'Nonsense' orientation of Pintail, Wigeon and Mallard from Nacton, Suffolk

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Introduction

'Nonsense' orientations in birds were so named by Matthews (1961) because they bore no constant relation to home or migration directions and seemed to have no function. They have been intensively studied in Mallard *Anas platyrhynchos* trapped at Slimbridge (51°44'N, 02°24'W) in Gloucestershire and at Peakirk (52°38'N, 00°17'W) in Cambridgeshire (Matthews 1961 through 1974; Matthews & Cook 1977, 1982). Some tests were also done at the latter site with Green-winged Teal *Anas crecca* (Matthews, Eygenraam & Hoffmann 1963). When the Wildfowl Trust took a lease on Nacton Decoy (52°01'N, 01°15'E) in Suffolk the opportunity arose to study the orientations of Pintail *Anas acuta* and Wigeon *Anas penelope*, which could be caught in fair numbers there, and also of another population of Mallard. However, in recent years the catches of duck at Nacton have declined drastically, probably as a result of improved conservation in the area and the development of alternative roosts on newly flooded reservoirs and other artificial water bodies. The lease is therefore being given up and it seems appropriate now to report on the series of orientation tests carried out between 1973 and 1978, as no further work will be possible at this site.

Methods

The duck were caught by the traditional method of using a trained dog to entice them off the decoy pond, into screened and netted pipes. If weather conditions were suitable, with winds of less than Beaufort Force 4 and the sun visible at least as a disc, the duck were transported in covered containers direct to a release site. Otherwise they were temporarily held in a spacious aviary until good conditions were forecast.

The duck were released singly, tossed up in successively different directions, and followed with binoculars until lost to sight. The vanishing bearing was noted to the nearest 1°, but these were grouped for analysis in 5° blocks. Those duck seen to land or lost prematurely, in less than $1\frac{1}{2}$ minutes, were discarded and only the vanishing bearings of birds lost in flight against the sky are included in building up a departure fan whose mean vector (m) and spread (r) about that mean are used to describe the orientation behaviour of the duck in a sample. The nearer r is to unity the less is the scatter about the mean, the more it approaches zero the closer the scatter is to randomness. Suitable statistical tests are described by Batchelet (1981).

A series of release sites were selected in different directions from Nacton to prevent bias in that respect. Releases took place at Debach (home bears 185° at 13 km), Wattisham (118° at 22 km), Cuckoo Tye (096° at 33 km) and Horsley Cross (041° at 18 km). The sites were in flat open ground with good all-round views, all except the last being disused airfields. Because of Nacton's situation close to the coast, no release point in the east was feasible.

In one set of tests, birds were equipped with small (25 × 5 × 5 mm) rectangular bar magnets. These were of a light alloy (Ticonel E) and weighed only 4·3 gm. Control birds were equipped with brass bars of similar size and weight, attachment in both cases being to a thin paper collar (which ensured that the bird rid itself of the magnet as soon as it bathed). The north-seeking pole pointed to the head in half of the birds, to the tail in the other half. The magnetic moment of the bars was approximately 220 gauss cm^3 and they would disrupt the earth's magnetic field in the head region, similar magnets being reported to have had a disruptive effect on pigeon orientation (Keeton 1971).

Results

Pintail

Five release sessions, all of birds caught in September, gave consistent and strongly clustered (r = 0·82) bearings (n = 105) with a mean vector (m) of 200° (Figure 1a).

Wildfowl 33 (1982):145–50

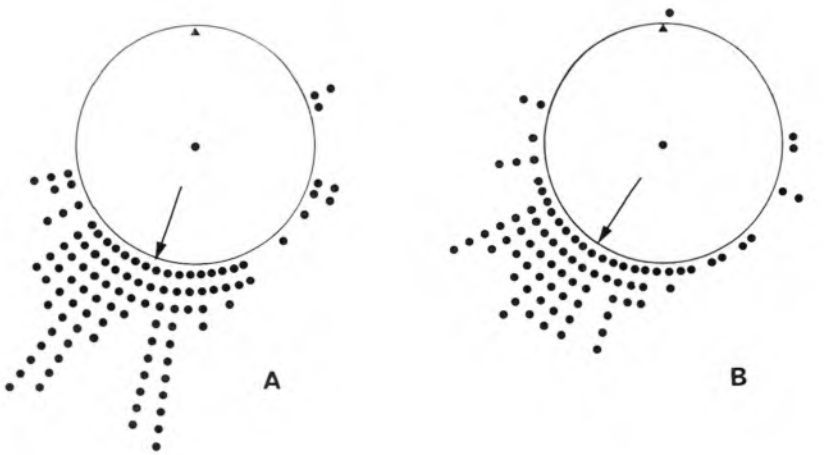

Figure 1. Vanishing bearings of Nacton Pintail (a) and Wigeon (b) released in sunny conditions after displacement to various points. The centripetal arrow indicates the mean vector. For statistical data see text. The small arrow head indicates north.

Wigeon

Four release sessions of birds caught in September and October also gave a well marked (r = 0·79) orientation, with bearings (n = 82) clustered about a mean of 214°. (Figure 1b). Although there is a slightly more westerly tendency the difference is not sufficient to be distinguished with statistical confidence.

Mallard

This species could be caught over a longer period than the other two, from August through to January. Overall, twelve release sessions gave a strong (r = 0·78) orientation with bearings (n = 307) having a mean of 180°. Again this is slightly different, more southerly, than the other two species but too much should not be made of this, especially as the monthly means (Figure 2, Table 1) ranged between 173° and 189°.

One session of Mallard releases was carried out under overcast conditions in October to check the conclusion in earlier studies (especially, Matthews & Cook 1977) that 'nonsense' orientations broke down to near random scatter when the birds were deprived of astronomical clues. With 37 bearings the scatter was indeed much greater (r = 0·32) and not to be distinguished at the 1% level from random. The fact that a southerly mean (204°) can be calculated does not, because of the scatter, indicate a residual orientation. However, it may be stressed that overcast thick enough to prevent *any* indication of direction is rare.

Table 1. Orientation data for Nacton-caught Mallard showing numbers (n) of satisfactory bearings and the tightness of their clustering (r) about the mean vector (m).

Month	n	r	m
August	56	0·91	176°
September	80	0·70	188°
October	44	0·79	189°
November	69	0·79	180°
December, January	58	0·80	173°
Overall	307	0·78	180°

Two sessions of Mallard releases were carried out in sunny conditions with half the birds equipped with magnets and half with control bars. These results, indicating no difference in orientation behaviour between the two groups, were confirmed by sets of data contemporaneously gathered from the two other Mallard populations available at Wildfowl Trust ringing stations, at Slimbridge and at Peakirk (Figure 3, Table 2). The latter releases, from Borough Fen Decoy, were carried out by our colleague, W. A. Cook. Their wider scatter, even early in the catching season (September/October) is typical of that population (Matthews 1963a; Matthews &

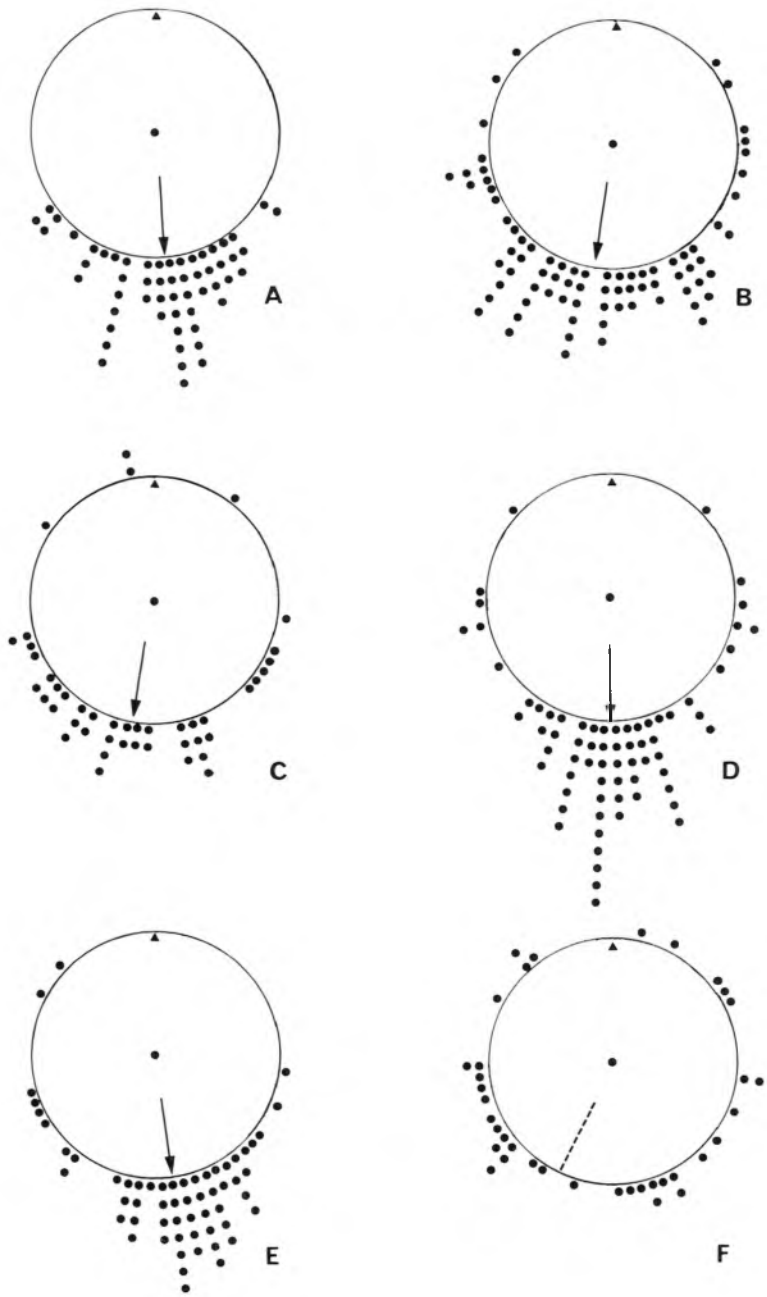

Figure 2. Vanishing bearings of Nacton Mallard released in sunny conditions in (a) August, (b) September, (c) October, (d) November, (e) December/January. A release under overcast is shown at (f).

Table 2. Orientation data for Mallard carrying brass (control) and magnet (experimental) bars.

Population	Condition	Brass			Magnet		
		n	r	m	n	r	m
Nacton	Sun	31	0·85	158°	29	0·82	162°
Peakirk	Sun	32	0·57	309°	34	0·65	305°
Slimbridge	Sun	37	0·76	310°	39	0·85	312°
Slimbridge	Stars	17	0·95	287°	17	0·86	295°

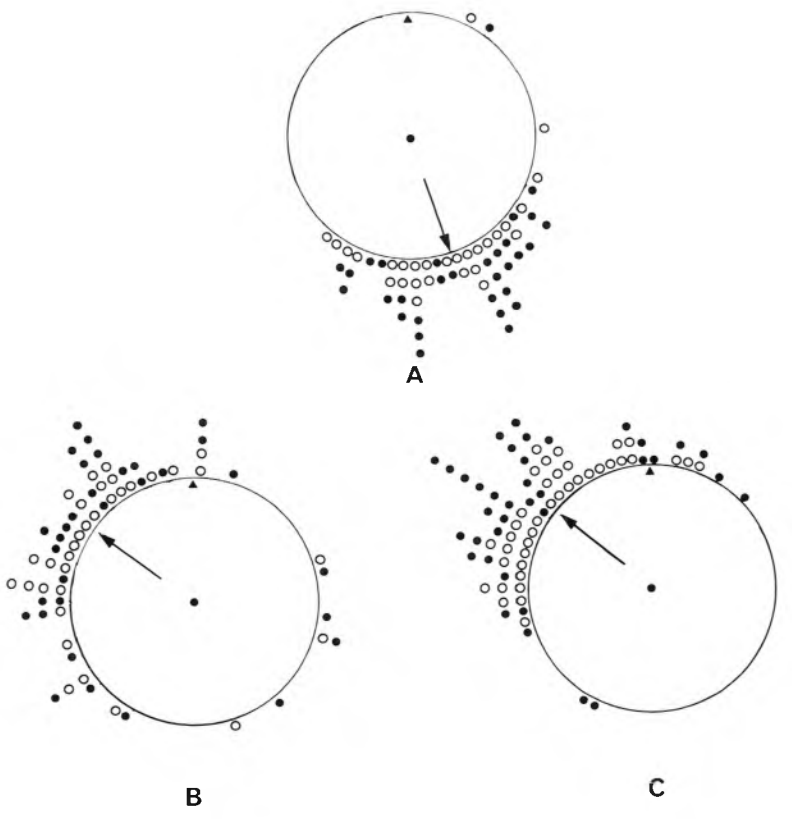

Figure 3. Vanishing bearings of Mallard released in sunny conditions with magnets (○) or brass bars (●) attached. Birds caught at (a) Nacton, (b) Peakirk, (c) Slimbridge.

Cook 1982) and is apparent in both controls and experimentals. The very different, north-westerly, orientation is similar to that of the Slimbridge population, although the latter's is always more marked (Matthews 1963a).

We add here (Table 2) the results of one release session of Slimbridge Mallard to test the effect of magnets when the birds were released at night under a starry sky. The flight of the birds was followed by attaching small lamps to their legs (Matthews 1963b). It is clear that even under these conditions there was no difference in the orientation of experimentals and controls.

Discussion

The SSW orientation of the Pintail contrasts strongly with the 'nonsense' orientations for this species recorded by Bellrose (1964) for birds caught in Illinois, USA, (269°/291°) and Saskatchewan, Canada, (NW). As with the Mallard, birds of the

same species but from different populations or areas thus have different 'nonsense' tendencies. This also appeared to be the case with Green-winged Teal *Anas crecca* studied at Peakirk (weakly NW), at Piaam in the Netherlands (WSW) and in the Camargue, France (WSW by S) by Matthews *et al.* (1963).

The SSW orientation of the Wigeon stands as the only information available for this species. It adds another wildfowl species, with orientation studied in one area only, to the Blue-winged Teal *Anas discors* (280°/291°) and the Canada Goose *Branta canadensis* (202°/213°) investigated by Bellrose (1964) in Illinois.

The southerly orientation of Nacton Mallard, while contrasting strongly with the north-westerly orientations for Slimbridge and Peakirk (and also for Illinois and Saskatchewan) is very similar to that found for Mallard trapped in the Central London parks (Matthews 1963a). However, Peakirk is no farther from Nacton than is London, so mere propinquity of populations is not sufficient to explain similarity in orientations. Indeed SSW Mallard orientations have been recorded in southern Germany—as well as SE ones in Sweden (Matthews & Cook 1982). Moreover, the studies at Peakirk have shown a strong contrast between the NW orientation of Mallard caught at Borough Fen Decoy and a virtual absence of orientation in those caught at Deeping Lake, only 2 km away (Matthews & Cook 1982). Indeed there is some evidence, from the orientation of recaptured birds released a second time, that Borough Fen does 'impose' an orientation on birds frequenting it whereas Deeping Lake does not.

The development of a site-specific rather than population-specific orientation might be an explanation for the three species tested from Nacton having similar orientations. 'Nonsense' orientation has been shown, by relays of observers, to be a short-lived phenomenon, disappearing after less than 10 minutes of flight (Matthews 1967). So we may be dealing with an escape reaction for which a direction of flight suitable for taking the bird out of danger in its normal environment might automatically be applied elsewhere. Thus the River Orwell lies to the south of Nacton, the River Thames lies south of the London parks and the River Severn lies north-west of the Slimbridge Decoy. On the other hand no such obvious refuge-relationship exists for Borough Fen and Deeping Lake. Moreover, it must be remembered that while some of the Mallard may have been bred locally to Nacton, most of them, and all the Pintail and Wigeon, have only recently arrived in the area and will not necessarily remain there for long. The great majority of duck trapped are only a few months old.

Another argument against the development of site-specific orientations is the conclusion from the Borough Fen studies that immigrant birds bring their own orientation tendencies with them. This is based on the analysis of 5109 bearings (Matthews & Cook 1982). From July into October the NW orientation is well-marked, thereafter the scatter increases to near-random levels, orientation only reappearing in March. These changes accord well in time with the immigration into eastern England of Mallard from the Baltic area. Moreover subsequent recoveries of ringed birds indicate that the farther east they originated the more diverse were their orientations. In other words the apparent breakdown of orientation in mid-winter was due to the mixing in of duck with other orientations.

It is therefore interesting to see that unlike those from Borough Fen (but like those from Slimbridge) the Nacton Mallard retain well-marked orientations into winter. (Table 2). We cannot use the argument advanced (Matthews 1963a) to explain the continued orientation at Slimbridge, namely that relatively few Baltic Mallard penetrate to western England. Rather, we would suggest that immigrants with the southerly tendencies, which would produce the appearance of randomness at Borough Fen, would be absorbed unnoticed at Nacton.

The suggestion that 'nonsense' orientation is related to migratory direction has already been discounted in the earlier work. Slimbridge-caught Mallard are largely non-migratory and the Borough Fen north-westerly tendency is not of migratory relevance. The SSW orientation of Nacton Pintail is closer to the line of movement of these birds from northern Scandinavia and through England down to West Africa. However, the Wigeon and Mallard are coming more from the east and remain in England. So in general we do not favour the idea that 'nonsense' orientation is a resumption of migration.

While we remain uncertain of the functions of 'nonsense' orientations, they are intriguing phenomena in themselves and they intrude upon the even more fascinat-

ing problem of how birds home to a goal area. This too has been studied largely by observing the departure bearings of displaced birds and apparent homeward orientation can be confused with or modified by 'nonsense' orientations. This was suggested by Matthews (1961) and has been reviewed and re-stated by Walraff (1978), who prefers the less provocative title of 'preferred compass directions' or PCD's.

The very marked nature of the orientations have made them suitable testing beds to find how birds determine the direction in which (for whatever reason) they need to fly. It has been shown that the Mallard use a time-compensated sun-compass during the day and determine the compass points from the configuration and relationship of the constellations at night (Matthews 1963b) and also use a time-compensated moon-compass when this is available (Matthews 1973). When the skies by day or night are heavily overcast, the orientation disappears and even close to 'home' recognized landmarks do not provide a substitute (Matthews & Cook 1977).

There is now a revived interest in the part played by the earth's magnetic field in bird orientation. In general a magnetic compass only seems to come into play when astronomical clues are absent. The lack of orientation in Mallard in such conditions may mean that they do not possess a magnetic compass. It certainly makes it impossible to test for its presence by disrupting magnetic input when it is most likely to be used. The best that can be done is to check, as we have (Table 2, Figure 3), whether there is any interference with orientation when astronomical cues remain available, and an artificial field is superimposed on the natural one. The answer is that there quite definitely is none. The results under sun bear out those of a series of experimenters with homing pigeons, listed in Keeton (1971), but the night release with magnets is the first of its kind to be published.

Acknowledgements

We were employed under contracts financed by the Natural Environment Research Council and the Nature Conservancy Council.

Summary

The 'nonsense' orientation of Pintail *Anas acuta*, Wigeon, *A. penelope* and Mallard *A. platyrhnchos* caught at Nacton Decoy, Suffolk, was observed in a series of releases. The mean orientations were Pintail—SSW, Wigeon—SSW, and Mallard—S. Mallard were also released carrying small bar magnets but their orientation was not disrupted.

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