Resource Specialist, Resource Generalist

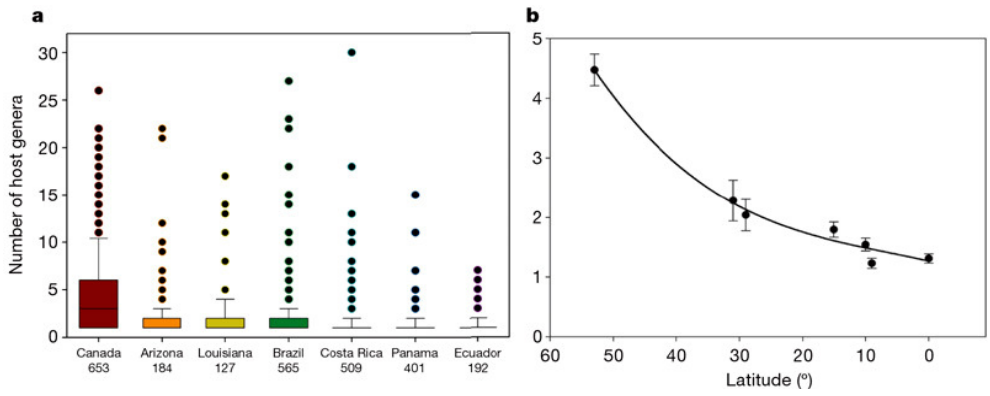
- Specialize: Choose Narrow Set of Resources
- Generalize: Choose Broad Set of Resources

Concepts Apply Across Extensive Consumer Choices

- Evolved Response, Phenotypically Plasticity

Approach: Dietary Choice

- Forager: Selecting food types, Discrete prey types
- Simple Optimality (Solitary Forager)
  - No Social Interaction



Number Host Plants Chosen by Butterfly Species

Varies with Latitude

Larval Herbivores: Often Choice ⇔ Oviposition

Canada: *Generalist* Species (4 -5 Host Genera)

Ecuador: *Specialist* Species (1 + Genus)

Why Do Some Consumers Choose Narrow Diet,

While Others Choose Broad Diet?

OPTIMAL DIET: "CONTINGENCY MODEL"

Constraints:

SIMULTANEOUS SEARCH, SEQUENTIAL ENCOUNTER

PREY TYPES 1 & 2

WHILE SEARCHING ENCOUNTER TYPE j AT RATE λ_j; j = 1, 2

Prey-type density, How "apparent" to forager

ENCOUNTER TYPE J ITEM:

ACCEPT: HANDLING TIME h_j, NET ENERGY E_j

REJECT: SEARCH CONTINUES

Mutually exclusive behaviors

ASSUME REPEATED CYCLES SEARCH AND HANDLING:

Important for Currency of Fitness

***Develop Currency of Fitness*:**

RANK PREY: PROFITABILITY E_j / h_j

$E_1 / h_1 > E_2 / h_2$: TYPE 1 "PREFERRED"

HYPOTHESIZE THAT SELECTION FAVORS INCREASES IN

NET RATE OF ENERGY GAIN WHILE FORAGING

COMPARE TYPE 1 SPECIALIST (NARROW DIET)

WITH GENERALIST (BOTH TYPES, BROAD DIET)

ASSUME FORAGER SEARCHES FOR TIME T_s

SPECIALIST

ENCOUNTERS $\lambda_1 T_s$ ITEMS, E_1 = ENERGY / ITEM

ENERGY = $\lambda_1 T_s E_1$

TIME = SEARCH + HANDLING

TIME = $T_s + \lambda_1 T_s (h_1)$

RATE OF ENERGY GAIN = ENERGY / TIME

SPECIALIST $R_1 = \lambda_1 T_s E_1 / (T_s + \lambda_1 T_s h_1)$

$R_1 = \lambda_1 E_1 / (1 + \lambda_1 h_1)$

GENERALIST: FASTER ENCOUNTER, LOWER PROFITABILITY

ENCOUNTER RATE $(\lambda_1 + \lambda_2)$, T_s SEARCH TIME

Simultaneous search

$(\lambda_J T_s)$ ITEMS OF TYPE J; J = 1,2

ENERGY $= T_s(\lambda_1 E_1 + \lambda_2 E_2)$

TIME = SEARCH + HANDLING

TIME $= T_s + T_s(\lambda_1 h_1 + \lambda_2 h_2)$

TIME $= T_s(1 + \lambda_1 h_1 + \lambda_2 h_2)$

RATE OF ENERGY GAIN GENERALIST

$R_{1,2} = \{T_s(\lambda_1 E_1 + \lambda_2 E_2)\} / \{T_s(1 + \lambda_1 h_1 + \lambda_2 h_2)\}$

$= (\lambda_1 E_1 + \lambda_2 E_2) / (1 + \lambda_1 h_1 + \lambda_2 h_2)$

BY HYPOTHESIS, PREDICT:

SPECIALIZATION IF $R_1 > R_{1,2}$

$R_1 > R_{1,2}$:

$(E_1 / E_2) h_2 > (1 / \lambda_1) + h_1$

1. Solve for R_1

SPECIALIZE: $(E_2 / h_2) < (\lambda_1 E_1) / (1 + \lambda_1 h_1) = R_1$

PROFITABILITY OF ENCOUNTERD ITEM < CURRENT RATE

Solve for Mean Time to Find Type 1 Item

SPECIALIZE: $(1 / \lambda_1) < (E_1 / E_2) h_2 - h_1$

LET $E_1 = E_2$:

$1 / \lambda_1 + h_1 < h_2$

FIND & EAT PREFERRED ITEM BEFORE CONSUME TYPE 2

SPECIALIZE: $(1/\lambda_1) < (E_1/E_2)\, h_2 - h_1$

OPTIMAL DIET INDEPENDENT OF TYPE-2 DENSITY λ_2

INCREASED λ_1, E_1

DECREASED h_1

INCREASED h_2

DECREASED E_2