

Supplementary material

Andreas Otterbeck* & Andreas Lindén 2024: Temporal increase in migratoriness and increasing male bias among residents in partially migrating Swedish sparrowhawks *Accipiter nisus*. — *Ornis Fennica* 101: 00–00.

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Supplementary Material S1

Correction for autumn migration counts at Falsterbo

We used annual autumn totals from the standardized migration counts at Falsterbo bird observatory in 1975–2015. The main observer changed once during this 40-year period (2001), accompanied by an adjusted methodology (Kjellén 2002). We tested for any discontinuity in the temporal trend in the count numbers caused by this switch, by using a generalized additive model (GAM) in R (version 3.5.1) (R Core Team 2018), applying a logarithmic link function and negative binomial error distribution. We fitted the model using the package “mgcv” (Wood 2011) and the function “gam”, setting the annual migration total as response. We set “Observer” (binary factor variable) and “Year” (continuous variable) as explanatory variables, modelled with a smoothing function. We used the default smoothing option, *i.e.*, thin-plate spline (“tp”) as the smoothing basis and a maximum of 9 degrees of freedom. Hence, we tested for any effect of “Observer” with the null hypothesis of no difference before and after 2001, adjusting for a flexible trend in time.

As we found no statistically significant effect of the observer ID (estimate: -0.043 , $SE = 0.223$, $z = -0.193$, $P = 0.847$) no correction factors were applied to our time-series from Falsterbo. Although some degree of discontinuity can visually be recognized at 2001, the standard errors reveal large uncertainty, which is largely a consequence of no temporal overlap using both methods, and partially a consequence of the flexibility of the temporal trend. The observed migrating numbers of sparrowhawks at Falsterbo have increased over time.

References: Kjellén, N. 2002: Sträckfågelräkningar i Falsterbo förr och nu. – Anser 41: 114–23.

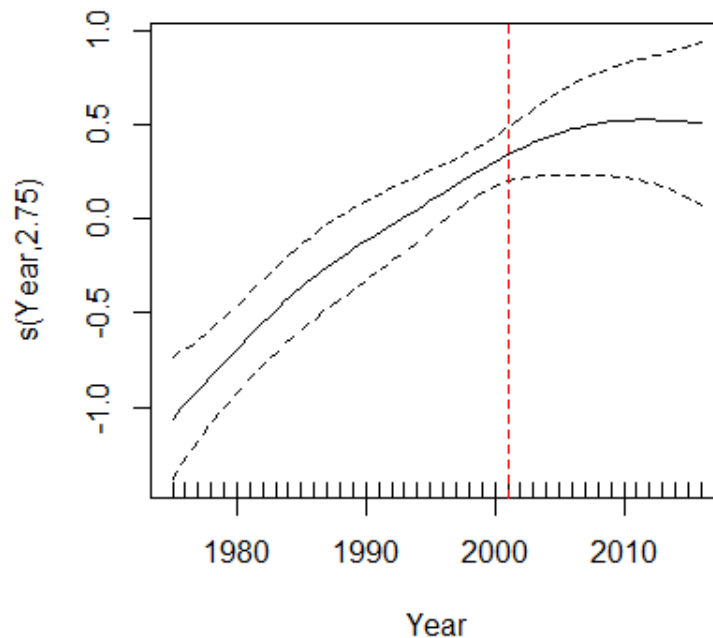


Fig. S1. Temporal trend in the number of migrating Sparrowhawks at Falsterbo, illustrated as the partial effect of the smoothing function of year (at the linear predictor scale). The red dashed line indicates when the observer changed.

Table S2. To obtain an index of annual variation in the winter prey abundance for Eurasian Sparrowhawk (*Accipiter nisus*) in Sweden, we multiplied the annual winter population indexes of the 10 most central prey species with the average annual number of observed individuals. These were further summed together, and the resulting sum was divided with its average (over all years) to provide an annual index of prey abundance.

Year	Great tit	Blue tit	Eurasian siskin	House sparrow	Eurasian tree sparrow	Fieldfare	Common blackbird	Brambling	Robin	Common redpoll	Win. prey
1975	5128	1676	396	1651	2917	723	519	1213	64	3163	0.59
1976	6914	2042	8710	1657	2231	31413	2498	24985	71	7327	2.96
1977	5865	1939	579	2166	2796	1496	772	1372	52	5620	0.76
1978	4175	1593	2958	1527	2362	946	987	600	16	334	0.52
1979	5832	2166	3662	1619	2775	3897	837	1723	56	6207	0.97
1980	6939	2240	3390	1830	3053	2163	491	440	47	999	0.73
1981	5477	1691	896	1597	2363	334	698	145	39	1894	0.51
1982	5607	1768	2710	1284	2449	1650	760	5574	89	5874	0.94
1983	6243	2174	2988	1756	1890	16736	860	3211	29	1966	1.28
1984	5510	2169	1455	1453	1776	3805	995	3955	43	4180	0.85
1985	5564	2079	965	1251	1971	1380	882	646	20	5785	0.69
1986	5598	2200	405	1535	2594	1859	1060	3170	46	1787	0.68
1987	6758	2584	3745	1361	2834	1661	399	9778	47	1481	1.03
1988	6075	2759	249	1560	2908	520	441	44	36	593	0.51
1989	6876	3289	5794	1464	2690	21026	1574	8797	60	2935	1.84
1990	6495	3139	348	1664	2963	669	669	173	61	1704	0.60
1991	5691	2839	2498	1275	2122	2191	879	1322	86	1422	0.68
1992	6226	2958	561	1435	2277	27482	2366	2893	99	195	1.57
1993	5747	2968	4072	1558	2806	2732	1175	19383	45	2726	1.46
1994	4544	2423	113	1449	2211	655	845	42	115	413	0.43
1995	5140	2767	1865	1684	1941	31761	3567	14357	118	4529	2.28
1996	5140	2647	542	1965	2126	409	1217	107	93	376	0.49
1997	5727	2939	204	1567	2003	1934	546	30	71	655	0.53
1998	5949	3286	3990	1126	2008	9629	1137	12476	71	3404	1.45
1999	5294	2846	93	1644	1868	403	742	52	71	173	0.44
2000	6168	3379	4367	1173	2241	7686	2527	54648	354	4723	2.94
2001	5194	2751	196	900	1896	392	1703	1364	134	962	0.52
2002	6343	3663	1414	1270	2145	9484	2079	1285	100	3683	1.06
2003	5744	3309	241	919	1726	378	1106	4	137	479	0.47
2004	6444	3840	1069	1080	1636	2102	1100	1219	129	959	0.66
2005	5893	3763	1165	1026	1836	1285	1487	4	141	1939	0.62
2006	9016	5265	2727	913	2333	4863	889	1598	152	3068	1.04
2007	6526	3904	448	648	1511	830	901	57	133	194	0.51
2008	6260	3830	258	867	1853	2204	1594	85	217	1407	0.63
2009	5782	3453	3851	708	1876	21763	4140	75584	140	1203	3.99
2010	5865	3256	193	625	1945	240	905	4	51	609	0.46
2011	6498	4007	2410	858	2050	3957	946	4544	150	1880	0.92
2012	6407	3659	890	855	1887	1972	879	4	33	1404	0.61
2013	6546	3588	1129	823	2243	3765	1017	1153	140	1342	0.73
2014	6532	4046	1687	901	2175	2659	1676	1522	249	1205	0.76
2015	5466	3834	619	641	1587	1784	1574	850	161	802	0.58
2016	6500	4362	1096	716	1634	2570	1464	133	118	1813	0.69

Table S3. The candidate GAM models were evaluated using Akaike’s information criterion (AIC), and sorted according to model parsimony from best to worst. This was done for three hypotheses regarding the overwintering population; the age proportion (first year or adult), the male/female proportion and the mean latitude at which overwintering individuals were recorded throughout an average winter. “Year.C” denotes centralized year (zero mean), “Year.f” denotes year as a factor variable, “Dow” denotes day of winter, “ln.MRR.C” denotes the logarithm of the migrant-to-resident ratio (zero mean) while “is.male” represents a binary variable of male gender (1 = yes, 0 = no). We rerun the best candidate models as GAMM. “s” before parenthesis denotes a smoothing function.

Model	Fixed	Random	Family	<i>n</i>	nLL	df	dAIC
Sex							
1	s(Dow) + Year.C	Year.f	Binomial	17152	11524.48	24.26	0.00
2	s(Dow) + ln.MRR.C	Year.f	Binomial	17152	11524.96	23.87	0.19
0	s(Dow)	Year.f	Binomial	17152	11522.89	26.64	1.60
Age							
0	s(Dow)	Year.f	Binomial	5597	2364.73	11.35	0.00
2	s(Dow) + ln.MRR.C	Year.f	Binomial	5597	2364.48	12.01	0.84
1	s(Dow) + Year.C	Year.f	Binomial	5597	2364.76	12.13	1.64
Latitude							
3	s(Dow) + is.male	Year.f	Gaussian	17152	37044.80	34.77	0.00
5	s(Dow) + is.male + ln.MRR.C	Year.f	Gaussian	17152	37044.83	35.11	0.74
4	s(Dow) + is.male + Year.C	Year.f	Gaussian	17152	37044.86	35.10	0.80
0	s(Dow)	Year.f	Gaussian	17152	37056.55	33.95	21.9
1	s(Dow) + Year.C	Year.f	Gaussian	17152	37056.56	34.30	22.6
2	s(Dow) + ln.MRR.C	Year.f	Gaussian	17152	37056.55	34.30	22.6

Table S4. An overview on whether the migration intensity, the resident population (or both) drives the linear patterns in the migration to resident ratio.

Response	Fixed	Estimate	SE	t	p
log(migration)					
	Intercept	−0.140	0.044	−3.162	0.003
	lnYRsums.c	−0.131	0.081	−1.620	0.114
	Temp.c	0.104	0.030	3.457	0.001
	Year.c	0.034	0.004	8.862	<0.001
log(win.pop)					
	Intercept	−0.053	0.038	−1.399	0.170
	lnYRsums.c	0.073	0.069	1.061	0.296
	Temp.c	0.039	0.026	1.519	0.137
	Year.c	−0.020	0.003	−6.226	<0.001