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SHIP WITH A SOUL: A BRIEF HISTORY OF THE CANADIAN OCEANOGRAPHIC RESEARCH VESSEL CSS/CCGS *HUDSON* (1963-2022)

DONALD C. GORDON*
Emeritus Scientist

Department of Fisheries and Oceans
Bedford Institute of Oceanography
Dartmouth, NS

After serving the Canadian oceanographic community with distinction for almost sixty years, the CSS/CCGS *Hudson* was recently retired. Her history and that of the Bedford Institute of Oceanography (BIO) were closely intertwined and she became a Canadian icon.

After World War II, there was a growing interest in oceanography around the world and it soon became a high priority of the Canadian federal government. In 1958, plans were announced by the Department of Mines and Technical Surveys (DMTS) to create BIO in Dartmouth, NS. Soon after, plans were also announced by DMTS to build a new oceanographic research vessel to be based at BIO. The driving force behind both these undertakings was Dr. William E. van Steenburgh, the Director-General of Science Services in DMTS.

The new vessel was designed by the marine engineering firm of Gilmore, German and Milne in Montreal with the capability of working anywhere in the world's oceans, in particular the North Atlantic and adjacent arctic waters. It was just the second scientific ship designed and built in Canada, the first being the hydrographic survey vessel CSS *Baffin* launched in 1956. She was built by Saint John Shipbuilding and Drydock, Ltd. in Saint John, NB at a cost of $7,500,000 and named after the early arctic explorer Henry Hudson (1565-1611). *Hudson* was launched in May 1963 and, after fitting out and sea trials, arrived at BIO in December 1963, a wonderful Christmas present for the recently opened institute. She was formally commissioned in February 1964 by the Honorable Paul Benedickson, Minister of DMTS.

* Author to whom correspondence should be addressed:
donald.gordon@ns.sympatico.ca [Sadly, the author is deceased.]

Upon arrival at BIO, she joined the existing fleet of research vessels which included CSS *Acadia,* CSS *Kapuskasing,* CSS *Baffin,* CSS *Maxwell* and CNAV *Sackville.* These were primarily hydrographic survey vessels and only the CNAV *Sackville*, operated by the Canadian Navy, was devoted to oceanographic research. At that time, BIO had only about fifty professional and technical staff belonging to the Canadian Hydrographic Service (CHS), the Atlantic Oceanographic Group (AOG) of the Fisheries Research Board (FRB) and the newly created Marine Sciences Branch (MSB). They were thrilled to have a brand-new state-of-the–art oceanographic research vessel available for their use. This was a period of unprecedented growth and both oceanographic staff and programs at BIO expanded rapidly over the ensuing decade.

Hudson was well-designed for her purpose. Her many features included a diesel electric propulsion system with two fixed blade propellers and bow thruster, an anti-roll system for stability, numerous wet and dry laboratories, open deck working areas fore and aft, numerous winches and cranes for handling all kinds of oceanographic equipment while underway and on station, a helicopter deck with hanger and hydrographic launches. Many improvements were made over the years as programs and equipment evolved. In addition, *Hudson* provided excellent accommodations for 28 scientific staff which allowed multidisciplinary programs to be carried out on a single cruise. She was also well-served over her entire career by excellent officers and crew. With the exception of some possible seasickness the first few days out, going to sea on *Hudson* was a pleasure for Canadian oceanographers.

It soon became evident that *Hudson* possessed outstanding sea kindliness and station keeping ability. She was able to operate effectively under extreme conditions, including in ice, and was ideally suited for winter work in the North Atlantic. This was partly due to the curved shape of her hull that afforded a more gentle passage over steep waves. With her extensive cruising range, she was capable of working anywhere in the world's oceans. She quickly developed the reputation of being one of the best oceanographic research vessels in the world and became the envy of other oceanographic institutions.

From 1963 to 1996, *Hudson* was operated by the BIO Ships Division under the responsibility of the science director. She was designated as the Canadian Science Ship (CSS) *Hudson* and painted white, the

traditional colour of oceanographic research vessels. She was manned by a single crew who were at sea most of the year between April and December. Then, as the result of a major DFO reorganization in 1996, the operation of *Hudson* was transferred to the Canadian Coast Guard and she became known as the Canadian Coast Guard Ship (CCGS) *Hudson*. She was subsequently painted red like other Coast Guard vessels but was still programed exclusively for oceanographic research. This transfer resulted in the introduction of the layday system for crewing. There were now two crews who served a month on followed by a month off which resulted in a significant boost to shipboard morale.

Although based at BIO, *Hudson* was used throughout her career by the entire Canadian oceanographic community. Principal non-BIO users included the DFO Maurice-Lamontagne Institute, the DFO Northwest Atlantic Fisheries Centre, Dalhousie University, McGill University and the University of Quebec. In addition, engineering staff from a number of Canadian R&D companies participated in numerous cruises. Many cruises also included international collaborators.

She spent an average of 167 days at sea each year and over her entire career carried out over 475 research cruises. It is estimated that she steamed approximately 1,565,000 nautical miles in support of science which is equivalent to sailing about 72 times around the world! While most of her work was done in the North Atlantic and Canadian Arctic, she also worked in the Caribbean Sea, South Atlantic, Antarctic and North and South Pacific. In her travels she made port calls in 18 other countries. During the Hudson 70 expedition, she became the first ship to circumnavigate the Americas and, in 1981, she circumnavigated North America which included traversing the Panama Canal. She made two successful passages through the fabled Northwest Passage, each by a different route. Except for her later years, she was very much an international traveler and informal ambassador for Canada (Fig 1a-f).

Over her lengthy career, *Hudson* supported research in all the major oceanographic disciplines in both the world's oceans and Canada's three oceans. Her work initially focused on understanding basic properties and processes of the ocean and underlying sediments and bedrock. In later years, it expanded as Canadian research priorities evolved to include more applied topics such as marine resource

development, the impacts of human activities on marine ecosystems, ocean monitoring and marine management.

Numerous marine engineering projects focused on testing at sea a wide range of new oceanographic equipment under development at BIO which when proven was extensively used on subsequent research cruises. Some of this equipment was subsequently transferred to industry for manufacturing and marketing.

Although designed primarily for oceanography, *Hudson* was also well suited for hydrography and conducted numerous hydrographic surveys in Canadian waters in support of navigational chart production. While traversing international waters, she routinely collected bathymetric data for the General Bathymetric Chart of the Oceans program (GEBCO). In more recent years she also was used to collect hydrographic data in support of extending Canadian territorial limits under the United Nations Convention on the Law of the Sea (UNCLOS).

Hudson was extensively used by geophysicists and geologists. Geophysical surveys of oceanic crust measuring bathymetry, gravity, magnetism and seismic properties were conducted in many locations but with particular focus on the Mid-Atlantic Ridge, off Atlantic Canada and in the eastern Arctic. The results had many applications including understanding the dynamics of plate tectonics and continental drift and helping to pave the way for the development of the Canadian offshore oil and gas industry. Geologists used *Hudson* to study sediments in environments ranging from coastal bays to abyssal depths using a wide variety of sampling and observational tools. This information was used to develop detailed maps of seabed properties and processes and contributed to increasing the understanding of geological history, sediment transport, seabed stability and geohazards. The results, including numerous maps, had many important applications and were used extensively by both industry and government.

Hudson was also extensively used by physical oceanographers to make fundamental contributions to the understanding of ocean circulation in both Canadian waters and the global ocean. Much of this work concentrated in the North Atlantic and the Labrador Sea which is an important site for deep water formation during the winter months. Early work used bathythermographs and Knudsen bottles with reversing thermometers to measure water properties at discrete

depths but these were later replaced by electronic instrumentation which measured conductivity and temperature continuously with depth (CTDs), thereby allowing the profiling of the entire water column. Over her career, *Hudson* was used to deploy and retrieve an extensive number of current meter moorings in both shallow and deep water, including the first such moorings in the Drake Passage. She made major contributions to the World Ocean Circulation Experiment (WOCE) and was used to deploy numerous profiling floats as part of the international Argo program. The results of this research had many important applications including global climate studies, development of offshore industries and fisheries management. *Hudson* was also used to study the properties and dynamics of sea ice.

Chemical oceanographers also made good use of *Hudson* to measure the concentration, distribution and dynamics of important chemicals in seawater and sediments in environments ranging from coastal waters to abyssal depths. These included hydrocarbons, nutrients, trace metals, organic carbon and components of the carbonate system. The results contributed to increasing the understanding of marine pollution and the impacts of human activities on ocean chemistry over time, including ocean acidification.

Hudson was also extensively used by biological oceanographers to study phytoplankton, zooplankton and benthic organisms in a wide variety of environments. A diverse array of sampling equipment was used to determine the species diversity, abundance, distribution and productivity of marine organisms. This work included the first biological oceanographic observations in the eastern arctic and the assessment of benthic communities in previously unstudied regions. Major contributions were made to international programs such as the Joint Global Ocean Flux Study (JGOFS). *Hudson* was also used to study the distribution of seabirds and whale migration. The results of this research had many applications, including understanding the effects of changes in ocean climate on marine ecosystems, fisheries and environmental management. Her work identifying sensitive seabed ecosystems played a major role in the creation of numerous protected areas closed to fishing activities such as The Gully Marine Protected Area (MPA), the coral closures in the Northeast Channel and the Stone Fence at the mouth of the Laurentian Channel and the closures in NAFO areas outside Canadian jurisdiction.

Numerous programs were carried out using *Hudson* to measure the impact of human activities on the ocean environment. One international

study examined the feasibility of disposing radioactive wastes in deep water sediments on the Sohm Abyssal Plain. The results clearly indicated that this was not advisable so the idea was dropped. Considerable effort was devoted to studying the fate and effects of operational wastes (drilling muds, cuttings and produced water) released from offshore oil and gas platforms on the Grand Banks and Sable Island Bank. These results were used to improve environmental monitoring programs and operational regulations. *Hudson* was also involved in carrying out large-scale field experiments with fishing vessels to determine the impacts of otter trawls and hydraulic clam dredges on benthic habitat and communities.

Beginning in 1998, *Hudson* was the principal vessel used in support of the Atlantic Zone Monitoring Program (AZMP), a major initiative involving the four Atlantic regions of DFO. Cruises collected physical, chemical and biological data along sixteen transects off Newfoundland and Labrador, Nova Scotia and in the Gulf of St. Lawrence to characterize oceanic variability at seasonal, interannual and decadal time scales and to establish relationships among the biological, chemical and physical variables. This extensive database, which continues to grow, is being used in many ways including assessing the impacts of climate change, validation of remote sensing data and oceanographic numerical models and the ecosystem management of fisheries. The results are reported in annual State of Ocean reports.

Hudson made many valuable contributions beyond serving as a platform for oceanographic research. While at sea, she was always on call for search and rescue missions and responding to environmental emergencies. In 1976, she rescued the crew of the *Cape Freels* who had taken to lifeboats after their fisheries patrol vessel caught fire and sank off Newfoundland. In 1979, she responded to the breakup of the oil tanker *Kurdistan* in the Cabot Strait. In 1982, she was the first to arrive on the scene when the *Ocean Ranger* capsized and sank in a severe storm on the Grand Banks. All hands were lost but she did recover some bodies and took them into St. John's. In 1987, *Hudson* rescued all 24 crew members of the MV *Skipper I*, a large bulk-carrier which foundered off the Grand Banks in hurricane-force winds and took them into St. John's. Then, in 1988, *Hudson* found the burning wreckage of the *Athenian Venture*, a Greek oil tanker which exploded and broke into two off Cape Race, Newfoundland. A day-long search found only one body of the twenty-nine people believed

to be on board. In 1988 she was involved in conducting surveys at the crash site of Swiss Air Flight 111 off Peggy's Cove and, in 2006, she suffered considerable damage when steaming to assist a stranded sailing vessel under hurricane conditions on the Grand Banks.

Over her career, *Hudson* suffered several mishaps of her own. For example, there were engine room fires in 1966 and 1974 with the latter leaving her dead in the water for several hours in the Sargasso Sea off Bermuda. Severe winter weather in the Labrador Sea in 1976 resulted in heavy seas smashing some windows and flooding the officer's lounge. That same year she lost a propeller in Lancaster Sound and had to finish her program and limp home under half power. Perhaps the potentially most threatening incident occurred in 1993 when she collided with an iceberg in Kangelugsuuak Fjord on the east coast of Greenland and ruptured her hull. Fortunately, there was a Danish naval vessel with a helicopter and divers nearby which came to her rescue and escorted her safely to Iceland for repairs.

On many occasions *Hudson* was open to the public. In 1967, she steamed to Montreal and welcomed over 20,000 visitors in just one week at Expo 67. She was frequently opened for public tours when visiting foreign ports and was always a popular attraction at BIO open houses. In addition, she also hosted many distinguished visitors both at home and away, including a visit of The Right Honourable Roland Michener, the Governor-General of Canada, in 1968.

In the mid 1990s, it was well recognized that *Hudson* would not last forever and discussions began on obtaining a suitable successor. While some early consultations on vessel design had occurred, it was not until 2017 that plans were finally announced to build a new Offshore Oceanographic Science Vessel (OOSV) as part of Canada's National Ship Building Strategy. This vessel is now under construction in Vancouver, BC and expected to arrive at BIO about 2026. This new vessel, yet unnamed, has specifications very similar to *Hudson* but will have a quite different deck layout and be equipped with new features including a dynamic positioning system for station keeping and multibeam sounding systems. While she appears on paper to be a suitable successor, it remains to be seen how well she will perform at sea under adverse conditions.

Near the end of her career, *Hudson* suffered numerous breakdowns which reduced her sea time considerably and unfortunately disrupted important time series of data collection. She never got to sea in 2017

and 2019. Several refits were carried out to extend her lifetime until her successor was available. However, time ran out and in early 2022 the Coast Guard announced that *Hudson* would be retired. She returned to BIO for the last time in January, a farewell open house for crew and staff was held in May and a formal decommissioning ceremony took place in July. In December, she left BIO under tow for the last time, almost 59 years to the day after she first arrived from Saint John, NB, and temporarily tied up on the Halifax side of the Narrows. In 2023, *Hudson* left Halifax Harbour for the last time and was towed to the R.J. MacIsaac Construction Ltd. shipyard in Sheet Harbour for demolition. Until the new Offshore Oceanographic Science Vessel arrives, east coast oceanographic cruises will reply on other vessels in the Coast Guard fleet or commercial charters.

Her longevity of 59 years is quite exceptional for research vessel, three years longer than the venerable CSS *Acadia*. However, it falls short of the 76 years that RV *Atlantis* served the Woods Hole Oceanographic Institution and the Argentinian Navy.

In summary, due to her size, facilities, crew and sea kindliness, *Hudson* was an exceptional oceanographic vessel. She went where few research ships could go and could work safely under extreme conditions. As a result, she supported ground-breaking multidisciplinary research throughout the world's oceans. She was an important factor in making BIO one of the top oceanographic institutes in the world. She became the queen of the Canadian oceanographic fleet and an icon for BIO. Both scientists and crew became very attached to her. In retrospect, the initial investment in building *Hudson,* $7,500,000, has paid huge dividends for Canada. She will be sadly missed but a similar successor is on the horizon. Her legacy of Canadian oceanographic research has provided a fundamental understanding of the waters and seabed surrounding Canada like no other ship and which will serve as a benchmark for the future generation of studies. She will be a tough act to follow.

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REFERENCES

Fig 1a The brand-new *Hudson* arriving at BIO in December 1963.

Fig 1b *Hudson* working in ice.

Fig 1c New colours after transfer to the Canadian Coast Guard.

Fig 1d ***Hudson*** **studying a natural hydrocarbon seep in Scott Inlet, Baffin Island.**

Fig 1e ***Hudson*** **studying operational drilling wastes at Hibernia.**

Fig 1f ***Hudson*****'s final return to BIO in January 2022.**