Tracking bluefin tuna from NZ with electronic tags

By Shelton Harley, Pete Saul and John Holdsworth

This article delves into the behaviour of the two bluefin tuna species that are caught in NZ waters: the southern bluefin tuna (SBT), and its larger relative the Pacific bluefin tuna (PBT).

The use of high tech electronic fish tags is enabling researchers to get a much better understanding of the wandering lifestyle of some of the largest fish in the ocean. With no highways or signposts these fish can travel thousands of miles, annually congregating in feeding or breeding areas.

Electronic tags can either be attached to the outside of the fish, detaching at a pre-programmed time to float to the surface and transmit data to passing satellites (pop-off tags) or be surgically implanted in the gut cavity of the fish to be recovered if/when the fish is recaptured (implantable tags). These electronic tags store data on water temperate, depth, and light levels every minute for months or even years which allow us to reconstruct their movements. Pretty amazing stuff really, but one would hope so at the cost of $4000–$5000 per tag!

This month we provide a bit of background on the biology of these two species, including details of how they are managed and how NZ's fisheries fit in to the global context. We discuss the objectives for the work – as you can't throw the equivalent of a high-end laptop computers over the side without good reason. Finally, we will share some of the information on how these fish move around the waters of the NZ and the south Pacific.

Electronic Tagging Objectives

The main objectives of the tagging is to improve the management of the species and increase the value that NZers gain from them. Specifically to determine:

1. How long do these fish spend within NZ waters ?
2. How do the fish in NZ mix with fish in the wider stock and who do we need to cooperate with to ensure sensible management?
3. What is it about NZ waters that they like?
4. Do these big tuna survive catch and release from the recreational fishery?

Tagging the Fish

When you have expensive tags to deploy, getting fish to the boat in optimal condition and ensuring the tag is well anchored is important. Catching large PBT can be very challenging and certainly tests every aspect of the fishing operation. These challenges have been well described in other articles (NZFN ref), but suffice it to say that these fish don't fight any less when you have the admirable intention of releasing them with a tag attached!!!

The external pop-off tags are attached using a nylon or titanium anchor placed into the dorsal muscle of the fish and trail on a short tether until they release at a pre-determined time. The implantable tags are sown into the abdominal cavity of the fish with a stalk protruding to take light and temperature measurements.

In 2006, nine PBT were tagged with pop-off tags at the Hokitika Trench. Six were tagged from "Cerveza 2", skippered by Larry Johnston, and three from "Apollo" skippered by Carey McIvor. Five of these were hand-lined and four were caught on rod and reel. These fish ranged from 190 to 270 kg, with recorded fight times ranging from 15 minutes on handline to over two hours for rod and reel.

In 2007 fifteen PBT were tagged in the Karamea Bight, all from "Cerveza 2" with fight times ranged from 30 minutes for the single handlined fish, to over three hours for those caught on rod and reel. The 2007 results in this article come from the three Ministry of Fisheries (MFish) funded tags only.

SBT were tagged by MFish scientific observers on board tuna longline vessels. The external pop-up tags were attached on larger fish caught off the north-east coast of the North Island. Over 70 smaller SBT were tagged off the west coast of the South Island in May and June with the implantable tags..

Results

Here we present data from seven PBT and ten SBT all tagged in 2006 or 2007. The Pacific bluefin tagged ranged in size from 190–340 kg. The SBT tagged with the pop-off tags ranged from 74–116 kg. Not all tags remained attached for the programmed period, with the time on the fish ranging from 16-180 days.

Survival Rates

At the beginning of the recreational PBT fishery there was debate as to whether large tuna were capable of surviving catch and release. In 2006, the results were equivocal. However, the 2007 results have proved beyond doubt that tag and release is a feasible option for this fishery, as all 15 tagged PBT survived, even after fight times of up to three hours. All the tags provided good data, and a trial with different tag anchors resulted in several pop-off tags staying on the fish for the full programmed term of six months.

The results from the SBT tagging were equally as positive with all fish surviving the initial post-capture period. Only one mortality was observed was a rather unfortunate fish that was eaten by a larger predator just over two weeks after being released. More on this interesting occurrence next month.

Tour de Nouvelle Zélande

Of interest to researchers was how these fished moved about NZ waters and the surrounding areas. For the PBT all fish showed similar patterns soon after tagging with a fairly rapid movement north from the South Island west coast and by 14 September all of the tuna shown here were above 37^{o} S. This hotspot was about level with the Manukau Harbour, around 175 NM out in the Tasman Sea (Figure 4).

A few fish worked an area south of Wanganella Bank while others passed close by and went toward Lord Howe Island or around the top of NZ. Mostly these fish stayed in waters with a surface temperature of 15 to 19^{o} C during spring.

After this initial movement most fish moved individually. Some spent time between Northland and the Kermadec Islands. Two moved right down the east coast of the South Island and their tags popped off southeast of Banks Peninsula in January and February. Another followed the pattern of moving northwest towards Lord Howe Island but returned to the Karamea Bight in December. This fish then moved down the coast and spent January and February close to the southwest corner of the South Island. Another fish looped westwards over the top of Lord Howe Island and moved down the east Australian coast. It spent November and much of December in Bass Strait, moved south off Tasmania in January, and later shed its tag as programmed in the south Tasman Sea in early March.

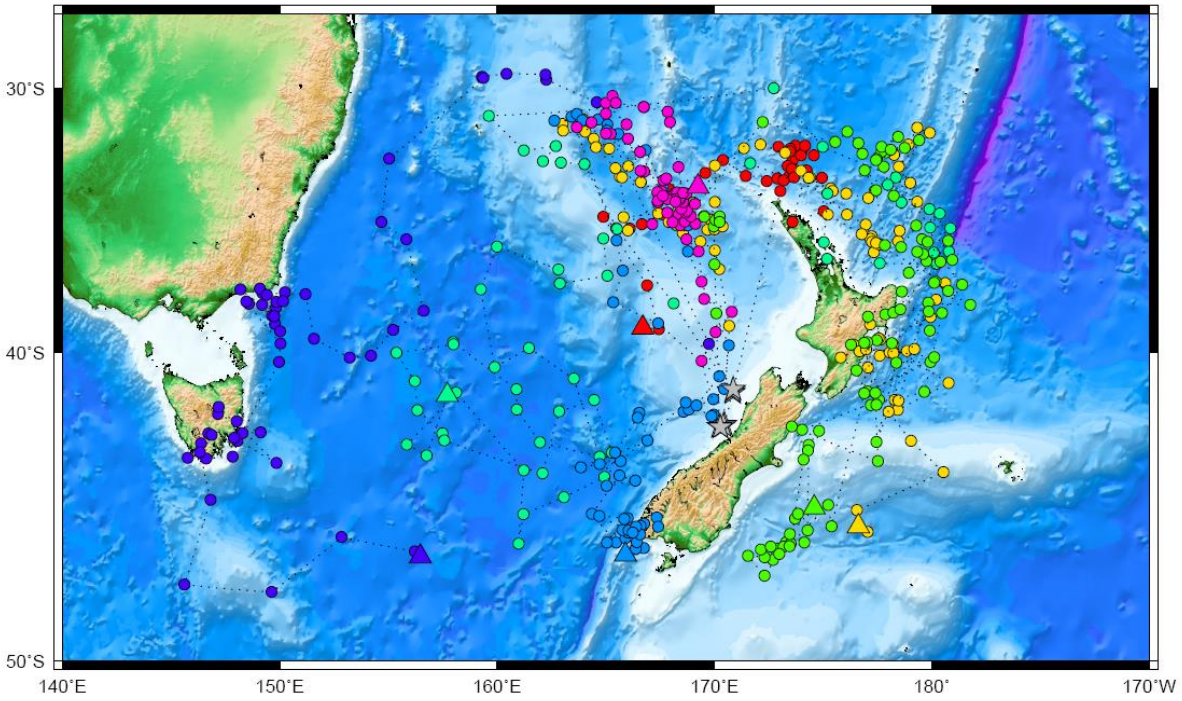

Figure 4. Pacific bluefin tuna tagging locations (stars) and pop-off tag release locations (triangles) for seven fish tagged in 2006 and 2007. The coloured circles are estimated positions using the time of dawn and dusk recorded but each tag (one colour per tag).

Movement – SBT

Most of the SBT tracks available to date come from PAT tags on fish released north of East Cape in July and August 2007. Generally tagged fish tended to work their way gradually north to be between 32^{o} and 35^{o} S during September (Figure 5). Some SBT shed their tags after short periods, but those that retained their tags dispersed in quite different directions. Three travelled west across the top of NZ. In October and November these fish were located somewhat south and west of the Pacific bluefin in the central Tasman Sea. One tuna then moved southwest to Tasmania, while another travelled around the bottom of the South Island to 48^{o} S,

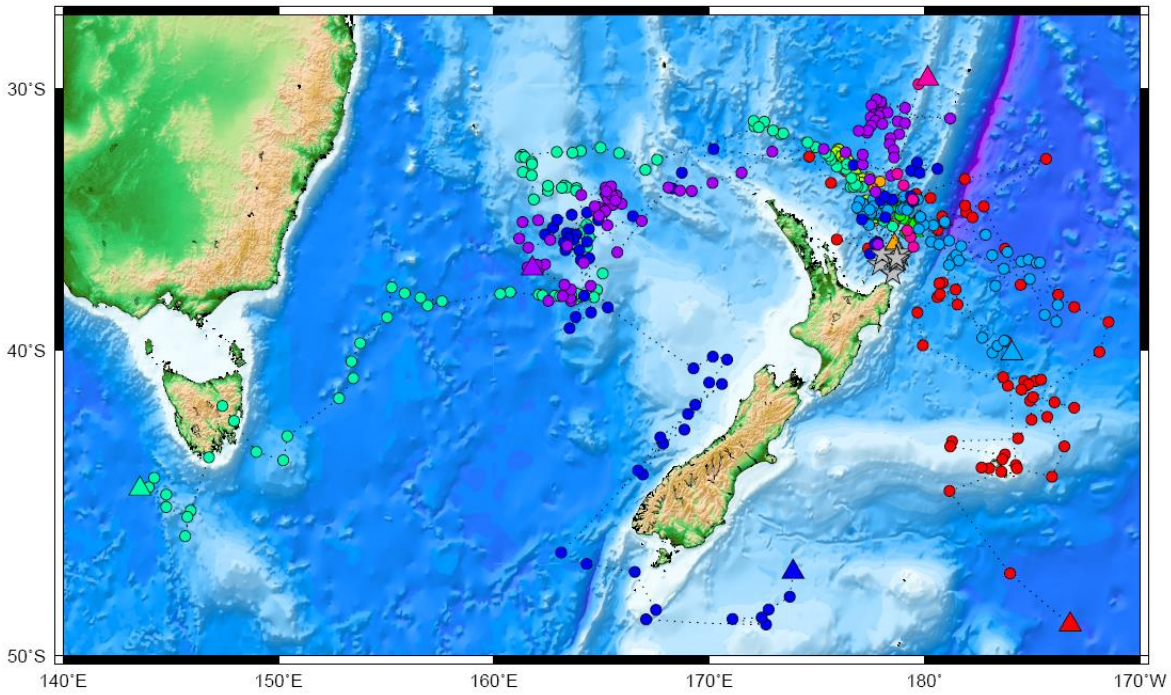

Figure 5. Southern bluefin tuna tagging locations (stars) and pop-off tag release locations (triangles) for nine fish tagged in 2006 and 2007. The coloured circles are estimated positions using the time of dawn and dusk recorded but each tag (one colour per tag).

before shedding its tag 180 NM off the south Otago coast. Two other SBT took the opposite route, leaving the East Cape area and moving south and east of NZ. One of these fish left and re-entered the EEZ on four occasions, eventually moving into international waters for the fifth time in January, before its tag popped off southeast of the Chatham Islands.

A Collaborative Effort

This work has only been possible due to the support of many agencies, both within NZ and internationally. Within NZ, funding has come from the Ministry of Fisheries (MFish – projects STN2003-01 and STN2004-01) and the NZ Marine Research Foundation. Tagging was made possible with the help of the MFish Scientific Observer Programme, owners, skippers, and crews of our tuna longline fleet, skippers, crew and clients on recreational charter vessels, and researchers from MFish and Blue Water Marine Research.

Our international colleagues provided support in the form of additional tags, technical assistance, and financial support for tag deployment. We are grateful to researchers from the National Research Institute of Far Seas Fisheries (Japan), CSIRO (Australia), and the Tuna Research and Conservation Centre (TRCC)(USA). We were particularly lucky to have Professor Barbara Block and George Shillinger of the TRCC and Tag-A-Giant Foundation involved.

Conclusions

We have only just started to look at the data that is available from these tags and we still have lots of SBT swimming around with internal tags. We have shown that we can attach tags to these fish and keep them on for up to six months. We have learnt

that PBT can survive the capture process whether taken by rod and reel or by handline.

These fish seem to spend a decent part of the year within our waters, but 200 miles is not far for them and they can easily slip in and out of our EEZ. None of these fish clearly headed to their spawning grounds, but perhaps one of the SBT was on the way there before its tag popped off.

There is an indication of some hotspots which these fish aggregate. In addition to where they were tagged, for SBT this appears to be an area on the southern Lord Howe Rise and for the PBT there is an areas to the south and west of Wanganella Bank which seems to appeal.

Next month we will delve further into the data on the water temperatures and depths that they prefer to learn more about what conditions they like and will share some of the fine scale diving data that these tags can provide. The results from all the tags will be published in a scientific journal. Planning is underway for long term tag deployments on PBT later this year.

Finally, the West coast fishery for PBT is pretty special. There are very few recreational fisheries for large bluefin like this left in the world. It is encouraging that many of the experienced skippers in this fishery have a tag and release policy. All anglers participating should be encouraged to take a responsible approach and help conserve this unique fishery. It is no longer acceptable for five anglers on a trip to bring home a fish each, just because it was their first bluefin capture. These fish deserve more respect than that, and what can anyone do with 1200 kg of tuna?

Bluefin Tuna Facts

- **Southern bluefin tuna (*Thunnus maccoyii*) are found in the southern hemisphere, mainly between 30° and 50° S**
- **They spawn in the Indian Ocean, south-east of Java from September to April**
- **They grow to a maximum size of about 2 metres and 180 kg**
- **The abundance of spawning age SBT is a fraction of what it once was**
- **SBT is managed by the Commission for the Conservation of Southern Bluefin Tuna (CCSBT: www.ccsbt.org)**
- **In 2007 the CCSBT agreed to reduce the overall catch limit by 20% down to 11,810 tonnes**
- **NZ commercial SBT catches are about 2.4% of the global reported catch**
- **Pacific bluefin tuna (*Thunnus orientalis*), sometimes called northern bluefin, are found throughout the Pacific Ocean**
- **They spawn between Japan and the Philippines from April to August**
- **Many young fish migrate to the waters off Baja California (Mexico)**
- **They probably grow up to 3 metres and 550 kg**
- **Most of the commercial catch is taken in the northern hemisphere**
- **Management of this species comes under the Northern Committee of the Western and Central Pacific Fisheries Commission (WCPFC: www.wcpfc.int)**
- **The scientists recommend not to increase fishing from current levels**
- **NZ commercial PBT catches are about 0.2% of the global reported catch**
- **Some individual fish can fetch over $20,000 on the Japanese market.**