Uniting Ecological & Economic History - Some Perspectives, Problems and Possibilities

Frank Oldfield(*)

Introduction

Whether our approach to linking ecology and economics has been through the 'energetic reductionism' proposed by Odum(1) and criticized in the present papers by Puntí(2), or through a formulation of nested contraints and goals, the socioeconomic within the ecological, as outlined by Pearce(3), we have hardly begun the task of exploring, through empirical study, linkages between ecological history and the history of socio-economic systems on temporal and spatial scales which inform our appraisal of present activities and their future implications. Small wonder; for the problems, philosophical, conceptual, methodological and technical are formidable, as are the barriers to mutual understanding. As our attention turns to the past, the business of communicating our concerns, and generating the essential giving and receiving of critique across disciplinary borders certainly gets no easier. At the outset we may well ask in some despair: - "Now that we can build models, who needs history?" Each of us would give a somewhat different answer, and I cannot claim to be able to remove from mine the taint of a perhaps rather Luddite empiricism, born equally of a life-time of dirty boots and fieldwork, and of a sense of the difficulty in shaping even our very best tools to the task of understanding the operation of ecological systems on any spatial or temporal scale relevant to issues of management and planning. In short, I share Deevey's view that 'Where time is required to see a result, there is no substitute for history'(4). More recently, Wasson and Clark(5), in paraphrasing Robert May(6), a distinguished ecosystem modeller, note that 'if there is only one stable state, historical effects are of no interest, but if there are many, then history is of over-riding importance'. A personal attempt to fuse the implications of May's perspectives and results with Laszlo's(7) models of systems change has already been published(8) and will be explored further below, but we may note *en passant* that May's conclusion is even further reinforced the moment we recognize the limitations of reductionism in any analysis of economic and ecological systems interactions.

Any propositions I develop here will reflect not only the very early stage we have reached in defining let alone pursuing the important issues; they will also inevitably reflect my academic experience which is 'environmental' rather than 'socio-economic'. On the environmental side of the bridge, the concepts, methods and literature in the field are technical and steeped in the principles, definitions and jargon of a whole gamut of earth- and life-sciences. This makes so much of the work on the reconstruction of

(*) Dept of Geography, University of Liverpool

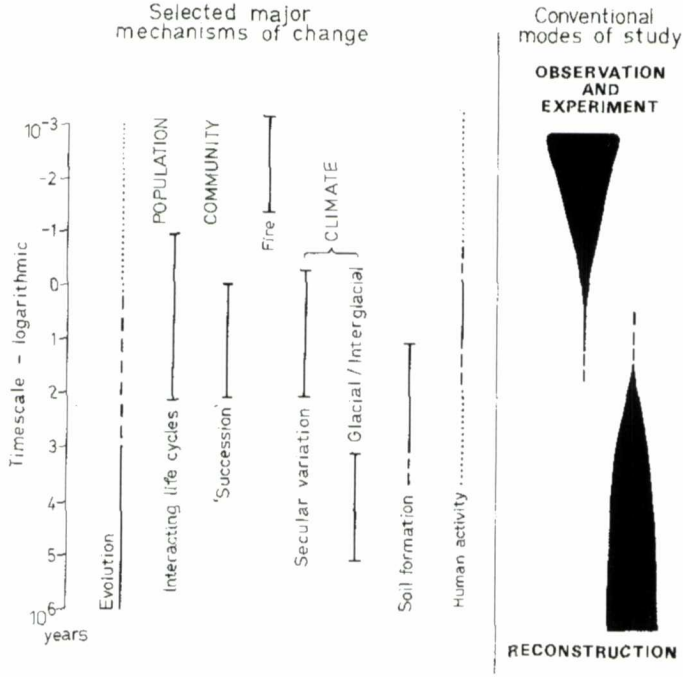
ecosystem functioning in the past only partially accessible even to the individual practitioners. How then can we communicate effectively to cultural, social and economic historians? The issue is not - how do we get this complex scientific stuff across to the uninitiated? It is very much more a question of working out how to share the aims, assumptions, limitations and ambivalences of the 'science' in such a way as to make them accessible to focussed critique from social-scientists, especially with regard to the exploration of problems like the establishment of priorities, the demystification of methodologies, the complementary evaluation and improvement of necessary assumptions, and the search for mutually compatible concepts, methods, taxonomies, spatial and temporal scales of study and resolution and eventually models and their components. I think progress begins through some loss of academic and intellectual xenophobia on both sides, and through a shared willingness to accept that in any study of the past there is no *necessary* positive correlation between the cost, sophistication and incomprehensibiliy of a technique, and the reliability and significance of the results it produces(9)(10).

We are presented with philosophical problems too which I am poorly qualified to define and explore. There is a rich and growing literature on the difficulties fundamental to any attempt to integrate contemporary studies of contemporary systems which have been pursued within conceptual frameworks ranging from the highly mechanistic and reductionist at one exteme to the humanistic, normative and intentional (or for that matter teleological) at the other. For the ecological historian interested in 'ecological problems' rather than 'problems in ecology'(11) these fundamental issues remain, but for me, they become modified in ways which, to the best of my knowledge, have been poorly explored by philosophers or historians of any kind. As we look into the past in our separate ways, we use quite different prisms to resolve the continuum of change into interpretable but necessarily fragmented constructs consonant with our training, skills, methods, aims and predilections. The historical ecologist, preoccupied with lake sediments and peat bogs for example, is not spared the need for value judgements; they simply take different forms from those which haunt the historian and the conceptual frameworks within which the judgements are made are often (though not always) quite different too. But this acknowledgement makes it hardly any easier to define the common ground on which such diverse contributions and dilemmas can be reconciled. Moreover, within the ambit of post-hoc rationalization about man-environment reciprocities and interactions in the past, there is frightening scope for imposing a retrospective determinism. Partly this is to do with the tension between narrative and analysis, and the need for 'coherent myths' to make possible any intellectually and emotionally satisfying meaning out of the past. Partly it reflects our greater willingness to impose on the lives of our predecessors, and on cultures less socio-economically 'sophisticated' than we believe our own to be, explanations which are more mechanistic than any we would accept for ourselves. Moreover, for the past especially there lies a huge and ill defined wilderness of possible explanations which we may each feel tempted to usurp with the armies of our own intellectual imperialism.

The Basic Issues

In order to make further progress in defining our approach to the ecological aspects of any proposed historical reconstruction, we need first to address issues of temporal *scale* . Do we look on timescales of years, decades, centuries, millenia or longer? In the light of Figure 1, and for a whole range of both intrinsic and pragmatic reasons outlined in Oldfield 1983(12), I propose we concentrate on decades and centuries. Next comes the question of time *span*. Where our primary aim is to place present problems, current trends and fears for the future into historical perspective,the decades and centuries of greatest concern are likely to be the most recent ones. This rather obvious proposition is also often reinforced by the extent to which rates of change have accelerated, and the forces driving change have increased in their effect during recent times, and especially since the beginning of the industrial revolution. However, where we are interested above all in processes and interactions on decadal and century timescales, irrespective of when, and without direct and necessary reference to the present day situation (which is not the same as saying without any bearing on our understanding of contemporary problems and their future implications) then we may turn to any time *span* for which suitable evidence is available(13). Extremely valuable work on rates of ecological response to stresses such as pathogen outbreaks or to relatively slow, incremental climatic changes has been carried out for much more remote time intervals in the past(14). In these cases however, complementary socio-economic insights will be absent or, at best, very sparse.

Fig. 1. Timescales and mechanisms of ecological change plotted against the time-frames for conventional modes of study



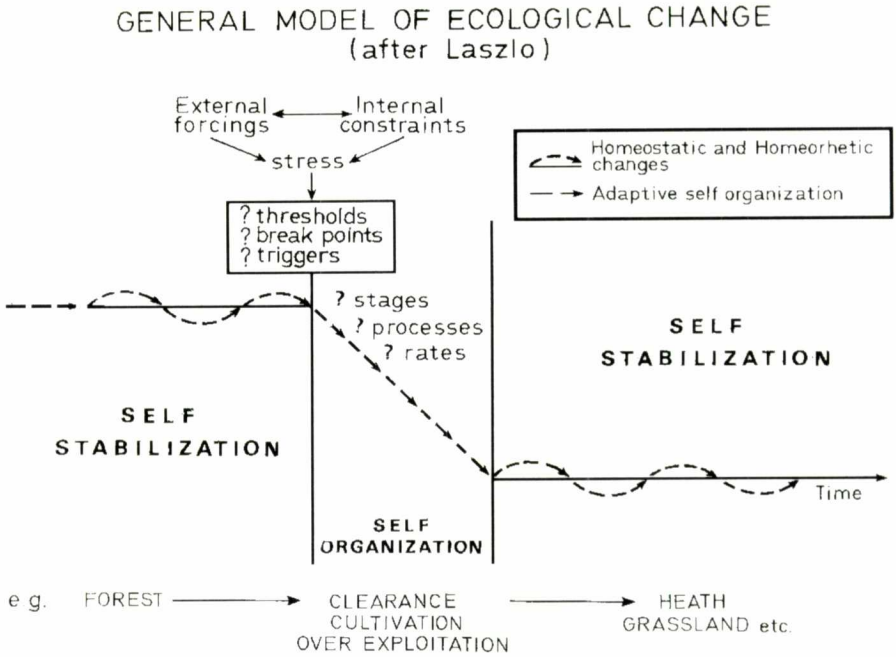
Given some choice of time span for a particular study, the next issue is that of temporal *resolution*. Within the decades or centuries chosen, do we seek to resolve change by the day, season, year, decade or whatever? This choice will reflect a whole variety of concerns and constraints, ranging from the types of problem being studied and the temporal resolution of any associated socio-economic or demographic data, to the options available as a result of the environmental context chosen for study.

Moreover issues of temporal and *spatial* scale are by no means mutually independent in environmental and ecological systems(15). If we anticipate some of the later debate, and acknowledge that lake or reservoir sediments form major repositories for the type of evidence we require, they can, depending on factors such as rates of sediment accumulation, sources of sediments, physiographic conditions and within-lake or within-sediment biogeochemical processes, provide opportunities for each temporal resolution ranging from individual storm events(16)(17) to decades at best(18).

Agreeing to attempt some linkage between ecological and socio-economic studies in the past implies sharing the responsability for addressing issues of temporal scale, span and resolution in the light of a wider and more diverse range of criteria than we would separately embrace in less methodologically transgressive studies. This brings us next to the question of conceptual models. From an ecological/environmental standpoint, three main types of model are current. These we may term 'successional'(19), 'cyclic/harmonic'(20) or 'alternative steady-state'(21). I believe we should open up and explore the whole area of debate about the mutual compatibility, intrinsic appropriateness and actual practicality of conceptuals models of change through time at each side of the bridge we are trying to build between ecological and socio-economic history. Figure 2 reflects my own preference for an 'alternative steady state' model within which concepts of succession (which have "goal-oriented' parallels in the social sciences) and for harmonic change (which are clearly analogous in many ways to economic 'cycles') can be nested. It also reflects my persisting hope that Lazlo's formulations may be a starting point we can all share.

The next questions to address are those of environmental context and of scientific methodology. Evidence for past environmental or ecological changes on timescales of decades and centuries is preserved

Fig. 2. A schematic model of ecological change based on Laszlo. This scheme applies to systems which, under stress, can undergo relatively rapid aperiodic shifts to alternative steady states

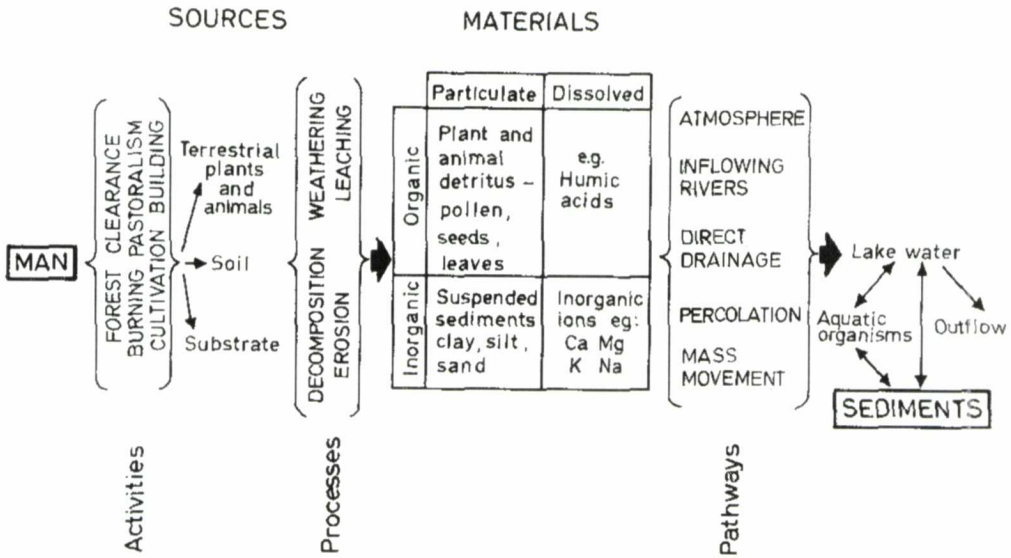


for, and accessible to us only in a limited range of contexts. Lake and reservoir sediments have, in many cases, accumulated at rates which allow us to achieve the type of temporal resolution already identified as crucial. Moreover, they often provide us with a record of change which integrates the effects of both 'natural' and anthropogenic processes within a combined lake and catchment system (the 'lake-watershed ecosystem' of Borman and Likens(22)) which is, to a substantial degree, bounded in a material sense and reasonably easy to delimit spatially. This proposition must however be strongly qualified for those situations where atmospheric inputs, both to the lake directly and to its waters via the catchment, are of major biogeochemical significance. Extreme examples are the lakes acidified as a result of atmospherically deposited emissions resulting largely from fossil fuel combustion(23). Where catchment processes dominate the sediment record, and our main concern is to use the latter to reconstruct the effect of human activities on the surrounding landscapes,the model in Figure 3 sets out in simplified form the nature of some of the important linkages between human impact and sediment accumulation. Several recent books and papers outline not only the beauties but also the special subtlety and ambivalence of much sedimentary evidence(24); however, there are rarely alternative sources for the type of evidence we need and lakes often provide environmental contexts within which the continuum from past to present can be observed and quantified.

Where our major concern is to isolate the atmospheric inputs to ecosystems in the past, it is often convenient, or even necessary, to turn to other preserving environments such as peat bogs or snow and ice fields. Peat bogs have the advantage of including certain types which are nourished entirely by atmospheric deposition and are also widespread in many of the cool temperate environments close to major industrial and urban areas. These, so-called, ombrotrophic peat bogs are the nearest things we, as species dependent on atmospheric quality, have to the old miner's canary, and a brief digression on the uniqueness of their environmental value is in order. The rate at which they are currently being degraded or destroyed by drainage and afforestation should not be seen simply as an ecosystem conservation issue in the currently familiar terms alone. Recognition of the special quality of these sites as recorders and sensitive indicators of the effects of atmospheric deposition, accessible to both contemporary and historical study, hence capable of linking present day observations and experiments to longer term historical

analysis(25), should form a major part of the cart to be made for their careful maintenance and sensibly limited exploitation. However, by way of dropping us back into the care we share, I very much doubt if my proposition makes it any easier to establish the economic value of such areas as ones to be protected adequately from exploitative damage!

Fig. 3. A simplified partial model of lacustrine sedimentation in a lake-watershed ecosystem strongly influenced by man



Some Concluding Remarks

One point which I believe merits emphasis is the need to aim, above all, for a quantitative insight into rates of change, not merely a series of qualitative statements in terms of states and dates. The need to share this aim arises from the dynamic nature of "baselines' in all our studies, and from the predominently non-linear nature of the systems interactions with which we are concerned. In consequence, the value of the empirical, historical evidence we desire will be heavily dependent on our success in quantifying *rates*. This applies whether the uses we have in mind are trend extrapolation, model building and testing, or simply the pragmatic resolution of policy and management issues.

I still see the search for some basis for communication as a massive first hurdle. The problem arises partly from our entrenched and mutually incomprehensible 'jargon taxonomies' partly from the sheer diversity of the organizing principles we are trying to encompass as we move all the way from geophysical methods at one extreme, to questions of culture, economics and demography at the other. To what extent can we share constructs like materials, energy, information and control in ways that avoid both the obscuring of evading of mutual critique, and the over mechanistic view of human affairs? Certainly there are strong indications that more ecologists are recognizing the need to cultivate and share a concern for the recent past in order to view contemporary problems and their future implications in a more realistic way(26).

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(11) e. g. Passmore, J. *Man's responsibility for Nature.* Duckworth, London, 1974.
(12) The reasons reflect the extent to which environmental and anthropogenic processes conspire to engender great interaction and dynamism on these timescales, and the way in which, as scientists, both for operational and sometimes for less defensible reasons, we have neglected these timescales by dividing our modes of study into process observation and experimental work on short timescales, or alternatively, reconstruction of ecological and environmental change on very long ones.
(13) Over the last 15 years, both 'environmentally' and socio-economically oriented research within the Annecy lake basin in E. France has been pursued by Geographers in Liverpool, much of it in ways and for timespans dictated largely by the availability of remarkably informative documentary evidence from the sixteenth century AD onwards. Preliminary statements outlining some of the data available appear in the following:Siddle, D. J. and Jones, A. M. "Sources for the reconstruction of a man-environment-ecosystem". *Liverpool Papers in Human Geography.* No. 3,1982. Higgitt, S.R. *Palaeocological stud, of recent environmental change in the drainage basin of the Lac d'Annecy* Unpublished Ph.D. University of Liverpool, 1985.
(14) See for example Davis, M. B. "QuaternaryHistory and the stability of forest communities". In West, D. C. *et al.* (Eds.). Davis, M. B. "Outbreaks of forest pathogens in Quaternary History". *Proceedings of the IV International Palynology Conference, Lucknow.* 3, 216-227, 1981.
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(17) For example, the availability of 14m of sediment in the 70 year old Umberumberka reservoir in S. Australia provides a basis for resolving environmental change on the basis of each individual climatic or anthropogenic event, but the practical problems posed by actually working at this level of resolution are extremely daunting (R. L. Clark, pers. comm).
(18)Many recently, reported studies of acidified lakes in both Europe and N. America fail to achieve better temporal resolution than this, despite which the evidence is highly indicative in terms of its policy making and managerial implications (see no. 23 below), See also Miller, K.M. and Heit, M. (1986), "A time resolution methodology for assessing the quality of lake sediment cores that are dated by ^{137}Cs." *Limnology & Oceanography* 31(6), 1292-1300.
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(21) Explicit application of this type of relatively well established model to actual ecological observations (as distinct from its use in, or deduction from, simulation models) still seems surprisingly rare.
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(26) The first steps were taken through the organization of a conference on 'Ecological History' held in Bad Homburg, West Germany, in 1988, and the formation of an INQUA working group on the palaeoecological study of recent environmental degradation.