Supplementary Information

Population demographics and dynamics of coconut crabs (*Birgus latro*) on Aldabra Atoll, Seychelles

# Habitat composition

supp_figures/principal-component-analysis.pdf

Figure First two components of the habitat composition in the 66 sections of our transects. Color indicates distance from shore

# Density models

We fitted a set of hierarchical distance sampling model for each of the 254 surveys performed.

First, we fitted four sets of models without detections or abundance covariates. The sets of models used a half-normal, negative exponential, hazard rate, or uniform detection function. The half-normal set of models had the lowest AIC in 39% of the surveys, the negative exponential in 36% of the surveys, the hazard rate in 23% of the surveys and the uniform in the resting 2%. However, in many cases the AIC value from the different functions was close to each other. We used a negative exponential detection function in our models because it was within two units of the model with the lowest AIC in 76% of the surveys.

To determine the influence of the habitat covariates we fitted a set of models in which the first and the second principal component as well as the distance from shore were included as both detection and abundance covariates. We found that for most surveys these habitat covariates had no significant effect on either the density or detectability of coconut crabs (Figure 2 and 3).

supp_figures/detection-coovariates.pdf

Figure Distribution of p-values of the three detection covariates. For a large majority of surveys neither distance from shore or habitat composition had a significant effect

supp_figures/density-coovariates.pdf

Figure Distribution of p-values of the three density covariates. For a large majority of surveys neither distance from shore or habitat composition had a significant effect

# Model summaries

## Density model

Parametric coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 35.370 1.694 20.88 <2e-16 \*\*\*

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edf Ref.df F p-value

s(yday) 4.967e+00 8.000 8.150 4.9e-13 \*\*\*

s(as.numeric(date)) 3.006e+00 3.736 3.006 0.0207 \*

s(moon\_ph) 1.622e-10 8.000 0.000 0.9160

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R-sq.(adj) = 0.244 Deviance explained = 26.9%

GCV = 715.44 Scale est. = 688.69 n = 240

## Count models

### Female crabs

Parametric coefficients:

Estimate Std. Error z value Pr(>|z|)

(Intercept) -1.00828 0.02353 -42.84 <2e-16 \*\*\*

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Approximate significance of smooth terms:

edf Ref.df Chi.sq p-value

s(month) 5.247 10.000 47.56 1.61e-10 \*\*\*

s(dist\_shore) 1.884 1.986 17.94 0.000306 \*\*\*

ti(month,dist\_shore) 7.935 20.000 26.38 0.000100 \*\*\*

s(moon\_ph) 1.854 2.000 31.93 3.26e-08 \*\*\*

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

R-sq.(adj) = 0.028 Deviance explained = 3.26%

-REML = 4011.3 Scale est. = 1 n = 5159

### Male crabs

Parametric coefficients:

Estimate Std. Error z value Pr(>|z|)

(Intercept) 0.1226 0.0134 9.147 <2e-16 \*\*\*

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Approximate significance of smooth terms:

edf Ref.df Chi.sq p-value

s(month) 4.225 10.000 104.721 < 2e-16 \*\*\*

s(dist\_shore) 1.156 1.287 15.631 0.000134 \*\*\*

ti(month,dist\_shore) 5.600 20.000 45.777 1.48e-10 \*\*\*

s(moon\_ph) 1.523 2.000 6.963 0.010438 \*

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

R-sq.(adj) = 0.0428 Deviance explained = 4.36%

-REML = 6601.7 Scale est. = 1 n = 5159

## Sex ratio

Parametric coefficients:

Estimate Std. Error z value Pr(>|z|)

(Intercept) 1.1314 0.0288 39.29 <2e-16 \*\*\*

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Approximate significance of smooth terms:

edf Ref.df Chi.sq p-value

s(month) 5.708 10 55.39 9.95e-13 \*\*\*

s(month):dist\_shore\_l 5.259 11 30.01 1.20e-06 \*\*\*

s(moon\_ph) 2.084 3 39.78 1.26e-10 \*\*\*

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

R-sq.(adj) = 0.0247 Deviance explained = 2.37%

UBRE = 0.095284 Scale est. = 1 n = 7993

## Size

### Female crabs

Parametric coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 30.5358 0.1572 194.3 <2e-16 \*\*\*

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Approximate significance of smooth terms:

edf Ref.df F p-value

s(month) 4.109 10.000 2.084 8.90e-05 \*\*\*

s(dist\_shore) 1.564 1.809 43.456 5.59e-15 \*\*\*

ti(month,dist\_shore) 1.029 20.000 0.135 0.0390 \*

s(moon\_ph) 1.127 3.000 1.005 0.0635 .

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

R-sq.(adj) = 0.0504 Deviance explained = 5.43%

GCV = 47.761 Scale est. = 47.37 n = 1942

### Male crabs

Parametric coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 40.6383 0.1604 253.3 <2e-16 \*\*\*

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Approximate significance of smooth terms:

edf Ref.df F p-value

s(month) 6.439 10.000 34.996 < 2e-16 \*\*\*

s(dist\_shore) 1.822 1.968 40.140 4.87e-16 \*\*\*

ti(month,dist\_shore) 6.594 20.000 3.578 1.22e-15 \*\*\*

s(moon\_ph) 2.340 3.000 25.949 < 2e-16 \*\*\*

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

R-sq.(adj) = 0.105 Deviance explained = 10.7%

GCV = 146.66 Scale est. = 145.86 n = 5969

Pleon

Female crabs

Parametric coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 1.74784 0.02708 64.54 <2e-16 \*\*\*

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Approximate significance of smooth terms:

edf Ref.df F p-value

s(month) 6.077 10 5.113 4.04e-10 \*\*\*

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

R-sq.(adj) = 0.0813 Deviance explained = 9.09%

GCV = 0.43423 Scale est. = 0.42469 n = 579

### Male crabs

Parametric coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 1.83844 0.01386 132.7 <2e-16 \*\*\*

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Approximate significance of smooth terms:

edf Ref.df F p-value

s(month) 4.902 10 7.423 <2e-16 \*\*\*

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

R-sq.(adj) = 0.0223 Deviance explained = 2.37%

GCV = 0.63554 Scale est. = 0.6335 n = 3299

## Eggs

Parametric coefficients:

Estimate Std. Error z value Pr(>|z|)

(Intercept) -6.875 2.171 -3.166 0.00154 \*\*

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Approximate significance of smooth terms:

edf Ref.df Chi.sq p-value

s(month) 2.6599 10 11.520 0.00305 \*\*

s(moon\_ph) 0.8229 2 2.352 0.05846 .

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

R-sq.(adj) = 0.151 Deviance explained = 38.5%

UBRE = -0.81121 Scale est. = 1 n = 422