

SHORT COMMUNICATIONS

**EFFECTS OF DITCH-BLOCKAGE ON ADULT ODONATA AT A
COASTAL RAISED MIRE SITE IN CENTRAL WEST WALES,
UNITED KINGDOM**

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In an attempt to halt the effects of drainage in peripheral areas of a coastal raised mire peatland system in central Wales, ditches were blocked with transverse dams. Dams created long linear pools, flooding the areas of most serious water-table draw-down and peat slumping resulting from the past drainage activity. As a consequence, the wildlife interest of the ditches has been considerably enhanced. The existence of high and stabilised water-tables in areas surrounding the ditching has eliminated non-peatland plant species established since water-table decline. The establishment of the long linear pools has led to increases in the numbers of adults of at least 6 odon. spp. and of breeding teal; overall numbers of insects were 2-43 times greater over blocked ditches than over undammed ditches.

INTRODUCTION

Cors Fochno is a coastal raised mire complex situated South of the Dyfi Estuary in central west Wales. The site comprises undamaged raised mire vegetation surrounded by peripheral areas of drained bog dissected by drains (cf. BOVEY 1984 for details). The remaining areas of undamaged mire are National Nature Reserve (NNR), but much of the interesting peripheral habitats lie within the Dyfi Site of Special Scientific Interest (SSSI) or NNR (Fig. 1).

Drainage since 1940 has caused damage to the western flanks of the mire, reducing the botanical interest and causing serious shrinkage and slumping of peat (for full details cf. FOX, 1984). In an attempt to halt the progressive effects of

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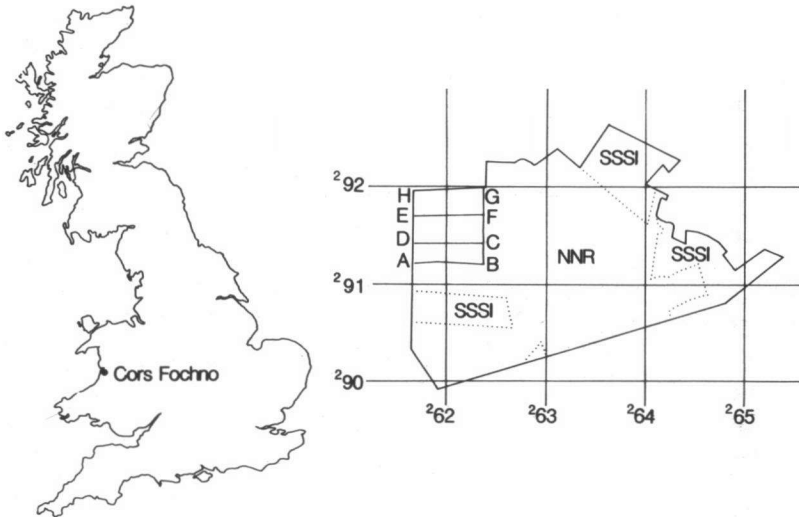


Fig. 1. Cors Fochno National Nature Reserve and Site of Special Scientific Interest, showing the location of ditches (A-G) monitored during dragonfly counts. Grid indicates National Grid Reference 100-metre intervals.

past drainage, the Nature Conservancy Council (NCC) blocked off a series of drainage dykes running westwards to discharge into the tidal Leri. This was done to sustain high water-tables, halt the desiccation of the upper peat horizons and reduce the large fluctuations in water-tables caused by the drainage.

To this end, dams were created straddling three parallel ditches running East-West on the W side of the mire, blocking ditchflow, and creating linear ponds. Work commenced in September 1981, with subsequent improvements in September 1982. A parallel dyke forming the boundary between NNR and adjacent ownership was not dammed during the period, but left in its original state.

The project is a long-term management initiative aimed at restoration of high and stable water-tables to safeguard the peatland as a whole. A base-line investigation was carried out on water-table behaviour before and after the blockage of dykes, on the effects of past drainage on vegetation pattern at the site and the evaluation of a gross hydrological budget for the mire as a whole (FOX, 1984). However, in the short term, the creation of open-water habitat (a relatively rare phenomenon on the undamaged sectors of the mire) has also led to a massive increase in the wildlife interest of the western bog and it is this feature which forms the basis of the present paper.

While primarily of importance as a peatland and for its flora, Cors Fochno is important for its invertebrate and ornithological interest (FOX, 1984). In parti-

cular, it is one of the most important sites in Wales for its dragonfly fauna (FOX, 1981; COKER & FOX, 1985) although nothing is known of this feature before drainage took place. The numbers of adults of some of the more common species of Odonata were monitored to assess the possible effects of ditch blockage.

SITE DESCRIPTION

The mire vegetation is well described in a number of publications, perhaps best in RATCLIFFE (1977). The western flank of the mire is modified raised mire vegetation, characterised by *Sphagnum tenellum* (Brid.) Brid. where *Sphagnum* cover is retained, with high percentage cover of *Erica tetralix* L. and *Calluna vulgaris* (L.) Hull, the former being typically most abundant in areas of high water-table subjected to regular firing. However, water-tables away from the ditching remain close to the surface and typical raised mire species such as *Rhynchospora alba* (L.) Vahl and *Andromeda polifolia* L. persist even in damaged zones of the bog.

The ditching on this part of the site was probably dug during 1940-45, improving tidal drainage existing to channel away water flooding from the course of the Leri at highest tides. This maritime influence was removed in the early 1960s when the ditching was improved and the western bank of the Leri created. The ditching was cut 2-3 m into the contemporary peat surface, causing considerable water-table draw-down in its immediate vicinity. This in turn had consequences for the vegetation and the peat structure, with substantial shrinkage (up to 3.5 m in 70 years) and slumping of peat adjacent to the ditches (FOX, 1984).

By 1980, the vegetation in the dykes was well developed comprising poor-fen type vegetation, with shallow, slow-flowing water and emergent *Juncus effusus* L., *Mentha aquatica* L., *Galium palustre* L., *Angelica sylvestris* L., etc. With the subsequent blockage of the ditches, deep linear pools about 2-3 m wide, 2-3 m deep and 20-40 m long (dependent on dam interval) were created and these rapidly developed into densely vegetated pools which proved highly attractive to Odonata.

METHODS

Water-table depth below the surface of the peat was read from stand-pipe dip-wells set at regular intervals along the blocked ditches at 5 m, 10 m and 25 m distances from the centre of the ditches. These were measured at weekly intervals during the period before and after dyke blockage.

During April-September 1980, 1982 and 1983, regular transects were walked and numbers of adult Odonata counted along the course and over adjacent water. The same observer carried out the census throughout, thus minimising between-year sampling error (but cf. MOORE, 1953 for a full discussion of sources of error).

The precise routes taken are shown in Figure 1: the ditch-lines E-F-C-D were blocked in September 1981, resulting in water-tables being elevated to 2 m above previous levels and the dams were strengthened and improved in September 1982. The ditch G-H was surveyed along unmodified dyke at approximately weekly intervals on the same dates as E-F-C-D in precisely the same way. Other transects were also surveyed but these are not considered here. Counts were only carried out when there were less than 5 octas cloud cover, wind strength less than Beaufort 3-4, air temperature in excess of 15°C and no precipitation in sight. Counts were all started after 11.00 hr and completed before 16.00 hr B.S.T. (after POLLARD, 1977, and methods of census work with butterflies), to coincide with peak flight activity of insects (MOORE, 1953).

RESULTS

Results from all stand-pipe dip-wells show that water-tables within the ditches were restored to levels approaching the contemporary peat surface adjacent to where the ditches had been cut. In addition, the fluctuations in the water-table were considerably dampened compared to the condition before blockage, when

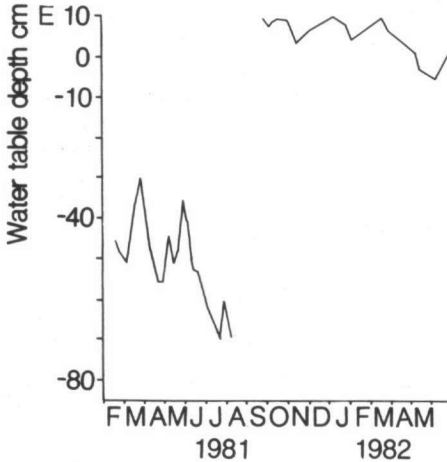


Fig. 2. Water-table behaviour in a stand-pipe dip-well 10 m North of the centre of the ditchline by point E shown in Figure 1. Lower trace indicates water-table depth below the surface of the contemporary peat surface before blockage; the subsequent upper trace shows water-table behaviour after ditch-damming activities.

Table 1

Changes in the maximum numbers counted per day of the six most common Odonata species along regular transects from Cors Fochno NNR 1980-1983. [Values indicate the magnitude of differences between maxima in 1980 and 1983]

Species	Ditches blocked in 1981	Ditches left unblocked
<i>Ischnura elegans</i>	11.7 x	0.9 x
<i>Pyrrhosoma nymphula</i>	2.4 x	1.2 x
<i>Lestes sponsa</i>	43.6 x	1.7 x
<i>Libellula quadrimaculata</i>	23.3 x	1.0 x
<i>Sympetrum danae</i>	13.5 x	0.5 x
<i>S. striolatum</i>	7.0 x	1.1 x

fluctuations were frequent and often violent (e.g. Fig. 2):

Adult Odonata benefited conspicuously from the ditch blockage, showing great increases over the number counted in 1980 before the damming. The lack of a similar increase in numbers along the stretch of ditch-line not subject to damming clearly puts the expansion in context (Fig. 3, Tab. 1). Increases in numbers of adults of the six most common species range from 2.4 times in *Pyrrhosoma nymphula* (Sulz.) to 43.6 times in *Lestes sponsa* (Hans.) as compared with their previous maximum numbers along transects.

DISCUSSION

With land reclamation and drainage, modern methods of dyke management and the use of pesticides in modern land use, wetland faunas have suffered in many parts of Britain from damage and decline in species diversity. It is thus encouraging to report a management initiative aimed at the conservation of the hydrological integrity of a peatland, which has in the short term seen an increase in the faunal interest on a coastal raised mire site.

It has been shown that both nesting female and duckling Teal

feed primarily on aquatic invertebrates, including dragonflies, Hemiptera, Coleoptera and Diptera (particularly the chironomids and mosquitos) (MUNRO, 1949; SWANSON & SARGEANT, 1972; SWANSON et al., 1979; DANELL & SJOBERJ, 1980). Since ditch blockage at Cors Fochno the number of pairs of breeding Teal, *Anas crecca* L., have increased by 3-4 times (an increase not reflected at undammed ditches on the same part of the site). This increase can thus be interpreted as resulting from an increase in the available dietary items (FOX, 1986), especially since Teal nest away from the ditches in site on dry mire vegetation.

Other species of dragonflies which occurred along the ditching in 1980 were present in greater numbers, including species such as *Aeshna juncea* (L.), *Ceri-*

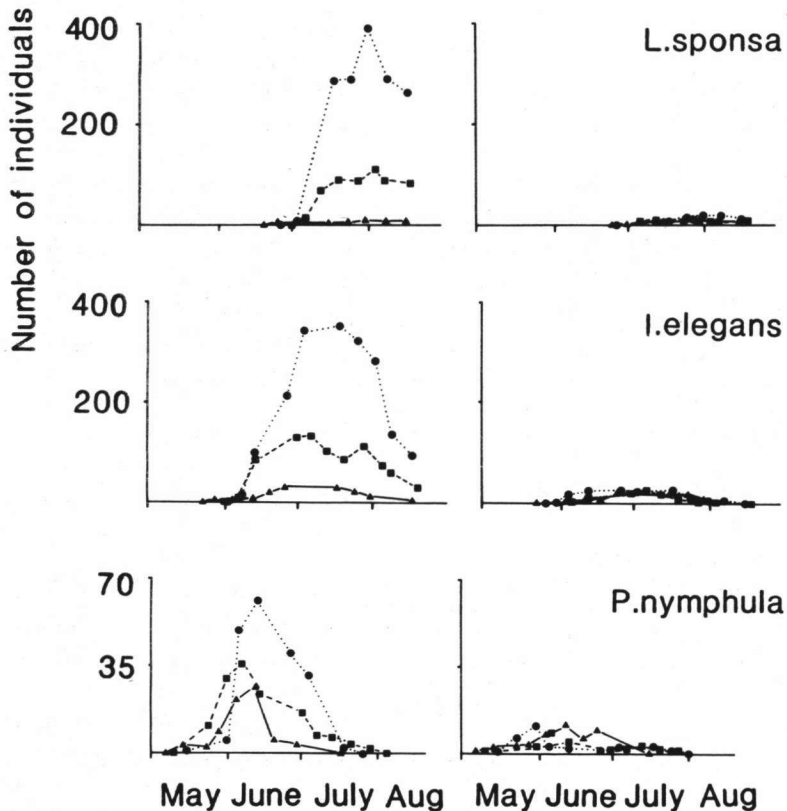


Fig. 3. Graphical plots of counts of Zygoptera from transects monitored on Cors Fochno National Nature Reserve. For each species, the left graph shows data from the ditch transect E-F-C-D which were blocked in September 1981, the right graph shows data from the ditch transect G-H which was not blocked at all. Data are shown for the three different seasons May-August as follows: \blacktriangle — \blacktriangle 1980; \blacksquare - - - \blacksquare 1982; \bullet \bullet 1983.

agrion tenellum (de Vill.) and *Coenagrion puella* (L.), all of which occur at such low densities as to make rigorous comparisons between years difficult. The increases in *C. tenellum* and *Orthetrum coerulescens* (Fab.) are particularly encouraging because both are rare and local in Wales. The potential for increase in the larger anisopterans, *Libellula quadrimaculata* L. and *Sympetrum danae* (Sulzer) (both apparently peatland species in west Wales), is also encouraging

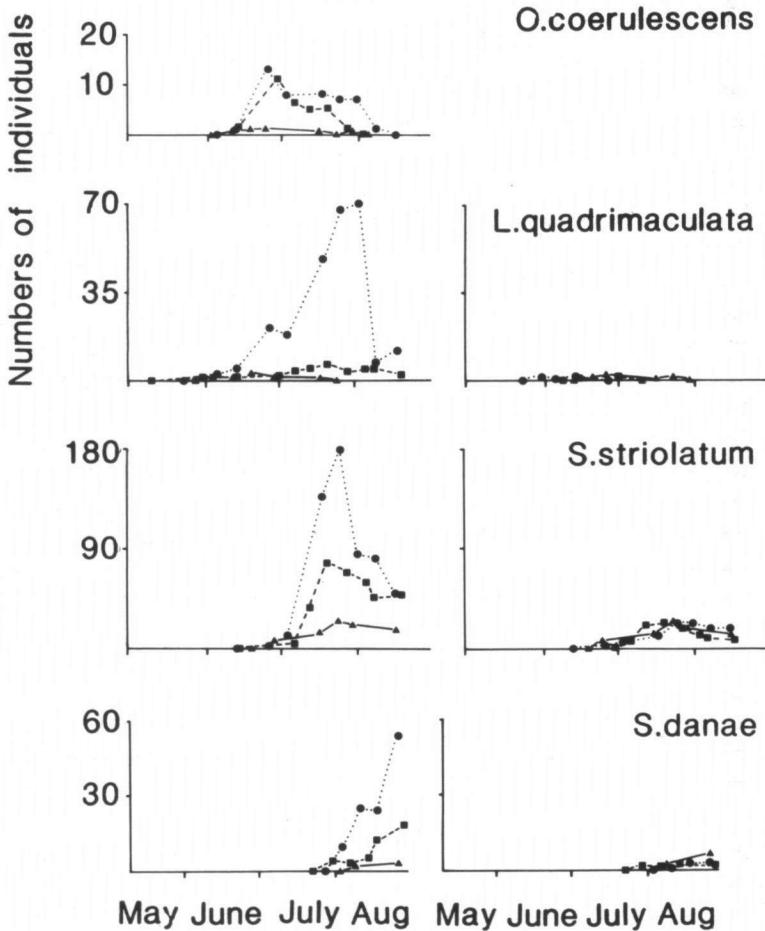


Fig. 4. Graphical plots of counts of Anisoptera from transects monitored on Cors Fochno National Nature Reserve. For each species, the left graph shows data from the ditch transect E-F-C-D which were blocked in September 1981, the right graph shows data from the ditch transect G-H which was not blocked at all. Data are shown for the three different seasons May-August as follows: ▲ ———▲ 1980; ■ - - - - - ■ 1982; ● ● 1983. — Note that *Orthetrum coerulescens* did not occur along G-H and hence is only considered from E-F-C-D.

given the alarming loss of just this habitat in recent years (RATCLIFFE & HATTEY, 1982).

With no records of Odonata from Cors Fochno before the commencement of drainage, it is impossible to assess the effect of ditching on the dragonfly fauna. However it is interesting to note, for example, that in the late 1970s *Ceriagrion tenellum* was restricted entirely to areas of peat cuttings and neglected drains infilled by *Sphagnum cuspidatum* Hoffm. Blockage of ditching on the west side of the mire has increased the number of small *Sphagnum*-filled depressions adjacent to ditches, which has led to the general increase in *C. tenellum* and *Orthetrum coerulescens* in the vicinity. It would therefore appear that, whilst the provision of linear bodies of water has enhanced numbers of the commoner species of Odonata, this has not been at the expense of rare ones, which also seem to have benefited directly or indirectly from the damming activities.

It has frequently been suggested that Odonata would be excellent indicators of the well-being of aquatic habitats (e.g. MOORE, 1953, 1964). They are predatory as larvae and adults and, being towards the top of the food chain of the aquatic environment, by analogy with birds of prey can give early warning of the decline of their prey species. It was proposed that a national recording scheme similar to that of butterflies (POLLARD, 1977) be established to monitor changes in abundance of Odonata (POLLARD, 1981). The use of constant method counts of adult Odonata has been reported by (BOSTON, 1984) but its use in monitoring major management changes has not been previously documented. However, it should be noted that the presence of adult dragonflies does not on its own provide definitive evidence of a breeding population at their site of occurrence.

The blockage of ditches seems to have had several effects: (1) It has stabilised high water-tables, providing suitable conditions for the development of emergent vegetation and removing undesirable terrestrial plant species which had invaded the area either as a result of drainage (e.g. *Pteridium aquilinum* (L.) Kuhn) or disturbance (e.g. *Aira praecox* L.); — (2) It has rewetted areas of peat previously desiccated by water-table draw-down which forms the basis for the original management; — (3) It has caused a conspicuous increase in the invertebrate biomass of the ditching reflected most obviously in the numbers of the predators.

Some interesting Odonata that occupy mires in Britain oviposit by preference in small pools or minute pockets of water containing *Sphagnum* mats. In similar management on other mire sites, it would therefore seem appropriate to supplement the creation of long, linear pools by dividing some into small *Sphagnum*-filled compartments to provide habitats accessible to a wider range of mire-inhabiting Odonata species.

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