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Research Ideas and Outcomes : Workshop Report   Print

New molecular methods to assess biodiversity. Potentials and pitfalls of DNA metabarcoding: a workshop report

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Abstract

This report presents the outcome of the joint work of PhD students and senior researchers working with DNA-based biodiversity assessment approaches with the goal to facilitate others the access to definitions and explanations about novel DNA-based methods. The work was performed during a PhD course (SLU PNS0169) at the Swedish University of Agricultural Sciences (SLU) in Uppsala, Sweden. The course was co-organized by the EU COST research network DNAqua-Net and the SLU Research Schools Focus on Soils and Water (FoSW) and Ecology - basics and applications. DNAqua-Net (COST Action 15219, 2016-2020) is a network connecting researchers, water managers, politicians and other stakeholders with the aim to develop new genetic tools for bioassessment of aquatic ecosystems in Europe and beyond. The PhD course offered a comprehensive overview of the paradigm shift from traditional morphology-based species identification to novel identification approaches based on molecular markers. We covered the use of molecular tools in both basic research and applied use with a focus on aquatic ecosystem assessment, from species collection to the use of diversity in environmental legislation. The focus of the course was on DNA (meta)barcoding and aquatic organisms. The knowledge gained was shared with the general public by creating Wikipedia pages and through this collaborative Open Access publication, co-authored by all course participants.

Keywords

barcoding, biodiversity, aquatic organisms, identification, metabarcoding, DNA

Date and place

The intensive, week-long PhD course workshop was held 25th to 29th of March 2019 at the Swedish University of Agricultural Sciences (SLU) in Uppsala, Sweden. The entire course period, including the individual and independent contributions before and after the workshop, lasted from March 8th to May 31st 2019 (Fig. 1).
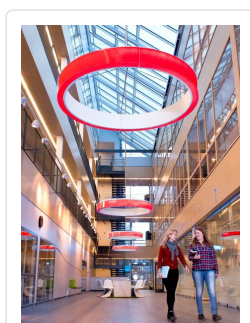
Introduction

This workshop report gives an overview of the outcomes of the SLU PhD course PNS0169 held in March 2019. As we assume that the course content, i.e. a basic introduction to DNA (meta)barcoding and its application in biomonitoring, is of interest to a broader audience, we decided to share this information by editing and creating public Wikipedia pages, and a glossary with common terms. To explain the background and to summarize the actual work within the course, we publish the course content and outcome as a workshop report.

The course was co-organized by the EU COST ActionDNAqua-Net, a transdicsiplinary network that aims to to develop new genetic tools for bioassessment of aquatic ecosystems in Europe and beyond, and the SLU Research Schools Focus on Soils and Water (FoSW) and Ecology - basics and applications. The course attracted 27 participants from 14 countries, and the 11 teachers included researchers from SLU and other organisations, among them from DNAqua-Net (Fig. 2, Table 1). The schedule included drafting texts for the Wikipedia page on DNA barcoding as well as on metabarcoding of different organism groups, and creating definitions for some common terms (find the syllabus here) used in organism identification (traditional and molecular). The resulting texts were further developed into full Wikipedia pages and into this workshop report, both during the intense course week at SLU in Uppsala and as joint homework after the course.

Table 1. Download as CSV
Participants.

First name	Family name	Category	Role	Affiliation	Country of work
Anders	Alfjorden	PhD student	Participant	Uppsala University, Institute of organismal biology	Sweden
Katherine	Apunte-Ramos	Lab Technician	Participant	University College Ghent (HOGent) & Universidad Regional Amazónica IKIAM	Belgium & Ecuador
Bonnie	Bailet	PhD student	Participant	SLU, Aquatic Sciences and Assessment	Sweden
Andrea	Carrera-Gonzalez	Research Laboratory Technician	Participant	University College Ghent (HOGent) & Universidad Regional Amazónica IKIAM	Belgium & Ecuador
David	Castro	PhD student	Participant	SLU, Department of Forest Genetics and Plant Physiology	Sweden
Cecilia	Di Bernardi	PhD	Participant	SLU,	Sweden

		student		Kaiserslautern	
Judit	Fekete	PhD student	Participant	University of Pannonia, Department of Limnology & MTA DRI Department of Tisza Research Institute	Hungary
Larissa	Frühe	PhD student	Participant	University of Kaiserslautern, Department of Ecology	Germany
Raquel	González	PhD student	Participant	Universidad de Valencia & Laboratorios Tecnológicos de Levante, S.L (Valencia)	Spain
Eirini	Gratsia	PhD student	Participant	Hellenic Centre for Marine Research, Institute of Marine Biology, Biotechnology and Aquaculture	Greece
Jasna	Hanjalić	PhD student	Participant	University of Sarajevo - Institute for genetic engineering and biotechnology	Bosnia and Herzegovina
Jasmina	Kamberović	Senior researcher	Participant	University of Tuzla, Faculty of Natural Sciences and Mathematics	Bosnia and Herzegovina
Ann-Marie	Kelly	PhD student	Participant	University College Dublin	Ireland
Carlotta	Meriggi	PhD student	Participant	SLU, Aquatic Sciences and Assessment	Sweden
Ilkka	Nousiainen	PhD student	Participant	Estonian University of Life Sciences	Estonia
Cintia	Organo	Post-doc	Participant	University of Southern Denmark, Department of Biology	Denmark
James	Orr	PhD student	Participant	Trinity College Dublin	Ireland
Athina	Papatheodoulou	PhD	Participant	Open University	Cyprus

				Management Unit	
Javier	Pérez Burillo	PhD student	Participant	Universitat Rovira i Virgili, Dept. of Geography & IRTA	Spain
Jasmina	Sargac	PhD student	Participant	SLU, Aquatic Sciences and Assessment	Sweden
Muhammad	Shahbaz	Post-doc	Participant	SLU, Department of soil and environment	Sweden
Kálmán	Tapolczai	Post-doc	Participant	University of Pannonia	Hungary
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Isa	Wallin	PhD student	Participant	SLU, Aquatic resources	Sweden
Maša	Zupančič	MSc student	Participant	National Institute of Biology	Slovenia
Sarah B.	Ørberg	PhD student	Participant	Aarhus University, Department of Bioscience	Denmark
Patrik	Bohman	Senior researcher	Teacher	SLU, Dept. of Aquatic Resources	Sweden
Norbert	Häubner	Investigator	Teacher	The Swedish Agency for Marine and Water Management, SwAM (HaV)	Sweden
Florian	Leese	Professor	Teacher	University of Duisburg-Essen	Germany
Björn	Lindahl	Professor	Teacher	SLU, Dept. of Soil SciencesSweden	Sweden
Jan-Niklas	Macher	Senior researcher	Teacher	Naturalis Biodiversity Center, Leiden	Netherlands
Sari	Peura	Associate professor	Teacher	SLU, Dept. of Forest Mycology and Plant Pathology	Sweden

Olle	Terenius	Senior researcher	Teacher	Uppsala University	Sweden
Valentin	Vasselon	Senior researcher	Teacher	AFB, Thonon-les-Bains INRA	France
Maria	Kahlert	Associate professor	Organisator & teacher	SLU, Dept. of Aquatic Science and Assessment	Sweden

Figure 2.
Participants of the PhD course PNS0169 at the Swedish University of Agricultural Sciences (SLU) in Uppsala, Sweden.

Aims

The main aim of the course was to give the students an insight into the paradigm shift from traditional morphology-based species identification to novel organism-identification approaches based on molecular markers. The course topics also included basic understanding of DNA (meta)barcoding and its potentials and pitfalls. In a broad sense, the course also aimed to educate the public, including interested stakeholders, by using the joint efforts of the students and teachers to create public information on the course topics. The aim of the course was to provide an overview of identification tools and methods currently used in environmental monitoring and research, including recent advances and challenges. The course touched on aquatic organisms, freshwater and marine, and provided additional sources for more information regarding certain organism groups as well as tools and methods. During the course, the students actively acquired information about the ongoing paradigm shift in identifying aquatic organisms for biodiversity and environmental assessment. With this information, the students should now be able to critically evaluate studies that utilized DNA-based taxonomy, and to judge in which contexts DNA-based results might differ from traditionally obtained ones. The students also got the opportunity to work on their own project as a supplementary, optional part of the course. While the course had an aquatic focus, the methodology is universal, and non-aquatic approaches were covered as well.

Key outcomes and discussions

The knowledge gained about the paradigm shift from traditional morphology-based species identification to the use of novel molecular methods was summarized by creating public Wikipedia pages, a glossary, and this collaborative Open Access publication coauthored by all participants.

Wikipedia pages

Instead of ordinary examinations, the course required an active participation in the creation or editing of Wikipedia pages about DNA barcoding. To ensure their quality of the text, the PhD students and senior researchers (the teachers) worked jointly on

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combination with a Glossary, which was also created as a course outcome, we hope that our work can help not only the participants of the course, but a also broader public, to gain knowledge about DNA (meta)barcoding. The edited or newly created Wikipedia pages are:

- DNA barcoding
- Microbial DNA barcoding
- Algae DNA barcoding
- Fish DNA barcoding
- Aquatic macroinvertebrate DNA barcoding
- DNA barcoding in diet assessment

Glossary: terms related to traditional and molecular identification

During the course the participants discussed terms related to traditional and molecular identification and the PhD students defined these terms in discussions with the teachers in their own words, based on existing definitions from other sources. We hope that this glossary can give an overview of both traditional and molecular terms often used in the context of identification of organisms (Suppl. material 1).

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Grant title

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2. SLU NJ-faculty research shools.

Hosting institution

Swedish University of Agricultural Sciences (SLU) in Uppsala, Sweden