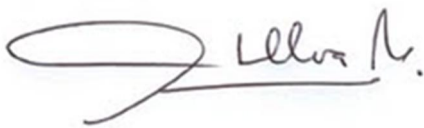



Name of the Center: Millennium Institute of Oceanography Instituto Milenio de Oceanografía	
Type (Institute or Nucleus)	INSTITUTE IC120019
Acronym	IMO
Reported period	January 1 to December 31, 2020
Starting date of the Center	DECEMBER 26, 2013
Web Page	http://www.imo-chile.cl
Host Institution(s)	Universidad de Concepción and Pontificia Universidad Católica de Chile
Address	Cabina 7, UdeC, Barrio Universitario S/N, Concepción
Stage	Continuity
End date of the Center	2023
Total amount	USD \$12.500.000 for 10 years
Total amount for the reported period	USD \$1.060.606

Contact Information	
Scientific Contact	Oswaldo Ulloa oulloa@udec.cl
Contact Information	Atilio Morgado atilio.morgado@imo-chile.cl

Declaración de Singapur
<i>Por este medio declaro que la información entregada en esta memoria anual es fidedigna, y que adhiero a la Declaración de Singapur, contenida en la Resolución Exenta N° 157 del 24 de enero de 2013 de Conicyt, como guía global para una conducta responsable en la investigación.</i>

<i>Institute / Nucleus Director Name</i>	<i>Institute / Nucleus Alternate Director Name</i>
Dr. Oswaldo Ulloa Quijada	Dr. H. Rubén Escribano Veloso
<i>Director's Signature</i>	<i>Alternate Director's Signature</i>
	

Index

Section	Page
1.1 Executive Summary	3
1.2 Resumen Ejecutivo	5
1.3 Outstanding achievements	6
2. Introduction	7
3. Scientific and Technological Research	10
4. Education and Capacity Building	17
5. Networking and other collaborative work	22
6. Outreach and Connections with Public and Private Sectors	24
7. Administration and Financial Management	27
8. Annexes	28
1. Institute Researchers	28
2. Research Lines	34
3. Publications	40
4. Organization of Scientific Events	48
5. Education and capacity building	49
6. Networking and other collaborative work	52
7. Outreach	61
8. Connections with other sectors	63
9. Financial Status	64
10. Outstanding Activities and Students Destination	65

1.1 Executive Summary

. 1.1 Executive Summary

The Millennium Institute of Oceanography (IMO, Instituto Milenio de Oceanografía) is a center of excellence established at the end of 2013, with the aim of exploring and researching the open and deep ocean. During 2020, IMO continued its 5-year second phase. In accordance with its approved extension plan, research was re-organized along two main lines:

I. A Variable and Changing Ocean.

II. The Deep Ocean.

Additionally, IMO continued its strong **Outreach Program** and **Educational** and **Networking** activities.

Major Achievements during 2020 include:

Scientific and technological:

Due to the pandemic, a major focus of IMO during year 7 was on the analysis of samples and data collected in previous research cruises, and on the publication of these results. No field activities were carried out during this period.

a) Publications

- 30 journal articles were published in 2020, of which 19 were authored or co-authored by the six current IMO associate researchers (3.2 articles per associate researcher) and one by the former associate researchers.
- Of the above articles, 6 included more than one IMO associate researcher (or former associate researcher) as author.
- 30% of the total articles included IMO students as authors.
- Several of the publications were based on observations and experiments carried out during IMO's oceanographic cruises.
- Significant advances have been obtained towards answering IMO's main scientific questions.

b) Deep- Ocean Observing System

- IMO was awarded a mayor equipment grant (FONDEQUIP MAYOR, >1 M\$US per grant) by the Chilean Agency for Research and Development to deploy during 2022 an Integrated Deep-Ocean Observing System (IDOOS) for geoscience research in the Atacama Trench.

Education and capacity building achievements:

- IMO graduated 3 PhD and 1 MSc students.
- All PhD students that have graduated from IMO are currently active in research.
- Due to the pandemic, no new postdoctoral researchers were incorporated into IMO.

Networking:

- IMO researchers have consolidated their involvement in major international programs and projects targeting global issues to the climate impact on ocean dynamics, marine ecosystem services and their social-economic consequences.
- New formal and externally related funded collaborative networks were initiated to develop some specific research topics within the framework of the two major IMO themes

Outreach:

IMO's outreach team continued with its well-established and successful program and developed some new initiatives. Due to the pandemic, some of them had to be replaced by "on-line" ones.

During 2020, IMO's documentary "Atacamex: exploring the unknown" —which was released in 2019— was broadcasted in the Chilean and Venezuelan open television and incorporated into the video platform "OndaMedia" (www.ondamedia.cl) of the Chilean Ministry of Cultures, Arts and Heritage. It also won an international award as best documentary at the 2020 UNOFEX International Film Festival in Monaco.

New initiatives included the development of video clips based on IMO's puppet characters, a TV series "Bichitos: Invisible Bugs" to address the current pandemic among children, and a popular science book on the Atacama Trench to be published in 2021.

1.2 Resumen Ejecutivo

El Instituto Milenio de Oceanografía (IMO) es un centro de excelencia establecido a finales de 2013, con el objetivo de explorar e investigar el océano abierto y profundo. Durante 2020, el IMO continuó su segunda fase de 5 años. De acuerdo con su plan de extensión aprobado, la investigación se reorganizó en dos líneas principales:

- I. Un océano variable y cambiante.**
- II. El océano profundo.**

Además, el IMO continuó con su sólido programa de divulgación y actividades educativas y de redes.

Los principales logros durante 2020 incluyen:

Científico y tecnológico:

Debido a la pandemia, el foco principal del IMO durante el año 7 fue en el análisis de muestras y datos recopilados en cruceros de investigación anteriores, y en la publicación de estos resultados. No se realizaron actividades de campo durante este período.

a) Publicaciones

- Se publicaron 30 artículos de revistas en 2020, de los cuales 19 fueron de autoría o coautoría de los seis investigadores asociados actuales del IMO (3,2 artículos por investigador asociado) y uno de los antiguos investigadores asociados.
- De los artículos anteriores, 6 incluyeron a más de un investigador asociado del IMO (o ex investigadores asociados) como autor.
- El 27% del total de artículos incluyó a estudiantes del IMO como autores.
- Varias de las publicaciones se basaron en observaciones y experimentos llevados a cabo durante los cruceros oceanográficos del IMO.
- Se han obtenido importantes avances en la respuesta a las principales preguntas científicas del IMO.

b) Sistema de observación del océano profundo

- El IMO recibió una subvención mayor para equipamiento (FONDEQUIP MAYOR, > 1 M \$ US por subvención) de la Agencia Chilena de Investigación y Desarrollo para desplegar durante 2022 un Sistema Integrado de Observación del Océano Profundo (IDOOS) para la investigación de geociencias en la Fosa de Atacama.

Logros en Educación y Desarrollo de Capacidades:

- Se graduaron 3 estudiantes de doctorado y 1 de maestría del IMO.
- Todos los estudiantes de doctorado que se han graduado del IMO están actualmente activos en investigación.
- Debido a la pandemia, sólo un investigador postdoctoral IMO fue incorporado.

Redes:

- Los investigadores de la OMI han consolidado su participación en los principales programas y proyectos internacionales que se centran en cuestiones mundiales relacionadas con el impacto del clima en la dinámica de los océanos, los servicios de los ecosistemas marinos y sus consecuencias socioeconómicas.
- Se iniciaron nuevas redes de colaboración formales y con financiación externa para desarrollar algunos temas de investigación específicos en el marco de los dos temas principales de la OMI.

Extensión:

El equipo de divulgación del IMO continuó con su programa bien establecido y exitoso y desarrolló algunas iniciativas nuevas. Debido a la pandemia, algunos de ellos tuvieron que ser reemplazados por otros "en línea".

Durante 2020, el documental del IMO “Atacamex: explorando lo desconocido” —que fue estrenado en 2019— fue transmitido en la televisión abierta de Chile y Venezuela e incorporado a la plataforma de videos “OndaMedia” (www.ondamedia.cl) del Ministerio de las Culturas, las Artes y el Patrimonio. También ganó un premio internacional como mejor documental en el Festival Internacional de Cine UNOFEX 2020 en Mónaco.

Las nuevas iniciativas incluyeron el desarrollo de videoclips basados en los personajes títeres de IMO, una serie de televisión "Bichitos: insectos invisibles" para abordar la pandemia actual entre los niños y un libro de divulgación científica sobre la Fosa de Atacama que se publicará en 2021.

1.3. Outstanding Achievements

New understating about the spatial and temporal variability of environmental factors and biological communities in the eastern South Pacific, as well as of the impact of low oxygen and high pCO₂ on planktonic communities is starting to emerge. This result is significantly based on IMO’s field observations and experiments carried out as part of its scientific plan.

IMO was awarded one of the three grants of the First Competition for Major Equipment (FONDEQUIP MAYOR, >1 M\$US per grant) by the Chilean Agency for Research and Development (ANID in Spanish) to establish an Integrated Deep-Ocean Observing System for geoscience research (IDOOS).

The documentary “Atacamex: exploring the unknow” won an international award as the best documentary at the UNOFEX International Film Festival 2020, held in Monaco. It was also broadcasted on open-signal tv in Chile and Venezuela.

The prospective “The Sea of Chile: Vision 2040” was presented at the Chilean Ministry of Foreign Affairs. IMO with other centers and academic units at Universidad de Concepción contributed to this science-policy initiative.

IMO researchers led a solicited scientific report to Chilean DIRECTEMAR and Ministry of Foreign Affairs to be used in evaluation of the possible ratification by Chile of the 2013 amendment to the London Protocol, the first treaty mechanism for governing ocean geoengineering.

Introduction

a) *Description of the Institute:*

The Millennium Institute of Oceanography (IMO, Instituto Milenio de Oceanografía) is a center of excellence, established at the end of 2013, with the aim of exploring and researching the open and deep ocean. Its vision is to become an internationally recognized institute in oceanographic research and education, leading exploration in the central and eastern area of the South Pacific Ocean, with impact on the country and society in general. IMO's commitment is to provide an intellectually stimulating environment for the production and dissemination of scientific knowledge that generates new understanding about the ocean, from a creative, daring and collaborative perspective. IMO's mission is: *i)* to conduct pioneering and interdisciplinary research in oceanography, addressing scientific problems in an integrative and collaborative manner; *ii)* to develop and apply new technologies and platforms for observational and experimental work in the ocean, including the use of the new Chilean research vessel Cabo de Hornos, and to reach unexplored areas of the South Pacific; *iii)* to increase human resources in ocean sciences in Chile and South America, through higher education and training in research based on direct observation and experimentation in the sea, and by attracting ocean scientists from all over the world to work in Chile; and *iv)* to inform and create awareness among the general public and decisionmakers about the importance of the ocean, its conservation and its relationship to humans and global change.

IMO has become a Latin American regional center of excellence in oceanography through: • An increasing number of publications in top-ranked international journals, reflecting IMO's cutting-edge research • Integration of the new Chilean research vessel R/V Cabo de Hornos for fundamental ocean research. • Implementation of advanced sampling technologies, including the use of an innovative submarine lander to repeatedly sample the deepest depths of the Atacama Trench. • High impact in human capacity building at regional, national and international levels. • High impact in dissemination of science to society at large through an internationally recognized outreach program. • Becoming integrated into and recognized in the international research community through extensive networking. • In ocean policy, IMO has been called on a. to provide logistical-technical support for reacting to a massive toxic algal bloom, b. to communicate the state-of-the-art of scientific understanding of the ocean to authorities and policymakers reacting to a foreign company's controversial bid to conduct commercial iron fertilization in Chilean waters, c. to participate in the formation of the Chilean National Ocean Policy. This Annual Report is a summary of the seventh year of activities and the fifth as a legal Non-Profit Private Corporation.

b) *Research Lines:* For the second five-year period (as approved in the extension), IMO re-organized itself around two interconnected research lines:

I. A Variable and Changing Ocean: This research line is organized around three grand questions:

- a. *How well do biogeochemical flows, community composition, and even population structure of key species correlate with physical oceanographic drivers?*
- b. *How does biogeochemical function differ among norm-oxic, OMZ, and AMZ marine systems?*

- c. *What is the resilience of key communities and organisms to a changing ocean, and can that be predicted by their origin?*

I. *The Deep Ocean:* This research line is organized around a single grand question:

What are the physical and biogeochemical characteristics of deep and ultra-deep waters of the eastern South Pacific, and which of those determine the diversity and functional structure of their pelagic communities?

Additionally, IMO has a strong Outreach Program and started a Geoscience Program, aimed at linking oceanography with geology and geophysics.

c) *Organization of research teams:*

During 2020, its seventh year, IMO consisted of 30 researchers: 6 of the original associate researchers, 4 senior researchers, including the former associate researcher Dr. Samuel Hormazábal, 11 adjunct researchers, 9 young researchers and 7 postdocs. The associate researchers: Drs. Osvaldo Ulloa (Director), Rubén Escribano (Deputy Director), Oscar Pizarro, Wolfgang Schneider, and Cristian Vargas (from University of Concepción, UdeC) and Peter von Dassow (from Pontifical Catholic University of Chile, PUC). They are distributed in Concepción and Santiago, respectively. IMO also include 21 professionals/technicians and assistants, 6 administrative staff, as well as 54 students (17 undergraduate, 20 M.Sc., and 17 Ph.D.).

During this period, IMO was organized around the 2 research lines, an outreach team (led by Pablo Rosenblatt, Director of Outreach), a central administrative office based at UdeC (led by Atilio Morgado, Executive Director), and a technology development and transfer team (established in 2016) led by Ing. Víctor Villagrán. The Science-Policy Program led by Dr. Carmen Morales (a former associate researcher and senior researcher) was discontinued as she went into retirement.

IMO had also four senior researchers during the period: Prof. Juan Carlos Castilla (PUC) and Dr. Gerrit van den Eng (MarCy, USA), both as advisors to the institute, and Dr. Samuel Hormazábal (a former associate researcher) and Dr. Carmen Morales, who continued with research activities.

Scientific and technical personnel, laboratories, and equipment are shared across the research lines, and also contribute to outreach and technology development. Drs. Cristian Vargas and P. von Dassow lead Research Line 1 and Drs. R. Escribano and O. Ulloa lead Research Line 2. Dr. Marcos Moreno—a well-known geoscientist—has joined IMO as Adjunct Investigator in Research Line II.

Each year, associate researchers meet at the beginning to define annual research priorities for each line—as well as for education, outreach, and technology development and transfer—and the budget is allocated according to these priorities. Meetings are held throughout the year to follow specific priorities. During 2020, an in-depth evaluation of the postdoctoral and young researchers was carried out.

a) **Scientific and technological research:**

The year 2020 has been different in several aspects due to the pandemic. For IMO scientific work, many planned tasks and activities were postponed, or in some cases cancelled upon the impossibility to be undertaken. Nevertheless, other activities could be maintained and most of them relied on previous (2018-2019) field and experimental work which allowed us to analyze data with no need for present activities. In this regard, data bases obtained from cruises performed during 2018 and 2019 became the most valuable source of information to keep up science under a pandemic situation.

Research Line I: A variable and Changing Ocean

How the three main questions of this research line (see description of research lines above) are integrated in the ongoing research is shown in Fig. 1.

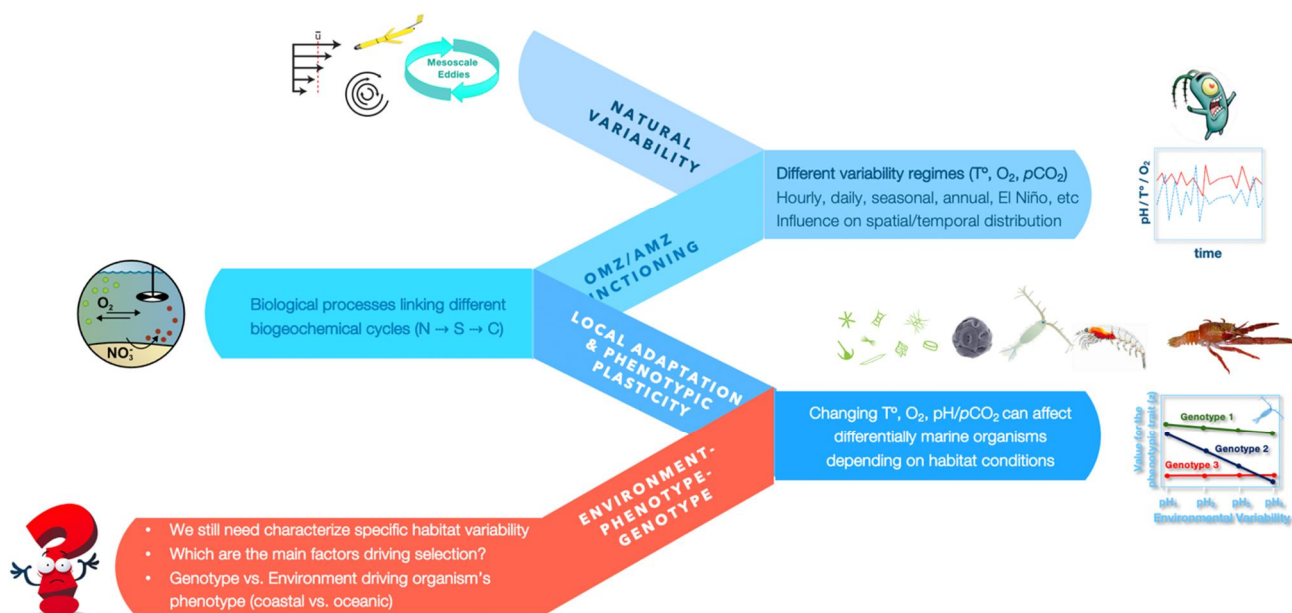


Fig. 1. Schematic representation of the three research questions addressed in Research Line I.

For question 1, based on 35 oceanographic campaigns conducted between 2015 and April 2016 in the Humboldt Current upwelling system (23°S), the daily-to-bimonthly hydrographic variations and coastal changes in the carbonates system during the 2015 El Niño event was evaluated. Evidence was provided that variability associated with El Niño can modify the carbonate system in northern Chile, by increasing phytoplankton biomass and reducing seawater pCO₂ (Aguilera et al., 2021a). This increase in phytoplankton biomass was also found to reduce the negative impact of low pH /high pCO₂ in zooplankton (Aguilera et al. 2021b). Moreover —based on direct observations in an area of intense mesoscale and sub-mesoscale activity in the zone between coastal and oceanic waters— evidence was provided of the contribution of turbulent mixing in locally increasing nutrient availability in the upper layer and, in turn, to sustain patches of large-size phytoplankton cells in an otherwise small-phytoplankton realm (Corredor-Acosta et al. 2020).

For question 2 and in collaboration with Julio Sepúlveda's group (University of Colorado; JS is an IMO Adjunct Investigator), cell membrane intact polar lipids (IPLs) were used to assess the biological characteristics of free-living versus particle-attached suspended organic matter across the strong oxygen gradient in waters off northern Chile (Cantarero et al. 2020). Marked differences were found between the two different size classes, as well as among the different redox layers. Results — which are based on IMO's LowpHOX II cruise in 2018— suggest that the oxygen-depleted waters of anoxic marine zones could provide additional sources of organic carbon to deeper waters.

For question 3, acoustic and net-based observations were used to assess the diel vertical migration of krill across a redox gradient (Riquelme-Bugueño et al. 2020). Results indicated that *Euphausia eximia* can spend several hours during daytime in anoxic and corrosive (high-pCO₂) waters, suggesting an adaptation to conditions predicted for open-ocean waters in a worst-case global warming scenario by 2150. Also, a microcosm experiment carried out during IMO's LowpHOX I cruise, revealed the effect of low pH/high pCO₂ conditions over the genetic diversity of the bacterial community (Aguayo et al., 2020), showing that small changes in pH may impact significantly the abundance and diversity of key microorganisms. Moreover, variable dissolved oxygen concentrations appear to modulate changes in protist diversity in marine waters (De la Iglesia et al., 2020).

Research Line II: The Deep Ocean

Regarding our goals focused on the deep offshore region of the southeast Pacific, important advance was made for understanding the factors and processes controlling distribution and diversity in the pelagic ecosystem. In oceanic regions, zonal gradients in oceanographic conditions from the upwelling zone and westward up the Pacific central gyre, are a key factor structuring zooplankton communities and their diversity patterns (González et al., 2020a). These gradients may even affect the population structure and its genetic diversity in widely distributed species over the south Pacific basin (González et al. 2020b). In the same context, data derived from the previous cruise MOPEX (Mesoscale Processes and Experiments) carried out in 2016 at central Chile (30°-33° S), allowed us to reveal that mesoscale transport may also be crucial for channeling organic C produced in the upwelling zone to the offshore and then promoting downward C flux to deep and ultra-deep waters over the Atacama Trench via daily vertical migration (Tutasi & Escribano, 2020) and mediated by trophic interactions (González et al. in preparation).

Prevailing mesoscale activity surrounding the seamount region and oceanic island is also an important physical process structuring observed distributional patterns of pelagic organisms in the southeast Pacific (Espinosa-Leal et al., 2020a). The influence of these mesoscale processes originated at the upwelling zone and affecting zooplankton assemblages can even reach the area within the South Pacific central gyre (Medellín-Mora et al., submitted). The food web structure is also strongly linked to environmental gradients and mesoscale processes which allow the mixing and exchange of zooplankton between onshore and offshore systems, including the seamount region (Espinosa-Leal et al., 2020b).

In ultra-deep (>1000 m) waters in the southeast Pacific, our major goals and challenges have been focused on the Atacama Trench. The ATACAMEX and SONNE Cruises carried out during the summer 2018 allowed to obtain unique samples and data which were subject to processing and analyses during 2019 and early 2020. From Lander deployments at both cruises down to >8000 m, in collaboration with our international partners, we discovered and described and new species of

scavenger amphipods, which was named as *Eurythenes atacamensis* in honor to ATACAMEX cruise (Weston et al. in press). Above the Atacama Trench we are also uncovering species diversity of several taxonomic groups, including gelatinous zooplankton (Fernández-Zapata et al., submitted), deep-water fishes (Ñacari PhD thesis work) and their associated parasite species (Ñacari et al., 2020), as well as metabolic processes controlling the downward flux of C to ultra-deep Atacama Trench (Fernández-Urruzola et al., submitted). More recently, molecular approaches, based on environmental DNA (eDNA) and zooplankton metabarcoding analyses, have been applied to water samples and zooplankton samples obtained during the ATACAMEX and Sonne cruises. eDNA data from water samples obtained down to 8000 m at the Atacama Trench are being assessed and compared to similar samples from Kermadec Trench (0-9000 m). Unexpectedly high genetic diversity and endemism of metazoan are some of the preliminary findings from eDNA analysis, while metabarcoding analysis of zooplankton samples from vertical layers down to 5000 m is being conducted and expected to be completed in the coming months.

Substantial progress on sample and data analysis has also been made for the 2019 international joint expedition EPIC, coordinated by JAMSTEC (Japan). During this cruise we obtained zooplankton samples at high vertical resolution (0-2000 m) across the southeast Pacific, from the Chilean coast up to near Tahiti Islands, along with physical and chemical measurements. The food web structure and diversity patterns are some of our target scientific goals to aim at with data obtained from this large-scale cruise.

During 2020, IMO has joined forces with the geophysics/geology community and secured funds to deploy the first Integrated Deep-Ocean Observing System (IDOOS) at the Atacama Trench and continental slope, linking cutting-edge monitoring technology for data acquisition within a novel transdisciplinary framework. The overarching goal of IDOOS is to detect and quantify a wide range of poorly understood deep-ocean processes ranging from the characterization of the structure and temporal variability of physical, geochemical, and biological conditions, up to detecting seafloor deformation associated with the build-up of strain leading to a great earthquake, over several years. Moreover, the implementation of biogeochemical sensors (O₂, pH/pCO₂) will improve our understanding about how climate change, and specifically global warming and ocean acidification, can impact the deep-ocean habitat of this unique reservoir of biodiversity for the Earth. Our observing system will have two principal elements (Fig. 2):

- A deep ocean moored system composed of a line anchored to the bottom of the sea with a set of oceanographic sensors located at different depths that allow the recording of different physical and biogeochemical parameters, such as water movement, temperature, salinity, pressure, dissolved oxygen, and CO₂, as well as different substances that sediment through the water column.
- A set of three sea-floor pressure and tilting sensors with the new capacity of removing instrumental drift and measuring vertical displacements related to inter-seismic locking, seismic deformation and slow slip or transient events. These sensors will be integrated with a dense network of ocean-bottom and onshore seismometers.

IDOOS will be deployed during 2022.

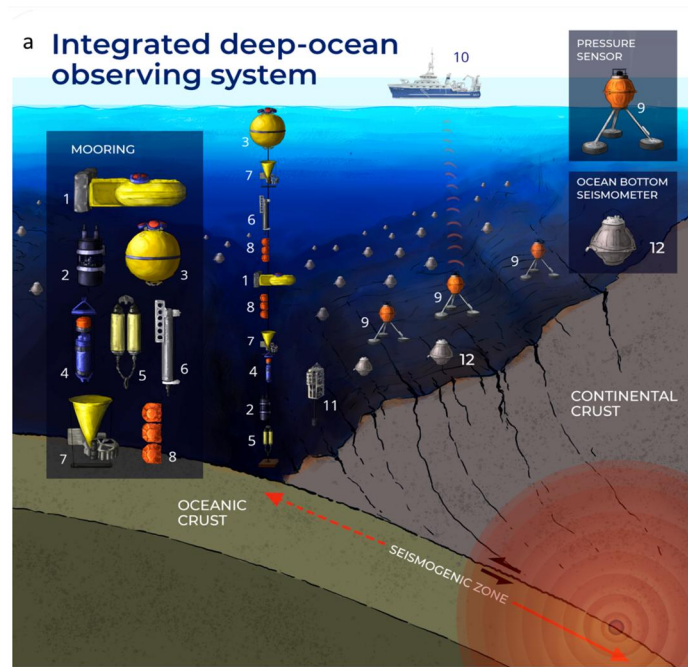


Fig. 2. IMO's Integrated Deep-Ocean Observing System (IDOOS) to be deployed in the Atacama Trench.

b) Productivity:

A total of 30 journal articles were published in year 7, of which 19 indexed (Web of Knowledge) were authored or coauthored by IMO current associate researchers (3.2 publications per associate researcher) and 1 by former associate researcher Carmen Morales and Samuel Hormazábal. From the 20, 60% were in Q1 journals. Furthermore, 52% of these publications were open access, reflecting our continued commitment to publish in highly ranked open access journals or to pay the required fee to make them open access. From the 20 total indexed articles published by the (former) associate researchers, 6 included more than one (former) associate researcher, reflecting the continuous collaborative work among IMO researchers or the number of joint articles produced, a number significantly higher than in the previous year. And the relative number of publications co-authored by students was 40%. Hence, the publication record in year 7 evidenced the effort of IMO associate researchers to publish joint high-quality research in top-level journals. A complete detail of publications is shown in Annex 3.

c) Outstanding publications:

1. The IMO research Riquelme-Burgeño led “Diel vertical migration into anoxic and high-pCO₂ waters: acoustic and net-based krill observations in the Humboldt Current” (published in 2020 in Scientific Reports) demonstrated the important finding that krill in the north of Chile are capable of migrating into deeper anoxic, very high CO₂ waters, suggesting that some species of this critical functional group may be able to adapt to possible future expansion of such zones under predicted climate change scenarios. This work synthesized complex results from acoustic, chemical, physical, and biological samplings aboard the first IMO-led cruise aboard the *R/V Cabo de Hornos* in 2015, and included the contributions of two IMO associate researchers and another IMO adjunct researcher.

2. PhD student Sebastian Cantarero and IMO adjunct researcher Dr. Sepúlveda led a paper using advanced analysis of lipids to understand microbial contributions to organic matter and its fluxes through anoxic waters off of northern Chile (Cantarero et al. 2020, “Size-Fractionated Contribution of Microbial Biomass to Suspended Organic Matter in the Eastern Tropical South Pacific Oxygen Minimum Zone”, published in *Frontiers in Marine Science*). This study resulted from an ambitious effort implemented aboard the cruise led by IMO in 2018, and involved two IMO associate researchers as well as other young and adjunct researchers. Additionally, it highlights the international composition of the IMO, as Dr. Sepúlveda is a professor at the University of Colorado.

3. Both IMO research lines rely on improving understanding of large-biological oceanography patterns in the Southeast Pacific, particularly extending knowledge from the Chilean coast to the very poorly sampled central gyre whose oceanographic center is just to the west of Easter Island. The paper by González et al. (2020) “Environmental Gradients and Spatial Patterns of Calanoid Copepods in the Southeast Pacific” is a major advance in this direction, in relation to one of the most important and diverse zooplankton groups. The paper integrates work from recently graduated IMO PhD student (and now IMO postdoc) Carolina González, IMO associate researcher Escribano, and IMO junior research Dr. Medellín.

4. The paper by Aguilera et al. 2020 “Intraseasonal Hydrographic Variations and Nearshore Carbonates System Off Northern Chile During the 2015 El Niño Event”, published in *JGR Biogeosciences*, with the contribution of IMO associate researcher Vargas, is important for giving unprecedented new insights into how climate variability, in this case the El Niño Southern Oscillation, affects the mosaics of waters with very distinct carbonate chemistry that impact the coast of Chile and other Eastern Boundary Current Systems. Additionally, it is important for IMO as it marks the continued scientific maturation and advance of Dr. Aguilera, formally a young IMO researcher and now an IMO adjunct researcher, who has expanded from his investigation from physio-ecology of copepods to now include the larger oceanographic context.

5. The paper by Pollak et al. 2020 (“Universal loop assembly: open, efficient and cross-kingdom DNA fabrication” published in *Synthetic Biology*), in which IMO associate researcher Von Dassow participated, shows how a basic IMO high-risk “blue sky” question led to a major advance in a completely different discipline (synthetic biology) that provides a major new tool for diverse fields such as cell biology and microbiology. As part of a global consortium looking to develop new tools for genetic investigation of marine protists, Dr. von Dassow explored whether it might be possible to isolate new protists based on the capacity to uptake and express foreign genetic material (included in Faktarova et al. 2020). This effort was limited by a lack of a simple DNA construction technology that was not highly specific to the target organism, a problem Dr. Pollak and Dr. Federici, collaborators from the Millennium Institute for Integrative Biology, were inspired to solve.

Summary table

<u>Category of Publication</u> ¹	<u>MSI Center Members</u>	<u>Number of Publications coauthored by students</u>	<u>Total Number of Publications</u>
ISI/WOS Publications or Similar to ISI/WOS Standard	Principal Researchers	7	19
	Other Researchers	2	11
SCOPUS Publications or Similar to SCOPUS Standard	Principal Researchers		
	Other Researchers		
SCIELO Publications or Similar to SCIELO Standard	Principal Researchers		
	Other Researchers		
Scientific Books and chapters	Principal Researchers		
	Other Researchers		
Other Scientific Publications	Principal Researchers		
	Other Researchers		
<u>Total of Publications</u>		9	30

¹ Nota: indicar la metodología o fuente utilizada para la categorización de las publicaciones

d) Congress Presentations:

The most relevant presentation is “Plankton Respiration in the Ultradeep Waters over the Atacama Trench: Implications for Particulate Organic Carbon Sequestration” at the ASLO Ocean Science Meeting. In this congress presentation first results from the Atacamex expedition were presented and involved 4 associate investigators. In spite of the pandemic, IMO researchers participated in several Chilean and international events (most in an online mode), particularly in areas related to IMO research lines. For example, Dr. Vargas participated as guest speaker in various meetings dealing with ocean acidification. The summary is given in the following table.

Summary Table

Type of presentation	Type of presentation	National Events [Number]	International Events [Number]
Principal Researchers	Conferences, oral communications, poster communications, others (specify)	2	1
	Invited presentations (not included in above row)	1	6
Other researchers (Adjunct, Senior, Young, Postdoctoral Researchers)	Conferences, oral communications, poster communications, others (specify)	0	4
	Invited presentations (not included in above row)	0	0
Students	Conferences, oral communications, poster communications, others (specify)	0	1
	Invited presentations (not included in above row)	0	0

Other achievements:

En esta sección se deben reportar otros resultados alcanzados dentro del marco de ejecución del centro de investigación.

- **Patents:** We do not have new patents during this period.
- **Intellectual property:** We do not have new intellectual properties during this period.
- **Organization of Scientific Events:** The scientific events are presented in Annex 4.
- **Scientific Editorial Boards:**

Nº	Nombre Publicación	Categoría Publicación	Miembro(s) del Comité	Año Inicio
1	Frontiers in Marine Science	Scopus	Víctor Miguel Aguilera Ramos.	2018
2	Frontiers in Marine Science	ISI/WOS o Similar a ISI/WOS standard	Cristian Antonio Vargas Galvez.	2019
3	Editorial Board de Nature Scientific Reports	ISI/WOS o Similar a ISI/WOS standard	Cristian Antonio Vargas Galvez.	2019
4	Journal of Plankton Research	ISI/WOS o Similar a ISI/WOS standard	Peter von Dassow .	2015
5	Frontiers in Physiology	ISI/WOS o Similar a ISI/WOS standard	Cristian Antonio Vargas Galvez.	2019
6	Associate Editor "Frontiers in Microbiology"	ISI/WOS o Similar a ISI/ WOS Standard--	Osvaldo Iván Ulloa Quijada.	2018
7	Oceanología	ISI/WOS o Similar a ISI/WOS standard	Víctor Miguel Aguilera Ramos.	2020
8	Frontiers in Marine Science	ISI/WOS o Similar a ISI/WOS standard	Víctor Miguel Aguilera Ramos.	2020
9	Revista Acta Oceanográfica del Pacífico	ISI/WOS o Similar a ISI/WOS standard	Pamela del Carmen Hidalgo Diaz.	2020
10	Editorial Advisory Board Members of ES&T(Environmental Science and Technology).	ISI/WOS o Similar a ISI/WOS standard	Mauricio Andrónico Urbina Foneron.	2020
11	Limnology and Oceanography	ISI/WOS o Similar a ISI/WOS standard	Osvaldo Iván Ulloa Quijada.	2020

- **Awards:**

The documentary “Atacamex: exploring the unknown” was an international award as the best documentary at the UNOFEX International Film Festival 2020, held in Monaco.

1. Education and Capacity Building

a) Education, Training and Capacity Building:

In 2020, despite the pandemic situation, IMO maintained the support and efforts for developing education and training activities at the Postdoctoral, PhD, Master and Undergraduate levels. At graduate level, the actions were conducted in association with 5 graduate programs related to oceanography and marine sciences in Chile: i) Doctoral Program in Environmental Sciences (UdeC), ii) Doctoral Program in Ecology (PUC), and iii) Doctoral Program in Oceanography (UdeC), iv) Master's Program in Oceanography (PUCV) and v) Master's Program in Oceanography (UdeC). Support for undergraduate careers and degrees was developed through 4 undergraduate professional careers: Marine Biology at PUC and UdeC, Oceanography at PUCV and Geophysics at UdeC. In addition, our program for Early Career Scientists (IECS), implemented in 2019 continued supporting some young scientists. Two IECS were maintained by IMO during the first half of 2020 and a third was hired starting September 2020.

Our Strategy Plan to increase the recruitment of graduate students, originally planned for 2020, was postponed due to the pandemic situation, and planned actions are to be resumed upon favorable conditions. This Strategy Plan mostly considers presential activities, such as courses focused on incorporation of practical activities in addition to lectures, needing academic and student mobility and for obvious reasons could not be implemented. Our alternate strategy was to invest more effort in supporting graduate students in terms of financial aid to help them maintain their thesis work under lockdown conditions. The following graph (Fig. a1) illustrates the different sources of funding (scholarships) for students doing their thesis at IMO.

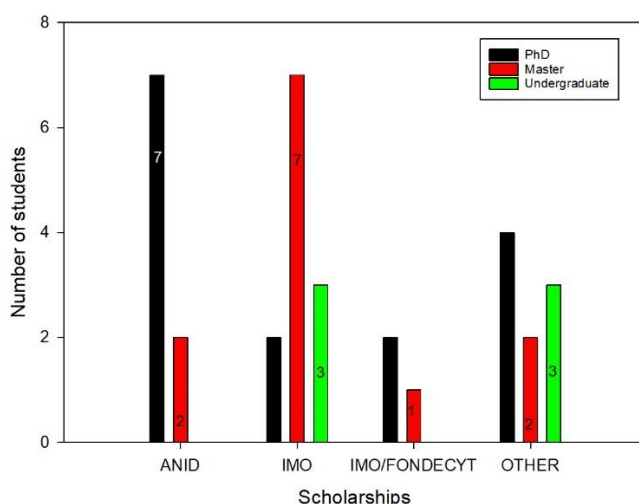


Figure a1: The different sources of funding to support undergraduate and graduate students carrying on their thesis at IMO. IMO/Fondecyt are concurrent grants complemented with IMO funding.

- Postdoctoral researchers

IMO supported 7 postdoctoral positions during 2020. Most of them continued their work from previous years, and these included IMO fully funded postdocs Carolina González and Erick Potvin, and those with external funding, such as Natalia Osma, Igor Fernández-Urruzola, Vera Oerder and

Paula Ruz supported by ANID/FONDECYT, and Sonia Yañez funded by a new UdeC postdoctoral funding. From our last international call for postdoctoral positions at IMO, conducted in early 2019, one of the selected PhD's was Dr. Jane Wong coming from the University of Hong Kong. She could finally arrive to Chile by late 2020, but due to the pandemic situation she could not initiate any laboratory or field research activity and finally decided to resign to the position and return home in January 2021, although she continues to work in collaboration with us on a study that incorporates bibliographic and meta-analysis and modeling. Therefore, no additional postdoctoral positions could be assigned by IMO in 2020 and no further actions have been taken since then.

b) Achievements and results:

The main IMO's educational achievements during 2020 were the following:

- In graduate and undergraduate programs. During 2020, IMO researchers invested time and efforts in 5 undergraduate and 6 graduate programs, including lecturing basic and advanced courses, practical work, and thesis supervision and co-supervision: Undergraduate Programs in Marine Sciences: Marine Biology at UdeC, PUC, and UCN, Geophysics at UdeC, and Oceanography at PUCV. Graduate Programs in Marine Sciences: M.Sc. in Oceanography at UdeC, M.Sc. In Oceanography at PUCV, M.Sc. in Ecology of Aquatic Systems at U. Antofagasta, Ph.D. in Oceanography at UdeC, Ph.D. in Environmental Sciences at UdeC, and Ph.D. in Biological Sciences at PUC. The total number of students directly linked to IMO has fluctuated year-after-year and is shown in the following Figure:

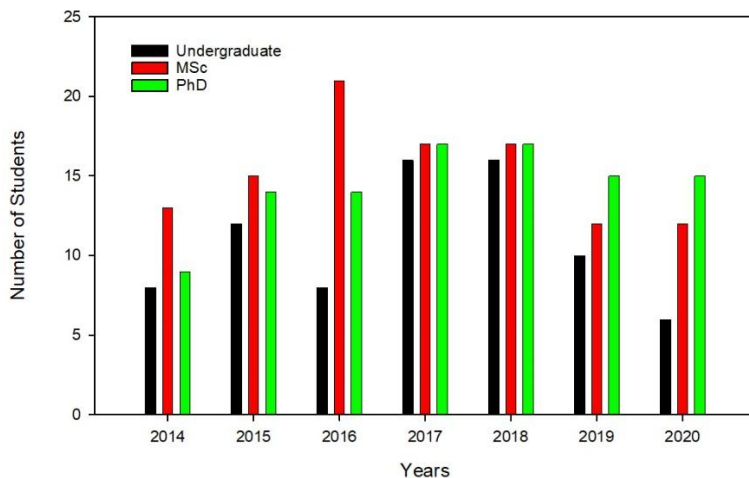


Figure b1: Total number of students since 2014 doing their thesis work at IMO. In 2020 there were 6 undergraduates, 12 in M.Sc., and 14 in Ph.D. Programs. IMO Associate Researchers are or were co-tutoring 50% or more students in each of these categories.

With respect to graduation, in 2020 IMO graduated 3 PhD and 1 MSc students. The evolution of graduating students each year shows a positive tendency through the years (Figure b2). The main outcome indicates that IMO has graduated 12 PhD and 15 MSc students between 2014 and 2020.

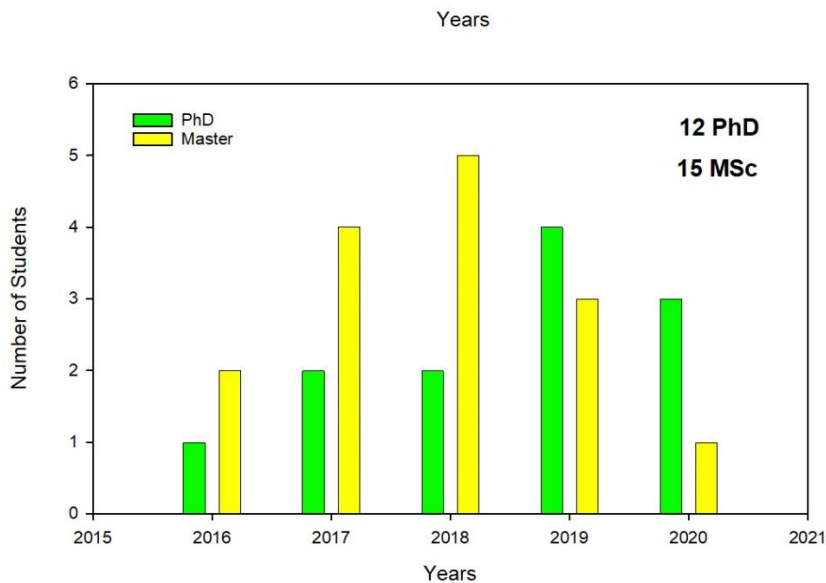


Figure b2: the number of new graduated students per year after doing their thesis at IMO.

Theses completed in 2020:

Lady Liliana Espinosa, Ph.D. thesis “Factores oceanográficos que modulan la estructura comunitaria de anfípodos hipéridos en la región oriental del Pacífico Sur”. Supervisor: Dr. R. Escribano.

Pritha Tutasi, Ph.D. Thesis “Downward C flux into the deep ocean by active transport of C mediated by zooplankton vertical migration” Supervisor: Dr. R. Escribano.

Freddy Hernández, PhD. Thesis “Impacto de la variabilidad climática durante la última década sobre la dinámica del giro subtropical en el Pacífico Sur Oriental y el volumen de Agua Intermedia del Pacífico Sur Oriental” Supervisor: Dr. Wolfgang Schneider.

Victoria Paz Salas Rojas, MSc. Thesis: "Remolinos de Mesoescala y Filamentos de Surgencia Alrededor del Monte Submarino O'Higgins (32.8°S y 73.8°W), Chile” Supervisor: Dr. Samuel Hormazábal.

Theses in progress:

Francisco Javier Díaz Rosas. PhD Thesis “Environmental and biotic controls on coccolithophores assemblages and *Emiliana huxleyi* populations: integrating cell traits, population dynamics and community structure”. Doctoral Program. Faculty of Biological Sciences, Pontificia Universidad Católica de Chile. Supervisor: Dr. P. von Dassow. Thesis submitted, May 2021.

Edgart Flores, Ph.D. Thesis, “Characterization of the organic matter in the Atacama Trench using lipid markers”. Co-supervisors: Dr. O. Ulloa and Dr. J. Sepúlveda.

Lenna Ortiz. Ph.D. thesis “Evolución biogeoquímica de los remolinos de mesoescala frente a la costa de Chile”. PhD Program in Oceanography, University of Concepción. Supervisor: Dr. O. Pizarro.

Matias Pizarro-Koch. Ph.D. thesis “Variabilidad de la zona de mínimo oxígeno frente a la costa central de Chile”. PhD. Program in Oceanography, University of Concepcion. Supervisor: Dr. O. Pizarro.

María Carla Marín M. PhD. Thesis. “Impacto de las ondas de Rossby extratropicales en la circulación profunda de la cuenca de Chile”. PhD. Program in Oceanography, University of Concepcion. Supervisor: Dr. O. Pizarro.

Ana Belén Venegas. Ph.D. Thesis "Interacciones físicas-biológicas que determinan la variabilidad en biomasa y producción del zooplancton en la zona de surgencia de Chile - Centro Sur: el rol de procesos advectivos y la interacción fitoplancton-zooplancton". PhD. Program in Oceanography, University of Concepcion. Co-supervisors: Dr. R. Escribano, Dr. C. Parada.

Braulio Fernández, MSc. Thesis “The community structure of deep-sea gelatinous zooplankton in the Southeast Pacific at the Atacama trench”. Co-supervisors: Dr. I. Fernández and Dr R. Escribano. Thesis defense by early 2021.

Francisca Olivares, M.SC. Thesis, “The planktonic Bacteria and Archaea of the Atacama Trench”. Supervisor: Dr. O. Ulloa. Thesis defense pending (expected mid 2021)-

Darinka Pecarevic, MSc. thesis, “Efecto de las ondas atrapadas a la costa y los remolinos de mesoescala sobre la surgencia costera frente a Chile central (32 – 34°S)”; Supervisor: Dr. S. Hormazabal; co-tutor: C.E. Morales; Thesis defense pending.

Katherine Gómez, MSc. Thesis, “Mesoscale activity in the upwelling and costal transition zone off Central Chile” Supervisor: Dr. S. Hormazabal.

Sibille Daniela Améstica, MSc. Thesis, “Mesoscale activity in the upwelling and costal transition zone off Central Chile” Supervisor: Dr. S. Hormazabal.

Edson Piscoya, MSc thesis, “Respuestas fisiológicas del fitoplancton marino ante el efecto sinérgico de bajos niveles de pH y O₂”, Supervisor: Dr. Cristian Vargas, Co-supervisor: Dr. Peter Von Dassow; Thesis defense pending.

Nadín Ramirez R. MSc thesis, “Estudio de la variabilidad de submesoescala en Chile central (~36°30’S) y de eventos de oxigenación de la zona de mínimo de oxígeno mediante observaciones realizadas con planeadores submarino”. Master Program in Oceanography, University of Concepcion. Supervisor: Dr. O. Pizarro.

Valerie Villegas, MSc. thesis, “Efecto de los caminos preferidos de remolinos de mesoescala en la distribución de la productividad primaria y de la zona de mínimo oxígeno en el Pacífico Sur-Oriental frente a Chile”; Supervisor: Dr. S. Hormazabal, co-Supervisor: Dr. P.A. Auger; thesis defense pending.

Enrique Ascencio, MSc. Thesis, “Respuesta fisiológica de dinoflagelados mixotróficos del género *Alexandrium* y *Prorocentrum* frente a condiciones de alto pCO₂/bajo pH”; Supervisor: Dr. Cristian A. Vargas, co-supervisor: Dr. Patricia Gómez (Departamento de Botánica, UdeC).

c) **Destination of students:**

All new PhD students graduated at IMO are currently all active young scientists in Chile. The present position and destiny of new graduated PhD from IMO is shown in the Table below.

Table b1: PhD students graduated at IMO 2015-2019 and their present working situation.

New PhD	Current Position
Montserrat Aldunate	Postdoctoral position at IMO
Valeria Anabalón	Researcher in another project in Chile
July Corredor	Researcher in another Chilean Center
Carolina González	Postdoctoral position at IMO
Johanna Medellín	Early Career Scientist IMO
Valentina Valdés	Postdoctoral position at UdeC
Paula Ruz	Postdoctoral position at IMO-PUCV
Sonia Yañez	Postdoctoral position at IMO-UdeC
Salvador Ramírez	Engineer-Researcher at UdeC and IMO
Pritha Tutasí	Researcher at INOCAR Ecuador
Freddy Hernández	Researcher at INOCAR Ecuador
Lady Liliana Espinosa	In Colombia applying to position

Regarding new graduated MSc at IMO, several of them have started PhD programs in Chile or abroad, while some are working as highly qualified technicians at Chilean University or Research Centers (Table b2)

Table b2: New MSc graduated at IMO during 2015-2020 and their present position.

New MSc	Current Position
Katerín Aníñir	Technician
Richard Cobo	Back in Ecuador
Marcela Contreras	Technician
Pamela Fierro	PhD program in France
Rosario Díaz	Profesional in Industry
Javiera Pavez	Technician
Paula Ruiz	PhD program in Chile
Belén Franco	PhD program in Denmark
Leissing Frederick	PhD program in Chile
Guillermo Feliú	PhD program in France
Constanza Merino	Unknown situation
Luis Valencia	Technician

2. Networking and other collaborative work

During 2020, IMO has continued its participation in different national and international collaboration networks in the framework of both research lines.

One of the highlighted aspects of the networking work at IMO has been the support that our institute has provided to the ***Latin-American Ocean Acidification Network (LAOCA)***. As previously mentioned in other annual reports, LAOCA is a regional effort for the coordination and support of Ocean Acidification (OA) research in the Latin-American region, with a main mission to communicate and strengthen the observing capacity of the OA process, as well as improving the comprehension of the potential impact of OA on marine populations, ecosystems, and their services provided to humans. LAOCA has been also defined as one of the main organisms communicating relevant information to stakeholders and decision makers in each respective member country, and involves more than 50 members from ten Latin American and Caribbean countries; including Argentina, Brazil, Cuba, Chile, Colombia, Costa Rica, Ecuador, México, Panamá, and Peru. Recently (October 2020), our associate, Dr. Vargas, has been designed as one of the Co-Chair of the Executive Council at LAOCA. During 2020, LAOCA launched its Governance plan, which provides broad concepts that seeks to provide guidelines for the basic structure, regulations, operation, and action plan of this international network, in order to coordinate more efficiently the regional research efforts in OA and integrate the region with the international networks that have been established for monitoring changing ocean conditions and their biological and ecological consequences at a global level. The Governance Plan is fully available at *Research Gate* website at:

https://www.researchgate.net/publication/344756618_Red_Latinoamericana_de_Acidificacion_del_Oceano_Plan_de_Gobernanza_Documento_Tecnico_Primer_Edicion_32_pp. During the last months, and upon SARS-CoV-2 pandemic, LAOCA is implementing a series of different actions aiming to integrate the research community and stakeholders, including the implementation of *Webinars*, a *Youtube Channel* (<https://www.youtube.com/channel/UCOi5g0d1HrBoYYaGGdj6Tig>), and the organization of *online* graduate training and workshop activities for this year 2021. Moreover, Dr. Vargas will support the connection between the structure of the Latin American community working on Ocean Acidification (e.g. IMO, LAOCA, the new *Millennium Institute SECOS*) and global (GOA-ON and IOCCP) network programs, as well as data management in South America for the production of global syntheses and data products.

IMO has also aimed to incorporate more actively the participation of young researchers in international networking tasks. For instance, IMO has also strengthened its collaboration with specific institutions in the region, such as the ***"Instituto de Investigaciones Marinas y Costeras José Benito Vives de Andrés" (INVEMAR)*** in Colombia, through an international collaboration program led by the young researcher, ***Dr. Johanna Medellín***, entitled ***"Strengthening of technical-scientific capacities of new methods for the study of marine biodiversity in Colombia and Chile - BIOMACC"***. This networking project aims to strengthen the technical-scientific capacities of human resources in relation to the study of marine biodiversity in Colombia and Chile, through the exchange of experiences and knowledge among the following Colombian institutions; INVEMAR and the Network of Marine Research Centers in Colombia, and the Universidad de Concepción and IMO at Chile. The networking strategy considers the organization of different capacity building actions, such as, graduate courses, workshops, expert's visits, and conferences. Finally, a significant achievement of this program will be the launching of a ***"Guide for recommendation and methodologies for the management of marine biodiversity"***. Similarly, our postdoctorate ***Dr. Natalia Osma*** is currently a full member of the recent ***SCOR Working Group 161 (2021-2024)***, which brings together experts in observation, experimentation, data analyses, and modeling to systematically compile and compare

data sets of mesopelagic microbial respiration in order to constrain respiration uncertainties and improve quantifications of organic matter flux and remineralization rates. A final outcome of this working group will be to improve projections of the effects of global change on the decline of oxygen in the world's oceans, with implications for fisheries and food security. She is participating as an expert on the use of biochemical approaches to quantify respiration rates in the ocean.

A significant highlight where IMO has played a significant role is the establishment of the *Scientific Network "Science Plastic Pollution Alliance of Chile (SPLACH)"*. Our adjunct researcher, *Dr. Mauricio Urbina* has played a major role in the establishment of the SPLACH network, an opportunity to both conduct an updated diagnosis of this problem and to develop a coordinated research agenda, in coordination with societal and political needs. The main objective of this network is the understanding of the potential impacts of plastic litter on organisms, the environment, and society, and to identify the solutions and the pathways necessary to establish vulnerability scenarios and mitigation strategies. Finally, the evidence produced by the SPLACH network is expected to aid in shaping government policies to mitigate the impacts and to support legal enforcement about plastic pollution in aquatic environments. A research paper led by Dr. Urbina entitled *"A country's response to tackling plastic pollution in aquatic ecosystems: The Chilean way"*, was published early this year in the journal *Aquatic Conservation* (Urbina et al. 2021), where the 28 members of SPLACH network present the main focus of this significant networking effort.

IMO has teamed with the GEOMAR Helmholtz Centre for Ocean Research (Kiel, Germany) and the Center for Hadal Research (HADAL) hosted by the University of Southern Denmark (Odense, Denmark) as international partners to establish the first Integrated Deep-Ocean Observing System (IDOOS) in the Atacama Trench.

In 2020, IMO researcher Dr. Von Dassow continued to participate in the Franco-Brazilian-Chilean International Research Network organized by the French CNRS titled IRN DABMA "Diversity and Biotechnology of Marine Algae" (formerly "Diversity, Evolution and Biotechnology of Marine Algae", GDRI N° 0803), as well as the Franco-Chilean binational CNR International Research Laboratory (IRL) 3614 "Evolutionary Biology and Ecology of Algae" (CNRS, Sorbonne Université, PUCCh, UACH).

At the national level, IMO has a permanent participation in different expert groups providing services to public and governmental agencies. For instance, *Dr. Vargas* is a permanent member of the *"Technical Advisory Committee on Climate Change (GTA-Cambio Climático Subpesca)"* at the Undersecretary of Fisheries, where he provides guidance and advice on different issues related with the impact of climate change on marine resources in Chile.

a) **Redes de Colaboración**

IMO has established several network relationships in the framework of technological development for ocean monitoring, especially in the framework of one of more significant challenge for our institute, the establishment of a deep-ocean observatory. In such framework, IMO has been establishing contact with different companies focused on the development of technology aiming to monitor key parameters for the comprehension about the impact of climate change on the deep ocean, such as, the partial pressure of carbon dioxide. IMO is actually working with the company Sunburst Sensors owned by Professor Michael DeGrandpre, the inventor of the SAMI technology for pH and CO₂ monitoring, and Mr. James Beck, who serves as its CEO. The company was originally

established as a vehicle for the transfer of technology from academia to the private sector, starting with the SAMI-CO2. Sunburst Sensors provides a means for proven technical innovations in autonomous chemical sensing to be made available to scientists, engineers and others around the world. Beyond this, the company has been able to successfully compete for grants via programs such as SBIR, MBRCT, NOPP, NSF, etc. and leverage this R&D funding into real world products.

Finally, IMO is also strengthening its collaboration strategy with other millennium centers (e.g. *Millennium Nucleus The Seismic Cycle along Subduction Zones*, *CYCLO* and *Millennium Nucleus in Ecology and Sustainable Management of Oceanic Islands-ESMOI*), and starting to implement a new collaboration with the *Coastal Social-Ecological Millennium Institute, SECOS*, which both constitute the only millennium institutes focused exclusively on the study of oceanic and coastal ocean in Chile, respectively.

3. Outreach and connections with other sectors

a) Outreach:

The general objective that we seek with the outreach activities is to disseminate among the general public and the school communities in particular knowledge related to marine sciences and the research outputs of our center.

The criteria to promote these activities are framed in identifying needs of the target audience, using diverse technological resources (ICTs) that can reach everyone and recognizing the diversity of audiences in terms of interests and learning methods.

In relation to the Outreach activities to the External Environment developed during 2020, the following stand out:

Book on the Atacama Trench: During 2020, we worked on producing a popular science book about the exploration of the deep ocean, and in particular the Atacama Trench. The book —entitled “Journey to the Underworld”— was written by Osvaldo Ulloa with the support of the outreach team in the areas of literature research, editing, communication and illustration. The book will be available during 2021.

Video clips “Estelita’s Creative Recipe”: Due to the pandemic, it was not possible to carry out the live puppet shows that were programmed for the year. However, we produced four video clips with the puppets as characters, addressing the following topics: Light in the Ocean; Ocean Currents; Ocean Pollution; and The Deep Ocean.

“Immerse yourself in creating” contest: This contest that brings together Art and Science is inspired by the interactive platform of the same name and encourages educational establishments in the Biobío and Ñuble regions to create different works of art inspired by the sea. During 2020, the 5th version of the contest was held, in which the participants (about 70 children and young people) had to create stories and/or illustrations. Due to the pandemic, the awards were sent directly to their homes and a face-to-face award ceremony could not be held.

TV Series “Lyn y Babas”: The production of the 3rd season of the children's animated tv series "Lyn y Babas" was carried out, in a co-production between IMO and “CNTV Infantil” (the only daily audiovisual programming for children of a public and educational nature in Chile). The new season

has 8 chapters, which are set on the beach (intertidal), where Lyn and her snail friend Babas meet, chapter by chapter, different organisms that inhabit this ecosystem. In addition, 8 informative video clips of each species were made with the real pictures recorded for the season. The series is available for free on the CNTV Infantil web platform and will be aired in 2021 by the Educational Television Network of the National Television Council and its associated platforms. It is expected to reach a public of more than 600 thousand spectators.

Trailer: <https://www.youtube.com/watch?v=CrMoFBhEENw>)

TV Program “Explorers: From the Atom to the Cosmos”: The fifth season of this series was produced, where the investigations carried out in centers of excellence in our country are presented. With an impact of 400 thousand average viewers per episode and a total of 5,600,000 viewers for the 14 episodes of the season. In the chapter dedicated to IMO, the following topics were addressed: Graduate Education in Oceanography; Research in Marine Microbiology; and Research in Mesoscale Eddies:

<https://www.youtube.com/watch?v=aLqYt0-2FB4>

https://www.youtube.com/watch?v=-NfSHc_xmfk

<https://www.youtube.com/watch?v=acv4Bp76fuU>

The TV children's series "Bichitos: Invisible Bugs”: this tv series was premiered in the context of the pandemic, in which 59 children from different regions of the country participated, who answered questions posed by themselves about viruses, generating a dialogue where they expressed opinions and recommendations about the pandemic that they, our country and the world were going through. Bichitos was a co-production of CNTV Infantil with the Millennium Institute of Oceanography, Science & Life Foundation and made by GVG producciones. The series participated in the Calibelula International Festival in Cali, Colombia and was seen by more than 1,500,000 children during its exhibition on TV Educa, and by more than 600,000 viewers on the educational television network of the National Television Council.

https://www.youtube.com/watch?v=fMi_jQ2_RzA

Documentary “Atacamex: Exploring the Unknown”: This documentary narrates the IMO expedition to the Atacama Trench in 2018. In 2020, the documentary was released on “Ondamedia” platform (www.ondamedia.cl) of the Chilean Ministry of Cultures, Arts and Heritage, becoming one of the most viewed documentaries on the platform, with more than 9000 views. The documentary won an international award as the best Documentary at UNOFEX International Film Festival 2020, held in Monaco. In addition, the documentary was broadcasted on the open-signal tv channel “La Red” for all of Chile in prime time and on the open-signal tv channel “La Tele Tuya” in Venezuela. To date we estimate that our documentary has been seen by more than 80 thousand people in Chile and more than a million in Venezuela.

Other events during 2020: Due to the pandemic, no face-to-face activities were held. Instead, various initiatives were carried out in virtual mode. Among them:

- Teacher training in art and marine sciences: Theoretical-practical training workshops were held for teachers in collaboration with the Artists of Steel Cultural Corporation. Around 70 teachers from different parts of the country participated.
- Conversations and online talks, through social networks and other platforms, aimed at the general public, students and/or teachers.

In the field of communications, the main objective has been to consolidate the Institute as a national benchmark in the study of the open and deep ocean, with special emphasis on the Southeast Pacific. To this end and given the existing health crisis situation—in which the possibilities of holding face-to-face events have been nil—a strategic plan was designed to allow the IMO to continue to have an active presence in the media.

In this sense, we have implemented a multi-level communication and dissemination plan, focused on different targets and which included various actions, aimed at:

- Children's audience, disseminating and promoting our children's audiovisual productions, and the contest.
- General public, with the diffusion of, mainly, the Atacamex documentary, in addition to other audiovisual pieces, and the diffusion of all the relevant work of the center.
(List of articles and reports in table 7.2 of the annex).

b) Connections with other sectors:

Scientific evaluation for the Chilean Navy and Ministry of Foreign Affairs of ground-breaking treaty on Ocean Geoengineering.

In July 2020 Dirección General del Territorio Marítimo y Mercante (DIRECTEMAR, the branch of the Chilean Navy responsible for coastal protection and observance of national and international maritime regulations), asked IMO associate research von Dassow and senior research Morales to provide a scientific report to support the evaluation conducted with the Ministry of Foreign Affairs on the possible ratification by Chile of the 2013 Amendment to the London Protocol on Ocean Dumping. While the 2013 Amendment was originally proposed as a solution to regulate highly controversial activities of Ocean Iron Fertilization for the purpose of manipulating marine productivity (either to support carbon sequestration or for potentially stimulating fisheries productivity), if it went into effect, the 2013 Amendment, would become the first international regulation of geoengineering.

The 2013 amendment has so far ratified by 6 countries. Therefore, Chile's eventual decision with respect to this treaty will provide an important precedent in establishing international agreements to regulate climate, especially the still very controversial geoengineering solutions that have been proposed.

DIRECTEMAR approached IMO researchers for their role in leading the scientific community to provide scientific advice to policy makers and the society at large in response to the proposal by a foreign private enterprise in 2017 to conduct massive iron fertilization bordering the coastal OMZ in the north of Chile, with the stated purpose of fishery stimulation. The report was co-lead by Dr. Morales and Dr. von Dassow, and also included the participation of IMO researcher Dr. Aguilera, included the participation of investigators from other important Chilean scientific research centers Dr. Humberto González (IDEAL, Centro de Investigación Dinámica de Ecosistemas Marinos de Altas

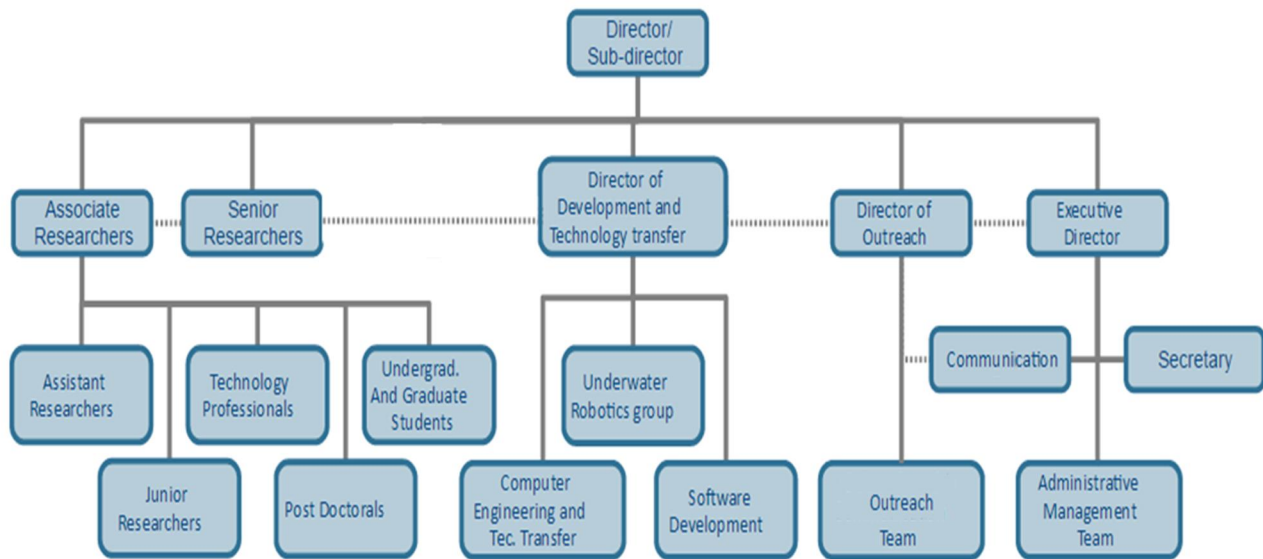
Latitudes; Universidad Austral de Chile) and Dr. Rodrigo Torres (IDEAL and CIEP, Centro de Investigación en Ecosistemas de la Patagonia). These researchers worked closely and rapidly with DIRECTEMAR to produce in only 6 weeks’ time a report that was sufficiently scientifically detailed but also accessible to policy makers. A follow-up oral presentation on the contents of the report was made in a joint presentation by Dr. von Dassow and Dr. Morales to the Chilean National Oceanographic Commission (CONA) on 30 September 2020.

c) **Other achievements:** No other achievements

4. **Administration and Financial Status** (1 página incluyendo tabla)

a) **Organization and administration:**

The following chart represent the organizational and operational structure during 2020.



Category	Female	Male	TOTAL
Assistant & Technicians	6	15	21
Administrative Staff	3	3	6
TOTAL	9	18	27

b) **Financial Status:**

c)

The Budget structure included a 65% of fund from ANID, and a 31% of Concurrent Public projects Funds not managed by IMO. The uses of the fund was the approximately the following:

- Subtotal salaries...56%
- Materials, consumables and maintenance...12%
- Operating costs...10%
- Management and office personnel expenses...8%
- Infrastructure...8%
- Assets and equipment...4%
- General expenses of the Host Institution...2%

The income details are presented in Annex 9.

5. Annexes:Annex 1.- Institute / Nucleus Researchers

1.

1.1 Tabla resumen de investigadores del centro

Categoría de Investigador	Cantidad	Promedio de edad	Nacionalidad		Distribución Genero		
			Nacional	Internacional	Masculino	Femenino	No Declara
Director	1	59	1	0	1	0	0
Director Alterno	1	63	1		1	0	0
Investigador Principal	4	54	2	2	4	0	0
Investigador Adjunto	12	51	12	0	10	2	0
Investigador Senior	4	67	3	1	3	1	0
Investigador Joven	8	39	4	4	2	6	0
Postdoctorante	9	31	4	5	3	6	0

1.2 Principal Researchers

Name	Research Line	Nationality	Gender	Date of birth	Profession	Academic Degree	Affiliation	Current Position	Relation with Center
				dd/mm/yy					
Oswaldo Ulloa Quijada	2	Chilean	M	21-05-1972	Marine Biologist	D	Universidad de Concepción	Responsible Director	2
Oscar Pizarro Arriagada	1 and 2	Chilean	M	28-03-1963	Oceanographer	D	Universidad de Concepción	Research Associate	2

Rubén Escribano Veloso	1 and 2	Chilean	M	16-04-1957	Marine Biologist	D	Universidad de Concepción	Substitute Principal	2
Peter Von Dassow	1	American	M	31-03-1974	Biologist	D	Pontificia Universidad católica de Chile	Research Associate	2
Wolfgang Schneider	1	German	M	16-02-1954	Oceanographer	D	Universidad de Concepción	Research Associate	2
Cristian Vargas Galvéz	1	Chilean	M	26-12-1972	Marine Biologist	D	Universidad de Concepción	Research Associate	2

1.3 Senior Researchers

Name	Research Line	Nationality	Gender	Date of birth dd/mm/yyyy	Profession	Academic Degree	Affiliation	Current Position	Relation with Center
Juan Carlos Castilla Zenobi	1,2	Chilean	M	19-08-1940	Biologist	D	Pontificia Universidad Católica de Chile	Professor	2
Gerrit van den Engh	1,2	Holland	M	06-03-1949	Biophysicist expert in cytometry	D	Becton Dickinson	Senior researcher	2
Carmen Morales	1,2	Chilean	F	16-07-1955	Biologist	D	Universidad de Concepción	Associate Professor	2
Samuel Hormazábal Fritz	1	Chilean	M	08-12-1967	Oceanographer	D	Pontificia Universidad Católica de Valparaíso	Associate Professor	2

1.4 Adjuncts Researchers

Name	Research Line	Nationality	Gender	Date of birth dd/mm/yy	Profession	Academic Degree	Affiliation	Current Position	Relation with Center
Víctor Aguilera Ramos	1	Chilean	M	01-11-1976	Marine Biologist	D	Universidad de Antofagasta	Profesor Asistente	2
Pamela Hidalgo Diaz	1, 2	Chilean	F	07-06-1966	Aquaculture Engineer	D	Universidad de Concepcion	Profesora Asistente	2
Marcos Moreno Switt	2	Chilean	M	27-08-1974	Geologist	D	Universidad de Concepción	Profesor asociado	2
Atilio Morgado Malebrán	1, 2	Chilean	M	23-05-1960	Marine Biologist	M	Instituto Milenio de Oceanografía	Director ejecutivo IMO	1
Marcelo Oliva Moreno	1, 2	Chilean	M	17-03-1952	Biologist	D	Universidad de Antofagasta	Profesor Titular	2
Ramiro Riquelme Bugueño	1, 2	Chilean	M	07-09-1978	Marine Biologist	D	Universidad de Concepcion	Profesor Asistente	2
Pablo Rosenblatt Guelfenbein	1, 2	Chilean	M	06-01-1955	Biologist	D	Instituto Milenio de Oceanografía	Director de Extensión	2
Julio Sepúlveda Arellano	1	Chilean	M	25-02-1977	Marine Biologist	D	University of Colorado Boulder	Investigador Department of Geological Sciences & Institute of Arctic and Alpine Research (INSTAAR)	2
Giancarlo Troni Peralta	2	Chilean	M	06-10-1975	Civil Engineer	D	Pontificia Universidad Católica de Chile	Profesor Asistente departamento de ingeniería mecánica y metalúrgica de la PUCCH	2
Mauricio Urbina Foneron	1	Chilean	M	22-09-1979	Aquaculture Engineer	D	Universidad de Concepción	Profesor Asistente, Departamento de Zoología, Fac, Cs. Naturales y Oceanográficas, UdeC.	2
Víctor Villagrán Orellana	1, 2	Chilean	M	02-03-1973	Civil Engineer	M	Universidad de Concepción	Assistant professor	2
Carolina Parada	1	Chilean	F	02-10-1970	Marine Biologist	D	Universidad de Concepción	Associate professor	

1.5 Young Researchers

Name	Research Line	Nationality	Gender	Date of birth dd/mm/yy	Profession	Academi Degree	Affiliation	Current Position	Relation with Center
Montserrat Aldunate Chinchón	1,2	Chilean	F	10-02-1984	Marine BiologD		Milennium Institute of Oceanography	Young Researchers	1
Marcela Alejandra Cornejo D'Ottone	1	Chilean	F	20-07-1977	OceanographeD		Pontificia Universidad Católica de Valparaíso	Associate Professor	2
Katty Donoso	1,2	Chilean	F	12-05-1982	Marine BiologD		Universidad de Concepción– Milennium Institute of Oceanography	Young Researchers	2
Maija Heller	1,2	German	F	26-11-1980	Marine Biogeochemic al	D	Pontificia Universidad Católica de Valparaíso	Associate Professor	2
Pedro Echeveste de Miguel	1	Spanish	M	03-08-1981	Bachelor of Biology	D	Universidad de Antofagasta	Secretary of Research and Assist. FACIMAR technique	2

Diana Medellín Mora	1	Colombiana	F	23-08-1977	Marine Biologist	B	Millennium Institute of Oceanography	Young Researchers	2
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1.6 Postdoctoral Researchers

Name	Research Line	Nationality	Gender	Date of birth dd/mm/yy	Profession	Academic Degree	Affiliation	Current Position	Relation with Center
Igor Fernández Urruzola	1	Spain	M	18-03-1983	Marine Biologist	D	Universidad de Concepción	Postdoctoral researcher	1
Carolina Gonzáles Espinoza	1, 2	Chilean	F	20-06-1990	Marine Biologist	D	Instituto Milenio de Oceanografía	Postdoctoral researcher	1
Carlos Henríquez Castillo	1	Chilean	M	06-05-1983	Biochemist	D	Universidad de Concepción	Postdoctoral researcher	1
Vera Oerder Gautron	1	French	F	22-07-1987	Climatologist	D	Pontificia Universidad Católica de Valparaíso	Postdoctoral researcher	1
Natalia Osma Prado	1	Spain	F	29-01-1983	Oceanographer	D	Instituto Milenio de Oceanografía	Postdoctoral researcher	1
Eric Potvin	1	Canadian	M	07-06-1983	Biologist	D	Instituto Milenio de Oceanografía	Postdoctoral researcher	1
Paula Ruz Moreno	1	Chilean	F	07-07-1983	Ecologist	D	Pontificia Universidad Católica de Valparaíso	Postdoctoral researcher	2
Ching Yan Wong	1	Chinese	F	23-11-1989	Marine Biologist	D	Instituto Milenio de Oceanografía	Postdoctoral researcher	1
Sonia Yáñez Tenorio	1, 2	Chilean	F	28-05-1987	Marine Biologist	D	Universidad de Concepción	Postdoctoral researcher	2

<u>NOMENCLATURE:</u>	[Academic Degree]	[Relation with Center]
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<p>[Gender] [M] Male [F] Female [ND] Does not Declare</p>	<p>[U] Undergraduate [M] Master [D] Doctoral</p>	<p>[1] Full time [2] Part time</p>
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Annex 2.- Research Lines

Nº	Research Line	Research Line Objectives	Description of Research Line	Researcher	Research Discipline	Starting Date [dd/mm/yy]	Ending Date [dd/mm/yy]	Status
1	Mesoscale processes	What is the role of mesoscale activity in governing energy and matter transfer and ecosystem dynamics in open ocean ecosystems	<p>Mesoscale eddies are characteristic of the southeastern Pacific (SEP) and connect areas with coastal upwelling with oligotrophic oceanic waters, as well as meso- and epipelagic domains. Eddies create unique and relatively isolated environments with distinct biological communities and chemical conditions, depending on the nature of the water trapped, the characteristics and path of eddies and their interactions with winds and topography. Seamounts, submarine mountain ranges and oceanic islands in the southeastern Pacific can also create or strengthen mesoscale activity and consequently increase biological production around them. Our hypothesis is that mesoscale eddies generated in the coastal area create conditions of deficient O₂/low pH in the open sea (or the opposite in areas with minimal oxygen), with corresponding changes in the structure of communities and biochemical cycles, and that differ significantly from those found in adjacent oceanic waters.</p> <p>To address this research theme, we will carry a field experiment to study the characteristics and evolution of mesoscale eddies generated in the sea beyond central Chile (~36 °S) and that are propagated to the northwest, reaching to around the Juan Fernández Archipelago. The field experiment will include time-series observations by satellite teledetection (e.g. ocean altimetry and color), an anchorage in the vicinity of the Juan Fernández Archipelago, and sections with a sailplane, as well as cruises oriented to processes.</p>	<p>Carmen Morales Samuel Hormazábal Carolina Parada. Marcela Cornejo. Juan C. Castilla. Oscar Pizarro. Peter von Dassow Cristian Vargas Heraclio Rubén Escribano Ramiro Riquelme Pierre Amael Auger Víctor Villagrán Pablo Rosenblatt</p>	<p>Ecology and environmental sciences. Oceanography Meteorology and climatology. Marine biology. numerical methods and computer science.</p>	26-12-2013	31-12-2018	Reformulated

2	Ocean Variability and Change	How large scale perturbations impact the transport and gradients in physical chemical water properties	<p>The subtropical cell controls the large-scale transport of heat, freshwater, carbon, nutrients and dissolved O₂ through the southeastern Pacific basin. These processes modulate chemistry and biology and the regional component of the climate variability.</p> <p>Models and field observations have shown that in the context of climate warming, the subtropical celda of the South Pacific is reinforced as a response to changes in surface winds on a large scale on the tropical Pacific. As well, it is expected that global warming directly affects the South Pacific by strengthening the degree of productivity.</p> <p>As the temperature of the upper layers increases, the stratification of oceanic water is reinforced, affecting the mixing of water masses and vertical diffusiveness in subtropical regions. In contrast, stronger coastal winds could increase vertical mixing and upwellings of eastern currents. It has been argued that coastal upwelling and transport by the Humboldt Current have intensified in recent decades and has been getting stronger on the scale of decades. This in turn has been modifying the properties of waters that participate in the subtropical cell and in an increase in the physical, biochemical and ecological gradients between the coastal and oceanic environments. The lower O₂ content of the warmer ocean waters and the higher gradients between upwelling and stratified oceanic waters contributes to expanding waters low in O₂/pH and high in pCO₂, which affects biological communities and the biogeochemical cycles in these waters.</p>	<p>Oscar Pizarro Arriagada. Wolfgang Schneider Ricardo Hernán De Pol Holz. Carolina Eugenia Parada Veliz. Samuel Ernesto Hormazábal Fritz Carmen Morales Van de Wyngard Peter von Dassow V́ctor Miguel Aguilera Ramos. Aldo Manuel Montecinos Gula Heraclio Rubén Escribano Veloso. V́ctor Enrique Villagrán Orellana Pierre Amael Auger Frauke Albrecht Pablo Rosenblatt</p>	<p>Biochemistry.</p> <p>Ecology and environmental sciences.</p> <p>Oceanography</p> <p>Meteorology and climatology.</p> <p>Marine biology.</p> <p>numerical methods and computer science.</p>	26-12-2013	31-12-2018	Finished
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3	Adapting to a Changing Ocean	How Key functional plankton groups adapt to changing ocean chemistry and impact biogeochemical cycling	<p>The strong and dynamic horizontal chemical gradients in the southeastern Pacific (SEP), from ultra-oligotrophic waters to coastal upwelling, exhibit highly variable combinations of low O₂ and pH/high pCO₂ and include strong vertical changes in O₂ concentrations, from saturation levels at the surface to undetectable levels in the nucleus of minimum oxygen zone (MOZ). These gradients cover a wide range of spatial-temporal scales.</p> <p>The responses of plankton communities and the feedback between community function and biogeochemical dynamics can depend in large measure on adaptations and capacities of acclimatization of key components, which can vary significantly among oceanic habitats. Moreover, the biological responses to multiple stress factors can be additive, synergetic or antagonistic.</p> <p>Our hypothesis is that the genomic variability among marine species is related to the differential functional responses to multiple stress factors and these determine the persistence or the modification of ecological/biogeochemical functions as the chemistry of the ocean changes.</p> <p>It is postulated that community functioning in highly stable environments like the South Pacific gyre is less robust in the context of changes in chemical conditions compared to that of highly variable environments, such as the oceanic coasts.</p> <p>Field and laboratory work will be undertaken to address this theme. In the first fieldwork undertaking, key representatives of functional plankton from areas with gradients of pCO₂, pO₂ and nutrients will be isolated. In association with this activity, a new collection of phytoplankton will be initiated at the PUC in coordination with the Roscoff Culture Collection.</p> <p>Perturbation experiments will be conducted with single stress factors on selected species, focusing on physiological variability in response to variations in pCO₂/pH, and O₂, and allow for improving the design of experiments with multiple stress factors. Based on these results, we conduct genomic analysis of species/genera (e.g. low O₂ – Prochlorococcus; low pH/high pCO₂ – Coccolithophore).</p>	<p>Peter von Dassow. Osvaldo Iván Ulloa Quijada. Cristian Antonio Vargas Galvez. Pamela del Carmen Hidalgo Diaz. Víctor Miguel Aguilera Ramos. Ricardo Hernán De Pol Holz. Alvaro Alfredo Muñoz Plominsky. Heraclio Rubén Escribano Veloso. Gerrit van den Engh. Víctor Enrique Villagrán Orellana Pedro Echeveste De Miguel. Pablo Rosenblatt</p>	<p>Numerical methods and computer science.</p> <p>Biochemistry.</p> <p>Marine biology.</p> <p>Biophysics.</p> <p>Microbiology</p> <p>Oceanography</p>	26-12-2013	31-12-2018	Finished
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4	the deep Ocean	<p>what are the community structures and the biogeochemical characteristics of the deep and abyssal waters of the ESP</p>	<p>The ecosystems of deep SEP waters are practically unknown. Exploration of mesopelagic (>500 m) and abyssopelagic communities (>3000 m) represent unique opportunities to discover new forms of life, species and genes for science, as well as a major challenge for oceanography in the South Pacific basin.</p> <p>This initiative will allow for identifying the mechanism through which communities are able to distribute themselves widely and colonize unique habitats like the Atacama Trench and the Nazca, Salas & Gómez and Juan Fernández ranges. Our hypothesis is that the ranges contribute significantly to the dispersion of species and the gene flows in the coast-ocean direction, driven by the circulation of water masses and mixing associated with the meso and large scale physical dynamics.</p> <p>To address this theme we will carry out deep water samplings, including a MOCNESS net (maximum depth of 6,500 m) with an underwater video profiler (UVP), conductivity, temperature and fluorescence sensors and stratified sampling nets.</p> <p>The underwater video profiler provides profiles of the distributions of particle sizes, while the net samplings will be divided into fractions for examining live animals, DNA analysis and taxonomic studies.</p> <p>Water samples will also be taken for molecular and genomic analyses of microbial communities (viruses to protists). In situ incubation systems will be developed to estimate microbiological activity/rates. Quantitative and qualitative assessments will also be made of fish parasites and plankton as biomarkers of the dispersion of host species and the colonization of habitats. Individual and biogeochemical models will be used to analyze the mechanisms that contribute to maintaining endemic communities and the connectivity among different islands, seamounts and other oceanic regions.</p> <p>Molecular analysis of selected plankton will be centered on DNA microsatellites and mitochondrial DNA to relate sampled populations and species in the coast-ocean direction and in the vertical dimension.</p>	<p>Heracio Rubén Escribano Veloso. Osvaldo Iván Ulloa Quijada. Marcelo Enrique Oliva Moreno. Pamela del Carmen Hidalgo Diaz. Wolfgang Schneider. Oscar Roberto Pizarro Arriagada. Peter von Dassow Cristian Antonio Vargas Galvez. Pablo Rosenblatt Guelfenbein. Ramiro Antonio Riquelme Bugueño. Víctor Enrique Villagrán Orellana. Pablo Rosenblatt Gerrit van den Engh.</p>	<p>Numerical methods and computer science. Biochemistry. Marine biology. Biophysics. Microbiology Oceanography Ecology and Environmental Sciences</p>	26-12-2013	31-12-2018	Reformulate
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1	A variable and changing Ocean	<p>The goals are: To determine the scales at which biogeochemical function, plankton community composition, and population structure of key zooplankton and phytoplankton are correlated with the physical structure of the ocean; To compare biogeochemical function in norm-oxic, OMZ, and AMZ waters, through participation in at least one major national cruise, in international cruise opportunities, and smaller focused field campaigns; To determine the roles of community robustness, population level variability, and phenotypic plasticity at individual levels in predicting responses to predicted future ocean multi-stressor conditions.</p>	<p>Dominant environmental drivers, such as naturally high pCO₂/low pH conditions partially coupled to naturally low O₂ or anoxic waters, must be crucial in shaping ecosystem and biogeochemical functioning in the ESP. Additionally, as the global ocean is both acidifying (due to absorption of anthropogenic CO₂) and losing O₂ (due to warming and increased stratification), The ESP also provides one of the most important natural laboratories for predicting future ocean function in the Anthropocene by understanding how biological systems adapt to and function under these conditions. The first period showed us the need to more effectively integrate the physical and chemical oceanographic understanding of the drivers of ocean variability, at the (sub)mesoscale (former Line 1) and on inter-annual to longer time scales (former line 2), with investigation of the consequences and responses at biogeochemical, ecological, and even organismal levels (former line 3). While the physical drivers are relatively well understood, the frontier of investigation is to understand the consequences for chemical, biogeochemical, and biological function, including potential adaptive responses.</p>	<p>Oscar Pizarro Arriagada. Wolfgang Schneider Cristian Vargas Samuel Ernesto Hormazábal Fritz Carmen Morales Van de Wyngard Peter von Dassow Víctor Miguel Aguilera Ramos. Heraclio Rubén Escribano Veloso. V́ctor Enrique Villagrán Orellana Frauke Albrecht Pablo Rosenblatt</p>	<p>Biochemistry. Ecology and environmental sciences. Oceanography y Meteorology and climatology. Marine biology. Numerical methods and computer science.</p>	<p>01-01-2019</p>	<p>31-12-2023</p>	<p>In Progress</p>
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2	The Deep Ocean	To determine what are the physical and biogeochemical characteristics of deep and ultra-deep waters of the eastern South Pacific, and which of those determine the diversity and functional structure of their pelagic communities?	To address this question, we will analyze hydrographic data and chemical and biological samples collected during our recent expeditions, as well as those resulting from the new initiatives planned for the second period. In particular, we will work on new and past hydrographic data (T, S, O ₂ , nutrients), as well as on new data on carbonate chemistry, inorganic radiocarbon ($\Delta^{14}\text{C}$), and the stable isotopic composition ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$) of particulate water-column matter. Moreover, we will continue investigating the abundance, diversity, and metabolic or trophic potential of their planktonic (microorganisms and zooplankton) communities, combining traditional techniques with modern molecular and genomic approaches.	<p>Heracio Rubén Escribano Veloso. Oswaldo Iván Ulloa Quijada. Wolfgang Schneider. Oscar Roberto Pizarro Arriagada. Marcelo Enrique Oliva Moreno. Pamela del Carmen Hidalgo Diaz. Peter von Dassow Cristian Antonio Vargas Galvez. Pablo Rosenblatt Guelfenbein. Ramiro Antonio Riquelme Bugeño. Víctor Enrique Villagrán Orellana. Pablo Rosenblatt Gerrit van den Engh</p>	<p>Numerical methods and computer science.</p> <p>Biochemistry.</p> <p>Marine biology.</p> <p>Biophysics.</p> <p>Microbiology</p> <p>Oceanograph y</p> <p>Ecology and Environmenta l Sciences</p>			
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Annex 3.- Publications (Total or partially financed by MSI)**3.1.- ISI/WOS Publications or Similar to ISI/WOS Standard:****3.1.1 Principal Researchers:**

N°	Título	Cuartil *	Autores	Investigador Principal asociados a la Publicación	DOI	Líneas de Investigación	N° investigadores principales	N° investigadores del centro ^{otra}	N° estudiantes	Fecha Publicación
1	Glacial Lake Outburst Flood (GLOF) Events and Water Response in A Patagonian Fjord. Water 2020,	Q2	Lauren Ross, Iván Pérez-Santos, Brigitte Parady, Leonardo Castro, Arnoldo Valle-Levinson and Wolfgang Schneider (2020).	Wolfgang Schneider	10.3390/w12010248	1	1	0	0	16-01-2020
2	Genetic diversity and novel lineages in the cosmopolitan copepod <i>Pleuromamma abdominalis</i> in the Southeast Pacific. Nature	Q1	González, C.E., Coetze, E., Escribano, R., Victoriano, P., Ulloa, O.	Rubén Escribano	https://doi.org/10.1038/s41598-019-56935-5	1	2	1	0	24-01-2020
3	Universal Loop assembly (uLoop): open, efficient, and species-agnostic DNA fabrication	Q1	Pollak, B., Matute, T., Nuñez, I., Cerda, A., Lopez, C., Vargas, V., Kan, A., Bielinski, V., von Dassow, P., Dupont, C., Federici, F.	Peter Von Dassow	https://doi.org/10.1093/synbio/ysaa001	1	1	0	0	05-02-2020
4	pH and other upwelling hydrographic drivers in regulating copepod reproduction during the 2015 El Niño event: A follow-up study	Q1	Aguilera V.M.	-	10.1016/j.ecss.2020.106640	1, 2	0	1	0	05-03-2020
5	Monitoring the occurrence of microplastic ingestion in Otariids along the Peruvian and Chilean coasts	Q1	Pérez-Venegas D.J., Toro-Valdivieso C., Ayala F., Brito B., Iturra L., Arriagada M.,, Urbina MAURICIO ANDRÓNICO.,, Galbán-Malagón C..	-	10.1016/j.marpolbul.2020.110966	1	0	1	0	01-04-2020

6	Loss of filamentous multicellularity in Cyanobacteria - the extremophile Gloeocapsopsis sp. UTEX B3054 retained multicellular features at the genomic and behavioral level	Q2	Urrejola C., Von Dassow PETER., van den Engh GERRIT., Salas L., Mullineaux C.W., Vicuña R., Sanchez-Baracaldo P..	Peter Von Dassow	10.1128/JB.00514-19	1	1	1	0	06-04-2020
7	Environmental costs of water transfers	Q1	Vargas C.A., Garreaud R., Barra R., Vásquez-Lavin F., Saldías G.S., Parra O..	Cristian Vargas	10.1038/s41893-020-0526-5	1	1	0	0	27-04-2020
8	Genetic tool development in marine protists: Emerging model organisms for experimental cell biology	Q1	Faktorová D., Nisbet R.E.R., Fernández-Robledo J.A., Casacuberta E., Sudek L., Allen A.E., ... , Von Dassow PETER., ... , Lukes J..	Peter Von Dassow	10.1038/s41592-020-0796-x	1	1	0	0	01-05-2020
9	The Influence of Diapycnal Nutrient Fluxes on Phytoplankton Size Distribution in an Area of Intense Mesoscale and Submesoscale Activity off Concepción, Chile	Q1	Corredor-Acosta JULY ANDREA., Morales C.E., Anabalón VALERIA SOLEDAD., Valencia LUIS PABLO., Hormazábal SAMUEL ERNESTO., Rodríguez-Santana A..	Samuel Hormazábal	10.1029/2019JC015539	1	0	2	1	20-05-2020
10	Response of phytoplankton assemblages from naturally acidic coastal ecosystems to elevated pCO ₂	Q1	Osma NATALIA., Latorre-Melín L., Jacob B., Contreras P.Y., Von Dassow PETER., Vargas C.A..	Peter Von Dassow	10.3389/fmars.2020.00323	1	2	1	1	25-05-2020
11	The role of the Magellan Strait on the southwest South Atlantic shelf	Q1	Brun A.A., Ramírez NADiN CRISTóBAL., Pizarro OSCAR ROBERTO., Piola A.R..	Oscar Pizarro	10.1016/j.ecss.2020.106661	1	1	0	1	31-05-2020
12	Autotrophic carbon fixation pathways along the redox gradient in oxygen-depleted oceanic waters	Q2	Ruiz PAULA SOFÍA., Ramírez-Flandes SALVADOR FRANCISCO., Rodríguez EDWIN IVÁN., Ulloa OSVALDO IVÁN.	Osvaldo Ulloa	10.1111/1758-2229.12837	1, 2	1	0	1	01-06-2020
13	Unexpected source and transport of iron from the deep Peru Margin	Q1	Lam P., Heller MAIJA IRIS., Lerner P.E., Moffett J.W., Buck K..	-	10.1021/acsearthspacechem.0c00066	1, 2	0	1	0	09-06-2020

14	Spatio-Temporal Variability of Chlorophyll-A and Environmental Variables in the Panama Bight	Q2	Corredor-Acosta JULY ANDREA., Cortés-Chong N., Acosta A., <u>Pizarro-Koch</u> MATÍAS BERNARDO., Vargas A., Medellín-Mora JOHANA., Saldías G.S., Echeverry-Guerra V., Gutiérrez-Fuentes J., Betancur-Turizo S..	-	10.3390/rs12132150	1	0	1	1	04-07-2020
15	Revealing enigmatic mucus structures in the deep sea using DeepPIV	Q1	Katija K., Troni GIANCARLO ., Daniels J., Lance K., Sherlock R. E., Sherman A. D., Robison B. H..	-	10.1038/s41586-020-2345-2	1	0	1	0	20-07-2020
16	Tidally Forced Saltwater Intrusions might Impact the Quality of Drinking Water, the Valdivia River (40° S), Chile Estuary Case	Q2	Garcés-Vargas J., Schneider WOLFGANG., Pinochet A., Piñones A., Olgún F., Briera D., Wan Y..	Wolfgang Schneider	10.3390/w12092387	1, 2	1	0	0	26-08-2020
17	Anthropogenic-noise-disrupts-mating-behavior-and-metabolic-rate-in-a-marine-invertebrate	Q4	Ruiz P.A., Hinojosa I.A., Uezúa A., Urbina MAURICIO ANDRÓNICO.	-	10.1121/2.0001302	1, 2	0	1	0	01-09-2020
18	Zooplankton diel vertical migration and downward C flux into the Oxygen Minimum Zone in the highly productive upwelling region off Northern Chile.	Q1	<u>Tutasi</u> , P., Escribano, R.	Rubén Escribano	10.5194/bg-17-455-2020	1	1	0	1	01-09-2020
19	Diel vertical migration into anoxic and high-pCO2 waters: acoustic and net-based krill observations in the Humboldt Current	Q1	Riquelme-Bugueño RAMIRO ANTONIO., Pérez-Santo I., Alegría N., Urbina MAURICIO ANDRÓNICO., Escribano R., Vargas C.A...	Rubén Escribano	https://www.nature.com/articles/s41598-020-73702-z	1	2	2	0	21-09-2020
20	Spatiotemporal Distribution of Key Pelagic Microbes in a Seasonal Oxygen-Deficient Coastal Upwelling System of the Eastern South Pacific Ocean	Q1	Molina V., Belmar L., Levipan H.A., <u>Ramírez-Flandes</u> SALVADOR FRANCISCO., Anguita C., Galán A., Montes I., Ulloa OSVALDO IVÁN.	Oswaldo Ulloa	10.3389/fmars.2020.561597	1	1	0	1	25-09-2020

21	Distinct oxygen environments shape picoeukaryote assemblages thriving oxygen minimum zone waters off central Chile	Q2	De la Iglesia R., Echenique-Subiabre I., Rodríguez-Marconi S., Espinoza J.P., Von Dassow PETER., Ulloa OSVALDO IVÁN., Trefault N..	Peter Von Dassow	10.1093/plankt/fbaa036	1, 2	2	0	0	01-10-2020
22	Fatty acid composition in the endemic Humboldt Current krill, <i>Euphausia mucronata</i> (Crustacea, Euphausiacea) in relation to the phytoplankton community and oceanographic variability off Dichato coast in central Chile	Q1	Riquelme-Bugueño RAMIRO ANTONIO., Pantoja-Gutiérrez S., Srain B., Schneider WOLFGANG., <u>Jorquera</u> E., Anabalón V..	Wolfgang Schneider	10.1016/j.pocean.2020.102425	1	1	1	1	01-10-2020
23	Size-Fractionated Contribution of Microbial Biomass to Suspended Organic Matter in the Eastern Tropical South Pacific Oxygen Minimum Zone	Q1	Cantarero S., Henríquez CARLOS ANDRÉS., Dildar N., Vargas C.A., Von Dassow PETER., Cornejo MARCELA ALEJANDRA., Sepúlveda JULIO CÉSAR.	Cristian Vargas	10.3389/fmars.2020.540643	1	2	2	0	22-10-2020
24	A comparison of marine Fe and Mn cycling: U.S. GEOTRACES GN01 Western Arctic case study	Q1	Jensen L. T., Morton P., Twining B.S., Heller MAIJA IRIS., Hatta M.,, Fitzsimmons J.N.	-	10.1016/j.gca.2020.08.006	1	0	1	0	01-11-2020
25	Adsorption of polyethylene microbeads and physiological effects on hydroponic maize	Q1	Urbina MAURICIO ANDRÓNICO., Correa-Araneda F.J., Aburto F., Ferrio J.P.	-	10.1016/j.scitotenv.2020.140216	1, 2	0	1	0	01-11-2020
26	Intra-seasonal hydrographic variations and nearshore carbonates system off northern Chile during the 2015 El Niño event	Q1	Vargas C.A., Aguilera V.M., Dewitte B..	Cristian Vargas	10.1029/2020JG005704	1	1	1	0	01-11-2020
27	Water column circulation drives microplastic distribution in the Martínez- Baker channels;	Q1	Gutiérrez M.H., Aranda M., Urbina MAURICIO ANDRÓNICO., Yañez J., Alvarez A., Pantoja-Gutiérrez S..	-	10.1016/j.marpolbul.2020.111591	1	0	1	0	01-11-2020

	A large fjord ecosystem in Chilean Patagonia									
28	Environmental gradients and spatial patterns of Calanoid copepods in the Southeast Pacific	Q2	González C.E., Medellín-Mora JOHANA., Escribano R..	Rubén Escribano	10.3389/fevo.2020.554409	1	1	2	0	09-11-2020
29	Early development and metabolic rate of the sea louse <i>Caligus rogercresseyi</i> under different scenarios of temperature and pCO ₂	Q1	Montory J.A., Cumillof J.P., Gebauer P., Urbina MAURICIO ANDRÓNICO., Cubillos V.M., Navarro J.M., Marín S.L., Cruces E..	-	10.1016/j.marenvres.2020.105154	1	0	1	0	01-12-2020
30	The Influence of pCO ₂ -Driven Ocean Acidification on Open Ocean Bacterial Communities during A Short-Term Microcosm Experiment in the Eastern Tropical South Pacific (ETSP) off Northern Chile	Q2	Aguayo PAULINA ANDREA., Campos V.L., Henríquez CARLOS ANDRÉS., Olivares FRANCISCA IGNACIA., De la Iglesia RODRIGO ALONSO., Ulloa OSVALDO IVÁN., Vargas C.A..	Oswaldo Ulloa	10.3390/microorganisms8121924	1	2	3	1	04-12-2020

***Q5: Ingresar esta opción para aquellos artículos que no posean cuartil.**

3.2.- SCOPUS Publications or Similar to SCOPUS Standard:

3.2.1 Principal Researchers:

Nº	Titulo	Cuartil	Autores	Investigador Principal asociados a la Publicación	DOI	Líneas de Investigación	Nº investigadores principales del centro	Nº investigadores del centro otra categoría	Nº estudiantes	Fecha Publicación
1										
2										
3										

3.3.- SCIELO Publications or Similar to SCIELO Standard

3.3.1 Principal Researchers:

N°	Título	Cuartil*	Autores	Investigador Principal asociados a la Publicación	DOI	Líneas de Investigación	N° investigadores principales del centro	N° investigadores del centro otra categoría	N° estudiantes	Fecha Publicación
1										
2										
3										

3.4.- Scientific Books and Chapters**3.4.1 Principals Researchers:**

N°	Título	Autores	Investigador Principal	Fuente	Volumen	Numero	Página Inicial	ISBN	Líneas de Investigación	N° investigadores principales del centro	N° investigadores del centro otra categoría	N° estudiantes	Fecha Publicación
1													
2													
3													

3.5.- Other Publications**3.5.1 Principals Researchers:**

N°	Título	Categoría Publicación	Otra Categoría	Cuartil	Autores	Investigador Principal	Fuente	Volumen	Numero	Página Inicial	Líneas de Investigación	N° investigadores principales del centro	N° investigadores del centro otra categoría	N° estudiantes	Fecha Publicación
1															
2															
3															

3.6.- “ISI/WOS Publications or Similar to ISI/WOS Standard”, “SCOPUS Publications or Similar to SCOPUS Standard” “SCIELO Publications or Similar to SCIELO Standard”, “Books and chapters in books” y “Other Publications [Other Researchers]”:

3.6.1 Other researchers:

N°	Categoría Publicación	Otra Categoría	Cuartil	Autores	Título	Fuente	Volumen	Numero	Página Inicial	ISSN	DOI	Líneas de Investigación	N° investigadores del centro otra categoría	N° estudiantes	Fecha Publicación
1															
2															
3															

3.5.- Collaborative publications:

Category of Publication	1 researcher		2 researchers		3 researchers		4 or more researchers	
	Nº	%	Nº	%	Nº	%	Nº	%
<i>ISI/WOS Publications or Similar to ISI/WOS Standard</i>	15	50%	8	27%	5	17%	2	7%
<i>SCOPUS Publications or Similar to SCOPUS Standard</i>	0	0%	0	0%	0	0%	0	0%
<i>SCIELO Publications or Similar to SCIELO Standard</i>	0	0%	0	0%	0	0%	0	0%
<i>Books and chapters</i>	0	0%	0	0%	0	0%	0	0%
<i>Other Publications</i>	0	0%	0	0%	0	0%	0	0%
<u>Total of publications</u>	15	50%	8	27%	5	17%	2	7%

Annex 4.- Organization of Scientific Events

Scope	Title	Type of Event	City	Country	Responsible Researcher	URL
National	Taller Administración de datos biogeográficos	Seminar	Valparaíso	Chile	Pamela Hidalgo	
National	Estresores múltiples en ecosistemas marinos y sus implicancias fisiológicas.	Videoconferencia	Valparaíso	Chile	Cristian Vargas	

Annex 5.- Education and capacity building**5.1 Capacity Building inside MSI Centers**

MSI RESEARCHER	NUMBER									TOTAL NUMBER PER MSI RESEARCHER
	Undergraduate students			Graduate students						
				Masters			Doctoral			
	F	M	ND	F	M	ND	F	M	ND	TOTAL
Samuel Hormazábal	0	1	1	6	0	6	0	0	0	7
Carmen Morales/Peter Von Dassow	0	0	0	0	0	0	0	0	0	0
Peter Von Dassow/Cristian Vargas	0	0	0	0	0	0	0	0	0	0
Cristian Vargas	0	0	0	0	2	2	0	0	0	2
Rubén Escribano	0	0	0	0	0	0	6	0	6	6
Samuel Hormazábal/ Carmen Morales/ Oscar Pizarro	0	0	0	0	0	0	0	0	0	0
Wolfgang Schneider/Oscar Pizarro	0	0	0	0	0	0	0	0	0	0
Oswaldo Ulloa/ Carmen Morales / Pamela Hidalgo	0	0	0	0	0	0	0	0	0	0
Carmen Morales/ Samuel Hormazábal	0	0	0	0	0	0	1	0	1	1
Oscar Pizarro	2	3	5	0	3	3	2	1	3	11
Oswaldo Ulloa	0	0	0	1	0	1	1	1	2	3
Mauricio Urbina	0	0	0	0	0	0	1	0	1	1
Peter Von Dassow	1	2	3	0	0	0	0	1	1	4
Rubén Escribano/ Ramiro Riquelme	0	0	0	0	0	0	1	0	1	1
Rubén Escribano/ Marcelo Oliva	0	1	1	0	0	0	0	1	1	2
Julio Sepulveda	0	0	0	0	0	0	0	1	1	1
Wolfgang Schneider	0	0	0	0	1	1	0	0	0	1
Samuel Hormazábal/ Marcela Cornejo	0	0	0	3	0	3	0	0	0	3
Samuel Hormazábal/ Pierre Amael	0	0	0	0	2	2	0	0	0	2
Rubén Escribano/ Pamela Hidalgo	1	1	2	0	1	1	0	0	0	3
Oscar Pizarro/ Carolina Parada	1	2	3	0	1	1	0	0	0	4
Pamela Hidalgo	0	2	2	0	0	0	0	0	0	2
TOTAL	5	12	17	10	10	20	12	5	17	54

Annex 5.2. - Short-term Traineeships of MSI students**Listado de Pasantías**

Student name	Institution	Country	Advisor	Project Description	Starting Date [dd/mm/yy]	Ending Date [dd/mm/yy]
Edgart Elvis Flores Rafael	The Department of INSTAAR at the UNiversity of Colorado	Estados Unidos de America	Julio Sepúlveda	Learning biogeochemical methods and samples analysis from HADES cruise, perform at Northern Chile, under supervision of Dr Julio Sepúlveda.	15-10-2019	15-01-2020
Ana Belén Venegas Ramos	Centro de investigación Laboratoire d'Océanograph ie Physique et Spatiable (LOP)	Francia	Pierre Amaël	Training for generate outputs of ROMS-Pisces models	30-12-2019	31-03-2020
Valentina Isabel Vargas Torres	Instituto Fomento Pesquero(IFOP)Departamento de Estudios de Algas Nocivas	Chile	Jorge Mardones	Know research and laboratory methods at CREAN Project (Centro de Estudios de Algas Nocivas), at IFOP.	03-02-2020	31-07-2020

Listado de Pasantías Externas

Intern Type	Intern Name	Academic Degree	Home Institution	Destination Institution	Country	Project Description	Starting Date [dd/mm/yy]	Ending Date [dd/mm/yy]
Estudiante	Edgart Fernando Dorado Roncancio	Pregrado	Universidad Nacional de Colombia	Instituto Milenio de Oceanografía (IMO)	Chile	research activities of mesopelagic zooplankton assembly, analysis of biological matrices and oceanographic data, data analysis and scientific manuscript of master's work entitled "Horizontal and vertical variation of the oceanic community of copepods in the Colombian Caribbean"	28-02-2020	29-05-2020

Annex 6.- Networking and other collaborative work

6.1 Formal Collaboration networks

There are not formal collaborations (funded by ICM-ANID) in this period.

Network Name	Network Scope	Researchers				Institutions
		From the Center		External		
		Researchers	Postdocs/ Students	Researchers	Postdocs/ Students	
Network 1						
Network 2						

NOMENCLATURE:
 [Network Scope]
 [N] National [I] International [LA] Latin American

Annex 6.2.- Collaboration Networks

Activity Name	Objective	Description	Co-Participants Institutions	Number of Research from the Center	Number of Postdocs/Students from the Center	Number of External Research	Number of External Postdocs/Students	Product	Name of the Center Principals Researchers Participating in the activity
Improving estimates of marine zooplankton production through the neutral red method (ZOO-NEST)", REDES 180141	Developing a standard protocol for zooplankton sampling using the neutral red staining to improve estimates of zooplankton production	Developing a standard protocol for zooplankton sampling using the neutral red staining to improve estimates of zooplankton production	Universidad de Swansea, Inglaterra	3	3	0	0	Protocol	Heraclio Rubén Escribano Veloso.
STRONG High Seas project workshop entitled 'Improving the knowledge base for cross-sectoral management and governance of the oceans in ABNJ of the Southeast Pacific	To Meet stakeholders to discuss current challenges as opportunities for global and regional ocean governance, foster knowledge and information sharing, and build new networks.	To allow the exchange of information among participants and explore relevant issues for conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction.	Permanent Commission of the South Pacific (CPPS) and the STRONG High Seas project coordinated by the Institute for Advanced Sustainability Studies (IASS) with six partners based in Europe, South America and Africa	3	0	12	0	Informe en preparación	Carmen Eliana Morales Van De Wyngard.

<p>TROPIC WEB IN THE DEEP OCEAN: UNDERSTANDING CARBON AND NITROGEN FLOW IN THE MARINE ECOSYSTEM (TROPHO-NET) REDES 180039</p>	<p>To analyse previous and new datasets from deep ocean oceanographic cruises (in the southern Pacific) and gain experience from exchanging of protocols and writing joint publications. To lead and participate in workshops on results obtained from deep ocean oceanographic cruises and data processing. To strengthen the advanced human capital formation by integrating PhD thesis committee of Chilean students and carrying out short-term training at IEO.</p>	<p>This is an International Collaborative Network established between IMO and IEO and funded by CONICYT of Chile, Grant REDES 10039. TROPHONET promotes joint research and academic exchange between the institutions.</p>	<p>Instituto Español de Oceanografía (IEO) La Coruña, España</p>	<p>4</p>	<p>6</p>	<p>3</p>	<p>0</p>	<p>Paper y Protocolo</p>	<p>Heraclio Rubén Escribano Veloso.</p>
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Strengthening of technical-scientific capacities of new methods for the study of marine biodiversity in Colombia and Chile BIOMACC	Strengthen the technical-scientific capacities of the human resources of the INVEMAR Institute and the Network of Marine Research Centers of Colombia, and of the IMO-UdeC of Chile regarding the study of marine biodiversity, through the exchange of knowledge and experiences between the two countries	This project is part of the Ibero-American Program for the Strengthening of South-South Cooperation, an intergovernmental initiative aimed at strengthening Ibero-American Cooperation from the enrichment of environmental and sustainable development processes between Colombia and Chile, for the creation and institutional strengthening, support for technological modernization and the establishment of networking mechanisms; as well as, the use and preservation of natural resources and the capacities of human capital	Agencia Chilena de Cooperación Internacional (AGCI) Agencia Para la Colaboración de Colombia (APC) Instituto de Investigaciones Marinas y Costeras INVEMAR (Colombia) Universidad de Concepción (UdeC) Instituto Milenio de Oceanografía (IMO)	8	16	19	0	Workshops and publications	Pamela del Carmen Hidalgo Diaz.
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<p>Setting the course for a sustainable blue planet - International Forum on Ocean Governance of the EU, European Commission and the European External Action Service</p>	<p>The second International Virtual Ocean Governance Forum takes stock and discusses the contributions and proposals made during the first round of webinars and workshops in April and July 2020, and during the online consultation from July to October</p>	<p>Analyze priority issues such as climate change, biodiversity, the blue economy, and key drivers for the transition, including funding, rules and implementation, ocean awareness, and cross-sector cooperation. Participants will discuss how to best transform these ambitions into action for the European Commission and the External Action Service in 2021</p>	<p>European Union International Ocean Governance Forum, External Action Service</p>	<p>1</p>	<p>0</p>	<p>10</p>	<p>0</p>	<p>Report (pending)</p>	<p>Carmen Eliana Morales Van De Wyngard.</p>
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<p>Online Annual Meeting, 143rd Assembly Comité Oceanográfico Nacional (CONA)</p>	<p>Fertilization of the Oceans: a scientific overview</p>	<p>Presentation and discussion of the topic</p>	<p>Pontificia Universidad Católica de Chile, Universidad de Concepción, Comité Oceanográfico Nacional -Chile</p>	<p>2</p>	<p>0</p>	<p>8</p>	<p>0</p>	<p>Exposición, debate de informe</p>	<p>Carmen Eliana Morales Van De Wyngard.</p>
<p>Annual meeting SCOR 2020 - Virtual</p>	<p>Ten SCOR working group proposals were submitted for consideration in the SCOR 2020 call for proposals.</p>	<p>Analysis of the proposals</p>	<p>International Council of Scientific Unions (ICSU; now the International Science Council), University of Delaware (USA)</p>	<p>1</p>	<p>0</p>	<p>20</p>	<p>0</p>	<p>Informes de discusión</p>	<p>Carmen Eliana Morales Van De Wyngard.</p>

<p>"Strengthening international ocean research, data and knowledge", Taller internacional en línea, EU International Ocean Governance (IOG) Forum, "Science, observations and data needs for international ocean governance", Thematic Working Group 3 (TWG3)</p>	<p>Compile actions necessary to strengthen the international ocean knowledge base that feeds decision-making.</p>	<p>The workshop focusing on the actions necessary to strengthen the international ocean knowledge base for decision-making. Particularly capacity building for marine science in developing nations; support for transdisciplinary research co-designed within the framework of the United Nations Decade of Ocean Sciences for Sustainable Development; enable global data access and interoperability; and simplify observations between different communities.</p>	<p>IOG Forum, "Science, observations and data needs for international ocean governance"</p>	<p>1</p>	<p>0</p>	<p>10</p>	<p>0</p>	<p>Informe</p>	<p>Carmen Eliana Morales Van De Wyngard</p>
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<p>9th Annual Meeting OBIS</p>	<p>Working with the Global Biodiversity Information Fund (GBIF), in areas of capacity development (development of training material on marine cases), harmonizing the publication of data and the interaction between OBIS nodes and GBIF nodes, in the development of data standards and representing biodiversity data</p>	<p>discuss and agree on the work plan for 2021, among the important activities in 2021 are: the data quality control tools and the QC reports will continue to be developed, including a record of the recommended vocabulary terms that are used for the measurements and sampling data. A new project team has been established to report on recommended data integration workflows for records derived from DNA sequences, including agreements on genetic data standards in collaboration with the Biodiversity Information Standards (TDWG) and the Genomic Standards Consortium (GSC).</p>	<p>OBIS- ESPOBIS</p>	<p>1</p>	<p>0</p>	<p>20</p>	<p>0</p>	<p>Informe y discusión</p>	<p>Pamela Hidalgo</p>
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International Research Network "Diversity, Evolution and Biotechnology of Marine Algae" (GDRI N° 0803)	International collaboration about marine algal biotechnology, diversity, and evolution	Tri-national (French, Chilean, Brazilian), with financing from the CNRS for travel, meetings, conferences.	(CNRS) IRN DABMA "Diversity and Biotechnology of Marine Algae".	1	1	20	0	Report	Peter von Dassow .
Unité Mixte International (ahora IRL) 3614 "Evolutionary Biology and Ecology of Algae"	International Collaboration in Evolutionary Biology and algae Ecology	Franco-Chilean unit financed by CNRS, France. On the Chilean side, only travel is financed. On the French side, researchers are funded	CNRS Sorbonne Université, PUC Chile, UACH	1	1	20	0	Report	Peter von Dassow .

Annex 7. - Outreach**7.1. - Outreach activities throughout the period**

Event Title	Type of Event	Scope	Target Audience	Date	Región	N° of Student from the Center	N° of Attendees	Durati on in days	Participating Researchers	Responsible for the activity
Teacher ICEC talk	Talk	National	Teachers	9-10-2020	Biobio	0	60	1	0	Bárbara Léniz
Boca Sur school Talk	Talk	National	Primary students	21-10-2020	Biobio	0	15	1	0	Bárbara Léniz
Santa Leonor School talk	Talk	National	General public	15-10-2020	Ñuble	0	50	1	0	Bárbara Léniz
Coihueco Science Fair	Talk	National	General public	21-10-2020	Biobío	0	150	1	0	Nadin Ramírez
Teletón summer	Workshop	National	Other	16-01-2020	Biobío	0	36	1	0	Felipe Gamonal
Teletón summer	Workshop	National	Other	17-01-2020	Biobío	0	33	1	0	Felipe Gamonal
Teacher workshop “Arts and Marine Sciences”	Workshop	National	Teachers	8-6-2020	Biobío	0	62	2	0	Bárbara Léniz Felipe Gamonal
"Bitácora Audiovisual: de una expedición a la fosa de Atacama" Virtual Conversation	Virtual conference	National	General public	25-06-2020	Biobío	0	60	1	1	Oswaldo Ulloa
Talk “Deep Ocean”	Talk	National	General public	04-06-2020	Biobío	0	60	1	1	Oswaldo Ulloa
Talk: "Mares y Política Exterior de Chile”	Talk	National	General public	30-07-2020	Biobío	0	60	1	1	Oswaldo Ulloa
Virtual conversation “"Acidificación del Océano: El otro problema del CO2”	Virtual conference	National	General public	05-08-2020	Biobío	0	60	1	1	Victor Aguilera
Campanil Talk: “Atacamex”	Virtual conference	National	General public	19-08-2020	Biobío	0	60	1	0	Felipe Gamonal

Films and Sciences talk	Virtual conference	National	General public	09-10-2020	Biobío	0	60	1	0	Felipe Gamonal
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7.2.- Articles and Interviews

Type of media and scope	Local/Regional		National		International		TOTAL
	N° Interviews	N° Articles	N° Interviews	N° Articles	N° Interviews	N° Articles	
Written	1	3	1	9	0	1	15
Internet	0	0	7	33	0	2	42
Audiovisual	1	0	4	0	1	0	6
TOTAL	2	3	12	42	1	3	63

Annex 8. - Connections with other sectors:

Activity	Type of Connection [Number]	Type of Activity [Number]	Institution Country	Agent Type [Number]	Economic Sector
Report for Chilean navy, DIRECTEMAR 2013	2	1	CHILE	2	Public Sector

NOMENCLATURE:

[Type of Connection] [1] Services Contract [2] Cooperation Agreement

[Type of Activity] [1] Development of Studies [2] Project Implementation [3] Training [4] Prospective Activity [5] Scientific Training
[6] Installation of Scientists [7] Others (specify at the table foot other type of activity)

[Agent Type] [1] Industry and Services [2] Organizations and Public Services [3] Educational Sector

Annex 9.- Total Funding:¹

Funds	2020 Sources of Funding	
	Amount [\$]	Percentage of resources used by the Center [%]
MSI	839.000.000	65%
Other public funds	22.000.000	96%
Concurrent Public projects Funds not managed by IMO	403.664.297	75%
ICM Funds	10.000.000	86%
FONDECYT projects	470.000	30%
Services Income	13.393.678	70%
Others (specify)	0	
TOTAL	1.288.527.975	68%

¹ Para aquellas fuentes de financiamiento con el mismo origen, se debe realizar sólo un ingreso con el valor total de la fuente de financiamiento y no ingresar uno a uno estos montos.

Annex 10.- Outstanding Activities

Nothing to report.

Name of the activity relevant in your discipline	Type of activity relevant in your discipline carried out	Description of the relevant activity in your discipline	Importance in your discipline of the activity	Possibility to maintain or replicate this activity