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Comparisons between the influences of habitat, body size and season on the dietary composition of the sparid *Acanthopagrus latus* in a large marine embayment

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Abstract

Seasonal samples from Shark Bay on the west coast of Australia were used to determine (1) the habitats occupied by the juveniles and adults of *Acanthopagrus latus* in this large subtropical marine embayment and (2) the extent to which the dietary composition of this sparid is influenced by habitat type, body length and season. Sampling was undertaken in two habitat types in which *A. latus* was known to be abundant, namely mangrove (*Avicennia marina*) creeks and nearby rocky areas, the latter comprising sandstone boulders and/or limestone reefs. The mean total length ±95% CLs of *A. latus* was far lower in mangrove creeks, 126 ± 6.1 mm, than in rocky areas, 313 ± 4.7 mm. As *A. latus* attains maturity at ca. 245 mm, the juveniles of this species typically occupy mangrove areas and then, with increasing body size, move to nearshore rocky areas, where they become adults. The species composition of the food ingested by juvenile *A. latus* in mangrove creeks differed markedly from that of large juveniles and adults in rocky areas. Based on analyses of data for both habitat types combined, this difference was far greater than that between size classes and season, which was negligible. There were indications, however, that, overall within each habitat, the dietary composition did change seasonally, although not with body size. *Acanthopagrus latus* fed predominantly on mangrove material, sesarmid crabs and small gastropods in mangrove habitats, and mainly on *Brachidontes ustulatus* in rocky areas, where this mytilid bivalve is very abundant. The mangrove material, which contributed nearly 40% of its overall dietary volume in mangrove creeks, consisted mainly of lateral root primordia. This apparently unique food source for a teleost is presumably ingested through subsurface nipping, which would be facilitated by the mouth and dentitional characteristics of sparids. The almost total lack of correspondence in the dietary compositions of fish in the length class that was well represented in both mangrove and rocky areas illustrates the extent to which this sparid is capable of opportunistic feeding behaviour.

Keywords: western yellowfin bream; diets; subtropical embayment; mangroves; rocky areas; body length; time of year

1. Introduction

Many marine species of fish remain in nearshore waters throughout their life cycle, whereas others, which likewise initially settle in those waters, subsequently move offshore as they increase in body size and age (Brown and McLachlan, 1990; Ayvazian and Hyndes, 1995; Clark et al., 1996). In some of the latter types of species, the offshore movements are accompanied by a marked change in habitat, such as the case which occurs in south-western Australia with *Sillaginodes punctata*, which migrates outwards, and often for considerable distances, from its nearshore unvegetated nursery areas to the reefs it inhabits as an adult (Hyndes et al., 1996). However, the conspicuous size-related habitat shift, which occurs in certain tropical fish species and is represented by a movement from nearshore seagrass or mangrove nursery areas to their

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nearby coral reef adult habitats, does not involve a marked change in water depth (Parrish, 1989; Cocheret de la Morinière et al., 2003).

The Sparidae is a predominantly marine family, which is found in the Indian, Pacific and Atlantic oceans (Nelson, 1994) and contains many species of commercial and/or recreational importance and some that are used for aquaculture (e.g. Foscarini, 1988; Kailola et al., 1993; Ingram et al., 2002). Certain sparids undergo size-related habitat shifts, which sometimes involve offshore movements, such as occurs with *Rhabdosargus sarba* (Hesp et al., 2004a), but on other occasions reflects just a shift in locality, such as is the case with *Acanthopagrus australis* (Blaber and Blaber, 1980; Pollock, 1982).

Sparids typically consume a wide range of benthic prey and also sometimes a substantial amount of plant material (Blaber, 1974; Havelange et al., 1997; Nasir, 2000; Sarre et al., 2000; Mariani et al., 2002; Tancioni et al., 2003). Furthermore, the diets of sparid species often differ markedly among locations, reflecting the opportunistic nature of the feeding behaviour of the members of this family (Sarre et al., 2000; Mariani et al., 2002; Tancioni et al., 2003). Such opportunistic feeding is facilitated by the possession of a substantial mouth gape and both canine and molariform teeth (Gommon et al., 1994; Linde et al., 2004). As with numerous other fish species (Werner and Gilliam, 1984; Platell and Potter, 1999, 2001), sparids typically undergo marked size-related changes in their diets, which is attributable to an increase in the size and strength of their jaws and to ontogenetic changes in their dentition (Stoner and Livingston, 1984; Booth and Buxton, 1997; Sarre et al., 2000; Tancioni et al., 2003). Although the food consumed by some fish species undergoes conspicuous seasonal changes (Schafer et al., 2002; Hourston et al., 2004), the limited amount of available data suggest that such changes are, at best, minimal in certain sparids (Dia et al., 2000; Pallaoro et al., 2004). However, Kallianiotis et al. (2005) found that, in the coastal waters of Greece, the sparid *Lithognathus mormyrus* did become more selective in its feeding during summer, when it focussed, in particular, on sedentary polychaetes.

The present study was conducted in Shark Bay, a large subtropical marine embayment on the central coast of Western Australia, which covers an area of ca. 13,000 km^2 and contains a wide diversity of habitats, including mangroves, rocky platforms, limestone reefs, bare sand and extensive areas of seagrass (http://whc.unesco.org). The great importance of Shark Bay and its environment can be recognised by its listing as one of only 16 World Heritage areas in Australia (http://whc.unesco.org). This embayment also contains commercial and/or recreational fisheries, which include those for three sparid species, i.e. *Pagrus auratus*, *Rhabdosargus sarba* and *Acanthopagrus latus* (Penn et al., 2005). An analysis of the catches obtained during various extensive studies of the fish fauna in the range of habitats found in Shark Bay (M. Pember, unpublished Honours Thesis, 1999; Travers and Potter, 2002; Hall et al., 2004; Fairclough et al., unpublished data) demonstrates that *A. latus*, also known as western yellowfin bream, is essentially restricted to mangrove creeks and areas where there are substantial amounts of sandstone boulders and/or limestone reefs, which are subsequently referred to as rocky areas.

The first aim of this study was to analyse the data collected during the above studies to test the hypothesis that, in Shark Bay, the juveniles of *Acanthopagrus latus* live mainly in mangrove creeks, whereas the adults occur predominantly in rocky areas and, if this is proven, it will reflect a well-defined size-related movement from the first to the second habitat. Emphasis was also placed on determining specifically whether any such movements occurred prior to the attainment of maturity. The second main aim was to test the hypothesis that, because of the opportunistic feeding behaviour of sparids, the dietary compositions of *A. latus* in the very different habitat types in which this species lives in Shark Bay will differ markedly and that the dietary composition will change with increasing body size. Finally, the extent, if any, of seasonal change in the diet of *A. latus* was explored.

2. Materials and methods

2.1. Study area and sampling regime

Acanthopagrus latus was sampled at several sites in Shark Bay during the day and at regular intervals between April 1999 and May 2002. The sites were located in small tidal creeks fringed by dense mangrove (*Avicennia marina*) stands and in rocky areas outside the creeks, all of which were situated in water depths <5 m and within 50 m of the shore. The fish in mangrove creeks were caught by seine netting and line fishing, while those in rocky areas were obtained by line fishing and commercial haul netting. The subsamples used for subsequent dietary analyses were chosen to represent the length range of the *A. latus* found in both habitat types in each season, except for in mangrove areas during spring when an insufficient number of fish was obtained for rigorous dietary analyses.

2.2. Laboratory analyses

The foreguts (guts) of each *Acanthopagrus latus* were removed and stored in 70% ethanol. Each gut was examined and its fullness estimated visually on a scale of 0 (empty) to 10 (100% full).

The contents of each gut were viewed under a dissecting microscope using reflected light and each dietary item was identified to the lowest possible taxon or recorded as unidentifiable. The percentage volumetric contribution of each dietary item to the dietary volume of each fish was estimated visually. Dietary items were then allocated to one of 23 taxonomic groups, subsequently referred to as dietary categories, which in turn belonged to one of four major ''taxa'', i.e. plant material, crustaceans, molluscs and other taxa. The percentage frequency of occurrence (%F) of each dietary category and of the major ''taxa'' in the guts of fish in mangrove and rocky areas was recorded. The percentage volumetric contribution (%V) of each dietary category to the gut contents of each fish in each habitat type was next calculated (see Table 1).