Tourism or permanent settling: Study shows different consequences for coastal fauna

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On undisturbed beaches of the Maldives hermit crabs occur in high numbers; they feed on washed up material and thus represent an important connection between the sea and the inland. Credit: Sebastian Steibl

Coasts are habitats for many endangered species and are therefore of great ecological value. They are also of great economic value, as humans

use them in very different ways: for instance as areas of permanent settling or as tourist destinations. Researchers at the University of Bayreuth have now for the first time been able to demonstrate in a study on the Maldives that these two forms of coastal land use lead to different ecological consequences shown in the model system hermit crabs. The scientists presented their findings in the journal *Scientific Reports*.

Scientific studies investigating how humans influence natural habitats in coastal regions face a fundamental problem: in many cases coasts are used simultaneously in very different ways. They serve the local population as residential areas, while the tourism industry attracts an international host of visitors with modern hotels and white beaches. This makes it impossible to determine exactly how these forms of land use differ in terms of their ecological impact. The Maldives, however, offer one great advantage in this regard: the different forms of land use are distributed separately among the archipelago's islands. At the same time, these tropical islands share almost identical climatic and geological conditions. "The Maldives are therefore an ideal system for identifying various anthropogenic influences on the fauna of coastal regions," says Sebastian Steibl M.Sc., lead author of the recently published study.

The researchers led by Prof. Dr. Christian Laforsch, who is Chair of Animal Ecology at the University of Bayreuth, took a closer look at three types of islands in the Maldives: islands populated by the local population without tourism, islands used exclusively for tourism, and uninhabited islands. They chose hermit crabs as a model organism. "These small creatures are coastal inhabitants with an important ecological function: on the one hand hermit crabs feed on washed up organic material from the sea, while on the other, they are eaten by larger terrestrial predators. That's why they form a crucial link between the sea and the inland," explains Laforsch.

White sandy beaches, like here on the Maldives, are anything but unspoilt: Measures to increase tourist attractiveness often destroy the habitat of many organisms. Credit: Sebastian Steibl

On those Maldivian islands inhabited by the local population, washed up material is left behind. As a result, crustaceans are found there as frequently as on completely uninhabited islands. Credit: Sebastian Steibl

Long coastal stretches of the permanently populated Maldivian islands are protected from erosion by sea walls, which severely limits habitat for coastal species. Credit: Sebastian Steibl

The research revealed striking differences:

- Fewer hermit crabs live on tourist coasts. This 80 to 85 percent decline in populations is mainly due to the fact that fine sandy beaches are artificially heaped up and washed up organic material is mechanically removed. Realizing the tourist ideal of 'clean' beaches means that the coastal fauna loses its food source and the available habitat shrinks. In contrast, a permanent settlement without tourism has no negative influence on a population of crabs. However, this only applies to the

undisturbed coastal areas of the populated islands, which, like the coasts of uninhabited islands, contain large amounts of organic material, e.g. seagrass. Unfortunately, many parts of the coasts of populated islands have been shored up with concrete walls to protect the shore from erosion, meaning that the natural habitat for the crabs has shrunk here as well.

- However, on the coasts of permanently populated islands, hermit crabs are 10 to 20 percent smaller in body size compared to the other island types. In their search for an explanation, the researchers observed that the crustaceans are used by the local population—as in many other countries—as bait for fishing. They suspect it is mainly the larger animals that are collected, leaving only smaller individuals behind. "Just as commercial fishing has already caused many species of fish to diminish in size, the size-selective gathering of hermit crabs could have led to smaller individuals in their populations," explains Steibl.

The study thus shows that two forms of land use can have very different effects on organisms. "This means further research will be necessary to break down the ecological consequences of human land use into as much detail as possible. Only in this way can effective environmental protection measures be developed that are specifically tailored to a particular form of land use. This applies especially to coastal regions, which have been hardest hit by the growth of the world population, as 50 to 75 percent of the world's population now live in the immediate vicinity of or directly on the coast," concludes Laforsch.

More information: Sebastian Steibl et al. Disentangling the environmental impact of different human disturbances: a case study on islands, *Scientific Reports* (2019). DOI: 10.1038/s41598-019-49555-6