## Contents

List of abbreviations 4  
Acknowledgements 6  
Summary 7  
Zusammenfassung 9  

### 1 Scientific background

1.1 Motivation 12  
1.2 The arctic-boreal ecotone in time and space 13  
1.2.1 Terrestrial plants composition and biodiversity 13  
1.2.2. Lake macrophytes and diatoms 14  
1.3 Sedimentary DNA metabarcoding as an ecological proxy 16  
1.4 Study area 18  
1.5 Objectives of the thesis 19  
1.6 Methods 20  
1.7 Thesis organizations 21  
1.7.1 Manuscripts and chapters 21  
1.7.2 Non-finalized research 22  
1.7.2 Author contributions 23  

### 2 Manuscript I: Genetic and morphological diatom composition in surface sediments from glacial and thermokarst lakes in the Siberian Arctic 24  

2.1 Abstract 24  
2.2 Introduction 25  
2.3 Materials and methods 28  
2.3.1 Sampling and collection of environmental data 28  
2.3.2 Diatom genetic assessment 30  
2.3.3 Raw sequence processing and taxonomic assignment 31  
2.3.4 Morphological diatom identification 32  
2.3.5 Statistical analyses 33  
2.4 Results 34  
2.4.1 Genetic-based diatom composition, diversity and diatom-environment relationship 34  
2.4.2 Morphological-based diatom composition, diversity and diatom-environment relationship 40  
2.4.3 Comparison of spatial diatom patterns obtained from the genetic and morphological approaches 42  
2.5 Discussion 42  
2.5.1 Genetic and morphological diatom composition and diversity 42  
2.5.2 Diatom composition is affected by lake type and lake water parameters 44
3 Manuscript II: Plant sedimentary ancient DNA from Far East Russia covering the last 28 ka reveals different assembly rules in cold and warm climates

3.1 Abstract
3.2 Introduction
3.3 Methods
3.3.1 Study area
3.3.2 Sampling and dating
3.3.3 Genetic laboratory works
3.3.4 Processing the sequence data
3.3.5 Statistical analyses
3.4 Results
3.4.1 Overview of the sequencing data and taxonomic composition
3.4.2 Taxonomic alpha and beta diversity
3.4.3 Phylogenetic alpha and beta diversity
3.4.4 Relationship between taxonomic composition and phylogenetic diversity
3.5 Discussion
3.5.1 Vegetation history revealed by sedaDNA
3.5.2 Patterns of taxonomic alpha diversity and their relationship to community composition
3.5.3 Relationship between richness and phylogenetic alpha and beta diversity

4 Manuscript III: Sedimentary DNA identifies modern and past macrophyte diversity and its environmental drivers in high latitude and altitude lakes in Siberia and China

4.1 Abstract
4.2 Introduction
4.3 Materials and Methods
4.3.1 Field sampling of surface and core samples
4.3.2 Environmental data
4.3.3 Molecular genetic laboratory work
4.3.4 Bioinformatic analyses
4.3.5 Statistical analyses
4.4 Results
4.4.1 Macrophyte diversity in surface sediments inferred from sedDNA
4.4.2 Relationship of modern macrophyte richness and environmental variables
4.4.3 The relationship between modern macrophyte community and environmental variables
4.4.4 Past macrophyte richness and composition inferred from sedaDNA
4.4.5 Past macrophyte compositional changes and its environmental drivers
4.5 Discussion
4.5.1 Retrieval of aquatic plant diversity using the trnL P6 loop plant DNA metabarc ode
4.5.2 Modern macrophyte diversity and its relation to environmental factors
4.5.3 Temporal macrophyte diversity as an indicator for past environmental change