Incorporation of SRP tagging data into the SBT operating model: discussion and recommendations

Paige Eveson, Rich Hillary, Marinelle Basson and Ann Preece

CCSBT-ESC/1208/23

Prepared for the CCSBT Extended Scientific Committee for the 17th Meeting of the Scientific Committee 27-31 August 2012, Tokyo, Japan

Wealth from Oceans Flagship

CSIRO Marine and Atmospheric Research

Acknowledgements

This work was funded by AFMA and CSIRO's Wealth from Oceans National Research Flagship.

Contents

1 Abstract

Complexities with including the Scientific Research Program (SRP) tagging data in the operating model for SBT are discussed. These include the unusually low returns from age 1 fish released off Western Australia, the lack of data for estimating reporting rates from certain fleets, and the potential need for a spatial model. With regard to the latter, results from previous analyses indicate that incomplete mixing of tagged and untagged fish may be greater issues for the 2000s SRP tagging data than for the 1990s tagging data; therefore, the most appropriate method for including the SRP data in the OM would be through a spatial model. The current OM is not spatially structured, so to include a spatial likelihood for the SRP data would ideally involve restructuring the OM. The movement towards a spatial OM is something currently being considered for other reasons as well, such as interpretation of CPUE data. In the meantime, however, a possible alternative is to include a spatial likelihood (i.e., that involves region-specific parameters) for the SRP data in the OM, but then also within the OM calculate aggregated ("non-spatial") parameters from the region-specific parameters. Even this approach would take a fair amount of time and effort to implement for reasons discussed, so guidance is sought from the SC as to whether it should be pursued.

2 Introduction

One of the priorities identified at the 2011 ESC meeting for consideration at the 2012 ESC meeting was the inclusion of data from the Scientific Research Program (SRP) tagging program (2001-2007) in the operating model (OM) (Anon. 2011). Currently, data from the 1990s tagging experiments are included in the OM through an additional likelihood component. The releases and recaptures are pooled across space and a traditional Brownie model is used to analyse the pooled data. There are a number of reasons why the SRP tagging data cannot be included in the OM in the same way as the 1990s data. In this paper, we discuss these reasons and provide suggestions for how best to deal with the various issues.

3 Methods and Discussion

As part of the SRP, the CCSBT initiated a large-scale tagging program to estimate juvenile fishing mortality rates beginning in the 2001/02 surface fishery season. The basic design of the tagging program was similar to that conducted in the 1990s as part of the CSIRO/NRIFSF Recruitment Monitoring Program with the aim to tag multiple cohorts at different ages in several years. Tags were released on juvenile SBT off the south coast of Western Australia (WA) and in the Great Australian Bight (GAB). Those released off WA were predominantly age 1 and those in the GAB were predominantly ages 2 and 3. The last year of SRP tagging was in the 2006/07 fishing season.

A number of issues make estimating mortality rates from the SRP tagging data complicated:

1. Fish released at age 1 off WA are lacking in the recaptures from subsequent years; this is in contrast to age 1 releases off WA in the 1990s and in contrast to other SRP releases (i.e., age 1 releases in the GAB, and age 2 releases off WA and in the GAB).
2. There is no information for estimating reporting rates for the longline fisheries in the 2000s. Tag seeding data are available for estimating reporting rates in the surface fishery, but the estimates are lower than previously assumed and have been questioned by industry.

3. Analyses applied to the SRP data suggest that a spatial model will provide more reliable estimates than a non-spatial model (a non-spatial model appears sufficient for the 1990s tagging data).

In terms of the lack of returns from age 1 WA releases (issue 1), this has been raised in several past CCSBT working papers (e.g., Polacheck and Eveson 2007; Eveson and Polacheck 2008, 2009). Three possible reasons identified and discussed in detail in Polacheck and Eveson (2007) are: (1) high tagging mortality of small fish; (2) high natural mortality rates on smaller/younger fish; and (3) incomplete mixing (i.e., a large fraction of the smaller fish tagged in WA did not migrate to the GAB at older ages in summer and also did not go to areas where the longline fisheries were operating in winter). We hoped to evaluate the third reason using tracks from archival tags that were deployed on age 1 SBT off WA as part of the Global Spatial Dynamics project. Unfortunately, the sample size was too small to draw any conclusions (n=8); however, there was nothing unusual in these 8 tracks to suggest the fish behaved differently to other tagged fish in the data set (see Section 8 of Basson et al. 2012). One way of dealing with this issue in the spatial model is simply to omit the age 1 WA releases from the analysis; this approach was taken in the analyses presented in Section 9 of Basson et al. (2012). While this is not ideal, it should provide unbiased estimates for the population of juveniles that visit the GAB.

The lack of reporting rates (issue 2) is not possible to solve for past tagging experiments, but we hope that future tagging experiments will involve a form of tags for which lack of reporting will no longer be a problem (see Harley et al. 2008; Davies et al. 2009). With regard to including the SRP tagging data in the OM, a range of plausible options will need to be considered for the reporting rates.

The need for a spatial model for the SRP tagging data (issue 3) is a more fundamental issue. Simulations in Polacheck et al. (2006) showed that in SBT-like situations, large biases can result from pooling the tagging data and applying a non-spatial model – how large depends on the extent of non-mixing and heterogeneity. Recent explorations and analyses of the SRP tagging data show that the parameter estimates derived from a spatial model can differ considerably from those obtained from a non-spatial model (e.g., Chapter 9 of Basson et al. 2012). The differences were not found to be as great for the 1990s tagging data, especially in the fishing mortality estimates. This suggests that non-mixing and spatial heterogeneity may have become more prevalent in the 2000s, in which case using a spatial model should provide more reliable estimates than a non-spatial model. The current OM is not spatially structured, so to include a spatial likelihood for the SRP data would require restructuring the OM. The movement towards a spatial OM is something currently being considered for other reasons as well, such as interpretation of CPUE data. However, in the meantime, a possible alternative for including the SRP tagging data might be to include a spatial likelihood (i.e., that involves region-specific parameters) but then, within the OM, calculate aggregated ("non-spatial") parameters from the region-specific estimates. For the abundance parameters, this simply means summing the parameters over regions, but for the mortality estimates, this requires calculating weighted averages based on the relative population size in each region, as described in Appendix 11, section 3.5.1, of Polacheck et al. (2006). Even this approach would not be a simple task, because it requires the tag release and recapture data as well as the catch data for ages 1 to 5 (at minimum) to be broken down by year, age, season and region (with 2 seasons and 4 regions as defined in the spatial tagging model). Furthermore, the spatial tag model as it stands is not parameterized in a manner consistent with the OM (e.g., it assumes instantaneous rather than discrete mortality rates; it does not model fishing mortality as a function of selectivity; it contains absolute abundance parameters; etc.). In summary, getting the data compiled as necessary for the spatial tag model and making sure that the parameterization of the tagging likelihood is consistent with other components of the OM will require a fair amount of time and effort. If the SC agrees that this approach should be pursued, then implementation can be pursued for next year's meetings.

4 References

Anonymous. 2011. Report of the Sixteenth Meeting of the Scientific Committee, Commission for the Conservation of Southern Bluefin Tuna, 19-28 July 2011, Bali, Indonesia.

Basson, M., Hobday, A.J., Eveson, J.P., and Patterson, T.A. 2012. Spatial interactions among juvenile southern bluefin tuna at the global scale: a large scale archival tag experiment. FRDC Report 2003/002.

Davies, C., Moore, A., Grewe, P., and Bradford, R. 2008. Report on the potential and feasibility of genetic tagging of SBT. CCSBT-ESC/0809/13.

Eveson, P., and Polacheck, T. 2008. Analyses of tag return data from the CCSBT SRP tagging program – 2008. CCSBT-ESC/0809/22.

Eveson, P., and Polacheck, T. 2009. Updated analyses of tag return data from the CCSBT SRP tagging program. CCSBT-ESC/0909/19.

Harley, S., Bradford, R., and Davies, C. 2008. Using passive integrated transponder (PIT) technology to improve performance of CCSBT's conventional tagging program. CCSBT-ESC/0809/14.

Polacheck, T., Eveson, J.P., and Laslett, G.M. 2006. Estimation of mortality ratres from tagging data for pelagic fisheries: analysis and experimental design. FRDC Report 2002/015.

Polacheck, T. and Eveson, P. 2007. Analyses of tag return data from the CCSBT SRP tagging program – 2007. CCSBT-ESC/0709/19.

CONTACT US

t 1300 363 400
+61 3 9545 2176
e enquiries@csiro.au
w www.csiro.au

YOUR CSIRO

Australia is founding its future on science and innovation. Its national science agency, CSIRO, is a powerhouse of ideas, technologies and skills for building prosperity, growth, health and sustainability. It serves governments, industries, business and communities across the nation.

FOR FURTHER INFORMATION

CSIRO Marine and Atmospheric Research
Wealth from Oceans Flagship
Paige Eveson
t +61 3 6232 5222
e paige.eveson@csiro.au
w www.csiro.au