of a larger project to estimate a net carbon budget for the Sanctuary system.
- A study of species and their ranges, along with a modeling effort, that can present scenarios of changes that may occur as a result of climate change. This effort could also lead to the identification of indicator species that are relatively easy to sample and could provide early indications of climate shifts.

### **Planned Use of Products and Actions**

- Adaptive management of resources likely to be affected by climate change
- Monitoring programs for indicator species
- Inform more environmentally responsible recreational, commercial, and research use of Sanctuary resources



### **Program References**

#### CINMS Management Plan

- Management Plan Conservation Science Action Plan CS.3, Resource Protection Action Plan RP.2.

#### CINMS Condition Report

- Are specific or multiple stressors, including changing oceanographic and atmospheric conditions, affecting water quality?
- What is the abundance and distribution of major habitat types and how is it changing?
- What is the condition or health of key species and how is it changing?

#### ONMS Performance Measures

1. Number of sites in which water quality, based on long-term monitoring data, is being maintained or improved.
2. Number of sites in which habitat, based on long-term monitoring data, is being maintained or improved.]
3. Number of sites in which select living marine resources, based on long-term monitoring data, are being maintained or improved.

#### Other Documents

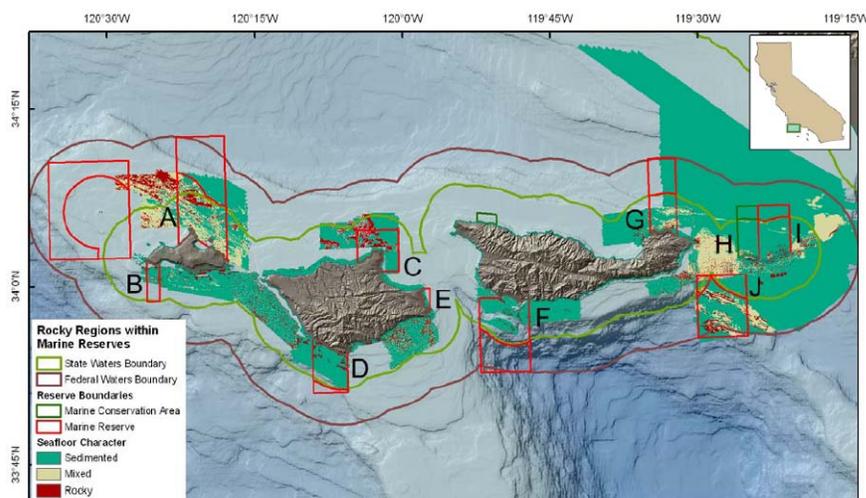
- 2008 Blue Seas Green Communities Advisory Council Challenge.
- Sanctuary Advisory Council Report (Ocean Acidification and the Channel Islands National Marine Sanctuary: Cause, effect, and response)  
[http://www.channelislands.noaa.gov/sac/pdf/CWG\\_OAR\\_final.pdf](http://www.channelislands.noaa.gov/sac/pdf/CWG_OAR_final.pdf)

*Updated: 5/26/2010*

*For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>*

# Channel Islands National Marine Sanctuary

## Habitat Characterization



CINMS Habitat Map. Map Credit: Guy Cochrane USGS.

### Management Issue

Limited baseline information on habitat extent and distribution reduces the ability of Channel Islands National Marine Sanctuary (CINMS or Sanctuary) to understand resources and recognize or respond to existing and emerging pressures and threats to Sanctuary resources.

### Description

Large portions of the Sanctuary are not characterized with regard to habitat type; only 30% of the Sanctuary is even mapped. Reliable habitat maps require state-of-the-art surveys using multi-beam, side-scan, and sub-bottom profiling; LIDAR or other technologies for depths less than 6 meters; habitat classification analysis; and habitat verification using ROVs, AUVs, and submersibles. Knowing the different habitat types, and their coverage and distribution, is crucial for effective resource management, for meeting the National Marine Sanctuary Act requirement to characterize sanctuaries, and for identifying the CINMS research and monitoring needs. In addition, as revealed in a survey of methodologies undertaken to validate the CINMS condition report, there are no decision support tools at hand to consistently translate scientific habitat characterization into overall assessments of habitat condition for managers.

### Questions and Information Needs

- 1) What are the habitat types and their distributions in the Sanctuary?
- 2) Where is rocky reef habitat, soft bottom habitat, kelp, and eelgrass?
- 3) How is habitat changing over time?
- 4) How is habitat changing inside versus outside reserves?

### Scientific Approach and Actions

- Surveys using multi-beam, side-scan, and sub-bottom profiling
- Surveys using LIDAR or other technologies for depths less than 6 meters
- Analysis for habitat classification
- Verification of habitat using using ROVs, AUVs, and submersibles
- Analysis of animal/habitat associations

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For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>

## **Key Partners and Information Sources**

US Geologic Survey, UC Santa Barbara, California Department of Fish and Game, Marine Applied Research and Exploration, Channel Islands National Park, Northwest Fisheries Science Center-NMFS



Golden Gorgonian coral on typical rocky reef habitat in CINMS. Photo Robert Schwemmer/NOAA

## **Management Support Products**

- Maps of habitat types
- Reports on distribution of habitat and changes over time

## **Planned Use of Products and Actions**

- Better management of sensitive habitat areas
- Informed selection of research and monitoring sites
- Informed response to vessel groundings and other emergencies

## **Program References**

### CINMS Management Plan

- Management Plan Conservation Science Action Plan CS.3

### CINMS Condition Report

- What is the abundance and distribution of major habitat types and how is it changing?
- What is the condition of biologically-structured habitats and how is it changing?
- What are the levels of human activities that may influence habitat quality and how are they changing?

### ONMS Performance Measures

- Number of sites in which habitat, based on long-term monitoring data, is being maintained or improve
- Percentage of the Sanctuary System that is adequately characterized.

*Updated: 5/26/2010*

*For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>*

# Channel Islands National Marine Sanctuary

## Protected Species

### Management Issue

Certain species found in the Channel Islands National Marine Sanctuary (CINMS or Sanctuary) are protected under laws in addition to the National Marine Sanctuaries Act. Mandates in these laws call for enhanced protection, restoration and recovery efforts from multiple agencies. These efforts need to be coordinated, prioritized and have their effectiveness verified.

### Description

In accordance with the NMSA and federal wildlife conservation laws such as the Endangered Species Act, Marine Mammal Protection Act, and Migratory Bird Treaty Act, the CINMS assists in determining the status and trends of protected species within the Sanctuary, and in population recovery efforts. While this status and trends monitoring is important, there is less coordinated effectiveness monitoring of the collection of restoration actions within the Sanctuary. The CINMS is currently assisting with a variety of studies initiated by partners addressing large cetaceans, white abalone, and several seabirds (Cassin's auklet, Xantus's murrelet, Ashy Storm-petrels). A collaborative needs assessment should be conducted with a focus on developing a prioritized list of studies and restoration activities needed within Sanctuary waters.



Nesting Xantus's murrelet (*Synthliboramphus hypoleucus*) Photo Credit: Darrell Whitworth

### Questions and Information Needs

- 1) What is the abundance, distribution, and status of populations of seabirds, marine mammals, and other endangered or sensitive species in the sanctuary?
- 2) What threats, natural and anthropogenic, do these species face?
- 3) Could restoration activities help recovery of these species?
- 4) What restoration activities would be most effective?
- 5) What restoration projects have been deployed in the sanctuary in the last 15 years? And which are most effective?
- 6) How are patterns of habitat use by large whales related to patterns of primary and secondary productivity?
- 7) Are there predictive relationships that relate monitored water conditions to whale distribution on a scale that can mitigate whale ship interactions?
- 8) How does the acoustic environment affect whale behavior and ecology?

### Scientific Approach and Actions

- Seek long term stability for monitoring of seabird habitats
- Field surveys for seabirds and marine mammals
- SCUBA surveys for sensitive marine species such as abalone
- Pilot restoration efforts such as enhanced nesting habitat
- Inventory restoration actions
- Analyze potential restoration activities such as predator removal and native vegetation enhancement
- Perform effectiveness monitoring of management actions to reduce large whale mortality with ongoing research on Blue Whale movement within the CINMS
- Coordinate with physical oceanography and remote sense research programs at the University of California Santa Barbara (UCSB)
- Analysis spatial and temporal data on whale locations and behavior with physical conditions to understand factors that influence distribution

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For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>

## Key Partners and Information Sources

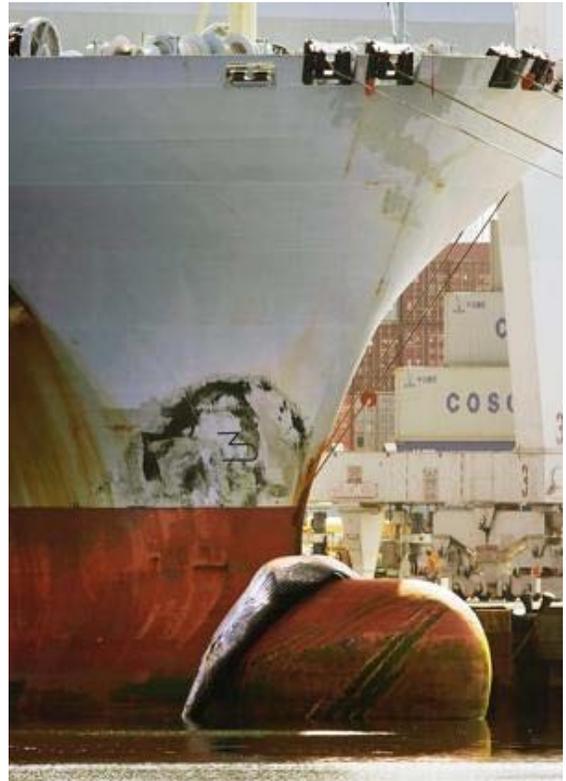
Channel Islands National Park, California Institute of Environmental Studies, Carter Biological Consulting, US Geologic Survey, UC Santa Barbara, National Marine Fisheries Service, UC San Diego, White Abalone Recovery Team, Cascadia Research Group, US Fish and Wildlife Service

## Management Support Products

- Data and reports on populations status and trends of selected species
- Maps of suitable habitat and targeted areas for restoration
- Cost/benefit analysis of restoration efforts
- Data on factors that influence distribution of whales
- A predictive model for whale distribution

## Planned Use of Products and Actions

- Inform stakeholders of species' status
- Focus research and resource protection efforts on critical habitats, sites, and species
- Incorporate information into adaptive management
- Collaborate with partners on restoration activities and recovery planning
- Coordinate management response with Coast Guard, potentially request Notice to Mariners for cargo ships to slow down in Santa Barbara Channel
- Educate the public about the threats to whales from large vessels
- Inform long term management planning for large whales in the sanctuary



Fin whale on the bow of a ship in Long Beach harbor. Photo: Long Beach Press-Telegram

## Program References

### CINMS Management Plan

- Management Plan Conservation Science Action Plan CS.3

### CINMS Condition Report

- What is the status of key species and how is it changing?
- What is the condition or health of key species and how is it changing?
- What are the levels of human activities that may influence living resource quality and how are they changing?

### ONMS Performance Measures

- Number of sites in which living marine resources, based on long-term monitoring data, are being maintained or improved

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*For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>*

# Channel Islands National Marine Sanctuary

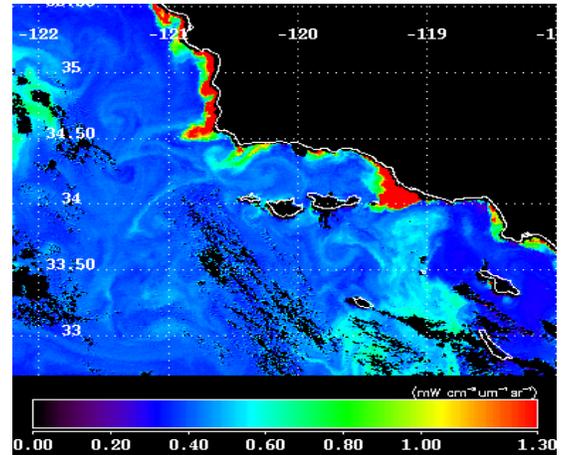
## Water Quality

### Management Issue

Critical to effective management of resources of the Channel Islands National Marine Sanctuary (CINMS or Sanctuary) is information of the status and trends of the water quality in and around the Sanctuary. To provide this information, an integrated water quality monitoring plan needs to be implemented.

### Description

Although some water quality monitoring has occurred in the Sanctuary, an integrated monitoring plan has not been implemented. Finalization of the water quality characterization assessment, continued support of the Southern California Coastal Water Research Project (SCCWRP) Southern California Bight comprehensive water and sediment quality monitoring studies, and installation of a flow-through water sampling system aboard R/V *Shearwater*, are part of the developing plan. However, to fully understand water quality in the sanctuary additional, coordinated sampling within the sanctuary is needed.



*Sediment plumes from mainland sources can reach the sanctuary. Image credit: <http://www.icess.ucsb.edu>*

### Questions and Information Needs

- 1) What are the status and trends of water quality in the Sanctuary?
- 2) What are the sources and levels of eutrophication and how are they changing?
- 3) What toxins, contaminants, pollutants, particulates are present?
- 4) Do Sanctuary waters pose human health risks?
- 5) How do vessel discharges affect water quality in the Sanctuary?
- 6) How persistent are legacy toxins (e.g., DDT) in the Sanctuary?
- 7) What are the levels and sources of these contaminants?
- 8) Are Harmful Algal Blooms occurring in the Sanctuary?

### Scientific Approach and Actions

- Working with water quality experts, establish sampling regime to measure contaminants
- Analyze data from R/V *Shearwater*'s SeaKeepers shipboard sensors
- Install in-situ water sampling equipment on moorings
- Conduct bacterial sampling
- Build field component to extend Bight monitoring program
- Coordinate with and use data from sentinel mussel watch program
- Investigate sources (such as concentrations of marine mammals) and effects (such as changes in algal communities) of eutrophication at the islands
- Assess status and trends of water quality indices

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For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>

## Key Partners and Information Sources

UC Santa Barbara, Santa Barbara ChannelKeeper, SCCWRP, Dept. of Fisheries and Ocean Canada, NASA, University of Georgia, Channel Islands National Park, local and state water quality control boards

## Management Support Products

- Reports on water quality status and trends in and around the sanctuary
- Identification of potential mitigation actions

## Planned Use of Products and Actions

- Identify potential threats to water quality
- Inform stakeholder communities of findings
- Work with appropriate partners to develop mitigation policies or regulations

## Program References

### CINMS Management Plan

- Management Plan Action Plan WQ.1

### CINMS Condition Report

- Are specific or multiple stressors, including changing oceanographic and atmospheric conditions, affecting water quality?
- What is the eutrophic condition of sanctuary waters and how is it changing?
- Do sanctuary waters pose risks to human health?
- What are the levels of human activities that may influence water quality and how are they changing?

### ONMS Performance Measures

- Number of sites in which water quality, based on long-term monitoring data, is being maintained or improved



*Cargo Ship in the Channel Islands National Marine Sanctuary. Photo credit: CINMS*

*Updated: 5/26/2010*

*For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>*

# Channel Islands National Marine Sanctuary

## Marine Zoning Monitoring

### Management Issue

Gaps in current monitoring programs for shallow subtidal marine reserves in the Channel Islands National marine Sanctuary (CINMS or Sanctuary) reduce the ability to fully evaluate reserve effectiveness.

### Description

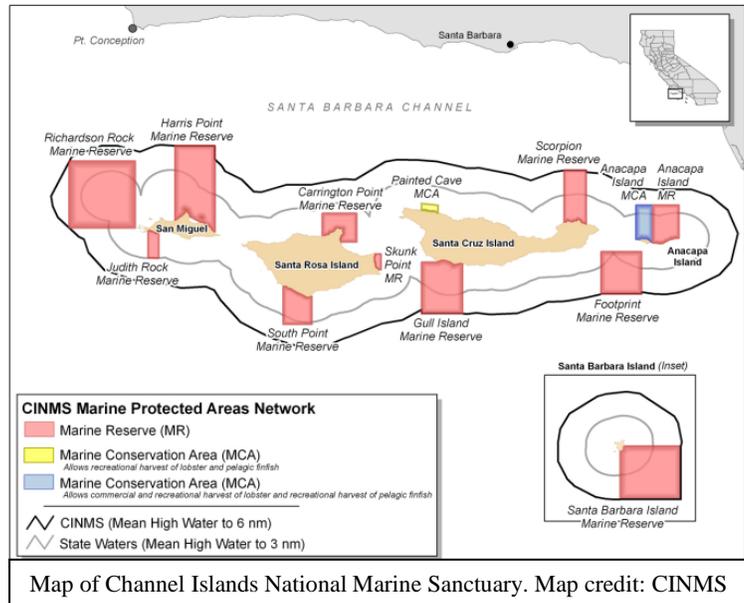
Marine reserves were implemented at the Channel Islands in 2003. Since then, numerous agents have conducted diverse monitoring. Reserve effectiveness is defined as restoring and/or protecting portions of the ecosystem that are perceived to require such protection given a history of human impact and perturbation away from historic condition. It is anticipated that fully effective reserves will improve conditions in immediately adjacent areas as a consequence of spatially heterogeneous mortality and density-dependant movement of individuals. However, not all habitats, communities, and species are monitored, and not all sites in the

sanctuary are monitored equally, which reduces the ability to understand, evaluate, and manage the resource. For example, species that are not observed on SCUBA surveys, such as rare, cryptic, or nocturnal species, and soft-bottom habitats, are not regularly monitored. In addition, research that analyses the ecosystem in a synthetic manner is underrepresented – for example there is no coordinated monitoring of animal movement. Some additional monitoring effort is needed to fill in these gaps – particularly spatial coverage across the sanctuary. Most importantly, there is no systematic monitoring of indicators of ecosystem health – manifest in diversity, stability, integrity of food webs and resilience in the face of perturbations such as fishing pressure and climate variability.

However, more important than additional monitoring is the need for significant synthesis of available monitoring data. In reviewing the information sources used to compile the 2008 SWIM condition report for CINMS, it was revealed that local experts relied extensively on raw data holdings and much less so on published papers and reports. This suggests that the monitoring that is done is not being assembled, synthesized and communicated as well as it might. Therefore, a large science need in the CINMS is more synthesis and communication of available monitoring into the scientific literature.

### Questions and Information Needs

- 1) Are there changes in abundance, diversity, biomass, or spawning biomass for species before and after the implementation of marine reserves given that species are within reserves?
- 2) What are the reserve effects on rare, cryptic, or nocturnal species?
- 3) What is the effectiveness of the reserves at restoring systems to more historical states – i.e. are once plentiful, but recently rare species returning and taking up their historical roles in the food web?
- 4) What are the reserve effects on soft bottom habitats?
- 5) What are indicators of ecosystem health?
- 6) How do reserves alter ecosystem function – where ecosystem function is described as: diversity, stability, integrity of food web and resilience of the community to perturbation?
- 7) What are the rates of animal movement across MPA boundaries – either as adults or juveniles?



Updated: 5/26/2010

For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>

## Scientific Approach and Actions

- Trapping (physical, video and acoustic “traps”) projects to capture species not observed on SCUBA surveys
- Soft sediment sampling, including regular eelgrass surveys
- Establish sites where there are spatial gaps in monitoring
- Evaluate rates of animal movement to incorporate into model of export process
- Support projects that study the effects of reserves on ecosystem function

## Key Partners and Information Sources

UC Santa Barbara, Channel Islands National Park, Partnership for Interdisciplinary Studies of Coastal Oceans, California Department of Fish and Game, collaborative partnerships with fishers

## Management Support Products

- Data, graphics, reports, & maps for a comprehensive list of species
- Species and habitat data from sites where information is lacking
- Reports on the effects of reserves on ecosystem function



A diver records fish during a survey. Photo Jessie Altstatt

## Planned Use of Products and Actions

- Refine monitoring protocols
- Produce protocols to monitor indicators of ecosystem function
- Incorporate results into adaptive management of marine reserves
- Focus resource protection efforts on sensitive habitats and species

## Program References

### CINMS Management Plan

- Management Plan Conservation Science Action Plan CS.3

### CINMS Condition Report

- What is the status of biodiversity and how is it changing?
- What is the status of environmentally sustainable fishing and how is it changing?
- What is the status of non-indigenous species and how is it changing?
- What is the status of key species and how is it changing?
- What is the condition or health of key species and how is it changing?
- What are the levels of human activities that may influence living resource quality and how are they changing?

### ONMS Performance Measures

- Number of sites in which habitat, based on long-term monitoring data, is being maintained or improved

*Updated: 5/26/2010*

*For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>*

# Channel Islands National Marine Sanctuary

## Deep Water Monitoring

### Management Issue

Deep water habitats in the Channel Islands National Marine Sanctuary (CINMS or Sanctuary) are poorly understood and monitored, affecting our ability to fully evaluate diverse management action effectiveness.

### Description

Over 91.5% of the CINMS is deeper than 100 feet in depth – or inaccessible to scientists diving on SCUBA equipment on a regular basis – and is thus much more expensive to monitor. Therefore, much more than 90% of what we know about the marine environment in CINMS comes from less than 10% of the site. In spring 2004 a framework for a deep water monitoring plan for the sanctuary was developed and in 2008 a proposal outline for monitoring was created. However, a monitoring plan has not been fully developed and implemented. Effort is needed to both finalize the plan and to implement the monitoring. In addition, federal reserves were established in 2007 and the majority of state reserves



*Cowcod observed in deep water by the Delta Submersible. Photo credit: NMFS/UCSB*

established in 2003 contain large portions of the deep water habitat that need to be monitored to evaluate the effectiveness of these zoning actions. Current knowledge gaps exist on both the conceptual and technical sides of the research, monitoring and evaluation problem. Conceptual gaps include an incomplete knowledge of deep water ecosystem dynamics sufficient to limit our ability to correctly target indicators of effectiveness of management actions –including MPA establishment. For example, the deep water monitoring framework from 2004 has a list of species of interest, but it is unclear what role these species play in the deep water community to suggest that knowledge of their population or stock status would be an indicator of ecosystem health. On the technical side of the problem, all of the available tools for working in deep water (ROV's, AUV's, towed instruments, submarines, deep diving technology, etc.) are potentially expensive. However, there is still no concise and comprehensive guidance on the relative cost per data point from these separate technologies operating in the diversity of deep water habitats existing in the sanctuary. The lack of such guidance prohibits the development of an effective monitoring program that would provide answers to the conceptual questions with the greatest economy. As a first step, compilations of existing data, as well as baseline assessments involving ROVs, AUVs, and submersibles, should be initiated. Then a comparative review of all available technologies should be performed. Finally, a broad study needs to be deployed to assay some framework elements of ecosystem dynamics in the deep waters around CINMS. With these tools in hand a successful and economical deep water research, monitoring and evaluation program can be deployed.

### Questions and Information Needs

- 1) What habitats, species, and communities exist in deep water areas of the Sanctuary?
- 2) What are the major sources of carbon in the deep water communities?
- 3) Do the deep water communities demonstrate a parallel range of diversity to the shallow water communities going from the far east to the far west of the Sanctuary?
- 4) How complex and diverse is the food web of the deep water communities (how hard will it be to assay the health of the food web for a given complexity)?
- 5) Are there changes in abundance, diversity, biomass, and spawning biomass in reserves compared to outside reserves?
- 6) What are the distributions, status and health of deep water habitat types, including biologically structured habitats, and how are they changing?
- 7) Are specific or multiple stressors, including changing oceanographic and atmospheric conditions affecting water quality, habitat status or ecosystem health?
- 8) What is the status of extracted species, how is it changing and how is extraction affecting the health of sanctuary resources?

*Updated: 5/26/2010*

*For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>*

## Scientific Approach and Actions

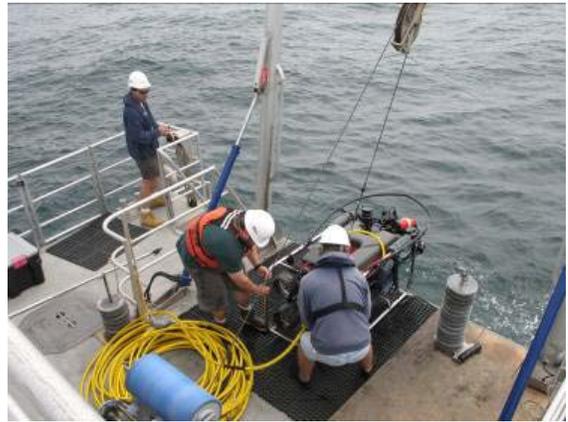
- Review all existing data and history of monitoring of deep water habitats in the Sanctuary
- Maintain surveys using ROVs, AUVs, towed instruments, gliders, acoustics and submersibles
- Review performance and capabilities (including cost) of available technologies for deep water monitoring
- Establishment of sites to be monitored annually.
- Establish the connectedness of deep water communities with shallow water communities
- Synthesize model food web for the deep water community and develop model of net carbon flux in the deep water

## Key Partners and Information Sources

UC Santa Barbara, Marine Applied Research and Exploration, California Department of Fish and Game, National Marine Fisheries Service, UC Santa Barbara Dr. Milton Love, Minerals Management Service, Monterey Bay Aquarium Research Institute, Ocean Protection Council & MPA Monitoring Enterprise

## Management Support Products

- Products including data, graphics, and maps illustrating the state of species, populations, and communities in deepwater habitat.
- Measures of connectedness between shallow and deep water communities that can inform predictions of management action consequences across boundaries.



*ROVs are used to access areas below SCUBA-diver depths. Photo credit: CDFG*

## Planned Use of Products and Actions

- Test and refine deep water monitoring protocols
- Improve decision making for management in deep water
- Incorporate results into adaptive management of reserves
- Create and update resource inventory for deep water habitat
- Focus research and resource protection efforts on sensitive habitats and species

## Program References

### CINMS Management Plan

- Management Plan Conservation Science Action Plan CS.3, CS. 6

### CINMS Condition Report

- What is the status of biodiversity and how is it changing?
- What is the status of environmentally sustainable fishing and how is it changing?
- What is the status of non-indigenous species and how is it changing?
- What is the status of key species and how is it changing?
- What is the condition or health of key species and how is it changing?
- What are the levels of human activities that may influence living resource quality and how are they changing?

### ONMS Performance Measures

- Number of sites in which habitat, based on long-term monitoring data, is being maintained or improved
- Number of sites in which living marine resources, based on long-term monitoring data, are being maintained or improved

*Updated: 5/26/2010*

*For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>*

# Channel Islands National Marine Sanctuary

## Invasive Species

### Management Issue

Invasive species in the sanctuary need to be tracked, monitored, and studied so that impacts to resources can be assessed and potential management actions, such as eradication, can be evaluated.

### Description

The CINMS location near a major metropolitan area adjacent to commercial shipping lanes, and the fact that it is frequented by commercial and recreational boaters makes it vulnerable to introduced marine invasive species. Invasive species have the potential to degrade habitat, outcompete native species, and disrupt ecosystem processes. Protection of sanctuary resources requires the sanctuary to be vigilant for invasive species so that they can be discovered when present, monitored, and studied so informed management decisions regarding control and mitigation can be made.



Juvenile *Sargassum horneri*. Photo by Jack Engle.

The sanctuary needs a plan to address invasive species in general, and has information needs for a recent arrival in particular. Specifically, *Sargassum horneri*, a non-native alga, was discovered in CINMS in fall 2009, and there are multiple information needs to guide appropriate management responses. In addition, the brown alga *Undaria pinnatifida* is currently found in mainland harbors and is a potential colonizer in CINMS.

### Questions and Information Needs

- 1) Questions regarding *Sargassum horneri*:
  - a. What is the spatial extent and density?
  - b. What is the best way to monitor the spread of species?
  - c. What is the rate of spread?
  - d. What are the habitat requirements or limitations?
  - e. What are the current or potential ecosystem effects?
- 2) What is the likelihood of *Undaria pinnatifida* arriving at CINMS and what are the habitat requirements and potential effects?
- 3) What are effective ways to receive information and communicate information among various groups (researchers, visitors, public)?
- 4) Recommendations and a plan are needed for an “early warning system” and action plan for future occurrences of invasive species.

### Scientific Approach and Actions

- SCUBA surveys for *Sargassum horneri*
- Mapping extent and spread
- Studies for ecosystem effects
- Evaluation of mitigation or restoration actions
- Development of action plan and communication plan

Updated: 5/26/2010

For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>

## Key Partners and Information Sources

Channel Islands National Park, UC Santa Barbara, recreational dive groups

## Management Support Products

- Data and reports on extent, rate of spread, and ecosystem effects of invasive algae
- Cost/benefit analysis of restoration efforts
- Action plan for identifying, tracking, and management analysis

## Planned Use of Products and Actions

- Evaluation of habitat and resource quality
- Focus research and resource protection efforts on potentially altered ecosystem
- Incorporate information into adaptive management
- Collaborate with partners on research and monitoring activities

## Program References

### CINMS Management Plan

- Management Plan Resource Protection Action Plan RP.1, RP.2

### CINMS Condition Report

- What is the condition of biologically-structured habitats and how is it changing?
- What is the status of non-indigenous species and how is it changing?
- What is the status of key species and how is it changing?
- What is the condition or health of key species and how is it changing?

### ONMS Performance Measures

- Number of sites in which living marine resources, based on long-term monitoring data, are being maintained or improved
- Number of sites in which habitat, based on long-term monitoring data, is being maintained or improved



*Undaria pinnatifida*. Photo credit SIMoN/MBNMS.

Updated: 5/26/2010

For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>

# Channel Islands National Marine Sanctuary

## Human Dimensions

### Management Issue

The human dimensions of the CINMS need to be monitored and the status and trends of marine resources that support and/or are impacted by human use need to be documented.

### Description

The sanctuary site is a public common, managed for multiple uses and for multiple stakeholder interests. The public money spent in the establishment and maintenance of the sanctuary site demands some accountability to address questions of status and trends of key marine resources that support and are impacted by human uses – both extractive and non-extractive. For example, marine reserves have had clear negative impacts on non-commercial, consumptive users of the sanctuary; it is important to be able to document and communicate how people are affected by the implementation of marine reserves. In addition to studying the economic effects on commercial and recreational fishers, a complimentary effort is needed to assess people's knowledge and perceptions of the reserves and their efficacy among recreational anglers and the businesses (e.g. charter and fishing supply) that cater to these anglers. Beyond this clear service to commercial interests, it is also important to establish how these extractive goods and services have been balanced and in some case traded for non-extractive goods and services.



Many recreational boaters and commercial fishers home port in Santa Barbara in between visits to the sanctuary.  
Photo credit: CINMS

### Questions and Information Needs

- 1) To what extent is the public aware of the trade-offs between consumptive and non-consumptive goods and services that *de facto* value those goods and services?
- 2) How well, if at all are members of the local and regional community able to distinguish the actual differences between the Sanctuary and zonal management actions (such as no-take reserves) within the sanctuary?
- 3) How, if at all, are the knowledge, attitudes and perceptions of the sanctuary users changing over time and in response to diverse management actions?
- 4) Do non-consumptive users of the marine environment benefit from no-take reserves established in April 2003 and federal reserves established in 2007?
- 5) If fishing effort is displaced to areas outside of reserves, how is it affecting the overall level of anthropogenic disturbance in the Sanctuary?

### Scientific Approach and Actions

- Data collection on spatial use patterns, expenditures, knowledge, attitudes and perceptions of non-consumptive users, using peer-reviewed survey instruments
- Conduct SAMSAP overflights
- Develop monitoring of large ship traffic using AIS and acoustics
- Analysis of recreational fishing effort and catch using existing data (using Cal Rec Fishing Survey data – CRFS)
- Analysis of commercial fishing effort and catch using existing data (using California Department of Fish and Game (CDFG) and National Marine Fisheries Service (NMFS) logbook and landings data)
- Methods and instruments for collection of data on perceptions and attitudes of recreational fishers

Updated: 5/26/2010

For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>

## Key Partners and Information Sources

CDFG, NMFS, Recreational fishing associations, CINMS naturalist Corps Volunteers, the University of California at Los Angeles (UCLA), and the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO)

## Management Support Products

- Custom ArcView program: Oceanmap
- Internet-based anchorage and boating survey ([www.oceanstudy.net](http://www.oceanstudy.net))
- Postcard and KAP (knowledge, attitudes and perceptions) survey instruments
- CINMS aerial flyover (SAMSAP) data



Sailboats at a Prisoners Harbor at Santa Cruz Island. Photo CINMS.

## Planned Use of Products and Actions

- Manage human activities in the Sanctuary at an appropriate spatial scale for the activity mode
- Account for human values and direct financial impacts of expenditures by Sanctuary users
- Test maximum potential economic impact estimates prior to designation of reserves
- Inform state-wide marine policymaking and multi-stakeholder process on human dimensions of marine reserve designation and management

## Program References

### CINMS Management Plan

- Management Plan Conservation Science Action Plan CS.3

### CINMS Condition Report

- What are the levels of human activities that may influence water quality and how are they changing?
- What are the levels of human activities that may influence habitat quality and how are they changing?
- What are the levels of human activities that may influence living resource quality and how are they changing?
- What are the levels of human activities that may influence maritime archaeological resource quality and how are they changing?

*Updated: 5/26/2010*

*For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>*

# Channel Islands National Marine Sanctuary Informatics

## Management Issue

Much data is collected within CINMS that could inform current and future management and evaluation of resource status, but this utility is not realized because the information conveyed by that data is not accessible

## Description

In reviewing the information and process used by regional experts in composing the 2008 SWIM condition report for the CINMS it was apparent that data is collected, but not available in an accessible format for use by sanctuary managers. For example, in answering questions about Living Marine Resources (i.e. what is the status of key species and how is it changing?) contributors relied on raw data or other local data holdings for 40% of their assessment, but peer-reviewed literature only 19% of the time – and the remaining 41% of the time they relied on no more than professional judgment having no access to relevant data. Follow up revealed that the CINMS is as intensively studied as any regional ecosystem in the Nation, but the agents collecting the data are not coordinated. Specifically, there are no data standards, protocols or business rules – in short, no informatics standards—that allow the sharing and confederation of the data that could inform management of the sanctuary. In addition, the cyber infrastructure (i.e. computing systems, data storage systems, advanced instruments and data repositories, visualization environments, and people, all linked together by software and high performance networks) necessary to make this work are not currently in place. Therefore, there is a need established for the introduction of an informatics program to confederate the available data in an accessible data network to replace current assessments that are forced to rely exclusively on judgment and guesswork.

## Questions and Information Needs

- 1) Who is collecting relevant data in the CINMS (i.e. how big a problem is this)?
- 2) How diverse are the data collection programs and the motivations for the individual agents and programs collecting monitoring data in the CINMS?
- 3) Who are and how diverse are the clients for the relevant data products that would be produced from a confederated informatics program in the CINMS?
- 4) How do we confederate atmospheric, oceanographic, acoustic, ecological and behavioral data that are all of different dimensionality and collected on different spatial and temporal scales and resolutions into common conceptual frameworks?
- 5) How do we confederate these diverse data types that are all of different dimensionality and collected on different spatial and temporal scales and resolutions into common data management framework?

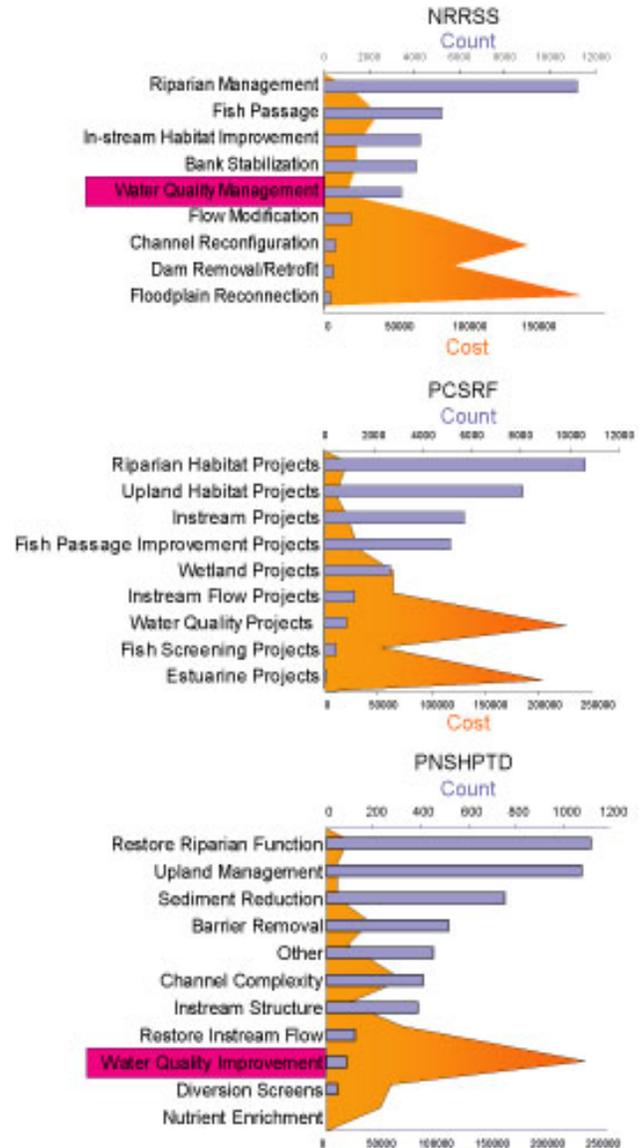


Figure 1. Three different data dictionaries (semantics) in use to describe management actions in the Pacific Northwest give polar opposite information when applied to the same management data. For example, water quality improvement projects go from very numerous (>2000 implemented) to rarely done (<200) – just by changing the data management protocols.

Updated: 5/26/2010

For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>

## Scientific Approach and Actions

- Perform information needs assessment – survey of information users to determine the scope and diversity of data that needs to be incorporated into the system
- Review the history of data collection in and around the CINMS
- Deploy back bone of data storage and access infrastructure
- Develop cooperative partnerships with data confederation and data visualization resources in region (NCEAS & UCSB)

## Key Partners and Information Sources

CDFG, NMFS, the University of California at Santa Barbara and Los Angeles (UCSB & UCLA), the National Center for Ecological Analysis and Synthesis (NCEAS), and the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO)

## Management Support Products

- Concise and relevant monitoring data to support assessments of resource status in the sanctuary
- Appropriate information as input for decision support models for management decisions
- Reduction in guesswork as an assessment method
- Compiled data available for scientific access to improve research productivity and enable breakthroughs not otherwise possible (i.e. the ability to ask questions on spatial and conceptual scales not possible in the absence of confederated data)

## Planned Use of Products and Actions

Organized and coordinated data will be available to provide science-based answers to assessments such as the SWIM condition reports, performance measures, and assessments of ecosystem health.

## Program References

### CINMS Management Plan

- Conservation Science Action Plan - CS.2
- Marine Reserve Monitoring - CS.2
- Comprehensive Data Management - CS.6
- Biological Monitoring of MPA Network – CS.6

### CINMS Condition Report

This project would be relevant to the entire condition report process as well as question such as:

- What is the status of biodiversity and how is it changing?
- What is the status of key species and how is it changing?
- What is the condition or health of key species and how is it changing?
- What are the levels of human activities that may influence living resource quality and how are they changing?

### ONMS Performance Measures

- Number of sites in which water quality, based on long-term monitoring data, is being maintained or improved
- Number of sites in which habitat, based on long-term monitoring data, is being maintained or improved
- Number of sites in which living marine resources (LMRs), based on long-term monitoring data, is being maintained or improved
- By 2017, 100% of the marine zones or networks of zones in place in the ONMS have methods implemented to assess their effectiveness

*Updated: 5/26/2010*

*For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>*

# Channel Islands National Marine Sanctuary

## Science-based Decision Support Protocols

### Management Issue

In spite of intense and long standing research and monitoring activities within the Channel Islands National Marine Sanctuary (CINMS or Sanctuary), there are no objective, testable and reliable methods or decision support models to convert complex monitoring data into assessments of resource status for use by managers.

### Description

In reviewing the evaluation process used by regional experts in composing the 2008 SWIM condition report for the Sanctuary it was apparent that in spite of all the monitoring historically and currently occurring in the Sanctuary there is no objective process to convert the amassed data into assessments of resource status. For example, in answering nine out of 14 questions about water quality, habitat condition and living marine resource status, contributors relied on their judgment in developing assessments 100% of the time. In none of those cases was an established benchmark or

decision support model used to translate the available data into an assessment that could be used by managers as science-based support for management decisions. As pointed out in the review of the SWIM report by the CINMS Advisory Council's Research Activities Panel, the systemic problem in the condition report is "no articulated decision support model or benchmark for performance. To the extent that the rating scheme is subjective, it should not be used as scientific support for management decisions." Therefore, there is a need established for the introduction of a research program that assembles the available information and then creates objective, testable linkages between information in order to develop overarching indicators of resource status. In many cases these relationships between indicators are not well enough understood to develop low-dimension assessments (i.e. good vs. fair vs. poor) of the status of an ecosystem that is complex and dynamic. Thus this need can only be addressed by a synthesis of available data and model of ecosystem process, likely supported by targeted, experimental field actions.

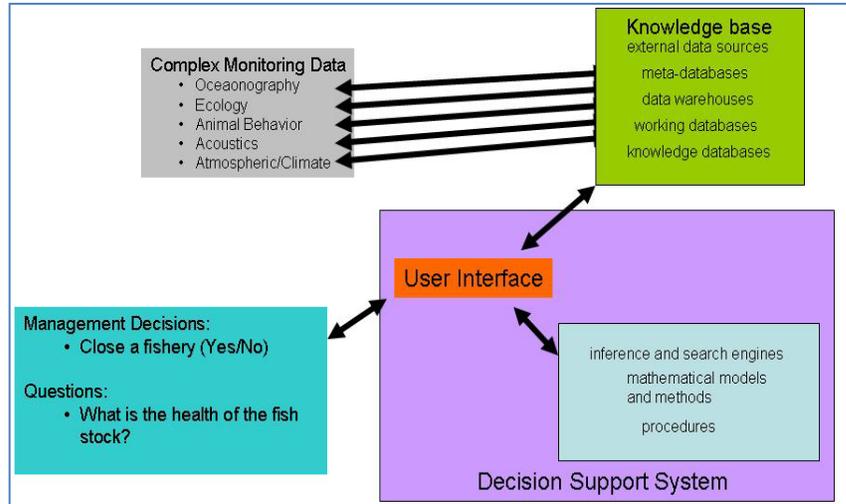


Figure 1. Decision Support Systems (DSS) have a user interface that operates within a discrete management decision context, and which reaches out in an automated manner to obtain the appropriate data and input that to the models and methods that produce the objective answers.

### Questions and Information Needs

- 1) What are all the decisions made by the diverse managers whose jurisdictions overlap the Sanctuary?
- 2) What are all the questions that must be answered for each of those decisions to be made?
- 3) What conceptual measures of resource health (i.e. "resilience", "reactance", "diversity") constitute answers to those questions?
- 4) What monitoring data (i.e. time series of species counts), and how are they assembled (diversity index, IBI, dominant eigenvalue of community interaction matrix) to express those conceptual measures of resource health or status?

Updated: 5/26/2010

For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>

## Scientific Approach and Actions

- Perform decision requirements assessment – survey of decision makers on their list of management decisions and questions
- Review the history of management decisions in and around the Sanctuary
- Review history of research efforts to develop conceptual measures of resource health
- Deploy pilot measures that assemble available data in tests of trial indicators and model assessments
- Review performance of test indicators on regular schedule to adaptively develop indicators that managers can actually use

## Key Partners and Information

### Sources

CDFG, NMFS, the University of California at Santa Barbara and Los Angeles (UCSB & UCLA), the National Center for Ecological Analysis and Synthesis (NCEAS), other resource management agencies who are developing parallel decision support tools (e.g. US EPA, US Forest Service), and the regional Air Quality Management Districts



Decision support protocols will use data collected in the field to inform models that will help management make decisions. Photo credit: Jessie Alstatt

## Management Support Products

- Concise and relevant monitoring data to support assessments of resource status in the sanctuary
- Appropriate decision support models for management decisions
- Reduction in guesswork as an assessment method

## Planned Use of Products and Actions

- Tested, objective, science-based tools that inject available monitoring data and output answers to the questions that need to be answered to make management decisions in the sanctuary

## Program References

### CINMS Management Plan

- Conservation Science Action Plan - CS.2
- Marine Reserve Monitoring - CS.2
- Comprehensive Data Management - CS.6
- Biological Monitoring of MPA Network – CS.6

### CINMS Condition Report

- This work is critical to the effective completion of documents like the condition report.

### ONMS Performance Measures

This work is critical to the effective analysis of performance measures. This work will help answer questions like:

- a. Number of sites in which water quality, based on long-term monitoring data, is being maintained or improved
- b. Number of sites in which habitat, based on long-term monitoring data, is being maintained or improved
- c. Number of sites in which select living marine resources, based on long-term monitoring data, are being maintained or improved

*Updated: 5/26/2010*

*For More Information -- <http://www.sanctuaries.noaa.gov/science/assessment>*