

The combined impact of global warming and pollution on coral reef fish

Today, fish populations around the world are subjected to a combination of human-induced stressors. These range from global stressors, like increased temperatures and ocean acidification, to more local ones, like pollution, coastal development, and boat traffic. But, despite this, most research to date has only studied the stressors as separate phenomena. Anthropogenic stresses strongly impact the sensory development and the survival of a coral reef fish via an endocrine disturbance, new study finds.



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Now, researchers have explored the combined impact of two stressors – increased temperature and pesticides – on a species of coral reef fish. Their results, published today in *Nature Communications*, show that both the stressors can disrupt the endocrine system of the fish. In fact, the combination of the two stressors was found to have a larger impact than if they were independent of each other. This study highlights the importance of considering more than one stressor in future research and sheds light on the effects multiple anthropogenic stressors have on animal populations.

The background of this research

Most reef fish have a pelagic larval phase, during which the larvae develop in the open ocean. These larvae will eventually colonize and settle in reef areas, usually along the shoreline. This transition is called larval recruitment and is accompanied by the metamorphosis of the larvae

into a juvenile. These two stages – recruitment and metamorphosis – are essential in the renewal of fish stocks and the maintenance of biodiversity.

Numerous studies have shown the harmful effects of global and local stressors on the sensory capacities of coral reef fish during larval recruitment. After initial research on the role of thyroid hormones on the metamorphosis of coral reef fish, the research teams sought to understand whether these hormones could also control the sensory development of the larvae and if the harmful effects of anthropogenic stresses on larval recruitment were caused by a disruption to this hormonal pathway.

Looking closely at convict surgeonfish

This study found that disturbances to thyroid hormones cause sensory defects in the fish and result in an increased vulnerability to predation.

Convict surgeonfish (*Acanthurus triostegus*) were exposed to the two chosen anthropogenic stresses – increased temperature and the pesticide, chlorpyrifos. The researchers used different ecological, functional, histological, and behavioral approaches, in both the field and the laboratory, to better understand the importance of thyroid hormones in the development of three sensory structures – the retina, the nostrils, and the lateral line. They also showed that these hormones control the acquisition of a predator's visual and chemical recognition behaviors, and thus impact the fish's vulnerability to predation.

They observed the effects of their two chosen stressors on the thyroid hormone levels of fish larvae. Both stresses were found to cause a decrease in the concentration of thyroid hormones in exposed fish. These same individuals also exhibited impaired sensory development and a greater vulnerability to predation. Treatment with a thyroid hormone was found to reverse these effects, which shows that it is the drop in the level of these hormones which induces the changes to the sensory organs and increases the vulnerability to predation.

These results demonstrate for the first time that different anthropogenic disruptors lead to the same consequences via a common internal mechanism: the disruption of an endocrine pathway. Their action can even be synergistic, since simultaneous exposure to low doses (+ 1.5 ° C and 5 µg L⁻¹ of chlorpyrifos), which have no impact separately, is enough to disturb the thyroid system of fish.

In the global context of declining fish stocks due to increased adult mortality, such defects in larval recruitment further threaten the maintenance of fish populations. This is especially relevant in the South Pacific islands where fish is the main protein resource. This study highlights the great sensitivity of young life stages of fish to anthropogenic stresses and further demonstrates that these anthropogenic stresses effectively converge towards impacting the signaling of thyroid hormones. This should lead to a major change in our appreciation of the effects of human-induced stressors on animal populations.



Figure:

Top: A Manini larva (*Acanthurus triostegus*) just before entering the reef. It has the typical transparency of a pelagic larva living in the ocean. If seen from below, the ventral "shield" will reflect the light and allow it to merge with the surface. (© Marc Besson)

Bottom: A juvenile of Manini, after its metamorphosis. The white and black pigmentation in comparison with the larva of the previous figure is clearly visible as well as the shape of the head (in particular the mouth) adapted to grazing behavior. (© Marc Besson)

Reference :

[Anthropogenic stressors impact fish sensory development and survival via thyroid disruption.](#)

Besson M, Feeney WE, Moniz I, François L, Brooker RM, Holzer G, Metian M, Roux N, Laudet V, Lecchini D. Nat Commun. 2020 Jul 17;11(1):3614. doi: 10.1038/s41467-020-17450-8. PMID: 32681015

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