



***CONSORTIUM FOR MARINE EDUCATION IN
CONSERVATION AND SUSTAINABILITY OF THE
CHILEAN SEA***

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EXECUTIVE SUMMARY

CONSORTIUM FOR MARINE EDUCATION IN CONSERVATION AND SUSTAINABILITY OF THE CHILEAN SEA

“Chile es Mar” (Chile is Sea). With this simple, yet meaningful statement, Juan Carlos Castilla, a world renowned Chilean marine biologist headed a newspaper article seeking to increase Chileans’ social awareness about their nations’ extraordinary uniqueness and marine wonders. Castilla argued conclusively that 80% of the Chilean country’s territory “is water”. However, the majority of the Chilean people have not yet become aware of their coastal and marine life and resources due to a lack of caring, profound marine culture. Moreover, according to a recent document released by the “Advance Conservation Strategies Group” of the David and Lucile Packard Foundation, due to its physical heterogeneity, oceanographic features, and ecosystems, *“the Chilean coast offers high levels of endemism and biodiversity within its five ecoregions”*. Furthermore, recently the Convention of Biodiversity, Nagoya meeting, approved the 2010 CBD, 10 goals Strategic Plan, framed under the so called **“Aichi Goals”**. Goal number one in this strategy states: *“At the latest in 2020, the public should be fully aware about the value of biodiversity and the steps that need to be taken for its conservation and sustainable use”*. Based on these concepts and needs and with the vision of the Chile California Council, and financial support by the Chilean Ministry of Foreign Affairs, a grant by the Packard Foundation, and matching funds by the Universidad Católica de Chile, the Universidad de Concepción, the Centro de Estudios Avanzados en Zonas Áridas and the NGO Wildlife

Conservation Society, a "Consortium for Marine Education in Conservation and Sustainability for the Chilean Sea" was launched in October 2011. An ambitious long-term vision was developed: *"To promote a cultural change on coastal and marine care in Chile, through long-term, science-based, globally linked educational programs, with public and private partners, and oriented toward society as a whole"*. The CC Council, Universities and WCS appointed a representative working team of 8 experts, directed by Dr. J. C. Castilla as the Scientific leader and Dr. Luis Pinto as the marine education specialist.

A comprehensive review-diagnosis about the state of science-based marine education for conservation and sustainability of the sea in Chile was completed in January 2012. Insufficient investment in non-formal marine science education projects was an important conclusion derived from the study. Although many of them included elements of creativity and innovation with a strong scientific basis, were ended because of a short term financing strategy, lack of permanent financing and of national coordination. Further, a lack of curricular alignment with the school program has discouraged teachers to participate. The lack of support stands against a real need for extracurricular activities where students are encouraged to learn by inquiry to increase their scientific learning skills. The review suggested that a considerable number of young professionals (mainly marine biologists) have chosen to "learn by doing" in the absence of a professional specialist trained in the dissemination and transfer of marine content from research and academia to schoolchildren. A major limitation to this grassroots approach is the lack of design and implementation of evaluation-assessment tools to measure the learning achieved by the student and the degree of progress in the marine cultural change. Thus, in Chile

capacity building in marine education is a key element to consider in any future marine education strategy. Furthermore, in Chile it is absolutely crucial to design a long-term Marine Education Program (MEP) based, among other aspects, on the development of specific marine education infrastructure, such as a series of Interactive Marine Education Centers (IMECs). Last but not least, there is not a single Public Marine Aquarium in Chile, and the implementation of at least one in the next 10 years has become a major national-private challenge. Without appropriate physical space where marine education initiatives take place, no success will be achieved.

The Consortium developed a comprehensive education and science-based approach for the development, first of a Pilot 5 year Marine Education Program (MEP) for Chile; and secondly, the launching and implementation, following the pilot stage, of a national Marine Education Program in the country. The Pilot MEP is based on a Governance scheme and 4 main pillars (see Figs. 1 & 2).

1. The Governance scheme of the Marine Education Program (Fig. 2) is based on a **Consortium Directory**, with participation of the four associated institutions, a **Consortium Advisory Board** and **Executor Partners**. All these bodies will function ad-honorem. Connected with these higher-level bodies there will be an **Executive Director**, a **Program Team** (of up to 3 professionals) and a **Financial Administrator**. These personnel must be hired to properly run and coordinate the Marine Education Consortium during its pilot, 5-year stage. The total cost for the implementation of this scheme over the five year pilot stage is of US\$ 819,000 (see Annex I).

2. Training of Human Resources for the Marine Education Program. This is the first pillar of the pilot MEP and focus on the

training of **Human Resources**, aiming to lay the groundwork for the long-term sustainability of the MEP and eventual launching of a National MEP. The training of human resources contains 8 main marine education sub-programs, including the training of: **young marine science leaders, marine science and natural science students (future teachers), communicators and K-12 schools students and teachers**. The full cost of 8 the sub-programs for the pilot stage amounts to US\$ 1,592,000 (see Annex II).

3. Marine Appreciation and Awareness of Knowledge-Outreach for the Marine Education Program. This is the second pillar of the pilot MEP and focuses on outreach and eventual launching of a National MEP, aiming to educate the general public, public and private decision makers, students and teachers about the value, beauty, uniqueness and potential of the Chilean sea and the importance of conservation and rational use of services for development and human well-being. The pillar is based on 5 specific outreach sub-programs and the full cost of them for the pilot stage is of US\$ 1,379,000 (see Annex III).

4. Physical Infrastructure and Associated Personnel for the Marine Education Program. This is the third pillar of the pilot MEP and focuses on the development of key **Marine Education Infrastructure and hiring of specialized personnel**, aiming to help “show what we do not see in the sea”: the uniqueness, beauty, magnificence, values and complexity of the marine life. This pillar is based on first priority building of four **Interactive Marine Education Centers (IMECs)**, around each of the participant institutions. As a second priority, having an **Itinerant Marine Traveling Exhibition** of marine life, called the **Sea-Bus**, that will bring the sea to different

localities, particularly those far away from the coast .The full cost for the building and hiring of the needed associated marine education specialist for the four IMECs is of US\$ 5,100,000 (see Annex IV).

5. A Foundation for the Marine Education Program. This is the most important and critical pillar of the MEP. In fact, the Consortium has reached the conviction that enough marine science of top world quality has been developed in Chile in the past 20 years, and that a group of leading scientist are ready to transfer that information to society. *The question is how?* That knowledge is mostly locked in scientific papers read by specialists and peers. If we want to transfer that information a foundation initiative is needed. We have designed a novel way to approach that challenge, based on the knowledge in the hands of Chilean marine scientists, whom will work for a full year in the development of a series of **Marine Education Training-Bricks (MET-Bricks)**, based on accumulated top Chilean **marine scientific knowledge, local ecological/traditional knowledge and marine cultural expressions**. The **learning-bricks** will be summarized, synthesized and assembled in two years, for easy public understanding (see Annex V; as an example, we are proposing 30 **comprehensive and novel titles and contents for such learning -bricks**). The total set of learning-bricks (probably 50 prepared by top scientists in Chile) will constitute the *"Knowledge Backbone of the Consortium"* for Marine Education in the country, regarding all MEP's sub-programs and activities. The full cost for this pillar is of US\$ 135,000 (see Annex V).

NOTE: the total cost of the Pilot Marine Education Program (5 years) is of US\$ 9,025.000

5. A Dream: Public Marine Aquaria for the Children of Chile in 2020.

The Directorate, Governance bodies, institutions and scientists of the Consortium will do their absolutely outmost to build the case, lobby and convince the Chilean government, public and private authorities to face the Chilean State challenge to present Chilean children and general public with a tworld-class Marine Aquarium in the year 2020. Our Marine Education Program, hereby delineated, and the existence at least of a Marine Aquarium, will greatly advance and contribute: *""To promote a cultural change on coastal and marine care in Chile, through long-term, science-based, globally linked educational programs, with public and private partners, and oriented toward society as a whole"".*

HISTORY AND OVERVIEW

CHILEAN CONSORTIUM FOR MARINE EDUCATION IN CONSERVATION AND SUSTAINABILITY

1. Background, Problem Definition and Vision

“Chile es Mar” (Chile is Sea). With this simple yet meaningful statement Juan Carlos Castilla, a world renowned Chilean marine biologist headed a newspaper article seeking to increase Chileans’ social awareness about their nations’ extraordinary uniqueness and marine wonders. Castilla’s awe-inspiring figures showed conclusively that 80% of the country’s territory “is water”. However, the majority of the Chilean people have not yet developed awareness or a caring culture for its costal and marine life and resources. The central valleys, Andean mountains, desert and Patagonia have captured their full imagination and folklore, and with few exceptions, they seem oblivious to the enormous gifts and uniqueness of its massive surrounding oceans. Castillas’ article suggests that Chileans are ready to embrace this forgotten natural wonder, that first class scientific knowledge has accumulated in the country and that time has finally arrived for Chilean marine scientists to transfer that knowledge to society!

In contrast, nobody would doubt Chile’s presence in the worlds’ marine and business platforms. Chile is ranked fifth in the world’s landing of fisheries, and is the seventh largest producer of aquaculture products. Fortunately, and thanks in part to Castilla’s on-going calls towards coastal marine resources co-management of small-scale marine resources and the planning and establishment of protected areas and limitation access to the coastal seas (sea-demarcation), these

environments are now subject to more strict regulations and permits. These regulations represent a significant step forward into marine conservation and a sustainable development mentality, versus the business as usual approach (mostly seen in industrial fisheries and the aquaculture of exotic species) that has yet to be fully developed and implemented not only in Chile but also in the Southeastern Pacific coasts.

According a recent document released by the “Advance Conservation Strategies Group” of the David and Lucile Packard Foundation, due to its physical heterogeneity, oceanographic features, and ecosystems, *“the Chilean coast offers high levels of endemism and biodiversity within its five ecoregions”*. Because of these biological characteristics the Southeastern Pacific coasts, the marine waters bodies of Chile and marine realms, it is possible to conclude that they are a national and international priority for conservation and sustainable management.

Overall, the degradation of marine ecosystems and failure to conserve marine biodiversity has significant economic, environmental and social consequences. Recognizing these dangers and its relevance, the Bureau of the United National Conference of Sustainable Development declared “Ocean Management” as one of the seven priority areas addressed by the Rio+20 Conference held in Brazil June 2010. It can be concluded therefore, that Marine Public Education is essential for long term, complex endeavors towards the creation of sustainable management of the marine environment in Chile – and the world. Furthermore, recently the Convention of Biodiversity, Nagoya meeting, approved the 2010 CBD, 10 goals Strategic Plan, framed under the so called “**Aichi Goals**”. Goal number one in this strategy is: *“At the latest in 2020, the public should be fully aware about the value of biodiversity and the steps that need to be taken for its conservation*

and sustainable use". This goal is perfectly aligned with the Marine Education Program we are presenting here, since we insist that it not possible to care, conserve and sustain something you do not know or are aware of. This is the case of the sea in Chile. Presently, a truly maritime culture does not exist in Chile.

Acknowledging the significance of Chile for Marine Conservation efforts and the absence of Chilean public awareness of these issues, a group of distinguished Chilean marine biologists, gathered to participate in a workshop called "Education for Marine Conservation." The workshop took place in Chile during January 2012, in the Coastal Marine Research Station of the *Pontificia Universidad Catolica de Chile (PUC)* (ECIM-PUC) at Las Cruces and was co-organized by the Chile – California Council, ECIM and the Wildlife Conservation Society. Headed by Juan Carlos Castilla, the workshop's goal were to ascertain the main components and factors needed to develop a comprehensive, integrated National Marine Education Program for Chile and to propose a long-term vision. After a fruitful discussion the group of experts arrived to a historic vision, to take the necessary steps to *"promote a cultural change on coastal and marine care in Chile, through long term, science-based, globally linked educational programs, with public and private partners, and oriented toward society as a whole"*.

2. The Marine Education Consortium

Based on this vision, three decisions were taken relative to the institutional, managerial and strategic planning needed to execute these goals:

- To create a Marine Education Consortium of leading Chilean Universities, with research and training capacity on marine

sciences, including the *Pontificia Universidad Catolica de Chile* (PUC), the *Universidad de Concepcion* (UdeC), the *Center for Advanced Studies in Arid Zones* (CEAZA) and the *Wildlife Conservation Society* (WCS), to provide scientific support to the above vision and its programs.

- To create the position and hire a Scientific Program Coordinator to manage the elaboration of the Marine Educational Program and to coordinate activities with public, private and other partners.
- To develop a Strategic Plan for the Program to establish short and long-term objectives, a route maps for the creation and implementation of formal educational and outreach educational programs, sponsored by the Chile – California Council, Chilean and international institutions.

The David and Lucile Packard Foundation financed, via the Chile-California Council, a small grant to accomplish these goals. At the same time, the partners of the Consortium matched these funds to hire a marine educator expert.

3. Experts and Working Meetings

A group of marine science and conservation experts, lead by J.C Castilla and marine educator Dr. Luis Pinto, have met regularly for about a year (August 2012- August 2013) to build a Marine Education Program for Conservation and Sustainability: Drs. Miriam Fernández and Sergio Navarrete (PUC); Dr. Bernardo Broitman and Mr. Claudio Vásquez (CEAZA); Drs. Ariel Valenzuela and Erasmo Macaya (initially formed part of the group Drs. Osvaldo Ulloa and Fabian Tapia, UdeC); Dr Barbara Saavedra (WCS); Mr. Salvador Vega, who represented the Ministry of Foreign Affairs. Occasionally, Mrs. Isabel Valdez and Ambassador Gabriel Rodríguez have attended meetings. Meetings

have taken place in Santiago, Las Cruces, Concepción and La Serena.

4. Marine Education in Chile

During August 2012- January 2013 an in-depth review on marine education in Chile was carried out and led by L. Pinto and J.C. Castilla. Main questions were: What kind of marine educational initiatives has taken place in Chile during the past 12-15 years? Which institutions have participated? What kind of formal, non-formal and outreach initiatives have been carried out? Which organizations have participated? Who has financed these initiatives and what were the results? Have following ups and evaluations been made? What metrics and measurements have been used to ascertain needs and track results? The data were gathered in a in-depth 90 page report (sent in May 2013 to the Chile-California Council. Findings helped the group of experts to identify marine education programs, to compare experiences, identify good practices, to detect gaps, opportunities and lessons learned, and to identify young marine science educator leaders in the country. The review was important to identify future needs, objectives and strategies for the development of the Consortium Marine Education Program.

5. Marine Education Santiago Seminar-workshop

The Consortium together with the Chile-California Council and the Imagen de Chile Foundation organized in Santiago during April 8 & 9 , 2013, a Seminar-Workshop as part of the activities funded by the Packard Foundation though the Chile-California Council. The organization was lead by the Chilean Ministry of Foreign Affairs in

close connection with Luis Pinto and J. C. Castilla. The Consortium partners collaborated very actively with the marine educational display. Every member of the Consortium produced a magnificent display to present their own Marine Educational Programs and activities. Leading material on marine education being produced in Chile was fully displayed. Activities were held at the Cultural Center Gabriela Mistral (GAM) in Santiago. About 270 people attended the Seminar (Government representatives, Senator Girardi, NGOs, Vice-Chancellors, Deans and Professor from P. U. Católica de Chile, U. de Concepcion, U. Catolica del Norte-CEAZA, WCS, other private and State Universities, Members of the CCC, Educational Centers, Marine Biology students, TV, radio and journalists). Ambassador Gabriel Rodriguez opened the Seminar emphasizing the ocean as one of the natural laboratories that Chile has to promote world-class research. He also informed the public about the support of the government to establish a program for education in marine conservation through the interaction of the Chile-California Council with the Consortium. The Under-secretary of the Ministry of the Environment, Mr. Ricardo Irarrázabal, followed recognizing the historic debt of the Nation with its seas and the need to train public officers in marine conservation issues. Juan Carlos Castilla was the next speaker starting with an introduction of the Consortium and the long-awaited aspiration for the promotion of marine education in Chile. He then introduced every member of the Consortium and exposed some of the marine education activities and initiatives each partner had carried out in their region. He postulated the importance of creating a National Program of Education for marine conservation and a pilot program to be lead by the Consortium in the creation of **Interactive Marine Educational Centers (IMECs)**. Finally, Ms. Julie Packard, Executive Director of the Monterrey Bay Aquarium, introduced to the public one of the most prominent and visited Aquarium in the world, the Monterey Bay Aquarium. Ms Packard presented the history of the Aquarium since its inception and the important events, novel to these types of institutions, opening new and revolutionary practices for the enjoyment of the

society. She stated very clearly the importance of reaching self-sustainability to be able to succeed in the Aquarium business, highlighting other initiatives that did not succeed due to a misjudgment in the scale of the enterprise.

The Seminar continued with a prerecorded salute and support to the aspirations of the Consortium by Dr. Jane Lubchenco, former head of the National Oceanic and Atmospheric Administration (NOAA). The Seminar finished with a small award to young Chilean leaders in marine education and conservation. Fourteen of them were recognized and their biography included within the written material given to all people attending the Seminar. The Consortium institutions met with Ms. Julie Packard to discuss and share ideas about the following steps in order to prepare a Strategic Plan and the Marine Education Program. It was emphasized the need for Chile of a world class Marine Education Program, the creation of Interactive Marine Educational Centers and Marine Aquaria, which the country lacks. The Chancellor of the P. Universidad Católica de Chile. Chancellor Ignacio Sánchez, invited Ms Julie Packard, members of the CCC, of the Consortium and top level Chilean entrepreneurs, representatives of the Ministry of Environment and the Navy, to a meeting to highlight the importance of the Marine Education Program for Chile. **Attendants:** Ms Julie Packard; Michael Grasty (Lawyer and expert in Marine Affairs); for Mr. Roberto Angelini , Mr Jorge Ferrando (Empresas Copec); for Mr. Paul Luksic (Minera Los Pelambres) Mr. Roberto Quijada, Gerente de Proyectos Especiales; for Mr. Alejandro Wolff (Embassador USA), Mr Pablo Valdez; Ms Gloria Hutt (Subsecretaria de Transporte); for the Navy and in representation of the Chief Commander, Capitán de Navío LT Sr. Otto Mrugalski Meiser, Subdirector de Intereses Marítimo y Medio Ambiente Acuático; Mr. Raúl Rivera (Presidente Foro Innovación) ; Mr. Timothy Purcell (Socio principal Linzor Capital) & Mrs Teresa Edenholtm ; Mrs. Alexandra Edwards; Mrs. Barbara Saavedra, WSC; Miss Kathleen Barclay American Chamber of Commerce –USA; Ambassador Gabriel Rodríguez (M RREE Stgo); Mrs. Isabel Valdés (CCC); Mr. Juan Eduardo Ibañez (CCC): Dean Juan

Correa; Dr. Juan Carlos Castilla (Science Director of Consortium); Vice Chancellor of Research, Dr. Juan Larraín (PUC); Mr. Alfonso Gómez; Chancellor ;Ignacio Sánchez (PUC). The Chancellor of the University presented the PUC 125 year medal to Ms Julie Packard. On April 9th members of the Consortium traveled together with Ms Julie Packard to the Marine Research Coastal Lab. of the Universidad Católica (ECIM) where the delegation was welcomed by the director of ECIM, Dr Sergio Navarrete. Several articles published in leading national newspapers plus four TV and radio interviews.

6. Moving Forward and Partnership

Regardless of the Chilean 4,200 kilometers of coast line - *although the real extension is over 84,000 kilometers if the islands in the southern region are added*- presently Chile does not have programs or facilities for elementary, medium and high school's (K-12) students and public Marine Education and Outreach:

- a) There is not a single Chilean Marine Education National Program and the sea, as a transversal subject, is almost absent from school syllabus
- b) Interactive Marine Education Centers do not exist in the country
- c) Marine Aquaria do not exist in the country
- d) Comprehensive and long-term educational programs (outreach) open to the public where “all folks” can come, enjoy, admire and learn about the Chilean Pacific Ocean wonders, uniqueness and needs for its sustainable protection do not exist in the country.

Any educational program aiming to represent the culture of a Nation requires the support and participation of a variety of social actors and

their interests. Certainly, our vision embraces the academia, but goes beyond the knowledge of experts in academia, and it would require also diverse national and international partners. For instance, California has many years of experience in marine public education and has several organizations with the expertise and focus in these areas. Taking this into account our expert group in Chile, invites the California Council to continue to be a key player and to sponsor our new initiative, using its connections and networks to support the hereby proposed Pilot five year Chilean Marine Education Program, centered around Coquimbo-La Serna; Santiago-Valparaiso; Concepcion-Talcahuano and Punta Arenas-Porvenir.

PILOT STAGE STRATEGIC PLAN

CHILEAN CONSORTIUM FOR MARINE EDUCATION IN CONSERVATION AND SUSTAINABILITY

Why?

Chile has one of the world's most important territorial seas in extent, production and equity value, both cultural and natural. It is poorly known and recognized by the general public despite a broad and deep scientific knowledge on its structure, function, resources and potentials. There are no instruments to promote awareness and appreciation of our ocean realm and beauties, including marine education and infrastructure programs that foster its understanding, observation and the development of a maritime culture. Thus, along the over 80,000 km of coastline (-it is a geographic and cultural mistake continuing to teach our children that the continental shore is 4200 km long!-) there is not a single Interactive Marine Education Centre (IMEC) for school or general public, even worst, not a single public Marine Educational Aquarium.

The Chilean sea supports a variety of national industries such as fisheries, tourism and ports, and provides key ecological and commercial services linked to food supply, nutrient cycling, recreation, wild stock fisheries, aquaculture, transport and marine traditions. At the same time, it is recognized that the intensification of human activities on the coast and in the open sea adversely affect marine ecosystems worldwide, threatening in the short and long term the well-being of the Chilean population. Therefore, marine conservation,

care, respect and a deep sense of proud for our sea are critical issues to be developed in Chile, specially to transit to and to achieve sustainability. Moreover, the planning for the road to development requires understanding of future climate change scenarios in this sea in order to define strategies to reduce the risks to the environment, food supplies and the economy.

What to do?

Despite its strategic importance, Chile completely lacks a Marine Education Program (MEP) to promote the knowledge and appreciation of this national asset. It is known that it is not possible to preserve, care and be proud of something we do not know. So far, Chile has been almost blind to the sea. **However, faced with future cultural and economic development, we have the opportunity to promote a cultural change that allows the stewardship, conservation and sustainable use of marine ecosystems and particularly the coastal-marine services.** This change must be based on the development of a science-based marine education program, that is nationwide in reach and of long-term duration, that has access to appropriate infrastructure, and that can be oriented not only to students and teachers of primary and secondary schools, but also reaches out to other relevant actors, such as journalists, government officials, senior managers from the private sector and the general public, among others.

Who?

In the past 20-25 years Chile has generated a world-class body of knowledge in marine sciences. As happened in developed countries at some point in their histories, time has arrived to develop explicit links and strategies to bridge the gap between the acquisition of this

knowledge and the rest of the national community. These skills and awareness must be transferred to students and the general public to develop the basic infrastructure that promotes marine education for the sustainability, dissemination, disclosure and valuation of the Chilean sea realms. In a global world we have an opportunity to build on foreign experiences, a salient one being the State of California, who currently leads the integration of Science with the best quality of marine education.

How?

In an effort without precedent in Chile the consortium, under the support of the international framework in place through the Chile-California Council, are working towards the establishment of a Consortium that may build and promote a long-term MEP, that is based on scientific knowledge and cultural assets, of global reach, with public-private partnerships, and focused towards a broad public.

We have develop a Vision-Purpose for our MEP, which is: *“To promote a cultural change on coastal and marine care and conservation in Chile, through long term science-based, globally linked educational programs, with public and private partners and oriented toward society as a whole”.*

This Consortium for Marine Education in Chile, with support from the Packard Foundation, has worked for a year in identifying gaps and existing opportunities in Chile, and has built a pilot Marine Education Program to be implemented over the next five years (2014-2019). We summarize here this proposal, indicating their main components, goals in the short and medium term and the required strategic steps to achieve its implementation. This document aims to serve as:

- An outline of the main steps, personnel, needs and infrastructure to lead towards a MEP, indicating stages, objectives and stakeholders needed to achieve the vision.
- A roadmap to implement the Program to help channel the participation of other national and international agencies and organizations.
- A summary of information to allow the promotion of the Marine Education Program between management bodies, funding agencies and other key partners.

1. The Marine Education Program (MEP)

The Consortium's Vision-Purpose that guides this pilot program is to promote a cultural change for coastal-marine stewardship in Chile through a long-term, science-based and global reach MEP oriented towards society as a whole. The MEP is based on a **Governance scheme, three main Pillars and one Foundation** (see Figs. 1 & 2).

- The Governance scheme (Fig. 2) is based on a **Consortium Directory**, with participation of the four associated institutions, a **Consortium Advisory Board** and **Executor Partners**. All these bodies will function ad-honorem. Connected with these higher-level bodies there will be an **Executive Director**, a **Program Team** (of up to 3 professionals) and a **Financial Administrator**. **These personnel** must be contracted to properly run and coordinate the Marine Education Consortium during its pilot, 5 years, stage (see Annex 1).

The first pillar is dedicated to the training of **Human Resources (Human Capital)**, which hopes to lay the groundwork for sustainability of the MEP, formally teaching marine literacy to K-12 schools students, teachers, and human resources specialized and young leaders in marine subjects. This pillar is based on the

development of formal educational and outreach programs addressed to K-12 students, teachers, university specialists of careers related to the sea, and communicators (see **Annex 2**).

- The second pillar will look into the development of an **Outreach Marine education Program (Social Capital)**, which hopes to educate students, teachers and the general public about the value, beauties, uniqueness and potentials of the Chilean sea and the importance of conservation and rational use of services for development and human well-being. This pillar is based on the design and implementation of specific outreach programs for students and teachers, private-public senior managers and mass communication programs (see **Annex 3**).

- The third pillar will be dedicated to the development of key **Marine Education Infrastructure**, which hopes to help “show what we do not see in the sea”: the uniqueness, beauty, magnificence, values and complexity of the marine life. This pillar is based on building **Interactive Marine Education Centers (IMECs)**, around each of the **participant institutions**, which are distributed throughout the country. Also, as a second priority, having an **Itinerant Marine Traveling Exhibition** of marine life, **called the Sea-Bus**, that will bring the sea to different localities, particularly those far away from the coast (see **Annex 4**).

-**Foundation.** The above pillars will be grounded in a series of novel **Marine Education Training- Bricks (MET-Bricks)**, that are based on sound **scientific knowledge, local ecological/traditional knowledge and marine cultural expressions**, that are accumulated in the history of Chile, and that will be synthesized and assembled for their easy public use during the first pilot year of the Consortium (see **Annex 5**).

2. Goals, deadlines & commitments

The efforts to help in the develop and creation of a marine culture in Chile is a long-standing process, for which the Consortium for Marine Education, hopes to become a milestone, allowing the training of the personnel, designing the teaching, outreach and material infrastructure, the tools, not only for its initial implementation but for its sustainability in the long term, and for their public use during the pilot stage. The pilot stage of our MEP hopes to be developed in five years and the plan is to transform this pilot stage into a National Marine Educational Program at the end of the five years.

3. Implementation and running processes

Listed below are the phases of the process, highlighting in each case priority actions to be conducted and explaining assessment ends in each action.

1. Birth of Marine Education Consortium is the phase in progress, aimed at developing the Marine Education Program, and a strategic proposal for implementation. This phase lasted for one year and was co-financed by the David & Lucille Packard Foundation. This proposed Program is the outcome of this phase.

2. Establishment of the Consortium and implementation basis for plans, which aim to develop priority actions to install the Consortium administratively, to implement priority educational programs with strategic partners, to synthesize and assemble accumulated scientific knowledge for their public use and to develop strategic inputs to

achieve program sustainability. **This phase is expected to last for two years.**

3. Growth and Consolidation, which aims to expand the base of Consortium partners, to complete the implementation of programs and infrastructure throughout the national territory, as well as to implement sustainable financing program. **This phase is expected to last for two years.**

In an adaptive approach we eventually will target for a 10 years National MEP operation.

4. Final Evaluation

Specifics, management strategies, responsibilities and managements for the first priority objectives, as those corresponding to each Pillar & Foundation of the Marine Education Program

PHASE	PRIORITY OBJECTIVES	TIME	RESPONSABILITY & ENGAGEMENT
1. BIRTH	1. To establish Consortium for Marine Education in Chile and appoint an ad-honorem Science Director 2. To propose a 5 year Pilot Marine Education Program (MEP) 3. To develop an Strategic Plan for the PEM's implementation	1 YEAR	Chile- California Council (CCC) Marine Education Consortium (MEC) Marine Education Consortium (MEC)
2. ESTABLISHMENT	1. To define Administrative Structure of Consortium, following Governance guidelines 2. To identify and establish Advisory Consultative Board 3. To identify and hire Executive Director and minimum operative staff & first steps in fund raising 4. To conform the MEP Directorate 5. To develop the set of Marine	2 YEAR	CCC & MEC MEC Directory MEC Directory CCC & MEC Directory Executive Director & MEC

	<p>Education Training-Bricks (MET-Bricks) that will serve as MEP foundations.</p> <p>6. To develop Education sub-programs for pre-school and K-8 school level, and to implement pilots in two schools in each core site of the Consortium: La Serena/Coquimbo; Las Cruces/San Antonio; Concepción/Talcahuano; Punta Arenas/Porvenir).</p> <p>7. To develop an Outreach/Communication Plan.</p> <p>8. To develop and implement outreach sub-programs for communicators, at the national and local level.</p> <p>9. To develop and implement an outreach sub-program for public/private Senior Managers.</p> <p>10. To develop the first two Interactive Marine Education Centers (IMECs); architecture, equipment, staff, business plan for its operation.</p>	<p>Executive Director & MEC</p> <p>Executive Director & MEC</p> <p>Executive Director & MEC</p> <p>Executive Director & MEC</p> <p>Executive Director & MEC</p> <p>Executive Director & MEC & Consortium Institutions</p> <p>MEC</p>
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	11. EVALUATIONS		
3. Growth & Consolidation	<p>1. To complete implementation of Administrative Structure, including operation staff.</p> <p>2. To develop Education Programs for high school levels, and implementation of two pilots in each core location of the Consortium (La Serena/Coquimbo, Santiago/Las Cruces, Concepción, Punta Arenas/Porvenir).</p> <p>3. Expansion of the Elementary Level Education Program to 30% of the schools in each core site of the Consortium.</p> <p>4. To fully implement Outreach/Communication Program.</p> <p>5 EVALUATIONS</p> <p>6. To start the operation of the first two IMECs.</p> <p>7. To develop Project of next two IMECs: architecture, equipment, staff, business plan for its</p>	3 YEARS	As above

	operation. 8. To implement Financing Plan.		
4 Evaluation	1. Final evaluation elementary and of high school Level Education sub-programs at each site of the Consortium. 2. Evaluation of MEP outreach 3. Start the operation in the last two Consortium IMECs and evaluations. 4. Adaptive Revision of Educational and Outreach sub-programs, and design a workplan and route for a National 10 years MEP		Last year of Pilot MEP: coupled with last year of the Growth and Consolidation Phase

	YEAR					
PHASE	0	1	2	3	4	5
Birth						
Establishment						
Growth & Consolidation						
Final Evaluation						

4. Governance

The MEP that will be under the aegis of the Consortium for Marine Education in Chile is a challenging project for its novelty and complexity. There are few successful Consortia experiences of in the country, even fewer that aim to integrate different institutions located in different parts of the country to achieve an extremely complex goal, such as a cultural change. The long term sustainment of this goal it will require planning and foresight.

The development process of the MEP will be accompanied by the design of a governance structure to allow a successful execution, and to facilitate decision-making and operation, which will privilege efficiency and effectiveness and ensure the necessary transparency.

Regardless of the stage of the project, to achieve an appropriate governance structure that guarantees the success of the MEP, the following is required:

- **A governance structure**, designed and working.
- **Process expedited**, explicit, established and functioning to facilitate decision making.
- A transparent and efficient structure of accountability.

This governance structure should be defined early and should be functional to the following objectives:

- Have the necessary University and NGO support for the implementation of the ME-Program.
- Channel, support and management of specific funds for the Program.
- Allow execution of the MEP activities in due time and form.

As a guideline, we present a proposal for the structure and we give some guidance on minimum functions expected from its components (see Fig. 2).

Consortium Directory, which should be composed by one representative from each member of the Consortium, with decision-making power on behalf of their institution. It is expected to:

- Provide a strategic political guidance to the MEP.
- Provide support to the Executive Director of the MEP to achieve the objectives of each stage of the project.

- Monitor the development of the MEP and goal achievement in agreement with the strategic plan and considering recommendations from specialized partners, scientists, technicians, etc., which will be channeled through the MEP Partners Group.
- Select the Executive Director of the MEP.

Consortium Advisory Council, which should be integrated by members of the public and private sectors and a representative of Chile-California Council. It is expected that this Council will:

- Advise the Consortium Directorate
- Support fund raising for the implementation of the MEP
- Encourage the integration of international experience in the MEP
- Support the political positioning of the Consortium and the MEP

Executor Partners, whose role is to provide technical support and act as co-executors of MEP activities and is expected to be composed of individuals or working groups from different backgrounds such as public and private, national and international, depending on the needs / opportunities of the MEP.

Financial Administrator, the entity that will manage the financial integrity of the Consortium managing and facilitating the channeling of national and international resources. In the initial stage of the MEP it could be a foreign agent, and the full operation stage of the Consortium may be an internal finance manager.

Executive Director, who will be responsible for leading the implementation of the MEP and will represent its interests. Among its functions it is expected to:

Develop, review and ensure the achievement of the specific objectives.

Report to the Consortium Directive Committee the needs and progress of the Program.

Develop skills and abilities in the members of the Program Operative Team.

Monitor all the Program activities, including the interaction with partners, budgets planning, and human resources, among others.

Ideally, the Executive Director should be a person with experience in marine sciences, able to interact in an international setting, possessing advanced management and strategic skills and have the proven capacity to manage complex programs.

Program Operative Team: a group of professionals who will run the MEP under the supervision of the Executive Director. At least one professional should be considered for each pillar of the Program: Human Resource Training, Outreach/Communication and Infrastructure. The **Financial Administrator** is part of this team

NOTE: Annex I contains the budget for the hiring of the Executive Director, the Program Operative Team and the Financial Administrator

Fig. 1

MARINE EDUCATION PROGRAM FOR CONSERVATION AND SUSTAINABILITY

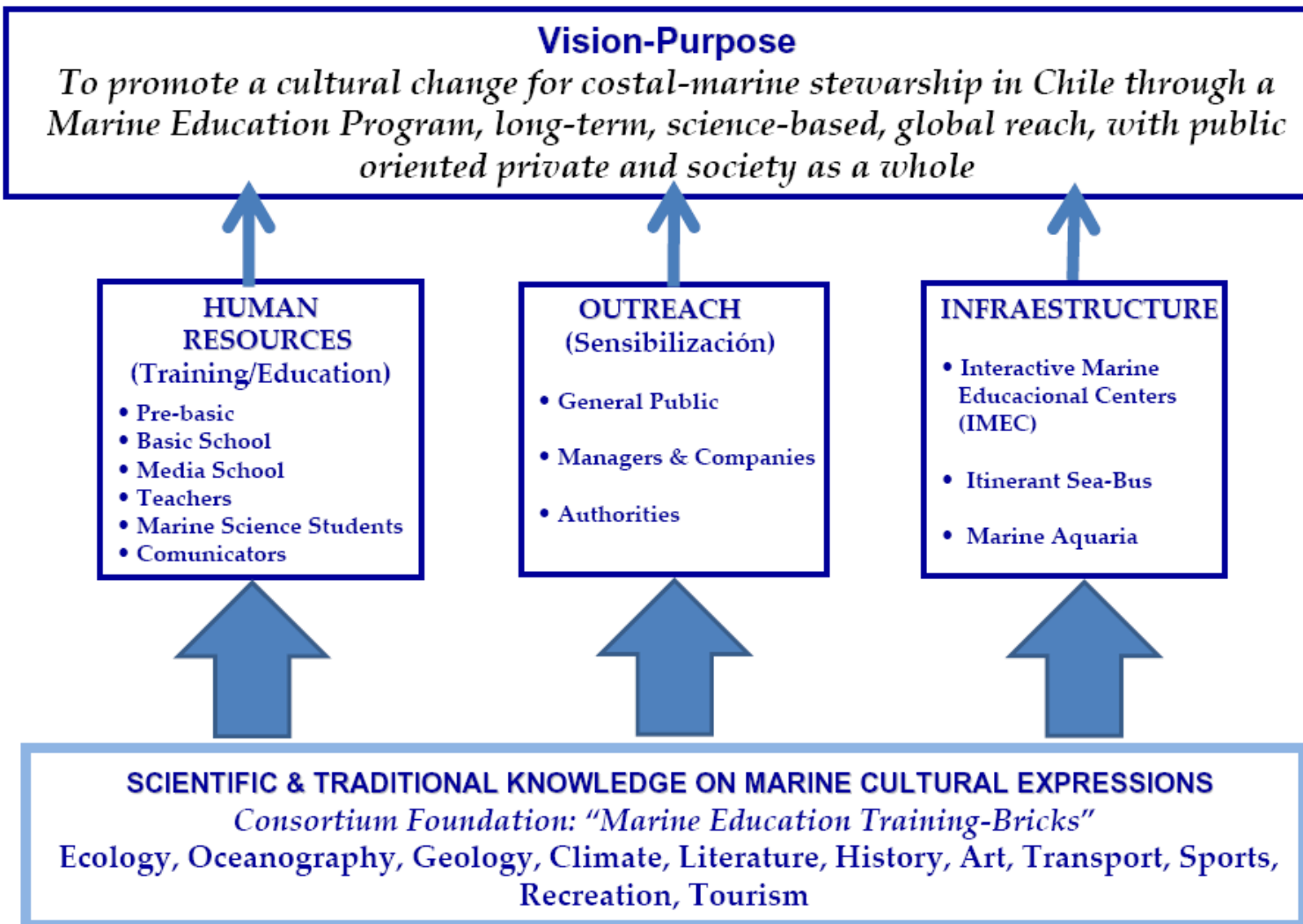
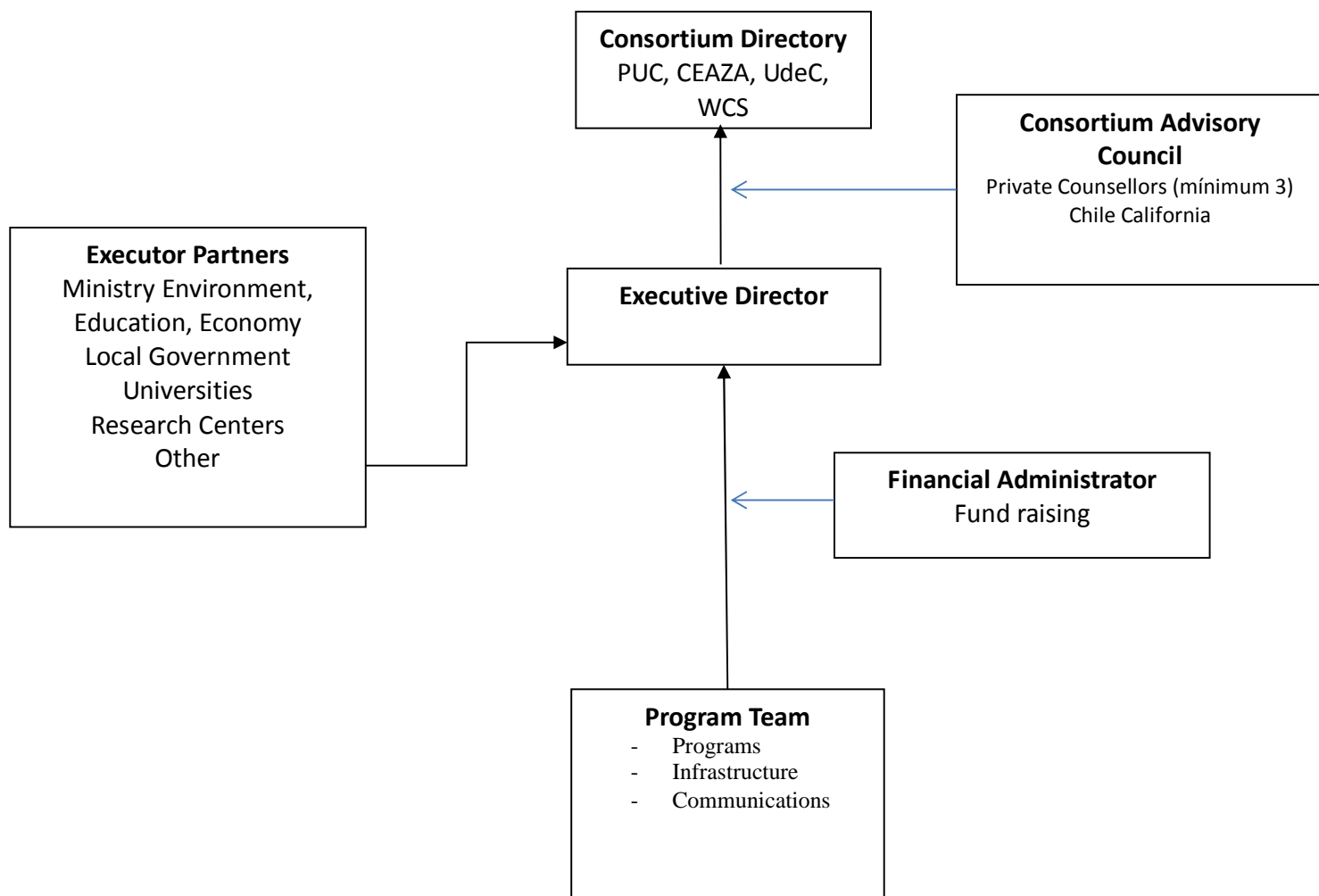


Fig. 2. Marine Education Consortium Governance Structure



Global Budget and Finance

The Marine Education Program is a major program, whose financing should come from different sources, public and private, local and global. Key in the process of establishment of the program is the installation of the proper staff who will execute this plan. The initial MEP proposal for the Directorate, training and outreach has been estimated at a total of US\$ 3,945,000 for the initial five years of implementation: 2014-2018. Further, the building, implementation and operation of the 4 Interactive Marine Education Centers amounts to **US\$ 5,100,000 (see below for details)**. This funding should be provided strategically, initially to cover priority objectives and sequentially incorporating new and broader goals. This amount most likely will be covered by more than one source of funding and, therefore, the development of MEP require the contribution of various sources, and may include contributions from the private sector, NGO's, international community and certainly the Chilean governments.

The process of funding the program already started, and was leaded by the David & Lucille Packard Foundation and Chilean funds. Considering the long-term projection of the MEP, their sustained funding should be considered early, for that is needed:

- **A startup** donation-based funding, to ensure the implementation of the two years **Establishment Phase of the ME-Program is needed**.
- Obtain economic contributions, although low, but continuous from the national or regional governments.
- Target strategic partners, ideally local/private who can contribute with the development of infrastructure.

- To develop a realistic business model for the MEP that considers the development of long term sources of finance.

A summary of the overall estimated **Budget for the 5 year Pilot Stage** of the ME Program (2014-2018), including costs for the Directorate, Pillars and Foundation is the following:

Objective	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Directorate and Personnel	111,000	147,000	183,000	189,000	189,000	819,000
Training of Human Resources	274,000	311,000	316,000	374,000	317,000	1,592,000
Outreach Programs	329,000	332,000	251,000	296,000	189,000	1,379,000
MEL-Bricks Program	75,000	45,000	10,000	5,000		135,000
Infrastructure		825,000	1,875,000	1,500,000	900,000	5,100,000
Total	789,000	1,660,000	2,635,000	2,364,000	1,595,000	9,025,000

DETAILED BUDGET FOR MEP DIRECTORATE AND EXECUTION OF SUB-PROGRAMS

1. Consortium Budget for Directorate Personnel Total Costs

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
0	111,000	147,000	183,000	189,000	189,000	819,000

2. Consortium Budget for Training of Human Resources Total Costs

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
0	274,000	311,000	316,000	374,000	317,000	1,592,000

3. Consortium Budget for Outreach Programs Total Costs

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
0	329,000	332,000	251,000	296,000	189,000	1,379,000

4. Consortium MEL-Bricks Program Total Costs

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
0	75,000	45,000	10,000	5,000		135,000

SUMMARY

I. TOTAL COSTS DIRECTORATE & SUB-PROGRAMS

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
0	789,000	835,000	760,000	864,000	695,000	3,925,000

II. INFRASTRUCTURE

TOTAL COSTS FOR 4 INTERACTIVE MARINE EDUCATION CENTERS

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
0		825,000	1,875,000	1,500,000	900,000	5,100,000

ANNEX I

GOVERNANCE: DIRECTORATE PERSONNEL FOR THE MARINE EDUCATION PROGRAM

According to Fig. 2 the Marine Education Consortium will have an **Executive Director**, a **Program Team** and a **Financial Administrator**. This professional personnel will have to be hired for the pilot running of the Program. Functions and responsibilities have been detailed in the Strategic Plan of the Program.

The Director has to be a well known scientist with experience in marine research, formation of scientists, outreach and ideally in marine education. The Director will need to be hired based in a full-time dedication scheme

The Program Team, that will work directly with the Director, will be formed by at the most 3 professionals with experience in: a) training of personnel in the area of marine sciences and education, b) experience in outreach programs, c) experience in the establishment and operation of marine labs, interactive education centers, aquaria etc. Program Team personnel will need to be hired based on full-time dedication to the Program

The Financial Administrator should have experience in financial matters and running of scientific/education programs and is thought that can be hired as half-time dedication.

Cost of Marine Education Consortium Directorate Personnel (in US\$)

Director of Marine Education Consortium (full-time)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
0	65,000	68,000	70,000	72,000	72,000	347,000

Central Program Team (up 3 professionals, full-time)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
0	30,000	62,000	95,000	98,000	98,000	383,000

Financial Administrator (part-time)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
0	16,000	17,000	18,000	19,000	19,000	89,000

Summary: Consortium Directorate Total Cost

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
0	111,000	147,000	183,000	189,000	189,000	819,000

ANNEX II

TRAINING OF HUMAN RESOURCES FOR THE MARINE EDUCATION PROGRAM

Human Resource (Capacity Building) is a key component of the Pilot Program and long-term Vision of the Marine Education Consortium.

In Chile, in the past 20 years, Marine Sciences (Biology, Ecology and Physical, Biological and Chemical Oceanography) have reached a high international standard, this backed by international publications and the creation of several national and regional Centers for Advanced Marine Science Studies. Chilean marine scientists have been recognized at the top science level in the country. For instance in the past four years two Marine Biologists have been awarded National Prizes in Science. There are several instances of international recognitions to Chilean marine scientists, particularly in the area of Marine Ecology, Conservation, Biodiversity, Sustainability, Physical Oceanography and Management of marine resources. Several schools of thoughts have been established and about 8 Coastal Marine Laboratories and Field Stations have flourished along the country. The country has over 30 years of solid and transparent policies for the allocation of funds to science, based in a well design and open competitive system, both for basic and applied science. A few marine science disciplines have taken full advantage of these funds and added international funds to develop long-term top scientific enterprises of world class. In its wide definition the science of Marine Coastal Conservation (Ecology, Sustainability, Biodiversity, Coastal Oceanography, Social-ecological systems) is one of those enterprises.

Today, it thrives in Chile and has been recognized in Latin America and in the world, as cited in the front line of advances and progress, and for the use of interdisciplinary approaches (Biology, Ecology, Social Sciences and Economy), to confront and solve coastal environmental socio-ecological-sustainability challenges.

The Consortium partners, research, facilities, geographical areas and human resources.

The Universities of this Consortium are among the largest and most prestigious in Chile: (a) P. Universidad Católica de Chile, (b) Universidad de Concepción, (c) Universidad Católica del Norte-Universidad de La Serena, as part of the Centro de Estudios Avanzados de Zonas Áridas (CEAZA), located in the near North and central Chile, represent approximately 70-80% of the marine scientific and teaching activities in Chile. All this judged by the high level of marine research, areas covered, the number and rate of publications and certainly by the quality of those publications (citations); investments, facilities and long-traditions; training of marine science undergraduate and post-graduate (Ph. D.) students and commitment with the country in the area. From the human resources (capacity building) point of view, in Chile these universities are responsible for training over 60% of undergraduate students (marine biologists, ecologists, oceanographers) and over 90% of the post-graduate students in the area (M.Sc & Ph.D). The Universidad Católica de Chile and the Universidad de Concepcion have the oldest and most prestigious doctorate programs in the area in Chile, and probably in Latin America.

The fourth partner of the Consortium, the NGO World Conservation Society (WCS), has a long-standing presence in Latin-American in

Conservation issues. In the case of Chile the WCS has a strong component in Marine Conservation in the Patagonia and Magellan areas and has worked and collaborated with the above Universities for a long-time. The WCS marine conservation program in southern Chile focus in a key geographical region of Chile (the most marine bio-diverse region!), where the Consortium Universities are rather weak. So, the association and synergism between those Universities and the WCS is critical. Therefore, the four Consortium partners cover over 70% of Chilean marine territories

Marine Education, knowledge accumulated and need for the training of human resources

The above scenario indicates that in Chile marine science research on topics and issues such as Marine Ecology, Conservation, Biodiversity and Sustainability, has reached a very high level. The same can be said regarding the formal university training of under and graduate students. Therefore, the marine Chilean community has accumulated a large volume of knowledge and specialists in the sea.

The country must treasure those achievements and needs urgently to take a step forward and share/communicate/outreach marine knowledge to society. A long-term program and a national sustained effort, need to be developed. It can be done. We do have the knowledge and a group of scientists in the Consortium is willing to do that. But we need to tackle the need for training of professional Marine Science Educators and leaders, Marine scientists, K-8 and secondary school teachers/students and communicators.

Marine Education Training Programs: 2014-2018

So far, Chile as a country has not committed sustained efforts to purposely develop and extend a marine culture to its 18 million population. According to our studies, perhaps the only places in which elements of a proper Chilean marine culture exist is in: (a) the extended artisan fisher communities, (b) communities in Chiloé Island, (c) the Rapanuis from Eastern Island. The Vision developed in our Consortium focus in the development of instruments and mechanisms to establish that culture widely, based on solid scientific knowledge. To archive that we propose to package the present knowledge in marine science in Chile in a set of professional modules, called: "**Marine Education Training-Bricks**" (**MET-Bricks**), to be developed by the specialists in the Consortium. Based on that we propose to develop training programs for:

(a) **Personnel for Marine Education** Training at the Consortium Centers. Total cost for the Consortium Pilot program, 2014-2018, will be US\$ 600, 000.

(b) **Young Marine Educator leaders in Chile**. In a review done by the Consortium, financed by the Packard Foundation in 2012-13, of marine educational programs and educators along the country, we identified a group of 15 self-trained marine scientists dedicated to marine education and working in different Chilean institutions and centers (no necessarily in centers of the Consortium). In our Consortium Pilot five years program (2014-2018) we propose to develop a special training program for them and future young marine scientists interested in marine education. The total cost of this key sub-program, 2014-2018, is estimated in US\$ 272,000.

(c) Marine education training for teachers and students at K-8 level.

We propose to develop a Consortium five year program to eventually target in 2018 to about 28-30 schools, 60-70 teachers and 2,000 students. To carry on this task, the existence in the second/third year of the Pilot Consortium Program of "Marine Educational Interactive Centers" (MEICs) in each of the partner institutions will be a key component (estimated costs of these MEICs are presented separately). The total cost of this Sub- program, 2014-2018, is estimated in US\$ 324,000.

(d) Marine education training for Chilean high schools teachers and students. We propose to develop a Consortium five year program to eventually target in 2018 about 20 schools, 60 teachers and 1,200 students. To carry on this task, the existence in the second/third year of the Pilot Consortium Program of "**Interactive Marine Education Centers**" (IMECs) in each of the partner institutions will be a key component. The total cost of this Sub- program, 2014-2018, is estimated in US\$ 425,000.

(e) Training of Chilean Marine Science Students. All the Universities participating in this Consortium have under graduate programs in marine sciences; therefore, we suggest introducing in their present curricula, training programs in Marine Education. Furthermore, we propose to develop a "Diplomado in Marine Education" . The total cost of this Sub- program, 2014-2018, is estimated in US\$ 111,000.

(f) Training of Chilean Undergraduate Basic Science Teachers in Physics, Biology, Geography and Chemistry. All the Universities participating in this Consortium have undergraduate programs in the formation of Basic Science Teachers in Physics, Biology, Geography and Chemistry. Therefore, we suggest introducing in their curricula a

training program in Marine Education. (f) The total estimated cost for the Science-based Marine Science Outreach and Education for Leading Chilean Communicators, 2014-2018, is of US\$ 101,000.

(g) **Science-based Marine Science Outreach and Education for Leading Chilean Communicators.** The total estimated cost for this sub-program, 2014-2018, amounts to US\$ 84,000.

(h) **Science-based Marine Education Training for Local Communicators at each of the Consortium's Centers.** The total estimated cost for this sub-program, 2014-2018, amounts to US\$ 104,000.

DETAILED DESCRIPTION OF THE CONSORTIUM MARINE EDUCATION SUB-PROGRAMS

Sub-program 1: Personnel for Marine Education Training at each of the Consortium Centers

Objectives

(a) To incorporate/hire a full-time professional Marine Educator at each of the Centers of the Consortium for the period 2014-2018, as part of the budget of the Consortium.

(b) To incorporate/hire a part-time professional in outreach (Marine Education) at each of the Centers of the Consortium for the period 2014-2018, as part of the institutional budget of each Centre

Presently, some Centers of the Consortium (i.e., Universidad Católica, CEAZA), that have small programs in marine education have part-time hired well trained professionals in Marine Education, mostly based on short term national or international projects (Milenio, Explora); nevertheless, so far, none of the Centers have been able to hire professionals in outreach.

The below proposed sub-programs can not be developed without hiring for the full period of the Pilot Program , 2014-1 2018, at each Consortium partner Centre a well trained professional specialized in Marine Education. Therefore, in the budget of the Consortium a total per year of US\$ 120,000 is allocated to this need.

As a counter-part each Centre will be responsible to contract a part-time professional in outreach (journalist, communicator) to team with

the professional specialized in Marine Education and coordinate with the Consortium Directorate.

Costs.

Cost of sub-program (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	sub-program total
0	120,000	120,000	120,000	120,000	120,000	600,000

Sub-program 2: Training of Chilean Young Marine Education Leaders and the Design of a “Diplomado in Marine Education”

Objectives

(a) The training and academic consolidation in Marine Education of 30-40 young marine scientists, under ca. 35 year old, leaders on Marine Education.

(b) The development of a joint-Consortium “Diplomado in Marine Education” for the Universities of the Consortium, and other institutions interested in Chile.

(c) To promote and advance in the establishment in Chile of a new Marine Culture.

Plan. During the 5 years Pilot Program on Marine Education the Consortium will organize 2 one-year training courses in Marine Education for young marine scientists under *ca.* 35 years old: 2015 and 2017. The Basic plan is for the selected leaders to further be exposed and experienced marine scientific and marine educational strength at the 3 universities of the Consortium and the WCS. Each year-course

will include at least summer and winter theoretical and practical training /capacitating /educational marine education activities of 10 days each (20 days of on-campus training) in two Universities or WCS centers. The Learning Modules of the Consortium will be used as “Marine Education Training-Bricks”: MET-Bricks. Lectures will be in charge of university experts on different scientific, humanistic, artistic, subjects, as well as communicational and educational specialists. Theoretical as well as demonstrative and field activities: at the coastal border, sea-platforms and coastal stations; fisheries and sailing activities and those linked to the Marine-Conservation-Aquaria Bus and Marine Education Interactive Centers of the Consortium, will be the critical for practical/educational marine training. Further, trainees will be trained based on linkages with present university and WCS Marine Educational on-going programs (outreaching, teachers and student trainings). In between the on-campus activities trainees will have to develop various tasks, such as write essays, reviews, and/or be part of specific marine educational activities or develop their own marine educational activities.

Organization. In 2014 The organization of activities will be on charge of the Consortium in agreement and cooperation with the universities and WCS partners. The on-campus activities will be carrying on in a sequential form at the Consortium Universities and WCS facilities. For each on-campus activity the Consortium will cover all expenses for 10-15 marine young trainees (transport, lodging, food, basic materials), selected via a national and open call. On terms, the guess University or WCS partner may select other 5-10 local, regional trainees. In this case the guess University or WCS will cover all expenses for own trainees. To organize de training activity the Directorate will require US\$ 12,000

On-campus training courses and evaluations. The training on-campus courses (10 days) will have a Director per campus and 2-3 specialists fully financed by the Consortium. Universities and WCS partners will provide a minimum of 3 specialists, (free of costs for the Consortium), mainly in charge of the MET-Bricks of the Consortium. The Consortium will finance one international expert in 2015 and 2017 (10 days each year), particularly focusing in a deficit marine educational area in Chile. The expert will participate in one of the on-campus activities and also offer lectures in partner universities, WCS and other Chilean universities or centers. Courses will include a prearranged flexible syllabus per on-campus activity, containing materials in MET-Bricks (and other) and using advantages of the guess University or WCS own activities and experiences. Trainees will be evaluated per on-campus activities and also based on extra tasks in between on-campus activities (essays, reviews, teaching activities, outreach). Practical field actives related to Marine Education will be important for student evaluations and in total 15-20 days/year of contact between trainees and students, teachers, public will be considered. All activities (lectures, materials, MET-Bricks, games, leaflets, etc) will be on line in a Consortium web-page.

Developing a Joint-Consortium "Diplomado in Marine Education": In 2017, based on the experience obtained in the training of Chilean marine educational leaders, and international experiences, the Consortium will offer to the Consortium Universities and WCS (-and also to other Universities in Chile-) a comprehensive syllabus aimed to a one year "Diplomado in Marine Education". Degrees will be given by each University.

Trainees and the "Diplomado in Marine Education". (a) The first group of 15 young marine scientists to be trained in 2015 have been already

identified by the Consortium. They have obtained their undergraduate degrees in Marine Sciences or related subjects and actually work in different Chilean Universities or in national agencies in Chile (i.e. EXPLORA), including those of the Consortium. A few of them have been trained abroad (i.e., N. Zealand), but the majority are self-trained professionals that need a deeper and comprehensive guided training program in Marine Education. (b) The second group of 15 young marine scientists will be trained in 2017. They will be drawn mainly from young marine scientists leaving university in 2014-2016. This taken into account that starting 2014 the Consortium will offer Marine Education basic courses to undergraduate marine science students (- see Consortium subprogram directed to marine science undergraduate students in Chile-), at least at U. Católica, U de Concepción and U. del Norte. Hereby, we project that in 2017 at least 15-20 of those students may be engaged in this sub-program. (c) The joint-Consortium “Diplomado in Marine Education” will be one of the major products of the Marine Education training programs and other activities of the Consortium develop along 2014-2018. The Marine Education Diplomado syllabus will relay on Consortium university undergraduate training courses and experiences obtained with trainees, and will be offered to the Universities of the Consortium and other outside the Consortium. This will promote and advance the establishment in Chile of a new Marine Culture.

Costs. The estimated cost for this sub-program, in 2014, is of US\$ 14,000. In 2015 and 2017 costs to run the training courses will be US\$ 74.000 per year. This includes: central coordination of Directorate, plans, programs, materials; 4 on-campus training activities including the cost of the Director for each on-campus course; up to 3 teachers/year (experts, scientists, journalists), cover of total expenses

for trainees selected by the Consortium for on-campus activities (15 trainees); allowance of US\$ 2500 for the University or WCS developing the on-campus activities. Else, two international experts, in 2015 and 2017, will be invited to Chile.

Costs.

Cost of sub-program (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	sub-program total
0	14,000	74,000	74,000	74,000	74,000	272,000

Sub-program 3: Marine Education Training for Chilean K-8 Teachers and Students

Objectives.

(a) To develop a set of 28 Didactic Guides for Marine Education at the K-8 level in Chile.

(b) To apply them in 4 Centers in Chile (3 Universities and WCS) to reach, at the end of the Pilot Consortium Program in 2018, a total of 35 schools, 60-80 teachers and 1500-2000 K-8 students

(c) To aim introducing curricula modifications and innovations in Chilean educational official programs, to promote, incentive and facilitate marine education in the K-8 educational level

(d) To promote and advance in the establishment in Chile of a new maritime culture in K-8 level teachers and students

Plan and organization. In 2014 members of the Consortium, jointly with other specialists, will plan and design 28 "*Didactic Guides for Marine Education at the K-8 level*": 7 Guides each partner, addressing all K-8 levels. Each Consortium partner will be responsible to conform scientific/pedagogical teams to produce 7 Didactic Guides that: (a) scientifically will be based on the Marine Educational Training Bricks, MET-Bricks of the Consortium, (b) educationally will be based on present K-8 educational goals in K-8 programs, and innovations to be seek for future programs. Guides will identify specific (s) educational goal (s) and include material and activities for teachers and students and also include evaluations regarding knowledge acquired and behavioral changes, leading to modify students and teachers' marine culture. The Guides will be comprehensively discussed and agreed among/between Consortium partners and the Direction of the Consortium, so to agree on common strategies. At this stage each partner and the Direction of the Consortium will receive US\$ 6,000 to archive above goals (total US\$ 30,000). This, to convey a small group of experts per partner to plan and design the Guides (i.e. professionals in education, curriculum, scientists, expert in evaluation). It is expected that the scientific expertise will be provided by the Consortium partners. The Direction of the Consortium will coordinate and overview the whole process and it may contract a part-time expert in K-8 education. All material produced will be circulated electronically, aiming to achieve a wide dissemination

Implementation. In 2015 the Consortium partners will start using a set of Guides (more adequate ones for each of them according to in-place marine educational infrastructure and personnel). The Consortium will provide up to US\$ 12,000 per partner to promote and help the implementation of these activities (total US\$ 48.000). It will be expected

that in this first year pilot stage, at least 2 K-8 schools, 8 teachers and 100 students (different K-8 levels, according to strategy of each Consortium partner) are targeted. Evaluation of activities will be carried out by the Direction of the Consortium and for it is estimated a cost of US\$ 12, 000.

2016, 2017, 2018. In 2016/2017 each partner of the Consortium should have obtained, based on own facilities, partner institution local, national or international connections, and the support of the Consortium their own “*Marine Educational Interactive Center*” (MEIC) / “*Centro Interactivo de Educación Marina*” (CIEM). Main goals are that when MEICs are fully installed, jointly each partner institution and the Consortium will be able to raise funds for at least US\$ 60,000 per year (50% and 50%; from the Consortium point of view US\$ 120,000 per year). The aim of the Consortium, at the end of the Pilot project in 2018, is to jointly reach a total of 28-30 schools, 60-80 teachers and *ca.* 2000 K-8 students. Very importantly, jointly the partners institutions and the Consortium will develop instruments to measure the acquisition of knowledge, behavior changes in students and teachers and progresses in the acquisition of a new marine culture in Chile. The Direction of Consortium will lead, coordinate, overview, follow and evaluate the application, adaptation and constant innovations in the use of the “*Didactic Guides for Marine Education at the K-8 level in Chile*” and for this it will require US\$ 12,000 per year (total US\$ 36,000).

Note: *The Consortium should be a key agent in supporting and seeking finance for the implementation (building and equipment) and personnel of 4 MEICs: one for each partner institution. Nevertheless, each partner institution will have to play also an active and key role in local, regional, national or international fund raising for MEICs. It is expected that the establishment of each CIEM will be guided by site specific characteristics and*

needs. The Consortium will provide to each center with US\$ 50.000 per years to help training activities 2016-2020. In a separate chapter the Program addresses strategies for the development and implementation of MEICs.

Long-term goal. After 2018, the goal is to transform this pilot Consortium program of Guides *for Marine Education at the K-8 level*, into a wide national program along the country and to succeed to introduce these educational innovations into Chilean official K-8 programs. Efforts will be made to invite and to incorporate other universities, along the way of our pilot Consortium program, aside from Consortium partner institutions.

Costs.

Cost of sub-program (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	sub-program total
0	36,000	72,000	72,000	72,000	72,000	324,000

Sub-program 4: Marine Education Training for Chilean High School Teachers and Students

Objectives.

(a) To prepare high school teachers and students (last four years, secondary school) with the appropriate skills, knowledge, mindset and marine culture to be stewards of the ocean

(b) To develop a set of 16 Advanced High School Didactic Guides for Marine Education and to engage youth in challenging, observational, inquiry-driven

and experimental marine education activities. Apply the Guides in the 4 partner's institutions of the Consortium (2014-2018), to reach at least 30 schools, 70 teachers and 2000 high schools students

(c) To introduce curricula innovations in Chilean educational official programs at the high school level to promote, incentive and facilitate marine education and the acquisition of a new marine culture

(d) To promote and advance in the establishment in Chile of a new maritime culture in K-8 level teachers and students

Plan. (a) In 2014 members of the Consortium, jointly with other specialists, will plan and design 35-40 "Advanced Didactic Guides for Marine Education at High School Levels": 5 Guides each partner, addressing all high school levels. Each Consortium partner will be responsible to conform scientific/pedagogical teams to produce Didactic Guides that: (i) scientifically will be based on the Marine Educational Training Bricks, MET-Bricks of the Consortium, (ii) educationally will be based on present high school educational goals, and innovations be foreseen for future programs. The Guides will identify specific (s) educational goal (s) and include material and activities for teachers and students and also evaluations regarding knowledge acquired and behavioral changes, leading to modify students and teachers' marine culture. The MET-Bricks of the Consortium will serve as the backbone for an integrated, didactic and hands-on approach for learning. Based on rigorous understanding of processes, mechanisms and phenomena occurring in the ocean, the "bricks" will have depth and breadth in the treatment of contextualized topics and up-to-date marine issues. Another important source of scientific information will be provided by Consortium researchers to expose students to the frontier of ocean science. The Guides will be

comprehensively discussed among/between Consortium partners and the Direction of the Consortium, so to agree on common strategies. At this stage each partner and the Direction of the Consortium will receive US\$ 5,000 to archive above goals (total US\$ 25,000). This, to convey a small group of experts per partner to plan and design the Guides (i.e. professionals in education, curriculum, scientists, expert in evaluation). It is expected that the scientific expertise will be provided by the Consortium partners. The Direction of the Consortium will coordinate and overview the whole process and it may contract a part-time expert in high school education. All material produced will be circulated electronically, aiming to achieve a wide dissemination

(b) In 2015 a multidisciplinary team, including a researcher from each institution of the Consortium, an expert in Didactic-Curricula in Science and an experienced Education and Public Outreach specialist will create a training course called *"Youngsters on board: becoming stewards of the ocean"*, based on the MET-Bricks of the Consortium and their implementation in a series of working environs where high school students are given opportunities to learn theory about ocean processes and acquire scientific skills through hands-on field work, inquiry and project-based activities. Students will attend seminars, produce a short video that integrates their learning, visit scientific labs, and present an experimental or bibliographic investigation at any of the Student Science Conferences or Fairs produced every year in the country. Students will attend classes during 10 weeks. In the following year all class-graduated students will attend a 6-days ocean campground to share their experiences, work within a specific topic with a Consortium researcher and his/her team, run experiments and lead hands-on activities with the public during the summer session and commit to actions reflecting their new attitude towards the ocean.

At this stage each partner and the Direction of the Consortium will receive US\$ 5,000 to achieve above goals (total US\$ 25,000).

Implementation. In 2015 the Consortium partners will start using the Advanced Guides (more adequate ones for each of them according to in-place marine educational infrastructure and personnel) and special emphasis will be placed on the methodologies used, given the special interest and new technological developments that high school students are so very fond of. The Consortium will provide up to US\$ 12,000 per partner to promote and help the implementation of these activities (total US\$ 48.000). The organization of activities will be in charge of the Consortium in agreement and cooperation with the universities and WCS partners. It is highly recommended that the Consortium works closely with the local School District (Departamento de Educación Municipal) to insure support from the public high schools. This will also be a great opportunity for Marine Science College students who have finished their training with the Consortium to become monitors. The Direction of the Consortium will require US\$ 12,000 to coordinate, follow and evaluate results. It will be expected that in this first year pilot stage, at least 2 high schools, 10 teachers and 120 students (different high school levels, according to strategy of each Consortium partner) are targeted. Evaluation of activities will be carried out by the Direction of the Consortium and for it is estimated a cost of US\$ 12, 000. The existent of the “*Marine Educational Interactive Center*” (MEIC) / “*Centro Interactivo de Educación Marina*” (CIEM) at each of the Consortium partners institutions will be essential in achieving the goals.

Note: *The Consortium should be a key agent in supporting and seeking finance for the implementation (building and equipment) and personnel of 4 MEICs: one for each partner institution. Nevertheless, each partner*

institution will have to play also an active and key role in local, regional, national or international fund raising for MEICs. It is expected that the establishment of each CIEM will be guided by site specific characteristics and needs. The Consortium will provide to each center with US\$ 50.000 per years to help training activities 2016-2020. In a separate chapter the Program addresses strategies for the development and implementation of MEICs.

2016. In 2016 partners of the Consortium should start the implementation of the program “*Youngsters on board: becoming stewards of the ocean*”.

2016-2018. In 2016, 2017 & 2018 the Consortium partner institutions should be in a position enabling them to run in alternative years one of the two designed high school training activities: *Advanced Guides or Youngster on Board*, according to facilities. Along these 3 years each partner institution and the Consortium should be able to raise funds (local, national or international connections and with the support of the Consortium) for at least US\$ 60,000 per year (50% and 50%). The Direction of Consortium will be assigned US\$ 20,000 to each partner institution per year, per 3 years, to run one or other program (total US\$ 240.000). The Direction of the Consortium will lead, coordinate, overview, follow and evaluate the application, adaptation and constant innovations in the use of the *Didactic Guides and Youngsters on board* programs and will require US\$ 10,000 per year (total US\$ 30,000). Importantly, jointly the partner’s institutions and the Direction of the Consortium will develop instruments to measure the acquisition of knowledge, behavior changes in students and teachers and progresses in the acquisition of a new marine culture in Chile. The aim of the Consortium, at the end of the Pilot project in 2018, is to jointly reach a total of 20 schools, 60 teachers and *ca.* 1200 high school students

Long-term goal. After 2018, the goal is to transform these pilot Consortium programs into wide national programs along the country and to succeed to introduce educational innovations into Chilean official high school educational programs. Efforts will be made to invite and to incorporate other universities, along the way of our pilot Consortium program, aside from Consortium partner institutions.

Costs.

Cost of sub-program (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	sub-program total
0	60,000	72,000	110,000	110,000	100,000	452,000

Sub-program 5: Training of Chilean Marine Science College Students

Objectives.

(a) To offer a one-semester course called "Skills and Competences in Marine Education in Chile"

(b) To set, in conjunction with sub-program 1, the bases for a "Diplomado in Marine Education" for Marine Sciences College students of the Universities of the Consortium, and other institutions interested in Chile, and to prepare a new generation of marine educators with the appropriate skills, knowledge and mindset to engaged in Marine Education and outreach

(c) To promote and advance in the establishment in Chile of a new Marine culture based on the vision of the Consortium.

Plan. During 2014 a multidisciplinary team, including a researcher from each institution of the Consortium, an expert in Didactic-Curricula in Science and an experienced Education and Public Outreach specialist will create a one-semester course on Marine Education, based on the MET-Bricks of the Consortium and their implementation in a series of working environments where the Marine Science undergraduate students will be given opportunities to learn from a wide range of marine science experts (using all skills from partners of the Consortium), work, interact and to innovate. Pre-requisite for the course will previous approval of contents related to Marine Biology, Oceanography and Marine Conservation. Along with the theory students will carry out various tasks, such as attending seminars, writing essays, and/or supporting specific marine educational activities at a local school or develop their own marine educational activities. Administrative work will include a plan to create and maintain a website linked to the websites of each one of the Consortium partners. The Directorate of the Consortium will lead, organize and complete this task. For this a total of US\$ 20,000 will be needed.

Contents and organization. The MET-Bricks of the Consortium will serve as the backbone for an integrated, didactic and challenging new approach to transfer knowledge and skills to college students. This, based on rigorous understanding of processes, mechanisms and phenomena occurring in the ocean. The MET-Bricks will have depth and breadth in the treatment, contextualized into Marine Education at large (formal and outreach) topics and up-to-date marine issues and challengers, especially for Chile. The organization of activities will be in charge of the Consortium Directorate in agreement and cooperation with the universities and WCS partners. It will be up to each member

institutions of the Consortium to allocate the course in their own institutions. The syllabus will be flexible and rely on own university undergraduate training courses. It is planned to invite 2 international experts (2015 and 2017) in marine education topics.

Implementation and networking. In 2015 the training course will be implemented in at least in one of the partner institutions. As suggested, feedback from this course and from sub-program 1, will play an important role in the development of the “Diplomado in Marine Education”. The Consortium will support the organization of Marine Science College alumni as an important step to maintain the momentum created initially. At some point during the Consortium Pilot Program, encouragement will follow for participation of alumni in their organization and a time and space will be offered where they can share their ideas, experiences and assess how well the program is tuned with the vision of the Consortium. For the College training course it will be needed US\$ 5000 per year per partner institution offering the course and US\$ 2,000 per year for the Directorate to coordinate and evaluate the activities

Costs.

Cost of sub-program (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	sub-program total
0	24,000	22,000	16,000	28,000	21,000	111,000

Sub-program 6: Marine Education Training Course for Undergraduate Basic Science Teachers (Physics, Chemistry, Biology, Geography)

Objectives.

- (a) To offer a one-semester course called “Skills and Competences in Marine Education for Undergraduate Basic Science Teachers”*
- (b) To adapt this program from Sub-program 5 (Marine Sciences College students) to prepare a new generation of marine science educators with the appropriate skills, knowledge and mindset to engaged in Marine Education.*
- (c) To promote and advance in the establishment in Chile of a new Marine culture based on the vision of the Consortium.*

Plan. To produce a deep marine cultural change regarding conservation, care and sustainability of our oceans it is essential to train University Basic Science Teachers in Marine Education. A second step is aiming for modification and innovations in the K-8 and secondary schools programs. In both aspects, the early training of undergraduate Basic Science Teachers is critical and completely absent today in Chile. Then, during 2014 a multidisciplinary team, including a researcher from each institution of the Consortium, an expert in Didactic-Curricula in Science and an experienced Education specialist will create a one-semester course on Marine Education for Basic Science Teachers, based on the MET-Bricks of the Consortium The course will no have pre-requisite. Along with the theory students will carry out various tasks, such as attending seminars, writing essays and educational activities at a local school or develop their own marine educational activities. Administrative work will include a plan to create and maintain a website linked to the websites of each one of the

Consortium partners. The Directorate of the Consortium will lead, organize and complete this task and provide material to develop the course. For this a total of US\$ 15,000 will be needed.

Contents and organization. The MET-Bricks of the Consortium will serve as the backbone for an integrated, didactic and challenging new approach to transfer knowledge and skills to Basic Science Teachers. The main challenger will be to adapt and organize knowledge for an uninformed audience, since no pre-requisite can be asked for. Learning will be based on understanding of processes, mechanisms and phenomena occurring in the ocean. The MET-Bricks will have depth and breadth in the treatment of themes, contextualized into Marine Education topics and up-to-date marine issues and challengers, especially for Chile. The organization of activities will be in charge of the Consortium Directorate in agreement and cooperation with the universities and WCS partners. It will be up to each member institutions of the Consortium to allocate the course in their own institutions. The syllabus will be flexible and rely on own university Basic Science Teachers training curricula

Implementation and networking. In 2015 the training course will be implemented in at least in one of the partner institutions. At some point during the Consortium Pilot Program, encouragement will follow for participation of alumni in their organization and a time and space will be offered where they can share their ideas, experiences and assess how well the program is tuned with the vision of the Consortium. For the Marine Education Training Course for Undergraduate Basic Science Teachers (Physics, Chemistry, Biology, Geography) it will be needed US\$ 7,000 per year per partner institution offering the course and US\$ 2000 for the Directorate to coordinate and evaluate the activities.

Costs.

Cost of sub-program (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	sub-program total
0	18,000	11,000	20,000	26,000	26,000	101,000

Sub-program 7: Science-based Marine Science Outreach and Education for Leading Chilean Communicators.

Objectives

(a) To inspire leading communicators (journalists, radio, television, social networks, etc.) from key Chilean media outlets, to take an interest in our proposed science-based Marine Education Program.

(b) To establish a positive relationship with participants and a commitment on their part to the general objectives of our Program.

(c) To show participants that the Consortium is an essential source of information on marine issues, regarding both conservation and education, and of expert consultation.

(d) To promote and advance in the establishment in Chile of a new Marine science-based culture based on outreach and the vision of the Consortium.

Plan The Consortium's coastal centers will hold 2 meetings: 2014 and 2016, in which 12 top leading journalists from different media outlets will share information and experiences regarding the science-based Marine Education Program, the impact that our outreach method's have on community education, and the importance of having Marine Interpretive Centers and aquariums in the country. This sub-program

will emphasize the Consortium ongoing long-term work, as well as the challenges and potential benefits of establishing a cultural change related to marine issues in Chile. Our goal is that the media commits to actively cooperating with us in our mission to spread an understanding and respect for Chilean oceans, conservation and sustainability, grounded in top and sound science. This sub-program seeks to rationally and emotionally engage communication top leaders from key media sources in Chile with our program, including leading figures from print media, radio, television and the Internet.

The sub-program will be developed using the experience gathered in our research Centers, designed in detail and implemented by Consortium Directorate, scientists, universities and associated research centers, as well as science journalists and communication experts. We expect to develop personal relationships with top communication leaders and instill in them a commitment to our program. Moreover, this subproject will help promote the Consortium as a source of expert information for leading news and media articles related to the ocean. Meetings will involve 12 participants each and will take place over the course of a two-day weekend. Some activities will be common to all meetings, and others will depend on the specific characteristics of the Center hosting the meeting. Each Center will have the following common activities: a) presentation of the program, description of education and marine conservation initiatives in Chile and the world, experiences of cultural appropriation associated with other marine centers (Monterrey, CA for example), b) a panel discussion on topics of interest to the Program (to be determined according to current issues), and c) a hands-on visit to a site in which scientific research is being conducted. We will have at least one practical activity with children related to conservation and marine education at each meeting. Furthermore, each venue will develop specific activities, designed both to show local area characteristics, and also to get participants involved through personal experiences, which could be, among others, diving, exploration of coastal ecosystems, participation in oceanography research, etc. The emphasis is on highlighting the peculiarities,

strengths and unique features of our ocean, and the need to develop a marine culture in Chile.

Participants. The Directorate and Consortium members will select guests based on their merits as driving leaders of public opinion. During each visit, guests will receive a small plaque commemorating his or her participation in the Program as a "leader" in marine cultural opinion. We will evaluate whether the information obtained from the panel can be presented in a public document. In addition, each participant will share his or her vision of the project with us. We will track participants' allegiance to the Program (in terms of information delivery, merchandising, etc.) through the entire duration of the project. Guests will be renewed annually, and supporting materials will be adapted to emphasize issues the Consortium considers of utmost importance for each stage of the project. The Consortium Directorate will be in charge of the general organization of the sub-program at large, while different teams will plan specific activities in conjunction with leaders from each Center. Consortium scientists and science journalists will lead each activity with the help of other experts according to specific needs. In addition, a previously trained outstanding career journalist will lead some of the activities. The Consortium will create supporting materials for all common activities, focusing on marine knowledge, oceanographic research, history and communication of Chile's marine world.

Costs. In 2014 the Consortium will plan and organize the first course and develop material for it; running costs for these activities will be centered in the Consortium Directorate (US\$ 8,000). The estimated costs to run each training course is of US\$ 36,000-40,000, this includes the cover of transport, lodging and meals and 2 experts (one communicator and one scientist). The host Center will be responsible

of local organization and providing all facilities to run the training course.

Costs.

Cost of sub-program (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	sub-program total
0	8,000	36,000		40,000		84,000

Sub-program 8 : Science-Based Marine Training for Local Communicators at the Consortium's Centers.

Objectives:

(a) To introduce the short and long term goals of our Marine Education Program, and establish constant and effective communication with media outlets (print media, radio, television, etc.) located in the vicinity of each Consortium Research Center, on issues related to science-based marine education.

(b) To deliver advanced science-based marine education concepts, develop skills and provide tools for communicators working near Consortium research centers: to encourage the reporting of news and events related to the ocean with a sound scientific basis, and promote the Marine Education Program in coastal communities near each Center.

(c) To develop a communication network, and local contacts/bridges between marine scientists and communicators at each Consortium Center.

(d) To promote and advance in the establishment in Chile of a new Marine science-based culture based on outreach and the vision of the Consortium.

Plan. We plan to conduct 4 annual meetings in 2014, 2015, 2016, 2017 with local and regional communicators, one per year in each regional Center. The meetings will serve to deliver tools (sources, background knowledge, journalistic and communication skills) in order to improve the coverage of science-based marine education issues. There will be activities common to all Centers and others specified locally. The goals are to enhance the professional capacity of communicators, and to create a virtual communication network to keep them updated on marine science and conservation issues. This subprogram focuses on engaging local and regional communicators living near coastal communities with our Consortium Marine Education Program. It will be designed and implemented by the Consortium and associated research centers, as well as by science journalists and communication experts. Each meeting will last 2-3 days and will involve 9 local invited participants from the city/region of the host center, plus one invitee from the other 3 centers. All costs will be covered by the Consortium, for a total of 12 communicators per year. Attendees will be renewed annually and supporting materials will be adapted to emphasize issues that the Consortium considers of utmost scientific and educational importance at each stage.

Activities. Each Center will have the following common activities: a) presentation of the program (main goals, action plan, national and international leading actors), b) a science journalism course (production of press materials with solid scientific contents, use of reliable national and international sources, relationship between scientists and journalists), c) a panel discussion about the participants' view on topics of interest to the Program, and d) a hands-on visit to a site in which scientific research is being conducted. In addition, each Center will develop specific activities, taking advantage of local

characteristics and facilities (scuba diving, research vessels, intertidal exploration, local aquariums, Interactive Marine Education Centers). Efforts will be made for the communicators to witness and participate in a local school visit to the Center. A virtual discussion group will be created for journalists and Consortium representatives in order to expedite communication between them. Attendees will be selected by regional Consortium members for their merits as communicators and driving leaders of public opinion. Each participant will receive material to facilitate their reporting (for example a digital recorder) and a certificate attesting to their participation. We will evaluate whether the information obtained from the panel can be presented in a public document. Each participant will video-record his or her vision of the project. Attendees will be informed of all relevant activities for the duration of the project.

Organization. Common activities will be organized by the Consortium, with the participation of local Centers, who will be the main promoters of a fluid line of communication between the Consortium, Centers and participants. Activities will be conducted sequentially in the four Centers, under the supervision of a central organizing group, with the participation of local representatives led by communicators appointed at each Centre. In the future, it is expected that these organizing groups will mediate between scientists and local communicators. Journalists, communicators and Consortium researchers will participate in all activities. The Consortium will create supporting materials for all common activities, focusing on science-based marine knowledge, oceanographic research, history and communication of Chile's marine world.

Cost. In 2014 the Consortium will plan and organize the first course and develop material for it. Running costs for these activities will be centered in the Consortium Directorate (US\$ 8,000). The estimated costs to run each training course is of US\$ 24,000, this include the cover

of transport, lodging and meals and 2 experts (one communicator and one scientist). The guest Center will be responsible of local organization and providing all facilities to run the training course.

Costs.

Cost of sub-program (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	sub-program total
0	8,000	24,000	24,000	24,000	24,000	104,000

SUMMARY: TOTAL COST FOR THE TRAINING OF HUMAN RESOURCES IN THE MARINE EDUCATION PROGRAM (2014-2018)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
0	274,000	311,000	316,000	374,000	317,000	1,592,000

ANNEX III

MARINE APPRECIATION AND AWARENESS OF KNOWLEDGE - OUTREACH PILLAR

OUTREACH FIRST PRIORITY PROGRAMS

Outreach (Knowledge Transfer), is the second key component of the Pilot Program of the Marine Education Consortium. The Marine Education Consortium is proposing a series of programs and sub-programs targeting the general public, children and students and decision-makers for first priority implementation during its pilot stage

INTRODUCTION

Today, society is confronted by an unprecedented challenge: "to leave behind a sustainable world to our future generations". Regarding marine systems, we know that humans and global climate change are exerting enormous pressures on them, but many impact stems from our lack of knowledge of ecosystem dynamics and functioning. Therefore, individuals, corporations and government are not able to correctly evaluate anthropogenic effects on marine environments. Indeed, at this moment, the transference to society of knowledge about how natural systems operate and evolve has a critical value.

Today, one of the greatest expectations that society has from scientific research is that of communicating natural systems science-based knowledge, impacts and solutions, thus contributing to human well-being. Then in our Marine Education Program it becomes critical to incorporate a strategic Pillar focused on the outreach/communication of scientific knowledge, which is dedicated to the *transfer of (mainly but*

not exclusively) science-based knowledge regarding marine conservation and sustainability through methodologies pertinent to pre-scholars, K-12 students, decision-makers and the general public, with the intention of increasing awareness in society as a whole about the functioning and the state of different marine ecosystems, in particular coastal ones.

As the general public we defined the set of people that do not meet a specific profile and may include citizens, communities, households, sportspeople, fishermen, unions,, etc. In the first stage, the strategies that will be used to transfer mainly science-based knowledge to this broad group of people has being designed following the analysis and assessment by our Consortium of the state of the art of marine education in Chile, and it seeks to incorporate local and regional issues and the specific capacities that this knowledge transfer may provide (e.g. gastronomy, tourism, changes in behaviour). In doing so, we will seek to establish strategic alliances with a diversity of government, public and private partners to help achieve a cross-sectional integration between the Consortium and the target public. This approach will allow us to broaden and deepen our impact, improve the perception of the program by its end users and optimize resource allocation. During the second stage, our Consortium will design specific strategies and outreach sub-programs that will consider the initial assessment, local and regional needs, the expertise of the institutions of the Consortium, seeking common objectives and ways to enhance cooperation.

PERSONNEL

The Marine Appreciation and Awareness of Knowledge Outreach Pillar can not be developed without hiring during the pilot stage (5 years) at least one professional (marine biologist, communicator,

journalist) at each of the institutions of the Consortium. These professional will, on one hand, be the key person at each of the institution to develop, adapt and apply the outreach sub/programs, and on the other, form part of the Consortium Outreach Team that will develop such programs and also seek for extra funding, guided by the Director of the Consortium.

Direct and indirect institutional contributions. Consortium university and research centers will provide the scientific knowledge for the development of sub-programs and will contribute in the process of validation and cultural organizations. Strategic alliances will be wide at public, government and private levels.

Cost of personnel (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Personnel total
0	120,000	120,000	120,000	120,000	120,000	600,000

SCOPE AND SUB/PROGRAMS

The scope of this pillar will focus on the following target audiences: 1) Children and Students, 2) Decision Makers, 3) General Public

1. CHILDREN AND STUDENTS

The first group that this strategy will focus on are mainly children (in general) and school students from an outreach point of view

Activities and material will be adapted for pre-school and school children and inserted into relevant educational programs. Based on

child development stages, support material will be designed as a teaching aid that will allow educators to acquire the role of mediators of marine science for preschoolers. School children will become integrated into the program using educational strategies that will allow their intellectual development through the acquisition of marine science knowledge. Educational methodologies will focus on inquiry-based learning using the scientific process, bolstering vocational interest in marine science careers.

Various disciplines of marine science will be included in the formal and informal education programmes from infancy to adolescence. This will be carried out through support networks with educational institutions, generation of teaching material and pre-school and school activities.

Sub-program 1: From the Ocean to the School

A programme will be conducted for the creation of pre-school and K-6 school child products that will encourage the early development of a marine culture within educational establishments around the Consortium institutions, through the design of material and activities, especially created for early childhood and pre-school-aged children that will stimulate their cognitive function and interest for coastal and marine ecosystems. The sub-programme will begin with pilot school-communities based on intervention by each consortium unit.

General objective. -To promote marine culture in early childhood and school-aged children through the creation of teaching material for educational establishments that have pre-school and elementary levels.

Specific objectives._-To identify marine science information that will allow the formation of icons, concepts and emblematic species in marine ecosystems for the development of children's products.

-To produce teaching material and carry out activities for children about marine science that will encourage understanding of marine ecosystems among the teaching community for increasing awareness and future protection. -To distribute teaching material to all educational establishments and encourage its use in various teaching scopes.

Description of type of activities. The programme will begin with a review of the literature in various marine science disciplines, and interviews will be conducted with scientists to establish icons, concepts and to identify emblematic species in marine ecosystems of Chile. Scientific content will then be drafted into teaching material such as stories, early-stimulation illustrations, child songs, and field and classroom activities that will present the information in a fun way, all of which will be validated by teaching teams from universities and educational institutions to include the material in the academic programmes of schools and pre-schools. Through partnerships with various cultural and artistic organizations, the work will be carried out in conjunction with artists, illustrators, musicians and designers to materialize the teaching tools into quality products for their subsequent national distribution. During the execution of the program, two summer camps will be conducted in each region (for 10-year-old children) to awaken interest in marine science in children finishing their elementary education.

Direct and indirect institutional contributions. Consortium university and research centers will provide the scientific knowledge for the development of icons and to identify emblematic species in marine ecosystems and will contribute in the process of validation and cultural

organizations, with artistic teams for the development of teaching material. Strategic alliances will also be established with the Ministry of Education, Junji and the Integra Foundation in order to assume costs and logistics needed for the distribution of material to reach as many as possible pre-and elementary school centers as possible.

Cost of sub-program (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	sub-program total
0	36,000	62,000	62,000	62,000	15,000	237,000

Sub-program 2: Marine Education Support Network

This sub-program will be based on work with pedagogical specialists and decision-makers in the scope of education to include marine science in school programmes in the Chilean school system, with the long term aim of including marine sciences in varied subjects, and that it may teach children to understand, value and look after their marine environment conservation and sustainability (- in the Consortium we have already developed a critical interception with pedagogical specialists in the Universidad Católica de Valparaíso, that we will be continued and enhanced-).

General objective._To establish links with specialists (see above) and decision-makers in the scope of elementary and secondary education to include contents and disciplines within marine science in formal and informal education programmes, encouraging understanding, awareness, care and sustainability of the marine environment.

Specific objectives. - To identify key players in the formal education system in Chile, as well as the diversity of institutions that look to improve the quality of education (universities, foundations, NGO, editorials, etc.) that work with the contents being taught at different levels of education.

- To promote instances so that key players, educational institutions and scientists can come together to include marine science, both formally and informally in the education system.

- To integrate marine science into formal education programmes through tangible products.

Description of type of activities. This sub-program begins with the identification of the key players and institutions involved in formal educational programs to understand their disposition and individual interests to be able to integrate marine science into the formal education system. A marine education seminar will then be conducted to establish concrete lines of action that will integrate marine science into formal programmes. Following the discussion and proposal of the key players, academic programs will be developed that include content and activities that will encourage marine education in all school levels and subjects.

Direct and indirect institutional contributions. Participating Consortium institutions will supply personnel and contacts to establish support networks within the education scope in order to identify key players and institutions that will participate in the development of new yearly academic programmes.

Cost of sub-program (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Sub-program total
0	17,000	17,000	29,000	33,000	29,000	125,000

3. PUBLIC AND PRIVATE DECISION MAKERS

The third targeted group will be public and private decision-makers. This diverse group, includes Chief Executives (COs), high-ranking public officers, representatives, regional Governors and councillors, Navy officers and other people involved in decision-making processes. To improve and focus the impact on this group, the program is divided into two sub-programs, which will be developed according to the needs of each group and will seek the interaction between different government agencies, entrepreneurs and research centers.

Sub-program 1: High Raking Public Officials, Decision-Makers

This group will includes personnel from Ministries (Undersecretaries and other high-ranking officials), Senate and National Deputies, Regional Governors and Councillors, Mayors and municipal councillors, regional ministry representatives (SEREMIS), Army, Naval and Policy forces, and other chief public officers. We will seek to transfer current marine science-based knowledge to this group, where national decision-making in concentrated, thus achieving a cross-sectional impact that considers both institutions and the territory so to promote the develop of a deeper marine culture and thereby to transfer marine science-based knowledge to all scopes of society.

Sub-program 2: High Ranking Private Senior Executives, Decision Makers

This group will include mainly Senior Executives and Directors or Managers of leading, national or international companies. They have high level formal education, but in general they lack specific opinions about conservation, biodiversity, natural heritage, ecosystem services and/or management tools to achieve conservation and sustainability of systems and resources; despite the fact that the national economy depends directly on the sustainability of natural resources.

In an effort to increase understanding and to inspire public and private national senior official and executives about topics related to ecology and marine conservation, the Senior Executive Network of the University of Development, the Ecology Society of Chile, along with the Ministry of the Environment and the Wildlife Conservation Society, have been delivered a so called "Master Lecture System" to national senior executives (2011-2012), with excellent reception and a large audience. Most importantly, a useful experience was developed for the design of a specific programme aimed at promoting education for marine conservation in Chile, as well as the identification of potential relevant participants.

General objective. To disseminate and transfer knowledge generated by the marine science community (national and international) among company executives and professionals in the public sector so that they can understand how companies are increasing the value of their economic activity in the field through their programmes of sustainable strategies and the way in which public policy is being applied in Chile, in order to evaluate private-public management and its impact on marine ecosystems.

Specific objectives. -To establish a network of companies and institutions interested in the development of marine culture that has the interest in learning and understanding various research lines within marine science in order to strengthen the sustainable development of marine environments. - To design and implement training modules for director teams of companies and public institutions interested in acquiring knowledge and methods in marine science that could benefit the implementation of strategies for economic and administrative development. - To generate a programme of the dissemination activities for regional and municipal councillors interested in incorporating marine science into regional and municipal development programmes.

Description of activities. Content modules will be developed to train National Directive and increase the value of the Chilean ocean and the need for its conservation in order to attain sustainable development. These training sessions will also consider visits to natural reserves, centers where high quality scientific research is being conducted. It is hoped that through these practices, directors will establish new contacts and acquire new experiences that will allow them to become open and inspired to acknowledge and promote the conservation of the Chilean ocean.

Some key points to consider in the development of this programme include: Must be hands-on. Must be led by scientists who have participated in integrative activities in non-academic spaces (e.g. company, general public), and who also have a high scientific level. Must include non-academia participants that can share their experiences in regards to the value of marine biodiversity and conservation (e.g. fishermen, entrepreneurs, tourism entrepreneurs, etc.).

A communication strategy will also be developed to include the participation of regional and municipal councillors in the pilot localities, so that they may consider marine science in the development of marine culture in their region and commune, and thereby contributing scientific information to decision-making processes and development strategies. The regional component will begin with four pilot programmes around each of the institutions of the Consortium, where regional networks will be formed with companies and public institutions, so as to establish the necessities for content, methodology and regional challenges involved in creating a new marine culture.

Direct and indirect institutional contributions. Participating Consortium universities and research centers will be responsible for the search of training partners and dissemination activities in regional and communal councils. They will also assess the topics and lines of work that interest the private and public sectors, which will then be included as training modules. Once a network is established with interested institutions in the marine education programme, partners will be sought to provide financing for training.

Cost of sub-program (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Sub-program total
0	53,000	33,000	35,000	33,000	23,000	177,000

3. GENERAL PUBLIC

At the pilot Consortium stage we will target two main sub-programs at the general public level

Sub-program 1: Alimentación Marina Responsable (MAR)/ Marine Responsible Eating (MRE)

The sub-program is designed to reach the general public informing on the status of the main exploited resources and fishing gears in Chile as a way to improve the conservation and sustainability of marine fisheries and ecosystems, and is similar to the "Seafood Watch Program" in USA. The average Chilean citizen is oblivious on the marine environment, affecting the empathy of the public with the natural wealth of marine resources and their conservation. The growing demand for marine resources worldwide imposes the challenge to increase awareness about threats faced by marine ecosystem, particularly those associated to the resources human consume as food source. One approach to confront this challenge is to educate citizens, providing scientific information about the status of the resources, the biology of the species, and the fishing gears used to catch our food. We propose to develop an educational program, using different mechanisms, to inform the citizens about the status of the resources, the biology of the species, and the fishing gears used to catch our food and have already experiences with this program for about one year (see Chileesmar.cl).

Main goal. The main goal is to motivate the average citizen to learn about the marine environment, to value marine ecosystems and to embrace actions to preserve them assuming responsible behaviors.

Specific goals: To identify the adequate avenues to deliver scientific information to the public. To communicate scientific information about marine ecosystems and fisheries using different friendly instruments for school children and general public. To develop a national strategy to reach the public using the instruments developed for school children and adults.

The program is planned to be organized along two main strategies. **(a) compilation and organization of scientific information, (b) delivery of the scientific information to the public.**

The working groups hired for the program will search scientific information on the biology, ecology and fisheries of marine resources exploited in Chile, the current status of those resources, and fishing gears used to catch them. The information will be organized and synthesized using pre-defined criteria in order to deliver clear and simple messages to the public (general public and school children). In addition, a search to identify the main chefs, restaurants, fishing coves, schools and other distribution centers where the educational material can be delivered. The information will be delivered to the public depends on (a) the design of the material, (b) the mechanism to deliver the material.

We plan to hire a group of professionals that will synthesis the scientific information to design the material that will reach the public. We foresee postcards and posters among the instruments to be designed. The mechanisms to deliver the material produced include: Informative centers located in fishing coves, main centers of distribution of marine species, national events. Delivery of material to restaurants (e.g., mats for drinks and for kids). Widely recognized chefs who may join the program delivering information through books, TV programs, social networks, restaurants). Posters and games for kids

directed to promote responsible attitudes to select sea food. QR codes and other applications for mobile phones.

Collaborations and partnerships. Center for Marine Conservation at ECIM (PUC). Chile California Council, The Packard Foundation and Sea Watch Program. Chilean Sub secretary of Fisheries, Chefs and restaurants

Cost of sub-program (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Sub-program total
0	48,000	55,000	40,000	23,000	14,000	180,000

Sub-program 2: Marine Education Videos

The sub-program is designed to reach the general public informing on marine advances in Chile regarding research on marine ecosystems, the state of our marine resources and needs for conservation leading to sustainability. Transfer of this knowledge will be channelled in partnership with top level and experienced professionals, seeking for joint-ventures, particularly from the financial point of view. We have already started conversations on this direction with leading and top professionals video and filming groups in Chile.

The main goal will be for the Consortium professionals to share knowledge and ideas for a comprehensive set of well designed marine education videos (at least 15) that may reach not only the geographical areas of interest around the institutions participating in the Consortium, but have a national audience.

For this purpose the experts of the Consortium will develop themes on marine education based on the Marine Education Learning-Bricks (MEL-Bricks) during the first two years of the pilot Consortium Program, and seek financial resources jointly with professionals in charge of filming.

Collaborations and partnerships. Consortium institutions, Chile California Council, The Packard Foundation, Chilean Sub secretary of Fisheries, Ministry of the Environment, Ministry of Education,

Cost of sub-program (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Sub-program total
0	55,000	45,000	25,000	25,000	10,000	160,000

GENERAL WORKING METHODOLOGY FOR OUTREACH PROGRAMS

Outreach through media, publicity, communications and information [cross sectional]

Massive outreach for consumers in locations such as supermarkets, malls and restaurants: TV, radio, web, print press. + **artistic actions** related to marine sciences such as plastic and scenic arts.

Creation of products directed to the different target publics, of motivational and educative character and related to science in action.

The generation of hands-on material that values the diversity of research themes encompassed by the marine environment

Actions of science. Teaching and practice of the scientific method (school science, citizen science). Direct transmission of knowledge regarding marine ecosystems through talks, hands-on activities, workshops and art.

**SUMMARY: GENERAL BUDGET FOR THE CONSORTIUM
OUTREACH FIRST PRIORITY PROGRAMS (2014-2017)**

Sub-programs	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	total BUDGET (US\$)
Personnel	0	120,000	120,000	120,000	120,000	120,000	600,000
Children & Students	0	53,000	79,000	91,000	95,000	44,000	362,000
Decision Makers	0	53,000	33,000	35,000	33,000	23,000	177,000
General Public	0	103,000	100,000	75,000	48,000	24,000	340,000
TOTAL	0	329,000	332,000	251,000	296,000	189,000	

1,379,000

OUTREACH SECOND PRIORITY PROGRAMS

MARINE APPRECIATION AND AWARENESS OF KNOWLEDGE- OUTREACH PILLAR

The Marine Education Consortium proposes three outreach/training programs as a second implementation priority. They are the following:

Sub-program 1. Scientific Tourism

This includes activities and material that transfer knowledge and basic marine science concepts to the special-interest food, hotel and tourism sector. It is proposed that the implementation of the sub-programme be in two pilot localities (Coquimbo and Magallanes) that are currently developing scientific tourism and have programmes in carrying out these activities, considering that for product design and activities, there are local and biogeographically factors to be considered in the transfer of content.

General objective. To associate marine science knowledge to the development of tourism activities by intervening in the various industries involved, so as to maximize the services provided in all the links of the value chain within the industry.

Specific objectives. - To assess the scientific information in the locality where each pilot programme will be carried out in order to identify and prioritize the information according to target groups. -To develop support networks and products for the food industry that will inform about marine resources consumed in restaurants located on the coast, promoting a healthy diet. -To train the hotel industry so it includes

products and supplies that will allow tourists to learn about the area's qualities, wildlife initiatives, as well as to gain knowledge into the scientific information associated to tourism milestones. -To associate scientific knowledge to the development of routes that will promote and strengthen special interest tourism, by identifying scientific knowledge in relation to species, ecosystems and/or cultural, natural and emblematic places.

Description of activities. Two areas will be chosen to launch a pilot programme in scientific tourism in the communes of La Higuera (IV Region) and Porvenir (XII Region). The programme will begin with an evaluation of the scientific information in the locality associated to marine science as well as identifying the key players involved in the tourism activity. The target public will then be identified in association to the programme that is being developed by the food and hotel industries, as well as by tourism operators for the development of activities and products that will strengthen tourism in the region. The following industries will be considered separately:

A) Food industry: this is aimed at small fishing coves and restaurants along the coast that are willing to use accessories (place mats, menus, signage) with information pertaining to ecology, fishing gear used, and the socio-cultural context associated to the marine resources extracted by fishermen and consumed by their client, which greatly vary within geographical zones along the Chilean coast. The development of products and mass activities that will motivate tourists to eat healthy is also included, and it may also provide information about seasons in which species are extracted (restrictions, capture periods, regulations), their minimum size for extraction and the ecological role of the species that make up marine resources in the ecosystems in the pilot areas. This line of work is directly linked to the economic activities

undertaken in the fishing coves, thus generating strategies to face seasonality and availability of marine resources are of extreme importance.

B) Hotel Industry: Identification of the hotel services most used by tourists, which may be in the commune where the programme is being carried out and/or in near-by cities. Attractive material will then be designed that will promote the topics of interest in each locality (hotels and other housing) to supply the learning material that will motivate tourists to learn more about the area and increase its value and responsible attitudes during their entire stay. There will also be training sessions directed at the different tourism services that promote marine science knowledge in each area.

c) Special-interest tourism: once the initial evaluation has been obtained, and the variety of services associated to the pilot areas identified, routes and signage will be developed that will motivate special-interest tourism associated with the natural and cultural heritage of the area. For this purpose, maps will be made pointing out services and milestones associated to scientific knowledge. This will hopefully generate attractive tourism routes that will captivate clients, strengthen the value chain of the economic activity, and improve the cultural and natural heritage of the coast and marine areas.

Direct and indirect institutional contributions. Institutions participating in the consortium that are involved with the proposed plan of action will contribute supplies and technical personnel for the development of the proposal, with the aim of establishing public-private partnerships that will support the proposal. As well, participating institutions commit to establishing support networks to

aid in the search of external funding for the development of the regional tourism activities.

Cost of sub-program (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Programme total
0	32,200	76,200	51,200	117,200	107,200	384,000

Sub-program 2: Coastline Watchers

A programme will be developed to encourage the visiting or resident general public to report emblematic marine species sightings (mammals, marine birds, fish and other), climate phenomenon in the coast, as well as stranded birds, mammals and marine turtles along the Chilean coast. This programme will be supported by the use of a web platform, wide-spread dissemination, and the use of social networks in order to increase the number of collaborators (watchers) in the coast, as well as to maintain a data base that is continually being updated.

General objective. To create a citizen platform that will utilize technology and social networks to allow the generation of scientific information regarding marine biodiversity in the coastline and increase awareness among the Chilean population.

Specific objectives. -To identify research questions and activities in which citizens could contribute valuable scientific information that will in turn aid in the development of research and increase awareness of marine biodiversity among citizens. -To design a functional web-based platform that is attractive, interactive and user-friendly, and that it will also allow citizens to input information about their area regarding marine biodiversity, climate phenomenon, stranded animals, and to

make this information visible in real time (graphs, maps). -To establish

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a protocol and strategy regarding the use of social networks and traditional media, and to establish links within public-private sectors in order to disseminate activities and results at a national level that will encourage citizens to participate in the programme and motivate them to take part in the activities. -To provide feedback with the publication of scientific information provided by the citizens, and the subsequent dissemination at a national level.

Description of activities. An assessment on marine species will be conducted that will allow the generation of citizen scientific information related to their ecosystem and life cycle to comprise a participatory data base that will aid in gaining knowledge on marine species, awareness and future conservation. An interactive web-based platform will then be designed that will allow the input of information, and a strategy will be established for the use of social networks to facilitate the delivery of information entered by the user. The programme will then be launched by national media and workshops will be conducted to teach the users how to input information into the system. Support networks will also be established to agree on strategic sites for the collection of information (marine reserves, national parks, etc.). Once the user has entered sufficient data on sightings or stranded marine animals, which answers questions on biology and distribution, the information will be used to generate general and scientific publications that provide feedback to the users, so that they value their contribution and are further encouraged to keep participating as coastline watchers.

Direct and indirect institutional contributions. Participating institutions will facilitate infrastructure, personnel and support networks for the design and dissemination of citizen science activities. They will then collect the information obtained from their analyses and scientific publications, as well as media diffusion of the results.

Cost of sub-program (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Sub-program total
	29,000	35,000	27,000	27,000	23,000	141,000

Sub-program 3: Improvement of Marine Conservation Skills for Officials of the Chilean Navy” Navy officials sub-program

According to the Book of the National Defense of Chile on the behaviour and organization of the National Defense, it states that the armed forces are mandated to “provide protection to the public, the land and to the goods and activities undertaken within national borders, and come together to support the country’s foreign policy.” Within this framework, it is necessary to incorporate the Chilean Navy within the work plan of the CECM, considering the diminished role that these institutions currently provide in the care, protection and conservation of marine ecosystems, and also considering the important role these national defense units should have in our country’s beaches and ocean. Navy officers are identified as key users of this programme, which can be started as a pilot programme using a methodology similar to the scientific method. As such, concrete actions can be incorporated by the Navy in the promotion of conservation and sustainability of the marine ecosystems of Chile.

General objective. To increase awareness and value the biodiversity of the marine ecosystems of our country, by increasing the abilities and skills of Navy officials, in order to incorporate into their decision making skills the protection and conservation of Chile's ocean".

Specific objectives. - To generate training modules about marine science in the Naval Academy so that officials become proficient in areas related to marine biodiversity, management of protected areas and marine education programmes. -To integrate and conduct training modules in semester programmes in the Naval Academy.-To promote dissemination activities that will incorporate Navy officials in

Description/activities .This sub-program intends to incorporate i) Training Modules on Marine and Environmental conservation aimed at student of the Naval Academy of the Chilean Navy, establishing the bases for their long term curricular implementation, ii) an Institutional Policy that strengthens the range of action and the permanent activities of the Navy, making explicit the commitment with the protection and conservation of marine ecosystems in Chile. In order to achieve these goals, the programme will be divided into 3 stages (semesters), as a pilot, for a period of 3 years, beginning in 2014. These are:

Definition of content and training programmes aimed at cadets of the Naval Academy. During the first two years of the program we will work closely with the Chilean Navy and the Naval Academy to identify the main scopes and institutional policies where the Chilean Navy is mandated to act in terms of care and protection of Chilean coasts. With this information, the content and material that could be incorporated into the Training Modules will be identified and

designed in detail, which will then be prepared according to the academic schedule of the Naval Academy.

The entire process will be conducted in conjunction with the Chilean Navy, strengthening the links between the consortium with officials in charge of the Naval Academy according to their policies and protocols. An important aspect in these first 2 years is to gather international knowledge about other military units in neighbouring countries, and plan visits to military units North America and Europe, which will be defined jointly by CECM and the Chilean Navy.

Implementation of Training Modules on Marine Conservation for students at the Naval Academic (throughout first and fourth years).

In the third year from its implementation, the programme will incorporate the Training Modules on Marine and Environmental Conservation, aimed at first-year student-cadets at the Naval Academy. These modules will be taught continuously throughout the students training process until their fourth year of study.

It is of paramount importance that the ME Program and the Naval Academy plan the management model, particularly the implementation of lectures and courses, issues pertaining to lecturers, such as civilians coming to the Naval Academy, and eventually granting degrees with the corresponding specialties for new graduates.

Design of the Marine Conservation Programme (MCP) of the Chilean Navy. Lastly, and alongside the development of the training activities at the Naval Academy, in the 3th year of the pilot programme a Marine and Environmental Conservation Programme will be

developed and it will take into account financial operational resources, institutional and human capital needed.

This educational tool will be presented to the Chilean navy for evaluation.

Direct and indirect institutional contributions .Participating universities and research centers will conduct the search for partners for training and for the dissemination activities within regional and municipal councils. They will also carry out the assessment on topics and lines of work that represent an interest for the public and private sectors, and that will allow them to gain sustainable economic development, encouraging marine culture. These topics of interest will be included in the training. Once a network of interested institutions is established within the marine education programme, partners will be sought to finance the training.

Cost of sub-program (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Program total
0	81,000	25,000	25,000	25,000	25,000	181,000

ANNEX IV

PHYSICAL INFRASTRUCTURE AND ASSOCIATED PERSONNEL FOR THE PILOT STAGE OF THE MARINE EDUCATION PROGRAM

A. FIRST PRIORITY FOR THE PILOT PROGRAM

There is a critical and key physical infrastructure unit that will be needed by the Consortium partners to develop the training of students, teachers, authorities, general public and the proposed outreach programs. This is establishment, implementation and full operation, including hiring of professional personnel, in each of the four partner institutions of **Interactive Marine Education Centers (IMECs)**

INTERACTIVE MARINE EDUCATION CENTERS (IMECs)

The implementation of the educational programs designed for the first 5 Pilot years by the Consortium, based on the "**Marine Education Training-Bricks**" (**MET-Bricks**) will require the implementation of **Interactive Marine Educational Centers (IMECs)** units at each of the geographic areas covered by the partner institutions.

These IMEC units will be designed first to receive K-12 students, teachers and public at large. The characteristics of each of these IMEC units will change depending on the existing facilities at the institution, geographic location, and the specific goals of each institution, beyond those established here as a Consortium.

The Consortium has defined that the minimum IMEC unit should be designed to receive 800 -1,000 students and about 30 K-12 teachers and 200-500 tourists or general public per month. It is expected to reach a mean total of *ca.* 10, 000 students, 360 teachers and 3, 600 general public per IMEC per year; depending on the specific location of the IMEC. It is planned that the first two IMEC facilities should be operative at the end of the second year of the Marine Education Program and the following two facilities at the end of the third year.

In all cases, the work with school students will extend well beyond simple guided visits. It will consider the delivery and evaluation of the educational material designed by the Consortium partners, which in many cases include activities before, during and after the actual visit of students to the center. We have therefore limited the number of students that can be attended by the IMEC units and have not included in the design considerations the short visits of students and tourists that surely will also take place.

In the specific description of the four IMEC units that follows, each Consortium partner has visualized a Center based on their own previous experience and that best suits their needs and commitments. But the basic infrastructure must be large enough to house the educational and outreach programs, represent well the local ecological components the researchers believe are critically characteristics of each region, and allow space to represent the features of the main marine ecosystems found in Chile (e.g. fiords, oceanic islands) and that might be well beyond the reach of the people attending that IMEC.

With these constraints and geographic variability, we have determined that the minimum unit to start the program in each center is a 300-350

m² IMEC unit per institution, provided with seawater and that allows at least three separate rooms to receive students.

The building/construction costs of IMECs in each of the institution will be variable depending on the region and existing facilities (e.g. access to seawater), but a minimum will be of *ca.* US\$ 600,000 each.

The operation of each of these IMEC units will at the very minimum require: **1)** a Coordinator, who will be responsible for the execution of the educational programs, the strategic planning of that specific IMEC unit, as well as local fund raising. This person will be in direct contact with the Consortium Board and will be responsible for adapting, implementing and evaluating new educational programs. **2)** At least two educators will be necessary to execute the programs with the students. We are considering that the IMEC units will attract university undergraduate volunteers (e.g. students of marine biologists, education) who will help the hired educators during the visits to the centers. **3)** At least two administrative/maintenance people, who must fulfill the secretarial and aquarium maintenance needs of the unit. We are considering cleaning and other maintenance as part of the operational costs.

The operational costs of each unit are estimated in about US\$ 125,000 in salaries and US\$ 100,000 in running costs, per year/per IMEC.

Estimated costs for building and running of the Interactive Marine Education Centers at the Consortium institutions

i) Planning & Building

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
0		600,000	1,200,000	600,000		2,400,000

ii) Personnel (full-time)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
0		125,000	375,000	500,000	500,000	1,500,000

iii) Running costs

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
0		100,000	300,000	400,000	400,000	1,200,000

Summary: Total Cost for 4 IMECs

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
0		825,000	1,875,000	1,500,000	900,000	5,100,000

DETAILED DESCRIPTIONS OF THE PROJECTED IMECs AT THE CONSORTIUM CENTERS, ACCORDING TO OBJECTIVES, NEEDS AND PLANS GIVEN BY EACH INSTITUTION

1. INTERACTIVE CENTER FOR MARINE EDUCATION IN MAGALLANES

Wildlife Conservation Society, Barbara Saavedra

City-Ecoregion: Channels and Fjords. The Magallanes Region concentrates a significant part of the Chilean coast, especially those belonging to the Ecoregion Channels and Fjords of Southern Chile. It has almost half of its surface in terrestrial protected areas, almost all with coastal fronts. Here is located the Multiple Use Protected Area Francisco Coloane, and the First Marine Chilean Park: Carlos III, located in the Magellan Strait. As consequence of its geological and geographical expansion these marine ecosystems of fjords and channels are unique in the world. Indeed, the region has the highest diversity of invertebrates along the coast of Chile, many of them endemic to this area or only representatives in Antarctica. Among the attractive marine biota and ecosystems, are emblematic species (e.g., whales, orcas, dolphins, penguins, albatrosses, prawns, oysters, corals) that are hand-reach to the visitors who venture to tread the coast line or dive in its cold waters, which directly support various economic activities.

The population size is small, being mainly concentrated in the city of Punta Arenas. The local economy, historically farming and resource extraction such as timber, minerals or benthic resources, is now

committed to promoting tourism. In fact, this region now receives almost half of the overseas visitors who visit the protected areas.

The salmon industry, concentrated in the northern Patagonia has not yet occupied the southernmost fjord for cultivation, but there are already plans for it and the community must be prepared to reconcile the competing demands on these unique ecosystems in the world.

Educational institutions and science. Despite its remoteness, and product of the entrepreneurial spirit of Magellan people, together with policies to promote remote areas, the region has a strong institutional and human capacity, especially on issues related to biodiversity and marine conservation. All these institutions have experience and interest in promoting environmental education in the area, which is evidenced in that each institution has developed permanent educational programs with local or national funds.

Research Centres and NGOs, the Universidad de Magallanes (UMAG), the Instituto de la Patagonia, el Centro de estudios del Hombre Austral, the Instituto Chileno Antártico (INACH), el Centro de Estudios Cuaternarios (CEQUA), la Fundación Tres Puentes, la Wildlife Conservation Society-Karukinka (WCS).

Existing Infrastructure. There are not a single marine aquarium in the zone, although there have been efforts to promote / develop infrastructure to do it. However, due to the nature of this initiative their funding efforts have not been successful or permanent over the time. Such is the case of UMAG, institution that few years ago tried to build a small aquarium, applying for funding from the Regional Council. This initiative was not approved, and it is said that its location (Bahía Laredo), relatively away from the city, would not have favored the arrival of visitors.

An interesting effort was carried out by Cristián Aldea, a CEQUA's researcher, who mounted an interactive Mobile Museum about the Seabed Biodiversity of Magallanes. This initiative was a great success and allowed the exposition to be shown in different parts of the Region, also allowed to conduct educational workshops and even diving experiences. This project was funded by Fondos de Protección Ambiental (FPA) granted by the Ministry of Environment (2011).

Regional Scientific and Technical Capacities. The Region has an important human capacity issues linked with the marine environments, with researchers associated with each of the institutions mentioned above, and with a long tradition journal (Anales del Instituto de la Patagonia). The Region has also demonstrated ability in developing and implementing environmental education programs, which are generally developed with the help of the institutions in the area, which often receive support from institutions in other parts of Chile and the world. The Region also has various companies and people who own businesses associated with the sea, from fishing, tourism diving, sailing, bird-watching tourism among others. The Region has a rich cultural environment, with several active leaders in their themes, with various cultural groups and cultural entrepreneurs, and even programs specifically designed to bring together art and science.

Fisheries and aquaculture. Fishing is the third economic activity in the Region of Magallanes, after mining and sheep farming. This activity is based primarily on benthic resource extraction as king crabs (patagonic centolla *Lithodes santolla*), sea urchins, oysters, clams (huepo or *Ensis macha*), and industrial fishing of southern hake (merluza austral *Merluccius cephalus*). Due to the size of the coast, and to the low population, fishing methods in the Region differs from northern Chile:

fishermen must travel long distances to access resources, they have no possibility of monitoring areas, and remain onboard fishing boats for extended periods of time not only to collect species, but for processing. Recently, salmon aquaculture activities have been added to the Region, which has increased its presence in the area at least two orders of magnitude, constituting a threat to marine biodiversity.

WCS-Chile, Tierra del Fuego and Karukinka. WCS is a global conservation NGO, which aims to develop science-based tools and education that allow the coexistence of biodiversity and human population. Their presence in Chile dates from the '70s, and his biggest project is now in Tierra del Fuego: Karukinka. It corresponds to the largest protected area in the Isla de Tierra del Fuego, which contains the most important forests existing at this latitude, the largest wetlands in the province and a unique rich coastline: the Seno de Almirantazgo. Karukinka is itself a conservation aim; at the same time is a great natural laboratory to test the conservation necessary for the XXI century, which combines development with welfare of the natural ecosystems. It is important to highlight Karukinka for having the best environmental education program in the Region, which is expected to serve as a basis for promoting marine education within the Consortium.

Potential partners and funding. The city of Punta Arenas is located directly on the edge of the Magellan Strait and has an important and significant private business activity, which is concentrated today in the Duty Free Zone, Dreams Casino and Hotel, both with direct and public access to the shoreline. These potential partners are interested in supporting the development of a Marine Educational Center. In addition, port activity is typical of this Region, and could provide a space for the development of a Marine Education Center at the port or

at the ferry pier. Because Magallanes is a remote Region, it has special allocation of regional funds (FONDEMA) that can be spent at discretion. Generally these funds are open to receive innovative proposals on tourism and education-related issues. In fact, in the past the Region has been specially awarded in Innovation grant issues, especially tourism. Also organizations such as CONICYT promote the attraction and insertion of human capital in regions.

Center proposal. Given the privileged status of biodiversity and marine landscapes in the Region, in addition to the institutional and human capacity as well as the distance to other cultural centers of the country, we think that Magallanes should have an Interactive Marine Education Centre

Main characteristics of the proposed Interactive Center: be close to the city, be located on the shores of the Estrecho de Magallanes; have regional Government support; have private support, be administered locally by any of the institutions of science / conservation present in the Region, or a combination of them together with the Consortium. Have an integrating role. Be a space for education and inspiration in marine issues, developing scientific areas and education activities. Be an agent of cultural change around the sea of Patagonia. Be focused on the sea of Patagonia and Antarctica, highlighting the similarities and differences with the rest of the country. Compared with other similar centers, our reference is the center of Puerto Madryn Ecocenter.

- The staff must include a **manager**, a person in charge of the education and able to run the Education Program, a **coordinator** of educational programs, a person in charge of the aquariums maintenance service, and **support staff**.

- The infrastructure should include an aquarium room, an exhibition room, a meeting room, and a practical work room (all rooms specially designed for children) and diving gears.
- The activities to be undertaken should include: aquarium-permanent exhibition, including "interactive" tanks (touch tanks), guide tours programs with content defined by the Consortium, courses to local schools in the area, short educational programs designed for children young tourists like summer-type camps, art exhibitions, diving courses, courses for marine wildlife watching (e.g. whales, albatross), professional practice and volunteer.

2. LAS CRUCES MARINE INTERACTIVE EDUCATION CENTER

Universidad Católica de Chile, Sergio Navarrete & Miriam Fernández

City-Ecoregion: Central Chile Coast. The town of Las Cruces is a locality of about 1,500-2,000 people located in the “costa central” of Chile, approximately 1.5 hours from the capital Santiago and 20 minutes from the port city of San Antonio. The town forms part of a series of small towns and fisher villages (“caletas”) that extends for about 25 km between Cartagena on the south and the towns of Algarrobo and Mirasol to the north. Despite the small size, Las Cruces has a rich history has one of the first and most opulent summer villages in Chile, which left a legacy of old, picturesque houses in different stages of conservation. Today the town is home to middle class residents and tourists, and it is characterized by the confluence of artists (writers, painters), retired people and fishers, as well as the presence of the Estación Costera de Investigaciones Marinas, PUC, with its Marine Reserve (No- take area), the oldest in Chile.

Collectively, the towns on the central coast receive about 1.5 million tourists in summer time (December-February) and winter break (July), mostly people from Santiago who own or rent summer houses and apartments. Thus, a sizable fraction of the population of Santiago, from lower, middle and upper socio-economic strata, visits the coast every year. Yet, besides the beaches and restaurants, the region offers very few outdoor or indoor activities and even fewer educational activities. The house-museum Pablo Neruda, located in Isla Negra is probably the main educational activity in the

region. There are several small parks/walks with great potential, but they are scarcely used and have scant infrastructure for visitors.

A series of scenic Caletas de Pescadores is one of the salient features of this stretch of coastline and their work represent one the main local economic activity in winter time (tourism is by far the main activity in summer). The system of Areas de Explotación y Manejo para Recursos Bentónicos (AMERB's = TURFS) was started in these villages after the work of Juan C. Castilla. Fishers exploit a large diversity of algae, invertebrates and fish, some of them for external markets, some for local consumption. Local seafood gastronomy is certainly one of the appeals of the central coast for tourists.

The shorelines of the Central Coast and of Las Cruces in particular are representative of the wave exposed, upwelling ecosystems that characterize most of the open coast of Chile. Marine flora and fauna are moderately diverse and possess a number of ecologically unique species, which are consumed by humans owing to their unusually large size (e.g. "picorocos", keyhole limpets, locos). The general ecology as well as conservation status of the species in this region is comparatively well known even from a worldwide perspective. General oceanographic features and driving climatic and ecological processes are continuously the subject of scientific studies and make of this region one of the best studied in the world.

Research and educational institutions. The province of San Antonio is one of the poorest provinces in the country, with one of the highest unemployment rates. Although the city itself is over 50,000 people in size, the only important economic activity is the port and there are no universities. Only branches of a few 'private universities' offer specialized, usually technical degrees to high

school graduates. People seeking university-level studies must therefore migrate to the city of Valparaíso (1.5 hr to the north) or Santiago. Public schools at the elementary (“*basica*”) and high school levels have persistently been among the worst evaluated in the entire country. There is only few and usually small private schools in the Province. For these reasons, there are no local educational outreach activities for children or the general public either in central coast towns or in the city of San Antonio. The outreach activities conducted by ECIM at Las Cruces over the past 12+ years have therefore been extremely well received by the local community and authorities. Because of this situation, there is always great enthusiasm by all public authorities to support outreach activities and the creation of an Interactive Center will count with their support. Potential partners for such an initiative can also be found in the local private (e.g. Sicti) and public industry (e.g. Codelco) associated to the port of San Antonio.

Existing physical infrastructure and human resources at ECIM . A number of outreach programs have been conducted at ECIM over the past 12 years with the support of short-term grants and volunteers from academia (professors, graduate students, research assistants). Since 2012, the Center for Marine Conservation (CCM) directed by Prof. Miriam Fernández, started the most ambitious outreach program conducted thus far at ECIM. To house the program and be able to receive courses from the Province of San Antonio and Santiago, the CCM together with ECIM built a small, 40m² aquarium room, ‘Chile-Mar’, designed to receive kids and work with them in touch tanks and educational games. Thus, ECIM has had significant experience working with kids and there is a

small group of young scientists that have specialized in this type of informal educational programs.

As indicated above, research on coastal ecosystems conducted at ECIM-PUC by professors and students have made of this small lab one of scientifically most productive and well respected research centers in marine ecology and conservation in Latin America. Therefore, the local scientific basis and human capacity for outreach programs can be well supported by ECIM and the Consortium partners. Due to space limitations and funding, the location of the Chile-Mar aquarium room within the research facilities of ECIM is not ideal (at the end of all research labs) and any expansion is physically constrained. The projected Interactive Marine Educational Centre (IMEC) proposed here will have to be relocated to a more accessible space within the University owned land at Las Cruces.

Proposed center. Based on our experience, the Las Cruces IMEC should have four different rooms. 1) It should have an **Auditorium for 40-50 people** where students can receive instruction for the activities they will conduct during the visit and information about the marine reserve. The auditorium would also be used to exhibit documentaries, short movies, and would be used as the main place for exhibits to the community at large. 2) **An Interactive Room** designed to learn about the ocean, including hands-on experiments on wind-driven currents, upwelling, internal waves, wave forces, measurements of pH and the effect of CO₂. The room will also have demonstrative panels and interactive boards where monitors can guide students in games and puzzles. The room should be big enough to house 30-40 students. 3) **An Aquarium Room** will have the five major marine ecosystems of Chile represented in live

aquaria in the walls. The theme of the room will be biodiversity and conservation. Each wall will have information about these ecosystems, including the main biological and ecological features, as well as the most typical species. There will be games in each of these walls to involve students in learning key features of each ecosystem, with emphasis in conservation. At the center of the room there will be a large touch tank subdivided in sections to hold rocky shore invertebrates and fish, as well as sandy bottom animals. 4) **A Marine Conservation Room** will be dedicated entirely to conservation and the sustainable use of the marine environment. It is important that all visitors come out with the feeling that this is one of the important things they learned in their visit. The main theme will be industrial and artisanal fisheries, management strategies, the impacts of aquaculture, pollution, and why these issues must concern them and exactly how they can help. They should go home with the message that marine conservation is not something other people' (e.g. scientists, managers) do, but that it is part of what they must do through their actions and decisions.

Potential partners. The schools of Education and Engineering at Pontificia Universidad Católica are obvious partners in the development/implementation of the educational programs. Financial partners will be sought from the private and government sectors. As indicated above, the main private and state-own companies involved in the Port of San Antonio have expressed interest in supporting long-term educational programs based at ECIM. Local Government through the Fondo de Desarrollo Regional is an obvious source of funding that must be explore by our Institution and the Consortium.

3. THE HOUSE OF THE SEA, NORTE DE CHILE

Centro de Estudios Avanzados, Bernardo Broitman & Claudio Vásquez

(CEAZA)

City-Ecoregion: Northern Chile. In the very arid northern Chile, including the regions known as “Norte Chico” and “Norte Grande”, cities are generally located in the coastal border inside bays on an otherwise extremely exposed and desolated coastline, particularly in the “Norte Grande, north of Caldera. The steep coastal range that abruptly raises up to more than 800 m above sea level, leaves scant surface for human settlements on the shoreline, and creates one of the driest deserts in the world in the interior valleys. The majority of these cities and towns, where urban areas coexist with coastal fisher settlements (caletas), are active hubs today or a living testimony of mining and fishing activities of the past. Coastal ecology is strongly defined by the semi-permanent upwelling of cold water nearshore, which fuels productive coastal fisheries that in the past also supported massive guano bird colonies, intensively mined during colonial times. Similarly, coastal benthic fisheries are extremely productive and since pre-hispanic times, the locations of all human settlements, either existing or abandoned, have been directly associated with the harvesting and local consumption of a large diversity of coastal species. In this way, ubiquitous coastal shell middens chronicle this long and rich history of seafood consumption, a staple of this sparsely populated region.

The sister cities of Coquimbo and La Serena, separated by less than 12 km, are among the fastest growing cities in Chile, accommodating together nearly half a million people. They and are expected to

become the third largest urban area in the country over the next 30 years. The general infrastructure in these cities, particularly the human and physical infrastructure devoted to tourism, has improved rapidly over the past decade. Mining agriculture, together with tourism and fishing are the main economic activities. The region receives over a million tourists yearly, mostly from Santiago metropolitan area (Chileans) and from Argentina. This number is expected to increase to over 1.5 million by the 2013-2014 season.

Small fishing villages, “caletas”, located in and near these coastal cities provide most of the fresh seafood for the local and tourist population. Due to the dry climate that dominates northern Chile, the physical infrastructure and architecture of these villages is quite different to the caletas in central and southern Chile. The “algueros”, seaweed collectors that live in improvised huts along the most isolated shores, are a socially and culturally distinctive characteristic of fishers in northern Chile. Besides local seafood markets, several caletas directly supply restaurants, which are sometimes administered by fisher families. Thus, as occurs in other parts of the country, seafood gastronomy is a very important tourist attraction to this region and imposes a high pressure on nearshore ecosystems.

Existing physical infrastructure and human resources. The northern region of Chile, includes the port cities of Coquimbo, Huasco, Caldera, Chañaral, Tal-tal, Tocopilla, Antofagasta, Iquique and Arica. At least three of these locations (Coquimbo, Antofagasta and Iquique) harbor comparatively large Universities (Universidad Católica del Norte, Universidad de Antofagasta and Universidad Arturo Prat de Iquique), which have research facilities located on the shore. These universities have offered for several decades undergraduate majors related to Marine Sciences.

The research program in marine ecology at Universidad Católica del Norte and its associated regional research center, CEAZA: Centro de Estudios Avanzados de Zonas Áridas, is by far the most prestigious and consolidated research group north of Santiago. Their scientists support a Master and a more recently a PhD program in Marine Ecology, which have strong emphasis on coastal processes, ecology and conservation.

Proposed center. We envision a cross-cultural center, the **House of the Sea**, which can be adaptively deployed across northern Chile following local heritage and stakeholders. The facility will be placed where science, education and (gastronomic) tourism can meet with traditional fisher communities. In this manner, the fishers' lifestyle and actions, and their role as the main intermediaries between the biota of coastal ecosystems and the general population, will be the central theme of the House of the Sea. The House of the Sea will have an urban infrastructure in Coquimbo, which will take advantage of an existing interactive aquarium inside the campus of UCN. Improving this facility, by expanding and/or remodeling its installations, will allow us to execute the near term components of the educational programs of the Consortium, and at the same time introduce to these students, as well as general public (tourists) to the new infrastructure, the house of the sea, which will be located in a rural area not too far from the city, like for instance caleta Totoralillo Norte. The House of the Sea will be a thematic aquarium located about an hour driving from the center of the city and dedicated to marine education for children and the general public. The architecture of the center will integrate the traditional fisher caleta of northern Chile with the visitor center itself, which will contain the aquaria and interactive rooms. Both, the infrastructure used by fishers for the extractive activity (boats, areas for net

preparation and repair, fishing gears, etc.), as well as the fisher's "artisanal" restaurants, will be incorporated in the architectonic design, creating a continuum with the visitor center. Live animals for exhibits and interactive classes will be obtained by local fishers, who will be trained by marine scientists in the holding and maintenance of live specimens in running seawater facilities. The visitor center will contain exhibits (aquaria) for the general public and sections for the interactive education (e.g. touch tanks), where the long-term components of the Consortium educational programs will be developed. Emphasis of the exhibits will be placed in local coastal ecosystems (such as subtidal kelp forests) from where fishers traditionally collect resources. But the exhibits will also include a brief demonstration of the other main coastal marine ecosystems of Chile, including the fiords and oceanic Islands.

Several of the tanks for exhibits (aquaria) will double as holding tanks where locally caught animals will be stored for purchasing at the local restaurant(s), or sold as live premium-quality products. The possibility of holding local animals and plants for prolonged periods of time will aid in the restocking of local fisheries, through massive spawning at the facilities. Restaurants at "house of the sea" will preserve the "artisanal" structure of the typical small restaurants observed at fisher caletas. The educational programs will take advantage of this traditional and picturesque fisher-tourist activity, and will learn about the ecological impact of the activity and the urgency to implement sustainable practices together with the fisher community.

We envision a large public impact of the house of the sea by creating the possibility for the general public and local fishermen to interact and reflect around the common goal of sustainable fisheries and learn about the kind of fishing and consumption (feeding) practices that can

help achieve this goal. An interesting opportunity will be provided by evidences of human occupation, such as abandoned industrial or mining settlements or shell middens, which can be incorporated or assimilated into the center facilities through short interpretative trails.

Potential partners. Universidad Católica del Norte, which is already part of CEAZA. Universidad de Antofagasta at Antofagasta. Universidad Arturo Prat at Iquique. Regional Government. Several mining companies who have large investments in the region.

4. TALCAHUANO INTERACTIVE MARINE PARK

Universidad de Concepción, Ariel Valenzuela

City-Ecoregion: Talcahuano-Concepción in the Bay of Concepción. The Talcahuano-Interactive Marine Park (Talcahuano-IMP) is already well advanced and planned for the Biobío Region, the second most populous region of Chile, with 1.9 million inhabitants from whom 1.5 million live in urban areas. The Region has an area of 37.046 km² and represents the 4.2 % of the Chilean territory and provides the country with a significant productive agriculture and stockbreeding economy as well as an important number of industrial activities like metallurgy, refinery, cellulose, iron and steel industry, forestry and fishing. Fisheries activities in the Region represent 56% of total fisheries in the country. Along the coastline small-scale aquaculture is present and there are 75 artisan fishing coves, representing 23% of the national artisanal fishers. The conurbation Concepción Talcahuano is the second most important conglomerate of Chile, here a strong industrial fishing activity was concentrated which led the “El Morro Area” to turn into one of the 5 most polluted places on earth during the 90s. Nevertheless, the Municipality of Talcahuano began to implement strategies to diminish the pollution in Talcahuano. Important progresses have been done. The past typical reddish color of coastal waters is gone; colonization of coastal waters by swans and fishes is a reality. The earthquake and tsunami of the 27 February, 2010 destroyed the entire coastal area. However, thanks to the Talcahuano Municipality effort and the support of the UdeC, biological, architectonic and material restorations have occurred. Nowadays, the El Morro Area is a leading example of the reconstruction plan for Talcahuano and an Urban Park of approximately 13 hectares is planned. The

Talcahuano-IMP is part of such a plan and it will be placed in the centre of this Urban Park, in the middle of the city and surrounded by two fishing coves. This will be an example of the 2010 post-tsunami recovery efforts and of marine conservation and restoration in southern Chile.

Research and educational institutions. In the Biobío region can be found the second largest student population of the country, with 425.000 student's registrations in primary and secondary education. In this region are located four traditional universities: the Universidad Católica de la Santísima Concepción, Universidad del Biobío, Universidad Federico Santa Marina and the Universidad de Concepción. Additionally there are 7 private universities and several technical centers. The Universidad de Concepción, in particular, keeps a marine education program through activities such as: ocean literacy (-seven principles of ocean literacy adjusted to the Chilean curricula-) that have been supporting activities such as the water monitoring program, the carbon footprint in bays /fjords, school in the sea, Argo education, and the marine sciences summer camps. The COPAS research program in oceanography has supported these activities and other related ones such as: internship workshops for school teachers and for undergraduate students. Moreover it exist an important working network associated with AquaSendas Center, COSEE y NMEA U.S.A, world ocean network, Int'l Pacific Marine Educators Network, Marine centers, NZ.

Proposed Talcahuano-IMP. The Talcahuano-IMP will provide access of Marine Sciences to local and regional communities, this via an interactive relationship with the public. Interactive activities will include exhibitions, marine samples and instruments, staging, conferences and seminars, as well as the development of activities that

are in accordance with the national curriculum of K-12 education, supported by the Marine Education Training-Bricks developed by the Consortium. The Talcahuano-IMP will be a place where the public is not only an observer but also an actor. Social inclusion will be part of our central policies for the Talcahuano-IMP. Many of the activities to be developed will be temporary exhibitions, workshops, conferences, marine animal's observation, scientific school camps and teacher trainings. The Talcahuano-IMP is planned as a unit that will promote a maritime culture in the community, prioritizing the protection and preservation of the marine fauna and its biodiversity, by supporting the private and public sector in the promotion of education and research in marine sciences. Our main objectives are: a) to teach the community about the preservation of the biodiversity and the care of the marine environment, b) to help as an innovative pedagogic resource and curricular complement for schools, c) to become a tourist attraction and a place for family recreation, d) to be a center of development for teaching and extension activities of the Universidad de Concepción and the Consortium. The Talcahuano-IMP will have an auditorium for 150 people, pedagogical laboratories, interactive classroom, aquarium classrooms, historical classroom and a marine fauna rescue centre.

Potential partners. The Talcahuano-IMP has already the official support of the Talcahuano Municipality and the Universidad de Concepción, the Regional Government and private companies associated with the use of the coastline such as: the fishing industry, iron and steel industry, metallurgical, forestry and cellulose industry.

B. INFRAESTRUCTURE SECOND PRIORITY FOR THE PILOT PROGRAM

There is a second important, although no critical, physical infrastructure unit that it would help achieving main Consortium goals. This is the implementation and full operation, including hiring of professional personnel, of a Consortium common marine itinerant education unit, the **Chilean Itinerant Sea-Bus**.

CHILEAN ITINERANT SEA-BUS (Sea-Bus)

To be successful and be able to cover at least a significant fraction of the diverse and geographically isolated Chilean population, the Consortium should also have an itinerant educational platform.

This need will be filled by the **Chilean Itinerant Sea-Bus**, which will carry the necessary infrastructure to take the sea and our educational programs to kids in communities preferentially far from the ocean, but also to those in the coast.

The Chilean Sea-Bus will be a fully equipped unit designed to hold live animals and to allow educators to execute some of the Consortium programs. The specific programs to be implemented will depend on the locality visited.

The estimated cost of full equipped Sea-Bus unit is of approximately US\$100,000, and its operation per year is estimated in US\$100,000, including salaries of operators and maintenance.

A PUBLIC MARINE AQUARIA FOR CHILE

The Directorate, Governance bodies, institutions and scientists of the Consortium will do their absolutely outmost to build the case, lobby and convince the Chilean government, public and private authorities to face the Chilean State challenger to present Chilean children and general public with a top world Marine Aquarium in year 2020. Our Marine Education Program, hereby delineated, and the existence at least of a Marine Aquarium, will greatly advance and contribute : "*To promote a cultural change on coastal and marine care in Chile, through long-term, science-based, globally linked educational programs, with public and private partners, and oriented toward society as a whole*".

ANNEX V

A FOUNDATION

CONSORTIUM MARINE EDUCATION PROGRAM LEARNING-BRICKS

The Marine Education Consortium has envisioned a learning strategy to transfer marine scientific knowledge to society: teachers, students, public. A group of scientists of the Consortium (marine biologist, oceanographer, fishery and conservation experts) will select and package 30-40 scientific key science-based topics on the Southern Pacific Ocean, particularly referred to Chile: Chilean oceanic islands, interior seas, Humboldt Current system, sub-Antarctic systems, coastal small-scale and industrial fisheries, marine biota, deep sea, conservation, uniqueness of Chilean marine realms, and develop/synthesized science based educational modules, of about 10 pages each, illustrated with no more than 5 figures or tables. In the Consortium we call the **“Marine Education Learning-Bricks” (MEL-Bricks)**. They will be the base for the transference of science based marine knowledge at different levels and audiences, via traditional (books, leaflets, guides) as well as modern methods (Internet, social networks)

Each MEL-Brick will have a central and attractive message/title inviting to be inquisitive and learn about science based marine unique characteristics of Chile. The first module, one of our maxima, is **“Chile es Mar” (“Chile is Sea”)** and will address the fact that Chile is about 80% sea! Here, we will combine geography, natural history, national

and international legislation and aim to change a basic aspect of the culture of our people: basically that Chilean territory is composed of terrestrial and marine realms. The traditional concept taught at Chilean schools is that the surface of Chile is 754.000 Km². *This has to be changed*. In fact, that is the surface of the Chilean terrestrial territory, while Chilean marine territory is over 3.5000.000 Km² ("Chile is Sea"). This appears as a simple national cultural concept; nevertheless, the concept that Chile indeed has an enormous and yet unexplored marine territory it does not form part of our culture. As a consequence of above, the idea that Chile is a "long and narrow country" needs to be changed to the fact that *"Chile is a long, wide and deep country"*. Further, the concept that Chile is a 4, 200 km long country, has to be changed. Indeed, the coastal extension of Chile is over 84, 000 km! We sustain that these MEL-Bricks will help to start building a new marine cultural vision of Chile

The aim of below science based MEL-Bricks (-as well as other topics, such of those based on literature, poetry, sport etc -) will be to transference accumulated scientific, literary and art knowledge/achievements in Chile and to educate to produce a cultural marine change in the population, particularly in pre-school, school children and the public, a greater sense for the need to understand, respect and conserve our ocean, to promote sustainability, and else to insufflate in Chileans a greater sense of maritime proud.

Responsibility. The Director of the Consortium will be responsible to lead, organize and in the lapse of two years to complete this foundational task. Experts from institutions of the Consortium, and from outside, will participate in the work. The Director will work with the associated Program Team to select the experts and provide

guidance so to produced at least 20 MEL-Bricks per year and to complete 40 at the end of the second year. During years 3, 4 and 5 new MEL-Bricks will be added and adaptations will be made. Most possible this work will end, among other things, in the production of a Marine Education Book for Chile (year 3) and in different printing as well as audiovisual materials (e, Videos etc)

Costs. Costs will be kept at a minimum, since we understand that this is one of the major contribution of experts inside the Consortium for its success.

Costs.

Cost of producing the MEL-Bricks (US\$)

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	sub-program total
0	75,000	45,000	10.000	5,000		135,000

30 EXAMPLES OF MARINE SCIENCE RELATED MEL-BRICKS

1. Chile is long, wide and deep: "*Chile es Mar*"

In Chile, at school, we are still taught our children that Chile is long and narrow. This is a deep cultural mistake, since the statement does not take into account the sea as a national territory. The terrestrial-territory of Chile is 756,096 km², while the sea-territory, that covers the territorial sea and the Exclusive Economic Zone, amounts to 3,681,989 km². Therefore, Chile is long, wide and deep: "*Chile es Mar*". We will

develop this MEL-Brick around those concepts, including elements of geography, oceanography, national and international legislation, history, biology and bio-geography, fisheries and social sciences.

2. Four major marine ecosystem jewels of Chile: Oceanic Islands, Humboldt, Patagonia and the Antarctic

Chile presents at least four major marine-oceanic ecosystems: Oceanic Islands, the Humboldt system; Patagonia-Magellan; Sub-Antarctic and Antarctic. There are also subdivisions in at least 8-10 smaller marine bio-geographic sub-systems. We will develop this MEL-Brick around those concepts, characterizing the major ecosystems and sub-systems based on elements of geography, geology, oceanography, biology, bio-geography, conservation and fisheries.

3. The incredible trip of Robinson Crusoe along Rapa Nui, Motumotiro Hiva, Desventuradas and Home

Chilean oceanic islands are little known by the population and scarcely mention in the Chilean educational programs. This MEL-Brick will describe them in depth based on terrestrial and submarine geology, bio-geographic characteristics, habitability, native and local communities, culture, importance for Chile regarding de EEZ, fisheries, potentials etc. We will develop this training educational brick through an imaginary trip of R. Crusoe, around above territories and oceanic realms and those elements characterizing the major oceanic island systems based on elements of geography, oceanography, biology, bio-geography, conservation and fisheries. The aim will be to educate, to produce a cultural change in the population and a greater

sense of proud, care and respect for our ocean native communities of Rapanui and marine systems.

4. We are not blind to the marine intertidal ecosystems!

One of the major drivers of the Marine Education Consortium is to communicate to society something extremely simple: **"We are blind to the sea, we are terrestrial animals and therefore, estrange to aquatic environments; normally we just see the surface of the ocean no more Therefore, to love, care, respect and conserve something you do not see is extremely complex and challenging"**. Intertidal) marine systems (sand, rock, other) are an exception to that. In fact during low tides we do have access to these systems and to a rich, abundant and wonderful marine fauna and flora. Patterns, processes and mechanisms can be explored, discovered and experimented on. Most of experimental advances in marine ecology have been done in these systems. They are speciously rich and accessible ecosystems to teach learn and enjoy marine life. Several members of the Consortium are world experts in these ecosystems and have published Marine Intertidal Field Guides. We will develop this MEL-Brick around above topics, characterizing ecosystems based on , biology and ecology (fauna, flora, competition, predation), conservation, human impacts and littoral food gathering (extremely important in Chile!), artisanal fisheries, connectivity among systems, larval production, coastal oceanography, etc.

5. Hunters of the sea, the long and epic traditions and skills of small-scale artisan Chilean fishers

The Chilean small-scale fishers of Chile are unique. Littoral food-gathering is extremely common in Chile and humans play key ecological role in littoral marine systems. As an example, registered professional divers amount to more than 12,000 (unknown number of skin-divers and unregistered divers!) and there are more than 70,000 small-scale fishers and over 7,000 small wooden or fiber-glass artisan boats (less than 10 m long). Shellfishes, algae, rock -fishes and other edible fishes form part of more than the 80 species extracted by artisan fishers in Chile. There are long standing traditions in these communities and the activity goes back to pre-Hispanic times. Several members of the Consortium are world experts in small-scale artisanal fisheries in Chile. We will develop this MEL-Brick around above topics, characterizing these hunters of the sea and their long and epic traditions and skills. We will tackle fisheries, economics and socio-ecological aspects.

6. The deserts of Atacama and Humboldt

Chile has two unique and wonderful deserts. One is the Atacama Desert which is considered the driest in the world; the other is little known by people and is the Humboldt Desert; is located deep in the Ocean in front of Atacama region. The Humboldt Desert is an aquatic desert, plenty of water, but without dissolved oxygen. It lays 150-300 m from the surface of the ocean and is in itself an ecosystem, without (anoxic) or with very little oxygen (hypoxic). In the past 20 years Chilean scientists have been working on both deserts and accumulated a fair amount of information. They want to shear this information with society. We will develop this MEL-Brick around above topics, characterizing the so called "deserts of Atacama and Humboldt". We will tackle oceanography, fisheries, and ecosystems functioning.

7. Sliding from the 7000 m at the top of the Aconcagua to 6000 m deep in the Atacama Trench

There is more than 13,000 m of difference between the tip of the Aconcagua Mountain in central Chile and the deepest zones of the so called Atacama Trench. The trench is little explored and still keeps a lot of wonderful secrets (functioning, fauna). Actually, most probably we know more about the moon surface than from the Atacama Trench. We need to explore more these bathyal systems, as well as Chilean deep canyons (as for example the Rio Maipo located in front of San Antonio and next to Las Cruces and ECIM). We will develop this MEL-Brick around the Atacama Desert and The Atacama Trench, characterizing them and given geological as well as biological perspectives. In the trench we will tackle, oceanography, fisheries and ecosystems functioning.

8. Clean and renewable energy from the ocean

In the future, the ocean will provide us with clean and renewable energy. The waves and particularly the tides can play a key role in it. There are scientists in Chile working on that direction and for instance the Chacao Channel, showing several meters of differential tides, is one of the models explored. We will develop this MEL-Brick around the clean and renewable energies from the ocean, characterizing wave and tide energy potentials in Chile.

9. The challenges of Mariculture in Chile

Chile is considered one of the ten top Aquaculture/Mariculture countries in the world. Nevertheless, the country faces still enormous challenges in the area; for one thing, most of the production in Chilean Mariculture comes from Salmo-Aquaculture, species that are cultivated in unique pristine Patagonian fiords and channels. This aquaculture of exotic, imported species (as salmons) faces serious marine pollution problems. The Mariculture of indigenous species in Chile is still one of the major challenges in the country. Further, we have to stop the use of fish-meal (from anchovy and related species) to feed salmons and move into a more diversify and sustainable aquaculture. We will develop this MEL-Brick around mariculture in the world and in Chile, pointing out advantages and challenges.

10. The South Pacific: engine of global climatic and oceanographic changes

In the south-eastern Pacific (Peru and Chile), and across the Pacific Basin, is located one of the most important and critical "climatic and oceanographic engines" in the world. Water masses circulation, El Niño and La Niña, global weather and climatic-oceanographic drivers (i.e. Walker Cell) depend on the functioning of this engine. We do not know exactly how this engine will react to climatic changes under way today. There is a lot of science on it, but still in its infancy. We like to present the main Southeastern Pacific scenarios and possible consequences (climate, oceanography, economic, fisheries) of future tipping points. We will develop this MEL-Brick around the south Pacific engine of global climatic and oceanographic changes, with particular attention to Chile.

11. "El Niño" and "La Niña" playground in the Pacific Basin

The "El Niño" and "La Niña" oceanographic and climate events are critical to understand both for present and future global scenarios. They are constantly changing and "playing" in the Pacific and affect primarily to southeastern countries such as Ecuador, Peru and Chile. We will develop this MEL-Brick around basic knowledge on the "El Niño" and "La Niña" events, causes, consequences, results in weather conditions, fisheries and natural disasters in the sea and in land (rain, droughts).

12. Wonder, diversity and enigmas of Chilean shellfishes

Chile is a privileged shellfish country!, We eat more than 80 different species of shellfishes, ranging from sea-squirt, giant barnacles and sea urchin to mollusks and crustaceans. The biodiversity is extremely elevated and there is in Chile a culinary culture for shellfish consumption. Some species are quite unique, like the loco that is exclusively found in Chile and southern Peru and nowhere else in the world. There are antique phylogenetic enigmas for what is that so, and we will display them in the MEL module. Thousands of divers and small-scale fishers depend on these traditional resources and exportation of some of them is economically important. We will develop this MEL-Brick around Chilean shellfishes biological and ecological, as well as fishery, characteristics and uniqueness.

13 Chile in constant movement earthquake and tsunami events

Chile is in a constant geological movement, since it lies on top of two major tectonic plates: Nazca and South America, and the portion of the Pacific Ocean facing Chile is in constant expansion. Nazca subside

under the South American Plate and frequently this is the origin of earthquakes. If one plate slides over the other and the water column above them is elevated, then a tsunami will occur. Chile is part of the so called “Pacific fire belt” and earthquakes and tsunami are and will be part of our life. We have to get use to them and develop an earthquake and tsunami culture.

14. The beauty and ignorance about the underwater sea-mounts of Chile

Chile lays on top of two major Tectonic Plates: The South American Plate and Nazca Plate, the later subside in the former. In northern Chile these plates meet down to 6000 m of depth, at the so called Atacama Deep Trench. West of the trench, at about 700 km, volcanoes at the Nazca plate gave origin to Desventuradas Island and 3000 Km further to the west to Rapa Nui and Salas y Gomez. The Juan Fernandez Archipelago is also part of the geology of this oceanic zone, but so also hundred of underwater sea-mounts, many of them almost unknown. Most probable we know more about the moon surface than about the underwater Chilean sea-mount realm. Chile has a challenge: to investigate more about the enigmatic deep ocean systems. Now, that the country has, for the first time, a world class oceanographic ship, The “Cabo de Hornos”, this challenge can be faced.

15. The wonder of the underwater marine forests of Chile

In Chile, the existence of marine underwater algae forests is little known. Nevertheless, for artisan fishers underwater kelp forests are key resources as well as critical habitats for fish and invertebrates they depend on. Abundant algae forests occur along the whole country,

from the shore down to about 30 meters. Some of them are visible in the surface of the ocean, as for instance those of *Macrocystis* huiros that have floating elements. Less known are the very abundant and commercially important underwater forests of *Lesonia* kelps, extracted by the hundred of thousand of tons by divers and used for pharmaceutical products. These forests provide habitat for the rich Chilean rock fish fauna and for commercially important invertebrates

16. Industrial fisheries in Chile: uniqueness, sustainability, management mistakes and challenges

Chilean industrial fisheries are abundant and rich. An important section of the Chilean coast is characterized by the constant upwelling of cold and fertilized (nitrate, phosphate) waters, that allow the existence of abundant phytoplankton and zooplankton and the development of short trophic marine chains involving some of the most productive fisheries of the world, such as anchovy, sardine and jack mackerel. Chilean and Peruvian coastal waters are extremely productive and unique. At one point, Chile and Peru accounted for about 18-20% of total fish landing in the world!. In spite of that, these fisheries have not been managed adequately and some of them are close to collapsing points. We have to learn about mismanagement mistakes and face future challenges to sustain and conserve them.

17. Beaches as recreation wonders for Chileans: enjoy, care and marine education

Sandy and rocky beaches are not only rich and key marine-terrestrial habitats, but wonders of recreation for Chilean and foreign tourists. We enjoy these systems from the extreme north of the country to sub-

antarctic rocky areas, but at the same time we need to develop more environmental friendly, ecological and respectful approaches. We need to teach our children (and adults at large!) not to unnecessarily remove organisms from the rocky shores and intertidal pools (starfishes, snails, crabs). On the other hand there is need to teach tourist about the beauties of intertidal rocky shore flora and fauna, functions and connections with subtidal systems. Indeed, a number of invertebrate species that arrive and settle in rocky shores (locos, sea-urchins) eventually move, later on in life, sub tidally and are resources extracted by artisanal fishers. In the Consortium we have published two Field Guides to teach students and public about the wonders of rocky and sandy beaches in Chile. We have to enjoy and care them

18. The microscopic life in the ocean

Our eyes are adapted to see less than 1% of oceanic life. We do not see 99% of life in the ocean. To access microscopic oceanic life we need to use optic or electronic instruments (microscopes). Among microscopic life in ocean the photosynthetic phytoplankton is extremely important, since they account for about 50% of photosynthesis in the planet; terrestrial vegetation accounts for the other 50%. Phytoplankton is eaten, among other, by zooplankton, also small living organisms that in turns are consumed by larger organisms such as fishes. Hence, phytoplankton and zooplankton are at the base of trophic chain. Also, marine bacteria form part of the rich and abundant microscopic life in the ocean.

19. Marine conservation: a Chilean common responsibility

Conservation is an elusive concept and understood in many different ways by people. Since natural systems (ecosystems) are always evolving, changing and adapting conservation needs to be understood dynamically. Moreover, human beings are part of ecosystems and certainly responsible for conservation and maintenance of services they provide us. Marine conservation is a common responsibility. We use services provided by marine ecosystems, such as fish, invertebrates, algae or recreation and it is our responsibility to use them rationally and in a sustainable way. The establishment of marine protected areas (parks, reserves) is one way to contribute to marine conservation; other is maintaining unpolluted marine systems. Above all, we need to develop a proper ethic for the marine environments; for instance, to fully respect the legislation regarding marine species bans and minimum sizes.

20. How did Chile solve the tragedy of the commons in the ocean?

In the marine realms private property does not exist. This means that resources and marine habitats belong to all of us or the Commons. When a resource belongs to the commons and nobody takes care of it, a tragedy occurs: usually misuse or over-exploitation. In the 60, 70 and 80's Chilean marine benthic coastal resources were extracted under an open access fishery systems and therefore over-exploited. In 1991 Chile solved this tragedy via the introduction in the legislation of a co-management system called Management and Exploitation Areas for Benthic Resources (MEABRs), allocating small portions of coastal areas to local small-scale fishery communities, exclusive extraction rights and making the communities co-responsible for the rational use of benthic resources. This system, for its extension, number of fishers involved and success, is unique in the world. Chile should be proud of

the scientists that developed the basic concept, for the legislation and implementation of the MEABRs and we have to communicate to society these achievements.

21. A self- fertilized ocean: Chilean cold and world's most rich and productive ocean

The coastal shores of Chile, particularly north of Concepcion, are bathed by cold waters that emerge from the depths of the ocean and are laden with nutrients. Dissolved minerals fertilize a myriad of minuscule algae, which multiply by the millions and feed some of the most productive fisheries in world. This MEL-Brick will be built on the wealth of information scientists have accumulated on how the coastal waters are enriched by the ocean flow patterns along the Chilean coast, responsible for injecting deep, nutrient-rich waters to coastal ecosystems. In this way, this educational module will help to build an appreciation for the subtle but fundamental connections between ocean currents, coastal flow and the richness of marine life along our coasts'.

22. Waters of an ocean in constant movement

The ocean is in a permanent state of motion. Water movement in the ocean is driven by both large and small processes, such as the rotation of the earth and the sea breeze that cools the coast during summer nights. In this way, ocean currents have been going around the planet and waves breaking upon the shore since the beginning of times. The perpetual movement of the ocean's waters is crucial to sustain life on the ocean and on the earth. Ocean circulation cools the planet by absorbing heat from the sun and sinking it into the cold and dark

abyssal ocean. In the same fashion, the growth of marine microalgae draws greenhouse gases from the atmosphere, which is buried in deep sediments after they die and sink to the abyss. This educational module will illustrate through simple, colorful and interactive physical experiments how different earth processes move the ocean waters and generate different phenomena, such as earthquakes-generated tsunamies or wind-driven upwelling of water that lie deep beneath the sea surface.

23. Terrestrial vegetation maintained by the cool and moist ocean breeze.

A salient feature of the Mediterranean and arid coast of Chile is the presence of fog, which is never welcomed by visitors, but plays a fundamental role for coastal plants and animals. The cold waters of the Pacific Ocean together with air from the south provide the lower atmosphere with plentiful moisture, the Camanchaca, that condenses and falls on the slopes of the steep coastal mountains. The thick blanket of moisture that covers these slopes during the night and mornings supplies the vegetation and the animals living within with a reliable source of water, particularly during the dry summer months. In the case of the coastal Atacama Desert many of the plant species are only found in these environments and comprise a large part, up to 20%, of all the native species of Chile. This educational and outreach brick will draw on research that has explored how coastal fog forms, how it depends on the circulation of the coastal ocean and how coastal ecological communities, including humans in the past, depend on this subtle, yet important source of water.

24. Antarctic the continent of nobody and all

Beyond Cape Horn, just south of the city of Punta Arenas, one of the most austral cities of the world, South America ends and the Southern Ocean spins eastward around the globe, unimpeded by any continents. Beyond the sea, lies the last continent to be discovered by humans: Antarctica, a land owned by no nation and open to anybody. Regardless of its extreme isolation and harsh weather conditions, the driest and coldest place on earth, Antarctica has become a symbol of how fragile is our planet and our oceans. The Antarctic peninsula, just 1200 km south, is been heavily impacted by global climate change and its ice shelves and coastal glaciers are collapsing rapidly, modifying the habitat of a myriad of species, from the tiny krill to penguins and whales. This educational and outreach brick will show our current knowledge of the Southern Ocean, how climate is impacting the species that inhabit these remote coasts and the enormous responsibility and opportunity for Chile to become one of the main stewards of the continent.

25. Sex in the sea: reproduction in the sea world

Marine animals invented the reproduction, and found different ways to produce their young's. However, how it is done varies tremendously among different life forms. When reproduction is asexual, it involves various means of splitting with little or non genetic novelty. However, in most organisms sexual reproduction is observed, involving recombination of genetic material to form genetically new offsprings. Complex courting and mating behaviors can be observed in marine animals reproducing sexually, although a great majority spawns eggs and sperm that mix and fertilize in the water. But life can be more complex. Even simple organisms, such as algae, can have

extremely complex life cycles alternating sexual and asexual reproduction. Using key species, we will show the wide range of reproductive modes in different life forms, discussing how aquatic life shapes reproduction and the consequences for courtship, mating, fertilization.

26. Parents in the ocean

Marine animals often do not protect their young in the same fashion we observed on land. Many young never meet their parents. However, parents of many species do care for their young helping them with small rations of food, providing safe environmental conditions, and defending them from predators. Some parents even die taking care of their young. The contrasting modes of parental care in the ocean will be explained with model species, highlighting the peculiarities of parental care associated to key characteristics of the ocean (oxygen acquisition, desiccation, and nesting).

27. The wonders of adaptations in the marine world

Living in the salty, dark, and wet world offers advantages but also challenges to marine organisms. A basic and fundamental process, respiration, is extremely difficult in the ocean in comparison to air to the point that marine animals expend 100 times more energy than us to acquire oxygen. Photosynthesis is also challenging. The production of organic matter by marine plants is reduced to a narrow layer of the ocean, where marine algae exhibit a wide arrange of adaptations to capture the extinguishing light. But when the world becomes dark in the deep ocean how predators catch their preys? How prey perceive

their food? The marvelous adaptations of marine organisms will be shown and discussed, in comparison to terrestrial organisms.

28. Global change and Ocean acidification

The consequences of man's use of fossil fuels (coal, oil and natural gas) in terms of global warming has not escaped anyone's attention. Ocean acidification is another, and much less known, result of the approximately 79 million tons of carbon dioxide (CO₂) released into the atmosphere every day. The impacts of ocean acidification on marine ecosystems are still poorly known but one of the most likely consequences is the slower growth of organisms forming calcareous skeletons or shells, such as corals and mollusks. In order to understand ocean acidification and its possible impacts, one needs to understand the behavior of carbon in nature. Carbon, as other elements, is circulating in different chemical forms and between different parts of the Earth system (atmosphere, biosphere and the oceans). These fluxes of carbon in inorganic (e.g. CO₂) and organic forms (sugar and more complex carbohydrates in the biosphere) constitute the carbon cycle. In a very short time span, human activities have used an old reservoir of carbon (fossil fuels) which took millions of years to accumulate, thus creating a new and massive flux of CO₂ into the atmosphere. The oceans can mitigate this additional carbon dioxide flux and thus help moderate global warming but this is not without consequences.

29. Glaciation and the Fjords of Patagonia

A fjord is a long, deep, narrow body of water that reaches far inland. Fjords are often set in a U-shaped valley with steep walls of rock on

either side. Fjords were created by glaciers. In the Earth's last ice age, glaciers covered just about everything. Glaciers move very slowly over time, and can greatly alter the landscape once they have moved through an area. This process is called glaciation. Glaciation carves deep valleys. This is why fjords can be thousands of meters deep. Fjords are usually deepest farther inland, where the glacial force was strongest. They are home to several types of fish, plankton and sea anemones. Some coral reefs are also found in these waters. Scientists know much less about these deep, cold-water reefs than they do about tropical coral reefs. But they have learned that the living things in cold-water reefs prefer total darkness. Organisms in cold-water reefs have also adapted to life under high pressure. Few organisms can survive in this cold, dark habitat.

30. Fjords and Channels: pristine waters surviving human impact

Fjords are more than just breathtaking views. They are a vital and necessary part of the coastal zone of southern Chile. Several problems have the potential to seriously affect fjords and channels in southern Chile. Water pollution in these waters could be due to direct flows of sewage, oil spills by ships traveling in inland waters, tankers and freighters flushing their tanks and bilges as they pass through. The establishment of aquaculture apart from the problem of introducing exotic species to these environments has increased the load of organic matter in fjords as part of the pellets provided to feed fish settles directly to the bottom. It is a major threat due to the consumption of dissolved oxygen by bacteria as cellular respiration and remineralization occurs at the water/sediment interface. As more and more people inhabit fjords, conflicts develop with local wildlife. There is concern that future mining activities will pollute or otherwise alter

the nearby fjord ecosystems and some of the heavy metals could go into the food chain causing biomagnification on top predators such as marine mammal and seabirds. The restricted circulation of deep fjord basins is particularly susceptible to the accumulation of materials such as heavy metals. An increase of tourism without establishing the carrying capacity of these fjords could also challenge the delicate balance among living organisms and their surrounding, mostly still unknown by marine scientists.

OTHER TITLES FOR FUTURE MARINE SCIENCE MEL-BRICKS
(to be developed)

- Challengers in an ocean of short trophic chains
- Wave surfing: The wind that destroys is also the wind of life
- Pacifying the Chilean sea thirst: Estuaries of Chile
- The uniqueness of the Chilean alive sea: Algae, animals and plankton
- The uniqueness of Chilean coral fauna: the splendor of colors, forms and diversity in cold and tropical waters
- Between Puerto Montt y Natales is more than glaciers....there is a whole ocean
- The littoral and the coast of Chile, where land meets the sea and marine life and joy are born
- A promise of splendor future? The blue-sea economy and contributions to the development of Chile
- Mammals and birds of the Chilean ocean
- Ten uniqueness of the Chilean oceans
- The Chilean Sea and local ecological knowledge

II. LITERATURE, POETRY, FILMING, THEATER RELATED MEL-BRICKS

(to be developed)

- Chile and the Sea: writers, poets, epics, traditions
- Chile and the Sea: Myths and legends' of the sea
- Chile and the Sea: Nobel prizes, G. Mistral and P. Neruda
- Chile and the sea: Theater, sculptures, paintings, architecture
- Chile and the Sea: Films, documental, videos

III. SPORTS, RECREATION, TRANSPORT REALTED MEL-BRICKS

(to be developed)

- Chile and the Sea: Maritime sports
- Chile and the Sea: Maritime transport
- Chile and the Sea: Recreation and wonders

ANNEX V

A REVIEW- DIAGNOSTIC ON MARINE EDUCATION PROGRAMS CARREID OUT IN CHILE IN THE PAST 20 YEARS

Luis A. Pinto & Juan C. Castilla.

Executive Summary

In January 2012, marine scientists representing the Coastal Station for Marine Research (ECIM), the Pontificia Universidad Católica de Chile (PUC), the Center for Oceanographic Research in the eastern South Pacific (COPAS), Universidad de Concepción (UdeC) and the Center for Advanced Studies in Arid Zones (CEAZA), Coquimbo, in conjunction with the Wildlife Conservation Society (WCS, Project and Center Karukinka) and the Chile-California Council met in Las Cruces, Chile, to discuss the need to establish a Consortium of Universities and Research Centers sharing a common Vision to *“promote a cultural change on coastal and marine care in Chile, through long term, science-based, globally-linked educational programs, with a public and private partnership oriented toward society as a whole”*.

Chile is a major maritime country where a fully developed maritime culture is absent. Moreover, marine education for the conservation and sustainable use of marine systems is deficient. The national school curriculum does not contain marine education and not enough specialists have been trained to deliver such knowledge appropriately.

Additionally, the country lacks the basic infrastructure required for the education and outreach endeavors. For example, there is no public marine aquarium in the country. This diagnosis was presented to the Universities and Centers of the Consortium, as well as to the Chile-California Council and the Packard Foundation. All of these institutions financially supported the information-gathering effort, a Workshop in 2013 and the development of an education program for Marine Conservation in Chile.

The established roadmap indicated the need to develop a strategic plan that would lead to the development of a National Marine Education Program according to the proposed Vision. For this purpose, it was necessary a previous diagnosis of what marine education projects and programs have taken place in Chile. This report responds to that need by bringing together background information on the development of programs and projects in Marine Education in Chile, aimed primarily at K-12 students over the last 20 years. The information includes institutions, stakeholders, goals, methodologies, results, impacts and issues that may have limited their effectiveness. The report provides an account of what has been developed at the level of non-formal education, as there is no formal curriculum about marine education in Chile. More than 50 outreach activities, projects and marine education programs have been carried out for the past 20 years, covering a broad spectrum of initiatives, from those aimed at pre-school to Senior High School. To name a few, a highlight in the 90's was the Marine Education Project (EDUMAR), conducted by PUC-UNESCO and the Ministry of Education of Chile (Center for Research in Education and Teacher Professional Development, CPEIP), with a program designed for teacher training and the development of field guides in marine education. In 2005, the COPAS-UdeC center started an outreach

program based on their research topics, which included the “School at Sea” with students from public schools using similar instrumentation as oceanographers do. Later their outreach program embraced the 7 *Essential Principles of Ocean Literacy* to train self-motivated science teachers living near the Bay of Concepcion and in the fjords of Patagonia as part of the COPAS Sur-Austral extension program in that area. During the last two years a *Summer Marine Science Camp* has taken place with students from the UdeC Talents School. A hands-on, multisensorial, highly-experiential marine program for blind students was developed by the *Marine Research Program of Excellence* (PIMEX) at UdeC with the support of the private sector. While in the north, the Marine Ecology program: *A world to discover* has been running at the Catholic University of the North (UCN). Another marine environmental program at UCN “*Scientific Detectives of litter on the beaches*” studies solid residues along the coast of Chile. While the program “*Chile is Sea*” of the Millennium Nucleus of Marine Conservation, PUC is targeting not only students but also people involved with the exploitation, consumption and monitoring of fish and shellfish in the Central region of Chile. A national ONG associated to former navy officers called Foundation “Sea of Chile” has worked for about a decade engaging students in best practices for seafood consumption and professions associated to the maritime industry. Additionally, between the years 2007-2013, the EXPLORA program from the Ministry of Education has funded 29 one-year projects with its main emphasis on marine science.

One important aspect that emerges from this exercise is the considerable number of uncoordinated initiatives, rather specific, short-term, and developed by universities, research centers, NGOs and Foundations in various fields of Marine Science and Marine

Conservation. Among them the ones that stand out are PUC, UdeC, CEAZA and internationally (recently in Chile) the WCS. Funding for these initiatives originates mainly from the National Commission for Scientific and Technological Research of Chile (CONICYT) through various research programs that consider dissemination of knowledge and marine education to the public, such as FONDAP, BASAL, FONDECYT, Milenio and more specifically the EXPLORA-CONICYT program. Over the past six years, 25% of the funding provided by EXPLORA for educational projects supported 4-6 marine science projects per year. Many of these projects include elements of creativity and innovation with a strong scientific basis; however, lack of permanent financing has hindered the continuity of these programs. As we suggested above, a lack of curricular alignment with the school program discourages teachers to participate since no extra hours are assigned by the Municipal Education Department (public schools) to participate. The lack of support stands against a real need for extracurricular activities where students are encouraged to learn by inquiry, thus increasing their scientific learning skills. Our data suggest that a considerable number of young professionals have chosen to "learn by doing" in the absence of a professional specialist trained in the dissemination and transfer of content from research and academia to schoolchildren. In other words, young marine educators have developed appropriate skills while carrying out their projects and programs individually. A major limitation to this grassroots approach is the lack of design and implementation of evaluation-assessment tools where the learning achieved by the student and the degree of progress in the cultural change that is desired can be measured. Thus, capacity building in marine education is a key element to consider in any future strategy the Consortium is taking about the design of a Marine Program. Another crucial element to consider in a long term

plan (decades) is infrastructure. Without physical spaces where the initiatives take place, no success will be achieved. There is no doubt that these variables are the most limiting factors for the initiatives collected in this study. Therefore, to achieve a National Marine Education Plan, work should first be focused on implementing a 5-10 year Pilot Plan, guided and conducted by the four institutions that participate in the Consortium created in January 2012. The Plan would span the geographical areas around the main institutions and should include at least the following objectives:

- 1) Co-aid in the academic preparation of marine education specialists at the university level and development of K-12 educational initiatives specific to the theme, with the ultimate aim of producing a cultural change in teachers, youth and the public at large.
- 2) Support the design of an educational program and curriculum in marine education in Chile for K-12 and college students.
- 3) Develop methodologies, mechanisms, tools and means to improve significantly the knowledge that every Chilean has about the ocean and their relationship with it, using advanced information technology and communications to produce a cultural change that translates into a national marine pride, respect, care and conservation of marine systems.
- 4) Coordinate an intra-Consortium alliance so that training activities, education, and outreach to the population are coherent, reproducible and synergistic.
- 5) Encourage, coordinate and link the establishment of training centers for marine education for school children of Chile (K-12), for instance through Interactive Centers of Marine Education in each of the

participating institutions, and to strongly support the creation of Marine Aquaria with national (and international) visibility.

6) Develop mechanisms for public-private partnership to fund initiatives that go in the direction of promoting a cultural change in relation to marine education, respect and care for the marine environment and coastal and ocean resources in Chile.

7) Promote collaboration between Universities, Centers, NGOs, Foundations and other stakeholders in Chile in relation to marine education and encourage international collaboration as well.

ANNEX VI

MAIN SCIENCE-BASED EDUCATIONAL MEP LINKED PRODUCTS OF THE CONSORTIUM DURING 2013

There are several main science-based educational products produce mainly along 2013 in parallel with the development of the Marine Education Program, financed both with the Packard Foundation grant to CCC and with institutions own funds

List of major ones

1. A Review-Diagnostic on Marine Education Programs carried out in Chile in the past 20 years (L. Pinto, J.C. Castilla and Consortium Team, 120 pgs).
2. 2013 re-edition of a Guide-Field Book for the Chilean intertidal (JC Castilla)
3. A set of 12 Marine Chilean Cards and postal's regarding the marine fauna of Chile (M. Fernández and team; Millennium Marine Conservation Project).
4. A set of 6 novel Marine Chilean cards highlighting fishing gears used in Chile (M. Fernández and team, Millennium Marine Conservation Project).

5. A Wokshop (April 2013), that took place in Santiago, Chile with the presence of Mrs. Julie Packard

6. Approxiamtely 12 newspaper interviews in national newspapers and about 6 TV presentations and interviews, including one of about 60 minutes (JC Castilla) in the Chilean TV Senate network