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DIVERSITY OF NAMIBIAN DRAGONFLIES: EFFECTS OF ANTHROPOGENIC CHANGES AND MODELLING ON DIFFERENT SCALES

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Description of the project and first results

The aim of our project is the development and application of a system for the modelling of Odonata diversity — on population, species and community level — in arid and semiarid regions of Africa. The model-system will help to understand the dynamics of Odonata communities and to evaluate different scenarios of global change and anthropogenic effects for ecosystem-management. Odonate diversity can be used as an indicator in this context.

Faunistic survey, monitoring and experimental studies

The Odonata fauna of Namibia consists of 100 species (Martens et al. in prep.). The highest species diversity – reflecting the presence of permanent rivers – is in the NE (Jödicke & Martens in prep.). To study diversity in arid regions on the species and community level we survey the Odonata of about 250 aquatic habitats in the western catchments, namely the Swakop, Kuiseb, Tschauchab, Ugab, Huab and Hoanib, and, additionally, in the Fish river. We recorded 52 species in these systems. We characterized the environment and the geographical situation of all sites. Based on these data habitat suitability models (see below) will help to evaluate the relevance of factors like habitat duration, vegetation, salinity, altitude and connectivity for the structuring of Odonata assemblages and the distribution of species. A number of sites are selected for long term monitoring to study phenology and variations in assemblage structures. Using artificial pond systems we studied habitat selection, life cycles, phenology, and priority. Our studies revealed clear patterns of habitat choice via oviposition, which effects larval density in different structured ponds (Suhling et al. 2001). All species of these ponds were able to develop within less than two months; *Pantala flavescens* requires only 31 days from oviposition to emergence. The short development allows species to use even short existing habitats and may be a major trait of desert Odonata (Suhling et al. in press). The field studies are accompanied by laboratory experiments, which revealed clear effects of priority, growth rate and intraguild predation in a two species assemblage, combining the widespread species *Trithemis kirbyi* and *Sympetrum fonscolombii*.

Molecular genetics

The molecular genetic analyses of several ncDNA and mtDNA marker reveal first data on the genetic diversity and genealogical relationships of the selected study species. The data provide first insights into spatial and temporal dynamics of selected key-species in correlation to different ecological settings (see below). The latter will help us to identify pathways used by Odonata to colonize the ephemeral desert habitats, which is not possible with traditional methods. The study includes different geographical scales: (a) between habitats in one catchment, (b) between catchments, (c) between the western catchments and other regions of Namibia (such as the savanna regions in the northeast), and (d) between Namibia and other regions like Kenya, in co-operation with BIOTA E07. Based on monitoring data we selected a set of key species, e.g. *Paragomphus genei*, which exclusively colonizes habitats within the floodplains. Others such as *Crocothemis erythraea* and *Anax imperator* are not limited, since they are excellent flyers. We compare the population structures/dynamics of these species in connection with differences in their mobility. Using additional information on environmental stress related genes (e.g. variation in heat shock proteins) provide insights into the adaptive potential of the selected species. Our study also includes genetic information on rare and extremely isolated species, which is a major task when setting up a conservation management plan. For analyses at the genus level we have chosen *Pseudagrion*, *Orthetrum* and *Trithemis*, which seem to be promising model systems to obtain insights into different stages of speciation and differences in species diversity patterns in combination with recent and historical habitat shifts.

Ecological modelling

Modelling is done on different scales. On the habitat scale suitability and population dynamic models will be developed and applied for selected species. We use logistic regression methods to model habitat suitability. These models are based on presence / absence data together with habitat parameters recorded during the survey (see above). As a result we get probabilities of occurrence in a given habitat for each species. Up to now data of the first survey were explored to find species suitable for modelling and to run first suitability models. For population dynamics we used a model based on “delay-differential-equation”, evolved by Crowley et al (1987) for Odonata of the temperate region. This model was fitted to the specific conditions of tropical desert Odonata using literature data as well as data of our own studies (Schroeder 2001). However, since we found that this model will cause some problems while combining it with habitat suitability models we decided to use the Leslie-matrix model instead, which allows the incorporation of more complex data. On the catchment scale different habitat models are coupled by a geographical information system (GIS) to form a multi-habitat model. To do so we take into account the spatial spread of the individuals and the gene flow between different populations. With this model system we will describe the diversity of Odonata under different scenarios, e.g increase of drought, increase of water use, building of dams. We produce distribution maps (basing on GIS), which allows the application of countrywide models the diversity in the second phase.

Identification keys

As a general preparation we produced keys to the adults and larvae of the Namibian Odonata, which will be published with the National Museum of Namibia, Windhoek. The larval key already allows identification of all genera, but not all species, since a number of larvae are undescribed. The adult key already allows identification of most of the species.

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