

## Index

### A

- access fees paid by distant water vessels *see* licensing and licence fees
- acidity of the ocean *see* ocean acidification; ocean acidity
- acoustics 240, 458–9
- adaptation, defined 46
- adaptations to address climate change and other drivers 832–4
- economic development and government revenue 815–19; supporting policies 819–21
- financing adaptations 863–4
- framework for selecting adaptations 812–13
- interactions among adaptations 838–40
- knowledge needed to implement adaptations 852
- maintaining the contribution of fish to food security 821–32; supporting policies 832–4
- maximising sustainable livelihoods 834–7; supporting policies 837–8
- monitoring required 843–4
- planning for implementation 840–3
- recommended adaptations and supporting policies 813–15
- adaptive capacity
- abiotic habitats 400–1
- aquaculture commodities 667–70, 673–4, 679–82, 685–7, 690–3, 695, 698, 701
- coastal fisheries species 526–8, 531–2, 534
- coral reefs 268–75, 539–40
- defined 46
- estuarine habitats 410–11, 415, 417, 606–7
- floodplain habitats 408–9
- food webs 224, 226, 228, 229, 231
- freshwater fish 596–7, 603–4, 606–11
- lake habitats 407
- mangroves 324–31
- Pacific Island countries and territories 758–63, 794
- riverine habitats 403, 404, 405–9, 412, 415, 417
- seagrasses 334, 336–43
- slopes habitats 404
- tuna 449, 452–3, 456, 459–60, 462, 465
- vegetated habitats 400–1, 412
- adaptive capacity, defined 36
- agriculture 8, 12
- air temperature *see* surface air temperature
- albacore global warming potential impact 475 *see also* tuna; tuna fisheries
- alternative fuels 817
- amphidromous species (fish) 390, 391, 581, 601, 603
- Antarctic ice sheet 273
- aquaculture 18–19, 31, 649–51, 830
- aquatic diseases 658, 701–5, 711–12, 715
- benefits and importance of 649–50
- aquaculture (*cont.*)
- climate change effects worldwide 25–9
- climate change threats in tropical Pacific 30–1
- economic development contributions 15, 750–1
- financing options 709
- food security *see* aquaculture commodities
- for food security
- gaps in knowledge and future research 709–12, 850–2, 860–1
- governance and planning failure 649, 750–1
- integrated vulnerability 704
- livelihoods *see* aquaculture commodities
- for livelihoods
- management strategies 712–16, 811
- market instruments 707–9
- opportunities 705–9
- systems 21
- aquaculture commodities for food security 18–19, 21, 650–1, 841–2
- gaps in knowledge and future research 709–10, 850–1
- production 651–5
- vulnerability to climate change 663–70, 706
- aquaculture commodities for livelihoods 15, 20, 21, 650–1
- gaps in knowledge and future research 711, 851
- opportunities 756–7
- production 655–63
- vulnerability to climate change 670–701, 706
- aquarium products and market 15, 258, 502, 541, 750, 751 *see also* marine ornamentals
- aragonite 129, 160–2, 172, 230–1
- Archipelagic Deep Basins Province 119–20, 126, 167–8, 201
- characteristics 202–3, 206; changes projected 220–3
- food webs 210–12, 214; vulnerability 222–31, 235, 236
- net primary production 275–6
- artisanal fishing 20, 437, 438, 501, 502, 504, 509–10, 580, 746, 748, 756
- Asian carp *see* carp
- Atlantic ocean tropical cyclones 77
- atmospheric circulation
- changes projected 91
- patterns 24
- present-day 57–9
- see also* tropical cyclones
- atolls 6, 7, 254–5
- attribution, defined 46

### B

- bacteria 197–201
- barramundi 584, 589, 601, 602

barrier layer (Warm Pool) 118, 119  
 barrier reefs 254–7, 305–6 *see also* coral reefs  
 bays and lagoons 113, 304–5, 384  
 bêche-de-mer 259, 504, 506, 518, 746 *see also*  
 sea cucumbers  
 benthic microalgae communities 131, 319–21,  
 343–5  
 bigeye tuna  
 global warming impact modelling 472–4  
 projected changes in catch 475–7  
*see also* tuna; tuna fisheries  
 biofuels 705, 707, 817  
 biogeochemical models 156–7, 158, 173,  
 219–20, 478–9  
 biological carbon pump 123, 191  
 biological production modelling 156–7  
 biological pump 123, 191  
 blocked river valleys 382, 408  
 bottom-dwelling fish *see* demersal fish  
 boundary currents 138–9  
 Bureau of Meteorology (Australia) 285, 350,  
 478

## C

calcareous organisms 170, 231 *see also* coral  
 reefs  
 calcite 129  
 calcium carbonate 129–31  
 capacity building 629, 835, 855, 856, 857, 862,  
 863  
 carbon dioxide  
 anthropogenic 129, 159–62  
 atmospheric concentrations 51–2, 270, 278,  
 282, 329  
 changes in dissolved inorganic carbon  
 341–2  
 dissolved in surface sea waters *see* ocean  
 acidification  
 elevated carbon dioxide effects on  
 mangroves 329–30  
 emissions 24–5, 276–84 *see also* emissions  
 scenarios  
 in oceans, effect on food webs 216–17  
 carbon labelling 708, 715  
 carbonate ions 129, 130, 160, 264–6  
 carbonate saturation 131  
 carp 587, 590, 654, 664–8  
 catadromous species (fish) 390, 581  
 catchment management 414–15, 419–20, 421,  
 598, 822–3 *see also* river systems  
 chemistry of sea water *see* seawater  
 chemistry  
 chlorophyll *a* concentrations 203–5, 211–12,  
 213, 218, 240 *see also* phytoplankton  
 ciguatera fish poisoning 543–4  
 clearing *see* vegetation clearing  
 climate  
 data required 857  
 defined 51  
 observations and records 54, 92  
 present-day 57–67  
 trends 67–77  
 climate change  
 boundary for ‘dangerous’ climate change  
 38  
 continuing 89  
 defined 51  
 due to human activities (evidence for) 51–2  
 projections 77–91, 864–6  
 threats for tropical Pacific 24–9, 30–1  
 vulnerability assessment 864–6 *see also*  
 vulnerability under specific organisms,  
 habitats or fisheries  
 climate change adaptation *see* adaptations to  
 address climate change and other drivers  
 climate change uncertainties 54–7, 92,  
 172–4 *see also* gaps in knowledge and future  
 research  
 climate models 32–5, 54–6, 172–3  
 ENSO simulations 83–92, 104  
 net primary production 193  
 new generation 90  
 oceanic features 104–5, 187  
 resolution 84, 173  
 shortcomings/improvements needed 77,  
 90, 92, 240–1, 477–9  
 simulation of tropical cyclones 84, 86–8  
*see also* biogeochemical models; ecosystem  
 models  
 climate system 51–3  
 climate variability 14, 51–4, 63–7, 103  
 cloud cover 227–8 *see also* solar radiation  
 CMIP3 models 33–5, 104, 172–3, 187  
 coastal circulation and island effects 137–41,  
 167–9  
 coastal fisheries 826–7, 831  
 benefits and importance of 495–6  
 catch estimates 513, 746–7  
 catch estimation methods 574–6  
 climate change threats 30  
 climate change vulnerability 496, 521–52,  
 838–40  
 economic development contribution 746–50  
 fishing methods 501  
 food security and 16–18, 495–6, 838–40  
 gaps in knowledge and future research  
 552–4, 849–50, 858, 860  
 harvest, stock and sustainable yields 509–  
 11; demersal fish 511–16; invertebrates  
 518–21; nearshore pelagic fish 517  
 livelihoods from 20, 288, 495–6, 756  
 main fisheries and their uses 497–509;  
 demersal fish 498–502; invertebrates  
 504–9; nearshore pelagic fish 502–4  
 management strategies 555–6, 808–10  
 production 509–11  
 range and habitats 16, 299–300  
 role of mangroves, seagrasses and intertidal  
 flats 308–15  
 coastal habitats 16, 299–300, 823–5  
 lagoons 384  
 management measures 286, 350–1  
 in PICTs 510

- coastal habitats (*cont.*)  
 wetlands 398–9  
*see also* coastal fisheries; coral reefs;  
 freshwater and estuarine habitats
- commercial fishing *see* fisheries
- community-based ecosystem approach to  
 fisheries management 810, 821, 826, 828,  
 855, 861
- confidence, defined 36, 47
- continental reefs 254–7 *see also* coral reefs
- Convention on the Conservation and  
 Management of High Migratory Fish Stocks  
 in the Western and Central Pacific Ocean 3,  
 22, 483, 807
- convergence zones *see* Intertropical  
 Convergence Zone; South Pacific  
 Convergence Zone
- Cook Islands economy 15
- cooperation *see* regional cooperation
- Coordinated Regional Climate Downscaling  
 Experiment 92
- copepods  
 hypoxic conditions 229  
 temperature increase effects 224
- coral bleaching 258, 262–4, 277, 281, 288, 536,  
 687, 690–1
- coral farming 20, 660, 687–91, 711
- coral reef degradation 28, 30, 131, 160, 162,  
 163  
 calcification decrease 264–5, 270–1, 281–2  
 coastal fisheries habitat degradation 495,  
 535–40, 689–91  
 erosion 259, 264, 265, 278, 282
- Coral Reef Triangle Initiative 284
- coral reef vulnerability assessment 267, 276,  
 283–4, 535–40  
 coral species sensitivity to climate change  
 273, 278–9, 280  
 low versus high carbon dioxide emissions  
 276–84  
 ocean acidification 264–6, 270–1  
 ocean circulation 275–6  
 sea-level rise 273–4  
 sea surface temperature 267–9, 281  
 solar radiation 269–70  
 tropical cyclones and floods 271–3, 282
- coral reefs 253–4  
 changes observed 262, 263–6, 268, 277–8  
 changes over time 266  
 changes projected 276–84 *see also* coral reef  
 vulnerability assessment  
 ciguatera fish poisoning 543–4  
 coral loss 262, 267, 278, 282  
 coral mortality 264, 277  
 critical requirements 260–2  
 cyclones and 258  
 degradation *see* coral reef degradation  
 distribution and structure 254–8, 269, 280,  
 288  
 establishment and growth 260, 262  
 fish populations 18, 28  
 fish species 6, 279  
 fish yield 515–16
- coral reefs (*cont.*)  
 gaps in knowledge and future research  
 284–6  
 global warming effects 262–3 *see also* coral  
 reef vulnerability assessment  
 impact of human activities 261  
 management strategies 278, 280–1, 282,  
 286–8, 555  
 ocean acidification effects 129–31, 160, 162,  
 170, 172, 264–6  
 recovery or collapse 283–4  
 role in supporting fisheries 258–60  
 sea-level rise and 257  
 sea surface temperature and 59, 257, 263–4  
 symbiotic relationships 262–4  
 threats 253, 257–8, 260–2, 266, 273, 279–80  
 water quality 279–80, 286
- Coral Sea Counter Current 110
- Coral Triangle Initiative 6
- CORDEX (Coordinated Regional Climate  
 Downscaling Experiment) 92
- Coriolis force 107, 121
- counter currents 109–10 *see also* North  
 Equatorial Counter Current; South  
 Equatorial Counter Current
- Coupled Model Intercomparison Project  
 Phase 3 (CMIP3) multi-model data set 33–5,  
 104, 172–3, 187
- Coupled Model Intercomparison Project  
 Phase 5 90
- crater lakes 380–1
- crown-of-thorns starfish 495
- crustaceans 259, 505–6, 519
- CSIRO (Australia) 285, 350, 478
- currents *see* ocean currents
- cyanobacteria 197, 224 *see also* *Trichodesmium*  
 blooms
- cyclones and storms *see* storms; tropical  
 cyclones

## D

- 'dangerous' climate change 38
- datasets *see* observational data
- deep waters  
 fish species 497  
 food webs 229  
 seagrasses 306
- deforestation *see* vegetation clearing
- demersal fish 498–502
- demersal fish, fisheries for 258  
 catch estimates 499, 513, 574–6, 747  
 coral reef habitats 501  
 harvest, stock and sustainable yields 511–16  
 main fisheries and uses 498–502  
 vulnerability 541–5, 864
- demography 9, 10, 18, 415, 417, 798–800
- detection, defined 46
- diazotrophy 197, 215, 216
- dinoflagellates in symbiosis with corals  
 262–4
- dissolved oxygen 127–8, 157–9, 170, 171  
 effect on food webs 216, 229–30

dissolved oxygen (*cont.*)  
freshwater fish vulnerability to change in  
607–9 *see also* freshwater and estuarine  
fisheries  
scenarios 451  
tuna vulnerability to change in 450–4  
distant water fishing nations 807, 817  
downwelling 155–6, 159, 194–5, 210  
dynamical downscaling 173

## E

East Australian Current 106, 109  
echinoderms 259  
ecological provinces 119–20, 201–2, 275  
boundaries 220  
characteristics 203–6; changes projected  
220–3  
food webs 206–12; differences 212–14;  
maintenance 214–17; vulnerability 222–36  
*see also* food webs  
location 204  
surface area 220–1  
*see also names of specific provinces:*  
Archipelagic Deep Basins; North  
Pacific Tropical Gyre; Pacific Equatorial  
Divergence; South Pacific Subtropical  
Gyre; Western Pacific Warm Pool  
economic development and government  
revenue 9–11, 12, 14–15  
aquaculture contribution 750–1  
coastal fisheries contribution 746–50  
effects of projected changes to surface tuna  
fishery 763–5  
implications of projected changes in tuna  
catches 778–80  
investments to implement adaptations 854  
tuna fisheries contribution 736–46  
vulnerability of plans 757–63  
Economic Partnership Agreement 745,  
816–17  
Ecopath model 193, 235, 237–9  
Ecosim model 235, 237–9  
ecosystem hierarchy in river systems 377, 378  
ecosystem models 235, 237–9, 467–75, 478–9  
*see also* biogeochemical models; climate  
models  
ecosystems  
effects of increased greenhouse gases 24–5,  
276–84  
vulnerability *see specific habitats and fisheries*  
eddies *see* ocean eddies  
eels 584, 589  
EEZ *see* exclusive economic zone (EEZ)  
Ekman transport 105–7, 115, 139  
El Niño–Southern Oscillation 14, 26, 57, 63–6  
climate anomalies 65–6, 90  
ENSO mechanism and Warm Pool 118–19,  
204, 205, 207, 209  
ENSO-Modaki 65  
ENSO simulations 83–92, 104  
impact on aquaculture 684–5, 686

El Niño–Southern Oscillation (*cont.*)  
impact on freshwater ecosystems 384, 397,  
399, 421  
impact on tuna 26, 443–6  
indices of activity 65  
influence on primary production 218,  
461–2, 463  
modelling 84, 86, 104, 172–3  
ocean properties and 103  
Pacific surface climate conditions 68–72,  
88–91, 112  
rainfall trends 71–2  
sea-level effects 136  
tropical cyclones 65–6, 73  
and wave conditions 134–5, 163  
emissions scenarios 37–9, 56–7, 77, 79, 90  
coastal fisheries projected changes 548–51  
coral reef projected changes 276–84  
fisheries vulnerability 37–9, 282, 864–6  
IPCC Special Report 34, 37–9, 56–7  
rainfall changes 82, 85, 91, 227, 282, 325  
ENSO *see* El Niño–Southern Oscillation  
environment of tropical Pacific *see* tropical  
Pacific Ocean  
Equatorial Undercurrent 106, 109, 127, 170,  
203  
estuaries  
flow 393  
freshwater fish and invertebrate  
vulnerability to changes in 620–3  
sea-level rise 398–9  
seagrass habitats 306  
types 383–4  
vulnerability to climate change 410–11, 415  
*see also* freshwater and estuarine fisheries;  
freshwater and estuarine habitats  
European market, supply to 745, 816–17  
exclusive economic zone (EEZ) 8, 11, 481–2  
expert opinion 36  
export production (nutrients) 196  
exposure, defined 36  
extinction events 266

## F

FFA *see* Pacific Islands Forum Fisheries  
Agency  
financial assistance for adaptations 863–4  
fish aggregating devices 258–9, 437, 829,  
841–2  
fish consumption 16–19, 543–4, 751–4, 801 *see  
also* food security  
fish distribution and abundance 26–30  
coral reefs 6  
freshwater *see* freshwater fish  
nursery areas 28  
ocean temperature and 110–11  
oceanic currents and 105  
oceanic environment 103  
target species 28–9  
*see also specific habitats and fisheries*  
fish farming 662, 693–5 *see also* aquaculture

- fish growth 28, 390  
 fish production (Fiji) 593–4  
 fish reproduction 27, 388  
 fisheries 9  
   climate change effects worldwide 25–9  
   climate change threats in tropical Pacific 30–1  
   importance of 12–20  
   management 11, 21–3, 813–14 *see also* management regimes and approaches  
   ocean acidity effects 24–5, 30 *see also* ocean acidification  
   opportunities for development *see* economic development and government revenue  
   optimisation of benefits 20–4  
   production 13–15, 25–6, 282  
   *see also specific fisheries*: aquaculture, coastal fisheries, freshwater and estuarine fisheries, oceanic fisheries, tuna fisheries  
 fisheries vulnerability to climate change 864–6  
   assessment approach 31–2  
   climate models 32–5  
   framework 35–7  
   scenarios for tropical Pacific 37–9, 282  
   *see also specific fisheries*: aquaculture, coastal fisheries, freshwater and estuarine fisheries, oceanic fisheries, tuna fisheries  
 Fisheries Zone 8  
 fishing licences *see* licensing and licence fees  
 fishing methods  
   artisanal fishing 20, 437, 438, 501, 502, 504, 509–10, 580, 746, 748, 756  
   coastal fisheries 501  
   for demersal fish 501  
   destructive practices 288, 495, 501, 550, 823  
   efficiency improvements 630  
   freshwater and estuarine fisheries 582–3, 590, 630  
   for mullet 585  
   oceanic fisheries 437–8  
   tuna fisheries 437–8  
   in turbid water 611  
 fishing mortality 442–3  
 flagtail 585  
 floodplain habitats 381–2, 387, 392, 394  
   freshwater fish and invertebrate vulnerability to changes in 618–19  
   vulnerability to climate change 408–9  
 floods  
   coral reef vulnerability assessment 271–3, 282  
   impact on aquaculture 666  
   impact on freshwater ecosystems 384  
 Fly River, PNG  
   barramundi catch 602  
   catchment 372, 374  
   estuary 383, 393, 399, 410  
   fish production 592–3  
   floodplain habitats 375, 376–7, 381–2, 387, 399, 408, 602  
   flow 394, 406  
   habitats (examples) 380  
   Fly River, PNG (*cont.*)  
     sediment loads and sensitivity 412  
     slopes region 381, 404  
     tidal fresh waters 382  
 food miles 708  
 food safety 816  
 food security 16–19, 780–9, 864  
   from aquaculture 18–19, 650, 651–5, 663–70, 706, 709–10  
   coastal fisheries role 495–6, 502, 838–40  
   coral reefs role 258–60, 288  
   estimating changes in abundance of fish 795–7, 841  
   fish consumption 751–2, 828–34, 838–40;  
     plans to maintain fish consumption 752–4; vulnerability of plans 766–76  
   freshwater and estuarine fisheries role 579  
   freshwater and estuarine habitats role 371  
   intertidal flats role 313–15  
   investments to implement adaptations 854–6  
 food web vulnerability 222–31  
   gaps in knowledge and future research 239–41, 846–8  
   integrated assessments for provinces 232–6  
   mixed layer depth changes 225–6  
   ocean acidification 230–1  
   oxygen concentration changes 229–30  
   solar radiation changes 227–9  
   temperature increases 222, 224–5  
   upwelling changes 226–7  
 food webs 191–4  
   Archipelagic Deep Basins Province 210–12, 214  
   bacteria, zooplankton and micronekton 197–201  
   carbon dioxide effects on 216–17  
   changes observed 217–18  
   changes projected 218–20  
   in deep waters 229  
   differences among provinces 212–14  
   dissolved oxygen effects on 216  
   freshwater and estuarine habitats 390, 391–2  
   gaps in knowledge and future research 239–41, 846–8  
   macronutrients and micronutrients 214–15  
   management interventions 241  
   microbial food webs 199  
   North Pacific Tropical Gyre 209, 210, 214  
   Pacific Equatorial Divergence 206–8, 209  
   phytoplankton production 194–7  
   solar radiation effects on 216  
   South Pacific Subtropical Gyre 209, 210, 214  
   structure and function 194–201  
   temperature impacts on 215–16  
   for tuna 191–201, 212–14, 215–16, 460–5;  
     modelling 235, 237–9  
     Warm Pool 208–9  
   forest resources 10  
   fork-tailed catfish 584, 589  
 Forum Fisheries Agency *see* Pacific Islands Forum Fisheries Agency

- French Polynesia economy 15  
 freshwater and estuarine fisheries 16, 17, 30, 643–5, 826–8  
 benefits and importance of 579  
 catch estimates 579, 582, 588  
 climate change vulnerability 30, 594, 599;  
 direct effects 594–611; indirect effects  
 611–23; integrated assessment 623–6  
 fishing methods 582–3, 630  
 food security and 579, 587, 864  
 gaps in knowledge and future research  
 626–7, 850, 860  
 harvest, stock and sustainable yields  
 587–94, 624–5  
 management strategies 598, 627–31, 810–11  
 nature of 580–7  
 production 579, 590–4, 623–6  
 species 583–7, 625–6, 643–6  
 freshwater and estuarine habitats 420–1, 826  
 climate change effects 393–9, 402, 420;  
 interaction with existing impacts 411–13  
 climate change vulnerability 399–411,  
 594–623; integrated assessment 413–19,  
 623–6; vulnerability reduction 423–4  
 critical requirements 390–3  
 examples 380  
 food webs 390, 391–2  
 functional process zones 379–84, 611–23  
 gaps in knowledge and future research  
 417–19  
 introduced species 586–7, 590, 593, 625–6,  
 630, 645  
 management strategies 415, 419–24, 598,  
 627–31  
 native species 583–6, 589–90, 645  
 natural variability 384  
 nature of 371–84  
 role in supporting fisheries 385–90  
 salinity increase 605–7  
 water temperature 397–8, 400, 595  
 water temperature change and fish  
 vulnerability 594–9, 664–5, 666–7  
*see also* freshwater and estuarine fisheries  
 freshwater clams 585, 590  
 freshwater eels 584, 589  
 freshwater fish 390, 581, 643–5  
 adaptive capacity 596–7, 603–4, 606–11  
 exposure to contaminants 596  
 fish production 376–7 freshwater and  
 estuarine fisheries  
 growth 390  
 introduced species 586–7, 590, 593, 625–6,  
 630, 645  
 migration 388–9, 581  
 native species 583–6, 589–90, 645  
 off-channel habitats 387  
 reproduction 388–9  
 riverine habitats 385–7, 423–4 *see also*  
 freshwater and estuarine habitats  
 vulnerability to change in: dissolved  
 oxygen 607–9; river flow 600–5; salinity  
 605–7; water temperature 594–9; water  
 turbidity 609–11  
 freshwater fisheries *see* freshwater and  
 estuarine fisheries  
 freshwater marshes 382, 408  
 freshwater prawn farming 661–2  
 freshwater prawns 585–6, 590, 692–3  
 fringing reefs 254–7, 305 *see also* coral reefs  
 fuel 817  
 functional process zones  
 freshwater and estuarine habitats 379–84  
 freshwater fish and invertebrates  
 vulnerability to changes in 611–23  
 river systems 373, 375, 377, 379, 380, 611–23  
 ‘The Future of Pacific Island Fisheries’ study  
 22–3
- G**  
 gaps in knowledge and future research  
 aquaculture 709–12, 850–2, 860–1  
 coastal fisheries 552–4, 849–50, 858, 860  
 coral reefs 284–6, 847  
 economic analysis 852  
 fish habitats 846–8  
 fish stocks 848–9  
 food webs 239–41, 846–8  
 freshwater and estuarine fisheries 626–7,  
 850, 860  
 freshwater and estuarine habitats 417–19,  
 848  
 investments needed 856–61  
 mangroves, seagrasses and intertidal flats  
 348–50, 847  
 oceanic fisheries 477–9, 848–9, 857–8  
 social dimensions 852  
 surface climate and tropical Pacific Ocean  
 845–6, 857  
 tuna fisheries 477–9  
 geostrophic motion 105, 108  
 giant clams 20, 519, 660–1, 688–91, 711  
 glaciers *see* ice sheet melting  
 Global Environmental Facility Coral Reef  
 Targeted Research Programme 284  
 Global Partnership for Climate, Fisheries and  
 Aquaculture 861  
 global surface temperatures *see* sea surface  
 temperature; surface air temperature  
 global warming 52–4  
 projected 79–81, 89–91  
 trends 67–77, 83  
 goby-fry 585, 589  
 government revenues *see* economic  
 development and government revenue  
 Grand Observatoire du Pacifique Sud 284  
 gravitational attraction effect on currents  
 107  
 Great Barrier Reef 262, 264, 267  
 green labelling 708–9  
 greenhouse gases  
 atmospheric concentrations 51–2  
 effects of increases on ecosystems 24–5,  
 276–84  
 emissions limitation 241, 281  
*see also* emissions scenarios

- Greenland ice sheet 273  
 gross domestic product *see* economic development and government revenue
- H**
- habitat modification 27–8, 30  
 Hadley circulation 24, 57–8, 65, 82  
 Hawaii Lee Counter Current 109  
 Hawaii Ocean Time-Series (HOT) station 152–3, 174, 217–18, 239  
 heterotrophy 197, 201  
 high islands 3–5, 210–11, 286  
   orographic effects 138, 140–1  
   runoff 210–11, 272, 276, 286  
   shading coral reefs 258, 269  
 High Nutrient-Low Chlorophyll (HNLC) systems 208  
 human habitation 7  
 human population 9, 10, 18, 415, 417, 798–800  
 hydrological cycle 24 *see also* rainfall
- I**
- ice sheet melting 135–6, 165–6, 170, 273  
 Indonesian Throughflow 106, 109  
 Inter-American Tropical Tuna Commission 480–1, 819  
 Interdecadal Pacific Oscillation 66, 103, 126  
 interglacial periods 166 *see also* paleoclimate  
 Intergovernmental Panel on Climate Change  
   Fifth Assessment Report 90  
   Special Report on Emissions Scenarios 34, 37–9, 56–7  
   vulnerability assessment framework 36  
 Intergovernmental Panel on Climate Change,  
   Fourth Assessment Report 33, 52  
 Interim Economic Partnership Agreement  
   between PNG and the EU 745, 816–17  
 internal waves 138, 139–40, 212  
 international science partnerships 284–5  
 intertidal flats 299–300  
   critical requirements 315–21  
   ecological and socio-economic roles 306–8  
   gaps in knowledge and future research 348–50  
   management strategies 350–1  
   projected vulnerability 343–5, 348, 398–9  
   role in supporting fisheries 313–15  
   variations linked to climate change 323  
   *see also* coastal habitats  
 intertidal invertebrates *see under*  
   invertebrates, fisheries for  
 Intertropical Convergence Zone 57–8, 65,  
 109, 169  
 introduced fish species *see under* freshwater fish  
 invertebrates 504–9, 518, 643–6 *see also* sea cucumbers; trochus  
 invertebrates, fisheries for  
   catch 507–9, 513, 574–6, 588, 747  
 invertebrates, fisheries for (*cont.*)  
   harvest, stock and sustainable yields 518–21  
   overfishing and management measures 748  
   shallow subtidal and intertidal  
     invertebrates 259, 506–9, 513, 518–21,  
     574–6  
   targeted invertebrates 259, 504–6, 513, 518,  
     574–6  
   vulnerability 546–7  
   *see also* freshwater and estuarine fisheries  
 investments 853  
   to fill gaps in knowledge 856–61  
   financing adaptations 863–4  
   to implement adaptations 854–6  
   to localise the vulnerability assessment 862  
   to monitor changes in resources and  
     adaptation success 861–2  
   to strengthen partnerships 861  
 iron concentrations 203, 207, 208, 215, 226–7  
 iron enrichment 215, 227, 241  
 islands  
   island effects (oceanic processes) 137–41,  
     167–9, 171  
   oceanic biological activity 210–11  
   river systems 372–9 *see also* freshwater and  
     estuarine habitats  
   sediment and nutrient discharge 210–11,  
     272, 286
- K**
- key challenges 865–6  
 knowledge gaps *see* gaps in knowledge and  
   future research  
 Kuroshio Current 106, 108
- L**
- La Niña conditions 14, 15, 63–5, 118, 127  
 and PEQD ecosystem 207  
 sea-level effects 136  
 and size of Warm Pool 204  
 and wave conditions 134–5, 163  
*see also* El Niño-Southern Oscillation  
 labelling of aquaculture products 708–9, 715  
 lagoons 133  
   coastal lagoons 384  
   seagrass habitats 304–5  
 lakes  
   coastal lagoons 384  
   freshwater fish and invertebrate  
     vulnerability to changes in 617–18  
   high-elevation 380–1, 406  
   low-elevation 382, 406–7  
   oxbow lakes 381–2, 387, 408  
   vulnerability to climate change 406–8  
 land temperatures, annual averages 53  
 latitudinal conveyor belt 207  
 licensing and licence fees 443  
   aquaculture 811  
   fishing 14, 435, 808, 815, 820, 833, 852, 855

forestry and mining 832  
 light *see* solar radiation  
 likelihood, defined 36, 46  
 live rock 20, 660, 689, 691  
 livelihood 19–20, 253, 288  
   aquaculture commodities 20, 650, 655–63,  
   670–701, 706, 711, 754, 834–8  
   defined, 19  
   from fisheries 754–7, 787–9, 834–8  
   plans to increase livelihood from fisheries  
   and aquaculture 756–7; vulnerability of  
   plans 776–8  
   role of coastal fisheries 502  
   role of intertidal flats 313–15  
 longline fishery 437–8, 743–4, 762–3, 816 *see*  
*also* tuna fisheries  
 lowland reaches 379, 381  
   freshwater fish and invertebrate  
   vulnerability to changes in 616–17  
   vulnerability to climate change 405–6

## M

macronutrients *see* nutrient supply  
 mammals 497  
 management regimes and approaches  
   adaptations and supporting policies 813–15  
   aquaculture 712–16, 811  
   coastal fisheries 555–6, 808–10  
   coastal zones 286, 350–1  
   community-based ecosystem approach to  
   fisheries management 810, 821, 826, 828,  
   855, 861  
   coral reefs 278, 280–1, 282, 286–8, 555  
   food webs and primary production 241  
   framework for selecting adaptations 812–13  
   freshwater and estuarine fisheries 598,  
   627–31, 810–11  
   freshwater and estuarine habitats 415,  
   419–24, 598  
   human rights approach 812  
   key challenges 865–6  
   oceanic fisheries 21–3, 435–6, 480–4, 806–8  
   sea-level rise 420–1  
   tuna fisheries 21–3, 435–6, 443, 480–4  
 mangrove jack *see* tropical freshwater  
 snapper  
 mangroves 279–80, 288, 299–300  
   critical requirements 315–21  
   gaps in knowledge and future research  
   348–50  
   management strategies 350–1  
   projected vulnerability 323–32, 345–6  
   role in supporting fisheries 308–11  
   species and communities 301–3  
   variations linked to climate change 321–2  
   *see also* coastal habitats  
 marine biodiversity 6  
 marine environment conservation and  
 protection 6, 11  
 marine fish farming 662, 693–5  
 marine ornamentals 660–1, 687–91, 751 *see*  
*also* aquarium products and market

marine pathogens 28  
 marine snow 199, 207, 209  
 marshes *see* freshwater marshes  
 mass-extinctions *see* extinction events  
 maximum sustainable yield in fisheries  
 management 441–2  
 Melanesia 3–6  
   aquaculture 18–19, 20  
   area 8, 256  
   coastal habitat area 510  
   fish catch and consumption 16–17, 498–9,  
   507, 513, 744, 747  
   fisheries *see* coastal fisheries; oceanic  
   fisheries  
   food security forecasts 18  
   forest resources 10  
   freshwater and estuarine fisheries  
   (summary) 643–4  
   livelihoods 20  
   population estimates 10, 18  
 Melanesians 6, 8  
 melt water *see* ice sheet melting  
 mesoscale eddies *see* ocean eddies  
 mesozooplankton  
   biomass 200–1, 202, 209, 213, 214, 219, 237–9  
   links with phytoplankton 200–1, 212  
 microbial food webs 199 *see also* food webs  
 microbial loop 199  
 micronekton 197–201  
   biomass 201, 208, 210, 214, 237–9  
   composition 214  
   migration 199–200  
   and thermal changes 215–16  
   tuna food source 201, 212, 460, 464–5  
 Micronesia 3, 4, 6  
   area 8, 256  
   coastal habitat area 510  
   fish catch and consumption 16–17, 499, 507,  
   513, 744, 747  
   fisheries *see* coastal fisheries; oceanic  
   fisheries  
   food security forecasts 18  
   freshwater and estuarine fisheries  
   (summary) 644  
   population estimates 10, 18  
 Micronesia Challenge 6, 284  
 Micronesians 6, 8  
 micronutrients *see* nutrient supply  
 microzooplankton 201, 202, 210  
 migrations of fish 388–9  
 milkfish 655, 668–70  
 Mindanao Current 106, 108, 109  
 Mindanao Eddy 106, 108  
 minerals *see* seabed minerals surveys  
 mixed layer depths 123–4, 126, 154–5  
   changes projected 220–1, 225, 455  
   food web vulnerability to changes 225–6  
 models *see* biogeochemical models; climate  
 models; ecosystem models  
 molluscs 259, 505, 506  
 monitoring programmes 22–3, 173–4, 843–4,  
 861–2 *see also* gaps in knowledge and future  
 research; observational data



montane reaches 379–80, 392  
 climate change vulnerability 401, 403  
 freshwater fish and invertebrates  
 vulnerability to changes in 612–13, 614  
 Mozambique tilapia *see* tilapia  
 mullet 585, 589

## N

National Oceanic and Atmospheric  
 Administration (USA)  
 Coral Reef Watch programme 285  
 Tropical Atmosphere Ocean (TAO) array  
 239  
 native fish species *see under* freshwater fish  
 natural resources 9–10  
 Nauru Agreement *see* Parties to the Nauru  
 Agreement  
 nearshore pelagic fish, fisheries for 258  
 catch estimates 513, 574–6, 747  
 harvest, stock and sustainable yields 517  
 main fisheries and their uses 502–4  
 vulnerability 545–6  
 New Caledonia economy 15  
 New Guinea Coastal Undercurrent 106, 109,  
 203  
 Nile tilapia *see* tilapia  
 nitrate concentration in tropical Pacific  
 Ocean 124  
 nitrogen 214  
 North Caledonian Jet 106, 109  
 North Equatorial Counter Current 109, 110,  
 150, 203  
 North Equatorial Current 105–6, 108–9, 110,  
 150, 169  
 North Fiji Counter Current 110  
 North Pacific Subtropical Gyre 152–3, 155  
 North Pacific Tropical Gyre 119, 126, 153,  
 154, 201; characteristics 205, 206; changes  
 projected 220–3; food webs 209, 210, 214;  
 vulnerability 222–31, 235, 236  
 North Queensland Current 106, 109  
 North Vanuatu Jet 106, 109  
 NPZ (Nutrient-Phytoplankton-Zooplankton)  
 model 193  
 nutricline 117, 123, 200–1, 202, 203, 232  
 nutrient supply 123–7, 170, 171, 191, 196–7,  
 226, 275  
 Archipelagic Deep Basins Province 210–12  
 for mangroves, seagrasses and intertidal  
 flats 318–20, 326–8, 338–9  
 in NPTG and SP5G 210  
 Pacific Equatorial Divergence 203  
 Warm Pool 204–5, 209  
*see also* food web vulnerability;  
 phytoplankton production; primary  
 production  
 nutrient transfer between PEQD and Warm  
 Pool 207, 208  
 nutrient transfer to surface waters 114,  
 117–20  
 changes observed 150–3  
 changes projected 153–7

nutrient transfer to surface waters (*cont.*)  
 mechanisms/processes 123–6, 138–41, 168,  
 169, 194–7, 198, 205, 211  
 in NPTG and SP5G 210  
 and thermocline 117, 194–5, 205  
*see also* nutrient supply

## O

observational data  
 acoustic data 240  
 ocean colour 217–18, 240  
 requirements 173–4, 239–40, 285, 322  
*see also* gaps in knowledge and future  
 research  
 ocean acidification  
 aquaculture commodities vulnerability  
 668–9, 671–2, 673–4, 677, 684, 689–90  
 changes observed 159–60, 170, 270  
 changes projected 160–2, 171, 172, 270–1,  
 278, 458, 529  
 coastal fisheries vulnerability 529–32  
 coral reef impacts 264–6, 270–1  
 effect on mangroves 330  
 effect on pelagic organisms 217  
 effect on seagrasses 340–2  
 food web impacts 217  
 food web vulnerability 230–1  
 implications of 129–31  
 monitoring required 174  
 tuna vulnerability 457–60  
 ocean acidity  
 effects on fisheries 24–5, 30  
 observed 458  
 stability 129  
 ocean chemistry *see* sea water chemistry  
 ocean circulation 123–7, 169  
 coastal circulation and island effects  
 137–41, 167–9  
 and productivity/function of coral reefs  
 275  
 ocean circulation projected changes  
 coastal fisheries species vulnerability 532–5  
 coral reef vulnerability 275–6  
 tuna vulnerability 454–7  
 ocean colour  
 records and data 217–18, 240  
 ocean currents 105–10, 169, 204  
 changes projected 170, 171, 532–4  
 coastal fisheries species vulnerability to  
 change 532–5  
 counter currents 109–10  
 effect on sea level 137  
 forces 107–8  
 speed 111  
 tuna vulnerability to change 454–7  
 ocean eddies 120–2, 126, 139, 140, 211, 212  
 changes observed 149–50, 151  
 changes projected 150, 171  
 effect on sea level 137  
 ocean models 240–1  
 ocean surface layers  
 height *see* sea surface height

ocean surface layers (*cont.*)  
 nutrients transfer to *see* nutrient transfer to surface waters  
 pigment data *see* ocean colour  
 salinity *see* seawater salinity  
 temperature *see* sea surface temperature; sea surface temperature projected changes  
 ocean temperature 24, 28, 110–20, 523–9  
 changes projected 170, 171, 524  
 and fish distribution and abundance 110–11  
 influence on food webs 215–16  
 mangroves, seagrasses and intertidal flats 324–5  
 and seagrasses 317, 323  
 surface temperature *see* sea surface temperature  
 vertical temperature structure 113–16, 122  
*see also* thermal expansion of sea water; Warm Pool  
 oceanic environment of tropical Pacific *see* tropical Pacific Ocean  
 oceanic fisheries  
 climate change vulnerability: direct effects 447–60; indirect effects 460–5; integrated assessment 466–75  
 fishing methods 14, 437–8  
 gaps in knowledge and future research 477–9, 848–9, 857–8  
 management strategies 21–3, 435–6, 480–4, 806–8  
 nature and status 435–43  
 primary production 460–2  
*see also* tuna fisheries  
 oceanic gyres *see* North Pacific Tropical Gyre; South Pacific Subtropical Gyre  
 oceanic reefs 254–7 *see also* coral reefs  
 octopus 259  
 off-channel habitats use by fish 387, 393  
 orbital forcing of the climate system 51  
 Ord River, WA 410  
 ornamental fish *see* aquarium products and market; marine ornamentals  
 orographic effects of high islands 138, 140–1  
 overfishing 495–6, 501, 509, 518, 663, 748  
 oxbow lakes 381–2, 387, 408  
 oxygen concentration *see* dissolved oxygen

## P

Pacific Climate Change Science Programme 90, 92, 285, 350, 478  
 Pacific communities  
 demography 9, 10, 18, 415, 417, 798–800  
 ethnic and cultural diversity 6–9  
 extent of 3, 4, 8  
 natural resources 9–10  
*see also* Pacific Island countries and territories  
 Pacific Decadal Oscillation 66, 69, 91, 103, 153, 218  
 Pacific Equatorial Divergence 118, 119, 125–6, 131, 145, 155, 169, 201–2  
 border with Warm Pool 204  
 characteristics 203–4, 205; changes projected 220–3  
 ecosystem modelling 241  
 food webs 206–8, 209, 215, 216;  
 vulnerability 222–31, 232, 236, 241  
 iron concentrations 226–7, 241  
 location 202, 204  
 mesozooplankton and micronekton 214  
 nutrient transfers 207, 208  
 oxygen-poor layer 158  
 Pacific Island countries and territories  
 capacity building 629, 835, 855, 856, 857, 862, 863  
 economies 9–15, 757–65 *see also* economic development and government revenue  
 exclusive economic zone (EEZ) 8, 11, 481–2  
 extent of 3–4, 8, 371  
 natural resources 9–11 *see also specific habitats and fisheries*  
 physical nature of 3, 5–6, 7, 371  
 population 9, 10, 18, 415, 417, 798–800  
 surface climate change projections (summary) 88–91  
 surface weather observations 54, 92  
 Pacific Islands Applied Geoscience Commission 11  
 Pacific Islands Forum Fisheries Agency 11, 20, 22–3, 435, 480, 806–7  
 Pacific Ocean *see* tropical Pacific Ocean  
 Pacific Oceans Solutions 284  
 Pacific Plan 22  
 Pacific Regional Oceanic and Coastal Fisheries (PROCFish) Development Project 498, 518, 572–3  
 Palau Arrangement 807  
 paleoclimate 92, 166, 168, 172  
 Papua New Guinea  
 demography 9, 10  
 physical nature of 5  
 Parties to the Nauru Agreement 21, 435, 443, 482, 746, 807  
 patch reefs 254–7, 305–6 *see also* coral reefs  
 pathogens *see* marine pathogens  
 pearls and pearl farming 649, 650, 656–7, 659, 670–4, 711, 750–1  
 pelagic fish 258, 502–3, 517, 749–50 *see also* nearshore pelagic fish, fisheries for; tuna  
 Pelagic Interaction Scheme for Carbon and Ecosystem Studies (PISCES) model 219–20  
 Penaeidae *see* shrimp  
 Philippines Current 108  
 phosphorus 215  
 photic zone 113, 123, 125–6, 195, 196, 201, 214  
*see also* nutrient transfer to surface waters  
 photo-acclimation of phytoplankton 216  
 photosynthetically active radiation 269–70  
*see also* solar radiation projected changes  
 phytoplankton 131  
 biomass 212, 213, 215, 237–9

- phytoplankton (*cont.*)  
   composition 197  
   and iron concentration 215, 227  
   links with mesozooplankton 200–1, 212  
   mixed layer depth changes 226  
   in NPTG and SP5G 209  
   NPZ model 193  
   and ocean chemistry 214–15, 217, 231  
   photo-acclimation 216  
   temperature increase effects 224  
   *see also* nutrient supply  
 phytoplankton blooms 127, 462, 463  
 phytoplankton production 194–201, 203, 208, 212, 216  
 PISCES model 219–20  
 poisoning from fish consumption 543–4  
 Polynesia 3, 4, 6, 7  
   area 8, 256  
   coastal habitat area 510  
   fish catch and consumption 16–17, 499, 507, 513, 744, 747  
   fisheries *see* coastal fisheries; oceanic fisheries  
   food security forecasts 18  
   freshwater and estuarine fisheries (summary) 644  
   population estimates 10, 18  
 Polynesians 6, 8  
 population (human) 9, 10, 18, 415, 417, 798–800  
 potamodromous species (fish) 390, 581, 603  
 prediction, defined 46  
 primary production 118, 191–2, 194–5, 196–7, 202–3  
   Archipelagic Deep Basins Province 212  
   contribution of corals 259  
   contribution of eddies 211  
   ENSO and PDO influences 218  
   and light availability 227–9  
   net primary production 194–5, 232, 233, 235, 275, 460–1  
   oceanic fisheries 460–2  
   Pacific Equatorial Divergence 203, 226–7, 232  
   Warm Pool 209, 232  
   *see also* nutrient supply  
 primary productivity 127, 153  
 PROCFish 498, 518, 572–3  
 projections, defined 46  
 provinces *see* ecological provinces  
 purse-seine fishery 13–14, 21, 815 *see also* tuna fisheries
- Q**  
 qualitative modelling 838–40, 875–6
- R**  
 radiative forcing of the climate system 51–3  
 rainfall  
   averages 62, 82  
   rainfall (*cont.*)  
     effects on river flow and habitats 384, 394–6, 397  
     indices 72, 74–6  
     seasonal variations 60–1, 64, 82  
     SPCZ location and 77, 79  
     trends 71–6, 79, 80, 82  
     *see also* river flow; runoff  
   rainfall changes projected 89–90, 271–2  
     B1 and A2 scenarios 82, 85, 91, 227, 282, 325  
     effects on river flow and habitats 393–6  
     impact on aquaculture 665–6, 668, 671, 675–7, 683, 688–9  
     mangrove vulnerability 325–6  
     seagrasses vulnerability 336–7  
     seasonal variations 85  
   rays 497  
   recreational fisheries 308, 310, 315  
   recruitment, defined 27  
   regenerated nutrients 194, 197 *see also* nutrient supply  
   regime shifts 26, 103  
   regional cooperation 11, 20–3  
   regional simulation 173  
   remineralisation 127, 131  
   representative concentration pathways 34, 90  
   reptiles 497  
   research requirements *see* gaps in knowledge and future research  
   resilience, defined 46  
   revegetation of catchments 419–20, 423, 822  
   river flow 376–7, 384, 390–9  
     freshwater fish vulnerability to change in 600–5  
     types 600–1  
   river herring 584, 589  
   river names 371  
   river systems 372–9  
     blocked river valleys 387, 408  
     climate change effects 393–9; interaction with existing impacts 411–13  
     ecosystem hierarchy 377, 378  
     functional process zones 373, 375, 377, 379–84, 401–6, 611–23  
     tidal rivers 383  
     *see also* freshwater and estuarine habitats  
   riverine habitats use by fish 385–7  
   Rossby waves 121, 150  
   runoff 210–11, 261–2, 272, 276, 286, 326, 393
- S**  
 salinity increase 605–7, 622, 623–4 *see also* sea water salinity; soils  
 salinity tolerance 605–7  
 sandfish 662–3, 686–9 *see also* sea cucumbers  
 saturation horizon 131  
 scenarios *see* emissions scenarios  
 scientific activities  
   fisheries resources 22–3  
   international science partnerships 284–5, 861

- scientific activities (*cont.*)  
*see also* gaps in knowledge and future research
- sea cucumber farming 662–3, 696–9
- sea cucumbers 259, 504, 506, 518, 519–20, 746, 748, 836
- sea level 135–7  
 changes observed 164–5, 170  
 changes projected 165–7, 171, 273  
 fluctuations 135, 164, 165
- sea-level rise 24, 30, 31, 135, 164–7
- coral reef vulnerability 273–4  
 drivers 135, 165–6  
 effect on aquaculture 666, 668, 669, 672, 673, 677–8, 680–2, 684, 685, 689  
 effect on freshwater ecosystems 394, 398–9, 402, 408, 410–11  
 effect on intertidal flats 323, 343–5  
 effect on mangroves 321–2, 330–2, 346  
 effect on seagrasses 342–3  
 future estimates 342  
 management strategies 420–1  
 projections 166–7, 171, 273  
 rate of increase 170, 172, 273
- sea surface height 105, 110, 121, 122, 151
- sea surface temperature 15, 28, 30, 35, 59–61, 112  
 annual averages 53, 67, 75  
 anomalies 53, 55, 65, 66, 69–70  
 and average ocean pH 131  
 changes observed 67, 143–5, 169 *see also* sea surface temperature projected changes and ciguatera fish poisoning 544  
 coral bleaching 263–4  
 during El Niño events 65, 66, 69–70, 112  
 monthly averages 62  
 processes affecting 112  
 seasonal variations 60–1, 64  
 trends 55, 67
- sea surface temperature projected changes 79–81, 84, 89, 91, 145–9, 170, 171, 222, 224, 276, 282, 524  
 aquaculture commodities vulnerability 670–1, 679, 683, 685–8  
 coastal fisheries vulnerability 523–9  
 coral reef vulnerability 59, 267–9, 281, 282  
 food web vulnerability 222, 224–5  
 mangrove vulnerability 324–5  
 seagrasses vulnerability 335–6  
 tuna vulnerability 447–50
- seawater chemistry 129–31, 159–62, 270, 318–20
- seawater density 107, 113–16, 119
- seawater salinity 115, 119, 170  
 and mangroves, seagrasses and intertidal flats 318–20  
 surface salinity 149
- seawater thermal expansion 135–6, 165–6, 170 *see also* sea-level rise
- seabed minerals surveys 11
- seagrasses 299–300  
 critical requirements 315–21
- seagrasses (*cont.*)  
 gaps in knowledge and future research 348–50  
 light requirements 333–4  
 management strategies 350–1  
 projected vulnerability 332–43, 346–8  
 role in supporting fisheries 311–13  
 species and habitats 302, 303–6  
 variations linked to climate change 323  
*see also* coastal habitats
- SEAPODYM model 237, 239, 467–75, 858–9
- seaweed farming 658–60, 683–7, 751
- Secretariat of the Pacific Community  
 Coastal Fisheries Programme 20  
 ‘The Future of Pacific Island Fisheries’ study 22–3  
 Oceanic Fisheries Programme 808  
 Regional Environment Programme 11  
 role 11, 20
- sediments 330–2  
 floodplain sedimentation 408–9  
 and mangrove, seagrass and intertidal flats environments 320–1  
 riverine habitats 412, 421, 423  
 sediment and nutrient discharge from islands 210–11, 272, 286  
 and turbidity 609–11
- sensitivity, defined 36
- Sepik River, PNG 372, 374, 394, 409
- shallow subtidal and intertidal invertebrates *see under* invertebrates
- sharks 260, 497
- shrimp 586
- shrimp farming 649, 657–8, 659, 674–83, 750–1
- significant wave heights 132–5, 163–4
- skipjack tuna  
 and ENSO events 443–6  
 global warming impact modelling 467–72  
 projected changes in catch 475–7  
*see also* tuna; tuna fisheries
- slopes reaches 379, 381, 392  
 climate change vulnerability 403–4  
 freshwater fish and invertebrates vulnerability to changes in 613–15
- snapper 585, 589
- socio-economic research needs 286, 479
- soils  
 mangrove, seagrass and intertidal flats environments 320–1  
 salinity 326
- solar radiation  
 effects on food webs 216  
 mangroves, seagrasses and intertidal flats requirements 315–17
- solar radiation projected changes  
 coral reef vulnerability 269–70  
 food web vulnerability 227–9  
 mangrove vulnerability 323–4  
 seagrasses vulnerability 332–4
- Solomon Islands  
 economy 15  
 fisheries resources and exploitation 514–15

- SOPAC *see* Pacific Islands Applied Geoscience Commission
- South Caledonian Jet 106, 109
- South Equatorial Counter Current 109, 110, 150, 170, 203, 275
- South Equatorial Current 105–6, 108–9, 110, 140, 150, 169, 170, 275
- South Pacific Convergence Zone 57–9, 65, 109, 126, 169, 172–3
- South Pacific Convergence Zone location  
ENSO events and 66, 74, 77  
PDO and 77  
rainfall and 77, 79  
through time 76–7, 81
- South Pacific experience 10 *see also* tourism
- South Pacific Subtropical Gyre 119–20, 126, 145, 153, 154, 155, 169, 201  
characteristics 205, 206; changes projected 220–3  
food webs 209, 210, 214; vulnerability 222–31, 235, 236  
western part *see* Archipelagic Deep Basins Province
- Southern Annular Mode 66–7, 135, 163–4
- Southern Oscillation Index 65, 69 *see also* El Niño–Southern Oscillation
- Spatial Ecosystem and Population Dynamics Model 237, 239, 467–75, 858–9
- spiny lobsters 259, 505
- storms 63  
climate change effects 24, 28, 31  
coral reef vulnerability 262, 271–3  
mangrove vulnerability 328–9  
swell 132  
*see also* tropical cyclones
- stratification (oceans) 114–15, 117, 153–4, 169  
barrier layer (Warm Pool) 118, 119  
changes projected 153–4, 172  
mixed layer *see* mixed layer depths  
and transfer of nutrients to surface waters 117, 123, 169, 195, 218
- subduction 127
- subsistence fishing 16–18, 288, 313–15, 316, 371, 574–6
- subtidal and intertidal invertebrates *see under* invertebrates, fisheries for
- surface air temperature 59  
global surface air temperatures 24, 38, 53, 67  
mangrove and intertidal flats requirements 316  
seasonal variations 60–1, 64  
trends 67, 68–71, 78
- surface air temperature increase  
impact on aquaculture 664–5, 674–5  
impact on freshwater ecosystems 394  
mangrove vulnerability 324–5  
observed 67, 88  
projected 79–81, 89, 91, 324
- surface fishery 437, 736–43, 757–61 *see also* tuna fisheries
- surface salinity *see under* sea water salinity
- swamp forests 382, 408
- swell waves 132–3
- Symbiodinium* 262–3, 267
- symbiotic relationships in coral reefs 262–3
- ## T
- targeted invertebrates *see under* invertebrates
- Te Vaka Moana Arrangement 435, 480, 807
- thermal expansion of sea water 135–6, 165–6, 170 *see also* sea-level rise
- thermocline 65, 113, 117, 195, 204–5, 206
- tidal fresh waters 382
- tidal rivers 383
- tilapia 18–19, 587, 590, 652–3, 664–8
- tourism 9, 10, 259, 260, 750, 751, 836
- trepanng *see* bêche-de-mer
- Trichodesmium* blooms 197, 210–11, 216
- trochus 259, 505, 518, 521, 748, 836
- trochus farming 663, 699–701
- trophic pyramid 191–2
- Tropical Atmosphere Ocean (TAO) array 239–40
- tropical cyclones 61–3, 88  
category and severity scale 62  
changes projected 84–8, 90, 91, 271–3  
coral reef vulnerability 271–3  
effect on aquaculture 684–5  
effect on sea level 137  
ENSO events and 65–6, 73, 88  
frequency and intensity 24, 31, 77, 83, 86–8, 90, 271  
impact on aquaculture 666, 669, 673, 679, 689–90  
impact on freshwater ecosystems 384, 394, 395–6, 600  
mangrove vulnerability 328–9  
seagrasses vulnerability 339–40  
spatial occurrence of 67
- tropical freshwater snapper 585, 589
- tropical instability waves 207
- tropical Pacific  
climate change effects 24–9  
climate change projections (summary) 88–91  
climate change scenarios 37–9, 90 *see also* emissions scenarios  
climate change threats 24–9, 30–1  
vulnerability assessment 864–6
- tropical Pacific Ocean  
acidification 129–31, 170  
changes (observed and projected) 141–69  
coastal circulation and island effects 137–41  
currents 105–10, 111, 169  
dissolved oxygen 127–8, 170  
eddies 120–2, 126–7  
features (summary) 169–72  
gaps in knowledge and future research 845–6, 857  
mixed layer depths 123–4, 126, 154–5  
nitrate concentration 124, 152–3  
nutrient supply 123–7, 170  
ocean temperature 110–20, 169

- tropical Pacific Ocean (*cont.*)  
 oceanic environment 103  
 sea level 135–7  
 stratification 114–15, 117, 153–4, 169  
 upwelling 125–6  
 wave height 131–5
- tropical Pacific Ocean changes (observed and projected)  
 acidification 159–62, 170, 171, 172  
 coastal circulation and island effects 167–9, 171  
 currents 141–3, 156–7, 170, 171  
 dissolved oxygen 157–9, 170, 171  
 eddies 149–50, 171  
 mixed layer depths 154–5  
 nitrate concentration 152–3  
 nutrient supply 150–7, 170, 171  
 ocean temperature 143–9, 169, 170, 171  
 recommendations to reduce uncertainties  
 in projections 172–4  
 sea level 164–7, 170, 171  
 stratification 153–4, 169, 172  
 summary 141, 169–72  
 upwelling 155–6, 171  
 wave height 163–4, 171
- tuna  
 catch *see* tuna catch  
 climate change vulnerability: bigeye tuna  
 472–7; direct effects 447–60, 864; indirect  
 effects 460–5; integrated assessment 466–  
 75; skipjack tuna 467–72, 475–7; yellowfin  
 and albacore 475  
 distribution and abundance 30, 105, 111,  
 462, 465, 469–71, 480–4  
 ecosystem-tuna simulations 466–75  
 feeding areas 229, 232, 462, 469  
 fisheries *see* tuna fisheries  
 food sources 191–201, 212, 235, 237–9 *see*  
*also* food webs  
 gaps in knowledge and future research  
 477–9  
 link with micronekton 201, 460, 464–5  
 observed effects of climate variability  
 443–6  
 reproduction 449  
 sensitivity to sound waves 458–9  
 species 435, 436–7  
 thermal tolerance 215, 448
- tuna catch 14, 191, 205, 438–40  
 bigeye catch 759, 762  
 longline fishery 743–4  
 plans to increase catch 749  
 projected changes 475–7, 757–9, 762, 778–80  
 skipjack catch 757–9  
 surface fishery 736–42  
*see also* tuna fisheries
- tuna fisheries 9, 11, 12–15, 807  
 climate change vulnerability 864; direct  
 effects 447–60; indirect effects 460–5;  
 integrated assessment 466–75  
 economic development contribution 435,  
 736–46, 749
- tuna fisheries (*cont.*)  
 economic development effects of projected  
 changes in the tuna fishery 763–5  
 employment and income opportunities  
 754–6  
 and ENSO cycle 26, 443–6  
 fishing methods 14, 437–8, 482, 736–7, 745  
 gaps in knowledge and future research  
 477–9, 848–9  
 management measures 21–3, 435–6, 443,  
 480–4, 806–8, 819  
 national economies vulnerability to  
 changes in tuna fisheries 757–63  
 nature and status 436–43  
 production 13–15, 26, 191, 435, 438–40,  
 736–46; sustainable harvest 441–3  
 role of coral reefs 258–9  
 species and their uses 436–8  
 stocks 436, 440–1, 807–8  
 and Warm Pool 116
- tuna processing operations 9, 14, 20, 31, 435,  
 745–6, 754–7
- turbidity 609–11
- turbulence in mixed layer 123–4
- U**
- ultraviolet radiation 227–9, 269–70 *see also*  
 solar radiation projected changes
- uncertainties 36–7, 239–41 *see also* gaps in  
 knowledge and future research
- United Nations Convention on the Law of  
 the Sea 11, 820
- United Nations Framework Convention on  
 Climate Change 281
- upwelling 125–6, 131, 138, 139, 155–6, 167–8,  
 171, 195  
 Archipelagic Deep Basins Province 211  
 changes projected 226–7  
 coral reef vulnerability to changes 275–6  
 food web vulnerability to changes 226–7  
 Pacific Equatorial Divergence 207, 226
- urbanisation 9, 417
- V**
- Vava'u Declaration on Sustainable Fisheries  
 22–3
- vegetated habitats  
 adaptive capacity 400–1, 412  
 management interventions 422  
 vulnerability to climate change 413–14
- vegetation clearing 412, 419–20
- vessel day scheme 482, 815–16
- volcanic eruptions 80, 164, 165
- vulnerability to climate change  
 assessment 864–6  
 assessment approach 31–9  
 defined 35  
 uncertainties in assessments 36–7, 239–41  
*see also* vulnerability under specific organisms,  
 habitats or fisheries

**W**

- Walker circulation 57, 65
- Warm Pool 14, 15, 59, 65, 106, 109, 112, 115, 116–19, 154, 169, 201–2
  - border with PEQD 204
  - changes projected 145–9, 171, 220–3
  - characteristics 204–5
  - ecosystem modelling 235, 237–9, 241
- Warm Pool and ENSO cycle 118–19, 204, 205, 207, 209
  - food webs 208–9, 214; vulnerability 222–31, 232, 236, 241
  - location 202
- warm water bowls 115
- water quality decline
  - effect on coral reefs 279–80, 286
  - freshwater turbidity 609–11
- water temperature
  - freshwater *see under* freshwater and estuarine habitats
  - in oceans *see* ocean temperature; sea surface temperature
- wave climate 132, 163
- wave height 131–5, 163–4, 171
- wave setup 133
- wave spectrum 132
- waves
  - internal waves 138, 139–40, 212
  - nature and effect of 131–3 *see also* wave height
  - Rossby waves 121, 150
  - tropical instability waves 207
- weather, defined 51
- Western and Central Pacific Fisheries Commission 11, 22, 435, 440, 443, 480–1, 807
- Western and Central Pacific Fisheries Convention 3, 22, 483, 807
- Western Pacific Regional Fishery Management Council 435
- Western Pacific Warm Pool *see* Warm Pool
- wetlands management 422, 424 *see also* freshwater and estuarine habitats
- whitebait 585, 589
- wind-driven upwelling 139
- wind-sea waves 132–3
- wind speed and direction 62
- winds
  - changes projected 91
  - effect on currents 107
  - present-day 57–9
  - seasonal variations 60–1
  - see also* atmospheric circulation; tropical cyclones

**Z**

- zooplankton 197–201
  - biomass 200–1, 202, 209–14, 219, 234, 235, 237–9
  - migration 199–200, 201
  - NPZ model 193
  - and ocean chemistry 217, 231
  - solar radiation effects on 216
  - and thermal changes 216
  - see also* nutrient supply

**Y**

- yellowfin tuna global warming potential impact 475 *see also* tuna; tuna fisheries





## Abbreviations

ADB	Asian Development Bank
AR	Assessment Report
ARCH	Archipelagic Deep Basins
BMA	benthic microalgae
BMP	best management practice
Ca <sup>2+</sup>	calcium ion
CaCO <sub>3</sub>	calcium carbonate
CAMS-OPI	Climate Anomaly Monitoring System and OLR Precipitation Index
CCSM	community climate system model
CE	cold eddy
CEAFM	community-based ecosystem approach to fisheries management
Chl	chlorophyll
CMIP	Coupled Model Intercomparison Project
CMM	conservation and management measure
CNMI	Commonwealth of the Northern Mariana Islands
COFI	Committee on Fisheries
CORDEX	Coordinated Regional Climate Downscaling Experiment
CO <sub>2</sub>	carbon dioxide
CO <sub>3</sub> <sup>2-</sup>	carbonate ion
CPUE	catch per unit effort
CSCC	Coral Sea Counter Current
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCM	deep chlorophyll maximum
DNA	deoxyribonucleic acid
D-UVC	distance-based underwater visual census
DWFNs	distant water fishing nations
EAC	East Australian Current
EAF	ecosystem approach to fisheries
EEZ	exclusive economic zone
ENSO	El Niño-Southern Oscillation
EOF	Empirical Orthogonal Function
EPA	Economic Partnership Agreement
EPO	Eastern Pacific Ocean
EU	European Union
EUC	Equatorial Undercurrent
FADs	fish aggregating devices
FAME	Fisheries, Aquaculture and Marine Environment Division of SPC
FAO	Food and Agriculture Organization of the United Nations
Fe	iron
FFA	Forum Fisheries Agency
FSM	Federated States of Micronesia

GDP	gross domestic product
GIFT	genetically improved farmed tilapia
GIS	geographic information system
GR	government revenue
H <sup>+</sup>	hydrogen ion
HCO <sub>3</sub> <sup>-</sup>	bicarbonate ion
H <sub>2</sub> CO <sub>3</sub>	carbonic acid
ha	hectare
HadISST	Hadley Centre Global Sea Ice and Sea Surface Temperature
HE	Halmahera Eddy
HIES	household income and expenditure surveys
HNLC	High Nutrient-Low Chlorophyll
HOT	Hawaii Ocean Time-Series
hPa	hectopascal
IATTC	Inter-American Tropical Tuna Commission
ICESCR	International Covenant on Economic, Social and Cultural Rights
IEPA	Interim Economic Partnership Agreements
ITF	Indonesian Throughflow
IPCC	Intergovernmental Panel on Climate Change
IPO	Interdecadal Pacific Oscillation
IPSL	Institut Pierre Simon Laplace
ITCZ	Intertropical Convergence Zone
IUU	illegal, unreported and unregulated
KURO	Kuroshio Current
MC	Mindanao Current
MCS	Monitoring, Control, Surveillance
ME	Mindanao Eddy
MLD	mixed layer depth
MSY	maximum sustainable yield
N <sub>2</sub>	di-nitrogen
NAPAs	national adaptation programmes of action
NCEP	National Centers for Environmental Prediction
NCJ	North Caledonian Jet
NEC	North Equatorial Current
NECC	North Equatorial Counter Current
NFCC	North Fiji Counter Current
NGCUC	New Guinea Coastal Undercurrent
NGO	non-governmental organisation
NH <sub>4</sub> (NH <sub>4</sub> <sup>+</sup> )	ammonium (ion)
NOAA	National Oceanic and Atmospheric Administration
NO <sub>3</sub> (NO <sub>3</sub> <sup>-</sup> )	nitrate (ion)
NP	new production
NPP	net primary production

NPTG	North Pacific Tropical Gyre
NPZ	Nutrient-Phytoplankton-Zooplankton
NQC	North Queensland Current
NSTCC	North Subtropical Counter Current
NVJ	North Vanuatu Jet
O <sub>2</sub>	oxygen
OA	ocean acidification
OFP	Oceanic Fisheries Programme
OMZ	Oxygen Minimum Zone
PaCFA	Global Partnership for Climate, Fisheries and Aquaculture
PAR	photosynthetically active radiation
pCO <sub>2</sub>	partial pressure of carbon dioxide
PDO	Pacific Decadal Oscillation
PEQD	Pacific Equatorial Divergence
PICTs	Pacific Island countries and territories
PISCES	Pelagic Interaction Scheme for Carbon and Ecosystem Studies
PNA	Parties to the Nauru Agreement
PNG	Papua New Guinea
PO <sub>4</sub> <sup>3-</sup>	phosphate
ppm	parts per million
PROCFish	Pacific Regional Oceanic and Coastal Fisheries
PSU	practical salinity unit
RCPs	Representative Concentration Pathways
REDD	Reduced Emissions from Deforestation and Forest Degradation
RMS	root mean square
ROC	Republic of China
RP	regenerated production
SAM	Southern Annular Mode
SAT	surface air temperature
SB	spawning biomass
SCJ	South Caledonian Jet
SCUBA	self-contained underwater breathing apparatus
SD	standard deviation
SE	standard error
SEAPODYM	Spatial Ecosystem and Population Dynamics Model
SEC	South Equatorial Current
SECC	South Equatorial Counter Current
SiO <sub>2</sub>	silicate
SODA	Simple Ocean Data Assimilation
SOI	Southern Oscillation Index
SOPAC	Applied Geoscience and Technology Division of SPC
SPC	Secretariat of the Pacific Community
SPCZ	South Pacific Convergence Zone

SPREP	Secretariat of the Pacific Regional Environment Programme
SPSG	South Pacific Subtropical Gyre
SRES	Special Report on Emissions Scenarios
SRP	soluble reactive phosphorus
SSH	sea surface height
SSS	sea surface salinity
SST	sea surface temperature
SSTCC	South Subtropical Counter Current
Sv	Sverdrup
SWH	significant wave height
TAO	Tropical Atmosphere Ocean
Tg	teragram
TIWs	tropical instability waves
TVMA	Te Vaka Moana Arrangement
UNCLOS	United Nation Convention on the Law of the Sea
UNFCCC	United Nations Framework Convention on Climate Change
UP	upwelling
USD	United States dollar
UVR	ultraviolet radiation
VDS	vessel day scheme
Warm Pool	Western Pacific Warm Pool
WCPFC	Western and Central Pacific Fisheries Commission
WCPO	Western and Central Pacific Ocean
WE	warm eddy
WPRFMC	Western Pacific Regional Fishery Management Council
WTPIA	Western Tropical Pacific Insular Area

## List of referees

The following people kindly peer-reviewed the chapters of this book.

Francisco Abascal  
Transform Aqorau  
Kate Barclay  
Chris Barlow  
Jon Barnett  
Devin Bartley  
Jaci Brown  
Kevern Cochrane  
Paul Dalzell  
Alasdair Edwards  
Simon Ellis  
Neil Holbrook  
Glenn Hurry  
Pene Lefale

Catherine Lovelock  
Tim McClanahan  
Christophe Menkes  
Steve Nelson  
Ian Perry  
Dan Polhemus  
Jeffrey Polovina  
Gary Preston  
Kelvin Richards  
Peter Thompson  
Martin Thoms  
Charlie Veron  
Meryl Williams  
Andrew Wright

