GREAT AUSTRALIAN BIGHT
RESEARCH PROGRAM

Southern bluefin tuna

Tracing their lives in and out of the Great Australian Bight

The Great Australian Bight (GAB) is a summer feeding ground for juvenile (1–5 year) southern bluefin tuna (SBT). Since the 1960s the tuna have shared the GAB with industries including commercial fishing, tourism, shipping, and oil and gas exploration. In winter months, many of the tuna travel thousands of kilometres to forage in oceans east and west of the GAB.

More than 800 juvenile SBT were tagged with archival tags (also known as data-logging tags) during CSIRO-led research in 1993–2009, of which more than 100 have been recaptured. These electronic tags monitored internal body temperature, swimming depth, water temperature and light levels. An analysis of data from tags returned to CSIRO has applied a much improved ability to estimate the positions of individual fish from light data, to identify patterns and variability in the way SBT move, dive and forage.

Developing a good baseline understanding of SBT movements, diving and foraging is important because large-scale changes in behaviour could impact Australia's SBT fishery, which catches juveniles in the GAB during summer. It can also impact the ability of scientists to collect specific information used for guiding management aimed at the recovery and future sustainable harvest of SBT (implemented by the Commission for the Conservation of Southern Bluefin Tuna).

This brochure presents new knowledge about how juvenile SBT live, in and out of the GAB, and highlights the impressive four-year journey of one individual, tracked by tag no. 0390278.

These analyses were undertaken through the Great Australian Bight Research Program, a collaboration between BP, CSIRO, the South Australian Research and Development Institute, the University of Adelaide, and Flinders University.

The Program aims to provide a whole-of-system understanding of the environmental, economic and social values of the region; providing an information source for all to use.

A further 125 tags were deployed under the GAB Research Program in 2014, providing for ongoing data collection.

Tagging dataset provides a baseline for understanding long-term change

The improved understanding of juvenile SBT presented here was made possible by the historical archival tagging dataset collected across the past two decades from more than 100 individuals. The tagging has documented common patterns and individual variability in tuna behaviour, and changes in this behaviour over time. This provides a 'baseline' from which distinguishing responses to longer-term environmental change (such as climate change), or pressures associated with human activities (such as commercial fishing or oil and gas exploration) is possible.

There is much more work to be done. For example, many of the models developed for the investigations described here could be refined with additional data covering factors such as the composition and distribution of prey, and the physiology of tuna themselves.

Ongoing collection of data from juvenile SBT will occur into the near future, facilitated by additional tagged tuna released in 2014 under the GAB Research Program. The returned tags will expand our 1998–2009 dataset, providing a basis for future analysis.

Design and layout: Louise Bell
Editing: Bryony Bennett
Southern bluefin tuna image: Mike Parry/Minden Pictures

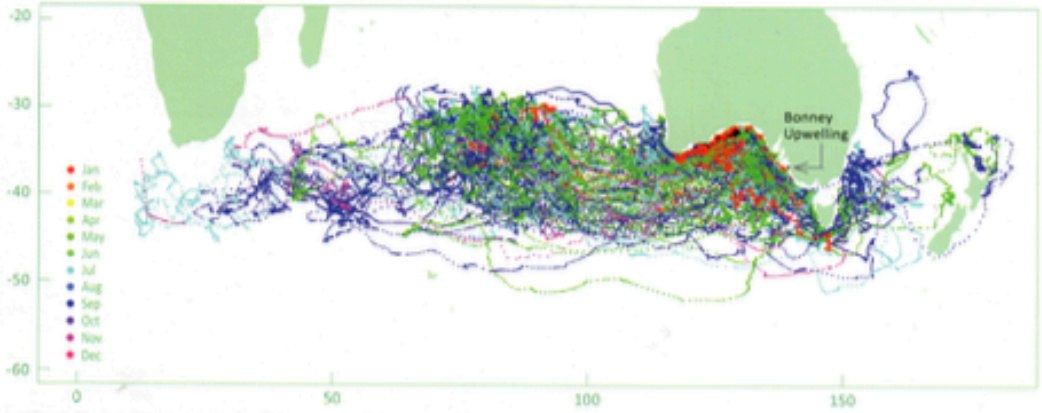
MOVEMENT

Most of the crowd heads west, while some head east, for winter

New tagging data highlight common migrations and individual marathons, from the GAB to South Africa and New Zealand.

Most juvenile SBT enter the GAB in early summer and stay until autumn, with the timing highly variable between individuals and years. As summer progresses, they tend to shift from areas in central GAB eastward towards the Bonney Upwelling system along the Victoria/South Australia border. They depart for the Indian Ocean and Tasman Sea across the autumn and winter months before returning the following summer.

COMPILED MOVEMENTS OF JUVENILE SOUTHERN BLUEFIN TUNA



DIVING AND SURFACING

Daytime surfacing unique to the GAB

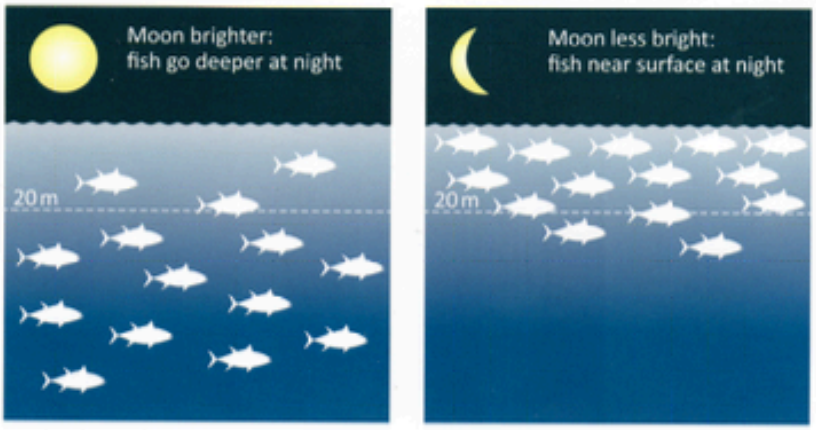
While some juvenile SBT break the norm, there are common patterns of diving and surfacing behaviour.

During summer in the GAB, juvenile SBT aggregate in large schools that spend most of the day in the warm surface layer of the ocean. In this top 20 metres of the ocean, the tuna are visible to aerial spotters that locate SBT schools for tuna fishers. This daytime surfacing is unique to the GAB. Outside the GAB, the fish tend to spend almost no time near the surface during the day. At night, juvenile SBT tend to be found near the surface both inside and outside the GAB (with a few deeper excursions outside).

As summer progresses through January to March, the waters of the GAB become warmer and there is greater mixing of warm surface waters with the waters that lie deeper. As the warm water temperatures preferred by juvenile SBT extend into deeper depths, the tuna also venture deeper, and spend less time at the surface.

As the moon moves through its cycle from a new moon to a full moon, juvenile SBT spend less time at the surface at night. This is probably because as the moon becomes brighter and the light penetrates the ocean, the prey of SBT move into deeper waters to avoid being seen by predators. It is also likely that as the light penetrates deeper, the tuna themselves have better visibility in deeper waters and can hunt more effectively.

SURFACING AND MOON PHASE

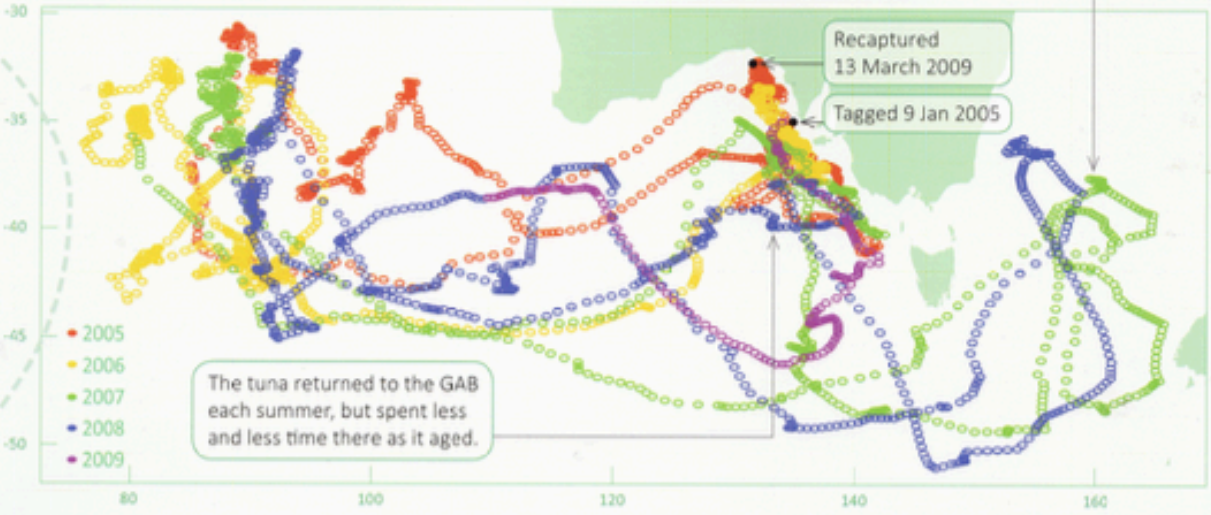


[tag no. 0390278]

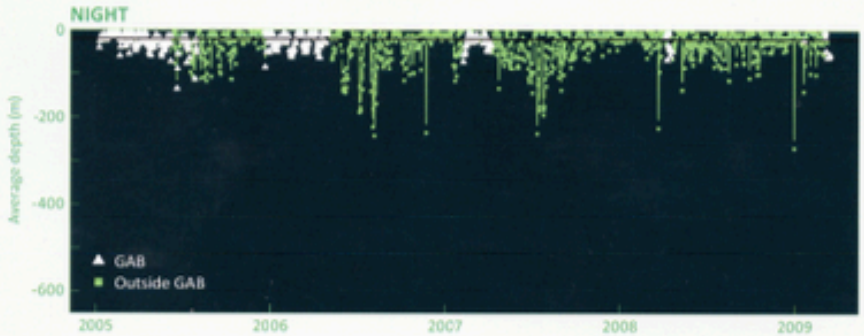
Four years in the life of

On 9 January 2005, a juvenile SBT was caught off Port Lincoln, South Australia (SA), and tagged with tag number 0390278. The tag was recovered when the tuna was recaptured off Ceduna, SA, more than four years later: this is the longest sequence of data recorded by an archival tag on a juvenile SBT. The tuna had travelled nearly 112,000 km in the four years, ranging more than 5,000 km from its release point, and covering an average of 73 km/day, with a longest daily swim of 300 km.

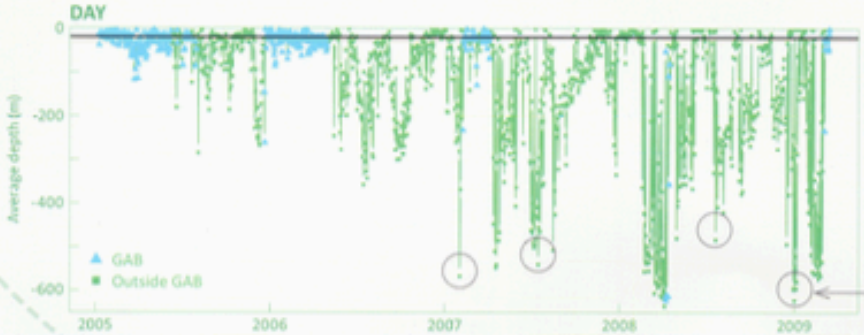
YEARLY MOVEMENTS TRACKED BY TAG NO. 0390278, 2005–2009



DIVING BEHAVIOUR TRACKED BY TAG NO. 0390278, 2005–2009



While in the GAB, this tuna spent most of its time close to the surface, during both day and night. In contrast, while outside the GAB, it spent more time in deeper waters, particularly during the day when it made frequent dives to depths greater than 100 m.

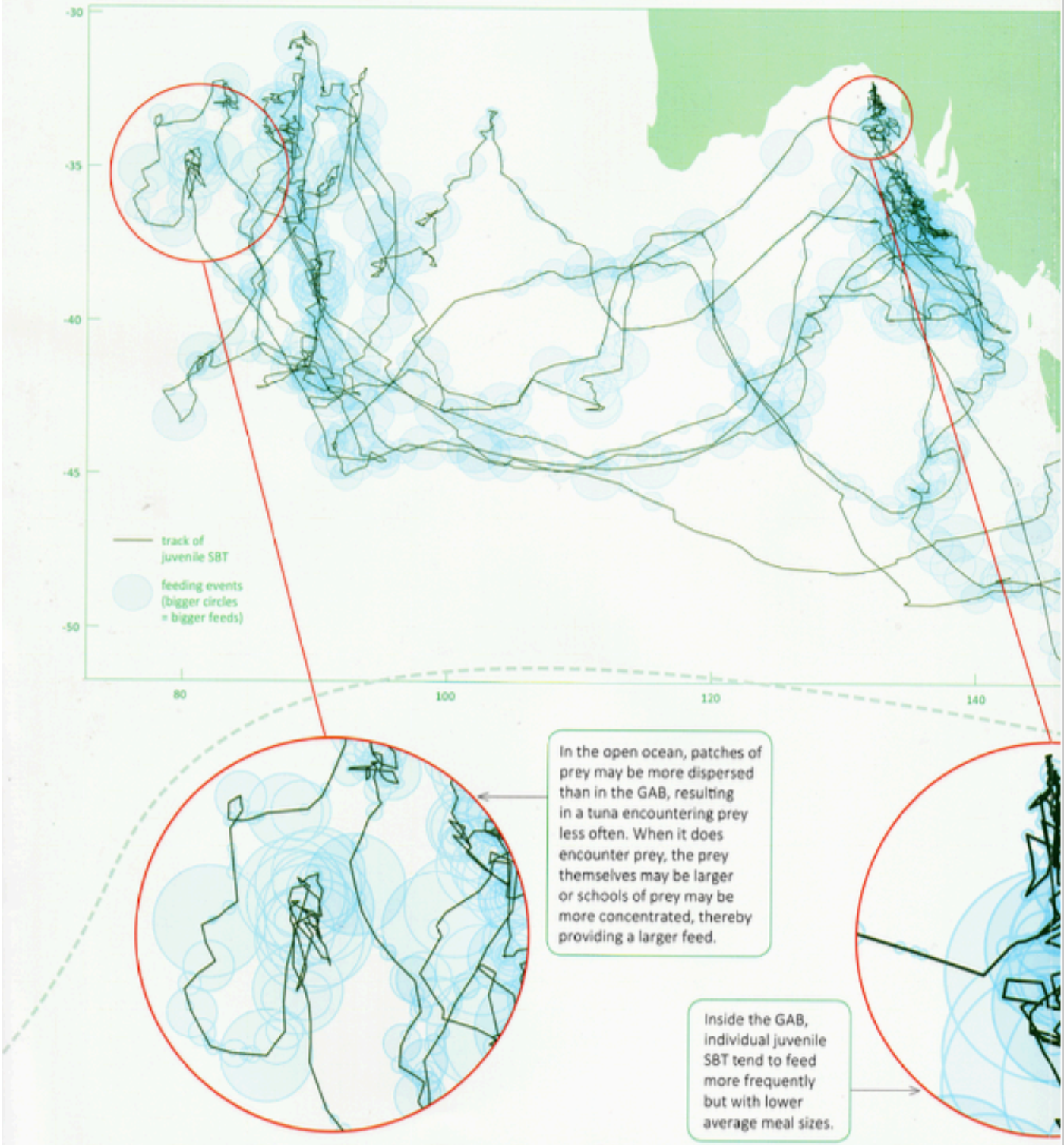


As it aged, the tuna progressively accessed deeper waters, probably due to changes in its physiology. By its third winter it was regularly moving deeper than 500 m during the day.

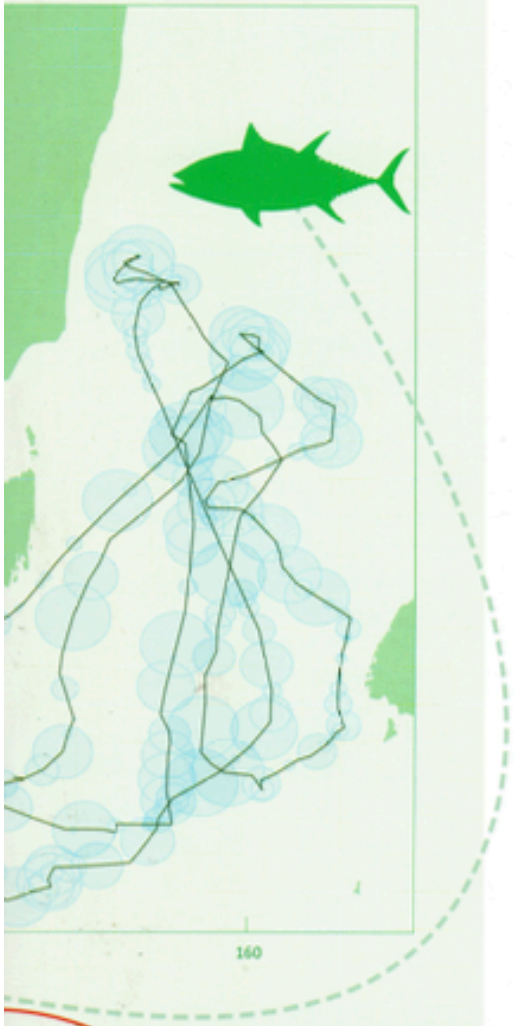
one **adventurous** southern bluefin

FEEDING

FEEDING EVENTS TRACKED BY TAG NO. 0390278, 2005–2009



tuna



Warm bellies reveal a good meal

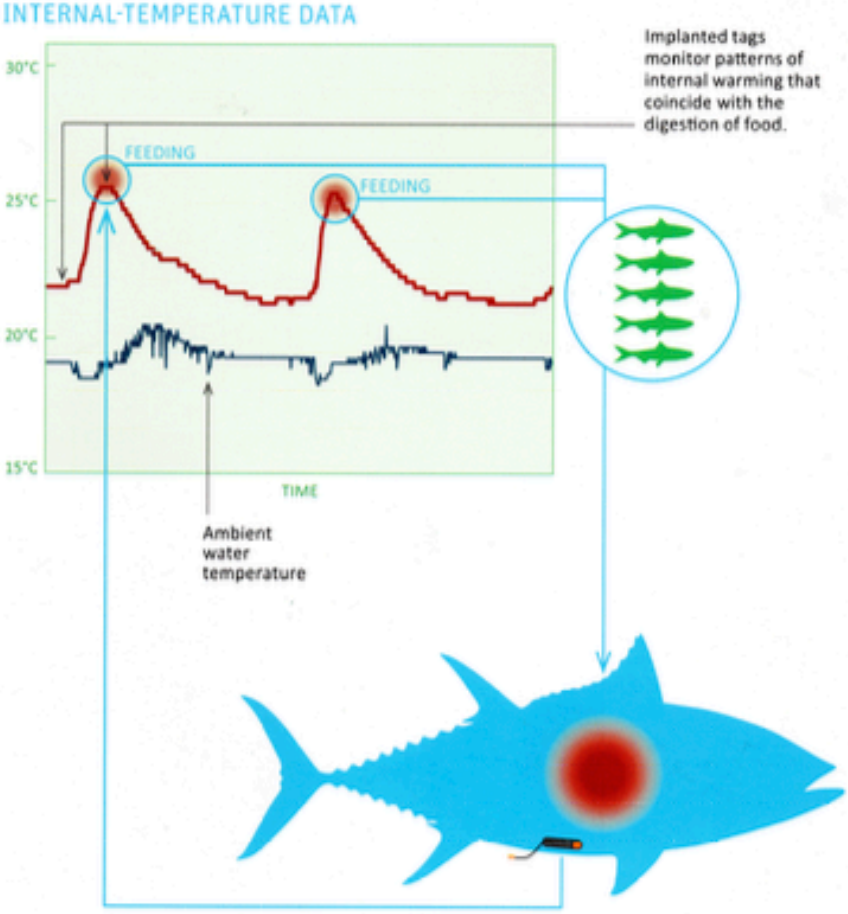
We're starting to see how the movements of juvenile SBT relate to their rapid growth during this phase of life.

Most fish have the same internal temperature as the water they swim in, but SBT maintain an elevated body temperature relative to the surrounding water. This adaptation, which is called endothermy, allows high-performance swimming and optimal digestion rates.

When a juvenile SBT feeds, its internal temperature undergoes a particular pattern of warming associated with the digestion of the food, and then returns to its 'baseline' temperature. Key indicators of this warming signal are calculated by monitoring captive SBT (in aquaculture cages) that have been implanted with archival tags and fed known quantities of food at known times.

These indicators are incorporated into an algorithm which is then applied to tag data from free-swimming SBT to determine where, when, and relatively how much they eat. (This research and modelling is in its early stages.)

IDENTIFYING FEEDING EVENTS FROM INTERNAL-TEMPERATURE DATA



For more information
www.misa.net.au/GAB

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