

First insights into spawning migration of European smelt (*Osmerus eperlanus*) in the River Wyre, England

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LOCAL AND GLOBAL INITIATIVES:

HOW SCIENCE SUPPORTS MANAGEMENT ACTIONS ON DIADROMOUS FISH

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Introduction

What is smelt?

- The “little cucumber” anadromous fish (spawning in fresh water in spring)
- Found in estuaries often as a dominant part of fish communities
- Once widely distributed and abundant in coastal waters from the Bay of Biscay to the Baltic Sea
- Large over the past two centuries due to over-fishing, loss of spawning habitat, barriers to migration, reduced water quality etc.
- Subjected to conservation efforts in the UK (UK BAP)
- The species has recently returned to many water courses in England (identified in 36 water courses)



Why smelt & why River Wyre?



- An important environmental indicator of good ecological status of waters under WFD
- Very sensitive to environmental change
- Commercially important species (especially in the past)
- Migratory species, connecting marine and fresh water habitats (transfer of nutrients and energy)

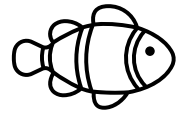
- Limited information on distribution and spawning habitats in the Wyre (important to focus conservation efforts)
- Evidence required for designation of MCZ



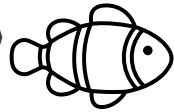
Objectives



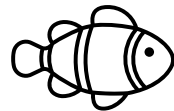
To confirm spawning population in the Wyre



To investigate time of spawning migration/spawning



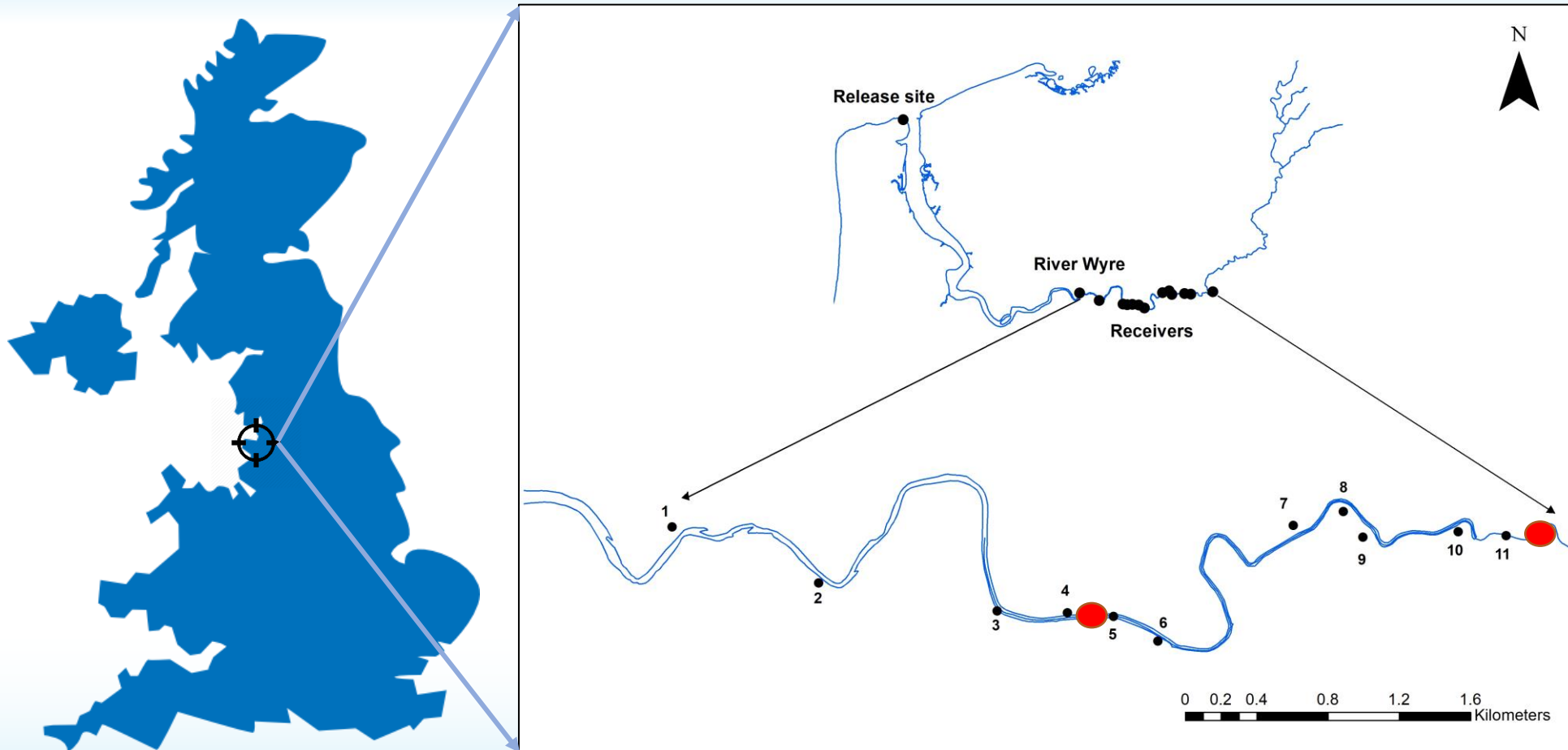
To investigate spawning locations



To describe smelt movement in relation to environmental factors

Materials and Methods

Study site – River Wyre, Lancashire, England



Field sampling, tagging and tracking

180 kHz VR2W acoustic receivers
(February 2021)



Beam trawl survey at Fleetwood (mid
February-March 2021)



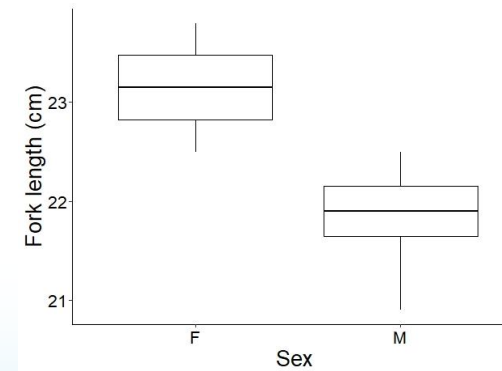
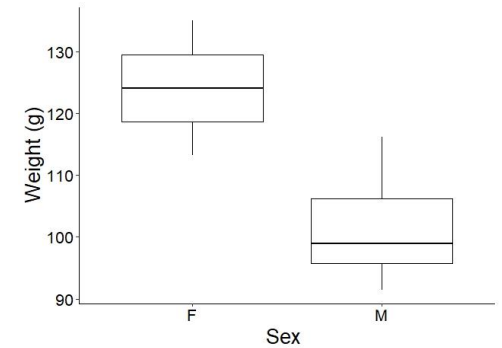
9 fish sexed (2 females, 7 males)
22 smelt capture, 16 suitable for tagging
(mean fork length \pm S.E. = 22.17 ± 0.23 cm)



Fish recovered and released



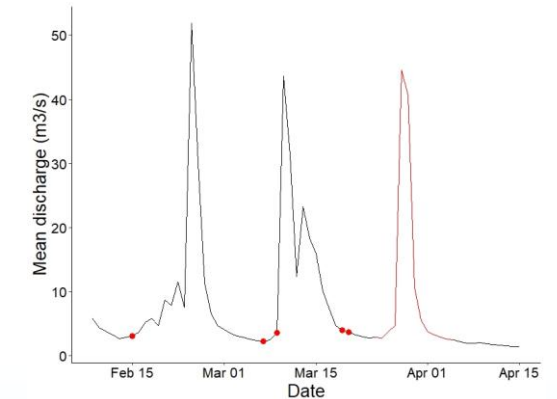
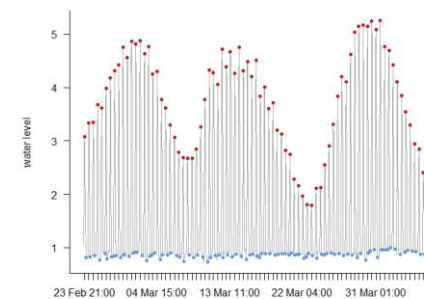
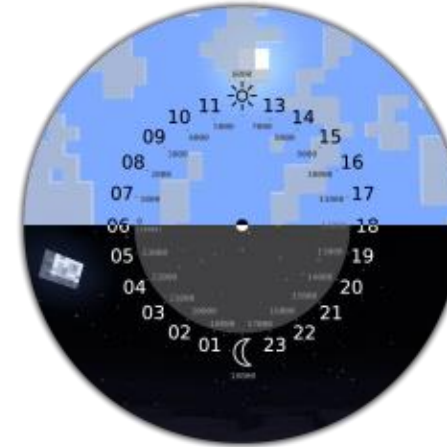
Fish anaesthetised (2 phenoxy ethanol) and tagged
(through stomach with V5-1H, 180 kHz tags)



Data analysis

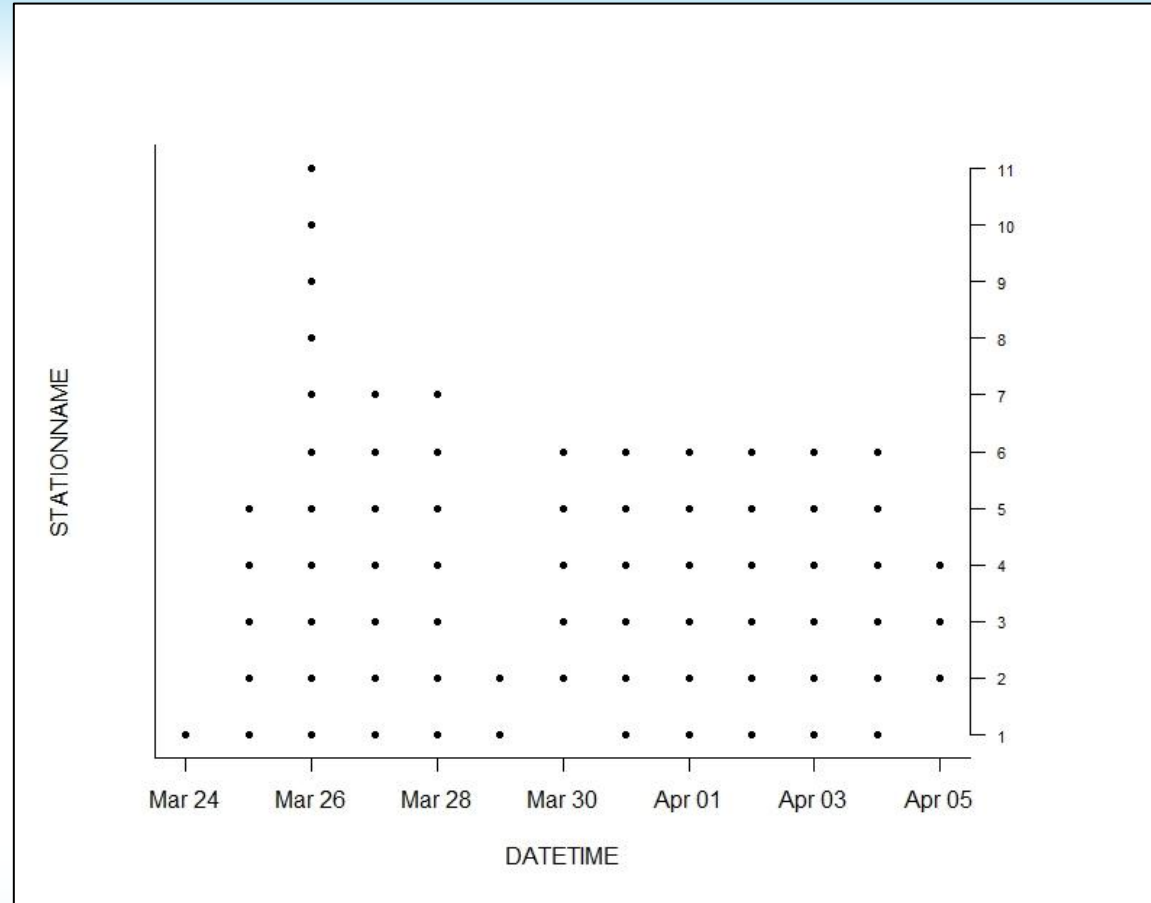
Acoustic data manipulated in R software with the package 'Vtrack' and analysed for the following metrics:

- Array residency index
- Migration distance in the study array
- Total daily movement (effect of fish length and sex)
- Upstream vs downstream movement
- Impact of river discharge
- Diel activity patterns
- Influence of tidal cycle
- Residency duration and location



Results

Summary



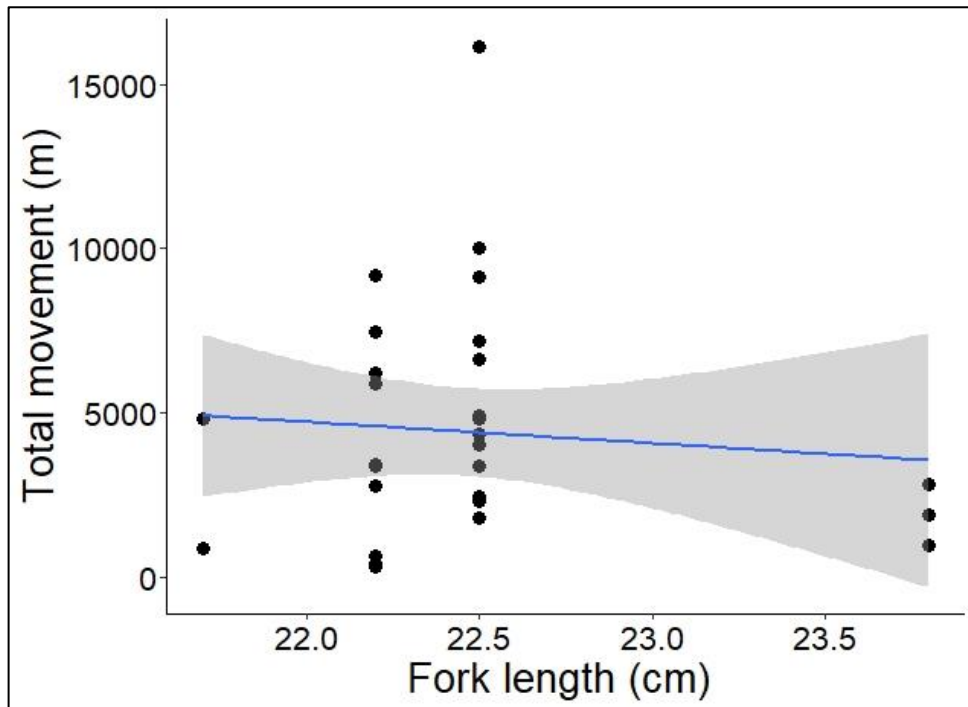
Daily detection rates

Summary

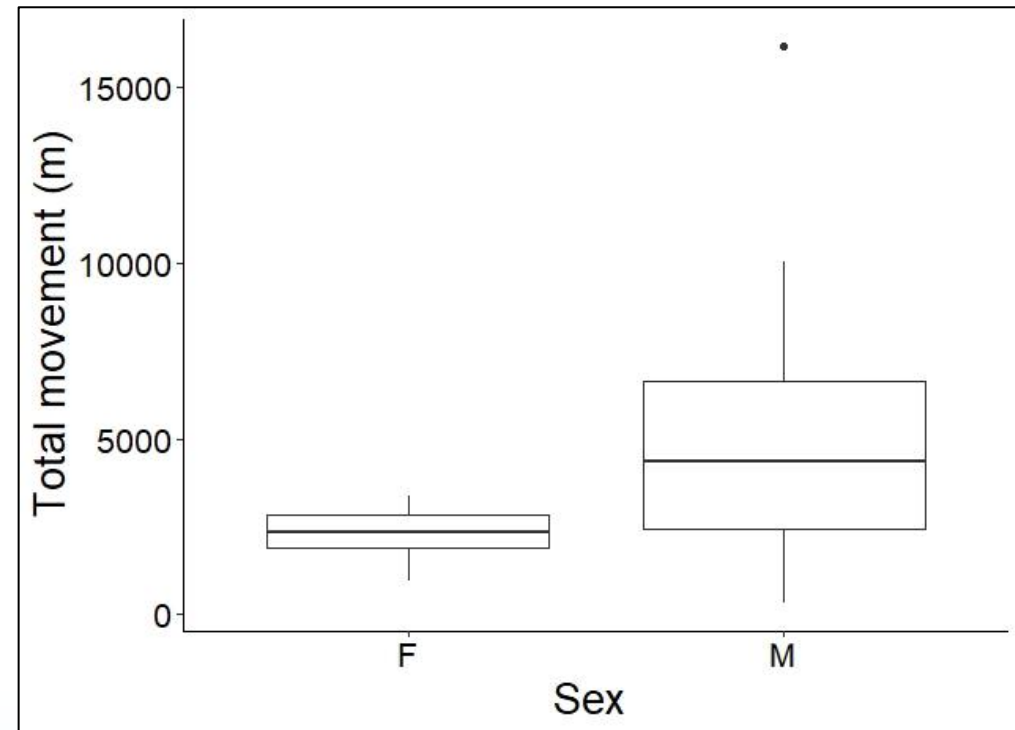
ID	Length (cm)	Weight (g)	Sex	Time of capture	Days of detection	No of detections	Residency index	Migration distance (m)	Total dist. (m)	Upstream dist. (m)	Downstream dist. (m)
A180-1702-52961	22.5	95	M	07/03/2021 12:15	10.3987	1685	0.4277	7125.27	75546.43	39915.21	35631.22
A180-1702-52963	22.2	96.4	M	07/03/2021 13:00	9.2958	1171	0.3823	5617.48	40005.37	21202.69	18802.69
A180-1702-52964	20.9	113.2	M	09/03/2021 15:25	0.0015	2	0.0001	0	0	0	0
A180-1702-52966	21.7	116.2	M	09/03/2021 15:50	1.0048	95	0.0413	3444.48	5696.10	2848.05	2848.05
A180-1702-52971	23.8	135	F	19/03/2021 09:05	1.1781	90	0.0485	3048.05	5696.10	2848.05	2848.05
A180-1702-52973	22.5	113.2	F	20/03/2021 10:00	1.0773	90	0.0443	3048.05	5696.10	2848.05	2848.05

Summary

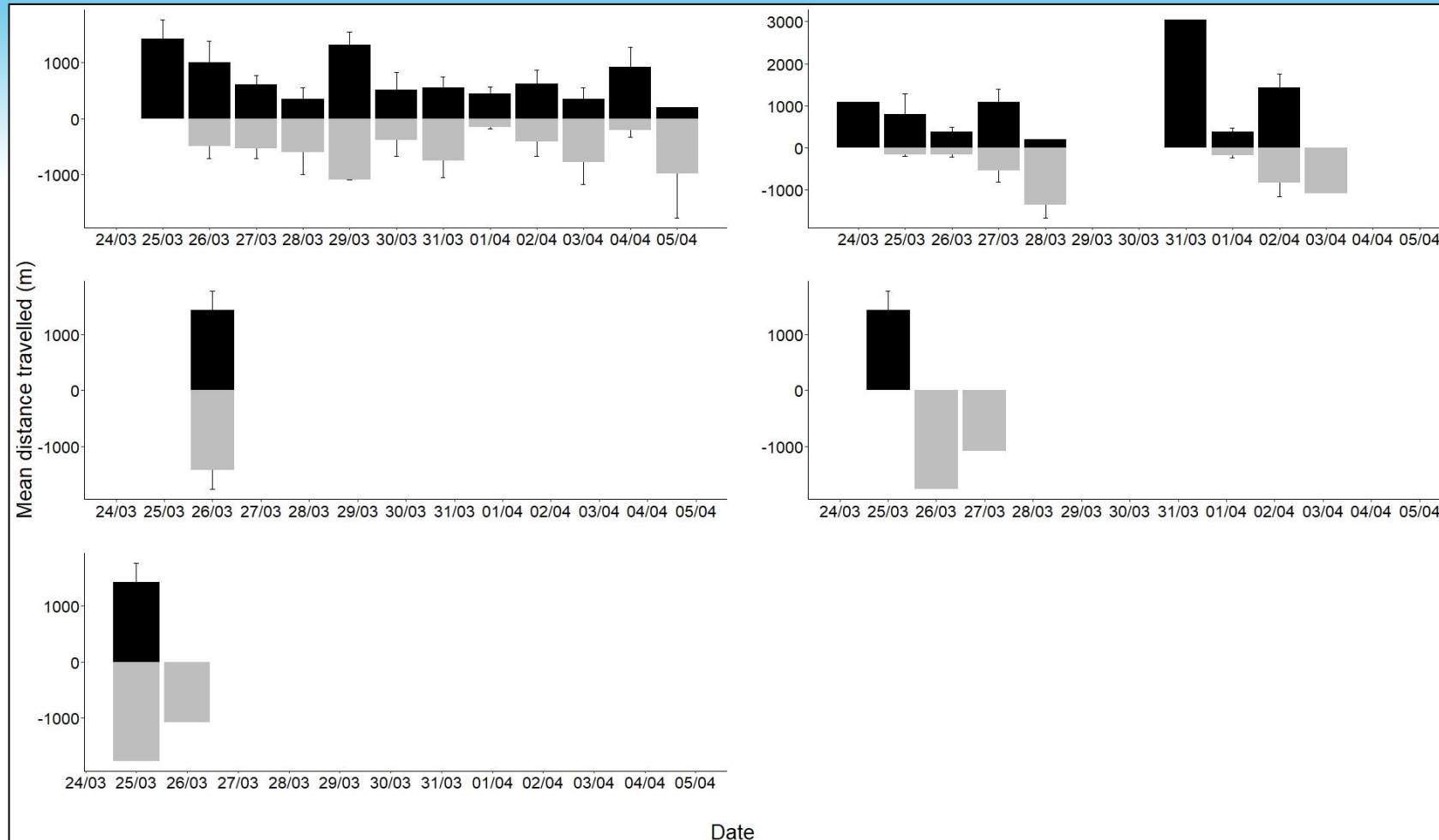
No significant impact of fish length on total movement



No significant difference between sex in movement

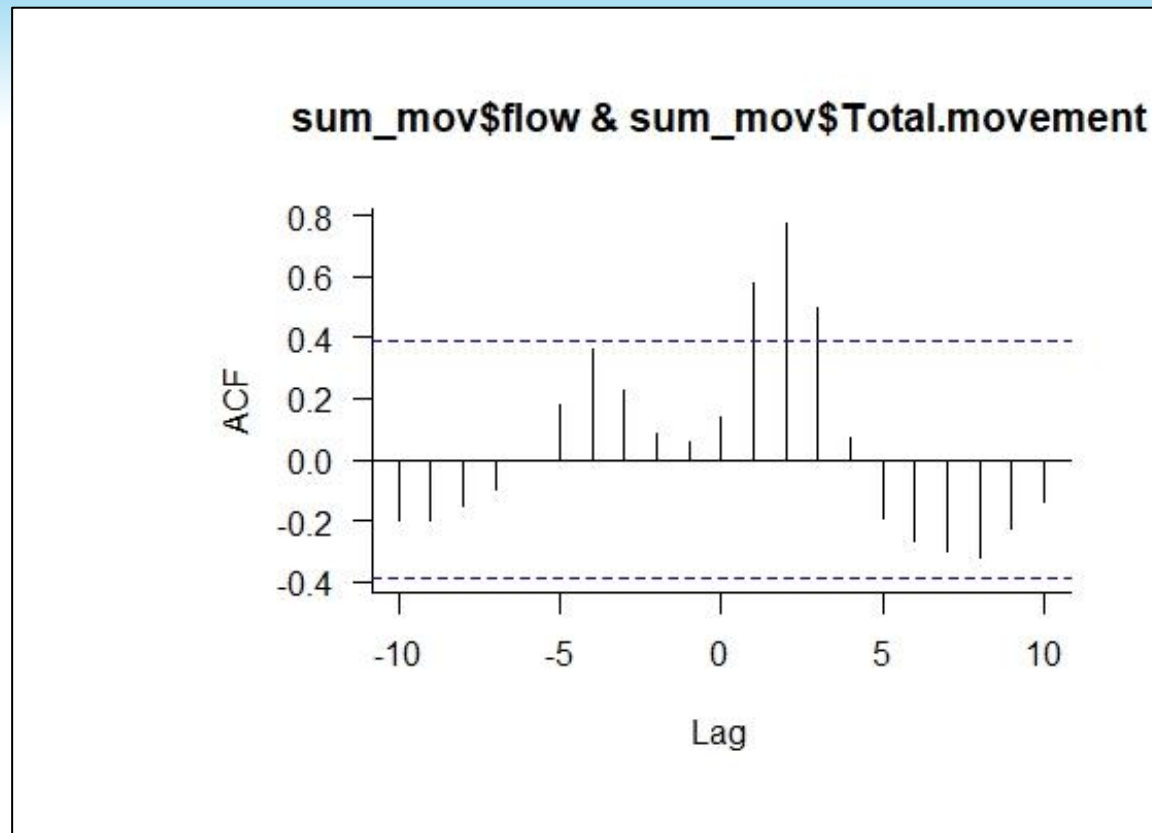
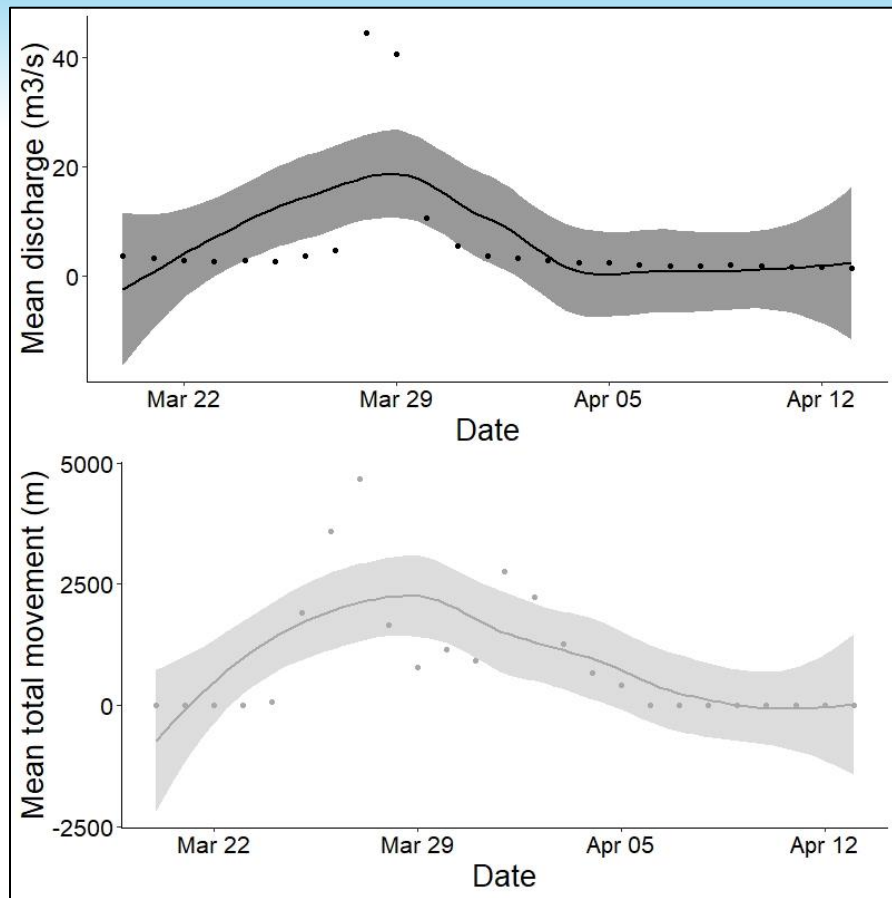


Summary



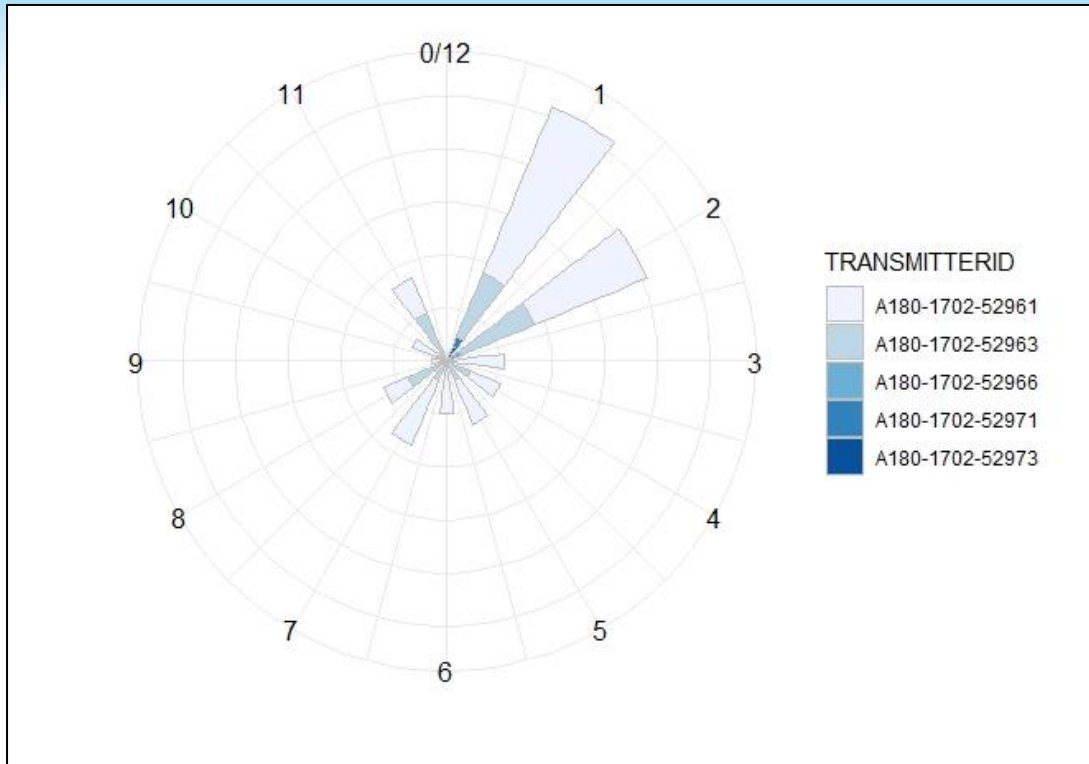
Upstream vs downstream movement

Impact of river discharge on movement



Cross correlation analysis of discharge and total daily movement

Impact of tides on movement

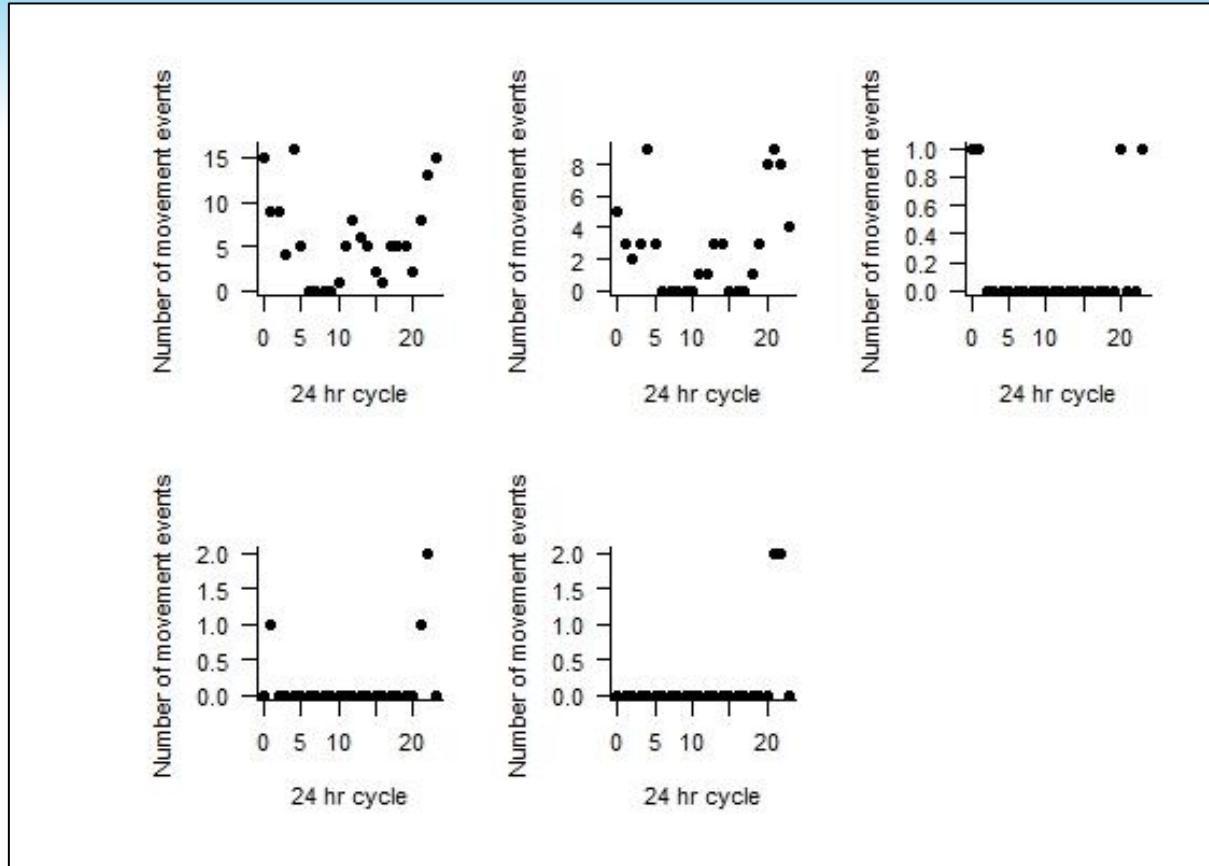


Time of arrival at receivers in relation to tides

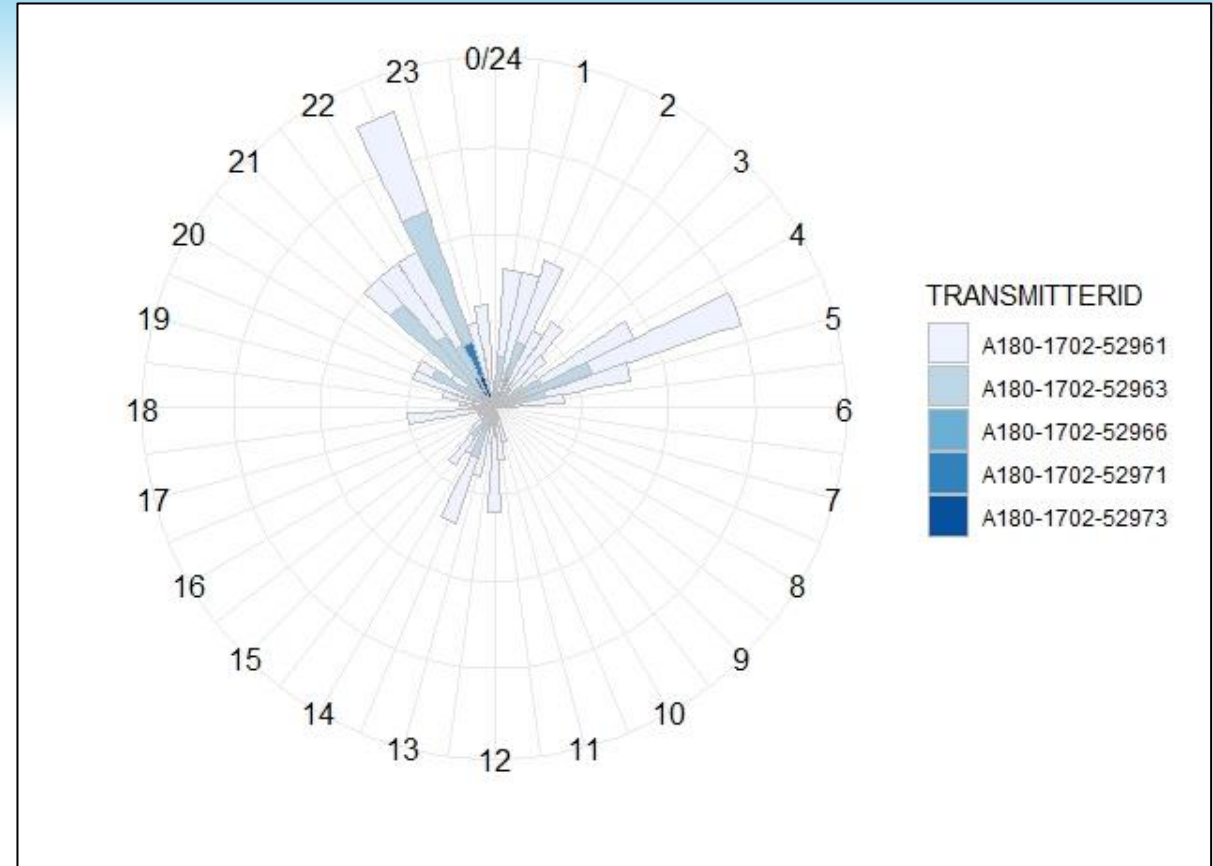


Time of arrival at receivers during upstream migration (top) and downstream migration (bottom)

Impact of time of day on movement

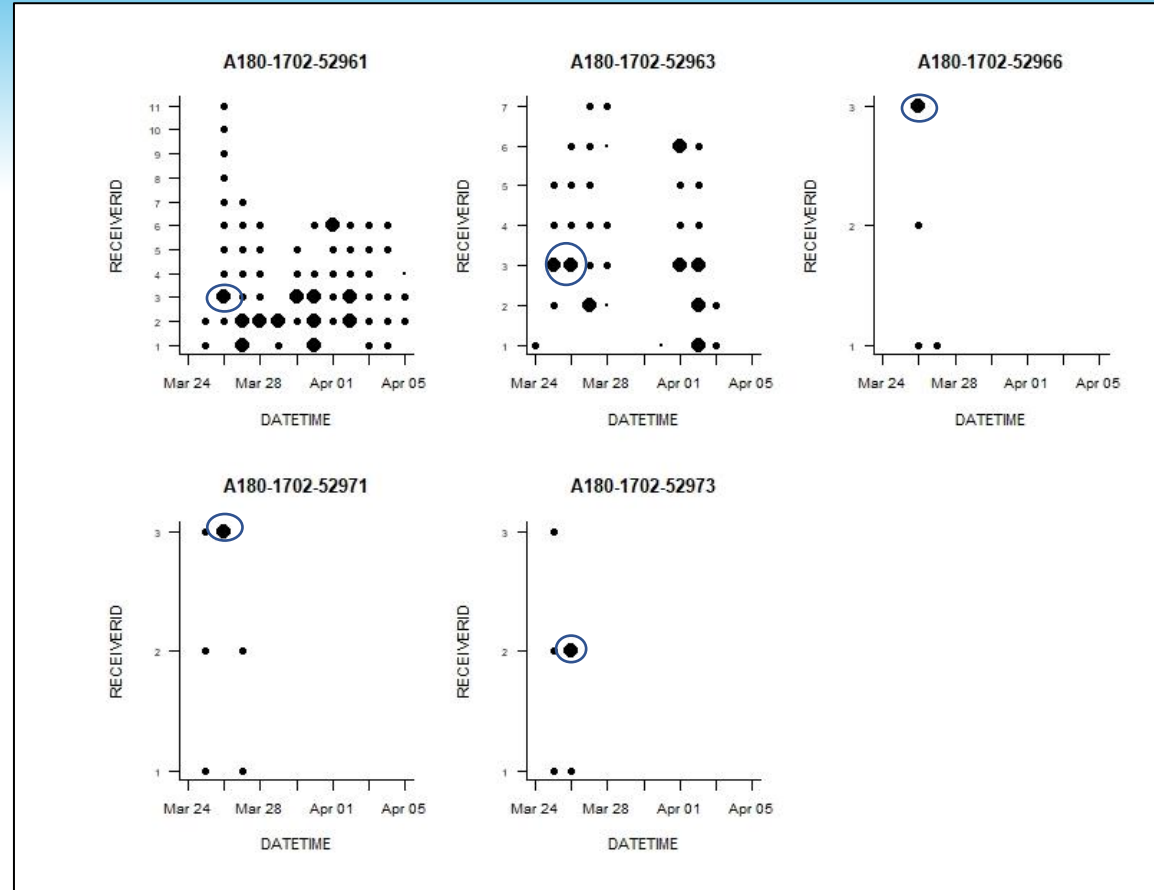
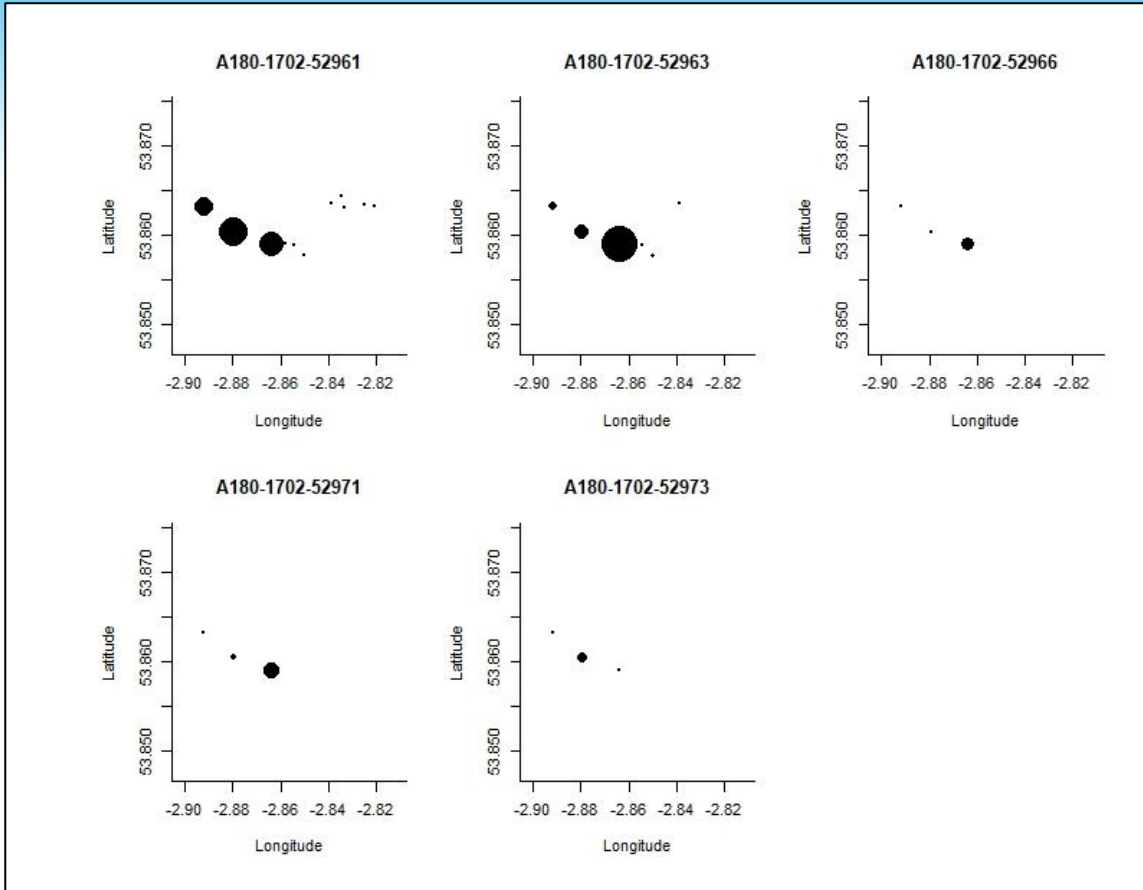


Number of movement events per time of day



Time of arrival at receivers in relation to time of day

Residency



Total residence time at each receiver plotted per fish (size of point represents the duration spent at each receiver)

Duration of time spent at each receiver per fish and day (size point indicates the duration of time spent at each location)

Discussion

Main conclusions

- Smelt spawn in early spring (temperatures between 5 and 6 °C as previously described)
- The presence of both male and female smelt for extended periods between the toll bridge at Cartford Inn and Whites Brook may suggest that the fish are spawning in this area as supported by previous tracking studies which have indicated that smelt spawn in the tidal reaches of rivers
- Movements were mainly nocturnal and impacted by tides and river flow as supported by other studies
- As in previous studies, the tagged fish spent relatively little time in the study area after spawning (1-13 days) before moving downstream and into the lower estuary

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