Evolutionary fitness and life history traits

Clutch size and fledgling success

Life history tradeoffs

All organisms have reproductive and growth ‘strategies’ that are a result of tradeoffs and constraints.

No organism can be ‘ideal’
Life history tradeoff: improving one life history trait is linked to weakening another.

Life history traits:
- Size of young
- Offspring growth rate
- Age at 1st reproduction
- # young
- Size of young
- Offspring survival rate
- Parent survival rate
- # of future young

Different types of life history strategies will be favored in different ecological situations.

Egg number can trade off w/egg survival in frogs

Manipulating tradeoffs (p.15)

*Parus major* females w increased rep effort
- 2 added chicks
- 2 added eggs
- Forced to lay 2 extra eggs

Fig. 1.7
These tradeoffs combine to maximize lifetime reproductive success (LRS)
- our best measure of fitness

Trade-offs occur at different levels
- Life-history tradeoffs maximizing LRS
- "day-to-day decisions" optimizing energy, time or some other currency

Optimal foraging theory (OFT)
- Marginal value theorem
- Heterogenous environment (ex. ladybugs, dolphins, primates, rodents, birds...)
- Patch “giving up time”

[Graph: Loading curve showing net energy gained over time in patch (min)]
Marginal value theorem (MVT)

MVT and dungflies

MVT and starlings
The currency that is optimized can vary according to the situation

Honeybees optimized energy efficiency (E gained vs. E spent)

Starlings optimized rate of food delivery

Crows and whelks (Fig 2.16)

Be aware of some words often used in OFT:

- “feeding strategies”
- “prey choice”
- “the organism wants to optimize X”
### What to eat?

E = energy gained from prey

\[
\frac{E_1}{h_1} > \frac{E_2}{h_2}
\]

### Why eat these?

Shore crab and mussels

<table>
<thead>
<tr>
<th>Mussel size</th>
<th>Profitability (sec)</th>
<th>% of diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>10</td>
</tr>
</tbody>
</table>

**Why eat these?**

- **Shore crab and mussels**

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**Examples:**

- **Parus major** - conveyer belt feeding (Krebs)

**What to eat?**

E = energy gained from prey

\[
\frac{E_1}{h_1} > \frac{E_2}{h_2}
\]

- If encounter #1 prey
- If encounter #2 prey

\[
\frac{E_2}{h_2} > \frac{E_1}{h_1 + S_1}
\]

\(S_1 = \) search time for prey #1
Risk-sensitive foraging

Do foraging decisions change when there is a greater need for food?

Animals tend to take more risks when they face a greater chance of starvation.

Study with juncos:
- **variable**: 0 (50%) or 6 (50%) seeds
- **fixed**: always 3 seeds

Juncos were trained to chose either feeding option.

They selected the ‘risk-prone’ variable option when exposed to cold temperatures (greater need)
How can animals avoid lean times?

- Energy requirements high especially for small endothermic animals

Food storage strategies

- Larder hoarders – rely on defense
- Scatter hoarders – rely on memory

Body reserves, food stores

- Parus major – fat stores
- Marsh tit – seed stores

Hippocampus size and food storing

Sections of bird brains - hippocampus
### Hippocampus size and food storing

- **European Species**
- **North American Species**

#### Foraging vs. predation risk

*Sticklebacks could ‘override’ their hungry internal state*

![Graph showing the impact of predation risk on foraging behavior.](image)

**Overview of OFT approach:**

1. Determine relevant factors
2. Create model
3. Test model

If animal doesn’t match model, go to 1.

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### Teaching how to feed

*Meerkats teaching with scorpions!*

- **With young pup calls**, dead scorpion given
- **With old pup calls**, live scorpion given
Overview of OFT approach:
What about alternatives to OFT?

- In a review of literature, MVT was contradicted in 75% of studies. Giving up time tends to be longer than predicted.

Note the assumptions of OFT models:
- Animal knowledge and processing
- Fitness depends on optimal foraging
- No interference from competitors, predators

Assumptions may or may not be true in reality