NOTES ON THE DRAGONFLY FAUNA OF VERY SMALL POOLS NEAR MÜNSTER, WESTFALIA, GERMAN FEDERAL REPUBLIC

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Abstract – The odonate fauna of small meadow pools was recorded for several years. Even the permanent pools cenoses are relatively poor; Lestidae are completely lacking. *Pyrrhosoma nymphula* and *Erythromma najas* dominate in clean waters, whereas *Ischnura elegans* withstands a certain degree of pollution. Adult Anisoptera are absent, save for *Anax imperator*, which established territories even at the smallest bodies of water.

Introduction

This paper attempts to give a concise survey, with ecological notes, of the dragonfly cenoses of very small pools, quite a lot of which can be found in the meadows and pasture land around Münster. They are used as watering places for cattle. Some of these pools are bomb holes of characteristic circular outline. I have been surveying a number of these pools for several years with respect to their dragonfly fauna and vegetation.

In the literature there are only very few ecological notes on the dragonfly fauna of small stagnant water bodies in Central Europe, either natural or artificial. The most profound approach to the ecology of small meadow pools in Northern Germany similar to those considered in my own paper, is the extensive work of KREUZER (1940), dealing also with Odonata. MÜNCHBERG (1956) recorded only 3 species breeding in bomb holes. DUMONT (1971) gave a detailed account of the dragonfly fauna of some bomb holes among other artificial water bodies in Belgium. Münchberg and Dumont dealt with the cenoses of both larvae and adults, while FISCHER (1961) concentrated on dragonfly larvae in small pools in Poland. There are some conspicuous differences between the findings of these authors and mine, as far as faunistics are concerned.

Vegetation

Several types of meadow pools can be distinguished:

(1) Shallow water of more or less astatic nature. Sparse vegetation of *Juncus*, *Lemna*, algae, and grasses like *Poa* and *Alopecurus* spp.

(2) Deep water of permanent nature. Submerged vegetation made up by *Ranunculus aquaticus, R. trichophyllus, Potamogeton natans, Polygonum amphibium, Myriophyllum spicatum, Juncus effusus, Lemna* spp. and filiform algae.

(3) Unfenced pools. Vegetation partly destroyed by trampling cattle. Excrements of cattle badly influence water quality.

(4) Fenced-in pools with additional vegetation at the water edge, represented by *Carex* spp., *Typha* spp., *Sparganium erectum, Iris pseudacorus, Alisma plantago-aquatica* and meadow grasses.

Species composition and abundance in the plant communities of course differ. Some pools are completely overgrown with one plant species, e.g. *Ranunculus aquatilis, Alopecurus aequalis*, or just *Lemna. Phragmites* is not found in any of these pools. No bushes or trees are growing at the water edge of any of these pools.

Chemism

Small pools are distinguished by extreme circadian and seasonal changes in the concentration of certain ions, partly due to photosynthesis, partly as a mere effect of water evaporation. However, in some pools considered here, concentration changes are

more markedly due to an increased influx of ions after bringing out artificial fertilizer, dung or liquid manure on the surrounding land. Coincidence of changes in ion concentration and electric conductivity with agricultural procedures could be ascertained even at large ponds of various size (RUDOLPH, 1978). Out of a greater body of chemical data collected over a year's period (except winter months) of one bomb hole located in meadows, some are listed in Table I.

Table I. Some chemical data of pool 1. (All figures for ions in mg/l; oxygen concentration was measured only once in March, 1977)

	1976		1977				
Month	*7*	*8*	*3*	*5*	*6*	*8*	*10*
pH	7.5	8.1	7.7	7.6	7.4	7.6	8.1
nitrite	0.035	0.05	0.022	0.005	0.005	0.04	0.025
nitrate	1.77	0.39	0.88	0.16	0.32	0.16	0.29
ammonia	0.06	0.38	0.26	2.10	0.22	0.22	0.18
phosphate	0.22	–	0.09	0.04	0.04	0.04	0.03
sulfate	–	36	83	79	–	255	36
oxygen			9.36				

In meadow pools the pH value in most cases is definitely alkaline, even in times of reduced photosynthetic activity. Electric conductivity is permanently high, signalling a great amount of ions in solution. Dragonfly larvae are not affected by high ion concentrations or rapid concentration changes, but actually nothing is known about the effect particularly on dragonfly larvae of H_2S, NO_2, NH_3 and NH_4, which are either directly toxic or involved in oxygen consuming nitrification processes. These ions are surely limiting factors, and their negative effect is demonstrated at those unfenced pools, which are polluted with cattle excrements and lacking almost any water arthropods.

The dragonfly fauna

Larvae of the following eurytopic species were found inhabiting small meadow pools: *Pyrrhosoma nymphula* (Sulz.), *Ischnura elegans* (Vander L.), *Enallagma cyathigerum* (Charp.), *Coenagrion puella* (L.), *C. pulchellum* (Vander L.), *Erythromma najas* (Hans.), *Aeshna cyanea* (Müll.), *Anax imperator* Leach, *Libellula quadrimaculata* L., *Sympetrum flaveolum* (L.), *S. vulgatum* (L.), *S. sanguineum* (Müll.).

It is possible that some other species regularly reproduce in these pools, but never reach appreciable numbers of larvae, and are thus easily overlooked. This holds for Anisoptera e.g. *Aeshna grandis* (L.) and *Cordulia aenea* (L.), which in the adult stage do not establish territories at the pools because of the small size and unsuitable vegetation, so that there is nearly no chance to meet them as adults at the pools.

Above all, species number and population density at the pools depended on the more or less astatic nature of the water body. FISCHER (1961) has stressed the fact that in those astatic ponds she investigated in Poland, the Lestidae outnumbered the Coenagrionidae. Of course the univoltine Lestidae are largely adapted to survive in astatic waters, but as a matter of fact, no Lestidae were found at any of the meadow pools within 5 years. This is in contrast to the findings of Fischer, KREUZER (1940), and my own observations of Lestidae at astatic waters of slightly different chemical character and differing location in the Münster area. So far no reason can be given for the absence of Lestidae from small meadow pools. *Libellula depressa* L., too, is said to withstand drying up of its habitats, but no larvae have been found. In our region this species is rare, and only one single male was ever met at a particular pool.

Though occasionally larvae of semivoltine species like *Pyrrhosoma nymphula, Aeshna cyanea* and *Libellula quadrimaculata* were found in pools drying up regularly only the univoltine *Sympetrum* species are likely to survive in these habitats. Larvae of *Sympetrum* species and of *Libellula quadrimaculata* were met with even in pools devoid of all macrophytes except flooded grass.

Pyrrhosoma nymphula, although not confined to narrow ecological limits, does not by far inhabit all permanent pools with sufficient vegetation. So far the distribution

pattern of this species cannot be explained. DUMONT (1971) suggested that *P. nymphula* is expelled from potential habitats by competition of *Coenagrion pulchellum* and *Enallagma cyathigerum*, but both these species are only very seldom met with at the meadow pools in Westfalia. Here dense populations of *P. nymphula* coexist with *I. elegans, C. puella* and *Erythromma najas*. The latter species colonizes nearly all pools with adequate habitat structure, i.e. floating macrophytes.

As could be expected, the more diversified dragonfly cenoses of both larvae and adults are found at less polluted permanent pools with great productivity, i.e. dense vegetation and rich arthropod fauna as a food supply.

Two pools with their characteristic cenoses shall be described in detail.

Pool 1

Bomb hole of about 5 m radius and a depth of about 2 m. Protected from cattle. Constant water level. Dense vegetation of *Juncus effusus, Carex pseudocyperus* and various meadow grasses covers about half of the water edge, with a few additional *Typha latifolia, Iris pseudacorus, Sparganium erectum* and *Alisma plantago-aquatica.* About a third of the water surface is covered with *Potamogeton natans* and *Ranunculus trichophyllus*. Dense submerged vegetation of *Myriophyllum spicatum* near to the water edge. Chemical data of this pool are given in Table I. Oxygen level is rather high. Other invertebrate fauna is rich. A few fishes (*Scardinius erythrophthalmus*) inhabit this pool and might impair the population of dragonfly larvae.

Larvae of the following species were recorded within five years: *Ischnura elegans, Coenagrion puella, Erythromma najas, Aeshna cyanea, Anax imperator, Libellula quadrimaculata, Sympetrum flaveolum, S. vulgatum, S. sanguineum.*

In the cenosis of larvae in early summer *I. elegans* is most abundant, followed by *C. puella, A. cyanea, A. imperator, E. najas* and *S. sanguineum* with decreasing numbers. Of *S. flaveolum, S. vulgatum* and *L. quadrimaculata* only a few larvae were caught.

The cenosis of the adults is completely different. *I elegans* dominates here as well, followed by *C. puella* and *E. najas*, but Anisoptera are encountered only very seldom, except for *A. imperator* and a few *Sympetrum* individuals. DUMONT (1971) states that *A. imperator* prefers large water surfaces and, therefore, does not inhabit the bomb holes investigated by the author, while *A. cyanea* finds sufficient "elbow room" even at the smaller bomb holes. On the contrary, in our region, *A. imperator* is the only anisopterous species permanently present in the adult stage at very small water bodies like the open meadow pools and bomb holes, provided that they offer erect growing plants to rest upon, like *Typha* and *Iris*. Obviously a pool of about only 5 m radius is of suffic ıt size to be occupied as territory by one ... *imperator* male. At one particular pool a male *Anax* was observed on 9 successive days patrolling throughout the day, but it is not sure whether it was the same specimen.

In our region, *A. cyanea* prefers ponds surrounded with bushes or trees.

The cenosis of the adult dragonflies is the *Erythromma najas - Anax imperator* cenosis of JACOB (1969), which is rather characteristic for small meadow pools in our region.

No changes in species composition of this cenosis were observed throughout the whole period of investigations.

Pool 2

Bomb hole of about 3 m radius and a depth of about 1 m. Permanent pool, but varying water level. Cattle can approach the water. Shallow litoral zone. No macrophytes at the water edge except meadow grasses, *Galium palustre, Myosotis palustris* and very few *Juncus effusus.* In every year the water surface is completely covered with *Ranunculus aquatilis* and *Lemna*. Filiform algae are intermixed with the *Ranunculus* plants and form a dense layer on the water surface.

Larvae of the following species of Odonata were recorded: *Pyrrhosoma nymphula, Erythromma najas, Ischnura elegans, Coenagrion puella, Aeshna cyanea, Anax imperator, Sympetrum sanguineum, S. flaveolum, Libellula quadrimaculata. Pyrrhosoma* larvae were most abundant in every year, followed by *Erythromma* and *Ischnura*. Only a few individuals of the other species were found. The weak occurrence of Anisoptera might be due to the fact that the densely overgrown pool is not easily detected by migrant animals.

Again the cenosis of the adults differed significantly from that of the larvae in that the Anisoptera were absent, except for some *Sympetrum* individuals. This kind of habitat is not occupied by male *Anax* individuals because of the lack of suitable resting places.

The quantitative aspect of the cenosis of adults reflects the numbers of larvae: *P. nymphula* is always most abundant, followed by *E. najas* and *I. elegans*. In late summer only *E. najas* and *I. elegans* are present. This cenosis cannot be classified in the terms of JACOB (1969).

Conclusions

The dragonfly fauna of small permanent meadow pools in Westfalia is relatively poor. Ecological conditions of these water bodies undergo drastic periodical changes, so that only eurytopic species may inhabit them, forming rather typical cenoses of imagines, with either *Ischnura elegans, Erythromma najas* or *Pyrrhosoma nymphula* as dominating species, mainly depending on vegetation character. Although at most pools only cenoses of adult Zygoptera are permanently present, these waters play an important role as reproduction reservoirs for anisopterous species as well.

References – DUMONT, H.J., 1971, *Bull. Annls Soc. r. ent. Belg.* 107: 211-235; – FISCHER, Z., 1961, *Int. Revue ges. Hydrobiol.* 46: 269-275; – JACOB, U., 1969, *Faun. Abh. Mus. Tierk. Dresden* 2: 197-239; – KREUZER, R., 1940, *Arch. Hydrobiol.* (Suppl.) 10: 359-572; – MUNCHBERG, P., 1956, *Arch. Hydrobiol.* 52: 185-203; – RUDOLPH, R., 1978, *Abh. Landesmus. Naturk. Münster* 40 (in press).

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