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Detection probability and abundance of a Long-eared Owl population in Switzerland

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Abstract. Traditional Long-eared Owl survey methods like auditory detection by fieldworkers are time-intensive and often yield uncertain results due to low detectability and observer bias. We analysed a large playback-assisted survey in the Canton of Zurich, Switzerland, using occupancy models. Surveys using playback were more effective than passive listening, as detectability was increased, while Tawny Owl presence reduced it. The best way to detect Long-eared Owls was to use playback during late March and early April. The combination of playback and occupancy modelling has led to a substantial reassessment of population size in our study area. Our findings emphasize the value of playback for optimizing survey methods for some species and provide essential baseline information for future studies and potential conservation actions.

Introduction

Due to their cryptic behaviour, the distribution and abundance of many owl species is often incompletely known (Aebischer 2008, Robb 2009). For example, in Switzerland, despite a good knowledge of many other breeding birds (Strebel et al. 2024), assessing population status and trends remains a challenge for owls. Auditory detection by fieldworkers is time-intensive and often suffers from a high incidence of false-negative errors (Robb 2009). This means, that a species is overlooked in the field, despite being present, i.e. imperfect detection (Kissling et al. 2010, Zuberogoitia et al. 2019, Kéry et al. 2024). For species like the Long-eared Owl *Asio otus* these limitations hamper our ability to collect reliable data on distribution, population size and long-term trends, all crucial for population studies and conservation planning.

Previous research has shown that playback increases the detection probability of many bird species (McGregor 2000, Grinde et al. 2018), especially for owl species (McGarigal & Fraser 1985, Martinez & Zuberogoitia 2003, Hannah 2009, Mori et al. 2014, Vrezec & Bertoncelj 2018, Zuberogoitia et al. 2019, Kéry 2023). Birrer (2014) has previously demonstrated the effectiveness of playback for Long-eared Owl surveys.

The Long-eared Owl is a characteristic species of forest-open areas ecotones and of various types of mosaic landscapes. Main threats include intensive agriculture and the associated decline in prey abundance and availability (Birrer 2009, Keller et al. 2020). In Switzerland, the Long-eared Owl population size is estimated to be between 2,000–3,000 territories (Knaus et al. 2018). This assessment has a large uncertainty for Swiss standards. In the Canton of Zurich, 31 territories were reported in 1988 and 59 in 2008 (Weggler et al. 2009). However, standardized, comprehensive surveys have been missing so far.

To bridge this gap, in 2020 we started a long-term project that aims at updating distribution and abundance information on Long-eared Owls in the Canton of Zurich with a systematic and standardized method. We used playback to increase the detection probability and compare it to auditory-only detection. Specifically, occupancy modelling was used to analyse the influence of playback, to find out whether there are interspecific interactions (especially with respect to the Tawny Owl *Strix aluco*), to assess temporal effects in detection probability, and to derive a rigorous population size estimate that accounts for imperfect detection. At the time of writing, half of the Canton has been covered by our surveys. Here we report our first findings.

Material and methods

The study was conducted in the Swiss Canton of Zurich. This area is situated in the eastern part of the Swiss plateau (1729 km²; altitude 330–1291 m a.s.l.) and for the most part composed of low-elevation river valleys, with forests covering 43% of the area, agriculture 30%, and urban areas 20% (Swiss Land Use Statistics, Bundesamt für Statistik, Bodennutzung, 2024).

Our study has been conducted in five years (2020–2024). Fieldwork was done by 90 volunteers from the Avimonitoring program Zurich (Ritschard 2020, Ritschard 2022, Ritschard 2023a, Ritschard 2023b, Ritschard 2024). They visited 2,218 point-count surveys (2.3 surveys/km²), covering 54% of the Canton of Zurich. Each year, a different set of communities were selected and all points within their corresponding administrative boundaries were surveyed.

Survey points had been a-priori selected by the coordination office in such a way that no forest edge or grove in the study area is further than 300 metres from any survey point. By doing so, we aim at a complete population survey of the Canton of Zurich. On average, 440 points were surveyed per year (ranging from 368 in 2023 to 539 in 2021). Volunteers were allowed to move the listening points by a maximum of a few dozen meters if this was suggested by local conditions. In hilly terrain, it was important to ensure that no obstacle (topography, building or similar) hindered the acoustic survey of the nearby forest edges. Therefore, the survey points were often placed at exposed locations.

Volunteers surveyed each point twice, once in March and again in April. The first visit ideally took place before March 20th, and the second before April 20th, with at least 10 days between the two visits. Surveys started approximately 30 minutes after sunset, i.e., at 7:00 p.m. in mid-March and 8:45 p.m. in mid-April. Up to 16 points were surveyed in one suitable evening.

In one survey, observers were asked to follow the following steps:

1. 120 sec. of passive listening (i.e. traditional auditory detection): if a Long-eared Owl was heard calling spontaneously, the survey was stopped, and the fieldworker moved to the next survey point. The main aim of the study was to detect territories with as little disturbance as possible and not to run the complete protocol at each survey point.
2. 15 sec. of playback (male hooting, 5 calls): once the owl answered, the playback was stopped, no additional survey on the point was done on that day, and the fieldworker moved to the next survey point.
3. 30 sec. listening in case there was no answer in step 2.
4. 15 sec. of playback: stopped if answer received, as in step 2.
5. 300 sec. of listening in case there was no answer in step 4.

In addition to male and female calls of Long-eared Owls, volunteers also registered whether they heard other owl species, especially Tawny Owls as potential predators or competitors of the smaller Long-eared Owls.

Although the initial passive listening period was stipulated to last 120 seconds, we realized that some people also recorded owls detected during the final approach to a prescribed listening point and during the initial preparation phase for playback. Thus, the actual duration of step 1 was typically between 180 and 240 seconds. We explicitly considered this imprecision in the modelling part (see below).

We analysed survey data with an occupancy model for a removal design (MacKenzie et al. 2017). We treated step 1 as the first occasion, steps 2 and 3 combined as the second, and steps 4 and 5 as the third one. Occasion 1 was listening-only, while occasions 2 and 3 were playback. Since occasion length was different, we expressed detection probability per 1-minute unit as our 'common currency' of comparison. Thus, detection probability is the probability to detect an owl during a 1-minute survey at a site that is in fact occupied by at least one owl.

Every survey point was only surveyed in a single year out of the five and we did not have any specific hypotheses or information about drivers of occupancy probability. Hence, we treated this parameter as a constant. Our main interest lay in the elucidation of spatial and temporal patterns in detection probability. Our detection model had fixed effects of the year treated as a factor, linear, quadratic and cubic effects of survey date as a continuous explanatory variable, and site-level detection of Tawny Owl and playback versus passive listening as two further factors. We dealt with the

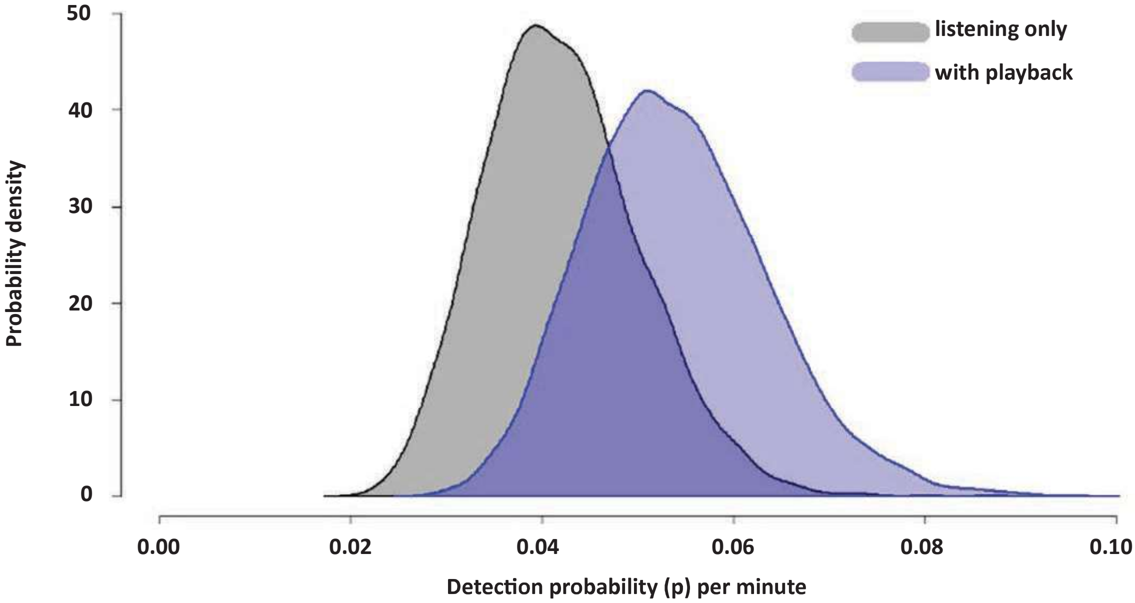

Figure 1. Effect of playback on the detection probability of the Long-eared Owl *Asio otus* (posterior distributions shown of per-minute detection probability for passive listening vs. playback).

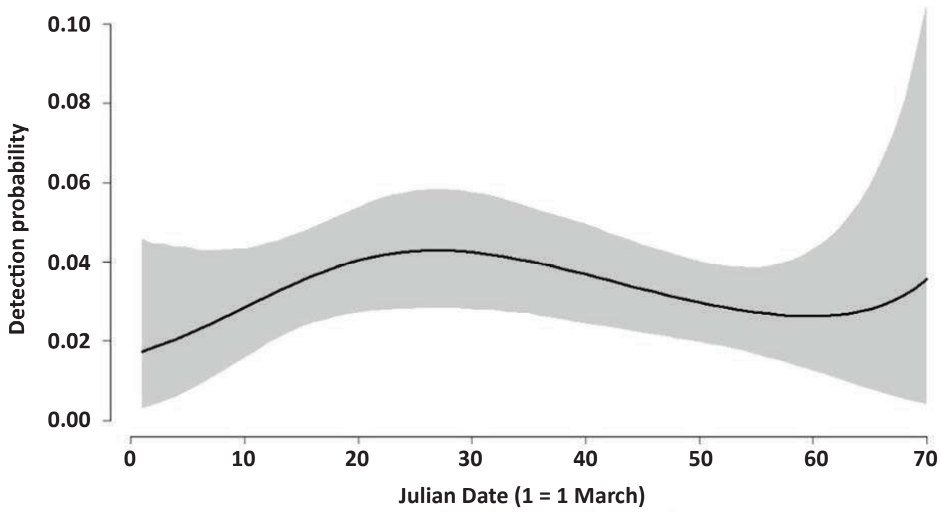

Figure 2. Effect of survey date on the detection probability of the Long-eared Owl *Asio otus* (posterior mean and 95% CRI shown).

imprecision in the duration of occasion 1 by placing a uniform prior on it in our Bayesian analysis (see below), with bounds 180 and 240 seconds, which properly accommodated the additional uncertainty stemming from this lack of knowledge.

We used Bayesian inference with MCMC methods implemented with program JAGS (Plummer 2003) and run from R via the package 'jagsUI' (Kellner 2024). We ran 4 chains for as long as needed for convergence to be reached for all parameters. This was assessed by visual inspection of traceplots and by values of Rhat that were at most 1.1 (Kéry & Kellner 2024). We present posterior means as point estimates of parameters and other estimates, and 95% quantiles of posterior distributions as 95% Bayesian credible intervals (CRIs) for an uncertainty assessment.

Results and discussion

In total, Long-eared Owl territories were found at 207 (9%) survey points. This corresponds to an observed value of the density of one territory per 3.9 km².

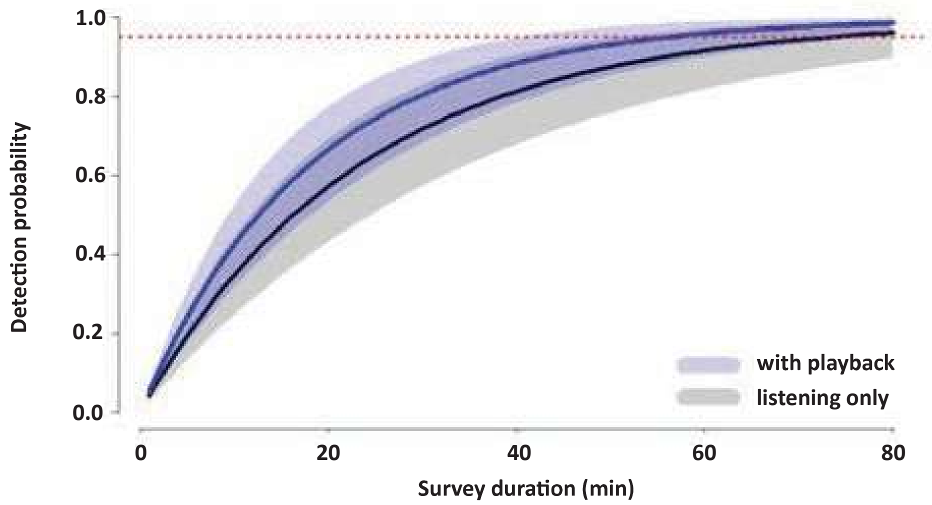

Figure 3. Effect of survey duration on detection probability of the Long-eared Owl *Asio otus*. Posterior means and 95% CRIs are shown for an occupied site with and without playback, without Tawny Owl *Strix aluco*, and averaged over all five years and on 1 April. The dotted red line indicates a detection probability of 0.95.

Occupancy modelling showed that the use of playback increased the average detection probability to 0.056 per minute (CRI 0.030–0.102) versus 0.044 (CRI 0.023–0.081) of the passive listening (Fig. 1).

Detection probability peaks from the last week of March to the first week of April (Fig. 2). The increase of detection probability at the end of the survey period around days 65–70 (early May) is an artefact caused by a quasi-lack of surveys then and the behaviour of polynomial terms in a regression model; therefore, it should be ignored.

For the design of field surveys, it is important to know how long the observer should wait at a listening point without playback to detect the species at e.g. 50% of all occasions. Figure 3 shows the model results for an average survey on 1st of April (i.e. at the peak of the vocalisation activity, Fig. 2): based on our study conditions, a survey without playback lasting 16 minutes detects approximately 50% of present territorial individuals and to detect 95% of the individuals the surveyor must spend around 74 min. With hypothetical playback of approximately 13 minutes, we would be expected to detect 50% and around 57 minutes until 95% of resident owls are detected. These numbers highlight the efficiency gains from this method; however we highly discourage the use of playback for more than a couple of minutes, otherwise it is to be feared that the territorial Long-eared Owl is stressed in an irresponsible manner or even scared off completely. With two minutes of playback, the model predicts a detection probability of app. 10%.

Long-eared Owl detection probability was reduced when Tawny Owls were present at a site (Fig. 4), likely due to avoidance behaviour by Long-eared Owls (Scott 1997, Keller et al. 2020). This is also known for other owl species (Zuberogoitia et al. 2008, Sergio et al. 2009, Lourenco et al. 2013, Theux et al. 2022). When a Tawny Owl was present at a site, detection probability was estimated to peak at 0.044 (see Fig. 1 and text above), while with Tawny Owl it was 0.035 (CRI 0.016–0.070).

For the whole studied area (covering 54% of the canton, excluding lake surface) our occupancy model estimated 415 territories (95% CRI 345–504). This number exceeds earlier estimates by Weggler et al. (2009) — 59 territories for the entire canton by far. While an increase in populations size of the Long-eared Owls may explain the increased abundance, it is highly unlikely that the species has increased thirteen times in 12–15 years. We attribute the higher abundance mainly to the systematic and species-specific surveys in combination with occupancy analysis that takes imperfect detection into account.

Results of our study have confirmed the above-mentioned earlier studies that playback-based surveys can substantially improve our capacity to monitor some cryptic owl species. In combination with systematic and broad-scale surveys and analysed with appropriate statistical methods such as occupancy models, they maximise their potential to improve fundamental

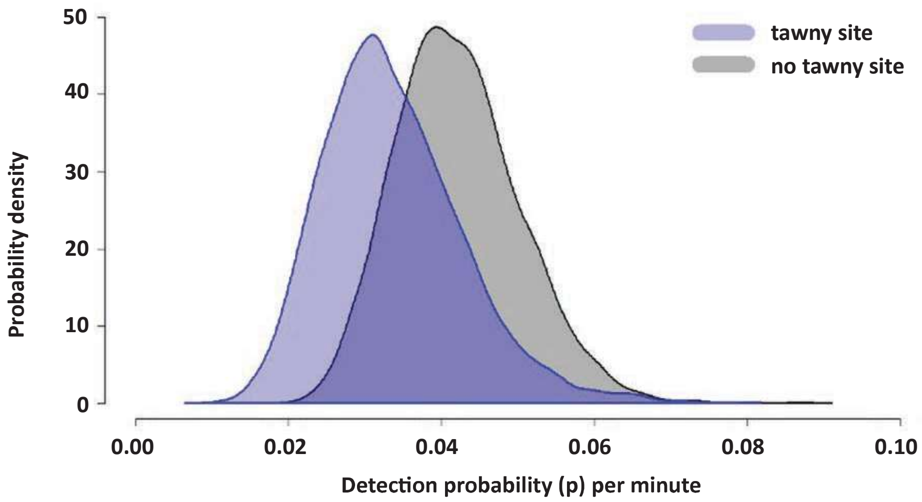

Figure 4. Posterior distributions of the effect of Tawny Owl *Strix aluco* on the detection probability of the Long-eared Owl *Asio otus* during an average year, without playback and on 1 April.

baseline information of cryptic species. Reliable estimates of distribution and abundance form the cornerstone of understanding species status, trends and habitat use, which are important in the context of population biology, as well as conservation. On the other hand, it is important to emphasize that playback can cause bias in population estimates due to changing bird behaviour (Anich et al. 2009), so it is important to follow the methodology, as well as ethical aspects (Sibley 2011, Davis et al. 2024) strictly.

These methods provide a repeatable framework for long-term monitoring and can be adapted for other cryptic species with low natural detectability. The findings also underscore the need for carefully planned survey timing and for the awareness of interspecies interactions, which can likewise bias survey results if not accounted for.

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References

Aebischer, A. 2008. Eulen und Käuze. Auf den Spuren der nächtlichen Jäger. Bern, Stuttgart, Wien.

Anich, N. M., Benson, T. J. & J. C. Bednarz. 2009 Estimating territory and home-range sizes: do singing locations alone provide an accurate estimate of space use? *Auk*, 126: 626–634.

Birrer, S. 2009. Synthesis of 312 studies on the diet of the Long-eared Owl *Asio otus*. *Ardea*, 97 (4): 615–624.

Birrer, S. 2014. Reaction of the Long-eared Owl *Asio otus* on imitations of wing-clapping and playback of mating calls — consequences for the population censuses. *Vogelwarte*, 52: 111–117.

Davis, R. A., Greenwell, C., Davis, B. J. & P. W. Bateman. 2024. Liked to death: the impacts of social media and photography on biodiversity. *Science of The Total Environment,* 949: 1–7.

Grinde, A. R., Niemi, G. J. & M. A. Etterson. 2018. Effects of experimental playbacks on availability for detection during point counts. *Journal of Field Ornithology*, 89 (1): 93–104.

Hannah, K. 2009. Call Playbacks increase detection rates of Northern Hawk Owl in recent burns. *Journal of Raptor Research*, 43 (3): 241–244.

Keller, V., Herrando, S., Voříšek, P., Franch, M., Kipson, M., Milanesi, P., Martí, D., Anton, M., Klvaňová, A., Kalyakin, M. V., Bauer, H.-G. & R. P. B. Foppen. 2020. European Breeding Bird Atlas 2: Distribution, Abundance and Change. European Bird Census Council & Lynx Editions, Barcelona.

Kellner, K. 2024. jagsUI: A Wrapper Around 'rjags' to Streamline 'JAGS' Analyses. doi: 10.32614/CRAN.package.jagsUI, R package version 1.6.2

Kéry, M., Royle, J. A., Hallman, T., Robinson, W. D., Strebel, N. & K. F. Kellner. 2024. Integrated distance sampling models for simple point counts. *Ecology*, 105 (5): e4292.

Kéry, M. & K. F. Kellner. 2024. Applied Statistical Modeling for Ecologists — A practical guide to Bayesian and likelihood inference using R, JAGS, NIMBLE, Stan, and TMB. Elsevier, London.

Kéry, M. 2023. Occupancy and Nmix models for the French national PCM survey (Pygmy Owl, Boreal Owl, Tawny Owl). Unpublished report. Sempach, Vogelwarte. 143 p.

Kissling, M. L., Lewis, S. B. & G. Pendleton. 2010. Factors influencing the detectability of forest owls in south-eastern Alaska. *Condor*, 112: 539–548.

Knaus, P., Antoniazza, S., Wechsler, S., Guélat, J., Kéry, M., Strebel, N. & T. Sattler. 2018. Schweizer Brutvogelatlas 2013–2016. Sempach.

Lourenco, R., Goytre, F., del Mar Delgado, M., Thornton, Michael; Rabaça, J. E., V. Penteriani. 2013. Tawny owl vocal activity is constrained by predation risk. *Journal of Avian Biology*, 141: 461–468.

MacKenzie, D. I., Nichols, J. D., Royle, J. A., Pollock, K. H., Hines, J. E. & L. L. Bailey. 2017. Occupancy estimation and modeling: Inferring patterns and dynamics of species occurrence (Second Edition). San Diego: Elsevier.

Martinez, J. A. & I. Zuberogoitia. 2003. Factors affecting the vocal behaviour of Eagle Owl *Bubo bubo*: effects of season, density and territory quality. *Ardeola*, 50: 255–258.

McGarigal, K. & J. Fraser. 1985. Barred Owl responses to recorded vocalizations. *Condor*, 87 (4): 552–553.

McGregor, P. K. 2000. Playback experiments: design and analysis. *Acta ethologica*, 3: 3–8.

Mori, E., Menchetti, M. & F. Ferretti. 2014. Seasonal and environmental influences on the calling behaviour of Eurasian Scops Owls. *Bird Study*, 61: 277–281.

Plummer, M. 2003. JAGS: A program for analysis of bayesian graphical models using Gibbs sampling. In K. Hornik, F. Leisch, & A. Zeileis (Eds.), Proceedings of the 3rd International Workshop in Distributed Statistical Computing (DSC 2003) (pp. 1–10). Vienna, Austria: Technische Universität, March 20–22.

Ritschard, M. 2020. Waldohreulen-Monitoring Kanton Zürich. Ergebnisse 2020. Bericht z. Hd. der Fachstelle Naturschutz Kanton Zürich.

Ritschard, M. 2022. Waldohreulen monitoring Kanton Zürich. Ergebnisse 2021. Bericht z. Hd. der Fachstelle Naturschutz Kanton Zürich.

Ritschard, M. 2023a. Bestandserhebung Waldohreule Kanton Zürich. Ergebnisse 2022. Bericht z. Hd. der Fachstelle Naturschutz Kanton Zürich.

Ritschard, M. 2023b. Bestandserhebung Waldohreule Kanton Zürich. Ergebnisse 2023. Bericht z. Hd. der Fachstelle Naturschutz Kanton Zürich.

Ritschard, M. 2024. Bestandserhebung Waldohreule Kanton Zürich. Ergebnisse 2024. Bericht z. Hd. der Fachstelle Naturschutz Kanton Zürich.

Robb, M. 2015. Undiscovered owls. A sound approach guide. UK.

Scott, D. 1997. The Long-eared Owl. London.

Sergio, F., Marchesi, L. & P. Pedrini. 2009. Conservation of Scops Owl *Otus scops* in the Alps: relationships with grassland management, predation risk and wider biodiversity. *Ibis*, 151: 40–50.

Sibley, D. 2011. The Proper Use of Playback in Birding. https://www.sibleyguides.com/2011/04/the-proper-use-of-playback-in-birding.

Strebel, N., Antoniazza, S., Auchli, N., Birrer, S., Bühler, R., Sattler, T., Volet, B., Wechsler, S. & M. Moosmann. 2024. *Zustand der Vogelwelt in der Schweiz: Bericht 2024*. Schweizerische Vogelwarte, Sempach.

Swiss Land Use Statistics 2024: land cover (NOLC04) by district and commune, in hectares. Bundesamt für Statistik, Bodennutzung https://www.bfs.admin.ch/bfs/de/home/statistiken/raum-umwelt/bodennutzung-bedeckung.html (v. 30.08.2024).

Theux, C., Klein, N., Garibaldi, E., Jacot, A., Eichhorn, S., Guisan, A. & J.-N. Pradervand. 2022. Food and habitats requirements of the Eurasian Scops Owl (*Otus scops*) in Switzerland revealed by very high-resolution multi-scale models. *Ibis*, 164: 240–254.

Vrezec, A. & I. Bertoncelj. 2018. Territory monitoring of Tawny Owls *Strix aluco* using playback calls is a reliable population monitoring method. *Bird Study*, 65: sup1: 52–62.

Weggler, M., Baumberger C., Widmer M., Schwarzenbach Y. & R. Bänziger. 2009. Zürcher Brutvogelatlas 2008 — Aktuelle Brutvogelbestände im Kanton Zürich 2008 und Veränderungen seit 1988. ZVS/BirdLife Zürich.

Zuberogoitia, I., Martinez, J.E., Zabala, J., Martinez, J.A., Azkona, A., Castillo, I. & S. Hidalgo. 2008. Social interactions between two owl species sometimes associated with intraguild predation. *Ardea*, 96: 109–113.

Zuberogoitia, I., Burgos, G., Gonzales-Oreja, J. A., Morant, J., Martinez, J. E. & J.Z. Albizua. 2019. Factors affecting spontaneous vocal activity of Tawny Owl *Strix aluco* and implications for surveying large areas. *Ibis*, 161: 495–503.

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