

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Seibold and colleagues investigated the dynamics of arthropod species in Germany using data from standardized inventories taken between 2008 and 2017 at both grassland and forest sites. The temporal trends in arthropod biomass, abundance and the number of species were modelled separately for grasslands and forests. Species of different dispersal abilities and trophic guilds were analyzed together. They demonstrate the temporal trends in arthropod communities in Figure 1 and changes in the dominance of species in Figure 2. How would you interpret the results in Figure 1 (5%) and figure 2 (5%)? If you are going to further investigate the biological responses, what kind of analysis or experiment would you perform? (5%)

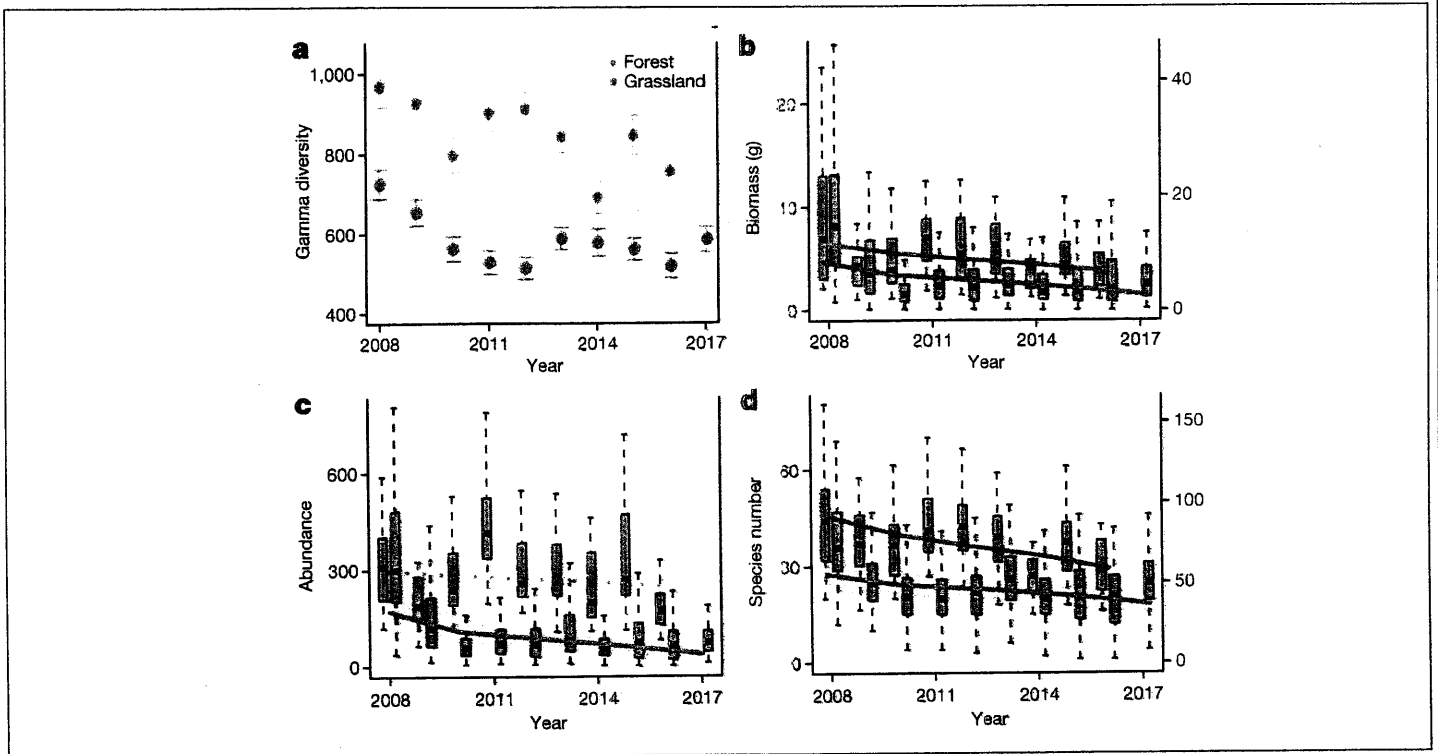


Fig. 1: Temporal trends in arthropod communities. (a) Gamma diversity (total number of species across all grassland or forest sites) and the 95% confidence intervals, (b) biomass, (c) abundance and (d) number of species of arthropods recorded in forest and grassland sites across Germany. Box plots show raw data per site and year. Solid lines indicate significant temporal trends ($P < 0.05$) based on linear mixed models and shaded areas represent confidence intervals. Note that the values of forest sites are generally higher than those of grassland sites. (Revised from Seibold et al. (2019))

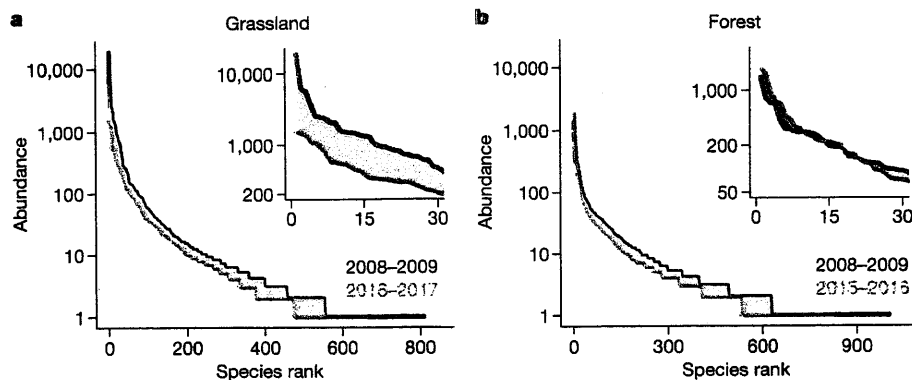


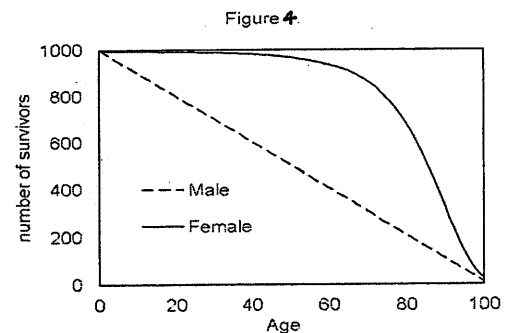
Fig. 2: Changes in the dominance of species. Rank abundance curves of arthropod communities for the first two and final two years of the study. The insets show the 30 most-abundant species. (Revised from Seibold et al. (2019))

2. Define the following terms (10%; 2 % each):

- (a) functional group
- (b) ecotone
- (c) resilience
- (d) mineralization
- (e) trophic cascade

3. Biodiversity is important to humanity and is necessary for the stability of the planet. Please explain the reason in terms of ecosystem services. (10 %)

4. Figure 4 on the right shows the survivorship curves of an imaginary mammal species. Assuming that, on an isolated island, the population has a stable age distribution for both gender and a stationary population size. (a) What might be the population pyramid look like for this particular animal? (b) Predict the reproduction variables for this population. (c) Explain the basis of your predictions. (10%)



5. Compare the biomass pyramids of a terrestrial ecosystem with that of an aquatic ecosystem and explain why both could be sustainable. (5%)

6. Explain the following ecological terms (15%; 3% each):

- (a) CAM (crassulacean acid metabolism) photosynthesis
- (b) entotherms
- (c) Müllerian mimicry
- (d) principle of allocation
- (e) Southern Oscillation

7. Give an example of “indirect effect” and discuss its significances for community structure. (6%)

8. Describe, with the help of illustrations, the possible relationships of diversity and stability of communities (8%)

9. Distinguish (a) density-dependent (DD) vs. density-independent (DI) population regulation (**4% each**); then discuss (b) whether and how DD and DI may be generally correlated with the ecology and life history of organisms? (**4% each**) (**total 16%**)

10. List the most common mechanisms responsible for cooperative and/or altruistic behaviors observed in the nature? (**5%**; **note: there are more than one!**)