

**A Game Theory Analysis of
Management Strategies for the
Southern Bluefin Tuna Fishery**

by

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A Dissertation in Partial Fulfilment of the Requirements
for the Degree of Master of Economics

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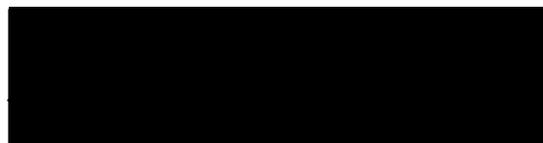
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DECLARATION

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree.

I certify that to the best of my knowledge any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

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Abstract

Management of the southern bluefin tuna population involves the identification of an overall policy which is not only biologically sound, but also economically viable to all participants. While there has been concern since the early 1980s about the state of the population of this species, it is only very recently that there has been widespread recognition that there is some danger of at least commercial extinction of the southern bluefin tuna.

The population structure of the southern bluefin tuna fishery was simulated over a twelve year cycle, initiated at a 1970 age-class. Simulations were repeated under the impact of 81 hypothetical harvesting policies. These policies were constructed from the combination of nine Australian and nine Japanese harvesting strategies. The Australian strategies reflected harvesting policies centred in one or more of the major areas of the coastal operation (New South Wales, South Australia and Western Australia), while the far more general Japanese strategies identified low to high levels of harvest taken from catches of tuna with narrow to broad age distributions. For each of these harvesting policies, the payoff to Australia and Japan was evaluated and the parental biomass ascertained. This information provided economic and biological indicators of the state of the southern bluefin tuna fishery under the effect of particular joint harvesting policies

With these indicators, a game theory analysis of the southern bluefin tuna fishery was carried out to assess the harvesting strategies defined for the two major participants (Australia and Japan). The Nash solution, to the Nash two-person nonzero-sum cooperative game, was identified. This had an optimal payoff and parental biomass

level well above a critical level of 220 000t identified for the population. The Australian strategy of harvesting three-to five-year-olds (primarily an operation centred in South Australia) was paired with a low-level Japanese catch taken from seven- to 15-year-old fish. The levels of age-classes in the population following the simulation under this policy were shown to be relatively stable, with levels maintained around the initial 1970 population structure.

In addition to the identification of an optimal policy, a feasible set was defined to include suboptimal policies having an acceptable level of parental biomass (greater than 220 000t) and a payoff within a 90 percent band of that identified for the optimal solution. These policies all had biological and economic characteristics similar to those found for the optimal policy.

Policies with characteristics similar to those recently practiced in the fishery were also considered. The results from these suggest that economic returns to Australia and Japan will, eventually, be lower than from policies in the feasible set. Further, the parental biomass of the population under the impact of such policies is likely to decline to a dangerously low level, with the likely effect of recruitment failure.

In this research the effect on both the economic returns to participants and also the state of the stock of southern bluefin tuna under the impact of a range of harvesting policies has been assessed. In addition, a model for assessing future harvesting policies given basic information on the level of the population and a range of alternative strategies available to participants was developed.

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