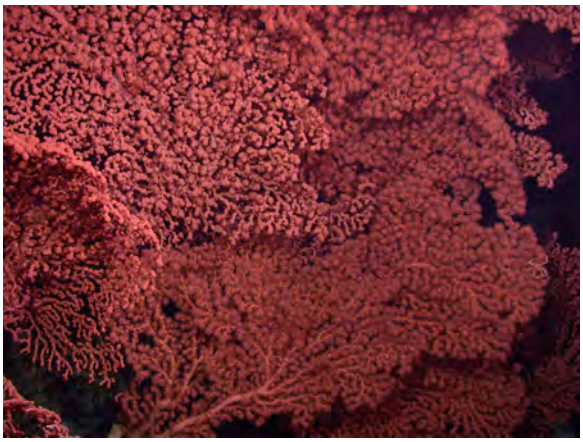
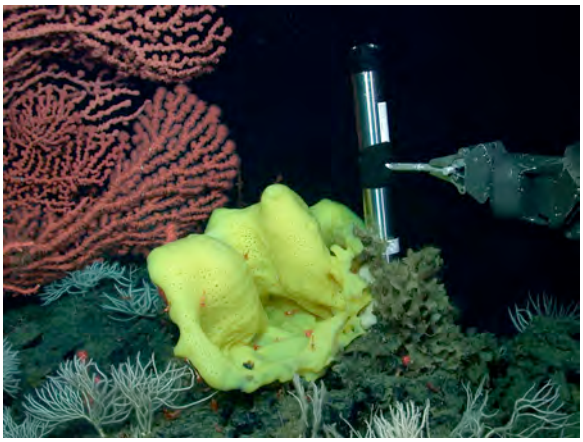
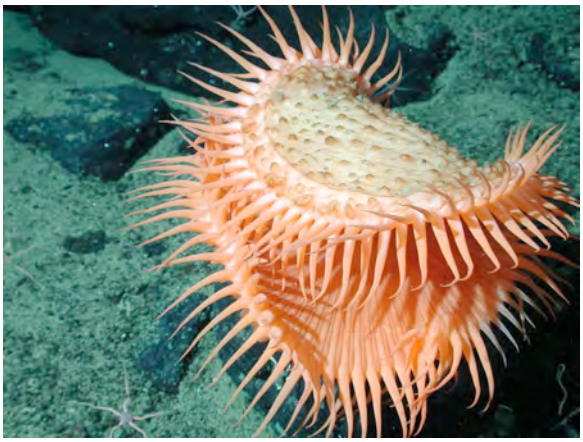
Monterey Bay National Marine Sanctuary

Davidson Seamount Management Zone

Management Plan

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Davidson Seamount Management Zone
Management Plan

EXECUTIVE SUMMARY

This plan for the Davidson Seamount Management Zone is an expanded version of the Davidson Seamount Action Plan in the Monterey Bay National Marine Sanctuary Final Management Plan (Appendix E; NOAA 2008b). It is a living document (i.e., periodically updated) with background information on the Davidson Seamount, and the activities necessary for effective understanding and protection of this unique area. Since the Action Plan was finalized in 2008, the language of some activities has changed in this report as a result of a better understanding of the seamount. Activities will be addressed annually through the Office of National Marine Sanctuaries Annual Operating Plans, as well as opportunistically with partners (Appendix B).

GOAL

Develop and implement a resource protection plan for the Davidson Seamount, increase understanding of the seamount through characterization and ecological process studies, and develop education programs for the seamount and other seamounts throughout the nation.

INTRODUCTION

Characteristics of Seamounts and the Davidson Seamount Management Zone

Less than 0.1 percent of the world's seamounts have been explored for what species live on them, and many species found on seamounts are new to science.

Seamounts are often dominated by suspension feeders, like corals, that grow on rock in an otherwise flat, low biomass, sediment-covered abyssal plain. In addition, seamounts create complex current patterns that can influence sea life above them. Commercially valuable fish species often concentrate around relatively shallow seamounts due to enhanced upwelling caused by current deflection. Conservation issues relevant to seamounts revolve around endemism, harvest, and the low resilience of species.

Davidson Seamount is located eighty statute miles to the southwest of Monterey, due west of San Simeon, and is one of the largest known seamounts in U.S. waters. It is twenty-six statute miles long and eight statute miles wide. From base to crest, Davidson Seamount is 7,480 feet tall; yet, it is still 4,101 feet below the sea surface at its highest point. Davidson Seamount has an atypical seamount shape, having northeast-trending ridges created by a type of volcanism only recently described, and it last erupted about 9.8 million years ago. This

Box 1: Davidson Seamount Websites

MBNMS Expanded to Include the Davidson Seamount
http://montereybay.noaa.gov/research/dsmz/welcome.html

SIMoN Photo Library: Davidson Seamount Creatures
http://www.sanctuarysimon.org/monterey/sections/seamounts/images.php?sec=sm

2006 Expedition: Exploring Ancient Coral Gardens
http://www.sanctuarysimon.org/monterey/sections/seamounts/project_info.php?projectID=100307&sec=sm

2002 Expedition: First Biological Characterization
http://www.sanctuarysimon.org/monterey/sections/seamounts/project_info.php?projectID=100114&sec=sm

large geographic feature was the first underwater formation to be characterized as a "seamount" and was named after the Coast and Geodetic Survey (forerunner to the National Ocean Service) scientist George Davidson.

Species associated with Davidson Seamount can be divided into habitats including: the sea surface habitat (birds in flight and on the sea surface), the midwater habitat (0 – 4,100 feet below sea surface), the seamount crest habitat (4,100 – 4,900 feet), the seamount slope habitat (4,900 – 8,200 feet), and the seamount base habitat (8,200 – 11,500 feet). The surface habitat hosts a variety of seabirds, marine mammals, and surface fishes, including albatross, shearwaters, jaegers, sperm whales, killer whales, albacore tuna, and ocean sunfish. At this time, there is no published evidence that the species composition in this surface habitat is different than adjacent areas without a seamount below, although in some years Davidson Seamount may enhance albacore fishing and the abundance of fin whales. Organisms in the midwater habitat have a patchy distribution with marine snow, organic matter that continually "rains" down from the sea surface, most likely providing an important food source for deep-sea animals. Swimming worms, Humboldt squid, and an undescribed mollusk have been seen above Davidson Seamount.

The seamount crest habitat is the most diverse, including *Paragorgia arborea* (a large gorgonian coral) forests, vast sponge fields (consisting of both described and undescribed species), crabs, deep-sea fishes, shrimp, and basket stars. The seamount slope habitat is composed of cobble and rocky areas interspersed with areas of ash and sediment that host a diverse assemblage of sessile invertebrates and rare deep-sea fishes. The seamount base habitat is the interface between rocky outcrops and the deep soft bottom. Species here are similar looking to their relatives in the nearshore, including sea cucumbers, urchins, anemones, and sea stars.

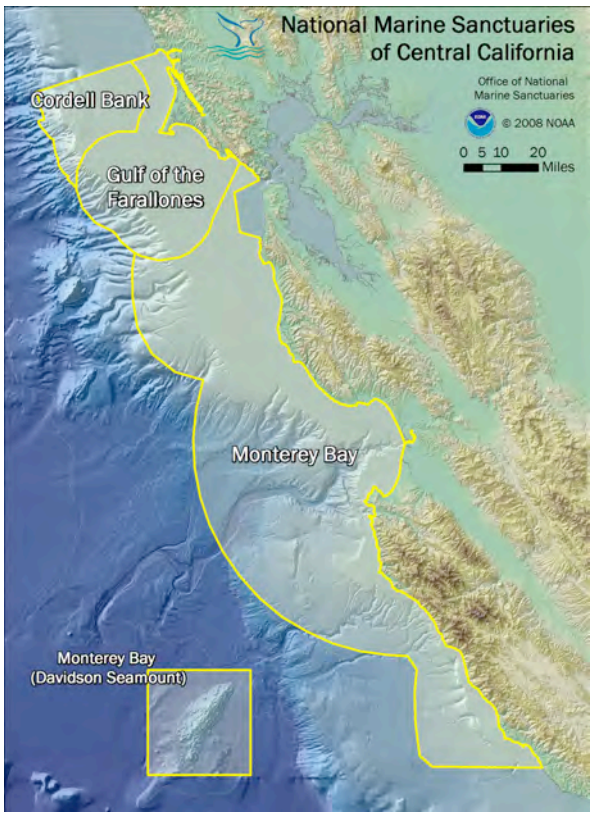

Figure 1: Davidson Seamount Management Zone within the Monterey Bay National Marine Sanctuary.

Anthropogenic influence on Davidson Seamount has been detected in the form of DDT in sediments near its base, and trash (e.g., bottles, cans, brooms, newspapers, buckets, curtains) discarded from the sea surface. However, because of the abundance of large, fragile species (e.g., corals greater than eight feet tall, some at least 200 years old) and an apparently, physically undisturbed seafloor, the area appears relatively pristine. The top of the seamount is too deep for most fish trawling technology; moreover, fish density is very low, and the species seen to date are not commercially desirable. The existing albacore tuna and swordfish/shark fisheries operate in the top 150 feet of water, thousands of feet above the summit of the seamount.

Davidson Seamount is regionally important for science, to study how the seamount is ecologically linked with the coastal waters, nearshore canyons, and species currently protected in the MBNMS. Protecting it will help facilitate research to understand how the Monterey Bay and Big Sur Canyon complexes have an effect on Davidson Seamount and what the migration pattern of species is between the seamount and nearshore.

National Significance of Davidson Seamount

Under the National Marine Sanctuaries Act (16 U.S.C. 1431 ET. SEQ., as amended by Public Law 106-513) there are standards for sanctuary designation. Sanctuary designation or expansion is premised upon setting aside areas of the marine environment that have nationally, and sometimes internationally significant living or nonliving resources. Sanctuary designation provides authority for comprehensive protection and management, including research, education, and outreach. Thus, designation does not require an existing or imminent threat. The MBNMS Management Plan, however, describes threats to the Davidson Seamount in the Davidson Seamount Action Plan (see below). In addition to resource protection, other management interests warrant including the Davidson Seamount in the National Marine Sanctuary System. Prior to designation in 2009, there was no comprehensive conservation and management scheme in place to protect the organisms on the seamount or the surrounding ecosystem. While resource protection is the primary purpose for designation as a national marine sanctuary, NOAA also seeks to increase national awareness and public understanding of seamount systems. Davidson Seamount has special national significance relative to:

<u>Conservation Qualities</u>

- Vulnerability of resource to damage: long-lived species; dominated by large fragile, slow-growing organisms; long recovery time if impacted.
- Special characteristics of resource: The area is pristine; it has large microhabitats of old corals and sponges; and it has relatively high numbers of rare and unidentified benthic species.
- Threat of collection: the large yellow sponge on Davidson Seamount is already of interest to bio-prospectors; there are small "precious corals" on Davidson Seamount that are similar to some already collected in Hawaii.
- There are no other seamount habitats currently under Sanctuary status.

<u>Ecological Qualities</u>

- Biologically special: Davidson Seamount has previously undiscovered species and species assemblages (large, adjacent, patches of corals and sponges); there is an opportunity to discover unique forms of competition (and other ecological processes) between these patches. These assemblages and high biological diversity are not as well developed on other Central California seamounts (i.e., Guide, Pioneer, and Gumdrop).
- Geographically special: Davidson Seamount is located in the California Current, which likely provides a larger flux of carbon (food) to the sessile organisms on the seamount surface relative to a majority of other seamounts in the Pacific.
- Physically special: Davidson Seamount is one of the largest seamounts in US waters. It, along with Guide, Gumdrop, Pioneer, and Rodriguez, is unlike typical oceanic-island volcanoes or near-ridge seamounts in that it is structurally more complex with northeast-

tending ridges. It may have unique links to the nearby Partington and Monterey submarine canyons.

Scientific Qualities

- With high-resolution mapping and 24 long/detailed ROV dives, the Davidson Seamount is one of the best described seamounts in the world.
- Rare or undescribed species (high diversity).
- Proximity to scientific research institutions makes the Davidson Seamount relatively accessible.
- Proximity to fishing fleets provides opportunities for cooperative research using these vessels.

Education Qualities

- Proximity to the Monterey Bay Aquarium and other education institutions provides excellent educational opportunities (e.g., an education display on seamounts). The proximity of education and research institutions in the Monterey Bay region facilitates interdisciplinary collaborations that enhance research and education.
- The National Marine Sanctuary Program has a well-developed education program in NOAA, providing an opportunity to educate the public about seamounts as well as cold water corals and sponges (interestingly, a recent survey of potential visitors to a planned Sanctuary visitor center indicates that one of the top interests of the public is seafloor topography).

Aesthetic Qualities

- Davidson Seamount has clearly captivated the imagination of the public (e.g., media and outreach from the May 2002 expedition: national news, BBC television program, newspaper articles, series of talks, new NOAA visitor center film, NOAA CD, NOS annual accomplishments, 140,000 hits per day web site).
- Charismatic issue: visually exciting; charismatic creatures like unique fish and large corals; aesthetic qualities of the seafloor are high relative to the rest of the Central California region.

Historical Qualities

- George Davidson is a historic figure in early charting and mapping, the Davidson Seamount was named after him.
- The Davidson Seamount was the first geologic featured described as a "seamount."

Potential Threats to the Davidson Seamount

NOAA determined the Davidson Seamount requires protection from the take or other injury to benthic organisms or those organisms living near the sea floor because of the seamount's special ecological and fragile qualities and potential future threats that could adversely affect these qualities (NOAA 2008a). Conservation issues related to seamounts revolve around endemism (species only found on a specific seamount), harvest, and low resilience of species. Existing and potential threats to Davidson Seamount include:

Bio-prospecting

- Some groups of organisms found on seamounts have been targeted for commercial products.
- Extensive collection of sensitive species for commercial use, or bio-prospecting, would damage the fragile ecosystem.

Cumulative research collection

- Worldwide, there has been increased interest in studying deep-sea corals such as the large bubble gum coral, *Paragorgia*. Davidson Seamount has several rare, slow growing coral species, including *Paragorgia*.
- Unmanaged collection of slow growing species, even to learn more about them, can damage fragile ecosystems.

Seafloor harvesting

- Presently, there is no known commercial harvesting activity on the Davidson Seamount and no known populations of fish or invertebrates to support a fishery.
- As discoveries of precious corals or other potential commercial species on Davidson Seamount become public, commercial harvest of any kind, with new deep-sea techniques to harvest the seabed, could cause severe damage.
- Exploratory benthic fishing could destroy habitat and long-lived species.

Marine debris/dumping

- Marine debris at Davidson Seamount was observed during research cruises in 2002 and 2006; including plastics, glass, and aluminum. Prior to sanctuary expansion in 2009 to include Davidson Seamount, the seamount area was not protected from targeted offshore dumping.

Although management agencies are responsible for some activities that may occur at the seamount, no comprehensive protection and management of organisms on the seamount or the surrounding ecosystem existed prior to sanctuary designation in 2009, and coordinated education or research programs addressing Davidson Seamount issues are in their infancy. By incorporating the seamount into the MBNMS, its resources will be protected and opportunities will be provided for a better understanding of the seamount.

Expansion of the MBNMS to Include Davidson Seamount Management Zone

The Davidson Seamount Management Zone (DSMZ) is a recent addition to the Monterey Bay National Marine Sanctuary (March 2009), as part of the adoption of the Final MBNMS Management Plan (October 2008; NOAA 2008b). This area encompasses approximately 775 square statute miles of ocean waters and the submerged lands there under. The boundary resembles a square box, approximately twenty-eight statute miles per side, centered on the summit of Davidson Seamount. The uniform lines and symmetry of the boundary configuration offer easy navigation by longitude and latitude even though the seamount is physically disconnected from the MBNMS boundaries contiguous with the shoreline (See Figure 1). Standard MBNMS regulations apply within the DSMZ (without the exemptions for seabed alteration; http://montereybay.noaa.gov/intro/mp/regs.html#prohibitions); and taking, disturbing,

injuring, or possessing any sanctuary resource below 3,000 feet within the DSMZ is prohibited. In addition, NMFS regulations (first effective June 2006) prohibit fishing with bottom contact gear, or any other gear that is deployed deeper than 3,000 feet, to protect essential fish habitat. For more information on MBNMS permitting requirements, see the website: http://montereybay.noaa.gov/resourcepro/permit/permits_need.html.

ACTION PLAN STATUS – STRATEGIES, ACTIVITIES, AND PARTNERS

Strategy DS-1: Conduct Site Characterization

The purpose of this strategy is to complete a number of already initiated studies on the DSMZ ranging from geological and biological characterization to zoological and oceanographic surveys, while developing a socioeconomic survey. The strategy will also result in a complete cultural history analysis and site characterization document for Davidson Seamount.

Activity 1.1: Complete Geologic and Biological Characterization of the Seamount

In addition to initiated studies, a complete analysis of existing video transects of species and habitat types from past National Oceanic and Atmospheric Administration (NOAA) and the Monterey Bay Aquarium Research Institute (MBARI) research cruises will be completed. In 2006, a collaborative research cruise with MBARI and the British Broadcasting Corporation (BBC) successfully obtained information from other unvisited areas of Davidson Seamount to produce an education video.

> **Status**: While it is one of the best-documented seamounts in the world, it is still 99.98% unexplored and the Sanctuary would like to reduce that number to 95%. Recent studies have begun to characterize the geology and biology of the seamount.
>
> Several studies by MBARI have focused on the geologic formation and age of seamounts off California, and reveal an unrecognized type of intraplate oceanic volcanism (Davis et al. 2002). Davidson and the other seamounts along the California continental margin are significantly younger than the crust beneath them. And it is suggested that Davidson Seamount erupted at the site of an abandoned spreading center. Seamount growth likely began when the ridge was abandoned ~20 million years ago. Seamount lava flow ages range from 9.8-14.8 million years ago (Paduan et al. 2007).
>
> A recent graduate thesis by Lundsten (MBARI and MLML) characterized the macroinvertebrates and fishes at Davidson Seamount with a comparison to other local seamounts (Lundsten 2007; Lundsten et al. 2009a, Lundsten et al.2009b).
>
> Further investigations, which add to areas explored, should begin focusing on organisms less than 5 centimeters tall as these were not considered in the earlier expeditions. To date, studies focused on the megafauna (>5 cm), and more information is needed for macro (>1 mm) and meiofauna (>45 µm).

Partners to Date:
Monterey Bay Aquarium Research Institute
Moss Landing Marine Laboratories

Activity 1.2: Identify Taxonomy and Natural History of Rare or New Species
Seamounts are known to have endemic species. This creates taxonomic questions concerning the possible discovery of new deep-water corals. Past surveys of Davidson Seamount found species that are rare or new to science altogether.

Status: At least 237 taxa have been documented at Davidson, including 18 species new to science (8 sponges, 1 hydroid, 4 corals, 1 ctenophore, 1 nudibranch, 1 polychaete, 1 seastar, and 1 tunicate). A Taxonomic Guide was published in 2008 as part of the Office of National Marine Sanctuaries Conservation Series (Burton and Lundsten 2008). Species new to science were described by Cairns (2007), Herrerra et al. (2010), and Mah et al. (2010).

Morphological, molecular, and in situ behavioral observations of the rare deep-sea anglerfish (*Chaunacops coloratus*) described by Lundsten et al. 2012.

Partners to Date:
Monterey Bay Aquarium Research Institute
Taxonomists from academic and museum institutions throughout the U.S. and Canada

Activity 1.3: Conduct Zoological Survey of Surface and Midwater Areas Above the Seamount
Additional cruises from the NOAA ships are necessary to describe surface and mid-water species, sea turtles, birds, and mammals. The Sanctuary Aerial Monitoring and Spatial Analysis Program (SAMSAP) has been tested within the area using local NOAA aircraft. The SAMSAP program is designed to monitor the locations of different kinds of commercial and recreational vessels as well as distributions of some species of interest, including cetaceans (whales and dolphins), and some physical conditions, such as spilled oil. During aerial surveys, observers document the precise locations of the vessels, animals and physical characteristics using a Global Positioning System (GPS). Observers distinguish between commercial and recreational vessels, and between consumptive and non-consumptive activities. When observers see fishing gear in the water, the type of fishing activity is noted.

Status: Surveys within the vicinity of Davidson Seamount completed by Collaborative Survey of Cetacean Abundance and the Pelagic Ecosystem (CSCAPE) using the NOAA Ship *McArthur II* (http://sanctuarysimon.org/monterey/sections/marineMammals/project_info.php?projectID=100273&sec=mm).

In July 2010, MBNMS staff and partners conducted a three-day survey of the waters above and around the Davidson Seamount aboard the NOAA Ship *McArthur II*; the first dedicated at-sea survey of the Seamount to record marine mammal and seabird observations (Newton et al. 2011).

When NOAA planes are stationed in central California, quarterly SAMSAP surveys should be initiated. Otherwise, this will be an opportunistic effort based on plane availability. MBNMS still needs to install computer systems to have SAMSAP fully incorporated into the MBNMS's monitoring program; otherwise, MBNMS is reliant on Channel Islands NMS staff.

In January and April of 2010, MBNMS staff and partners conducted two, single-day aerial surveys of the surface waters surrounding the Davidson Seamount using NOAA's DeHavilland Twin Otter N48RF aircraft (http://www.sanctuarysimon.org/projects/project_info.php?projectID=100381&site=true) .

Another effort has been to interview NOAA Fisheries seabird and marine mammal scientists and whale watching boat staff, and include their observations of sea surface animals in the vicinity of the Davidson Seamount (MacKnight et al. 2011).

Partners to Date:
NOAA's Fisheries Service
Channel Islands National Marine Sanctuary
University of California at Santa Cruz
Moss Landing Marine Laboratories
Institute for Bird Populations
Marine mammal and seabird observers from academic and local institutions

Activity 1.4: Initiate Oceanographic Surveys of Seamount Region

Oceanographic surveys will be conducted using the NOAA ships and satellite imagery. The data from the surveys will be linked with national coastal observatories (i.e., Central and Northern California Ocean Observing System) resulting in a better understanding of ocean current patterns on and around Davidson Seamount. This will also enable researchers to determine how the ocean current patterns affect life on and around Davidson Seamount and generally, how Davidson Seamount has an influence on the regional ecology.

Status: Physical Oceanographers from Stanford University and MBARI (Sarah Rizk and John Ryan) have recently completed a report entitled, "Seamount Influences of Surface Ocean Circulation," which examines the influence of the Davidson Seamount on the circulation patterns of the California Current and California Undercurrent (Rizk and Ryan 2006).

During a marine mammal and seabird survey aboard the NOAA Ship *McArthur II* in July 2010, CTD casts were conducted at night above Davidson Seamount (to 1000 m) to collect temperature and salinity profiles (Newton 2012).

Partners to Date:
Monterey Bay Aquarium Research Institute
University of California at Santa Cruz

Activity 1.5: Complete Socioeconomic (Commercial, Recreational, Research Uses) Analysis
In comparison to the rest of the MBNMS, there are relatively few user groups in the Davidson Seamount region. However, a comprehensive understanding of key users of the seamount region is needed. Learning more about who uses the seamount region over a period of time is critical to effective education and protection.

Activity 1.6: Characterize Cultural History of Davidson Seamount
Throughout history Davidson Seamount has played a role in mapping, fishing, whaling, and research. The role of the seamount in the region's rich maritime past will be characterized, including the history of the seamount's namesake, George Davidson. His many contributions to maritime history and his personality as a maritime figure are important and have heritage value. Among the results of this activity will be reports. A video for visitor centers was created and disseminated among the public, stimulating interest that has heuristic value.

> **Status**: The history of activities at Davidson Seamount was characterized and presented on the CD-ROM "Exploring the Davidson Seamount" (MBNMS 2003).
>
> A video was created for the San Simeon Discovery Center exhibit, and published on the DVD-ROM, "Natural Wonders of Davidson Seamount" (MBNMS 2009).
>
> A profile of George Davidson, as pioneer scientist and surveyor, was added to the MBNMS Site Characterization (http://montereybay.noaa.gov/sitechar/george.html).
>
> **Partners to Date**:
> Monterey Bay Aquarium
> Monterey Bay Aquarium Research Institute
> British Broadcasting Corporation
> Moss Landing Marine Laboratories
> NOAA Fisheries
> Alliance for Coastal Technologies, University of Maryland
> Office of Ocean Exploration

Activity 1.7: Incorporate Site Characterization Document in MBNMS Websites
All relevant data from above activities have been incorporated into the SIMoN website, updating all physical and biological information; but still need to be incorporated into MBNMS website. A Davidson Seamount chapter will be added to the MBNMS Site Characterization, while incorporating all seamount information into the geology chapter.

> A profile of George Davidson, as pioneer scientist and surveyor, was added to the MBNMS Site Characterization (http://montereybay.noaa.gov/sitechar/george.html).

Strategy DS-2: Conduct Ecological Processes Investigations

In addition to characterizing the seamount region, Strategy 2 will result in process studies to determine the causes of distribution and abundance of species. Several hypotheses to be tested include the role of seamounts as either: 1) islands, where seamounts serve as a sink for larval

recruits originating in adjacent habitats; or 2) oases, where seamounts serve as a source of larvae integral to the surrounding areas. Another proposed hypothesis is seamounts acquire heightened biodiversity through the presence of coral and sponge fields, which promote local species coexistence by offering increased habitat complexity. High biodiversity of seamounts may also reflect rapid habitat turnover associated with substrate type, currents, temperature, oxygen concentration, and other abiotic/biotic parameters encountered across the flanks and summits of the seamount. Currently, we are assessing these hypotheses, and other ecological process studies, utilizing data collected from Remotely Operated Vehicle (ROV) dives at Davidson Seamount conducted in 2000, 2002, 2006, 2007, and 2009 through a collaboration of MBARI, Save The Earth, MBNMS, and other NOAA partners.

Activity 2.1: Conduct Regular Benthic Surveys of Davidson Seamount
The DSMZ benthos must be monitored. Based on information from early site characterization and preliminary studies, a benthic monitoring plan will be developed for Davidson Seamount. Data from this monitoring program will be made available through the Sanctuary Integrated Monitoring Network (SIMoN) website.

> **Status**: MBNMS developed a relationship with MBARI to regularly return to Davidson Seamount to conduct surveys. Two cruises were completed in 2009 to study the effects of ocean acidification. In 2009, development of a benthic monitoring plan was initiated. A more detailed plan is still necessary, outlining locations of fixed transects and determining the power to detect differences with existing ROV collected data.
>
> In 2014, scientists from Claremont Colleges and NOAA's Center for Coastal Environmental Health and Biomolecular Research will measure habitat quality for deep-sea corals in term of abundance, biomass, and geochemistry of *Calytrophora* aggregations [Primnoidae] at Davidson Seamount and Monterey Canyon habitats.
>
> **Partners to Date**:
> Monterey Bay Aquarium Research Institute
> Keck Science Department, Claremont Colleges
> NOAA's Center for Coastal Environmental Health and Biomolecular Research

Activity 2.2: Conduct Deep-water Coral Age Determination and Restoration Studies
Cold-water corals are receiving increased attention in terms of scientific studies and conservation. The relatively pristine nature of Davidson Seamount and its diverse coral populations provide for a number of opportunities for age determination, and restoration efforts to historical locations of corals in impacted areas of the MBNMS. A research plan for deep-water coral studies will be developed, linking the activities to the resource protection portion of Davidson Seamount action plan.

> **Status**: Two age and growth studies of corals have been completed, published, and presented to many audiences (e.g., academic, government, public; Andrews et al. 2005, 2007, 2009). Bamboo coral colony age estimates exceed 400 years.
>
> Coral transplant studies were initiated in 2009, to study the effects of ocean acidification.

Partners to Date:
Moss Landing Marine Laboratories
Monterey Bay Aquarium Research Institute

Activity 2.3: Perform Research on Seamount to Expand Understanding Distribution and Abundance of Species

Designation of Davidson Seamount as a managed area provides the status and opportunity for advancing the basic ecological understanding of seamounts. One such example would be to determine causes of high diversity and patchiness of Davidson Seamount corals and sponges.

Status: Study published that examines species composition between seamount and non-seamount communities (McClain et al. 2009). Little support was found for the seamount endemicity hypothesis among megafauna at Davidson Seamount which states that seamounts possess a set of isolating mechanisms that produce highly endemic faunas. Instead, an assemblage of cosmopolitan species similar to other deep-sea benthic habitats was documented. Despite the similarity between the seamount and non-seamount communities, preliminary results suggest that seamount assemblages may be structured differently and potentially serve as source of larvae for suboptimal, non-seamount habitats.

Study published that examines depth-related patterns in assemblage structure, diversity, and density at Davidson Seamount (McClain et al. 2010). Changes of 50% in assemblage composition (beta-diversity, faunal turnover) were observed over as little as a ~1500 meter depth interval down the flanks of the seamount. Diversity and density exhibited no consistent bathymetric pattern and can vary greatly on a single isobath.

Partners to Date:
Monterey Bay Aquarium Research Institute
National Evolutionary Synthesis Center

Activity 2.4: Understand Links with Coastal Area of Sanctuary

It is important to understand how the seamount is linked ecologically with the coastal area of the Sanctuary. For effective ecosystem management, we should understand questions, such as how the Monterey Bay and Big Sur Canyon complexes have an effect on the DSMZ, or what the migration and dispersal patterns of species are among these diverse systems.

Status: Study published that examines species composition between seamount and non-seamount communities (McClain et al. 2009). Little support was found for the seamount endemicity hypothesis among megafauna at Davidson Seamount which states that seamounts possess a set of isolating mechanisms that produce highly endemic faunas. Instead, an assemblage of cosmopolitan species similar to other deep-sea benthic habitats was documented. Despite the similarity between the seamount and non-seamount communities, preliminary results suggest that seamount assemblages may be structured differently and potentially serve as source of larvae for suboptimal, non-seamount habitats.

Partners to Date:
Monterey Bay Aquarium Research Institute
National Evolutionary Synthesis Center

Activity 2.5: Initiate up-to-date faunal inventory for Davidson Seamount
A single cohesive database of existing biota is necessary, including information on the species' biogeography (known distribution of the species on Davidson, Eastern Pacific Seamounts, seamounts globally, and non-seamount habitats), habitat preference, trophic level, and range of densities.

Status: Craig McClain (MBARI) has recently completed the database, but we need to determine appropriate location (e.g., SIMoN, MBARI, NCEAS, CenSeam, NCDDC) to place database for the long-term.

Partners to Date:
Monterey Bay Aquarium Research Institute
National Evolutionary Synthesis Center

Activity 2.6: Development of long-term monitoring plan through analyses of faunal database
Analyses of a faunal database will enable a long-term monitoring plan to be developed to understand ecological processes at the seamount, and the sensitivity and resilience of seamount biological communities to anthropogenic perturbations.

Strategy DS-3: Develop Resource Protection Program

MBNMS regulations will protect and enhance understanding of Davidson Seamount. Two modifications to standard MBNMS regulations were established to address resource threats: (1) because of the depth of the seamount, there is no need to have exceptions to the regulation prohibiting drilling into, dredging or otherwise altering the seabed that allow for anchoring vessels, aquaculture, kelp harvesting or lawful fishing operations, harbor maintenance, or collection of jade, therefore these exceptions do not apply in the DSMZ; and (2) an additional regulation to prohibit the removal, collection or extraction of animals or other biological material in areas below 3,000 feet of the sea surface (unless a permit is obtained for this activity).

Activity 3.1: Continuously Characterize the Potential Threats to Davidson Seamount
A threats and protection plan will be developed based on a thorough literature review, workshops with experts, and a socioeconomic and biological characterization. Initial research has enabled the identification of potential threats to Davidson Seamount and associated resources.

Status: Threats assessment for Davidson Seamount Management Zone completed and posted on MBNMS Technical Reports web page (MBNMS 2012).

Potential threats include the following:

A. <u>Bio-prospecting</u>
Some groups of organisms found on Davidson Seamount have been targeted for collection in

other areas of the world for developing medicine. Discovering medicinal uses for natural products is important for enhancing human health services, however over-collection of rare or sensitive species can disrupt natural habitats.

B. Cumulative research collecting of long-lived species

Where there are limited populations of slow growing species, research collection can be detrimental. Over the last two years, there has been increased worldwide interest in studying deep-sea corals such as the large pink gorgonian coral, *Paragorgia arborea*, found on Davidson Seamount, and they are often collected. This problem is exacerbated on seamounts that have a high degree of endemism, and Davidson Seamount has several other taxa that are slow growing and rare. Research is critical to understanding and managing ecosystems, so appropriate scientific collecting is often encouraged with permits to ensure minimal impacts.

Status: MBNMS regulations (March 2009) prohibit disturbance of a Sanctuary resource >3,000 feet (unless a permit is obtained). Using the Office of National Marine Sanctuaries permit program, MBNMS will facilitate shared access to collected specimens, and collections will be determined based on species abundance estimates (see Strategies 1 and 2).

C. New or unknown forms of seafloor disturbance, including exploratory fishing / new technologies to harvest from the seabed

Harvesting from Davidson Seamount is not a currently known commercial activity. With new discoveries of precious corals or other commercial species, in concert with more effective harvest technologies being explored at depths of greater than 4,000 feet, commercial harvest at Davidson Seamount could quickly cause severe impacts before mitigating regulations could be enacted. The concerns relative to impacts to Davidson Seamount are largely for protecting a fragile area before it is severely impacted.

Status: NMFS regulations (first effective June 2006) prohibit fishing with bottom contact gear (or any other gear) that is deployed deeper than 3,000 feet.

D. Marine debris / dumping

The Davidson Seamount area should not be a discharge and dumping location, and education about the site's significance could augment existing federal regulations regarding at-sea dumping.

E. Ocean acidification

Although changes in ocean chemistry due to anthropogenic release of CO_2 are relatively well established, what needs more attention is determining what impact this drop in pH will have on deep-sea organisms.

Status: Jim Barry (MBARI) and MBNMS are collaborating on long-term monitoring, modeling deep-sea coral distribution, and predictions of change to the deep-sea due to ocean acidification. During two research cruises in March-April 2009, bamboo corals

were transplanted to deeper depths, and clams were collected for shipboard studies of metabolic rate changes in response to elevated CO_2 levels.

Partners to Date:
Monterey Bay Aquarium Research Institute

Activity 3.2: Initiate Resource Protection Measures as Necessary
Characterization of the potential threats to Davidson Seamount may require initiation of additional protective measures or enhanced enforcement of existing regulatory measures to ensure adequate protection. Integration of the SAMSAP program (see Strategy 1) will enable enhanced monitoring abilities for the DSMZ including vessel traffic monitoring and fishing use that currently occurs in the DSMZ. In addition SAMSAP will provide biological monitoring capabilities to the MBNMS to establish potential conflicts between the surface use of marine organisms such as cetaceans and vessels.

Status: Completed 1 SAMSAP survey in 2009, looking for vessels.

Partners to Date:
Channel Islands National Marine Sanctuary

Activity 3.3: Develop and Implement Enforcement Plan for DSMZ
Based on the above activities, a threats management plan will be developed. Incorporated into this plan will be the identification of collaborative agencies to develop enforcement partnerships, perhaps in association with any new, federal marine protected areas. Enforcement of Sanctuary regulations relevant to Davidson Seamount will be integrated into the MBNMS enforcement program. The distance of Davidson Seamount from the coastline will require coordination of the U.S. Coast Guard, NOAA Office of Law Enforcement, and the California Department of Fish and Game to establish surveillance and response capabilities for the area. Aerial surveys, such as SAMSAP, will be incorporated into the enforcement effort as well as patrols on USCG and NOAA ships.

Status: The Davidson Seamount Management Zone Management Plan was updated (version 6).

Activity 3.4: Develop Permitting Criteria to Facilitate Continued Research and Education
This permit process should facilitate the continuation of research and education while minimizing impacts to the benthic habitat of the seamount, to accompany extending the regulations and the MBNMS permit program into this new habitat.

Status: Special conditions for research and education permits at DSMZ was created to minimize impacts to benthic organisms and habitat.

Strategy DS-4: Conduct Seamount Education and Outreach Initiatives

Davidson Seamount has captivated the public through numerous media reports (including the CBS Nightly News and American Airlines in-flight news) and through NOAA's Ocean Explorer web site (http://oceanexplorer.noaa.gov/explorations/06davidson/welcome.html). A recent

survey of the public, related to developing a visitor center for the MBNMS, found that one of their top interests was in "seafloor topography" of which canyons and seamounts are dramatic examples. Proximity to the Monterey Bay Aquarium and other education institutions provides excellent education opportunities (e.g., displays on seamounts). The proximity of education and research institutions in the Monterey Bay region facilitates interdisciplinary collaborations that enhance research and education. Davidson Seamount and MBNMS's research efforts have generated significant interest in the Cambria and San Simeon area and has been prominently featured in the San Simeon Visitor Center.

Activity 4.1: Conduct an Educational Needs Assessment
The MBNMS will actively work with the Sanctuary Education Panel to identify target audiences. Subsequently, an educational needs assessment will be completed. Finally, relevant information regarding the DSMZ will be synthesized.

Activity 4.2: Develop and Implement Davidson Seamount Education and Outreach Program
Information on the DSMZ will be incorporated into educational material and interpretive centers. These will include items such as CD-ROMs, a website, and print material. Building on the opportunity that the DSMZ will be the only seamount in the National Marine Sanctuaries Program, educational information on seamount biological diversity, habitats, and species of related interest, such as cold-water corals and sponges will be provided to all relevant NOAA programs.

> **Status**: Davidson Seamount information (e.g., images, video, scientific results) has been incorporated into Visitor Centers, web sites, SIMoN Photo Library, CD-ROM, DVD-ROM, radio interviews, and various print materials. See Appendix C: Literature and Presentations Relevant to Davidson Seamount Research.
>
> **Partners to Date**:
> Monterey Bay Aquarium Research Institute
> Monterey Bay Aquarium

Activity 4.3: Use of Davidson Seamount Footage within the MBNMS Interpretive Center and Other Virtual Experiences
Incorporate Davidson Seamount video and still photos into the exhibits of the San Simeon Coastal Discovery Center. Creating a narrative of selected footage will encourage use of the video footage obtained beyond the MBNMS. As the National Marine Sanctuary Program (NMSP) telepresence program develops, the potential for use of this high quality footage is very likely; creating prepared footage for use will be key to its use across the nation.

> **Status**: Davidson Seamount video and still photos have been incorporated into the exhibits of the San Simeon Coastal Discovery Center and Santa Cruz Exploration Center (see Interpretive Plan), and the SIMoN Photo Library.
>
> **Partners to Date**:
> Monterey Bay Aquarium Research Institute

Activity 4.4: Involve MBNMS Education Staff in Davidson Seamount Research
Involvement by the education staff in research on Davidson Seamount will increase public knowledge of the seamount, expose the uniqueness of the region, and ensure necessary outreach pieces are created for use in resource management decision making.

Activity 4.5: Involve the Education and Outreach Mechanisms within NOAA to Promote the Existing and New Research on Davidson Seamount
The 2002 mission to the seamount, in conjunction with NOAA's Office of Exploration and Research (OER), was hugely successful due to the combined efforts of the MBNMS, NMSP, and OER. This relationship and others should always be considered when new cruises and campaigns are considered.

Activity 4.6: Expand Outreach and Education Efforts in San Simeon / Cambria Region
MBNMS will develop additional outreach materials and displays for the San Simeon Coastal Discovery Center to address the increased interest in the region regarding the natural resources of Davidson Seamount. As part of the MBNMS Communication Plan, a series of steps is outlined to interpret the addition of Davidson Seamount to the MBNMS. This is part of the expected Joint Management Plan release.

> **Status**: MBNMS staff have incorporated discussion of Davidson Seamount into local presentations and outreach events, including two docent enrichment lectures and numerous public lectures
>
> **Partners to Date**:
> Monterey Bay Aquarium Research Institute
> Moss Landing Marine Laboratories

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APPENDICES

APPENDIX A: Literature and Presentations Relevant to Davidson Seamount Research

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APPENDIX B: Partners in Past Work Related to Davidson Seamount

British Broadcasting Corporation

California Department of Fish and Game

California Sea Grant College Program

CenSeam: A Global Census of Marine Life on Seamounts

Claremont Colleges

Fishermen

Institute for Bird Populations

Monterey Bay Aquarium

Monterey Bay Aquarium Research Institute

Monterey History and Art Association / Maritime Museum of Monterey

Moss Landing Marine Laboratories

National Evolutionary Synthesis Center

Naval Postgraduate School

NOAA's Center for Coastal Environmental Health and Biomolecular Research

NOAA's National Marine Fisheries Service

NOAA's Office of Ocean Exploration and Research

Save The Earth

The Ocean Conservancy

United States Coast Guard

University of California Santa Cruz

NATIONAL MARINE SANCTUARIES ™

DAVIDSON SEAMOUNT

Action Plan Summary

MONTEREY BAY NATIONAL MARINE SANCTUARY

THE ISSUE:

The National Oceanic and Atmospheric Administration (NOAA) is considering protecting the resources and qualities of the Davidson Seamount through inclusion in the Monterey Bay National Marine Sanctuary (MBNMS).

OUR GOAL

The sanctuary's goal is to incorporate Davidson Seamount into the MBNMS and develop and implement a resource protection plan for the seamount, increase understanding of the seamount through characterization and ecological studies and to develop education programs for this and other seamounts throughout the nation.

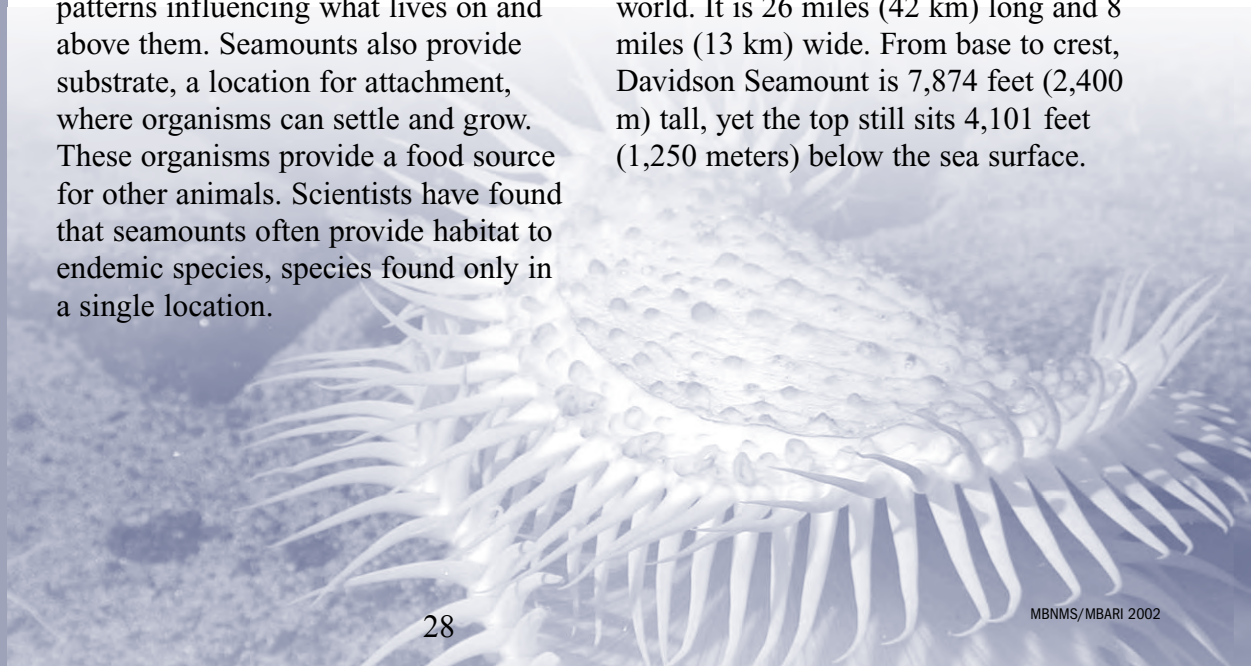
BACKGROUND INFORMATION

Seamounts are underwater mountains with steep sides rising over 3,280 feet (1,000 meters) above the surrounding seafloor. There are over 30,000 seamounts in the Pacific Ocean alone, yet remarkably, less than 0.1% of the seamounts in the world have been explored.

Studies that have been conducted over seamounts indicate that seamounts function as "oases of life," with higher species **diversity** and **biomass** found on a seamount and in the waters around it than on the surrounding seafloor. Seamounts rise up high in the water column, creating complex current patterns influencing what lives on and above them. Seamounts also provide substrate, a location for attachment, where organisms can settle and grow. These organisms provide a food source for other animals. Scientists have found that seamounts often provide habitat to endemic species, species found only in a single location.

The National Marine Sanctuaries Act requires a review of boundaries during a management plan review. The MBNMS received many comments during the public scoping period suggesting many boundary expansions, including moving the southern boundary up to 80 miles south, or adding the four seamounts west of the current MBNMS boundary. The MBNMS evaluated these public suggestions and is further considering adding only the Davidson Seamount to the MBNMS.

Davidson Seamount is located 75 miles (120 km) southwest of Monterey and is one of the largest seamounts in the world. It is 26 miles (42 km) long and 8 miles (13 km) wide. From base to crest, Davidson Seamount is 7,874 feet (2,400 m) tall, yet the top still sits 4,101 feet (1,250 meters) below the sea surface.



MBNMS/MBARI 2002

SOME OF THE UNIQUE QUALITIES OF THE DAVIDSON SEAMOUNT:

The following criteria, from the NMSA, are used to determine qualification of sites seeking National Marine Sanctuary status. These guidelines were examined by the working group and Sanctuary Advisory Council to determine Davidson Seamount's elligibility and were outlined as follows:

Conservation Qualities: Davidson Seamount is the largest seamount in the eastern Pacific Ocean and is one of the largest seamounts in the world. It may have unique links to the nearby Partington and Monterey submarine canyons. The seamount is home to fragile deep sea coral forests estimated to be ***more than 100 years old***. It provides habitat for many rare and endemic species.

Ecological Qualities: Davidson Seamount has a pristine undersea ecosystem containing a diversity of habitats and sea life. A 2002 research expedition documented previously undiscovered species and species assemblages including large patches of corals and sponges. This biological diversity is not currently known to exist on other central California seamounts.

Education Qualities: Davidson Seamount's proximity to the MBNMS and the Monterey Bay Aquarium offer excellent opportunities to educate the public about seamounts, cold-water sponges and corals, and seafloor topography.

Scientific Qualities: NOAA has worked in partnership with marine research institutions and universities to explore Davidson Seamount and it is now one of the better-studied seamounts in the world. With a history of detailed research dives and high-resolution maps, scientists can learn a great deal from the information gathered at Davidson Seamount. The seamount's proximity to Monterey scientific research institutions makes it accessible for further study.

Historical Qualities: The Davidson Seamount was the first geologic feature described as a seamount. It was first mapped in 1933 and was named for George Davidson, a historic figure in early charting and mapping.

Aesthetic Qualities: Hundreds of high-quality photographs, maps and video of Davidson Seamount's unique creatures, including fishes, deep sea corals, and invertebrates as well as the seamount's remarkable topography are available via NOAA websites, visitor centers, CD products, newspaper articles, television broadcasts, and presentations.

What Are The Threats To Davidson Seamount?

There is currently no comprehensive conservation and management scheme in place to protect the organisms on the seamount or the surrounding ecosystem. Existing federal and state regulations do not protect Davidson Seamount from a variety of potential threats:

Marine debris/dumping: The Davidson Seamount area is not presently protected from targeted offshore dumping.

Bio-prospecting: Some groups of organisms found on seamounts have been targeted for commercial products. Extensive collection of sensitive species for commercial use, or bio-prospecting, would damage the fragile ecosystem.

Seafloor harvesting: Presently, there is no known commercial harvesting activity at Davidson Seamount and no known populations of fish or invertebrates to support a fishery. As discoveries of precious corals or other potential commercial species on Davidson Seamount become public, commercial harvest of any kind, with new deep sea techniques, could cause severe damage.

Installation of cables or other structures: Listening arrays have been installed on nearby seamounts and commercial fiberoptic cables have been laid nearby. The large corals and other fragile species could be severly damaged by uncontrolled construction or ther seabed disturbance.

Cumulative research collection: Worldwide, there has been increased interest in studying deep sea corals such as the large pink bubblegum coral, *Paragorgia*. Davidson Seamount has several rare, slow growing coral species, including *Paragorgia*. Unmanaged collection of slow growing species, even to learn more about them, can damage fragile ecosystems.

Would Existing Fisheries Be Affected?

Existing fishing activities would not be affected. Two commercial fisheries currently active in the waters above Davidson Seamount – drift gill netting for swordfish and sharks, and trolling for albacore tuna – operate in the top 150 feet (46 meters) of water, 3,951 feet (1,204 meters) above the seamount. Proposed regulations would not affect, in any way, these fisheries. The MBNMS is working with the Pacific Fishery Management Council to draft a regulation prohibiting fishing only at the Davidson Seamount, and only below the 3,000 foot water depth.

THE SANCTUARY'S ACTION PLAN

The sanctuary's "Davidson Seamount Action Plan" was developed jointly with a variety of stakeholders and partners and includes the following components:

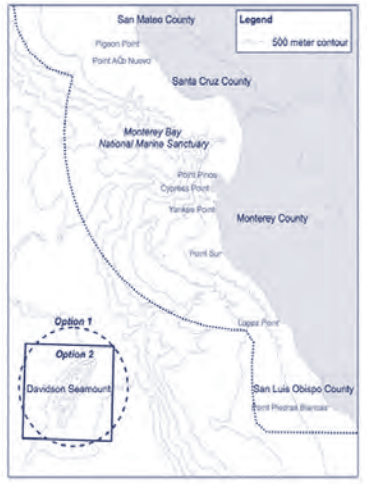
- Developing a Draft Environmental Impact Statement for inclusion of the Davidson Seamount into the Monterey Bay National Marine Sanctuary
- Drafting regulations to prohibit activities harmful to the Davidson Seamount
- Characterizing the Davison Seamount region, including the oceanography, biology, geology, cultural history, and socio-economics of the seamount
- Conducting ecological studies to better understand the seamount, including regular benthic studies, conducting deepwater coral aging and restoration studies, and performing research on the distribution and abundance of species at the Davidson Seamount
- Developing a comprehensive resource protection program to identify and characterize potential threats and to develop an enforcement plan
- Developing outreach and education programs to inform the public about the Davidson Seamount's geologic, oceanographic, and ecologic qualities

For a complete listing of the sanctuary's "Davidson Seamount Action Plan" please visit http://sanctuaries.nos.noaa.gov/jointplan/m_reptoad.html and scroll down the page.

How Would the Public Benefit?

Some of the public benefits of including Davidson Seamount in the Monterey Bay National Marine Sanctuary are:

- Comprehensive protection of a unique, pristine geologic formation for existing and future generations
- Increased national awareness and public understanding of seamount systems
- Protection of rare, new and fragile species and their ecologically significant habitat
- Enhanced long-term research vital to future resource management

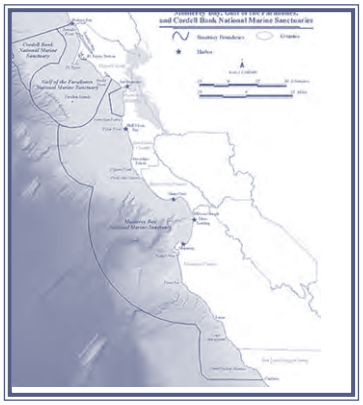


Davidson Seamount is one of the largest seamounts in the world and rises more than 7,800 feet (2400 meters) above the ocean floor.

The Joint Management Plan Review (JMPR)

"Davidson Seamount" is one of the action plans in the MBNMS Draft Management Plan. The MBNMS Draft Management Plan includes twenty-eight plans that, once finalized, will guide sanctuary management for the next five years. The plan is a revision of the original management plan, adopted with sanctuary designation in 1992, and is focused on how to best understand and protect the sanctuary's resources.

The National Marine Sanctuary Program (NMSP) is updating the management plans for the Cordell Bank, Gulf of the Farallones, and Monterey Bay National Marine Sanctuaries in what is known as the Joint Management Plan Review (JMPR).



GLOSSARY

Biomass: The total weight of living organisms.

Diversity: The number of different species inhabiting a particular area.

George Davidson
As a young man.

How You Can Get Involved in the MBNMS Management Plan Process

The MBNMS welcomes your ideas about important resource management issues in the sanctuary. A Draft Management Plan and Draft Environmental Impact Statement are scheduled for release to the public in 2006. Following their release, hearings will be held in several locations throughout the region to gather public comment. Written comments will be accepted as well. To find out about public hearings, or how to submit written comments, please visit our website at http://www.sanctuaries.nos.noaa.gov/jointplan.

Resources

Monterey Bay National Marine Sanctuary
http://montereybaynoaa.gov/resourcepro/resmanissues/coastal.html
National Oceanic and Atmospheric Administration's Office of Exploration
http://www.oceanexplorer.noaa.gov/explorations/02davidson/davidson.html
Sanctuary Integrated Monitoring Network (SIMoN) http://www.mbnms-simon.org

THE MONTEREY BAY NATIONAL MARINE SANCTUARY

Stretching from Marin to Cambria, the Monterey Bay National Marine Sanctuary encompasses 276 miles of shoreline and 5,322 square miles (4,625 nautical miles) of ocean, extending an average distance of 30 miles from shore. At its deepest point, the sanctuary reaches down 10,663 feet (more than two miles). The sanctuary was established for the purposes of resource protection, research, education, and public use. Its natural resources include one of our nation's largest kelp forests and one of North America's largest underwater canyons. It is home to one of the most diverse marine ecosystems in the world, including 33 marine mammal species, 94 seabird species, 345 fish species, and numerous invertebrates and plants. This remarkably productive marine environment is fringed by spectacular coastal scenery, including sandy beaches, rocky cliffs, rolling hills, and steep mountains.

Published in 2006 by MBNMS 299 Foam Street Monterey, CA 93940 (831) 647-4201 Design by Michelle Keefe

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Ecological Characterization of Davidson Seamount

Management Issue

The unique habitat and organisms associated with the Davidson Seamount need to be characterized and studied to assess management needs for resource protection.

Description

Studies indicate that seamounts function as deep-sea "islands" of localized species distributions, dominated by suspension feeders (e.g., corals) that grow on rock in an otherwise flat, low biomass, sediment-covered abyssal plain. The Monterey Bay National Marine Sanctuary (MBNMS or Sanctuary) needs to increase understanding of the Davidson Seamount through habitat characterization and the study of ecological processes so that the sensitive and long-lived species found there can be protected. Human threats include bio-prospecting, cumulative impacts from research collecting of long-lived species, new or unknown forms of seafloor disturbance, new technologies to harvest from the seabed, ocean acidification, and marine debris/dumping. To assess the potential impacts of such threats on Davidson Seamount habitats and animals, research is needed on temporal changes in the biological community associated with Davidson Seamount; on the taxonomy and natural history of Seamount species; on the age structure of coral communities and their suitability to restore more impacted Sanctuary habitats; on how mid-water and surface-water species use areas above the seamount; and on the ecological links between the seamount and other habitats of the Sanctuary.

Bubble gum coral (Paragorgia arborea) *on the Davidson Seamount at 1310 meters. Image credit: NOAA/MBARI*

Questions and Information Needs

1) Are there temporal changes in the biologic community living on or near the Davidson Seamount?

2) What is the taxonomy and natural history of described or rare species found on the seamount?

3) What is the age structure of the coral community living on the Davidson Seamount, and can these corals be used to restore historical coral populations in more impacted areas of the Sanctuary?

4) Which species use mid-water and sea surface areas above the seamount?

5) What are the oceanographic conditions, including pH, and how do they influence regional ecology?

6) What is the historical role of the seamount in mapping, fishing, whaling, and research? How does the Davidson Seamount historically and geologically relate to other seamounts?

7) Are there ecological links between the seamount and other habitats of the Sanctuary (e.g., migration pathways and nutrient transport)?

8) How do Davidson Seamount explorations further our understanding of basic seamount ecology?

Scientific Approach and Actions

- Conduct regular biologic surveys of habitats associated with the Davidson Seamount
- Conduct deepwater coral ageing and restoration studies
- Understand links with Sanctuary's coastal areas

Updated: 11/28/2012

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

Potential Key Partners and Information Sources

Monterey Bay Aquarium Research Institute, Moss Landing Marine Labs, Monterey Bay Aquarium, National Centers for Coastal Ocean Science, National Evolutionary Synthesis Center, National Marine Fisheries Service

Management Support Products

- Geological, biological and ecological characterization
- Site characterization document

Planned Use of Products and Actions

- Implement resource protection plan
- Increase understanding through characterization and ecological process studies
- Develop education programs and visitor center displays

Program References

MBNMS Management Plan

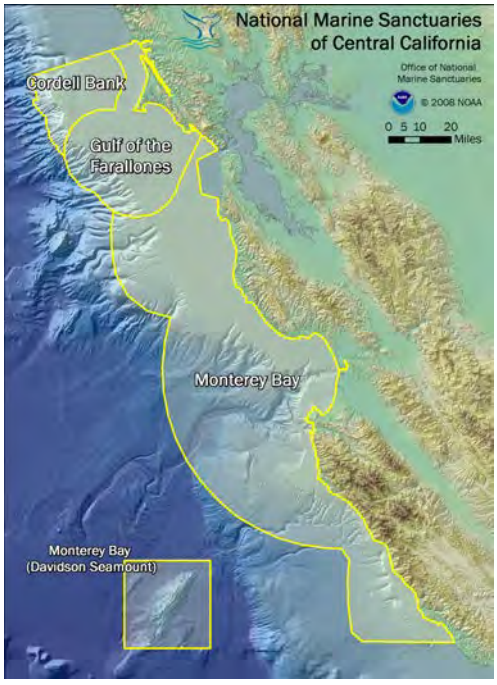
- Davidson Seamount Action Plan, Strategy DS-1, DS-2

MBNMS Condition Report

- Davidson Seamount not included in condition report, because it was only recently included in the Sanctuary in 2009

ONMS Performance Measures

- Davidson Seamount is adequately characterized
- Develop education and outreach opportunities about the seamount at visitor centers and a series of media products related to its incorporation into MBNMS



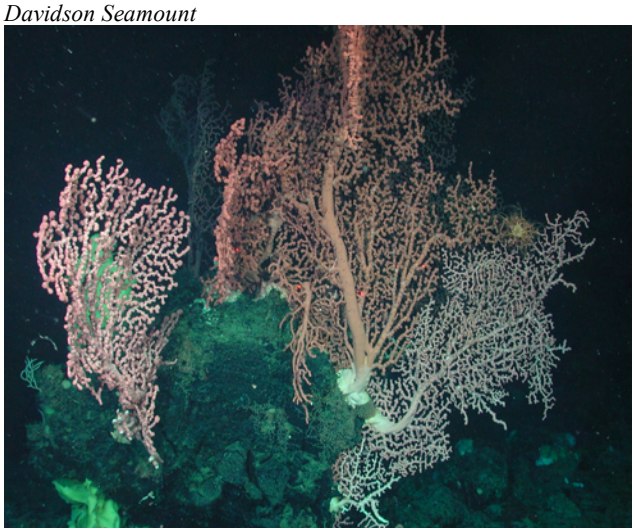
Location of Davidson Seamount relative to the Monterey Bay National Marine Sanctuary. Map credit: MBNMS/SIMoN

Davidson Seamount Action Plan

Goal

Develop and implement a resource protection plan for the Davidson Seamount, increase understanding of the seamount through characterization and ecological process studies, and develop education programs for the seamount and other seamounts throughout the nation.

*Figure DS-1: Fragile cold-water corals (*Paragorgia arborea*) at Davidson Seamount*



Introduction

Less than 0.1 percent of the world's seamounts have been explored for what species live on them, and many species found on seamounts are new to science. Seamounts are often dominated by suspension feeders, like corals, that grow on rock in an otherwise flat, low biomass, sediment-covered abyssal plain. In addition, seamounts create complex current patterns that can influence sea life above them. Commercially valuable fish species often concentrate around relatively shallow seamounts due to enhanced upwelling caused by current deflection. Conservation issues relevant to seamounts revolve around endemism, harvest, and the low resilience of species. A survey in the southwest Pacific suggests that up to one-third of the species on seamounts can be endemics.

Davidson Seamount is located seventy-five miles to the southwest of Monterey, due west of San Simeon, and is one of the largest known seamounts in U.S. waters. It is twenty-six miles long and eight miles wide. From base to crest, Davidson Seamount is 7,480 feet tall; yet, it is still 4,101 feet below the sea surface at its highest point. Davidson Seamount has an atypical seamount shape, having northeast-trending ridges created by a type of volcanism only recently described, and it last erupted about 9.8 million years ago. This large geographic feature was the first underwater formation to be characterized as a "seamount" and was named after the Coast and Geodetic Survey (forerunner to the National Ocean Service) scientist George Davidson.

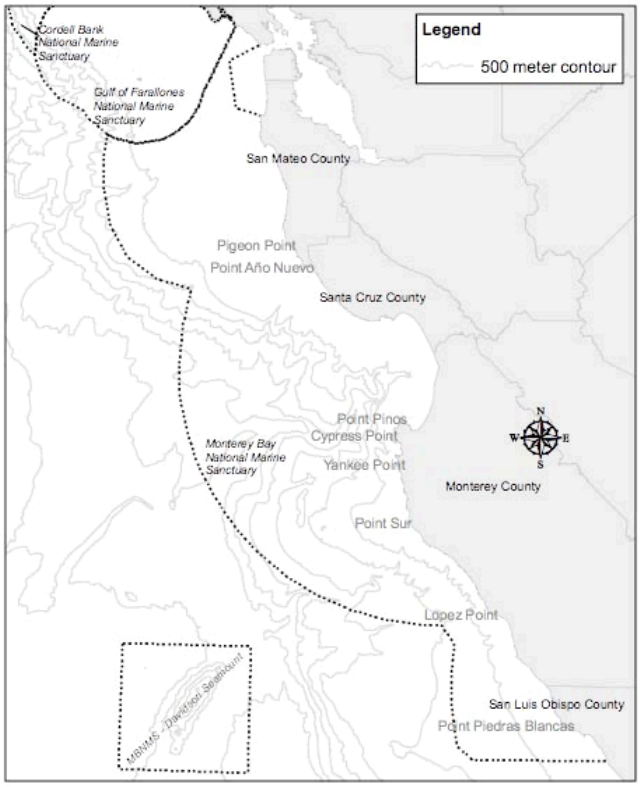
Species associated with Davidson Seamount can be divided into habitats including: the sea surface habitat (birds in flight and on the sea surface), the midwater habitat (0 – 4,100 feet below sea surface), the seamount crest habitat (4,100 – 4,900 feet), the seamount slope habitat (4,900 – 8,200 feet), and the seamount base habitat (8,200 – 11,500 feet). The surface habitat hosts a variety of seabirds, marine mammals, and surface fishes, including albatross, shearwaters, jaegers, sperm whales, killer whales, albacore tuna, and ocean sunfish. At this time, there is no published evidence that the species composition in this surface habitat is different than adjacent areas without a seamount below, although in some years Davidson Seamount may enhance albacore fishing. Organisms in the midwater habitat have a patchy distribution with marine snow, organic matter that continually "rains" down from the sea surface, most likely providing

an important food source for deep-sea animals. Swimming worms, and an undescribed mollusk have been seen above Davidson Seamount.

The seamount crest habitat is the most diverse, including Paragorgia arborea (a large gorgonian coral) forests, vast sponge fields (consisting of both described and undescribed species), crabs, deep-sea fishes, shrimp, and basket stars. The seamount slope habitat is composed of cobble and rocky areas interspersed with areas of ash and sediment that host a diverse assemblage of sessile invertebrates and rare deep-sea fishes. The seamount base habitat is the interface between rocky outcrops and the deep soft bottom. Species here are similar looking to their relatives in the nearshore, including sea cucumbers, urchins, anemones, and sea stars.

Anthropogenic influence on Davidson Seamount has been detected in the form of DDT in sediments near its base, and trash (e.g., bottles, cans, brooms, newspapers, buckets, curtains) discarded from the sea surface. However, because of the abundance of large, fragile species (e.g., corals greater than eight feet tall, some at least 200 years old, as well as vast fields of sponges) and an apparently, physically undisturbed seafloor, the area appears relatively pristine. The top of the seamount is too deep for most fish trawling technology; moreover, fish density is very low, and the species seen to date are not commercially desirable. The existing albacore tuna and swordfish/shark fisheries operate in the top 150 feet of water, thousands of feet above the summit of the seamount.

Figure DS-1: Davidson Seamount Management Zone within the Monterey Bay National Marine Sanctuary.



Davidson Seamount is important for science to study how the seamount is ecologically linked with the coastal waters, nearshore canyons, and species currently protected in the MBNMS. Protecting it will help facilitate research to understand how the Monterey Bay and Big Sur Canyon complexes have an effect on Davidson Seamount and what the migration pattern of species is between the seamount and nearshore.

Threats to the Davidson Seamount

Conservation issues related to seamounts revolve around endemism (species only found on a specific seamount), harvest, and low resilience of species. Existing and potential threats to Davidson Seamount include bio-prospecting, cumulative impacts from research collecting of

long-lived species, new or unknown forms of seafloor disturbance, new technologies to harvest from the seabed, "exploratory" benthic fishing which could destroy habitat and long-lived species, and marine debris/dumping. Although management agencies are responsible for some activities that may occur at the seamount, there is currently no comprehensive protection and management of organisms on the seamount or the surrounding ecosystem, and coordinated education or research programs addressing Davidson Seamount issues are in their infancy. By incorporating the seamount into the MBNMS, its resources will be protected and opportunities will be provided for a better understanding of the seamount.

Expansion of the MBNMS to Include Davidson Seamount Management Zone

The Davidson Seamount Management Zone (DSMZ) is a recent addition to the MBNMS, as part of the adoption of this management plan. This area encompasses approximately 585 square nautical miles of ocean waters and the submerged lands there under. The boundary resembles a square box, approximately twenty-five nautical miles per side, centered on the summit of Davidson Seamount. The uniform lines and symmetry of the boundary configuration offer easy navigation by longitude and latitude even though the seamount is physically disconnected from the MBNMS boundaries contiguous with the shoreline (See Figure DS-1). Standard MBNMS regulations apply within the DSMZ, without the exceptions for seabed alteration. Below 3,000 feet, in addition to a general prohibition by the MBNMS, a prohibition on fishing was implemented by NMFS in June of 2006 to address potential threats to the seamount and natural resources.

Strategy DS-1: Conduct Site Characterization

The purpose of this strategy is to complete a number of already initiated studies on the DSMZ ranging from geological and biological characterization to zoological and oceanographic surveys, while further initiating a socioeconomic survey. The strategy will also result in a complete cultural history analysis and site characterization document for Davidson Seamount.

Activity 1.1: Complete Geologic and Biological Characterization of the Seamount

In addition to initiated studies, a complete analysis of existing video transects from the Davidson Seamount Management Zone (DSMZ) of species and habitat types from past NOAA and the Monterey Bay Aquarium Research Institute (MBARI) research cruises will be completed. In 2006, a collaborative research cruise with MBARI and the British Broadcasting Corporation (BBC) successfully obtained information from other unvisited areas of Davidson Seamount to produce an education video.

Activity 1.2: Identify Taxonomy and Natural History of Rare or New Species

Seamounts are known to have a high percentage of endemism. This creates many taxonomic questions concerning the possible discovery of new deep-water corals. Past surveys of Davidson Seamount indicate species that are rare or new to science altogether.

Activity 1.3: Conduct Zoological Survey of Surface and Midwater Areas Above the Seamount

Additional cruises from the NOAA ships are necessary to describe surface and mid-water species, sea turtles, birds, and mammals. The Sanctuary Aerial Monitoring and Spatial Analysis Program (SAMSAP) has been established within the area using local NOAA aircraft and has

been incorporated into the MBNMS's monitoring program. The SAMSAP program is designed to monitor the locations of different kinds of commercial and recreational vessels as well as distributions of some species of interest, including cetaceans (whales and dolphins), and some physical conditions, such as spilled oil. During aerial surveys, observers document the precise locations of the vessels, animals and physical characteristics using a Global Positioning System (GPS). Observers distinguish between commercial and recreational vessels, and between consumptive and non-consumptive activities. When observers see fishing gear in the water, the type of fishing activity is noted.

Activity 1.4: Initiate Oceanographic Surveys of Seamount Region

Oceanographic surveys will be conducted using the NOAA ships and satellite imagery. The data from the surveys will be linked with national coastal observatories (i.e., Central and Northern California Ocean Observing System) resulting in a better understanding of ocean current patterns on and around Davidson Seamount. This will also enable researchers to determine how the ocean current patterns affect life on and around Davidson Seamount and generally, how Davidson Seamount has an influence on the regional ecology.

Activity 1.5: Complete Socioeconomic (Commercial, Recreational, Research Uses) Analysis

In comparison to the rest of the MBNMS, there are relatively few user groups in the Davidson Seamount region. However, a comprehensive understanding of key users of the seamount region is needed. Learning more about who uses the seamount region over a period of time is critical to effective education and protection.

Activity 1.6: Characterize Cultural History of Davidson Seamount

Throughout history Davidson Seamount has played a role in mapping, fishing, whaling, and research. By working with the Monterey History and Art Association/Maritime Museum of Monterey, the MBNMS can characterize and further highlight the role of the seamount in the region's rich maritime past, and the history of the seamount's namesake, George Davidson. His many contributions to maritime history and his personality as a maritime figure are important and have heritage value. Additionally, a history concerning the types of seamounts nationally and worldwide will be included. Among the results of this activity will be reports. A video for visitor centers was created and disseminated among the public, stimulating interest that has heuristic value.

Activity 1.7: Incorporate Site Characterization Document in MBNMS Websites

All relevant data from above activities (1.1-1.6) will be incorporated into the MBNMS websites, updating all physical and biological information. A Davidson Seamount chapter will be added to the MBNMS Site Characterization, while incorporating all seamount information into the geology chapter.

Strategy DS-2: Conduct Ecological Processes Investigations

In addition to characterizing the seamount region, Strategy DS-2 will result in the description of process studies to determine the causes of distribution and abundance of species. Several hypotheses to be tested include the role of seamounts as either: 1) islands, where seamounts serve as a sink for larval recruits originating in adjacent habitats; or 2) oases, where seamounts serve as a source of larvae integral to the surrounding areas. Another proposed hypothesis is

seamounts may acquire heightened biodiversity through the presence of coral and sponge fields, which promote local species coexistence by offering increased habitat complexity. High biodiversity of seamounts may also reflect rapid habitat turnover associated with substrate type, currents, temperature, oxygen concentration, and other abiotic/biotic parameters encountered across the flanks and summits of the seamount. Currently, we are assessing these hypotheses, and other ecological process studies, utilizing data collected from Remotely Operated Vehicle (ROV) dives at Davidson Seamount conducted in 2000, 2002, 2006, and 2007 through a collaboration of MBARI, MBNMS, and other NOAA partners.

Activity 2.1: Conduct Regular Benthic Surveys of Davidson Seamount

The DSMZ benthos must be monitored. Based on information from early site characterization and preliminary studies, a benthic monitoring plan will be developed for Davidson Seamount. Data from this monitoring program will be made available through the Sanctuary Integrated Monitoring Network (SIMoN) website.

Activity 2.2: Conduct Deep-water Coral Age Determination and Restoration Studies

Cold-water corals are receiving increased attention in terms of scientific studies and conservation. The relatively pristine nature of Davidson Seamount and its diverse coral populations provide for a number of opportunities for age determination, and restoration efforts to historical locations of corals in impacted areas of the MBNMS. A research plan for deep-water coral studies will be developed, linking the activities to the resource protection portion of Davidson Seamount action plan.

Activity 2.3: Perform Research on Seamount to Expand Understanding Distribution and Abundance of Species

Designation of Davidson Seamount as a managed area provides the status and opportunity for advancing the basic ecological understanding of seamounts. One such example would be to determine causes of high diversity and patchiness of Davidson Seamount corals and sponges.

Activity 2.4: Understand Links with Coastal Area of Sanctuary

It is important to understand how the seamount is linked ecologically with the coastal area of the Sanctuary. For effective ecosystem management, we should understand questions, such as how the Monterey Bay and Big Sur Canyon complexes have an effect on the DSMZ, or what the migration and dispersal patterns of species are among these diverse systems.

Activity 2.5: Initiate up-to-date faunal inventory for Davidson Seamount

A single cohesive database of existing biota will be created including information on the species' biogeography (known distribution of the species on Davidson, Eastern Pacific Seamounts, seamounts globally, and non-seamount habitats), habitat preference, trophic level, and range of densities.

Activity 2.6: Development of long-term monitoring plan through analyses of faunal database

Analyses of a faunal database will enable a long-term monitoring plan to be developed to understand ecological processes at the seamount, and the sensitivity and resilience of seamount biological communities to anthropogenic perturbations.

Strategy DS-3: Develop Resource Protection Program

MBNMS regulations will protect and enhance understanding of Davidson Seamount. Two modifications to standard MBNMS regulations were established to address resource threats: (1) because of the depth of the seamount, there is no need to have exceptions to the regulation prohibiting drilling into, dredging or otherwise altering the seabed that allow for anchoring vessels, aquaculture, kelp harvesting or lawful fishing operations, harbor maintenance, or collection of jade, therefore these exceptions will not apply in the DSMZ; and (2) an additional regulation has been issued to prohibit the disturbance, collection or harvesting of any sanctuary resources in areas below 3,000 feet of the sea surface (unless a permit is obtained for this activity).

Activity 3.1: Continuously Characterize the Potential Threats to Davidson Seamount

A threats and protection plan will be developed based on a thorough literature review, workshops with experts, and a socioeconomic and biological characterization. Initial research has enabled the identification of potential threats to Davidson Seamount and associated resources, including the following.

A. *Bio-prospecting*
   Some groups of organisms found on Davidson Seamount have been targeted for collection in other areas of the world for developing medicine. Discovering medicinal uses for natural products is important for enhancing human health services, however over-collection of rare or sensitive species can disrupt natural habitats.
B. *Cumulative research collecting of long-lived species*
   Where there are limited populations of slow growing species, research collection can be detrimental. Over the last two years, there has been increased worldwide interest in studying deep-sea corals such as the large pink gorgonian coral, Paragorgia arborea, found on Davidson Seamount, and they are often collected. This problem is exacerbated on seamounts that have a high degree of endemism, and Davidson Seamount has several other taxa that are slow growing and rare. Research is critical to understanding and managing ecosystems, so appropriate scientific collecting is often encouraged with permits to ensure minimal impacts.
C. *New or unknown forms of seafloor disturbance, including exploratory fishing / new technologies to harvest from the seabed*
   Harvesting from Davidson Seamount is not a currently known commercial activity. With new discoveries of precious corals or other commercial species, in concert with more effective harvest technologies being explored at depths of greater than 4,000 feet, commercial harvest at Davidson Seamount could quickly cause severe impacts before protective regulations could be issued. The concerns relative to impacts to Davidson Seamount are largely for protecting a fragile area before it is severely impacted.
D. *Marine debris / dumping*
   The Davidson Seamount area should be excluded from targeted dumping, and education about the site's significance could augment existing federal regulations regarding at-sea dumping.
E. *Ocean acidification*

Although changes in ocean chemistry due to anthropogenic release of CO2 are relatively well established, what needs more attention is determining what impact this drop in pH will have on deep-sea organisms.

Activity 3.2: Initiate Resource Protection Measures as Necessary

Characterization of the potential threats to Davidson Seamount may require initiation of additional protective measures or enhanced enforcement of existing regulatory measures to ensure adequate protection. Integration of the SAMSAP program will enable enhanced monitoring abilities for the DSMZ including vessel traffic monitoring and fishing use that currently occurs in the DSMZ. In addition SAMSAP will provide biological monitoring capabilities to the MBNMS to establish potential conflicts between the surface use of marine organisms such as cetaceans and vessels.

Activity 3.3: Develop and Implement Enforcement Plan for DSMZ

Based on Activities 3.1 and 3.2, a threats management plan will be developed. Incorporated into this plan will be the identification of collaborative agencies to develop enforcement partnerships. Enforcement of Sanctuary regulations relevant to Davidson Seamount will be integrated into the MBNMS enforcement program. The distance of Davidson Seamount from the coastline will require coordination of the U.S. Coast Guard, NOAA Office of Law Enforcement, and the California Department of Fish and Game to establish surveillance and response capabilities for the area. Aerial surveys, such as SAMSAP, will be incorporated into the enforcement effort as well as patrols on USCG and NOAA ships.

Activity 3.4: Develop Permitting Considerations to Facilitate Continued Appropriate Research and Education

This permit process should facilitate the continuation of appropriate research and education while minimizing impacts to the benthic habitat of the seamount, to accompany extending the regulations and the MBNMS permit program into this new habitat.

Strategy DS-4: Conduct Seamount Education and Outreach Initiatives

Davidson Seamount has captivated the public through numerous media reports (including the CBS Nightly News and American Airlines in-flight news) and through NOAA's Ocean Explorer web site (http://oceanexplorer.noaa.gov/explorations/06davidson/welcome.html). A recent survey of the public, related to developing a visitor center for the MBNMS, found that one of their top interests was in "seafloor topography" of which canyons and seamounts are dramatic examples. Proximity to the Monterey Bay Aquarium and other education institutions provides excellent education opportunities (e.g., displays on seamounts). The proximity of education and research institutions in the Monterey Bay region facilitates interdisciplinary collaborations that enhance research and education. Davidson Seamount and MBNMS's research efforts have generated significant interest in the Cambria and San Simeon area and will be prominently featured in the San Simeon Visitor Center.

Activity 4.1: Conduct an Educational Needs Assessment

The MBNMS will actively work with the Sanctuary Education Panel to identify target audiences. Subsequently, an educational needs assessment will be completed. Finally, relevant information regarding the DSMZ will be synthesized.

Activity 4.2: Develop and Implement Davidson Seamount Education and Outreach Program

Information on the DSMZ will be incorporated into educational material and interpretive centers. These will include items such as CD-ROMs, a website, and print material. Building on the opportunity that the DSMZ is the only seamount in the National Marine Sanctuaries Program, educational information on seamount biological diversity, habitats, and species of related interest, such as cold-water corals and sponges will be provided to all relevant NOAA programs.

Activity 4.3: Explore the Potential Use of Davidson Seamount Footage within the MBNMS Interpretive Center and Other Virtual Experiences

Incorporate Davidson Seamount video and still photos into the exhibits of the San Simeon Coastal Discovery Center. Creating a narrative of selected footage will encourage use of the video footage obtained beyond the MBNMS. As the National Marine Sanctuary Program (NMSP) telepresence program develops, the potential for use of this high quality footage is very likely; creating prepared footage for use will be key to its use across the nation.

Activity 4.4: Involve MBNMS Education Staff in Davidson Seamount Research

Involvement by the education staff in research on Davidson Seamount will increase public knowledge of the seamount, expose the uniqueness of the region, and ensure necessary outreach pieces are created for use in resource management decision making.

Activity 4.5: Involve the Education and Outreach Mechanisms within NOAA to Promote the Existing and New Research on Davidson Seamount

The 2002 mission to the seamount, in conjunction with NOAA's Office of Exploration and Research (OER), was hugely successful due to the combined efforts of the MBNMS, NMSP, and OER. This relationship and others should always be considered when new cruises and campaigns are considered.

Activity 4.6: Expand Outreach and Education Efforts in San Simeon / Cambria Region

MBNMS will develop outreach materials and displays for the San Simeon Coastal Discovery Center to address the increased interest in the region regarding the natural resources of Davidson Seamount. MBNMS staff will also incorporate discussion of Davidson Seamount into local presentations and outreach events.

Action Plan Partners: Monterey History and Art Association / Maritime Museum of Monterey, Monterey Bay Aquarium Research Institute, Moss Landing Marine Labs, Monterey Bay Aquarium, Save The Earth, United States Coast Guard, National Marine Fisheries Service, UC Sea Grant, fishermen, The Ocean Conservancy, California Department of Fish and Game

Table DS.1: Measuring Performance of Davidson Seamount Action Plan

Desired Outcome(s) For This Action Plan:	
Protect Davidson Seamount from potential threats while increasing understanding of the seamount through characterization, public education efforts and ecological process studies.	
Performance Measure	**Explanation**
By 2012, Davidson Seamount is adequately characterized.	Implementation of this action plan will result in protection of the seamount, but more importantly, an understanding of the fragile communities and habitat associated with Davidson Seamount. The 2006 research cruise to Davidson Seamount created a valuable addition to the body of knowledge in the site characterization, which must be built upon through further research and monitoring. Performance will be measured for this action plan through an annual assessment of our understanding of the habitats and species of Davidson Seamount.
Develop education and outreach opportunities about the seamount at visitor centers by 2010 and a series of media products related to its incorporation into MBNMS by 2009.	NMSP will incorporate awareness of Davidson Seamount into surveys related to national marine sanctuaries and the sanctuary system.

Table DS.2: Estimated Timelines for Davidson Seamount Action Plan

Davidson Seamount Action Plan	**YR 1**	**YR 2**	**YR 3**	**YR 4**	**YR 5**
Strategy D S-1:Conduct Site Characterization			●——▶	——▶	——▶
Strategy DS-2: Conduct Ecological Processes Investigations		●——▶	——▶	——▶	
Strategy DS-3: Develop Resource Protection Program	●·····	●——▶	——▶	——▶	——▶
Strategy DS-4: Conduct Seamount Education and Outreach Initiatives			●——▶	——▶	——▶

Legend	
Year Beginning/Ending : ●——●	Major Level of Implementation: ——
Ongoing Strategy : ●——▶	Minor Level of Implementation: ·····

Table DS.3: Estimated Costs for Davidson Seamount Action Plan

Strategy	**Estimated Annual Cost (in thousands)***				
	YR 1	**YR 2**	**YR 3**	**YR 4**	**YR 5**
Strategy DS-1: Conduct Site Characterization	$24	$28	$16	$8	$12
Strategy DS-2: Conduct Ecological Processes Investigations	$285	$0	$33.5	$10	$6
Strategy DS-3: Develop Resource Protection Program	$36	$40	$40	$72	$76
Strategy DS-4: Conduct Seamount Education and Outreach Initiatives	$30	$70	$14.5	$8	$14
Total Estimated Annual Cost	*$375*	*$138*	*$104*	*$98*	*$108*

* Cost estimates are for both "programmatic" and "base" (salaries and overhead) expenses.