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Varying foraging strategies of Labridae in seagrass habitats: Herbivory in temperate seagrass meadows?

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Abstract

The diets of five species of Labridae in south-western Australia were examined to determine whether: (1) grazing of seagrass and epiphytic algae is a prominent feature of the food web within the deeper seagrass meadows of this temperate region; (2) levels of grazing differ among different seagrass systems; and diets differ among these closely-related species. Fish were collected seasonally from three seagrass habitats mainly comprising either *Posidonia sinuosa*, *Posidonia coriacea* or *Amphibolis griffithii* between the summer of 1996/97 and spring of 1997. Consumption of considerable amounts of algae and seagrass by *Odax acroptilus* and seagrass by *Haletta semifasciata* indicates that macrophyte grazing by fish is a component of the trophic dynamics of south-western Australian seagrass meadows. *O. acroptilus* and *H. semifasciata* were both omnivorous, feeding on a range of epifauna, infauna and flora, whereas *Siphonognathus radiatus*, *Neoodax balteatus* and *Notolabrus parilus* were carnivorous, feeding predominantly on motile epifauna, such as molluscs and crustaceans. The level of macrophyte grazing is likely to be underestimated in temperate offshore meadows of *P. sinuosa* and *A. griffithii* where omnivorous labrids, monacanthids and terapontids are abundant. Stable isotope data for *O. acroptilus* from the study region suggest that animal prey is more important to tissue maintenance than macrophyte material. Macrophytes may be grazed to acquire attached animal prey or for fulfilling energy requirements. Based on the distribution of prey, it appears that species in *A. griffithii* meadows forage within and below the seagrass canopy, whilst species in *P. sinuosa* meadows are likely to forage towards the basal area of this seagrass.

Keywords: Epiphytic algae; Herbivores; Mouth morphology; Resource partitioning; Seagrass

1. Introduction

Seagrass meadows often contain high diversity and densities of fish, which are generally attributed to greater structural complexity and food availability in these vegetated habitats (Heck and Orth, 1980; Orth et al., 1984; Bell and Westoby, 1986; Connolly, 1994). Despite the high levels of primary production through seagrass and associated epiphytic algae (Duarte and Cebrian, 1996), herbivory is considered low in temperate seagrass meadows (see Pollard, 1984; Bell and Pollard, 1989; Bell and Harmelin-Vivien, 1983). This contrasts to tropical regions, where consumption of seagrass and epiphytic algae by fish can be high (Randall, 1965; McRoy and Helfferich, 1980; Lobel and Ogden, 1981; Stoner and Livingston, 1984; Pinto and Puchihewa, 1996; Valentine and Heck, 1999; Kirsch et al., 2002). However, in a recent review, Valentine and Duffy (2006) concluded that levels of herbivory have generally been underestimated.

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In temperate seagrass meadows of Australia, the diets of fish have been shown to be dominated by motile invertebrate epifauna (see Pollard, 1984; Robertson and White, 1986; Edgar and Shaw, 1993, 1995a,b), but this may be related to the many studies focusing on fish communities in very shallow, protected seagrass meadows, where juvenile fish can be numerous (Burchmore et al., 1984; Middleton et al., 1984; Robertson, 1984; Bell and Pollard, 1989; Connolly, 1994; West and King, 1996; Rotherham and West, 2002). The adults of a number of fish species occupy deeper and/or more exposed areas than their juveniles (see Gillanders et al., 2003). Since some species shift from consuming predominantly invertebrates as juveniles to consuming large quantities of plant material as adults (Stoner and Livingston, 1984; Carseldine and Tibbetts, 2005), and fish communities differ in deeper, more exposed areas with different seagrass habitats (e.g. Scott, 1981; Bell and Harmelin-Vivien, 1982; Hyndes et al., 2003), the focus of such studies may confound any conclusions regarding the level of grazing in temperate Australian seagrass meadows.

Species of Labridae, a family that now includes species of the former Odacidae (Gomon, 1997; Clements et al., 2004), can be relatively abundant in temperate seagrass meadows (Scott, 1981; Bell and Harmelin-Vivien, 1982; Edgar and Shaw, 1993; Guidetti and Bussotti, 2000; Hyndes et al., 2003; Bonaca and Lipej, 2005). Whilst most labrid species have been shown to consume invertebrate prey (Scott, 1981; Bell and Harmelin-Vivien, 1983; Robertson and White, 1986; Denny and Schiel, 2001; Gillanders, 1995), some species have been found to consume algal material (Scott, 1981; Kabasakal, 2001; Choat and Clements, 1992; Clements and Choat, 1993). This is particularly the case for species in the genus *Odax*, which consume macroalgae in reef habitats (Choat and Clements, 1992; Clements and Choat, 1993).

Since labrids, including an *Odax* species, are a dominant part of the fish fauna in a mosaic of seagrass habitats in south-western Australia (Hyndes et al., 2003), it is possible that grazing on seagrass or algae occurs in this seagrass complex. However, the dominant species of labrids vary among seagrass habitats (Hyndes et al., 2003) and the level of grazing may vary among these species. The primary aim of this study was, therefore, to determine whether macrophyte grazing is a prominent feature of the food web within the seagrass meadows of this temperate region, and whether levels of such grazing differ among different seagrass systems. The secondary aim was to examine differences in the diet of labrid species in those seagrass systems. Both aims have been achieved through examining the diets of abundant labrid species from temperate seagrass habitats at depths of 4–9 m in south-western Australia. We have compared gut content data to published stable isotope data from the region to determine the nutritional relevance of macrophytes and prey to key species. Since dietary differences can be explained by differences in fish size among other factors (Hyndes et al., 1997; Labropoulou and Papadopoulou-Smith, 1999; Platell and Potter, 2001; Swanson et al., 2003), we have examined the diets of different sized fish to help explain any differences in their diets, and drawn on published data on the distribution of epiphytic flora and fauna to examine differences in foraging behaviour.

2. Materials and methods

2.1. Sampling regime

A small (1.0 wide × 0.5 m deep; 2.5/1.0 mm mesh) and a large (2.5 wide × 1.5 m deep; 25/10 mm mesh) beam trawl were used to collect the odacine labrids *Siphonognathus radiatus* Quoy and Gaimard, 1834; *Odax acroptilus* Richardson, 1846; *Neoodax balteatus* Valenciennes, 1840 and *Haletta semifasciata* Valenciennes, 1840 and the pseudolabrine labrid *Notolabrus parilus* Richardson, 1850. Fish were collected from seagrass habitats comprising predominantly either *Amphibolis griffithii* (J. Black) den Hartog, *Posidonia sinuosa* Cambridge and Kuo or *Posidonia coriacea* Cambridge and Kuo at water depths of 4–9 m located in the Owen Anchorage region in the marine waters off Fremantle (32°03.2′ S, 115°44.0′ E) on the lower west coast of Australia. Fish were collected during summer (February 1997), autumn (April/May 1997), winter (July/August 1997) and spring (October/November 1997). All five labrid species were shown to be relatively abundant in these seagrass habitats during each season (MacArthur and Hyndes, 2001; Hyndes et al., 2003).

The diet of each species was examined in one or more of the three seagrass habitats in which it was relatively abundant. For each season, guts were removed from up to 15 *S. radiatus* collected in all three seagrass habitats, i.e. *A. griffithii*, *P. sinuosa* and *P. coriacea* meadows, as well as from *O. acroptilus* and *N. parilus* collected in *A. griffithii* meadows and from *N. balteatus* and *H. semifasciata* collected in *P. sinuosa* meadows. Gut samples were stored in 70% ethanol. When possible, the guts for each species were taken from a wide size range of fish that were collected over a large area for each habitat, thereby avoiding bias towards a particular size of fish or area of the study region. Whilst small juveniles of