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\[ \frac{d}{dt} \left( \begin{array}{c}
H(t) \\
H(t) \\
\end{array} \right) = \left( \begin{array}{c}
-1 \\
-1 \\
\end{array} \right) \]

Initial conditions relate to the general model, taking the form...

Models for host-parasite interactions are discussed...

Introduction

We demonstrate that individual behavior can stabilize classical (Nicholson–Bazykin) host-parasite population dynamics. Our model assumes that hosts can be divided into at least two phenotypes and that parasites either do not attack one or both. Theoretical results are consistent with the hypothesis of...
TABLE 1

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H$</td>
<td>Proportion of hosts that escape parasitism when host and parasite populations are $\eta$ and $\rho$</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Population size of host species</td>
</tr>
<tr>
<td>$\rho$</td>
<td>Population size of parasitoid species</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>Conversion rate of parasitoid into parasitoids in the next year</td>
</tr>
<tr>
<td>$d$</td>
<td>Number of parasitoids in year $t$</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>Conversion rate of attacks into parasitoids</td>
</tr>
<tr>
<td>$\phi$</td>
<td>Proportion of parasitoids that escape parasitism when host and parasite populations are $\eta$ and $\rho$</td>
</tr>
<tr>
<td>$\delta$</td>
<td>Proportion of parasitoids that escape parasitism when host and parasite populations are $\eta$ and $\rho$</td>
</tr>
<tr>
<td>$\eta_0$</td>
<td>Proportion of parasitoids that escape parasitism when host and parasite populations are $\eta$ and $\rho$</td>
</tr>
<tr>
<td>$\delta_0$</td>
<td>Proportion of parasitoids that escape parasitism when host and parasite populations are $\eta$ and $\rho$</td>
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<td>Proportion of parasitoids that escape parasitism when host and parasite populations are $\eta$ and $\rho$</td>
</tr>
</tbody>
</table>

Physiological variables such as host's search and detection abilities (Mañé et al. 1978) and the Niblo-Anderson-Bailey model (1978) correspond to choosing of the conversion of attacks on hosts into parasitoids in the next year.

$((\alpha)d^\rho - \delta^\phi)_{\gamma} = (d\gamma)^{\phi}_{\rho}

(\text{Table I})$
Perhaps the most famous of the models based on spatial heterogeneity is the one due to M. P. Hassell (1978). The model can be derived simply by

assuming that the parameter α in (1.2) has a distribution caused by spatial

characteristics. Thus, the parameters α in (1.2) change from place to place.

Models Based on Spatial Heterogeneity (patchiness)

on behavior.

briefly discuss are models based on spatial heterogeneity and models based

on behavior. The first group are models based on spatial dynamics (Beddington et al., 1978). Two other methods that we

introduce in this section are the host dynamical or both host and

parasite interactions with the host. In this section, we introduce the population dynamics that can clearly be done by

studying the population dynamics. These can clearly be done by

labelling situations that lead many investigators to study means of

The observed persistence of host and parasite populations in natural and

2. PREVIOUS WORK

earlier r is the next r is the path were by population dynamics.

environmental conditions exists and the conditions are linked from one

mechanism in general is the viability of behavior, especially if r range of

host choice patterns which show great diversity. That is, an optimally

host choice pattern which shows greatest diversity. Our work

Nicholson–Bailey model of a within-generation event (can be studied by the

parasites and vectors) has received considerable attention. However, host choice behavior by individual

with-in-generation factors. However, host choice behavior by individual

with-in-generation factors complete the host–parasite dynamics. Population ecology and those which occur

between species that happen with-in-generation events and those which occur

between species that happen with-in-generation events. Furthermore, understanding host–parasite dynamics is

important for biological control. For this reason, the stimulation of host

actual situation. Furthermore, understanding host–parasite dynamics is

and laboratory, the simple Nicholson–Bailey model cannot represent the

environmental costs according to random search.

The assumption underlying (1.2) is that parasites

MAGEL AND KOLBERG
composed of parasites emerging from host type 1 and those emerging from type 2 next season is

\[(\lambda', L)^{\mathrm{H}} + (\lambda L)^{\mathrm{H}} \times (\lambda', 0)^{\mathrm{H}} \times (I + \lambda', 0)^{\mathrm{H}} \]

The total number of uninfected hosts at the end of the season is

The total number of uninfected hosts at the beginning of the season is

Note that these equations reduce to the previous, simpler form under

\[\int (\lambda', 0)^{\mathrm{H}} (I - L)(\lambda', 0)^{\mathrm{H}} (\lambda', 0)^{\mathrm{H}} (\lambda', 0)^{\mathrm{H}} \, dx \]

These equations can be solved directly to give

\[\begin{align*}
\text{for } *i < 1 & \quad - (\lambda', i)^{\mathrm{H}} H \frac{(\lambda', 0)^{\mathrm{H}} + (\lambda', 0)^{\mathrm{H}}}{(\lambda', 0)^{\mathrm{H}} (\lambda', 0)^{\mathrm{H}}} \sigma = (\lambda', i)^{\mathrm{H}} \frac{n_p}{p} \\
\text{for } *i > 1 & \quad - (\lambda', i)^{\mathrm{H}} H \frac{(\lambda', 0)^{\mathrm{H}} + (\lambda', 0)^{\mathrm{H}}}{(\lambda', 0)^{\mathrm{H}} (\lambda', 0)^{\mathrm{H}}} \sigma = (\lambda', i)^{\mathrm{H}} \frac{n_p}{p}
\end{align*}\]

Methods for determining *i are described in the next two sections. In particular, such that for *i > 1 (\lambda, \lambda' \geq 0) *i is targeted by a within-season dynamics on hosts, in particular, there is often
could arise, for example, if crowding of offspring decreases their size (e.g., more hosts are of type I and thus subject to parasitism. The functions \( \omega_1 \) and \( \omega_2 \) are parameters as host population declines, more and

\[
(4.1)
\begin{equation}
\left( (1 - \exp(-H\omega_1)) / (1 - \omega_1) \right) \omega_2 = (L^2) \omega
\end{equation}
\]

of a density-dependent production of phenotypes is a density-dependent production of phenotypes in our season depends upon total host population. An example of this kind of phenotypic change will be the weakens when the distribution of host

A Behavioral Defense for „Hard-Wired“ Parasitoids

- Population Dynamics for „Hard-Wired“ Parasitoids

\[ (3.6) \]

\[
(1 + \mu L)H = (1 + \mu L)H
\]

\[ (3.5) \]

\[
[(L^2 - (\mu L)^2)H + [(L^2 - (\mu L)^2)H]d = (1 + \mu L)0 \]

The simplest assumption about \( T \) is that it equals neither 0 or \( T \). When

The simplest assumption about \( T \) is that it equals neither 0 or \( T \). When
Assume that while searching for the parasite, the host avoids detection. We define expected lifetime of the host by $\gamma$. We also assume that opposition is in a host of type 2, increments the expression for the expected lifetime of the host by $\gamma$. We also assume that opposition is in a host of type 1.

\[
\gamma = \gamma_H \cdot \left( \frac{\gamma_H}{\gamma_H^2} \right) (\gamma_H) \cdot \left( \frac{\gamma_H}{\gamma_H} \right) \cdot \left( \frac{\gamma_H}{\gamma_H} \right) = \gamma_H
\]

The probability that a host of type 1 or 2 is encountered is

\[
\gamma = \gamma_H
\]

So that the probability of encountering one of $H$ hosts in a single period

Assuming random search gives

To parameter $a$, as follows. First, when there is only one host present, this program by studying behavior as a source of within-host variance and this parameter reflects the influence of taking into account "spatial and other forms of within-host variance on the parasites' behavior in situ." (D. J. Haas, 1997). Hassell (1987) stresses the importance of taking into account "spatial and other forms of within-host variance" on the parasites. At the same time, it is not an explicit (cf. Manfred, 1987) to follow behavior of the parasites. We refer to Hassell's (1987) and Clark's (1988) To do this we refer to Hassell's (1987) and Clark's (1988). To do this we refer to Hassell's (1987) and Clark's (1988). To do this we refer to Hassell's (1987) and Clark's (1988).
RESULTS

change is incorporated into (3.3). The between-year dynamics of hosts and parasites is generally a nonlinear function of $H$ and $N$, and when this is the most important part, however, the formula for the expected value of each season is given by the following relationship:

$$\ln(\frac{L}{1-L}) = \ln(1-\frac{1}{\alpha}) + \ln(1+\frac{1}{\alpha})$$

where $\alpha = \frac{H}{N}$. The value of $L$ is the proportion of host populations that are infected at the start of each season.

In this section, we provide illustrative description of the dynamics of the between-year differences in which the allocation of hosts to the two types of hosts is independent of the total host population. These are the standard Nicholson-Bailie model with parameters $\alpha$ and $\gamma$. We have now described these models for the between-season dynamics of the system.
Facultative parasitism is replaced by one with even fewer points. 

**Figure 2.** Host-parasite phase planes when $y^* = 0.5$.

(a) For "hard-wired" parasitism, the limit cycle is replaced by a "strange" cycle seen when $y^* = 0.75$ is replaced by a strange attractor (b) The strange attractor seen for $y^* = 0.75$ is replaced by a strange attractor when the limit cycle is replaced by a "strange" attractor with apparent discontinuities (Krulevitch, 1989).

This appears to be an example of a general bifurcation diagram (Krulevitch, 1989). This appears to be an example of a general bifurcation diagram (Krulevitch, 1989).
Fig. 4. Host-parasite phase planes when \( m = 0.5 \).

Fig. 3. The distribution of \( \rho \) over 10,000 generations for different values of \( \beta \) with \( \rho = 0.0005 \), \( \rho = 0.0006 \), \( \rho = 0.0007 \), \( \rho = 0.0008 \), and \( \rho = 0.0009 \). The parameter measuring the strength of density dependence.
They occur on different time scales (individuals vs. populations) because parameter estimation and testing of the theory can be decoupled because all of these parameters can be measured in the laboratory or field case. Characteristics like within-season environment and behavior of the parasite, which are used in our models involve a number of additional parameters, which are used to estimate stability of measures to extinction.

In order to increase reproductive success, it is bad for the population measured in terms of increased reproductive success, is bad for the population measures in terms of increased reproductive success. For example, these correspond to the "hard-wired" density-dependent (Pfeffer et al. 1997) phenomenon, individual behavior leads to situations in which what is good for the individual, measured in terms of increased reproductive success, is bad for the population. However, even in this case, the resulting dynamics can be changed if the distribution of host phenotypes is altered. Thus, the density-dependent, individual behavior leads to complex predicted behaviors, which leads to incomplete model predictions. In our case, however, the results are more consistent with the predictions of our model. Our results show that individual behavior can stabilize the standard model as well as for the model of "facultative" parasites (Pfeffer et al. 1997).

The parameter measures the maximum density-dependent, individual behavior leads to complex predicted behaviors, which leads to incomplete model predictions. In our case, however, the results are more consistent with the predictions of our model. Our results show that individual behavior can stabilize the standard model as well as for the model of "facultative" parasites (Pfeffer et al. 1997).

Finally, let us consider the case in which the distribution of hosts at the optimal model, considerable feedback validation.