



**Movements of satellite tagged porpoises and
potential future monitoring in the Danish Wadden Sea**

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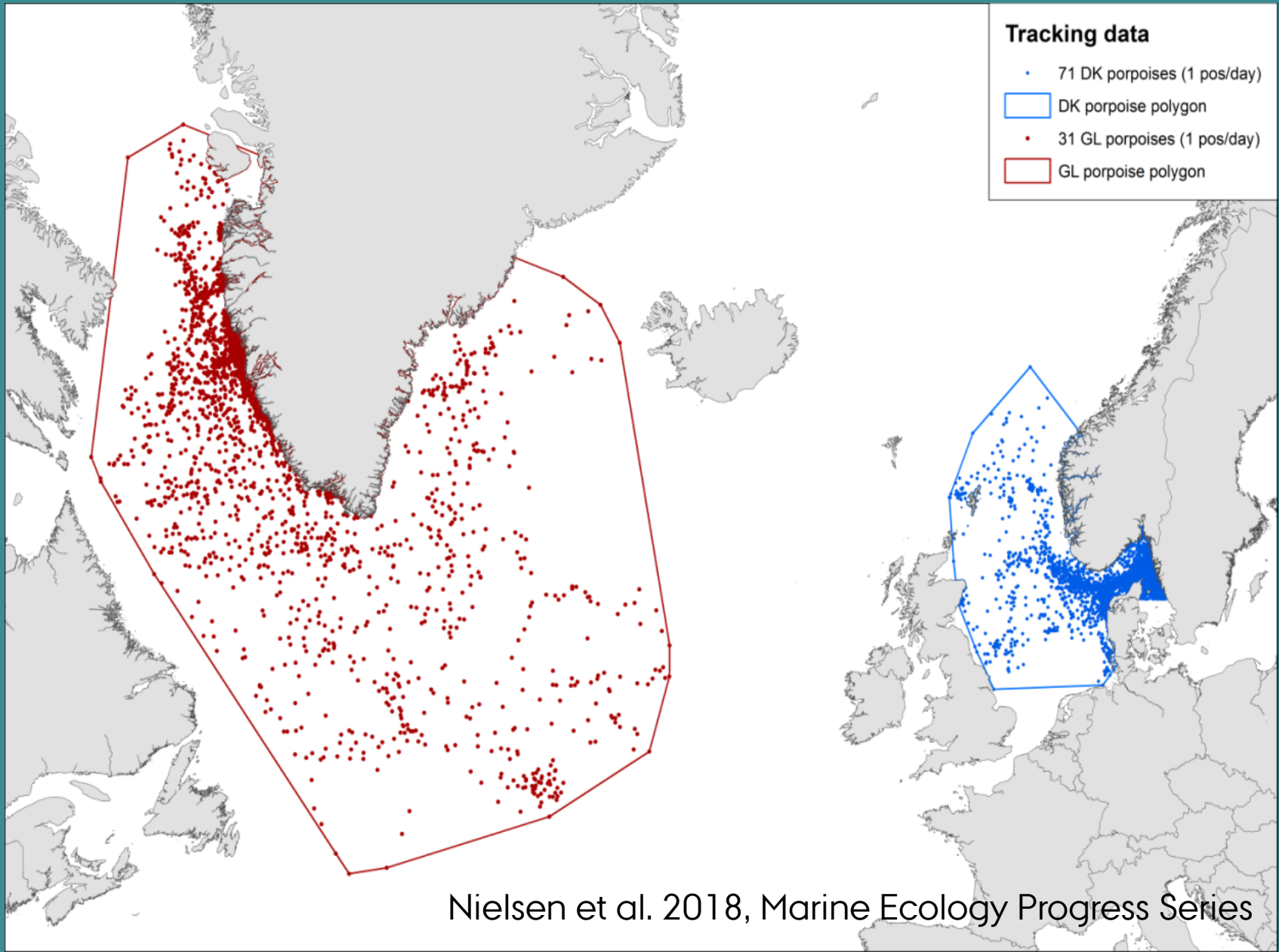
Tagging program in cooperation with Danish pound net fishermen since 1997

- Approximately 200 porpoises



e.g. Sveegaard et al. 2011 Marine Mammal Science

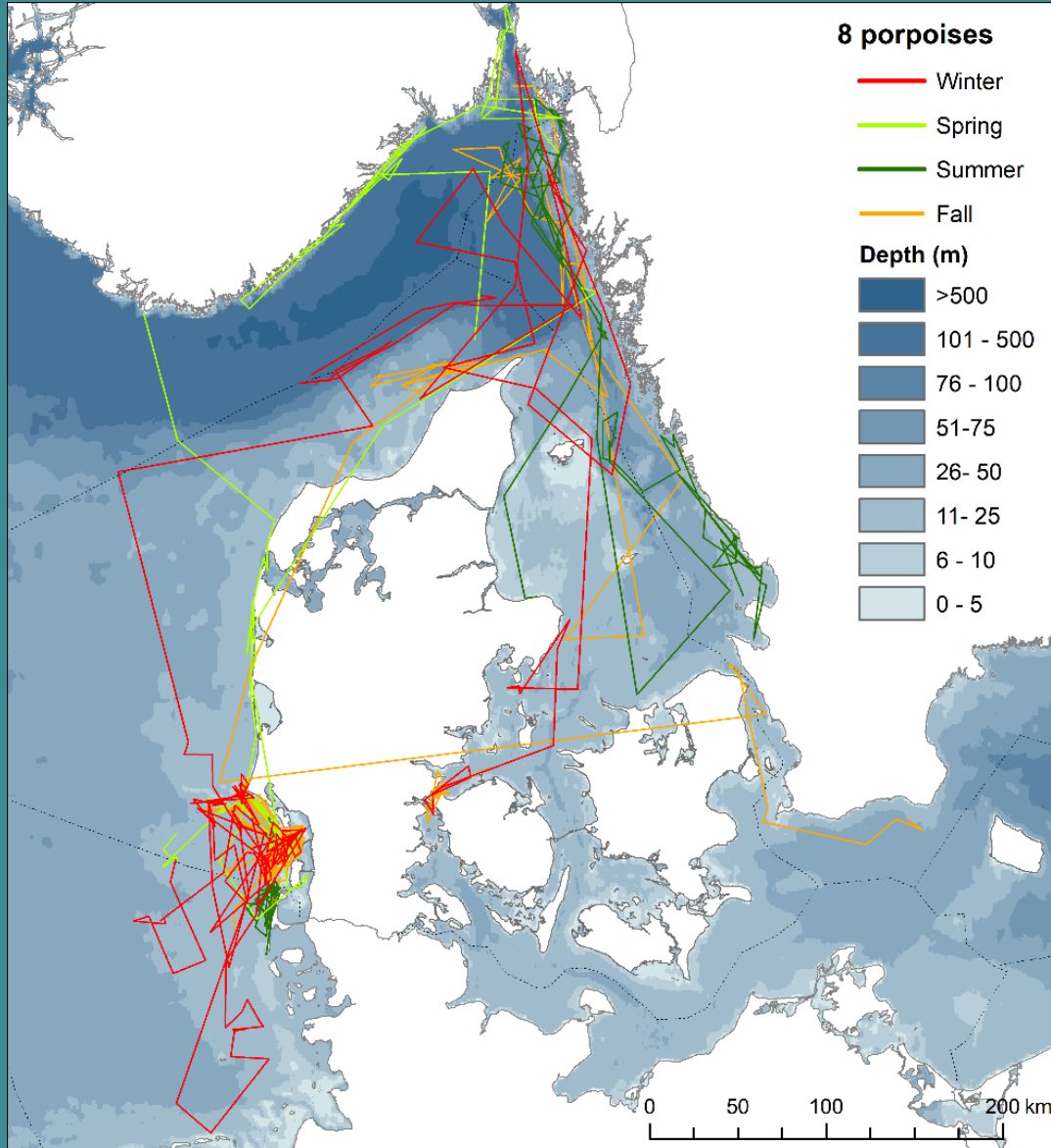
Long-term and large scale movements of porpoises from Greenland and North Sea



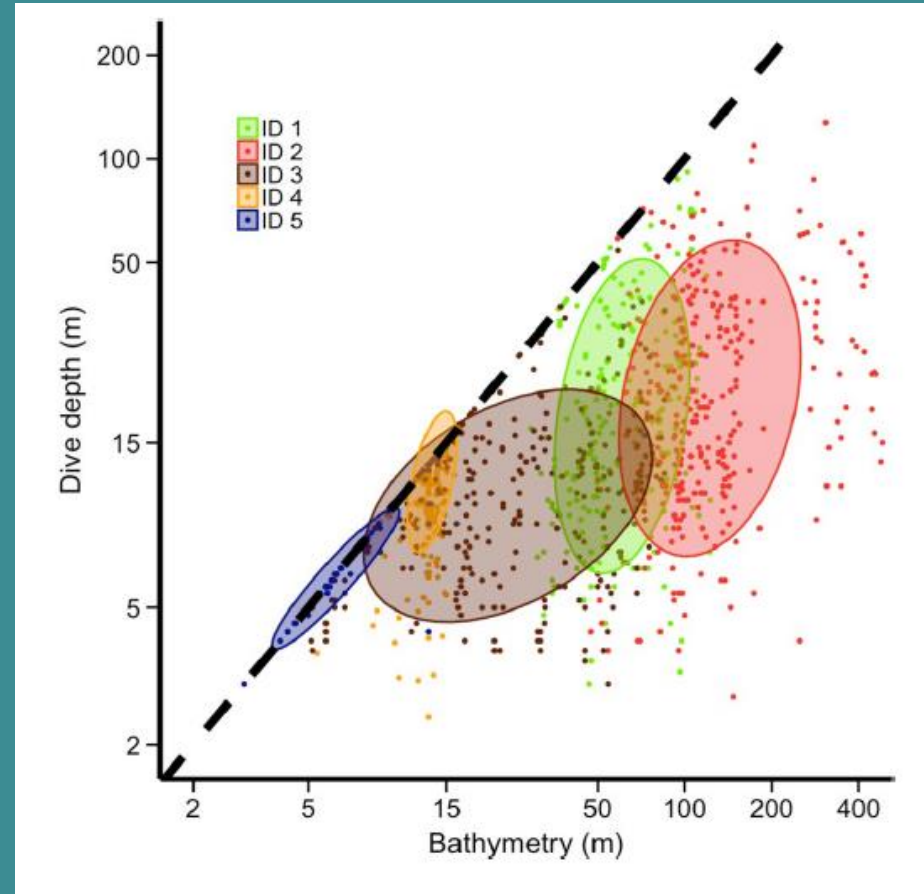
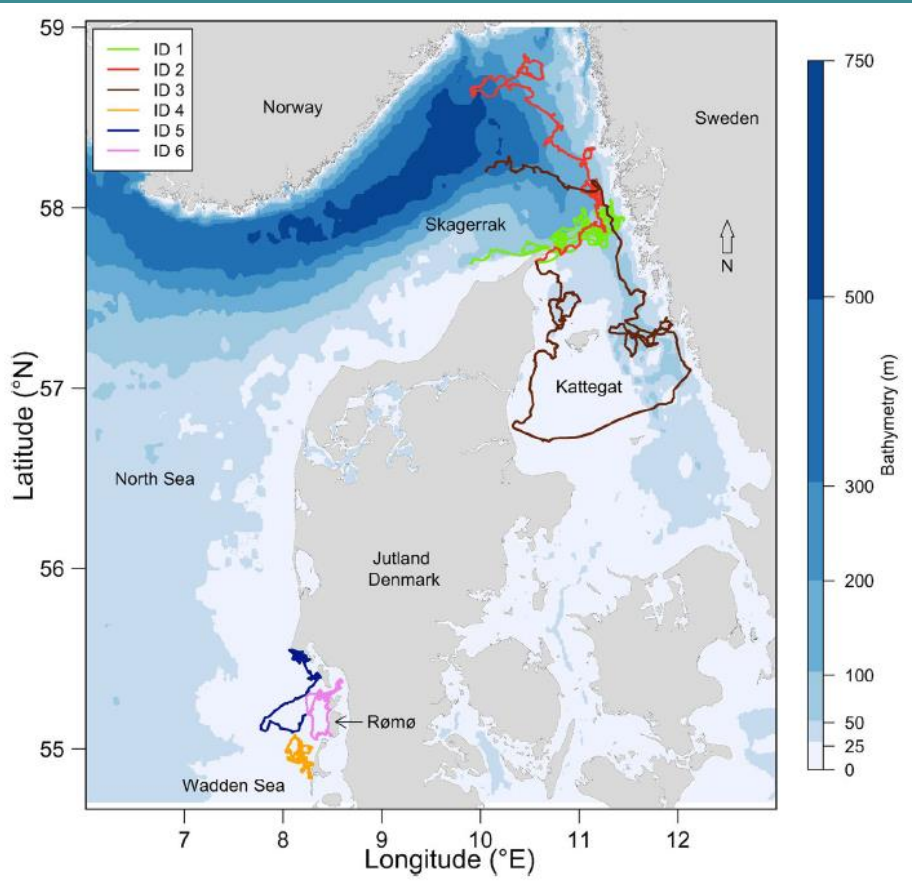
8 tagged porpoises visiting the Wadden Sea

	Porpoise	Argos ID	Tagging site	Date	Last location	Duration
Tagged in the Danish Wadden Sea	Male 118 cm	138067	Rømø West	03-jun-14	04-okt-14	123
	Male 127 cm	149165	Mandø/Knude Dyb	20-sep-16	04-jun-17	257
	Male 140 cm	149166	Mandø/Knude Dyb	19-sep-16	26-apr-17	219
	Male 130 cm	149167	Mandø/Knude Dyb	19-sep-16	10-jun-17	264
	Male 123 cm	149170	Mandø/Knude Dyb	19-sep-16	30-dec-16	102
	Male 125 cm	149171	Mandø/Knude Dyb	21-sep-16	18-mar-17	178
	Average					191
Tagged in IDW	Male 126 cm	83306	Fjellerup Strand	04-jul-11	09-nov-12	494
	Male 107 cm	138073	Fænø	30-okt-14	18-apr-15	170
	Average					332

Movement of 8 satellite tagged porpoises using the Wadden Sea



Fine scale movements and dive depths for the first 10 days of 6 tagged porpoises



Part I - conclusions on Wadden Sea porpoise movements

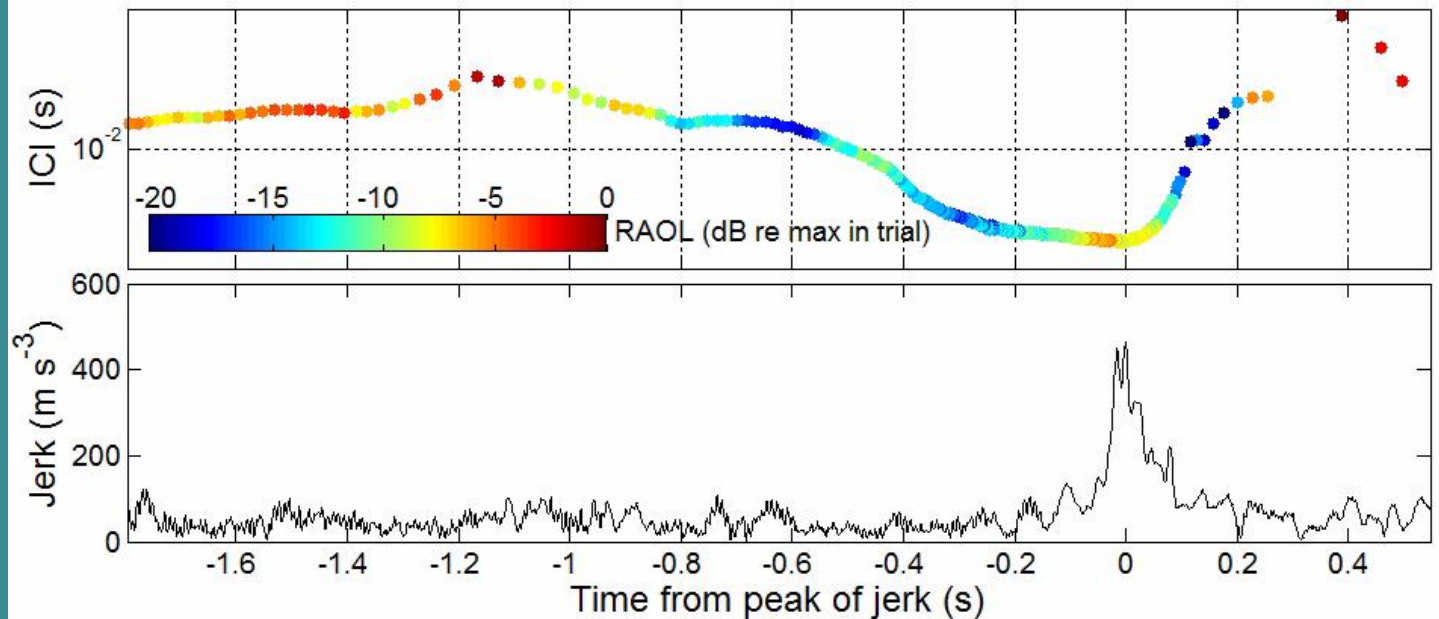
1. First insight to porpoise movements in the Wadden Sea.
2. Porpoises tagged in the Wadden Sea are local to the area year round (only males tagged!).
3. Some movements between Denmark and Germany.
4. Porpoises visiting the Wadden Sea in winter and spring (from Inner Danish Waters) has a daily movement rate 2.5-8 times higher than Wadden Sea animals.
5. Limited dive data suggest bottom feeding in shallow waters (4-15 m) for the Wadden Sea porpoises.
6. Can we talk about Wadden Sea porpoises (population)?

Sampling super high resolution data for hours or low resolution up to years depending on question asked



Foraging

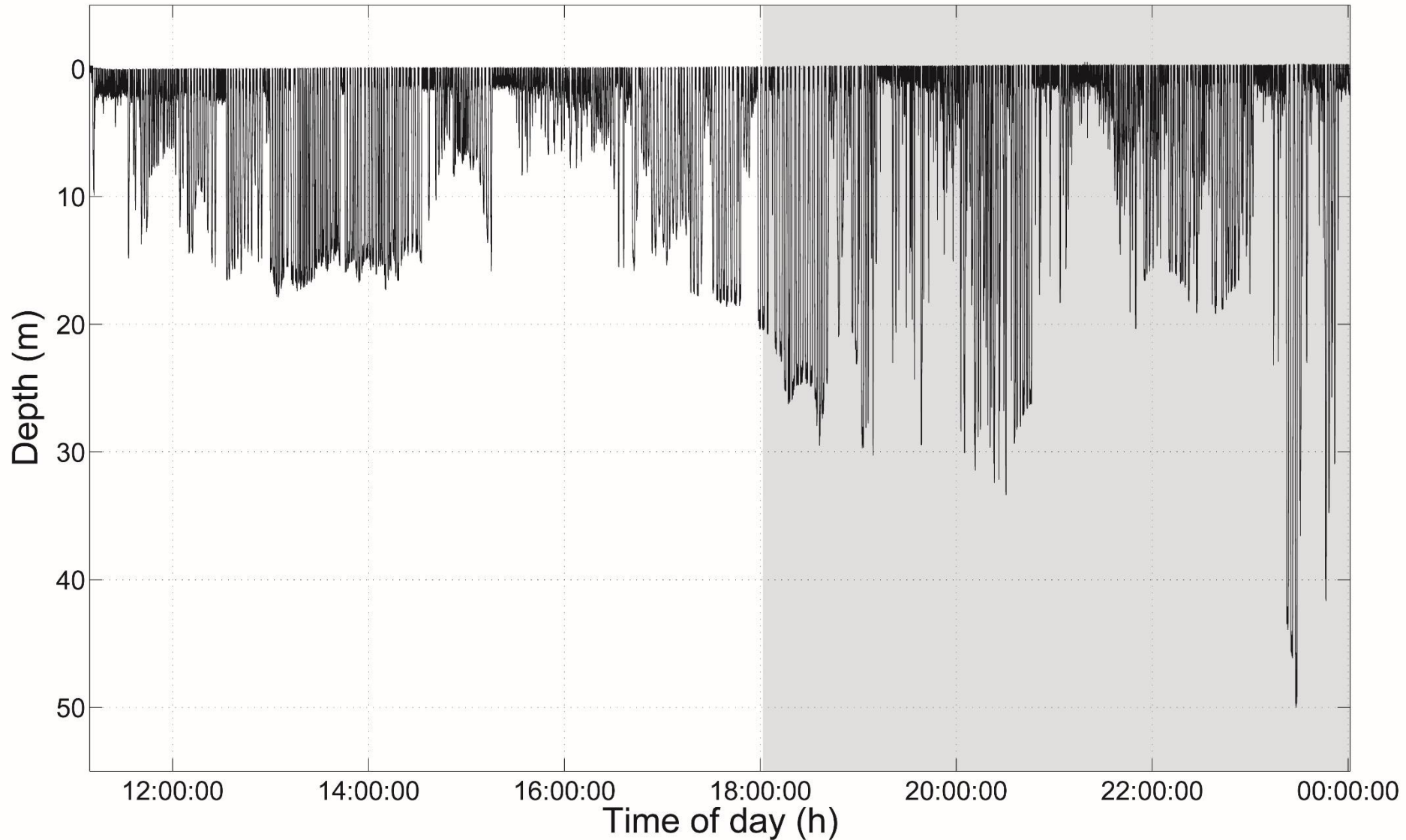
Catching a fish blindfolded in a captive controlled experiment in Fjord&Belt



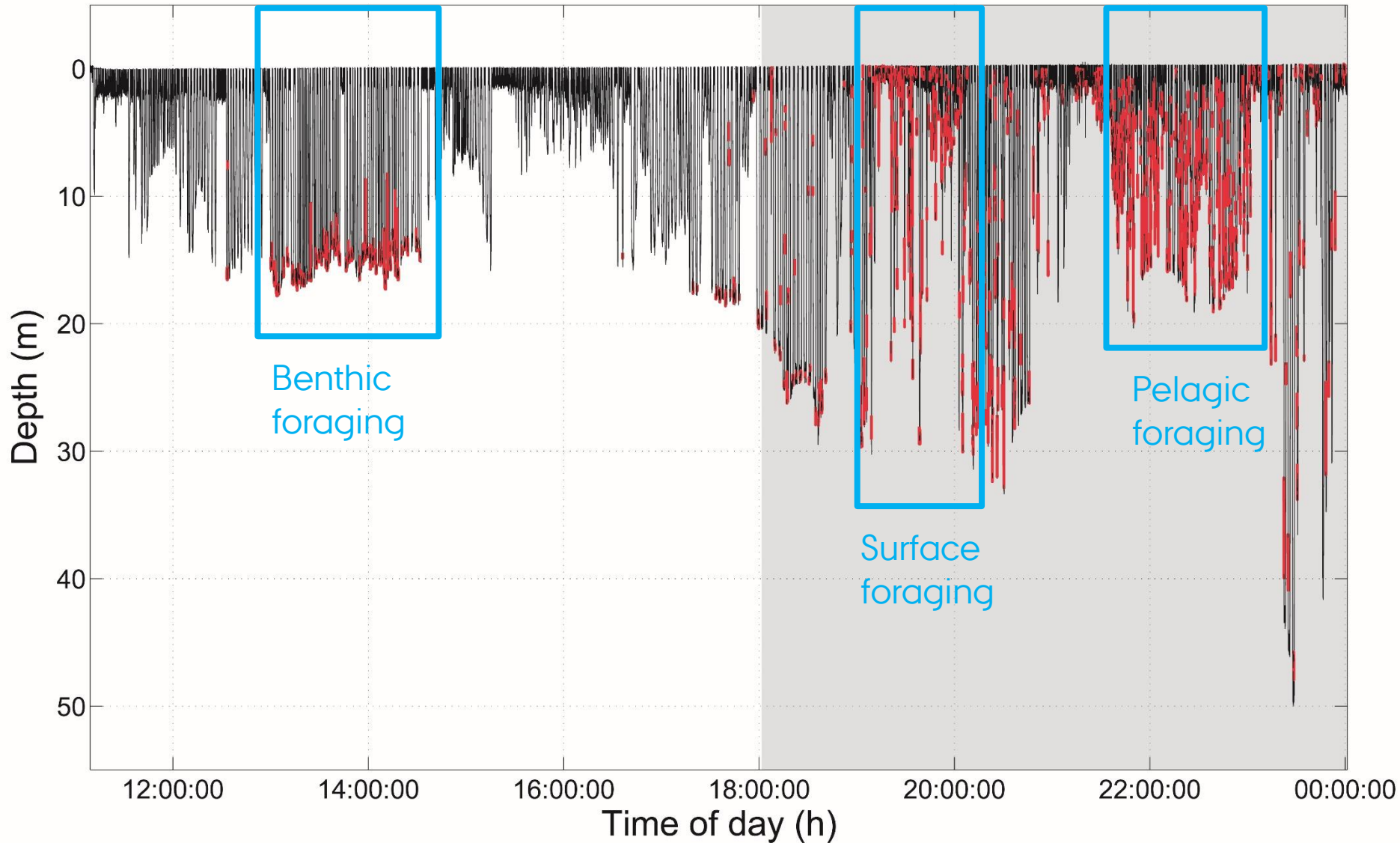
Animation of a feeding dive where a porpoise is catching 20 small fish

Echolocation of prey by a subadult, male harbour porpoise during a pelagic dive

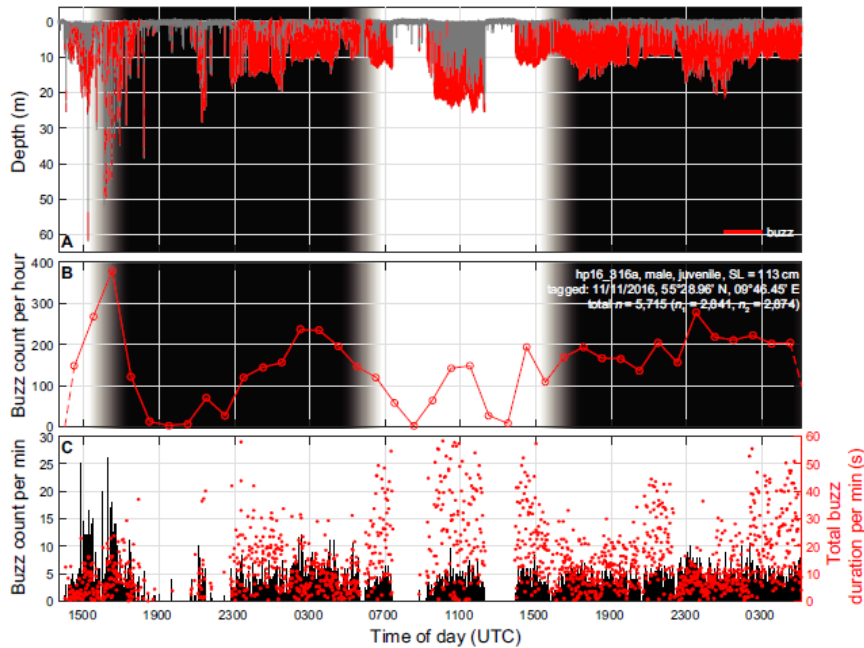
Porpoises dive to variable depths...



...and forage nearly continuously



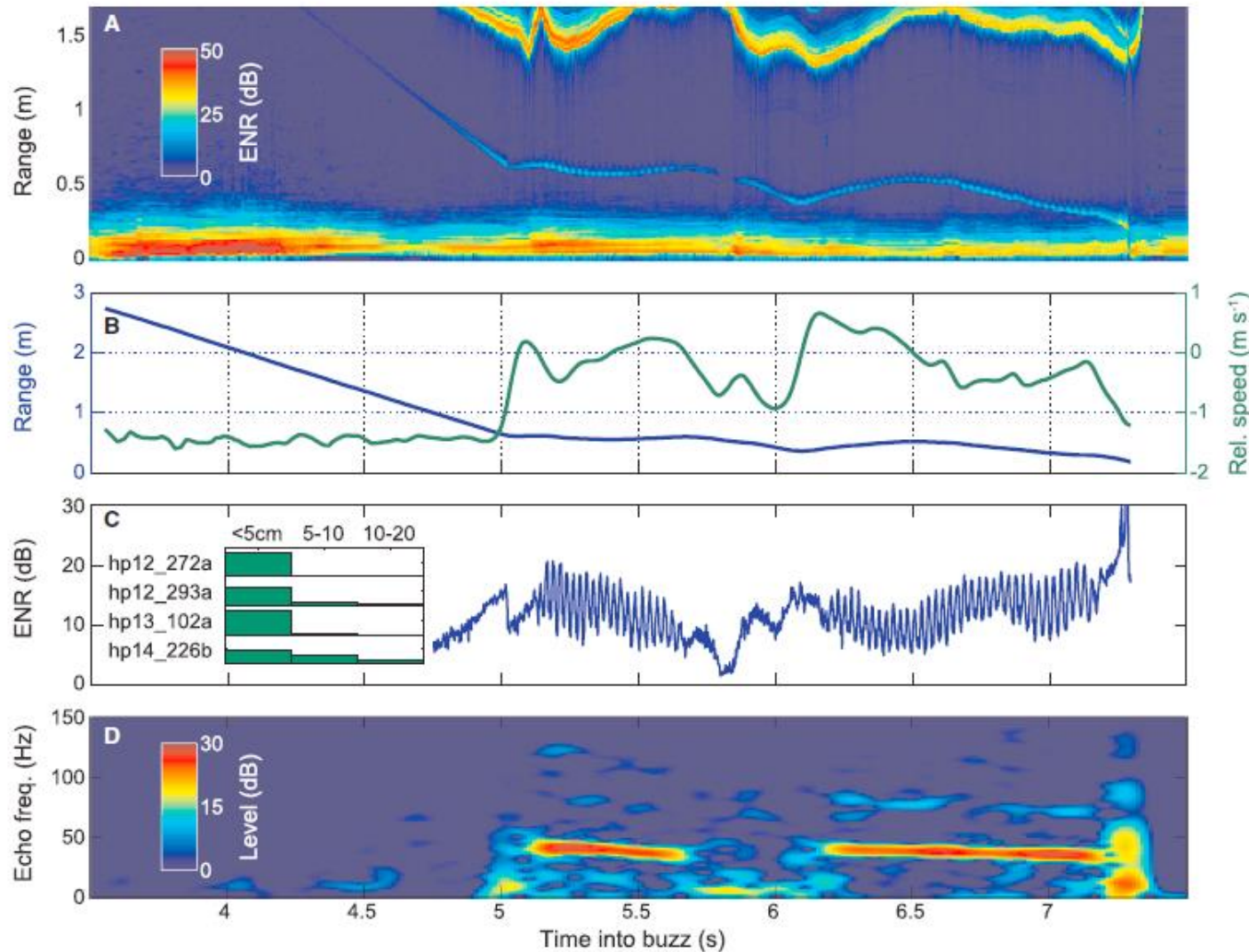
Consistent high foraging rate over 40 hrs – mostly at night



Wisniewska et al. 2018,
Marine Mammal Science

ID	Sex	Deployment date	Standard length (cm)	Tag duration (h)	No. of feeding buzzes	Buzzes per hour
hp16_316a	♂	11 Nov 2016	113	39.1 (39.5)	5,715	146
hp13_102a	♂	12 Apr 2013	114	22.7 (23.7)	3,405	162
hp12_272a	♀	28 Sep 2012	122	17.8 (21.9)	1,821	106
hp13_170a	♂	19 Jun 2013	122	15.3 (15.3)	1,222	60
hp14_226b	♂	14 Aug 2014	126	19.8 (20)	3,234	153
hp12_293a	♀	19 Oct 2012	163	16.4 (17.7)	1,346	86
hp15_116a	♀	24 Apr 2015	170	12.4 (13)	906	73
Mean buzz rate juveniles						125.4
Mean buzz rate adults						79.5

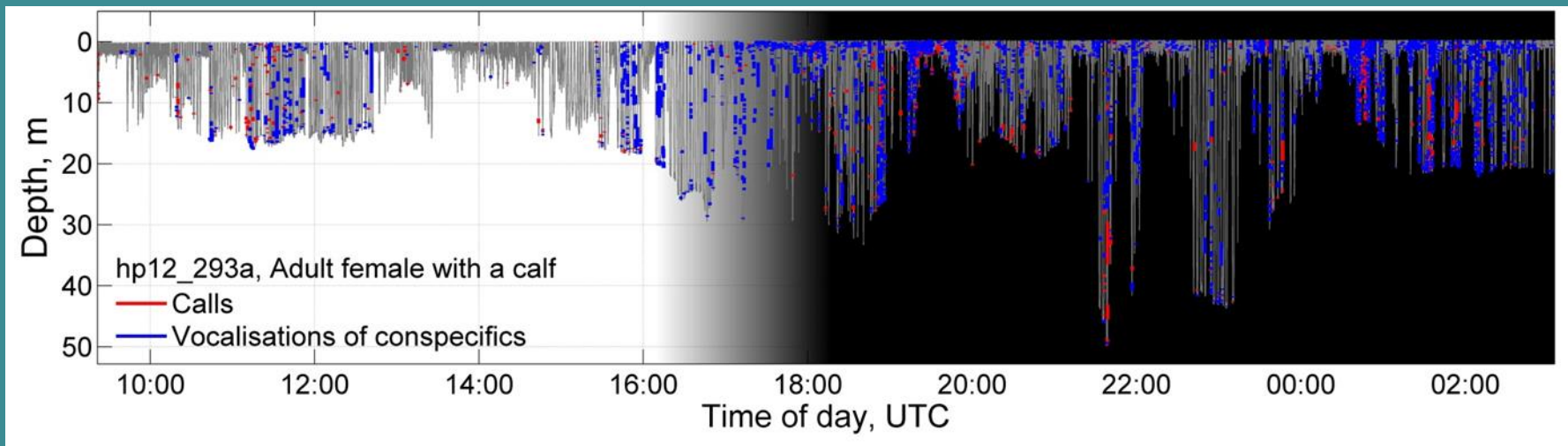
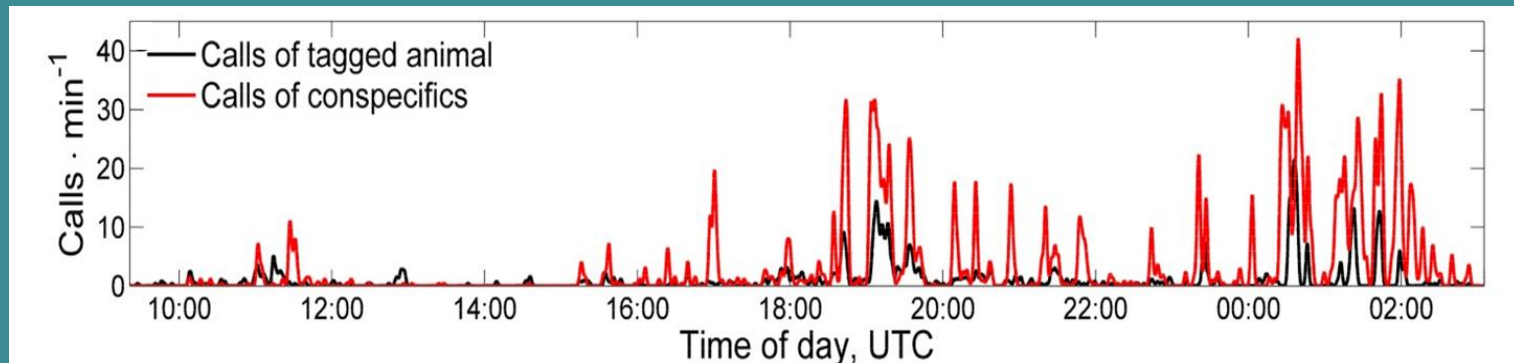
Prey size and daily consumption based on echograms from the DTAG recordings on porpoises



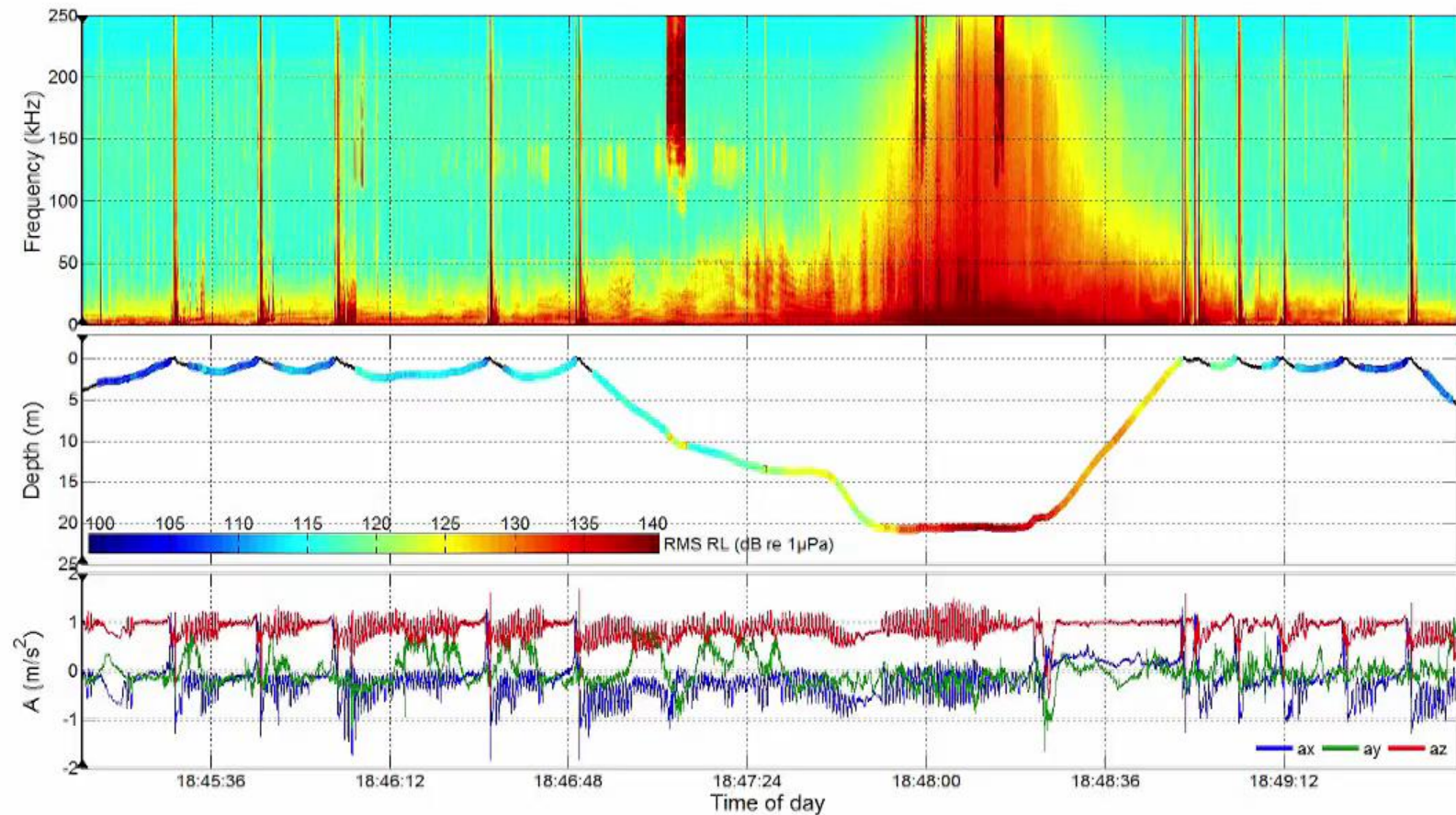
Given a mean buzz rate for juveniles of 125/h and

- 1) assuming that the mean weight of fish eaten was around 1 g (5 cm goby or sand ell, see panel C on figure) and
- 2) a 90% prey capture success rate,
- 3) a porpoise would consume about 2.7 kg/24 h, which is roughly 10% of the body weight of a young porpoise, which fits well with other studies.

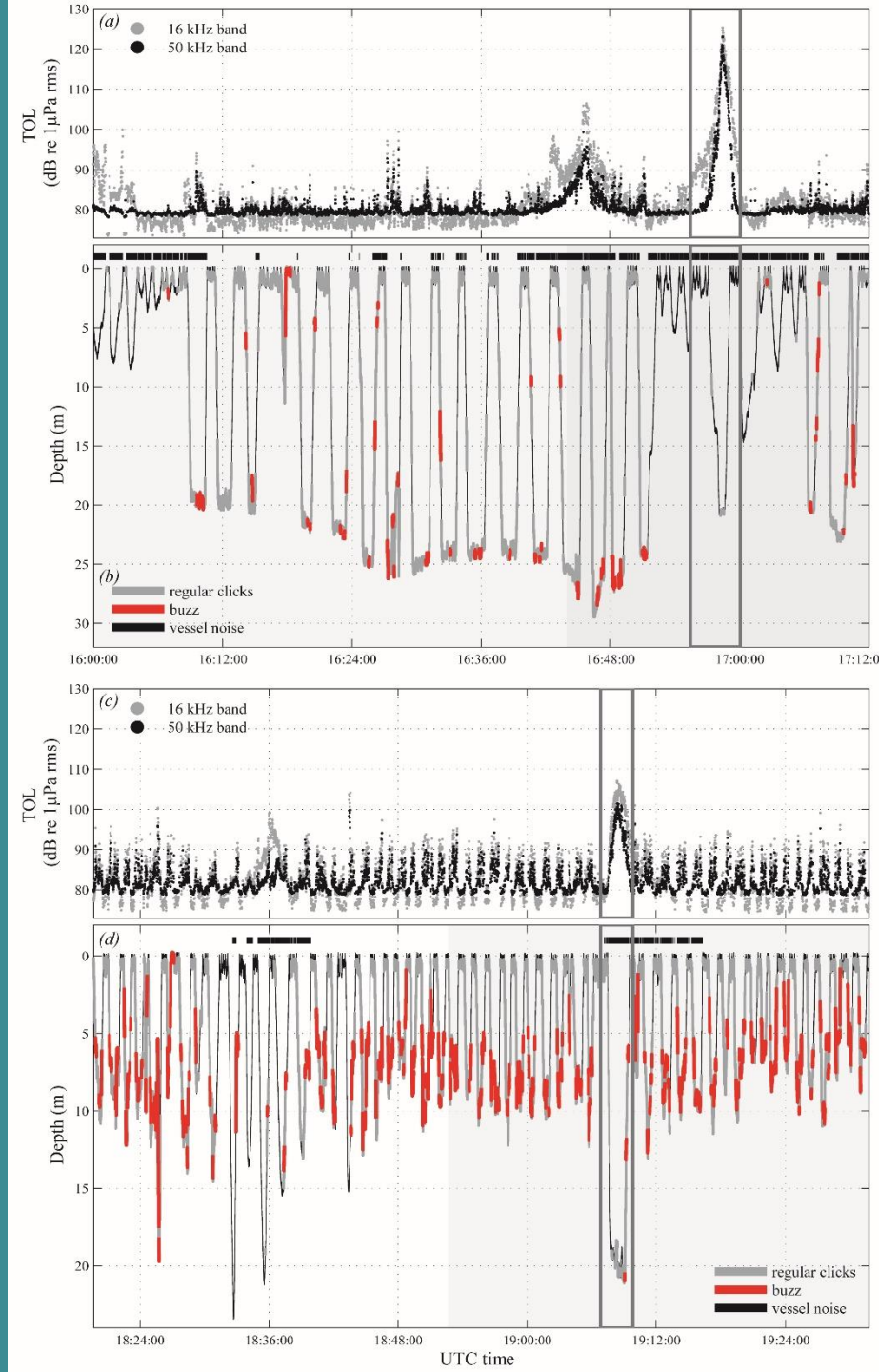
Social interactions



Ship avoidance from wild porpoise



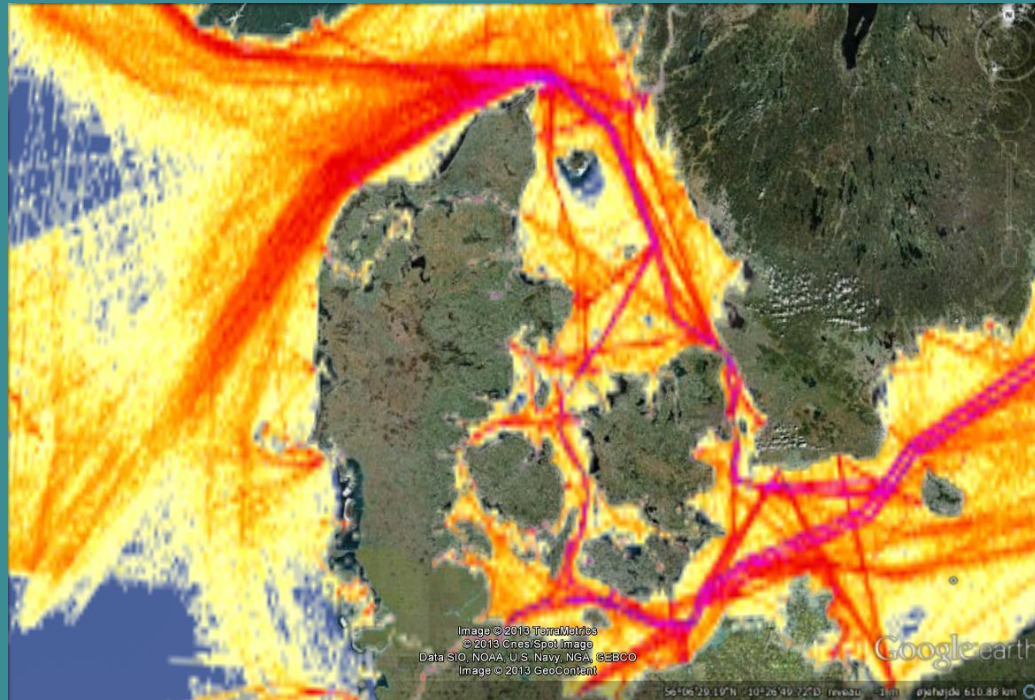
Reactions to fast ferries



Porpoises can hear ship noise 16-73% of their time

Wisniewska et al. 2018, Royal Proceeding B

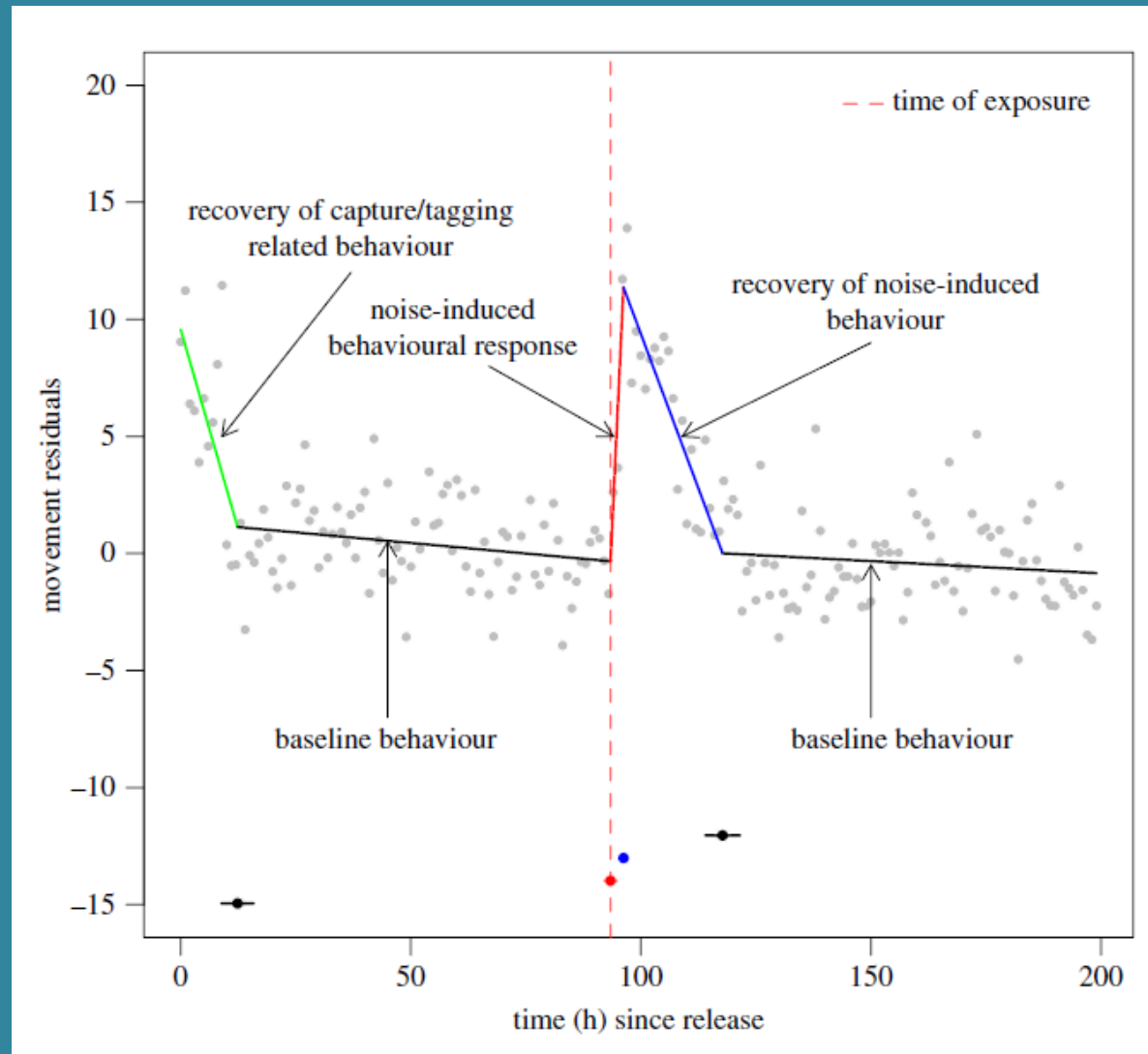
	hp12_293a	hp13_102a	hp13_145a	hp13_170a	hp14_226b
vessel noise exposure time (h)	11.5	17.4	2.1	2.4	3.4
vessel noise exposure time (%)	65	73	30	16	17



AIS data from 2010

<http://www.soefartsstyrelsen.dk/ais/Sejladsmoenstre/Sider/WebMapServices.aspx>

Porpoise avoidance to 1 min airgun exposure



van Beest et al. 2018. Royal Society Open Science

Potential future monitoring in the Danish Wadden Sea

- Aerial surveys – little information gained from NOVANA (Danish Marine Monitoring Program)
- Acoustic monitoring – could be used at the entrances of major tidal trenches to monitor presence and movements.
- Tagging more porpoises (females!) to understand better how they use the Wadden Sea.
- Genetic comparison between Wadden Sea and North Sea porpoises.
- More studies on effects of disturbances will help manage populations.



Thanks to co-authors, the amazing field team and the pound net fishermen



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