Supplementary material

Andrea Santangeli*, Stuart H. M. Butchart, Mark Pogson, Astley Hastings, Pete Smith, Marco Girardello & Atte Moilanen: Mapping the global potential exposure of soaring birds to terrestrial wind energy expansion. — Ornis Fennica 95: 1–14.

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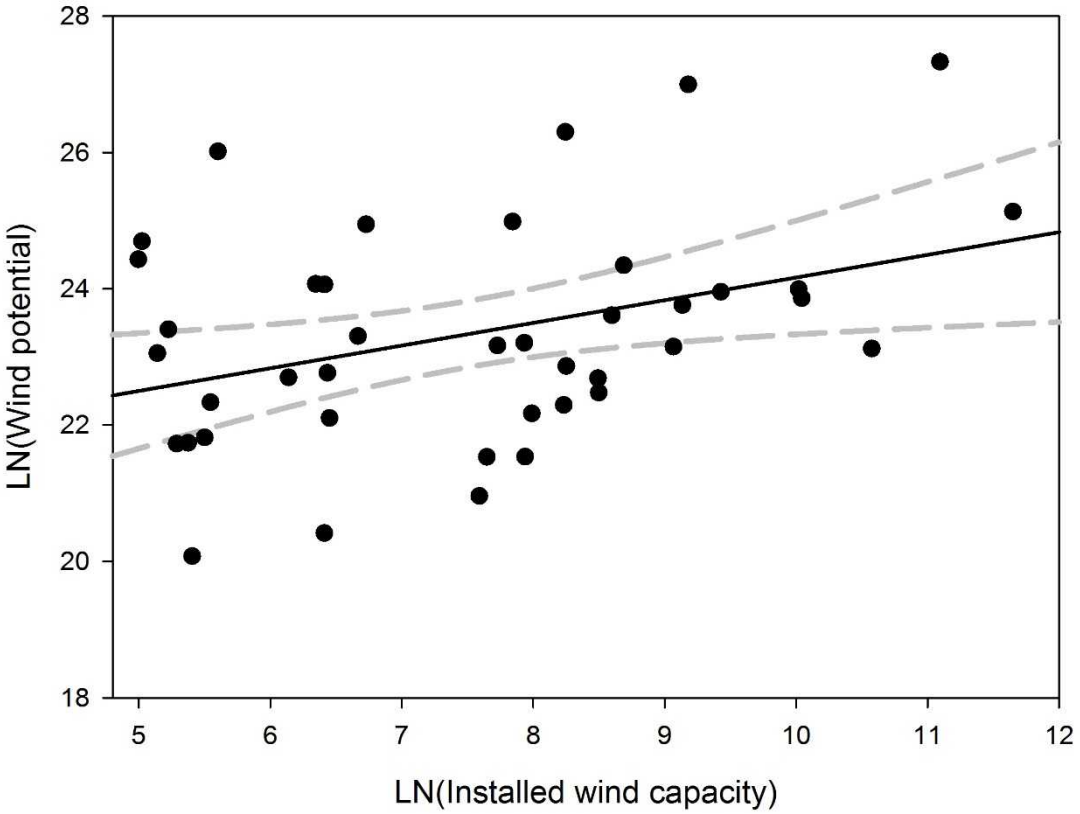

Figure S1. Positive significant correlation ($F_{1, 39} = 6.021$, $p = 0.019$, $R^2 = 0.13$; statistics derived from a simple linear model including energy potential as the response, and installed capacity as predictor) between wind energy potential (Pogson et al. 2013 cited in reference list of main article) and installed wind power capacity by each country until end of 2014 (data from Global Wind Energy Council available at: www.gwec.net/global-figures/graphs/ . Each dot represents a single country (see list below). The black line depicts the linear regression (mean) with 95% CI around it (grey dashed lines). Both wind potential (i.e. estimated maximum possible wind power which can be harnessed using existing wind turbine technology, EJ/y) and installed wind power capacity (MW) are shown in the natural log scale.

List of 41 countries shown in the above figure for which wind energy potential and installed wind energy capacity data were available:

Argentina
Australia
Austria
Brazil
Canada
Chile
China
Costa Rica
Denmark
Egypt

Ethiopia
France
Germany
Greece
Honduras
India
Ireland
Italy
Japan
Mexico
Morocco
Netherlands
New Zealand
Nicaragua
Pakistan
Peru
Philippines
Poland
Portugal
Romania
South Africa
South Korea
Spain
Sweden
Taiwan
Thailand
Tunisia
Turkey
United Kingdom
United States
Uruguay

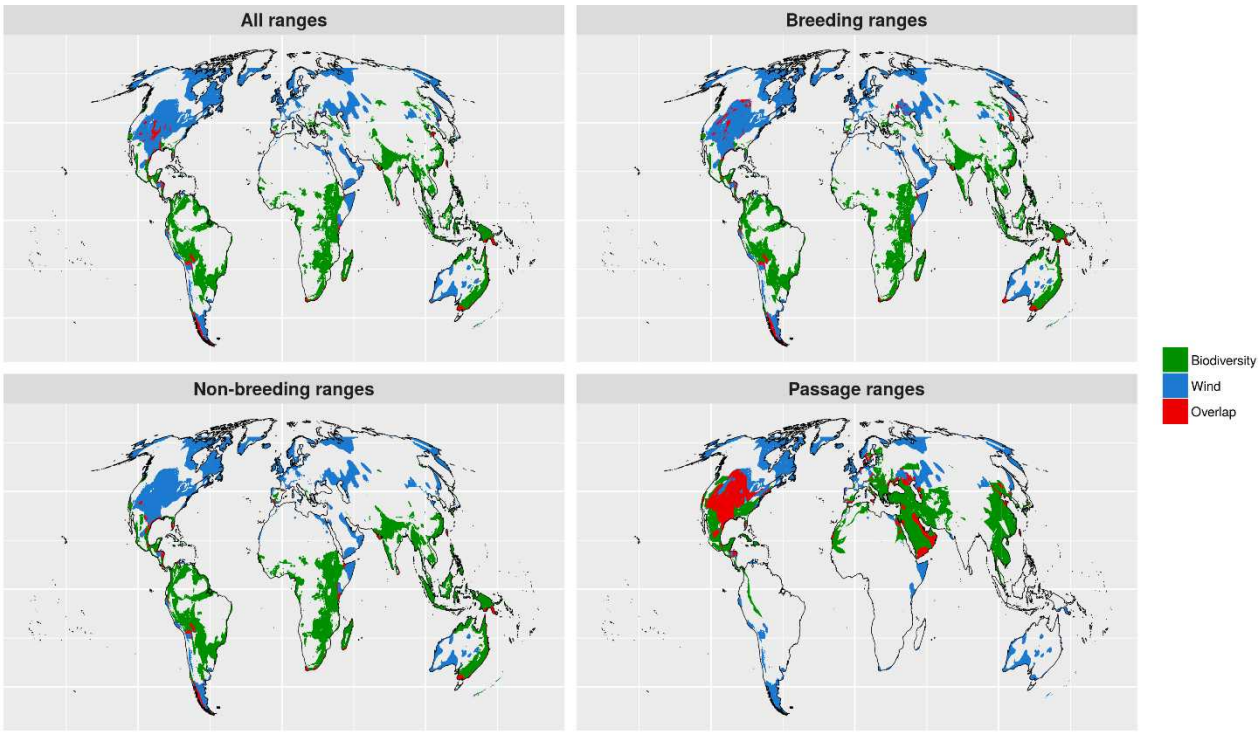

Figure S2. The distribution of the top-ranked areas for potential wind energy development (top-ranked 30%; in blue), the top-ranked areas for soaring bird species conservation (top-ranked 30%; in green), and the areas where these above two overlap (in red) when the full, breeding, non-breeding and passage ranges of species are considered for deriving priorities for soaring bird conservation.

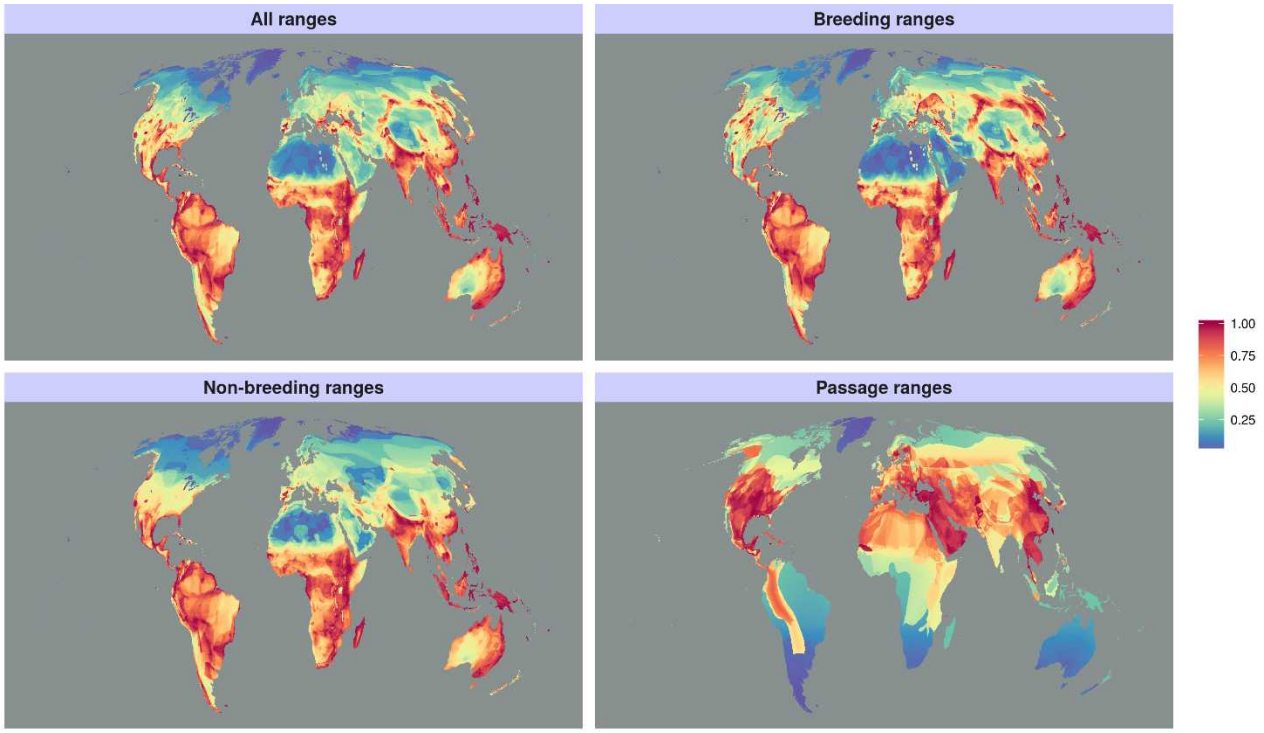

Figure S3. The ranked priority areas for soaring bird conservation across the global terrestrial realm when the full range, the breeding, non-breeding and passage range are considered. Priority values range from zero, least value, to 1, highest value (red areas in the maps) for conservation.

Table S1. This table includes a list of the 505 soaring bird species that were used for the analyses. Names are given as Latin names.

Accipiter albogularis
Accipiter badius
Accipiter bicolor
Accipiter brachyurus
Accipiter brevipes
Accipiter castanilius
Accipiter cirrocephalus
Accipiter collaris
Accipiter cooperii
Accipiter erythrauchen
Accipiter erythropus
Accipiter fasciatus
Accipiter francesiae
Accipiter gentilis
Accipiter griseiceps
Accipiter gularis
Accipiter gundlachi
Accipiter haplochrous
Accipiter henicogrammus
Accipiter henstii
Accipiter hiogaster
Accipiter imitator
Accipiter luteoschistaceus
Accipiter madagascariensis
Accipiter melanochlamys
Accipiter melanoleucus
Accipiter meyerianus
Accipiter minullus
Accipiter nanus
Accipiter nisus
Accipiter novaehollandiae
Accipiter ovampensis
Accipiter poliocephalus
Accipiter poliogaster
Accipiter princeps
Accipiter rhodogaster
Accipiter rufitorques
Accipiter rufiventris
Accipiter soloensis
Accipiter striatus
Accipiter superciliosus
Accipiter sylvestris
Accipiter tachiro
Accipiter toussenelii
Elanus caeruleus
Elanus leucurus
Elanus scriptus
Ephippiorhynchus asiaticus
Ephippiorhynchus senegalensis
Erythrotriorchis buergersi
Erythrotriorchis radiatus
Eudocimus albus
Eudocimus ruber
Eutriorchis astur
Falco alopex
Falco amurensis
Falco ardosiaceus
Falco berigora
Falco biarmicus
Falco cenchroides
Falco cherrug
Falco chicquera
Falco columbarius
Falco concolor
Falco cuvierii
Falco deiroleucus
Falco dickinsoni
Falco eleonorae
Falco fasciinucha
Falco femoralis
Falco hypoleucos
Falco jugger
Falco longipennis
Falco mexicanus
Falco moluccensis
Falco naumanni
Falco newtoni
Falco novaeseelandiae
Falco peregrinus
Falco ruficollis
Falco rufigularis
Falco rupicoloides
Falco rusticolus
Falco severus
Falco sparverius
Falco subbuteo
Falco subniger
Falco tinnunculus

Accipiter trinotatus
Accipiter trivirgatus
Accipiter virgatus
Aegypius monachus
Agamia agami
Anastomus lamelligerus
Anastomus oscitans
Anthropoides paradiseus
Anthropoides virgo
Antigone antigone
Antigone canadensis
Antigone rubicunda
Antigone vipio
Aquila adalberti
Aquila africana
Aquila audax
Aquila chrysaetos
Aquila fasciata
Aquila gurneyi
Aquila heliaca
Aquila nipalensis
Aquila rapax
Aquila spilogaster
Aquila verreauxii
Aramus guarauna
Ardea alba
Ardea brachyrhyncha
Ardea cinerea
Ardea cocoi
Ardea goliath
Ardea herodias
Ardea humbloti
Ardea insignis
Ardea intermedia
Ardea melanocephala
Ardea pacifica
Ardea plumifera
Ardea purpurea
Ardea sumatrana
Ardeola bacchus
Ardeola grayii
Ardeola idae
Ardeola ralloides
Ardeola rufiventris
Ardeola speciosa
Aviceda cuculoides
Falco vespertinus
Falco zoniventris
Gampsonyx swainsonii
Geranoaetus albicaudatus
Geranoaetus melanoleucus
Geranoaetus polyosoma
Geranospiza caerulescens
Geronticus calvus
Geronticus eremita
Gorsachius goisagi
Gorsachius magnificus
Gorsachius melanolophus
Grus americana
Grus grus
Grus japonensis
Grus monacha
Grus nigricollis
Gymnogyps californianus
Gypaetus barbatus
Gypohierax angolensis
Gyps africanus
Gyps bengalensis
Gyps coprotheres
Gyps fulvus
Gyps himalayensis
Gyps indicus
Gyps rueppelli
Gyps tenuirostris
Haliaeetus albicilla
Haliaeetus leucocephalus
Haliaeetus leucogaster
Haliaeetus leucoryphus
Haliaeetus pelagicus
Haliaeetus sanfordi
Haliaeetus vocifer
Haliaeetus vociferoides
Haliastur indus
Haliastur sphenurus
Hamirostra melanosternon
Harpagus bidentatus
Harpagus diodon
Harpia harpyja
Harpyopsis novaeguineae
Helicolestes hamatus
Henicopernis infuscatus
Henicopernis longicauda

Aviceda jerdoni
Aviceda leuphotes
Aviceda madagascariensis
Aviceda subcristata
Balaeniceps rex
Balearica pavonina
Balearica regulorum
Bostrychia bocagei
Bostrychia carunculata
Bostrychia hagedash
Bostrychia olivacea
Bostrychia rara
Botaurus lentiginosus
Botaurus pinnatus
Botaurus poiciloptilus
Botaurus stellaris
Bubulcus ibis
Bugeranus carunculatus
Busarellus nigricollis
Butastur indicus
Butastur liventer
Butastur rufipennis
Butastur teesa
Buteo albigula
Buteo albonotatus
Buteo augur
Buteo auguralis
Buteo brachypterus
Buteo brachyurus
Buteo buteo
Buteo galapagoensis
Buteo hemilasius
Buteo jamaicensis
Buteo japonicus
Buteo lagopus
Buteo lineatus
Buteo nitidus
Buteo oreophilus
Buteo plagiatus
Buteo platypterus
Buteo refectus
Buteo regalis
Buteo ridgwayi
Buteo rufinus
Buteo rufofuscus
Buteo socotraensis
Herpetotheres cachinnans
Hieraaetus ayresii
Hieraaetus morphnoides
Hieraaetus pennatus
Hieraaetus wahlbergi
Hieraaetus weiskei
Ibycter americanus
Icthyophaga humilis
Icthyophaga ichthyaetus
Ictinaetus malaiensis
Ictinia mississippiensis
Ictinia plumbea
Ixobrychus cinnamomeus
Ixobrychus dubius
Ixobrychus eurhythmus
Ixobrychus exilis
Ixobrychus flavicollis
Ixobrychus involucris
Ixobrychus minutus
Ixobrychus sinensis
Ixobrychus sturmii
Jabiru mycteria
Kaupifalco monogrammicus
Leptodon cayanensis
Leptodon forbesi
Leptoptilos crumenifer
Leptoptilos dubius
Leptoptilos javanicus
Leucogeranus leucogeranus
Leucopternis kuhli
Leucopternis melanops
Leucopternis semiplumbeus
Lophaetus occipitalis
Lophoictinia isura
Lophotibis cristata
Lophotriorchis kienerii
Macheiramphus alcinus
Megatriorchis doriae
Melierax canorus
Melierax metabates
Melierax poliopterus
Mesembrinibis cayennensis
Micrastur buckleyi
Micrastur gilvicollis
Micrastur mintoni
Micrastur mirandollei

Buteo solitarius
Buteo swainsoni
Buteo trizonatus
Buteo ventralis
Buteogallus aequinoctialis
Buteogallus anthracinus
Buteogallus coronatus
Buteogallus gundlachii
Buteogallus lacernulatus
Buteogallus meridionalis
Buteogallus schistaceus
Buteogallus solitarius
Buteogallus urubitinga
Butorides striata
Calherodius leuconotus
Caracara cheriway
Caracara plancus
Cathartes aura
Cathartes burrovianus
Cathartes melambrotus
Cercibis oxycerca
Chelictinia riocourii
Chondrohierax uncinatus
Chondrohierax wilsonii
Ciconia abdimii
Ciconia boyciana
Ciconia ciconia
Ciconia episcopus
Ciconia maguari
Ciconia microscelis
Ciconia nigra
Ciconia stormi
Circaetus beaudouini
Circaetus cinerascens
Circaetus cinereus
Circaetus fasciolatus
Circaetus gallicus
Circaetus pectoralis
Circus aeruginosus
Circus approximans
Circus assimilis
Circus buffoni
Circus cinereus
Circus cyaneus
Circus hudsonius
Circus macrosceles
Micrastur plumbeus
Micrastur ruficollis
Micrastur semitorquatus
Microhierax caerulescens
Microhierax erythrogenys
Microhierax fringillarius
Microhierax latifrons
Microhierax melanoleucos
Micronisus gabar
Milvago chimachima
Milvus migrans
Milvus milvus
Morphnarchus princeps
Morphnus guianensis
Mycteria americana
Mycteria cinerea
Mycteria ibis
Mycteria leucocephala
Necrosyrtes monachus
Neophron percnopterus
Nipponia nippon
Nisaetus alboniger
Nisaetus bartelsi
Nisaetus cirrhatus
Nisaetus floris
Nisaetus lanceolatus
Nisaetus nanus
Nisaetus nipalensis
Nisaetus philippensis
Nisaetus pinskeri
Nyctanassa violacea
Nycticorax caledonicus
Nycticorax nycticorax
Pandion haliaetus
Parabuteo leucorrhous
Parabuteo unicinctus
Pelecanus conspicillatus
Pelecanus crispus
Pelecanus erythrorhynchos
Pelecanus occidentalis
Pelecanus onocrotalus
Pelecanus philippensis
Pelecanus rufescens
Pelecanus thagus
Pernis apivorus
Pernis celebensis

Circus macrourus
Circus maurus
Circus melanoleucos
Circus pygargus
Circus ranivorus
Circus spilonotus
Circus spilothorax
Clanga clanga
Clanga hastata
Clanga pomarina
Cochlearius cochlearius
Coragyps atratus
Corvus albicollis
Corvus albus
Corvus bennetti
Corvus brachyrhynchos
Corvus capensis
Corvus caurinus
Corvus corax
Corvus corone
Corvus coronoides
Corvus crassirostris
Corvus cryptoleucus
Corvus dauuricus
Corvus edithae
Corvus enca
Corvus florensis
Corvus frugilegus
Corvus fuscicapillus
Corvus imparatus
Corvus jamaicensis
Corvus leucognaphalus
Corvus levaillantii
Corvus macrorhynchos
Corvus meeki
Corvus mellori
Corvus monedula
Corvus moneduloides
Corvus nasicus
Corvus orru
Corvus ossifragus
Corvus palmarum
Corvus rhipidurus
Corvus ruficollis
Corvus sinaloae
Corvus splendens
Pernis ptilorhynchus
Pernis steerei
Phalcoboenus albogularis
Phalcoboenus australis
Phalcoboenus carunculatus
Phalcoboenus chimango
Phalcoboenus megalopterus
Phimosus infuscatus
Pilherodius pileatus
Pithecophaga jefferyi
Platalea ajaja
Platalea alba
Platalea flavipes
Platalea leucorodia
Platalea minor
Platalea regia
Plegadis chihi
Plegadis falcinellus
Plegadis ridgwayi
Polemaetus bellicosus
Polihierax insignis
Polihierax semitorquatus
Polyboroides radiatus
Polyboroides typus
Pseudastur albicollis
Pseudastur occidentalis
Pseudastur polionotus
Pseudibis davisoni
Pseudibis papillosa
Pyrrhocorax graculus
Pyrrhocorax pyrrhocorax
Rostrhamus sociabilis
Rupornis magnirostris
Sagittarius serpentarius
Sarcogyps calvus
Sarcoramphus papa
Scopus umbretta
Spilornis cheela
Spilornis elgini
Spilornis holospilus
Spilornis kinabaluensis
Spilornis klossi
Spilornis rufipectus
Spizaetus isidori
Spizaetus melanoleucus
Spizaetus ornatus

Corvus tasmanicus
Corvus torquatus
Corvus tristis
Corvus typicus
Corvus unicolor
Corvus validus
Corvus woodfordi
Cryptoleucopteryx plumbea
Daptrius ater
Dryotriorchis spectabilis
Egretta ardesiaca
Egretta caerulea
Egretta eulophotes
Egretta garzetta
Egretta gularis
Egretta novaehollandiae
Egretta picata
Egretta rufescens
Egretta sacra
Egretta thula
Egretta tricolor
Egretta vinaceigula
Elanoides forficatus
Elanus axillaris
Spizaetus tyrannus
Spiziapteryx circumcincta
Stephanoaetus coronatus
Syrigma sibilatrix
Terathopius ecaudatus
Thaumatibis gigantea
Theristicus branickii
Theristicus caerulescens
Theristicus caudatus
Theristicus melanopis
Threskiornis aethiopicus
Threskiornis bernieri
Threskiornis melanocephalus
Threskiornis moluccus
Threskiornis spinicollis
Tigriornis leucolopha
Tigrisoma fasciatum
Tigrisoma lineatum
Tigrisoma mexicanum
Torgos tracheliotos
Trigonoceps occipitalis
Urotriorchis macrourus
Vultur gryphus
Zebrilus undulatus
Zonerodius heliosylus

Table S2. Ranking of the models, including those with ΔAIC<4 used for the multi-model averaging and inference, for investigating the effect of selected predictor variables on potential wind energy development within the full range of soaring birds. AIC values, difference in AIC between each model and the best ranked (ΔAIC), and AIC weight for each model are also shown in the respective column. In each model (represented here by a row) the independent variables included (columns) are marked with a V. FS means foraging strategy, Mass the body mass of the species, Migration depicts whether the species is migrant or resident, and RL the Red List category. Variables v1 to v2 depict the eigenvectors included in each model to account for spatial autocorrelation.

Model	Mass	Migration	FS	RL	v1	v2	AIC	ΔAIC	weight
1	V	V		V	V	V	1383,6	0,00	0,64
2	V	V	V	V	V	V	1385,1	1,50	0,29
3	V	V			V	V	1390,3	6,70	0,02
4		V		V	V	V	1390,9	7,30	0,02
5	V	V	V		V	V	1391,8	8,20	0,01
6		V			V	V	1392,3	8,70	0,01
7		V	V	V	V	V	1392,8	9,20	0,01
8		V	V		V	V	1394,1	10,50	0,00
9	V			V	V	V	1414,5	30,90	0,00
10	V		V	V	V	V	1415,0	31,40	0,00
11				V	V	V	1420,8	37,20	0,00
12			V	V	V	V	1422,0	38,40	0,00
13					V	V	1428,4	44,80	0,00
14	V				V	V	1429,0	45,40	0,00
15	V		V		V	V	1429,1	45,50	0,00
16			V		V	V	1429,1	45,50	0,00

Table S3. Ranking of the models, including those with ΔAIC<4 used for the multi-model averaging and inference, for investigating the effect of selected predictor variables on potential wind energy development within the breeding range of soaring birds. AIC values, difference in AIC between each model and the best ranked (ΔAIC), and AIC weight for each model are also shown in the respective column. In each model (represented here by a row) the independent variables included (columns) are marked with a V. FS means foraging strategy, Mass the body mass of the species, Migration depicts whether the species is migrant or resident, and RL the Red List category. Variables v1 to v2 depict the eigenvectors included in each model to account for spatial autocorrelation.

Model	Mass	Migration	FS	RL	v1	v2	AIC	ΔAIC	weight
1	V	V		V	V	V	1391,9	0	0,55
2	V	V	V	V	V	V	1393	1,10	0,31
3	V	V			V	V	1396,1	4,20	0,07
4	V	V	V		V	V	1397,2	5,30	0,04
5		V			V	V	1398,8	6,90	0,02
6		V	V		V	V	1400	8,10	0,01
7		V		V	V	V	1400,1	8,20	0,01
8		V	V	V	V	V	1401,2	9,30	0,01
9	V		V	V	V	V	1423,2	31,30	0,00
10	V			V	V	V	1424,4	32,50	0,00
11				V	V	V	1432,5	40,60	0,00
12			V	V	V	V	1433,4	41,50	0,00
13	V		V		V	V	1435,8	43,90	0,00
14	V				V	V	1436,6	44,70	0,00
15					V	V	1437,3	45,40	0,00
16			V		V	V	1437,7	45,80	0,00

Table S4. Ranking of the models, including those with ΔAIC<4 used for the multi-model averaging and inference, for investigating the effect of selected predictor variables on potential wind energy development within the non-breeding range of soaring birds. AIC values, difference in AIC between each model and the best ranked (ΔAIC), and AIC weight for each model are also shown in the respective column. In each model (represented here by a row) the independent variables included (columns) are marked with a V. FS means foraging strategy, Mass the body mass of the species, Migration depicts whether the species is migrant or resident, and RL the Red List category. Variables v1 to v2 depict the eigenvectors included in each model to account for spatial autocorrelation.

Model	Mass	Migration	FS	RL	v1	v2	AIC	ΔAIC	weight
1	V	V		V	V	V	1410,4	0,00	0,58
2	V	V	V	V	V	V	1412,4	2,00	0,21
3		V		V	V	V	1414,6	4,20	0,07
4	V	V			V	V	1415,8	5,40	0,04
5		V			V	V	1416,1	5,70	0,03
6		V	V	V	V	V	1416,6	6,20	0,03
7	V	V	V		V	V	1417,8	7,40	0,02
8		V	V		V	V	1418	7,60	0,01
9	V			V	V	V	1419,6	9,20	0,01
10	V		V	V	V	V	1421,3	10,90	0,00
11				V	V	V	1424	13,60	0,00
12			V	V	V	V	1426	15,60	0,00
13					V	V	1428,3	17,90	0,00
14	V				V	V	1428,5	18,10	0,00
15	V		V		V	V	1430,1	19,70	0,00
16			V		V	V	1430,2	19,80	0,00

Table S5. Ranking of the models, including those with ΔAIC<4 used for the multi-model averaging and inference, for investigating the effect of selected predictor variables on potential wind energy development within the passage range of soaring birds. AIC values, difference in AIC between each model and the best ranked (ΔAIC), and AIC weight for each model are also shown in the respective column. In each model (represented here by a row) the independent variables included (columns) are marked with a V. FS means foraging strategy, Mass the body mass of the species, and RL the Red List category. Variables v1 to v2 depict the eigenvectors included in each model to account for spatial autocorrelation.

Model	Mass	FS	RL	v1	v2	AIC	ΔAIC	weight
1	V		V	V	V	188,9	0,00	0,55
2	V	V	V	V	V	190,9	2,00	0,21
3			V	V	V	192,1	3,20	0,11
4				V	V	193,9	5,00	0,04
5		V	V	V	V	194,0	5,10	0,04
6	V			V	V	195,5	6,60	0,02
7		V		V	V	195,9	7,00	0,02
8	V	V		V	V	197,3	8,40	0,01