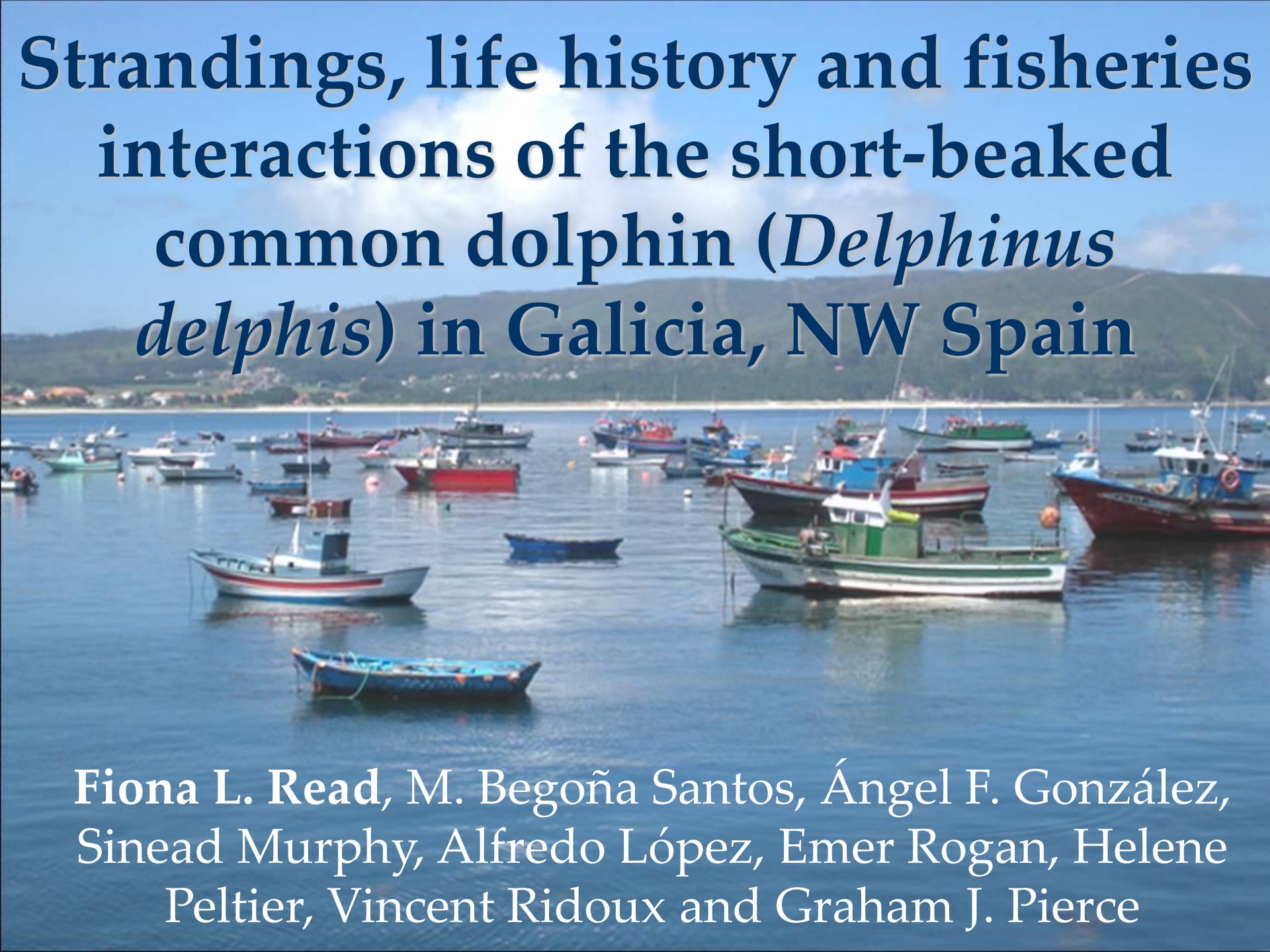
Strandings, life history and fisheries interactions of the short-beaked common dolphin (*Delphinus delphis*) in Galicia, NW Spain



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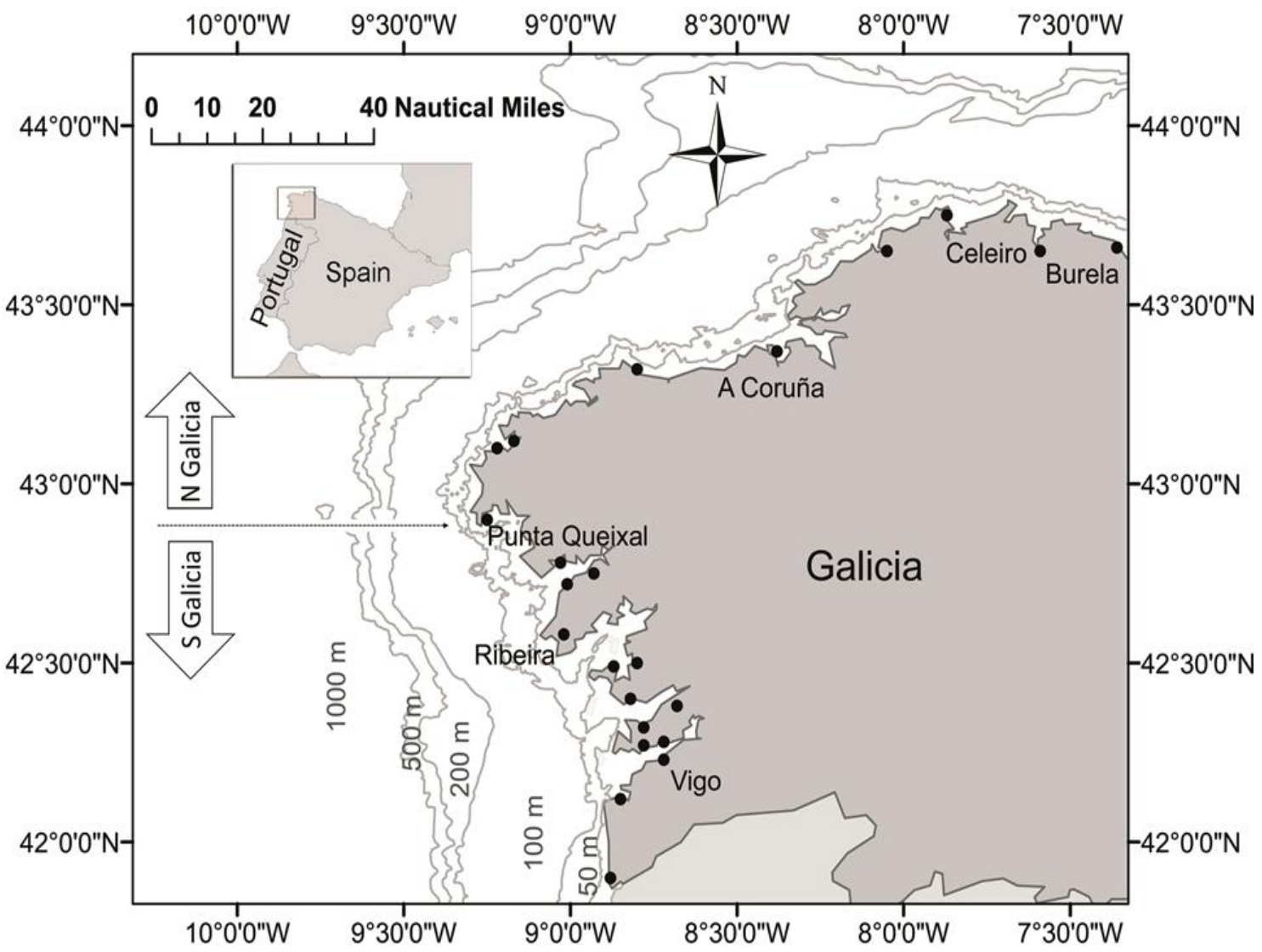
Galicia, North-West Spain



Goetz *et al*. (2014)

Galicia, North-West Spain

- High productivity and biodiversity due to the seasonal upwelling system
  - Over 300 species of fish, 75 species of cephalopods
  - Important nursery grounds for hake, sardine, scad and blue whiting
  - Marine mammals are abundant: 28 species recorded
- One of the world's main fishing regions
  - Estimated 1 million trips annually from 85 over harbours
  - Main gears used, *e.g.*, traps, seines, longlines, trawls, gillnets
  - 90% of the fleet is small-scale vessels (≤ 12 meters) operating in coastal waters
  - Many vessels are polyvalent
  - Socially and economically dependent on fisheries

<u>Important area for cetacean and fishery interactions</u>

Short-beaked common dolphin

- Genetics and skull morphometrics: One continuous north-east Atlantic population
- Heavy metals and stable isotopes: Separate offshore and continental shelf stocks?
- 185,204 common dolphins in European Atlantic waters (Cañadas *et al*., 2009)*
- Most abundant cetacean recorded in sightings and strandings in Galicia
- Evidence to suggest population is at carrying capacity
- High level of fisheries interactions

*NB: there is a new population estimate based on SCANS III (see Hammond et al., 2017)

Objectives

- Quantify life history parameters (age structure, age and length at sexual and physical maturity, pregnancy rate, mortality rate, etc.) for common dolphins in Galicia
- Examine evidence for temporal trends stranding patterns and mortality rates
- Draw inferences on population status
- Use age-at-death data to estimate total and fisheries mortality rate for common dolphins in Galicia
- Examine trends in fisheries interactions of common dolphins in Galicia
- Provide recommendations on future work of common dolphin-fisheries interactions in Galicia, and the NE Atlantic

Methods

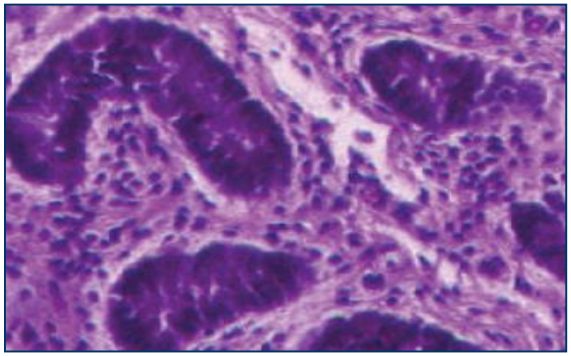
Fisheries interactions

Necropsies of strandings

Carcass recovery scheme

Fishery interviews

Life history data

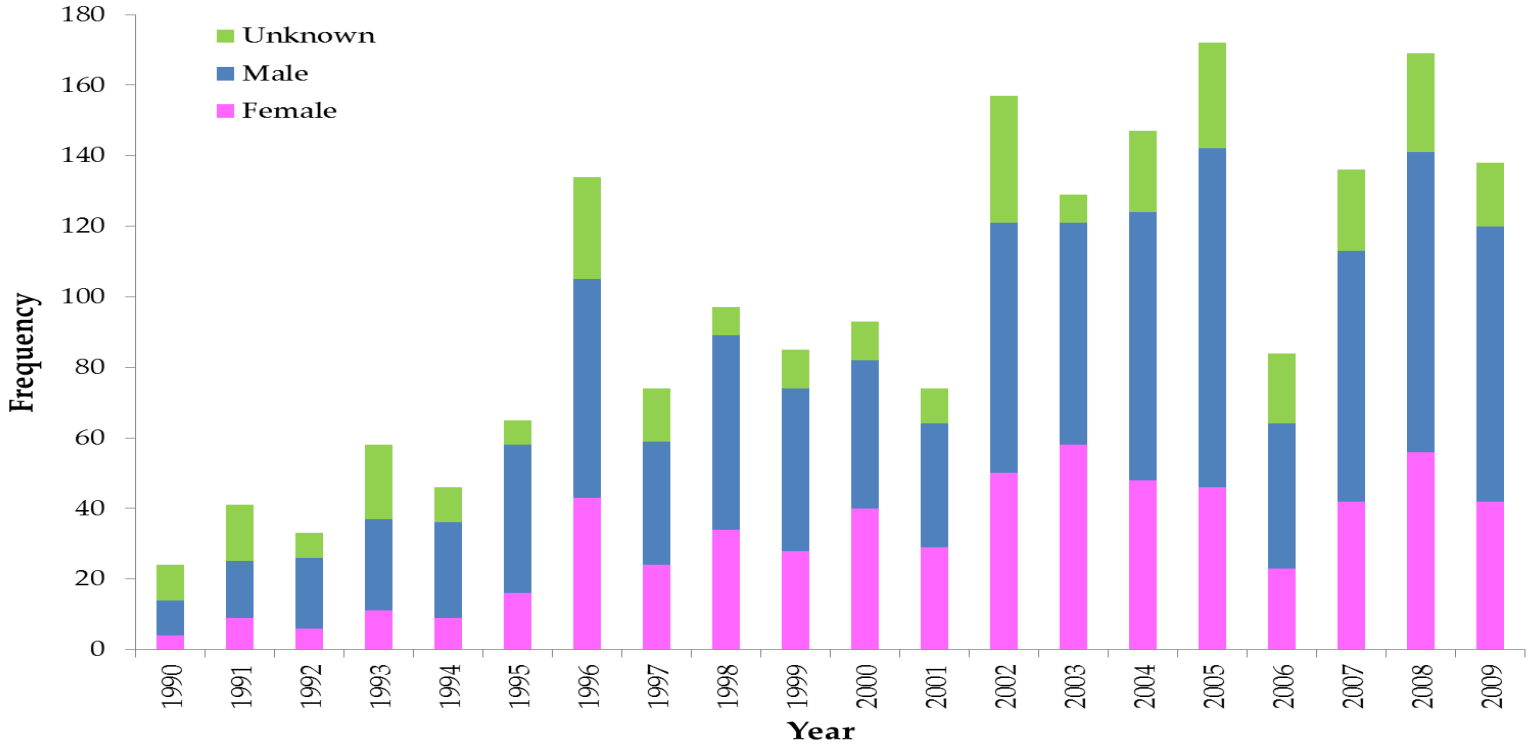


- maturity status
- mortality rates
- which animals interact

Results

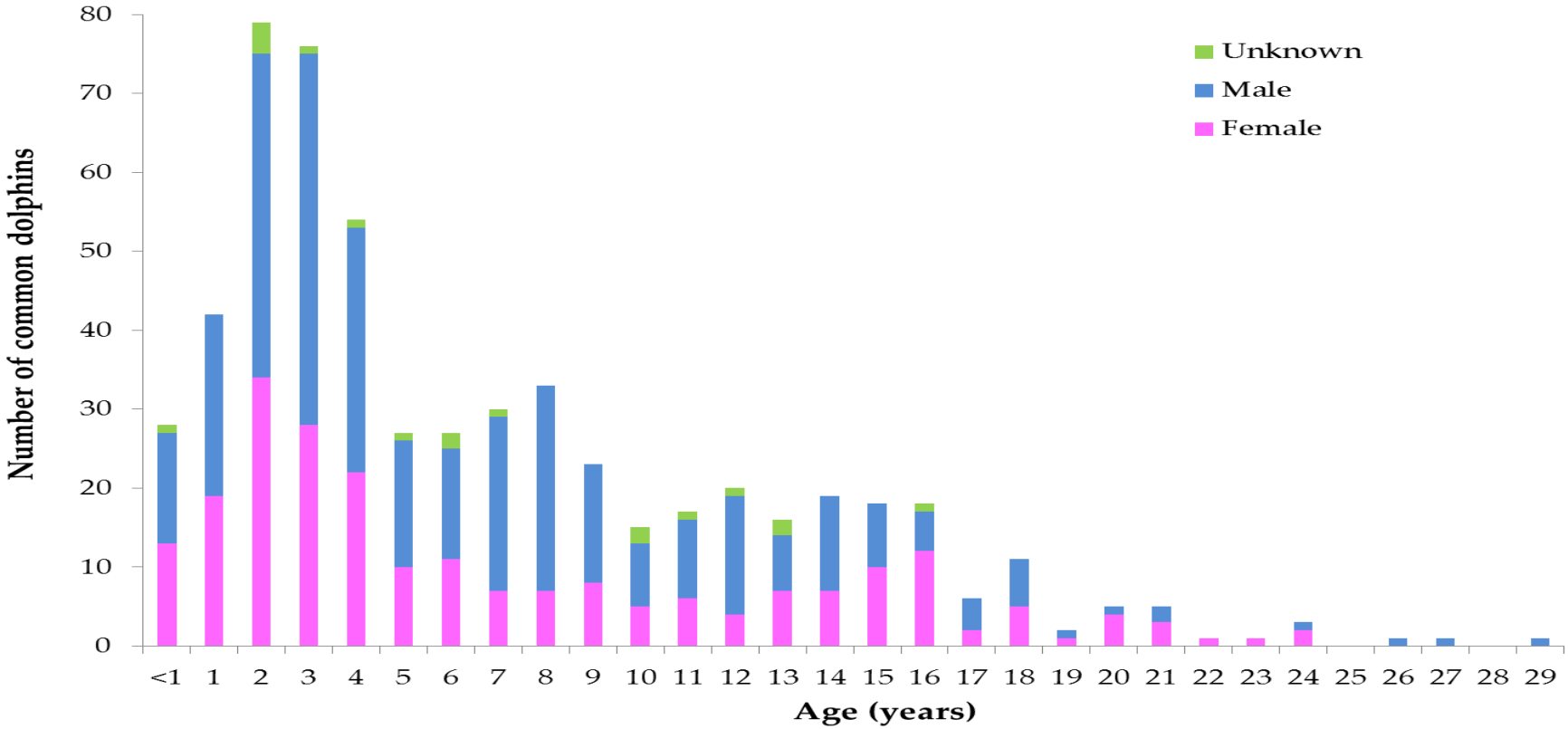
Strandings

- 1880 strandings and 76 bycaught and handed-in by fishers
- High inter-annual variation in strandings ($P = < 0.001$)
- Higher proportion of males: annually and seasonally
- Higher proportion of strandings in South Galicia ($P = < 0.001$)
- Peaks of strandings in winter (46%) and spring (26%)



Age structure

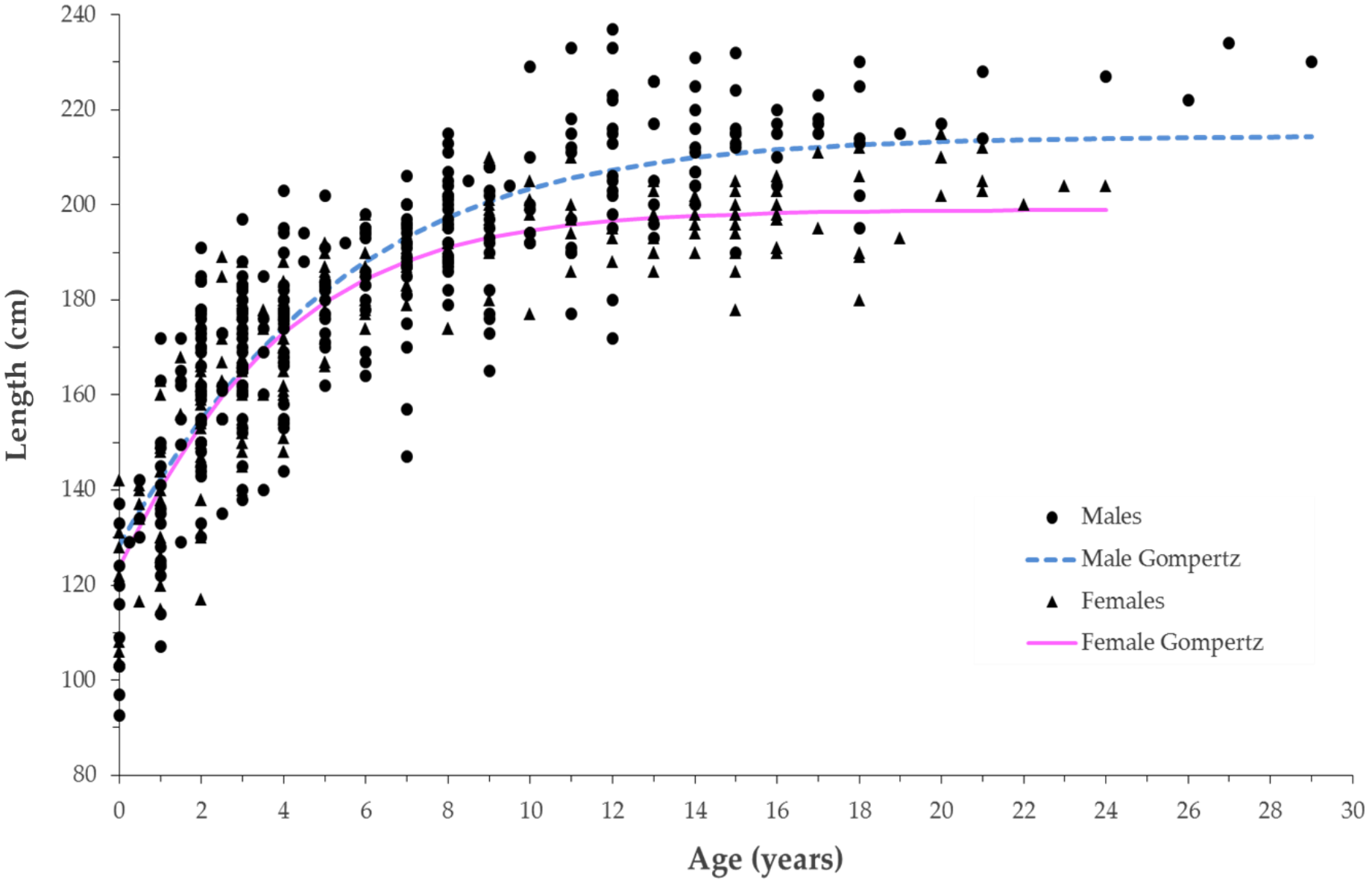
- 578 dolphins aged: 229 females, 331 males, 18 unknown
- Significant difference in age structure of males and females ($P = 0.001$)
- High number of males aged 7-12 years old



Life history parameters

	Females	Males
Maximum length (cm)	252 (n = 610)	240 (n = 982)
Maximum age (years)	24 (n = 229)	29 (n = 331)
Length sexual maturity (cm)	187 (n = 221	204 (n = 266)
Age sexual maturity (years)	8.4 (n = 168)	10.5 (n = 216)
Length physical maturity (cm)	199 (n = 224)	214 (n = 331)
Age physical maturity (years)	11 (n = 224)	11 (n = 331)
Pregnancy rate	0.33-0.36 (n = 80)	na
Calving interval (years)	2.7-3.0 (33-36 months)	na
Annual mortality rates	12.4	13.1

Gompertz growth curve



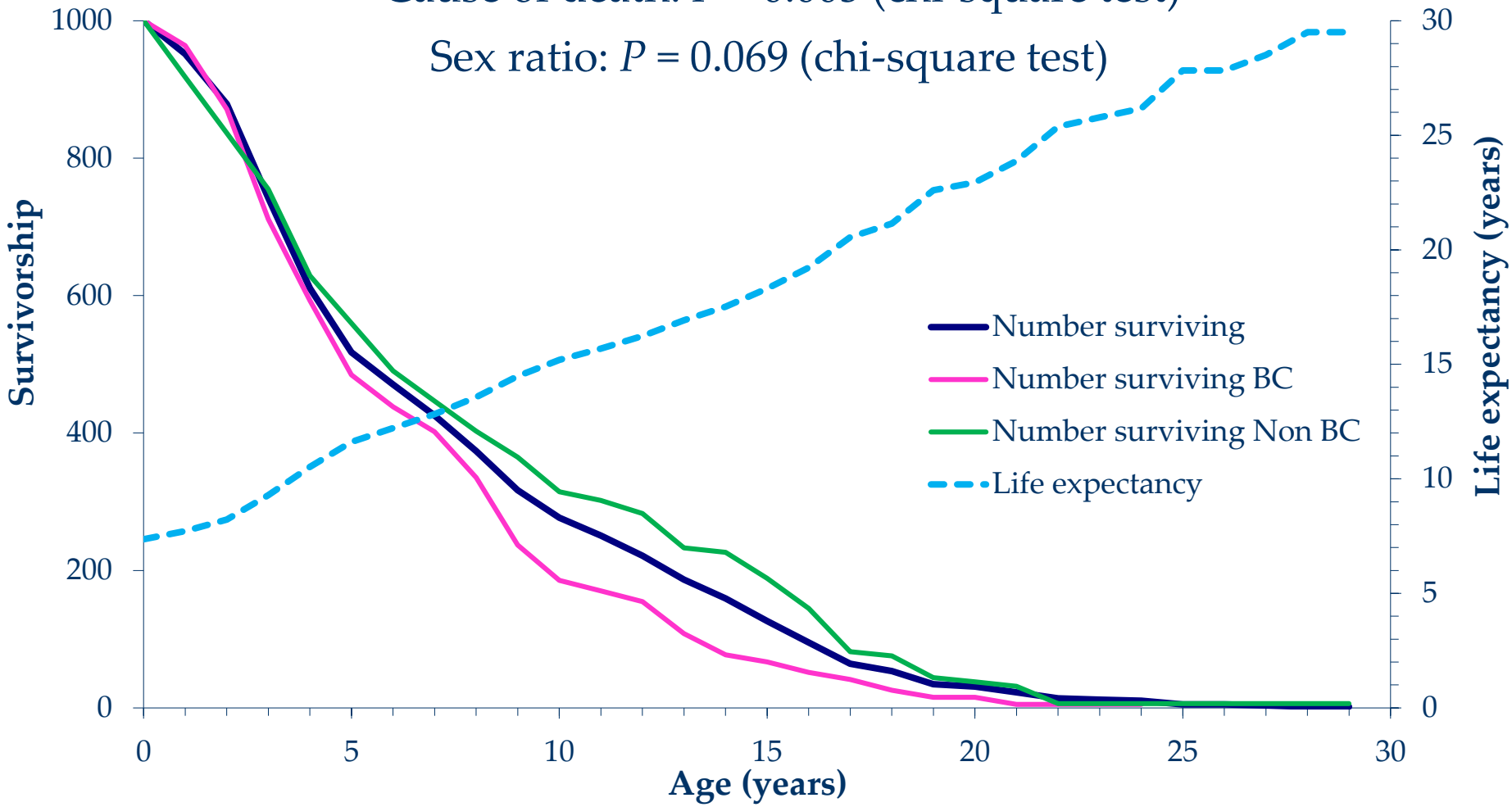
Fisheries interactions

Annual mortality rate: 13% (known cause of death)

Annual mortality rate due to fisheries interactions: 5.2% = **1.1% of NE pop^{n}**

Cause of death: $P = 0.003$ (chi-square test)

Sex ratio: $P = 0.069$ (chi-square test)



Fisheries interactions

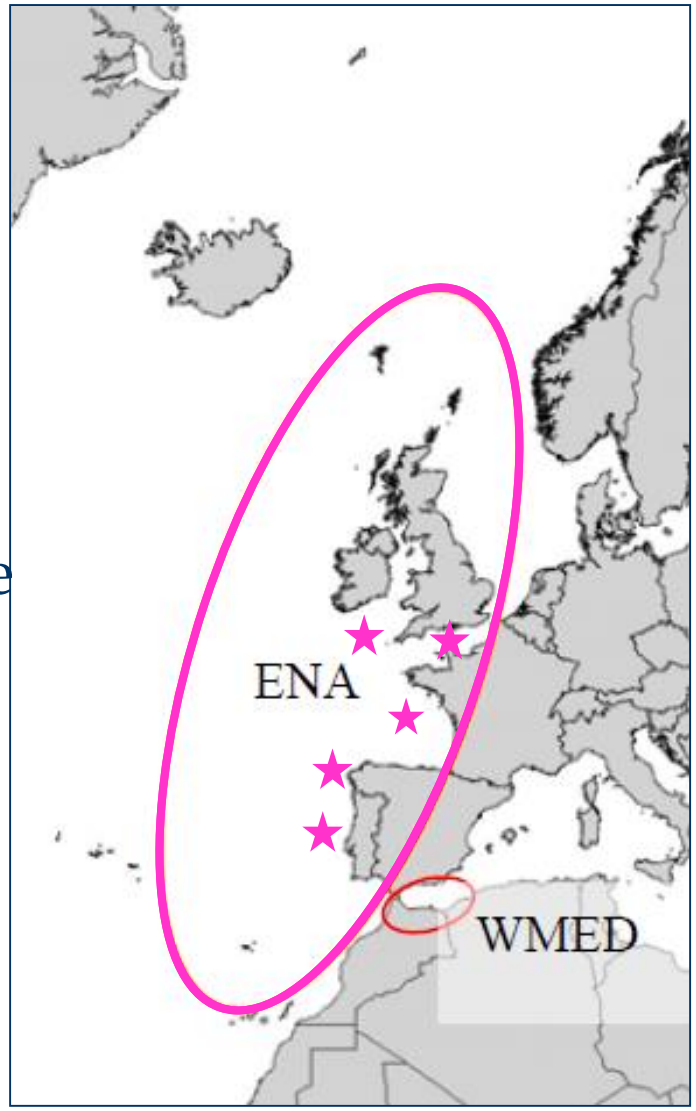
- Recovered carcasses from pair trawls and gillnets
- % deaths due to fishery interactions among animals with diagnosed C.O.D:
  - 1990 - 1999: 36% evidence of interactions
  - 2000 - 2009: 58% evidence of interactions
- Inter-annual variation in bycatch rates ($P = < 0.001$)
- Higher bycatch rate in South Galicia ($P = < 0.001$)
- Bycatch in gillnets: single event; trawls up to 8 dolphins
- Evidence for age- and sex-segregation
- Pregnant females more susceptible to bycatch?

Discussion

- High year-to-year variation indicates more than reporting is influencing stranding rates
- Life history methods need to be standardised, *e.g.*, APR
- Juvenile and sub-adult males more likely to be bycaught
- Higher number of strandings in South Galicia and winter and spring – area/season for monitoring/mitigation
- Evidence (or lack) of fisheries interactions needs to be recorded
- High overlap of common dolphins and fisheries in Galicia
- Biological impact of fisheries interactions is unknown, *e.g.*, one or two management units

NE Atlantic

- Genetics and morphometrics:
  - one continuous population
- SCANS II (2005); CODA (2007):
  - 174, 484 individuals (cv 0.26)*
- Low annual pregnancy rate: 33%
- High level of bycatch occurs across the range
- Levels of fisheries interactions are most likely to be unsustainable
- Max. anthropogenic removal rate:
  - ca. 3000 individuals per year



*NB: there is a new population estimate based on SCANS III (see Hammond *et al.*, 2017)

NE Atlantic

Dates	Area	Method	Annual bycatch estimate	Reference
1998-1999	Galicia	Interviews	1648	Lopez *et al.*, 2003
2008-2010	Galicia	Interviews	1707	Goetz *et al.*, 2014
2011-2012	Northern Spain	Interviews	2328	Lopez *et al.*, 2012
1990-2009	Galicia	Strandings	1950	This work
1990-2009	French NE Atlantic	Strandings	4000	Peltier *et al.*, 2014
2007-2010	French NE Atlantic	On-board observers	480	Peltier *et al.*, 2014

Conclusions

- Necropsies + interviews → high rate of fishery interactions
- Current levels of interactions exceed ASCOBANS & IWC limits
- Biological impact is unknown – Carrying capacity? Separate stocks?
- Carcass drift models would increase our knowledge of interactions
- Increased monitoring of bycatch with on-board observers or REM is essential
- The use of interviews should not be underestimated
- Better collaboration between countries to develop consistent monitoring and mitigation programmes *e.g.*, MSFD
- Legislation needs to be updated *e.g.*, include monitoring of vessels <12 meters, total fishing effort
- Enforcement of legislation, EU Action Plan, self-regulation?
- Overall, realignment of funding priorities

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