## Explanation

### NOPP

#### Affirmative description–

The affirmative increases the federal funding allocated to the National Oceanographic Partnership Program, an interagency organization that collaborates research between agencies such as NASA, NOAA, and the MMS. That would result in increased exploration of the oceans through instruments like satellites and submersible exploration vehicles, especially in international waters like the Pacific and the Atlantic. Afterwards, the data collected from the research will be used to inform responses to climate change and increase international scientific cooperation.

#### Affirmative advantages–

The aff has two advantages:

1. Marine Science – The affirmative argues that current investments in ocean research are inadequate and will continue to decline into the future. Because of funding issues, the world lacks proper information about the effects of global warming on marine ecosystems globally which prevents effective solutions. That ensures inevitable biodiversity loss which results in the human population exceeding the Earth’s carrying capacity, causing extinction.
2. Maritime Cooperation – The affirmative argues that recent disputes in the South China have damaged US-Sino relations dramatically, and that recent fishing vessel disputes could serve as a spark for regional conflict.

#### Negative Answers to the Marine Science Advantage:

The negative can introduce a variety of arguments against the Marine Science advantage. First, the negative argues that current NOAA funding levels are sufficient to explore the oceans. Second, the negative argues that ocean acidification is not occurring in the status quo. Third, the negative argues that even if ocean acidification was happening, it would not have a large impact on species biodiversity. Fourth, the negative argues that ocean acidification would be beneficial to marine species

#### Negative Answers to the Maritime Conflict Advantage:

The negative has a variety of answers to the Maritime Conflict Advantage. First, the negative argues that science cooperation efforts have empirically failed and are unworkable. Second, the negative argues that current science diplomacy efforts are already effective and resolving conflict. Third, the negative argues that there is a low likelihood of conflict in the South China Seas. Fourth, the negative argues that even if conflict was likely in the South China Seas, it would not escalate to nuclear weapons use or draw in other countries.

#### Negative answers to Solvency:

The negative argues that NOPP interagency coordination efforts fail because of bureaucratic obstacles. Second, the negative argues that it takes too long for the affirmative to collect ocean data.

## 1AC

### 1AC — Plan

#### The United States federal government should substantially increase its ocean exploration through the National Oceanographic Partnership Program.

### 1AC — Marine Science

#### Contention 1 is Marine Science Leadership–

#### First, cuts to ocean exploration are destroying US marine science leadership

Mclain, 12 - Assistant Director of Science for the National Evolutionary Synthesis Center (Craig, March 15, 2012 “Losing Deep-Sea Science in the United States” http://deepseanews.com/2012/03/losing-deep-sea-science-in-the-united-states/)

As the case in 1962, our nation’s scientific numbers have never been greater or more diverse. Yet sadly, our nation’s commitment to science continues to diminish. Other countries like China are doubling funding of science, while the National Science Foundation budget increases are barely enough to cover inflation. Scientists, myself included, and the public are troubled that the United States “is at risk of losing its global leadership position in scientific research.” The country is now ranked 6th in the world with regard to the proportion of its gross domestic product that is invested in research and development and that young high school students score relatively poorly in math and science compared to teens in other nations. Nowhere is this more apparent than in deep-sea research. The deep sea remains the least explored habitat on Earth. Ironic given the deep sea is also the most prevalent habitat on Earth. I am troubled by what I see in the field amongst my colleagues around me. Funding and tools required for deep-sea research continue to diminish. A colleague of mine in a recent email, the impetus for this post, stated “When I started my career there were 6-7 [submersibles] in the US available for research. There has been a steady loss of [submersible] assets since then.” With regard to funding, my American deep-sea colleagues seem to largely support their research program by doing research in other areas, like NSF supported polar or shallow water research, piecing in deep-sea research when rare funds or opportunities are available. I fund my own program through general evolutionary research funding at NSF as opposed to deep-sea specific programs. The gem of the United States deep-sea research, the Monterey Bay Aquarium Research Institute (MBARI), is supported by the private Packard Foundation. One of deep-sea science’s most valued long-term ecological research sites, Station M (post, post, post), has struggled over the years to find government funding. Research at Station M now continues at MBARI again due to a private foundation. The massive increase in deep-sea biology publications in the last decade by U.S. researchers largely reflects the $100 million, 10 year, Census of Marine Life initiative funded by the Sloan Foundation, another private foundation. And because the lack of assets and funding, what I observe around me is diminishing number of younger generations filling the positions of deep-sea researchers. Our prominent rank as leading country in deep-sea science, first to discover high deep-sea diversity and hydrothermal vents, will be lost. In the past decade U.S. government funding of deep-sea science dwindled. During my career, the first to go was the Office of Naval Research followed by the Department of Energy, both moving away from funding basic deep-sea science. Another blow is imminent. John R. Smith, the Science Director at the Hawai‘i Undersea Research Laboratory, sent an email out notifying the community that NOAA has zeroed out funding for the Undersea Research Program (NURP) for FY13 beginning Oct 1, 2012, and put all the centers on life support funding (or less) for the current year. Many other NOAA programs, mostly extramural ones, have been cut to some level, though it appears only NURP and another have had their funding zeroed out completely. Striking is that within the FY13 NOAA Budget the Office of Ocean Exploration, the division that contains NURP, took the second biggest cut of all programs (-16.5%). Sadly, the biggest cut came to education programs (-55.1%). NOAA’s National Under Research Program (NURP) is one of the last programs in the United States, outside of the National Science Foundation, to support deep-sea science. NURP’s annual budget is around $4 million which supports 3 centers and a habitat covering the entire Pacific, West Coast & Polar Regions, east Coast & Gulf of Mexico, and an underwater habitat in the Florida Keys. From NOAA’s 2013 budget highlights National Undersea Research Program -$4.0M: NOAA determined that NURP was a lower-priority function within its portfolio of research activities, particularly given that other avenues of Federal funding for such activities might be pursued. NOAA will continue to support the Ocean Exploration program. I am unclear what these other funding sources are. Please somebody let me know! NSF’s Biological Oceanography program does fund deep-sea research, along with everything else in marine biology and biological oceanography, but funding rates of proposals hover between 5-10%, similar to other programs at NSF. The tragedy at hand, in addition to NURP being an agency that still funds basic deep-sea science and exploration, is the potential loss of a vital asset. NURP also supports Smith’s organization the Hawai‘i Undersea Research Laboratory (HURL). HURL maintains and operates the only other U.S. publically held human operated submersible, Pisces 4 and Pisces 5, outside the Alvin at Woods Hole Oceanographic Institute. HURL’s community tools not only include the Pisces IV and V but remotely operative vehicles also sadly rare in the United States. With just $2.5 million a year HURL operates all these vehicles and 20 support staff vital to operating and logistics. And somehow, much to my astonishment, there still seems to be money left over to support some science. $4 million is a minute fraction (0.08%) of NOAA’s requested $5,060,400,000 2013 budget. Let’s see what that extra $4 million looks like in NOAA’s requested budget $5,064,400,000 Citizens of the United States are at turning point. If we choose path A, our current one, we relinquish our place of prominence in deep-sea science, and science in general. We deny our country’s greatness as explorers; the legacy that Kennedy envisioned. Similar to our dismantling of NASA’s manned space flight program, we turn our backs on manned deep-sea discovery. We forfeit job creation, economic stimulus, and technological innovation that emerges out of basic scientific research, especially that centered on meeting the extremes of exploring an environment covered by 2.5 miles of water. We turn over deep ocean exploration to private enterprise and the wealthiest amongst us. I choose path B. I choose the path where we, as Kennedy stated in 1962, “measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone.” I choose the path where we investigate and discover the mysteries of the deep oceans as an open and public effort. I choose for the taxpayer to become partners with scientists to share in share in our discovery, ambition, and passion. I choose a path where we are originators, as opposed to observers, of innovative and impactful science. I choose path B because the American spirit is to reduce “vast stretches of the unknown and the unanswered” and to thrive when “the unfinished still far outstrip our collective comprehension.” Ultimately, I believe that $4 million is a bargain for submersibles that offer us a view and knowledge of Earth’s last frontier. If you too choose path B, then I must ask you to join me in the task at hand. I ask you to write a letter of support of both NURP and HURL to one of the Hawaii Senators, Dan Inouye, who happens to chair the Senate Committee on Appropriations, with a copy to the NOAA Director Jane Lubchenco. Their contact information is listed below.

#### Second, acidification, warming and de-oxygenation all threaten to overwhelm marine ecosystem resilience– that collapses biodiversity

**Young, 14 –** thesis submitted for a Bachelor of Science in Mechanical & Ocean Engineering at MIT **(**Grace, “Missiles & Misconceptions: Why We Know More About the Dark Side of the Moon than the Depths of the Ocean” 1/17, [http://mseas.mit.edu/publications/Theses/Grace\_C\_Young\_BS\_Thesis\_MIT2014.pdf)](http://mseas.mit.edu/publications/Theses/Grace_C_Young_BS_Thesis_MIT2014.pdf)//DH)

The misconceptions that drove spending on space were mirrored in our lack of knowledge about the ocean's importance. Our ambivalence about the ocean is reflected in the vast disparity in research funding. Today, however, we are beginning to understand how dependent we are on the ocean, and how the impact of human-induced climate change, pollution, and overfishing on the ocean are far more threatening to our survival than whether we “control the heavens." The ocean, which cover's 71% of Earth's surface, produces at least half the oxygen we breath and filters deadly carbon dioxide.86 It is a crucial regular of global climate and weather, but one we do not understand. Since 1950 there has been a dramatic increase in extreme weather,87 requiring billions of dollars spent globally towards repair and response efforts. Moreover, eight of the world's top ten largest cities are located on the seacoast. The ocean they adjoin is profoundly changing in complex ways we do not understand. Marine species are disappearing before we know of their existence. These species are not only matters of curiosity, but can hold secrets to understanding life and medicine, and are integral to the health of marine ecosystems.{ The oceans have become 26% more acidic since the start of the Industrial Revolution and continue to acidify at an unprecedented rate.88 Acidification affects marine ecosystems; it especially harms shelled creatures such as oysters and muscles that filter water,89 but can benefit sea grass and other invasive plants that will overwhelm ecosystems and accelerate the extinction of marine animal species.90 At the same time acidification from climate change is threatening entire ecosystems, industrial and agricultural pollution, plus increasing volumes of human trash are threatening to overwhelm the ocean's ability to regenerate. The National Academy of Science estimated that in 1975 more than 750 tons of garbage was dumped into the ocean every hour.91 Fortunately, in 1987 the US ratified Marpol Annex V, an international treaty that made it illegal to throw non-biodegradable trash overboard from ships in the waters of signatory countries. While this is progress, the MARPOL law is difficult to enforce. Governments do not know where or when dumping happens because there is no infrastructure for monitoring or policing the vast oceans. Sadly, Nature magazine reported that during the 1990s debris in the waters near Britain doubled, and debris in the Southern Ocean encircling Antarctica increased one hundred fold.92 Today we do not know how much trash is in the ocean. Author Donovan Hohn noted in 2008, “Not even oceanographers can tell us exactly how much floating scruff is out there; oceanographic research is simply too expensive and the ocean too varied and vast."93 But the number is not good. Stranded whales and other marine life with trash filling their bellies serve as a powerful harbinger for what is to come (Figure 11), and more oceanographic research is needed. Along with pollution and climate change, overfishing is among the greatest threats facing our ocean and human wellbeing. A study in Science projected that all commercial fish and seafood species will collapse by 2048.94 Already, populations of large fish, including tuna, swordfish, marlin, cod, halibut, skates, ounder, and others, have reduced by 90% since 1950, according to a 2003 study in Nature.95 A world without seafood will harm developing nations the most. More than 3.5 billion people globally depend on the ocean for their primary source of food, and most of those people are in fast-growing developing regions of Asia and Africa.96 In 20 years, the number could double to 7 billion.97 Fortunately, according to a pivotal paper published in Science in 2006, overfishing is proven to be a reversible problem, but only if humans act effectively within the next decade.98 Otherwise, global malnutrition and famine is on the horizon as so far aquaculture has not been able to keep up with the dramatic losses of wild catch. “Unless we fundamentally change the way we manage all the oceans species together, as working ecosystems, then this century is the last century of wild seafood," marine ecologist Steve Palumbi warned.99 NOAA has made substantial progress in regulating US fisheries, although that fact must be taken with a grain of salt because the US imports 91% of its seafood.100 Moreover, the most catastrophic overfishing is occurring in international waters where traditional industrial fishing nations continue to resist stronger efforts at global regulation. Realizing the ocean's importance to humankind, President Kennedy became a staunch advocate for ocean research shortly before he died. Exactly a month before his assassination, he asked Congress to double the nation's ocean research budget and greatly expand ocean research for the sake of worldwide security and health. He called for a global ocean research initiative: The ocean, the atmosphere, outer space, belong not to one nation or one ideology, but to all mankind, and as science carries out its tasks in the years ahead, it must enlist all its own disciplines, all nations prepared for the scientific quest, and all men capable of sympathizing with the scientific impulse.101 He had no chance to see his plans through, however, and his successor, Lyndon Johnson, was focused on space as the “high ground" and “control of the heavens" for perceived military and geo-political reasons. 4.3 Extent of Oceanographic Knowledge During the space race, leaders believed that the ocean was an already conquered territory. In 1962, President Kennedy called space a “new ocean,"102 although 95% of the ocean remains unseen by human eyes.103 As mentioned previously, Johnson suggested space technology would be to the 20th century what ships were to the British Empire for the past millennia,104. Kennedy echoed Johnson's words: We set sail on this new sea because there is new knowledge to be gained, and new rights to be won, and they must be won and used for the progress of all people. For space science, like nuclear science and technology, has no conscience of its own. Whether it will become a force for good or ill depends on man, and only if the United States occupies a position of preeminence can we help decide whether this new ocean will be a sea of peace or a new terrifying theater of war.105 The truth remains, however, that we have not conquered the seas. As discussed in Sections 2.2 and 3.2, ocean exploration has largely been a surface affair. 90% of the ocean's volume, the dark, cold environment we call the deep sea, is largely unknown.106 In 1960, when Jacques Piccard and Don Walsh became the first men to reach the deepest part of the ocean, they saw only saw two fish,107 so it was mistakenly envisioned that the deep ocean was essentially lifeless. In reality, however, it is teaming with life. Tim Shank, a deep-sea biologist at Woods Hole Oceanographic Institution, explained why the explorers did not see much life near the Mariana Trench: The waters above the Challenger Deep are extremely unproductive in part because algee at the surface prevents food from being cycled in deeper waters. \If it had been a trench with a productive water column, like the Kermadec Trench near New Zealand, I think he would have seen much more biology," he told Nature.108 Fantastic photos from Cousteau's shallow water missions helped to fill the gap, showing brilliant life in sea, but those only scratched the surface. An estimated two thirds of marine species are yet to be discovered.109 In 2014, NASA's budget is $17 billion. Its space exploration budget alone is $3.8 billion,110 hundreds of times more than NOAA's office of ocean exploration and research budget of $23.7 million.111k The discrepancy in funding for ocean exploration, particularly in comparison to that for space, has lasting effects that inhibit efforts for continued exploration. After his mission to the Mariana Trench in 2012, James Cameron candidly told the press that the state of today's ocean exploration is “piss poor."112 He continued, The public needs to understand that the US government is no longer in a leadership position when it comes to science and exploration, as they were in the 1960s and 1970s. We have this image of ourselves in this country as number one, leading edge, that sort of thing and it is just not the case.113 Cameron, who privately funded his journey to the Mariana Trench, noted that private individuals such as Eric Schmidt, Google's former chief executive and founder of the Schmidt Ocean Institute, have made strides in trying to up for what governments are not doing, but progress is still slow due to lack of government infrastructure. Author Ben Hellwarth explains: [P]rivate groups--including the team of Jacques Cousteau, who was as great a pitchman and fundraiser as anyone--would find sea dwelling and exploration a tough business to pursue, especially without a government-primed infrastructure and market like the one that evolved for space travel. The situation was something like tech mogul Elon Musk trying to launch SpaceX without the benefit of a space station or the many trails NASA blazed with its billions.114 To illustrate, Hellwarth elaborates with the recent history of the undersea habitat Aquarius: The kind of public interest and unbridled enthusiasm that has long sustained the space program and NASA's multibillion-dollar budgets has never materialized for like-minded quests into the ocean. Last year's near closure of the world's only sea base was the latest case in point. If you can't name this unique, American-run undersea outpost, you are not alone, and that's at least part of the problem. It's called the Aquarius Reef Base, and for the past two decades, this school-bus-sized structure has been operating a few miles south of the Florida Keys and a few fathoms below the surface. From its beginning Aquarius has typically had to squeak by on less than $3 million a year, sometimes much less than a drop in the fiscal bucket by space program standards. (NASA's estimated cost of a single space shuttle launch, for example, was $450 million.) Then last year the National Oceanic and Atmospheric Administration, which owns Aquarius, decided to pull the plug on the base. An organized effort to save Aquarius created an unusual surge in media and other attention, not major front-page headlines, to be sure, but there was at least a discernible spike.115 Even after the Cold War ended in the early 1990s with fall of Berlin Wall, NASA's budget remained dramatically larger than budgets for ocean research. The reason for the budget disparity has less to do with commercial or military reasons, and more to do with lingering geo-political issues and inertia from the Cold War, including constituencies in Congress, an independent governmental agency, and established defense contractors that benefit from government-funded space exploration. Contractors such as Boeing and Lockheed Martin, for example, have immense capacity to lobby Congress for further funding. Ocean exploration, on the other hand, had almost no constituency outside of the scientific community, which alone has little political clout. Because of the lingering effects of misconceptions, ocean exploration lags far behind space exploration, to the point that our dearth of oceanographic knowledge may result in serious harm to humankind in the next generation. 5 Conclusion: Will There Be a Sputnik for the Ocean? The sea, the great unifier, is man's only hope. Now, as never before, the old phrase has a literal meaning: We are all in the same boat. Jacques Cousteau Since 5000 BC, humans have progressed from star-gazers to moon-walkers and from shallow-water swimmers to deep-sea explorers. Technological innovation drove exploration in both space and sea to unprecedented levels, particularly during the mid-1900s. With the start of the Cold War, however, ocean exploration proceeded at a snail's pace compared to space research. This sudden shift in priority was due to misconceptions about the military and geopolitical importance of space and the ocean's importance to human wellbeing. Looking back, there are many \what ifs" in the history of exploration. For example, what if Eisenhower had his wish of making NASA part of the Department of Defense? Then we most likely would not have reached the moon or Mars because those NASA missions were not primarily military-oriented. What if the Soviets launched the first deep sea vehicle rather than the first orbiting satellite? Might there have been a Sputnik-like reaction towards the ocean rather than space? What if Kennedy wasn't assassinated and got his wish of creating a global ocean research initiative in the 1960s? Looking ahead, progress in ocean exploration and management looks dire. This is especially tragic because marine environments and ecosystems are degrading, even disappearing, at the fastest rate in 300 million years,116 as they face the triple threat of acidification, warming, and deoxygenation. “The health of the ocean is spiraling downwards far more rapidly than we had thought.. . . The situation should be of the gravest concern to everyone since everyone will be affected by changes in the ability of the ocean to support life on Earth," Professor Alex Rogers of Oxford University emphasizes.117 The US government probably will not fund the necessary research anywhere near the scale it continues to fund space research. As such, scientists are increasingly looking for private and industrial support. James Cameron, the Cousteau legacy, and Eric Schmidt among others are showing that privately-funded ocean exploration is possible. The underfunded and oft-delayed “SeaOrbiter" project, which aims to be the ocean equivalent of a space station, shows how difficult fund-raising for such projects can be.118 Yet SeaOrbiter would cost a tiny fraction of a single space shuttle flight. That the ocean was a place for international collaboration probably hurt it during the decades of Cold War hysteria; but hopefully we can now use that to an advantage, to bring nations together. The European Organization for Nuclear Research (CERN) showed how large-scale multinational research, funded by a combination of governments and industry sectors, can be successful. The future of ocean exploration might depend on a oceanographic version of CERN. Or, it could be in research studies tied to national interests, like the space program. As a recent national forum on the future of the ocean stated, ocean exploration as an urgent necessity, and an issue of national security.119 Let us hope that not only the US government, but also the entire global community recognizes the importance of aggressive ocean research and management before it is too late.

#### Third, biodiversity loss results in destruction of the Earth and extinction

Dingle 11 – Sarah Dingle is a reporter for ABC Radio Current Affairs. (“Ocean heading for mass extinction, scientists warn”, ABC News, <http://www.abc.net.au/news/2011-06-21/ocean-heading-for-mass-extinction-scientists-warn/2766340>, June 21, 2011)

Scientists are warning of a potential marine massacre with a mass extinction of sea life akin to the death of the dinosaurs. A new report says the seas are battling pollutants, overfishing and warming, and warns that without swift action the fight to save species could be lost. The International Program on the State of the Oceans report brought together coral reef ecologists, toxicologists and fisheries scientists. And when they compared notes, the result was grim. Co-author Professor Ove Hoegh Guldberg, who specialises in reef ecosystems, says scientists found "unprecedented warming". "We're seeing acidification in the ocean and now we're starting to see a drop in oxygen concentration throughout the major part of the ocean," he said. "Now it's impacting directly on sea life, but the other is that it is a potential early step towards conditions which are associated with so-called mass extinction events." Professor Guldberg does not want to be alarmist, but says a growing human population is to blame for many of the changes. He warns the pressure will only increase, with the world's population set to grow by another 3 billion people in the next 30 to 50 years. "As human populations have expanded in coastal areas – and it's really boomed throughout the world – you've had the modification of coastlines by the very fact that by destabilising vegetation you get nutrients and sediments going out in those coastal waters," he said. "That's had a tremendously damaging effect in our neighbourhood. In South-East Asia for example, the entire loss of marine ecosystems that used to be there and used to support people." Dr. Alex Rogers is the scientific director of the International Program on the State of the Oceans and a professor of conservation biology at Oxford University. He says when he got together with his colleagues they realised changes in ocean temperatures were occurring much faster than they had expected. "The changes that people had been predicting would happen in the lifetime of our children, or our children's children, are happening really now before our eyes," he said. Dead zones Professor Guldberg says concerns about marine environments often take a back seat both in public debate and scientific research. "They did a study last year where I counted the number of peer-reviewed papers on climate change on the land versus the sea and there were 20 more papers, 20 times as many papers, associated with problems on land versus the sea," he said. He says the sea provides up to a quarter of the world's protein and is concerned about the proliferation of dead zones if nothing is done. Dead zones are areas where oxygen levels in the water drop to zero, a condition known as anoxia. He says in these conditions only certain species survive. "It won't be fish that we like to eat. There are animals and plants - well in fact I shouldn't say animals but more plants and bacteria, green slime, that will prosper in the anoxic environment," he said. Professor Guldberg says the ocean is the life support system for the planet's atmosphere and if uncontrolled degradation continues, the threat of mass extinction is real and does not just apply to the sea. "If we barrel along as we are right now, there's an increasing risk that we will be entering into one of these mass extinction events," he said. "This is where you essentially get a runaway set of conditions which will be very unsustainable as far as human or any other life that we have on the planet today." "This comes back to the fact that the ocean is central to the climate and conditions across the entire planet." Professor Guldberg says to control the pace of change the world must move to zero emissions within the next 40 years. The report's findings will be presented at the United Nations headquarters in New York this week.

#### Fourth, greater ocean exploration is vital to understanding deep-ocean thermohaline circulation, which determines our ability to adapt to climate change

**Goodwin, 9** – The Harmon Project, NOAA Goodwin is PhD Marine Biologist and Science Writer at National Oceanic and Atmospheric Administration (“Why Do We Explore” <http://oceanexplorer.noaa.gov/okeanos/edu/leadersguide/media/09whydoweexplore.pdf>)

Why Ocean Exploration Is Important Today Curiosity, desire for knowledge, and quest for adventure continue to motivate modern explorers. But today, there are additional reasons to explore Earth’s ocean, including climate change, energy, human health, ocean health, innovation, research and ocean literacy. Climate Change Since the middle of the 1800’s, Earth’s average temperature has warmed by about 1°F. This doesn’t sound like much of a change, but it is important to realize that Earth’s average temperature is now warmer than it has been at any time since at least 1400 AD. We say “at least” because 1400 AD is as far back as scientists have good estimates of temperatures. Other evidence suggests that Earth’s temperature is warmer now than it has been in many thousands of years, maybe nearly 100,000 years. It is also important to remember that most averages include numbers that are higher and lower than the “average” value. So the warming in some areas can be much higher than 1°F, while other areas may actually be cooler. Debate continues about the causes of climate change and the relative importance of long-term climate cycles, greenhouse gases, and other factors; but it is clear that: • Mountain glaciers are melting; • Polar ice is decreasing; • Springtime snow cover has reduced; • Ground temperature has been increasing in many areas; and • Sea level has risen by several inches in the last 100 years. Global climate is strongly influenced by interactions between Earth’s atmosphere and ocean, but these interactions are complex and poorly understood. While the deep-ocean might seem far removed from the atmosphere, one of the most significant climatic influences results from the “deep-ocean thermohaline circulation” (See the Diving Deeper section on page 18 for more information about the THC). The causes and effects of the THC are not fully known, but we do know that it affects almost all of the world’s ocean and plays an important role in transporting dissolved oxygen and nutrients. For these reasons, the deep-ocean THC is often called the “global conveyor belt.” We also know that the part of the THC that is the Gulf Stream is at least partially responsible for the fact that countries in northwestern Europe (Britain and Scandinavia) are about 9°C warmer than other locations at similar latitudes. Recent changes in the Arctic climate have led to growing concerns about the possible effects of these changes on the deep-ocean THC. Dense water sinking in the North Atlantic Ocean is one of the principal forces that drives the circulation of the global conveyor belt. Since warmer temperatures and increased freshwater inflow from melting ice cause seawater density to decrease, these changes could also weaken the global conveyor belt. Trends toward a warmer climate are having impacts in the tropics as well. A major concern is the impact of higher temperatures on coral reefs. In the Caribbean, surveys of 302 sites between 1998 and 2000 show widespread recent mortality among shallow- (≤ 5m depth) and deep-water (> 5m depth) corals (Kramer, 2003). Many scientists believe that the widespread decline of coral reefs is the result of accumulating stresses, one of which is increased water temperature. There are many other potential impacts of changing climate, ranging from the possible extinction of species such as the polar bear to year-round access to sea routes through the Arctic. Ocean exploration can provide some of the essential knowledge about ocean-atmosphere interactions that is needed to understand, predict, and respond to these impacts. Energy “For kicks, oceanographer William P. Dillon likes to surprise visitors to his lab by taking ordinarylooking ice balls and setting them on fire. ‘They’re easy to light. You just put a match to them and they will go,’ says Dillon, a researcher with the U.S. Geological Survey (USGS) in Woods Hole, Mass. If the truth be told, this is not typical ice. The prop in Dillon’s show is a curious and poorly known structure called methane hydrate.” from “The Mother Lode of Natural Gas” by Rich Monastersky http://www.sciencenews.org/sn\_arch/11\_9\_96/bob1.htm Methane hydrate is a type of clathrate, a chemical substance in which the molecules of one material (water, in this case) form an open lattice that encloses molecules of another material (methane) without actually forming chemical bonds between the two materials. Methane is produced in many environments by a group of Archaea known as the methanogenic Archaeobacteria. These Archaeobacteria obtain energy by anaerobic metabolism through which they break down the organic material contained in once-living plants and animals. When this process takes place in deep-ocean sediments, methane molecules are surrounded by water molecules, and conditions of low temperature and high pressure allow stable ice-like methane hydrates to form. Besides providing entertainment for oceanographers, methane hydrate deposits are significant for several other reasons: • The U.S. Geological Survey has estimated that on a global scale, methane hydrates may contain roughly twice the carbon contained in all reserves of coal, oil, and conventional natural gas combined. • Methane hydrates can decompose to release large amounts of methane which is a greenhouse gas that could have (and may already have had) major consequences to the Earth’s climate. • Sudden release of pressurized methane gas may cause submarine landslides which in turn can trigger catastrophic tsunamis. • Methane hydrates are associated with unusual and possibly unique biological communities containing previously unknown species that may be sources of beneficial pharmaceutical materials. While potential benefits as an alternative energy source are exciting, methane hydrates may also cause big problems. Although methane hydrates remain stable in deep-sea sediments for long periods of time, as the sediments become deeper and deeper they are heated by the Earth’s core. Eventually, temperature within the sediments rises to a point at which the clathrates are no longer stable and free methane gas is released (at a water depth of 2 km, this point is reached at a sediment depth of about 500 m). The pressurized gas remains trapped beneath hundreds of meters of sediments that are cemented together by still-frozen methane hydrates. If the overlying sediments are disrupted by an earthquake or underwater landslide, the pressurized methane can escape suddenly, producing a violent underwater explosion that may result in disastrous tsunamis, often called “tidal waves” which is misleading since they have nothing to do with tides. The release of large quantities of methane gas can have other consequences as well, since methane is one of the so-called “greenhouse gases.” In the atmosphere, these gases allow solar radiation to pass through but absorb heat radiation that is reflected back from the Earth’s surface, thus warming the atmosphere. Many scientists have suggested that increased carbon dioxide in the atmosphere produced by burning fossil fuels is causing a “greenhouse effect” that is gradually warming the atmosphere and the Earth’s surface. A sudden release of methane from deep-sea sediments could have a similar effect, since methane has more than 30 times the heat-trapping ability of carbon dioxide. In 1995, Australian paleoceanographer Gerald Dickens suggested that a sudden release of methane from submarine sediments during the Paleocene epoch (at the end of the Tertiary Period. about 55 million years ago) caused a greenhouse effect that raised the temperatures in the deep-ocean by about six degrees Celsius. The result was the extinction of many deep- sea organisms known as the Paleocene extinction event. More recently, other scientists have suggested that similar events could have contributed to mass extinctions during the Jurassic period (183 million years ago), as well as to the sudden appearance (1 many new anima] phyla during the Cambrian period (the Cambrian explosion.” about 520 million years ago). Besides methane clathrates, regions such as the Gulf of Mexico produce significant quantities of petroleum. Often, the presence of hydrocarbons at the surface of the seafloor is accompanied by “cold-seep communities” which are biological communities that derive their energy from gases (such as methane and hydrogen sulfide) and oil seeping out of sediments. In addition to locating new sources of hydrocarbon fuels, exploration of these communities frequently reveals species that are new to science and provides information on ecology and biodiversity that is needed to protect these unique and sensitive environments. For more information about methane hydrates, visit http:// oceanexplorer.noaa.gov/explorations/03windows/welcome. html. For more information about protecting sensitive environments as part of exploration and development of ocean mineral resources, visit http://oceanexplorer.noaa.gov/ explorations/07mexico/welcome.html. Human Health Improving human health is another motive for ocean exploration. Almost all drugs derived from natural sources come from terrestrial plants. But recent explorations have found that some marine invertebrates such as sponges, tunicates, ascidians, bryozoans, and octocorals can also produce powerful drug-like substances. Many of these are sessile (non-moving), bottomdwelling animals that do not appear particularly impressive; yet, they produce more antibiotic, anti-cancer, and anti-inflammatory substances than any group of terrestrial organisms. The potential for discovering important new drugs from deep-ocean organisms is even greater when one considers that most of Earth’s seafloor is still unexplored, and deep-sea explorations routinely find species that have never been seen before. Chemicals produced by marine animals that may be useful in treating human diseases include: Ecteinascidin – Extracted from tunicates; being tested in humans for treatment of breast and ovarian cancers and other solid tumors; acts by blocking transcription of DNA Topsentin – Extracted from the sponges Topsentia genitrix, Hexadella sp., and Spongosorites sp.; anti-inflammatory agent; mode of action not certain Lasonolide – Extracted from the sponge Forcepia sp.; antitumor agent; acts by binding with DNA Discodermalide – Extracted from deep-sea sponges belonging to the genus Discodermia; anti-tumor agent; acts by interfering with microtubule networks (you may want to review the function of microtubules here) Bryostatin – Extracted from the bryozoan Bugula neritina; potential treatment for leukemia and melanoma; acts as a differentiating agent, forcing cancer cells to mature and thus halting uncontrolled cell division Pseudopterosins – Extracted from the octocoral Pseudopterogorgia elisabethae (sea whip); antiinflammatory and analgesic agents that reduce swelling and skin irritation and accelerate wound healing; acts as an inhibitor of phospholipase A, which is a key enzyme in inflammatory reactions w-conotoxin MVIIA – Extracted from the cone snail Conus magnus; potent pain-killer; acts by interfering with calcium ion flux, thereby reducing the release of neurotransmitters A striking feature of this list is that all of the organisms (except the cone snail) are sessile (non-moving) invertebrates. To date, this has been true of most marine invertebrates that produce pharmacologically-active substances. Several reasons have been suggested to explain why sessile marine animals are particularly productive of potent chemicals. One possibility is that they use these chemicals to repel predators, since they are basically “sitting ducks.” Since many of these species are filter feeders, and consequently are exposed to all sorts of parasites and pathogens in the water, they may use powerful chemicals to repel parasites or as antibiotics against disease-causing organisms. Competition for space may explain why some of these invertebrates produce anti-cancer agents. If two species are competing for the same piece of bottom space, it would be helpful to produce a substance that would attack rapidly dividing cells of the competing organism. Since cancer cells often divide more rapidly than normal cells, the same substance might have anti-cancer properties. For more information about drugs from the sea, visit http:// oceanexplorer.noaa.gov/explorations/03bio/welcome.html. Ocean Health “Anyone familiar with the state of the world’s oceans would have a hard time feeling optimistic. From coral reefs overwhelmed by coastal runoff to tiny but ecologically-vital plankton that are suffering from climate change, the diversity of sea life is fading.” (Allsopp, et al., 2007). The health of Earth’s ocean is simultaneously threatened by over-exploitation of large species, destruction of benthic habitats, invasive species, rising temperatures, and pollution (Jackson, 2008). Recently, another stress has been recognized: ocean acidification. For many years, carbon dioxide in Earth’s atmosphere has been increasing. Regardless of the reasons for this increase and the possible connection with climate change, dissolved carbon dioxide in the ocean has increased along with atmospheric CO2 . More dissolved carbon dioxide means a lower ocean pH. This, in turn, leads to a decrease in carbonate ions that are essential to the process of calcification through which many organisms produce shells and other skeletal structures. In addition to corals, shellfish, echinoderms, and many marine plankton also build body parts through calcification. Pteropods are planktonic snails that are an important component of food chains in high-latitude regions, and have been shown to have pitted or partially dissolved shells in waters where carbonate ions are depleted. For more information about ocean pH and carbon dioxide, see pages 20-22 in the Diving Deeper section. On June 5, 2008, NOAA Oceanographer Richard A. Feely told the U.S. House of Representatives Subcommittee on Energy and Environment that the ocean currently absorbs 22 million tons of carbon dioxide daily, and that scientists estimate the pH of ocean surface waters has fallen by about 0.11 units from an average of about 8.21 to 8.10 since the beginning of the industrial revolution. Feely also said that if carbon dioxide emissions continue according to predictions, the surface water pH will decrease to about 7.8 – 7.9 by the end of the century. “To put this in historical perspective, the resulting surface ocean pH would be lower than it has been for more than 20 million years,” he said. “Life will find a way,” according to chaos theorist Ian Malcolm in Jurassic Park (Crichton, 1990). But the question is, “Which life?” Deep-sea explorers often find biological organisms thriving in conditions that would be extremely hostile to humans. But this does not mean that species can simply adapt to stresses from falling pH, rising sea levels and temperatures, pollution and overfishing. We urgently need to learn more about ocean ecosystems and how they affect the rest of our planet. This is one of the most important modern reasons for ocean exploration. Without a doubt, human curiosity, the desire to understand our world, and the excitement of discovery are still among the reasons we explore Earth’s ocean; but we also explore to survive.

#### Fifth, stable federal exploration funding is the bellwether for catalyzing investment in adaptation technologies and generating better decision-making for ocean ecosystem management

**Avery, 13 -** DIRECTOR, WOODS HOLE OCEANOGRAPHIC INSTITUTION (Susan, “DEEP SEA CHALLENGE: INNOVATIVE PARTNERSHIPS IN OCEAN OBSERVATION” S. HRG. 113–268, 6/13, gpo.gov)//DH

The importance of the ocean in daily life, whether you live on the East Coast, the Great Plains, or the Mountain West, cannot be oversimplified or understated. In short, it is one of the most fundamental reasons why our planet is capable of supporting life and why we are able to sustain the economy and way of life that are among our national hallmarks. Our fate has always rested in one way or another with the ocean and its interaction with the atmosphere, land, and humanity. The ocean plays a critical role in governing Earth’s climate system helping to regulate global cycles of heat, water, and carbon. The rates and regional patterns of land temperature and precipitation depend on the ocean’s physical and chemical balances. It touches us every day, wherever we live through our climate and weather; rainfall, floods, droughts, hurricanes, and devastating storm surges such as what we witnessed with Hurricane Sandy. The services the ocean provides—and that we often take for granted—range from endless inspiration and deep-seated cultural heritage to the very air we breathe and the rain that waters our crops. Roughly half of the oxygen we breathe and about 80 percent of the water vapor in our atmosphere comes from ocean processes. The ocean feeds us, processes waste, holds vast stores of mineral and petroleum reserves, and provides inexpensive transportation of goods and people. Its rich biodiversity is a potential source for new medicines and an insurance policy for our future. Many of these things it provides the planet without our intervention; other things we actively seek and extract—and we will continue to do so. In 2010, maritime economic activities contributed an estimated $258 billion and 2.8 million jobs to the national economy.1 In addition, roughly 41 percent of the Nation’s GDP, or $6 trillion, including 44 million jobs and $2.4 trillion in wages, was generated in the marine and Great Lake shoreline counties of the U.S. and territories. 2 The key for the future of the ocean and for humanity will be to learn how to balance these economic activities with the natural functioning of the ocean. We know that the ocean is taking up more than 80 percent of the heat that is generated by rising levels of greenhouse gases in our atmosphere.3 Excess carbon dioxide mixed into the upper ocean is lowering the pH of seawater, making it more acidic and raising the potential for large-scale change at the base of the marine food chain and in the coral reef ecosystems that are considered the breadbasket of the tropical oceans and an important source of biodiversity and income for many regions. Excess heat is causing Arctic sea ice to retreat to levels never before seen, setting up the likelihood of still further melting driven by positive feedback loops, as well as disruptions to the Arctic ecosystems that have evolved in an environment partly reliant on ice cover for millions of years. Sea level is also rising, both as a result of increased melting of terrestrial ice caps and of thermal expansion of the seawater, resulting in higher probabilities of more frequent and more severe storm surges such as those associated with Hurricane Sandy. Our ability to build properly designed and appropriately scaled adaptations into cities and societies around the world is predicated on our ability to accurately predict how, when, and how much the ocean will change in the future. For these reasons and many others, our nation must recognize that the ocean is changing almost before our eyes. Perhaps the question is, not how much can we afford to invest in research on the ocean, but rather how can we afford not to? Despite its importance, there remain many unanswered questions about the ocean. It is far more difficult to observe than the atmosphere. Because the ocean is opaque to most forms of electromagnetic radiation, satellite observations are limited in the type and resolution of information they can gather. We are capable of monitoring many surface features, including waves, winds, temperatures, salinity, carbon, color (a measure of biological productivity), as well as some large-scale subsurface features. But satellites cannot tell us much about the diversity of life in the ocean or the many fine-scale dynamic processes at work beneath the surface, nor can they tell us much about the internal complex biogeochemistry that supports life. Satellites can’t show us the bottom of the ocean, where volcanic hydrothermal vents sustain rich communities of exotic organisms—which might answer questions about the early evolution of life. To learn more about these important parts of the ocean system, we must have more and better eyes in the ocean and, at the same time, work to surmount the huge challenges of working in a cold, corrosive, and physically punishing environment. Frontiers in the Ocean Jim Cameron is a visionary who is capable of looking beyond what we are currently able to see. Let me tell you about another visionary. In the mid-1930s, a physicist from Lehigh University named Maurice Ewing sent letters to several oil companies. He asked them to support a modest research program to see whether acoustic methods used to probe buried geological structures on land could be adapted to investigate the completely unknown geology of the seafloor. Ewing later wrote: ‘‘This proposal received no support whatever. I was told that work out in the ocean could not possibly be of interest to the shareholder and could not rightfully receive one nickel of the shareholder’s money.’’ 4 Ewing did get a $2,000 grant from the Geological Society of America, however, and he and his students came to Woods Hole Oceanographic Institution to use its new ocean-going research ship, Atlantis. The ship and the institution were launched by a $3 million grant from the Rockefeller Foundation. The scientists launched novel experiments using sound waves to probe the seafloor. To Ewing, the ocean was annoyingly in the way. To study the seafloor, he and his colleagues had to learn how to negotiate the intervening water medium. In the process, they unexpectedly made profound and fundamental discoveries about ocean properties and how sound propagates through seawater. In 1940, on the eve of war, Woods Hole’s director, Columbus O’Donnell Iselin, wrote a letter to government officials, suggesting the ways the institution’s personnel and equipment could be better utilized for the national defense. Soon after, one of Ewing’s students, Allyn Vine, began incorporating their newly gained knowledge to build instruments called bathythermographs, which measured ocean properties. Vine trained naval personnel to use them to escape detection by sonar. It was the first among many subsequent applications of this research that revolutionized submarine warfare. Many scientists pursued the marine geophysics research initiated by Ewing. Their work culminated in the late 1960s in the unifying theory of plate tectonics. It transformed our understanding of continents, ocean basins, earthquakes, volcanoes, tsunamis, and a host of other geological phenomena—including significant oil reservoirs beneath the seafloor—where oil companies now routinely drill and make money for their shareholders. Al Vine remained in Woods Hole and spearheaded deep-submergence technology, including the research sub Alvin, which was named after him. Two years after it was completed, Alvin was applied to a national emergency, locating a hydrogen bomb that accidentally dropped into the Mediterranean Sea. A decade later, Alvin found seafloor hydrothermal vents. To humanity’s utter astonishment, the vents were surrounded by previously unknown organisms sustained not by photosynthesis but chemosynthesis. This discovery completely changed our conceptions of where and how life can exist on this planet and elsewhere in the universe. Thirty-five years later, Alvin was again called into action to help assess and monitor the Deepwater Horizon oil spill and its impacts in the Gulf of Mexico, but at the same time, the ocean science community was able to bring much more to bear in a time of national crisis. The community’s unparalleled response in the Gulf was enabled by more than three decades of technological advancements related to development of remotely operated and autonomous underwater vehicles and new sensors and data assimilation techniques, and integrated networks of sensors, vehicles, and platforms that have opened the ocean to the light of new study, many of which were developed through novel partnerships with private funders. Society has benefitted in the past from public-funded/private-funded partnerships that advance research and development, probably even before Queen Isabella financed Columbus’s voyage of discovery in 1492. But I emphasize: It’s a partnership. One doesn’t replace the other. Each augments the other. In an unexpected bit of poetry, the NSF annual report from 1952 says: ‘‘That which has never been known cannot be foretold, and herein lies the great promise of basic research. . . . [It] enlarges the realm of the possible.’’ The bottom line question is: How much are we willing to invest in enlarging the realm of the possible? Jim Cameron did that with DEEPSEA CHALLENGER. He enlarged the realm of the possible by demonstrating that even the deepest part of the ocean is not beyond our physical presence. Still other advances are expanding the possible in many ways through the development and deployment of novel sensors, autonomous vehicles, and new ways for humans and machines to interact. There is a revolution in marine technology underway that is positioning us to reach many unexplored frontiers in the ocean—and the ocean has many. The deep ocean is only one. We have barely gained access to explore the ocean beneath our polar ice caps— at a time when rapidly disappearing sea ice has profound implications for Earth’s climate, for ocean ecosystems, expanded shipping, oil and mineral resource development, and national security. There is the microbial frontier, where 90 percent of the ocean biomass resides and which is invisible to the human eye. There are about 300,000 times more microbes in the ocean than there are observable stars in the universe.5 Ocean scientists have just begun to explore this universe of marine microbes, which holds the key to healthy biological functioning of the ocean ecosystem, much as the microbiome in the human body is critical to our health. They are also searching for unknown biochemical pathways and compounds, for new antibiotics, and for novel treatments for diseases such as Alzheimer’s and cystic fibrosis. Then there is the frontier of temporal and spatial scales that must be overcome to monitor and forecast changes to the deep and open ocean. The ocean exhibits large, basin-wide patterns of variability that change over periods ranging from days and weeks to years, decades, and longer. Understanding and observing these patterns, including El Nin˜ o-Southern Oscillation (ENSO), offer potential for improved prediction of climate variability in the future. For most of my career, I have been an atmospheric scientist. The atmosphere and ocean are both fluids (one that is compressible, the other incompressible). These two systems are interwoven and inseparable. But while we have long-established, extensive networks of meteorological instruments continually monitoring our atmosphere, we have just begun to establish a relative toehold of long-term observatories to understand, and monitor how the ocean operates. To truly comprehend Earth’s dynamic behavior and to monitor how it affects us back on land, scientists must establish a long-term presence in the ocean, including platforms and suites of physical, chemical, and biological sensors from which to view how the ocean and seafloor change in fine resolution over seasons, years, and decades. This same observing capability will provide the basis for improved forecasts from models that incorporate data and observations from the ocean, atmosphere, and land and that provide the basis for decision making by national, state, and local agencies. Variability such as weather events associated with ENSO has significant societal and economic impacts in the U.S., and a combination of a dedicated ocean-observing system in the tropical Pacific plus models that forecast ENSO impacts is now in place to help society adapt in times of increased variability. The promise of additional benefits from observing, understanding, and predicting the ocean and its impacts is real. Modeled reconstructions by Hoerling and Kumar of the 1930s drought in the Central U.S. recently linked that event to patterns of anomalies in sea-surface temperature far from the U.S.6 The global scale of the circulation of the ocean and basin-scale patterns of ocean variability on decadal and longer time scales may present sources of improved predictive skill in future weather and climate models. Moving forward, we need to be even more adaptive and agile, applying new technologies in ways that both make crucial observations more effectively and make coincident observations of the biology, chemistry, and physics of the ocean. At the same time we need at our modeling and prediction centers to establish the resources and mindset that will support testing and adoption of research results that lead to improved predictions. We are on the edge of exploration of many ocean frontiers that will be using new eyes in the ocean. Public-funded/private-funded investment in those eyes is required, but will not be successful without adequate and continuing Federal commitment to ocean science. Support such as Jim’s and the Schmidt Ocean Institute, which was founded by Eric Schmidt and operates the research vessel Falkor, help fill gaps in support for research and development or for access to the ocean. However, the fact remains that Federal funding is by far the leading driver of exploration, observation, and technical research and development that has a direct impact on the lives of people around the world and on U.S. economic growth and leadership. It also remains the bellwether by which philanthropic entrepreneurs judge the long-term viability of the impact their investment will have on the success that U.S. ocean science research will have around the globe.

#### Sixth, the plan provides a dedicated federal funding stream that restores US scientific reputation and attracts scientists into research collaboration

NRC 3 – Committee on Exploration of the Seas, Ocean Studies Board Division on Earth and Life Studies (“Exploration of the Seas: Voyage into the Unknown”, National Research Council, the National Academies Press, <http://explore.noaa.gov/sites/OER/Documents/national-research-council-voyage.pdf>)

The major drawback of a NOPP-sponsored ocean exploration program is that NOPP itself cannot directly receive funds appropriated by Congress. Garnering the financial resources for NOPP projects is dependent on the goodwill and cooperation of the member organizations. Interagency coordination is not unprecedented—the National Polar-orbiting Operational Environmental Satellite System combined the efforts of the Departments of Commerce (NOAA) and Defense to consolidate satellite needs for polar data gathering. NOAA leads the management, the Department of Defense leads acquisition efforts, and NASA provides technology developments to meet the systems’ operational requirements. However, funding a major program through separate line items in many agency budgets is not a desirable situation. The committee believes that NOPP could be a nearly ideal home for ocean exploration if the difficulties in funding NOPP programs can be overcome. The tremendous disadvantage NOPP programs face in the federal funding process has received considerable attention from the U.S. Commission on Ocean Policy. A National Oceanic and Atmospheric Administration Funded Exploration Program In recognition of the need for a separate program for ocean exploration, and in response to the report of the President’s Panel on Ocean Exploration (National Oceanic and Atmospheric Administration, 2000), NOAA created an Office of Ocean Exploration in 2001 and has received modest funding to support it. NOAA managers develop program plans and choose expeditions from solicited proposals after seeking advice from a panel of peer reviewers. Clearly, capitalizing on this existing NOAA program and office could assist in the establishment of a new, large-scale program. The office has leveraged agency assets efficiently, and NOAA has worked to seek adequate funding for the program. Since its establishment, the NOAA program has included an engaged and substantial outreach program, and it has shown commitment to elementary and secondary education. NOAA’s experience in public affairs, education, and outreach would be an asset to an ocean exploration program. There are specific elements of NOAA upon which a successful, truly global program can be built. They include NOAA’s rapid response capability, the ocean and atmospheric modeling work done in conjunction with NASA, and problem solving demonstrated by targeted programs such as the Hydrothermal Vents Program and the Geophysical Fluid Dynamics Lab. NOAA’s current program has significant drawbacks, however. Outside the agency, the Ocean Exploration program is perceived as favoring internal NOAA agency topics and U.S. coastal regions, as opposed to exploring new frontiers in the least known oceans. The perception arises, in part, from the opaque budget and program selection processes. Program goals are vague, making it difficult to maintain exploration priorities independent of NOAA’s mission. As a result, it could be difficult for the agency to maintain program direction true to its founding vision in times of fiscal hardship and in the face of pressure to focus on the agency mission. Recurring problems, such as slow grant processing and a lack of responsiveness to researchers, undermine the program’s reputation in the oceanographic community, and are likely to only get worse if the program grows in size. For instance, the academic research community is not engaged in the expedition-planning process. As a result, support from the community is not likely to increase as necessary for a premier program. Although allowances should be made for this young program, the trends in management, funding, and involvement of the scientific community have been troubling. Congressional earmarks are already appearing in the program budget resulting in a limited programmatic flexibility; the highest priority areas and highest quality proposals often do not receive funding. The office appears to be somewhat of an orphan—ocean exploration is not included in the latest NOAA strategic plan (National Oceanic and Atmospheric Administration, 2003b). There also are no plans for a completely external, independent assessment of program success. If these problems were allowed to persist in the management or oversight of a larger program, the quality and effectiveness of the program would be seriously compromised. For a large-scale ocean exploration program to be successfully led by NOAA, there must be a fundamental departure from the current NOAA Office of Ocean Exploration. At a minimum, the agency would need to demonstrate a high-level commitment to exploration, a more open forum for setting program goals, a more transparent decision-making process, more efficient program management, the willingness to involve major agency partners and undergo external review, and an improved ability to protect ocean exploration funds from redirection towards mission-oriented research. The U.S. Commission on Ocean Policy has recognized some of the structural problems that limit the effectiveness of NOAA as the nation’s oceans agency. A National Science Foundation Funded Exploration Program The National Science Foundation already has experience in running a major ocean exploration program. The International Decade of Ocean Exploration (IDOE) was a large-scale ocean exploration effort that incorporated many separate projects from 1971 to 1980. Congress provided funding through NSF, a non-mission-oriented agency, and, although the program was directed by an NSF program manager, advice was provided by a steering group comprising of members of the academic community. The program was deemed a success and remained true to the founding vision. A new program in ocean exploration that followed the examples of IDOE would benefit from NSF’s reputation for excellence both nationally and internationally. Incorporating an exploration program into NSF would not create any new institutions, and it would take full advantage of University- National Oceanographic Laboratory System capabilities. NSF also has relatively low administrative overhead, leaving more funds available for research. NSF has successfully managed the U.S. Antarctic Program (National Science Foundation, 1997), which shares some elements of an ocean exploration program: high-tech infrastructure, multidisciplinary research, grants management, and logistical support. NSF management of other successful programs—the Ridge Interdisciplinary Global Experiments, the Ocean Drilling Program (ODP), and the World Ocean Circulation Experiment—is familiar to the oceanographic community and could result in strong research community involvement and support. Programs conducted under this model, especially IDOE, have boosted the international visibility and scientific output of the oceanographic community and produced data sets of lasting value. Incorporating an ocean exploration program within NSF would not be without problems. During IDOE, NSF had difficulty engaging federal partners, such as NOAA, NASA, and the U.S. Navy, so assets were not effectively leveraged. Scientists from agencies with stated missions were at a disadvantage in academic peer review because of their unfamiliarity with the process and with the academic research community. Although siphoning of exploration funds to agency missions must be avoided, a successful exploration program should allow agency scientists to compete fairly in the proposal process. More importantly, an NSF model could result in a loss of commitment from NOAA, the agency that is most aggressively pursuing the program. Finally, although NSF has significant input into the scheduling of the University-National Oceanographic Laboratory System facilities for NSF-funded science, its experience in operating ships through ownership or lease is restricted to the Office of Polar Programs and ODP, and thus it has less control over the capabilities and operations than is necessary for an exploration program. After weighing the issues involved in oversight and funding, perhaps the most appropriate placement for an ocean exploration program under the auspices of NOPP, provided that the problems with routing funds to NOPP-sponsored projects is solved. This solution has the best chance of leading to major involvement by NOAA, NSF, and other appropriate organizations such as the Office of Naval Research. The committee is not prepared to support an ocean exploration program within NOAA unless the major shortcomings of NOAA as a lead agency, as described above, can be effectively and demonstrably overcome. A majority of the committee members felt that the structural problems limiting the effectiveness of NOAA’s current ocean exploration program are insurmountable. A minority of the committee members felt that the problems could be corrected. If there is no change to the status quo for NOPP or NOAA, the committee recommends that NSF be encouraged to take on an ocean exploration program. Although a program within NSF would face the same difficulties of the existing NOAA program in attracting other federal (and nonfederal) partners, NSF has proven successful at managing international research programs as well as a highlyregarded ocean exploration program that remained true to its founding vision. Finding: After exhaustive deliberation, the committee found that an ocean exploration program could be sponsored through NOPP, or through one of the two major supporters of civilian ocean research in the nation: NOAA or NSF. Recommendation: NOPP is the most appropriate placement for an ocean exploration program, provided the program is revised to accept direct appropriations of federal funds. If those funding issues are not resolved, NOAA (with consideration to the comments above) or NSF would be appropriate alternatives.

### 1AC — Maritime Conflict

#### Contention 2 is Maritime Conflict:

#### First, maritime conflicts are likely in the South China Sea over unsustainable fishing practices– transnational marine science collaboration is vital to creating trust necessary for durable peace

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Fishing for Peace? The Need for a New EBM Initiative in the South China Sea Littoral states to the South China Sea have put forward competing claims to its marine resources, resulting in hotly contested fishing zones. This was demonstrated most recently in January 2014, when China provoked international concern by announcing that foreign vessels must first seek Chinese permission to fish in waters under the jurisdiction of Hainan, China’s southernmost province.67 This action underscored the importance of fisheries management for building the mutual trust essential to long-term regional cooperation, and for minimizing the risk of conflict among claimant states in the near term. The economic and cultural importance of fishery resources have previously provided a rationale for increased civilian patrols in the South China Sea and a rallying point for nationalist sentiment. Declining fish stocks and government encouragement have driven fishing vessels farther into disputed Exclusive Economic Zones (EEZs), where they frequently clash with the law enforcement vessels of other claimants. The degradation of fishing stocks – and the multiplication of maritime conflicts – can be directly linked to overfishing and the region’s lack of a sustainable fishery management system.68 Scientific dialogues and early stage scientific interactions among conservation scientists, climate specialists, marine biologists, oceanographers, and other scientific stakeholders have the potential to maintain and generate long-term increases in fish stock in the South China Sea, building mutual trust and minimizing the fishing vessel clashes that could possibly lead to diplomatic or even military conflict.69 Previous bilateral efforts have been made to establish Joint Fishery Committees (JFC) and Joint Fishing Zones (JFZ) in the South China Sea. For example, China established a JFC with Vietnam in 2004 under the Gulf of Tonkin Agreement.70 The Sino-Vietnamese JFC was an important step because it established maritime fishing boundaries between the two claimant states and a joint cooperative fisheries management program, complete with fishing regulations and a dispute settlement mechanism. The major role of the JFC is to determine the quota of fishing vessels allowed in the joint resource management area each year. As David Rosenberg explains, “the JFC [between China and Vietnam] employs a ‘quantity control approach’ that quantifies the total allowable catch (TAC) of several target species, the status of each resource, the extent of traditional fishing activities, modern fishing methods and management, and then derives the allowable number of vessels.”71 But existing agreements are primarily bilateral and the JFZs are limited to managing fisheries in narrowly defined geographical areas. A more comprehensive, multilateral ecosystem-based management (EBM) approach is urgently needed to manage fisheries and maritime resource extraction in the South China Sea. An ecosystem-based management approach is essential for the sustainability of fisheries and building mutual trust in the region.72 Scientific evaluations and collaborations on fisheries must move from a mono-species approach at the national level to a multi-species, ecosystem approach at the multilateral level. The United Nations Environment Program (UNEP) and the Global Environment Facility both advocate such an EBM approach to fisheries management. EBM seeks to manage “human uses at a scale that encompasses its impact on marine and coastal ecosystem functions, rather than scales defined by jurisdictional boundaries.”73 In the South China Sea, an ecosystem-based approach will enable a comprehensive understanding of functioning marine ecosystems by providing information on the environmental factors affecting the natural viability of the stocks of exploited species, predator-prey relationships, ocean structures and patterns, breeding grounds, and the environmental impact of fisheries.74 While an ecosystem-based approach is the optimal way to ensure the sustainability of fisheries in the South China Sea, the UNEP program remains highly abstract, in both theory and practice. The Coral Triangle Initiative (CTI) has begun to implement an EBM approach in the Coral Triangle region in the seas near the Solomon Islands, Timor-Leste, Indonesia, Papua New Guinea, the Philippines, and Malaysia.75 However, it has not yet expanded to the South China Sea. Furthermore, two additional challenges remain: the physical management of fisheries and enforcement of fishing regulations in the South China Sea is weak, and there is a lack of funding for concrete EBM approaches. Most importantly, the scientific capacity gaps between various East Asian and Southeast Asian states remain vast, limiting the ability of some governments’ policies to align with scientific best practices. An effective EBM approach would seek to build regional marine scientific capacity, a regional scientific network for effective EBM science and best practices, and mutual trust among participants. Given the direct connection between sustainable fisheries management and promoting durable peace in the Asia-Pacific region, a new initiative is needed to complement stalemated efforts for scientific and technical cooperation under the DoC framework. Specifically, the following steps should be taken to build an ecosystem-based approach for sustainable marine resource extraction among claimant states: A scientific advisory committee should be established under the auspices of the DoC. Simply creating a new EBM initiative between claimant states will not generate mutual trust; it is essential that it be linked to policy discussions under the DoC. This advisory committee should be composed of scientific and policy experts from each of the claimant states and experts from select nongovernmental and international organizations, such as the Global Environment Facility, Conservation International, or the Asian Development Bank. The advisory committee will be tasked with ensuring the EBM programs’ scientific findings are shared regularly with policy officials in each claimant state – through ministries of science or foreign policy – to build shared understandings of the status of the marine environment and principles for its future management. This will also ensure governments – particularly those with greater gaps in scientific capacity – are aware there is a developing scientific community they can utilize for scientific and policy advice.76 It is essential to convene a regional meeting of scientists at the track 1.5 level with the aim of developing scientific capacity, generating trust, and building a regional network of key scientific and policy stakeholders. This meeting would provide a venue for scientists to discuss EBM and propose new areas of scientific research in EBM in the South China Sea. Ideally the meeting would provide a venue for scientists to identify scientists from other claimant states with mutual research interests, providing the personal basis for them to consider near to long-term scientific engagement. Additionally, funding from multiple independent sources should be provided for early stage scientific interactions between claimant state scientists on scientific and policy issues identified at the meeting.77 Examples of early-stage interactions on EBM to be supported under this scheme include student and faculty fellowships or more substantial awards for technical workshops, laboratory work, or virtual joint research. The scientific findings from these interactions will inform the policy dialogue under the DoC. These suggestions build on current EBM efforts by the United Nations Environment Program (UNEP) and the United Nations Development Program (UNDP). Programs such as Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), funded by the UNDP, that attempted to implement an EBM approach to fisheries. However, territorial conflicts among claimant states largely caused the initiative to fail. But this failure was not necessarily a function of an EBM approach to fisheries, but rather a result of the methods used to implement the program. PEMSEA expands the definition of an EBM approach beyond a strict scientific and technical approach to an approach that attempts to tackle all the challenges to South China Sea sustainability: governance, management, monitoring, and economic assessment issues.78 While at first glance this may seem to be a positive implementation method, it is essential to incorporate all requisite stakeholders – government, NGOs, and industry – to attempt to congruently address the myriad of challenges preventing South China Sea sustainability.79 However, when the environment and stakeholder relationships are characterized by a lack of trust, issues such as governance, management, and monitoring tend to get mired in policy discussions, which can cause the overall program to fail. In contrast, this study’s proposed EBM approach is far narrower and seeks to strictly use science as a tool to begin building trust, setting aside these controversial policy issues to focus first on confidence-building measures. The goal is to use science as a mechanism to implement an EBM approach while also building trust, which can later be used to advance policy dialogue. The Future Potential of Science Diplomacy in the South China Sea A new EBM scientific initiative in the South China Sea has the potential to promote sustainable marine resource extraction – and more importantly, lasting regional peace – in two specific ways. First, it would build mutual trust by developing a transnational network of scientists and related national ministries and thereby enabling their regular communication, interaction, and potential long-term collaboration. Second, greater sustainability of fishing stocks and better regional fisheries management will slow the decline of marine resources, thus decreasing the likelihood of fishing vessels crossing into disputed territories and causing clashes that can lead to diplomatic or even military conflict. Given the lack of progress in scientific and technical cooperation over the past decade under the DoC framework, a new EBM scientific initiative will provide a vital alternate mechanism to promote the multilateral cooperation and mutual trust so urgently needed in the South China Sea.

#### Second, specifically the risk of a South China Sea dispute is high and will draw in the U.S.

Dupont and Baker, 14 - \* Nonresident Fellow at the Lowy Institute for International Policy \*\* Principal Engineer, CSC/ServiceMesh (Alan and Christopher, “East Asia’s Maritime Disputes: Fishing in Troubled Waters” March 01, 2014 https://twq.elliott.gwu.edu/east-asia%E2%80%99s-maritime-disputes-fishing-troubled-waters)

Chinese fishing boats are also appearing in unprecedented numbers around Indonesia’s Natuna Island group. This is a collection of 272 islands located at the southern end of the South China Sea in the province of Riau Islands, nearly 2000 kilometers from the Chinese mainland. This illustrates how far south the Chinese fishing fleet is now sailing and the extent of its fishing and territorial claims. In June 2009, the Indonesian Navy detained 75 Chinese fishermen in eight boats for illegally fishing in the EEZ of the Natunas, which provoked a typically blunt demand from Beijing for their immediate return.30 The Chinese response raised fears in Jakarta that China’s expansive claim to the South China Sea might cut across the northern edge of the Natunas’ EEZ, even though Indonesia is not a claimant to any of the disputed features in the Spratly Island group to the north and has never regarded China as a neighbor in maritime delimitation.31 A more serious incident a year later confirmed Jakarta’s worst fears. An Indonesian naval ship detained ten Chinese fishing boats to the north of the Natunas, but well within the 200 nautical mile EEZ, which Indonesian officials maintain had encroached in a “deliberate and coordinated manner.” Within a few hours of their detention, two frigate-sized ships “armed with heavy guns” arrived and engaged in a tense confrontation before the fishing vessels were released.32 Anxious to avoid any conflict with China, or to give substance to Chinese claims to the Natunas, the Indonesian government chose to play down the incident publicly, although officials privately voiced their misgivings about Chinese intentions and the obvious coordination between the intruding fishing vessels and Chinese maritime agencies.33 If such behavior were confined to a single sea or country, one could make a case that China’s assertiveness might be no more than oversensitivity to a particular area or an especially prickly bilateral relationship. However, China’s equally uncompromising stance on territorial issues in the East China Sea and its aggressive use of its fishing and paramilitary fleets in disputes with multiple countries throughout the Western Pacific, irrespective of the strength of historical ties with China, suggests otherwise. Take the case of South Korea: in 2011, Seoul seized nearly 500 Chinese fishing vessels, up 20 percent from the previous year, with Chinese intrusions peaking during the crab season.34 South Korean authorities claim that the sheer number of Chinese vessels fishing illegally, and their increasingly aggressive tactics, threatens to overwhelm their maritime law enforcement capabilities. In recent years, there have been several deaths at sea, including the December 2011 knifing of two South Korean coast guard officers by a Chinese trawler captain, resulting in the death of one ROK coast guard officer.35 In one particular incident, Chinese trawlers, lashed together in groups of up to twelve, fought pitched battles with the South Korean coast guard using boathooks, metal bars and shovels, while coast guard officers responded with rubber bullets.36 A Chinese fishing trawler also helped bring a simmering territorial dispute with Japan to the boil. In September 2010, a Japanese coast guard vessel was rammed by a Chinese fishing trawler while trying to detain the trawler for illegally fishing in the waters surrounding the Senkaku/Diaoyu islands. Although not the first time incidents involving the Chinese fishing fleet had precipitated terse Sino–Japanese diplomatic exchanges,37 this incident was notable for two reasons. The confidence the Chinese trawler captain displayed and the sharpness and immediacy of Beijing’s language in responding to his and his crew’s arrest contrasts starkly with the more sober and measured tones adopted by other countries when China has detained their fishing boats.38 China’s official news agency, Xinhua News, accused Japan of creating a mock collision in “a severe violation and flagrant challenge of China’s territorial sovereignty” and of “play[ing] tricks by deceiving the world and international public opinion.”39 The dispute continues to fester and is arguably the most dangerous in the region because it involves East Asia’s two largest powers and risks drawing in the United States as Japan’s ally and ultimate security guarantor.

#### Third, those conflicts escalate to nuclear weapons use, destroying agriculture and food yields

**Wittner 11** - Emeritus Professor of History at the State University of New York/Albany (Lawrence S. Wittner, 11/28, "Is a Nuclear War With China Possible?", [www.huntingtonnews.net/14446](http://www.huntingtonnews.net/14446))

While nuclear weapons exist, there remains a danger that they will be used. After all, for centuries national conflicts have led to wars, with nations employing their deadliest weapons. The current deterioration of U.S. relations with China might end up providing us with yet another example of this phenomenon. The gathering tension between the United States and China is clear enough. Disturbed by China’s growing economic and military strength, the U.S. government recently challenged China’s claims in the South China Sea, increased the U.S. military presence in Australia, and deepened U.S. military ties with other nations in the Pacific region. According to Secretary of State Hillary Clinton, the United States was “asserting our own position as a Pacific power.” But need this lead to nuclear war? Not necessarily. And yet, there are signs that it could. After all, both the United States and China possess large numbers of nuclear weapons. The U.S. government threatened to attack China with nuclear weapons during the Korean War and, later, during the conflict over the future of China’s offshore islands, Quemoy and Matsu. In the midst of the latter confrontation, President Dwight Eisenhower declared publicly, and chillingly, that U.S. nuclear weapons would “be used just exactly as you would use a bullet or anything else.” Of course, China didn’t have nuclear weapons then. Now that it does, perhaps the behavior of national leaders will be more temperate. But the loose nuclear threats of U.S. and Soviet government officials during the Cold War, when both nations had vast nuclear arsenals, should convince us that, even as the military ante is raised, nuclear saber-rattling persists. Some pundits argue that nuclear weapons prevent wars between nuclear-armed nations; and, admittedly, there haven’t been very many—at least not yet. But the Kargil War of 1999, between nuclear-armed India and nuclear-armed Pakistan, should convince us that such wars can occur. Indeed, in that case, the conflict almost slipped into a nuclear war. Pakistan’s foreign secretary threatened that, if the war escalated, his country felt free to use “any weapon” in its arsenal. During the conflict, Pakistan did move nuclear weapons toward its border, while India, it is claimed, readied its own nuclear missiles for an attack on Pakistan. At the least, though, don’t nuclear weapons deter a nuclear attack? Do they? Obviously, NATO leaders didn’t feel deterred, for, throughout the Cold War, NATO’s strategy was to respond to a Soviet conventional military attack on Western Europe by launching a Western nuclear attack on the nuclear-armed Soviet Union. Furthermore, if U.S. government officials really believed that nuclear deterrence worked, they would not have resorted to championing “Star Wars” and its modern variant, national missile defense. Why are these vastly expensive—and probably unworkable—military defense systems needed if other nuclear powers are deterred from attacking by U.S. nuclear might? Of course, the bottom line for those Americans convinced that nuclear weapons safeguard them from a Chinese nuclear attack might be that the U.S. nuclear arsenal is far greater than its Chinese counterpart. Today, it is estimated that the U.S. government possesses over five thousand nuclear warheads, while the Chinese government has a total inventory of roughly three hundred. Moreover, only about forty of these Chinese nuclear weapons can reach the United States. Surely the United States would “win” any nuclear war with China. But what would that “victory” entail? A nuclear attack by China would immediately slaughter at least 10 million Americans in a great storm of blast and fire, while leaving many more dying horribly of sickness and radiation poisoning. The Chinese death toll in a nuclear war would be far higher. Both nations would be reduced to smoldering, radioactive wastelands. Also, radioactive debris sent aloft by the nuclear explosions would blot out the sun and bring on a “nuclear winter” around the globe—destroying agriculture, creating worldwide famine, and generating chaos and destruction.

#### Fourth, stronger marine science partnerships act as confidence building measures that dampen conflict incentives and bolster inter-state relations

**Crosby, 7 –** executive director, National Science Board (Michael, “Improving International Relations Through Marine Science Partnerships”, Law, Science and Ocean Management, p. 275-276

There are a number of successful international marine science partnerships and specific models that should be considered for implementation in other regions of the world. Often, such partnerships developed between nations are built upon a long history of close ties and cooperative relationships. An example of this type of international marine science partnership exists between Ireland and the United States. However, marine science partnerships have also been demonstrated to not only support the conduct of excellence in cooperative research, but also to serve as vehicles for improving relationships between nations. When marine science partnerships are developed and implemented between nations having limited or historically tense relationships, these partnerships may be viewed as "confidence building measures" or "confidence and security building measures" in the context discussed more extensively by Kraska6. The extended premise is that joint acquisition and distribution of knowledge through international marine science partnerships serve to bring transparency to what may otherwise be opaque relationships between nations. Transparency builds trust and confidence, and reduces tension, even if the parties still "agree to disagree" on the underlying substantive issues. International marine science partnerships can also lead to an ever- expanding circle of issues that build constituencies by broadening the numbers and types of participants, including governments and nongovernmental organizations. The partnerships tend to include an array of scientific, technical, environmental, ecological, legal, administrative, and economic interests. The involvement of all of these interests has a progressive effect, helping to improve foreign relations between governments and build goodwill between peoples of different nations.

#### Fifth, the plan establishes a global model of marine research collaboration, increasing cooperation with other countries

**Pages, 4** – Media Relations Officer at National Academies (Patrice, “Exploration of the Deep Blue Sea” National Academies In Focus Magazine, Winter/Spring, <http://www.infocusmagazine.org/4.1/env_ocean.html>)

The oceans cover nearly three-quarters of the Earth's surface, regulate our weather and climate, and sustain a large portion of the planet's biodiversity, yet we know very little about them. In fact, most of this underwater realm remains unexplored. Three recent reports from the National Research Council propose a significantly expanded international infrastructure for ocean exploration and research to close this knowledge gap and unlock the many secrets of the sea. Already a world leader in ocean research, the United States should lead a new exploration endeavor by example. "Given the limited resources in many other countries, it would be prudent to begin with a U.S. exploration program that would include foreign representatives and serve as a model for other countries," said John Orcutt, the committee chair for one of the reports and deputy director, Scripps Institution of Oceanography, University of California, San Diego. "Once programs are established elsewhere, groups of nations could then collaborate on research and pool their resources under international agreements." Using new and existing facilities, technologies, and vehicles, proposed efforts to understand the oceans would follow two different approaches. One component dedicated to exploration would utilize ships, submersibles, and satellites in new ways to uncover the ocean's biodiversity, such as the ecosystems associated with deep-sea hydrothermal vents, coral reefs, and volcanic, underwater mountains. A second component -- a network of ocean "observatories" composed of moored buoys and a system of telecommunication cables and nodes on the seafloor -- would complement the existing fleet of research ships and satellites. The buoys would provide information on weather and climate as well as ocean biology, and the cables would be used to transmit information from sensors on fixed nodes about volcanic and tectonic activity of the seafloor, earthquakes, and life on or below the seafloor. Also, a fleet of new manned and unmanned deep-diving vehicles would round out this research infrastructure. Education and outreach should be an integral part of new ocean science efforts by bringing discoveries to the public, informing government officials, and fostering collaborations between educators and the program's scientists, the reports say. These activities will expand previous international programs. For example, the observatory network will build on current attempts to understand the weather, climate, and seafloor, such as the Hawaii-2 Observatory -- which consists of marine telephone cables running between Oahu and Hawaii and the California coast -- and the Tropical Atmosphere Ocean Array, which contains about 70 moorings in the Pacific and was key to predicting interannual climate events such as El Niño. The National Oceanographic Partnership Program, an existing collaboration of 14 federal agencies, would be the most appropriate organization to house the ocean exploration program, which would cost approximately $270 million the first year, and about $100 million annually thereafter, according to the Research Council. The National Science Foundation is expected to fund the observatory network program, which would cost about $25 million per year, and provide funds for the construction and operation of at least one new manned submersible and possibly several remotely operated vehicles. "Over the next decade, new international collaborations dedicated to ocean exploration and research will most likely lead to new discoveries that could increase public awareness of the oceans as a common global bond, highlighting their importance in our lives," Orcutt said.

#### Sixth, a new ocean exploration within the NOPP fosters international coordination in marine research efforts

NRC 3 – Committee on Exploration of the Seas, Ocean Studies Board Division on Earth and Life Studies. (“Exploration of the Seas: Voyage into the Unknown”, National Research Council, the National Academies Press, <http://explore.noaa.gov/sites/OER/Documents/national-research-council-voyage.pdf>)

Incorporating a new ocean exploration program into the U.S. marine science field presents numerous challenges. The large scale of the program, the interdisciplinary nature of the research, and the need for participation by a number of agencies must be taken into consideration. The United States maintains the world’s largest national commitment to national and international ocean research. Progress in the ocean sciences is largely attributable to support given to individual, independent projects and to large-scale, multiple-investigator programs. Support of U.S. ocean research programs comes primarily from the National Science Foundation (NSF), the Office of Naval Research, the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), and the U.S. Geological Survey, with additional support from many other government and private sources. The large scale of the program, the interdisciplinary nature of the research, and the need for participation by a number of agencies must be taken into consideration. In a review of processes for selecting regional marine research, the National Research Council described four approaches: community plans, scientists’ plans, agency plans, and legislative mandates (National Research Council, 2000b). Briefly, community plans are developed using a broad range of input from stakeholders, planners, and researchers; scientists’ plans are developed generally through a series of scientific fora; agency plans seek to meet mission requirements; and legislative mandates are direct congressional requests. Of the four types of approaches, both the scientists’ and agency plans are the most commonly used for project selection, and could be appropriate for ocean exploration. NOAA funds research more readily using the agency plan model, while NSF uses the scientist plan model (National Research Council, 2000b). Within NOAA, this agency-driven research agenda serves to assist the agency with meeting its mission, which in the case of NOAA, includes such diverse needs as support for regulations protecting living resources (fisheries and protected species), navigational charts, and weather forecasting. Most NSF ocean research is motivated by scientists’ plans and conducted under individual, competitively funded grants. Panels of peer reviewers judge proposals according to a host of criteria including investigators’ track records, the importance of problems to be addressed, and the adequacy of investigative techniques. Broader criteria also are considered— educational benefits, outreach, and whether contributions are possible that will benefit society. This process has worked well for short-term (twoto three-year) projects with clear, testable hypotheses. Larger programs, such as the World Ocean Circulation Experiment, the Integrated Ocean Drilling Program, and the Ridge Interdisciplinary Global Experiments complement the smaller projects. The larger programs are developed with more integrated, interdisciplinary, and long-term goals that are too lengthy and intricate to be completed by a single investigator. Projects within those programs are selected not only for their scientific excellence, but also for their anticipated contributions to broader program goals. Ocean exploration best fits within this last category of funding models: the program must be larger, better coordinated, longer term, and more interdisciplinary than individual investigator grants, while still being primarily science (rather than mission) driven. Individual exploration expeditions should be chosen based on their quality and their contribution to broader exploration goals. Even using this model as the basis for exploration, there are several choices for where this large-scale program would be placed within the federal government and how it would be structured. The National Research Council noted in its report Global Ocean Science that “[t]he effectiveness and to some degree, the character of these major programs can be greatly influenced by the program’s structure” (National Research Council, 1999). For that reason, the committee invested substantial time and effort in debating the lead agency and administrative structure for ocean exploration so as to achieve a program that is: 1. goal and theme oriented; 2. scientifically excellent and creative; 3. international; 4. well funded in the long term; 5. reasonably independent from the missions of agencies involved; 6. provided with access to the highest-quality technical assets; 7. multisector, involving government, commercial, academic, private, and nongovernmental organizations; 8. highly visible to the public and involved in educational outreach; 9. efficiently managed; and 10. independently evaluated. PLACEMENT OF OCEAN EXPLORATION WITHIN THE FEDERAL GOVERNMENT The committee struggled with the difficulty of simultaneously satisfying goals 4 and 7 above. Consistent, adequate funding for a large-scale program requires a strong advocate and leader to guide the initiative through the federal budget process. This is a potential argument for housing exploration within a single agency, but only if the agency considers the program a high priority. If the agency does not have a vested interest in the success of the program, other efforts will be promoted instead, almost surely resulting in the program’s demise. Placing an exploration program within a single agency, however, can dampen the interagency cooperation that is especially important in ocean research, which unlike space research, is scattered among a number of agencies including NSF, Navy, and NOAA. In recognition of the fact that many federal ocean science agencies bring capabilities and expertise to the table, the U.S. Congress created the National Ocean Partnership Program (NOPP) (Box 5.1). A National Oceanographic Partnership Program Sponsored Exploration Program NOPP is the government’s best attempt to date at interagency cooperation. NOPP has embraced the task of implementing ocean observatories in an integrated, multi-agency manner. For example, through NOPP, there is not just one agency advocating ocean observing: there are many. Through NOPP’s Ocean.US office, which is jointly supported by several NOPP member agencies, this inter-governmental organization is tackling major issues on the development, installation, and operation of ocean observatories that either cannot or should not be undertaken by one agency in isolation. NOPP is able to pool funds from the partner agencies and nonfederal sources to fund research proposals that respond to a broad interagency solicitation. The program has consistently encouraged proposals from teams that include academic, commercial, federal, and other not-for-profit partners. The leaders of the agencies meet twice annually to review program accomplishments and directions, and an Interagency Working Group is tasked with the dayto-day operation of the program. The program’s independent advisory group, the Ocean Research Advisory Panel, has already recommended that NOPP embrace ocean exploration as an additional theme area to complement ocean observing and to better engage the public in ocean issues. NOPP is an existing organization that would allow the major agencies with an interest in ocean exploration and the necessary assets, such as NOAA, NSF, and the Navy, to pursue a major program cooperatively, and assume leadership of various aspects as fits with the agency’s ability. For example, NOAA might take on the task of systematic ocean mapping, with NSF piggybacking programs for assessing biodiversity in the midwater, while the Minerals Management Service adds the equipment and expertise to assess nonliving resources on those mapping expeditions. An additional advantage of placing an ocean exploration program under the auspices of NOPP is that it allows for other member agencies, such as the National Aeronautics and Space Administration (NASA), the U.S. Geological Survey, and the Environmental Protection Agency, to participate at any level without any additional bureaucracy. Within NOPP, a new Ocean Exploration Interagency Task Force could integrate the initiative across the full range of governmental capabilities and encourage efficient use of funds. Task force membership should include representatives from all federal agencies with ocean interests, including the National Endowment for the Humanities, to ensure that relevant ocean exploration disciplines, such as marine archaeology, are included. The task force should be aware of and promote efficient leveraging of assets that could be achieved by conducting ocean exploration activities during the course of other oceanographic missions. The task force would convene to coordinate ocean exploration initiatives and opportunities at the government level worldwide. The group would encourage cooperative international use assets. Funding agencies should be engaged early through the task force to plan for collaborative exploration programs proposed by international groups of scientists.

### 1AC — Solvency

#### Contention Three is Solvency:

#### Research-driven adaptation strategies build in resilience to prevent total ecosystem collapse

**Doney, 8 -** Senior Scientist Marine Chemistry & Geochemistry Department Woods Hole Oceanographic Institution (Scott, **“**The Federal Ocean Acidification Research and Monitoring Act: H.R. 4174” Written testimony presented to the Committee on Science and Technology, Subcommittee on Energy and Environment, United States House of Representatives6/5, <http://www.whoi.edu/page.do?pid=8916&tid=282&cid=43766>

Major gaps exist in our current scientific understanding, limiting our ability to forecast the consequences of ocean acidification and hindering the development of adaptation approaches for marine resource managers. Thus far, most of the elevated CO2 response studies on marine biota, whether for calcification, photosynthesis or some other physiological measure, have been short-term laboratory or mesocosm experiments ranging in length from hours to weeks. Chronic exposure to increased CO2 may have complex effects on the growth and reproductive success of calcareous and non-calcareous plants and animals and could induce possible adaptations that are not observed in short term experiments. Our present understanding also stems largely from experiments on individual organisms or a species in isolation; consequently, the response of populations and communities to more realistic gradual changes is largely unknown. Other aspects of ocean biogeochemistry may be strongly influenced by rising CO2 levels. Recent experiments with one of the most abundant types of phytoplankton, Synechococcus, showed significantly elevated photosynthesis rates under warmer, high CO2 conditions. Elevated CO2 also enhanced nitrogen fixation rates (production of biologically useful nutrients from dissolved nitrogen gas) for a key tropical marine cyanobacteria, which would in effect fertilize the surface ocean and offset predicted reductions in tropical biological production due to climate warming and stratification. Further, a major but underappreciated consequence of ocean acidification will be broad alterations of inorganic and organic seawater chemistry beyond the carbonate system. Acidification will affect the biogeochemical dynamics of calcium carbonate, organic carbon, nitrogen, and phosphorus in the ocean as well as the seawater chemical speciation of trace metals, trace elements and dissolved organic matter. A fully-integrated research program with in-water and remote sensing observing systems on multiple-scales, laboratory, mesocosm (large volumes of seawater either in tanks or plastic bags), and field process studies, and modeling approaches is required to provide policymakers with informed management strategies that address how humans might best mitigate or adapt to these long-term changes. This program should emphasize how changes in the metabolic processes at the cellular level will be manifested within the ecosystem or community structure, and how they will influence future climate feedbacks. A program should include the following components: Systematic monitoring system with high resolution measurements in time and space of atmospheric and surface water carbon dioxide partial pressure (pCO2), total dissolved inorganic carbon, alkalinity, and pH to validate model predictions and provide the foundations for interpreting the impacts of acidification on ecosystems; In regions projected to undergo substantial changes in carbonate chemistry, tracking of abundances and depth distributions of key calcifying and non-calcifying species at appropriate temporal and spatial scales to be able to detect possible shifts and distinguish between natural variability and anthropogenic forced changes; Standardized protocols and data reporting guidelines for carbonate system perturbation and calcification experiments; Manipulative laboratory experiments to quantify physiological responses including calcification and dissolution, photosynthesis, respiration, and other sensitive indices useful in predicting CO2 tolerance of ecologically and economically important species; New approaches to investigate address long-term subtle changes that more realistically simulate natural conditions; Manipulative mesocosm and field experiments to investigate community and ecosystem responses (i.e., shifts in species composition, food web structure, biogeochemical cycling and feedback mechanisms) to elevated CO2 and potential interactions with nutrients, light and other environmental variables; Integrated modeling approach to determine the likely implications of ocean acidification processes on marine ecosystems and fisheries including nested models of biogeochemical processes and higher trophic-level responses to address ecosystem-wide dynamics such as competition, predation, reproduction, migration, and spatial population structure; Robust and cost effective methods for measuring pH, pCO2, and dissolved total alkalinity on moored buoys, ships of opportunity, and research vessels, floats and gliders; Studies on the human dimensions of ocean acidification including the socio-economic impacts due to damaged fisheries and coral reefs; Assessment of potential adaptation strategies needed by resource managers including reducing other human stresses (over-fishing, habitat destruction, pollution) to increase ecosystem resiliency as well as local-scale mitigation efforts.

#### A dedicated NOPP funding stream will maximize ocean science partnerships and lead to applied solutions for ocean ecosystem management

**Watkins et al, 9** - Watkins chaired the U.S. Commission on Ocean Policy, served as the President of the Joint Oceanographic Institutions, and founding President of the Consortium for Ocean Research and Education (James, How the Oceanographic Community Created a National Oceanographic Partnership Program” Oceanography Vol. 22, Iss. 2. Published by the NOPP. https://darchive.mblwhoilibrary.org/bitstream/handle/1912/2982/22.2\_watkins.pdf?sequence=1) zabd

The successes of the ocean partnership effort started more than ten years ago have been impressive. The partnership effort, backed by the goal of preparing the nation to address complex new questions, inspired significant attention at high levels of government. This attention was then held further as the Presidential and Pew Ocean Commissions issued their reports (Pew Oceans Commission, 2003; US Commission on Ocean Policy, 2004) and presented their recommendations. Additionally, the momentum and community focus provided in the lead-up and development of NOPP demonstrated to the full oceanographic community the effectiveness of partnering to conduct research. A decades worth of extraordinary research involving all sectors has proven the value of the partnership concept. NOPP has provided a much-needed mechanism for project funding. Partnering among research scientists is remarkably more common than it was ten years ago. The ocean science community has new and sophisticated tools available to address increasingly complex multidisciplinary problems that require many areas of expertise. The federal agencies have encouraged a cross-institution and cross-discipline approach to answer ever more complicated research problems with great success. Perhaps most importantly. NOPP provides the forum for dialogue, debate, and decision-making regarding the most exciting research topics and challenges. While the structural goals originally described in Oceans 2000 were well met, the inherent goal of leveraging the partnership program to draw new funding to ocean science fell short. As a community, we succeeded in bringing together performers from academia, government, and industry as never before. But we have not effected change in the resourcing of our field. Although the ocean community has no reliable way to measure and track funding (which is another need that should be met), it is fair to say that funding has not kept pace with increasing demands. Moreover, dedicated NOPP funding has been sporadic and was never broadly subscribed. Was this a failure in inducing partnering in Congress? Or was it simply a consequence of inadequate attention to one or more of the fundamental principles identified above? So, where do we go from here to make best use of the foundation built over the last ten years? There is a great opportunity in this time of political transition to consider changes to the ocean partnership. It is easily argued that NOPP is more necessary now than ever before as we struggle to understand the role of the ocean in our changing climate and attempt to consider marine ecosystems in whole rather than part. In the past, NOPP was solely focused on research, and new requirements for partnering in ocean science continue to arise. For instance, the recent Ocean Research Priorities Plan and Implementation Strategy (JSOST. 2007) recommends a number of research programs for which NOPP is proving to be an ideal implementing mechanism. In addition, as we succeed in connecting our research to societal needs, we would argue that now is the time to expand the portfolio to the applications of research and the coordination with such issues as ecosystem health, marine operations (including ocean observing), and human health. Another intriguing possibility is in the area of climate services. There are initial discussions underway on how to approach climate services, a federal function that arguably must involve all agencies with an ocean purview. With proper buy-in from the ocean agencies and leadership from NORLC. NOPP could provide an expanded mechanism to address critical aspects of a climate service without creating an entirely new bureaucratic structure. In summary, we have much to appreciate from the evolution of NOPP. It has served as a catalyst for the maturation of our research community and helped us realize that the impact of our research efforts can be compounded through effective collaboration, coordination, and cooperation. It is our responsibility, now, to take these enhanced skills of partnering and apply them to society’s most exigent needs with haste and vigor.

#### US oceans leadership creates the political will for protection– change is empirically possible

**Sielen, 14 -** ALAN B. SIELEN is Senior Fellow for International Environmental Policy at the Center for Marine Biodiversity and Conservation at the Scripps Institution of Oceanography (“Sea Change: How to Save the Oceans” 4/16, <http://www.foreignaffairs.com/articles/141198/alan-b-sielen/sea-change?sp_mid=45656665&sp_rid=aHVyd2pzMTJAd2Z1LmVkdQS2)//DH>

The rebirth of the seas will require large doses of education to dispel the myth of an ocean with an endless bounty and an unlimited capacity to assimilate waste safely: an ocean too big to fail. People must believe that the stakes are high and that the consequences of a failed ocean are unacceptable. Increased awareness about the costs of the oceans’ degradation has come from the grass roots: individuals and citizen groups educating the public, organizing community action, encouraging better consumer choices, and holding elected officials accountable. The rebirth of the seas cannot, however, rely on these efforts alone. Government leaders are in a unique position to seize the bully pulpit. In the United States, successes under both Republican and Democratic administrations are reminders of what is possible. Russell Train, chairman of U.S. President Richard Nixon’s Council on Environmental Quality, led efforts to secure an international agreement on prohibiting the dumping of toxic waste into the ocean at the 1972 United Nations Conference on the Human Environment in Stockholm. In 1977, U.S. President Jimmy Carter, responding to a series of tanker accidents off U.S. shores, called for a major international treaty on tanker safety and pollution prevention. Eleven months later, industries and most maritime countries backed two major international agreements: the MARPOL Protocol to prevent pollution from ships and the SOLAS Protocol for the safety of life at sea. Steady U.S. leadership contributed to the adoption in 1993 of a global ban on dumping radioactive waste into the ocean. In 2006, U.S. President George W. Bush established the Northwestern Hawaiian Islands Marine National Monument, the world’s largest ocean preserve.

## 2AC — Marine Science

### They Say “NOPP Has Sufficient Funding Now”

#### Low levels of ocean exploration funding have diminished US marine science leadership

Conathan, 13 - Center for American Progress (Michael, June 20, 2013 “Space Exploration Dollars Dwarf Ocean Spending” http://newswatch.nationalgeographic.com/2013/06/20/space-exploration-dollars-dwarf-ocean-spending/)

“Star Trek” would have us believe that space is the final frontier, but with apologies to the armies of Trekkies, their oracle might be a tad off base. Though we know little about outer space, we still have plenty of frontiers to explore here on our home planet. And they’re losing the race of discovery. Hollywood giant James Cameron, director of mega-blockbusters such as “Titanic” and “Avatar,” brought this message to Capitol Hill last week, along with the single-seat submersible that he used to become the third human to journey to the deepest point of the world’s oceans—the Marianas Trench. By contrast, more than 500 people have journeyed into space—including Sen. Bill Nelson (D-FL), who sits on the committee before which Cameron testified—and 12 people have actually set foot on the surface of the moon. All it takes is a quick comparison of the budgets for NASA and the National Oceanic and Atmospheric Administration, or NOAA, to understand why space exploration is outpacing its ocean counterpart by such a wide margin. In fiscal year 2013 NASA’s annual exploration budget was roughly $3.8 billion. That same year, total funding for everything NOAA does—fishery management, weather and climate forecasting, ocean research and management, among many other programs—was about $5 billion, and NOAA’s Office of Exploration and Research received just $23.7 million. Something is wrong with this picture. Space travel is certainly expensive. But as Cameron proved with his dive that cost approximately $8 million, deep-sea exploration is pricey as well. And that’s not the only similarity between space and ocean travel: Both are dark, cold, and completely inhospitable to human life. Yet space travel excites Americans’ imaginations in a way ocean exploration never has. To put this in terms Cameron may be familiar with, just think of how stories are told on screens both big and small: Space dominates, with “Star Trek,” “Star Wars,” “Battlestar Galactica,” “Buck Rogers in the 25th Century,” and “2001 A Space Odyssey.” Then there are B-movies such as “Plan Nine From Outer Space” and everything ever mocked on “Mystery Science Theater 2000.” There are even parodies: “Spaceballs,” “Galaxy Quest,” and “Mars Attacks!” And let’s not forget Cameron’s own contributions: “Aliens” and “Avatar.” When it comes to the ocean, we have “20,000 Leagues Under the Sea,” “SpongeBob SquarePants,” and Cameron’s somewhat lesser-known film “The Abyss.” And that’s about it. This imbalance in pop culture is illustrative of what plays out in real life. We rejoiced along with the NASA mission-control room when the Mars rover landed on the red planet late last year. One particularly exuberant scientist, known as “Mohawk Guy” for his audacious hairdo, became a minor celebrity and even fielded his share of spontaneous marriage proposals. But when Cameron bottomed out in the Challenger Deep more than 36,000 feet below the surface of the sea, it was met with resounding indifference from all but the dorkiest of ocean nerds such as myself. Part of this incongruity comes from access. No matter where we live, we can go outside on a clear night, look up into the sky, and wonder about what’s out there. We’re presented with a spectacular vista of stars, planets, meteorites, and even the occasional comet or aurora. We have all been wishing on stars since we were children. Only the lucky few can gaze out at the ocean from their doorstep, and even those who do cannot see all that lies beneath the waves. As a result, the facts about ocean exploration are pretty bleak. Humans have laid eyes on less than 5 percent of the ocean, and we have better maps of the surface of Mars than we do of America’s exclusive economic zone—the undersea territory reaching out 200 miles from our shores. Sure, space is sexy. But the oceans are too. To those intrigued by the quest for alien life, consider this: Scientists estimate that we still have not discovered 91 percent of the species that live in our oceans. And some of them look pretty outlandish. Go ahead and Google the deepsea hatchetfish, frill shark, or Bathynomus giganteus. In a time of shrinking budgets and increased scrutiny on the return for our investments, we should be taking a long, hard look at how we are prioritizing our exploration dollars. If the goal of government spending is to spur growth in the private sector, entrepreneurs are far more likely to find inspiration down in the depths of the ocean than up in the heavens. The ocean already provides us with about half the oxygen we breathe, our single largest source of protein, a wealth of mineral resources, key ingredients for pharmaceuticals, and marine biotechnology. Of course space exportation does have benefits beyond the “cool factor” of putting people on the moon and astronaut-bards playing David Bowie covers in space. Inventions created to facilitate space travel have become ubiquitous in our lives—cell-phone cameras, scratch-resistant lenses, and water-filtration systems, just to name a few—and research conducted in outer space has led to breakthroughs here on earth in the technological and medical fields. Yet despite far-fetched plans to mine asteroids for rare metals, the only tangible goods brought back from space to date remain a few piles of moon rocks. The deep seabed is a much more likely source of so-called rare-earth metals than distant asteroids. Earlier this year the United Nations published its first plan for management of mineral resources beneath the high seas that are outside the jurisdiction of any individual country. The United States has not been able to participate in negotiations around this policy because we are not among the 185 nations that have ratified the U.N. Convention on the Law of the Sea, which governs such activity. With or without the United States on board, the potential for economic development in the most remote places on the planet is vast and about to leap to the next level. Earlier this year Japan announced that it has discovered a massive supply of rare earth both within its exclusive economic zone and in international waters. This follows reports in 2011 that China sent at least one exploratory mission to the seabed beneath international waters in the Pacific Ocean. There is a real opportunity for our nation to lead in this area, but we must invest and join the rest of the world in creating the governance structure for these activities.

#### New funding is vital to effective exploration

NRC, 3 – National Research Center (Committee on Exploration of the Seas Ocean Studies Board Division on Earth and Life Studies “Exploration of the Seas: Voyage into the Unknown ( 2003 )” pp 136-137 [http://www.nap.edu/openbook.php?record\_id=10844&page=136 )](http://www.nap.edu/openbook.php?record_id=10844&page=136)//gingE)

MOVING BEYOND THE EXISTING PROGRAM The National Oceanic and Atmospheric Administration’s (NOAA) Office of Ocean Exploration, which was established in 2000, does not have the wherewithal to undertake the interdisciplinary, global ocean exploration program proposed in this report. Significantly higher allocations are needed to support a more comprehensive program. More money is needed to increase the program’s scope, its flexibility, and researchers’ access to equip- ment—all of which will serve to increase its chances for success. The budget for NOAA’s Office of Ocean Exploration is indicative of current limitations on U.S. ocean exploration. Initially funded at $4 million in 2001, during ensuing years the program has been funded for $13.2 million and $14.2 million annually. The budget for fiscal year 2004 is in the same range although at the time of publication Congressional support is uncertain. This initial effort has been worthwhile, and it serves as a basis for evaluating what can be accomplished. The effort has been partially pro- posal driven and partially driven by agency mission, without significant thematic direction or input from the scientific community. That aside, some regional workshops have been held to engage more members of the scien- tific community in the office’s efforts. Fiscal limitations have constrained NOAA’s ability to carry out a com- prehensive exploration program. Critical elements, such as the following, have been compromised by a lack of money: • Postcruise science is not funded. Not all discoveries are made during an actual offshore effort, and some discoveries could be missed if specialized onshore tests cannot be performed. Few significant discoveries have been announced or exploited. • Data management is not funded, so the oceanographic research community has little access to information. • Only limited technology development is funded. New sensors, for example, to investigate novel sites or measure unsampled properties of the ocean, are not being developed. • Ship costs are usually leveraged with other planned programs. The resulting ad hoc efforts do not allow complete freedom to explore a particular site or to venture out of relatively well-studied areas to explore the entire world’s oceans. • Project planning is often for the short term because of the nature of government budgeting and within-agency appropriations. • International cooperative efforts are not supported. • The scientific community does not see the program as a significant resource of funding for sustained exploration programs. The NOAA effort is not large enough to generate significant discoveries in the ocean sciences nor is it likely to advance the new technologies that could initiate commercial opportunities. Despite its small budget; however, the NOAA program has demonstrated that there is substantial interest from the U.S. ocean research community. The NOAA exploration program has received many proposals that it was unable to fund.

### They Say “Ocean Acidification Isn’t Happening”

#### Acidification is a key internal link to biodiversity—affects food chains, entire ecosystems, and uniquely affects ptetropodal species

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Within Earth’s vast oceans exists a diverse population of beautiful creatures that depend on a delicate balance of chemistry to remain viable. The tiniest animals are often the most important and underestimated species in any environment; they also are among the most vulnerable.¶ In the frigid waters of the Southern Ocean, off the coast of Antarctica, one such creature is the pteropod, Limacina helicina antarctica. These pea-sized marine snails, popularly known as sea butterflies because they appear to be using two “wings” when they swim, serve as a major food source for commercial fishes such as pink salmon. Yet this crucial resource is on the wane, as increasing levels of acid in the ocean threaten to dissolve its aragonite shell and impair its normal development.¶ More than 200 years ago, people developed a variety of machines to accomplish tasks traditionally completed by hand. These great advances in technology, how- ever, have come at a steep price: the industrial and agricultural activities that drive our global economy have added significantly to the levels of carbon dioxide in the atmosphere. Most carbon dioxide remains in the air, but as much as 25 percent is absorbed by the world’s oceans, according to the National Oceanic and Atmo- spheric Administration (NOAA). Once in the water column, carbon dioxide (CO2) reacts with water (H2O) to yield carbonic acid, which releases hydrogen ions (H+), effectively increasing acidity.¶ Since the start of the Industrial Revolution, the pH level of the world’s oceans has dropped by 0.1 unit, which amounts to a 30-percent increase in acidity. Es- timates based on business-as-usual scenarios from the Intergovernmental Panel on Climate Change (IPCC) suggest that if current trends persist, oceanic pH could drop by another 0.5 unit by the end of this century. That is a huge change: a 150-percent increase in acidity. Such an alteration in the marine environment could have devastating results both for ocean organisms and for the people who depend on them.¶ Metals occur naturally in many coastal and estuarine environments and are essential for the growth and survival of microorganisms that live by means of photosynthesis. A balance of trace metals, such as iron, nickel, copper, zinc, and cadmium, is crucial. If trace-metal concentrations fall too low, photosynthesis falters; if they rise too high, the excess of metal may prove toxic. For any given substance (metal, nutrient, or even a contaminant), the amount that may be readily metabolized is known as bioavailable.¶ The potential of ocean acidification to influence the bioavailability of metals comes down to basic chemistry. Increasing influxes of CO2 cause a decrease in pH, which results in an increase in H+ and thus a decrease in hydroxide and car- bonate ions in most surface waters. Normally, both hydroxide and carbonate form strong complexes with divalent and trivalent metals, effectively sequestering those compounds from uptake by photosynthetic organisms; under acidified conditions, however, hydroxide and carbonate remain as free metals that are bioavailable.¶ Recent environmental models suggest that hydroxide and carbonate ions will de- crease consistently—as much as 82 and 77 percent, respectively—by the end of the century. Such a decrease is expected to change the speciation of a number of metal ions. Most organic macromolecules in seawater are negatively charged; therefore, as a result of lowered pH, the surface of the organic macromolecules is less available to form complexes with metals.¶ A number of studies have predicted that ocean acidification might exacerbate the potential effects of other anthropogenic stressors, thereby raising the bioavailability of environmental contaminants, particularly that of waterborne metals. Acidification also modifies the interactions between marine organisms and metals. Ambient trace-metal concentrations in the open ocean are low; marine organisms have evolved efficient mechanisms to compensate for this, many of which are yet to be characterized. Not surprisingly, small increases in the concentration of normally scarce metals often prove toxic.¶ Individual metal species have different fates and cause varied impacts, depend- ing on their function in the environment. For example, should ocean acidification increase the available concentration of free ionic copper, productivity in photosynthetic organisms may decrease. The resulting increase in free ionic copper in the environment can cause physiological damage to some aquatic species. Copper af- fects the activation of olfactory receptor neurons by competing with natural odor- ants for binding sites; such an effect has been shown to impair the sense of smell in juvenile coho salmon (Oncorhynchus kisutch). These fish depend on olfaction to find food, avoid predators, and migrate. According to one study, even low levels of copper produced a physiological stress response, characterized by hyperactivity, elevated blood levels of the stress hormone cortisol, and an increase in the synthesis of metallothionein, a metal-detoxifying protein.¶ On the other hand, antagonistic (decreased) toxicities have been observed be- tween carbon dioxide and free ionic copper in a small coastal crustacean, Amphi- ascoides atopus. Metal toxicity was likely antagonistic because of the presence of increasing H+ and the competition for binding sites between CO2 and copper for H+. Alternatively, the observed antagonistic effect could be due to the animal’s sup- pressed metabolism, which would reduce its rate of metal transport. If acidified conditions should cause the concentration of dissolved iron to rise, this may stimu- late photosynthesis, giving rise to a negative feedback mechanism. This mechanism has a potential positive effect: Ocean acidification may actually make more iron bio- available, thanks to both the increased fractionation of dissolved iron and elevated iron (Fe2+) concentrations in coastal systems.¶ Effects on the Food Web¶ The effects of ocean acidification fall not just on certain species or particular regions, but throughout the food webs of the globe. According to the NOAA Ocean and Great Lakes Acidification Research Plan, changes in ocean chemistry probably exert several indirect effects: shifting predator-prey interactions, increasing the prevalence of invasive species, modifying the distribution of pathogens, or altering the physical structure of ecosystems. Naturally, some organisms are expected to experience greater effects than others. Among those most likely to take a hit are the calcifying organisms, such as corals, clams, scallops, oysters, and other shellfish. Conversely, some photosynthetic zooxanthellae (the symbionts that live on coral and provide its nutrition) or shallow nearshore seagrasses may be individually stimulated by an increase in carbon dioxide. Their stimulation is expected to change the dynamics of the ecosystem by disrupting nutritional transfer from zooxanthellae to corals and by interfering with the efficient use of carbon by thriving seagrasses, leading to overpopulation.¶ Initial studies focused on the negative effects of decreased calcium carbonate (CaCO3) saturation and on the inability of calcifying organisms to produce protec- tive shells; more recent studies show that acidification may also take a toll on species growth, behavior, and survival. Noncalcareous species such as fish have shown impaired development and decreased olfactory ability, as well as some evidence for changes in body composition and a decrease in growth rate. Bacterioplankton may also be affected by acidification, exhibiting longer bloom times, increased growth rate, and increases in nitrogen fixation. A secondary impact for humans and wildlife may arise from the extended bloom of certain bacterioplankton, which can secrete substances that are toxic to some humans and wildlife.¶ When carbonate concentrations decrease in the oceans and bivalves become less able to extract it effectively, they form thinner shells that make them more susceptible to predators. A computer simulation of future ocean conditions showed that three ecologically and commercially important bivalve species—the hard clam (Mercenaria mercenaria), the bay scallop (Argopecten irradians), and the Eastern oyster (Crassostrea virginica)—would suffer delayed metamorphosis and reduced growth in response to lower levels of carbonate. The impaired ability of each species to form a calcified skeleton appeared likely to translate into prolonged predation on the more vulnerable species and a decrease in the survival rate of their larvae.¶ Within the marine environment, the sea butterfly is an indicator species currently threatened by the pH changes taking place both in deep water and near the¶ ocean surface. Among the first ecosystems to be identified as vulnerable, of course, were the coral reefs. In addition to the vulnerability of the coral species themselves, coralline algae, calcareous benthic foraminifera, and other reef-building species may be affected. One review estimates that by the middle of the century, corals and calcifying macroalgae will calcify 10 to 50 percent less than before the Industrial Revolution. This steep decrease will take a toll not only on the coral’s functioning but also on other ecosystem dynamics (such as the interaction between coral and its symbionts) and on the architectural complexity of the reefs the corals construct. In one study, researchers postulate that the loss of architectural complexity will decrease habitat diversity, which in turn will drive down biodiversity. This decrease, together with the loss of coral reef species through bleaching, disease, and overexploitation, threatens the persistence of coral reef and fish communities and of the sustenance fishers who depend on them.¶ If ocean acidification continues as expected, can evolution offer a key to the health of marine organisms? Not all species can adapt rapidly to changing environ- ments; those that have this capability, however, show that rapid evolution can alter responses to environmental change, ultimately affecting the likelihood that a population will persist. During the Paleocene-Eocene thermal maximum, a brief warming spell that occurred about 55 million years ago, animals that evolved lighter skeletons were able to remain in areas where calcium carbonate is relatively difficult to obtain.¶ The capacity for organisms to undergo rapid evolution is likely dependent on their existing genetic variation. For example, the purple sea urchin (Strongylocen- trotus purpuratus) that inhabits the Pacific Coast is known for its ability to adapt quickly to acidified conditions. In its larval development and morphology, the purple sea urchin shows little response to lower acidity; nevertheless, in the genome of this organism, researchers have observed substantial allelic change in a number of functional classes of proteins involving hundreds of loci. For millions of years, the upwelling of waters rich in carbon dioxide from the ocean’s depths have exposed these organisms to significant highs and lows of acidity; this is the probable explana- tion for their chemical tolerance.¶ Coastal Regions¶ The major culprit behind ocean acidification has been atmospheric carbon dioxide, although other factors have also contributed to the problem, especially in coastal regions. Freshwater tributaries, pollutants from surface runoff, and soil erosion can acidify coastal waters at significantly higher rates than carbon dioxide alone. In 2007, researchers at the Woods Hole Oceanographie Institution (WHOI) surveyed the waters of the eastern United States and the Gulf of Mexico to measure levels of CO2 and other forms of oceanic carbon. When they compared these to the water’s total alkalinity, the study revealed that the East Coast was considerably more sensi- tive to acidified conditions than was the Gulf of Mexico.¶ Regular inputs from the Mississippi River, surface runoff, and other human im- pacts all affect the pH of the Gulf of Mexico. These factors, coupled with the high ratio of alkalinity to dissolved inorganic carbon, help to explain why the Gulf of¶ Mexico has so far resisted acidification. As the WHOI researchers traveled north, they noted decreases in the ratio of alkalinity to dissolved inorganic carbon, indicat- ing that those regions, specifically the coastline north of Georgia, would be more vulnerable if carbon dioxide levels were to increase there.¶ Subsistence fisheries, too, are likely to be harmed. According to a Blue Ribbon Panel Report from the state of Washington, ocean acidification is already demonstrating an impact on oyster shell growth and reproduction. Planning and resource management hold some promise for addressing the threat of acidification, but the unpredictable time scale and the variable nature of the effects remain stubborn challenges.¶ Safeguarding Ocean Chemistry¶ Anthropogenic inputs of carbon dioxide to the atmosphere are likely to continue causing environmental damage for the foreseeable future—and not only in the air we breathe. The oceans play a significant role in sequestering carbon from the atmo- sphere. Indeed, they work so well as a carbon sink that until recently most scientists believed the carbon storage capacity of the oceans to be nearly limitless, thereby serving as a negative feedback mechanism for atmospheric carbon inputs. These initial hypotheses were wrong. We are now witnessing changes in ocean chemistry that will affect inorganic and organic metal speciation and could even increase the bioavailability of toxic metals. Clearly, we cannot continue to rely on the oceans to buffer the effects of our pollution indefinitely.¶ The effects of ocean acidification are far from uniform. Coastal regions are likely to be disproportionately affected by compounding carbon input sources such as runoff from agriculture, industry, and urban populations. Moreover, certain marine species are vulnerable to acidification whereas others are relatively resilient. Using current legislation—in particular, the U.S. Clean Water Act and the Clean Air Act—to enforce more stringent emissions standards may offset some of the harm caused by the rising acidity of the oceans. Confronting this threat will require broader public awareness, clear interpretation of data, and reasoned predictions. Ultimately, more sustainable practices, including reducing anthropogenic emissions of carbon dioxide to the atmosphere, must be adopted globally to offset the harm already done and to ensure that marine ecosystems remain viable.

#### Ocean acidification policy is failing—it’s both anthropogenic and economically devastating

Bienkowski, 13 – the daily climate, writer @ nature climate change (Brian, “U.S. Effort on Ocean Acidification Needs Focus on Human Impacts”, Jan 11, 2013, Scientific American, http://www.scientificamerican.com/article/us-effort-on-ocean-acidification-needs-focus-on-human-impacts)

A federal plan to tackle ocean acidification must focus more on how the changes will affect people and the economy, according to a review of the effort by a panel of the National Research Council.¶ "Social issues clearly can't drive everything but when it's possible they should," said George Somero, chair of the committee that wrote the report and associate director at Stanford University's Hopkins Marine Station. "If you're setting up a monitoring station, it should be where there's a shellfish industry, for example."¶ Acidification is one of the larger problems associated with greenhouse gas emissions, as oceans serve as a giant sponge for carbon dioxide. When carbon dioxide is dissolved in seawater, water chemistry changes and acidity increases. More acidic seawater can hurt ocean creatures, especially corals and shellfish, because it prevents them from properly developing their skeletons and shells. Shrinking coral reefs could dent eco-tourism revenue in some coastal areas. It also could trigger a decline in fish populations dependent on those reefs.¶ Decreasing shellfish populations would harm the entire ocean food chain, researchers say, particularly affecting people who get their protein or paycheck from the sea. Globally, fish represent about 6 percent of the protein people eat. ¶ The acidification blueprint was drafted by nine federal agencies in March 2012. It establishes guidelines for federal research, monitoring and mitigation of ocean acidification. In reviewing the plan, the research council, which advises the government on science policy, recommended that federal research and action be focused on issues with human and economic consequences. ¶ Pacific Northwest¶ The panel cited the Pacific Northwest as an economic example, where high acidity levels have hampered oyster hatcheries, worth about $270 million and 3,200 jobs to coastal communities there. It is unclear if ocean acidification is the culprit, but it could be a harbinger of things to come, according to the report.¶ In 2011, U.S. commercial fishers caught 10 billion pounds of seafood valued at $5.3 billion, according to the National Oceanic and Atmospheric Administration.¶ The panel also suggested the plan should have a clearer mission, prioritized goals and ways to measure progress.¶ "This plan would cost a lot of money so there needs to be priorities and ways to prove impact," Somero said. "The federal budget simply won't allow for everything that needs to be done."¶ In 2009, Congress passed the Federal Ocean Acidification Research and Monitoring Act, creating a federal program to deal with ocean acidification. ¶ Somero said the agencies will take the recommendations and "tune up" the plan.¶ Ocean acidification is an "emerging global problem," according to NOAA. Over the past 250 years, about one third of the carbon dioxide produced by the burning of fossil fuels has ended up in oceans, according to a 2010 study. Over that time, ocean acidity has increased about 30 percent, according to the National Research Council.¶ Ocean advocacy groups supported the panel's recommendations.¶ "Ocean acidification is one of the greatest threats to marine life and fisheries," said Matthew Huelsenbeck, a marine scientist at Oceana. "We are encouraged that the Council has suggested communicating this issue to policy makers and the public to increase awareness and hopefully lead to solutions."¶ Julia Roberson, a director at the Ocean Conservancy, said the original plan was a good first step and she hopes government will use the council's suggestions.¶ Amid recommendations, the panel also offered praise for the federal effort, saying the plan does "an excellent job of covering the breadth of current understanding of ocean acidification and the range of research that will be required to advance a broadly focused and effective National Ocean Acidification Program."

### They Say “No Impact to Acidification”

#### **Increase in Ocean Acidification leads to mass extinction**

Uthicke 13 - Senior Research Scientist (Sven, “Early victims of ocean acidification could go extinct this century”) AIMS Gov. <http://www.aims.gov.au/docs/media/latest-releases/-/asset_publisher/8Kfw/content/early-victims-of-ocean-acidification-could-go-extinct-this-century>

Increasing ocean acidification could lead to the extinction of an entire class of marine organisms by 2100 say a team of scientists from the Australian Institute of Marine Science (AIMS). "Forams – or foraminifera – are much like an amoeba with a shell," explains Dr Sven Uthicke, lead author of the study which was published last week in the prestigious scientific journal Scientific Reports, an online journal of Nature. "As CO2 levels increase, our oceans will become more acidic, making it more difficult for these small marine creatures to form the shells they need to survive. "These simple organisms are vulnerable to increasing ocean acidification as they lack the complexity and energy reserves of other skeleton-based marine creatures, like corals and sea urchins. "We conducted a study in Papua New Guinea, where subsurface volcanic activity has caused naturally-occurring CO2 to continuously bubble up from the seabed. These "CO2 seeps" have created localised changes to seawater acidity similar to those expected throughout the world's oceans by the end of this century if CO2 emissions continue unabated. "These seeps provide important clues to what the marine world might look like in the future," he says. "Our analysis of samples collected more than half a kilometre from these seeps revealed healthy and diverse communities of forams, similar to those you would find on the Great Barrier Reef. However, the samples we took closer to the seeps, where CO2 concentrations were higher, showed a very different picture. "In the high CO2 conditions closer to the seeps, the water was more acidic, and disturbingly the number and diversity of forams was significant lower. We also observed intermediate effects of acidification on forams such as corroded or ‘pitted' shells. "Of most concern, not one single species of foram was found in samples drawn from locations where conditions had already reached acidification levels predicted for our oceans by 2100 in all but the most optimistic emissions scenario." The results echo mass extinctions of marine organisms that occurred millions of years ago, when the Earth experienced significant increases in CO2, temperature or both. Although some forams were able to survive during these past events, the current rate of CO2 increase is much faster than anything seen before. "In previous studies at these seeps we looked at the response of other organisms, such as corals – we found similar if less dramatic results – many coral species were unable to grow in these increasingly acidic conditions," says Dr Katharina Fabricius, a co-author of the present study. "In the grand scheme of things, the small and simple nature of forams might make them seem fairly unimportant compared to say, corals. "However, foram shells account for up to 40% of the composition of some cays and sandy sea beds of coral reefs – and these habitats are home to a significant number of coral reef species such as seabirds and turtles. "Of course the long-term implications of any disappearance of forams from the reef are not certain and will require further investigation, but these findings do add to concerns regarding the health resilience of coral reefs if ocean acidification progresses as predicted under current CO2 emission scenarios.

#### **Ocean Acidification leads to mass extinction – no species will survive**

Harrabin 09 – Environment analyst BBC News (Roger, “Coral lab offers acidity insight”) BBC News. <http://news.bbc.co.uk/2/hi/science/nature/7936137.stm>

Carbon dioxide emissions from human activities are acidifying the oceans and threaten a mass extinction of sea life, a top ocean scientist warns. Dr Carol Turley from Plymouth Marine Laboratory says it is impossible to know how marine life will cope, but she fears many species will not survive. Since the Industrial Revolution, CO2 emissions have already turned the sea about 30% more acidic, say researchers. It is more acidic now than it has been for at least 500,000 years, they add. The problem is set to worsen as emissions of the greenhouse gas increase through the 21st Century. "I am very worried for ocean ecosystems which are currently productive and diverse," Carol Turely told BBC News. "I believe we may be heading for a mass extinction, as the rate of change in the oceans hasn't been seen since the dinosaurs. "It may have a major impact on food security. It really is imperative that we cut emissions of CO2." Dr Turley is chairing a session on ocean acidification at the Copenhagen Climate Change Congress. Testing times The problem is most acute for creatures which make calcified shells. Up to 50% of the CO2 released by burning fossil fuels over the past 200 years has been absorbed by world's oceans This has lowered the pH value of seawater - the measure of acidity and alkalinity - by 0.1 The vast majority of liquids lie between pH 0 (very acidic) and pH 14 (very alkaline); 7 is neutral Seawater is mildly alkaline with a "natural" pH of about 8.2 The IPCC forecasts that ocean pH will fall by "between 0.14 and 0.35 units over the 21st Century, adding to the present decrease of 0.1 units since pre-industrial times" Natural lab shows sea's acid path Laboratory tests suggest starfish may be wiped out before the end of the century if current emissions trends continue. Scientists fear mussels may not be able to cope, either. Oysters may be less vulnerable, and farmed oysters may fare better than wild oysters.

### They Say “Acidification Is Slow And Stable”

#### **Warming, acidification and deoxgenation are destroying ocean ecosystems and it’s becoming faster**

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An ambitious new study describes the full chain of events by which ocean biogeochemical changes triggered by humanmade greenhouse gas emissions may cascade through marine habitats and organisms, penetrating to the deep ocean and eventually influencing humans. Previous analyses have focused mainly on ocean warming and acidification, considerably underestimating the biological and social consequences of climate change. Factoring in predictable synergistic changes such as the depletion of dissolved oxygen in seawater and a decline in productivity of ocean ecosystems, the new study shows that no corner of the world ocean will be untouched by climate change by 2100. "When you look at the world ocean, there are few places that will be free of changes; most will suffer the simultaneous effects of warming, acidification, and reductions in oxygen and productivity," said lead author Camilo Mora, assistant professor at the Department of Geography in the College of Social Sciences at the University of Hawai'i at Mānoa (UH Mānoa). "The consequences of these co-occurring changes are massive -- everything from species survival, to abundance, to range size, to body size, to species richness, to ecosystem functioning are affected by changes in ocean biogeochemistry." The human ramifications of these changes are likely to be massive and disruptive. Food chains, fishing, and tourism could all be impacted. The study shows that some 470 to 870 million of the world's poorest people rely on the ocean for food, jobs, and revenues, and live in countries where ocean goods and services could be compromised by multiple ocean biogeochemical changes. Mora and Craig Smith with UH Mānoa's School of Ocean and Earth Science and Technology (SOEST) worked with a 28-person international collaboration of climate modelers, biogeochemists, oceanographers, and social scientists to develop the study, which is due for publication October 15 in the scientific journal PLOS Biology. The researchers used the most recent and robust models of projected climate change developed for the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) to inform their analysis. They quantified the extent of co-occurrence of changes in temperature, pH, oxygen, and primary productivity based on two scenarios: a business-as-usual scenario wherein atmospheric CO2 concentrations could reach 900 ppm by 2100, and an alternative scenario under which concentrations only reach 550 ppm by 2100 (representing a concerted, rapid CO2 mitigation effort, beginning today). They discovered that most of the world's ocean surface will be simultaneously impacted by varying intensities of ocean warming, acidification, oxygen depletion, or shortfalls in productivity. Only a very small fraction of the oceans, mostly in polar regions, will face the opposing effects of increases in oxygen or productivity, and nowhere will there be cooling or pH increase. "Even the seemingly positive changes at high latitudes are not necessary beneficial. Invasive species have been immigrating to these areas due to changing ocean conditions and will threaten the local species and the humans who depend on them," said co-author Chih-Lin Wei, a postdoctoral fellow at Ocean Science Centre, Memorial University of Newfoundland, Canada. The researchers assembled global distribution maps of 32 marine habitats and biodiversity hotspots to assess their potential vulnerability to the changes. As a final step, they used available data on human dependency on ocean goods and services and social adaptability to estimate the vulnerability of coastal populations to the projected ocean biogeochemical changes. "Other studies have looked at small-scale impacts, but this is the first time that we've been able to look the entire world ocean and how co-occurring stressors will differentially impact the earth's diverse habitats and people," said co-author Andrew Thurber, a postdoctoral fellow at Oregon State University. "The real power is in the quantitative, predictive approach using IPCC climate models that allow us to see how much it will all change, and also how confident we can be in our estimates." By 2100, global averages for the upper layer of the ocean could experience a temperature increase of 1.2 to 2.6° C, a dissolved oxygen concentration reduction of ~2% to 4% of current values, a pH decline of 0.15 to 0.31, and diminished phytoplankton production by ~4% to 10% from current values. The seafloor was projected to experience smaller changes in temperature and pH, and similar reductions in dissolved oxygen. Of the many marine habitats analyzed in the study, researchers found that coral reefs, seagrass beds, and shallow soft-bottom benthic habitats would experience the largest absolute changes in ocean biogeochemistry, while deep-sea habitats would experience the smallest changes. Co-author Lisa Levin, a professor at Scripps Institution of Oceanography at the University of California, San Diego, notes: "Because many deep-sea ecosystems are so stable, even small changes in temperature, oxygen, and pH may lower the resilience of deep-sea communities. This is a growing concern as humans extract more resources and create more disturbances in the deep ocean." "The deep-sea floor covers most of the Earth's surface and provides a whole host of important ecosystem services including carbon sequestration in seafloor sediments, buffering of ocean acidity, and providing an enormous reservoir of biodiversity," said Smith. "Nonetheless, very little attention has been paid to modeling the effects of climate change on these truly vast ecosystems. Perhaps not surprisingly, many deep seafloor ecosystems appear susceptible to the effects of climate warming over the next century." "The impacts of climate change will be felt from the ocean surface to the seafloor. It is truly scary to consider how vast these impacts will be," said co-author Andrew K. Sweetman, who helped to convene the original team of investigators and now leads the deep-sea ecosystem research group at the International Research Institute of Stavanger, Norway. "This is one legacy that we as humans should not be allowed to ignore."

## 2AC — Maritime Conflict

### They Say “Current Science Diplomacy Solves”

#### Instability coming now—science diplomacy increases soft power that’s necessary to prevent military conflict

Royal Society, 10 – a Fellowship of more than 1400 outstanding individuals from all areas of science, mathematics, engineering and medicine (January, 2010, “New frontiers in science diplomacy” https://royalsociety.org/policy/publications/2010/new-frontiers-science-diplomacy/)

‘Science diplomacy and science and technology cooperation . . . is one of our most effective ways of influencing and assisting other nations and creating real bridges between the United States and counterparts.’ Hillary Clinton, US Secretary of State A third dimension of science diplomacy is science for diplomacy. Joseph Nye, former dean of the Kennedy School of Government at Harvard University famously distinguished between ‘hard power’, which uses military and economic means to coerce the behaviour of other nations, and ‘soft power’, which builds on common interests and values to attract, persuade and influence (Nye 2004). Science has always played a role in the development of hard power capabilities, such as military technologies. But science for diplomacy primarily draws on the ‘soft power’ of science: its attractiveness and influence both as a national asset, and as a universal activity that transcends national interests. The soft power of science interacts with international relations in several ways, ranging from cultural diplomacy to more traditional forms of negotiation and mediation (see Figure 1). Types of science for diplomacy include: • Science cooperation agreements, which have long been used to symbolise improving political relations, for example between the US, USSR and China in the 1970s and 1980s. A scientific agreement was the first bilateral treaty to be agreed between the US and Libya in 2004, after Libya gave up its biological, chemical and nuclear weapons programmes. • New institutions can be created to reflect the goals of science for diplomacy. Perhaps the best example is the European Organisation for Nuclear Research (CERN), which was founded after World War II to help rebuild bridges between nations. CERN enabled some of the first post-war contacts between German and Israeli scientists, and kept open scientific relations with Russia and other Eastern bloc countries during the Cold War. • Educational scholarships are a well- established mechanism for network- building and encouraging partnerships. For example, the Royal Society runs the Newton International Fellowships scheme, in partnership with the Royal Academy of Engineering and British Academy, to select the best early stage post-doctoral researchers from around the world, and offer them long-term support to sustain relations with institutions in the UK.7 • ‘Track two’ diplomacy can be used to involve those working outside an official negotiation or mediation process, including scientists and other academics. To be effective, it requires outside participants who remain credible and influential. Official ‘track one’ processes must also recognise the role of track two efforts. For example, it was openly acknowledged during the Cold War meetings between national academies that both sides would report back to their political leaders. • Science festivals and exhibitions, particularly linked to the history of science, can be an effective platform from which to emphasise the universality of science, and common cultural interests. China, India, Iran and other Islamic countries are particularly proud of their contributions to the history of science (see Case study 1). 4.1 New dimensions of international security Cooperation on the scientific aspects of sensitive issues may sometimes be the only way to initiate a wider political dialogue. The soft power of science, and the universality of scientific methods, can be used to diffuse tensions even in ‘hard power’ scenarios, such as those relating to traditional military threats. For example, technologies to verify nuclear arms control agreements were a rare focus of joint working between the US and USSR during the Cold War. Lessons from the Cold War are once again highly pertinent. In the run-up to the May 2010 Review Conference of the Nuclear Non-Proliferation Treaty (NPT), nuclear disarmament is firmly back on the international agenda. However, the timescale for disarmament is long, as illustrated by the history of negotiations over the Chemical Weapons Convention. After the Geneva Convention banned the use of chemical weapons in 1925, negotiations for a treaty banning their production and stockpiling did not start until the 1980s, and the convention entered into force only in 1997. Even now, stockpiles of chemical weapons in the US and Russia have yet to be destroyed. So focusing in 2010 on the challenges of the final stages of a nuclear disarmament proc ess may be premature. A more practical next step could be to establish the scientific requirements for the verification regime necessary to support future stages of negotiation (Pregenzer 2008). In 2008, the Norwegian Minister of Foreign Affairs suggested that a high-level Intergovernmental Panel on Nuclear Disarmament could be established (based on the model of the Intergovernmental Panel on Climate Change). This panel could begin by identifying the scientific and technical aspects of disarmament, and then set out a research agenda necessary to achieve them. International cooperation would be essential, both between nuclear and non-nuclear weapon states, as all would need to have confidence that Figure 2. Multiple stress zones. reductions are taking place. The recent initiative between the UK and Norwegian governments on disarmament verification sets a precedent here, and could be expanded to include additional States (VERTIC 2009). However, security threats now extend beyond the military domain, with environmental security attracting particular attention (Abbott C, Rogers P & Sloboda S 2007). Essential resources, such as freshwater, cultivable land, crop yields and fish stocks, are likely to become scarcer in many parts of the world, increasing the risk of competition over resources within and between states (UNEP 2009). This could intensify as previously inaccessible regions, such as the Arctic Ocean, open up as a consequence of climate change and ice melt. Substantial parts of the world also risk being left uninhabitable by rising sea levels, reduced freshwater availability or declining agricultural capacity. Many of the regions that are vulnerable to the impacts of these multiple stresses are already the locus of existing instability and conflict (see Figure 2).

### They Say “Science Diplomacy Fails”

#### Science diplomacy provides a cooperative framework to avoid conflict

Royal Society, 10 – a Fellowship of more than 1400 outstanding individuals from all areas of science, mathematics, engineering and medicine (January, 2010, “New frontiers in science diplomacy” https://royalsociety.org/policy/publications/2010/new-frontiers-science-diplomacy/)

Science diplomacy is not new, but it has never been more important. Many of the defining challenges of the 21st century— from climate change and food security, to poverty reduction and nuclear disarmament—have scientific dimensions. No one country will be able to solve these problems on its own. The tools, techniques and tactics of foreign policy need to adapt to a world of increasing scientific and technical complexity. There are strong foundations on which to renew momentum for science diplomacy. Advances in science have long relied on international flows of people and ideas. To give an example close to home, the post of Foreign Secretary of the Royal Society was instituted in 1723, nearly 60 years before the British Government appointed its first Secretary of State for Foreign Affairs. Throughout the Cold War, scientific organisations were an important conduit for informal discussion of nuclear issues between the United States and the Soviet Union. Today, science offers alternative channels of engagement with countries such as Iran, Saudi Arabia and Pakistan. The potential contribution of science to foreign policy is attracting more attention in several countries. In the UK, the Prime Minister Gordon Brown recently called for a ‘new role for science in international policymaking and diplomacy’ (Brown 2009). This report attempts to define this role, and to demonstrate how scientists, diplomats and other policymakers can make it work in practice. The report is based on the evidence gathered at a two-day meeting on ‘New frontiers in science diplomacy’, which was hosted by the Royal Society from 1\_2 June 2009, in partnership with the American Association for the Advancement of Science (AAAS). The meeting was attended by almost 200 delegates from twenty countries in Africa, Asia, Europe, the Middle East, North and South America. Attendees included government ministers, scientists, diplomats, policymakers, business leaders and journalists (see Appendix 1 for the meeting agenda). Three dimensions of science diplomacy Drawing on historical and contemporary examples, the meeting explored how science can contribute to foreign policy objectives. Key points to emerge from the discussion include: • ‘Science diplomacy’ is still a fluid concept, but can usefully be applied to the role of science, technology and innovation in three dimensions of policy: The Royal Society New Frontiers in Science Diplomacy I January 2010 I v 􏰀 informing foreign policy objectives • with scientific advice (science in diplomacy); 􏰀 facilitating international science cooperation (diplomacy for science); 􏰀 using science cooperation to improve international relations between countries (science for diplomacy). • Scientific values of rationality, transparency and universality are the same the world over. They can help to underpin good governance and build trust between nations. Science provides a non-ideological environment for the participation and free exchange of ideas between people, regardless of cultural, national or religious backgrounds. • Science is a source of what Joseph Nye, the former dean of the Kennedy School of Government at Harvard University, terms ‘soft power’ (Nye 2004). The scientific community often works beyond national boundaries on problems of common interest, so is well placed to support emerging forms of diplomacy that require non- traditional alliances of nations, sectors and non-governmental organisations. If aligned with wider foreign policy goals, these channels of scientific exchange can contribute to coalition- building and conflict resolution. Cooperation on the scientific aspects of sensitive issues—such as nuclear non-proliferation—can sometimes provide an effective route to other forms of political dialogue. vi I January 2010 I New Frontiers in Science Diplomacy The Royal Society Science diplomacy seeks to strengthen the symbiosis between the interests and motivations of the scientific and foreign policy communities. For the former, international cooperation is often driven by a desire to access the best people, research facilities or new sources of funding. For the latter, science offers potentially useful networks and channels of communi- cation that can be used to support wider policy goals. But it is important that scientific and diplomatic goals remain clearly defined, to avoid the undue politicisation of science. • Foreign ministries should place greater emphasis on science within their strategies, and draw more extensively on scientific advice in the formation and delivery of policy objectives. In the UK, the appointment of Professor David Clary FRS as the Chief Scientific Adviser at the Foreign and Commonwealth Office creates an important opportunity to integrate science across FCO priorities, and develop stronger linkages with science-related policies in other government departments. • Regulatory barriers, such as visa restrictions and security controls, can also be a practical constraint to science diplomacy. Immediately after September 11 2001, the imposition of stringent travel and visa regimes in countries like the US and the UK severely limited opportunities for visiting scientists and scholars, particularly from Islamic countries. Whilst the strictest controls have since been lifted, the value of scientific partnerships means that further reforms may be needed. • Scientific organisations, including national academies, also have an important role to play in science diplomacy, particularly when formal political relationships are weak or strained. The scientific community may be able to broker new or different types of partnerships. The range of actors involved in these efforts should expand to include non-governmental organisations, multilateral agencies and other informal networks. • There need to be more effective mechanisms and spaces for dialogue between policymakers, academics and researchers working in the foreign policy and scientific communities, to identify projects and processes that can further the interests of both communities. Foreign policy institutions and think tanks can offer leadership here, by devoting intellectual resources to science as an important component of modern day diplomacy. • Science diplomacy needs support and encouragement at all levels of the science community. Younger scientists need opportunities and career incentives to engage with policy debates from the earliest stage of their careers. There is much to learn from related debates over science communication and public engagement by scientists, where there has been a culture change within science over the past ten years. • Three immediate areas of opportunity for science diplomacy were highlighted at the meeting: 􏰀 New scientific partnerships with the Middle East and wider Islamic world A new initiative to support these efforts, ‘The Atlas of Islamic-World Science and Innovation’, was announced at the meeting, with partners including the Royal Society, Organisation of Islamic Conference, Nature, the British Council and the International Development Research Centre (see Case study 1). 􏰀 Confidence building and nuclear disarmament The Royal Society New Frontiers in Science Diplomacy I January 2010 I vii 􏰀 With the Review Conference of the Nuclear Non-Proliferation Treaty (NPT) taking place in May 2010, it is timely to consider how cooperation on the scientific aspects of nuclear disarmament could support the wider diplomatic process. Governance of international spaces International spaces beyond national jurisdictions – including Antarctica, the high seas, the deep sea and outer space – cannot be managed through conventional models of governance and diplomacy, and will require flexible approaches to international cooperation, informed by scientific evidence and underpinned by practical scientific partnerships (see Case study 2).

#### Key to cooperation with other countries

Royal Society, 10 – a Fellowship of more than 1400 outstanding individuals from all areas of science, mathematics, engineering and medicine (January, 2010, “New frontiers in science diplomacy” https://royalsociety.org/policy/publications/2010/new-frontiers-science-diplomacy/)

‘International scientific and engineering collaboration is imperative to meet global challenges. Models of international scientific collaboration can lead the way for international diplomacy and policy.’ Professor John Beddington FRS, Chief Scientific Adviser to the UK Government The second dimension of science diplomacy—diplomacy for science—seeks to facilitate international cooperation, whether in pursuit of top-down strategic priorities for research or bottom-up collaboration between individual scientists and researchers. Flagship international projects, such as the International Thermonuclear Experimental Reactor (ITER) and the Large Hadron Collider (LHC) are one approach. These projects carry enormous costs and risks, but are increasingly vital in areas of science which require large upfront investments in infrastructure, beyond the budget of any one country. However, such projects are the visible tip of a large iceberg of everyday, bottom-up collaboration that takes place between individual scientists and institutions. The stereotype of the scientist as a lone genius no longer holds true. The scientific enterprise is now premised on the need to collaborate and connect. Globally there is ‘an invisible college of researchers who collaborate not because they are told to but because they want to ... because they can offer each other complementary insight, knowledge or skills’ (Wagner 2008). Collaborations are no longer based purely on historical, institutional or cultural links. This creates an opportunity for the foreign policy community. Science can be a bridge to communities where political ties are weaker, but to develop relationships in these areas, scientists may require diplomatic assistance, whether in contract negotiations, intellectual property agreements or dealing with visa regulations. Many countries conduct bilateral summits specifically on science issues, in order to establish government-level agreements on joint funding and facilitation of research. The UK, for example, has regular high-level meetings on science and innovation with Brazil, China, India, Russia, South Africa and South Korea. These are not only symbolic of cordial relations, but they provide an overarching framework within which scientists can work together. For the UK, these processes have resulted in a number of successful funding initiatives, including the UK-India Education and Research Initiative and the Science Bridges schemes with China, India and the US. Research Councils UK (RCUK) has also opened offices in Beijing, Brussels, New Delhi and Washington DC as part of the UK’s efforts to drive bilateral research with strategic countries. Global policy challenges must be addressed in a holistic way, drawing not only on science and technology, but also on economic, social, political and behavioural sciences. Interdisciplinary collaboration will be crucial, as illustrated by the recent consultation by the International Council on Science (ICSU) on the future of earth system research, which highlighted ‘the complex inter-relationships between biological, geochemical, climate and social systems’ and suggested that ‘natural science should no longer dictate the Earth system research agenda; social science will be at least as important in its next phase’ (Reid et al. 2009). Competition hasn’t gone away: the growing scientific capabilities of China, India, Brazil and others will challenge Europe and the US in some areas. But it is short sighted to view these developments primarily as a threat. As science and innovation capabilities grow worldwide, a central question is whether more defensive, national strategies gather momentum, or whether the countervailing impulse towards global collaboration will prove stronger. Efforts to strengthen national science and innovation systems remain vital, but must increasingly be accompanied by more creative and better- resourced mechanisms for orchestrating research across international networks in pursuit of shared goals—such as tackling climate change, food and energy security. The Large Hadron Collider is an excellent example of what countries can achieve by working together: a scale of scientific investment and ambition that no one country could manage alone.

#### Science diplomacy key to reversing all existential impacts

Sackett, 10 – former Chief Scientist for Australia, former Program Director at the NSF, PhD in theoretical physics (Penny, August 10, 2010, “Science diplomacy: Collaboration for solutions,” Forum for Australian-European Science and Technology cooperation magazine, http://www.chiefscientist.gov.au/2010/08/science-diplomacy-collaboration-for-solutions/)

Imagine for a moment that the globe is inhabited by a single individual who roams free across outback plains, through rainforests, across pure white beaches — living off the resources available. Picture the immensity of the world surrounding this one person and ask yourself, what possible impact could this single person have on the planet? Now turn your attention to today’s reality. Almost 7 billion people inhabit the planet and this number increases at an average of a little over one per cent per year. That’s about 2 more mouths to feed every second. Do these 7 billion people have an impact on the planet? Yes. An irreversible impact? Probably. Taken together this huge number of people has managed to change the face of the Earth and threaten the very systems that support them. We are now embarked on a trajectory that, if unchecked, will certainly have detrimental impacts on our way of life and to natural ecosystems. Some of these are irreversible, including the extinction of many species. But returning to that single individual, surely two things are true. A single person could not have caused all of this, nor can a single person solve all the associated problems. The message here is that the human-induced global problems that confront us cannot be solved by any one individual, group, agency or nation. It will take a large collective effort to change the course that we are on; nothing less will suffice. Our planet is facing several mammoth challenges: to its atmosphere, to its resources, to its inhabitants. Wicked problems such as climate change, over-population, disease, and food, water and energy security require concerted efforts and worldwide collaboration to find and implement effective, ethical and sustainable solutions. These are no longer solely scientific and technical matters. Solutions must be viable in the larger context of the global economy, global unrest and global inequality. Common understandings and commitment to action are required between individuals, within communities and across international networks. Science can play a special role in international relations. Its participants share a common language that transcends mother tongue and borders. For centuries scientists have corresponded and collaborated on international scales in order to arrive at a better and common understanding of the natural and human world. Values integral to science such as transparency, vigorous inquiry and informed debate also support effective international relation practices. Furthermore, given the long-established global trade of scientific information and results, many important international links are already in place at a scientific level. These links can lead to coalition-building, trust and cooperation on sensitive scientific issues which, when supported at a political level, can provide a ‘soft politics’ route to other policy dialogues. That is, if nations are already working together on global science issues, they may be more likely to be open to collaboration on other global issues such as trade and security. Many countries have recognised the value of science diplomacy.

### They Say “No Risk of Conflict”

#### China on the verge of militarizing fishing disputes

Dupont and Baker, 14 - \* Nonresident Fellow at the Lowy Institute for International Policy \*\* Principal Engineer, CSC/ServiceMesh (Alan and Christopher, “East Asia’s Maritime Disputes: Fishing in Troubled Waters” March 01, 2014 https://twq.elliott.gwu.edu/east-asia%E2%80%99s-maritime-disputes-fishing-troubled-waters)

The use of the civil maritime agencies for strategic purposes seems to be increasing in line with the new emphasis on the maritime domain. The 11th Five-Year Plan declared an intention to expand China’s maritime law enforcement agencies and equip them with a suite of modern aircraft and ships. By 2015, the CMS is expected to have 16 aircraft and 350 patrol vessels. Other agencies, notably the MSA and FLEC, will also receive new ships and aircraft, including 36 modern cutters and patrol boats by 2018.53 This will give China the most powerful and modern paramilitary fleet in Asia by the end of this decade, surpassing Japan’s own highly capable coast guard by a substantial margin, with obvious implications for the Senkaku/Diaoyu conflict and other, equally contentious territorial disputes in the South China Sea. Recognizing the increasing importance of fish, as well as energy and sea- borne trade to the nation’s economic development, China’s 12th Five-Year Plan, released in March 2011, called for even greater emphasis on the marine economy and has allocated additional funding to maritime border and fisheries protection.54 Chinese authorities are also providing their fishing vessels with satellite navigation and modern communications systems so that they can remain in touch and notify the relevant government agencies should foreign countries seek to harass or arrest them.55 In a little noticed, but highly significant, decision at the 2013 National People’s Congress, Beijing has also begun the process of establishing a larger and better equipped national coast guard by consolidating the main agencies responsible for maritime law enforcement and fisheries protection including the CMS, FLEC, CCG, and CASB. Merging these four dragons into one under the control of the State Oceanic Administration ought to improve the coordination problems which have plagued China’s maritime law enforcement agencies. But far from allaying neighbors’ anxieties, a powerful and centralized Chinese coast guard with more potent capabilities and Asia-wide responsibilities may have the reverse effect—exacerbating maritime tensions in the absence of accompanying policy changes. And in a particularly controversial move, aimed at strengthening the legal basis for its claim to 2 million square miles of the South China Sea, China’s southern province of Hainan has passed legislation that came into force on January 1, 2014, requiring non-Chinese fishing vessels wanting to operate in the South China Sea to first obtain permission from the Hainan authorities. Failure to do so will result in vessels being forcibly removed or impounded, with crews facing fines of up to 500,000 yuan (US$83,000) and their catches confiscated.56 The risk here is further blurring the lines between fisheries protection and maritime security. This could lead to the militarization of fishing disputes throughout the Western Pacific, especially in the South China Sea where China’s territorial claims are both extensive and opaque. On several occasions, PLA Navy ships have shadowed sizeable Chinese fishing fleets and their supporting paramilitary vessels. In April 2011, a report prepared by the Armed Forces of the Philippines recorded a Jianghu-V class missile frigate warning three Philippine fishing vessels from Jackson Atoll, a rich fishing ground 140 nautical miles west of Palawan. The frigate threatened to open fire if the Filipino fishing boats did not immediately leave the area, then fired three warning shots, forcing the Filipino fishermen to cut their anchors. When one of the Filipino fishing vessels returned three days later to retrieve its anchor, the captain observed several Chinese fishing boats exploiting the marine living resources around the atoll.57 Even if China were to maintain a separation between its civil maritime agencies and the PLA Navy, and were to reduce the number of agencies responsible for fisheries protection, the tactics of using paramilitary ships to enforce territorial claims and perceived fishing rights will continue to have a destabilizing effect throughout the region, provoking matching responses.58 Taiwan has considered deploying tanks and missile-armed patrol boats to Itu Aba in the Spratlys.59 And in response to the “illegal” incursions of Chinese fishing fleets, Seoul has announced that it will build new maritime police bases on Baeknyeong and Heuksan islands on the west coast of South Korea beginning in 2014.60

#### South China Sea conflict on the brink

Reuters, 6/20 (“China urges peaceful development of seas, says conflict leads to "disaster"” Fri Jun 20, 2014 http://www.reuters.com/article/2014/06/21/us-southchinasea-china-idUSKBN0EW07L20140621 )E

Concern over China's motives has risen in the region after China sent four more oil rigs into the South China Sea, less than two months after it positioned a giant drilling platform in waters claimed by Vietnam around the Paracel Islands. The lack of any breakthrough in the dispute suggests China and Vietnam are far from resolving one of the worst breakdowns in relations since they fought a brief war in 1979. Among the obstacles is Beijing's demand for compensation for anti-Chinese riots that erupted in Vietnam after the drilling platform was deployed at the beginning of May. Speaking at a forum in Beijing on Saturday, China's top diplomat, State Councillor Yang Jiechi, who visited Vietnam this week to discuss the rig dispute, said China had both the patience and sincerity to push for talks to resolve such spats. But China would not sacrifice its sovereignty, he added. "China will not trade its core interests and will not swallow the bitter pill of harming China's sovereignty, security and development interests," said Yang, who outranks the foreign minister. China's state news agency Xinhua, in a report late on Friday, accused Vietnam of encouraging trawlers to fish in disputed waters around the Paracel Islands by using financial incentives, saying the problem was rampant. "Vietnamese seized by Chinese law enforcement authorities for illegal fishing confessed that they were given large subsidies by the Vietnamese government to fish in 'disputed waters'," Xinhua said in the English-language report. "In addition, armed Vietnamese fishing vessels have repeatedly looted Chinese fishing boats, posing a serious threat to the safety of Chinese fishermen's lives and property," it added. The Philippines said this week it will ask an international arbitration tribunal in the Hague to make a speedy ruling on its dispute with China over exploiting waters in the South China Sea after Beijing refused to take part in the proceedings.

#### Multiple factors for South China Sea instability

Dupont and Baker, 14 - \* Nonresident Fellow at the Lowy Institute for International Policy \*\* Principal Engineer, CSC/ServiceMesh (Alan and Christopher, “East Asia’s Maritime Disputes: Fishing in Troubled Waters” March 01, 2014 https://twq.elliott.gwu.edu/east-asia%E2%80%99s-maritime-disputes-fishing-troubled-waters)

Fish as a Strategic Commodity Nations have long fought for control of critical resources. People often think of gold, silver, and in more recent times, oil, gas, and precious metals. But fish has begun to assume comparable strategic significance for China because of both its scarcity and centrality to the economy, lifestyles, and diet of many Chinese people. Of course, the depletion of fish stocks is not solely a Chinese problem. It is an emerging global security issue rooted in the burgeoning international demand for food, coming at a time when the fishing industry faces a host of supply-side problems including chronic overfishing, the environmental destruction of fish habitats, a massive increase in world fishing fleets, and ill-directed state subsidies. Since 1950, the total annual catch of wild and farmed fish from aquaculture has grown five-fold (to 148 million tons with a market value of US$217.5 billion).4 Far from being a triumph of post- industrial technology and farming practices, this unprecedented harvest has taken a severe toll on the wild fish population. Less than 15 percent of all fisheries have room for growth, with the remaining 85 percent categorized by the UN Food and Agricultural Organization (FAO) as fully exploited, depleted, or recovering from depletion.5 These global trends are mirrored in the seas near China. Fish yields in the Yellow and East China Seas have fallen dramatically over the past 20 years. In the South China Sea, which produces about 10 percent of the annual global fisheries catch, overfishing has severely depleted fish stocks to the point where coastal areas are down to only 5-30 percent of their unexploited stocks.6 This worries Beijing because China is both the world’s largest fish producer and consumer. More than nine million fishers—a quarter of the world’s total —are Chinese, and the Chinese Ministry of Agriculture estimates that, if fisheries-related household income and value-added revenue is included, the fishing sector contributes $330 billion (1.992 trillion yuan) to the Chinese economy annually, about 3.5 percent of GDP.7 However, despite impressive absolute and relative gains in supply that have allowed China to increase its proportion of world fish production from 7 percent to 34 percent since 1961, Chinese per capita consumption of fish (31.9 kg) is now more than double that of the rest of the world (15.4 kg) and threatens to outrun supply.8 If this were not sufficient cause for concern, three other negative developments threaten a perfect storm for China’s hard-pressed fishing industry. First, the country’s booming population, fast growing middle-class, and rapid economic transition have forced millions of farmers and workers from the hinterland to coastal provinces, increasing demand for fish products and adding both to the pool of itinerant fishers as well as pressure on the supply of wild fish. At the same time, economies of scale favoring larger commercial operations have reduced incomes and food security for traditional fishing communities in a “complex, negative feedback cycle.”9 Second, since more fishers seek to exploit the remaining reserves of fish, China has been at the forefront of a major expansion in the size and power of Asia’s fishing fleets. While other regions stabilized the size of their fishing fleets in the last quarter of the 20th century, Asia’s doubled in size during the same period and today makes up three quarters of the world’s powered fishing fleet.10 China has the world’s largest by number and tonnage if the inland fleet is included.11 Regulating and reducing the size of the fleet to sustainable levels has been problematic, complicated by domestic political and economic pressures to support local fishing communities and by an unwillingness to impose license restrictions and catch limits.12 The Chinese government has not helped matters, providing subsidies to the fishing sector of over $4 billion annually, roughly a quarter of all Asian subsidies and around 15 percent of the world total.13 Subsidies artificially prop up prices and encourage unprofitable fishers to stay in business when the money would be better spent restructuring the industry and reducing the number of fishing vessels over time. In recent years, Beijing has made serious efforts to address the supply imbalance by attempting to downsize the national fishing fleet, accelerate investment in the fishing industry, retrain unemployed fishers, and impose fishing bans and catch caps, all with limited success.14 There are still too many fishing boats chasing too few fish, and it is difficult for traditional fishers to give up their trade, which remains a lucrative occupation as prices continue their steady rise. Third, international legal constraints as codified in the 1982 UN Convention on Law of the Sea (UNCLOS) have both reduced the area of open ocean for fishing and linked fishing rights to sovereignty issues, which has complicated the adjudication and settlement of both territorial and fishing disputes in the East and South China Seas. The declaration of Exclusive Economic Zones (EEZs)—a sea-zone extending 200 nautical miles from a state’s coastline, islands, and other sovereign maritime features—is a further complication, allowing states to claim all the resources beneath the sea in the EEZ including fish, oil, gas, and valuable sea-bed minerals. As a result, Chinese and fishers from other countries face an unpalatable choice: either abide by the rules and see their catches and income severely reduced, or risk fishing illegally and face the possibility of arrest and impoundment of their catches.

### They Say “US Never Gets Drawn In”

#### Absent cooperation, US will use military force which risks an existential threat

Glaser, 12 - senior fellow with the Freeman Chair in China Studies and a senior associate with the Pacific Forum, Center for Strategic and International Studies (Bonnie S., “Armed Clash in the South China Sea Contingency Planning Memorandum No. 14” April 2012 http://www.cfr.org/world/armed-clash-south-china-sea/p27883)

A second contingency involves conflict between China and the Philippines over natural gas deposits, especially in the disputed area of Reed Bank, located eighty nautical miles from Palawan. Oil survey ships operating in Reed Bank under contract have increasingly been harassed by Chinese vessels. Reportedly, the United Kingdom-based Forum Energy plans to start drilling for gas in Reed Bank this year, which could provoke an aggressive Chinese response. Forum Energy is only one of fifteen exploration contracts that Manila intends to offer over the next few years for offshore exploration near Palawan Island. Reed Bank is a red line for the Philippines, so this contingency could quickly escalate to violence if China intervened to halt the drilling. The United States could be drawn into a China-Philippines conflict because of its 1951 Mutual Defense Treaty with the Philippines. The treaty states, "Each Party recognizes that an armed attack in the Pacific Area on either of the Parties would be dangerous to its own peace and safety and declares that it would act to meet the common dangers in accordance with its constitutional processes." American officials insist that Washington does not take sides in the territorial dispute in the South China Sea and refuse to comment on how the United States might respond to Chinese aggression in contested waters. Nevertheless, an apparent gap exists between American views of U.S. obligations and Manila's expectations. In mid-June 2011, a Filipino presidential spokesperson stated that in the event of armed conflict with China, Manila expected the United States would come to its aid. Statements by senior U.S. officials may have inadvertently led Manila to conclude that the United States would provide military assistance if China attacked Filipino forces in the disputed Spratly Islands. With improving political and military ties between Manila and Washington, including a pending agreement to expand U.S. access to Filipino ports and airfields to refuel and service its warships and planes, the United States would have a great deal at stake in a China-Philippines contingency. Failure to respond would not only set back U.S. relations with the Philippines but would also potentially undermine U.S. credibility in the region with its allies and partners more broadly. A U.S. decision to dispatch naval ships to the area, however, would risk a U.S.-China naval confrontation. Disputes between China and Vietnam over seismic surveys or drilling for oil and gas could also trigger an armed clash for a third contingency. China has harassed PetroVietnam oil survey ships in the past that were searching for oil and gas deposits in Vietnam's EEZ. In 2011, Hanoi accused China of deliberately severing the cables of an oil and gas survey vessel in two separate instances. Although the Vietnamese did not respond with force, they did not back down and Hanoi pledged to continue its efforts to exploit new fields despite warnings from Beijing. Budding U.S.-Vietnam relations could embolden Hanoi to be more confrontational with China on the South China Sea issue. The United States could be drawn into a conflict between China and Vietnam, though that is less likely than a clash between China and the Philippines. In a scenario of Chinese provocation, the United States might opt to dispatch naval vessels to the area to signal its interest in regional peace and stability. Vietnam, and possibly other nations, could also request U.S. assistance in such circumstances. Should the United States become involved, subsequent actions by China or a miscalculation among the forces present could result in exchange of fire. In another possible scenario, an attack by China on vessels or rigs operated by an American company exploring or drilling for hydrocarbons could quickly involve the United States, especially if American lives were endangered or lost. ExxonMobil has plans to conduct exploratory drilling off Vietnam, making this an existential danger. In the short term, however, the likelihood of this third contingency occurring is relatively low given the recent thaw in Sino-Vietnamese relations. In October 2011, China and Vietnam signed an agreement outlining principles for resolving maritime issues. The effectiveness of this agreement remains to be seen, but for now tensions appear to be defused.

#### Laundry list of impacts to South China Sea conflict

Glaser, 12 - senior fellow with the Freeman Chair in China Studies and a senior associate with the Pacific Forum, Center for Strategic and International Studies (Bonnie S., “Armed Clash in the South China Sea Contingency Planning Memorandum No. 14” April 2012 http://www.cfr.org/world/armed-clash-south-china-sea/p27883)

Warning Indicators Strategic warning signals that indicate heightened risk of conflict include political decisions and statements by senior officials, official and unofficial media reports, and logistical changes and equipment modifications. In the contingencies described above, strategic warning indicators could include heightened rhetoric from all or some disputants regarding their territorial and strategic interests. For example, China may explicitly refer to the South China Sea as a core interest; in 2010 Beijing hinted this was the case but subsequently backed away from the assertion. Beijing might also warn that it cannot "stand idly by" as countries nibble away at Chinese territory, a formulation that in the past has often signaled willingness to use force. Commentaries and editorials in authoritative media outlets expressing China's bottom line and issuing ultimatums could also be a warning indicator. Tough language could also be used by senior People's Liberation Army (PLA) officers in meetings with their American counterparts. An increase in nationalistic rhetoric in nonauthoritative media and in Chinese blogs, even if not representing official Chinese policy, would nevertheless signal pressure on the Chinese leadership to defend Chinese interests. Similar warning indicators should be tracked in Vietnam and the Philippines that might signal a hardening of those countries' positions. Tactical warning signals that indicate heightened risk of a potential clash in a specific time and place include commercial notices and preparations, diplomatic and/or military statements warning another claimant to cease provocative activities or suffer the consequences, military exercises designed to intimidate another claimant, and ship movements to disputed areas. As for an impending incident regarding U.S. surveillance activities, statements and unusual preparations by the PLA might suggest a greater willingness to employ more aggressive means to intercept U.S. ships and aircraft. Implications for U.S. Interests The United States has significant political, security, and economic interests at stake if one of the contingencies should occur. Global rules and norms. The United States has important interests in the peaceful resolution of South China Sea disputes according to international law. With the exception of China, all the claimants of the South China Sea have attempted to justify their claims based on their coastlines and the provisions of UNCLOS. China, however, relies on a mix of historic rights and legal claims, while remaining deliberately ambiguous about the meaning of the "nine-dashed line" around the sea that is drawn on Chinese maps. Failure to uphold international law and norms could harm U.S. interests elsewhere in the region and beyond. Ensuring freedom of navigation is another critical interest of the United States and other regional states. Although China claims that it supports freedom of navigation, its insistence that foreign militaries seek advance permission to sail in its two-hundred-mile EEZ casts doubt on its stance. China's development of capabilities to deny American naval access to those waters in a conflict provides evidence of possible Chinese intentions to block freedom of navigation in specific contingencies. Alliance security and regional stability. U.S. allies and friends around the South China Sea look to the United States to maintain free trade, safe and secure sea lines of communication (SLOCs), and overall peace and stability in the region. Claimants and nonclaimants to land features and maritime waters in the South China Sea view the U.S. military presence as necessary to allow decision-making free of intimidation. If nations in the South China Sea lose confidence in the United States to serve as the principal regional security guarantor, they could embark on costly and potentially destabilizing arms buildups to compensate or, alternatively, become more accommodating to the demands of a powerful China. Neither would be in the U.S. interest. Failure to reassure allies of U.S. commitments in the region could also undermine U.S. security guarantees in the broader Asia-Pacific region, especially with Japan and South Korea. At the same time, however, the United States must avoid getting drawn into the territorial dispute—and possibly into a conflict—by regional nations who seek U.S. backing to legitimize their claims. Economic interests. Each year, $5.3 trillion of trade passes through the South China Sea; U.S. trade accounts for $1.2 trillion of this total. Should a crisis occur, the diversion of cargo ships to other routes would harm regional economies as a result of an increase in insurance rates and longer transits. Conflict of any scale in the South China Sea would hamper the claimants from benefiting from the South China's Sea's proven and potential riches. Cooperative relationship with China. The stakes and implications of any U.S.-China incident are far greater than in other scenarios. The United States has an abiding interest in preserving stability in the U.S.-China relationship so that it can continue to secure Beijing's cooperation on an expanding list of regional and global issues and more tightly integrate China into the prevailing international system.

## 2AC — Solvency

### They Say “No Cooperation”

#### The NOPP model is empirically successful – increasing its exploration focus is vital to interagency coordination and public visibility

**Pomponi, 4** ­- Acting Managing Director, Harbor Branch Oceanographic Institution (Shirley, “U.S. Commission on Ocean Policy: Recommendations for an Updated National Ocean Policy” Congressional Testimony, 5/5, <http://www.floridaoceanalliance.org/documents/04_May_Pomponi_testimony.pdf>)

Coordinating ocean and coastal research and education programs. One of the most significant conclusions of the new report is that the patchwork of agencies and processes that have evolved over the past three decades to oversee the nation's ocean interests is simply not up to the challenge of fixing the problems identified. To remedy the situation, the report recommends substantial restructuring at the federal level, including mechanisms for making ocean policy decisions through a high-level interagency governance structure. Focusing specifically on ocean and coastal science, more than a dozen federal agencies currently fund research or education activities. Consequently, interagency coordination is essential to avoid duplication and strengthen the scientific basis for ocean management. The Commission proposes to build on the model created under the National Oceanographic Partnership Program (NOPP) in 1997. NOPP promotes national goals of assuring national security, advancing economic development, protecting quality of life, and strengthening science education and communication through improved knowledge of the ocean. It creates a higher level of coordinated effort and synergy across the broad oceanographic community by establishing partnerships on two fronts. First, NOPP relies on collaboration among fifteen federal agencies, calling on the top official of each participating agency to serve on an interagency council that provides program oversight. Second, NOPP increases the visibility for ocean issues on the national agenda by facilitating projects among federal agencies, academia, industry, and other governmental and non-governmental organizations. While investment in the program to date has been relatively modest, it has proven to be an effective mechanism for building and coordinating federal ocean science partnerships. Consequently, the oceanographic community generally supports the Commission’s recommendations to use NOPP as a model for coordinating expanded interagency ocean science investments.

#### NOPP model is vital to inter-agency coordination

**McNutt, 2** - President and CEO, Monterey Bay Aquarium Research Institute (Marcia, Testimony for the U.S. Commission on Ocean Policy, “Ocean Exploration”, 6/14, <http://govinfo.library.unt.edu/oceancommission/meetings/june13_14_02/mcnutt_testimony.pdf>)

The sorts of systematic data sets necessary to “fill in the blanks” for the ocean will not self-assemble from individual PI proposals and do not fall squarely within the purview of only one federal agency. Therefore, it is not obvious how such a program should be structured. In making my own recommendation in this regard, I took the following approach: consider what outcomes for the program drive its management, and look for successful models that can be emulated. First, the program must be discovery-based. For that reason, it should either not be housed in a mission-oriented agency, or if it is, steps should be taken to protect the program from the inevitable pressures to divert funds from exploration in order to tackle pressing, short-term, mission-related issues. Second, the program must have a vision, and be conducted in an organized and systematic manner so that the fruits of each exploration mission can be incorporated seamlessly into that larger vision. For that it will require long-term funding (for example, 10 years for the first installment). Long-term funding allows long-term planning, such that assets and technology can be prepared and tested in advance for the challenges of upcoming missions. Third, the program must be inclusive. This is a big job, and will require using the talents and marine assets of several federal agencies (notably NFS, Navy, NOAA, and NASA), the academic community, the private sector, and ideally, international partners. Any organizational structure must encourage the participation of any and all of these groups in order to maximally effective and should be judged on its success in this regard. What the Federal Agencies Contribute NSF’s mission is, of course, fundamentally discovery-based. It has a tradition of excellence, and a commitment to integrating across disciplines, advancing technology, expanding understanding, furthering formal and informal education, and collaborating internationally. It is the primary support for the UNOLs fleet, academic ocean research, and the deep-sea submergence facility. Ocean observatories, a required component to explore in the 4th dimension of time, are already a high priority for the agency. Furthermore, NSF has no in-house science centers or research labs in oceanography, and thus would be immune from pressure to support exploration on anything but a merit basis. I honestly cannot imagine an ocean exploration program that excludes NSF. The Navy has a distinguished history of innovation with respect to marine technology, and knows how to proceed orderly and systematically towards a long-term goal. It is thanks to the Navy that we have swath mapping systems, ocean bottom seismometers, environmental acoustic arrays, and autonomous underwater vehicles. The assets and experience that the Navy would bring to the program, in addition to the high probability that it will ultimately benefit from the fruits of exploration, argue for Navy involvement. NOAA has already taken the lead in forming its own ocean exploration program, and is well ahead of the other agencies in this regard. Lack of a long-term budget line has prevented the agency from planning a systematic program integrating technology development, discovery, data management, and education, but the agency has done an excellent job in attracting media attention to new discoveries. Quite admirably, the agency has stated that no more than 50% of the funding for exploration will be allocated to its own NOAA centers and labs, but as you can imagine, this decision has not been well received by all within the agency. NOAA also has made a commitment to ocean observing. Its Equatorial array has figured prominently into operational forecasting while still allowing for research innovation. And finally, there is NASA. If there is any agency that truly embraces the concept of exploration, it is NASA. And this agency always takes the big picture. Many maps of important environmental parameters that are NOT blank over the ocean (e.g., Figure 6, chlorophyll from SeaWIFS) are courtesy of NASA. This agency has much experience in managing large data sets and making them available to a wide audience. NASA is the master in high tech instrumentation and remote sensing. But NASA does not have much ocean experience, in situ. Teaming NASA with the other agencies mentioned previously is a powerful combination. Other agencies as well, such as the US Geological Survey, the Minerals Management Service, the Environmental Protection Agency, and the Department of Energy, also have relevant expertise and much to gain from ocean exploration. The program must encourage their participation. A Candidate Model In looking to models for how to establish a program in exploration, I want to bring your attention to the example set by the Ocean Drilling Program (Figure 7). In its early days especially, ODP was an exploration program, albeit centered on one asset as opposed to the array of assets that will be needed for ocean exploration. While funding for the program is through NSF, the Foundation wisely recognized that its peer panels that consider unsolicited proposals would not be an appropriate organizational mechanism for building a coherent program. Therefore, through a contract with the Joint Oceanographic Institutions, ODP was established with a centralized advisory structure that sets long-term goals, looking out for the technology development that needs to be undertaken today in order to be ready for future drilling legs. Most of the infrastructure for the program, such as the drill ship, the sample archives, special services, etc. are awarded on a contract basis, with competitions reopened periodically and subjected to external review. ODP employs a rather small staff, mainly to provide systematic procedures for shipboard measurements and for oversight of the contractors. The program places a high priority on rapid publication of its results through the ODP volumes that sit in every marine research library. ODP has entrained the broad community in planning through the COSOD workshops, but then uses panels of distinguished outside experts to sort through the ideas and weave the best into a coherent program. The broad oceanographic community is aware of that program and of the geographic priorities in any given year, and thus can respond with targeted proposals for each leg. Thematic panels sort through the proposals to select the very best strategies for achieving the long-term goals. Representatives from the academic community, federal agencies, and the private sector have been involved in the program through attendance at workshops, participation on advisory panels, and as members of the shipboard science party. This broad ownership has been the best mechanism to ensure that the fruits of the program are transferred back into the research community – federal, academic, and private. I cannot stress enough that a closed program which merely creates wonderful databases, sample archives, and published volumes will not have the intended impact. People are the best vector for disseminating ideas and discoveries. Finally, ODP is the premier example of a successful international program. Of course, the ODP model cannot be applied without some modification to ocean exploration. Agencies other than NSF must be involved and engaged, perhaps through an arrangement like NOPP. An ocean exploration program would place relatively more emphasis on assets of opportunity than on specialized program assets (such as an exploration flagship) than is the case for ODP, although ODP has certainly contracted for other ships and equipment when necessary. Ocean exploration would also likely need more committed, long-term leadership than the ODP panel structure allows, in that achieving the goals of exploration will require more patience and a consistent direction.