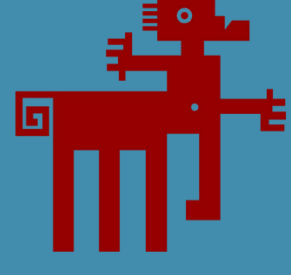


# Review of necropsy cases in cetaceans with diagnosis of human interaction (2012-2023)



UAB

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## INTRODUCTION

Fishery activities represent a significant threat to cetacean populations globally (16), primarily due to incidental capture, known as "bycatch" (Fig. 1) (2, 11, 13). In the Mediterranean sea, several species (Fig. 2) have experienced notable declines as a result (4, 6), some of them are considered vulnerable by the International Union for Conservation of Nature (IUCN) (4).

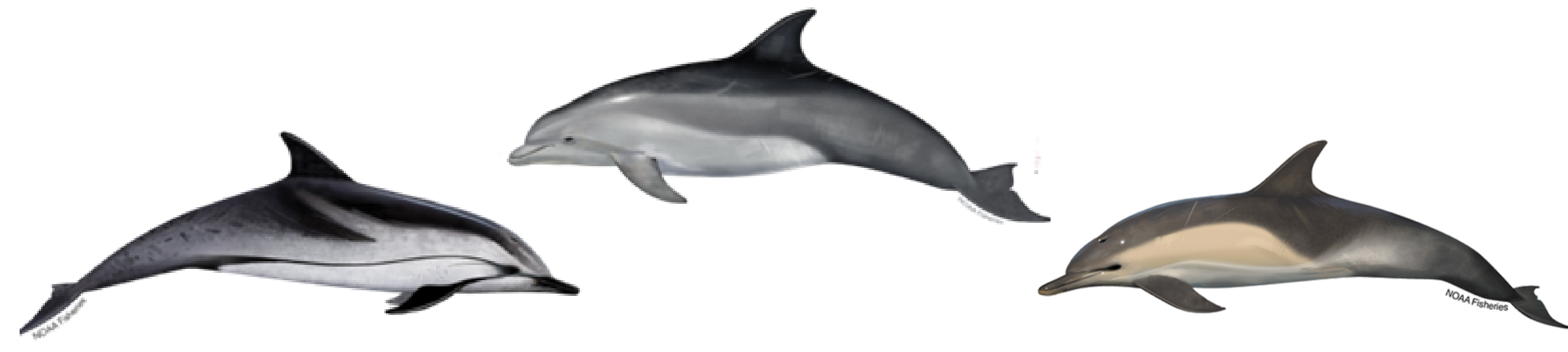


Fig. 2. Graphic representations of *Stenella coeruleoalba*, *Tursiops truncatus* and *Delphinus delphis*, species affected by bycatch. Source: <https://www.fisheries.noaa.gov/species/>



Fig. 1. *Tursiops truncatus* caught by fishing nets and pulled out from water. Source: <https://seas-at-risk.org>

Detecting bycatch in stranded cetaceans poses challenges, as there are no characteristic lesions (14). Indications such as skin cuts or impressions (15), broken teeth (12), fractures, PUE signs and/or changes in lungs, may suggest this occurrence (5, 14).

## Objectives

The aim of this study is to identify the pathological patterns indicative of human interaction (bycatch), if there is a relationship between them. Furthermore, it seeks to determine the annual frequency of strandings during the period 2012-2023, and if sex, geographical location (along Catalan coast) or specie are influential factors for bycatch.

## MATERIAL AND METHODS

This study reviewed 131 necropsy reports of cetaceans found along the Catalan coast from 2012-2023, with 38 involving suspected or confirmed human interaction. Necropsies were performed by certified pathologists at the UAB following established procedures (13). For bycatch cases, another table listed specific lesions, with bar and coincidence charts assessing common patterns. Data from the necropsies were compiled into an Excel table, including life history, body condition, lesions, human interaction evidence, and CT scans. Dynamic tables analyzed strandings by species and year, and human interaction by species, sex, and coastal zone. The correlation between human interaction and sex was statistically tested.

## RESULTS

### Bycatch criteria applied

Approximately 98% of bycatch cases (n = 38) were in good nutritional condition without signs of emaciation or disease, and over 80% had non-digested prey in their stomachs. About 45% exhibited external entanglement evidence such as lacerations from fishing nets. Around 10% had broken or missing teeth, while another 10% had small penetrating wounds, some also presenting mutilations or head fractures. CT scans confirmed PUE in select cases by detecting abundant gas bubbles in organs and tissues, among the 38 cetaceans diagnosed with bycatch, 40% showed PUE signs.

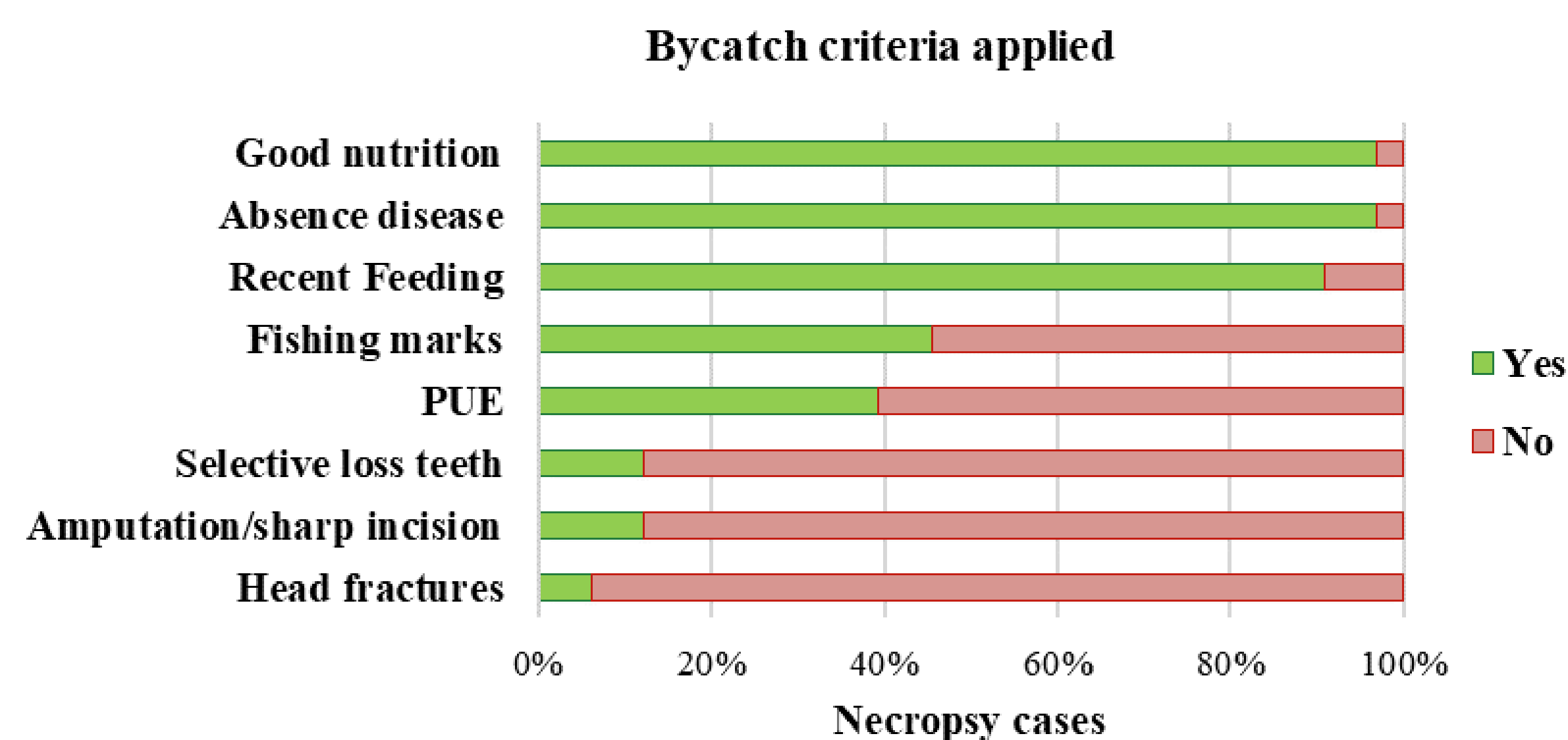


Fig. 3. Percentage of necropsied cases that shows any of established bycatch diagnostic criteria (5, 13, 14).

In some individuals, the confluence of several lesions has been observed. As shown in Fig. 4, 9 out of 38 individuals (24%) exhibit PUE signs and net marks, and 2 others exhibit net marks and amputations. Only 1 case presented PUE signs, marks of fishing gears, and selective loss of tooth.

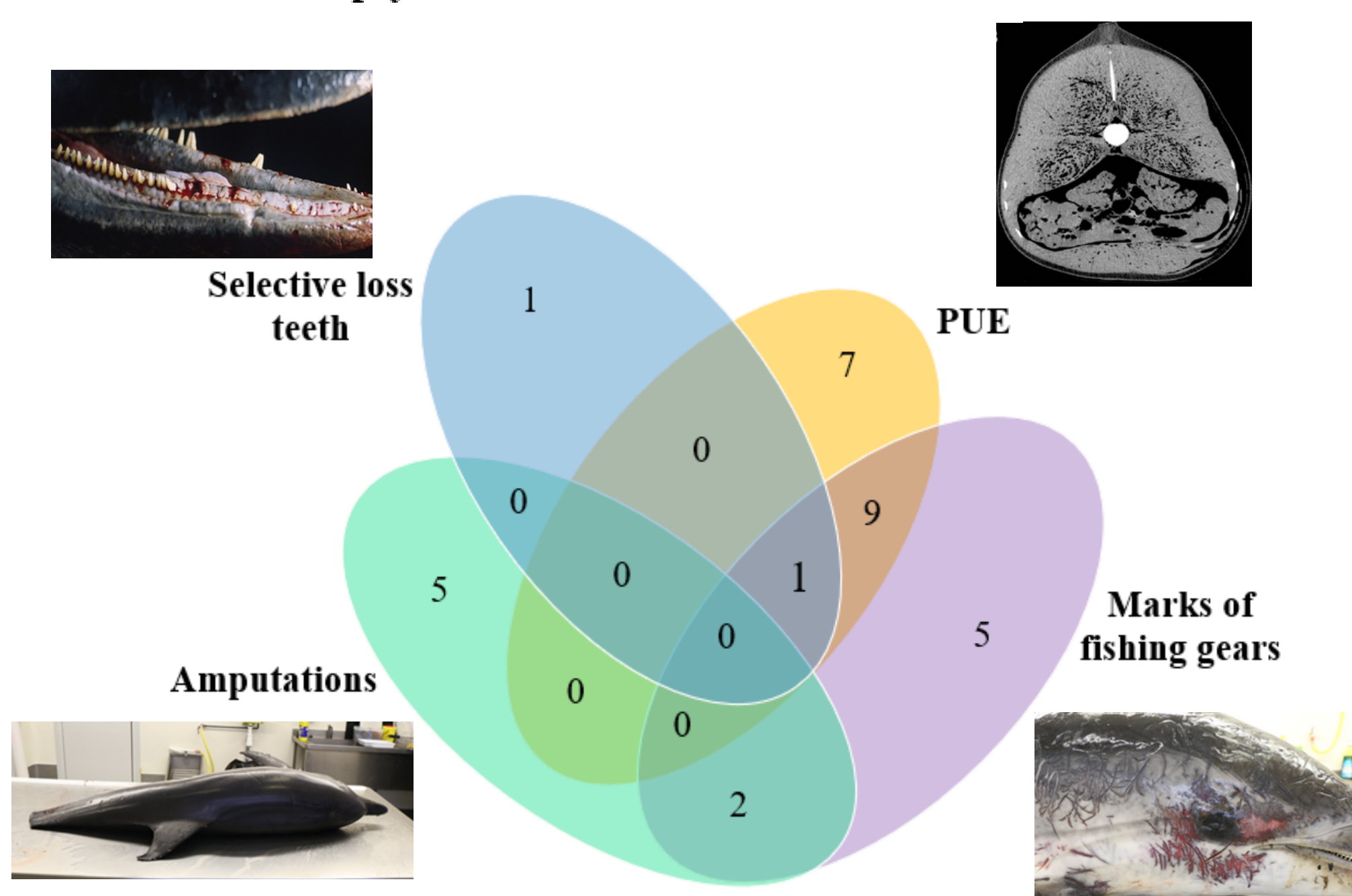


Fig. 4. Graph illustrating the coincidence of diagnostic criteria for fishery interaction, including PUE lesions, amputations, fishing marks and selective tooth loss, observed or not in the 38 bycatch cases.

### Stranded cetacean per year

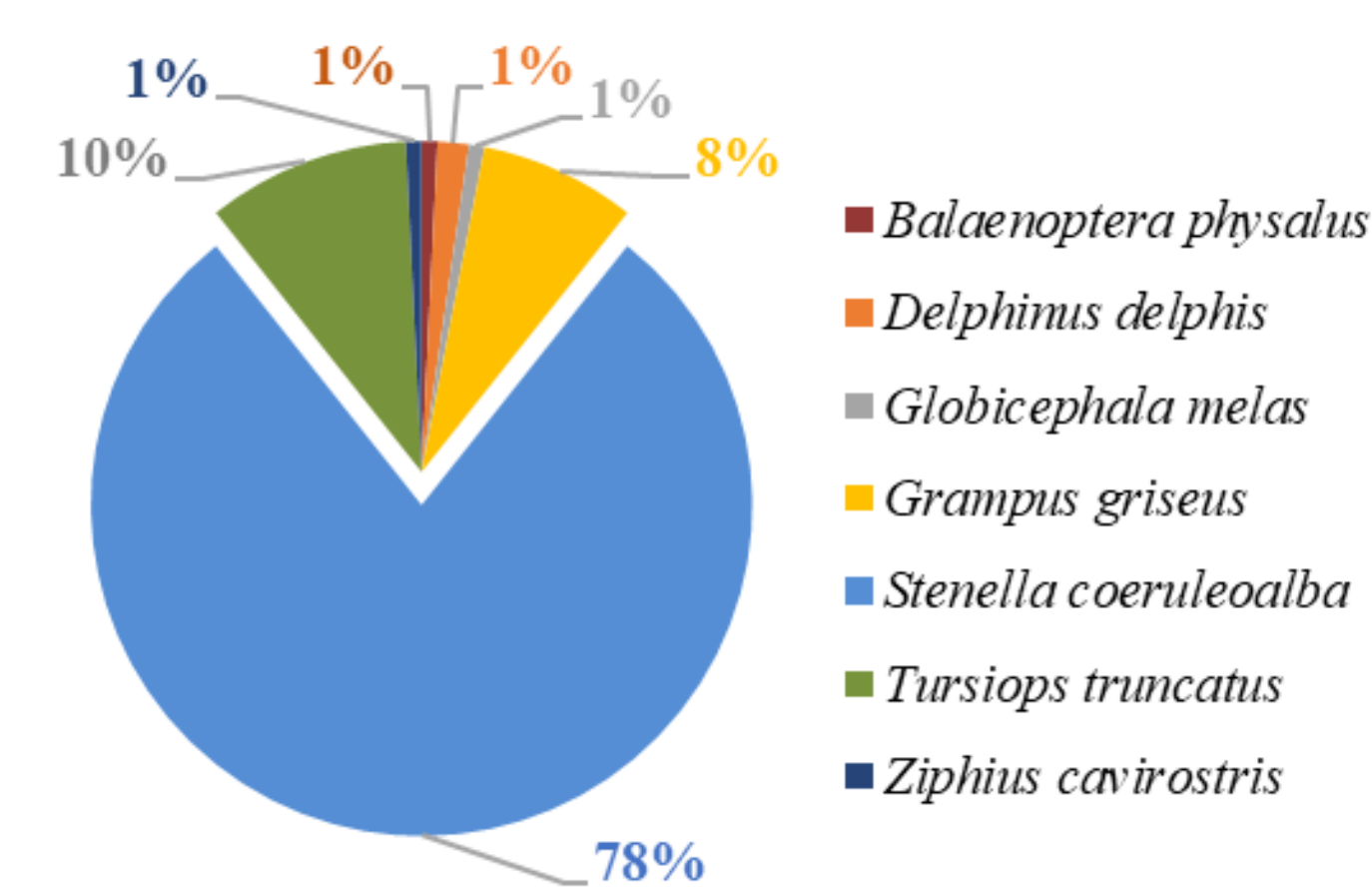


Fig. 5. Percentage of each stranded species found along Catalan coast from 2012-2023.

Among the 131 reviewed cetaceans, *Stenella coeruleoalba* represent the 78% of the strandings, primarily in 2017 and 2018. *Tursiops truncatus* and *Grampus griseus* each represent less than 10%, majority registered in 2012 and 2016 respectively.

The remaining species *Balaenoptera physalus*, *Delphinus delphis*, *Globicephala melas*, and *Ziphius cavirostris* were encountered sporadically, representing 1% of the strandings.

### Species, sex and geographic location as influential factors for bycatch

From 2012 to 2023, 38 out of 131 stranded cetaceans (29%) were attributed to human interaction (bycatch).

*Stenella coeruleoalba* had the highest incidence of strandings, with about 26% (n = 103) due to bycatch. *Tursiops truncatus* had fewer strandings (10%, N = 131) but a higher proportion of bycatch cases, approximately 69% (n = 13).

*Ziphius cavirostris* was diagnosed with bycatch in only one necropsy, preventing a clear pattern.

Among the 131 necropsied individuals (62 females, 69 males), females showed a higher incidence of bycatch-related signs than males. However, 55% of males displayed signs consistent with natural causes of stranding. Statistical analysis resulted in a p-value > 0.05, indicating that these correlations are not significant in this case.

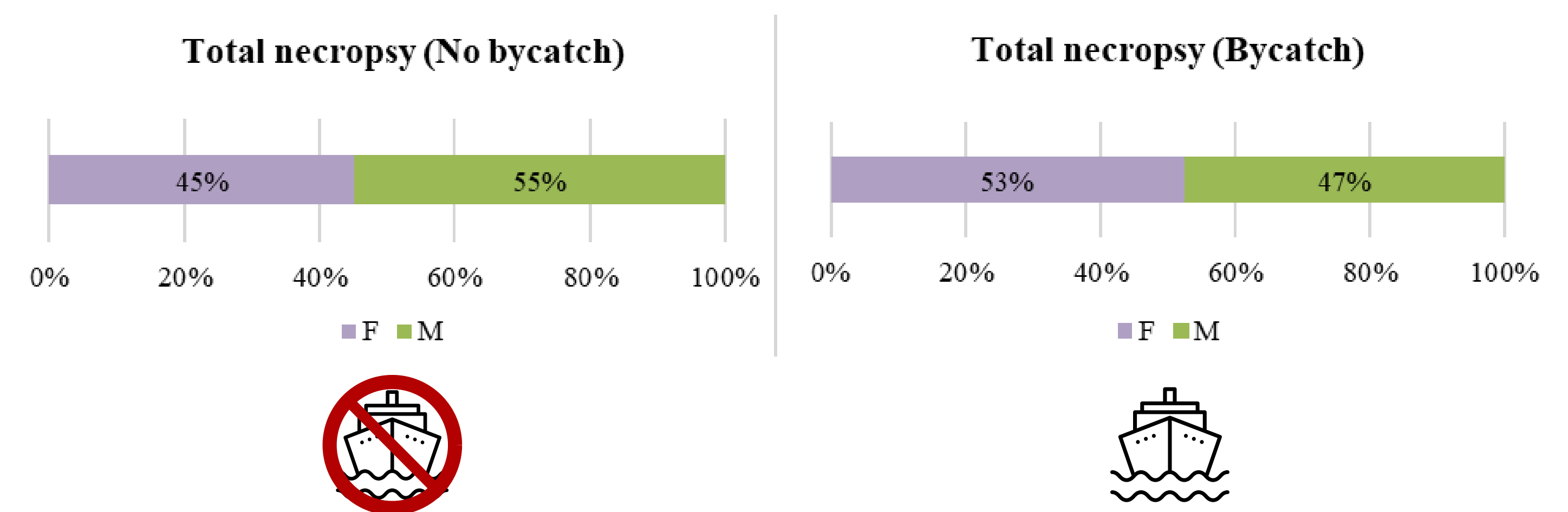


Fig. 7. Figures displaying the percentages of necropsied females and males with lesions indicative of fishery interaction (bycatch) or with other diagnoses.

The potential correlation between cetacean strandings along the coast and fishery interaction, was assessed. Among the 38 cetaceans stranded with signs of bycatch, 42% were concentrated along the Costa Brava, followed by Costa Daurada, Costa Garraf, and Costa Maresme, with lower percentages.

However, the Costa Daurada had the highest percentage of strandings due to natural causes (48%, n = 93), while the Costa Brava and Costa Garraf had notably lower percentages.



Fig. 8. Graphical representation of the Catalan coasts analyzed in the study. Source: <https://100playas.com/cuatro-costas-cataluna-cual-te-quedas/>.

## DISCUSSION

A total of 131 necropsy cases of stranded small cetaceans along the Catalan coast between 2012 and 2023 were reviewed. The lesion findings related to bycatch were consistent with previous reports. *Stenella coeruleoalba* was the most frequently stranded species, followed by *Tursiops truncatus* and *Grampus griseus*. Fishery interactions caused death in 29% (N = 131) of the necropsied individuals; Bottlenose dolphins were most affected (69%, n = 38). No significant sex-related differences in human interaction were found, but a larger sample size is needed. Bycatch is a significant threat to cetaceans globally, particularly in the Mediterranean Sea. The study highlights the need for improved diagnostic criteria and strategies to reduce cetacean interactions with fishing activities. Addressing bycatch is essential for the conservation and recovery of cetacean populations in the Mediterranean and beyond.

## References

