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

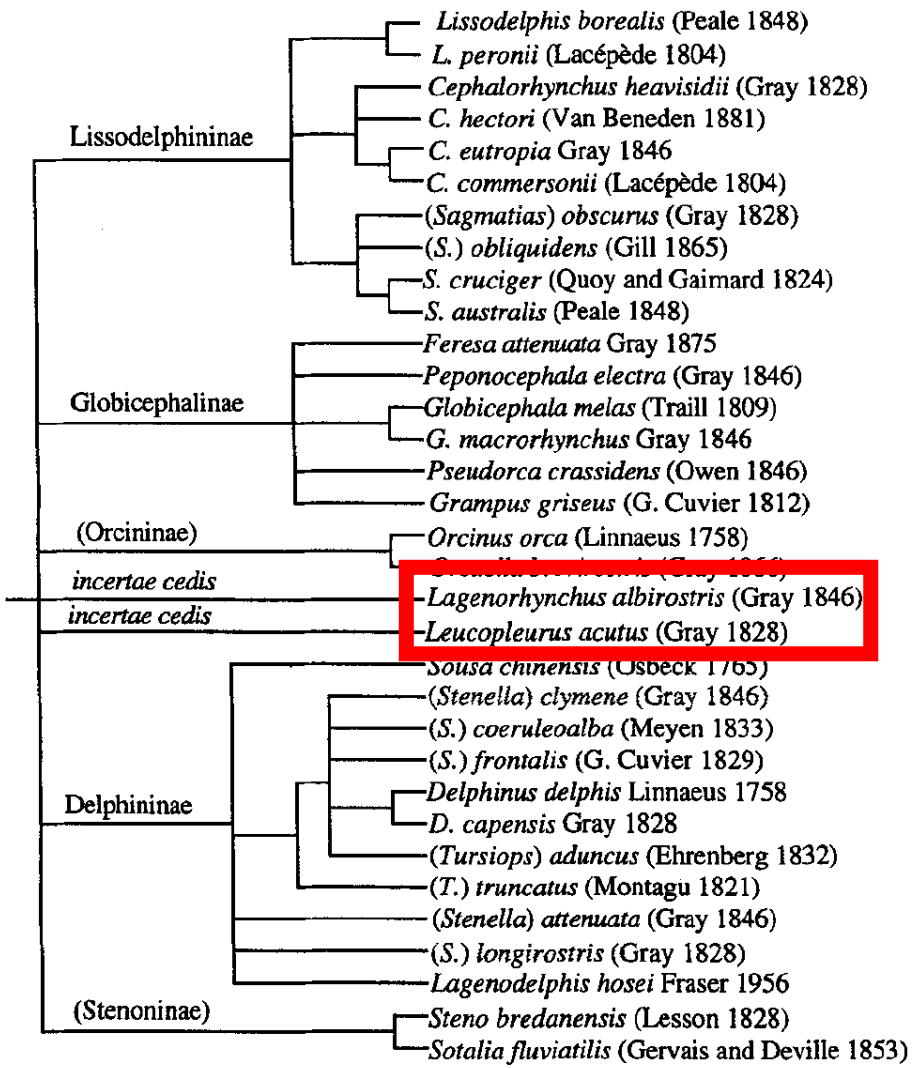
*Peter G.H. Evans*

School of Ocean Sciences, University of Bangor & Sea Watch Foundation, UK

# Atlantic White-sided Dolphin Systematics - 1

**Cytochrome b analysis**

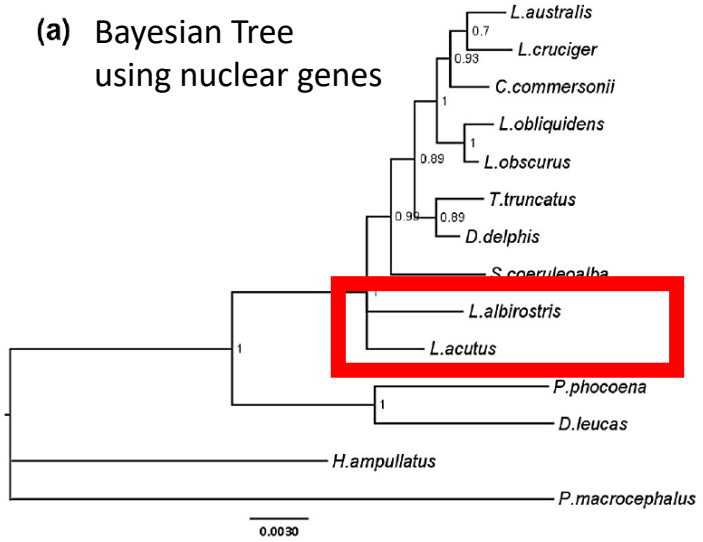
- Suggested that Atlantic white-sided dolphin (*Lagenorhynchus acutus*) should be in a separate genus



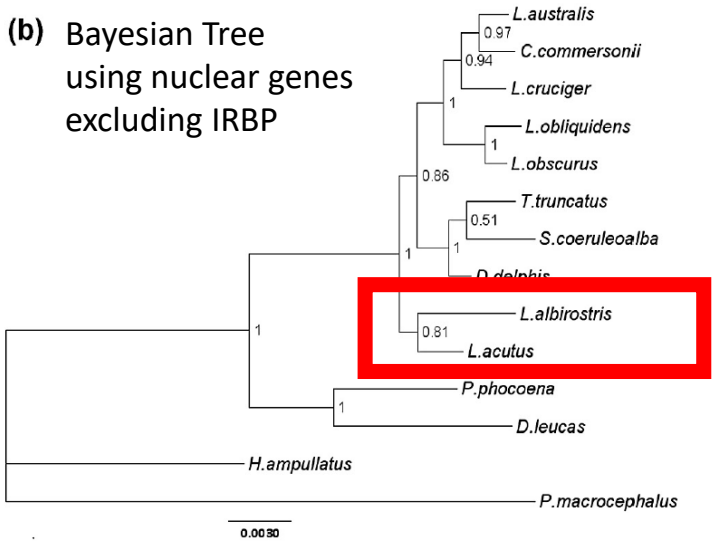

**Source:** Le Duc *et al.*, 1999

# Atlantic White-sided Dolphin Systematics - 2

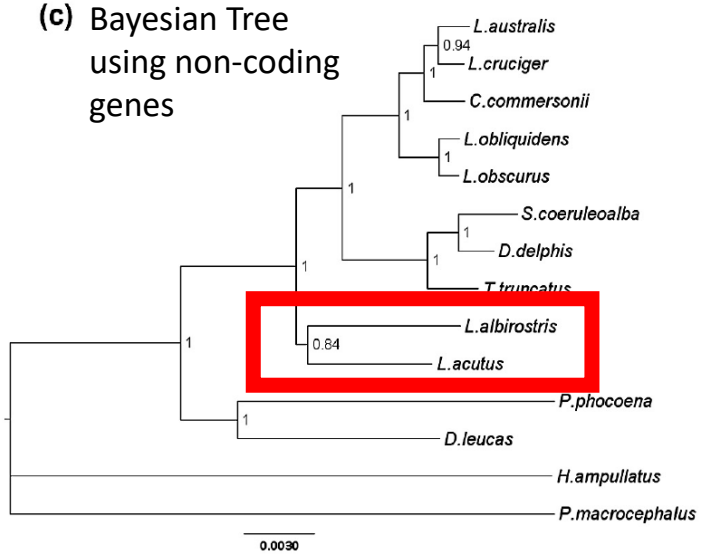
**(a)** Bayesian Tree using nuclear genes



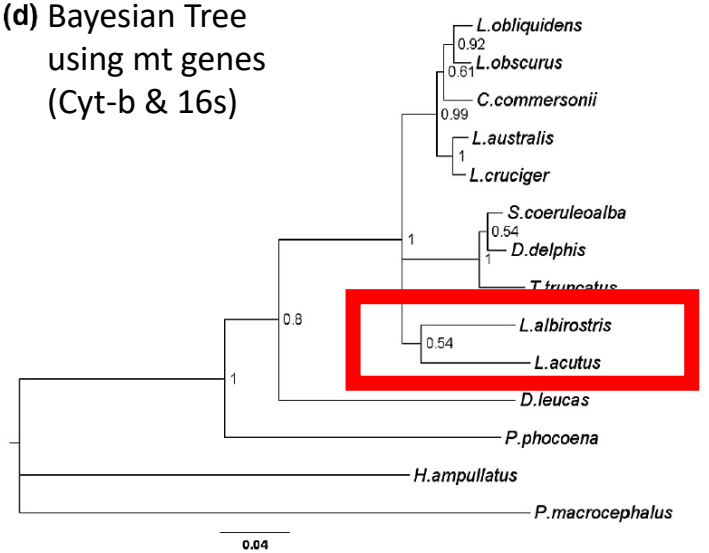

**(b)** Bayesian Tree using nuclear genes excluding IRBP




**(c)** Bayesian Tree using non-coding genes




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

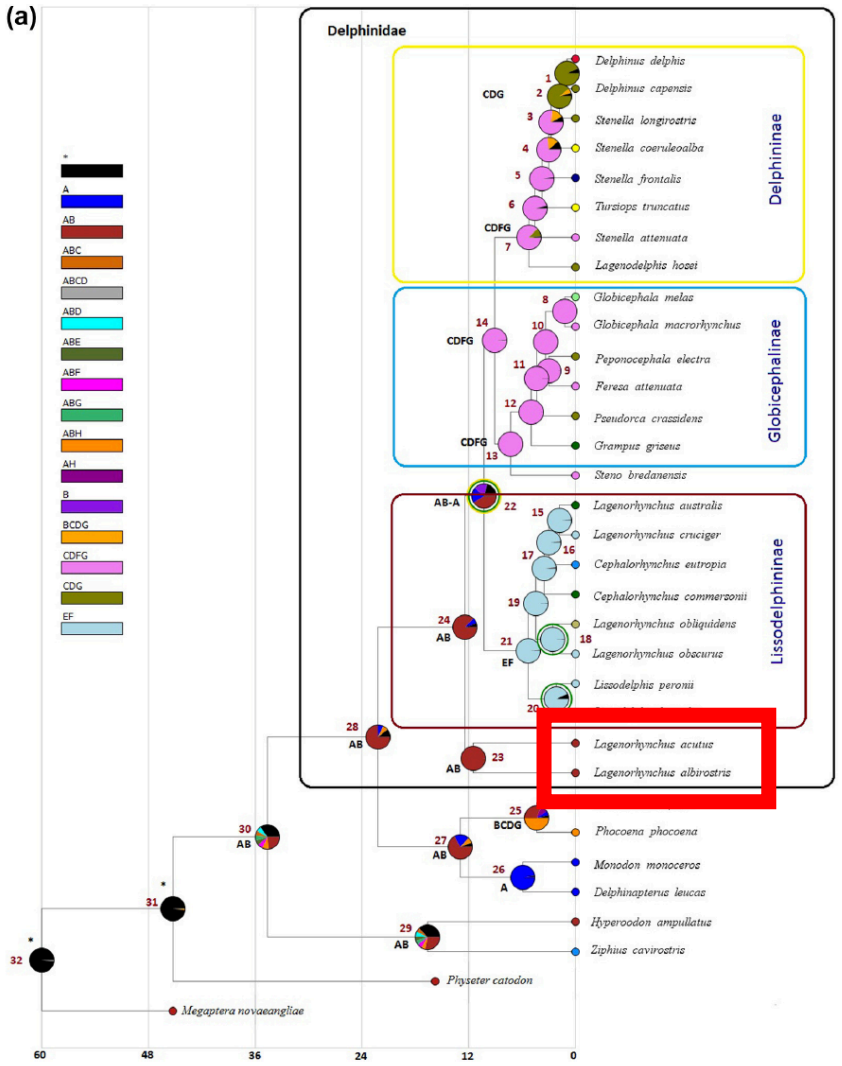



**Source:** Banguera-Hinestroza *et al.*, 2014

# Atlantic White-sided Dolphin Systematics - 3

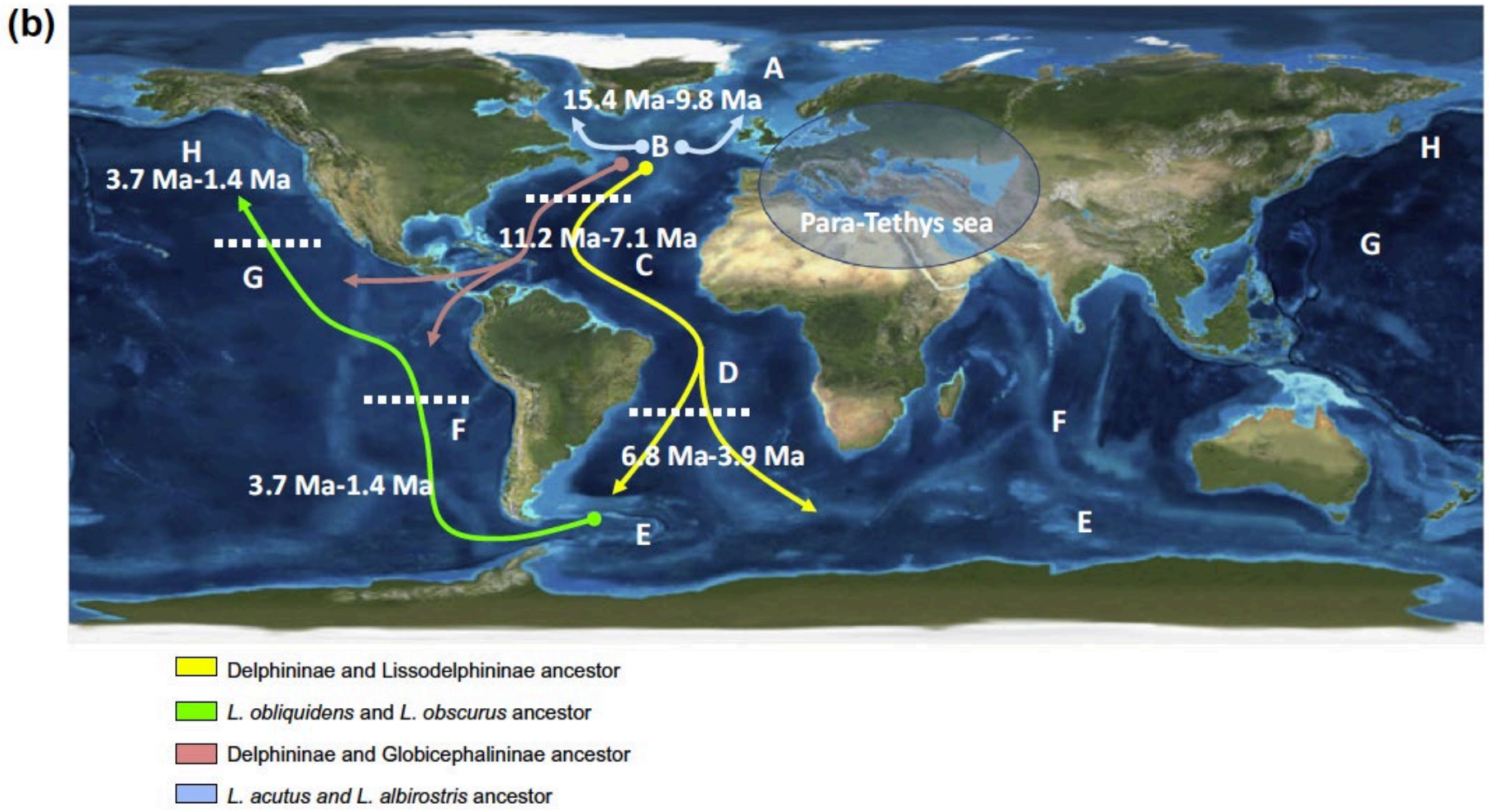
- Estimated biogeography based on the Island Bayesian Analysis. The proportional support for different areas at a given node is represented by pie charts

- *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.



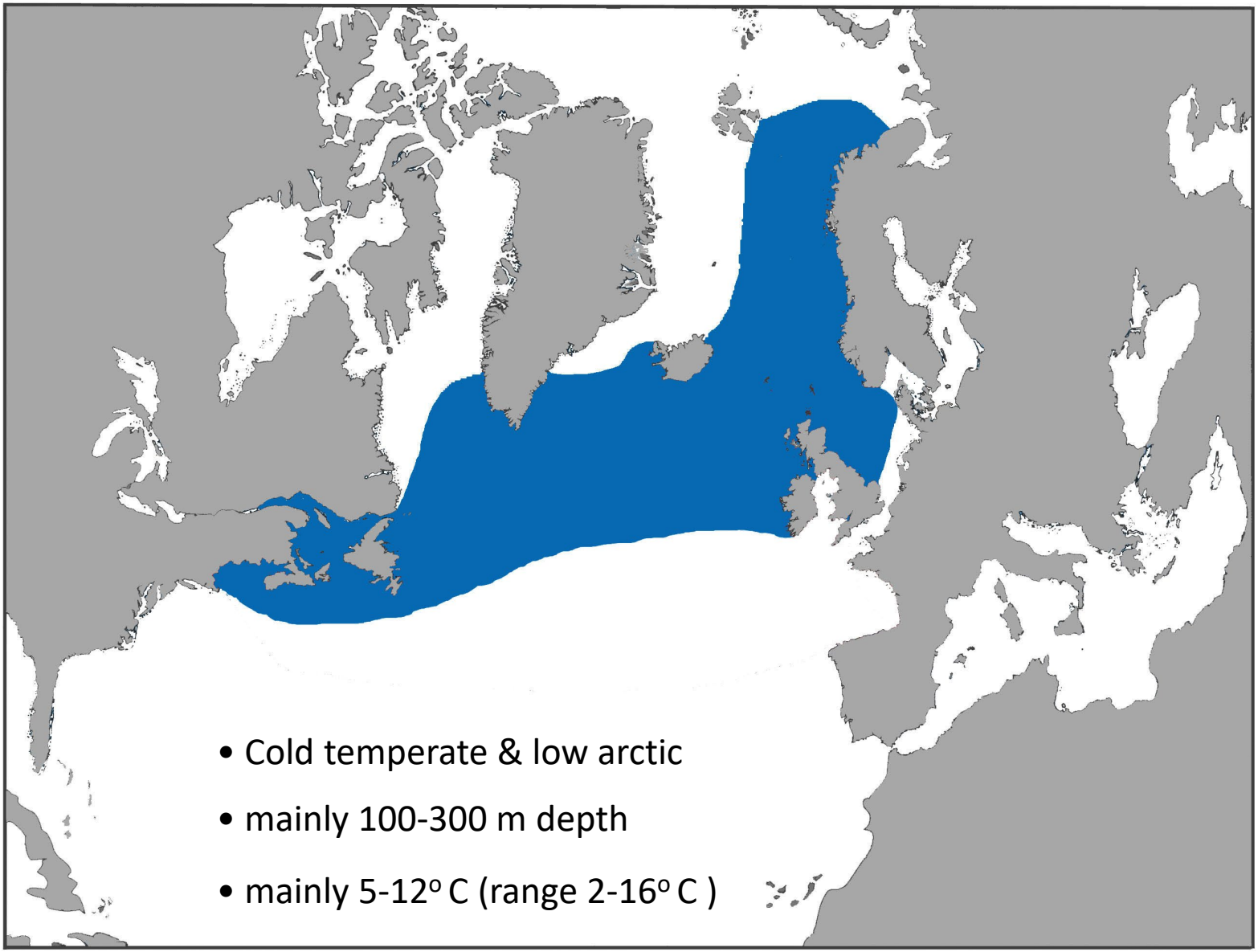

**Source:** Banguera-Hinestroza *et al.*, 2014

# Atlantic White-sided Dolphin Systematics - 4

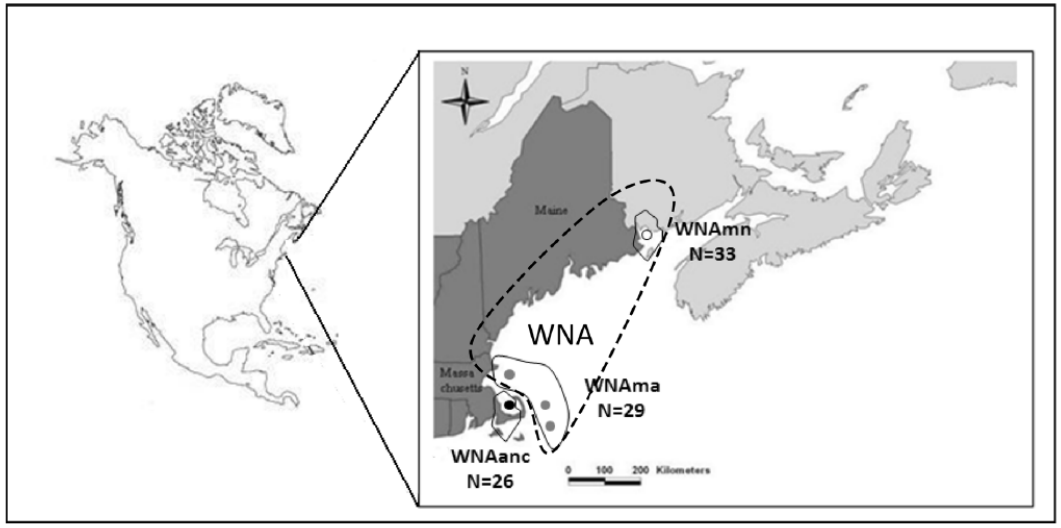


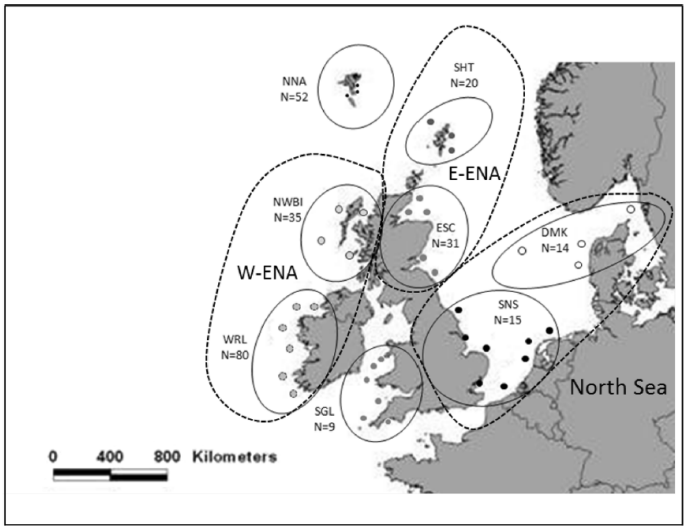

**Source:** Banguera-Hinestroza *et al*., 2014

# Atlantic White-sided Dolphin Distribution in North Atlantic



# Atlantic White-sided Dolphin Population Structure



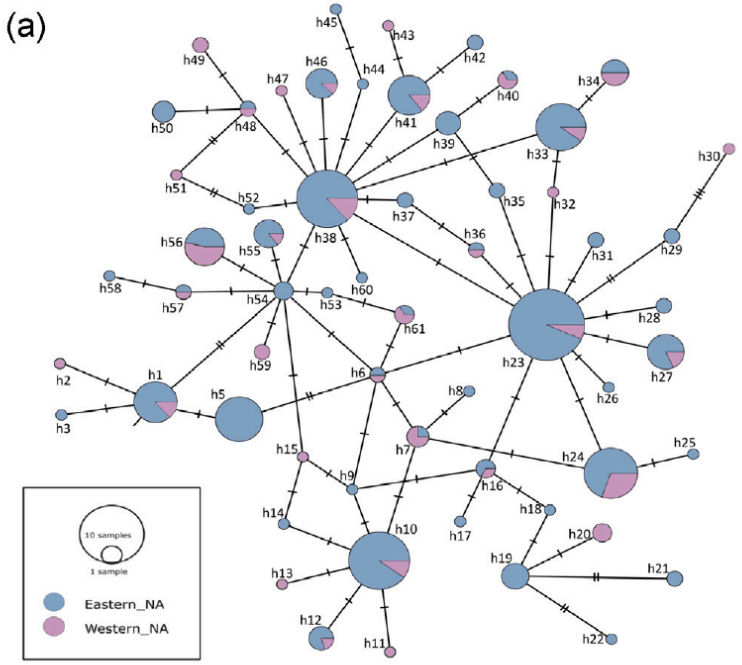

- No evidence for phenotypic differences in skull characteristics between western and eastern North Atlantic
- mtDNA analysis indicated panmixia across the North Atlantic, although animals from the North Sea (East Scotland & Shetland) showed some genetic differentiation from the rest
- High haplotype 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

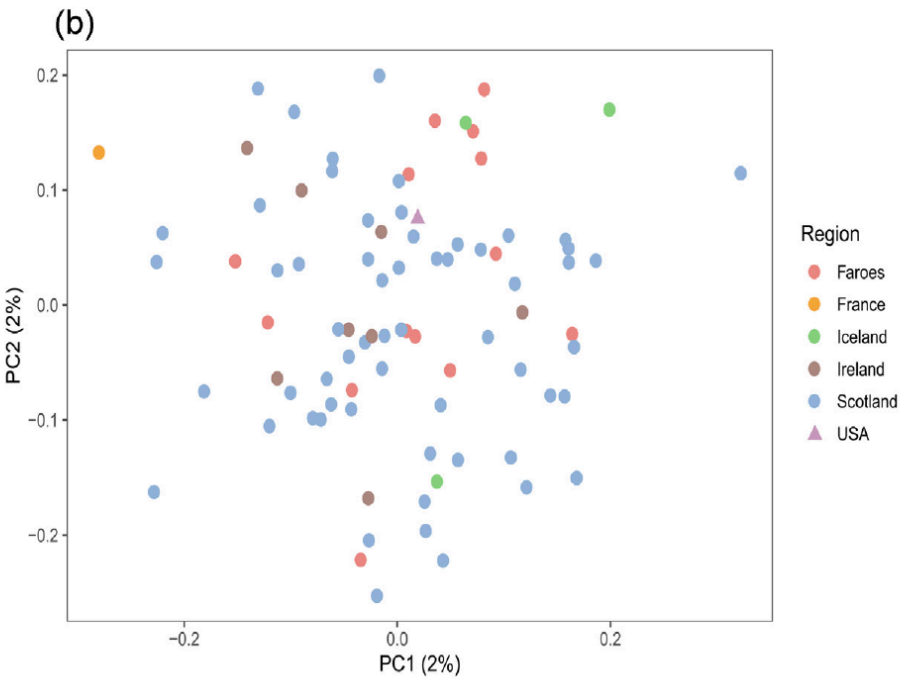
# Atlantic White-sided Dolphin Population Structure

Minimum spanning network of mtDNA haplotypes



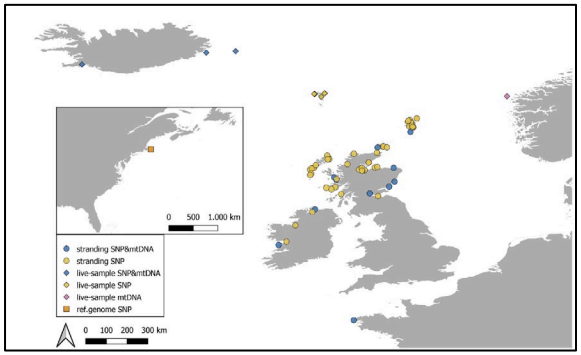

Circle size is relative to the number of individuals sharing each haplotype, Colours represent east and west North Atlantic

Plot of the first two PCA axes for 86 individuals & 2381 SNPs

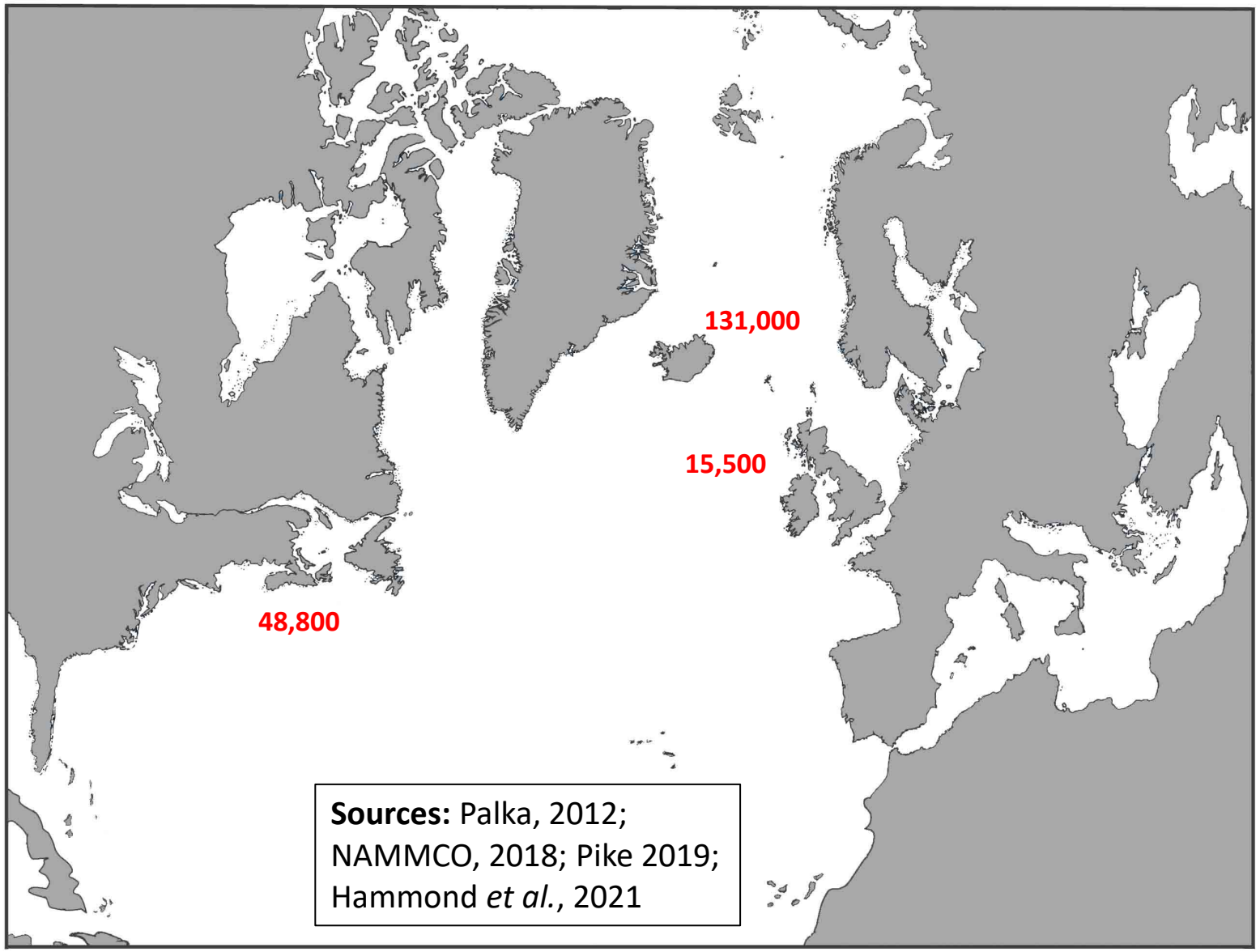



Shows absence of genetic clustering across six sampled regions of the North Atlantic.

**Source**: Gose *et al.* (2023)



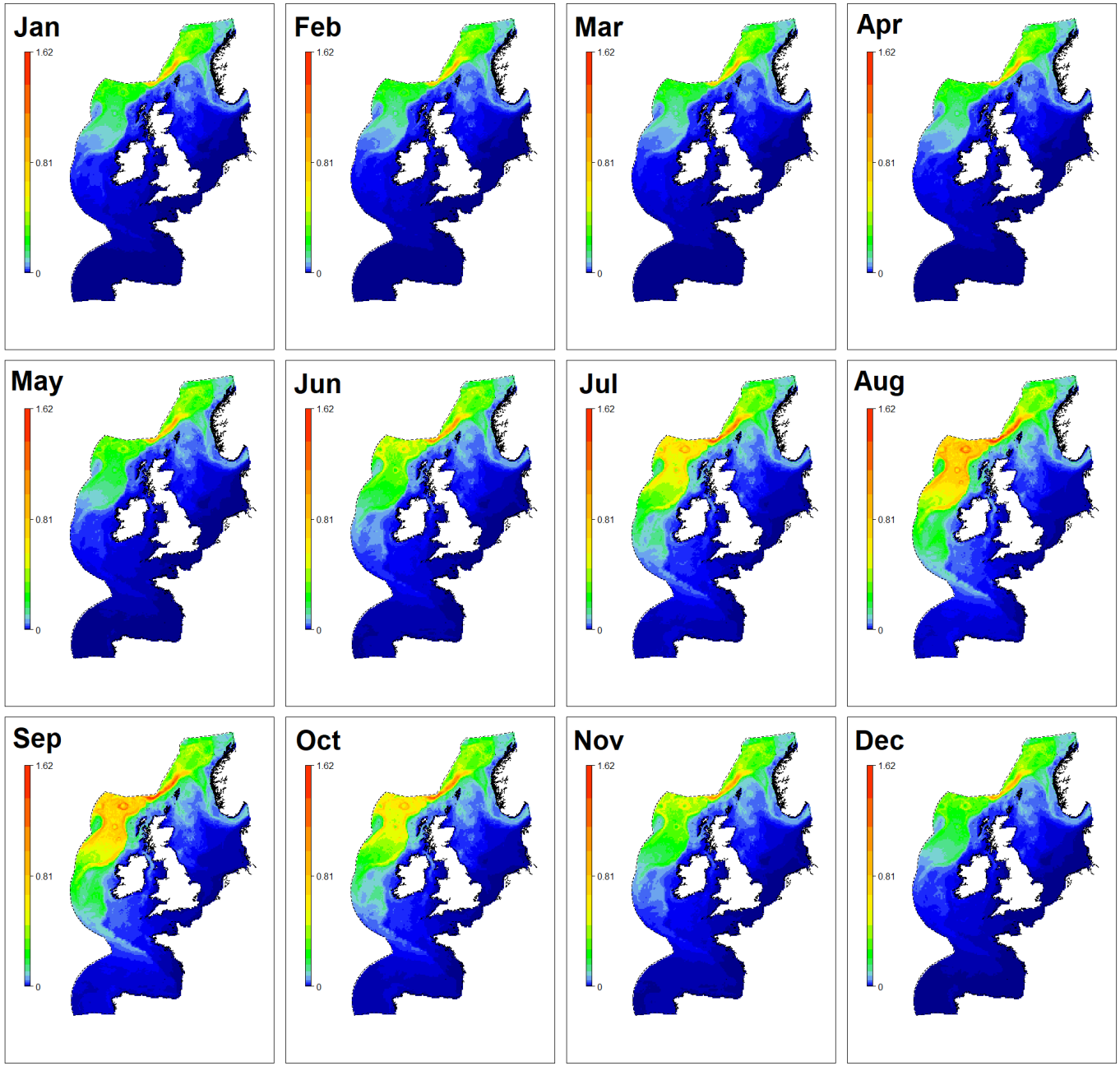
# Atlantic White-sided Dolphin Abundance Estimates



# Atlantic White-sided Dolphin Abundance Estimates

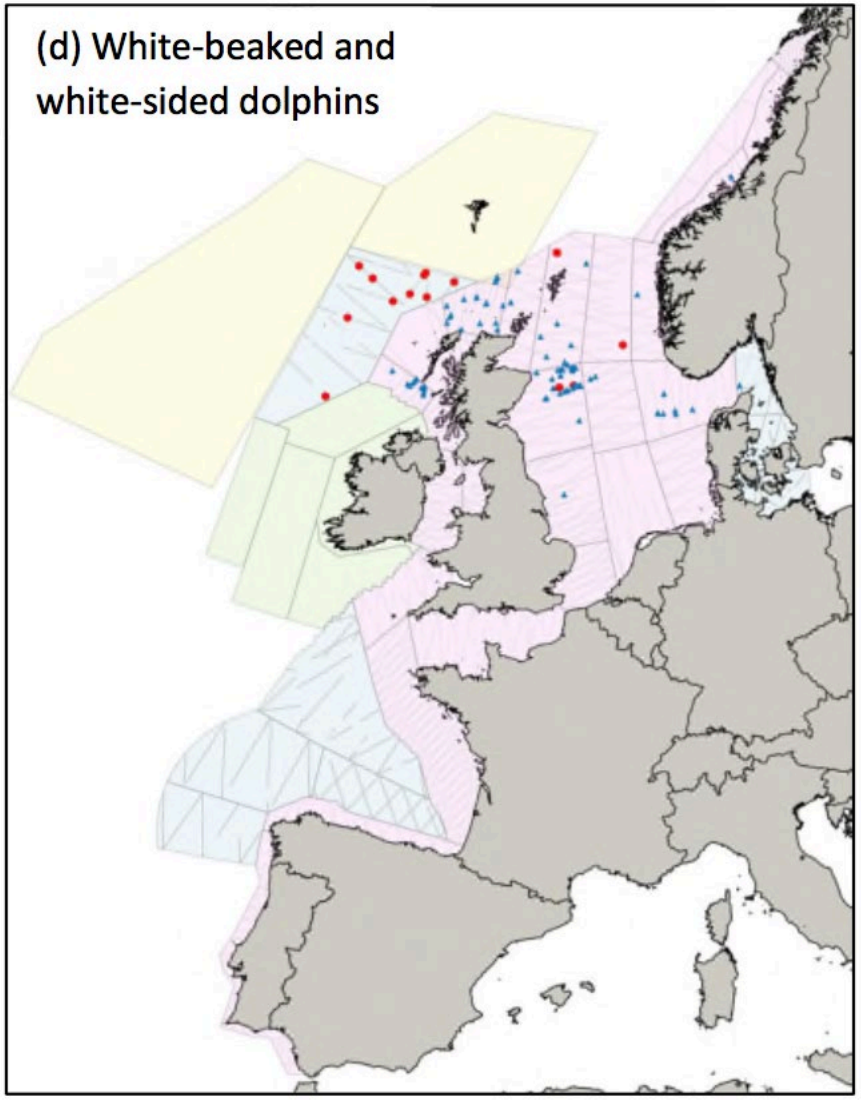
| | | |
|---|---|---|
| • W North Atlantic south to Nova Scotia (Winn & Edel, 1982) | 30,000 | late 1970s-early 1980s |
| • Southern Gulf of Maine to Cabot Strait (Palka *et al*, 1997) | 27,000 | July-Sept 1995 |
| • Gulf of St Lawrence (Kingsley & Reeves, 1998) | 12,000+ | July-Sept 1995 |
| • Western 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 |
| • T-NASS Survey (NAMMCO, 2018; Pike *et al*., 2019) | 131,000 | Summer 2015 |
| • SCANS 3 Survey Area (Hammond *et al*., 2021) | 15,500 | July 2016 |
| • SCANS 4 Survey Area (Gilles *et al*., 2023) | 3,500+ (excludes offshore NW Scotland) | Summer 2022 |

# Atlantic White-sided Dolphin Densities in NW Europe



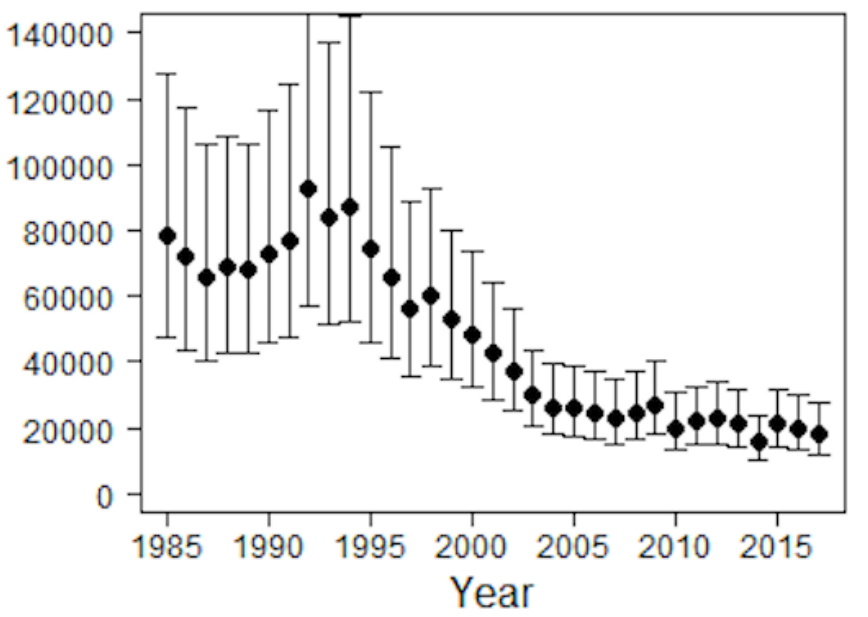

**Source:**
Waggitt et al, 2020

# Atlantic White-sided Dolphin Population Trends




WBD = blue triangles; AWSD = red circles

**Source:** Hammond *et al.* (2017)

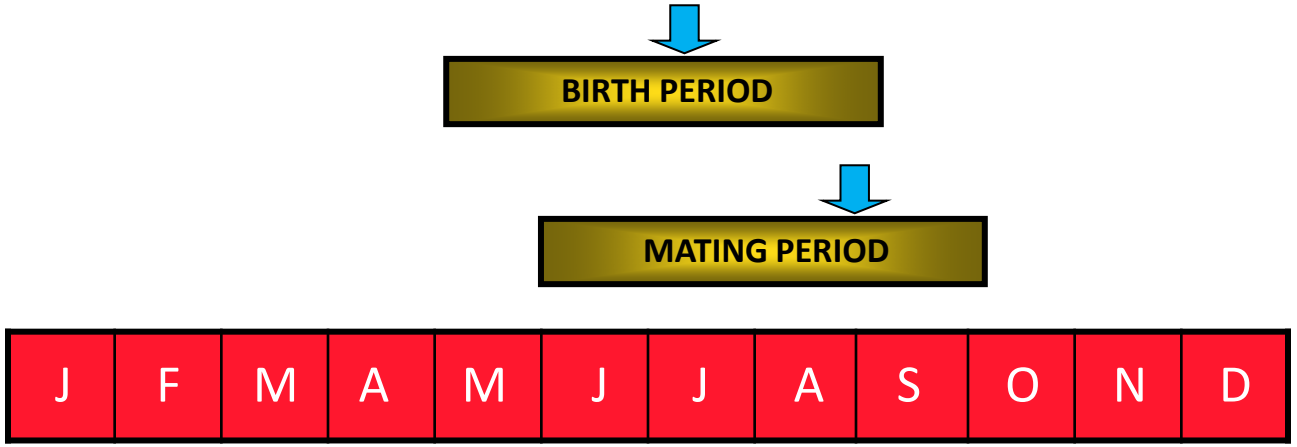



**Population Trend:** Decline from c. 80,000 in mid-1980s to c. 20,000 in mid-2000s

**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

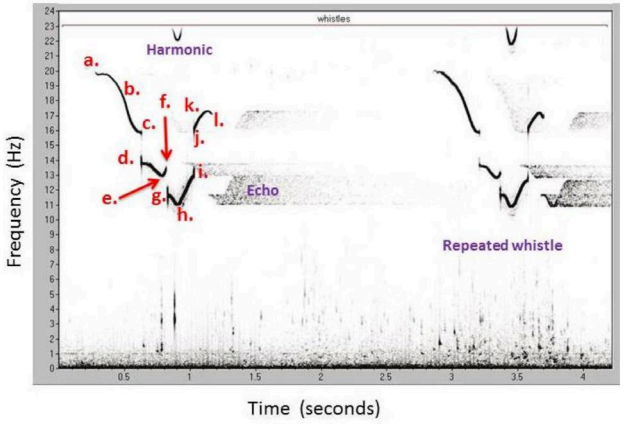
# Atlantic White-sided Dolphin Group Sizes

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)

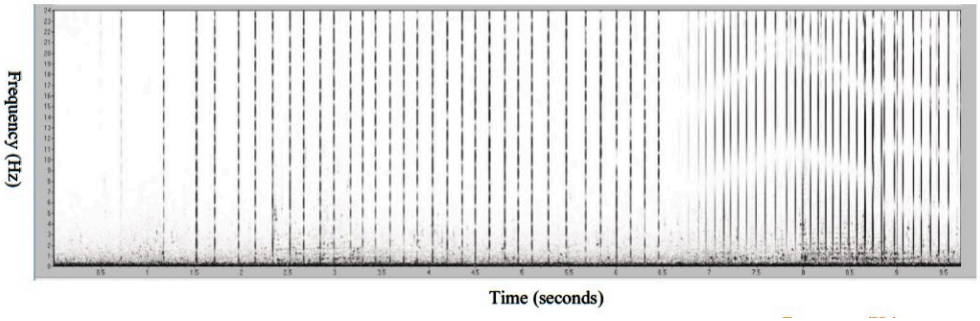
# Atlantic White-sided Dolphin Acoustics

- 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)

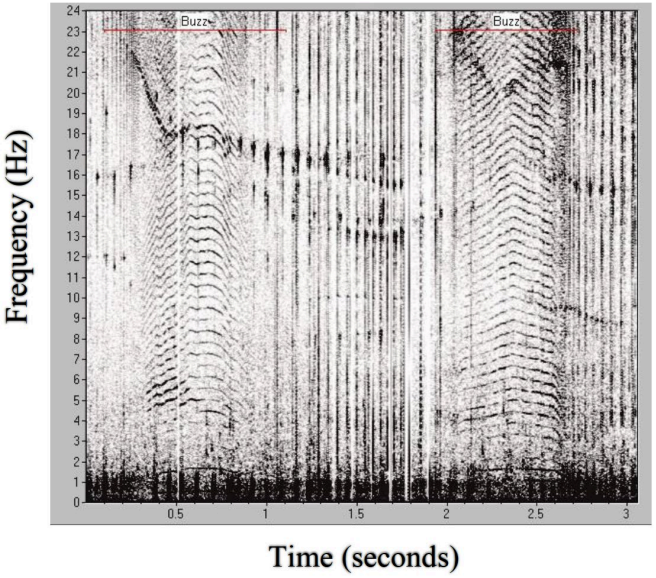
**a) Whistles**



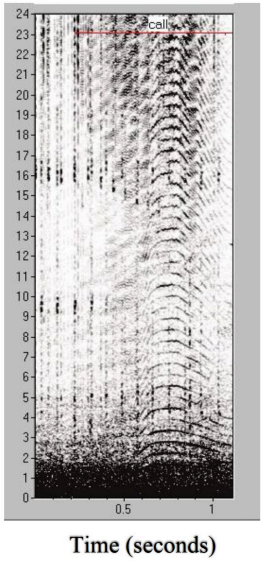

**b) Clicks**




**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

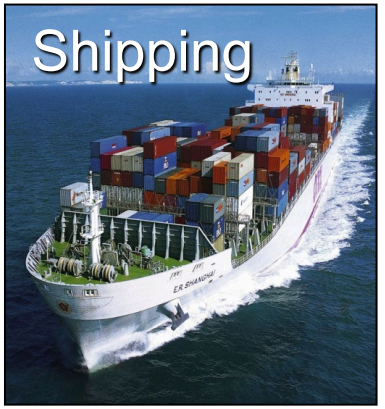

Over fishing

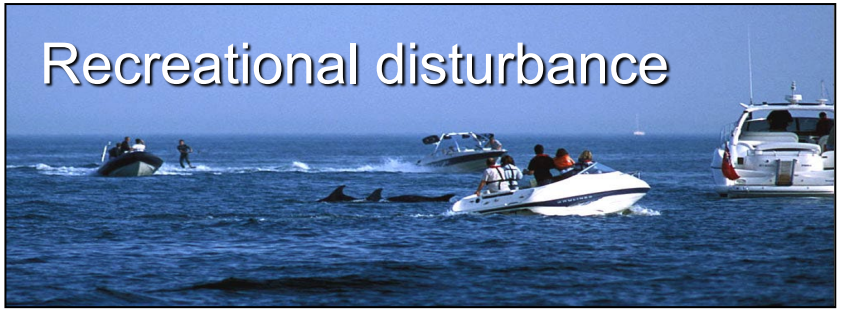

Entanglement in
fishing gear


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 (inc. microplastics and discarded fishing gear) | | 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

| 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** |

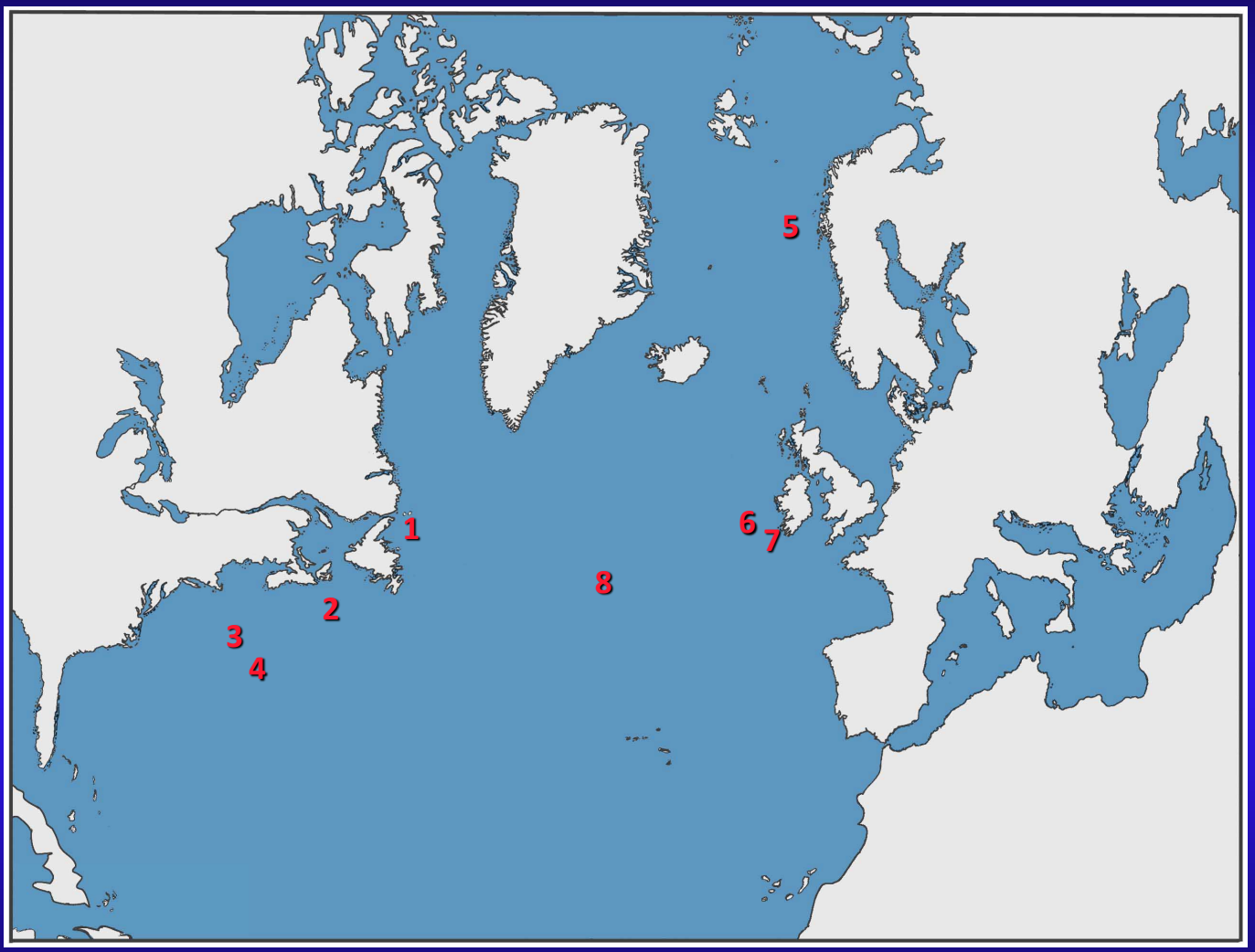

- Annual catches vary from 1-546, and have averaged 234 between 1998-2017 (total 4,683)
- Catches made mainly in July-Nov

**Sources:**
Bloch & Mikkelsen, 2009; WDC, 2018

# Atlantic White-sided Dolphin Health Status

- Of 79 PMEs 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

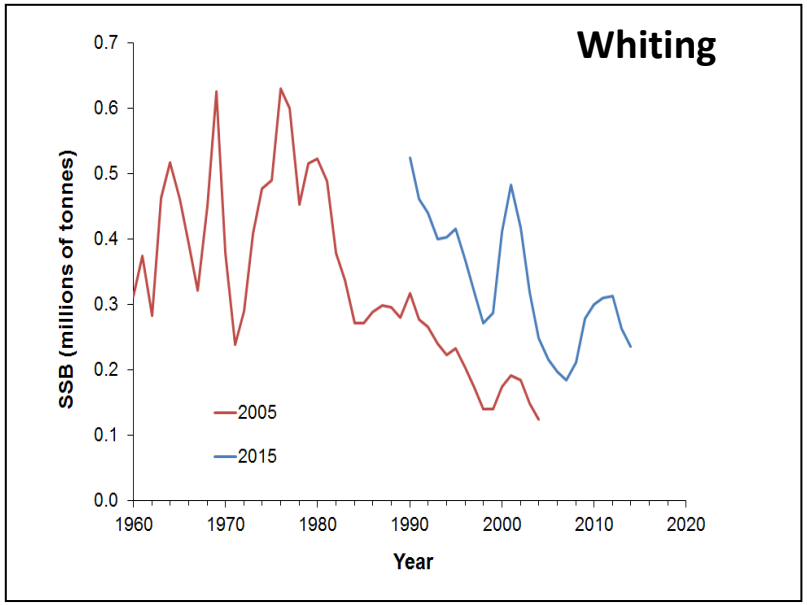


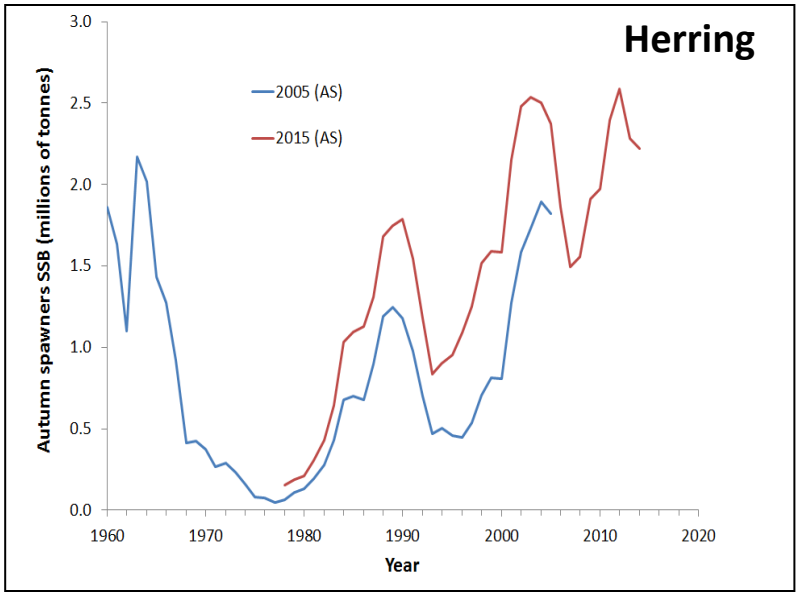

| | Principal Species |
|---|---|
| 1 | Herring, northern shortfin squid |
| 2 | Herring, silver hake, northern shortfin squid |
| 3 | Northern shortfin squid, rainbow smelt, silver hake, sandeel |
| 4 | Silver hake, spoonarm octopus, haddock, sandeel, lanternfish |
| 5 | Mackerel, herring |
| 6 | Mackerel,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

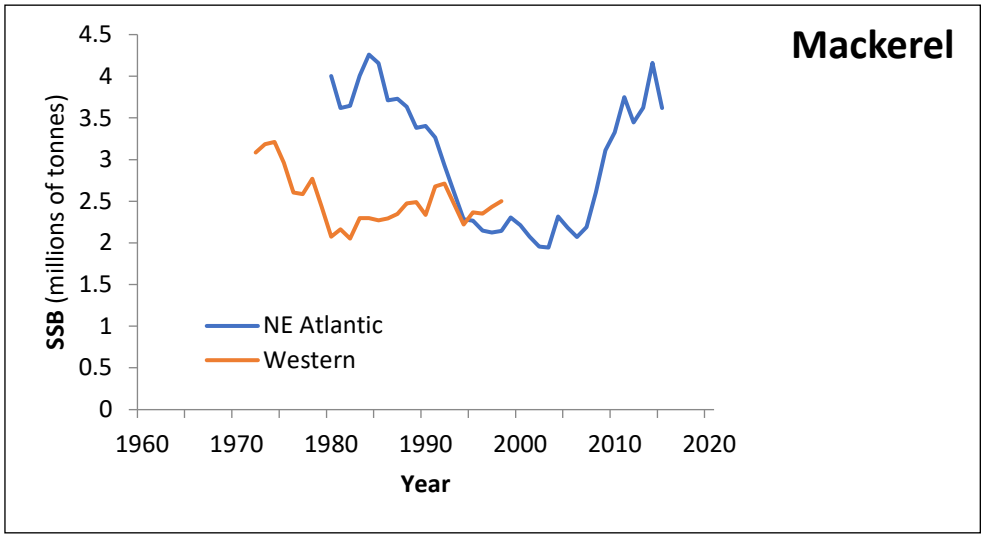
(**Sources**: Sergeant & Fisher, 1957; Katona *et al*., 1978; St. Aubin & Geraci, 1979; Sergeant *et al.,* 1980; Evans, 1987; Couperus, 1997; Nottestad *et al.,* 2001; Doksaeter *et al*., 2008; Hernandez-Milian *et al*., 2016)

# Temporal trends in fish prey species

## Spawning Stock Biomasses




**Source:** ICES data

# Atlantic White-sided Dolphin: Research Questions

- There is a need for better abundance estimates across all areas of the North Atlantic
- Genetic sampling should include northern & north-eastern parts of the species range
- Studies of life history parameters (ages & lengths at sexual maturity, reproductive rates, life spans) from stranded & bycaught animals are badly needed
- Studies of diet through stomach contents, stable isotope and fatty acid analyses are also deficient
- Development of an audiogram for the species is a missing gap
- More contaminant studies are needed involving liaison between stranding networks to build sample sizes and more representative coverage
- Studies should examine the potential effects of climate change

*Thank you for listening*