



Bio-inspired acoustic beacons to limit fishery by-catch of common dolphins *Delphinus delphis*



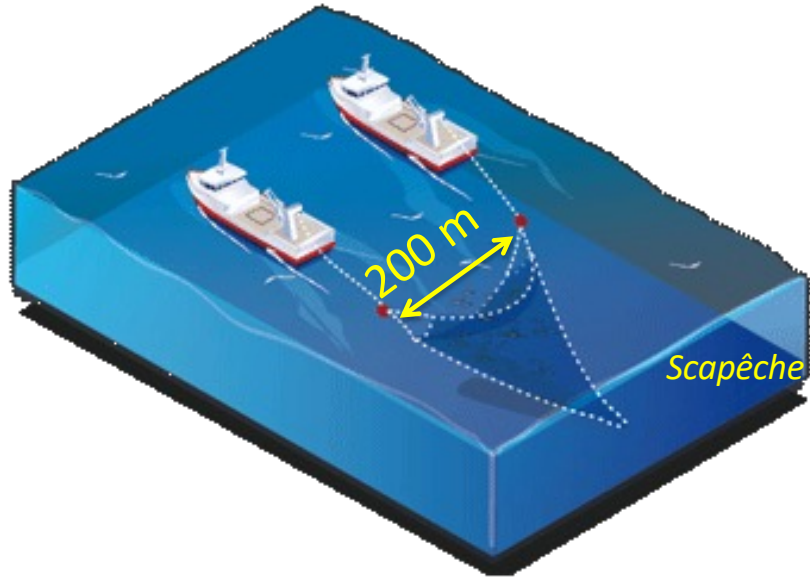
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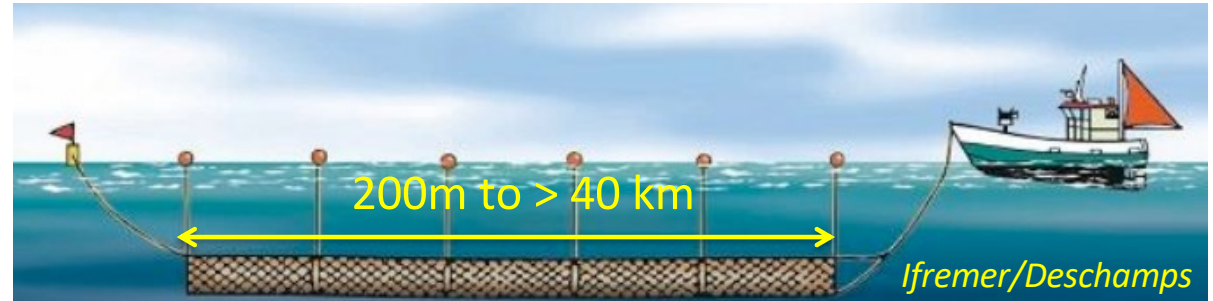
5-6 February 2025



Main fisheries involved in common dolphin bycatch in the Bay of Biscay

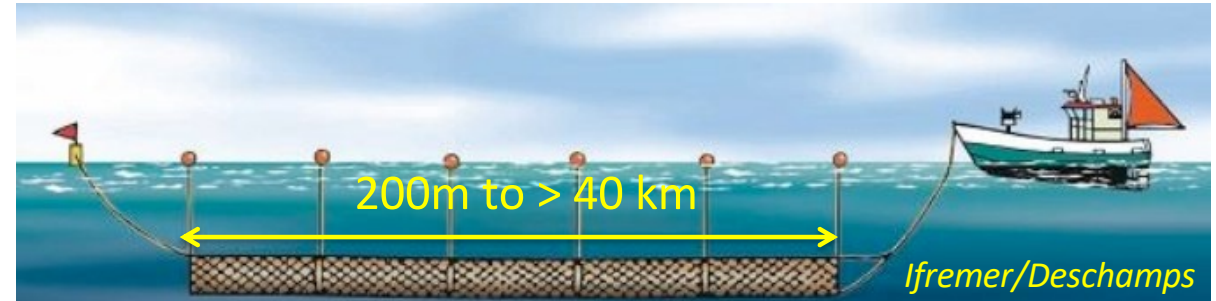
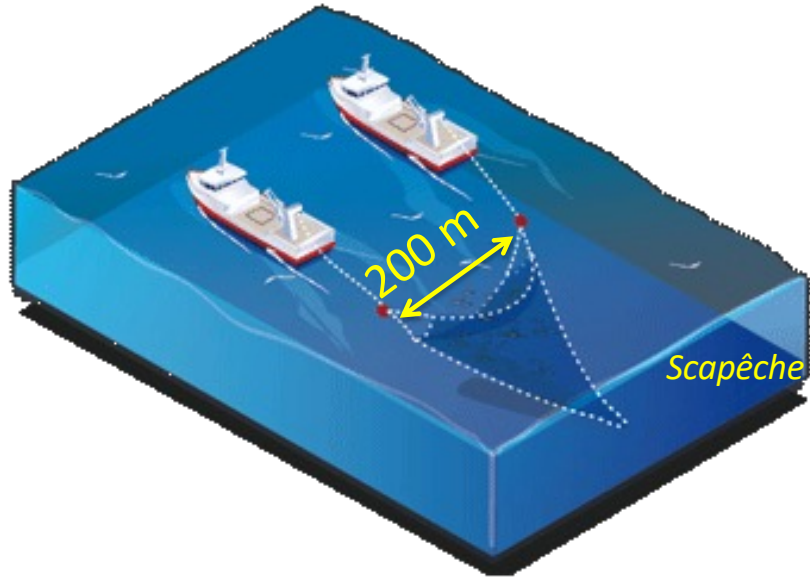


Pelagic paired-trawlers (n = 12 FR)



Netters (n = 525 FR vessels + foreign vessels)
13 different métiers

Main fisheries involved

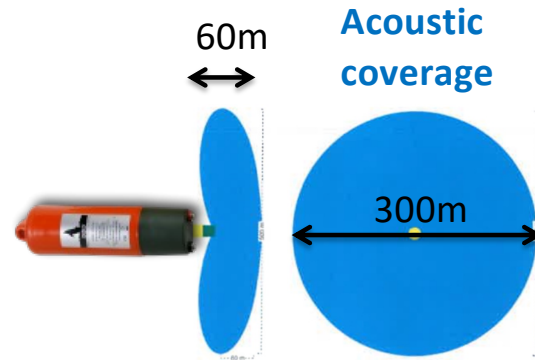


Pingers: acoustic repellent devices

Pingers mandatory for paired-trawlers since 2020-21, but devices **not applicable** to netters

No pingers covering the **entire fishing operation** available for netters

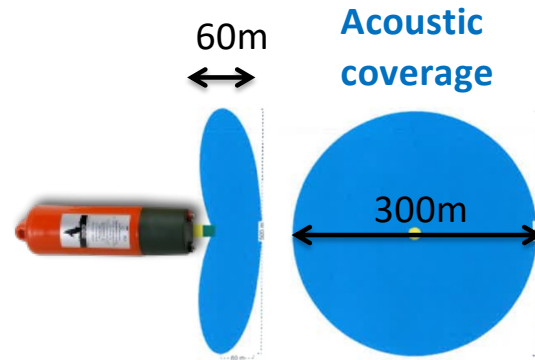
Pingers



Pingers emit within the frequency range used by dolphins but:

- **Various results** about their **efficiency** according to the device, species, and fishery
(Hamilton & Baker 2019)
- Continuous emission, **acoustic pollution, temporary habitat displacement**
(Kynh et al. 2015)

Pingers



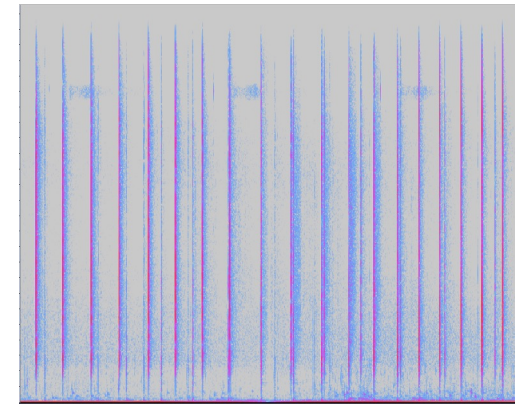
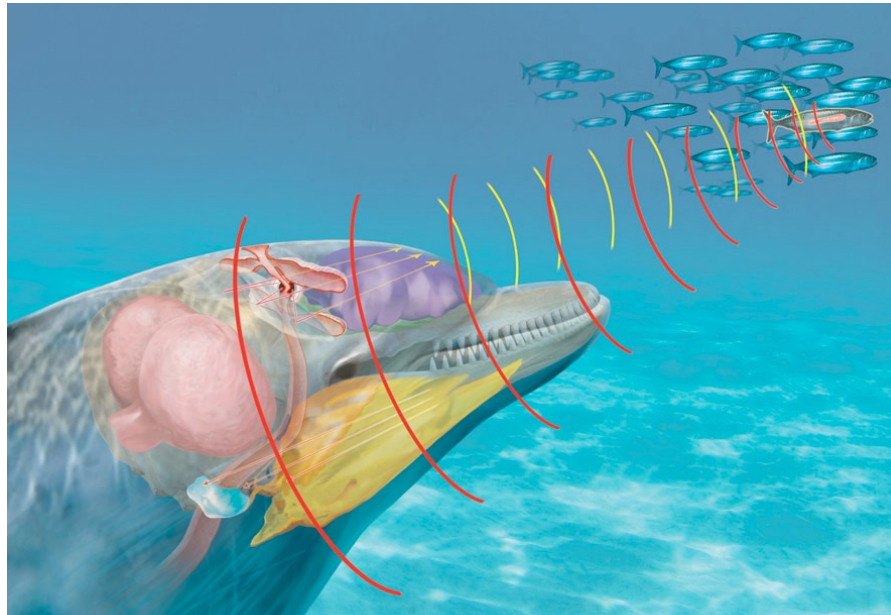
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- **Various results** about their **efficiency** according to the device, species, and fishery
(Hamilton & Baker 2019)
- Continuous emission, **acoustic pollution, temporary habitat displacement**
(Kynh et al. 2015)
- Emitted signals **not in relation** to the **types of signals** used by dolphins: **not interpretable**
(for harbour porpoise: Culik et al. 2015)

-> **Technological innovations** of acoustic devices are **still needed**

(Hamilton & Baker 2019)

Echolocation



Echolocation clicks

Net detectability ~ few meters (Schevill & McBride 1956, Kastelein et al. 2000)

Returning echoes contain features of the echolocated situation (Au & Hastings 2008)

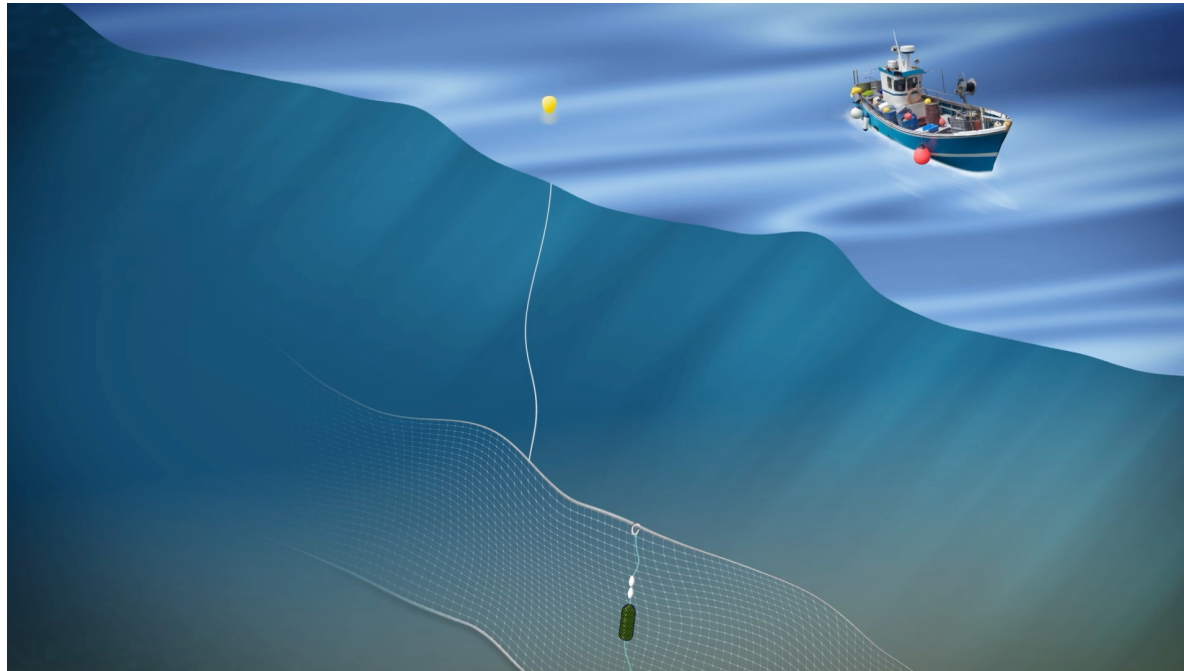
Playback experiments of returning echoes: **responses** of the individuals
interpretable by **con-specific**

(Xitco & Roitb 1996, Götz et al. 2006, Kassewitz 2016)

Main objective

- To develop **prototypes of a bio-inspired acoustic beacon** emitting **returning echoes** of echolocation clicks **on a net**, with a dolphin entangled

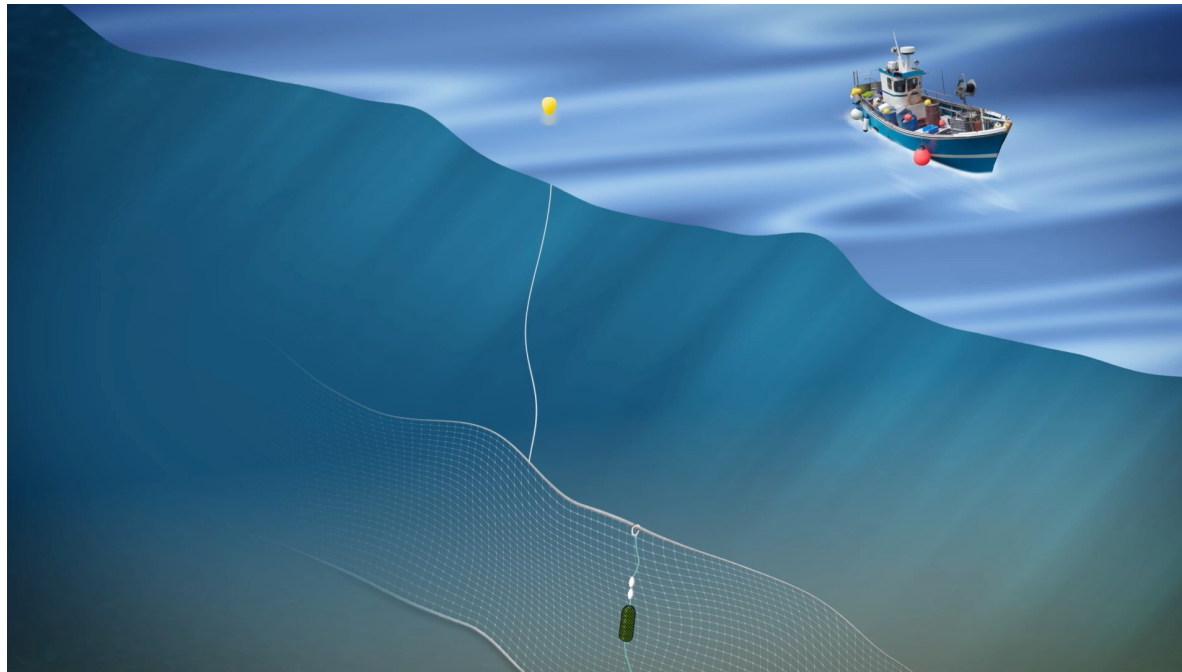
= emit the **returning echoes** that a dolphin should get **if he had echolocated on a net**



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= emit the **returning echoes** that a dolphin should get **if he had echolocated on a net**



- **Complex signal** within 20-200kHz ; 0.62 ms
- **170 dB** re 1 μ Pa @ 1m
- Device to be set **every 500 m** on a net ; emits when **dolphins detected**

Behaviour responses of dolphins to bio-inspired signals

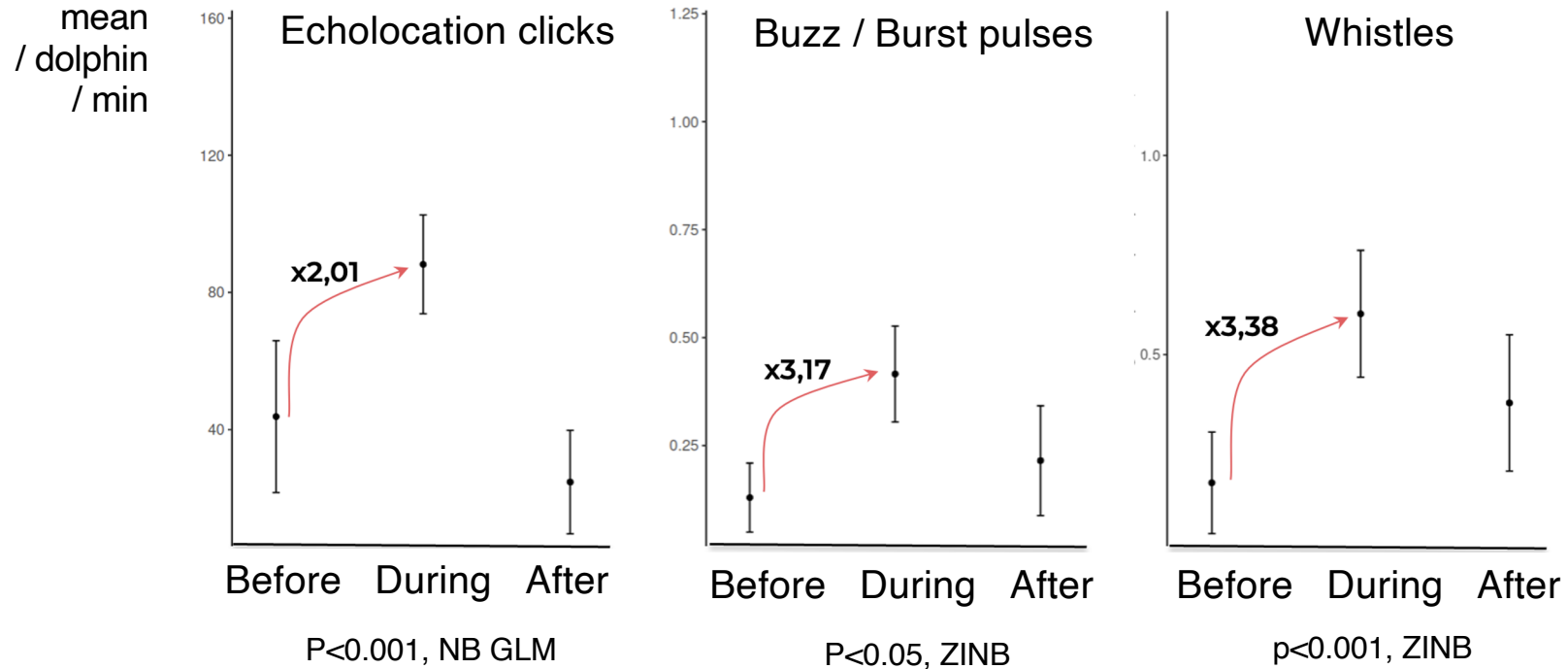
Experiments at sea in the French Brittany, 12 days in summers 2020-21

- **59 sequential treatment** (before, during, after beacon emission) with **47 dolphins' groups**
- **Experimental modalities:**
 - With and without setting a piece of net (4 different nets)
 - Initial behavioural states: foraging, travelling, socializing, milling, attraction
- **Surface visual observations** within 50m (6 main response variables) and **acoustic recording**



Acoustic response

361 min of recordings (512 kHz, 32 bits) ; semi-automatic detection methods

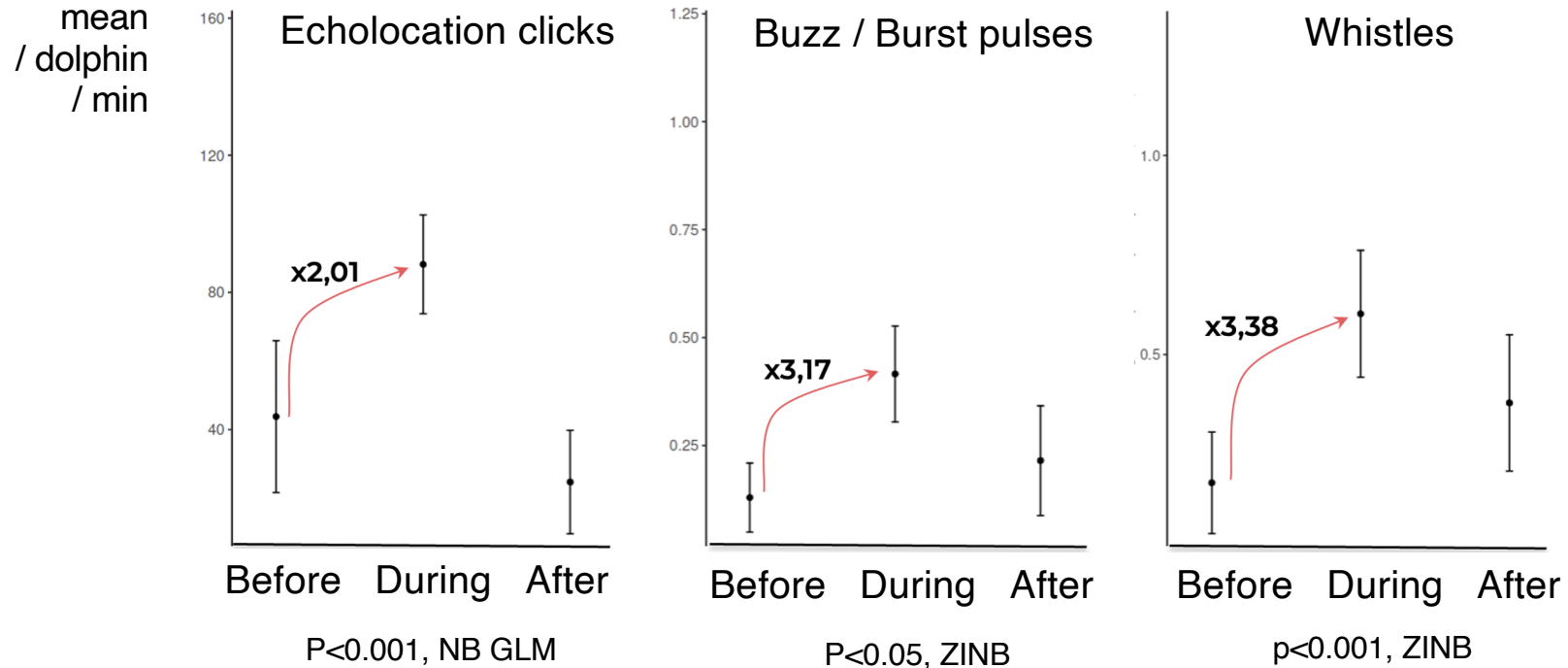


Lehnhoff et al. (2022)

-> Dolphins **echolocate more** and **communicate differently** when the device is emitting

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Surface visual observations

-> Prospect at **5-30m** from the source emission, before **calmly leaving**, **without stressful escape** behavior (compared to STM DDD pinger, Van Canneyt et al. 2006)

Tests during fishing operations

- **1043 fishing operations (FO)** observed on **10 netters**, during 240 days at sea in 2021-22
- Nets of **200m to 40km**

	FO observed	FO with by-catch (<i>Del. delphis</i>)	Bycatch Rate	Nb of FO mal-operated with BYC
Net without beacon	634	2	0,003	-
Net with beacon	408	3	0,007	3

-> **Complementary tests** needed to assess its efficiency in limiting by-catch

Conclusions & perspectives

- Dolphins **echolocate more** and **communicate differently** when the device is activated. They **prospect at 5-30m** from the source emission, before **calmly leaving**
Tests during **fishing operations** are promising



- **Efficiency tests in limiting by-catch**: action plan 2024-2026 of the French government
-> **65 FR netters** (N=525) to be equipped with DOLPHINFREE beacons
- To create bio-inspired signals dedicated to **other odontocetes** impacted by by-catch -> done for *Tursiops truncatus*

Thank you for your attention



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