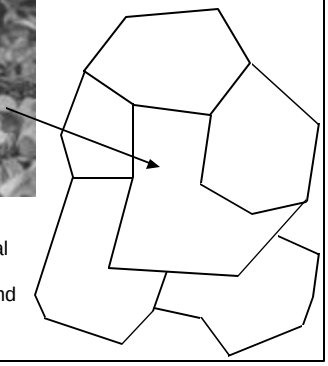
Territory Size: Jacanas



1. Sex role reversal
2. Males provide all parental care duties
3. Females setup and defend large territories, used to attract males

Territory Size: Impalas

1. Male impalas defend territories that contain food resources
2. Females wonder widely in search of food for themselves and their offspring
3. Males copulate with females when they are on their territory
4. Larger territories = more females

Costs and Benefits to Territory Size

Benefits	Costs

- benefits and costs generally increase with territory size

Cost - Benefit Analysis

What is the optimal territory size?

Cost - Benefit Analysis

(Janetos, 1980)

Net Benefits: $NB(s) = B(s) - C(s)$

Set Derivative to 0: $\frac{dNB(s)}{ds} = 0$

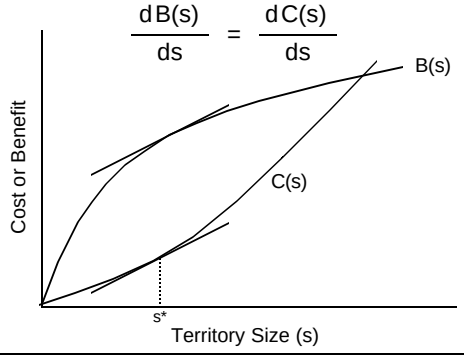
$$\frac{dNB(s)}{ds} = \frac{dB(s)}{ds} - \frac{dC(s)}{ds} = 0$$

$$\frac{dB(s)}{ds} = \frac{dC(s)}{ds}$$

Cost - Benefit Analysis

Optimal territory size maximizes Net Benefits

$$\frac{dB(s)}{ds} = \frac{dC(s)}{ds}$$



Cost - Benefit Analysis

What is optimal territory size for a high quality versus low quality territory?

Territory Size: Convict Cichlids

1. Both male and female cichlids defend feeding territories
2. Bigger territories have more food, but also attract more competitors
3. Males and females will also defend nesting territories such as a rock cavity
4. Large cavities can house larger broods

Optimal Territory Size in the Convict Cichlid

(Praw and Grant 1999)

1. Set out to test cost-benefit analysis theory
2. To do this they tested the two assumptions and the two predictions of the theory:

A1: There are increasing benefits to territory size, but with diminishing returns

A2: There are increasing costs to territory size

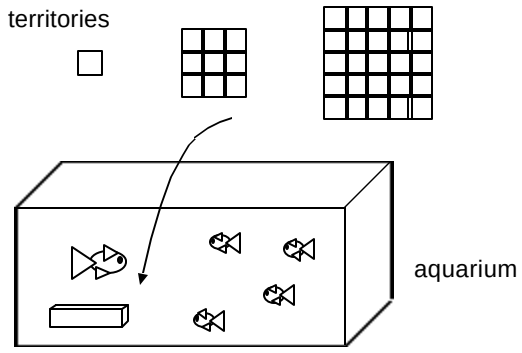
P1: Optimal territory size should be intermediate in size

P2: Optimal territory size should maximize net benefits (fitness)

Experimental Design

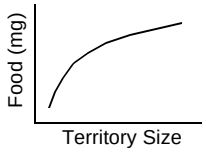
1. Into standard sized aquariums, modified ice cube trays were placed which contained a varying number of “cells”.
2. Territories included 1, 9, 25, 49, 81 or 121 cells.
3. Territories were square, thus the sides were 1, 3, 5, 7, 9 or 11 cells.
4. Each aquarium contained a single territory and one large fish (territory owner) and four smaller fish (intruders).

Experimental Design



Experimental Design

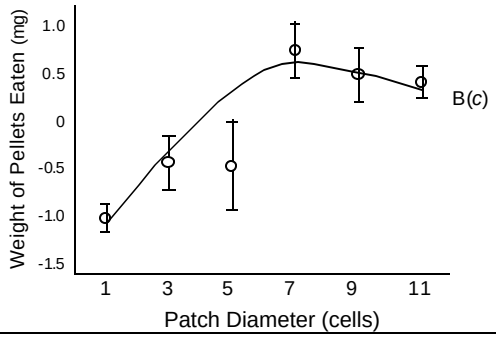
5. Food was placed into each cell prior to a trial, but with diminishing returns: 13 mg, 26 mg, 38 mg, 48 mg, 51 mg and 54 mg.



6. Benefit was measured as the weight of pellets eaten by the territory owner.
7. Cost was measured by the number of intrusions by competitors.
8. Net benefit was measured as growth rate of territory owner (surrogate of fitness)

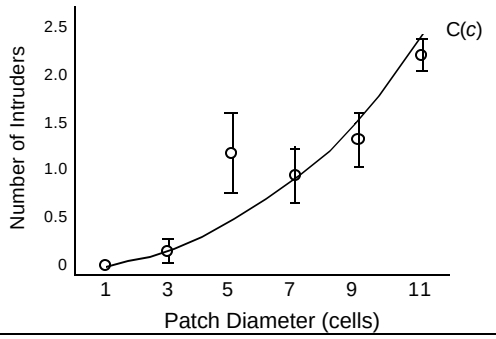
Results: Benefits

$B(c) = -0.024 \cdot c^2 + 0.44 \cdot c - 1.51$



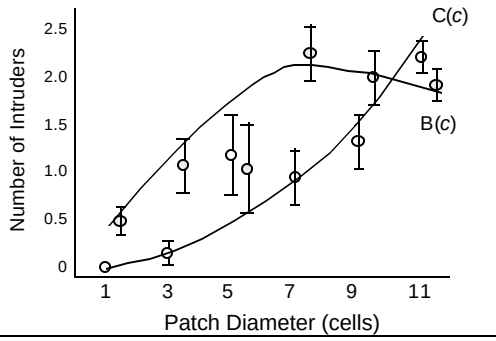
Results: Costs

$C(c) = 0.0064 \cdot c^2$



Results: Net Benefits

$NB(c) = B(c) - C(c)$



Results: Net Benefits

Benefit Function: $B(c) = -0.024 \cdot c^2 + 0.44 \cdot c - 1.51$

Cost Function: $C(c) = 0.0064 \cdot c^2$

Maximum Net Benefit:

Derivative of Benefit:

Derivative of Cost:

Results: Growth Rate

Fastest growing individuals were those that had a territory with a diameter of just over 7 cells