

Coping behaviour as an adaptation to stress: post-disturbance preening in colonial seabirds

S. A. L. ...
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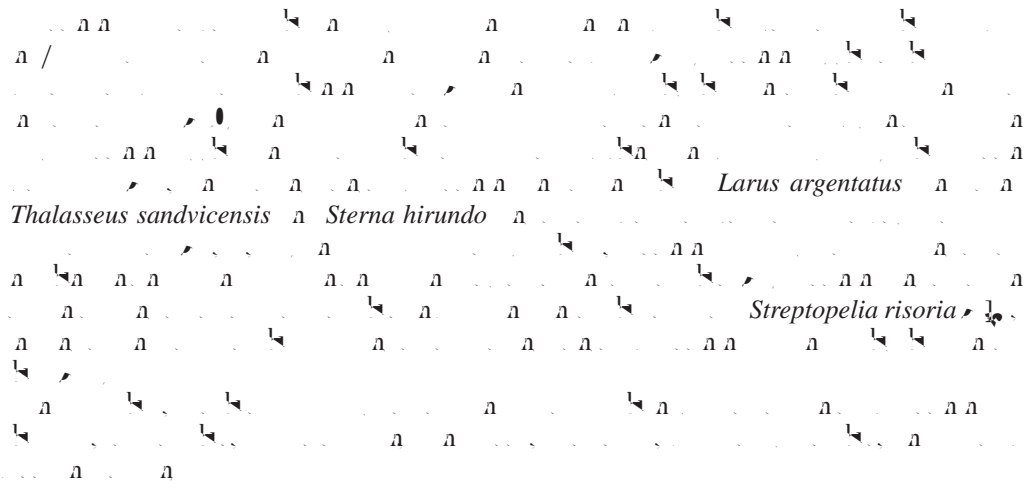
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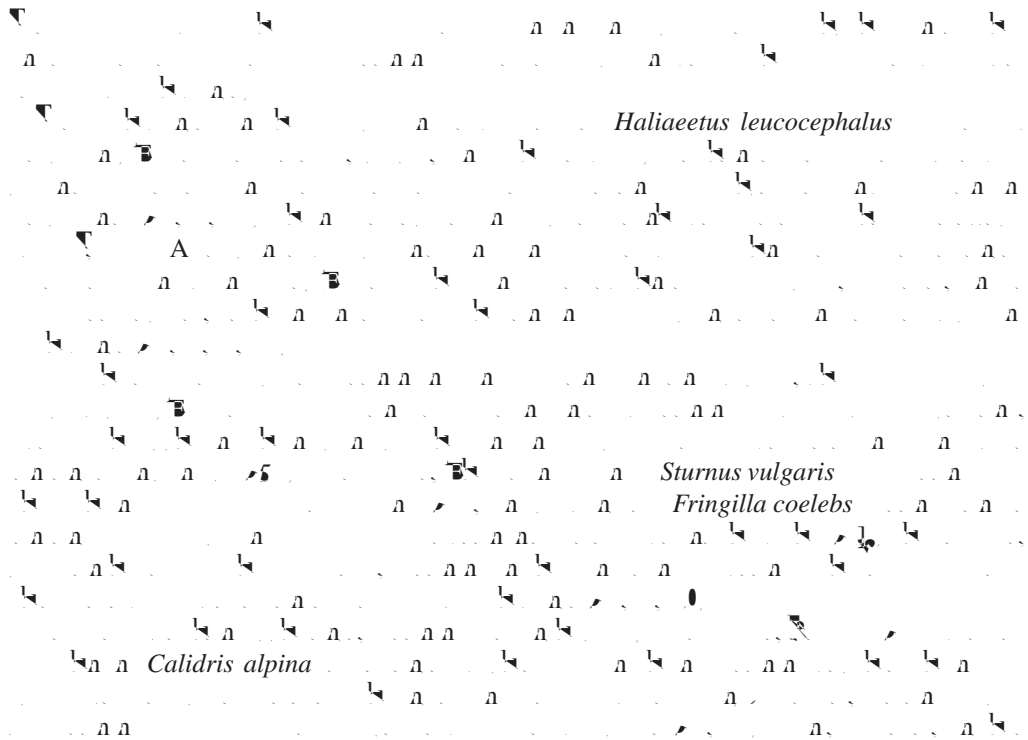
Abstract ...

Keywords: ...

AMS Subject Classification Code ...



1.3. Preening as a hypothetical coping behaviour after eagle disturbance



B β

$$\frac{N}{t} = b(\beta)N - d(\beta)N$$

$b(\beta)$ β $d(\beta)N$

β

$(n +)$

$$\frac{N}{t} = b(\beta)N$$

$$a(\boldsymbol{\beta}) = a_0 \left(-\sum_{j=1}^{n-1} \left(\frac{\beta_j - \alpha_j}{j} \right) \right) \left(-\left(\frac{\beta_n}{n} \right) \right)$$

$a_0 > 0$ $\beta_n > 0$ ($\beta_n < 0$) $a(\boldsymbol{\beta})$ a_0

$\beta_i = \alpha_i$ ($i = 1, \dots, n-1$) $\beta_n = 0$

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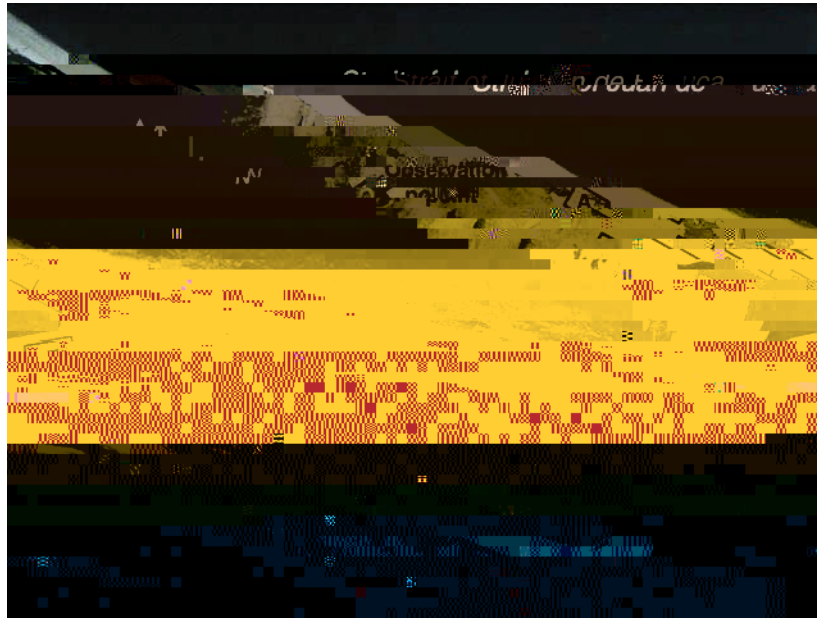


Figure 1. Aerial view of the study area, showing the location of the observation point and the surrounding landscape.

3.1. Data

The data were collected from a series of observations made at the observation point. The observations were made at regular intervals of 10 minutes, starting from 08:00 hours and ending at 18:00 hours. The data were recorded as a series of binary values (0 or 1) representing the presence or absence of a certain feature. The data were then analyzed using a series of statistical tests to determine the significance of the results.

\mathcal{S}	\mathcal{I}	D	D
$\frac{d\mathcal{S}}{dt} = \lambda - \beta \mathcal{S} \mathcal{I} - \mu \mathcal{S}$	$\frac{d\mathcal{I}}{dt} = \beta \mathcal{S} \mathcal{I} - \gamma \mathcal{I} - \mu \mathcal{I}$	$\frac{dD_1}{dt} = \gamma \mathcal{I} - \mu D_1$	$\frac{dD_2}{dt} = \mu D_1 - \mu D_2$

$$\lambda - \beta \mathcal{S} \mathcal{I} - \mu \mathcal{S} = 0 \quad \beta \mathcal{S} \mathcal{I} - \gamma \mathcal{I} - \mu \mathcal{I} = 0 \quad \gamma \mathcal{I} - \mu D_1 = 0 \quad \mu D_1 - \mu D_2 = 0$$

	n	\mathbb{S}_3	\bar{r}
β_1	$0 \ 1 \ 0$	\mathbb{S}	
β_2	$0 \ 0 \ 1$	$0 \ 0 \ 0$	
β_3	$-1 \ 0 \ 0$	$0 \ 0 \ 0$	
β_4	$-0 \ 0 \ 0$	$0 \ 0 \ 0$	
β_5	$-0 \ 0 \ 0$	$0 \ 0 \ 0$	
β_6	$-0 \ 0 \ 0$	$0 \ 0 \ 0$	
β_7	$0 \ 1 \ 0$	\mathbb{S}	
β_8	$0 \ 0 \ 0$	$0 \ 0 \ 0$	$-0 \ 0$
β_9	$0 \ 0 \ 0$	$0 \ 0 \ 0$	$-0 \ 0 \ 0$
β_{10}	$-0 \ 0 \ 0$	$0 \ 0 \ 0$	$-0 \ 1 \ 0$
β_{11}	$0 \ 0 \ 0$	$0 \ 0 \ 0$	-0
β_{12}	$0 \ 0 \ 0$	$0 \ 0 \ 0$	$-0 \ 1 \ 1 \ 1$
β_{13}	$-0 \ 0 \ 0$	$0 \ 0 \ 0$	$-0 \ 0 \ 0$
β_{14}	$0 \ 0 \ 0$	$0 \ 0 \ 0$	$-0 \ 1 \ 1 \ 0$
β_{15}	$0 \ 0 \ 0$	$0 \ 0 \ 0$	$-0 \ 1 \ 0 \ 0$
β_{16}	$-0 \ 0 \ 0$	$0 \ 0 \ 0$	$-0 \ 0 \ 0 \ 0$
β_{17}	$0 \ 0 \ 0$	$0 \ 0 \ 0$	$-0 \ 0 \ 0 \ 0$
β_{18}	$-0 \ 0 \ 0$	$0 \ 0 \ 0$	$-0 \ 0 \ 0 \ 0$
β_{19}	$-0 \ 0 \ 0$	$0 \ 0 \ 0$	$-0 \ 0 \ 0 \ 0$
β_{20}	$-0 \ 0 \ 0$	$0 \ 0 \ 0$	$-0 \ 0 \ 0 \ 0$

	c	\mathbb{S}_3	\mathbb{S}
$n / n \dots D = D = 0$	0	$0 \ 1 \ 0$	\mathbb{S}
\mathbb{S}_3	0	$0 \ 0 \ 0$	$0 \ 0 \ 0$
\mathbb{S}_3	0	$0 \ 0 \ 0$	$0 \ 0 \ 0$
$A \mathbb{S}_3$	0	$0 \ 0 \ 0$	$0 \ 0 \ 0$
$n / n \dots D = n D = 0$	0	0	$0 \ 1 \ 0$
\mathbb{S}_3	0	$0 \ 0 \ 0$	$0 \ 0 \ 0 \ 0$
\mathbb{S}_3	0	$0 \ 0 \ 0$	$0 \ 0 \ 0 \ 0$
$A \mathbb{S}_3$	0	$0 \ 0 \ 0$	$0 \ 0 \ 0 \ 0$
$n / n \dots D = 0 \ n D =$	0	0	$0 \ 1 \ 0$
\mathbb{S}_3	0	$0 \ 0 \ 0$	$0 \ 0 \ 0 \ 0$
\mathbb{S}_3	0	$0 \ 0 \ 0$	$0 \ 0 \ 0 \ 0$

β	w_+	β	w_+	β	w_+	A	w_+
$\beta < \beta_c$	$w_+ < 0$	$\beta < \beta_c$	$w_+ < 0$	$\beta < \beta_c$	$w_+ < 0$	A	$w_+ < 0$
$\beta = \beta_c$	$w_+ = 0$	$\beta = \beta_c$	$w_+ = 0$	$\beta = \beta_c$	$w_+ = 0$	A	$w_+ = 0$
$\beta > \beta_c$	$w_+ > 0$	$\beta > \beta_c$	$w_+ > 0$	$\beta > \beta_c$	$w_+ > 0$	A	$w_+ > 0$

$\beta < \beta_c$ $w_+ < 0$ $\beta < \beta_c$ $w_+ < 0$ $\beta < \beta_c$ $w_+ < 0$ A $w_+ < 0$
 $\beta = \beta_c$ $w_+ = 0$ $\beta = \beta_c$ $w_+ = 0$ $\beta = \beta_c$ $w_+ = 0$ A $w_+ = 0$
 $\beta > \beta_c$ $w_+ > 0$ $\beta > \beta_c$ $w_+ > 0$ $\beta > \beta_c$ $w_+ > 0$ A $w_+ > 0$

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 $\beta = \beta_c$ $w_+ = 0$ $\beta = \beta_c$ $w_+ = 0$ $\beta = \beta_c$ $w_+ = 0$ A $w_+ = 0$
 $\beta > \beta_c$ $w_+ > 0$ $\beta > \beta_c$ $w_+ > 0$ $\beta > \beta_c$ $w_+ > 0$ A $w_+ > 0$

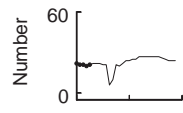
$$w_+ < 0 \quad w_+ = 0 \quad w_+ > 0$$

$\beta < \beta_c$ $w_+ < 0$ $\beta < \beta_c$ $w_+ < 0$ $\beta < \beta_c$ $w_+ < 0$ A $w_+ < 0$
 $\beta = \beta_c$ $w_+ = 0$ $\beta = \beta_c$ $w_+ = 0$ $\beta = \beta_c$ $w_+ = 0$ A $w_+ = 0$
 $\beta > \beta_c$ $w_+ > 0$ $\beta > \beta_c$ $w_+ > 0$ $\beta > \beta_c$ $w_+ > 0$ A $w_+ > 0$

4. Simulation of the Darwinian dynamics model for comfort preening

$\beta < \beta_c$ $w_+ < 0$ $\beta < \beta_c$ $w_+ < 0$ $\beta < \beta_c$ $w_+ < 0$ A $w_+ < 0$
 $\beta = \beta_c$ $w_+ = 0$ $\beta = \beta_c$ $w_+ = 0$ $\beta = \beta_c$ $w_+ = 0$ A $w_+ = 0$
 $\beta > \beta_c$ $w_+ > 0$ $\beta > \beta_c$ $w_+ > 0$ $\beta > \beta_c$ $w_+ > 0$ A $w_+ > 0$

$\frac{dS}{dt} = \lambda - \mu S - \beta SI$
 $\frac{dI}{dt} = \beta SI - (\mu + \gamma)I$
 $\frac{dR}{dt} = \mu S + \gamma I - \mu R$



6. Discussion

As a result of the above analysis, we have shown that the system (1) has a unique positive equilibrium point E^* for all values of β and γ . The stability of E^* is determined by the eigenvalues of the Jacobian matrix $J(E^*)$. The characteristic equation of $J(E^*)$ is given by

$$\lambda^3 - (a+b+c)\lambda^2 + (ab+bc+ca)\lambda - abc = 0$$

where $a = \beta S^*$, $b = \beta I^*$, and $c = \beta R^*$. The eigenvalues of $J(E^*)$ are the roots of this cubic equation. It can be shown that the eigenvalues are real and distinct, and that the system is stable if and only if the eigenvalues are all negative. This is the case if and only if $\beta < 1$.

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6.1. Inferential

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6.3. Biological

A. *...*

... (N > 0) ...

$$N = \frac{a_0 - f(u)}{d_0 + d f(u)}$$

A

n

$$N = \frac{-a_0(u) - f(u)}{d f(u)}$$

A

... (N*, u*) ...

$$H(u) = \frac{-u}{...}$$

A

... H ...

H

Let A be a matrix with $J = 0$ and $J < 0$ on J , $n \times n$.

$$J = s \left(a, \left(\frac{u}{v} \right) \right)$$

	S	I	R
$\frac{dS}{dt} = \lambda - \beta SI - \mu S$	$\lambda - \beta SI - \mu S$	$\beta SI - \mu I$	$\beta SI - \mu R$
$\frac{dI}{dt} = \beta SI - \mu I$	$\beta SI - \mu I$	$\beta SI - \mu I$	$\beta SI - \mu R$
$\frac{dR}{dt} = \beta SI - \mu R$	$\beta SI - \mu I$	$\beta SI - \mu I$	$\beta SI - \mu R$
$\frac{dA}{dt} = \beta SI - \mu A$	$\beta SI - \mu I$	$\beta SI - \mu I$	$\beta SI - \mu R$
$\frac{dN}{dt} = \lambda - \mu N$	$\lambda - \mu N$	$\lambda - \mu N$	$\lambda - \mu N$