

ZOOPLANKTON DIVERSITY IN RELATION TO POND AGE AND ISOLATION

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INTRODUCTION

Ponds are small ecosystems that highly contribute to regional diversity. Our knowledge on the contribution of both regional and local processes to community structure of local pond communities is still limited. We explored the association between cladoceran species richness, pond age and the degree of isolation. To disentangle the effects caused by dispersal limitation in the cladoceran community itself and the potential impact of the establishment of keystone groups, the effect of fish and vegetation was also assessed.



MATERIAL & METHODS

Pond age: we surveyed a total of 126 farmland ponds distributed over almost the entire Belgian territory varying widely in age, ranging from 4 to more than 100 years ('old ponds')* and combined this study with a dataset involving 25 ponds with an age of three years at the moment of sampling ('recent ponds').

Isolation: we estimated the number of ponds that occurred within a circular area of 20km² around each of the 126 studied ponds. For each sampled pond we calculated the degree of isolation as the average of the inter-pond distances divided by the total number of ponds within the defined circular area.

Species richness: cladocerans were collected once in 2003 and once 2004 from a 40L subsample. Of each pond and during each sampling campaign at least 300 specimens of cladocerans were screened.

POND AGE

We observed that local cladoceran species richness increases with pond age (Fig. 1). Our data also show that old ponds with a well-developed submersed vegetation cover contained significantly more cladoceran species than old ponds without such vegetation, whereas ponds with fish are less species rich than fishless ponds (Fig. 2).

The majority of recent ponds lacked fish and vegetation, suggesting that the difference in vegetation cover could be one reason for the lower average species richness in recent ponds. However, species richness in the set of recent ponds was also significantly lower than in old ponds that lacked fish and vegetation (Fig. 2). The cladoceran species composition of recent ponds was also a subset of the species inhabiting old ponds. This suggests that the lower species richness of recent ponds is also partly the result of dispersal limitation.

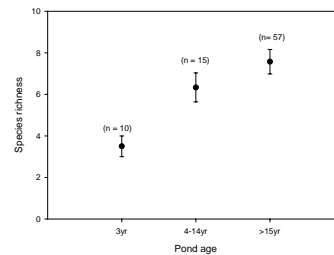
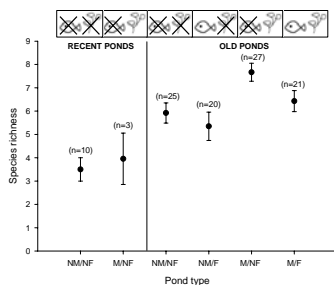


Fig. 1: Mean cladoceran species richness for three age classes of ponds



Overall, our results suggest both a direct impact of dispersal limitation in the focal group of organisms as well as a strong indirect impact of key structuring factors like fish and macrophytes, on the diversity of cladoceran communities in ponds.

Within the framework of habitat restoration practices, our results suggest that one should not only try to compensate for the tremendous loss of small aquatic systems by the creation of new ponds, but that conservation strategies should also invest in the maintenance and management of older ponds. A sufficient number of well-established ponds is important to provide source populations of species that typically occur in mature biotopes.

Fig. 2: Mean cladoceran species richness for six different types of ponds. M: high submersed vegetation density, NM: no or marginal submersed vegetation density, F: with fish, NF: without fish

ISOLATION

Contrary to what is predicted by the theory of island biogeography, our study shows that zooplankton species richness is positively affected by geographic isolation (Fig. 3). This pattern can be explained by differential dispersal capacities of keystone species, like vegetation and fish. Zooplankton and macrophytes are generally better dispersers than fish because they produce desiccation-tolerant propagules that are readily dispersed by wind and animal vectors, whereas fish dispersal is mainly dependent on direct hydrological connections or translocations by man. We observed that the majority of isolated ponds contained a well developed vegetation cover and lacked fish, whereas most ponds in less isolated regions contained fish and lacked a well developed vegetation cover.

Increasing connectivity of aquatic systems can have ambiguous results. On the one hand a larger number of plant and invertebrate species will be able to colonize the systems on a short time scale, but on the other hand, direct connection may have a strong homogenizing effect because all water bodies may get colonized by fish.

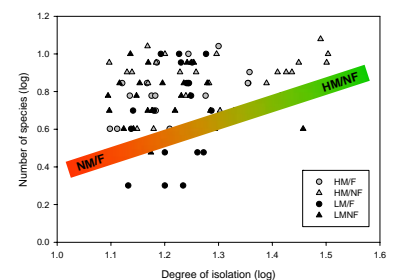


Fig. 3: The number of species in relation to the degree of isolation. M: high submersed vegetation density, NM: no or marginal submersed vegetation density, F: with fish, NF: without fish

ACKNOWLEDGEMENTS

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* Declerck S., De Bie T., Dirk E., et al. (2006) Ecological characteristics of small farmland ponds: Associations with land use practices at multiple scales. *Biological Conservation* 131: 523-532.