Going beyond panaceas

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In the context of governance of human–environment interactions, a panacea refers to a blueprint for a single type of governance system (e.g., government ownership, privatization, community property) that is applied to all environmental problems. The aim of this special feature is to provide theoretical analysis and empirical evidence to caution against the tendency, when confronted with pervasive uncertainty, to believe that scholars can generate simple models of linked social–ecological systems and deduce general solutions to the overuse of resources. Practitioners and scholars who fall into panacea traps falsely assume that all problems of resource governance can be represented by a small set of simple models, because they falsely perceive that the preferences and perceptions of most resource users are the same. Readers of this special feature will become acquainted with many cases in which panaceas fail. The articles provide an excellent overview of why they fail. Furthermore, the articles in this special feature address how scholars and public officials can increase the prospects for future sustainable resource use by facilitating a diagnostic approach in selecting appropriate starting points for governance and monitoring, as well as by learning from the outcomes of new policies and adapting in light of effective feedback.

resources | social–ecological systems | sustainability

This issue of PNAS features eight articles that address the challenging issue of how to go beyond relying on abstract cure-all proposals for solving complex problems related to achieving sustainable social–ecological systems‖ (SESs). *The Oxford English Dictionary* defines panacea as "a remedy, cure, or medicine reputed to heal all diseases; a . . . universal remedy" (ref. 4, p. 122). A core aspect of panaceas is the action or tendency to apply a single solution to many problems. In the governance of human–environment interactions, a panacea refers to recommendations that a single governance-system blueprint (e.g., government ownership, privatization, community property) should be applied to all environmental problems. The aim of this special feature issue is to provide theoretical analysis and empirical evidence to challenge the presumption that scholars can generate simple, predictive models of linked SESs and deduce general solutions to problems of the overuse of resources.

The Prevalence of Panaceas

Scholarly journals are peppered with works predicting ecological disasters unless some preferred cure-all is adopted (5–9). The best known is Hardin's (10) article "The Tragedy of the Commons." Hardin predicted that herders using open-access pastures (his metaphor for human–environmental interactions) would be driven to ruin by their pursuit of private interests while imposing harm on others. To solve the problem of overuse, Hardin recommended that a coercive force outside of individual psyches impose either a Leviathan or private ownership.

Many scholars have mapped Hardin's ideas onto a range of human–environment systems and have predicted dire consequences for their long-term viability unless his first solution, government ownership, is imposed. Even though >100,000 areas around the world are formally protected, and the effectiveness of many of these areas is unknown, some advocates still call for further efforts to create protected areas as the only way to protect biodiversity (11, 12). Others argue that "the *only* way to avoid the tragedy of the commons in natural resources and wildlife is . . . by creating a system of private property rights" (ref. 13, p. 467). Marketable permits continue to be presented as the optimal method for solving free-rider problems and for providing effective common-pool resource management (14–16).** Furthermore, collaborative approaches involving community participation are frequently "portrayed as a cure-all," to the distress of researchers who work in the field (ref. 26, p. 382).

Advocates of panaceas make two false assumptions: (*i*) all problems, whether they are different challenges within a single resource system or across a diverse set of resources, are similar enough to be represented by a small class of formal models; and (*ii*) the set of preferences, the possible roles of information, and individual perceptions and reactions are assumed to be the same as those found in developed Western market economies.†† Large studies of land-use and land-cover change have not found evidence for any single, ever-present driver of change (27, 28). Experimental and field research has consistently found that individuals overtly facing the same situation vary substantially in their behavior (29, 30). As Ackoff (ref. 31, p. 8) has reflected, "panacea proneness is a diluted form of fundamentalism" rather than a method of serious diagnosis.

Panaceas Frequently Fail

The track record of the use of panaceas is one of repeated failures (32). For example, Higgs (ref. 33, p. 247) outlines how efforts to turn the regulation of the Washington salmon fishery entirely over to the state government, a frequently recommended cure-all, generated "a legal and economic horror story" that reduced productivity of the fishery to a "small fraction" of what it was at the

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Abbreviation: SES, social–ecological system.

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‖Socio-ecological systems (1), social–ecological systems (2), and coupled human–environmental systems (3) are commonly used in the literature to describe systems of human–environment interactions.

**Economists recently have begun to call into question the presumption that privatization is a panacea and the only way to protect the commons (17–19). In contrast to panacea thinking, solid empirical studies of diverse property-rights systems have been undertaken by Eggertsson (20), Libecap (21, 22), Libecap and Wiggins (23), Blomquist *et al.* (24), and Acheson (25).

††We thank Scott Page for pointing out these two basic errors of panacea thinking (personal communication, October 2, 2006).

turn of the 20th century. Bacho (34) documents how the panacea of decentralization, as implemented in a multiethnic district of Ghana, generated extensive ethnic conflict. Gelcich *et al.* (35) report how imposing a blueprint comanagement system on a traditional lottery system for managing a marine ecosystem weakened the level of trust in a community and intensified conflict.

Clark (36, 37) illustrates how applying bioeconomic models as panaceas has led to an excess of fishing vessel capacity, conflict among fishers and with fishing communities, and the enrichment of a select few. Von Weizsaecker *et al.* (38) challenge the view that privatization is always the best option for delivering public services and present 50 case studies on best-case vs. worst-case experiences of efforts to privatize water, transport, and energy as they potentially impact climate change (see also ref. 39). In his deep analysis of failed state planning, Scott (ref. 40, p. 6) makes a strong case against "hegemonic planning mentality that excludes the necessary role of local knowledge and know-how."

Going Beyond Panaceas

The special feature contributes both theoretical methods and empirical findings that will help applied sustainability scientists to go beyond panaceas. Ostrom (41) presents a framework for systematic diagnosis of the structure and outcomes of complex, multitier SESs. The framework enables scholars to diagnose which deeper-tier variables are relevant to a particular class of problems. For example, in contrast to an inshore fishery (25), analyzing ocean fisheries characterized by roving bandits (42) involves parameters regarding the size of the resource system, the lack of an overall governance system, the lack of a long-term interest in the resources, and the impact of global markets.

Perrings (43) builds on the research articles in this special feature to provide a perspective on the challenges of going beyond panaceas. Among those challenges are overcoming strong disciplinary boundaries, understanding the impact of globalization, and building uncertainty and learning into theoretical and empirical studies of dynamic SESs.

Three articles build on case-study comparisons and focus on community management (44), forest governance (45), and water institutions (46). Berkes (44) stresses the dilemmas involved in achieving development and conservation objectives in a globalized world. He indicates key strategies to improve the likelihood of achieving a critical understanding of multilevel systems: clearly designating multiple objectives, structuring deliberation, drawing lessons from scientific research, and adopting a complex–systems perspective form the foundation for designing conservation projects that enhance biodiversity and promote local development.

Nagendra (45) finds in a comparative analysis of 55 diverse forests in Nepal that three variables are significantly associated with forest change: the form of ownership of a forest, the size of the user group harvesting from a forest, and the existence of actual monitoring on the ground. Further developing the multitier framework for analyzing SESs (41), Meinzen-Dick (46) discusses diverse irrigation institutions and finds no single pillar is sufficient to assure effective performance. Instead, a tripod of government, market, and community institutions is needed to achieve equitable, fair, and sustainable irrigation management in contemporary settings.

The other three research articles use formal methods, including robust control (47), agent-based classifier models (48), and Bayesian learning (49). Anderies *et al.* (47) show for a simple SES in which society experiences uncertainty concerning parameter values for the model of the underlying biophysical system that it is difficult, if not impossible, to find globally robust strategies that can reduce vulnerability to all parameter uncertainties. Whereas they do not explicitly include learning processes aimed at reducing parameter uncertainty and improving performance over time, they do suggest ways in which robustness analysis can inform the learning process. Wilson *et al.* (48) show that continuous learning and adaptation on the part of fishers are important, but not sufficient, explanations of the self-organizing social processes that facilitate governance in the Maine lobster fishery. The particular biological and technological circumstances of the fishery are equally important determinants of the feasibility of collective action. Brock and Carpenter (49) also show that learning is no panacea and that it does not necessarily lead to successful governance of SESs. In SESs that experience episodic structural change, applying Bayesian learning processes can lock the system into a governance style that is inappropriate when a structural change occurs.

The Importance of Diagnosis, Monitoring, and Learning in Applied Science

The study of the governance of SESs, and of sustainability science more generally (50), is an applied science like medicine and engineering, which aim to find solutions for diverse and complex problems. In diagnosing problems, the applied scientist examines attributes of a problem, layer by layer, and focuses on traits that are thought to be essential in a particular context. When an initial solution is adopted, considerable effort is made to dig deeply into the structure of the problem and to monitor various indicators of the system. On the basis of this information, applied scientists change their actions and learn from failures. The study of SESs, however, is not yet a mature applied science, but as the articles in this special feature attest, excellent research that can form the foundation for a mature applied science does exist.

Diagnosing the multiple processes occurring in complex, nested SESs is far more challenging than recommending a favorite cure-all solution to a simplified picture of all fisheries, all forests, or all terrestrial ecosystems. If sustainability science is to grow into a mature applied science, we must use the scientific knowledge acquired in the separate disciplines of anthropology, biology, ecology, economics, environmental sciences, geography, history, law, political science, psychology, and sociology to build diagnostic and analytical capabilities.

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1. Gallopín GC, Gutman P, Maletta H (1989) *Int Soc Sci J* 121:375–397.
2. Berkes F, Folke C (1998) *Linking Social and Ecological Systems* (Cambridge Univ Press, Cambridge, UK).
3. Turner BL, II, Matson PA, McCarthy JJ, Corell RW, Christensen L, Eckley N, Hovelsrud-Broda GK, Kasperson JX, Kasperson RE, Luers A, *et al.* (2003) *Proc Natl Acad Sci USA* 100:8080–8085.
4. *The Oxford English Dictionary* (1989) comps Simpson JA, Weiner ESC (Clarendon, New York), 2nd Ed, Vol 11.
5. Montero JP (2000) *J Public Econ* 75:273–291.
6. Rees J (1992) *Geoforum* 23:383–394.

7. Terborgh J, Schaik CP (1997) in *The Land Stand*, eds Krame RA, van Schaik CP, Johnson J (Oxford Univ Press, Oxford), pp 15–35.
8. Tipton CA (1995) *Va Environ Law J* 12:381–421.
9. Williams M (2003) *Deforesting the Earth* (Univ of Chicago Press, Chicago).
10. Hardin G (1968) *Science* 162:1243–1248.
11. Lovejoy TE (2006) *Trends Ecol Evol* 21:329–333.
12. Terborgh J (1999) *Requiem for Nature* (Island, Washington, DC).
13. Smith RJ (1981) *Cato J* 1:439–468.
14. Armstrong CW, Sumaila UR (2001) *Land Econ* 77:350–359.
15. Pearce D, Markandya A, Barbier EB (1989) *Blueprint for a Green Economy* (Earthscan, London).
16. Yaron D, Dinar A (1982) *Am J Agr Econ* 64:681–689.
17. Kikeri S, Nellis J (2004) *World Bank Res Obser* 19:87–118.
18. Rose CM (2002) in *The Drama of the Commons*, ed Committee on the Human Dimensions of Global Change, National Research Council (Natl Acad Press, Washington, DC), pp 233–257.
19. Tietenberg T (2002) in *The Drama of the Commons*, ed Committee on the Human Dimensions of Global Change, National Research Council (Natl Acad Press, Washington, DC), pp 197–232.
20. Eggertsson T (2005) *Imperfect Institutions* (Univ of Michigan Press, Ann Arbor, MI).
21. Libecap GD (1989) *Contracting for Property Rights* (Cambridge Univ Press, Cambridge, UK).
22. Libecap GD (2007) *Mar Resour Econ*, in press.
23. Libecap GD, Wiggins SN (1985) *J Polit Econ* 93:690–714.
24. Blomquist W, Schlager E, Heikkila T (2004) *Common Waters, Diverging Streams* (Resources for the Future, Washington, DC).
25. Acheson J (2003) *Capturing the Commons* (Univ Press New England, Lebanon, NH).
26. Conley A, Moote MA (2003) *Soc Nat Resour* 16:371–386.
27. Lambin EF, Geist HJ, Lepers E (2003) *Annu Rev Environ Resour* 28:205–241.
28. Kaimowitz D, Angelsen A (1998) *Economic Model of Tropical Deforestation* (Center for International Forestry Research, Bogor, Indonesia).
29. Atran S, Medin D, Ross N, Lynch E, Vapnarsky V, Ek' EU, Coley J, Timura C, Basan M (2002) *Curr Anthropol* 43:421–450.
30. Camerer C (2003) *Behavioral Game Theory* (Princeton Univ Press, Princeton).
31. Ackoff RL (2001) *Syst Pract Act Res* 14(1):3–10.
32. Acheson J (2006) *Annu Rev Anthropol* 35:117.
33. Higgs R (1996) in *Empirical Studies in Institutional Change*, eds Alston LJ, Eggertsson T, North DC (Cambridge Univ Press, New York), pp 247–279.
34. Bacho FZL (2005) *Ghana J Dev Stud* 2:7–36.
35. Gelcich S, Edwards-Jones G, Kaiser MJ, Castilla JC (2006) *Ecosystems* 9:951–966.
36. Clark CW (2006) *Popul Ecol* 48:95–98.
37. Clark CW (2006) *Worldwide Crisis in Fisheries* (Cambridge Univ Press, Cambridge, UK).
38. Von Weizsaecker EU, Young O, Finger M (2005) *Limits to Privatisation* (Earthscan, London).
39. Van Berkel R, van der Aa P (2005) *J Eur Soc Policy* 15:329–343.
40. Scott JC (1998) *Seeing Like a State* (Yale Univ Press, New Haven, CT).
41. Ostrom E (2007) *Proc Natl Acad Sci USA* 104:15181–15187.
42. Berkes F, Hughes TP, Steneck RS, Wilson JA, Bellwood DR, Crona B, Folke C, Gunderson LH, Leslie HM, Norberg J, *et al.* (2006) *Science* 311:1557–1558.
43. Perrings C (2007) *Proc Natl Acad Sci USA* 104:15179–15180.
44. Berkes F (2007) *Proc Natl Acad Sci USA* 104:15188–15193.
45. Nagendra H (2007) *Proc Natl Acad Sci USA* 104:15218–15223.
46. Meinzen-Dick R (2007) *Proc Natl Acad Sci USA* 104:15200–15205.
47. Anderies JM, Rodriguez AA, Janssen MA, Cifdaloz O (2007) *Proc Natl Acad Sci USA* 104:15194–15199.
48. Wilson J, Yan L, Wilson C (2007) *Proc Natl Acad Sci USA* 104:15212–15217.
49. Brock WA, Carpenter SR (2007) *Proc Natl Acad Sci USA* 104:15206–15211.
50. Clark WC, Dickson NM (2003) *Proc Natl Acad Sci USA* 100:8059–8061.