POLICY BRIEF
15/2012
Secretariat of the Pacific Community

Oceanic fisheries and climate change

Photo: Nathalie Behring

Purpose

The aim of this policy brief is to:

- alert Pacific Island countries and territories (PICTs) to the projected effects of climate change on the contributions that oceanic fisheries make to economic development and government revenue; and
- identify the adaptations and policies needed to reduce the threats and capitalise on the opportunities.

Key messages

Projected redistribution of tuna further east has implications for the economic benefits derived from industrial fisheries, and for the supply of tuna for food security. Several practical adaptations can reduce the risks to PICTs in the west and optimise the benefits for those in the east.

Significance of oceanic fisheries

Total annual catches of skipjack, yellowfin, bigeye and albacore tuna from the Western and Central Pacific Ocean (WCPO) have recently been as high as ~2.5 million tonnes, worth ~USD 4.3 billion (Table 1). Harvests from the exclusive economic zones (EEZs) of PICTs make up ~50% of this catch.

Tuna fisheries are of vital importance to the economies of PICTs and the food security of their populations. License fees from distant water fishing nations (DWFNs) contribute 3–40% of government revenue for seven PICTs and locally based fishing fleets and processing operations account for 3–20% of gross domestic product (GDP) in four PICTs. Some of the larger countries plan to increase the benefits from tuna by 'domesticating' more of the industry – 7000 jobs can be created for every 100,000 tonnes of tuna processed locally. Tuna also contributes significantly to the high levels of fish consumption across the region.

Observed effects of climate on tuna

The El Niño-Southern Oscillation (ENSO) has a strong effect on tuna catches (Figure 1). ENSO changes the convergence zone between the Western Pacific Warm Pool (water >29°C) and the cooler nutrient-rich waters of the eastern equatorial Pacific – a prime feeding area for tuna.

During La Niña events, tuna are mostly caught further to the west. When the trade winds ease during El Niño episodes, tuna follow the Warm Pool as it expands east.

ENSO determines where national and foreign fleets fish, and the total licence fees PICTs receive from DWFNs.

Table 1 Total catch and estimated landed value of the four main species of tuna caught in the Western and Central Pacific Ocean in 2010. Source: SPC Oceanic Fisheries Programme.

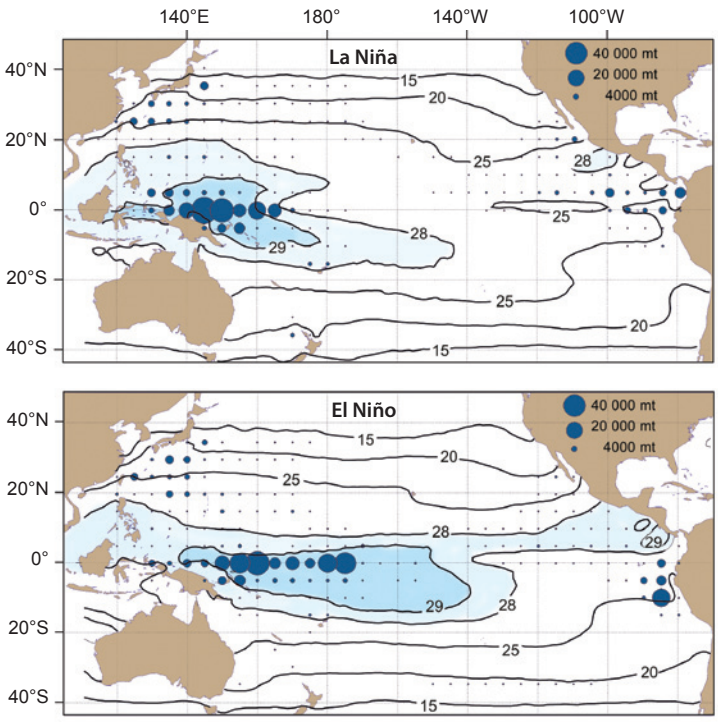
Species	Catch (tonnes)	Value (USD x 1000)
Skipjack	1,610,578	2,154,000
Yellowfin	558,761	1,127,000
Bigeye	125,757	669,000
Albacore	126,017	342,000
Total	**2,421,113**	**4,292,000**

Projected effects of climate change on tuna

The features of the tropical Pacific Ocean that influence the distribution and abundance of tuna – currents, water temperature, dissolved oxygen and nutrient supply – are expected to change in the future (Table 2). The average position of the convergence between the Warm Pool and the cooler nutrient-rich equatorial waters is likely to move to the east. The productivity of food webs supporting tuna is also projected to decrease in the Warm Pool and increase in the eastern equatorial region.

These changes are expected to affect where tuna spawn, the survival and growth of juveniles, and where the adults feed. Preliminary modeling indicates that tuna are likely to move progressively to the east (Figure 2, Table 3). However, much uncertainty remains. In particular, the possible impacts of ocean acidification on juvenile and adult tuna are not well understood.

Figure 1 Representative skipjack tuna catches (blue circles) in the Western and Central Pacific Ocean during a La Niña event (top panel), and an El Niño event (bottom panel). Lines are isotherms (°C). Source: Lehodey et al. (2011) Chapter 8 PDF: http://www.spc.int/climate-change/fisheries/assessment/main-book.html



Economic implications

An eastward shift in distribution of tuna would have mixed implications. Contributions from tuna to government revenue and GDP should eventually increase for PICTs in the central and eastern Pacific, and decline for those in the west, as tuna move progressively east (Table 4).

Adaptations

Several management measures can help reduce the threats to the economic and food security benefits received from tuna and also help capitalise on the opportunities.

Full implementation of the vessel day scheme (VDS): The 'cap and trade' provisions of the VDS enable all PNA[1] members to receive some level of benefits during ENSO events, regardless of where tuna are concentrated. As redistribution of tuna occurs, the periodic adjustment of allocated vessel days within the VDS will reduce the need for members to purchase days.

Develop and maintain trade preferences: The global sourcing provisions of an economic partnership agreement with the European Union, for example, assist countries processing tuna to obtain and export fish at competitive prices. Developing and maintaining trade preferences will help ensure that these countries have viable processing industries as tuna are redistributed further east.

Diversify sources of fish for canneries: Other adaptations to help countries in the west secure fish for canneries include: reducing access for DWFNs to their EEZs to provide more fish for national vessels; requiring DWFNs to land some of their catch for use by local canneries; and enhancing arrangements for national fleets to fish in the EEZs of other PICTs.

Immediate conservation and management measures for tuna: Stopping the overfishing of bigeye tuna, and preventing overfishing of skipjack, yellowfin and albacore tuna, will maintain stocks at healthy levels and make these valuable species more resilient to climate change.

[1] Parties to the Nauru Agreement (Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Palau, Papua New Guinea, Solomon Islands, Tuvalu)

Table 2 Changes to the main features of the tropical Pacific Ocean projected to occur under a high (IPCC A2) emissions scenario in 2035, 2050 and 2100, relative to 1980–1999. Source: Ganachaud et al. (2011) Chapter 3 PDF: http://www.spc.int/climate-change/fisheries/assessment/main-book.html

Ocean feature	2035	2050	2100
Currents	South Equatorial Current decreases at the equator; Equatorial Undercurrent becomes shallower; South Equatorial Counter Current decreases and retracts westward in the upper 50 m		
Sea surface temperature	+0.7 to +0.8°C	+1.2 to +1.6°C	+2.2 to +2.7°C
Nutrient supply	Decline due to increased stratification and a shallower mixed layer, with a possible decrease of up to 20% by 2100		
Dissolved oxygen	Decrease due to lower oxygen intake at high latitudes. Possible increase near equator due to reduced remineralisation of plankton		
Aragonite saturation (Ω)*	Ω ~ 3.3	Ω ~ 3.0	Ω ~ 2.4
Warm Pool area	+ 250%	+480%	+ 770%
Warm Pool eastern edge	166°E–169°E	167°E–172°E	170°E–179°E

* A measure of ocean acidification

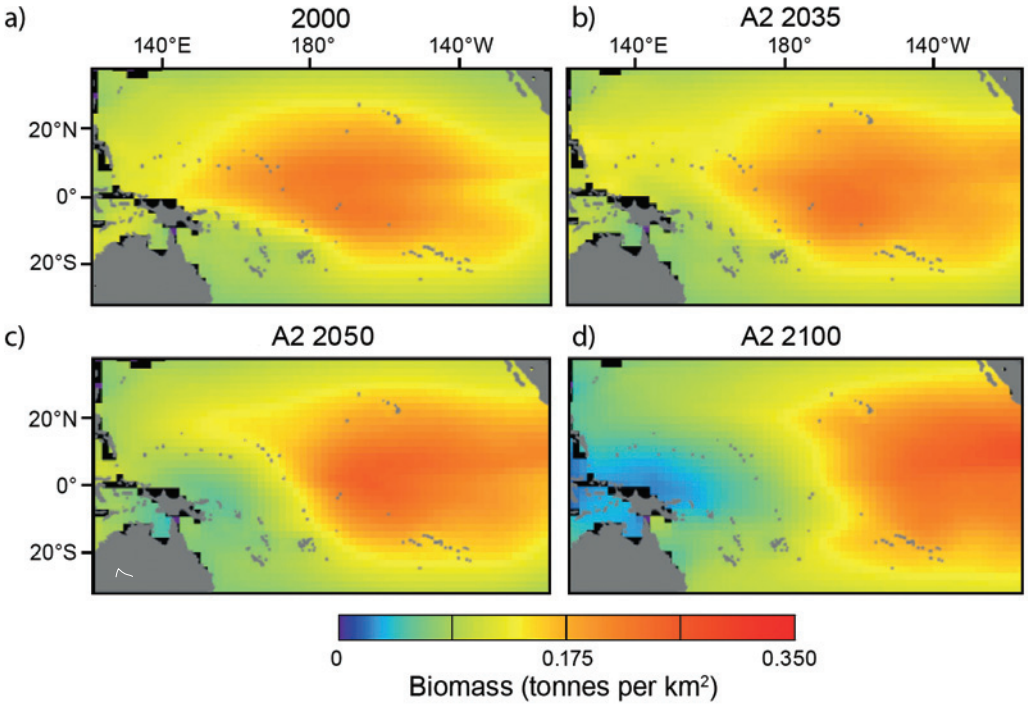


Figure 2 Projected estimates of total biomass (tonnes per km²) of skipjack tuna from the SEAPODYM model based on average (1980–2000) fishing effort in (a) 2000, (b) 2035, (c) 2050 and (d) 2100. Projections are for a high (IPCC A2) emissions scenario. Source: Lehodey et al. (2011) Chapter 8 PDF: http://www.spc.int/climate-change/fisheries/assessment/main-book.html

Energy efficiency programmes for industrial fleets: Energy audits to identify how to reduce fuel use during fishing operations should assist fleets to cope with rises in oil prices and minimise CO_2 emissions. Energy efficiency programmes should also reduce the costs for fleets fishing further afield as the distribution of tuna shifts to the east.

Environmentally friendly fishing operations: Minimising the effects of existing fishing operations, and those projected to occur as tuna move east, on non-target species will help meet the requirements of certification schemes.

Increase access to tuna and bycatch for food security: Promoting the storage and distribution of low-value tuna and bycatch from industrial vessels transhipping their catch at major ports will provide inexpensive fish for rapidly growing urban populations.

Safety at sea: Conducting safety audits of longline and purse-seine vessels operating within the cyclone belt should help achieve acceptable standards for safety at sea in the event of more severe cyclones.

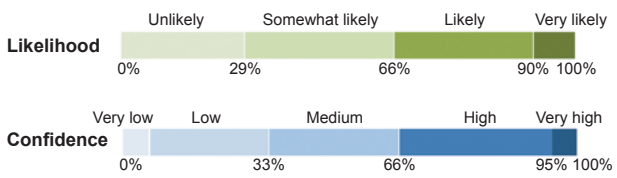
Climate-proof infrastructure: Constructing new wharfs for fishing fleets and fish processing facilities that are designed to prevent inundation by rising sea levels and withstand the effects of more severe cyclones should help safeguard essential infrastructure.

Suggested supporting policy actions

- Promote transparent access agreements between PICTs and DWFNs so that allocations under the VDS (and other fishing effort schemes) are understood by all stakeholders; and strengthen national capacity to implement these schemes.
- Adjust national tuna management plans and marketing strategies to provide more flexible arrangements to sell tuna, or acquire tuna needed for local processing operations.
- Allocate the necessary quantities of tuna from industrial catches for food security to increase access to fish in urban areas.
- Dedicate a proportion of the revenue from fishing licences to improve access to tuna for food security.

Table 3 Projected percentage changes in average catches of skipjack and bigeye tuna for the eastern (15°N–20°S; 130°–170°E) and western Pacific (5°N–15°S; 170°E–150°W) in 2035, 2050 and 2100 under a high (IPCC A2) emissions scenario relative to 1980–2000. Source: Lehodey et al. (2011) Chapter 8 PDF: http://www.spc.int/climate-change/fisheries/assessment/main-book.html

Tuna species	West			East		
	2035	2050	2100	2035	2050	2100
Skipjack	+10	0	-20	+30 to 35	+40 to 45	+25 to 30
Bigeye	0 to -5	-10 to -15	-30 to -35	0 to +5	0 to -5	-15 to -20



Suggested supporting policies *cont'd*

- Include the implications of climate change in the future management objectives of the Western and Central Pacific Fisheries Commission (WCPFC).
- Require all industrial tuna vessels to provide operational-level catch and effort data to improve the models for estimating the redistribution of tuna stocks.
- Finalise the declaration of national ocean boundaries in compliance with the United Nations Convention on the Law of the Sea.
- Apply national management measures to address the implications of climate change for subregional concentrations of tuna in national archipelagic waters beyond the mandate of WCPFC.
- Develop further measures to reduce the capture of bigeye tuna by purse-seine.
- Use regional trade and preferential access agreements to market environmentally friendly tuna products, and develop distribution channels that minimise CO_2 emissions.

Table 4 Projected changes (%) to contributions of tuna fisheries to GDP and government revenue for Pacific Island countries and territories (PICTs) in the western and eastern Pacific resulting from projected alterations in skipjack tuna catch in 2035, 2050 and 2100 under a high (IPCC A2) emissions scenario. Projected changes are relative to midpoints for 1999–2008. Source: Bell et al. (2011) Chapter 12 PDF: http://www.spc.int/climate-change/fisheries/assessment/main-book.html

PICT	GDP				Government revenue			
	1999 –2008 (%)	Change (%)			1999 –2008 (%)	Change (%)		
		2035	2050	2100		2035	2050	2100
West								
FSM	1.5-5	+0.5	0	-0.5	6-12	+1	+0.5	-1
Marshall Islands	10-25	+4	+4	+2	2-5	+0.5	+0.5	0
Nauru					10-25	+4	+3	-0.2
Palau					2-3	+2.5	+0.5	-1
PNG	1.5-4	+0.5	-0.3	-0.8	<1	+0.01	- 0.05	-0.15
Solomon Islands	2-5	+0.1	-0.2	-0.6	<5	+0.1	-0.1	-0.4
East								
American Samoa	20-25	+4	+3	- 2	5-20	+3	+2	-1
Kiribati					30-50	+15	+15 to 20	+10
Tokelau					2-15	+5	+6	+5
Tuvalu					10-25	+6	+7	+4

Further reading

Bell JD, Johnson JE and Hobday AJ (eds) (2011) Vulnerability of Tropical Pacific Fisheries and Aquaculture to Climate Change. Secretariat of the Pacific Community, Noumea, New Caledonia (Chapters 3, 4, 8, 12 and 13).

Gillett R (2009) Fisheries in the Economies of Pacific Island Countries and Territories. Asian Development Bank, Manila, Philippines.

Gillett R and Cartwright I (2010) The Future of Pacific Island Fisheries. Secretariat of the Pacific Community, Noumea, New Caledonia.

SPC (2012) The Western and Central Pacific Tuna Fishery: 2010 Overview and Status of Stocks. SPC Policy Brief 14/2012. Secretariat of the Pacific Community, Noumea, New Caledonia.

Technical assistance

For scientific advice on the status of tuna stocks in the Western and Central Pacific Ocean contact SPC's Oceanic Fisheries Programme (ofp@spc.int). For advice on management of tuna fisheries in the region, contact the Forum Fisheries Agency (info@ffa.int).

CONTACT DETAILS
Secretariat of the Pacific Community

SPC Headquarters
BP D5,
98848 Noumea Cedex,
New Caledonia
Telephone: +687 26 20 00
Fax: +687 26 38 18

SPC Suva Regional Office
Private Mail Bag,
Suva,
Fiji Islands
Telephone: +679 337 0733
Fax: +679 337 0021

Website: www.spc.int