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Research mortality allowance

Proposed allowance for 2017 and 2016 usage report

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Summary

Australia requests research mortality allowances (RMA) for two projects on southern bluefin tuna (SBT) in 2017. The overall RMA requested by Australia is small (1.7 t) and for projects will enhance our understanding of the biology and ecology of SBT.

The two projects requesting RMA are:

1) A 0.5 t RMA is requested for a study examining the molecular basis for endothermy using SBT as a novel model. This project will involve the capture of small SBT off southern Western Australia. Larger fish will be purchased from Port Lincoln aquaculture farms and so not included in the RMA request. RMA has been granted previously for this project, however due to delays in the project commencing no RMA has been used in 2015 or 2016.

2) A 1.2 t RMA is requested for a project examining the health of wild SBT. RMA has been granted previously for this project. In 2016, to date, a total of 1.044 t of the 1.2 t RMA has been used.

In 2015, Australia was granted 6.70 t of RMA for four projects in 2016. Two of those projects are also requesting RMA for 2017. As of 1 June 2016, a total of 1.561 t, from two projects, had been used.

1 Proposals for 2017

i) Does the "membrane pacemaker" theory hold true for endothermic fish?

This project, to be undertaken by CSIRO, will use SBT as a model to test prevailing theories of the evolution of endothermy (warm-bloodedness). Bluefin tunas are top predators whose removal or displacement due to over-fishing or climate change could destabilize marine ecosystems. Captive breeding is a possible solution but its success is limited by our understanding of tuna thermal biology. This project will rectify this.

This project will investigate the molecular basis of endothermy using a novel model, SBT. Endotherms maintain their internal body temperature by conserving metabolically generated heat, whereas ectotherms depend on heat from the environment. Despite its evolutionary significance, the molecular basis of endothermy is still not well understood. Tunas provide unique models to investigate this because their bodies consist of both endothermic and ectothermic organs and they only develop the capacity for endothermy during the first year of their lives. The outcome of this project will be a greater understanding of vertebrate thermal biology leading to better predictions of the effects of climate change on ecosystem stability.

Recently it was suggested that the limited success of bluefin tuna captive breeding may be due to under-developed capacity for endothermy when the young fish are transferred from the warm water of the hatchery to the cooler water of the sea cages. This was based on observations of Pacific bluefin tuna but it may also be true for SBT. The growth of the SBT aquaculture industry is limited by high rates of cold-induced mortalities in captive bred fish proposed to be due to underdeveloped endothermy. Small (incipiently endothermic) SBT are found in Australian coastal waters from Western Australia to the GAB.

We will compare small (40 to 60 cm fork length) SBT with similarly sized Australian bonito, a close ectothermic relative. These species, in this size range, are found in waters off southern Western Australia during the period November to February each year.

The specific aims of this project are:

1) To investigate the ontogeny of red muscle endothermy in small (incipiently endothermic) SBT.

2) To compare mitochondrial respiration rate, proton leak rate and membrane lipid unsaturation in endothermic versus ectothermic organs/tissues of large (fully endothermic) SBT and similarly-sized Australian bonito.

3) To determine the effects of varying membrane unsaturation on mitochondrial respiration rate and proton leak rate in a recently established SBT cell line.

4) To explore the transcriptional regulation of mitochondrial biogenesis and its role in the ontogeny of red muscle endothermy in fish.

The project proposes to capture around 50 young-of-the-year SBT in waters between Albany and Fremantle. The project is aiming to capture fish with body sizes ranging from 20 to 80 cm fork length (i.e. encompassing the size of 55 cm fork length where the onset of significant red muscle warming is expected). The maximum weight expected for this size range is less than 10

kg. The maximum take is estimated as 50 x 10 kg = 500 kg. These fish are not available from the commercial fishery in the Great Australia Bight.

Larger SBT with body sizes ranging from 100 to 150 cm fork length (i.e. in the range where we expect well-developed red muscle warming) will be obtained during normal commercial harvests from tuna farms located near Port Lincoln, South Australia, and are not included in the request for RMA.

RMA was approved for this project in 2016. However, the project did not commence in 2016 and no RMA was therefore used (see Section 2).

Based on the above, an RMA of 0.5 t is requested for this project for 2017.

ii) Health assessment of wild southern bluefin tuna

The major aim of this project is to assess the health of wild SBT. As well as traditional health assessments including histology, microbiology, immunology and haematology, this project will aim to further develop and apply new molecular methods, including those for pathogen detection and associated pathology in wild SBT. New molecular methods will be developed which could help to identify specific blood borne biomarkers for various pathogens (disease agents) and ultimately could lead to non-lethal health assessment for these animals.

This project, undertaken by researchers from the University of Tasmania, will have significant scientific and ethical benefits. The results of this project will contribute to the knowledge of the health of wild SBT populations including pathogen prevalence and/or intensities. Identification of suitable health biomarkers could also negate the need for destructive sampling of animals. This project could therefore have implications for future SBT research.

Most health assessments for SBT have been conducted using ranched animals. Comparatively, the health status of non-ranched wild SBT has received little attention. Some wild SBT sampling has previously been conducted with participation of SBT industry as part of Aquafin Cooperative Research Centre and Fisheries Research and Development Corporation projects. This research was based on frozen and formalin fixed samples that were collected by the industry from tuna schools captured for ranching so for example the samples for pathogen detection (particularly some species of parasites) were limited. All SBT were from the Great Australian Bight, further limiting interpretation of the results. Some of the results from this work with wild tuna have been published (please see Rough et al. 2005, Aiken et al. 2007, Aiken et al. 2008, Aiken et al. 2009, Kirchoff et al. 2014).

This project was granted 1.2 t RMA request granted for 2016. In 2016, a total of 60 SBT have been caught for this project, amounting to 1.044 t (see Section 2). This RMA request is to cover further work in 2017. Based on the above, an RMA of 1.2 t is requested for this project for 2017, based on an estimate of 20 SBT with a maximum weight of 60 kg each.

To date, several publications from this research are in review or have been published (e.g. Balli et al. 2016).

2 Summary of 2016 RMA usage

A total of 6.7 t of RMA was granted in 2015 for Australian research projects undertaken in 2016. To date (1 June 2016), 1.561 t of RMA has been utilised in 2016, well below the amount granted, although additional RMA may be used during the remainder of 2016.

1) A 1 t RMA was approved to continue initiatives focused on investigating: (a) the spatial dynamics and mortality rates of SBT utilising electronic tagging techniques; (b) the impacts of noise associated with oil and gas exploration on SBT in the Great Australian Bight. No RMA for this project has been used in 2016.

2) A 0.5 t RMA was approved to use SBT as a model to test prevailing theories of the evolution of endothermy (warm-bloodedness), described in Section 1 proposal i). However, the project did not commenceand no RMA was used in 2016.

3) An RMA of 1.2 t was approved for a project examining the health of wild SBT. A total of 1.044 t of SBT was used for this project in 2016.

4) Finally, a 4 t RMA was approved for the pilot gene-tagging implementation in 2016, to cover incidental mortalities. While this RMA was approved to Australia, the Extended Commission agreed to fund this project in 2016 and the progress report is provided in CCSBT-ESC/1609/07. A total of 0.517 t RMA was utilised in 2016 for this project.

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