Supplementary Information

Individual activity interacts with climate and habitat features in influencing GPS telemetry performance in an Alpine herbivore

Párraga Aguado M.A., Sturaro E., Ramanzin M.

Figure S1: distribution of the location errors (distance of received locations from true location) obtained in stationary collar tests from 6283 GPS locations received at 181 collars position points in the area used by the Alpine ibex colony of the Marmolada massif, eastern Italian Alps.

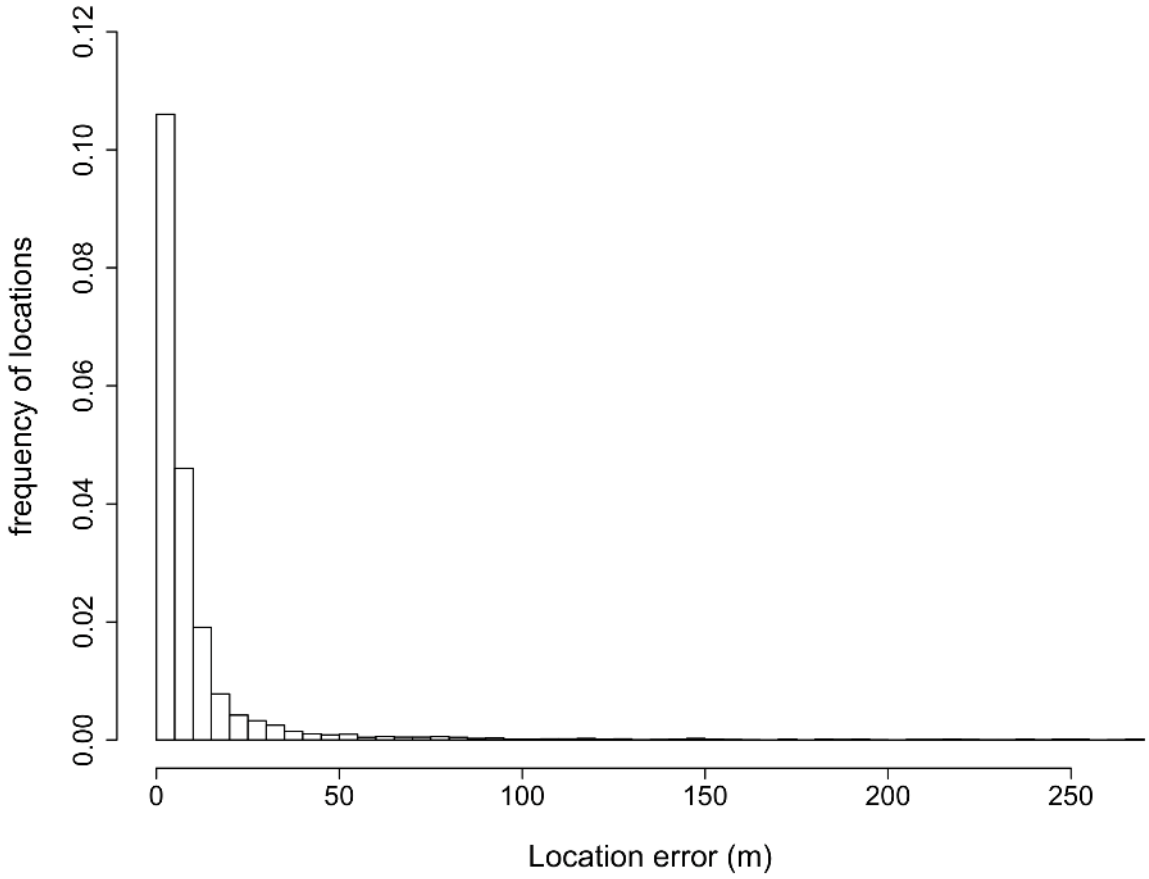

Figure S2: mean daily temperatures, precipitations, and snow depth recorded during the study period in two meteo stations located at elevations of 2250 and 2032 m a.sl in proximity of the study area of the Marmolada massif, in the eastern Italian Alps. Weeks start from December 21st

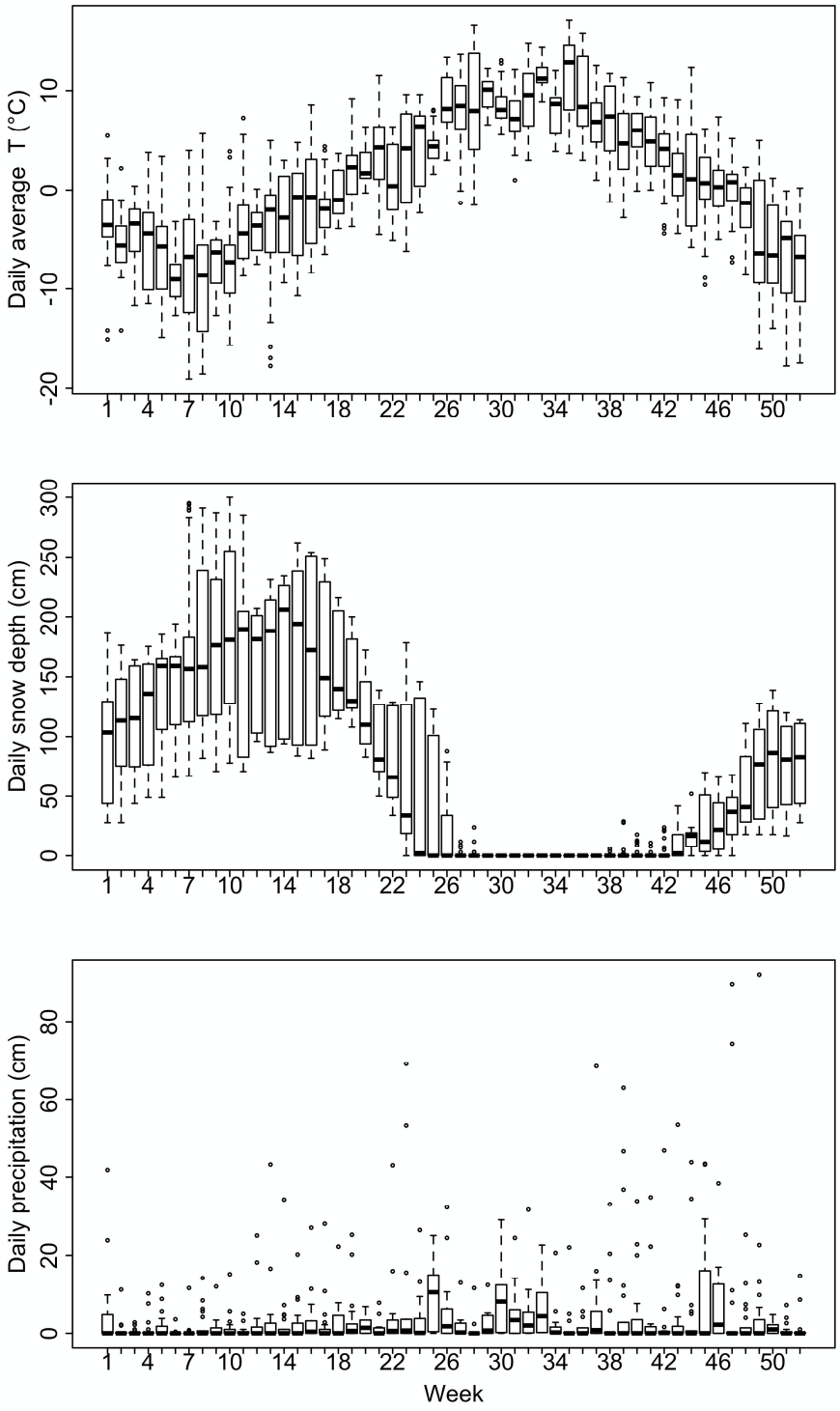

Table S3: Generalized linear mixed models compared for the analysis of probability of acquiring a scheduled location (PFix, successful vs. unsuccessful attempted locations) and probability of an acquired location to be classified as 3D (P3D, 3D vs. 2D acquired locations), and linear mixed models compared for the analysis of location error (LE, distance of received locations from collars position points) in stationary collar tests in the Marmolada massif, eastern Italian Alps. All models included collar position point as random factor.

	Model	Sky view class	Land cover (forest vs. open)	Fix interval (5 vs. 30 min)	NAV (3D vs. 2D)
PFix and P3D	1	X	X	X	
	2	X	X		
	3	X		X	
	4		X	X	
	5	X			
	6		X		
	7			X	
LE	1	X	X	X	X
	2	X	X		X
	3	X		X	X
	4		X	X	X
	5			X	X
	6				X

Table S4: Generalized additive mixed models compared in the analysis of probability of acquiring a scheduled location (successful *vs* unsuccessful attempted locations) and probability of an acquired location to be classified as 3D (3D vs. 2D acquired locations) with GPS locations attempted during summer (weeks 23-42, with week 1 starting from December 21st) on 11 Alpine ibex females of the Marmolada colony, in the eastern Italian Alps, during September 2010 to September 2013. All models included the individual animal as random factor.

Category of factors	Model	Week (spline)	Hour (cyclic cubic spline)	Sky view class	Land cover (forest vs. open)	Precipitation (present vs. absent)	Stochastic temperature	Activity rate
Temporal	1	X	X					
Temporal + physical obstruction	2	X	X	X				
	3	X	X	X	X			
Temporal + climate	4	X	X			X		
	5	X	X				X	
	6	X	X			X	X	
Temporal + behavior	7	X	X					X
Temporal + physical obstruction + climate	8	X	X	X		X		
	9	X	X	X			X	
	10	X	X	X		X	X	
	11	X	X	X	X	X		
	12	X	X	X	X		X	
	13	X	X	X	X	X	X	
Temporal + physical obstruction + behaviour	14	X	X	X				X
	15	X	X	X	X			X
Temporal + climate + behavior	16	X	X			X		X
	17	X	X				X	X
	18	X	X			X	X	X
Temporal + physical obstruction + climate + behavior	19	X	X	X		X		X
	20	X	X	X			X	X
	21	X	X	X		X	X	X
	22	X	X	X	X	X		X
	23	X	X	X	X		X	X
	24	X	X	X	X	X	X	X

Table S5: Generalized additive mixed models compared in the analysis of probability of acquiring a scheduled location (successful *vs* unsuccessful attempted locations) and probability of an acquired location to be classified as 3D (3D vs. 2D acquired locations) with GPS locations attempted during winter (weeks 43-52 and 1-22, with week 1 starting from December 21st) from 11 Alpine ibex females of the Marmolada colony, in the eastern Italian Alps during September 2010 to September 2013. All models included the individual animal as random factor.

Category of factors	Model	Week (spline)	Hour (cyclic cubic spline)	Sky view class	Land cover (forest vs. open)	Precipitation (present vs. absent)	Stochastic temperature	Stochastic snow depth	Activity (spline)
Temporal	1	X	X						
Temporal + physical obstruction	2	X	X	X					
	3	X	X	X	X				
Temporal + climate	4	X	X			X			
	5	X	X				X		
	6	X	X					X	
	7	X	X			X	X		
	8	X	X			X		X	
	9	X	X				X	X	
	10	X	X			X	X	X	
Temporal + behavior	11	X	X						X
Temporal + physical obstruction + climate	12	X	X	X		X			
	13	X	X	X			X		
	14	X	X	X				X	
	15	X	X	X		X	X		
	16	X	X	X		X		X	
	17	X	X	X			X	X	
	18	X	X	X		X	X	X	
	19	X	X		X	X			
	20	X	X		X		X		
	21	X	X		X			X	
	22	X	X		X	X	X		
	23	X	X		X	X		X	
	24	X	X		X		X	X	
	25	X	X		X	X	X	X	
	26	X	X	X	X	X			
	27	X	X	X	X		X		
	28	X	X	X	X			X	
	29	X	X	X	X	X	X		
	30	X	X	X	X	X		X	
	31	X	X	X	X		X	X	
	32	X	X	X	X	X	X	X	
Temporal + physical obstruction + behaviour	33	X	X	X					X
	34	X	X		X				X

	35	X	X	X	X				X
Temporal + climate + behavior	36	X	X			X			X
	37	X	X				X		X
	38	X	X					X	X
	39	X	X			X	X		X
	40	X	X			X		X	X
	41	X	X				X	X	X
	42	X	X			X	X	X	X
Temporal + physical obstruction + climate + behaviour	43	X	X	X		X			X
	44	X	X	X			X		X
	45	X	X	X				X	X
	46	X	X	X		X	X		X
	47	X	X	X		X		X	X
	48	X	X	X			X	X	X
	49	X	X	X		X	X	X	X
	50	X	X		X	X			X
	51	X	X		X		X		X
	52	X	X		X			X	X
	53	X	X		X	X	X		X
	54	X	X		X	X		X	X
	55	X	X		X		X	X	X
	56	X	X		X	X	X	X	X
	57	X	X	X	X	X			X
	58	X	X	X	X		X		X
	59	X	X	X	X			X	X
	60	X	X	X	X	X	X		X
	61	X	X	X	X	X		X	X
	62	X	X	X	X		X	X	X
	63	X	X	X	X	X	X	X	X

Figure S6: proportion of acquired over attempted locations obtained from stationary collars positioned in 181 position points with different sky view classes (% of visible sky from collar position point) within the area used by the Alpine ibex of the Marmolada colony, north eastern Italian Alps.

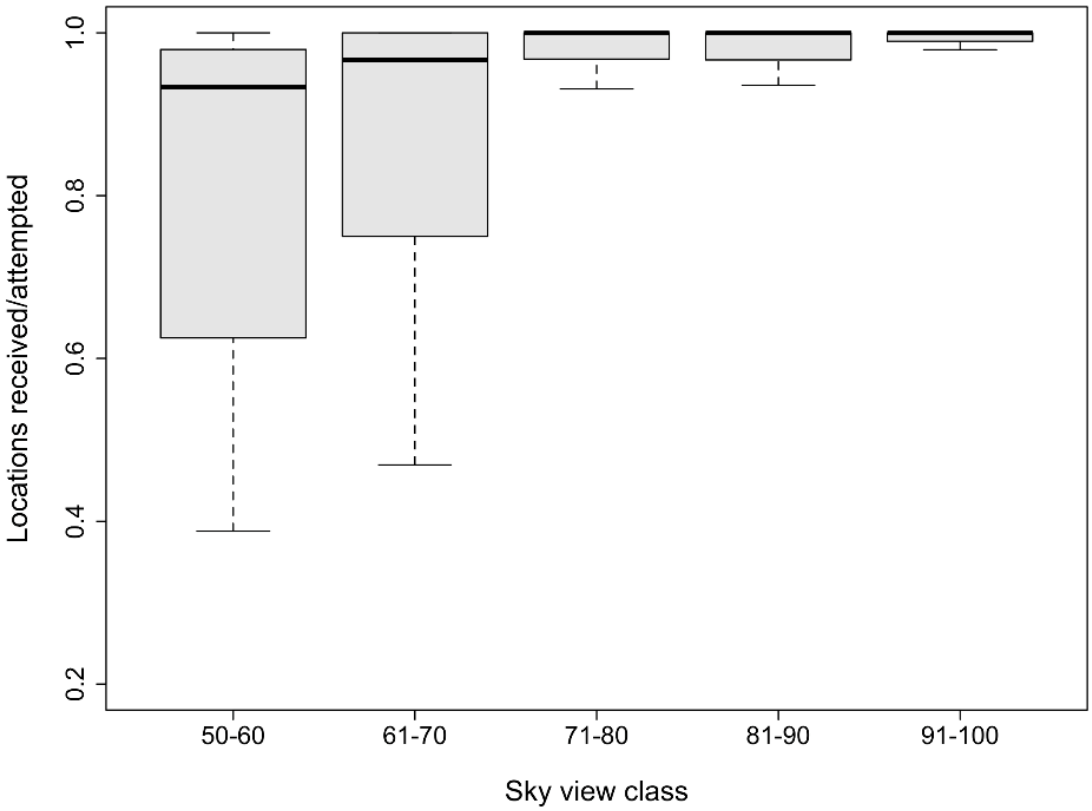

Figure S4: proportions of 3D locations in the locations acquired by 181 stationary collars positioned in 181 position points with different sky view classes (% of visible sky from collar position point) within the area used by the Alpine ibex of the Marmolada colony, north eastern Italian Alps, and attempting locations at intervals of 5 or 30 minutes.

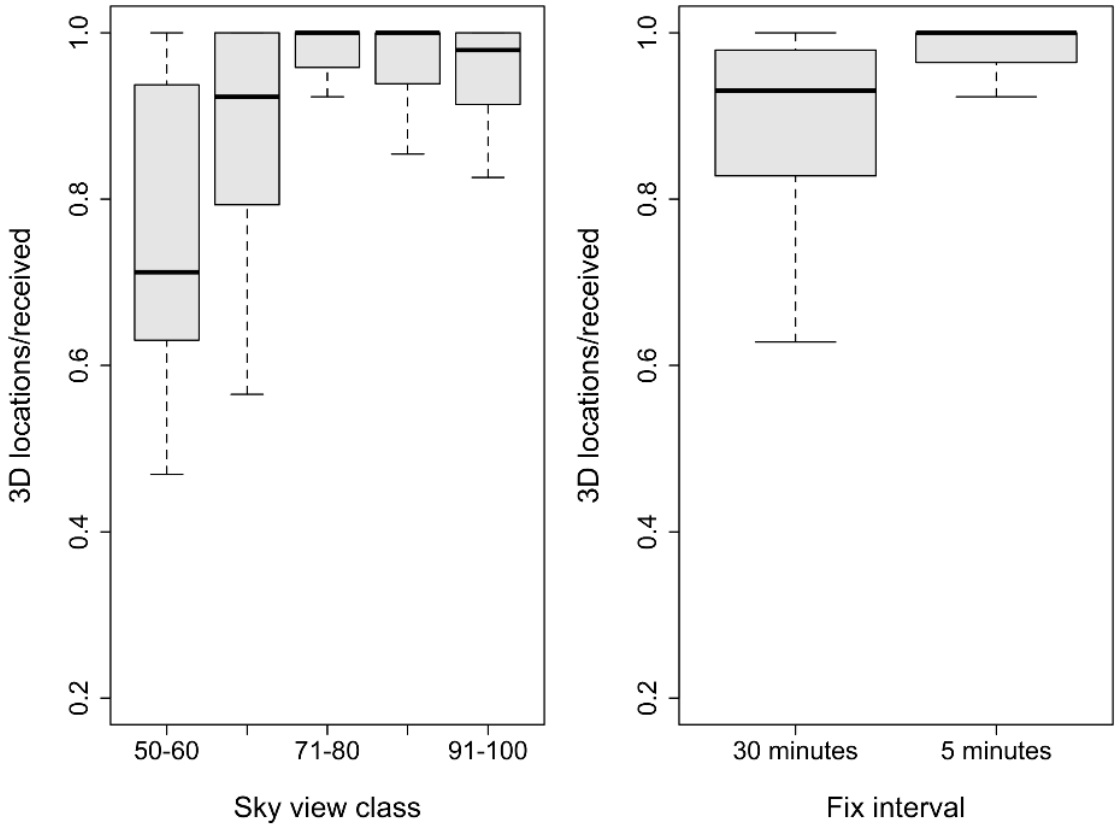

Figure S8: location error (distance from true location, m) of locations acquired from stationary collars positioned in 181 position points with different sky view classes (% of visible sky from collar position point) and land covers within the area used by the Alpine ibex of the Marmolada colony, north eastern Italian Alps, and attempting locations at intervals of 5 or 30 minutes.