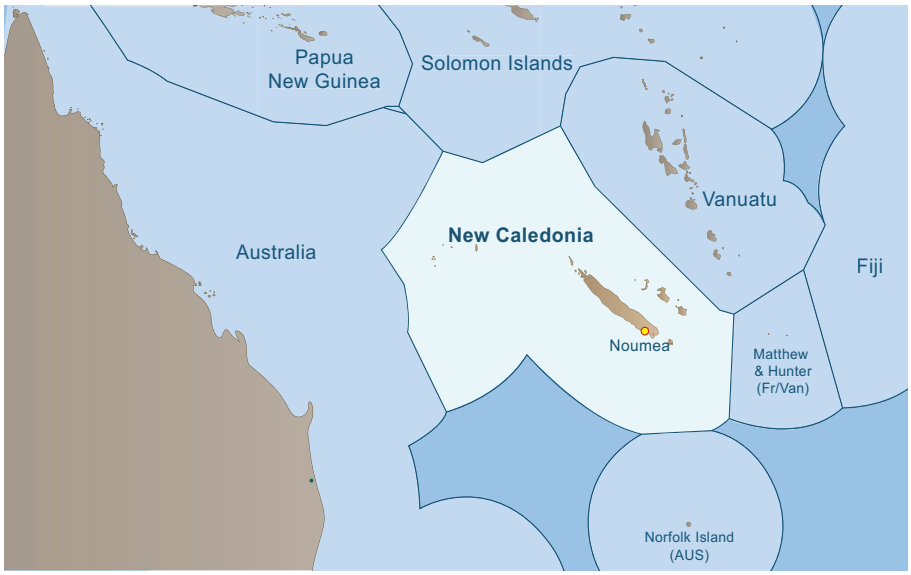
2.10 New Caledonia



Key features

Population

Year	2010	2035	2050	2100
Population (x 1000)[a]	252	323	343	372
Population growth rate[a]	1.3	0.7	0.3	0

a = Data from SPC Statistics for Development Programme (www.spc.int/sdp).

EEZ area (km²) 1,111,900

Land area (km²) 19,100

Land as % of EEZ 1.7

Fisheries and aquaculture activities: Oceanic fisheries, coastal fisheries, freshwater and estuarine fisheries, and coastal aquaculture.

Membership of regional fisheries management arrangements: Western and Central Pacific Fisheries Convention (participating territory); Melanesian Spearhead Group.

Surface climate and the ocean

Existing features

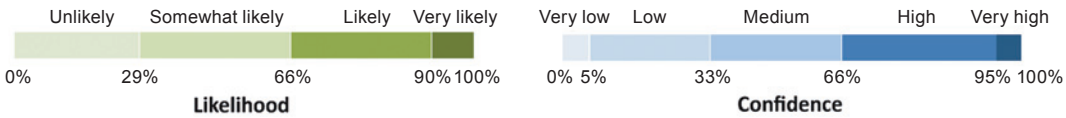
New Caledonia has a tropical-subtropical climate {Chapter 2}. Recent air temperatures in Noumea have averaged 23.5°C and average rainfall is ~ 1050 mm per year. New Caledonia lies within the Archipelagic Deep Basins Province (ARCH) {Chapter 4, Figure 4.6}. The climate and ocean within this province are influenced by a complex current regime caused by the occurrence of many islands, archipelagos and seamounts. These formations divert oceanic circulation to create eddies, resulting in upwelling, downwelling and other mesoscale processes {Chapter 3, Section 3.2.9, Figure 3.1}. ARCH Province is characterised by a patchwork of nutrient-rich and nutrient-poor water bodies that can vary over short timeframes.

Projected changes to surface climate

Air temperatures in New Caledonia are projected to increase due to climate change under the low (B1) and high (A2) emissions scenarios in 2035 and 2100 {see Chapter 1, Section 1.3 for definition of scenarios} relative to long-term averages {Chapter 2, Section 2.5, Table 2.6}. Rainfall is expected to decrease overall, with reductions occurring during winter and increases during summer.

Climate feature[a]	1980–1999 average	Projected change			
		B1 2035	A2 2035	B1 2100*	A2 2100
Air temperature (°C)	23.5 (Noumea)	+0.5 to +1.0	+0.5 to +1.0	+1.0 to +1.5	+2.5 to +3.0
Rainfall (mm)	1066 (Noumea)	+5 to +15%	+5 to +20%	+10 to +20%	+10 to +20%
		More extreme wet and dry periods			
Cyclones (no. per year)	2.3	➢ Total number of tropical cyclones may decrease ➢ Cyclones are likely to be more intense			

* Approximates A2 in 2050; a = for more detailed projections of rainfall, air temperature and cyclones in the southern subtropical Pacific, see www.cawcr.gov.au/projects/PCCSP.



Projected changes to the ocean

The projected changes to the key features of the tropical Pacific Ocean surrounding New Caledonia relative to the long-term averages are expected to result in increases in sea surface temperature (SST), sea level and ocean acidification. Changes to ocean currents (increases in the South Pacific gyre) and reductions in nutrient supply are also expected to occur {Chapter 3, Sections 3.3 and 3.4, Tables 3.1 and 3.2}.

Ocean feature	1980–1999 average	Projected change			
		B1 2035	A2 2035	B1 2100*	A2 2100
Sea surface temperature (°C)	25.1[a]	+0.6 to +0.8	+0.7 to +0.8	+1.2 to +1.6	+2.2 to +2.7
Sea level (cm)	+6 since 1960				
IPCC **		+8	+8	+18 to +38	+23 to +51
Empirical models ***		+20 to +30	+20 to +30	+70 to +110	+90 to +140
Ocean pH (units)	8.08	-0.1	-0.1	-0.2	-0.3
Currents****	Increase in South Pacific gyre	SEC decreases at equator; EUC becomes shallower; SECC decreases and retracts westward			
Nutrient supply	Decreased slightly	Decrease due to increased stratification and shallower mixed layer			< -20%

* Approximates A2 in 2050; ** projections from the IPCC-AR4; *** projections from recent empirical models {Chapter 3, Section 3.3.8}; **** applies mainly to the area 0°–10°S north of New Caledonia; a = average for EEZ derived from the HadISST dataset; SEC = South Equatorial Current; EUC = Equatorial Undercurrent; SECC = South Equatorial Counter Current

Oceanic fisheries

Recent catch and value

New Caledonia has a small longline fishery within its exclusive economic zone (EEZ). Recent average catches (2004–2008) by this fishery have been > 2140 tonnes per year, worth ~ USD 10.4 million. See 'Coastal Fisheries' below for contributions of tuna to nearshore artisanal and small-scale commercial fisheries.

Local oceanic fisheries	Average annual catch (tonnes) 2004–2008	Average annual catch value (USD million)* 2004–2008
Tuna		
Longline	1975	10.2
Other oceanic fish[a]	167	0.2
Total	**2142**	**10.4**

* Calculated using market value per tonne for 2004–2008; a = billfish catch only, valued at USD 1000 per tonne.

Existing oceanic fish habitat

The waters surrounding New Caledonia within ARCH are influenced by eddies and other mesoscale processes (boundary currents, jets, wind-driven upwelling, internal waves and tidal mixing) created by the way landmasses divert surface currents

{Chapter 4, Section 4.3.4}. These mesoscale processes commonly bring nutrients to surface waters and result in a variable mosaic of feeding areas for tuna and other large pelagic fish {Chapter 3, Section 3.2.9}.

Projected changes to oceanic fish habitat

The area of the ARCH Province remains the same by definition. However, key components of the food web (net primary production and the biomass of zooplankton) are expected to decrease significantly under the B1 and A2 scenarios by 2100 in ARCH {Chapter 4, Table 4.3}.

ARCH feature	Projected change (%)			
	B1 2035	A2 2035	B1 2100*	A2 2100
Net primary production	-5	-8	-20	-33
Zooplankton biomass	-5	-6	-17	-26

* Approximates A2 in 2050.

Projected changes in oceanic fisheries production

Preliminary modelling suggests that under the B1 and A2 scenarios, catches of skipjack tuna in the EEZ of New Caledonia are expected to increase in 2035 and 2100, relative to the 20-year average (1980–2000). This increase is particularly significant under A2 in 2100. Catches of bigeye tuna are projected to remain relatively stable under both scenarios in 2035 and B1 in 2100, and to increase slightly under A2 in 2100 {Chapter 8, Section 8.7}. Modelling for yellowfin tuna and albacore is now in progress. The trends for yellowfin tuna are expected to be similar to those for skipjack tuna, whereas albacore are expected to move poleward .

Projected change in skipjack tuna catch (%)			Projected change in bigeye tuna catch (%)		
B1/A2 2035	B1 2100*	A2 2100	B1/A2 2035	B1 2100*	A2 2100
+22	+19	+39	+1	+1	+6

* Approximates A2 in 2050.

Coastal fisheries

Recent catch and value

The coastal fisheries of New Caledonia are made up of four categories: demersal fish (bottom-dwelling fish associated with coral reef, mangrove and seagrass habitats), nearshore pelagic fish (including tuna, Spanish mackerel, rainbow runner, wahoo and mahi-mahi), invertebrates targeted for export,

and invertebrates gleaned from intertidal and subtidal areas {Chapter 9, Section 9.2.1}. The total annual catch was estimated to be 4850 tonnes in 2007, worth > USD 24.5 million. The commercial catch was 1350 tonnes. Demersal fish are estimated to make up 55% of the total catch.

Feature	Coastal fisheries category				Total	Total value (USD m)*
	Demersal fish	Nearshore pelagic fish[b]	Targeted invertebrates	Inter/subtidal invertebrates		
Catch (tonnes)*	2670	560	300	1320	4850	24.5
Contribution (%)[a]	55	12	6	27	100	

* Estimated total catch and value in 2007 (Gillett 2009)[1]; a = method for calculating disaggregated catch data for each category is outlined in Chapter 9 {Appendix 9.2, Supplementary Table 9.1}; b = catch dominated by non-tuna species.

Existing coastal fish habitat

New Caledonia has ~ 36,000 km^2, the largest area estimated for any Pacific Island country and territory of coral reef habitat {Chapter 5}. There are also significant areas of mangroves, deepwater and intertidal seagrasses, and intertidal sand and mud flats {Chapter 6}. These habitats support many important fisheries species.

Habitat	Coral reef[a]	Mangrove[b]	Seagrass[b]	Intertidal flat
Area (km^2)	35,925	205	936	n/a

a = Includes barrier, patch and fringing reefs and reef lagoons {Chapter 5, Table 5.1}; b = values from Chapter 6, Table 6.1; n/a = data not available.

Projected changes to coastal fish habitat

Climate change is expected to add to the existing local threats to coral reefs, mangroves, seagrasses and intertidal flats in New Caledonia, resulting in declines in the quality and area of all habitats {Chapters 5 and 6}.

Habitat feature[a]	Projected change (%)		
	B1/A2 2035	B1 2100*	A2 2100
Coral cover[b]	-25 to -65	-50 to -75	> -90
Mangrove area	-10	-50	-60
Seagrass area	-5 to -10	-5 to -20	-10 to -25

* Approximates A2 in 2050; a = no estimates in reduction of intertidal flats available; b = assumes there is strong management of coral reefs.

Projected changes in coastal fisheries production

All categories of coastal fisheries in New Caledonia are projected to show progressive declines in productivity due to both the direct effects (e.g. increased SST) and indirect effects (changes to fish habitats) of climate change {Chapter 9, Section 9.5}.

Coastal fisheries category	Projected change (%)			Main effects
	B1/A2 2035	B1 2100*	A2 2100	
Demersal fish	-2 to -5	-20	-20 to -50	Habitat loss and reduced recruitment (due to increasing SST and reduced currents)
Nearshore pelagic fish[a]	0	-10	-15 to -20	Reduced production of zooplankton in food webs for non-tuna species and changes in distribution of tuna
Targeted invertebrates	-2 to -5	-10	-20	Habitat degradation, and declines in aragonite saturation due to ocean acidification
Inter/subtidal invertebrates	0	-5	-10	Declines in aragonite saturation due to ocean acidification

* Approximates A2 in 2050; a = non-tuna species dominate the nearshore pelagic fishery {Chapter 9, Tables 9.8 and 9.10}.

The overall projected change to coastal fisheries catch reflects the relatively heavy reliance on demersal fish and the projected decrease in productivity of all components of coastal fisheries. As a result, potential catches from coastal fisheries in New Caledonia are likely to decrease slightly under both scenarios in 2035. By 2100, declines are expected to be more substantial, particularly under the A2 scenario.

Coastal fisheries category	Contrib. (%)**	Projected change in productivity (P) and catch (%)					
		B1/A2 2035		B1 2100*		A2 2100	
		P***	Catch	P***	Catch	P***	Catch
Demersal fish	55	-3.5	-2	-20	-11	-35	-19
Nearshore pelagic fish	12	0	0	-10	-1	-17.5	-2
Targeted invertebrates	6	-3.5	-0.2	-10	-0.6	-20	-1
Inter/subtidal invertebrates	27	0	0	-5	-1	-10	-3
Total catch[a]			**-2**		**-14**		**-25**

* Approximates A2 in 2050; ** contribution of each component to total coastal fisheries catch in New Caledonia; *** median projected change in productivity based on range in Chapter 9; a = assumes that proportion of each category remains constant.

Freshwater and estuarine fisheries

Recent catch and value

The main freshwater and estuarine species caught in New Caledonia include eels, flagtails (jungle perch), tilapia, tropical snappers (especially mangrove jack), mullet and *Macrobrachium*. These species are mostly taken by subsistence fishers from lowland rivers and lakes. The estimated annual freshwater fish catch in 2007 was 10 tonnes, worth USD 45,800 {Chapter 10}[1]. No data are available on the volume and value of the catch of estuarine species taken by commercial fishers, but some estuarine species appear regularly in the fish market in Noumea.

Existing freshwater and estuarine fish habitat

The larger rivers of New Caledonia provide a range of freshwater and estuarine fish habitats that support fish and invertebrates {Chapter 7, Table 7.1}.

Island	Largest river	Catchment area (km^2)	River length (km)
Grande Terre	Le Diahot	589	100
Grande Terre	Tontouta	380	38

Projected changes to freshwater and estuarine fish habitat

The projected changes to rainfall patterns in New Caledonia {Chapter 2, Section 2.5.2} are expected to result in greater variability, and possible loss, in the area and quality of all freshwater fish habitats {Chapter 7, Table 7.5}. Sea-level rise is expected to increase the area of estuarine habitat {Chapter 7}.

Projected changes to freshwater and estuarine fish habitat area (%)		
B1/A2 2035	B1 2100*	A2 2100
-5 to +10	-10 to +5	-20 to +20

* Approximates A2 in 2050.

Projected changes in freshwater and estuarine fisheries production

Greater variability in rainfall and river flows are expected to result in minimal changes, or even slightly reduced production, from freshwater and estuarine fisheries in New Caledonia by 2100 under both scenarios {Chapter 10, Section 10.5}.

Projected changes in freshwater and estuarine fish catch (%)		
B1/A2 2035	B1 2100*	A2 2100
0 to +2.5	-2.5	0

* Approximates A2 in 2050.

Aquaculture

Recent and potential production

Penaeid shrimp have been produced from coastal habitats in relatively large quantities (~ 2000 tonnes per year) in New Caledonia for many years. Shrimp are the largest agro-food export from New Caledonia, providing valuable employment opportunities in remote rural areas {Chapter 11} and contributing one third of the combined value of production from fisheries and aquaculture. Trials for growing hatchery-reared sea cucumbers (sandfish) in earthen ponds are underway and farming of marine fish (rabbitfish) to supply the local market has also recently commenced.

Aquaculture commodity	Annual production (tonnes)	Annual value (USD million)*
Penaeid shrimp	2000	29

* 2007 data.

Existing and projected environmental features

Many of the features of surface climate and the ocean important to the aquaculture of shrimp, marine fish and sea cucumbers are expected to change in ways that are likely to affect production. Changing rainfall and increasing air and sea temperatures in New Caledonia are likely to affect coastal aquaculture. In addition, sea-level rise is expected to affect the drainage of shrimp ponds, reducing farm profitability {Chapter 11}.

Environmental feature	1980–1999 average	Projected change			
		B1 2035	A2 2035	B1 2100*	A2 2100
Air temperature (°C)	23.5[a]	+0.5 to +1.0	+0.5 to +1.0	+1.0 to +1.5	+2.5 to +3.0
Annual rainfall (mm)	1066[a]	+5 to +15%	+5 to +20%	+10 to +20%	+10 to +20%
Cyclones (no. per year)	2.3	➢ Total number of tropical cyclones may decrease ➢ Cyclones are likely to be more intense			
Sea surface temperature (°C)	25.1	+0.6 to +0.8	+0.7 to +0.8	+1.2 to +1.6	+2.2 to +2.7
Sea level (cm)	+6 since 1960				
IPCC **		+8	+8	+18 to +38	+23 to +51
Empirical models ***		+20 to +30	+20 to +30	+70 to +110	+90 to +140
Ocean pH (units)	8.08	-0.1	-0.1	-0.2	-0.3

* Approximates A2 in 2050; ** projections from the IPCC-AR4; *** projections from recent empirical models {Chapter 3, Section 3.3.8}; a = data for Noumea.

Projected changes in aquaculture production

Higher air temperatures could enhance shrimp growth in the medium term, and improve survival of shrimp if the existing variability in temperature decreases. However, by 2100 increasing summer temperatures and declining rainfall are likely to reduce growth rates of the blue shrimp presently produced in New Caledonia. Changing rainfall and increasing SST are expected to increase the mortality and incidence of disease in shrimp farms {Chapter 11, Table 11.5}. Sea-level rise is also expected to affect the existing infrastructure of shrimp ponds {Chapter 11, Section 11.3.2.2}.

Production of sandfish and rabbitfish is likely to have a low vulnerability to increasing air temperature and SST, sea level and ocean acidification in 2035. These changes are expected to have increased negative effects on production of these commodities by 2100 {Chapter 11}.

Aquaculture commodity	Use	Projected change		
		B1/A2 2035	B1 2100*	A2 2100
Shrimp	Livelihoods	↑	↓	↓
Marine fish	Livelihoods	↓	↓	↓
Sea cucumbers	Livelihoods	↓	↓	↓

* Approximates A2 in 2050.

Low — Medium — High: Projected increase

Low — Medium — High: Projected decrease

Economic and social implications

Economic development and government revenue

Current contributions

The locally-based longline fishery makes only very minor contributions to gross domestic product (GDP) due to the large size of New Caledonia's economy and made up only 0.05% of GDP in 2007.

Industrial fishery	Contribution to GDP*		Contribution to GR**	
	USD m	GDP (%)	USD m	GR (%)
Surface	0	0	-	-
Longline	1.7	0.05	n/a	n/a

* Information for 2007, when national GDP was USD 8829 million (Gillett 2009)[1]; n/a = data not available.

Projected effects of climate change

Any changes to the contribution of the tuna fishery to GDP due to the projected changes in the distribution and abundance of tuna resulting from climate change are likely to be negligible {Chapter 12}.

Food security

New Caledonia is among the group of PICTs (Group 1) where the estimated sustainable production of fish and invertebrates from coastal habitats will be more than enough to supply the national population with the 35 kg of fish per person per year recommended for good nutrition[i] {Chapter 12, Section 12.7.1}.

Current contributions of fish to food security

Average national fish consumption in New Caledonia is estimated to be 26 kg per person per year[2], below the recommended level for good nutrition. However, fish consumption in rural areas is 55 kg per person per year.

Fish consumption per person (kg)			Fish provided by subsistence catch (%)	
National	Rural	Urban	Rural	Urban
26	55	11	91	42

Effects of population growth

New Caledonia will have an increasing total demand for fish for food due to the predicted growth in population. However, the large areas of coral reef are expected to continue to provide a great surplus of fish relative to the catch needed for good nutrition of the population until at least 2100.

Variable	2010	2035	2050	2100
Population (x 1000)	252	323	343	372
Fish available per person (kg/year)[a]	428	334	314	290
Surplus (kg/person/year)[b]	393	299	279	255

a = Based on 3 tonnes of fish per km^2 of coral reef habitat {Chapter 9}; b = relative to recommended consumption of 35 kg per person per year.

Additional effects of climate change

The effects of climate change on coastal fisheries are not expected to cause declines in the fish available per person significant enough to affect food security in New Caledonia. The large area of coral reefs relative to population size will continue to supply a surplus of coastal fish for food security up to 2100 even if the production of coastal fisheries declines by up to 50%.

i Based on fish contributing 50% of dietary protein as recommended by the SPC Public Health Programme (SPC 2008)[25].

Livelihoods

Current contributions

Coastal fisheries provide important opportunities to earn income for coastal communities in New Caledonia, with 46% of households in representative coastal communities deriving their first or second income from catching and selling fish. Shrimp farming provides > 550 jobs in rural areas[4]. The numbers of full-time and part-time jobs that have been created by tuna fishing are undetermined.

Coastal households earning income from fishing (%)			Jobs in aquaculture*
1st	2nd	Both	2007
23	23	46	560

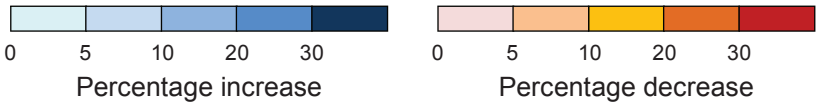
* Ponia (2010)[4]; information derived from Chapter 12, Table 12.6 and the SPC PROCFish Project.

Projected effects of climate change

The effects of climate change on the potential to create more livelihoods based on fisheries and aquaculture are difficult to estimate because there is still scope to derive new jobs from oceanic fisheries, the nearshore component of coastal fisheries and coastal aquaculture. However, the A2 emissions scenario is expected to eventually enhance or retard these opportunities as indicated below.

Year	Projected change under A2 scenario			
	Oceanic fisheries**	Coastal fisheries		Aquaculture (coastal)
		Nearshore pelagic fish	Other resources	
Present*	⇧	⇧	⇩	⇧
2035	↑	No effect	↓	↓
2050	No effect	↓	↓	↓
2100	↓	↓	↓	↓

* Indicates general direction of new opportunities for livelihoods based on the activity; ** based on projected changes in skipjack tuna catches; freshwater and estuarine fisheries not included due largely to their subsistence role



Adaptations and suggested policies

The plans New Caledonia has to derive greater socio-economic benefits from fisheries and aquaculture will depend heavily on interventions to:

1. increase access to tuna, and the efficiency of longlining operations;

2. manage coastal fish habitats and fish stocks to ensure these resources continue to provide fish for food security; and
3. increase the number of livelihoods that can be based on fishing, tourism and coastal aquaculture.

The adaptations and suggested policies to achieve these plans under a changing climate are summarised below (see Section 3 for details).

Economic development and government revenue

Adaptation no. (Section 3.2)	Summary of adaptation	Supporting policy no. (Section 3.3)
E3	Immediate conservation management measures for bigeye tuna	E8
E4	Energy efficiency programmes for industrial tuna fleets	E9
E5	Environmentally-friendly fishing operations	
E7	Safety at sea	E10
E8	Climate-proof infrastructure	E11
E9	Pan-Pacific tuna management	E2

Food security

Adaptation no. (Section 3.4)	Summary of adaptation	Supporting policy no. (Section 3.5)
F1	Manage and restore vegetation in catchments	F1, F2, F18
F2	Foster the care of coastal fish habitats	F1–F3, F18
F3	Provide for landward migration of coastal fish habitats	F4, F5, F18
F4	Allow for expansion of freshwater habitats	F4, F18
F5	Sustain production of coastal demersal fish and invertebrates	F6, F7, F13, F18
F6	Diversify catches of coastal demersal fish	F6, F13, F18
F7	Manage freshwater and estuarine fisheries to harness opportunities	

Sustainable livelihoods

Adaptation no. (Section 3.6)	Summary of adaptation	Supporting policy no. (Section 3.7)
L1	Improve technical and business skills of communities	L1, L2
L2	Rebuild populations of sea cucumbers and trochus	L2
L3	Develop coral reef ecotourism ventures	L3
L4	Diversify production of coastal aquaculture commodities	L4, L5
L5	Modify locations and infrastructure for coastal aquaculture	L6