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Resilience

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'Resilience', a quality of 'complex adaptive systems', has moved far beyond its original applications in environmental science to become a ubiquitous term in contemporary practices of crisis management. Developed within ecology in the 1970s, complex systems theory served to conceptualise the stable or resilient dynamics of ecosystems subject to extractive industry. The concept of resilience has in recent years rapidly infiltrated vast areas of the social sciences, becoming a key term in finance, central banking, corporate strategy, psychology, development, urban planning, public health, education and national security. Malleable and capacious enough to encompass human and non-human 'systems' within a single analytic, the concept of resilience is well established in the lexicon of global governance.

Origins

The ecologist Crawford Holling did important work to renovate classical systems ecology in terms of the new 'complexity sciences'. His work on resilience marked a shift away from the mechanistic assertions of equilibrium typical of post-war cybernetics. The key image of science that propelled the formalisation of economics (in the 1870s) and ecology (in the 1950s), was of smooth and continuous returns to equilibrium after a shock, one derived from different vintages of classical mechanics and thermodynamics. Holling's classic (1973) paper 'Resilience and Stability of Ecological Systems' exemplifies the destabilisation of the notion of 'equilibrium' as the core of the ecosystem concept and the normal terminus of ecosystem trajectories. It initiated a retreat amongst ecologists from the idea that there exists a 'balance of nature' to which ecosystems will return if left to self-repair. Speaking as an experienced resource manager and conservation ecologist, Holling began his paper noting that:

traditions of analysis in theoretical and empirical ecology have been largely inherited from developments in classical physics and its applied variants [...] But this orientation may simply reflect an analytic approach developed in one [field] because it was useful and then transferred to another where it may not be (1973: 1).

He went on to distinguish between an existing notion he calls 'engineering resilience' and his alternative, a properly 'ecological' resilience. Engineering resilience, associated with mathematical models, is an abstract variable, simply the time (t) it takes an ecosystem to return to a stable maximum (or equilibrium position) after disturbance. The return is simply assumed, and the equilibrium state conflated with long-term persistence. Holling articulated instead a complex version of resilience which can account for the ability of an ecosystem to remain cohesive even amidst extreme perturbations. 'Ecological' resilience designates the complex biotic interactions that underpin "the persistence of relationships within a system", thus resilience is "a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist" (1973: 17).

Holling criticized the management theory of 'maximum sustained yield' (MSY), long dominant in industrial forestry and fisheries, with its claims to quantify the 'surplus' portion of a population that can be harvested year in year out, without undermining the regenerative capacity of the ecosystem. Holling's argument here was that the long-term expectation of stability may be inherently destabilizing. Acting on assumptions of a permanent resource yield may undermine the complex interdependencies comprising the resilience of the system as a whole, rendering its organisation ever more fragile and vulnerable to collapse. 'The very approach...that assures a stable maximum sustained yield of a renewable resource might so change these deterministic conditions that the resilience is lost or reduced so that a chance and rare event that previously could be absorbed can trigger a sudden dramatic change and loss of structural integrity of the system' (1973: 21).

Holling's perspective reflects emerging critical voices which, in the early 1970s, insisted that intensive maximisation of agricultural and industrial production would at some point meet inherent limits, resulting in mass extinctions and intolerable over-pollution. For him, the equilibrium analysis was dangerously abstract: glossing over the unknowably complex interdependencies of ecosystems pressed into the

conditions of maximized yield, it accelerated the process of fragilization, potentially leading to irreversible losses of biodiversity, thus “resilience is concerned with probabilities of extinction...” (1973: 20). By contrast, Holling’s perspective opens up a management approach capable of sustaining productivity even under conditions of extreme instability. Its ability to adapt to crisis events derives from the fact that it has abandoned long-term expectations:

A management approach based on resilience...would emphasize the need to keep options open, [...] and the need to emphasize heterogeneity. Flowing from this would be not the presumption of sufficient knowledge, but the recognition of our ignorance: not the assumption that future events are expected, but that they will be unexpected. (1973: 21).

This passage is significant because it so clearly anticipated the guiding ideas of contemporary complex systems theory and its practical applications in crisis response. ‘Resilience’ now denotes an approach to risk management which foregrounds the limits to predictive knowledge and preventative action, insisting on the prevalence of the unexpected, seeking to ‘absorb and accommodate future events in whatever unexpected form they may take’.

Evolution

In the late 1990s, Holling formed the Resilience Alliance, a consortium which would build consensus with mainstream economists and ambitiously expand the insights of the resilience perspective well beyond ecology. These initiatives were brought together within the Stockholm Resilience Centre, a high-profile think tank which promotes and applies ‘resilience thinking’ in international environment and development policy. Holling and his colleagues were now concerned to advance resilience as an integral property linking societies *and* ecosystems, reconceptualised as unified co-evolutionary systems. This research into ‘social-ecological resilience’ aspires to become a general systems theory integrating society, the economy, and the biosphere in a totality dubbed the ‘Panarchy’:

... the structure in which systems, including those of nature (e.g., forests) and of humans (e.g., capitalism), as well as combined human-natural systems (e.g., institutions that govern natural resource use such as the Forest Service), are interlinked in continual adaptive cycles of growth, accumulation, restructuring, and renewal. (Gunderson & Holling 2002, cover)

There are significant differences between this account of socio-ecological resilience and Holling's earlier work. Holling was no longer arguing that ecological communities are at risk of irreversible extinction under the stress conditions of maximum sustained yield. Now, resilience is proposed as a perspective capable of analysing *all* socio-ecological systems in terms of an 'adaptive cycle' of recurring events, characterised by phases of rapid growth (r) toward a temporary stable maximum (K), then collapse (Ω), and spontaneous reorganisation for a new growth phase (α).

Having emerged as a critical perspective on modernist theories of economic growth in the post-WW II era, resilience theory today presents itself as an alternative theory of growth in far-from-equilibrium conditions, in which the capacity of systems to spontaneously re-organise through catastrophic events is denoted as 'capital'.

[IMAGE HERE]

[Holling figure-8 loop.... Gunderson and Holling 2002.
<http://www.ecologyandsociety.org/vol7/iss1/art14/inline.html>]

Arguably, the proliferation of 'resilience' across so many spheres of governance can be traced to its formal, political and ontological resonance with the influential philosophy of the Austrian economist and arch-neoliberal protagonist, Friedrich Hayek. From the 1970s, Hayek's radical critique of socialist, Keynesian and neoclassical economics would increasingly take the form of an account of market society as an evolving 'spontaneous order', far too complex for any individual or government to understand or predict, much less to regulate for social objectives, including long-term ecological stability (Hayek 1974).

From the 1990s, the International Monetary Fund, the World Bank and other global institutions began incorporating strategies of 'resilience' into their logistics of crisis management, financial (de)regulation and development (eg. WB 2006). With the post-9/11 revolution in 'homeland security', resilience has become a byword among agencies charged with coordinating security responses to climate change, critical infrastructure protection, natural disasters, pandemics and terrorism (Evans and Reid 2014), reorienting these once distinct policy arenas toward a horizon of critical future events which (we are told) we cannot predict or prevent, but merely adapt to

by 'building resilience'. In the process, resilience has largely ceased to operate as a critique emphasizing the fragility of complex communal life, and now arguably functions to naturalise power and normalise catastrophe. This can be seen when prominent ecologists propose that global financial markets should be understood as complex adaptive ecosystems (May, Levin and Sugihara 2008), or argue against conservationists that "Nature is so resilient that it can recover rapidly from even the most powerful human disturbances" (Kareiva, Lalasz and Marvier 2012).

Learning Resources

Ecology and Society, previously named *Conservation and Society*, is the house journal of the Resilience Alliance.

www.ecologyandsociety.org/

Stockholm Resilience, an international policy centre dedicated to promoting 'resilience thinking' in the 'governance of social-ecological systems', is closely aligned with the Beijer Institute of Ecological Economics.

www.stockholmresilience.org

www.beijer.kva.se

Resilience as a framework for the analysis and organisation of national security is exemplified in the policy documents of the US Department of Homeland Security.

<https://www.dhs.gov/topic/resilience>

Established in 2013, the journal *Resilience: International Policies, Practices and Discourses* provides a forum for critical social scientists to engage with 'resilience', its policy frameworks and their consequences.

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