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Supplementary material

Appendix 1

Table A1. Model selection for Aride Island's two-species shearwater samplings based on the Deviance Information Criterion (DIC). (z) denotes plot variation in the detection parameter, while (.) denotes constant detection rates for all plots.

Model		DIC	ΔDIC
P.pacificus	*P.bailloni*		
$p_R(z), p_S(z)$	$P_R(z), p_S(z)$	627.51	0.00
$p_R(z), p_S(z)$	$p_R(z), p_S(.)$	651.59	24.08
$p_R(.), p_S(z)$	$p_R(.), p_S(z)$	654.40	26.89
$p_R(z), p_S(.)$	$p_R(z), p_S(.)$	657.09	29.58
$p_R(z), p_S(z)$	$p_R(.), p_S(z)$	662.37	34.86
$p_R(z), p_S(.)$	$p_R(z), p_S(z)$	665.58	38.07
$p_R(z), p_S(.)$	$p_R(.), p_S(.)$	666.35	38.84
$p_R(.), p_S(z)$	$p_R(z), p_S(z)$	666.66	39.14
$p_R(.), p_S(z)$	$p_R(.), p_S(.)$	682.89	55.38
$p_R(z), p_S(z)$	$p_R(.), p_S(.)$	684.58	57.07
$p_R(.), p_S(.)$	$p_R(.), p_S(z)$	684.93	57.42
$p_R(z), p_S(.)$	$p_R(.), p_S(.)$	686.40	58.89
$p_R(.), p_S(.)$	$p_R(z), p_S(z)$	688.23	60.71
$p_R(.), p_S(z)$	$p_R(z), p_S(.)$	695.90	68.39
$p_R(.), p_S(.)$	$p_R(z), p_S(.)$	702.62	75.11
$p_R(.), p_S(.)$	$p_R(.), p_S(.)$	713.44	85.93

Table A2. Parameter estimates for Aride Island's two-species shearwater sampling. The best model includes variation in occupancy, sighting and response probabilities for both species

Parameter	Mean Estimate	SD
Wedge-tailed Shearwater		
μ_{Ψ}	-1.224	0.471
σ_{Ψ}	1.109	0.534
μ_{ps}	0.948	0.349
σ_{ps}	0.909	0.615
μ_{pr}	2.011	1.067
σ_{pr}	1.656	1.620
Tropical Shearwater		
μ_{Ψ}	-0.493	0.869
σ_{Ψ}	3.107	1.184
μ_{ps}	0.201	9.875
σ_{ps}	4.994	2.890
μ_{pr}	4.431	0.384
σ_{pr}	0.754	0.471

Table A3. Root mean squared error, bias and percentage of realized number of occupied burrows falling in the estimated 95% confidence intervals for different combinations of parameters in the simulations with two species

Parameters						RMSE		Bias		Proportion of realised values in the estimated confidence intervals	
Ψ_A	Ψ_B	P_{VA}	P_{RA}	P_{VB}	P_{RB}	species A	species B	species A	species B	species A	species B
0.3	0.3	0.3	0.3	0.3	0.3	1.83	1.45	0.41	0.38	0.9	0.95
0.3	0.3	0.3	0.5	0.3	0.3	1.69	1.42	0.52	0.32	0.9	0.95
0.3	0.3	0.3	0.5	0.3	0.5	1.26	2.15	0.27	0.82	0.7	0.8
0.3	0.3	0.3	0.7	0.3	0.3	2.26	0.62	0.71	0.13	0.95	0.9
0.3	0.3	0.3	0.7	0.3	0.5	1.77	0.73	0.45	0.10	0.75	0.75
0.3	0.3	0.3	0.7	0.3	0.7	1.07	1.26	0.17	0.27	0.85	0.7
0.3	0.3	0.5	0.3	0.3	0.3	1.38	1.43	0.25	0.16	1	0.85
0.3	0.3	0.5	0.3	0.5	0.3	1.59	1.44	0.51	0.25	0.85	0.85
0.3	0.3	0.5	0.5	0.3	0.3	1.20	1.22	0.19	0.43	0.95	0.8
0.3	0.3	0.5	0.5	0.3	0.5	1.89	1.51	0.39	0.36	0.9	0.7
0.3	0.3	0.5	0.5	0.5	0.3	1.53	1.09	0.45	0.45	0.9	0.9
0.3	0.3	0.5	0.5	0.5	0.5	1.07	1.26	0.29	0.38	0.75	0.95
0.3	0.3	0.5	0.7	0.3	0.3	1.47	0.86	0.28	0.23	0.95	0.95
0.3	0.3	0.5	0.7	0.3	0.5	1.48	1.00	0.22	0.26	0.75	0.65
0.3	0.3	0.5	0.7	0.3	0.7	1.10	0.91	0.34	0.22	0.9	0.8
0.3	0.3	0.5	0.7	0.5	0.3	1.68	0.83	0.51	0.22	0.9	0.65
0.3	0.3	0.5	0.7	0.5	0.5	1.39	0.80	0.45	0.19	0.8	0.7
0.3	0.3	0.5	0.7	0.5	0.7	1.36	0.75	0.39	0.13	0.8	0.7
0.3	0.3	0.7	0.3	0.3	0.3	1.77	1.31	0.25	0.34	0.8	0.85
0.3	0.3	0.7	0.3	0.5	0.3	1.61	0.85	0.47	0.22	0.95	0.65
0.3	0.3	0.7	0.3	0.7	0.3	0.77	1.11	0.22	0.18	0.9	0.9
0.3	0.3	0.7	0.5	0.3	0.3	1.39	0.95	0.21	0.24	0.9	0.75
0.3	0.3	0.7	0.5	0.3	0.5	1.31	1.27	0.41	0.46	1	0.75
0.3	0.3	0.7	0.5	0.5	0.3	1.47	1.14	0.32	0.21	0.85	0.6
0.3	0.3	0.7	0.5	0.5	0.5	1.10	1.21	0.22	0.46	0.7	0.85
0.3	0.3	0.7	0.5	0.7	0.3	1.17	1.03	0.31	0.23	0.8	0.85
0.3	0.3	0.7	0.5	0.7	0.5	0.75	0.72	0.15	0.08	0.85	0.7
0.3	0.3	0.7	0.7	0.3	0.3	1.37	0.60	0.36	0.14	0.9	0.5
0.3	0.3	0.7	0.7	0.3	0.5	1.56	0.64	0.39	0.16	0.85	0.6
0.3	0.3	0.7	0.7	0.3	0.7	1.01	0.57	0.25	0.10	0.9	0.7
0.3	0.3	0.7	0.7	0.5	0.3	1.19	0.53	0.30	0.01	0.8	0.6
0.3	0.3	0.7	0.7	0.5	0.5	1.14	0.91	0.28	0.29	0.85	0.65
0.3	0.3	0.7	0.7	0.5	0.7	0.87	0.85	0.08	0.24	0.75	0.5
0.3	0.3	0.7	0.7	0.7	0.3	1.11	0.35	0.32	0.05	0.85	0.5
0.3	0.3	0.7	0.7	0.7	0.5	0.82	0.91	0.28	0.30	0.75	0.5
0.3	0.3	0.7	0.7	0.7	0.7	0.37	0.81	-0.01	0.12	0.85	0.6
0.5	0.3	0.3	0.3	0.3	0.3	0.88	1.14	0.07	0.15	0.95	0.95
0.5	0.3	0.3	0.5	0.3	0.3	0.49	1.10	0.04	0.13	1	1

Parameters						RMSE		Bias		Proportion of realised values in the estimated confidence intervals	
Ψ_A	Ψ_B	P_{VA}	P_{RA}	P_{VB}	P_{RB}	species A	species B	species A	species B	species A	species B
0.5	0.3	0.3	0.5	0.3	0.5	0.72	1.39	0.17	0.17	0.95	1
0.5	0.3	0.3	0.7	0.3	0.3	0.80	0.96	0.14	0.12	0.9	0.95
0.5	0.3	0.3	0.7	0.3	0.5	0.88	0.97	0.36	0.11	0.95	0.95
0.5	0.3	0.3	0.7	0.3	0.7	0.57	1.08	0.02	0.04	0.95	0.95
0.5	0.3	0.5	0.3	0.3	0.3	0.68	1.16	0.09	0.14	1	0.95
0.5	0.3	0.5	0.3	0.5	0.3	0.62	1.19	0.19	0.15	1	1
0.5	0.3	0.5	0.5	0.3	0.3	1.00	1.14	0.13	0.10	0.85	0.95
0.5	0.3	0.5	0.5	0.3	0.5	0.84	1.03	0.28	0.09	1	0.95
0.5	0.3	0.5	0.5	0.5	0.3	0.83	1.08	0.11	0.12	0.85	0.9
0.5	0.3	0.5	0.5	0.5	0.5	0.59	1.03	0.14	0.07	1	0.95
0.5	0.3	0.5	0.7	0.3	0.3	0.76	0.59	0.07	0.04	1	1
0.5	0.3	0.5	0.7	0.3	0.5	0.59	1.00	0.08	0.20	0.95	0.95
0.5	0.3	0.5	0.7	0.3	0.7	0.54	0.87	0.15	0.07	0.9	1
0.5	0.3	0.5	0.7	0.5	0.3	0.71	0.95	0.20	0.11	1	1
0.5	0.3	0.5	0.7	0.5	0.5	0.48	0.77	0.09	0.13	0.95	0.95
0.5	0.3	0.5	0.7	0.5	0.7	0.43	0.62	0.15	0.02	1	1
0.5	0.3	0.7	0.3	0.3	0.3	0.76	1.18	0.02	0.20	0.9	0.95
0.5	0.3	0.7	0.3	0.5	0.3	0.77	1.01	0.22	0.13	0.95	1
0.5	0.3	0.7	0.3	0.7	0.3	0.52	0.69	0.10	0.08	1	1
0.5	0.3	0.7	0.5	0.3	0.3	0.94	0.61	0.23	0.02	0.85	0.95
0.5	0.3	0.7	0.5	0.3	0.5	0.64	1.13	0.04	0.20	0.95	0.85
0.5	0.3	0.7	0.5	0.5	0.3	0.63	1.10	0.08	0.19	1	0.95
0.5	0.3	0.7	0.5	0.5	0.5	0.65	0.52	0.19	0.08	0.95	0.95
0.5	0.3	0.7	0.5	0.7	0.3	0.58	0.90	0.07	0.09	0.95	0.95
0.5	0.3	0.7	0.5	0.7	0.5	0.43	0.67	0.12	0.10	1	0.9
0.5	0.3	0.7	0.7	0.3	0.3	0.73	0.84	-0.01	0.12	0.85	0.85
0.5	0.3	0.7	0.7	0.3	0.5	0.95	0.74	0.29	0.05	0.95	1
0.5	0.3	0.7	0.7	0.3	0.7	0.50	0.84	0.10	0.10	1	0.95
0.5	0.3	0.7	0.7	0.5	0.3	0.73	0.65	0.07	0.07	0.95	0.9
0.5	0.3	0.7	0.7	0.5	0.5	0.50	0.75	0.13	0.08	1	0.9
0.5	0.3	0.7	0.7	0.5	0.7	0.64	0.69	0.25	0.09	1	1
0.5	0.3	0.7	0.7	0.7	0.3	0.65	0.29	0.23	0.04	1	1
0.5	0.3	0.7	0.7	0.7	0.5	0.41	0.62	0.11	0.08	0.95	0.95
0.5	0.3	0.7	0.7	0.7	0.7	0.46	0.54	0.12	-0.02	0.85	0.95

JAGS model for the analysis of the two-species dataset.

```
model{
	oc.mean.1~dnorm(0,0.01)
	oc.sigma.1~dunif(0,10)
	oc.tau.1 <- 1/(oc.sigma.1^2)

	oc.mean.2~dnorm(0,0.01)
	oc.sigma.2~dunif(0,10)
	oc.tau.2 <- 1/(oc.sigma.2^2)

	pr.mean.1~dnorm(0,0.01)
	pr.sigma.1~dunif(0,10)
	pr.tau.1 <- 1/(pr.sigma.1^2)

	pr.mean.2~dnorm(0,0.01)
	pr.sigma.2~dunif(0,10)
	pr.tau.2 <- 1/(pr.sigma.2^2)

	ps.mean.1~dnorm(0,0.01)
	ps.sigma.1~dunif(0,10)
	ps.tau.1 <- 1/(ps.sigma.1^2)

	ps.mean.2~dnorm(0,0.01)
	ps.sigma.2~dunif(0,10)
	ps.tau.2 <- 1/(ps.sigma.2^2)
```

```
    for (j in 1:nquad) {
        logit_poc.1[j]~dnorm(oc.mean.1,oc.tau.1)
            poc.1[j]<-
exp(logit_poc.1[j])/(1+exp(logit_poc.1[j])+exp(logit_poc.2[j])
)

            logit_poc.2[j]~dnorm(oc.mean.2,oc.tau.2)
            poc.2[j]<-
exp(logit_poc.2[j])/(1+exp(logit_poc.1[j])+exp(logit_poc.2[j])
)

            logit_pr.1[j]~dnorm(pr.mean.1,pr.tau.1)
            pr.1[j] <-
exp(logit_pr.1[j])/(1+exp(logit_pr.1[j]))

            logit_ps.1[j]~dnorm(ps.mean.1,ps.tau.1)
            ps.1[j] <-
exp(logit_ps.1[j])/(1+exp(logit_ps.1[j]))

            logit_pr.2[j]~dnorm(pr.mean.2,pr.tau.2)
            pr.2[j] <-
exp(logit_pr.2[j])/(1+exp(logit_pr.2[j]))

            logit_ps.2[j]~dnorm(ps.mean.1,ps.tau.1)
```

```
                ps.2[j] <-
exp(logit_ps.2[j])/(1+exp(logit_ps.2[j]))

                pi[j,1] <- 1-(poc.1[j] + poc.2[j])
                pi[j,2] <- poc.1[j]
                pi[j,3] <- poc.2[j]
 }

 for (i in 1:ndata){
       oc[i] ~ dcat(pi[quadrat[i],])
              occupied[i] <- oc[i] - 1

              he[i,1] ~
dbern(equals(occupied[i],1)*pr.1[quadrat[i]])
    he[i,2] ~ dbern(equals(occupied[i],2)*pr.2[quadrat[i]])

              se[i,1] ~
dbern(equals(occupied[i],1)*ps.1[quadrat[i]])
              se[i,2] ~
dbern(equals(occupied[i],2)*ps.2[quadrat[i]])

             occ.1[i] <- equals(occupied[i],1)
             occ.2[i] <- equals(occupied[i],2)
 }
```

```
 N.1 <- 5110*sum(occ.1[1:ndata])/nquad
 N.2 <- 5110*sum(occ.2[1:ndata])/nquad

for (q in 1:nquad){
    for (b in 1:ndata){
           is.2[b,q]<-equals(quadrat[b],q)*occ.2[b]
        is.1[b,q]<-equals(quadrat[b],q)*occ.1[b]
     }

    n.2[q]<-sum(is.2[,q])
    n.1[q]<-sum(is.1[,q])
}

}
```