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### Sustainability in a multi-level cultural evolutionary framework

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Humans are obligatorily cooperative, and in comparison to other animals we cooperate extensively and with unrelated conspecifics. This cooperation enables us to create techniques and technologies that accelerate the speed at which we consume natural resources. Ironically, our cooperative nature has spurred an environmental crisis, culminating in global climate change. Cultural evolutionary theory can guide our understanding of how cooperation and social learning shape social dilemmas, including the overexploitation of global fisheries and historical changes in fisheries management systems in smaller-scale societies over time. In this paper, I propose a cultural evolutionary explanation for the emergence and persistence of both crises and solutions. Based on this framework, I provide a step-by-step process for designing studies of multi-level cultural systems of resource management, including tradeoffs between validity and control, time scale, and use of qualitative/quantitative methods data collection and analysis. This approach is open to historical data as well as new and existing data sets, case studies, and mathematical simulations. Finally, I present a tutorial and code in the R environment that allows users to manipulate collected or simulated data in order to explore the empirical implications of group-level sustainable cultural systems. Both the framework and the R-based tool are published openly.

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