Environmental Change and Biodiversity - Summary of responses and comments:

One response received:

1. Adrian Newton (ApSci)

Alternative name suggestions:

Author	Name suggestion/s	Comments
1. Newton	None stated	Richard Stillman (ApSci): "The link between environmental change and biodiversity is key as predicting how biodiversity will respond to future environmental change is one of the most important challenges faced by environmental scientists."

Brief theme summary:

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1. Newton	We are currently experiencing a global biodiversity crisis, with high rates of species extinction and widespread habitat loss resulting from human activities. Other forms of environmental change include degradation of ecosystems, pollution, overharvesting of natural resources, spread of invasive species and anthropogenic climate change. Together, these pressures are having a significant impact on the ecological processes on which human life depends.	John Stewart (ApSci): "Humans have relied on the biotic environment since the first appearance of the genus Homo. Changes to the environment are thought to be a principle driver of both the evolution of humans as well as determining the fate of any given population. Therefore, the research theme on Environmental change and Biodiversity is also relevant to a number of members in the Archaeology Academic group in the School of Applied Sciences as well as individuals who work across the school. The theme's scope so far outlined clearly invokes biological response processes that should include evolution in addition to geographical range change with extinction as one extreme form and maybe invasive species on the other. As part of evolution subspecific and species level evolution should be added. If evolution is included then morphological and behavioural evolution should be considered subsets. Given that not all morphological and behavioural change is genetic then these need also to be included as opposing response modes to environmental change. The inclusion of behaviour as a response clearly opens the door to inclusion of the human species and its responses to environmental change through time and space. The latter would include much of what the archaeologists study." Emma Jenkins (ApSci): "the origins of agriculture and sedentism, fits

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		well within its scope. It can be argued that the transition from mobile-hunter-gatherers to sedentary farmers had one of the greatest impacts of all human innovations on the environment, irreversibly altering the landscape and even leading to the creation of new species of plants and animals. Why humans made this transition is still not understood, although environmental change is thought to be one potential driver. In addition, the change from a nomadic to a settled lifestyle increases the likelihood of developing an infectious disease, not only because of increased population density, but because the advent of sedentism brought with it commensalism. Two of the main human commensals are the house mouse and black rat both of which are not only carriers of infectious diseases, but can also decimate grain stores. Furthering our understanding of how humans adapted to past environmental change feeds into one of the big questions this theme poses, namely: What are the likely effects of environmental change on provision of ecosystem services, and human wellbeing?"

Scope of theme: what is included:

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1. Newton	Biodiversity loss, including: • extinction of species • environmental degradation • loss of ecosystem condition • habitat loss • environmental pollution • climate change • depletion of natural resources Human responses to the biodiversity crisis, including • sustainable use of natural resources • protected areas • ecological restoration Also: • effectiveness of management and policy responses	Rudy Gozlan (ApSci): "I would re-emphasise the implications of biodiversity changes on human health in particular through the emergence of infectious diseases. There is an increasing body of evidence showing a direct link between the change in animal communities (decline, species introduction etc.) and the transmission and virulence of key infectious diseases. Last June, the new Policy Platform on Biodiversity and Ecosystem Services (IPBES, UN science body) was established to address how changes to the diversity of life will affect human well-being. Within that specific framework, changes in biodiversity will also modify the risk of exposure to infectious disease as infectious diseases stem at a minimum from interactions between host and pathogen. On one hand a high biodiversity could provide a lager pool of novel pathogens but on the other hand it could also reduce pathogen transmission for long established and newly emerging diseases."

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	• impacts on ecosystem services and human wellbeing	Demetra Andreou (ApSci): “Parasites outnumber free-living by approximately 50 % and are integral to food webs, ecosystem function and services. Changes in biodiversity can have dramatic effects on parasite diversity, prevalence and impact and can increase the risk of disease emergence (as pointed out by Prof. Gozlan above). This is of particular concern to human populations especially in the tropics. It is thus imperative to empirically test how changes in biodiversity can affect disease emergence as well as develop risk assessment exercises for identifying potential disease emergence hot spots. The available expertise at Bournemouth University provides the opportunity for a multi-disciplinary approach in addressing this question and provides ample opportunities for collaboration across different schools. In addition, biodiversity loss increases the vulnerability of ecosystems to invasion by non-native species. Invasive species also carry with them their novel parasitic fauna which can further impact native biodiversity and lead to further biodiversity declines. Where these declines include species of high economical and societal value, this can translate to significant reduction of ecosystem services and subsequently human well being.” Dan Franklin (ApSci): “Given the point we find ourselves at in human history, the topics of the theme represent some of the most important areas of modern science. As someone who works on microbial ecology it is clear to me that we need to understand how the foundation of the food web may shift in response to anthropogenic pressures. For example, it is possible that in a warming ocean, physical changes in water column structure (that is, stratification – where warmer surface water becomes cut off from deeper nutrient rich water) may lead to different patterns of plant production with unknown consequences for fish production. This possibility was highlighted in a recent controversial article in Nature (doi:10.1038/nature09268) which employed complex data-blending techniques to generate a finding of a significant decline in plant abundance and production over the last century. On the other hand, plant production may be increasing. The point is, we don’t really know, and primary production would be the biological process upon which everything else depends. The photosynthetic microbes which

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		drive the biogeochemical cycles we depend upon will always be here, but we don't know how they will change in activity and composition due to anthropogenic pressures. Studying primary production and environmental change is therefore an important subject of research. More generally, attempting to provide practical help in adapting to the challenges of climate change and population growth is the great challenge of ecology. This has been recognised for a long time (Vitousek Ecology, Vol. 75, No. 7. (Oct., 1994), pp. 1861-1876). Photosynthetic microbes may have the potential to help due to their high yield of carbon-neutral hydrocarbons." Duncan Golicher (ApSci): "The scope of this theme includes biodiversity loss, extinction of species and environmental degradation. These are all depressingly familiar issues for ecologists working on tropical forests, in which a large proportion of the world's terrestrial biodiversity is concentrated. The Millennium Ecosystems Assessment forecasted the extinction of a large fraction of tropical tree species over the course of the next century. But, how much do we really understand the process of tropical extinctions? How accurate are our current estimates of deforestation and consequent extinction rates? In 2008 Stephen Hubbell applied neutral theory to estimate the number, relative abundance, and range size of tree species in the Amazon metacommunity. Hubbell's calculations led to an estimated 37% loss rate over the course of the next century under the most optimistic scenario. Most of the vulnerable species have small range sizes making them susceptible to local habitat loss. However calculations of extinction rate based on species area curves, including those produced by Hubbell, have a fundamental flaw. The area required to remove the last individual of a species (extinction) is larger, almost always much larger, than the sample area needed to encounter the first individual of a species doi:10.1038/nature09985. As a consequence of finally noticing this error, Hubbell's group have revised the estimate downwards. The moral of the story is that all methods based on extrapolation are fraught with danger. Unfortunately, they do still have to be applied in the tropics due to the mismatch between available evidence and that required to provide robust estimates of biodiversity loss. Throughout most of the tropics species distributions remain poorly mapped. Relationships between

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		total biodiversity and composition of vegetation remain poorly typified. The degree of resilience to climatic fluctuations has not been fully explored. Much of the diversity outside protected areas has not been sampled. Interpretation of vegetation differentiation and distribution is frequently too simplistic; there are still large parts of the planet for which few or no botanical data exist, and many rare and sparsely distributed species remain undiscovered. In order to inform and influence global conservation issues it is important to bring together new data and develop efficient and informative methods for analysing such data. We urgently need greater knowledge regarding not only where tropical species are found, but why they are found where they are and how sensitive they are to environmental change." Andrew Ford (ApSci): "The varied effects of anthropogenic climate change, pollution and use of natural resources (not least water resources), and their impacts on both the geosphere and biosphere, are very significant. I see great potential in capitalising on our collective expertise in both the environmental sciences and geospatial science." Ant Diaz (ApSci): "Here's another important facet to consider if we are to predict and ameliorate negative interrelationships between environmental change, ecological processes and biodiversity – the role of changes in multiple species interactions in driving these relationships." Ross Hill (ApSci): "One of the areas of interest to me in the debate on the impacts of environmental change on biodiversity is the observed shifts in the timing of plant activities (such as flowering, bud burst and leaf fall) and the affects this will have on ecosystem functioning."

Scope of theme: what is excluded:

Author	Summary	Comments
1. Newton	Any element that does not have a significant environmental component.	

Which big societal questions are addressed by this theme?

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1. Newton	• How may extinction risk be assessed? • What is the current rate of biodiversity loss? • What are the likely effects of climate change on the world's ecosystems and associated biodiversity? • How vulnerable is the earth system to biodiversity loss? • What are the likely effects of environmental change on provision of ecosystem services, and human wellbeing? • Are there tipping points in ecological processes? • Are there thresholds of environmental impact beyond which recovery is impossible? • How resilient are ecological systems to environmental change? • Will the earth system be able to support human society in future, if the biodiversity crisis is not addressed? • How can the biodiversity crisis be addressed? • What are the risks of ecosystem collapse?	Roger Herbert (ApSci): "The marine and coastal environment is often 'out of sight and mind', yet as the Census of Marine Life showed, there is still much to be discovered; of the 250,000 known marine species, there is an estimated 750,000 yet to be described, excluding more than a billion different types of microorganism (http://www.coml.org). This information is necessary to help address some of the greatest issues facing mankind: how much of the ocean do we need to protect? how can we manage our seas to support sustainable fisheries? what is the role of marine organisms in climate regulation?" Ant Diaz (ApSci): "Being able to better understand and so predict the effect of multiple species interactions on ecosystem responses to environmental change is one of the most crucial challenges facing ecologists in the 21st century. Success and effective communication and integration of new understanding with that from other fields of science, humanities and conservation practice is essential."

How do these link to the priorities of the major funding bodies?

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1. Newton	Many of these issues are now featuring in calls from NERC (eg through the LWEC programme and the BESS programme), and from the EC.	Rudy Gozlan (ApSci): "It is also very similar to the NERC research agenda in Biodiversity Science." "The sub-theme of emerging infectious diseases within the wider biodiversity one is clearly aligned with a wide range of funding body such as the World Health Organisation, the European Centre for Disease Prevention & Control and the 2012 Health theme of FP7 (theme 2.3.3 Potentially new and re-emerging epidemics/2.3.4 Neglected infectious diseases)." "Finally, this theme on sustainable development, biodiversity and human wellbeing clearly fit within the REF UoA 7 (Environmental Sciences)". Demetra Andreou (ApSci): "Invasive parasites and their impact on native communities is an important research avenue that fits in with this BU research theme as well as those of NERC and the European

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		Community."

How does this theme interlink with the other BU themes currently under consideration:

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1. Newton	There is a strong potential link with the Green Economy and Sustainability, but also potential to develop links (particularly on ecosystem services) with Health and wellbeing, Recreation and leisure, Culture and society or Society & Social Change, Entrepreneurship and economic growth.	Rob Britton (ApSci): "This theme on Environmental Change and Biodiversity should resonate with many across BU – not just those working directly in these particular fields, but all who take an interest in how the decisions we take as a society influence the natural world around us (and then feedback). For example, the societal questions of 'What are the likely effects of environmental change on provision of ecosystem services, and human wellbeing?' and 'Are there thresholds of environmental impact beyond which recovery is impossible? are highly important for our future wellbeing and require informed debate in- and outside of BU if we are to take the most appropriate decisions on aspects such as energy and food production that maximises output whilst minimising environmental impact (see http://www.bbc.co.uk/news/science-environment-13756853 for an example of how aquaculture is changing in relation to this). The theme is also very cross-cutting, particularly with the Green knowledge economy and sustainability, with high potential for developing some exciting multi-disciplinary research collaborations across the university in future. That the theme is strongly allied to a number of external funding priorities (see previous blog entries) serve to strengthen it further." Richard Stillman (ApSci): "I agree that this is an important research theme with good links to themes such as Leisure and Recreation, Culture and Society, Health and Wellbeing, and Green Economy and Sustainability." Ant Diaz (ApSci): "Unprecedented rates of global environmental change make it imperative that we understand and address the challenges this poses for the conservation of biodiversity, ecological processes and the resultant ecosystem services on which we all depend. We can work towards achieving this both directly through increased understanding in core physical and life sciences and

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		through links with other BU research themes centred on human health and society.”

Further comments from interested academics, groups and/or Schools:

- None stated.