Macrobenthic prey availability in flatfish nursery grounds and the potential for food competition between 0-group plaice and dab during ontogenetic development

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Introduction

The quality of nursery grounds is an important factor that determines the recruitment of juvenile flatfish to the adult stocks (Gibson, 1994). Over the last decades, a strong decline in commercial fisheries of plaice (*Pleuronectes platessa* L.) and dab (*Limanda limanda* L.) in the north-eastern Atlantic region has occurred (Millner et al., 2005). In some areas this trend was preceded by a decline in juvenile abundances (Désaunay et al., 2006). To evaluate anthropogenic and climate impacts on flatfish nurseries we need a good understanding of the biotic and abiotic factors that influence condition, growth and survival of juvenile fish.

This study is a first step towards assessing the quality of flatfish nursery grounds in Galway Bay. Our aim was to describe spatial and temporal trends in the diet of flatfish species that are sharing the same nurseries. Responses to food availability were measured to assess the potential for interspecific competition in relation to size-related growth of juvenile flatfish.

Methods

• 4 Nursery grounds were surveyed from June-September in 2008 and 2009 (Fig.1).

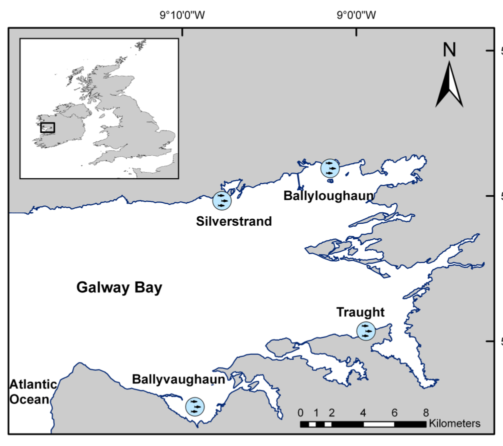

Fig.1. Map of Galway Bay and position of nursery grounds

Fig.2. Collection of flatfish

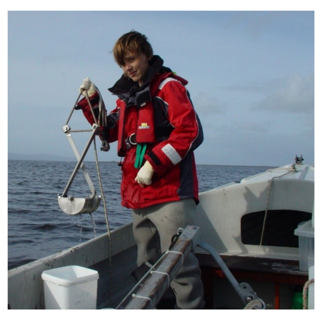

Fig.3. Collection of macrobenthic samples

• Juvenile plaice and dab were collected using a beam trawl. The diet of 651 fish was analysed and prey were counted and classified into major taxonomic groups (Fig. 2 & 4).
• Macrobenthic prey samples were collected with a Van Veen grab, washed in a 1 mm sieve and the density of major benthic groups was calculated (Fig. 3 & 5).
• Sediment particle size analysis was carried out (Fig. 6) and the mean sediment size (phi) was calculated.
• Organic matter was measured using the percentage loss on ignition (LOI).

Fig.4. Gut content analysis

Fig.5. Sorting of macrobenthos

Fig.6. Sediment particle size analysis

Results

→ Less than 1 % of all fish analysed had empty stomachs and were excluded from further analyses.
→ The diet of plaice and dab consisted of a wide variety of benthic invertebrates (Table 1).
→ The overall dietary composition differed significantly between species, years and nursery grounds (two-way ANOSIM).
→ Stomach samples from 2008 were characterized by
a lower stomach fullness,
a higher number of prey taxa,
a lower prey abundance and
a higher Shannon Wiener prey diversity
compared to samples from 2009 (two-way ANOVA).
→ Dab had a higher stomach fullness and a lower number of prey taxa compared to plaice (two-way ANOVA).

	Plaice		Dab	
	% N	% F	% N	% F
Oligochaeta	0.82	4.20	13.19	37.65
polychaeta	17.41	65.97	2.00	17.06
Siphons Bivalvia	3.53	17.02	0.08	0.59
Bivalvia	12.04	53.78	9.27	47.65
Gastropoda	0.53	8.61	0.19	8.82
Amphipoda	9.11	60.08	16.44	70.00
Mysidacea	0.18	3.15	0.00	0.00
Cumacea	9.16	50.00	1.71	30.59
Copepoda	39.93	73.53	52.25	92.94
Ostracoda	5.81	40.34	3.39	38.24
Decapoda	1.26	11.97	1.40	14.71
Isopoda	0.14	1.26	0.00	0.00
Echinoidea	0.04	0.21	0.02	0.59
Arachnida	0.05	1.68	0.07	3.53
Chironomidae	0.00	0.21	0.00	0.00

Table 1. Relative importance of major prey taxa to the overall diet of plaice (n = 476) and dab (n = 170), expressed as frequency of occurrence (% F) and numerical contribution (% N).

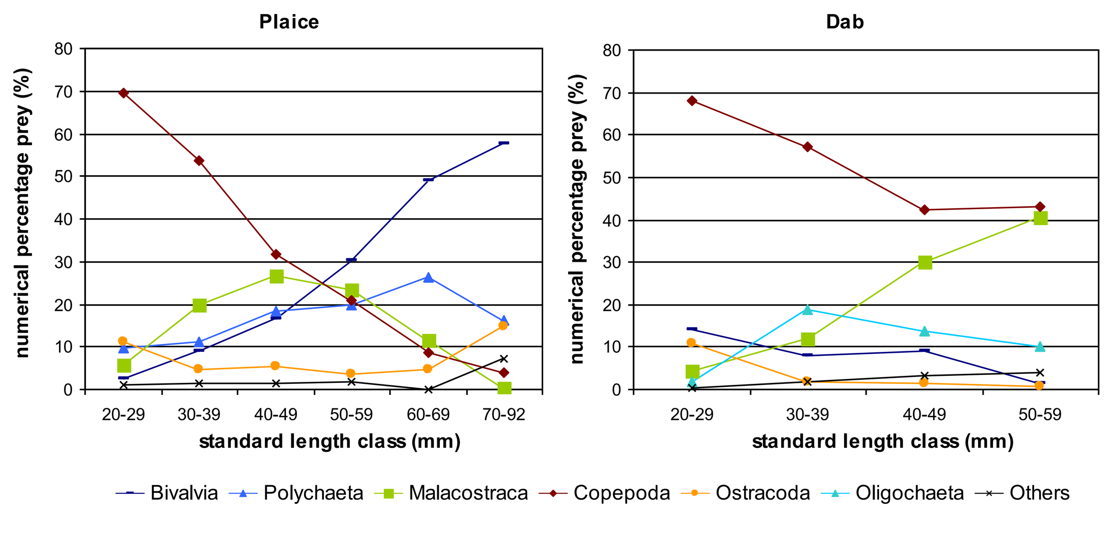

Fig.7. Diet composition in different size classes of plaice and dab

→ 0-group plaice and dab fed on similar prey items but they showed a different composition of dominant prey classes with their ontogenetic development (Fig.7).
→ With increasing fish size, we found a
decrease in stomach fullness
decrease in prey abundance
increase in prey diversity
(two-way ANOVA).

→ The dietary overlap between dab and plaice (Fig. 8)
decreased with julian date,
was higher in 2008 compared to 2009
and differed between nurseries
(Generalized Linear Model, GLM).

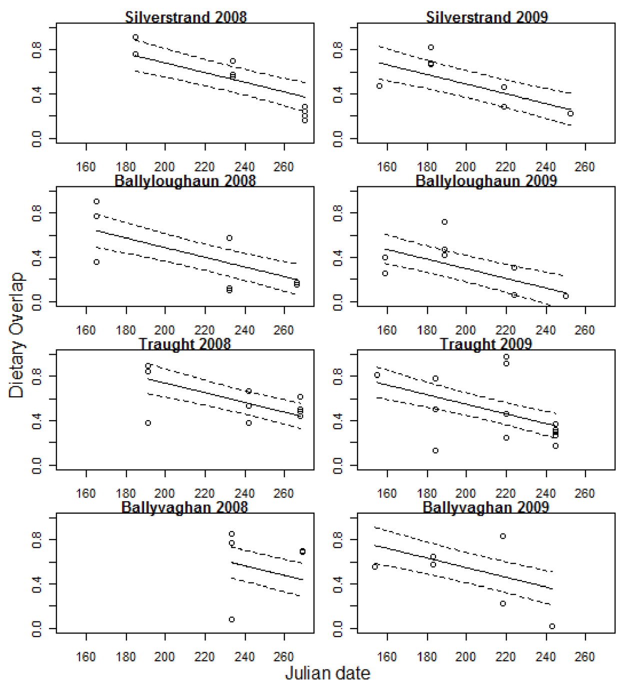

Fig.8. Result of a GLM predicting the dietary overlap between plaice and dab for different nursery grounds in 2008 and 2009.

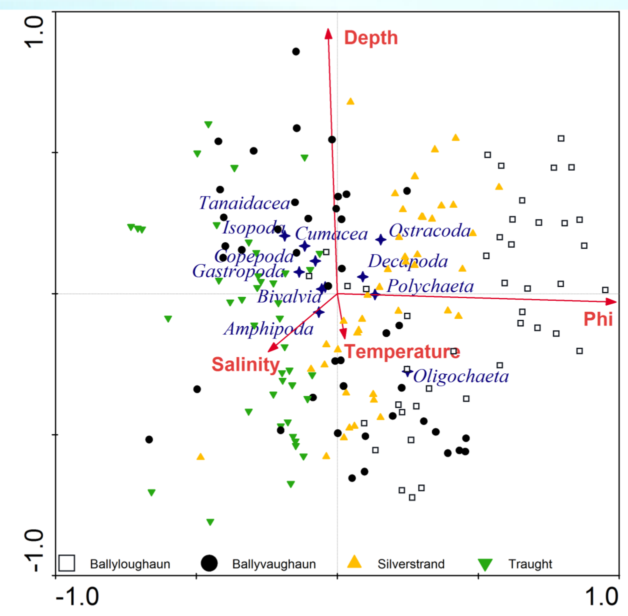

Fig.9. A triplot showing the species, samples and environmental variables in the Correspondence Analysis

→ Nursery grounds revealed distinct macrofaunal communities (Fig. 9) which were highly associated with the mean sediment particle size and the depth (Correspondence Analysis, CCA).
→ A correlation was found between the spatial differences in the macrobenthic communities with those in plaice and dab diets (RELATE).

Conclusions

• Juvenile plaice and dab are opportunistic feeders but a clear distinction in diet composition suggests a partitioning of food resources between both species.
• Interspecific competition is more likely to occur just after settling when the dietary overlap is high, however, the density of flatfish in nursery areas did not have an effect on the dietary overlap suggesting that there was an abundant food supply in all nursery grounds.
• The feeding efficiency, estimated by stomach fullness, was variable between years and nurseries and this reflected differences in the productivity of the macrobenthos in the sediment.
• Further research will be conducted to assess if the temporal and spatial differences in diet composition and food availability affect the growth and condition of juvenile flatfish.

Literature cited:

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