Supplement

Table S1. Comparison of temperatures in the Auk Lab and on natural ledges measured using an RS PRO RS1710 PT1000 Probe Wired Digital Thermometer within ca 10–20 minutes of each other on 4 days in 2022. All measurements were carried out on the mid-point of ledges with a similar level of sun exposure (natural ledges 1 and 2, and ledges T5 and F5 in the Auk Lab, see Fig. 1).

Date (time)	Temperature (°C)			
	natural ledges		Auk Lab	
	1	2	T5	F5
2022-07-16 (18:19–18:29)	30.1	28.9	30.5	30.2
2022-07-18 (18:18–18:26)	20.8	20.3	21.8	21.5
2022-07-19 (17:19–17:37)	32.3	36.3	34.5	35.8
2022-07-20 (15:32–15:47)	36.1	31.9	32.7	34.3

Table S2. Comparison of timing of laying (mean ordinal day of laying) between the Auk Lab and adjacent natural ledges, together with the number of pairs used to calculate these means.

Year	**Timing of laying natural ledges**	**N**	**Timing of laying Auk Lab**	**N**
2017	137	84	138	51
2018	136	59	137	58
2019	138	61	138	66
2020	150	77	145	67
2021	140	89	141	82

Table S3. Comparison of mean breeding success (total number of fledged chicks divided by the total number of pairs that laid at least one egg in the respective study area) between the Auk Lab and adjacent natural ledges, together with the number of pairs used to calculate these means.

Year	Breeding success natural ledges	N	Breeding success Auk Lab	N
2017	0.68	164	0.62	47
2018	0.60	125	0.71	55
2019	0.70	84	0.80	65
2020	0.63	88	0.61	62
2021	0.71	94	0.78	78

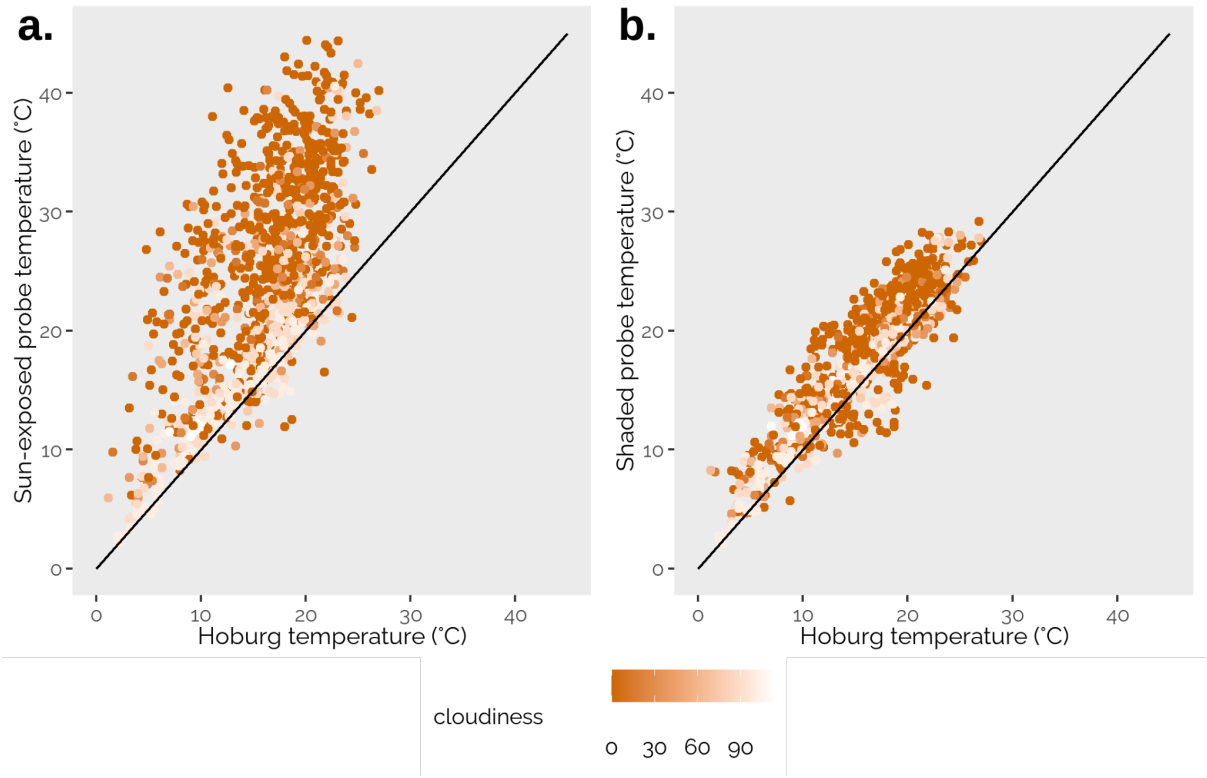

Fig. S1. Comparison of temperatures measured at the Hoburg A weather station with measures from (a) the local sun-exposed temperature probe and (b) the local shaded probe. Shading indicate cloudiness (percentage cover) based on data from Hoburg A. The data are matched on an hour-by-hour basis and only covers the hours 15:00–21:00 (hottest part of the day and interval used in most analyses).

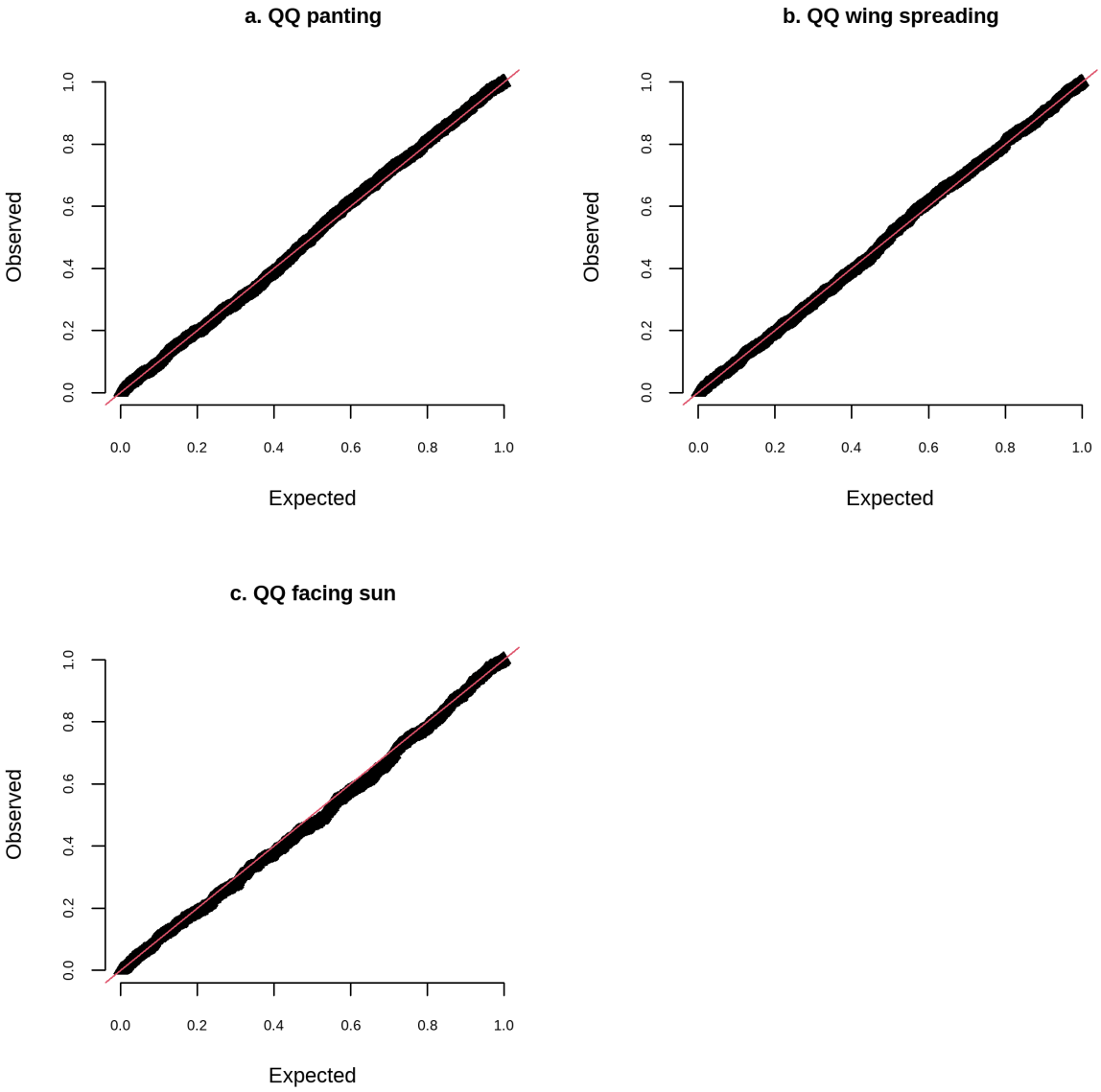

Fig. S2. QQ-plots for the full fitted models (temperature + sun exposure + temperature × sun exposure) for the behaviours panting (a), spreading wings (b) and orientation towards the sun (c). The figures were produced using the package DHARMa (Hartig 2021).

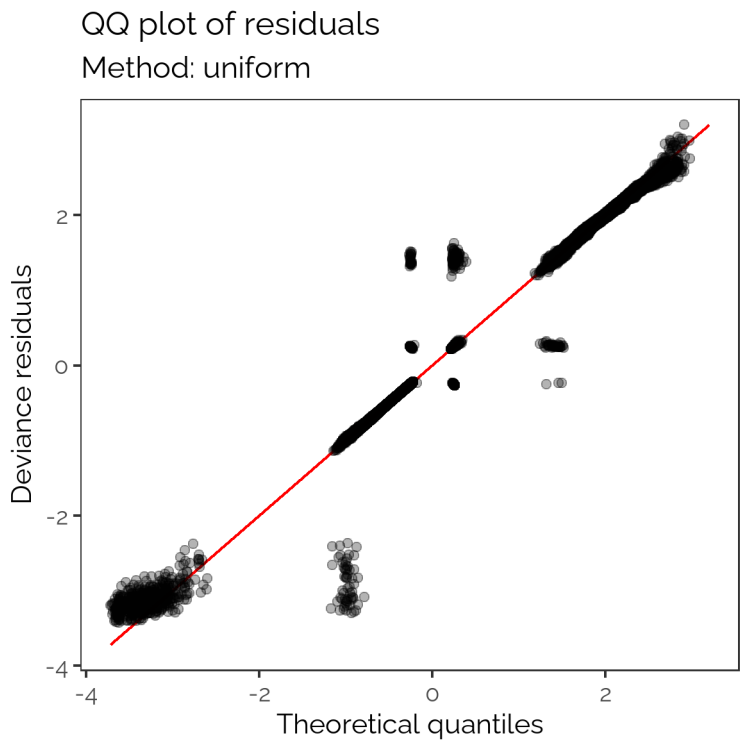

Fig. S3. QQ-plots for the fitted GAM models (day since egg laying + hour + temperature). The figure was produced using the function *qq.gam* in the package *mgcv* (Wood 2017). The plot suggests a good fit, albeit with some outliers.

Table S4. Year, date, time for all egg/chick losses recorded with our camera system in 2019–2022, together with a description of the sequence of events that led to the loss, as well as whether we judge the loss to be heat-related.

	Year	Date	Time	Reason for egg/chick loss	Heat-related
1	2019	May 28	16:33	Egg lost due to fight between neighbours.	No
2	2019	June 1	NA	Egg lost due to being crushed by parent, unknown exact time.	No
3	2019	June 5	19:12	Egg abandoned due to heat, predated by gull 3 hours later at 22:32.	Yes
4	2020	May 15	04:27	Egg abandoned for unknown reason, predated by gull 1 hour later at 05:30.	No
5	2020	June 8	NA	Egg lost due to being crushed by parent, unknown exact time.	No
6	2020	June 25	NA	Egg lost due to being crushed by parent, unknown exact time.	No
7	2020	June 26	15:57	Egg accidentally kicked off ledge by parent that due to heat has moved to the edge.	Yes
8	2020	June 27	17:32	Egg accidentally kicked off ledge by parent that due to heat has moved to the edge.	Yes
9	2020	June 27	17:44	Chick abandoned in the sun, dies.	Yes
10	2020	June 27	18:49	Egg accidentally kicked off ledge by parent that due to heat has moved to the edge.	Yes
11	2020	July 13	23:58	Egg accidentally kicked off ledge by parent in the middle of the night as it suddenly decides to leave.	No
12	2020	July 17	23:39	Chick falls off ledge by accident.	No
13	2021	May 25	10:24	Egg lost due to a neighbouring razorbill attacking all nearby incubating guillemots, egg rolls off the ledge.	No
14	2021	June 9	08:25	Egg lost due to fight between neighbours.	No
15	2021	June 12	NA	Egg lost due to being crushed by parent, unknown exact time.	No
16	2021	June 18	15:57	Egg lost due to parent being chased off by other bird and is then accidentally kicked off ledge edge.	No
17	2021	June 26	16:27	Chick dies for unknown reason.	No
18	2021	July 6	14:30	Egg lost due to fight between neighbours.	No

19	2021	July 7	NA	Egg lost due to neglect by parents, as it is being largely ignored for an entire day.	No
20	2022	May 15	03:06	Egg kicked down by accident during fight.	No
21	2022	May 18	08:43	Egg kicked down by accident during fight.	No
22	2022	May 18	18:12	Egg lost after bird is disturbed and leaves, later eaten by a herring gull.	No
23	2022	May 19	14:32	Egg kicked down by accident during fight.	No
24	2022	May 21	05:12	Egg kicked down by accident during fight.	No
25	2022	May 25	10:57	Egg kicked down by accident during fight.	No
26	2022	May 27	12:43	Egg repeatedly left unsupervised for unknown reason, another bird accidentally kicks it down.	No
27	2022	June 1	05:27	Egg kicked down by accident during fight.	No
28	2022	June 1	14:47	Egg left unsupervised after unknown disturbance, herring gull takes egg.	No
29	2022	June 7	21:13	Egg moved around by parent and eventually kicked down.	No
30	2022	June 20	20:58	Egg left by parent after panting in the heat, then accidentally kicked down.	Yes
31	2022	June 23	21:39	Chick was dead when hatched.	No
32	2022	June 25	19:13	Chick left unsupervised in the sun, parent back and forth on ledge, then leaves. Chick likely dead from heat exposure.	Yes
33	2022	June 25	19:26	Egg left unsupervised because of heat, kicked down later by another bird.	Yes
34	2022	June 25	19:30	Chick left unsupervised in the sun, likely dies from heat.	Yes
35	2022	June 26	19:21	Chick left unshaded in the sun (but parent standing right next to it, panting), likely dies from heat exposure.	Yes
36	2022	June 26	19:37	Chick left unsupervised as parent leaves due to heat, another bird then accidentally pushes the chick down from the cliff.	Yes

37	2022	June 26	19:48	Egg lost when parent accidentally pushes it down after walking around in the heat with the egg.	Yes
38	2022	June 26	20:17	Egg moved around by parent all over the ledge in the heat, then sits right on the edge and egg falls when parent flies away.	Yes
39	2022	June 26	22:55	Chick lost for unclear reason, probably accidentally pushed down by parent.	No
40	2022	June 27	02:45	Chick accidentally pushed from cliff by parent.	No
41	2022	July 4	12:35	Parent sits close to the edge. Something scares the guillemots and when the parent leaves it accidentally pulls the chick over the edge.	No
42	2022	July 5	19:40	Parent moves around a bit with the egg and when exposed a herring gull steals the egg.	No
43	2022	July 13	01:52	Chick is left alone for over an hour. Can't walk properly and falls over the edge.	No
44	2022	July 13	15:32	Egg left alone close to the edge. Another adult lands on the cliff and accidentally knocks it over the edge.	No
45	2022	July 15	08:14	Unsupervised chick accidentally kicked off the ledge by other adult.	No
46	2022	July 16	13:32	Chick is left alone and a lesser black-backed gull comes and takes the chick.	No
47	2022	July 17	10:47	Parent gets scared and leaves the egg unsupervised. A herring gull comes and steals the egg.	No
48	2022	July 17	14:28	Chick was left alone and walked around for a while until jumping off the edge (chick too young to have fledged).	No

Table S5. Comparison of candidate models for Cox proportional hazards models of failure at the egg stage. ΔAIC_C indicates AIC_C relative to the model with the lowest AIC_C. Predictors included in all models with a $\Delta AIC_C < 4$ were considered to have strong support (see Burnham & Anderson 2002) and are highlighted in bold. Plus signs indicate variables included in the model.

cloud	**temperature**	ledge side	year	ΔAIC_C
	+	+		**0.00**
+	**+**	+		**1.28**
	+			**2.60**
+	**+**			**3.81**
	+	+	+	14.28
+	+	+	+	15.98
	+		+	16.53
+	+		+	18.20
		+		20.78
+		+		22.58
				24.72
+				26.52
		+	+	34.89
+		+	+	36.99
			+	38.31
+			+	40.42

Table S6. Comparison of candidate models for Cox proportional hazards models of failure at the chick stage. ΔAIC_C indicates AIC_C relative to the model with the lowest AIC_C. Predictors included in all models with a $\Delta AIC_C < 4$ were considered to have strong support (see Burnham & Anderson 2002). Plus signs indicate variables included in the model.

Cloud	Temperature	Ledge side	Year	ΔAIC_C
			+	**0.00**
		+	+	**0.12**
+			+	**0.22**
+		+	+	**0.60**
		+		**2.46**
				2.67
+				**2.93**
+		+		**2.99**
	+		+	4.33
+	+		+	4.34
	+			5.47
	+	+	+	5.80
+	+			5.81
+	+	+	+	6.15
	+	+		6.51
+	+	+		7.17

LITERATURE CITED

Burnham KP, Anderson DR (2002). Model selection and multimodel inference. Springer, New York

Hartig F (2021) DHARMa: Residual Diagnostics for Hierarchical (Multi-Level / Mixed) Regression Models. R package version 0.4.3. https://CRAN.R-project.org/package=DHARMa

Wood S (2017). Generalized Additive Models: An Introduction with R, 2nd edition. Chapman and Hall/CRC