

Estimation of the sampling effort per UTM 10x10 square for the Catalan Winter Bird Atlas 2006-2009

When it was started the design of the methodology for the Catalan Winter Bird Atlas 2006-2009, a pilot study was conceived in order to determine the percentage of species detected within a 10x10 km² square in a certain sampling period relative to their real number. This study aims at establishing the sampling effort per square needed by means of quantitative data, and at adapting the atlas methodology to the available human resources, taking into account the magnitude and the special demands of this atlas project.

In order to build the effort graphs, the data had to be collected in one-hour fractions so that, in each fraction, all the detected species had to be annotated, regardless of whether they were detected in previous fractions or not. Ideally, each square had to be surveyed a minimum of eight effective hours. In order to minimize both the effect of the bird movements in and out the square and the variation in weather conditions along the winter, the collaborators were asked to carry out their surveys in just one day or in two consecutive days. Surveys were mostly conducted on foot, although fractions done by car were also accepted for open areas where driving allowed a better square coverage, provided that driving was slow, on roads, with rolled down windows, and paying careful attention to bird detection.

Species accumulation graphs were used in order to estimate the effort needed per square. These graphs extrapolate species richness data from samples of a certain size. The non parametric estimators Chao2 and Jackknife 2 (Jack2) were selected to calculate the theoretical species richness from all the available samples (one-hour fractions) in each square. These estimators were selected because they perform better for a reduced number of samples and moderate species richness, which is the case for this study.

24 10x10 UTM squares were surveyed for this pilot study. These squares constitute a representative sample of the main environments of Catalonia and also of its main climate and geographical gradients, from the sea level up to more than 2.000 m

Estimated values of richness range between 33 and 111 species/square (mean = 63, SD = 18), for the Chao-2 estimator, whereas they range between 39 and 120 species/square (mean = 71, SD = 19) for the Jack-2 estimator. Taking into account these figures, it was built the species accumulation graph relative to surveying time: in eight one-hours censuses was detected between 71% (after Chao2) and 81% (after Jack2) of the total

number of species occurring in a square (Fig 2). Despite the fact that four squares provided data for more than eight hours, the sample size was manifestly insufficient to estimate these percentages beyond eight one-hour censuses.

71-81% of detected species seems an acceptable percentage for the timed effort surveys, and will allow a solid basis for performing robust comparisons among squares both temporally (between and within years) and spatially. It appears unrealistic to request more than eight hours of effort in a season as climatologically complex as the winter and with so few day light hours, especially for such a large project.

Location	10x10 UTM	Observed richness	% according to model (Chao2)	% according to model (Jack2)
Alfacada-illa de Buda	CF10	83	75%	69%
Santa Maria de Miralles-La Llacuna	CF79	28	74%	65%
Banyeres del Penedès-La Múnia	CF87	63	76%	68%
St. Sadurní d'Anoia-La Granada	CF98	62	90%	79%
El Poal-Vilasana- Mollerussa	CG21	64	81%	70%
Serradell-Sant Gervàs	CG28	29	88%	74%
Guissona-Hostafrancs	CG52	41	89%	78%
Calaf-Calonge de Segarra	CG72	43	85%	71%
Rialp-Llessúí	CH40	63	82%	72%
Puigpedrós-Pic de la Muga	CH90	29	49%	53%
Collbató-Montserrat	DF08	58	74%	64%
Esparregura-St. Esteve ses Rovires	DF09	57	86%	76%
Barcelona-La Floresta	DF28	49	73%	69%
Barcelona-Badalona	DF38	51	86%	75%
Montcada-Mollet del Vallès	DF39	57	76%	66%
El Masnou-Premià de Mar	DF49	43	82%	68%
Guardiola de Berguedà-Bagà	DG07	35	79%	65%
La Garriga-Cardedeu	DG41	45	92%	83%
Bescanó-Anglès	DG74	64	95%	88%
Banyoles-Fontcoberta	DG86	44	82%	71%
Verges-Parlavà-Belcaire d'Empordà	EG05	56	82%	73%

Table 1. Richness observed in 8-hour censuses in different 10x10 UTM squares, and its percentage relative to the square total richness obtained by means of the estimators Chao 2 and Jack 2.

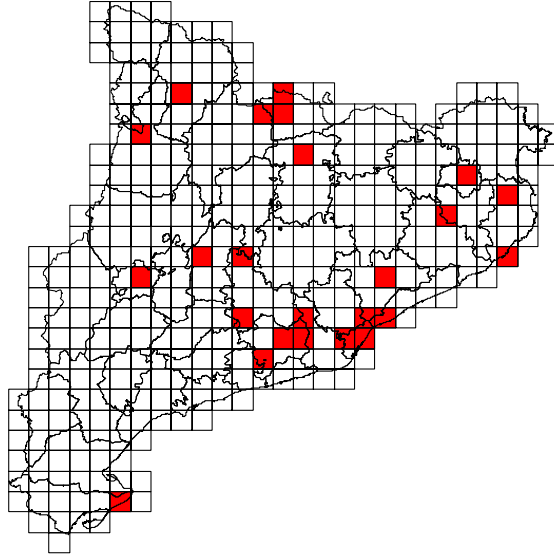


Figure 1. Location of the squares (red) that have participated in this pilot study.

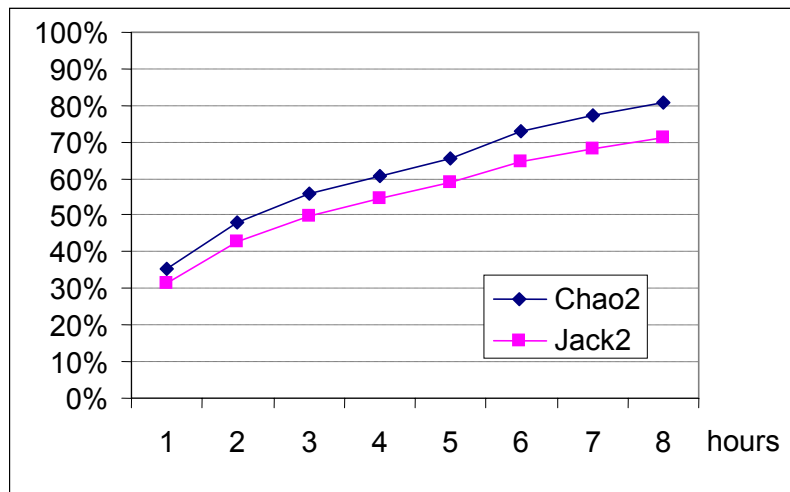


Figure 2. Mean percentage of the species detected in a 10x10 UTM square depending on the sampling effort invested (1-8 hours). For each square (n=24) this percentage was obtained dividing the number of accumulated species detected in the field by the estimated number of species. The richness estimated for each square was obtained by means of the Chao2 and Jack2 estimators, using the entire available sample in each case (between 5-10 hours, depending on the square).