

# Full Proposals for International Polar Year 2007-2008 Activities

## Proposed IPY Activity Details

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### 1.0 PROPOSER INFORMATION

(Activity ID No: 93)

#### 1.1 Title of Activity

International Collaborative Expedition to collect and study Fish Indigenous to Sub-Antarctic Habitats, 2007

#### 1.2 Short Form Title of Proposed Activity

ICEFISH-2007

#### 1.3 Activity Leader Details

Cinzia Verde  
Institute of Protein Biochemistry, CNR, Naples  
Italy

#### 1.4 Lead International Organisation(s) (if applicable)

NULL  
NULL  
NULL  
NULL

#### 1.5 Other Countries involved in the activity

Italy  
USA  
South Africa  
NULL  
Australia  
France  
NULL  
NULL  
Brasil  
UK  
NULL  
NULL  
Germany  
New Zealand  
NULL  
NULL

#### 1.6 Expression of Intent ID #'s brought together in this proposed activity

533

#### 1.7 Location of Field Activities

Antarctic

### **1.8 Which IPY themes are addressed**

1. Current state of the environment
2. Change in the polar regions
3. Polar-global linkages/tele-connections
4. Exploring new frontiers
5. The polar regions as vantage points

### **1.9 What is the main IPY target addressed by this activity**

1. Natural or social science

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## **2.0 SUMMARY OF THE ACTIVITY**

In a world experiencing climate global changes, loss of biodiversity and depletion of fisheries, the biotas of the Antarctic and the Sub-Antarctic offer compelling natural laboratories for understanding the evolutionary impact of these processes. Since the IGY (1957-58), biologists have made impressive progress in understanding the Antarctic ichthyofauna. However, research integration into the broader marine context has been limited, largely due to lack of access to Sub-Antarctic fishes. These fishes, in particular those of the dominant suborder Notothenioidei, are critical for a complete understanding of the evolution, population dynamics, eco-physiology and eco-biochemistry of their Antarctic relatives. The ICEFISH programme is designed to fill these critical gaps in our knowledge. Cruises, encompassing the South Atlantic, South Pacific and South Indian Ocean sectors constitute the ICEFISH programme, the first comprehensive international survey of the Sub-Antarctic marine habitat. The first, ICEFISH-2004 (17 May –17 July 2004) was a resounding success. Extensive fishing was performed in the South Atlantic sector: Burwood Banks, Falkland Islands/Islands Malvinas, Shag Rock, South Georgia, South Sandwich Islands, Bouvetoya, and Tristan de Cunha, at depths ranging from tidepools to the abyss (for information on the cruise, participants, and detailed science projects, see [www.icefish.neu.edu](http://www.icefish.neu.edu)). Although autonomous, ICEFISH-2007 builds on the important legacy of ICEFISH-2004. It will sample the Sub-Antarctic Pacific sector, including Campbell and Scott Islands, Antipodes, Auckland, Macquarie, and Balleny Islands. Fishing will be multi-modal, using Otter, mid-water, Blake and MOCNESS trawls, plankton nets, beach seining, tide pooling, and traps. We will charter a suitable ice-strengthened ship/icebreaker, equipped with aquaria with running seawater to maintain live specimens, and with high-quality research laboratories. Twenty-four to 28 scientists will participate, largely those of the 2004 cruise, ensuring continuity of the scientific focus of the ICEFISH programme. The scientific activity will cover a wide range of topics, many of which will develop work carried out in ICEFISH-2004. We will summarise some of these topics:

- Systematics and evolutionary studies to relate Sub-Antarctic notothenioids to their Antarctic relatives through morphological, molecular and cytological analyses. The diversity of habitats and attendant species likely to be collected in ICEFISH 2007 clearly warrant such a comparative analysis, which will shed light on evolutionary diversity and radiative capacity within this sub-order.
- Life history strategies and population dynamics to characterise the composition, distribution, habitat preferences and diets of the Sub-Antarctic species, and larval recruitment.
- Diversity and biogeography. Documentation of fish biodiversity and possible discovery and description of unknown species, for example in the vicinity of the Balleny Islands and Scott Island (CCAMLR Statistical Subarea 88.1), where the fish fauna is poorly known. As transition zones between the Antarctic and Sub-Antarctic notothenioid faunas, these islands are key to recognizing and understanding latitudinal gradients in faunal composition in the Pacific Sector of the Southern Ocean. Liparids of the Southern Hemisphere are important from an evolutionary and zoogeographic perspective; many of these species are known only from one or two specimens. In addition, new species are still being found frequently. ICEFISH-2007 would be an important opportunity to sample previously poorly sampled regions to add to knowledge of the distribution and evolution of the family. Collection at depths below 1000 m is desirable.
- Physiological, biochemical and molecular-biological studies of organ and tissue systems to

analyse the evolutionary basis of the adaptations of high-Antarctic notothenioids relative to their ancestral stock.

- Genomic resources for Sub-Antarctic notothenioids (nucleic-acid libraries for comparative studies of the genomes of high- and low-latitude species). Because of the causal linkage between the thermal histories of marine environment, and the waxing and waning of the antifreeze trait, the extent of the antifreeze genotypic and functional capacity in related notothenioids within and outside of the high-Antarctic is an excellent biological indicator of regional variations or changes in thermal environments in the Southern Ocean. Spleen and testis tissues will be frozen for future preparation of DNA and RNA that will be used to evaluate the antifreeze glycoprotein genotype, Erythrocytes from red-blooded species and white blood cells from icefishes will be embedded in agarose plugs and used to prepare high molecular weight DNA for the construction of bacterial artificial chromosome (BAC) libraries. The BAC libraries will permit the global analysis of genome evolution of the notothenioids driven by thermal challenges.

### **2.1 What is the evidence of inter-disciplinarity in this activity?**

From a thematic point of view, ICEFISH-2007 covers a wide range of physiology, biochemistry, molecular biology, ecology and taxonomy of Antarctic fish, notably of the dominant suborder Notothenioidei. With these backgrounds, ICEFISH-2007 tries to provide a broad view of biogeographical distribution and biochemical processes. In addition to the use of conventional approaches, advanced and unique techniques will be available to all participants. The goal to relate evolution, eco-physiology, eco-biochemistry, and population dynamics of the Antarctic fishes to their low-latitude relatives will use the synergy of anatomy, physiology, biochemistry, biophysics, molecular biology, morphological and molecular systematics, cytogenetics, life-history strategies, taxonomy, phylogeny. Interaction with other disciplines, e.g. oceanography, physics, zoogeography, marine geology, is also envisaged. ICEFISH-2007 employs various techniques to detect, determine and describe genetic signatures (DNA and RNA), biomarkers (lipids, carbohydrates, proteins and their constituents), biological index species, geochemical records, climatological parameters, glacial features, etc.

### **2.2 What will be the significant advances/developments from this activity? What will be the major deliverables? What are the outputs for your peers?**

Because notothenioids occupy high trophic niches, they constitute an important sentinel taxon for monitoring the impacts of climate change on species biodiversity and of depletion of marine fisheries on community dynamics in the Southern Ocean. The work will contribute to a better understanding of the effect of such changes by contrasting the potential acclimatory capacity of the eurythermal Sub-Antarctic notothenioids to the severely restricted acclimatory responses available to high-latitude notothenioids of the Southern Ocean. It will also contribute to development of a baseline understanding of these sensitive ecosystems, one against which future changes in species distribution and survival may be evaluated judiciously. Phylogeographical analyses of organisms and environmental DNA sequences will help to understand inter-relationships of geographical separation and species separation (i.e. speciation or micro-evolution). The study of evolution of ecosystems is useful to reconstruct past environmental climate changes, and provides key baseline information about the effect of past climate changes on polar fish, and also on how these organisms may respond to future climate changes. ICEFISH-2007 will use techniques dealing with the dynamic behaviour of complex systems, ranging from biochemistry to ecology. ICEFISH-2007 will be supported by the ICEFISH web site ([www.icefish.neu.edu](http://www.icefish.neu.edu)), developed by HW Detrich. Deliverables will include: 1) cruise planning, 2) post-cruise reporting, 3) workshops, 4) publications, 5) training PhD students, 6) a community outreach programme, 7) media coverage, 8) conference proceedings, 9) sequence submissions to databases (e.g. Genbank), and 10) synergistic interactions with EBA, CAML, ANDEEP, CCAMLR, and other SCAR programmes.

### **2.3 Outline the geographical location(s) for the proposed field work (approximate coordinates will be helpful if possible)**

Locations	Coordindates
Campbell Island	
Scott Island	

The Antipodes	
Auckland Island	
Macquarie Islands	
Balleny Islands	

#### 2.4 Define the approximate timeframe(s) for proposed field activities?

Arctic Fieldwork time frame(s)	Antarctic Fieldwork time frame(s)
	03/07 - 04/07

#### 2.5 What major logistic support/facilities will be required for this project?

Icebreaker  
Ice strengthened research ship  
Autonomous Underwater Vehicle  
Remotely Operated Vehicle

**Further details** – Fishing nets, traps, etc. Existing field stations where possible. Possible sharing with other IPY activities (EBA, CAML, ANDEEP, CCAMLR)

#### 2.6 How will the required logistics be supplied? Have operators been approached?

Source of logistic support	Likely potential sources	Support agreed
Consortium of national polar operators		
Own national polar operator	Y	
Another national polar operator	Y	
National agency		
Military support		
Commercial operator		
Own support		
Other		

#### 2.7 If working in the Arctic regions, has there been contact with local indigenous groups or relevant authorities regarding access?

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### 3.0 STRUCTURE OF THE ACTIVITY

#### 3.1 Origin of the activity

This is a pulse of activity during 2007-2009 within an existing programme

**If part of an existing programme please name the programme – ICEFISH**

#### 3.2 How will the activity be organised and managed? Describe the proposed management structure and means for coordinating across the cluster

ICEFISH-2007 will mainly count on national funding sources. Again, the main role of ICEFISH-2007 is to provide a base for interdisciplinary and interdependent collaborations to increase chances for more data, samples, expeditions, logistics, etc. The ICEFISH-2007 participants have an established forum based on meetings and e-mail exchanges. These communications have worked successfully, and we are confident that ICEFISH-2007 will be well managed, further developed, and successfully realised internationally and interdisciplinarily as a part of IPY activities. It will be coordinated by an International Project Steering Committee, led by Italy. Proper coordination will be ensured by the Lead Contact, considering that the aims of the project fall within the guidelines of the life-science sector of the Italian Antarctic

Programme. Furthermore, the second Contact was the Chief Scientist of ICEFISH-2004 and led this cruise to a resounding success. A post-ICEFISH-2004 cruise symposium will take place next August (2005) at the Darling Marine Center, Walpole, ME, USA. The Proceedings will be published in a special issue of a leading polar journal. Similar coordination outcomes are envisaged for ICEFISH-2007.

### **3.3 Will the activity leave a legacy of infrastructure and if so in what form?**

Yes. The ICEFISH sampling programme will provide voucher specimens of Sub-Antarctic fishes that will be deposited in museum collections around the world. In addition, genomic resources will be archived for distribution to polar marine biologists, for example: collection of specimens of fish species, bulk DNA extracted in a wide range of Sub-Antarctic habitats, PCR-based clone libraries (e.g. of 16S rRNA genes), meta-genomic libraries.

### **3.4 Will the activity involve nations other than traditional polar nations? How will this be addressed?**

Not directly. However, post-cruise activities (e.g. workshops) will be widely advertised, and participation of researchers from nations that have not traditionally engaged in polar research will be encouraged. These interactions will lead to international collaborative work by scientists of many nations on the samples collected during ICEFISH-2007.

### **3.5 Will this activity be linked with other IPY core activities? If yes please specify**

ICEFISH was developed in the framework of SCAR international and multidisciplinary programmes. ICEFISH-2007 is tightly linked with EBA and CAML; synergy is also planned with CCAMLR. These IPY core activities have a very wide scope; ICEFISH-2007 is an integral part of these larger programmes because it specifically addresses a very important theme common to all.

### **3.6 How will the activity manage its data? Is there a viable plan and which data management organisations/structures will be involved?**

The ICEFISH web site also serves as the conduit for data management. This feature has already been implemented through the Cruise Data section of the site. We will work closely with JCADM to ensure timely data release and metadata support. Modelling of interactions between environmental change and organism responses will be performed, to facilitate change predictions in Antarctic and Sub-Antarctic fish. Data management will also be in accordance with the operating data management systems of the participating institutions. Processed data will be made available to IPY and other databases as required. Genomics, proteomics, sequences and other data will flow into a number of pertinent databases (e.g. Genbank).

### **3.7 Data Policy Agreement**

**Will this activity sign up to the IPY draft Data Policy (see website)**

Yes

### **3.8 How will the activity contribute to developing the next generation of polar scientists, logisticians, etc.?**

The participants in ICEFISH-2007 will include experienced scientists (who will give lectures illustrating their field of research) and a young student cohort. The students will receive first-hand experience and training in the logistics of expeditionary polar biology, such as resource planning, fishing technologies, etc. They will continue their polar education by analysing cruise samples at their home institutions. These students will form the next generation that continues the development of polar fish biology. (see also 3.9) ICEFISH-2007 is committed to undergraduate and post-graduate education. This educational effort will increase interests and researchers in polar sciences and expeditions, and will thus stimulate policy decisions on polar programmes. Involvement into an international, multidisciplinary project will highly motivate young scientists. ICEFISH-2007 has direct relevance to global change, and will encourage further research activities.

### **3.9 How will this activity address education, outreach and communication issues outlined in the Framework document?**

The ICEFISH web site will support ICEFISH-2007. Among the important features of the site are educational programmes directed to kindergarten through high school students (K-12) and an "Ask a Scientist" email applet that permits students to communicate with ICEFISH scientists as the cruise progresses. The site will serve as a gateway for general public, including young generations, to increase their awareness of Polar and Global environments; it will serve as well as a forum for partners to discuss incoming schedules and obtained outcomes, deposit data to share, offer/request laboratory uses, etc. PhD students will be trained. Conferences, seminars and workshops will be scheduled to disseminate knowledge on the Sub-Antarctic ichthyofauna and its importance in the Southern Ocean to children/teachers. This will also be pursued through conference proceedings, media coverage, publication of books and production of images and videos. For input to databases, see 3.6 and 3.7. Synergy with CAML, EBA, ANDEEP, CCAMLR, and interactions with other SCAR programmes, will provide additional outreach and communication to a worldwide audience. In summary, the strategy involves development of high-quality communication products, targeting research scientists, decision-makers, media, the general public and school communities. It will involve attractive visual materials - carefully developed to interest and educate youth as well as wider audiences.

### **3.10 What are the proposed sources of funding for this activity?**

Funding will be sought from national agencies, also for ship chartering (Italy: Italian National Programme for Antarctic Research, PNRA). Participation of other countries: several contributions to ICEFISH-2007 are from projects currently financially supported by national institutions. Cost-sharing initiatives are under investigation. International funding agencies (European Union, etc) will also be solicited for support. The Project Leader will apply for chartering a suitable ship. One option will be the R/V Tangaroa, from NIWA, and negotiations (necessary for the application to PNRA), are currently in progress.

### **3.11 Additional Comments**

ICEFISH-2007 will comprise at least 24 scientists from 9 countries. Collaborations are expected to take place at all levels among individuals, within and between themes. We are open for collaborations with individuals and teams participating in other IPY activities. It will form an integral and important component of EBA and CAML, the first of which covers all Antarctic organisms and the second Antarctic marine life. ICEFISH is also important to understanding the biogeography, evolution, and adaptation of fishes along the latitudinal gradient that extends from the Antarctic to the Arctic. As an intermediate geographical system between the polar extremes, study of the Sub-Antarctic and its marine fish fauna will provide vital information pertinent to a global synthesis of the characteristics of marine ecosystems. ICEFISH will meet almost all (and probably all during implementation) of the 9+5 criteria. Detailed commitment to research and logistics requires final decisions on funding, especially regarding ship chartering.

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## **4.0 CONSORTIUM INFORMATION**

### **4.1 Contact Details**

#### **Lead Contact**

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**4.2 Other significant consortium members and their affiliation**

<b>Name</b>	<b>Organisation</b>	<b>Country</b>
Guido di Prisco	Institute of Protein Biochemistry, CNR, Naples	Italy
Marino Vacchi	University of Genova	Italy
Guillaume Lecointre	National Museum of Natural History, Paris	France
Don Robertson	NIWA, Christchurch	New Zealand
John Macdonald	University of Auckland	New Zealand
Joe T Eastman	Ohio Univ, Athens	USA
Arthur L DeVries	Univ of Illinois, Urbana	USA
Hans-Otto Poertner	AWI, Bremerhaven	Germany
Dick Williams	Australian Antarctic Division	Australia
Edith Fanta	Universidade Federal do Parana', Curitiba	Brasil
Ian A Johnston	Gatty Mar Lab, Univ of St Andrews	UK
Ofer Gon	SA Soc of Systematic Biol, Grahamstown	South Africa