TÉCNICO LISBOA

Sustainable Development, Energy and Environment

MEGE 2019-2020

Biodiversity and Ecosystem Services

– Notes on the assignment –

- Question 1
  A correct answer would identify the control variables and relate each of them to a level of biodiversity organization, from populations to ecosystems.
  The control variables proposed to monitor Biosphere Integrity are Extinction rate, as a measure of Genetic Diversity, and the Biodiversity Intactness Index (BII), as measure of Functional Diversity. Changes in **extinction rate** ultimately relate to changes in **species population abundance** that may eventually lead to species extinction; the **BII** provides a measure of change at the **community level**, and therefore of changes in functional diversity.
  The control variables proposed to monitor Land-system change are the **Area of forested land as % of original forest** (or as % of potential forest at the biome level), as proposed by Steffan et al. 2015, or the **HANPP**, as proposed by O'Neillet al. 2018. These variables address biodiversity change at a broader level of biodiversity organization, being associated to the **ecosystem level**.

- Question 3.2
  The example shows: 1) the importance of wild pollinators to achieve higher levels of crop yield, and 2) that crop yield increases with higher visitation rates (linked to higher population abundance) from both wild pollinators and domestic honeybees. The role of wild pollinators in this example supports the **land sharing** approach. In this approach, production and biodiversity conservation, here represented by the maintenance of natural habitats, are spatially integrated and ecosystem services, such as pollination, play an important role in agricultural production. In the land sparing approach production and conservation land are disconnected, and production is less reliant on the ecosystem services supplied by natural habitats. The management of honeybee abundance through the installation of beehives, could be associated to a **land sparing** approach and motivated by the lack of wild pollinators in agricultural land.

- Question 4
  A correct answer would discuss the functional ecological role of each species and the potential contribution to climate mitigation and to climate adaptation [note: most groups only addressed mitigation and ignored the adaptation dimension in their answer]. Elements for discussion include:

  Sea otters contribution to climate mitigation: sea otters regulate the population of sea urchins enabling the development of kelp ecosystems, which sequester and store large amounts of carbon.
  Sea otters contribution to climate adaptation: Kelp ecosystems attenuate waves and contribute to coastal protection, reducing the risk of flooding and erosion.
  Bisons contribution to climate mitigation: Bisons maintain and help restoring grassland ecosystems, promote carbon sequestration in the root system (belowground), and control the encroachment of woody species and the risk of intense fires [note: bisons, as other ruminants, emit methane, the use

of bisons in restoration assumes a correct management of grazing and population density to ensure net carbon sequestration]
Bisons contribution to climate adaptation: Grazing maintains an heterogenous distribution of fuel load in the landscape which increases landscape resilience to fire disturbance (i.e., less intense fires and faster recovery); higher levels of soil organic matter contribute to enhanced water retention in the soil and higher resistance to soil erosion, also increasing ecosystem resilience to natural disturbances.

- Question 5 iv)

Ecosystem service	Spatial relationship	Notes
Water quality regulation	Directional	Nutrient and sediment retention are directional processes related to water flow
Climate regulation (carbon sequestration)	Omni-directional	Carbon sequestration contributes to the regulation of GHG at the global scale, the benefit is global without a directional bias.
Recreation areas	In-situ	The benefit is realized locally when people visit these areas.
Habitat for wildlife	In-situ	The benefit is realized locally when wildlife uses the habitat (omni-directional was also accepted, assuming a more dynamic definition of habitat).
Food production (farmland)	In-situ	The benefit is realized locally when crops are harvested.

- Question 6.3
  A correct answer would acknowledge the joint contribution of both natural and human inputs to the ecosystem services generated by retention ponds. Retention ponds are built, improved, or managed by humans, to make the best use of the natural ecological processes and the ecosystem services they provide, namely water flow regulation.