



Improving fleet efficiency to maximise economic yield in a Western Australian prawn fishery



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ABSTRACT

The Shark Bay trawl fishery is Western Australia's most valuable prawn fishery (worth AUD\$25 million in 2014). The 18-vessel fleet targets western king prawns (*Penaeus latisulcatus*), brown tiger prawns (*P. esculentus*) and also retains saucer scallops (*Ylistrum balloti*) and blue swimmer crabs (*Portunus armatus*). Increased fuel prices, falling prawn prices and lower catches of other species, following extreme environmental events, have impacted fishery profits. A biomass dynamics model with an economic component indicated that total revenue levels start to decline when annual effort increases beyond ~ 200 fishing days per boat. Annual effort required to achieve MEY, when based solely on prawn fishing, is 115–150 days per boat after accounting for fixed and variable fishing costs and annual fishing efficiency increases of 1–2%. From 2007–2014, the adjusted effort was 188–192 days per boat. Fishing occurred between March and November during 7–8 fishing periods, separated by 5–8 day (low catchability) moon closure periods. An empirical daily profit assessment (2007–2015), accounting for recruitment variation, daily prawn size compositions, monthly market prices for different prawn species and sizes, and daily fishing costs, showed vessels made profits on ~ 115–160 days and losses on ~ 15–55 days per year, when fishing occurred near the full moon. The fishery benefitted in 2013–2015 by starting later in the year and better targeting within-season effort. This management strategy within the effort-control framework, which improved profitability, maintained higher spawning stocks and reduced ecosystem fishing impacts, has wider application in prawn fishery management.

1. Introduction

The Shark Bay trawl fishery (Fig. 1) is Western Australia's most valuable fishery for prawns (shrimp) with a catch of 1924 t valued at AUD\$25 million in 2014 [1]. The fishery targets western king prawns (*Penaeus latisulcatus*) and brown tiger prawns (*Penaeus esculentus*), but also profits from several other retained species, of which saucer scallops (*Ylistrum balloti*) and blue swimmer crabs (*Portunus armatus*) are the most important. Historically, the fishery was very profitable with revenues approaching \$40 million, but more recently it has suffered from increased fuel cost and reduced prawn prices, down about 25% since the mid-1990s, primarily through competition with small aquaculture-produced prawns. The loss of production of scallop and blue swimmer crabs following an extreme marine heat wave and river flooding events in the summer of 2010/11 [2] has also significantly impacted on total revenues, although these stocks and catches are now recovering.

Commercial prawn trawling in Shark Bay began in 1962 with four

boats operating. The fishery was one of the first subject to limited-entry management when a limit on vessel numbers to 25 was implemented in 1963 [3]. In the early 1970s, adaptive management was used to incrementally expand the fleet and production, aiming to maximise the social and economic benefits from the fishery [4]. This process resulted in catches initially increasing then levelling out when boat numbers were increased to 35 in 1975.

Prior to 1975, many vessels were dual purpose, fishing for lobsters in the summer and in Shark Bay for prawns during winter. However, a management decision requiring that vessels be dedicated to prawn fishing resulted in the introduction of larger, more stable purpose-built trawlers, leading to fishing extending from February/March to October. More recently the season start and finish dates have been set to take into account the lunar cycle [5] with fishing occurring between mid-March and November.

Although boat numbers were limited, fleet fishing power and effective fishing effort continued to increase [6], with catches not rising

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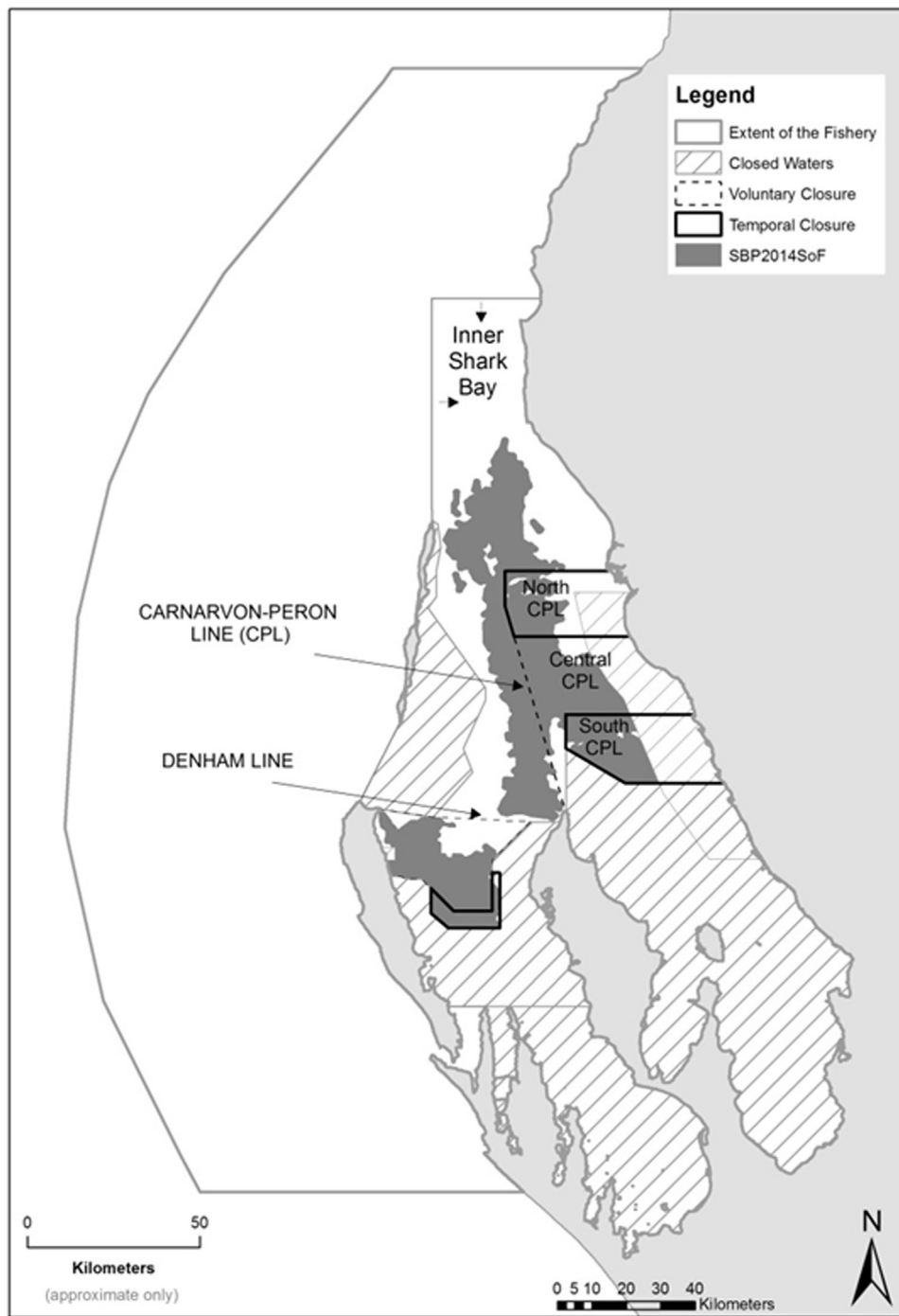


Fig. 1. The main boundaries of the Shark Bay Prawn Managed Fishery, Inner Shark Bay, North CPL, Central CPL, South CPL, trawl closures, permitted trawl area (extends out to the 200 m isobath) and area trawled in 2014. The Carnarvon-Peron line and Denham line demarcate areas of the fishery which are closed to fishing early in the season to protect small prawns.

commensurately with the increases in effort. The economic focus through this period was on maximizing catch volume through targeting small western king prawns near nursery areas. This focus was viable at the time due to the advent of mechanical prawn peeling machines which could be used to process the large catches of small prawns into then more valuable prawn meat. However this increasing effort, primarily focused on the western king prawns, was ultimately to the detriment of the more vulnerable brown tiger prawn stock, which suffered recruitment overfishing in the early 1980s [7], although the combined species production was relatively unchanged (Fig. 2).

In the early 1990s, exceptionally high saucer scallop recruitment [8] significantly impacted on western king prawn catches because fishing

effort became directed towards scallops. These lower catches of both prawn species led to management decisions to reduce the total allowable effort (TAE) to facilitate the recovery of the brown tiger prawn stock and improve the economic viability of the fleet [4]. This involved a government-sponsored, industry-funded licence buy-back and was successful in allowing the brown tiger prawn stock to recover [7] (Fig. 2). The 1990 buyback reduced the fleet to 27 boats and a further buyback in the mid-2000s reduced licence and boat numbers to 18. This restructure resulted in the removal of smaller vessels with those remaining changing from a two net (twin gear) to a more cost-effective, four-net (quad gear) configuration between 2005 and 2007. The fleet used the same aggregate fleet headrope allocation (790 m) less 8% to

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