

AN ECOLOGICAL APPRAISAL OF THE ITCHEN VALLEY FLOOD-PLAIN

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INTRODUCTION

THE River Itchen rises near the village of Cheriton, Hampshire, and is about 30 miles (48 km) long. Two substantial tributaries, the River Arle and the Candover Brook, join the Itchen about 4 miles (6.4 km) downstream of the source and there are a number of minor tributaries in the middle and lower reaches. The river valley is straddled by the City of Winchester and, lower downstream, bordered by extensive development around the railway town of Eastleigh. The estuary, which is not considered in this paper, lies entirely within the City of Southampton.

The Itchen is one of the larger Wessex chalk streams and flows in a relatively wide flood plain mostly devoted to grazing and (locally) hay meadows but with an extensive, though discontinuous, area of unreclaimed fen vegetation. Chalk streams and their flood plains are known to be biologically rich, productive habitats. The scientific literature, however, is comparatively sparse, though it does include important work on the Dorset Frome by the Freshwater Biological Association (Westlake *et al* 1970) and various papers on specific aspects, such as the ecology of weed cutting (Soulsby 1974). These studies, however, are mostly confined to the stream itself and do not cover the flood plain as a whole, though a series of studies of the River Avon, carried out by University College Southampton in the 1930s included a useful appraisal of some aspects of the ecology of floated water meadows (Berry 1935).

The present survey arose directly from the City of Winchester Planning Department's need for development control guidance in the valley. In a broad sense the survey seeks

to identify the ecological characteristics and nature conservation value of the valley. Apart from a review of historical sources and scientific literature and current work, the main elements of the study were a survey of the flood plain vegetation, most of which was carried out for the Nature Conservancy Council by Mrs. R. Tittensor in June–August 1976; and a survey of riparian and flood plain birds by members of the Ornithological Section of the Hampshire Field Club and Archaeological Society in March–August 1976. Despite its social and economic importance, the freshwater fishery in the Itchen lies beyond the province of the survey. Figures 1–3 are based on the 1976 surveys and are intended to indicate the relative value to nature conservation of different parts of the valley.

PHYSICAL AND CHEMICAL CHARACTERISTICS

Physically and chemically the Itchen is a characteristic chalk stream. The characteristics of the chalk stream eco-system arise from a unique combination of physical and chemical features. The rivers lie generally in shallow, irregular basins of the Chalk, which is a soft, permeable, fine-grained Upper Cretaceous rock rich in some of the major nutrients necessary for growth. Rainfall on the chalk percolates rapidly and accumulates in vast aquifers: there is little surface run-off. The chalk streams are thus mainly spring fed by base-rich water, the flows of which vary seasonally only within a narrow amplitude which follows the normal pattern of a later summer minimum and later winter maximum. Heavy rainfall may superimpose minor short term fluctuations in flows but floods

are rare. The Candover valley pilot ground-water regulation scheme, by which water is pumped from the valley aquifer into the stream to maintain summer flows for abstraction downstream, will have the effect of narrowing further the limits within which water flows vary on the Itchen. The mean gradients of the valleys tend to be relatively steep so that river velocities are moderately high. Dissolved oxygen and carbon dioxide are generally at or near saturation.

Chalk stream water is hard and relatively rich in phosphate, nitrate and some other nutrients and has a pH of 7.5 to 8.5. Nutrient concentrations, like the river flows, tend to exhibit relatively small seasonal fluctuations. Similarly, because the rivers are spring fed, water temperatures remain relatively constant through the year, at least in the upper reaches. The system is thus both stable and nutrient rich and in consequence productivity of aquatic plants and animals is notably high.

The flood plain comprises Quaternary laminates of gravel, loamy alluvium and peat. These deposits have not been thoroughly investigated but such scattered data as exist (e.g. borehole reports accompanying planning applications for gravel extraction) suggest that there are several metres of gravel underlying the lower reaches of the valley, overlain (alternatively) by the more recent alluvium or peat, the latter achieving depths of around 3 metres in discontinuous spreads, presumably associated with former areas of permanent saturation. Here the alluvium may be arranged peripherally to a peat zone following the centre of the valley but this demands elucidation. In the upper valley peat is more widespread and above Winchester occupies most of the flood plain.

LAND USE HISTORY

Before man began to manipulate the system it is probable that chalk streams flowed in shifting channels through flood plains dominated by carr and reed. The early history of clearance and drainage in the

Itchen valley to provide grazing, is little known but recent archaeological evidence from Winchester suggests that some clearance may have taken place as early as the Iron Age. There were evidently Romano-British drainage systems around Winchester, the break-up of which was followed by a reversion to marsh (Winchester Research Unit, F. Green, pers. comm.). Archaeological evidence from Winchester suggests that the valley in the vicinity of the settlement there was being systematically drained for meadow by the eighth century or before (Biddle 1975, 328).

More sophisticated modifications began with the diversion and training of water-courses to provide water-heads for mills. From early in the seventeenth century the flood plains of the Wessex chalk streams started to be transformed by the construction of floated water meadows. These were essentially permanent irrigation systems in which the meadow was formed into successive ridges and furrows. Water was led into carriers along the crowns of the ridges and permitted to overflow down their sides into drains or draws which carried the water into a main drain and off the meadow. The purpose of the meadows was to irrigate without flooding and simultaneously to enhance the nutrient status of the land with base-rich water which at times was rich also in suspended alluvium. The ridge-and-furrow layout thus served an essential function in maintaining a steady flow through the meadow. The process of watering was skilled and the systems often complex, with intricate patterns of meadows, the water used on one sometimes serving another before passing back into the river. The periodicity of watering, grazing and mowing for hay likewise varied during the year and over time as techniques changed to accommodate new ideas and changing opinion. The water meadow in the eighteenth and nineteenth centuries served as a vital adjunct to chalkland farming in that it not only yielded an early bite but was a highly

productive source of grazing and hay during a period when generally the amount of pasture on the chalkland was diminishing in favour of arable. Such was the competition for water that there were frequent cases of litigation between the respective owners of meadows and mills.

In the Itchen valley water meadows were at first largely concentrated below Winnall because the extensive areas of peat in the upper valley were thought to be less suitable for watering. Extensive areas of the upper Itchen, however, were converted to water meadows in the first half of the nineteenth century, the first impetus being provided by the scare-price period of the French wars early in the century (Naish 1960; Sheail 1971; Vancouver 1810; Williamson 1861).

For complex reasons the water meadows declined in the late nineteenth and in the twentieth centuries. One of their functions had been to support the sheep flocks which until the end of the nineteenth century were essential in manuring the arable where they were folded at night. Release from this dependence arrived in the form of artificial fertilisers and these, with the high cost of labour and maintenance involved in the meadows, spelt their ultimate demise. This is a simplistic explanation which ignores contributory factors but by the end of the 1930s few meadows were still in operation. Some had been converted into fish hatcheries (Moon and Green 1940).

It has not been possible to trace the last date on which a meadow was floated in the Itchen valley but so far as can be determined from local enquiries there have been no working meadows there for two, and possibly three, decades. Milling declined concurrently with the water meadows, the mills and leets becoming derelict and ultimately demolished or (where the business survived until more recently) converted into dwellings.

The construction of water meadows and mill leets created a multiplicity of water

courses in the valley. Other developments involving a manipulation of the water flow have included the construction of the Itchen Navigation, the excavation of duck decoys and the establishment of a substantial water-cress industry in the headwaters. All these developments have left their mark on the valley, enhancing rather than detracting from its biological diversity.

Between 1189 and 1204 the Bishop of Winchester made the Itchen navigable for barges from Southampton to Winchester and thence to the head of the river by constructing 'a great dyke' at Alresford—Alresford Pond, now a biologically important wetland, presumably originally a balancing lake (Page 1908). This early navigation evidently used the main river channel, and appears to have been disused by the seventeenth century. In 1665 a new Itchen Navigation was authorised by Act of Parliament, involving the construction of a new canal, the relics of which survive today along the 11 miles from Woodmill, Southampton to Blackbridge Wharf, Winchester. This Itchen Navigation never appears to have thrived but it persisted long enough to carry its last commercial barge in 1869. In fact, long before then it had become more important as a main carrier for the water meadows, a function which it continued to serve after its commercial demise (Course 1969).

I have been able to trace two former duck decoy ponds in the valley. The North Stoneham Decoy (SU 549168) was constructed early in the nineteenth century and abandoned in the 1870s (Payne-Gallwey 1886). It is still traceable, but overgrown. There is also clear map evidence and some visible relics of a second small decoy pond, hitherto unrecorded, in the upper Itchen valley, near Abbots Worthy (SU 501324).

Successful cress growing depends on a steady flow of relatively warm water. This was obtained in the early beds in the nine-

teenth century by siting them immediately below natural springs, and the industry thus grew up around the headwaters of the river. Though elsewhere the more recent sinking of boreholes has permitted a new freedom of location, in the Itchen valley the beds remain concentrated in roughly their original position: in the Alresford area cress growing is a substantial industry.

With the abandonment of the mills and water meadows, the system of waterways in the valley has become less complex as more recent engineering works have concentrated on fewer, better defined channels in which (presumably) stream velocities have tended to increase. Somewhat ahead of this mid-twentieth century trend, the Itchen, in common with other chalk streams, developed as an important recreational fishery.

Unmanaged chalk streams are naturally rich in fish—both in numbers and species diversity—but most species have long been unfashionable or unsuitable for fly fishing and since the late nineteenth century the Itchen has been deliberately managed to exclude ‘coarse’ fish and encourage ‘game’ fish. The chalk streams do not naturally support high populations of trout, though individuals may achieve considerable size, and thus the Itchen—again in common with other chalk streams—has developed largely into a ‘put-and-take’ river in which rainbow trout are regularly introduced to satisfy sporting demand. Only in the uppermost reaches of the Itchen (including its two main tributaries) are there ‘natural’ brown trout populations. Downstream, there are good runs of salmon and sea trout but neither species regularly penetrates in numbers much above

Winchester. Coarse fish are excluded from the river by regular electro-fishing, but in recent years a few coarse fishing ponds have been established in the valley and there are likely to be demands for others.

To encourage spawning and facilitate rod fishing (and to help prevent flooding) the luxuriant growths of weed in the river are regularly cut. At one time this was carried out with great care by hand to produce patterns of weed and clear water suitable for the maximum number of fish territories, but today cutting is mostly mechanised and relatively large scale. Modern weed cutting, the reduced dispersal of the water flow over the flood plain, and deliberate land drainage have probably lowered the water table over much of the flood plain in the middle and lower reaches of the valley, notably in the three to four miles above the estuary. Dried out water meadows and the traces of former leets now high and dry above their points of supply are widely evident; and even in the Candover valley and the headwater reaches of the Itchen there are relics of simple catch-work water meadows in a similar condition.

VEGETATION

During the 1976 survey each distinguishable unit of vegetation was assigned to one of 11 pre-determined types. Figures 1–3 are simplified vegetation maps on which these have been combined to show four main types. They also show cressbeds, which can be regarded as a distinctive riparian habitat, albeit an artifact. Table 1 gives the total area and the number of separate fragments of each type. Each of the vegetation types

TABLE 1
VEGETATION OF THE ITCHEN VALLEY FLOOD PLAIN, HAMPSHIRE, 1976

<i>Vegetation type</i>	<i>Area</i>	<i>Number of fragments</i>	<i>Average fragment size</i>
Fen	534ac (216.2ha)	32	16.7ac (6.7ha)
Herb-rich grassland	901ac (364.0ha)	32	28.1ac (11.4ha)
Unimproved but species-poor grassland	962ac (389.4ha)	37	26.0ac (10.5ha)
Improved grassland	721ac (292.0ha)	20	36.0ac (14.6ha)

distinguished on Figure 1, together with cressbed and aquatic vegetation is discussed below.

The grasslands fall within the loose definition of 'neutral' grassland, that is, the soils are neither markedly alkaline nor acid (Tansley 1939; Duffey *et al* 1974). Great variability exists within each category and the distinctions between them are not absolute. The point at which herb-rich grassland becomes species-poor was a matter of subjective judgement. Similarly, some 'unimproved' but species-poor grassland may have seen a brief interlude of herbicide treatment in the past, though this is often hard to tell now; and some areas of improved grassland have been untreated for sufficient years to permit recolonisation by herbs, particularly on the wetter parts. Nonetheless, the distinctions were considered realistic and useful.

The numbers and average sizes of separate areas of each of the main vegetation types (Table 1) show that there are few really extensive tracts of any one type. Figures 1-3 confirm that they are distributed in a complex and intimate mosaic along the flood plain. Figures 1-3 are themselves a simplification because mapped boundaries are sometimes necessarily arbitrary and fail to distinguish small areas of one vegetation type within the matrix of another. Particularly in the upper Itchen, above Winchester, the fens and meadows form an intricate pattern, often grading one into another through tall herb communities and *Salix* scrub.

There is a general correlation between fen and herb-rich meadow, and peat accumulation, though there is at present insufficient data to determine if this is absolute. Both types become progressively more frequent towards the upper reaches of the river. Above Winchester there are reaches where the river flows in a wide, shallow bed between ill-defined margins marked by tussocks of sedge *Carex paniculata* which in turn give way to

reed beds and carr. The flood plain above Kingsworthy is relatively narrow and wooded and fisheries are the dominant landowning interest. Below Winchester it is generally drier, more heavily grazed or improved and the river flows between well defined banks. Fen and littoral vegetation become progressively sparse as one proceeds downstream.

Fen

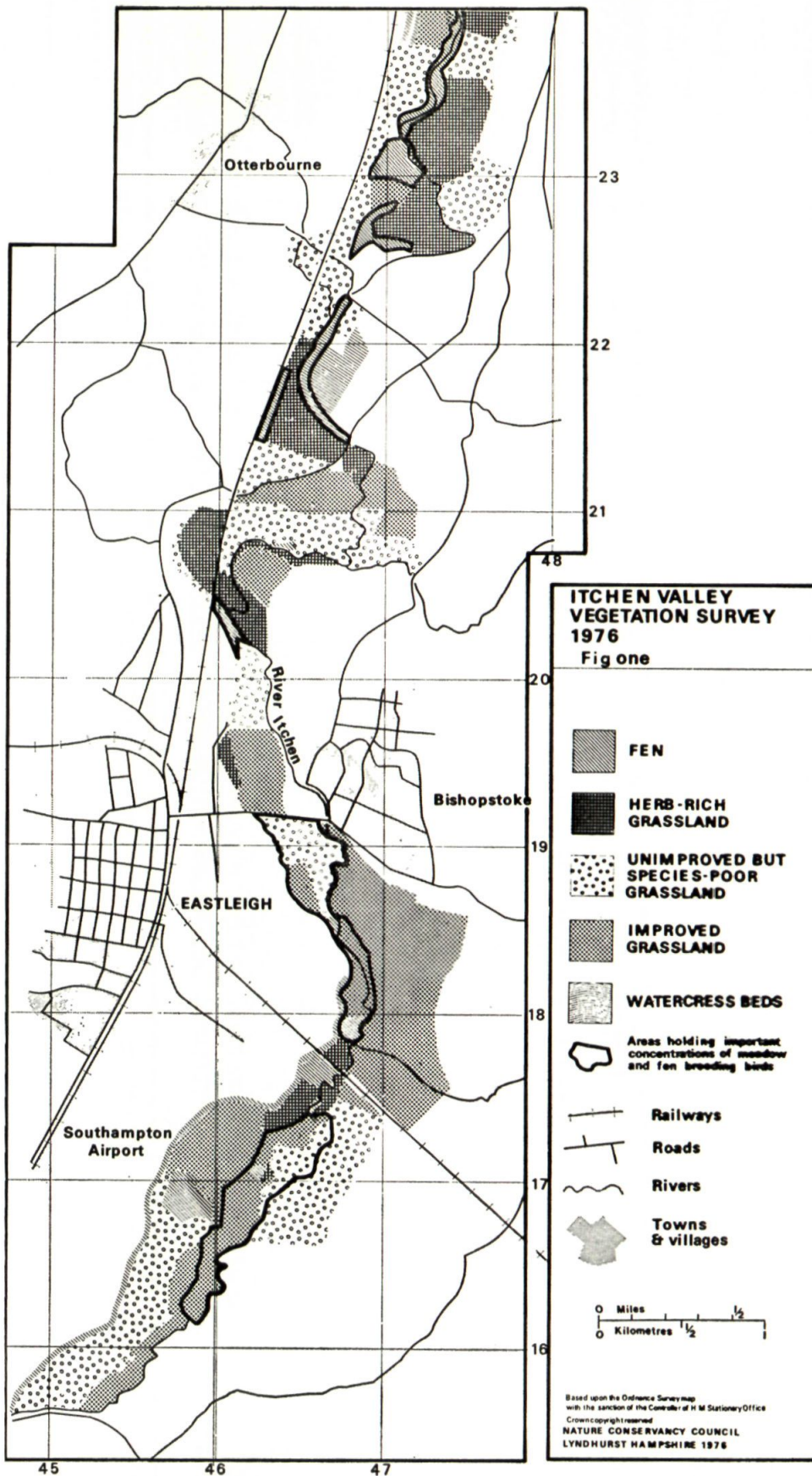
The areas combined under the general heading of 'fen' comprised:—

1. Woodland dominated by alder *Alnus* and/or willow *Salix*, grading on drier (or very long established) sites to wet oak *Quercus* woodland in which ash *Fraxinus* and willows *Salix alba* were sub-dominant and there was a rich under-story dominated by hawthorn *Crataegus*, blackthorn *Prunus spinosa*, sallow *Salix* spp and hazel *Corylus*.

2. Vegetation dominated by tall grasses and herbs, ranging from monospecific beds of reed *Phragmites communis*; through a reed *Phragmites*/reed grass *Phalaris arundinacea* community in which other reed-like plants such as bur-reed *Sparganium erectum* and in places reed-mace *Typha latifolia* were sometimes prominent; to a mixed community including all or some of these species and various tall herbs such as water dropwort *Oenanthe fistulosa*, great water dock *Rumex hydrolapathum* and great willow herb *Epilobium hirsutum*. Both the tall grass/herb community and the alder and willow carr (with which it was frequently associated) were characterised by a high water table and most sites were on relatively deep peat, though in a few places they occupied the sites of former floated water meadows and thus represented a reversion from meadow to fen conditions. On drier sites this community sometimes carried small poplar *Populus* plantations of relatively recent origin.

Herb-rich Meadows

These meadows comprise rich communities



of grasses, sedges and herbs. As a rule of thumb, on the richest sites one hectare of meadow will support around 50 species. No absolute total for the vegetation type has been determined but it is certainly in excess of 100 and probably many more. On the very rich meadows it is difficult to determine which are the dominant plants, but in four such meadows in the upper Itchen for which probably fairly complete plant lists are available, the grasses red fescue *Festuca rubra*, rough meadow grass *Poa trivialis*, Yorkshire fog *Holcus lanatus* and great water grass *Glyceria maxima*; the sedges *Carex disticha*, *C. hirta* and *C. paniculata*; and the herbs *Caltha palustris*, *Cirsium palustre*, *Dactylorhiza incarnata*, *Filipendula ulmaria*, *Mentha aquatica*, *Ranunculus acris*, *Trifolium pratense*, *Menyanthes trifoliata* and *Valeriana dioica* were constant and common. In three of the four meadows (not necessarily the same three) three more grasses, tall fescue *Festuca arundinacea*, fete-grass *Glyceria fluitans* and rye-grass *Lolium perenne*; the sedge *Carex acutiformis*; and at least eight more flowering plants also occurred commonly. The average number of species per meadow was 55.5.

The meadows support large populations of many locally distributed or attractive plants now very restricted in distribution because of the limited amount of suitable habitat: the marsh orchid *Dactylorhiza incarnata* and bogbean *Menyanthes trifoliata* may be cited as examples. Some sites are known to be particularly rich in orchids. One of the meadows at St. Cross, south of Winchester, supports large hybridising populations of the marsh orchid group, *Dactylorhiza praetermissa*, *D. incarnata*, *D. fuchsii* and probably the very rare *D. traunsteineri*, besides a large population of common twayblade *Listera ovata*. A thorough investigation of the valley would no doubt reveal other similar assemblages.

The precise structure of the plant communities of individual meadows appears to depend on a number of variables of which

soils, ground water regime and grazing intensity are probably the most important. In general, the wetter the site and the more peaty the soil, the richer it is in species. The ground water regime may vary on a micro scale within a meadow, where the ridge-and-furrow of old water meadows can give rise to distinctive local zonation in the plant community. Intensive grazing tends to favour the grasses at the expense of the flowering plants and some three to four grasses dominate a species-rich but comparatively sparse sedge and herb flora. On the other hand, on little-grazed meadows the tall herbs, rushes and reed-like plants characteristic of the fen areas, tend to invade at the expense of the smaller, less vigorous species. The meadows thus exhibit considerable variability.

What effect did the water meadow episode in the history of the valley have on the meadow flora? During the present study the former extent of water meadows was plotted from air photographs, on which the patterns of ridge-and-furrow show clearly. Unfortunately it was not possible to identify certainly a modern herb-rich meadow which was not at some time floated. Thus there is at present no comparative situation from which to draw conclusions.

Sheail (1971) and Duffey *et al* (1974) concluded that the irrigated meadows would have been poor in species because of intensive grazing and the selective removal of the agriculturally less useful dicotyledons by the meadsmen—a likely practice in view of the high costs of meadow construction and maintenance. Duffey *et al* (1974) describes floated meadows as being dominated by *Festuca arundinacea*, *F. pratensis* and *Bromus commutatus*. Anomalously, the sward of a functioning water meadow in the Avon valley, Hampshire, studied by Fream (1888) in the late nineteenth century, supported no less than 85 species, besides others confined to the draws and carriers. To what extent the

species-rich meadows of today have 'recovered' their flora after a period of impoverishment thus remains debatable, though further examination of the few remaining working (and recently abandoned) meadows (mostly in the Avon valley) ought to provide elucidation. Much may depend on whether the meadows were formed on alluvium or on peat. The latter sites were less favoured and were developed latest. They were less easy to manage and may have retained a richer flora.

Unimproved but species-poor meadows

These meadows may be derived from herb-rich meadows via consistent heavy grazing and lowering of the water table since the abandonment of the floated meadow systems; or they may be on alluvial soils naturally supporting a sward relatively poor in herbs. They are dominated by grasses, usually fescue, rough meadow grass, Yorkshire fog, false oat *Arrhenatherum elatius* and sometimes perennial rye-grass *Lolium perenne*. False oat appears to be essentially associated with the botanically poorer, drier and more heavily grazed meadows, whilst much of the rye-grass may have been introduced from leys through droppings of animals. The herb flora mainly comprises species which withstand heavy grazing such as thistles *Cirsium arvense* and *C. palustre*; buttercups *Ranunculus acris*; and sometimes ragwort *Senecio jacobaea*; though in most meadows relict pockets of other herbs survive, especially in low moist hollows, old drains and the furrows of the former water meadows.

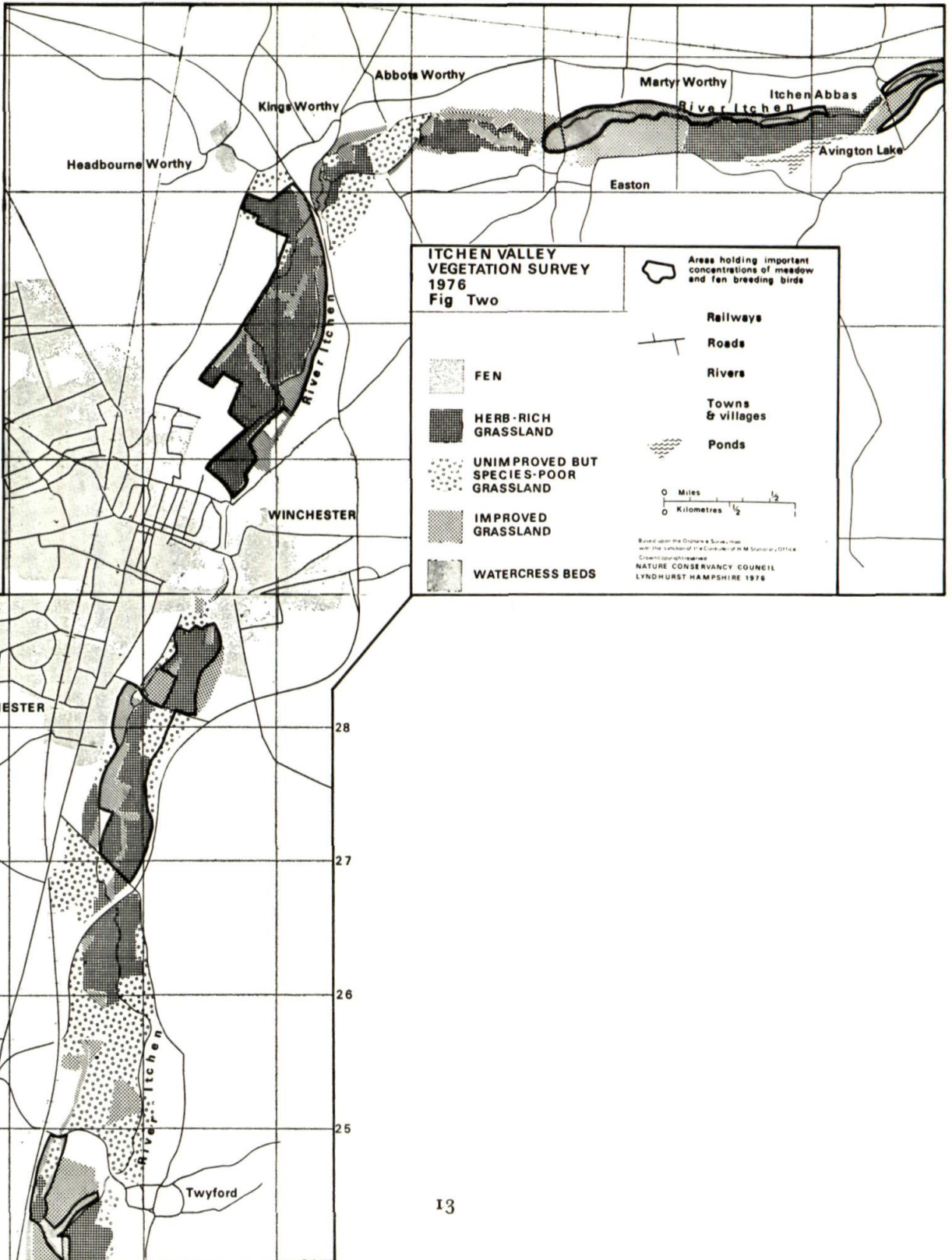
Improved Grassland

This category includes meadows which have been cultivated and reseeded with commercial seeds mixtures or have been frequently sprayed and/or fertilised. Though native grasses occur and, indeed on some sites which have seen no treatment for a number of years, may be important components of the sward, the vegetation type is essentially an artifact of modern farming.

Aquatic Vegetation

The Itchen is rich in plant nutrients and supports an abundant and species-rich aquatic flora. At the height of the growing season the bed of the river is everywhere covered with vegetation unless recently cut. Butcher (1927) considered that current velocities and degrees of silting were the main determinants of aquatic plant distribution. The relatively rapid flowing upper reaches above Martyr Worthy with a fall of 12-20 ft/mile and a generally gravelly bottom were dominated by robust plants with strong rooting systems, mainly water crowfoot *Ranunculus pencillatus*, fool's watercress *Apium nodiflorum*, water parsnip *Berula erecta* and in places water dropwort *Oenanthe fistulosa*, with watercress *Rorippa nasturtium-aquaticum* near the banks. With reduced flow in the middle reaches of the river (corresponding roughly to a fall of 6-11ft/mile) mare's tail *Hippuris vulgaris*, bur-reed *Sparganium simplex* and great water parsnip dominate the community; and in the lower reaches (with a fall of less than 6ft/mile and a silty bed), canadian pondweed *Elodea canadensis* and starwort *Callitriche stagnalis*, plants with filamentous, adventitious roots and weak stems, were the dominants. This overall pattern is complicated by local variations resulting from changes in river velocity and sedimentation caused especially by such artifacts as bridges and training walls.

A rapid survey of the river in 1976 confirmed that there had been no great changes in the composition of the aquatic flora since Butcher's survey but further variations in the relative abundance of the dominant plants are now brought about by periodic weed cutting, the objects of which are to reduce weed cover and allow the silt to be washed downstream (Soulsby 1974). On a 'game' fish river such as the Itchen, the reduction of weed growth to provide fish territories and spawning grounds is an integral part of management. Most 'coarse' fish spawn in weed and weed cutting also contributes (with



electro-fishing) to the reduction in numbers of coarse fish in favour of more game fish—though a balance is needed because both are equally dependent on invertebrates, in turn dependent on weed and the mud accumulated by weed. Looked at in a purely ecological light, weed cutting is likely (depending on its scale) to diminish the ecological diversity of the river—witness the River Avon, where cutting has been blamed for a decline in the numbers and weights of coarse fish (Wessex Water Authority 1976). The relationship between weed, invertebrates and fish deserves further elucidation.

Watercress Beds

Watercress beds are interesting artifacts of the chalk stream ecosystem. Water enters the beds usually from boreholes at about 50-55°F and is directed over prepared gravel surfaces on which the cress grows. The annual cycle begins with the cleaning of the beds in late summer and autumn, every vestige of the old crop being removed. Regrowth can be either from seedlings or mature plants. Cropping takes place during the winter and spring, throughout which it is essential to maintain a relatively high water temperature and ensure an even flow of water over all parts of the bed. Though the crop is monospecific and the conditions under which it is grown impose rigid limits on biological development, the beds support large active invertebrate populations throughout the winter, which provide a rich food source for ducks, waders and a variety of passerine birds. Ducks and blackbirds, in particular, can achieve nuisance status by 'bruising' the cress on a sufficient scale to cause commercial losses.

FAUNA

Invertebrates

Regular sampling of invertebrates in the Itchen was begun by the former Hampshire River Authority in 1972. Samples were taken

from the river bed at 34 stations in February and August using a box sampler of 0.05m² inserted to a depth of 5cm. Nine samples were taken at each station and combined for analysis. This programme was greatly curtailed after 1974, with detailed sampling being confined to only twelve stations. The results show no marked differences in the fauna between stations. Numbers, however, vary considerably between samples taken from the same sites for reasons which are not clear. This makes numerical analysis of doubtful value but it is possible to derive a general description of the fauna.

Most of the biomass comprises Oligochaete worms; Crustaceans (mainly shrimps *Gammarus pulex*, though water louse *Asellus asellus* were common); Ephemeroptera (mayflies—mainly *Baetis* spp., *Heptagenia* spp., *Ephemerella ignita*, *Caenis moesta* and *Ecdyonurus* spp); and Diptera (mainly midges Chironomidae and blackflies Simuliidae). These four groups dominate the fauna but Hirudinea (leeches), Trichoptera (caddisflies) and Coleoptera (beetles) are important. Most animals appear in the bottom samples in their larval forms. Bottom sampling also misses the abundant gastropod snails associated with weed; small gastropods must rank as important contributors to the riparian fauna. Though the maximum numbers of individuals and species of each of the main groups recorded was high (4000 Oligochaetes/m²; 4000 Crustacea/m²) and reflects the great productivity of chalk streams, the range of groups present is comparatively narrow. Groups notably poorly represented include Plecoptera (stoneflies) and Odonata (dragonflies) which are more characteristic of still waters and acid streams.

The invertebrate fauna of the cress beds was investigated briefly as part of the present survey. In mid-October and late December 1976 samples of both cress and substrate were taken from a bed in the headwaters of the Arle. As expected in a situation where

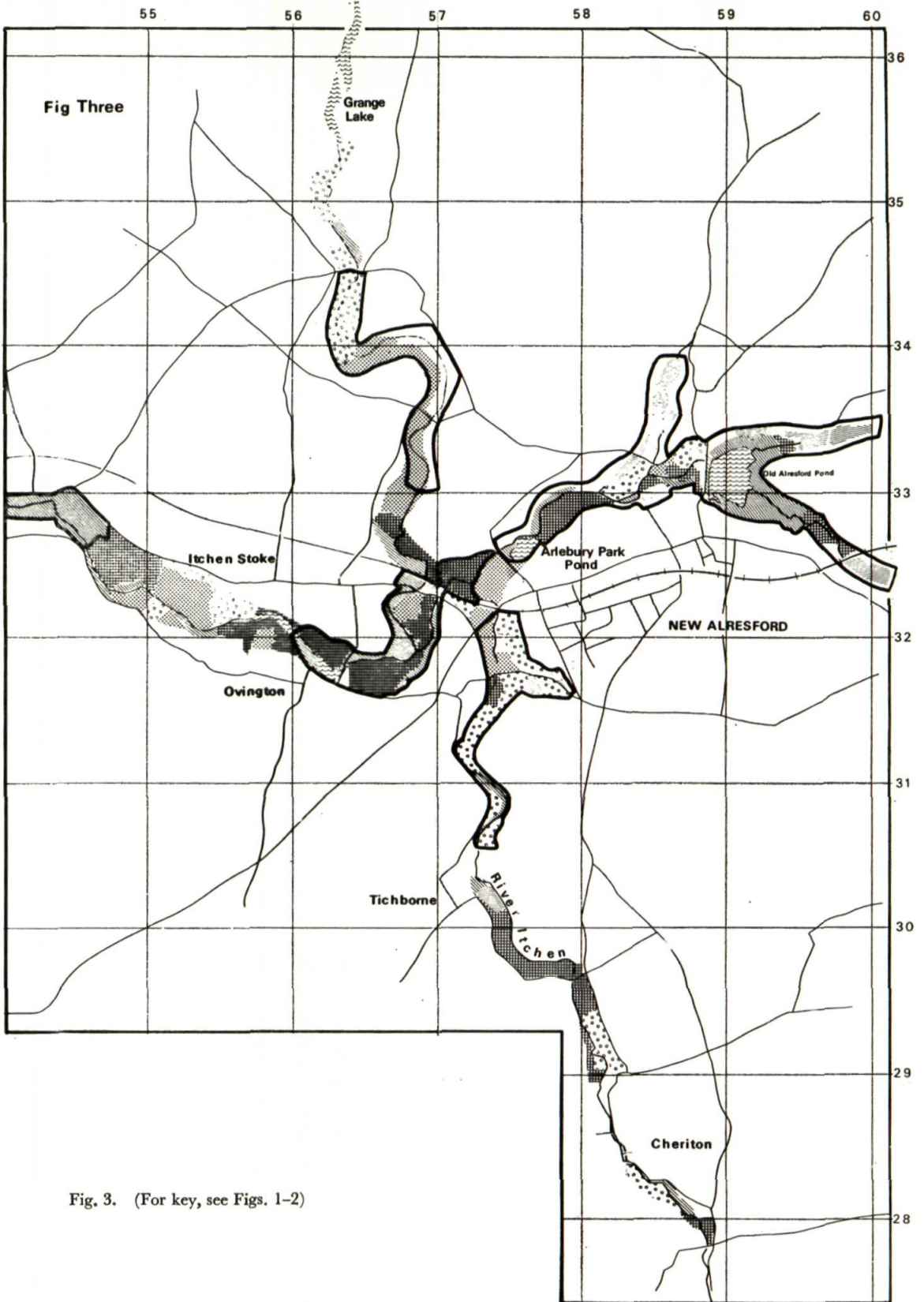


Fig. 3. (For key, see Figs. 1-2)

the invertebrate habitat is virtually destroyed annually, the fauna was confined to a relatively few animals, though some of those occurred in considerable numbers. In the earlier sample, the only species actually associated with the foliage and stems of the cress was a pulmonate snail tentatively identified as *Limnaea peregra*. The root systems of the cress, however, sheltered large numbers of Ephemoptera larvae and smaller numbers of Diptera, Trichoptera and Coleoptera larvae. In the substrate, Oligochaetes were common and both Ephemoptera larvae and Platyhelminth (flatworms) were present. In sum, most of the biomass of the cress itself comprised Gastropods, and their eggs and Ephemoptera larvae; and that of the substrate comprised Oligochaetes.

By the time of the later sample the fauna of the cress had changed dramatically and was dominated by huge numbers of shrimps *Gammarus pulex* and midge (Chironomid) larvae. The Ephemoptera larvae which had dominated the October sample had presumably hatched, leaving only relatively small numbers of over-wintering individuals.

Mammals

Three native aquatic mammals now occur in Britain—the water vole *Arvicola amphibius*, water shrew *Neomys fodiens* and otter *Lutra lutra*. All are present on the Itchen. Bones of a fourth species, the beaver *Castor fiber*, have been found in an early Roman or possibly pre-Roman context during excavations at Winchester (*Winchester Studies*, 9 (2), forthcoming). Water shrews and water voles are common on the Itchen, particularly on the middle and upper reaches where bank sides are well vegetated. During the 1976 surveys, water voles were seen in large numbers and water bailiffs confirmed that they were particularly numerous, probably because weed cutting had been minimal in order to conserve water levels in the exceptionally dry summer, which in turn had prevented the sudden local rises in water

level which normally flooded many breeding burrows.

The otter has declined both in numbers and range in Britain since the nineteenth century. In the 1960s, perhaps continuing into the 1970s, there has been a further, apparently sharp decline, the causes of which remain arguable, though disturbance, habitat destruction and perhaps pollution have probably played important roles (Nature Conservancy Council, 1977). During a recent national survey of the species, animals or their signs were recorded frequently above Winchester and there is thought to be an established breeding population in the upper Itchen. Evidence of otters occurs with generally decreasing frequency south of Winchester and there is no recent firm evidence of breeding. There appears to be a strong general correlation between the diminishing occurrences of the species and diminishing amounts of bankside vegetation progressing downstream. Otters need as little disturbance as possible (and especially the tolerance of water bailiffs); and frequent areas of fen and other riverside cover where they may establish breeding holts and find places to lay up during the day. Both breeding holts and daytime hovers can be enlarged holes in or near the river banks well protected by vegetation, hollow trees or dense undergrowth. For otters to persist on a river, dense bankside vegetation at frequent intervals appears essential: the upper Itchen is thus an ideal otter river but it becomes progressively less so downstream from Winchester.

Birds

Table 2 shows the numbers of each of 15 species of wetland birds recorded during the 1976 survey of the Itchen valley carried out by 18 members of the Hampshire Field Club and Archaeological Society Ornithological Section, coordinated by J. M. Cloyne. Each observer was allocated a section of the valley and asked to record on 1:10 560 maps the

location and the breeding activity of individuals of each species during five spaced visits between March and August. No previous attempt had been made to quantify the avifauna of the Itchen (or probably any other) chalk stream valley. In the event, some four miles of the Upper Itchen between Kings Worthy and Itchen Stoke was not examined, although some information (qualitative rather than quantitative) is available for this reach from earlier years. Moreover, the figures for some species are certainly underestimates because the number of visits was well below that normally required for census work of this kind (International Bird Census Committee 1969). In particular, reed warbler *Acrocephalus scirpaceus* populations are

known from ringing studies in the valley to have been grossly under-recorded, whilst water rails *Rallus aquaticus* are probably under-represented in the Table because of their elusive and skulking behaviour.

The 15 species fall into three groups: seven are associated with the watercourses themselves; four with fen vegetation; and four with flood plain meadows. Between them they probably span the complete spectrum of invertebrate food sources, whilst they include two partial fish-eaters (little grebe *Podiceps ruficollis* and tufted duck *Aythya fuligula*), one species dependent completely on small fish (kingfisher *Alcedo atthis*), and one habitual grazer of both aquatic and terrestrial vegetation (coot *Fulica atra*).

TABLE 2

NUMBERS OF RIPARIAN AND FLOOD PLAIN BIRDS IN THE ITCHEN VALLEY, HAMPSHIRE, 1976

Species	Visit 1	Visit 2	Visit 3	Visit 4	Visit 5	Breeding Pairs	
	(March)	(late April— early May)	(mid-May)	(June)	(July-Aug)	Proved	Suspected
<i>Riverine Species</i>							
Coot	244	239	154	168	135	65	25+
Kingfisher	15	22	15	15	10	5	10
Little Grebe	65	32	22	22	26	12	14
Tufted Duck	100	77	50	52	46	10	12
Grey Wagtail	88	80	53	58	45	31	7
Mallard	263	408	402	369	556	74	0
Teal	63	21	7	12	14	3	0
<i>Meadow species</i>							
Lapwing	201	165	177	311	162		c75
Redshank	71	94	48	132	0	33	34
Snipe	422	130	30	46	41	29	11
Yellow Wagtail	0	15	14	48	3	22	2
<i>Fen species</i>							
Reed Bunting	71	91	72	74	16	45	28
Reed Warbler	0	3	45	61	2	0	50+
Sedge Warbler	0	90	196	126	21	0	100+
Water Rail	27	13	1	5	1	2	10

From a survey by the Ornithological Section of the Hampshire Field Club and Arch. Soc. 1976. See text for explanation.

Further comments on each of these groups follows, embracing both data from the 1976 survey and records from earlier years derived mainly from J. M. Cloyne *in litt* and *The*

Hampshire Bird Report, published annually by the Ornithological Section of the Hampshire Field Club and Archaeological Society.

Riverine Species

Three species (little grebe, grey wagtail *Motacilla cinerea* and kingfisher) exhibit a continuous and regular distribution along the main river channels to within roughly four miles of the estuary, below which they become fewer and of irregular occurrence. Two other species (coot and mallard *Anas platyrhynchos*) exhibit a not dissimilar pattern but show a more pronounced tendency to increase in numbers towards the headwaters. The small population of teal *Anas crecca* is confined to the valley above Winchester and the three breeding pairs recorded in 1973 were all in the river headwaters. Similarly, most of the tufted duck breeding in the valley occurred above Winchester, although in 1976 and previously, at least three pairs bred on the reach of the river immediately upstream of the estuary.

These distributions, with a tendency towards an up-river increase in abundance, correlate with decreasing amounts of riverside vegetation, increased grazing intensity on the flanking meadows and probably increasing disturbance, in the lower reaches of the river. Below Eastleigh bank clearance is virtually complete and fen vegetation virtually absent from the flood plain. Nest sites and cover are sparse and suitable cliffs for the hole-nesting kingfisher are also infrequent.

Meadow Species

Breeding populations of the three waders (lapwing *Vanellus vanellus*, redshank *Tringa totanus* and snipe *Gallinago gallinago*) are concentrated on less intensively grazed pastures in the upper Itchen valley above Winchester, with most of the redshank in the headwaters. Snipe, on the other hand, also occur as a scatter down the four miles of valley below Winchester where grazing tends to be more intensive.

In 1976, 21 of the 24 breeding pairs of yellow wagtails *Motacilla flava* were on the flood plain of the lower Itchen below East-

leigh, the reach of the river which otherwise tended to be impoverished of breeding wetland birds, though both from 1976 and previous records it seems likely that a thin scatter of yellow wagtails breed northward to Winnall Moors immediately above Winchester. The concentration below Eastleigh is not readily explicable, though there may be some correlation with the grazing intensity there, for yellow wagtails feed habitually round cattle.

Fen Species

The distribution of the four fen species (reed warbler, sedge warbler, reed bunting *Emberiza schoeniclus* and water rail) closely reflects that of the main areas of fen vegetation and all four species thus become progressively more numerous as one progresses upstream, though reed buntings also occur widely down the length of the flood plain wherever reed-filled ditches, hedges or scrub occurs.

The distribution of the riverine species was difficult to summarise in map form but the main breeding areas of the meadow and fen species in the valley are shown on Figures 1-3. The 1976 survey was concerned essentially with breeding populations. The upper Itchen valley, however, also supports substantial numbers of ducks and coots in autumn and winter, centred on Avington and Grange Park Lakes and Arlebury and Arlesford Ponds and the intervening stretches of valley. Some indication of the size which these assemblies can achieve is given in Table 3. Among other important wetland groups, four species of waders regularly occur on passage or over-winter in the upper Itchen. Three species (redshank, snipe and green sandpiper *Tringa ochropus*) are associated essentially with the larger cress beds. The fourth, the lapwing, occurs widely on the chalklands and flocks regularly frequent the valley, though the main feeding grounds are on nearby farmland. Probably in excess of 150 redshank have been present in the valley during the autumn and winter since the early

1970s but it is not known if the birds are derived from the local breeding population. The habit of wintering in the valley appears to be of recent origin and is probably associated with the recent run of mild winters: most inland breeding redshank over-winter on the coast. Snipe occur in numbers which may exceed 100 in a single small meadow, particularly in and around certain cress beds. The numbers of green sandpipers (a passage migrant with a residual wintering population in southern England) recorded in the valley during the 1976 survey, which covers the main passage periods, were as follows:

Visit 1 (March)	25
Visit 2 (late April-early May)	29
Visit 3 (mid-May)	1
Visit 4 (June)	19
Visit 5 (July-August)	68

Of the order of 15-25 individuals have over-wintered since 1970.

The attraction of the cressbeds to the waders (and other birds) evidently lies in a large and readily accessible food supply. By the time the second invertebrate sample was

taken in December 1976, redshank and green sandpiper had been feeding regularly on the bed for at least a month. Feeding redshank watched on the beds in winter 1975/76 ran lightly over the cress, taking prey from just beneath the surface with sudden stabs of the bill. Pecking rates were greatly in excess of those normal on intertidal mudflats. Almost certainly they were exploiting the huge numbers of shrimps in the beds and feeding on the beds probably starts in response to a late autumn hatch. As a feeding ground for birds the beds have the advantage of relatively constant year-round temperatures which may assist in ensuring a continuous invertebrate food supply. Besides the waders, the cress beds attract large numbers of passerine birds, notably grey wagtails, pied wagtails *Motacilla alba*, meadow pipits *Anthus pratensis*, water pipits *Anthus spinoletta spinoletta*, black-birds *Turdus merula* and other thrushes, besides ducks. Little is known about the food of any of these species at the beds. The water pipits, of which 30 to 40 over-winter on the Itchen cress beds, form one of a few regular wintering populations in England, other groups also occurring mainly on Wessex chalk stream cress beds.

TABLE 3 MAXIMUM NUMBER OF COOT AND DUCKS RECORDED ON WATERS IN THE UPPER ITCHEN VALLEY, 1970 TO 1976*

	COOT	MALLARD	TEAL	WIGEON	SHOVELER	TUFTED DUCK	POCHARD
Avington Lake	200	795	200	100	25	36	37
Grange Park Lane	43	1250	153	30	46	35	52
Arlebury Pond	—	250	—	—	—	—	—
Alresford Pond	266	800	270	83	45	28	64

*Derived from *The Hampshire Bird Report* published annually by the Ornithological Section of the Hampshire Field Club and Archaeological Society and from monthly counts carried out for The Wildfowl Trust.

CONCLUSIONS

1. Though its chalkland catchment is intensively agricultural, the Itchen valley flood plain remains relatively little 'improved' agriculturally and is rich in riparian habitats.

In particular, large areas of fen and herb-rich meadows survive, the latter probably comprising the largest assemblage of species-rich neutral grassland in England. Both fen and herb-rich meadows are of great nature conservation importance, both because of their restricted distribution and their intrinsic floristic and faunistic richness. Nonetheless, these habitats should not be seen in isolation. The valley comprises a mosaic of habitats, which from physical, ecological and historical viewpoints form a single, coherent system. The drier species-poor meadows, in particular, should not be ignored: small changes in water regime or management may be all that is needed for their enrichment.

2. There is a gradient of biological enrichment from the estuary to the source, in the sense that herb-rich meadows, fen and river bank vegetation become progressively more frequent. In the upper Itchen the vegetation is luxuriant and the water table high. In the lower reaches, the water table tends to be lower, grazing is often intensive and the river banks become progressively more impoverished of vegetation. This general picture is reflected in the distribution of most wetland birds (a notable exception being the yellow wagtail), water voles and otters.

3. The chalk stream valleys as a group are likely to be richer in the range and abundance of organisms they support than rivers deriving their water from neutral or base-poor strata. However, comparable habitat surveys of chalk streams have been organised by the Nature Conservancy Council on the Frome (Dorset), Piddle (Dorset), Avon (Hampshire, Dorset, Wiltshire) and Test (Hampshire) and their tributaries, and of these only the flood plain of the Test above Stockbridge approaches that of the Itchen in

abundance of herb-rich meadows and fen habitats.

4. Conservation of the scientific interest of the Itchen valley depends largely on individual landowners resisting the temptation to reclaim or 'improve' its fens and meadows or 'tidy' the river bank; and partly on the development control policies of the Local Planning Authorities in preventing physical development. In the former context it would be all too easy to lower the water table further and convert the unimproved meadows to sown leys. Probably only the pre-eminence of fishing in the valley has directed attention away from agricultural improvement since the demise of the floated water meadows. Whether lowering water tables and converting the present species-rich meadows to leys is always agriculturally beneficial is arguable in the context of the Itchen and it would be of value to compare the productivity of the damp unimproved meadows with the drier sown leys. In a study of Woodwalton Fen, Cambridgeshire, Williams *et al* (1974) found that live weight gains of Galloway steers on pasture ecologically comparable to the unimproved Itchen meadows, competed favourably with sown leys. It was also striking that in the drought year of 1976 the former remained lush and green in stark contrast to the parched grass of 'improved' grassland. Probably most landowners in the Itchen valley are conscious of its special attributes. The scientific and nature conservation value of the flood plain and river, however, demands acknowledgement also by the statutory authorities most likely to influence their future (notably the Southern Water Authority, Ministry of Agriculture and Local Planning Authority) and a willingness to co-operate in ensuring that the biological diversity which survives today is not surrendered to agricultural or other benefits which in the national context may be insignificant.

Acknowledgements

Many people made this appraisal possible by answering questions about their own fields of experience, interest or research, or by permitting access to their land. In particular I wish to thank Ruth Tittensor, who carried out most of the vegetation survey, and the many landowners and water bailiffs who helped her; John Cloyne and those members of the Hampshire Field Club and Archaeological Society Ornithological Section, who carried out the bird surveys; and P. G. Soulsby, Area Biologist, Southern Water Authority; D. A. Wells and J. M. Waters, Nature Conservancy Council; Paul Chanin, Department of Biological Sciences, University

of Exeter; D. A. Beeson; W. M. M. Baron, Science School, Winchester College; Julian Cremona; the late D. W. H. Ffennell; and A. C. Berrie, Freshwater Biological Association; for assistance with various aspects of the survey. I am grateful for the encouragement of the Planning Department, City of Winchester (and in particular A. F. Rutter); and to the Technical Services Branch, Nature Conservancy Council, for preparing the figures. I should also like to thank Professor K. Gregory, Department of Geography, University of Southampton; and F. J. Green, Dept. of Archaeology, University of Southampton, for commenting on a draft of this paper.

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(This article is published with the aid of a grant from Winchester City Council. The assistance of the Nature Conservancy is also gratefully acknowledged.)