

Aquaculture and its future under climate change

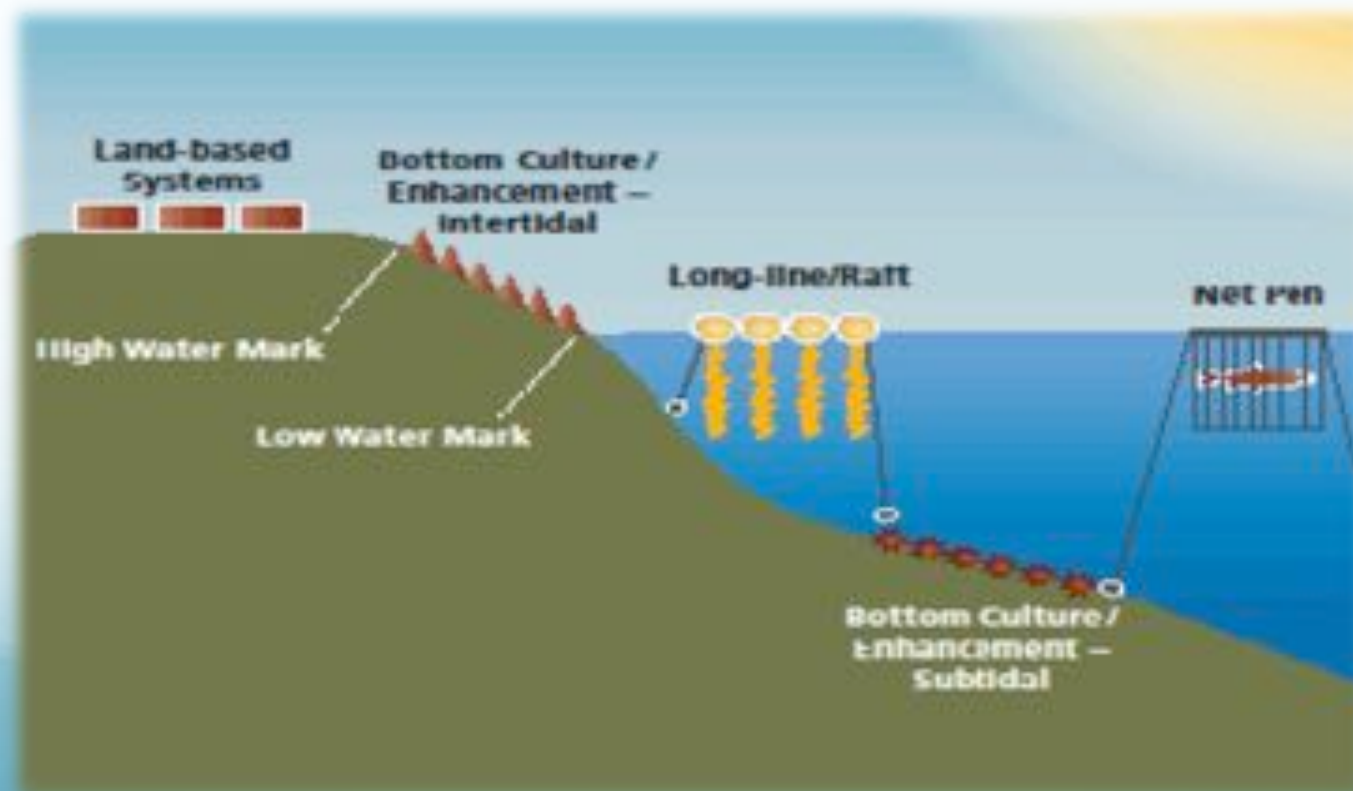
Muhammed Oyinlola
Nereus Program Annual Meeting
June 2016



Aquaculture... the act of fish husbandary

Mariculture

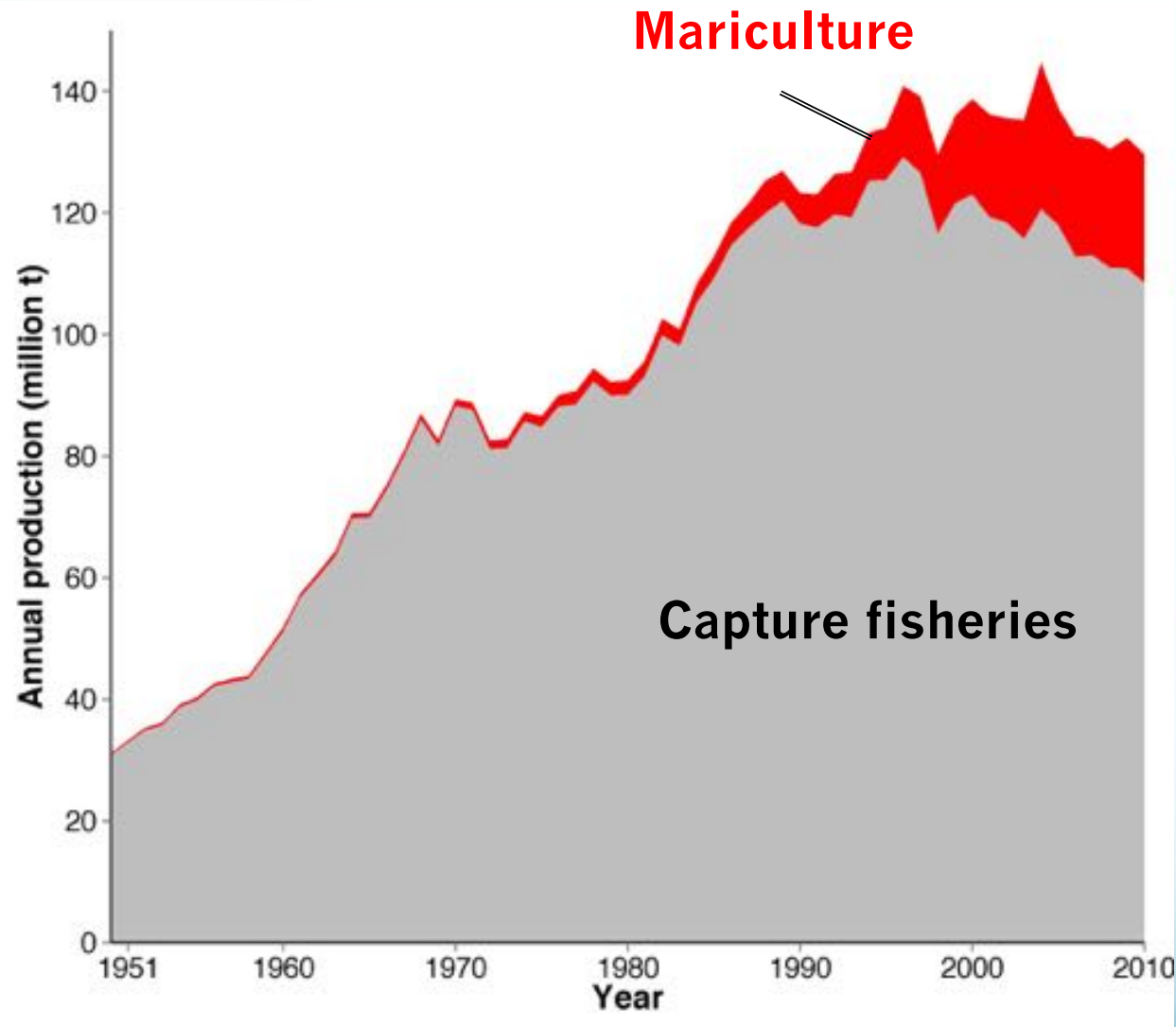
Cultivation of **aquatic** organism which the end product takes place in seawater, such as fjords, inshore and open waters, and inland seas or inland facility in which salinity generally exceeds 20 PSU.



Modify from
DFO, 2012

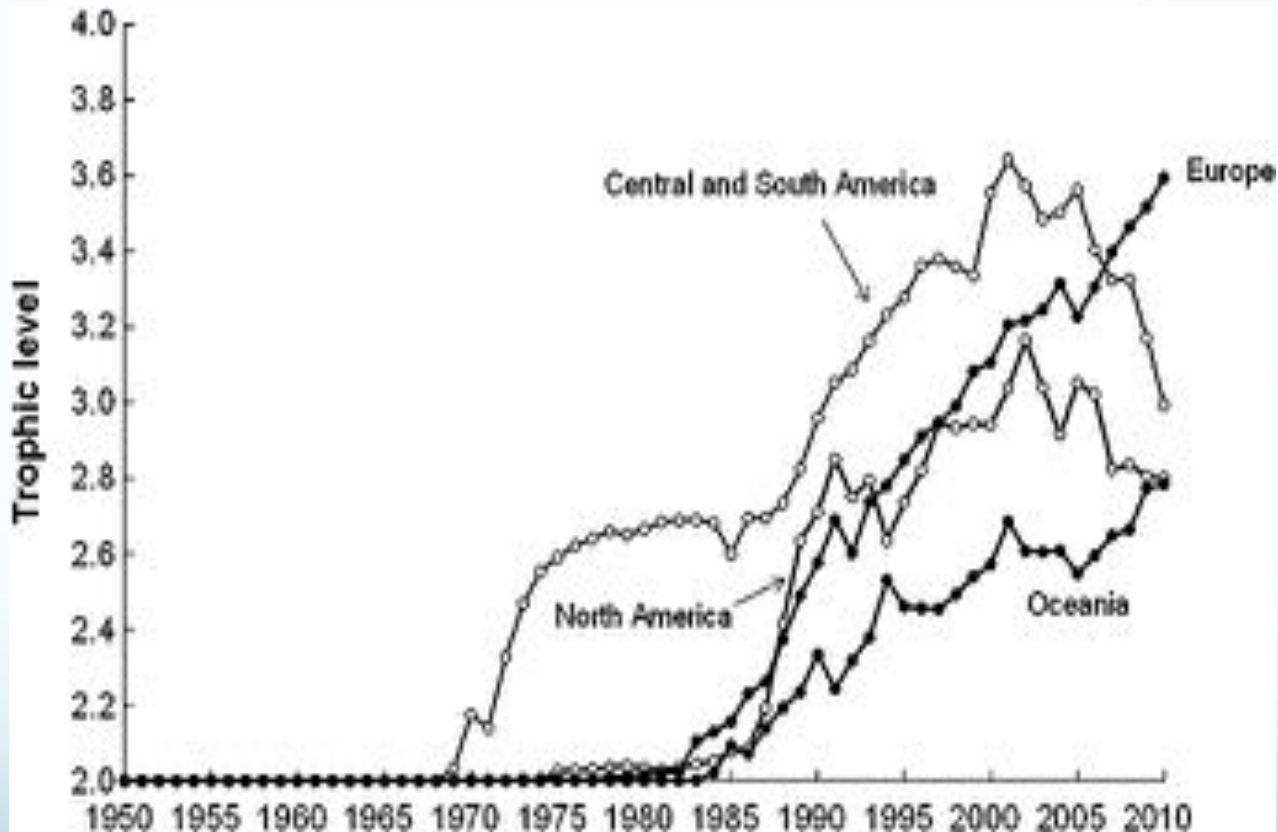


Global seafood production



Data source: Pauly & Zeller (2016); Campbell & Pauly (2013); Watson, Cheung *et al.* (2012)

Farming up the trophic level



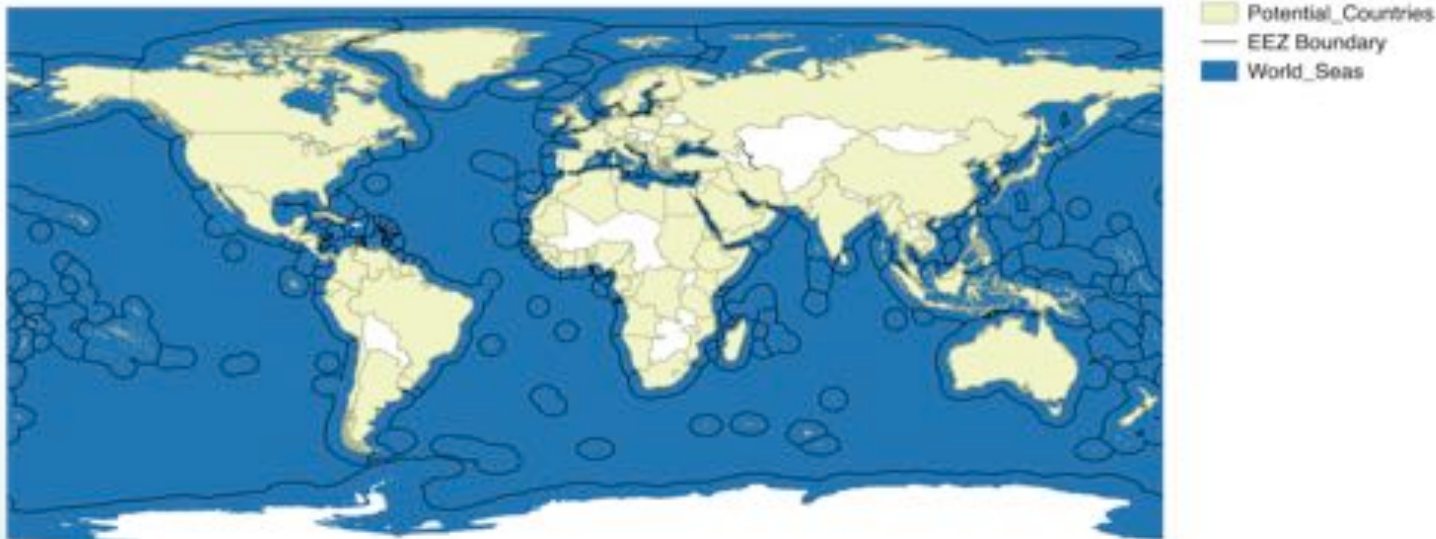
Desirable characteristics of organisms in aquaculture

- **Biological traits** e.g., fast growth, efficient conversion of food, high fecundity, artificial feed
- **Disease resistance**
- **Ability to breed in captivity**
- **Wide range environmental parameter tolerance**
- **Consumer acceptability and economic variability**
- **Supporting system (technology)**
- **Suitable environment for culturing**



Research questions

- What marine areas are suitable for farming existing cultured species at present?
- How would the suitability of these areas for mariculture affected by climate change and ocean acidification?



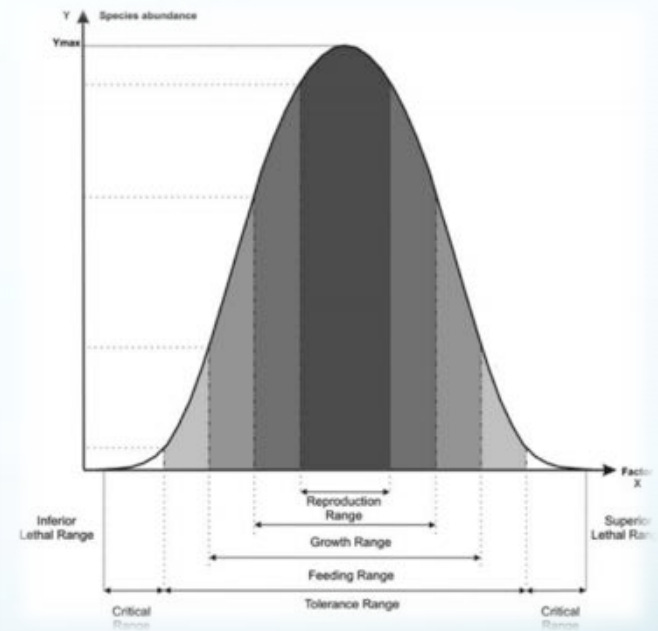
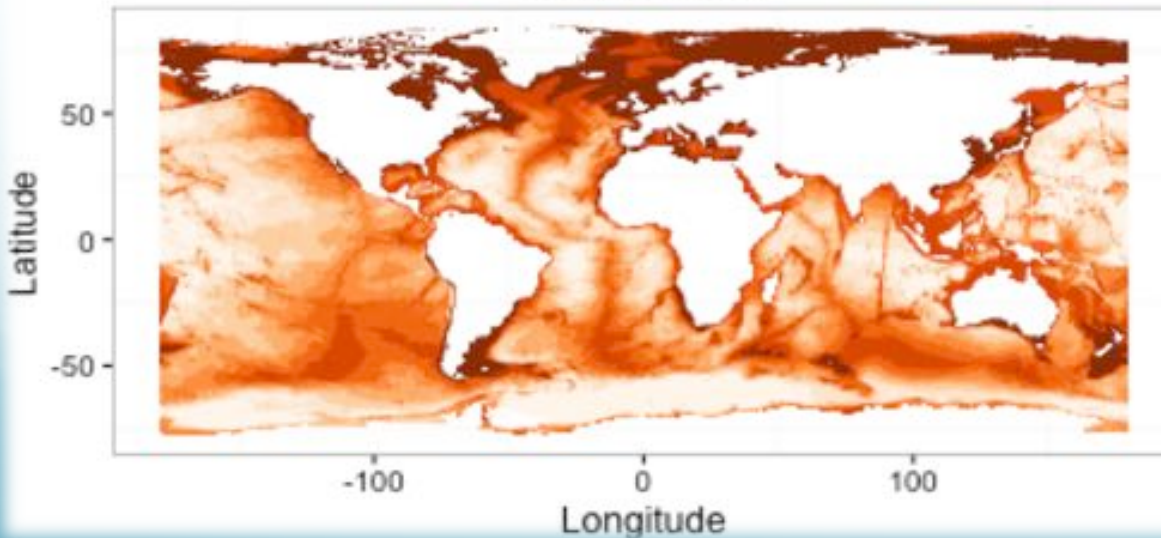
Map showing marine area available for mariculture



Species distribution models

- Predicting habitat suitability of marine areas for cultured species.

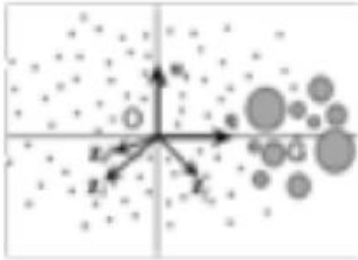
Salmo salar



Use of four modeling approaches

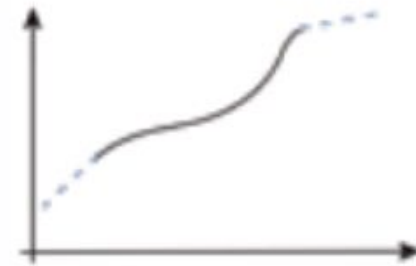
ENFA

ecological niche factor analysis
(based on PCA)



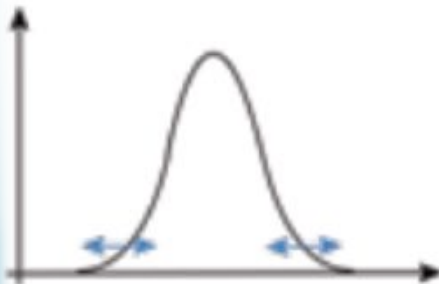
MAXENT

maximal entropy modelling



NPPEN

non-parametric ecological niche model



BIOCLIM (SRE)

surface range envelopp



Input data

- Presence data of wild populations
 - IUCN, OBIS, GBIF, FishBase
- Presence data of farmed species (102)
 - SAU Global Mariculture Database
- Environmental data: NOAA, NASA, GEBCO
- Other biological and habitat information
 - FishBase , Encyclopedia of Life



Mariculture spatial location database



Salmon Farm, BC
-125.012 50.326



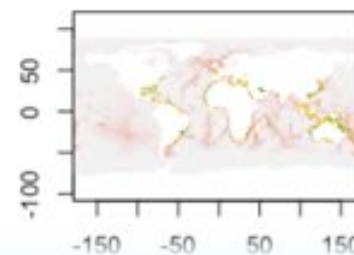
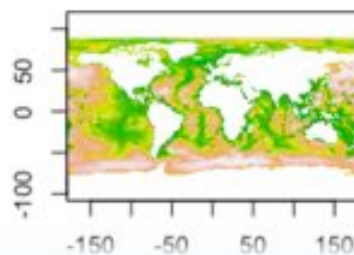
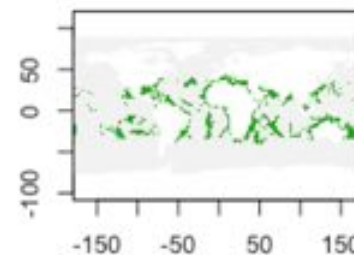
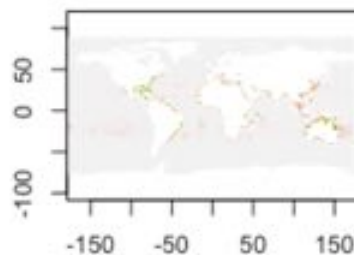
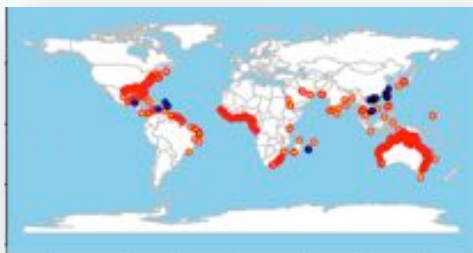
Tuna Farm,
Malta
14.405 35.962



Google
Earth to
ground
truth
mariculture
location
within each
EEZ



Cobia- *Rachycentron canadum*



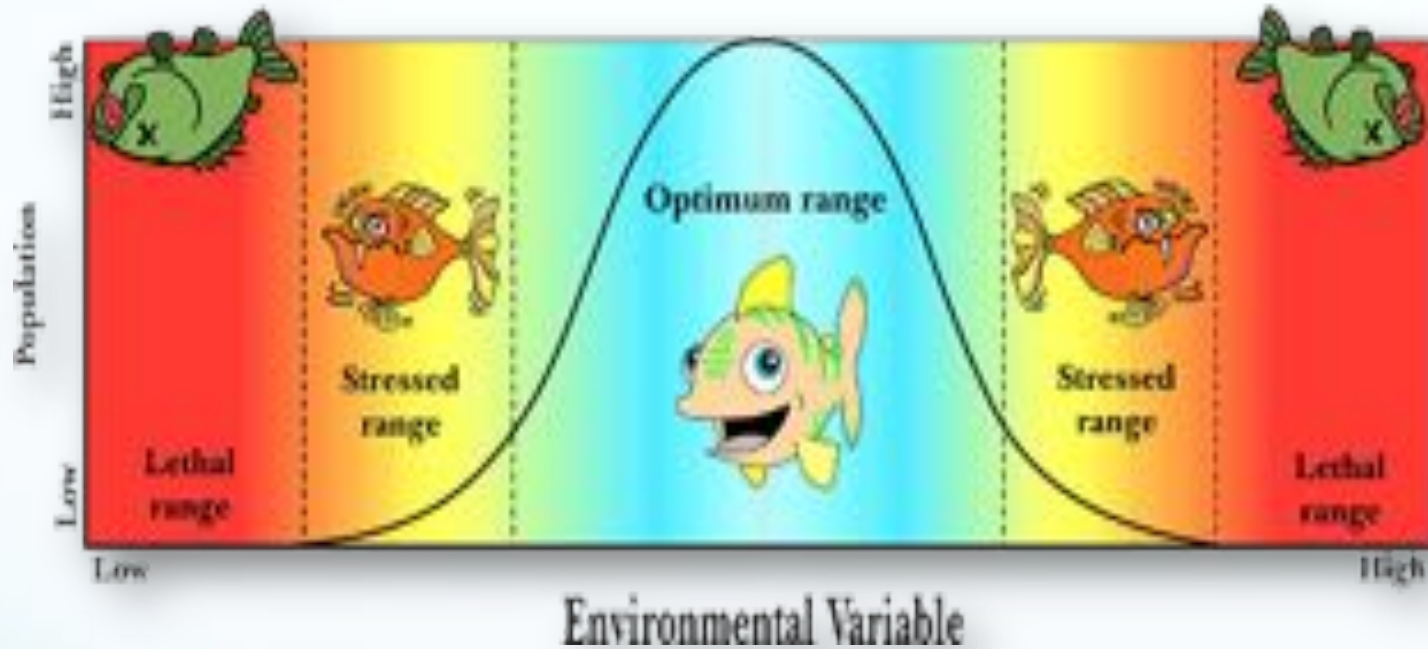
Multi-model weighted Map – Natural Habitat suitability index (HSI)



Multi-model weighted Map – Mariculture HSI



Applying threshold of suitability



Predicted values for known mariculture location
Predicted Value Background locations or
absence(Natural Habitat)

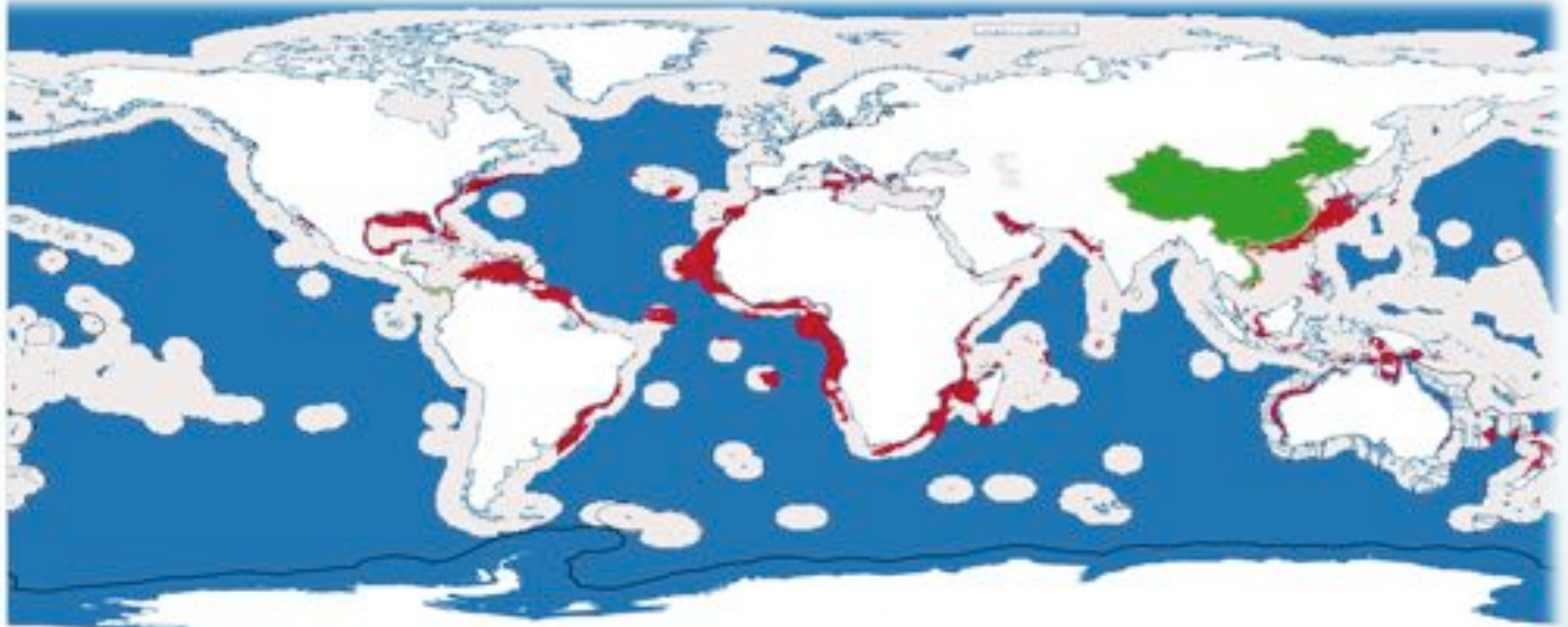


Potential Area Criteria

Criteria	Potential Area	Threshold
Boundaries	Within EEZ only	200nm (370.4km)
Favorable environment based on Habitat Suitability index	Area greater or equal to the prevalence value (i.e. modeled prevalence is closed to observed prevalence)	Derived for each species.
Conflicting use area	Areas outside protected areas	Potential areas exclude marine protected areas



Potential area for Cobia culture

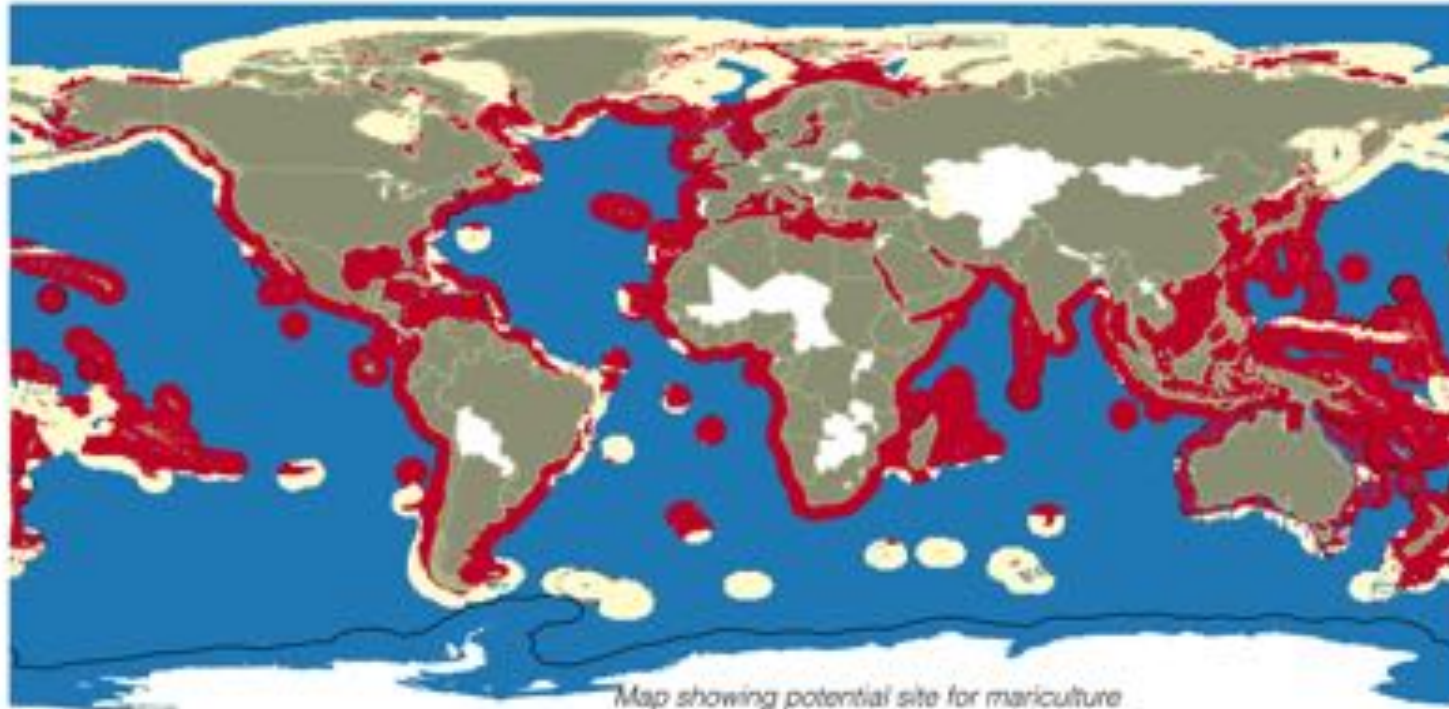


Map showing potential Cobia culture Area

- Present Cobia Culture Countries
- Not Available Area
- Available Area
- EEZ Boundary
- World_Seas



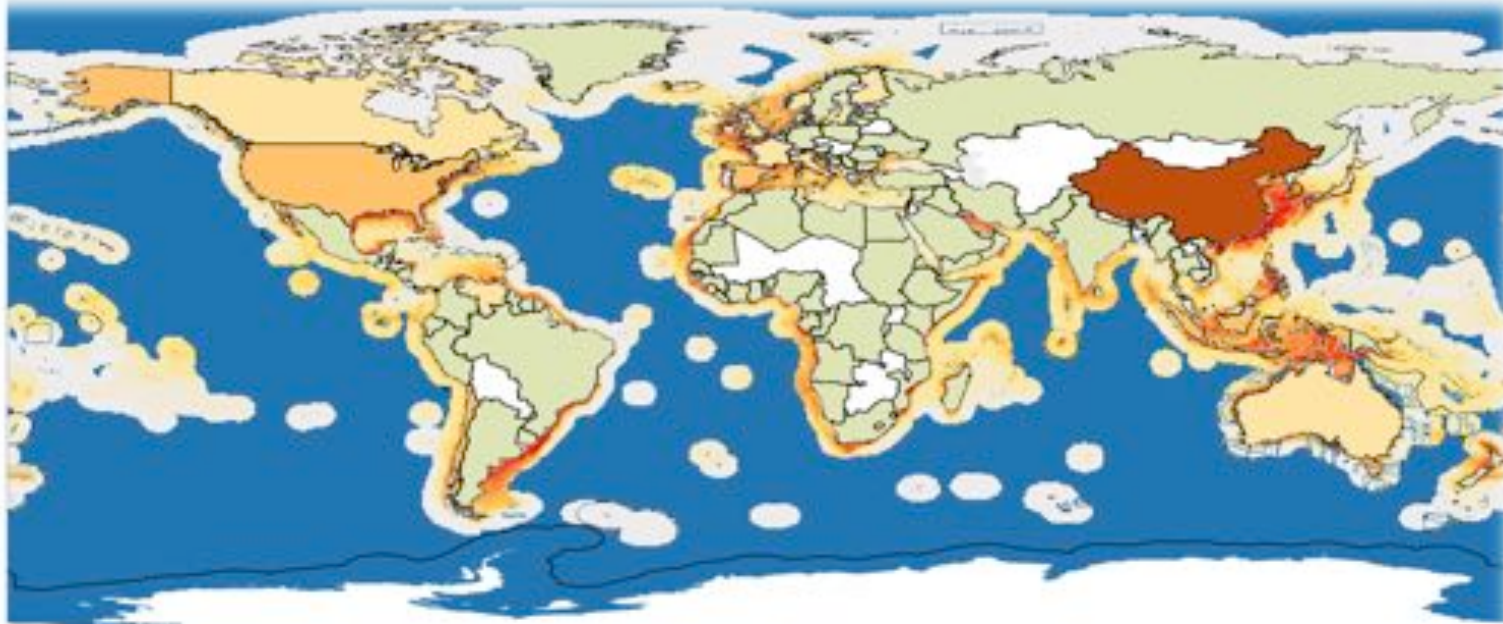
Total marine areas available for mariculture



- Potential_Countries
- Mariculture_Potential_Site
- Not Available Area
- Available Area
- EEZ Boundary
- World_Seas



Culture Species Richness (102 species)



Map showing potential species richness



Future works

- Predicting future changes in mariculture suitability under climate change;
- Apply species distribution model to predict the spatial range of pathogens and their overlap with the current and potential mariculture areas;
- Developing shared socio-economic pathways for aquaculture (SSPAs);
- Using bio-economic model to explore the potential socio-economic impacts of climate change on mariculture.



Thank you for listening



Ranking of Present Site

