

Monti, F., Grémillet, D., Sforzi, A., Dominici, J. M., Bagur, R. T., Navarro, A. M., Fusani, L., Klaassen, R. H. G., Alerstam, T. and Duriez, O. 2018. Migration distance affects stopover use but not travel speed: contrasting patterns between long- and short-distance migrating ospreys. – J. Avian Biol. 2018: e01839

Supplementary material

APPENDIX 1:

Mean values of migratory parameters for Western Palearctic ospreys, reported for autumn migration and both adults and juveniles. All birds from Sweden were Long-distance migrants (LDM) while all birds from Corsica, Balearics or Italy were Short-distance Migrants (SDM). * represents individuals for which migration was not complete (or when bird died) with a destination wintering site not available (na). The sex determination was not available for juveniles.

Bird ID	Sex	Origin	Age	Year	Start	End	Duration of migration (days)	Cumulative Migration distance (km)	Migration speed (km/d)	Direct migration Distance (km)	Maximum distance (km)	Daily Distance travelled (km/d)	Path Straightness index	Time in Stopover (days)	Wintering site
M52	M	Sweden	adult	2006	30-Aug	29-Oct	60	6167.75	102.79	5530.00	372.00	167.80	0.90	27	Senegal
			adult	2007	20-Jul	24-Sep	66	5748.76	87.10	5536.00	362.70	177.60	0.96	27	Senegal
			adult	2008	15-Aug	06-Oct	52	5794.97	111.44	5529.00	565.10	230.10	0.95	32	Senegal
			adult	2009	30-Jul	17-Sep	49	5897.99	120.36	5531.60	470.10	288.10	0.94	31	Senegal
			adult	2010	05-Aug	20-Sep	46	5784.01	125.73	5515.60	520.90	223.10	0.95	20	Senegal
M77*	M	Sweden	adult	2006*	05-Sep	24-Oct	49	2377.10	48.51	1912.10	270.30	113.90	0.80	24	na
M57	M	Sweden	adult	2009	14-Sep	23-Oct	39	5816.11	149.13	5520.93	498.50	237.40	0.95	18	Senegal
F53	F	Sweden	adult	2006	02-Aug	28-Sep	57	6972.45	122.32	5919.20	396.70	192.90	0.85	25	Ghana
			adult	2007	29-Jun	20-Sep	83	6722.15	80.98	5919.60	388.70	169.70	0.88	36	Ghana
			adult	2008	28-Jul	11-Nov	106	8784.19	82.86	5918.50	460.80	168.30	0.67	66	Ghana
F58	F	Sweden	adult	2008	15-Aug	29-Sep	45	6027.57	133.94	5585.80	534.80	210.10	0.93	20	Guinea-Bissau
F69	F	Sweden	adult	2007	11-Aug	02-Oct	52	7003.17	134.67	6023.30	490.20	204.70	0.86	22	Guinea-Bissau
			adult	2008	16-Aug	09-Oct	54	6476.82	119.94	6023.10	499.80	218.30	0.93	26	Guinea-Bissau
			adult	2009	27-Jul	29-Sep	64	6560.26	102.50	6023.30	441.80	187.60	0.92	29	Guinea-Bissau
J75-09	/	Sweden	adult	2012	11-Sep	10-Nov	60	4952.70	82.54	3998.25	458.68	161.60	0.81	36	Morocco
mean ad							<i>58.86</i>	<i>6336.35</i>	<i>105.43 ± 33.6</i>	<i>5612.44</i>	<i>461.48</i>	<i>202.66</i>	<i>0.89</i>	<i>29.64</i>	
J60-07	/	Sweden	juv	2007	13-Aug	19-Oct	67	4391.80	65.54	3318.20	477.70	185.70	0.76	47	Morocco

J61-07*	/	Sweden	juv	2007*	28-Aug	20-Oct	53	6120.05	115.47	4808.43	460.36	168.70	0.79	25	Niger
J63-07*	/	Sweden	juv	2007*	30-Aug	30-Sep	31	489.06	15.77	368.40	232.17	185.90	0.75	30	na
J60-08*	/	Sweden	juv	2008*	18-Aug	19-Oct	62	2392.10	38.58	807.78	474.45	134.08	0.34	40	na
J57-08*	/	Sweden	juv	2008*	24-Aug	20-Sep	27	552.10	20.44	291.86	224.09	114.60	0.53	20	na
J75-09	/	Sweden	juv	2009	19-Aug	13-Nov	86	6527.91	75.90	4249.34	576.24	200.70	0.65	49	Morocco
			imm	2011	11-Jul	03-Sep	54	4808.14	89.03	4005.71	397.61	173.30	0.83	32	Morocco
J76-09	/	Sweden	juv	2009	01-Sep	21-Oct	50	6217.18	124.34	5372.18	426.63	242.30	0.86	27	Senegal
J60-09	/	Sweden	juv	2009	24-Aug	25-Sep	32	5396.12	168.62	4890.72	539.50	249.30	0.91	14	Mauritania
J53-10	/	Sweden	juv	2010	30-Aug	12-Nov	74	6826.91	92.25	5170.38	494.37	104.10	0.76	21	Senegal/Ghana
J60-10	/	Sweden	juv	2010	22-Aug	16-Nov	86	7991.95	92.92	4732.02	685.74	257.90	0.59	58	Ivory Coast
J58-10*	/	Sweden	juv	2010	30-Jul	/	/	/	/	/	/	/	/	/	/
J66-07*	/	Sweden	juv	2007	18-Jul	/	/	/	/	/	/	/	/	/	/
mean juv							64.14	6022.86	81.64 ± 48.2	4534.08	513.97	201.90	0.77	35.43	
F02	F	Corsica	adult	2013	24-Sep	04-Oct	10	2416.98	241.69	2407.43	342.19	249.44	0.99	0	Morocco
F03	F	Corsica	adult	2013	20-Aug	21-Aug	1	429.52	429.52	240.84	219.32	217.63	0.56	0	Sardinia-Italy
F04	F	Corsica	adult	2013	13-Sep	15-Sep	2	1608.15	804.07	1356.21	741.59	519.47	0.84	0	Andalucia-Spain
M05	M	Corsica	adult	2013	24-Jun	25-Jun	1	257.91	257.91	239.38	220.32	111.51	0.93	0	Sardinia-Italy
	M	Corsica	adult	2014	30-Jun	30-Jun	1	260.19	260.19	237.01	260.19	260.19	0.91	0	Sardinia-Italy
F06	F	Corsica	adult	2013	10-Aug	15-Aug	5	1597.77	319.55	1326.47	520.90	243.50	0.83	1	Andalucia-Spain
	F	Corsica	adult	2014	17-Aug	24-Aug	7	1748.01	249.71	1385.69	362.28	172.26	0.79	0	Andalucia-Spain
F08	F	Corsica	adult	2013	12-Aug	16-Aug	4	1524.80	381.20	1317.92	398.27	271.50	0.86	0	Morocco
	F	Corsica	adult	2014	17-Aug	22-Aug	5	1553.43	310.68	1317.75	445.32	231.00	0.85	0	Morocco
MB5	M	Balearics	adult	2009	09-Nov	17-Nov	8	3525.57	440.69	3246.87	603.56	327.44	0.92	0	Mauritania
mean Medit							4.40	1492.23	400.80 ± 194.4	1307.56	411.39	260.39	0.85	0.10	
F10	/	Italy	juv	2013	30-Jul	06-Aug	7	886.79	126.68	444.60	218.87	110.60	0.50	2	Abruzzo-Italy
F11	/	Balearics	juv	2013	04-Aug	09-Aug	5	1059.50	211.90	976.32	277.99	175.60	0.92	0	Andalucia-Spain
F12	/	Balearics	juv	2013	28-Aug	02-Sep	5	1387.26	277.45	1129.19	525.76	229.39	0.81	0	Morocco

F13	/	Balearics	juv	2013	10-Aug	16-Aug	6	1060.46	176.74	930.55	368.13	265.05	0.88	2	Andalucia-Spain
F14	/	Balearics	juv	2013	08-Aug	14-Aug	6	1116.19	186.03	756.69	368.48	194.90	0.68	3	Morocco
F15	/	Balearics	juv	2013	29-Jul	03-Aug	5	758.79	151.75	607.67	246.58	151.70	0.80	2	Andalucia-Spain
F16	/	Balearics	juv	2013	07-Aug	11-Aug	4	1072.84	268.21	678.98	318.27	202.13	0.63	0	Algeria
F17	/	Corsica	juv	2013	15-Aug	19-Aug	4	639.09	159.77	463.01	204.62	127.84	0.72	0	Sardinia-Italy
F18*	/	Corsica	juv	2013*	20-Aug	25-Aug	5	1451.85	290.37	952.30	584.27	236.27	0.66	0	Malta
F20	/	Italy	juv	2013	05-Aug	08-Aug	3	518.22	172.74	425.77	184.92	125.92	0.82	0	Campania-Italy
JUV1-57	/	Balearics	juv	2000	02-Aug	10-Aug	8	1129.43	141.17	690.25	/	/	0.61	/	Mauritania
JUV2-59	/	Balearics	juv	2000	01-Aug	05-Aug	4	/	/	617.10	/	/	/	/	Morocco
JUV3-60	/	Balearics	juv	2000	17-Aug	16-Oct	60	2003.13	33.38	930.01	/	/	0.46	/	Algeria
D7_fosp20	/	Italy	juv	2014	21-Aug	28-Aug	7	1087.20	155.31	714.08	364.57	135.90	0.66	0	Sicily-Italy
CIV_fosp21	/	Corsica	juv	2014	16-Aug	21-Aug	5	1301.38	260.27	652.46	330.16	217.04	0.50	0	Algeria
H7_fosp25	/	Italy	juv	2014	17-Aug	28-Aug	11	2514.36	228.57	954.38	386.17	205.17	0.38	0	Algeria
E7_fosp27	/	Italy	juv	2014	21-Aug	27-Aug	6	1499.08	249.84	722.60	408.34	214.21	0.48	0	Sicily-Italy
CAP_fosp24	/	Corsica	juv	2014	14-Aug	17-Aug	3	754.84	251.61	575.94	165.98	114.29	0.76	0	Sicily-Italy
mean juv							8.56	1174.28	196.57 ± 67.2	721.74	329.79	181.94	0.66	0.90	

APPENDIX 2:

Distances between stopover sites during autumn migration for Swedish (LDM) and Mediterranean (SDM) ospreys. Code of countries for breeding sites (BS), stopovers (STPx) and wintering ground (WG) is reported, as well as the number of stopover used.

Bird ID	Sex	Origin	Status	year	BS	STP1	STP2	STP3	STP4	STP5	WG	Distance BS_STP1	Distance STP1_STP2	Distance STP2_STP3	Distance STP3_STP4	Distance STP4_STP5	Distance STPlast_WG	Number STP
M52	M	Sweden	adult	2006	SW	SW	FR	FR	MO	MO	SN	481.14	961.01	152.67	1938.58	295.52	2212.53	5
			adult	2007	SW	GE	GE	GE	FR	MO	SN	597.70	257.09	129.05	609.93	2234.27	1929.49	5
			adult	2008	SW	FR	SP	/	/	/	SN	1434.49	915.83	/	/	/	3236.13	2
			adult	2009	SW	FR	/	/	/	/	SN	1440.15	/	/	/	/	4128.70	1
			adult	2010	SW	FR	FR	/	/	/	SN	1442.77	417.25	/	/	/	3706.35	2
M77*	M	Sweden	adult	2006*	SW	FR	FR	FR	/	/	*	1598.50	229.11	99.54	/	/	*	3
M57	M	Sweden	adult	2009	SW	FR	SP	/	/	/	SN	1182.16	1437.65	/	/	/	2871.09	2
F53	F	Sweden	adult	2006	SW	SW	GE	SP	/	/	GH	239.01	898.62	2045.72	/	/	3311.29	3
			adult	2007	SW	GE	AL	/	/	/	GH	1014.63	2483.47	/	/	/	2664.43	2
			adult	2008	SW	GE	SP	AL	MO	RMM	GH	944.17	2077.61	666.20	370.47	2201.07	951.71	5
F58	F	Sweden	adult	2008	SW	BE	FR	/	/	/	GNB	886.53	508.90	/	/	/	4212.81	2
F69	F	Sweden	adult	2007	SW	GE	MO	/	/	/	GNB	978.30	2406.70	/	/	/	2685.02	2
			adult	2008	SW	GE	MO	/	/	/	GNB	978.39	2372.33	/	/	/	2721.18	2
			adult	2009	SW	GE	/	/	/	/	GNB	978.47	/	/	/	/	5080.86	1
J75-09	/	Sweden	adult	2012	SW	GE	FR	FR	FR	MO	MO	295.83	647.00	388.57	339.83	1508.84	929.85	5
J60-07	/	Sweden	juv	2007	SW	SW	FR	/	/	/	MO	136.50	1777.43	/	/	/	1424.97	2
J61-07*	/	Sweden	juv	2007*	SW	PL	/	/	/	/	*	916.62	/	/	/	/	*	1
J63-07*	/	Sweden	juv	2007*	SW	SW	/	/	/	/	*	286.94	/	/	/	/	*	1
J60-08*	/	Sweden	juv	2008*	SW	SW	N	CZ	/	/	*	291.67	524.31	912.41	/	/	*	3
J57-08*	/	Sweden	juv	2008*	SW	PL	/	/	/	/	*	292.44	/	/	/	/	*	1
J75-09	/	Sweden	juv	2009	SW	SW	FR	/	/	/	MO	138.02	1094.45	/	/	/	2947.02	2
			juv	2011	SW	GE	GE	GE	/	/	MO	309.13	408.83	138.93	/	/	3266.18	3
J76-09	/	Sweden	juv	2009	SW	FR	/	/	/	/	SN	1570.05	/	/	/	/	3828.30	1
J60-09	/	Sweden	juv	2009	SW	GE	MO	/	/	/	RIM	493.57	3083.39	/	/	/	1292.60	2

J53-10	/	Sweden	juv	2010	SW	FR	MO	/	/	/	SN	1764.68	1013.53	/	/	/	2456.94	2
J60-10	/	Sweden	juv	2010	SW	BI	IT	RMM	/	/	RMM	718.09	1440.02	3176.75	/	/	659.89	3
F06	F	Corsica	adult	2013	FR	SP	/	/	/	/	SP	613.83	/	/	/	/	776.53	1
F10	/	Italy	juv	2013	IT	IT	/	/	/	/	IT	314.16	/	/	/	/	104.68	1
F13	/	Balearics	juv	2013	SP	SP	/	/	/	/	SP	269.50	/	/	/	/	663.37	1
F14	/	Balearics	juv	2013	SP	SP	/	/	/	/	MO	501.55	/	/	/	/	336.99	1
F15	/	Balearics	juv	2013	SP	SP	/	/	/	/	SP	267.68	/	/	/	/	358.23	1

APPENDIX 3:

Estimated coefficients of variables influencing the autumn migratory components of Swedish (LDM) and Mediterranean (SDM) ospreys, in the selected models (see model selection in Tab. 1).

Model Set	N_model set	Variables	B	0.95 confidence intervals	
Duration	1	Intercept	60.873	54.94	66.54
		Population(Med)	-55.721	-63.05	-48.17
Cumulative migration distance	1	Intercept	6217.1	5593.14	6692.17
		Population(Med)	-4908.6	-5497.28	-3823.79
Total migration speed	1	Intercept	113.941	51.34	176.50
		Population(Med)	281.874	185.74	377.81
		Age(juv)	-3.199	-57.51	49.92
		Population(Med)*Age(juv)	-204.179	-304.18	-104.30
Direct migration distance	1	Intercept	4994.66	4587.22	5397.93
		Population(Med)	-3535.10	-4179.13	-2888.34
		Age(juv)	132.15	-177.10	309.80
	2	Population(Med)*Age(juv)	-856.41	-1478.68	-241.56
		Intercept	5044.0	4621.59	5467.51
		Population(Med)	-4092.2	-4616.02	-3570.98
Path Straightness index	1	Intercept	0.903	0.815	0.990
		Population(Med)	-0.089	-0.192	0.007
		Age(juv)	-0.1407	-0.22	-0.056
	2	Intercept	0.85203	0.77	0.92
		Age(juv)	-0.15085	-0.23	-0.06
Daily distance travelled	1	Intercept	201.425	155.65	246.46
		Population(Med)	69.171	6.50	136.23
		Age(juv)	5.522	-56.60	68.23
		Population(Med)*Age(juv)	-99.708	-186.66	-15.26
	2	Intercept	226.72	na	na
		Age(juv)	-41.81	na	na
Stopover duration	1	Intercept	31.571	27.24	35.79
		Population(Med)	-31.15	-36.73	-25.48
Number of stopover	1	Intercept	2.7588	2.18	3.37
		Population(Med)	-2.5022	-3.33	-1.52
Mean distance BS_STP1	1	Intercept	945.6	659.41	1265.83
		Age(juv)	-387.0	-731.71	-27.21
	2	Intercept	393.3	-42.73	829.42
		Population(Swe)	424.1	-65.46	907.83
		Intercept	731.0	497.14	968.43
Mean distance STPlast_WG	1	Intercept	448	-611.08	1507.00
		Population(Swe)	2243.3	1018.92	3299.54

APPENDIX 4:

a) Results of model selection of GLMM on the effects of population, habitat and age on cross-country speed (in km.h⁻¹): in bold selected models are shown.

Model ID	(Intercept)	Habitat	Population	Age	Habitat:Population	Habitat: Age	Population: Age	Habitat:Population: Age	df	logLik	AICc	dAICc	Weight
40	32.48	+	+	+			+		8	-7276.12	14568.31	0.00	0.51
48	32.45	+	+	+	+		+		9	-7276.09	14570.28	1.97	0.19
56	32.49	+	+	+		+	+		9	-7276.11	14570.32	2.01	0.18
64	32.46	+	+	+	+	+	+		10	-7276.09	14572.30	3.99	0.07
128	32.34	+	+	+	+	+	+	+	11	-7275.87	14573.89	5.58	0.03
6	31.50	+		+					6	-7282.26	14576.56	8.25	0.01
8	30.24	+	+	+					7	-7281.98	14578.03	9.72	0.00
22	31.43	+		+		+			7	-7282.17	14578.41	10.10	0.00
2	29.74	+							5	-7284.85	14579.74	11.43	0.00
24	30.20	+	+	+			+		8	-7281.91	14579.89	11.58	0.00
16	30.23	+	+	+	+				8	-7281.97	14580.02	11.71	0.00
4	28.27	+	+						6	-7284.54	14581.13	12.82	0.00
32	30.16	+	+	+	+	+			9	-7281.86	14581.82	13.51	0.00
12	28.25	+	+		+				7	-7284.53	14583.12	14.81	0.00
39	34.75		+	+			+		7	-7340.11	14694.28	125.97	0.00
5	32.70			+					5	-7344.38	14698.79	130.48	0.00
1	30.85								4	-7346.11	14700.24	131.93	0.00
7	32.23		+	+					6	-7344.34	14700.73	132.42	0.00
3	30.24		+						5	-7346.05	14702.13	133.82	0.00

b) Results of model selection of GLMM on the effects of population, habitat and age on tailwind (in km.h⁻¹): in bold selected models are shown.

Model ID	(Intercept)	Habitat	Population	Age	Habitat:Population	Habitat: Age	Population: Age	Habitat:Population: Age	df	logLik	AICc	dAICc	Weight
56	10.80	+	+	+		+	+		9	-6346.16	12710.44	0.00	0.33
64	10.96	+	+	+	+	+	+		10	-6345.76	12711.66	1.22	0.18
40	11.15	+	+	+			+		8	-6347.97	12712.02	1.58	0.15
48	11.32	+	+	+	+		+		9	-6347.01	12712.14	1.70	0.14
39	11.43		+	+			+		7	-6349.38	12712.83	2.39	0.10
128	10.98	+	+	+	+	+	+	+	11	-6345.76	12713.68	3.24	0.07
22	4.51	+		+		+			7	-6352.01	12718.09	7.65	0.01
24	8.37	+	+	+		+			8	-6351.20	12718.49	8.05	0.01
2	4.33	+							5	-6354.89	12719.83	9.39	0.00
32	8.47	+	+	+	+	+			9	-6350.93	12719.96	9.52	0.00
4	8.32	+	+						6	-6354.12	12720.30	9.86	0.00
12	8.44	+	+		+				7	-6353.21	12720.48	10.04	0.00
1	4.51								4	-6356.41	12720.85	10.41	0.00
3	8.51		+						5	-6355.65	12721.33	10.89	0.00
6	4.91	+		+					6	-6354.76	12721.57	11.13	0.00
8	8.50	+	+	+					7	-6354.07	12722.21	11.77	0.00
16	8.66	+	+	+	+				8	-6353.14	12722.36	11.92	0.00
5	5.14			+					5	-6356.26	12722.57	12.13	0.00
7	8.73		+	+					6	-6355.58	12723.20	12.77	0.00

c) Results of model selection of GLMM on the effects of population, habitat and age on airspeed (in km.h⁻¹): in bold selected models are shown.

Model ID	(Intercept)	Habitat	Population	Age	Habitat:Population	Habitat: Age	Population: Age	Habitat:Population: Age	df	logLik	AICc	dAICc	Weight
24	23.12	+	+	+		+			8	-6562.54	13141.17	0.00	0.29
56	22.85	+	+	+		+	+		9	-6562.40	13142.92	1.74	0.12
32	23.05	+	+	+	+	+			9	-6562.43	13142.98	1.81	0.12
22	27.64	+		+		+			7	-6564.48	13143.02	1.85	0.12
8	22.96	+	+	+					7	-6564.97	13144.01	2.84	0.07
64	22.75	+	+	+	+	+	+		10	-6562.27	13144.68	3.51	0.05
16	22.82	+	+	+	+				8	-6564.44	13144.96	3.79	0.04
40	22.45	+	+	+			+		8	-6564.49	13145.07	3.89	0.04
6	27.28	+		+					6	-6566.80	13145.65	4.47	0.03
4	22.35	+	+						6	-6566.87	13145.79	4.62	0.03
48	22.30	+	+	+	+		+		9	-6563.93	13145.98	4.81	0.03
2	25.95	+							5	-6568.01	13146.05	4.88	0.03
128	22.69	+	+	+	+	+	+	+	11	-6562.23	13146.62	5.45	0.02
12	22.19	+	+		+				7	-6566.28	13146.63	5.46	0.02
7	24.27		+	+					6	-6584.01	13180.07	38.89	0.00
5	28.02			+					5	-6585.14	13180.31	39.14	0.00
1	26.62								4	-6586.24	13180.51	39.34	0.00
3	23.67		+						5	-6585.58	13181.19	40.02	0.00
39	23.90		+	+			+		7	-6583.77	13181.61	40.44	0.00

d) Estimated coefficients of variables influencing flight performances of Swedish (LDM) and Mediterranean (SDM) ospreys crossing the Mediterranean region, in the selected models (see model selection above).

Model Set		Variables	B	0.95 confidence intervals	
Cross-country speed	Best	Intercept	32.47	28.74	36.52
		habitat(sea)	10.55	8.77	12.34
		Population(Swe)	-2.49	-7.24	1.98
		Age(juv)	-7.2817	-10.80	-4.03
		Population(Swe)* Age(juv)	8.69	3.99	13.77

Tailwind	Best	Intercept	10.8	3.49	18.17
		habitat(sea)	4.075	0.92	7.22
		Population(Swe)	-10.707	-18.581	-2.77
		Age(juv)	-6.076	-11.91	-0.71
		habitat(sea)* Age(juv)	-4.33	-8.80	0.139
	Second	Population(Swe)* Age(juv)	12.252	4.99	20.26
		Intercept	11.15	3.95	18.40
		habitat(sea)	1.91	-0.31	4.13
		Population(Swe)	-10.91	-18.64	-3.16
		Age(juv)	-7.304	-12.94	-2.22

Airspeed	Best	Intercept	23.125	16.95	29.07
		habitat(sea)	5.215	1.67	8.74
		Population(Swe)	6.321	0.02	12.57
		Age(juv)	-4.109	-7.318	-0.75
		habitat(sea)* Age(juv)	5.539	0.61	10.479
	Second	Intercept	27.64	23.37	31.85
		habitat(sea)	5.14	1.58	8.69
		Age(juv)	-3.56	-7.11	0.03
		habitat(sea)* Age(juv)	5.47	0.49	10.46