Ardeola 44(2), 1997, 157-161

ESTIMATING THE SIZE OF LITTLE GREBE *(TACHYBAPTUS RUFICOLLIS)* BREEDING POPULATIONS

Ricard GUTIÉRREZ* & Jordi FIGUEROLA**

SUMMARY.—*Estimating the size of Little Grebe* (Tachybaptus ruficollis) *breeding populations.* The estimation of Little Grebe *Tachybaptus ruficollis* breeding numbers has been found to be quite difficult, given the shy behavior of breeding birds. Different methods have been used, although their accuracy has never been tested. The breeding population was estimated in 1994 at 27 different water bodies in the Llobregat Delta (NE Spain). Breeding numbers were estimated by two methods: a) call census plus territory mapping, and b) direct nest searches. Breeding call surveys gave a 19% underestimate as compared with direct nest searches. Differences occurred in localities with more than one pair. The reliability of both methods was not affected by pond size or density of breeding pairs. However, distance between nests was lower in erroneously censussed ponds and nest location also introduced biases. Localities with error in breeding call surveys had less vegetated edges than the rest. Call censuses were a good method for determining the presence of breeding birds, although the number of breeding pairs was usually underestimated. Estimates obtained by nest searches were more accurate but they required a greater investment of field work. The choice between these two methods will depend on research objectives and study area characteristics.

Key words: Breeding population, census biases, census techniques, Europe, Little Grebe, NE Spain, population size.

RESUMEN.—*Comparación de métodos de censo de poblaciones nidificantes de Zampullín Común* (Tachybaptus ruficollis). A causa de su comportamiento esquivo, es difícil la estimación del tamaño poblacional del Zampullín Común *Tachybaptus ruficollis* durante la época de cría. Se han utilizado al efecto diferentes métodos, si bien nunca se ha contrastado su precisión relativa. Se estimó en 1994 la población nidificante de Zampullín Común en 27 masas de agua diferentes del Delta del Llobregat (NE España). La población reproductora se determinó por dos métodos: a) censo de aves cantoras y mapeo de sus territorios y b) búsqueda directa de sus nidos. Los censos efectuados mediante el recuento de aves cantoras dieron una subestimación del 19% en comparación con la búsqueda directa de nidos. Las diferencias se dieron en localidades con más de una pareja nidificante. La fiabilidad de los métodos no estuvo afectada por el tamaño del humedal o la densidad de parejas reproductoras. No obstante, la distancia entre nidos resultó menor en las lagunas erróneamente censadas y la localización de los nidos también introdujo desviaciones. Las localidades con error en el muestreo basado en el canto presentaban márgenes menos vegetados que el resto. Los censos basados en el canto fueron adecuados para determinar la presencia de aves nidificantes, si bien el número de parejas reproductoras fue normalmente subestimado. Las estimas obtenidas mediante búsqueda de nidos fueron más precisas pero requirieron un mayor esfuerzo en trabajo de campo. La elección entre estos dos métodos dependerá de los objetivos de la investigación y de las características del área de estudio.

Palabras clave: Errores de censo, Europa, NE España, población reproductora, tamaño poblacional, técnicas de censo, Zampullín Común.

INTRODUCTION

Assessing the size of breeding populations is important in determining the importance of wetlands (Amat *et al.*, 1985; Grimmet & Jones, 1989), and detecting changes in population sizes or habitat quality (Furness & Greenwood, 1993). The number of breeding waterbirds is usually determined by ground counts (Dzubin, 1969; Koskimies & Väisänen, 1991; Cowardin & Blohm, 1992) or by aerial surveys (Martin *et al.*, 1979). Detection probabilities of pairs on ground counts was assumed to be 1 (Martin *et al.*, 1979). However, the shy

* Reserves Naturals Delta del Llobregat. Departament d'Agricultura, Ramaderia i Pesca. Gran Via de les Corts Catalanes, 612-614, 2n. E-08007 Barcelona.

** Departament de Biologia Animal (Vertebrats). Facultat de Biologia. Universitat de Barcelona. Avda. Diagonal, 645. E-08028 Barcelona.

behavior of Little Grebes *(Tachybaptus ruficollis)* in the breeding season (Cramp & Simmons, 1977) makes difficult the estimation of breeding numbers (e.g. Oró, 1991; Moss & Moss, 1993). Territory mapping and call survey methods have been used, in addition to traditional individual counting (Ahlen, 1966; Dejonghe, 1978; Jacob, 1982; Sackl, 1982; Vinicombe, 1982; Calvario & Sarroco, 1988). However, the suitability of these methods has not been tested for this species and the problem of obtaining accurate censuses of Little Grebe has not been resolved by using the time-consuming and problematic territory mapping (e.g. Enemar *et al.*, 1976; Svensson, 1979; Tomialojc, 1980; Oelke, 1981; Kwak & Meijer, 1985; Tellería, 1986; Oró, 1991).

The suitability of territory mapping and breeding call surveys as compared with direct nest searches was tested in a wetland area in southwestern Europe, to assess the performance of both methods in a range of wetlands with different covers of aquatic vegetation.

Methods

The size of Little Grebe breeding population was surveyed in the Llobregat Delta, a wetland area near Barcelona (northeastern Spain) during April-May 1994. Birds breed in man-made ponds, brackish lagoons and channels (Mean surface = 2.129 ha, SD = 2.987, range 0.075-11.070 ha, $n = 27$). Breeding numbers of Little Grebes in the study area were estimated by two methods conducted by two independent groups of observers with similar field experience during the same day or the day after: a) detection of simultaneous calling males during 1-3 morning visits to each site; although the use of tape recordings could improve detectability of secretive waterbirds (Gibbs & Melville, 1993), they were not used because of the characteristics of the study sites (water bodies were of small size, its perimeter could be easily surveyed on foot, and they had little vegetation cover) and to avoid the methodological problems associated with the use of tape-lures (mainly call distortion and uncontrolled changes in the potency of the player; and b) by direct nest and brood searches. Nests were located by walking systematically along the edge of the vegetated areas surrounding the water surfaces, and by mapping territories with adults and chicks (Tellería, 1986). The whole of the vegetated surface could be easily surveyed by one or two people and this makes us confident that estimates obtained by this second method reflect the total number of breeding birds. To discern possible factors affecting the accuracy of methods, we tried to establish the causes of differences between the estimates of the two methods. Distances between neighbouring nests were measured with a tape to the nearest meter when they were less than 30 m or if longer they were estimated on a 1:1000 map (to the nearest 5 m). Additionally, we noted nest location and estimated vegetation cover at the pond edge as a proportion between the vegetated perimeter (to the nearest meter) and the total perimeter. Pond surface data were square-root transformed to attain normality (Sokal & Rohlf, 1986).

Results

Breeding surveys gave positive results in 24 out of the 27 localities surveyed. In all localities, breeding birds were detected by both methods. Breeding numbers estimated using the call survey method were lower than those derived from direct nest searches (Wilcoxon paired-sample test, $T = 2.25$, $P = 0.02$). The differences between the two methods appear in those localities used by two or more pairs (Table 1). In fact different estimates of breeding numbers were obtained in 9 localities (69% of the water bodies with more than one breeding pair, but only 37% of localities with positive results), breeding call surveys giving underestimates in eight of the localities and overestimates in only one. The overall estimate of breeding populations using the call survey method was 19% lower than the result of nest searches. Method reliability was not affected by water body size, since ponds with and without error were on average of the same size (ANOVA, $F_{1,22} = 0.47$, $P = 0.51$). Density of breeding pairs did not differ between the two groups (ANOVA, $F_{1,22} = 0.03$, $P = 0.87$). The possible causes of differences in estimated numbers ($n = 9$) appeared to be: a) the high mobility of males (11.10% of the cases), established after long periods of observation of

TABLE 1

Estimates of breeding pairs obtained from breeding call surveys (method a) and nest searches (method b). The mean difference between the estimates of the two methods was 0.58 pairs (SD = 1.38, n = 24). The estimates from method b were used to calculate the density of breeding pairs.
[Estimas del número de parejas reproductoras obtenidas a partir del seguimiento de las llamadas territoriales (método a) y de las búsquedas de nidos (método b). La diferencia media entre las estimas obtenidas con ambos métodos fue de 0,58 parejas (SD = 1,38; n = 24). Las densidades de parejas reproductoras se obtuvieron a partir de las estimas obtenidas con el método b.]

Locality *[Localidad]*	Method a *[Método a]*	Method b *[Método b]*	Surface (ha) *[Superficie (ha)]*	Density *[Densidad]* (N.º pairs/ha)
L'Arana	1	1	1.12	0.893
Magarola	1	1	0.92	1.087
Ricarda	6	6	8.40	0.714
Roberta	2	2	1.48	1.351
Bassa Golf 1	1	2	1.28	1.563
Bassa Golf 2	1	2	0.50	4.000
Bassa Golf 3	2	3	1.23	2.439
Bassa Golf 4	1	1	0.40	2.500
Bassa Golf 5	5	4	1.00	4.000
Bassa Golf 6	2	3	0.75	4.000
Bassa Radar	1	1	0.07	13.333
Hazard Nord	1	1	0.20	5.000
R. Bogues	2	2	1.42	1.408
Remolar	1	1	8.51	0.117
Vidala	11	14	8.12	1.723
Vidaleta	1	1	3.04	0.328
R. S. Climent	12	18	11.07	1.626
C. Dimoni BG	1	1	1.40	0.714
C. Dimoni BP	1	2	0.35	5.714
Reguerons L	2	2	0.75	2.667
Reguerons C	1	1	1.85	0.541
Murtra	4	5	1.97	2.538
B. Llanassos	1	1	0.20	5.000
C. Filipines	1	1	0.07	14.286

individuals and, b) short distances between pairs (88.90% of the cases). This last observation is supported by the fact that nests in ponds with problems in breeding call surveys were more closely distributed than in non problematic ponds (distances between nests in correctly counted ponds: 146.9 m, SD = 55.29, n = 8; in erroneously censussed ponds: 48.8 m, SD = 17.55, n = 17; ANOVA, $F_{1,23}$ = 45.70, P < 0.001). Ten pairs (13.16% of the 76 surveyed) bred in reeds *Phragmites australis* and cattail *Typha sp.* stands in the centre of ponds. The census of these areas was especially difficult. The other pairs (n = 66 pairs, 86.84%) bred on reed areas along the edge of water bodies. Most of the non-detected pairs using the call survey (n = 14) occupied territories in cattail stands (Fisher exact test, P = 0.002). Localities with error in breeding call surveys were less vegetated along their water edges than well-censussed localities (Mann Whitney U-test, Z = –2.57, P = 0.01).

DISCUSSION

The estimation of bird numbers is a common problem that has not been resolved for a great number of species. A good surveying method must give consistent and unbiased estimates of bird numbers, but it must also involve a low economic cost (Dawson, 1985). Breeding call surveys are a good and reasonably economic method of assessing the pre-

sence of breeding Little Grebes. Nevertheless, in our study area it does underestimate the size of the breeding population (by *ca.* 20%). The main problem of this method is that the estimation error is not evenly distributed. Erroneous estimations only occur in a part of the censussed localities, with large differences in localities with a high number of breeding pairs, where nests are grouped together and not evenly distributed along the water edge. Despite the Little Grebe not being a typical colonial grebe (Cramp & Simmons, 1977), reduced vegetation cover at water edges added to the effect of nesting in the centre of ponds (i.e. Viksne, 1982; Owen & Black, 1990) would explain the occurrence of nest grouping in some areas. Additionally, although all territories found by breeding call surveys proved to be in use, it cannot be ruled out that these were singing and not breeding birds, since breeding calls occur all year around in our study area, apparently not associated with active reproduction (Gutiérrez *et al.*, 1995). Therefore, an early census could be biased by the inclusion of non-breeding birds. At least in localities where two successive broods occur in a season, the best census time would be the middle and last part of the incubation period (in the studied localities the 2nd and 3rd week of May).

Nest searches give presumably better estimations of breeding numbers, but it requires approximately four times more time and hard work than call surveys (authors pers. obs.). We think that the two methods apply to different objectives and study area characteristics. Breeding call surveys could be a cheap and quick method to cover large water bodies, and the best method in deep ponds —where territory mapping could be very difficult and time-consuming—, or to monitor population changes in a single locality. However, in small and medium-sized ponds, when comparisons of populations sizes between different localities are planned or when an accurate estimation is required, direct nest searches could be the most reliable method because it is not affected by differences in vegetation cover or by the presence of stands of vegetation.

ACKNOWLEDGMENTS.—Direcció General del Medi Natural funded RG fieldwork. We are also indebted to F.J. Santaeufemia, F. Cerdá and M. Lockwood for their participation in Little Grebe surveys. A. Gutiérrez gave valuable comments during the preparation of a first draft of this manuscript. M. Lockwood improved the English of an early draft.

BIBLIOGRAPHY

AHLEN, J. 1966. Studies on the distribution and ecology of the Little Grebe, *Podiceps ruficollis* (Pall.) in Sweden. *Var Fagelvard*, suppl. 4: 1-45.

AMAT, J. A., DÍAZ PANIAGUA, C., HERRERA, C. M., JORDANO, P., OBESO, J. R. & SORIGUER, R. C. 1985. *Criterios de valoración de zonas húmedas de importancia nacional y regional en función de las aves acuáticas*. ICONA. Monografías 35.

CALVARIO, E. & SARROCO, S. 1988. Biologia reproduttiva del Tuffetto *(Tachybaptus ruficollis)* in una localitá dell'Italia centrale, Fiume Peschiera (Lazio). *Avocetta*, 12: 1-11.

COWARDIN, L. M. & BLOHM, R. J. 1992. Breeding population inventories and measures of recruitment. In, B. D. J. Batt, A. D. Afton, M. G. Anderson, C. D. Ankney, D. M. Johnson, J. A. Kadlec & G. L. Krapu (Eds.): *Ecology and management of breeding waterfowl*, pp. 423-445. University of Minnesota Press. Minneapolis.

CRAMP, S. & SIMMONS, K. E. L. (Eds.). 1977. *The birds of the western Paleartic. Vol. I.* Oxford University Press. Oxford.

DAWSON, D. G. 1985. A review of methods for estimating bird numbers. In, K. Taylor, R. J. Fuller & P. C. Lack (Eds.): *Bird census and atlas studies*, pp. 27-33. BTO. Tring.

DEJONGUE, J. F. 1978. Notes sur les comportements du Grèbe castagneux, *Podiceps ruficollis* en période de Nidification. *Nos Oiseaux*, 34: 237-244.

DZUBIN, A. 1969. Assessing breeding populations of ducks by ground counts. Saskatoon wetlands seminar. *Canadian Wildlife Service Report Series*, 6: 178-230.

ENEMAR, A., HÖJMAN, S. G., KLAESSON, P. & NILSSON, L. 1976. The relationship between census results and the breeding population of birds in subalpine birch forests. *Ornis Fennica*, 53: 1-8.

FURNESS, R. W. & GREENWOOD, J. J. D. (Eds.). 1993. *Birds as monitors of environmental change*. Chapman and Hall. London.

GIBBS, J. P. & MELVIN, S. M. 1993. Call-response surveys for monitoring breeding waterbirds. *Journal of Wildlife Management*, 57: 27-34.

GRIMMET, G. R. I. & JONES, T. A. 1989. *Important bird areas in Europe*. International Council for Bird Preservation, Technical Publication 9. Cambridge.

GUTIÉRREZ, R., ESTEBAN, P. & SANTAEUFEMIA, F. X. 1995. *Els Ocells del Delta del Llobregat*. Lynx Edicions. Barcelona.

JACOB, J. P. 1982. Dénombrement et évolution de la population de Grèbes castagneux *(Tachybaptus ruficollis)* nicheurs en Brabant. *Aves*, 19: 239-244.

KOSKIMIES, P. & VÄISÄNEN, R. A. 1991. *Monitoring bird populations*. Zoological Museum. Finish Museum of Natural History. Helsinki.

KWAK, R. & MEIJER, R. 1985. Species-specific acceptance levels in the mapping method. In, K. Taylor, R. J. Fuller & P. C. Lack (Eds.): *Bird census and atlas studies*, pp. 73-81. BTO. Tring.

MARTIN, F. W., POSPAHALA, R. S. & NICHOLS, J. D. 1979. Assessment and population management of North American migratory birds. In, J. Cairns, Jr., G. P. Patil & W. E. Waters (Eds.): *Environmental biomonitoring, assessment, predictions and management — certain case studies and related quantitative issues*, pp. 187-219. International Cooperative Publishing House. Fairland.

MOSS, D. & MOSS, G. M. 1993. Breeding biology of the Little Grebe *Tachybaptus ruficollis* in Britain and Ireland. *Bird Study*, 40: 107-114.

OELKE, H. 1981. Limitations of the mapping method. *Studies on Avian Biology*, 6: 114-118.

ORÓ, D. 1991. Cens de cabussets *(Tachybaptus ruficollis)* nidificants al Delta de l'Ebre. *Butll. Parc Natural Delta de l'Ebre*, 6: 30-33.

OWEN, M. & BLACK, J. M. 1990. *Waterfowl Ecology*. Chapman and Hall. Glasgow.

SACKL, VON P. 1982. Ökologie und Brutbiologie einer Population des Zwergtauchers, *Tachybaptus ruficollis*, in der Steiermark. *Egretta*, 25: 1-11.

SOKAL, R. R. & ROHLF, F. J. 1986. *Introducción a la bioestadistica*. Reverte. Barcelona.

SVENSSON, S. 1979. Census efficiency and number of visit to a study plot when estimating bird densities by the territory mapping method. *Journal of Applied Ecology*, 16: 61-68.

TELLERÍA, J. L. 1986. *Manual para el censo de los vertebrados terrestres*. Raíces. Madrid.

TOMIALOJC, L. 1980. The combined version of the mapping method. In, H. Oelke (Ed.): *Bird census work and nature conservation*, pp. 92-106. Dachverband Deutscher Avifaunisten. Göttingen.

VINICOMBE, K. 1982. Breeding and population fluctuation of the Little Grebe. *British Birds*, 75: 204-218.

VIKSNE, J. 1982. Restoration of water level and management of islands for nesting ducks at Lake Kanieris, Latvian SSR, USSR. In, D.A. Scott (Ed.): *Managing Wetlands and their birds*, pp. 123-127. IWRB. Slimbridge.

[Recibido: 7-1-97]
[Aceptado: 23-4-97]