

## Introduction



The twaite shad (*Alosa fallax* Lacépède), is an anadromous clupeid – a marine species with freshwater spawning phase. They are iteroparous (multiannual spawners) and possibly philopatric (homing to natal rivers to spawn) [1]. Hybridisation with allis shad (*A. alosa* L.) also occurs [2]. In Europe both twaite and allis shad are of conservation concern with anecdotal evidence for decline in numbers due to potential factors such as pollution, reduced access to spawning grounds, poor recruitment, hybridisation and marine by-catch [1]. In Ireland, twaite shad enter a number of rivers from April to June to spawn. These rivers are located principally in the south of the country, five of which are designated Special Areas of Conservation (SACs) for this species (Fig. 1).

Knowledge of behaviour and movements are especially important to aid conservation efforts. There is a lack of detailed information for twaite shad regarding behaviour during their annual spawning migration, e.g. residency time in freshwater & estuarine habitats, movements and behaviour, timing of spawning and the importance of environmental variables (temperature, tides, river discharge, etc.). Acoustic telemetry may help to answer many of these questions.

## Methods



Twaite shad were captured in the middle reaches of the Barrow estuary during 2012 (May 10<sup>th</sup>, n=8, 400-430mm, 1170-1350g) and 2013 (May 10<sup>th</sup> & 22<sup>nd</sup>, n=13, 403-450mm, 950-1370g) using drift netting. The study was expanded to include the Munster Blackwater R. in 2013 (May 16<sup>th</sup> & 28<sup>th</sup>, n=4, 400-450mm, 900-1380g). Fish were fitted externally with acoustic transmitters (Vemco V9) and released at point of capture. Movements throughout the tidal section of the R. Barrow and the confluent R. Nore were monitored *via* an array of 11 acoustic receivers (Vemco VR2/VR2W) covering a distance of 43km by river from the upper tidal limits downstream to the coast (Fig. 1). On the Munster Blackwater an array of 6 receivers monitored the 30km tidal section of this river. A range of environmental variables (water temperature, tides, lunar phase, river discharge) were simultaneously recorded for both locations to examine their potential impacts on behaviour.

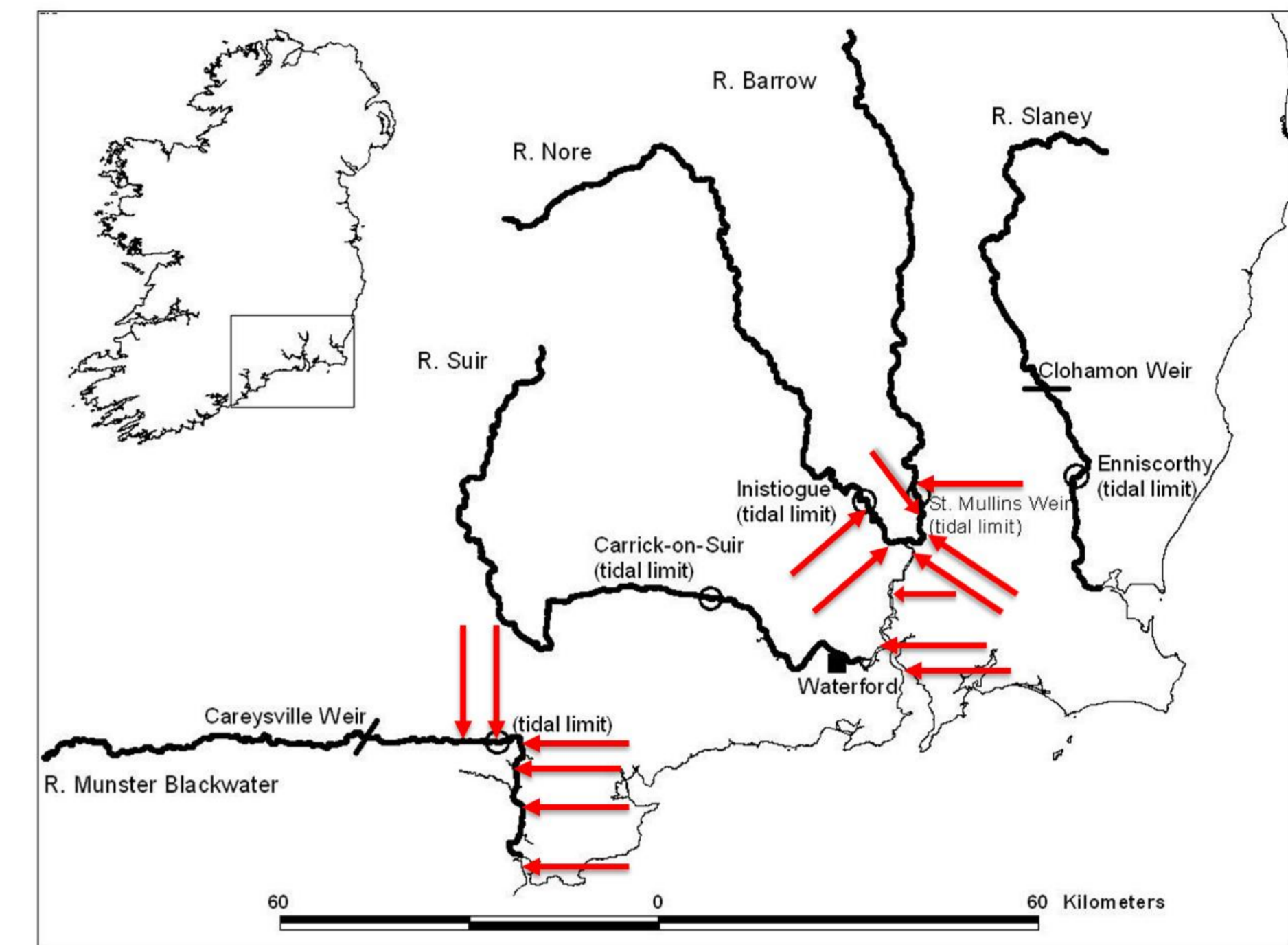


Figure 1. Twaite shad SACs & locations of acoustic receivers.

## Results & Discussion

During 2012 locational data were obtained for 7 (88%) of the 8 tagged fish on the R. Barrow. For 2013, data were obtained for 12 (92%) of the 13 tagged on the R. Barrow and 3 (75%) of the 4 tagged on the Munster Blackwater. Twaite shad were highly mobile during their spawning migration (Figs. 2 & 3), typically demonstrating a number of upriver forays of up to 35km on rising tides and falling back a similar distance with ebb tides, before periods of prolonged and synchronous residency of 1-2 weeks at the spawning grounds. This latter behaviour was independent of tidal phase and coincided with steady rise in water temperatures from 13°C to 19°C during late May-early June. Following presumed spawning, tagged shad returned to lower estuarine waters over 1-3 days. An interesting observation was an instance of long distance coastal movement by a tagged shad from the Munster Blackwater estuary to the Barrow estuary over 3 days in 2013 (July 12<sup>th</sup> - July 15<sup>th</sup>), a distance of 85km. The role of environmental variables needs to be further investigated.

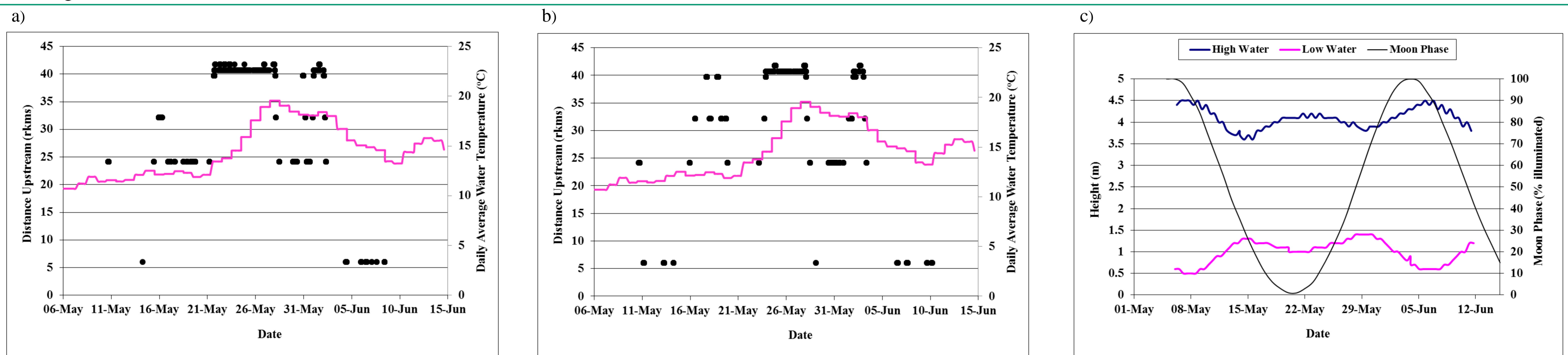


Figure 2. Examples of twaite shad behaviour during their spawning migration into the R. Barrow during May and June 2012. Figures 2a and 2b show the locations of 2 individual fish, respectively, as recorded by static acoustic receivers over varying distances between open sea (0 river kilometres) to the spawning grounds at the upper tidal limits (43 river kilometres). Superimposed on both is the corresponding daily average water temperature, whilst tidal and lunar phases are contained in Figure 2c.

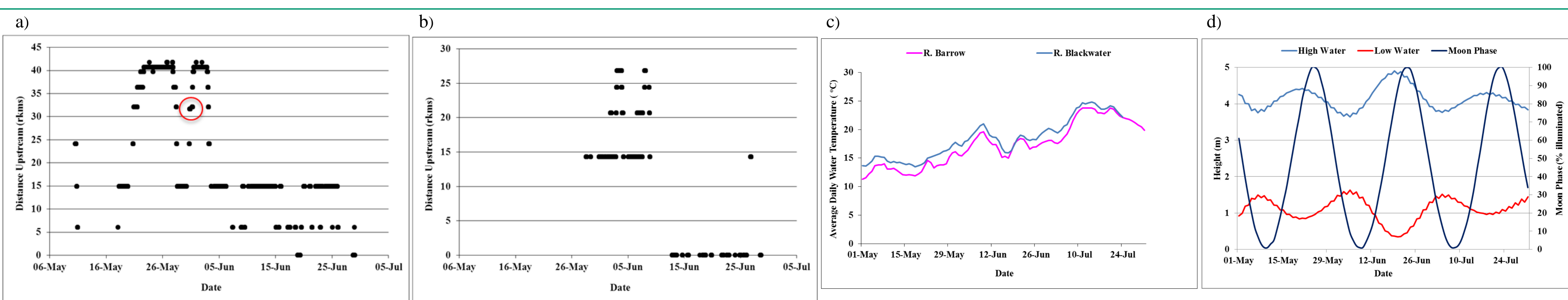


Figure 3. Examples of individual twaite shad behaviour during their spawning migration into the R. Barrow (Fig. 3a) and Munster Blackwater (Fig. 3b) during May and June 2013. Displayed also are the corresponding daily average water temperatures for both rivers (Fig. 3c), as well as the tidal and lunar phases for the region (Fig. 3d). Locations are as recorded by static acoustic receivers over varying distances between open sea (0 river kilometres) to the spawning grounds at the upper tidal limits (43 and 28 river kilometres, resp.). A foray from the R. Barrow into the adjacent R. Nore is indicated by the red circle in Fig 3a.

## References

- [1] King, J. J. & Roche, W. K. (2008). Aspects of anadromous Allis shad (*Alosa alosa* Linnaeus) and Twaite shad (*Alosa fallax* Lacépède) biology in four Irish Special Areas of Conservation (SACs): status, spawning indications and implications for conservation designation. *Hydrobiologia* **602**, 145–154.
- [2] Coscia, I., Rountree, V., King, J.J., Roche, W.K. & Mariani, S. (2010). A highly permeable species boundary between two anadromous fishes. *Journal of Fish Biology* **77**, 1137–1149.