Common Pool Resource Challenges in Herbicide Resistance Management

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Outline

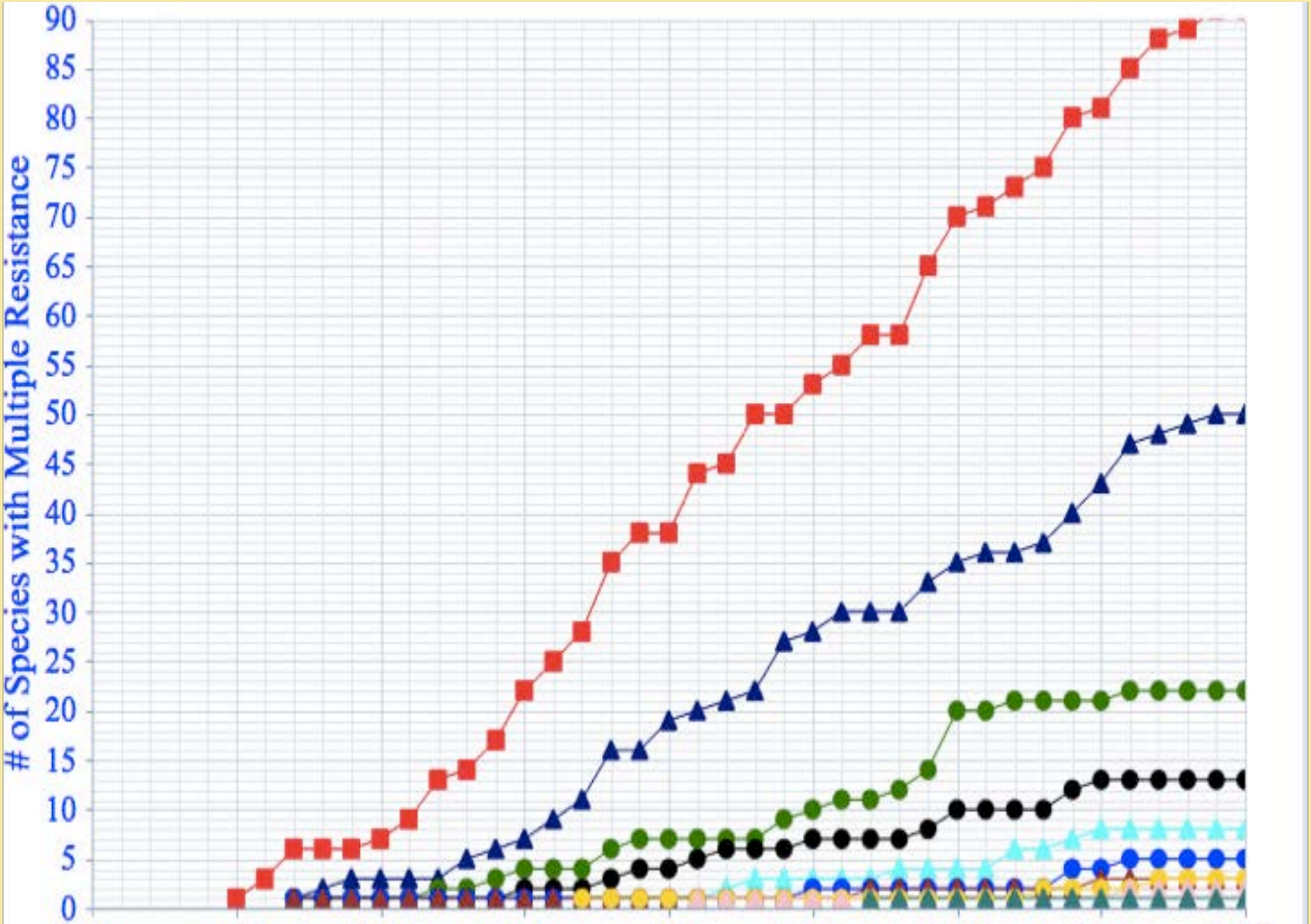
- Common pool resource (CPR) challenges with herbicide resistance
- Why community-based approaches?
- Design principles
- Evidence and lessons from community-based programs for CPR management
- Acknowledgment: Joint work with George Frisvold


THE PROBLEM

Harvesting ragweeds and corn!

Glyphosate Resistant Giant Ragweed (*Ambrosia trifida*) infesting Roundup Ready Corn. Photo: Dr. Bill Johnson

Multiple SOA resistance is rising! (Heap)



2000-2005: 17% of growers hand-weeded
5% cotton acres at *$2.40/A*

2006-2010: 92% of growers hand-weeded
52% cotton acres at *$23.70/A*

Source. S. Culpeper. U. Georgia

Common Pool Resource Dynamics

- Herbicide resistance (HR) occurs due to selective ecological pressure on weeds.
- Weed resistance mobility occurs from natural processes, e.g., pollen drift, water flows, and from machinery operations.
- Hence the genetic pool of weeds susceptible to control by certain herbicides is a common pool resource shared across farms and the community landscape.

Common Pool Resource Challenges

- Grower actions affect other growers via
  weed gene movement (n*onexcludable externality*)
- If farmers feel their control actions will not be matched by their neighbors, they have less incentive to manage HR on their lands.
- It's an assurance problem! (Individual decisions depend on those of the group.)
- With mobility, strategies to control HR farmer by farmer will not optimize welfare; some form of collective action is necessary (Ostrom).

Why Community-Based Approaches?

1. Voluntary education and tech assistance for individual farmers are not working well.
2. Top-down prescriptive regulation could be used, but……
   - Lack of flexibility increases control expense
   - Prescriptive practices often stymie innovation
   - High monitoring and enforcement costs to check compliance across the landscape (Do we really want a weed police?)

Why Community-Based Approaches?

3. Public or private technology/practice subsidies can have similar problems…….
   - Difficult to identify strategic targets
   - Additionality? Will payments just become income transfers without altering behavior?
4. Resource privatization is generally infeasible due to geographic scope of weed mobility.
5. What's left? -- Community-based common pool resource management, an exercise in institutional (socio)economics (Ostrom et al)

Design Principles for CPR Mgmt
(Ostrom et al.)

1. Clearly define resource boundaries
2. Adapt rules to local conditions
3. Ensure broad participation by "appropriators"
4. Monitor accountability to appropriators with sanctions

Design Principles for CPR Mgmt
(Ostrom et al.)

5. Employ graduated sanctions

6. Use cheap and easy conflict resolution mechanisms

7. Recognize self-determination of the community, e.g., state statute

8. Consider “polycentric” governance (multiple layers) for larger issues

Evidence on CPR Design Principles (Cox, Arnold and Tomas)

- Meta analysis of 91 CPR studies found good empirical support for all principles.
- Suggested refinement of principles 1, 2 & 4:
  - 1a. Clearly defined boundaries: Individuals or households who have rights to withdraw resource units from the common-pool resource (CPR) must be clearly defined.
  - 1b. Clearly defined boundaries: The (geographical) boundaries of the CPR must be well defined.

Evidence on CPR Design Principles (Cox, Arnold and Tomas)

- 2a. Congruence between appropriation and provision rules and local conditions: Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions.
- 2b. Congruence between appropriation and provision rules and local conditions: The benefits obtained by users from a CPR, as determined by appropriation rules, are proportional to the amount of inputs required in the form of labor, material, or money, as determined by provision rules.

Evidence on CPR Design Principles (Cox, Arnold and Tomas)

- 4A. Monitoring: Monitors are present and actively audit CPR conditions and appropriator behavior.

- 4B. Monitoring: Monitors are accountable to or are the appropriators.

CPR applications relevant to HRM

- *Public initiatives* (e.g., invasive and noxious weed control)
- *Joint private-public* strategies (e.g., boll weevil eradication)
- *Producer associations* with sanctions written in state law (e.g., pink bollworm control in CA, AZ and NM)

But CPR programs are complex….

Agrawal (2003) – meta review of studies

- Factors affecting formation do not have unequivocal effects, e.g., size of group.
- Higher group heterogeneity is not always a disadvantage.
- Need to account for resource, social/political contexts and community/personal values

Insights from literature

- Exchange of information important
  - Multi-directional vs. uni-directional flow
  - Listening is underrated
- Building institutional capacity takes time and requires maintenance (even after crises subside).
- "If/then" statements based on scientific information that show economic consequences are more effective than exhortations of what people "should" do.

Concluding Observations

1. HR is a ***wicked problem*** (interacting biophysical, technological, economic and social systems) that defies simple solutions.
2. Private and/or public collective approaches are necessary when mobile HR traits exist.
3. Ostrom's design principles can help guide CPR management, but context matters.
4. Success will likely require participatory research that uses local knowledge and social capital to foster trust and minimize transaction costs.

References

- Agrawal, A. 2003. Sustainable Governance of Common Pool Resources: Context, Methods and Politics. *Annual Review of Anthropology*. 32:243-62
- Cox, M., G. Arnold, and S. V. Tomas. 2010. “A Review of Design Principles for Community-Based Natural Resource Management,” *Ecology and Society* 15(4): 38 (available at http://www.ecologyandsociety.org/vol15/iss4/art38/)
- Ervin, et al. National Research Council. 2010. *The Impact of Genetically Engineered Crops on Farm Sustainability in the United States*. National Academies Press.
- Ervin, D. and R. Jussaume. 2014. “Herbicide Resistance: Integrating Social Science into Understanding and Managing Weed Resistance and Associated Environmental Impacts,” *Weed Science* 62 (2): 403-414

References

- Heap, I. The International Survey of Herbicide Resistant Weeds. Online. Internet. Wednesday, April 29, 2015 . Available www.weedscience.org
- Ostrom E (1990) Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge, UK: Cambridge University Press. 298 p.
- Ostrom E, Chang C, Pennington M, Tarko V (2012) The Future of the Commons: Beyond Market Failure and Government Regulation. London, UK: Institute for Economic Affairs. 104 p

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