



Development of telemetry for understanding fish movements around offshore windfarms

David Sims (dws@mba.ac.uk)

P.I. QBEX NERC-Defra strategic research project

QBEX Team: Steve Cotterell, Nick Humphries, Julian Metcalfe, Serena Wright, Mike Bell, Brendan Godley, Matt Witt, Tony Bicknell, Dan Conley, Mel Austen, Caroline Hattam, Liam Faisey





What overlap is there between fish and MREIs?

Do fish remain within MREI areas?

Do they move away then return?

Are they displaced permanently?

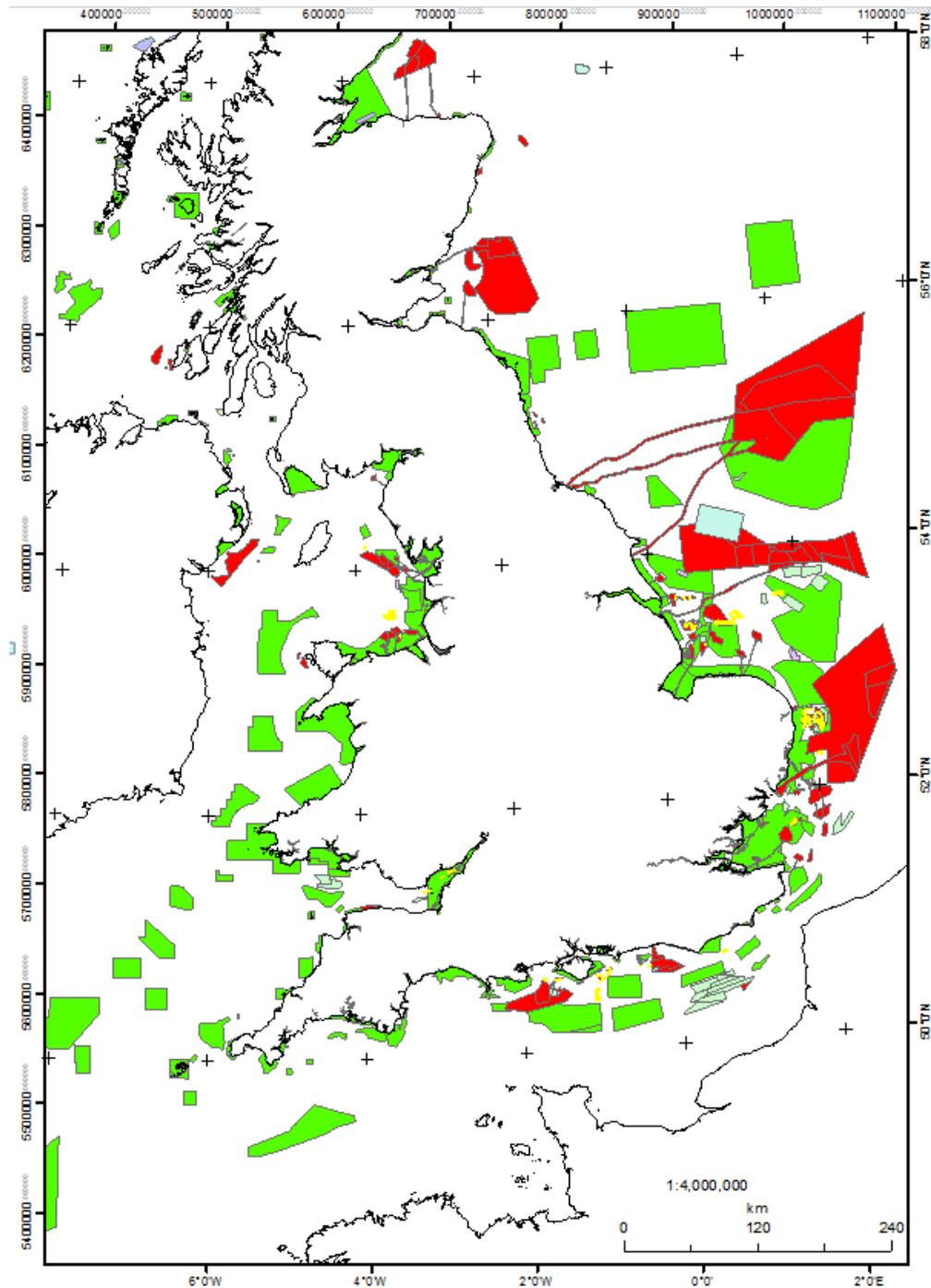
Are migratory routes affected?

Do they aggregate in preferred habitat of reduced area?

Are they more vulnerable to spatially focused fisheries?



Conservation zones
Energy extraction
Aggregate extraction
Aggregate pending
.....

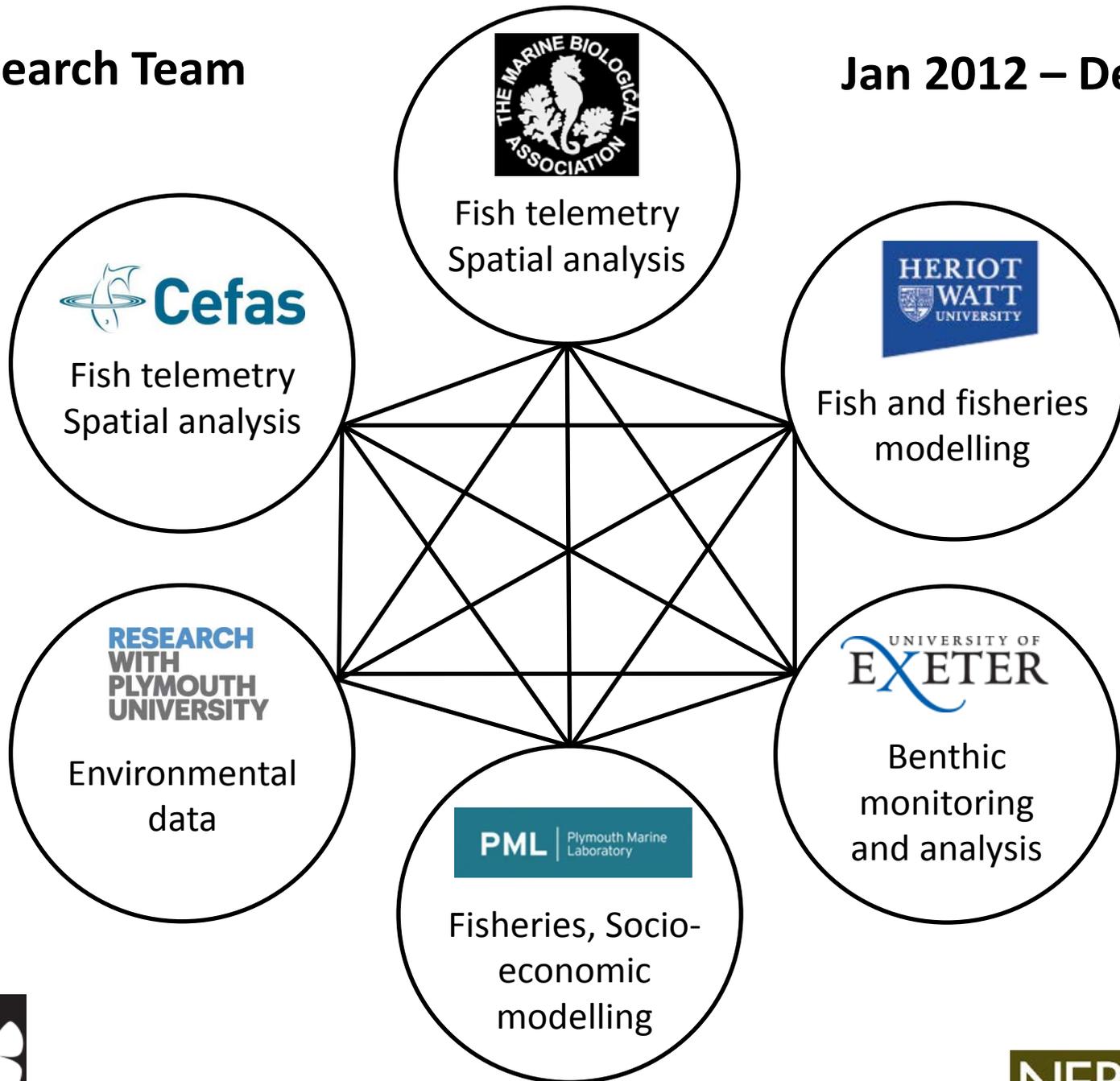


Focus of research:

- Use novel tracking technologies to determine fish spatial movements across broad spatio-temporal scales (metres to 100s of km, and minutes to years)
- Quantify tracked fish interactions with MREIs
- Before-and-after: determine whether installations have affected fish migration routes and space use patterns
- Model potential impacts of MREIs on fisheries

Research Team

Jan 2012 – Dec 2015

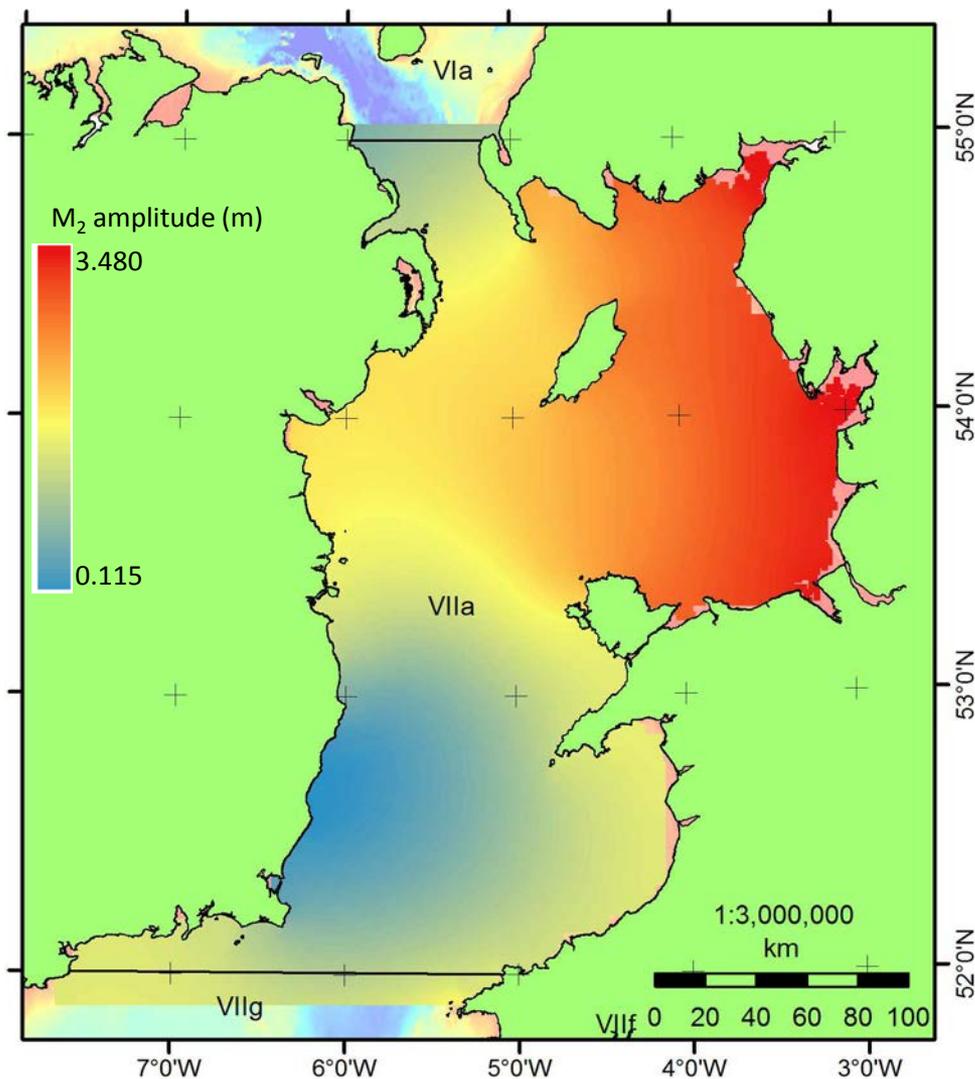


- Tag large numbers of fish with long-term acoustic or archival tags
- Reconstruct paths using new modifications to tidal geolocation method



340 electronic tags deployed in Irish Sea, Celtic Sea, southern North Sea





- Methodological improvements to Tidal Geolocation Model (TGM)
- Down to 1 km spatial resolution (from 12 km)

Model matches tidal pattern in tag depth data with geographical domain of known tidal composition

2-state hidden Markov model (HMM): work of Pedersen et al. 2008

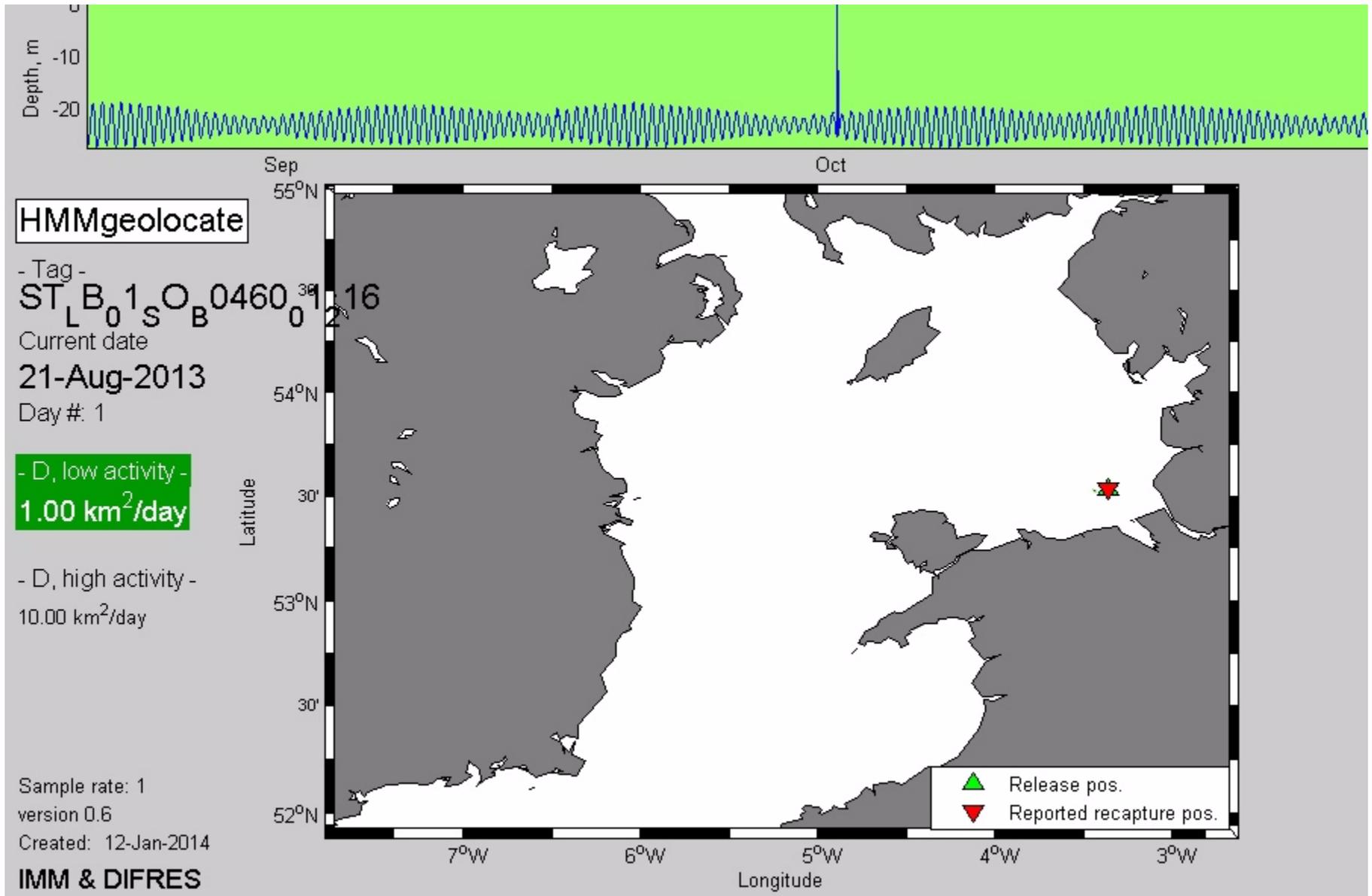
Coverage based on ICES area VIIa (Irish Sea)

1 km grid in UTM30N (cm -5.75°)

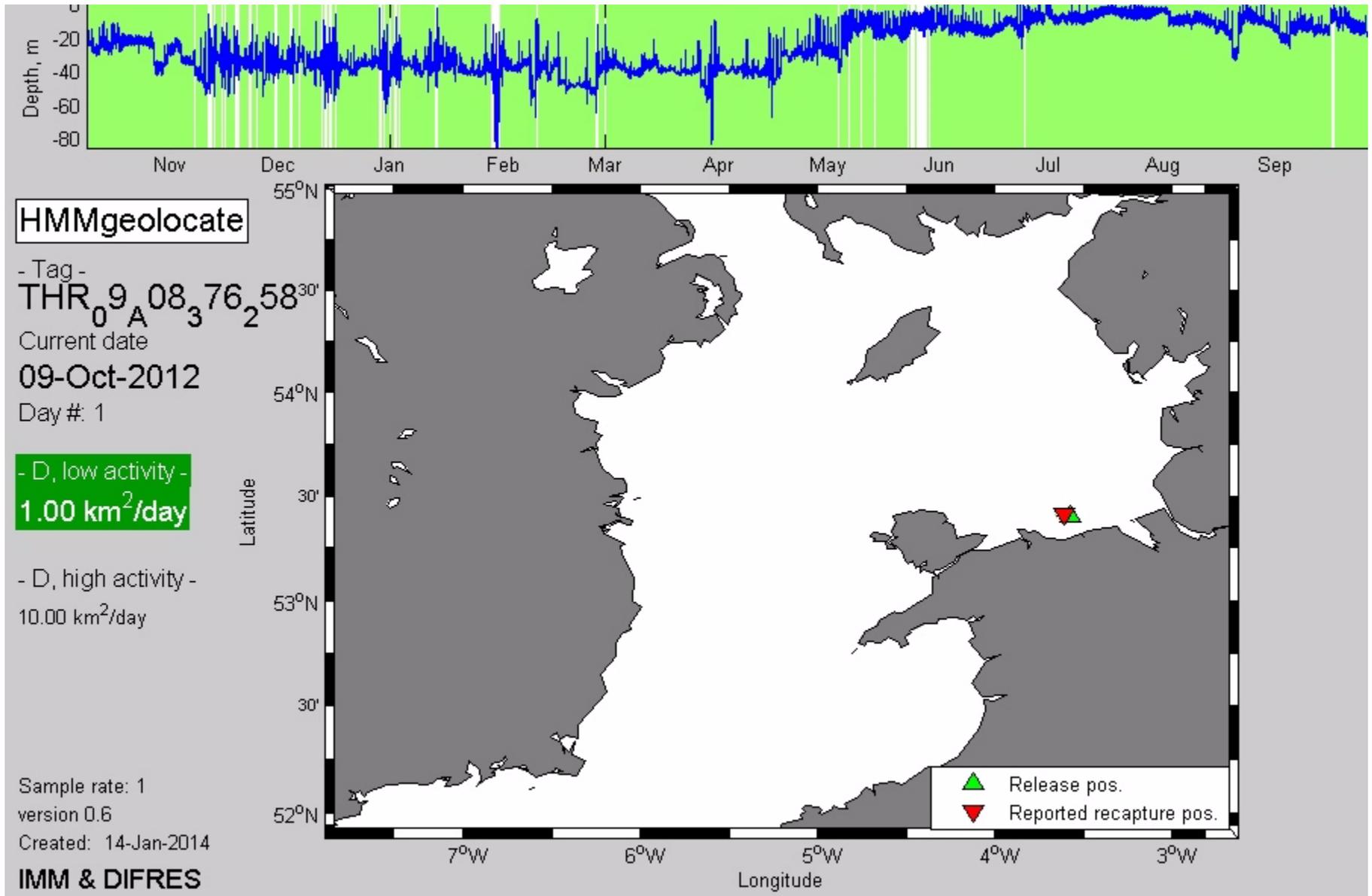
351 rows x 331 columns (116,181 points)

Amplitude and phase values for 11 tidal harmonic constituents for grid from OSU TMD

Tag data from fixed mooring confirms model performance

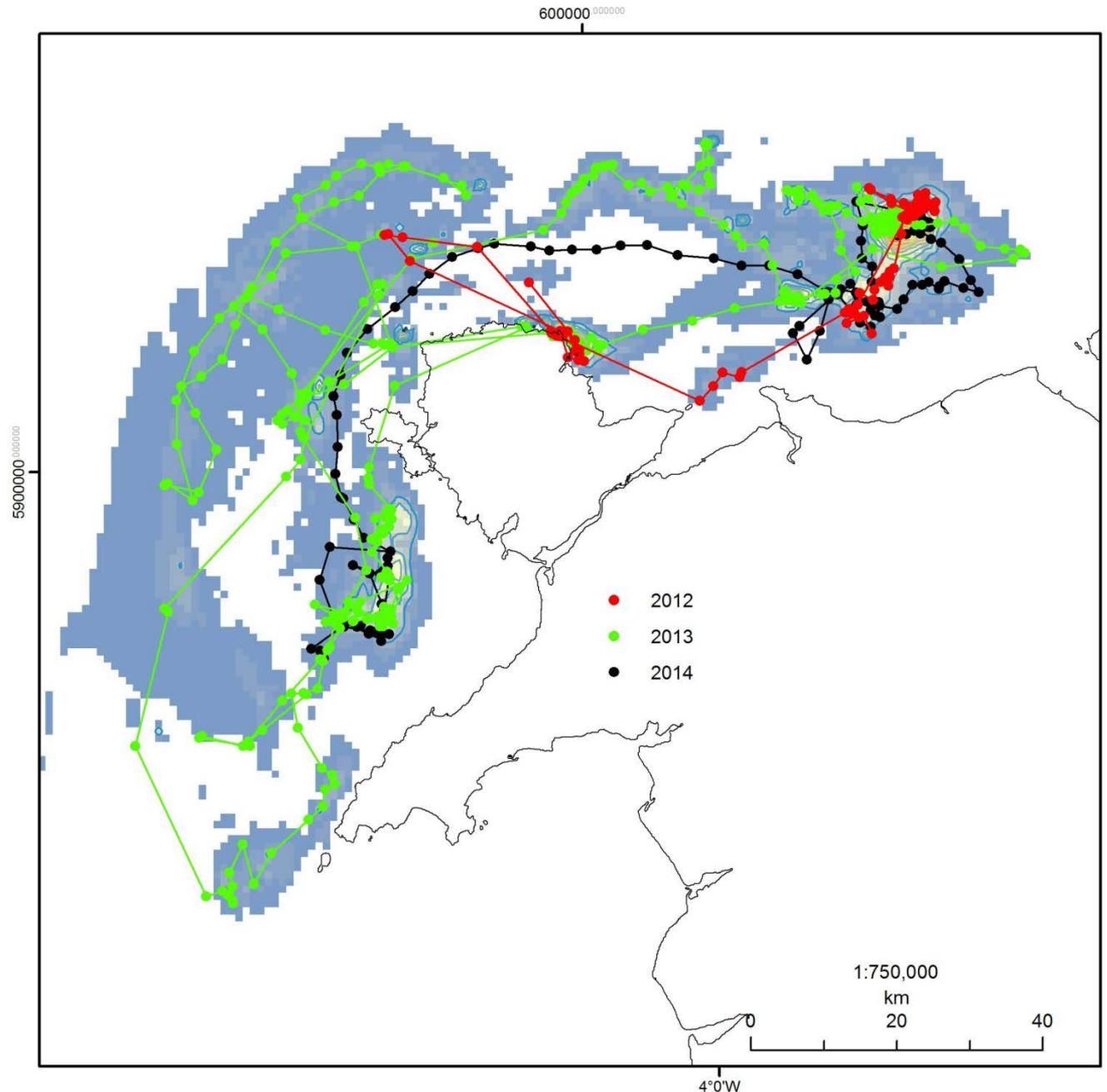


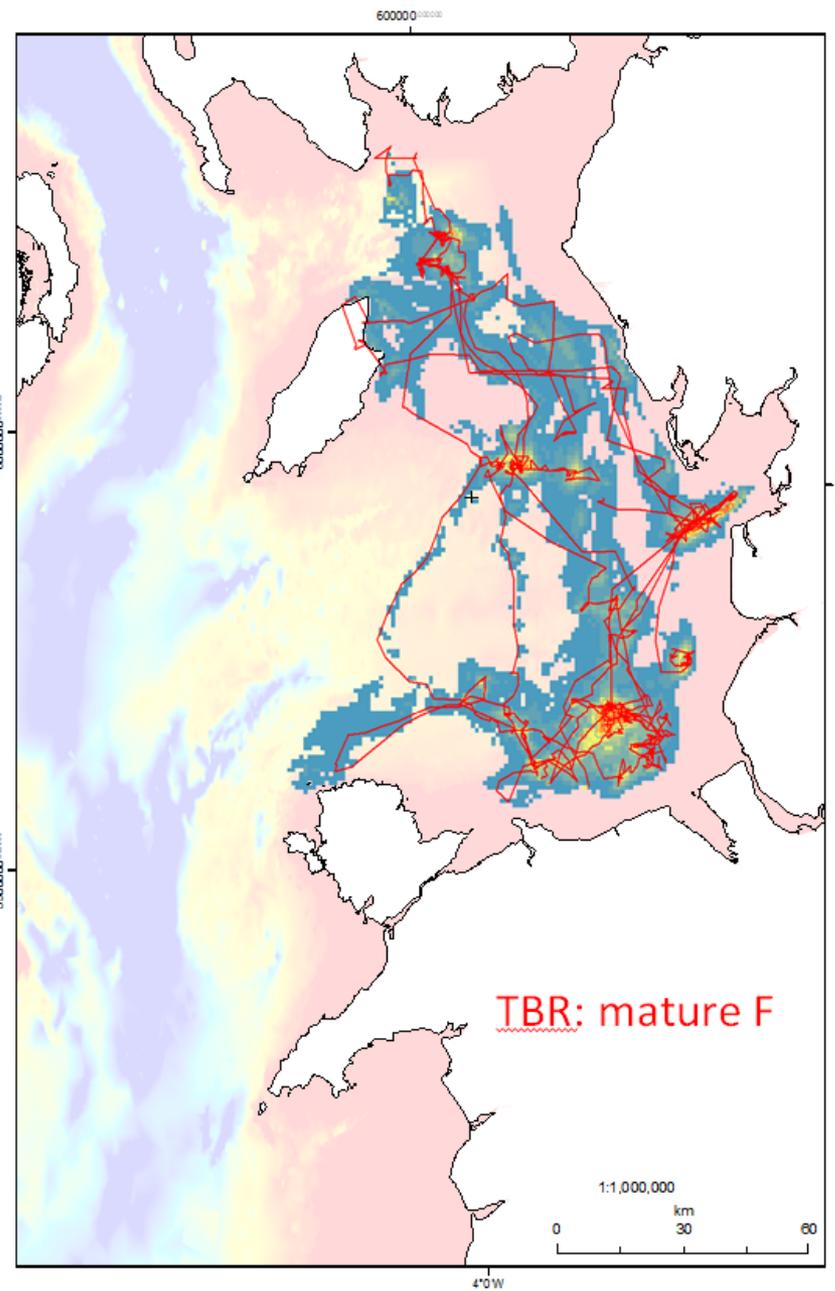
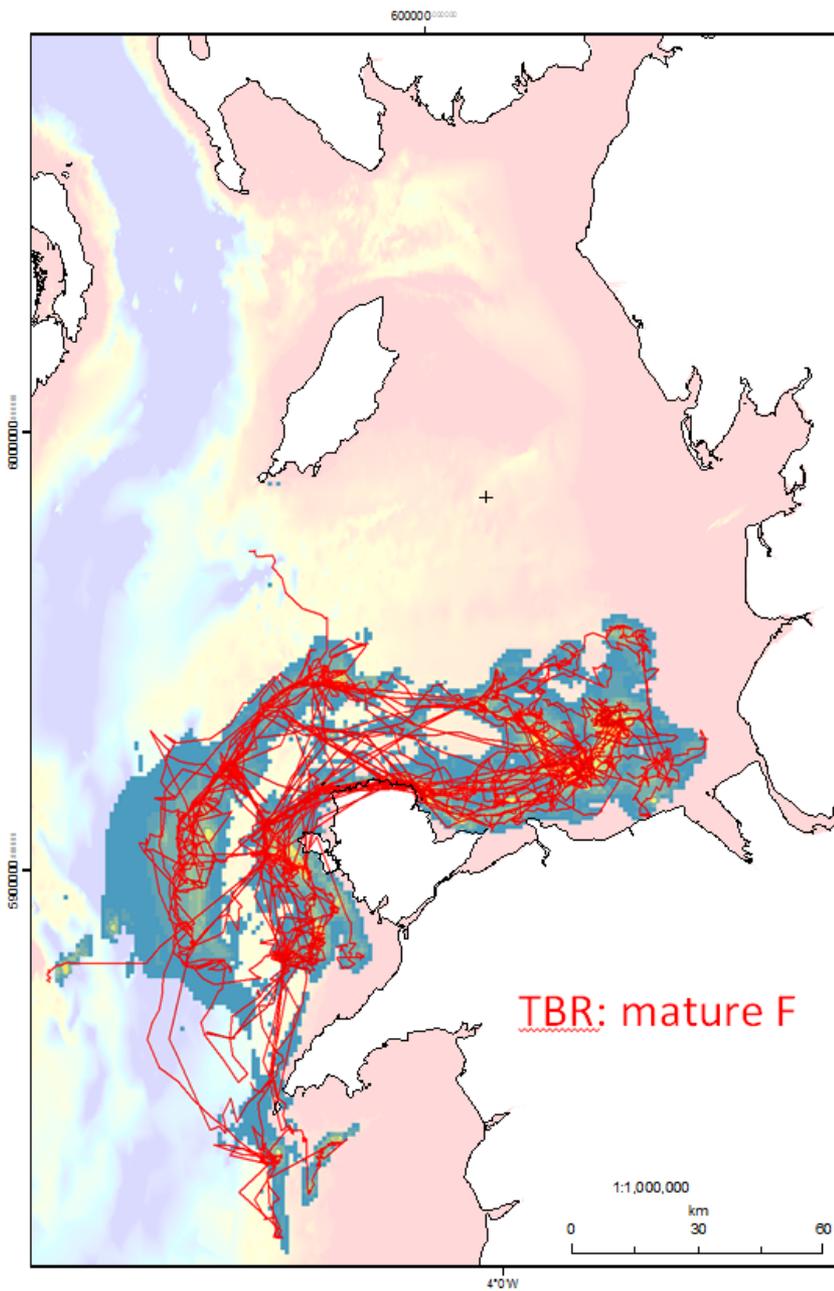
Movements of female thornback ray tagged near North Hoyle wind farm

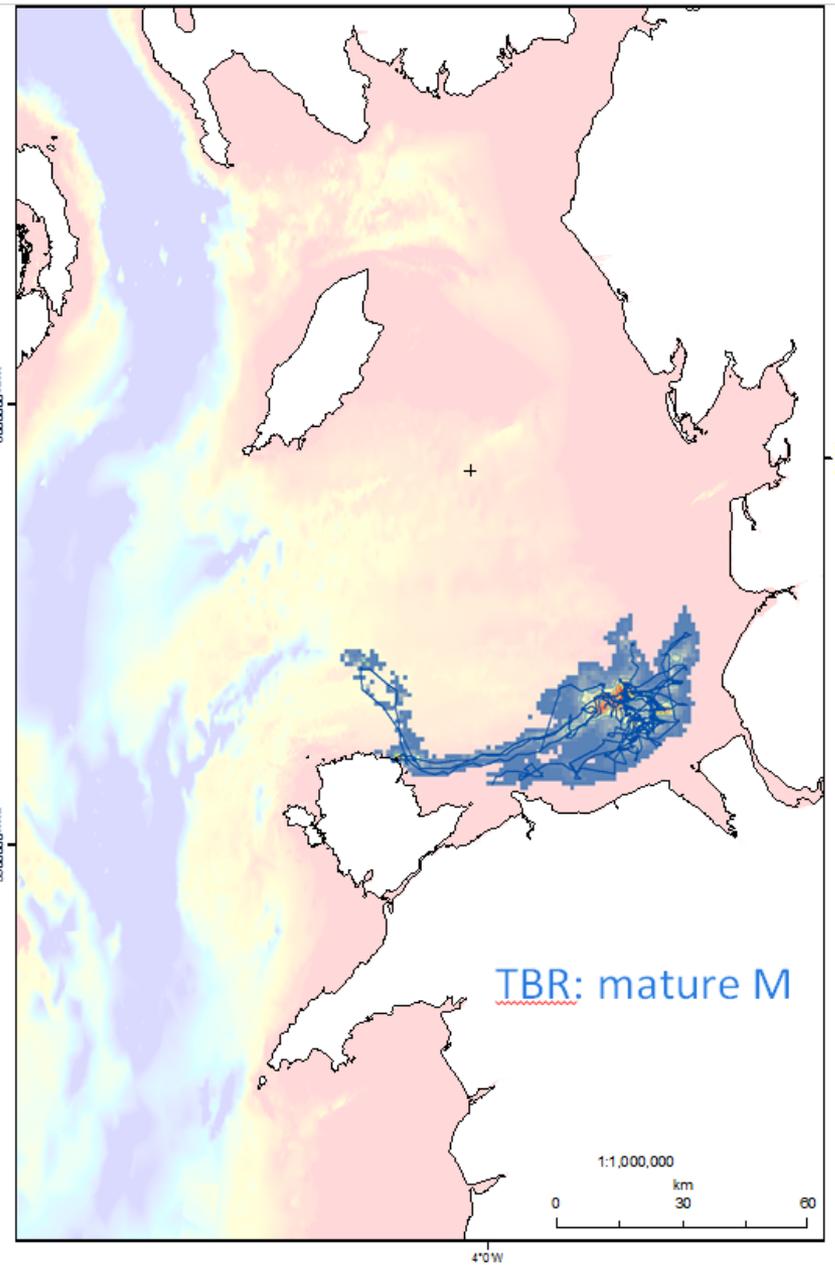
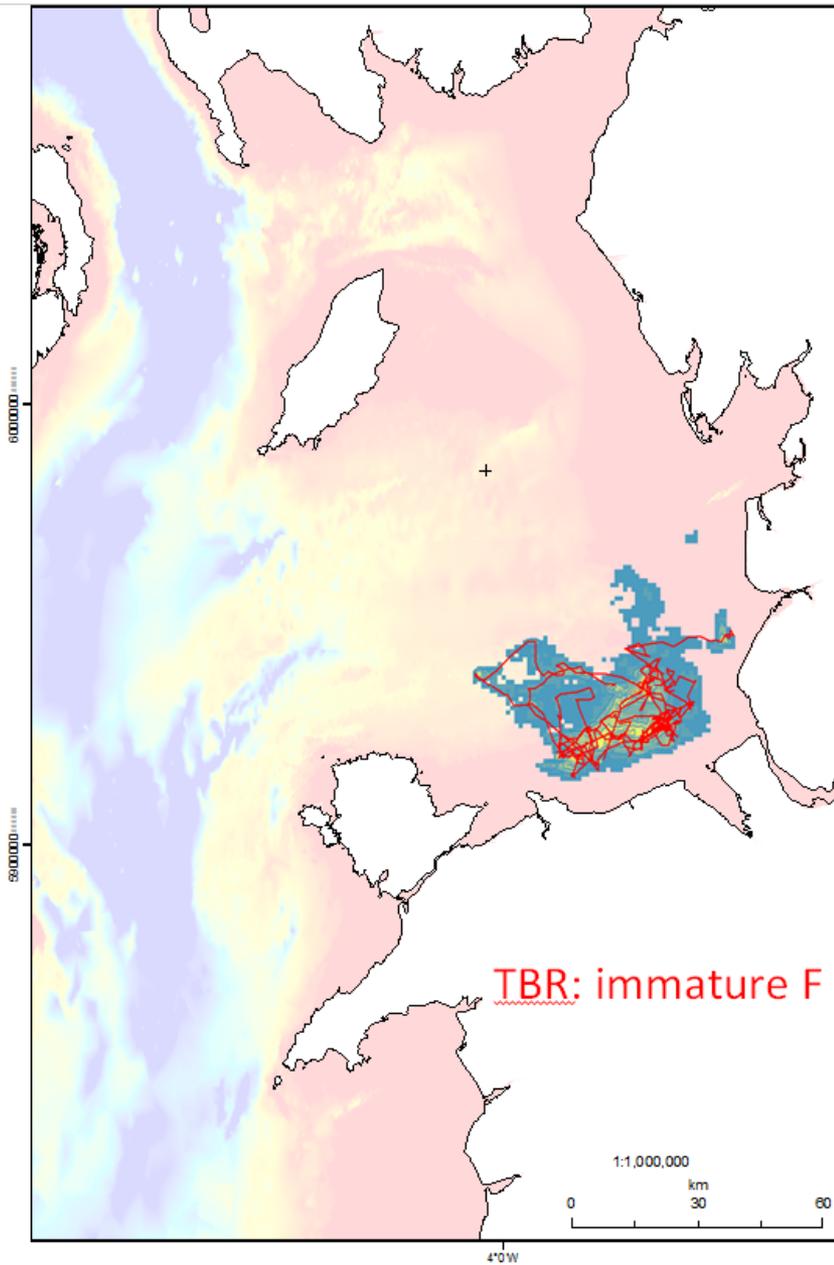


Two year track:

- two winter migrations to the west
- fidelity to summer grounds





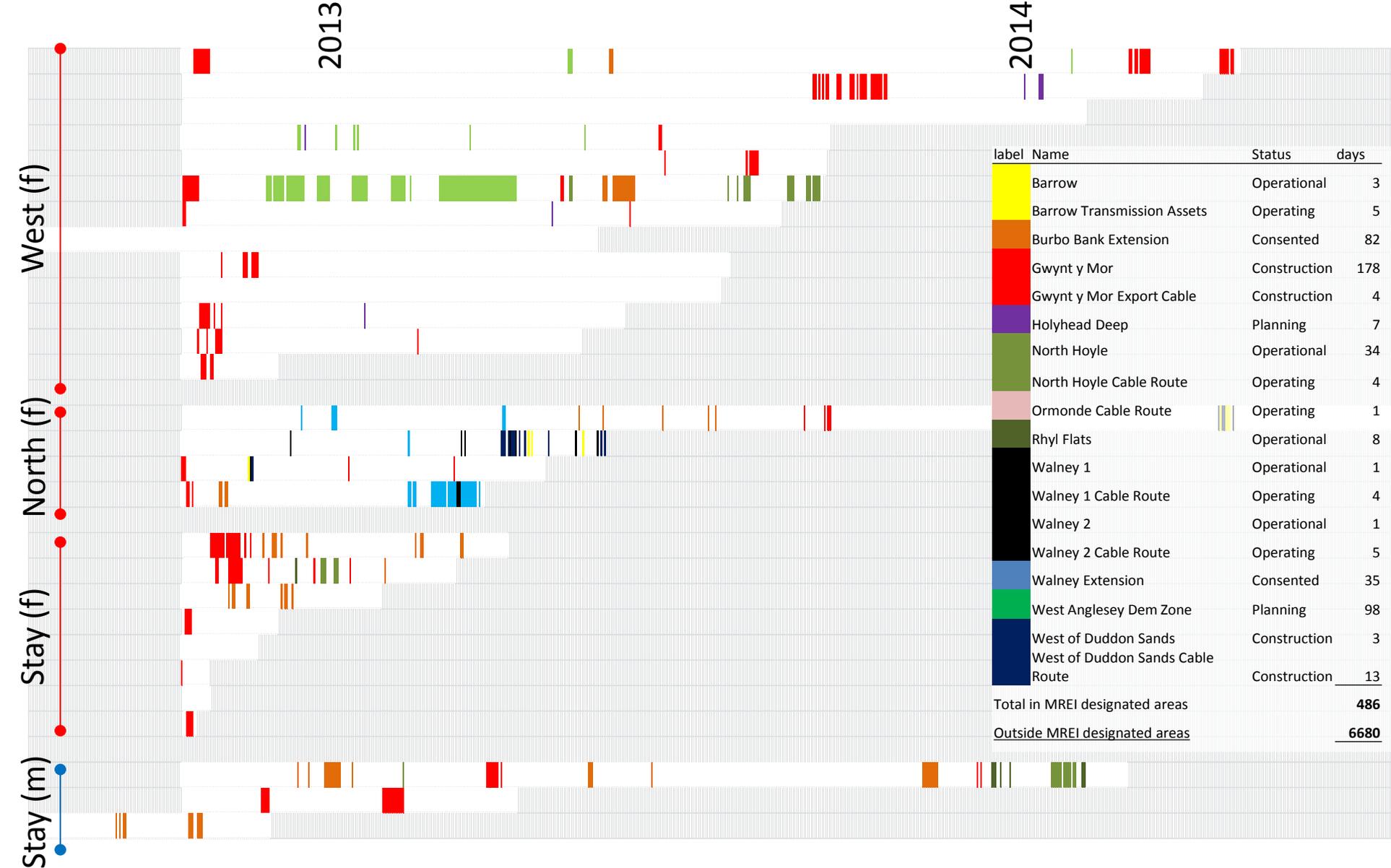




Spatial/temporal overlap

Can quantify spatial and temporal overlap of fish and MREIs (operational, under construction and planned)

Interaction with MREIs (operating and other)



6.7 % of geolocated days ($n = 7166$) within 18 different MREI areas

Before-and-after study: Uses Cefas Data Archive along with new tagging

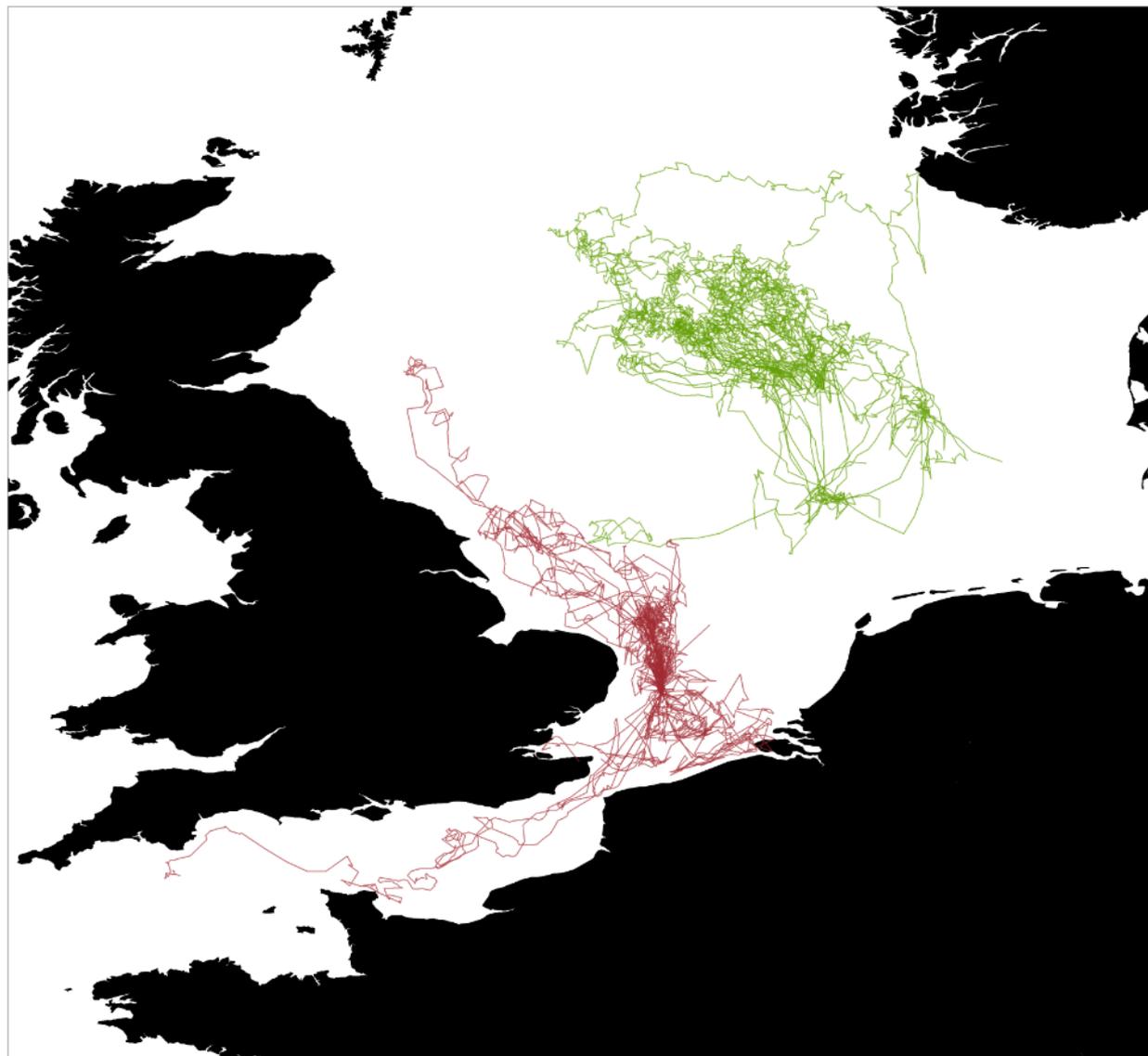
Example tracks

Plaice

2004-05

Deployment 1

Deployment 2

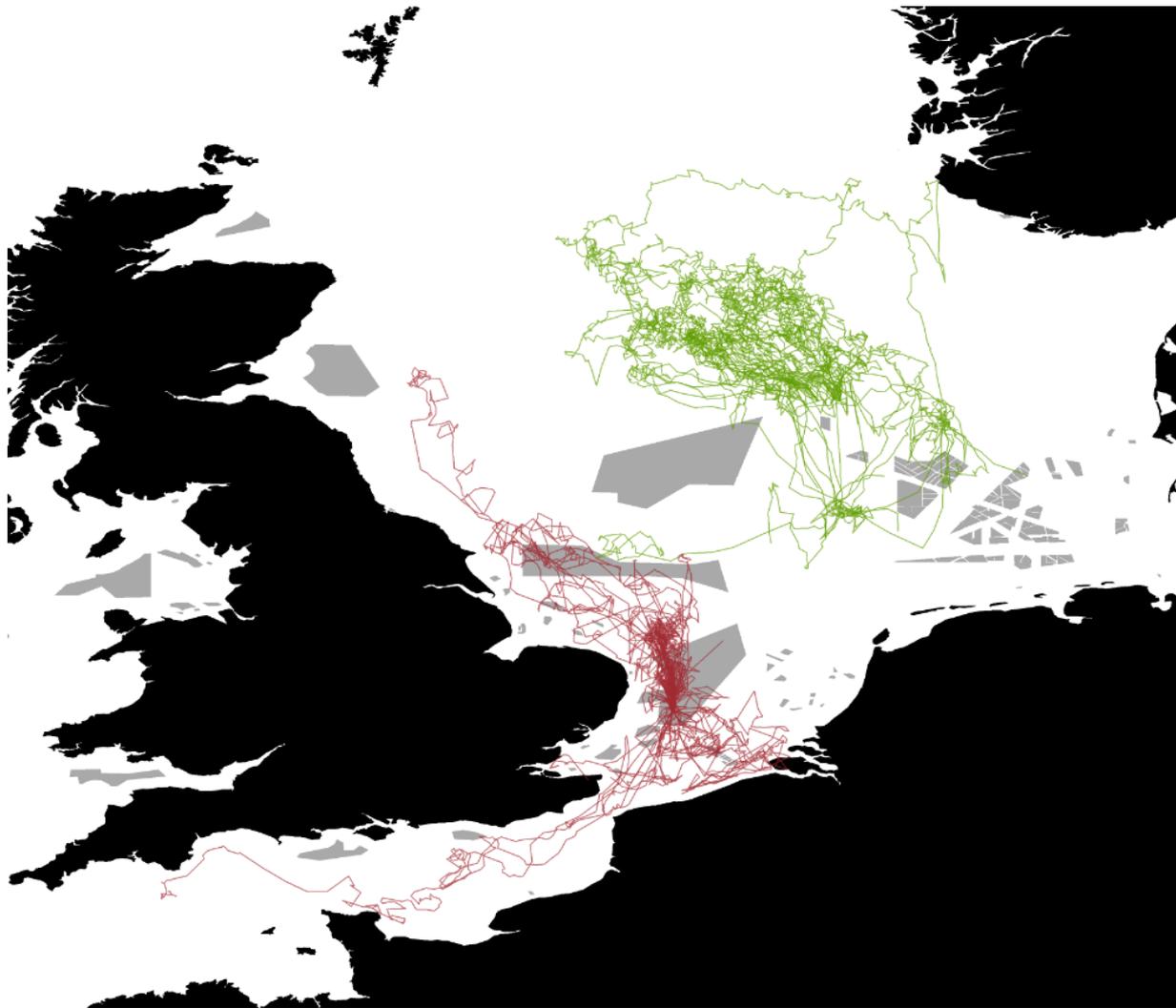


Cefas archive

includes:

Thornback ray

Cod



Example tracks

Plaice

2004-05

Deployment 1

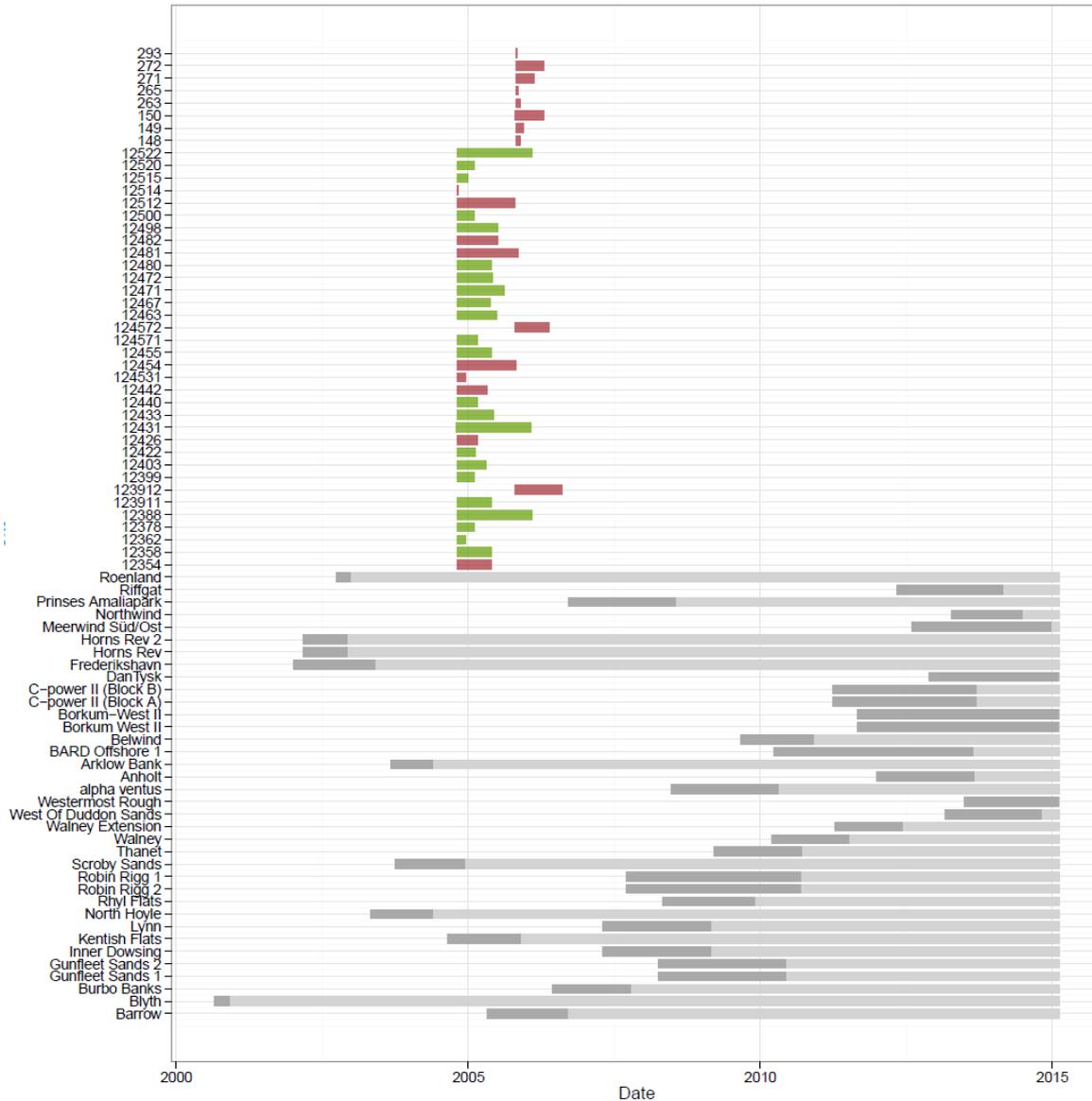
Deployment 2

Windfarm locn

Timeline of fish tracks vs windfarm construction and operation phases

Individual fish

Windfarm location



New tagging 2014-2015

compare with



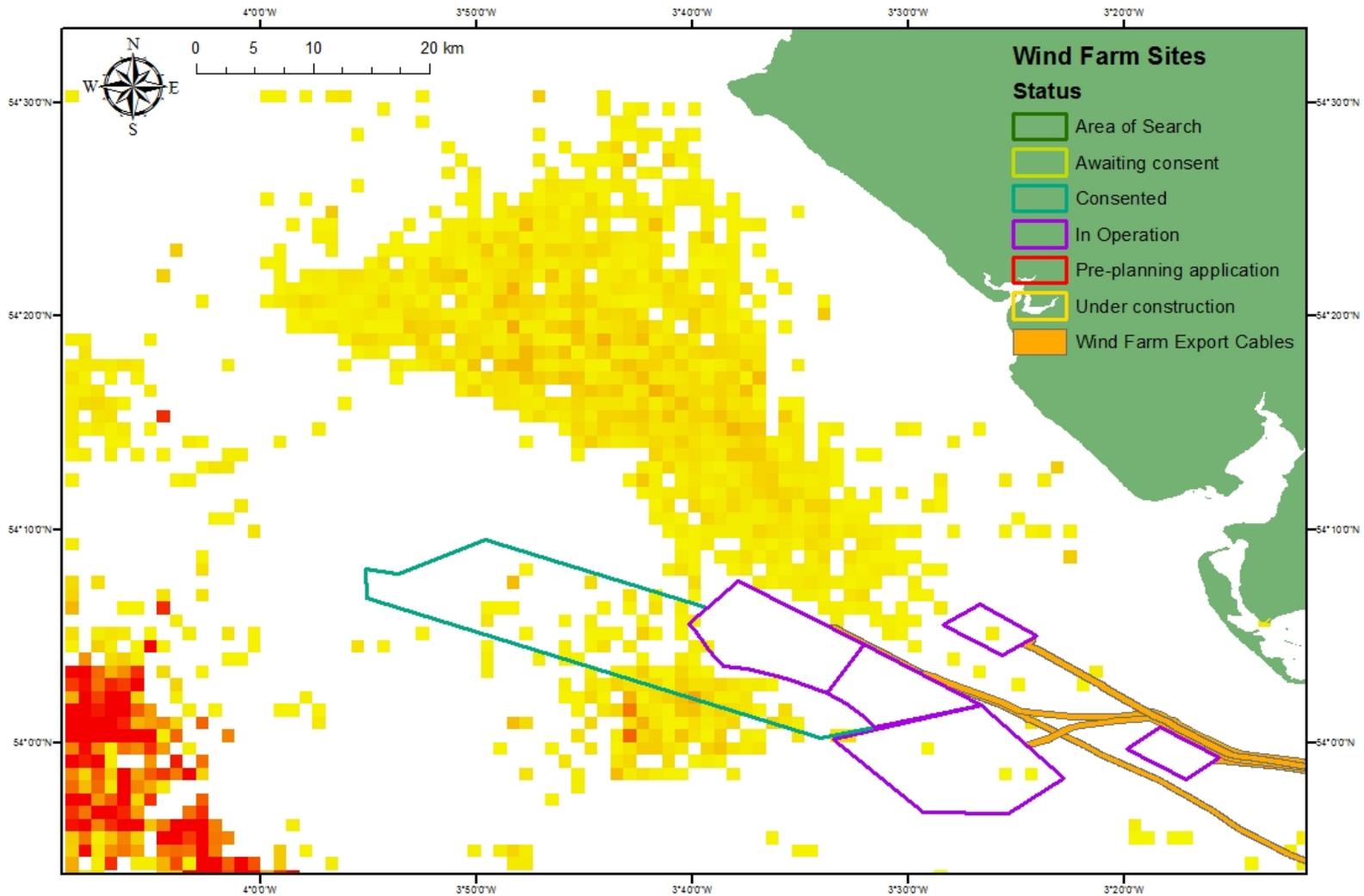
2005-2009



1999-2004



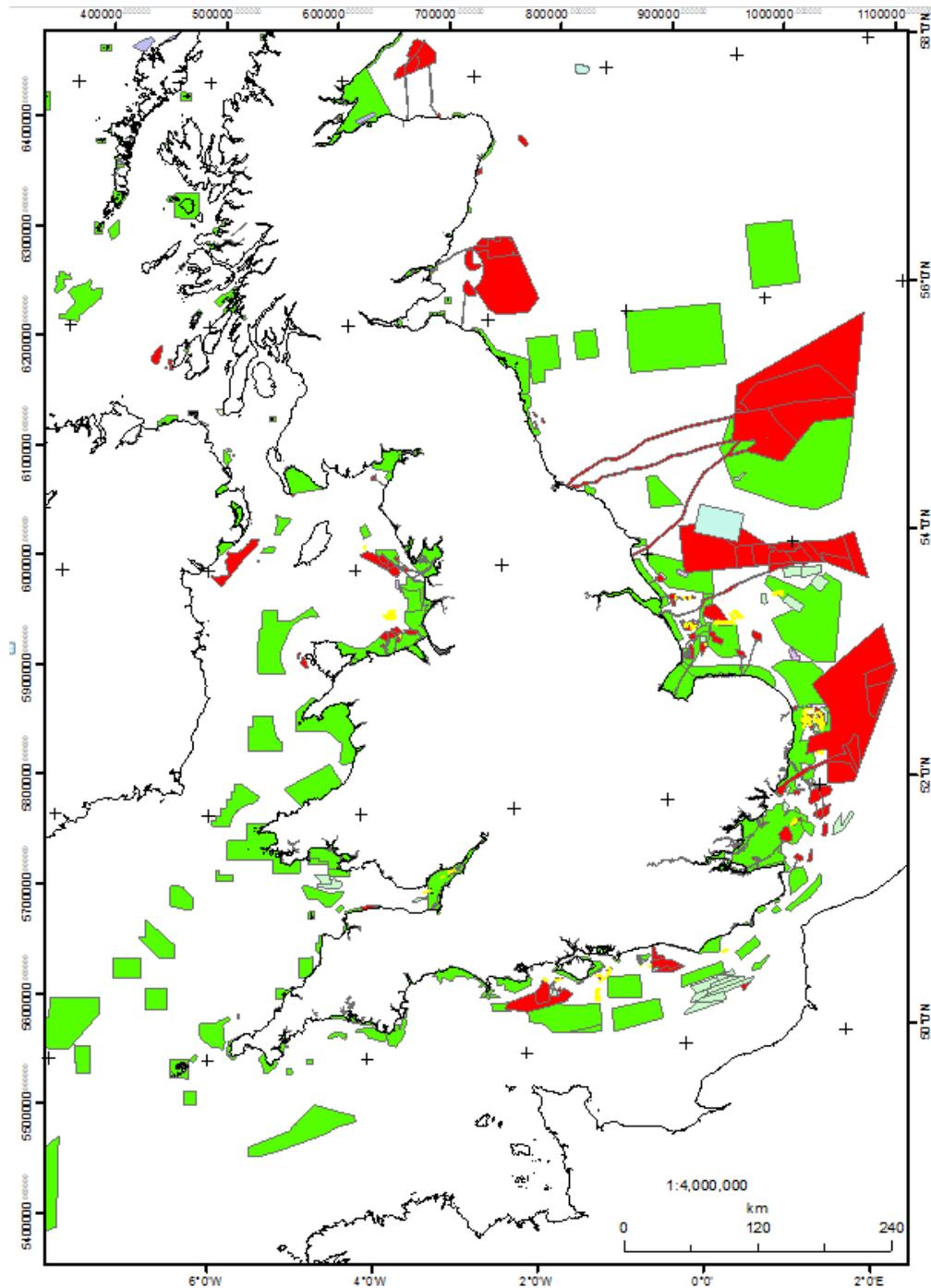
MREIs and fisheries



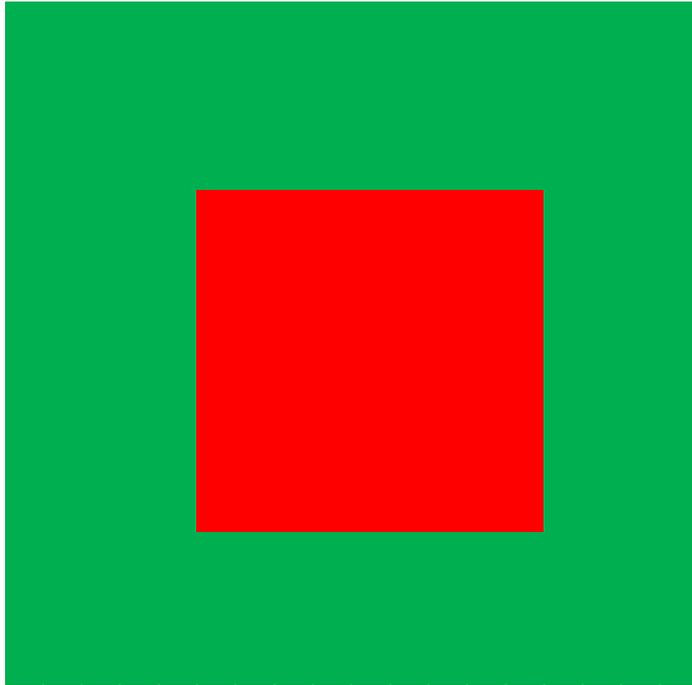
Vessel Monitoring System (VMS) data showing displacement and reduction in landings (value) per grid cell (2008-2012)

Data: MMO

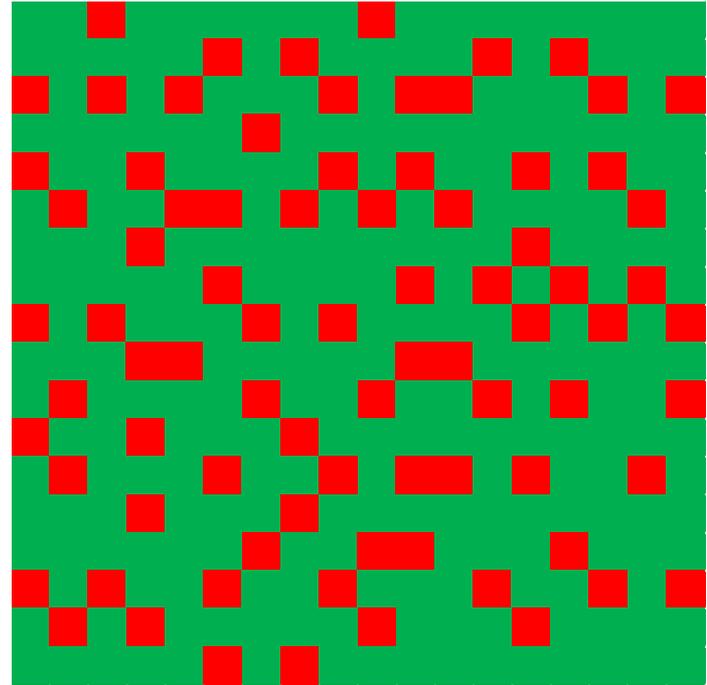
Conservation zones
Energy extraction
Aggregate extraction
Aggregate pending
.....



Simulating the effects of closed area design

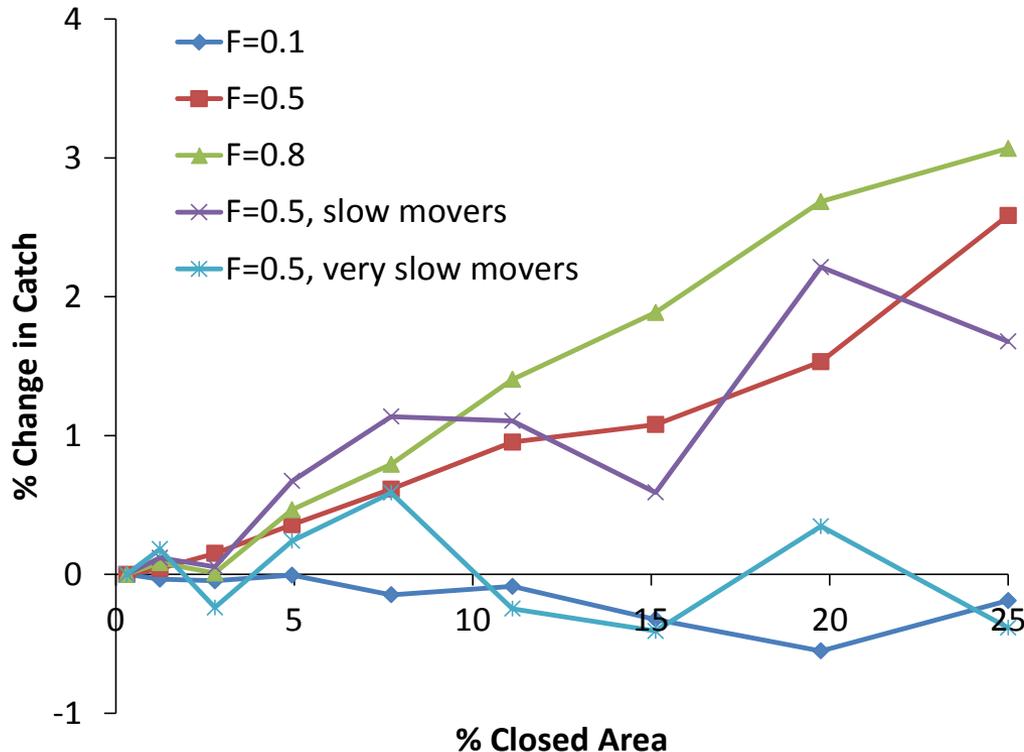


25% closure, single area



25% closure, multiple areas

Change in catch owing to dividing the total closure into multiple small areas



- Dividing the closure up has most effect at high fishing pressures
- Multiple areas have the same effect as one single area only if fish movements are very limited in spatial scale

Conclusions

Telemetry

- Improved tidal geolocation method allows finer scale tracking of bottom-dwelling fish
- Tracked migratory fish returned to preferred habitats in vicinity of windfarms
- Certain sex and/or age classes remain on grounds year-round
- Can quantify time spent within and adjacent to MREIs (and other areas)
- Shows potential of before-and-after tracking to assess impacts
- Demonstrated potential of VMS for assessing cost (and social) impacts

Telemetry data driven fishery simulations

- Small closures (<10% of ground), little effect on catches, may even enhance them
- Higher levels of closure, loss of catch slightly higher if fish movements limited
- Closure between multiple areas decreases any loss of catch at higher fishing pressures unless movements very limited in scale

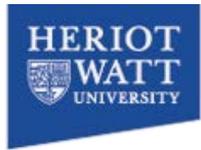
Thanks to  team and the funders  



David Sims (P.I.) – Stephen Cotterell – Nick Humphries – Liam Faisey



Julian Metcalfe – Serena Wright – Vicky Bendall



Mike Bell – Jonathan Side



Brendan Godley – Matt Witt – Tony Bicknell



Dan Conley



Mel Austen – Caroline Hattam