Tuesday, November 27

Opening
Chair: Charlie Kennel

Dr. Charlie Kennel, Director of Scripps Institution of Oceanography (SIO), and Chair of POGO, welcomed the participants and thanked Bedford Institute of Oceanography for hosting POGO 3.

He spent a few minutes reviewing the history of POGO. The idea of POGO was born in discussions between SIO, Southampton Oceanographic Centre (SOC) and Woods Hole Oceanographic Institution on ocean observations on a global scale. Among other issues, the discussions dealt with implementation and co-ordination of plans developed by GOOS regarding *in situ* measurements in the ocean.

These informal discussions were brought to a wider group at a meeting in Paris, sponsored by the Sloan Foundation and hosted by the Intergovernmental Oceanographic Commission (IOC). Seven of the larger institutions around the world were invited, as well as several international organisations. At the meeting, they discussed whether it was worthwhile to form an organisation such as POGO. They also discussed the goals and membership criteria for such an organisation. There surfaced two different conceptions of how it should be formed. One was that POGO should be an organisation where the leaders of major oceanographic institutions can meet and discuss major issues. At the same time, the need to be inclusive was also recognised, bearing in mind the goal of global observations. We have moved forward with both of these ideas in mind with a larger group of organisations.

At that time, the plans for the physical side of ocean observations were better developed than the biological side. The need to advance the biological side of the observations was recognised. Dr. Kennel noted that biological observations were the focus of POGO 3.

The next meeting (the first official meeting of POGO) was held in La Jolla. Again, the idea of the conception of the group was at issue. There were discussions on what a group of directors of oceanographic institutions could do that was different from what was already being done. The sense of identity that emerged made it clear that Directors could only do together what they could do individually. As directors, their job was to advocate to the government, to see that the science got done, and that their scientists worked together in collaboration. POGO would facilitate these actions at the international level.

The criteria for membership were discussed again. Primary criteria were a commitment to global ocean observations, and the capability to make basin-scale observations. This led to a rather interesting group of institutions including private and government laboratories. All the institutions involved in POGO
shared a central bond: commitment to building a global observation system. Also, as a Non-Governmental Organisation, POGO could do certain things that could not always be done, because of government restrictions.

In the intervening time, Dr. Bob Gagosian and Dr. Kennel went to several foundations in New York City requesting funding. They believed that POGO needed a professional, trained, Executive Director. The foundations were supportive. The plan was to procure start-up funds for three years to establish a Secretariat. POGO was to become self-sufficient at the end of three years through dues collected from members. There were four foundations that decided to support POGO. Dr. Kennel reported that POGO was well on its way to carrying out the initial commitment to the foundations.

POGO-2 marked a new development in the organisation. The meeting was held in Sao Paulo, thanks to Prof. Rolf Weber and the Instituto Oceanographico at the University of Sao Paulo. That meeting had a theme, and it was Southern Hemisphere Observations. POGO could advocate something that no government could do – that the world should pay attention to the southern hemisphere. At POGO-2, they also refined their understanding of the membership criteria. The levels of membership were defined more carefully – dues were established on a sliding scale, ranging from $15K to $5K. It was also decided that consortia could be formed for the purpose of membership. Certain limitations on membership by country were also eliminated.

Dr. Kennel said he was pleased to report that POGO had a significant percentage of dues-paying members. He had the pleasure to return to the foundations in New York and say that POGO was well on its way to becoming self-supporting and self-governing. In the future, POGO would seek outside support only for specific projects, and not for core support.

Dr. Kennel mentioned that, at POGO-2, it was decided that the theme for POGO-3 would be global biological oceanography, and that a small meeting of experts would be convened prior to POGO 3, so that they could advise POGO on how POGO directors could help global biological oceanography. Dr. Kennel reminded the participants that Time Series observations and the Argo programme had also been priorities for POGO since its inception, and that these aspects of the observations were also proceeding well.

He mentioned that brief discussions had been held on where POGO 4 and 5 might be held and that these issues would be settled later in the meeting. He then turned the podium over to Dr. Mike Sinclair, Director of the Bedford Institute of Oceanography (BIO).

Dr. Mike Sinclair then requested Dr. Laura Richards, Regional Director, Science, from the Pacific Region, Department of Fisheries and Oceans (DFO) to speak a few words on behalf of Dr. Elisabeth Marsollier, Director General, DFO, who had been unable to attend the meeting because of a family crisis. Dr. Sinclair noted that it was fitting that Dr. Richards should be at the POGO meeting, since it meant that both the East and West coasts of Canada were represented at POGO.

Dr. Richards then conveyed a message from Dr. Marsollier. On behalf of the Governor of Canada, and DFO, she welcomed everyone. She mentioned that Dr. John Davis was unable to attend because he has taken a new job, but noted that he would have a continued interest in POGO and oceanography. Canada was happy to be a part of POGO; oceans were important to Canada. In the Speech to the Throne, the importance of the oceans was highlighted, as were the direct benefits to Canadians of investing more into oceanography. There was a need to work with other countries, so Canada was
happy for this partnership in POGO. Canada was already active in the Argo Programme and was already working with Chile on this project.

Dr. Sinclair then introduced Mr. Neil Bellefontaine, the Director General of Maritime Regions. Dr. Bellefontaine welcomed the participants on behalf of the DFO. He regretted that the timing of the meeting did not allow the participants to take full advantage of the locality, but he noted that there were still a lot of beautiful things to see. The meeting coincided with the opening of lobster fishing. He drew the attention of the participants to the beautiful beaches and forests in the area. With respect to the Agenda, he said he found it informative and interesting. Oceanography was a high priority for Canada. There had been a lot of change in the North Atlantic ecosystems as of late. There had been a sharp decline in North Atlantic salmon and cod. The causes for this decline were not fully understood. Variabilities at decadal time scales and climate change had been considered in efforts to understand these changes. On the other hand, snow crab and other cold-water species were appearing in new areas. It had been postulated that changes in ocean climate resulted in changes in fish populations, which in turn affected the fisheries.

He noted that climate variability and other global-scale changes affected us locally, and hence Canada supported GOOS and POGO. He noted that, in part due to the biological and fishery changes, Canada had started a programme of monitoring the waters of the continental shelf, which he though would compliment the efforts of GOOS and POGO. He said he was glad POGO chose this area for its meeting, and wished the conference success.

Dr. Sinclair then spoke of the history of ocean observations. He pointed out that 2001 marked the anniversary of a meeting that took place a century ago: in 1901 the heads of many oceanographic laboratories, mostly from Northern Europe, met in Oslo. Their objective was to prepare a research plan for physical oceanography and fisheries. They felt there was a need for international co-ordination. Climate variability was a major topic in 1901. A paper presented stated that there had been long-term climate variability and that these changes affected climate and fisheries. They had a migration hypothesis: the fish migrated under the ice and changes in ice cover affected migration patterns. They came up with a long-term research plan and set up an international research laboratory in Oslo to standardise measurements. They had large-scale plans and large-scale vision. They established co-ordination, and they made sustained observations over the intervening century, and they did training: Sverdrup was trained in this context. There was capacity building aimed in this instance for North Americans. They agreed upon a data management protocol, and standardisation. The message for POGO from this brief look at history was that research directors could make a difference. Dr. Sinclair complemented Dr. Kennel, Dr. Gagosian and Dr. Roe for their vision and for bringing POGO Directors together. He was sure that POGO would be useful, and that the members were doing the same sort of things the directors in 1901 wanted to do.

Dr. Kennel thanked Dr. Sinclair. He then added a couple of points to his own historical recount of POGO. He mentioned that, after securing foundation funding, POGO was in a position to hire an Executive Director. After a long search, Dr. Shubha Sathyendranath was selected. He said POGO was pleased that Shubha had agreed to take over as Executive Director, and that BIO was willing to make a significant commitment and contribution to hosting the POGO Secretariat.

He then conveyed a message from Dr. Gagosian, who had wanted to attend. Dr. Gagosian noted that the agenda looked great, but that the “scheduling gods” were against him. He wished the meeting the very best and said he was present in spirit at the meeting.
The participants then introduced themselves. Dr. Kennel observed that the participants were a diverse group of institutions and international programmes. The purpose of the meeting was to facilitate dialogues between these institutions and programmes.

The agenda was then adopted with a minor modification to include a presentation from Prof. Lappo on the last day of the meeting. Dr. Kennel emphasised the need to arrive at specific actions by the end of the meeting, to be executed by the Secretariat and the Executive Committee.

The Minutes of the Second Meeting of POGO were then approved.

**Main Themes**

**Chair:** Mike Sinclair

The next session, on the Main Themes of POGO, was chaired by Dr. Sinclair.

**Time Series Observations (Action 4 from POGO 2): Bob Weller**

In his presentation, Dr. Weller focused on the activities of the Time Series Working Group (WG). Dr. Weller noted that 2001 had been a good year for Time Series observations. Many sectors had come together. Over the past year, the WG made the approach more interdisciplinary. The Time Series Group had a wide role to play. Their meeting at WHOI in May 2001 was supported by UNESCO, POGO and CLIVAR. A draft report was available, but it required more work. But it was a stepping-stone. The WG came to an agreement on what a Time Series was. It was included in the handout to participants.

At the workshop, the participants tried hard to have each basin represented, as well as to have different oceanographic fields represented. Past Time Series stations were examined, and the requirements of new stations were studied. The density of observations was considered: the southern hemisphere was sparsely occupied. The ocean weather sites were examined to see what was being done currently. The participants worked on the philosophy on how to decide on other sites.

One of the groups they brought in was the DEOS group. Through the last year, in CORE and NSF, there has been a big push to establish seabed observatories and to link them to other projects and disciplines. JGOFS sites and core requirements for JGOFS and climate were shown. Each mooring should meet these requirements. The WG discussed the findings of the meeting on the Indian Ocean. The participants at the meeting made recommendations for time-series sites in the Indian Ocean, and their advice was taken into consideration.

Based on these considerations, a map was produced, showing desirable sites for time-series observations. The participants also came up with a basic strategy for a pilot project. The proposed sites were to be linked to those that were already established, or were planned by various countries. The pilot projects should be able to demonstrate in a short, finite period the usefulness and importance of time-series observations.

The sites that were funded and planned fall into two types: air-sea flux sites and ocean observatory sites. The number of planned sites was encouraging. The conclusions from the effort so far was that there was a lot of progress, the disciplines were coming together well, there was good co-ordination with scientists involved in the study of ocean carbon cycle, such as JGOFS. There were to be a number
of sessions on time series at various meetings. A press release was also planned. In short, the plans for time-series observations were advancing well.

Dr. Weller mentioned that there was a need for a website and a brochure, to think about ways to put forward the benefits of time series observations, and requested help from POGO in this. He also suggested that the draft report and the other issues be discussed further in the discussion group planned to meet in the afternoon.

During discussions that followed the presentation, Dr. Kennel asked what the philosophy was behind the draft report. Dr. Weller reported that the approach of the WG was inspired by that of Argo, and the successful path that they had followed. The WG was looking into collaboration and capacity building. He added that the maintenance of Time Series was a substantial responsibility; hence it was important to have the commitment of POGO directors.

Dr. Ausubel then said that everyone saw the benefits of Time Series observations. The sooner the stations were established the better it would be. He added however, that it would be helpful to know when the scientific benefits would begin to flow. Bob agreed, and pointed out that the WG was planning to showcase some examples that would provide valuable results in the next five years.

Dr. Piccolo had a question regarding the contact person for the planned site off Argentina. Dr. Weller responded that the site in question was advocated by Dr. Edmond Campos. Dr. Narayanan enquired about data policy. Dr. Weller clarified that the tentative plan was to make all data available immediately, similar to Argo. There were additional discussions on how to maintain long-term funding for some selected sites that were operated in research mode and not operational mode. Dr. Hill said it was very hard to get sustained funding, at least in the UK. He suggested that it would be good to link it to operational requirements or to demonstrate that assimilated data from one of these sites would have an impact in forecasting. The high cost of maintaining these sites was also discussed. Dr. Roe reported that some time-series stations in the UK had received funding for five years, but that DEOS had not received funding in the UK. In responding to a question from Dr. Piccolo, Dr. Weller stated that the WG did not consider coastal stations yet, but that it may be necessary to incorporate data from such sites, even if they were not considered directly. Further discussions highlighted the need for operational oceanographic observations to serve the needs of research. Dr. Katsaros noted that research inputs helped maintain the sites up to date, at least in the development phase. The need for standard sets of observations at all selected sites and the need to make these sites multi-disciplinary were also discussed. A small number of core measurements had been selected for the sites based on air-sea flux and JGOFS requirements. Dr. Kennel suggested that it would be useful for the group to identify concerns that could only be addressed through global-scale, operational observations. In discussions regarding criteria for selection of sites, Dr. Weller said that the group examined each site on a feasibility v/s payoff graph. The availability of ship to service the site and the scientific value were considered. The military implications, sensitivities of governments to measurements in the EEZ, and the interpretation of the Law of the Sea in this context were also discussed. Dr. Wilson spoke of the need to convince governments that data from Time Series stations could be as useful as XBT or Argo floats, as long as the data were available openly and freely. The need to apply pressure to obtain continued support for maintenance of Time Series sites, and the role that POGO could play in this context were discussed.
Argo (Action 2A from POGO 1): Dean Roemmich

Dr. Roemmich spoke next. He showed a schematic diagram of the Argo floats that provided information on temperature, salinity and current velocity. It was an integral element of the observation system that was expected to provide the justification for many other elements. Argo was designed to give a real-time climate of the ocean. Data were available on line. Dr. Roemmich spoke of advances in the technology that allowed deployment of floats from air or sea. He spoke of the various applications of Argo, which included contributions to the study of climate and the ocean heat budget. Its broad appeal had helped bring in the resources. Argo was designed to reveal the detailed vertical structure of temperature anomalies and large-scale heat transport at a variety of time scales. He pointed out the role of the oceans in mediating climate change, and the need to study the oceans if we were to understand global warming, and rise in sea level. He also demonstrated how Argo data could monitor the ENSO (El Niño – Southern Oscillation) signal. He indicated that sea level and heat storage were closely linked. He showed a slide to illustrate that the temperature changes could be detected at depths greater than 800 meters, thus highlighting the need for data from deep waters, and not just from the surface. Observations from the deep waters were necessary when longer time scales were considered. He also showed figures to illustrate the use of Argo data to study anomalies in the salt and water budgets. He noted the usefulness of Argo data for modeling. He urged POGO to encourage the utilization of Argo data to the fullest extent.

With respect to the planning, Dr. Roemmich reported that, in 2002-2004, the number of floats deployed would be over 700/year. This was close to the target of around 750/year that was required to achieve a sustained float population of 3000 floats in the ocean at any given time. The Argo Science Team was fairly confident that commitment necessary to attain to the global array is now available. The strategy was to deploy the floats regionally, in high priority areas. Once an acceptable level of floats was attained in a high-priority region, participating countries would contribute to the global array, to cover the less populated regions. Ten of the 15 participating nations already had floats in the water. It was expected that there would be a rapid increase in coverage in certain areas, over the next few years.

Sources of data and information pertaining to the Argo programme included:
Argo science team (www.argo.ucsd.edu)
Argo Information Centre (argo.jcommops.org) - float locations, international co-ordination, links
Global Argo Data Center (www.ifremer.fr/coriolis)

There were many other websites, since many of the PIs operated their own web sites, for example: sio-argo.ucsd.edu.

There was a lot of interest in adding more sensors to the Argo system. Development and testing for biological and geo-chemical sensors were being carried out. Moorings were the best place for testing.

Finally, Dr. Roemmich made some suggestions on what POGO could do:
1. As brought out at POGO-2 by Dr. StanWilson, the Argo programme needed help in making sure that all nations could utilise Argo data. Capacity building was needed for long-term sustaining of the programme.
2. Oceanographers advocated certain elements of Argo. However, it had to be recognized that Argo was not a complete observation system: it should be part of an integrated observation system. As
POGO built a vision of an observation system, it should also work on convincing the world that the total observation system would be greater than the sum of its parts.

Dr. Gould noted that salinity still required some work and wondered how these data would be handled in delayed mode. Dr. Roemmich replied that the quality control in delayed mode would be discussed at the next Argo meeting. They had to agree on how to obtain equivalency of data. There was a semi-automated system in place from PMEL, to compare the salinity data from the float to the high-resolution system that was already in place. Regional centers would be responsible for the delayed mode quality control and the comparison across the region.

Dr. Laura Richards enquired about the team's vision of Argo in the long term beyond the pilot project phase. Dr. Roemmich responded that the vision differed from country to country. The view of the science team was that it was a long-term project. Eventually, the survival of the project as implemented would depend on advances in technology. Currently, Argo was exploiting new developments in technology. Dr. Kennel asked if there was a statement of principles or guidelines that would define the long-term evolution of Argo. Dr. Roemmich replied that it was not yet available: they had had to deal with more pressing issues. In responding to another question on the evolution of Argo, Dr. Roemmich stated that Argo would provide us the statistics of variability: the redesign of Argo could be based on these statistics. Dr. Wilson commented that it was remarkable that there already was consensus on open data policy, and recognition that data had to be available in real-time to be of use.

Dr. Sinclair reminded participants that POGO-1 gave general support for Argo, and that Dr. Roemmich’s presentation was an update on the programme. He drew attention to Dr. Roemmich’s call to promote Argo applications energetically, to help maintain Argo, and suggested that this issue may be given more consideration at POGO-4.

Action Items recommended:

1. Work with Argo to help advance the SEREAD Project.
2. Promote Argo use within POGO member institutions, to highlight its value, and promote its long-term survival.

Report of the Biology Workshop (Action 2 from POGO 2): John Field

Dr. Field thanked POGO for the opportunity to come back to Nova Scotia. His presentation was a short summary of the report. At the workshop, the participants considered a number of points regarding the need for biological observations on a global scale as listed below:

- The role of the oceans in global change
- Obligations under UN Convention on biodiversity
- Collapsing fisheries and stocks: “responsible fisheries”
- Coral reefs and mangrove changes show fragility of ecosystems
- All need long term monitoring, beyond inter-governmental sector
- POGO needed to co-ordinate monitoring and link to physical observations

The participants considered what could POGO do to enhance the biological aspects of the existing elements of a global observational system. The premise was that any proposed observations must serve scientific and societal needs for large-scale ocean observations. The group took into consideration input from SCOR-IOC group on Oceans 2020, the SCOR-IGBP group on Ocean Futures, the
requirements of GOOS and CoML, and on-going and emerging international programmes such as GLOBEC and SOLAS.

Discussions ranged from microbes to fish and whales. Factors that were taken into consideration included:

- Need to record marine biodiversity and functional diversity
- Existing biological and chemical sensors
- Promising new technologies for automation and global observations
- Range of observation platforms examined (satellites to drifters and buoys)
- Need for adequate data acquisition, management and distribution systems
- Needs of southern hemisphere, for obtaining global coverage.

Societal and scientific concerns that emerged during the discussions included the conservation of biodiversity, and sustainable management of living resources, as well as the response of ocean biota to global change, bio-invasion of alien organisms modifying ecosystems, plans to fertilise the ocean with iron and nitrate and threatened habitats.

Major questions for new research that had emerged from the deliberations of the SCOR-IGBP Working Group on Ocean Futures were transport and transformation of carbon, carbon sequestration and the role of marine food webs. There was recognition that these problems were interconnected, and that biological processes below the euphotic zone (the "twilight zone") could be important in understanding the global role of the oceans in climate change. Links between carbon fluxes and biodiversity were understood to be potentially important.

Of the major scientific issues that demand global, long-term monitoring, those that impact on biological aspects were grouped under the following three categories:

1. Global Change and Carbon Cycle
2. Constraints on Primary production and remineralisation
3. Biodiversity and ecological function.

The working group considered the biological sensors that were available for operational use, and those that showed promise of development in the near future. Key variables for biological measurements were identified and tabulated according to their relevance for key scientific issues, their ease of measurement, adaptability to various platforms and cost. Issues related to time and space scales in the ocean were also considered.

Different platforms that were available for biological sensors were also considered. Some of them, such as satellites, had good spatial coverage but observe only the surface and only a few properties. The various platforms were complimentary.

The group also considered data management. Operational oceanography required data archival, data management and data distribution. Science needed timely and free access to data. This required special attention in the case of biological variables, which were more complex and varied than physical or chemical data. Some lessons in data management could be learned from programmes such as JGOFS and GLOBEC that used distributed data archives, and the Ocean Biogeographical Information System (OBIS) for recording biodiversity that was being developed under CoML.
The group also discussed the needs for capacity building, and specific aspects identified for special attention included the following:

- Microscopy
- Ocean Colour (emphasis on extracting information on phytoplankton communities)
- Molecular Techniques
- Data management and assimilation (all nations)

The major recommendations from the meeting were that POGO should link with other marine efforts (e.g. SCOR Regional Centres, GOOS), and initiative Pilot Projects such as those envisaged within GOOS. The importance of involving Partners from developing countries in such initiatives was also noted.

The WG recommended a two-pronged action plan for POGO. The first of these, at the regional level, aimed at developing capacity for biodiversity monitoring at the regional level. The second action aimed at the global level, and targeted phytoplankton dynamics, primary production and the global carbon cycle. These two proposals were deemed viable, and within reach of POGO.

In conclusion Prof. Field mentioned that there was a remarkable consensus on the useful potential role of POGO. There was excitement about new sensor developments, and the potential for operational biological oceanography at the global scale. Finally, there was an amazing agreement among participants on prioritizing the variables, and arriving at a small number of key variables for a global observation system.

During the discussions that followed, several participants remarked that the report was a very good one, and should be more publicized. Dr. Sathyendranath noted that the report was still in a draft form, and that it would be more widely distributed once it was finalized. There were questions on links between POGO and GOOS, and Prof. Field responded that the various GOOS panels were well represented at the meeting. Dr. Roe remarked that there was a degree of pragmatism in the proposed projects and that restrained the ideas that were put forth. Prof. Field added that pragmatism was the main guideline for pruning the variables to a short list. There were discussions on integrating biological and physical sciences, on coordination between the proposed pilot plans and resource surveys, links to other international projects, on pushing new technological advances, on developing the sampling design, and regarding the use of Argo-type technology for biological sampling.

Chair: Roald Vaage

The presentations on the main POGO Themes continued after lunch, with Dr. Roald Vaage as Chair.

Census of Marine Life: Jesse Ausubel

Dr. Jesse Ausubel thanked POGO for the opportunity. He said that POGO was a group that could claim some paternity for CoML. It was important that the POGO Directors understood the program and could therefore promote it. On the other hand, CoML could win political and large-scale support for ocean observations, and thus help the POGO’s cause.

He said that the Census was a ten-year program that would end in 2010 with a report on what was known and what was unknown in marine life. It was a collaboration and partnership of marine laboratories that do research, government institutions that do surveys, and other people with expertise
in biodiversity, for example in museums. It was a scientific research programme, but one that involved working with different groups. He said that Prof. Field’s presentation in the morning made the case for biodiversity, and proceeded directly to the CoML Programmes that fell into three categories:

- HMAP (History of Marine Animal Populations) – what lived in the oceans in the past
- OBIS (Ocean Biogeographical Information System) - what lives in the oceans now
- Demonstration projects
- Future of Marine Animal Populations

With respect to the historical component of CoML, he remarked that any census had more value if it had data from the past, for comparison with the present. CoML aimed to assemble and make available long time series on marine animal populations, and to build a database on marine biodiversity and promote its applications. CoML also planned to show what the populations were like before fishing became important, in the primal or pristine ocean. This would be a valuable reference point, especially in the context of marine conservation. HMAP Case studies were being developed all around the world. A Caribbean center had just been opened that would focus on coral reefs. Three centers had already been established.

OBIS: any information - historical or new - was valuable only if it was accessible. The revolution in informatics was affecting all disciplines. This was discussed a little in São Paulo in regards to genetics. OBIS would be the main infrastructure for the next generation of marine biology. The system needed to assimilate geo-referenced data on all species. In Nova Scotia, the scientific community working on squids began a program. Similarly, different communities were getting themselves organised. The plan was to integrate these data and then produce maps and other products. OBIS was an area in which POGO could take part. It was starting in a bottom-up way, but there would come a time when there would be a need to think about who houses the servers, etc. POGO institutions would need to think about that because OBIS was being established in these institutions right then. This would cut across governmental and non-governmental institutions. OBIS was part of GBIF (created by a ministerial declaration). GBIF was entirely terrestrial and so they requested OBIS to become the marine part of GBIF. All of this was very young and evolving. International committee for OBIS included members from the UK, Germany, Australia and New Zealand, among others.

CephBase was an example of components of OBIS. It was developed in Nova Scotia at Dalhousie University. Once completed, one would have images, distribution maps, and particular analyses such as the collapse of a certain species. The concept of OBIS was very ambitious and might become the living legacy of CoML.

Specific projects and their observational needs: Dr. Ausubel showed a map of the distribution of the initial projects. The goal was to develop about 30 demonstration projects. These projects, along with the other elements of CoML, were expected to lead to a good report by 2010. One of the projects was concerned with the mid-Atlantic ridge. The goal was to survey life in, and above, the ridge, which had never before been measured. The Norwegian R/V G.O. Sars was expected to be used in this project.

Another example was ChEss (Chemosynthetic Ecosystems) through which CoML was hoping to learn more about vent communities. Again, POGO could be interested the initiative. DEOS (Deep Ocean Observatories System) was driven by a seismic motive, not a biological one. Dr. Ausubel asked whether it would be possible to begin thinking about the deep-ocean analogue of the surface-ocean stations that Dr. Weller had talked about.
Dr. Ausubel then talked about bio-probes, which Prof. Field had also mentioned. A couple of the projects planned to use animals as the platforms for sensor. In one of these projects, Dr. Barbara Lock aimed to tag 5K animals (10 or so species) and to follow their behaviour for a year and a half. The animals would provide information not only about where they are, but also about the ocean: the probes made good CTD measurements.

He then spoke about salmon. Under the leadership of David Welsh, off the west coast of Canada, they hoped to stimulate the construction of a set of coastal curtains (navy permitting) that would be useful in surveying many types of animals that stayed on the shelf. The plan was to tag the salmon as they left the rivers and then follow them up the coast. Not many receivers were needed to listen to the tagged animals, and it could be a very interesting part of the global ocean observing system, if there were curtains like this up and down many coasts. This was a demonstration project that could be used for other species, if successful.

Regarding the current status of the project, Dr. Ausubel stated that half a dozen projects were underway. Some field experiments were expected to start by late 2002. Most of them would be completed in 2003-5. During that time 25 more projects would be developed. It was hoped that regional/national committees would be able to identify the most feasible and valuable projects.

Dr. Ausubel concluded by stressing that the Census had tended to set very high demands for biological observations in the oceans. This was true whether it was deep-ocean, vents, open-ocean, or ridge systems that were being studied, or innovative ideas that were being developed, such as coastal curtains or bio probes for learning about the behaviour of animals and the physics of oceans. There were also challenges in integrating many observations and observational programmes that go on. He added that the leaders of POGO institutions could play useful roles in addressing these issues.

Responding to a question from Dr. Richards on the long-term vision of CoML, Dr. Ausubel said that it obviously would not be possible to count every fish in the sea. The scientific steering committee had decided that they wanted to build upon the data that was already being collected reliably, but they wanted to go beyond that. The Steering Committee felt that they should stimulate projects that would yield some figures in areas that were completely unknown. The aim was to say what was known, as well as what was not known. They hoped to fill in some of the blank spots, and show what had not been visited or counted.

Dr. Peter Frank asked if CoML had any intention to study single-celled organisms. Dr. Ausubel replied that they did have some discussion about that. They had conversations with the microbial community to see how it might be possible bring this in. It was up to the microbial community to step forward and tell CoML what the big next step was. If they came forward with an idea, then it would be embraced by the Steering Committee of CoML.

Dr. Kennel then enquired whether CoML would be able to respond to questions regarding the health of marine life. Dr. Ausubel replied that the baseline information on most of the species in the ocean was so poor that it would be difficult to say whether populations were better or worse relative to a decade ago. The exceptions were the species near the shore that were fished regularly. So when people asked for real information on marine biodiversity, it was very hard to supply suitable responses. Currently, it was not even possible to give a range of how many species there were in the oceans.
A Biodiversity Workshop in S. America: Shubha Sathyendranath

This was followed by a presentation on a proposed workshop in South America. Professor Gallardo was to make this presentation but he was unable to attend. The proposal was related to presentations earlier in the day, and to the question of how POGO and CoML could assist in monitoring biodiversity. The goal was to compile information on what was known on marine biodiversity in South America and to develop pilot projects. The idea for such a workshop emerged following the Dartington Meeting, and was taken forward at a meeting organized by the Census of Marine Life Meeting in Mar del Plata (Argentina). It was also a follow up to the São Paulo Declaration to enhance biological observations in the Southern Hemisphere.

The goals of the workshop were to foster the goals, initiatives, ideas, and technologies of both CoML and POGO, and to explore possibilities for local and north-south cooperation in the South American region.

The objectives of the workshop were stated as follows:

- To learn about CoML and POGO and of the opportunities for international cooperation in new projects related to biodiversity and ocean observations
- To exchange information on South American national activities and priorities in the area
- To identify possible new projects addressing problems of either regional or global relevance
- To create a regional committee to promote new initiatives in this area

The expected outputs were development of concepts and priorities for new field projects in the South American Region; formation of a South American Committee for the Census of Marine Life and POGO initiative; and publication of Workshop Proceedings (preferably in both English and Spanish).

The proposed venue was the Universidad de Concepción, Chile, and the tentative dates were 3-4 days in the first or second week of November 2002. Dr. Sathyendranath added that there were still a lot of details to be worked out. They would work further on the proposal and would submit it for funding support to the Sloan Foundation, provided there was sufficient interest in the POGO community.

Dr. Weber and Dr. Knap commented in favour of the marine biodiversity initiative in S. America.

The Indian Ocean: A Regional Focus for POGO 4. A proposal: Ian Poiner

Dr. Ian Poiner followed with a presentation that put forward the Indian Ocean as a regional focus for the next POGO meeting.

He began by putting forth three main arguments why the Indian Ocean merited special attention: 1.5 billion people were profoundly influenced by the Indian Ocean; many of the problems were shared by the people in the region, and were best addressed by regional approaches to observing systems; and finally, the Indian Ocean was poorly studied, compared with other oceans. The major societal concerns included storm surges, defence and fisheries. On the science side, there was a need to promote process studies with priority on fluxes. Hydrological cycle and salinity were key elements. There was a need for integration and links with user communities. One of the draws for the Indian Ocean was capacity building and regional co-operation. A sustained observing system for the Indian Ocean was both desirable and feasible.
He then summarized recent activities in the Indian Ocean. Various meetings had occurred, including the following:

- Workshop on Sustained Observations of Climate in the Indian Ocean (SOCIO), in November 2000, Australia, discussed societal and science drivers and issues.
- Argo: IO Implementation Planning Meeting in July 2001, India, developed national commitments. Argo deployment was progressing.
- GOOS: IO GOOS Indian Ocean Principals’ Meeting was held in Nov 2001, in India. This led to the establishment of a development committee.

Dr. Poiner highlighted the need to integrate physics and ecology. He illustrated the point using fisheries and tagging as a telling example: conventional tagging data became much more useful when combined with other information such as sea-surface height, sea-surface temperature. Such information was extremely useful, besides being exciting science.

He added that very little was known of the biodiversity of the high seas, and this was an important issue, particularly in the Indian Ocean. Better knowledge could lead to better management.

He suggested some possible themes, if POGO-4 focused on the Indian Ocean:

- Seasonal (monsoonal) and inter-annual variation, and the role of the Indian Ocean in the climate system
- Whole system integration - physics, chemistry, biology, impacts
- Storm surges in Southern Asia
- Coastal issues - links between basin, shelf, coast and terrestrial systems
- Continued development of the Indian Ocean observing system
- Biodiversity conservation
- Capacity building to use operational products (IO rim countries and IO Island states)
- R/V co-ordination - vessel time was certainly an issue in the Indian Ocean.

He offered to host POGO-4 at CSIRO Hobart. It was the head of marine research in Australia. In conclusion, he remarked that POGO4 could help provide direction for the continued development of a sustained observation system for the Indian Ocean; for the use of the data for whole system integration and understanding impacts; and for improved capacity building to use operational products that targeted the Indian Ocean rim and Indian Ocean Island Nations.

The comments from Dr. Roemmich, Dr. Roe and Dr. Gould were in favour of having the Indian Ocean as a regional focus for the next POGO meeting. Dr. Gould added that CLIVAR had a large emphasis on the Indian Ocean. It was grappling with its implementation strategy. He pointed out the need to avoid duplication of effort. Dr. Poiner responded that POGO could examine the several initiatives that were going on, and help minimise duplication and maximise efforts.
Towards a data assimilative model of the North Atlantic: Progress and Prospects: Dan Wright

In the last formal presentation of the day, Dr. Dan Wright from BIO spoke about efforts that were being taken locally that would assimilate data on the North Atlantic. The work was being carried out with Prof. Keith Thompson from Dalhousie University.

The basic goals of the study were to:
1. Develop a methodology that allowed realistic simulations at affordable resolution.
2. Interpret decadal scale changes in hydrography.
3. Provide physical information to biologists studying primary productivity.
4. Provide optimal estimates (nowcasts) of conditions for initialisation of climate change simulations and regional studies.

The model used was of a coarse resolution: a third of a degree model, which has been in use for 10 - 15 years. He showed a slide of the diagnostic estimate of the annual mean stream function, which was based on putting salinity and temperature data into the model. The results were not satisfactory. This was a typical result from modelling done at such a resolution. To avoid the problem, one had to go to about a tenth of the degree resolution, and that corresponded to a tremendous increase in computer resources. The issue was to restore the model to the mean. This had problems because of seasonal changes and mixing processes. So the restoring curve was replaced by only the climatology. This created a model with a reasonable background. He showed one set of results with seasonal nudging that matched the observed data. The nudging maintained the mean but allowed variability. What they had at this stage was an efficient way to keep the model on track. When one assimilated Argo data into a model, one had to be sure that the model would not drift. That part of the work was now done. So they were now moving on to assimilating Argo data into their model.

He then discussed the nature of the challenges involved in assimilating Argo data. If one had three buoys relatively close to each other, off the coast, the model ran through a couple circulation patterns, accounting for temporal correlation of information. Also, if one looked at the hydrographic information from the three floats, say one propagating along the slope, one within the Northern recirculation, and one that started in an eddy but escaped, it would be difficult to figure out what was going on. There were a lot of challenges. But both DFO and Dalhousie were encouraging them to take up this challenge. The plan was sketched out for the next four years. They would be looking for graduate students to get involved in the work.

Dr. Sinclair asked if the nudging would not distort the variability they were looking at. Dr. Wright replied that it did distort it a bit, but that it was much better than before. The indications were that the model was doing the right thing but there was more work to be done to make sure. Dr. Wilson noted that it was important to get positive feedback, to maintain funding for projects such as Argo funded, and enquired if he saw improved forecasts due to this modeling. Dr. Wright replied that he was going to hindcast over the last 40 years. They were also working on making the model results widely available. They also hoped to get the data into a national archive. The model results helped show major problems with current datasets.

Dr. Frank enquired about the possibilities of assimilating data into biological models. Dr. Wright replied that he advocated the use of simple models and an incremental approach. Ocean colour gives some of the necessary information. Dr. Vaage then asked about the uses of the model for biology, and Dr. Wright replied that the model could contribute most to studies of the low end of the food chain.
mostly for phytoplankton and to some extent copepods. Dr. Poiner added that such models could also serve a descriptive purpose for fisheries.

This brought the main session to an end for the first day. It was followed by three informal breakout sessions.

**Breakout Sessions**

Each of the sessions were chaired by two people:

1. Biology: **Chair: John Field/Mike Sinclair**
2. Time Series: **Chair: Bob Weller/Ed Hill**
3. Indian Ocean: **Chair: Ian Poiner / Nick Owens**

**Wednesday, November 28**

**Capacity Building (Action 5 from POGO 2)**

**Chair: Howard Roe**

Dr. Roe reminded the participants that he had made a presentation on capacity building in São Paulo. He remarked that the Fellowship programme was quite exciting and it was not off the ground at that time last year.

**Fellowship Programme, ASI: Shubha Sathyendranath**

Dr. Sathyendranath spoke about the fellowship programme, which had been put in place with help from IOC and SCOR, and the Austral Summer Institute (ASI). At POGO-2, the participants decided on a few initiatives in capacity building. These were:

- POGO-IOC-SCOR Visiting Fellowship Programme
- Participation in, and co-sponsoring of, on-going training programmes of other organisations
- Advertise existing programmes in Training, Capacity Building
- SEREAD Project (Scientific Educational Resources and Experience Associated with the Deployment of Argo drifting floats in the South Pacific Ocean)
- POGO participation in the WHOI-UdeC Austral Summer Institute

In addition to setting up the Fellowship Programme, POGO also decided to participate in on-going training. Dr. Stuart, in her presentation, was scheduled to talk about POGO involvement in IOCCG training course. Ms. Hunter was to make a presentation on advertising through the POGO web, Dr. Roemmich on SEREAD.

The Fellowship programme was implemented in 2001 with generous support from IOC and SCOR. The announcement went out in April and stayed open for 2 months. There were 42 applications with a regional/national breakdown of 10 from India, 12 from South America, 5 from Indonesia and none from Africa.
Once the application process was closed, a committee of three (from IOC, SCOR and POGO) went through the applications and ranked them based on the following criteria:

- Quality of application;
- Relevance to POGO priority areas;
- Potential capacity-building
- Regional impact
- Regional distribution of awards

Based on the review, fellowships were offered to 13 fellows. [See presentation on POGO web for home and host institutions of successful candidates.] The committee also managed to achieve a balance of male (7) and female (6).

The programme had so far received two negative comments: 1) POGO should cover expenses at the host institute; and 2) POGO should concentrate on training courses to be cost effective, instead of fellowships. However, the overall response had been very positive and many host institutions had been more helpful than could have been expected. Some have even provided additional funds to make it feasible. She quoted from a host supervisor from the USA:

“The fellowship program provides an excellent opportunity for young investigators and technicians to be immersed in a professional environment, have contact with experts in the field, and develop stronger links with present or potential colleagues. POGO provides a mechanism to develop technical skills. … POGO helps develop good will and understanding between different cultures. This is a wonderful program, and all efforts should be made to ensure its continuity.”

Funding was in place for 2002, again thanks to IOC and SCOR, and the proposal was that POGO continue the programme in 2002. In addition, she proposed that a visiting professorship be added. POGO would pay travel and honorarium. The host institute would pay all local expense. It would be up to the developing country to make the request.

Austral Summer Institute: It was a UdeC and WHOI initiative on specific topics in Oceanography. It provided training for Chilean students and the primary source of professors/lectures were from the US and Chile. POGO’s role had been to provide funds to non-Chilean, Latin American participants to attend the courses. Last year POGO provided funds for 2 Argentinean students to travel to Chile, and UdeC covered local expenses.

The ASI had approached POGO for support for five participants from South American countries (other than Chile) in the next ASI. These five had been pre-selected from all applicants by the ASI. She recommended that POGO support all these five candidates.

There were questions from the floor on how the visiting Professorship might be structured. There were also discussions on the need for the Fellowships to stay focused on increasing large-scale observations, and on the role that POGO could play in advertising other existing opportunities for training on the POGO web site. The funding implications, and links with GOOS initiatives were also discussed. In general, it was felt that the Fellowship and training programmes were working well, but might need fine tuning, as and when necessary. Dr. Piccolo commented that there was a really nice outcome from the Argentinean students going to the ASI. They were invited to attend a course that occurred after the ASI, and thus a communication was established between Argentina and Chile. Dr. Richards noted that PICES would be willing to help POGO with the Fellowship programme. Dr. Sathyendranath requested information on agencies from participating countries that might be interested in funding the program.
SEREAD: Dean Roemmich

Dr. Roemmich began by reminding his audience that the southern, western Pacific was basically nothing but EEZs. There was a real need to get floats into that region because of the ENSO effects, and progress had been made. A regional body known as SOPAC was working on the EEZ issue and they had all agreed to allow Argo floats into their EEZs. He gave credit to Dr. Stan Wilson for a lot of the progress. The arrangement was that the Argo team had to inform a country if it was deploying in the EEZ of any country, and then also help them to use the data, particularly in secondary education. The SEREAD programme was conceived in this context. SEREAD was a secondary education program aimed at generating awareness and understanding by Pacific Islands students of ocean/climate science. SEREAD would utilize Argo floats and other internet-accessible ocean data. SEREAD was developing locally relevant teaching resources for Pacific Island secondary schools, within existing curricula. It was a collaborative effort involving ocean scientists, secondary teachers, and education ministries.

He said that the textbooks in the high schools were often from developed countries, and the material was often not relevant to the students, and it made learning more difficult. SEREAD did not create the curriculum, but it planned to provide relevant teaching resources. SEREAD could provide material and examples to provide relevance in science curriculum. They were not limited to Argo data, but it was a starting point. Later, it would include other internet-accessible data.

The SEREAD Steering Committee held its second meeting in Suva Aug 20-21. Than Aung (Univ South Pacific) was the Project Leader.

A SEREAD Prospectus has been written. Contacts had been made with education ministries, and schools were being identified for participation in the pilot phase of the programme. Required teaching resources were to be identified, including development of a SEREAD web page. School visits were planned prior to the end of the 2001 school year.

Thus, the project was moving forward. Resources for this came from a number of organizations: The time and travel of all participants were donated. The funding used so far had been for the visits of Dr. Aung to schools, and related activities. The project leader was really putting in a lot of time, and in order to really work, SEREAD needed to support the project leader at least 1/2 time so that he could really do what was needed to go forward.

Dr. Kennel asked to what extent the experience would be transferable, if another region should wish to emulate SEREAD. Dr. Roemmich responded that SEREAD was based on a model that would be transferable. They thought the need from the South Pacific region was the most pressing, but that it should be possible to repeat the effort elsewhere. Dr. Roemmich thought that there might be a need for some other experts, perhaps different members of the Argo Science Team, to develop material for other regions. Dr. Kennel thought that POGO might be able to help with the development of material for other regions. Dr. Sathyendranath informed the participants that a Professor from Dalhousie University had shown interest in a SEREAD-like approach to teaching oceanography in Canadian schools. Dr. Roemmich said that such interested people should be directed to Bill Erb, or to Than Aung. A problem was that the internet interface had not been implemented yet.
The São Paulo Declaration (Action 1 from POGO 2) Follow-up

This was followed by two presentations on capacity building in the Southern Hemisphere that were relevant to the São Paulo Declaration of POGO.

JAMSTEC Hydrographic Survey Plan in the S. Hemisphere: Masao Fukasawa

First, Dr. Fukasawa spoke about JAMSTEC's plans for the Southern Hemisphere. JAMSTEC wanted to enhance research capacity for the Southern Hemisphere, so they proposed a hydrographic survey plan for the Southern Hemisphere.

JAMSTEC had four activities in the Southern Hemisphere: Pacific/Indian tropical oceanography, Pacific/Indian General ocean circulation, Arctic Oceanography, and Ocean Carbon Cycle. The second and fourth of these could benefit from the São Paulo Declaration. He highlighted some of the projects in the Southern Hemisphere. There were 4 scientific priorities: heat and freshwater flux, basin/inter-basin overturn, ocean carbon cycle, and 4D interpolated data base (Earth simulator).

TaV-PI was a very big project in Japan, in which a number of Japanese researchers participated. So one had to pay attention to the expected role of Japan in international research programs such as WOCE and CLIVAR. Japan was mainly responsible for the North Pacific. But thinking of the São Paulo Declaration, they considered doing something more southern, such as having a cruise along WHP lines. So JAMSTEC had proposed a circumpolar cruise down around 30° South. It would include 17 multiple core sampling stations. It would also have CTD transects.

An outline of the cruise was presented as follows:

- Six legs (4 legs for WHP) by R/V Mirai
- Port calls at Brisbane, Papeete, Valparaiso, Santos, Cape Town and Freemantle
- All stations of WHP lines will be re-occupied
- Every station includes a surface-to-bottom CTDO cast with 36 Niskin bottles of 12l, LADCP and transmissometer
- Sampling parameters are salinity, DO, nuts, CFC11, 12, 113, TAlk, DIC, DOC, pH, 14C, 3He/4He
- Underway measurements are meteorology, pCO2, surface T, S, nuts, ADCP, bathymetry (multi narrow beam), geo-magnetism
- Data will be delivered to WHPIO (if still existed) and also through JAMSTEC HP within three years.

The cruise would be on the R/V Mirai. There were rooms for 40 researchers, two main winches, 9 major labs (w/5 dry labs), and also underway facilities. The cruise would be long and pass many borders, so they anticipated many problems: EEZ problems, failure of apparatus, preparation of chemical regents and their disposal. So they asked for help from the institutions present. There would be room on the cruise for up to six people in each leg that could be used for the capacity building asked for in the São Paulo Declaration. The CLIVAR website had more information on the proposed cruise.

Dr. Kennel remarked that the São Paulo Declaration had found a listener and that JAMSTEC had responded in a very concrete way. This was a very positive development. Dr. Fukasawa noted that this was a contribution to CLIVAR, and he acknowledged the leadership of Mr. Chijiya in making the
initiative possible. Dr. Gould enquired about the delivery of the data, particularly of the hydrographic sections. Dr. Fukasawa said they would like to have the data up in one year. The data would be available for all researchers everywhere in three years. Dr. Sathyendranath remarked that it was a very impressive proposal, and offered to work with JAMSTEC on the capacity building aspects of the cruise. Dr. Ulloa said that Chile had a related research project, and offered to work with JAMSTEC on the cruise initiative. Dr. Fukasawa responded that they were hoping for collaboration. Dr. Weber also promised support. Dr. Kennel thought that having an educational element to the cruise might be desirable. Dr. Roe remarked that the Volvo Around the World Yacht race was doing something similar to Dr. Kennel’s suggestion, very successfully. He added that SOC was also discussing participation in the JAMSTEC cruise. They were planning a cruise that would parallel the JAMSTEC cruise in certain portions. Dr. Harry Bryden was the contact person for the SOC cruise. Mr. Chijiya requested cooperation and assistance from POGO directors with the program. They wanted that these plans be made known widely. Dr. Fukasawa was the contact for the project.

Chilean Efforts to enhance SH capacity: Osvaldo Ulloa

Dr. Ulloa spoke about some of the initiatives that had taken place in Chile since the last meeting.

- A New Chilean Center for Ocean Research (COPAS) to study the eastern South Pacific was being established. The centre would carry out large, basin-scale activities relevant to POGO.
- The Second ASI was planned, with physical oceanography as the theme. Three more institutes were also planned for, with the themes of new observing technology, ocean and climate, and paleo-oceanography. They were all related to POGO initiatives.
- Laboratory for instrument calibration and development was planned. There was a need to ensure that observations produce high quality data. The planned facility would be capable of calibrating CTD and similar instruments. They had the support of Scripps Institution, and expected to become functional by March 2002. On a small scale, they would be able to provide support for other countries in the region. They could use this facility for capacity building in the region.
- New Research Vessel: The situation with their research vessel was that Chile had only one Research Vessel, built in the 60s, and owned and operated by Navy. It was to be decommissioned by 2004. A committee was formed in July to tackle the problem of finding a replacement ship. The objective was to develop and implement a plan for the replacement and administration of the research vessel.

They were planning for a ship of at least 60 m in length, preferably around 70 m. Crew would be needed, as well as equipment. The committee considered alternatives: A new ship, a ship operated by an international body, or a used ship. A new ship was desirable, but unlikely, although they would continue pursuing the idea. They consulted Dr. Bernal about a ship with an international ownership, if there was sufficient interest. The third option was to try to find a used ship, with the money coming from private foundations. They had been searching for a ship that could last around 10 years. They were also looking into problems of administration, and had found a private company that would be willing to operate the ship, in a not-for-profit capacity.

Dr. Roe remarked that the problem would resonate in a lot of countries. They had gone through a similar process and were trying to replace a ship in the UK, and were willing to share their experiences. Dr. Bernal said that it was worth looking at the Ocean Drilling Programme as an example. It was a successful international programme. In science, one has to think globally and share responsibilities. There had been discussions at IOC about acquiring a ship with a UN flag. Chile had built a research
vessel for Iceland, which showed that the technology existed in Chile for it to build its own research vessel. He wondered if it would be possible to form a consortium to help solve the problem: he exhorted the audience to be visionaries, to make a concerted effort to solve the problem.

Dr. Roe responded that Dr. Bernal’s remarks echoed thoughts that are around the world. In Europe, there was talk of a European fleet, a concept of shared infrastructure. But the ideas had not got far because of nationalist issues, and because of differences in scheduling and research needs of various countries. A solution in this was not likely to be rapidly forthcoming. The drilling program was a success in this area, but it was a very focused programme, which made it a bit easier. In Europe, they do share major equipment, and that was an optimistic sign.

A lengthy discussion followed, in which Dr. Hill, Dr. Vaage, Dr. Piccolo, Dr. Gould, Dr. Weller and Dr. Weber participated. There was general consensus that large infrastructure such as ships remained a shared problem to which shared, innovative solutions had to be found. There were lessons to be learned from the failed attempts of the past to address this problem.

Links to other Agencies and Programmes
Chair: Peter Lemke

IOCCG: Venetia Stuart

The first presentation in this session was by Dr. Venetia Stuart, who spoke about the International Ocean Colour Coordinating Group (IOCCG). In the field of ocean colour, it was essential to have international co-operation to collect and validate data. There were standard products generated from ocean-colour data, as well as additional products. Many of these were still under evaluation. There were also a number of derived products. Applications of the data could be grouped into three broad categories: (1) quantifying ocean carbon flux, (2) ocean ecosystem studies, and (3) coastal zone monitoring and management.

IOCCG was established in 1996 and endorsed by CEOS. It had a project office at BIO and was chaired by Dr. Trevor Platt. There were about 20 members on the committee, which consisted of scientific members and members nominated by space agencies. Members were rotated periodically.

The aims of the IOCCG were to develop a consensus among users on key issues related to satellite-ocean-colour science and technology; advocate the importance of ocean-colour data to the global community; optimize quality of data for calibration and validation; broaden the user community for ocean-colour data through advanced training courses; promote the long-term continuity of satellite ocean-colour data sets; and facilitate merging and access to ocean-colour data.

The IOCCG addressed these goals through the formation of specialised scientific working groups; capacity building initiatives; co-ordination with other scientific programmes and international bodies (SIMBIOS, CEOS, IGOS, POGO, JGOFS); IOCCG web site, which acted as a comprehensive site for information on ocean-colour (http://www.ioccg.org); and bi-monthly ocean-colour news. Newsletter went to about 1000 names via email.

There were three working groups that had completed their work and have produced reports. In addition to these three, there were a number of working groups that were currently active on:
1. Calibration of Ocean-Colour Sensors to Common Standards (Chair: Dr. R. Frouin).
2. Comparison of Atmospheric Correction Algorithms (Chair: Dr. Menghua Wang).
IOCCG had another broad focus in Capacity Building, and had organized many training courses. In Training Course Number 6, POGO was a cosponsor and this was very helpful. Reports of all these training courses were on the IOCCG web site. The response of students at the end of these had always been very positive. IOCCG also had other capacity building initiatives. For example, it sent 8 Russians to a conference on marine optics in Moscow, it helped organise a workshop in Noumea, it participated in the SEAMEO course in Indonesia. The origin of students who attended the courses was world-wide.

She identified common ground between IOCCG and POGO as follows:

- IOCCG observed from space, but the need to validate data requires in situ observations, so there was overlap with POGO.
- Both were interested in optimising the quality of data (for calibration and validation)
- Both were concerned with data access and exchange and improving data policies
- Both strived to build a long-term, global, time series of data necessary to monitor environmental change
- Both had a strong mandate in capacity building

She then addressed how the two groups could co-ordinate. The IOCCG submitted a list of essential and highly desirable measurements to POGO for the biology workshop. In addition to the in situ measurements at stations, there were a number of measurements that could be taken in transit that would also be useful for ocean-colour validation and applications. If POGO could advocate the taking of these types of measurements, it would go a long way in solidifying the quality of ocean-colour datasets.

There were currently six sensors in orbit, but not all were global or operational. There were four more sensors to be launched in the near future. However, the future of ocean colour was not secure. POGO and the IOCCG could work together to address this problem.

A third area where IOCCG and POGO could collaborate was in capacity building. She listed some of the planned activities of the IOCCG, and invited POGO participation. There were training courses planned to be held in Cape Town (December 3-13, 2001) and New Caledonia (September 2002). Furthermore, there was a proposal led by Dr. Robert Frouin to conduct an ocean-colour training cruise jointly with the Shirshov Institute. The plan was to use R/V Akademik Ioffe. The main issue was one of raising sufficient funds in a timely fashion, to carry out such a cruise.

She summarised areas of co-ordination as

- encourage in situ calibration/validation efforts to optimise data quality
- encourage studies involving coastal algorithm development
- support plans for development of an uninterrupted, global stream of ocean-colour data (ensure continuity)
- support ocean-colour training initiatives (POGO Fellowships, sponsoring training courses)
- provide POGO representation at IOCCG Committee meetings (Next meeting 10-12 January, 2002, Villefranche, France)

She noted that the POGO Fellowship Programme was also useful for the IOCCG.
Dr. Kennel noted that he was partial to this programme. When he was at NASA they noted what had come to pass – there was going to be a number of ocean-colour sensors in space. There was a need for calibration and inter-calibration. He remarked that the US programme SIMBIOS was born out of this concern. He thought that such efforts were a very positive development. Collaboration of those who make the measurements on the ground and those in the air needed to be increased.

Dr. Narayanan enquired after the long-term retention of trainees. Dr. Stuart replied that a formal survey had not been done, but the general response appears to be very positive. Dr. Sathyendranath added that the long-term effect and benefit vary very much from country to country or institution to institution. Some times one had to wait for many years to note a response, but some responses were immediate.

**GOOS and COOP: Tony Knap**

Dr. Tony Knap then reported on GOOS and COOP (Coastal Ocean Observing System of GOOS) and OOPC. He was the co-chair of COOP, along with Tom Malone. Since COOP was fairly new, he spoke mainly of concepts and principles rather than implementation. COOP came out of three panels that dealt with public health, living marine resources and ecosystem health. In COOP 2000, the terms of reference were defined. The sponsors were IOC, UNEP, WMO, ICSU, FAO and IGBP. The terms of reference dealt with coordination with OOPC, GCOS and GTOS to formulate design and implementation plans; marine services and public safety; public health; ecosystem health; and living marine resources. It was an organisational effort to co-operate, co-ordinate, and collaborate, to take what existed and to facilitate a more cost-effective use of the existing infrastructure. Within GOOS there were only two panels. COOP had the responsibility to deal with the non-physical aspects of observations, and he thought they could work with POGO on this subject.

Benefits of COOP would include dealing with the effects of climate change on people; improved forecast and more effective mitigation effects of storms; improved detection and prediction of effects of climate change; and safer, more efficient marine operations. In addressing changes in the status of coastal ecosystems and living marine resources, COOP could help protect/restore habitats and mitigate effects of human activities on coastal ecosystem; and manage (sustain, restore) living resources in an ecosystem context.

He identified the following phenomena of interest, related to major coastal issues:

- Marine services and public safety: sea state, sea ice, coastal currents, flooding, shoreline changes, shallow water bathymetry
- Public health: seafood contamination, abundance of pathogens
- Status of coastal marine ecosystems: habitat, biodiversity, HABs, invasive species, water clarity, hypoxia
- Status of living marine resources: abundance and harvest of exploitable living resources, disease and mass mortalities

He addressed the question of why a global system was required for coastal ecosystems. The system as envisaged would begin on a local scale, but there would be regional enhancements. He pointed out that coastal ecosystems had external forcings, such as global warming and sea level rise; extreme weather events; ocean currents, waves, tides and storm surges; river and ground water discharge; physical
restructuring of the environment; construction of impervious surfaces and dams; harvesting living and nonliving resources; nutrient enrichment, sediment loading, chemical contamination; and introductions of non-native species. He noted that phenomena of interest were related through ecosystem dynamics, and suggested that robust physical-ecological models were possible; there was a small set of variables that would serve many needs if measured for sufficiently long periods on regional to global scales. He showed a table of common variables that had been developed by the panel. The idea was to have a global backbone that would be regionally enhanced. The goal was a user-driven, end-to-end system that would make integrated and sustained measurements.

POGO and COOP had scope for coordination in the selection of common variables, selection of key variables for coastal issues, selection and justification of time series stations, providing expertise in pilot project selection and implementation, and in capacity building.

During discussions, Dr. John Cullen added that COOP wanted to have a transparent procedure that would lead to the selection of a minimum number of variables, and maximum number of phenomena detection. Dr. Knap mentioned that, at the start of each meeting, one day was devoted to user groups of the region, so as to obtain an idea of what the regional enhancements should be in each region.

Dr. Knap then proceeded to make a presentation on OOPC, on behalf of Dr. Neville Smith. OOPC had multi-purpose objectives: climate change, carbon inventories, rising sea level, slow climate variations, forecasts for ENSO and other phenomena with interannual variability, phenomena with intra-annual to seasonal variability, and ocean forecasting, among others. Many things were happening; GODAE and Argo; UNFCCC/GCOS Adequacy Report; Indian Ocean and South Atlantic plans; SURFA; and the Global Ocean Time series Observatory System, which was tied closely to POGO.

There was on-going work on SST, SOOP, ENSO, remote sensing, sea-ice, repeat hydrography, carbon cycle, JCOMM, data and information management. He noted that OOPC and POGO were working well together on such things as Argo and the time series observatories.

Dr. Kennel then recounted some discussion within the Pew Commission. There was ubiquity of scientific issues around the world. Where there was no ubiquity was in the approach to the solution. Nor was there a common perception with respect to the seriousness of the issues around the world.

Dr. Sinclair noted that the human activities surrounding a locality should be treated as the human variable. Dr. Bernal added that most global observing systems were not user driven, they had been driven by science. Someone had to make an explicit effort to involve the users. Dr. Knap responded that they had been trying to get the real users involved through the user forums. Dr. Piccolo then raised a question about how the user and the science community would communicate. Dr. Knap responded that one of the aims of COOP was to see if the scientific programs that existed could be made into operational programs that could be integrated into COOP, if a user requirement existed.

**IOC, IGOOS and IGOS: Patricio Bernal**

Dr. Patricio Bernal said that IOC had its last assembly in July and members had discussed POGO and they welcomed the initiative. There were two main comments from the governments to POGO:
1) Continue efforts to avoid overlapping of POGO and other programmes;
2) POGO could be a good tool for capacity building. There was a need to continue to build linkages. This was a welcome activity.
The IOC was restructuring its science programs to better adapt them to international science today. The IOC was now focusing on "ocean ecosystem science" addressing the integration of research in physics, chemistry, and biology. Carbon and climate was another stream of science, as was marine protection and science for coastal management.

The IOC would continue to work with POGO, as in the fellowship program, and also look for ways to increase the activity. In general, UNESCO had had a lot of success with a twinning program that brought together a northern hemisphere institution with a southern hemisphere one. It created a platform for activities such as education, social science and eco-tourism. That scheme could be mapped into an ocean-centered network. If POGO came with such a program to IOC, they would probably adopt it.

The leadership of IGOOS had been renewed. IOC was asking for a review of the structure of GOOS. JCOMM had been created, and it belonged to both WMO and IOC/UNESCO. One meteorologist and one oceanographer per country were nominated to help plan it. It would meet every four years and would work through technical subsidiary bodies.

Dr. Wilson noted that, similar to the discussion of Chile’s need for a ship and looking beyond nations, there was a recognition at the IGOS meeting that there was a need to look beyond nations to get the implementation of GOOS, particularly around the Mediterranean. There were various observing systems within IGOS: UN sponsored activities on the one hand, and CEOS on the other hand. IGOS was a mechanism to entrain the resources in the space agencies of the world to build global observing systems.

A milestone in IGOS was when a joint CNES, NASA, EUMETSAT, NOAA announcement was made to provide the follow up to JASON-1. It was planned to have one IGOS meeting annually, and to have one-year chairmanships - one from UN, one from CEOS – that ran in parallel, but out of phase by six months. The plan was to decouple IGOS and CEOS meetings.

The themes of IGOS include: oceans theme; global carbon theme; global water cycle theme; geological and geophysical hazards theme; and coral reef theme. IGOS was considering a coastal theme.

Dr. Bernal believed that the global observing system would be largely funded by public finances: but to obtain those funds, a strong private sector advocacy was needed. Dr. Knap responded that a problem with getting private industry interested was the difference in culture between science and industry. The time frames were different. This was going to be a big issue for GOOS. Dr. Bernal agreed that it was a cultural difference that needed to be addressed, to have the observing system that was envisioned. Dr. Katsaros remarked that an altruistic attitude was needed at times.

PICES: Laura Richards

Dr. Laura Richards then spoke about PICES, which stood for the North Pacific Marine Science Organization. She was interested in the similarities that existed between POGO and PICES. Her presentation was created by Alex Bychkov, and was divided into five different sections.

She spoke first of the role of PICES. It was an intergovernmental scientific organization established in 1992 to:
• promote and co-ordinate marine scientific research in the northern North Pacific and adjacent marginal seas, particularly north of 30ºN;
• advance scientific knowledge about the ocean environment, global weather and climate change, living resources and their ecosystems, and the impact of human activities on them; and
• promote the collection and rapid exchange of scientific information on these issues.

Current members were Canada, Japan, China, Korea, Russia, and the USA (it was hoped that Mexico would soon join PICES).

One of their monitoring initiatives made use of the Continuous Plankton Recorder (CPR) for wide-scale monitoring of the zooplankton in the North Pacific. In 1999, funding for PICES pilot CPR project was awarded by the North Pacific Marine Research Initiative Program. Objective of pilot project was to collect data needed to design a major long-term zooplankton-monitoring program. Two CPR routes were selected for initial coverage. Pilot program was initiated in early 2000 and was to be completed in 2002. PICES was actively seeking funding to continue and expand this program.

She quoted the October 2000 resolution of the PICES Science Board: “Recognizing the urgent need for basin scale monitoring PICES encourages the development of observing programs with dense regional coverage of parameters using voluntary observing ships and similar cost-effective ecosystem observing systems, and that the Organization will develop procedures for promoting such programs under its monitoring framework.” The science board was the superstructure of the science activities in PICES.

They also convened workshops, such as the 3-day MONITOR workshop on Voluntary Observing Systems (VOS) planned for Corvallis or Seattle in Feb-Mar 2002. The workshop goals were to identify key observations that should be made in a VOS long-term monitoring effort; review the current status of autonomous oceanographic instrumentation that could be included in a “sea-chest” fitted to VOS; and establish a basis for funding an actual advanced instrumentation package for VOS. Intended participants were manufacturers and users already involved with suitable instruments, including those with current VOS packages.

PICES invited POGO to work together to support existing CPR programs and where feasible, establish new CPR programs; to collaborate on the development of monitoring additional variables on voluntary observing ships; and to co-sponsor and to participate in the MONITOR workshop on Voluntary Observing Systems (VOS). PICES would be interested in working with anyone who was interested in such initiatives, and participating in the workshop.

It was felt that there was a need for an ecosystem status report and that PICES can fill that need. There were some prototypes - there was a Canadian report that could be a model to follow. There was some interest in this: the CoML held a workshop and there was a report of that workshop. The first PICES report was expected by Fall 2003. The PICES Secretariat will be sponsoring a number of workshops to advance the report. To facilitate the production of the report, PICES planed to host a visiting scientist at the Secretariat office in Sidney BC, arranged by secondment from national agencies or other international science organizations. PICES requested that the POGO institutions let their staff know that this opportunity existed.

The theme of the 11th annual meeting of PICES was technological advances in marine scientific research. Again, participation was welcome.
PICES had a number of activities related to the ocean carbon issues. In 1999 and 2000, PICES co-sponsored between-laboratory comparisons of measurement techniques for dissolved inorganic carbon and total alkalinity in seawater. The intent was to evaluate the methodology and improve the quality of oceanic CO₂ measurements. The results were reviewed at two workshops and were to be published in the *PICES Scientific Report Series* in Dec. 2001. Fifteen laboratories from six countries (7 from Japan, 4 from the US, and 1 from each of Canada, Korea, Russia and Taiwan) were involved. Ten laboratories from Canada, Japan, U.S.A., Australia, Germany, France and China-Taipei expressed interest in a new inter-comparison for the $^{13}$C/$^{12}$C ratio of inorganic carbon in seawater, which was planned for 2001/2002. PICES planned to continue such exercises at about 2-year intervals. PICES convened two workshops to identify data sets on the oceanic CO₂ system in the North Pacific, and to recommend mechanisms of data and information exchange. These activities had led to an inventory of North Pacific CO₂ data, available on a web site in Japan, draft formats for CO₂-related data, and an agreement between various groups on technologies for CO₂ data exchange (Live Access Server & Ocean DataView). In 2001, PICES established a new WG 17 on *Biogeochemical data integration and synthesis*, whose lifespan would be between 3 and 4 years. PICES activities were recognized by the IOC-SCOR Ocean Carbon Advisory Panel as contributing to the high quality of CO₂ measurements and to an international North Pacific CO₂ data synthesis. The Panel emphasized the importance of international participation in the design of Ocean Carbon Observation System and supported PICES as an excellent forum for the Pacific region.

Dr. Richards proposed that PICES and POGO should explore and facilitate possible collaboration on these issues through joint workshops or other activities. PICES was interested in collaborating with POGO on various aspects of capacity building in marine science, especially on topics related to climate change and marine ecosystem variability. PICES was prepared to participate in the POGO-IOC-SCOR Visiting Fellowship Programme where applicable. For example, PICES might facilitate contacts among researchers wishing to be involved – either among PICES member countries or more broadly. PICES invited POGO to work together on the Open (virtual) University concept.

As stated before, the PICES Secretariat could act as a clearinghouse for the POGO fellowship applicants, maybe on the student side, or the scientist side. PICES was also interested in training programs.

Dr. Gould expressed interest in developing relationship between CLIVAR and PICES.

**Chair: Dr. Sergei Lappo**

**CLIVAR: John Gould**

Dr. Gould said that CLIVAR was one of the projects of the WCRP. The first of the projects was TOGA, which was created with the idea of making improved predictors of ENSO effects. WOCE was the program that most closely aligned with POGO's interest. It dealt with the physics of oceans and the role of ocean circulation in global climate. WOCE was coming to an end. This was the main program of WCRP with an ocean observation focus. GEWEX, which did not have an end date, was mostly a hydrosphere/land experiment. CLIVAR was to look at the climate system, and its variability on various time scales. There was no biology or biogeochemistry in CLIVAR. In 1998 there was an "initial" implementation plan. The international conference brought together interested nations, and requested commitments if appropriate.

CLIVAR objectives were as follows:
• Describe and understand physical processes responsible for climate variability and predictability on seasonal, interannual, decadal, and centennial time-scales, through collection and analysis of observations and the development and application of models of the coupled climate system, in cooperation with other relevant climate-research and observing programmes.

• To extend the record of climate variability over the time-scales of interest through the assembly of quality-controlled paleoclimatic and instrumental data sets.

• To extend the range and accuracy of seasonal to interannual climate prediction through the development of global coupled predictive models.

• To understand and predict the response of the climate system to increases of radiatively active gases and aerosols and to compare these predictions to the observed climate record in order to detect the anthropogenic modification of the natural climate signal.

CLIVAR was interested in the monsoon systems in India and America, ENSO and also African climate variability, the North Atlantic Oscillation, and climate change prediction, detection and attribution.

He listed the CLIVAR observational issues/challenges as follows:

• There was a wide range of scientific, regional and national interests and priorities that was truly global in scope. There was a need to integrate the national efforts into a global whole.

• Integration of timescales - this impacted the type of data systems that was needed.

• Need for operational (GOOS/GCOS) and research observations.

• Full involvement of developing countries (particularly in modelling).

• Climate data management (Integration of atmosphere and ocean).

Some POGO relevant activities:

• Developing global observations strategy through CLIVAR Ocean Observation Panel and basin panels for Atlantic, Pacific, Southern Oceans. An Indian Ocean Panel did not exist, partly because of the Australian monsoon panel, which was largely focused on the Indian Ocean. But this could change.

• Working with Ocean Carbon community on global hydrography. Previous August there had been a workshop dealing with carbon.

• Reviewing WOCE standards (validity after 10 years).

• Southern XBT lines.

• Strong support for Argo.

• Handling ocean data through existing centres (WOCE, TAO, Pirata).

A key challenge for CLIVAR was to know what was going on and spreading information, and POGO could help by improving communication. With respect to CLIVAR funding, he mentioned that the science was funded in the individual countries. Atmospheric science and ocean science were often funded through different agencies and so it was a challenge to develop a truly coupled program. CLIVAR name did not always appear in national proposals. This made it hard to keep track of what was being done. WCRP supports a lot of the travel for the CLIVAR panels. There was also an International CLIVAR Funding Office. CLIVAR had five full time people, spread out over the globe. Funding for that comes from the UK and the USA, with additional funding from Germany, Canada, Japan, and France. The challenge that the ICPO (International CLIVAR Project Office) faced was that much of the money supported people. Funds for operating were lacking.

Dr. Ulloa enquired about the involvement of developing countries in CLIVAR. Dr. Gould replied that almost all South American countries were participating in CLIVAR. Many African countries were
involved, but not all. They were considering a Mediterranean CLIVAR, as a means of getting more northern Africa participation. The involvement of Southeast Asian countries was less than ideal.

In response to a question from Dr. Sinclair, Dr. Gould said that there was a Working Group on seasonal to decadal prediction. The prediction of monsoons was an area they were working on, but making less progress – they were still far from adequate understanding.

Some discussion followed on the desirability of including additional measurements on CLIVAR cruises related to biology and biogeochemistry.

**JCOMM: Savithri Narayanan**

Dr. Savi Narayanan said that JCOMM had been established only a few months earlier. JCOMM was the product of the WMO and the UN. It had a body of experts, and the first session was held in June 2001 in Iceland. There was a Management Group that oversaw Observations, Services, Capacity Building and Data Management in JCOMM. Stan Wilson co-coordinated the Observations Group. Most of the services were associated with meteorology. Data management and capacity building required considerable work.

Short-term plans were to complete the JCOMM organisation. There was still a need to select individuals for various teams. They needed guidance on areas that were not physical, such as biology. They planned to bring about integration and modifications to existing activities and programs. These included directing JCOMM towards GOOS requirements, especially the coastal requirements, and also working on capacity building and data management.

She noted that there were many data centers contributing to the users. Data were stored here, there and everywhere. There were a number of data sources and it should be put into an integrated data system. There would then be an interface to the end users in a one-stop shop.

She mapped the road to the future. It is important to have a data policy for international groups such as POGO, IOC. There was a need to recognize that scientific data were a capital asset. There was a need for a change in mind-set. Data management should not be an afterthought, but part of the project planning. One had to build bricks and construct a new system for the 21st century of data management.

There were key advances in data management. Before Argo, real time was considered to be one month, but Argo has made data available at much shorter time scales. Coastal GOOS had a data management plan. The IODE Symposium in Fall 2002 would be dedicated to biological data. There was an ocean data and information technology pilot project, let by Dr. Neville Smith.

In summary, she noted that POGO had a major role to play in JCOMM. Training could be done through fellowships and training courses. POGO institutions could facilitate cultural change through education, and encourage sharing resources and sharing data. Scientists had to be encouraged to support science by contributing data, by moving data into databases.

Dr. Bernal remarked that oceanography was not organized at the national level in the same way as meteorology. Dr. Vaage enquired about the concept of an integrated database. Dr. Narayanan elaborated that the nature of the database depended on each country. In Canada, they were trying to have distributed sites, based on expertise. Centralised databases did not work too well.
Reports of Working Groups, Action Items
Chair: Charlie Kennel

Capacity Building: The following actions were recommended on capacity building:

2. Continue support of ASI
3. With respect to SEREAD:
   a) Continue support of SEREAD at current level
   b) Work with SEREAD to look for outside funding
   c) Recommend that SEREAD develop resource packages that are transferable to other regions.
   d) POGO members to collaborate with SEREAD
   e) IOC to help with multilingual translations
4. Work with JAMSTEC to publicise, facilitate the JAMSTEC offer for on-cruise training.
5. Work with JCOMM, IOCCG, PICES, IOC, GOOS on collaborative efforts.
6. North-South partnership development, and partnerships among institutions to be fostered.
7. Explore possibility for raising additional funds through Foundations, with help from IOC.

Time Series Working Group:

The group noted that POGO members recognized and wished to emphasize that the establishment of an integrated ocean observing system must include sustained, global, multidisciplinary time-series observatories as an essential element,

- To observe the time (and depth) variability of the interior ocean environment and relevant processes, and to detect events and changes in these;
- To provide sustained observations from critical, confined, representative, or adverse ocean regions
- To provide sustained simultaneous observations of a wide range of multidisciplinary variables.

Therefore, the group requested POGO members to

- Encourage, support and facilitate efforts towards the implementation and maintenance of time series observatories within their institutions.
- Cooperate with each other on implementation, capacity building, maintaining and sharing time series data, and to optimize the scientific benefit of time series observatories.
- Advocate the long-term national and trans-national support for such observatories.
- Contribute to these activities as an important part of outgoing international science programs and to the global ocean observing system.

The following Action Items were recommended:

1. The POGO Secretariat to help the Time Series Working Group to set up a Time Series web site that would provide an inventory of all time series data and links to data.
2. POGO Secretariat to help the Time Series Working Group with producing a brochure.
3. POGO to help with capacity building for time series observatories through fellowships and technology transfer.
4. Directors to advocate the need for long-term time-series observatories.

Report of the Biology Working Group, and discussion
The following Action Items were recommended, following discussions on the POGO Biology Initiative:

1. With respect to the Report of the Dartington Workshop:
   a) Consider publishing the report of the Dartington workshop as the first of a POGO series. Web-based publication to be considered as an alternative.
   b) Send report to funding agencies etc with a covering executive summary.
   c) Encourage institutes to develop sensors, and make available deployment opportunities, according to the recommendations in the Report.

2. Develop an inventory of available/developing sensors by e.g. using the POGO web.

3. Encourage sensor development for uses on Ships of Opportunity.

4. Encourage institutes to make measurements of the key variables as often as possible (Chla, pCO2, NO3, wind, CTD).

5. Encourage and participate in the development of \textit{in situ} float sensors.

6. Establish a working group of experts to encourage and be aware of on going programmes and new opportunities and developments. This was to be a standing committee. Caution was to be exercised to avoid duplication of efforts elsewhere.

7. Proceed with S. American workshop, encourage wide participation, and publish report in POGO series.

8. Invite institutions to review their biological databases with a view to making these available \textit{via} OBIS.

9. Hold a workshop on molecular techniques/opportunities for marine biology. (Be aware of other ongoing initiatives).

10. Review ongoing programme of tagging/acoustic networks to see if writer application is possible.

11. Advertise POGO at meetings.


\textbf{Report of the Indian Ocean Working Group}

Dr. Owens reported on the Indian Ocean Working Group, and on the idea of making Indian Ocean the regional focus for POGO-4. The group took into account the huge societal concerns of the Indian Ocean region, which was globally important. Local infrastructure was relatively poor, but there was a need to enhance and develop existing activities, because it offered exciting science. Storm surges, coastal phenomena and the Indian Ocean dipole were identified as issues that merited particular attention. The working group concluded, based on their discussions, that POGO should take a special interest in the region, and that it could make a difference. Dr. Owens noted that what was required was promotion of sustained observations. Access to EEZ was mentioned as problem. The need for an Indian Ocean Panel for both CLIVAR and GOOS was noted. Promotion of JGOFS type of activity was recommended.

\textbf{Thursday, November 29}

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<th>POGO Business</th>
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<td>Chair: Rolf Weber</td>
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\textbf{POGO Incorporation; Membership; Finance (Action 6 from POGO 2): Shubha Sathyendranath}

Dr. Shubha Sathyendranath reported that POGO was registered as a not-for-profit society under the Societies Act of Nova Scotia. The by-laws were written to reflect the Terms of Reference and
procedures decided upon at POGO-2. It was made as simple as possible. The by-laws could be changed when necessary. The Society had no insurance coverage. So if anyone did anything for POGO, that person had to be insured by his or her own institutions. The Society could not employ people directly. It added a level of complexity to the Society that they avoided. POGO had a bank account, an accountant, and a credit card. A number of prominent and important institutions had become members of POGO. Dr. Kennel emphasized that POGO had become independent: it was a separate, corporate, legal entity.

Dr. Sathyendranath then discussed the finances. It was the first year that they had started to collect dues. Budget items discussed included the secretariat, capacity building, POGO travel, POGO meetings, Time Series Working Group, POGO brochure, and POGO Biology Meeting. She noted that the financial situation was good for the current year because many members had started to contribute to membership dues. POGO had also received funding from IOC and SCOR, and also from some charitable foundations in the USA. POGO had a surplus that year because of the grants from the foundations, which would help POGO through the next year, but the POGO financial situation in the long term was not as secure as desired, since the foundation grants were not renewable.

Dr. Kennel noted in particular that he had a discussion with the Surdna Foundation. They considered POGO a success, however they would not renew the initial grant. They were willing to entertain proposals for individual projects, but not for core support. The same situation applied to Rockefeller Brothers, Lounsbery, and Sloan Foundations.

There followed discussion on projected expenses for 2002, based on the recommended Action Items from the previous day. Based on project expenditures and income, Dr. Kennel noted that POGO should try to get new members. There were several inquiries from the USA in particular that merited pursuit. He also thought it unwise to take on some of the proposed action items until funding was secured for the activities. He expressed the view that the proper way to fund POGO activities was to have the core funding go to core functions, and that the project funding be from outside. Dr. Sathyendranath pointed out that membership dues had to be raised to about 200 K, to maintain the level of core activities envisioned within POGO. The core budget would have to be increased further, if the level of funding for capacity building activities such as Fellowships was to be increased. During the following discussions, it was emphasized that there was some flexibility around the guidelines established at POGO-2 for membership.

**Data Exchange and Management (Action 3 from POGO 2): Shubha Sathyendranath**

Shubha Sathyendranath reported that a data exchange exercise was initiated at POGO-1. The goal was to move towards a common system or approach, and facilitate the exchange of data between POGO member institutions. Dr. Bob Weller set up a test site at WHOI using DODS; however the institutional response was poor. The action then moved to the Secretariat. One of the actions considered at POGO-2 was to explore the possibility of promoting the use of Matlab for data processing and distribution. The Secretariat contacted Matworks to obtain a group license for distributing Matlab at low cost to POGO institutions from developing countries, as in a distributed POGO "campus." But Matlab was not interested, and it ceased to be a financially viable option. Exploring other avenues, POGO approached NCAR through Dr. Kennel. NCAR was informed that POGO wanted to make DODS more accessible to developing countries, and requested help to facilitate the activity. Nothing had yet come of this. POGO Secretariat also had conversations with Prof. Peter Cornillon at the University of Rhode Island about using IDL. Again, the explored options were quite expensive.
She noted that IODE had invested much effort in creating a starter kit and resource tool kit for the development of data management facilities, and suggested that POGO could work with them to improve their products. There was also a PICES data meeting that Neville Smith had organised to address issues related to data and information management and distribution. It had been cancelled and was rescheduled for next summer. Without a doubt, data management, timely distribution and access were major problems that faced oceanographers. The success of any observational scheme depended heavily on timely distribution of the data to the user community. This required a concerted effort, and POGO should do whatever possible to find a solution. Several international agencies and organisations (for example: JGOFS, OBIS, CLIVAR, JCOMM, GOOS, PICES, IODE, IOC) were aware of the issues that faced oceanographic data management and distribution, and had pooled expertise and resources into solving the problems. Whatever POGO did had to be well co-ordinated with these other efforts, to avoid duplication. Furthermore, the Secretariat has no expertise in this area. Based on this background, the following recommendations were made:

1. Recruit experts from the data management arena from POGO institutions to help the Secretariat. This can be achieved through the establishment of a small working group
2. Rely on Dr. Neville Smith’s workshop to learn about ongoing efforts elsewhere, and to suggest what POGO could do to complement these efforts.

Dr. Gould remarked that POGO could be more effective by exerting pressure on groups such as the IODE, rather than by working in house on such issues, at the risk of duplication. There was agreement that duplication of efforts was to be avoided, and that the need was to promote exchange of information and ideas about data availability, and difficulties with data management. Dr. Lemke remarked on the different cultures between oceanographers, meteorologists and satellite experts - all these had different data streams. Data management chairs got together in Germany and POGO could learn from this. They got together to have a unified idea of data management.

**Action Items:**

It was decided to go ahead with the formation of a small ad hoc working group on data issues. Dr. Savi Narayanan was requested to be a member of the group, and she kindly accepted. It was also decided to approach Mr. Roy Lowry to be a member. Dr. Sathyendranath was to be the third member of the group. The terms of reference for this working group was to be developed later by the Secretariat, in consultation with the POGO Executive Committee. The committee to report at POGO 4.

**Chair: Charlie Kennel**

The session on POGO Business continued with an animated discussion on what POGO Directors could do collectively to promote POGO causes. Dr. Kennel pointed out that typically Directors had very little discretionary funds at their disposal. The power of institutions resided in the stability that institutions provided, which allowed them to make long-term commitments. He noted that it was possible for Directors to commit in-kind resources. The purpose was to contribute to the long-term growth of scientists. The Directors of institutions had influence that could be exerted at various levels that could influence the outcome at longer time scales. It was important to recognize what directors could and could not do. Dr. Roe and Dr. Owens added that the value of POGO was that you could harness this type of collective power that resided in Directors and that it could achieve more than what would be possible individually. The other strength came from their power to help each other, which was facilitated by POGO providing a forum where problems of mutual interest could be discussed. Dr.
Piccolo mentioned that they were in moving in Argentina towards a national forum in oceanography, along the lines of CORE.

Dr. Roemmich suggested that a first step towards the exercise of this collective power had to be the definition of what the global observing system was to be. During discussions that followed, it was pointed out that POGO saw its role as one of implementation. GOOS had the mandate to define the ocean component of the global observing system. However, the members felt that it would be useful for POGO to have something like a brochure that would outline the vision of a complete observing system, the gaps in the system, and the actions required to reach the goal. The brochure would show that the institutional basis for managing and operating such a system was incomplete and that the community must learn to work together, find funding, and deal with managerial problems such as funding and policy issues. The international community needed to band together.

The group then discussed Southern Hemisphere Action Items, and approved the following:

1. The POGO participants applauded the tremendous response from JAMSTEC to the SP Declaration in proposing the SH circumnavigating cruise, and resolved to facilitate and collaborate in the initiative, as and when appropriate. Details to be worked out over the coming year, with support from the Secretariat.

2. The need for a suitable ship based in S.E. Pacific to enhance S.H. observations, articulated by Dr. Ulloa, was recognized by POGO as an important issue that had to be addressed. POGO, consistent with its SP Declaration, encouraged members to work together to find creative solutions to the problem.

POGO Web Site: Wendy Hunter

Ms. Wendy Hunter gave a brief presentation on the website. It was an international site that was viewed by audiences around the world. The recent redesign of the site allowed for two versions of the site so that people with slower Internet connection times could access a simpler version whereas those with fast connection times could see the more graphically-enhanced version.

Before giving the Directors a brief tour of the site, Ms. Hunter stressed the need for content. It was important that the directors and their staff send information to Ms. Hunter to post on the site. The tour of the site included the Table of Contents, the Meetings page, Links, Participants and Opportunities in Oceanography. Ms. Hunter ended the tour with the STIC page, showing the directors the Institutional Profiles and encouraging them to have it filled out for their institution. Dr. Ulloa pointed out the need for a “What is POGO” section, and Ms. Hunter agreed to work on it.

POGO Media and Outreach Group: Cindy Clark

Ms. Cindy Clark began the presentation with a brief outline of the genesis and growth of the group. The group wrote, rewrote, reviewed, and finally produced the brochure. The purpose of the brochure was to serve as a promotional tool among peers for POGO. It was not designed for the media or the general public, or politicians. It was to advocate and increase support and funding for Time Series and Argo. It was also to get the word out about POGO within the scientific community. The contents of the brochure came out of POGO-1 and POGO-2. She exhorted the members to use the brochure and to provide feedback to the group. Some members of the group met informally in April, on the occasion of another meeting in Miami. New members have been recruited to the group, although there were still
obstacles to overcome. Whereas the group had success with the production of the brochure, it had been unable to carry out the projects on a southern hemisphere fact sheet, and to produce another background document on POGO. She requested Directors to encourage their people to have some time to commit to POGO. She suggested that the name of the working group be changed to News and Information group, to express more accurately what the group did. She planned to develop a welcome packet for new members, and to get people within the group to be more involved in the activities of the group. They proposed to prepare a News and Information mission and guidelines, and to help Ms Hunter with the POGO web site. There was great diversity in the group - skills, talents and job functions. This was an asset, but it would take a while to understand who could do what for the group. The group was very committed to serving the needs of POGO.

Dr. Kennel said he did not know of any other initiatives in the international community similar to that of the Group, and that it was truly innovative. He encouraged POGO members to make use of the group. The participants felt that it was more important to produce a background paper / brochure on POGO than to produce a southern hemisphere fact sheet.

There were discussions on the desirability of translating the brochure into other languages. Ms. Clark spoke of their goal to move towards electronic versions for translations. For example, there was a plan to have electronic letterheads available on the website so that the translations could be printed on to it.

Further discussions dealt with outreach activities. It was decided to use the POGO web site to promote existing outreach material, to evaluate the resource material developed through SEREAD and to stay abreast of developments and activities at IOC.

**Venue, Dates and Theme of POGO 4**

With respect to inter-sessional activities leading up to POGO 4, it was decided that POGO should co-ordinate fully with the efforts that have gone on recently in the Indian Ocean. Co-ordination with the Perth office of IOC was recommended. Efforts are to be made to find more participants and members from the region. It was important to ask the countries of the region what their needs were, and to respond to their needs. The idea was to plan an agenda that seeks to bring to the Indian Ocean discussion the continuing themes of POGO, such as Argo, Time Series and biological observations.

**Election of New Office Bearers**

**Chair: Rolf Weber**

Dr. Sathyendranath introduced the subject, and provided background information on the structure of the Executive Committee. Since POGO was new the year before, a transition structure was put in place. Of the two ad hoc members elected to the Executive Committee at POGO-2, one was to rotate out so as to have an Asian representation on the Executive. Since it was decided to hold POGO-4 in Australia, with CSIRO hosting the event, Dr. Nan Bray would become the new member of the Executive. Thus, a new Asian member had to be elected to the Executive. Furthermore, the incoming chair had to be elected as well. The nominations were to be put forward by a nominating committee, which had been set up, with Rolf Weber (outgoing member of the POGO Executive) as the Chair, and Cintia Piccolo and Nick Owens as members. Dr. Weber reported that the nominating committee proposed JAMSTEC (Mr. Hirano) as the Asian member of the Executive Committee and SIO (Dr. Roe) as the Incoming Chair of POGO. The nominees were elected by acclamation.

Thus the new Executive Committee of POGO acquired the following composition:
NIWA: New Zealand’s Oceanographic Capabilities and Research Programmes: Rob Murdoch

Dr. Rob Murdoch began with an overview of NIWA. It was a state-owned enterprise and the institute was expected to make a profit. The institute paid taxes, but not dividends. They had been able to put much money into building resources. Capacity building had been a problem, so they had a partnership with many universities. They raised their funds from users, and through consultancy.

Mission statement of NIWA: To provide a scientific basis for the sustainable management and development of New Zealand's atmospheric, marine, and freshwater systems and associated resources.

They owned and operated two vessels. One was *Tangaroa* (which had a fish factory on board) and the other smaller one was *Kaharoa*. The research vessels were available for charter. They had acquired a lot of equipment by reinvesting their profits. NIWA had research programmes in marine geology, ocean variability, ocean/atmosphere interactions, ocean productivity, ocean ecosystems, near shore/offshore exchange, Southern Ocean, air-sea exchange of greenhouse gases.

The objective of their project SOIRREE was to enhance understanding of the role of iron in the Southern Ocean. The institute also had a successful joint research effort on benthic processes and sequestration of carbon. Their biophysical mooring had been listed in the Time Series mooring array. They were interested in collaboration in this area. NIWA also had programmes on Subantarctic currents and sea ice, and ecosystem changes in the Southern Ocean. NIWA was involved in SOLAS, and Dr. Murdoch welcomed collaboration on experiments planned in the context of SOLAS. The New Zealand government had increased efforts in the Antarctic region so they had begun Antarctic surveys.

NIWA participated in SEREAD. They did a programme called Sea & Learn, in which they took about 200 students to sea each year on their smaller ship for a day. They also took teachers out on some voyages. They had a visiting scientist program. They had also set up a virtual centre on climate prediction.

Oceanography in South Africa: John Field

Dr. John Field covered three aspects of oceanography in South Africa in his presentation. He first provided an overview of their biological research program, then he spoke about potential POGO partners or consortium of partners in South Africa, and, as a representative of South Africa, he addressed the idea of becoming a member of POGO.

He began by talking about the Benguela Ecology Programme. South Africa worked with other countries to the north on this programme. The research was inter-institutional, in which government departments, universities, museums and others participated. The first phase of the programme was in
1980-85. The current phase adopted an integrated approach to the problem. The programme deals with fisheries in relation to environmental variability. An expert system had been created to try and understand anchovy recruitment. The studies had led to new conceptual models of links between the physical environment and food web structure and functioning. The physical forcings determined whether sardines or anchovies would thrive. Ecosystem approach to fisheries had been communicated to managers. They are not using it yet, but they were listening. They had also gained a better understanding of ecosystems.

Moving on to the second part of the talk, he wondered if the Benguela Ecology Programme could be a POGO partner, instead of an institution. If so, there were also other Southern African initiatives that merited consideration: BENEFIT (1995-) and also BCLME (funded by the GEF for 5 years). There were also two South African institutions that could become members: Marine & Coastal Management (formerly Sea Fisheries) which has 3 research vessels, and the University of Cape Town. He noted that it would be a difficult decision to justify the cost of membership: $5 K would support two grad students or a post-doctoral fellow for a year in South Africa. During discussions, participants expressed the desirability of having South Africa involved in POGO.

New Chilean Centre for Oceanography

Dr. Osvaldo Ulloa spoke about oceanography in Chile. Chile did not have a national oceanographic institute, but there was a strong research community and there was an oceanography department at the Universidad de Concepción.

A few years ago, Chile decided to invest in science, and to create some centres for advanced research. Three such centres were started a few years ago, and then a second round began. This had led to the establishment of COPAS - Centre for Ocean Research in the Eastern South Pacific. It was funded for 5 years, and was renewable for another 5 years. The funding was rather small considering what they wanted to do; but it opened the possibility to do some things, especially in collaboration with other nations. If POGO wanted to organise a meeting to foster research in that area, they would be happy to host it. The goal of the Centre was to carry out advanced research on regional aspects of oceanography and paleo-oceanography in the ESP and on the role of this ocean in the global climate system. Training of young scientists was part of the mandate. Scientific motivation included the fact that the eastern south Pacific was a vast and poorly studied region, strongly affected by ENSO cycle, highly productive, supporting one of the major fisheries of the world, contained an intense oxygen minimum zone, and was the location of the formation of a major intermediate water mass.

Some of the Prime Scientific Questions addressed at the centre were:

1. What are the links between equatorial, mid-latitude, and sub-polar regions in the ESP ocean affecting the variability of the ocean-atmosphere-climate-system?
2. What are the links between community structure and material fluxes between the sea surfaces and the sea floor and how do they change in response to environmental perturbation?

They had six research programs dealing with physical processes; primary production and biogeochemistry of greenhouse gasses; and trophic and metabolic processes in the pelagic system; among others.
There was an educational component to the programme. It was planned to have a strong inter-national and national networking, and an outreach component aimed at children as well as the general public and politicians.

Professor Gallardo was Director; Dr. Ulloa was sub-director. They have a technical council and an external advisory panel. It was hoped that the centre would become the focal point for major research initiatives in the ESO (international and national co-operation, global programs/projects). Scientific discoveries of national and international relevance were expected.

Responding to a question from Dr. Roe, Dr. Ulloa mentioned that the centre had 12 full time researchers, 10 technicians, 8 students, 1 systems administrator, a couple of engineers. But they expected to grow. The size would depend on the development of the research program.

**Atlantic Oceanographic and Meteorological Laboratory: Kristina Katsaros**

Dr. Kristina Katsaros spoke next of the Atlantic Oceanographic and Meteorological Laboratory. There were 12 labs associated with NOAA. Two of these were wet labs: AOML and PMEL. They were keen to be associated with POGO. AOML partnered with many US institutions: (University of Miami, WHOI, etc). They had four divisions: hurricane research, ocean chemistry, physical oceanography, and remote sensing.

Some of the facilities and activities of AOML were: the Drifting Buoy Data Assembly Centre and the Global Drifter Program, the XBT network, the SEAS program, and a US Argo Data Centre. They had a global interest that went beyond the Atlantic. They were trying to develop GOOS Centre data products. The lab had a research vessel (the Ronald H. Brown) and also two aircraft used in hurricane research that could be launchers for airborne XBTs, and could launch floats. It was sometimes cheaper to use an aircraft.

Speaking of their sister organization, the PMEL, Dr. Katsaros mentioned that they had a strong research program in fisheries oceanography near Alaska. They were going to establish new moorings for longer time series observations. Dr. Katsaros’ counterpart at PMEL (Dr. Eddie Bernard) was a tsunami expert and he had a number of state-of-the-art deep-sea moorings in place to study tsunamis. There might be more that could be done with that network of moorings for other purposes. There was a lot of soft money between the two labs and about 100 scientists. She used scatterometer data for heat flux measurements. The NOAA labs covered a lot of the climate research. She was very interested in the POGO partnership and wanted to share resources with other members.

**Measuring and Modelling Abyssal Climate: Charlie Kennel**

Dr. Charlie Kennel then made a brief presentation on behalf of Dr. Walter Munk. The essential point was that the entire data set on the abyssal ocean was very sparse. Understanding heat storage and transfer in that portion of the ocean was vital to understand the role of the oceans in climate and global warming. Currently, knowledge was limited by sparse and inconsistent observations and inadequate modelling capabilities. Acoustic sensors on mooring systems would improve our datasets.

Dr. Fukasawa remarked that tomography was a very powerful tool if they could be used in a basin-wide system.
Oceanography at Dalhousie University: John Cullen

Dr. John Cullen began by pointing out that the Oceanography Department at Dalhousie University was multi-disciplinary. They participated in major programs, were partners with government agencies and private sector partners and had strong international collaboration.

There were four NSERC Industrial Research Chairs in the department for regional ocean modelling (Senior and Junior chairs), Environmental Observation Technology and Ocean Acoustic Technology. These chairs had given marine observation and prediction a boost. Based on these chairs, they had decided to develop a Centre for Marine Environmental Prediction. The goal was marine prediction using advanced computational and visualization techniques, guided and tested with environmental observation systems. The CMEP Vision was an integrated approach to marine environmental science. Atmospheric processes and ocean physics, as well as biological and chemical processes were included. They built on partnerships to achieve their goals. Research areas of the centre were beach erosion and sediment transport, storm surge modeling, environmental modeling and assessment, seasonal ocean climate prediction, climate change, impacts and adaptation, and interdisciplinary marine ecosystem modeling.

Canadian Foundation for Innovation put $3.6 million into infrastructure for a Marine Environmental Prediction System. It covered coastal embayment, continental shelf, and the North Atlantic basin. It represented the development of very significant capabilities. The whole project was in the implementation phase. These resources also helped them to enhance partnerships.

They had a coastal component at Lunenberg Bay with a sophisticated instrument system moored in the Bay. There was also a real-time modelling and visualisation element to the project. The goal was to develop the atmospheric model, use that to drive the circulation model and then incorporate that with bio-optical and sediment models.

Passive optical measurements were well suited for detecting biological variability with depth and time. The mooring measured sunlight, and the penetration of sunlight into the water. This allowed detection of blooms and characterised the water, showing sub-surface structures. Interactions between biology and physics were revealed in this manner. Thus, a small number of measurements yielded a lot of information on the water.

Validation of models was central to CMEP. They had a storm-surge prediction model that worked well. The centre had core personnel in place conducting active research; key partnerships were established; major infrastructure had been secured; and strategy for future development was strongly dependant upon partnerships and leveraging. The CMEP vision was much grander, and it would be possible to do it only through co-operation with universities, government, industry, and may be POGO.

He then spoke of Dalhousie links to POGO interests: people in the department participated in major programs (SOLAS, CLIVAR, GODAE, NOPP); they were deeply involved in GOOS-COOP; and they had commitment to ocean observation and prediction (CMEP). With respect to biological observations, he added that he supported the idea of putting optical and other sensors on Argo floats. During discussions, Dr. Cullen said that their plans for predictions included simulation of biological changes.

Dr. Sinclair commented that Canada had wanted to create a consortium for oceanography, and that POGO had helped move it forward.
**Shirshov Institute: Sergei Lappo**

Professor Sergei Lappo then spoke about the project "Meridian" in Russia, which was accepted in October 2001.

Main goals were to co-ordinate the Russian ocean observations at large scales, and then to build an international floating institution - University of Russian Investigations. The project was a multi-disciplinary program of field ocean research on Russian R/Vs. To reduce the cost of the expeditions they planned to use chartered R/Vs that had paid up tracks from homeport to the port of destination. The vessel routes crossed all climatic and natural earth zones. The cruise periods corresponded to important biological cycles: biological autumn in the Northern Hemisphere and biological spring. Three transatlantic hydrographic sections were carried out in 1999, 2000 and 2001.

Implementation plan included field investigation on interaction of ocean and atmosphere; high-quality, full-depth, hydrographic measurements; wide range of geophysical observations; aerosol and atmospheric precipitation measurements; pollution measurements and verification of satellite data.

The following ships were involved: Akademik Ioffe (a multi-purpose R/V), Akademick Sergei Vavilov, Akad Mstislav Keldysh (with submersibles possibilities), Akad Fedorov (with Arctic/Antarctic capabilities), Akad Atrakho (for geological work) and Akad Shakalsky (for hydrometeorological work).

The project was financed partly by the Russian state budget and partly by scientific participating groups and other grants. Everyone who would like to make ocean observations was invited to participate in the project Meridian.

Dr. Kennel then mentioned the capacity building possibilities of their Miami-Kiel cruises.

Dr. Weber said he was impressed by the progress of POGO in one year. The São Paulo Declaration was very important. It was a rewarding experience working on the Executive Committee.

In closing, Dr. Kennel said that one never quite knew initially if an organisation would start to function and persist. But after having seen how the last two meetings unfolded, he was certain that POGO was on its way and would continue for a long time. He thanked the participants. He also thanked Lee Geddes, Marilyn Landry, and Wendy Hunter for their help, Jeff Anning, for technical support, and Glen Harrison. He then thanked Mike Sinclair, the director for BIO, for hosting an excellent meeting. He then declared POGO-3 closed, and invited everyone to Australia for the next meeting.