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Monitoring of breeding birds in Umbria, Central Italy, between 2000 and 2005

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Abstract – Common species of birds breeding in Umbria were monitored from 2000 to 2005 by means of an annual repeated survey of 1574 point-counts scattered across the whole region. 20 points were placed in each 10x10 km UTM grid unit, located 1 km apart from each other along low traffic roads, crossing the most representative environments. We obtained yearly population indices for 67 species and examined population trends; in order to avoid possible first-time effects, we performed all the analyses omitting the first year. Furthermore we calculated multi-species indicators for species associated with farmland and woodland habitat, taking the geometric means of annual specific population indices. 42 % of the species for which trends could be produced have declined during the years 2001 to 2005, whilst only 28 % have increased. Multi-species indicators seem to show a better situation for farmland than for woodland birds.

INTRODUCTION

Since the breeding season 2000, the "Osservatorio Faunistico Regionale dell'Umbria", in cooperation with "Provincia di Perugia" and "Provincia di Terni", has been carrying out annual surveys to produce yearly population indices for common species of breeding birds. The regional monitoring scheme collaborates with a similar scheme across the rest of Italy (Progetto MITO2000 - Fornasari *et al*., 2002).

Lately, driven by the need to elaborate effective methods to measure changes in biodiversity, multi-specific indicators for farmland bird species (Farmland Bird Index - FBI) and woodland bird species (Woodland Bird Index - WBI), have been developed and proposed at a European level (Gregory *et al.*, 2005).

Here we describe: a) population trends observed in Umbria over the period of the study; b) the results obtained through calculating FBI and WBI from the data collected.

METHODS

Umbria (Central Italy) is one of the smallest Italian regions (8450 km^2). Without coasts, it is characterized by an eastern highland and a western sector with a predominantly hilly morphology. The most widespread habitats are woodland and agricultural cultivations, covering 41,4 % and 41,5 % of the region respectively; urban and industrial settlements comprise only about 5 % of the area.

During six consecutive breeding seasons (2000-2005) a team of 14 ornithologists carried out an annual survey of 1574 points (the same each year), scattered across the whole region.

Points were selected using the following sampling pattern: in each 10x10 km UTM grid unit, we traced a route along low traffic roads, paying attention that it would pass at least through the most representative environments; along the selected routes, points were placed 1 km apart from each other, assuring for each grid unit a density of one sampling point every 5 km^2. We verified *a posteriori* that the selected points were broadly representative of habitats within the region, although with a bias towards agricultural cultivations (49,3 % in the sample vs. 41,5 % in the study area), while woods were under-represented (30,7 % vs. 41,4 %).

The method used in the field was a version of point-counts without distance limit from the observer, during a period of 10 minutes each.

For 67 species recorded in at least 1 % of all stations, we used the software package TRIM version 3.53 (Pannekoek & van Strien, 2005) to compute population indices on an annual basis and to assess their trends. TRIM uses a log-linear Poisson regression procedure that gives a trend estimate (**b**). This is the exponential of the slope parameter of a linear regression between years (more exactly the

Table 1. Criteria to classify trend estimates.

95% confidence interval of b		TREND designations
lower limit	**upper limit**	
	< 0.95	steep decline
	<1.00 and ≥ 0.95	moderate decline
> 0.95 and ≤ 1.00	≥ 1.00 and < 1.05	stable
> 1.00 and ≤ 1.05		moderate increase
> 1.05		strong increase
≤ 0.95	≥ 1.00	uncertain
≤ 1.00	≥ 1.05	uncertain

independent variable is "year - 1") and the corresponding yearly counts transformed as natural logarithm; **b** expresses the mean annual change of the counts during the period of the study. TRIM supplies a confidence interval (at 95 % probability level) of the trend, on the basis of which the trend is classified (Tab. 1). We used TRIM in the following way: each point has been considered as a location itself; no covariates were inserted; model type 2 (*linear trend*) has been used, with the *stepwise* procedure to select the points where the slope of the log-linear equation changes (*changepoints*); to estimate the equation parameters and their standard errors we turned to the GEE (Generalised Estimating Equations) procedure.

Since many species showed a steep increase between the first and the second year of the survey, we suspected that it might depend to a large extent on the increasing surveyors' experience. Therefore, in order to avoid these very likely startup effects (reported in other monitoring programmes too - Kendall *et al.*, 1996), we omitted year 2000 and restricted all analysis to the period from 2001 to 2005.

Among the 67 common species, 27 species were typical of agricultural habitat and 19 species characteristic of woodland habitat, according to the classification worked out by the MITO2000 project (Progetto MITO2000, 2006). For these two groups, farmland and woodland species, we determined two multi-specific indicators of the population trends, as proposed by Gregory *et al.* (2005). Such indicators are calculated by simply taking the geometric means of annual specific populations' indices. In doing this, we followed two slightly different approaches:

a) in one case we applied the methodology shown by Gregory *et al.* (op.cit.). For this indicators are produced for species that are largely associated with farmland or woodland habitat irrespective of the habitat of the sampling points;
b) in the other case, we repeated the calculation procedures of the specific populations' indices taking into account the points placed in agricultural habitat only (N = 826) for the farmland species, and the ones placed in woodland habitat only (N = 459) for the woodland species. In this way, the indicators reflect changes within the habitat of interest.

RESULTS

In Tab. 2 we compare the population trend estimates (**b**) computed using all data (i.e. surveys 2000-2005) with the estimates calculated omitting the first year (i.e. surveys 2001-2005): 54 species out of 67 (80,6 %) show a decrease of the trend estimate if the first survey is removed. This result strongly suggests that a startup effect actually occurred and justifies the exclusion of the first year from the analysis.

In Tab. 3 the trends of the 67 species between 2001 and 2005 are given in more detail: 10 species (14,9 %) show a strong increase; 9 (13,4 %) a moderate increase; 19 (28,4 %) a moderate decline; 9 (13,4 %) a strong decline; 5 (7,5 %) are stable and 15 (22,4 %) show an uncertain trend.

The trends of FBI and WBI obtained through the procedure that takes into account the whole set of sampling points are in good concordance with the trends obtained taking into account only the points belonging to the proper environment (Fig. 1). This concordance reflects the high proportion of species (70,4 % amongst farmland and 73,7 % amongst woodland birds) showing a significant correlation between populations' indices obtained with the two different methods (Tab. 4, Tab. 5); it is worth to note that sometimes the correlation is high, even if only a little part of the sites in which a species was found is included in the habitat of interest (see for example the chaffinch *Fringilla coelebs* and the blackcap *Sylvia atricapilla* in Tab. 5).

WBI decreased substantially whilst FBI showed a de-

Table 2. Comparison between the trend estimates computed using all data (b_0) and omitting the data from the first year (b_1), with corresponding standard errors. For each species, the difference between the two estimates (b_1 - b_0) is shown.

years	2000-2005		2001-2005		b_1 - b_0
SPECIES	b_0	**SE**	b_1	**SE**	
Buteo buteo	1,007	0,024	0,929	0,026	-0,078
Falco tinnunculus	1,075	0,030	1,075	0,039	-0,001
Coturnix coturnix	1,044	0,020	1,158	0,031	0,114
Phasianus colchicus	0,986	0,010	0,953	0,012	-0,032
Gallinula chloropus	0,993	0,043	1,046	0,062	0,054
Columba palumbus	1,195	0,017	1,112	0,018	-0,084
Streptopelia decaocto	1,323	0,028	1,319	0,034	-0,003
Streptopelia turtur	1,013	0,007	0,957	0,008	-0,057
Cuculus canorus	1,000	0,007	0,943	0,008	-0,057
Apus apus	1,096	0,012	1,114	0,015	0,018
Merops apiaster	1,166	0,058	1,226	0,079	0,060
Upupa epops	1,053	0,014	1,041	0,017	-0,012
Jynx torquilla	0,960	0,026	0,892	0,030	-0,069
Picus viridis	0,977	0,013	0,830	0,014	-0,147
Picoides major	1,066	0,037	0,972	0,039	-0,094
Galerida cristata	1,213	0,029	1,241	0,040	0,028
Lullula arborea	1,064	0,015	0,984	0,016	-0,080
Alauda arvensis	0,987	0,011	0,948	0,013	-0,039
Hirundo rustica	1,040	0,009	1,059	0,012	0,019
Delichon urbica	1,075	0,012	1,062	0,016	-0,013
Motacilla flava	1,154	0,054	1,207	0,076	0,053
Motacilla alba	1,019	0,019	0,988	0,022	-0,031
Troglodytes troglodytes	0,987	0,009	0,916	0,010	-0,072
Erithacus rubecula	1,068	0,008	0,977	0,008	-0,091
Luscinia megarhynchos	1,008	0,007	0,952	0,009	-0,057
Phoenicurus ochruros	1,105	0,057	1,027	0,062	-0,078
Phoenicurus phoenicurus	1,308	0,075	1,269	0,077	-0,040
Saxicola torquata	1,052	0,015	1,017	0,018	-0,034
Oenanthe oenanthe	0,945	0,037	0,923	0,045	-0,022
Turdus merula	1,082	0,005	1,006	0,005	-0,075
Turdus viscivorus	1,118	0,048	1,036	0,051	-0,082
Cettia cetti	0,960	0,017	0,890	0,019	-0,070
Cisticola juncidis	0,963	0,013	0,936	0,016	-0,028
Hippolais polyglotta	1,011	0,022	1,034	0,029	0,023
Sylvia cantillans	1,120	0,018	1,064	0,021	-0,056
Sylvia melanocephala	0,975	0,016	0,937	0,019	-0,038
Sylvia communis	0,910	0,025	0,858	0,030	-0,052
Sylvia atricapilla	1,056	0,004	0,984	0,005	-0,072
Phylloscopus bonelli	1,038	0,016	0,970	0,018	-0,068
Phylloscopus collybita	1,001	0,010	0,933	0,011	-0,068
Regulus ignicapillus	1,097	0,034	0,953	0,031	-0,144
Muscicapa striata	1,204	0,056	1,352	0,104	0,147
Aegithalos caudatus	1,011	0,019	0,933	0,021	-0,078
Parus palustris	0,996	0,041	0,874	0,041	-0,122
Parus ater	0,940	0,031	0,908	0,038	-0,032
Parus caeruleus	1,127	0,011	1,036	0,012	-0,091
Parus major	1,143	0,010	1,103	0,011	-0,040
Sitta europaea	1,009	0,025	0,953	0,028	-0,057
Certhia brachydactyla	1,062	0,025	1,000	0,028	-0,062
Oriolus oriolus	1,087	0,014	1,034	0,016	-0,054
Lanius collurio	0,996	0,018	1,001	0,024	0,005
Garrulus glandarius	0,988	0,012	0,916	0,013	-0,072
Pica pica	1,075	0,016	1,050	0,019	-0,025
Corvus monedula	1,054	0,027	1,059	0,036	0,004
Corvus corone cornix	0,993	0,006	0,961	0,007	-0,031
Sturnus vulgaris	1,075	0,012	1,046	0,014	-0,029
Passer italiae	0,983	0,008	0,990	0,010	0,007
Passer montanus	1,120	0,020	1,074	0,023	-0,046
Fringilla coelebs	1,038	0,005	0,991	0,006	-0,047
Serinus serinus	1,001	0,006	0,966	0,008	-0,036
Carduelis chloris	0,979	0,009	0,927	0,011	-0,052
Carduelis carduelis	0,973	0,007	0,932	0,008	-0,041
Carduelis cannabina	1,052	0,025	0,943	0,026	-0,109
Emberiza citrinella	0,893	0,055	0,737	0,054	-0,156
Emberiza cirlus	0,971	0,008	0,919	0,009	-0,052
Emberiza cia	1,036	0,049	1,085	0,069	0,048
Miliaria calandra	1,000	0,011	0,970	0,014	-0,030

crease between the first and second years followed by a recovery. Differences between FBI and WBI trends are even more pronounced if the values obtained within the habitat of interest are considered.

DISCUSSION

The data collected up to now seem to show that in Umbria a great part of common bird species is declining. As a matter of fact, 42 % of the species whose trend has been produced have decreased over the period of the study, whilst only 28 % have increased. The situation appears worst for woodland species compared with farmland ones, as shown by the trends of WBI and FBI. This result is quite different from the general European findings, that show a relative stability of WBI and a sharp decline of FBI (Gregory *et al.*, op.cit.). However, our results must be considered on-

ly as preliminary, since they are based on a small number of years.

From a methodological point of view, we have verified that the trends of FBI and WBI remain basically unchanged both using all the sites (points) available, or previously selecting them on the basis of their environmental features. This result corresponds to the conclusions who got Newson *et al.* (2004) based on experiences made in the UK and suggests that in wide monitoring scheme reliable FBI and WBI calculations are possible even if the habitat characteristics in the surveyed sites are not recorded.

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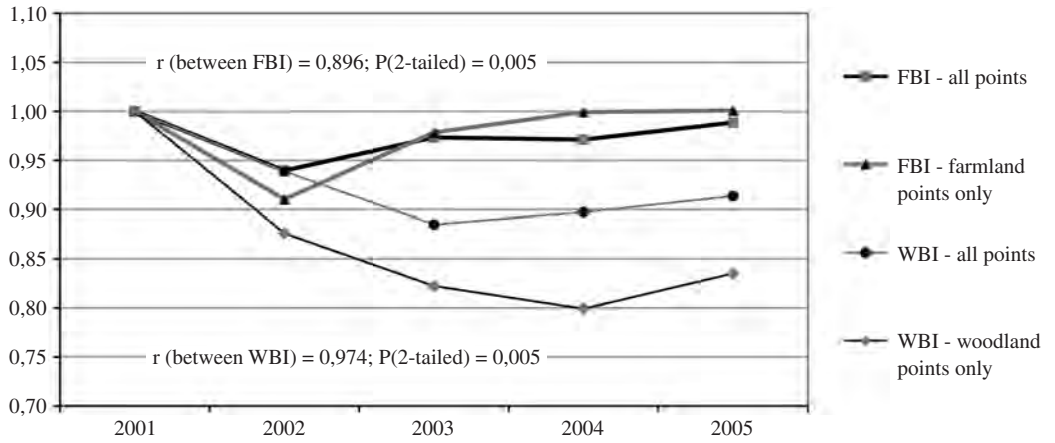

Figure 1. Trends of the multi-species indicators over 2001-2005.

Table 3. Results of the trend estimation for common breeding birds in Umbria, Italy for the period 2001-2005. We present the trend estimate (b) with standard errors and 95 % confidence intervals. Trends are classified as stable (S), moderate decline (MD), steep decline (SD), moderate increase (MI), strong increase (SI), and trend uncertain (U), according to the criteria shown in Table 1. F = farmland; W = woodland.

SPECIES	habitat	number of points of occurrence	b	SE	95% confidence interval		TREND
					lower limit	upper limit	
Buteo buteo	F	366	0,929	0,026	0,877	0,980	MD
Falco tinnunculus	F	254	1,075	0,039	0,999	1,150	U
Coturnix coturnix		229	1,158	0,031	1,097	1,218	SI
Phasianus colchicus		760	0,953	0,012	0,929	0,978	MD
Gallinula chloropus		39	1,046	0,062	0,925	1,167	U
Columba palumbus		747	1,112	0,018	1,077	1,147	SI
Streptopelia decaocto		280	1,319	0,034	1,253	1,385	SI
Streptopelia turtur	F	1234	0,957	0,008	0,941	0,973	MD
Cuculus canorus		1258	0,943	0,008	0,928	0,959	MD
Apus apus		1050	1,114	0,015	1,085	1,143	SI
Merops apiaster		68	1,226	0,079	1,070	1,381	SI
Upupa epops	F	746	1,041	0,017	1,007	1,074	MI
Jynx torquilla		287	0,892	0,030	0,833	0,950	MD
Picus viridis	W	788	0,830	0,014	0,802	0,857	SD
Picoides major	W	194	0,972	0,039	0,895	1,049	U
Galerida cristata	F	217	1,241	0,040	1,162	1,319	SI

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SPECIES	habitat	number of points of occurrence	b	SE	95% confidence interval		TREND
					lower limit	upper limit	
Lullula arborea		584	0,984	0,016	0,952	1,015	S
Alauda arvensis	F	415	0,948	0,013	0,923	0,974	MD
Hirundo rustica	F	1009	1,059	0,012	1,034	1,083	MI
Delichon urbica	F	746	1,062	0,016	1,031	1,092	MI
Motacilla flava	F	58	1,207	0,076	1,058	1,356	SI
Motacilla alba	F	465	0,988	0,022	0,944	1,032	U
Troglodytes troglodytes	W	935	0,916	0,010	0,896	0,936	SD
Erithacus rubecula	W	1073	0,977	0,008	0,961	0,994	MD
Luscinia megarhynchos	F	1058	0,952	0,009	0,935	0,968	MD
Phoenicurus ochruros		65	1,027	0,062	0,905	1,148	U
Phoenicurus phoenicurus		75	1,269	0,077	1,117	1,420	SI
Saxicola torquata	F	607	1,017	0,018	0,983	1,052	U
Oenanthe oenanthe		37	0,923	0,045	0,834	1,012	U
Turdus merula		1541	1,006	0,005	0,996	1,016	S
Turdus viscivorus	W	126	1,036	0,051	0,936	1,136	U
Cettia cetti	F	237	0,890	0,019	0,852	0,927	SD
Cisticola juncidis	F	429	0,936	0,016	0,905	0,967	MD
Hippolais polyglotta	F	277	1,034	0,029	0,977	1,091	U
Sylvia cantillans	W	512	1,064	0,021	1,024	1,105	MI
Sylvia melanocephala		414	0,937	0,019	0,899	0,974	MD
Sylvia communis		229	0,858	0,030	0,800	0,916	SD
Sylvia atricapilla	W	1549	0,984	0,005	0,975	0,994	MD
Phylloscopus bonelli	W	341	0,970	0,018	0,935	1,005	U
Phylloscopus collybita	W	702	0,933	0,011	0,911	0,955	MD
Regulus ignicapillus	W	204	0,953	0,031	0,893	1,013	U
Muscicapa striata	W	121	1,352	0,104	1,148	1,555	SI
Aegithalos caudatus	W	564	0,933	0,021	0,893	0,974	MD
Parus palustris	W	129	0,874	0,041	0,794	0,954	MD
Parus ater	W	100	0,908	0,038	0,833	0,982	MD
Parus caeruleus	W	1110	1,036	0,012	1,013	1,058	MI
Parus major		1292	1,103	0,011	1,081	1,124	SI
Sitta europaea	W	249	0,953	0,028	0,898	1,008	U
Certhia brachydactyla	W	310	1,000	0,028	0,946	1,054	U
Oriolus oriolus		755	1,034	0,016	1,003	1,064	MI
Lanius collurio	F	394	1,001	0,024	0,954	1,048	S
Garrulus glandarius	W	817	0,916	0,013	0,890	0,942	SD
Pica pica	F	415	1,050	0,019	1,013	1,087	MI
Corvus monedula		273	1,059	0,036	0,988	1,129	U
Corvus corone cornix	F	1521	0,961	0,007	0,948	0,975	MD
Sturnus vulgaris	F	922	1,046	0,014	1,018	1,074	MI
Passer italiae	F	914	0,990	0,010	0,970	1,009	S
Passer montanus	F	467	1,074	0,023	1,030	1,119	MI
Fringilla coelebs	W	1410	0,991	0,006	0,980	1,003	S
Serinus serinus	F	1176	0,966	0,008	0,951	0,980	MD
Carduelis chloris	F	1020	0,927	0,011	0,905	0,948	SD
Carduelis carduelis	F	1266	0,932	0,008	0,916	0,948	SD
Carduelis cannabina	F	208	0,943	0,026	0,892	0,994	MD
Emberiza citrinella		55	0,737	0,054	0,631	0,844	SD
Emberiza cirlus	F	1046	0,919	0,009	0,901	0,937	SD
Emberiza cia		58	1,085	0,069	0,950	1,219	U
Miliaria calandra	F	498	0,970	0,014	0,943	0,996	MD

Table 4. Farmland species: comparison between the analysis carried out on the whole set of points of occurrence and only on the points included in farmland habitat. We present the trend assessments under the two methods and the Pearson correlations between population indices (* correlation significant at the 5 % level; ** correlation significant at the 1 % level). Trend abbreviations as in Table 3.

SPECIES	number of points of occurrence		points in farmland habitats (%)	TREND		Pearson correlation (N=5) between population indices obtained in farmland habitat and in the whole set of points	
	farmland habitat	all habitats		farmland habitat	all habitats	r	P (2-tailed)
Buteo buteo	153	366	41,8	U	MD	0,563	0,323
Falco tinnunculus	150	254	59,1	U	U	0,986	0,002 **
Streptopelia turtur	694	1234	56,2	MD	MD	0,927	0,023 *
Upupa epops	407	746	54,6	U	MI	0,838	0,076
Galerida cristata	206	217	94,9	SI	SI	0,999	0,000 **
Alauda arvensis	296	415	71,3	MD	MD	0,940	0,018 *
Hirundo rustica	694	1009	68,8	MI	MI	0,975	0,005 **
Delichon urbica	500	746	67,0	MI	MI	0,912	0,031 *
Motacilla flava	58	58	100,0	SI	SI	1,000	0,000 **
Motacilla alba	282	465	60,6	U	U	0,855	0,065
Luscinia megarhynchos	709	1058	67,0	MD	MD	0,974	0,005 **
Saxicola torquata	445	607	73,3	U	U	0,940	0,017 *
Cettia cetti	195	237	82,3	SD	SD	0,993	0,001 **
Cisticola juncidis	371	429	86,5	MD	MD	0,999	0,000 **
Hippolais polyglotta	193	277	69,7	U	U	0,978	0,004 **
Lanius collurio	238	394	60,4	U	S	0,762	0,134
Pica pica	316	415	76,1	MI	MI	0,948	0,014 *
Corvus corone cornix	810	1521	53,3	MD	MD	0,910	0,032 *
Sturnus vulgaris	649	922	70,4	MI	MI	0,782	0,118
Passer italiae	674	914	73,7	S	S	0,986	0,002 **
Passer montanus	444	467	95,1	MI	MI	0,985	0,002 **
Serinus serinus	757	1176	64,4	MD	MD	0,964	0,008 **
Carduelis chloris	635	1020	62,3	MD	SD	0,935	0,020 *
Carduelis carduelis	779	1266	61,5	MD	SD	0,985	0,002 **
Carduelis cannabina	74	208	35,6	U	MD	0,721	0,169
Emberiza cirlus	496	1046	47,4	MD	SD	0,931	0,022 *
Miliaria calandra	326	498	65,5	S	MD	0,742	0,151

Table 5. Woodland species: comparison between the analysis carried out on the whole set of points of occurrence and only on the points included in woodland habitat. We present the trend assessments under the two methods and the Pearson correlations between population indices (* correlation significant at the 5 % level; ** correlation significant at the 1 % level). Trend abbreviations as in Table 3.

SPECIES	number of points of occurrence		points in woodland habitats (%)	TREND		Pearson correlation (N=5) between population indices obtained in woodland habitat and in the whole set of points	
	woodland habitat	all habitats		woodland habitat	all habitats	r	P (2-tailed)
Picus viridis	300	788	38,1	SD	SD	0,997	0,000 **
Picoides major	86	194	44,3	U	U	0,108	0,863
Troglodytes troglodytes	362	935	38,7	SD	SD	0,988	0,002 **
Erithacus rubecula	449	1073	41,8	MD	MD	0,961	0,009 **
Turdus viscivorus	69	126	54,8	U	U	-0,214	0,730
Sylvia cantillans	178	512	34,8	U	MI	0,442	0,456
Sylvia atricapilla	459	1549	29,6	MD	MD	0,967	0,007 **

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SPECIES	number of points of occurrence		points in woodland habitats (%)	TREND		Pearson correlation (N=5) between population indices obtained in woodland habitat and in the whole set of points	
	woodland habitat	all habitats		woodland habitat	all habitats	r	P (2-tailed)
Phylloscopus bonelli	196	341	57,5	MD	U	0,990	0,001 **
Phylloscopus collybita	357	702	50,9	MD	MD	0,992	0,001 **
Regulus ignicapillus	114	204	55,9	MD	U	0,929	0,022 *
Muscicapa striata	24	121	19,8	U	SI	0,507	0,383
Aegithalos caudatus	214	564	37,9	MD	MD	0,903	0,036 *
Parus palustris	83	129	64,3	MD	MD	0,965	0,008 **
Parus ater	74	100	74,0	MD	MD	0,971	0,006 **
Parus caeruleus	394	1110	35,5	U	MI	0,962	0,009 **
Sitta europaea	144	249	57,8	U	U	0,918	0,028 *
Certhia brachydactyla	119	310	38,4	U	U	-0,476	0,418
Garrulus glandarius	375	817	45,9	SD	SD	0,944	0,016 *
Fringilla coelebs	450	1410	31,9	S	S	0,975	0,005 **

REFERENCES

Fornasari L, De Carli E, Brambilla S, Buvoli L, Maritan E, Mingozzi T 2002. Distribuzione dell'avifauna nidificante in Italia: primo bollettino del progetto di monitoraggio MITO2000. Avocetta, 26 (2): 59-115.

Gregory RD, van Strien A, Vorisek P, Gmelig Meyling AW, Noble D, Foppen R, Gibbons DW 2005. Developing indicators for European birds. Philosophical Transaction of the Royal Society B 360: 269-288.

Kendall WL, Peterjohn BG, Sauer JR 1996. First-time observer effects in the North American Breeding Bird Survey. The Auk 113 (4): 823-829.

Newson SE, Noble DG, Eaton M 2004. Preliminary BBS-based habitat-specific indicators for wild bird population: 1994-2002. BTO Research Report No.368, British Trust for Ornithology, Thetford.

Pannekoek J, van Strien A 2005. TRIM 3 manual. Trends and Indices for Monitoring data. Statistics Netherlands, Voorburg. Available at http://www.ebcc.info.

Progetto MITO2000 2006. Possibili andamenti delle specie comuni nidificanti in Italia e indicatori dello stato di conservazione dell'avifauna italiana 2000-2005. Available at http://www.mito2000.it.


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