The moulting of Tufted Duck and Pochard on the IJsselmeer in relation to moult concentrations in Europe

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Introduction

After separation from the Waddenzee by the Afsluitdijk (in 1932), the former Zuiderzee lost its tidal movements and gradually changed into a fresh water lake, the IJsselmeer (Figure 1). In 1942, 1957 and 1968 parts of that IJsselmeer were reclaimed. Although a decision whether the final polder, 'Markerwaard' in the southwest, will be reclaimed has not yet been taken, its northwest dike (Markerwaarddijk) was completed in 1975. From 1974 the Dienst der Zuiderzeewerken gave the authors permission to make observations from the dike under construction, giving possibilities to get a complete view on the distribution of wintering birds. Already in 1974 it appeared that large numbers of Tufted Duck *Aythya fuligula* and Pochard *Aythya ferina* were also present in summer. Soon it became clear that these birds were in wing moult. Counts have since shown that apart from being an important wintering and migratory area the IJsselmeer is also an important moulting centre for Tufted Duck and Pochard.

Apart from several local studies (see later) little is known about the moult of Tufted Duck and Pochard in Western Europe. This seems true for several other species of waterfowl. Yet a knowledge of moult migration and moulting centres is of vital importance. This is a missing link between the reasonably well known breeding grounds and the quite well documented wintering areas. When protecting migratory waterfowl insufficient attention has been given to the moult problem. Probably this holds true for the flyways as well; mass ringing of diving ducks, sea ducks and sawbills is urgently needed.

The moulting process

In waterfowl the flight feathers are shed simultaneously, rendering the birds flightless and rather helpless during the moult. The birds withdraw to special areas providing sufficient food, safety from predation (and disturbance), and a suitable depth of water. If these conditions are not met in the breeding grounds the birds perform a moult migration. In Aythyini the moult migration is mainly performed by males (Salomonsen 1968; Dementiev & Gladkov 1967). In general the moulting season is certainly one of the most critical periods in the annual life cycle of ducks (Reichholf 1974).

Male Tufted Duck leave the breeding grounds just before the female starts laying or soon after the beginning of incubation. In Finland and the Netherlands all males have disappeared from the breeding grounds in the first week of July (Hilden 1964; Zomerdijk 1974, 1976b). Body moult has usually started already. The peak of wing moult is in the end of July/early August and each bird is flightless for 3–4 weeks. The females moult later, usually after the young have fledged. They start leaving the breeding grounds from the beginning of July; birds which lost their nests leave early. The departure of females is therefore spread over 6–8 weeks, and the peak of female wing moult is August/September. In the Netherlands small numbers of females may moult in the breeding area (Zomerdijk 1976a,b).

In general the Pochard breeding cycle closely resembles that of the Tufted Duck. However, the Pochard starts a few weeks earlier. So in most moult centres the Pochard arrives 2–4 weeks earlier and the peak of wing moult is earlier too (Bezzel 1964). On the IJsselmeer first records are always of Tufted Ducks. This is thought to be a result of the larger local breeding population. The largest increase in Pochard numbers is in July. This fits with the moult peak of males at end July/early August, and indicates the arrival of birds from great distances.

The IJsselmeer is a huge freshwater lake with a surface of about 180,000 ha. As a wintering area it is of outstanding importance for diving ducks (Van der Wal 1976, 1978), a result of an abundant food supply, relative quietness and recent mild winters. The Zebra mussel *Deissena polymorpha* is the most important food organism during winter and probably during the moulting time as well. There is no natural predation and the hunting season is closed at the time of the moult. The water depth varies from less than one up to eight metres. The moulting place is almost entirely 4 m deep and is one of the quietest places of the

IJsselmeer. It lies out of the main shipping routes and water recreation in this area is scanty (Figure 2). However, the construction of a recreation harbour in the vicinity of the moult centre may increase the disturbance. Up to now the main disturbing factor is the wind. In this respect the dike may give shelter to large groups of moulting ducks.

The moulting groups are mostly band-like (cf. Scholl 1970) and the birds keep an individual distance of approximately 0·5 metre. Wintering groups show a much higher density. Furthermore the moulting birds stay far from the dike and flee early from vessels

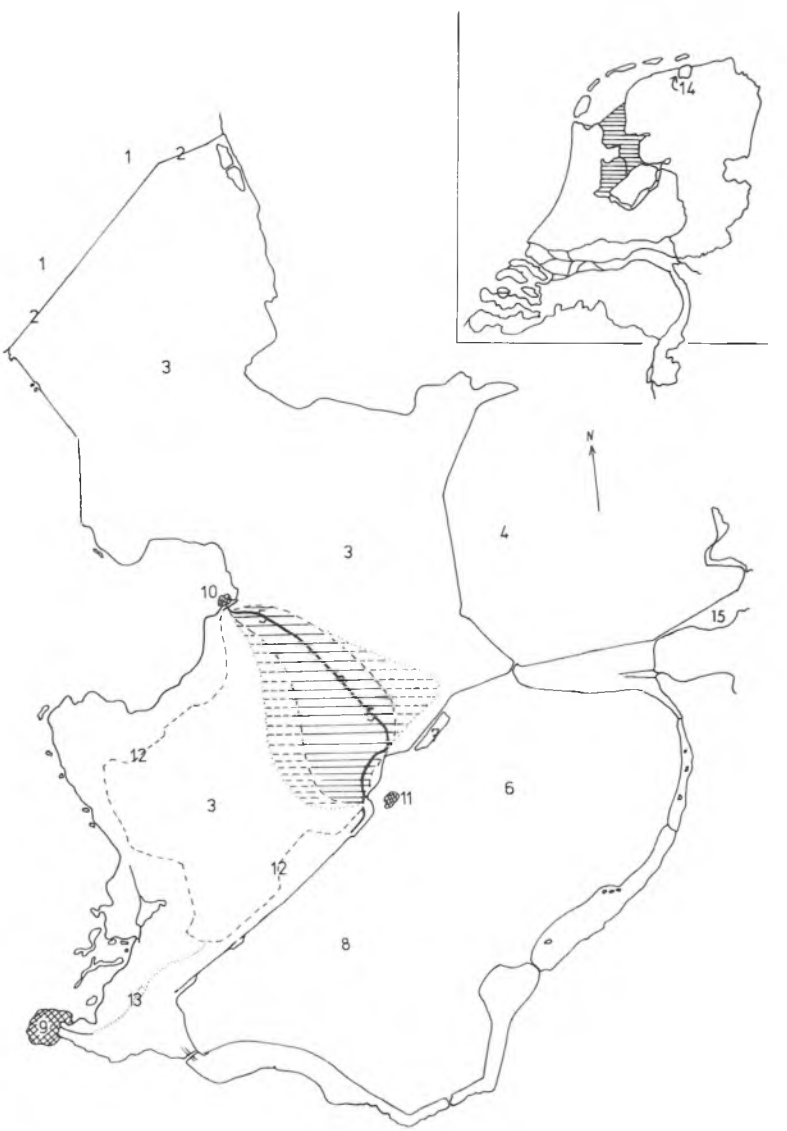

Figure 1. The IJsselmeer, its site in the Netherlands and the location of the moulting centre.
1, Waddenzee; 2, Afsluitdijk (1932); 3, IJsselmeer; 4, Noordoostpolder (1942); 5, Markerwaarddijk (1976); 6, Oost Flevoland (1957); 7, Fish hatchery ponds; 8, Zuid Flevoland (1968); 9, Amsterdam; 10, Enkhuizen; 11, Lelystad; 12, Possible dike traces for future polder; 13, Planned dike, separating heavy polluted water (south) from less polluted water; 14, Lauwermeer (on small map); 15, Zwarte Meer.

Hatched area (solid lines): Moulting centre (normal); (dashed lines): Extended moulting centre, under windless conditions.

and planes.

Mass feeding behaviour has never been observed, but the day–night rhythm in feeding activity is less distinct than in winter.

A lower sex-ratio in groups near the dike (see later) raises the question whether the females might prefer other parts of the moulting area. This could be a matter of more shelter and/or less depth but this has not been investigated further.

Counting methods

In 1974 and 1975 irregular counts were undertaken. Since the Markerwaarddijk had not yet been completed, and the counts were performed by only one of the authors, total numbers of the birds could not be obtained in one day. Depending upon the amount of time available, the part of the dike near Enkhuizen or near Lelystad was counted (see Figure 1).

In 1976 and 1977 fortnightly counts of the whole moulting area were performed by both authors. Other parts of the IJsselmeer were checked incidentally. The dike stretches were covered by car. On the Markerwaarddijk a stop was made every kilometre to search the water surface with 7 × 50 and 15 × 80

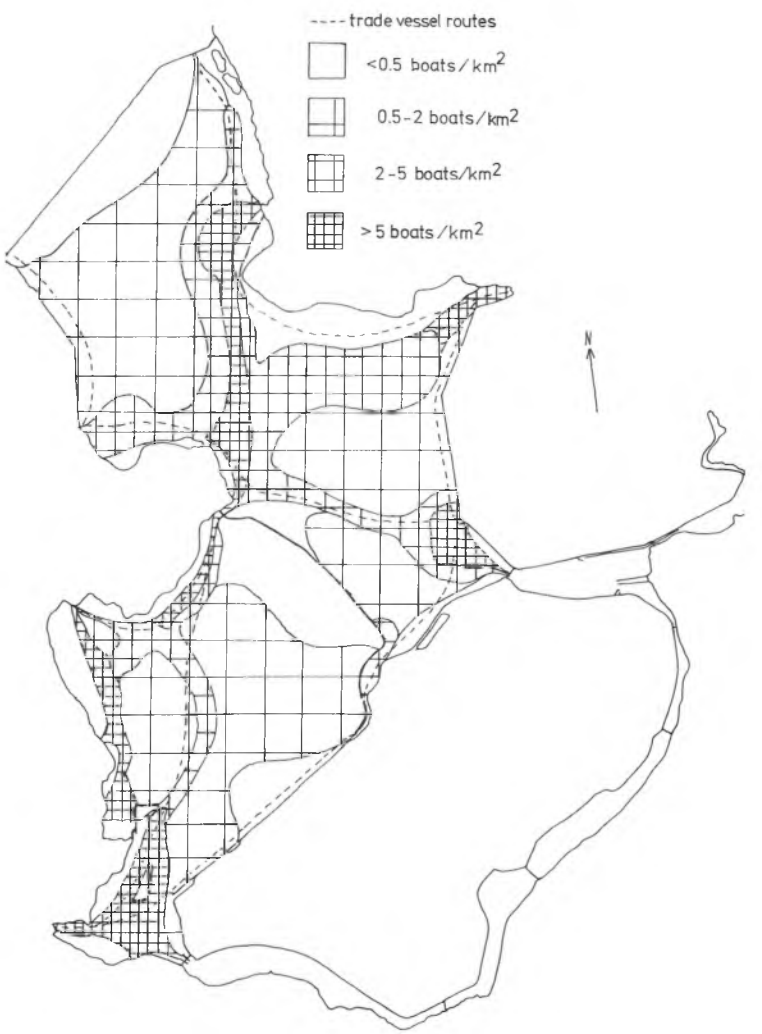

Figure 2. Recreation navigation on the IJsselmeer. A snapshot on Whit Sunday (6 June) 1976, a peak recreation day. After Meyboom and Hellinga (1977). Trade vessel routes drawn in by authors.

binoculars. Birds were then counted and, as far as possible, sexed using telescopes (15–60 x 60 and 40 x 60). The moulting birds mostly lay far from the dike in bands several kilometres long. Moving the observation point as necessary gave problems in separating the part of the group already counted from those still to be counted. Mostly the groups were counted by both observers separately; when large differences resulted a new count was made, when the difference was small the mean of both counts was taken.

When Tufted Duck and Pochard could not be counted separately the ratio Tufted Duck/Pochard was fixed by samples made by both observers. When such samples were impossible, a ratio Tufted Duck/Pochard was estimated on the basis of nearer groups.

Before the males drop their wing feathers they start body moult. In the Pochard no serious problems arose; the males remain recognizable. In Tufted Duck the recognition of males is more difficult. The white flank becomes dark and the tuft is temporarily lost. Although the neck and breast remain darker than in females this is only visible under good light conditions. Sex-ratio counts were made by both observers separately. When sex-ratio counts had to be made in large groups samples were taken throughout the whole group. With these precautions, differences will be small and can be neglected.

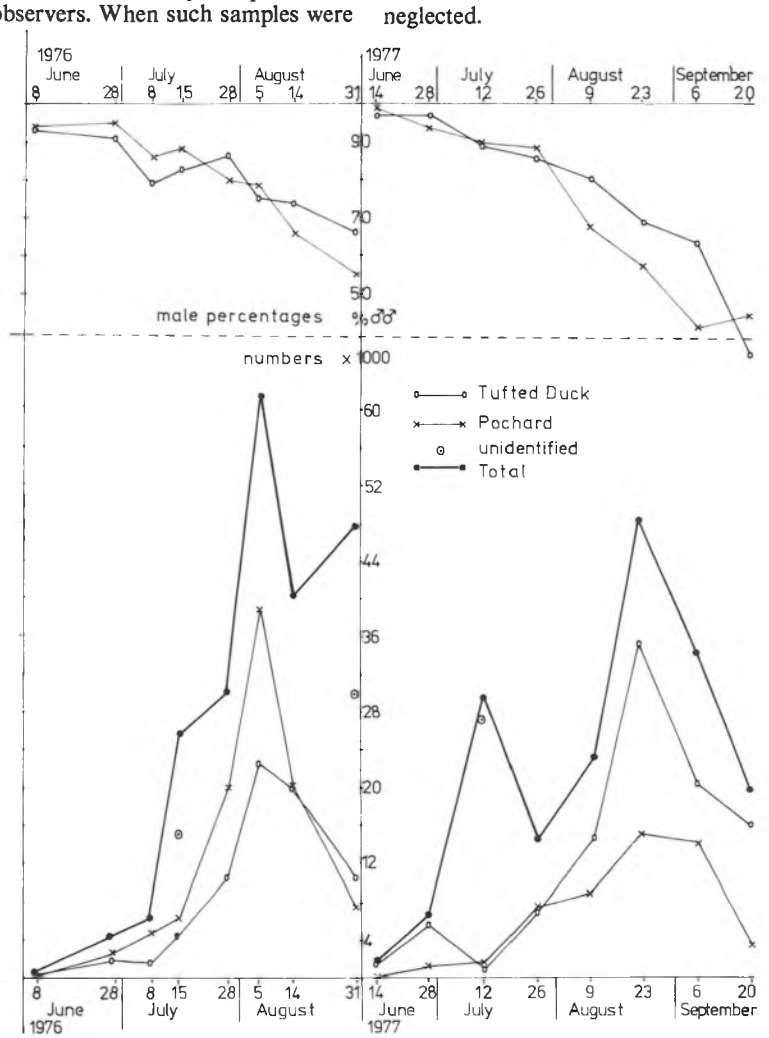

Figure 3. Lower. Numbers of Tufted Duck, Pochard and unidentified ducks in 1976 and 1977. Upper. Sex-ratios expressed as percentages of males.

Results of IJsselmeer counts

The results of the counts are compiled in Table 1 and 2. The incomplete results of 1974 and 1975 (Table 1) have not been further analysed. Those of 1976 and 1977 (Table 2) are plotted in Figure 3.

The sex-ratio data are accurate; separate counting of both observers never differed more than 5% and, taken over the day, were

Table 1. Total numbers and sex-ratio of Tufted Duck, Pochard and unidentified ducks counted from the Maarkerwaarddijk in 1974 and 1975, at Enkhuizen (a) and Lelystad (b). Sex-ratios are expressed as percentages of males.

1974 Date	28.5	4.6	7.6	11.6	18.6	20.6	25.6	3.7	8.7	10.7	8.8	9.8	22.8
Place	a	a	a	a	a	b	a	a	b	a	b	a/b	a/b
Tufted Duck	30	247	70	270	2,000	360	4,700	3,500	1,165	700	6,500	600	—
Pochard	—	—	6	41	258	18	1,200	1,750	308	750	3,500	2,200	—
Unidentified	—	—	—	—	—	—	—	—	—	—	—	—	12,500
Total	30	247	76	311	2,258	378	5,900	5,250	1,473	1,450	10,000	2,800	12,500
Tufted Duck sexed	30	247	0	270	1,388	303	2,072	2,776	463	604	940	259	0
% males	97%	96%		98%	98%	93%	97%	96%	93%	98%	87%	32%	
Pochard sexed	—	—	0	441	197	18	464	1,128	127	645	831	402	0
% males	—	—		93%	96%	—	96%	97%	88%	96%	83%	67%	

1975 Date	29.5	19.6	2.7	4.7	29.7	1.8
Place	a	a	a	b	a/b	b
Tufted Duck	62	770	800	1,890	—	5,500
Pochard	—	1,300	600	1,440	—	1,900
Unidentified	—	—	—	—	10,000	—
Total	62	2,070	1,400	3,330	10,000	7,400
Tufted Duck sexed	62	350	312	576	0	910
% males	89%	97%	98%	96%		95%
Pochard sexed	—	595	594	815	0	628
% males	—	98%	98%	97%		81%

Table 2. Total numbers and sex-ratio of Tufted Duck, Pochard and unidentified ducks, counted from the Maarkerwaarddijk in 1976 and 1977. Sex-ratios are expressed as percentages of males.

1976 Date	8/6	28/6	8/7	15/7	28/7	5/8	14/8	31/8
Tufted Duck	320	2,053	1,403	4,249	13,075	22,550	19,729	10,388
Pochard	113	2,805	4,875	8,234	20,157	38,970	20,279	6,634
Unidentified	—	—	—	15,000	—	—	—	30,000
Total	433	4,858	6,278	27,483	33,232	61,520	40,008	47,022
Tufted Duck sexed	320	1,345	600	1,607	4,375	1,606	1,305	3,593
% males	93%	91%	79%	83%	86%	75%	74%	67%
Pochard sexed	113	1,891	1,126	1,720	2,491	3,940	2,656	3,533
% males	94%	95%	86%	88%	80%	79%	66%	55%
Unidentified, ratio Tufted Duck: Pochard	—	—	—	35:65	—	—	—	85:15

1977 Date	14/6	28/6	12/7	26/7	9/8	23/8	6/9	20/9
Tufted Duck	1,733	5,342	821	6,689	14,470	34,931	20,247	15,857
Pochard	175	1,149	1,482	7,248	8,824	14,927	14,130	3,589
Unidentified	—	—	27,500	—	—	—	—	—
Total	1,908	6,491	29,803	13,937	23,924	49,858	34,377	19,446
Tufted Duck sexed	1,105	2,205	607	1,465	865	1,450	3,264	4,296
% males	97%	97%	89%	86%	81%	69%	63%	34%
Pochard sexed	142	664	671	2,556	1,533	2,237	2,207	2,227
% males	99%	94%	90%	89%	68%	57%	41%	44%
Unidentified, ratio Tufted Duck: Pochard	—	—	35:65	—	—	—	—	—

even less than 2·5%. However, under favourable conditions the male percentages in large distant groups appeared to be higher than in small near groups. We therefore conclude that the male percentages are minimal. The total numbers are thought to be reasonably complete, except for 26 July 1977 when due to the weather conditions a lot of birds were missed. In the beginning of the moulting season the presence of the birds north-east or south-west along the dike is mainly governed by wind direction. However, only with wind forces of 5 Beaufort and more do the birds really seek shelter along the dike. In the course of the moulting season the birds gradually appear more along the south-west side of the dike, in the Markerwaard area. This displacement has to be performed before the birds drop their wing feathers. Poorter and Sluys (1977) mention this distribution too. The moult concentrations stay in a defined area (Figure 2). Elsewhere only small numbers of moulting diving ducks have been found.

Several observations from before 1974 are known:

In September 1937 and July 1938 near Horst and Elburg, about 1,000 Pochard were seen. In the 1940s and 1950s 3,500–4,000 Pochard, mostly males, were annually found on the Zwarte Meer. In September they increased to more than 10,000 (Timmerman 1956). More recent counts include:

31 July 1966 Markerwaarddijk, 2,500 Pochard
9 August 1970 Oost Flevoland, 3,000 Pochard
August 1971 and later Zuid Flevoland, 1,500–3,500 Pochard
22 August 1970 Oost Flevoland, 10,000 Pochard and Tufted
24 August 1971 Oost Flevoland, 300 Pochard, 4,500 Tufted
27 August 1972 Oost Flevoland, 7,000 Pochard and Tufted
(B. van Poelgeest and J. van der Kamp, pers. com.).

So it seems probably that in the case of Pochard, and possible to a lesser extent for Tufted Duck, that they have been moulting in the IJsselmeer area for many years.

Concentrations elsewhere in Europe

In the Federal Republic of Germany, the Ismaninger Teichgebiet near Munich is well known as a moulting area for Tufted Duck and Pochard, since the early 1950s, and numbers have increased since 1955, when an increase in water depth made the circumstances favourable. The increase is well documented (Figure 4A) and can be seen as a developing tradition (Bezzel 1964). Mean numbers for the period 1970 to 1976 were: Tufted Duck 9,320 (max: 12,274) and Pochard 18,215 (max: 21,432) (E. v. Krosigk, *in litt.*).

The area consists of flood control lakes with a surface of 9,000 ha and a depth varying from less than 0·5 m to 4 m. Human disturbance is almost absent; the area is padlocked and sailing and hunting are not allowed (J. Reichholf, *in litt.*). In 1973 there was an epidemic disease among the birds which may mean an uncertain future for the Ismaninger Teichgebiet (E. v. Krosigk, *in litt.*; Reichholf 1974).

On four lakes in Schleswig Holstein, moulting Tufted Ducks have been recorded. On the Selenter See, 6,000 and 7,800 male Tufted Ducks were counted in 1969 and 1970. On the Dobersdorfer See, 600 were seen in 1969. On the Kasseteich and Brammerteich, several hundreds were present in August but it is not certain whether these birds actually moulted wing feathers (Scholl 1970).

In South Niedersachsen near Slazgitter–Heerte, 200 Tufted and 400 Pochard moulted at two lakes in 1976. Elsewhere in this country some 50 Pochards might moult (P. H. Barthel, *in litt.*).

In the German Democratic Republic three lakes and a salt water bay of the Baltic hold approximately 18,500 moulting Pochard and 5,000 moulting Tufted Ducks annually. In lakes near Peitz, 4,000–5,000 Pochard moult. In lakes near Lewitz, 4,500–5,000 Pochard moult. On the Krakower Obersee, 1,000–3,000 Pochard and 2,000–5,000 Tufted (August 1976 even 8,000) moult. Another 2,000–3,000 Pochard moult on the Neuwarper See, a salt water bay on the boundary with Poland (H. Litzbarski, *in litt.*).

In the United Kingdom, Abberton Reservoir in Essex is the largest known moulting centre for Tufted Duck and Pochard. Between 1950 and 1969 there was an increase in numbers (Figure 4B). Since 1970 the numbers seem to fluctuate around means of 2,195 Pochard (max: 3,096) and 2,016 Tufted Duck (max: 3,389). The reservoir consists of a large drinking water basin with varying depth. The area is padlocked, fishing, hunting and sailing are not allowed (R. King, pers. com.). A regular flock of 900

(max: 1,200) Tufted Duck moult on reservoirs in London (P. J. Oliver, *in litt.*).

For Ireland no real moult concentrations are known. However, large numbers of Pochard (1970–1976: 12,000–20,000) on Lough Corrib in September bring this area under suspicion of being a moulting centre. Unlike Pochard, Tufted Duck breed in Ireland in large numbers. On Lough Cullen about 5,000 Tufted Duck concentrate in September, which could mean this was a moult concentration too. From Lough Neagh positive information on the moult of diving ducks is lacking (B. Stronach, *in litt.*).

Joensen (1973) mentions the moulting of small numbers of Tufted Duck and Pochard in Denmark, almost exclusively on fresh water.

On lake Ringsjön in Sweden about 1,000 Tufted Duck moulted in the late sixties, but the lake is no longer important. On Lake Hulsjön about 1,000–1,300 Pochard moult. Moulting of both species occurs on Lake Tåkern, but details are not available. Up to 5,000 Tufted Duck may moult in the archipelagoes of the south east coast. Only small numbers of Tufted Duck and hardly any Pochard are suspected of moulting elsewhere in Sweden (L. Nilsson, *in litt.*).

Numbers of moulting Tufted Duck and

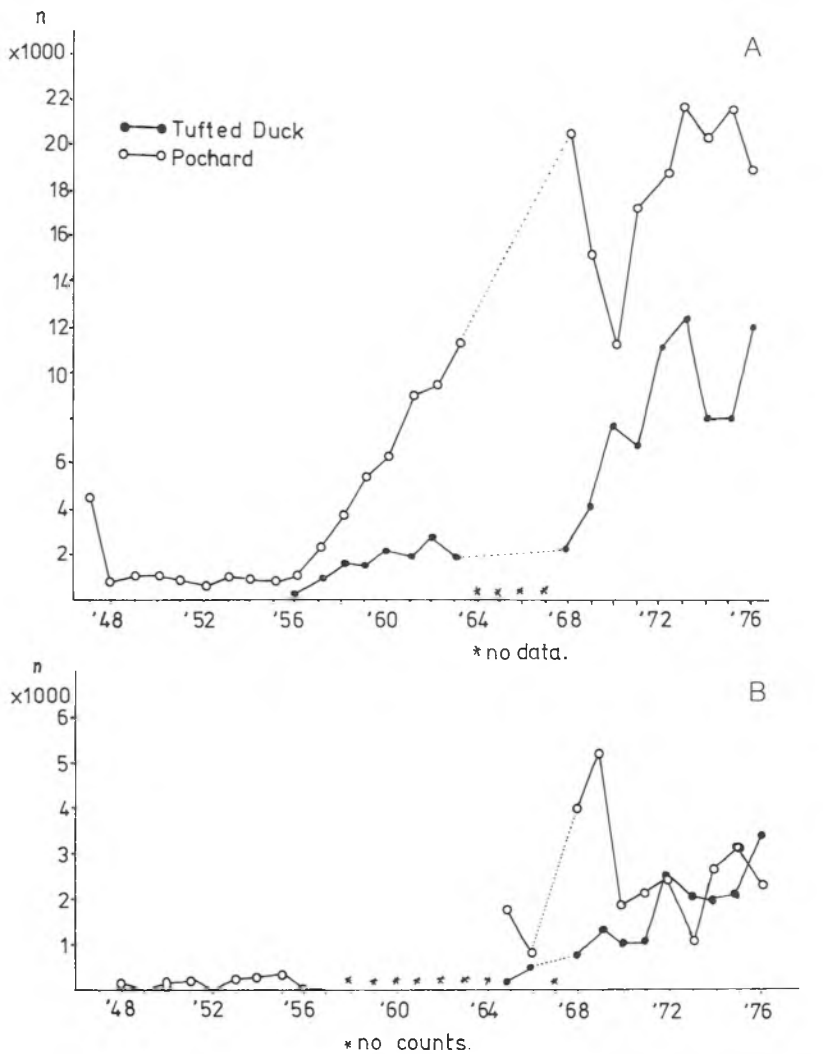

Figure 4A. Numbers of moulting Tufted Duck and Pochard at the Ismaninger Teichgebiet, southern Germany, 1947–1963 (Bezzel 1964) **and 1968–1976** (E. v. Krosigk, *in litt.*). **B. Numbers of moulting Tufted Duck and Pochard at Abberton Reservoir, Essex, UK, 1948–1976** (R. King, *in litt.*).

Pochard have been recorded since the thirties in the Estonian SSR (Kumari 1961). Matsalu Bay is a moulting area for several waterfowl species (Paakspuu 1969) and apparently the numbers fluctuate rapidly. In recent years 7,000–8,000 Pochard and some 500 Tufted Duck were involved. In 1976 fewer Pochards were recorded (E. Kumari, *in litt.*). See also Kumari (1976, 1979).

See Figure 5 for map of known and suspected moulting areas of the two species in Europe.

Discussion

The numbers of Tufted Duck and Pochard moulting in the IJsselmeer, especially along the Markerwaarddijk, since 1974 appear to be the highest in Western Europe.

No exact data are available as to whence the birds come. Neglecting unidentified birds, Tufted Duck maxima in 1976 and 1977 were at least 22,500 and 34,931. With male percentages of 75% and 69% this gives ap-

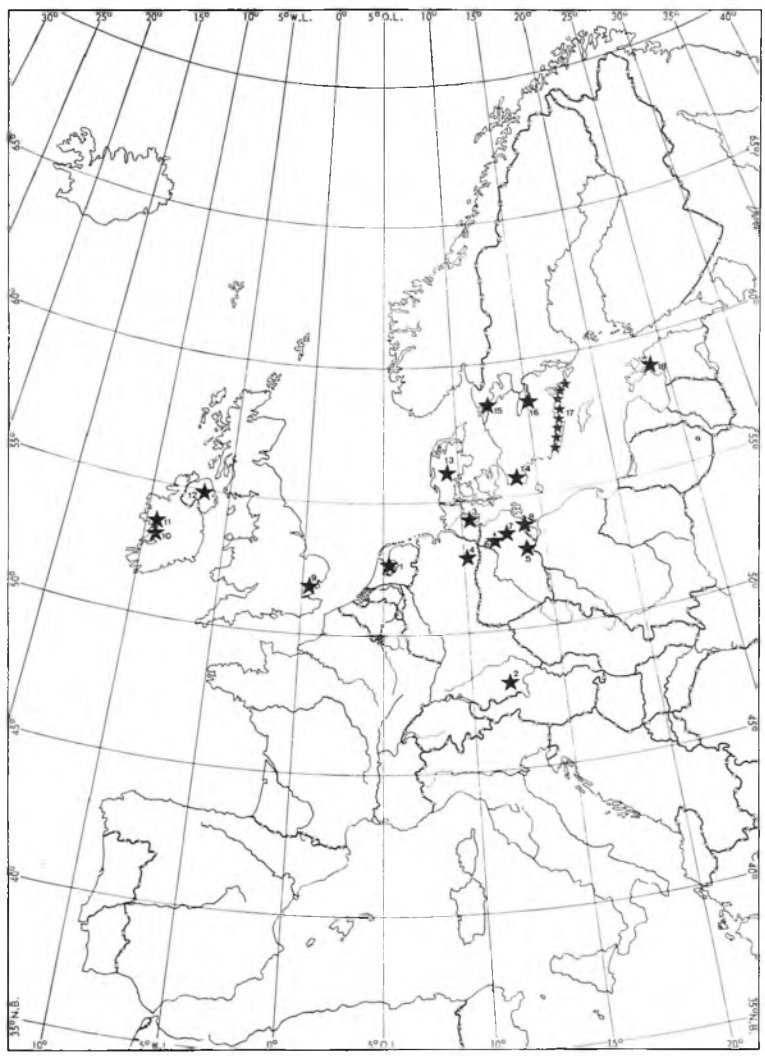

Figure 5. Known and suspected moulting centres of Tufted Duck and Pochard in Europe.

1, The IJsselmeer; 2, Ismaninger Teichgebiet; 3, Kasseteich, Passader-, Dobersdorfer-, and Selenter See; 4, Lakes near Salzgitter-Heerte; 5, Lakes near Peitz; 6, Lakes near Lewitz; 7, Krakower Obersee; 8, Neuwarper See; 9, Abberton Reservoir; 10, Lough Corrib; 11, Lough Cullen; 12, Lough Neagh; 13, Denmark; 14, Lake Ringsjön; 15, Lake Hullsjön; 16, Lake Tåkern; 17, Archipelagos Swedish east coast; 18, Matsalu Bay.

proximately 17,000 and 24,000 males. Pochard maxima were 38,970 (1976—79% males) and 14,927 (1977—57% males) corresponding to 30,500 and 8,500 males.

The Dutch population can be estimated at 5,000 breeding pairs of Tufted Duck and 2,000 of Pochard. It is clear that most moulting males, at least 28,500 Pochard (1976) and 19,000 Tufted Duck (1977), originated from outside the Netherlands. To some extent this is confirmed by observations (T. V. Spanje, *in litt.*); on 24th and 25 June 1976, between 02.00 and 07.00, 260 and 503 male Pochards were seen at the Lauwermeer, flying south-west following canals in the direction of the IJsselmeer.

For Tufted Duck it is possible that the moulting birds originate from Northern Europe. Sweden alone holds an estimated 24,000 breeding pairs of Tufted but only 5,000 of Pochard (L. Nilsson, *in litt.*). The 30,500 male Pochard on the IJsselmeer (1976) cannot originate only from Denmark, Sweden, Germany and the Netherlands, but must come from more eastern countries. To some extent this is indicated by a few recoveries of moulting Pochard ringed at Abberton Reservoir (R. King, pers. com.).

The totals of the moulting birds located in Europe give about 80,000 Pochard and 68,000 Tufted Duck, including these, we only suspect to be moulting (e.g. Ireland). With an overall male percentage of 75% (derived from the IJsselmeer data at moult peak) this gives some 60,000 male Pochard and 50,000 male Tufted Duck.

Mid-winter populations of Pochard and Tufted Duck in north-west Europe have been estimated at 250,000 and 500,000 (Atkinson-Willes 1974). Assuming an overall sex-ratio of 1:1 this would give 125,000 male Pochard and 250,000 male Tufted Duck.

The last figure also includes first year males that had not yet moulted and did not join the summer moult concentrations. Assuming that first year males equal adult males in number, we are left with an estimate of 62,500 adult Pochard males, very close to the 60,000 actually located.

The 50,000 Tufted Duck males located during the moult less closely match the estimated 125,000 adult males derived from the north-west European mid-winter population, allowing 50% first year males. Probably other moulting centres exist in Poland (Masuria) and the USSR, and it is hoped that this paper will serve to elicit information on this score. Salomonsen (1968), surmises that many males perform wing moult at the breeding grounds. Dementiev and Gladkov (1967), however, report this in the case of only small flocks or individual males of Pochard. Large moulting flocks (up to several hundreds) are annually found at certain lakes all through the Soviety Union.

Of Tufted Duck fewer moulting flocks are known (Dementiev & Gladkov 1967). Hilden (1964) and Zomerdijk (1967b) investigating breeding grounds both conclude that all males leave the breeding sites in the beginning of incubation.

Apart from a sufficient food supply, a suitable water depth and a good field of view, quietness seems to be a major factor determining the suitability of lakes as moulting centres. The moulting centre on the IJsselmeer will be destroyed by the reclaiming of the Markerwaard and is threatened by an increase in recreational disturbance.

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Summary

This paper deals with the wing moult of Tufted Duck *Aythya fuligula* and Pochard *Aythya ferina* on the IJsselmeer in the Netherlands.

In a restricted quiet part of this huge freshwater lake, large concentrations of these diving ducks have been present in July–August since at least 1974. The concentrations appear to be the largest in Europe and must have originated for a substantial part from outside the Netherlands.

The male percentages are very high and decrease gradually during the season. Moulting of males at breeding grounds is unusual. A similarity in the number of located moulting Pochard males in Europe and north-west European mid-winter population estimates suggests that most of the moulting areas are known. For Tufted Duck very many moulting adult males are apparently unlocated.

Knowledge of moulting centres is of vital importance in the protection of migratory waterfowl. The moult centre on the IJsselmeer is seriously threatened by a planned reclaiming of a new polder and an increase in recreation disturbance.

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A male Common Eider *Somateria m.mollissima*. (*Philippa Scott*)