

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



Suzanne C.Mills RicardoBeldade LauraHenry  
DavidLavery Sophie L.Nedelec Stephen  
D.Simpson Andrew N.Radford

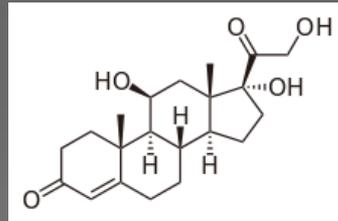
# *Introduction*

- ◉ Anthropogenic noise is a well-recognized global pollutant that has a wide range of effects on wildlife.
- ◉ Human activities that generate sound have been on the rise since the Industrial Revolution and both landscapes and waterscapes have been altered throughout the world.

## How does noise act on living beings?

One of the fundamental components of the neuroendocrine system, the hypothalamic-pituitary-adrenal (HPA) axis, involves three responses:

A primary response (initial neuroendocrine response), where HPA releases glucocorticoid (GC) hormones that have multiple regulatory effects on an individual's biology (secondary and tertiary responses)



glucocorticoid

Anthropogenic noise has been proven to stimulate the initial hormonal response with elevations in GC levels, both in fish, amphibians, mammals and birds... But not in all cases

# Studies

- Most experimental noise studies have considered immediate responses to single, relatively short-term exposures, but repeated exposure to noise could lead to a heightened or lessened response.

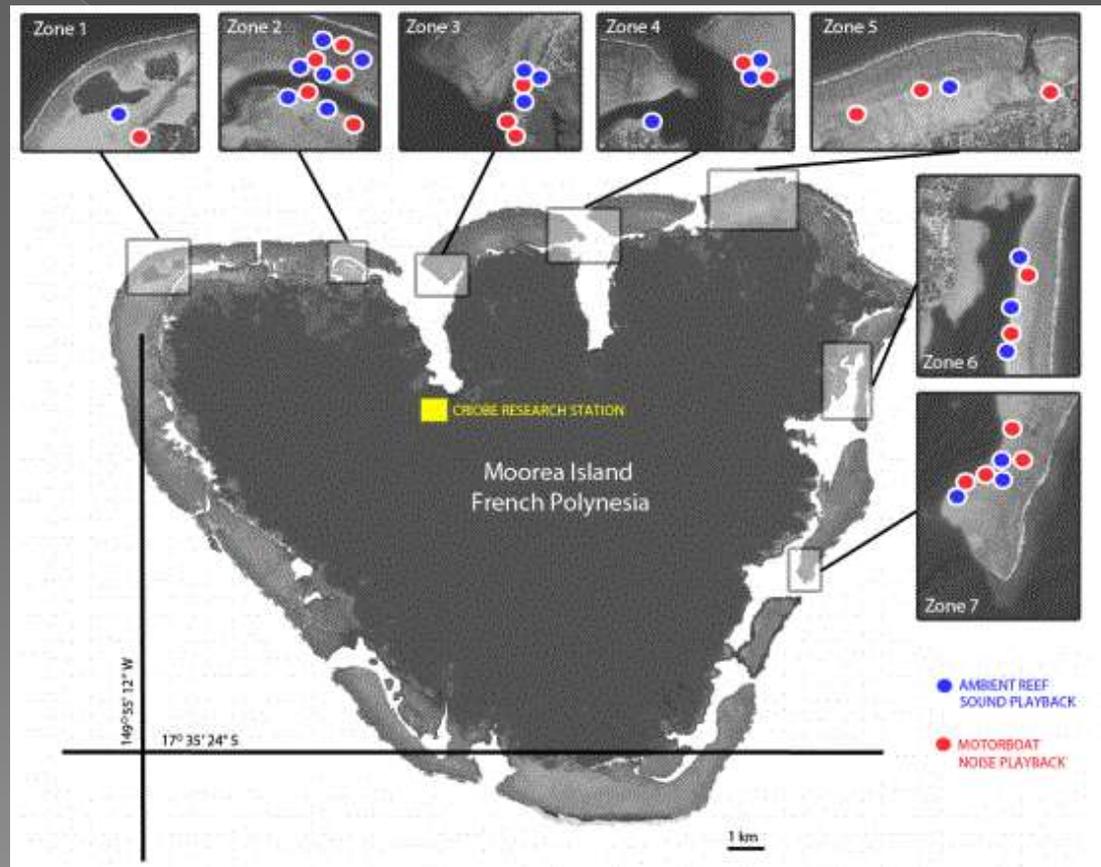


# Experiments

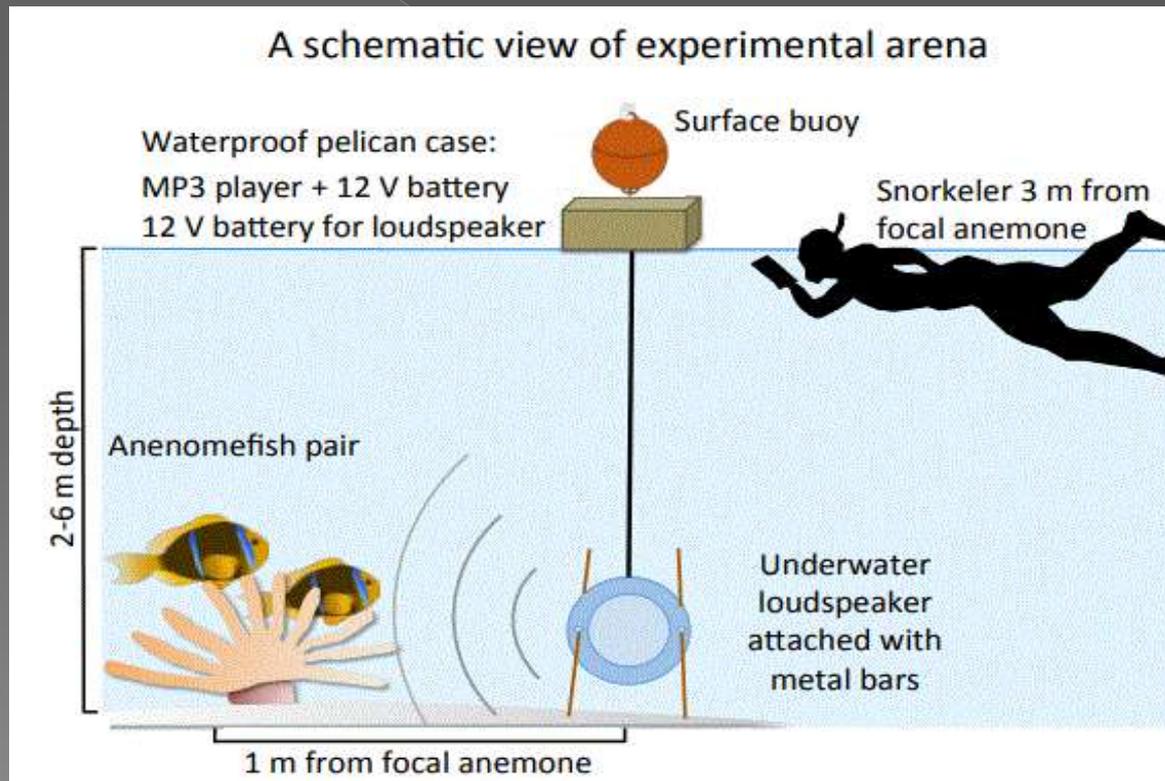
Two field experiments were carried out to investigate the short-term (1 h) and long-term (48 h) effects of ship noise reproduction on the behavior of male and female anemonefish, GC, and androgens.

# Experiment 1 (1h)

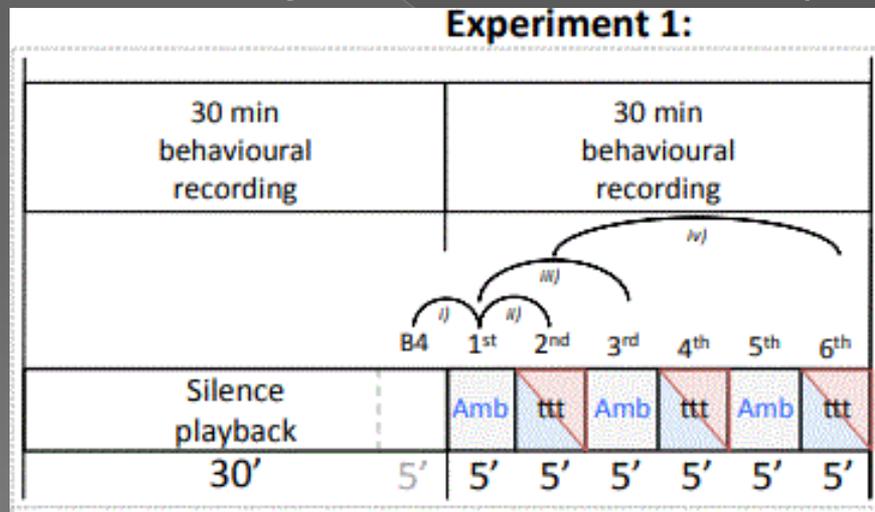
An underwater loudspeaker was placed 1 m from the focal anemone to which a pair of anemonefish was associated. The pairs were assigned alternately to ambient and motorboat treatments. Focal anemones were in seven zones around Moorea with equal numbers of both treatments in each zone.



The loudspeaker was switched on to play a silent track (a 30 min period of silence on all playback tracks) and, after a 10 min acclimation period to the presence of the loudspeaker and a snorkeler 3 m from the host anemone, the baseline behaviour of both the male and female fish was recorded for 20 min.

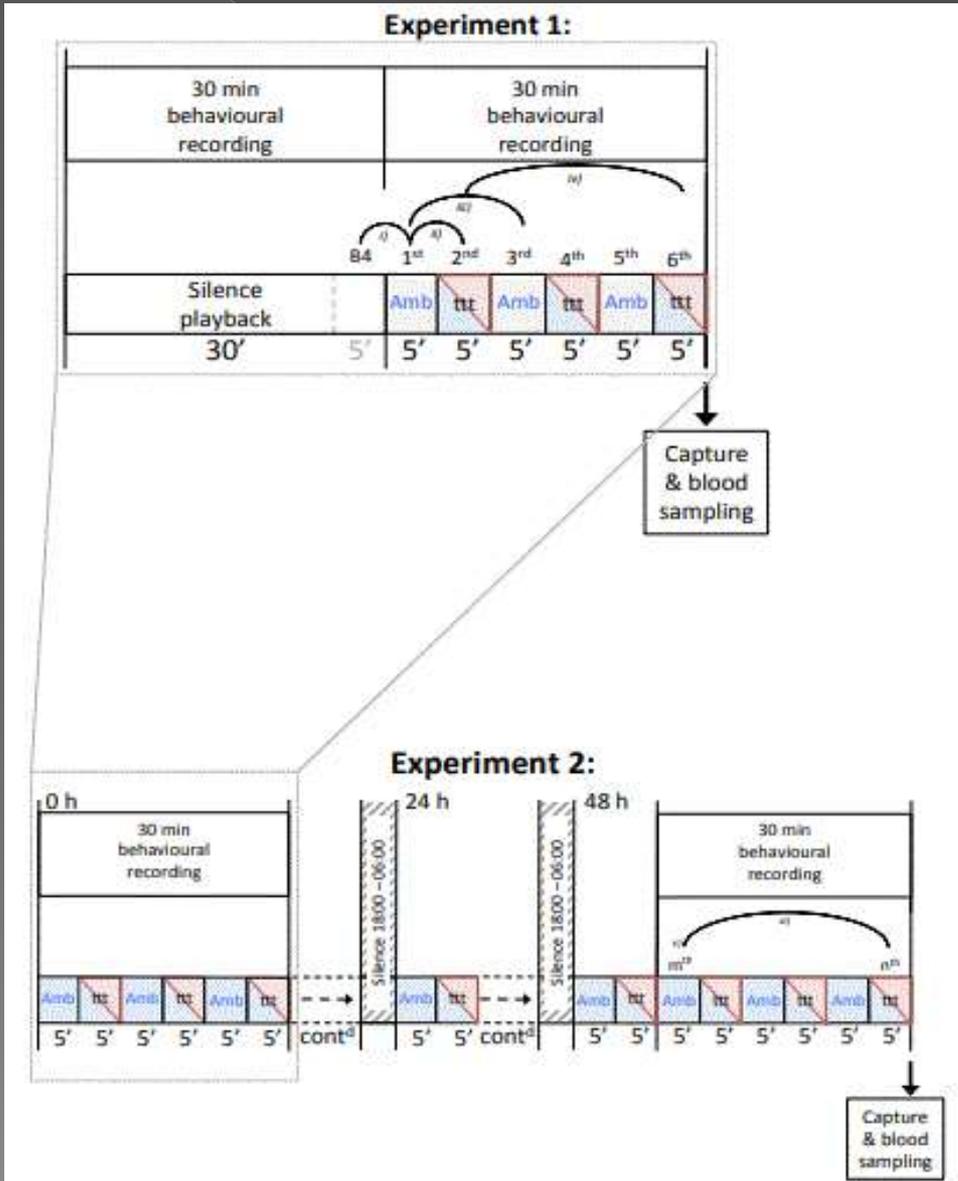


A trial then continued with a 30 min sound-treatment track that consisting of either alternating 5 min periods of ambient-reef sound and ambient-reef sound plus motorboat noise. (Behavioral observations of the focal pair were taken during each 5 min period)



Then, at the end of the experiment, hormone blood samples were taken from 20 pairs to assess cortisol levels.

# Experiment 2 (48h)



During the 48-hour test period, the motorboat treatment pairs received approximately 24 hours of playback noise. (The speakers were silent at night).

At the end of 48 h, and after a 10 min acclimation period to the presence of a snorkeler conducting behavioural observations, the behaviour of the focal pair was recorded during a final 30 min playback period.

Next, The 20 pairs were captured for hormonal sampling.

# Results

## Behavioural responses: Experiment 1

- ◉ The initial reproduction of the noise from the boat induced strong behavioral responses in both females and males, such as a significant hiding increase , a decrease in the mean distance to the anemone, and an increase in its aggressiveness.



# Results

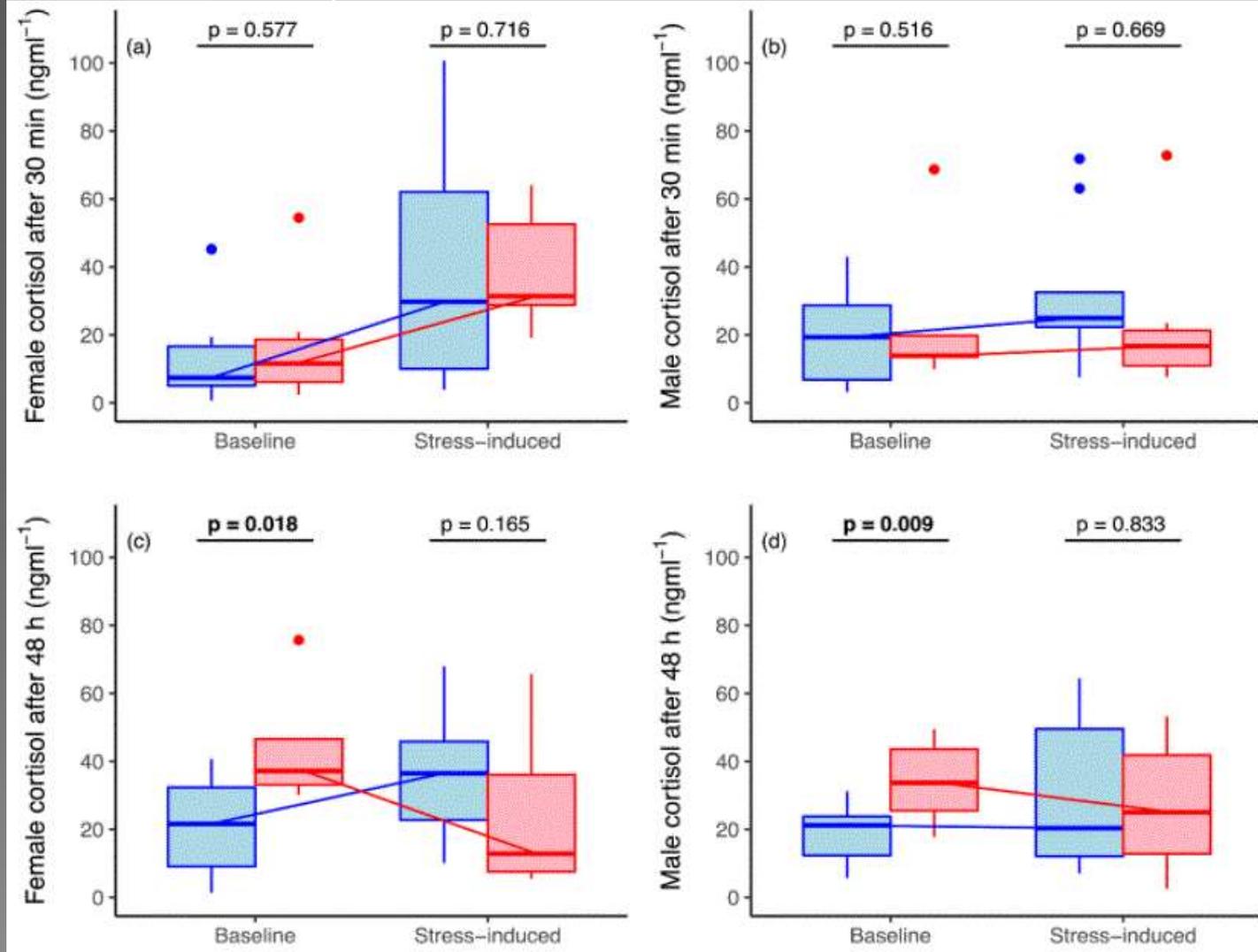
## Behavioural responses: Experiment 2

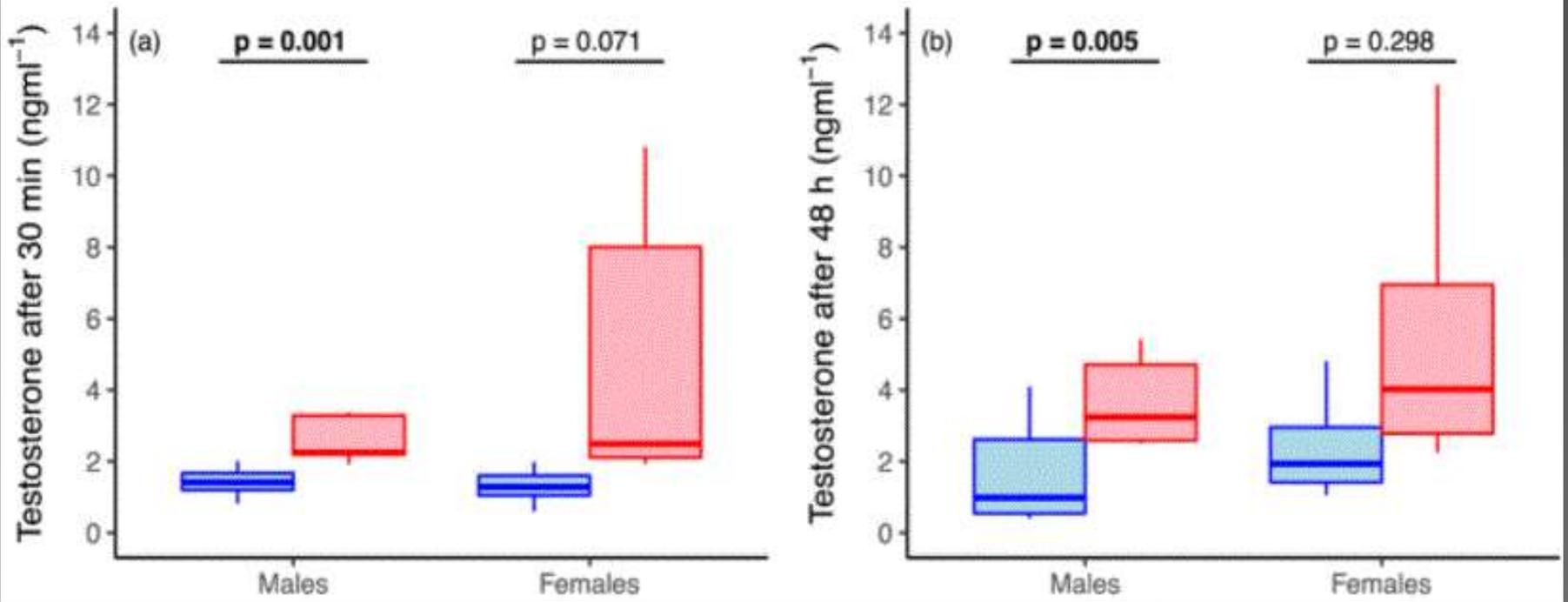
In despite of a trend for females to increase hiding and males to increase aggression when exposed to motorboat-noise playback compared to ambient-sound playback, there was no evidence for a longer-term effect of intermittent motorboat-noise playback on baseline behaviour.

# Results

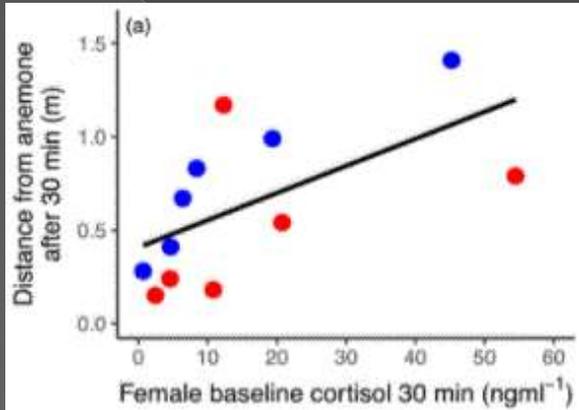
## Hormonal responses

- Cortisol levels were affected by longer-term, but not short-term, noise exposure.

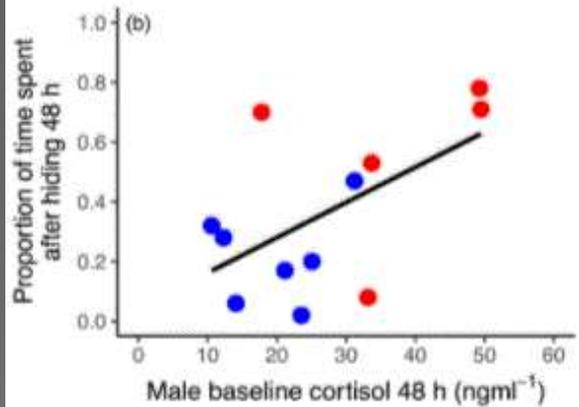




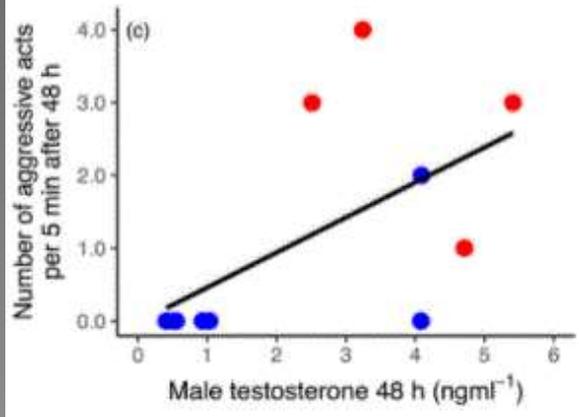
# Relation between behavior and hormones



In Experiment 1, only female distance from the anemone was significantly related to baseline cortisol levels.



In Experiment 2, hiding and aggressiveness increased with increasing baseline cortisol and testosterone concentrations for both sex.



# Behavioural effects



(Aggressiveness)



**Higher energy expenditure**



**Increased rates of foraging**



Problem: Increase of hiding levels

# Conclusions

The neuroendocrine system is possibly the most important physiological mechanism underlying survival in our world.

Activation of this system modifies entire sets of physiological, behavioral and cellular traits, and it has been shown in a wild fish population that the reproduction of motor boat noise triggers responses with concomitant impacts on behavior.



**Grazie per l'attenzione !**