# Proposal: Proportion of juvenile southern bluefin tuna moving into southern Western Australia – implications for fishery-independent assessment

プロポーザル：西オーストラリア州南部へ移動するミナミマグロ若齢魚の割合 －漁業とは独立した資源推定への利用

Hobday, Alistair J. [1,2]* , Kawabe, Ryo. [3], Takao, Yoshimi[4], Miyashita, Kazu[5], Itoh, Tomoyuki[6]

アリスター・ホブデイ、河邊玲、高尾芳三、宮下和士、伊藤智幸

[1] CSIRO Marine and Atmospheric Research, GPO Box 1538, Hobart, Tas, 7001. Alistair.Hobday@csiro.au
[2] School of Zoology, University of Tasmania, Private Bag 5, Hobart, Tas 7001.
[3] Institute for East China Sea Research, Nagasaki University, Nagasaki, Japan
[4] NRIFE, Ibaraki, Japan
[5] Field Science Center for the Northern Biosphere, Hokkaido University, Hakodate, Japan
[6] NRIFSF, Shimizu, Japan

**Summary**
It is not currently known if all juvenile southern bluefin tuna that move down the coast of western Australia from the spawning ground subsequently move into southern Australia. A fraction of fish may instead remain on the west coast, or move into the Indian Ocean. Specifically, this experiment will be to examine the fraction of fish that move from the west coast to the southern coast over the austral summer. This information is important to the estimates of fish abundance along the southern coast. We propose to deploy an array of 70 listening stations in southern Western Australia and acoustically tag 130 SBT to examine the question of migration pathways to the southern Western Australia summer feeding grounds. The locations of the listening stations will be the same as used in 2002-2007 to continue to develop a time series of residence and migration routes along the coast. Fish will be tagged on the west, south-west and south coasts, and the detection records used to determine migration and residence times. We seek the support and endorsement of the CCSBT for the continuation of this preliminary study on a critical life history stage of southern bluefin tuna.

**要約**
産卵場からオーストラリア西岸を南下したミナミマグロ若齢魚の全てがオーストラリア南部へ移動するのかは、現在不明である。一部の魚はオーストラリア西岸に滞在したりインド洋へ移動するのかもしれない。本実験は、夏季に西岸から南岸へ移動する魚の割合を調べるものである。この情報は南岸の魚の資源量を推定する上で重要である。計画は、リスニングステーション

70 基を西オーストラリア州南岸に列状に配置し、ミナミマグロ 130 個体に音響タグを装着、放流して、西オーストラリア州南岸の夏季の摂餌場への回遊経路を調べるものである。リスニングステーションの設置位置は、2002-2007 年と同じとし、沿岸での移動経路と滞在の時系列データを継続して得るものとする。魚は、西岸、ならびに南西岸、南岸から放流し、検出データは回遊と滞在時間を決定できる。我々は、ミナミマグロの生活史における重要な時期を対象とした本研究の継続について、CCSBT の支援と支持を求める。

**Background**

Results from the first five years of the acoustic experiment demonstrate that the acoustic monitoring approach can be used to monitor the movements of small SBT in coastal regions (Hobday et al 2007). Internal acoustic tags can be implanted in SBT, listening stations can be deployed and recovered, free swimming tagged fish can be detected, and the detection range of receivers is suitable for open water use. The scale of the approach is suitable for assessing movements on the scale of 1-500 km.

Residence times and school fidelity from acoustic monitoring can provide important biological parameters used in analyzing the results from surveys and conventional tagging programs, on which population assessments are often based (Kawabe et al 2007). Advantages of this acoustic tagging approach include the ability to simultaneously detect multiple individuals and to examine movement rates and visitation patterns over a longer period of time compared to active tracking studies.

We have shown that once in southern Western Australia, fish appear to be generally resident within the acoustic array for up to 100 days, moving in both directions following tagging, and leading to mixing between schools in the region. The proposed project will continue to build on the success of studies in 2002-07 that demonstrated acoustic monitoring can provide information about the movement and migration pathways of juvenile SBT in southern Australia. In this proposal we will examine the following hypotheses.

1. Juvenile SBT do not move south around the coast in the austral summer
2. There is no difference in movement patterns between fish of different size

In the investigation of these hypotheses, additional exploration on the environmental association with movement and residence times, and habitat use will be obtained.

These data are relevant and necessary for the estimation of the proportion of the juvenile stock that is in southern Australia during the austral summer, when other fishery-independent surveys are completed.

**Preliminary Results relevant to this proposal**

In 2006-07 we tagged 70 juvenile southern bluefin tuna “upstream” to the west of the listening stations and 50 fish within the traditional acoustic monitoring areas (**Figure 1)**. The fish tagged to the west represent a preliminary experiment for that proposed here. The preliminary experiment was funded by research funds of the scientists named to this proposal.

The time for a fish to swim from the furthest tagging location to the first receiver (370 nm) was estimated to take 16 days at a swimming speed of 1 knot. The array was deployed for a total of 180 days, and was in place for 140 days after the last fish was

tagged. Equipment was recovered at the end of May, 2007. This is considered sufficient time for fish to move from the west coast to the south coast.

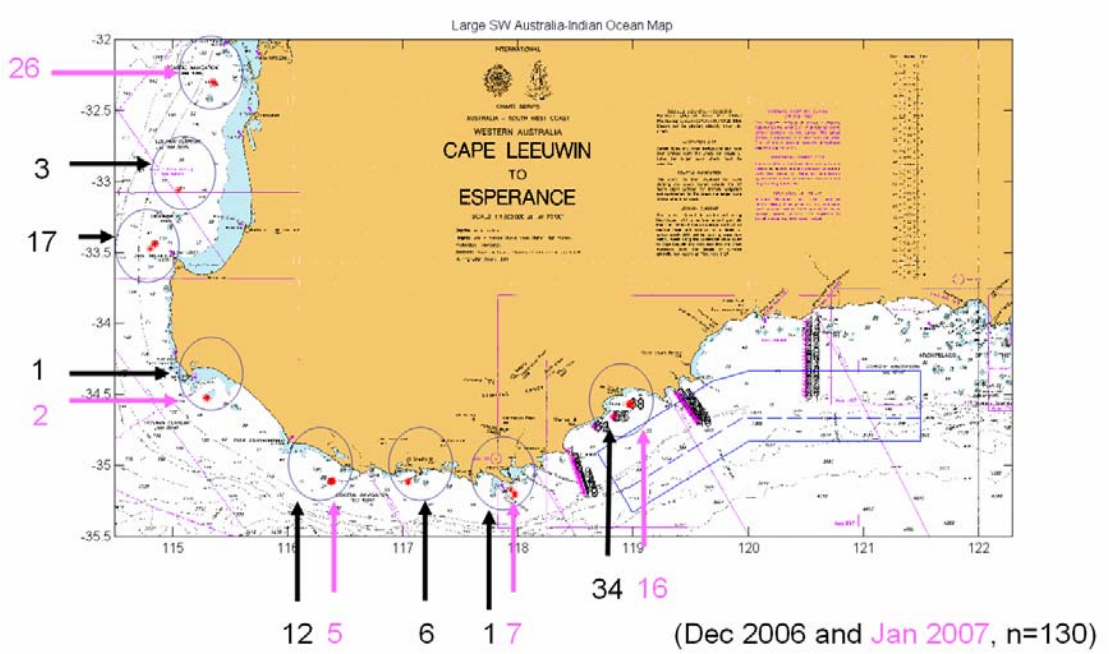


**Figure 1.** The location of listening stations along the southern coast of Western Australia for the 2006-07 experiment. Fish were tagged in a number of locations in December 2006 and January 2007, as indicated by the red stars on the map. The number of fish tagged at each location is shown in black for December and magenta for January.

Although analysis of the 2006-07 experiment is not yet complete, some preliminary results are relevant to this proposal. It appears that fish stayed local to the tagging area, and in the region of the acoustic receivers, moved from the array region. The fish tagged within the array region were not replaced by tagged fish from the west. Only one fish tagged on the west coast was detected at the array (**Figure 2)**, and in general, the detection of fish decreased with distance to the west of the array (**Figure 3).** This suggests that there is not a "conveyor belt" of fish moving from west to east. It raises the possibility that there are local feeding grounds, with fish quasi-resident over the summer at several locations along the coast. Part of the future challenge is to identify conditions that might define feeding grounds where juvenile SBT are found over the summer. Surveys in only one of these regions (e.g. the acoustic survey area shown in Figure 1) may underestimate the abundance of juvenile SBT. Variable migration rates can lead to changes in the estimates that are not due to recruitment, but to interannual variation in fish presence.

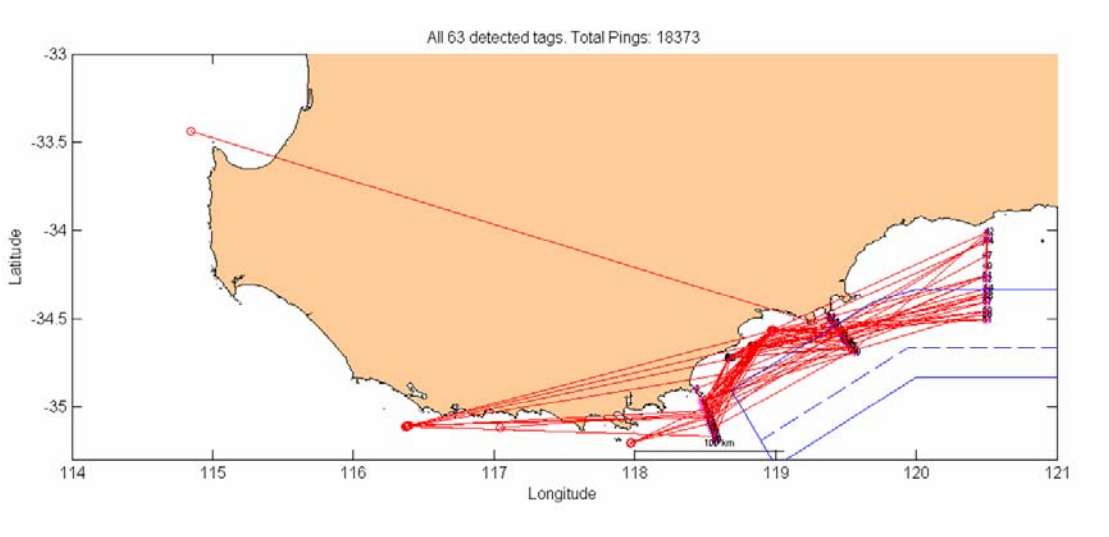


**Figure 2.** The movement paths of detected SBT (n=63) from the tagging location for the 2006-07 experiment.

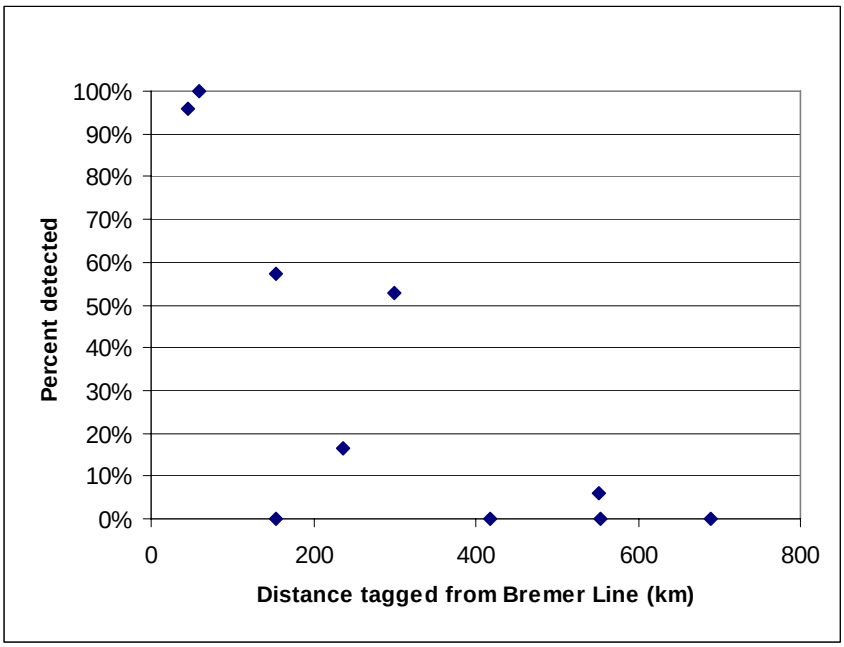


**Figure 3**. Detection of tagged southern bluefin tuna at the Bremer Bay Line (Line 2) in the 2006-07 experiment. Note the decline in detection with increased distance from the lines.

## Budget

A$130, 000

- Vessel charter: 20 days at $3500 per day
- Tags: 130
- Mooring supplies (rope, chain, replacement anchors and floats)
- Shipping and transport of equipment
- Travel and accommodation for scientists
- Listening stations available from previous years

## References

Hobday, A. J., Kawabe, R., Takao, Y, Miyashita, K., Itoh, T. 2007. Migration paths for juvenile southern bluefin tuna in southern Western Australia determined via acoustic monitoring – summary of 2003-2007 experiments. CCSBT SC meeting. September 2007.

Kawabe, R., K. Fujioka, A. Hobday, Y, Takao, K. Miyashita and T. Itoh. 2007. The effect of the spatial and temporal distribution of juvenile SBT on Acoustic and Trolling Survey abundance estimates. CCSBT SC meeting. September 2007.