Regional OA vulnerability assessment

Johanna Johnson, Johann Bell, Alex sen Gupta

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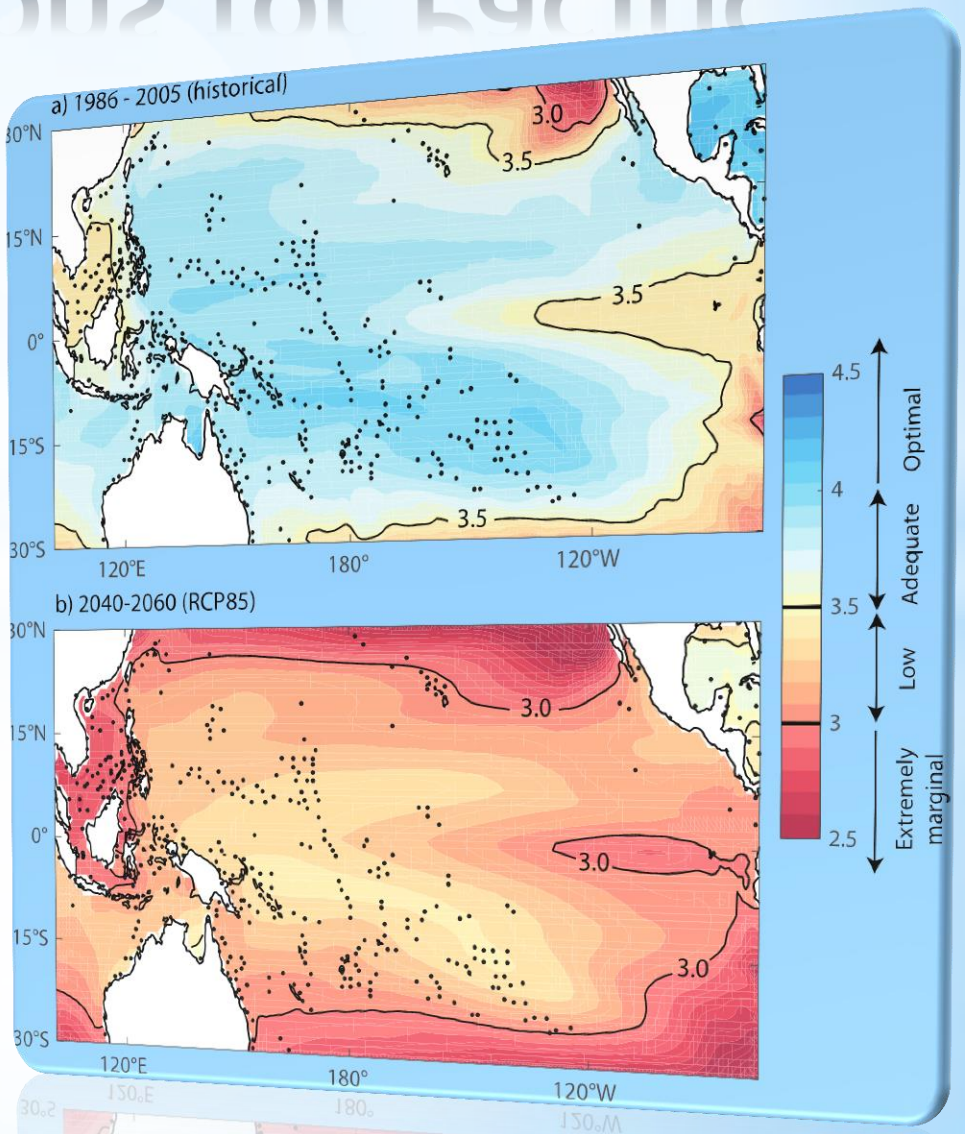
Outline

- OA projections for Pacific
- Vulnerability of tropical habitats and fisheries
- Implications for food security, livelihoods and national economies
- Reef-dependent communities
- Priority adaptations
- Regional hot-spots

OA projections for Pacific

- Current ocean pH 8.1
- Decline of 0.3 units by 2050 (RCP8.5)
- Aragonite saturation decline to 3 – 3.5
- Marginal for calcification
- Significant biological implications



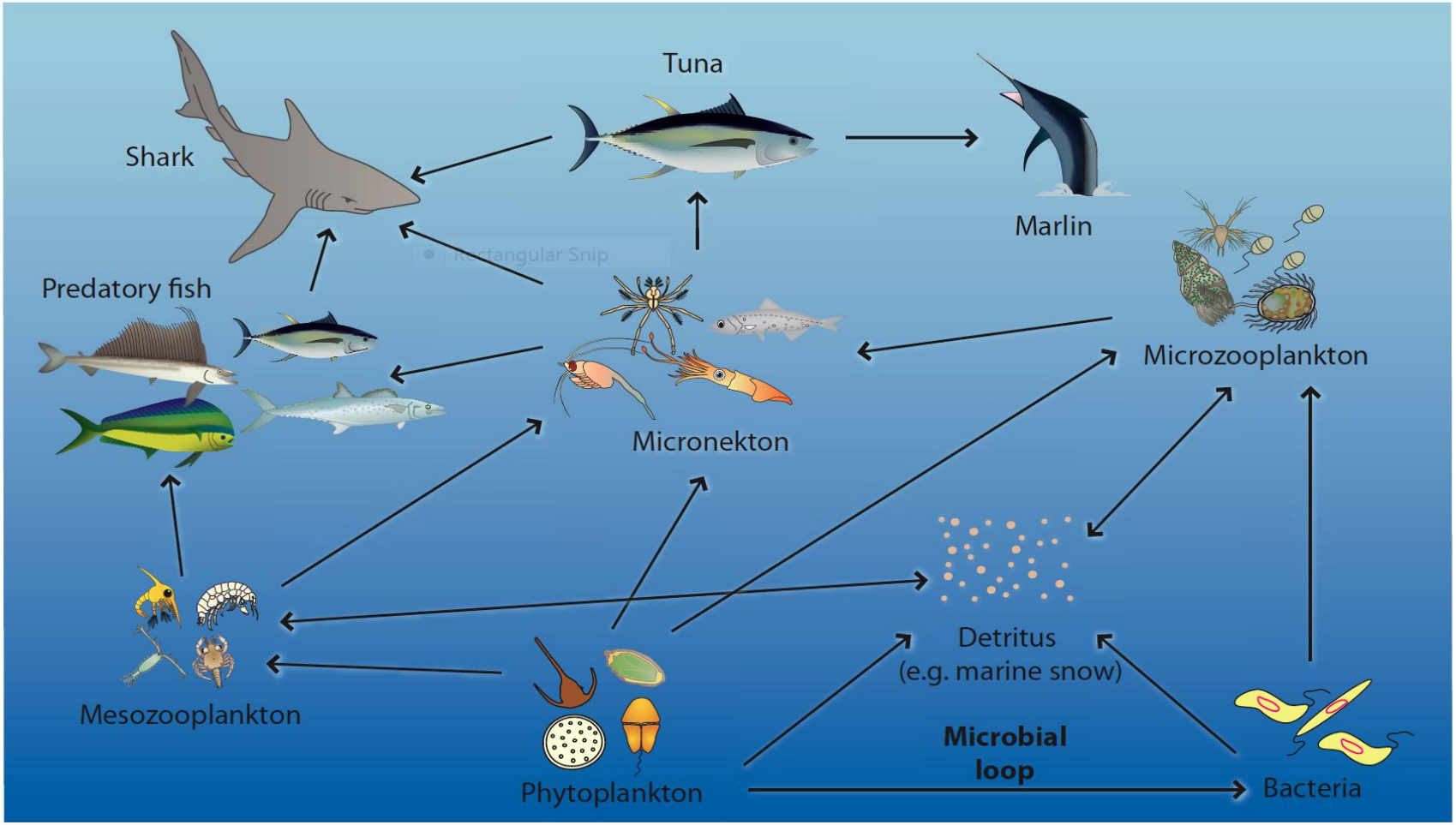
Vulnerability of reef habitats

- Lower aragonite saturation reduces calcification rates by ~10%
- Scleractinian corals, certain plankton (pteropods), molluscs, crustaceans, sea cucumbers
- Reduced coral reef growth and structural integrity; eventually bioerosion exceeds growth
- Increased susceptibility to other disturbances (e.g. storms, disease, borers)

Vulnerability of reef fisheries

- Loss of reef habitat & structure (indirect)
- Laval stages – reduced survival, growth, metabolism
- Larval reef fish loss of olfactory senses (detecting settlement habitat & predators)
- Reduced growth and more shell deformities in molluscs
- Altered sea cucumber larval survival and spicule strength
- Declining productivity

Vulnerability of ocean habitats



- Decreased calcification of some plankton and micronekton
- Changes in oceanic food web (abundance of grazers and microbes)
- Minor indirect effects on tuna – skipjack, albacore, yellowfin & bigeye

Vulnerability of tuna: prelim

- Reductions in yellowfin tuna larval growth and survival, and deformities
- Possible narrowing of optimal thermal performance window altering resistance, metabolic rate and behaviour of tuna
- Additional energy required to compensate for acidosis could lower growth rates and egg production
- Altered growth and formation of the aragonite ear bones (otoliths)

Vulnerability of aquaculture

- Pearl oysters – reduced survival and growth of wild spat; weaker shells and reduced pearl quality
- Shrimp – possible deformities in blue shrimp due to thinner shell
- Seaweed - growth enhanced by higher CO_2, however, likely to be offset by other climate impacts
- Marine ornamentals – weaker shells and deformities (giant clams), reduced growth and density (corals)

*Most vulnerable resources

Asset	Value/service	Impacts	PICTs likely affected
Coral reefs	Critical habitat, fisheries resources, livelihoods, coastal protection	Reduced calcification, loss of structural integrity, susceptibility	Those with significant reef-dependent communities
Reef fish	Wild fisheries, food security, livelihoods	Larval impacts, reef habitat loss, changed community composition	Those with significant reef demersal fisheries
Molluscs	Wild fisheries, food security	Reduced growth, shell deformities	Those with significant reef invertebrate fisheries
Sea cucumbers	Wild fisheries exports, livelihoods	Compromised larval survival and growth	Those with significant reef invertebrate fisheries
Pearl Oysters	Aquaculture, livelihoods, economic revenue	Weaker shells, poor quality pearls	French Polynesia, Cook Is, FSM, Marshall Is
Blue shrimp	Aquaculture, livelihoods, economic revenue	Shell deformities	New Caledonia
Marine ornamentals	Aquaculture, livelihoods, economic revenue	Shell deformities (giant clams), reduced growth & density (corals)	Cook Is, Fiji, FSM, Kiribati, Marshall Is, Palau, Solomon Is, Tonga, Vanuatu

Regional plans and policies

- Va'vau Declaration on Pacific Fisheries Resources 'Our Fish, Our Future' 2007
- Pacific Islands Regional Coastal Fisheries Management (Apia) Policy 2008
- Future of Pacific Island Fisheries 2010
- Vulnerability of Tropical Pacific Fisheries and Aquaculture to Climate Change 2011
- A New Song for Coastal Fisheries – Pathways to Change 'The Noumea Strategy' 2015
- Regional Roadmap for Sustainable Pacific Fisheries 2015
- National Tuna Management Plans & National Aquaculture Plans

*Plan goals

(1) Ensure growing populations in the region have access to 35 kg of fish per person per year

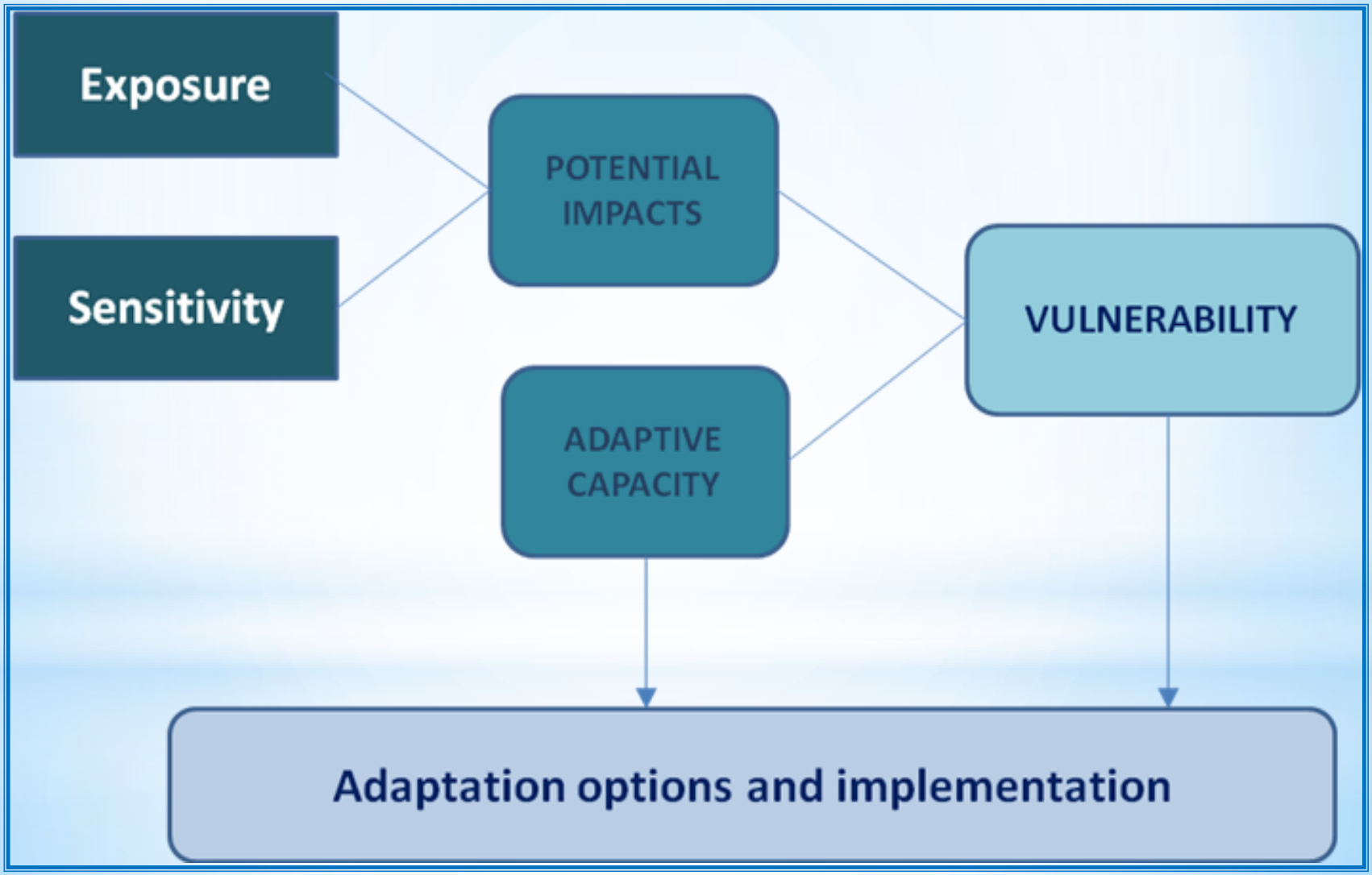
(2) Identify the number of livelihoods that can be sustained from coastal fisheries and the development of aquaculture

(3) Optimize the benefits of tuna resources in the region for economic development and government revenue

Implications for food security

- Assessed 22 PICTs (relative)
- Exposure to declines in reef fish and invertebrates available under OA and population growth
- Sensitivity function of recommended fish consumption per person of 35 kg/year (or higher national levels)
- Capacity to adapt based on health, education, governance and economy size

*VA framework



Least vulnerable: Group 1

* PICTs where coastal fisheries are expected to meet the increased demand for fish for the foreseeable future given OA and population growth

PICT	Sub-region	Recommended adaptations
Cook Islands	Polynesia	• Continue sustainable management of reef habitats and fish stocks to secure future harvests • Support fishers who may need to travel greater distances to maintain reef fish harvest levels to supply urban markets as demersal fish stocks decline
Marshall Islands	Micronesia	
New Caledonia	Melanesia	
Palau	Micronesia	
Pitcairn Islands	Polynesia	
Tokelau	Polynesia	

Moderately vulnerable: Group 2

* PICTs where the area of coral reef should be able to produce the fish needed in the future, but where it will be difficult to distribute the fish to urban centres from remote islands, atolls and reefs

PICT	Sub-region	Recommended adaptations
FSM	Micronesia	• Continue sustainable management of reef habitats and fish stocks to secure future harvests • Support fishers who will need to travel greater distances to maintain reef fish harvest levels to supply urban markets as demersal fish stocks decline • Improve fish distribution networks for remote regional communities • Identify other sources of fish to 'fill the gap' in the medium-term, e.g. expand national infrastructure for FADs, use bycatch from industrial tuna fleets
French Polynesia	Polynesia	
Kiribati	Micronesia	
Niue	Polynesia	
Tonga	Polynesia	
Tuvalu	Polynesia	
Wallis & Futuna	Polynesia	

Most vulnerable: Group 3

* PICTs where coral reefs do not have the potential to produce the fish needed for good nutrition of their populations by 2050 due to OA and population growth

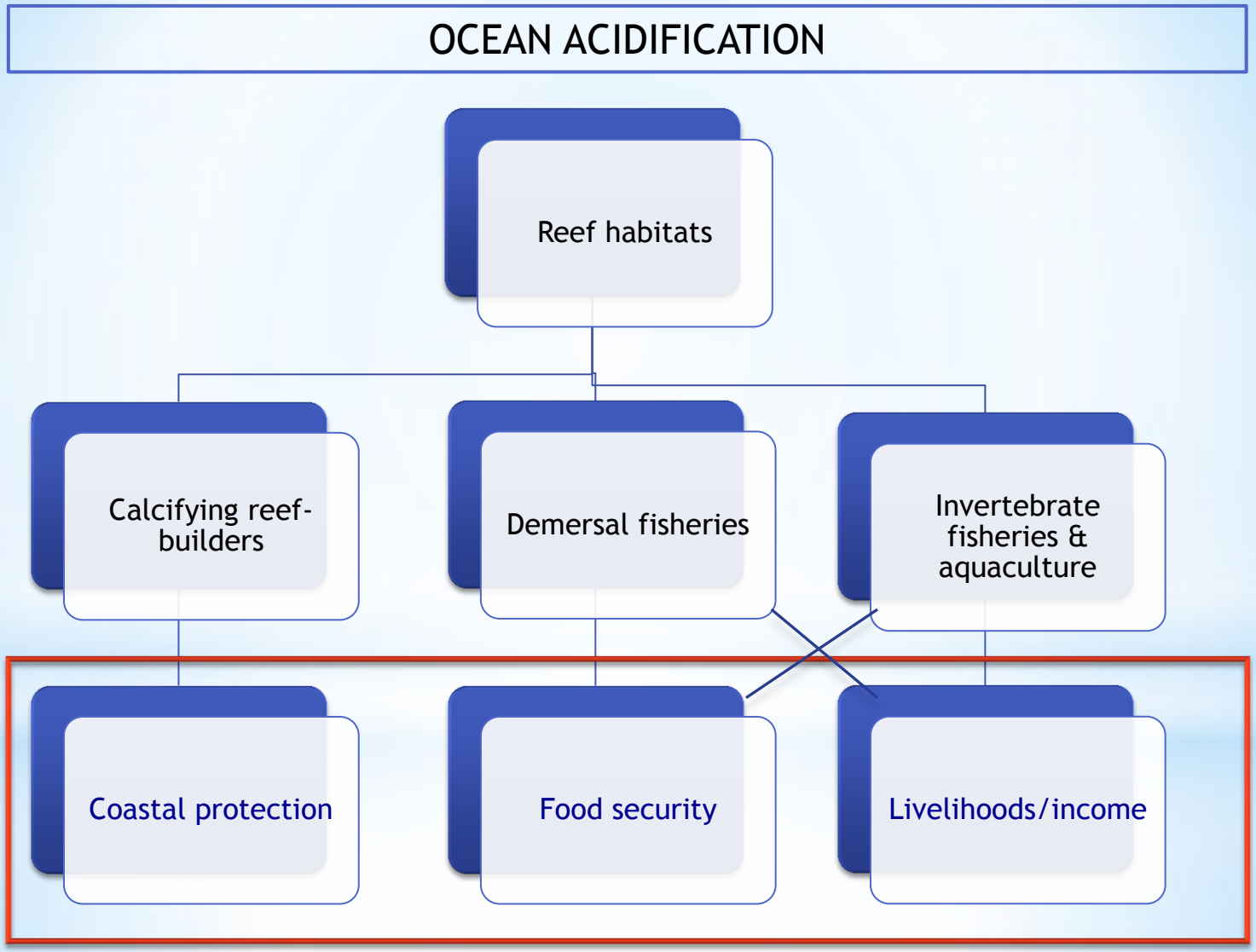
PICT	Sub-region	Recommended adaptations
American Samoa	Polynesia	• Improve management of reef habitats and fish stocks to secure sustainable future harvests • Identify other sources of fish to 'fill the gap' in the short-term, e.g. expand national infrastructure for FADs, use bycatch from industrial tuna fleets and develop small-pond aquaculture • Improve fish distribution networks for remote regional communities • Promote policies and plans that deliver greater allocations of tuna resources to food security
Fiji	Melanesia	
Guam	Micronesia	
Nauru	Micronesia	
CNMI	Micronesia	
PNG	Melanesia	
Samoa	Polynesia	
Solomon Islands	Melanesia	
Vanuatu	Melanesia	

Implications for food security

- Group 3 PICTs (population growing & vulnerable): immediate adaptation actions
- Group 2 PICTs (remote & vulnerable): require support
- Group 1 (least vulnerable): support to not become vulnerable over time or due to other drivers
- Sub-regional patterns emerging

Implications for livelihoods

* Negative impacts on reef fisheries; pearl, shrimp & MO aquaculture
* Alternative suite of income generating activities, e.g. shift from reef fish to nearshore tuna
* Shift from mariculture to freshwater ponds that will benefit from increasing rainfall
* Marketing of alternative reef eco-tourism experiences
* Government incentives important



*Reef-dependent communities

Reef-dependent communities

- Preliminary assessment 22 PICTs (relative)
- Exposure to reef habitat and reef fisheries declines by 2050
- Sensitivity to changes in food security and livelihoods
- Capacity to adapt based on health, education, governance and economy size

*Most vulnerable reef-dependent

PICT	Sub-region	Source of vulnerability
Kiribati	Micronesia	High reef to land area, demersal/invert catch, fish consumption, household earnings; poor health & small economy size
Marshall Islands	Micronesia	High reef to land area, fish consumption, household earnings; small economy size
FSM	Micronesia	High reef to land area, fish consumption, household earnings; small economy size
PNG	Melanesia	High demersal/invert catch, household earnings; poor governance and small economy size
American Samoa*	Polynesia	High reef to land area, coastal population, fish consumption; small economy size
Solomon Islands	Melanesia	High demersal/invert catch, household earnings; poor health, governance and small economy size

* Possibly confounded by lack of data for household earnings & education

Preliminary findings

* Key drivers: high reef area, high household income dependence, poor governance and small economies Micronesia top 3 most vulnerable
* Reviewing VA indicators and criteria (e.g. is reef to land area a suitable proxy for coastal protection…)
* Provincial & local scales (including coastal nutrient loading)
* Incorporating other livelihoods (e.g. aquaculture) and economic revenue (e.g. from tourism)

Implications for economic development & revenue

- Western & Central Pacific supplies 50% of global tuna
- OA impacts not well understood
- Impacts of global warming will shift tuna stocks east with implications for PICTs in the west
- Kiribati, Tuvalu, Tokelau, Cook Islands & French Polynesia future opportunities to negotiate increased access fees from DWFN

Priority adaptations

- Target adaptations to main sources of vulnerability for PICTs
- Improve management of reefs to enhance resilience to future OA
- Sustain production of reef fisheries to ensure future sustainable harvests for food security (CEAFM)
- Diversify coastal fisheries catches to target tuna around FADs and targetreef fish catches to changes in species composition
- Increase access to tuna for urban centres by distributing small tuna and bycatch from industrial tuna fleets
- Develop coastal fisheries for small pelagic species (e.g. sardines)
- Improve simple post-harvest methods to maximize ‘good’ catches
- Develop hatchery and grow-out systems for freshwater pond aquaculture, alternative pH-tolerant mariculture species

*Summary of OA vulnerability

Asset	Regional importance	Vulnerability	
Coral reefs	High	Very high	
Reef fish & invertebrates	High	High to	Moderate
Aquaculture	Moderate – High	Species dependent	
Oceanic habitats	Moderate	Low?	
Tuna	Very high	Low?	
Food security	Very high	Very high	
Livelihoods	Very high	High to	Moderate
Reef-dependent communities	-	High to	Moderate
Economic development & revenue	Very high	Moderate to	Low

Regional hot-spots

- Group 3 (American Samoa, CNMI, Fiji, Guam, Nauru, PNG, Samoa, Solomon Is, Vanuatu) for food security adaptations
- High vulnerability reef-dependent communities (Kiribati, Marshall Is, FSM, PNG, American Samoa, Solomon Is) for community-based adaptations that target food security, livelihoods and reef services (e.g. coastal protection)
- Cook Is, Fiji, French Polynesia, FSM, Kiribati, New Caledonia, Marshall Is, Palau, Solomon Is, Tonga, Vanuatu for aquaculture adaptations
- Case studies to improve understanding of OA vulnerability of key resources (e.g. pearl oysters in French Polynesia)

Regional hot-spots

- Group 3 (American Samoa, CNMI, Fiji, Guam, Nauru, PNG, Solomon Is, Vanuatu) for food security adaptations
- High vulnerability reef-dependent communities (Kiribati, Marshall Is, FSM, PNG, American Samoa, Solomon Is) for community-based adaptation (CBA) that target food security, livelihoods and reef services (e.g. coastal protection)
- Cook Is, Fiji, French Polynesia, FSM, Kiribati, New Caledonia, Marshall Is, Palau, Solomon Is, Tonga, Vanuatu for aquaculture adaptations
- Case studies to improve understanding of OA vulnerability of key resources and communities, and synergistic pressures

Breakout Group discussion points

- Local/Provincial assets, importance and vulnerability
- Considering other pressures, e.g. coastal nutrient loading, SST+ etc.
- Incorporating a range of livelihoods (e.g. fisheries, aquaculture)
- Incorporating national economic revenue activities (e.g. tourism)

*Thank you

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