

THE ATLANTIC WHITE-SIDED DOLPHIN IN EUROPE: RESEARCH & CONSERVATION



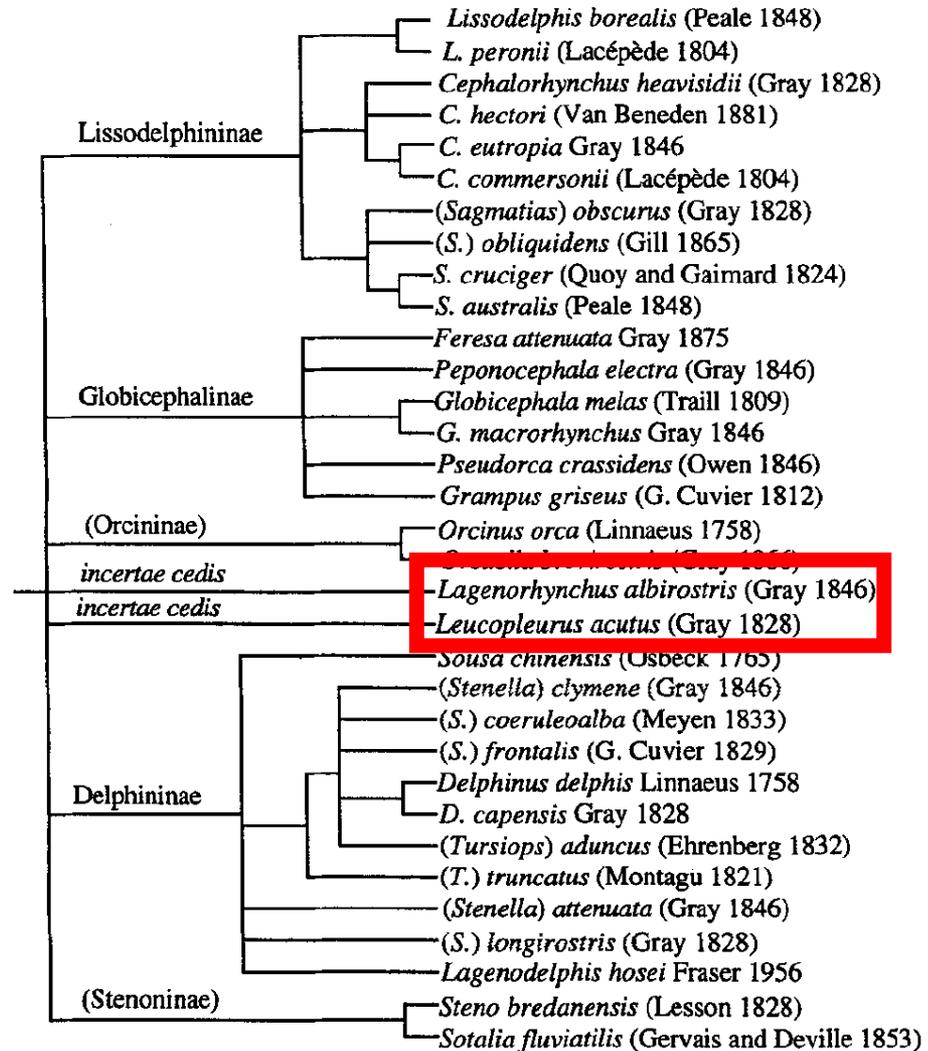
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Atlantic White-sided Dolphin Systematics - 1

Cytochrome b analysis

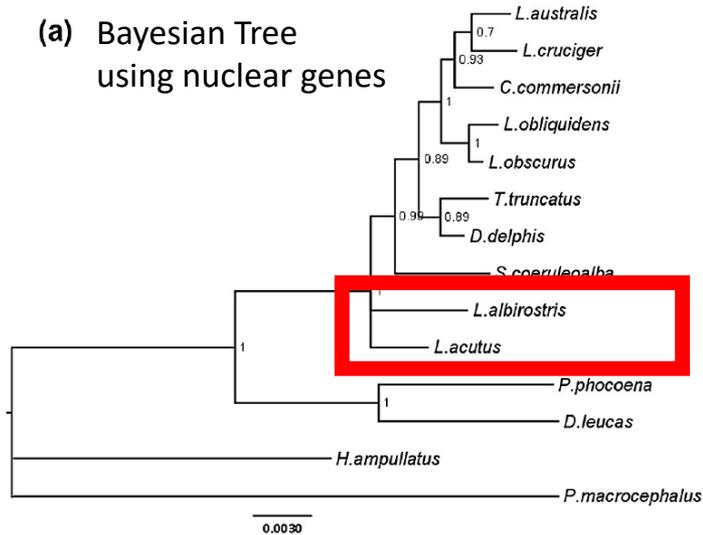
- Suggested that Atlantic white-sided dolphin (*Lagenorhynchus acutus*) should be in a separate genus



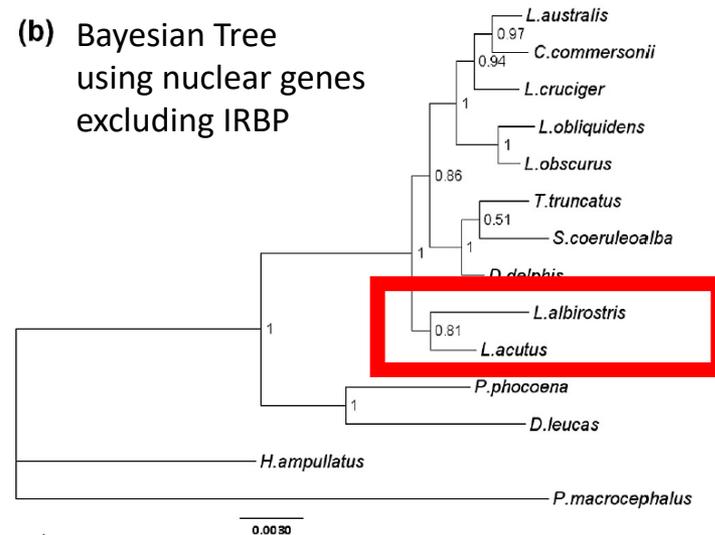
Source: Le Duc *et al.*, 1999

Atlantic White-sided Dolphin Systematics - 2

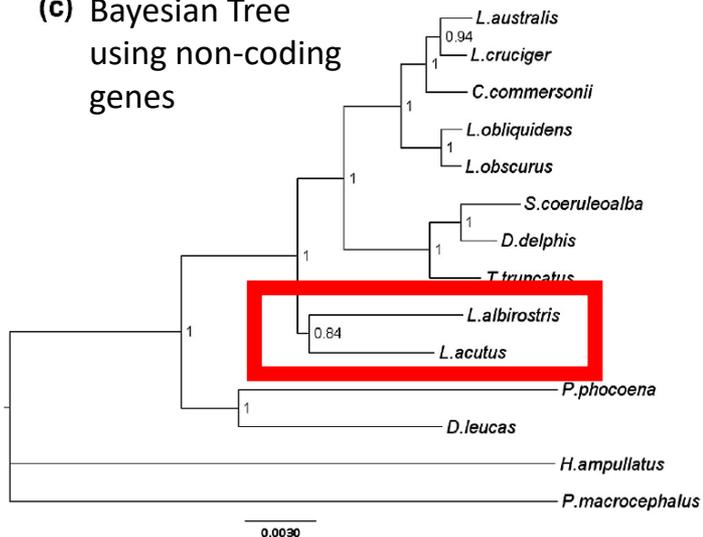
(a) Bayesian Tree using nuclear genes



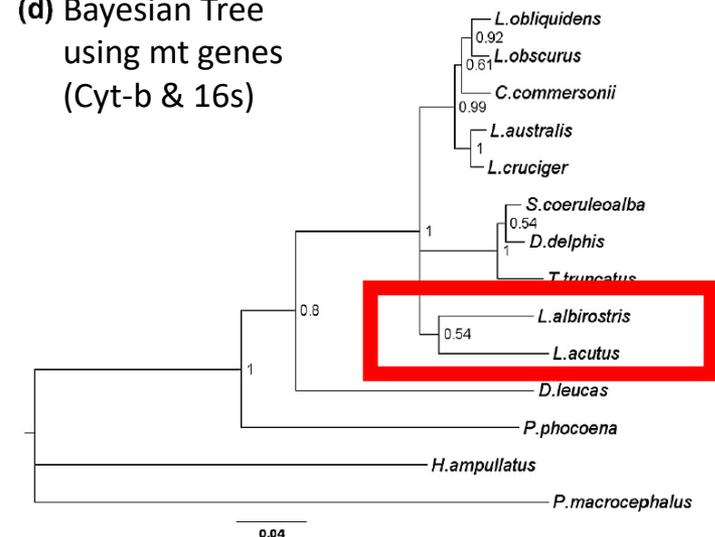
(b) Bayesian Tree using nuclear genes excluding IRBP



(c) Bayesian Tree using non-coding genes



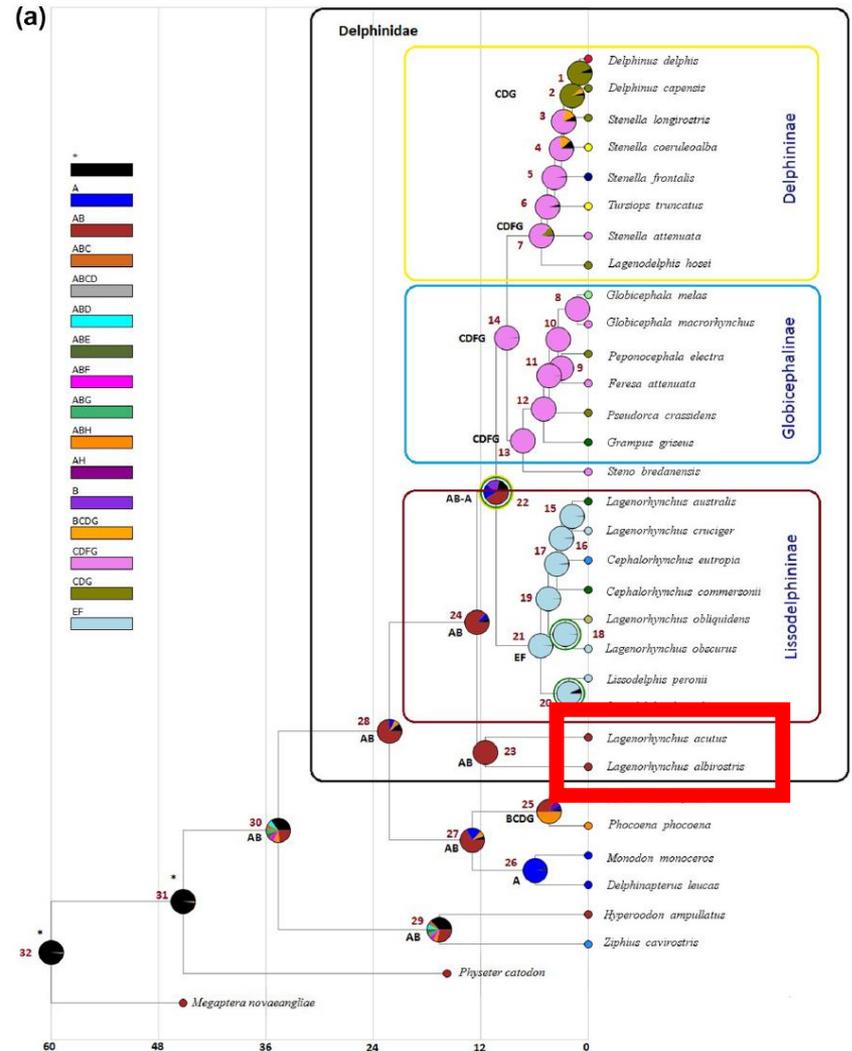
(d) Bayesian Tree using mt genes (Cyt-b & 16s)



Source: Banguera-Hinestroza *et al.*, 2014

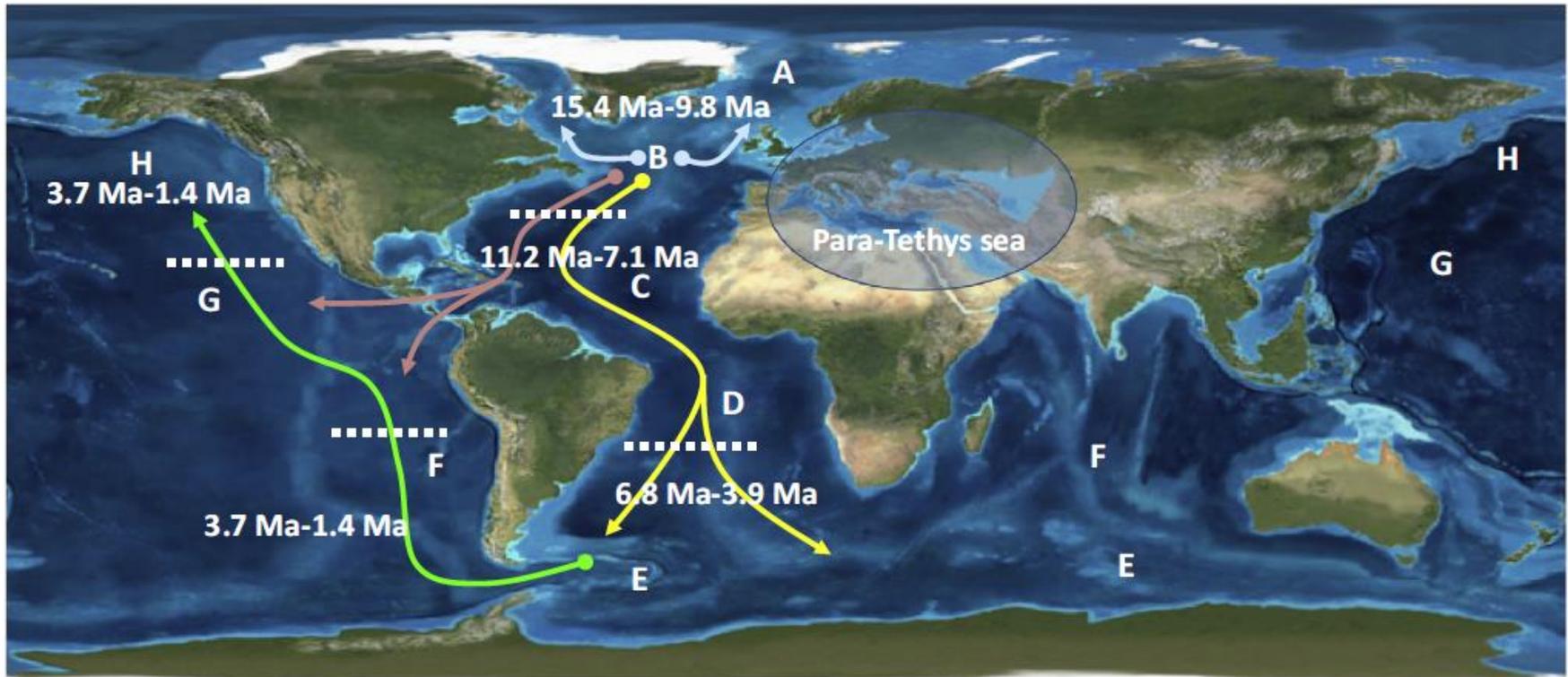
Atlantic White-sided Dolphin Systematics - 3

- Estimated biogeography based on the Island Bayesian Analysis. The proportional support for different areas at a given node is represented by pie charts
- *L. acutus* and *L. albirostris* likely shared a common ancestor that arose in the North Atlantic around the Middle Miocene, pre-dating the radiation of subfamilies Delphininae, Globicephalinae and Lissodelphininae.



Atlantic White-sided Dolphin Systematics - 4

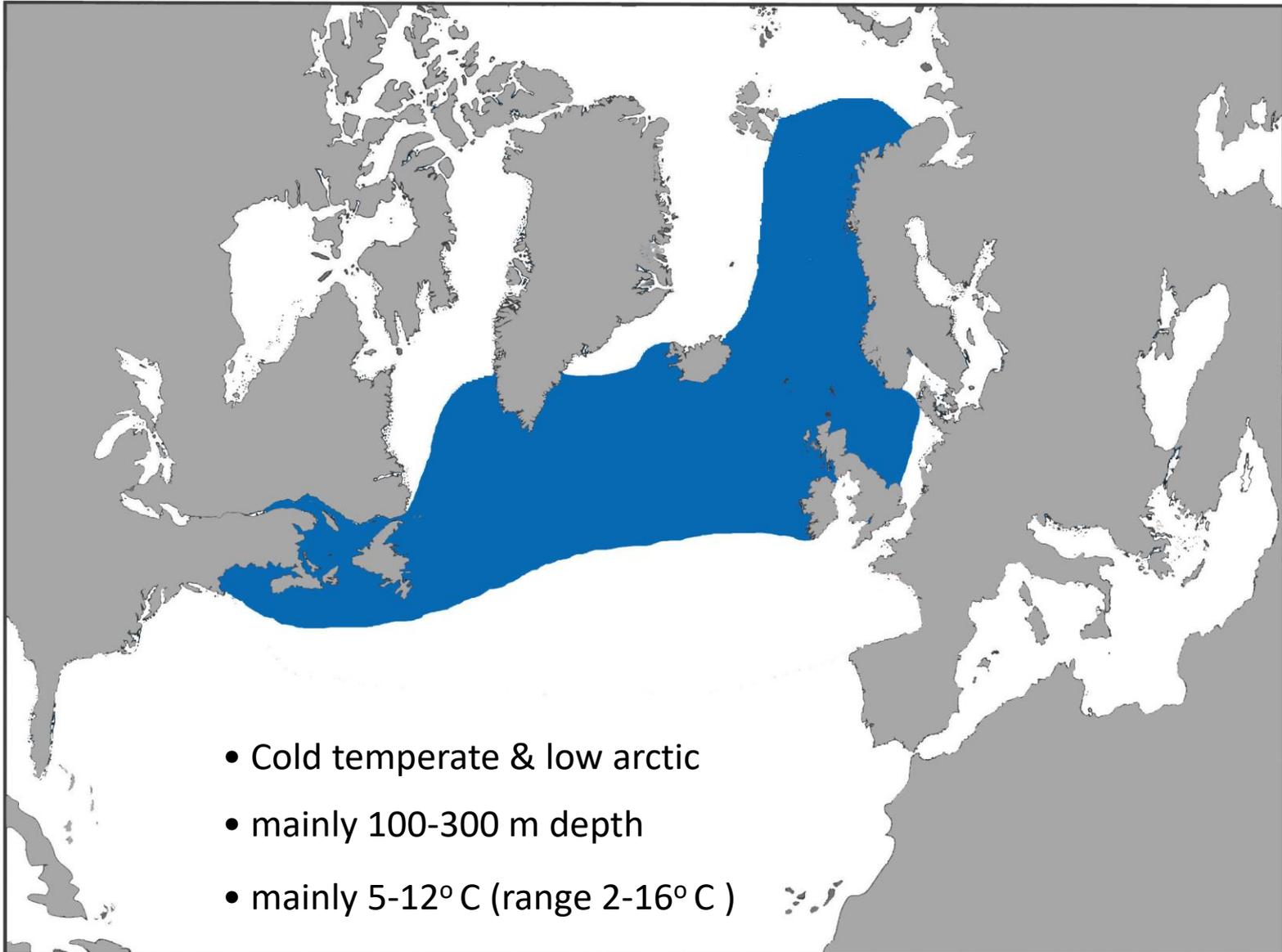
(b)



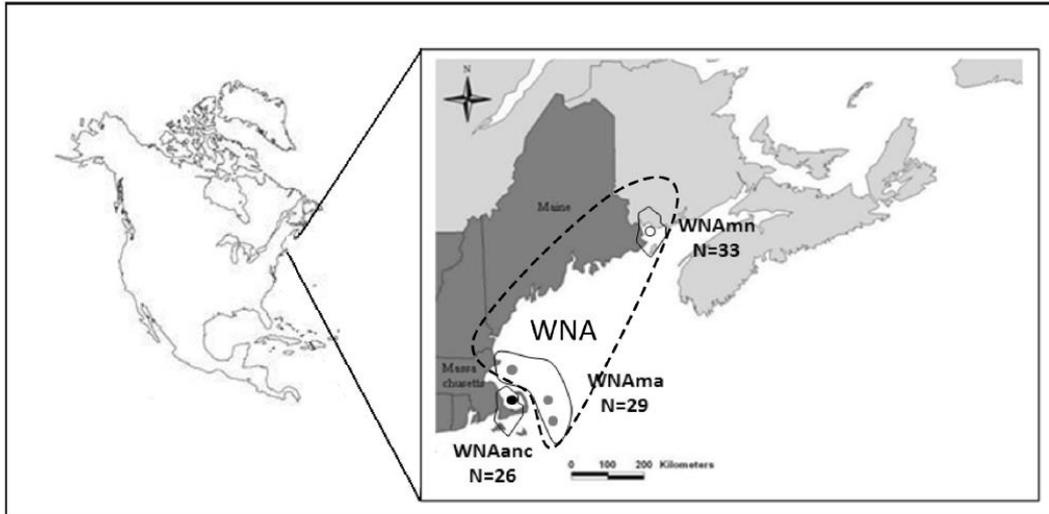
- Delphininae and Lissodelphininae ancestor
- *L. obliquidens* and *L. obscurus* ancestor
- Delphininae and Globicephalinae ancestor
- *L. acutus* and *L. albirostris* ancestor

Source: Banguera-Hinestroza *et al.*, 2014

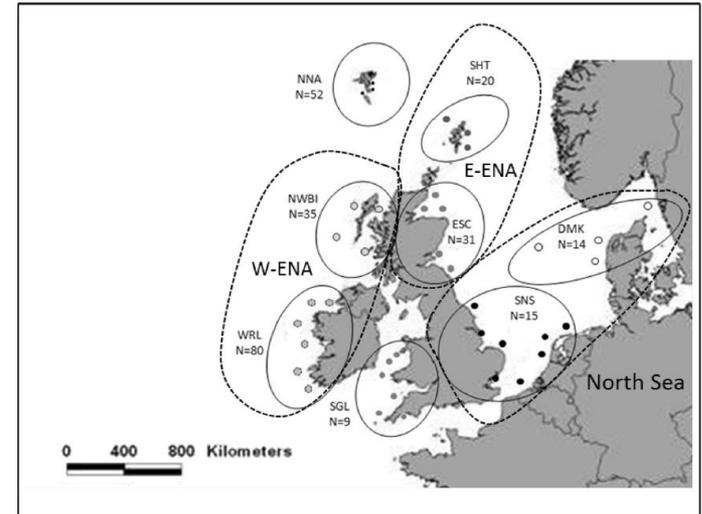
Atlantic White-sided Dolphin Distribution in North Atlantic



Atlantic White-sided Dolphin Population Structure



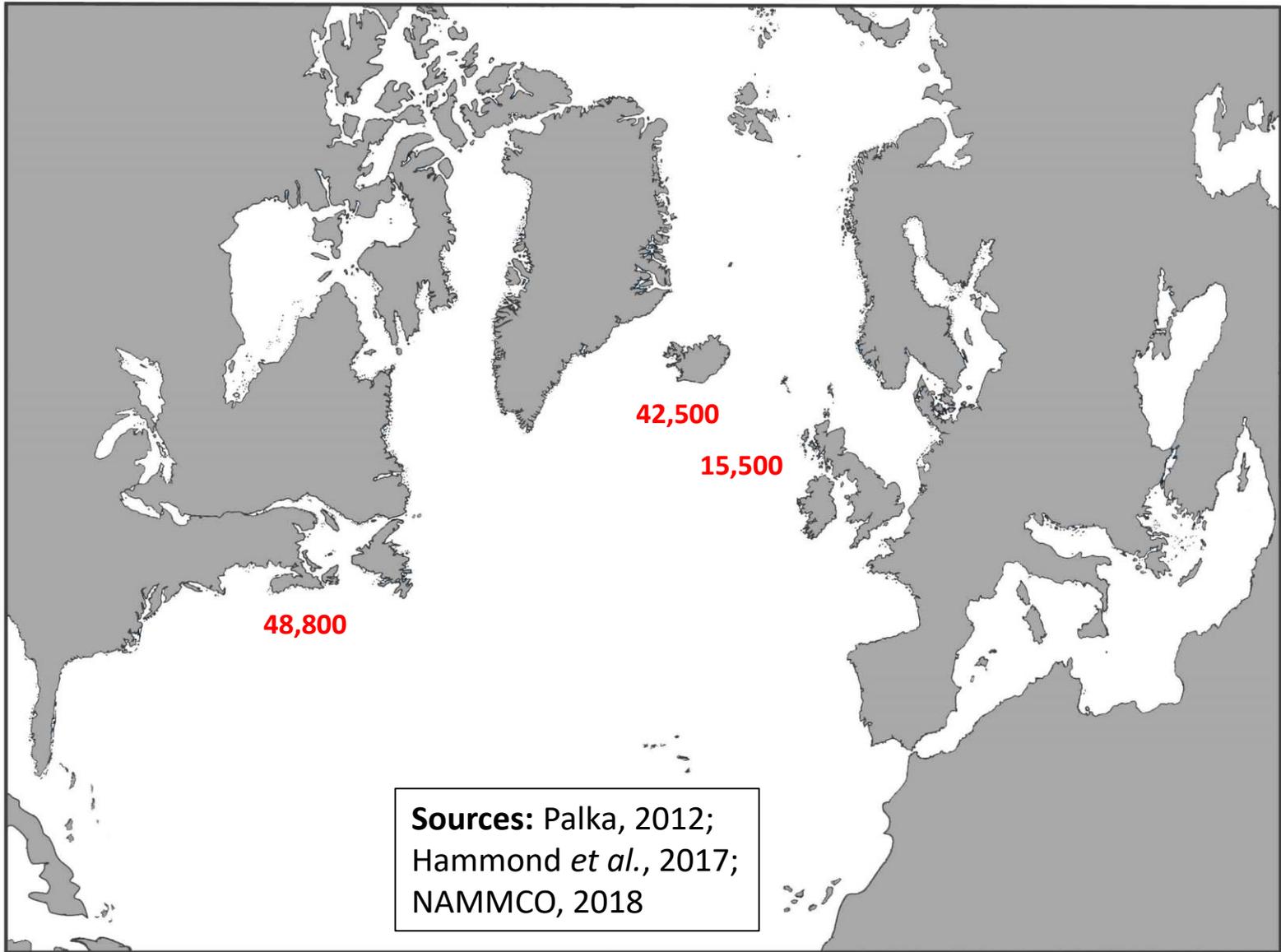
- No evidence for phenotypic differences in skull characteristics between western and eastern North Atlantic
- mtDNA analysis indicated panmixia across the North Atlantic, although animals from the North Sea (East Scotland & Shetland) showed some genetic differentiation from the rest
- High haplotype diversity ($h=0.93$)
- Low nucleotide diversity ($\pi=0.009$) indicating past bottleneck
- North-eastern region of the North Atlantic may merit separate management



- Relatively low sub-structuring in white-sided dolphin compared with white-beaked dolphin, based on RADSeq of whole genome
- Observed heterozygosity = 0.010-0.012 from microsatellite analysis, with average gene diversity over 10 loci of 0.73
- Likely rapid population expansion after most recent glaciation (9,000-14,000 years ago).

Source: Mikkelsen & Lund, 1994; Evans & Teilmann, 2009; Banguera-Hinestroza *et al.*, 2014

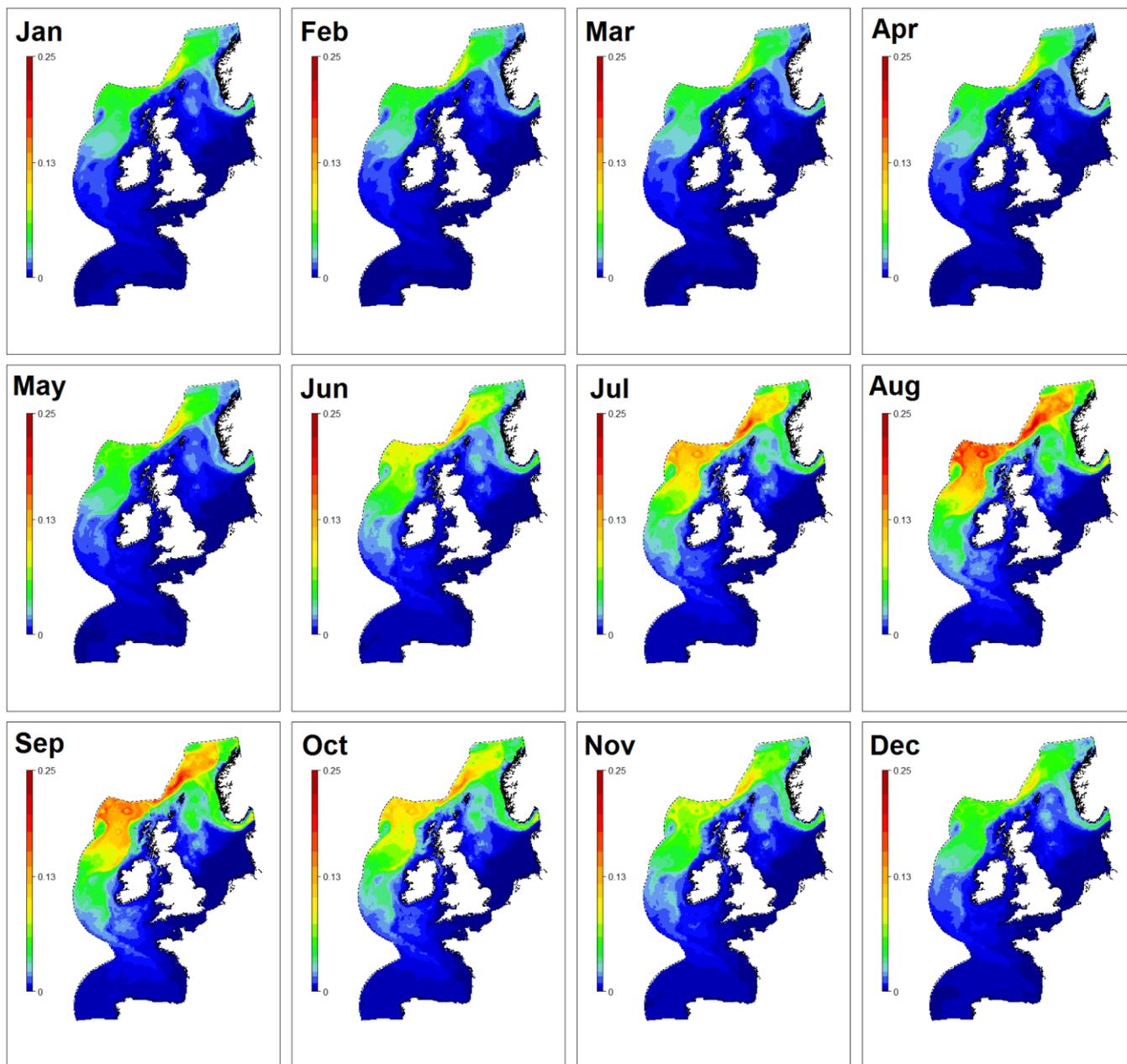
Atlantic White-sided Dolphin Abundance Estimates



Atlantic White-sided Dolphin Abundance Estimates

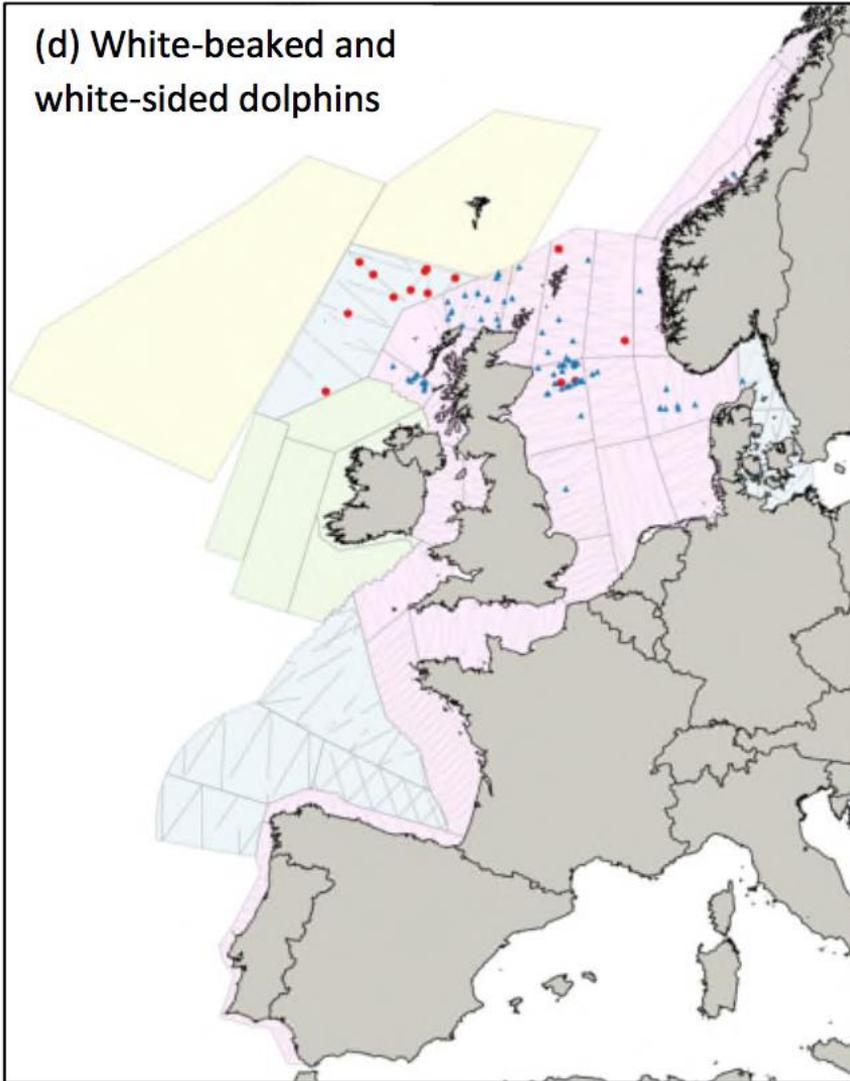
• W North Atlantic south to Nova Scotia (Winn & Edel, 1982)	30,000	late 1970s-early 1980s
• Southern Gulf of Maine to Cabot Strait (Palka <i>et al</i> , 1997)	27,000	July-Sept 1995
• Gulf of St Lawrence (Kingsley & Reeves, 1998)	12,000+	July-Sept 1995
• Western North Atlantic (Central Virginia – Lower Bay of Fundy) (Palka, 2012)	48,819	June-Aug 2011
• NW Scotland (21,371 west of Outer Hebrides & 74,626 in Faroe-Shetland Channel) (Macleod, 2004)	96,000	July-Aug 1998
• SCANS 3 Survey Area (Hammond <i>et al.</i> , 2017)	15,500	July 2016
• T-NASS Survey (NAMMCO, 2018)	42,547	Summer 2015

Atlantic White-sided Dolphin Densities in NW Europe



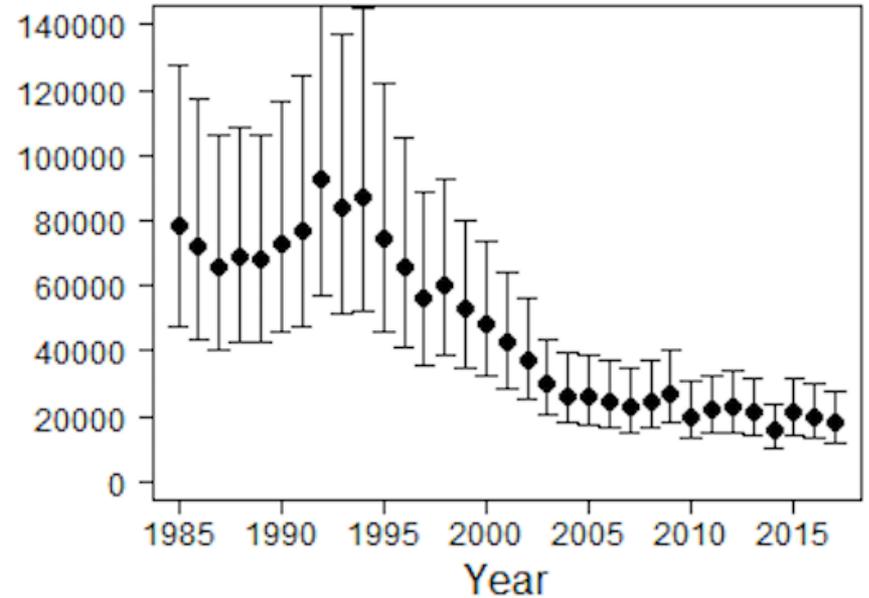
Source:
MERP Project

Atlantic White-sided Dolphin Population Trends



WBD = blue triangles; AWSD = red circles

Source: Hammond *et al.* (2017)

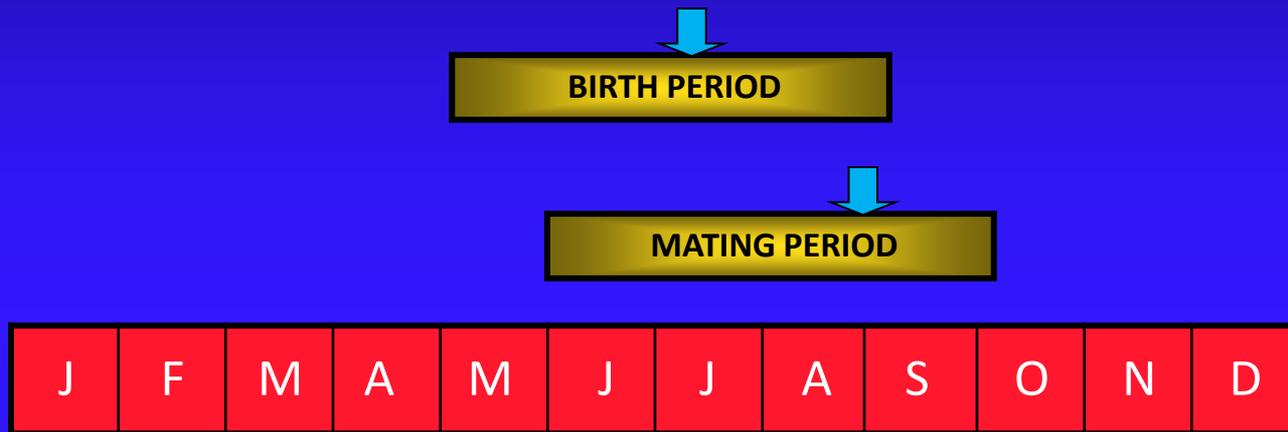


Population Trend: Decline from c. 80,000 in mid-1980s to c. 20,000 in mid-2000s

Source: MERP Project (2018)

Total Abundance: July 2016: 15,510
(CV=0.72; 95% CI: 4,389-54,807)

ANNUAL CYCLE OF THE ATLANTIC WHITE-SIDED DOLPHIN



Gestation Period: 10-12 months

Lactation Period: 18 months

Calving Interval: 2-3 years

Atlantic White-sided Dolphin Life History Parameters

Growth & Reproduction

- Length at birth is 110-120 cm at c. 25 kg weight
- Males become sexually mature at 230-240 cm length and 8-9 years of age
- Females become sexually mature at 201-222 cm length and 6-8 years of age
- Adult males average 250 cm length up to 280 cm & 230 kg
- Adult females average 224 cm length, up to 250 cm & 180 kg

Life Span

- Males at least 22 years
- Females at least 27 years



Sources: Sergeant *et al.*, 1980; Perrin & Reilly, 1984; Addink *et al.*, 1997; Reeves *et al.*, 1999; Evans & Smeenk, 2008; Cipriano, 2017

Atlantic White-sided Dolphin Group Sizes

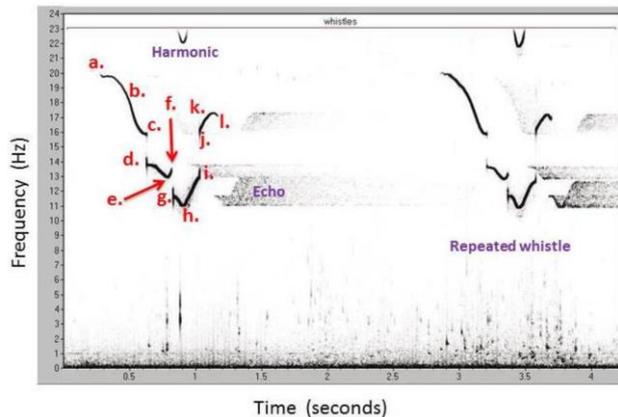


Average (Range) Group Sizes: 39 (1-500) – UK (Evans, 1992; Anderwald, 2002; Evans *et al.*, 2003)
60 (1-544) – Faroe Islands (Bloch & Mikkelsen, 2009)
50-60 (1-500) – Newfoundland, Canada (Sergeant & Fisher, 1957)
42 (1-500) – Nova Scotia & Cape Cod (Winn & Edel, 1982)
52 (1-2,500) – New England, USA (Weinrich *et al.*, 2001)

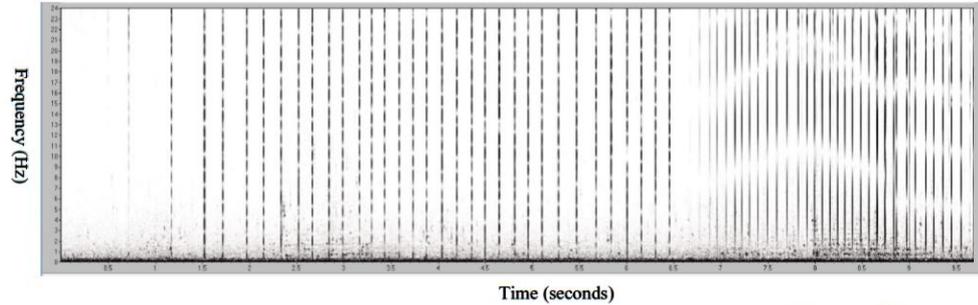
Atlantic White-sided Dolphin Acoustics

- Echolocation clicks are broadband sounds (30-40 kHz) but containing frequencies >100 kHz; (Schevill & Watkins, 1962; Hamran, 2014)
- Burst pulse signals such as buzzes and calls not well studied. They comprise concave calls, and are produced mainly during socialising (Hamran, 2014)
- Pure tonal whistles recorded in Nova Scotia and Massachusetts with dominant frequencies of 6-15 kHz (Steiner, 1981)
- Stereotyped whistles range from 11-20 kHz; duration 853 ms (Hamran, 2014)

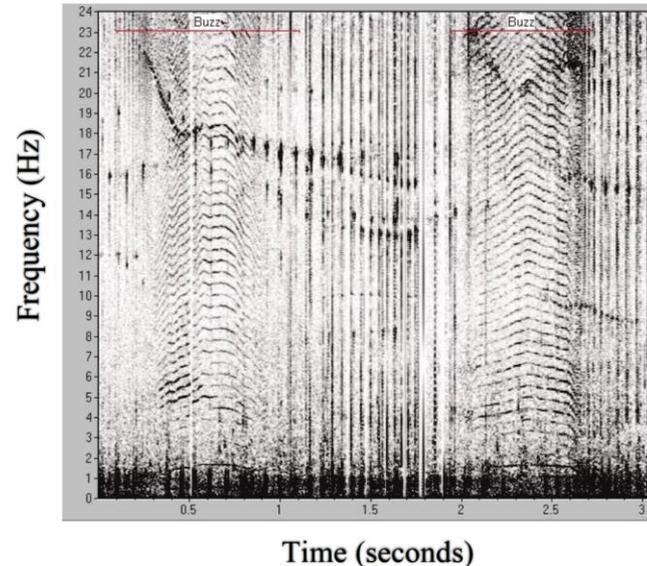
a) Whistles



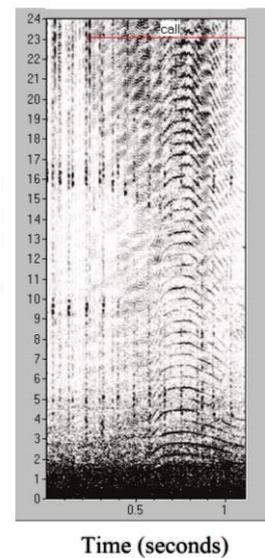
b) Clicks



c) Buzzes



d) Calls



Atlantic White-sided Dolphin Behaviour

- Sometimes bow-rides or stern-rides vessels; breaches are commonly observed; leaps at a shallow angle (Evans, 1987)
- May form mixed groups with other species, e.g. fin & humpback whales, pilot whales, white-beaked, common dolphins (Evans, 1982)
- Swim speeds average 5.7 km/hour (range 1.8-14.2 km/hour (Mate *et al.*, 1994))
- Mean dive duration of a radio-tagged individual was 38.8 sec, and never more than 4 min, with 89% of its time spent underwater (Mate *et al.*, 1994)
- A radio-tagged individual mainly occupied water of depths of between 18-90 metres (Mate *et al.*, 1994)
- Probably can travel great distances: one satellite-tagged individual travelled 309 km in 64.3 hours (Mate *et al.*, 1994)



Whaling



Over fishing



Entanglement in fishing gear



Ship strikes



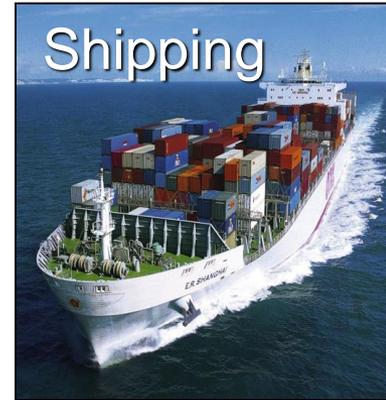
Pollution



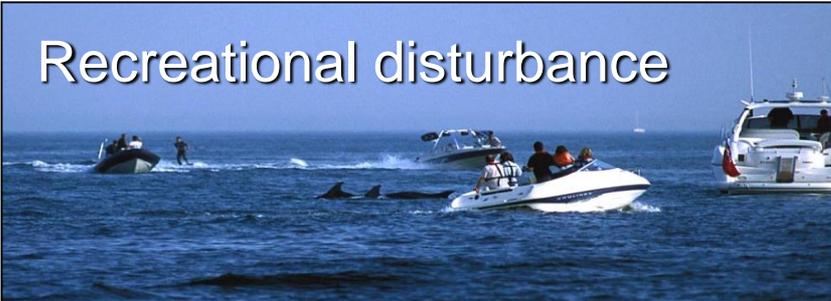
Active sonar



Shipping



Recreational disturbance



Climate



Change

Wind farm construction



Atlantic White-sided Dolphin

Threat Matrix

		Greater North Sea	Celtic Seas	NE Atlantic	
POLLUTION & OTHER CHEMICAL CHANGES	Contaminants	M	M	M	
	Nutrient enrichment	L	L	L	
PHYSICAL LOSS	Habitat loss	L	L	L	
PHYSICAL DAMAGE	Habitat degradation	L	L	L	
OTHER PHYSICAL PRESSURES	Litter (<u>inc. microplastics and discarded fishing gear</u>)	L	L	L	
	Underwater noise changes	Military Sonar	M	M	M
		Seismic surveys	M	M	M
		Pile-driving	M	M	M
		Shipping	M	M	M
	Barrier to species movement (offshore windfarm, wave or tidal device arrays)	L	L	L	
	Death or injury by collision	L	L	L	
BIOLOGICAL PRESSURES	Introduction of microbial pathogens	L	L	L	
	Removal of target and non-target species (prey depletion)	M	M	M	
	Removal of non-target species (marine mammal bycatch)	M	M	M	
	Disturbance (e.g. wildlife watching)	L	L	L	
	Deliberate killing + hunting	L	L	M	

Source: Updated from ICES, 2015

Faroese small cetacean catches: Atlantic White-sided Dolphins



- Annual catches vary from 1-546, and have averaged 234 between 1998-2017 (total 4,683)
- Catches made mainly in July-Nov

Sources:
Bloch & Mikkelsen, 2009;
WDC, 2018

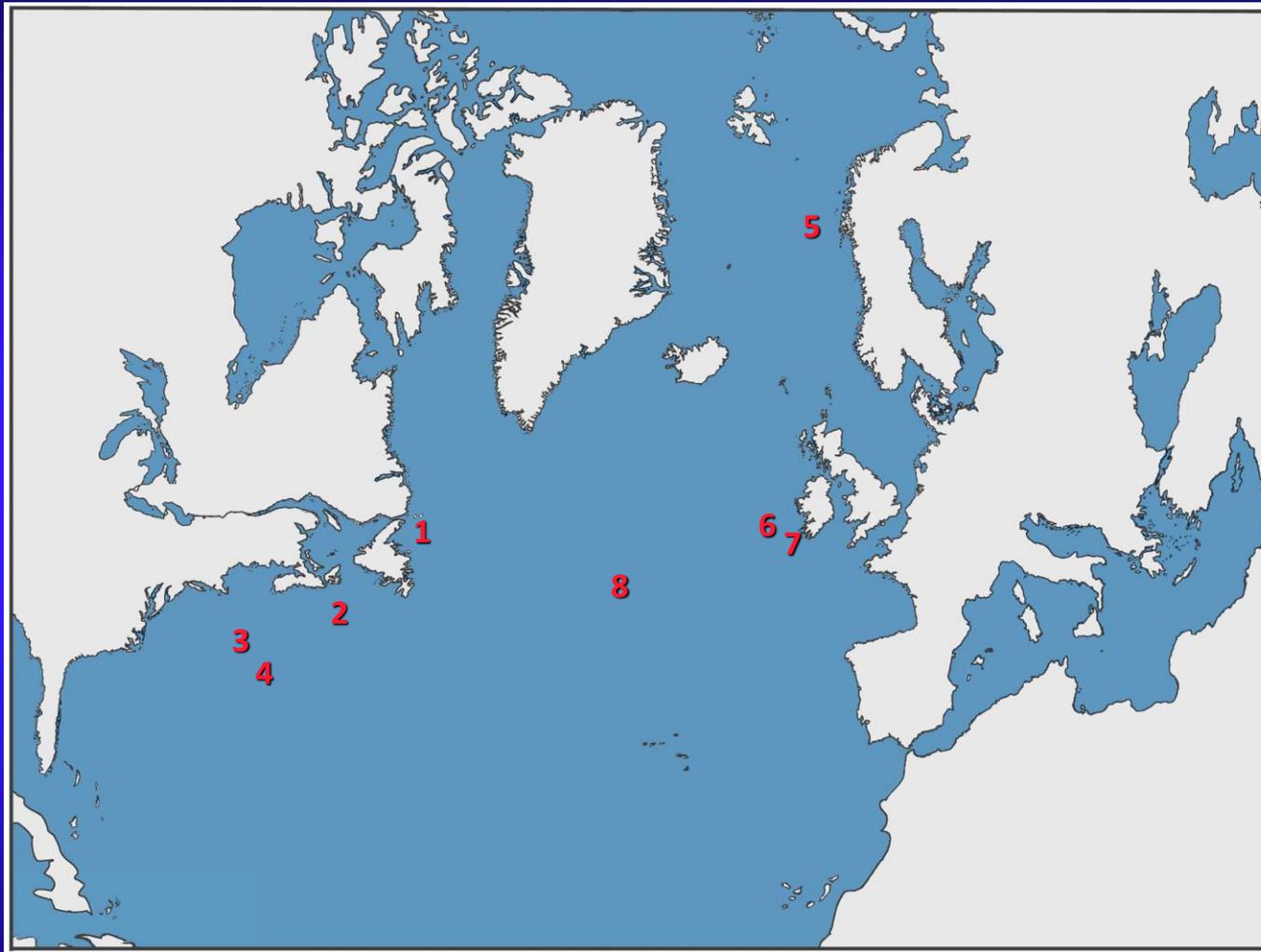
Year	Long-finned pilot whales	White-sided dolphins	Common bottlenose dolphins	Risso's dolphin	Bottlenose whales ('strandings')	Total
1998	815	543				1,358
1999	608					608
2000	588	265			3	856
2001	918	546	6			1,470
2002	626	773	18		6	1,423
2003	503	186	3			692
2004	1,012	333				1,345
2005	302	312			1	615
2006	856	622	17			1,495
2007	633				3	636
2008		1			7	8
2009	310	170	1	3	2	486
2010	1,107	14		21		1,142
2011	726					726
2012	713				2	715
2013	1,104	430				1,534
2014	48				5	53
2015	501				2	503
2016	295					295
2017	1,203	488				1,691
Total	12,868	4,683	45	24	31	17,651

Atlantic White-sided Dolphin Health Status



- Of 79 PME in the UK from 1995-2015, 45 were live strandings, 9 had died with generalised bacterial infections, 6 starvation, 5 meningo-cephalitis, 4 bycatch, 4 *Brucella* infection, 1 circulatory failure, 1 bacterial pneumonia, 1 liver infection, 1 skeletal pathology, 1 parasitic gastritis, 1 stillborn (Bennett *et al.*, 2000; SAC, 2000; Jepson, 2005; Deaville & Jepson, 2011; Deaville, 2011, 2012, 2013, 2014, 2015)
- Mercury in liver of a juvenile from NW Ireland was relatively high (44 ng/g wet weight) (Law *et al.*, 1991)
- Maximum concentrations (ng/g lipid) have been 3,290 dieldrin, 145 HCB, 73 mirex, 63 lindane, 23,100 p, p'-DDE, 401 heptachlor epoxide, 767 oxychlordane, 1,230 *cis*-chlordane, and 7,020 *trans*-nonachlor, 19 µg/g zinc, 12 µg/g cadmium (Kuehl *et al.*, 1991, 1994; Borrell, 1993; Palka *et al.*, 1997; McKenzie *et al.*, 1998 ; Das *et al.*, 2002)

Diet of Atlantic White-sided Dolphin

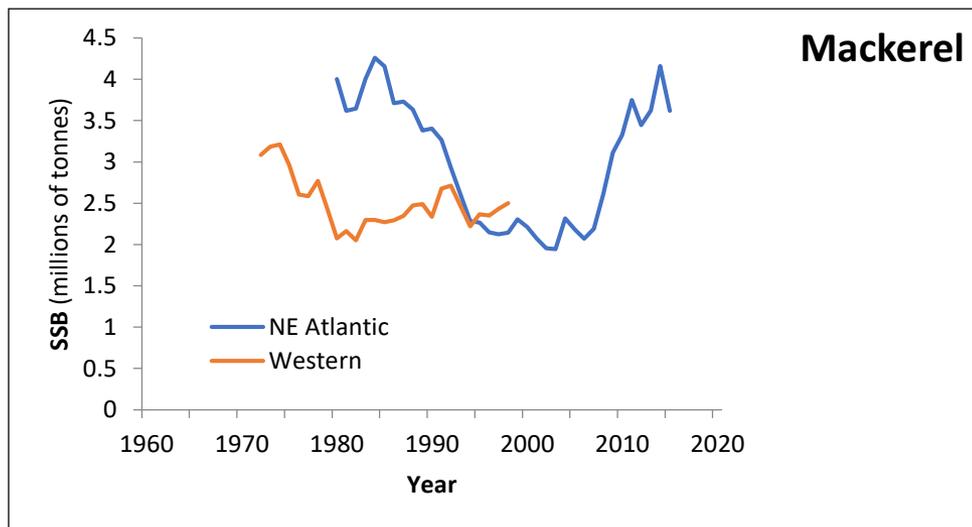
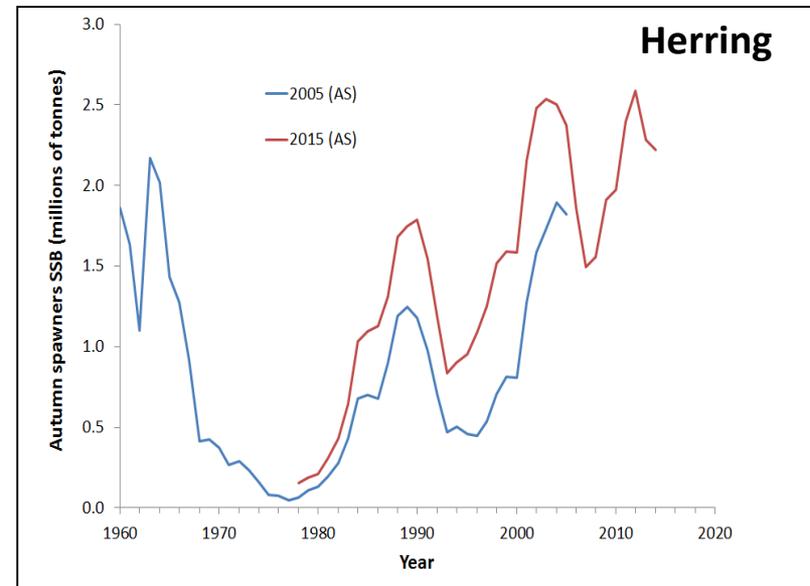
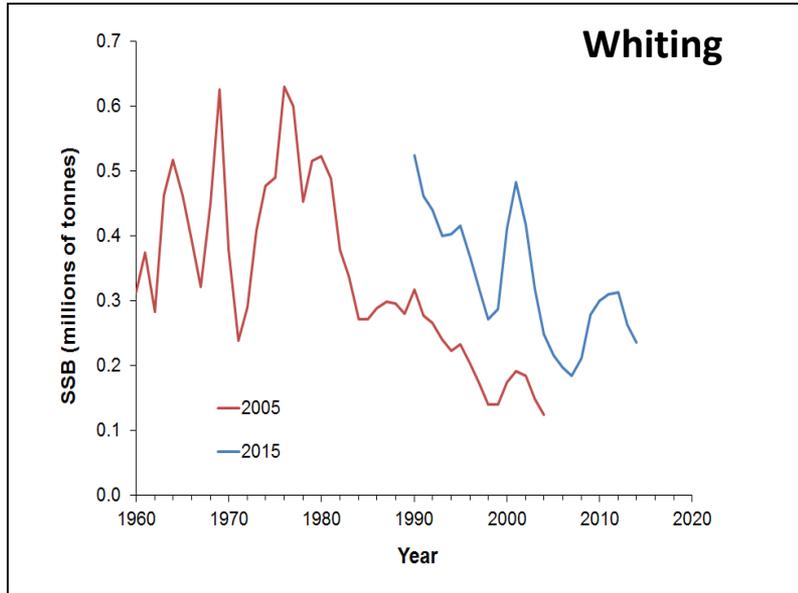


- Principal Species
- 1 Herring, northern shortfin squid
 - 2 Herring, silver hake, northern shortfin squid
 - 3 Northern shortfin squid, rainbow smelt, silver hake, sandeel
 - 4 Silver hake, spoonarm octopus, haddock, sandeel, lanternfish
 - 5 Mackerel, herring
 - 6 Mackerel, silvery pout, lanternfishes
 - 7 Blue whiting, *Trisopterus* spp., whiting, horse mackerel, herring
 - 8 Glacier lanternfish

(Sources: Sergeant & Fisher, 1957; Katona *et al.*, 1978; St. Aubin & Geraci, 1979; Sergeant *et al.*, 1980; Evans, 1987; Couperus, 1997; Nottestad *et al.*, 2001; Doksaeter *et al.*, 2008; Hernandez-Milian *et al.*, 2016)

Temporal trends in fish prey species

Spawning Stock Biomasses



Source: ICES data

Atlantic White-sided Dolphin: Research Questions

- Better abundance estimates across all areas of North Atlantic
- Genetic sampling in northern & north-eastern parts of range
- Studies of life history parameters (ages & lengths at sexual maturity, reproductive rates, life spans) from stranded & bycaught animals
- Studies of diet through stomach contents, stable isotope and fatty acid analyses
- Development of an audiogram for the species
- More contaminant studies
- Studies of likely effects of climate change



Thank you for listening

