English Abstract

In the thesis, I focus on the current condition and trends of all known populations of *Coenagrion mercuriale*, *Leucorrhinia pectoralis* and *Ophiogomphus cecilia* (dragonflies and damselflies) in Baden-Württemberg (southwestern Germany). These three Odonata species are protected under European law (listed in annex II of the habitats directive). Vector- and raster-based GIS methods play an important role in the analysis of the data. A synoptic discussion of the results leads to concrete recommendations for action plans for protection of the species.

As a starting point, all accessible **data** on the species' occurrences and population sizes were compiled and digitised. To gain additional insight into certain aspects of ***Coenagrion mercuriale* population biology**, field experiments were carried out using a unique method of marking the animals with UV ink and searching for them at night with a portable black light lamp. The recapture rate was 35% (140 out of 305 specimens), however, only 11 animals had moved away from the place were they had been marked. The maximum distance of their movement was 300 m. The longest period between marking and last recapture was 16 days. In three instances, marked individuals were found *in copula* at night. Employing the Lincoln index, the results of mark-recapture experiments showed that the actual population size was 2 to 2.5 times higher than the numbers estimated by conventional field methods. The sex ratio of animals marked was 713 males : 152 females (82:18). The recapture rate on the fifth day after marking was significantly lower for females (3%) than for males (11%). The hypothesis that fertilized females emigrate more frequently than males and thus play a key role in colonization and recolonization events is discussed. The results confirm empirical knowledge that, in the study area, *C. mercuriale* shows only very little tendency to emigrate from its home waters.

In the GIS-based **habitat model for *Coenagrion mercuriale***, a groundwater model and land use data for the Upper Rhine valley were employed. A preference analysis was used to detect "high density areas" with a positive electivity index and a statistically significant χ^2 deviation measure, in which the species occurs at an elevated frequency. In the natural geographic region „Freiburger Bucht" (214 km²), "high density regions" lay within grassland in which the groundwater table was 2 m or less below the surface, and within farmland where the groundwater table was 1 m or less below the surface. In the "Offenburger Rheinebene" (851 km²) they lay within grassland in which the groundwater table was 1,5 m or less below the surface; farmland, even in areas with high groundwater levels, was not to be classified as a "high density region" – probably due to the predominance of corn fields. These model results were very plausible. Additional data analyses demonstrated that the model cannot be used for the adjacent natural geographic regions because these have different landscape-related characteristics.

The raster-based **dispersal model for *Coenagrion mercuriale*** took into consideration: on the species level, biological information (dispersal behaviour); on the patch level, information on the size of the subpopulations (emigration rate); and on the landscape level, information on the quality and spatial configuration of the matrix (definition of the cost surface). Land use data and a slope model were incorporated into the design of the cost surface. The model output allowed for a differentiated interpretation of the degree of isolation between individual subpopulations. An "optimistic scenario" (few large metapopulations) was contrasted with a "neutral scenario" (distinct size reduction and fragmentation of the metapopulations).

By **combining the "high density areas" of the habitat model with the dispersal model zones for *Coenagrion mercuriale***, three "suitability classes" were calculated. They indicate where measures for the stabilisation of the metapopulations are most urgent and, at the same time, promising.

To **document the habitats of *Leucorrhinia pectoralis*,** biotypes were mapped in the most significant areas with species occurrences in Upper Swabia (prealpine region of South-Germany). A comparison between digital aerial photographs from 1996 and 2001 allowed the **detection of habitat changes** caused by vegetative succession.

In order to **model the long distance dispersal of *Leucorrhinia pectoralis***, the slope model was used as a cost surface. The possible role of cost paths as migration routes was discussed. A "cost distance matrix" was calculated to quantify the spatial relationship between the individual areas occupied by the species.

For ***Ophiogomphus cecilia***, a series of measurements taken from a data catalogue of the Landesanstalt für Umweltschutz Baden-Württemberg revealed that in many bodies of flowing water the water quality has markedly improved throughout the past two decades. This circumstance, combined with intensified search efforts and possibly climatic factors has probably led to an increase in the number of known populations during the last few years.

Metapopulation structure and trends in the overall population size are described in detail in the chapter, "Current status of the studied Odonata species and recommendations for their protection". In addition, concrete recommendations for the species' protection, the implementation of the monitoring programmes, and the compilation of the reports regulated by the habitats directive are given.

The thesis ends with a **discussion of methods**, focusing on the applied approach and the GIS methods used. I conclude that, given careful planning and data evaluation, advanced GIS models, such as habitat and dispersal models, are generally of high value for issues of nature conservation.