

# PRODUCER - SCROUNGER GAME

n-Person Game

Economics of Social Parasitism

Assume group foraging, then generalize

1. L.-A. Giraldeau & L. Lefebvre. 1987. *Anim. Behav.* 35:387.

Pigeons, test-tubes & seed-trays

A. Forging-task: Cultural transmission

B. Tilted tray: Scrounging feasible

No cultural transmission

Scroungers follow producers in group

C. No scrounging opportunity: learn task socially

*Individuals can learn to scrounge other individuals' discovery of resources*

Food: indefensible = scramble parasitism

Feeding groups: stealth & aggressive parasitism

Within & Between Species

Barnard, CJ & Sibly, RM. 1981. *Animal Behaviour* **29**:543.

## Producers and Scroungers

House Sparrows (*Passer domesticus*): aviary foraging

Producers searched for & discovered food clumps

Scroungers joined at clump, acquired food

*n*-Person game: given group size,

*ESS frequency of scrounging*

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## Assumptions of Producer-Scrounger Game

Fix group (or population size)

$q$  = frequency of **scrounger** in group

$1 - q$  = frequency of **producer** in group

Total resource production declines as  $q$  increases

Since fewer producers

Fitness of scrounger strongly frequency-dependent;

Declines faster with  $q$  than does producer fitness

$W_P(q)$  producer fitness

$W_S(q)$  scrounger fitness

Limit  $q \rightarrow 0$       $W_S(q) > W_P(q)$

*Rare scrounger more fit than producers*

*Scrounger invades Producer*

Limit  $q \rightarrow 1$       $W_S(q) < W_P(q)$

*Rare producer more fit than scroungers*

**Finder's share** of resource clump

Consumed before scroungers arrive

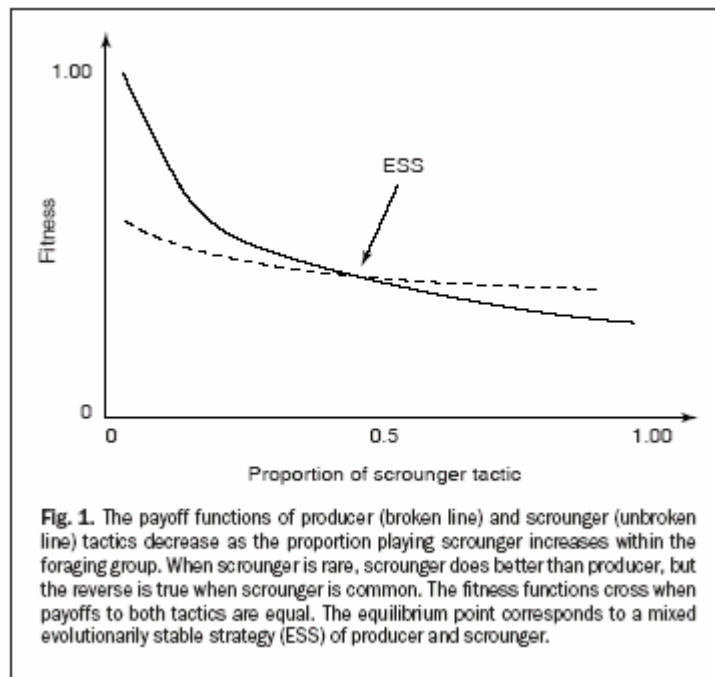
*Producer invades Scrounger*

n-Person Game with ESS  $q^* : 0 < q^* < 1$

$W_S(q^*) = W_P(q^*)$      Equal fitness at ESS

$$\left( \frac{dW_S}{dq} \right)_{q^*} < \left( \frac{dW_P}{dq} \right)_{q^*}$$

Scrounger fitness decays faster in  $q$



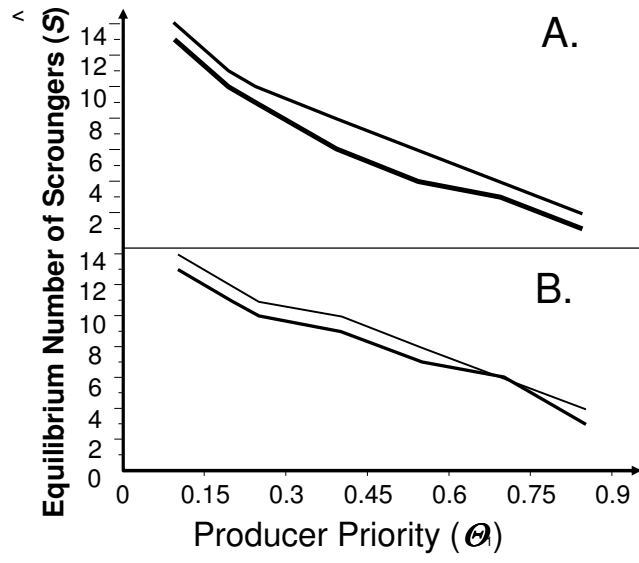
ESS frequency of scrounger  $q^*$

*Increases* with amount resource per discovery

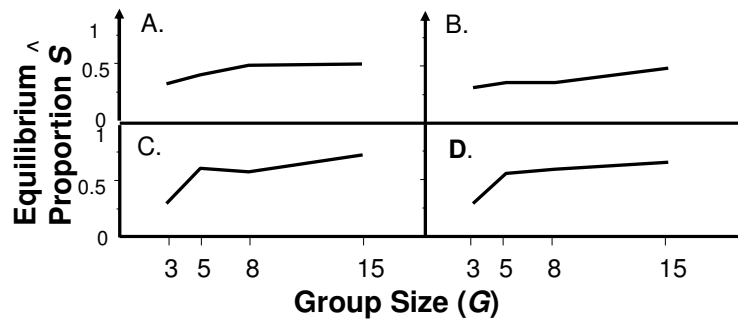
*Decreases* with finder's share

*Increases* with group size

# Finder's Share



## Group Size



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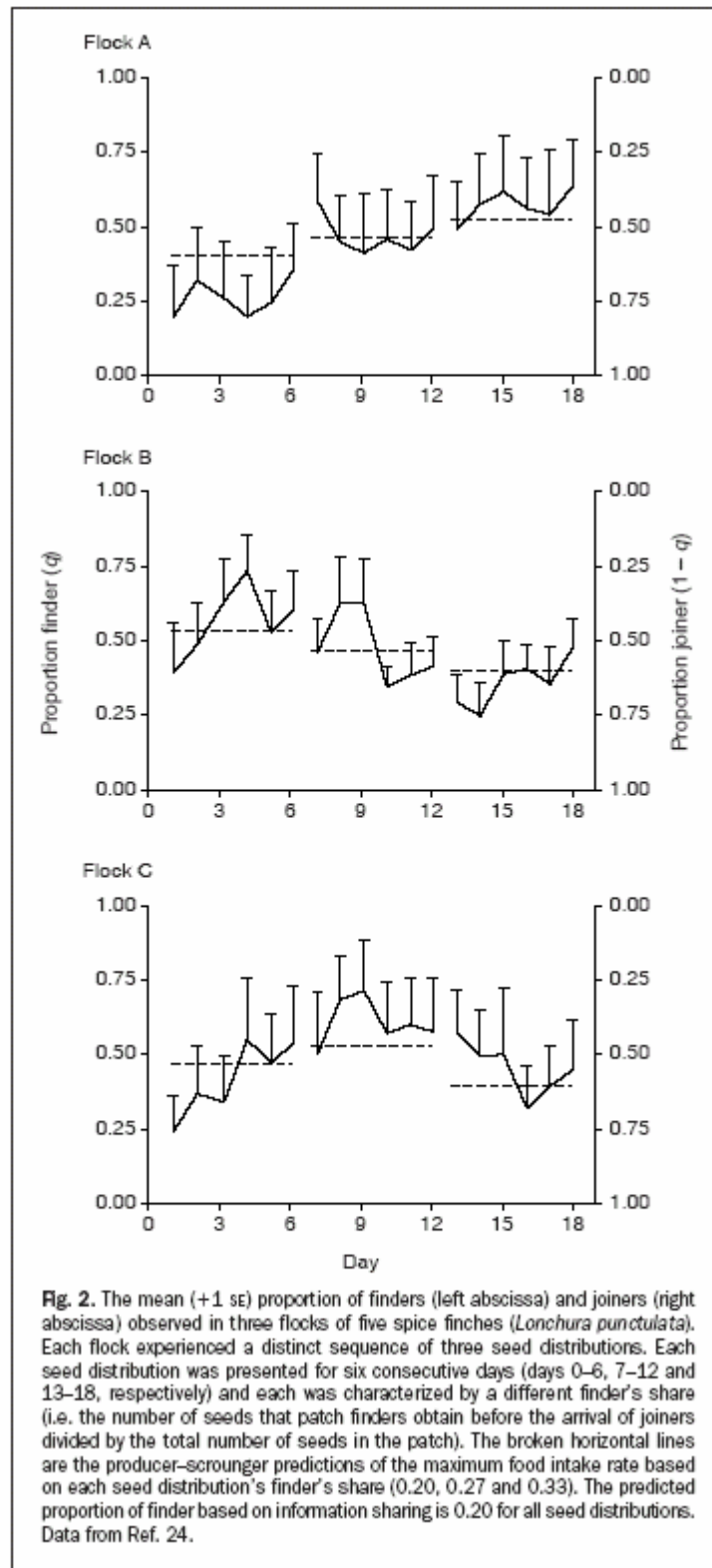
Spice finches (*Lonchura punctulata*)

Finder's share predicts variation in scrounging

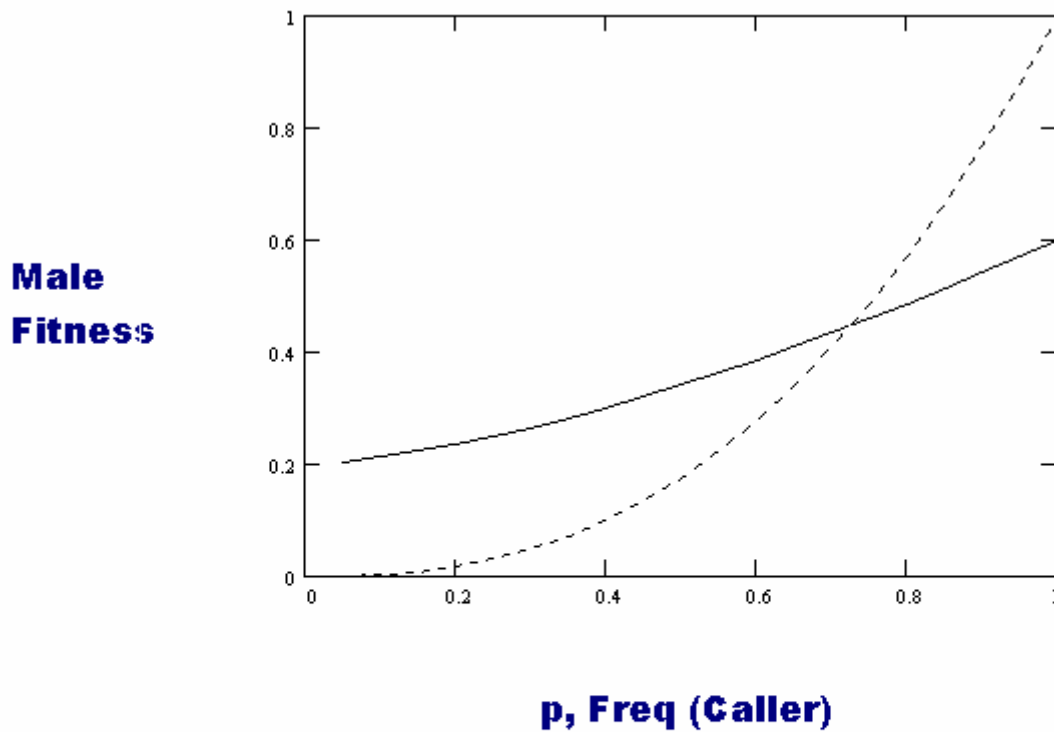
Groups of 5 individuals

Clump sizes: 20, 10, 5 seeds; Increasing finder's share

## Finder's Share Predicts Scrounger Frequency



## Caller-Satellite Males



**Solid line: Caller Fitness**

**Broken line: Satellite Fitness**

**Freq (Satellite) = 1 - p**

Satellite (Scrounger) Invades Caller (Producer)

Caller (Producer) Invades Satellite (Scrounger)

Other Examples?