PML | Plymouth Marine Laboratory

espa Deltas ecosystem services for poverty alleviation

Projecting fish production in Bangladesh under climate change

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UKaid from the British people | NATURAL ENVIRONMENT RESEARCH COUNCIL | E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL | espa ecosystem services for poverty alleviation

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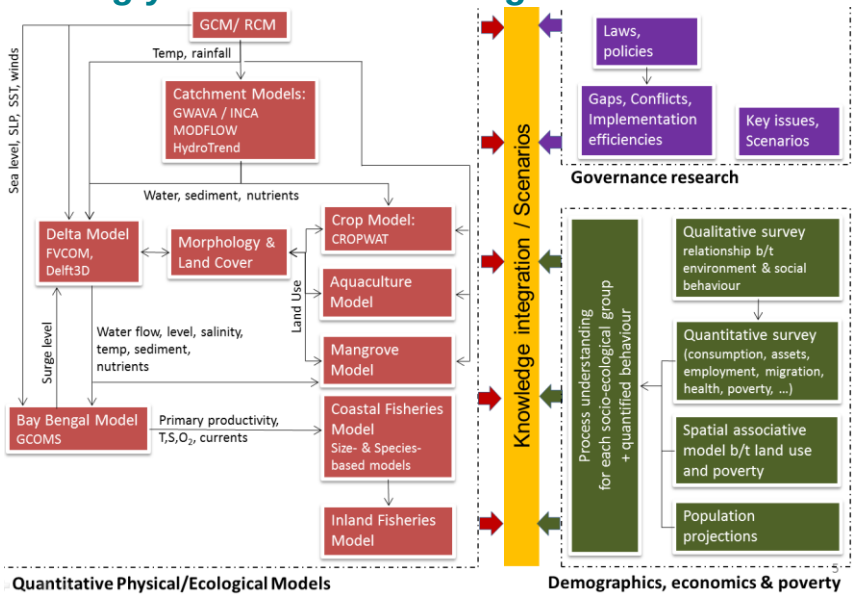
ESPA Deltas project:

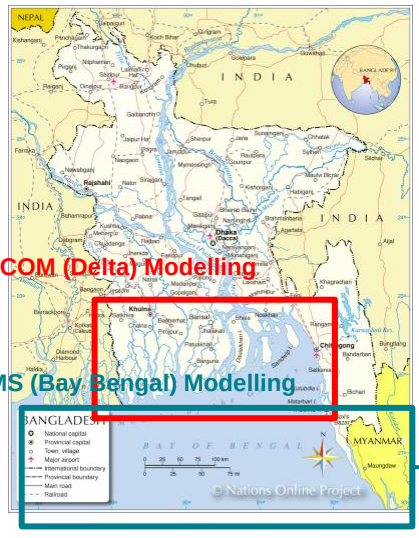
Overarching aim:
to provide the Bangladeshi policy makers with the knowledge and tools that enable them to evaluate the effects of policy decisions on people's livelihoods

Consortium:
UK (7), Bangladesh (11), India (4)
Lead partner: University of Southampton; Fisheries and marine leader: PML

Strongly based on modelling and collaboration



PML contribution in WP5: a modelling effort



FVCOM (Delta) Modelling

GCOMS (Bay Bengal) Modelling

Fisheries Modelling

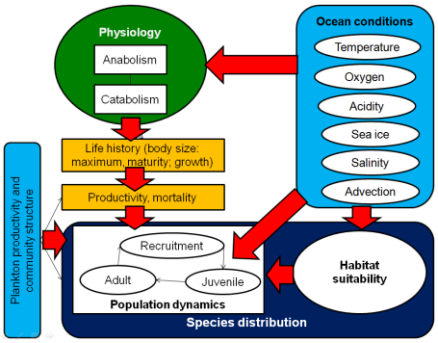
Jose Fernandes
Manuel Barange
TARA, BAU

Scenarios

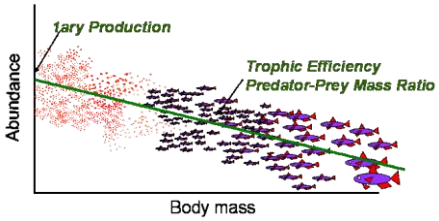
Ricardo Torres
Susan Kay
NOC-L, BUET

Modelling fish biomass and distribution

Species-based model



Size-spectrum model



Species-based + size-spectrum model = species interactions

Fernandes JA, Cheung WWL, Jennings S, Barange M, *et al.* (2013). Modelling the effects of climate change on the distribution and production of marine fishes: accounting for trophic interactions in a dynamic bioclimate envelope model. *Global change biology*, 19(8): 2596-2607.

Queirós A., **Fernandes JA**, …, Cheung WWL, Barange M, Widdicombe S. (2014). Scaling up experimental ocean acidification and warming research: from individuals to the ecosystem. *Global change biology*, DOI: 10.1111/gcb.12675.

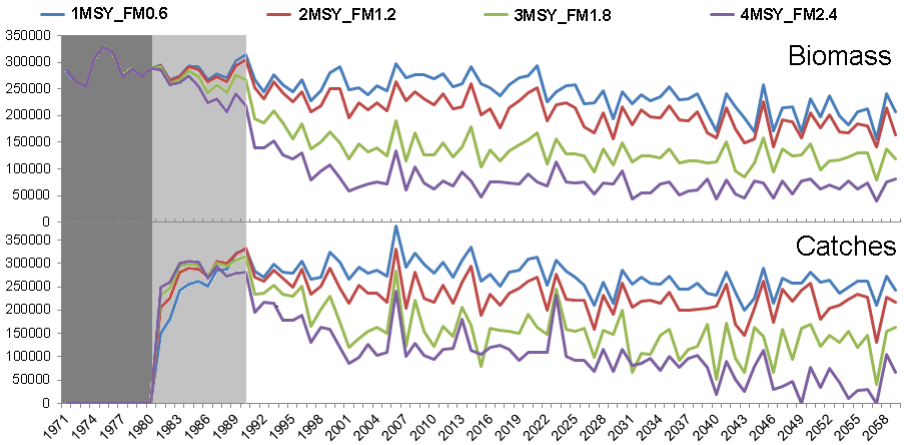
What we know about fisheries in Bangladesh?

Data source	1971	1981	1991	2001	2011
DoF marine	---	---	---	415 420	546 333
DoF inland open water	---	---	---	688 435	1 054 585
DoF inland close water	---	---	---	786 604	1 460 769
DoF total	---	---	---	1 890 459	3 061 687
FAO marine	87 920	118 200	258 884	379 497	607 492
FAO total	162 325	554 476	689 727	1 068 417	1 726 586
FAO marine Hilsa	---	---	114 681	154 654	198 574
FAO total Hilsa	---	---	099 487	229 714	313753

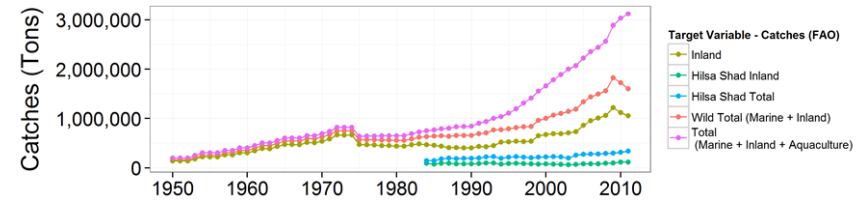
- Subsistence sector 46% of the catches.
- Artisanal fisheries 44% of the catches.
- Industrial fisheries 10% of the catches.
- Hilsa Shad 18% and Bombay Duck 9% of the catches.

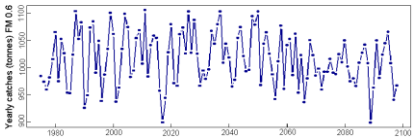
Hilsa Shad projections and management scenarios

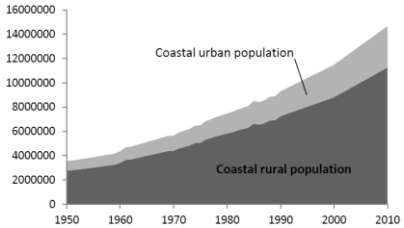
	BOBLME, 2010							Haldar & Amin 2005	Amin et al., 2008	Ahmed et al., 2006	Rahman et al., 2012		
Year	92	95	96	97	98	99	00	02	03	06	02	03	09
FM	1.25	1.43	1.78	2.01	2.18	2.49	1.62	2.16	1.92	1.39	2.15	1.94	1.87



Productivity vs fishing pressure (marine vs inland)



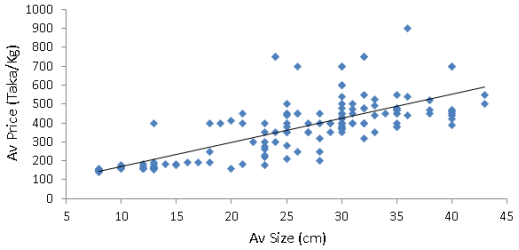




- Marine catches from models
- Wild inland catches from:
  - models
  - + scenarios cultured
  - + scenarios river usage
- Inland cultured from land usage + scenarios cultured

Fish market data and integration work

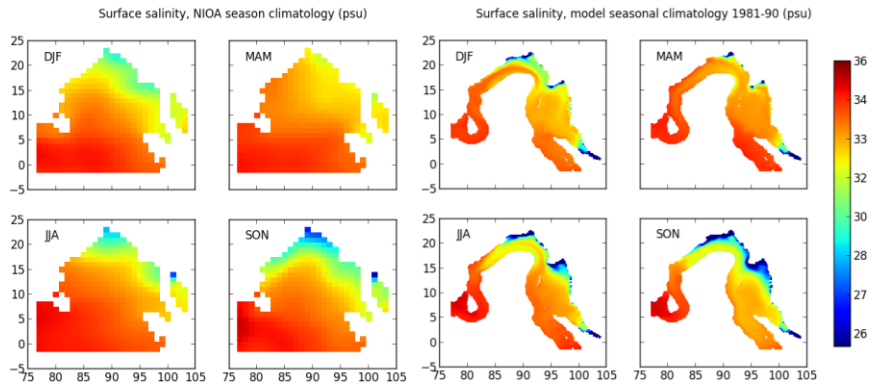
Size-prize relationship for Hilsa shad



Interviewing stakeholders (Cox's bazar 2014)

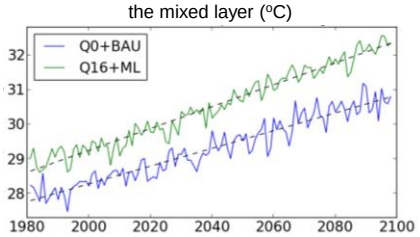
Or the other way around?

Model validation – surface salinity

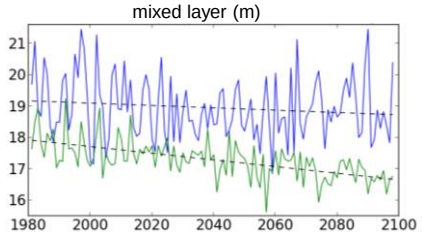


Projections at Bangladesh exclusive economic zone

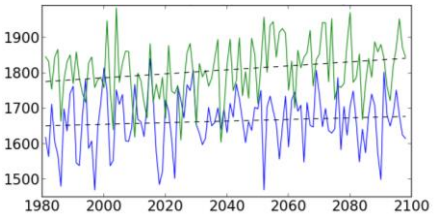
Annual mean temperature of the mixed layer (°C)



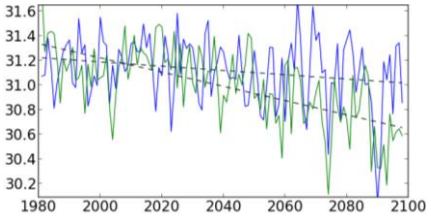
Annual mean depth of mixed layer (m)



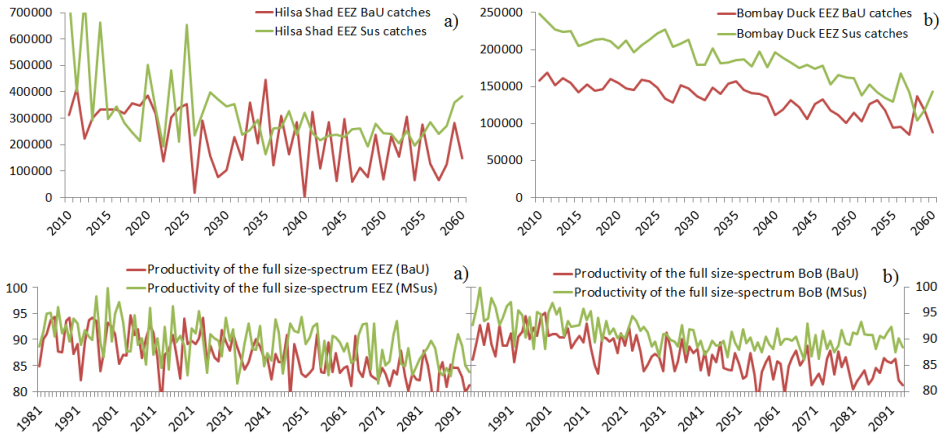
Annual mean net primary production (mg C $m^{-2}d^{-1}$)



Annual mean column-average salinity (psu)



Fisheries projections and full scenarios



- BaU: Business as Usual (Q0 + 3 times MSY)
- MSus: More Sustainable (Q16 + MSY)

Preliminary conclusions for Bangladesh EEZ

- All models projects **decreases** on potential catches comparing present and future (two main **species** between **-27 and -48%**; **total productivity -3.5 to -5%**).
- However, **higher** catches on average in the **more sustainable scenario by species** (**+42% higher in Hilsa Shad and +51% in Bombay Duck**) or in **total productivity (+4.9%)**.
- Therefore, climate change can impact negatively in Bangladesh fisheries. However, **good management can mitigate** potential catches lost due **climate change**.
- However, there can be additional **side effects** of climate change such as **smaller size catches** with lower economic value **impacting income** and livelihoods.