



A substantial recruitment year for the western yellowfin bream (*Acanthopagrus latus*, Sparidae) sustains years of high catch rates in the inner gulfs of Shark Bay, Western Australia

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Abstract. A large increase in the annual commercial catch and catch per unit effort of western yellowfin bream (*Acanthopagrus latus*) in the inner gulfs of Shark Bay, Western Australia, from 2002 to 2005 prompted an examination of the age structure of the 2005 catch. Sectioned otoliths from 108 fish were assessed to determine whether the cause was related to an increased abundance following a substantial recruitment. The 1999 age class was exceptionally strong, contributing 48.1% of the sample, and according to published growth rate estimates, this cohort would have recruited to the fishery at the same time catch rates began to increase. Year class strengths of older cohorts were consistent with catch sampling carried out in 1999 and 2000, together demonstrating highly variable interannual recruitment, a trait commonly reported for sparids. Neither Leeuwin Current strength nor rainfall was found to be associated with year class strength. Factors determining and possibly predicting year class strength in this species in Shark Bay remain unknown and require further research.

Keywords: recruitment; western yellowfin bream; *Acanthopagrus latus*; Shark Bay; otolith; year class strength, age

Introduction

Shark Bay, Western Australia, is a World Heritage Property with a complex marine embayment (Fig. 1) in a semi-arid to arid climate (Francesconi & Clayton 1996). The commercial fishery for western yellowfin bream (*Acanthopagrus latus*, Sparidae) in the inner gulfs forms part of the Shark Bay Beach Seine and Mesh Net Managed Fishery (Norriss & Jackson 2006). Commercial fishers are legally required to submit catch and effort data to the Western Australian Department of Fisheries, declaring the weight and species composition of their catch each month, and number of days fished (effort). In 2002, the total annual commercial *A. latus* catch, and catch per unit effort (CPUE), began to increase (Fig. 2). In

2003, 2004 and 2005 the catch and CPUE further increased to about 2.5 times the long-term annual average, prompting an investigation into the reasons for this increase, which was either due to a change in behaviour of fishers related to increased targeting and/or fishing efficiency and/or a proliferation in abundance following highly successful recruitment to the fishery.

Growth rates for Shark Bay *A. latus* estimated by Hall *et al.* (2004) suggest that the year class spawned in 1999 would have dominated recruitment to the 250 mm minimum total legal length for the fishery during 2002, the year when catch and CPUE began to increase. We therefore tested the hypothesis that the increased catch and CPUE was due to a proliferation in abundance dominated by the 1999 year class.

Methods

During 2005 a sample of 108 commercially-caught *A. latus* were collected from the local fish factory at Denham, Shark Bay, the only port of landing for the product. Catches from multiple fishers on several occasions were taken to ensure the sample was representative of the *A. latus* population in the fishery. Sagittal otoliths were removed, sectioned and examined microscopically under reflected light (Fig. 3). Their opaque zones are formed annually (Hall *et al.* 2004), and there is a short, distinct spawning period during late winter and early spring (Hesp *et al.* 2004), enabling

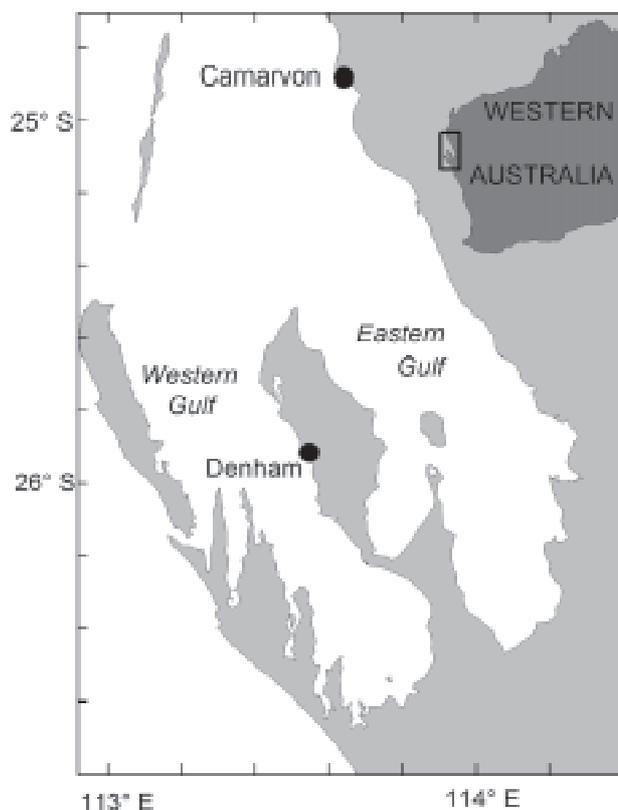


Figure 1. Map of Shark Bay, Western Australia, where the Shark Bay Beach Seine and Mesh Net Managed Fishery occurs predominantly in the inner gulfs (Eastern and Western) south of latitude 25°30' S.

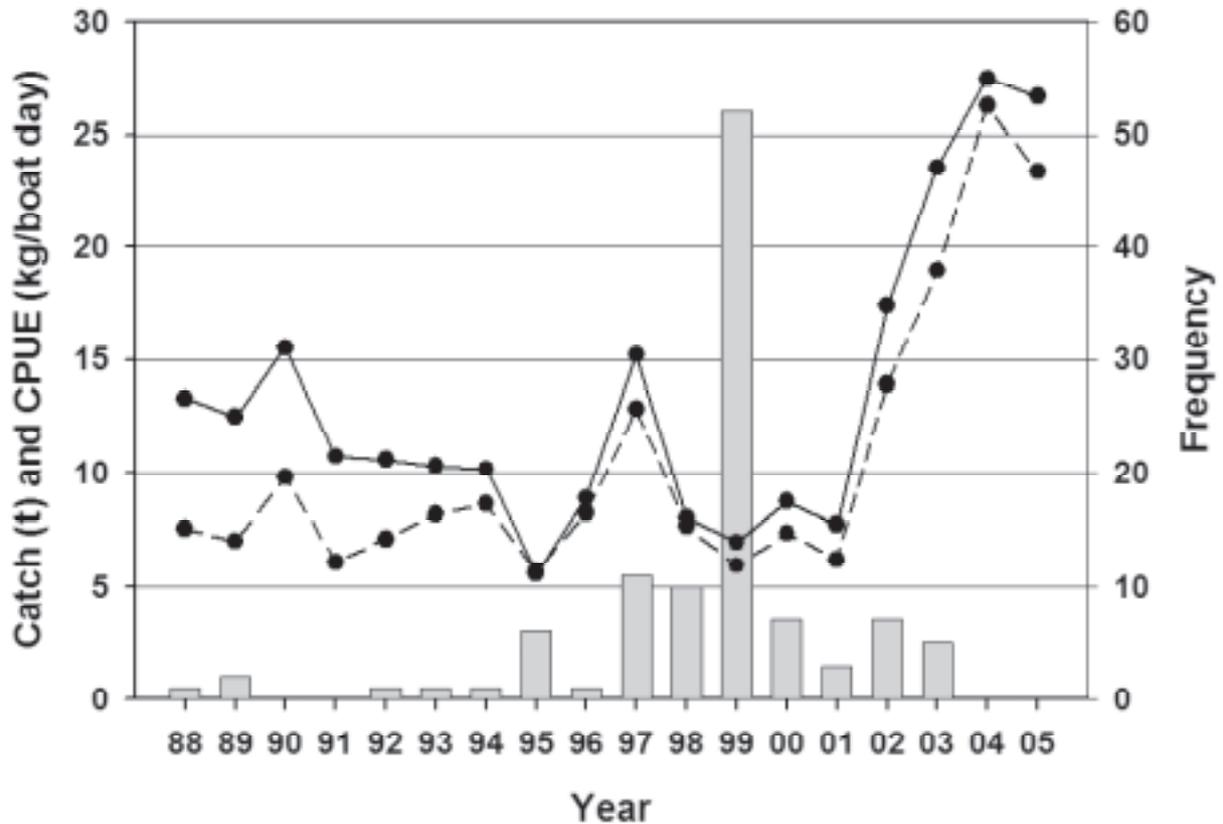


Figure 2. Total annual catch (solid line) and catch per unit effort (dashed line) for Shark Bay *A. latus* each calendar year (source: CAES, Dept. Fisheries, WA), and the frequency of individuals in each year class (bars) from a commercially-caught sample (n=108) collected in 2005.

accurate aging of individuals. We could thus allocate the year of birth to each fish and assess the relative abundance of each year class in the catch sample.

Results and Discussion

A very strong 1999 year class was observed, comprising 52 (48.1%) of the 108 fish that we sampled (Fig. 2). Based on age and growth parameters estimated by Hall *et al.* (2004), the mean total length of the 1999

year class as at 1 January 2002 was 215 mm (95% c.i. 208 to 221), and at 31 December 2002 was 271 mm (95% c.i. 261 to 279). With a minimum legal length of 250 mm, the 1999 year class would have recruited to the fishery during 2002, consistent with the limited increase in catch and CPUE that year. The elevated catch and CPUE in 2003 and 2004 was consistent with full recruitment of this highly abundant year class to the fishery in those years. The dominance of the 1999 year class in our sample, together with the timing of the increased catch and CPUE, constitutes strong evidence that the high

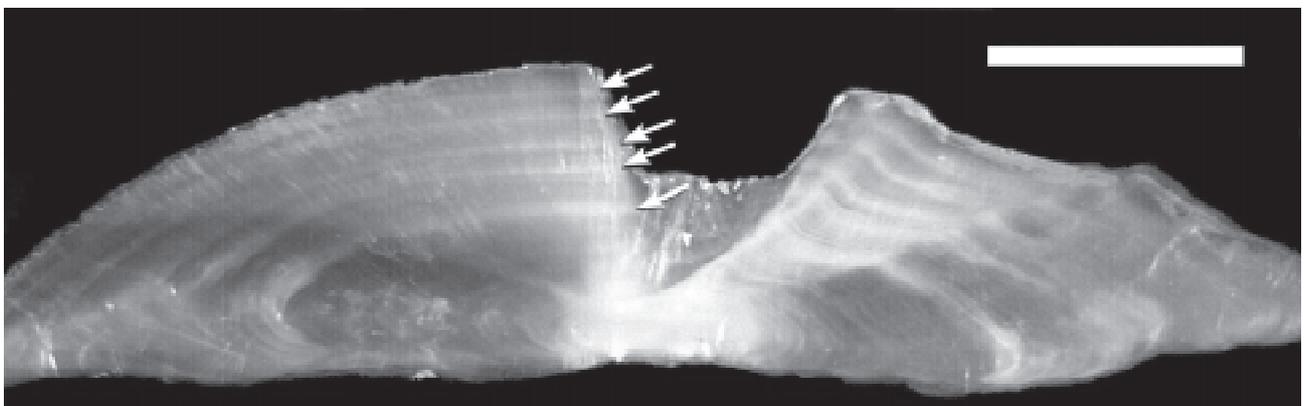


Figure 3. Cross section of a Shark Bay *A. latus* sagittal otolith from the 1999 year class, caught in 2005. Opaque zones (arrowed) are formed annually. Reflected light; scale bar = 1 mm.

catch and CPUE was caused by an increased abundance of fish available to fishers generated by recruitment of the strong 1999 year class to the fishery. Although increased targeting by fishers and/or fishing efficiency cannot be totally excluded in this multi-species fishery, the strength of the 1999 year class has been a major influence.

The 1995 year class also exhibited relatively strong recruitment (Fig 2), confirming a similar observation by Hall *et al.* (2004) from commercial catch samples from 1999 and 2000. This suggests that all three samples provided consistent and representative age structures of the population. The 1995 year class was not associated with an increase in catch or CPUE, indicating that such an increase requires particularly strong recruitment like the 1999 year class. Hall *et al.* (2004) also found a strong 1990 year class which we failed to detect, although these very old fish may have almost disappeared from the population by the time we sampled in 2005.

Catch-at-age sampling shows that interannual recruitment is highly variable, a common feature of sparids worldwide (e.g. Azeta *et al.* 1980; Geoghegan & Chittenden 1982; Francis 1993; Vigliola *et al.* 1998; Hamer & Jenkins 2004), sometimes affecting catch and CPUE (McGlennon *et al.* 2000). In temperate southern Australian estuaries, variability in year class strength for the congeneric *A. butcheri* is associated with rainfall and river flow, in turn influencing catch and CPUE (Norriss *et al.* 2002). There was no known rainfall event in arid Shark Bay associated with the 1999 *A. latus* recruitment, however.

Water temperature is strongly correlated with year class strength in the sparid *Pagrus auratus* in New Zealand (Francis 1993). Along the West Australian coast the warm, southward-flowing Leeuwin Current is a major oceanographic feature affecting recruitment of fish and invertebrates (Caputi *et al.* 1996), including the northern waters of Shark Bay (Joll & Caputi 1995). Sea levels, an index of Leeuwin Current strength, at nearby Carnarvon indicate no distinctive timing or feature of the current that might explain the 1999 *A. latus* recruitment event. Moreover, the penetration of the current into the shallow inner gulfs, where the *A. latus* fishery operates, appears minimal based on hydrodynamic modelling (Nahas *et al.* 2003) and the existence of frontal systems (transitional regions between mixed and stratified water columns) around the entrances of Shark Bay (Nahas *et al.* 2005).

Intertidal mangrove creeks in Shark Bay are an important habitat for juvenile *A. latus* (Hesp 2003), and possibly a key to determining year class strength. Relative to other years 1999 had a distinct lack of very low tides in Carnarvon in the months following spawning. No relationship is apparent between tides and year class strength among other years, however. Key factors determining and possibly predicting year class strength for this sparid remain unknown and require further research.

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