



HIPPIES' scientist Iain Staniland searches for homeward-bound female fur seals using a directional antenna to pick up signals from their VHF tags. Nick Gales

HIPPIES assessed who eats whom around Heard Island

In the summer of 2003 the Australian Antarctic Division (AAD) conducted an ambitious ecosystems study of the key predators that breed on sub-Antarctic Heard Island, their prey and the regional ocean environment. Called the 'Heard Island Predator-Prey Investigation and Ecosystem Study' or 'HIPPIES', the recently completed research provided an insight into the predatory food web in the region, giving important new baseline information for local fisheries management.

Australia oversees two important commercial fisheries for Patagonian toothfish and mackerel icefish in the waters around the Heard Island and McDonald Islands region of the vast southern Indian Ocean. To manage these fisheries sustainably, scientists need to understand the effects of harvesting on the target species, on predat-

tors of those species, and on the prey and competitors of the target species. This food web information will allow more accurate modelling of the effects of fishing on all species, and inform subsequent management planning.

'It was a study on a grand scale,' says Dr Nick Gales, a marine biologist with the AAD's Southern Ocean Ecosystems Programme.

'Twelve of us established three field camps on Heard Island, which we used as a base to attach satellite trackers to animals, while our marine science colleagues on the research ship *Aurora Australis* spent 40 days rolling and pitching around Heard Island in a carefully constructed pattern, studying the animals.'

The basic approach was to choose the predator species that, by virtue of their numbers, consume the most food from

the waters immediately around Heard Island. In order of abundance these were the macaroni penguins (numbering in the millions), the king penguins (numbering in the tens of thousands) and the Antarctic fur seals (numbering in the thousands).

The experiment coincided with the busy summer breeding season on the island, during which the penguins and female fur seals were alternating their time on shore caring for their offspring and offshore consuming food for themselves and their young.

'Before an animal headed off to sea we would catch it and, following animal ethics guidelines, attach a satellite radio tag – which gave us regular locations – and a dive data logger – giving us data on all the animal's diving and swimming behaviour,' Dr Gales says.

'Trips to sea varied from a

few hours to a few weeks. When the penguin or seal returned to Heard Island we recaptured it, removed the equipment and collected samples – scats (droppings) and milk from fur seals and stomach contents from penguins – to identify what they had been eating.

'Male fur seals were included in the work, but as they take no parental responsibility and we were unable to recapture them, we only placed satellite tags on them so that we could record where they went to feed. We also placed satellite tags on some black-browed albatross and light-mantled sooty albatross. We need to understand where these birds forage so we can assess the degree to which they overlap with the areas fished by longline vessels – these are a risk to the birds if they attempt to take baits from the hooks.'

At any one time almost 100 animals were being tracked around Heard Island via the French Argos satellite tracking system, and gigabytes of data were being collected on diving behaviour. To make sense of all these interlocking tracks the researchers developed software that generated maps of each animal's whereabouts, and mathematically derived grids showing overall animal foraging intensity.

To collect the suite of data necessary to provide a complete enough picture of the physical and biological processes influencing predator and prey relationships, specialised ship-based trawls, acoustic echo soundings and regular measurements of the water column, were combined with data of sea surface temperature and water colour taken from space sensors.

The foraging tracks of fur seals, king penguins and macaroni penguins around Heard Island revealed a great deal (see the tracks diagram). Female fur seals hunted close to the island while caring for their young and were observed to eat mostly icefish and myctophids (small

Research

schooling fish). Male fur seals have no parental responsibility and so forage further afield, to the neighbouring Iles Kerguelen, down the Kerguelen Plateau and along the continental shelf near Antarctica – where it is possible that they feed on krill.

King and macaroni penguins looked for myctophids and squid in similar areas, although macaroni penguins travelled further – up to 1000 km in one case. Not bad for a small bird. Earlier in the breeding season, however, when their chicks are young, macaroni penguins tend to forage much closer to Heard Island.

‘We only visit this remote and operationally challenging region sporadically, but each time we learn a little more about what is there and how best to manage it,’ Dr Gales says.

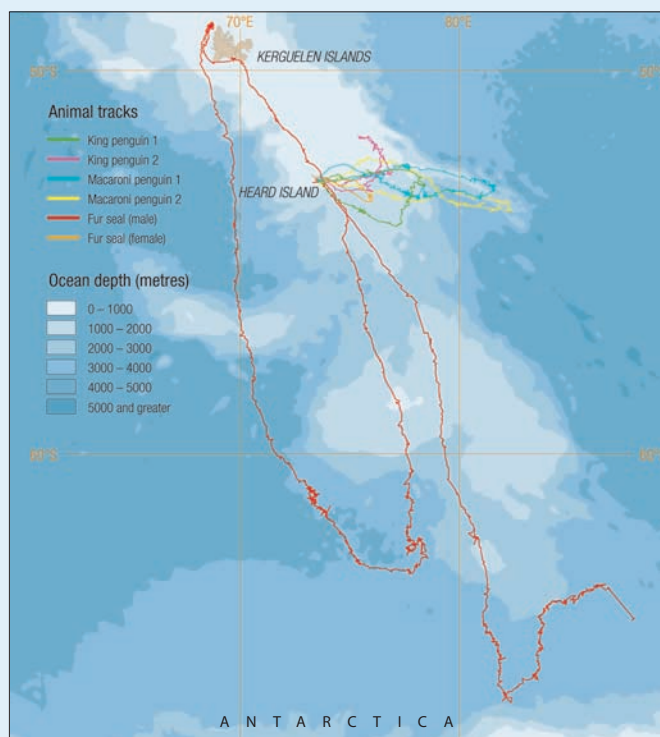
Right: Foraging tracks of fur seals, king penguins and macaroni penguins around Heard Island between December 2003 and February 2004. AAD

‘HIPPIES has taken us a big step towards a sustainable, ecosystem-based fisheries model that we hope can give us confidence in fisheries management of this region. The experiment has also taught us many scientific lessons to help us conduct similar experiments elsewhere in the Australian Antarctic Territory.’

● **Nick Gales and Andrew Constable**

This article is adapted from Australian Antarctic Magazine, Issue 7.

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