

ELECTRONIC DATA STORAGE TAGS REVEAL DETAILS OF SEASONAL MOVEMENTS AND BEHAVIOUR OF THORNBAC RAYS (*Raja clavata*) IN THE THAMES ESTUARY

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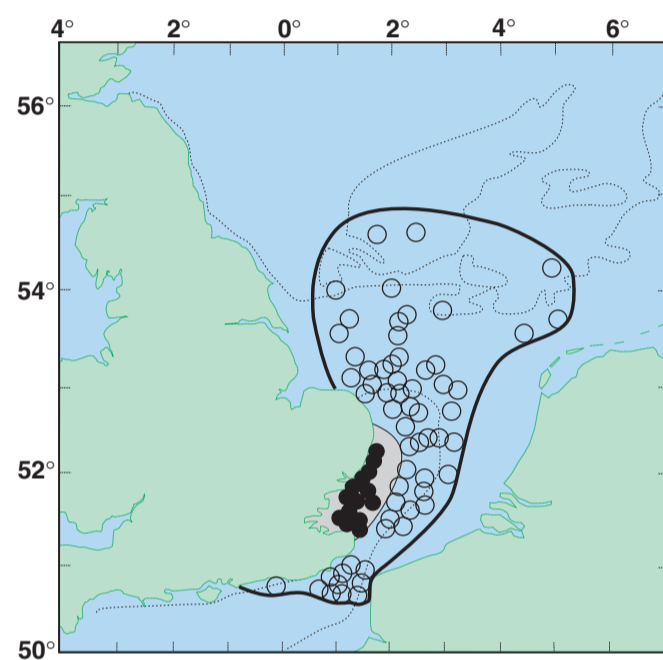


Understanding the movements and behaviour of individual fish is crucial to developing models of population movements that can be used to predict the likely efficacy of different management measures such as closed areas or closed seasons.

Introduction

- Rays have low fecundity, late age and large size at maturity. These life history traits make them particularly vulnerable to fishing.
- Stocks of four species of ray in the North Sea have declined over the last few decades as a result of exploitation.
- Closed areas have been suggested as a possible conservation measure. However, information about fish movements and behaviour are necessary to assess the efficacy of such management methods.

Previous conventional tagging experiments carried out between the 1950's and 1970's indicate that thornback rays in the Thames Estuary form a local sub-population that exhibits only small-scale movements.



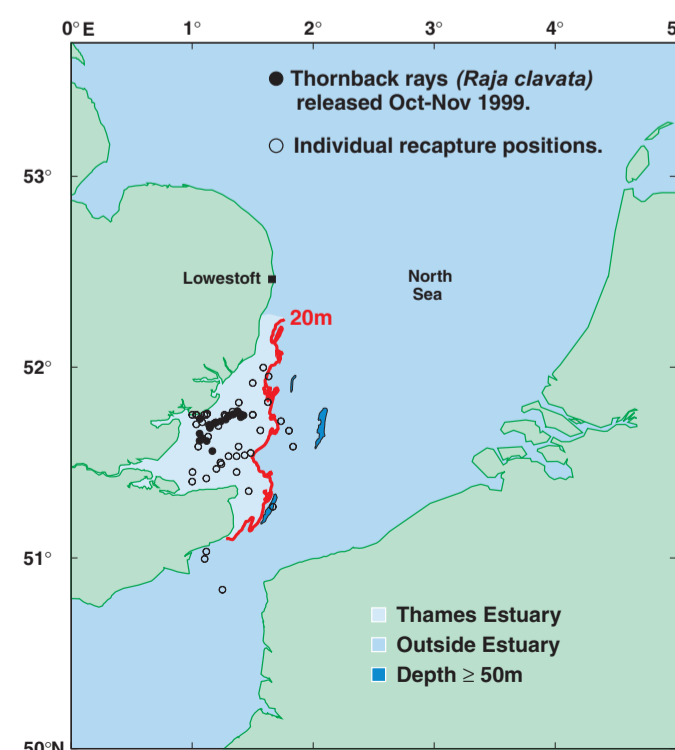
However, conventional tagging data consists only of release and recapture positions, with no information about movements whilst the fish is at liberty. Also, data are compromised by the level and distribution of fishing activity.

Figure 1. Conventional tag recaptures (○) of the thornback ray released (●) in the Thames Estuary. The area shaded grey represents the limits within which 80% of the recaptures were found and the solid line represents the limits within which 100% of the recaptures were found. (Figure redrawn from Walker et al., 1997)

Tagging with data storage tags

In 1999 we tagged 97 thornback rays with electronic data storage tags (DST's) in the Thames Estuary, a further 100 rays were tagged in 2000. These tags record pressure (depth), temperature and ambient light continuously for extended periods (> 1 year). Patterns of behaviour are inferred from changes in depth and geographical movements are interpreted from hydrostatic data (times of high and low water), recorded when a fish is stationary on the seabed, and from temperature records.

Results 1: Tag recaptures



Forty one (42%) of the tags released in 1999 have been returned yielding over 5,000 days of data. As with conventional tagging experiments 81% of these were recaptured within the Thames Estuary (inside the 20m contour, Figure 2).

Figure 2. Release and recapture positions for 41 Fish equipped with DST's.

However, the depth data for individual fish show that 82% of fish recaptured within the Thames Estuary did not remain there all the time.

Results 2: Individual depth record.

None of the Thames Estuary is deeper than 35m at high water. Outside the estuary depths can be up to 60m.

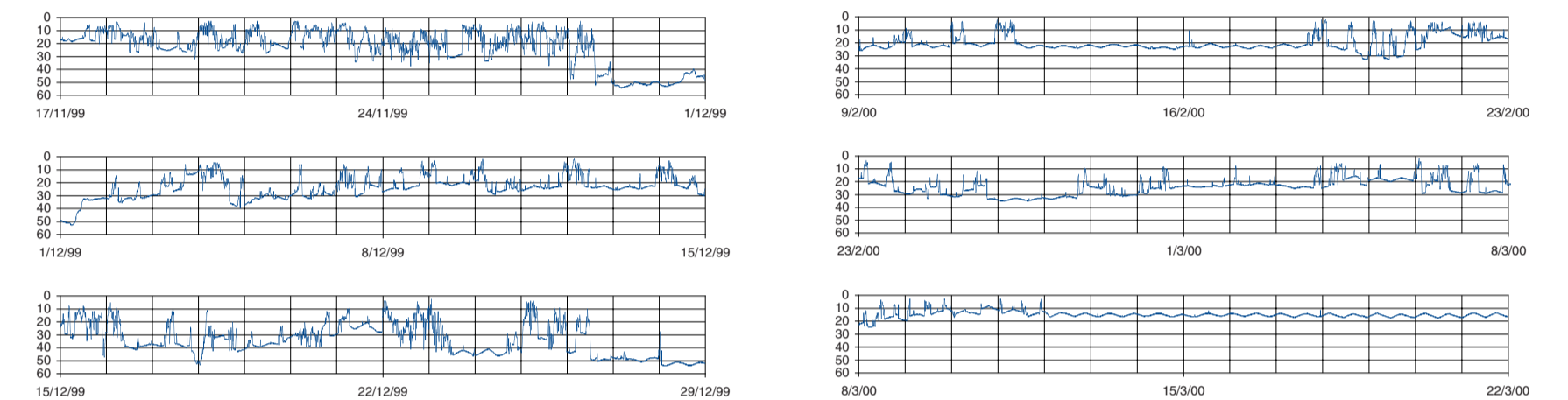


Figure 3a. November - December

Figure 3b. February - March

Figure 3. Depth record of an individual ray. The fish was released in the Thames Estuary in October. During November and December it spent several periods at depths >50m (i.e. outside the Thames Estuary). However, by March the fish was in depths <30m. The fish was recaptured in July 2000 in the Thames Estuary.

Results 3: Time at depth for all fish.

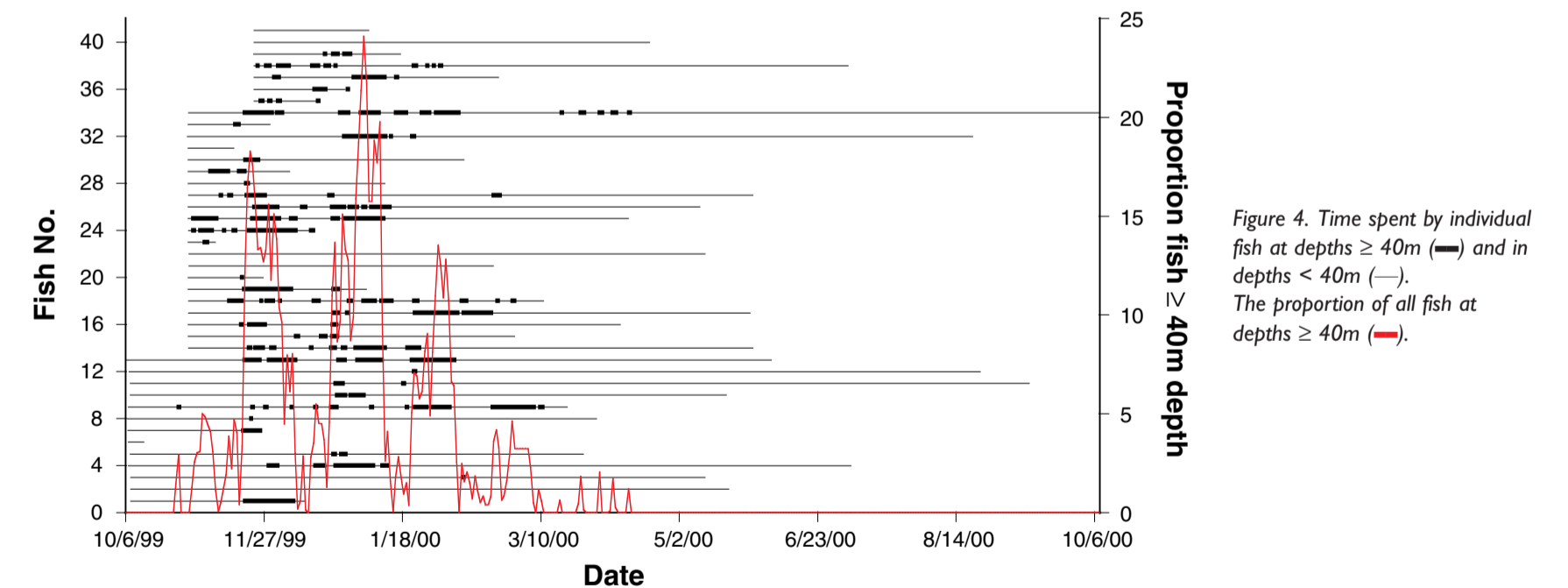


Figure 4. Time spent by individual fish at depths ≥ 40m (—) and in depths < 40m (—). The proportion of all fish at depths ≥ 40m (—).

There is a clear trend: movement into deeper water occurred mostly between November and March. During this time movement into deep water appeared to be strongly rhythmic.

Conclusion

Our results indicate that 81% of tagged fish are recaptured within the Thames Estuary. However, they move outside the Thames Estuary for some of the time, particularly between November and March. Therefore the majority of fish are moving over a wider area than indicated by previous conventional tagging experiments. Thornback rays are known to spawn in the early summer in shallow water. We do not yet know whether this movement is related to spawning, feeding or temperature.