Reprinted from

The Scientific Management of Animal and Plant Communities for Conservation

The 11th Symposium of
The British Ecological Society
University of East Anglia, Norwich
7–9 July 1970

edited by E. Duffey and A. S. Watt

Blackwell Scientific Publications
Oxford London Edinburgh Melbourne
1971

Water management in nature reserves

L.W.G.HIGLER *Research Institute for Nature Management, Netherlands,* Leersum*

Introduction

The department of Hydrobiology of the Research Institute for Nature Management is dealing with the following types of investigation.

1 Making an inventory of all types of water in the Netherlands in, as well as outside, Reserves. This basic research is necessary, as little was known about the hydrobiology of Dutch waters except for some oligotrophic 'vens' and for brackish waters (Redeke 1922, 1933).

2 Characterization and classification of these waters with the help of chemico-physical analysis, geomorphological observations and in particular the study of biocommunities of micro- and macro-organisms.

3 Geographical and ecological research on rare or threatened species, which includes experiments in the laboratory and for larger animals work in the field (Higler 1967).

4 Basic research on problems such as eutrophication, pollution, etc.

The information gathered in this way is used for giving directions for the purchase and management of nature reserves or newly created landscapes like 'polders', sand diggings, recreation parks and so on. The management *sensu stricto* is performed by the owners or managers of reserves or by governmental authorities. One of our tasks is to investigate the effects of the advisory measures after they have been executed. On the basis of geomorphological and historical data a classification of Dutch waters has been made, but from a hydrobiological point of view this is not satisfactory. Our goal is the characterization and classification on the basis of biological criteria, but for the time being we are using the old system. The main stagnant waters in the Netherlands, for example, can be divided into dune lakes, broads, 'vens', old dyke breaks and old river branches. A number of representative examples of each category has been purchased as nature reserves.

* R.I.N. Communication nr. 18.

Marshes with open water

They form a fascinating variety of land, water and all the transitional stages in between with a rich abundance of flora and fauna. The broads were created from peat pits by the action of wind and water. They are shallow and contain fresh water rich in nutrients. One of the most interesting characteristics of these areas is the autochtonic swamp succession.

The transition between open water and floating vegetation, consisting of *Stratiotes aloïdes* L., turned out to be especially rich in aquatic organisms. For evaluation of these broads we need a good insight into the structure of the ecosystem. Studies on the presence and distribution of macro-organisms adhering to *Stratiotes* plants showed a specific distribution pattern for a number of insect larvae (Fig. 1). We constructed a scheme of potential

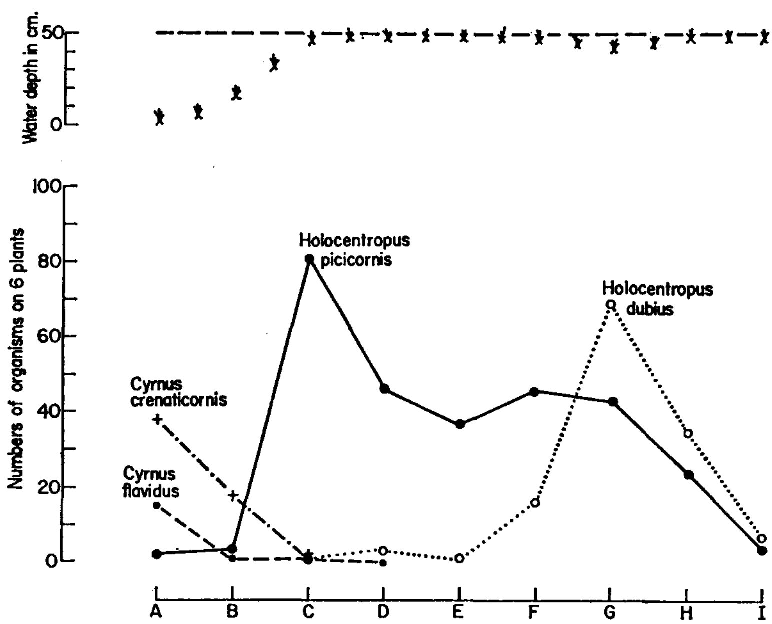

Figure 1. Distribution of *Polycentropodidae* larvae in an autochtonic swamp succession with *Stratiotes aloïdes* (Venematen, July 1967).

occupation of *Stratiotes* plants by larvae of Trichoptera and Ephemeroptera in a well-developed autochtonic swamp succession during the summer (Fig. 2). We found that the numerical differences between samples (consisting of six plants each), in the series from open water to shore, were significant for all the animals considered. Using simple methods for numerical analysis we found that corresponding stages in the swamp succession in different broads were characterized by the presence or absence of a few specific animals

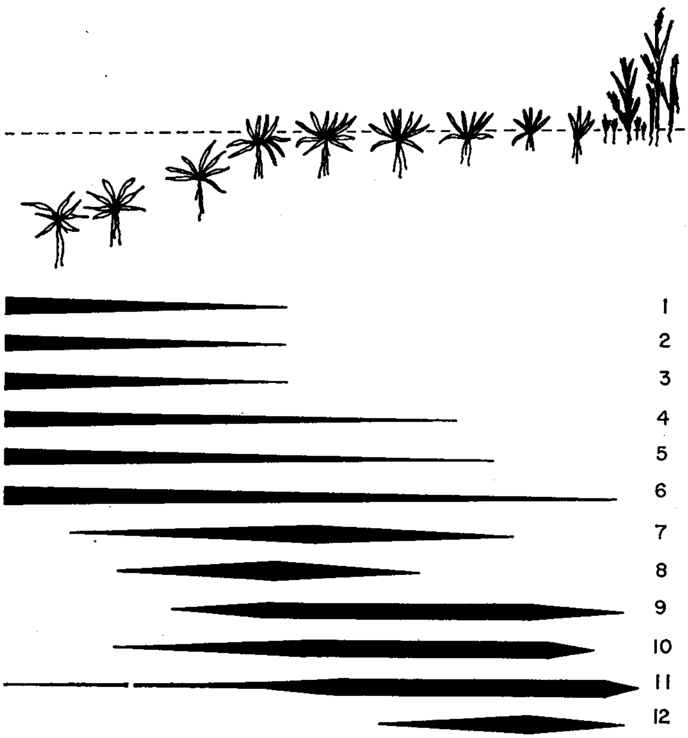

Figure 2. Distribution of larvae of Trichoptera and Ephemeroptera in an autochtonic swamp succession with *Stratiotes aloïdes* (end of June/end of July).

1. *Cyrnus crenaticornis*
2. *Cyrnus flavidus*
3. *Caenis horaria*
4. *Caenis robusta*
5. *Agraylea multipunctata*
6. *Oxyethira costalis*
7. *Agraylea pallidula*
8. *Cyrnus insolutus*
9. *Oecetis furva*
10. *Holocentropus picicornis*
11. *Oxyethira fagesii*
12. *Holocentropus dubius*

according to the scheme in Fig. 2 (Brantjes & Higler 1970). We are able to use this scheme as a measure in comparable situations. A better knowledge of the autecology of the animals considered makes the scheme directly applicable for the interpretation of established dissimilarities. The scheme represents the situation in an undisturbed and unpolluted broad.

The threats to these reserves are severe; they make the management very difficult. Leentvaar (1964) establishes that in the Netherlands nearly all waters form part of a system of canals in which the water is kept by dykes, pumps and sluices and that the need for regulation of the amount of water influences, at the same time, its quality. That is why these marshes are threatened more and more by pollution. The polluting effect is in many cases enlarged by a decrease of seepage water in those reserves where seepage plays an important role in the water management. Solutions to this problem are difficult to find. In a number of cases it is possible to replace the inflowing water by clean water from other places, or to purify the incoming water by using a few peat pits as natural purification plants.

As a matter of course these areas are extraordinarily attractive for recreation. This often causes an inadmissible disturbance of the very sensitive vegetation, if not direct pollution (e.g. spilled oil from motor boats, etc.). An adequate enlightenment and careful supervision can be effective in these cases. Another big problem in managing this type of reserve is caused by the autochtonic swamp succession itself. In about 30 to 40 years open water can be changed into land. The richness and value of the broads is due to this process. However, it is not easy to freeze this dynamic structure or to create a brand-new starting-point for the same situation under the now changed circumstances. In nature reserves experiments are done to test the possibilities of 'freezing' (by thinning out the *Stratiotes* plants) and recycling the swamp succession (by digging out peat pits as far as the mineral bottom). It is absolutely necessary to find solutions to these problems, for the significance of these reserves is not only defined by scientific and recreational importance but also by such economic factors as reed and rush culture, fisheries and in particular by their hydrological influence on the surrounding meadows and haylands (Schroevers & Segal, 1964).

Running waters

So far we have not mentioned running waters, although there are hundreds of streams in the Netherlands. They form a distinct category of 'lowland-rivulets' (Redeke 1948). These streams are dependent on rainfall, so they have a very variable water drainage. The speed of the current varies from 0 to about 100 cm/sec and the bottom correspondingly consists of silt, sand, pebbles or small boulders. The fauna is partially that of fast-running water, partially that of stagnant water and partially a type typical for this special kind of stream.

Many of the rivulets have been canalized and most of them are polluted by waste water or agricultural drainage. The undisturbed ones are few in number and they are threatened by the same risks. Management is difficult, in particular if there is no supervision on the upper course. Reserves ought to be formed in such a way that the total basin is under control. In practice one has to look for the best management for sections of a water course within a reserve. The necessity of canalization of a section under management can sometimes be removed by short-circuiting the stream, but a much better solution appears to be the partial covering of a cross-section with boulders without cementing them. In some cases this can be practised without much digging or disturbance of the natural course of the rivulet. A number of stream-sections in reserves are involved in such experiments.

The pollution of running waters as well as remedies for this evil are too well known to discuss here. An exception must be made for a special kind of pollution we meet in some areas of the Netherlands where there are concentrations of fattening farms for calves and pigs. The pollution caused by the liquid manure of these animals is characterized by a high ammonia content. One of the most important 'lowland rivulets', the 'Hierdense beek', is situated in a region where about 36,000 calves are raised. Though periodical chemical samples were taken by governmental authorities no trace of this kind of pollution was observed for some years. A biological evaluation showed a community typical of slightly polluted water in a number of sections and from this it was possible to determine the sources of pollution. We used an adaptation of the known saprobe-systems in order to estimate the degree of pollution. This method has functioned better in this case than the traditional methods of chemical sampling. The illegal drainage of the liquid manure at irregular times makes management extraordinarily difficult. We have proposed the pumping of all liquid manure by a pipe-line to a nearby purification plant which raises the costs per calf by about 6 guilders (about 70p).

New developments in the fight against sewage-water drainage include the possibility of treatment of this water in the surrounding woods. In the Hierdense beek area, experiments will be done in which the liquid manure is pretreated in simple biological plants. Further purification entails the horizontal passage of the prepared liquid manure through the sandy soil. If these experiments succeed, we are nearer to the solution of many sewage-water problems.

References

BRANTJES N.B.M. & HIGLER L.W.G. (in press). Een numerieke vergelijking van macrofauna in Stratiotesverlandingen. *Med. Hydrobiol.* 4, (2).

HIGLER L.W.G. (1967) Some notes on the distribution of the waterbug, *Gerris najas* (Degeer, 1773), in the Netherlands (Hemiptera-Heteroptera). *Beaufortia*, 14, 87–92.

LEENTVAAR P. (1964) Management and changing of water quality in the Netherlands. *Proc. MAR Conf. Int. Un. Conserv. Nat. nat. Resour.*, New Series no. 3, 267–70.

REDEKE H.C. (1922) Zur Biologie der niederländischen Brackwassertypen. *Bijdr. Dierk.*, 22, 329–35.

REDEKE H.C. (1933) Über den jetzigen Stand unserer Kenntnisse der Flora und Fauna des Brackwassers. *Proc. Congr. int. Limnol.*, 6th, 46–61.

REDEKE H.C. (1948) *Hydrobiologie van Nederland. De zoete wateren.* Amsterdam, 580 pp.

SCHROEVERS P.J. & SEGAL S. (1964) The economic significance of the phytocenological research in the marsh-regions of the Netherlands. *Proc. MAR Conf. Int. Un. Nat. Conserv. nat. Resour.*, New Series no. 3, 260–6.

Printed in Great Britain by
W & J Mackay Limited, Chatham, Kent