UNIVERSITY
OF SKÖVDE

School of Bioscience

WRITTEN EXAMINATION

Course Applied Molecular Ecology A1F

Examination Final written examination

Course code BV716A

Credits for written examination 3.5 cp

Date 2025-05-28

Examination time 14.15-18.30h

Examination responsible Sonja Leidenberger

Teachers concerned Sonja Leidenberger, Tomas Jonsson, Niclas Norrström

Aid at the exam/appendices No additional aids are allowed

Other

Instructions

- ☐ Take a new sheet of paper for each teacher.
- ☐ Take a new sheet of paper when starting a new question.
- ☒ Write only on one side of the paper.
- ☒ Write your name and personal ID No. on all pages you hand in.
- ☒ Use page numbering.
- ☒ Don´t use a red pen.
- ☒ Mark answered questions with a cross on the cover sheet.

Grade points 40. The written exam will determine the grade of the course. You have to reach at least 50-59% = E, 60-69% = D, 70-79% = C, 80-89% = B, and more than 90% = A in the exam.

Examination results should be made public within 18 working days

Good luck!

Total number of pages

Molecular Applied Molecular Ecology, BV716A, VT 2025

Final examination 28th of May 2025 **In total: 40 points**

The written exam will determine the grade of the course. You have to reach at least 50-59% = E, 60-69% = D, 70-79% = C, 80-89% = B, and more than 90% = A in the exam.

Goal 1: *provide an in-depth explanation of theories, applications, and scientific methods in the field of molecular ecology,*

Goal 2: *formulate ecological, evolutionary, population genetic, and other biological questions where molecular analyses are particularly suitable,*

Goal 3: *independently plan and conduct a project in DNA barcoding*

A) Barcoding (10 points)

1. What is meant by "delimitation of DNA barcoding"? (3 points)

a) Explain shortly what it means. (1 point)

b) Name two methods that can be used. (1 point – 0.5 for each method)

c) Name two challenges with delimitation of DNA barcoding. (1 point – 0.5 for each challenge)

2. Chose one application area of DNA barcoding and describe in detail why the technique has revoluzionized the area you have chosen. (2 points)

3. What is the "barcode gap"? (2 points)

4. Why is Photographing/Documentation an important step in the barcoding workflow? (2 point) and in which barcode database it is obligatory to upload a photo? (1 point)

B) Applied Molecular Ecology (10 points)

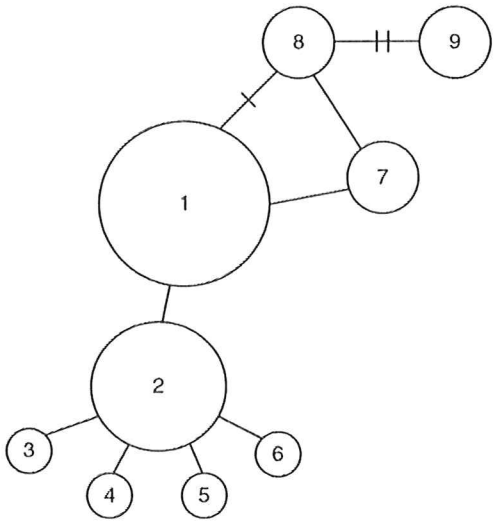
1. Haplotype networks have been essential tools in conservation genetics for many years.

What does the haplotype network below showing us? Explain

a) How many haplotypes exist in the analysed population? (1 point)

b) Which are the two most dominant haplotypes in the population? (1 point)

c) How many mutation steps exist between Haplotype4 and Haplotype 9? (1 point)



2. Explain what alpha, beta and gamma diversity is. (1.5 points)

3. What is the Nagoya – protocol? Name the three key principles. (1.5 points)

4. Conduct a short, but individual project plan (step-by-step) for a DNA barcoding analysis. Your plan has to describe a) the goal of your study, b) the skills/equipment you need for the practical feasibility and c) the possible challenges you might face/have to be aware of. (4 points)

C) Ecological risk assessment and evoluationary conservation biology (10 points)

1. What is the concept of Adverse Outcome Pathways (AOPs)?

a) Explain the general structure and purpose of an AOP. (1p)

b) Describe how AOPs can help link molecular-level changes to ecologically relevant outcomes at higher biological levels. (1p)

2. Define ecotoxicogenomics and discuss its application in environmental risk assessment.

a) What molecular methods are commonly used? (1p)

b) How can this approach be used to detect environmental stress? (1p)

3. Dynamic Energy Budget (DEB) models are used in ecological risk assessment.

a) Briefly explain the theoretical foundation of DEB models. (1p)

b) How can DEB models be linked to AOPs to improve ecological relevance? (1p)

4. How does molecular ecology contribute to evolutionary conservation biology?

a) Define the goals of evolutionary conservation biology and explain how molecular data support these goals. (1p)

b) Give one example of how molecular tools can help identify evolutionary processes relevant to conservation. (1p)

5. Explain the concept of landscape genetics.

a) How does this field differ from traditional population genetics? (1p)

b) Describe how it can be applied in conservation planning or ecological risk assessment. (1p)

D) Evolution (10 points)

1. Mutualistic and antagonistic interactions can produce two main types of coevolutionary processes that can be studied using molecular techniques.

a) Briefly describe what characterizes/distinguishes these two processes and give one example each. (2p)

b) Explain the so called 'Red Queen hypothesis', that is, what does it maintain about the evolution of species in relation to eachother? (1p)

2. Explain what 'genotype-environment interactions' mean and describe, using graphs, what this interaction may look like if there is a) no phenotypic plasticity, b) continous phenotypic plasticity and c) discrete phenotypic plasticity. (4p)

3. Define what 'paleogenomics' is and give two examples of general questions within this field where molecular techniques can be useful. (3p)