ESSENTIAL CONCEPTS OF GLOBAL ENVIRONMENTAL GOVERNANCE

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and Amandine Orsini*

Routledge
Taylor & Francis Group

LONDON AND NEW YORK

earthscan
from Routledge

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CARRYING CAPACITIES PARADIGM

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Carrying capacity can be defined as *the quantity of some X that can or should be supported or conveyed by some Y*; in most of its many applications, exceeding a carrying capacity is considered damaging to *X*, *Y*, or both.

Scholars in many fields have discarded the concept of carrying capacity, but it persists and has in recent decades proliferated in debates about human populations and the environment on which they depend at the **scale** of Earth or significant subunits thereof. Although the term itself is not always used, carrying capacity is thus a pivotal idea for **population sustainability** and **sustainable development**.

The carrying capacities paradigm can be defined as the suite of methods, concepts, and assumptions that inform and support the view that human–environment interactions can and should be understood in terms of the *X:Y* ratios that carrying capacities describe or prescribe. Developing and improving methods to measure and communicate such ratios is often central to debates about the limits to growth, **ecosystem services**, biocapacity, and natural capital. But the origins and implications of the paradigm's supporting concepts and assumptions frequently pass unexamined.

At its origins, the paradigm married the concerns of neo-Malthusians regarding world population with the methods of systems analysis and **scenarios**. Neo-Malthusianism arose around the time of World War II; its marriage to systems analysis dates to the rise of computers in the post-War period. The most influential example is *The Limits to Growth* (Meadows et al. 1972), the landmark report of the Club of Rome's Project on the Predicament of Mankind.

After defining the predicament as reconciling economic and population growth with the limits of a finite world, the Club—a think-tank of "world citizens" from business, politics and academia—turned to Professor Jay

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Forrester of the Massachusetts Institute of Technology to develop "a formal, written model of the world" based on "the scientific method, systems analysis, and the modern computer" (Meadows et al. 1972: 21). Forrester's models had originally been developed to understand industrial and corporate dynamics, but were subsequently applied to cities and the world. In his own report on the world model, Forrester (1971) concluded that industrialization was the prime driver of both population growth and environmental problems, and that developing countries therefore might best avoid future problems by not industrializing.

Although far more sophisticated than Malthus's principle of population, *The Limits to Growth* model relied, like Malthus, on the mathematical disparity between arithmetic and geometric (or exponential) growth. Exponential or "nonlinear" growth involves complicated positive feedbacks among subsystems; left unchecked, the authors warned, "the limits to growth on this planet will be reached sometime in the next one hundred years. The most probable result will be a rather sudden and uncontrollable decline in both population and industrial capacity" (Meadows et al. 1972: 23).

The Limits to Growth sparked raging debates in scholarly and policy realms, and its authors have twice published updated reports based on current data and model refinements (Meadows et al. 1992, 2004). But the basic conceptual framework has persisted while tools for quantifying the Xs and Ys of carrying capacity have proliferated. These include the "IPAT formula"—Impact = Population × Affluence × Technology—to account for the relative impact of economically unequal populations, and ecological footprint analysis, which measures humanity's impacts in terms of the number of planets identical to Earth needed to supply our demands and absorb our wastes indefinitely (Wackernagel and Rees 1996). Values over 1.0 indicate and quantify "overshoot," and were reached in the late twentieth century. Ecological footprint analysis can also be conducted at smaller scales, and online "calculators" now enable consumers, investors, firms, cities, and nations to measure their footprints in real units of land and water. Scholarly subfields have emerged to measure "biocapacity" and identify ecological indicators of human impacts, such as the percentage of Earth's annual terrestrial and aquatic net primary production that is used or degraded by human activities.

Criticisms of the carrying capacity paradigm have also persisted, mainly among economists and other proponents of **liberal environmentalism** and **ecological modernization**. Some have challenged the quality of the models used in *The Limits to Growth* and subsequent studies. Others have simply dismissed the paradigm's advocates as

Cassandras whose predictions of collapse have failed the test of time. The recent world economic crisis and growing evidence of anthropogenic climate change, on the other hand, have buttressed the paradigm's supporters, who point out that Cassandra was, in fact, correct.

Overlooked in the debates are the underlying concepts and assumptions of the carrying capacities paradigm itself. From systems analysis, it inherited a commitment to models that were necessarily bounded and closed, so that they could be constructed and run as complex programs of equations and algorithms (see **Thermoeconomics**). This was (and arguably still is) seen as the cutting edge of scientific and technological practice, but it can account neither for un-modeled exogenous factors, nor for endogenous qualitative change in the model components and variables themselves.

Even more serious are the conceptual difficulties internal to the concept of carrying capacity itself. It would seem impossible, by definition, that humanity's ecological footprint could exceed 1.0 Earths. Proponents aver that lags in system response permit such a scenario. But this begs the question. Any $X{:}Y$ ratio derived from logic or models is an idealist postulate, empirical violations of which necessitate the invocation of some mediating factor or opposing force (e.g. Malthus's "misery and vice") that simultaneously enforces the putative limits—if not immediately, then in some indefinite future—and explains (away) the disparity between the ideal and the real. Exploiting the combination of positive and normative in its very definition, carrying capacity becomes immune to empirical test (Sayre 2008).

Over-shoot, in systems analysis, refers not to the measured disparity between burden and capacity, but to the failure of effective feedback mechanisms to enforce the postulated limit. Proponents of the carrying capacities paradigm are, in effect, trying to function as such a mechanism by alerting society to the growing environmental and social ills of industrial capitalism. It is a salutary ambition, but the rhetorical power of quantitative science does not appear sufficient to the task.

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CITES

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The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) tackles one of the sources of biodiversity depletion, the global trade in wildlife and wildlife products booming with globalization that is worth billions of dollars every year. Although not all of these animals and plants are in imminent danger of extinction, unlike the black rhino, the Asian tiger, or the African elephant, the widely publicized International Union for Conservation of Nature (IUCN) Red List of Threatened Species released annually since 1963 vindicates the need of international cooperation to regulate trade in wildlife.

A draft text adopted by the IUCN congress in 1963 led to the agreement signed in Washington on March 3, 1973. The CITES came into force on July 1, 1975, and there are now more than 175 parties to it. Adopted in the wake of the 1972 Stockholm conference, it is one of the few multilateral environmental agreements, where the United States— on the basis of its robust domestic conservation legislation—still plays the role of a lead state, and one reflecting from the onset predominantly Western concerns about wildlife protection.

More than 33,000 species are listed on Appendix 1 (banning trade), Appendix 2 (allowing limited trade with a quota system), or Appendix 3 (voluntary listing by at least one range state to monitor trade) with different sets of countries involved, and various political and economic implications. Therefore, it is more a collection of species-specific sub-regimes within a common framework. CITES has been shaped by norms and ideas as much as power relations or economic interests: the concept of "endangered species" for instance was constructed through intense debates between **conservation and preservation** (Mofson 1997) approaches in the protection of emblematic species such as the African elephant and big whales (Epstein 2006).

Relying on a system of import/export permits enforced by the member states' customs and police, CITES is a relatively **effective** agreement in

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