

to the reserve with their families in late autumn.

One of the benefits to be derived from a well-established Mallard population has been the attraction of other species of wildfowl to the reserve. Twenty-one different species have now been recorded, not including feral geese, introductions or escapes, and there has been a general increase in the number of different species seen each year. Data for the severe winter of 1962-63 shows how important such local reserves can be under extreme conditions; no less than seventeen species were recorded during this period.

As might be expected, the number of species visiting the reserve is considerably lower during the summer, but even here a definite increase has been observed since the reserve was established. The summer of 1966 was particularly successful, with

a record number of seven summer visiting species; these included Tufted Duck which amounted to a total of 720 duck-days, affected in no small way by the notable presence of five breeding pairs. (It should be noted that young birds were not included in the calculation of "wildfowl-days" until fully grown.) It is interesting to note that this first breeding record occurred in the year following the initial release of seven hand-reared Tufted Duck. Five of the latter were colour-ringed, but no such rings were observed among breeding birds.

In 1965, fifteen Gadwall were released, followed by a further nineteen in 1966, with two Pochard in the same year. It remains to be seen what effect these introductions have on the status of the reserve as a natural breeding ground for these species.

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Part II. The feeding ecology of local Mallard and other wildfowl

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Summary

The feeding habits of Mallard *Anas p. platyrhynchos* in an area near Sevenoaks, Kent, were investigated by 226 stomach analyses and by observations between 1957 and 1965. The main feeding areas included the river and its banks, the wet meadows by the river, the gravel pits and their margins and beneath oak trees *Quercus robur* in the valley. The dominant plants in these areas are described. The food taken varied each year, depending on the production and availability of food items, which were correlated with changes in the habitat (e.g. river clearance, grazing) and with the effects of differing weather conditions (e.g. flooding, dry summers).

The most frequently taken foods were: in the river, the leaf and stem of water crowfoot *Ranunculus aquatilis*, together with the mollusc *Hydrobia jenkinsi* and the caddis fly *Hydropsyche angustipennis*, and to a lesser extent the seeds of flote-grass *Glyceria fluitans*; from the river banks, the seeds of bur-reed *Sparganium erectum* and water-pepper *Polygonum hydro-piper*; from the wet meadows, the seeds of creeping buttercup *Ranunculus repens*, persicaria *Polygonum persicaria*, hammer sedge *Carex hirta* and sharp dock *Rumex conglomeratus*; in and around the gravel pits a wide variety, mainly the seeds of alder *Alnus glutinosa*, various *Polygonum* species, *S. erectum* and parts of horsetail *Equisetum*, as well as Chironomidae and *Hydropsyche* larvae.

Acorns were eaten in the years when oaks produced seed.

Forty other wildfowl were collected and their stomach contents were analysed. They included Teal *Anas c. crecca*, Wigeon *A. penelope*, Tufted Duck *Aythya fuligula*, Pochard *A. ferina*, Smew *Mergus albellus*, White-fronted Geese *Anser a. albifrons* and Canada Geese *Branta canadensis*.

Introduction

The food and feeding habits of Mallard *Anas p. platyrhynchos*, and other species of ducks and geese, were studied over an eight year period in an area along the River Darent between Sevenoaks and Otford, Kent. This area includes two gravel pits, the details of which have already been described (Harrison et al. 1962, Olney 1964) and in which extensive management has already taken place. It was quite obvious from observations that birds feeding in the area between Otford and the gravel pits were fighting to and from the pits where some feeding was also taking place, but whose prime value, at least in the beginning of the survey, was as a roosting area. It follows that any food study would have to consider the area as a whole, though most birds were collected away from the pits.

Methods and materials

From 1957 to 1965, mainly during the allowed shooting season of 1st September to 31st January, 266 birds of ten species were collected. Of these only eleven were found to be empty of food. Eight birds were collected within the protected season under a licence issued by the Nature Conservancy. The methods of analysis were the same as those described in detail elsewhere (Olney 1961, 1963a). The nomenclature of all seeding plants follows that of Clapham, Tutin and Warburg (1962).

The main feeding areas include: (1) the river and its banks, (2) the meadows by the river—especially when they are partially flooded, (3) the gravel pits and their margins, and in the case of Mallard (4) beneath the oak trees *Quercus robur* which are scattered along the river valley. It is not possible in this paper to go into much detail when considering the vegetation. Within the river the dominant plants are water crowfoot *Ranunculus aquatilis*, horn-wort *Ceratophyllum demersum*, flote-grass *Glyceria fluitans*, canadian pondweed *Elodea canadensis*, star-wort *Callitriche* sp., and duckweed *Lemna* spp. The river is fringed mainly with common bur-reed *Sparganium erectum* and reed-grass *Glyceria maxima*, and in some years with extensive patches of water-pepper *Polygonum hydropiper*. Alder *Alnus glutinosa* and willows *Salix* spp. are found along the river and throughout the valley. The meadows adjacent to the river are typically alluvial grassland habitats often containing semi-aquatic communities where the drainage is impeded. The most frequently occurring species here are various grasses,

creeping buttercup *Ranunculus repens*, persicaria *Polygonum persicaria*, hammer sedge *Carex hirta*, sharp dock *Rumex conglomeratus* and soft rush *Juncus effusus*.

Most of this report is concerned with the Mallard. Relatively little material was obtained from the seven other species (five ducks and two geese) studied. This is described and discussed at the end of the paper. Two general locality names are used: the *Otford area*, which includes the grazing meadows adjacent to the river between Otford and the gravel-pits and the river and its banks, and the *gravel pit area*, which includes the pits and their margins.

MALLARD

a. *Otford area*. Two hundred and ten Mallard were collected from this area between 1957 and 1965. The main food items found in the stomach contents of these birds are shown in Table I. Plant material, mainly seeds, occurred in 204 (97.1%) of the birds, and occupied 85.7% of the total volume. Animal material was found in 85 (40.5%) birds and occupied 14.3% of the total volume.

The seeds of creeping buttercup *Ranunculus repens* were found more frequently than any other species, occurring in 35.2% of all birds examined. This is a common species in the meadows alongside the River Darent, particularly in those areas which are liable to flood. It was not always possible to distinguish between the seeds of *R. repens* and meadow buttercup *R. acris*, and in such cases they have been included *R. repens*. In four years of survey this was the most frequently occurring plant (Table II).

Common bur-reed seeds were found in 28.1% of the birds, occurring in each year, though rarely were they found in large numbers. In three years of the survey they were the most frequently occurring species. *S. erectum* is the dominant species of the river edges, and with planting it is now common in parts of the gravel pits.

The seeds of persicaria were found in 50 birds and occurred in all years apart from the first year. This species is found in a wide range of habitats in this area and can be particularly common in the wetter parts of the grazing meadows and in the disturbed communities around the pits. The closely related species, pale persicaria *P. lapathifolium* and knotted persicaria *P. nodosum* ecologically resemble (at least in this area) *P. persicaria*. Distinguishable seeds occurred in seven and six birds respectively.

Water-pepper seeds were found in 27 birds in all years apart from the 1958-59 shooting season. This species is characteristically found in damp places, and on river banks and can produce large numbers of seeds. Occasionally birds are shot which are crammed full of these seeds, and for example in November 1964, two birds were collected which contained c.3,500 and 1,500 seeds respectively.

The hammer or hairy sedge is a common plant of the damp, grazing meadows alongside the river, and its seeds were an important part of the diet of those birds feeding in this area. The seeds occurred in 37 birds and were found in each year of the survey, though not in great quantity.

The seeds of clustered or sharp dock were found in 33 birds and occurred in each season, apart from 1960-61. This variable species is a characteristic species of the damp grasslands by the river, and is also found, though less frequently, around the gravel pits.

The most commonly eaten grass species was flote-grass, whose seeds were found in 26 birds. This was a particularly important species during the 1964-65 season, when it was found in nine of the 34 birds examined, and in three birds shot in December and January large numbers

were found—one bird had eaten over 9,000 seeds. Other grass species which occurred included reed-grass, glaucous sweet grass *G. declinata*, marsh foxtail *Alopecurus geniculatus* and Italian ryegrass *Lolium multiflorum*. However, none of these occurred often or in quantity.

Alder seeds were found in 25 birds in seven of the eight seasons. It is a common tree of the wetter parts of the valley and has been extensively planted around the gravel pits. The amount and availability of seed produced appears to vary considerably from year to year.

The seeds of *Rosa* spp., and hawthorn *Crataegus monogyna* occurred in 20 and 17 birds. These plants have a limited distribution in the valley and around the pits.

Acorns, the seeds of *Quercus robur*, though they occurred in only 16 birds, formed a substantial part of the total volume (45.3%). They were found in four of the eight years. The production of acorns varies from year to year and from tree to tree, and very large numbers were produced in some years by the relatively few (17) trees in the valley and around the pits. Mallard could often be seen feeding under these trees.

Blackberry *Rubus fruticosus* agg. is widespread and common around the pits and throughout the valley. The seeds

Table I. Main food items from the stomach contents of 210 Mallard from the Otford area, 1957-65.

Plant material	volume in ml.	Frequency	% of total frequency
Seeds:			
<i>Ranunculus repens</i>	15.3	74	35.2
<i>Sparganium erectum</i>	5.0	59	28.1
<i>Polygonum persicaria</i>	7.7	50	23.8
<i>Carex hirta</i>	6.95	37	17.6
<i>Rumex conglomeratus</i>	2.9	33	15.7
<i>Polygonum hydropiper</i>	16.15	27	12.9
<i>Glyceria fluitans</i>	20.8	26	12.4
<i>Alnus glutinosa</i>	4.8	25	11.9
<i>Rosa</i> spp.	2.4	20	9.5
<i>Quercus robur</i>	264.3	17	8.1
<i>Crataegus monogyna</i>	4.15	17	8.1
<i>Rubus fruticosus</i> agg.	0.8	16	7.6
Leaf and shoot:			
<i>Ranunculus aquatilis</i>	19.0	19	9.0
<i>Equisetum</i> spp.	8.9	13	6.2
Animal material			
Hydropsychidae	27.95	33	15.7
<i>Hydrobia jenkinsi</i>	11.8	30	14.3
Chironomidae	2.2	14	6.7
Total volume	= 583.9 ml.		
Plant material	= 500.3 ml. = 85.7% of total volume		
	97.1% of total frequency		
Animal material	= 83.6 ml. = 14.3% of total volume		
	40.5% of total frequency		

Table II. Numbers of occurrences of principal food plants and animals in Mallard viscera obtained in eight seasons near Sevenoaks, Kent, 1957-8 to 1964-5.

Food	Site	1957/58	1958/59	1959/60	1960/61	1961/62	1962/63	1963/64	1964/65	total
<i>Ranunculus repens</i>	wet meadows	—	27	7	7	14	3	6	10	74
<i>Carex hirta</i>	„ „	2	14	4	3	6	1	2	5	37
<i>Rumex conglomeratus</i>	„ „	2	13	5	—	7	1	3	2	33
<i>Polygonum persicaria</i>	wet meadows and gravel pits	—	14	6	11	5	6	4	4	50
<i>Ranunculus aquatilis</i>	river	—	—	9	3	1	2	2	2	19
<i>Glyceria fluitans</i>	„	—	6	—	2	4	—	5	9	26
<i>Hydrobia jenkinsi</i>	„	3	6	8	2	2	8	1	—	30
<i>Hydropsyche</i> sp.	river and gravel pits	—	3	8	1	11	5	2	3	33
<i>Polygonum hydropiper</i>	river banks	1	—	1	7	4	5	2	7	27
<i>Sparganium erectum</i>	river banks and gravel pits	5	13	10	12	9	3	3	4	59
<i>Alnus glutinosa</i>	gravel pits	—	5	2	4	1	1	2	10	25
<i>Equisetum</i> sp.	„ „	—	2	—	4	4	—	1	2	13
Chironomidae	„ „	—	2	2	1	2	—	5	2	14
total		13	105	62	57	70	35	38	60	440

were found in 16 birds and in each year of the survey, though never in large quantities.

Cereal grains were not found frequently though the amounts eaten were large. Wheat *Triticum aestivum* grains were eaten by nine birds and formed 7.6% of the total volume, and barley *Hordeum distichon* grains were eaten by six birds and formed 9.5% of the total volume.

Seeds of other species taken did not occur in any appreciable quantity or frequency. All of them are species which occur in the area, and are typical members of wet situations, grassland and disturbed communities.

Plant material other than seeds occupied 6.4% of the total volume. The leaf and shoot of various submerged aquatics occurred the most frequently with those of water crowfoot being found most often (9.0%). Other species found included a number of filamentous algae, canadian pondweed, horned pondweed *Zannichellia palustris*, and starwort. Duckweed was found in only one bird. All these species are common within the river or in the gravel pits. The stem and particularly the tips of horsetail *Equisetum* spp. which can be very common in parts of the wetter areas of the gravel pits, were found in 13 birds. In November 1961, two Mallard were shot which had been feeding on turnips.

Animal material was found in 89 (40.5%) birds and comprised 14.3% of the total volume. The larvae, and to a lesser extent the pupae, of the caddis fly *Hydropsyche angustipennis* occurred the most often, being found in 33 birds. They were taken in all but one of the eight years, usually in association with water crowfoot. They have been a particularly common member of the river fauna in

this area. Jenkin's spire shell *Hydrobia jenkinsi*, also a common inhabitant of the river, was found in 30 birds. Other molluscs taken included the freshwater mussels *Sphaerium*, *Pisidium*, and *Anodonta*, and the gastropod *Bithynia tentaculata*. Only *Sphaerium corneum* occurred at all frequently (eight birds) and in any quantity, and though *Anodonta* is common in parts of the gravel pits, it was only found in one bird.

A considerable number of insect larvae and adults were taken, the most common of which were the non-biting midge (Chironomidae) larvae which occurred in 14 birds. At least eight Diptera families were identified (Stratiomyidae, Psychodidae, Dolichopodidae, Empididae, Chironomidae, Rhagionidae, Ephydriidae and Simuliidae), though only Chironomids and the larvae and pupae of the black-flies *Simulium ornatum* and *S. erythrocephalum* occurred in any quantity. The larvae and adults of a number of water beetles were also taken including *Helophorus aquaticus*, *H. flavipes*, *Ilybius fuliginosus*, *Haliphys* sp., *Elmis* sp., and surprisingly considering its comparatively large size (about 29 mm.), one adult *Dytiscus marginalis*.

Crustaceans taken included the waterlice *Asellus aquaticus* and *A. meridianus*, the shrimp *Gammarus pulex* and in two birds small crayfish *Astacus pallipes*. There is some evidence that the numbers of *G. pulex* increased in the river after 1961 but after two years decreased because of the sterilization of female *G. pulex* by the parasite *Polymorphus minutus* (Crompton and Harrison 1965). This parasite was found in 50% of 104 Mallard between 1961 and 1964, though the number of possible intermediate hosts, including *G. pulex*, found in the diet of Mallard was not high.

Table III. Stomach contents of 16 Mallard from Sevenoaks gravel pit area, 1959-65.

Plant material	Frequency	Animal material	Frequency
<i>Equisetum</i> spp. tips	4	Larvae:	
Algae	2	<i>Hydropsyche</i> sp.	4
Seeds:		Chironomidae	3
<i>Sparganium</i>	3	Psychodidae	3
<i>Alnus glutinosa</i>	3		
<i>Polygonum persicaria</i>	3		
<i>Polygonum amphibium</i>	2		
<i>Rumex conglomeratus</i>	2		
<i>Rubus fruticosus</i> agg.	2		

Seeds occurring only once: Wheat, Barley, *Polygonum hydropiper*, *P. lapathifolium*, *P. nodosum*, *Lolium multiflorum*, *L. perenne*, *Bromus sterilis*, *Holcus lanatus*, *Juncus inflexus*, *Phleum pratense*, *Poa trivialis*, *Plantago lanceolata*, *Crateagus monogyna*, *Chenopodium album*, *Atriplex patula*.

Animal material occurring only once: *Gammarus pulex*, *Asellus* sp., *Limnaea pereger*, *Anodonta* sp., Rhagionidae larvae, Dolichopodidae larvae.

Earthworms were taken by seven birds and in three formed the major part of the stomach contents. Only two species could be definitely identified: *Allolobophora caliginosa* and *Eiseniella tetraedra*.

The leech *Helobdella stagnalis* which is common in the shallower parts of the gravel pits was found in a Mallard shot in November 1961.

The only time fish were found was in January 1963, when two birds were found to contain small trout *Salmo fario* remains.

b. *Gravel pit area*. Sixteen Mallard were collected from this area between 1959 and 1965, including eight collected outside the shooting season. The list of species found is shown in Table III.

Few conclusions can be drawn from such a small sample. It does indicate that relatively more animal material is taken in the summer month (in July and August when six birds were collected, five contained animal material and occupied 60% of the total volume) and that the majority of plant species taken are those associated with disturbed habitats such as would occur around the edges of the pits.

Discussion

Each shooting season the diet and feeding habits changed to some extent (Figure 1 and Table IV) and these changes can be correlated with changes in the habitat (e.g. river clearance, cattle grazing, etc.) and with the effects of differing weather conditions (e.g. flooding, dry summers, etc.). Field observations on feeding were often confirmed by subsequent stomach analyses, and could be linked to changes in environmental conditions.

In 1957 much of the feeding occurred in the river and along the banks of the river. Though only seven birds were collected during the 1957-58 season the food they contained, which was mainly *S. erectum*, confirmed the field observations.

The wet summer and September floods of 1958 caused the meadows adjacent to the river to be inundated throughout most of the shooting season, though not to any great depth. Most feeding appeared to take place in the meadows—this is confirmed by the stomach contents—and to a lesser extent by the river banks. Statistical analysis showed significantly higher frequencies of wet meadow species taken in 1958-59. In this year also

Table IV. Main feeding areas and foods of Mallard near Sevenoaks, Kent.

Main areas	Main foods
Wet meadows	<i>Ranunculus repens</i> , <i>Carex hirta</i> , <i>Polygonum persicaria</i> , <i>Rumex conglomeratus</i> .
River	<i>Ranunculus aquatilis</i> , <i>Hydropsyche</i> sp., <i>Hydrotia jenkinsi</i> , <i>Glyceria fluitans</i> .
River banks	<i>Sparganium erectum</i> , <i>Polygonum hydropiper</i> .
Gravel pits	<i>Alnus glutinosa</i> , <i>P. persicaria</i> , <i>Equisetum</i> spp., <i>S. erectum</i> , <i>Hydropsyche</i> sp., Chironomidae.
River valley and pits	<i>Quercus robur</i> .

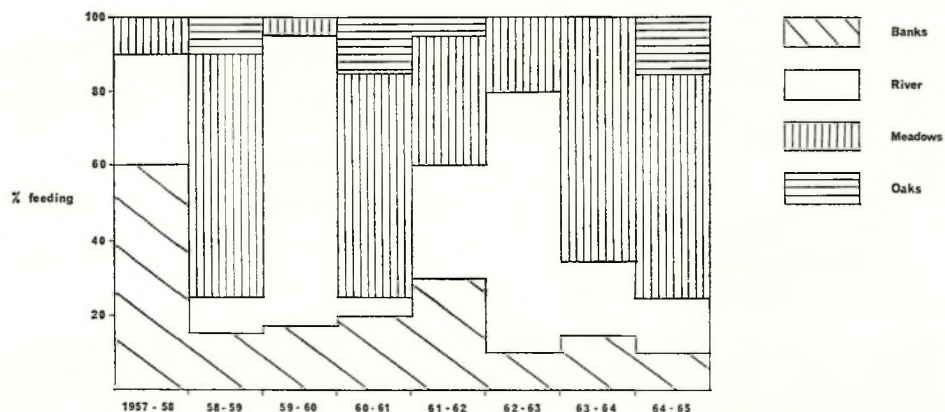


Figure 1. Feeding habits of Mallard in the Kent study area, 1957-58 to 1964-65.

most of the oak trees in the valley produced large quantities of acorns and many birds from November onwards were seen feeding under them.

The 1959 summer was very dry and hot and with extensive cattle grazing most meadow vegetation was eaten down and comparatively little seed was produced. In consequence the meadows were not favoured feeding grounds during the 1959-60 shooting season, and most of the food taken was obtained from the river with relatively frequent and large amounts of animal material being eaten, especially caddis-fly and black-fly.

The late summer, autumn and winter of 1960 were distinguished by prolonged and at times heavy rain. This resulted in widespread flooding of the water-meadows, where most of the feeding took place. Comparatively little feeding occurred in the river itself, though the seeds of bur-reed occurred in 46.2% of the birds examined from the 1960-61 season and appeared to be obtained mainly from the river banks. It was in this year, following the floods, that Mallard were first seen to be feeding on horsetail tips, particularly *Equisetum arvense*. The acorn crop was again large, after a year when virtually none were produced.

In 1961 a hot dry summer was followed by rain, and in the beginning of 1962 extensive flooding of the water-meadows occurred. Feeding during this season was spread over a large area, and food was taken from the meadows, from the river and from the river banks in about equal proportions. Again it was a year when some of the oaks produced large acorn crops.

During the 1962-63 shooting season, following a rather cool and wet summer, rain and snow occurred with a prolonged very cold spell into the spring of 1963. In the summer and autumn of 1962 the river was widened and a large proportion of the river bank flora was destroyed, particularly the beds of bur-reed. It was noted that most birds fed mainly in the river, or on the meadows before they were covered with snow and ice. Much of the food taken consisted of animal material (79.3% of the total volume; the most in any of the eight years under consideration) and most of this was obtained from the river, or later on when this was frozen over, from the open parts of the gravel pits. Again, statistical tests showed significantly higher frequencies of river species as compared with wet meadow and gravel pit species.

In 1963 the summer was cold and rather dull with a comparatively mild but

wet autumn and winter, with the resultant widespread flooding of the low-lying meadows. There was also some weed clearance in the river during the summer and autumn. Most feeding occurred in the shallow flooded meadows and to a lesser extent in the river and on the banks, where the flora had re-established itself after the drastic clearance of the year before.

The summer of 1964 was dry followed by some rain and shallow flooding, and the conditions for meadow feeding were ideal with a good seed crop being produced and wet conditions prevailing. A large proportion of the food during the 1964-65 season was obtained from the wet meadows with comparatively little being taken from the river and its banks. This was again a year when acorns were produced in considerable quantities and Mallard were often seen feeding under the oak trees in the river valley. Plants characteristic of gravel pits featured significantly in the analysis of stomach contents.

It is obvious then that the general diet changes from year to year and this can be related to factors which effect the production and availability of food items. This does emphasise the need for food studies in one area to extend over a number of consecutive years.

The most striking change in the area in the last ten years has been the development of the gravel pits. More and more wildfowl feeding occurs within and immediately around the pits and this is likely to increase as the planting programme (Harrison, Harrison and Olney 1962, Olney 1964, Harrison and Harrison 1964) takes effect and more seed is produced, and more invertebrates become established, particularly amongst the submerged plants. The overall population of wildfowl is likely to increase, with extra feeding areas around and within the pits, and with the continued undisturbed river valley between Sevenoaks and Otford. This pattern of change (more feeding areas and more birds) is already becoming obvious.

OTHER SPECIES

Teal *Anas c. crecca*

Otford area. Sixteen Teal were collected from this area during the shooting season between 1959 and 1964. Seeds occurred in 15 of these birds and animal material in six. Then contents of the food tracts are shown in Table V.

The seeds of *Ranunculus repens*, *Rubus fruticosus* agg. and *Polygonum persicaria*, and Chironomidae larvae occurred the

most frequently and in the greatest quantity. This closely follows the rating of foods found in 96 Teal collected from inland waters around the country (Olney 1963a), and appears therefore to be a true indication of what the normal diet in this area is.

forming the largest proportion, is similar to that found in the larger samples described by Olney (1963b).

Otford area. Few Tufted Ducks fed in this area and only three were collected from off the river during 1962-63. Animal material predominated with the caddis-fly

Table V. Food in stomach contents of 16 Teal from Otford area, 1959-64.

Plant material	Frequency	Animal material	Frequency
Seeds:		Chironomidae larvae	6
<i>Ranunculus repens</i>	7	<i>Pisidium</i> sp.	2
<i>Rubus fruticosus</i> agg.	4		
<i>Polygonum persicaria</i>	4		
<i>Rumex conglomeratus</i>	3		

Seeds only occurring once: *Polygonum nodosum*, *P. amphibium*, *P. aviculare*, *Glyceria* sp., *Scirpus lacustris*, *Galium aparine*, *Rorippa officinale*, *Alnus glutinosa*, *Sambucus nigra*, *Juncus* sp., *Trifolium repens*.

Animal material occurring only once: *Asellus* sp., *Planorbis* sp., *Hydrobia jenkinsi*, Limnophilidae larvae, Polycentropidae larvae, Lumbricidae.

Wigeon *Anas penelope*

Two Wigeon feeding in the meadows of the river valley were collected in January 1963, and both contained grasses, including rough meadow-grass *Poa trivialis*, annual meadow-grass *P. annua*, and creeping fescue *Festuca rubra*.

Tufted Duck *Aythya fuligula*

Gravel pits. The number of Tufted Duck visiting the gravel pits has increased dramatically since 1960 (Harrison, Harrison and Meikle 1967), presumably mainly due to the increase in the invertebrate aquatic fauna. Five birds were collected in 1962 and one in 1964. The list of food items found is shown in Table VI. The type of food found, with molluscs

Hydropsyche angustipennis being found in each bird and forming the major part of the contents. Parts of a small crayfish *Astacus pallipes* were found in one bird and in another Tufted Duck picked up dead by the Bradbourne Lakes in January 1963, less than a mile away from the river, most of its last meal consisted of crayfish.

Pochard *Aythya ferina*

A Pochard collected on the gravel pits was found to contain food consisting mainly of a filamentous algae and a few Chironomidae larvae.

Smew *Mergus albellus*

Two female Smew were collected in January 1963 from off the river and were found to contain a number of small trout *Salmo fario*, the longest of which was 14 cm.

Canada Goose *Branta canadensis*

Eight Canada Geese were collected in the Otford area between 1960 and 1963, four of which were found to be empty of food. Three of the others had fed mainly on the leaf, stem and roots of white clover *Trifolium repens* and to a lesser extent on grasses. One bird had fed exclusively on barley grains.

White-fronted Goose *Anser a. albifrons*

A bird shot in January 1964 in the Otford area contained a number of grasses, including the creeping bent *Argostis stolonifera* var. *palustris*, and creeping fescue *Festuca rubra*.

Table VI. Stomach contents of six Tufted Ducks from Sevenoaks gravel pits, 1962 and 1964.

Animal material	Frequency
<i>Hydrobia jenkinsi</i>	3
<i>Pisidium</i> sp.	3
<i>Anodonta</i> sp.	2
<i>Limnaea pereger</i>	2
Chironomidae	3
<i>Helobdella stagnalis</i>	2

Animal material occurring only once: *Planorbis complanatus*, *Gammarus pulex*, *Asellus aquaticus*, *Plantambus maculatus*.

Plant material occurring only once: *Ceratophyllum* sp., *Elodea canadensis*, and *Ranunculus aquatilis* leaf.

Acknowledgements

I am most grateful to Dr. J. G. Harrison and his family for collecting all the material for this survey, and for their unfailing hospitality.

This work was carried out as part of a project initiated and financed by the Wildfowl Trust and the Natural Environ-

ment Research Council (Nature Conservancy) and in its later stages by the R.S.P.B. I am greatly indebted to all three organizations.

Finally, I would like to express my gratitude to the Kent Sand and Ballast Company for granting me full facilities on their land.

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Part III. An appraisal of the planting programme, 1959-66

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Summary

The production of food (seed) and cover by plants, introduced in the course of management of the W.A.G.B.I.—Wildfowl Trust Experimental Reserve, was estimated in 1966. There were considerable differences between the yields of the sixteen species investigated, when food was assessed in terms of dry weight. In general, much higher yields could be obtained from agricultural crop species.

The amount of food produced was inadequate to support the winter population of wildfowl observed; the prime function of the reserve was to act as a roost in the vicinity of alternative feeding areas.

Considerable cover had been developed through planting, and appeared to be reflected in an increase in the breeding population. The moderate amount of food available may have been an important additional factor of the success of the reserve as a breeding station for wildfowl.

On the basis of results obtained, recommendations are made for short- and long-term planting programmes for similar areas.

Introduction

The establishment of wildfowl food and cover plants within the Kent Sand and Ballast Reserve was commenced in 1959. At that time, the reserve consisted of two gravel pits, both in active operation, with little or no marginal and submerged vegetation. The selection of plant species was based on results from the analysis of viscera of wildfowl shot in the immediate vicinity (Olney 1967). Planting has been carried out continuously since 1959, and

has always reflected the results obtained from viscera analysis. In recent years, new species have been added which, although not necessarily of previous local importance to wildfowl, have been shown by Olney (1962, 1963a, 1963b, 1964) to be of general value to overwintering wildfowl in Great Britain. Wherever possible, planting to provide resting and loafing cover has incorporated species that are known to provide food also.

Perhaps the most difficult problem in