Of holism and reductionism

Permaculture & the Science of Hunches

Chris Smaje

Permaculture emphasizes holism. It addresses problems through wider relationships and patterns scaled at different system levels, avoiding the reductionism that isolates a problem within a specific sub-system of the wider whole and tries to solve it narrowly at that level only. The science from which it draws most inspiration is ecology, the biological discipline par excellence of relationships, systems, and levels.

Yet what interests me here are some tensions between permaculture as an holistic practice and ecology as a reductionist science. I want to make a reductionist biological critique of some aspects of permaculture's holism, but also a holistic critique of certain forms of scientific reductionism. The result, I hope, will be some pointers toward improving permaculture's scientific grounding, without losing the movement's wider insights. Or to put it another way, sometimes it's good to be holistic, whereas at other times a bit of reductionism fits the bill, and some subtlety is needed when choosing. My comments below represent my own personal journey in and around the worlds of permaculture and science—apologies in advance for over-generalizations or misrepresentations.

A reductionist ecology

Biology and ecology confront the incredible world of organisms and their interactions, but there's no point simply marveling at the complexity of it all—understanding proceeds from reducing it to simpler elements and then building up again. For example, 19th century biologists discovered that soluble nitrogen compounds were critical plant nutrients, and this enabled them to characterize the nitrogen cycle which brings plants, grazing mammals, soil detritivores, and microorganisms into relationship with each other.

A key relationship in the nitrogen cycle is the mutualism between certain bacterial biochemists, who can fix nitrogen into plant-available ammonium, and plants able to take advantage of this skill, such as alders, which are often pioneers in nitrogen-poor soils. It's tempting to take an holistic perspective and consider such plants to be generous trailblazers for the wider biotic community, which can take up residence only after the generously nutrifying efforts of the pioneering alders. But ecological research suggests instead that the excess nutrient is a function of atmospheric nitrogen's virtually limitless availability, and the priority of pioneer plants comes mainly from their competitive advantage in establishment and not from their communitarian benevolence (1).

To push this insight to a more general conclusion: biodiversity in the wild usually results from niche occupation by organisms with specialist skills in tapping often recalcitrant resources, whereas human cultivation usually relies on getting high returns from a small number of organisms that respond impressively to high resource availability when humans make conditions favorable for them. This explains why, at least at a given level of the system (a vegetable bed, for example), there is little compelling evidence that polycultures or companion planting are, in general, more productive than monocultures. And it's why ecologist Ford Denison warns against what he calls "misguided mimicry of nature" in designing agricultural systems (2).

From science to scientism

The gold standard in science is the controlled experiment. By carefully defining a problem in terms of associations between variables that are then rigorously manipulated, it becomes possible to develop and test causal hypotheses about how the various parts of the universe relate to each other and to the whole.

As a reality check to prevent us from leaping to conclusions on the basis of what we think is probably going on or what we'd like to think is going on, this experimental method in science is pretty much the only game in town. Sure, we can scoff about the reductionism of lab work and how it over-simplifies the complexities of real-world relationships. But nobody ever figured out how to replace biological nitrogen fixation with a synthetic alternative by musing on the irreducible complexity of nature; that trick was figured out in the lab, and then taken into the field. It's hard to gainsay its technical success. Something like 40% of our food globally now relies on nitrogen fertilizer synthesized industrially using air and fossil fuels.

There's an obvious catch here, though. The experimental method enables scientists to understand plant nutrition and develop synthetic alternatives, but it doesn't tell us whether those alternatives ought to be adopted. The widespread use of synthetic fertilizers in agriculture has led to eutrophication in rivers, lakes, and seas and the emission of greenhouse gases, among other problems, which may or may not prove remediable by further technical interventions. The larger point

remains: should we adopt synthetic fertilization, or any particular innovation enabled by the scientific method? Science has nothing to say about this.

So when people say that we need a "scientific agriculture" (for which read "large-scale, capital-intensive, labor-light, and biotech-heavy"), or that we must embrace "technological progress," the concepts of science and technology lose their only true moorings in the experimental method and start to function as ideologies—symbols for the kind of politics, economies, and societies that its proponents favor. In this way, science becomes "scientism"—a political metaphor that has precious little to do with science as a method of enquiry. We might debate, for example, whether vitamin A deficiency in South Asia is best tackled by developing transgenic golden rice or by community agroecology projects, and we might adduce certain kinds of scientific evidence in favor of one view or another. But that pervasive brand of scientism in contemporary culture, which always favors the higher tech solution: golden rice over agroecology, represents ideology rather than science.

Others go further: a long tradition of science criticism questions the distinction I've just drawn between ideology and science. In this view, scientific enquiry isn't some value-neutral enterprise that reveals objective truth, but is a social practice defined by the same ideological blinders that afflict politics and society. The society of scientists is a maelstrom of personalities and power politics no different from any other walk of life, in which some people and some questions get promoted over others for reasons that have nothing to do with truth. Personally, I'm happy to go a fair way along that road with the critics of scientific practice—of the military-industrial complex, the corporate takeover of science, and so on. However, I'd argue that ultimately there is a difference between science and ideology. I don't think the kind of ecological findings about nitrogen I mentioned earlier can be described as ideological in any useful way, and scientific enquiry is self-correcting in a way that is scarcely true of religion, politics, or ideologies like scientism. In science, ultimately the truth will out, whereas these other modes of thought are almost endlessly capable of legitimating themselves to avoid facing their limitations.

Permaculture: from self-legitimation to emergence

So much for the critique of science as a self-legitimating political metaphor. The same can be said of permaculture. Many of us in the permaculture movement are attracted politically by the values of a flourishing community, mutual aid, social cooperation, balance, and moderation. I think we're therefore predisposed to look for these values in the natural world and the wider universe, and to latch on to any supportive evidence that seems to confirm our worldview. I've already touched on some ways in which nature doesn't always play ball with us. I'm not sure it much matters, because we don't need to model the rules for human interaction after those of the natural world—and in any case, these values have complexities enough in their own terms (anyone who thinks that a commons or a community is a naturally self-organizing entity that maximizes net benefit probably needs to read some more history). But we do need to pay attention to the way the natural world works in our traffic with it as gardeners or farmers because, as with scientific enquiry, we can delude ourselves with wishful thinking about landscape design only for so long.

We can, if we like, describe the relationships between organisms as cooperative in preference to a Darwinian emphasis on competition. But it's not very illuminating either way to use such singular, determinist labels, and it takes a lot of ideological conjuring to characterize the relationship between, say, lions and zebras as cooperative. Only by appointing ourselves lofty judges of lion and zebra-kind can we afford the luxury of an holistic view that holds the dance of death they enact as the benign unfolding of some larger plan for their self-improvement. If I were an individual zebra, however old or sick, I'd more likely take the reductionist position of not wanting to get eaten.

Nevertheless, the lion-zebra example illustrates the concept of emergent properties, which may help permaculturists escape the dissonance between ecological realities and communitarian ideals. Emergence occurs when the whole is greater than the sum of its parts, just as the form of a future cake cannot be deduced from its specific ingredients. The agronomist Andy McGuire, building on the insights of ecologists like Denison, has argued that there are no emergent properties in ecosystems, and therefore human designers can better nature by improving on the genomes of its constituent organisms and combining them in novel ways (3). At one level, as a gardener and farmer, I can scarcely disagree, because my daily practice involves propagating improved varieties in non-natural combinations to give me products that I would never otherwise obtain.

But at another level, I do disagree because there <u>is</u> emergence in nature. Emergence doesn't require the presence of some mystical unifying force of the kind that accords alders the role of benevolent trailblazers (there are many enthusiasts in the permaculture movement for such mystical forces—I'm not myself persuaded that this is more than self-legitimating ideology). But lions and zebras, while doing no more than following their individual dramas of predation and survival, help create an emergent ecosystem that cannot be derived analytically from its parts. It's not a community in any meaningful human sense—it's not cooperative and it's not necessarily balanced. More important than any such questionably anthropocentric values is its emergent and conditioning form, which I would characterize in the words of ecologists Philip Grime and Simon Pierce, "within all branches of the tree of life, constraints of habitat interacting with the limited

potentiality of the organisms themselves have restricted the outcomes of natural selection to a rather narrow range of basic alternatives in life-history, resource allocation, and physiology" (4).

The great inspiration of Denison's work is his emphasis on the tradeoffs faced by every organism in the context of these limited options that evolution presents, and at a higher emergent level the tradeoffs we also face as human assemblers of agro-ecosystems built around arrays of similarly limited organisms. The essence of a tradeoff is that "having more of one good thing usually means having less of another" (Denison, p. 44), and I'd be inclined to turn this point against Denison's own argument that "Local sourcing of nutrients in natural ecosystems... is a constraint imposed by the lack of external inputs, not an example of 'nature's wisdom.' " For while there may be no mystical wisdom of nature, our understanding of tradeoffs suggests that drawing in more external inputs, more good things from somewhere else, usually imposes deficiencies elsewhere in the total system.

Here, permaculture, as an approach in human ecology, can build bridges between the economy of nature and the ecology of humanity. The human doctrine that most strongly motivates the overcoming of local resource constraints is capitalism. Requiring a compound annual growth rate of at least 3% to preserve its impetus, the *modus operandi* of the capitalist economy is to seek out new global arenas for investing capital and absorbing wage labor, and thus to eliminate any local constraints to its expansion (5). By my calculations, at 3% the global economy will have to grow from its present $85 trillion to $246 trillion by 2050, all else remaining equal. Not all growth necessarily impacts negatively elsewhere, but it's hard to imagine a tripling of the global economy within a generation that won't draw down natural capital even faster than at present. And, for many of us, it's hard to see what benefit this relentless growth ultimately brings to the majority of humanity, let alone the rest of the biosphere.

A basic insight of permaculture is that to get out of this impasse, it's worth exploring some of nature's lessons on making do with what we've got, avoiding waste, avoiding the total system costs imposed by overcoming local constraints, and finding ways to live more convivially within the parameters of our environs rather than feeling the need to define ourselves over and against them. To be fair, Denison himself writes "we may learn much from studying the adaptations of wild plants that evolved under... constraint" (p.106), and the real force of his complaint about the "misguided mimicry of nature" is not that it's misguided to mimic nature, but that it's easy to mimic nature misguidedly. If the permaculture movement keeps refreshing its engagement with a reductionist ecology, it'll avoid making a lot of unnecessary mistakes of this sort, which mostly stem from too reductionist an approach to various specific practices that have become permaculture's sacred cows: perennial cropping, zero tillage, swales, mulching, forest gardens, livestock tractoring, and so on. All of these are appropriate in some situations, but not in others (and, I'd submit, often in fewer situations than permaculture education generally conveys).

When reductionist science hitches itself to an expansionist economic doctrine such as capitalism, it easily fosters troublesome hybrid ideologies like scientism. In contrast, complementing science with an holistic doctrine of sufficiency such as permaculture could help us make better design decisions and ultimately enjoy a productive, convivial social ecology.

I accept that in the long run nature overcomes limits, that it's not in balance, that whole assemblages of organisms rise and fall. But we need to design for the human short-run, not for nature's deep time, and if permaculture sometimes errs in its vision of nature as a balanced, functional whole, this is a more appropriate fiction for staving off humanity's fall than scientism's fiction of humans overcoming all.

The science of incremental hunches

At present, the scientific establishment is not even very aware of permaculture. If we want to bring more of the benefits of reductionist science into our present practice, we'll have to do it ourselves.

And herein lies a problem. The experimental method is tremendously costly in time and money. Even quite simple agronomic trials can involve much skilled labor by many people working with huge sample sizes in order to produce worthwhile data. Although there are welcome signs that various permaculture institutions are becoming more interested in formal research studies, it seems unlikely that the movement as a whole can command the resources to do much scientific research, particularly with the small-scale and highly diverse cropping it tends to practice. On this score, I have to confess a poor record on my own part in seeing through various mini-experiments I've initiated on tillage and fertilization, polycultures, and pest-repelling intercrops, which have all fallen by the wayside in the face of my need as a commercial grower to focus on production. I'm hopeful that my current experiments in small-scale wheat growing and extensive pig husbandry will prove longer-lived than some of those previous efforts.

But maybe it's possible to develop a permacultural science more in keeping with the movement's amateur, grassroots character. Gardeners and farmers always have hunches about what works in their particular situations. We can go a long way towards being more scientific permaculturists if we subject these hunches to a little gentle testing through observation. This is a cornerstone of both good science and good permaculture, albeit a difficult one to master, as it's easy to observe what we want to observe and allow received wisdom to prevent us from observing objectively. Cultivate true observation as a key permaculture skill—so much more important than the clichéd and outcome-focused permaculture standards of zero

till, perennial cropping, and so on mentioned above. We can go further still if we keep good notes, ground ourselves in the rudiments of reductionist scientific methodology, and try to keep abreast of ecological thinking, regardless of how well it accords with our fondest notions about how the world should be. In this way, we can develop a skilled and responsive local practice as permaculturists based on a science of incremental hunches which avoids clichéd one-size-fits-all permaculture design, while remaining true to the wider insights in political ecology of the permaculture movement.

I'm neither a great scientific permaculturist nor an expert commercial grower. But my practice over time has inclined toward traditional mixed land uses from my region—clover leys, annual vegetables, orchards, permanent pasture, and wooded pasture—in other words, local sourcing of inputs and dealing with natural constraints by multiplying the cycling of those inputs. We can learn a lot from the reductionist science of contemporary ecology, but there's much to learn too in the natural wisdom—the "natural science?"—of tried and tested agricultural systems, a fact which ecological research indeed increasingly reveals (6). Δ

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Quotes

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