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Seasonality and differences in insect emergences among 3 lakes around Constance (Germany) and their influences on bat activity between spring and early summer.

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Résumé

Les échanges entre les écosystèmes aquatiques et terrestres sculptent la diversité spécifique et fonctionnelle de la nature. Les émergences d'insectes aquatiques des écosystèmes lentiques produisent d'importantes ressources saisonnières pour les consommateurs terrestres que sont les chauves-souris. Cette étude a été réalisée sur 3 lacs par l'intermédiaire de mesures hydrologiques, de piégeage d'insectes et d'enregistrements acoustiques (ultrasons). L'objectif a été d'étudier les différents liens entre la qualité de l'eau, les insectes aquatiques et terrestres et l'activité des chauves-souris, aux alentours de Constance en Allemagne. Les émergences d'insectes entre le printemps et le début d'été ont été saisonnières avec en général deux pics en termes d'intensité. L'émergence a été le plus souvent plus importante pendant les nuits. Les observations réalisées indiquent une influence combinatoire de la profondeur, de la température de l'eau, de sa qualité (comme l'eutrophisation) et des habitats alentours. L'activité des chauves-souris enregistrée provient majoritairement d'espèces opportunistes et à évoluée dans le temps de la même façon que les émergences. Statistiquement, cette activité a été corrélée de façon plus importante avec le nombre d'insectes capturés sur la berge. Cependant, ce nombre a été fortement influencé par l'intensité des émergences. Les lacs étudiés diffèrent sur quasiment tous les paramètres qui les caractérisent : surface, habitats environnants, qualité de l'eau, population de poissons et de chauves-souris. Ces différences ont résulté sur l'impossibilité de prouver un réel effet de l'eutrophisation sur les variables étudiées. Cependant, cette étude aura permis de pointer les limites et les améliorations possibles de ce genre de problématique tout autant que d'émettre des hypothèses sur les échanges entre milieux aquatiques et terrestres, par le biais des émergences d'insectes aquatiques et de l'activité des chauves-souris.

Mots-clés : flux, émergence, chauves-souris, activité, lac, eutrophisation.

Abstract

Subsidies between aquatic and terrestrial systems are a driving force in the species and functional diversity in nature. Aquatic insect emergences in lentic systems are providing a seasonal and important amount of resources for terrestrial consumers as bats. This study done on 3 lakes has investigated with water measurements, insect collections and acoustic monitoring, what are the potential links between water quality, aquatic-terrestrial insects and the bat activity around Constance in Germany. Insect emergences between spring and early summer were seasonal with in general 2 peaks. The emergence was usually higher during nights. Observations indicated an influence of the combination of the depth, the water temperature, the water quality (with eutrophication) and surrounding habitats. Bat activity recorded was mainly due to opportunistic species and changed over time in the same way as the emergence. Statistically, the bat activity was more correlated with flying insects than insect emerging from lakes. However flying insects collected were highly influenced by emergences. Studied lakes are differing on almost all parameters: area, surrounding habitats, water quality, fish population and bat population. Those differences have lead on the impossibility to prove a real eutrophication effect on emergences as well as on bat activity. However this study has highlighted limits, possible improvements with such problematic and have drawn potential hypothesis on subsidies between aquatic and terrestrial systems, through aquatic insect emergences and bat activity.

Keywords: subsidies, emergence, bat activity, acoustic monitoring, lake, eutrophication.

Introduction

Aquatic as wells as terrestrial systems can produce material as well as organisms in various forms. This production does not always stay where it appeared and can move according to diverse forces from one system to another. Those movements are called subsidies and are known to shape, to transform, to create strong links between habitats. Subsidies are important components of the species and the functional diversity in nature. Moreover they are strongly influencing the resilience and the resistance of an entire ecosystem. They can be continuous as well as under pulse forms.

Subsidies from lentic to terrestrial systems are not extremely described. However they can have the potential to create stronger linkages than do lotic systems. The impressive example of insect emergences in some lakes is one real proof. This example is known to considerably enhance predator population living in terrestrial habitats. In Europe, insect emergences from lentic systems are mainly composed of Chironomidae (Diptera family). This family can be used as a freshwater biomonitoring.

European bats are insectivorous and can benefit from such pulse subsidies. Moreover they are really sensitive to different ecological modifications on their habitats explaining why they are considered as good bioindicators. Chironomidae emergence can be affected by different water pollution, as for example the eutrophication. This pollution is hypothetically affecting bats because depend on this food resources.

This study has the aim to increase the knowledge on aquatic insect emergences in different lakes and to study how the bat activity is affected by them. We suppose that the eutrophication as well as different other parameters can influence the seasonality of emergences, its intensity and its species diversity. Following this, the bat activity can react differently according to specifities of each species. Having better knowledge concerning all those processes can give new arguments and explanations to people who are working for lakes or bats protection.

This study is based on the collection of aquatic and terrestrial insects coupled with acoustic monitoring of bats. 3 different lakes differing in their trophic status are investigated within the protocol, followed from April until the beginning of July 2012.

The first part of this thesis is relating what is known and what is important to know on subsidies, Chironomidae and bats. The second part is commonly describing the materials and methods applied. Results are following it and are trying to give a sufficient overview on what has been observed. The last part contains a discussion describing limits on what has been done, discovered or not and is comparing results to the bibliography.

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