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# Ripple Marks

The Story Behind the Story BY CHERYL LYN DYBAS

## Ocean Takeover: Throughout the Seas, Cephalopods Rise Up

"Before my eyes was a horrible monster, worthy to figure in the legends of the marvelous," exclaims Professor Aronnax in Jules Verne's *Twenty Thousand Leagues Under the Sea*. The scene unfolds aboard the submarine *Nautilus*.

"It was an immense cuttlefish, being eight yards long," breathed Aronnax. "It swam crossways...with great speed, watching us with its enormous staring green eyes. Its eight arms, or rather feet, fixed to its head, that have given the name cephalopod to these animals, were twice as long as its body, and were twisted like the furies' hair."

Then seven more poulps, as Aronnax called them, appeared. The crew feared an ocean filled with such creatures.

### FICTION BECOMES FACT

From the sea monsters of Jules Verne, to the Kraken of Norse legend, to H.P. Lovecraft's Cthulhu, "cephalopods, and their supremacy in the sea, are steeped in mythological intrigue and popular culture," says marine scientist Zoe Doubleday of the University of Adelaide in Australia.

What was once fiction, however, is turning out to be fact, Doubleday and Bronwyn Gillanders, also of the University of Adelaide, report in the May 2016 issue of the journal *Current Biology*. Based on observations over the past 60 years, cephalopods are indeed taking over the seas.

To investigate long-term trends in the animals' abundance, the researchers

reviewed data from locations as far-flung as the Falkland Islands, Spain, Korea, Canada, New Zealand, Peru, Portugal, Indonesia, Mauritius, Japan, Morocco, Australia, Chile, the United Kingdom, United States, and Madagascar.

"Our analyses show that since the 1950s, cephalopod abundance has increased around the globe," says Doubleday.

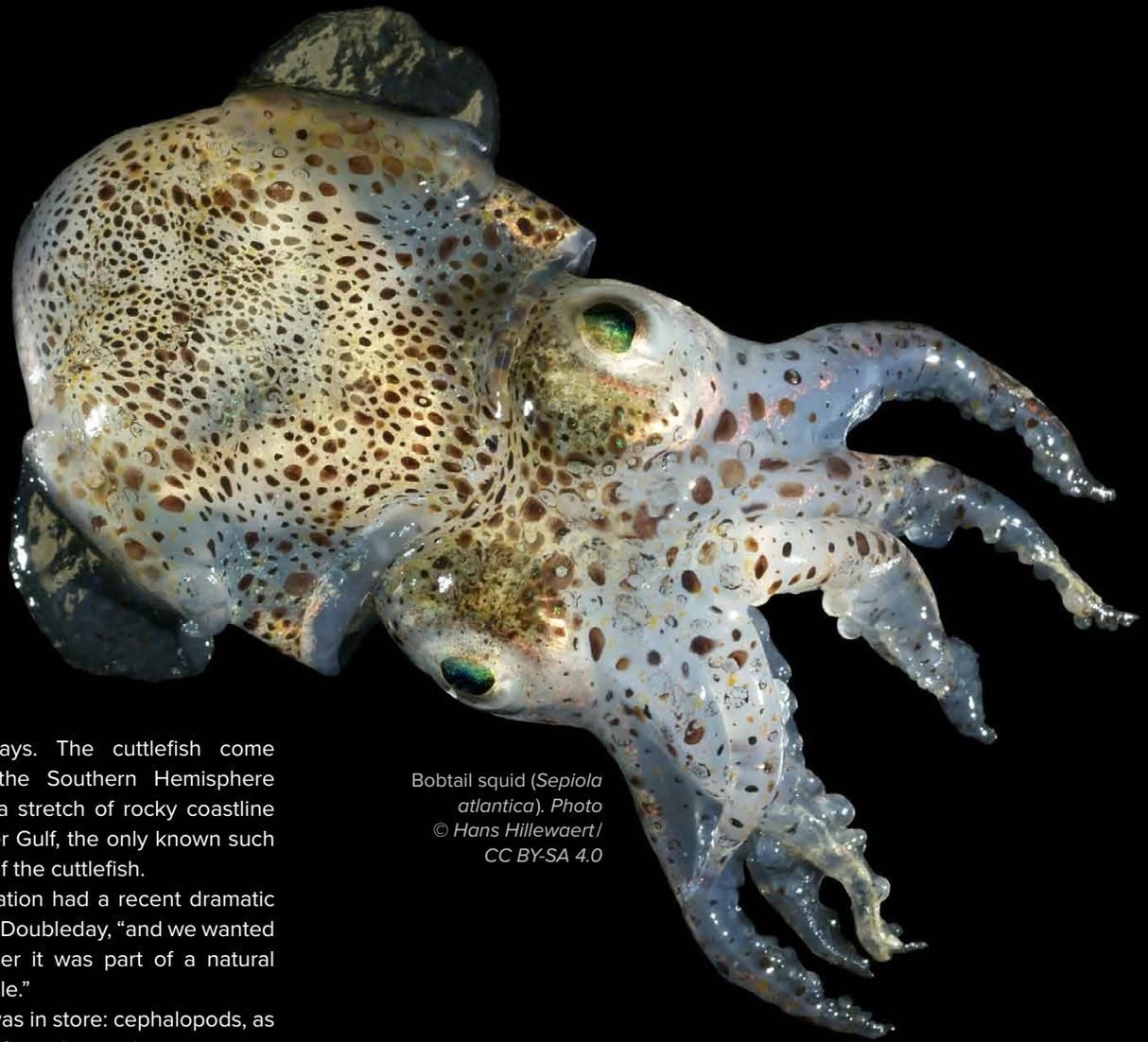
### ICONIC CUTTLEFISH LEADS TO WIDER STUDY

The research stemmed from an investigation of declining numbers of the iconic Giant Australian cuttlefish.

"There's been a lot of concern about this species, especially at its world-renowned breeding grounds in South Australia,"



Giant Australian cuttlefish.  
Photo credit: Scott Portelli



Bobtail squid (*Sepioloideia sepioides*). Photo © Hans Hillewaert / CC BY-SA 4.0

Doubleday says. The cuttlefish come together in the Southern Hemisphere winter along a stretch of rocky coastline in the Spencer Gulf, the only known such aggregation of the cuttlefish.

“This population had a recent dramatic decline,” says Doubleday, “and we wanted to see whether it was part of a natural oscillating cycle.”

A surprise was in store: cephalopods, as a whole, have been increasing.

“Since the start of the study,” says Doubleday, “Giant Cuttlefish numbers have been bouncing back. It’s a mystery.”

Gillanders, who led the project, says that large-scale changes in the marine environment brought about by human activities may be driving the worldwide cephalopod increase.

“Cephalopods are often called the ‘weeds of the sea,’” offers Doubleday. “They have a unique set of biological traits, including rapid growth, short life-spans, and flexible development. That allows them to adapt to changing conditions more quickly than many other marine species. They may be benefiting from a changing [warming] ocean environment.”

### RESULTS CONSISTENT FROM ROCK POOLS TO THE OPEN SEA

The consistency of the results was the biggest surprise.

“Cephalopod populations can fluctuate wildly,” Doubleday says. “The fact that we observed long-term increases in species

that inhabit everything from rock pools to the open ocean is remarkable.”

She and Gillanders reviewed cephalopod catch rates (catch per unit of fishing or sampling effort) from 1953 to 2013. The data were from non-target, bycatch, and target species. Target species sustained varying levels of fishing pressure, ranging from developed fisheries to developing, artisanal, and subsistence fisheries.

“Our data set included all major oceanic regions (69% Northern Hemisphere, 31% Southern Hemisphere), along with key taxa (52% squid, 31% octopuses, 17% cuttlefish and sepiolids),” write the researchers in their *Current Biology* paper. Sepiolids, also called bobtail squid, are closely related to cuttlefish, but have a rounded mantle and no cuttlebone.

The study involved 35 cephalopod species in six families.

The scientists looked at demersal species, which live in continental shelf waters and have low dispersal capacities in the tens of kilometers; benthopelagic species,

with moderate dispersal capacities in the hundreds of kilometers; and open ocean pelagic species with high dispersal capacities in the thousands of kilometers.

The result was the same: more cephalopods.

### ECOLOGICAL RAMIFICATIONS

The ecological ramifications are complex.

“The increase in abundance has significant implications for the marine food web,” says Doubleday. Cephalopods are found in all marine habitats and, in addition to being voracious predators, are important food sources for many other animals.

“Increases in cephalopods could affect [threaten] their prey, including commercially valuable fish and invertebrates,” the scientists write in their paper. Conversely, more cephalopods might benefit human communities that depend on them as fisheries resources, and marine predators that rely on them for food.

Cephalopods are important in the diets of many marine birds and mammals,



Squid-eating rockhopper penguins surf the waves in the Falkland Islands. Photo credit: Ilya Raskin

“particularly in productive, cooler oceanic [water] masses such as the Southern Ocean and cool currents such as the Benguela off the west coast of Southern Africa,” according to a paper by P.J.N. (Nico) de Bruyn of the University of Pretoria and colleagues in the *South African Journal of Wildlife Research*.

In the Falkland Islands, an archipelago on the Patagonian Shelf in the South Atlantic Ocean, Magellanic penguins depend on the squid *Loligo gahi* for about 50% of their diet. In 2002, when numbers of *Loligo* were very low, the penguins suffered an almost total breeding failure. According to an assessment by Falklands Conservation, an organization that works to conserve the Falklands environment, “the population crash appeared to be the result of changes in ocean temperatures, resulting in huge reductions in the availability of prey species.”

The penguins’ fortunes have changed, however. Numbers of squid in the family Loliginidae, which includes *Loligo gahi*, are on the rise in Falklands waters, found Doubleday and Gillanders, offering squid-eating species such as Magellanic penguins a possible horn of plenty.

#### CRYSTAL BALL NEEDED

What will happen to cephalopod numbers in the future? “It’s a difficult, but important, question to answer,” says Doubleday. “It may tell an even bigger story about how human activities are changing the oceans.”

The researchers are investigating the factors responsible for cephalopods’ proliferation. Early results show that cephalopods may not increase indefinitely, however. “Ocean acidification, for example, may affect [decrease] cephalopod survival,” says Gillanders.

As finfish stocks have declined, cephalopods have become more important in global fisheries. But cephalopod catches may have peaked in recent years, with some species showing signs of overfishing. The squid catch in South Korea’s East Sea, for instance, has been on a steady

downward turn over the past four years.

“It will be critical to manage cephalopod stocks appropriately,” write Doubleday and Gillanders, “so they don’t face the same fates as many of their longer-lived oceanic counterparts.”

The challenge, says Doubleday, “is that we don’t really know what effect higher numbers of cephalopods are having on the oceans, nor if they will keep increasing or begin to decline. At this stage, we can only speculate.”

Jules Verne’s Professor Aronnax might have agreed. “The great depths of the ocean are unknown to us,” Aronnax mused in *Twenty Thousand Leagues Under the Sea*. “What passes in those remote depths...we can scarcely conjecture.”

While we wonder, untold numbers of tentacled creatures ply the seven seas. 🐙

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