An ecological outline of a moulting area of Teal, Vejlerne, Denmark*

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Introduction

This description of the moulting area of Teal *Anas crecca* in the marshland of Vejlerne, North-West Jutland, Denmark, is based on investigations by the Game Biology Station and was inspired by the Wetland Management Research Group of the International Waterfowl Research Bureau (IWRB).

As the literature gives extremely scanty information on the nature of moulting areas, the abiotic and biotic conditions in Vejlerne at the present time cannot be compared with the situation in other moulting areas for Teal. The Research Group therefore will consider it useful if the present description will stimulate to further research on moulting areas and on the ecology of dabbling ducks during the wingmoult period.

The marshland of Vejlerne (57°04′N, 09°00′E), which is privately owned, is a scientific reserve and Project MAR locality (Olney, 1965). It is administered by the owners in conjunction with the Nature Conservation Council (Naturfredningsrådet) of Denmark. The reserve covers an area of about 6,000 ha and includes shallow lakes, grazing meadows, and reed beds.

These coastal marshes were formed from shallow brackish inlets of the Limfiord during an unsuccessful attempt of drainage in the latter half of the last century. The reserve is now used for harvesting reeds, cattle grazing, fishing, supervised shooting and for scientific investigations. The marshland is mainly surrounded by agricultural land, and the moulting area comprises less than 1% of the total area of the reserve.

Data concerning the moulting area

The moulting area of approximately 50 ha occurs in the wide part of the south-western section of Selbjerg Vejle, a shallow lake of 900 ha (including reed beds (Figures 1, 2)). The immediately adjacent areas are refuges for pre- and post-moulting birds. The total number of moulting male Teal in the years 1966–1971 were 1,000–1,200, 1,000–2,000, 1,000–1,200, 800–1,000, 400–600, and 200–300 respectively. In addition, there were several hundred moulting male Mallard *A. platyrhynchos*, Shoveler *A. clypeata*, and Wigeon *A. penelope*.

The area has been by far the most important moulting area for Teal in the period of investigation and has probably long been used traditionally. In the other lakes of the reserve, where several important moulting areas for other species of dabbling ducks are found, occasionally a smaller number of groups of Teal (in all a maximum of 100 individuals in a year) moult, as for example in the north-western corner of Selbjerg Vejle, Glombak, Tömmerby Fiord, Veslös Vejle, and Hanvejle.

The moulting area in Selbjerg Vejle is probably the most important for Teal in all Denmark. According to the literature only one moulting area is known, viz. Nakskov Indrefiord, Lolland, South-East Denmark, where up to 1,000 birds have been observed (Bloch *et al.*, 1972).

Observations of smaller flocks of drakes (not moulting) in June–July in the eastern part of the country (Palm, 1950) indicate that birds on moult migration pass Denmark, or that the country holds several smaller moulting areas. On the basis of ringing recoveries Wolff (1966) has shown that moulting areas must exist in the north-western Europe.

In relation to the size of the breeding population in Vejlerne (presumed to be less than twenty pairs in the whole reserve), the number of moulting male Teal clearly indicates a moult migration into the area. The males arrive at the marshland of Vejlerne in late June–early July, and are found in shallow lakes and along lake shores in flocks of 50–300. During the wingmoult, flocks of ten to twenty birds are usually seen together, whereas post-moult flocks generally number several hundred and even up to about 1,000 birds. Immature birds, and possibly adult females, come to the area in the first half of August and can be observed together with the post-moult males.

The moulting period is mainly from 10 July to 10 August. Maximum numbers of flightless birds occur around 20 July.

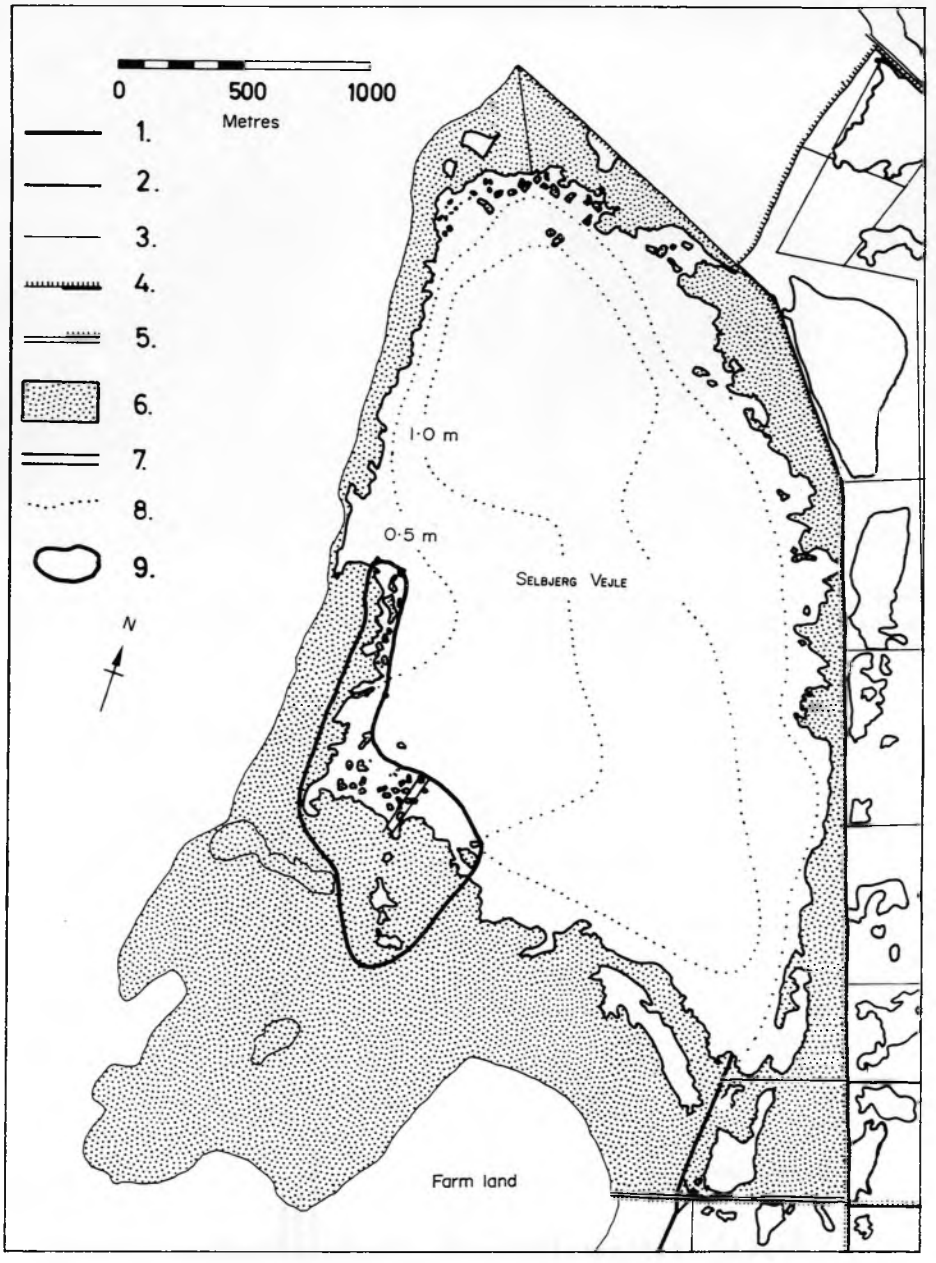

Figure 1. The moulting area and its surroundings in Selbjerg Vejle. 1, Main canal; 2, canal; 3, ditch; 4, dyke/dyke by canal; 5, road; 6, reed beds; 7, transect presented in Figure 4; 8, lines of depths; 9, moulting area.

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Figure 2. A view over the moulting area, where patches of reeds alternate (mix) with open water. In the background the vast reed beds of several hundreds of metres' width, which separate the moulting area from the neighbouring agricultural land.

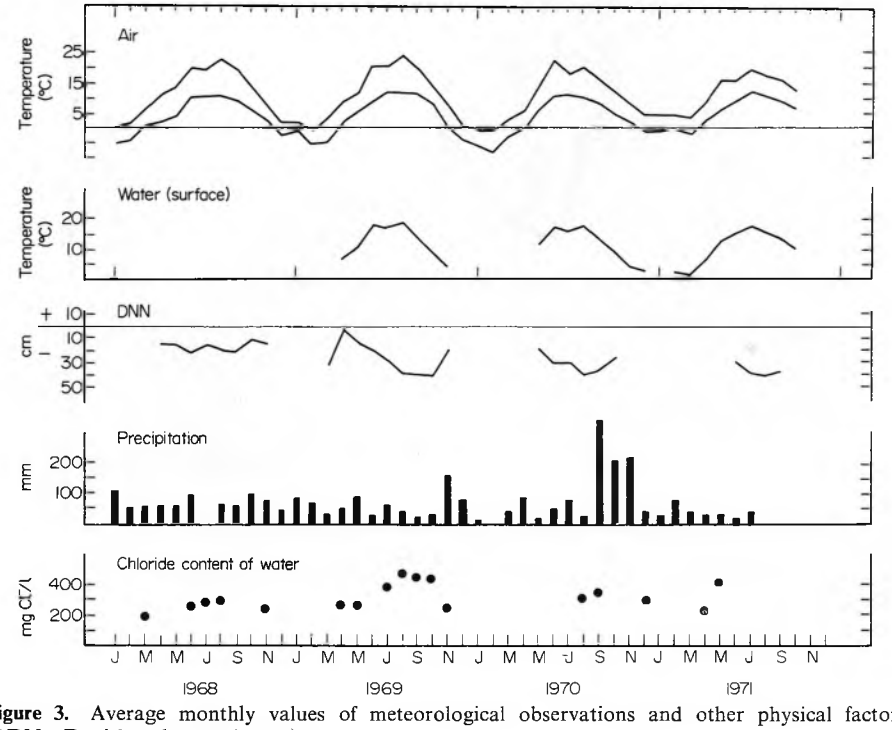


Figure 3. Average monthly values of meteorological observations and other physical factors. (DDN = Danish ordnance datum.)

The environment of the moulting Teal

The following are some of the physical, chemical and biological conditions, which are assumed to be of importance to the ducks in their choice of moulting area.

Climatic effects and other physical and chemical factors

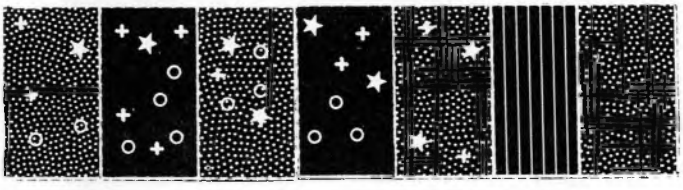
The location of the moulting area in the south-western corner of Selbjerg Vejle is very much due to prevailing winds varying between south-west and north-west. A flourishing reed-marsh has developed at this, the leeward side of the lake. Consequently, much material is deposited in these sheltered surroundings. The birds prefer those parts of the reed-beds which are free from wind and waves.

The water level (Figure 3) is generally at its lowest in August and September, by which time the summer evaporation has long been effective. The water level during the moulting period is determined partly by precipitation in the summer months and partly by that of the previous year. It appears that the water level is one of those factors which determine the distribution of the moulting ducks (Kortegaard, 1974).

The temperature of the water surface (Figure 3) generally follows that of the air. On average, the water temperature has been between 16 and 19°C during the moulting period, i.e. 2–4°C under the average monthly temperature of the air. Water temperature is important for the development of the plant and animal life on which the flightless birds are dependent for nutrition. Gavrin (1970) considered that water temperature was the factor which determined the time of moulting, whereas Hochbaum (1955) and Balat (1970) were of the opinion that the time of the wingmoult of dabbling ducks is determined by the time of breeding. In addition, different age-classes of males appear to have different moulting times, at least in a Mallard population (Boyd, 1961).

The chloride content of the water varies between 200 and 500 mg Cl^-/litre during the year, indicating that the water is slightly brackish (oligohaline, *sensu* Redeke, 1922). The concentration of chloride is apparently greatest in the summer months, when the water level is at its lowest (as seen in particular from the 1969 results). According to Schierup (1970), the bottom deposits of the

Table 1. A description of the plant community in the moulting area, south-west corner of Selbjerg Vejle. The occurrence of plants was determined by Hult-Sernanders method for analysis of the degree of cover.

Species	Typical plant community (cf. Fig. 4)									
										
Phragmites communis	5		5		5		5			
Typha latifolia	1	5								
Scirpus tabernaemontani	1									
Scirpus maritimus	1									
Bidens tripartitus	1									
Sium latifolia	x									
Galinum palustre	1									
Potamogeton pectinatus				(1)	(1)		(2)		(1)	
Potamogeton perfoliatus			(*)							
Myriophyllum spicatum			(1)	(2)	(2)		(1)		(2)	
Lemna minor		1								
Calliergonella sp.					(x)					
Chara aspera			(1)	(3)	(2)		(4)		(3)	
Chara polyacantha							(x)		(x)	
Phragmites stems/m²	>200	–	250	–	150		–		25	

* Floating specimens.
x, Indicates that the species are observed.

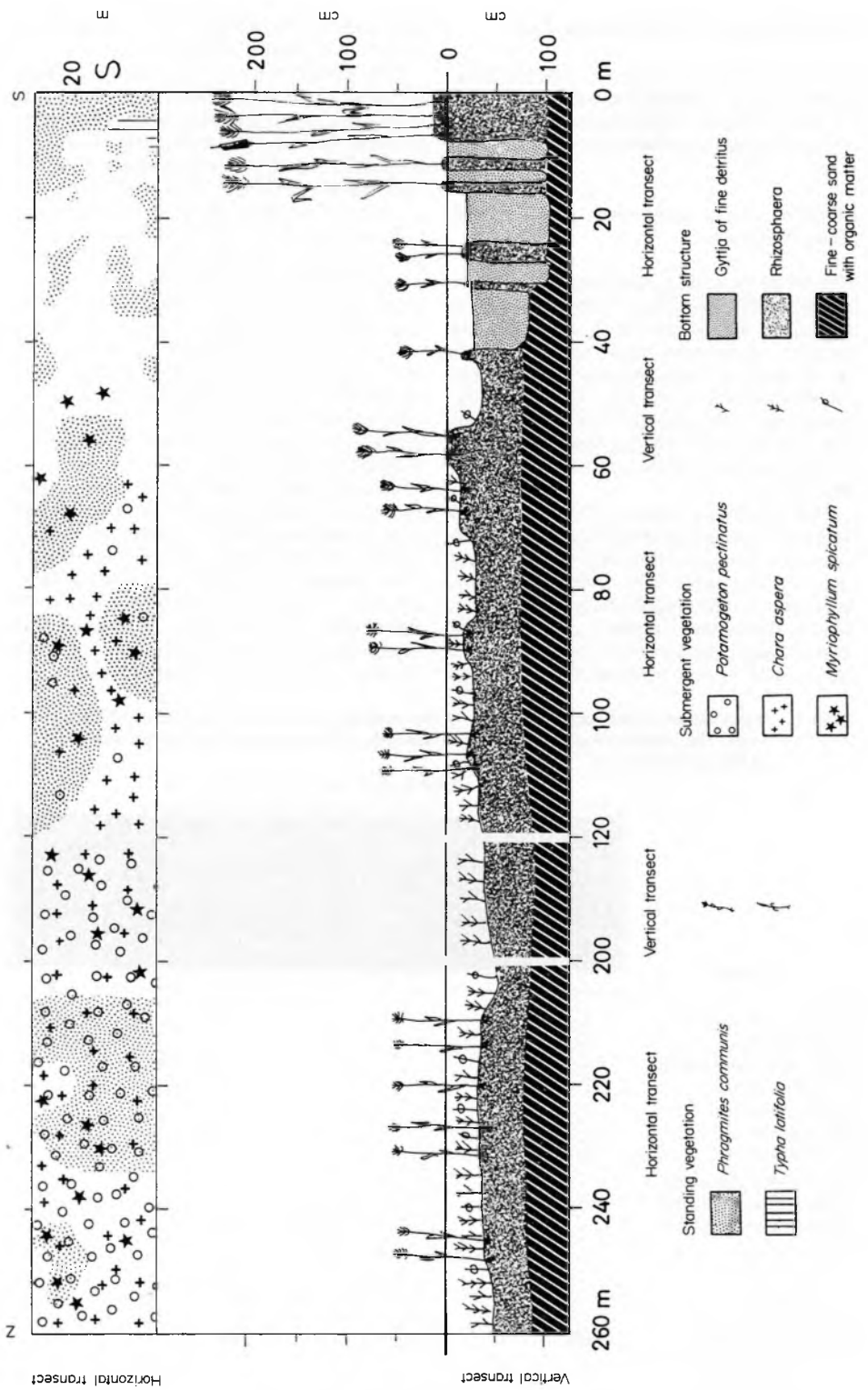


Figure 4. The botanical and topographical transect of the moulting area.

Vejlerne lakes contain residual salts from previous periods of salinity, which may explain the chloride values found. The present effect of the salt water of the Limfiord is presumed to be small, but it is possible that salt water may seep in from underground.

The water in Selbjerg Vejle is slightly polluted from neighbouring agricultural areas (grade II, i.e. β-mesosaprobic, *cf.* Liebmann, 1960–1962).

The botanical and topographical outline

The moulting area is a rather homogeneous biotope, so, although only one transect was investigated it is felt that it characterizes the environment satisfactorily. The transect (Figure 4) was made in a part of the moulting area in July 1968, in which the greatest number of flightless Teal were seen during the moulting period. It consisted of quadrats 20×20 m, started in the dry reed-beds nearest land and passing through the belt of vegetation to some way out into the open water, in all a distance of 260 m. The quadrats were laid in a straight line one after the other, and the corners marked with 2-m wooden posts.

The species composition of the plant community of each quadrat was determined, and the occurrence of each species recorded using Hult-Sernander's method for the analysis of degree of cover (Sernander, 1900; Du Rietz, 1921) using a scale of 0–5. In the present situation it was only possible to determine the occurrence of the standing vegetation in this way. The frequency of the submerged vegetation was determined by another comparative method, in which the bottom was scraped with a rake, and the amount of plant material collected was estimated on a scale of 0–4 (numbers in brackets in Table 1). This method was used because of the depth and poor light transmission of the water. In addition, the density of the reeds *Phragmites communis* was measured as the number of stems per square metre, and the height of the reeds (full grown) measured in each plant community; this is shown in the vertical transect of Figure 4.

At the corner of each quadrat and at one or more places within each single plant community, the depth of the water and of loose detritus (Gyttja, decaying organic matter) and the extent of the root- and rhizome-formations of mainly *Phragmites communis* (rhizosphaera-layer) were measured with a metre-stick. The water depth was taken to be the visible zone with clear water, and the depth of the detritus was taken as the depth through which the metre-stick passed before being stopped by a firmer layer. The rhizosphaera-layer was taken to be the distance through which the metre-stick passed before striking a hard layer.

In Figure 4, both horizontal and vertical transects through the moulting area are given, the symbols used representing the occurrence of the plants. Only the dominant species have been shown, the complete species list for the transect being given in Table 1. The following plants were also present in the moulting area: mare's tail *Hippuris vulgaris*, water crowfoot *Batrachium sp.*, purple loosestrife *Lythrum salicaria*, and lesser reedmace *Typha angustifolia*.

The occurrence of fungi and algae (except the Characeae) was not determined. On the extensive underwater rhizome systems of Selbjerg Vejle, the growths (especially of stonewort *Chara*) were amongst the most luxuriant in the area. In the inner zone of 0–60 m shown in Figure 4, larger aquatic plants are lacking and the water is poorly oxygenated. In addition, much marsh-gas is produced.

Small islands and clumps of reeds (probably formed by the stranding of floating masses of vegetation (Hürlimann, 1951)) contribute very much to the appearance of the area as a system of reeds and shallow water. Clumps and small islands serve as refuges and are of great importance, as dabbling ducks go on to land to preen (McKinney, 1965).

Human activity and the possible effect of predators

The area is almost unapproachable by terrestrial mammals (including man), and human activity has mainly been limited to visits in July and early in August, when flightless birds have been ringed by the Game Biology Station.

In the period of investigation 1965–1971 404 moulting Teal (practically all males) are ringed in Vejlerne, and of this all but two are ringed in the area mentioned here (the results of the ringing will be published in another paper from Game Biology Station). This involved the following actions, each of 3–5 hours' duration: two catches in the middle of July 1965; eleven catches from 7 to 29 July 1966; eight catches from 6 July to 3 August 1967; ten catches from 17 July to 7 August 1968; six catches from 21 to 31 July 1969; five catches from 15 to 28 July 1970; and six catches in the period 8 to 28 July 1971.

There has been a decline in the number of moulting birds in the period of investigation.

Whether this decline reflects the disturbance in connection with the ringing programme carried out is uncertain. It has been maintained by several workers that moulting dabbling ducks do not tolerate much human traffic in the moulting areas (Hochbaum, 1944; Szijj, 1965; Lebret, 1971). The pronounced shyness, present among ducks just before and during the flight-feather moulting and the remote location of the moulting areas (Oring, 1964; Kortegaard, in press) make this probable.

It is, however, difficult to estimate the importance of the disturbance, since a range of factors important to the habitat selection of the ducks, and of which disturbance is only one of them, are unknown or incompletely examined. Thus the number of other moulting dabbling duck species in Vejlerne have changed in the period of investigation both in and out of the areas, in which catches have been made. Previously Paludan (1965) has registered a decline in the number of moulting Greylag Goose (*Anser anser*) after some years of catches and ringing without known reason(s). However, contemporary with disappearance of the geese certain changes took place on the terrain. Thus a range of islands disappeared (probably because of raising of the water level). These had been important loafing places for the moulting geese. In addition, a strong overgrowing with *Phragmites* has taken place on the meadows in Bygholm Vejle, which was the most important foraging area before and after the wingmoult. All these conditions may have had an influence on the number of moulting geese, but here again it must be pointed out that our knowledge of the different factors of the habitat selection is insufficient.

Fox *Vulpes vulpes*, otter *Lutra lutra*, and more recently mink *Mustela vison* occur in the area, but it is presumed that the flightless birds are only in real danger from mink (cf. Oring, 1963).

On being disturbed, flightless birds swim away in the edge of the reed zone, often in the inner zone of 0–60 m (Figure 4). Flightless Teal are very timid, and the possibility of avoiding attention is almost certainly important in their habitat selection.

Description of the invertebrate fauna

In June, July, and August, samples of the invertebrate fauna were collected from such areas as the inner zone (0–60 m) and the outer zone (60–260 m) (Figure 4). A Birge-Ekmann bottom grab (Ekmann, 1911; Birge, 1922) and standardized net samples (mesh size 1 mm) were used. The outer zone comprised a rich variety of vegetation and many small invertebrates were found, the dominant forms being given in brackets in the list below: Oligochaeta (*Stylaria*), Hirudinea, Crustacea (*Gammarus*, Ostracoda), Ephemeroptera (*Cloëon* larvae). Odonata (*Coenagrion* larvae), Heteroptera (*Corixa*), Neuroptera (*Sialis* larvae), Trichoptera (Psycomyidae larvae and eruciform larvae), Lepidoptera (*Nymphula* larvae), Coleoptera, Diptera (Chironomidae larvae), Hydrachnidae (*Hydracarina*) and Gastropoda (*Planorbis*). In the inner oxygen-poor zone there was a less varied fauna (Hirudinea, Crustacea, Neuroptera, Trichoptera, Coleoptera and Diptera), and judging from the samples, the number of animals was only about one-tenth of that of the outer zone. In three bottom samples from the outer zone there were 2,500, 3,800, and 150 Chironomid larval tubes per m^2 respectively, whereas in three samples from the inner zone the numbers per square metre were 450, 720, and 415 respectively. It should be pointed out that collection of samples with a bottom-grab in the habitat described was rather difficult, and this may have effected the results obtained from the few samples collected.

Flightless Teal were observed several times to be feeding in the outer zone (Figure 4).

Food items

The food of flightless drakes was not clearly determined, as stomachs of eleven birds only were collected and examined. Of these, ten contained only small amounts of food, four contained duck down, and all contained gravel.

The birds were not collected immediately after feeding, nor was the digestive tract preserved immediately after death. Thus, according to Koersveld (1950), most of the soft parts will become unrecognizable in a short space of time due to the action of the digestive juices. Indeed, only the harder parts of animal material were found—statoblasts of Bryozoa, ephippia of Cladocera, the more heavily chitinized parts of Coleoptera, head capsules of Chironomidae and carapaces of Hydrachnidae. Animals lacking easily visible hard parts—Trichoptera, Oligochaeta (Chaetogaster, Stylaria), and Lepidoptera (*Nymphula*), all common on aquatic plants, were not observed. The collection of stomachs of flightless birds thus presents certain problems.

The majority of the stomachs examined contained soft plant remains, e.g. several

fragments of *Chara* were found, which occurred as an interwoven mass in the stomach contents.

Seeds found included club rush *Scirpus sp.*, spiked watermil *Myriophyllum spicatum*, mare's tail *Hippuris vulgaris* and a few specimens of marsh cinquefoil *Comarum palustre* and sedge *Carex* sp. Flightless Teal, therefore, appear to exist on a mixed diet consisting of invertebrates, seeds, and fresh plant material.

The food of Teal during the moulting period has only been mentioned by Dement'ev *et al.* (1952) who reported that in different areas either plant or animal food was dominant in stomachs examined. This indicates that Teal are well able to adapt themselves to available food sources. Lebret (1971) has observed flightless Teals taking food on tidal mudflats.

A comparison with an important moulting area of Mallard

This moulting area for Teal in the southwestern part of Selbjerg Vejle is quite different from the most important moulting area for Mallard, which is on the flooded overgrown meadows ('marshes') in the northern part of Bygholm Vejle. Here the water level is generally lower, and the open surfaces of water cover comparatively limited areas. We have never observed moulting Teal in this area.

Conclusion and summary

Some of the features which are typical of the moulting area can be summarized briefly as the topography, water level (20–60 cm), shelter from prevailing winds, water temperature (16–18°C), food (rich plant and animal life), clumps and small islands as refuges, and occasional patches of standing vegetation in water, which offer shelter and a means of escape. These factors are presumably important in the habitat selection by the birds ('proximate factors', cf. Hildén, 1965). In addition, the relationship to predators (including man), social factors, past tradition (moulting migration) and internal factors (timidity and physiological stress) apparently also play a part in the habitat selection, but these factors have not been investigated.

From the experience gained in this study, a description of a moulting area of dabbling ducks should cover the following points. (a) Latitude and longitude; country; surface area; legal status; numbers and species of duck concerned; period of moulting. (b) Measurements of water level, air and water temperature, chloride content and other water qualities. (c) Description of the topography and vegetation of the moulting area, including species composition and relative occurrence of species. (d) Collection of invertebrate samples from typical plant communities during the moulting period. (e) Collection of duck stomach contents for comparison with points (c) and (d). These should be obtained immediately after the ducks have fed, and be preserved at once in 4% formalin (Harrison, 1960). (f) Description of other conditions which affect the flightless birds or their habitat.

It is hoped that this article will stimulate the investigation of moulting areas of Teal and other dabbling ducks in other localities. In this way, a fair impression can be gained of the general and specific requirements of these birds for their moulting areas. Such knowledge is necessary for the conservation and management of the moulting areas of duck.

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