Database on wetland vegetation in East Africa

Alvarez M, Behn K, Möseler BM, Oyieke H, Malombe I, Tiller K, Langensiepen M, Becker M
• Are impacts of cropping on wetlands reversible?
• Are they also affecting productivity of agro-ecosystems?
• How to assess the status of those wetlands?
Contents

- Classification of vegetation
- Biomass recovery
- Regeneration/degradation dynamics
- Assessment methods
1,312 plots in total
354 plots in wetlands
200 plots of wetlands’ vegetation

Alvarez et al. (2012) *Biodivers Ecol* 4
Vegetation sampling

Rectangular plots, 4 m² size (10 per community type)

Preferential sampling

Record of vascular plant species

Abundance: cover percentage

Dengler et al. (2008) *Phytosociology*
Environmental variables

Land use duration and intensity

Soil cores of depth 0-20 cm (mixed samples)

Chemical analysis:
- pH (H$_2$O)
- Electric conductivity
- Organic C
- Total N
- Plant available P
- Exchangeable K
Land uses

- Unused fields
- Grazing lands
- Fallows
- Croplands
Bibliographic references

Exhaustive collection for...
• data sources
• syntaxonomical overview
• additional documentation

Phot. 3. Freshly cut drain in virgin Papyrus swamp. *Cyperus papyrus*, *Miscanthidium violaceum* and *Ficus umbellatus* distinguishable on left.

Eggeling (1935) *J Ecol* 23
Cocktail classification

Aquatic vegetation

communities of...
• *Nymphaea lotus*
• *Pistia stratiotes - Eichhornia crassipes*

Riparian vegetation

communities of...
• *Cyperus papyrus*
• *Typha domingensis*
• *Cyperus latifolius*
• *Cyperus exaltatus*
• *Phragmites mauritianus*
Cocktail classification

Grassland vegetation communities of...
- *Sporobolus agrostoides*

Weed communities
On going classification
## Cocktail classification

<table>
<thead>
<tr>
<th>Community type of...</th>
<th>Code</th>
<th>SWEA II</th>
<th>SWEA I</th>
<th>Total</th>
</tr>
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<tr>
<td><em>Nymphaea lotus</em></td>
<td>HY001</td>
<td>8</td>
<td>-</td>
<td>8</td>
</tr>
<tr>
<td><em>Pistia stratiotes-Eichhornia crassipes</em></td>
<td>HY002</td>
<td>10</td>
<td>-</td>
<td>10</td>
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<tr>
<td><em>Cyperus papyrus</em></td>
<td>HE001</td>
<td>10</td>
<td>9</td>
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<tr>
<td><em>Typha domingensis</em></td>
<td>HE002</td>
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<td><em>Cyperus exaltatus</em></td>
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<tr>
<td><em>Cyperus latifolius</em></td>
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<tr>
<td><em>Phragmites mauritianus</em></td>
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<tr>
<td><em>Heliotropium indicum</em></td>
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<td><em>Sporobolus agrostoides</em></td>
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<td>-</td>
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<tr>
<td>Ambiguous classification</td>
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<td>-</td>
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<td>Non classified</td>
<td>?</td>
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<td>154</td>
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<td>206</td>
<td>306</td>
<td></td>
</tr>
</tbody>
</table>
Syntaxonomical scheme

Phragmito-Magno-Caricetea Klika in Klika & Nowák 1941
  Typho-Cyperetea Knapp 1965
    Papyrus Lebrun 1947
    Papyrion Lebrun 1947
      Cypero papyri-Cyclosoretum interruptus ass.nov. [HE001]
      Cyperetum latifolii ass.nov. [HE004]
  Phragmitetalia australis Koch 1926
    Phragmition australis Koch 1926
      Typhetum domingensis Borhidi & Muñiz 1983 [HE002]
      Phragmitetum mauritianus ass.nov. [HE005]
      Cyperetum exaltati ass.nov. [HE003]

Soncho-Bidentetea pilosae Hoff et al. 1985
  Bidentetalia pilosae Leonard in Mullenders 1949
    Ecliption albae Lebrun 1947
    Polygonetum senegalense Cook 1968 [HE006]

Potametea Klika in Klika & Nowák 1941
  Nymphaetalia loti Lebrun 1947
    Nymphaeion loti Lebrun 1947
      Lemno-Pistietum Lebrun 1947 [HY001, HY002]
      Nymphaetum Cook 1968 [HY001]

Ceratophylletea Den Hartog & Segal 1964
  Ceratophylletum demersi Corillion 1957 [HY002]

Themedo-Hyparrhenietea Knapp 1965
  Hyparrhenio-Digitarietalia mombasanae Knapp 1965
    Sporobolitetum agrostoidis ass.nov. [TE001]
Biomass recovery
Biomass recovery

Regeneration dynamics

Cyperus latifolius

Cyperus exaltatus

Dry matter (g m$^{-2}$) vs. time (days)
Regeneration vs. degradation

Constellation diagram

- Heliotropium indicum
- Typha domingensis
- Cyperus papyrus
- Cyperus exaltatus

- 8 common species
- 7 common species
- 4 common species or less

MDS 1 vs. MDS 2
Regeneration vs. degradation

Regeneration pathway

- a: Alpha diversity
- b: Proportion of annuals
- c: Soil reaction
- d: Soil nitrogen content

Degradation stage

HI: Heliotropium indicum
TD: Typha domingensis
CP: Cyperus papyrus
CE: Cyperus exaltatus
Regeneration vs. degradation

Regeneration pathway:
- Heliotropium indicum
- Typha domingensis
- Cyperus papyrus

Degradation pathway:
- Cyperus exaltatus
WET-Health & GlobE-typology

- Vegetation ecology
- Hydrology
- Soil science
- Agronomy
- Socio-Economics
- Geography
Assessment of floristic and structural variables of vegetation: the impact of agricultural use in East African wetland ecosystems


INTRODUCTION

Seasonally and permanently flooded wetlands in East Africa are strongly impacted by human activities. Intensiﬁcation of crop production and livestock grazing and the associated loss of wetlands results in the degradation of wetland functions and biodiversity resulting in a reduction of productivity and provisioning of future ecosystem services. Given the considerable costs associated with the support of decision making for users and managers are required. In this regard, we aim to design rapid assessment methods that may be suitable for East Africa.

METHODS

During a survey carried out in 2015 the vegetation status of around 200 plots characterized by density, leaf cover, and plant type and intensity within randomly selected study sites distributed in Kenya, Tanzania, and Uganda were assessed by means of variables related to the floristic composition, plant species diversity and vegetation structure. Such variables were selected among those that can be quickly measured or estimated.

The analyzed use units represented the diversity of uses from near-natural vegetation (e.g. stands of reeds, Cyparrhes papaya) to medium-disturbed grazing land up to intensively used croplands.

Furthermore, the disturbance intensity was estimated according to the Wet Health & GlobE-typology approach (Kotte et al., 2012, Ecological Indicators 13, 284–293).

STUDY AREA

The assessment variables strongly respond to the land use, Component 1 (33.8 %) is mainly an intensity gradient. As expected, annual crops are wetland indicators for high land use intensity while perennial shrublands in semi-arid vegetation. However, due to weed management and seasonal droughts, the total cover of annual species is of lower importance than the proportion of annuals. Regarding perennial species the total coverage is more meaningful. Coverages of Monocotyledons and Dicotyledons as well as their ratio can help to differentiate between different (semi-)natural vegetation types rather than between land use intensities.

Surprisingly, the Cover of Cyperaceae are of little informative value, according to this analysis. This is likely due to the fact that Cyperaceae are rare in the studied part of the Kilimanjaro foothills (TZ), where natural vegetation consists mainly of Poaceae. In the Kenyan, Rwandan and also the Ugandan site, Poaceae are generally more abundant in units of medium or past disturbance (grazing lands and ﬁelds) while Cyperaceae indicate low land use intensity. Also, of all assessed variables, Cyperaceae show the strongest difference between wetland and surrounding non-wetland plots.

CONCLUSION & OUTLOOK

Preliminary results show that some of the assessed variables can be used for a rapid assessment for the agricultural impact on East African wetland vegetation.

Fortunately, the proportion of annual and the total cover of perennial species are meaningful. Cyperaceae can be a valuable indicator for the land use intensity as well as the identiﬁcation of wetlands on some sites, while it is of no information on other sites.

This study is embedded in the multidisciplinary Globs-wetlands project. A common database for the results of different disciplines is in preparation. Once established, it gives the opportunity for further analysis of these vegetation variables in reference to data from agronomy, hydrology, soil science and socio-economy.

Furthermore, a planned link with the EWEA-VegetDatabase (GID-ID: AF-06-006) will allow the application of this assessment to plots surveyed in Kenya and Tanzania.

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see Kai Behn‘s poster...
• Classification of vegetation units

• Rotation management
• Restoration?

• Cost-efficient assessment methods
GlobE-Wetlands database

SWEA-Dataveg

- Relevés
  - Species
  - Abundance

Plot related data
- Soil properties
- Land uses

EA-Splist
- Nomenclature
- Taxonomy
- Species traits
Agricultural use and vulnerability of small wetlands in East Africa

Reconciling future food production with environmental protection

Thank you!
European Institutions

- University of Bonn (DE)
- Research Centre Jülich (DE)
- University of Cologne (DE)
- University of Mainz (DE)
- Wageningen Agricultural University (NL)
- ETH Zürich (CH)
African Institutions
• National Museums of Kenya (KE)
• University of Dar es Salaam (TZ)
• Makerere University (UG)
• Kenyatta University (KE)
• Rwanda Environment Management Authority (RW)
• Africa Rice (TZ)
• Rwanda Agriculture Board (RW)
• National Crops Resources Research Institute (UG)
• Kigali Institute of Science and Technology (RW)