False alarm: the effects of boat noise on the anti-predator behaviour in Pacific sand lance

Meredith White, Nora Carlson, Francis Juanes
Department of Biology, University of Victoria

Background

- In coastal regions, boat noise has dramatically increased, posing a serious threat to many coastal marine animals[1]
- Boat noise can cause negative behavioural and physiological effects to fish[2]

- The Pacific sand lance (*Ammodytes personatus*, PSL) is a coastal forage fish that is a crucial prey source for over 100 marine species[3]

Objective: Investigate how boat noise affects anti-predator behaviour in PSL, and determine how these effects might influence the fitness of both PSL and their predators

Methods

- For 12 days, I held PSL in two enclosures in two tanks: in one tank I played intermittent boat noise recordings (playbacks), and in the other I played silence (Fig. 1)
- I recorded PSL anti-predator behaviour (e.g., burrowing in sand and startling) by watching underwater video footage
- In the boat noise tank, I coded the first 3 minutes of 06:00 and 09:00 times for 11 days. In the silence tank, I coded the first 3 minutes of 06:00 and 08:00 times for 10 days

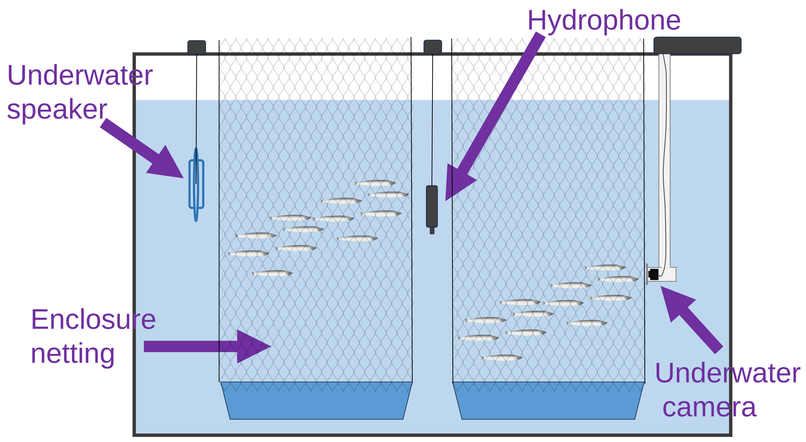

Figure 1. Schematic of experimental tank

Results

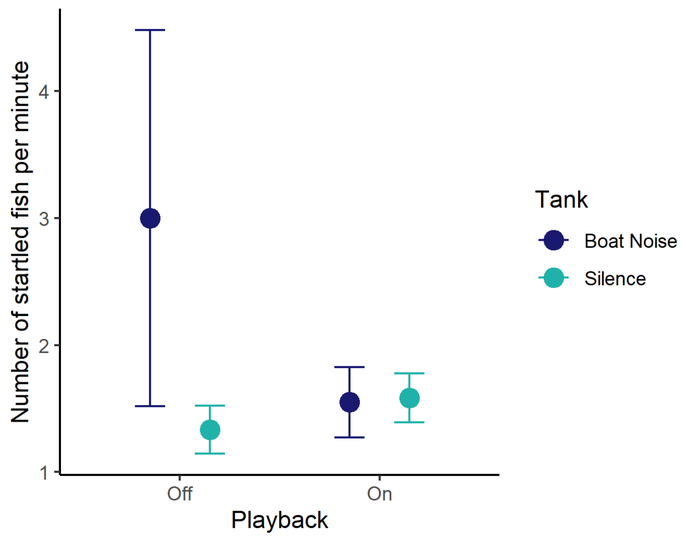

Figure 2. Number of fish that startled per minute in each tank, on days when playbacks were on or off

Tank:Playback on or off days * (p=0.02)
Day * (p=0.04)

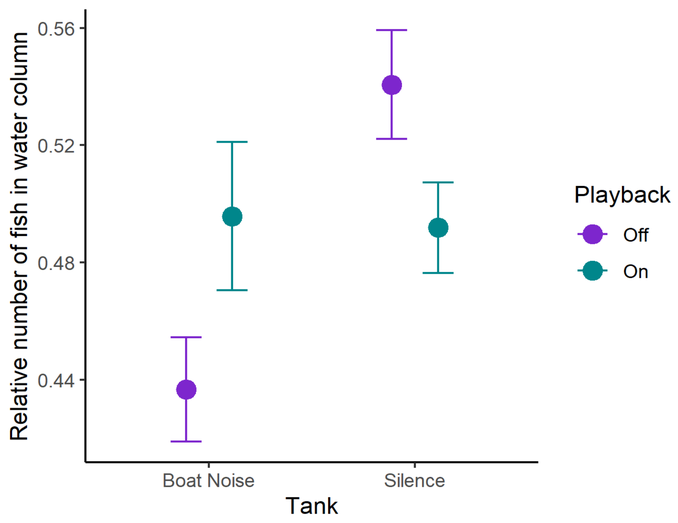

Figure 3. Relative number of fish in water column per minute in each tank, on days when playbacks were on or off

Tank:Playback on or off days *** ($\chi 2 = 18.1730$, $p<0.001$)
Day **** ($\chi 2 = 8.4274$, $p<0.01$)

Discussion

- PSL startled at a greater rate on days when they were not exposed to boat noise compared to days exposed to boat noise. This suggests…
  - ➢ Boat noise masks the auditory cues that stimulate PSL startling behaviour, which may negatively impact their fitness and increase their availability as a prey source
- The number of fish in the water column increased on days when playbacks were on in the boat noise tank, and the opposite trend occurred in the silence tank. This suggests…
  - ➢ Unmeasured tank-specific differences (e.g., external noise and light levels) prompted this variation instead of the playback trials

Future Directions

- Incorporate behavioural data from more time periods in the day over a longer period
- Explore whether different types of boat noise cause differential anti-predator responses in Pacific sand lance

References

1. **Duarte, C. M., L. Chapuis, S. P. Collin, D. P. Costa, R. P. Devassy, V. M. Eguiluz, C. Erbe, T. A. C. Gordon, B. S. Halpern, H. R. Harding, *et al.* 2021**. The soundscape of the Anthropocene ocean. *Science* **371**: eaba4658.
2. **Cox, K., L. P. Brennan, T. G. Gerwing, S. E. Dudas and F. Juanes**. **2018**. Sound the alarm: A meta-analysis on the effect of aquatic noise on fish behavior and physiology. *Global Change Biology* **24**: 3105–3116.
3. **Robards, M. D., M. F. Willson, R. H. Armstrong and J. F. Piatt**. **2000**. *Sand lance: a review of biology and predator relations and annotated bibliography.* U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.

Acknowledgments

This research was supported by the Jamie Cassels Undergraduate Research Awards, University of Victoria. Supervised by Dr. Nora Carlson and Dr. Francis Juanes. Thank you to Nora for all your help with field work and data analysis!

Poster Produced on 27 February 2024