

2007 MONITOR NATIONAL MARINE SANCTUARY CONDITION REPORT

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The document that follows is a copy of the draft Monitor National Marine Sanctuary Condition Report. Reviewer comments are embedded.

Monitor National Marine Sanctuary
Condition Report

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Comment [kb1]: The very small size and singular historical/cultural focus of the Monitor Sanctuary result in a less consistent fit within the SWiM matrix than that afforded more environmentally oriented sanctuaries. However, the Sanctuary staff members have responded admirably to address this, both in terms of the Condition Report format and in developing projects and partnerships to increase more formal monitoring of the environmental elements of the Sanctuary.

While the Condition Report is more than satisfactory, there are a few sections which would benefit from clarification.

Security of sites in all sanctuaries appears to be an issue not easily resolved due to the physical factors of size or location and attendant costs. *Monitor* Sanctuary staff members have been both pragmatic and creative, and focused efforts on education and outreach. The latter are effected through a variety of means including visual, print and electronic media and via the raising, conservation, exhibition and interpretation of salient components of the vessel and its contents. Not only do these methods reach the broadest possible public, they address the reality that while the deterioration of the site might be slowed, it cannot be stopped. Tacitly expressed is the consideration that environment will come to play an increasingly significant role in this sanctuary.

Overall the staff members of the Monitor National Marine Sanctuary have done a superior job of recognizing and taking steps to remedy any deficiencies of information, such as the placement of the Diamond Shoals Data Buoy within the Sanctuary (Pg. 14). Also, they have appropriately and adequately identified the current status of the Sanctuary and trends that could have effects in the future. This report will add to the battery of planning tools being employed for the management of this very important site and NOAA's first sanctuary.

Comment [PT2]: Who are the peer review group? Did the outside experts meet to develop the condition assessments?

Comment [kb3]: Overall, the Monitor Condition report is a well written overview of both the history and current status of the National Marine Sanctuary.

Cover photo credits left to right:

Map: Bathymetric Grids provided by NOAA's NGDC Coastal Relief Model. Divins, D.L., and D. Metzger, NGDC Coastal Relief Model, Vol2, <http://www.ngdc.noaa.gov/mgg/coastal/coastal.html>

Suggested Citation:

National Marine Sanctuary Program. 2007. *Monitor* National Marine Sanctuary Condition Report 2007. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Sanctuary Program, Silver Spring, MD. ** pp.

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Abstract

In an effort to protect the most famous shipwreck in US history, the *Monitor* was designated our first National Marine Sanctuary on January 30, 1975. The sanctuary is comprised of a column of water extending from the ocean's surface to the seabed and is one nautical mile in diameter. The Sanctuary boundaries protect the wreck of the USS *Monitor*, which lies 16 miles south-southeast of Cape Hatteras, North Carolina. Water depth in the sanctuary varies between 218 feet and 230 feet, depending on the tidal cycles and the Gulf Stream. Since its sinking in 1862, the *Monitor* has become a productive artificial reef. Numerous fish species including black sea bass, oyster toadfish and great barracuda call the *Monitor* home.

Scientists from the National Oceanic and Atmospheric Administration (NOAA) continue to study the wreck site of the *Monitor* today. They are learning more each year about the ship's construction, design and performance, as well as information regarding her loss on a stormy evening in December 1862 in an area of the Atlantic Ocean known as the Graveyard of the Atlantic. While most of the research conducted in the *Monitor* sanctuary to date has focused on the archaeological documentation of the shipwreck, NOAA scientists are now interested in studying the water quality and marine environment of the wreck site. A NOAA data buoy installed in the sanctuary in 2006 is providing scientists and the public the opportunity to monitor weather and sea conditions 24 hours a day.

The sanctuary's remote distance from shore poses special challenges for enforcement but is also one of the greatest factors in the *Monitor*'s continued preservation. The site depends heavily on education, word-of-mouth within the dive community, and voluntary compliance with regulations. When those are ineffective, partnerships with other government agencies such as the U.S. Coast Guard are vital to enforcing sanctuary regulations. *Monitor* sanctuary regulations prohibit anchoring, stopping, and drifting within the sanctuary; conducting salvage or recovery operations; using diving, dredging, or wrecking devices; conducting underwater detonation; drilling in the seabed; laying cable; and trawling. Access is generally limited to scientific research conducted under a permit issued by NOAA; however, special-use permits are issued for non-research visits to this historic vessel.

Initial dives in the 1970s indicated the *Monitor*'s iron hull, having been inundated with saltwater for over 100 years, was deteriorating at an accelerated rate. In response to this deterioration, NOAA developed a plan to recover significant "iconic" sections of the wreck for conservation and public display. Additionally, NOAA developed a plan to help stabilize the wreck from further deterioration as much as possible. Through an elaborate selection process, please describe the process. The Mariners' Museum in Newport News, VA was selected as NOAA's partner in this endeavor in 1987. Numerous recovery expeditions to the *Monitor* have returned a variety of artifacts including huge iron components such as the propeller, engine and rotating gun turret, delicate glass bottles, lumps of coal, wood paneling, a leather book cover and even walnut halves. Through a detailed conservation process and a variety of educational programs the history of the *Monitor* lives on.

Monitor National Marine Sanctuary

- The *Monitor* National Marine Sanctuary was designated on January 30, 1975 as the nation's first national marine sanctuary
- The sanctuary is located 16.1 miles off Cape Hatteras, North Carolina
- The USS *Monitor* was the first warship to use the invention of the turret successfully
- Management of the sanctuary is focused on preventing further deterioration of the wreck, recovery of important ship components and artifacts, and protecting the wreck from damage by human activities such as vessel anchoring and fishing.

Comment [A4]: Other NOAA-produced documents give the depth of the *Monitor* wreck at 235 – 240 feet.

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Comment [kb5]: There are four places where reference is made to the accelerating deterioration of the *Monitor* due both to natural and cultural factors (Pgs. 4, 5, 18 & 19) yet the Tables on pages 5 and 19 provide ratings of "Good/Fair" and show the bar symbol indicating the situation is not changing.

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Comment [A6]: The actual management plan for recovering 'iconic' artifacts – 'Charting a New Course for the *Monitor*' – was officially released in April 1998 (released as a draft in November 1997), following a series of dives in the early 1990s that showed the *Monitor* was deteriorating at a rapid rate – the plan refers to 'accelerated deterioration since 1990.' NOAA reported the deterioration

Comment [kb7]: The Abstract refers to NOAA having "developed a plan to help stabilize the wreck from further deterioration as much as possible," but this does not seem to appear in the report except perhaps on page 20 where there is a comment about the possibility of placing cathodic protection on the wreck site. Even this sounds as though it is more of a consideration than part of a developed plan. While there is no place to include this plan in the context of the report, a citation as to where it might be available would be helpful, and a reference to it ought to be included in the table on page 5 under Sanctuary Response in point 15.

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Comment [A8]: The Mariners' Museum was chosen prior to the release of the 1998 plan.

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Comment [A9]: I suggest a complete rewrite of this paragraph so that it conforms with official NOAA documentation.

Comment [PT10]: Generally, must be prepared to answer the question: "so, if everything worthwhile has been removed and displayed, and there are no negative impacts on the site, then why is the *Monitor* still a NMS?"

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Status:



Trends: ▲ Conditions appear to be improving.
 — Conditions do not appear to be changing.
 ▼ Conditions appear to be declining.
 ? Undetermined trend.
 N/A Question not applicable.

Comment [kb11]: Footnotes could be helpful in some cases. In the Table on Page 5, for example, a footnote could list what activities were potentially harmful in Rows 8 and 14 under Column "Description of Findings".

Monitor National Marine Sanctuary Condition Summary Table

Condition Summary: The results in the following table are a compilation of findings from the "State of Sanctuary Resources" section of this report. (For further clarification of the questions posed in the table, see Appendix A.)

#	Questions/Resources	Rating	Basis for Judgment	Description of Findings	Sanctuary Response
WATER					
1	Are specific or multiple stressors, including changing oceanographic and atmospheric conditions, affecting water quality and how are they changing?	—	Water current modeling and its effects on dissolved oxygen. No human impacts.	Conditions do not appear to have the potential to negatively affect living resources or habitat quality.	The <i>Monitor</i> National Marine Sanctuary regulations state that discharge of waste material within sanctuary boundaries is prohibited. [Any indication of discharge though? Samples taken?] There is a need to develop a water quality monitoring program in order to track conditions that could affect the integrity of the site.
2	What is the eutrophic condition of sanctuary waters and how is it changing?	N/A	The <i>Monitor</i> is located in water that is too deep for eutrophication to be a direct concern.	N/A	
3	Do sanctuary waters pose risks to human health and how are they changing?	—	No evidence that there is any risk posed.	Conditions do not appear to have the potential to negatively affect human health.	
4	What are the levels of human activities that may influence water quality and how are they changing?	—	Relatively no hazardous discharges, debris or other impacts.	Few or no activities occur that are likely to negatively affect water quality.	
HABITAT					
5	What is the abundance and distribution of major habitat types and how is it changing?	▲	<i>Monitor</i> attracts biological assemblages as an artificial reef.	Habitats are in pristine or near-pristine condition and are unlikely to preclude full community development.	The <i>Monitor</i> National Marine Sanctuary's regulations prohibit activities that could in any way alter the sanctuary's existing habitats or disturb or damage its natural resources. Activities such as anchoring, discharging waste material into the water, seabed drilling, seabed cable-laying, the detonation of explosive material, dredging and trawling are highly restricted within the sanctuary's boundaries.
6	What is the condition of biologically-structured habitats and how is it changing? [Please define "biologically-structured."]	N/A	There are no biologically-structured habitats. [But aren't there biological communities on the wreck itself?]	N/A	
7	What are the contaminant concentrations in sanctuary habitats and how are they changing?	—	Lack of sources and constant resuspension of sediments flushing any contaminants that may accumulate.	Contaminants do not appear to have the potential to negatively affect living resources or water quality. [Any sampling performed?]	
8	What are the levels of human activities that may influence habitat quality and how are they changing?	—	Limited human activity due to remote location and restrictions.	Some potentially harmful activities exist, but they do not appear to have had a negative effect on habitat quality.	
LIVING RESOURCES					
9	What is the status of biodiversity and how is it changing?	?	Lack of biological monitoring program. [Needed or planned for the future?]	N/A	Prohibition of commercial fishing in the sanctuary helps to eliminate pressure of fishing gear on the living resources. The <i>Monitor</i> sanctuary goal is to coordinate scientific research monitoring of the ecological condition of the sanctuary.
10	What is the status of environmentally sustainable fishing and how is it changing?	N/A	Fishing is not an issue of concern. [What about nets and lines?]	N/A	
11	What is the status of non-indigenous species and how is it changing?	?	Lack of biological monitoring program. [Aren't there known species – lionfish, etc.? Is monitoring needed or planned for the future?]	N/A	
12	What is the status of key species and how is it changing?	N/A	No key species have been identified.	N/A	
13	What is the condition or health of key species and how is it changing?	N/A	No key species have been identified.	N/A	
14	What are the levels of human activities that may influence living resource quality and how are they changing?	—	Evidence that fishing activities affect habitat quality and thus living resources.	Some potentially harmful activities exist, but they do not appear to have had a negative effect on living resource quality.	
MARITIME ARCHAEOLOGICAL RESOURCES					
15	What is the integrity of known	—	Combination of natural	Selected archaeological	The <i>Monitor</i> sanctuary was specifi

Comment [kb14]: The Abstract refers to NOAA having "developed a plan to help stabilize the wreck from further deterioration as much as possible," but this does not seem to appear in the report except perhaps on page 20 where there is a comment about the possibility of placing cathodic protection on the wreck site. Even this sounds as though it is more of a consideration than part of a developed plan. While there is no place to include this plan in the context of the report, a citation as to where it might be available would be helpful, and a reference to it ought to be included in the table on page 5 under Sanctuary Response in point 15.

	maritime archaeological resources and how is it changing?		deterioration and accelerated deterioration due to recovery activities from 1998-2002. <u>[Has this been determined as the cause of accelerated deterioration?]</u>	resources exhibit indications of disturbance, but there appears to have been little or no reduction in historical, scientific, or educational value.	designated to protect and preserve remains of the <i>Monitor</i> . Therefore, <i>Monitor</i> sanctuary regulations prohibit removal and damage to any historical resource in the sanctuary such as subsurface salvage or recovery operation, diving, lowering below any grappling, suction, conveyor, wrecking device are also prohibited.
16	Do known maritime archaeological resources pose an environmental hazard and is this threat changing? <u>[Add questions for MHP site]</u>	—	Lack of hazardous cargo	Known maritime archaeological resources pose few or no environmental threats.	
17	What are the levels of human activities that may influence maritime archaeological resource quality and how are they changing?	—	Prior evidence of marine debris and anchoring. Site is susceptible to future incidents of fishing strikes and debris accumulation	Selected activities have resulted in measurable impacts to maritime archaeological resources, but evidence suggests effects are localized, not widespread. <u>[The Monitor is the only thing there so localized impacts are a problem.]</u>	A major exhibit on the <i>Monitor</i> was opened at The Mariners' Museum News, Virginia to better inform the about the <i>Monitor</i> and its history.

Comment [kb12]: There are four places where reference is made to the accelerating deterioration of the *Monitor* due both to natural and cultural factors (Pgs. 4, 5, 18 & 19) yet the Tables on pages 5 and 19 provide ratings of "Good/Fair" and show the bar symbol indicating the situation is not changing.

Comment [A13]: I would amend this – as substantial portions of the midships' bulkhead have collapsed following hurricane activity in 2004 onward. Need to check with MNMS staff on exact date of collapse and extent thereof.

Comment [kb15]: Point 16 on the table on page 6, regarding whether or not archaeological resources might pose an environmental threat, immediately begged the question as to whether the converse might be true; could environmental/natural factors prove a hazard to the archaeological resources? Due to the heavy environmental weighting of the matrix questions, there is no place to explicitly address this but clearly this concern occurred to *Monitor* Sanctuary staff members who covered it astutely in other sections on pages 14, 16 and 18.

Comment [PT16]: The Sanctuary Response for number 15 says nothing relative to the status of the MHP. What about actual impacts from activities?

Comment [PT17]: Please add a couple of MHP elements for MHP sites in table and in text.

Comment [PT18]: Why is the “-” listed for Maritime Archaeological Resources (number 15) when page 13 of the text describes a deterioration of the integrity of the archaeological resources? Same for number 17.

Comment [PT19]: The N/A in the Living Resources section should be changed to a “?” as we cannot accurately denote these conditions due to a lack of information and monitoring. Why is N/A listed for numbers 12 and 13 instead of a “?” as we cannot respond to these without biological monitoring?

About This Report

This report provides a summary of resources in the National Oceanic and Atmospheric Administration's Monitor National Marine Sanctuary, pressures on those resources, the current condition and trends, and management responses to the pressures that threaten the integrity of the marine environment. Specifically, this document includes information on the status and trends of water quality, habitat, living resources and maritime archaeological resources and the human activities that affect them. It presents responses to a set of questions posed to all sanctuaries (Appendix A). Resource status is rated on a scale from good to poor, and the timelines used for comparison vary from topic to topic. Trends in the status of resources are also reported, and are generally based on observed changes in status over the past five years [good to put specific dates here], unless otherwise specified. Evaluations of status and trends were made by sanctuary staff, based on interpretation of quantitative and, when necessary, non-quantitative assessments and observations of scientists, managers and users. In many cases, sanctuary staff consulted outside experts familiar with the resources and with knowledge of previous and current scientific investigations. The ratings reflect the collective interpretation of the status of local issues of concern among sanctuary program staff and outside experts based on their knowledge and perceptions of local problems, but the final ratings were determined by sanctuary staff. Similar reports summarizing resource status and trends will be prepared for each marine sanctuary approximately every five years and updated as new information allows. This information is intended to help set the stage for management plan reviews at each site and to help sanctuary staff identify monitoring, characterization and research priorities to address gaps, day-to-day information needs and new threats. This report has been peer-reviewed and complies with the White House Office of Management and Budget's peer review standards as outlined in the Final Information Quality Bulletin for Peer Review.

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Introduction

The National Marine Sanctuary Program manages marine areas in both nearshore and open ocean waters that range in size from less than one to almost 140,000 square miles. Each area has its own concerns and requirements for environmental monitoring. Nevertheless, ecosystem structure and function in all these areas have similarities and are influenced by common factors that interact in comparable ways. Furthermore, the human influences that affect the structure and function of these sites are similar in a number of ways. For these reasons, in 2001 the program began to implement System-Wide Monitoring (SWiM). The monitoring framework (National Marine Sanctuary Program, 2004) facilitates the development of effective, ecosystem-based monitoring programs that address management information needs using a design process that can be applied in a consistent way at multiple spatial scales and to multiple resource types. It identifies four primary components common among marine ecosystems: water, habitats, living resources, and maritime archaeological resources.

By assuming that a common marine ecosystem framework can be applied to all places, the National Marine Sanctuary Program developed a series of questions that are posed to every sanctuary and used as evaluation criteria to assess resource condition and trends. The questions, which are shown on page iii and explained in Appendix A, are derived from both a generalized ecosystem framework and from the National Marine Sanctuary Program's mission. They are widely applicable across the system of areas managed by the sanctuary program and provide a tool with which the program can measure its progress toward maintaining and improving natural and archaeological resource quality throughout the system.

Comment [PT20]: Need Appendix A to review this document.

Site History and Resources

Overview

The *Monitor* National Marine Sanctuary was established on January 30, 1975 in recognition of the uniqueness and archaeological significance of the Civil War ironclad *USS Monitor* shipwreck site. The *Monitor* was a major technological advancement in warship design and is often called the most significant ship in American history. It sank in a storm on December 31, 1862 off Cape Hatteras, North Carolina in an area **popularly known as** the Graveyard of the Atlantic in 230 feet of water. The wreck of the *Monitor* is listed on the National Register of Historic Places and is a National Landmark.

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Comment [A21]: Again – check for consistent number and align all NOAA MNMS reports to the same number.

The *Monitor* sanctuary was designated by the Secretary of Commerce under the National Marine Sanctuary Act of 1972 and is administered by the National Oceanic and Atmospheric Administration's (NOAA) National Marine Sanctuary Program. The *Monitor* was the first national marine sanctuary in a program that now consists of thirteen sanctuaries and one marine national monument.

The mission of the *Monitor* sanctuary is to preserve, protect and manage the remains of the *Monitor*. Since the establishment of the sanctuary, dozens of research and recovery expeditions have been conducted within the sanctuary. These expeditions have resulted in detailed documentation of the wreck and surrounding area and the recovery of over 1200 artifacts from the wreck site. Many of these artifacts have already completed the conservation process and are currently on exhibit at The Mariners' Museum in Newport News, Virginia.

<http://monitor.noaa.gov/>
<http://www.mariner.org/>

Location

The *Monitor* sanctuary is located on the Atlantic continental shelf approximately 16.1 miles south-southeast of Cape Hatteras, North Carolina. The sanctuary encompasses a vertical column of water from the surface to the seabed one nautical mile in diameter. Water depth in the sanctuary varies **between 218 feet and 230 feet**, depending on the tidal cycles and the Gulf Stream.

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Comment [PT22]: Add Map.

NOAA Year 2003 Research Expedition to the Monitor National Marine Sanctuary, Expedition Operational Manual, 2003.

<http://monitor.noaa.gov/visit/welcome.html>
<http://www.mariner.org/>
<http://monitor.noaa.gov/about/expeditions.html>

Discovery and Designation

The *Monitor* was discovered in 1973 by an interdisciplinary team of scientists from Duke University's Marine Laboratory. The discovery was preceded by extensive historical research and the selection of probable areas for the *Monitor's* sinking. The search team located **what they believed to be** the wreck of the *Monitor* using side-scan sonar and remotely-operated cameras. In 1974, the U.S. Navy and the National Geographic Society launched a second expedition that confirmed the identity of the *Monitor* and produced detailed photographic documentation of the wreck site. One year later, on January 30, 1975, the *Monitor* National Marine Sanctuary was designated as the nation's first sanctuary.

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A Look at the *Monitor* National Marine Sanctuary: Past, Present, and the Future, *Monitor* National Marine Sanctuary 1994.
<http://monitor.noaa.gov/visit/welcome.html>

Recovery, Research and Conservation Efforts

Since the establishment of the *Monitor* National Marine Sanctuary in 1975, **numerous research and recovery** expeditions have been organized by NOAA and the US Navy. Recovered artifacts are transported to The Mariners' Museum in Newport News, Virginia for conservation. Once conservation is complete artifacts are available for exhibition and study. While the majority of *Monitor* artifacts remain at The Mariners' Museum, other facilities including the Richmond (Virginia) National Battlefield Park, Civil War Naval Museum in Columbus, Georgia, Nauticus in Norfolk, Virginia and soon the Graveyard of the Atlantic Museum in Hatteras, North Carolina also display artifacts from the ship.

Comment [A23]: Need to include extensive involvement of Harbor Branch, NC Division of Archives and History as it wasn't just NOAA and the US Navy every time. Also, there have been numerous private dives with NOAA involvement that have yielded artifacts as well. Check with MNMS staff on specifics – but Farb, Gentile-Hess, etc. all recovered artifacts.

Timeline

1977 - The very first artifact recovered from the *Monitor* site was a brass navigation lantern. It was raised from the ocean floor during the first submersible dive in 1977.

1979 – 83 - Expeditions in 1979 and 1983 recovered numerous small artifacts and the *Monitor's* unique four-fluked anchor.

1980 – 1990s - During the 1980s and through the late 1990s many brief reconnaissance expeditions were carried out to recover exposed artifacts and to further document the wreck and assess the preservation of the site. During these expeditions the researchers began to notice extensive deterioration of the wreck. The dramatic change in the condition of the *Monitor* motivated Congress to require NOAA to prepare a preservation plan for the *Monitor*.

Comment [PT24]: Why then in the summary table does it state that deterioration was partly “due to recovery activities from 1998-2002?”

1987 - On March 9, 1987, The Mariners' Museum in Newport News, Virginia was designated the principle museum for the *Monitor* National Marine Sanctuary. The museum acts as the primary conservation facility for large and small artifacts recovered from the site.

Comment [A25]: The Curatorial Services Agreement also states that in addition to conservation, the Museum will exhibit and interpret the artifacts. Don't know if that's necessary here.

1998 - NOAA released a six-step proposal for stabilizing a portion of the hull and recovering the vessel's steam engine and rotating turret. With the help of the U.S Navy, the *Monitor's* propeller and 11-feet of the propeller shaft was recovered in 1998.

1999 - Starting in 1999, NOAA and the Navy began planning large scale recovery expeditions and implementing the stabilization plan.

2001 - More than 250 artifacts, including the *Monitor's* vibrating lever steam engine were successfully recovered.

Comment [A26]: The Batten Conservation Lab did not open until 2006 – need to move this to the 2006 entry.

2002 - Perhaps the last of the major recovery expeditions to the *Monitor* took place in 2002 and resulted in the raising of the gun turret and two XI-inch Dahlgren smoothbore guns. The engine, guns and gun turret are currently undergoing conservation at The Mariners' Museum.

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Deleted: During the same year, the Batten Conservation Laboratory Complex at the Mariners' Museum opened. This state of the art facility houses thousands of small and large *Monitor* artifacts where scientists study the corrosion process and preserve components of the shipwreck. The conservation facility is open to the public during regular Mariners' Museum hours.

2006 - A team of researchers conducted a major mapping expedition to the *Monitor* to collect high-resolution digital still and video imagery that will be used to generate a high quality photographic mosaic of the site. During the same year, the Batten Conservation Laboratory Complex at the Mariners' Museum opened. This state of the art facility houses thousands of small and large *Monitor* artifacts where scientists study the corrosion process and preserve components of the shipwreck. The conservation facility is open to the public during regular Mariners' Museum hours.

Comment [A27]: Dahlgren guns are always designated by Roman numerals – not Arabic – just another of John Dahlgren's eccentricities.....

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2007 – The new USS *Monitor* Center opens at The Mariners' Museum.

Comment [A28]: Shouldn't there be mention of the ongoing surveying and mapping trips to the site? Also – the major initiative in 2006 which will (hopefully) result in a 3D photomosaic of the wreck.

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<http://monitor.noaa.gov/about/expeditions.html>

<http://www8.nos.noaa.gov/onms/park/Parks/USSMonitor/>

<http://www.mariner.org/>

<http://www.monitorcenter.org/>

Water

The *Monitor* sanctuary waters are dominated by the Gulf Stream Current that interacts dynamically with the southerly-flowing Labrador Current. Cold, fresh Labrador waters influence the path of the Gulf Stream, pushing it south in the spring. The Gulf Stream is the primary determinant of the chlorophyll concentration and the level of biological productivity in the region. Its velocity is high enough to transport fine to medium sand. Interaction of the Gulf Stream and the Labrador Currents create unpredictable eddies and rapidly changing weather conditions. The northeast currents are faster (more than 0.2 knots) than the currents flowing to the west and southwest (less than 0.2 knots).

Comment [PT29]: Please expand this section to include discussion of bio-structured habitats.

<http://www.sciencedaily.com/releases/2004/06/040604032005.htm>

http://www.po.qso.uri.edu/color/publications/i_dsr2.2003.07.017.pdf

Sheridan, R., 1979, Site Charting and Environment Studies of the *Monitor* Wreck, *Journal of Field Archaeology*, Vol.6, No.3, pp.253-264

Habitat

The *Monitor* National Marine Sanctuary, located on the slope of the continental shelf and in the warm Gulf Stream waters, is a suitable place for a variety of marine life. The types of habitats observed within the sanctuary's boundaries include scattered natural rocky outcrops, sand flats, muddy patches, and artificial hard surfaces created by the *Monitor* itself and scattered artifacts. The sanctuary has high densities of benthic infauna, organic carbon, and a significant concentration of benthic fish and megafaunal invertebrates.

http://oceanexplorer.noaa.gov/explorations/islands01/background/islands/sup8_thepoint.html

Geology

In 1979, the University of Delaware's Department of Marine Geology and Geophysics performed a geological survey in the *Monitor* National Marine Sanctuary, focusing primarily on the area near and under the wreck. Geophysical profiling and stratigraphic sampling of the sea floor was required in order to estimate the hazards of the future recovery operations at the *Monitor* site. The survey's results were as follows:

- A detailed magnetic map of the *Monitor* site was prepared. The total magnetic field of the site varies from 53,850 gammas on the north and west to 53,870 gammas on the south and east, with a regional gradient at the wreck site of 1.2 gammas per 100 m.
- The acoustic system penetrated sediments up to 50 feet deep and revealed four subbottom reflectors that were named for convenience A, B, C, and D (from shallowest to deepest). All four reflectors were inclined to the southeast and truncated at the sea floor. The acoustic profiles exposed a 10 m relief, low level ridge and swale features in reflectors A and B around the wreck site. The relief was caused by erosion and deposition in a coastal environment during periods of low sea level. The ridge and the swale are evidence of ancient galleys and stream valleys. Also, accumulation of peat observed in the area indicates ancient estuary environments.
- Piston core had seven important sections - three below the hiatus (2.9 – 5.5m) and three above it (2.7m - 0m). Starting from the bottom, the three units below the hiatus included: coarse shell hash mixed with sand; medium to coarse sand with worm burrows, echinoid and pelecypod shells; and gravelly mud. The units above the hiatus included: coarse sand with many shell fragments; muddy sand and plastic clay; and fine sand. The piston core proved that the *Monitor* Terrace is an erosional environment where a thin layer of transitory sand is underlain by older Pleistocene sediments. The silty clay units were deposited during glacial events that caused regression of the sea. Water content of the sediments indicates a density of 2.0 g/cm³.

Newton, J., Final Expedition Report - Geological Study. Origin of the Ridge and Swale, Mariners' Museum Library, NOAA General File, Box 1, Folder1.

Sheridan, R., 1979, Site Charting and Environment Studies of the *Monitor* Wreck, Journal of Field Archaeology, Vol.6, No.3, pp.253-264.

Sheridan, R., 2004, Iron from the Deep. The discovery and recovery of the USS *Monitor*, Naval Institute Press.

Living Resources

Presence of the Gulf Stream and location near the northern boundary of tropical reef fish habitat makes the *Monitor* National Marine Sanctuary very attractive for a variety of marine life. From the surface to the bottom, the sanctuary experiences seasonal migrations of cetaceans, sea turtles, and fishes, including sharks and manta rays. **Temperate and sub-tropical fish species**, such as the greater amberjack, black sea bass, bank sea bass, scup, and grouper, represent the most abundant species that seasonally visit the sanctuary's waters. Additionally, the sanctuary acts as an artificial reef, and provides winter habitat for loggerhead sea turtles.

Comment [kb30]: Change suggested by SEFSC/SERO

Deleted: Tropical fish

Encrusting organisms and motile invertebrates are also present in the *Monitor* sanctuary. Invertebrates include crabs, brittle stars, sea urchins, snapping shrimp and spiny lobsters. Tree coral, whip coral, Sea anemones, hydroids, barnacles, tube worms, mussels, oysters and at least forty species of sponges have been identified in the sanctuary.

<http://www.nrdc.org/water/oceans/priority/part2.asp>

Dixon, R., Biology of the *USS Monitor*, NOAA Center for Coastal Fisheries and Habitat Research, Beaufort, NC, 1990.

Comment [PT31]: Does this source fill in information for the summary table?

Maritime Archaeological Resources

There is only one identified archeological site within the *Monitor* National Marine Sanctuary waters - the wreck of the *USS Monitor*. The *Monitor* represents one of the most important naval vessels in the American history. Designed by Swedish-American engineer John Ericsson and constructed in 1862, the *Monitor* was a significant technological

Comment [A32]: No – what Ericsson designed in 1854 was not the *Monitor*, though it was a turreted warship.

Deleted: in 1854

advancement in warship design. The most innovative feature of the *Monitor* and the one that became her distinguishing characteristic was her revolving turret. Though other designers had toyed with the idea of developing turrets for warships, the *Monitor* was the first warship to use the invention successfully. It measured 21 feet in diameter and 9 feet in height, and its armored walls were made of eight layers of 1-inch armor plate. It could rotate two 11-inch Dahlgren smoothbore guns in any direction. The *Monitor* was built almost entirely from iron and was fully steam-powered. Its engineering spaces, galley, crew and officer quarters were all located below the waterline.

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Deleted: cannons

The *Monitor* was launched at Greenpoint, New York, where it was constructed, on January 30, 1862. Following final construction and sea trials, the *Monitor* was ordered to steam to Hampton Roads, Virginia. On March 9, 1862, the ironclad engaged in battle with the CSS *Virginia*, a confederate ironclad launched on February 17, 1862. The *Virginia* was constructed over the burned hull of the USS *Merrimack*.

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In the early morning hours on March 9, 1862, the *Monitor* and the *Virginia* began bombarding each other at point-blank range. After four hours, the battle ended in a draw and neither vessel suffered considerable damage. Following the fall of Norfolk and the destruction of the *Virginia* (at the hands of her own crew) in May of 1862, the *Monitor* steamed up the James River in support of McClellan's Peninsular Campaign. The *Monitor* unsuccessfully engaged in an attack on Drewry's Bluff on May 15, and withdrew with the rest of Union forces to Hampton Roads in July, following the Seven Days Battle. Ordered to Washington DC for repairs, she spent much of October undergoing a refit and returned to Hampton Roads in November. She was ordered to Beaufort in late December, 1862.

Deleted: The *Monitor* returned to Hampton Roads and remained there throughout the rest of the year.

The *Monitor's* short history ended on December 31, 1862. The vessel sank while being towed to Beaufort, North Carolina by the USS *Rhode Island*. She was lost in a gale off Cape Hatteras. Most of the crew was rescued by the *Rhode Island*. However, four officers and twelve crewmen lost their lives.

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A Look at the *Monitor* National Marine Sanctuary: Past, Present, and the Future, *Monitor* National Marine Sanctuary 1994. <http://monitor.noaa.gov/publications/welcome.html>
Monitor National Marine Sanctuary We site, Charting a New Course for the *Monitor* <http://monitor.noaa.gov/plan/page03.html>

Comment [A33]: No indication that this was how the 16 men died. Best to leave it out.
Deleted: while trying to reach the lifeboats

Pressures on the Sanctuary

Numerous human activities and natural events and processes affect the condition of natural and archaeological resources in marine sanctuaries. This section describes the nature and extent of the most prominent pressures on the *Monitor* sanctuary.

Comment [PT34]: I think each of these sub-sections need to be beefed up to provide more information, e.g., even though sanctuary regulations prohibit most activities what are the real conditions present, and what do you anticipate future wants, needs, research, etc. will be?

Recreational Fishing, Boating and Diving

Recreational fishing, boating and diving are potential stressors to marine species and artifacts at the site of the *Monitor*. The structure of the wreck is very fragile and any assault, including anchoring and use of bottom fishing gear could cause considerable damage.

Due to its location in the Gulf Stream, the *Monitor* sanctuary is a very popular destination for recreational fishing and boating. Many charter boat captains take their clients to the sanctuary offering not only great fishing but also an opportunity to be on the wreck site of the famous *Monitor*. Recreational fishing is targeted at species such as black sea bass (*Centropristis striata*), bank sea bass (*Centropristis ocyurus*), as well as groupers (*Epinephelus* and *Mycteroperca*), snappers (*Lutjanus* and *Rhomboplites*), grunts (*Haemulon*), and many others. Between 1987 and 1990, patterns of accelerated deterioration were noted along the remaining segments of the lower hull, and sections of the midship's bulkhead collapsed. This damage has been attributed to natural deterioration as well as human activities.

Comment [kb35]: Another area requiring clarification is the remark on page 12 that, "the *Monitor* sanctuary is a very popular destination for recreational fishing and boating. Many charter boat captains take their clients to the sanctuary offering not only great fishing but also an opportunity to be on the wreck site..." and page 19 contains remarks on debris resulting from charter boat fishing vessels "visiting" the site. Yet the report subsequently states that it is prohibited to anchor, stop or drift within the sanctuary. This raises the question then, how is it possible to "visit" the site? The only possibility appears to be to transit across it but then how do the clients experience the great fishing noted previously?

In 1991, a private fishing vessel was cited by the U.S. Coast Guard for illegally anchoring in the sanctuary. Evidence documented by NOAA strongly suggested that this anchoring incident resulted in the skeg and propeller shaft dislocation, pulling it to starboard and down, ripping it loose from the lower hull and exposing the aft end of the engine room. In an effort to relieve stresses on the stern, the propeller and 11 feet of shaft were recovered in 1998.

Comment [PT36]: See summary table line 15.

Within the past few years, the biggest concern among the sanctuary's staff has been marine debris, particularly the possibility of commercial fishing gear striking the wreck. Other concerns include the dumping of soda cans, beer cans, and leftover food in the sanctuary. Leftover food such as chicken bones, presents a particular threat to archaeological research because they could be recovered and mistakenly treated as a part of the *Monitor's* pantry supplies.

Comment [A37]: Probably not – but I guess it's a good idea to leave this in as a cautionary statement.

Biology of the *USS Monitor*, NOAA Center for Coastal Fisheries and Habitat Research, Beaufort, NC, 1990.

Add: military activities? – sound waves

Add: Artifact recovery? -- unpermitted

Commercial Fishing

Despite the prohibition of commercial fishing, there have been a few incidents involving such activity that have caused serious damage to the sanctuary's living and archaeological resources. Besides the 1991 anchoring incident mentioned above, increasing quantities of commercial and sport fishing gear are being found in the sanctuary. In 1997, commercial fishing gear was found tangled in the *Monitor*. Also, during a 2004 NOAA and US Navy expedition to the site, divers identified damage to the hull of the wreck and observed remains of a trawling net and long lines. However, because damage may have occurred due to the recent passing of a hurricane, no criminal charges were issued.

Comment [PT38]:

Comment [kb39]: The statement on page 19 that "human impacts at the site are likely not to change within the next five years" does not concur with that on page 13 that "increasing quantities of commercial and sport fishing gear are being found in the sanctuary."

Research

General research goals for the sanctuary include archaeological recovery, dissemination of historical and cultural information preserved at the site and the continued scientific study of the *Monitor* as an artificial reef. Research activities themselves can cause unintended damage and potentially accelerate deterioration of the site, so there is careful review and monitoring of both public and private sponsored research activities in order to ensure that the site is protected and preserved.

Comment [PT40]: Any documented damage from research projects?

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Natural Deterioration

Strong currents, high-temperature, and high-salinity water in the *Monitor* National Marine Sanctuary have a major effect on the sanctuary's living and non-living resources. Since its discovery, the wreck has suffered significant deterioration in almost every portion of its hull, with the most extensive damage occurring in the stern.

Comment [PT41]: So, is this an increasing problem?

Additionally, hurricanes present a significant threat to the sanctuary resources. In 2003, Hurricane Isabel passed through the *Monitor* sanctuary, with its eye located only $\frac{3}{4}$ of a mile from the actual *Monitor* site, dislodging bottom plating and disrupting the galley area. These environmental stressors accelerate deterioration of the wreck of the *Monitor*.

Comment [kb42]: In the Pressures on the Sanctuary section under the Natural Deterioration header it states that Hurricane Isabel passed through the sanctuary in 2004. The correct date is 2003.

Monitor National Marine Sanctuary Web site, Charting a New Course for the *Monitor* <http://monitor.noaa.gov/publications/welcome.html>

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State of Sanctuary Resources

This section provides summaries of the condition and trends within four resource areas: water, habitat, living resources, and archaeological resources. For each, sanctuary staff and outside experts considered a series of questions about each resource area. Answers are supported by specific examples of data, investigations, monitoring, and observations, and the basis for judgment is provided in the text and summarized in the table for each resource area. Where published or additional information exists, the reader is provided with appropriate references and web links.

Water

Water clarity in the *Monitor* National Marine Sanctuary varies with turbidity, water temperature, the presence of organic matter in the water column, and the intensity of sunlight. Visibility in the sanctuary ranges from zero to 200 feet.

Although there is not a water quality monitoring program at the *Monitor* sanctuary, a high abundance of apparently healthy marine life in the sanctuary may indicate that the water quality is good and that there are few, if any, risks to human health. Nutrient levels fluctuate with oceanographic conditions but are generally low and there are no apparent coastal anthropogenic influences.

Comment [kb43]: Is there any data to support this statement?

In Spring of 2004, NOAA's National Centers for Coastal Ocean Science (NCCOS) conducted a survey of ecological conditions of the U.S. South Atlantic Bight. The survey covered the near-coastal shelf waters (1 nm from shore, or ~10m in depth, seaward to the 100-m shelf break) from Nags Head, North Carolina to West Palm Beach, Florida. The primary focus of the survey was to collect bottom sediment samples for the analysis of benthic macroinfaunal community structure and measurement of concentrations of chemical contaminants in sediments. Some of the samples were collected in the vicinity of the *Monitor* sanctuary. General results of the survey have shown that bottom water physical characteristics were highly variable across the region. Temperature ranged from 6.8°C to 24.2°C. Salinity ranged from 21.2 psu to 37.2 psu, and dissolved oxygen ranged from 6.8 mg/L to 9.8 mg/L.

While the above ranges may characterize the *Monitor* sanctuary waters, there has been no additional scientific study conducted to date to support it. Research addressing water quality and eutrophic condition in the *Monitor* sanctuary is needed.

In 2006 the NOAA Diamond Shoals Data Buoy was moved into the boundaries of the *Monitor* National Marine Sanctuary. This buoy collects real-time data on water temperature, surface and subsurface currents and wind speed at the site. The buoy will allow for future tracking of these conditions within the sanctuary.

- *Are specific or multiple stressors, including changing oceanographic and atmospheric conditions, affecting water quality and how are they changing?*

The water quality in the *Monitor* sanctuary is considered to be good and not changing. However, it is important to note the distinction that although water quality can be considered good in relation to living marine resources, such conditions can be considered poor in regards to the preservation of wreck sites.

The strong currents, high-temperature, and high-salinity water that are found off the coast of Cape Hatteras, North Carolina has the potential to accelerate the deterioration rate of the *USS Monitor*. The strong currents bring dissolved oxygen that corrodes the metal on the wreck. The data buoy therefore provides critical information on the changes in these parameters over time. Water current modeling will be an area of heavy focus in research in coming years (NURC pers. comm.).

In 2007, The Monitor Sanctuary working with the National Data Buoy Center added an Acoustic Doppler Current Profiler to the Diamond Shoals Data Buoy. This instrument will allow the public and scientists to better understand the subsurface environment over the wreck. Additionally, staff at the *Monitor* sanctuary is looking to collect water quality data by installing future PH and water chemistry instruments to the Buoy at the site. Such meters would allow for a better understanding of the pH levels at the site and the affects that acidification may be having on the wreck and the ecosystem.

- *What is the eutrophic condition of sanctuary waters and how is it changing?*
Given the depth and distance from shore of the *USS Monitor* eutrophication is not a concern.

- *Do sanctuary waters pose risks to human health and how are they changing?*
There is no evidence suggesting that sanctuary waters pose any risks to human health; in this respect water quality is considered to be good and not changing.

- *What are the levels of human activities that may influence water quality and how are they changing?*
Although there is visitation to the site, typically by charter fishing boats, there are relatively no hazardous discharges, minimal debris at present, or other known impacts on the water quality at the sanctuary.

Comment [kb44]: There is no mention of the stresses caused by "Recreational Fishing, Boating and Diving" as described on page 12 (1991 private fishing vessel incident; or the marine debris, particularly the possibility of commercial fishing gear striking the wreck) last two paragraphs on the page.

Comment [PT45]: Any relationship between corrosion and salinity/conductivity measurements?

Comment [PT46]: Any results from this to present?

Comment [kb47]: the summary table is coded clear with an N/A, and the basis for judgment is "...too deep..." - I would suggest a better answer can be found on page 10 under "Water" - "...waters are dominated by the Gulf Stream that interacts dynamically with the southerly-flowing Labrador Current. Cold, fresh Labrador waters influence the path of the Gulf stream..."

Comment [kb48]: there should be some mention of the NMS activity of recovering artifacts temporarily influencing water quality.

Comment [kb49]: Perhaps should mention that the NOAA-supported recovery operations on the site that has a most dramatic effect on the site/habitat. The removal of the turret and engine had a dramatic and immediate effect on site integrity, not to mention the preparation that included blasting portions of the hull clean of encrustation.

Water Quality Status & Trends

Good	Good/Fair	Fair	Fair/Poor	Poor	Undet.
▲ = Improving		— = Not changing		▼ = Getting worse	
? = Undetermined trend		N/A = Question not applicable			
Issue	Rating	Basis for Judgment			
Stressors	—	Water current modeling and its affects on dissolved oxygen. No			

		human impacts.
Eutrophic Condition	N/A	The <i>Monitor</i> is located in water that is too deep for eutrophication to be a direct concern.
Human Health	—	No evidence that there is any risk posed.
Human Activities	—	Relatively no hazardous discharges, debris or other impacts.

Comment [PT50]: Why not a good rating here as the sanctuary waters are well-mixed?

Cynthia Cooksey, May 2004, Cruise Report Spring 2004 Survey of Ecological Conditions of U.S. South Atlantic Bight. NOAA Year 2003 Research Expedition to the Monitor National Marine Sanctuary, Expedition Operational Manual, 2003.

Habitat and Living Resources

Since designation in 1975, the *Monitor* National Marine Sanctuary has focused primarily on documenting, preserving and managing the remains of the *Monitor*. Because of this focus few studies have been conducted regarding the habitats and living resources of the sanctuary. In 1982, scientists from Pennsylvania State University conducted a study of organisms encrusting the hull of the *Monitor* shipwreck. They examined the wreck's concretionary crust for growth and diversity of bryozoans – tiny polyps that live in colonies attached to hard objects on the sea floor. The study identified eleven species of encrusting cheilostome bryozoans, serpulid worms, corals, and pelecypods. The species found are typical of hard bottoms at mid-depths on the Atlantic shelf.

Comment [PT51]: Is there a reason for this? Why are more studies being performed now (as described below in "Current Research"?)

In 1990, the NOAA Fisheries Lab in Beaufort, North Carolina conducted a study of the living resources in the *Monitor* National Marine Sanctuary. Utilizing visual observations on two dives and video tape from four dives the NOAA researchers were able to assess species diversity in the sanctuary. Twenty-five species of fish were observed. The most abundant species appeared to be red barbie (*Hemanthias vivanus*), while the predominant predator was greater amberjack (*Seriola dumeril*). Other common species included scad, black sea bass, bank sea bass, slippery dick, and vermilion snapper. The study also identified encrusting organisms and motile invertebrates from one grab sample and recorded video footage. The most abundant coral growing on the wreck of the *Monitor* was the ivory bush coral (*Oculina arbuscula*). Approximately 40 species of sponges were identified.

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Current Research

Currently, there are several studies related to living resources being conducted in close proximity to the *Monitor* sanctuary. Marine biologists at NOAA's Center for Coastal Fisheries and Habitat Research in Beaufort are conducting research concerning the lionfish (*Pterois volitans*). The lionfish is the first marine invasive fish known to have established itself in Atlantic waters. During a private research dive to the site in 2007, several large adult Lionfish were observed on the wreck. Adult lionfish are about 17 inches long and have been observed and caught from Florida to Cape Hatteras, usually on wrecks and natural hardbottom at depths of 85 to 300 feet. The lionfish is near the top of the food chain and could threaten local ecosystems. Species such as snapper and grouper may be at risk as lionfish feed on the same food sources and compete for the same habitat. Also, lionfish pose a danger to divers and fisherman; spines of the lionfish may cause an extremely painful sting, resulting in swelling and sometimes paralysis.

Comment [kb52]: - Lionfish are best characterized as carnivores or piscivores (i.e. fish eating) predators, but because of their small size are not "near the top of the food chain".

Another study being conducted in the vicinity of the *Monitor* sanctuary is examining zooplankton and ichthyoplankton dynamics, as well as other aspects of the ecosystem. The National Marine Fisheries Service Northeast Fisheries Science Center (NMFS NESFC) initiative started in the 1960's and led to the Marine Resources Monitoring Assessment and Prediction Program (MARMAP) in 1987, and later to the Ecosystem Monitoring Program (EcoMon), which started in the mid 1990's. Most of the NEFSC plankton sampling has occurred north of Cape Hatteras, thus samples are sparse in the vicinity of the *Monitor* sanctuary. The top 25 taxa accounted for 78% of the total zooplankton collected. The most abundant was the copepod *Centropages typicus* followed by the cladoceran *Penilia avirostris* and unclassified ostracods. Other abundant taxa included appendicularia, chaetognaths, and several other copepods.

Other studies underway near the *Monitor* sanctuary include benthic surveys organized by researchers from NOAA and the University of North Carolina at Wilmington and University of North Carolina Chapel Hill.

- *What is the abundance and distribution of major habitat types and how is it changing?*

The *USS Monitor*, like many other shipwrecks in the Graveyard of the Atlantic area, provides a habitat structure to the otherwise sandy bottom that is found off the coast of Cape Hatteras, North Carolina. The *Monitor* and other wrecks create new habitat by acting as an artificial reef that supports both transitory organisms, such as migrating cetaceans, sea turtles, and fishes, and local communities such as encrusting organisms and motile invertebrates.

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It has been observed that when a piece of the *Monitor* is removed or disturbed there is succession of life that returns to the site over time. So while the *Monitor* diversifies the area's habitat types, ecological succession results in a diversification of biological assemblages.

- *What is the condition of biologically-structured habitats and how is it changing?*

There are no biologically-structured habitats at the *Monitor* sanctuary.

Comment [kb53]: the answer ignores the encrusting faunal composition or abundance

- *What are the contaminant concentrations in sanctuary habitats and how are they changing?*

Contaminants in sediments at the *Monitor* sanctuary are considered to be low. This is most likely attributable to the remote location of the wreck and the strong currents of the Gulf Stream. The strong currents cause a constant resuspension of sediments, thus flushing any contaminants that might otherwise accumulate.

Comment [PT54]: Yes there are. Please describe the community on the wreck and how it creates habitat for other creatures.

- *What are the levels of human activities that may influence habitat quality and how are they changing?*

There is relatively little human activity that influences the habitat quality at the *Monitor* sanctuary. There is limited visitation to the site, and those that do visit are typically on chartered fishing boats, but there are relatively no hazardous discharges, little debris or other impacts on the habitat quality.

Comment [kb55]: Is there data to support this statement?

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[Insert "Habitat Status & Trends" Table below here]

- *What is the status of biodiversity and how is it changing?*

The living resource assemblage at the *Monitor* sanctuary is currently poorly known due to the lack of a biological monitoring program. Anecdotal evidence shows that the sanctuary experiences seasonal migrations of cetaceans, sea turtles, and fishes, including sharks and manta rays. Tropical and temperate fish, such as black sea bass, snapper and grouper, represent the most abundant species that seasonally visit the sanctuary's waters. Encrusting organisms and motile invertebrates are also present in the sanctuary. Invertebrates include crabs, brittle stars, sea urchins, snapping shrimp and spiny lobsters. Sea anemones, hydroids, barnacles, tube worms, mussels, oysters and at least forty species of sponges have been identified in the sanctuary.

Excessive levels of biofouling do not occur on the *Monitor*; nevertheless, there is a need for a biological monitoring program to determine how living resource assemblages may be affecting the site.

[Insert "Living Resources Status & Trends" Table below here]

- *What is the status of environmentally sustainable fishing and how is it changing?*

The removal of fish is not an issue that affects the *Monitor* sanctuary. The MNMS lies within the jurisdiction of the South Atlantic Fishery Management Council (SAFMC). The SAFMC manages fishery species of interest at the *Monitor* site. [Expand to discuss allowable gear use, removal of fish to date, etc.]

- *What is the status of non-indigenous species and how is it changing?*

The status of non-indigenous species at the *Monitor* sanctuary is currently unknown due to the lack of a biological monitoring program.

Comment [PT56]: Is this something planned for the future? What about lionfish as described in the text?

- *What is the status of key species and how is it changing?*

No species that inhabit the *Monitor* are currently considered key species. Nearly all monitoring and research is devoted to archaeological resources.

- *What is the condition or health of key species and how is it changing?*

No species that inhabit the *Monitor* are currently considered key species. Nearly all monitoring and research is devoted to archaeological resources.

- *What are the levels of human activities that may influence living resource quality and how are they changing?*

There is evidence that fishing activities can affect habitat quality and thus the living resources at the *Monitor* sanctuary.

Trawling and anchoring can affect the biological community at the sanctuary because these activities can remove or damage portions of the wreck, thus resulting in the removal of hiding locations for fish and invertebrates. These activities are prohibited by sanctuary regulation.

Comment [kb57]: In this section it should be noted that trawling and anchoring are not currently permitted within the sanctuary

Habitat Status & Trends

Good	Good/Fair	Fair	Fair/Poor	Poor	Undet.
▲ = Improving — = Not changing ▼ = Getting worse ? = Undetermined trend N/A = Question not applicable					
Issue	Rating	Basis for Judgment			
Abundance/Distribution	▲	<i>Monitor</i> attracts biological assemblages as an artificial reef.			
Structure	N/A	There are no biologically-structured habitats.			
Contaminants	—	Lack of sources and constant resuspension of sediments flushing any contaminants that may accumulate.			
Human Impacts	—	Limited human activity due to remote location and restrictions.			

Living Resources Status & Trends

Good	Good/Fair	Fair	Fair/Poor	Poor	Undet.
▲ = Improving — = Not changing ▼ = Getting worse ? = Undetermined trend N/A = Question not applicable					
Status	Trend	Basis for Judgment			
Biodiversity	?	Lack of biological monitoring program.			
Extracted Species	N/A	Fishing is not an issue of concern.			
Invasive Species	?	Lack of biological monitoring program.			
Key Species	N/A	No key species have been identified.			
Health of Key Species	N/A	No key species have been identified.			
Human Activities	—	Evidence that fishing activities affect habitat quality and thus living resources.			

Cuffey, R., Fonda, S., Bryozoans encrusting the 1862 *Monitor* Shipwreck off Cape Hatteras, Cheesebox, 1982, Vol.1, Number1.
 Dixon, R., Biology of the *USS Monitor*, NOAA Center for Coastal Fisheries and Habitat Research, Beaufort, NC, 1990.
http://www.reef.org/cgi-bin/georep.pl?region=TWA&geogr=93030026&min_date=00%2f00%2f&max_date=00%2f00%2f&species=&sort=&inverts=&exp
<http://www.nefsc.noaa.gov/>
<http://ncseagrant.org/index.cfm?fuseaction=story&pubid=132&storyid=179>

Maritime Archaeological Resources

Since the establishment of the *Monitor* National Marine Sanctuary in 1975, dozens of research and recovery expeditions have been conducted within the sanctuary. These expeditions have resulted in detailed documentation of the wreck and surrounding area and the recovery of the anchor, steam engine, propeller and propeller shaft, rotating gun turret, two XI-inch guns and carriages, and over one thousand smaller artifacts from the wreck site.

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Deleted: cannons

To date, research expeditions have recovered over 1200 artifacts from the wreck. Many of these artifacts have already undergone conservation and are currently on exhibit at The Mariners' Museum in Newport News, Virginia. Many artifacts, including the gun turret, guns and engine are undergoing conservation.

Deleted: cannons

The wreck of the *Monitor* lies upside down on a relatively flat, sandy bottom in 230 feet of water. The hull lies in an east-west orientation with the bow pointing (approximately) at 273 degrees. The port side of the inverted hull is raised above the seabed, as it was originally supported by the turret following sinking. Prior to turret recovery in 2002, a series of grout bags were installed underneath the armor belt to provide structural support. The port side's maximum

relief is 9.5 feet at the stern angling down towards the seabed at the bow. Height above the seabed at the bow is 6.5 feet. Maximum elevation in the wreck is 12.5 feet at the port boiler.

The starboard side of the wreck is completely buried in the sand except for short segments of the armor belt at the bow and stern. Hull frames also protrude from the sand on the starboard side.

All of the lower hull plating forward of the midships bulkhead degraded and collapsed before the *Monitor* was discovered in 1973. The last three sections of intact hull plating and a section of bottom plating over the engine and Fire Room were removed by NOAA and the US Navy in 2001 to gain access to the *Monitor's* steam engine. Bottom plating covering the boilers and galley area was dislodged from the wreck in 2003. This damage is attributed to the eye of Hurricane Isabel passing within ¼ of a mile of the wreck in September 2003.

The damage caused by Isabel also destroyed the remaining side framing along the port and starboard sides of the boilers and completely collapsed the remaining portions of the midships bulkhead. Accelerated deterioration of the stern was first documented in 1990. By 1995, approximately 6 feet of the port armor belt had deteriorated in this area. Approximately 24 feet of the stern has disintegrated since the vessel sank in 1862.

This accelerated deterioration of the armor belt was combined with deterioration of the ship's armored decking. Several deck plates were observed hanging down from the wood planking to which they were originally spiked. Others had completely dropped off and were buried in the sand.

All of these observations led NOAA to release a revised management plan in 1998 that led to the shoring up of the hull in 2000 and the recovery of the *Monitor's* steam engine in 2001 and the rotating gun turret in 2002. A 45-foot section of the port armor belt was removed by NOAA and the Navy in 2002 to gain access to the rotating gun turret. This segment was cut free and lifted off the wreck and placed 50 feet to the north of its original location.

During the summer of 2006, NOAA worked with a private research organization to continue documenting the damage from the 2003 hurricane. Deterioration at the stern is continuing.

NOAA Year 2003 Research Expedition to the Monitor National Marine Sanctuary, Expedition Operational Manual, 2003.
<http://monitor.noaa.gov/moncoll/moncollection.html>

- *What is the integrity of known maritime archaeological resources and how is it changing?*

In general terms, the condition of the *Monitor* is considered to be in fair to fair/poor condition due to the decay process that has occurred naturally over time since it first sank in 1862. Strong currents, high-temperature, and high-salinity water in the *Monitor* National Marine Sanctuary have a significant effect on the sanctuary's living and non-living resources. Since its discovery, the wreck has suffered significant deterioration in almost every portion of its hull, with the most extensive damage occurring in the stern.

Recovery efforts by researchers in 1998 did result in accelerated deterioration rates of the wreck. In an effort to relieve stresses on the stern, the propeller and 11 feet of shaft were recovered in 1998. Such activities resulted in the exposure of wood pieces. Also, it is thought that the ship worm *Teredo navalis* could be affecting the wood on the wreck by increasing its deterioration rate. It is believed that the site should stabilize and deterioration rates will slow in the coming years.

- *Do known maritime archaeological resources pose an environmental hazard and is this threat changing?*

The *Monitor* does not pose an environmental threat to its environment because it does not contain potential contaminants or hazardous cargo.

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

The integrity of the wreck in relation to anthropogenic impacts is considered to be fair. Although there is limited visitation to the site, typically by charter fishing boats, there are relatively no hazardous discharges, debris or other impacts to the *Monitor*.

However, there has been evidence of marine debris and anchoring impacts to the site. The first evidence of anchoring was documented in the 1990's and incidents have continued. However, the frequency of anchoring does not seem to

Comment [kb58]: There are four places where reference is made to the accelerating deterioration of the *Monitor* due both to natural and cultural factors (Pgs. 4, 5, 18 & 19) yet the Tables on pages 5 and 19 provide ratings of "Good/Fair" and show the bar symbol indicating the situation is not changing.

Comment [A59]: This paragraph seems out of sequence slightly – especially given the observations of 2001 and 2003 above it? Or maybe I'm reading it wrong. But I suggest slight revision to the sequence of these paragraphs.

Comment [kb60]: This statement ought to be reflected in the two relevant tables.

Comment [PT61]: Why?

Comment [kb62]: NOAA activities have had major impacts on Sanctuary resources because of the unique situation in which significant archaeological resources are being extracted from the actual sanctuary area and being moved to another site (i.e., Mariner's Museum in VA). So, there is a net loss of archaeological material within the actual sanctuary. Plus, the integrity -- the "completeness" of the site -- has obviously declined with the removal of the turret, engine, etc., although there are extenuating circumstances. Also, additional archaeological material on site that may be in jeopardy due to exposure, etc., are not being recovered during recent research activities apparently due to funding constraints. So, there is a potential for material to be lost or degraded due to natural processes.

be changing. In 1991 a private fishing vessel illegally anchored in the sanctuary and likely resulted in the skeg and propeller shaft dislocation and removal from the lower hull, thus exposing the aft end of the engine room.

Within the past few years debris has been observed on the wreck. Most debris, like cans and food, is the result of charter fishing vessels visiting the site. One threat that marine debris poses to the site is that it could be recovered and mistakenly treated as part of the *Monitor's* artifacts. There have also been observations of commercial fishing gear, monofilament, trawling nets and long lines tangled on the site. Looting is a potential pressure that exists, however, because of the depth and remote location of the site it is unlikely to occur. Because of this, it is also believed that human impacts at the site are likely not to change within the next five years.

Comment [kb63]: The statement on page 19 that “human impacts at the site are likely not to change within the next five years” does not concur with that on page 13 that “increasing quantities of commercial and sport fishing gear are being found in the sanctuary.”

Maritime Archaeological Resources Status & Trends

Good	Good/Fair	Fair	Fair/Poor	Poor	Undet.
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▲ = Improving — = Not changing ▼ = Getting worse
 ? = Undetermined trend N/A = Question not applicable

Issue	Rating	Basis for Judgment
Integrity	—	Combination of natural deterioration and accelerated deterioration due to recovery activities from 1998-2002.
Threat to Environment	—	Lack of hazardous cargo
Human Activities	—	Prior evidence of marine debris and anchoring. Site is susceptible to future incidents of fishing strikes and debris accumulation

Comment [kb64]: There are four places where reference is made to the accelerating deterioration of the *Monitor* due both to natural and cultural factors (Pgs. 4, 5, 18 & 19) yet the Tables on pages 5 and 19 provide ratings of “Good/Fair” and show the bar symbol indicating the situation is not changing.

Response to Pressures

The *Monitor* National Marine Sanctuary was specifically designated to protect and preserve the remains of the *Monitor*. Therefore, the *Monitor* sanctuary regulations prohibit the removal and damage to any historical or cultural resource in the sanctuary. Sanctuary regulations prohibit anchoring, stopping, and drifting within the sanctuary; conducting salvage or recovery operations; using diving, dredging, or wrecking devices; conducting underwater detonation; drilling in the seabed; laying cable; and trawling. Access is generally limited to scientific research conducted under a permit issued by NOAA; however, special-use permits are issued for non-research visits to this historic vessel.

Comment [PT65]: Are these mid-water trawls?

Access to the wreck site is restricted to those with research and non-research permits. NOAA has issued a number of research permits since 1976 to private and public groups interested in conducting research on the *Monitor* in direct support of NOAA goals. Non-research permits have been issued since 1994 in response to requests by the technical diving community. Each private vessel that enters the sanctuary to conduct diving operations, whether for research or non-research purposes, is required to have a NOAA observer aboard. Enforcement of sanctuary regulations is led by the USCG with support from NOAA and guidance by NMFS. NMFS and the USCG hold annual briefings to assess enforcement efforts.

Enforcing sanctuary regulations is difficult given the *Monitor's* remote location. The sanctuary does not have the resources to maintain a physical presence on-site. Therefore, sanctuary staff depends heavily on the watchful eyes of fishermen and dive operators as well as patrolling efforts by the U.S. Coast Guard. Officers from NOAA's Fisheries Office for Law Enforcement also help collect evidence and prosecute offenders, when necessary.

Additional enforcement is accomplished by educating potential user groups about sanctuary regulations and the resources they are designed to protect. By creating an understanding of the value and beauty of the sanctuary we hope to encourage voluntary compliance with sanctuary regulations. To date education efforts have mainly focused on k-12 students, Civil War enthusiast groups, the general public and citizen groups via lectures, participation in community events and presentations at schools located in the sanctuary region. Expanded education efforts in North Carolina focusing on dive clubs and charter boat companies are currently underway.

Comment [kb66]: Education programming can be a powerful tool not only for regulation enforcement, but also can be used to instill a greater appreciation for the resource, which in turn can result in stewardship from user groups.

Monitor National Marine Sanctuary Web site, Regulations <http://monitor.noaa.gov/about/regs.html>

Recreational Fishing, Boating, and Diving

The *Monitor* National Marine Sanctuary's regulations prohibit activities that could alter the sanctuary's existing habitats or disturb and damage its natural resources. Recreational fishing, boating and diving are potential stressors to marine species and the site of the *Monitor*. Therefore, the sanctuary prohibits anchoring and diving without a permit within its boundaries. Other activities such as discharging waste material into the water, detonation of explosive material, seabed drilling, seabed cable-laying, dredging and trawling are also prohibited within the sanctuary's boundaries. Each violation can result in civil penalties of \$50,000. Prohibition of commercial fishing and trawling in the sanctuary helps to eliminate the pressure of fishing gear on the living resources.

Deleted: in any way

The *Monitor* sanctuary is committed to providing educational programs and materials that teach about the history, discovery, recovery, conservation and wreck site of the USS *Monitor*. One of the best ways to learn about the *Monitor* is to visit The Mariners' Museum in Newport News, Virginia. The Museum and NOAA have brought the story of this unique ironclad to the public through the dramatic USS *Monitor* Center. The Center serves as the primary visitor center for the *Monitor* sanctuary, and tells the story of the *Monitor* through a rich array of original artifacts, archival materials, immersive multimedia experiences, a full-scale external replica, and recreated ship interiors that transport the visitor back in time to 1862.

Comment [PT67]: Don't believe that this paragraph fits with heading. How about placing it under a new heading concerning education and outreach?

Monitor National Marine Sanctuary Final Regulations, NOAA. <http://monitor.noaa.gov/about/regs.html>
The North Carolina Coastal Ocean Observing System <http://nccoos.unc.edu>

Comment [A68]: Not sure why this paragraph is under 'Recreational Fishing, Boating and Diving section.' Suggest moving it up to the larger heading of 'Response to Pressures.'

Commercial Fishing

To prevent destruction of the *Monitor*, alteration of existing habitats, and deposition of marine debris, the *Monitor* National Marine Sanctuary prohibits ~~restricts?~~ commercial fishing and usage of gears such as trawls and dredges.

Comment [PT69]: Does it?

Research

Since 1977, research at the *Monitor* site has been directed toward documenting the wreck in detail and understanding how it has been affected by natural deterioration and human activities. Because research itself may result in harm to the resource, or increase the risk of harm, all research conducted at the *Monitor* site is subject to the sanctuary's permit regulations.

Comment [PT70]: Please add research concerning the MHP.

The *Monitor* sanctuary's long-term goal is to coordinate scientific research and monitoring of the ecological conditions of the sanctuary. This would allow staff to track and compare natural and human-caused changes in habitat and living resources including the impacts of invasive species on the condition of the sanctuary and the *Monitor*.

The University of North Carolina at Chapel Hill (UNC) has been collecting data on water quality off Cape Hatteras for several years. Considering the proximity of the *Monitor* sanctuary to the area of UNC research, the existing data may be applicable to the sanctuary's waters. A partnership with UNC could be a starting point to establish the *Monitor* sanctuary's own water quality monitoring plan in the near future. Parameters of particular interest include currents, temperature, salinity and pH, all of which affect deterioration rates of artifacts as well as living resource conditions.

Comment [PT71]: Any other future research efforts to mention?

Natural Deterioration

The *Monitor* will continue to deteriorate due to the natural process of corrosion. It is believed that the wreck will remain for centuries as we have seen on other shipwrecks. What can and is being done to slow the process however is to reduce disruption of the site as much as possible and limit access to the site to those individuals with a legitimate research design or to individuals specifically trained to dive on wrecks without disruption. Additionally, NOAA is looking at the possibility of placing cathodic protection on the wreck site to further reduce the corrosion rate. Ultimately the wreck will return to the sea and so it is imperative that NOAA work to understand as much as we can about the wreck and her history while she remains.

Deleted: Unfortunately, nothing can stop the slow deterioration of the wreck site

Concluding Remarks

Since its designation, the *Monitor* National Marine Sanctuary has accomplished many missions to protect and preserve the wreck of the famous Civil War ironclad. This report indicates that additional study of the sanctuary's living resources and general marine environment may be warranted. Conducting biological research, ongoing archaeological investigation, developing effective monitoring programs and establishing new partnerships with scientific communities will help guide management actions and better preserve sanctuary resources. Continued efforts in public education through exhibiting and various media outlets are important approaches to ensuring long term protection of the sanctuary and the information it has yet to reveal about the life and times of the *Monitor*.

Deleted: . However, t

Deleted: the deficiency of scientific data regarding

Comment [PT72]: Please add more about education and outreach efforts.

Acknowledgements

We would like to thank Tane Casserley, a maritime archaeologist with the National Marine Sanctuary Program's Maritime Heritage Program, who assisted in answering the set of 17 questions and Jeff Johnston, a historian with the *Monitor* National Marine Sanctuary, who provided additional content for the report.

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A Look at the *Monitor* National Marine Sanctuary: Past, Present, and the Future, *Monitor* National Marine Sanctuary 1994. <http://monitor.noaa.gov/publications/welcome.html>

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Response to Pressures

Overview

Monitor National Marine Sanctuary Web site, Regulations ((<http://monitor.noaa.gov/about/regs.html>))

The North Carolina Coastal Ocean Observing System Web site (<http://nccoos.unc.edu>)

Recreational Fishing, Boating and Diving

Monitor National Marine Sanctuary Final Regulations, NOAA. (<http://monitor.noaa.gov/about/regs.html>)

Additional Resources

NOAA's National Marine Fisheries Service <http://www.nefsc.noaa.gov/>

The North Carolina Coastal Ocean Observing System <http://nccoos.unc.edu>