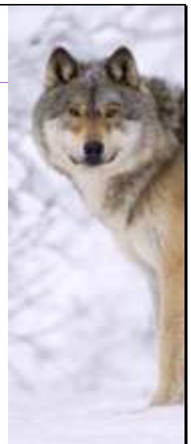
Behavioral Ecology of Vertebrates



Unit 5. Competitors

Module 2 Habitat

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Learning, Discovering and Sharing Knowledge

Last unit we talked about co-evolution of predators and prey, this unit we will talk about competitors. If you recall, when we looked at "predators as editors", it the co-evolution resulted in stepwise change in two different species (separate gene pools for predator and prey species). In this unit, we apply the same concept to co-evolution of genotypes within one species (one gene pool). We also add one more modeling "tool" to our toolkit: game theory.

Learning Objectives (Davies et al. 2012:144)

Competition of genotypes within one species:

1. **Exploitation**: indirect competitors "gobble up" resources; choose the "rich" over "poor" patch.
2. **Resource defence**: direct competitors switch tactics (escalate, assess, de-escalate) based on the social context
3. **"Personalities"**: genetic polymorphisms within populations adapted to ecological cycles; shifting behavior syndromes within populations (% shy, % bold)

Exploitation competition influences decisions of when to switch between poor and rich patch. Resource defense involves decisions of when to escalate or de-escalate based on assessment of resource defendability. Recently more attention has shifted to testing hypotheses about animal personalities and how flexible individuals might be in terms of assessing when to escalate or de-escalate depending on the genetic cards dealt at birth and how they learn to play those cards. In addition to "shy" vs "bold" tactics, we will discuss individual variation in "fighter", "sneaker" and "mimic" tactics.

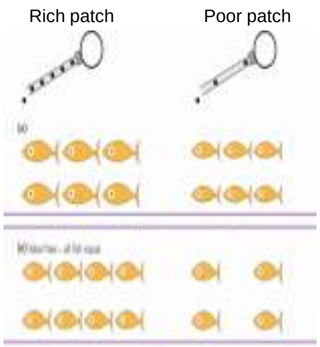
Indirect competitors "gobble up" resources

1. EXPLOITATION

During our field trip, we observed competition for food resources via indirect exploitation. This group of sable is waiting for the feed truck to arrive and scatter pellets along the road. At this time of year, their food resource is very clumped in space and in time. Competitors who get there first get more pellets than those who lag behind. Lets hear from some of our field trip participants. What did you observe on the field trip that illustrated exploitation (scramble) competition? How do we distinguish indirect exploitation competition from direct "despotic" competition?

1.1 Exploitation (Davies et al. 2012:120, Fig. 5.5)

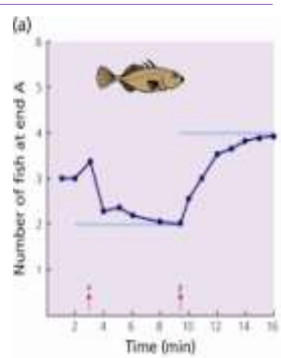
- H1. Ideal Free Distribution Model
- Assumptions:
  - No conflict
  - Each fish free to move
  - Rich patches fill first
  - Competitors choose based on rate of return
- Unequal competitors
  - big fish eat 2X
  - little fish eat 1X



First a bit of background about one of the simplest models related to exploitation competition. | Break for chat Q/A | Alyssa will chat a bit with us about how this hypothesis has been tested in fish and ducks (next slides).

1.2 Competition for food- sticklebacks (Fig 5.2)

- Prey pipetted into both sides of tank; one end was presented prey at twice the rate as the other.
- Which side of the tank a fish chooses depends on where the others go.
- Sticklebacks distribute in the "ratio of the patch profitabilities"
  - *4 fish at the fast-rate end*
  - *2 fish at the slow-rate end.*
- **Why was there a shift at time Y?**

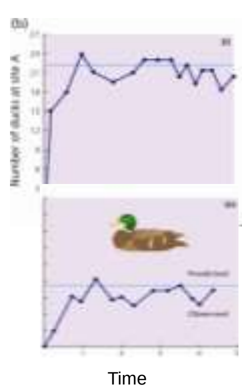


Credits: A. Marsh (edited by J. Packard)

Test of Ideal Free Distribution model of exploitation competition. | break to chat about Q | They switched locations on the rate of return of the pipettes at time Y

1.3 Competition for food- ducks (Fig 5.2)

- Bread was thrown into a pond; one side at twice the rate as the other.
- Just like the sticklebacks, the numbers of ducks on either end matched that ratio of the patch profitabilities
  - *number of ducks doubled on the side of the pond with twice the amount of food.*
- In this experiment, the equilibrium flock sizes occur within a minute, before each duck had a chance to visit both sides of the pond.
- **How could ducks reach stable distribution so quickly?**

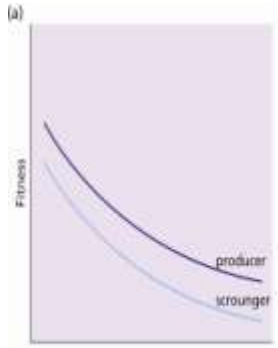


Credits: A. Marsh (edited by J. Packard)

Test of Ideal Free Distribution model of exploitation competition. | break to chat about Q | Open Q, no definitive answer provided. What would be your alternative hypotheses? How could you test one or more of those hypotheses?

1.4 Producers vs. scroungers (Davies et al. 2012 Fig. 5.9)

- "producer" tactic searches and samples rich vs. poor patches
- "scrounger" tactic follows the crowd
- Strategy or tactic?
  - Strategy (genetic)
  - Tactic (learned)
- **How would you test if it is strategy or tactic?**



1.4 Poll- lets see if you understand

Exploitation competition: which of these topics would you like to chat more about?

a) Application to pellet feed at Fossil Rim
b) Hypothesis of Ideal Free Distribution (IFD)
c) Stickleback example: test of IFD
d) Duck example: test of IFD

Davies et al. 2012, Fig 5.12

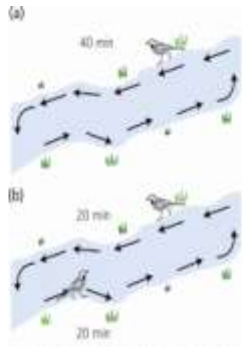
Direct competitors switch tactics (social context)

2. RESOURCE DEFENSE

Active direct defense of a resource also influences competition. In the sable, we watched adults escalate toward youngsters who quickly stepped aside. However, the youngsters usually circled around and came in to eat at another spot at the trough. This concept of switching between defending a resource and waiting to gain access to the resource has been tested in horseshoe crabs by Jane Brockman at Univ Florida. In this application, the resource is a female about to lay eggs. The male behind her chose "defense" tactics. The male at the side chose "assess" tactics. The idea here is that the payoff for these tactics varies with the social context. The genetic strategy is to switch between tactics based on the social context.

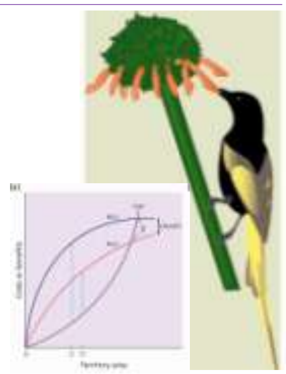
2.1 Territorial defense (Davies et al. 2012, Fig. 5.8)

- Pied wagtails defend stream bank where food accumulates
- Poor conditions- takes longer to get the same amount, no sharing
- Good conditions- switch to sharing tactic



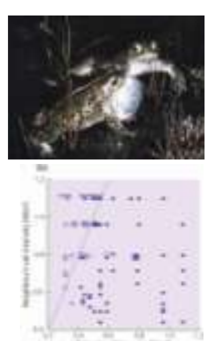
2.1 Economic defendability (Davies et al. 2012, Fig. 5.7)

- Sunbirds are nectar-feeders
- IF "poor" patch THEN costs of defense outweigh benefits
- IF "rich" patch THEN benefits of defense outweigh costs
- Switch tactics conditional on nectar



2.2 Switcher strategy (Davies et al. 2012:90, Fig. 5.11)

- Natterjack toad males migrate to ponds where females lay eggs
- Callers gained 80% of copulations
- Sneakers are smaller and do not call (40%)
- Test conditional tactic: remove large males and small males start calling



2.2 Game theory models (Davies et al. 2012:117)

- Game theory based on Monte Carlo gambling
- "winning" strategy depends on context
  - H wins if ratio is H<D
  - D wins if ratio is H>D
  - Switcher always wins
- Stable ESS
  - Genetic mix if H=D 50:50
  - Switcher genotype 100%

Player 1 strategy	Player 2 strategy	
	"Hawk"	"Dove"
"Hawk"	-25	50
"Dove"	0	25
"Switcher"	0	50

"Hawk" always escalates
"Dove" always de-escalates
"Switcher" assesses conditions
de-escalates to "Hawk"
escalates to "Dove"

Adding a "tool" to our toolkit. Assumptions are a better match to reality than optimality theory. Predicts which genotype will increase in % in a gene pool, based on the other genotypes present.

Basis for prediction how individuals choose to switch tactics depending on what others are doing in the social context

2.5 Poll- lets see if you understand

About which of the previous topics would you like to chat more?

a) Concept of resource defense (horseshoe crabs)
b) Pied wagtails- territorial defense
c) Sunbirds- economic defendability
d) "Switcher" strategy (genotype) & tactics (phenotype) in natterjack toads
e) Game Theory Models- adding to our toolkit

Lets dialogue more about this using the elearning discussion tool

Davies et al. 2012 Fig. 5.13

Polymorphisms within populations

3. "PERSONALITIES"

Dung beetles have two tactics: "Guarders" and "Sneakers". The switch occurs during development, related to nutrition. Those that get better nutrition switch to guarding female burrows, the others sneak copulations through side tunnels. In this photo, which would you guess is the "escalate" tactic, the one on the left with the horn, or the one on the right without the horn? Note that individuals cannot switch tactics after a certain stage in development.

3.1 "Personalities" (Davies et al. 2012:143)

- Phenotype e.g. "shy" or "bold" results from:
  - Genotype "temperament" *(cards dealt at birth)*
  - Environment "coping styles" *(learned tactics)*
- Gene pool
  - Fixed strategy *(1 phenotype = 1 genotype)*
  - Mixed strategy *(2 fixed genotypes or 1 switcher genotype with a developmental trigger)*
  - Conditional *(1 genotype switches tactics conditional on others in the social context)*

3.2 Genetic polymorphism (Davies et al. 2012:139)

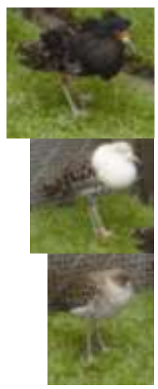
- Ruffs (shorebird species)
- 3 genotypes within one species
- Each genotype codes for a different strategy
- Test: genetic polymorphism
- Selection varies due to:
  - H1: physical environment
  - H2: social environment

Genetic Strategy

Territorial fighters

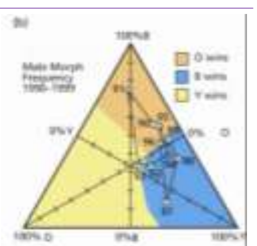
Satellite sneakers 17%

Female Mimic 1%



3.1 Lizard polymorphism (Davies et al. 2012, Fig. 5.19)

- Side-blotched lizards
  - •Orange- large territory
  - •Blue- small territory *(1 female)*
  - •Yellow- female mimic
- Proportions shift in the gene pool – variable "behavior syndromes"
- Why?



3.4 Poll- lets see if you understand

About which topic would you like to chat about more?

a) Concept of individual variation in "personality"
b) Genetic polymorphism in ruff shorebirds- maintenance of a rare allele (female mimic)
c) Genetic polymorphism in side blotched lizards- shifting proportions are frequency dependent

Lets dialogue more about this using the elearning discussion tool

Summary (Davies et al. 2012:144)

Competition of genotypes within one species:

1. **Exploitation**: indirect competitors "gobble up" resources; choose the "rich" over "poor" patch.
2. **Resource defense**: direct competitors switch tactics (escalate, assess, de-escalate) based on the social context
3. **"Personality"**: genetic polymorphisms within populations that are adapted to ecological cycles; shifting behavior syndromes within populations