BIOdelta4 : Biodiversity Assessment in Tyrol

25.11.2020

Project I : Sept. 2018 - Sept. 2019

- **Preproject work:** Biodiversity indicators most relevant in the Biosphere Reserve „Vienna woods“
- **Literature research:** Interdisciplinary research on possibilities to aggregate indicators
- **Literature research:** Biodiversity indicator choice in European countries
- **Statistic evaluation:** Reliabilty of national biodiversity reporting and monitoring in Europe

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- Collecting all **monitoring data available** for Tyrol
- Extracting **possible biodiversity indicators**
- Ranking biodiversity **indicators with highest significance** for biodiversity based on literature resaerch
- Developing a **flow chart for biodiversity assessment** quality
- Creating a **structure** for a potential composite biodiversity index in Tyrol and adjecent countries
- **Choosing biodiversity indicators** for Tyrol
- Searching for **reference areas**
- Get **inventory data** from multiple data providers
- Agree on theoretical **indicator evaluation**
- **Scientific discussion of the BIOdelta4 concept**

Flow chart for improving biodiversity assessment quality

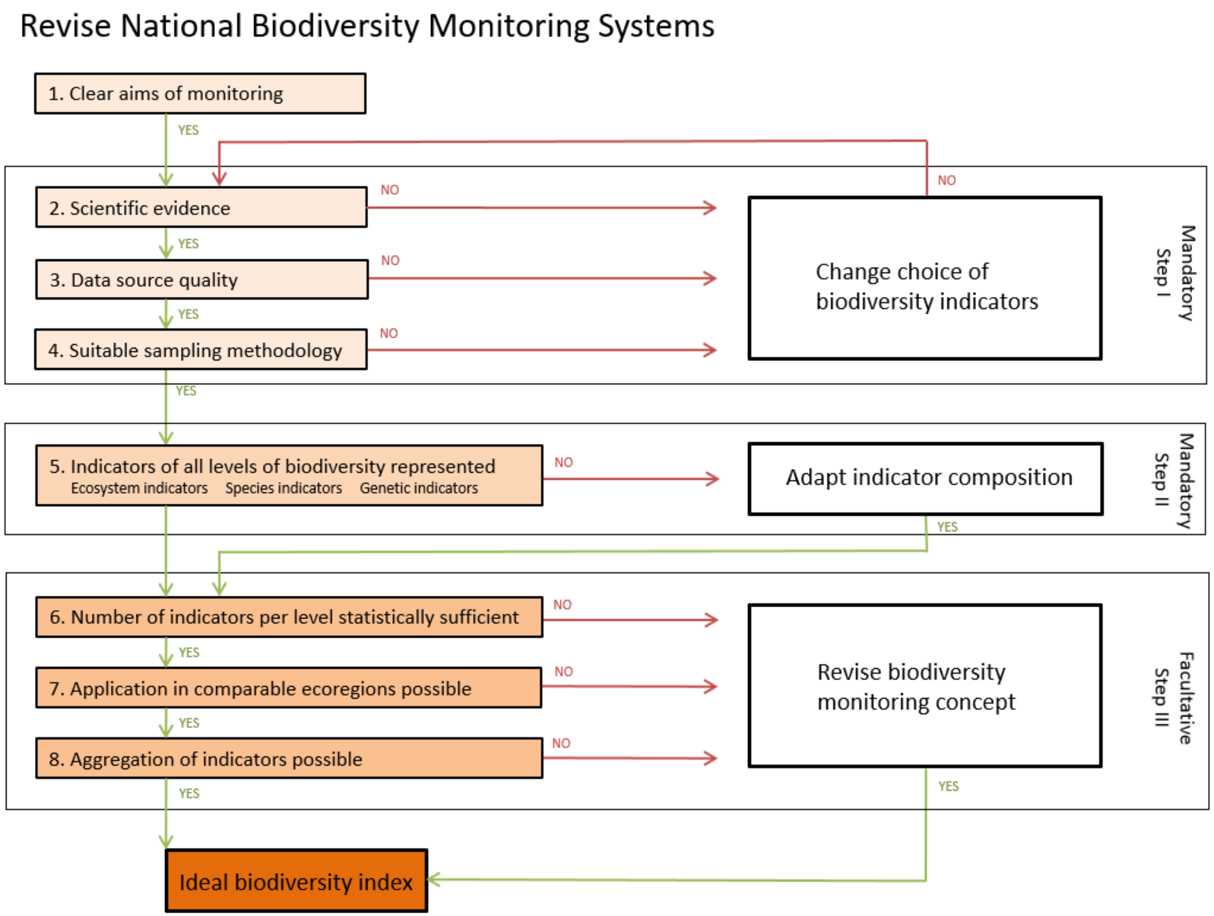


Fig. 1: Flow chart guiding to the revision of national biodiversity monitoring systems according to the CBD. Step I and step II should mandatory be fulfilled by all CBD countries, whereas step III could be applied facultatively to further enhance quality of biodiversity monitoring and reporting (Ette & Geburek 2020).

Composition of the biodiversity index

All three dimensions of biodiversity are considered equally in the indicator set:

Species diversity	Ecosystem diversity	Genetic diversity
Shannon Index	Tree layer structure	Connectivity
Tree species composition	Developmental level	Landscape fragmentation
Ground vegetation composition	Dead wood	Forest gap structure
Bonus: Game damage	Bonus: Structural features	Bonus: Genetic features

S. Ette

SWOT Analysis of BIOdelta4

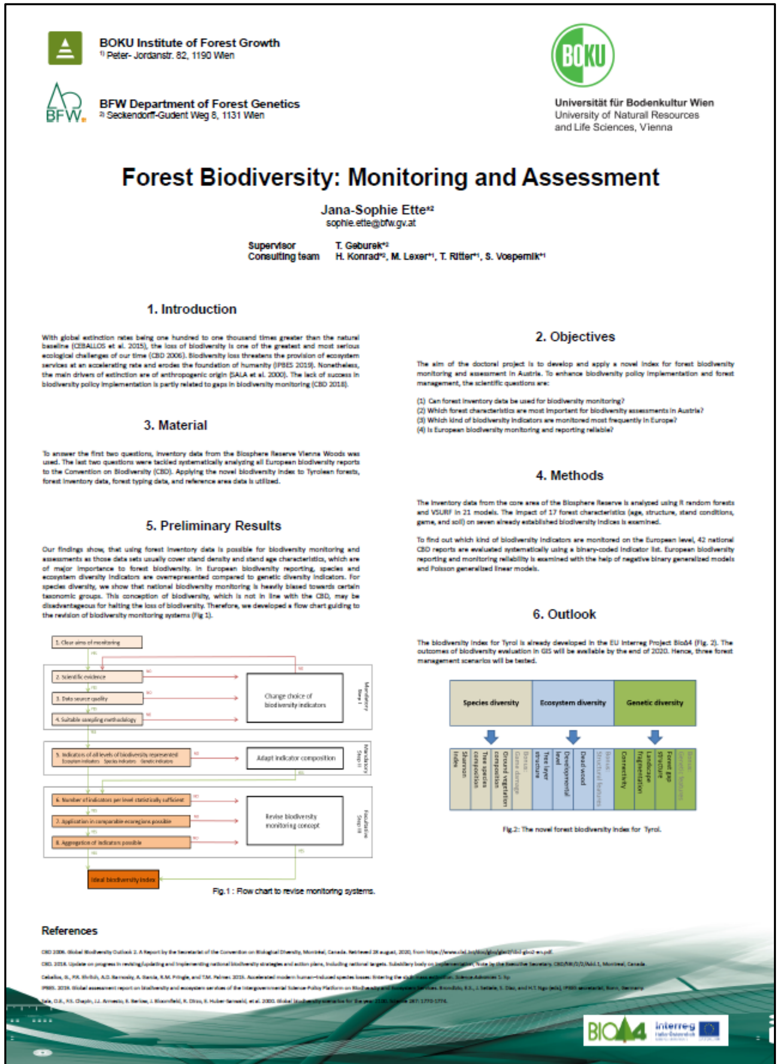
Modular concept Based on available inventory data Applicable on different scales & countries In line with Convention on Biological Diversity (CBD) requirements Transparency of biodiversity assessment	Indicator choice impacts outcomes Missing inventory data for some forest types Statistical security for rare forest types
Transferable to all areas with forest typing Most indicators are dirigible by forest managers Smart phone application for biodiversity possible Impact of forest management/policy assessable in advance	Political support for BIOdelta4 Acceptance of forest owners for BIOdelta4 Missinterpretation S. Ette

Project II : Sept. 2019 - Sept. 2020

- **Literature research:** Different Modelling approaches for indicators chosen
- **Literature research:** Impacts of Forest management on biodiversity in Tyrol
- **Literature research:** Negative effects of Austrian climate change adaption strategies on biodiversity

- **Harmonization** of inventory data
- **Data Gap analysis**
- Adapting **calculation methods**
- **Statistical reliability checks** on biodiversity indicator choice
- **Preparations for modelling single indicators**
- Creation of **QGIS projects**
- Evaluation of **single biodiversity indicators**
- **Aggregation** of biodiversity evaluation outcomes
- **Management scenario analysis** for Tyrol
- **Handbook on biodiversity monitoring and assessments** using the BIOdelta4 index
- **Scientific publication** of project I outcomes in the journal AMBIO
- **Scientific publication** of project II outcomes in preparation

Scientific discussion



- Within BFW institutes
- With LK Tirol
- At University of Life Sciences Vienna
- With biodiversity experts from sixteen forest research institutions of Germany
- At a biodiversity conference in Germany

Scientific Publication

Why European biodiversity reporting is not reliable

Ette Sophie & Thomas Geburek (2020)

Accepted Version, will appear in AMBIO: the Human Environment

d. Abstract

The Convention on Biological Diversity (CBD) aims to end the loss of biodiversity, which is one of the greatest ecological challenges of our time. The lack of success in biodiversity policy implementation is partly related to gaps in biodiversity monitoring. Our overall objective is to contribute to the preparation of the upcoming post-2020 period by a review of biodiversity indicator choices in European CBD reports and hence in national monitoring systems. Negative binary generalized models and poisson generalized linear models prove that through free indicator choice in CBD reporting, countries do not choose biodiversity indicators according to their national geographic and socioeconomic characteristics. Moreover, species and ecosystem diversity indicators were chosen with a disproportionate frequency compared to that of genetic diversity indicators. Consequently, trends derived from national CBD reports and monitoring systems in Europe are not reliable, which should be an alarming signal concerning biodiversity policy implementation. Finally, a flow chart to revise national biodiversity monitoring systems is proposed.

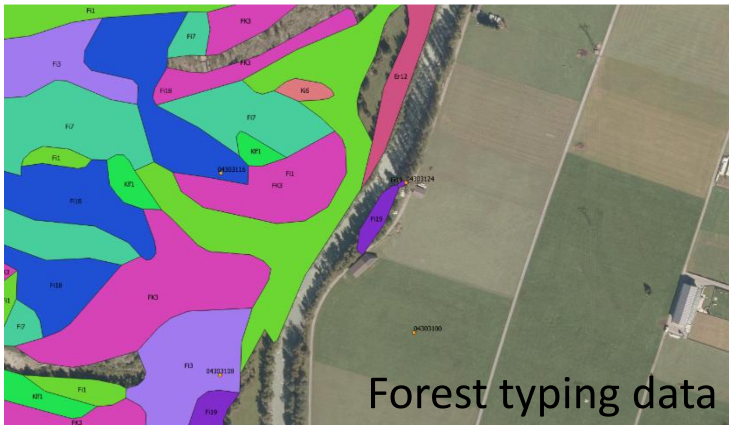
e. Key words

Biodiversity indicators, biodiversity monitoring, biodiversity policy implementation, European species diversity

Main results of BIOdelta4 - Project I will soon be published in AMBIO named:

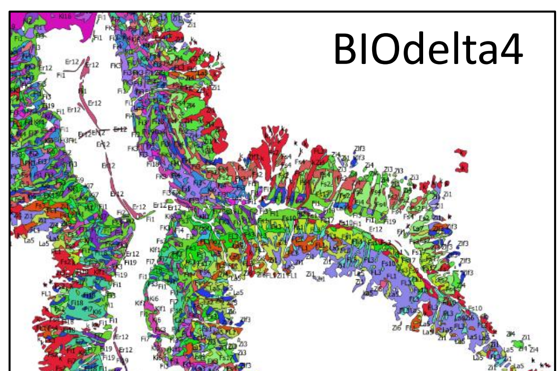
´Why European biodiversity reporting is not reliable´ (Ette & Geburek 2020)

Visualisations of BIOdelta4 outcomes



Forest typing data

Multiple inventory data



BIOdelta4

Challenges in BIOdelta4 interpretation: Genetic Diversity

- Genetic consequences may be species-specific (Kavaliauskas et al. 2018) or even population-specific (Neale et al. 1985, Adams et al. 1998, Piotti et al. 2013)
- Tree populations are able to buffer or delay effects of disturbance (Piotti 2009, Kavaliauskas et al. 2018)
- Formal comparison between managed and unmanaged stands in central European forests often is prevented (Sabatini et al. 2018)
- Genetic diversity loss may therefore be more nuanced than signals look like (Lowe et al. 2013)

Challenges in BIOdelta4 interpretation: Species Diversity

- For impact assessment, it is necessary to consider a variety of biodiversity metrics as taxa response is highly complex (Aubin et al. 2013)
- Different spatial scales play a crucial role in evaluating consequences of forest management on species diversity
- Gamma-diversity frequently is neglected while alpha-diversity is heavily focused
- Common problems of statistical biodiversity indicators are reference period and reference surface size
- Biodiversity indicator (species) choice heavily influence the evaluation outcome (Ette 2018). It is hence hardly possible to evaluate biodiversity in an objective way to be in ´good´ ecological condition

Challenges in BIOdelta4 interpretation: Ecosystem Diversity

- Ecosystems can vary heavily in size and therefore system boarders do overlap multiple times
- Therefore, biodiversity assessments are mainly executed in large ecosystems (forest types) or ecosystems of conservation interest (red listed)
- For rare and small ecosystems, interactions between species assemblages, reestablishment or fragmentation is hence poorly understood

Options:
Landscape planning tools for Tyrol

Tab. 2: Biodiversity conservation principles and suitable forest management strategies (Adapted from Lindenmayer & Franklin 2002):

Principle	Management Strategy
Maintenance of connectivity	Ecological corridors Protection of sensitive habitats Retention forestry Careful planning of road infrastructure
Maintenance of landscape heterogeneity	Ecological corridors Protection of sensitive habitats Spatial planning of cut over sites Increased rotation length Planning of road infrastructure Mimicry of natural disturbance regimes
Maintenance of stand complexity	Retention forestry Habitat creation (Cavity tree formation) Prolonged rotation length Mimicry of natural disturbance regimes
Landscape and stand heterogeneity	Mimicry of natural disturbance regimes

Options:
Strategies for Tyrol

- **Very natural forests:** Non-intervention management, passive management or benign neglect strategy (Friedel et al. 2006, Brunet et al. 2010, Müller & Bütler 2010, Lassauce et al. 2011, Müller et al. 2013, Bernes et al. 2015). Applied in strictly protected areas.

- **Extensive Forests:** Active management is needed to keep characteristics (Lindenmayer et al. 2006, Verschuyl et al. 2011, Kuuluvainen et al. 2012, Fartman et al. 2013, Hedwall & Mikusinski 2015, Sebek et al. 2015, Löf et al. 2016). Applied in less strict protected areas.

- **Heavily degraded forests:** Stand scale restoration may reintroduce ecological values (Barnes et al. 2015). The European Union´s Biodiversity Strategy aimes to restore 20% of all degraded ecosystems by 2020.

Options:
Management restrictions

Tab.3: Various types of timber management restrictions, their general cost level and value for threatened species in general (Bergseng et al. 2012).

Type of measure	General cost level	Qualitative value for biodiversity
No treatment	Low - High [a]	High
Increased rotation cycle	High	High
Min. proportion of old growth forests	High [a]	High
Shelterwood cutting	Low - medium [a]	Low - medium [b]
Selective cutting	Low - medium [a]	Low
Retention of trees	Low	Low - medium
No planting or thinning	Low	Low

[a] Cost depends on the area covered.

[b] Value for biodiversity depends on the type of cutting (Higher value for more closed cutting).

Options:
Continuous cover forestry (CCF)

- Enriches forest structure, while artificially limiting intraspecific competition (MacArthur & MacArthur 1961, Carey et al. 1999, Wilson 2000, Brunet et al. 2010)

- **Pro :** Often shown to be better in providing timber and non-timber ecosystem services than clear-cut forestry (Pukkala et al. 2011/2016, Tahvonen 2016, Tahvonen & Rämö 2016, Peura et al. 2018). Moreover, ecosystem modelling shows higher biodiversity values for CCF than for clear cutting (Peura et al. 2018) particularly for species of late successional stages (Kuuluvainen et al. 2012)

- **Contra:** Uneven-aged management raises alpha-species diversity while beta-diversity decreases (Whittaker et al. 2001, Schall et al. 2017). On the landscape scale management units tend to become more homogenous whereas within stand species diversity rises (Schall et al. 2016)
- Artificial gap creation can generally have negative effects on the spruce-fir mixing balance and hence on genetic and taxonomic diversity of the understory layer and associated species (Lafond et al. 2015)

Options:
Retention forestry

- Much scientific evidence for biodiversity benefits arising from different retention tree approaches (Vanderwel et al. 2007, Lindenmayer et al. 2012, Fedrowitz et al. 2014)
- Positive response to forest structural complexity for a wide spectrum of forest taxa (Roth 1976, Poulsen 2002, Tews et al. 2004, Hedenas & Hedström 2007, Gustafsson et al. 2010, Stein et al. 2014, Baker et al. 2015)
- The positive effect on species diversity rises with the retention level applied (Fedrowitz et al. 2014)
- Rotation time may be shortened if levels of retention rise (Lindenmayer et al. 2006)
- The ecological effects of retention forestry depend strongly on the individual trees chosen for selection and their spatial arrangement (Scott & Mitchell 2005, Rosenvald et al. 2008)
- Moreover, maintenance of genetic diversity Austrian *Picea abies* stands can be favored through retention forestry (Unger et al. 2011)

Options:
Mimicry of disturbance regimes

- Enhance structural diversity (Bergeron et al. 1999, Seymour et al. 2002), stand resilience (Cordonnier et al. 2008, Lafond et al. 2014) and dead wood abundance (Bolton & D´Amato 2011)
- Facilitate characteristic alpha-diversity and natural disturbance refugia (Johns 1996, Van Nieuwstadt et al. 2001, Mackey et al. 2002)
- For alpine sites group selection is more advantageous than single tree selection (Gauquelin & Courbaud 2006, Lafond et al. 2015)
- Unclear if always advantageous compared to traditional shelterwood systems if small-scale gap dynamic is not the prevailing natural disturbance (Schall et al. 2016)

Conclusions of BIOdelta4 for Tyrol

- Biodiversity can never fully be represented by a single number
- Oversimplifying biodiversity and might lead to inappropriate conclusions
- For decision making, always focus on the consequences of practice on different spatial and temporal levels as well as on the three dimensions of biodiversity: Ecosystem Diversity, Species Diversity and Genetic Diversity
- There will always be positive and negative responses of practices depending on landscape conditions, taxonomic groups, and temporal and spatial scale of the analysis

Conclusions of BIOdelta4 for Tyrol

- Management needs to become more flexible and use novel measures like predictions from forest models to face large uncertainties
- Harvest should be targeted to sites with highest timber production potential and smallest losses to biodiversity. Contrary, it is reasonable to promote nature conservation in areas of high ecological and social values and low economic potential
- Indicators need definition of suitable baselines and become meaningful in comprehensive indicator sets
- Large spatial scales (regional- national) should be of higher importance for decision-making in forest management than small spatial scales (stand scale)

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