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**Tropical diversity**

This course looks at the biodiversity of the tropics, including rainforests and other biomes. The materials for this course were originally designed for participants in Myanmar, so learning about tropical ecosystems was very relevant. However, knowledge of tropical regions is also important to any student of conservation and the environment. Tropical ecosystems, and rainforests in particular, are extremely biodiverse and contain a large proportion of the earth’s species, up to two-thirds of all known species. Understanding this, and why it occurs, is vital to the future of conservation and environmental protection. This is certainly not saying that tropical ecosystems are the only important ones on the planet. In spite of this, tropical ecosystems are important regardless of the method that you use to value the natural world.

***Lecture 1 – Conservation biogeography***

In order to understand why the tropics are particularly biodiverse and important, we have to understand why biodiversity and species composition is spatially variable, and the patterns that have produced the patterns we observe. Biogeography is the study of diversity across space and time. This lecture covers the genesis of the field, and how life on earth can be split into broad biogeographic realms. Species distributions are determined by both ecology and history, including processes of extinction, dispersal and vicariance. Different species have different types of distribution due to these factors. Ecological factors can be used to define an organism’s niche, which is a multidimensional space defined by the environmental variables that a species’ particular biology allows it to survive and bree in. This is most easily visualised using two axes.

The importance of evolutionary history in determining a species’ niche is demonstrated by the concept of phylogenetic niche conservatism. Evidence:

* The distribution of one species can often be used to predict the distribution of closely related species
* It takes species a long time to colonise new niches and ecological opportunities

*Reading*

*Richardson DM & Whittaker RJ (2010) Conservation biogeography – foundations, concepts and challenges*

A seminal paper that defines the foundation of the field of conservation biogeography, which is the application of biogeography to conservation problems. This highlights how important biogeography and is and how it has practical applications for protecting the natural world.

*Holt et al. 2013. An Update of Wallace’s Zoogeographic Regions of the World. Science 339, 74–78.*

Whilst Wallace’s theories and analysis were fundamentally correct, he was limited by the knowledge and technology of his day. An example of this is the application of evolutionary theory to biogeography. This paper shows how the inclusion of phylogenetic data updates zoogeographic regions, and alters the results. This emphasises how important evolutionary knowledge and theory is to all aspects of studying the natural world.

*Wiens JJ et al (2010) Niche conservatism as an emerging principle in ecology and conservation biology. Ecology Letters 13: 1199–1324*

Gives more detail on niche conservatism, and the evidence for its importance in ecology and conservation.

***Lecture 2 – Tropical diversity***

This lecture takes the biogeographic principles from the first lecture, and applies them to demonstrate how they have given rise to tropical ecosystems including rainforests (although rainforests are not the only ecosystems that occur in the tropics). It is important to remember that historical factors are crucial, alongside ecological ones, and that is why ecosystems can be different even if they occur in identical environmental conditions on different continents. Rainforests are extremely biodiverse, and the threats they face are therefore vital for conservation. This includes deforestation, which has been extensive in South East Asia. The causes of deforestation in South East Asia are discussed.

*Reading*

[*https://www.worldwildlife.org/biome-categories/terrestrial-ecoregions*](https://www.worldwildlife.org/biome-categories/terrestrial-ecoregions)

Gives greater explanation of WWF’s terrestrial ecoregions, 14 Major Habitat Types reflect the diverse array of organisms adapted to life on land.

*Bradshaw et al. 2009. Tropical turmoil: a biodiversity tragedy in progress. Frontiers in Ecology and the Environment*

Gives an overview of the threats that face tropical ecosystems.

*Gibson et al. 2011. Primary forests are irreplaceable for sustaining tropical biodiversity. Nature*

The relative biodiversity value of primary forests and degraded/secondary forests is important, as the former are shrinking while the latter are growing. If there is little difference in biodiversity value, this would be good news for conservation as losses as one is converted to the other would be limited. However, this paper is worrying for conservation as it provides evidence that biodiversity levels are much lover in degraded forests, although this does vary with geography, taxonomy and type of disturbance.

*Castelletta et al. 2000. Heavy extinctions of forest avifauna in Singapore: lessons for biodiversity conservation in Southeast Asia. Conservation Biology*

South East Asia has experienced extensive deforestation. Singapore is the epitome of this, as it has lost almost all of its lowland rainforest. This paper shows the effect of this on the avifauna of the area.

*Lim et al. 2017. Untangling the proximate causes and underlying drivers of deforestation and forest degradation in Myanmar. Conservation Biology*

Provides more detail on the causes of deforestation in Myanmar covered in the lecture. Understanding the relationships of a complex socio-ecological system such as this is difficult, and this paper demonstrates how it can be done. This links to lecture 2 in the Conservation course.

***Lecture 3 – Cradles or arks***

The first two lectures have shown why biodiversity varies spatially, what ecosystems occur in the tropics and what threats they face. None of this explains why we observe a latitudinal biodiversity gradient though, with greater diversity in the tropics near the equator. Why this occurs isn’t necessarily important for conservation, as the reasons why we observe this diversity should not affect whether we conserve it. However, it is a very interesting global pattern and is worth investigating. This lecture covers hypotheses for why the LBG might occur, and evidence for these.

*Reading*

*Rosenzweig ML, Sandlin EA. 1997. Species diversity and latitudes: listening to area's signal. Oikos 80:172–76*

Provides more detail for the hypothesis that greater land area in the tropics give rise to greater diversity.

*Mannion et al 2014 The latitudinal biodiversity gradient through deep time. Trends in Ecology & Evolution Volume 29, Issue 1, January 2014, Pages 42-50*

A lot of the material from the lecture comes from this paper. It gives much more detail on the theory involved, and the literature it is based. It also shows LBGs from other time periods in the earth’s history.

*Jablonski, D., Roy, K. and Valentine, J.W., 2006. Out of the tropics: evolutionary dynamics of the latitudinal diversity gradient. Science, 314(5796), pp.102-106.*

The ‘Out of the Tropics’ model posits that the LBG is explained by both higher levels of speciation and lower levels on extinction in the tropics. This paper provides evidence for this, and is the origin of the marine bivalves example at the end of the lecture. A good exercise is to think how this ties into the concept of niche conservatism, as taxa have to expand towards the poles and colonise different ecosystems for this to work.