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Empirical data versus expert opinion and environmental impact assessment– a case study of twaite shad (*Alosa fallax*) migration in the Bristol Channel

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Why look at twaite shad and the Bristol channel?

- 2nd highest tidal range in the world -> MRE opportunity
- Tidal energy feasibilities (2010) highlighted risks
- 4 recognised UK spawning populations
- Protected in the Severn Estuary & surrounding rivers
- Key EIA/HRA consenting risk and topical issue for marine energy developments
- Anadromous - adults enter river and spawn April-June, multiple spawners
- Extensive 6 yr tracking dataset (290 tagged emigrants) – real data to compare with expert opinion

HM Government
Department of Energy and Climate Change

South West RDA

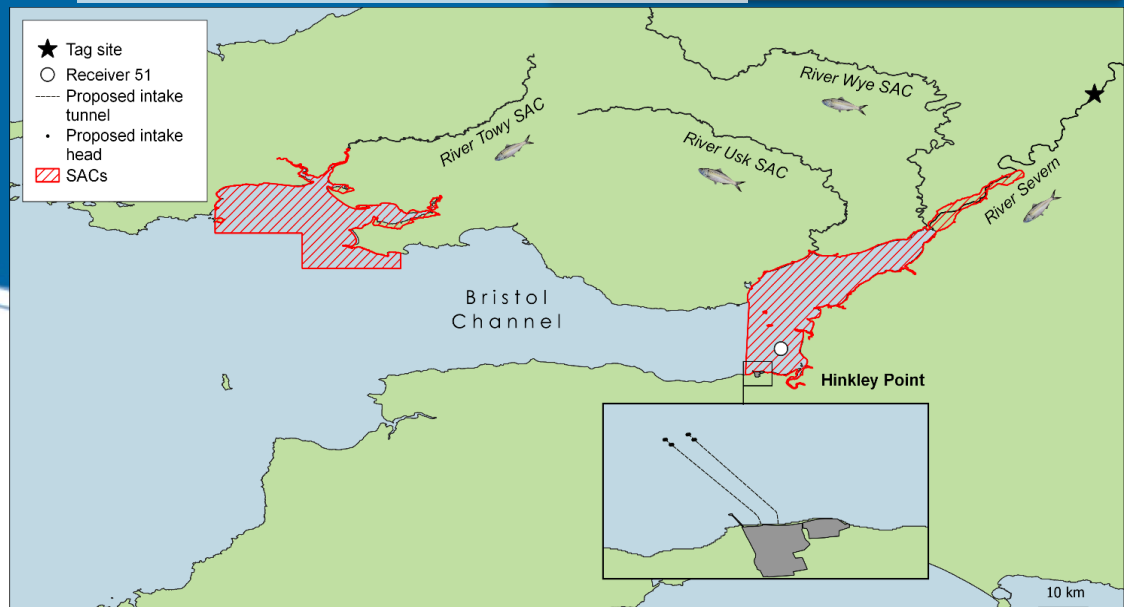
Llywodraeth Cymru
Welsh Assembly Government

Swansea Bay

SEVERN TIDAL POWER

Feasibility Study Conclusions and Summary Report

*"fish are likely to be severely affected with **local extinctions and population collapses predicted** for designated fish, including Atlantic salmon and twaite shad. This could mean the **loss of twaite shad as a breeding species in the UK**"*



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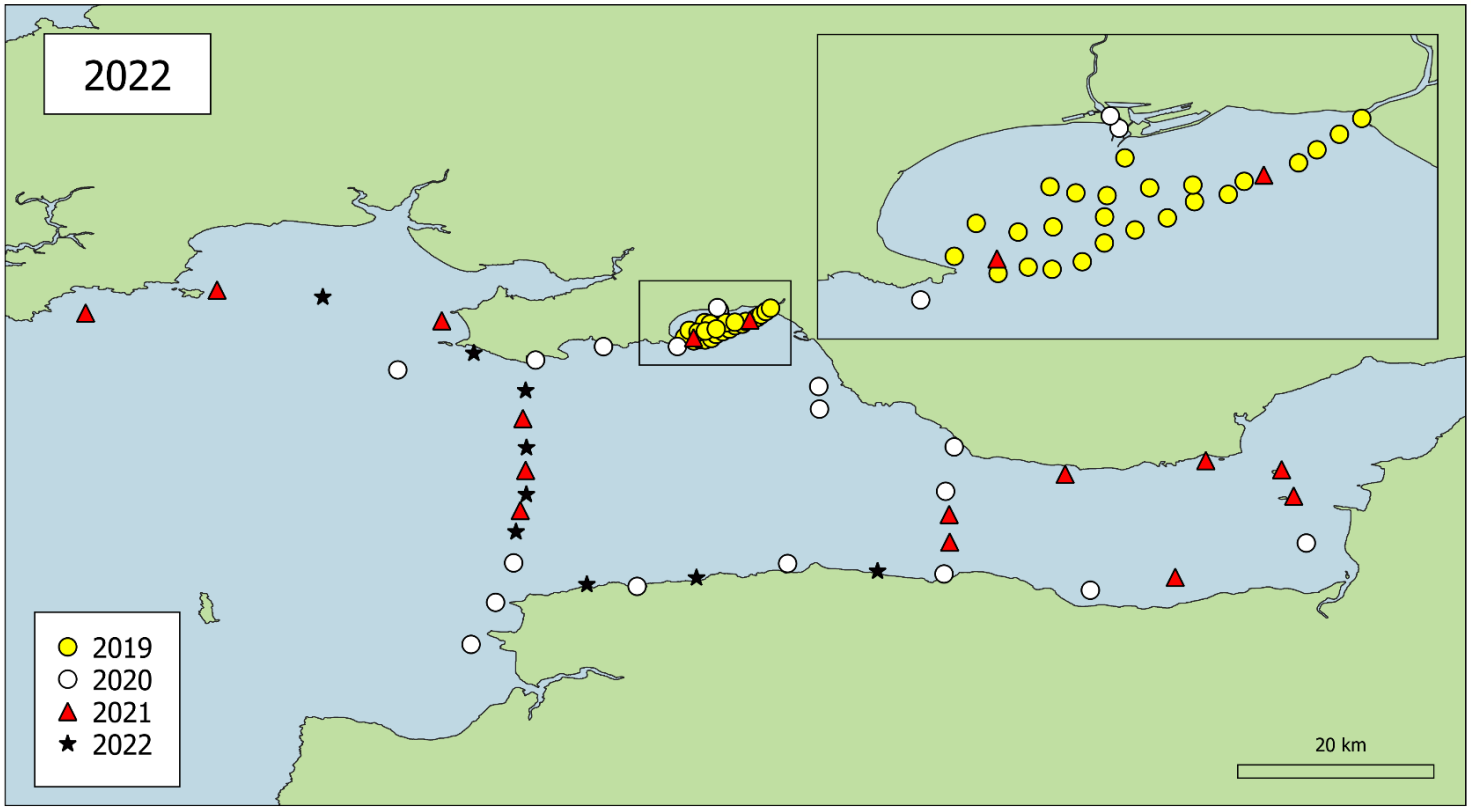
Adult Shad Tagging (UTS)

- Fish acoustically tagged on way up to spawn
- 2.5 year life (2 full seasons at sea)
- Highly reliable receiver station at Stonebench (lower estuary) to detect emigrants

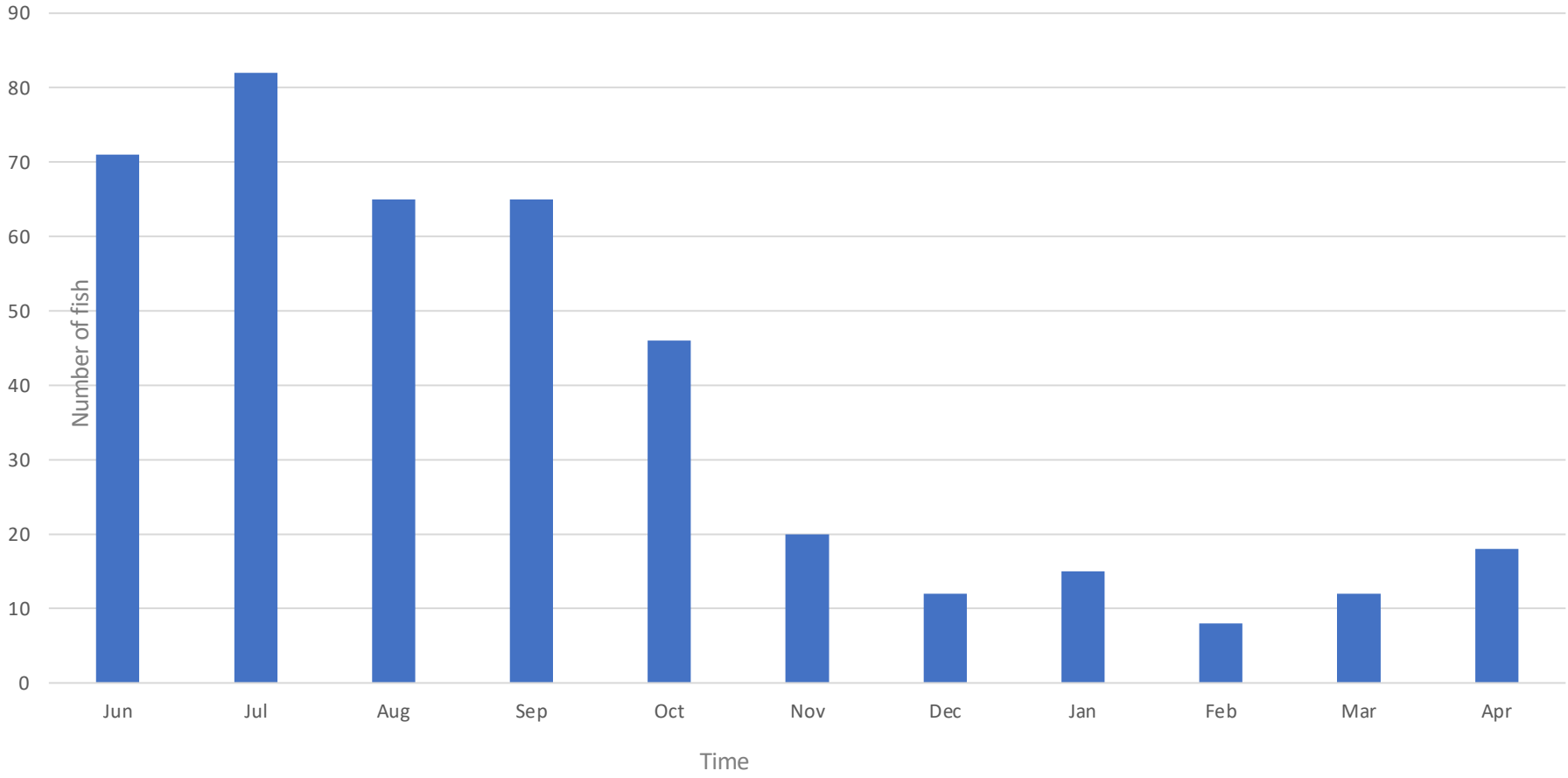
Year	Total tagged	Emigrants
2018	73	58
2019	100	91 (67+24)
2020	0	33(4+29)
2021	47	46 (34+12)
2022	100	62(55+7)
2023	50 (depth sensor)	?
2018-21	370	290+?

Dataset for this presentation based on 4 years data and 232 emigration events (highlighted)

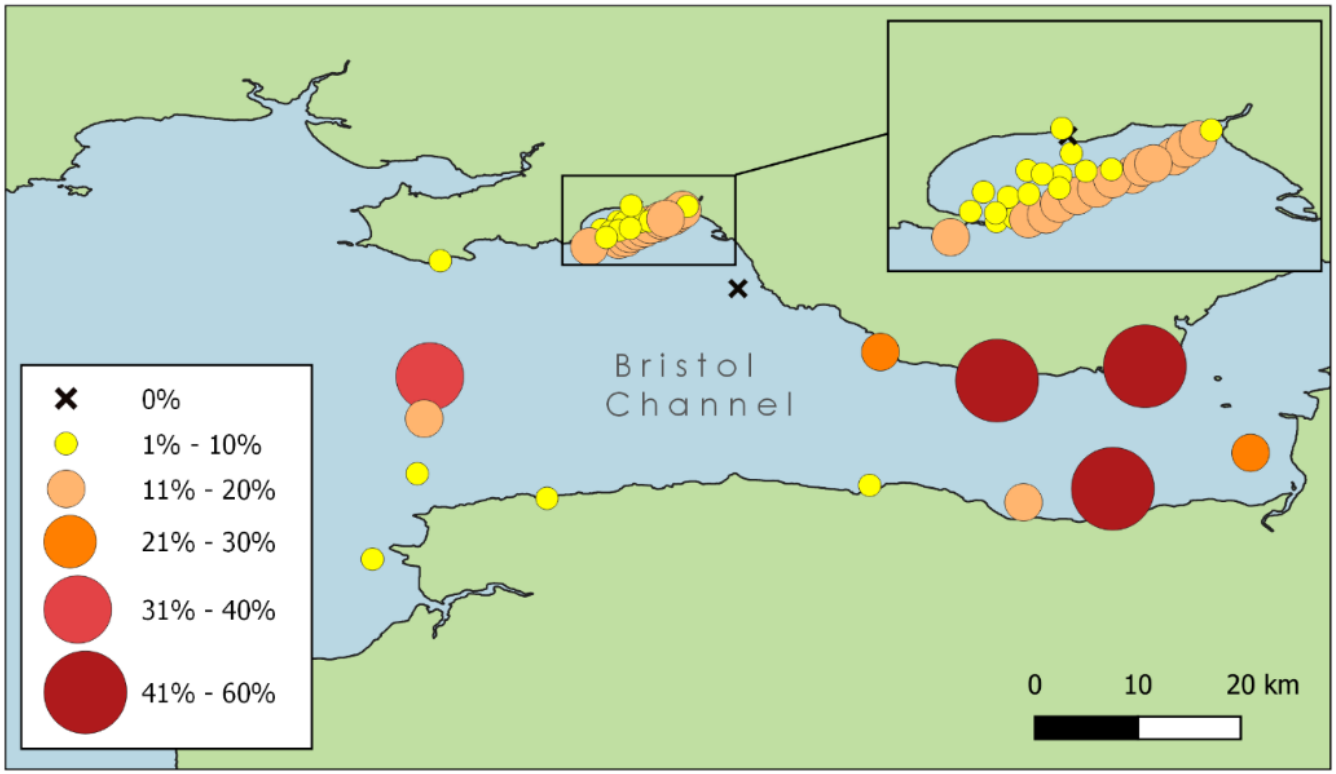
Array in 2022 (Swansea bay inset)



Context : Monthly unique fish detections in the inner Bristol Channel 2019/20-2022/23 combined. n=230 emigrants



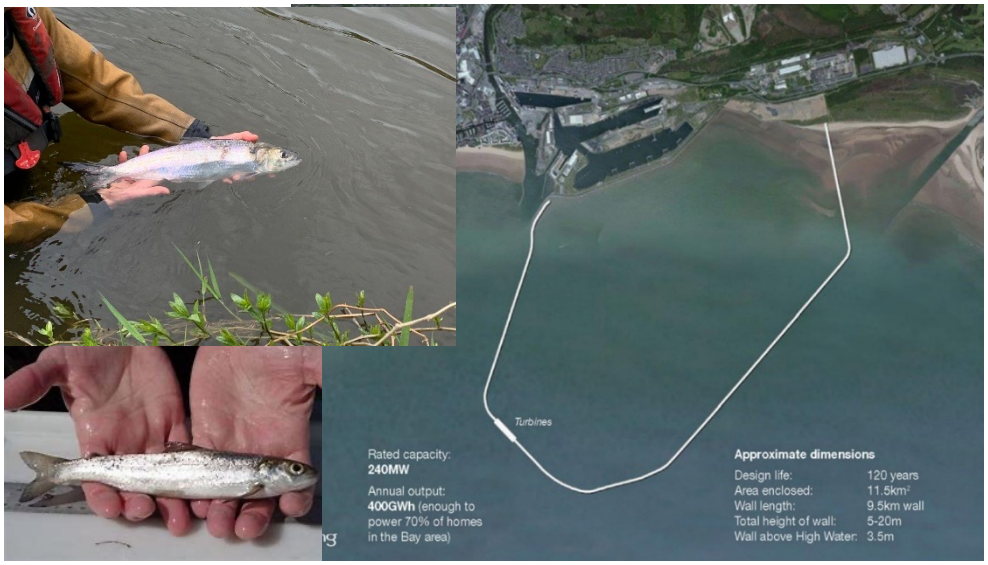
Wider migration (Proportion of tagged fish seen in summer foraging period)



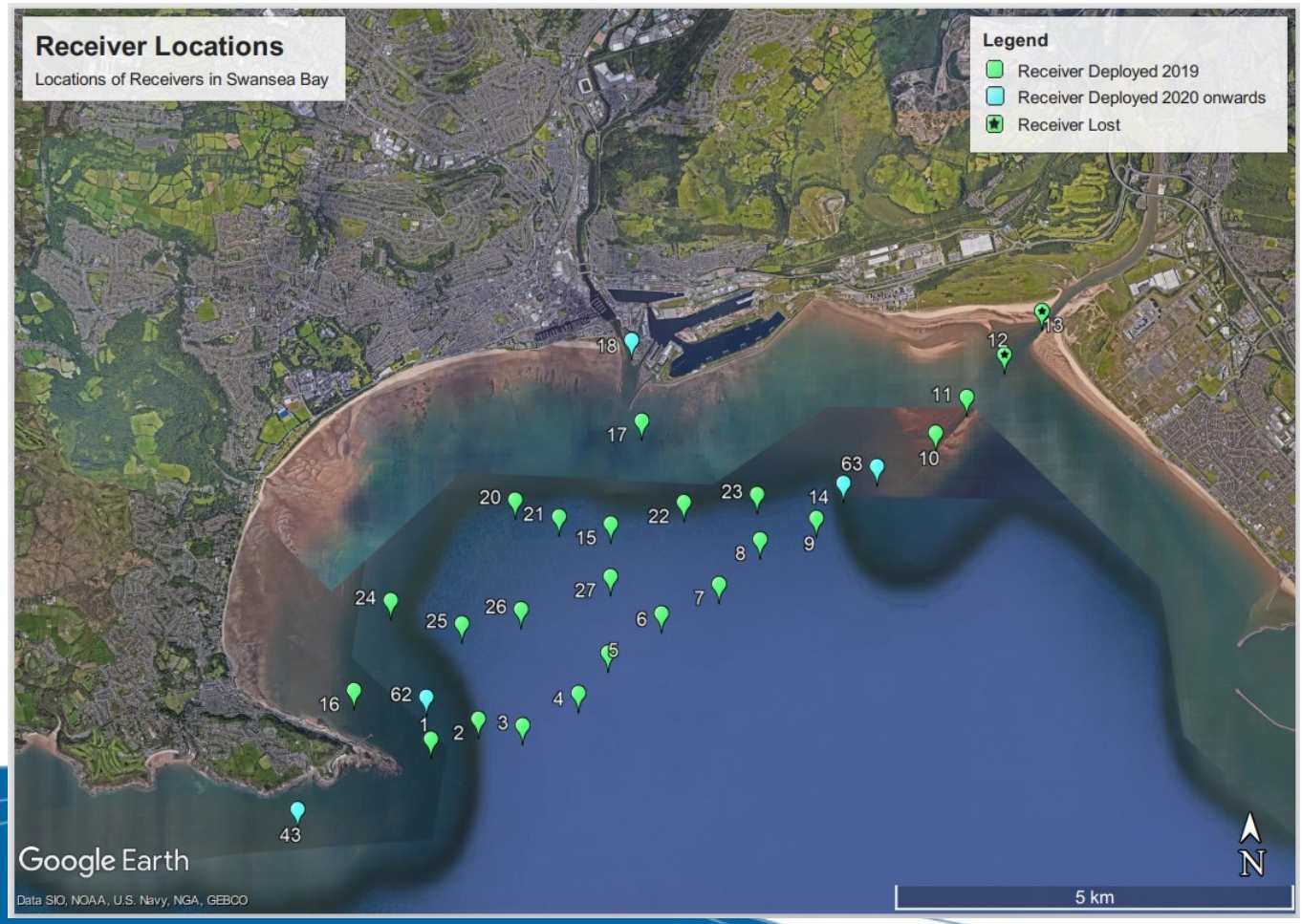
Case study 1– Swansea Bay Tidal Lagoon

Swansea Tidal Range

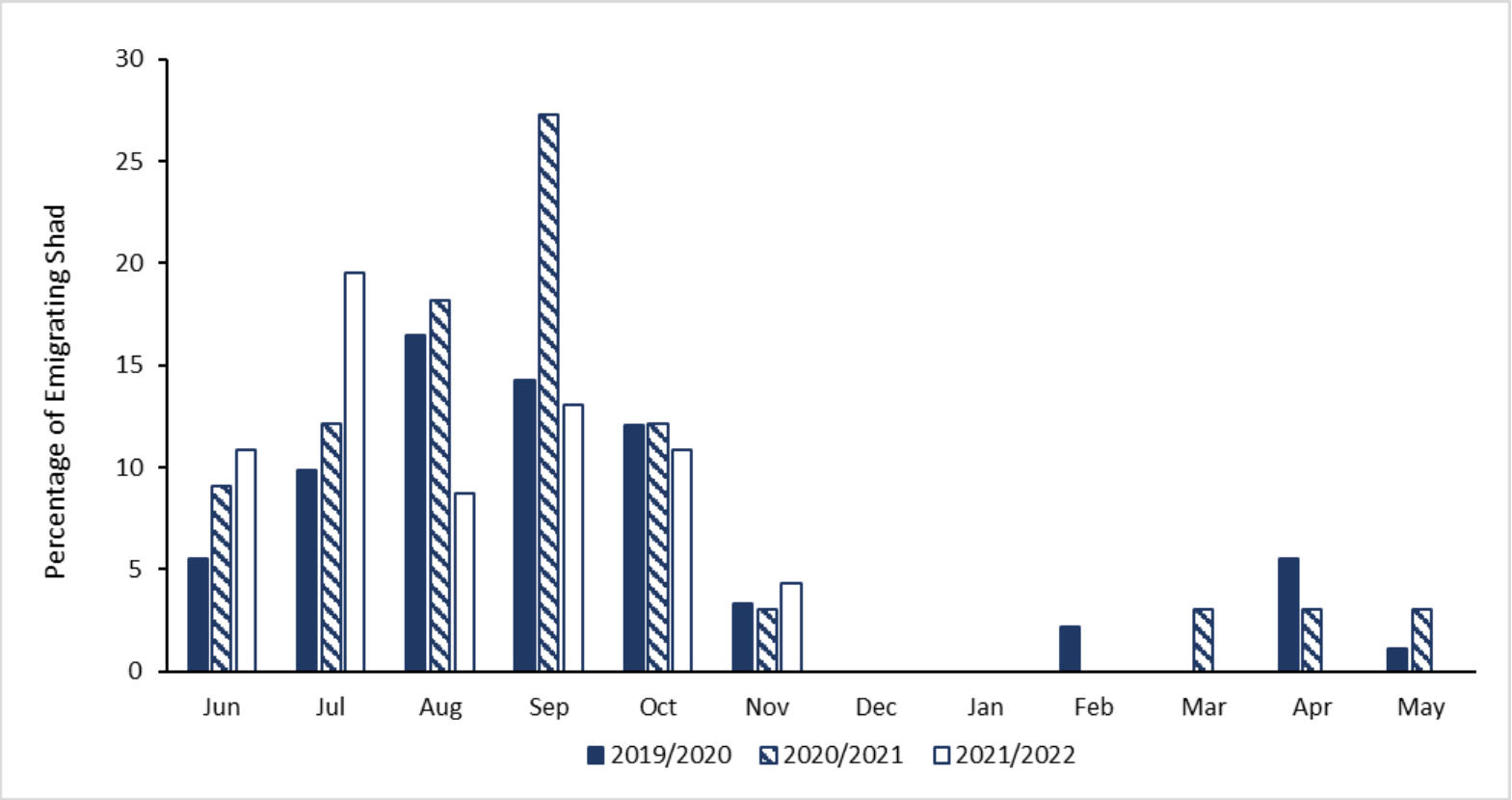
- MRE Tidal range pilot scheme
- Originally promoted by TLP (DCO 2016, now lapsed no marine licence secured)
- Now promoted by DST Innovations Ltd
- Concerns re entrainment / turbine impacts for anadromous species including salmon, sea trout, shad, eels and lamprey
- Case study data from Swansea bay array -> acoustic tracking of twaite shad, sea trout and salmon to quantify exposure risk



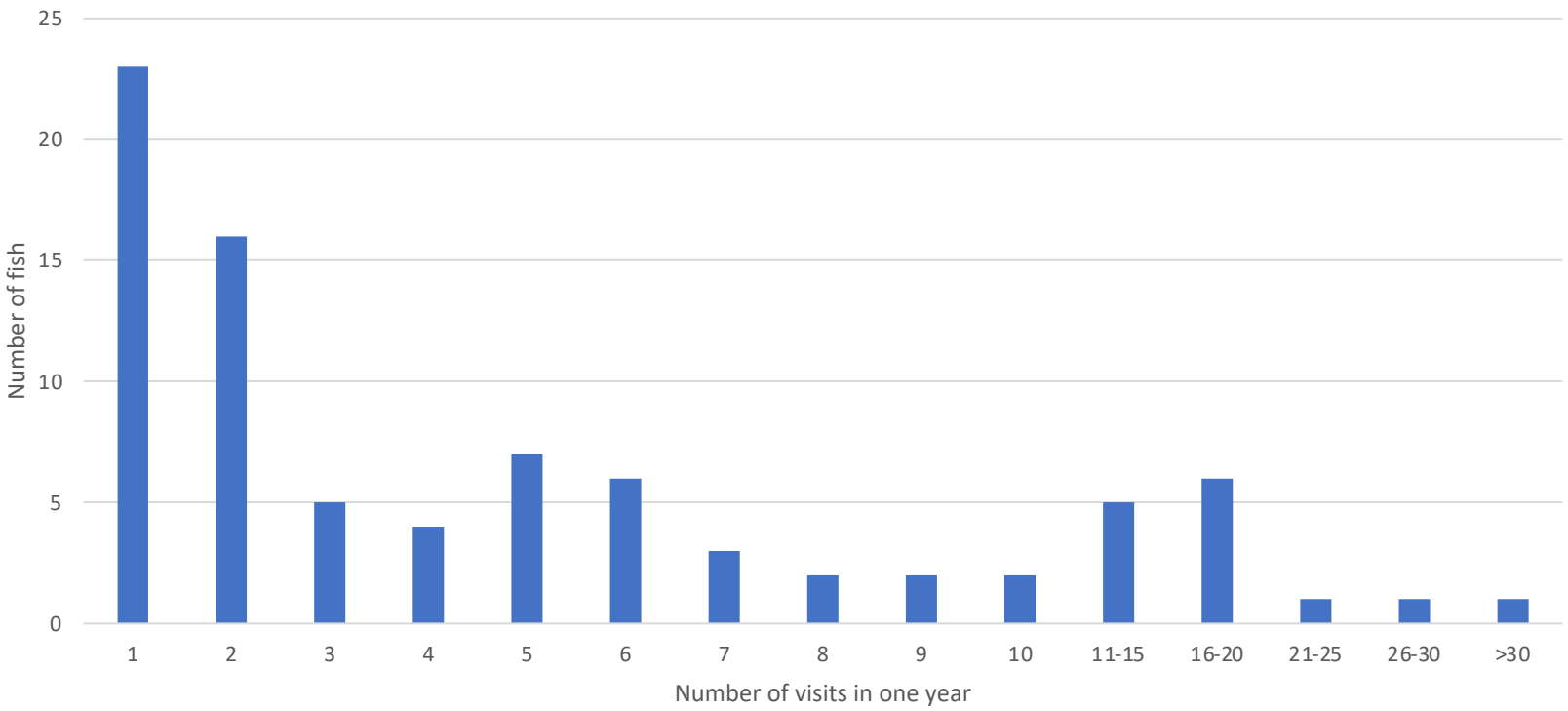
Swansea Bay receivers



Example data - Percentage of Twaite shad that left the Severn detected in Swansea bay by month (three years shown)



Frequency of Twaite Shad visits to Swansea bay, 2019-2023



Fish seen in Swansea Bay

> *The limited evidence of shad being present in Swansea Bay indicates that the risk of them entering the bay and then encountering the turbines is low*

Comments from Swansea Bay tidal lagoon -supporting evidence for HRA, TLP, 2017

Fish seen in Swansea Bay

Year	Emigration events (2019-2021)	Detected in Swansea Bay	Number of returners	Number of returners seen in Swansea Bay	% of emigrants seen in SB (95% intervals in brackets)	% of returners seen in SB (95% intervals in brackets)
2019/20	91	25	45	17	27.5 (19-38)	38 (24-53)
2020/21	33	16	14	10	48.5 (31-66)	21 (42-92)
2021/22	46	16	11	8	34.8 (21-50)	73 (39-94)
2022/23	62	29	32	20	46.8 (34-60)	63 (44-79)
Overall	232	86	102	55	37 (31-44)	54 (44-64)

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Data: 37% of emigrants and 54% of returners seen in Swansea Bay. The majority seen are present on multiple occasion spread over some months.

'Twaite shad do not demonstrate natal site fidelity' → return to multiple rivers and are widely distributed, Source: Swansea Bay Tidal lagoon HRA, 2017.

- Receivers deployed in Severn, Wye, Usk, Tywi
- No straying to Usk or Tywi
- Some straying to Wye (NB could also have been Wye fish tagged in Severn)
- Overall 94% fidelity, no longer distance straying

Return year	% to Severn	Sample Size
2019	97	34
2020	93	45
2021	93	14
2022	91	11
2023	94	32
Overall	94	136

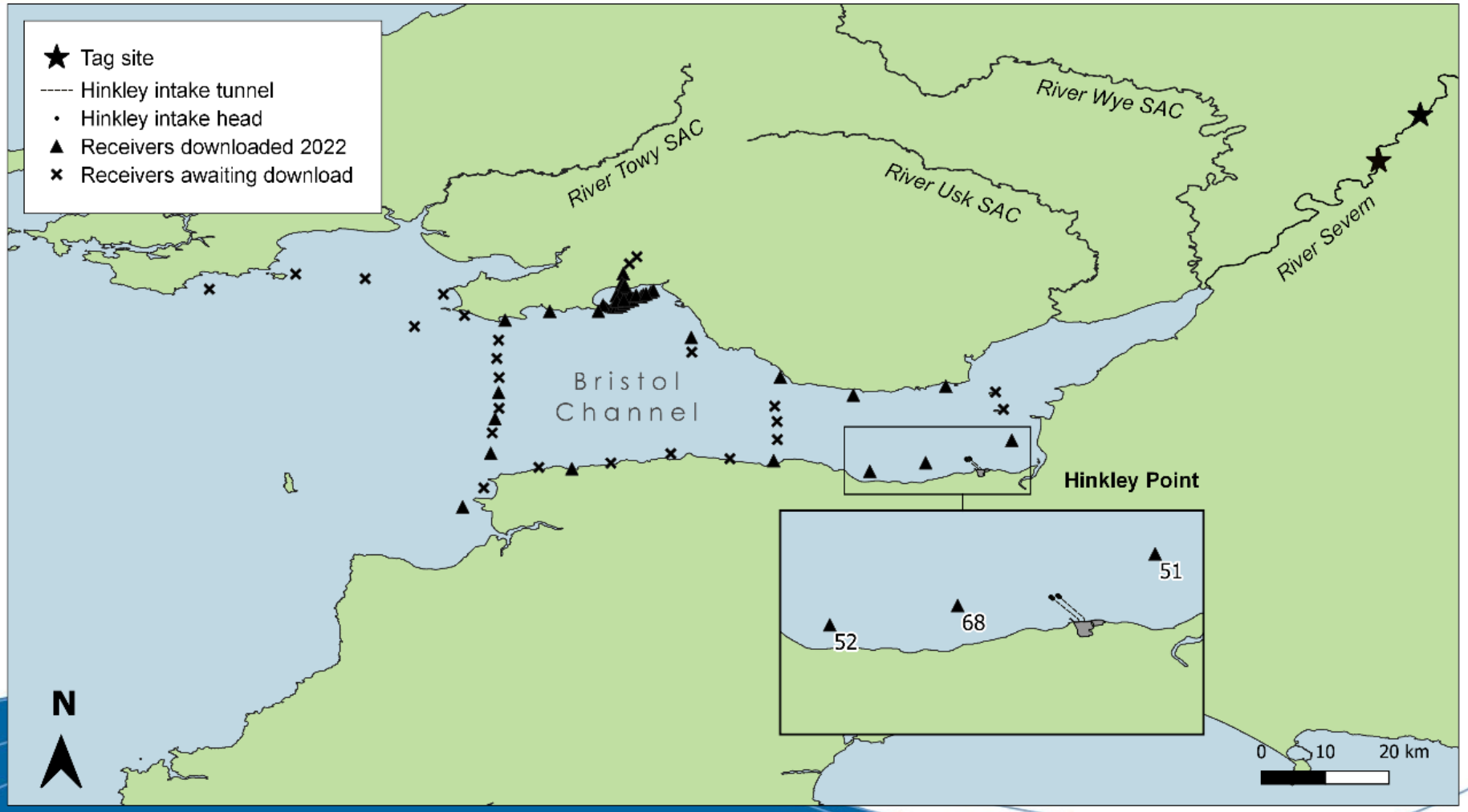
Source UTS / Mark Yeldham

Case studies – Hinkley Point ‘C’ abstraction

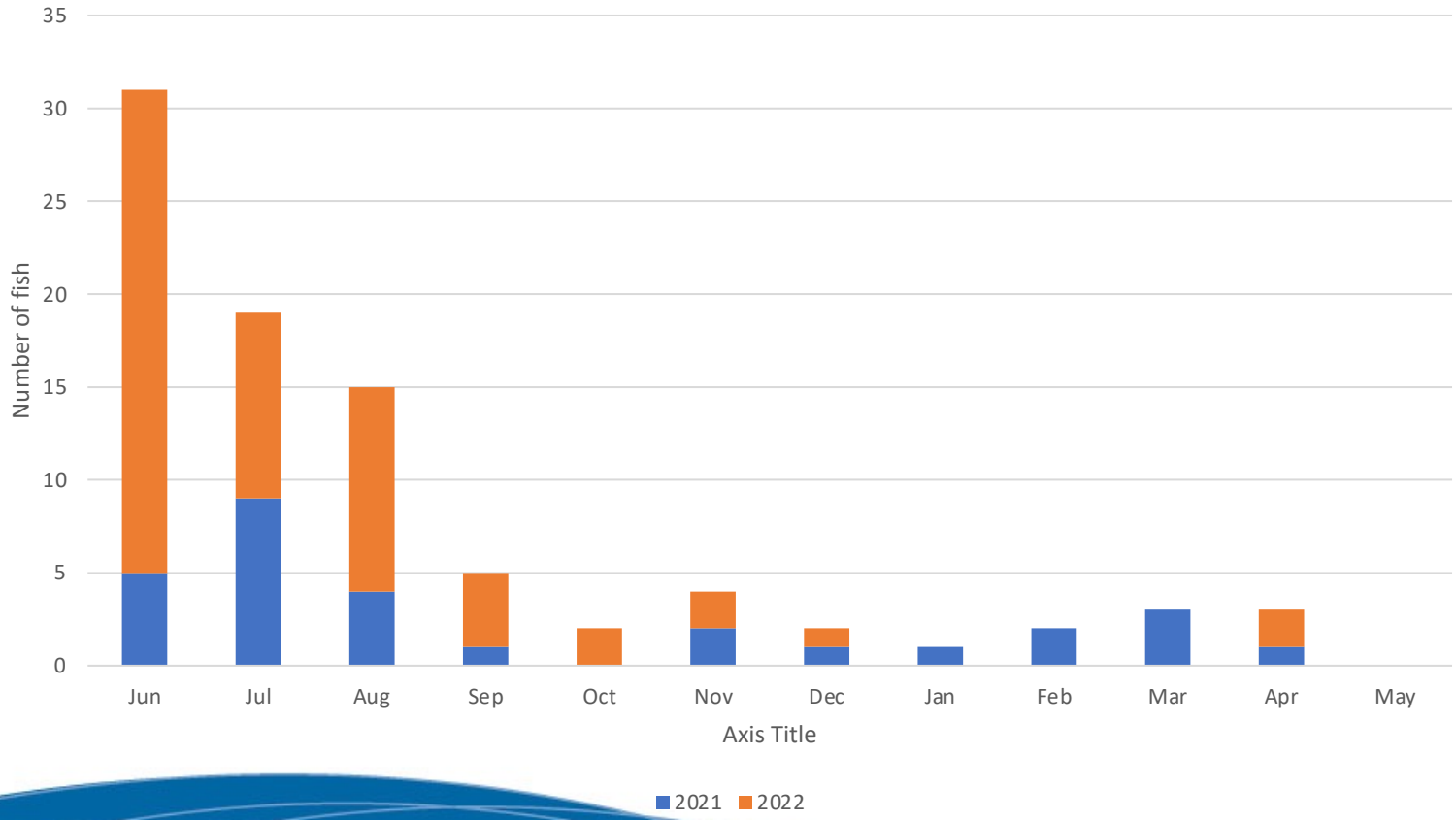
Hinkley Point C abstraction

- Cooling water for nuclear power station new build (132 cumecs)
- 4 low velocity side entry (LVSE) intake heads; 3.3km offshore
- EDF wish to remove AFD, citing safety/practicality and lack of environmental impact. (Public enquiry and ongoing discussion)
- Case study data from 3 tracking receivers deployed in Bridgewater Bay as part of migration study of wider movements

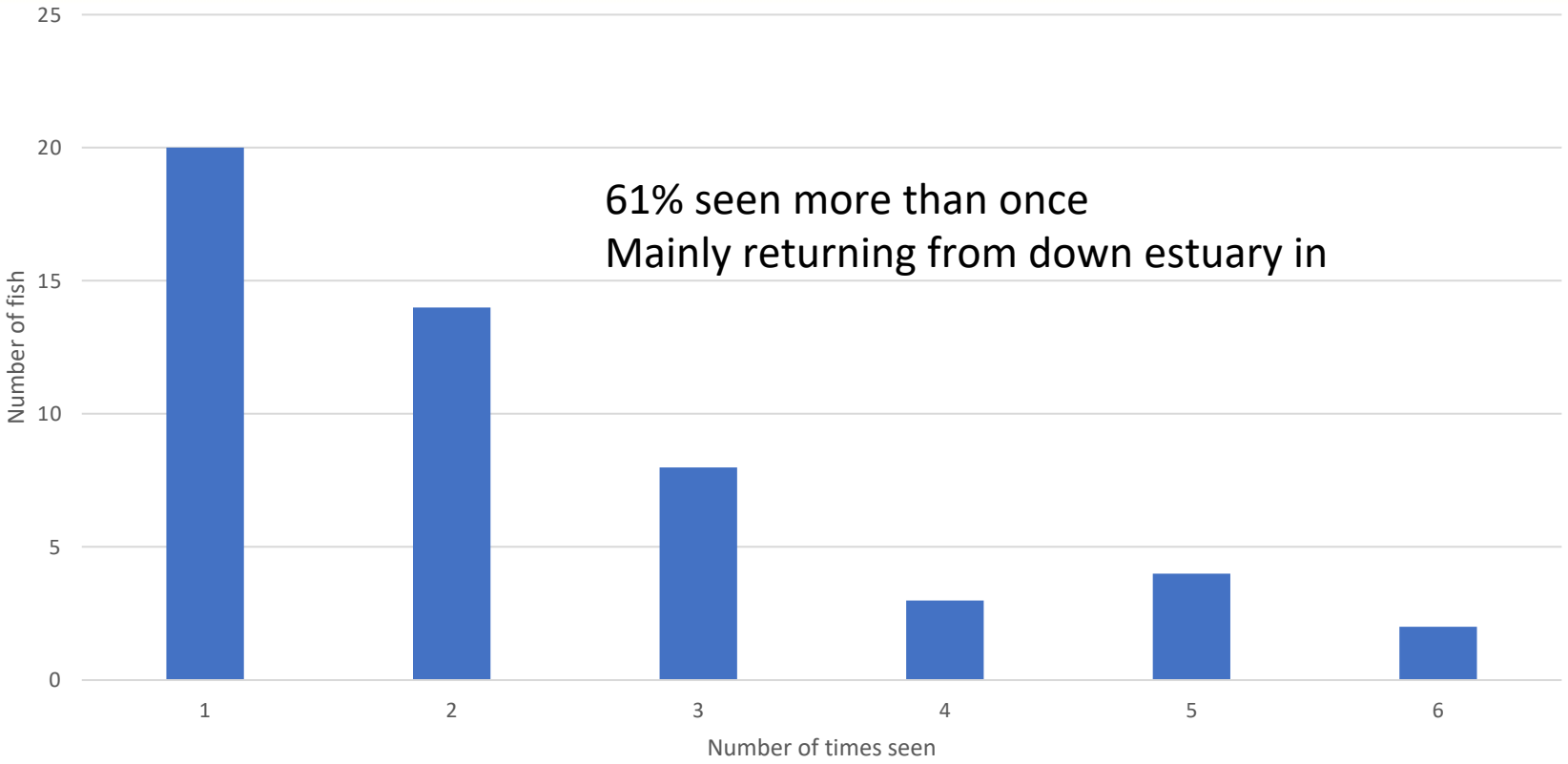
Bridgwater Bay receivers



Bridgewater Bay Monthly distribution (51,52,68), n=87



Returners to Bridgewater Bay



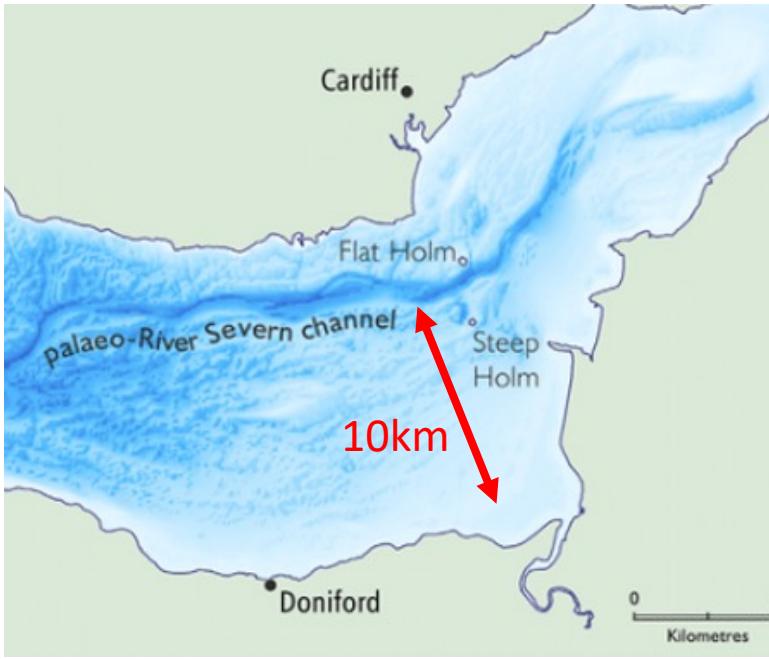
Hinkley Point C Public enquiry evidence - EDF

Adult twaite shad behave similarly to salmon and sea trout and will use

"*selective tidal stream transport on the floodtide, close to the sea surface and in midchannel following an olfactory trail to their natal rivers*

.....

the deep water channel is more than 10km to the north of either HPB and HPC intakes……they will only abstract from a layer near to the seabed. The distance from the main channel and the surface migratory pattern means that none of these species would be expected to be impinged in any significant numbers at either station"



Fish seen in Bridgewater Bay

Limitations

- 3 receivers, range <400m
- Tag ping rate 1 every 10 minutes from July
- Not deployed for this purpose - ca 6 km in either direction (upstream/downstream) not at immediate site
- Receivers 'bracket' the abstraction at a similar distance offshore

Year leaving	Emigrants	n detected	% detected	95% CL
2021	46	14	30.4	partial
2022	62	38	61.2	48-74%

Year of return	Returners	n detected	% detected	95% CL
2022	11	8	63	partial
2023	32	24	75	57-88%

Fish seen in Bridgewater Bay

- Data: A substantial part of the Severn population use Bridgewater Bay.
- Overall 32/43 returners are seen (69%; 95% CI 59-86%) and 52/108 emigrants seen (48%; 95%CL 38-58%)

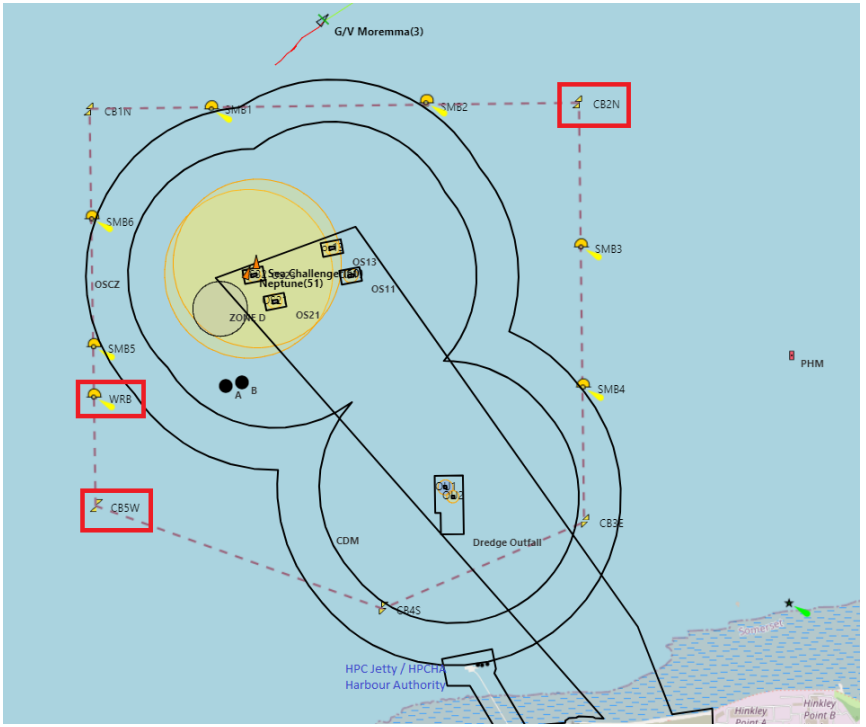
Year leaving	Emigrants	n detected	% detected	95% CL
2021	46	14	30	partial
2022	62	38	61	48-74%
Totals	108	52	48	38-58

Year of return	Returners	n detected	% detected	95% CL
2022	11	8	63	partial
2023	32	24	75	57-88%
Totals	43	32	69	59-86

Next steps

Hinkley

- 50 depth/temp tags deployed in Severn this year (plus 2022 V9 pinger tagged fish) 48 to sea, 31 depth tags
- 73 also tagged with V9 pinger in Tywi and 11 on Wye
- 9 additional receivers deployed on marker buoys around HPC works (+51,52,68)
  -> better evidence of immediate proximity
  -> evidence of depth use



Swansea

- IBM modelling using actual data
- Compare with past predictions

Lessons learnt

- We should not extrapolate behaviour across species
- Presence=potential risk to adults. We need to understand and measure aggregation and avoidance behaviour (and we can).
- Real data shows even experienced opinion and resulting models can be very wrong
- Models need to be based on real species-specific data to be credible
- This should be part of standard EiA for major marine schemes -> reduce consenting risk

- Cost of tracking (< £1m to date; <0.07 % Swansea Bay Lagoon cost and <.004% Hinkley cost)

- Need to consider central funding approach

Ambition

- Quantitative risk exposure data ***can*** be collected for adult populations, including:

  - seasonal proportion of population present
  - number and duration of visits
  - tidal/diurnal availability,
  - migration speed
  - freshwater and marine survival

- We can use the same approach to directly monitor population level impacts on adult spawners post construction

- We *can* collect area availability and measure entrainment rates

- We *can* directly measure survival of fish passing through the RR system

- We *can* directly quantify impact on adult spawners and relate that to population impacts

- We don't need to wait for enough data to show statistical changes in a very variable system -> earlier interventions if problems arise

- These approaches to pre and post construction assessment should be a major part of the standard, not done to provide hindsight

Thank you for listening