Nature conservation considering vector ecological burdens – do renaturation measures in wetlands alter the mosquito species composition and abundances?

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Abstract: Stechmücken (Diptera: Culicidae) sind ein Teil von Feuchtgebieten und gehören zu deren Biodiversität. Häufig steigt ihre Zahl nach der Durchführung von Naturschutzmaßnahmen an. Solche Naturschutzmaßnahmen sind z. B. Wiedervernässungen und Aufforstungen. Das Problem ist, dass Anwohnerinnen und Anwohner sich häufig gegen diese Maßnahmen auflehnen, da sie hohe Stechmückenzahlen oder gar eine Plage befürchten. Jedoch fehlen Studien, die überprüfen inwiefern sich Naturschutzmaßnahmen auf die Stechmückenfauna auswirken und darauf aufbauend Steuerungsoptionen anbieten. Deswegen ist es das Ziel dieses Projekts, die Disziplinen, Vektorökologie, Naturschutz, Raumplanung und Sozialwissenschaften, zu verknüpfen. Die Ergebnisse eines Stechmückenmonitorings vor und nach einer Maßnahme in einem Feuchtgebiet sollen Naturschutzmaßnahmen in der Zukunft unterstützen. In diesem Beitrag werden die Methodik des Forschungsprojekts und die Ergebnisse aus dem ersten Jahr des Projekts präsentiert.

Keywords: Renaturation, nature conservation, mosquitoes

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Introduction

Wetlands are essential ecosystems for society and nature. Just to name a few of their many indispensable functions: CO_2- and flood water retention, recreational aspects and biodiversity hotspots (Maltby & Acreman 2011). Globally wetlands have been decreasing since the last century; in Europe more than 60 % of the wetlands have been declined (Ramsar 2014). In densely populated countries such as Germany, it is vital to find suitable solutions that ensure the development of wetlands in the next centuries. Therefore, many national and international laws oblige the state and actors in water management to conduct protection and renaturation measures. These measures are primarily based on renaturation of former floodplains, reforestation of typical vegetation, and reestablishment of fluvial and pluvial processes that create small stagnant water pools. Habitats with stagnant water, however, are perfect breeding habitats for mosquitoes. Mosquito larvae develop continuously and quickly in such small pools (Willott 2004).

The crux is that citizens often dissent against nature conservation measures in wetlands, which could enhance mosquito populations, since they are afraid of high mosquito abundances and potential infection risks. Therefore, it is essential to find solutions for this problem addressing society, nature conservation and vector ecology. The present contribution displays a project dealing with the aforementioned disciplines by combining different tools such as quantitative interviews (sociology), mosquito monitoring (vector ecology), and developing a decision tree for stakeholders (spatial planning, nature conservation). The overall research questions are:

1. How do nature conservation measures change the mosquito populations regarding abundance and species composition; which specific nature conservation measure affects the mosquito populations?
2. Is it possible to develop recommendations regarding a preventive mosquito control for stakeholders in the water management sector based on the results of question 1?

In this contribution, the concatenation of the disciplines, the project's framework and first objectives are illustrated. The goal of this project is to clarify how it is possible to combine different disciplines in nature conservation conflicts.

Methods

Six different study areas in Germany, based on the following criteria, were chosen:

1. Relevant wetlands for biodiversity: checking the lists of the federal nature agencies and Ramsar convention sites
2. Nature conservation measures carried out since 2000: after the implementation of the Water Framework Directive in 2002 nature conservation management in freshwaters has changed. Additionally, it is essential to obtain documents before the implementation of the measure and planning and public agencies are only obliged to save documents for 10 to 15 years
3. Vector ecological relevance: scanning papers and databases
4. Close to cities: societal interest and nature conservation should collide

The next step is to collect data on mosquito nuisance before the nature conservation measure (= pre-measure nuisance). The pre-measure nuisance will be then compared to mosquito data after the implementation of the measure. The hypothesis is that different stakeholders (public authorities such as forest or nature agencies, NGOs, interest groups and planning agencies) have done a mosquito monitoring before implementing the measure. In the summer of 2018, the stakeholders were contacted via e-mail or phone. The project was presented and the stakeholders were asked for mosquito data before the measure.

In March 2019, a mosquito monitoring in the study areas has started. This will be continued throughout 2019 and 2020 with the aim of comparing the mosquito situation before the nature conservation measure, the pre-measure nuisance, with the mosquito situation after the measure, the post-measure nuisance. From March to September each year breeding habitats are mapped and mosquito larvae are caught with a 350 ml standardised dipper. The breeding habitats are within a 2 km radius from the nature conservation measure. Furthermore, 16 mosquito traps are installed as well within this 2km radius. The adult traps (BG-Sentinel trap with CO_2, Biogents), installed from May to October, work in a biweekly rhythm for 24 h.

Quantitative questionnaires are used with the intention of measuring the perception of mosquito nuisances. These questionnaires will be distributed to citizens living adjacent to the area, in which the nature conservation measure has been implemented. The questionnaire consists of twenty questions, with the first ones asking for demographic data (gender, age, children, time spent outside), perception of the mosquito nuisance before and after the implementation of the nature conservation measure, knowledge about vector-borne diseases and protection measures against mosquito bites. The main goal of this questionnaire is to evaluate the citizens' perception of mosquito nuisance before and after the implementation of nature conservation measures and if there are demographic indices about the perception. A pilot questionnaire was distributed in 2018.

Results and Discussion

The chosen study areas are presented in Table 1. In these areas the measures started in 2001, the latest was terminated in 2015. Table 1 also presents the specific location of nature conservation measures in the study area.

The stakeholders' response to the project was primarily positive – many recognised its urgency and / or have encountered problems with citizens after implementing a nature conservation measure in their past.

Based on the results of the pre- and post-measure nuisance, it is possible to develop a framework for stakeholders, who plan a nature conservation measure in a wetland. By selecting different biotope types and measures, it will be possible to develop a framework for single nature conservation measures. The stakeholders could then check the potential effects of the measure on the mosquito population before implementing the nature conservation measure. Additionally, the goal is to present potential hotspots, i. e. areas where nature conservation measures are planned and a vector ecological problem has been reported in Germany. Based on the knowledge obtained from this project, it is then possible to develop a preventive mosquito control plan. Such a preventive control could be for example: informing citizens;

implementing buffer stripes (Verdonschot & Besse-Lototskaya 2014); thwarting the dry phase of temporary pools, making temporary pools bigger (Dale & Knight 2012); supporting specific vegetation that impedes the oviposition of mosquitoes (Walton & al. 2016).

Table 1: Study areas, their federal states, main nature conservation measures conducted, time period and specific location of nature conservation measure implementation.

Study Areas	Federal States	Measure	Time period	Specific location
Müritz	Mecklenburg-Western Pomerania	Rewetting	2015	Waren Zotzenseeniederung
Drömling	Lower Saxony and Saxony-Anhalt	Small pools, rewetting	2001-2010	Wolfsburg; borders of the Drömling
Ammersee	Bavaria	Management	Yearly	Dießen
Chiemsee	Bavaria	Rewetting	2012	Felden
Danube	Bavaria and Baden-Wuerttemberg	Renaturation of riparian forests	2001-2014	Neustadt, Neuburg, Ingolstadt, Riedlingen
Rhine	Baden-Wuerttemberg	Renaturation of the riparian forests	2011-2014	Weil, Rastatt, Eggenstein-Leopoldshafen, Mannheim

In order to implement a preventive mosquito control, coherent knowledge of the effects of nature conservation measures on mosquito populations for specific biotope types is vital. Further, local knowledge of citizens and stakeholders is essential, wherefore the integration of stakeholders and citizens right from the beginning of planning the nature conservation measure is advisable.

Of course, the perception of the society, especially when it comes to such an emotional topic, is subjective. However, the questionnaire about the post-measure nuisance only acts as an additional tool and should support the data obtained from the mosquito monitoring. Whether the results of the mosquito monitoring and the questionnaire correlate, will be studied in the project.

Conclusion and Outlook

The aim of this project is to concatenate the sociology, vector ecology, nature conservation management and spatial planning. This is done, by using different methods from the single disciplines. In 2018 the project's outline was developed, study areas were found and pre-measure nuisance data were collected. These activities will be supported by a mosquito monitoring in 2019 and 2020 as well as questionnaires about the mosquito nuisance. The results will help to solve the question, to what extent nature conservation measures have an impact on mosquito populations. Moreover, the results should help to implement a preventive mosquito monitoring for nature conservation measures.

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