IMPROVED DECISION MAKING BY MIGRATING RAPTORS DURING PEAK PERIOD OF MIGRATION

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Abstract

Earlier studies had shown that raptors on autumn migration at Buskett, Malta, tended to appear when windstrength in the early morning was low (below 10 knots; GOOD conditions). Only a small proportion of raptors migrated when wind strength in the early morning was high (above 10 knots; BAD conditions). All raptor species except the kestrels showed such behaviour, the principal species involved being Honey Buzzard Pernis apivorus, Marsh Harrier Circus aeruginosus and Hobby Falco subbuteo. Data for three migration seasons (1976-78) were divided into three periods: EARLY (1-15 September), PEAK (16-30 September) and LATE (1-15 October), and the fraction of raptors (all species except the kestrels) migrating in BAD conditions calculated. The fraction migrating during BAD conditions was significantly lower during the PEAK period. The average wind speed in which raptors migrated was calculated for each of the three periods. Raptors migrating during the PEAK period flew in an average wing speed which was lower than raptors migrating EARLY or LATE. It is suggested that socialisation during the PEAK period when many birds were on migration simultaneously might have improved the quality of decision making. Unfortunately, uncertainty about what actually takes place during strong northwesterly winds greatly reduces the value of this study and it is possible that the reported effect is an artefact.

Introduction

In an earlier paper (Thake 1986-87), the results of correlation analyses were used to show the fraction of raptors migrating during "GOOD" weather was positively correlated with the number of raptors on migration at the time. In short, raptors migrating over Malta appeared to be making decisions of better quality when many raptors were on migration simultaneously. Further analyses have been made using original data in an attempt to make the effect more apparent. The results of these analyses are reported hereunder.

Methods

The methods employed to obtain the raw data were described in earlier papers (Thake 1977, 1980, 1986-87). Calculations were performed using a CASIO FX 801P programmable calculator, using computer programs devised and tested by the author.

Analyses Performed

The daily totals of all species of raptors excluding the kestrels were used in this study. Each total was coupled with wind strength data recorded during the same day. If wind strength was higher than 10 knots, the day was scored as "BAD"; if less than 10 knots, the day was scored as "GOOD". The daily totals were split into three periods: EARLY (1-15 September), PEAK (16-30 September) and LATE (1-15 October).

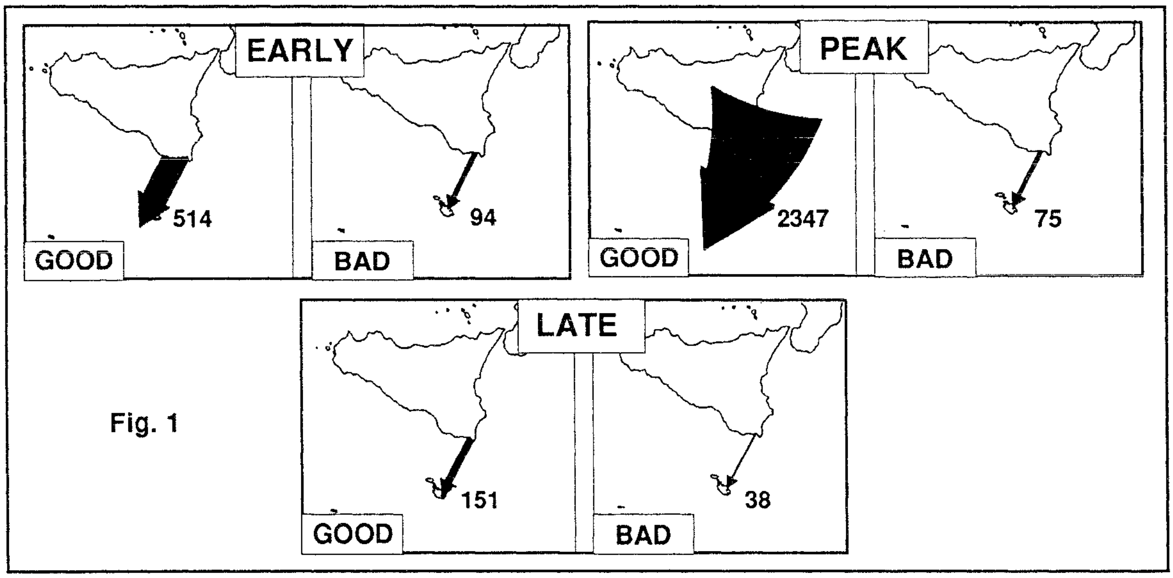

Fig. 1: Variations in the quality of decision making over the migration season.The migration season is divided into "EARLY", "PEAK" and "LATE" periods, and the total numbers of raptors seen at Buskett when the weather was scored as "GOOD" and when the weather was scored as "BAD" are depicted on the maps (See Table 1).

Analysis A : The proportions of raptors migrating during "GOOD" and "BAD" weather in each of the three periods (EARLY, PEAK and LATE) were compared. Chi square analysis showed no significant difference between the EARLY and LATE periods. The PEAK period differed significantly from the other periods (see Table 1).

Table 1
Variation in the quality of decision making over the migration season

	Number migrating in "good" weather	Number migrating in "bad" weather
early 1 - 15 Sept	514	94
peak 16 - 30 Sept	2347	75
late 1 - 15 Oct	151	38

Statistical analysis: The data were analysed as a 3 x 2 contingency table.
Chi square = 185.877. Degrees of freedom = 2. $p << .001$

The z test for the difference between two proportions was performed. Data for EARLY and LATE periods were combined and tested against the proportions recorded during the PEAK period. $z = 13.4426$; $p << .01$

Analysis A is open to criticism because arbitrary conditions have been imposed by the analyst in deciding what constitutes a "GOOD" and a "BAD" day for migration. Light winds are indicative of anticyclonic conditions, the best type of weather for migration. Correlation analysis of data from Buskett have shown that most raptor migration occurs in light winds (Thake 1977-78, 1980, 1981-83), and wind strength is the best predictor of daily totals. Migration when wind strength is low makes good sense in the Central Mediterranean. The minimum sea crossing here for raptors using the Malta route is about 420 km and raptors cannot risk getting caught at sea in bad weather. The most dangerous type of weather which might be encountered at this time of year is that caused by an Atlas lee depression which has moved out over the Central Mediterranean. The probability that this will occur is small if the wind strength is low. Thus, there can be no doubt that light winds are best for raptor migration but the analyst's act of choosing 10 knots as a boundary between "GOOD" and "BAD" weather is clearly arbitrary. The analyses described below (analyses B and C) attempt to overcome this difficulty.

Analysis B : Data for 1983 were added to 1976-1978 data in order to increase the samples size. All species of raptors except the kestrels were included in the analysis. The migration season was divided into EARLY, PEAK and LATE periods. The percentages of raptors migrating at various wind strengths were calculated. The results are listed in Table 2.

Table 2
Distribution of sightings at various wind strenghts, at various times during the migration season.

Wind strength (in knots)	Early	Peak	Late
Calm	31.7%	27.9%	29.1%
1 - 5	11.6	35.6	12.1
6 - 10	20.3	30.5	31.9
11 - 15	35.8	5.8	3.8
16 - 20	0.2	0.0	20.9
21 - 25	0.2	0.1	2.2
Total number of raptors seen	**438**	**2520**	**182**
Number of days in sample	**35**	**47**	**24**

The data were analysed as a contingency table by Chi square analysis (see Table 3). The tendency for migration to occur at lower wind strengths during the peak period of migration is quite clear. However, an important discrepancy was noted. The distribution of sightings with wind strength during the EARLY period differed significantly from that during the "LATE" period. (2 x 6 contingency table. Chi square = 150.66 p << .005). The tendency for migration to occur during lighter winds in the PEAK period was analysed explicitly in Analysis C.

Analysis C **:** The data were employed to obtain values for the mean wind strength prevailing on days when the birds migrated. The raw data are shown in Table 4. These data were analysed by single classification ANOVA. This technique compares samples in order to determine whether the samples could have arisen by random sampling from a single population. This was not the case. Raptors migrating during the PEAK period did so at lower wind strengths than raptors migrating EARLY or LATE.

Table 3
Distribution of sightings at various wind strengths, at various times during the migration season.

Wind category (Knots)	0	1 - 5	6 - 10	11 - 15	16 - 20	21 - 25
Early	139	51	89	157	1	1
Peak	704	897	768	147	1	3
Late	53	22	58	7	38	4

The data were analysed as a 3 x 6 contingency table.
Chi square = 1065.344. p << .005

Table 4
Single classification ANOVA: Variation of mean strength "Early", during the "Peak" and "Late" in the migration season. The mean wind strength is the average calculated over the total number of birds migrating during the category (e.g. the mean wind speed during which raptors migrated EARLY in the season was 6.73 knots).

	Mean (knots)	**S.D.**	**Sample size**
EARLY	6.73	5.6	438
PEAK	4.3	3.9	2520
LATE	7.68	7.0	182

$F_{2,3137} = 98.511$; $p << .01$

Discussion

The various analyses reported in this paper show beyond any reasonable doubt that raptors migrating during the peak migration period made fewer mistakes about when to migrate than raptors which migrated early or late in the season. The implication is that decision making improved when many birds were on migration simultaneously. Some form of social interaction which improves the quality of decision making might be taking place. Thake (1984-85) has suggested that animals making decisions in a group on a majority basis should experience an improvement in performance relative to the performance of single animals, and the accuracy of majority decision making increases with group size. This is one of the forms of social interaction which might have given rise to the improved decision making reported here. Majority decision making might have been responsible for the improved quality of decision making when many raptors were migrating together.

Another possibility is that a greater fraction of raptors which migrate EARLY and LATE are inexperienced birds. The experienced adults might tend to migrate during the peak migration period and their judicious decision making might influence the behaviour of inexperienced birds. As a result a smaller proportion of the inexperienced birds would make mistakes during the PEAK period.

Yet another factor operating might be an effect by which raptors which migrate EARLY and LATE are more confident birds which respond by social facilitation less readily. They are more likely to strike out of their own.

Raptors which migrate EARLY and LATE might be more motivated to migrate than raptors migrating during the peak migration period. Raptors migrating EARLY might be adopting a strategy which envisages their arrival on the wintering grounds before other conspecifics. Such a strategy ought to be advantageous because a bird which arrives early on the wintering grounds is already a territory holder when other conspecifics arrive. Territory owners are generally at an advantage in territorial disputes (Krebs & Davies 1981). EARLY birds ought to be in a hurry and are more likely to decide to migrate when weather is not very favourable. Raptors migrating LATE might be adopting a strategy which involves them in a longer period of premigratory fattening. If such a strategy results in their arriving in better condition on the wintering grounds, the strategy might be adaptive. For instance, a bird which is in good condition might be better able to resist attempts to evict it made by the Afrotropical related species. It is conceivable that LATE birds might be in hurry also because they would be at a disadvantage if they were to arrive late on the wintering grounds. All suitable territories might be occupied already. Thus, raptors migrating LATE might conceivably opt to migrate in weather which birds migrating during the PEAK period would avoid. The hypotheses outlined above are not mutually exclusive and the true explanation might be a very complex one indeed.

The results published in this paper are based on inadequate data. It is conceivable that wind direction might cause the stream of migrating birds which passes through the Maltese Islands to shift in such a way as to cause the totals to vary. If this is so, Buskett totals might be related to the total number of raptors on migration, in a complicated manner.

Comparison of results obtained at Buskett with published results obtained elsewhere (Richardson 1978, Alerstam 1978) as regards the effect of wind strength on migration intensity show no major qualitative differences. However, wind determined drift and leading line effects cause much variation in daily totals elsewhere (e.g. Porter & Willis 1968, Finlayson et al 1976, Alerstam 1978). Buskett totals are known to be subject to a small leading line effect operating in southerly winds (including sea breezes - Thake 1980). Thus, Buskett totals are known to be distorted but it is what actually happens when winds blow between northwest and west which gives greatest cause for concern. The dearth of sightings of raptors in the Maltese Islands in northwesterly and westerly winds above about 10-15 knots is open to three main interpretations. It might be that few raptors attempt to migrate across the Sicilian channel under such conditions. This interpretation is assumed implicitly in the analyses reported in this paper. An alternative interpretation of the observations envisages the stream of migrating raptors being shifted eastwards by the northwesterly winds, and failing to make a landfall on the Maltese Islands. If this interpretation is correct, the "decision making" which is presumed in this paper to have taken place when birds fail to appear in Malta is an artefact, created by wind determined drift. Beaman and Galea (1973) suggested that many raptors fly over the Maltese Islands at great height during tail winds (northwesterly winds have a favorable northerly component). The author's field observations confirm that raptors are often seen flying higher that usual in light tailwinds, but the raptors seen always used conventional thermal soaring. Each bird or flock would soar in a thermal until it had reached sufficient height after which it would glide southwards. Raptors never soared higher than the base of convective cloud. When cloudbase was low, some birds could be seen disappearing into the mist at the base of the cloud, only to reappear after a few seconds as they glided out of the thermal. Relative humidity in Malta is so high that convective cloud base usually lies below 1000m and is never above 1600m. Thus, cloud base and the thermals below are never so high that raptors soaring directly above the observer are invisible. It seems unlikely that the few raptors which are sighted at Buskett in strong northwesterly winds represent the lowest portion of a major migratory movement at a high altitude. A more plausible hypothesis is that the leading line effect of the southern coast of Malta fails to operate in moderate to strong northwesterly winds. If this hypothesis is correct, the dearth of sightings in northwesterly winds is an artefact and the analyses reported in this paper are invalid.

Unfortunately, there are no reports of observations in southern Sicily where the birds leave the coast bound for Malta and North Africa. Observations made there would provide a direct record of the decision making made by raptors in different weather conditions, and would be more elegant than results produced here in Malta can ever be. There are also no observations of the migratory movements by means of radar. Radar ought to provide direct evidence for what actually takes place. Thus, the results reported in this paper are published with the admonition that the reported effect might be artefact.

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INTER-SPECIFIC AND INTRA-SPECIFIC INTERACTIONS AMONG BIRDS FEEDING ON NECTAR IN MALTA - WINTER AND SPRING 1978

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Abstract
Observations of interactions among various species of birds which were feeding on nectar of Antholyza aethiopica and Prunus domestica italica revealed the following interspecific "peck order" among the avian nectarivores. High ranking birds evicted lower ranking ones from nectar sources: (1) male Blackcap Sylvia atricapilla; (2) Sardinian Warbler Sylvia melanocephala and Subalpine Warbler Sylvia cantillans; (3) female Blackcap and Chiffchaff Phylloscopus collybita. Sardinian Warblers are resident all the year round, while the Chiffchaffs were probably all winter residents. One of the Blackcaps was a winter resident while most of the rest were probably spring passage migrants. The Subalpine Warbler is a spring passage migrant and does not breed locally. Chiffchaffs employed hovering as a means of extracting nectar rapidly from the flowers, before they could be evicted by the other birds. They were also observed hovering in order to probe flowers which could not be probed easily by climbing the peduncle. When Chiffchaffs could feed at flowers undisturbed, they generally climbed the peduncle, hovering relatively infrequently only when flowers were in an awkward position.

Introduction

Casual observations of nectar feeding produced a number of instances of interactions among birds which were using or trying to use the source of nectar. Most such interactions were recorded at large patches of *Antholyza aethiopica*. This is an alien African species which is the most prolific producer of nectar locally. Interactions were also observed among birds drinking nectar from Greengages *Prunus domestica italica*. An account of these observations is reported hereunder.

Study Method

Observations were made during winter and spring 1987 at the following localities: Tal-Balal, Magħtab, San Anton Gardens, St Aloysius College, the Seminary at Tal-Virtù. Observations were made by standing or sitting some distances away from the nectar source and observing any happenings through binoculars, whenever birds were seen approaching the nectar source. Short notes were made in the field and these were rewritten in full in the evening. The best studied area was San Anton where on one occasion, a patch of flowers was watched continuously between 09.00hrs and 17.00hrs.

Results

Tal-Balal (19.2.87): a pair of Sardinian Warblers *Sylvia melanocephala* were nectar feeding from a large patch of *Antholyza aethiopica* growing in their territory. A large flowering Almond Tree *Prunus dulcis* was not visited at all, even though it was partly surrounded by the *Antholyza* patch. Both the male and the female were seen visiting the *Antholyza* patch; four visits by the male and three by the female in two hours. No other species attempted to use this patch of flowers.

Magħtab (7.2.87, 9.2.87, 20.2.87): There were several plant species which were producing usable quantities of nectar. A large patch of *Antholyza aethiopica* about 50m away from a group of Carob trees *Ceratonia siliqua* was used most frequently by a male Blackcap *Sylvia atricapilla*, but a pair of Sardinian Warblers from the same group of Carob trees also used the *Antholyza* patch. Whenever the Blackcap's visits coincided with the presence there of a Sardinian Warbler, he would evict the Sardinian Warbler by means of a short chase in flight. This also happened on 20.2.87 when the birds had started using a smaller patch nearby. A pair of Sardinian Warblers from a nearby territory could be seen nectar feeding from Almond trees.