# Harmony and Ecology

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## Notions of Harmony and Balance in Nature

It is common in discussions about our relationship with the living planet – especially with regard to the devastating impact of human activity on the health of our global ecosystem – to hear talk about the need to live in 'harmony' with the natural world. The philosopher Arne Naess (1912-2009), founder of the 'Deep Ecology' movement, for example, defines his notion of 'ecosophy' specifically as a 'philosophy of ecological harmony or equilibrium'.[1] Similarly, David Cadman defines harmony as 'an expression of wholeness', with which comes the understanding that human beings (and our actions) are enmeshed within a wider network of 'connections and relationships'.[2] This chapter will explore what observations of ecological systems can tell us about the nature of harmony, and related ideas such as 'balance' and 'equilibrium'.

As other chapters in this book have explored, the idea that the natural world is in a delicate state of equilibrium, or that there is *harmony in nature*, is a very ancient one, with parallel concepts found in numerous societies right across the world. The Taoist concept of yin and yang, whereby the cosmos is understood as an interconnected whole consisting of balanced binary oppositions, is perhaps the clearest expression of this idea, though there are also parallel concepts in different cultural contexts. As Fritjof Capra explains:

> The philosophical and spiritual framework of deep ecology is not something entirely new but has been set forth many times throughout human history. Among the great spiritual traditions Taoism offers one of the most profound and most beautiful expressions of ecological wisdom, emphasizing both the fundamental oneness and the dynamic nature of all natural and social phenomena.[3]

Indeed, so fundamental have these ideas been to our way of thinking for so long that philosopher of science Gregory Cooper suggests the notion of balance 'usually functions as a background assumption' shaping the way we go about making sense of the natural world. He points out, however, that 'rarely has it been brought forward for explicit study'.[4]

When we observe natural systems we see all manner of simultaneous processes in action – growth, symbiosis, and interconnection (what we might consider 'positive' features of ecology), as well as competition, predation, death and decay (which could equally be considered as 'negative' features of ecology). A call to live in harmony with the living principles of nature could, therefore, be taken in either direction. Ecological principles could just as easily be cited as supportive of a worldview based on 'survival of the fittest' as one based on reciprocal, mutually beneficial, relationships. Furthermore, commentators such as Kristin Shrader Frechette have suggested that those who seek to draw ethical principles from 'natural principles' frequently make 'misguided appeals to ecological laws,' despite a lack of consensus in ecological science.[5] This is very slippery territory, and it is well worth taking a moment to unpack what observations of living systems *can* tell us about harmony. In order to do this we will look at key debates on the dynamics of ecosystem functioning, and ecological theories and models used to explain them, and will conclude with the case of permaculture as a means of living 'in harmony' with natural processes. As we will see, however, the kind of harmony engendered in the natural world is far from clear-cut or straight forward.

## Ecology

The field of ecology is a relatively new area of research for science. Its roots go back to the nineteenth century, but it did not reach maturity as a distinct discipline until the middle of the twentieth century.[6] A key concept emerging from the study of ecology is the notion of the 'ecosystem'. Pioneer of scientific ecology Eugene Odum (1913-2002), defines the ecosystem as referring to:

> A unit of biological organization made up of all of the organisms in a given area (that is, 'community') interacting with the physical environment so that a flow of energy leads to characteristic trophic structure and material cycles within the system.[7]

In other words, an ecosystem is a complex system of interactions between living organisms (plants, animals, microbes, fungi) and the non-living environment (water, minerals, gases, sunlight, and so on). Above all, therefore, ecosystems are all about *relationships* – relationships between organisms, as well as relationships between organisms and the non-living environment. From this perspective everything is connected, from the smallest bacterium to the largest trees and mammals, bound together through the reciprocal exchange of vital non-living elements. These interactions include the exchange of energy and nutrients through 'food webs'.[8] Plants (whether we are talking about shrubs, trees or phytoplakton), are referred to as 'primary producers' – they capture energy from the Sun by photosynthesis, which enters into the food chain when consumed by herbivores – 'secondary consumers' – who in turn may be consumed by predators. Thus the Sun's energy is distributed amongst biological organisms in an ecosystem, gradually decreasing as it moves higher up the food chain.[9] Energy and nutrients are also constantly cycling around this system through processes of growth and decay. Energy and nutrients collected and stored by trees, plants and animals are slowly released back into the wider system through the action of decomposers such as bacteria and fungi.

Distinctive ecosystems develop in, and are adapted to, specific geographical and environmental niches, so that we can talk of, for example, saltwater ecosystems, freshwater ecosystems, desert ecosystems, woodland ecosystems, and so on. Groups of ecosystems that share similar environmental characteristics are often referred to as biomes.[10] Another major concept in ecology is the notion of 'succession' in ecosystems. Succession refers to the processes by which living organisms colonise and transform environmental niches to suit their own needs, as well as the needs of successive species. Bare scrub land, for example, is colonised by pioneer species, which transform soil and climate conditions as they develop to allow other plant species to move in. Odum defines succession as referring to three key parameters:

> (i) It is an orderly process of community development that is reasonably directional … (ii) It results from modification of the physical environment by the community; that is, succession is community-controlled even though the physical environment determines the pattern, the rate of change, and often sets limits as to how far development can go. (iii) It culminates in a stabilized ecosystem in which maximum biomass … and symbiotic function between organisms are maintained per unit of available energy flow.[11]

Each stage of succession is referred to as a *sere*. At each successive sere the plant community tends to become more biodiverse, and so more complex. The process of succession eventually culminates with a relatively stable 'climax community'.[12]

The organisms that make up an ecosystem are, therefore, active in transforming local environmental conditions to suit their own needs. Hardy pioneer species colonise bare land and transform the structure of soils, which in turn creates new conditions for other species to inhabit. *Co-operation* between species in an ecosystem, therefore, seems to be essential (though we cannot ignore the very real role of *competition*). Indeed, organisms often work *mutually* (where one species acts as a host for another, for example, the remora fish, which feeds on the parasites of sharks), and sometimes *symbiotically* with one another (where two organisms live an entirely interconnected life, as in the case of mycorrhizal fungi in the root systems of trees) to create optimum conditions for biodiversity. This observation seems to run counter to the mainstream reductionist Darwinian concept of competition and 'survival of the fittest' as the sole drivers of evolution[13] and is a point of contention amongst ecologists, who often tend towards one or the other interpretation.

## Emergentism versus Reductionism

In their paper on the sociology of ecological science, John Bellamy Foster and Brett Clark[14] delineate a tension early in the development of the field between those researchers who assumed an organicist, holistic and teleological interpretation of ecosystem development, and those who assumed a materialist, mechanistic, systems view. This is known as the 'holism-reductionism' debate, or the 'emergentism-reductionism' debate.[15] As an example of an holistic approach, Foster and Clark refer to the work of plant biologist Frederic Clements (1874-1945), who is best known for his research into plant succession. For Clements, the direction of succession towards greater biodiversity and complexity was indicative of a teleological drive, with the climax community essentially understood as a single living organism:

> Clements provided an idealist, teleological ontology of vegetation that viewed a 'biotic community' as a 'complex organism' that developed through a process called 'succession' to a 'climax formation'. He therefore presented it as an organism or 'superorganism' with its own life history, which followed predetermined, teleological paths aimed at the overall harmony and stability of the superorganism.[16]

From this perspective, succession is always directed towards 'harmony' and 'stability' within the ecosystem and is the natural process by which such super-organisms grow to maturity. Understood through the lens of organicism (emergentism), ecosystem development is a harmonic process, with different elements working together for the mutual benefit of the 'superorganism'. James Lovelock's famous 'Gaia hypothesis' is essentially an extension of this general observation about ecosystems to the whole Earth system. The Gaia hypothesis, developed by Lovelock in the 1970s, suggests that the Earth itself is a single living system, composed of multiple inter-related parts (including the chemical and mineral composition of the Earth, as well as all organic life forms), which work together to maintain a stable global system.[17]

This teleological perspective has its critics, however. In his 1982 book *The Extended Phenotype*, outspoken atheist and evolutionary biologist Richard Dawkins argued against the Gaia hypothesis on the grounds that it seems to present a top-down teleological explanation for global homeostasis (i.e. that it is, in some sense, purposeful). He writes:

> A network of relationships there may be, but it is made up of small, self interested components. Entities that pay the costs of furthering the well being of the ecosystem as a whole will tend to reproduce themselves less successfully than rivals that exploit their public-spirited colleagues, and contribute nothing to the general welfare.[18]

Dawkins' view differs from that of Lovelock primarily on the grounds that the former presents a reductionist view based on *competition* of individuals within the system (who have no thought for the 'greater good'), while the latter presents an holistic view based on top-down co-operation between biotic and abiotic components of the Earth system. At its core the holism-reductionism debate represents a clash of paradigms – between blind mechanism and teleological organicism. Such disagreements are characteristic of debates in ecology (as well as most other fields) and are unlikely to ever be fully resolved.

## Biodiversity and Ecosystem Stability

Just as there have long been debates between holists and reductionists, so too have there been disagreements between ecologists who suggest that ecosystems become *more resilient* to change the *greater the diversity* of species they contain, and those who suggest that *simpler* ecosystems are more resilient. This is known as the 'complexity-stability debate'.[19] Researchers in the 1950s, such as Eugene Odum, who assumed a broadly organicist view of ecology, argued that greater connections for energy transfer within an ecosystem resulted in that system being less susceptible to the loss of a single species, or to unexpected climate fluctuations. In this scenario, if an element is removed from a food web it can be compensated for by redirecting energy flows, or by drawing energy from other parts of the system, so it makes sense to see an adaptive benefit in having a highly biodiverse ecosystem.[20] With this principle in mind, then, ecosystems were understood to develop towards *increased complexity* and *increased biodiversity*, leading to a greater number of energy pathways within the system. This is known as the 'insurance hypothesis'.[21]

By the 1970s, however, this view was increasingly challenged by a new generation of researchers who held that ecosystems with *fewer* elements were more resilient. Basing their models on Newtonian physics, they argued that the more elements a system contains the more chaotic it becomes, and so the more likely it is to collapse. From this perspective simpler ecosystems were thought to be more resilient to change, while larger more complex systems were thought to be less so. Here, again, we see the re-emergence of the holism-reductionism debate. Those who hold that greater biodiversity in a system leads to greater resilience are adopting an holistic perspective that emphasises complexity and reciprocal interconnections between organisms, while those adopting a reductionist view rather focus in on the micro-level, and emphasise a mechanistic simplicity. In reality, however, the truth is likely somewhere in between these two strong positions.

## Trophic Cascades

Other important processes affecting the overall balance and stability of ecosystems, and which offers support to an holistic interpretation of ecosystem functioning, are so-called *trophic cascades*, defined as:

> Reciprocal predator-prey effects that alter the abundance, biomass or productivity of a population community or trophic level across more than one link in a food web … Trophic cascades often originate from top predators, such as wolves, but are not necessarily restricted to starting only in the upper reaches of the food web.[22]

The classic example of the capacity of trophic cascades to transform ecosystems is the case of the eradication, and eventual re-introduction, of wolves in Yellowstone National Park. In 1995, after seventy years of near-extinction as a result of hunting, wolves were re-introduced to the Yellowstone National Park with remarkable consequences. In the absence of predatory wolves, large populations of red deer had resulted in overgrazing around streams and rivers, which in turn had affected the stability of riverbanks. When the wolves returned, red deer numbers declined and, as a consequence, trees along riverbanks were able to flourish, which in turn re-stabilised the riverbanks. The new larger trees shaded and cooled the river, providing cover for fish and creating new habitats for insects and birds. The effects of the re-introduction of wolves into Yellowstone were seen right the way through the ecosystem, encouraging much higher levels of biodiversity through the creation of new niches for exploitation by other species.[23]

What balance there is in ecosystems, therefore, comes from *both* the 'bottom up' perspective – plants, as primary producers, are the foundation of ecosystems – *and* the 'top down' perspective – through the activities of higher predators and their cascading influence on species lower down the food chain. This effect, which is well documented, resonates with ideas about ecological harmony through biodiversity and complexity. Pace *et al.* note that trophic cascades occur in all manner of diverse ecosystems; 'from the inside of insects to the open ocean … in streams, lakes and the marine intertidal zone … fields, soils [and] forests'.[24] Trophic cascades, therefore, appear to be universal characteristics of ecosystem dynamics and go a long way towards demonstrating that harmony in nature is a dynamic process that is never fully in balance. It is a constantly fluctuating ebb and flow that arises through complex interactions between organisms and the environment.

## Permaculture and Harmony

In essence, permaculture is a design process for the regeneration of natural systems based on the observed principles of ecology. It was developed in Australia in the 1970s by ecologist Bill Mollison (1928-2016) and his student David Holmgren[25] and has been steadily growing as a loosely organised global movement ever since.[26] The term itself derives from the conjunction of the words 'permanent' and 'culture' (or 'agriculture'), so *perma*-culture could be understood as a design system for creating ecologically rooted 'permanent cultures' that are 'regenerative,' rather than just 'sustainable'. One of the most popular formulations of permaculture makes use of twelve key design principles, drawing from the work of David Holmgren, and in particular from his book *Permaculture: Principles and Pathways Beyond Sustainability.* The twelve principles are:

1. Observe and interact
2. Catch and store energy
3. Obtain a yield
4. Apply self-regulation and accept feedback
5. Use and value renewable resources and services
6. Produce no waste
7. Design from patterns to details
8. Integrate rather than segregate
9. Use small and slow solutions
10. Use and value diversity
11. Use edges and value the marginal
12. Creatively use and respond to change[27]

This is not quite the place to give a full analysis of the twelve principles, but suffice to say that they are inspired by observations of ecosystem functioning, and especially of processes such as succession and its tendency towards increasing biodiversity within a system. Mollison and Holmgren explain that permaculture 'unlike modern annual crop culture, has the potential for continuous evolution towards a desirable climax state'.[28] In a sense, then, permaculture is about allowing natural processes to do their thing, but in a way that can be channelled towards meeting the needs of human beings (such as food production), while also enhancing biodiversity and building resilience. Holmgren's twelve principles are themselves couched within a wider tripartite permaculture ethic of:

13. Earth care
14. People care
15. Fair share

These three simple ethics provide a grounding for work in permaculture: to regenerate and protect the Earth system, upon which all life depends and to care for all people (which might even be expanded along the lines of the 'new animism,' to include non-human persons as well as human persons).[29] The final ethic is grounded in the observation that there is very little waste in natural ecosystems – all resources are constantly cycled and redistributed, and surplus is always invested back into the system. Permaculture is just one example of a practice inspired by observations of natural systems. There are various other forms of agricultural and horticultural practice – such as agroforestry, syntropic agriculture, and other grassroots approaches – that have a demonstrated efficacy in producing abundant yields, enhancing biodiversity and reducing reliance on fossil fuels and pesticides for maintenance. Permaculture and related practices are useful examples of practical methods of harmonising with natural processes, and in so doing having a positive impact on the local environment.

## Conclusions

The kind of harmony we see manifest in the natural world is not directly equivalent to, for example, the harmonious relationships found in geometry, or in music. This form of harmony is largely abstracted from nature (notwithstanding remarkable cross-overs): it is clean, neat and rational. The kind of harmony we see expressed in nature is much messier, and much more chaotic – indeed, environmental researcher Daniel Botkin talks of 'discordant harmonies' in nature.[30] It is the difference between understanding the world in terms of rationality and the order of Newtonian mechanics on the one hand, and as a dynamic organism on the other. This is a point that was made by empiricist philosopher David Hume (1711-1776) in the eighteenth century in his critique of William Paley's (1743-1805) argument for intelligent design, which holds that the world resembles the intricate mechanism of a watch – evidence of a divine designer. Hume writes:

> The world plainly resembles more an animal or a vegetable than it does a watch or a knitting-loom. Its cause, therefore, it is more probable, resembles the cause of the former. The cause of the former is generation or vegetation. The cause, therefore, of the world, we may infer to be something similar or analogous to generation or vegetation.[31]

Biologist Rupert Sheldrake makes a similar point in his suggestion that what physicists refer to as the 'laws of nature' (the speed of light, the universal gravitational constant, and so on), are perhaps best thought of as 'habits' rather than eternal unchanging laws. If, as Hume suggests, the world really does resemble more 'an animal or vegetable' than a mechanism, then we might also expect natural laws to be dynamic, to evolve and change over time. Drawing on evidence such as apparent fluctuations in measurements of the speed of light since the 1920s, Sheldrake summarises:

> The idea that 'laws of nature' are fixed while the universe evolves is an assumption left over from pre-evolutionary cosmology. The laws may themselves evolve or, rather, be more like habits…the 'fundamental constants' may be variable, and their values may not have been fixed at the instant of the Big Bang. They still seem to be varying today.[32]

Much as Sheldrake suggests, harmony, balance and equilibrium in nature are perhaps best not thought of as 'laws of nature,' but rather as something more like habits, or tendencies. Harmony, therefore, can shift and change – it is dynamic, not static – and as Hume reminds us, seems to embody organic rather than mechanistic qualities. Observations of ecological systems, just as any other object of scientific inquiry, require an interpretive framework in order to be understood. Reductionist eco-science alone will do little to reverse the damage we have done to the planetary system. Naess suggests that 'Eco-science (ecology) is not enough. Eco-wisdom (ecosophy) is needed: How to live on Earth enjoying and respecting the full richness and diversity of life-forms of the ecosphere'.[33] Perhaps we need the myth of harmony (whether it is an oversimplification or not) to truly alter our collective behaviour. Trying to construct a new worldview based upon objective scientific observations of the natural world will not work – we need to go a step further.

## NOTES

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