Afr. J. Ecol. 1998, Volume 36, pages 295–302

Home range size and dispersion in the helmeted guineafowl (*Numida meleagris galeata* Pallas) of the Waza National Park, Cameroon

HANSON LANGMIA NJIFORTI[1] and KATIA HUESO KORTEKAAS[2]

[1]*Institute of Animal and Veterinary Research (IRZV), PO Box 77 Maroua, Cameroon;*
[2]*Centre for Environmental Studies (C.M.L.), P.O. Box 9518, 2333 CC Leiden, The Netherlands*

Summary

Field investigations of the home range size and emigration pattern of wild helmeted guineafowl (*Numida meleagris galeata* Pallas) from 1992 to 1995 showed that home range size ($\pm$95% confidence limits (CL)) varied with season from $3{\cdot}6 \pm 1{\cdot}5\,km^2$ for the dry seasons to $3{\cdot}1 \pm 1{\cdot}5\,km^2$ for the rainy seasons. Home range size varied depending on whether it was estimated with data for adult males, adult females or young birds, with a higher home range size for young birds, closely followed by adult males. Group size ($\pm$95%CL) varied by month, and was highest between March and April ($47{\cdot}0 \pm 8{\cdot}1$ birds/group) and lowest in August $9{\cdot}0 \pm 5{\cdot}1$ birds/group). More young birds ($\pm$95%CL) ($36{\cdot}8 \pm 19{\cdot}6$%) dispersed than adult males ($21{\cdot}1 \pm 1{\cdot}9$%) or adult females ($13{\cdot}5 \pm 1{\cdot}8$%). There was a highly significant positive correlation between group size and the number of birds emigrating from the group. There was also a significant negative correlation between the weights of birds at tagging and the percentage that emigrated during the first year of study but not later. This is suggested to be linked to the high number of young birds emigrating, since they weigh relatively less than adults. The lack of correlation between body weight and number of birds emigrating a year or later after birds were tagged was thought to be due to the fact that birds tagged while young attained adult weight within a year.

Key words: Cameroon, emigration, guineafowl, home range

Résumé

Les recherches sur le terrain de la taille de l'habitat et du schéma d'émigration de la pintade casquée (*Numida meleagris galeata* Pallas), effectuées entre 1992 et 1995 ont montré que la taille de l'habitat (limite de confiance (CL) de $\pm$95%) variait avec les saisons, de $3{,}6 \pm 1{,}5\,km^2$ en saison sèche à $3{,}1 \pm 1{,}5\,km^2$ en saison des pluies. La taille de l'habitat variait selon qu'on le calculait avec les données concernant les mâles adultes, les femelles adultes ou les jeunes oiseaux, la taille la plus grande étant celle de l'habitat des jeunes oiseaux, suivie de près par celui des mâles adultes. La taille des groupes (CL $\pm$95%) variait de mois en mois, et était la plus élevée entre

Correspondence and Present address: Centre for Environmental Studies and Development in Cameroon (C.E.D.C.), PO Box 410 Maroua, Cameroon.

mars et avril (47,0 ± 8,1 oiseaux par groupe) et la plus petite en août (9,5 ± 5,1 oiseaux par groupe). Les jeunes oiseaux étaient plus nombreux (CL ± 95%) (36,8 ± 19,6%) à se disperser que les mâles adultes (21,1 ± 1,9%) et que les femelles adultes (13,5 ± 1,8%). Il y avait une corrélation très significativement positive entre la taille du groupe et le nombre d'oiseaux qui quittaient le groupe. Il y avait aussi une corrélation significativement négative entre le poids des oiseaux au marquage et le pourcentage de ceux qui quittaient le groupe dans la première année de l'étude, mais plus après. On suggère de relier ceci au grand nombre de jeunes oiseaux qui quittent, puisque leur poids est relativement moindre que celui des adultes. On a pensé que le manque de corrélation entre le poids et le nombre d'oiseaux qui quittaient le groupe un an ou plus après avoir été marqués était dû au fait que les oiseaux marqués jeunes atteignaient un poids d'adulte au bout d'un an.

Introduction

The successful management of any wildlife species for exploitation or for conservation requires good knowledge of the ecology and behaviour of the species to be managed. Managers of species that are to be exploited need to be sure that the off-take from an exploited area can be effectively replaced, either through immigration into the area from neighbouring regions or through offspring. Unfortunately, the dispersal pattern of any given species can depend on a number of factors such as behaviour, population density, food availability and local environmental factors on which information is usually lacking during the setting up of an exploitation project. Local variations in both mortality and dispersal patterns within the same species often make it inappropriate to extrapolate from data of other regions.

This study was aimed at investigating the dispersal pattern and home range size of the helmeted guineafowl (*Numida meleagris galeata* Pallas) in order to assess the consequences of these on a guineafowl hunting project in the buffer zone of the Waza National Park.

Theoretical considerations

White & Garrott (1990) reviewed the methods for estimating home range size and evaluated the two most commonly used ones:

1) minimum area polygon (Mohr, 1947) - this method constructs a convex polygon by connectng the outer locations of sightings of the animal. The area of the polygon resulting from this gives the home range size for the animal. This method considers all the animals' locations as 'normal' movements, and uses this in calculating the home range. The advantages of this method are its simplicity, flexibility and ease of calculation. An important disadvantage is that the polygon includes all locations, not taking into account occasional 'excursions' out of the home range.
2) 95% ellipse method (Jennrich & Turner, 1969) - this method draws an ellipse around 95% of the animals' locations. Here, only 95% of the animal's movements are considered normal. The centre of the ellipse is the most probable location for the animal (the mean x and y locations), i.e. the mean location. This method has the advantage of being independent of sample size (above 20 locations). It also has the advantage of including an F-statistic for additional precision. This F-statistic

estimates the centre of the ellipse in the home range based on the data (White & Garrott, 1990) giving a higher accuracy to the home range estimate; it also demands a greater samples size.

Materials and methods

Study area

The study area covers about 35 km^2 in the western part of the Waza National Park in Northern Cameroon. The terrain in this area is gently undulating, with an average altitude of about 307 m. Yearly maximum temperature is *c.* 40°C and the minimum is *c.* 18°C. The hottest month is April (average temperature 32·8°C) and the coldest is January (average temperature 26·1°C). There are two main seasons, a rainy season from May to October and a dry season from November to April. Rainfall varies from 500 to 800 mm per year. The vegetation of this region was described by Wit (1975) and recently by Gaston (1991) and is of a Sudan–Sahelian type.

Catching, tagging, and tracking

The methods of catching and tagging are described in Njiforti (1997). When birds were caught, their weight was measured using a 0·05 g precision spring balance. Weighed birds were classes into 15 weight classes (from 0·6 g to 1·3 kg) of 0·05 g difference. The sex of each bird was determined by careful examination of the cloaca (Ayeni, 1980). Since it was impossible to determine the sex of all young birds accurately, they were combined in a class as ‘young’.

Each bird was tagged with either leg-rings, leg-rings and neck-rings, or leg-rings and necklace radio-transmitters (Biotrack, U.K.). All leg-rings had three colour combinations. A Mariner 57 (Biotrack, U.K.) radio receiver was used to locate radio tagged birds, and a 10 × 50 binocular was used for birds with neck or leg rings. The search for tagged birds was made either from the back of a 4-wheel drive pick-up truck, or on foot. For each located bird, the geographical position was determined with a G.P.S. (Global Positioning System) device in degrees, minutes and seconds. Information on the group size and time of day was also recorded. Tracking was carried out with at least a 24-h interval, to increase the chances of having statistically independent locations.

The G.P.S. bird locations were later converted to metres North of the Equator and East of the Greenwich meridian and analysed for home range size using a specially designed computer program (McPaal, Smithsonian Institution, U.S.A.). This program can estimate home range and plots both the polygon and the 95% ellipse of the calculated home range. It also has possibilities of including an *F*-statistic in the calculation of the ellipse method.

Birds that left their parental groups were divided into two groups: those that left their parental group, joined another for some time, but later returned to the group (temporarily emigrated); and those that left to a known destination without coming back (emigrated or dispersed). The birds that emigrated were used for further analysis on the percentage of emigrants from each group. The relationship between the group size, age and weight of birds and the number of emigrants was investigated using correlation statistics. Pearson’s two-tailed correlation was used except where otherwise

Table 1. Mean home range size estimates for tagged guineafowl over a 3 years period

Age/sex	Mean home range km^2 ± 95% confidence limits: Dry season	Rainy season
Adult females	3·1 ± 1·2	2·8 ± 1·3
Adult males	3·8 ± 1·5	3·2 ± 1·9
Young unsexed	4·0 ± 1·9	3·4 ± 1·2
Overall mean	3·6 ± 1·5	3·1 ± 1·5

Table 2. Annual percentage migration of guineafowl according to age and sex over a 3 year period

	N	Migrated	% of N
Adult females			
1992/93	61	9	14·8
1993/94	50	7	14·0
1994/95	34	4	11·8
		Mean ± 95% CL	13· ± 1·8
Adult males			
1992/93	73	14	19·2
1993/94	58	13	22·4
1994/95	37	8	21·6
		Mean ± 95% CL	21·1 ± 1·9
Young birds			
1992/93	36	20	55·6
1993/94	24	8	33·3
1994/95	14	3	21·4
		Mean ± 95% CL	36·8 ± 19·6

N = number of birds at the beginning of season, CL = Confidence limits.

stated. For all values, 95% confidence limits have been reported except where stated otherwise.

Results

Group size

The mean monthly group size for all the study years varied with month, from a high between the months of March and April (47 ± 8·1 birds per group) to a low in August (9 ± 5·1 birds per group). The variation in group size with month is shown in Fig. 1. The period when the group size was lowest coincided with the breeding season. This was due to the formation of breeding pairs. However, most breeding pairs still stayed within their home range despite being away from the group. Groups of up to 15–20 birds could still be seen during the breeding seasons but were made up mostly of unpaired birds (adult males, females and first-year males or females). By the time the breeding season ended in September–October each year, the group sizes started increasing again as unsuccessful and later on successful breeders rejoined the groups.

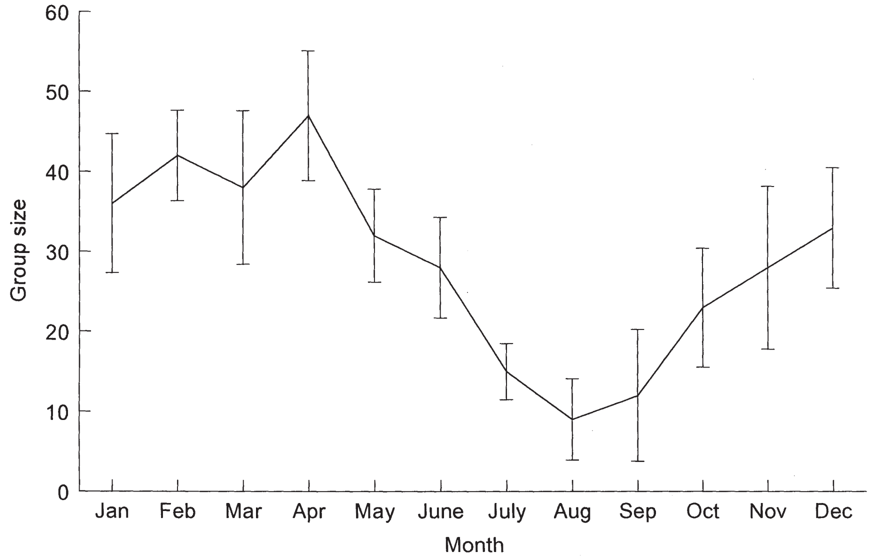

Fig. 1. Variation in mean monthly guineafowl group size from 1992 to 1995. Vertical lines are the 95% confidence limits for the group size.

Home range

The overall mean home range was $3{\cdot}6 \pm 1{\cdot}5$ km^2 for the dry season and $3{\cdot}1 \pm 1{\cdot}5$ km^2 for the rainy season (Table 1). There was a statistically significant difference between the dry and the rainy season home range estimates based on the location of adult females, adult males and young birds (Table 1, paired t-test, $t = 6{\cdot}92$, d.f. $= 2$, $P < 0{\cdot}05$). Home range estimates based on data from young birds were larger than those of adults (females or males) for both dry and rainy seasons (Table 1).

Emigration

More (unsexed) young birds emigrated during the study than either adult females or adult males. More adult males also emigrated than adult females (Table 2). In total, $23{\cdot}8 \pm 13{\cdot}4$% of the birds emigrated each year.

Influence of group size, age and weight on emigration

There was a highly significant positive correlation between the annual mean group size and the number of birds that emigrated from the group, (Fig. 2, $R = 0{\cdot}95$, $P = 0{\cdot}05$). When all birds were considered, there was a significant negative correlation between the weight of birds at tagging and the number that emigrated between 1992/1993 and 1993/1994, (Fig. 3, $R = 0{\cdot}88$, $P = 0{\cdot}05$). However, when only adult birds were considered, the correlation was not statistically significant ($P = 0{\cdot}14$). Between 1994 and 1995, the correlation became insignificant even when only birds tagged young were considered ($P = 0{\cdot}23$).

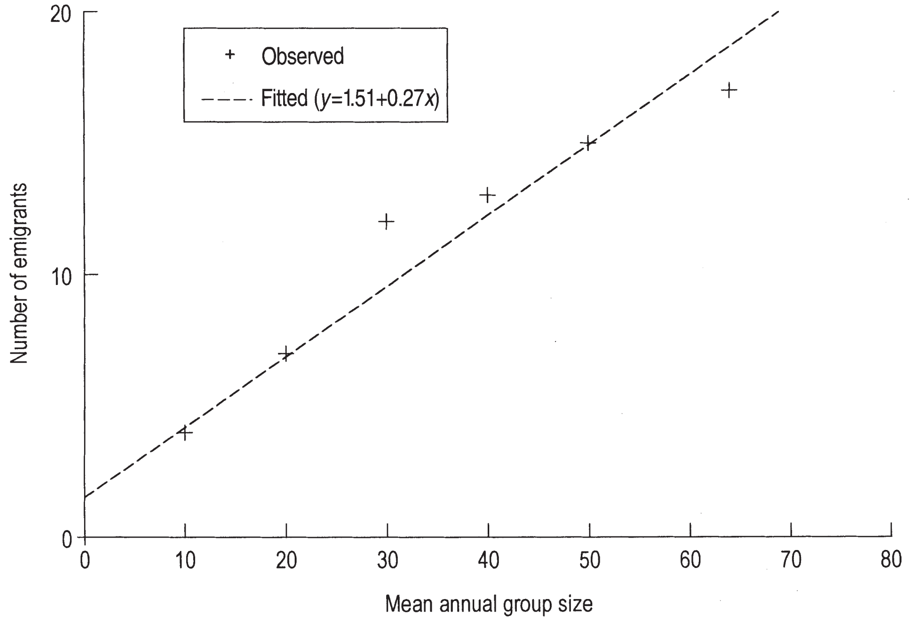

Fig. 2. Correlation between mean annual guineafowl group size and number of birds emigrating during the year.

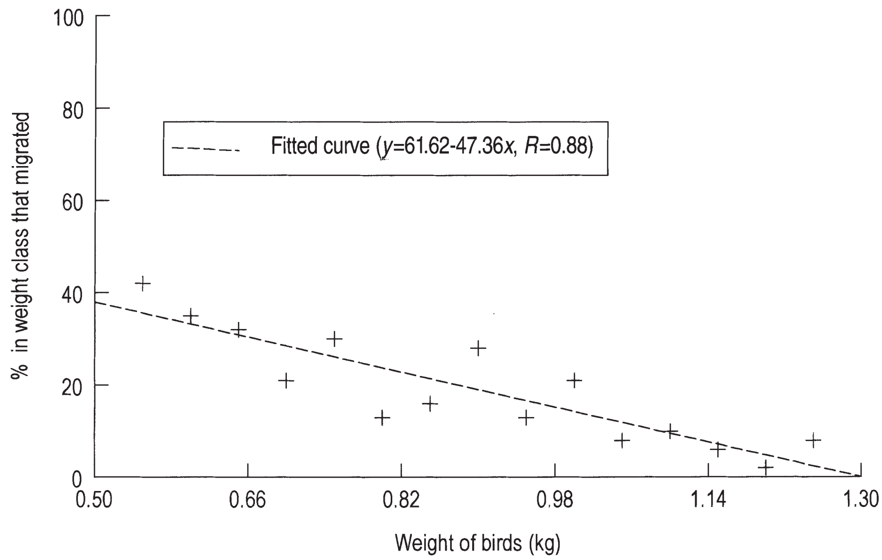

Fig. 3. Correlation between the weight of birds at tagging and the percentage that emigrated within the first year after tagging.

Discussion

Studies on home range can be very useful for the biological understanding of a species and much attention has been focused on this aspect of ecology lately (see

Worton, 1987; Harris *et al*., 1990; and Aebischer, Robertson & Kenward, 1993). The difference in dry and rainy season home range recorded here has also been reported in other social species, e.g. pheasants *Phasianus* spp. (Whiteside & Guthery, 1983; and Gatti, Dumke & Pils, 1989). Grey Partridges *Perdix perdix* (Smith, Hupp & Ratti, 1982), partridges *Alectoris rufa* L. (Ricci, 1985). This type of variation in home range with seasons has also been reported in large mammals like the African elephant *Loxondonta africana* (Blumenbach) (Jackmann, 1983; Viljoen & Bothma, 1990).

Variations in food supply might explain the variation in guineafowl home range size between the wet and the dry season in the Waza region since food supply is high during the wet seasons and low during the dry seasons (Njiforti, 1997). Other studies have shown that food can play a major role in home range size (Mackie & Nel, 1989; Lovari, Valier & Lucchi, 1995).

The bigger home range in size in young birds as compared to adults might indicate a prelude to emigration. Many tagged young guineafowl emigrated during the study. The negative correlation between birds' weight and the number of birds emigrating might have been caused by the high number of young that emigrated as compared to adults since young birds generally weigh less than adults. This could explain why between 1994 and 1995, the correlation became insignificant, since all birds tagged while young were then adults. The slightly lower home range based on the location of females than that based on males' locations might be linked to the lower mobility of females during egg-laying, and incubation. Males might also have to migrate in search of females during the breeding season.

It is not known if the tagging affected the emigration and home range of the birds. There are many contradictory arguments on the influence of tagging on birds. There are those who find no influence, e.g. O'Connor, Pyke & Spencer, 1987) for honeyeaters (*Phylidonyris* sp.), Amstrup (1980) for grouse, Marcstroem, Kenward & Karlbom (1989) for pheasants. There are also numerous reports of influences ranging from change in behaviour to increase in mortality, see Sorenson (1989) for the redheads (*Aytha americana*), Hines & Zwickel (1985) for the blue grouse (*Dendragapus obscurus*), Marks & Marks (1986) for the sharp tailed grouse (*Tympanuchus phasianellus columbianus*) and Johnson & Sibly (1989) for geese. However, it is known that mortality does not differ between guineafowl tagged with radios, leg-rings or neck-rings (Njiforti, 1997). An implication of the result obtained here is that off-take of guineafowl in the buffer zone of the Waza National Park will be replaced mainly by immigrating young birds.

Acknowledgements

This research was funded by the Netherlands Government through The Netherlands Organization for International Co-operation in Higher Education (NUFFIC) and Leiden University/CEDC. Special thanks also to to the Institute of Animal and Veterinary Research (IRZV) and the Ministry of Environment and Forest Cameroon, for facilitating the research. Prof. Dr H.H.T. Prins of Wageningen Agricultural University (The Netherlands); Prof. Dr H. A. Udo de Haes and Ir. Hans de Iongh of Leiden University (The Netherlands) commented on the drafts. Mr E. Kouahou of IRZV was particularly helpful throughout the data collection phase. Lastly, we must not forget the game wardens of Waza National Park who were most helpful.

References

AEBISCHER, N.J., ROBERTSON, P.A. & KENWARD, R.E. (1993) Compositional analysis of habitat use from animal radio tracking data. *Ecology* **74,** 1313–1325.

AMTRUP, S.C. (1980) A radio collar for game birds. *J. Wildl. Manage.* **44,** 214–217.

AYENI, J.S.O. (1980) *The Biology and Utilization of the Helmet Guinea Fowl* (Numida meleagris galeata *Pallas*) *in Nigeria*, PhD thesis, University of Ibadan.

GASTON, A. (1991) Synthèse cartographique. In: *CTA & IEMVT, Elevage et potentialités pastorales sahéliennes–Cameroun Nord*. CTA-IEMVT, Paris.

GATTI, R.C., DUMKE, R.T. & PILS, C.M. (1989) Habitat use and movements of female ring-necked pheasants during fall and winter. *J. Wildl. Manage.* **53,** 462–475.

HARRIS, S., CRESSWELL, W.J., FORDE, P.G., TREWHELLA, W.J., WOOLLARD, T. & WRAY, S. (1990) Home range analysis using radio tracking data – a review of problems and techniques particularly as applied to the study of mammals. *Mamm. Rev.* **20,** 97–123.

HINES, J.E. & ZWICKEL, F.C. (1985) Influence of radio packages on young blue grouse. *J. Wildl. Manage.* **49,** 1050–1054.

JACHMANN, H. (1983) Spatial organization of the Kasunga elephant. *Bijdr. Dierk.* **53,** 179–186.

JENNRICH, R.I. & TURNER, F.B. (1969) Measurement of non-circular home range. *J. theor. Biol.* **22,** 227–237.

JOHNSON, I.P. & SIBLY, R.M. (1989) Effects of plastic neck collars on the behaviour and breeding performance of geese and their value for distant recognition of individuals. *Ringing Migration* **10,** 58–62.

LOVARI, S., VALIER, P. & LUCCHI, M.R. (1994) Ranging behaviour and activity of red foxes (*Vulpus vulpes*) in relation to environmental variables, in a Mediterranean mixed pinewood. *J. Zool.* **232,** 323–339.

LUCHERINI, M., LOVARI, S. & CREMA, G. (1995) Habitat use and ranging behaviour of the red fox (*Vulpes vulpes*) in a Mediterranean rural area: Is shelter availability a key factor? *J. Zool.* **237,** 577–591.

MACKIE, A.J. & NEL, J.A.J. (1989) Habitat selection, home range use and group size of bat eared foxes in the Orange Free State. *S. Afr. J. Wildl. Res.* **19,** 135–139.

MARCSTROEM, V., KENWARD, R.E. & KARLBOM, M. (1989) Survival of ring necked pheasants with backpacks, necklaces and leg bands. *J. Wildl. Manage.* **53,** 808–810.

MARKS, J.S. & MARKS, V.S. (1986) Influence of raio collars on survival of sharp tailed grouse. *J. Wildl. Manage.* **51,** 468–471.

MOHR, C.O. (1947) Table of equivalent population of North American small mammals. *Am. Midl. Nat.* **37,** 223–249.

NJIFORTI, H.L. (1997) *The Biology and Management of Wild Helmeted Guineafowl* (Numida melagris galeata *Pallas*) *in the Waza Region of North Cameroon*. PhD thesis, University of Wageningen.

O'CONNOR, P.J., PYKE, G.H. & SPENCER, H. (1987) Radio tracking honeyeater movements. *Emu* **87,** 249–252.

RICCI, J.C. (1985) Variations of space use mode in the red legged partridge (*Alectoris rufa*) from pairing period to incubating period. *Acta Oecol. Gen.* **6,** 281–293.

SMITH, L.N.M., HUPP, J.W. & RATTI, J.T. (1982) Habitat use and home range of gray partridge in Eastern South Dakota. *J. Wildl. Manage.* **46,** 580–587.

SORENSON, M.D. (1989) Effects of neck collar radios on female redheads. *J. Field Ornith.* **60,** 523–528.

VILJOEN, P.J. & BUTHMA, P.J. (1990) Daily movements of desert elephants in the Northern Namibia Desert. *S. Afr. J. Wildl. Res.* **20,** 69–72.

WHITE, C.G. & GARROTT, R.A. (1990) *Analysis of Wildlife Radio-Tracking Data*. Academic Press, Inc. San Diego, California.

WHITESIDE, R.W. & GUTHERY, F.S. (1983) Ring necked pheasant movements, home ranges and habitat use in West Texas. *J. Wildl. Manage.* **47,** 1097–1104.

WIT, P. (1975) *Assistance to the National Parks of the Savannah Zone in Cameroon: Preliminary notes on the vegetation of Waza National Park*. FAO, Rome.

WORTON, B.J. (1987) A review of models of home range for animal movement. *Ecol. Model* **38,** 277–298.

(Manuscript accepted 24 May 1997)