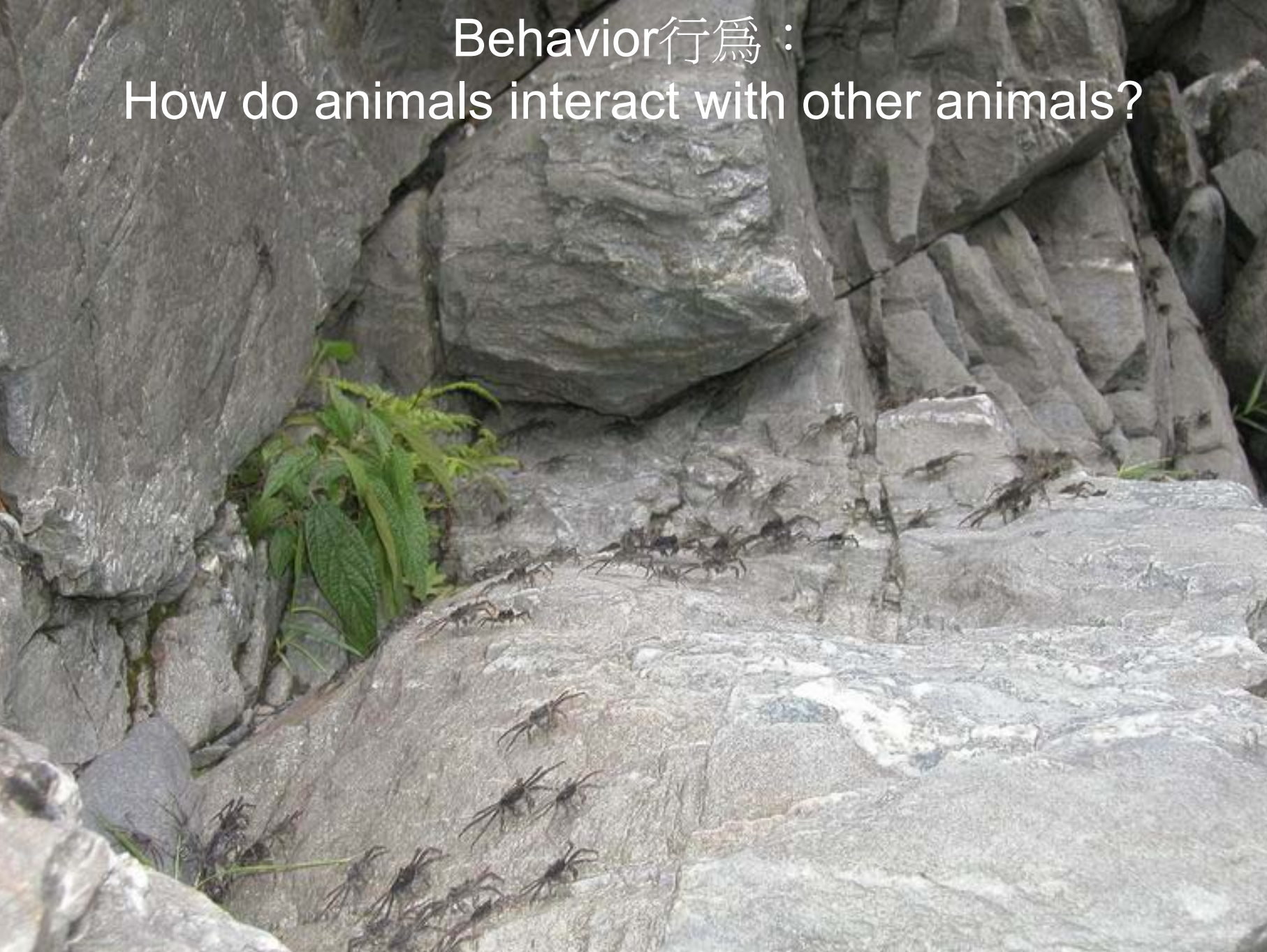Behavior行爲：
How do animals interact with other animals?
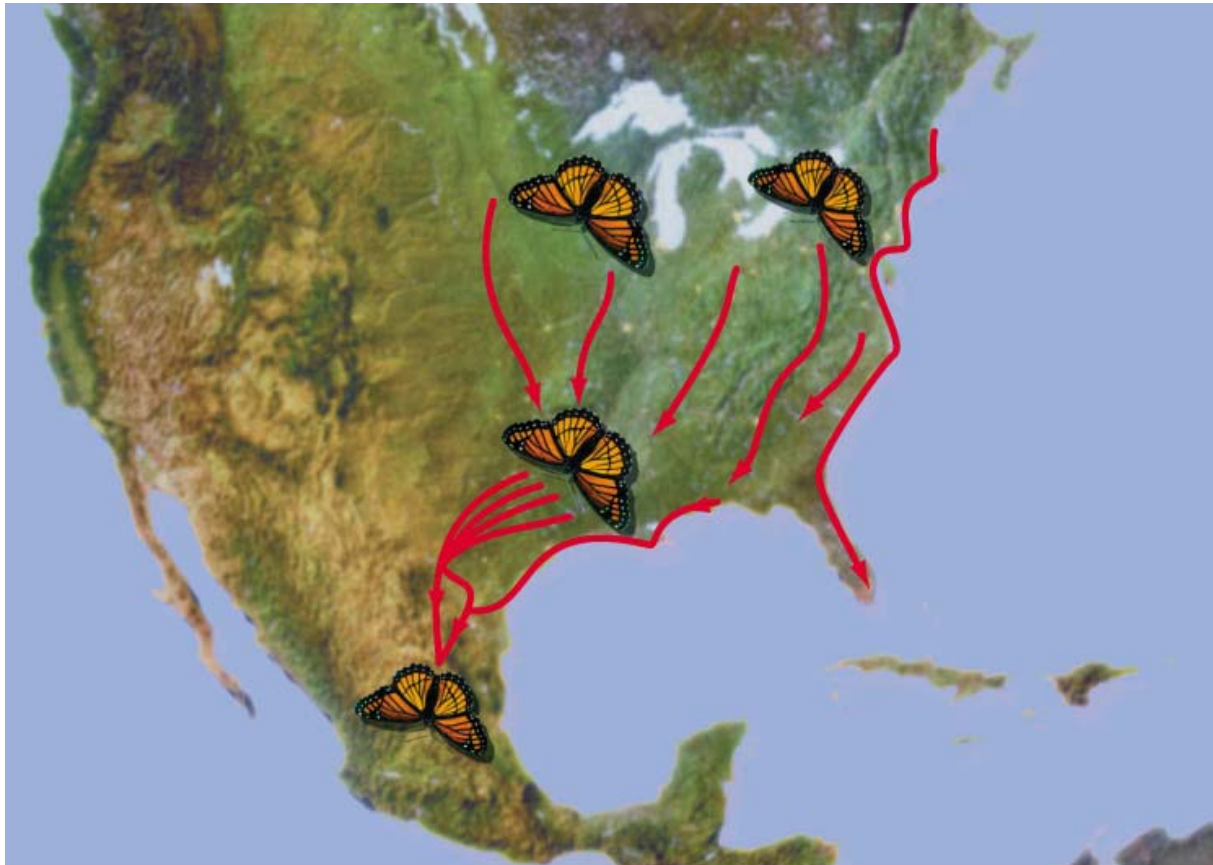
# 台灣絨螯蟹

- 夏季洄游下海產卵，幼苗於河口成長約半年
- 冬季幼蟹溯河到中上游山區生活

(a) Spring migratory path of the Monarch butterfly

Migratory movements of monarch butterflies

(b) Fall migratory path of the Monarch butterfly

# Migratory movements of monarch butterflies

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# 台灣的紫蝶幽谷

- 台灣有沒有遷移性的蝴蝶？它們的遷移行為如何？為什麼要遷移？它們怎樣辨認遷移的路徑？和其他動物的遷移方式一樣嗎？

台東大武加羅板蝴蝶谷

金斑行鳥的遷移路徑

Breeding range of
Pacific golden plover

Winter range of
Pacific golden plover

Breeding range of
Atlantic golden plover

Winter range of
Atlantic golden plover
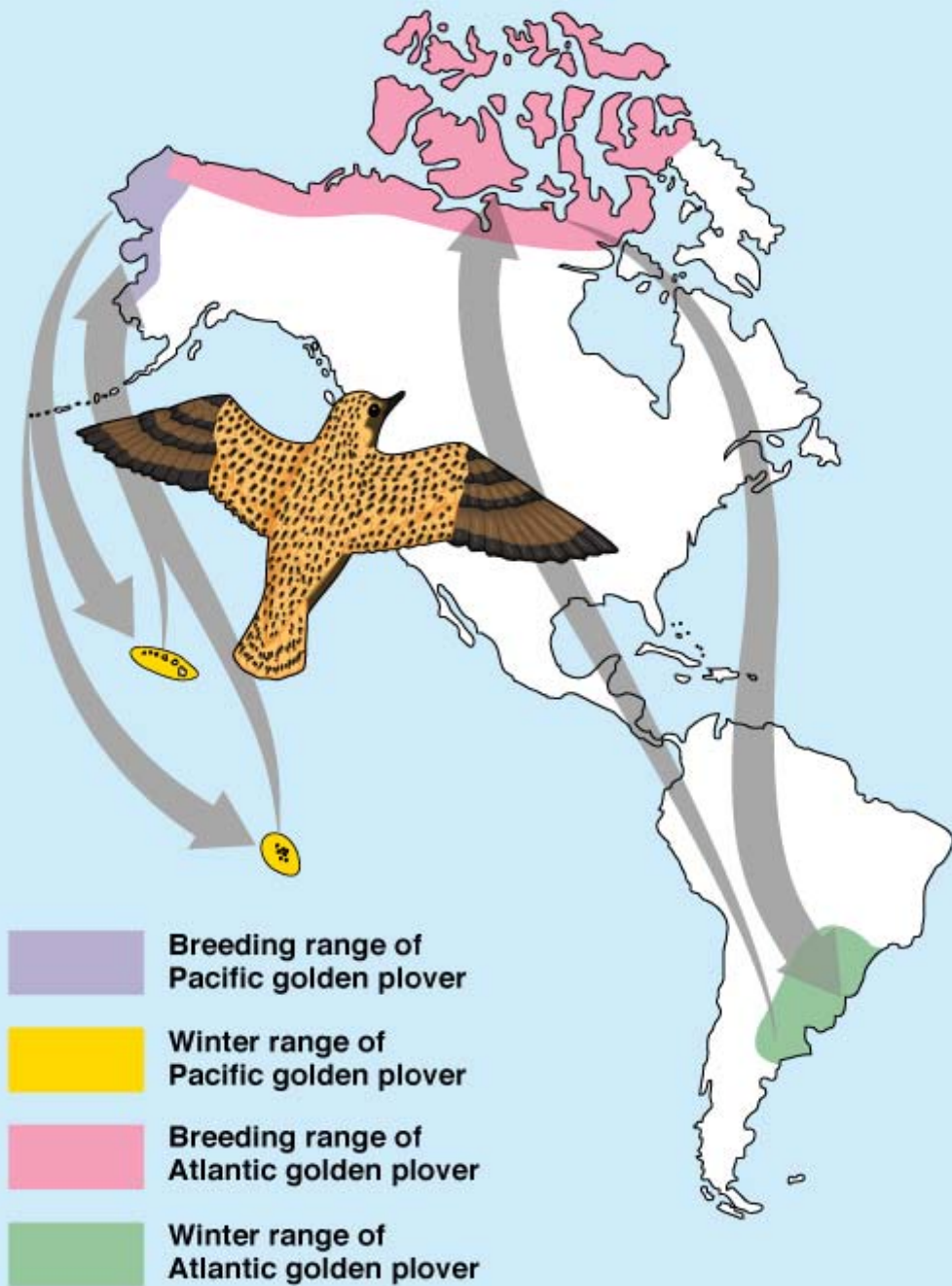
北大平洋鯨類的洄游路線

# Animal behavior

- **Foraging Behavior**
- **Territorial Behavior**
- **Mating Behavior**

# Behavioral Ecology

**Ethology**

**(G)**

**=Custom, habit;**

**. Survival value**

**. Causation**

**. Development**

**. Evolutionary history**

# 行爲生態學

- 將行爲學、生態學、進化論、遺傳學、數學和經濟學思想緊密地結合起來，並加入經濟學思想，探索新的理論和研究方法，且在新理論和新觀念的探索上提出了許多全新的概念，如進化穩定對策、博奕論、最適模型、兩性利益衝突、親緣選擇、廣義適合度、利他主義、行爲權衡和決策以及基因的自私性等。

- 從覓食行爲、生殖行爲、社會行爲、生境選擇和領域行爲、社群、捕食、信號與通訊、資源競爭等不同角度，探討行爲生態學的基本理論、基本內容和基本方法。

# Animal behavior

- How do innate and learned behaviors differ?
- How do animals communicate?
- How do animals interact?
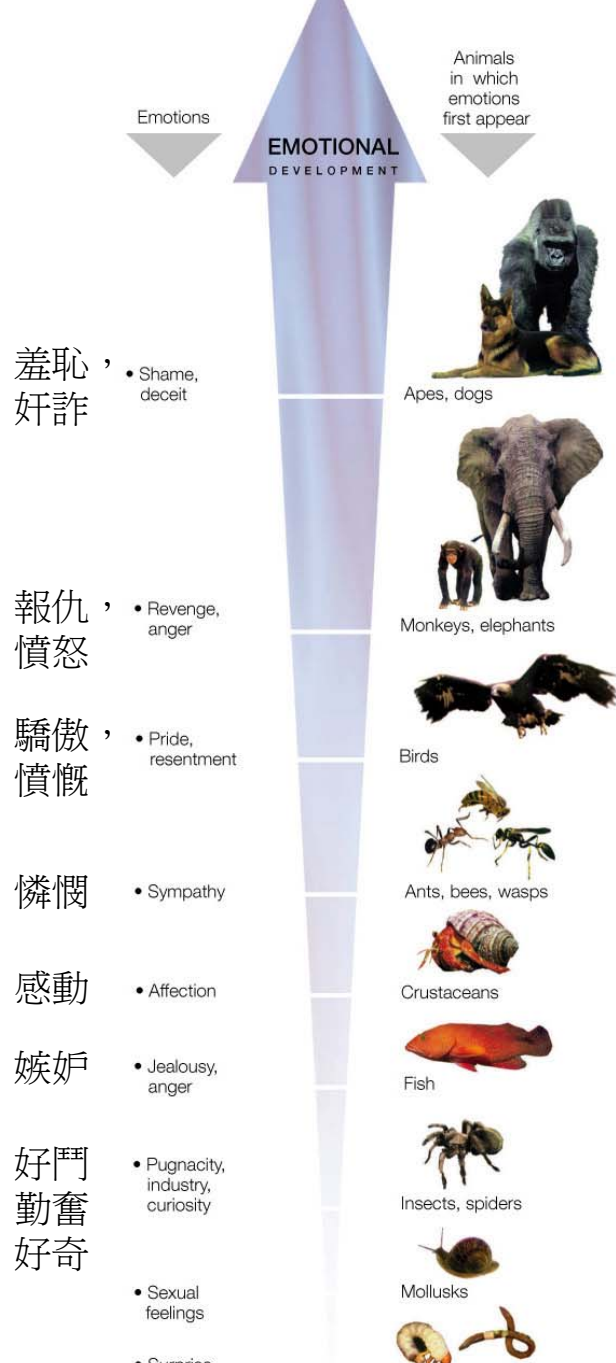- Can biology explain human behavior?

# behavior

- Results form both genes and environmental factors

- Innate behavior is developmentally fixed

- Classical ethology presaged an evolutionary approach to behavioral biology

- Behavioral ecology emphasizes evolutionary hypotheses: science as a process

# Animal behavior

- Innate先天性：
  - Reflexes反射,
  - Taxis趨向,
  - Instincts本能

# Animal behavior

- Learned學習：
  - Habituation習慣化：loss of a response
  - Imprinting銘刻現象：critical period
  - Association聯想：Trial and error, classical conditioning
  - Imitation模仿：Observe and learn
  - Innovation創造：Reasoning, without prior experience

| Emotions | EMOTIONAL DEVELOPMENT | Animals in which emotions first appear |

羞恥， 奸詐 — Shame, deceit — Apes, dogs

報仇， 憤怒 — Revenge, anger — Monkeys, elephants

驕傲， 憤慨 — Pride, resentment — Birds

憐憫 — Sympathy — Ants, bees, wasps

感動 — Affection — Crustaceans

嫉妒 — Jealousy, anger — Fish

好鬥 勤奮 好奇 — Pugnacity, industry, curiosity — Insects, spiders

— Sexual feelings — Mollusks

— Surprise

The evolution of

Courtesy Larry Underwood

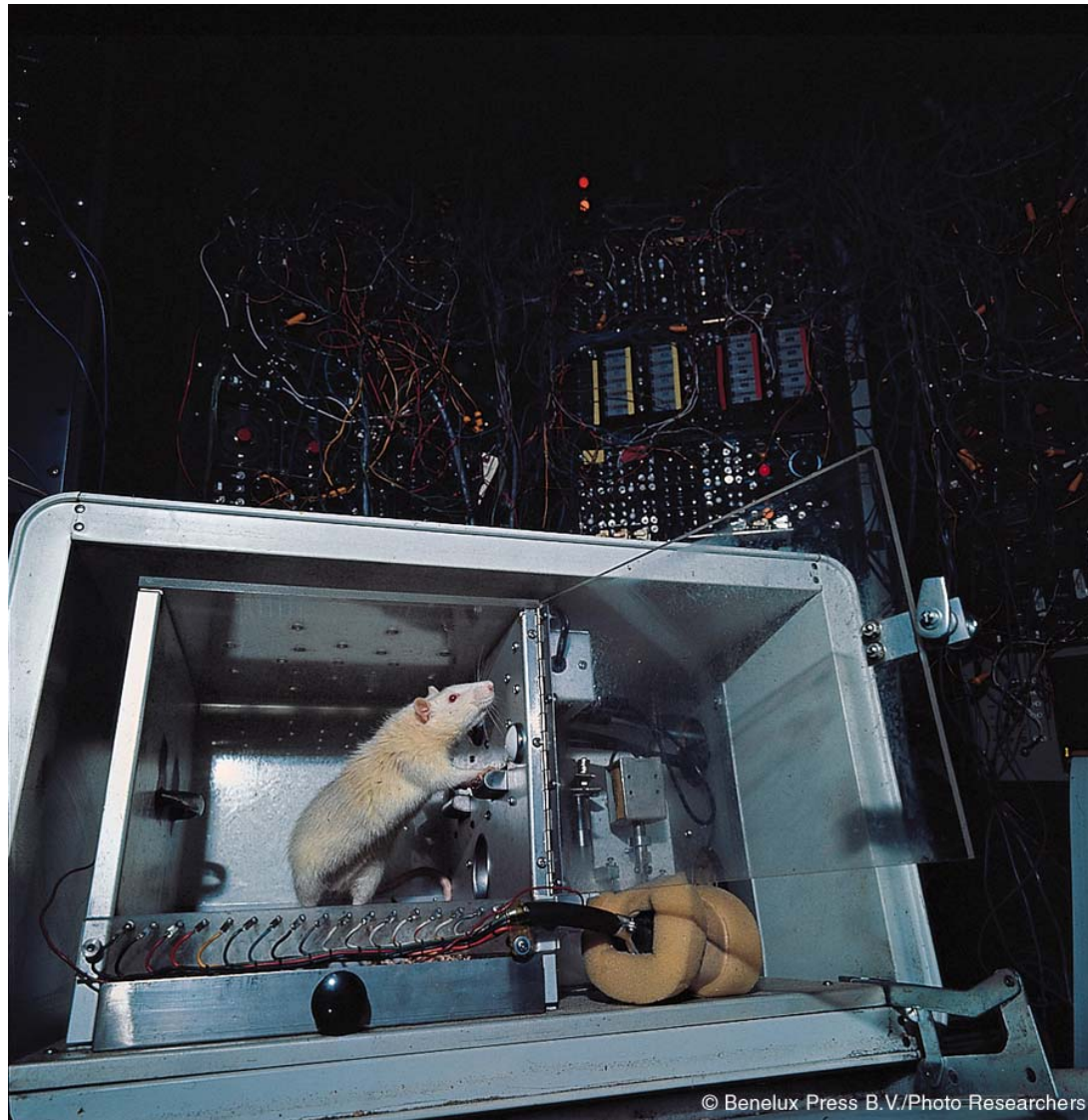Is hunting behavior in wolves learned or is it instinctive?

(a) Normal salivation

(b) Bell is rung when food is presented

(c) Salivation at the sound of ringing bell

Dogs learning experiments:

© Benelux Press B.V./Photo Researchers

Operant conditioning experiments

© Alaska Stock Images

Parental or maternal care

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# How do innate and learned behaviors differ?

- Innate behaviors can be performed without prior experience

- Learned behaviors are modified by experience

- There is no sharp distinction between innate and learned behaviors

# How do animals communicate?

- Visual communication in most effective over short distances
- Communication by sound is effective over longer distances
- Chemical messages persist longer but are hard to vary
- Communication by touch helps establish social bonds

# How do animals interact?

- Competition for resources underlies many forms of social interaction

- Sexual reproduction commonly involves social interactions between mates

- Social behavior within animal societies requires cooperative interactions

# Can biology explain human behavior?

- The behavior of newborn infants has a large innate component
- Innate tendencies can be revealed by exaggerating human releasers
- Simple behaviors shared by diverse cultures may be innate
- People may respond to pheromones
- Comparisons of identical and fraternal twins reveal genetic components of behavior

# Resources: Assessing Obtaining, and Defending

非排它性的資源分配


專制的資源分配(強領域性)

非排它性與專制性的混合策略：

蚜虫的孤雌生殖模式

(1)平均產於葉片上

(2)大個體先佔據葉柄附近

# Bourgeois model
# 對策博奕

當自己是資源佔有者時表現為鷹，

當自己是入侵者表現為鴿

. **Fighting strategy is frequency dependent**

. **The ESS（進化穩定對策） is often a mixture of different strategy types, Hawk and Dove.**

. **The ESS is dependent on the versus of scores in the game.**

**.ESS is not necessarily the "best" strategy.**

# Game strategy

If larger, behave like a Hawk, if smaller, behave like a Dove, if equally, adopt the Bourgeois strategy.

# Ritual Display:
# 儀式性展示

**Young males: weak voices Dove strategy**

**Alder males:    Hawk strategy**

©Addison Wesley Longman, Inc.

鸑鷈的配對行為

# Animal Communication

Light signals
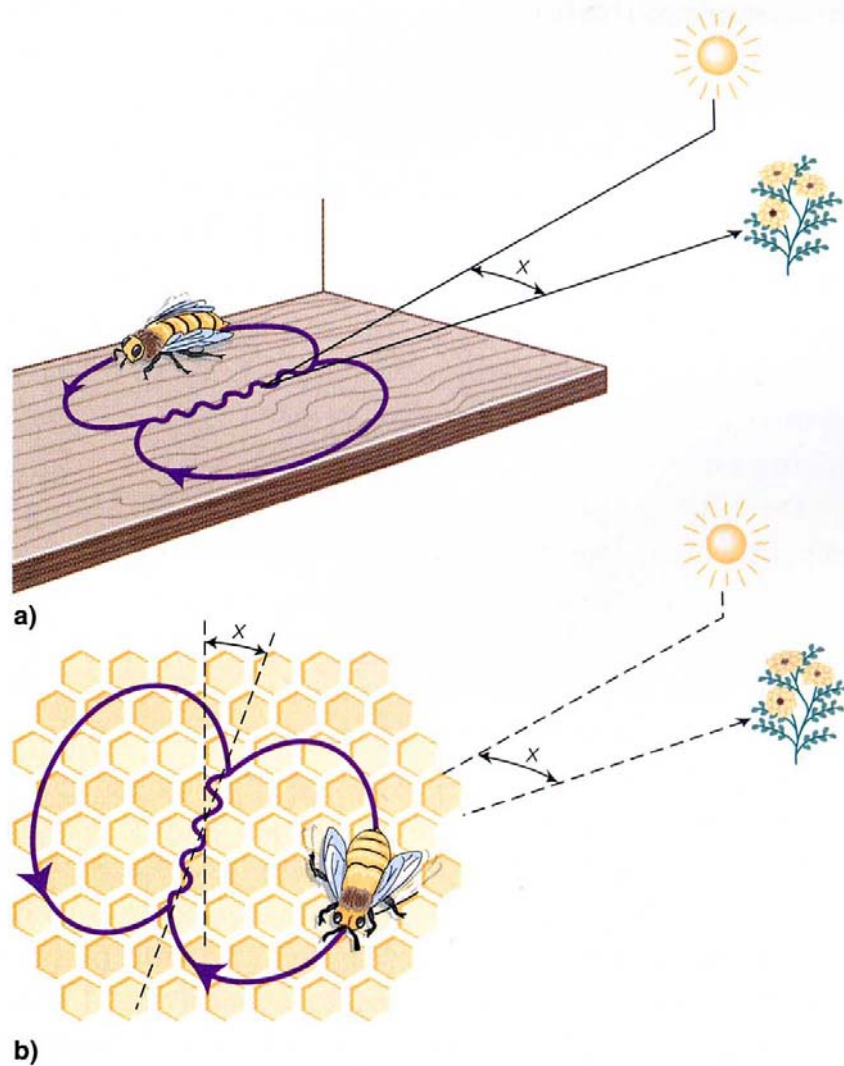
Mimic signals
(predator)

Pheromones

a)

b)

**FIGURE 8.5** The waggle dance of the honeybee, which is performed both (**a**) outside the hive and (**b**) inside the hive on a vertical surface. (*From Frisch 1967*)
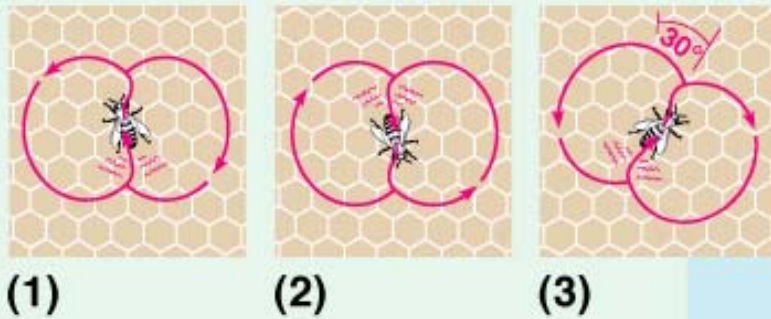
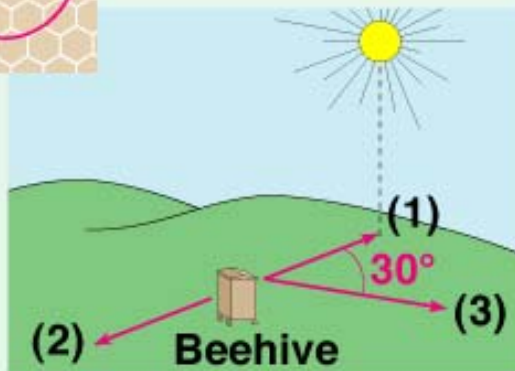39

B. Bees clustering around a recently returned worker

C. Round dance, indicating that food is nearby, in an unspecified direction

(1)　　　(2)　　　(3)

D. Waggle dance, probably indicating both distance and direction of food farther away

蜜蜂的訊息傳遞方式

# Louder calls attract

**more females**

  **Parasites**

  **Predators**

# Foraging Behavior and Optimality in Individuals.

**Optimality Theory:**

**Natural selection should produce animals that are maximally efficient at propagating their gametes and also at performing all other functions that subserve this function in the end.**

# Forage 掠食

The predators stayed in each patch until their rate of intake the marginal value) dropped to a level equal to the average intake for the habitat.

All patches should eventually be reduced to the same marginal value and that the marginal value should equal to average rate of intake for the habitat.

# Forage 掠食

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. All patches should eventually be reduced to the same marginal value and that the marginal value should equal to average rate of intake for the habitat.

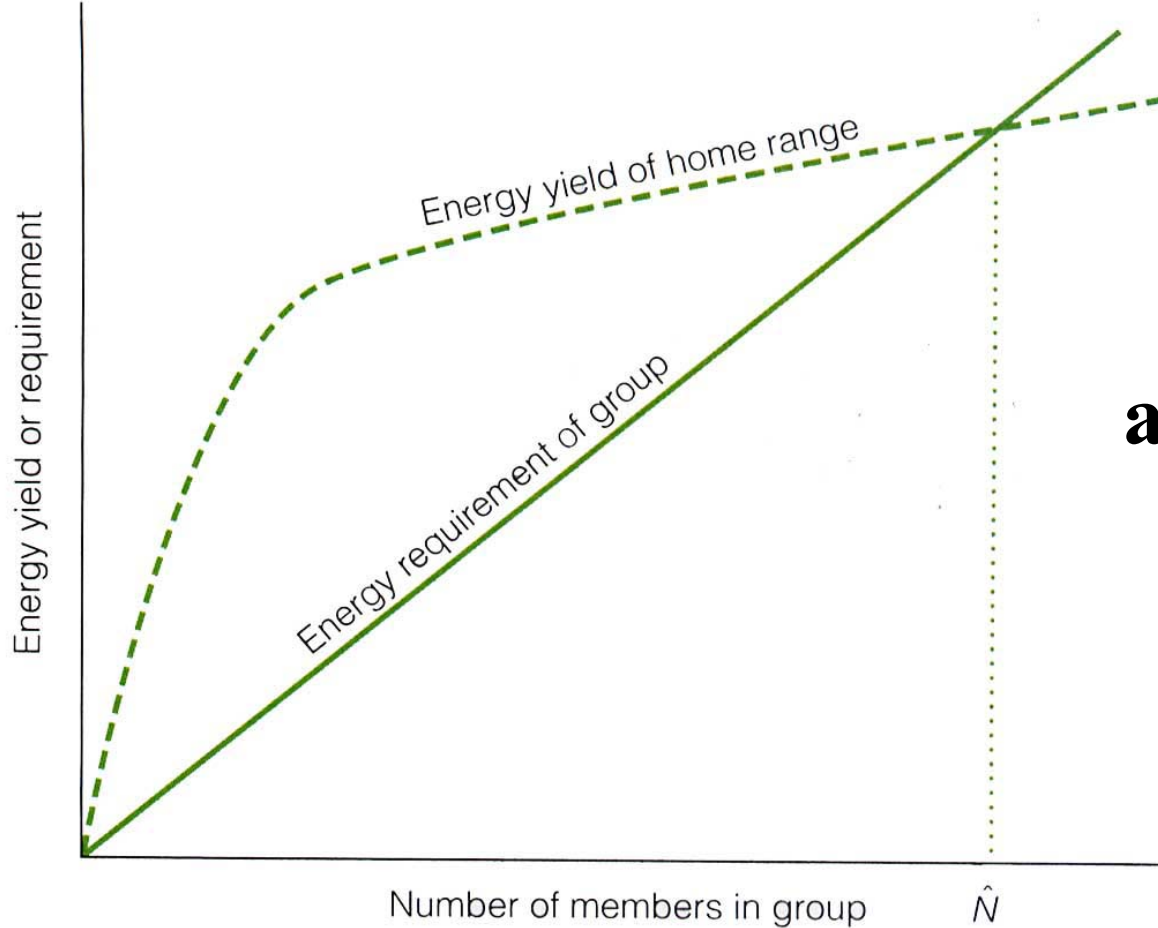# Territorial Behavior

**FIGURE 8.7** Many species of pinnipeds form harems such as the one shown here. A single dominant bull guards a group of females from other males. (*Photo by Eastcott/Momatiuk/Animals Animals*)

# Social system

1. Group size and structure.
2. The mating system.
3. Cooperation and helping.

**Group size and structure**

**FIGURE 8.10** A model of optimization of group size, expressed as a function of the habitat's energy yield and the group's energy requirements. If unaltered by other selection pressures, the optimal group size ($\hat{N}$) should change via evolution to a point at which the habitat's energy yield is fully utilized.
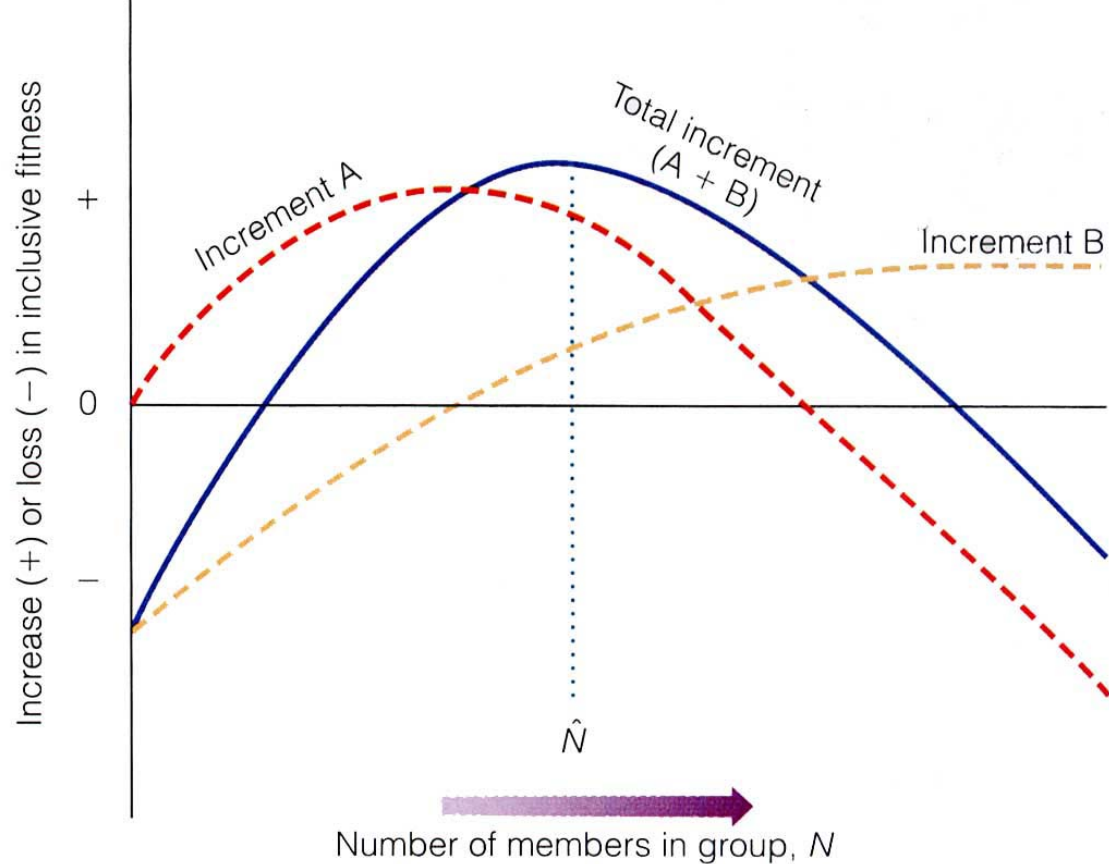
**Optimal group size**

**FIGURE 8.11** A more general model of optimal group size, given as a function of the maximum sumed components of group fitness. Two social contributors to fitness, indicated by A and B, could represent, for example, the increments due to superior group foraging and the increment due to superior group defenses against predators.

# Mating Behavior and Optimality

# The Battle of the sexes

**The maintenance of sex ratios**

**Asexual V.S. Sexual reproduction**

**Low ⟷ higher range variability much more rapid evolutionary adaptation**

**Fail to reproduce      Muller's ratchet**

**Correct genetic errors**

# Tangled-Bank 混亂庫

-Ghiselin (1974)

Theory：

The advantage of sexual reproduction results from the slight differences among offspring, which enable them to occupy microscopically different niches and to avoid competing as severely as the might.

# Mating system

**Polygamous polygyny (common)**
          **polyandry (rare)**


**Polygyny 一夫多妻**


**Monogamy一夫一妻**


**Polyandry 一妻多夫**

# Sexual reverse性轉變

**Protogynous hermaphroditism** 雌性先熟性轉變

**=Protogyny**

**Protandrous hermaphroditism** 雄性先熟

**=Protandry**

# Sexual dimorphism
# 性別二態現象

**Being attractive to mates**

**Bizarre male**

  **or attractive predator**

# The exception to the 1:1 sex ratio

. Different costs to produce or

. Local mate competition

. One male dominates in breeding

. Low dispersal powers

. Host- size effect

# Sexual selection:

**Selection by one sex for specific characteristics in individuals of the opposite sex, usually exercised through courtship behavior**

. **Intrasexual selection: favoring competitive fighting**

. **Intersexual selection: attract females.**

# Sex ratio

**Why males fact over females?**

**(1) Males have a much greater reproductive potential than females.**

**(2) Strong selective pressures to be good at seeking out and competing for females.**

# Why do many species have a 1:1 sex ratio?

# living in Groups：

.Increasing Vigilance 警戒

. Dilution Effect

# Altruism 利它主義：

**In an evolutionary sense, enhancement of the fitness of an unrelated individual by acts that reduce the evolutionary fitness of the altruistic individual.**

# Kin selection： 同族選擇

**A form of genetic selection in which alleles life in their rate of propagation because they influence the survival of in who carry the same alleles.**

# Ritual Display:

儀式性展示

**Young males: weak voices Dove strategy**

**Elder males:    Hawk strategy**

**Louder calls attract more females**
   **→Parasites**
   **→Predators**

# Cooperation and helping

1. Genetically based cooperation

2. Habitat saturation and food supply

    1. Division of labor and helpers.

    2. Mate sharing.

    3. Infanticide.

**B: donor sacrifices**

**C: recipient gains**

**R: coefficient of relatedness B to C**

**Altruism between Relatives**

**aposematism (warning coloration)**

**Synchronized estrous cycles**

**Altruism between Unrelated Individuals**

利它主義

**Reciprocal altruism**

相互適應

**Castes 階級現象**

**Alloethism:**

**A regular change in behavior patterns as a function of size.**