CRANE SPRING MIGRATION OVER GALLOCANTA (SPAIN)

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Introduction

Throughout the last years we have observed an increase in the numbers of Common Cranes *(Grus grus)* staging at Gallocanta lake (NE-Spain) during both migratory periods (*Alonso* et al., in press). This led us to carry on a study on the prenuptial migratory period. Similar studies have also been made at other localities (*Rinne,* 1974; *Alerstam—Bauer,* 1973; *Karlsson—Swanberg,* 1984; *Swanberg,* 1986; *Deppe,* 1981). This paper describes the general pattern of the spring migrations 1984 and 1985, including some preliminary data on the influence of weather.

Study area

Laguna de Gallocanta (40.58 N, 1.30 W, 990 m a. s. 1.) is a saline lake with a water surface of 1400 ha. It lies in a very flat basin of 53 637 ha, most of which is intensively cultivated farmland, mainly wheat and barley (fig. 1). In the last two years sunflower has also been grown in the zone. The basin is surrounded by low mountains (up to 400 m above the level of the lake).

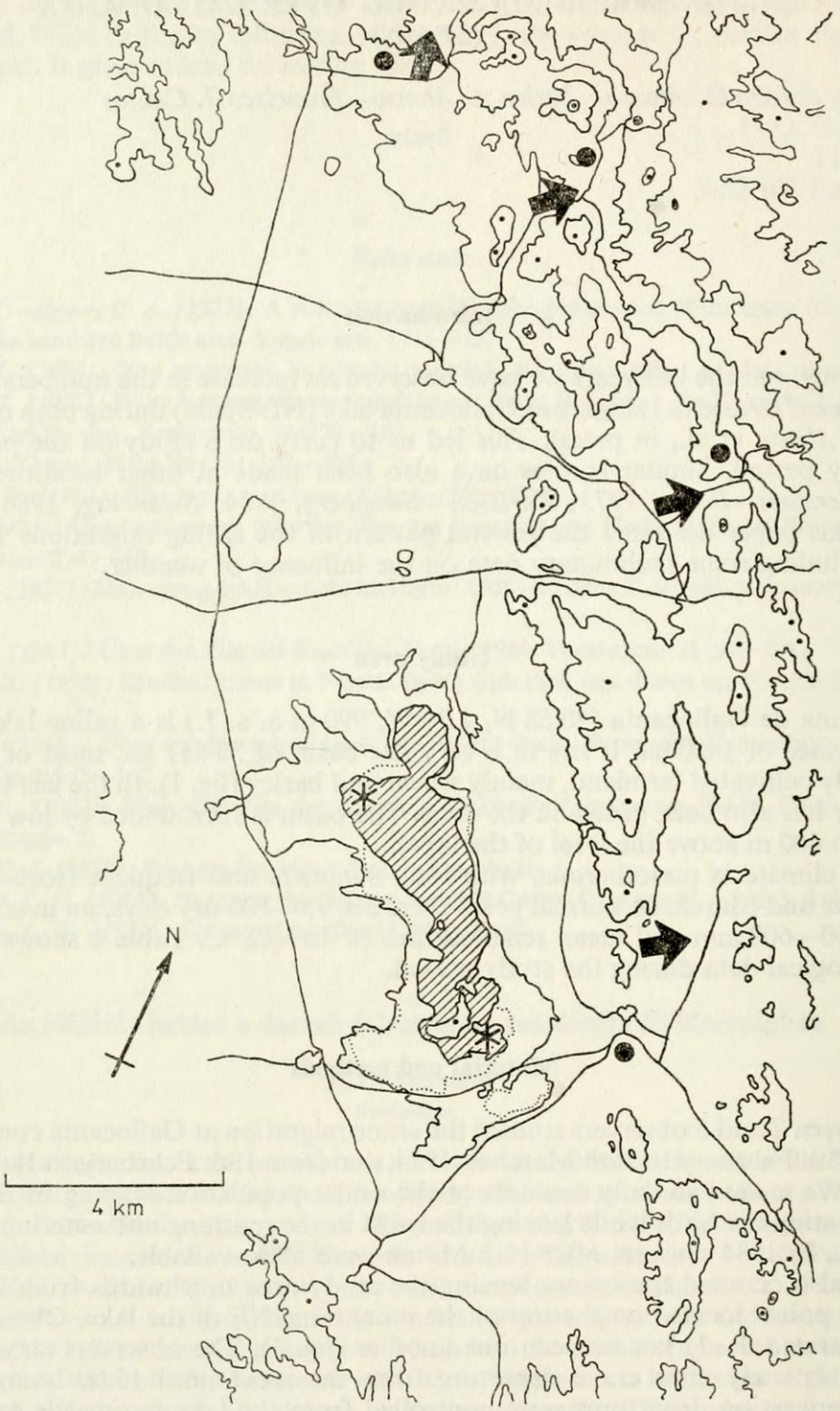
The climate is mesothermic, with mild summers and frequent frosts between November and March. In normal years there are 75—100 dry days, an average rainfall of 400—600 mm and mean temperatures of 10—12 °C. Table 1 shows detailed meteorological data during the study period.

Material and methods

Between 2 and 5 observers studied the crane migration at Gallocanta continuously from 18th February to 19th March in 1984, and from 18th February to 18th March in 1985. We made two daily censuses of the crane population staging in the study area, counting the birds while leaving the roost in the morning and entering it in the afternoon. In 1984 censuses after 19th March were also available.

We also counted the cranes leaving the study area northwards from 2—4 observation points located on the top of the mountains NE of the lake. Observatories were separated 4—11 km between one another (fig. 1). The observers stayed there from immediately after crane departure from the roost until 16.00 hours. Later, possible migration departures were controlled from the lake basin. We calculated the numbers of cranes arriving at the study area each date from the daily censuses and migration departure figures.

Observations were made with the aid of binoculars 8×30, telescope 20—60× and radios connecting the different observatories, so that duplications while counting



Figure/1. The study area

Table 1.

Main weather data during the study

Date	1984					1985				
	Max. temp. °C	Min. temp. °C	Pre-cipit. mm	Wind speed m/sg	Main wind direction	Max. temp. °C	Min. temp. °C	Pre-cipit. mm	Wind speed m/sg	Main wind direction
13 Feb.	6.2	1.4	—	2.5	N					
14	4.4	2.6	—	6.0	NNE					
15	9.2	5.6	—	3.5	W					
16	11.2	6.4	—	2.2	SW					
17	11.6	6.6	—	1.5	N					
18	11.8	4.4	—	2.4	W	7.4	3.6	—	2.0	NE
19	6.8	1.2	13	11.2	W	8.4	−1.8	7	3.5	E
20	10.6	1.0	—	3.5	SW	8.6	−4.0	—	7.0	E
21	10.2	0.4	2	15.0	WSW	3.0	−1.6	—	0.0	—
22	8.0	3.2	3	9.6	W	7.4	−0.8	16	0.0	—
23	7.0	1.2	4	15.5	NW	11.4	−3.6	1	0.0	—
24	6.0	−0.6	—	13.0	N	8.6	−2.2	—	3.5	NE
25	4.0	−2.8	—	0.0	—	11.6	3.6	—	2.5	W
26	5.8	−6.6	—	5.0	W	12.4	2.0	42	3.4	SW
27	5.4	−3.4	3	4.0	SE	15.6	−1.0	—	3.7	WSW
28	2.2	0.8	146*	5.5	E	16.0	1.8	—	8.7	WSW
29	6.0	0.4	—	5.2	WSW					
1 March	2.6	−1.8	9	6.9	NW	11.0	5.2	18	10.0	NW
2	8.6	−3.2	—	7.5	NW	10.2	2.2	—	15.5	W
3	8.8	−1.8	—	5.0	N	13.6	5.0	1	8.0	SW
4	5.6	−3.0	—	14.0	N	8.8	2.8	—	9.7	NW
5	12.2	−5.8	—	1.3	SW	7.6	0.2	1	8.4	N
6	14.6	−4.6	—	0.3	E	10.0	−2.2	—	6.7	N
7	16.2	−3.8	—	0.6	S	11.6	−4.0	—	8.0	N
8	14.2	−3.0	—	8.8	NE	10.2	−2.4	—	7.0	NE
9	7.0	−2.2	—	12.0	NNE	19.6	−3.0	—	2.3	SW
10	5.2	−4.0	—	10.4	N	13.0	3.2	—	8.4	NE
11	7.6	7.8	—	0.0	—	11.8	−2.0	—	10.0	N
12	11.6	−6.2	—	2.4	WSW	8.0	−0.4	10	17.4	N
13	11.4	0.4	8	13.3	S	9.2	−3.8	—	6.5	NNE
14	8.0	−0.8	9	7.0	WSW	11.4	−4.6	—	6.3	WNW
15	7.8	−2.0	—	4.0	SW	9.6	0.2	+	5.0	NW
16	8.4	2.0	18	3.3	WNW	11.6	−4.8	—	10.7	NW
17	7.4	0.2	—	11.6	SW	10.0	−3.0	—	13.5	NW
18	12.4	−2.6	—	2.2	SW	6.2	2.6	12	14.5	NW
19	11.6	−0.8	18	5.0	SE					

*Snow

departing flocks could be completely avoided. We measured the air temperature, wind speed and direction, cloudiness, athmospheric pressure and relative humidity every hour at the main observatory. The number of birds, flight direction and height, and time of departure were recorded for each departing flock when it flew over the observation point. Additionally, 1—2 observers aged (adults or juveniles) many of the birds contacted during all-day surveys of the feeding areas, and also obtained complementary information about the movements of the cranes inside the basin.

Results and discussion

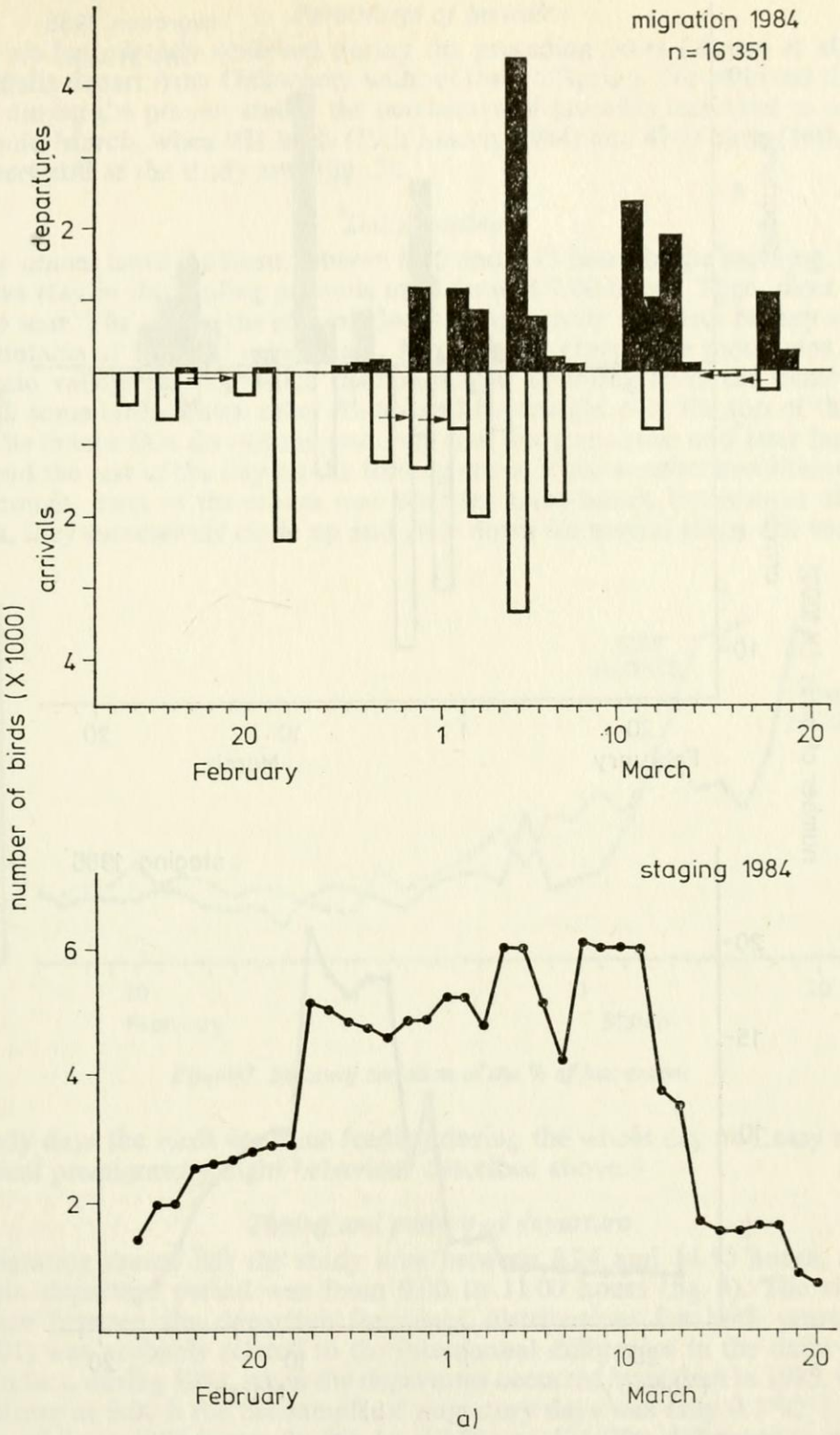
Migration phenology and crane numbers

The crane spring migration takes place at Gallocanta between mid February and late March (fig. 2). In 1984, crane numbers regularly decreased after 19th March until 8th April, when the last 11 cranes left the area. The length of arrival and departure periods in Gallocanta were approximately equal in both years. In general, departure figures were not very much correlated with arrival figures during the previous day, indicating that cranes tend to stay more than one night at Gallocanta. In fact, we never observed cranes arriving from other wintering localities and migrating over Gallocanta northwards without staging there for at least one night (see also below, timing and pattern of departure). More precisely, the weighted "mean arrival dates" were the 1st March, in 1984, and the 5th March, in 1985, and the weighted "mean departure dates" were the 9th March, in 1984, and the 10th March, in 1985. This indicates that, on average, one crane spent respectively 8 and 5 days in our study area, showing the importance of this zone as one of the first migratory staging points during prenuptial migration. The period of the most intensive crane migration coincides with the first days of March. First arrivals and departures ocurred in mid- and late February, respectively for 1984 and 1985, but important departures only took place after a considerable increase in the number of staging birds.

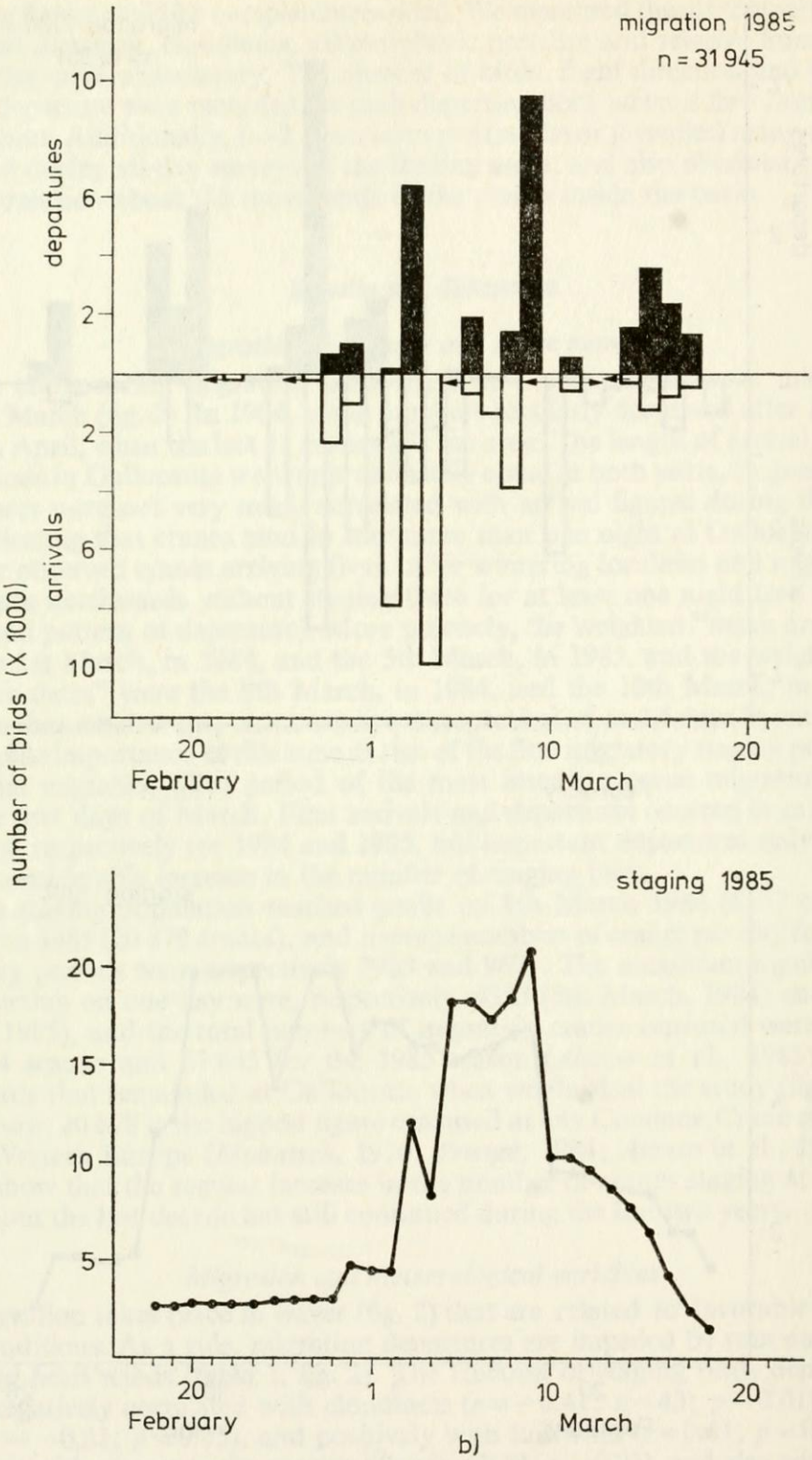
The staging population reached peaks on 8th March 1984 (6107 cranes), and 9th March 1985 (20 878 cranes), and average numbers of cranes per day for the whole migratory periods were respectively 3923 and 9679. The maximum numbers of cranes departing on one day were, respectively, 4353 (5th March, 1984) and 9328 (9th March, 1985), and the total numbers of migrating cranes censused were 16 351 for the 1984 season and 31 945 for the 1985 season (*Alonso* et al., 1985), including those birds that remainded at Gallocanta when we finished the study (fig. 2). So far as we know, 20 878 is the highest figure censused at any Common Crane staging locality in Western Europe (*Makatsch,* 1970; *Prange,* 1984; *Alonso* et al., 1985). These figures show that the regular increase in the number of cranes staging at Gallocanta throughout the last decade has still continued during the last two years.

Migration and meteorological variables

Migration takes place in waves (fig. 2) that are related to favorable meteorological conditions. As a rule, migration departures are impeded by rain and snowfalls or strong head winds (table 1, fig. 2). The fraction of staging birds departing each day is negatively correlated with cloudiness ($r=-0.41$; $n=43$; $p<0.01$) and wind speed ($r=-0.31$; $p<0.05$), and positively with tail wind ($r=0.41$; $p<0.01$) and its increment with respect to the previous day ($r=0.54$; $p<0.01$), and also with the increment in temperature ($r=0.34$; $p<0.05$) (*Alonso* et al., in preu).



Figure|2. Numbers of cranes arriving at departing from and roosting at Gallocanta through the 1984 and 1985 prenuptial migratory periods (a—b) P.T.O.

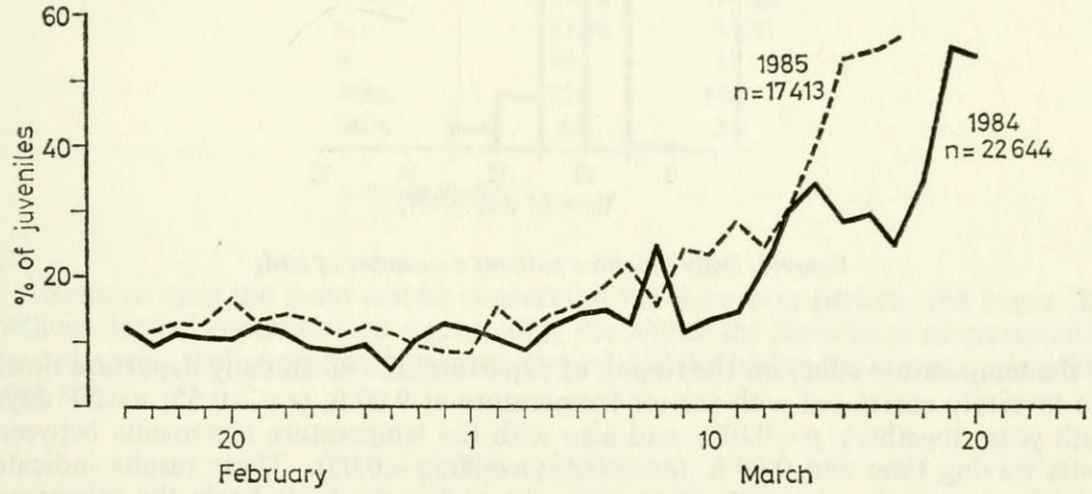

migration 1985
n = 31945
departures
arrivals
number of birds (X 1000)
10
6
2
2
6
10
20
February
1
10
March
20
staging 1985
20
15
10
5
20
February
1
10
March
20
b)

Percentage of juveniles

As we had already observed during the preceding years (*Alonso* et al., 1984), many adults depart from Gallocanta without their offspring. We observed that same pattern during the present study: the percentage of juveniles increased to over 50% during mid March, when 931 birds (19th March, 1984) and 4169 birds (16th March, 1985) were still at the study area (fig. 3).

Daily routine

The cranes leave the roost between 6.30 and 7.15 hours in the morning. Usually, the flocks stay in the feeding grounds until around 9.00 hours. Then, most of them begin to soar. The size of the soaring flocks progressively increases as they approach the mountains at NE and gain height. Most cranes cross these mountains through 3—4 main valleys (fig. 1), which facilitates their counting from the observatories, although some birds follow other routes and fly straight over the top of the mountains. The cranes that do not migrate may soar for some time and later land again and spend the rest of the day on the feeding areas. If the weather conditions are not good enough, most of the cranes may soar for some hours, but instead of leaving the area, they successively circle up and glide down for several times. On very windy

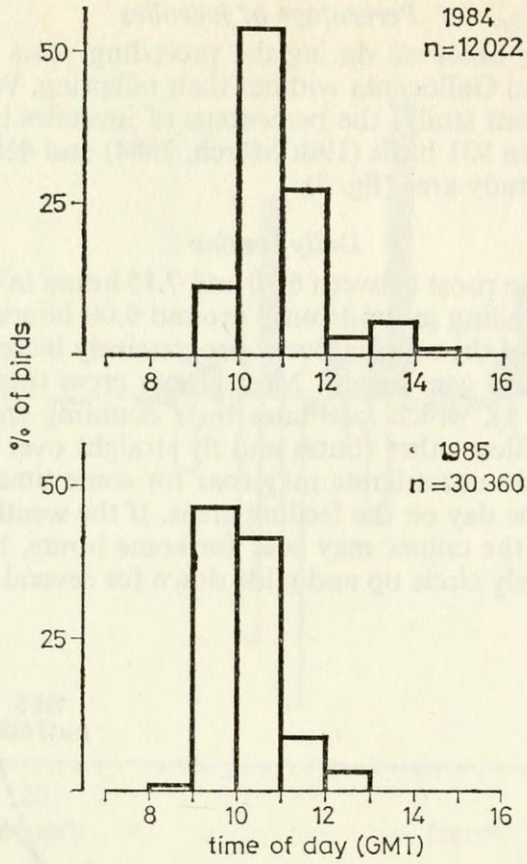


Figure|3. Seasonal variation of the % of juv. cranes

or cloudy days the birds continue feeding during the whole day and may not show the typical premigratory flight behaviour described above.

Timing and pattern of departure

Migrating cranes left the study area between 8.24 and 14.55 hours, although the main departure period was from 9.00 to 11.00 hours (fig. 4). The significant difference between the departure frequency distributions for both years (χ^2-test, $p<0.001$) was probably related to the interannual differences in the daily temperatures. In fact, during 1984, when the departures occurred later than in 1985, the mean temperature at 9.00 h for the sample of migratory days was only 0.7 °C ($\sigma_n=2.78$; $n=18$), while in 1985 it was 3.1 °C ($\sigma_n=2.28$; $n=12$). The difference is significant ($t=2.36$; $p<0.02$). We have compared the mean temperatures at 9.00 h because it is normally at that time when migrating flocks begin to fly. Supporting the hypothesis



Figure/4. Daily departure pattern; n=number of birds

of the temperature effect on the timing of departure, the mean daily departure times are inversely correlated with the air temperature at 9.00 h ($r=-0.55$; $n=30$ days both years together; $p<0.01$), and also with the temperature increments between roost leaving time and 0.99 h ($r=-0.42$; $n=30$; $p<0.05$). These results indicate that the sooner the air temperature rises, the earlier the birds begin the migratory flight, and suggests that a certain threshold could exist, below which the start of a migratory flight would be uneconomical.

The size of the flocks leaving the area was highly variable (table 2). The mean flock size was significantly lower in 1984 than in 1985 ($t=3.72$; $p<0.001$). As the total numbers of departing birds censused in 1984 and 1985 were, respectively, 15 614 and 30 333, and the numbers of departure days, 18 and 12, the average daily numbers of cranes leaving the area were, respectively, 867 and 2528 cranes, the difference between the latter figures being statistically significant ($t=2.35$; $p<0.05$). This suggests that the higher average flock size observed in 1985 could have been simply determined by the higher number of birds migrating through Gallocanta this year. Supporting this hypothesis, a significant correlation exits between the mean departure flock size and the number of birds departing for the sample of 30 days of migration ($r=0.49$; $n=30$; $p<0.01$). A similar correlation exists between the number of birds departing and the duration of the daily departure intervals ($r=0.49$; $n=30$; $p<0.01$; table 3).

Table 2.

Size of departing flocks

	1984	1985
Mean	37.02	51.07
s. e.	2.10	3.14
n	313	595
Max.	380	550
Min.	1	1

Table 3.

Daily departure interval (minutes between the first and the last departing flock)

	1984	1985
Mean	77.55	109.08
s. e.	13.98	11.81
n	18	12
Max.	222	148
Min.	0*	35

* A single flock.

Summarizing the main results concerning the departure pattern, the better the metheorological conditions on a given day, the higher the percentage of cranes that leave the area, the longer the departure interval and the higher the average migrating flock size.

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Summary

Common Crane *(Grus grus)* spring migration was studied during 1984 and 1985 at Gallocanta lake (NE-Spain). The migratory period extended from mid February to late March. It was estimated that one bird spent, on average, 8 and 5 days, respec-

tively for 1984 and 1985, in the study area. The first days of March were the period of most intensive crane migration. Peak staging population figures were reached on 8th March 1984 (6107 cranes) and 9th March 1985 (20 878 cranes). The total numbers of migrating cranes censused were 16 351 and 31 945, respectively during the 1984 and 1985 seasons. Preliminary correlations between numbers of birds departing and some meteorological variables are given. Also, the effect of air temperature on the timing and pattern of departure is discussed.

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A darvak tavaszi vonulása Gallocanta (Spanyolország) fölött

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A szerzők a daru *(Grus grus)* tavaszi vonulását tanulmányozták az északkelet-spanyolországi Gallocanta-tónál 1984. és 1985. év során. A vonulás február közepétől március végéig tartott. Becslések szerint egy-egy madár átlagosan 8 napot töltött a pihenőhelyen 1984-ben és ötöt 1985-ben. A daru tavaszi vonulásának legmozgalmasabb szakasza március első napjaiban volt, 1984-ben a pihenő darvak számának csúcsa március 8-ra (6107 egyed), 1985-ben március 9-re (20 878 egyed) esett. A vonuló darvak összesen észlelt száma 1984-ben 16 351, 1985-ben 31 945 volt. Az eltávozó madarak száma és néhány meteorológiai változó közötti összefüggéseket közölnek előzetesen. Ezen kívül kitérnek arra, hogy milyen hatással van a léghőmérséklet az eltávozás idejére és módjára.