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COST-EFFECTIVE ESTIMATES OF WATER RAIL *RALLUS AQUATICUS* BREEDING POPULATION SIZE

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SUMMARY.—*Cost-effective estimates of water rail* Rallus aquaticus *breeding population size.*

Aims: To propose a rapid and cost-effective method to obtain reliable population estimates of *Rallus aquaticus*.

Location: Northern Italy.

Methods: Optimal period and effectiveness of playback use were investigated through dedicated surveys.

Results: Playback use resulted in a greatly enhanced detection rate; the use of broadcasted vocalizations during end of March - April could allow rapid and effective estimates of number of territories.

Conclusion: Water Rail censuses should be undertaken using playback song, between the end of March and the first half of April, the period which proved to be the best both in Italy and UK and provided high detection rates associated with a low risk of including winter migrants.

Key words: bioindicator, call/response, census methods, playback, Rallidae.

RESUMEN.—*Evaluaciones efectivas del tamaño de las poblaciones reproductoras del rascón europeo* Rallus aquaticus.

Objetivos: Proponer un método rápido y efectivo para la obtención de estimas fiables del tamaño poblacional de *Rallus aquaticus*.

Localidad: Norte de Italia.

Métodos: El periodo óptimo y la eficacia del método del "playback" fueron investigados por medio de programas de monitorización intensivos.

Resultados: El uso del playback resultó como una mejora importante en la tasa de detección; la reproducción de vocalizaciones durante finales de marzo – principios de abril podría permitir una estima rápida pero eficaz del tamaño poblacional.

Conclusiones: Los censos de rascón europeo deberían llevarse a cabo mediante el método del playback, entre finales de marzo y la primera mitad de abril, siendo este el periodo que ha demostrado ser más idóneo tanto en Reino Unido como en Italia, y que el ha generado tasas de detección más elevadas, asociadas a un bajo riesgo de incluir individuos invernantes.

Palabras clave: bioindicador, reclamo/respuesta, métodos de censo, playback, Rallidae.

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Introduction

Despite a global distribution and use of both forest and wetland habitats, the Rallidae are relatively poorly represented in ornithological research literature. The elusive habitats of the marsh-dwelling rails in particular have discouraged concerted survey effort and ecological study. With few exceptions (e.g. Jenkins and Ormerod, 2002; Brambilla and Rubolini, 2004), very few exhaustive surveys have been carried out on these species in Europe and most effort has concentrated on the near-threatened corncrake *Crex crex* (e.g. Green, 1995; Gautschi *et al.*, 2002; Green, 2004; Tyler and Green, 2004). Public interest, conservation attention and available resources are usually focused on charismatic or highly threatened species and rallids are therefore rarely explicitly considered in conservation surveys or monitoring programs. However, many rail populations are known to have declined during recent decades, because of the destruction and degradation of wetlands (Collar *et al.*, 1994). Long-term surveillance of population size is therefore important for the conservation of the endangered and declining species and their habitats.

The water rail (*Rallus aquaticus*) is still quite widespread throughout european wetlands, but is reported to have undergone large regional declines (e.g. Pulcher, 1988; Gibbons *et al.*, 1993; Delov and Flade, 1997). Recent studies in the UK and Italy (Jenkins and Ormerod, 2002; Brambilla, 2003; Brambilla and Rubolini, 2004) have estimated population sizes and described habitat preferences. It appears from these studies that the water rail has a strong preference for areas of wet/flooded *Phragmites* reed. Other bird species (e.g. bittern *Botaurus stellaris*, Tyler *et al.*, 1998, and great reed warbler *Acrocephalus arundinaceus*, Martínez-Vilalta *et al.*, 2002) also prefer such areas of wet, flooded reed and wetland managers frequently need to monitor and maintain extensive areas of reeds in standing water (e.g. Tyler *et al.*, 1998). There are, therefore, two compelling reasons to monitor water rail: first, it is a species in decline and subject to hunting pressure in some countries, and second, it is an indicator of habitat quality, as it is associated with flooded reeds (a priority habitat for other conservation-dependent bird species) and shows rapid responses to habitat change (see also under "Material and Methods").

Until now, four different methods have been used to collect data on water rail populations: trapping with baited cages (Jenkins *et al.*, 1995; Fuertes *et al.*, 2002), locating nests (De Kroon, 2004), territory mapping (Brambilla and Rubolini, 2004) and playback (Jenkins and Ormerod, 2002). The first three of these methods require substantial investment in time and resources and are generally carried out over several days or weeks. Moreover, animal trapping is sometimes associated with increased stress levels or risk of harm. Jenkins and Ormerod (2002) developed a playback method, but this was not ground-truthed to sites of known breeding densities.

The use of broadcasted vocalizations is a key tool available for monitoring many bird species (Kosinski *et al.*, 2004) and particularly several rallids (Tomlinson and Todd, 1973; Johnson and Dinsmore, 1986; Green, 1995; Gilbert, 2002; Hinojosa-Huerta *et al.*, 2002; Jenkins and Ormerod, 2002; Allen *et al.*, 2004), but estimates of its effectiveness with water rail are currently lacking and, even with playback use, survey efficiency could be improved by focusing efforts during periods and conditions when birds are most likely to be detected (Prescott *et al.*, 2002; Rehm and Baldassarre, 2007). In this paper playback techniques are advocated for surveying water rails and a case study from a well-surveyed wetland in Italy is used to compare playback results among different periods by working with known water rail breeding densities. This work aimed at (i) providing a field test for the supposed optimal period for vocal surveys, and (ii) quantifying the increment of detection rate with playback use.

Material and Methods

The work was carried out at a wetland site which holds the highest recorded water rail breeding densities in Italy and where several studies have been conducted (e.g. Brambilla, 2003; Brambilla and Rubolini, 2003, 2004; Brambilla, 2005). The study area (c. 25 ha of wetland area, see cited studies for details) comprised open water, *Typha spp*. extensions and *Phragmites australis* reed beds often in alternated patches, swamp sedges (*Carex spp*.), other marginal wet grasslands generally mowed for hay-making, wet woodland and willow scrubland. The site has a peculiar elongated shape that, together with the distribution of water bodies and the presence of trails at the reed bed border, allowed the accurate mapping of the species (see Brambilla and Rubolini, 2004, for further details). In this site, a census was carried out each spring (end of February - June) during 2000 - 2007. Population estimates were obtained by regular visits (at least one visit every two weeks) to the study site to map the territories of breeding water rail pairs; during each visit detailed maps of the study site were annotated with all contacts with the species (see Brambilla, 2003, and Brambilla and Rubolini, 2004, for details of field work). We alternated census sessions listening to spontaneous vocalizations (all contacts recorded through accurate territory mapping) with sessions broadcasting taped calls and songs. Male song and pair duet are the most useful recorded vocalizations for water rail census and were used in this work (see also Brambilla and Rubolini, 2004); playback stimulation consisted in one male's song followed by a pair duet, all repeated twice, for a total of 50 seconds of broadcasting (see also Gilbert *et al.*, 1998). The protocol used in this site has been described in full details by Brambilla and Rubolini (2004), and a similar method has proved to be effective for rail monitoring both in Europe (Gilbert, 2002; Jenkins and Ormerod, 2002; Brambilla, 2003) and elsewhere (Tomlinson and Todd, 1973; Johnson and Dinsmore, 1986). Responses recorded during playback sessions were used to discriminate between neighbouring pairs, but were excluded from definition of territory boundaries (sometimes birds tended to move towards the tape player, thus reducing the accuracy of territorial locations; see Brambilla and Rubolini, 2004). Population size was estimated to be 23 breeding pairs from 2002 to 2005 (Brambilla, 2005); a slight decrease occurred in 2006 due to prolonged snow-cover during the winter. However, during 2006 a reduction in the amount of water entering the wetland due to works at the adjacent railway, determined a decrease in standing water in reedbeds and lowered water level in almost all the waterbodies of the area (Mangiacotti and Scali, 2008). In spring 2007, the rail population decreased to 15 ± 2 breeding pairs, despite a mild winter, and the number of territories in 2008 was even lower (12 ± 2). This negative response to lowered water levels, which caused a reduction in the flooded proportion of reedbeds, further confirms the indicator values of the water rail.

During 2000 - 2003, most effective census sessions (higher percentage of territories detected per session) were invariably concentrated between the last week of March and the first week of April and the use of playback greatly enhanced detection rates. Therefore, the period from the end of March to the beginning of April is likely to be the most suitable period for surveying this species, especially by means of playback census. In spring 2004 the optimal period for vocal surveys was investigated by dividing the wetland into two sub-areas (western and eastern sectors) and conducting broadcast vocalization surveys (male song and pair duet) in the western part on 31st March and in the eastern one on 1st April, with playback use (one stimulation in each one of four and five

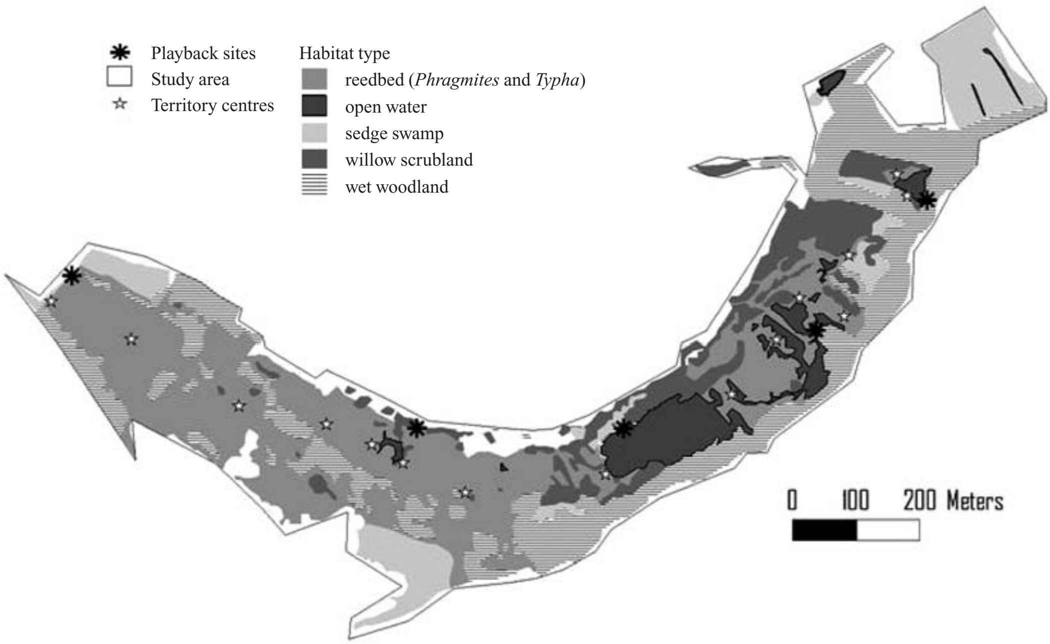

FIG. 1.—Location of broadcasting sites (asterisks) and approximate distribution of breeding water rail pairs in the 2007 breeding season (stars). In that year characterized by a reduced water level, territories were mainly located in the inner part of the reedbed and close to water bodies, thus further highlighting the potential use of water rail as indicator of habitat quality for wet reed beds.
[Localización de los lugares de grabación (asteriscos) y distribución aproximada de parejas reproductoras de rascón europeo durante la estación reproductora de 2007 (estrellas). Los años que presentaron una reducción en el nivel de agua, los territorios se localizaron principalmente en la parte interior del carrizal y cerca de los cursos de agua, por tanto, en adelante se puede destacar el uso potencial del rascón europeo como indicador de la calidad del hábitat de los humedales.]

different sites in the eastern and western portions of the area, respectively); surveys lasted for one hour and half (for a total of three hours), starting from dusk (cf. Polak, 2005). The number and position of territories settled in the wetland in 2004 were estimated by means of further 12 visits with territory mapping, adopting the above method, for a total of c. 40 hours of fieldwork. The reliability of breeding population size estimates of this species achieved through a single (or a few, depending on wetland size) field session(s) in the likely most suitable period was thus empirically evaluated using 2004 data.

To provide a quantitative assessment of the effectiveness of playback use and to model response in relation to date and hour, in winter – spring 2007 (3 January – 29 May) survey results obtained through listening to spontaneous vocalizations and through playback stimulations, respectively, were compared. For this purpose, five different sites within our study wetland were selected (figure 1); they were scattered over the entire area and at a minimum distance of 250 m. Then, at each site a number (2 - 11) of field experiments was carried out; experiments were designed as follows: ten minutes of listening to spontaneous vocalizations, playback stimulation (male's song followed by pair duet, all repeated twice, for a total of 50 seconds of broadcasting), and other additional ten minutes of listening to species vocalizations. During each phase the minimum number of different individuals heard during the ten-minutes period was counted. Results of listening to spontaneous calls with detection after playback stimulation were compared by means of a paired-samples t-test. To assess if playback response could be affected by date or hour of playback experiments, the effect of experiment date (calculated as days from 1st January) and hour (calculated as hours after 7 a.m.) on the response was tested, by means of a mixed regression model. In this procedure, the number of individuals detected after playback stimulation was the response variable, while date and hour and their respective squared terms (to test for non-linear effects) were entered as predictor; site of the experiments was treated as random factor to control for possible non-independence of response data from the same sites, because of their own characteristics, position and breeding density of the species in the surrounding portion of the wetland. We considered a full-factorial model and then obtained a minimum adequate model, sequentially removing non-significant factors from the model. Results of the stepwise procedure were then compared with the outcomes of an information-criteria based approach (model selection based on AIC value). The mixed model analysis was performed by means of the R software (R v. 2.1.1; R Development Core Team, 2005; package nlme); the model was fitted by means of the maximum likelihood method (Venables and Ripley, 2002; see also Brambilla *et al.*, 2006).

RESULTS

On 31st March 2004, 13 pairs were counted out of the 13 breeding pairs known to be in the western portion of the wetland. On 1st April 2004, 9 pairs were counted in the eastern portion out of 10 known breeding pairs. Therefore, with only two field sessions (for overall 3 hours of fieldwork) all but one (95.7 %) of the breeding pairs known to occur through territory mapping (which required 40 hours in the field) were counted. An additional four field sessions were carried out during the second half of April and May, but estimates were consistently lower than the earlier surveys (maximum number of pairs counted per session never exceeded 80 % of the ones known to be present).

The field experiments carried out in winter – spring 2007 quantitatively confirmed how the use of playback greatly enhances rail detection rate, as the number of individuals counted after playback stimulation was significantly higher than the number of birds counted before broadcasting vocalizations ($t = -5.15$, $p < 0.001$).

The regression analysis confirmed that higher response values are found in the central part of the breeding season. In the full-factorial regression mixed model, date ($\beta = 0.08 \pm 0.03$ SE, $p = 0.031$) and its quadratic term ($\beta = -5.9 \times 10^{-4} \pm 2.2 \times 10^{-4}$ SE, $p = 0.018$) were the only predictors with a significant effect and suggested that the response to playback was significantly influenced by date of the experiment, being higher at intermediate values; hour and its quadratic term indeed had no effect on playback response (all $p > 0.7$). The minimum adequate model obtained after sequential removing of non-significant variables included date ($\beta = 0.07 \pm 0.03$ SE, $p = 0.050$) and its quadratic term ($\beta = -5.2 \times 10^{-4} \pm 2.1 \times 10^{-4}$ SE, $p = 0.026$) as predictors (intercept: $\beta = 0.74$) and further confirmed that the response to playback was higher at intermediate dates (i.e. central period of the season, end of March – first half of April; according to the model equation, peak should be around 6th April) and lower at the two extremes of the breeding period. The minimum adequate model was the one displaying the lowest AIC (Akaike's information criterion); the consistency between results obtained throughout different approaches further confirmed the model's validity. The sessions carried out between end of March and first week of April allowed us to contact all the pairs settled in census areas.

Notably, the number of birds counted through spontaneous calls was positively correlated ($r = 0.51$, $p = 0.012$) with the number of individuals counted after playback stimulations, suggesting that spontaneous vocalizations may also peak during early April.

Discussion

Playback of conspecific calls has been frequently used in Nearctic waterbird counts (and specifically also for rail surveys) to increase detection rates, assess demographic trends and evaluate seasonal variation in rates of species detection (e.g. Legare *et al.*, 1999; Allen *et al.*, 2004; Conway *et al.*, 2004; Rehm and Baldassarre, 2007).

Water rail monitoring could greatly benefit from protocols that include broadcast of conspecific calls in periods adequately selected to reduce the possible effects of temporal variation in detection probability.

From our example, 10 - 15 ha of accessible wetland habitats may be surveyed by a single worker with a tape-recorder in a single day. This method is therefore simple to undertake and the necessary expertise can be quickly acquired. Manpower and equipment requirements are extremely low, yet the results are both reliable and useful as demonstrated by our data. The 2004 playback survey showed an accuracy of 95.7 %, despite requiring only 7.5 % of the time needed by season-long detailed territory mapping, thus being *c.*13 times less time-consuming than the latter method.

In short, playback surveys are advantageous over other methods because: (i) detection rates are enhanced; (ii) no stress to the birds because of capture and handling; (iii) for small wetlands, a single session may be sufficient; (iv) affordable equipment, and (v) good population estimates are obtained.

Optimal survey periods may differ geographically according to varying latitude, altitude and overall climatic conditions (see Rehm and Baldassarre, 2007). However, in the west of the United Kingdom, Jenkins (1999) also selected the last week of March and early April for playback surveys due to reduced response rates from late April onwards (due to declining territorial behaviour with the ongoing season, particularly after egg laying) and the potential presence of winter migrants in march. Late winter surveys (i.e. February – first half of March) may be biased by the occurrence of winter migrants (as found in our Italian study site, with birds appearing in February – March but leaving before April), which in this period could occur in wetland sites where resident breeders are already engaged in territory definition, thus providing an overestimation of the population size. In the spring of 2004, all the pairs encountered during the two sessions of 31st March and 1st April were observed or heard at least twice during the breeding season, thus confirming that all the pairs were resident in the site and were unlikely to represent migrants. Therefore, the end of March and the beginning of April may be regarded as the optimal period for water rails counts in northern Italy. Although further assessments of the response rate to playback surveys in different parts of Europe are needed to identify in more detail the optimal survey periods in different regions, the last week of March and the first half of April may be regarded with reasonable approximation as a suitable period for water rail censuses over much of Europe. This is consistent with what suggested by Gilbert *et al*. (1998) for UK (late March in southern England, late April in northern Scotland); the slightly postponed period suggested for northern Scotland could be easily explained by the different climatic context.

In conclusion, water rail could be easily and rapidly censused adopting the above described method; this, coupled with its sensitivity to ecological variation in reedbed quality, makes this species a potentially useful indicator of the status of flooded reed habitats.

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BIBLIOGRAPHY

ALLEN, T., FINKBEINER, S. L. and JOHNSON, D. H. 2004. Comparison of detection rates of breeding marsh birds in passive and playback surveys at Lacreek National Wildlife Refuge, south Dakota. *Waterbirds*, 27: 277-281.

BRAMBILLA, M. 2003. Densità riproduttiva e invernale del Porciglione *Rallus aquaticus* in una zona umida della Lombardia. *Avocetta*, 27: 151.

BRAMBILLA, M. 2005. Densità riproduttiva di tre specie di Rallidi nelle Torbiere di Albate-Bassone (CO). *Avocetta*, 29: 49.

BRAMBILLA, M. and RUBOLINI, D. 2003. Selezione dell'habitat di nidificazione nella Gallinella d'acqua *Gallinula chloropus*. *Avocetta*, 27: 152.

BRAMBILLA, M. and RUBOLINI, D. 2004. Water Rail *Rallus aquaticus* breeding density and habitat preferences in northern Italy. *Ardea*, 92: 11-18.

BRAMBILLA M., RUBOLINI D. and GUIDALI, F. 2006. Eagle Owl *Bubo bubo* proximity can lower productivity of cliff-nesting Peregrines *Falco peregrinus*. *Ornis Fennica*, 83: 20-26.

COLLAR, N. J., CROSBY, M. J. and STATTERSFIELD, A. J. 1994. *Birds to Watch 2. The World List of Threatened Birds.* Birdlife Conservation Series No. 4. Birdlife International. Cambridge.

CONWAY, C. J., SULZMAN, C., and RAULSTON, B. E. 2004. Factors affecting detection probability of California Black Rails. Journal of Wildlife Management, 68: 360-370.

DE KROON, G. H. J. 2004. A comparison of two European breeding habitats of the Water Rail *Rallus aquaticus*. *Acta Ornithologica*, 39: 21-27.

DELOV, V., and FLADE, M. *Rallus aquaticus* Water Rail. 1997. In, W. J. M Hagemeijer and M. G. Blair, (Eds.): *The EBCC Atlas of European Breeding Birds. Their distribution and abundance.* T & AD Poyser. London.

FUERTES, B., GARCÍA, J. and COLINO, J. M. 2002. Use of fish nets as a method to capture small rails. *Journal of Field Ornithology*, 73: 220-223.

GAUTSCHI, B., ARTER, M. K., HUSI, R. E., WETTSTEIN, W. and SCHMID, B. 2002. Isolation and characterization of microsatellite loci in the globally endangered Corncrake, *Crex crex* Linne. *Conservation Genetics*, 3: 451-453.

GIBBONS, D. W., REED, J. B. and CHAPMAN, R. 1993. *The New Atlas of Breeding Birds in Britain and Ireland 1988-1991.* T&AD Poyser. London.

GILBERT, G., GIBBONS, D. W. and EVANS, J. 1998. *Bird Monitoring Methods: A manual of techniques for UK key species.* RSPB/BTO/JNCC/WWT /ITE/The Seabird Group, Sandy.

GILBERT, G. 2002. The status and habitat of Spotted Crakes *Porzana porzana* in Britain in 1999. *Bird Study*, 49: 79-86.

GREEN, R. E. 1995. The decline of the Corncrake *Crex crex* in Britain continues. *Bird Study*, 42: 66-75.

GREEN, R. E. 2004. A new method for estimating the adult survival rate of the Corncrake *Crex crex* and comparison with estimates from ring-recovery and ring-recapture data. *Ibis*, 146: 501-508.

HINOJOSA-HUERTA, O., DESTEFANO, S. and SHAW, W. W. 2002. Evaluation of call-response surveys for monitoring breeding Yuma Clapper Rails (*Rallus longirostris yumanensis*). *Journal of field ornithology*, 73: 151-155.

KOSINSKI, Z., KEMPA, M. and HYBSZ, R. 2004. Accuracy and efficiency of different techniques for censusing territorial Middle Spotted Woodpeckers *Dendrocopos medius*. *Acta Ornithologica*, 39: 29-34.

JENKINS, R. K. B. 1999. *The Ecology of Water Rail* (Rallus aquaticus). Unpublished PhD thesis. School of Biosciences. Cardiff University.

JENKINS, R. K. B., BUCKTON, S. T. and ORMEROD, S. J. 1995. Local movements and population-density of Water Rail *Rallus aquaticus* in a small inland reedbed. *Bird Study*, 42: 82-87.

JENKINS, R. K. B. and ORMEROD, S. J. 2002. Habitat preferences of breeding Water Rail *Rallus aquaticus*. *Bird Study*, 42: 2-10.

JOHNSON, R. R. and DINSMORE, J. J. 1986. Habitat use by breeding Virginia rails and soras. *J of Wildlife Management*, 50: 387-392.

LEGARE, M. L., EDDLEMAN, W. R., BUCKLEY, P. A. and KELLY, C. 1999. The effectiveness of tape playback in estimating Black Rail density. *Journal of Wildlife Management*, 63: 116-125.

MANGIACOTTI, M. and SCALI, S. 2008. Spawning site selection by anurans in the SCI “Palude di Albate” (IT2020003), management implications. *Atti del VII Congresso Nazionale SHI.*

MARTÍNEZ-VILALTA, J., BERTOLERO, A., BIGAS, D., PAQUET, J. Y. and MARTÍNEZ-VILALTA, A. 2002. Habitat selection of passerine birds nesting in the Ebro Delta reedbeds (NE Spain), Management implications. *Wetlands*, 22: 318-325.

POLAK, M. 2005. Temporal pattern of vocal activity of the Water Rail *Rallus aquaticus* and the Little Crake *Porzana parva* in the breeding season. *Acta Ornithologica*, 40: 21-26.

PRESCOTT, D. R. C., NORTON, M. R. and MICHAUD, I. M. G. 2002. Night surveys of Yellow Rails, *Coturnicops noveboracensis*, and Virginia Rails, *Rallus limicola*, in Alberta using call playbacks. *Canadian Field-Naturalist*, 116: 408-415.

PULCHER, C. 1988. Porciglione (*Rallus aquaticus*). In, Mingozzi, T., Boano, G. and Pulcher, C. (Eds.): *Atlante degli uccelli nidificanti in Piemonte e Val d’Aosta 1980-1984.* Museo regionale di Scienze Naturali di Torino Monografia VIII.

R. DEVELOPMENT CORE TEAM. 2005. *R, a language environment for statistical computing. R Foundation for Statistical Computing.* Vienna.

REHM, E. M., and BALDASSARRE, G. A. 2007. Temporal variation in detection of marsh birds during broadcast of conspecific calls. *Journal of Field Ornithology*, 78: 56-63.

TOMLINSON, R. E. and TODD, R. L. 1973. Distribution of two western Clapper Rail races as determined by responses to taped calls. *Condor*, 75: 177-183.

TYLER, G. A., SMITH, K. W. and BURGESS, N. D. 1998. Reedbed management and breeding bitterns *Botaurus stellaris* in the UK. *Biological Conservation*, 86: 257-266.

TYLER, G. A. and GREEN, R. E. 2004. Effects of weather on the survival and growth of Corncrake *Crex crex* chicks. *Ibis*, 146: 69-76.

VENABLES, W. N. and RIPLEY, B. D. 2002. *Modern Applied Statistics with S*. 4th edition. Springer. Berlin.

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