How commercial fisheries are managed

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Quickly comparing and understanding different fishery management approaches (and their outcomes) is a useful and important skill for policy makers. Now, a group of students (and one professor) at the University of Washington have made it much easier. Last month they published *How commercial fisheries are managed*, a paper that graphically represents every kind of fishery management scheme for easy comparison, while also using real-world case studies to explain each one.

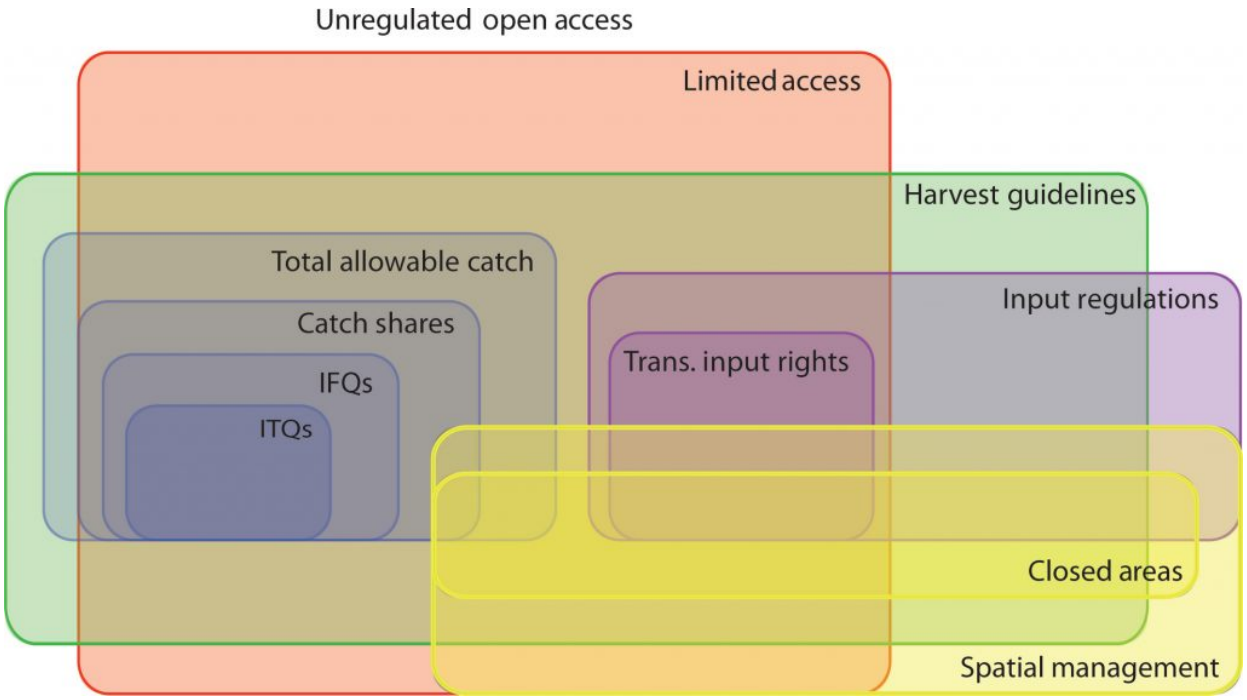
Anderson et al. 2018 and its discussion will be highly useful for fishery managers and policy makers and would also be a good addition to any kind of discussion on natural resource management.

Three paths in fishery management

Generally speaking, there are 3 ways to regulate fisheries:

1. Limiting catch
2. Limiting fishing effort
3. Limiting spatial access (marine protected area)

Anderson et al. 2018 traces each path's evolution in the figure below.



Venn diagram representing the relationships among common approaches to fishery management, with regions of greater overlap indicating additional restrictions. Beginning from unregulated open access, the diagram represents three pathways: 1) limiting catch (travels down the left of the diagram), beginning with limited access and adding restrictions on total allowable catch, allocating harvest rights through catch shares, individual allocation through individual fishing quota (IFQ) and individual transferable quota (ITQ); 2) limiting effort (travels down the right of the diagram) through establishing non-binding harvest guidelines, imposing input restrictions and then transferable input rights; and 3) controlling spatial access (travels right to left across the bottom) by establishing regulated-take or closed no-take areas, with the range of effort or catch controls applying within regions where fishing is permitted. From Anderson et al. 2018.

The paper also commented on triple bottom line outcomes for each management approach.

Management Approach	Economic	Ecological	Community
Open Access	Profit attracts entry into fishery until depleted stocks, saturated markets or costs of competitive fishing eliminates profit, the bioeconomic equilibrium.	Determined by stock pressure at point of zero profit. For valuable species, entry leads to overfishing. Can be sustainable for species with limited markets.	High employment during depletion phase, but low profits and wages mean poor jobs. Displacement and community disruption when stocks collapse.
Harvest Guidelines	Unenforced guidelines do not change Open Access outcomes.	Unenforced guidelines do not change Open Access outcomes.	Unenforced guidelines do not change Open Access outcomes
Limited Access	Incumbent fishermen invest in harvesting power to compete for more fish until profit is eliminated, leading to bioeconomic equilibrium.	Effort increases by permit holders lead to higher fishing pressure, depleting stocks, except for short-lived, highly fecund species	Low profits and wages mean poor jobs. Displacement and community disruption when stocks collapse.
Input Regulations	Fishermen increase unregulated inputs, capital stuffing, until profit is eliminated.	Capital stuffing increases effort and stock pressure.	Employment can increase if crew not regulated input, but low profit means poor jobs.
Tradable Input Regulations	Input rights shifted to those who can capital stuff most efficiently. They continue to do so until profit is eliminated.	Shifting input rights to more effective capital stuffers exacerbates resource depletion.	Crew displaced from selling vessels; adverse effects in communities whose residents sell; remaining jobs still low-paying.
Total Allowable Catch (TAC)	Fishermen invest to compete more effectively for fish, until profit is eliminated.	Correctly set and enforced TACs support sustainability.	Race-to-fish leads to seasonal, high-paying and dangerous jobs.
Catch Shares	Groups receiving collective allocations can coordinate rather than compete, reduce costs to and improve price.	Correctly set and enforced TACs support sustainability.	Stakeholders make tradeoff between number and quality of jobs, but non-members disenfranchised.
Individual Fishing Quota (IFQs)	Individually fixed catch quantity induces fishermen to maximize profit per fish by cutting costs, improving price.	Correctly set and enforced TACs support sustainability.	Less intensive fishing may reduce employment, but profits mean jobs are safer, better paying.
Individual Transferable Quota (ITQs)	Like IFQ, but additionally quota moves to more efficient vessels, increasing profitability of the fleet.	Correctly set and enforced TACs support sustainability.	Crew displaced from consolidation; remaining jobs safer, better paying; disproportionate adverse effects in communities whose residents sell.
Spatial Management	Behavioral response and economic outcomes from fishing zone determined by approach, above, in place there.	Closing areas calibrated to the life history of the species increases biomass within the area, and may create spillover to be caught.	Community outcomes from where fishing allowed determined by approach, above, in place there.

Summary of behavioral changes observed under each approach to effort management, with associated economic, ecological and community outcomes. Background shading indicates generally negative (red), mixed (yellow) or positive (green) outcomes; gradients reflect outcomes depend on other features of management. From Anderson et al. 2018

Positive social, ecological, and economic outcomes are the major goals of fishery management. When we write or tweet about “improving fishery management” we mean improving one or more of these outcomes until all three are satisfactory.

Is there a best way to manage fisheries?

This is a tricky question for a variety of reasons. First, everything in management comes down to the capacity of the regulating body—rules are followed as well as they are enforced. Some governing bodies only have the capacity to enforce harvest guidelines. Some can organize and operate a full catch share system. Mixing and matching regulations to maximize capacity is the way to go. Improving management often means improving capacity to manage.

Second, there is widespread *philosophical* disagreement about approaching fishery management. Policy makers with a capitalist bent tend to prefer economic outcomes. Others believe ecological outcomes should weigh higher than social outcomes (or vice versa). There are many ways to value a natural resource. However you feel about fishery management, Anderson et al. 2018 will better inform your opinion.

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