Effects of Climate Change on Fisheries

Dr. Vincent V. Hilomen
Biodiversity Management Bureau
Department of Environment and Natural Resources

The effects of climate change on fisheries are profound

- Sea level rise from melting of polar ice caps can affect habitats of fishes
- Increase in sea temperatures from effects of green house gasses can push fishes to higher latitudes and deeper waters
- More intense weather disturbances from accumulation of heat can destroy habitats of fish
- Ocean acidification from increased CO_2 in oceans can corrode and weaken skeletal system of organisms (shells, bones, coral reefs, etc.)

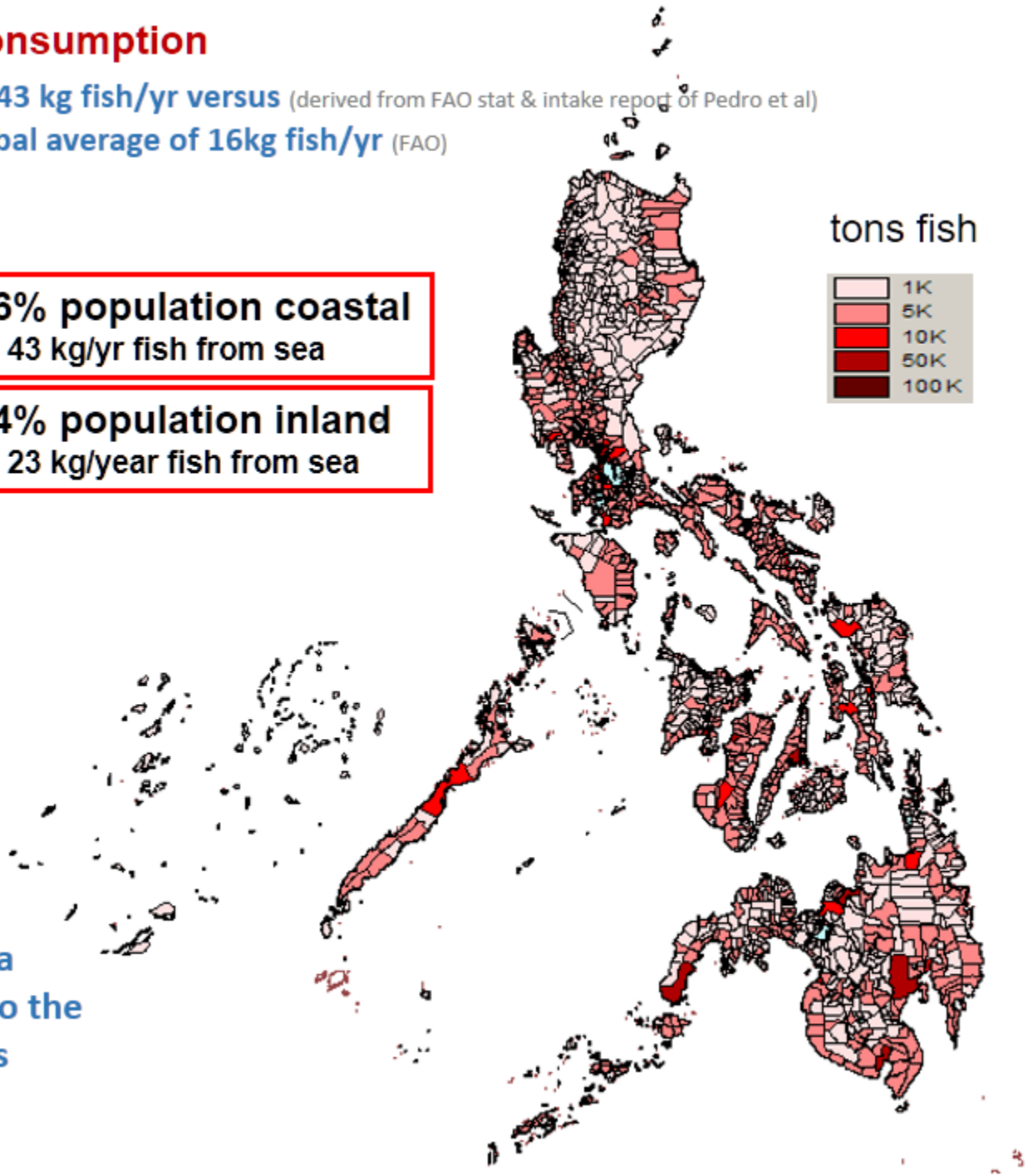
FISHERIES ARE VERY IMPORTANT TO US!

Consumption

23-43 kg fish/yr versus (derived from FAO stat & intake report of Pedro et al)
global average of 16kg fish/yr (FAO)

56% population coastal
@ 43 kg/yr fish from sea

44% population inland
@ 23 kg/year fish from sea

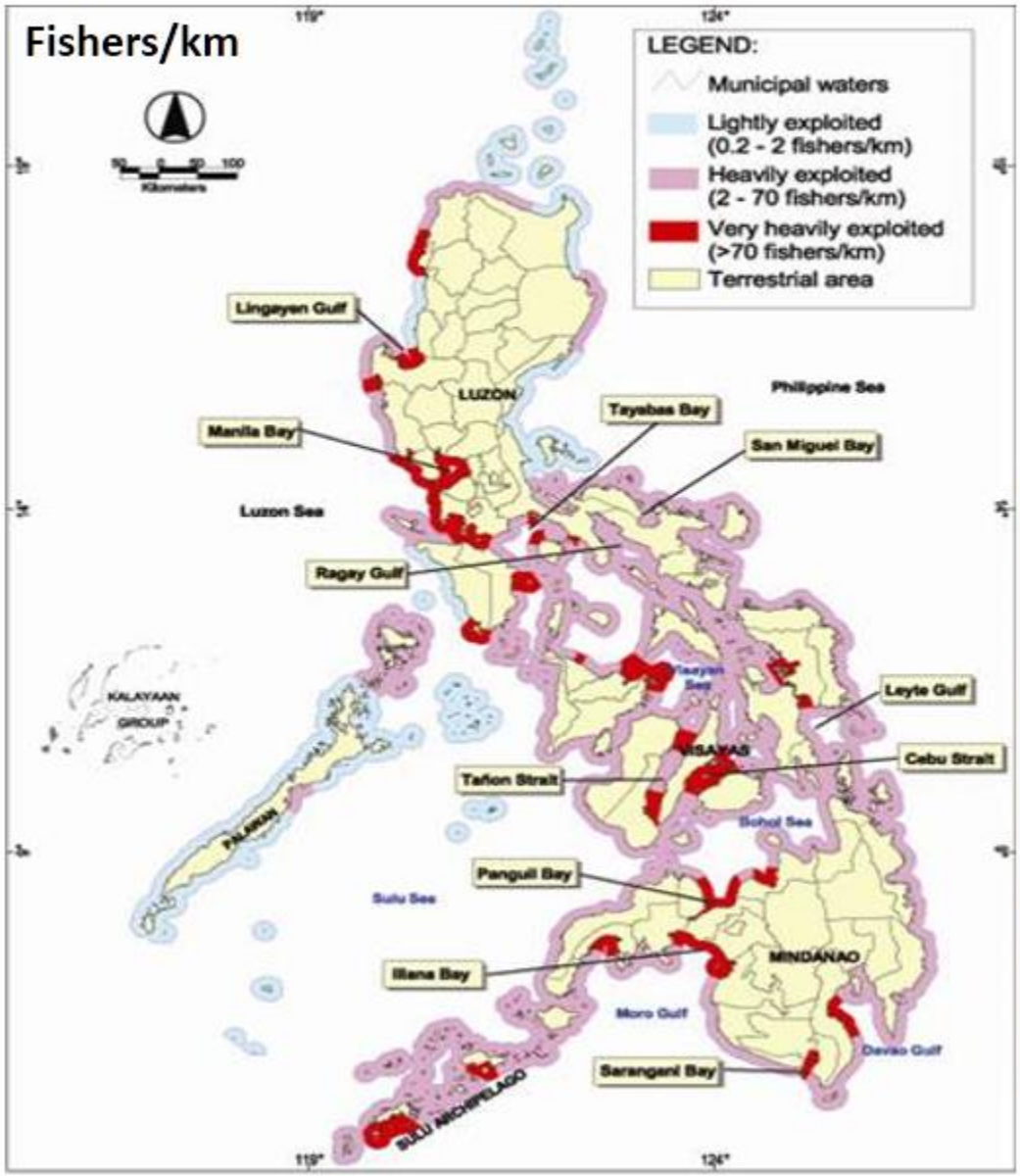


Protein Requirement
– PDRI 62-71 g/day*

Philippine Dietary Reference Intakes 2015:
Summary of Recommendation, FNRI-DOST

Marine resources contribute a significant portion (19-36%) to the food supply of the Philippines

Livelihood



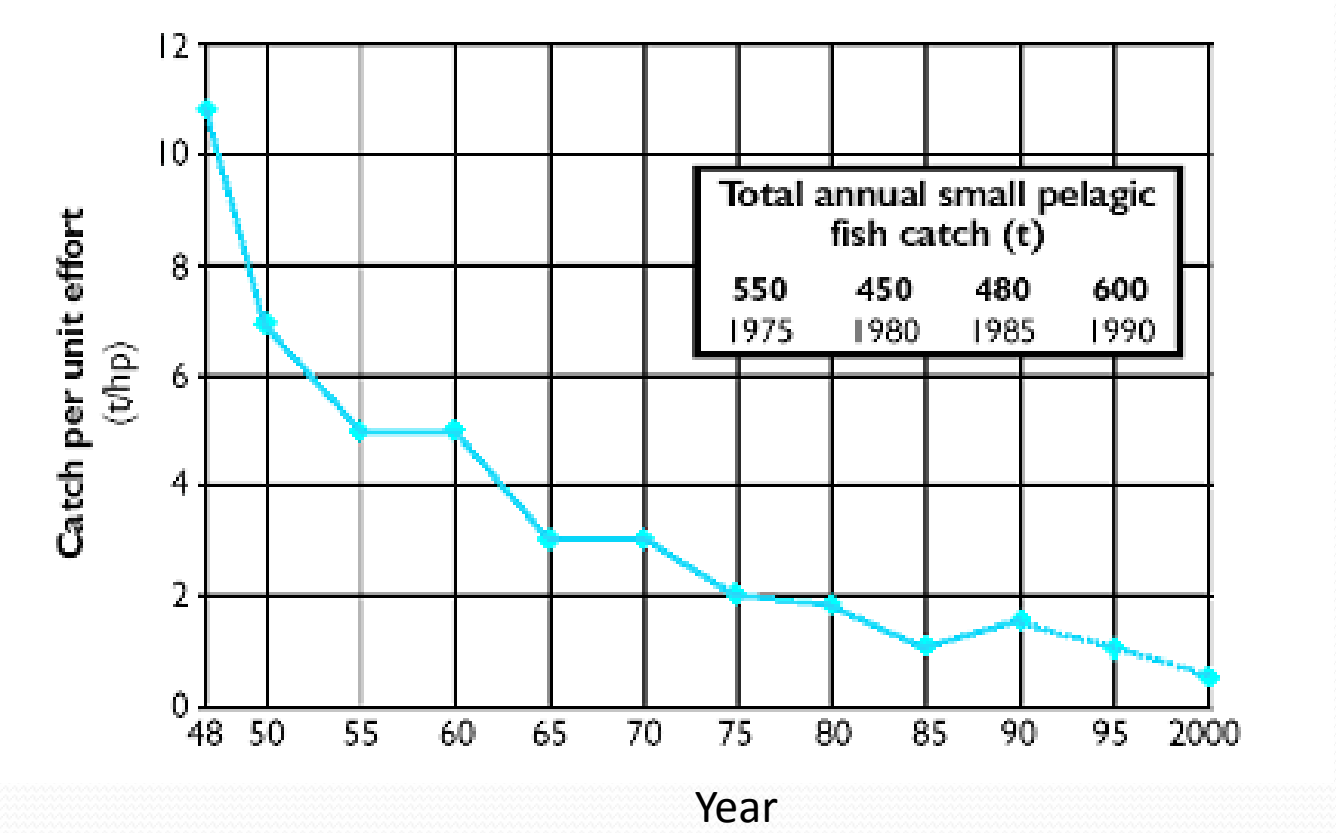
Coastal population rely heavily on coastal agriculture and fisheries in terms of livelihood. Artisanal fishers are typically also seasonal farm hands.

But fishers are also identified as the most impoverished sector of the society with poverty incidence of 39.2 %

Slide from Dr. P. Aliño

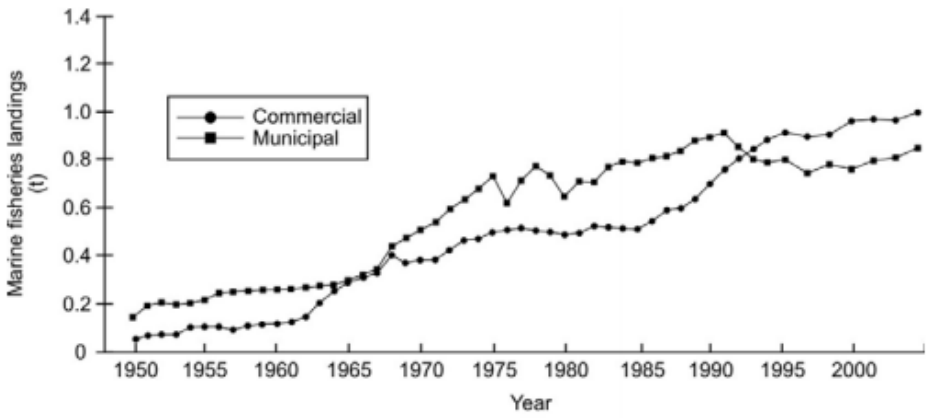
BUT WHAT IS THE CURRENT CONDITION OF OUR FISHERIES RESOURCES?

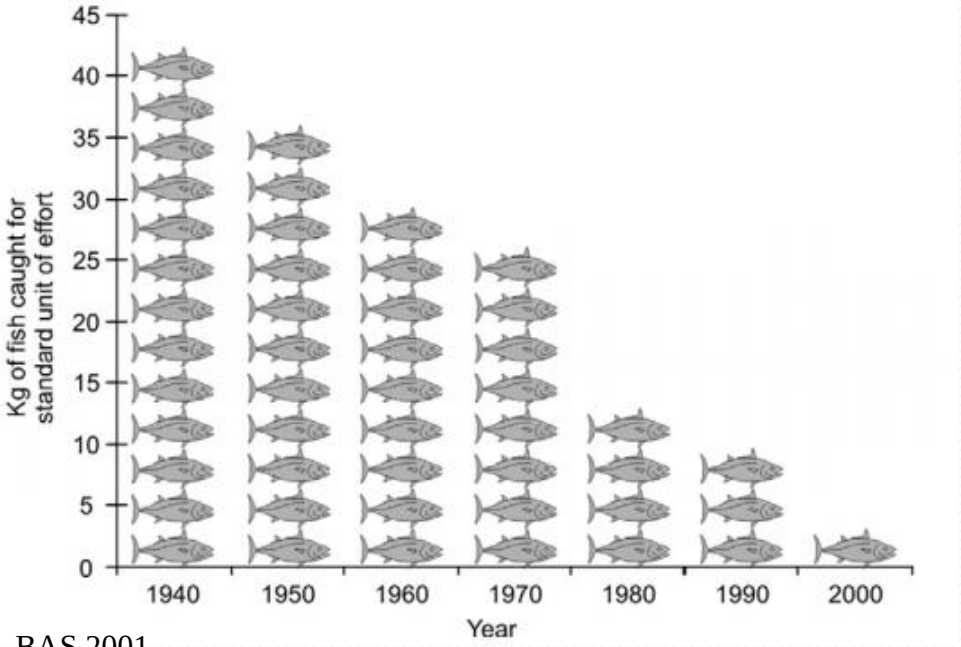
Trend of CPUE



Trend of catch per unit effort since 1948 (Dalzell et al 1987) Silvestre and Pauly 1989; Dalzell and Corpuz 1990; BFAR 1997, Campos 2004)
Source: http://www.oneocean.org/flash/the_philippine_seas.html

Status of fisheries in the Philippines





BAS 2001

- While CPUE has been in a steep decline, marine capture fisheries landing for both commercial and municipal fishing increase over time
- This can only be possible by:
  - Increasing fishing effort
  - Shifts in catch composition from more valued to less valued fish

Not so good news: Resources in decline



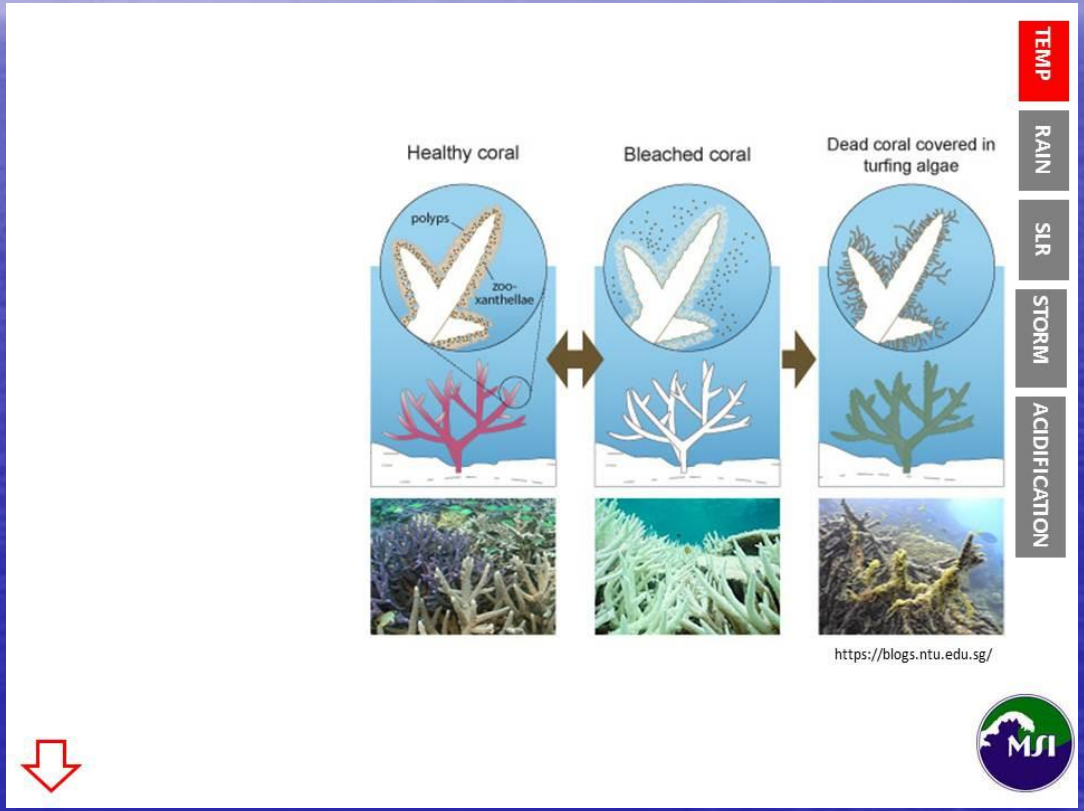


Resource/ Habitat	Status	Source
Corals	*Degraded state*	BFAR-NFRDI-PAWB. 2005. BINU
Seaweeds	*Unknown (except declining seed source)*	-do- GTZ. 2009.
Seagrasses	*Heavily stressed*	BFAR-NFRDI-PAWB. 2005. BINU
Mangroves	*Degraded state*	-do-
Invertebrates	*Declining trend*	-do-
Demersal fishes	*Declining trend*	-do-
Small pelagic fishes	*Declining trend*	-do-
Tunas	*Stable trend (except Bigeye tuna)*	WCPFC. 2009
Sharks and rays	*Declining trend*	NPOA Sharks. 2009
Marine turtles	*Threatened*	BFAR-NFRDI-PAWB. 2005. BINU
Marine Mammals	*Threatened*	IUCN Red List. 2009

HOW DOES CLIMATE CHANGE AFFECT FISHERIES?

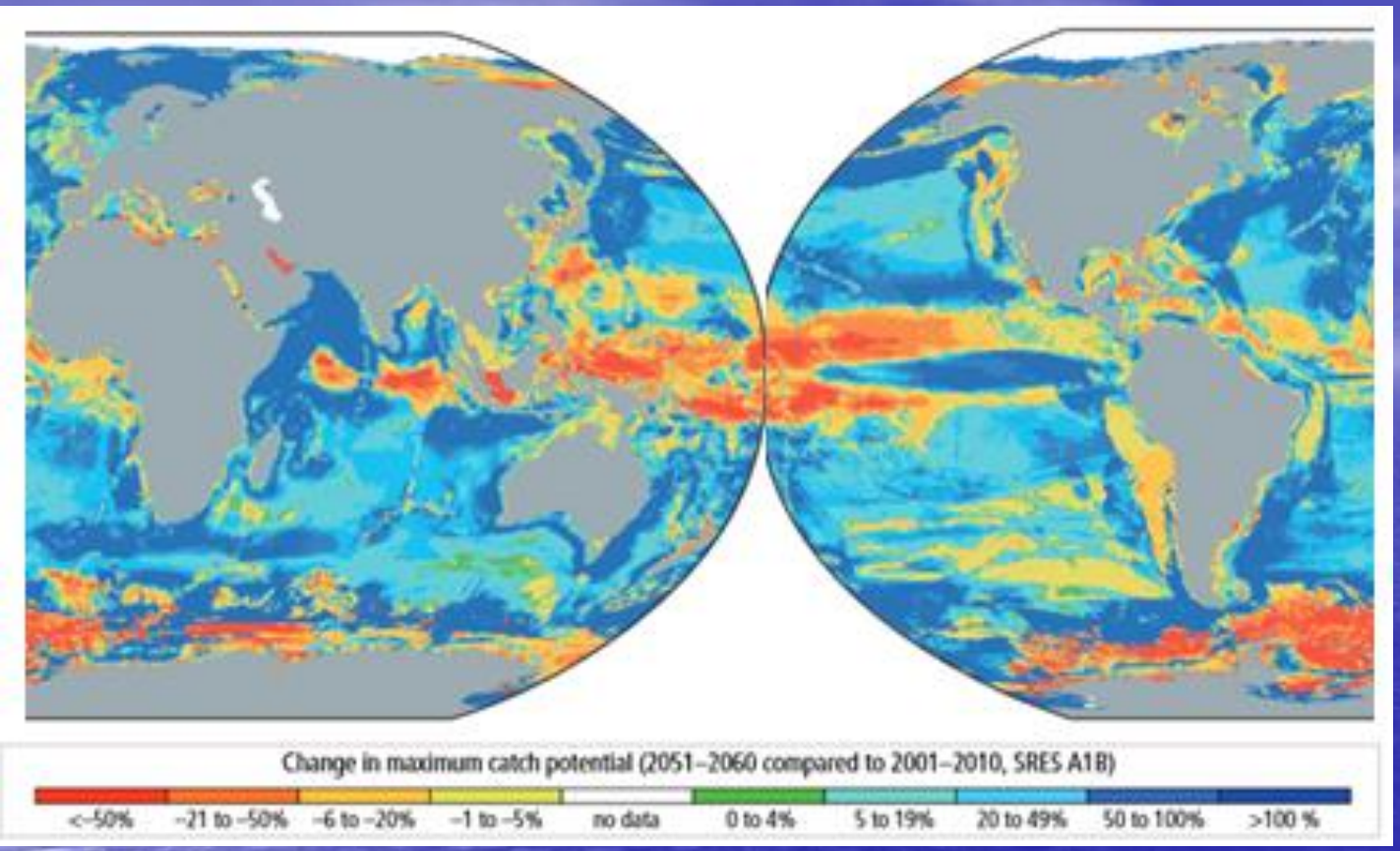
Increase in temperature

Coral bleaching- >3ºC increase in water temperatures can cause corals to bleach –prolonged bleaching leads to coral death – compromise complexity in reef – loss of fish habitat



Increase in temperature

- Because temperature is cue to biological clocks of many marine organisms
  - Confuse their biological cycles
  - Can compromise reproduction
  - Can affect synchrony patterns
- More scary is increased temperatures can push fishes away from the tropics to higher latitudes and deeper waters!



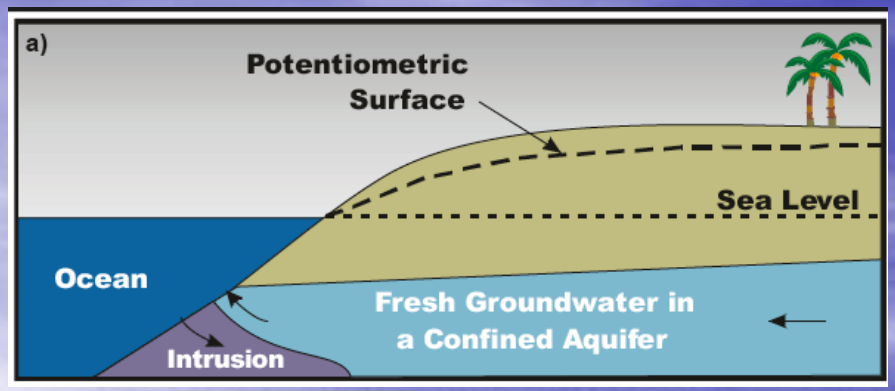
Implications:

- Fish migrate to higher latitudes to escape warm waters
- Food security in tropics (Philippines) compromised

Projected global redistribution of maximum catch potential of ~1000 exploited marine fish and invertebrate species.

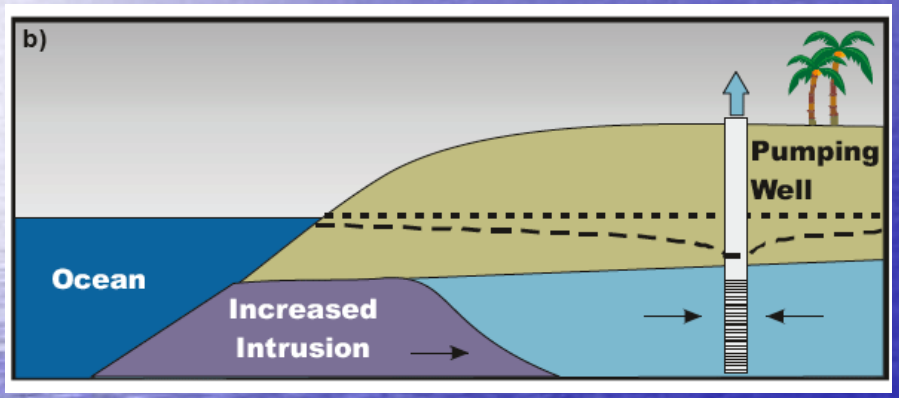
(Projections compare the 10-year averages 2001–2010 and 2051–2060 using ocean conditions based on a single climate model under a moderate to high warming scenario, without analysis of potential impacts of overfishing or ocean acidification.)

Source: IPCC –AR5

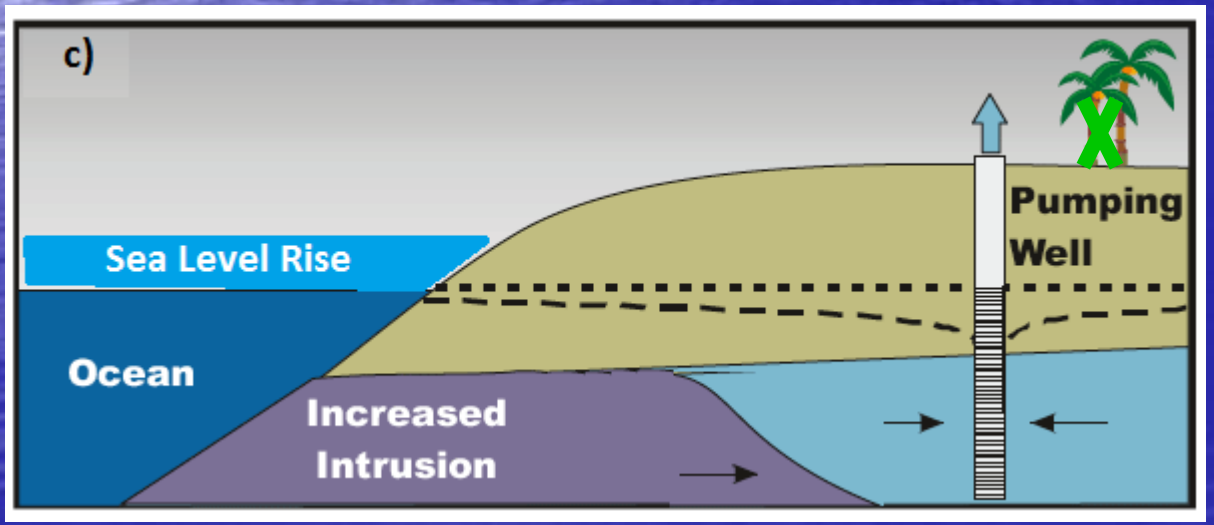


Sea level rise, together with groundwater pumping, may enhance salt water intrusion.

This may eventually lead to lowland agriculture failure.



Agricultural failure may also lead to movement of farmers to coastal areas, creating additional pressure on coastal fisheries.



modified from www.wrd.org

TEMP
ACIDIFICATION
RAIN
STORM
SLR

In mangroves, the hazard of concern is sea level rise.

The main effect is on the establishment of the propagules which need to be above sea surface during the daytime in order to photosynthesize.

The United Nations estimates that 13% of world's mangroves will be drowned by 2100.

http://www.greenpeace.org/international/news/climate-change-in-the-pacif

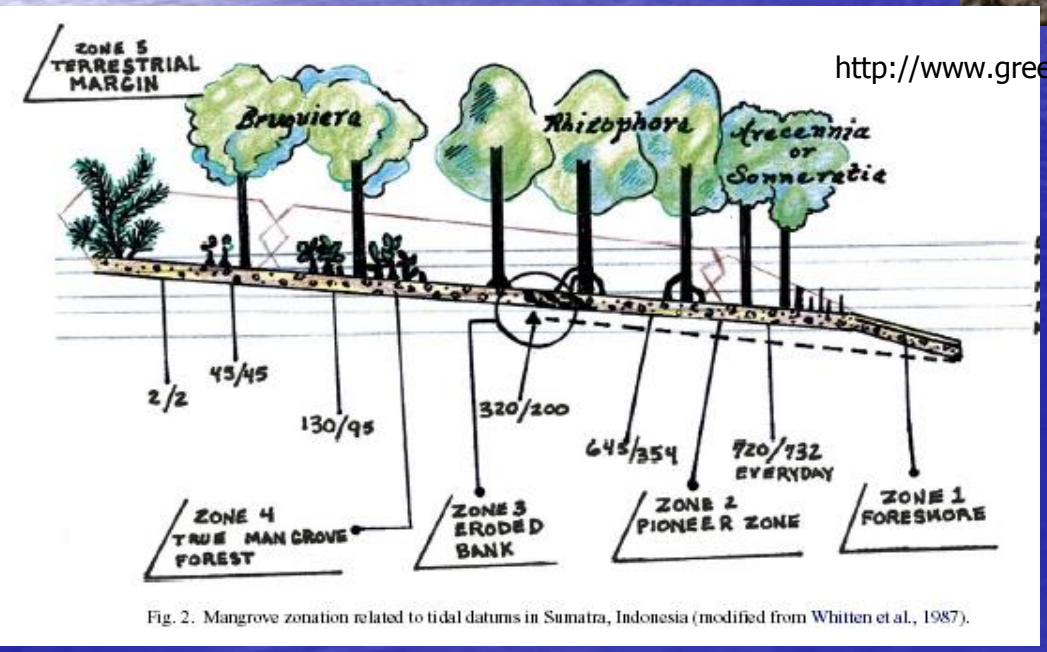


Fig. 2. Mangrove zonation related to tidal datums in Sumatra, Indonesia (modified from Whitten et al., 1987).

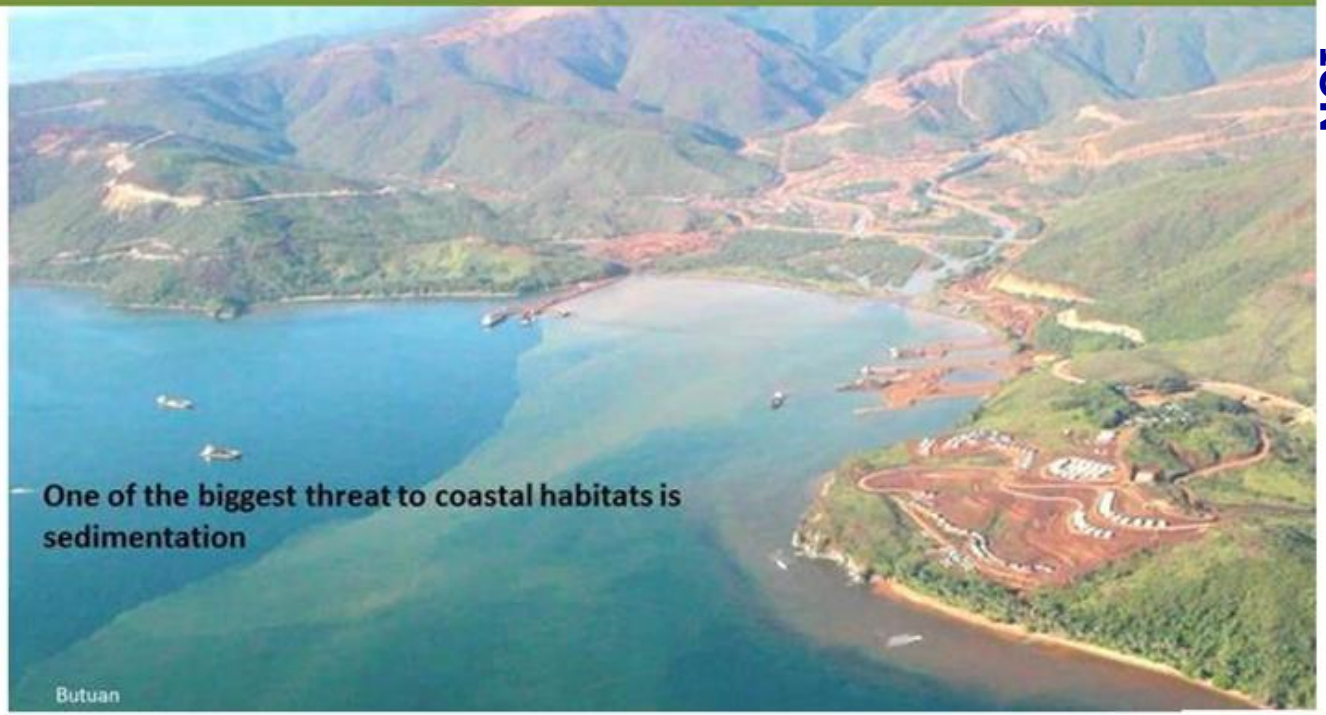
It is also expected that there will be change in species composition as sea level rise may favor faster growing spp in new areas.

Mangroves are spawning, feeding and nursery grounds of many food fish

TEMP
ACIDIFICATION
RAIN
STORM
SLR

Even the best protected sites are challenged by a combination of climate and human-induced external threats.

One of the worst perennial threats is coastal sedimentation, which can make the water turbid – making it hard for seagrass to grow. Worse still, it can bury and suffocate coral reefs.

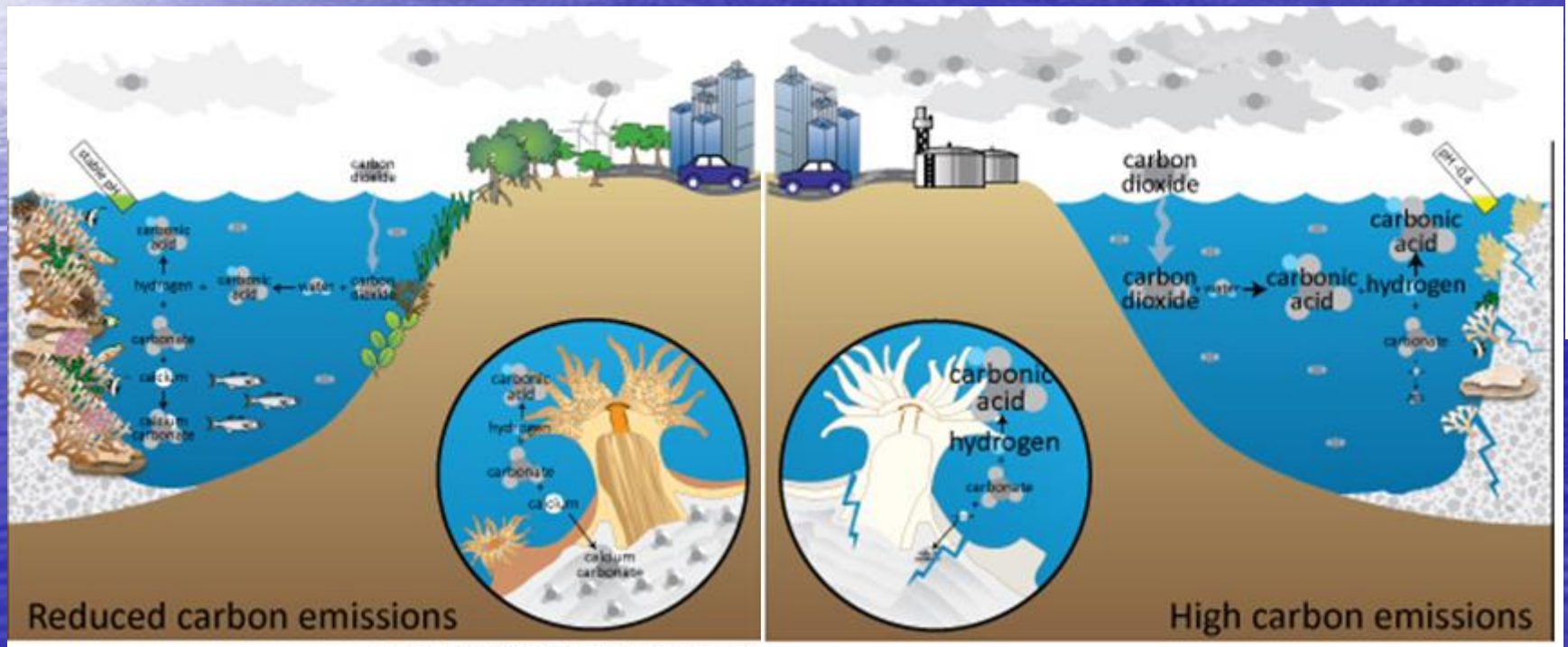


TEMP
ACIDIFICATION
RAIN
STORM
SLR

In addition, climate change is bringing about change in ocean pH

This can lead to additional loss of coral reef structure.

Between 1751 and 1994 surface **ocean pH** is estimated to have decreased from approximately 8.25 to 8.14. Ocean pH is globally projected to increase 0.3-0.4 units by 2100.

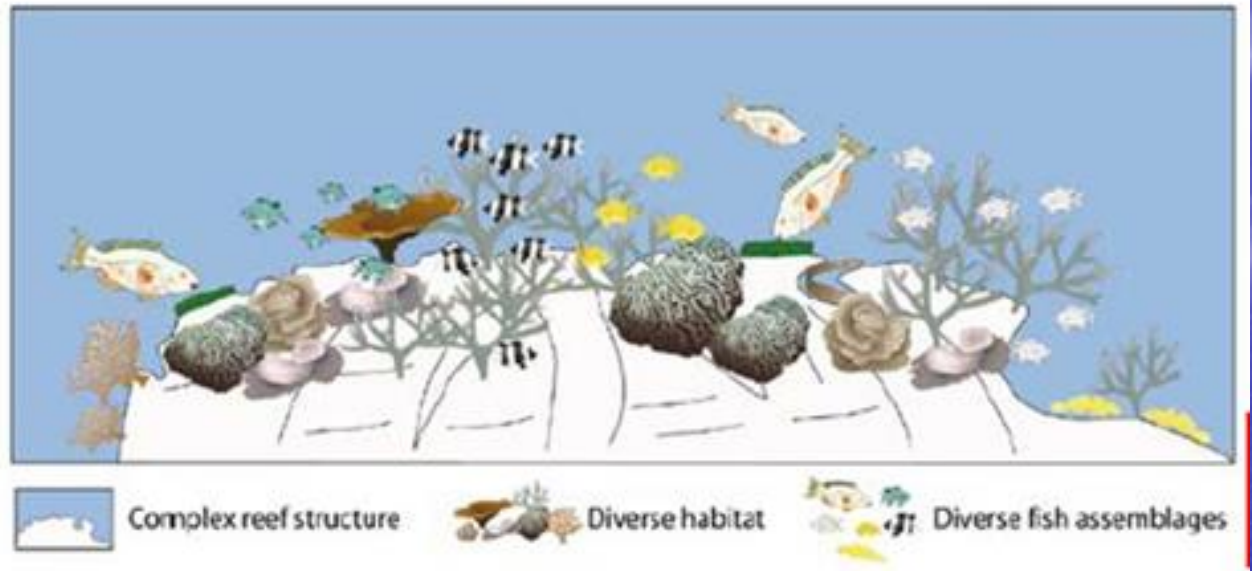


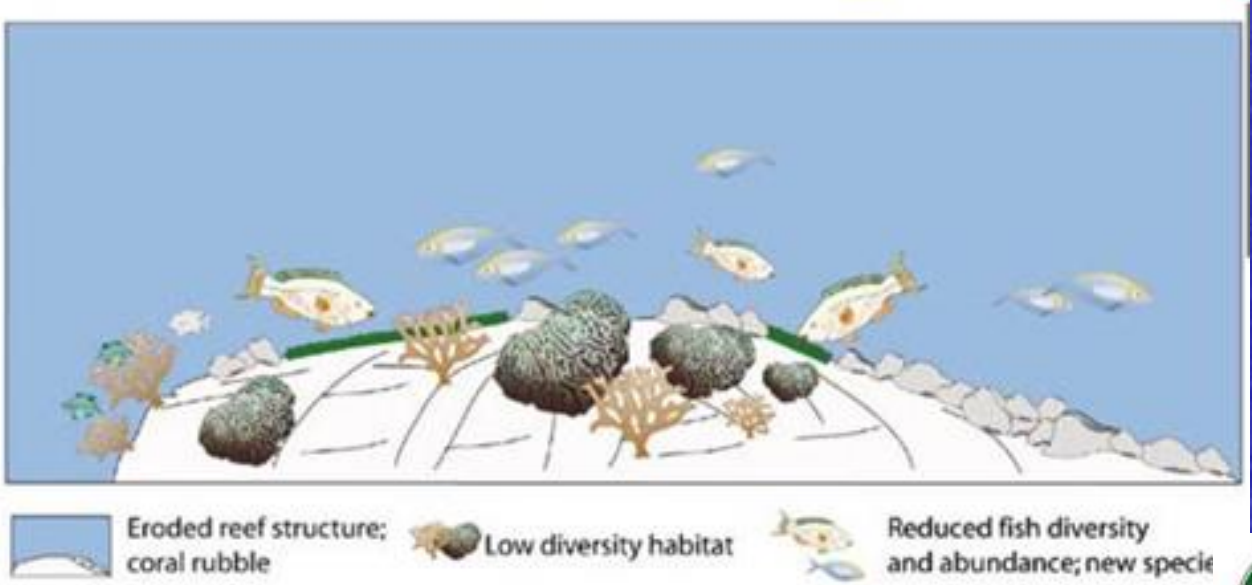
https://www.e-education.psu.edu/earth103/node/722

EXPOSURE – Ocean Acidification

A complex reef architecture harbors a diverse marine ecosystem.

Loss of coral structure can lead to a decrease in both fish biomass and diversity.





Munday *et. al.*, 2007

TEMP
ACIDIFICATION
RAIN
STORM
SLR

What we can do…

Problem	The science in the solution (Policy)
Coral bleaching (inc. T^{o})	• Improvement and enhancement of marine biodiversity to allow fast and early recovery from disturbances (e.g. Bolinao Reefs vs. Tubbataha Reefs) • Protection and conservation of reefs and allow them to naturally recover
Habitat loss	• Identify and protect spawning, nursery and feeding grounds of fish • Studies have shown that areas with mangrove, seagrass and coral reefs perform better as a refugia therefore these 3 habitats should be priority

What we can do…

Problem	The science in the solution (Policy)
Fish migration	• Explore species more tolerant to variability of physico-chemical factors for sea ranching and aquaculture with care for environment • Aquaculture must select sites and observe proper stocking density, feeding volume and frequency • Saline tolerant fish species • Spatial distribution and migration patterns of fish • Develop early warning systems of marine biodiversity and habitat • Improve post harvest technologies and food safety • Vulnerability assessments of coastal areas

What we can do…

Problem	The science in the solution (Policy)
Changes in reproductive schedules of fish	• Determination of fish reproductive schedules • Determination of spatial and temporal closures of fisheries • Formulation of calendar of fishing activities (sequence of which species to harvest over a season)

What we can do…

Problem	The science in the solution (Policy)
Ocean acidification	• Develop plans to reduce emission of green house gasses (think globally, act locally) • Construct a carbonate saturation map to determine the spatial patterns of intensity of ocean acidification • Implement an expanded communication, education and public awareness programs to inform and educate people on how they can contribute to the reduction of this threat

Efforts of government to address these problems exist

- DOST
- DA-BFAR through NFRDI
- DENR through BMB
- DILG
- DTI
- DSWD

THANK YOU FOR YOUR ATTENTION

NACRE

2nd Expert Group Meeting on the Impact of Climate Change on Food Security

PCAARRD Actions towards a Climate Resilient Future

APEC Symposium/Workshop on Planning a Collaborative Research, Development and Extension Program on Climate Change among APEC Member Economies

LTDavid et al., UPMSI