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**Biodiversity, its value human impacts**

This course is an introduction to the concept of biodiversity, its value and what humans are doing to drive its decline and destroy the natural world. We recommend that this course is taught before the other courses, as it gives some context for why the natural world and the diversity of life we can observe are so important. Whilst the other courses will stand alone if need be, and the Ecology and Evolution ones can be taught for the interest of understanding the natural world and how it functions rather than in a conservation context, this course sets up why ecological and evolutionary processes are important to humans and in the face of environmental degradation.

This course covers what biodiversity is, what it provides for society, and how humans are driving its destruction. As the TIDE teaching resources were originally designed for participants in Myanmar, there is also a course that covers tropical diversity specifically.

***Lecture 1 – Biological diversity***

This lecture introduces the concept of biodiversity. We recommend that if teaching this you do pause the presentation when prompted to ask participants what they think biodiversity is before the definition is given. One of the most interesting and useful aspects of the definition of biodiversity is that it covers life at all levels of organisation, from genetics right up to ecosystems. Whilst this is a benefit, it cane also make the concept difficult to grasp, so this point is worth emphasising. Evolution is the process that has given rise to all the biodiversity we can observe, and therefore is fundamental to understanding all aspects of these course. The fact that the vast majority of species have not been described shows just how much we still have to learn about the natural world. The lecture then moves onto why we should care about biodiversity, and evidence for the relationships between diversity and function/services. There is no guarantee that greater diversity leads to better/greater supply of function/service. Evidence does suggest that this is often the case, but it is worth pointing out that it is important this is tested and not just assumed.

The final part of the lecture covers how biodiversity is measured and estimated, including new technologies that can help with this.

*Reading*

*Tilman, D., Isbell, F. and Cowles, J.M., 2014. Biodiversity and ecosystem functioning. Annual review of ecology, evolution, and systematics*

Summarises the evidence for the relationships between species diversity and ecosystem function, including productivity, stability, invasibility and nutrient dynamics from many experiments. This may be driven by several different factors. This highlights the great importance of protecting biodiversity for the future of the life on earth.

*Raven, P.H., Chase, J.M. and Pires, J.C., 2011. Introduction to special issue on biodiversity. American Journal of Botany*

Gives more background on the genesis of the term biodiversity, and the academic study of the diversity of life on earth. Whilst there are different categories of study, they are all interlinked and need each other to function effectively.

*Swenson, N.G., 2011. The role of evolutionary processes in producing biodiversity patterns, and the interrelationships between taxonomic, functional and phylogenetic biodiversity. American Journal of Botany*

Biodiversity is ultimately the net result of speciation and extinction. These are evolutionary and ecological processes, and this work highlights to importance of integrating both ecology and evolution to study and understand the global patterns of biodiversity we observe.

*Taberlet, P., Coissac, E., Pompanon, F., Brochmann, C. and Willerslev, E., 2012. Towards next‐generation biodiversity assessment using DNA metabarcoding. Molecular ecology*

Provides an introduction of one of the recent technological innovations that have changed the study of biodiversity, ecology and taxonomy.

***Lecture 2 – The impacts of humans on biodiversity***

The previous lecture looked at biodiversity and how we classify and study it. This one covers how humans and damaging and destroying it. We expand on this in the Conservation course. Declines are widespread but are geographically and taxonomically variable. The lecture briefly touches on land use change and climate change, two of the biggest threats to biodiversity (the same diagrams are used here and in the Conservation course, which has been done on purpose in order to reinforce their importance). An important theme in this lecture is spatial variation, in threats to biodiversity and the declines that they drive. Taken together, human impacts are surpassing ‘planetary boundaries’. Once we pass these thresholds or tipping points it is likely to lead to irreversible and abrupt environmental change.

Human impacts on the natural world are pervasive, and will be recorded in the geological record. This has led to suggestions that we are in a new epoch called the Anthropocene. There is debate over when the start date of this should be:

* the start of farming which led to many extinctions of large bodied species
* European colonisation of American which led to the deaths of millions of indigenous people, sharp population decline, forest regrowth and a drop in carbon dioxide levels, The lecture finishes by looking at human population size
* Industrial revolution
* Height of nuclear testing in 1946
* Great Acceleration

The lecture finishes by looking at huma population growth, which leads to increased resource use. It is vital to note that while obviously more humans means more resource use, this has not happened equally ore equitably around the world. Some countries bear much more responsibility for both past and current resource use, and this much be accounted for in conservation and development.

*Reading*

*Ellis, et al. (2010) Anthropogenic transformation of the biomes, 1700 to 2000. Global ecology and biogeography*

Contemporary distribution of species and biomes does not just rely on evolutionary and ecological processes, it also relies on the action of human societies. This paper shows how widespread human land use change/ecosystem conversion has been, and emphasises how modern ecology must take account of human action.

*Thuiller (2007) Climate change and the ecologist Nature*

Summaries the consequences climate change will have for biodiversity, and what we can do to tackle them.

*Butchart (2010) Global biodiversity: indicators of recent declines Science*

Provides evidence using many indicators of biodiversity and threats that biodiversity is still declining and actions to mitigate and reduce threats are not being effective.

*Foley (2011) Solutions for a cultivated planet Nature*

The protection of the natural world is not the only challenge that humanity faces. With population growth comes greater demand for food. A billion people are already chronically malnourished, and population growth will only make this worse. How to meet greater demand for food without destroying the planet is one of the grand challenges of this century. This paper covers the current state of global agriculture, its effect on the natural world, and offers solutions for how the world can meet demand for food while staying within planetary boundaries.

***Lecture 3 – The Benefits of Living with Nature***

The previous two lectures have covered what biodiversity is and how humans are destroying it. This lecture looks at why this is important. Of course nature is valuable for its own sake, and many would consider species inherently valuable. However, protecting the natural world is also important from an anthropocentric point of view. The benefits people get from the natural world are named ecosystem services. This lecture where this terminology comes from, different types of ecosystem services, and how large scale planning is trying to integrate them with development. The lecture finishes by covering the origins of conservation biology. This is built on in the Conservation course.

*Reading*

[*https://www.millenniumassessment.org/en/index.html*](https://www.millenniumassessment.org/en/index.html)

Gives more detail on the MEA.

*Rode, et al. (2015) Motivation crowding by economic incentives in conservation policy: A review of the empirical evidence. Ecological Economics*

Whilst it is certainly true that the natural world provides many benefits to human society, is this the best way to justify conservation and persuade people that it is necessary? Valuing nature and rewarding or paying people to protect it are not the only ways to persuade people to carry out conservation. Is this better or worse than getting people to valuing nature for its own sake. This paper looks at how economic incentives could interact with intrinsic motivations, and whether they reinforce or undermine them.