

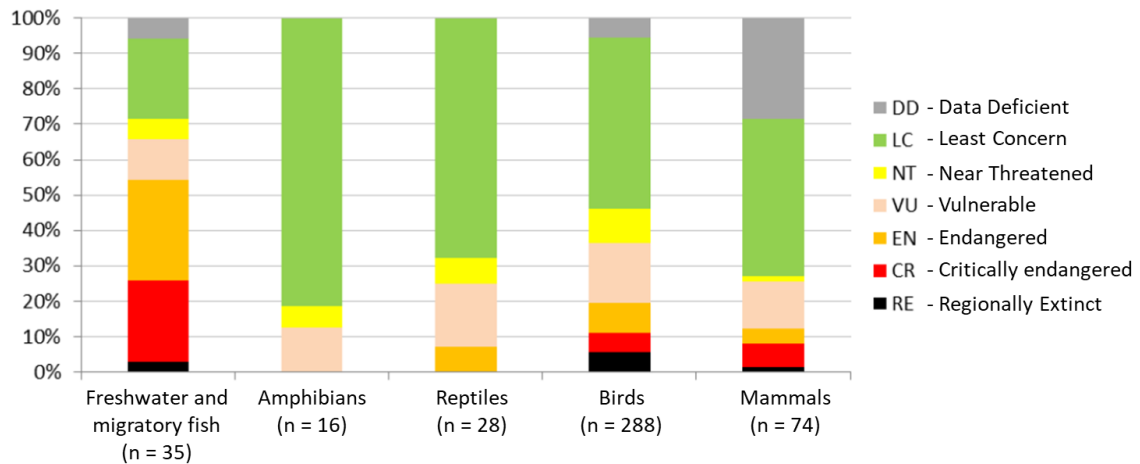
Biodiversity and Ecosystem Services

Question 1

Biosphere integrity and *Land-system change* are two of the Earth-system processes included in the Planetary Boundaries framework. Explain the links between the control variables being used to monitor the change in these systems and biodiversity, considering its different levels of organization, from populations to ecosystems.

Question 2

The plot shows the Portuguese conservation status of vertebrate species in mainland Portugal. Freshwater and migratory fish are the most threatened group (69%, classified as CR, EN, VU, or NT), followed by birds (40%), reptiles (32%), mammals (26%) and amphibians (19%).



The table lists five of the most threatened fish species. Columns show the scientific and common names, the Portuguese (national) conservation status (PT - CS), the global (IUCN) conservation status (IUCN - CS) and a link for the respective assessment sheet at the IUCN website

Species	PT - CS	IUCN - CS	Assessment sheet @ IUCN
1. <i>Acipenser sturio</i> (Atlantic sturgeon /Esturjão)	RE	CR	https://www.iucnredlist.org/species/230/13040963
2. <i>Iberochondrostoma lusitanicum</i> (--- / Boga Portuguesa)	CR	CR	https://www.iucnredlist.org/species/60791/12398911
3. <i>Iberochondrostoma almaçai</i> (--- / Boga do Sudoeste)	CR	CR	https://www.iucnredlist.org/species/135497/4132949
4. <i>Anaocypris hispanica</i> (--- / Saramugo)	CR	EN	https://www.iucnredlist.org/species/1199/3318827
5. <i>Luciobarbus comizo</i> (--- / Cumba)	EN	VU	https://www.iucnredlist.org/species/2575/9457226

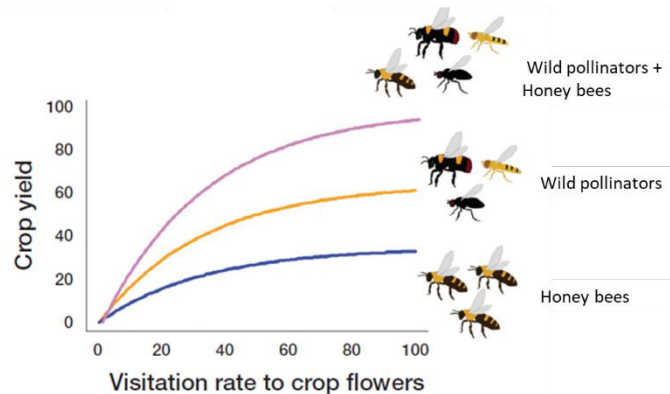
Question 2 (cont.)

Using the information available at the IUCN website, answer the following questions.

1. The Atlantic sturgeon is already extinct from most of its former range. What is the current distribution range of the species and what was its former range? What are the main causes of decline?
2. The national and the global conservation statuses agree for species 2 and 3 but differ for species 4 and 5. Can you explain why?
3. Explore the assessment sheet for species 2 to 5 and identify the main threats affecting all species (hint: see "Threats in detail")

Question 3

The plot shows changes in crop yield as a function of pollinator visitation rate by honey bees, wild pollinators and both.



Source: Garibaldi et al. 2014, DOI: 10.1890/130330; Note that both variables are expressed in relative terms, where 0 and 100 are the minimum and maximum values)

1. Crop yield can be limited by insufficient pollination due to low abundance levels of pollinators. A possible solution to this problem is to increase the abundance of managed species, namely honey bees. Do you agree with these sentences? Justify.
2. This example supports which farming approach: land sparing or land sharing? Justify.

Question 4

Sea otters and bison can be important allies in climate change mitigation and adaptation. Do you agree with this statement? Justify.

Question 5

About 90% of the drinking water consumed in New York is filtered and captured in the Catskill-Delaware watershed, in an area of more than 4000 km². Hence, the watershed generates a service of water purification, which is very important to the 8 million people living in the city. In the early 90s, the conversion of natural habitats for agriculture and urbanization, driven by economic development, became a threat. The degradation of natural ecosystems and the increased input of nutrients and sediments in aquatic systems, through infiltration and runoff, jeopardized the ecosystem's ability to purify water. Challenged by the trends of land use change that threatened water quality, New York City officials had to explore response options. Their choice was to implement a watershed protection plan, which consisted in a combination of land acquisition and management agreements with landholders to protect and restore the watershed ecosystems. The policies implemented received the support of a broad range of stakeholders, including the city of New York and the local communities affected by the watershed management, but also with influence on that management. From an economic perspective the ecosystem management costs were much lower than the cost of building and maintaining a water treatment plant. In addition to the water purification service this option also enhanced other services, namely carbon sequestration, recreation areas and habitat for wildlife.

1. Using the information in the text above, identify:

- i) the indirect drivers of ecosystem change
- ii) the direct drivers of ecosystem change
- iii) the ecosystem services referred in the text and the effect of the protection plan on these services (increase, decline, no effect), justify.
- iv) classify the services identified in iii) according to the spatial relationships between service production areas and service benefit areas (*sensu* Fisher et al. 2009)

Question 6



“Retention ponds are ponds or pools designed with additional storage capacity to attenuate surface runoff during rainfall events. They consist of a permanent pond area with landscaped banks and surroundings to provide additional storage capacity during rainfall events. They are created by using an existing natural depression, by excavating a new depression, or by constructing embankments. Existing natural water bodies should not be used due to the risk that pollution events and poorer water quality might disturb/damage the natural ecology of the system.

Retention ponds can provide both storm water attenuation and water quality treatment by providing additional storage capacity to retain runoff and release this at a controlled rate. Ponds can be designed to control runoff from all storms by storing surface drainage and releasing it slowly once the risk of flooding has passed. Runoff from each rain event is detained and treated in the pond. The retention time and still water promotes pollutant removal through sedimentation, while aquatic vegetation and biological uptake mechanisms offer additional treatment. Retention ponds have good capacity to remove urban pollutants and improve the quality of surface runoff”

Source: <http://nwrp.eu/measure/retention-ponds>

1. Retention ponds act as green infrastructure to manage storm water and regulate surface runoff. In a few sentences, classify this solution in terms of its potential contribution to climate change action and biodiversity conservation
2. Retention ponds deliver several ecosystem services to people in urban areas. Name two examples and justify their contribution to human well-being.
3. “Ecosystem services are the relative contribution of natural capital to human well-being, they do not flow directly” (Costanza et al. 2017). In a few sentences explain how this statement applies to retention ponds in urban areas.

Assignment deadline: 13 December 2019

Submit to: vania.proenca@tecnico.ulisboa.pt

Submit your answers in a Word or PDF file (typewritten answers only, please. no handwritten answers).
Write student names and IST numbers at the top of the first page.