

Stefan Kruse



Effects of forest invasion and retreat on tundra biodiversity inferred from sedimentary ancient DNA of lake Levinson Lessing, Taymyr Peninsula, Russia

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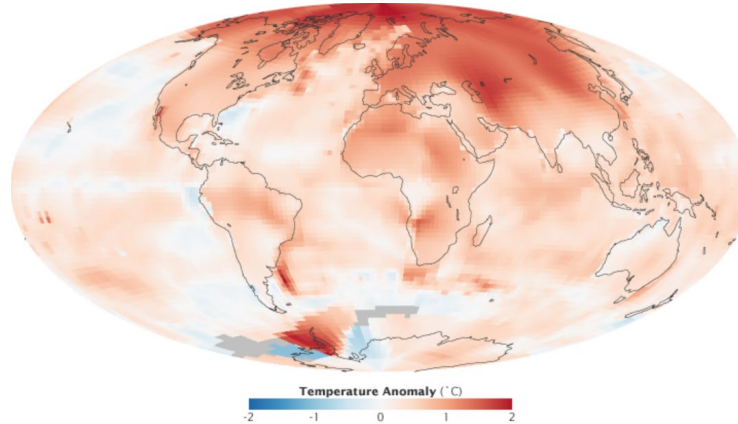
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- Global Warming and Arctic amplification¹



NASA GISS temperature trend 2000–2009, showing strong arctic amplification

- Observed impact on Arctic ecosystems:
ex: Tundra greening & shrubs invasion²
- How will it affect biodiversity dynamics?

- „looking backward to look forward“³

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PERSPECTIVES

Looking backwards to look forwards: conservation genetics in a changing world

A. Rus Hoelzel

Understanding past ecological changes enhances our ability to predict how ongoing warming will affect ecosystems

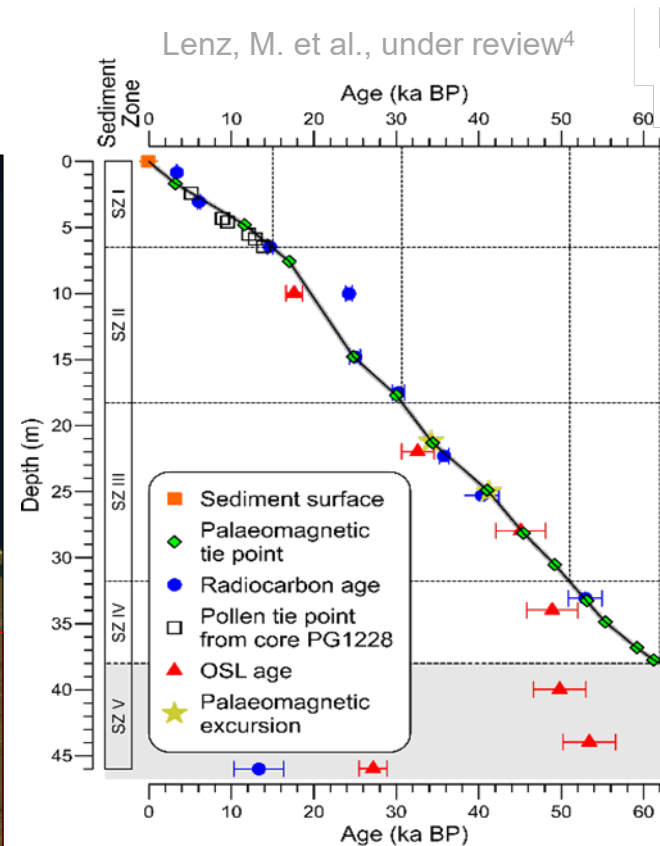


Reconstructing past vegetation can help forecast the effects of global warming on northern biodiversity

Study Site

• Levinson Lessing Lake

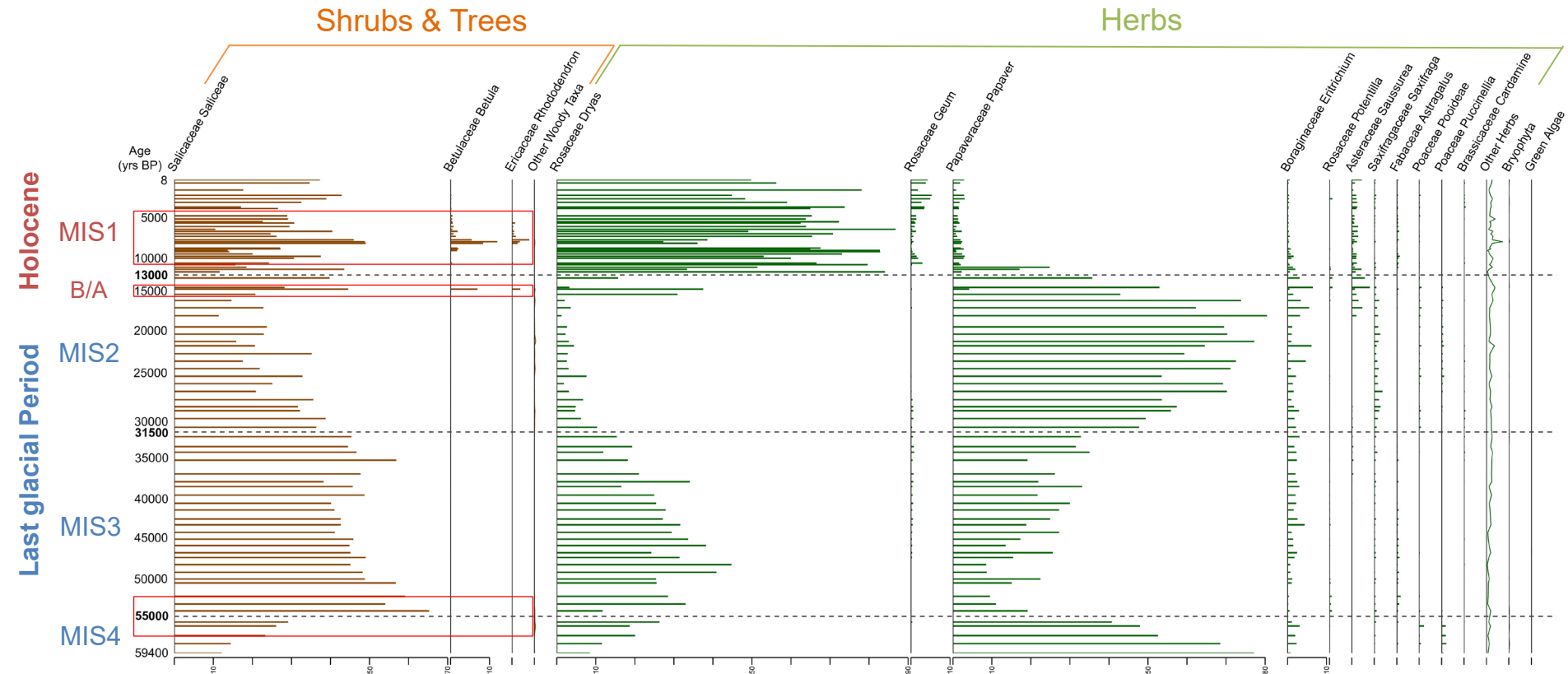
In the tundra of the far north Taymyr Peninsula (northern Central Siberia)



Sediment core spanning the last ~60 ka

- Past vegetation reconstruction using *sedaDNA*
 - DNA extraction from 83 samples
 - PCR amplification (trnL g/h)⁵ in triplicates
 - Sequencing on Illumina HiSeq platform (2 × 125 bp)
 - Taxonomic assignment with OBITools⁶ at 100% identity
- Investigation of past Composition changes
 - Was there past tundra greening?
 - Woody taxa invasion in the lake vicinity?
- Investigation of past plant diversity change
 - How past diversity was affected? Measure of Hill numbers

Greening events in the past?

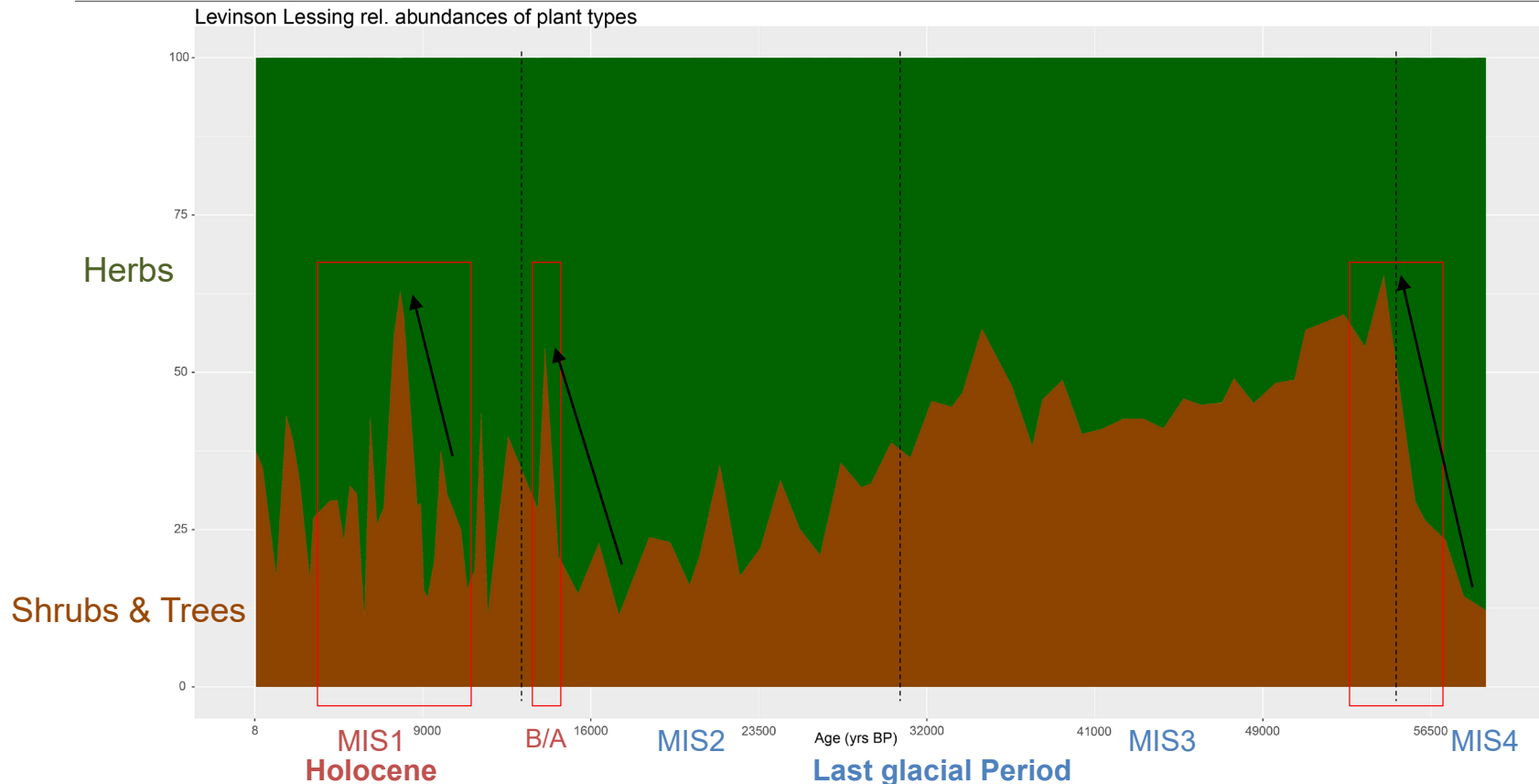


No extreme warm events covered by the core *but*:

Some warming events with increased woody taxa proportion:

- Transition MIS4 to MIS3
- Bølling / Allerød: ~14,500 yrs BP
- Beginning of the Holocene / MIS1: ~10,000 to 5,000 yrs BP

Greening events in the past?

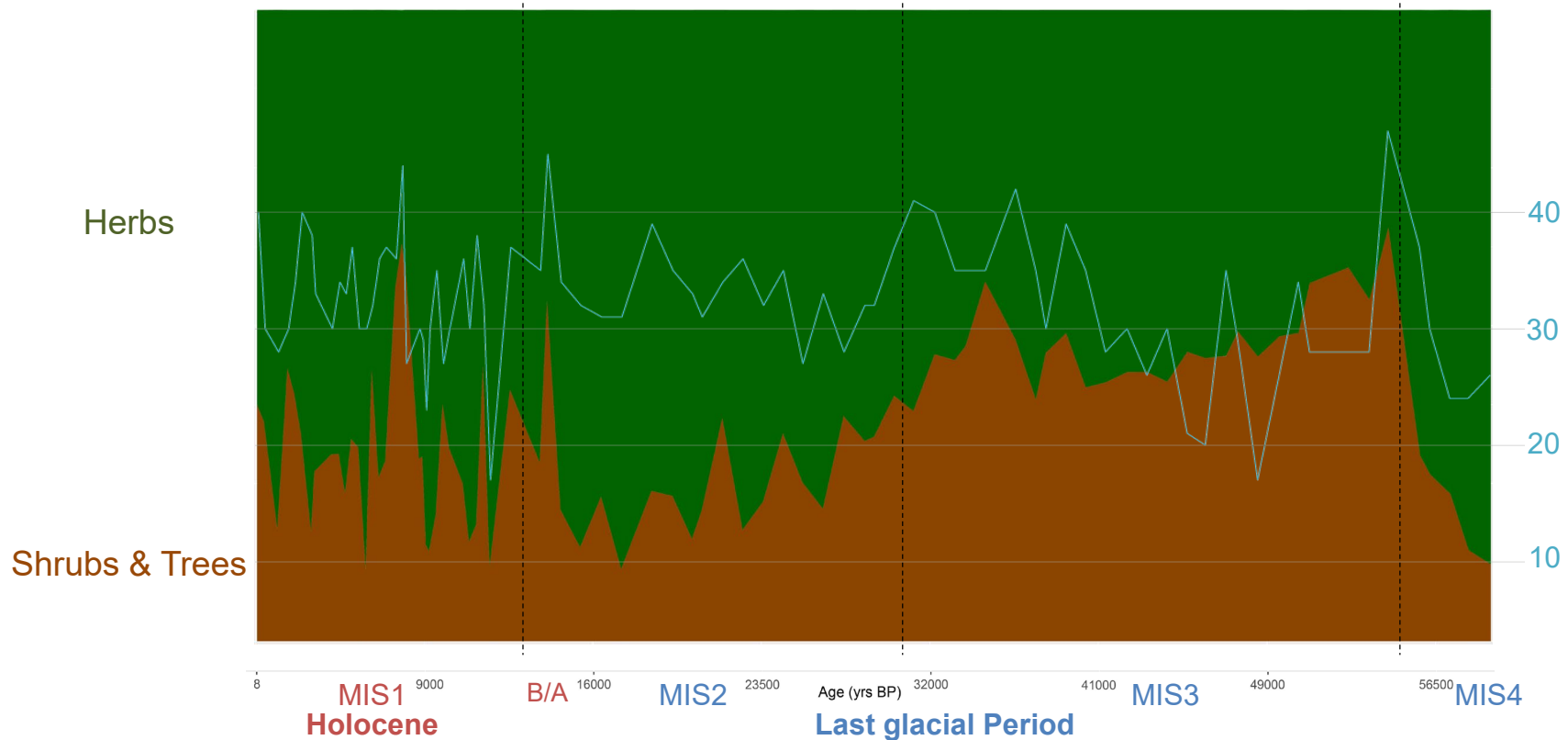


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Impact on biodiversity indexes

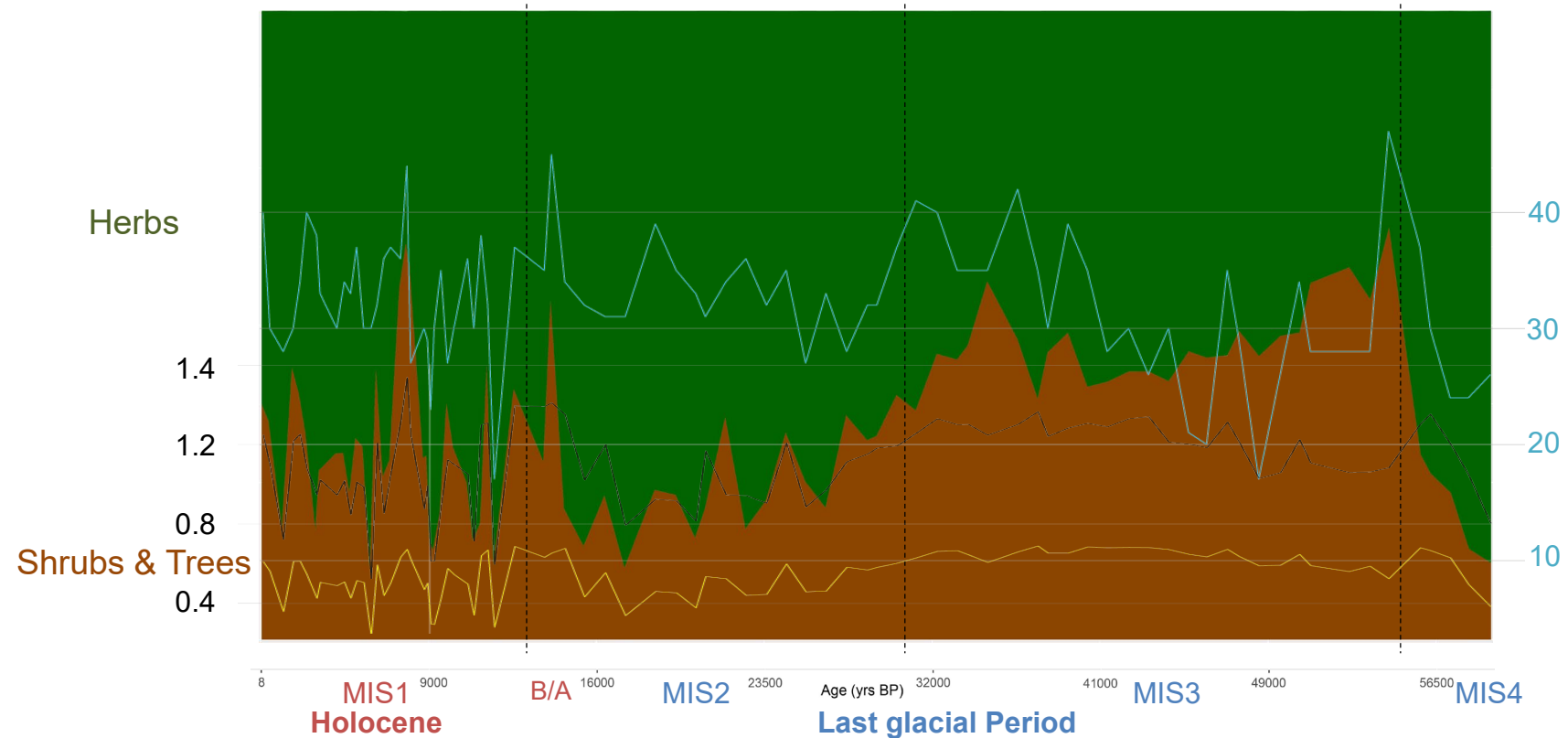


- Hill number $q=0$: richness

The 3 observed pics in richness: during the warming events

BUT: no correlation between the relative proportion of woody taxa and the observed richness: pearson t-test, 0.2, p-value = 0.069.

Impact on biodiversity indexes



- Hill number $q=0$: richness (no correlation, pearson t-test, 0.2, p-value = 0.069)
- Hill number $q=1$: Shannon (positive correlation, pearson t-test, 0.65, p-value = $2.1e^{-11}$)
- Hill number $q=2$: Simpson (positive correlation, pearson t-test, 0.72, p-value = $2.6e^{-14}$)

Conclusions

- Past vegetation composition changes:
 - Record do not span any extreme glacial / interglacial transitions
 - But transitions between stadials and interstadials with events of woody taxa invasions in the lake vicinity:
 - Transition between MIS4 and MIS3
 - Bolling – Allerød event: ~14,500 yrs BP
 - Holocene Climate Optimum: ~10,000 yrs BP to ~5,000 yrs BP
- Past vegetation diversity changes:
 - No correlation between proportion of woody taxa and richness
 - Positive correlation between proportion of woody taxa and shannon index
 - Positive correlation between proportion of woody taxa and simpson index

An increased proportion of woody taxa do not directly affect the number of plant species detected but both the evenness and effective taxa number are improved. However, further investigations are needed such as on other kingdoms and to what extent this diversity is improved

References

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- ⁶**Boyer, F., et al.** (2015) „OBITOOLS: a UNIX-inspired software package for DNA metabarcoding“, *Molecular Ecology Resources*, 16