

The predator survives – but the ecosystem crashes

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What do killer whales, polar bears and humans have in common? They are adaptable predators with the ability to select new prey when their favourite food is in low supply. But this change can disrupt entire ecosystems.

"If the predator is efficient at killing its prey, such a change can lead to negative effects in the long term, for the entire food web, even if in the short term it benefits the predator's survival," says David Gilljam, doctoral student in theoretical biology, who joined with Professor Bo Ebenman and PhD Alva Curtsdotter to publish a new model-based study in *Nature Communications*.

By working with both natural and computer-generated food webs, the researchers can show how the overexploitation of resources caused by predators changing their prey can, in the worst case, lead to an extinction cascade, where species after species is wiped out in a domino effect.

A dramatic example of this is the killer whale, whose main prey was newborn whale calves. When whale populations fell dramatically due to intensive hunting, they began to hunt seal instead. Then when the seal population was quickly eradicated, the [killer whales](#) moved on to [sea otters](#). This reduced the pressure on sea urchins, the preferred diet of the sea otters. As a result, the sea urchins grazed down the kelp beds that have served as nurseries for many different fish species and small marine animals.

"Think of a rope that's made of a number of twisted fibres. When force is applied to the rope, the force is spread across all the fibres. If one fibre breaks, the remaining fibres take all the force, with more force on each individual fibre. If more break, eventually the whole rope will fail," says Prof Ebenman.

Examples from the real world:

- As the ice in the Arctic melts, it gets more and more difficult for the [polar bears](#) to hunt seal – their natural prey. Instead they have started to venture onto the land, to feed on the eggs and young of ground-nesting birds, which are already the prey of other predators such as arctic foxes. The risk is that the predatory pressure on these birds will be too great.
- West-African fishermen are abandoning their fishing grounds in times of poor supply – which is caused by industrial-scale fishing. Instead they are hunting on nature reserves, which leads to drastic reductions to the populations of prey animals there. Humans are an extremely flexible, efficient predator, who have massive impact on ecosystems.

The theoretical simulations presented by the LiU biologists completely contradict what we previously believed took place, when a predator loses its favourite prey.

"The belief was that an extinction cascade would be avoided if the predator is adaptable and can shift to another prey. Our new results indicate that the opposite can occur, and the consequences can be even worse. A change in [prey](#) is a double-edged sword – in the short term it can help a flexible predator survive, but long term it can negatively affect the entire existence of the food web," says Prof Ebenman.

More information: "Adaptive rewiring aggravates the effects of

species loss in ecosystems," by D. Gilljam, A. Curtsdotter & B. Ebenman. *Nature Communications* 6:8412, September 2015. [DOI: 10.1038/ncomms9412](https://doi.org/10.1038/ncomms9412)

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