Fine-scale foraging cues for African penguins in a highly variable marine environment

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Supplement

Table S1. Top five candidate generalized linear mixed-effects models (GLMMs) predicting the occurrence probability of African penguins in relation to bathymetry (Bat), bathymetry as a quadratic term (Bat^2), chlorophyll a (Chla), distance to the nearest colony (Dcol), distance to the nearest neighbouring colony (DNcol), sea floor slope (Sl), sea surface temperature (SST), and sea surface temperature as a quadratic term (SST^2). AICc scores were used to rank models and those within 4 ΔAICc were model averaged to derive fixed effect estimates used in generating plots (see Fig. 4 in the main article).

Response	Fixed effects	AICc	Δ AIC	weight
Presence	$Bat + Bat^2 + Chla + Dcol + DNcol + Sl + SST^{2\,+}$	18052.29	0	0.64
	$Bat + Bat^2 + Chla + Dcol + DNcol + Sl + SST + SST^2$	18053.41	1.12	0.36
	$Bat + Bat^2 + Chla + DNcol + Sl + SST^2$	18082.90	30.61	0.14
	$Bat + Bat^2 + Chla + DNcol + Sl + SST + SST^2$	18083.43	31.14	0.11
	$Bat + Bat^2 + Chla + Dcol + DNcol + Sl$	18091.42	39.13	0.20

Table S2. Top five candidate linear mixed-effect models (LMMs) testing how bird dive parameters were influenced by sea surface temperature (SST), thermocline characteristics (TG: thermocline gradient, TI: thermocline intensity, TD: thermocline depth), the type of dive (Fo: foraging vs. search), time of day (Tim) and bathymetry (Bat). AICc scores were used to rank models and those within 4 ΔAICc were model averaged to derive fixed effect estimates (see Table 1 in the main article).

Response	Fixed effects	AICc	ΔAICc	Weight
|Dive depth - TC depth|	Bat + Fo + TG + TI + Tim + Tim^2	66187.80	0	0.46
	Bat + Fo + TI + Tim + Tim^2	66189.36	1.56	0.21
	Bat + Fo + SST + TG + TI + Tim + Tim^2	66189.53	1.73	0.19
	Bat + Fo + SST + TI + Tim + Tim^2	66191.02	3.22	0.09
	Bat + Fo + TG + TD + TI + Tim + Tim^2	66194.51	6.71	0.02
Max dive depth	Bat + Fo + SST + TG + Tim + Tim^2	70891.33	0	0.43
	Bat + Fo + SST + TG + TI + Tim + Tim^2	70892.08	0.75	0.29
	Bat + Fo + SST + TG + TD + Tim + Tim^2	70893.55	2.22	0.14
	Bat + Fo + SST + TG + TD + TI + Tim + Tim^2	70895.36	4.03	0.06
	Bat + Fo + SST + Tim + Tim^2	70895.97	4.64	0.04
Bottom time	Bat + Fo + SST + TG + Tim + Tim^2	66156.30	0	0.46
	Bat + Fo + SST + Tim + Tim^2	66157.06	0.76	0.31
	Bat + Fo + SST + TG + TI + Tim + Tim^2	66159.21	2.91	0.11
	Bat + Fo + SST + TI + Tim + Tim^2	66159.86	3.56	0.08
	Bat + Fo + SST + TG + TD + Tim + Tim^2	66162.53	6.23	0.02
Descent rate	Bat + Fo + SST + TG + Tim + Tim^2	66156.30	0	0.46
	Bat + Fo + SST + Tim + Tim^2	66157.06	0.76	0.31
	Bat + Fo + SST + TG + TI + Tim + Tim^2	66159.21	2.91	0.12
	Bat + Fo + SST + TI + Tim + Tim^2	66159.86	3.56	0.08
	Bat + Fo + SST + TG + Tim + Tim^2	66162.53	6.23	0.02
Ascent rate	Bat + Fo + TG + Tim + Tim^2	7409.56	0	0.61
	Bat + Fo + TG + Tim	7410.52	0.96	0.38
	Bat + Fo + SST + TG + Tim + Tim^2	7418.95	9.39	0.01
	Bat + Fo + SST + TG + Tim +	7419.87	10.31	<0.01
	Bat + Fo + TG + TI + Tim + Tim^2	7420.09	10.53	<0.01

Table S3. Top ten candidate generalized linear mixed-effects models (GLMM) estimating whether African penguins dived below or above the thermocline in response to sea surface temperature (SST), the thermocline structure (TG: thermocline gradient, TI: thermocline intensity, TD: thermocline depth), the type of dive (Fo: foraging vs. search), time (Tim) and bathymetry (Bat). AICc scores ranked models and models separated by <4 ΔAICc were model averaged (see Table 2 in the main article).

Response	Fixed effects	AICc	ΔAICc	Weight
Presence below thermocline	Bat + Fo + SST + TG + TD + TI + Tim + Tim^2	8870.27	0	0.2
	Bat + Fo + SST + TG + TD + TI	8870.51	0.24	0.18
	Bat + Fo + SST + TG + TD + Tim + Tim^2	8870.54	0.27	0.18
	Bat + Fo + SST + TG + TD	8870.86	0.59	0.15
	Bat + Fo + SST + TG + TD + TI + Tim	8872.01	1.74	0.09
	Bat + Fo + SST + TG + TD + TI + Tim^2	8872.32	2.05	0.07
	Bat + Fo + SST + TG + TD + Tim	8872.47	2.20	0.07
	Bat + Fo + SST + TG + TD + Tim^2	8872.74	2.47	0.06
	Bat + Fo + TG + TD + Tim + Tim^2	8895.24	24.97	<0.001
	Bat + Fo + TG + TD + TI + Tim + Tim^2	8896.24	25.97	<0.001

Table S4. Top five candidate linear mixed-effects models (LMMs) testing how bird dive parameters were influenced by sea surface temperature (SST), the characteristics of the water column when no thermocline was present (CT: average column temperature, SI: stratification index), the type of dive (Fo: foraging vs. search), time (Tim) and bathymetry (Bat). AICc scores ranked models and models separated by <4 ΔAICc were model averaged (see Table 3 in the main article).

Response	Fixed effects	AICc	ΔAICc	Weight
Max dive depth	Bat + Fo + Tim + SST + CT + SI	12262.9	0	0.52
	Bat + Fo + Tim + Tim^2 + SST + CT + SI	12265.53	2.63	0.14
	Bat + Fo + Tim + CT + SI	12266.86	3.97	0.07
	Bat + Fo + Tim + SST + CT	12267.90	5.0	0.04
	Bat + Fo + Tim + Tim^2 + SST + CT	12268.40	5.5	0.03
Bottom time	Bat + Fo + Tim + SST + CT + SI	11620.12	0	0.01
	Bat _ Fo + SST +CT	11620.53	0.41	0.08
	Bat + Fo + Tim + SST + CT	11620.67	0.55	0.08
	Bat + Fo + SST	11620.71	0.59	0.08
	Bat + Fo + SST + CT + SI	11620.98	0.86	0.07
Descent rate	Bat + Fo	759.72	0	0.79
	Bat + Fo + SST	762.97	3.25	0.16
	Bat + Fo + SI	767.42	7.70	0.02
	Bat + Fo + CT	767.66	7.93	0.02
	Bat + Fo + SST + CT	768.33	8.61	0.01
Ascent rate	Bat + Fo	1127.73	0	0.85
	Bat + Fo + CT	1132.83	5.10	0.07
	Bat + Fo + SI	1133.26	5.53	0.05
	Bat + Fo + SST	1135.58	7.85	0.02
	Bat + Fo + Tim	1136.60	8.87	0.01