INSTITUT FÜR ENERGIE- UND UMWELTFORSCHUNG HEIDELBERG

FURTHER DEVELOPMENT OF THE **HEMEROBY APPROACH** FOR THE **INTEGRATION** OF **LAND USE AND** BIODIVERSITY **INTO LIFE CYCLE (IMPACT) ASSESSMENT**

Mirjam Busch (1), Horst Fehrenbach (1), Birgit Grahl (2), Joachim Reinhardt (1)

(1) Institut für Energie- und Umweltforschung Heidelberg (Germany)

(2) INTEGRAHL (Germany)

8th Congress [avniR] 2018, 7th & 8th of November at the Lilliad, in Villeneuve d'Ascq

The Hemeroby Approach

The so-called „UBA method“

since the late 90ies

→ further development by ifeu and INTEGRAHL

→ incorporated in ongoing projects on

- **land use backpacks** (funded by the German Federal Environmental Agency (UBA))
- **recycled concrete** (funded by Federal Ministry of Education and Research (BMBF))

Conceptual and Methodical Basics

- **Naturalness is the safeguard subject**

  → capturing also information on **biodiversity, soil quality and ecosystem services**

  → **promotion of natural characteristics in general as favourable**

- **The negative impact = loss of naturalness**
- **It's a midpoint indicator → close to th**
- Focus on **occupation impact**

present further developments: **integration of transformation**

Indicative typology

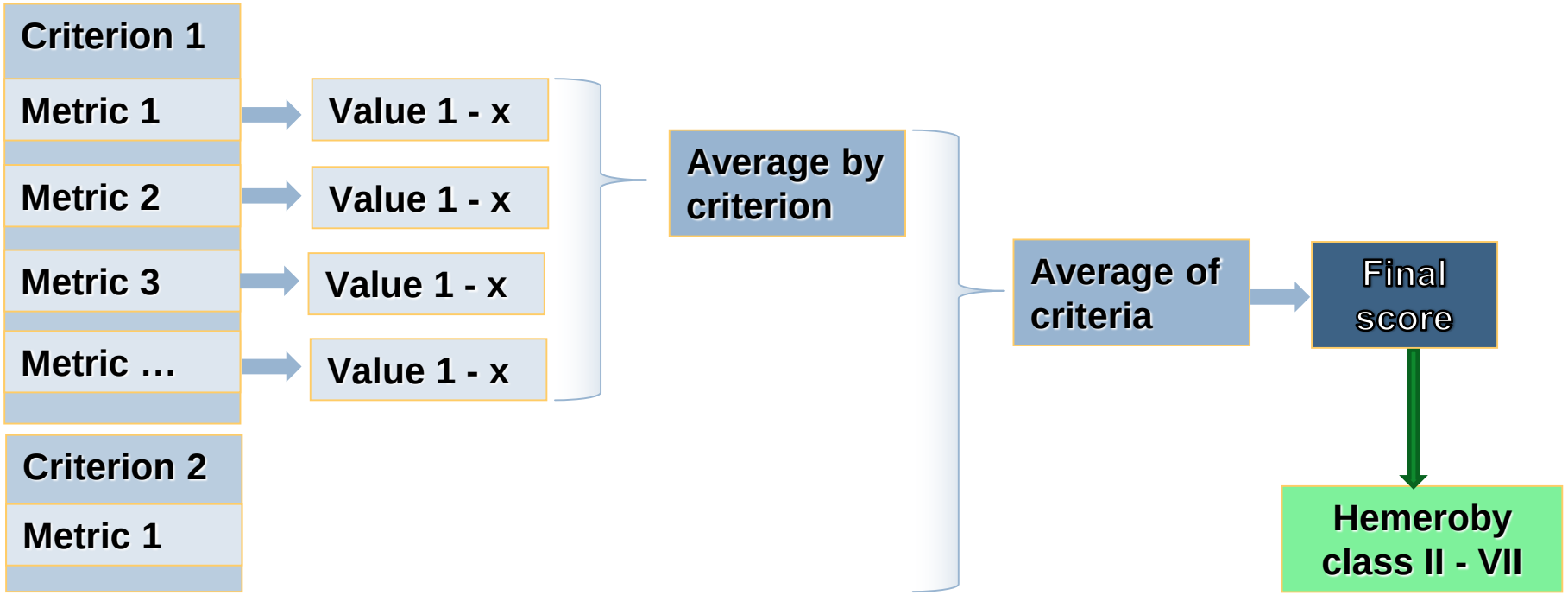
Ordinal scale of 7 hemeroby classes

→ It's applicable for **every land-use type**

→ **Aggregation** of different classes into a single indicator value: **Distance-to-Nature-Potential (DNP)** (based on Fehrenbach et al. (2015))

I	Natural
II	Close-to-nature
III	Partially close-to-nature
IV	Semi-natural
V	Partially distant to nature
VI	Distant-to-nature
VII	Non-natural

Determination of the classes based on indicators



Indicative typology

Hemeroby class		Indicative Exempels		
I	Natural			
II	Close-to-nature			
III	Partially close-to-nature			
IV	Semi-natural			
V	Partially distant to nature			
VI	Distant-to-nature			
VII	Non-natural			

Indicative typology

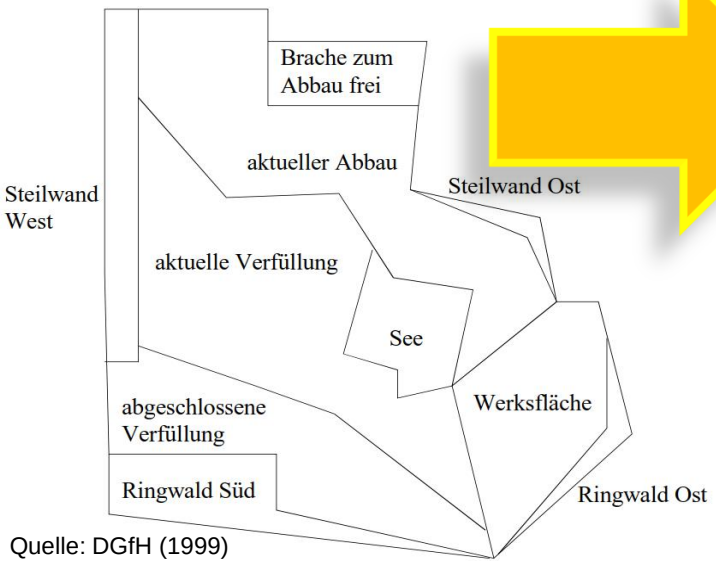
Hemeroby class		Indicative Exempels for forested area	for agricultural land	for other land type
I	Natural	-	-	Undisturbed ecosystem, pristine forest, no utilisation 
II	Close-to-nature	Close-to-nature forest manage-ment, 	-	-
III	Partially close-to-nature	Inter… ma…	…d …s	
IV	Semi-natural		…ards etc.	
V	Partially distant to nature	Mono… forest 	…ate agric. …oderate intensity, SRC, fertilized grassland 	-
VI	Distant-to-nature	-	Large-area, highly intensified arable land in cleared landscape 	
VII	Non-natural	-	-	Sealed areas

Lignite open cast mines, natural stone mines, wind and solar power plants???

development of indicator sets

Hemeroby Concept – Surface Mining

Which areas have to be considered?



Quelle: DGfH (1999)

A) Area subjected to mining

B) Operational areas and stockpiles

- Spoil heap and dumps
- Operating buildings and processing plant
- Stationary & mobile conveyor (machinery, conveyor, railways, gondola lift systems)
- Roadways
- Storage stockpiles

Deutsche Gesellschaft für Holzforschung (Hrsg.) (1999). VERIFIZIERUNG VERSCHIEDENER METHODEN ZUR WIRKUNGSABSCHÄTZUNG DES WIRKKRITERIUMS NATURRAUMINANSPRUCHNAHME / LANDNUTZUNG / LANDVERBRAUCH. Bearbeiter: ifeu Heidelberg, IKP Universität Stuttgart, Bundesforschungsanstalt für Forst- und Holzwirtschaft Hamburg. München, 1999

Hemeroby Concept – Surface Mining

Which areas have to be considered?

A) Area subjected to mining

B) Operational areas and stockpiles

- Spoil heap and dumps
- Operating buildings and processing plant
- Stationary & mobile conveyor (machinery, conveyor, railways, gondola lift systems)
- Roadways
- Storage stockpiles

- **Permanently sealed industry areas**

→ **Hemeroby class VII**

Hemeroby Concept – Surface Mining

Which areas have to be considered?

A) Area subjected to mining

B) Operational areas and stockpiles

- Spoil heap and dumps
- Operating buildings and processing plant
- Stationary & mobile conveyor (machinery, conveyor, railways, gondola lift systems)
- Roadways
- Storage stockpiles

- **Temporarily and punctually stressed followed by potential succession**
- **Reference period: 1 year**

→ Only limited near-natural development is possible in this period

→ **Hemeroby classes V to VII**

(based on biotope values for mining areas (class I to max. III))

Hemeroby Concept – surface mining
Criteria and metrics

Criterion 1

Severity of the interven

Criterion 2

Biotope development

(How valuable and important is the mini
possibilities are available?)

Criterion 3

Durability of the intervention

Underlying idea:

→ develop raw-material specific metrics which are valid for all raw materials

→ Starting point: German surface mines

Hemeroby Concept – surface mining
Criteria and metrics

Criterion 1 Severity of the intervention	Metric 1: maximum extraction equipment capacity [m³/h] (How much area is punctual stressed?)	e.g. <100 or > 1000 m³/h
	Metric 2: Annual mining per mine [t/a]: How much connected area is subject to the intervention?	e.g. > 100,000 t/a or > 2 Mio. t/a
	Metric 3: Intervention in the water balance (water table drawdown, dewatering)	e.g. water table drawdown, dewatering)
	Metric 4: Dumping in mines: Will a potential succession be disturbed by dumping?	e.g. direct fill up
Criterion 2 Biotope development		
Criterion 3 Durability of the intervention		

Hemeroby Concept – surface mining
Criteria and metrics

Criterion 1

Severity of the intervention

Criterion 2 Biotope development	Metric 1: Potential biotope values (I-III) (based on Küpfer 2016/LuBW 2005)	e.g. quarry face = II, sand sole = I
	Metric 2: Development of small biotopes (structural diversity) and possibilities for succession	e.g. quarry faces or nutrient poor sole with waterholes
	Metric 3: High quality of the natural development without human intervention	e.g. no development possible or high-valued biotopes
	Metric 4: Importance for the biotope network following IUS (1999)	e.g. high, middle, low

Criterion 3

Durability of the intervention

Hemeroby Concept – surface mining
Criteria and metrics

Criterion 1
Severity of the intervention

Criterion 2
Biotope development

Criterion 3 **Durability of the intervention**	Metric 1: Harmful residues on-site: Prevention of real near-natural development	e.g. heavy metals, high acidity
	Metric 2: Renaturation potential: What can be done with the area at best?	e.g. high-value biotopes

Hemeroby Concept – surface mining
Criteria and metrics

Criterion 1 Severity of the intervention	Metric 1: maximum extraction equipment capacity [m³/h] (How much area is punctual stressed?)
	Metric 2: Annual mining per mine [t/a]: How much connected area is subject to the intervention?
	Metric 3: Intervention in the water balance (water table drawdown dewatering)
	Metric [illegible] dumping?
Criterion 2 Biotope development	Metric 1: Potentia[illegible]
	Metric 2: Develop[illegible] for succession
	Metric 3: High qua[illegible]
	Metric 4: Importar[illegible]
Criterion 3 Durability of the intervention	Metric 1: Harmful residues on-site. Prevention of real near-natural development
	Metric 2: Renaturation potential: What can be done with the area at best?

metrics are defined by three different value groups:

- value group 1 = **“closest to nature”**
- value group 2
- value group 3 = **“most distant to nature”**

Examples: German natural stone and lignite surface mines

criterion/metric	natural stone	lignite
Criterion 1: Severity of the intervention		
maximum extraction equipment capacity [m³/h]	250 m³/h	2,400 m³/h
Annual mining per mine [t/a]:	200,000 – 1.Mio t/a	42.9 Mio t/a
Intervention in the water balance	dewatering, partly: water table drawdown	water table drawdown
Dumping in mines	Dumping: about 25 %	yes

Examples: German natural stone and lignite surface mines

criterion/metric	natural stone	lignite
Criterion 1: Severity of the intervention		
maximum extraction equipment capacity [m³/h]	250 m³/h	2,400 m³/h
Annual mining per mine [t/a]:	200,000 – 1.Mio t/a	42.9 Mio t/a
Intervention in the water balance	dewatering, partly: water table drawdown	water table drawdown
Dumping in mines	Dumping: about 25 %	yes
Criterion 2: Biotope development		
Potential biotope values (I-III)	II	III
Development of small biotopes (structural diversity) and possibilities for succession		
High quality of the natural development without human intervention		
Importance for the biotope network		

Examples: German natural stone and lignite surface mines

criterion/metric	natural stone	lignite
Criterion 1: Severity of the intervention		
maximum extraction equipment capacity [m³/h]	250 m³/h	2,400 m³/h
Annual mining per mine [t/a]:	200,000 – 1.Mio t/a	42.9 Mio t/a
Intervention in the water balance	dewatering, partly: water table drawdown	water table drawdown
Dumping in mines	Dumping: about 25 %	yes
Criterion 2: Biotope development		
Potential biotope values (I-III)	II	III
Development of small biotopes (structural diversity) and possibilities for succession		
High quality of the natural development without human intervention		
Importance for the biotope network		
Criterion 3: Durability of the intervention		
Harmful residues on-site		
Renaturation potential		

Examples: German natural stone and lignite surface mines

criterion/metric	natural stone	lignite
Criterion 1: Severity of the intervention		
maximum extraction equipment capacity [m³/h]	250 m³/h	2,400 m³/h
Annual mining per mine [t/a]:	200,000 – 1.Mio t/a	42.9 Mio t/a
Intervention in the water balance	dewatering, partly: water table drawdown	water table drawdown
Dumping in mines	Dumping: about 25 %	yes
Criterion 2: Biotope development		
Potential biotope values (I-III)	II	III
Development of small biotopes (structural diversity) and possibilities for succession		
High quality of the natural development without human intervention		
Importance for the biotope network		
Criterion 3: Durability of the intervention		
Harmful residues on-site		
Renaturation potential		
Aggregation	**4.75 → class VI**	**9 → class VII**

Outlook – Hemeroby concept for surface mines

Adjustment of metrics according to global conditions

Generation of a data base for raw material extraction outside Germany

Development of a method for integration of transformation aspects for surface mines

Handling of long-term devastation (no use possible in the years after mining)

Characterized results: Electric energy from wind power and lignite

- **Energy supply from lignite (Germany):**
  - Occupation (LCI level) per t lignite = 3.07 m^2*a/t
  - Occupation (LCIA level) per t lignite = 3.07 m^2-e (DNP)*a/t

    (DNP = Distance-to-Nature-Potential)

  → **3.14 m^2-e (DNP)*a/MWh**
- **Energy supply from wind power plant (onshore)** (prelimilary figures for Germany)
  - Occupation (LCI level) per t MWh = 0.5 m^2*a/MWh
  - Occupation (LCIA level) per t MWh **= 0.36 m^2-e (DNP)*a/MWh**

INSTITUT FÜR ENERGIE- UND UMWELTFORSCHUNG HEIDELBERG

Thank you for listening!

mirjam.busch@ifeu.de

Wilckensstraße 3 69120 Heidelberg Telefon +49 (0)6 221. 47 67 - 0 Telefax +49 (0)6 221. 47 67 - 19 www.ifeu.de

Results at LCI level examples of specific occupation values

Specific occupation/ hemeroby class	Area subjected to mining [m²*1a/t]	Spoil heap and dumps [m²*1a/t]	Operational area (buildings, stationary & mobile conveyor, roadways, storage stockpiles, …) [m²*1a/t]
Sand, gravel	0.037 (1) → class VI	0.0026 (2,3) → class VI	0.1556 (2,3) – class VII
Limestone	0.015 (1) → class VII	0.0157 (2,3) → class VII	0.1221 (2,3) – class VII
Lignite	Operational area: 3.071(4) → class VII		

(1) BGR (2017), (2) LAGB Sachsen-Anhalt (2012), (3) NMUEK & NLÖ 2002, (4) Statistik der Kohlewirtschaft e.V.

(1) BGR – Bundesanstalt für Geowissenschaften und Rohstoffe (2017): Deutschland – Rohstoffsituation 2016. – 190 S.; Hannover.
(2) Landesamt für Geologie und Bergwesen Sachsen-Anhalt (Hrsg.) (2012). Rohstoffbericht Sachsen-Anhalt 2012. Mineralische und energetische Bodenschätze – Sachstand und neue Nutzungswege. Mitteilungen zu Geologie und Bergwesen von Sachsen-Anhalt. Band 17, 2012
(3) Niedersächsisches Umweltministerium und Niedersächsisches Landesamt für Ökologie (2002). Arbeitshilfe zur Anwendung der Eingriffsregelung bei Bodenabbauvorhaben auf der Grundlage des „Leitfadens zur Zulassung des Abbaus von Bodenschätzen nach dem NNatG und dem NWG“. 24.09.2002