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1) Background

Cetaceans are only visible when breaching or very close to the sea surface. Information on species-specific 'availability' is required to produce meaningful population estimates from digital aerial survey data. 'Availability bias' can be calculated as either:

- the % of time spent surfacing from the cetacean's total activity budget, or
- using an equation such as Barlow et al.'s (1988):
 $Pr(\text{being visible}) = (s + t)/(s + d)$

Where *s* is the average time spent at the surface, *d* is the average time spent below the surface and *t* is the window of time within visual range of the observer.

2) Aims

- Undertake a systematic literature review of cetacean availability.
- Analyse the rejected papers
- Calculate estimates of availability where possible

3) Methods

Aim one

- We undertook a systematic literature review using ISI Web of Knowledge of journals relating to **marine mammals** and **seabirds** visiting UK waters
- 22 search strings, including terms "diving", "duration", "surface duration", "availability bias" and "cetacean".
- Papers systematically filtered for 1) duplicates, 2) relevant subject criteria, 3) cetacean species relevant to UK waters.
- Remaining papers (n=17) were analysed for any viable metrics from which to calculate availability.

Aim two

- Rejected papers (n=11) were analysed to see why availability could not be calculated.

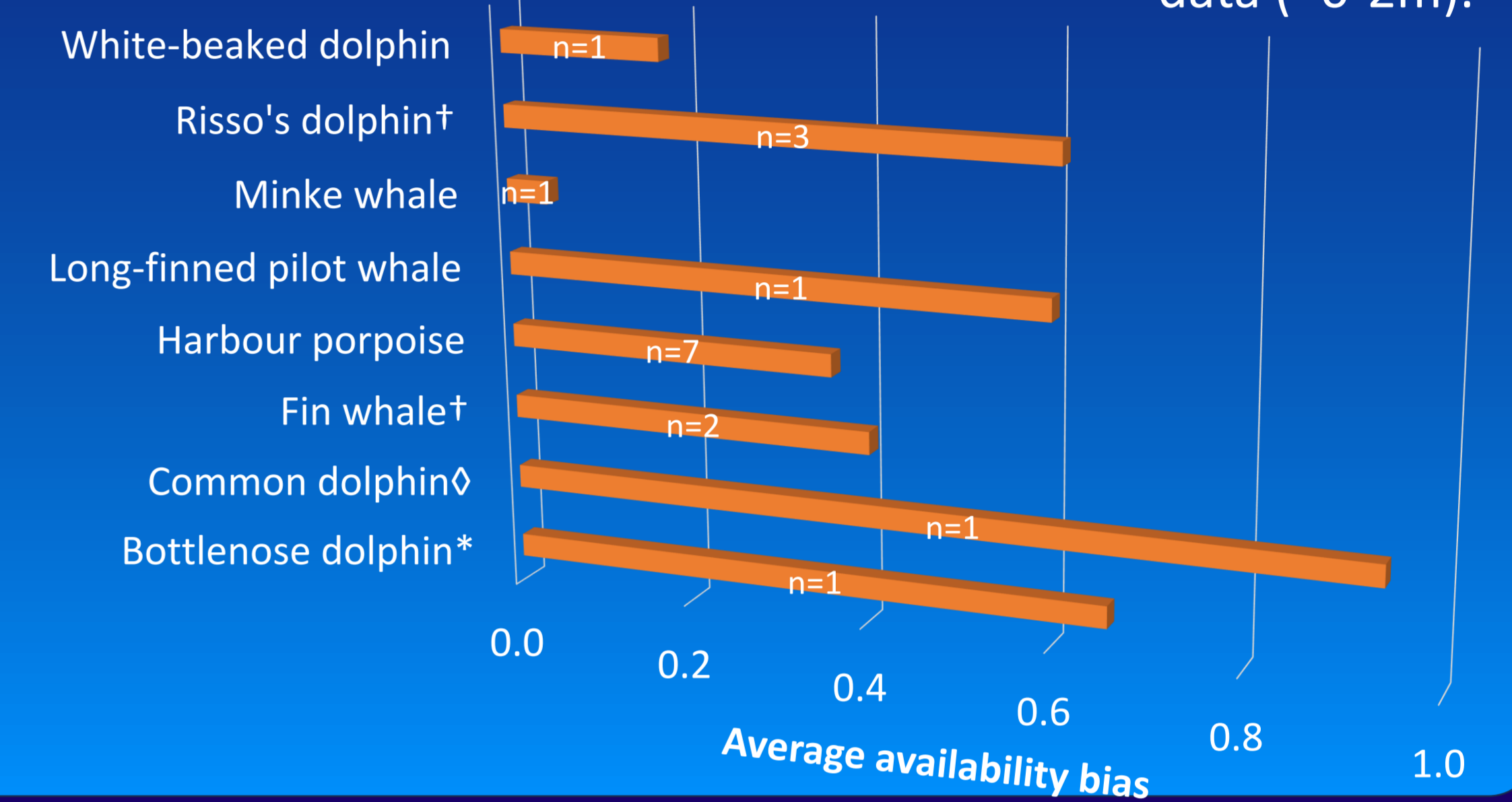
Aim three

- Ten additional studies from a previous literature review were added to the final results of cetacean availability (n=16).

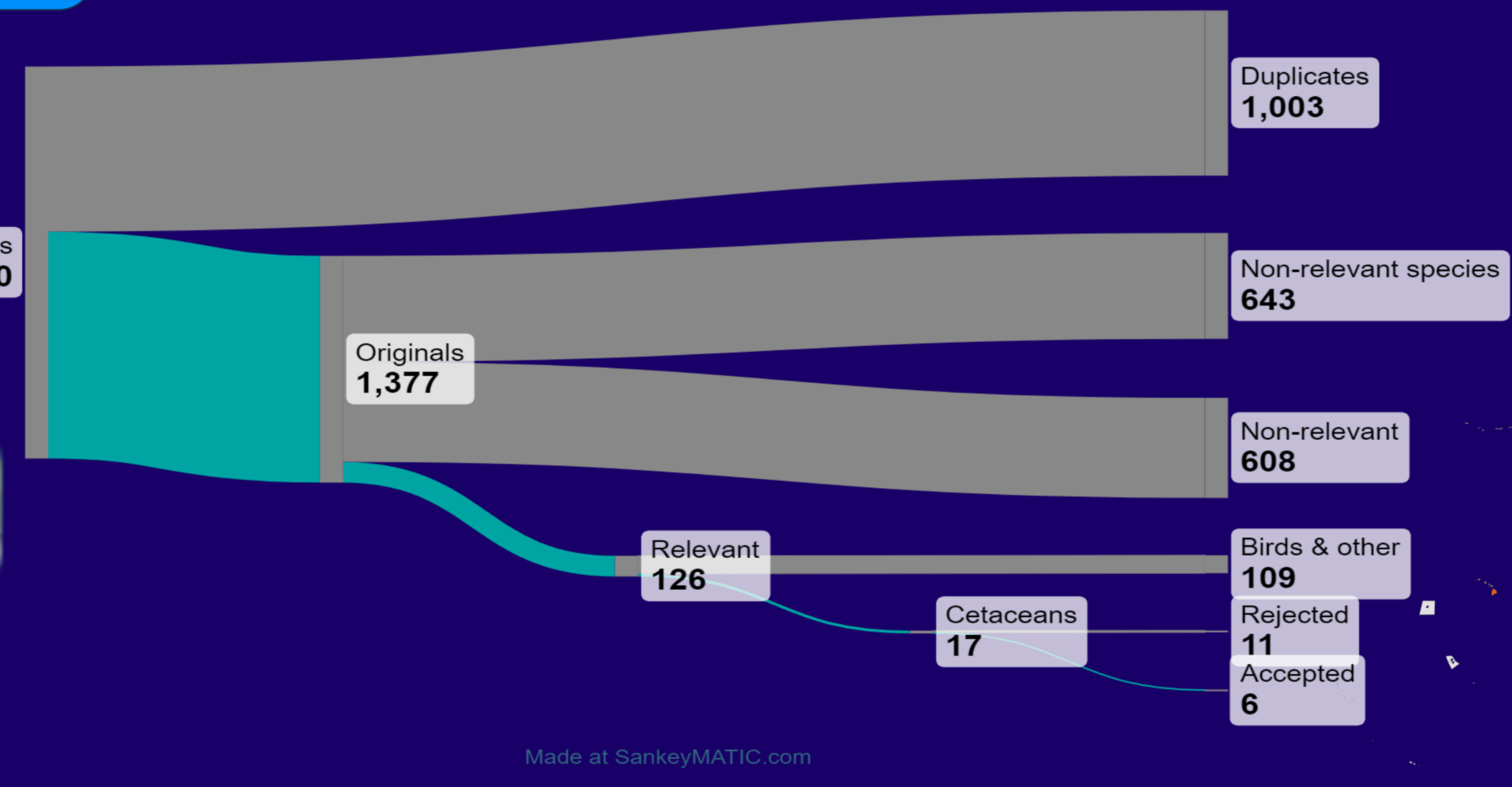
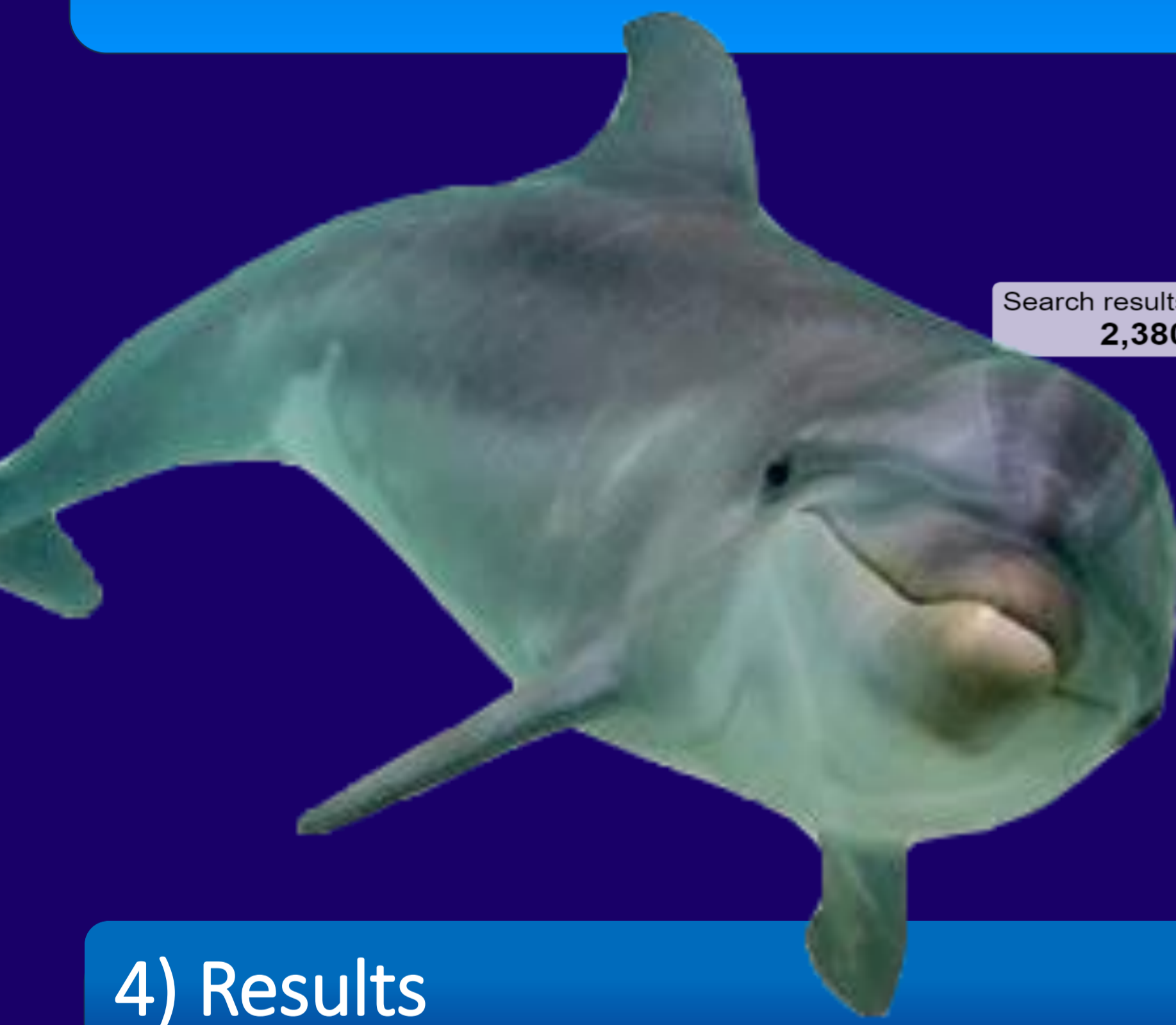
5) Results

Aim three: Availability bias

Availability was calculated for 8 species across 10 countries, each with limitations and caveats. The depth threshold at which surfacing behavior was defined ranged from 0-50m (avg. = 11m); often deeper than that required to correct digital aerial survey data (~0-2m).



†Depth threshold significantly exceeds that relevant for digital aerial survey data
‡Relates to groups (not individuals)
*Diving could not be fully disentangled from all other behavioural categories



4) Results

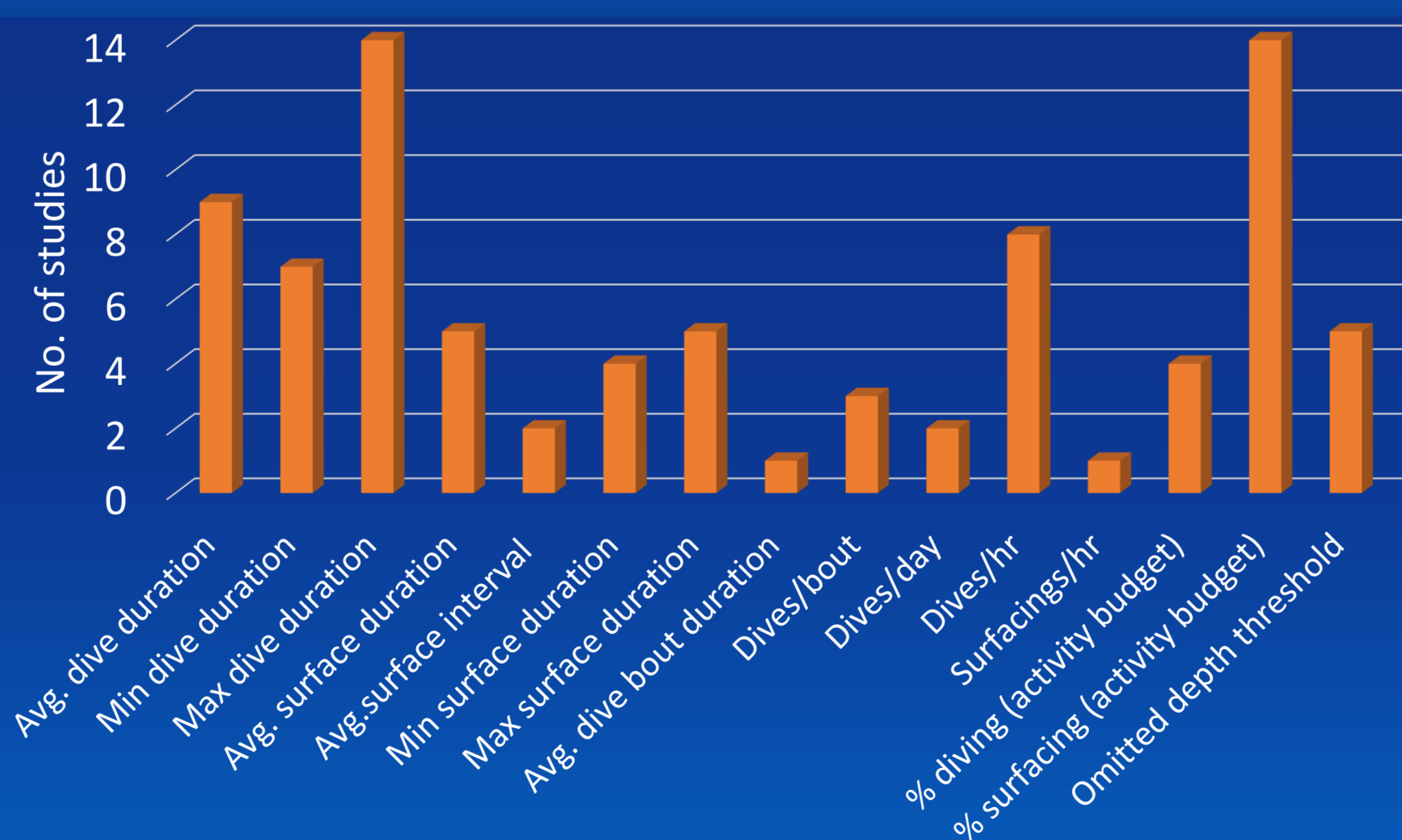
Aim one: Literature review

- 1,377 papers spanning 1969 – 2023.
- Of 1,377 articles, only ~1% had relevant content on cetaceans linked to UK waters.
- Despite high-quality tracking and observational cetacean studies, only 35% (n=6) provided metrics from which availability could be calculated, across 4 species.

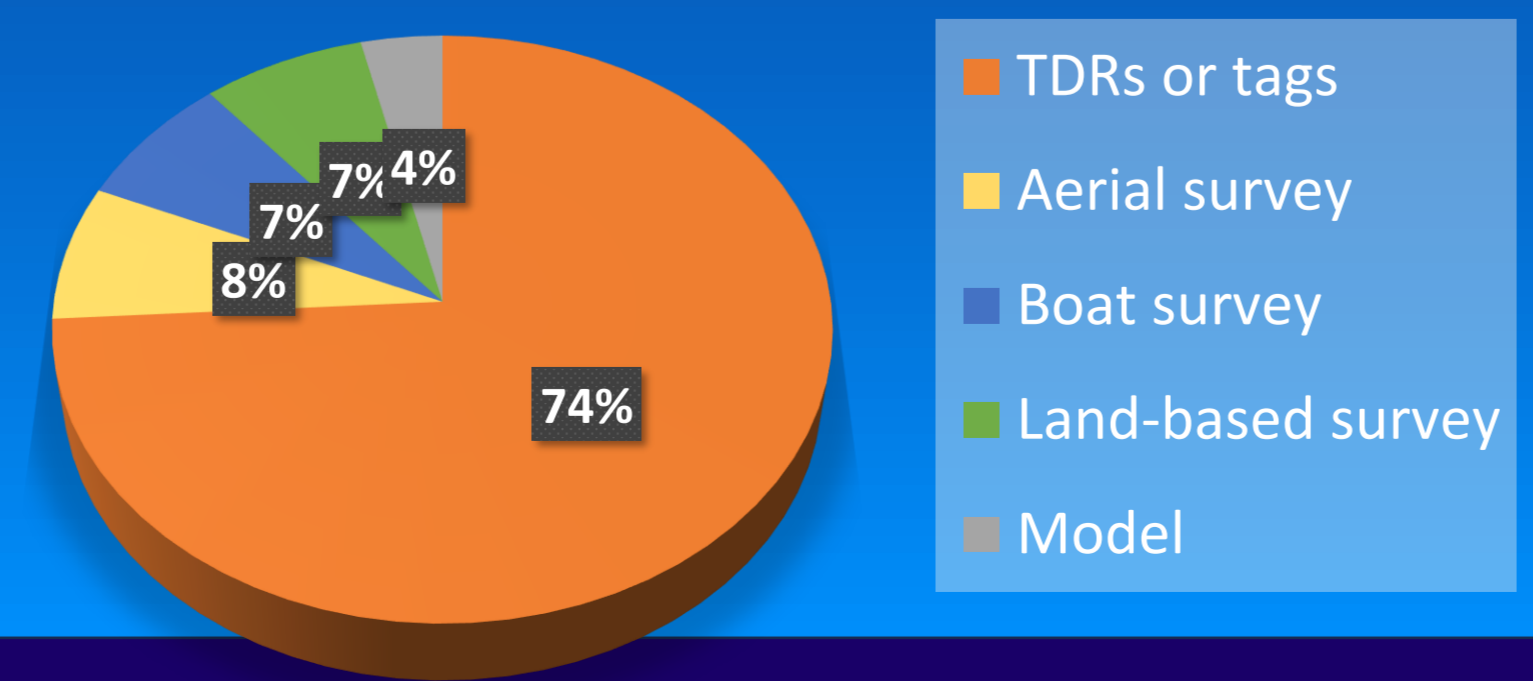
Aim two: Reasons for rejection

- Many studies had incomplete or omitted data, e.g. mean time spent diving but not surfacing.
- Many were only concerned with segments of activity budgets, such as dive bouts, ignoring behaviours that are likely to be captured during aerial surveys, e.g. periods of travelling.
- In some studies, diving or surfacing could not be disentangled from grouped behavioural categories, such as 'socialising'.

Variability in presented metrics in all cetacean studies



Data collection method across all cetacean studies



6) Conclusions

- Availability information is **LIMITED**.
- Knowledge sharing is essential if we are to protect cetaceans whilst achieving sustainable energy development.
- Plea to future tracking studies:** Report surfacing as a % of total activity budget or provide metrics to calculate it, e.g. average time spent above and below the surface.
- Ideally, depth threshold should be 0m for digital aerial corrections (at most 2m).

Depth used to define surfacing in studies

