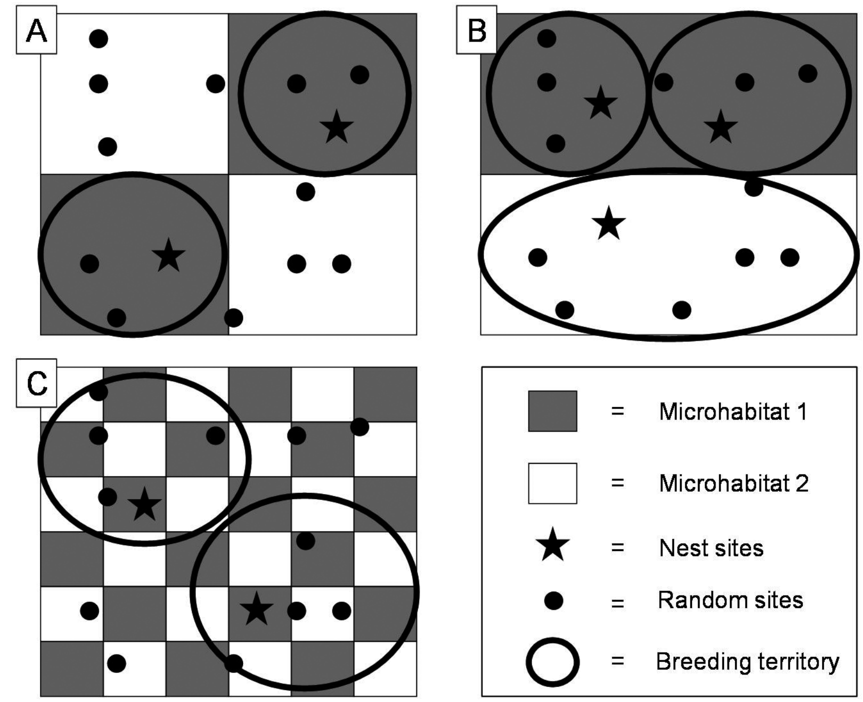
Oikos

o18835
Latif, Q. S., Heath, S. K. and Rotenberry. J. T. 2011. An ‘ecological trap’ for yellow warbler nest microhabitat selection. – Oikos 120: 1139–1150.

Appendix 1

Here, we explain the importance of comparing nest habitat use to habitat availability within individual territories to attribute apparent microhabitat preferences to within-territory nest microhabitat selection. In all scenarios (A–C), comparing mean nest microhabitat values (use) to random-site values (availability) would suggest a preference for Microhabitat 1. However, when available microhabitats are not evenly distributed over the study area, apparent microhabitat preferences may be determined by territory location (A, B). Territory selection would most strongly influence apparent preferences if some portion of the study area is not occupied by territories (A). However, even if territories occupy all of the study area, a higher territory density where Microhabitat 1 is more abundant would arise in an apparent preference for Microhabitat 1 (B). Attributing apparent preferences to microhabitat selection would be easiest when microhabitats are evenly distributed among territories (C). However, regardless of the distribution of microhabitats (A–C), comparison of nest to random sites within individual territories would reveal preferences specifically arising from within-territory nest site selection.



Appendix 2

Habitat means and standard deviations for nest and random sites measured along tributaries of Mono Lake, CA. Species-specific covers are all absolute percentages (shrub cover × relative cover / 100).

Habitat variable	Rush Creek			Lee Vining Creek		Mill Creek		Wilson Creek	
	Nest site means ± SD	2000–2005 Random site means ± SD	2006–2008 Random site means ± SD	Nest site means ± SD	Random site means ± SD	Nest site means ± SD	Random site means ± SD	Nest site means ± SD	Random site means ± SD
Overhead cover	54.7 ± 33.6%	21.6 ± 27.5%	45.5 ± 34.7%	41.5 ± 36.8%	16.4 ± 24.5%	46.4 ± 34.4%	16.7 ± 20.0%	64.8 ± 27.6%	25.3 ± 30.3%
Shortest vegetation measured (m)	1.6 ± 0.7	1.6 ± 0.8	1.3 ± 0.7	1.6 ± 1.3	2.0 ± 1.7	2.7 ± 2.6	3.0 ± 1.4	1.5 ± 0.7	1.4 ± 0.8
Tallest vegetation measured (m)	4.0 ± 1.4	3.9 ± 1.8	4.3 ± 1.7	4.6 ± 2.5	5.5 ± 3.1	7.7 ± 4.2	7.3 ± 3.8	3.9 ± 1.4	3.2 ± 1.3
Shrub cover[a]	65.8 ± 21.1%	56.3 ± 25.6%	63.5 ± 22.7%	58.7 ± 22.1%	37.9 ± 25.7%	44.2 ± 19.8%	39.5 ± 22.6%	61.5 ± 21.4%	42.5 ± 25.9%
Willow cover	42.2 ± 26.9%	24.8 ± 25.2%	38.8 ± 28.6%	23.3 ± 22.8%	12.0 ± 15.6%	9.3 ± 15.2%	6.6 ± 12.1%	55.0 ± 20.9%	29.3 ± 26.0%
Rose cover	18.5 ± 28.8%	15.5 ± 23.6%	16.9 ± 25.8%	17.3 ± 23.1%	9.1 ± 18.3%	16.9 ± 20.3%	5.6 ± 11.7%	n/a	n/a
Cottonwood cover	n/a	n/a	n/a	4.5 ± 7.4%	5.5 ± 10.0%	11.0 ± 11.0%	5.4 ± 8.4%	n/a	n/a
Non-riparian cover	4.2 ± 9.8%	15.3 ± 20.3%	7.1 ± 13.2%	11.8 ± 17.2%	10.8 ± 16.7%	6.2 ± 7.5%	20.2 ± 19.3%	5.4 ± 12.1%	11.7 ± 18.4%
Willow stems	228.3 ± 228.0	116.5 ± 144.6	159.1 ± 192.5	136.5 ± 149.8	89.6 ± 141.3	46.4 ± 71.7	44.0 ± 84.0	355.2 ± 172.6	203.4 ± 236.8
Rose stems	293.0 ± 622.2	140.7 ± 314.0	264.1 ± 391.0	159.0 ± 295.8	68.4 ± 152.4	164.9 ± 227.9	37.0 ± 76.9	n/a	n/a
Cottonwood stems	n/a	n/a	n/a	14.4 ± 28.5	19.0 ± 43.5	40.0 ± 50.1	18.5 ± 34.2	n/a	n/a
No. sites measured	904	150	421	355	177	61	178	51	166

[a] any woody vegetation that does not fit ‘tree’ criteria of ≥ 5.0 m in height and ≥ 8 cm diameter at breast height.

Appendix 3

Relationships between daily nest survival rates (DSR) for natural and experimental yellow warbler nests in the Mono Lake basin, CA, and spatiotemporal factors used as covariates in logistic exposure models describing microhabitat-preference-survival relationships. DSR estimates were calculated for all levels of class covariates and for two days-of-the-year (± one SD from the mean day nests were observed). Estimates and their standard errors (SE) were averaged across models (using weighted averaging; Burnham and Anderson 2002; weights provided in Appendix 4). The logistic exposure model fitted to Wilson Creek data included no covariates.

Dataset	Covariates	model-averaged DSRs ± SE
Rush Creek natural nests (2000–2008)	Year	2000: 0.951 ± 0.011, 2001: 0.951 ± 0.011, 2002: 0.951 ± 0.011, 2003: 0.951 ± 0.011, 2004: 0.951 ± 0.011, 2005: 0.951 ± 0.011, 2006: 0.951 ± 0.011, 2007: 0.951 ± 0.011, 2008: 0.951 ± 0.011
	Day-of-year	day 146: 0.937 ± 0.007, day 196: 0.946 ± 0.007
	Plot	lower: 0.929 ± 0.007, upper: 0.945 ± 0.003
	Stage	egg: 0.924 ± 0.004, nestling: 0.963 ± 0.004
	Parasitism	parasitized: 0.938 ± 0.004, non-parasitized: 0.944 ± 0.005
Rush Creek experimental nests (2006–2007)	Year	2006: 0.898 ± 0.015, 2007: 0.854 ± 0.017
	Day-of-year	day 143: 0.832 ± 0.030, day 202: 0.914 ± 0.020
Lee Vining Creek natural nests, (2000–2005)	Stage	egg: 0.940 ± 0.005, nestling: 0.971 ± 0.005
Mill Creek natural nests (2000–2005)	Stage	egg: 0.953 ± 0.009, nestling: 0.968 ± 0.012

Appendix 4

Logistic exposure models describing variation in daily nest survival for yellow warblers in Mono Lake basin riparian habitats, CA. Models describe nest survival relationships with yellow warbler microhabitat preference (Prf_years; preference scores derived from discriminant function models comparing nest to random sites; years indicate when the data were collected upon which discriminant models were fitted) and with covariates: Year (Y), Day-of-year (D), Plot (Pl; upper versus lower), Stage (S; egg vs nestling), and the status of parasitism (Par) by brown-headed cowbirds. Models with preference parameters and covariates are compared to covariate-only models and models with only an intercept (Int). –LL = negative log-likelihood, k = the number of model parameters, Δ_i = the difference in AIC_c or $QAIC_c$ between the ith model and the best-fit model in a given model-set (lowest AIC_c or $QAIC_c$), w_i = the weight of evidence for the ith model, and $n_{effective}$ = the number of observation days represented in the data. $QAIC_c$ was used when $c > 1$ ($c = \chi^2_{GOF} / DF$; χ^2_{GOF} = the Hosmer and Lemeshow goodness-of-fit statistic calculated for the maximally-parameterized model that best-fit the data).

Dataset	Model parameters	–LL	k	Δ_i	w_i
Rush Creek natural nests (2000–2008; $n_{effective}$ = 6803)	Int + Y + D + Pl + S + Par + Prf_2006–2008	1091.7	14	0.0*	0.57
	Int + Y + D + Pl + S + Par + Prf_2001–2003	1093.8	14	2.0*	0.20
	Int + Y + D + Pl + S + Par	1096.7	13	2.9*	0.13
	Int + Y + D + Pl + S + Par + Prf_2004–2005	1095.3	14	3.5*	0.10
	Int (Constant survival)	1148.7	1	30.9*	< 0.01
Rush Creek experimental nests (2006–2007; $n_{effective}$ = 764)	Int + Y + D + Prf_2006–2008	188.8	4	0.0	0.87
	Int + Y + D	192.0	3	4.2	0.11
	Int (constant survival)	195.6	1	7.4	0.02
Lee Vining Creek natural nests, (2000–2005; $n_{effective}$ = 2799)	Int + S	398.2	2	0.0	0.47
	Int + S + Prf_2004–2005	397.0	3	0.9	0.30
	Int + S + Prf_2000–2003	397.9	3	1.8	0.19
	Int (constant survival)	405.6	1	4.7	0.04
MC, natural nests (2000–2005; $n_{effective}$ = 618)	Int + S + Prf_2000–2005	77.0	3	0.0	0.68
	Int + S	79.3	2	2.7	0.17
	Int (constant survival)	80.5	1	3.0	0.15
WC, natural nests (2000–2005; $n_{effective}$ = 507)	Int (constant survival)	65.4	1	0.0	0.73
	Int + Prf_2000–2005	65.4	2	2.0	0.27

$\Delta AIC_c = -2\times LL + 2k + 2k/(n_{effective} - k - 1)$

*indicates $\Delta QAIC_c$ values; $QAIC_c = -2\times LL/c + 2(k+1) + 2(k+1)(k+2)/(n_{effective} - (k+1) - 1)$, where c = 2.0, 2.2, and 1.7 for Rush Creek natural nest models, Lee Vining Creek models, and Wilson Creek models, respectively.

$w_i = e^{-0.5*\Delta_i} / \sum_{0-j} e^{-0.5*\Delta_i}$

Appendix 5

Logistic exposure models describing variation in daily nest survival for yellow warblers along Rush Creek, a tributary of Mono Lake, CA. Candidate models included all possible combinations of several microhabitat effects of interest: Substrate (Subs; class variable describing nest shrub species: willow, rose, or sagebrush [only natural nests occupied sagebrush]), a willow – rose gradient in microhabitat patch structure (PC1), and a rose – sagebrush gradient in microhabitat patch structure (PC2; natural nests only). In addition, all models except a constant survival model (intercept-only) included a series of covariates that controlled for sources of variation not of immediate interest. –LL = negative log-likelihood, k = the number of model parameters, Δ_i = the difference in QAICc between the ith model and the best-fit model (lowest QAICc) within each model-set, and w_i = the weight of evidence for the ith model.

Dataset	Model parameters	–LL	K	Δ_i	w_i
Natural nests (2000–2008; $n_{effective}$ = 6315)	Int + $Covars^N$ + PC1	982.6	23	0.0	0.29
	Int + $Covars^N$ + PC1 + Subs	980.6	25	0.9	0.18
	Int + $Covars^N$ + PC1 + PC2 + Subst	979.4	26	0.9	0.18
	Int + $Covars^N$	985.0	22	1.8	0.12
	Int + $Covars^N$ + PC1 + PC2	982.5	24	1.8	0.11
	Int + $Covars^N$ + PC2	984.5	23	3.0	0.06
	Int + $Covars^N$ + PC2 + Subs	982.8	25	4.4	0.03
	Int + $Covars^N$ + Subs	984.6	24	5.2	0.02
	Constant survival	1052.2	1	66.3	< 0.01
Experimental nests (2006–2007; $n_{effective}$ = 764)	Int + $Covars^E$ + Subs	178.5	6	0.0	0.42
	Int + $Covars^E$ + PC1	179.2	6	0.9	0.26
	Int + $Covars^E$ + PC1 + Subs	177.8	7	1.1	0.24
	Int + $Covars^E$	182.6	5	3.4	0.08
	Constant survival	195.6	1	12.6	0.00

$Covars^N$ = Year (2000 – 2008) + Day-of-year + Plot (upper vs lower) + Stage (egg vs nestling) + cowbird parasitism status + Concealment + Concealment × Year

$Covars^E$ = Year (2006, 2007) + Day-of-year + Concealment + $Concealment^2$

$QAIC_c = -2\times LL/c + 2(k+1) + 2(k+1)(k+2)/(n_{effective} - (k+1) - 1)$. c = 1.3 for natural nests and 1.5 for experimental nests.

$w_i = e^{-0.5*\Delta_i} / \sum_{0-j} e^{-0.5*\Delta_i}$

Appendix 6

Relationships between predator-specific bite rates of clay eggs (PSBR) and a microhabitat preference gradient calculated for Rush Creek yellow warblers (2006–2008; Mono Lake basin, California). $n_{effective}$ = number of observation days represented in the data. k = number of parameters in each model. β ± SE = parameter estimate ± standard error describing a preference effect on predator-specific daily nest survival rates (DSR). Δ_{Pref} = change in AIC_c when preference parameters were included in DSR models (preference model minus covariate-only model). Covariates were Year and Date for avian-specific models and a quadratic Date (Date + $Date^2$) for the rodent-specific model. AIC_c values for constant survival models (intercept-only) were greater than covariate-only models by 2.6 and 1.0 for avian and rodent datasets, respectively.

Dataset	$n_{effective}$	k	Δ_{Pref}	Evidence ratio	β ± SE	PSBR ± SE	
						at preference gradient score = –1	at preference gradient score = 1
Failure = avian bite	741.5	4	–6.0	20.3	–0.56 ±0.20	0.40 ± 0.07	0.78 ± 0.08
Failure = rodent bite	1149.5	4	–4.7	10.3	–0.58 ± 0.23	0.15 ± 0.05	0.41 ± 0.11

Evidence ratio = $w_{preference\_model} / w_{covariate\text{-}only\_model}$, where $w_i = e^{-0.5*\Delta_i} / \sum_{0-j} e^{-0.5*\Delta_i}$ and Δ_i = difference in AIC_c between the ith and the best-fit model. To simplify, the Evidence ratio = $1/e^{-0.5*\Delta_{Pref}}$