Ecological Economics 69 (2010) 690–699

Contents lists available at ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

Coevolutionary ecological economics

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ARTICLE INFO

Article history:
Received 28 September 2009
Accepted 28 September 2009
Available online 11 November 2009

Keywords:
Evolution
Coevolution
Socio-ecological systems
Development

ABSTRACT

This paper maps a coevolutionary research agenda for ecological economics. At an epistemological level coevolution offers a powerful logic for transcending environmental and social determinisms and developing a cross-disciplinary approach in the study of socio-ecological systems. We identify four consistent stories emerging out of coevolutionary studies in ecological economics, concerning: environmental degradation and development failure in peripheral regions; the lock-in of unsustainable production–consumption patterns; the vicious cycle between human efforts to control undesirable micro-organisms and the evolution of these organisms; and the adaptive advantages of other-regarding, cooperative behaviors and institutions. We identify challenges in the conceptualization of coevolutionary relationships in relation to: the interaction between different hierarchical levels of evolution; the role of space and social power; uneven rates of change and crises. We conclude with the political implications of a coevolutionary perspective based on the premises of pragmatism.

1. Introduction

Fifteen years passed from the publication of “Development Betrayed” (DB) (Norgaard, 1994). The principal betrayals of development diagnosed in the book — environmental degradation, political deadlock in dealing with it, and intensifying cultural and ethnic hatred — are even more acute today. DB offered coevolution as an alternative framework for “revisioning” development. Coevolution has been recognized as a key framework for understanding change in complex, social–ecological systems (Folke et al., 2005) and as a foundational concept for ecological economics (Gowdy, 1994; Costanza et al., 1997; Spash, 1999). However a coevolutionary research agenda has not taken off within ecological economics (EE). The epistemological and methodological challenges of coevolutionary research are formidable (Norgaard and Kallis, in press). This special section presents a diverse collection of contributions that aim to reinvigorate the coevolutionary analysis of ecological–economic change. This opening article positions these contributions within the growing literature of (co)evolutionary approaches in environmental studies and economics (van den Bergh, 2007; Faber and Frenken, 2009; various contributors in Rammel et al., 2007). Our ambition is to map a tentative coevolutionary research agenda for EE.

Let us start with a basic definition of evolution and coevolution. Evolution is a process of selective retention of renewable variation (Campbell, 1969; Nelson, 1995). It applies to complex populations of entities that are similar in key respects, but within each type there is some degree of variation (Hodgson, 2010-this issue). Evolution involves the three Darwinian processes of variation, inheritance, and selection. An evolutionary analysis explains how variety is generated (renewed) in the population, how advantageous properties are retained and passed on and why entities differ in their propagation (Hodgson, 2010-this issue; Nelson, 1995). Evolving entities might include organisms in the biological world, or organizations, institutions and technologies in the social world. Units of selection might include genes, habits, norms, strategies or behaviors (Kallis, 2007a). Although evolution in biological and social systems may exhibit the same three Darwinian processes, they also differ in significant ways. In social systems the generation of variation is sometimes partly guided, while in biological systems it is accidental through mutations (Warring, 2010-this issue; Aldrich, 1999; Boyd and Richerson, 1985).

Two systems coevolve when they both evolve in the above indicated sense and they have a causal influence on each other's evolution (Kallis, 2007a).[1] Interacting systems might be biological, social or both. Coevolution is different than mere co-dynamic change although they are often misused synonymously (van den Bergh and Stagl, 2003; Winder et al., 2005). The difference in coevolution is that at least one — social or environmental — system is evolving, i.e. changing through variation, selection and inheritance. Also coevolution is not a normative concept; it is emphatically not about social

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[1] The range of coevolutionary phenomena can be expanded by relaxing the condition of reciprocity (i.e. only one system affects the evolution of the other) or by accepting as sufficient that at least one (and not necessarily) all of the interacting systems are evolving.

0921-8009/$ – see front matter
doi:10.1016/j.ecolecon.2009.09.017

systems changing in harmony with nature as Thiele (1999) or Conrad and Salas (1993), mean it. Coevolutionary relationships can be mutually cooperative, but also competitive parasitic, predatory or dominative. Coevolution is a value-free process of change (Norgaard, 1994). Norgaard (1984) proposes instead to use the term coevolutionary development for coevolution between society and nature that is valued as beneficial by humans.

Coevolution is all-pervasive. For example, as the environment of one species consists of multiple other species, coevolutionary relations characterize almost all of what normally passes as evolution in biology. Biologists find useful methodologically the distinction between "direct" — clearly defined and documented, species-to-species — coevolution and more widespread, "diffuse" coevolution (Futuyma and Slatkin, 1983). Many of the systems that matter in the social and natural worlds, such as institutions, technologies, beliefs, values, genes, human and animal behaviors, are evolving diffusedly affecting the evolution of each other (Norgaard, 1994). Rather than debating whether a focus on direct or diffuse coevolution makes more sense for EE (see debate between Winder et al. (2005), Norgaard (2005), and Winder (2005)), a more productive approach is to recognize that each has something to offer (Kallis, 2007b). A generalized "coevolutionary logic" (Porter, 2006) of diffused evolving interdependence offers a good basis for a new epistemology or "cosmology" as Norgaard (1994) put it. On the other hand for formal theorizing (Nelson, 1995) and the development of an empirical research program focus has to shift to direct "coevolutionary mechanisms" (Porter, 2006). An understanding that "everything" might be coevolving with everything else needs to be complemented with the identification of what is coevolving with what and how in specific conditions or contexts and as relevant to specific analytical and policy purposes (Malerba, 2006; Kallis, 2007b; Norgaard and Kallis, in press).

The next two sections revisit the material of DB under this perspective. Section 2 clarifies the different types of coevolutionary mechanisms that are relevant for empirical EE research. Section 3 shows how these mechanisms put together suggest a broader coevolutionary logic, and illustrates the power of this logic to transcend mal-adaptive epistemological dichotomies that confound EE and environmental studies in general. Section 4 synthesizes recent coevolutionary contributions, including those in this special section, into four key theses. Each of these relies on an eclectic combination of coevolution with other theories and analytical tools, as relevant to the specific application and domain of study. Section 5 identifies challenging research questions in coevolutionary studies. Section 6 engages with broader normative and epistemological issues and concludes with the contribution of coevolution to policy.

2. Coevolutionary mechanisms

Here we offer a conceptual breakdown of five types of coevolution that are important for EE (see also van den Bergh and Stagl, 2003; Gual and Norgaard, 2010-this issue). In a different work we discuss in detail the unavoidable tensions between any such reducing categorization and the broader coevolutionary logic which suggests a more widespread coevolution between all the systems described below (Norgaard and Kallis, in press).

2.1. Biological coevolution

This refers to reciprocal evolution between two or more interacting species (Ehrlich and Raven, 1964; Thompson, 2005). Examples abound: the evolution of the beaks of hummingbirds and the shape of the flowers they feed on, the behavior of bees and the distribution of flowering plants, the biochemical defenses of plants and the immunity of their insect prey, or "tri-partite" relations, such as those between nutcracker birds, pine trees and squirrels (Ehrlich and Raven, 1964; Thompson, 2005; Pennisi, 2007). Coevolutionary interactions, intensities and rates between the same species vary depending on ecological settings. Thompson (2005) calls such variations "geographic mosaics".

Interest on biological coevolution has surged because of its importance for sound conservation policies. Coevolution sheds light on keystone species or the impacts from the reintroduction or invasion of new species in ecosystems (Pennisi, 2007). Ecological–economic models dealing with biodiversity should take biological coevolution into account. Furthermore, equilibrium concepts, such as the "marginal value" of species, are inappropriate in coevolutionary settings. Temporally and spatially varying interactions mean that the ecological value of species varies geographically. Extinction of keystone species has far reaching evolutionary effects and cannot be valued like any other species (van den Bergh and Gowdy, 2000).

2.2. Social coevolution

This includes reciprocal evolution of two or more social systems. Here too possibilities abound and include — among others — coevolution of technologies and institutions (Nelson, 2002), populations of industries and universities (Murmann, 2003), behaviors and institutions (van den Bergh and Stagl, 2003), populations of producers and consumers, or supply–demand coevolution (Safarzynska and van den Bergh, in press; Janssen and Jager, 2008; Saint Jean, 2005; Windrum et al., 2009), organizations and their environments (Porter, 2006; McKelvey, 1982; Baum and Singh, 1994; Lewin and Volberda, 1999), political strategies and technological paradigms (Ward, 2003), or perceptions and actions (Weick, 1979). Applications relevant to environmental policy abound. Social evolution and coevolution can be employed to shed light on the emergence and performance of environmental institutions (Hodgson, 2010-this issue), lock-in barriers and transition policies for the adoption of environmental technologies (Safarzynska and van den Bergh, in press; van den Bergh, 2007; Faber and Frenken, 2009) or the potential evolution of greener corporations (Porter, 2006).

2.3. Gene–culture coevolution

This refers to interactions between cultural evolution[2] and biological evolution of the human species (Durham, 1991). Warring (2010-this issue) lists several examples such as the coevolution of sign language with deafness, lactose-tolerance with dairy farming, incest taboos with brother–sister mating or sickle-cell anemia with forest clearing practices (see also Durham, 1991; Laland and Boogert, 2010-this issue). Crucially, the human mind, cognition and perception seem to have evolved influenced by the cultural context (language, use of tools, etc) (Deacon, 1997; Dunbar, 1993; Laland and Boogert, 2010-this issue).

Gene–culture coevolution and dual genetic–cultural inheritance theories imply that human behavior is not solely biologically determined; endogenous cultural dynamics should be accounted for (Warring, 2010-this issue). Cultural learning, imitation and experimentation shape human behaviors; they are conditioned by human biology, and in turn change it (Norgaard, 1994). Neo-classical economics' behavioral assumptions of genetically-determined, selfish maximizers are unrealistic (Manner and Gowdy, 2010-this issue; Warring, 2010-this issue). Bounded rationality, routinised behavior and choice through heuristics may offer better behavioral foundations for EE (van den Bergh et al., 2006).

[2] Culture might be considered as a subset of the social world, and cultural evolution as a particular case of social evolution. Durham (1990) limits the definition of culture to ideational phenomena and includes in his definition only values, ideas and beliefs that guide human behavior and not the behavior itself. Cultural anthropologists and ecologists often focus on non-Western, subsistence societies; by default sometimes cultural evolution is used to denote evolution of habits or artifacts in such "primitive" societies, compared to "social evolution" of technologies, laws or organizational forms in "advanced" contemporary societies.