National Marine Sanctuaries
National Oceanic and Atmospheric Administration
Stellwagen Bank National Marine Sanctuary

WINTER/SPRING 2010

News from
Gerry E. Studds
Stellwagen Bank
National Marine Sanctuary

Stellwagen Banknotes

Sanctuary Birds

Gannet in Flight
Photo: Susan Parks

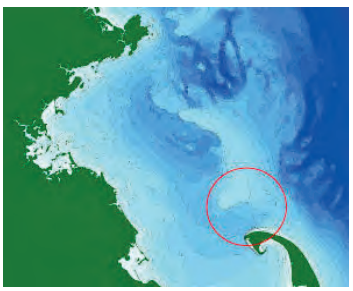
Diving Gannet
Photo: Michael Thompson

Northern Gannet
Fast Facts

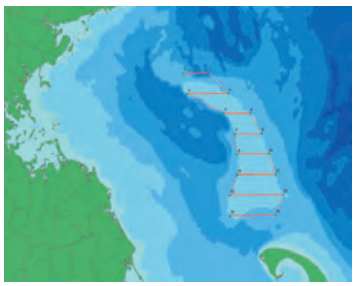
Scientific Name: *Morus bassanus*
Length: 40 inches
Wingspan: 70 inches
Weight: 6.5 lbs.
Distinguishing characteristics: White with black wingtips, long pointed bill, tail and wings, yellow head. Juveniles have mottled dark plumage. Males and females are similar in size and coloring.
Interesting behaviors: Birds plunge dive from heights of up to 130 feet; use wings and feet to swim in pursuit of prey. Dives can be as deep as 72 feet. Most mate monogamously for life.
Range: Open ocean most of the year. Six North American breeding colonies – 3 in Gulf of St. Lawrence and three off coast of Newfoundland. In Europe, 32 colonies from Brittany, France to Norway. Found in the sanctuary year-round, commonly in winter.
Prey: small fish and squid
Status: Populations appear to be increasing.
Fast Fact: Sanctuary scientists and whale watchers often look to the air when searching for whales. Northern gannets prey on the same food as humpbacks and fin whales. The birds serve as a highly visible indicator of the presence of sand lance and other schooling fish.

New Bird Count Area Targets Sanctuary

Kittiwakes, gannets, gulls and murres are all winter visitors to the Stellwagen Bank sanctuary. And this winter, they were all counted during the annual Christmas Bird Count, which featured a redefined Stellwagen Bank count area. Instead of the conventional circle that incorporated part of Provincetown, the survey area now consists of a set of survey lines that cover the bank – an area totally enclosed within the sanctuary. There is no Cape Cod land component associated with this particular count anymore.



Former Stellwagen Bank CBC Circle



New Stellwagen Bank CBC Survey Tracks

Christmas Bird Counts, organized under the National Audubon Society, have been held worldwide for over 100 years. The Stellwagen count has a history of some 21 years, as organized by the Massachusetts Audubon Society, although many of those years did not include marine components due to inclement weather. For the past 10 years, the sanctuary has been a co-sponsor of the count.

"In the past we tried to pull together enough interested bird enthusiasts to help charter a whale watching vessel to take us out to the bank," said project leader Simon Perkins of Mass Audubon. "Unfortunately, with a single target day for the count, we were often skunked, due to wind, waves and bad weather."

Now, Mass Audubon and the sanctuary are partnering and employing a flexible schedule with a small, dedicated contingent of specialists. Upon determination of the best available weather day (less than 15 knots of wind) in the Bird Count calendar of mid-December to early-January, the count team can mobilize within a day to hit the water using the sanctuary's research vessel *Auk*. This year the team had a two day notice before departure on Dec. 31.

The survey team hopes to make this a seasonal project, so that avian resources can be identified, along with any changes in bird population numbers, ranges or diversity over long time periods.

"We'd like to see the sanctuary become a sentinel site for studies of regional global change and ocean acidification," said sanctuary superintendent Craig MacDonald. "These surveys will provide us with a dataset for a group of animals that has not yet been well studied on the bank."

The new survey tracks are laid out in east-west segments 2.5 nautical miles apart. The endpoints of each track intersect the 40-meter bathymetry line, keeping the count area on the top of the bank. The tracks range the entire length of the bank, for a total survey length of 63 nautical miles. These tracks comprise a subset of a study area developed by sanctuary research coordinator David Wiley for research that focused primarily on whales and fishing gear (although birds were also counted) in the mid-1990s and 2001-2002. The researchers hope to see if there is any correlation between the new counts and Dave's earlier findings.

To view data from this year's Christmas Bird Count, visit the National Audubon Society's Web site at http://cbc.audubon. org/ Cedarcrest/current_ table. html.

Contact the sanctuary for information about receiving copies of our publications.

STELLWAGEN Banknotes
Winter/Spring 2010

Cover photos: Feeding humpback whale by Jeremy Winn. Taken under NOAA Fisheries Permit #605-1904

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National Marine Sanctuaries

Whale Research

(Background photo) Humpback whales and seabirds feed on sand lance in the sanctuary. The NOAA ship Nancy Foster *served as mission control during the July research cruise.*

(Photo below) Humpback's tail appears at the start of a feeding dive, framing a whale watch boat in the distance. Photos taken under NOAA Fisheries Permit #605-1904.

Scientists Revisit Sanctuary to Tag Humpback Whales

From July 17 to Aug. 1, 2009, the sanctuary served as the location for a collaborative project to investigate the underwater behavior of humpback whales. Eighteen animals were tagged providing 100 hours of data; and for the first time, three animals were tagged in the same feeding group. During this sixth year of the project, more than 20 scientists from nine institutions worked off the NOAA ship *Nancy Foster* and the R/V *Auk*. In addition to the tag data, which records whale movements and sounds, the researchers mapped sand lance density in the region to attempt to better understand whale feeding behaviors. This year the project incorporated the use of a video-plankton recorder to determine the abundance of plankton, the humpback prey's prey. As in past years, fecal samples were collected for nitrogen analyses. The institutions participating in this multi-year project are: Stellwagen Bank National Marine Sanctuary; Duke University; University of New Hampshire; Woods Hole Oceanographic Institution, Bioengineering Laboratory; Whale Center of New England; Penn State University; Harvard University; University of Vermont; and NOAA Fisheries.

Photo: Jeremy Winn

Photo: Susan Parks

Photo: Susan Parks

Right Whale Photos (top to bottom): Tail during dive; callosities on head; broad, flat back with tag attached.

Right Whale Behavior Studied

Seven right whales were tagged in April in a project with Susan Parks of Penn State (see page 12) and the sanctuary's Leila Hatch as co-principal investigators. The multi-institution research team investigated right whale calling rates. These data will be compared with detections made at acoustic buoys in the shipping lanes. Additional studies looked at water column use or how often whales could be found at depths where ships might present problems. Photos taken under NOAA Fisheries Permit #655-1652-01.

Whales Tagged during 2009 Cruises

1 unnamed fin whale
14 named humpbacks
Glowstick
Solas (3 times)
Upsilon
Milkyway
Tripod (2 times)
Entropy
Fern's calf
Fern
Lavalier's calf
Lavalier
Jabiru
Draco
Samovar
Valley

Seven right whales and one humpback were tagged during the April 2009 cruise.

All work was done under NOAA Fisheries Permits #605-1904 #655-1652-01

Currents

Ocean Policy Task Force: Interim Framework Released

On Dec. 14, 2009, President Obama's Ocean Policy Task Force released its Interim Framework for Effective Coastal and Marine Spatial Planning for a 60-day public review and comment period. The framework offers a comprehensive, integrated approach to planning and managing uses and activities on regional scales. NOAA's work in shifting the shipping lanes through Stellwagen Bank National Marine Sanctuary was used as the signature case study of the report. The effort to realign the Boston Vessel Traffic Separation Scheme is a positive example of endangered species protection through spatial planning.

To view a copy of the Interim Framework visit http://www.whitehouse.gov/administration/eop/ceq/initiatives/oceans/interim-framework.

NOAA Tide Predictions On-Line

NOAA Tide Predictions is a new web-based tool that provides free, user-friendly access to official U.S. tide predictions for nearly 3,000 locations around the nation. Whether you are a professional mariner or a casual boater, you can take advantage of the application to get customized, reliable, and accurate tide predictions.

After locating the appropriate station from the Tide Predictions page, you can have the program prepare a customized tide graph for any day or specified week or month. Tide tables are available for download in either XML or plain text format. The data may also be exported for print.

While the main goal of the service is to ensure navigational safety and promote the efficient transport of goods, services and people throughout the nation's maritime transportation system, the data are available for anyone needing to know what the tides will be for any given future day, week, month or year. Tide Predictions is a service of NOAA's Center for Operational Oceanographic Products and Services. The Web site is http://tidesandcurrents.noaa.gov/tide_predictions.shtml.

Sanctuary Shellfish Closure

At the request of the U.S. Food and Drug Administration, NOAA's Fisheries Service is extending the temporary paralytic shellfish poisoning (PSP) closure through December 31, 2010, due to the presence of high levels of the toxin that causes PSP. The entirety of the sanctuary is within the closure zone, which restricts the harvesting of all bivalve molluscan shellfish with the exception of sea scallop adductor muscles shucked at sea. The final emergency rule is available at NMFS's Northeast Regional Office at www.nero.noaa.gov/nero/hotnews/redtide.

Wolffish Decision Announced

In the last issue of Banknotes, we reported on a petition to list the Atlantic Wolffish as an endangered species. After careful review, NOAA's Fisheries Service announced in November that the fish is not currently in danger of extinction or likely to become endangered in the foreseeable future, and therefore denied the petition. The Atlantic wolffish will continue to be classified as a species of concern. Although this does not extend special protections to the fish, NOAA devotes resources to a variety of conservation efforts intended to ensure that species of concern do not require listing under the Endangered Species Act.

The biological review team concluded that Atlantic wolffish in U.S. waters form the southernmost component of a larger population centered off the Canadian Maritime Provinces. The population is found in a variety of habitats over a large area in which there are few barriers to migration. This widespread population allows the species to accommodate pressures posed by habitat changes, fishing, predation, disease, and other man-made or natural influences.

There is no directed U.S. fishery for Atlantic wolffish, which are usually landed on commercial groundfishing trips. Although numbers are not at a critical stage, NOAA Fisheries' 2009 population assessment noted concerns about the number and declining average weights of adult fish. The New England Fishery Management Council has recently proposed including wolffish in the northeast groundfish management plan and to prohibit possession of them in federally managed commercial or recreational fisheries. Recent studies show that these fish have a relatively high survival rate when released alive after capture.

Reports on Humpback Songs

Stellwagen Bank's own postdoctoral researcher Danielle Cholewiak and her work on humpback songs attracted her fair share of attention at the biennial Marine Mammal Conference, held this past November in Quebec City. During her graduate studies at Cornell University, Cholewiak spent four winters off of Mexico's Pacific coast eavesdropping on humpback whales with underwater acoustic recorders. When she retrieved the recorders and analyzed the sounds, she found that humpback songs change when another male is around. As Cholewiak noted, "Only male humpback whales sing, and it's as if one whale is saying to another, 'Hey, I'm talking to you.' It may be a little macho one-upmanship." She found that when one singer encounters another, his song often changes to become closer to that of the second whale. The songs are actually a series of chirps, hums, and whups (as defined by the researchers) that are put together into "phrases." When a set of phrases is used repeatedly, it is called a theme.

Cholewiak also recorded particular songs, simplified each song to three themes, and then broadcast the new versions into the water through speakers hanging under her boat. When the whale heard the revised version of his song, he began to adapt and simplify his singing. "I was really surprised that the whales responded to the recording," said Cholewiak, who compared the work to earlier studies on bird behavior. "Other researchers had only looked at whale movements during playbacks, and found no significant results. But playbacks seem to have a notable effect on song characteristics."

Cholewiak is now putting her marine mammal acoustic knowledge to use at the sanctuary where she is studying background noise and the masking effects of these sounds on whale communication. "This noise may have a major impact on a whale's ability to safely use its habitat," she said. "For endangered right whales, humpbacks and fin whales, three of the sanctuary's most visible and cherished species, understanding the consequences of noise inputs may lead to better conservation programs."

Humpbacks under Review

Humpback whales, a marine mammal species now listed as endangered under the Endangered Species Act, has come up for review by NOAA's Fisheries Service. In the 10 years since its last status review, the Pacific population has shown significant rebound, with growth rates of 4 to 7 percent a year in recent decades. A recently completed multi-national study, entitled Structures of Population, Levels of Abundance and Status of Humpback Whales (SPLASH), estimated the Pacific population at 18,000-20,000 individuals, a significant increase from the mid-1960s estimate of 1,400. The Atlantic population also appears to be increasing, but that rate is not as well quantified. A study in the early 1990s put the total at 10,600. A year-end status of the stocks estimate from NOAA Fisheries is expected to show a larger population.

Up until 1988, there was no formal process for delisting a species once it was on either the Endangered or Threatened lists under the Endangered Species Act. An amendment passed that year required the development of objective criteria for delisting. In the June 2002 issue of *Ecological Applications*, the sanctuary's marine ecologist Leila Hatch, then a graduate student at Cornell University, co-authored a paper on the evaluation of recovery criteria, which showed that population size was the most quantitative and frequently used criterion for the evaluation of recovery, and therefore the criterion for delisting.

While the numbers may be up, there are other factors that may play a role in the continued recovery of the species. "Some populations of the species, particularly those in the South Pacific near our sanctuary in American Samoa and off the coast of Japan still have low numbers. And we have no way of knowing how global warming, ocean acidification, pollution and changing prey patterns will affect the North Pacific and North Atlantic populations," said Hatch. "In order for the Endangered Species Act to be a viable tool for conservation, we need to be able to respond when populations rebound," she added. Many factors must be considered, including habitat quality, fragmentation, food web dynamics, human uses and policy developments, before delisting is allowed.

NOAA Fisheries Service estimates that the status review process should take about a year, and that an announcement may be made before the end of 2010. If warranted, a proposed revision to the humpback whale listing status would follow.

Codfish hide
In shipwreck
Photo: Douglas Costa

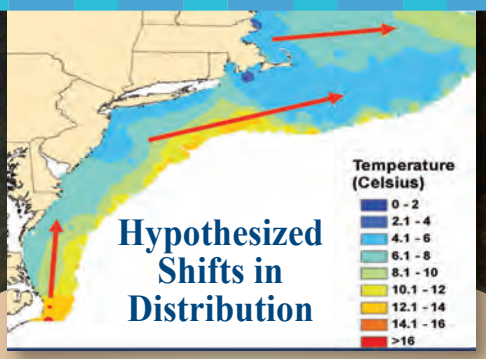
Why the Interest in Catch Shares?

Around the country there is growing interest in moving away from traditional effort based fisheries management approaches such as regulating the numbers of days fishermen can fish or restricting access to certain areas during times of year when fish aggregate and/or spawn. Catch share programs are now in place in 13 federally managed fisheries in the United States. Sector management is a type of catch share program, where a group of fishermen are afforded a share of the total catch and more flexibility in making daily business decisions about how and when they want to fish. The group's share is based on the catch history of all the individual vessels that make up the sector.

The New England Fishery Management Council in June approved the development of 17 new fishing sectors, and modification to two existing sectors, under the Northeast Multispecies Fishery Management Plan Amendment 16. Under proposed measures which are now under review by NOAA Fisheries Service, fishermen holding federal limited access groundfish permit have the option to either join a fishing sector or continue to fish under days at sea regulations.

For the 2010 fishing year, 784 of the 1,480 eligible Northeast multispecies permit holders opted to be in a sector. This represents about 95% of historical commercial Northeast multispecies catch. These sectors plan to fish widely throughout Georges Bank and the Gulf of Maine, including the waters of Stellwagen Bank National Marine Sanctuary. One of the benefits that sectors provide to participating fishermen is exemption from some rolling closure restrictions. Fishermen have more freedom to fish where they want because they only have a set amount of quota for each groundfish stock and once it is reached they must stop fishing for that stock.

Catch share programs can be effective and efficient tools for managing and rebuilding fish stocks provided they include comprehensive monitoring programs. NOAA has committed $16.7 million to get additional sectors up and running in 2010. Funding for this effort was announced in April by Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator Jane Lubchenco, Ph.D. The use of sectors will also aid in the process of meeting Congress's new requirement that annual catch limits – a sustainable catch amount set for each stock – be in place for all fish stocks by 2011.



North Atlantic Fish Populations Shifting as Ocean Temperatures Warm

About half of 36 fish stocks in the Northwest Atlantic Ocean, many of them commercially valuable species, have been shifting northward over the last four decades, with some stocks nearly disappearing from U.S. waters as they move farther offshore, according to a study by NOAA researchers from the Northeast Fisheries Science Center in Woods Hole. The study focused on familiar fish species, including Atlantic cod, haddock, yellowtail and winter flounders, spiny dogfish and Atlantic herring, all of which are important sanctuary species, as well as several less well-known species. The study was based on NOAA Fisheries survey data collected every spring from 1968 through 2007. Several of the surveys tracks are located within or near the sanctuary.

The findings, published in the journal *Marine Ecology Progress Series*, show the impact of changing coastal and ocean temperatures on fisheries from Cape Hatteras, N.C. to the Canadian border.

"During the last 40 years, many familiar stocks have been shifting to the north where ocean waters are cooler, or staying in the same general area but moving into deeper, cooler waters than where they traditionally have been found," said Janet Nye, lead author and postdoctoral researcher. "They all seem to be adapting to changing temperatures and finding places where their chances of survival as a population are greater."

In addition to survey data on each of the stocks, the researchers also took into account fishing activities on the species over time, as well as natural cycles in ocean temperature. Ocean temperatures in the northwest Atlantic have increased since the 1960s and 1970s, and the authors found significant changes in species distribution consistent with warming in 24 of the 36 stocks studied.

Ten of the 36 stocks examined had significantly expanded their range, while 12 had significantly reduced it. Changes in a species range can be caused by both temperature changes and fishing activity, with heavily fished stocks appearing more sensitive to climate change and often showing a larger shift.

Seventeen of the 36 stocks occupied increasingly greater depths, and three stocks occupied increasingly shallower waters. However, the temperature at which each stock was found did not change over time, suggesting that fish are moving to remain within their preferred temperature range. While consumers will find familiar fish species at their local fish markets for the foreseeable future, fishermen may have to travel farther to catch some species until eventually it will not be economical. More information about the study can be found on the Web at: http://www.nefsc.noaa.gov/press_release/2009/SciSpot/SS0916/index.html.

MSI: Shipwreck

MARINE SCIENCE INVESTIGATION

Wreck Coordinates
Lat: 42° 18.731' N
Long: 70° 17.843' W

(Background photo) The hull is broken into two large pieces with its stem lying upside down. All photos on this page unless noted, courtesy of Heather Knowles, Northern Atlantic Dive Expeditions, Inc

Shipwreck Photos (top to bottom); The pilothouse with its strangely-shaped windows is separated from the rest of the hull; Doors on three sides of the pilothouse provide entry for properly trained divers; A diver peers into the pilothouse; Invertebrates camouflage a sea raven.

Help Sanctuary Archaeologists Identify a Mystery Wreck

An unidentified fishing trawler shipwreck rests on top of Stillwater Bank in 105-110 feet of water in the Outbound Lane of the Port of Boston's Traffic Separation Scheme, also known as the Boston shipping lanes. The steel-hulled trawler's identity has not yet been determined. The sanctuary is seeking help from those individuals who might know its name or have information on recent trawler shipwrecks in the sanctuary.

Identification Clues:

The trawler is broken into four main components - pilothouse, hull, stern, and net reel surrounded by smaller hull fragments. Since the vessel is broken into pieces, its overall length cannot be precisely measured but is coarsely estimated at 65 feet. Measurement of the trawler's stern indicates a breadth of approximately 19 feet. The vessel's hull is painted light blue and white and there are no obvious indications as to why the vessel sank. The quantity of invertebrate growth covering the hull suggests that it sank before 1990. Steel stern trawlers came into common use in the late 1960s. These clues suggest a likely sinking date between 1970 and 1990.

Reporting:

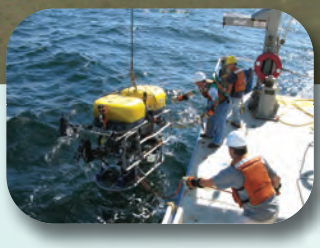
Although the shipwreck is modern, sanctuary archaeologists would like to identify the vessel and learn something of its history as do local scuba diving charter operators, who are now taking divers to the site. If you would like to dive on this wreck, a list of dive charters that visit the sanctuary is available on the sanctuary's Web site under the "Visitor Information" section. "We are very interested in talking to anyone from the fishing community who may have information about the identity of this vessel and its history," said sanctuary historian Matthew Lawrence. "Each wreck is a window into the area's maritime tradition, and fishing has been a key factor in New England's history." Please contact the sanctuary if you have any information about this vessel by phone at 781-545-8026 ext. 213 or by e-mail at matthew.lawrence@noaa.gov.

Maritime Heritage

UPDATE:
NURC-UConn is now the Northeast Undersea Research, Technology and Education Center at the University of Connecticut. NURTEC will continue to partner with the sanctuary on a variety of undersea expeditions.

(Background Photo): A ceramic pitcher from the steamship Portland *is now home to northern pink shrimp. Photo: NOAA/SBNMS and NURC-UConn*

Archaeologists and scientists in the ROV control van monitor the video feed. Photo: NOAA/SBNMS and NURC-UConn



K2 is launched off the R/V Connecticut *to explore the sanctuary's deepwater shipwrecks. Photo: NOAA/SBNMS and NURC-UConn*

A cusk hides inside one of Portland's *steam release pipes. Photo: NOAA/SBNMS and NURC-UConn*

Northern cerianthids sit on the seafloor near a shipwreck. Photo: NOAA/SBNMS and NURC-UConn

2009 Characterization and Monitoring Cruise Review

Stellwagen Bank National Marine Sanctuary partnered with the National Undersea Research Center at the University of Connecticut (NURC-UConn) in September 2009 for a two-day remotely operated vehicle (ROV) cruise. The collaborative project sought to characterize and monitor the sanctuary's maritime heritage resources, shipwrecks. Researchers conducted operations off the R/V *Connecticut* with the newly developed NURC-UConn ROV *Kraken 2 (K2)*. The cruise returned to the steamship *Portland* and documented four other historic shipwrecks. NURC-UConn's staff and technical capabilities allow the sanctuary to fulfill its National Historic Preservation Act mandates, which require the sanctuary to inventory the historic resources under its jurisdiction and assess them for eligibility to the National Register of Historic Places.

K2 was an ideal platform for archaeological survey. The ROV's Zeus high definition video camera and Scorpio still camera captured imagery of diagnostic features and artifacts that will help sanctuary archaeologists interpret the shipwrecks. Dives on the steamship *Portland* focused on previously documented areas, to record changes to the site's structure and artifact distribution. The updated imaging capabilities of *K2* resulted in the highest quality imagery yet captured on the shipwreck.

Revisiting the *Portland* on a nearly annual basis, the project is documenting changes to the site from biologic, oceanographic, and anthropogenic (human-caused) forces. The ROV surveys recorded human impacts to the site, such as the presence of fishing gear, the movement of artifacts, and the destruction of artifacts and features, to help guide management decisions seeking to preserve the shipwreck for current and future generations.

Research has shown that the greatest impact and biggest future threat to the archaeological integrity of sanctuary shipwrecks is from commercial fishing. Commercial fishing also negatively affects a shipwreck's aesthetic and recreational qualities.

NURC-UConn scientists brought a holistic approach to the project through their ability to characterize the marine life now living on the shipwrecks. Sanctuary shipwrecks become oases of biological diversity, hosting a myriad of colorful Gulf of Maine marine life that use the shipwreck structure as substrate and refuge. *K2's* advanced imaging capabilities were also put to use collecting photos and video of these organisms for further analysis.

Project support was provided by the Office of National Marine Sanctuaries' Maritime Heritage Program and Office of National Marine Sanctuaries' Northeast Region.

Ocean & Climate Literacy

The Office of National Marine Sanctuaries, as caretaker of our nation's system of special marine protected areas, believes that an ocean and climate literate public is important for understanding and adapting to the global changes that are affecting our sanctuaries, our ocean and our world.

What is Your Ocean and Climate Literacy Score?

1. How much of the Earth's primary productivity takes place in the sunlit layer of the ocean?

2. What percentage of the world's water is in the ocean and unfit for drinking?

3. There is greater higher order diversity in the ocean than on land with more animal phyla represented in the sea. T or F ?

4. You have probably heard about the problem of sea level rise. What is/are the major cause(s)?

5. What is the name of the force due to the Earth's rotation that affects the world's ocean circulation system?

6. What factors create circulation patterns in Massachusetts Bay and the sanctuary?

7. Is the freezing point of seawater slightly lower or higher than that of fresh water?

8. Is electrical conductivity of seawater higher or lower than fresh water?

9. Sand consists of tiny bits of animals, plants, rocks and minerals. What is the foremost component of Stellwagen Bank's sand?

10. Less than 5% of the ocean has been explored. T or F?

11. Due to increasing levels of carbon dioxide, the oceans are becoming more acidic. T or F?

12. What is the difference between climate and weather?

13. What is the difference between a weather forecast and a climate forecast?

14. What are the three key heat-trapping gases in the atmosphere?

15. Earth's average temperature is now warmer than it has been for at least the past 1,300 years. T or F?

16. During the 20th century and up until 2009, the Earth's globally averaged surface temperature rose by approximately how many degrees?

17. Ocean warming due to climate change will occur more quickly in the higher latitudes than in the tropics. T or F?

18. Scientific observations and climate model results indicate that human activities are now the primary cause of most of the ongoing increase in Earth's globally averaged surface temperature. T or F?

19. What are the three options for Stellwagen Bank National Marine Sanctuary species if the habitat changes through global warming?

20. How many oceans do we have on our planet?

Spreading the Word About Ocean and Climate Literacy

Ocean and climate literacy means understanding the influence of the ocean and climate on you – and how you can influence the ocean and climate. An ocean and climate-literate person:

- understands the essential principles and fundamental concepts about the functioning of the ocean and climate;
- can communicate about the ocean and climate in a meaningful way; and
- is able to make informed and responsible decisions regarding climate, the ocean and its resources.

NOAA, in concert with other government agencies and nongovernmental organizations, is helping to build a more knowledgeable public that can tackle the pressing ocean and climate issues confronting our society. One such effort is the development of essential principles for ocean and climate literacy. Ocean literacy is defined by seven essential principles while climate literacy is defined by nine. These principles are outlined in guides found at NOAA's National Ocean Service education Web site http://www.nos.noaa.gov/education/literacy.html.

Many scientists and educators collaborated to produce these guides, which outline the knowledge required to be considered ocean and climate literate in accordance with the National Science Education Standards (NSES). Educators teaching grades K-12 can use the concepts and principles in these guides to fulfill many of the NSES content standards.

Answers:

1. 50%; 2. 97%; 3. T; 4. melting of ice caps on land and expansion of warming sea water; 5. Coriolis effect; 6. shape of the adjacent land, seafloor topography, tides, wind; 7. lower; 8. much higher; 9. rock; 10. T; 11. T; 12. Weather is the specific condition of the atmosphere on a particular place and time, measured in terms of variables that include temperature, precipitation, cloudiness, humidity, air pressure and wind. Climate is the long-term average of conditions in the atmosphere, ocean, ice sheets and sea ice described by statistics, such as means and extremes; 13. A weather forecast is a prediction about the specific atmospheric conditions expected for a location in the short-term future (hours to days). A climate forecast is a prediction about average or extreme climate conditions for a region in the long-term future (seasons to decades); 14. carbon dioxide, methane, nitrous oxide; 15. T; 16. 1.33°F or 0.74°C; 17. T; 18. T; 19. adapt, migrate, perish; 20. one interconnected ocean with major ocean basins.

How did you score?

20-18 Excellent! You are well versed in ocean and climate literacy. With constant advances in ocean and climate science, it is important that you remain inquisitive and conscientious about these critical issues.

17-13 Good. You have a good foundation in ocean and climate literacy but should increase your awareness about these important subjects.

12-6 Fair. You have a basic awareness of ocean and climate literacy principles, but should make the effort to increase your understanding of these important environmental concepts.

6-0 Needs Improvement. You have not been paying attention to the news and conditions around you. A more informed citizen will be better able to adapt to climate change and care for important ocean resources.

Telly Awards Photo: CRG

Sanctuary Video Wins Awards

The sanctuary's five-minute overview video "Stellwagen Bank: A Sanctuary Worth Protecting" received three Telly awards this past year in the categories of Academic/Education. Nature/Wildlife and Social Issues. The Telly competition recognizes achievement in video and film productions. The video was also named a finalist in the 2009 Blue Ocean Film Festival's short program category. To watch the video, visit our home page at http://stellwagen. noaa.gov

Sanctuary Sunset. Photo: Anne Smrcina

Marine Art Contest

Amazing animals abound in sanctuary waters. Students in grades K-12 are invited to explore the biodiversity of New England's only National Marine Sanctuary and illustrate nature's wonders in this annual contest.

Minke Whale by Timothy Ready, Plymouth South High School, grade 12

Mackerel by Sienna C., Plymouth South Middle School, grade 7

Students Interpret Sanctuary Species in Annual Art Contest

Humpback Whale by Kathleen Mills, Sandwich High School, grade 11

Goosefish by Mark S., South Shore Charter Public School, Norwell, grade 2

Paintings and drawings of humpback whales, a goosefish and a naked sea butterfly were among the winning entries in the 2009 marine art contest sponsored by the Massachusetts Marine Educators (MME) and co-sponsored by the sanctuary and four other organizations. The contest attracted more than 400 entries in five categories – grades K-4, grades 5-8, grades 9-12, computer graphics and scientific illustration. "We received a wonderful collection of art that illustrated the great diversity of species in the sanctuary and Gulf of Maine," said sanctuary education coordinator and contest director Anne Smrcina. "The judges loved the fact that many students were daring and chose species that are not well known to the public but fascinating in their own right. We're looking forward to seeing what students submit this year." For 2010, the contest theme will remain the same – "Amazing Ocean Creatures of Stellwagen Bank National Marine Sanctuary and the Gulf of Maine."

The deadline for submission of entries is April 25, 2010. A first, second and third place winner will be selected in each division; prizes will include aquarium and museum passes, cash awards and certificates. All winning artwork will be displayed on the sanctuary Web site at http://stellwagen.noaa.gov (gallery section). For more information about the 2010 contest, visit the sanctuary Web site or www.massmarineeducators.org.

2010 Marine Art Contest

Grades K-12
Divisons: K-4, 5-8, 9-12,
Scientific Illustration
Computer Graphics

Theme: *Amazing Ocean Creatures of Stellwagen Bank National Marine Sanctuary and the Gulf of Maine*
ENTRY DEADLINE:
April 25, 2010

SEND ENTRIES TO:
MME Art/Poster Contest
c/o Anne Smrcina
Stellwagen Bank
National Marine Sanctuary
175 Edward Foster Road
Scituate, MA 02066

Kemp's Ridley Sea Turtle by Morgan O., Milton Academy, grade 7

Ocean Acidification

Sea Scallop
Photo: USGS

NOAA Agencies Addressing Issue of Ocean Acidification in Local Waters

You've probably heard about the issue of global warming, but do you know about the other carbon problem?

The steadily increasing volume of carbon dioxide (CO_2) emissions is not only exacerbating the greenhouse effect and raising global temperatures, but it's also increasing ocean acidity. This change in the acidity of seawater may have far-reaching effects on life in the ocean – and by extension, the entire planet.

To better understand what is happening in our waters, Congress passed the Federal Oceanic Acidification Research and Monitoring Act in early 2009. Three agencies have been tasked with implementing this act – NOAA , NASA, and the National Science Foundation (NSF). NOAA's role is to: 1. establish a long-term monitoring program, 2. develop strategies to adapt to these changes, 3. provide education and outreach programs, and 4. support research that studies ocean acidification effects on ecosystems and the impacts these changes will have on society and the economy. The major idea is that if we can expect certain changes, we can prepare for them and not be blind-sided. If an ecosystem becomes more acidic, perhaps other stressors, like extra nutrients or pollution can be reduced to help ease the impact. If acidity levels vary over time and space, human uses, such as shellfish farming, may have to accommodate these new natural cycles.

The sanctuary is now working with NOAA's Fisheries Service northeast office in the development of a regional plan. One key element for the sanctuary is the establishment of Stellwagen Bank as a sentinel site in the monitoring program.

NOAA's Ocean Acidification Concerns

- Reduced calcification rates
- Significant shifts in key nutrients and trace elements
- Shift in phytoplankton diversity
- Reduced growth, production and life span of adults, juveniles and larvae
- Reduced tolerance to other environmental fluctuations
- Changes to fitness and survival
- Changes to species biogeography
- Changes to key biogeochemical cycles
- Changes to food webs
- Reduced sound absorption
- Reduced homing ability
- Reduced recruitment and settlement
- Changes to ecosystems and their services

Acid Test: The Movie

A visually stunning documentary on ocean acidification has been released by the Natural Resources Defense Council. The 20-minute show can be viewed at the NRDC Web site at: http://www.nrdc.org.

Ocean Literacy Fast Facts

Phytoplankton use CO_2 and H_2O to produce oxygen and sugar in a process called photosynthesis. Most of the oxygen we breathe was created at sea. Photosynthesis and the process of respiration also move CO_2 into deep water.

Ocean Chemistry 101

There's an old chemistry class adage that says, *"Do as you ought'a, add acid to water."* That slogan was intended to keep students safe from splashes and acid burns. Today the slogan could be revised to fit a new global safety issue – *"Do as we ought'a, reduce CO_2 in seawater."* This reduction is necessary to slow the process of ocean acidification.

Ocean Acidification Chemical Reactions

CO_2 *(atmos)* $\leftrightarrow CO_2$ *(aqueous)*

H_2O *(water)* + CO_2 *(carbon dioxide)* $\leftrightarrow H_2CO_3$ *(carbonic acid)*

$H_2CO_3 \leftrightarrow H^+ + HCO_3^-$ *(bicarbonate)*

$H^+ + HCO_3^- \leftrightarrow 2H^+ + CO_3^{-2}$ *(carbonate)*

$Ca^{+2} + CO_3^{-2} \leftrightarrow CaCO_3$ *(calcium carbonate)*

Over the past century and a half, a vast amount of carbon dioxide (CO_2) from the atmosphere has entered the ocean. On average, the ocean absorbs about 25% of all the carbon dioxide we emit from the burning of fossil fuels and land use changes, such as burning and decay. A recent article in the journal *Nature* claims 2.3 billion tons of CO_2 were absorbed in 2008 alone. The chemical reaction that CO_2 undergoes in the ocean is detailed above.

Carbon dioxide moves from the atmosphere into the water at the ocean's surface. As the CO_2 concentration increases in seawater, it reacts quickly with water to form carbonic acid. The acid dissociates to form a hydrogen ion and a bicarbonate ion. Most of the resulting hydrogen ions react with carbonate ions to produce more bicarbonate ions. As a result, more CO_2 in the water increases the amount of hydrogen ions, thereby increasing acidity and decreasing the number of carbonate ions. Scientific measurements show that since the mid-1800s (the start of the Industrial Revolution) ocean acidity has increased by 30%. Recent changes are even more rapid. This rate of change in ocean acidity is many times faster than any changes discovered over the last 55 million years.

The reduction in carbonate ions can have detrimental effects for many animals, such as clams, mussels and oysters and many forms of zooplankton and phytoplankton. The calcium carbonate that makes up the shells and skeletons is formed by a reaction of calcium and carbonate ions. Delicate coral reefs, now under so many pressures, ranging from warming waters to pollution, would be at significant risk. These harmful effects can be likened to a marine version of osteoporosis. Not only would shells not grow, but with increasing acidity some may start to dissolve.

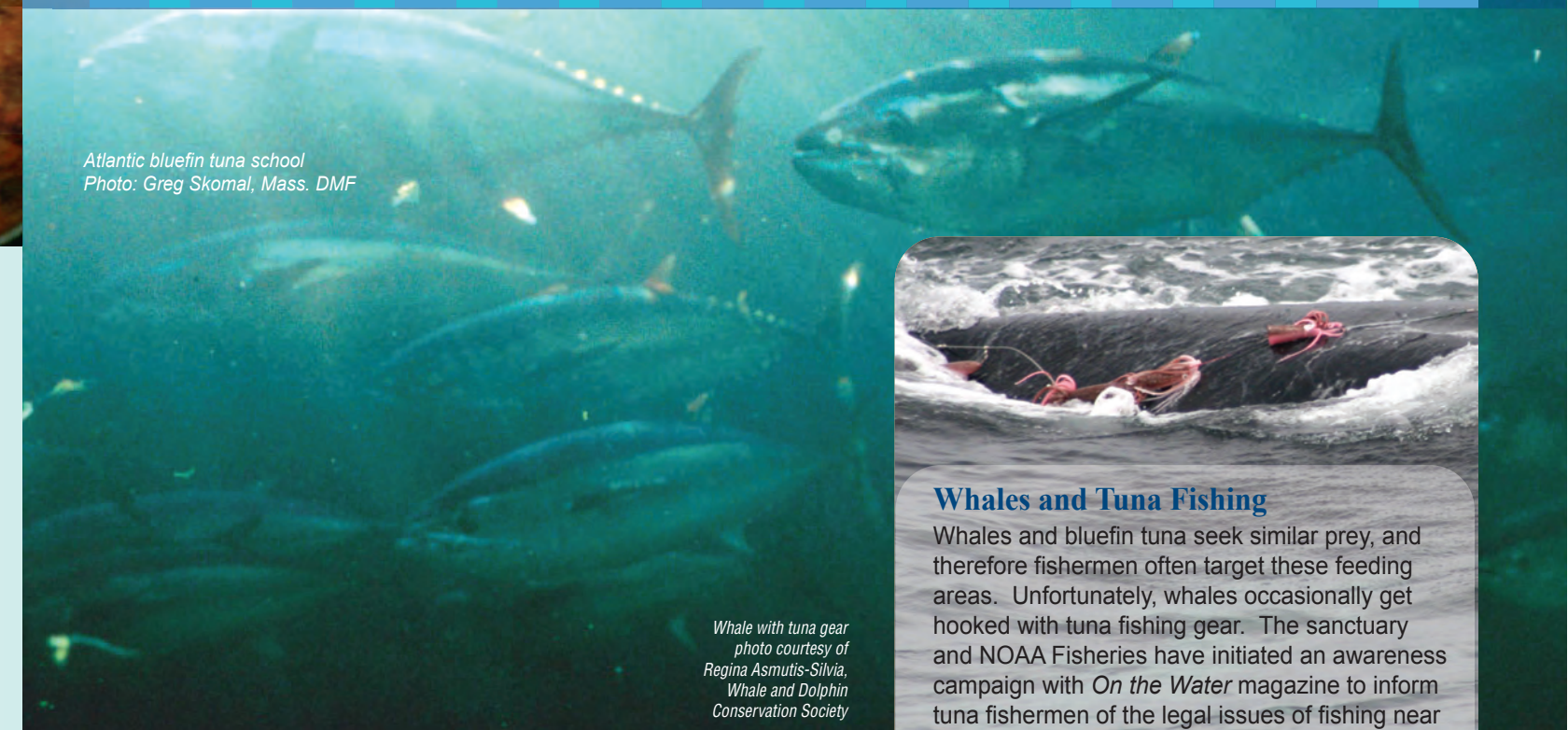
The ramifications of more acidic ocean water in the Stellwagen Bank sanctuary are still unknown. The projected change in pH (acidity) is a big question. Researchers believe that ocean acidification may be heightened in the higher latitudes – the polar regions – and upwelling areas, some of the areas with the most productive fisheries. Denser, colder water is more efficient at absorbing carbon dioxide. More acidic waters may show changes in sound transmission, thereby affecting whales and other vocalizing animals, or it may affect the ways predators find their prey. The only given is that ocean acidification is presently happening and the marine science community is very concerned.

How Acidic is the Ocean?

Scientists use the pH scale to measure how acid or basic a solution is - 7 is neutral, more than 7 is basic and less than 7 is acidic. It may seem counter-intuitive, but if more hydrogen ions are in solution, the pH goes down and the solution is more acidic. Since the pH scale is logarithmic, a one point drop means a 10-fold increase in acidity.

The ocean is basically basic (pH 8.0-8.3). Ocean acidity varies from place to place depending on upwelling and other inputs. Fresh water is neutral at 7. The more acidic a solution is the lower its number, e.g., milk (6), tomato (4), lemon juice (2), battery acid (0). In reverse, the more basic an item, the higher its number, e.g., baking soda (9), ammonia (11), oven cleaner (13), and sodium hydroxide (14). Historically, ocean water has been slightly basic, but relatively constant over millions of years. Monitoring has shown that seawater pH has gotten more acidic since the start of the industrial revolution

Creature Feature



Atlantic bluefin tuna school
Photo: Greg Skomal, Mass. DMF

Whale with tuna gear
photo courtesy of
Regina Asmutis-Silvia,
Whale and Dolphin
Conservation Society

Whales and Tuna Fishing

Whales and bluefin tuna seek similar prey, and therefore fishermen often target these feeding areas. Unfortunately, whales occasionally get hooked with tuna fishing gear. The sanctuary and NOAA Fisheries have initiated an awareness campaign with *On the Water* magazine to inform tuna fishermen of the legal issues of fishing near whales, including penalties for harming and/or harassing these protected species.

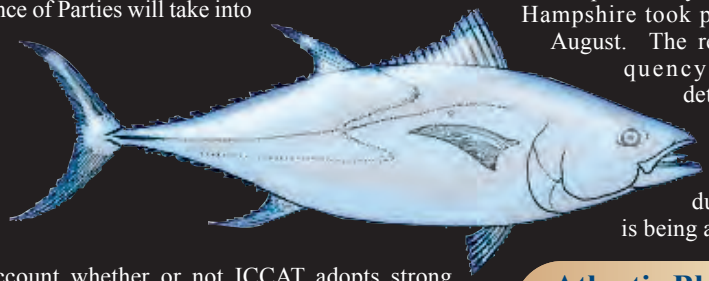
Species Spotlight: Atlantic Bluefin Tuna

It's fast, it's streamlined, and it's one of the most prized catches in the ocean. It's the Atlantic bluefin tuna. But because of its value as a sport fish and a palate pleaser, this tuna has been widely overfished. Now recognized as a trans-Atlantic traveler, researchers believe individual fish may move between the East Coast of the United States and the eastern Atlantic and Mediterranean Sea. Data proving these long-distance migrations have been collected from tags placed on fish in the Gulf of Maine and recovered thousands of miles away.

In the fall of 2009, Dr. Jane Lubchenco, Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator, announced this nation's support for listing Atlantic bluefin tuna on the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The proposal, put forward by the principality of Monaco, would prohibit international trade of the species. In addition, Dr. Lubchenco advocated for stiffer controls on bluefin tuna fishing for the eastern stock that spawns in the Mediterranean Sea.

Over the past 40 years, adult bluefin tuna populations have declined by 72% in the eastern Atlantic and 82% in the western Atlantic. Dr. Lubchenco stated that the status of the western stock, which spawns in the Gulf of Mexico and is fished primarily off the North American coast, has recently stabilized due to the establishment of well-enforced, science-based quotas. she called for ICCAT, the International Commission for the Conservation of Atlantic Tunas, to set responsible science based quotas for the eastern stock, to better enforce quotas, and to close fishing during spawning periods in the Mediterranean.

The final U.S. decision on whether to vote for Monaco's proposal at the 2010 CITES Conference of Parties will take into account whether or not ICCAT adopts strong management and compliance measures. At its November 2009 meeting, ICCAT made significant strides to improve the status of the stocks, but Dr. Lubchenco noted, "It is insufficient to guarantee the long-term viability of either the fish or the fishery. While we are disappointed that the total allowable catch is not lower, we strongly support the commitment to set future catch levels in line with scientific advice, shorten the fishing season, reduce capacity, and close the fishery if the stocks continue to decline. We remain committed to pursuing every legitimate avenue to recover Atlantic bluefin tuna and ensure their long-term survival."



In the sanctuary and other local waters, giant bluefin are caught commercially by harpoon, handlines, purse seines and rod and reel. Schools of smaller bluefin are the target of recreational fishermen and charter boats. Authority to manage this species has been delegated to NOAA Fisheries Service, Highly Migratory Species Division.

A recent pilot study by the University of New Hampshire took place in the sanctuary in August. The researchers used high-frequency multibeam sonar to determine the feasibility of estimating the mass of juvenile bluefin schools. The data collected during the five-day project is being analyzed this winter.

Atlantic Bluefin Tuna

Fast Facts

Common Name: Atlantic Bluefin Tuna
Scientific Name: *Thunnus thynnus*
Predators: Humans, orcas, pilot whales, sharks
Prey: Smaller fish, squid, crustaceans
Range: West Atlantic from Brazil to Newfoundland; East Atlantic from Canary Islands to Norway and throughout the Mediterranean Sea.
Growth Rate/Life Span: Slow growers; live to 20 years and older
Size: Can grow to more than 10 feet
Weight: : Max. 1,496 lbs. (Mass. record of 1,228 lbs. in Cape Cod Bay)
Speed: Up to 50 mph

Acclaim for Sanctuary Science

David Wiley (second from right) receives his award from (left to right) Deputy Secretary Dennis Hightower, DOC Secretary Gary Locke, and DOC Under Secretary and NOAA Administrator Jane Lubchenco, Ph.D.

Sanctuary Scientist Awarded Top Commerce Honor

David Wiley, sanctuary research coordinator, has been awarded a Gold Medal by the Secretary of Commerce for his leadership in designing and implementing innovative research projects to protect endangered whales in and around the sanctuary. The Gold Medal is the Department of Commerce's highest honorary award, presented annually for distinguished performance in support of the department's critical objectives.

Wiley's groundbreaking research led to the relocation of shipping lanes within the sanctuary and the world's first real-time system for notifying ships about the locations of whales in their paths. The estimated risk of ships striking whales while using the shipping lanes in the sanctuary has been reduced by 81 percent, including a 58-percent reduction in risk to critically endangered North Atlantic right whales.

Wiley has worked with fishermen to redesign fishing gear to reduce the risk of whale entanglement and pioneered methods to successfully rescue mass stranded whales and dolphins. His techniques are being adopted by NOAA in Southern California, and interest has been expressed in replicating his efforts internationally.

"Dr. Wiley is one of the most innovative and dedicated scientists I have met in my career," said Craig MacDonald, sanctuary superintendent. "Couple that with his extraordinary ability to team and partner with others, and his steadfast focus on mission objectives, and you have a formula for great leadership success."

Wiley received his Ph.D. in Environmental Studies from Antioch University with a focus on environmental decision-making and conservation biology. He has been investigating the marine environment for over 20 years, and his research has appeared in numerous scientific journals such as *Conservation Biology, Animal Behavior, Environmental Management,* and *Fishery Bulletin.*

Wiley is past recipient of a Switzer Environmental Leadership Award, a Gulf of Maine Visionary Award, and a Massachusetts Society for the Prevention of Cruelty to Animals' Human Hero award. He was named a NOAA Employee of the Year in 2007. Wiley and other NOAA honorees were recognized at a ceremony in Washington, D.C. on Nov. 19.

Susan Parks, Ph.D.

Presidential Award goes to Sanctuary Research Partner

Susan Parks, an assistant professor at Penn State and part of the Stellwagen Bank sanctuary tagging team studying whale behavior, has been awarded a 2009 Presidential Early Career Award. The White House issued the announcement on July 9.

The Presidential awards program was established in 1996 to identify and honor outstanding researchers who are beginning their independent research careers, and to provide recognition of their potential leadership across the frontiers of scientific knowledge during the 21st century. One hundred researchers across the country were selected for this prestigious honor.

Parks' primary research interest is in bioacoustics, integrating the fields of biological oceanography, behavioral ecology and physiology to address questions related to acoustic communication. She studies the use of sound for communication, hearing abilities, and the impacts of noise on both sound production and reception. Her current research focuses on the use of sound by North Atlantic right whales, studying behavioral aspects of sound production, perceptual abilities and impacts of noise on acoustic communication. She was co-principal investigator of the April 2009 right whale tagging research cruise in the sanctuary along with the sanctuary's marine ecologist Leila Hatch.

Sanctuary Science Papers

Five papers featuring sanctuary science were included in *Marine Ecological Progress Series*, Vol. 395, 2009. The issue focused on acoustics in marine ecology. Sanctuary Research Coordinator David Wiley was co-author on two papers with Michael Thompson, the sanctuary's GIS analyst co-authoring one; our marine ecologist Leila Hatch was lead author on one paper and co-author on another; and a fifth paper highlighted work in the sanctuary.

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