Fisheries science, an overview

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Food production on land

mostly high intensity which requires artificial inputs and land modification – e.g. tree felling, fertilizer, pesticides



Food production at sea

Wild capture – no inputs, some 'land modification', variable energy use, environmental control



ZOOPLANKTON

FISH / SHELLFISH

Oceanography drives everything



Much of our seabed was once dry



Shallow seas are key to the productivity of our waters:

Tidal mixing Wave mixing Warming Cooling



Spatial variability in water column characteristics related to depth, temperature and seabed topography and current



Shelf-Sea Stratification and Fronts



A snapshot of primary production and suspended material in the North Sea: this provides detailed spatial information

Permanent monitoring stations set up to provide greater insight into the prevailing physical and biological processes

Shallow tidally mixed areas are more productive

River discharge important for nutrients



Water column observations North Dogger – detailed temporal obs.



Fluorescence ($\mu g l^{-1}$) and Density ($\sigma_t kg m^{-3}$)



Depth (m)



There is a continuous transport pathway along the west coast from late spring – autumn



Strong flow along contours & weak exchange across pathway

Do plankton use this pathway?

"Red Tides"

Karenia mikimotoi is associated with fish and shell fish deaths. Instances of exceptional blooms of K. mikimotoi are associated with the pathway.







What is a fisheries scientist?



An environmental lobby group



Former UK fisheries Minister Chair of ICES





Celebrity chef



EU Commissioner

What should a scientist do? **Answer specific questions Provide independent evidence Evaluate different scenarios Suggest alternative approaches** What shouldn't a scientist do? Manipulate the data Be selective in their use of evidence **Ignore different scenarios** Have an agenda

The answer is obvious isn't it?



The policy or question

An opinion about the policy or question

...Well actually a bit more complex



The policy or question

Well, firstly it depends on your objectives...you might reduce fishing effort which would benefit stock status and the seabed, but you need to consider the socio-economic effects....or you might use a technical measure such as a gear modification.....or you might use MPAs, but you need to think about the effects of displaced activity...or you might use all of the above



Different paths to achieve the policy goal or answer the question



All fish gone by 2048

Not all science is good.....it varies in quality like everything else

Status (health) of major fish stocks



What we need to know to manage fisheries so that they are sustainable









Wider Ecosystem

Other species

People



How does natural death rate vary?

Short-lived fast growing species that mature at an early age have higher natural death rates and hence can tolerate high levels of fishing pressure



Contributors to natural death rate

There a many natural sources of natural mortality, predators, competition, cannibalism, parasites and disease, changes in habitat and environment (e.g. temperature)



What affects fishing mortality?

Examples:

Amount of fishing activity – more = increased mortality unless stock size increases

Not just the fish landed = deaths of **discards and escapees**

There are ways to limit fishing mortality:

Effort controls = days at sea

Total Allowable Catch = only limit on landed fish, not total number of fish that can be killed – **can encourage bad practices**

Market forces = high grading = discarding of fish that legally can





be sold

What affects recruitment?

There are many different factors that affect recruitment, temperature and food availability, predators, connectivity across entire populations



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Climate linked changes in plankton and recruitment





What we need to know to manage fisheries so that they are sustainable

Sothat's just the fish we are trying to catch

What about effects of fishing on the ecosystem?

And on other species including, fish, birds, mammals and reptiles?

And what about social objectives, employment, enforcement, slavery...?

I'm never bored!





Wider Ecosystem





Other species

People



Example of a trophic cascade, where fishing predators affects the rest of the system

Effects of fishing on the wider ecosystem

e.g. trawl impacts on the seabed





Tracks of otter trawlers on an intensively fished mud seabed

Understanding trawl footprint is critical





Computed ecological impact of fishing based on VMS records of bottom fishing disturbance for vessels >15 m



Resilience to disturbance: size-based effects

Body size	Growth	Mortality	Production/ Biomass	Vulnerability to extra mortality
Small	Fast	High	High	Low
Large	Slow	Low	Low	High



Scoloplos, short lived, small



Arctica, long lived, large



Fishing changes food availability for fish – fish follow the food



Any fishing activity has some form of impact on the marine environment



The majority of studies of static gears have focused on bycatch, very few have studied direct physical impacts on the seabed and its associated communities

Just because we catch a few birds or mammals doesn't automatically mean a fishing activity is unsustainable



Effects on people - management





Summary

Fisheries scientists have a clear role Fisheries scientists do not just count fish and shellfish They need to understand:

- Environmental factors that affect fish and shellfish
- Different life stages of the target species (what fishermen are trying to catch)
- What is landed at port, killed at sea, what survives
- How fishing impacts on the environment (e.g. seabed)
- How fishing affects other species
- How fishermen respond to management and how management impacts fishermen

