Climate Change and Aquatic Genetic Resources for Food and Agriculture: State of Knowledge, Risks and Opportunities

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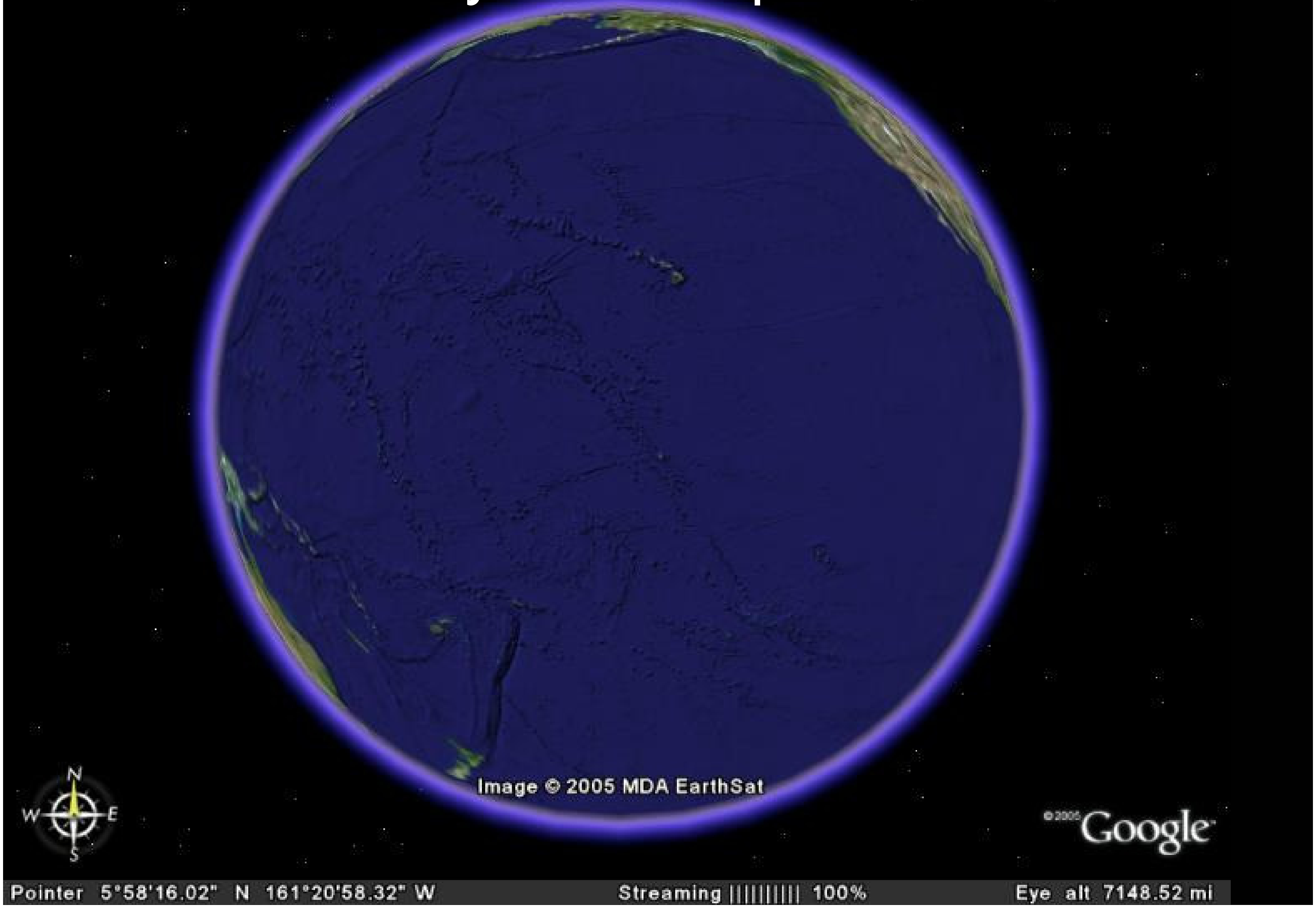
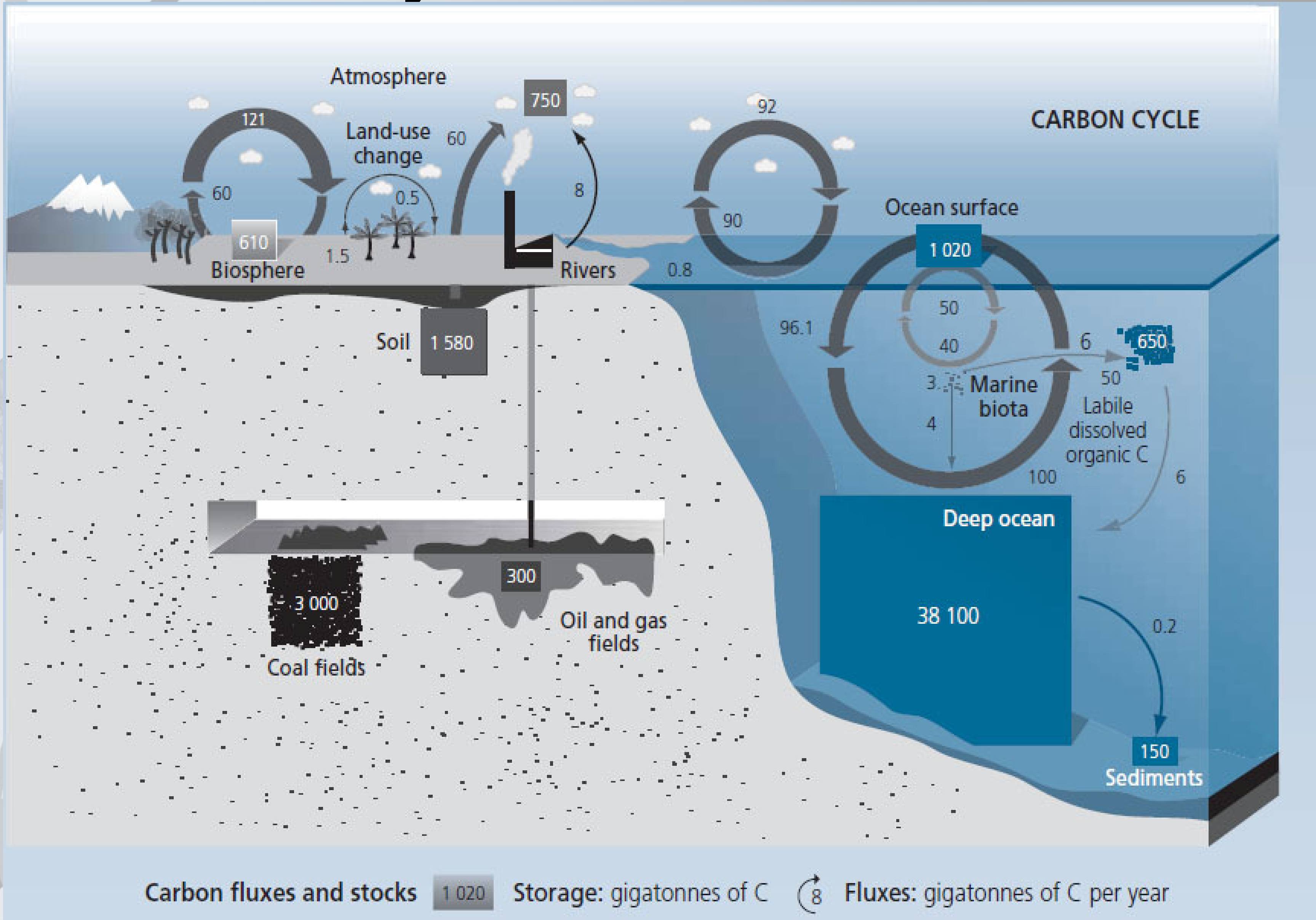
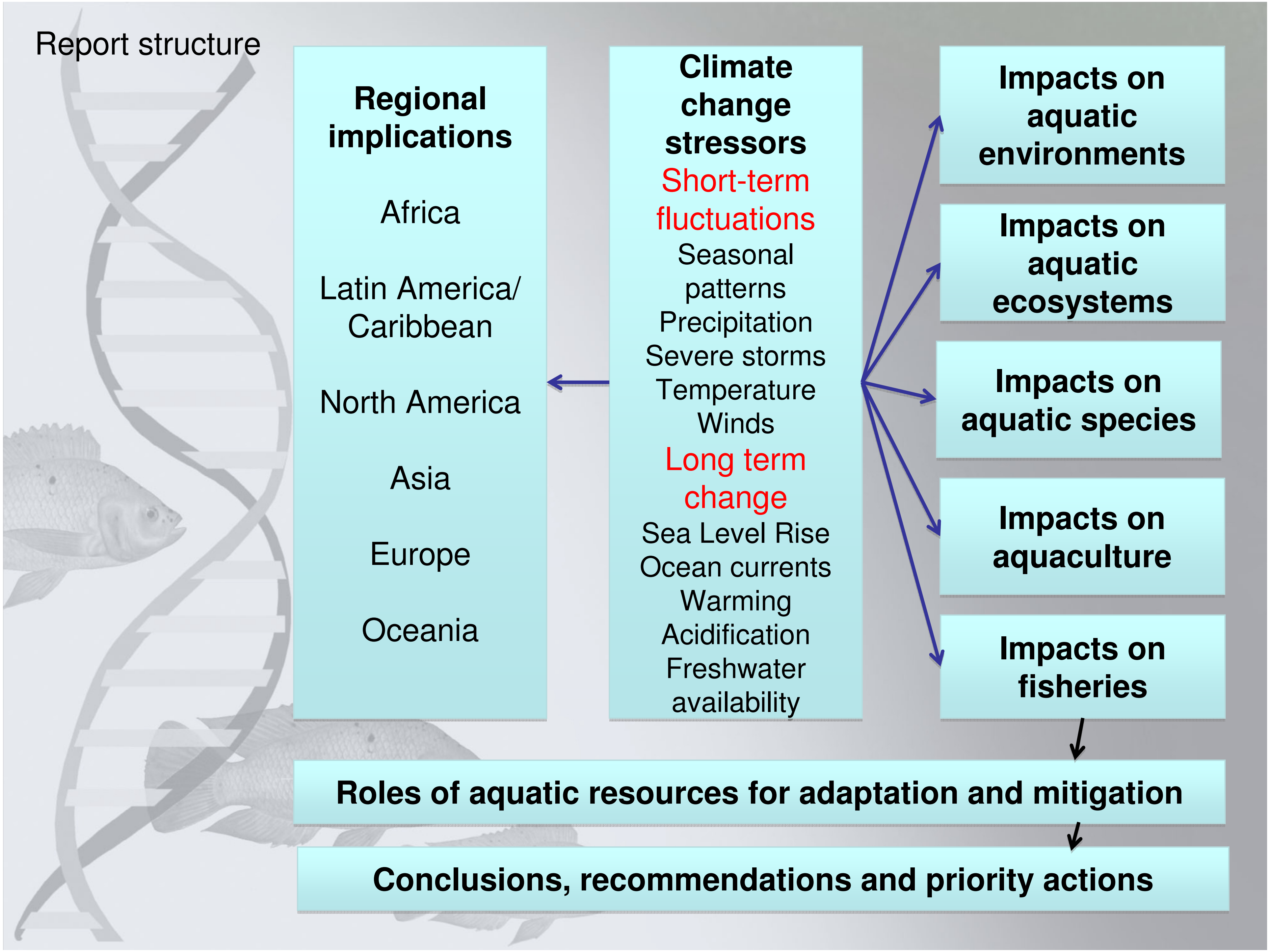
And they call this planet Earth ?



Carbon Cycle



FAO. 2010. The State of World Fisheries and Aquaculture (SOFIA 2010).


Report structure
Regional implications
Africa
Latin America/ Caribbean
North America
Asia
Europe
Oceania
Climate change stressors
Short-term fluctuations
Seasonal patterns
Precipitation
Severe storms
Temperature
Winds
Long term change
Sea Level Rise
Ocean currents
Warming
Acidification
Freshwater availability
Impacts on aquatic environments
Impacts on aquatic ecosystems
Impacts on aquatic species
Impacts on aquaculture
Impacts on fisheries
Roles of aquatic resources for adaptation and mitigation
Conclusions, recommendations and priority actions

Aquatic Genetic Resources and Climate Change: the Big Picture

- Uncertainty and Risk
- Chaotic Weather
- Chaotic Genomes/Phenotypes/ Ecosystems
- Chaos + Chaos = Surprises (nice and nasty!)
- INFORMATION ABOUT AqGR! The key to fostering adaptation and mitigation

To be ‘aquatic’ means facing:

- Death, repressed growth, inability to reproduce, and lowered immune responses from the following: hypoxia, unsuitable temperatures, and reductions in the quality (e.g., pollution, salinity change) and quantity of surrounding waters

- Challenges from alien species, pathogens and parasites

Climate change is raising (or lowering) all of these risks

Expected Changes in Environmental Parameters in 2050

Climate zone	Surface Temp. (°C)	Bottom Temp. (°C)	Salinity ppt	Bottom Salinity	Ice concentration (%)
Arctic	+0.7	**+1.6**	**-1.2**	**-0.8**	**-9**
Temperate N	+0.4	+0.8	-0.7	-0.3	-2
Subtropical N	+1.0	-0.1	-0.3	-0.0	0
Tropical	**+1.4**	-0.3	-0.2	0.0	0
Subtropical S	+0.5	+0.3	-0.2	0	0
Temperate S	+0.4	+0.7	-0.1	0.0	-0.3
Antarctic	+0.7	+0.5	-0.2	0.0	-3

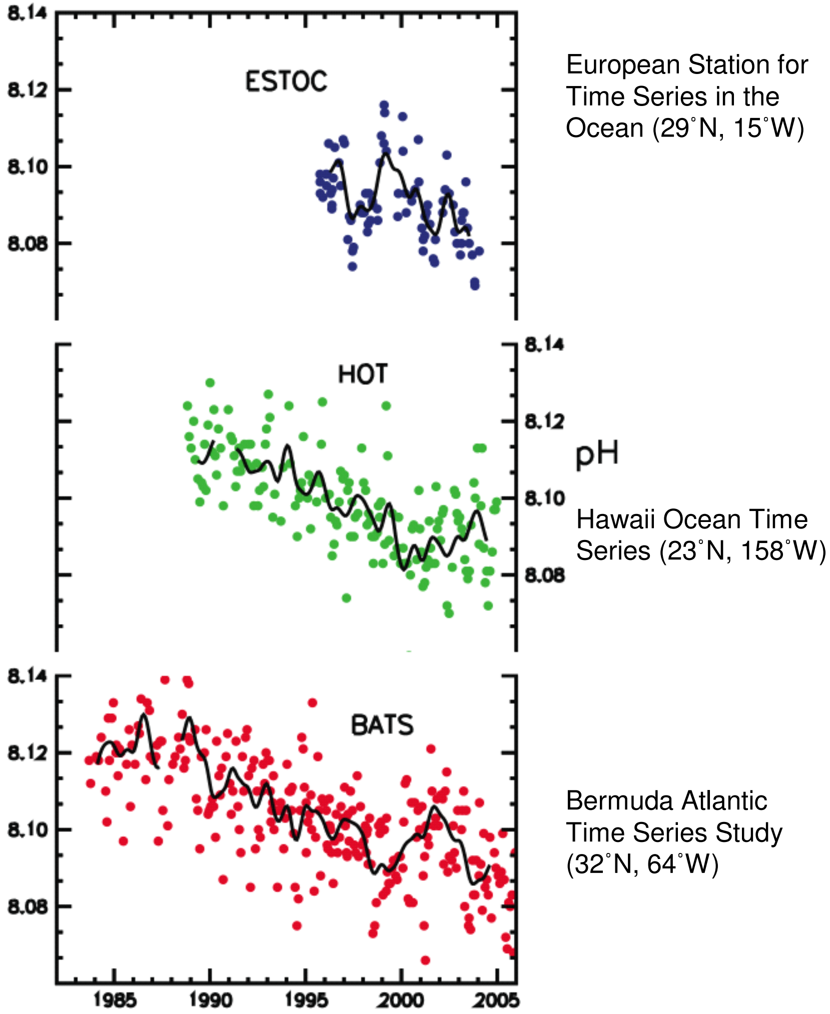
Source: Rainer Froese, IFM-GEOMAR, Kiel, Germany, EDIT Symposium

Coral bleaching

Photo by Nicolas Bailly, FishBase, Philippines, 2010

Increasing acidification of the oceans

- Dissolved CO_2 forms a weak acid
- pH decreases as dissolved CO_2 increases
- Direct observations of pH over last two decades show pH decreases of about 0.02 units per decade
- Projections based on SRES scenarios give reductions in average global surface pH of 0.14 to 0.35 units over the 21st century
- Bad news for marine organisms which use aragonite and calcite to build shells



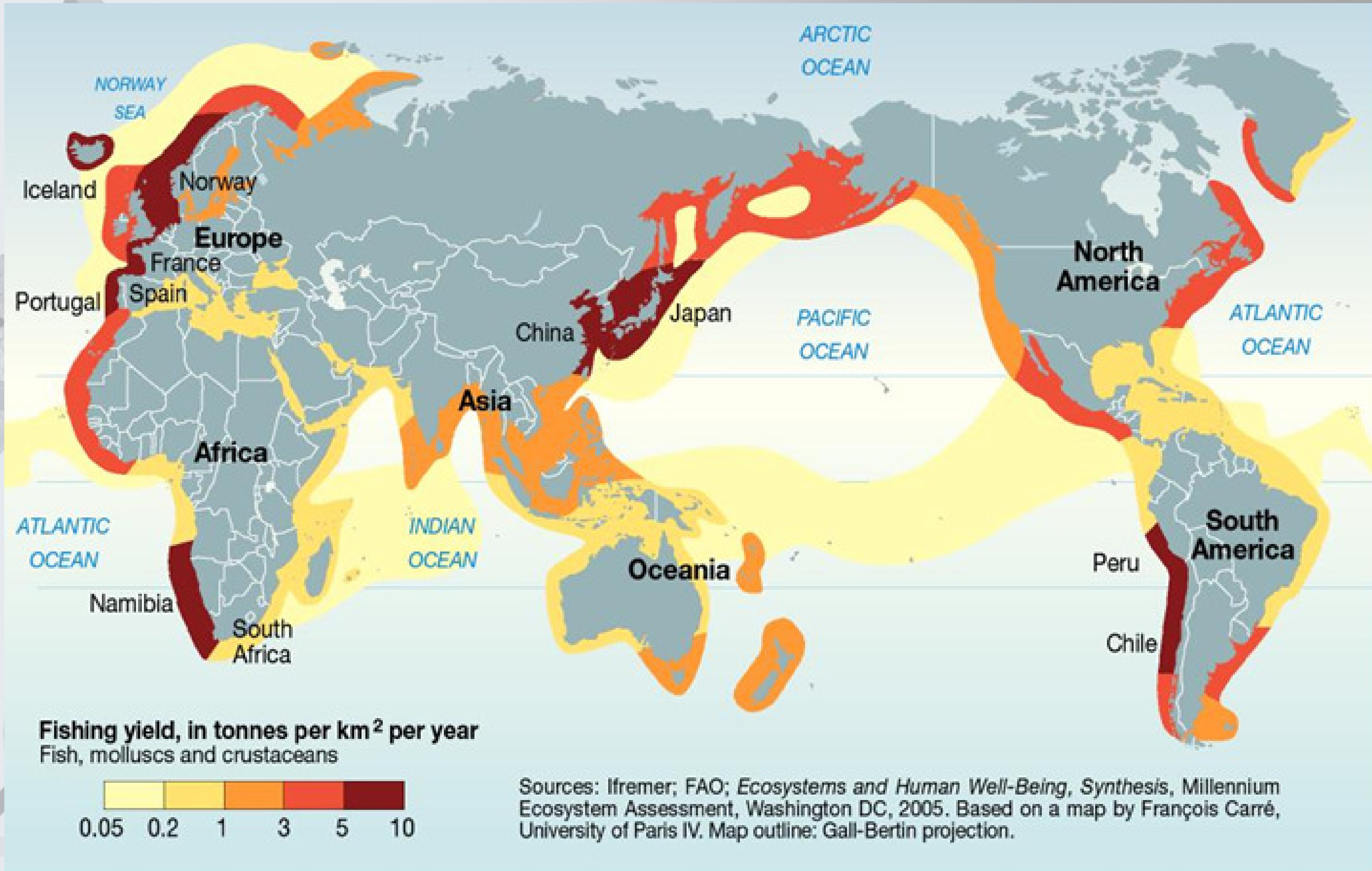
(IPCC Fourth Assessment Report)

Inland fisheries

- Are typified by:
  - Fragmented populations with limited scope for movement; and high genetic diversity
- Are susceptible to:
  - Temperature fluctuations – altering water stratification
  - Variable precipitation – altering river flows and lake levels
  - Low dissolved oxygen – as waters get warmer and more polluted
  - Lake and reservoir turnover – of anoxic waters to the surface
  - Water quality changes – pollution and saline intrusion
  - Changes in the connectivity of waters - due to water abstraction, droughts and floods

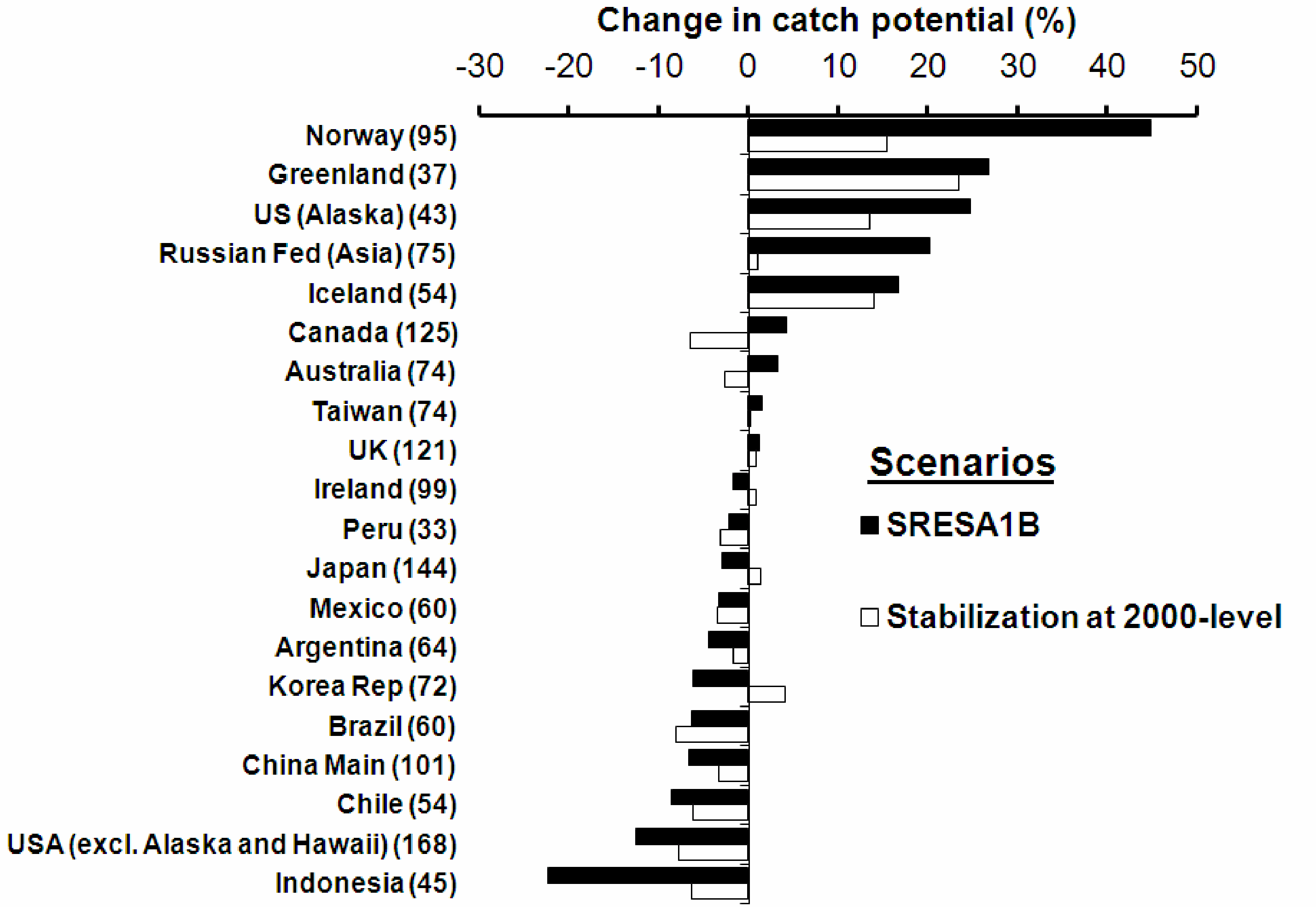
Coastal fisheries

- Fishing yield per km^2 per year



Change in fisheries catch

Projected changes in averaged maximum catch potential from 2005 to 2055 by the 20 Exclusive Economic Zone regions with the highest catch in the 2000s

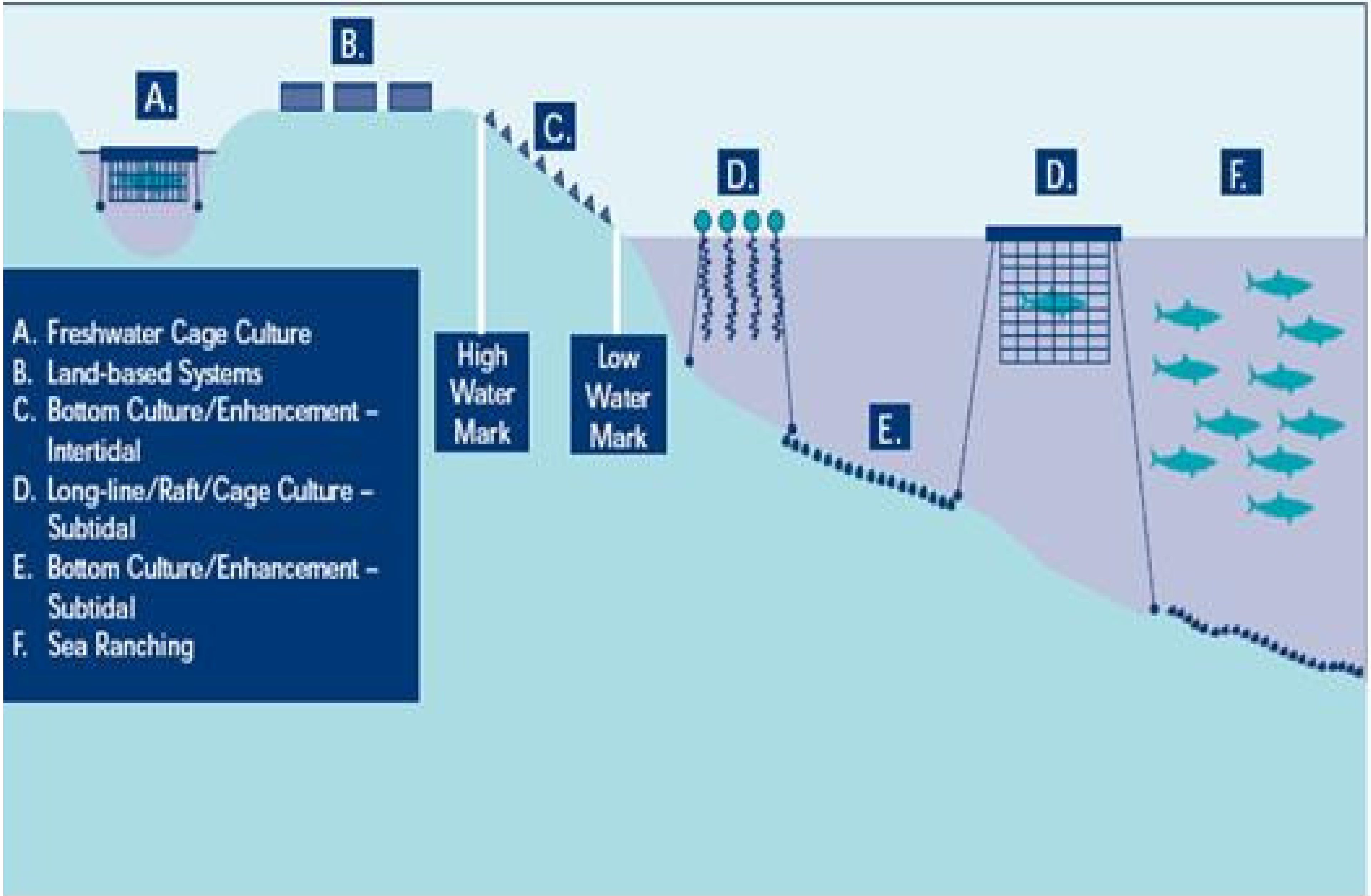


Source: Pew Sea around us project – Fisheries, Ecosystems and Biodiversity

Vulnerability - Fisheries

More vulnerable	Less vulnerable
Inland	Marine
Shallow water	Deep water
Long pelagic stage	Short pelagic stage
Complicated life cycle	Simple life cycle
Long generation time	Short generation time
Narrow tolerance range	Wide tolerance range
Sessile species	Mobile species
Less fecundity	Great fecundity

Aquaculture



Vulnerability - aquaculture

More vulnerable	Less vulnerable
Freshwater	Marine water
Shallow water	Deep water
Wild fry/seed collection	Hatchery production
Long culture cycle	Short culture cycle
Narrow tolerance range	Wide tolerance range
High trophic level species	Low trophic level species

Adaptation to Climate Change is Ongoing Through:

- target species of capture fisheries moving to new waters - e.g., more tropical marine fish in the North Atlantic summer
- natural selection - e.g., scope to adapt to more changing waters; high fecundity; wide dispersal
- the farming of lower risk species - e.g., tilapia; white legged shrimp; catfish
- increasing applications of biotechnology - e.g., selective breeding; hybridization; genomics; progressive domestication

Mitigation of Climate Change:

- Keep freshwater wetlands ‘wet’; maintain connectivity of waters
- Stabilize hydrological regimes on watersheds, by interventions such as multipurpose farm ponds
- Establish partnerships among sectors, including climate change mitigation as an objective
- ‘Twin’ and co-finance objectives, policies and actions for fish production and genetic resources conservation
- Reappraise, for climate change-related carbon and nitrogen fluxes and storage, wetland farming systems that include fish
- Reappraise, for climate change-related carbon and nitrogen fluxes and storage, integrated agriculture-aquaculture and wastewater reuse

IMPROVING AND SUSTAINING CONTRIBUTIONS OF AQUATIC GENETIC RESOURCES IN MEETING CLIMATE CHANGE CHALLENGES

Musts to do:

- **Take good care of aquatic ecosystems**
- **Maintain diverse gene pools, by supporting the conservation of aquatic genetic resources; as immediate and long-term goals, twinned with production goals**
- **Address ALL anthropogenic stressors that threaten those goals; not only climate change**

Musts to avoid:

- **Unsustainable exploitation of natural resources**
- **Degradation and loss of aquatic habitats**
- **Sector-specific policies, institutions and actions that produce conflict and/or miss opportunities for partnerships and synergy among different sectors**

Photocredit Ernie Penaranda, The Philippine Star, Vol XXV No. 305. p1.