Evolutionary fitness and life history traits

Clutch size and fledgling success

Clutch size and # surviving young

Fig. 1.5
All organisms have reproductive and growth ‘strategies’ that are a result of tradeoffs and constraints.

No organism can be ‘ideal’

**Life history tradeoffs**

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

Manipulating tradeoffs (p.15)

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

![Diagram showing costs and benefits of clutch size](image)
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 (e.g., ladybugs, dolphins, primates, rodents, birds...)
- Patch “giving up time”

Loading curve
Marginal value theorem (MVT)

MVT and dungflies

Dungflies

MVT and dungflies

p.56
The currency that is optimized can vary according to the situation

- Starlings optimized rate of food delivery
- Honeybees optimized energy efficiency
  (E gained vs. E spent)
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”

Shore crab and mussels

Mussel size

<table>
<thead>
<tr>
<th>Size</th>
<th>Profitability</th>
<th>% of diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50</td>
<td>50%</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>30%</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>10%</td>
</tr>
</tbody>
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Why eat these?

Shore crab and mussels

p.59
What to eat?

E = energy gained from prey
h = handling time

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

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

Examples:
Parus major - conveyer belt feeding (Krebs)
Do foraging decisions change when there is a greater need for food?

Risk-sensitive foraging

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 choose either feeding option.

They selected the ‘risk-prone’ variable option when exposed to cold temperatures (greater need).
Energy level if choosing:

<table>
<thead>
<tr>
<th>State</th>
<th>i</th>
<th>ii</th>
<th>Best to choose</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>7</td>
<td>8 or 6</td>
<td>ii (risk)</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9 or 7</td>
<td>i (safe)</td>
</tr>
</tbody>
</table>

How can animals avoid lean times?

- Energy requirements high especially for small endothermic animals

Body reserves, food stores

- Parus major – fat stores
- Marsh tit – seed stores
Food storage strategies

Larder hoarders - rely on defense

Scatter hoarders - rely on memory

Hippocampus size and food storing

Sections of bird brains - hippocampus

Hippocampus size and food storing

EUROPEAN SPECIES

NORTH AMERICAN SPECIES

- Food storing birds
- Non-food storing birds

Hippocampus size

Dietary volume (t/yr)
Foraging vs. predation risk

Sticklebacks could ‘override’ their hungry internal state

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

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