INDIVIDUAL BASED ANALYSIS OF THE FUNCTIONAL OVERLAP AMONG FOUR TEMPERATE FISH SPECIES

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Abstract

We conducted individual-based analyses of species' functional niches based on their microhabitat utilisation patterns during foraging and computed functional overlaps in terms of space partitioning and behavioural traits. The sampling took place on rocky reefs of Mallorca (Balearic Islands, Western Mediterranean) during May-June 2015. We sampled 328 fish belonging to four species representing different life history traits and feeding behaviours. All species studied demonstrated distinct patterns of spatial overlap and niche partitioning. The results of this study will help determine functional redundancy and complimentary of temperate fish species and thus better our understanding of the ecological characteristics and processes of shallow subtidal environments.

Keywords: Fish behaviour, Coastal systems, Teleostei, North-Western Mediterranean

How habitat influences the distribution of organisms is of central importance to ecology. Within the marine environment, species-specific microhabitat associations of fishes have been widely reported [1]. However, most studies to date measure the fundamental niche of an organism, while the functional niche is generally unaccounted for. We looked at individual-based patterns of: i) fish habitat partitioning as a function of the space occupied at any given moment; ii) behaviour traits, based on what the fish do while moving; and iii) microhabitat utilisation, based on where the fish eat. The sampling took place on the algal covered rocky reefs of South-Western Mallorca in the Balearic Islands, Western Mediterranean, over the course of May and June, 2015. The most commonly occurring species within the families expressing different life history traits and belonging to distinct feeding guilds were selected: *Symphodus tinca* (mesophagous), *Coris julis* (microphagous), *Diplodus vulgaris* (omnivorous) and *Sarpa salpa* (herbivorous). A randomly selected individual was followed underwater and its behaviour was continuously recorded [2]. The type of behaviour and the time for which it was expressed, as well as the surface type and the substratum type the fish interacted with for any of the defined behavioural traits were noted. The categories of behaviours included intraspecific and interspecific aggression, diffused, focused and water column feeding, searching, roaming, hovering, rubbing, cleaning and advertising. The surface types considered were exposed horizontal and vertical, underside and concealed surfaces, while the substratum types included rock, rubble, sand and *Posidonia*, as well as morphotypes of various algae (erect tree-like, filamentous, soft leaf-like, tubular, plumose, bulbous, leathery and turf). The total number of individuals sampled was 328.

The observational data across all species revealed a majority preference for the horizontal open space which in the case of *S. salpa*, was as high as 94% of the total observational time spent. The remaining three species demonstrated a small preference for open vertical areas spending on average 20% of the total time interacting with this surface type. The dominant behaviour for all four species was roaming. *D. vulgaris* demonstrated hovering, a behavioural characteristic that was unique to this species, as well as searching, also demonstrated by *C. julis*. With regards to the feeding modes, *S. salpa* was the only species to express the preference for focused, rather than diffused feeding. In terms of where the feeding occurred, turf and erect tree-like algal morphotypes were the preferential morphotypes chosen by all species. *D. vulgaris* and to some extent *C. julis* also demonstrated feeding within filamentous algae morphotype. While no other species spent any notable time feeding within *Posidonia* beds, *S. salpa* spent 35% of the total time feeding within this habitat (Figure 1). The analysis of similarity (ANOSIM), combining habitat preference, behaviour patterns and feeding microhabitat utilisation, revealed highly significant differences between all the species observed (R=0.33, p<0.01).

Although demonstrating similar preference for habitat partitioning each species can be characterised by distinct patterns of behaviour and microhabitat use during feeding. In addition, combining the habitat preference, behaviour patterns and feeding microhabitat utilisation points to spatial overlapping and niche partitioning between the species. The results of this study may have crucial consequences for the understanding of spatial overlapping and the niche partitioning of temperate fish species and may be useful to identify species' functional niche shifts in response to changing environments such as shallow temperate littoral systems.
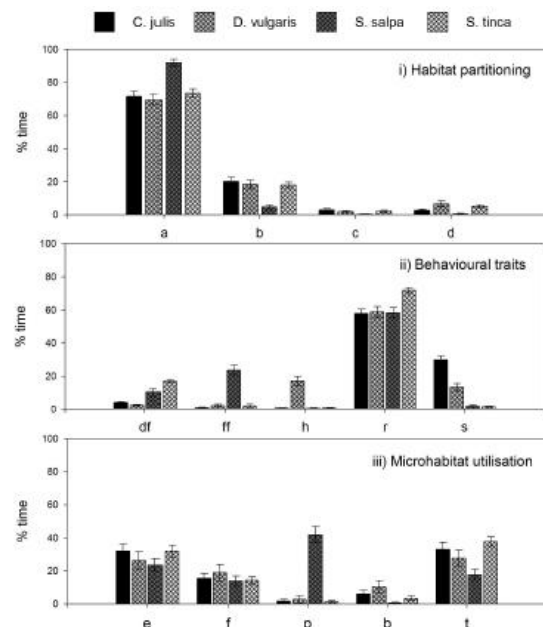

Fig. 1. I) Habitat partitioning patterns; a=open, horizontal, b=open, vertical, c=underside, d=concealed, ii) comparison of behavioural traits, df=diffused feeding, ff=focused feeding, h=hovering, r=roaming, s=searching iii) feeding microhabitat preferences expressed by the four species studied; e=erect tree-like and f=filamentous algal morphotypes, p=*Posidonia*, b=barrens, t=turf. Error bars show Standard Error of the Mean.

References

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