

FINAL PROJECT REPORT

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1) INTRODUCTION

Around the world, bats make seasonal migrations searching for hibernation sites or habitats with an abundant food supply. Also in Europe there are migratory bat species, e.g. the Noctule bat (*Nyctalus noctula*), the Leisler's bat (*Nyctalus leisleri*) or the Nathusius' s pipistrelle (*Pipistrellus nathusii*) (DIETZ *et al.* 2007; HUTTERER *et al.* 2005; NEUWEILER 1993). However, the routes taken by the bats and the cues used for orientation and navigation during their migrations are still unknown (DIETZ *et al.* 2007; FENTON 1992; HOLLAND 2007; NEUWEILER 1993).

In the context of bat migration, one assumption is that rivers with their accompanying riparian forests are of great importance as they provide guidelines for long-distance orientation and feeding areas for migrating bats (MESCHEDE & RUDOLPH 2004). In spite of little evidence to prove this assumption it has been shown that some migratory bat species in Bavaria typically inhabit riparian forests and concentrate there especially during migratory seasons in the spring and in the autumn (see Fig 1) (MESCHEDE & HELLER 2000).

This project investigates the importance of rivers for migrating bats in the alpine range of southern Bavaria and northern Austria. One aim of the project is to support the idea that, while migrating to alpine hibernation sites, bats use rivers as landmarks. The second aim is to evaluate rivers and riparian forests as feeding habitats for bats in general compared to other ecologically similar habitats as lakes with nearby woodland.

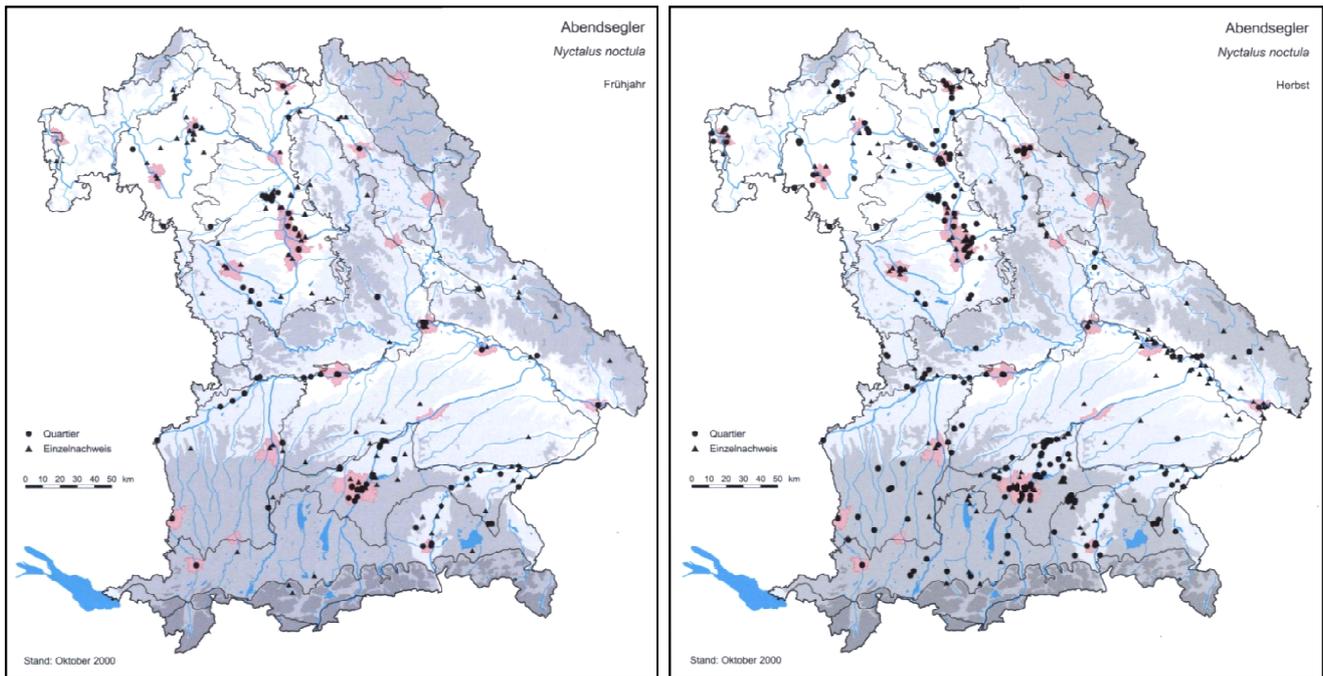


Fig 1: Distribution of the Noctule bat (*Nyctalus noctula*) during spring (left) and fall (right) in Bavaria since 1985. There is an obvious concentration along the rivers Donau, Inn and Isar (Graphics by MESCHEDE & RUDOLPH 2004).

2) METHODS

In the years 2010 and 2011, subjects of our study were the rivers Inn and Salzach with their accompanying riparian forests. We recorded and compared bat activity and species composition during the spring and fall migrations and nursery seasons 2010/2011 at paired sampling sites:

- a) along the rivers which represent linear landscape elements in the alpine range of southern Bavaria and northern Austria
- b) at water bodies with no proximity to the rivers (lakes in a distance of at least 4 km from the rivers which represent similar but isolated habitats).

We selected a total of twenty-four sampling sites (twelve pairs, see Fig 2 and 3) and recorded bat activity at 96 nights with automatic recording systems (batcorder). At every sampling night, bat calls were recorded digitally as call sequences from dusk till dawn. Through this method we obtained nearly 100.000 call sequences within the sampling periods.

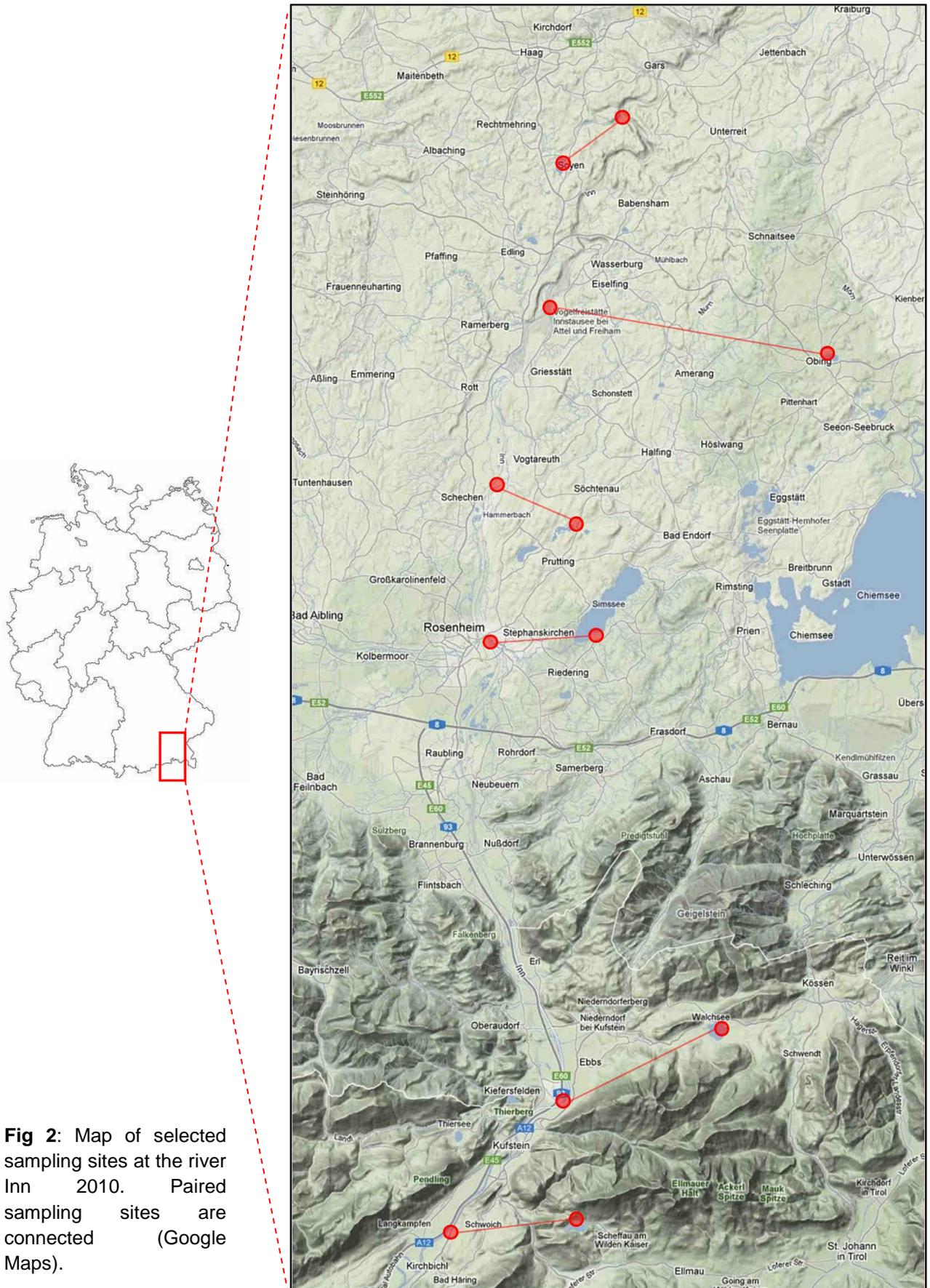


Fig 2: Map of selected sampling sites at the river Inn 2010. Paired sampling sites are connected (Google Maps).

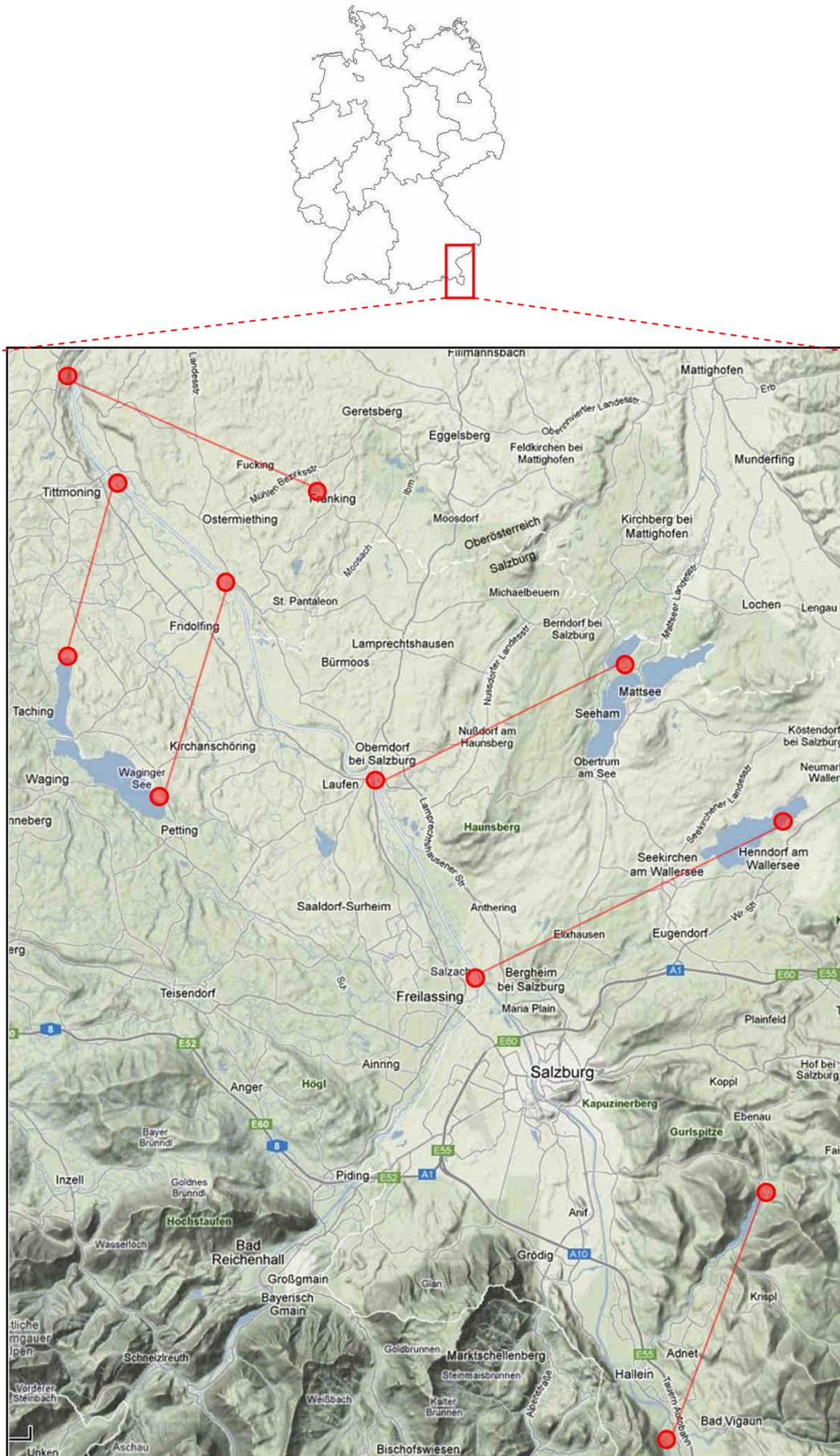


Fig 3: Map of selected sampling sites at the river Salzach 2011. Paired sampling sites are connected (GoogleMaps).

For the 2010 data, an analysis of calls with a discrimination on species level has been conducted. For this purpose, every sampling night was divided in parts of quarters of an hour. For every part, presence or absence of a bat species was determined, resulting in a percentage of presence per night.

As for the 2011 data, only a preliminary analysis has been conducted so far. This means that the number of recorded call sequences was counted for every bat species. Species discrimination was implemented by the automated data analysis tool of the batcorder-system (bclident) and has not been confirmed manually to date.

Due to the difficulty in the discrimination of bat calls in the genus *Myotis*, species of *Myotis* are combined into a group including *M. daubentonii*, *M. brandtii*, *M. mystacinus*, *M. nattereri* and *M. emarginatus*. Due to the fact that the discrimination of the species *Pipistrellus nathusii* and *Pipistrellus kuhlii* by their calls is not possible on a secure level (MESCHÉDE & RUDOLPH 2004), they were also combined into a group.

3) RESULTS AND DISCUSSION

Results for the different species/species groups are represented in the following figures. A statistical analysis of the data is not yet realized but will be conducted as soon as possible.

3.1) INN 2010

Figures A show the average percentage of recorded bat activity per night within the sample period 2010 at the river Inn and at lakes, respectively. In Figures B, the same data are plotted as the ratio of bat activity at river and lake.

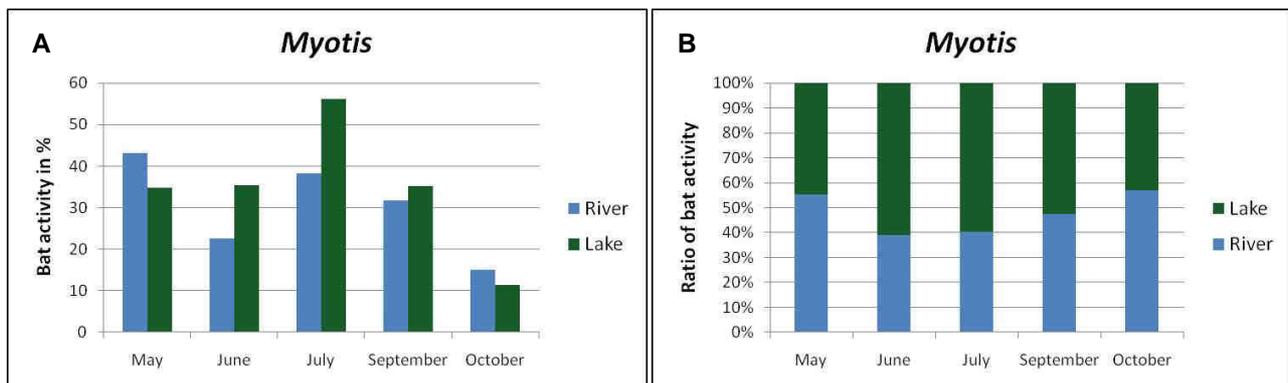


Fig 4: Results for the species group *Myotis* at the river Inn 2010.

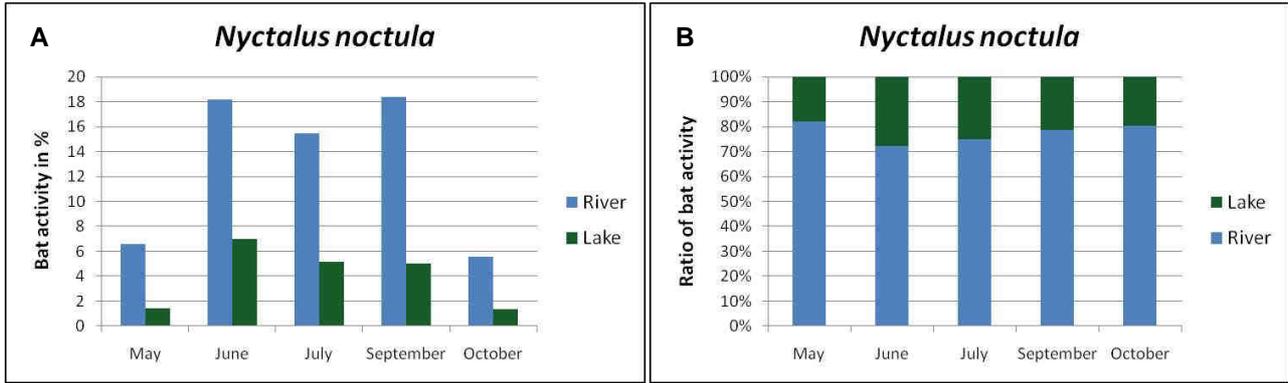


Fig 5: Results for the species *Nyctalus noctula* at the river Inn 2010.

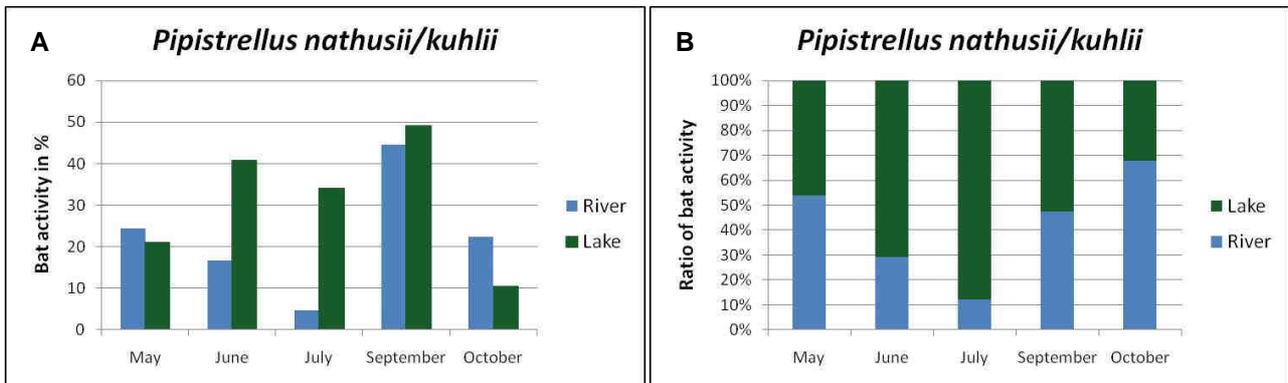


Fig 6: Results for the species group *Pipistrellus nathusii/kuhlii* at the river Inn 2010.

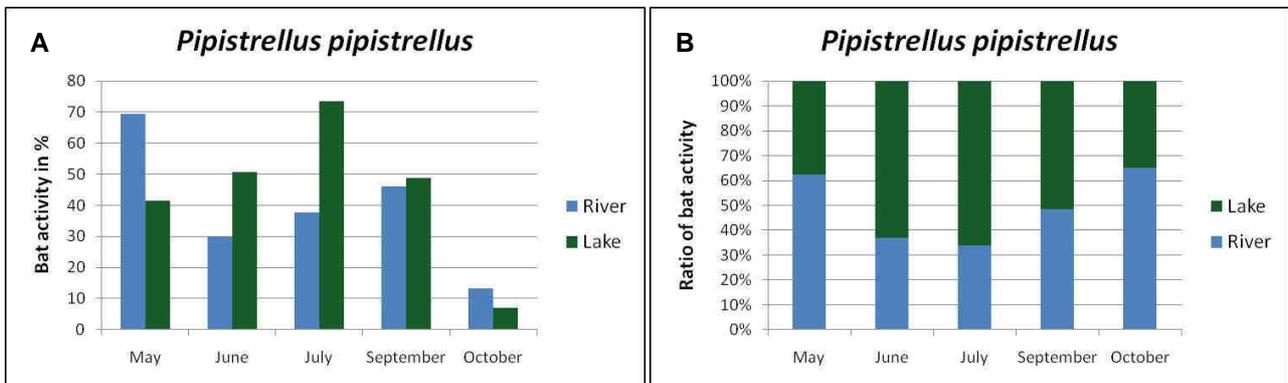


Fig 7: Results for the species *Pipistrellus pipistrellus* at the river Inn 2010.

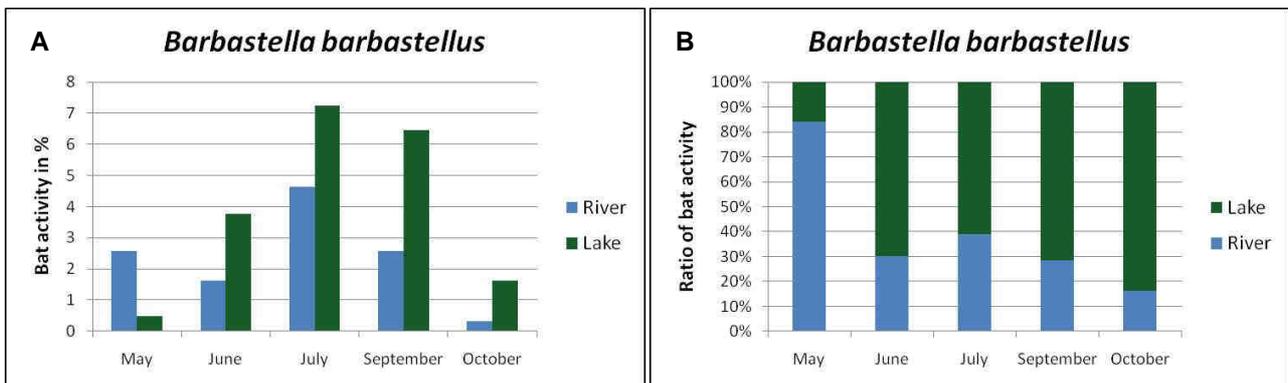


Fig 8: Results for the species *Barbastella barbastellus* at the river Inn 2010.

As expected, at migration periods in spring and fall a seasonal shift in bat activity from lakes to the river can be seen, especially regarding *Pipistrellus pipistrellus*, *Pipistrellus nathusii/kuhlii* and *Myotis*. Particularly in the *Myotis* species, this may reflect a movement from and to their alpine hibernation sites.

Nyctalus noctula, a long-distance migrant, can be generally found more often foraging at the river, but data also reveals a slight shift of activity from lake to river at migration periods. The generally higher activity of *N. noctula* at the river may be due to the fact that there are colonies of this species at two cities located at the river (Rosenheim and Wasserburg) and bats may stay there to forage near their roosting sites.

In *Barbastella barbastellus* no shift in activity could be observed in fall. However, this species occurred only in very low numbers which makes interpretations difficult.

In summary, data coincides with the hypothesis that rivers play an important role for bat species during migration. But as long as a statistical analysis of the data is still pending, a conclusive interpretation is not quite possible.

3.2) SALZACH 2011

Figures A show the number of recorded calls sequences within the 2011 sample period at the river Salzach and at lakes, respectively. In Figures B, the same data are plotted as the ratio of bat activity at river and lake. Note that the depicted data are based on a preliminary analysis.

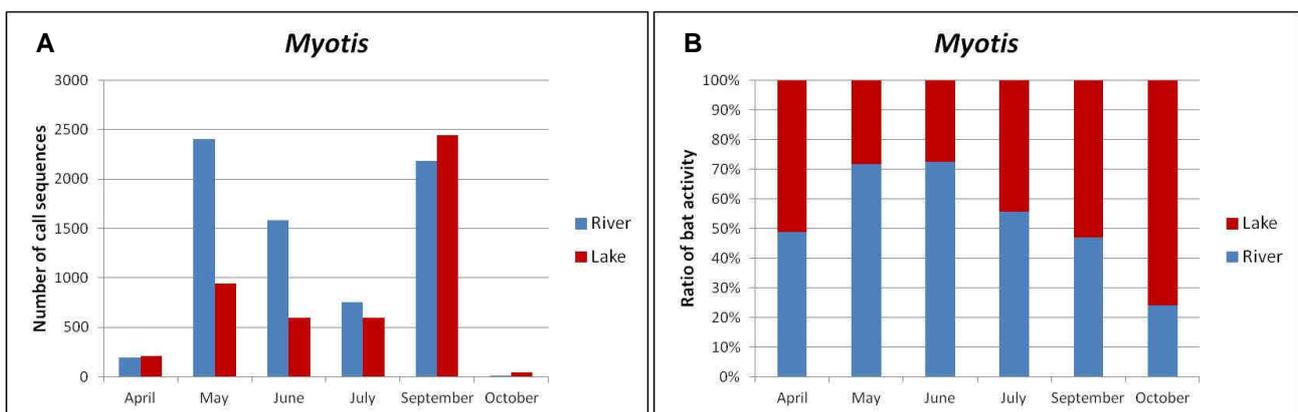


Fig 9: Results for the species group *Myotis* at the river Salzach 2011.

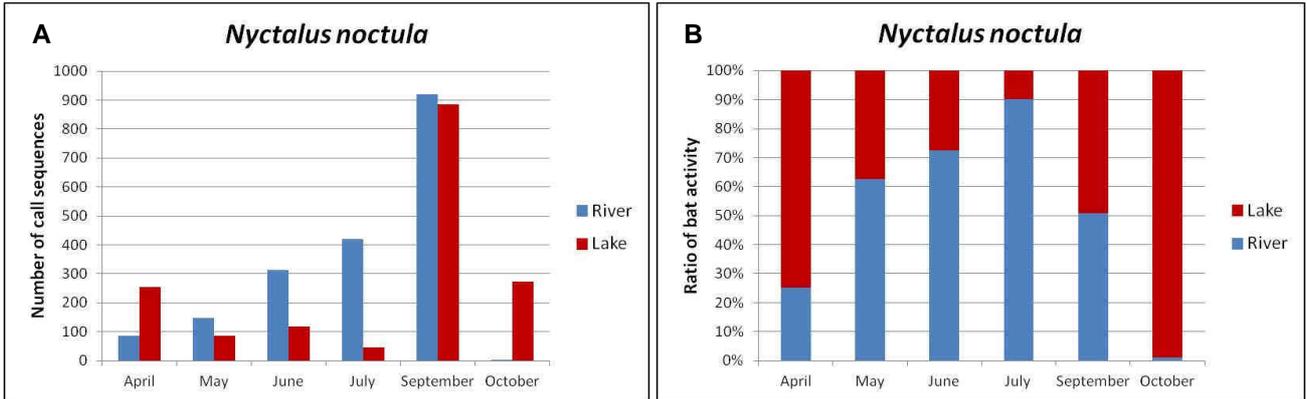


Fig 10: Results for the species *Nyctalus noctula* at the river Salzach 2011.

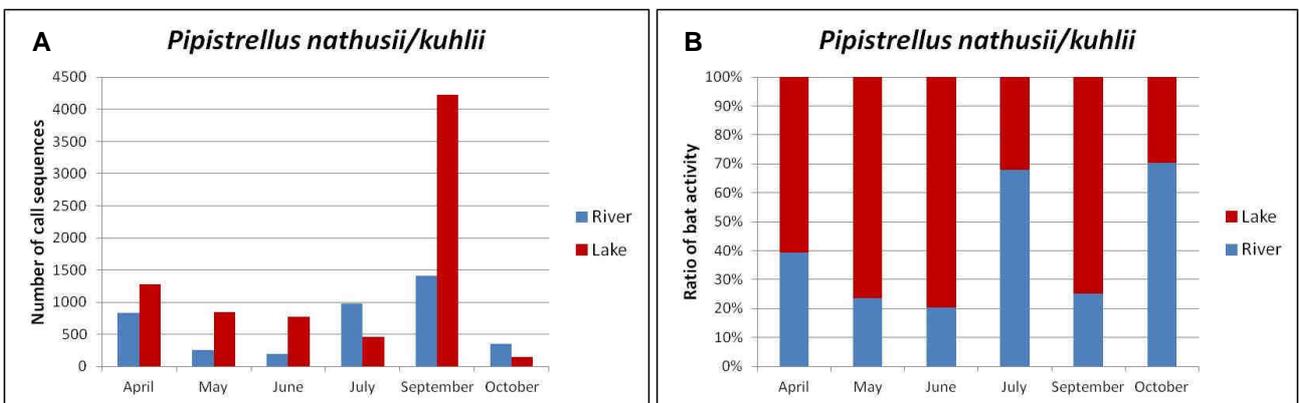


Fig 11: Results for the species group *Pipistrellus nathusii/kuhlii* at the river Salzach 2011.

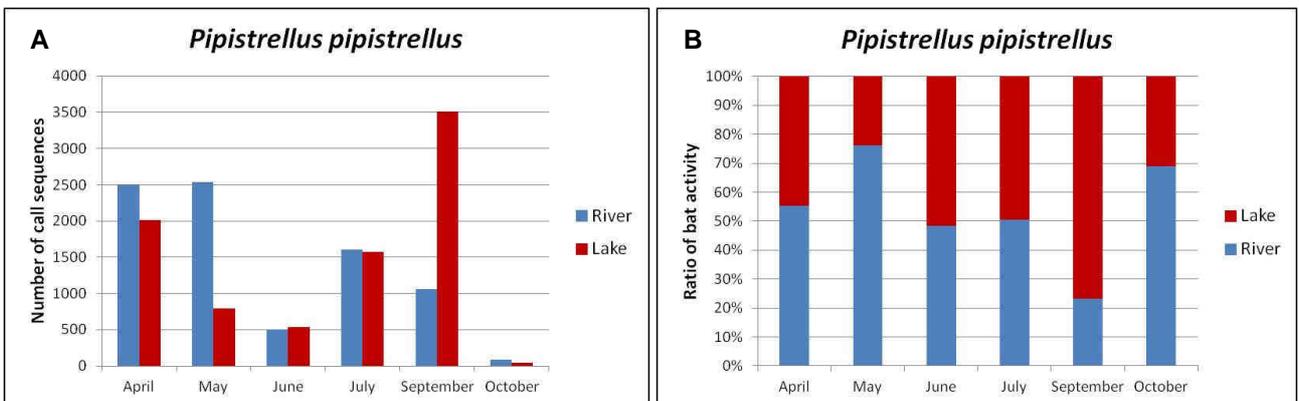


Fig 12: Results for the species *Pipistrellus pipistrellus* at the river Salzach 2011.

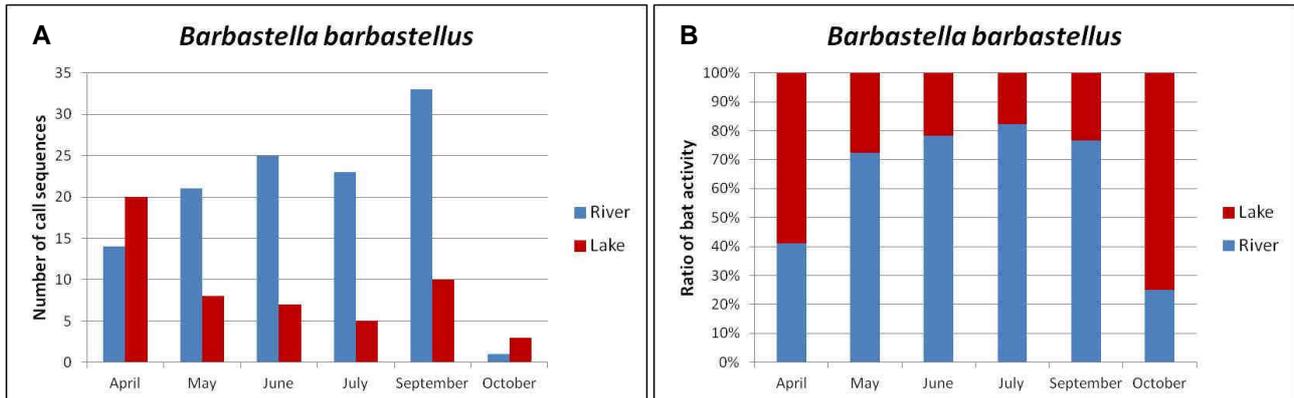


Fig 13: Results for the species *Barbastella barbastellus* at the river Salzach 2011.

For the species/species group *Myotis*, *Nyctalus noctula* and *Barbastella barbastellus*, data collected at the river Salzach 2011 show a different pattern than the data collected at the river Inn 2010. With these bat species, activity at the river is higher at the nursery season compared to migration periods. Thus, a migratory movement in spring and fall along the river Salzach cannot be assumed. To find an explanation for the different findings at the rivers Inn and Salzach, a closer look at other influencing factors such as food abundance, availability of roosting sites and climatic conditions at rivers and lakes is necessary and will be conducted within the next months.

In *Pipistrellus nathusii/kuhlii* and *Pipistrellus pipistrellus*, however, migratory movements in spring and fall are indicated what coincides with our findings of 2010. A final data analysis showing a percentage of presence per night, as it has already been realized for the data of 2010, may enhance this effect.

However, conclusive interpretations of the data will only be possible after a detailed data analysis including a discrimination of all recorded bat species, a comparison of factors such as food abundance and climatic conditions and a statistical analysis.

4) CONCLUDING REMARKS

In the framework of this project, a huge amount of data could be collected helping us to understand the importance of rivers with their accompanying riparian forests for migrating bats. This will enable us to develop guidelines which allow bats to be taken into account in habitat management in riparian forests and to provide advice for planning applications with regard to bats.

Furthermore, this project is performed in close collaboration with the Austrian Coordination Centre for Bat Conservation and Research (KFFOE) and could be realised only with the aid of several people. Up to now, one master's thesis (ZEUS 2010) and two bachelor's theses (REICHENBACH 2011; RICHTER 2011) were successfully completed within the framework of this project and one diploma thesis is still in progress. Thus and due to the close collaboration with local land owners, knowledge about the bat fauna and the habitat requirements of bats could be passed on and we could hopefully promote this way the sympathy for bats at local level.

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