HAWAII AND THE SEA: roots and branches

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'A nation that forgets its past, has no future' W. Churchill

The Governor's Advisory Committee on Marine Affairs was founded on 22 April 2024, more than 50 years after the publication of the influential reports, **Hawaii and the Sea 1969: A plan for State Action** *and* **Hawaii and the Sea 1974**. *The first report in 1969 was commissioned by Governor John A. Burns as the State's response to the Stratton Commission Report,* ***Our Nation and the Sea*** *(published in January 1969), which itself was in response to reports published by the U.S. National Academy of Sciences Committee on Oceanography (NASCO) in 1929 (NASCO-I) and 1959 (NASCO-II). The two NASCO reports are the deep roots of the 2024 Governor's Advisory Committee, and the many acted-upon recommendations of NASCO-I, NASCO-II, the Stratton Commission, and the two State of HI reports are the diverse branches. What follows is a brief historical account of the vision, leadership, and action of those past thought leaders. The future is today, and the opportunities for the people of Hawai`i are boundless. Our Advisory Committee on Marine Affairs is well positioned to change the course of history*

I. Historical Background: NASCO-I (1927-29)

In 1923, Assistant Secretary of the Navy, Theodore Roosevelt, Jr., commissioned the US Navy's Experimental and Research Laboratory (predecessor to the Naval Research Laboratory). Later in 1924, Roosevelt invited the heads of various government agencies as well as the Carnegie Institution, the American Geophysical Union, and the National Research Council (NRC) – National Academy of Sciences (NAS) to an oceanography planning meeting in Washington, D.C. on 1 July 1924; this event would become the "First US Interagency Conference on Oceanography."

The conferees recommended that an interdisciplinary expedition, termed the Maury Research Expedition (in honor of Lieutenant Matthew Fontaine Maury, a pioneer in naval oceanography) be planned and implemented. Henry Bryant Bigelow, the person who would later become a key figure in future planning efforts, represented the US Bureau of Fisheries at the conference. Despite all good intentions, this planned oceanographic expedition got caught up in the politics and the scandals of the day; the Secretary of the Navy Edwin Denby and Roosevelt were both forced to resign in 1924. Curtis Wilber, Denby's successor as secretary, favored naval air programs so the planned Maury sea-based program failed due to lack of appropriation and other support.

On 27 April 1927, the NAS acted on the following resolution: "That the president of the academy be requested to appoint a committee on oceanography from the sections of the academy concerned, to consider the share of the USA in a worldwide program of oceanographic research, and report to the academy." Academy member Frank R. Lillie, then director of the Marine Biological Laboratory at Woods Hole, had requested the establishment of this new committee. With this request and subsequent committee action, Lillie had planted a major seed for oceanography Thus began a benchmark event in the history of marine sciences in our nation.

The academy president, Albert Michelson, accordingly appointed NAS members William Bowie (geodesist with the US Coast and Geodetic Survey), Ed Conklin (professor of biology at Princeton University), Benjamin Duggar (professor of physiology and economic botany at University of Wisconsin), John Merriam (president of the Carnegie Institution of Washington), and T. Wayland Vaughan (director of the Scripps Institution of Oceanography) to the committee; Lillie was appointed committee chair, and Henry Bryant Bigelow – then curator of oceanography in the Museum of Comparative Zoology at Harvard University – was engaged as secretary.

In 1931, after his election to the NAS, Bigelow was appointed a full member of the committee; Arthur Day (a geophysicist), another newly elected member of the academy, was later added to the committee. In July 1935, Frank Lillie became the president of the NAS and Bigelow succeeded him as chair of the influential NAS Committee on Oceanography (NASCO).

The stated mission of NASCO was to assess the status of the field of oceanography in the nation. The work of NASCO was published in an academy report in November 1929, in a 263-page monograph, *Oceanography: Its Scope, Problems, and Economic Importance*, written by Bigelow and eventually published by Houghton Mifflin Company in 1931, and in a 225-page monograph, *International Aspects of Oceanography: Oceanographic Data and Provisions for Oceanographic Research*, written by Vaughan and others and published by the NAS in 1937. The former was the "official committee report" while the two latter "reports" were comprehensive assessments of the extant knowledge of the sea that were commissioned, partly, as a result of the 1929 Lillie Committee Report. These two monographs served as the background for the classic work *The Oceans: Their Physics, Chemistry, and General Biology* by Sverdrup, Johnson, and Fleming that appeared later in 1942 (see Figure 1).

An extended excerpt of the 1929 Lillie Committee Report was also published in *Science* (vol. 71: 84-89) in 1930 as an article titled, "A developing view-point in Oceanography" by Henry Bryant Bigelow. According to Bigelow, the Committee concluded that "the establishment on our Atlantic coast of a new organization dedicated to the encouragement and prosecution of oceanographic investigation is the greatest need at the present time both from the point of view of American oceanography and also for adequate participation of this country in a study necessarily international."

In an authoritative account of "Education in oceanography: History, purpose, and prognosis" that was prepared for the NAS-NRC's *Fifty Years of Ocean Discovery* published in 2000, Arthur Nowell of the University of Washington concluded that the 1929 Lillie Committee Report should be considered the true beginning of academic oceanography in the US. At the time this blue-ribbon committee was established, the only formal PhD-granting educational program in oceanography was at the newly founded Scripps Institution of Oceanography (note: Technically, the degree awarded was a PhD in zoology at UC at Berkeley for research conducted in marine biology at Scripps). According to Nowell, one of the main conclusions of the 1929 Lillie Report regarding the relatively new field of oceanography was, "The graduate student, sufficiently devoted to the subject and fitted for advanced instruction or research finds far fewer avenues than the importance of this field of science demands." The report went on to conclude that the human resource issue is the greatest handicap for progress, not ships, laboratories, or even money. Nowell lamented that despite this important conclusion from this very high-profile NAS committee, there is little evidence that the report had any immediate influence on education *per se*; however, the impact of the Lillie report on research in the new field of oceanography was quite profound.

Foremost among the many lasting achievements of NASCO was the establishment, in 1931, of the Woods Hole Oceanographic Institution (WHOI), an expansion of the research capacity at the Bermuda Biological Station for Research, and expansion of research laboratories at both the University of Washington and Scripps Institution of Oceanography. All of these enhancements were supported by gifts from the Rockefeller Foundation. The funding provided to establish WHOI was $2.5 M, including the resources necessary to construct a seagoing laboratory, later christened the R/V *Atlantis* in 1931.

These connections between the Rockefeller Foundation, Frank Lillie, the NAS, and WHOI, however, ran much deeper than what might be perceived from the committee's fine achievements. As it is now well known, Lillie – who had been elected to the NAS in 1915 for his pioneering work in developmental biology – had worked closely with Wickliffe Rose, then president of the General Education Board of the Rockefeller philanthropies prior to the formation of the NASCO. There was at that time a great interest on the board to assist fishery science in the US. Lunching at the Quadrangle Club of the University of Chicago – where Lillie was a professor – in October 1925, the two men discussed the field of oceanography and the possibility of establishing a new oceanographic institution on the east coast of the US, possibly at Woods Hole. The two met again in October 1927 to discuss these matters and agreed to consider other locations in the context of the "committee" but that "Woods Hole seemed the likeliest to be chosen."

Henry Bigelow, chair of NASCO, was appointed the inaugural director of WHOI, and a 12-member board – including 6 persons from NASCO – was established to oversee the institution's direction and progress. Included as a member of the WHOI board was T. Wayland Vaughan, then director of the Scripps Institution of Oceanography; Frank Lillie, then president of the NAS, was appointed president of the board. So, in effect, WHOI was directed, at least initially, by the 1927 NASCO.

In a 14 March 1930 article in *Science* (vol. 71: 277-278), Bigelow announced to the scientific world the incorporation of WHOI, a new establishment for the study of the sea. The article reported that the choice of Woods Hole was, in part, a result of the close proximity of two world-class research institutions, the National Marine Fisheries Laboratory and the Marine Biological Laboratory. The non-profit, independent organization would, according to Director Bigelow, have informal associations with other educational and research institutions.

From the beginning, there were strong academic connections between WHOI and both Harvard and Yale Universities. Bigelow, the founding director of WHOI, had a staff appointment in Harvard's Department of Oceanography at the Museum of Comparative Zoology, and Columbus Iselin II, WHOI's second director, was the assistant curator of the museum; Alfred Redfield also held a professorship at Harvard. The connection to Yale University was through the Peabody Museum and, later, the Bingham Oceanographic Foundation. Albert E. Parr, a research associate in oceanography at WHOI, was also the curator of the Bingham Oceanographic Collection at Yale. WHOI has also had a long-standing collaboration with the Massachusetts Institute of Technology (MIT), and in 1968 the two institutions created a joint PhD program in oceanography.

A final point made by Bigelow in his 1930 *Science* article, "A developing view-point in oceanography" was a call to arms for interdisciplinary research in marine sciences. After providing several pages of explicit links between biological, chemical, physical, and geological processes in the sea, Bigelow concludes by stating, "There is, I think, no need to quote more examples to show that the different disciplines of oceanography inevitably interlock, or to prove the intellectual necessity of not only recognizing but indeed acting upon this unit, if we hope ever to gain a thorough understanding of the sea and its inhabitants. Any attempt (conscious or unconscious) to hold them apart can result only in frustrating this high aim and in setting us

backward to the stage of simply gathering and accumulating facts in unrelated categories." He reiterated these key points at the end of his 1931 book *Oceanography: Its Scope, Problems, and Economic Importance*, "There is, we think, no need of further argument to prove that these several disciplines do inevitably interlock, or to point the intellectual necessity not only of recognizing, but of acting upon this unity, if we hope ever to gain any sound understanding of the sea, or of the lives of its inhabitants."

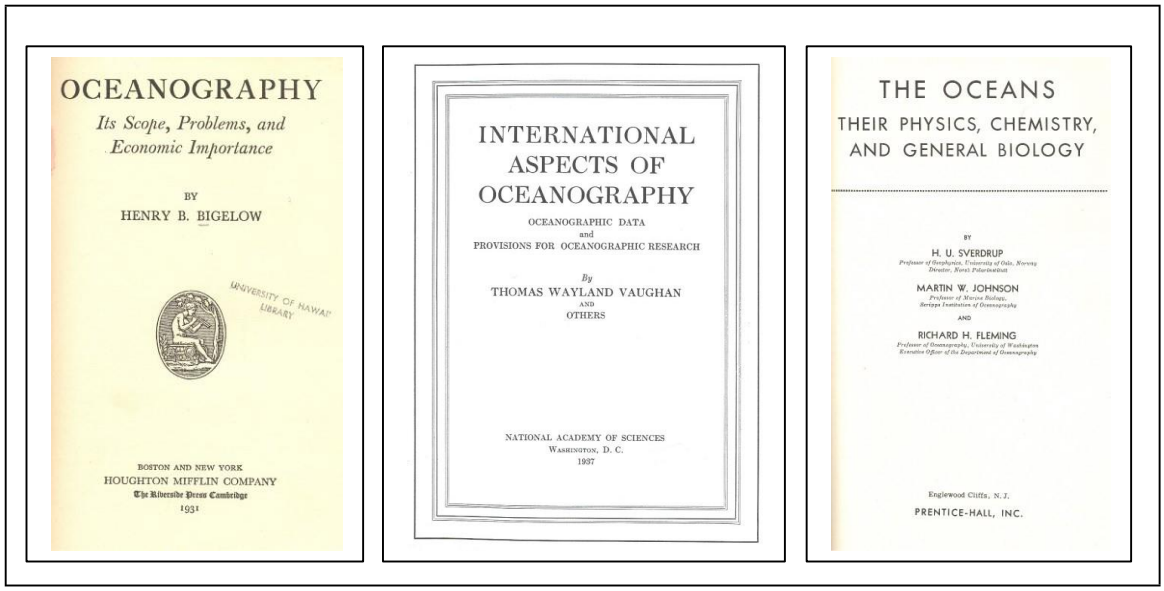


Figure 1: Collection of ocean classics: The Bigelow (1931) and Vaughan et al. (1937) monographs (shown above left and center) were products of the NAS Committee on Oceanography. These works led to the publication, in 1942, of the monumental work of Sverdrup, Johnson and Fleming, *The Oceans: Their Physics, Chemistry and General Biology*.

II. Historical Background: NASCO-II (1957-59)

On 10 November 1957, a second NASCO was established to study the needs and opportunities in the field of oceanography. NASCO-II included Harrison Brown, Maurice Ewing, Columbus Iselin, Fritz Koczy, Sumner Pike, Roger Revelle, Gordon Riley, Milner Shaefer, and Athelstan Spilhaus. The committee was chaired by Harrison Brown, a California Institute of Technology geochemist.

In February 1959, NASCO-II released a 12-volume report, "*Oceanography 1960-1970*" describing the status of marine science with numerous recommendations for possible implementation over the next decade. This was known subsequently as the NASCO Report.

Immediately after the report was published, US Senator Warren Magnuson of Washington state introduced senate resolution #136 to establish a special subcommittee on oceanography in the U.S. House of Representatives merchant marine and fisheries committee to hold hearings on the NASCO findings and recommendations. This eventually led to the creation of a Presidential Commission – the so-called Stratton Commission – charged with making a comprehensive, long-range assessment of current marine research activities in the US, and future needs (see below).

While NASCO-II was conducting their review of the field of oceanography, a separate committee at the Office of Naval Research (ONR) was conducting an independent assessment. On 1 January 1959 just prior to the release of the NASCO-II Report, the Chief of Naval Operations – Admiral Arleigh Burke – distributed a separate report that had been prepared by Gordon Lill, Arthur Maxwell, and Feenan Jennings, all of ONR, "*The Next Ten Years in Oceanography*" – known subsequently as the TENOC Report. This document was a "call to arms" for the enhancement of basic research in oceanography and a cornerstone of the Report was a call for more oceanographers. ONR was ready, willing, and able to invest large sums of money in academic institutions to support their important marine science missions, including new research vessels to provide access to the sea.

III. Historical Background: The Stratton Commission (1966-69)

One of the major outcomes of the NASCO-II Report was the establishment of the Stratton Commission, and their eventual report – *Our Nation and the Sea*. In 1966, the US Congress passed the marine resources and engineering development act authorizing a Commission on Marine Science, Engineering and Resources. The Commission's charge was to make recommendations on the "full and wise use" of the marine environment. Julius Stratton, chairman of the board of Ford Foundation and former president of MIT, was selected chair of the commission.

This group soon became known as the "Stratton Commission" and their product, *Our Nation and the Sea*, published in January 1969, was known as the Stratton Report (Figure 2). The 15 members of the commission, all appointed by US President Lyndon B. Johnson, included academics, lawyers, politicians, and corporate executives.

The final report of the commission's findings, *Our Nation and the Sea: A Plan for National Action, 1969* made 126 recommendations in 17 categories, including several controversial ones. Shortly after the Stratton Commission report was delivered to President Johnson, with a copy to President-elect Richard M. Nixon, there was intense discussion and debate over several of the major recommendations, including the creation of the National Oceanic and Atmospheric Administration (NOAA) as a "wet NASA." At this time, the country was preoccupied with the Vietnam war and the competing space program appeared to have more immediate and explicit dividends, if not a greater public following. We put a man on the moon for $35 B, but that same year invested only $0.5 B for ocean research.

Eventually on 3 October 1970, NOAA was established by US President Nixon; Robert White, a member of the Stratton Commission, was appointed the founding undersecretary of commerce for oceans and atmosphere – the administrator of NOAA.

Other acted-upon recommendations of the Stratton commission were the creation of the Environmental Protection Agency, Coastal Zone Management Act, National Marine Sanctuaries Act, Marine Mammal Protection Act, Fisheries Conservation and Management Act, and the creation of the University National Oceanographic Laboratory System (UNOLS).

Figure 2: The Stratton Commission and their report to the nation. Members of the Stratton Commission left to right are: (1) Leon Jaworski, attorney, (2) Taylor Pryor, president, The Oceanic Foundation, (3) John Knauss, dean, Graduate School of Oceanography, University of Rhode Island, (4) James Crutchfield, professor of economics, University of Washington, (5) George Reedy, president, Struthers Research and Development Corporation, (6) Robert White, administrator, US Department of Commerce, (7) Jacob Blaustein, director, Standard Oil Company (Indiana), (8) John Perry, Jr., president, Perry Publications, Inc., (9) Hubert Humphrey, vice president of the US and chair of the Marine Sciences Council, (10) Charles Baird, undersecretary of the navy, (11) Julius Stratton, chairman, The Ford Foundation, (12) David Adams, commissioner of fisheries, North Carolina Department of Conservation and Development, (13) Richard Geyer, head, Department of Oceanography, Texas A&M University, (14) Frank DiLuzio administrator, US Department of the Interior, (15) George Sullivan, M.D., General Electric Reentry Systems, (16) Carl Auerbach, professor of law, University of Minnesota, and (17) Alton Lennon, US congressman, advisor to the commission. The front cover of the Stratton Commission report, *Our Nation and the Sea*, published in 1969, is shown at right.

The work of the Stratton Commission focused national attention on the sea and was largely responsible for enhanced funding for marine sciences, including the International Decade of Ocean Exploration (IDOE) program that began in 1968 while the commission was still conducting their assessment. The "political" justifications included food from the sea, maritime threats to world order, coastal pollution and shoreline deterioration, seabed gas, oil and mineral exploration, and ocean commerce. The scientific justifications were outlined in a NAS/NAE joint publication, *An Oceanic Quest*, which appeared in 1969. The primary mission of IDOE was "To achieve more comprehensive knowledge of ocean characteristics and their changes and more profound understanding of oceanic processes for the purpose of more effective utilization of the ocean and its resources." In principle, IDOE would sponsor a number of large-scale, long-term comprehensive research projects to address challenging scientific problems that were well beyond the scope of individual or even small groups of investigators – the beginnings of "big ocean science" at NSF.

The US component of the international program became official in October 1969 when President Richard Nixon announced the new initiative; NSF was given lead responsibility for program management. The Mansfield amendment of 1970, which was passed at the height of the Vietnam war, forbade the US Department of Defense from funding projects in basic science unless they were related to military function or operations. This action may have enhanced support for the IDOE program, which in 1969 seeded NSF with $15 M in new money to support numerous, mostly field, ocean research initiatives.

The 10-yr mandated IDOE program ended in 1980 after a total investment of more than $200 M. Unlike other special programs before it, the funding that had been available for IDOE projects remained in the NSF ocean sciences budget after the decade-long program had ended. According to a written account by Richard Lambert (1988, *Marine Technology Society Journal* 32: 68-73) this more than doubled the annual NSF budget for non-biological oceanographic support.

This decade-long program achieved remarkable success. Several major IDOE research program included NORPAX, GEOSECS, SEAREX, MANOP, and CENOP.

IV. Post-2000 Activities

A. Ocean Commission and Pew Oceans Commission (2001-04)

In May 1998, "The Stratton Roundtable" was convened in Washington, D.C. to evaluate the impact of *Our Nation and the Sea*, thirty years hence, and to consider the best design of investigation for a Stratton Commission II. Looking back on the long term impact of the Stratton Commission on US policy, Harry N. Scheiber characterized it in his round table presentation as being "uneven." These roundtable discussions, however, did eventually lead to a second ocean commission to assess the current state of marine affairs.

In 2001, as mandated by the *Oceans Act of* 2000 (P.L. 106-256), US Congress authorized and President George W. Bush appointed a second ocean commission and charged them with a comprehensive review of national ocean policy to pursue the following objectives (www.oceancommission.gov): (1) achieve responsible use, protection and stewardship of ocean/coastal resources, (2) resolve conflicts between all involved in operations, resources recovery and protection, (3) enhance commercial industries, (4) increase knowledge of ocean condition/behavior and influence on climate and environmental changes, (5) advance education and training, (6) increase investments in technology, (7) preserve the US role in world oceans affairs, (8) improve the structure of federal agencies and programs, and (9) enhance federal, state and local government partnerships.

The 16-member US Commission on Ocean Policy (12 of whom were selected from a list submitted by congress), was chaired by Admiral James D. Watkins (US Navy, retired), former

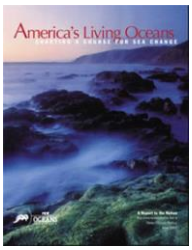
chief of naval operations under President Ronald Reagan, former secretary of energy under President George H.W. Bush and founding president of the Consortium for Oceanographic Research and Education (CORE). Commission members include Robert Ballard, Ted Beattie, Lillian Borrone, James Coleman, Ann D'Amato, Lawrence Dickerson, Vice Admiral Paul Gaffney II, Marc Hershman, Paul Kelly, Christopher Koch, Frank Muller-Karger, Ed Rasmuson, Andrew Rosenberg, William Ruckelshaus, and Paul Sandifer. The NAS Ocean Studies Board helped to establish a science advisory panel to assist in ensuring the scientific reports presented to the Commission were based on the best available scientific information.

After a series of regional public meetings to receive testimony, the commission submitted an interim report in October 2002 of their progress to date. In a sobering assessment the commission concluded, "The oceans are in trouble. Our coasts are in trouble. Our marine resources are in trouble. All, perhaps, in serious trouble." In an editorial published in *Oceanography* (Watkins 2002, vol. 15: 4-6), Admiral Watkins summarized the key points of the mid-term report. He stressed "that the recommendations alone were not the most important part of the Commission's work; rather it is the implementation of those recommendations that will fundamentally affect our nation's relationship with the seas." He lamented that the most serious challenge of all is whether there is enough will, enough of a sense of urgency, within the halls of Congress and the White House to resolve these important issues. Their preliminary report was released on 20 April 2004 for review by the governors of U.S. coastal states and other stakeholders. The final report to the President and Congress "*An Ocean Blueprint for the 21st Century*" was delivered on 20 September 2004. In his transmittal letters to the President, Senate Majority Leader William Frist and Speaker of the House Dennis Hastert, Admiral Watkins stressed that "the value of the oceans and coasts to the nation is immense and their full potential remains unrealized." He went on to say that our oceans are in serious trouble "due to rapid growth along our coasts, land and air pollution, unsustainable exploitation of too many of our fishery resources and frequently ineffective management." He ended by stating "The urgent need for action is clear … our report is just the beginning of what must be a sustained effort." The Commission expired on 19 December 2004 as called for under the Oceans Act of 2000. On 10 December 2008, Admiral Watkins was honored by President George W. Bush with the Presidential Citizens Medal in recognition of his exemplary deeds of service to the nation, including but not limited to his leadership of the U.S. Commission on Ocean Policy.

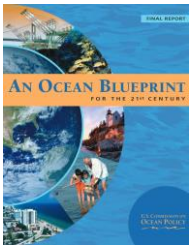
B. Pew Oceans Commission (2001-03)

Concurrent with the efforts of the Ocean Commission, the Pew Charitable Trusts established an independent Pew Oceans Commission led by former member of the US House of Representatives and former White House Chief of Staff under President Bill Clinton Leon Panetta. Members of the Pew Oceans Commission included John Adams, Eileen Claussen, Carlotta Leon Guerrero, Mike Hayden, Geoffrey Heal, Charles Kennel, Tony Knowles, Jane Lubchenco, Julie Packard, Pietro Parravano, George Pataki, Joseph Riley Jr., David Rockefeller, Vice Admiral Roger Rufe, Kathryn Sullivan, Marilyn Ware, and Patten White, representing a broad range of marine scientists, business leaders, government executives, and ocean stakeholders. In June 2003, the Pew Oceans Commission released a 144-page report entitled "America's Living Oceans: Charting a Course for Sea Change." The themes of the study included pollution, over-fishing, invasive species, coastal development, and the general health of

the ocean. The overall conclusion of the report was that America's seas are in trouble and that stronger federal oversight, revised pollution laws and tighter fishing regulations would be necessary to restore and preserve the remaining ocean commons. In the Foreword section of the report, Committee Chair Panetta stated "A century ago, President Theodore Roosevelt committed the nation to the critical objective of preserving our land. Today, we have a similar responsibility to the seas that cover about 71 percent of our planet. These recommendations provide an opportunity and the means to meet our obligation and provide for our children a bountiful ocean legacy."



Left: The 2003 Pew Oceans Commission report, America's Living Oceans: Charting a Course for Sea Change
Right: Final report of the Commission "An Ocean Blueprint for the 21st Century" was released on 20 September 2004.



C. Joint Ocean Commission Initiative: 2005-Present

The Joint Ocean Commission Initiative (hereafter, Joint Initiative) grew from the efforts of the concurrent US Commission on Ocean Policy and the Pew Oceans Commission. It was originally co-chaired by Admiral James Watkins and the Honorable Leon Panetta, the Chairs of the aforementioned Commissions, but later led by a leadership council that is co-chaired by Christine Todd Whitman, former EPA Administrator under President George W. Bush and former governor of New Jersey, and Norman Mineta, Secretary of Commerce under President Bill Clinton and Secretary of Transportation under President George W. Bush. Committee members include a broad range of scientists, executives and ocean policy exports. Jane Lubchenco, a member of the Pew Oceans Commission and member of the NAS, serves as a member of the Joint Initiative.

The independent reports of the US Commission of Ocean Policy and Pew Oceans Commission reached similar conclusions of the state of our oceans and coast and shared similar recommendations for policy action. The primary mission of the Joint Initiative is to "accelerate the pace of change that results in meaningful ocean policy reform." To date, the Joint Initiative has focused its efforts in seven priority areas: national ocean policy reform, regional and state ocean leadership, international ocean leadership, ocean science, research and education, fisheries management reform, and oceans and climate change. In June 2010, former EPA Administrator William Ruchelshaus replaced Todd Whitman as co-chair of the Joint Initiative, and on 19 July 2010, then-President Barack Obama signed Executive Order 13547 establishing a National Policy for the Stewardship of the Oceans, Our Coasts and the Great Lakes.

Since its founding in 2005, the Joint Initiative has released several influential reports and action plans including: *From Sea to Shining Sea* (2006); *Once Coast One Future* (2009); *Changing Oceans Changing Worlds* (2009); *Charting the Course: Securing the Future of American's Oceans* (2013); and *Ocean Action Agenda: Supporting Regional Ocean Economies and Ecosystems* (2017). They also periodically release US Ocean Policy "report cards" assessing recent progress on the recommendations made by the two previous Commissions.

D. National Ocean Council (2009-present)

On 12 June 2009, President Obama constituted an Interagency Ocean Policy Task Force and charged it with developing a national ocean policy. On 19 July 2010, the White House Council on Environmental Quality released a report entitled "Final Recommendations of the Interagency Ocean Policy Task Force." They presented an outline for a comprehensive national policy for the stewardship of the oceans, our coasts, and the Great Lakes. Since no single agency has jurisdiction over the ocean, the task force recommended the establishment of a new National Ocean Council to establish high-level direction and policy guidance. The Council includes members from many federal agencies including NSF and NOAA. Under President Obama's leadership, the National Ocean Council was very proactive, but since the election of President Donald Trump, the work has stalled. In a 19 June 2018 opinion piece published in *Science*, David Malakoff declared "Trump's new ocean policy washes away Obama's emphasis on conservation and climate." We can only wait and see what happens in 2020.

E. Intergovernmental Panel on Climate Change Assessment Report V (2013-2014)

The Intergovernmental Panel on Climate Change (IPCC) was created in 1988 under the leadership of the World Meteorological Organization and the United Nations Environmental Program. Their stated mission was "to provide governments of the world with a clear scientific view of the world's climate." The IPCC process is to assess on a comprehensive, objective, open and transparent basis the scientific, technical, and socio-economic data relevant to understanding the scientific risk of human-induced climate change and its potential impacts and options for adaptation and mitigation. Periodic reports have been policy-neutral, but also policy-relevant. To date, five assessment reports have been published: AR-1 (1990), AR-2 (1995), AR-3 (2001), AR-4 (2007), and AR-5 (2013/2014). AR-4 involved 3,500 experts from 130 countries and shared 2007 Nobel Peace Prize with former Vice President Al Gore. The AR-4 prize-winning message was: *Warming in the climate system is unequivocal*. However, it was not until AR-5 that any comprehensive assessment of the ocean was presented. In 2014, the AR-5 working group II report included two ocean chapters: Chapter 6 *Ocean Systems* and Chapter 30 *Open Oceans*. Additional marine ecosystem assessments also appeared in Chapter 5 *Coastal Systems* and Chapter 28 *Polar Systems*. Two main messages from Chapter 6 were: *Ocean ecosystems have responded and will continue to respond to climate changes of different rates, magnitudes and durations* and *Climate change alters physical, chemical and biological properties of the ocean.*

F. NAS/NRC: Sea Change: A Decadal Survey of Ocean Sciences 2015-2025

In 2013, NSF's Division of Ocean Science asked the NRC's Ocean Studies Board to undertake a decadal survey of ocean sciences to provide guidance from the ocean sciences community on research and infrastructure priorities for the coming decade. The Committee for the Decadal Survey of Ocean Sciences 2015 was eventually tasked "to develop a list of the top ocean science priorities for the next decade in the context of the current state of knowledge, ongoing research activities and resource availability." The final report, *Sea Change: A Decadal Survey of Ocean Sciences 2015-2025*, was delivered to NSF in late January 2015.

G. Science 20 (S20) 2019 Tokyo Conference

In March 2019, representatives from the National Academies of Sciences of the G20 nations (the so-called Science 20 or S20 group) met in Tokyo, Japan to assess threats to coastal and marine ecosystems with special attention to climate change and marine plastic waste. Their S20 Japan 2019 report will be used to help guide discussions later in the year at the formal G20 meeting, also in Tokyo.

H. Intergovernmental Oceanographic Commission of UNESCO: Decade of Ocean Science for Sustainable Development (2021-2030)

At the United Nations Framework Convention on Climate Change (UNFCCC) 21st Conference of the Parties (COP-21), for the first time, the ocean was officially integrated into the outcome document. The report of this 10-11 September 2018 meeting was published as the "High Level Ocean and Climate Conference Bulletin" later in September 2018. The COP-21 conference was organized by the Ocean and Climate Platform, an alliance of non-governmental organizations and research institutions that was created on World Ocean day in 2014, and by UNESCO's Intergovernmental Oceanographic Commission (IOC). This report, and others to follow, will serve to inform the UN's Decade of Ocean Science for Sustainable Development project that is currently planned for 2021-2030.