Changes in the Structure of Demersal Fish Communities of the South East Australian Continental Shelf from 1915 to 1961

by

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Certificate of Authorship of Thesis

Except as specially indicated in footnotes, quotations and the bibliography, I certify that I am the sole author of the thesis submitted today entitled -

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in terms of the Statement of Requirements for a Thesis issued by the University Higher Degrees and Scholarships Committee.

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Abstract

Haul-by-haul steam trawler catch and effort data for 1918–23, 1937–43 and 1952–57, which covers a large portion of the history of steam trawling in the Australian South East Fishery, were examined in detail for the first time. There were 64,371 haul records in total. The catch-rate for all retained catch combined shows a strong decline overall, with a brief recovery during World War II, probably due to increased retention of previously discarded species. The fishing fleet moved to more distant fishing grounds and deeper waters as the catch-rate declined. The catch-rates of the main commercial species followed a similar pattern in a number of regions within the fishery. The catch-rate of the primary target species – tiger flathead (*Neoplatycephalus richardsoni*) – dropped considerably from the early, very high, catch-rates. Chinaman leatherjacket (*Nelusetta ayraudi*) and latchet (*Pterygotrigla polyommata*) – species that were apparently abundant in the early years of the fishery – virtually disappeared from catches in later years. The appearance of greater catches of jackass morwong (*Nemadactylus macropterus*), redfish (*Centroberyx affinis*), and shark/skate during the war and afterwards was probably due to increased retention of catches of these species. The disappearance of certain species from the catch may be due to high fishing pressure alone, or to a combination of fishing pressure, changes in the shelf habitat possibly caused by the trawl gear, and environmental fluctuations.

Catch-rates in weight per haul per species were standardised to annual indices of abundance using a log-linear model. Standardised annual index trends for flathead, latchet and leatherjacket indicate a strong to severe decline over the period covered by the data. All species showed seasonal patterns, but the peak season varied depending on the species. The distribution of standardised catch-rate by area also differed greatly by species, and no single area showed consistent differences across all species. Day trawls caught more flathead, redfish and latchet, while night trawls caught more morwong and leatherjacket. Moon phase had less influence on catch-rates than the other factors examined. Correlation of annual index trends with a number of annual mean environmental factors was examined and no strong correlations were found.

Annual catches of the major commercial trawl species on the SE Australian shelf were estimated from recorded total trawl catches, catch species composition from sub-samples and estimates of the rate of discarding. These annual catches, standardised indices of abundance and biological population parameters were used in single-species stock reduction models to estimate absolute biomass trends. Biological population parameters and the biomass estimates were used to calculate management reference point fishing mortality rates $F_{0.1}$, F_{spr30} and F_{msy}. Results showed that simple plausible population models can be constructed that account for catches over the long period of time from 1915 to 1961.

Simple mass-balance ecosystem models were built for the demersal community of the SE Australian shelf for 1915 and 1961 using the Ecopath software. Model inputs were consistent with a more comprehensive SE marine ecosystem model in development by CSIRO. The models demonstrate that biomass estimates produced by the single species stock reduction models can be consistently integrated into simple plausible mass-balance ecosystem models.

Modern stock assessments for the main commercial species in this fishery today mostly used data collected since about 1985. Abundance indices and total catch estimates from this study have been used in the most recent assessments for tiger flathead and morwong, allowing construction of the exploitation history for these species spanning almost 100 years. Use of the historical information has increased confidence in the estimates of the modern stock assessments – particularly management reference points, and has allowed us to quantify changes in fish abundance that have simply been documented anecdotally in the past.

Table of Contents

List of Figures

List of Tables