Karen Gerhard (undersearreflections.com)

A male dugong that arrived off Cocos (Keeling) island, in the Indian Ocean. The nearest seagrass is located in Indonesia, over 1000 km away.

Dugongs Are Both Hoons & Homebodies

The sedentary appearance of the dugong may be deceptive, according to a satellite tracking study by James Sheppard.

Evidence from a satellite tracking study conducted by James Cook University (JCU) and the Reef Cooperative Research Centre (CRC) indicates that dugongs spend much of their time foraging around key areas of core habitat, and also frequently travel long distances in search of warmer waters and sweeter seagrass meadows.

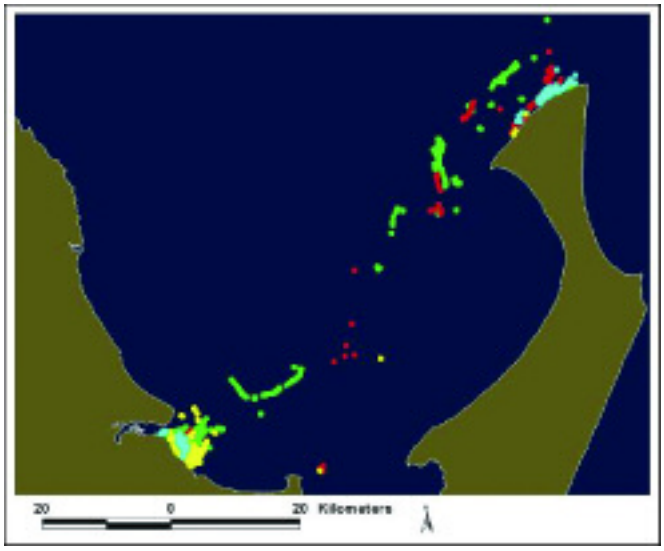
Dugongs are seagrass specialist feeders and a seriously threatened key component of seagrass ecosystems. They face numerous sources of human-related mortality such as boat strike, incidental drowning in fishing nets and degradation to seagrass habitat from terrestrial runoff. Australia is internationally recognised as the last stronghold of dugong numbers, and increasing resources are being focused on improving the ecological basis for dugong conservation management. The rapidly urbanising coast of Queensland, where dugongs are found in high numbers, presents a particular challenge to researchers and management agencies in terms of reducing the impacts of development on marine resources and habitats. Consequently, there is an urgent need for more information on dugong behaviour, spatial ecology and habitat use.

The latest global positioning system technology was used to follow the movement patterns of 22 dugongs captured in Hervey Bay, Queensland. During 2003–2004, the animals were tracked for 3–4 months at a time at a previously unobtainable high resolution (<10 metres). The resulting extensive dataset revealed that dugong movement behaviour can be broadly classified into two types: "homebodies" that forage around core habitats, and "hoons" that travel long distances over short time periods. These two movement types seem to be interchangeable within any population.

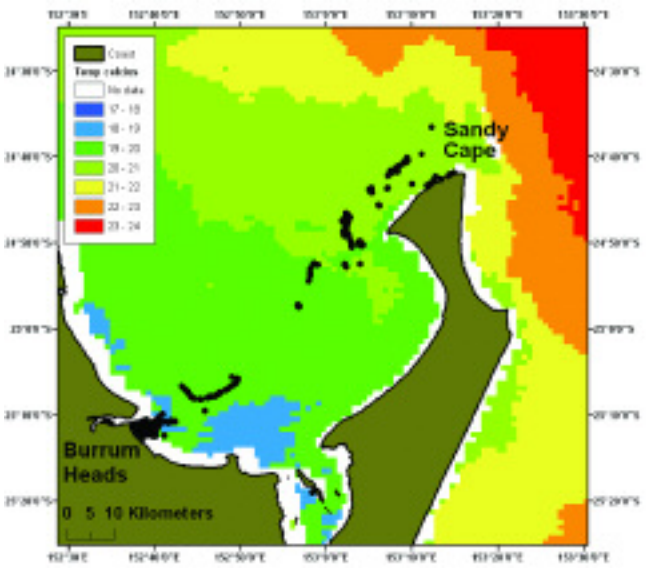
The JCU tracking study revealed that dugongs exhibit high site fidelity to specific areas of core seagrass habitat, which they use intensively. Following capture and tagging, many of the tracked animals spent days to months in habitat "hot spots" of less than 25 km^2, commuting back and forth with the tides to feed on intertidal seagrass meadows. These "homebodies" continued to move in and out with the tides at night, and were presumably still feeding during this time. In fact, tracked dugongs were generally closer to the shore at night than during the day.

"Travelling dugongs seem to know exactly where distant seagrass food resources are, and the fastest way to get to them."

Previous analysis of dugong stomach contents suggests that



Location fixes of four dugongs tracked during July 2003. Movement paths travel from the capture/foraging site at the mouth of the Burrum River across the middle of the bay to Sandy Cape, at the northern tip of Fraser Island. Each colour represents an individual dugong and each dot is a separate location fix.



Narawi, a 2.2-metre male tagged in Hervey Bay during July 2003, made this 80 km return movement from the capture site at Burrum Heads to Sandy Cape at the northern tip of Fraser Island. Each black dot represents a GPS location fix from the satellite tag attached to the animal's tail. The move is superimposed over sea surface temperature measurements for Hervey Bay from a NOAA thermal imaging satellite at the start of the move Note the higher temperatures at Sandy Cape compared with the colder inner bay. Courtesy AIMS

dugongs are fussy eaters. The satellite tracking data identified core areas of habitat that seemed to be important to dugongs in the region. These habitat hot spots possessed dense meadows of the types of seagrass that dugongs seem to prefer, namely high nutrient and low fibre varieties. This suggests that the animals are maximising their nutrient intake by intensifying their grazing over areas of quality seagrass food.

Not all tracked dugongs stayed put, however. For reasons that are currently unclear, 17 animals of various age, size and sex class simply left their habitat hot spots. These "hoons" travelled long distances at comparatively high speeds to new, distant habitats.

For example, a 1.9-metre male called Wunai left Hervey Bay shortly after tagging. In just 12 days he travelled 500 km north along the Queensland coast before reaching seagrass meadows near Mackay.

Some dugongs even made return movements. Bum'kaman travelled 285 km north to the waters off Great Keppel Island, where he stayed for a week before making the return journey back to Hervey Bay.

An interesting feature of these long-distance moves is that dugongs make regular deep dives (presumably to the sea floor) all along their travel route, possibly for navigational purposes. This has implications for certain fishing practices: placing a net on the sea floor does not necessarily negate the risk of incidentally entangling a dugong.

Not all dugong long-distance moves were unpredictable. During July, the coldest month of the year, six dugongs made direct 80 km trips across the middle of Hervey Bay. These animals became resident off Sandy Cape at the far northern tip of Fraser Island, where they stayed for a few days before making the return trip back across the bay to the inshore foraging grounds. This strange movement behaviour was repeated several times during July. A survey of the marine habitat off Sandy Cape revealed a general absence of seagrass but plenty of tiger sharks! Nothing to eat and lots of predators – so what was the attraction?

An examination of sea surface temperature coverages provided by the National Oceanic and Atmospheric Administration (NOAA) and the Australian Institute of Marine Science (AIMS) gave a potential explanation. During July, the East Australian Current sweeps down the coast of Queensland, bringing warm water from the tropics. Due to its geomorphology and the cooling influence of the land in winter, Hervey Bay effectively acts like a giant isolated cup of cold water. The East Australian Current does, however, sweep off Sandy Cape on its way south. Consequently, water temperatures around the cape are up to 3–5°C warmer than the inner bay.

Like their cousins, the manatee dugongs have low thermal tolerance, and at the high latitudes of their range they actively seek out sources of warm water during winter. In Hervey Bay, they seem to use the warm waters off Sandy Cape to maintain thermal regulation before returning to forage over the seagrass meadows of the inner bay.

The directed nature of dugong long-distance movements and the incidences of return trips imply an advanced spatial

James Sheppard (centre) with his James Cook University dugong catching team with an animal that has just been safely fitted with a satellite tracking device. Photo: Cedric Desloires

memory. Travelling dugongs seem to know exactly where distant seagrass food resources are, and the fastest way to get to them. What is curious, however, is that often these movements will take the animal past bays containing extensive meadows of apparently suitable seagrass resources. This is vividly illustrated during extreme climatic degradation of seagrass meadows supporting large dugong populations.

For example, in 1992 two floods followed by a cyclone wiped out 1000 km^2 of seagrass in Hervey Bay. The resident dugong population crashed, and dead and emaciated dugongs even began washing up south of Sydney. These dugongs, which were probably seeking out fresh food resources, bypassed areas known to possess extensive seagrass meadows.

It may be that the location of optimal seagrass food hot spots is "taught" by dugong mothers to their calves. This maternally transmitted cultural tradition may be the reason why not all dugongs know where the good grass is all of the time.

The JCU research has shown that dugong movement behaviour and spatial ecology are certainly more complex than previously understood. The seagrass upon which dugongs depend is extremely patchy across space and time. Dugongs seem to respond to this heterogeneity by using different movement strategies depending on the status of their food resources.

Small-scale movement occurs while dugongs forage intensively around hot spot areas of high seagrass quality. When the quality of the food resource declines, the dugongs then travel long distances to other hot spots previously known to possess high nutritional value. From an ecological perspective, such bet-hedging makes perfect sense because it allows foraging efficiency to be maintained in the face of an unpredictable food supply.

From a management perspective, identifying areas used most intensively by dugongs allows identification of what might constitute "ideal" dugong habitat. These areas can then be the focus of conservation measures.

Understanding the motivations and cues driving dugong movement behaviours, especially movements within the boundaries of conservation areas such as dugong protection areas, will improve the effectiveness of dugong management activities. It will also enhance our ability to predict and mitigate the deleterious effects of human activities across dugong ranges, with the ultimate aim of restoring dugong populations around the coast of Australia.

James Sheppard is a PhD student at James Cook University. A publication detailing the research fiindings into the large-scale movements of dugongs is published in the 27 June 2006 edition of the *Journal of Experimental Marine Biology & Ecology*.