How a nested framework illuminates the challenges of comparative environmental analysis

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How a nested framework illuminates the challenges of comparative environmental analysis

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Stratospheric ozone loss is on course to become a solved environmental problem, with all significant producing countries (including China and India) undertaking complete phase-outs of ozone-depleting substances. The universal concurrence and speed with which ozone loss has been addressed are sometimes heralded as signs that effective international agreements on other problems of the global commons are just around the corner. However, progress on many other issues has been strikingly limited. Is ozone the exception, rather than the rule, and if so why? Here we present one way to illuminate why some environmental problems are more tractable than others by consideration of a “nested” (vs. nonnested) framework. [Nested governance schemes are an established part of the common pool of resource literature (e.g., refs. 1 and 2), where use of the term “nesting” or “polycentricity” generally refers to the spatial scale of governance (e.g., grassroots to national); our focus here is broader.] We will refer to nesting as having three components: intellectual, societal, and institutional. Intellectual nesting refers to the academic communities that study the roots of the problem as well as possible solutions. Societal nesting refers to the sectors of human actors and activities that are associated with the problem. Institutional nesting describes the types of governance or management structures that could address the problem. We define a fully nested environmental problem as one for which the science of the problem is rooted within multiple, disparate disciplines, and for which the causes, impacts, and solutions are nested within different sectors of society and government. Within these definitions, we discuss marine biodiversity loss as an example of a deeply nested environmental problem, climate change as a mostly nested environmental problem, and ozone depletion as a much less-nested environmental problem.

Marine biodiversity loss encompasses diminishing diversity at the genetic, species, and ecosystem levels. One threat to marine biodiversity is habitat degradation, which has many causes, including physical disturbance from bottom trawling and pollution released into the ecosystem, leading to a nested set of scientific and societal actors and activities involved with the problem. Trawling impacts are studied by fisheries scientists and marine ecologists; trawling activities are usually regulated by fisheries management agencies. Pollution, on the other hand, is often land-based, is the focus of water, soil, and watershed scientists, and may be regulated by coastal municipalities. Thus, habitat degradation is nested within a wide range of both fishing and land-based activities, is studied by diverse intellectual communities, and has deep institutional nesting of management strategies. This is only one facet of marine biodiversity loss.

Climate change is arguably less intellectually nested than marine biodiversity loss, but is very strongly socially and institutionally nested. The dominant source of anthropogenic climate change is human emissions of carbon dioxide, implying less intellectual nesting regarding the scientific basis of the primary problem than marine biodiversity loss. The societal and institutional aspects of climate change, however, are particularly strongly nested. For example, the impacts of climate change create distinct challenges in different geographic areas and sectors of society: for some the biggest threat is sea level rise; for others, it is an increased frequency of drought. The industries and institutional bodies involved in the emissions of carbon dioxide range extremely broadly and cross many sectors. For example, the transport of goods across a large distance by any given mode of transportation involves the producer of the good, the transportation service, the manufacturer of the vehicle, the buyer of the

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good, the producer of the fuel consumed by
the vehicle, and the regulator of the market in
which that fuel is sold, which creates nesting
that spans a vast set of actors and activities.

Ozone is a much less-nested environmental
problem. The science behind ozone
depletion primarily involves atmospheric
chemistry (albeit with important links to
stratospheric dynamics, health, and ecosys-
tem sciences), creating a clear intellectual
center for ozone-depletion science. The
great bulk of the ozone-depleting chemicals
were manufactured by a single nonnested
industry already subject to regulation for
other chemical products they made, so that
management precedents within nonnested
institutions already existed in many coun-
tries. At an early stage consumers and
governments attacked the problem using
a simple and nearly nonnested strategy by
limiting the use of these chemicals in
spray cans.

By categorizing environmental problems
as intellectually, societally, and institutionally
nested or nonnested, one can gain a basic
understanding of some key complications to
progress in addressing them. Is extensive
nesting an insurmountable barrier to prog-
ress? Challenges of intellectual nesting, al-
though great, have been reduced by scientific
assessments (e.g., of ozone depletion and
climate change) that bridge nested disciplin-
ary divides and form epistemic communities
(e.g., ref. 3). The intellectual nesting of bio-
diversity loss is beginning to be addressed
through the Intergovernmental Platform on
Biodiversity and Ecosystem Services. Strong
societal and institutional nesting affect the
efficacy of regulatory institutions and inter-
national treaties designed to address these
problems, but have seldom been formally
assessed. If societal and institutional nest-
ing were to be assessed in a manner sim-
ilar to the assessment of science, progress
on nested issues could likely advance. We
hope this framework for the comparative
analysis of nested environmental problems
will prove useful as we work toward cre-
tive solutions.

1 Ostrom E (1990) Governing the Commons: The Evolution of
Institutions for Collective Action. (Cambridge Univ Press, New York,
NY).
2 Ostrom E (2010) Nested externalities and polycentric institutions:
Must we wait for global solutions to climate change before taking