Ecosystems

Biodiversity under threat

Section outline

Measures of biodiversity

Threats to biodiversity from direct action and indirect action operating at a range of scales from local to global

Ecosystems at greatest risk including tropical rainforests, coral reefs and wetlands

What is biodiversity?

Biodiversity refers to the variety and variability of life on Earth at the genetic, the species, and the ecosystem level [UN Environment Programme]

It is not distributed evenly:

- Generally biodiversity increases from the poles to the tropics (‘*latitudinal gradient in species diversity*’): TRF covers <10 % of earth's surface but contains c. 90% of the world's species
- Terrestrial biodiversity is thought to be 25x that of marine ecosystems
- Marine biodiversity tends to be highest along Western Pacific coasts (where sea surface temperature is highest) and in the mid-latitudinal band in all oceans
- Certain so-called ‘hotspots’ have especially high levels of biodiversity (e.g. Madagascar) – these are areas that also are threatened with or are experiencing destruction

In nature, biodiversity is influenced by variations in temperature, precipitation, altitude, soils, geography and the presence of other species (both competitors and complementary ones) – *suggest reasons for this*

How is biodiversity measured?

Biodiversity can be measured by:

Richness – the number of different kinds of organisms in an area (usually species, spp)

Abundance/evenness – how many individuals of each spp there are/in proportion to other spp – a site with a low degree of evenness indicates dominance by a few spp

A common way to quantify diversity is using Simpson's Index (handout) – this would be a useful tool for a fieldwork investigation…

How is biodiversity measured?

Diversity can also be measured in terms of:

- Life form type (e.g. grasses, shrubs, vertebrates, invertebrates…)
- Functional type (e.g. nitrogen-fixing, deep-rooted, herbivore, insectivore…)
- The variety of ecosystems within an area

How is biodiversity measured?

Diversity may be measured at different scales (handout):

Alpha diversity refers to spp richness in one particular ecosystem

Beta diversity compares spp richness between ecosystems in terms of the number of spp that are unique to each of the ecosystems

Gamma diversity is a measure of the total spp richness for different ecosystems within a region

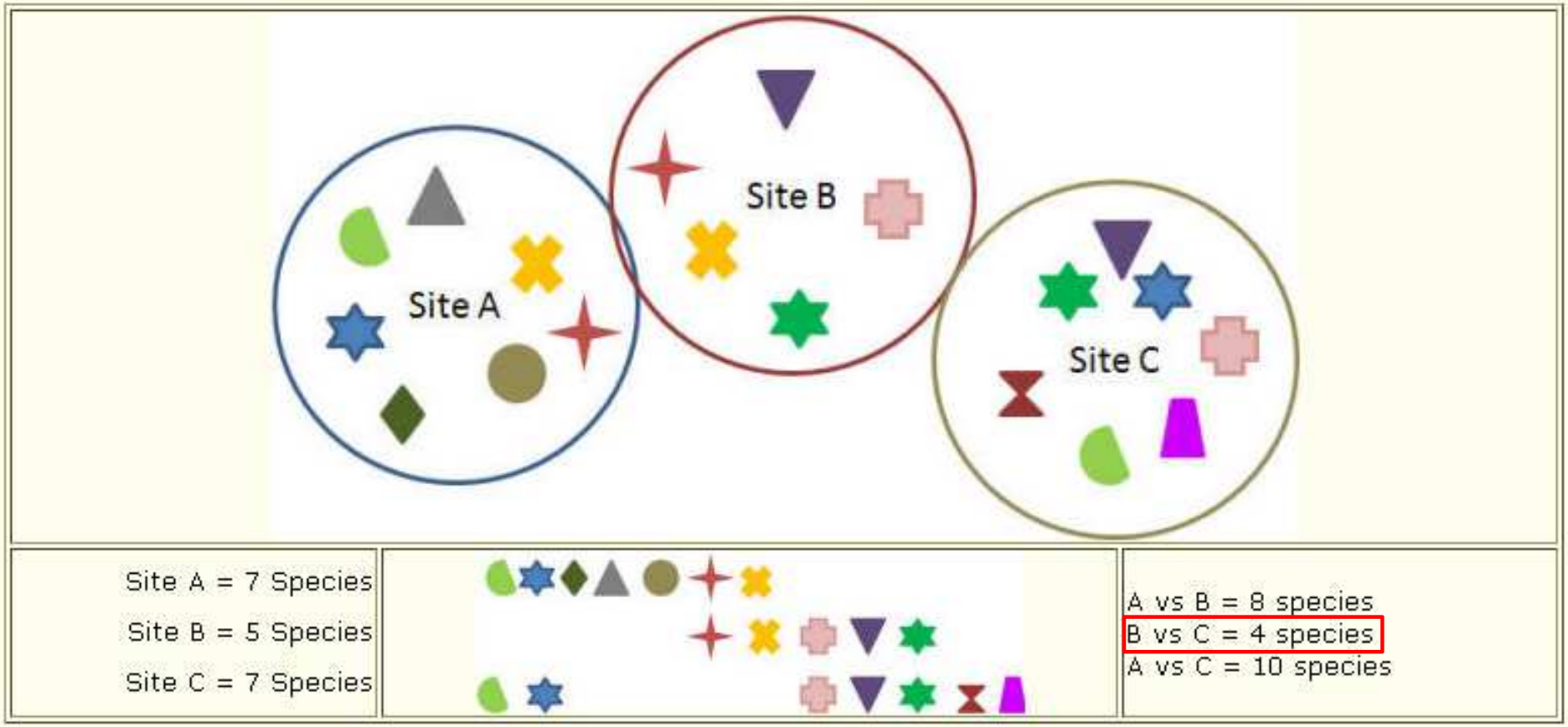
http://www.webpages.uidaho.edu/veg_measure/Modules/Lessons/Module%209(Composition&Diversity)/9_2_Biodiversity.htm

How is biodiversity measured?

Alpha Diversity = richness and evenness of individuals within a habitat unit. For example in the figure below, **Alpha Diversity** of Site A = 7 species, Site B = 5 species, Site C = 7 species.

Beta Diversity = expression of diversity between habitats. In the example below, the greatest **Beta Diversity** is observed between Site A and C with 10 species that differ between them and only 2 species in common.

Gamma Diversity = landscape diversity or diversity of habitats within a landscape or region. In this example, the gamma diversity is 3 habitats with 12 species total diversity.



http://www.webpages.uidaho.edu/veg_measure/Modules/Lessons/Module%209(Composition&Diversity)/9_2_Biodiversity.htm

Is greater biodiversity always better?

Benefits of high plant biodiversity:

- Different food for a variety of insect and vertebrate species.
- Variety increases likelihood that some plants will survive disturbances (e.g. drought) thereby maintaining a degree of **resilience** and stability.
- Variety of genetic material is useful for long-term survival/stability of ecosystem.
- Different organism fulfil different roles, e.g. soils improved by nitrogen fixers, and deep rooted plants bring that up nutrients from deeper in the soil.
- Some species work together so that both can survive (called *commensalism*).

Is greater biodiversity always better?

Issues with high plant biodiversity:

- Diverse communities can be the result of fragmented or degraded sites where species richness is due to presence of disturbance species (e.g. poppies).
- Plant communities with high diversity can be more difficult to manage because of their different requirements.
- High biodiversity may not be very stable – plant communities that are in **equilibrium** with the prevailing site characteristics (*climax vegetation* – more later) usually have lower biodiversity that preceding stages in the *succession* (ditto), as *dominant* plants out-compete others that then disappear from the ecosystem.

Threats to biodiversity

'Drivers' of change can be natural (e.g. natural disasters) or human-induced, and direct or indirect

Direct action/threats

Explicitly/unequivocally alter ecosystems.

Major drivers: climate change, plant nutrient use (i.e. application of fertilizers leading to *eutrophication*), land conversion, and diseases and invasive species

Indirect action/threats

An indirect driver operates more diffusely, by altering one or more direct drivers. **Millennium Ecosystem Assessment** categories: demographic, economic, socio-political, scientific and technological, and cultural and religious.

https://enviroliteracy.org/ecosystems/drivers-of-biodiversity-loss/
http://www.millenniumassessment.org/documents/document.331.aspx.pdf

Ecosystems at greatest risk

Tropical rainforests

Coral reefs (e.g. https://oceanservice.noaa.gov/facts/coralreef-climate.html)

Wetlands ("a place where the land is covered by water, either salt, fresh or somewhere in between. Marshes and ponds, the edge of a lake or ocean, the delta at the mouth of a river, low-lying areas that frequently flood - all of these are wetlands")*

(e.g. https://wetlandinfo.ehp.qld.gov.au/wetlands/management/pressures/)

For each of the above, identify what direct and indirect drivers might be threatening these ecosystems, and what the impacts might be. Research an example to give some more specific details of the above

Why are these ecosystems at greatest risk? Justify your decision

* https://www.worldwildlife.org/habitats/wetlands 10/09/17