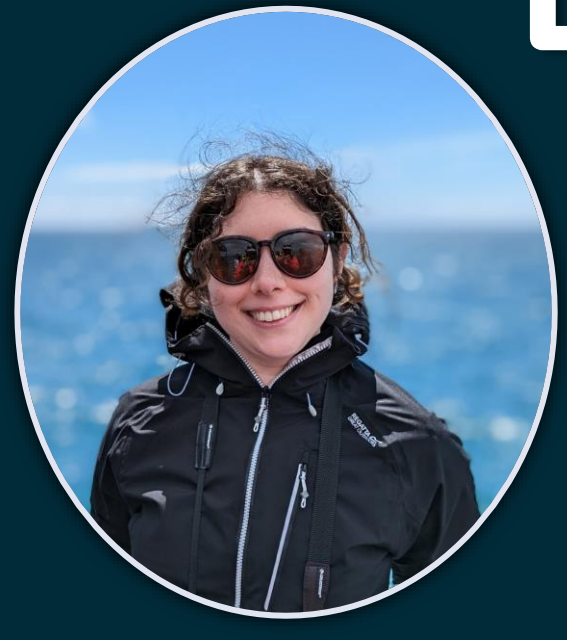


Lidocaine use in large pelagic fish research



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1 Fish & pain relief

Pain relief for wild fish during tagging is refuted due to uncertainties regarding anaesthetic efficacy, safety, and increased air exposure times. Both the tagging process and the tag can harm the fish, possibly leading to unnatural post-tagging behaviours (1,2,3,4). We developed a pain relief protocol for integration into our standard tagging procedures, evaluating its effects on tagging safety, efficiency, and fish behaviour in wild Atlantic bluefin tuna (ABT), *Thunnus thynnus*.

Can we safely and rapidly administer pain relief to wild fish during tagging?

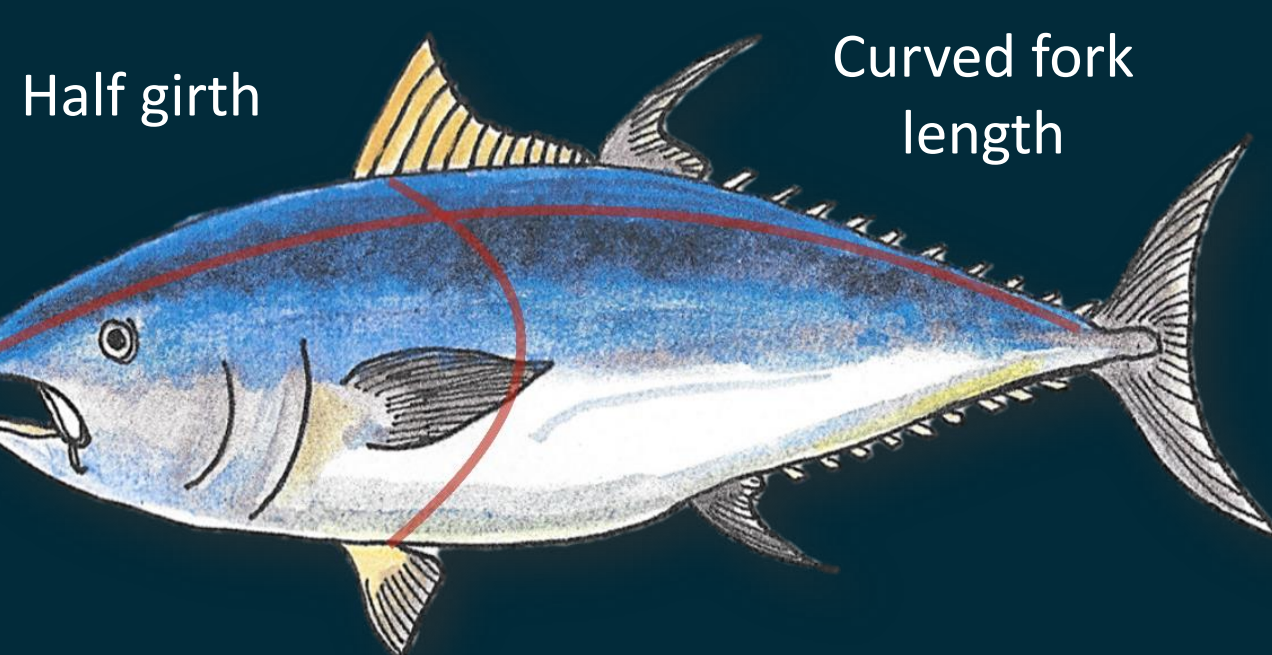
Fish sentience & 3Rs

Fish are sentient and possess nociceptors (5,6). A local anaesthetic, like lidocaine, can mitigate nociception, enhancing welfare and reducing behavioural bias (7,8). In the UK, the Animals (Scientific Procedures) Act 1986 advocates for the 3Rs and mandates that procedures be conducted under anaesthesia unless it increases suffering beyond the procedure's impact (9).

Capture



Measure



Time ABT spent on deck

Select dose

Dosage table: 2% lidocaine, 0.1 (ml/kg)

CFL (cm)	Half girth (cm)	Mass (kg)	Dose (ml)
140 - 149	42 - 54	44	4
150 - 159	54 - 57	54	5

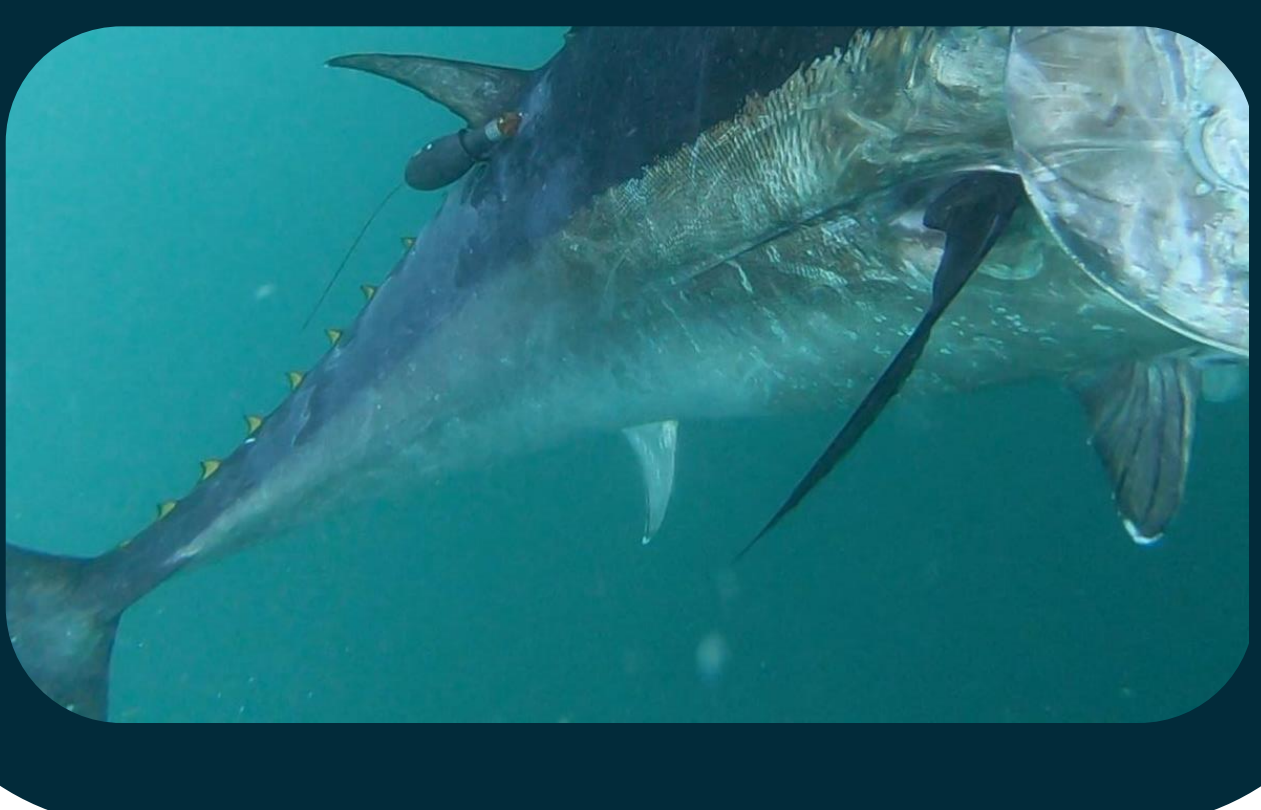
Administer dose



Tag

Accelerometer MiniPAT Acoustic tag

Recover & release



2 How to deliver lidocaine

ABT (n=132) were caught and tagged with either one or two tags in the English Channel. Doses were based on estimated fish mass of 108 previously tagged fish. A paper template was attached to each ATB which enabled accurate delivery of the analgesia to the tag sites (Fig.1). ABT tagged prior to 2022 did not receive lidocaine. All tagging activity on deck was recorded and analysed (Fig.2A, 2B).

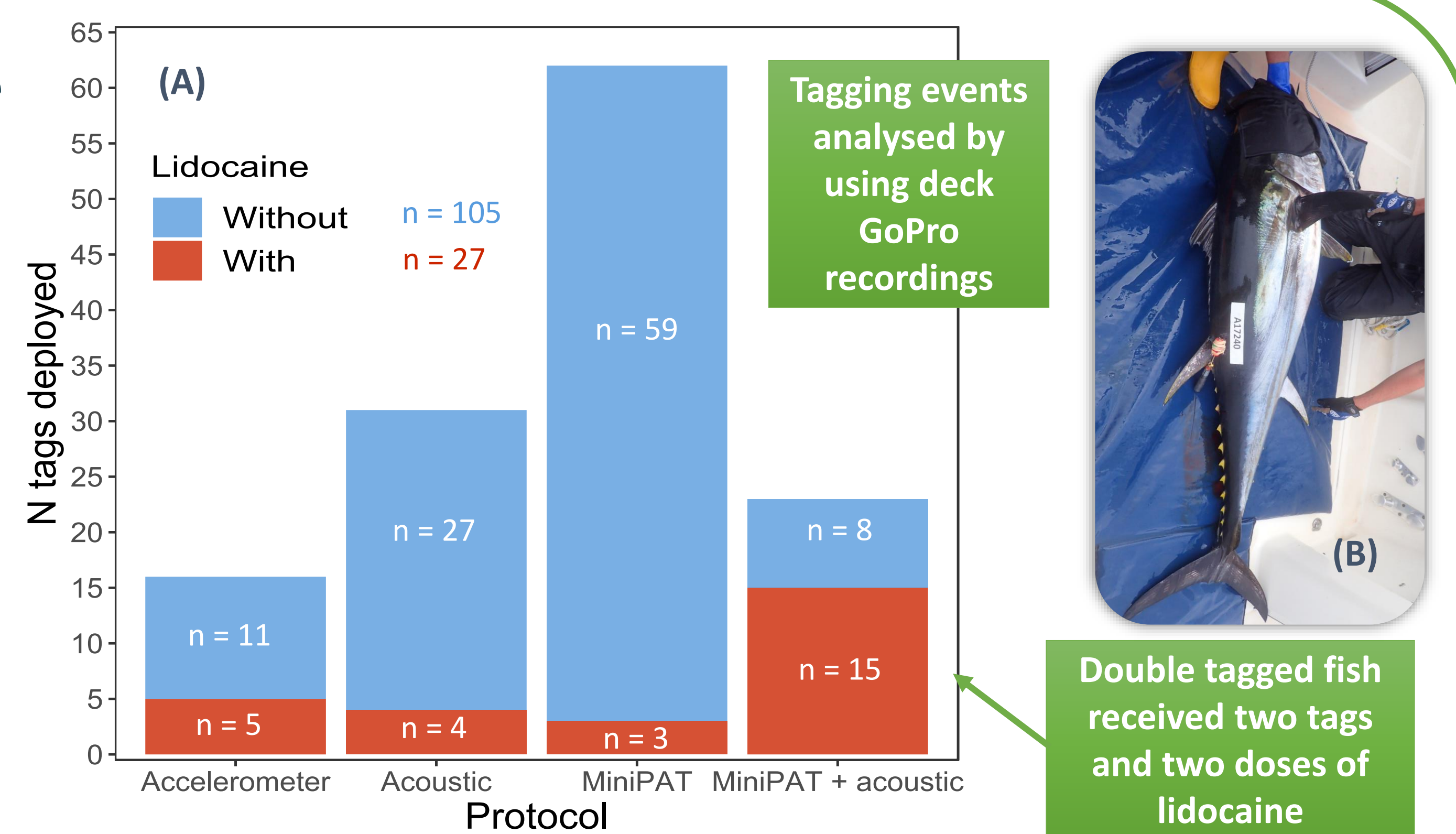


Figure 2. (A) Stacked bar plot showing numbers of on deck tagging events recorded with GoPros, with and without lidocaine. Protocols highlight tag types used. (B) Example image of ABT on deck.

3 Changes to time spent on deck

Single tag scenarios

- Addition of lidocaine **did not significantly increase the mean time spent on deck** (Welch Two Sample t-test: $t(13) = 0.98$, $p = 0.17$, Cohen's $d = -0.3$; Fig.3).

Double tag scenarios

- Mean time spent on deck **significantly increased when lidocaine was administered** (Welch Two Sample t-test: $t(16.5) = 5.31$, $p < 0.005$, Cohen's $d = -2.2$; Fig.3).

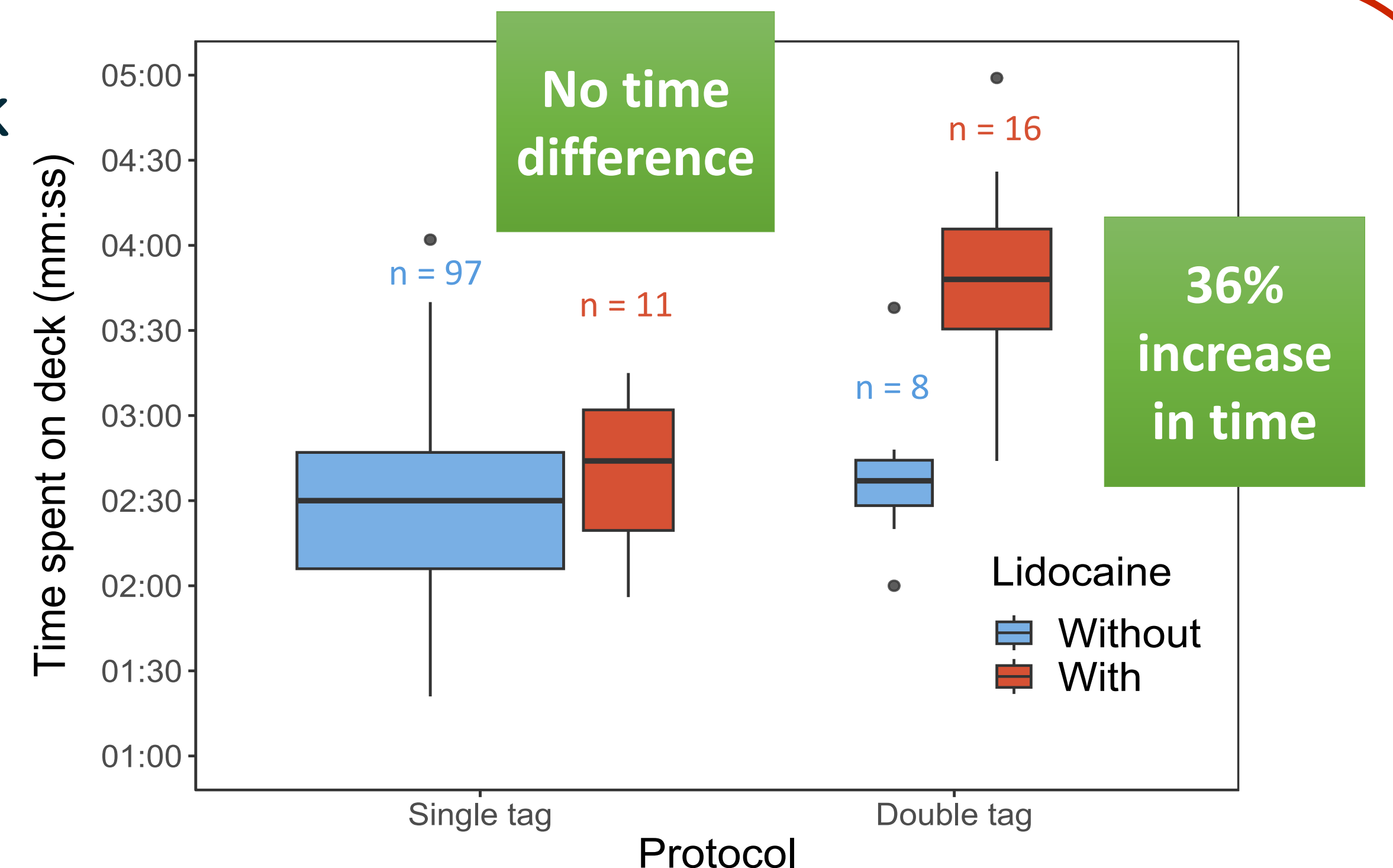


Figure 3. Total time that ABT spent on deck during single or double tag attachment with or without the administration of lidocaine. The bold horizontal black line in the box centres represents the median, the box shows the interquartile range (IQR) and the whiskers represent the individual value closest to 1.5 * the IQR from the box extent.

4 Preliminary results: effects of lidocaine on behaviour

MiniPATs (n=21) were physically recovered after full deployments (1-2 years) and the vector of the dynamic body acceleration (VeDBA) was analysed (Wilcoxon rank-sum test: $W = 11613$, $p < 0.05$; Fig. 5A, 5B).

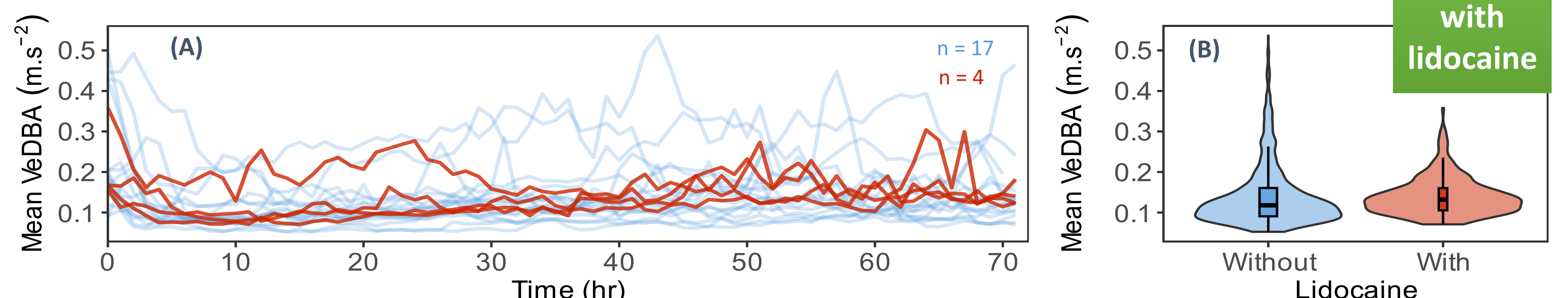


Figure 5. (A) ABT mean hourly VeDBA calculated from 0.2 Hz acceleration data collected from MiniPAT tags deployed with or without lidocaine. (B) Randomly sampled mean VeDBA (n = 20 samples/fish) shown as a violin and box plot. The bold horizontal black line in the box centres represents the median, the box shows the interquartile range (IQR) and the whiskers represent the individual value closest to 1.5 * the IQR from the box extent.

Our study demonstrates that lidocaine administration is safe and practical for large fish on deck, without undue delay. We recommend adoption of pain relief during tagging, the 3Rs approach.

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