New analyses of juvenile sprat growth and temporal origin in the German Bight (North Sea)

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The relatively shallow and highly productive German Bight in the south-eastern North Sea is recognised as an important retention (Bartsch and Knust, 1994) and nursery area for the larval and juvenile stages of many commercial fish species. The pre-recruit stages of sprat Sprattus sprattus, an ecologically and economically important clupeid, are particularly abundant in this area at most times of the year, which has made the species a preferred candidate in many larval growth and recruitment studies.

In the late 1980s and early 1990s, investigations conducted within the framework of the Sardine-Anchovy-Recruitment-Programme (SARP) compiled important information on seasonal and inter-annual spawning variability and larval abundance (e.g. Alheit et al., 1987) and tested, for example, the hypothesis that larval growth is promoted in the vicinity of tidal or river plume fronts (e.g. Munk, 1993; Valenzuela and Vargas, 2002). Other approaches focused on the juvenile stage of sprat, using otolith microstructure analysis to deduce the temporal origin of individuals and whether certain periods of the year are more conducive to larval survival than others (Alshut, 1988).

More than a decade later, the German GLOBEC project has followed up on these previous investigations with a new 3 year programme of multi-disciplinary field research in the German Bight. In a recent GLOBEC study, the growth histories and temporal origins of sprat juveniles sampled during three consecutive cruises in August, September, and October 2004 were studied by means of otolith microstructure analysis. A high month-to-month variability in sprat length distributions was encountered in the catches (Fig. 1), showing a continuous decline of the proportion of adult sprat (defined as > 90 mm TL) in the area, while the mean size of juveniles increased first from 71.1 mm TL in August to 76.4 mm TL in September, but decreased to 74.8 mm TL in October again. The majority of sprat juveniles, particularly in August and September 2004, were substantially larger than those caught during previous investigations, which may point to considerable interannual differences in the production and survival of sprat offspring from the German Bight and its adjacent spawning grounds. Uncertainties with regard to differences in gear selectivity and sampling locations, however, are known constraints to such comparisons across studies and decades.

Backcalculated days of first increment formation (dif), a proxy for hatch day, indicated that the majority of sprat juveniles in 2004 originated from the spring months April and May (Fig. 1). Although from one survey to the next, later born juveniles appeared in the sampled population, whilst the earliest born conspecifics continuously disappeared (Fig. 1). However, the main...
spawning season in the German Bight generally commences later, typically at the end of May (Munk, 1993), which is consistent with seasonal monitoring data obtained for 2004 at Helgoland Roads (Fig. 2). Thus, many of sprat juveniles encountered in late summer and autumn of 2004 in the German Bight may have been produced outside the study area, and either drifted and/or actively migrated subsequently into it (Alshut, 1988).

Otolith-based length and growth backcalculations suggested a second pattern in the seasonal dynamics of juvenile sprat in the German Bight. When backcalculated to a common date just prior to the beginning of the first survey (8 August), individuals present in the area in October were substantially smaller than those present in September, which in turn were smaller than those present in August. Similarly, a comparison of relative, i.e. ‘age-independent’ otolith growth rates clearly showed that sprat juveniles remaining in the area in October were those that grew slowest on average between the end of July and September 2004. In other words, the largest and fastest growing sprat juveniles seemed to have progressively disappeared from the study area, either as a consequence of selective migration and/or selective mortality. The latter would challenge a paradigm in larval fish ecology, being that larger and faster growing individuals generally have higher survival probabilities (Leggett and Deblois, 1994). Interestingly, however, average growth rates for sprat larvae in the German Bight – as compiled from the literature – were found to be consistently as high or even higher than backcalculated larval growth rates of juveniles with similar temporal origins (Fig. 3). To eliminate some of the many sources of uncertainty inherent to such comparisons (e.g. different methods to estimate growth rates from otoliths), further analyses are presently carried out with sprat larvae sampled during 2004 in the German Bight.

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