

Seminar 9

DNA-based techniques in monitoring ecosystems

Overview:

You are part of an international panel of researchers, policymakers, and environmental managers working together to develop a comprehensive strategy for monitoring ecosystem health in response to rapid biodiversity loss. The seminar will explore how DNA-based techniques such as environmental DNA (eDNA) sampling, metabarcoding, and genome sequencing can revolutionize ecosystem monitoring efforts. Participants will discuss the opportunities, challenges, and practical applications of these methods in various ecological contexts.

Rapid environmental changes due to human activity, habitat destruction, and climate change are causing biodiversity loss at an unprecedented rate. Traditional monitoring methods are time-consuming, labor-intensive, and often insufficient to capture the full complexity of ecosystems.

Challenge: How can DNA-based techniques complement or replace traditional methods to provide real-time, cost-effective, and comprehensive ecosystem data?

Case study contexts for discussion:

- **Marine Ecosystems:** Using eDNA to monitor fish populations and detect invasive species.
- **Freshwater Systems:** Assessing water quality and tracking amphibian populations through DNA metabarcoding.
- **Forest Ecosystems:** Identifying species interactions (e.g., predators, pollinators) using DNA from soil or plant material.
- **Urban Biodiversity:** Detecting microbial diversity and monitoring green spaces for conservation purposes.

Key areas for discussion:

1. Scientific perspectives

- What are the advantages of DNA-based monitoring techniques compared to traditional methods?
- How can DNA metabarcoding improve our understanding of species interactions and ecosystem functions?
- What are the limitations or uncertainties of using eDNA in large-scale studies?

2. Practical applications

- How can these techniques be scaled for national or global biodiversity monitoring programs?
- What infrastructure (labs, data processing, skilled personnel) is necessary to implement these techniques effectively?

3. Ethical and policy considerations

- What ethical concerns could arise from the use of DNA data in ecosystem monitoring?
- How can DNA-based monitoring inform policy and contribute to achieving international biodiversity targets like the Aichi or Kunming-Montreal targets?

Seminar format:

- **Introduction (10 minutes)**
- **Small group discussions (30 minutes):** Divide into small groups to simulate a real-world scenario.
- **Case study analysis (30 minutes):** A local government wants to monitor a wetland that serves as a critical habitat for endangered species, using a limited budget. Each group must:
 1. Propose a DNA-based monitoring plan.
 2. Outline the benefits and challenges of their approach.
 3. Present their plan to the larger seminar group for discussion.
- **Panel discussion (20 minutes):** Each group presents their solution.
- **Conclusion and Q&A (10 minutes).**

Expected outcomes

1. An enriched understanding of the latest DNA-based monitoring techniques and their potential applications.
2. Practical strategies to integrate these techniques into ecosystem management plans.
3. Insights into how interdisciplinary collaboration (science, policy, ethics) can address challenges in monitoring ecosystems.