Teachers' Resource Sheet on

Fisheries and climate change

Anyone who fishes will tell you that you don't catch the same number or type of fish every time you go fishing! Catch is influenced by the bait you use, where you fish and the tide. It also depends on whether you fish during the day or at night, the prevailing weather conditions and, importantly, the time of year.

In recent years, scientists have identified another reason why the catches of some fish species* change – climate. They have recorded strong relationships between the El Niño-Southern Oscillation (ENSO) and tuna catch. When the southeast trade winds blow more strongly than usual (La Niña conditions), they push the area of warm water in the western Pacific (the Warm Pool) up against Papua New Guinea (Fig. 1). But when the trade winds are weaker than usual (El Niño conditions), the Warm Pool extends far to the east. Changes in the Warm Pool driven by the trade winds affect the catch of skipjack tuna because this valuable species is caught in greatest numbers near the eastern edge of the Warm Pool and the location of this edge can vary in by 3,000 to 4,000 km depending on the strength of an El Niño or La Niña.

The dramatic effect of ENSO on skipjack tuna demonstrates just how profound the effects of climate on fish can be. Based on these observations, there is every reason to expect that global warming, caused by higher concentrations of carbon dioxide (CO_2) and other greenhouse gases in the atmosphere, will also affect other fish species.

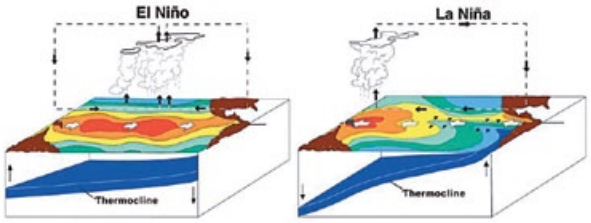

Figure 1. Effects of El Niño and La Niña conditions on the Pacific Ocean (source: SPC).

In considering this, we need to think about two different categories of fish – coastal fish and oceanic fish. Most coastal fish in the tropical Pacific are associated with coral reef habitats (Fig. 2), whereas most oceanic fish are caught offshore (Fig. 3). Most of the oceanic fish we catch are large, highly mobile species like yellowfin, bigeye, skipjack and albacore tuna, but also marlin, wahoo and mahi mahi. These species range widely across the region and are caught as they pass through the exclusive economic zones (EEZs) of Pacific Island countries and territories (the area within 200 nautical miles of the islands).

Coastal fish

The rising sea surface temperature is expected to alter the times of year when coral reef fish spawn and the food available to juvenile coral reef fish during the first few weeks or months of the planktonic (floating) phase of their lives far from shore. Survival during this phase affects how many juvenile fish are available to 'settle' back on coral reefs and replenish the fish stocks there. However, climate change is expected to have its greatest effect on coastal fish by altering the coral reefs themselves. As the ocean warms, corals will bleach more frequently – bleaching occurs when warm water stresses corals and they expel the tiny plants (zooxanthellae) within their tissues that provide them with organic compounds (food) by photosynthesis.*

The build-up of CO_2 in the atmosphere also has another negative effect on coral reefs. The CO_2 dissolves in seawater, making the ocean more acidic and reducing the calcium carbonate available to corals to build their skeletons.

The increased coral bleaching and ocean acidification, will progressively degrade coral reefs – they will lose their complex structure and provide fewer places for the fish and prey for fish, to live. Decreases in coastal fish production will follow because not all coral reef fish will be able to adapt to the loss of the shelter and food they need. By 2035, climate change is expected to reduce that catch of coastal fish by 2%–5%, increasing to 20% by 2050.

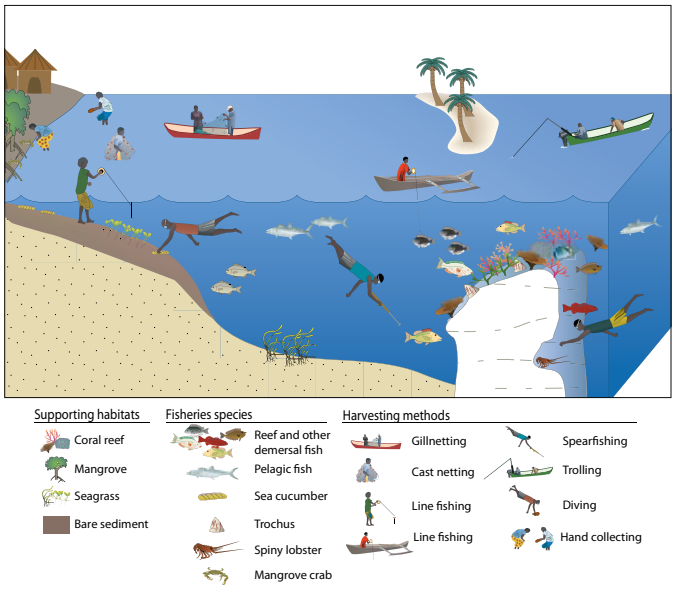

Figure 2. Range of coastal fishing activities in Pacific Islands (source: SPC).

This resource sheet is one of a series produced by the Pacific Community (SPC) to assist teachers in introducing fisheries topics into school curricula.

Each sheet should be used in conjunction with the Guide to Teachers' Resource Sheets, which contains suggestions for student activities and exercises. All words marked with an asterisk (*) are defined in a glossary in this guide.

Pacific Community
Communauté du Pacifique

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Oceanic fisheries

Unlike the effects of climate change on coastal fisheries, some Pacific Island countries and territories may benefit from increased catches of some important oceanic fish as the ocean warms. The reason for this is that there will be a steady increase in the overall size of the Warm Pool – it will extend further to the east under normal conditions. Over time, the distribution of tuna will be more like that observed during strong present-day El Niño conditions.

Pacific Island countries and territories further to the east are likely to receive more requests from purse-seine fishing vessels owned by distant water fishing nations (DWFNs) to fish for skipjack tuna in their EEZs because this fish could well be found in greater abundance there. Increased fishing by DWFNs will add to the revenue the government receives from fishing licence fees. Skipjack tuna could eventually be caught in higher numbers a bit further away from the equator than it does at the moment as sea surface temperature increases to be within the range preferred by this species.

Scientists are still in the process of determining the most likely effects of climate change on the other species of tuna.

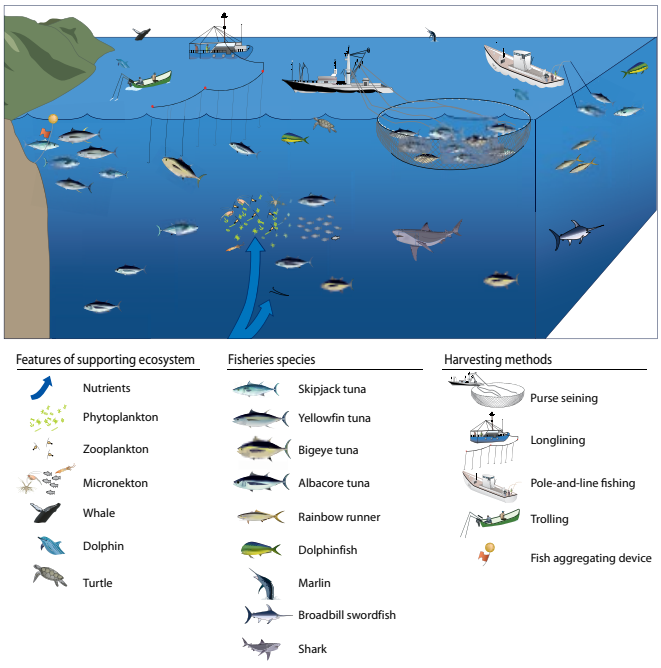

Figure 3. Range of oceanic fishing activities in Pacific Islands (source: SPC).

Interesting fact

Although the body temperature of most fish is the same as the temperature of the water in which they swim, the body temperature of tuna is warmer than the surrounding water. Tuna have a countercurrent heat exchanger that enables them to retain body heat generated as a by-product of metabolism. http://en.wikipedia.org/wiki/Countercurrent_exchange_system