



• “Scale misperceptions and the  
spatial dynamics of a social-  
ecological system”



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What questions to the authors wish to address?

- What are the consequences of misunderstanding the spatial structure of a natural resource population?
- What if the spatial scale of natural populations doesn't match the scale of decision-making, regulation, and management?

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## The subject of study: regulated ocean fisheries

- Large jurisdictions remain the norm for regulatory agencies
- out of necessity, must ignore small-scale elements that may be of key operational importance to individual systems
- is the poor performance of fisheries in maintaining population levels the result of discrepancies in scale?

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## the problem of overfishing

- May be caused by inadvertently destroying the spatial structure of a population rather than just harvesting too many fish
- given this, at what scale should fishery management operate?

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## 2 alternative views of population behavior

- panmictic: high rate of mixing between local populations, if one local population is wiped out, it will quickly be re-colonized
  - no need to manage local populations separately, so scale misperceptions do not matter

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- Metapopulation: local populations are fairly discrete, and reproductively separated, by means of different spawning sites from other local populations
- with these characteristics, it differs spatially from panmictic populations by the cause and patterns through which fishing may bring about extinction
  - ex: total take vs. spatial distribution of take

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## Set-up of the model

- 3 local, harvested populations, which managers assume are one large, undifferentiated population
- examined as either panmictic or metapopulation, and under different management rules: open access, constant percent harvest quota, and sole ownership
- compared to a baseline, one “true” population model

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## The different management rules

- Open access: when rents are positive, entry takes place, when negative, exit. Assumes transactions costs minimal, no lags
- constant percentage harvest quota: 28% times the number of fish to be caught, allocated to a number of boats
- rent-maximizing sole owner: uses a 5 year trend comparing results with number of boats to find the ideal harvest rate

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## More on the model

- Panmictic and metapopulations characterized in terms of a logistic stock/recruitment relationship
- differ in terms of critical minimum population: for panmictic, no minimum size specified, for metapopulation, minimum size was .05 of the carrying capacity

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## Variables in the model

- transrate: a function of the difference in the density of the 2 populations, measure how able fish are to move between local populations
- switchrate: the rate of profit of fishing each of the 3 local population is equalized to the extent that fishermen can move back and forth between them
- both are large sources of internal variability

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## Further hypotheses

- Scale misperceptions are at their worst when one of the local populations is near the critical minimum point. Will happen when:
  - open access rule leaves metapopulation structures very vulnerable
  - profit differentials should cause fishermen to move to sites of higher density
  - fish, however, move to sites of low density (in panmictic, instead of one “true” population)

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## Testing the hypotheses

- Back to the original question- Does the management rule make a difference if there is a misperception of appropriate population scale?
- Simply put, yes, but only if the system is subject to some internal or external variability

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## More results

- Open access rule worse than assumed if population is actually panmictic, and far worse if metapopulation
- when a scale misperception problem is present, the migration of fish and fishermen helps to mitigate the adverse effects on local populations (to follow lower densities and higher profit margins, respectively)

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## Overall conclusions

- Extent of scale mismanagement depends on the kind of population structure assumed
- if panmictic, this leads to few problems for local populations
- if local populations more closely follow a metapopulation structure, the wrong scale could lead to inadvertent overfishing

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## Policy prescriptions

- Shift from centralized regulatory and management agencies to local agencies that can better appraise local ecological conditions, and the best scale for policy

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## critiques

- Categories of management rules very broad
  - sole ownership very rare, setting quotas is very contentious, and set at a more local level, distortion by corruption likely