Behavioral Ecology of Vertebrates

Unit 3. Economic Decisions

Module 2 Habitat

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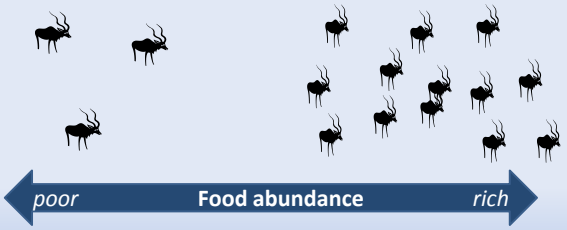
Learning, Discovering and Sharing Knowledge

Learning Objectives (Davies et al. 2012:81)

Optimality models clarify foraging :

1. **Decisions**: e.g. Where to search? Who to follow? What to eat? Handling? Sharing?
2. **Currencies**: e.g. Minimize costs? Maximize benefits? Calories? Time? Risk aversion?
3. **Constraints**: e.g. Imperfect knowledge? Maladaptive instinctive responses? Cognitive limitations? Special requirements for scarce nutrients? Environmental fluctuations?



Foraging traits/strategies (phenotype/genotype)

1. DECISIONS

1.1 Application (Davies et al. 2012:78, Fig. 3.14)

- Scorpions are nutritious and deadly to meerkats
- Naïve individuals are at risk in reintroductions
- Decision mechanisms: juveniles learn handling tactics from adults
- TIP: Pre-release training

1.2 Decisions (Davies et al. 2012:80, Table 3.1)

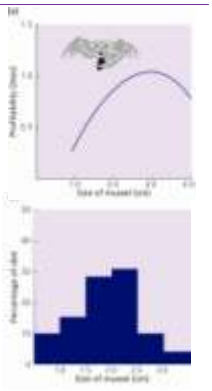
DECISION	ANIMALS	SOURCES
Where to eat? *(patch choice, cache retrieval)*	Juncos, squirrel, stickleback, bluegill sunfish, marsh tits	Pg 63, 68, 73-75
What to eat? *(diet, size)*	Shore crabs, great tits	Pg 60 , 62
How to handle food? *(load size, caching)*	Starlings, great tits, marsh tits, Clark's nutcracker, pinion jays, scrub jays	Pg 54, 68

1.3 Where to eat (Davies et al. 2012:76, Fig. 3.12)

- Sticklebacks select "rich" over "poor" food patches
- **H1**: watch others and use "public information" *(nine-spined not armored)*
- **H2**: individual trial & error *(three-spined is well armored)*
- Species-specific trade-off

1.4 What to eat (Davies et al. 2012:60, Fig. 3.4)

- Shore crabs eat mussels that vary in size
- **H1**: choose large size *(maximize benefits of more meat)*
- **H2**: choose intermediate size *(minimize costs of opening)*
- Reject H1 *(mean is 2 not 3)*
- **H3**: constraints *(sampling & developmental size change)*



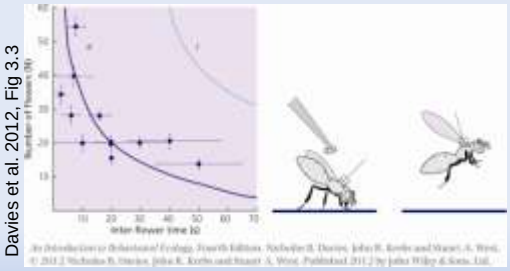
1.5 Handling (Davies et al. 2012:69-71, Figs. 3.9, 3.10)

- Corvids, chickadees and titmice store seeds *(thousands per individual)*
- Species differ in spatial memory *(Clark's nuthatch better than jays)*
- Constraint: smaller "spatial memory" brain in non-storing species *(hippocampus)*

1.6 Poll- lets see if you understand

Would you like to chat more about any of the items we just covered re. "decisions"?

a) Practical applications – "decision mechanisms"
b) Examples of decisions from the literature
c) Where to eat (patch choice in sticklebacks)
d) What to eat (prey size in shore crabs)
e) How to eat (caching/handling in corvids)

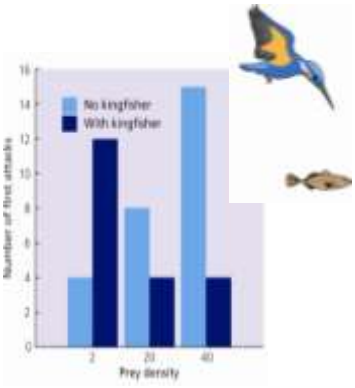

Davies et al. 2012, Fig 3.3

How we measure costs and benefits

2. CURRENCIES

2.1 Application (Davies et al. 2012:47, Fig. 3.11)

- Predator effect in dispersal corridors
- Sticklebacks choose rich > poor patches
- **H1**: currency is rate of return *(light blue)*
- **H2**: currency is risk avoidance *(dark blue)*

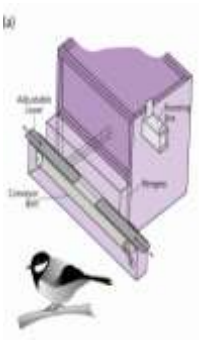


2.2 Currency (Davies et al. 2012:80, Table 3.1)

DECISION	CURRENCY	TEST
Where to eat?	Minimize risk • Squirrel • Stickleback • Bluegill sunfish • Juncos	 Size vs. distance Hunger vs. danger Habitat vs. age Fixed vs. variable
How to handle food?	Maximize net rate of gain • Starlings • Great tit	 Load vs. distance Large vs. small prey
What to eat?	Maximize nutrients	Calories vs. protein

2.3 Maximize benefits (Davies et al. 2012:47, Fig. 3.11)

- Great tits given a choice between small and large prey on a conveyer belt
- **H1**: currency is rate of return *(many small = few large)*
- **H2**: currency is intake per handling time *(large)*
- Individuals switch as conveyer belt speeds up



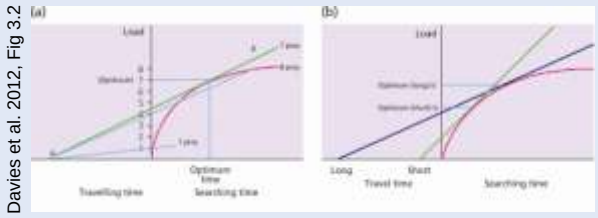
2.4 Minimize costs (Davies et al. 2012:47, Fig. 3.11)

- Blue-gill sunfish obtain more food in benthos than in reeds
- Bass prey on sunfish outside the safety of the reeds
- **H1**: currency is rate of return *(large sunfish in benthos)*
- **H2**: currency is risk avoidance *(small sunfish in reeds)*
- Constraint: switch with size

2.5 Poll- lets see if you understand

Would you like to chat further about any of the items we just covered?

a) Practical applications of "currencies"
b) Examples of how currencies from literature
c) Maximizing benefits
d) Minimizing costs



Davies et al. 2012, Fig 3.2

When optimality models do not match reality

3. CONSTRAINTS

3.1 Application

(Spalton et al. 1999)

- Arabian oryx were reintroduced to Oman
- Setback: mortality when oryx did not find water
- Constraint: imperfect knowledge of resources
- Solution: train matriarch, others follow

3.2 Constraints

(Davies et al. 2012:80, Table 3.1)

CONSTRAINTS	EXAMPLE	ANIMAL
Travel time	Rate of return is reduced by travel to deliver food to nest	Starling
Handling time	Takes twice as long to grab and eat a large compared to small worm	Great tits
Energy reserves	Storing body fat makes individuals more vulnerable to predation	Great tits
Memory capacity	Species that do not store food have smaller hippocampus	Passerine songbirds

3.3 Travel time (Davies et al. 2012:53, Fig 3.1)

- Starlings collect larvae that they feed nestlings
- **H1**: maximize rate of return in patch
- Test: H1 rejected
- Constraints: load size and travel time *(if forage further, carry larger load)*

3.4 Local traditions (Davies et al. 2012:77)

- Blue-headed wrasse mate at sites where others congregate
- Not optimal based on resource quality
- Constraint: local tradition maladaptive
- Test: Removed/replaced fish => optimal sites

3.12 Poll- lets see if you understand

Would you like to chat further about any of the items we just covered?

a) Practical application of "constraints"
b) Examples of constraints from the literature
c) Travel time as a constraint (starlings)
d) Local traditions as a constraint (wrasse)

Summary

(Davies et al. 2012:81)

Optimality models clarify foraging :

1. **Decisions**: e.g. Where to search? Who to follow? What to eat? Handling? Sharing?
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