Why Restoration?

By
R. Eugene Turner
Department of Oceanography and Coastal Sciences
Louisiana State University
Baton Rouge, LA 70803

"That which is not good for the beehive cannot be good for the bees."
Marcus Aurelius; Meditations
Book 6, section. 54.

"What is the use of a house if you haven't got a tolerable planet to put it on?"
Henry David Thoreau

Definition: ECOLOGICAL RESTORATION
"Ecological restoration is an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability. And, Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed."
Society for Ecological Restoration 2004

"Why Restoration? Because, it must be done, it can be done, and it is being done;
We can improve upon the quality and quantity of our efforts."

Restoration is an intentional and positive response to a tragedy and a dilemma, and a response that needs to be done. Restoration offers a response to the human-created tragedy of species loss, habitat destruction or damage and change; it respects our heritage, and offers a way of change for a better future. It strives to address the question: How does the same species, *Homo sapiens var. politicus*, var. *domesticus,* and var. *economus*, live in a world with at least the minimum needs for food and shelter and also with resources to nurture its existential and spiritual needs, which include the right of all life forms to exist? It respects two great lessons: (1) The great lesson of ecology that everything is inter-connected, and, (2) The great lesson of religions and spirituality to nurture our indestructible compassion for all life. The practice of restoration addresses the dilemma of how to learn about, develop understanding of, and work with those lessons; and its time has come.

The Anthropocene
Restoration is a response to the consequences of the fact that humans are a dominant biogeochemical and physical agent on earth. The cumulative effect of this development was so great that the present epoch is called the Anthropocene (Steffan et al. 2008). The Anthropocene began about 200 years about when humans earnestly succeeded in separating themselves from intimate contact with nature on a daily basis and had a cumulative impact at the global scale. Ask yourself: what your relatives did to find food several generations ago, then the next generation, and now? Today, most of us have little experience of how to squeeze milk from a farm animal, to

grow crops, to harvest wild plants, or to build shelter. We can put our arms around most of the largest trees we see on a regular basis, if we see any, and wouldn't spend the night outdoors without our cell phone or earplugs. Hurricane Katrina drove people from New Orleans to find refuge in Baton Rouge, where I live. Some of these people complained about the sound of crickets at night – What is that racket? Someone call the sheriff! They were not silly or unintelligent people; they were only people unaccustomed to the sounds of frogs and crickets at night. Some of the night sounds they may have been used to are the city sounds of gunshots, cars and trolleys, TV and music, but not the noise from animals in a pond ecosystem. Stars cannot be seen clearly because of light pollution. Over the last few hundred years our baseline experience with nature has shifted, and there is a disconnect with the reality of our several hundred thousand years of genetic inheritance.

The transition to the Antrhropocene in the New World by the end of the 1800s was chronicled especially well in '*The Earth as Modified by Human Action*' written by G. P. Marsh (1885). Marsh was a linguist fluent in 20 languages, ambassador to Italy and traveled widely. He could see the broad picture of change from an intellectual point of view, within cultures from personal contact, and in landscapes he visited. And changes were happening quickly for him. He saw the US landscape transformed radically: virgin forests were cleared, the newly-invented John Deere plows turned Big Bluestem prairies into farmland, and ecosystems became unsustainable or unavailable for the people of the First Nations. He clearly would have been a proponent of restoration as a logical next step in social development ("*...Man, who even now finds scarce breathing room on this vast globe, cannot retire from the Old World to some yet undiscovered continent, and wait for the slow action of such causes to replace, by a new creation, the Eden he has wasted"* [Marsh, p. 228]).

Indicators

Some indicators of these changes and impacts are in Figure 1 (Steffan et al., 2008).

- Vitousek et al. (1997) estimated that 25% of the CO2 concentration results from human actions, about half of the world's freshwater supply is used, half of the nitrogen fixation is by industrial fixation of Nitrogen gas (an energetically-expensive conversion), that more than 20% of the plant species in Canada are invasive species, 20% of the bird species are extinct in the last 2000 years, and that more than 70% of the marine fisheries are fully exploited (Vitousek et al. 1997).
- Seventy-nine percent of the Earth's terrestrial surface is missing all the mammals present circa 1500 (Morrison et al. 1996).
- One billion people are without safe drinking water and 2 billion are without proper sewage treatment.
- Fifty-two percent of the land on the planet is disturbed land, meaning that it has lost part or all of its natural ecological functions. If we exclude the uninhabitable land, then the disturbed land is 75% of the planet.
- The total land area is 148,939,100 km^2 and there are 6 billion people (today). Thus the inhabitable land is 107 x 10^6 km^2 and there are 1.78 ha (4.4 ac) for each person, and the population is growing. In 25 years or so, the area per person will be half that number (2.2 ac per person). How densely populated is your home town? Your state? Your neighborhood? *Could you gather and manufacture or trade for all of your food, housing materials, gadgets, transportation, etc., on the average 4.4 acres (today's average)?*

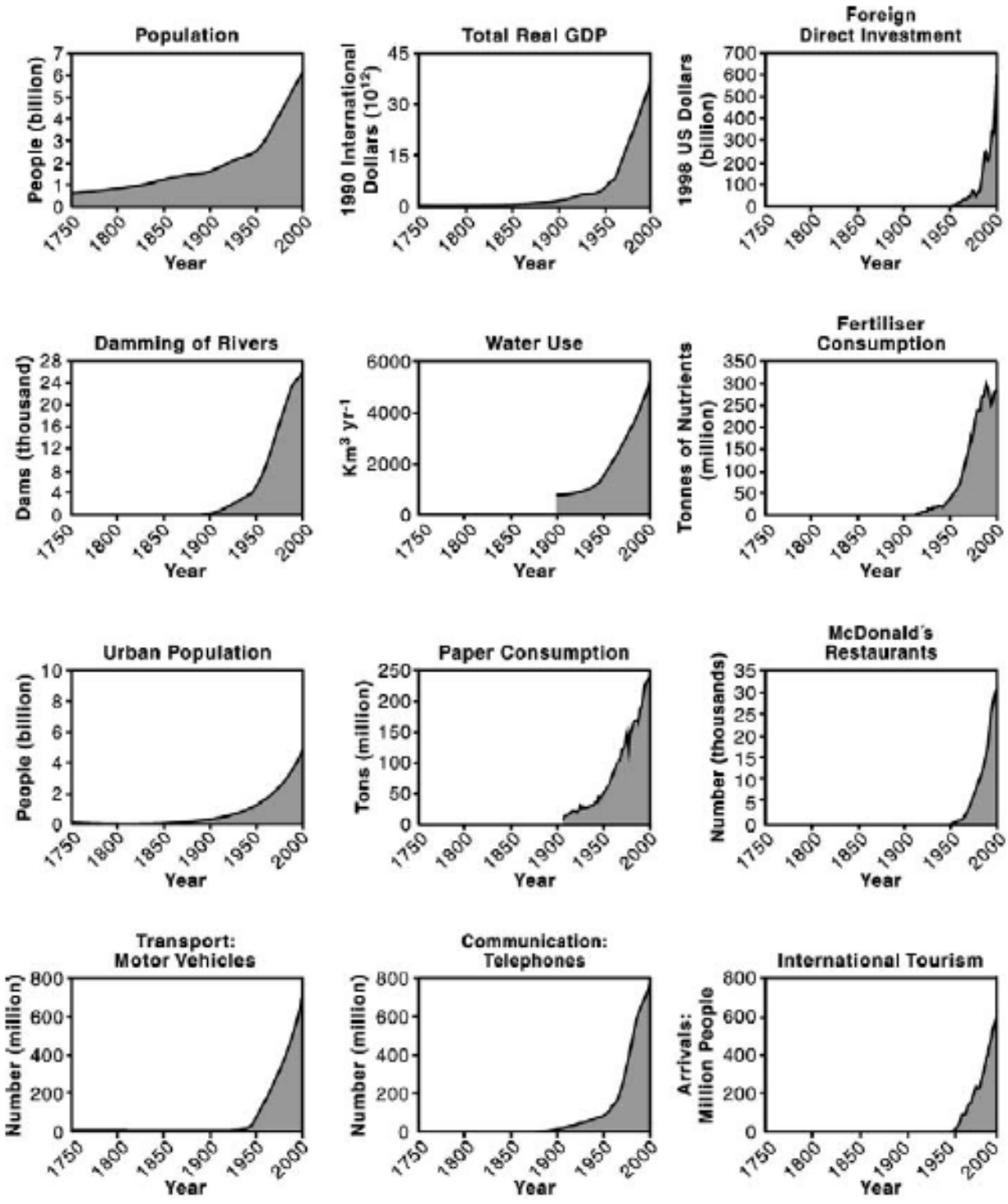

Figure 1. Indicators of the transition to the Anthropocene. From Streffen et al. 2008.

"An invasion of armies can be resisted, but not an idea whose time has come. "

Victor Hugo

Restoration has been done, is being done, and needs to be done

Restoration became necessary when conservation was not enough, or was not successful and the passivity that lets natural restoration happen was insufficient. Successful examples of habitat restoration are now found throughout the world as personal or local restoration efforts have been transformed into national, and even international programs (e.g., Bernhardt et al. 2005; Falk et al. 2006). This conclusion is evident in recent scientific publications, legislation and programs funded. For example, the United Nations is involved in restoring the marshes of southern Iraq - the 10,000+ year old home of the Ma'Dan or 'Marsh Arabs' (Thesiger 1964; UNEP 2001). The rationale for this restoration effort is largely based on a human rights issue - it is explicitly recognized that the Ma'Dan culture depends entirely on "their" wetland ecosystem. Coastal rivers and estuarine systems have been restored (e.g., Delaware Bay, Thames) and federal agencies were formed to restore soil (e.g., Soil Conservation Service in the 1930s). Restoration has, in other words, achieved political respectability at many scales, and represents a serious reversal of some social views - not that this is, at all, sufficient in a qualitative or quantitative sense. Restoration is found within the political jurisdiction that you live in – and it is one purpose of this class to uncover the details of that fact.

Restoration requires resources, which means time and will and sometimes finances, and also legal authority. Society has some of the money (and fossil fuel) now. But in a few more decades, after more wars and wasted opportunities, we will have less discretionary funds -- and more people. As non-renewable resources decline, our dependence on renewable resources increases. The time for doing something is now, when resources are available and the problems have not increased further.

While scientific investigations have quantified some of the many impacts of the Anthropocene, the science of restoration is about sustainable systems. The science of restoration is, therefore, about making progress in addressing a partially-identified problem with a very applied sense of value. Its value is immediate, applicable to many, and is long-lasting. It deals with the forces that have driven the equilibrium of pre-Anthropocene environments towards undesirable outcomes (humans now and later; other species). It may seem like a thick, unwieldy, and imponderable set of immense problems. But, unlike the drivers of the present outcomes, working out the new equilibrium is more forward-looking, intentional, and gives a chance to implement goals now, rather than later. Restoration has, therefore, a hopeful view that is one of reconciliation. We have significant choices remaining to ignore or embrace regarding species composition, exploitation, respect for future generations, governance, etc. …. Or not. One thing is for sure….. passive engagement is a choice for business as usual.

The need for restoration expertise

Box 1. An analogy for restoration managers and scientists:

Suppose that the electricity in a meeting room stopped, and then the electricity in the entire building was no longer in service. The air conditioner does not work, it is getting hot, and you take off your outer garment or tie to be cooler. The few windows are opened, but the alignment of the building is not meant for cross-ventilation and the small breeze through the room is insufficient to compensate for the heat generated by the people in it. The food in the refrigerator is starting spoil - the ice cream is melting. The cooks cannot cook, and the elevators do not move. The talk that you traveled a day to get here for is soon to be canceled if the system is not fixed. What do you do? Who do you call? -- a plumber, a lawyer, or an electrician? You will seek the help, of course, of an electrician - someone with the expertise to match the identified problem. It would be good if they were known for doing fine professional work and that they had access to the proper repair tools, and that the specialist learned by apprenticeship working with another specialist, rather than from his cousin Jimmy "hip bop", the car mechanic. But (s)he cannot complete job without someone to unlock the doors to the fuse box and they will get here sooner and fix it faster if they know the local building codes and construction methods. After the immediate problem is fixed, people might reasonably wonder about longer-term issues concerning this building or the next meeting. How many times is this going to happen again? Can we learn from this? What do we want the next meeting place to look like? How should it be designed? Who needs to be involved in constructing it? And, importantly, will it be sustainable?

Scientists guide many environmental restoration efforts through direct involvement in a project, or indirectly through the incorporation of research results and development of 'best management practices', empirically defined outcomes and predictions, or even theoretical constructs. Their (our) progress in these endeavors has been non-linear and embedded with obstacles. There have been twists and turns in the priorities, methods, and perceived factual basis for conclusions. The generalizations about restoration trajectories among and within ecosystems have been sparse. Because the science of restoration is so young, we should not have expected anything but this result. The practice of restoration is not yet the same as when building a bridge that taxpayers cross daily, whose weight, structural integrity, and load capacity, etc., are well-defined in manuals and textbooks used in hundreds of classrooms. Although habitat restoration is supported by individuals and public entities, it is clear that there is also much to learn that would help meet the stated and un-stated objectives.

Restoration, to be successful, also requires the meaningful metrics of success and an informed view of how to achieve success. We should not claim success if we don't measure success and don't have metrics that mean something – in the ecological sense. And the path to success requires practice. In that sense the practice can inform ecologists about issues not related to restoration. So it is a two-way communication between theoretical and applied science (Falk, Palmer and Zedler 2006).

Restoration is more than science, management or applied science

Scientists and managers have a job to do for a crowded planet. Restoration requires expertise to potentially do it right (Box 1). We must have technical skills, absolutely. – *but*, *we must also be invited to participate and we need equipment and supplies and assistance*. Even without adequate external help, our profession has some essential capabilities that are within our sphere of influence to sustain, and even improve. These possibilities mostly involve our professionalism. An essential one is that we need to learn from one another - which is one purpose of this class. Take risks and ask for opinions from others, identify what is needed, and seek out the uncertainties even when success looks unlikely, and consider speaking up (politely) when questions need to be asked - others probably have similar questions, but are too shy to ask. If we do this then maybe we can more often identify potential problems with the circuitry before a fuse blows or before the power is cut off, and repair problems quickly, so that the flow of energy continues in a sustained way to benefit everyone in the room.

Goals

Restoration ecology pulls together a wide range of ecological activities.

- It challenges conservationists to shift from protection to the longer-term goal of restoring the whole ecosystems and society.
- Applied ecologists are challenged to de-emphasize manipulation of single components of ecosystems and shift attention to the entire ecosystem.
- Theoretical ecologists are challenged to develop practical tools to guide restoration and the indicators to monitor its success.

Three goals are possible:

1. To repair biotic communities.
2. To re-establish biotic communities on the same sites if they are destroyed.
3. To construct synthetic communities elsewhere if the original site is no longer an option.
4. To have meaningful participation of society

It is going to take a long, long time to accomplish this. The disturbance of terrestrial soils 200 to 2000 years ago is evident today (Walters and Merritt 2008; Dupouey, et al. 2002). *So let us begin now!*

References

Bernhardt, E. et al. (and 24 co-authors) 2005. Synthesizing U.S. river restoration efforts. Science 308: 636-637.

Dupouey, J. L., E. dambrine, J. D. Laffite, and C. Moares 2002. Irreversible impact of past land use on forest soils and biodiversity. Ecology 83: 2978-2984. (PDF file)

Falk, D.A., M. A. Palmer and J. B. Zedler 2006. Foundations of Restoration Ecology. Society for Ecological Restoration International, Island Press. 364 pp.

Foster, D., F. Swanson, J. Aber, I. Burke, N. Brokaw, D. Tilman and A. Knapp 2003. The importance of land-use legacies to ecology and conservation. BioScience 53: 77-88.

Hannah, L., D. Lohse, C. Hutchinson, J. L. Carr, and A. Landernai 1994. A preliminary inventory of human disturbance of world ecosystems. Ambio 23: 246-250.
Marsh, G. P. 1885. The earth as modified by human action*:* A last revision of man and nature. Charles Scribner's & Sons. New York:
Morrison, J. C., W. Sechrest, E. Dinerstein, D. S. Wilcove, and J.F. Lamoreux 2007. Persistence of large mammal faunas as indicators of global human impacts. J. Mammology 88: 1363-1380.
Shepard, P. 1996. The Only World We've Got : A Paul Shepard Reader. San Francisco; Sierra Club Books.
Steffen, W., P. J. Crutzen and J. R. McNeill 2008. The Anthropocene: Are humans now overwhelming the great forces of Nature? Ambio 36: 614-621.
Vitousek, P. M., H. A. Mooney, J. Lubchenco, J. M. Melillo 1997. Human domination of earth's ecosystems. Science 277: 495-499.
Walter, R. C. and D. J. Merritts 2008. Natural streams and the legacy of water-powered mills. Science 319: 299-304.

Related readings

Abram, D. 1996. The Spell of the Sensuous. Random House, Inc. New York. Chapter 1.
Benayas, J. M. R., A. C. Newton, A. Diaz and J. M. Bullock 2009. Enhancement of biodiviersity and ecosystem services by ecological restoration: A meta-analysis. Science 325: 1121-1124.
Demenocal, P. B., E. R. Cook, D. Demeritt, A. Hornborg, P. V. Kirch, R. McElreath, and J. A. Tainter 2005. Perspectives on Diamond's collapse: How societies choose to fail or succeed. Current Anthropology 46: S91–S99.
Ellis, E. C. 2009. Earth science in the Anthropocene: New epoch, new paradigm, new responsibilities. EOS 90: 473.
Foster, D., F. Swanson, J. Aber, I. Burke, N. Brokaw, D. Tilman and A. Knapp 2003. The importance of land-use legacies to ecology and conservation. BioScience 53: 77-88.
Jackson S.T. and R. J. Hobbs 2009.Ecological restoration in the light of ecological history. Science 325: 567-569.
Kareiva, P. 2008. Ominous trends in nature recreation. Proceedings Nat. Acad. Sci. 105: 2757–2758.
Nagarajan, P. 2006. Collapse of Easter Island: Lessons for Sustainability of Small Islands. J. Developing Societies 22: 287-301
Rick, T. C. and J. M. Erlandson 2009. Coastal exploitation. Science 325: 952-953.
Turner, R. E. 2005. On the cusp of restoration: Science and society. Restoration Ecology 13: 165-173.