



## Researching Sydney Harbour

**A**n exciting vision is developing at SIMS – a flagship long term program to monitor the health of Sydney Harbour, and to provide guidance for its better management.

### The Challenge:

Living with access to Sydney Harbour is a privilege – for the ample supply of green public space around the foreshores and the magnificent views from the clifftops and buildings, for its beaches and for the wealth of marine life for all to enjoy.

Australia has one of the highest levels of marine biodiversity in the world, with many of our marine species found nowhere else. Sydney Harbour is one of, if not the, most biodiverse harbours in Australia, but surprisingly, there has been no comprehensive inventory of Sydney Harbour's biodiversity. This is despite records dating back over 130 years.

Significant efforts have been made during the past 20 years to clean up the Harbour, but a combination of urban and industrial development continues to feed into it a potentially damaging mix of heavy metals, sewage, plastics and chemicals. Urban runoff increases water nutrients; industrial cooling using harbour water elevates water temperature – all of these factors combine with natural variations, and climate change, to place stress on the Harbour's marine inhabitants. We know far too little on what impact these stressors might be having on the marine populations that contribute to the amenity and productivity of the Harbour.



Photo: Hamilton Lund Tourism NSW

### SIMS' visionary program will focus on the long term health of Sydney Harbour:

- Documenting for the first time the full range of marine species in Sydney Harbour, and its valuable marine habitats - a baseline for future studies.
- Exploring the interactions of natural and man-made stressors on marine populations, to pinpoint the factors with the greatest negative impact. This knowledge will aid in on-going Harbour management.
- Developing the knowledge and skills to undertake rehabilitation of degraded areas - a pioneering approach.
- Monitoring Harbour Health over ten years or more - a Report Card on how the Harbour is coping and the effectiveness of remediation measures. (continued on page 3)

## News in brief

### Doctoral fellowships

Applications are about to be called for the award of three doctoral fellowships in 2011. This follows the award, earlier this year, of the inaugural three doctoral fellowships at SIMS.

SIMS Foundation has the objective of continuing to award at least three fellowships each year. Experience world-wide is that such fellowships produce outstanding young researchers who go on to make major contributions in their field of expertise.

They will also be a significant source of future researchers for SIMS as later on many of them will tend to bring their own students to work at SIMS.

### Marine Masters Course

Professional and tertiary education in marine science is critical for supplying the required expertise to marine industries and for long term sustainability of the marine environment.

SIMS has initiated planning for a new Masters of Marine Science and Management to be taught in conjunction with its four member universities. Students will be able to enrol at any of the four universities and take subjects at the universities and at SIMS. The program will be broadly based with subjects covering the whole spectrum of marine science.

## Hurry - book now!

There are still a few tickets available for our first annual fund raising dinner to be held at Sergeants Mess on Monday 8th November 2010

Guest speaker:  
Dr. Mark Norman  
Chief Scientist  
Museum of Victoria

Jane Rutter will play a collection of pieces with the theme of Nature & the Oceans

Bookings 9969-2664.  
Cost is \$150 per head.



LEFT:  
Photomontage of Building 19  
as it will be seen from the road after  
renovation.



ABOVE:  
The old barracks Building 19, as seen  
from the road before renovation.



ABOVE:  
Building 19 - work in progress.

## Work is under way!!

Stage 1 of SIMS' infrastructure upgrade is under way. Work in progress includes renovation of Building 19, upgrade of the aquarium and conversion of Building 22 into a laboratory complex. Above is a photomontage of the new administration and conference centre for SIMS, located in the former barracks Building 19. A mezzanine floor also is being added to accommodate post-graduate students. It is expected to be ready for occupation by the end of March 2011.

As the new face of SIMS, public exhibition areas will be adjacent to the main entrance to enable the showcasing of SIMS' research. A display of SIMS merchandise also will be included. Conference facilities on the upper level will hold more than 70 people as SIMS, with its many collaborative institutions, has proven to be a sought after location for conferences associated with marine research. Other facilities within the building include accommodation for the Director, Chief Operating Officer and a small number of administrative staff, service areas for the technicians responsible for managing the laboratories and the aquarium, IT and communication facilities for the whole of SIMS and security services to safeguard SIMS' infrastructure.



ABOVE:  
Building 22, now being converted to a  
laboratory complex.



LEFT:  
Aerial view of the Chowder Bay  
precinct with the various SIMS  
buildings identified. This image has  
been displayed in earlier issues of the  
newsletter but is reproduced here  
to enable ready identification of the  
infrastructure upgrade works.

## Oyster research

The Harbour, like other river estuaries, is kept clean and functioning by the abundant plant, animal and microbial life in the water, in the sediments on the ocean floor and associated with the rocks around the foreshore. An important aspect of the role of SIMS is to develop an understanding of how these organisms work together to maintain the good health of the Harbour, and to monitor and predict changes and threats to the system.

An obvious resident around the Harbour, on rocky shores, on piers and walls is the Sydney Rock Oyster. SIMS scientists are investigating the idea of using the oyster as a signaling species, to provide us with an easily accessible early warning of increases in polluting heavy metals before they become biologically dangerous.

Metals reach the Harbour through run off from industrial, transport and other human activities. A build up of these pollutants can place severe stress on a range of marine plants and animals, and also build up in the food chain, making recreational fishing a potential health hazard. It is therefore important to know if trace metals are on the rise – then their source can be tracked and the inflow controlled.

Daisy Taylor and Emma Thompson, Macquarie University scientists working at SIMS, have found that oysters exposed in the laboratory to even very low levels of trace metals in the water undergo marked changes in their protein makeup. These changes can be detected easily using well-established protein profiling methods.

This approach looks like being an ideal basis for a pollution monitoring and early warning system, given that oysters occur widely around the Harbour and can be collected regularly from multiple key sites with little impact on populations. Field studies using oysters collected from different locations are now in progress to confirm the laboratory findings.

If successful, then this technology will be an important part of delivering SIMS' vision: to monitor the health of Sydney Harbour and contribute to its better management for the future.

## Researching Sydney Harbour (cont.)

### Why SIMS?

SIMS brings together marine researchers from right across the Sydney area. SIMS' location at Chowder Bay provides direct access to a range of Harbour habitats. With the wealth of scientific expertise available, the support of partner universities and of Government Departments involved in the marine environment, SIMS is an ideal focal point for such a comprehensive and long term program.

### Stages of the program

The program will be developed over several years as baseline data are collected and remediation methods are trialled. Collation of all past studies done on Sydney Harbour, accessing both published and rare unpublished material is the first essential step. More survey work will be carried out in a range of habitat areas, both natural and man-made (wharves, seawalls etc). This work will fill the gaps in documenting Harbour marine species and habitats. From this work, a number of key sites will be selected for long term monitoring of environmental health and biodiversity.

Results from the earlier stages will guide the design of pilot projects in habitat restoration – to test the feasibility of larger and more costly programs to follow. The involvement and support of governments, scientific and conservation groups and the community at large will be vital for the success of these initial pilot projects, and of later large scale rehabilitation efforts.

### When will the program begin?

SIMS is already working to co-ordinate a range of existing research programs that can contribute to achieving this important vision for the healthy future of Sydney Harbour. But to develop the comprehensive range of activities required even at the first stage, dedicated funding will be needed. SIMS will be seeking backing from government, its sponsors, supporters and the Harbour community to get this important program under way as soon as possible. We shall keep you up to date as we develop our plans for this major research project.

Our thanks to Marilyn Sleigh for contributing this article.



Treasures of Sydney Harbour:

*Left:*

A colourful Nudibranch

*Right:*

A dwarf lion fish at the wreck of the *Centurion*

Both photos by Erik Scholgl



*Left:*

Daisy Taylor and Emma Thompson collecting oyster specimens for analysis in the laboratory

## Seal research - a talk by Dr. Iain Field

*Each year, a number of scientific lectures are scheduled by SIMS to enable supporters to hear the latest on research from those at the coal face. Most recently, Dr. Iain Field, a Macquarie University Research Fellow in the Graduate School of the Environment, gave a wonderful presentation on Antarctic research using elephant seals.*

The Antarctic, of which Australia claims 42%, and the surrounding Southern Ocean, are arguably the most important, yet least observed, of marine habitats. Connecting all the world's oceans, the physical structure of the Southern Ocean profoundly influences world climate and ecology, and plays a key role in global warming. The merging of oceanography and marine mammal ecology advances our understanding of the world's oceans and its top predators, and allows us to predict how these species will be affected by future global warming. As well, it will provide important data on ocean properties throughout the Antarctic winter - data currently unavailable but crucially important to climate scientists.

Seals are apex predators that are sensitive to changes in climatic variation and the distribution and abundance of prey. Their responses are manifest in changes in their foraging location, foraging success and reproductive output (Hindell et al. 2003). Therefore monitoring where these predators go at sea for their foraging, can provide information on the availability of their prey and the quality of their environment.

As seals forage successfully they increase their stores of blubber, become more positively buoyant and change how they sink and float in the water. Change in the daily rate at which they sink or float, known as the drift rate, can then provide a measure of biological productivity. The power of such an approach is that combining data on the movements of multiple seals foraging at sea, enables identification of regular and transient hotspots of biodiversity in the Southern Ocean.

To carry out this research, Iain Field spends months at a time on subantarctic Macquarie Island and in the Antarctic with a research team. Tagging the elephant seals is their task. This is no mean feat. On average a female can weigh about 500 kgs and a male, over 2,000 kgs. These seals need to be caught and then sedated before the research tag is glued to the seal's fur. "We catch the seals on the beach by hand; they're wild animals and so should be treated as dangerous, and they are very big, so sometimes we need four of us to restrain them," says Field. "Then we'll sedate them so that the animal is safe as well as making it safe for us. Once sedated, we measure and weigh them. Then we glue the unit to the seal's head which takes about 20 minutes."

Field explains that gluing these units to the heads of the seals is the best way of monitoring their movements and previous research has shown that attaching the tracking devices in this way has no detrimental effect. Also, each year the seals moult their fur and skin and at this point the units will drop off. The units are satellite linked, so the information is relayed in almost real time. The seal's head is the only place to which it can be glued as when the seal comes up to breathe the only part of their body that breaches the surface is the head. And that's when the data is relayed, via satellite back to the researchers, whenever the seal surfaces.

It is only early days in this research but Field says that they have enough tagged seals to determine where the hotspots are and how they are changing from season to season - crucial information.

The information for this article has been adapted from the talk by Dr. Iain Field, Macquarie University Quest Magazine and the web site of the Australian Integrated Marine Observing System (IMOS).



Photo: Chris Oosthuizen  
Close-up of a tagged elephant seal



Photo: Iain Field  
Tagged elephant seal heads for the ocean



Image of the tracks of fifteen tagged elephant seals between January and September, 2010.

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and click the **DONATE NOW**  
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cheque or credit card details.**

Last issue we showed a photo of SIMS headquarters at Chowder Bay.

This time we thought we would include a photo of one of the far flung places where SIMS' scientists work. This is Macquarie Island where Iain Field and his fellow researchers work on elephant seals. The buildings at the research base are in the background whilst seals laze in the foreground.

