

Supplementary Materials

In these supplementary materials we reported the results that we chose not to include in the main text to favour the readability of the manuscript, but that we considered useful to fully understand the analysis used in this research. The rationale and the details of the analysis process were fully described in the text.

Table S1: Sample size and data collection schedule for the activity rhythms of Alpine Ibex (*Capra ibex*) in the Gran Paradiso National Park (Italy).

Collar identity	Ibex identity	Sex	Cohort	Study area	Monitoring starting date	Monitoring end date
12227	V07J	male	2005	PNGP	6/6/2013	17/7/2013
12228	V06J	male	2004	PNGP	22/5/2013	8/12/2014
12229	V03G	male	2000	PNGP	15/5/2013	4/10/2013
12230	V13G	male	2004	PNGP	28/6/2013	24/7/2013
12231	V17H	male	2004	PNGP	22/5/2013	12/9/2013
12232	V02L	male	2004	PNGP	9/5/2013	17/7/2013
12233	V10G	male	2002	PNGP	28/6/2013	25/10/2013
12234	V04J	male	2004	PNGP	7/5/2013	2/8/2013
12235	V09J	male	2005	PNGP	6/6/2013	17/1/2015
12236	V14E	male	2002	PNGP	7/5/2013	16/10/2013
12293	V04N	female	2007	PNGP	9/5/2014	4/1/2016
12505	V02N	female	2010	PNGP	8/5/2014	17/4/2016
12506	V07N	female	2009	PNGP	13/5/2014	7/6/2016
12507	V01N	female	2010	PNGP	22/4/2014	4/4/2016
12508	V05N	female	2009	PNGP	9/5/2014	8/10/2015
12509	V11N	female	2008	PNGP	16/9/2014	8/10/2015
12510	V03N	female	1999	PNGP	8/5/2014	22/4/2016
12511	V06N	female	2010	PNGP	8/5/2014	9/3/2016
12512	V08N	female	2010	PNGP	14/5/2014	10/5/2016
15716	V06O	male	2005	PNGP	13/5/2015	19/9/2015
15717	V14L	male	2004	PNGP	27/5/2015	6/1/2017
15718	V05O	male	2009	PNGP	13/5/2015	22/12/2016
15720	V09O	male	2010	PNGP	26/5/2015	11/12/2016
15721	V01O	male	2009	PNGP	5/5/2015	25/12/2016
15722	V07O	male	2010	PNGP	26/5/2015	14/9/2017
12510	V18L	male	2005	PNGP	18/10/2017	22/12/2017
12512	V16L	male	2010	PNGP	19/10/2017	22/4/2018

Table S2: Sample size and data collection schedule for the activity rhythms of Alpine Ibex (*Capra ibex*) in the Swiss National Park (Switzerland).

Collar identity	Ibex identity	Sex	Cohort	Study area	Monitoring starting date	Monitoring end date
30189	189	male	1998	SNP	15/6/2006	16/5/2007
30194	194	female	1997	SNP	15/5/2007	11/11/2008
30197	197	female	1999	SNP	12/6/2007	21/12/2007
30208	208	male	2003	SNP	6/7/2009	15/6/2010
30227	227	male	2005	SNP	24/5/2011	20/5/2013
30223	223	female	2006	SNP	24/4/2013	21/4/2015
30179	179	female	1998	SNP	29/4/2013	13/2/2014
30229	229	male	2005	SNP	2/5/2013	27/11/2013
30206	206	male	2001	SNP	6/5/2013	22/9/2013
30230	230	male	2004	SNP	6/5/2013	27/9/2013
30231	231	male	2004	SNP	14/5/2013	24/11/2013
30232	232	male	2006	SNP	14/5/2013	28/10/2013
30233	233	female	2005	SNP	22/5/2013	17/5/2015
30234	234	female	2005	SNP	3/6/2013	26/10/2014
30235	235	female	2008	SNP	21/6/2013	18/6/2015
30212	212	male	2004	SNP	8/5/2014	22/11/2014
30221	221	male	2002	SNP	23/4/2015	3/12/2015
30239	239	male	2009	SNP	23/7/2015	1/10/2017
30251	251	male	2005	SNP	10/5/2017	26/2/2018
30252	252	female	2008	SNP	12/5/2017	20/6/2019

Table S3: Predictor variables included in the alternative models on the nocturnal activity of Alpine Ibex (*Capra ibex*) in the Gran Paradiso National Park (Italy) and Swiss National Park (Switzerland).

Model #	Anim ID	Sex	Site	NB	PDAT	Temp PDH			Temp NH			Temp FDH			J date	Prec PDH	Prec NH
						min	mean	max	min	mean	max	min	mean	max			
1	x	x	x	x	x										x		x
2	x	x	x	x	x										x	x	
3	x	x	x	x		x									x		x
4	x	x	x	x		x									x	x	
5	x	x	x	x			x								x		x
6	x	x	x	x			x								x	x	
7	x	x	x	x				x							x		x
8	x	x	x	x				x							x	x	
9	x	x	x	x					x						x		x
10	x	x	x	x					x						x	x	
11	x	x	x	x						x					x		x
12	x	x	x	x						x					x	x	
13	x	x	x	x							x				x		x
14	x	x	x	x							x				x	x	
15	x	x	x	x								x			x		x
16	x	x	x	x								x			x	x	
17	x	x	x	x									x		x		x
18	x	x	x	x									x		x	x	
19	x	x	x	x										x	x		x
20	x	x	x	x										x	x	x	

Anim ID = identity of ibex, included as random factor; Sex = sex of the monitored ibex; Site = site where ibex were monitored (area with/without the predator); NB = night brightness; PDAT = proportion of diurnal active time; Temp PDH (min, mean, max) = minimum, mean and maximum temperature of the previous diurnal hours, respectively; Temp NH (min, mean, max) = minimum, mean and maximum temperature of the nocturnal hours, respectively; Temp FDH (min, mean, max) = minimum, mean and maximum temperature of the following diurnal hours, respectively; J date = Julian date; Prec PDH = mean of precipitation recorded during the previous diurnal hours; Prec NH = mean of precipitation recorded during the nocturnal hours. All the predictor variables were included in the models in interactions with sex and site.

Table S4: Set of alternative models predicting the proportion of nocturnal active time in Alpine ibex (*Capra ibex*) monitored from May to October 2013-2019 in the Gran Paradiso National Park, Italy and Swiss National Park, Switzerland. The best model (in bold, first row) was selected with the minimum AIC criterion.

Model #	Predictor variables included in the model	df	AIC	delta AIC
7	sex + site + (NB*sex*site) + (temp PDH max*sex*site) + (prec NH*sex*site) + (J date*sex*site)	117.2	-15392,3	0.0
5	sex + site + (NB*sex*site) + (temp PDH mean*sex*site) + (prec NH*sex*site) + (J date*sex*site)	117.5	-15335,5	56,78
8	sex + site + (NB*sex*site) + (temp PDH max*sex*site) + (prec PDH*sex*site) + (J date*sex*site)	119.3	-15131,0	261,29
6	sex + site + (NB*sex*site) + (temp PDH mean*sex*site) + (prec PDH*sex*site) + (J date*sex*site)	120.0	-15063,2	329,14
18	sex + site + (NB*sex*site) + (temp FDH mean*sex*site) + (prec PDH*sex*site) + (J date*sex*site)	120.3	-14985,0	407,33
17	sex + site + (NB*sex*site) + (temp FDH mean*sex*site) + (prec NH*sex*site) + (J date*sex*site)	115.8	-14961,6	430,76
20	sex + site + (NB*sex*site) + (temp FDH max*sex*site) + (prec PDH*sex*site) + (J date*sex*site)	117.9	-14880,7	511,63
19	sex + site + (NB*sex*site) + (temp FDH max*sex*site) + (prec NH*sex*site) + (J date*sex*site)	115.5	-14821,8	570,57
13	sex + site + (NB*sex*site) + (temp NH max*sex*site) + (prec NH*sex*site) + (J date*sex*site)	125.9	-14810,3	582,02
2	sex + site + (NB*sex*site) + (PDAT*sex*site) + (prec PDH*sex*site) + (J date*sex*site)	121.8	-14713,2	679,14
14	sex + site + (NB*sex*site) + (temp NH max*sex*site) + (prec PDH*sex*site) + (J date*sex*site)	123.7	-14593,4	798,92
11	sex + site + (NB*sex*site) + (temp NH mean*sex*site) + (prec NH*sex*site) + (J date*sex*site)	120.9	-14548,7	843,65
1	sex + site + (NB*sex*site) + (PDAT*sex*site) + (prec NH*sex*site) + (J date*sex*site)	115.8	-14512,8	879,52
12	sex + site + (NB*sex*site) + (temp NH mean*sex*site) + (prec PDH*sex*site) + (J date*sex*site)	124.6	-14375,5	1016,83
9	sex + site + (NB*sex*site) + (temp NH min*sex*site) + (prec NH*sex*site) + (J date*sex*site)	119.4	-14308,7	1083,64
15	sex + site + (NB*sex*site) + (temp FDH min*sex*site) + (prec NH*sex*site) + (J date*sex*site)	116.9	-14267,8	1124,51
16	sex + site + (NB*sex*site) + (temp FDH min*sex*site) + (prec PDH*sex*site) + (J date*sex*site)	121.5	-14234,6	1157,71
10	sex + site + (NB*sex*site) + (temp NH min*sex*site) + (prec PDH*sex*site) + (J date*sex*site)	122.8	-14206,2	1186,16
4	sex + site + (NB*sex*site) + (temp PDH min*sex*site) + (prec PDH*sex*site) + (J date*sex*site)	119.5	-14064,2	1328,1
3	sex + site + (NB*sex*site) + (temp PDH min*sex*site) + (prec NH*sex*site) + (J date*sex*site)	115.3	-13946,5	1445,78

df = degree of freedom; AIC = Akaike information criterion; delta AIC = difference in AIC value between the AIC of a given model and the best model (lowest AIC); sex = sex of the monitored ibex; site = site where were monitored ibex (area with/without the predator); NB = night brightness; PDAT = proportion of diurnal active time; temp PDH (min, mean, max) = minimum, mean and maximum temperature of the previous diurnal hours, respectively; temp NH (min, mean, max) = minimum, mean and maximum temperature of the nocturnal hours, respectively; temp FDH (min, mean, max) = minimum, mean and maximum temperature of the following diurnal hours, respectively; J date = Julian date; prec PDH = mean of precipitation recorded during the previous diurnal hours; prec NH = mean of precipitation recorded during the nocturnal hours. All the predictor variables were included in the models in interactions with sex and site.

Table S5: Set of alternative models predicting the proportion of nocturnal active time in female Alpine ibex (*Capra ibex*) monitored from May to October 2013-2019 in the Gran Paradiso National Park, Italy and Swiss National Park, Switzerland. The best model (in bold, first row) was selected with the minimum AIC criterion.

Model #	Predictor variables included in the model	df	AIC	delta AIC
7	repr st + site + (NB*repr st*site) + (temp PDH max*repr st*site) + (prec NH*repr st*site) + (J date*repr st*site)	75.0	-4697.4	0.0
5	repr st + site + (NB*repr st*site) + (temp PDH mean*repr st*site) + (prec NH*repr st*site) + (J date*repr st*site)	72.5	-4667.2	30.2
17	repr st + site + (NB*repr st*site) + (temp FDH mean*repr st*site) + (prec NH*repr st*site) + (J date*repr st*site)	73.3	-4594.9	102.5
13	repr st + site + (NB*repr st*site) + (temp NH max*repr st*site) + (prec NH*repr st*site) + (J date*repr st*site)	71.1	-4593.8	103.6
19	repr st + site + (NB*repr st*site) + (temp FDH max*repr st*site) + (prec NH*repr st*site) + (J date*repr st*site)	72.9	-4589.7	107.8
8	repr st + site + (NB*repr st*site) + (temp PDH max*repr st*site) + (prec PDH*repr st*site) + (J date*repr st*site)	71.5	-4580.9	116.5
6	repr st + site + (NB*repr st*site) + (temp PDH mean*repr st*site) + (prec PDH*repr st*site) + (J date*repr st*site)	70.9	-4546.0	151.4
20	repr st + site + (NB*repr st*site) + (temp FDH max*repr st*site) + (prec PDH*repr st*site) + (J date*repr st*site)	70.0	-4535.3	162.1
18	repr st + site + (NB*repr st*site) + (temp FDH mean*repr st*site) + (prec PDH*repr st*site) + (J date*repr st*site)	72.5	-4532.1	165.3
11	repr st + site + (NB*repr st*site) + (temp NH mean*repr st*site) + (prec NH*repr st*site) + (J date*repr st*site)	73.1	-4511.4	186.1
9	repr st + site + (NB*repr st*site) + (temp NH min*repr st*site) + (prec NH*repr st*site) + (J date*repr st*site)	72.7	-4474.3	223.1
1	repr st + site + (NB*repr st*site) + (PDAT*repr st*site) + (prec NH*repr st*site) + (J date*repr st*site)	63.8	-4472.1	225.3
14	repr st + site + (NB*repr st*site) + (temp NH max*repr st*site) + (prec PDH*repr st*site) + (J date*repr st*site)	67.3	-4470.8	226.6
15	repr st + site + (NB*repr st*site) + (temp FDH min*repr st*site) + (prec NH*repr st*site) + (J date*repr st*site)	67.1	-4460.7	236.7
3	repr st + site + (NB*repr st*site) + (temp PDH min*repr st*site) + (prec NH*repr st*site) + (J date*repr st*site)	63.9	-4434.2	263.2
2	repr st + site + (NB*repr st*site) + (PDAT*repr st*site) + (prec PDH*repr st*site) + (J date*repr st*site)	63.9	-4419.2	278.2
12	repr st + site + (NB*repr st*site) + (temp NH mean*repr st*site) + (prec PDH*repr st*site) + (J date*repr st*site)	66.9	-4387.7	309.8
10	repr st + site + (NB*repr st*site) + (temp NH min*repr st*site) + (prec PDH*repr st*site) + (J date*repr st*site)	63.7	-4360.4	337.0
4	repr st + site + (NB*repr st*site) + (temp PDH min*repr st*site) + (prec PDH*repr st*site) + (J date*repr st*site)	60.7	-4359.2	338.2
16	repr st + site + (NB*repr st*site) + (temp FDH min*repr st*site) + (prec PDH*repr st*site) + (J date*repr st*site)	60.2	-4357.9	339.5

df = degree of freedom; AIC = Akaike information criterion; delta AIC = difference in AIC value between the AIC of a given model and the best model (lowest AIC); repr st = reproductive status (with/without kid) of the monitored female ibex; NB = night brightness; PDAT = proportion of diurnal active time; temp PDH (min, mean, max) = minimum, mean and maximum temperature of the previous diurnal hours, respectively; temp NH (min, mean, max) = minimum, mean and maximum temperature of the nocturnal hours, respectively; temp FDH (min, mean, max) = minimum, mean and maximum temperature of the following diurnal hours, respectively; J date = Julian date; prec PDH = mean of precipitation recorded during the previous diurnal hours; prec NH = mean of precipitation recorded during the nocturnal hours. All the predictor variables were included in the models in interactions with sex and site.

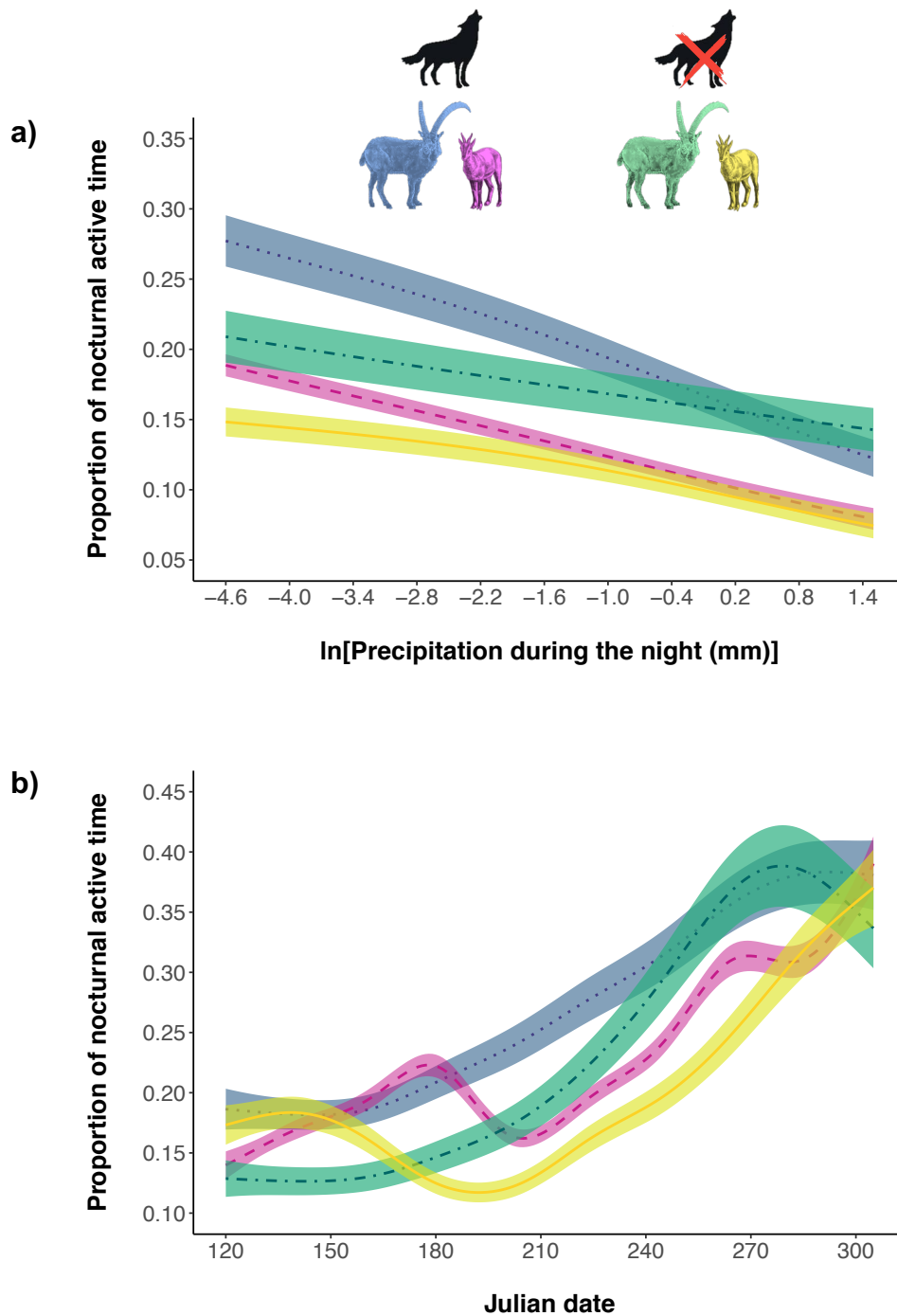


Figure S1: Values predicted by the best Generalized Additive Model (see the text for more details) for the proportion of nocturnal active time of Alpine ibex (*Capra ibex*) in the Gran Paradiso National Park (GPNP, Italy) and the Swiss National Park (SNP, Switzerland). The figure shows the effects exerted by precipitation recorded during the night (a) and the Julian date (b) for males (dotted blue line) and females (dashed pink line) in the area with the predator (GPNP) and for males (dot-dashed green line) and females (solid yellow line) in the area without the predator (SNP). The predictions are given according to the mean of all other covariates in the model, for the collar ID 12507. The coloured shaded areas are the estimated standard errors.

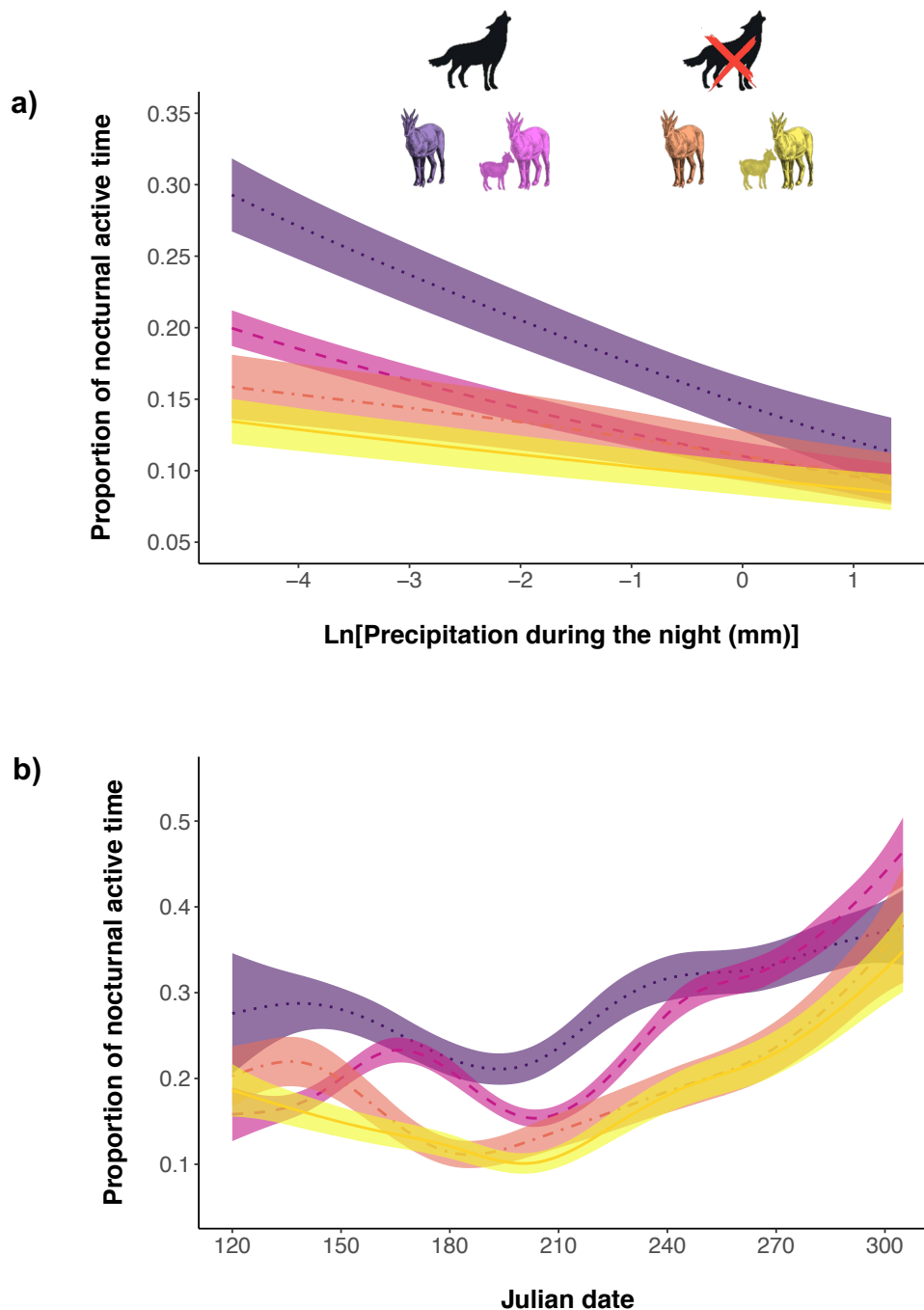


Figure S2: Values predicted by the best Generalized Additive Model (see the text for more details) for the proportion of nocturnal active time of Alpine ibex (*Capra ibex*) females in the Gran Paradiso National Park (GNP, Italy) and the Swiss National Park (SNP, Switzerland). The figure shows the effects exerted by precipitation recorded during the night (a) and the Julian date (b) for females without kid (dotted violet line) and females with kid (dashed pink line) in the area with the predator (GNP) and for females without kid (dot-dashed orange line) and females with kid (solid yellow line) in the area without the predator (SNP). The predictions are given according to the mean of all other covariates in the model, for the collar ID 12507. The coloured shaded areas are the estimated standard errors.