

15 Dec 2006  
DATE

**NATIONAL PROGRAM FOR ADVANCE RESEARCH CENTERS**  
**(FONDAP)**

**CONTINUITY PLAN EVALUATION REPORT**


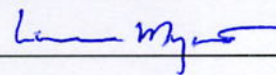
This form is intended to facilitate your work as a referee and standardize the evaluation reports. Each topic is expected to be evaluated with concepts ranging from outstanding to poor and detailed technical comments supporting your views on the proposal and the site visit. If the proposal or the site visit do not contain information on the given topic, please indicate so in your evaluation.  
Your final overall comments and recommendations are an important part of the review process.

**I. PROJECT INFORMATION**

**CENTER'S NAME:** Centro de Investigacion Oceanografica en el Pacifico Sur-Oriental (COPAS)

**DIRECTOR:** Carina B. LANGE

**II. EVALUATION PANEL**

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### III. PROPOSAL EVALUATION

#### 1.- Goals and objectives for the next five-year period

##### i.- Comments

COPAS has proposed only small changes to the three scientific themes that guided its research during Phase I. The first two themes – focusing on connections among large scale and local processes, such as El Niño-Southern Oscillation (ENSO) and local oceanic circulation or the functioning of the oxygen minimum zone, are continuations of the previous work. Of vital interest is how the oxygen minimum zone reacts to climate change in the Southern Hemisphere, and especially within the most productive region in the world, i.e., the coastal ocean off of Peru and Chile. The third theme has been modified to include the interaction with land via the fjords of southern Chile. The goals defined in these three themes are appropriate for this region in terms of their focus on issues important to the country, building on topics that can be uniquely studied in this region, and acting as an excellent framework on which to build a multidisciplinary oceanography research team. We applaud this new stress on the land-sea interface, as we believe that COPAS will have greater success in promoting oceanography in Chile in the long run if it clearly addresses issues that interact with land. The coastal ocean of southern Chile has no analog anywhere else in the world. Its variability and sensitivity to climate change is crucial to understanding the hydrological cycle on land, which in turn is the basis for planning involving issues of hydrology (agriculture, aquaculture) and fjord dynamics (aquaculture). Of course topics in the first two themes also involve issues that affect the terrestrial environment of Chile – e.g., ENSO variations influence terrestrial climate –, but the connections that will be studied in fjords are both more immediate in time and more obvious to the people of the country. The COPAS team has integrated the fjord work in such a way that it does not draw too heavily from the deeper-water research activities.

The educational goals of COPAS are unchanged from Phase I, and rightly so. The Center intends to train scientists at various university levels to build the human resources who will conduct future research and participate in future decision-making about the ocean in Chile, and more generally South America. This goal is vital for many reasons. The objectives of extending TOPAS and of continuing to recruit students from other countries will aid strongly in extending COPAS' influence throughout South America.

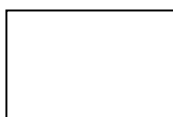
The COPAS team proposes to continue its extensive time investment into networking. We agree strongly with this goal, as it integrates the Center with many other organizations for mutual benefit. It provides a strong multiplier effect for the direct investment made in the COPAS unit. By networking strongly both within Chile and with other institutions world-wide, COPAS acts as an intermediary in linking more than itself to the rest of the world.

The goal of increased outreach activities also continues unchanged. COPAS has done well in this activity, which will have important long-term benefits for oceanography in Chile. The specific objectives associated with this goal are all appropriate and contribute in different and important ways to its achievement. Of special note is the proposed expansion of the web page into Spanish, which has the greatest potential to extend COPAS' impact to the national scale. Greater national appreciation of the kind of exciting science done in COPAS will aid marine sciences throughout Chile, and help build support for the expensive infrastructure that will be needed to perform advanced marine sciences work.

##### ii.- Evaluation



Outstanding



Very Good



Good



Poor

2.- Expected educational impact of the center in the short and long term. Please analyze the Center strategy to influence on human resources formation (PhD students and postdoctoral fellows).

i.- Comments

COPAS has been a strong producer of students in oceanography since its inception, via a combination of courses and thesis opportunities. As such, its graduates have gone on to work at many institutions throughout Chile, and given the uniquely strong emphasis in oceanography available at UDEC these students have been able to spread this expertise around the country. In conversation, we have heard good things about these graduates. More importantly, the oceanography education promotes a greater appreciation of the fact that Chile is a maritime country (owning more wet than dry real estate) whose day-to-day workings are intimately tied to phenomena that may not be evident from the land. This impact will go well beyond the borders of Chile, as our interviews with students make it clear that they are becoming familiar with the scientific and organizational attributes of COPAS and intend to port them to their own country. COPAS thus has the potential to become a “mothership” of oceanography in South America.

The post-docs make up an even more intercontinental group than the graduate students. Passage of these persons through COPAS at this stage of their career will echo for decades via the professional relationships formed in their time here, and will aid in networking Chile to the rest of the world for a long time.

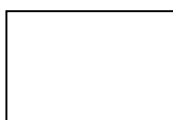
Oceanography involves many disciplines, which necessarily involve many technologies. For this reason, expansion of COPAS’ educational products will affect technology availability in Chile. Various new measurement technologies, and people trained in them, will provide an educational impact beyond simply more oceanography in Chile. We saw evidence for this process, as an example, via a chemical oceanographer interacting with a laboratory involved in pharmaceuticals and developing methods that could be used in tracking copper in the environment. Educational impacts often show up in unexpected ways.

The Center’s strategy is straightforward – simply to emphasize university-based graduate education supplemented with a smaller number of special programs such as TOPAS. This model is a long-proven one, and there is no need for alteration at this point. At both the national and international scales, these impacts can be extremely long-lasting – witness, for example, the extraordinary influence of graduate education in Chemistry in Germany at the end of the 19<sup>th</sup> century on the career of students from the United States. After only five years, for example, three Ph.D. graduates of COPAS are already in faculty positions.

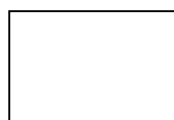
ii.- Evaluation



Outstanding



Very Good



Good



Poor

3.- Initiatives that would be undertaken by the Center related to scientific and technological innovation and its applications to the development of the country. Please analyze the Center strategy to get involved with problems to the development of the country.

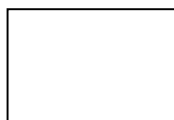
## i.- Comments

Oceanographic knowledge does not generally lend itself to short-term applications. It is, however, of crucial importance in such medium- and long-term applications as the sustainable exploitation of marine resources, sustainable aquaculture, marine tourism, marine biodiversity, and the prediction of climatic effects on land resources, including freshwater (e.g., effects of precipitation on hydroelectric power and agriculture). Other relevant aspects mentioned by COPAS in its Continuity Plan are offshore methane and industrial pollution.

More than half the territory of Chile is oceanic. Marine Chile offers one of the largest arrays of environments and ecosystems on Earth and is one of the richest marine regions in terms of biological resources. Also, it deeply influences Chilean terrestrial environments. Clearly, the medium- and long-term development of Chile largely depends on its marine component, and thus strongly relies on insights derived from Chilean oceanography.

The Evaluation Committee thinks that COPAS is still too young and too small to contribute immediately to the economic development of the country, and thus its primary task during Phase II should be consolidation and fundamental research. But we do support the Center's initiative to create a Task Team on Knowledge Applications (TTKA). In the same vein, the inclusion in COPAS of Dr. Leonardo Castro, a specialist of fish larvae, is a strong manifestation of the Center's interest in the sustainable management of fish resources. Another candidate area would be linkage of oceanic temperature time series, on decadal to geological time scales, to terrestrial records so that predicted changes in oceanic circulation might be used to forecast climatic impacts on land. The Evaluation Committee suggests that the TTKA primarily focuses its efforts on exploring the application of oceanographic knowledge to the development of Chile after Phase II, when the Center could proceed to an expansion of its membership, as well as its scientific and geographic domains. Of course, this should not prevent COPAS from occasional transfers or contributions to the application of oceanographic knowledge during Phase II.

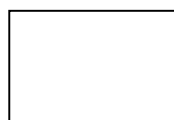
## ii.- Evaluation



Outstanding



Very Good



Good



Poor

4.- Main goal changes since the first proposal of the Center and their effects in the plan for the following period.

## i.- Comments

The scientific goals were well chosen to begin with, and they were designed to inform research over decades. As noted above, the principal scientific goals in the Continuity Plan are largely unchanged with the exception of the new attention to the southern part of Chile, especially the fjord areas. And as previously discussed, we agree wholeheartedly with this new scientific goal. This large region hosts terrestrial and marine features that are unique on the planet, and need to receive increased attention in the context of climate change and increasing human utilization. There are also numerous new scientific objectives that have evolved from the previous work, and these are to be expected after five years of research. They are discussed in more detail in Section 5.

Of greater importance in this section is the emergence of new cross-cutting themes that were designed to extract greater value from the research performed by the six teams. One such significant new trend is the greater emphasis on the goal of synthesizing the data, to culminate in a book on the Eastern South Pacific (ESP). This goal is important not only for achieving a holistic view of the workings of the ESP, but also as a concrete target that will continue to inform and orient future research activity. Modeling is a process that will play an important role in this synthesis, and the planned hiring of a biogeochemical modeler will aid greatly with aspects of the synthesis. Of course, a modeler by her/himself cannot achieve the syntheses, and the emerging conceptual models that many individual Research Programs are developing will drive the synthesis work. The planned work on database organization and public accessibility will also aid in these syntheses, and should further both the goals of international collaboration and outreach. In the long run, there will be a need for a formal feedback from the users of the database (e.g., researchers, public utilities, companies, decision makers) to the database manager.

Likewise, the emerging goal to place the biological information in a genetic and marine biodiversity context is a goal that will help organize the large mass of information on community structure and function that is emerging. We drew the impression that researchers are building this biodiversity context strongly in conjunction with the functional roles of the organisms in biological and biogeochemical processes. This connection will be important in linking the findings of this group to other international initiatives focused on topics such as climate change and oxygen depletion in polluted coastal zones.

The COPAS plans to address the increasing need to connect its research with other sectors of society that might need its information products, in part, by forming a Task Team on Knowledge Applications (TTKA). The TTKA will likely be especially active in such areas as fisheries or methane deposits. The motivation behind the TTKA is important, but in the Continuity Plan and during the site visit, we saw little concrete evidence for how, or how well, this is likely to work.

## ii.- Evaluation



Outstanding



Very Good



Good



Poor

## 5.- Research lines of the Center, including their feasibility and updating validity.

## i.- Comments

The research lines of the Center are grouped, on the one hand, by three major themes, and on the other hand, by six programs tied to principal investigators. The major themes (for short: general patterns and variability, oxygen deficiency, thermocline and fjord conditions) comprise high priority items in the investigation of the waters off Chile related to general circulation including heat transport, stratification and upwelling, and the associated biogeochemistry and productivity of Chilean waters in the framework of eastern South Pacific oceanography). In general, the approach to the topics involved emphasizes fundamentals (what every oceanographer would recommend) as well as those aspects that are both cutting-edge science and feasible given the limited resources available.

Turning to the individual Research Programs we find the following:

### Research Program 1 (Circulation and mixing in the eastern South Pacific, PI: Dr. Wolfgang Schneider).

Feasibility does not appear to be a problem in respect of the data gathering aspects. The data to be gathered will be greatly welcomed by the oceanographic community; they fill important gaps in knowledge about the region. The shortness of the record poses some problems regarding the determination of ENSO impacts, since ENSO events (both El Niño and La Niña) vary in amplitude and internal phasing. Also, the impacts of different types of ENSO events on the marine and terrestrial environments of Chile do not vary linearly with shifts in ENSO properties. Thus, insights gained from one or a few such events, while valuable in developing general predictions, cannot yield detailed scenarios for climate change with a high degree of confidence. The quality of the Regional Ocean Modeling Systems (ROMS) to be applied to the patterns of variability of upwelling, for example, will depend on the length of records available for tuning models for each region considered. As far as gathering information off southern Chile, details regarding the logistics remain to be worked out, presumably in collaboration with CIEP. Integration of the emerging information into the larger framework of SE Pacific circulation will move this effort to the cutting edge of oceanographic research, but this task will prove challenging given the limited resources available.

### Research Program 2 (Microbial communities and water-column biogeochemical cycling, PI: Dr. Osvaldo Ulloa).

This research program is conducted in the oxygen minimum zone (OMZ) located off northern Chile, and in the upwelling ecosystem off Concepción. Exciting results of the work conducted within the remarkably strong OMZ have attracted international attention. In a nutshell, the studies conducted during Phase I have provided the elements needed to understand the whole biogeochemical nitrogen cycle, which is now ready to be modeled, and the work planned for Phase II mostly concern the carbon cycle, with special attention devoted to methane (the greenhouse effect of this gas in the atmosphere is much higher than that of carbon dioxide). The success of this program during Phase I shows that the work planned for Phase II is both feasible and at the cutting edge of international science.

Research Program 3 (Plankton dynamics and its role in carbon cycling in the Eastern South Pacific, PI: Dr. Ruben Escribano). During Phase I, the work focused on descriptive aspects, including taxonomy and the structure of plankton populations, because little was known about the plankton. Keystone species (which control carbon fluxes) were identified in the upwelling area, and conceptual models were developed. The studies planned for Phase II will address dynamic aspects of the plankton communities, including feeding fluxes (using lipid biomarkers). The work will use existing conceptual tools and internationally accepted techniques, and the success of Phase I shows that the plans for Phase II are both up to date with international science and feasible. The information is useful both at the regional level (i.e., Chilean waters), and for comparing patterns among different coastal systems in the World Ocean.

Research Program 4 (Pelagic-benthic coupling in the eastern South Pacific, PI: Dr. Humberto Gonzalez). This research program has focused on the role of the planktonic ecosystem in water-column carbon cycling. Important baseline work on organisms responsible for organic and inorganic carbon fluxes has been done, which has been vital in integrating the biology with the chemistry of the system. Results indicate that while the northern waters provide the classical carbon source term to the atmosphere, southern waters off Chile are surprisingly strong as a carbon sink. This realization leads this RP to focus more strongly on southern waters, especially the biological pumping of carbon in the inshore fjord system, and to integrate recent concerns about ocean acidification into their investigations. Another new direction for this research program is the addition of a person specializing in

ichthyoplankton, which explores a group of organisms heretofore given little attention and opens an important linkage to fisheries issues in Chile. We find these developments logical and worthy.

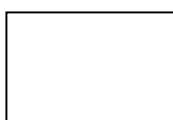
Research Program 5 (Benthic community structure, metabolism, biogeochemistry, ESP, PI: Dr. Renato Quiñones). This research program has explored a wide variety of topics relating to the benthic environment in the ESP, both in the sediments themselves and in the water column just above. A variety of interesting discoveries have ensued, such as giant bacteria and anaerobic respiratory metabolism, which have clearly influenced the proposed work for the Continuity phase. New directions, such as the role of oceanic acidification in metabolism and research into southern Chile waters, will receive attention. The group shows strong inclination toward generic discovery as well as generation of information vital to regional questions of the ESP, and this combination builds confidence in the further development of a strong research group.

Research Program 6 (Paleo-studies in the eastern South Pacific, PI: Dr. Carina Lange). Feasibility of core collections is contingent upon access to the fjord regions, which will be worked out through collaborative ship use. So far, Program 6 has delivered interesting information on the response of coastal ocean dynamics to climate change in the recent geological past. Such information is useful in the construction of scenarios for future developments. The strategies underlying planning of future work are appropriate to the task of reconstructing the response of the fjord ecosystems to climate change in terms of productivity in the water and of oxygen content at the water-sediment interface. Some of the methods proposed are in the experimental stage, and their efficacy as proxies is yet to be proven. Such uncertainty is expected at the cutting edge of research.

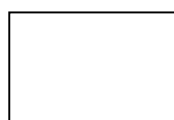
## ii.- Evaluation



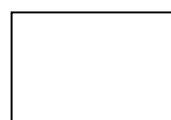
Outstanding



Very Good



Good



Poor

6.- Where applicable, new lines of research that arose during this period and how they were considered in the present proposal.

i.- Comments

Several new lines of research have appeared in this proposal relative to the original proposal. We have addressed these new directions above; they include topics such as the southern fjords, the role of chemosynthesis in carbon and nitrogen cycling, carbon sinks/sources along the latitudinal gradient, novel findings in anaerobic respiratory metabolism and the various roles of archaea and giant bacteria in low oxygen zones. The group is building on these discoveries and allowing them to redirect research to some extent. Because COPAS is also constrained to continue many of the original lines of research into Phase II (e.g., moorings), these new directions will require some redirection of effort or augmentation by additional funding such as separate research proposals. We saw more evidence for the latter, in the form of additional research proposals that are being spun off from the discoveries enabled by the COPAS funding. Of course the work in these new projects ties in nicely with the work funded by FONDAP.

These discoveries and the follow-up on them provide not only fuel for rich scientific discovery in the Continuity phase of COPAS, but also the seeds for extending COPAS in some form past the next five years. While the shape of programmatic opportunities is not clear at this time, the group is clearly thinking about the longer term future.

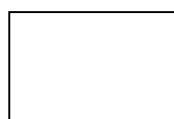
ii.- Evaluation



Outstanding



Very Good



Good



Poor

7.- Synergies and interactions between the members of the Center and their purpose in the Continuity Plan (not only based on publications or thesis, but also, for example, on emerging



new research lines (areas) in the nearest future). Remember that the whole should be greater than the sum of work of individual researchers.

#### i.- Comments

Overall, the Evaluation Committee was impressed by the level of synergies and interactions among the members of COPAS, despite the lack of a common building of the UDEC campus. There is no doubt that the whole is much greater than the sum of its parts. However, creating and maintaining such a level of coherence in such difficult circumstances is very demanding on the human and material resources of the Center. The Committee thinks that this situation needs to change soon to avoid threatening the very existence of the group.

Synergies among the members of COPAS are evidenced by numerous joint publications, etc., and also by activities that would not have been possible for individual researchers or small groups. These concern research, education, outreach and networking.

For research, the Center makes possible the long-term, multidisciplinary approaches that are essential for addressing marine systems. These include, for example: long-term *in situ* ocean observations (e.g., time-series, moorings), which cannot be achieved by small teams or individual grants. The moorings serve as a platform for concurrent projects, and are key for promoting national and international collaboration and networking. Other collaborative projects are linked to “long” cruises on oceanographic vessels, in which several researchers participate (depending on ship size); to acquisition, sharing, deployment and maintenance of sea-going and shore-based laboratory equipment, which would be impossible to acquire and especially to maintain by individual initiatives.

For education, COPAS provides a multidisciplinary research environment for graduate and advanced undergraduate students that is unique in Chile, and probably in all of South America. Graduate students from all over the continent are attracted to this pole of oceanographic excellence, where they find a diversity of activities, a wealth of data, interactions with researchers from different disciplines, oceanographic cruises, and participation in national and international meetings/courses/workshops. The size of the resulting student pool is much larger than that attainable by a sum of individual laboratories. In addition, the Center trains technical personnel, who are a key component of field and laboratory activities. Finally, after a few years of existence, COPAS already attracts students and postdoctoral fellows not only from Latin America but also from North America and Europe.

The topic of outreach has only recently become very important as an issue, as concerns individual investigators, anywhere. In contrast, COPAS team members are successfully engaged in conducting a very diverse program of outreach activities.

For networking, the national and international links of COPAS go largely beyond those are taken beyond those of the individual members of the Center. The COPAS network is at par with that of other internationally recognized oceanographic institutions of similar size, but often much older than COPAS.

The Evaluation Committee notes the absence of a regular series of seminars within COPAS. Such seminars are essential in any Center, and especially COPAS whose members are physically dispersed. The Committee understands very well that the directors of COPAS are over-loaded by numerous tasks, and cannot take on the task of organizing internal seminars, especially in years such as 2006 (writing of the Continuity Plan) and 2007 (preparation of the building on the UDEC campus). The directors could perhaps build on the interest of students and postdoctoral fellows for regular Center-wide scientific exchanges, and put them in charge of organizing the seminars, as done in several institutions abroad. This being said, the Committee reiterates its conclusion that COPAS as a whole is much greater than the sum of its parts.

ii.- Evaluation



Outstanding



Very Good



Good



Poor

8.- Center organization net including its nearest links (companies, associated institution, other units within the same institution, etc), and international and national collaboration.

i.- Comments

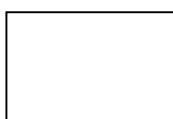
Clearly, the COPAS Center is well integrated with its host institution, the University of Concepción (UDEC) by way of membership within the Faculty of Natural and Oceanographic Sciences, within the Department of Oceanography. The continuing evolution of this integration is of the utmost importance in maintaining the vitality of the Center. It is also welcome to see a faculty member from the Department of Geophysics proposed for membership in the Center; this move broadens the impact of COPAS on the University. The Center is also linked with several national institutions, important examples being the Universidad Austral de Chile and the CIEP. International links to Germany, Norway, France, Japan and the USA have proved useful, and are proving invaluable for their intellectual, educational and logistical exchanges. Further links to countries of the South Pacific Ocean (e.g., New Zealand, New Caledonia) and South Africa (which is involved the Namibian coastal upwelling system) might be profitably established. Links to the Chilean Navy (SHOA) are noteworthy, and broadening of these connections for mutual benefit should be explored. Historically, oceanographic centers in various countries with links to naval research have enjoyed an advantage over others. Links with other academic organizations involved in environmental research might be explored. In Chile, a nation where marine processes dominate the climate, ecologic, hydrological and agricultural issues can depend strongly on findings in oceanography. An effort to link to organizations involved in Chile's economy and especially in Chile's public education is noteworthy and should be pursued. The links provided through education are strong, especially to other countries in Latin America. The associated transfer of know-how will greatly stimulate development of oceanographic and coastal environmental research in these other countries.

In summary, we are very impressed with the networking achieved by COPAS, and despite the few suggestions above we rate the proposed efforts in these areas very highly. Both from the proposal and from discussions during the site visit we expect COPAS to continue building on the already-strong networks in place.

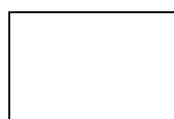
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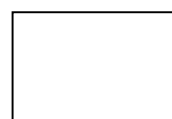
Outstanding



Very Good



Good



Poor

## 9.- Outreach strategy.

### i.- Comments

COPAS has had remarkable success in outreaching to school children in the region of Concepción; the diversity and quality of activities is very impressive. An important element of future planning (during Phase II, or after) will be the expansion of this type of outreach to a broader, national audience. Outreach to the public in general (that is, to Chileans and to South America) will have to rely largely on modern methods of communication, e.g., through the Internet, as proposed. An important element is linkage to professional educators and relevant institutions (e.g., museums, aquaria, and science centers). Important steps have been taken with linking to the Natural History Museum of Concepción and to Centro AquaSendas. Efficient connection to the external outreach organizations will depend on setting up a proper interface between COPAS researchers and these organizations, e.g., by employing a professional outreach person, as already planned by COPAS.

In summary, the Evaluation Committee was impressed by the diversity of COPAS outreach activities, and stresses the need for some approaches that would reach out beyond the area of Concepción. A modern, dynamic web site may be the first thing to do (experience in many other centers show that it is often more efficient to link with similar, existing web sites, or rely on professional expertise than developing the whole web site from scratch in house). Reaching the general public in Chile (and beyond) is crucial at a time when COPAS legitimate ambitions require public support at the national level (e.g., for the funding of the building, or a large oceanographic ship).

### ii.- Evaluation



Outstanding



Very Good



Good



Poor

10.- Economic feasibility: coherence between needs, operational costs, new positions, major equipment, traveling and per diem, among others, and proposed activities (1US\$  $\approx$  550 Chilean pesos).

#### i.- Comments

The work proposed, including research, education, outreach and networking, represents effort that would cost far more in most other countries. The level of achievement reached in the first five years of COPAS gives evidence that most if not all of the proposed work will in fact be done. The budget is therefore a terrific value for the funds requested.

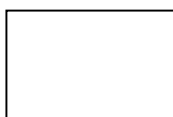
In terms of the allocations of different budget items for the various lines, we find them quite normal and justifiable. The ratios of salaries to operational costs, the amount and cost of travel for the research, outreach and networking activities, the resources devoted to technical staff salaries, and the fraction of personnel costs allocated to administration all look quite reasonable.

The one item that looks inappropriate is the level of overhead, or indirect costs, provided to the university. Overhead rates of 2-3% cannot possibly go far in remunerating the institution for the expenses arising when hosting an individual research program. The reviewers all come from funding structures that recognize the real costs that institutions undergo in order to allow effective research activity on campus. We realize that this problem is built into structures far larger than the FONDAP grant, CONICYT, and even higher in Chile, and cannot be solved in negotiations for this proposal. Nevertheless, we encourage both the university administration and CONICYT to seek changes that would allow extra funding to be made available to help the institution pay for COPAS. The long-term success of centers such as the FONDAP ones – indeed for university research in general – will benefit research greatly in ways beyond simply helping the institution pay for bookkeepers. Paying overhead provides a positive feedback loop that will encourage changes in university structure favoring the research enterprise on campus. Our comments do NOT imply that we would favor taking a greater fraction of the existing total cost of the COPAS grant and reallocating it into overhead. Such a shift would cripple the program. Rather, the budget allocations to CONICYT need to recognize these costs, and shift them into the funding process for each grant.

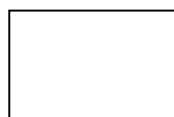
#### ii.- Evaluation



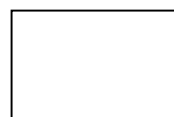
Outstanding



Very Good



Good



Poor

11.- Economic feasibility for Institutional commitment: coherence between needs, operational costs, new positions, major equipment, traveling and per diem, infrastructure, among others, and proposed activities (1US\$  $\approx$  550 Chilean pesos). Resources coming from other sources considering that other funds make the Center activities more consistent.

#### i.- Comments

The commitment of the University to this center meets the 20% required match, via a combination of land donation for a new building, operational funding for items such as equipment maintenance, and salary for a biogeochemical modeler. This latter person will occupy a new position to be created at UDEC. We regard this commitment as important to the success of COPAS. Our impression is that the administration is solidly behind the COPAS effort, and realizes the unique opportunities associated with this initiative, especially with regard to creating an internationally prominent center for oceanographic research in Latin America.

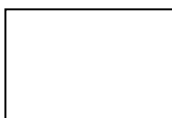
In this context, we note that beyond the formal match requirements there is a large commitment for a building to be constructed in 2008, which will enable the continuation of COPAS through and after the present funding cycle. The money for this building will be raised at UDEC via existing internal funds and fund-raising during 2007. It became clear to us that the successful completion of this effort will be crucial to maintaining the enthusiasm and the integrity of the excellent group of marine scientists that has been assembled during Phase I. It will also solve a number of pressing internal problems, such as inappropriate laboratory space, and lack of frequent contacts among COPAS members. This commitment solidifies the investments made so far in making sure that UDEC's position in South American oceanography is greatly strengthened.

COPAS researchers have been remarkably successful in bringing in outside grants beyond the COPAS base funding. While specific figures were not available, we obtained the impression that COPAS funding is leveraged more than twofold into other grants, which greatly contributes to the outstanding overall productivity of the center.

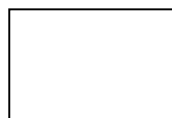
#### ii.- Evaluation



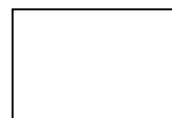
Outstanding



Very Good



Good



Poor

## 12.- Final overall comments and recommendations.

### i.- Comments

The Evaluation Committee was impressed by the dedication, efficiency and long-term vision of the COPAS Director, Prof. Carina Lange. This also applies to the Deputy Director, Prof. Renato A. Quiñones.

The achievements of the COPAS team, as noted previously in the overall evaluation of their final report for Phase I of the Center, are truly impressive in any setting, but especially in regard to the short time and the limited resources that were available in the initial phase of growth. We are confident that this astonishing level of achievement can be maintained in Phase II, given the outstanding abilities and enthusiasm of the investigators and their associates. The impact on the level of discourse in matters oceanographic across all of Latin America, and especially in Chile, should soon be felt as the people with advanced degrees from the University of Concepción take up their tasks in society. The links into the international community engaged in studying the dynamics of the oceans and the life within will greatly intensify, to the advantage of all concerned. In this exchange, the special position of Chile, as the guardian of the most productive seas outside of Antarctica, must be emphasized. Without sufficient information from the Chilean marine realm, our global picture of the ocean's response to the ongoing climate change would be glaringly incomplete. In addition, the ocean's response to such change is of special interest to Chile, because its climate is dominated by marine processes, especially with regard to precipitation and runoff, which in turn are of crucial importance in all discussions involving agriculture and hydro-energy development.

The creation of the COPAS entity through the commitment of FONDAP-CONICYT and the host, the University of Concepción, has opened exciting new opportunities for Chilean leadership in oceanography of the eastern South Pacific, one of the least known major ocean regions in the world. It is now time to seize this opportunity in full measure, by ensuring the continuation of this remarkable development.

We fully agree that the research topics chosen for Phase II, which are but little changed from those of Phase I, are the ones deserving the highest priority.

There are two crucial over-arching developments that go beyond scoring points with important discoveries in international journals: (1) The fact that there is now a commitment to in situ sustained ocean observations (time-series, moorings) on a decadal scale, and (2) the educational impact on Chile and, more generally, all of South America. Sustained ocean observations are absolutely necessary for capturing the true variability of the marine environment on time scales that are relevant in human affairs (agriculture, aquaculture, hydrological cycle). Education is the basic ingredient of economic development, and environmental education is becoming ever more important as the growing economic activities impact the environment in undesirable ways. Not only are the COPAS members holding up well in the international competition among their scientific peers, but as importantly, they are doing work that truly matters to Chile, to South America, and to the world.

The Evaluation Committee stresses the importance of a collective effort involving most or all members of COPAS in developing conceptual models, based on the COPAS data and incorporating knowledge from other sources on both the ESP and comparable environments. The continuous interaction among hypotheses, data acquisition, process studies, data analysis and synthesis, and conceptual and numerical modeling is fundamental to high-quality science. The hiring of a biogeochemical modeler is an indication that COPAS understands and values this approach.

### Recommendations

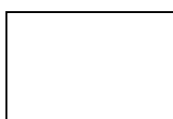
1. The Evaluation Committee recommends continuation of the funding of COPAS for another five years at the requested level. Chile is making an excellent investment, and stands poised to obtain much return on it in coming decades.
2. The Committee recommends that the University of Concepción complete construction of a building adequate to provide COPAS with appropriate laboratory space and contiguity of its research groups, as per the correspondence that we have been shown.

3. The Committee recommends continuance of the organizational structure of COPAS, its proposed scientific groups and themes, stated goals (in science, education, outreach, and networking) and key personnel. Nevertheless, COPAS should develop mechanisms that allow it to maintain continuity in its core observational and multidisciplinary cruise programs, while encouraging a weaning of ideas incubated within COPAS-funded activity away and towards other funding sources. We realize that some of this weaning is already happening, but we believe that a formalized mechanism will encourage more of it.
4. The Committee recommends that CONICYT find a way to incorporate additional funds for overhead costs, in order to facilitate and encourage future evolution of the host academic institutions into ones in which research is encouraged.
5. Last, there are many specific recommendations that can be found on the preceding pages of this evaluation.

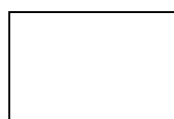
## ii.- Evaluation



Outstanding



Very Good



Good



Poor