Daphnia Fishery: Population Dynamics in Response to Harvesting and Stochasticity

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Why does harvesting increase variance?

Exploited populations have been shown to have amplified variance over time, but the mechanism behind this is not empirically understood.

Hypotheses

1. **Intrinsic destabilization of nonlinear dynamics[1,2]**
2. **Increased tracking of environmental stochasticity[1-4]**

These processes could work either independently or in concert to increase population variance. Both have similar manifestations, but different management implications.

Methods

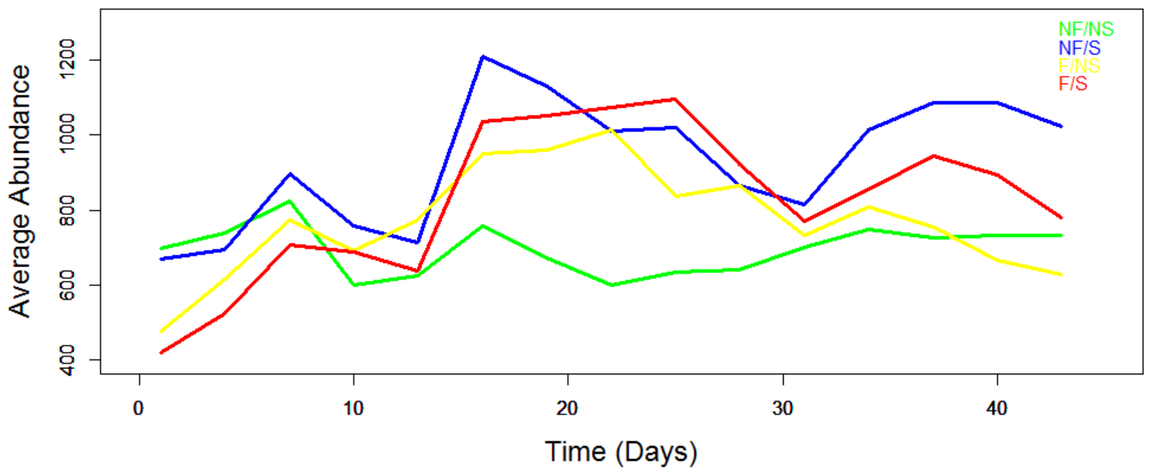
Daphnia magna

Harvesting
Removal of adults at MSY through filtration
Stochasticity
Random variation in the food supply
Abundance and Size Distribution
Random sampling and filtering of adults
Measuring Variability Over Time
Coefficient of variation

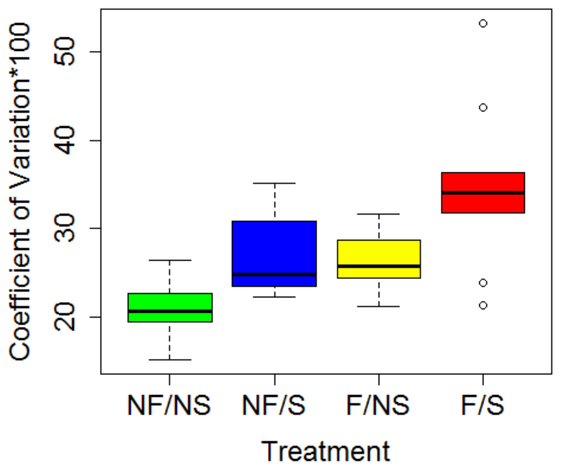
	No Fishing	Fishing
No Stochasticity	NF/NS	F/NS
Stochasticity	NF/S	F/S

Pilot: harvesting intrinsically increases variance in exploited populations

Average abundance by Treatment



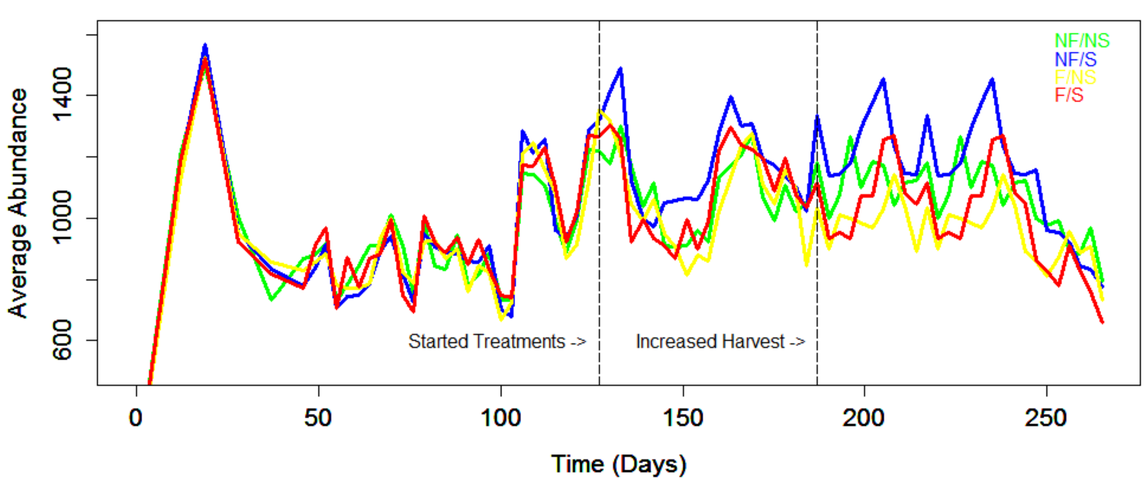
Coefficient of variation



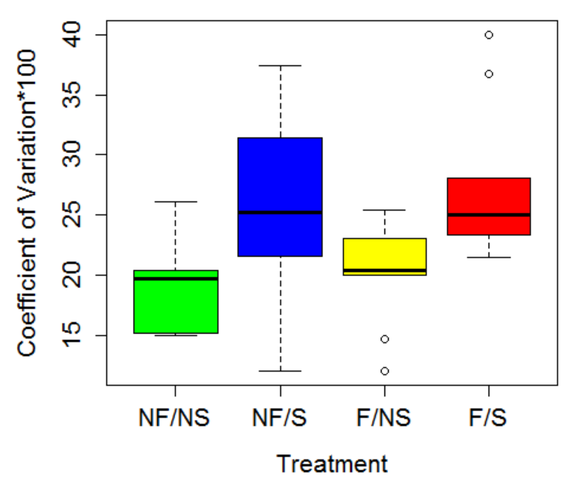
- Significant increase of the coefficient of variation by fishing ($p<0.01$) and by stochasticity ($p<0.01$) without an interaction
- Unexploited and exploited populations show the same response to stochasticity
- Suggests that **harvesting has an intrinsic effect on increasing variance** over time in exploited populations
- Protocols were altered during this short pilot, warranting a longer term experiment

Long-term experiment: ongoing, still inconclusive

Average abundance by Treatment



Coefficient of variation



- Populations were seeded with 150 individuals and allowed to stabilize for 126 days
- Treatments did not yield differences after 59 days, so harvesting effort was increased
- 17 data points with increased fishing effort
- Fishing effect not significant ($p=0.42$)
- Stochasticity effect significant ($p<0.01$)

Next Steps

- Experiment will continue into fall 2016 with financial assistance from an NSERC USRA.
- Harvesting effort and food supply variance will be increased further if effects are not seen.
- Differences in fecundity and size/age distribution among treatments will be measured.

Acknowledgements

The graduate students in the MK Lab provided insightful feedback, and the undergraduate volunteers and work studies put in long, dedicated hours of work in the lab. Jessica Phillips provided helpful insight in preparation of this presentation. Devon Keller worked early mornings and late nights on all sampling days assisting in treatments and population maintenance.

References

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