Hormonal and behavioural effects of motorboat noise on wild coral reef fish


Highlights

- Fish exposed to boat-noise playback responded both behaviourally and hormonally.
- Exposure to motorboat-noise playback increased circulating cortisol levels.
- Some behaviours showed carry-over effects from motorboat noise after it had ceased.
- Stress-responses to an additional environmental challenge were impaired.
- Hormonal pathways are proximate mechanisms driving behavioural responses to noise.

Abstract

Anthropogenic noise is an emergent ecological pollutant in both terrestrial and aquatic habitats. Human population growth, urbanisation, resource extraction, transport and motorised recreation lead to elevated noise that affects animal behaviour and physiology, impacting individual fitness. Currently, we have a poor mechanistic understanding of the effects of anthropogenic noise, but a likely candidate is the neuroendocrine system that integrates information about environmental stressors to produce regulatory hormones; glucocorticoids (GCs) and androgens enable rapid individual phenotypic adjustments that can increase survival. Here, we carried out two field-based experiments to investigate the effects of short-term (30 min) and longer-term (48 h) motorboat-noise playback on the behaviour, GCs (cortisol) and androgens of site-attached free-living orange-fin anemonefish (Amphiprion chrysopterus). In the short-term, anemonefish exposed to motorboat-noise playback showed both behavioural and hormonal responses: hiding and aggression increased, and distance moved out of the anemone decreased in both sexes; there were no effects on cortisol levels, but male androgen levels (11-ketotestosterone and testosterone) increased. Some behaviours showed carry-over effects from motorboat noise after it had ceased, and there was no evidence for a short-term change in response to subsequent motorboat-noise playback. Similarly, there was no evidence that longer-term exposure led to changes in response: motorboat noise had an equivalent effect on anemonefish behaviour and hormones after 48 h as on first exposure. Longer-term noise exposure led to higher levels of cortisol in both sexes and higher testosterone levels in males, and stress-responses to an additional environmental challenge in both sexes were impaired.
androgen levels correlated with aggression, while cortisol levels correlated with hiding, demonstrating in a wild population that androgen/glucocorticoid pathways are plausible proximate mechanisms driving behavioural responses to anthropogenic noise. Combining functional and mechanistic studies are crucial for a full understanding of this global pollutant.