Global Warming is Good (If You Like Calamari)

Taylor Bildstein finds that climate change and overfishing of predators are increasing the biomass of squid in our oceans.

An unexpected creature seems to be taking over the world. It accounts for more of the world's biomass than we humans. It eats everything in its path, grows until it dies or is eaten, colonises wherever possible and, according to Dr George Jackson from the Institute of Antarctic and Southern Ocean Studies in Tasmania, it loves our current environmental disasters. Global warming and the depletion of world fisheries give this marine mollusc an advantage like no other marine creature.

Sheer numbers of squid, which increase from year to year, are now making it the major player in the world's oceans. Squid are a member of the cephalopod group of tentacled, big-headed sea molluscs that also includes octopus and cuttlefish. While world catches of finfish have remained fairly stable or declined over the past three decades, the cephalopod catch has increased substantially.

"This trend has been suggested to be due to both a removal of cephalopod predators such as toothed whales and tunas and an increase of cephalopods due to the removal of finfish competitors," says Dr Jackson. "Just as fast-growing weeds can quickly colonise an area of ground that has been denuded of vegetation, the rapid growth of squids and short life cycles have enabled them to move into regions that have been heavily over-fished."

And it's not just local researchers who support this claim. Prof Paul Rodhouse, Head of the Biological Sciences Division at the British Antarctic Survey, and a fellow cephalopod researcher reported in 1998 that "data from 15 key FAO [Food and Agriculture Organisation of the United Nations] areas reveal that, with the exception of the north-east Atlantic, cephalopod landings have increased significantly over the last 25 years while groundfish have risen more slowly, remained stable, or declined."

Groundfish are a key group of cephalopod predators, including flounder, halibut, cod, hake, redfish, bass, mullet, sharks, rays and chimaeras. "Very few scientists dispute that the phenomenon is near universal," says Dr Daniel Pauly, Professor at the Fisheries Centre of the University of British Columbia, Canada.

Jackson says that squid populations are no longer controlled by the limitation of food because chronic overfishing has ruined natural competition in marine ecosystems. The fish that squid used to share food resources with have now been fished out from the food web by global fishing practices, leaving squid with much more to eat.

They have a protein-based metabolism so they don't get fat when there's plenty of food: they just grow bigger. "Many species have exponential growth," says Jackson.

In the 1980's, French researchers found that lipids that are eaten pass through the digestive system of European squid and are eliminated in mucus strings contained in the faeces.

Cephalopods also have very limited carbohydrate stores compared with other

molluscs and fish, according to Dr Jayson Semmens of the Tasmanian Aquaculture and Fisheries Institute. And while fish will use stored fats at reproduction time to enlarge their gametes, squid, which do not have fat stores, burn protein.

Dr Jackson has found that several squid species use mantle muscle as an energy source during reproduction. The only place where a small quantity of lipid is stored in a cephalopod is the digestive gland, an organ similar to the liver of a fish.

In 1998, Semmens found that, unlike fish, the role of the digestive gland of a group of tropical squid species was to excrete lipids, rather than to store them. “The exact nature of energy storage in cephalopods has long been referred to as a biochemical mystery,” Semmens wrote in the Proceedings of the Royal Society of London in 1998.

Squid populations are not being controlled by predation to the extent that they once were. George Jackson and other scientists say that this is a result of “fishing down food webs,” where the larger fish (squid predators) are removed for human consumption. According to 1994 FAO statistics, tuna landings have risen from 2 to 4 million tonnes/year. “Given that tuna diet is approximately 25% oceanic squids and consumption is about 10% bodyweight/day, this 2 tonne difference accounts for an extra 20 million tonne of squid in the world’s oceans in recent years,” says Jackson.

Humans have also interfered with squid populations in a much less direct manner by facilitating climate change. “The fascinating thing about squid is that they’re short-lived,” says Jackson. “I haven’t found any tropical squid in Australia older than 200 days. Some of the cooler ones live more like a year.

“Many of the species have exponential growth, particularly during the juvenile stage. This means, particularly during the juvenile stage, if you increase temperature by even a degree it has this tremendous snowballing effect of rapidly increasing their growth rate and their ultimate body size. They get much bigger, they can mature earlier and it just accelerates everything.

“They’re very sensitive to temperature changes in the environment and they seem to respond very quickly because they have this phenomenal form of growth. They’re not storing much; everything that gets eaten is transformed to growth predominantly, rather than storing it for a rainy day. You just heat them up a little bit and everything just ticks over that much faster.

“An increase in water temperature due to global warming could also favour population expansion of squids over fish,” says Dr Jackson.

According to research by Ralph Mitchell of the Tasmanian Fishing Industry Council, squid are literally turned on by temperature as reproduction is onset by a warm water temperature trigger. It’s not until a suitably warm day in about January that reproduction starts, even though the animals have been ready for up to a month. With increases in temperature around the world because of human-driven

climate change, squid may become confused and mate more frequently, or earlier in the season, further contributing to the epidemic. Climate change could also

affect their distribution and other environments.

“Some of the tropical species, like one of the species I’ve looked at - the big-finned reef squid Sepioteuthis lessoniana - these squid grow so dramatically different when you increase the temperature that should global warming increase world temperature, well there’s no reason that this squid couldn’t extend its range to other areas and perhaps change environments in areas where it didn’t occur before,” Jackson says.

“Oceans in the tropics are now 1.5°C warmer than they were 100 years ago,” says the director of the University of Queensland’s Centre for Marine Studies, Prof Ove Hoegh-Guldberg. According to the Intergovernmental Panel on Climate Change (IPCC), based in Geneva, Switzerland, average world sea surface temperatures have increased by 0.4-0.8°C since the late 19th century, with the greatest increases observable since 1975. The IPCC expects sea surface temperatures to continue to rise.

So how do we control this potential marine monopoly? Unless we slow global warming and stop fishing down food webs, the damage won’t be remediated. Research is also required to find a solution but squid are hard to study and therefore hard to manage, for a few reasons.

“They’re often not easy to catch, especially big, oceanic ones because they can avoid nets,” says Dr Jackson. “Any captive observational work is difficult because they’re so delicate: their skin’s only one cell thick, so they’re easy to get damaged.”

Population studies of squid in the wild are difficult compared to studies of fish populations, because fish live 7-30 years or more, making resident fish populations more easily monitored in the wild each year. Squid can’t be monitored this way.

“Things are happening on a very rapid scale. When you come back 8 months later, most of the squid are a different population,” says Dr Jackson.

Australia doesn’t have an open squid fishery, like other areas of the world, and employs a precautionary approach. “The fisheries for bottom fishes in the islands ringing Antarctica have collapsed quite a while ago,” says Pauly. “Australia, on the other hand, has a management regime that is not as bad as elsewhere.”

The Commonwealth Environmental Protection and Biodiversity Conservation Act (EPBC, 1999) requires that a management plan must be put in place before greater fishing catches can be had by Australian fishers, and that such a plan be based on the best available scientific information. Without accurate biological data, which is yet to be mustered, the resource must operate under the “precautionary principle”.

Squid data are currently being collected, but on a scale that is only a fraction of that of fish studies. “There’s really only a couple of us (squid biologists) at the moment, over the nation,” says Dr Jackson.

But squid fishers won’t invest in the infrastructure needed to harvest and then process the landed catch until they can be sure that the industry is viable and compliant with the EPBC Act.

Even if this occurs, we'll have to eat a lot of calamari before human appetites begin to affect the squid population like natural predators and competitors did before we fished them out.

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