A BASLINE STUDY OF LARVAL AND JUVENILE FISH IN THE TIDAL THAMES

SUMMARY REPORT

Funded by:

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The Thames estuary runs through the heart of London. It has provided London inhabitants with food and served as a transport route and hub for recreational activities for centuries, but there is still much to learn about its wildlife. Estuaries are one of the most poorly studied ecosystems on Earth due to tidal dynamics and logistical challenges associated with sampling. To start bridging this knowledge gap ZSL, together with partners Bournemouth University and SC^2, were commissioned by Tideway to conduct a study of the most abundant, vulnerable and understudied life stages of fish utilising the tidal Thames. These are fish in their early life history stages (ELHS), i.e. when they are eggs, larvae and juveniles. The project aimed to establish a pre- Thames Tideway Tunnel (London's new super sewer) baseline for ELHS fish which may be used to compare biodiversity and abundance of species after the sewer is completed in the future. A secondary aim was to broaden our understanding of how each species used the estuarine habitat, both along the tidal Thames and within the water column and how habitat utilisation changes as they develop in their first year. Throughout this survey we invited volunteers along to inspire and connect them with the estuary, giving them the opportunity to see the abundance of life the Thames supports.

This report summarises the key findings of the study. A detailed scientific report is available from ZSL upon request.

METHODS

A bespoke multi-method approach was developed to sample the ELHS stage in fish and was used across three Thames sites at Greenwich, Blackfriars and Putney (fig 1). The mid-channel waters were sampled using ichthyoplankton nets (fine mesh tows) at two depths (surface and 2 m). The foreshore intertidal zone was sampled using both seine nets, to understand the general fish assemblage, and intertidal sweep nets, to understand the use of the extreme margins by ELHS fish. Greenwich and Putney were sampled using all the above-mentioned methods approximately every two weeks on spring tides from March to October in 2017 and 2018. The third site, Blackfriars, was sampled by intertidal nets alone in summer months in 2017 and 2018 with citizen scientists.

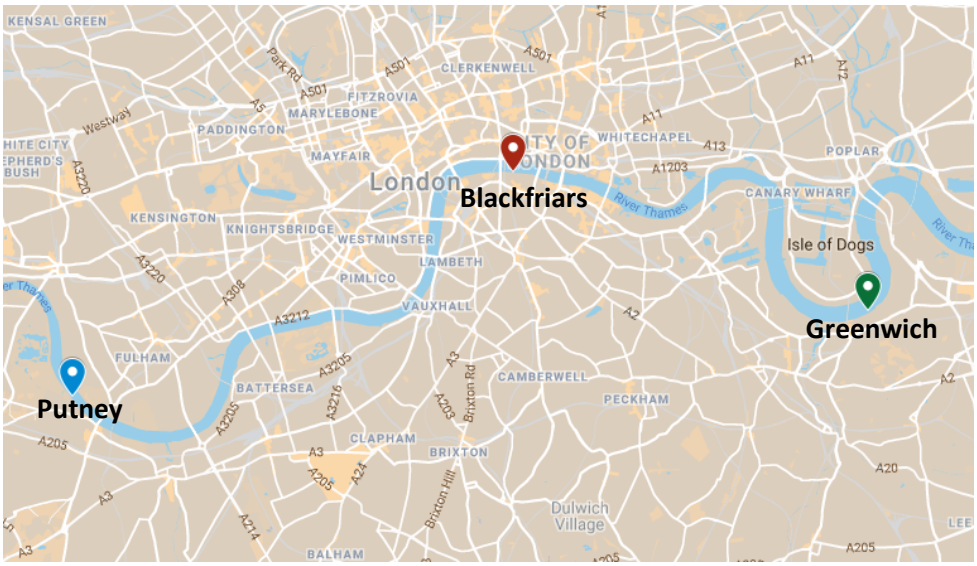

Figure 1: Survey sites. Blue: Putney; Red: Blackfriars; green: Greenwich.

RESULTS

In total, 512 mid-channel nettings, 821 intertidal nettings and 116 seine nettings were conducted across all three survey sites. A total of 8,346 individual fish were caught throughout the surveys, belonging to 24 different species and one hybrid, a roach-bream. Putney had the greatest abundance of fish caught (7,206) but the species richness was similar between the main survey sites (Putney n=21, Greenwich n=19). One highlight was catching a short-snouted seahorse (*Hippocampus hippocampus*) at Greenwich in October 2017.

The species abundance peaked during mid-summer. Across all sites, 66% of the catch was represented by three marine species (common goby, flounder and bass) (figure 2a-c) and 22% were represented by three freshwater species (roach, three-spined stickleback and dace) (figure 3a-c). Overall, the intertidal zone had a higher abundance and species richness of juvenile fish, compared to the mid-channel area.

140 volunteers helped during the surveys and citizen science events.

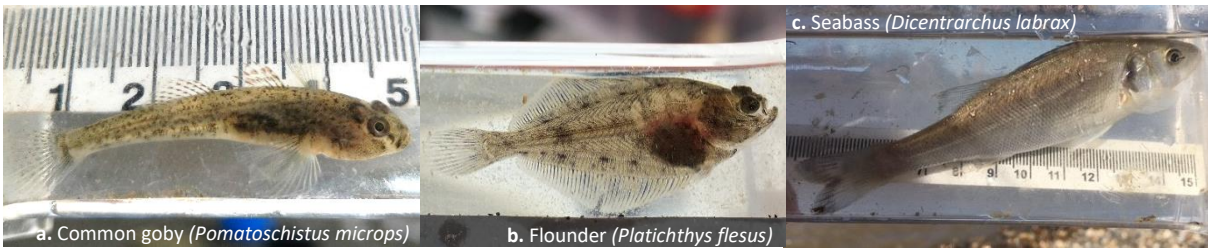

Figure 2. Most abundant marine species

Figure 3. Most abundant freshwater species

Spatial and temporal variation

Differences were found between the sites along the estuary and between survey years. In 2017, a total of 3,500 individual fish were caught at Putney, comprising 21 species (fig 4). The top five most abundant species, making up 91% of the catch, were common goby (54%), flounder (13%), three-spined stickleback (11%), bass (7%) and roach (6%). The catch abundance was similar across both years, with 2018 having a total catch of 3,706 individual fish, and a slight shift in the most abundant species. Making up 85.5% of the catch, in order of abundance were common goby (32%), flounder (30%) roach (18%) and dace (5.5%). Newly hatched smelt larvae were recorded in 2017, but for the first time in three years, this species was not recorded in Putney in 2018.

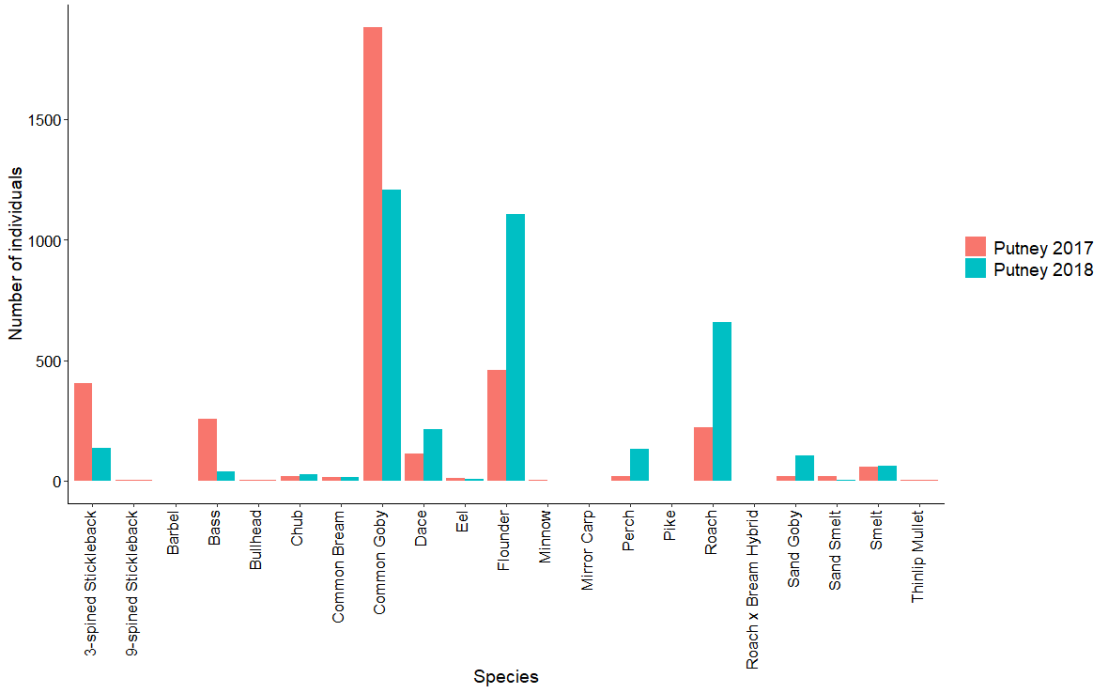

Figure 4. Species composition at Putney in 2017 and 2018

A total of 511 individuals were caught at Greenwich in 2017, comprising 18 species, with five species making up 93% of the catch. These were common goby (38%), bass (28%), flounder (12%), three-spined stickleback (8%) and eel (7%). Similarly, 544 individuals were captured in 2018 from 16 different species, but the species dominating the catch shifted somewhat (fig 5). Comprising 85% of the total catch were smelt (43%), bass (13%), eel (11%), common goby (10%) and flounder (8%).

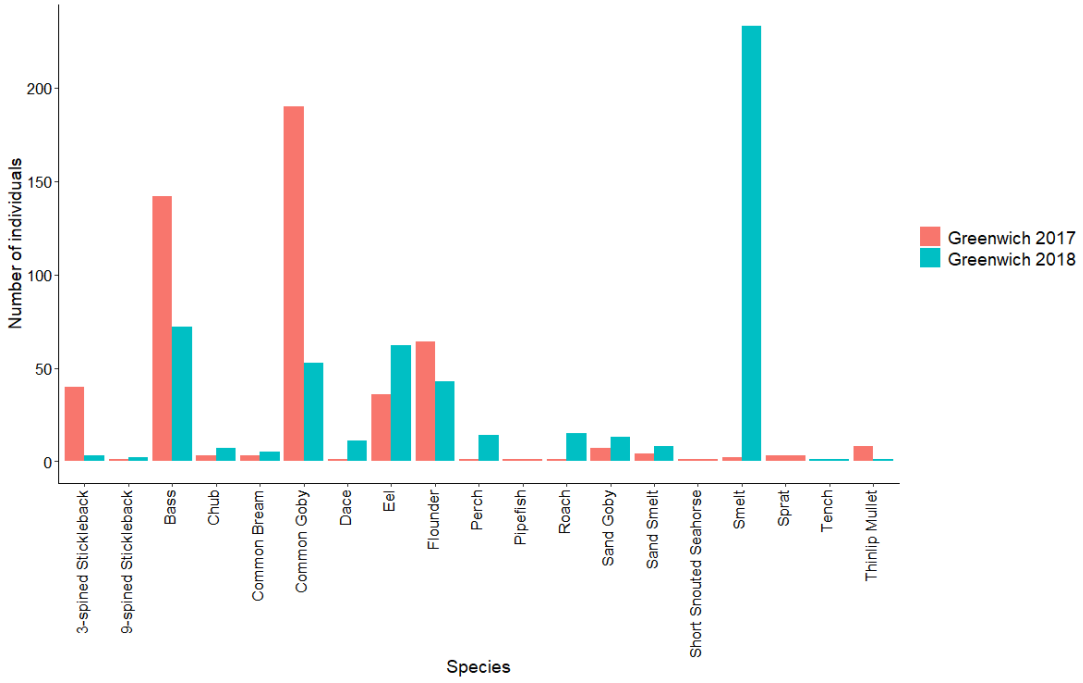

Figure 5. Species composition at Greenwich in 2017 and 2018

In contrast to Putney, as can be observed in Figure 5, smelt were recorded in relatively high numbers in 2018 in Greenwich. The smallest size recorded was 14 mm, and so the smelt arriving here were already several weeks old.

At Blackfriars a total of 110 individuals were caught, comprising nine species (fig 6). It is important to note that far fewer surveys were conducted at this site compared to Putney and Greenwich. Bass dominated the catch in 2017, making up 58%, whereas in 2018 it made up just 12% of the total 60 individuals caught. Conversely in 2018 dace dominated, making up 65% of the catch, while only making up 8% in 2017.

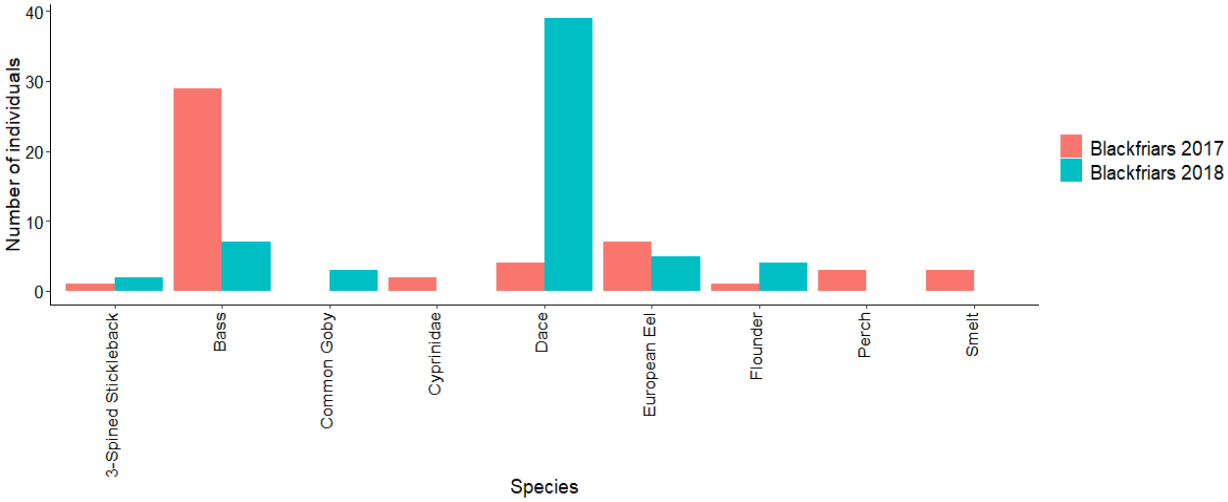

Figure 6. Species composition at Blackfriars in 2017 and 2018

CONCLUSION

Adding to previous studies this survey further solidifies the knowledge that the Tidal Thames plays a vital role as a spawning and nursery ground for fish, with over 20 species found as juveniles in the Thames. The species composition and abundance varied with location along a saline gradient, with Putney having a higher abundance of freshwater species and Greenwich more predominantly marine species. Smelt was the one species that drastically changed its distribution between the two years. Putney was previously identified as being close to a key spawning grounds for smelt, yet no individuals were found at this site in 2018. This could indicate that smelt did not succeed in spawning at Wandsworth that year or that spawning changed in timing and/or location. The change or addition of suitable spawning sites for smelt in the tidal Thames and/or its tributaries can be supported by the high abundances of several weeks old smelt were found at Greenwich in 2018. Environmental conditions including water temperature, dissolved oxygen and salinity linked to river flow could be factors contributing to this change. Further research into site selection for spawning smelt should be conducted to identify what constitutes suitable spawning habitat.

The results have demonstrated that the entire estuary is very important for fish in their first year of life. Fish were found in high numbers both along and within the tidal Thames, including mid-channel and along the estuary edges, and they appeared to select different habitat utilisation at different stages of their development. In general it appeared that ELHS fish are initially found mid-channel as larvae or small juveniles being carried by the tidal flow. As they develop, some fish start to move into the margins to utilise selective tidal stream transport (STST). STST is the process by which fish harness the energy of the tides to move up (or down) the estuary, moving to the margins to shelter in protected shallow water to avoid the falling tide.

In this survey the intertidal zone consistently had the highest abundance of juvenile fish, although catch in this zone only peaked after June / July, once the larvae had had time to develop. We examined three fish species in detail and were able to identify interesting patterns on how flounder, bass and smelt selected the part of the estuary habitat they favoured, depending on their developmental stage. Flounder were initially found in the midchannel at Greenwich at the beginning of the year, and were found swimming vertically with an eye either side of their head. By the time flounder was caught at Putney they were primarily caught in the margins, and one of their eyes had migrated to the top of their head, and their gut and mouth had developed (fig 7). At this time they had started swimming as flatfish and had moved from the pelagic (water column) to the bethic zone (riverbed).

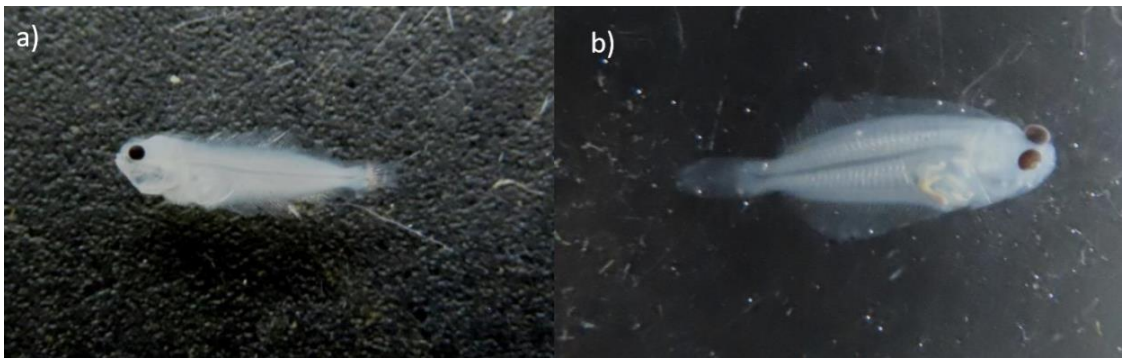

Figure 7. Photographs showing the different ontogenetic stages of flounder a) an ELHS flounder with eyes on both sides of its head b) an ELHS flounder whose eyes have migrated to the top of their head – note food visible in digestive tract

Bass also made a shift between the midchannel and the margins as they developed, however this was found to be dictated by their size, rather than a substatial shift in development. Bass seemed to move from the midchannel to the margins when they grew longer than 17-20 mm, and presumably had the swimming strength to be able to position themselves in the water. Smelt however were not found to change habitat and remained primarily in the midchannel up to a size of 80 mm. More research is needed to understand whether or not smelt will start to use the margins and selective tidal stream transport and at what point in their development this will occur.

As the Thames is an urban estuary, most of its riverbanks have been subject to modification due to housing and commercial developments, significantly reducing the marginal habitat available for ELHS fishes. In some areas, no shallow, sheltered water on the margins exists any longer in the Thames. This is cause for concern, as we do not know the short-, nor long-term effects from the lack of intertidal habitat on the ELHS fish. It is not unreasonable to assume that limitations of this habitat forces the fish to expell more energy on movement as it reduces the likelyhood for fish to be able to shelter and




avoid the tides. This is why future riverbank modification needs to be thoroughly assessed, to not just maintain but improve the habitat when new developments are planned.

The 24 species identified in this survey are of both commercial and conservation importance, several covered by national and international legislation. As their combined utilisation covers the entirety of the river channel it is of the utmost importance that measures are taken to ensure vital habitat is protected, and degraded habitat is restored, so that the Thames can continue to support its biodiverse and abundant fish assemblage.

FINAL REMARKS

This study represents the most comprehensive survey of fish in their early life history stages in any estuary within the UK to date. The methodology developed for this survey, spanning years, sites and survey techniques gave us new, unique insights into what species utilise the tidal Thames as a spawning and nursery ground and how their habitat use varies spatially and temporally.

More research is needed both within the Thames and across other estuaries, so that we can continue to develop our understanding of this most vital habitat on this critical life stage of fish.

A more detailed scientific report is available for this study. If you are interested in getting a copy please email Marineandfreshwater@zsl.org.

Acknowledgements

ZSL would like to express its gratitude to the many volunteers who donated their time and effort to the project. With such an extensive methodology we really could not have done it without them. We would also like to take this opportunity to thank Tideway for funding this project.