UNITED NATIONS DECADE OF OCEAN SCIENCE
FOR SUSTAINABLE DEVELOPMENT

2021-2030
NATIONAL OCEANOGRAPHIC PLAN

2022 Update

NATIONAL OCEANOGRAPHIC COMMITTEE
2020

United Nations Decade of Ocean Science for Sustainable Development
2021-2030 NATIONAL OCEANOGRAPHIC PLAN

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Each geographic diagram in this document is simplified, and it does not compromise the Chilean State in any way.

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I.- INTRODUCTION

The National Oceanographic Committee (CONA) is currently composed of 31 national institutions, including governmental bodies and services, universities, institutes, scientific societies and companies. It was created by Supreme Decree No. 814 of 10 September 1971, and is chaired by the Director of the Hydrographic and Oceanographic Service of the Chilean Navy (SHOA).

CONA is responsible for organizing national bodies and entities dedicated to the research of the ocean and its natural resources, assisting the Committee's President to elaborate, promote and maintain national programs in marine sciences, and preparing an Oceanographic Plan that systematically establishes the national oceanographic scientific activities. The creation decree, in item 5.b), states: "It is the responsibility of the Committee to ensure that the Chilean Decade Plan of Oceanographic Research is kept up to date".

In this context, the Hydrographic Institute of the Chilean Navy (currently SHOA) elaborated the first 1970-1980 Decennial Plan of Oceanographic Research, which has been updated over the years. Its last issued version as National Oceanographic Plan, in 2010, was in force until 2020.

For the drafting of these plans, the Committee has coordinated their preparation with the marine scientific community, which has actively participated contributing to identifying the priority topics of national interest.

In this opportunity, CONA endeavors that the 2021-2030 National Oceanographic Plan constitutes the Chilean response to the **United Nations 2030 Agenda for Sustainable Development** and, mainly to the **United Nations Decade of Ocean Science for Sustainable Development**, initiative that has been called for by the United Nations (UN), on recommendation of the Intergovernmental Oceanographic Commission (IOC). The plan should link national priorities with the world process, within the framework of existing structures and resources available at a national level.

For the preparation of this National Plan, CONA established the DECADE task group, which was assigned the following working program:

- To propose, in the 142nd Assembly of CONA (Jun. 2019), the necessary actions for the setting of a National Plan on the Decade, considering indicators of expected progress and achievement regarding Target 14A of the Sustainable Development Goal No.14 of the 2030 Agenda, aiming at contributing to UN with National Reports.

- To propose, in the 143rd Assembly of CONA (Nov. 2019), a 2021-2030 National Research Plan to be run by the national marine scientific community as a contribution to the United Nations Decade of Ocean Science for Sustainable Development, according to the guidelines proposed by IOC in its document called "Roadmap for the United Nations Decade of Ocean Science for Sustainable Development". Likewise, to suggest the related protocol for monitoring the development of the Plan.

This document is the result of the work of the DECADE Task Group.

II.- DIAGNOSIS OF THE MARINE SCIENTIFIC RESEARCH CAPACITY IN CHILE

A.- General

With the objective of making a diagnosis of the capacity to carry out a Marine Scientific Research (MSR) in Chile, the following aspects should be considered: human resources, infrastructure, equipment and funding. Human resources comprise qualified researchers, whose preparation level ranges from students to professionals, master's degrees and doctorates. In terms of infrastructure, it is mainly related to research centers, where duly implemented offices and laboratories operate for the development of the different areas of marine sciences. Regarding equipment, coastal stations, monitoring systems and the use of vessels are highlighted. In relation to funding, we refer to the resources made up of contributions to research through projects, scholarships for students, funds for the operation of research centers, among others.

Each of these aspects is detailed below. As a whole, they will allow us to describe what we have called capacity to carry out MSR in Chile.

B.- Human Resources

We think it is important to dimension and quantify the available and active human resource in the work related to MSR.

At the level of professional education, 14 institutions offer degrees in the area of marine biology: 11, aquaculture; 3, oceanography; and 1, ocean civil engineering. This gives an approximate capacity of 442 quotas.

Regarding technical higher education, 5 institutions deliver degrees in the field of aquaculture with 140 quotas. Likewise, 17 doctoral programs and 21 master programs in marine o related disciplines are offered.

1. Bachelor's degrees

The following table gives information on bachelor's degrees in the field of Marine Sciences, offered by Chilean universities.

Table 1a. Bachelor's degrees related to Marine Sciences

DEGREE	INSTITUTION	QUOTAS	SEMESTERS
Marine Biology (1)	Pontifical Catholic University of Chile	30	10
Marine Biology	Andrés Bello University	60	10
Marine Biology	Arturo Prat University	10	10
Marine Biology	Austral University of Chile	45	10
Marine Biology	Catholic University of the Most Holy Conception	25	10
Marine Biology	Catholic University of the North	15	10
Marine Biology	University of Antofagasta	15	10
Marine Biology	University of Concepción	35	10
Marine Biology	University of Los Lagos	62	10
Marine Biology	University of Magallanes	20	10
Marine Biology	University of Valparaíso	50	10
Aquacultural Engineering (2)	Andrés Bello University	0	10
Aquacultural Engineering	Catholic University of the North	10	10
Marine Biotechnology and Aquacultural Engineering	University of Concepción	20	10
Ocean Civil Engineering	University of Valparaíso	30	12
Oceanography (3)	Pontifical Catholic University of Valparaíso	15	10
TOTAL QUOTAS	-	442	-

(1) With special admission, up to 43 quotas.
(2) Since 2017, student admission is closed.
(3) While Oceanography in the Pontifical Catholic University of Valparaíso (PUCV) has been offering 15 vacancies the last years, the actual enrollment has always exceeded 20 students, reaching up to 28 in 2018.

2. Technical degrees

The following table gives information on technical degrees related to Marine Sciences, provided by Chilean universities and centers.

Table 1b. Technical degrees related to Marine Sciences

DEGREE	INSTITUTION	QUOTAS	SEMESTERS
Higher Technician in Aquaculture	Arturo Prat University	25	4
Higher Technician in Aquaculture	Catholic University of Temuco	15	4
Higher Technician in Salmon Farming	Austral University of Chile	30	5
Higher Technician in Aquaculture	University of Magallanes	30	4
Higher Technician in Aquaculture Production	Santo Tomás Technical Training Center	40	5
TOTAL QUOTAS	-	140	-

3. Postgraduate programs

The following table shows information on the doctoral (17) and master's (21) postgraduate programs offered by Chilean universities, centers and institutes.

Table 1c. Postgraduate Programs related to Marine Sciences

DOCTORAL POSTGRADUATE PROGRAM	UNIVERSITY - CENTER - INSTITUTE
Doctorate in Aquaculture	Pontifical Catholic University of Valparaíso, Catholic University of the North, University of Chile
Doctorate in Marine Biology	Austral University of Chile
Doctorate in Biology and Applied Ecology	University of la Serena / Catholic University of the North/ Center for Advanced Studies in Arid Zones(CEAZA) / Institute of Agricultural Research (INIA)
Doctorate in Environmental Sciences, mention in Continental Aquatic Systems	University of Concepción
Doctorate in Antarctic and Subantarctic Sciences	University of Magallanes
Doctorate in Applied Sciences, mention Coastal Marine Systems	University of Antofagasta
Doctorate in Biological Sciences, mention Ecology	Pontifical Catholic University of Chile
Doctorate in Aquaculture Sciences	Austral University of Chile
Doctorate in Sciences, mention in Biodiversity and Bio-resources	Catholic University of the Most Holy Conception
Doctorate in Sciences, mention in Conservation and Management of Natural Resources	University of Los Lagos
Doctorate in Sciences, mention in Ecology and Evolutionary Biology	University of Chile
Doctorate in Sciences, mention in Management of Renewable Aquatic Resources	University of Concepción
Doctorate in Conservation and Management of Biodiversity	Santo Tomás University
Doctorate in Integrative Ecology	Mayor University
Doctorate in Ecology and Evolution	Austral University of Chile
Doctorate in Conservation Medicine	Andrés Bello University
Doctorate in Oceanography	University of Concepción
MASTER'S POSTGRADUATE PROGRAM	**UNIVERSITY - CENTER - INSTITUTION**
Master's Degree in Aquaculture	Catholic University of the North
Master's Degree in Aquaculture	Arturo Prat University
Master's Degree in Port Administration and Management	University of Valparaíso
Master's Degree in Applied Sciences, mention Fisheries Biology	Arturo Prat University
Master's Degree in Aquaculture Sciences	University of Chile

Master's Degree in Sciences, mention Biodiversity and Conservation	University of Valparaíso
Master's Degree in Sciences, mention Management and Conservation of Natural Resources in Subantarctic Environments	University of Magallanes
Master's Degree in Sciences, mention in Oceanography	University of Concepción
Master's Degree in Sciences, mention Fisheries	University of Concepción
Master's Degree in Sciences, mention Production, Management and Conservation of Natural Resources	University of Los Lagos
Master's Degree in Marine Sciences, mention Coastal Resources	Catholic University of the North
Master's Degree in Applied Ecology	Austral University of Chile
Master's Degree in Aquatic Systems Ecology	University of Antofagasta
Master's Degree in Marine Ecology	Catholic University of the Most Holy Conception
Master's Degree in Management of Aquatic Resources	Pontifical Catholic University of Valparaíso
Master's Degree in Environment	Catholic University of the Most Holy Conception
Master's Degree in Environment and Sustainable Development	Mayor University
Master's Degree in Meteorology and Climatology	University of Chile
Master's Degree in Aquaculture Nutrition	Austral University of Chile
Master's Degree in Oceanography	Pontifical Catholic University of Valparaíso / University of Valparaíso
Master's Degree in Natural Resources	Andrés Bello University

4. Participation of national human resource in the international platform

The human resource that integrates the national marine scientific community actively participates in the international platform. Perhaps, the most relevant aspect is to identify the organizations, working groups, commissions or committees where there is an active participation, with the aim of obtaining an overview on the specific disciplines and subjects involved, not quantitatively dimensioning the number of technicians, professionals or experts engaged. Table 2 shows a summary of this participation.

Table 2. Participation in the International Platform

INTERNATIONAL ORGANIZATION	PARTICIPATING NATIONAL INSTITUTION
International Seabed Authority (ISA)	Directorate General of the Maritime Territory and Merchant Marine (DIRECTEMAR)-Ministry of Foreign Affairs (MINREL)-Ministry of Mining
Big Ocean Network (Management and Best Practice of Large Scale Marine Areas)	Catholic University of the North
Commission for the Conservation of Antarctic Antarctic Marine Living Resources (CCAMLR)	Chilean Antarctic Institute (INACH)-Antarctic Directorate (DIRANTARTICA)-Undersecretariat for Fisheries (SUBPESCA)
Permanent Commission for the South Pacific (CPPS), Coordinated Program for Research, Surveillance and Control of Marine Pollution in the Southeast Pacific (CONPACSE)	DIRECTEMAR-SHOA-SUBPESCA

INTERNATIONAL ORGANIZATION	PARTICIPATING NATIONAL INSTITUTION
United Nations Convention on the Law of the Sea (UNCLOS)	DIRECTEMAR-MINREL
CPPS, Regional Study of the “El Niño” Phenomenon (ERFEN)	Meteorological Directorate of Chile (DMC)-Fishing Promotion Institute (IFOP)-SHOA-SUBPESCA
CPPS, GOOS (Global Ocean Observing System) Regional Alliance for the South-East Pacific Region (GRASP)	SHOA
CPPS, Database Specialized Working Group (GT-BD)	SHOA
CPPS, Tsunami Specialized Group (GT-Tsunami)	SHOA
COP25 Water	Catholic University of the Most Holy Conception
COP25 Oceans	Catholic University of the Most Holy Conception -INACH
COP25 Cryosphere	Austral University of Chile-INACH
International Study of the Marine Biogeochemical Cycles of Trace Elements and Isotopes (GEOTRACES)	Center for Research on Patagonia Ecosystems (CIEP)
Committee for Environmental Protection (CPE) of the Antarctic Treaty System	INACH
Global Ocean Acidification Observing Network (GOA-ON)	CIEP
GOA-ON, Latin American Ocean Acidification Network (LAOCA)	Center for Advanced Studies in Arid Zones (CEAZA)
Global Seamount Assessment Program (GSAP)	Catholic University of the North - Millennium Nucleus Center of Ecology and Sustainable Management of Oceanic Islands (ESMOI)
Intergovernmental Oceanographic Commission (IOC), Advisory Body of Experts on the Law of the Sea (ABE-LOS), Advisory Council of Experts on the Law of the Sea	SHOA
IOC, Global Investigation of Pollution in the Marine Environment (GIPME)-Marine Pollution Monitoring Programme System (MARPOLMON), Marine Pollution Research and Monitoring	DIRECTEMAR-SHOA
IOC, Global Ocean Observing System (GOOS)	SHOA
IOC, Global Sea Level Observing System (GLOSS)	SHOA
IOC, Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG-PTWS), Pacific Tsunami Warning International System , International Tsunami Center (ITIC), Tsunami Information Center; International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU), Tsunami Warning System	SHOA
IOC, International Oceanographic Data and Information Exchange (IODE)	SHOA
IOC, Ocean Data and Information Network for the IOCARIBE and South America Regions (ODINCARSA-LA), Ocean Data Regional Group and Information Network for Latin America, South America and the	SHOA

INTERNATIONAL ORGANIZATION	PARTICIPATING NATIONAL INSTITUTION
Caribbean	
IOC, Intergovernmental Panel on Harmful Algal Blooms (IPHAB), Group of Harmful Algal Blooms of South America	SHOA-IFOP-National Fisheries Service (SERNAPESCA)
International Association for the Physical Sciences of the Oceans (IAPSO), participation in sea level, tides and tsunami issues	SHOA
International Association of Aquatic and Marine Science Libraries and Information Centers (IAMSLIC)	University of Magallanes
International Hydrographic Organization (IHO)	SHOA
IHO Tides, Water Level and Currents Working Group (TWCWG)	SHOA
International Union for Conservation of Nature (IUCN), World Commission on Protected Areas (WCPA)	Catholic University of the North
IUCN, Large Scale Marine Protected Areas Task Force	Catholic University of the North
Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) Working Group 40	Catholic University of the North -ESMOI
Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM), from World Meteorological Organization (WMO) and Intergovernmental Oceanographic Commission (IOC), Joint Committee for Oceanography and Marine Meteorology	Chilean Navy Weather Service (SERVIMET)-SHOA
Joint IOC/WMO/CPPS Working Group on the Investigations of El Niño	Directorate for the Environment (DIMA)-DMC-MINREL-SHOA-University of Chile
International Maritime Organization, London Convention and Protocol	DIRECTEMAR
Antarctic Treaty Consultative Meeting	INACH-DIRANTÁRTICA-DIRECTEMAR
Meeting of Managers of Latin American Antarctic Programs	INACH
Scientific Committee on Antarctic Research (SCAR)	INACH
Scientific Committee on Oceanic Research (SCOR)	SHOA- SCOR NATIONALCOMMITTEE
SCOR, full member, Chemical Speciation Modelling in Seawater to meet 21st Century Needs, SCOR WG 145	CIEP
SCOR, full member, Changing Ocean Biological Systems, SCOR WG 149	Austral University of Chile
Expert Team on Sea Ice (WMO-ETSI), International Ice Charting Working Group (IICWG)	SERVIMET
South Eastern Pacific Circulation from Argo Floats (SEPICAF)	CEAZA-Catholic University of the North-University of Concepción-Pontifical Catholic University of Valparaíso
Ship Observations Team (WMO-SOT), Voluntary Observing Ships (VOS)	SERVIMET
World Wide Met-Ocean Information and Warning Services Coordinators (WWMIWS-C) METAREA-XV	SERVIMET

C.- Infrastructure

Infrastructure considers the formal organization created in Chile for coordinating MSR, which mainly includes the National Oceanographic Committee (CONA) and the Chilean Society of Marine Sciences (SCHCM). Likewise, the presence and availability of research centers, institutes and laboratories is considered as infrastructure, in addition to publications, libraries, databases and digital repositories.

1. National Oceanographic Committee (CONA)

The National Oceanographic Committee is a public body created by Supreme Decree No. 814 of 10 September 1971, with the purpose of assisting and coordinating the institutions that carry out oceanographic research, in compliance with Law No. 16771 in the field of oceanography.

Originally, the Committee consisted of the following 9 institutions:

- Hydrographic and Oceanographic Service of the Chilean Navy (SHOA)
- Ministry of Foreign Affairs, Directorate of Environment and Ocean Affairs (MINREL-DIMA)
- Fishing Promotion Institute (IFOP)
- Pontifical Catholic University of Valparaíso (PUCV)
- Chilean Navy Weather Service (SERVIMET)
- National Service of Geology and Mining (SERNAGEOMIN)
- National Fisheries Service (SERNAPESCA)
- University of Concepción (UDEC)
- University of Chile (UCH)

Since its creation in 1971 to date, the following institutions have been incorporated (22):

- Undersecretariat for Fisheries (SUBPESCA)
- Andrés Bello University (UNAB)
- Arturo Prat University(UNAP)
- Austral University of Chile (UACH)
- Catholic University of the Most Holy Conception (UCSC)
- Catholic University of the North (UCN)
- University of Antofagasta (UANTOF)
- Pontifical Catholic University of Chile (PUC)
- National Research and Development Agency (ANID) [former National Commission for Scientific and Technological Research (CONICYT)]
- Meteorological Directorate of Chile (DMC)
- Chilean Antarctic Institute (INACH)
- National Oil Company (ENAP)
- National Museum of Natural History (MNHN)

- Ministry of Health (MINSAL)
- University of Los Lagos (ULAGOS)
- Directorate General of the Maritime Territory and Merchant Marine (DIRECTEMAR)
- University of Magallanes (UMAG)
- University of Valparaíso (UV)
- Minera Escondida Ltda.
- Chilean Society of Marine Sciences (SCHCM)
- Ministry of the Environment (MMA)
- Mayor University (UMAYOR)

CONA's President is the Director of SHOA, who has the support of the Executive Secretariat and the assistance of the Assembly, the Technical Council on Planning and Programming (CTPP) and 10 Working Groups.

2. Chilean Society of Marine Sciences (SCHCM)

The Chilean Society of Marine Sciences is a private law corporation created on 14 October 1994, whose origin and structure comes from the Committee of Marine Sciences-Chile, founded on 17 December 1960.

SCHCM's objectives are the promotion and dissemination of scientific and technological research in the field of Marine Sciences, the scientific, educational and technical counseling of public or private, national, and international institutions, the publication and circulation of the works of the Society, its members or other people, and, in general, any action aimed at the better understanding by the community of the importance of Marine Sciences for the Chilean scientific, economic, social and cultural development.

Currently, SCHCM has a record of 335 associates and its organizational chart is composed of the Board of Members, the Directory and the Advisory Committee. The Directory is made up of a President, Vice President, Secretary, Treasurer and Director, which is entirely renewed every two years.

3. Centers and Institutes of marine scientific research

The following table provides information on some of the Centers and Institutes committed to developing marine scientific research, and indicates their sponsoring and/or host institution(s).

Table 3. Centers and Institutes of Scientific Research related to Marine Sciences

CENTER	HOST INSTITUTION
Biotecmar	Catholic University of the Most Holy Conception
Aquaculture Fisheries Center of Applied Research (CAPIA)	Santo Tomás University
Bahía Lomas Center	Santo Tomás University
UC Center for Global Change	Pontifical Catholic University of Chile
(Center of Applied Ecology and Sustainability CAPES) (*)	Pontifical Catholic University of Chile
Center for Climate and Resilience Research (CR)2 (*)	Sponsored by the University of Chile, in association with the Austral University of Chile and the University of Concepción, among others
Center for Advanced Studies in Arid Zones (CEAZA) (*)	Not applicable
Center for Studies of the Quaternary, Fire-Patagonia and Antarctica (CEQUA foundation) (*)	Founded by the University of Magallanes and the Fishing Promotion Institute
Austral Biotech Research Center	Santo Tomás University
Center for Climate Change Research and Innovation (CIICC)	Santo Tomás University
Center for the Socioeconomic Impact of Environmental Policies (CESIEP)	Pontifical Catholic University of Chile and University of Talca as host institutions; University of Conception, University of el Desarrollo, Mayor University as partner institutions
Research and Technological Center in Applied Phycology and other Biological Resources (CIDTA)	Catholic University of the North
Patagonian Research Center (CIEP) (*)	Main institution: Austral University of Chile. Partner institution: University of Concepción
GAIA Antarctica Research Center (CIGA)	University of Magallanes
Research Center for Integrated Disaster Risk Management (CIGIDEN) (*)	Pontifical Catholic University of Chile, Federico Santa María Technical University, Andrés Bello University and Catholic University of the North
Research Center and Natural Resources Management (CIGREN)	University of Valparaíso
Center for Oceanographic Research COPAS Sur-Austral (*)	University of Concepción
Marine Observation Center for the Study of Risks from Coastal Environment (COSTA-R)	University of Valparaíso
Regional Center of Environmental Studies (C.R.E.A.)	Catholic University of the Most Holy Conception
Center of Environmental Sciences (EULA)	University of Concepción
Center for Dynamic Research of High Latitude Marine Ecosystems (IDEAL) (*)	Led by Austral University of Chile (UACH), with the following partner institutions: University of Concepción (UDEC) and the Center for Studies of the Quaternary, Fire-Patagonia and Antarctica (CEQUA) in Punta Arenas. The Chilean Antarctic Institute (INACH) provides the logistics financing
Center for Research on Biodiversity and Sustainable	Catholic University of the Most Holy

CENTER	HOST INSTITUTION
Environments (CIBAS)	Conception
Center for Environmental Research (CENIMA)	Arturo Prat University
Quintay Center of Marine Research (CIMARQ)	Andrés Bello University
Center for Research and Development of Coastal and Environmental resources (i~ mar)	University of Los Lagos
Interdisciplinary Center for Aquaculture Research (INCAR)	University of Concepción as host institution. Andrés Bello University and Austral University of Chile as partner institutions
Center for the Study of Multiple-Drivers on Marine Socio-Ecological Systems (MUSELS) (**)	University of Concepción
Cape Horn Sub-Antarctic Center	Institute of Ecology and Biodiversity, University of Magallanes, Pontifical Catholic University of Chile, University of North Texas
Hémera Earth Observation Center	Mayor University
Puerto Montt Institute of Science and Technology	Arturo Prat University
Institute of Marine and Limnological Sciences	Austral University of Chile
Institute of Ecology and Biodiversity (IEB)	Not applicable
Patagonian Institute, areas of biology, geosciences and environmental studies group	University of Magallanes
Millennium Institute of Oceanography (IMO)	University of Concepción and Pontifical Catholic University of Chile
Laboratory of physical modelling of coastal processes, University of Valparaíso	School of Ocean Civil Engineering, University of Valparaíso
Millennium Nucleus CYCLO (**)	Austral University of Chile, University of Concepción, Pontifical Catholic University of Valparaíso
Millennium Nucleus Center of Ecology and Sustainable Management of Oceanic Islands (ESMOI) (**)	Host Institution: Catholic University of the North; Partner institutions: University of Chile, University of Concepción
Millennium Nucleus Paleoclimate	University of Chile and Pontifical Catholic University of Chile
Millennium Nucleus of Invasive Salmonids (INVASAL)	Host Institution: University of Concepción. Participation of researchers from University of Antofagasta, University of Valparaíso, University of Chile, University of Concepción, University of Magallanes and the Melimoyu Ecosystem Research Institute (MERI Foundation)
Observatory for the Sustainability of Aquaculture Ecosystem (OSEA)	Project from the University of Los Lagos
Network for Extreme Environment Research (NEXER)	University of la Frontera, University of Antofagasta, University of Magallanes
The interplay between subduction processes and natural disasters in Chile (INSUD)	University of Chile

(*) The abovementioned centers were created with funding from ANID (former CONICYT).

(**) The abovementioned centers were created with funds from Millennium Science Initiative.

4. Visualizers and databases

There are some portals and means for the visualization of the data gathered by different equipment and monitoring networks, under the administration of specific entities or jointly by some of them. However, it is deemed necessary to have integrated, coordinated and centralized information in the event of an emergency so as to perform analysis and early detection of contingencies and their proper management.

Table 4 indicates some of the information visualizers available in the country.

Table 4. Visualizers and databases

VISUALIZER	INSTITUTION	PARAMETERS
National Register of Protected Areas http://areasprotegidas.mma.gob.cl/	MMA	Register of information on Chilean terrestrial, marine, public and private protected areas
Electronic Library and Platform of Technological Management of the Mytilus chilensis Resource (BiblioMit) https://www.bibliomit.cl/	Technological Institute of Mussel Farming (INTEMIT)	pH, salinity, oxygen, phytoplankton
Center for Oceanographic and Meteorological Data, CDOM http://www.cdom.cl/	COPAS Sur-Austral + CEAZA	Temperature, salinity, oxygen concentration, among other oceanographic and meteorological parameters
CEAZA-Met http://www.ceazamet.cl/	CEAZA	Meteorological and oceanographic parameters, such as air temperature, atmospheric pressure, wind direction and intensity, oxygen, salinity, water temperature and chlorophyll
Chilean Integrated Ocean Observing System, CHIOOS https://chioos.cl/	UDEC	Online data on surface currents, wave height and wave power from WERA HF ocean radars in Hualpén Lighthouse and Edificio Olas. Currently not available online
Oceanographic and Atmospheric Information System in the Los Lagos and Aysén Regions, CHONOS http://chonos.ifop.cl/	IFOP	Real-time data and 72-hour synoptic forecast of currents, temperature, salinity and atmospheric variables
POAL Data visualizer https://www.directemar.cl/directemar/site/edic/base/port/datos_poal.html	Directorate of Maritime Interests and Aquatic Environment (DIRINMAR)	Environmental monitoring data: water matrix, sediment and biota
Davis Automatic Weather Stations in the Captain of the Port's Offices http://web.directemar.cl/met/jturno/estaciones/davis.htm	SERVIMET	Real-time data and online records of atmospheric pressure, wind direction and intensity, air temperature, relative humidity, precipitations, extreme values and trends (daily-monthly-annual)
Coastal Synoptic Weather Stations (VAISALA) http://orca.directemar.cl/Meteo/	SERVIMET	Display of online data on atmospheric pressure, wind direction and intensity, air temperature and relative humidity (last 72 hours)

VISUALIZER	INSTITUTION	PARAMETERS
Weather Explorer http://explorador.cr2.cl/	CR2	Air temperature, precipitation, discharge in coastal stations
Marine Explorer http://marino.minenergia.cl/	Ministry of Energy	Tool for analyzing wave behavior on the coasts of continental Chile
GEOOSs Observational Geoportal https://geoos.org/	San Ignacio del Huinay Foundation+ PUCV	Display, downloading and integration of georeferenced information from other portals and providers of national and international scientific and technical data from different areas, such as oceanographic and meteorological data, satellite imagery and modeling
Salmon Chile INTESAL http://mapas.intesal.cl/publico/	Salmon Technological Institute (INTESAL)	Phytoplankton, harmful algae, red tide, chlorophyll *a* concentration
Swell Warning System, SAM https://marejadas.uv.cl/	School of Ocean Civil Engineering, UV	7-day wave forecast
General Forecast http://www.meteochile.gob.cl/	DMC	Real-time and delayed time data, regarding daily, monthly and annual data on temperature, precipitation, atmospheric pressure, wind, humidity, radiation, etc.
Chilean Wave Atlas https://oleaje.uv.cl/	School of Ocean Civil Engineering, UV	Statistical and wave forecast information
Valdivia Environmental Monitoring Network, R.E.M.A. https://rema.uach.cl/	UACH	Water and meteorological parameters, such as air temperature, atmospheric pressure, wind direction and intensity, solar radiation, rainfalls, relative humidity, salinity, temperature, oxygen and water level
Sea Surface Temperature and Attached Sensors http://www.shoa.cl/php/tsm.php http://www.shoa.cl/php/sens_mar.php	SHOA	Sea surface temperature, and some stations that monitor air temperature, atmospheric pressure and relative humidity
Wave buoys real- time monitoring http://www.shoa.cl/php/boyas?idioma=es	SHOA	Watchkeeper and Triaxys Buoys meteorological and oceanographic parameters
Climate simulation platform http://simulaciones.cr2.cl/	CR2+MMA	Data visualization and downloading to perform weather forecast
Environmental Data Time Series of the Magallanes and Chilean Antarctic Region, STARM http://www.starm.cl/	IDEAL+UACH	Water and meteorological parameters, such as air temperature, atmospheric pressure, wind direction and intensity, solar radiation, rainfalls, relative humidity, salinity and temperature
Meteorological visualizer and Climate Simulation Platform http://vismet.cr2.cl/	CR2+UCHILE	Current and historical data display system (precipitation and air temperature), recorded at an hourly level in more than 500 stations operated by the Meteorological Directorate of Chile, the Directorate General of Waters and the National Agroclimatic Network

5. Libraries, resources and visibility of marine scientific information

a.- Libraries

The country has an infrastructure composed of libraries and information centers, which mainly belong to universities. Nevertheless, the units specialized in the marine-aquatic area are scarce, among them:

1) Library of the Faculty of Marine Sciences and Natural Resources from the University of Valparaíso.

2) Library of the Faculty of Natural Resources from the Pontifical Catholic University of Valparaíso.

3) Library of the Fishing Promotion Institute.

4) Library of the Hydrographic and Oceanographic Service of the Chilean Navy.

5) Maritime Technical Library (BTM) from the Directorate of Maritime Interests and Aquatic Environment.

Information resources on aquatic and marine sciences are part of the bibliographical information kept by other information units, such as those dependent on the Arturo Prat University, Catholic University of the North, University of Concepción, University of the Most Holy Conception, Austral University of Chile, University of Magallanes and on other institutions, namely the National Service of Geology and Mining, the National Museum of Natural History and the Chilean Antarctic Institute.

Most of the libraries belonging to the country's study centers have access to millions of digital documents through databases in the most diverse areas, such as IEEE, Scopus, Web of Science, EBSCO and JSTOR.

The Electronic Library of Scientific Information (BEIC), program funded by ANID and administered by the Consortium for Access to Electronic Scientific Information (CINCEL), is the most important instrument of access to scientific information of the country and is **freely** available for all the national institutions (100 to date) that conduct research activities on science and technology and that are CINCEL associates or clients. BEIC provides access to the full text of journals that are selected or published by editors like Springer, Oxford University Press, Science Direct-Freedom Collection, Wiley-Blackwell, Science Magazine, ACS Web Editions, Annual Reviews and Nature Publishing Group.

It should be noted that, given the importance of this topic for the marine scientific knowledge dissemination within the framework of the work of CONA, there is the Working Group on “Marine Information Management” (WG MIM), which brings together librarians from the main information units or libraries of the country related to the marine scientific community

The objectives of the WG MIM are:

- Develop activities and/or projects aimed at the identification and systematization of the sources and points of access to Chilean marine scientific literature, to make it available to researchers.

- Maintain contact and collaboration with professionals of other areas, especially with CONA’s Working Groups in activities that promote the identification, organization and dissemination of marine scientific information.
- Organize, promote and participate in training and development events related to Marine Sciences information.

- Promote the exchange of marine and aquatic scientific information among the information units belonging to CONA, particularly that generated as a result of the activities of CONA and its Working Groups, such as workshops, seminars, congresses, etc.

b.- Chilean scientific journals on aquatic and marine sciences

In general, the number of scientific journals and, in particular, of Marine Sciences journals, has followed a decreasing trend in the last decade. Several titles of journals have disappeared, and the ones still present do not keep the printed format and are completely digital, as a consequence of phenomena from the whole editorial industry, technological innovations and the dissemination of information on the internet. The above, owing to the immediacy of digital information, lower edition costs, the possibility of including multimedia content, real-time content updates and a digital audience without geographical barriers. To date, the titles of national journals available are:

- *Latin American Journal of Aquatic Research*, former Investigaciones Marinas (Marine Research) (Pontifical Catholic University of Valparaíso), in digital format.

- *Revista de Biología Marina y Oceanografía (Journal of Marine Biology and Oceanography)* (University of Valparaíso), in digital format.

- *Gayana*, resulting from the merger of *Gayana Oceanología y Gayana Zoología* (Gayana Oceanology and Gayana Zoology) (University of

Concepción), in digital and printed format.

Some of the peripheral publications that, without being specifically aimed at studying the marine-aquatic problematics, contain work on the topic, are: *Revista Chilena de Historia Natural* (Chilean Journal of National History), Andean Geology (former *Revista Geológica de Chile*- Geologic Journal from Chile), *Revista Aqua* (Aqua Journal), *Revista de Geografía Norte Grande* (Far North Journal of Geography) and *Revista de Marina* (Marine Journal)

c.- Visibility and dissemination of marine scientific information

Publications and other results from marine scientific research are indexed and filed in diverse online information systems, such as indexes, directories, databases and digital repositories. The three titles of national marine scientific journals are included in the following services of indexes, abstracts and databases:

- *Gayana* (University of Concepción): Biological Abstracts, SciELO,Science Citation Index Expanded, Scopus, Zoological Record, ASFA, Agricultural & Environmental Science Database, BIOSIS Previews.

- *Revista de Biología Marina y Oceanografía* (University of Valparaíso): Biological Abstracts, BIOSIS Previews, SciELO, Science Citation Index Expanded, Scopus, ASFA, Zoological Record.

- *Latin American Journal of Aquatic Research* (Pontifical Catholic University of Valparaíso): ASFA, SciELO, Science Citation Index Expanded, Scopus, Zoological Record, Biological Abstracts, BIOSIS Previews.

Other online information systems that make Chilean journals on Marine Sciences visible, are:

- SciELO (Scientific Library On-Line): the scientific library SciELO Chile, regional project developed in Chile by ANID, is currently one of the best known academic databases, being an electronic library that includes a selected collection of Chilean scientific journals, in all areas of knowledge.

- DOAJ (Directory of Open Access Journals): it is an online directory of scientific and academic free access journals, meeting high quality standards through peer review or editorial quality control, freely available for everyone once they are issued, based on the definition of free access.

- RedALyC (Network of Scientific Journals of Latin America and the Caribbean, Spain and Portugal): system of indexation of open access journals of certified scientific and editorial quality.

- LATINDEX (Regional Online Information system for Scientific Journals from Latin America, the Caribbean, Spain and Portugal): it gathers and disseminates information on serial scientific publications produced in Ibero-America.

- BIBLAT (Latin American Bibliography): portal specialized in scientific and academic journals issued in Latin America and the Caribbean, which offers bibliographic reference services and full text of articles and documents published in more than 3.000 journals.

- DIALNET: it is one of the largest databases of scientific content in Ibero-American languages and has several documentary resources.

- PERIÓDICA (*Index of Latin American Journals in Sciences*): database that provides bibliographical records of original articles, technical reports and other documents issued in Latin American and Caribbean journals specialized in all areas of medicine, exact and natural sciences.

d.- Databases comprising aquatic sciences

- ASFA Database:

  Cited by the majority of professionals of aquatic and marine sciences information as their primary database. The Aquatic Sciences and Fisheries Abstracts (ASFA) database is the main reference in the field of fisheries, aquatic and marine sciences. The ASFA database has been published and distributed around the world by virtue of a cooperation agreement between the ASFA publisher (ProQuest) and the Food and Agriculture Organization of the United Nations.

  Input to the ASFA database is provided by a growing international network of information centers that monitors serial publications, books, reports, conference proceedings, translations and grey literature covering science, technology and management of marine, brackish water, and freshwater environments. The three titles of Chilean journals on aquatic sciences in force are incorporated in the ASFA database.

- Academic Research Complete (EBSCO):

  Designed for academic institutions, this multidisciplinary database is a leading resource for academic research. It is compatible with high

level research in key areas of academic study by providing journals, periodical publications, reports, books and more.

- SCOPUS (ELSEVIER):

  SCOPUS is a bibliographical database of abstracts and citations from articles of scientific journals. It encompasses areas of science, technology, medicine and social sciences (including arts and humanities). It contains journals, monographic series, congress acts, books and patents. In some cases, it gives access to the full text of the documents included. Likewise, it offers bibliometric tools to assess the performance of publications and authors, according to the citations from each article. These tools are based on metric studies conducted by different experts, such as the Spanish research group Scimago, or CWTS (Centre for Science and Technology Studies) from Leiden University (The Netherlands).

- GEOBASE (ELSEVIER)

  It is a database of indexed research literature unequalled in its coverage of international geoscience literature, which corresponds to earth sciences, ecology, geology, human and physical geography, environmental sciences, oceanography, geomechanics, alternative energy sources, pollution, waste management and nature conservation.

e.- Digital repositories

Institutional digital repositories, known as open access files, gather the intellectual production of a discipline or institution. They are an important means of collection, preservation and access to scientific production, providing the full text of documents with open access to the academic and scientific community.

They have emerged as a response from institutions, especially academic, due to the constant increase in prices and the need for institutions to conserve, preserve and make their intellectual heritage available to their academic and research community. Therefore, open access, free of economic and computing obstacles, and the dissemination of research results are the basic objectives of any repository, beyond the type of content included or the particular functionality given by the institution.

Regarding the marine field, it is worth noting the Inventory of Marine and Aquatic Repositories (IMAR), a joint project between the International Association of Aquatic and Marine Science Libraries and Information Centers (IAMSLIC) and the International Oceanographic

Data and Information Exchange (IODE) of the Intergovernmental Oceanographic Commission (IOC), to search for open access institutional repositories that include marine and/or aquatic environment content.

In 2019, 61 repositories from 22 countries have been identified, 5 of them of international character. The latter include the repositories OceanDocs, supported by the IODE program of IOC and Aquatic Commons of IAMSLIC, in collaboration with IODE and FAO-ASFA, which are detailed below:

- OceanDocs, from IODE-IOC contains publications on marine sciences in digital form, such as preprints, published articles, technical reports, working papers, etc. OceanDocs collects, preserves and facilitates access to the research results from members of the community of institutions linked to and represented in IODE-IOC.

- Aquatic Commons, with more than 20.000 documents to date, is a thematic repository covering marine, coastal, estuarine, brackish and fresh water environments. It includes all aspects of science, technology, management and conservation of these environments, their organisms and resources, as well as economic, sociological and legal aspects.

In the broader academic field, the *Red de Repositorios Latinoamericanos* (Latin American Repository Network) from the University of Chile offers simultaneous access to 138 institutional repositories from Latin America, providing a search engine and full text browsing of more than 2.200.000 academic documents developed by professors and researchers from the various institutions incorporated. Currently, repositories from 19 Latin American countries are available. The aim of this portal is providing an easy access tool to electronic publications issued in full text in different Latin American repositories.

Additionally, OpenDOAR (Directory of Open Access Repositories) is a global directory of open access academic repositories. OpenDOAR permits searching for repositories or the repositories' content. "LA Referencia" (the reference) has a similar function, a network of open access repositories in Latin America, with special emphasis on publicly funded results.

D.- Equipment for Marine scientific Research

1. Coastal stations

There are 16 coastal stations in Chile for marine sciences, 12 of them are operated by universities, 2 by the Fishing Promotion Institute (IFOP) and 2 by the Chilean Antarctic Institute (INACH). They are located in continental Chile, from the bay of Coquimbo in the north (29° 57' 56" S, 71°21'10" W) to Laredo bay in the south (52° 58' 09" S, 70° 49' 35" W). In the Chilean Antarctic Territory, these stations are situated in Fildes bay (62º 12' 04″S, 58º 57' 45″ W) and in South bay (64º 52' 33″S, 63º 35 '02″ W) (table 5 and fig.1).

Table 5. Coastal Stations

COASTAL STATIONS	UNIVERSITY - CENTER - INSTITUTE
Coastal Center of Marine Research, Guayacán	Catholic University of the North
Coastal Center of Marine Research, Tongoy	Catholic University of the North
Montemar Marine Biology Station	Faculty of Marine Sciences and Natural Resources from the University of Valparaíso
Quintay Marine Research Center (CIMARQ)	Andrés Bello University
Marine Research Coastal Station (ECIM), Las Cruces	Pontifical Catholic University of Chile
Dichato Marine Biology Station	University of Concepción
Abate Juan Ignacio Molina Marine Biology Coastal Station	Catholic University of the Most Holy Conception
Calfuco Coastal Laboratory of Aquatic Resources	Austral University of Chile
CEACIMA Marine Station	i~ mar, University of Los Lagos
Quempillén Experimental Station	Austral University of Chile
Hueihue Mariculture Center	Fishing Promotion Institute
Putemún Center of Technology for Aquaculture	Fishing Promotion Institute
Tortel Laboratory of Coastal Oceanography	University of Concepción, COPAS Sur-Austral, CIEP, Municipality of Tortel
Laredo Bay Center of Marine Culture	University of Magallanes
Profesor Julio Escudero Base, in Fildes Bay from Rey Jorge island	Chilean Antarctic Institute
Yelcho Base in South Bay, from Doumer island	Chilean Antarctic Institute

2. Monitoring networks

In the field of monitoring networks, there are currently oceanographic buoys and wave measurement buoys installed throughout the Chilean coast, as well as weather, sea level and wave stations using HF radar for the observation of oceanographic and meteorological parameters. However, given the high maintenance costs of the platform and the necessary equipment for their operation, information transfer and processing, this activity is developed within the framework of projects and specific institutions.

Likewise, there are other observation programs for the monitoring of biological parameters, pollution, biodiversity, etc. Nevertheless, there is no consolidated information in this regard to identify all the monitoring plans on Marine Sciences that are being developed. For that reason, identifying them is necessary for their coordination, integration and centralization, with the purpose of effectively and efficiently having information for use in management plans and eventual disasters, in addition to avoiding the multiplication of efforts and information.

Considering the needs indicated in the preceding paragraphs, the 2019 “Ocean Roundtable”, set up within the COP25 framework, drafted the report “Proposal for an Integrated Information System for the Ocean in Chile (CHIOOS)” that considers three implementation phases to be developed in a time frame of 6 to 8 years. This plan contemplates as its first stage: “the integration of existing systems into an associative network and under an appropriate governance, with human resources and funding from multiple sources, including the participation of the industrial world, private companies and civil society”. The Ministry of Science, Technology, Knowledge and Innovation received this proposal, and is expected to be supported and implemented by the State.

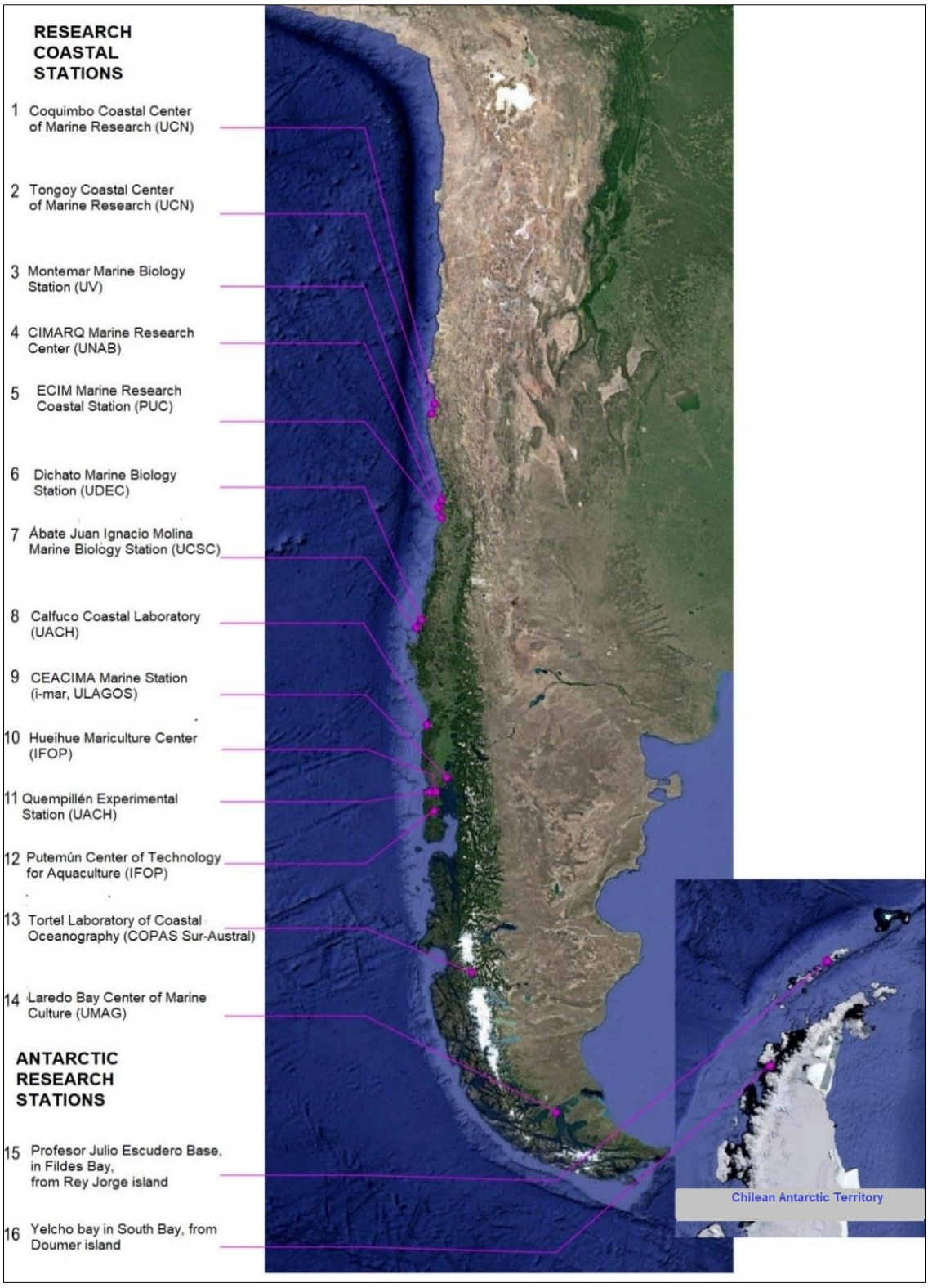

Figure 1.- Research Coastal Stations (Image: *Google Earth)*

The following table indicates some of the monitoring systems available in the country:

Table 6. Monitoring Systems

PROGRAM	INSTITUTION	SYSTEMS	PARAMETERS
Acidification of the Oceans in Chile	IDEAL+UACH	Buoy installed in Seno Ballena, Strait of Magellan	Observation system for measurement of pH, pCO2 and oxygen in fjords with glacial influence
POSAR Buoy	CR2: UCHILE + UDEC	Coastal Buoy at 10 km from the Itata river mouth	Surface meteorology (Temp., sea level pressure, SOLRAD, NETRAD, Rh and wind) and surface oceanography (Temp., DO, SAL, Nutrients, Chlorophyll, pH, pCO2). At the end of the plan, it was ashore in maintenance work
Fixed Weather Stations	SERVIMET	Captain of the Port's Offices and Coast Guard Lighthouses	Record of weather conditions in ports, bays, islands and channels
Mobile Stations: Voluntary Weather Observing Ships	SERVIMET	-Esmeralda Cabo de Hornos -Marinero Fuentealba -Sargento Aldea -Aquiles -Former Óscar Viel - Frigate Lynch	Conditions recorded on board Chilean Navy vessels in scientific commissions, support to Antarctic campaigns, training cruises and deployment through international waters
Study of aquaculture environmental performance in Chile and its effect on ecosystems sites	IFOP	Sampling stations in Atacama, Coquimbo, Biobío, Los Ríos, Los Lagos, Aysén and Magallanes	In water column: CTD, oxygen, nutrients. In sediments: Organic matter, pH, sulfide, benthic macroinfauna
High resolution modelling applied to hydrodynamic transport	IFOP	Oceanographic sampling stations in selected areas from Chiloé, Aysén and Magallanes	Correntometry, sensors for continuous record of oxygen and salinity. CTD an meteorological variables (with stations)

PROGRAM	INSTITUTION	SYSTEMS	PARAMETERS
Reloncaví Marine Observatory (OMARE)	i~ mar	Oceanographic buoy	Atmospheric variables measurement such as air temperature, humidity, atmospheric pressure, wind speed and direction. Furthermore, marine variables using CTDO (temperature, conductivity, oxygen, pH, fluorescence and water turbidity) and ADCP (currents from the surface up to approx.130 m depth)
Program of management and monitoring of harmful algal blooms and marine toxins in the Pacific Ocean from Biobío to Aysén	IFOP	Sampling stations in 21 transects perpendicular to the coast at 2,5 and 10 miles	CTD-O, nutrients, phytoplankton abundance (harmful phytoplankton and total phytoplankton)
Program of management and monitoring of red tides in the Chilean fjords and channels system	IFOP	Sampling stations in inland seas from Chiloé, Aysén and Magallanes	CTD-O, nutrients, phytoplankton abundance (harmful phytoplankton and total phytoplankton).
Phytoplankton Monitoring Program (PROMOFI)	INTESAL	Samplings between Los Lagos and Magallanes Regions	Sampling of phytoplankton, harmful algae and red tide, chlorophyll *a* concentration.
Monitoring and surveillance program on mytilids larval availability for the sustainability of aquaculture in the inland sea of Chiloé and other areas of interest for mussel growing in the Aysén Region	IFOP	Sampling Stations	Mytilid larvae abundance
Coastal Environmental Observation Program (P.O.A.L.)	DIRINMAR	Arica to Punta Arenas, including Rapa Nui and Chilean Antarctic Territory	Annual fluctuations of the levels of the main components of domestic, industrial, oil hydrocarbon and Persistent Organic Pollutants wastes in bays, lakes and rivers, under the jurisdiction of DIRECTEMAR
CEAZA-Met Network	CEAZA	Surface weather station raft and submerged oceanographic sensors (Tongoy)	Meteorological and oceanographic parameters

PROGRAM	INSTITUTION	SYSTEMS	PARAMETERS
Valdivia Environmental Monitoring Network (REMA)	UACH	Navigation beacons and weather station on the School's roof (Valdivia river estuary)	Weather and water monitoring such as air temperature, atmospheric pressure, wind direction and intensity, solar radiation, rainfalls, relative humidity, salinity, temperature, oxygen and water level
Weather Monitoring Network	IFOP		Outdoor temperature, external humidity, wind speed, wind direction, rainfall, atmospheric pressure, internal temperature, internal humidity, solar radiation and UV radiation
Ocean-Atmosphere Interaction Monitoring Network, National Network of Sea Level monitoring, National Tsunami Warning System (SNAM)	SHOA	Oceanographic buoys and sea level stations	Sea level, sea surface temperature. In some stations, air temperature, atmospheric pressure, relative humidity, waves and currents
Weather time-series in Punta Santa Ana	IDEAL+ UACH	Weather station	Weather monitoring of air temperature, atmospheric pressure, wind direction and intensity, solar radiation and relative humidity
Oceanographic monitoring in Punta Santa Ana, Beagle Channel and Seno Ballena	IDEAL+UACH	Subsurface anchoring system in Punta Santa Ana and Beagle Channel. Biogeochemical Buoy in Seno Ballena	Anchorages: temporal variation of temperature, salinity, light and oxygen dissolved at different levels. Beagle Channel: in addition to the abovementioned, sediment tramps. Buoy: pCO2 measurement
Chilean Integrated Ocean Observing System (CHIOOS) of the BioBío Region	UDEC	HF Radars	Sea level variations, marine currents, time estimation and arrival direction of a seismic-origin tsunami, and impact probability on bays. Wave, analysis of displacement of debris owing to oil spill, emissaries plumes
Surface water monitoring system of Magallanes Region (FerryBox)	IDEAL+UACH	From Punta Arenas to Puerto Williams. Equipment will be installed by the end of 2020	Temperature, salinity, dissolved oxygen, oil concentration, chlorophyll, pH, pCO2 and nitrate
Surface water monitoring system, installed on Karpuj boat	INACH	From Punta Arenas to Puerto Williams, crossing of Drake	Continuous record of temperature and salinity during the navigation track that will tentatively be

PROGRAM	INSTITUTION	SYSTEMS	PARAMETERS
		Passage, Antarctic Peninsula to Doumer island	operational in 2022
Oceanographic Observing System	MUSELS+ UDEC	Buoys located in the localities Vilupulli and El Manzano	Observing system for high-standard measurements of temperature, salinity, dissolved oxygen, chlorophyll, turbidity and pH in aquaculture areas in Chiloe's inland sea, and the area of Hornopirén
Swell warning system	School of Ocean Civil Engineering, UV	Seven-day local wave and swell forecasts (in some places)	Wave prediction: height, period and direction in some towns

3. Vessels for conducting research

Regarding the availability of major platforms for research on Marine Sciences, currently, the country has the vessels AGS *Cabo de Hornos* of the Chilean Navy and the *B/I Abate Molina (Scientific Vessel)* of the Undersecretariat for Fisheries, administered by the Fishing Promotion Institute. The former is one of the most modern marine scientific platforms of its type, with the capacity to conduct fisheries and oceanographic research studies in different areas, such as physical, biological, chemical and geological. The latter is preferably oriented towards fisheries research, due to its size and equipment.

The Talcahuano industrial plant of Shipyards of the Chilean Navy (ASMAR) is conducting, through the "Proyecto Antártica I" *(Antarctica I Project)*, the construction of a polar class vessel for the Chilean Navy, which will have the adequate capacities and characteristics for the development of logistics operations, search and rescue in Antarctica, as well as the necessary equipment and habitability to carry out scientific missions. This vessel will replace the AP *Óscar Viel* and will be the biggest one built in Chile and the first icebreaker built in Western South Pacific. According to a survey conducted by INACH to the Antarctic scientific community, the priority lines of research to be developed on board the new icebreaker would be related to biological oceanography, geological oceanography, chemical oceanography and the study of deep-sea ecosystems. The operational area would extend from the Drake Passage to Alejandro I Island in the Antarctic Peninsula, including the Bellingshausen sea and Weddell sea.

It is reasonable to expect that the new icebreaker *Almirante Óscar Viel* will allow doing research in Antarctica, however, considering our country's sea extension, having only two research platforms in the future is not enough. For this reason, it is necessary and urgent to plan at least another research

platform, in addition to the costs of construction, maintenance and funding that will allow its operation, for the development of research in marine sciences in Chile.

Regarding smaller platforms, while some of them belong to Chilean institutions of marine scientific research, in general, they have displacement limitations or their useful life is complete. The following table illustrates the current availability:

Table 7. Vessels for conducting research

VESSELS	UNIVERSITY - CENTER - INSTITUTE
Vessel RS *Karpuj*	Chilean Antarctic Institute
Vessel *Hugo Moyano*	Chilean Antarctic Institute
Vessel *Isabel*	Chilean Antarctic Institute
B/I *Abate Molina*	Fishing Promotion Institute
Vessel *Ilán*	Pontifical Catholic University of Chile
Vessel *Megalodón*	Pontifical Catholic University of Chile
Antares	Arturo Prat University
Rigel	Arturo Prat University
Vessel *Tobago II*	Catholic University of the Most Holy Conception
L/C *Stella Maris II*	Catholic University of the North
L/C *Kay-Kay II*	University of Concepción
L/C *Ten Ten*	University of Concepción
AGS *Cabo de Hornos*	Chilean Navy

E.- Funding for marine scientific research

In the area of marine sciences, there is the availability of a series of national funding sources of diverse origins, such as state, private and international funds, and from research departments of different universities (own funds). Among the state funds available in our country, the following stand out:

- Concurso Anillos-Antárticos (Antarctic Rings Competition): Managed jointly by ANID (National Research and Development Agency) through the Associative Research Program (PIA) and the Chilean Antarctic Institute (INACH), as the national institution in charge of planning, coordinating, guiding and controlling scientific and technological activities on the Antarctic continent. This competition funds, coordinates, develops and monitors the Antarctic Science Research Rings projects. For this purpose, INACH supports the development and implementation of project activities to be carried out in the Antarctic territory and/or associated ecosystems.

- Concurso Regular INACH (INACH Regular Competition): It supports scientific proposals to be carried out in Antarctica, from researchers with Chilean affiliation, and is based on seven lines of research, mainly those promoted by the Scientific Committee on Antarctic Research (SCAR), corresponding to: 1) The condition of the Antarctic ecosystem; 2) Antarctic thresholds: ecosystem

resilience and adaptation; 3) Climate change in Antarctica; 4) Astronomy and Earth Sciences; 5) Biotechnology; 6) Human footprint in Antarctica; and 7) Social Sciences and humanities. This competition supports both field and desk-based proposals.

- INACH-Correos Chile Competition: It encourages undergraduate students to do their thesis on Antarctic topics and consists of a stay on the frozen continent, generally at the Profesor Julio Escudero base, where the selected student carries out his/her research and at the same time works at the office of Correos Chile, located in Villa Las Estrellas. This competition covers the stay in Antarctica, food and airfare.

- CIMAR program: Marine Research Cruises in Remote Areas, conducted by SHOA-CONA with funds granted by the Ministry of Finance. Its general objective is to study in a multidisciplinary way oceanographic, meteorological, biodiversity and underwater morphology aspects in remote geographical areas, where knowledge of the marine environment has a strong influence on the sustainable socioeconomic development of local communities and the country in general.

- FONDECYT: National Fund for Scientific and Technological Development, under ANID. Its mission is to encourage and promote the development of basic scientific research in the country. To this end, it promotes the initiatives of individual and group of researchers, financing research projects of excellence, without distinction of areas or disciplines.

- FONDEF: Scientific and Technological Development Support Fund, under ANID. Its mission is to strengthen and benefit from the scientific and technological innovation capabilities of universities and national research and development institutions, by financing projects of high quality, significance and impact to improve the productivity and competitiveness of the main sectors of the economy, and to enhance the population's quality of life.

- REGIONAL: A program created with the mission of promoting the scientific and technological development of the country's regions, through joint work with Regional Governments and Research Centers, consistent with the needs and priorities defined by the regions for their economic and social development.

- PIA: Associative Research Program, to coordinate various instruments and initiatives to support associative research and the promotion of excellence research centers.

- FONDAP: Fund for Research Centers in Priority Areas, under ANID. Its mission is to finance the establishment of centers of excellence, dedicated to scientific research of the highest level within a given area, in order to

contribute to the strengthening of postgraduate training of young researchers, while giving the opportunity to develop activities within the same center.

- PAI: Attraction and Insertion of Advanced Human Capital Program, under ANID. It is aimed at enhancing the academic, scientific and technological capacities of national institutions that develop science and technology, through the recruitment of internationally recognized scientists for national universities, thus allowing for the consolidation of cooperation networks. In addition, it supports work insertion of new researchers, trained in Chile and abroad, both in academia and in the productive sector.

- FONDEQUIP: Scientific and Technological Equipment Program, intended to encourage and promote the development of research in the country, through funding for the acquisition, updating and/or access to medium and major scientific and technological equipment, aimed at conducting frontier research and moving towards a knowledge-based society and economy.

- Millennium Science Initiative: Program under ANID, with the main objective of promoting the development of scientific and technological research of excellence in Chile. To this end, it supports the creation of high quality research centers and institutes in the areas of Social and Natural Sciences.

- PCI: Program of International Cooperation under ANID, whose mission is to encourage joining and strengthening international networks with the objective of incorporating the national scientific community into frontier knowledge.

- FIPA: Fisheries and Aquaculture Research Fund, under the Ministry of Economy, Development and Tourism, that is intended to finance studies necessary to support the adoption of fishery and aquaculture management measures for the conservation of hydrobiological resources, considering biological, fisheries, aquaculture, economic and social aspects. The annual budget consists of a Basic Program of projects to be carried out and an incremental program with projects whose execution depends on obtaining extra financial resources over the initially authorized budget.

- MINISTRY OF THE ENVIRONMENT: In 2018 and 2019 funded the study “Determination of the risk of the impacts of Climate Change on the coasts of Chile”, aiming at generating information on projections of threat, exposure, vulnerability and risk of human and natural systems of the coastal area located in 104 communes of continental Chile, in addition to Rapa Nui and Juan Fernández archipelago. The objective of this study was to set the basis for the design of policies and the implementation of adaptation measures. The developer team consists of 21 researchers from 5 universities (PUC, UV, UPLA, PUCV and Catholic University of el Maule) and 3 research centers (Center for Global Change of the Pontifical Catholic University, CIGIDEN and COSTAR-UV).

Table 8 presents, organized by national funding source, the number of research projects and the total amount allocated for 2018. In attention to the fact that there is no more specific information, it can only be estimated in a referential way that in the country approximately 54 trillion was assigned to marine technological and scientific research in 2018.

Table 8. National funding sources of projects related to Research on Marine Sciences, 2018

FUNDING SOURCE	No. OF PROJECTS	2018 AMOUNT
INACH	15	(1) 160.946.249
CIMAR	7	(2) 86.922.603
ANID (former CONICYT)		
FONDECYT	173	6.959.717.000
FONDEF	12	1.389.158.000
REGIONAL	3	(3) 1.100.000.000
PIA	7	(4) 1.403.611.000
FONDAP	5	(3) 4.700.000.000
PAI	1	160.925.000
FONDEQUIP	0	0
Millennium Science Initiative	4	(3) 1.452.000.000
PCI	14	269.460.436
CORFO	9	34.294.000.000
FIPA	92	2.006.815.758
MMA	1	(5) Approx. 90.000.000
Total	343	Approx. 54.073.556.046

(1) It does not include logistical expenses for transportation to Antarctica, accommodation and food for researchers.
(2) It does not include operating costs, fuel, accommodation and food for scientists, which are included on board the vessel AGS-61 Cabo de Hornos.
(3) In the case of FONDAP, Regional and Millennium Science Initiative, regarding the centers, the total amounts transferred to each of them for research related to Marine Sciences are considered.
(4) In the case of PIA, the funds of the centers' lines of research related to Marine Sciences were considered.
(5) Reference information that will be updated once background information from MMA is available.

III.- GUIDELINES FOR THE 2021-2030 NATIONAL OCEANOGRAPHIC PLAN

For the elaboration of 2021-2030 National Oceanographic Plan, the National Ocean Policy and the Implementation Plan of the initiative “United Nations Decade of Ocean Science for Sustainable Development” have been considered as a reference.

A.- National Ocean Policy (NOP)

NOP was established as a State policy that concerns all sectors, since the activities carried out in the ocean are heterogeneous and comprise a variety of development areas, providing numerous opportunities for different activities, such as artisanal and industrial fishing, extractive fishing industry and aquaculture, maritime transportation and the development of ports in service of our foreign trade, tourism,

marine sciences, renewable energies, among others.

This policy was created by the Council of Ministers, with sectorial contributions from the Ministries of Foreign Affairs; National Defense; Economy, Development and Tourism; and Environment, and will be executed on a sectorial basis through an Ocean Program for its implementation, updating, follow-up and compliance.

The objectives of NOP (summarized) are the following:

- Conservation of the ocean and its biodiversity.
- Sustainable economic development of the ocean and its resources.
- Sovereignty and safety regarding the national ocean area.
- Proper interaction of our ocean with extra-territorial jurisdictional areas.
- Positioning Chile as a relevant actor in international ocean affairs.
- Protecting freshwater reserves.
- Promotion of public awareness and understanding of the ocean.
- Strengthening the institutional structure in order to improve coordination, information and decision making.
- Protecting and safeguarding the interests of Chile in the Antarctic continent, as established in the Antarctic Policy of our country.

Particularly with regard to **scientific development**, the Ocean Policy recognizes the need to generate conditions to establish an institutional structure that facilitates marine scientific and technological development, since it identifies this as the basis for the design and implementation of public policies and timely decision-making to ensure the conservation of marine ecosystems and the sustainable use of the ocean to contribute to social welfare and national cultural identity. Six main lines of action are identified in this field: institutional structure, research, infrastructure, human capital training, marine education of society and international collaboration.

CONICYT (now ANID), in July 2017, published a technical report, prepared by a working group, with the participation of renowned professionals in the area of Marine Sciences, on the Specific Objective No. 7 of the Ocean Policy Proposal “Scientific and Technological Development”. The document makes a detailed diagnosis and then specifies each of the main axes identified in the NOP, establishing the Objectives, Challenges and Opportunities, as well as recommended actions.

B.- United Nations Decade of Ocean Science for Sustainable Development 2021-2030

The Decade of Ocean Science for Sustainable Development initiative offers us a strategic approach to identify the expected Results at the end of the Decade, the Challenges at stake, and the Goals to be achieved, which are presented below.

1. Expected results at the end of the Decade

a. A clean ocean where sources of pollution are identified and reduced or eliminated.

Society generates a wide range of pollutants, including marine litter, plastics, excess nutrients, anthropogenic underwater noise, hazardous chemicals, organic toxins, and heavy metals. These pollutants come from a wide variety of point and nonpoint, land-based and marine sources. The resulting pollution is unsustainable for the ocean and threatens ecosystems, human health and livelihoods. It will be critical to urgently reduce the knowledge gaps and, likewise, to generate priority interdisciplinary and co-produced knowledge on the causes and sources of pollution and its effects on ecosystems and human health. This knowledge will ensure solutions jointly formulated by multiple stakeholders to eliminate the source of pollution at the origin, mitigate harmful activities, remove ocean pollutants and support the transition of society to a circular economy.

b. A healthy and resilient ocean where marine ecosystems are understood, protected, restored and managed.

The degradation of marine ecosystems is accelerating due to unsustainable activities on land and in the ocean. To sustainably manage, protect, or restore marine and coastal ecosystems, it is necessary to address priority knowledge gaps related to them and their responses to multiple agents of disturbance. This is particularly true in cases where multiple human stressors interact with climate change, including acidification and rising ocean temperatures. This knowledge is important for developing tools to implement management frameworks that strengthen resilience, recognize thresholds, and avoid ecological tipping points, thus ensuring ecosystem functioning and the continued provision of ecosystem services for the health and well-being of society and the planet as a whole.

c. A productive ocean supporting sustainable food supply and a sustainable ocean economy.

The ocean is the foundation for future global economic development and human well-being and health, including food and livelihood safety for hundreds of millions of the world's poorest people. Therefore, knowledge and tools to support the recovery of wild fish stocks, implement sustainable fisheries management practices and contribute to the sustainable expansion of aquaculture, while protecting essential biodiversity and ecosystems, will be critical. The ocean also provides essential goods and services to a wide variety of established and emerging industries, including extractive industries, energy, tourism, transportation and pharmaceuticals. Each of these sectors has specific and priority needs in terms of increasing knowledge and support for innovation, technological development and tools

that support decision making to minimize risk, avoid sustained damage and optimize their contribution to the development of a sustainable ocean economy. Governments also require information and tools, for example, through national accounts that incorporate ocean indicators, to guide the development of sustainable ocean economies and promote marine sectors.

d. A predicted ocean where society understands and can respond to changing ocean conditions.

A large part of the ocean is not adequately mapped or observed, or is only partially understood. Exploration and understanding of the key elements of ocean changes, including its physical, chemical and biological components, and its interactions with the atmosphere and cryosphere are essential, particularly considering climate change. This knowledge is necessary from the land-sea interface along the coasts of the world to the open ocean and from the surface to the deep seabed. It must include past, current and future ocean conditions. A more useful and integrated understanding, coupled with accurate prediction of ocean ecosystems and their responses and interactions, will allow the implementation of ocean management to be dynamic and adaptive, considering the constantly changing ocean environment and use.

e. A safe ocean where life and livelihoods are protected from ocean-related hazards.

Hydrometeorological, geophysical, biological, and human-caused hazards have devastating, cascading, and unbearable effects on coastal communities, ocean users, ecosystems, and economies. The changing frequency and/or intensity of threats related to weather and climate are exacerbating these risks. Mechanisms and processes are required to assess priority hazards, mitigate, predict and warn about these threats, and formulate adaptive responses to reduce short and long-term risks on land and at sea. There is a need for greater ocean data density and improved forecasting systems, including those related to sea level, marine weather, and climate, starting from near real-time to decadal scales. When these improvements are linked to education, dissemination and communication, they will enhance policy and decision making, and integrate individual and community resilience.

f. An accessible ocean with open and equitable access to data, information and technology and innovation.

Inequalities in capabilities or competencies to develop ocean science must be eliminated by simultaneously improving access to and quality control of data, knowledge and technology. This must be combined with increased skills and opportunities for collaboration in data collection, knowledge generation and technological development, particularly in Least Developed

Countries (LDCs), Small Island Developing States (SIDS) and Landlocked Developing Countries (LLDCs). Increased dissemination of relevant, quality-controlled ocean knowledge through appropriate and accessible products to the scientific community, governments, educators, businesses, industry and general public will improve management, innovation and decision-making, thus contributing to societal goals related to sustainable development.

g. An inspiring and engaging ocean where society understands and values the ocean in relation to human well-being and sustainable development.

In order to motivate behavioral change and ensure the effectiveness of the solutions formulated under the Decade, there needs to be a radical change in the relationship society has with the ocean. This can be achieved through ocean literacy approaches, both formal and informal educational and awareness-raising tools, and through measures to ensure equitable physical access to the ocean. These approaches will together build a significantly broader societal understanding of the economic, social and cultural values of the ocean and the multiple roles it plays in ensuring health, well-being and sustainable development. This outcome will highlight the ocean as a place of wonder and inspiration, thereby also influencing the next generation of scientists, policy makers, government officials, managers and innovators.

2. Decade challenges

a. Challenges related to knowledge and solutions

Challenge 1: Understand and map land- and sea-based sources of pollutants and contaminants and their potential impacts on human health and ocean ecosystems, and develop solutions to remove or mitigate them.

Challenge 2: Understand the effects of multiple stressors on ocean ecosystems, and develop solutions to monitor, protect, manage and restore ecosystems and their biodiversity under changing environmental, social and climate conditions.

Challenge 3: Generate knowledge, support innovation and develop solutions to optimize the role of the ocean in sustainably feeding the world's population under changing environmental, social and climate conditions.

Challenge 4: Generate knowledge, support innovation and develop solutions for equitable and sustainable development of the ocean economy under changing environmental, social and climate conditions.

Challenge 5: Enhance understanding of the ocean-climate nexus and

generate knowledge and solutions to mitigate, adapt and build resilience to the effects of climate change across all geographies and at all scales, and to improve services including predictions for the ocean, climate and weather.

b. Challenges related to basic infrastructure

Challenge 6: Enhance multi-hazard early warning services for all geophysical, ecological, biological, weather, climate and anthropogenic related ocean and coastal hazards, and mainstream community preparedness and resilience.

Challenge 7: Ensure a sustainable ocean observing system across all ocean basins that delivers accessible, timely and actionable data and information to all users.

Challenge 8: Through multi-stakeholder collaboration, develop a comprehensive digital representation of the ocean, including a dynamic ocean map, which provides free and open access for exploring, discovering and visualizing past, current and future ocean conditions in a manner relevant to diverse stakeholders.

c. Key challenges

Challenge 9: Ensure comprehensive capacity development and equitable access to data, information, knowledge and technology across all aspects of ocean science and for all stakeholders.

Challenge 10: Ensure that the multiple values and services of the ocean for human well-being, culture and sustainable development are widely understood, and identify and overcome barriers to behavior change required for a step change in humanity's relationship with the ocean.

3. Decade objectives

The Decade Implementation Plan identifies 3 Objectives, which are described below. For each of them, an attempt is made to succinctly compile what the Chilean Marine Scientific Community has been doing, and then highlight the activities-actions that need to be reinforced or incorporated into the 2021-2030 National Oceanographic Plan. Annex "A" describes the actions that, according to the Decade objectives, are estimated to be completed or pending to be completed.

a. Objective 1

Identify required knowledge for sustainable development and increase the

capacity of ocean science to deliver needed ocean data and information.

b. Objective 2

Build capacity and generate comprehensive knowledge and understanding of the ocean, including human interactions and interactions with the atmosphere, cryosphere and the land-sea interface.

c. Objective 3

Increase the use of ocean knowledge and understanding and develop capacity to contribute to sustainable development solutions.

4. Linking the objectives of the Decade with the Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda

The Decade Goals are interdisciplinary and universal, which reflects the cross-cutting nature of ocean science. They will support the achievement of all Sustainable Development Goals of the 2030 Agenda that benefit from a better understanding of the oceans (Fig. 2), and in particular SDG 14 and other SDGs that also have an ocean dimension, such as SDG 2 on food security, SDG 8 on economic growth, SDG 12 on sustainable consumption, and SDG 13 on climate change, among others.

Upon examining Figure 2, it is evident that Sustainable Development Goal SDG 14, is the one with the greatest impact on the role that CONA has to fulfill, particularly target 14A, which states:

> *14A Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular Small Island Developing States (SIDS) and Least Developed Countries (LDC).*

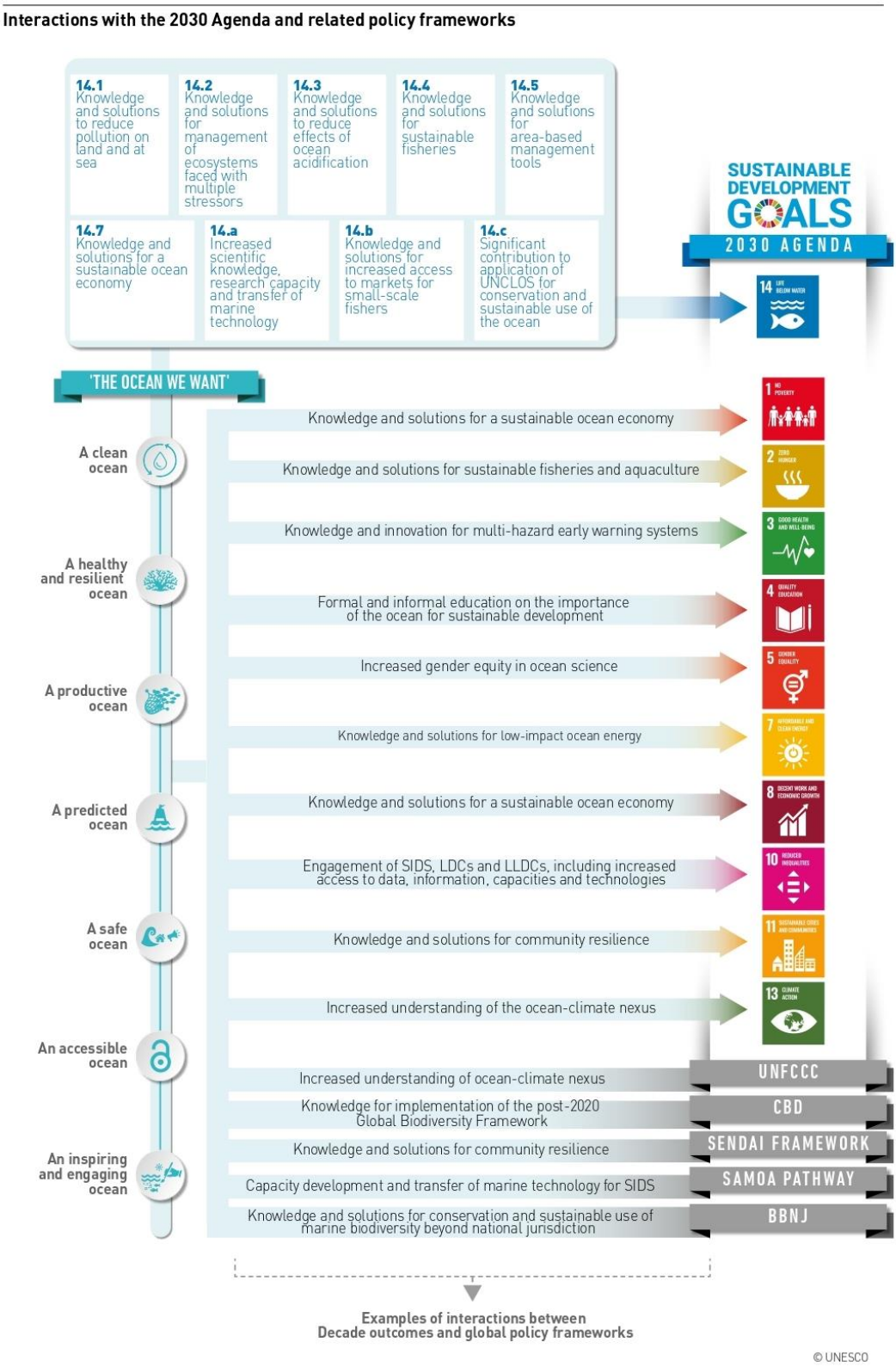

Fig. 2.- Source: United Nations Decade of Ocean Sciences for Sustainable Development 2021-2030 Implementation Plan, Version 2, July 2020, from IOC). (Description acronym: SIDS Small Island Developing States, LDC Least Developed Countries, LLDC Landlocked Developing Countries, UNFCCC United Nations Framework Convention on Climate Change, CBD Convention on Biological Diversity, BBNJ Biodiversity Beyond National Jurisdiction).

IV.- 2021-2030 NATIONAL OCEANOGRAPHIC PLAN. NATIONAL SPECIFIC OBJECTIVES AND COURSES OF ACTION, ACCORDING TO THE CHALLENGES AND OBJECTIVES OF THE DECADE

Consistent with the outline of the objectives of the implementation plan and the Decade challenges, and particularly inspired by the Sustainable Development Goal - SDG14, the following are the priority areas for developing national marine scientific research, and which together with the specific objectives, courses of action and their benefits, constitute the National Plan for the 2021-2030 Decade .

This Decennial Plan is essentially dynamic, and an annual assessment is strongly recommended so as to incorporate potential new requirements for knowledge and adjustment of its priorities, as well as the related scientific and technological progress.

A.- AREA 1: Oceanography and biodiversity of the Southern Ocean

Specific objective: Enhance knowledge of oceanography and its influence on the cryosphere, global climate and ecosystems of the Southern Ocean.

Courses of action:

- Implement a new program of oceanographic and geological cruises in sub-Antarctic and Antarctic waters.
- Conduct expeditions to monitor benthic biodiversity in key areas of the Southern Ocean, seamounts, and in the proposed area of the Marine Protected Area (MPA) Domain 1 of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR).
- Enhance knowledge of Antarctic ecosystems that will allow sustainable fishing activities in scenarios of environmental change under a precautionary approach.
- Understand the changes taking place and the effect of human activities in Antarctic waters, thus protecting its biodiversity and the sustainable management of resources.

Benefits:

- Understand alterations in these southern ecosystems that are highly sensitive to climate change.
- Support the settlement of human activities and the development of sustainable aquaculture in southern regions.

B.- AREA 2: Climate change, coastal zones and ocean ecosystems

Specific objective: Understand the impact of climate change on Chilean coastal zones and ocean ecosystems.

Courses of action:

- Develop regional models to produce local projections of different oceanographic variables, such as waves, sea level, surface temperature and others.
- Evaluate the impact of sea level rise, changes in oceanographic variables and land conditions in coastal zones (deltas, estuaries, fjords, etc.).
- Develop baselines and predictive models of impacts in coastal zones, especially in those inhabited areas where population is concentrated.
- Continue monitoring oceanographic and meteorological variables to establish a baseline for climate change studies and validation of associated models.

Benefits:

- It will allow the implementation of local adaptation and mitigation measures for human communities in coastal zones, according to future climate change scenarios.
- Improvement of climate change adaptation plans for fisheries and aquaculture and future Adaptation Plan for the Coastal Zone.

C.- AREA 3: Early warning systems

Specific objective: Improve early warning systems for hazardous events of natural (geological, ecological, biological, climatic) or anthropogenic origin.

Courses of action:

- Implementation Xof monitoring systems and use of predictive models.
- Implementation of satellite surveillance systems, *in situ* observation networks of continuous recording consisting of fixed sensors such as buoys and anchorages, as well as sensors and equipment installed on vessels of opportunity with regular and fixed routes.
- Having a larger network of seismic sensors to monitor seismic and volcanological risk events in the Bransfield Basin, to anticipate the associated risks.

Benefits:

- Reduce risks in the coastal zone due to tsunamis, bad weather, storms and swells.
- Generate early warnings of Harmful Algal Blooms (HAB) in populated areas, artisanal extraction of marine resources and aquaculture production in Patagonia.
- Timely response to local pollution events due to spills and hydrocarbon spills.
- Prevention of environmental disasters.
- Quantification and simulation of marine environmental phenomena associated with risks to inhabitants, infrastructure and coastal ecosystems.

D.- AREA 4: Impact of marine pollution

Specific objective: Understand and evaluate the impact of marine pollution on ocean ecosystems and its possible consequences on human health.

Courses of action:

- Implementation of new coastal environment observing programs that include monitoring of floating debris (macro and micro), metallic micronutrients (iron, zinc, copper, molybdenum and cobalt), and other anomalous elements derived from human activities or natural processes (mercury, phosphates, arsenic, etc.).

Benefits:

- Contribute to the development of effective mitigation and remediation plans for marine ecosystems affected by pollution.
- Ensure sustainable aquaculture development in areas of Patagonian fjords and channels that considerably contribute to the national economy.
- Enhance knowledge of the impact of increased levels of pollutants (macro and micro floating debris, metallic micronutrients and other anomalous elements, among others) on marine organisms.
- Improve the understanding of ocean-land interactions and anthropogenic effects in the coastal zone.
- Strengthen the Coastal Environmental Observation Program (POAL).

E.- AREA 5: Ocean observing network

Specific objective: Implement a permanent and integrated ocean observing network off Chile and in Antarctica, through a climate change observatory that will also allow determining a latitudinal gradient from the northern zone to the Antarctic polar circle.

Courses of action:

- Promote the installation of a Chilean Integrated Ocean Observing System (CHIOOS), proposed by the ocean roundtable (COP25), using fixed observation platforms such as radars, buoys, anchorages, underwater cables, coastal weather stations, as well as mobile platforms, volunteer ships, satellites, marine gliders, drifting buoys, unmanned vehicles, etc.
- Having a network of sensors for temperature, pH, salinity and oxygen in the Southern Ocean.

Benefits:

- Contribute to the development of safer and more sustainable fisheries and aquaculture.

- Contribute to the development of baselines and models of the condition and changes in the regional ocean.
- Contribute to the efforts to achieve a better understanding of the global ocean system.
- Improve and validate local forecasts of climate events such as swells.
- Continuously monitor climate change indicator variables (e.g., surface air temperature, sea surface temperature, pCO2 and pH).

F.- AREA 6: Ocean information system

Specific objective: Implement a cooperative and open ocean information system.

Courses of action:

- Updating, standardizing and strengthening the current National Hydrographic and Oceanographic Data Center (CENDHOC) as a national archive and repository that brings together public and private data for the use of the entire community.

Benefits:

- Free, efficient and equitable access to oceanographic information to increase the synergy and productivity of available data.
- Facilitate decision making by territorial authorities, intendancies and municipalities through the availability of standardized, geo-referenced and updated information.
- Improve the transfer of knowledge from academics to public servants and private sector workers.
- Generate an effective contribution of regional information to different international organizations.
- Increase the social benefit and productivity of oceanographic data collected in the country.
- Promote inter-institutional collaboration in scientific research.

G.- AREA 7: Seabed and associated geological/geophysical processes

Specific objective: Enhance knowledge and information on seabed and associated geological/geophysical processes and capabilities for their development.

Courses of action:

- Systematically conduct high-resolution bathymetric and sub-seabed mapping in the Exclusive Economic Zone (EEZ).
- Increase instrumental capability for measurements of geophysical variables and sediment sampling on national research vessels and in public institutions.

- Create and strengthen programs in marine geology in public institutions.

- Encourage, sponsor and support scientific research projects in marine geology/geophysics.
- Promote participation of specialists in marine geology/geophysics in other related committees, for example, in marine conservation, pollution, climate change, etc.
- Create special funds for development of research in marine geology/geophysics, including equipment.
- Encourage educational and outreach programs and activities in marine geology/geophysics research.

Benefits:

- Generate data and information, as well as infrastructure and equipment for the progress of the discipline, which is the least developed of the Marine Sciences in the country.
- Contribute data and information to numerous oceanographic disciplines on issues of environmental impact (including pollution, for example, the “tailings” case), ecosystem conservation and protection, climate and oceanographic change, sustainable development, and adequate use of energy and mineral resources.
- Contribute to national and international geological risk assessment and management plans, including tsunami generation and propagation, and identification of hazards such as submarine landslides, active volcanism, changes in sedimentation patterns, coastal erosion processes, etc.
- Contribute to the creation of specialists.
- Contribute to educate the community on geological hazards associated with earthquakes, tsunamis, coastal, climatic and oceanographic changes.

ANNEX A

ACTIONS THAT REGARDING THE DECADE CHALLENGES AND OBJECTIVES ARE CONSIDERED COMPLETED OR PENDING COMPLETION

Objective 1: Identify the knowledge needed for sustainable development and increase the capacity of ocean science to deliver the required ocean data and information.

ACTIONS COMPLETED

The following Networks, Systems and Programs have been implemented:

- Ocean-Atmosphere Interaction Monitoring Network.
- National Sea Level Monitoring Network.
- National Tsunami Warning System (SNAM).
- Red Tide Management and Monitoring Program.
- Coastal Environmental Observation Program (POAL).
- Swell Warning System (SAM).
- Maritime weather forecasting systems (Chilean Navy Weather Service).
- Permanent monitoring program of oceanic and atmospheric variables in the coast and oceans of the Southeast Pacific, for the study and behavior of El Niño and La Niña phenomena (ERFEN-CPPS).
- Online Oceanographic Observing System for the prevention of environmental disasters in the Region of Los Lagos.
- Numeric Modelling and Oceanographic Monitoring System of environmental processes in different space and time scales, and their effects on marine ecosystems and fishery resources.
- Marine Observation Center for the Study of Risks from Coastal Environment (COSTA-R).
- Program of Marine Scientific Research Cruises in Remote Areas (CIMAR), including follow-up studies in Marine Protected Areas and areas of Channels and Fjords in Southern Chile.
- Monitoring of oceanographic conditions of high latitude systems, Magellan and Antarctica, through the installation of permanent anchorages in Punta Santa Ana, in the Strait of Magellan, Beagle Channel and Doumer Island (Antarctica).
- Implementation of biodiversity collections.

Climate change projections of ocean variables such as waves and mean sea level have been generated for the next decades, from 2026 to 2045, considering a scenario of 8.5 Representative Concentration Pathways (RCPs) of the Intergovernmental Panel on Climate Change (IPCC).

Under implementation is the South Eastern Pacific Circulation from Argo Floats (SEPICAF), consisting of the deployment of 18 ARGO buoys in the period 2020-2022, obtained through the Ocean Observation Research and Technology Program (CORIOLIS) of the French Research Institute for the Exploitation of the Sea (IFREMER).

Since 2018, carbonate system parameters (pH, pCO2, aragonite) have been recorded in waters of the Strait of Magellan and specifically in Seno Ballena.

Since 2019, INACH maintains in Fildes Bay and South Bay, sensors anchored between 8 and 14 meters, mini-CTD star-Oddi and Ph HOBO MX, for monitoring temperature, salinity and pH. This monitoring is part of the Program to support the Establishment of the Marine Protected Area, proposed in 2018 by Chile and Argentina in Domain1, which includes the West Antarctic Peninsula and South Scotia Arc, of CCAMLR, which has the collaboration of other CCAMLR member countries and is under discussion.

ACTIONS PENDING COMPLETION

Observation Component:

- Expand the network of wave buoys to validate and adjust swell forecasts.
- Rationalize the number and geographical location of coastal stations, ensuring adequate resources to guarantee their continuous operation.
- Provide standardization and collective resources for the maintenance of oceanographic and meteorological sensors to allow measuring all the parameters that are currently necessary for monitoring sea and ocean-atmosphere interaction.
- Improve observation capabilities and progressively change from discrete to continuous monitoring, particularly in regions far from the coast and in remote areas.
- Implement a satellite monitoring system for chlorophyll-a and various pigments of phytoplankton functional groups, suspended material, and particulate and dissolved organic carbon, among others, to determine their impact on the coastal waters of Chile.
- Conduct monitoring of marine debris on beaches and microplastics in the sea, in the main seaside places under the jurisdiction of the Maritime Authority.
- Establish and maintain a Humboldt Current Observing Network, a crucial element of the Global Ocean Observing System (GOOS).
- Enhance existing biodiversity protections as a way to preserve natural biodiversity, relating them to Goal 14 and potentially to Goal 13. Highlighted are the re-stocking of

macro-algae, or expansions of them, as they are a critical habitat for maintaining biodiversity; they help coastal resilience to the effects of climate change by acting as natural wave buffers; and, in addition, there are serious proposals to enhance the use of seagrass beds with regard to carbon storage, in what is called the “Blue Carbon Initiative” to reduce greenhouse gas emissions.

Coordination component:

- Develop and implement a system for providing updated and geo-referenced information to the National System for the Coordination of Territorial Information (SNIT) to support authorities' decision-making.

- Strengthen the national coordination of all institutions, centers and agencies involved, to form a large national system for observation and monitoring of oceanographic and meteorological variables, in order to avoid duplication of sampling.

- Strengthen CENDHOC, so that it centralizes information and contributes to compliance with international standards, so that SNIT provides validated and official information to the general public.

- Consider the implementation of a CHIOOS, which provides quality, standardized and publicly accessible data for the study, monitoring, management and surveillance of the ocean and its resources.

- Consolidate and integrate all monitoring systems carried out for the study of HABs in order to avoid duplication of effort and funding.

- Establish protocols of agreement so that relevant national agencies facilitate access to the information they hold in their repositories.

Development component:

- Develop a HAB Early Warning System.

- Develop high-resolution numerical models of ocean and coastal circulation for modeling extreme situations; and climate change projections of ocean variables such as waves, swells, meteorological tides and mean sea level during the 21st century.

- Develop spatial analysis capabilities for the hydrography of coastal systems.

- Develop systems for the elimination of pollution-causing by-products derived from farming systems.

- Develop an Adaptation Plan for the Chilean coasts against coastal risks, such as climate change, earthquakes, tsunamis, etc.

- Produce risk maps of coastal systems for each locality, in order to contribute to integrated and sustainable management.

- Generate a local swell forecast system in all Chilean port areas and important coves, in

order to increase safety of coastal settlements.

- Train professionals capable of maintaining and exploiting a CHIOOS.

- Develop the monitoring of annual fluctuations in the concentration levels of the main components of domestic and industrial waste, petroleum hydrocarbons and particulate organic carbon in bays, lakes and rivers.

- Identify key physical processes that are responsible for upwelling and improve their representation in models.

- Within the framework of CCAMLR, achieve the adoption of the MPA in Domain 1 and develop a follow-up and monitoring plan.

Objective 2: Build capacity and generate comprehensive knowledge and understanding of the ocean, including human interactions, and interactions with the atmosphere, cryosphere and land-sea interface.

ACTIONS COMPLETED

Actions that have been implemented or executed:

- Millennium Nucleus of Ecology and Sustainable Management of Oceanic Islands (ESMOI), which allows generating the necessary scientific base to strengthen a strategy for sustainable management and conservation of the biodiversity of seamounts and Chilean oceanic islands: Ecoregions of Easter Island (Rapa Nui and Motu Motiro Hiva), Desventuradas Islands (San Ambrosio and San Félix) and Juan Fernández Archipelago (Robinson Crusoe, Alejandro Selkirk, Santa Clara).

- High Latitude Marine Ecosystems Program (IDEAL), to determine the connectivity between the Sub-Antarctic and Antarctic systems and the impact of Global Climate Change on these systems.

- Coastal laboratories for the study of multiple stressors (climate change, ocean acidification) along the coast of Chile and Antarctica.

- Assessment of chemical, physical and biological variables in fjords and channels between Punta Arenas and Puerto Williams; monitoring the surface ocean from Puerto Williams to Punta Arenas and from Cape Horn to Punta Arenas supported by a continuous surface ocean monitoring system (FONDEQUIP (EQM190013)).

- Studies to understand the impact of increased levels of metallic micronutrients (iron, zinc, copper, molybdenum and cobalt) on coastal picophytoplankton communities and how their increase alters taxonomic composition, functional stability and primary productivity in coastal oceans.

- Research programs aimed at collecting technical background to develop Discard Reduction Plans for target species and accompanying fauna and Bycatch (trawl selectivity).

- The COPAS Sur-Austral Center conducted the project “Training for Teachers S.O.S. Oceans” in Ñuble, Aysén and Biobío, to contribute to the formal incorporation into Primary Education Programs of relevant content regarding the impacts of climate change on the ocean, its resources and human activities.

- Integral Program for the Development of Algae Aquaculture for small-scale Artisanal Fishermen, based on technology transfer by SUBPESCA/IFOP.

- Project “Observatory for the sustainability of the Aquaculture Ecosystem of the Tenth Region (OSEA)”, to incorporate the concept of sustainability in artisanal fishermen and contribute to the sustainable development of aquaculture in the inland sea of Chiloé.

- Millennium Nucleus Program Marine Conservation Center, to further the knowledge of the processes and interactions that affect biodiversity, population abundance, productivity and connectivity between marine communities at spatial scales that are relevant for their management. In addition, the study and understanding of social determinants to generate conservation plans that consider all parties involved, artisanal fishermen, consumers, decision-makers and community in general.

- The compilation of evidence of floating garbage impact (macro and micro) on the national marine fauna has begun; however, more background information and studies are needed to understand its implications.

- The “Chile MIO Project” is underway, aimed at making the sea known to the entire community, with special emphasis on school groups, by means of a transmedia strategy and Augmented Reality and Virtual Reality applications that incorporate acoustic landscapes and teach about Chile's marine biodiversity and different marine ecosystems.

ACTIONS PENDING COMPLETION

Observation component:

- Develop marine chemistry, particularly in the study of the role of bioactive metals in marine biota, improving techniques for the determination of trace metals.

- Conduct baseline and long-term monitoring studies to gain knowledge of the biodiversity and both organic and inorganic resources of the numerous reserves, parks and MPAs, including studies in the proposed MPA of Domain 1 in Antarctica. Knowledge of these ecosystems will make it possible in the future to verify the potential biogeographic connections between them and will contribute to the knowledge of the continental shelf biodiversity in the corresponding regions, as well as to generate scientific guidelines for their conservation, protection and management.

- Determine the effect of climate change on oceanic ecosystems off Chile and in Antarctica, as well as on glaciers, and their impact on the ecosystems of fjords and channels.

Coordination component:

- Monitor, follow up and assess the effectiveness of plans and measures implemented to reduce discard.

- For the management of fisheries, provide fishery, biological, population and economic indicators associated with large-scale fishing activities to evaluate the performance of the administration measures that have been implemented.

- Transfer of technology and knowledge for the development and/or restocking of management areas of artisanal fishing or small-scale fisheries.

- Transfer of technology and knowledge for the development of strategies that allow users of marine resources to adapt to the decline or loss of these resources in order to recover their livelihoods.

- Generate bulletins on the progress of oceanographic topics, so as to find solutions in other sciences, the results of which contribute to the improvement of the technology transfer network and reduce the knowledge gaps regarding oceanography.

- Study ocean-land interactions and anthropogenic effects in the coastal zone.

- Promote a greater integration of scientists from different disciplines (oceanographers, electrical, electronic, mechanical, naval and commercial engineers) and create growth poles for the transfer of new technologies, according to the needs of the country.

- Generate new working groups and programs for the study and monitoring of Ocean Acidification, and develop information mechanisms (SDG 14.3).

- Improve coordination and collaboration between fishery and oceanographic research centers, in the development of long-term research programs that allow for the integration of the progress achieved in data and information, through different biological oceanography programs, in order to increase national capabilities for marine scientific research.

- Conduct periodic training in oceanographic topics and in the use of oceanographic sensors.

- Implement certified laboratories for CTD calibration without the need to send the equipment abroad.

Development component:

- In an effort to explore new ways of marine conservation, projects are being carried out to evaluate the potential of implementing “no-take zones” in management areas, through rights of territorial use for fishing programs.

- Identification and valuation of the ecosystem services provided by bio-engineering species of animal and plant origin, with a view to integrated and sustainable management.

- Development of biotechnology for use in different markets, for example, use of sustainable products for agriculture, based on the use of algae.

- Analysis of theoretical and methodological foundations for the development of the sustainable use of coastal socio-ecological systems.

- Generate school outreach programs on the sea and its oceans, its hydrobiological resources, and climate change, to encourage a more informed and committed population towards the care of the ocean and its resources.

- Predict the variability of the ocean system off Chile, according to future climate change scenarios.

- Know the short, medium and long term impact of ocean acidification, global warming and deoxygenation on marine organisms and the environment at local and regional level, and its effect on marine ecosystems and biodiversity in Chile and Antarctica.

- Integrate the atmospheric, hydrographic and oceanographic variability that manifests itself in the oceanic region off Chile and its effects on the continental and insular territory.

- Strengthen the syllabus of Marine Science degrees, including chemistry, biogeochemistry and analytical chemistry, to increase the development of the study of the role of bioactive metals in marine biota.

- Generate hydrographic climatologies to validate predictive models of the variability of the oceanic system off Chile, according to future climate change scenarios.

- In relation to floating garbage (macro and micro) in the marine environment, identify the main sources; determine and assess the impact they have on marine biota; determine changes in their distribution patterns; and generate dispersion models, considering for example the extension of aquaculture activities towards the south of Chile and the abandonment of cultivation centers in the inland sea of Chiloé.

- In order to value, protect and preserve biodiversity and ecosystem services in remote areas (e.g., Oceanic Islands, Chilean Patagonia), promote multidisciplinary studies to identify the main sources of pollutants and develop predictive models of dispersion in the marine environment.

- Develop baselines of the underwater acoustic landscape and acoustic characterization of noise-generating activities in the marine environment, in order to assess their potential impacts on the physiology and behavior of marine mammals, fish and invertebrates, and establish mitigation measures.

- Increase the development of research lines in paleoceanography and paleoclimatology for the study of climate change and/or catastrophic tectonic events in continental Chile, insular Chile and Antarctica.

- Define ecosystem indicators for the environmental performance of large-scale

aquaculture, which will allow regulating these farming activities, and thus avoid the environmental impact.

- Assess the environmental condition and characterization of lakes where aquaculture activities are carried out.

- Implement a census and maintain a registry to generate an updated inventory of existing marine species throughout continental, Antarctic and insular Chile.

Objective 3: Increase the use of knowledge and understanding of the oceans, and build capacity to contribute to sustainable development solutions.

ACTIONS COMPLETED

Actions that have been implemented, executed or elaborated:

- National biological and fisheries data collection program implemented by IFOP and directly financed by SUBPESCA, complemented in 2005 by a scientific observers program.

- Program to assess exploited resources subject to catch quotas, implemented by IFOP and directly financed by SUBPESCA (allowable catch levels).

- CCAMLR Scientific Observers Course, conducted on October 2017 by INACH, for researchers who embark on fishing vessels in Antarctica, related to the resources: krill, deep sea cod and icefish. The objective was to train and familiarize future scientific observers in the mitigation measures published each year by CCAMLR, in order to: mitigate bycatch of seabirds and marine mammals; regulate fishing; and environmental protection, related to waste in the Southern Ocean.

- Program of complementary studies for the evaluation of exploited resources and their fisheries, financed by FIPA (Fisheries and Aquaculture Research Fund) and assigned through public bidding.

- Climate Change Adaptation Plan for Fisheries and Aquaculture, which provides guidelines for the adaptation of these sectors to climate change.

- Establishment of MPAs for the conservation and sustainable management of marine biodiversity. Administration and regulatory measures are established for access to fishing and other activities to prevent negative impacts on this biodiversity and the ecosystem.

- The regulatory framework (Law 20657) focuses on the biosustainability of hydrobiological resources, sets standards for artisanal and industrial fishing, develops a new regulatory framework for the aquaculture sector, and defines the characteristics and attributions of IFOP's Fisheries and Aquaculture Research Council.

- The General Law on Fisheries and Aquaculture creates the institutional framework of the Scientific Technical Committees on Fisheries and Aquaculture and the Management Committees and Management Plans, for fishery resources in full exploitation, in order

for fisheries to reach their maximum sustainable yield level; and for the elaboration of recovery and mitigation plans.

- Creation of several Research Centers with transversal orientation of the different disciplines of Marine Sciences, or related to them by the study of climate, disaster risks and sustainability (CIGIDEN, COPAS Sur-Austral, CR2, IDEAL, INCAR, CEAZA, CEQUA, CIEP, CAPES, CECs, IEB, IMO, ESMOI, MUSELS, INVASAL, MILLENNIUM NUCLEUS CENTER OF MARINE CONSERVATION, etc.).

- The Millennium Nucleus Center for the Socioeconomic Impact of Environmental Policies (CESIEP), in order to assess environmental, social and economic sustainability.

- Institutional transformations in the administration of benthic resources, for the sustainable management of coastal socio-ecological systems.

- CR2 and the Environmental Law Center of the University of Chile created the Observatory of the Climate Change Law for Chile, aiming to build bridges between scientific knowledge and decision-makers.

- Important initiatives have been developed through the Ministry of the Environment, by leading programs for information gathering, such as the Global Biodiversity Information Facility (GBIF).

A Monitoring Program of public-private collaboration between companies, research centers and universities was initiated, which allowed the installation of equipment with the latest technology to obtain continuous surface records of oceanographic variables such as temperature, salinity, oxygen, pH, CO2, turbidity, chlorophyll, and the measurement of the optical characteristics of water, along with a seawater collector during navigation in fjords and channels, from the Strait of Magellan to the Beagle Channel.

Currently underway is the project “Associative Research and Scientific-Technological Transfer for Training and Innovation in the Tourism Sector in the Magallanes Region”, which is part of the Science-Business Linkage Program. This initiative, developed since 2013, corresponds to the alliance between the private sector and several institutions. Said project allows the monitoring of sea surface chemistry, in relation to inorganic nutrients, acidity, alkalinity, seawater saturation with respect to calcium carbonate and concentration of photosynthetic pigments.

A project is currently underway to generate an initial technical proposal of ecosystem indicators for the environmental performance of salmon farming, which will make it possible to regulate the maximum production by area, according to the ecological carrying capacity.

ACTIONS PENDING COMPLETION

Observation component:

- Develop a long-term program for the observation of ocean acidification in remote but strategic marine areas, both for the country and the region, such as the Nazca-Desventuradas Marine Park, through multi- and pluri-territorial alliances.

- Strengthen an automatic data collection system, with the implementation of anchorages; installation of equipment in vessels of opportunity (e.g., ferry-box); and networking of meteorological stations; covering continental Chile, insular Chile and Antarctica.

- Complement oceanographic and meteorological measurements in situ with those obtained by satellites. The original data and the subsequent processing of the information should be in charge of an agency that validates and controls data quality.

Coordination component:

- Establish a coordination policy first at national and then regional level (Chile, Peru and Ecuador) to integrate and maintain a network that provides information to projects related to acidification (GOA-ON) and deoxygenation (SEPICAF, TPOS2020), considering the Southeast Pacific region is the most lacking in data regarding both topics.

- Encourage and promote the integration of the research centers that have been created, as a means of generating standardized and validated information and products for use of decision-makers.

- Establish a national center with the technical capabilities to calibrate and repair oceanographic equipment.

- Coordinate public and private efforts, particularly with regard to those sectors that carry out activities in the ocean, to join the Blue Economy challenge by contributing to initiatives that promote a sustainable, integrated and ecosystem management of the ocean.

Development component:

- Develop a strategy, methodologies and tools necessary to implement a solid marine spatial planning, involving mainly coastal areas.

- Research program on options to reduce the impacts of fishing activities on the ecosystem, consistent with plans to mitigate discards and bycatch.

- Develop, circulate and implement a national regulation to guide and ensure compliance with minimum standards for marine measurements, including calibration, based on internationally adopted practice and definitions, to validate information.

- Consider the planning of at least another oceanographic research platform, as well as the costs of construction, maintenance and funding that will allow its operation, in order to meet the high demand that has been generated in the last years by the scientific community, which would allow, among other aspects, to expand the scientific knowledge of oceanic waters that remain unexplored and that require the collection of baseline information.

ANNEX B

LIST OF MEMBERS OF THE DECADE TASK GROUP

No.	Name	Proposing institution
1	Dr. Sandra Ferrada	Chilean Society of Marine Sciences
2	Dr. Samuel Hormazábal	Pontifical Catholic University of Valparaíso
3	Dr. Jaime Letelier	Fishing Promotion Institute
4	Dr. Jorge Valdés	University of Antofagasta
5	CDR (Retd) Alejandro de la Maza	Chilean Navy Weather Service
6	Dr. Antonio Brante	Catholic University of the Most Holy Conception
7	Dr. Humberto González	Austral University of Chile - ANID (former CONICYT)
8	Dr. Peter Von Dassow	Pontifical Catholic University of Chile
9	Ms. Guisella Muñoz	Undersecretariat for Fisheries
10	Ms. Jenny Maturana	Directorate of Maritime Interests and Aquatic Environment
11	Ms. Eugenia Valdebenito	Directorate of Maritime Interests and Aquatic Environment
12	Ms. Claudia Villarroel	Meteorological Directorate of Chile (Chilean Directorate General of Aeronautics)
13	Dr. Luis Lara	National Service of Geology and Mining
14	Dr. Ítalo Masotti	University of Valparaíso (Task Group Scientific Advisor)
15	CAPT Hugo Gorziglia	Hydrographic and Oceanographic Service of the Chilean Navy (Head of Task Group)
16	Dr. Rodrigo Hucke	Austral University of Chile
17	Dr. Osvaldo Ulloa	University of Concepción - ANID (former CONICYT)
18	Dr. Renato Quiñones	University of Concepción - ANID (former CONICYT)
19	Dr. Cristian Aldea	University of Magallanes
20	Dr. Pablo Gallardo	University of Magallanes
21	Dr. Alejandro Buschmann	University of Los Lagos - ANID (former CONICYT)
22	CDR Carlos Zúñiga	Hydrographic and Oceanographic Service of the Chilean Navy
23	Mr. Juan Fierro	Executive Secretary of CONA
24	Ms. Pilar Ortiz	Scientific advisor of CONA

ANNEX C

ACTIONS CONTRIBUTING TO THE DECADE, MANAGED BY CONA MEMBER INSTITUTIONS AND ENDORSED BY THE INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

2021

Activity 1: Cycle of seminars of ANID Centers in the Decade of the Oceans: “Science with impact on the development of resilience in coastal areas”.

The seminar cycle was organized by the ANID Priority Area Research Centers, made up by CIGIDEN (Research Center for Integrated Disaster Risk Management), CR2 (Center for Climate Science and Resilience), CEDEUS (Center for Sustainable Urban Development) and SECOS (Millennium Institute in Coastal Socio-Ecology), along with the Hydrographic and Oceanographic Service of the Chilean Navy (SHOA).

The aim was to discuss interdisciplinary research and the need for collaboration between ANID centers of excellence to connect scientific work with global and national agendas on disaster risk management, climate change adaptation and sustainable development. The activity focused on the challenges faced by coastal areas, and highlighted the work carried out by scientific and technological research centers, universities and national and international public institutions, which are directly related to decision making regarding integrated disaster risk management, adaptation to climate change and sustainable development.

It was conducted online in four sessions, between 8 and 29 June 2021, attended by 60 national and international panelists, from academia, politics, public service and NGOs, and with an audience of around 1150 professionals of diverse profiles who were connected from Chile, Peru, Spain, Venezuela, Mexico, Ecuador, United States, Germany, Spain, Argentina, Brazil, Portugal, Paraguay, Canada, Uruguay, Colombia, United Kingdom, Nicaragua, France, Australia, Guatemala, Dominican Republic and Antarctica.

Activity 2: Web Portal of the Regional Tide Gauge Network

Web portal managed by GRASP (GOOS Regional Alliance for South-East Pacific), which allows visualizing sea level data. It currently includes data from 64 sea level stations, located in the South-East Pacific region and managed by various institutions in each GRASP member country (Colombia, Ecuador, Peru and Chile). This portal is a coordinated effort of these four countries, all of which have created this tool to facilitate the observation of operational oceanographic and meteorological variables in the southeastern Pacific region. The main objective has been to integrate the operational oceanographic and meteorological information of the region, so that GRASP member institutions, as well as scientists, academics, researchers and students can access sea level information displayed in the portal, integrating all these variables in a regional framework. Future plans are to integrate data related to sea surface temperature and other meteorological variables.

The Web portal of the Regional Tide Gauge Network is hosted at https://coos.inocar.mil.ec/visores/red_mareografica/ and can also be accessed through the website of the Permanent Commission for the South Pacific (CPPS) (http://cpps-int.org/)

Activity 3: Cycle of Seminars on Chilean Bays: Challenges and opportunities for their protection

Organized by the Aquatic Environment Contamination working group of the National Oceanographic Committee, aiming to generate a space for interaction to review, from a scientific and legal perspective, the current state of knowledge on the system of bays in Chile. Therefore, it addressed the main physical-chemical, biological, social and legal processes and interactions that occur within these bays, as well as the challenges that arise in a context of climate change. These seminars were held online, weekly, from 21 October to 2 December 2021, and were attended by approximately 624 people.

In each session, through the dialogue between scientists, political actors, implementing agencies and NGOs, the aim was to achieve a better understanding of the dynamics of bay behavior; to make visible the progress that the country has made in collaboration with scientific institutions; to identify the needs and challenges regarding the availability of open data, education, participation and local government; and to discuss the legal and institutional changes that should be considered in order to have a better approach to global and local challenges faced by bays in particular and coastal areas in general. Likewise, it was established that the solution to the problems caused by past activities such as pollution, overfishing and regulation of the coastline require a management with a deeper understanding of its connections, dynamics and spatial-temporal patterns.

Activity 4: Workshop to present the preliminary results of the Marine Research Cruise in Remote Areas, CIMAR 25 Fjords.

This workshop was organized by CONA, with the sponsorship of SHOA, and was held in three online sessions: 5 and 12 November, and 3 December 2021. The objective was to present to the national scientific community the preliminary results and experiences obtained in each of the projects carried out during the cruise.

The presentation of the preliminary results allowed the authors to interact and correlate their data, and with this integration to support innovation and oceanic research for various purposes. The workshop is also an opportunity to exchange information with the rest of the CONA member institutions and attending specialists.

In compliance with the objectives of CIMAR, these projects aim to contribute to the sustainable development and dissemination of oceanographic, biological and environmental knowledge of the southern channels. The information collected, as well as that from previous cruises, was saved at SHOA's National Hydrographic and Oceanographic Data Center (CENDHOC).

Approximately 300 researchers, students and professionals from various public and private institutions in the country participated in the workshop sessions.