

Jody Deming, Chair IAPP 8 January 2003

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**International Arctic Polynya Program (IAPP)**

**Science Coordinating Group (SCG)**

Meeting Deliberations

Riga, Latvia

7–8 November 2002

MEETING ATTENDANTS:

Jody Deming (USA), chair\*

Dave Barber (CAN), member\*

Knud Falk (DEN), member

Louis Fortier (CAN), member\*

Hans–Jürgen Hirche (GER), member\*

Heidi–Marie Kassens (GER), member in absentia\*

Paul Wassmann (NOR), member\*

Hiroshi Sasaki (JPN), guest\*

Torkel Nielsen (DEN), guest\*

Søren Rysgaard (DEN), guest\*

\*present at the Nordic Arctic Research Symposium in Sigulda, Latvia, just prior to this meeting, where joint discussions of IAPP issues were also held)

AGENDA:

Thursday, 7 November

I. Update since last meeting (Quebec, 9–13 Sept 2001)

A. AOSB meeting (Grøningen, April 2001)

New members accepted

PEACE endorsed but as PACE

Rapid development of PACE encouraged, linked to ASOF

B. Polynya textbook editors identified: Dave Barber and Walker Smith

C. Report from Canada (Louis Fortier)

CFI award for research icebreaker

New proposal for Arctic Center of Excellence

CASES'02 cruise, related mooring cruise

Planning for CASES'03-'04 freeze-in

D. Reports from other countries

Denmark

Germany

Norway

USA

Friday, 8 November

II. Plans for future

A. Work to develop PACE or new "terms of reference"

B. Discuss Canadian IMPACS and how to develop international aspects

C. Discuss how to incorporate time-series work in other polynyas (Russian Shelf, Northeast Water)

III. Other business

IV. Adjourn

DISCUSSION:

Members and guests were welcomed by the Chair, who reviewed briefly the goals of the meeting and feedback from the AOSB (item I-A on the agenda). We then discussed the status of an upper level (senior undergraduate, beginning graduate) textbook on polynyas that would introduce and highlight the power of integrated international and multidisciplinary studies to reveal important concepts and patterns in polar marine ecosystems. Two willing editors have been identified: Dave Barber at the University of Manitoba and Walker Smith at the Virginia Institute of Marine Sciences. Their collective expertise will enable a thoughtful and balanced treatment of the physical (including hydrographic, ice-related, atmospheric, etc.) and biological (including organism-based, pelagic-benthic, biogeochemical, etc.) aspects of polynyas, as well as comparisons between Arctic and Antarctic systems. Progress on the book, however, is on hold due to the recurring theme of an already heavy burden of existing

commitments. The multiple IAPP-related events that are happening in parallel now, as discussed below, fully occupy our membership. Also, as a result of the very successful Nordic Arctic Research Symposium (NARP), organized by Paul Wassmann and held in Sigulda, Latvia, just prior to the IAPP meeting in Riga, a significant state-of-the-art monograph is under development to address marine ecosystems in a comparative and pan-Arctic sense. Although this monograph and the polynya textbook will have different audiences and purposes, many on the IAPP-SCG (including Barber) will be intensely involved in the monograph, since the Arctic polynyas now well-known as a result of IAPP activities will be featured in it.

We spent the rest of the first day of the meeting discussing the many IAPP-related issues emerging from Canada (item I-C), as well as developments in other countries (I-D). This discussion naturally began to incorporate the remaining agenda items, addressing primarily the definition of the newly envisioned IAPP program called PACE, for Polynyas in the Arctic's Changing Environment, and its first planned Canadian-led component called IMPACS, for International Monitoring Program in Arctic Canadian Seas. Deliberations on both days were dynamic and productive. The main points are summarized below. Action items are indicated in bold along the way.

### 1) The immediacy of CASES

The Canadian Arctic Shelf Ecosystem Study (CASES) represents the third and final phase of meeting the original terms of reference of the IAPP, which basically called for a series of time-intensive interdisciplinary studies of three major polynyas. CASES includes a three-year study of the Cape Bathurst polynya that forms on the Mackenzie Shelf and extends into the Amundsen Gulf, depending on annual conditions. The original perspective of the IAPP terms of reference was a bold one of polynyas as potential bellweathers of climate change in the Arctic. We are still engaged by this perspective, but the scientific approach has matured from one of seemingly isolated "internal" studies of a single polynya to one that addresses both "internal" and "external" consequences and feedbacks, from polynya to the wider Arctic and vice versa. We are especially concerned with a multidisciplinary basis for predicting the future of existing ecosystems. CASES will benefit from this maturing approach, which will ultimately require long-term work in time-series mode – indeed, CASES can be seen to represent a first step in PACE, but the demands of developing the approach in timely fashion for CASES are significant. Year One of CASES has already begun. In 2002 long-term moorings were deployed on the Mackenzie Shelf from the CCG *Wilfred Laurier* in late Summer and an IAPP-trademark interdisciplinary cruise was accomplished aboard the CCG *Pierre Radisson* in Fall (as summarized by Deming, Fortier and Fortier in the AOSB Newsletter of December 2002). We thus devoted our CASES-related discussion time to how best to launch the unique Year Two of the program, whereby the newly dedicated Canadian research icebreaker will be frozen into the ice on the Mackenzie Shelf during winter 2003–2004, and how to more fully develop international partnerships.

Tentative dates for the next International CASES Workshop to plan the details of the freeze-in year were set for 22–24 January 2003 in Montreal. These dates have since been confirmed and announced broadly by Louis Fortier.

International (non-Canadian) players already involved via supported or pending proposals include: Mitsuo Fukuchi and colleagues (JPN, aspects of primary and secondary production and particle flux), Peter Wadhams (UK, buoy deployments to track circulation), Weislaw [Ma](#) [Author ID1: at Fri Jan 3 12:10:00 2003 ] [We](#) [Author ID2: at Fri Jan 3 12:10:00 2003 ] [slo](#) [Author ID1: at Fri Jan 3 12:10:00 2003 ] [a](#) [Author ID2: at Fri Jan 3 12:10:00 2003 ] [wski](#) (USA, physical models to describe and predict circulation), Dennis Darby (USA, sediment paleomarkers to estimate past circulation and climate variability), Peter Minnett (USA, meteorological and other methods to estimate heat flux and role of cloud formation), Kirk Cochran (USA, thorium isotopes to estimate particle flux), and Jody Deming (USA, microbial methods to determine enzyme activities and active organisms on particles and in ice).

Other investigators presumed to be seeking funds for CASES or planning to contribute in other ways include Dave Holland (USA, physical models to describe and predict circulation), Kevin Arrigo (USA, remote sensing and models to describe variability in primary production), Paul Wassmann (NOR, zooplankton analyses of sediment trap material), Tish Yager and Brian Burd (USA, methods to determine microbial succession on particles), and Paul Renaud, Will Ambrose and Lisa Clough (USA, benthic methods to estimate pelagic–benthic coupling).

We discussed how to encourage additional investigators to join CASES, beyond the broad announcements and workshops that have already taken place for CASES. Jackie Grebmeier is invited to the CASES workshop to further explore links with investigators involved in the US Shelf–Basin Interactions (SBI) program that she leads, west of the CASES region. Knud Falk is attempting to entrain marine bird researchers from Denmark. We hope that IAPP member Sue Moore (USA) will be able to bring a new marine mammal component to the project. Meeting guests Torkel Nielsen (DEN, pelagic protist and microbial carbon cycling) and Søren Rysgaard (DEN, benthic microbial carbon cycling and diagenesis) expressed interest in CASES and will attend the CASES workshop. Entraining researchers from Roscoff, Germany, or involved in the new program on the microbiology of Arctic sediments directed by Bo Barker Jorgensen (GER, director of the Max Planck Institute for Marine Microbiology) may also be possible.

**ACTION ITEM:** All members to be pro–active in contacting the above and other members of their national and international networks to encourage participation in CASES.

## 2. The need to enhance European interest in IAPP research

The three polynyas studied under the auspices of the IAPP form in the waters of Greenland/Denmark and/or Canada; two of them (North Water and Cape Bathurst Polynya) are currently targeted for long–term time–series research under PACE. This geographic fact partly accounts for the continuing substantial contributions from Denmark and Canada to polynya research; it has not precluded the involvement of US or Japanese investigators. It appears, however, to have stymied, especially recently, the entrainment of European researchers (notwithstanding that the first IAPP project in 1991–1993 on the Northeast Water was German–led). The challenge is not lack of scientific interest but lack of agency interest (e.g., European Union) and local institutional interest in supporting Arctic research beyond the Barents Sea.

The important exception is the heroic effort of Heidi–Marie Kassens to continue German research in the Laptev Sea on the Russian Shelf. The IAPP has not been able to launch one of its trademark international and interdisciplinary projects on the Laptev Sea polynya for geopolitical reasons, even though this polynya ranks amongst the largest in the Arctic. Kassens indicated some hope that the high–level German agreement with Russia, currently driven by geological interests, may be renewed and expanded to include roles for other international players and disciplinary interests. If such a transition occurs, the IAPP will be keenly interested in the possibilities. Kassens also apprised us of the potential to develop IAPP–style research in the Laptev Sea through the IARC program based in Alaska.

We also discussed the relatively smaller polynyas that occur off Spitsbergen as possible targets for European–led IAPP–style projects that could also include parallel contributions to IAPP studies of the larger polynyas. What these features do not appear to have in common with the larger recurrent coastal polynyas, however, is a highly adapted ecosystem. The Danes present at the meeting indicated the likelihood of renewed interests in the North Water (and the Northeast Water) from the perspective of the long–term time–series studies under development in PACE.

We also considered the future of polynyas as identifiable regional formations. Although discrete, recurring entities in the recent past and today, their destiny in a rapidly changing Arctic environment

may well be conversion to receding ice edge. To the extent that polynyas can be considered a subset of the pan-Arctic receding ice edge, the Barents Sea becomes a prominent region for comparative study in light of PACE. Like the large recurrent coastal polynyas already studied, the receding ice edge of the Barents Sea supports a highly adapted ecosystem. The polynya ice-edge comparison may provide a logical entry for more European researchers into IAPP-motivated research.

Coming fresh from the success of Wassmann's NARP meeting in Sigulda (where an international group of Arctic researchers instructed graduate students from the Nordic countries), we all recognized the need to enhance educational opportunities more broadly for students interested in the Arctic. None of the programs planned or envisioned by established Arctic investigators will come to fruition in the absence of a new generation of innovative Arctic researchers.

**ACTION ITEMS:** Deming to discuss with the AOSB at its next meeting (29–30 March 2003) the prospects for enhancing European involvement in IAPP-fostered research beyond the Barents Sea. All IAPP members to work within their communities to raise awareness of the research opportunities expected to be available through PACE. Wassmann to develop further his comparative diagram, sketched during the meeting, of high-production (North Water) and low-production (Northeast Water) polynyas with a high-production receding ice edge (Barents Sea) for possible use in the PACE document. PACE to include explicit educational and outreach components.

### 3. The general definition and development of PACE

In a sea of acronyms, we first discussed (again) the merits of creating a new one (PACE) versus re-writing the terms of reference for the IAPP. We agreed that both efforts are one in the same and that, in agreeing to create PACE, we are following a natural progression of events. The original IAPP terms of reference led to the three NEW, NOW and CASES projects, conducted as three-year programs in series. The results of these projects provide the basis for generating PACE, conducted as a ten-year (minimum) program with individual polynyas studied in parallel. We envision PACE as an umbrella document to help guide the development of specific programs likely led by one nation or another, as in the past.

The first PACE program under development is the Canadian-led IMPACS. It embraces the long-term study of two polynyas, the North Water and Cape Bathurst Polynya, and thus builds upon the NOW and CASES data bases. It also links directly to the Arctic-Subarctic Ocean Flux (ASOF) program, via geographic commonality. Other PACE programs could be developed for simultaneous study of the Northeast Water, the Laptev Sea Polynya, the Spitsbergen polynyas, or the receding ice edge of the Barents Sea, as discussed above.

We discussed that the maturation process from "internal" polynya studies (NEW, NOW, CASES) to combined "internal" and "external" studies (IMPACS and other PACE programs) will require vigilance in making scientific connections with results emanating from other Arctic programs. IMPACS will effectively establish two polynya observatories, one in the North Water and the other in the Cape Bathurst Polynya. Existing Arctic observatories, though narrower in disciplinary focus than PACE programs, can provide valuable insights into effects and feedbacks related to polynyas: e.g., the North Pole, Barrow Strait, and Bering Strait Observatories. The possibility of detecting global connections through Antarctic Observatories in the Ross Sea and Terra Nova Bay polynyas should not be overlooked.

**ACTION ITEMS:** Leaders of IMPACS and ASOF to make explicit contact to optimize parallel program development

### 4. Refining the draft PACE document

We spent considerable time discussing the set of variables to be included in the PACE document and how to organize them scientifically and operationally. The existing list of variables was modified as follows (IAPP members with expertise to contribute further in each case are indicated parenthetically, along with other recommended contacts):

*Physical variables and parameters* (no change; Dave Barber will coordinate with Peter Minnett, Mark Johnson and Andrew Willmott to reconsider these)

1. Cloud types, extent and surface radiative forcing
2. Wind vectors
3. Ice movement and thickness
4. Ice-bridge stability (North Water)
5. Open water extent
6. Surface albedo
7. Mixing depth (T, S)
8. Sea level

*Chemical/biogeochemical variables and parameters*

9. Air-sea exchange of CO<sub>2</sub> (Leif Anderson; Lisa Miller, Tim Papakyriakou, other contacts)
10. Nutrients = nitrogen species and silicate (Jean-Eric Tremblay, other contact)
11. Particle flux (Wassmann, Deming; Kirk Cochran, other contact)
12. Benthic remineralization and diagenesis (Deming; Søren Rysgaard, other contact)

*Biological variables and parameters*

13. Phytoplankton and new production (Tsuneo Odate, Wassmann; Jean-Eric Tremblay, other contact)
14. Zooplankton population structure and development status (Louis Fortier, Hans-Jürgen Hirche)
15. Bird feeding strategies, surface and diving (Knud Falk)
16. Macrobenthos, biomass and community structure (Deming; Søren Rysgaard, Jon Grant, other contacts)
17. Marine mammal habitat use (Sue Moore, Dave Barber)

We also developed the following organizational scheme from an operational perspective:

1. Established point stations for continuous or semi-continuous measurements (e.g., meteorological stations on shore, long-term moorings at sea);

2. Annual ship-based operations at the end of the open-water season for concentrated labor-intensive measurements and experimentation (e.g., to take the pulse of the ecosystem with as many of the above variables as possible)
3. Remote sensing for continuous or semi-continuous measurements (e.g., chlorophyll fluorescence, surface temperature, open water, etc.)
4. Modeling of the disciplinary classes of variables, with eventual coupled models

Given the interdisciplinary scientific goals of a long-term observatory program like PACE and the operational constraints in the current Arctic environment as faced by IMPACS, we need to view most of the above variables as "integrator state variables." For the final PACE document, we must strive to identify variables (further refine the list above) that integrate as much of what has happened during the open-water season as possible, since the ship-based opportunities to measure them annually are planned for the end of the season. Obvious exceptions are those measurements that can be made continuously or semi-continuously. Process-oriented and short-term measurements are of lower priority. We fully understand, however, that mobilizing to measure most state variables also positions researchers to make other opportunistic measurements. To refine and finalize the PACE document, we need thoughtful scientific writing (with a few key references) on each of the listed variables or parameters to explain why the variable is necessary to measure. The writing should include an indication of operational mode of collection. Where possible, we should also explain how each variable or parameter will contribute to understanding "internal" and "external" effects and feedbacks of environmental change on the physics (opening, maintenance, closure) and chemistry (pelagic and benthic) of the polynya and the all-important ecosystems presumably adapted to current conditions. Consider how a given type of measurement, after a ten-year study is completed, can be expected to reveal variability in the system; e.g., what range of values will have to be exceeded to deduce significant change?

**ACTION ITEMS:** Each IAPP member listed parenthetically above to identify the specific variables or parameters to be measured in their area of expertise, keeping in mind the charge to identify "integrator state variables" and drawing upon other expert input as needed. Each IAPP member identified above to write a paragraph explaining the rationale behind the selection of that variable or parameter and [Author ID1: at Fri Jan 3 12:10:00 2003 ]to [Author ID1: at Fri Jan 3 12:11:00 2003 ]include 2-4 key references[Author ID1: at Fri Jan 3 12:10:00 2003 ]. Dave Barber to coordinate with other IAPP members listed above to reconsider the physical variables and provide a paragraph and key references [Author ID1: at Fri Jan 3 12:11:00 2003 ] on each one, explaining the rationale for its inclusion. All writing to be sent by email to [jdeming@u.washington.edu](mailto:jdeming@u.washington.edu) by the week of 17 February 2003. Problems with this timing to be addressed to Deming. Deming to collate contributions into a revised draft for distribution to members by early March and to the AOSB at their next meeting at the end of March (29-30 March 2003).

Prior to adjourning we discussed the next possibility for the IAPP to meet. Unfortunately, no clear option for a quorum to meet in the next six months has been identified, although some members will be present at the Gordon Research Conference on Polar Marine Sciences in Ventura, CA, March 16-21. At that time, those members can at least take stock of the PACE document as it exists then.

**ACTION ITEM:** Members to send to Deming possible IAPP meeting venues (meetings you may be attending already) during the period of July 2003 to March 2004.