Marine Pollution Bulletin 83 (2014) 425–429

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Protecting the hand that feeds us: Seagrass (*Zostera marina*) serves as commercial juvenile fish habitat

Chiara M. Bertelli, Richard K.F. Unsworth *

Seagrass Ecosystem Research Group, College of Science, Wallace Building, Swansea University, Swansea SA2 8PP, UK

ARTICLE INFO

Article history:
Available online 30 August 2013

Keywords:
Seagrass
Fish
Nursery habitat
Conservation
Fisheries
Food security

ABSTRACT

Although fisheries are of major economic and food security importance we still know little about specific juvenile habitats that support such production. This is a major issue given the degradation to and lack of protection afforded to potential juvenile habitats such as seagrass meadows. In the present study we investigate the role of seagrass in supporting juvenile fish of commercial value. By assessing seagrass relative to adjacent sand we determined the presence of abundant juvenile fish. Nine commercial species were recorded and the most abundant of these were Plaice, Pollock and Herring. We provide the first quantitative evidence of the presence of juvenile fish of commercial value in seagrass surrounding Great Britain. Although the species that we found in seagrass as juveniles are not obligate seagrass users the resources that seagrass meadows offer to these fish provide significant long-term fitness benefits, potentially enhancing the whole population.

1. Introduction

To meet the needs of the predicted human population of 2050 a 50% increase in current supply of fish and aquatic invertebrates is estimated to be required (FAO, 2010). This will require supporting marine and coastal ecosystems (e.g. nursery habitats) that can maximise fisheries productivity. Despite the fact that in 2010, total landings of fish and shellfish into the UK and into Ireland were 606,295 and 245,856 tonnes, respectively, with a first-sale value of £719 million and £208 million (Cheung et al., 2012) we still know little about the specific nursery habitats that support such production. Seagrass meadows are one such potential nursery habitat but these systems are now recognised as being lost at similar rates to tropical rainforests (Orth et al., 2006; Waycott et al., 2009).

Seagrasses are marine plants found in shallow coastal areas, growing on sheltered sandy or muddy substrates where they provide habitats, resources and shelter for many marine invertebrates and fish. As such seagrass meadows globally are considered to be important for juvenile and larval stages of many commercial, recreational and subsistence fish and shellfish (Beck et al., 2001; Heck et al., 2003; Jackson et al., 2001; Unsworth et al., 2008). Many species of fish found residing in structurally complex seagrass habitats as juveniles have been found to have reduced predatory pressure, lower energy requirements and higher feeding and growth rates than those in other temperate coastal habitats (Heck et al., 2003; Renkawitz et al., 2011). This increases their potential lifetime fitness (Heck et al., 2003; Renkawitz et al., 2011). Their role as a juvenile fish nursery is the major reason cited for seagrass protection, yet evidence from some locations suggests that this may not always be the case and that their ecosystem service value (MEA, 2005) can change with factors such as environmental gradients and anthropogenic impact (Barbier et al., 2008; Beck et al., 2001).

In the UK, seagrass meadows (dominated by one species, *Zostera marina*) are of conservation importance under the OSPAR treaty and within a range of legislation related to marine conservation zones, EU Special Areas of Conservation and the EU habitats directive yet there is limited evidence of their true ecosystem service value (including as a fish nursery). In spite of limited knowledge, the nursery value of seagrass meadows has in some cases been the main justification cited for designating a place (e.g. the Isles of Scilly), as a Special Area of Conservation (SAC) (Jackson et al., 2011). Though most of the seagrass meadows in British waters have been mapped, few have been studied with respect to the juvenile fish assemblages associated with them, with the exception of the *Zostera marina* meadows around Jersey (Jackson et al., 2002) that are subject to very different environmental conditions to those around the mainland U.K. Geographic variation has been raised as one of several factors for the value of a nursery ground. For example, seagrass meadows in the United States have been found to be more important as fish nursery grounds than those in Australia (Beck et al., 2001; Gillanders, 2006). The assumption of the ecological value of seagrass meadows in the Irish Sea on the basis of studies carried out elsewhere is therefore unreliable. The aim of this study was to determine the role seagrass meadows in the Irish Sea for providing habitat for juvenile fish with a focus on the commercially exploited species.

* Corresponding author. Tel.: +44 1792 602133; fax: +44 1792 602133.
E-mail address: r.k.f.unsworth@swansea.ac.uk (R.K.F. Unsworth).

0025-326X/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.marpolbul.2013.08.011

2. Materials and methods

Porth Dinllaen is located within the Pen Llyn a'r Sarnau SAC on the Llŷn Peninsula in North Wales, UK (52°56′35.30″N 4°33′58.74″W). It is a small natural harbour protected by a headland to the north, sheltering the bay from all except north-easterly winds. As a result of this shelter Porth Dinllaen has one of the largest seagrass beds in Wales covering over 28 hectares (Boyes et al., 2005; Egerton, 2011).

A beach seine net (31 m in length, 2 m depth with a 10 mm mesh size) was used to sample fish over areas of seagrass and sand at low tide, sampling an area of approximately 60 m^2. The distribution of the seagrass at Porth Dinllaen is throughout the intertidal and therefore due to sampling at low tide all seine hauls were exclusively over the targeted habitat (seagrass or sand). The seine net was chosen to include a lead line at the bottom without lead weights to minimise damage to the seagrass. Trials hauls with the seine net on seagrass and sand revealed that the lead line was effective and that net remained on the seafloor. Catches in both habitats contained juvenile flatfish indicating the ability of the net to catch bottom dwelling fish.

Many previous studies looking at seagrass fish communities have used seine nets due to the relative ease of deployment and manageability (Guest et al., 2003) or owing to the waters being generally too turbid for the use of underwater visual census (Nagelkerken et al., 2001a). There are concerns that seine nets under-sample fast swimming and pelagic fish species, as well as small fishes such as gobies and blennies (Gell and Whittington, 2002). Additionally, during daylight hours large fish may be better at net avoidance thereby biasing the sampled community structure. We chose to use a seine net as despite the many drawbacks of beach seine netting that have been extensively discussed in the literature, seine netting remains the most effective method for shallow coastal fish surveys (English et al., 1997; Nagelkerken et al., 2001b).

This study was carried out in June and September 2012 around spring tides and involved sampling 3 sites in seagrass and 1 site on sand for their fish assemblages (see Fig. 1). Each seagrass site was chosen on the basis of sufficient continuous seagrass and ease of sampling with a seine net. All seagrass sites comprised of at least 50% seagrass cover (*Zostera marina*). Seagrass cover was assessed in additional studies using haphazard placement of quadrats throughout the sampled areas (Unsworth unpublished data). The sand site was comprised of bare fine sand with the occasional small boulder. Site differences in terms of physical conditions were not measured but considered to be negligible because of the close proximity of the sites (Jackson et al., 2006). At each site on each sampling occasion 3 to 4 seine hauls were taken during the day on an incoming tide and all fish caught were identified, counted and their total length measured. Fish were then returned to the sea. Additional night time sampling (4 seine hauls) was conducted at site 3 (seagrass) and site 4 (sand) during the night (also on an incoming tide) (see Fig. 1). Sampling during each month was conducted on spring tides and carried out over a period of three days, sampling times between sites varied by a maximum of three hours limiting any sampling bias. All repeat samples at each site were haphazardly placed and separated by at least 50 m. These can be considered to be independent of each other. Samples collected in September were collected at the same sites as those in June and were again placed in a haphazard fashion.

All data is presented as means together with their standard deviations (±). The study was primarily an analysis of seagrass fish assemblages and contains an unbalanced design (3 seagrass sites and 1 sand site). Data collected at night was only conducted only at two sites (1 of each habitat type). Due to multi-species nature of the data and the unbalanced design the study statistical analysis was limited to the use of multivariate methods.

Analysis of differences in fish assemblage structure between habitat type and time of day was conducted using multivariate non-Metric Multidimensional Scaling ordination (nMDS) and Bray–Curtis cluster analysis using the computer package PRIMER (Clarke and Warwick, 1994). The Bray–Curtis similarity index was applied on square-root transformed data generating a rank similarity matrix, which was then converted into an MDS ordination (Clarke, 1993). To check on the adequacy of the low-dimensional approximations seen in cluster and MDS the use of PRIMER v6.1.5 enabled clusters to be superimposed upon the MDS ordination (Clarke and Gorley, 2006). A two-way ANOSIM was used to investigate differences identified from MDS and cluster (Clarke and Warwick, 1994).

3. Results

Of a total of 33 species of fish caught, 26 different species were recorded in seagrass and 23 in sand. A mean of 36.0 ± 5.7 fish per seine haul were recorded in seagrass, the most abundant of these were Pollack (*Pollachius pollachius*), Sand goby (*Pomatoschistus*

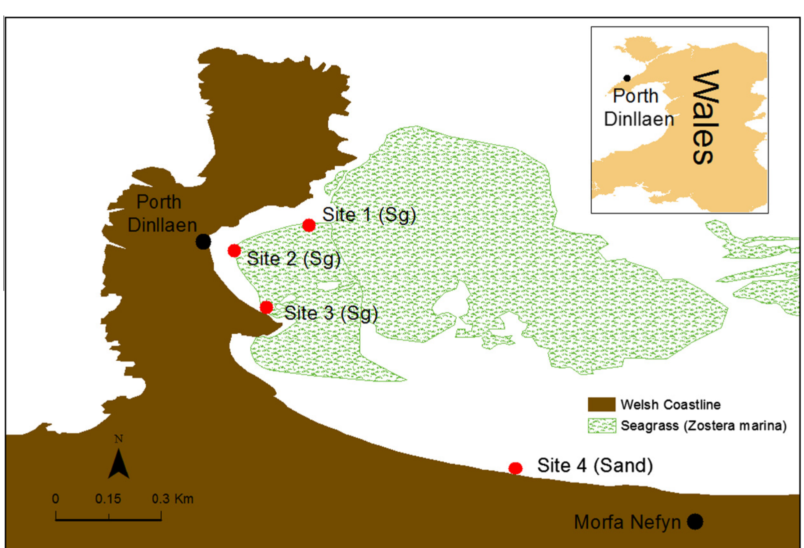

Fig. 1. Map of the sampling sites at Porth Dinllaen, North Wales. Sites labelled as seagrass (Sg) and sand (Sa).