

Electronic Supplementary Materials

SM1: Comparison of IAH and HHH statistically significant variables among occupied and vacant sites. We reported the neighbouring sites distance (km), p-value and standard deviation of each test.

		Occupied (82)	Vacant (56)
IAH	Mean NND1 (km)	14.09	10.31
	Standard deviation	6.44	5.19
	$t_{136} = 3.66$, p-value < 0.05		
	Mean NND2 (km)	20.67	16.65
	Standard deviation	8.60	7.35
	$t_{136} = 2.87$, p-value < 0.05		
	Mean NND1/NNDX	1.40	0.84
	Standard deviation	0.91	0.52
	$t_{136} = 4.18$, p-value < 0.05		
HHH	Mean TC5 (sq. km)	38.11	34.14
	Dev. standard	14.45	10.90
	$t_{136} = 1.75$, p-value < 0.05		
	Mean TF5 (sq. km)	39.75	44.69
	Standard deviation	14.69	12.54
	$t_{136} = 2.06$, p-value < 0.05		
	Mean TC5/TF5	1.62	0.92
	Standard deviation	2.54	0.65
	$t_{136} = 2.00$, p-value < 0.05		
	Mean (NND1/NNDX)/(TCL5/TC5)	0.59	0.35
	Standard deviation	0.47	0.31
	$t_{136} = 3.32$, p-value < 0.05		

SM2: Comparison of the impact of protection over IAH (NND1, Maximum mean elevation, NND1/NNDX) and HHH (TC5, TCL5) and hybrid ((NND1/NNDX)/(TCL5/TC5)) variables measured on occupied sites.

		Occupied protected	Occupied Unprotected
Samples		42	40
IAH	Mean NND1	12.30	15.96
	Standard deviation	6.29	6.13
	$t_{80} = 2.67, p\text{-value} < 0.05$		
	Maximum Mean elevation (m)	2047.14	1759.33
	Standard deviation	323.95	305.36
	$t_{80} = 4.14, p\text{-value} < 0.05$		
	Mean NND1/NNDX	1.11	1.71
	Standard deviation	0.64	1.04
	$t_{80} = 3.25, p\text{-value} < 0.05$		
HHH		Occupied protected	Occupied unprotected
	Mean TC5 (sq. km)	40.08	36.04
	Standard deviation	16.96	11.07
	$t_{80} = 1.27, p\text{-value} = 0.21$		
	Mean TCL5 (sq. km)	17.92	16.70
	Standard deviation	13.30	8.42
	$t_{80} = 0.49, p\text{-value} = 0.62$		
	Mean (NND1/NNDX)/(TCL5/TC5)	0.43	0.76
	Standard deviation	0.34	0.53
	$t_{80} = 3.39, p\text{-value} < 0.05$		

SM3: Comparison of NND1/NNDX ratio over vacant and occupied sites localized in protected and non-protected areas.

Territories located inside Protected Areas			
	Vacant	Occupied	Tot.
NND1/NNDX ≥ 1	2	19	21
NND1/NNDX < 1	6	23	29
Tot.	8	42	50
$\chi^2 = 0.45$, p-value = 0.50			
Territories located outside Protected Areas			
	Vacant	Occupied	Tot.
NND1/NNDX ≥ 1	8	26	34
NND1/NNDX < 1	40	14	54
Tot.	48	40	88
$\chi^2 = 19.51$, p-value < 0.05			

SM4: Comparison of NND1/NNDX for vacant and occupied sites

	Vacant	Occupied	Tot.
NND1/NNDX ≥ 1	10	45	55
NND1/NNDX < 1	46	37	83
Tot.	56	82	138
$\chi^2 = 17.51$, p-value < 0.05			
NND1/NNDX	0.83+/- 0.52	1.40+/-0.91	
$t_{136} = 4.18$, p-value < 0.05			

SM5: Preliminary data on dead Golden Eagles in the Central Apennines in the last 20 years

Date	Region	Age	Sex	Cause	Protected area
June 2013	Abruzzo	NA	N/A	Poisoning	Yes
September 2013	Umbria	NA	N/A	Shot	No
November 2013	Umbria	Subadult	N/A	Shot	No
March 2019	Umbria	Subadult	Male	Poisoning	No
March 2019	Umbria	Subadult	Female	Poisoning	No
May 2020	Marche	Adult	Male	Shot	Yes
September 2021	Marche	Juvenile	N/A	Electrocution	Yes
February 2022	Lazio	NA	N/A	Shot	Yes
March 2023	Lazio	Subadult	N/A	Poisoning	Yes
April 2023	Abruzzo	NA	NA	NA	NA
April 2023	Marche	NA	NA	NA	Yes
June 2023	Lazio	Adult	Male	Poisoning	No