

Supplementary material

Appendix 1. Complete data set (Table A1) and lists of data sources used in this work.

Table A1. Complete data set of the respond and predictor variables for the 75 species of diurnal raptors used in this work. Territory size index was calculated only for territorial species for which we had data on distances to nearest neighbour nests (n=36). Reversed sexual dimorphism was calculated using body mass and cubed wing length ($RSD = 100 \times [(female\ body\ measure - male\ body\ measure) / (0.5 \times (female\ measure + male\ measure))]$). Hunting habitat: 1 = open habitat; 2 = semi-open habitat; 3 = closed habitat. Prey agility (i.e. species' main prey): 1 = carrion; 2 = invertebrates; 3 = reptiles and amphibians; 4 = fish; 5 = mammals; 6 = birds. Territorial behaviour: 0 = non-territorial; 1 = facultative; 2 = territorial. Territory size index = mean inter-nest distance / \log_{10} (mid-range of male body mass). ND = Not Determined.

| Family | Species | RSD (body mass) | RSD (cubed wing length) | Hunting habitat | Prey agility | Territorial behavior | Territory size index |
|------------|---------------------------------|-----------------------|----------------------------------|--------------------|-----------------|-------------------------|-------------------------|
| Falconidae | <i>Micrastur semitorquatus</i> | 33.6 | 14.2 | 3 | 5 | 0 | - |
| Falconidae | <i>Herpetotheres cachinnans</i> | 12.9 | 1.1 | 2 | 3 | 2 | ND |
| Falconidae | <i>Caracara plancus</i> | 13.3 | 4.1 | 1 | 1 | 2 | ND |
| Falconidae | <i>Ibycter americanus</i> | 20.7 | 6.1 | 3 | 2 | 2 | ND |
| Falconidae | <i>Milvago chimango</i> | 3.7 | 15.2 | 1 | 1 | 0 | - |
| Falconidae | <i>Phalcoboenus australis</i> | 10.5 | 8.5 | 1 | 1 | 1 | - |
| Falconidae | <i>Falco deiroleucus</i> | 54.3 | 40.0 | 1 | 6 | 2 | 2994.7 |
| Falconidae | <i>Falco rufigularis</i> | 48.3 | 49.6 | 1 | 6 | 2 | ND |
| Falconidae | <i>Falco vespertinus</i> | 7.0 | 10.5 | 1 | 2 | 1 | - |
| Falconidae | <i>Falco columbarius</i> | 20.9 | 27.1 | 1 | 6 | 2 | 936.1 |
| Falconidae | <i>Falco sparverius</i> | 11.0 | 9.9 | 1 | 2 | 1 | - |
| Falconidae | <i>Falco eleonora</i> | 10.3 | 18.7 | 1 | 6 | 0 | - |
| Falconidae | <i>Falco subbuteo</i> | 28.0 | 12.0 | 1 | 6 | 2 | 1982.8 |
| Falconidae | <i>Falco tinnunculus</i> | 18.7 | 15.3 | 1 | 5 | 1 | - |
| Falconidae | <i>Falco naumanni</i> | 27.6 | 5.0 | 1 | 2 | 0 | - |
| Falconidae | <i>Falco mexicanus</i> | 37.2 | 32.4 | 1 | 5 | 2 | 865.3 |
| Falconidae | <i>Falco pelegrinoides</i> | 54.8 | 37.1 | 1 | 6 | 2 | 1630.0 |
| Falconidae | <i>Falco peregrinus</i> | 44.3 | 38.2 | 1 | 6 | 2 | 3264.3 |
| Falconidae | <i>Falco rusticolus</i> | 38.3 | 19.4 | 1 | 6 | 2 | 2932.9 |
| Falconidae | <i>Falco cherrug</i> | 32.8 | 35.1 | 1 | 5 | 2 | 1995.8 |
| Falconidae | <i>Falco biarmicus</i> | 37.0 | 31.9 | 1 | 6 | 2 | ND |

Table A1. Continuation

| Family | Species | RSD (body mass) | RSD (cubed wing length) | Hunting habitat | Prey agility | Territorial behavior | Territory size index |
|--------------|---------------------------------|-----------------------|----------------------------------|--------------------|-----------------|-------------------------|-------------------------|
| Cathartidae | <i>Coragyps atratus</i> | 8.8 | 0.1 | 1 | 1 | 0 | - |
| Cathartidae | <i>Cathartes aura</i> | 13.5 | 5.0 | 1 | 1 | 0 | - |
| Pandionidae | <i>Pandion haliaetus</i> | 25.0 | 13.5 | 1 | 4 | 1 | - |
| Accipitridae | <i>Elanus leucurus</i> | 11.8 | 4.4 | 1 | 5 | 1 | - |
| Accipitridae | <i>Elanus caeruleus</i> | 17.0 | 7.7 | 1 | 5 | 2 | 1200.1 |
| Accipitridae | <i>Pernis apivorus</i> | 8.0 | 2.9 | 2 | 2 | 2 | 963.6 |
| Accipitridae | <i>Elanoides forficatus</i> | 7.6 | 10.9 | 2 | 2 | 0 | - |
| Accipitridae | <i>Gypaetus barbatus</i> | 6.7 | 1.0 | 1 | 1 | 2 | ND |
| Accipitridae | <i>Neophron percnopterus</i> | 15.4 | 11.8 | 1 | 1 | 2 | ND |
| Accipitridae | <i>Circaetus gallicus</i> | 11.8 | 7.1 | 1 | 3 | 2 | 842.7 |
| Accipitridae | <i>Aegyptius monachus</i> | 7.8 | 16.3 | 1 | 1 | 1 | - |
| Accipitridae | <i>Gyps fulvus</i> | 6.4 | 13.3 | 1 | 1 | 0 | - |
| Accipitridae | <i>Harpia harpyja</i> | 61.4 | 22.0 | 3 | 5 | 2 | 2726.4 |
| Accipitridae | <i>Spizaetus ornatus</i> | 36.7 | 22.6 | 3 | 6 | 2 | ND |
| Accipitridae | <i>Aquila pomarina</i> | 37.3 | 9.5 | 1 | 5 | 2 | 1177.1 |
| Accipitridae | <i>Aquila clanga</i> | 17.7 | 16.1 | 1 | 5 | 2 | ND |
| Accipitridae | <i>Hieraetus pennatus</i> | 31.6 | 27.8 | 1 | 6 | 2 | 1780.0 |
| Accipitridae | <i>Aquila chrysaetos</i> | 32.8 | 23.0 | 1 | 5 | 2 | 2555.5 |
| Accipitridae | <i>Aquila fasciatus</i> | 19.0 | 11.2 | 1 | 6 | 2 | 2679.1 |
| Accipitridae | <i>Aquila nipalensis</i> | 18.8 | 23.8 | 1 | 5 | 2 | 1745.4 |
| Accipitridae | <i>Aquila adalberti</i> | 19.7 | 20.0 | 2 | 5 | 2 | 2353.7 |
| Accipitridae | <i>Aquila heliaca</i> | 39.2 | 16.0 | 1 | 5 | 2 | 2024.6 |
| Accipitridae | <i>Accipiter striatus</i> | 51.9 | 55.8 | 3 | 6 | 2 | 2034.8 |
| Accipitridae | <i>Accipiter nisus</i> | 53.1 | 48.7 | 3 | 6 | 2 | 587.0 |
| Accipitridae | <i>Accipiter gentilis</i> | 32.0 | 31.1 | 2 | 6 | 2 | 1404.8 |
| Accipitridae | <i>Accipiter cooperii</i> | 61.6 | 44.2 | 3 | 6 | 2 | 1525.7 |
| Accipitridae | <i>Accipiter bicolor</i> | 57.4 | 55.7 | 3 | 6 | 2 | ND |
| Accipitridae | <i>Circus aeruginosus</i> | 22.2 | 14.6 | 1 | 6 | 1 | - |
| Accipitridae | <i>Circus cinereus</i> | 38.1 | 32.4 | 1 | 6 | 1 | - |
| Accipitridae | <i>Circus cyaneus</i> | 40.9 | 27.0 | 1 | 5 | 1 | - |
| Accipitridae | <i>Harpagus bidentatus</i> | 13.4 | 16.6 | 3 | 2 | 2 | 700.8 |
| Accipitridae | <i>Milvus milvus</i> | 25.7 | 9.9 | 1 | 1 | 2 | 472.3 |
| Accipitridae | <i>Milvus migrans</i> | 16.3 | 10.1 | 1 | 1 | 1 | - |
| Accipitridae | <i>Haliaeetus albicilla</i> | 29.2 | 28.2 | 1 | 4 | 2 | 2277.9 |
| Accipitridae | <i>Haliaeetus leucocephalus</i> | 21.5 | 23.6 | 1 | 4 | 2 | 1144.6 |
| Accipitridae | <i>Rostrhamus sociabilis</i> | 14.5 | 2.9 | 1 | 2 | 0 | - |
| Accipitridae | <i>Ictinia mississippiensis</i> | 24.0 | 11.9 | 2 | 2 | 0 | - |
| Accipitridae | <i>Ictinia plumbea</i> | 11.4 | 6.1 | 2 | 2 | 2 | 212.0 |

Table A1. Continuation

| Family | Species | RSD (body mass) | RSD (cubed wing length) | Hunting habitat | Prey agility | Territorial behavior | Territory size index |
|--------------|--------------------------------|-----------------------|----------------------------------|--------------------|-----------------|-------------------------|-------------------------|
| Accipitridae | <i>Buteogallus anthracinus</i> | 40.8 | 14.3 | 2 | 3 | 2 | 551.9 |
| Accipitridae | <i>Parabuteo unicinctus</i> | 25.9 | 22.5 | 1 | 5 | 2 | ND |
| Accipitridae | <i>Buteo magnirostris</i> | 18.8 | 11.7 | 2 | 3 | 2 | 340.9 |
| Accipitridae | <i>Buteo nitidus</i> | 17.5 | 15.2 | 2 | 3 | 2 | ND |
| Accipitridae | <i>Buteo lineatus</i> | 24.1 | 8.8 | 2 | 3 | 2 | 551.1 |
| Accipitridae | <i>Buteo ridgwayi</i> | 25.8 | 28.1 | 3 | 3 | 2 | ND |
| Accipitridae | <i>Buteo platypterus</i> | 24.8 | 22.1 | 2 | 5 | 2 | 316.4 |
| Accipitridae | <i>Buteo jamaicensis</i> | 17.0 | 20.2 | 2 | 5 | 2 | 741.1 |
| Accipitridae | <i>Buteo solitarius</i> | 31.5 | 28.3 | 2 | 6 | 2 | ND |
| Accipitridae | <i>Buteo galapagoensis</i> | 36.3 | 31.5 | 2 | 6 | 2 | ND |
| Accipitridae | <i>Buteo swainsoni</i> | 34.9 | 13.0 | 1 | 5 | 2 | 916.4 |
| Accipitridae | <i>Buteo albonotatus</i> | 33.2 | 30.9 | 2 | 6 | 2 | 1925.7 |
| Accipitridae | <i>Buteo regalis</i> | 15.8 | 5.5 | 1 | 5 | 2 | ND |
| Accipitridae | <i>Buteo lagopus</i> | 21.0 | 18.0 | 1 | 5 | 2 | 914.7 |
| Accipitridae | <i>Buteo rufinus</i> | 36.5 | 19.3 | 1 | 5 | 2 | ND |
| Accipitridae | <i>Buteo buteo</i> | 15.2 | 12.5 | 1 | 5 | 1 | - |

LISTS OF REFERENCES

Main data sources for all variables except territory size:

Cramp, S. 1998. The complete Birds of the Western Palearctic on CD-ROM. — Oxford University Press.

del Hoyo, J. et al. 1994. Handbook of the birds of the world. — Lynx Edicions.

Ferguson-Lees, J. and Christie, D. A. 2001. Raptors of the World. — Christopher Helm.

Natureserve 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. Natureserve.

Publications that provided RSD data for some species:

Bollmer, J. L. et al. 2003. Variation in morphology and mating system among island populations of Galapagos Hawks. — Condor 105: 428-438.

Gaby, S. R. P. 1982. Age-specific resource utilization by wintering migrant Turkey Vultures (*Cathartes aura*) in south Florida. University of Miami.

- Miller, A. H. 1952. Supplementary data on the tropical avifauna of the arid upper Magdalena Valley of Colombia. — *Auk* 69: 450-457.
- Mosher, J. A. and Matray, P. F. 1974. Size dimorphism a factor in energy savings for Broad-winged Hawks. — *Auk* 91: 325-341.
- Woolaver, L. G. et al. 2013. Nestling sex ratio in a critically endangered dimorphic raptor, Ridgway's Hawk (*Buteo ridgwayi*). — *J. Raptor Res.* 47: 117-126.

Publications that provided data on territorial behaviour for some species:

- Berry, R. B. et al. 2010. Isolation and decline of a population of the Orange-breasted Falcon. — *Condor* 112: 479-489.
- Hengstenberg, D. W. and Vilella, F. J. 2005. Nesting ecology and behavior of Broad-winged Hawks in moist karst forests of Puerto Rico. — *J. Raptor Res.* 39: 404-416.
- Kennedy, P. L. et al. 1995. Breeding biology of the Zone-tailed Hawk at the limit of its distribution. — *J. Raptor Res.* 29: 110-116.
- Panasci, T. A. and Whitacre, D. F. 2002. Roadside Hawk breeding ecology in forest and farming landscapes. — *Wilson Bull.* 114: 114-121.
- Schulze, M. D. and Cordova, J. L. 2000. Behavior, diet, and breeding biology of Double-toothed Kites at a Guatemalan lowland site. — *Condor* 102: 113-126.

Publications that provided data on territory size:

- Anthony, R. G. 2001. Low productivity of Bald Eagles on Prince of Wales Island, southeast Alaska. — *J. Raptor Res.* 35: 1-8.
- Bakaloudis, D. E. et al. 2005. Nest spacing and breeding performance in Short-toed Eagle *Circaetus gailicus* in northeast Greece. — *Bird Study* 52: 330-338.
- Baker, A. J. et al. 2000. The Orange-breasted Falcon *Falco deiroleucus* in Mesoamerica: a vulnerable, disjunct population? — *Bird Conserv. Int.* 10: 29-40.
- Balbontin, J. et al. 2008. Land-use changes may explain the recent range expansion of the Black-shouldered Kite *Elanus caeruleus* in southern Europe. — *Ibis* 150: 707-716.
- Beissinger, S. R. et al. 1988. Vocalizations, food habits, and nesting biology of the Slender-

- billed Kite with comparisons to the Snail Kite. — *Wilson Bull.* 100: 604-616.
- Bergo, G. 1984. Population size, spacing and age structure of Golden Eagle *Aquila chrysaetos* (L.) in Hordaland, West Norway. — *Nor. J. Ornithol.* 7: 106-108.
- Bezzel, E. and Fuenfstueck, H.-J. 1994. Brutbiologie und Populationsdynamik des Steinadlers (*Aquila chrysaetos*) im Werdenfelser Land/Oberbayern. — *Acta Ornithoecologica* 3: 5-32.
- Bielaniński, W. 2006. Nesting preferences of Common Buzzard *Buteo buteo* and Goshawk *Accipiter gentilis* in forest stands of different structure (Niepolomice Forest, Southern Poland). — *Biologia* 61: 597-603.
- Bisson, I. A. et al. 2002. Factors influencing nest-site selection by Spanish Imperial Eagles. — *J. Field Ornithol.* 73: 298-302.
- Bosakowski, T. et al. 1996. Habitat and spatial relationships of nesting Swainson's Hawks (*Buteo swainsoni*) and Red-tailed Hawks (*B. jamaicensis*) in northern Utah. — *Great Basin Nat.* 56: 341-347.
- Bosch, J. et al. 2005. Nesting habitat selection of Booted Eagle *Hieraaetus pennatus* in Central Catalonia. — *Ardeola* 52: 225-233.
- Brambilla, M. et al. 2010. Environmental factors affecting patterns of distribution and co-occurrence of two competing raptor species. — *Ibis* 152: 310-322.
- Brown, A. F. and Stillman, R. A. 1998. The return of the Merlin to the south Pennines. — *Bird Study* 45: 293-301.
- Brown, B. T. et al. 1992. Density of nesting Peregrine Falcons in Grand Canyon National Park, Arizona. — *Southwest. Nat.* 37: 188-193.
- Brown, C. J. 1997. Population dynamics of the Bearded Vulture *Gypaetus barbatus* in southern Africa. — *Afr. J. Ecol.* 35: 53-63.
- Buczek, T. et al. 2007. Legowe ptaki szponiaste *Falconiformes* Lasow Parczewskich - zmiany liczebności i rozmieszczenia w latach 1991-1993 i 2002-2004. — *Notatki Ornitol.* 48: 217-231.
- Caniot, P. 1996. Suivi de la reproduction de l'Aigle Royal *Aquila chrysaetos* dans le

- departement de l'Ariege de 1992 a 1995. — *Alauda* 64: 187-194.
- Castaño, J. P. 2007. Dinámica poblacional del Águila Imperial Ibérica *Aquila adalberti* en la provincia de Toledo (1989 - 2006). — *Ardeola* 54: 309-317.
- Castaño, J. P. and Guzman, J. 1995. Aspectos sobre la reproducción de *Aquila adalberti* y *Aquila chrysaetos* en Sierra Morena oriental. — *Ardeola* 42: 83-89.
- Castellanos, A. and Jaramillo, F. 1997. Peregrine Falcon recovery along the west central coast of the Baja California Peninsula, Mexico. — *J. Raptor Res.* 31: 1-6.
- Clouet, M. and Goar, J. 2006. L'Aigle Royal *Aquila chrysaetos* au sud du Sahara. — *Alauda* 74: 441-446.
- Craig, T. H. et al. 1984. Results of a helicopter survey of cliff nesting raptors in a deep canyon in Southern Idaho. — *Raptor Res.* 18: 20-25.
- Cugnasse, J.-M. 1984. Le Faucon Pelerin *Falco pelegrinus* dans le sud du Massif Central de 1974 a 1983. — *Alauda* 52: 161-176.
- Demerdzhiev, D. A. et al. 2011. Status of the Eastern Imperial Eagle (*Aquila heliaca*) in the European part of Turkey. — *Acta Zool. Bulg.* 3: 87-93.
- Dombrowski, A. et al. 2000. Gniazdowanie ptaków drapieżnych *Falconiformes* i kruk *Corvus corax* w krajobrazie rolniczym pod Siedlcami w latach 1978 i 1999. — *Notatki Ornitol.* 41: 201-212.
- Erdman, T. C. et al. 1998. Productivity, population trend, and status of Northern Goshawks, *Accipiter gentilis atricapillus*, in Northeastern Wisconsin. — *Can. Field-Nat.* 112: 17-27.
- Fasce, P. et al. 2011. Long-term breeding demography and density dependence in an increasing population of Golden Eagles *Aquila chrysaetos*. — *Ibis* 153: 581-591.
- Frenzel, R. 1983. Spacing of nest sites and foraging areas of Bald Eagles. — In: Anthony, R. G. et al. (eds), *Proceedings of a workshop on habitat management for nesting and roosting Bald Eagles in the Western United States.*
- Gainzarain, J. A. et al. 2000. Breeding density, habitat selection and reproductive rates of the Peregrine Falcon *Falco peregrinus* in Alava (northern Spain). — *Bird Study* 47:

225-231.

- Garland, T. et al. 1993. Phylogenetic analysis of covariance by computer simulation. — Syst. Biol. 42: 265-292.
- Gavashelishvili, A. and McGrady, M. J. 2006. Breeding site selection by Bearded Vulture (*Gypaetus barbatus*) and Eurasian Griffon (*Gyps fulvus*) in the Caucasus. — Anim. Conserv. 9: 159-170.
- Gil-Sanchez, J. M. et al. 2004. A nine-year study of successful breeding in a Bonelli's Eagle population in southeast Spain: a basis for conservation. — Biol. Conserv. 118: 685-694.
- Grant, C. V. et al. 1991. Raptor population-dynamics in Utah Uinta Basin: the importance of food resource. — Southwest. Nat. 36: 265-280.
- Grubb, T. G. 1995. Food-habits of Bald Eagles breeding in the Arizona desert. — Wilson Bull. 107: 258-274.
- Hengstenberg, D. W. and Vilella, F. J. 2005. Nesting ecology and behavior of Broad-winged Hawks in moist karst forests of Puerto Rico. — J. Raptor Res. 39: 404-416.
- Hobbs, R. J. et al. 2006. Breeding biology and nest-site selection of Red-tailed Hawks in an altered desert grassland. — J. Raptor Res. 40: 38-45.
- Horne, G. and Fielding, A. H. 2002. Recovery of the Peregrine Falcon *Falco peregrinus* in Cumbria, UK, 1966-99. — Bird Study 49: 229-236.
- Jenkins, A. R. and van Zyl, A. J. 2005. Conservation status and community structure of cliff-nesting raptors and ravens on the Cape Peninsula, South Africa. — Ostrich 76: 175-184.
- Jordano, P. 1981. Relaciones interespecíficas y coexistencia entre el Águila Real (*Aquila chrysaetos*) y el Águila Perdicera (*Hieraaetus fasciatus*) en Sierra Morena Central. — Ardeola 28: 67-88.
- Karyakin, I. and Nikolenko, E. 2009. Peregrine Falcon in the Altai-Sayan Region, Russia. — Raptors Conserv. 16: 96-128.
- Karyakin, I. V. and al, e. 2010. Golden Eagle in the Altai-Sayan Region, Russia. — Raptors Conserv. 18: 82-152.

- Karyakin, I. V. et al. 2011. Eagles of the Aral-Caspian Region, Kazakhstan. — *Raptors Conserv.* 22: 92-152.
- Karyakin, I. V. et al. 2010a. Saker Falcon in the Karatau Mountains, Kazakhstan. — *Raptors Conserv.* 19: 152-163.
- Karyakin, I. V. and Nikolenko, E. G. 2008. Monitoring results on the Saker Falcon population in the Altai-Sayan Region in 2008, Russia. — *Raptors Conserv.* 14: 63-84.
- Karyakin, I. V. and Nikolenko, E. G. 2010. The Imperial Eagle in the Republic of Khakassia and Krasnoyarsk Kray, Russia. — *Raptors Conserv.* 20: 158-176.
- Karyakin, I. V. et al. 2009a. Imperial Eagle in the Altai Mountains. — *Raptors Conserv.* 15: 66-79.
- Karyakin, I. V. et al. 2009b. Imperial Eagle in the Altai Mountains: Results of the Research in 2009, Russia. — *Raptors Conserv.* 16: 129-138.
- Karyakin, I. V. and Pazhenkov, A. S. 2010. The Imperial Eagle in the Samara District, Russia. — *Raptors Conserv.* 20: 97-118.
- Karyakin, I. V. et al. 2010b. The Imperial Eagle in the Ural Region, Russia. — *Raptors Conserv.* 20: 128-145.
- Katzner, T. E. et al. 2003. Coexistence in a multispecies assemblage of eagles in Central Asia. — *Condor* 105: 538-551.
- Kennedy, P. L. et al. 1995. Breeding biology of the Zone-tailed Hawk at the limit of its distribution. — *J. Raptor Res.* 29: 110-116.
- Kostrzewa, A. 1991. Interspecific interference competition in three European raptor species. — *Ethol. Ecol. Evol.* 3: 127-143.
- Liberatori, F. and Penteriani, V. 2001. A long-term analysis of the declining population of the Egyptian Vulture in the Italian peninsula: distribution, habitat preference, productivity and conservation implications. — *Biol. Conserv.* 101: 381-389.
- Lopez-Lopez, P. et al. 2004. Patrón de distribución del Águila Real *Aquila chrysaetos* y del Águila-Azor Perdicera *Hieraaetus fasciatus* en la provincia de Castellón. — *Ardeola* 51: 275-283.

- Lopez-Lopez, P. et al. 2007. Population size, breeding performance and territory quality of Bonelli's Eagle *Hieraaetus fasciatus* in eastern Spain. — Bird Study 54: 335-342.
- Mahaffy, M. S. and Frenzel, L. D. 1987. Elicited territorial responses of Northern Bald Eagles near active nests. — J. Wildl. Manag. 51: 551-554.
- Margalida, A. and Garcia, D. 1999. Nest use, interspecific relationships and competition for nests in the Bearded Vulture *Gypaetus barbatus* in the Pyrenees: influence on breeding success. — Bird Study 46: 224-229.
- Marquiss, M. and Newton, I. 1982. A radio-tracking study of the ranging behavior and dispersion of European Sparrowhawks *Accipiter nisus*. — J. Anim. Ecol. 51: 111-133.
- Martell, M. et al. 1998. Nesting and migration of Swainson's Hawks in Minnesota. — Loon 70: 72-81.
- Martinez, J. E. et al. 2010. Potential impact of wind farms on territories of large eagles in southeastern Spain. — Biodivers. Conserv. 19: 3757-3767.
- Martinez, J. E. et al. 2008. The effect of intra- and interspecific interactions on the large-scale distribution of cliff-nesting raptors. — Ornis Fenn. 85: 13-21.
- McIntyre, C. L. et al. 2006. Characteristics of the landscape surrounding Golden Eagle nest sites in Denali National Park and Preserve, Alaska. — J. Raptor Res. 40: 46-51.
- Messenger, A. and Roome, M. 2007. The breeding population of the Hobby in Derbyshire. — Br. Birds 100: 594-608.
- Mooney, N. J. and Brothers, N. P. 1987. The Peregrine Falcon, *Falco peregrinus macropus* S, in Tasmania. 1. Distribution, abundance and physical characteristics of nests. — Aust. Wildl. Res. 14: 81-93.
- Moorman, C. E. and Chapman, B. R. 1996. Nest-site selection of Red-shouldered and Red-tailed Hawks in a managed forest. — Wilson Bull. 108: 357-368.
- Morneau, F. et al. 1994. Abundance and distribution of nesting Golden Eagles in Hudson-Bay, Quebec. — J. Raptor Res. 28: 220-225.
- Mougeot, F. and Bretagnolle, V. 2006. Breeding biology of the Red Kite *Milvus milvus* in Corsica. — Ibis 148: 436-448.

- Muñoz, A. 1993. Situació dels Falconiformes nidificants a la Península de Llevant de Mallorca. — Anuari Ornitol Balears 8: 31-38.
- Newton, I. et al. 1986. Spacing of Sparrowhawks in relation to food-supply. — J. Anim. Ecol. 55: 361-370.
- Nielsen, J. T. 2004. Spurvehogens *Accipiter nisus* bestandsudvikling, ynglehabitat, alderssammensætning og ungeproduktion i Vendsyssel, 1977-97. — Dan. Ornitol. Foren. Tidsskr. 98: 147-162.
- Nilsson, I. N. et al. 1982. Diet choice, resource depression, and the regular nest spacing of birds of prey. — Biol. J. Linn. Soc. 18: 1-9.
- Obst, J. 1994. Tree nesting by the Gyrfalcon (*Falco rusticolus*) in the Western Canadian Arctic. — J. Raptor Res. 28: 4-8.
- Olsen, P. D. and Olsen, J. 1988. Breeding of the Peregrine Falcon *Falco peregrinus*. 1. Weather, nest spacing and territory occupancy. — Emu 88: 195-201.
- Panasci, T. A. and Whitacre, D. F. 2002. Roadside Hawk breeding ecology in forest and farming landscapes. — Wilson Bull. 114: 114-121.
- Pedrini, P. and Sergio, F. 2001. Density, productivity, diet, and human persecution of Golden Eagles (*Aquila chrysaetos*) in the central-eastern Italian Alps. — J. Raptor Res. 35: 40-48.
- Pennycuik, C. J. and Kline, N. C. 1986. Units of measurement for fractal extent, applied to the coastal distribution of Bald Eagle nests in the Aleutian Islands, Alaska. — Oecologia 68: 254-258.
- Penteriani, V. 1997. Long-term study of a Goshawk breeding population on a Mediterranean mountain (Abruzzi apennines, central Italy): Density, breeding performance and diet. — J. Raptor Res. 31: 308-312.
- Penteriani, V. et al. 2001. An approach to identify factors and levels of nesting habitat selection: a cross-scale analysis of Goshawk preferences. — Ornis Fenn. 78: 159-167.
- Penteriani, V. et al. 2002. Immediate species responses to catastrophic natural disturbances: Windthrow effects on density, productivity, nesting stand choice, and fidelity in

- Northern Goshawks (*Accipiter gentilis*). — Auk 119: 1132-1137.
- Pepler, D. et al. 2001. Estimating the breeding population of Booted Eagles in the Cape Province, South Africa. — J. Raptor Res. 35: 15-19.
- Quinn, J. L. and Kokorev, Y. 2000. Direct and indirect estimates of Peregrine Falcon population size in northern Eurasia. — Auk 117: 455-464.
- Radovic, A. and Mikuska, T. 2009. Population size, distribution and habitat selection of the White-tailed Eagle *Haliaeetus albicilla* in the alluvial wetlands of Croatia. — Biologia 64: 156-164.
- Reynolds, R. T. et al. 2005. Sampling considerations for demographic and habitat studies of Northern Goshawks. — J. Raptor Res. 39: 274-285.
- Reynolds, R. T. and Wight, H. M. 1978. Distribution, density, and productivity of *Accipiter* hawks breeding in Oregon. — Wilson Bull. 90: 182-196.
- Ritchie, R. J. and Shook, J. E. 2011. Recovery and trends of Peregrine Falcons breeding in the Yukon-Tanana Uplands, East-Central Alaska, 1995-2003. — J. Raptor Res. 45: 150-159.
- Rizzolli, F. et al. 2005. Density, productivity, diet and population status of the Peregrine Falcon *Falco peregrinus* in the Italian Alps. — Bird Study 52: 188-192.
- Rodríguez-Estrella, R. 2000. Breeding success, nest-site characteristics, and diet of Swainson's Hawk (*Buteo swainsoni*) in a stable population in northern Mexico. — Can. J. Zool. 78: 1052-1059.
- Rodríguez, B. and Siverio, M. 2006. Density and breeding habitat characteristics of an insular population of Barbary Falcon *Falco peregrinus peregrinus* (El Hierro, Canary Islands). — Ardeola 53: 325-331.
- Rutz, C. et al. 2006. Population limitation in the Northern Goshawk in Europe: a review with case studies. — Stud. Avian Biol. 31: 158-197.
- Sadoti, G. 2008. Nest-site selection by Common Black-Hawks in southwestern New Mexico. — J. Field Ornithol. 79: 11-19.
- Sara, M. and Di Vittori, M. 2003. Factors influencing the distribution, abundance and nest-

- site selection of an endangered Egyptian Vulture (*Neophron percnopterus*) population in Sicily. — Anim. Conserv. 6: 317-328.
- Scheller, W. et al. 2001. Verbreitung, Bestandsentwicklung und Lebensraumsituation des Schreiadlers *Aquila pomarina* in Mecklenburg-Vorpommern. — Vogelwelt 122: 233-246.
- Schoegel, J. 2007. Hohe Siedlungsdichte des Baumfalcken *Falco subbuteo* im Unterallgaeu. — Ornithol. Anz. 46: 63-67.
- Schulze, M. D. and Cordova, J. L. 2000. Behavior, diet, and breeding biology of Double-toothed Kites at a Guatemalan lowland site. — Condor 102: 113-126.
- Seavy, N. E. et al. 1998. Breeding biology and behavior of the Plumbeous Kite. — Wilson Bull. 110: 77-85.
- Selas, V. 1997a. Breeding density of Sparrowhawk *Accipiter nisus* in relation to nest site availability, hatching success and winter weather. — Ornis Fenn. 74: 121-129.
- Selas, V. 1997b. Influence of prey availability on re-establishment of Goshawk *Accipiter gentilis* nesting territories. — Ornis Fenn. 74: 113-120.
- Selas, V. 1998. Does food competition from Red Fox (*Vulpes vulpes*) influence the breeding density of Goshawk (*Accipiter gentilis*)? Evidence from a natural experiment. — J. Zool. (Lond.) 246: 325-335.
- Sergio, F. et al. 2005. Preservation of wide-ranging top predators by site-protection: Black and Red Kites in Donana National Park. — Biol. Conserv. 125: 11-21.
- Sergio, F. and Bogliani, G. 1999. Eurasian Hobby density, nest area occupancy, diet, and productivity in relation to intensive agriculture. — Condor 101: 806-817.
- Siverio, M. et al. 2011. Long-term monitoring of an insular population of Barbary Falcon *Falco peregrinus pelegrinoides*. — Ostrich 82: 225-230.
- Sodhi, N. S. et al. 1992. Breeding ecology of urban Merlins (*Falco columbarius*). — Can. J. Zool. 70: 1477-1483.
- Solonen, T. 1993. Spacing of birds of prey in Southern Finland. — Ornis Fenn. 70: 129-143.

- Steenhof, K. et al. 1999. Long-term Prairie Falcon population changes in relation to prey abundance, weather, land uses, and habitat conditions. — *Condor* 101: 28-41.
- Stewart, R. E. 1949. Ecology of a nesting Red-shouldered Hawk population. — *Wilson Bull.* 61: 26-35.
- Stoj, M. 2008. Rozmieszczenie, liczebność i wybrane aspekty ekologii rozrodu orla przedniego *Aquila chrysaetos* w polskiej części Karpat w latach 1997-2007. — *Notatki Ornitol.* 49: 1-12.
- Stout, W. E. et al. 1998. Urban, suburban and rural Red-tailed Hawk nesting habitat and populations in southeast Wisconsin. — *J. Raptor Res.* 32: 221-228.
- Stout, W. E. and Rosenfield, R. N. 2010. Colonization, growth, and density of a pioneer Cooper's Hawk population in a large metropolitan environment. — *J. Raptor Res.* 44: 255-267.
- Suarez, S. et al. 2000. Nesting habitat selection by Booted Eagles *Hieraaetus pennatus* and implications for management. — *J. Appl. Ecol.* 37: 215-223.
- Tjernberg, M. 1985. Spacing of Golden Eagle *Aquila chrysaetos* nests in relation to nest site and food availability. — *Ibis* 127: 250-255.
- Uchida, H. et al. 2007. Breeding ecology of Northern Goshawk at hilly terrain area in central Japan. — *Jpn. J. Ornithol.* 56: 131-140.
- Vargas-González, J. D. and Vargas, F. H. 2011. Nesting density of Harpy Eagles in Darien with population size estimates for Panama. — *J. Raptor Res.* 45: 199-210.
- Vargas-González, J. d. J. et al. 2006. Estado y distribución actual del Águila Arpía (*Harpia harpyja*) en Centro y Sur América. — *Ornitol. Neotrop.* 17: 39-55.
- Verdejo, J. and Lopez-Lopez, P. 2008. Long-term monitoring of a Peregrine Falcon population: size, breeding performance and nest-site characteristics. — *Ardeola* 55: 87-96.
- Watson, A. and Rothery, P. 1986. Regularity in spacing of Golden Eagle *Aquila chrysaetos* nests used within years in Northeast Scotland. — *Ibis* 128: 406-408.
- Whitaker, D. M. et al. 1996. Breeding season irruptions of Rough-legged Hawks (*Buteo*

- lagopus*) on insular Newfoundland. — Arctic 49: 306-310.
- White, C. M. et al. 1981. The status and distribution of the Peregrine Falcon in Victoria, Australia. — Emu 80: 270-280.
- Widen, P. 1985. Breeding and movements of Goshawks in boreal forests in Sweden. — Holarct. Ecol. 8: 273-279.
- Wightman, C. S. and Fuller, M. R. 2005. Spacing and physical habitat selection patterns of Peregrine Falcons in central West Greenland. — Wilson Bull. 117: 226-236.
- Wiklund, C. G. et al. 1998. Mechanisms determining the spatial distribution of microtine predators on the Arctic tundra. — J. Anim. Ecol. 67: 91-98.
- Wright, P. M. 1997. Distribution, site occupancy and breeding success of the Merlin *Falco columbarius* on Barden moor and fell, north Yorkshire. — Bird Study 44: 182-193.
- Wyllie, I. and Newton, I. 1991. Demography of an increasing population of Sparrowhawks. — J. Anim. Ecol. 60: 749-766.
- Zawadzka, D. and Zawadzki, J. 1998. The Goshawk *Accipiter gentilis* in Wigry National Park (NE Poland)- numbers, breeding results, diet composition and prey selection. — Acta Ornithol. 33: 181-190.
- Zawadzka, D. et al. 2006. Rozwoj populacji, wymagania środowiskowe i ekologia bielika *Haliaeetus albicilla* w Puszczy Augustowskiej. — Notatki Ornitol. 47: 217-229.

Appendix 2. Figure A1.

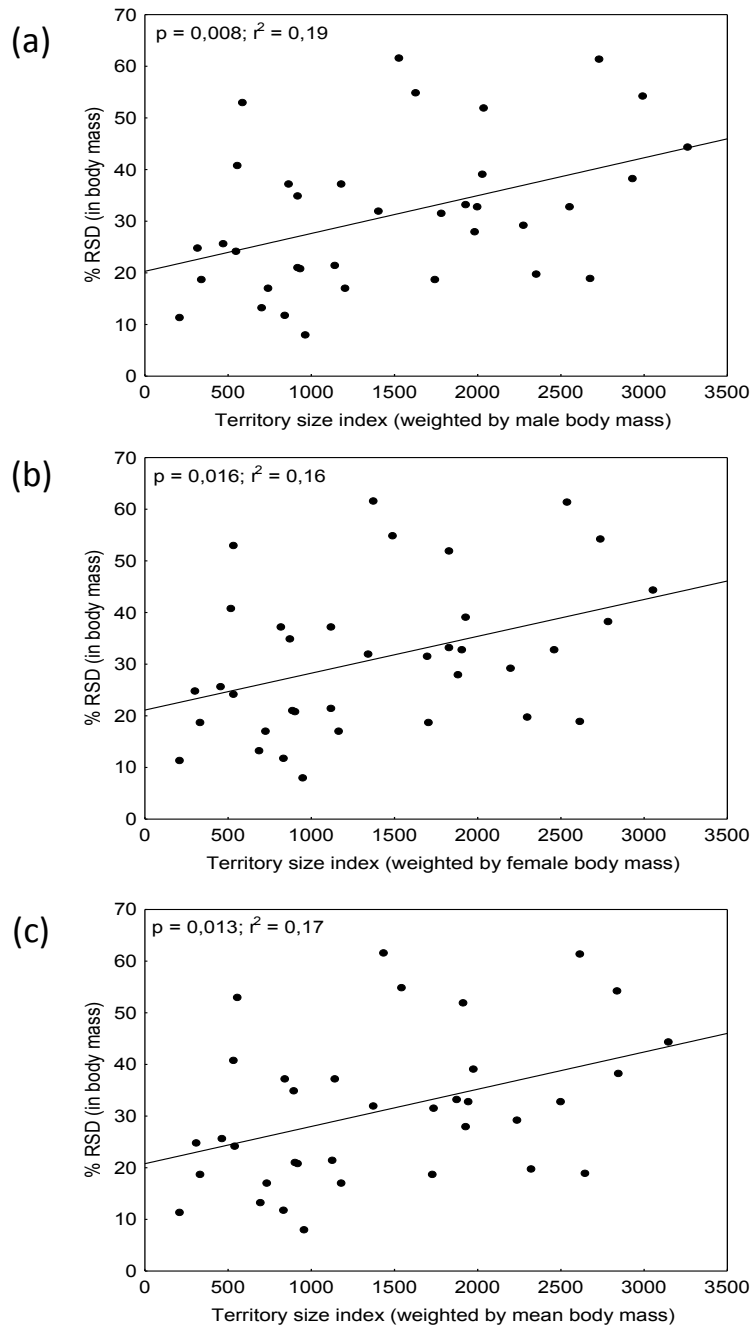


Figure A1. Relationship between RSD in New World and Western Palearctic raptors and territory size index (average nearest-neighbour inter-nest distance in the population/ $\log_{10}(\text{body mass})$) using body mass of: (a) male; (b) female; and (c) mean of both sexes.

Appendix 3. Table A1 and Figures A1-A4.

Table A1. Proportions of RSD variation explained (R^2) individually and jointly by agility of the main prey, hunting habitat structure and territoriality or territory size. These data are summarised in Figure 3.

| | All raptors (75 species) | Territorial raptors (36 species) |
|---|-----------------------------|-------------------------------------|
| Total | 0.513 | 0.398 |
| Prey agility | 0.433 | 0.292 |
| Hunting habitat | 0.108 | 0.058 |
| Territoriality | 0.160 | |
| Territory size | | 0.188 |
| Prey agility & Hunting habitat | 0.035 | -0.037 |
| Prey agility & Territoriality | 0.141 | |
| Prey agility & Territory size | | 0.167 |
| Hunting habitat & Territoriality | 0.042 | |
| Hunting habitat & Territory size | | -0.064 |
| Prey agility & Hunting habitat & Territoriality | 0.032 | |
| Prey agility & Hunting habitat & Territory size | | -0.041 |

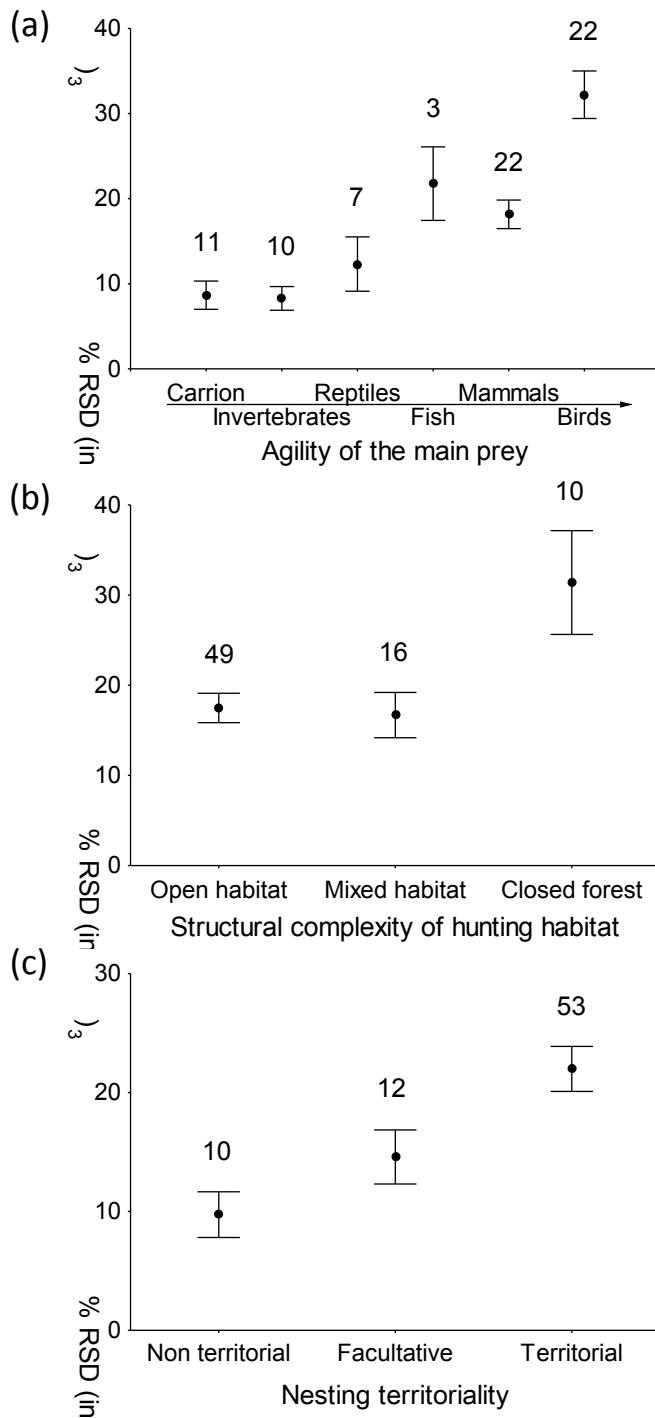


Figure A1. RSD of New World and Western Palearctic raptors was measured in terms of the cubed wing length and depicted as a function of: (a) agility of the main prey; (b) hunting habitat in breeding season; and (c) territorial nesting behaviour. Error bars indicate 1 S.E. and number above bars the number of raptor species.

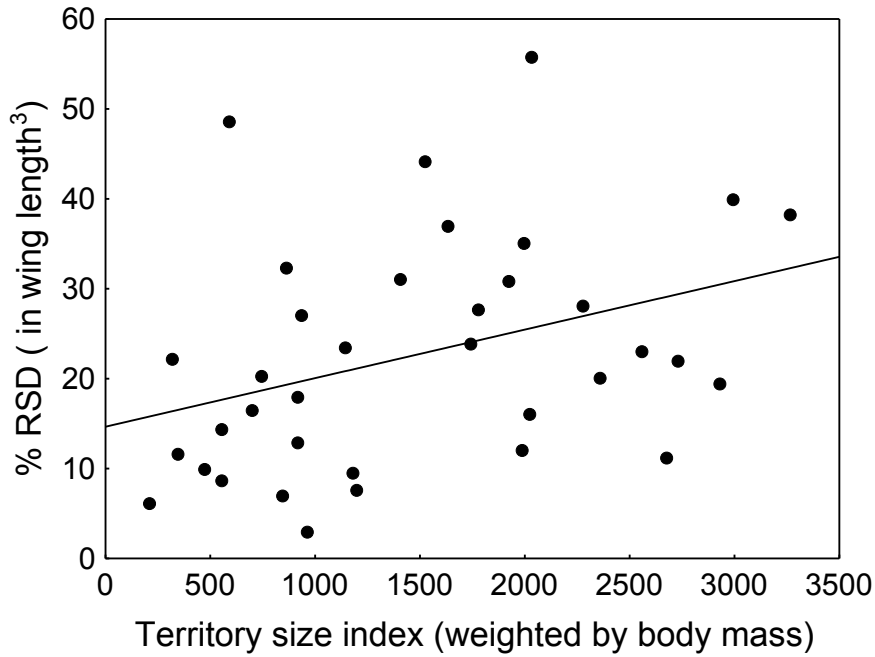


Figure A2. RSD of New World and Western Palearctic raptors was measured in terms of the cubed wing length and depicted as a function of territory size index: average nearest-neighbour inter-nest distance in the population/ \log_{10} (mean male body mass).

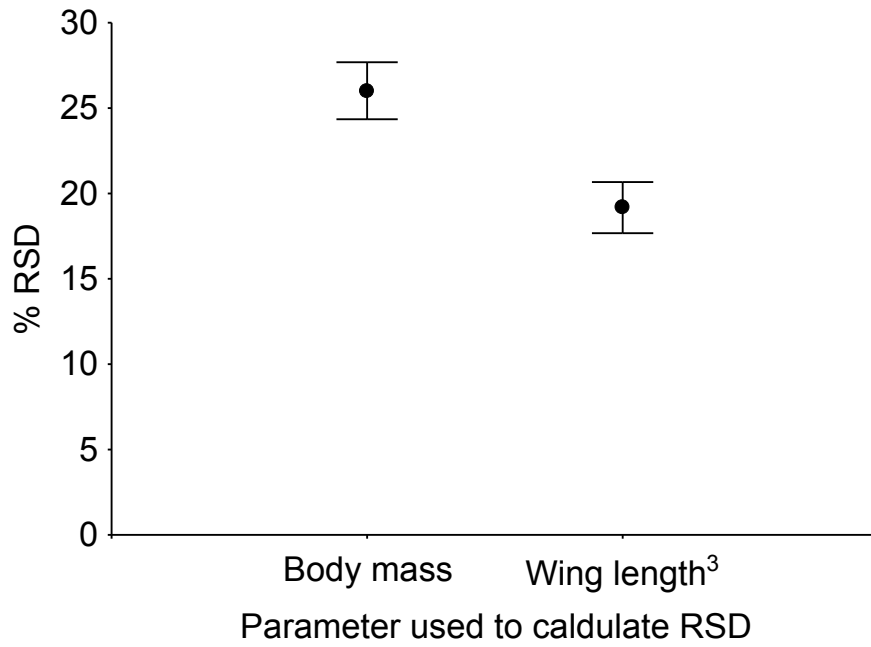


Figure A3. Comparison of RSD calculated based on body mass and RSD calculated based on cubic wing length for New World and Western Palearctic raptors. Error bars indicate 1 S.E.

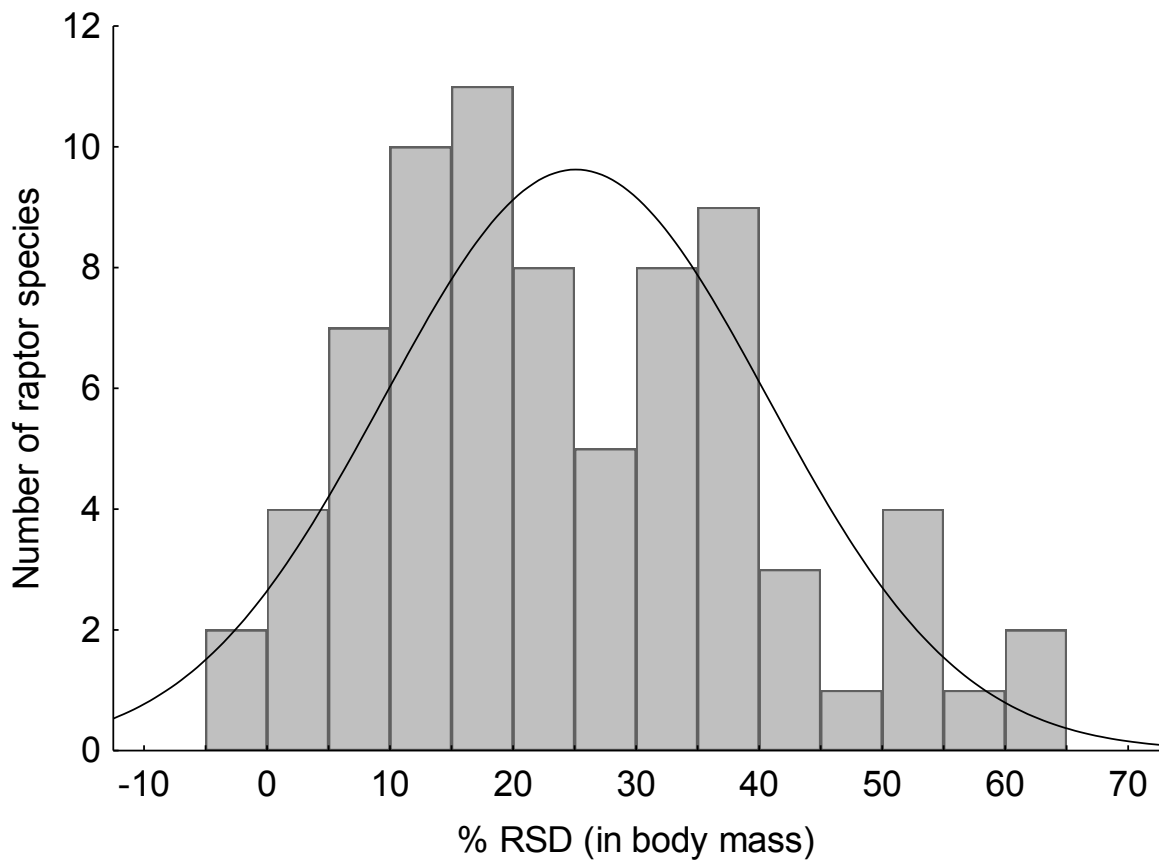


Figure A4. Histogram of the distribution of RSD in the studied raptor species. The line show the normal distribution.

Appendix 4. Table A1.

Table A1. Generalized Linear Mixed Models (GLMM) with (i.e. GLMM.phylo) and without (i.e. GLMM) a random effect characterizing the phylogenetic relationships among species. Models are fitted within a Bayesian framework that uses Markov Chain Monte Carlo (MCMC) methods instead of adjusting maximum likelihood (Hadfield and Nakagawa 2010). Posterior means of coefficients together with their 95% Confidence Intervals are indicated for each predictor. Also, the Deviance Information Criterion (DIC) of each model is reported. Models were fit using a thinning interval of 10 a burn-in period of 3,000 iterations, and 17,000 iterations for models to converge. We report fixed effects to allow direct comparison against OLS and PGLS results. Results qualitatively coincide with those yielded by OLS and PGLS models in identifying prey agility and hunting habitat as significant predictors and, models accounting for phylogenetic relationships as showing better fits than non-phylogenetic models.

| Model | Hunting habitat | | | | Prey agility | | | | Territoriality / Territory size | | | | DIC |
|--------------------|-----------------|------------|-----------|----------|----------------|------------|-----------|----------|---------------------------------|------------|-----------|----------|---------|
| | posterior mean | low 95% CI | up 95% CI | <i>P</i> | posterior mean | low 95% CI | up 95% CI | <i>P</i> | posterior mean | low 95% CI | up 95% CI | <i>P</i> | |
| GLMM (75sp.) | 5.113 | 1.701 | 8.451 | 0.003 | 4.586 | 3.184 | 5.884 | 0.001 | 2.108 | -1.887 | 5.857 | 0.261 | 568.655 |
| GLMM.phylo (75sp.) | 5.114 | 1.575 | 8.727 | 0.006 | 4.347 | 2.780 | 5.725 | 0.001 | 2.679 | -0.706 | 6.629 | 0.147 | 563.094 |
| GLMM (36sp.) | 6.923 | 1.775 | 12.522 | 0.011 | 4.411 | 1.135 | 7.941 | 0.007 | 0.005 | -0.001 | 0.010 | 0.116 | 283.572 |
| GLMM.phylo (36sp.) | 6.989 | 1.892 | 13.240 | 0.020 | 4.356 | 0.772 | 7.362 | 0.011 | 0.004 | -0.001 | 0.010 | 0.121 | 282.911 |