Parasites and Sexual Selection

George A. Lozano

1. Parasites and sexual selection
2. Immunity and sexual selection
3. Foraging, Immunity and sexual selecion.

“Mr. Charles Darwin had the gall to ask”

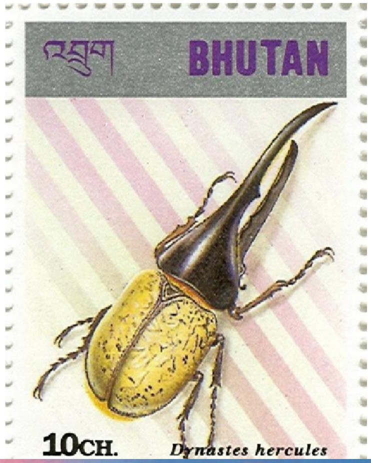
1. Population growth…
2. It never occurs
3. Strife
4. Short and tall, heavy and light
5. Heritability
6. Winners and losers
7. Change!

Sexual Selection

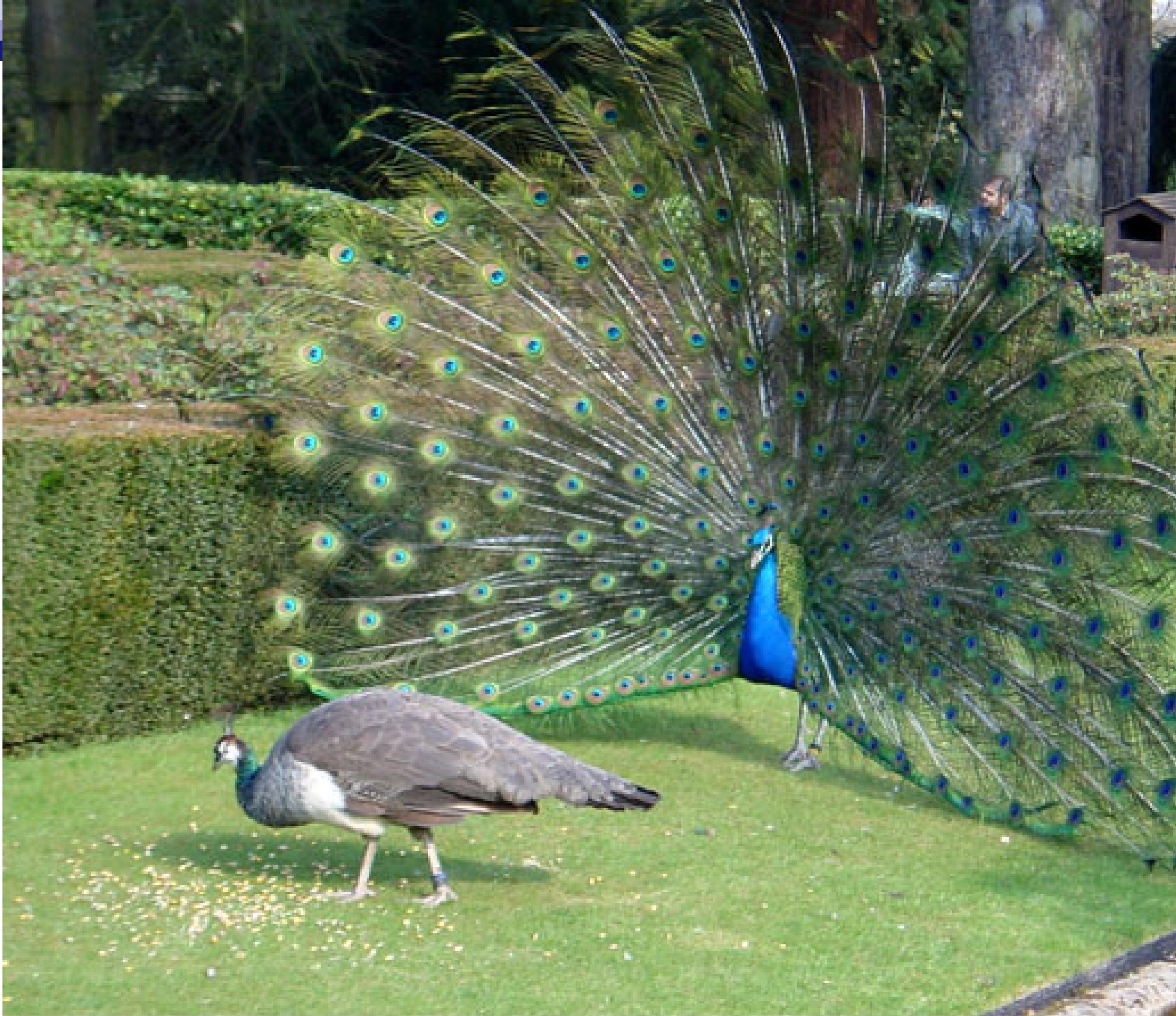
- Competition among gametes for fusion partners.

- Antagonism between sexual and natural selection
- Imagine a population…
- Anisogamy

Consequences of sexual selection




Snow Frost



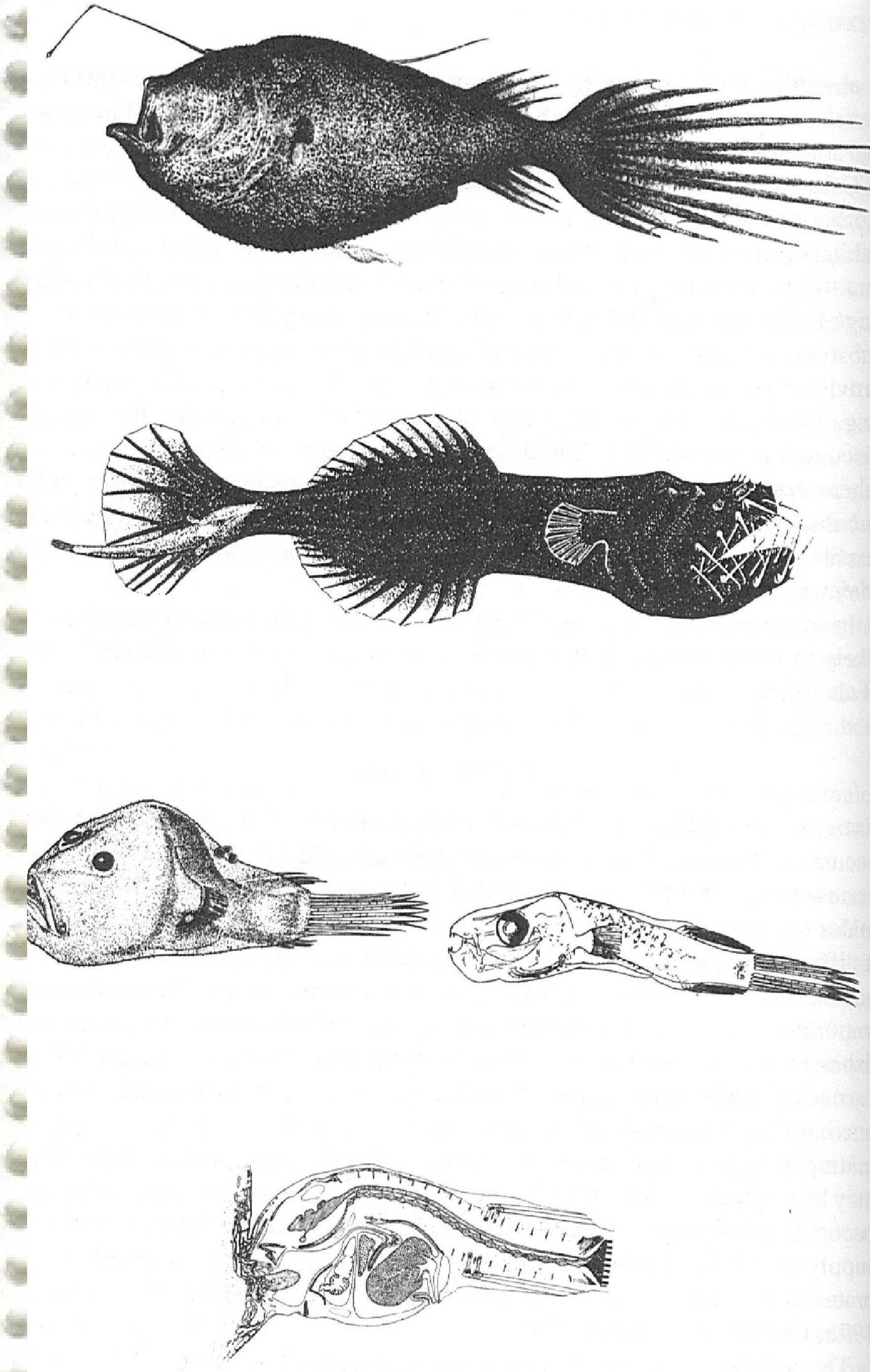
- **Sexual selection.- selection arising from differential access to mates (Darwin 1859, 1871). (i.e., from competition among gametes for fusion partners)**

- **Anisogamy – consequences to the bearers. Quantity vs. quality. Sex-dependent variance in RS. The sexes are different!!**

- **Results: fancy tails, courtship behaviour, direct competition for mates, sexual size dimorphism, different parental roles, etc., etc. etc….**


BLACK-THROATED TROGON (Trogon rufus)
Male (top) and female. From a tempera painting by Don R. Eckelberry


འབྲུག
BHUTAN
10CH.
Dynastes hercules



Sexual selection

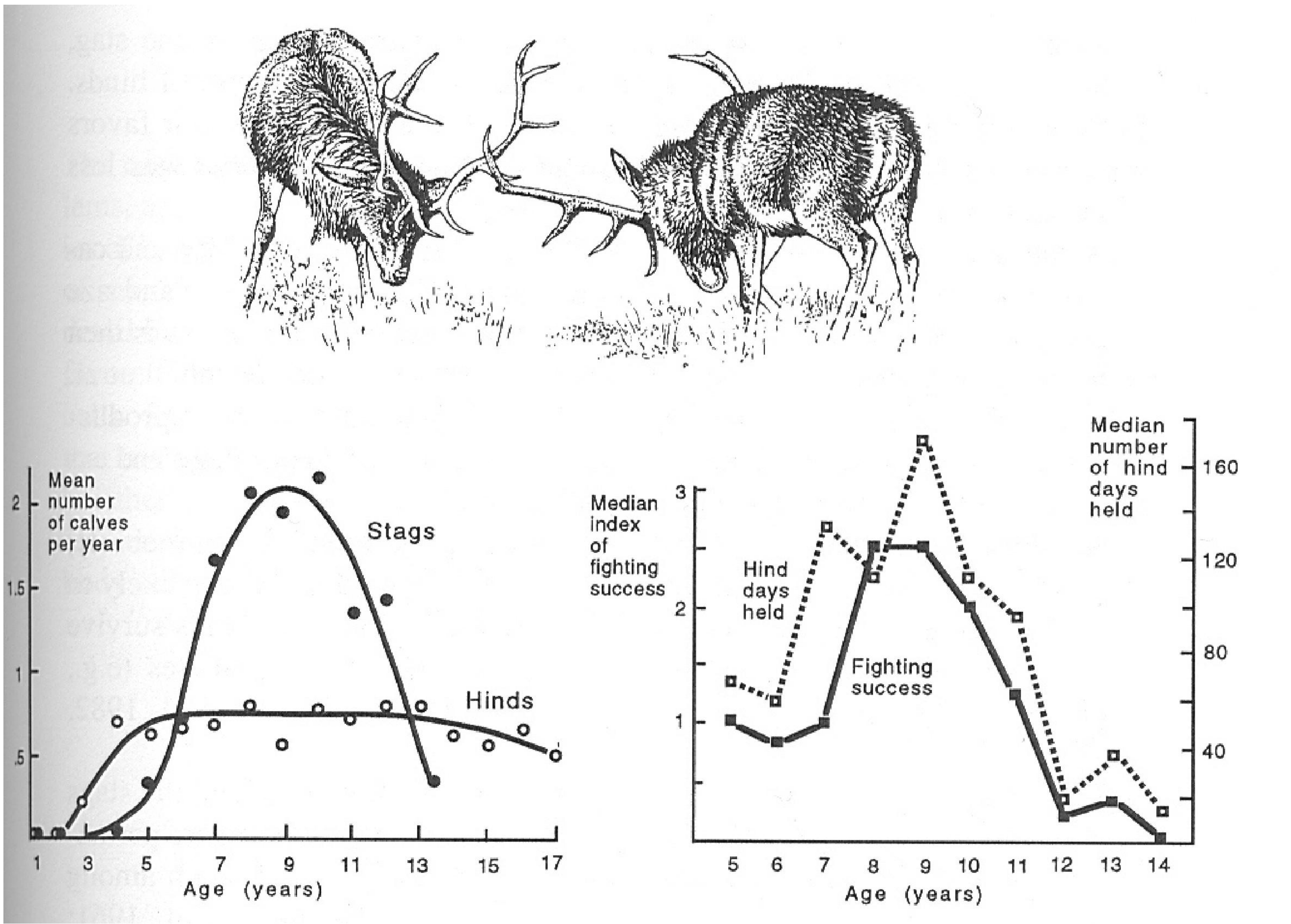
1. Intrasexual
   - Competition among members of one sex for access to members of the opposite sex
2. Intersexual (epigamic)
   - Selectivity among potential sex partners

3.- Sexual selection - Intrasexual

1. Intrasexual
   - Competition among members of one sex for access to members of the opposite sex.
   - Scrambles, endurance contests, fights, avoidance of fights , mate guarding, etc.

   - Parasites affect vigour, of course.

Intrasexual competition



Sexual selection - Intersexual

A. Intrasexual
   - Competition among members of one sex for access to members of the opposite sex.

B. **Intersexual (epigamic)**
   - **Selectivity among potential sex partners**
   - **Why be choosy?, how to choose?.**
     - Good genes, complementary genes, parental ability, ample resources, health, etc.

(Female) mate choice

I. Arbitrary traits

II. Indicator mechanisms (Zahavi, and others)

Indicator mechanisms

- Well, when male traits preferred by females actually INDICATE something about the male's quality

- Health, strength, low parasite load, vigour, compatibility, ample resources, parasite resistance, good territory, good parent, etc.… i.e., **GOOD GENES**

Parasite mediated sexual selection

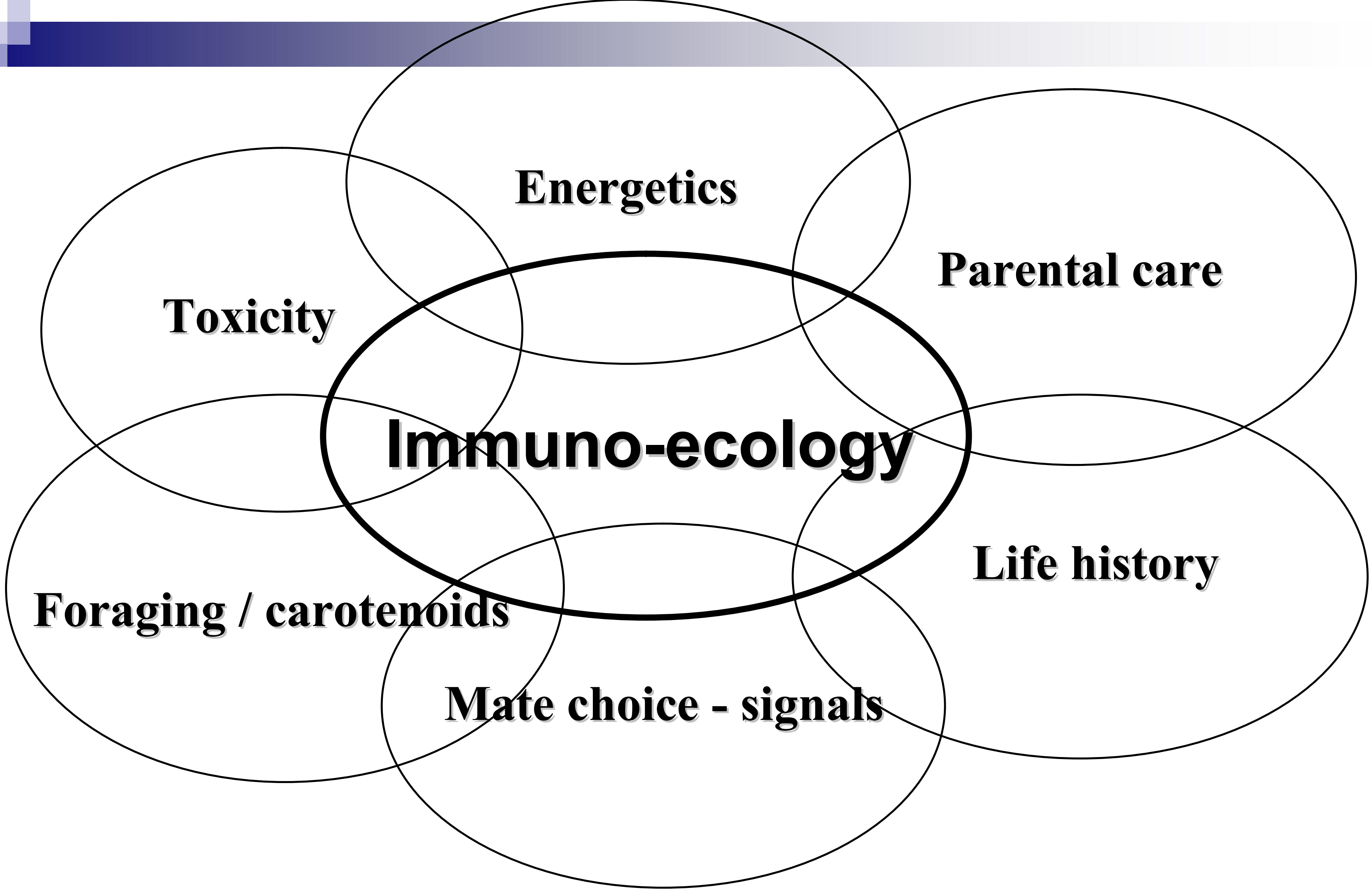
- **‘Red Queen’ hypothesis**
- **Hamilton and Zuk 1982 Co-evolutionary arms race between hosts and parasites.**
- **Fancy feathers hence indicate heritable variation in parasite resistance.**
- **Countless “tests” and much confusion kept people “busy” in the 80’s and 90s.**

Immunocompetence handicap hypothesis – a better try.

- **T causes the development of SST's**
- **T also affects immune function**
- **Trade-off in the allocation of resources.**

- **Males with the most elaborate sexual traits are the ones better able to withstand the negative effects of T.**

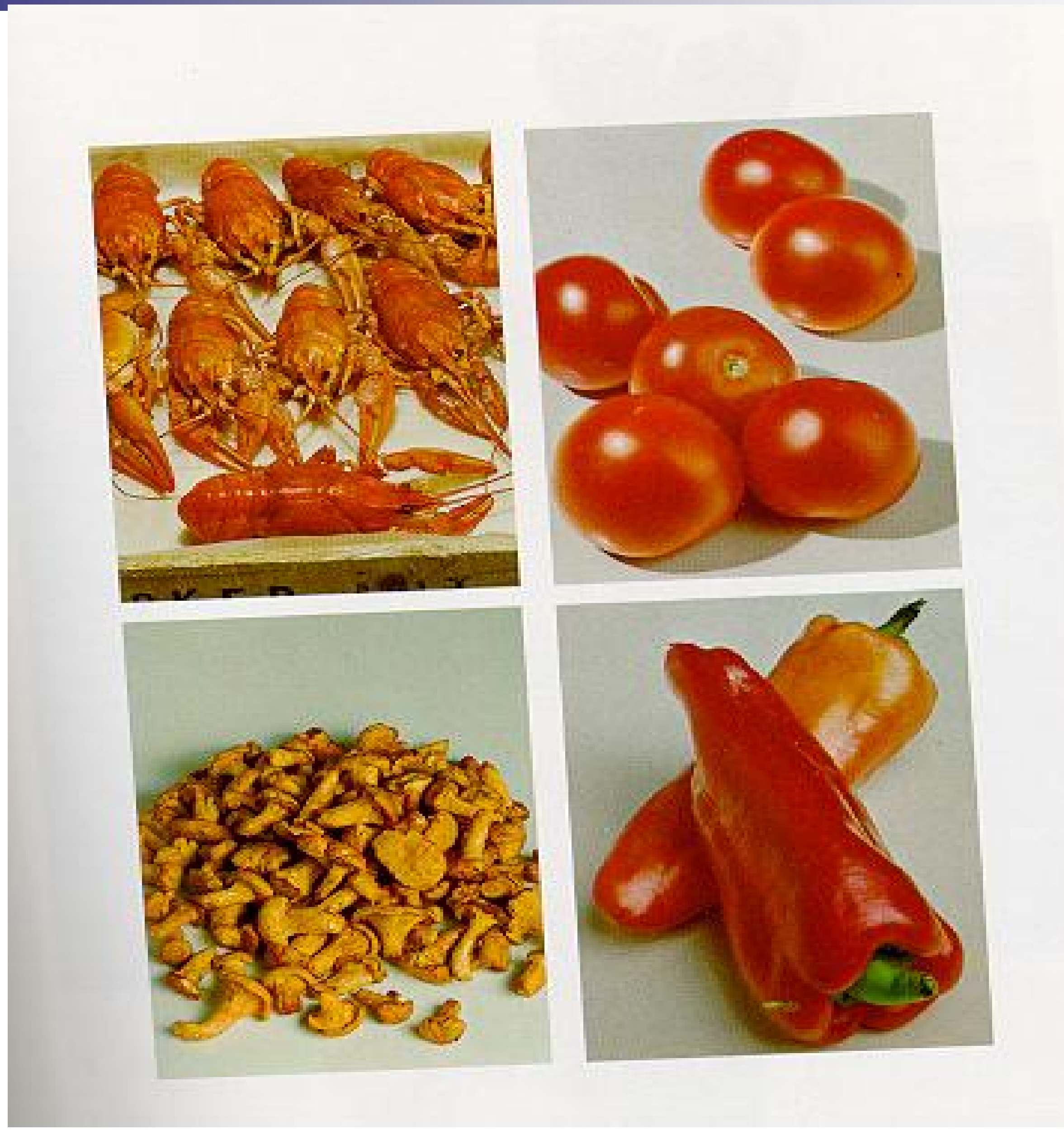
- **Folstad and Karter (1992)**

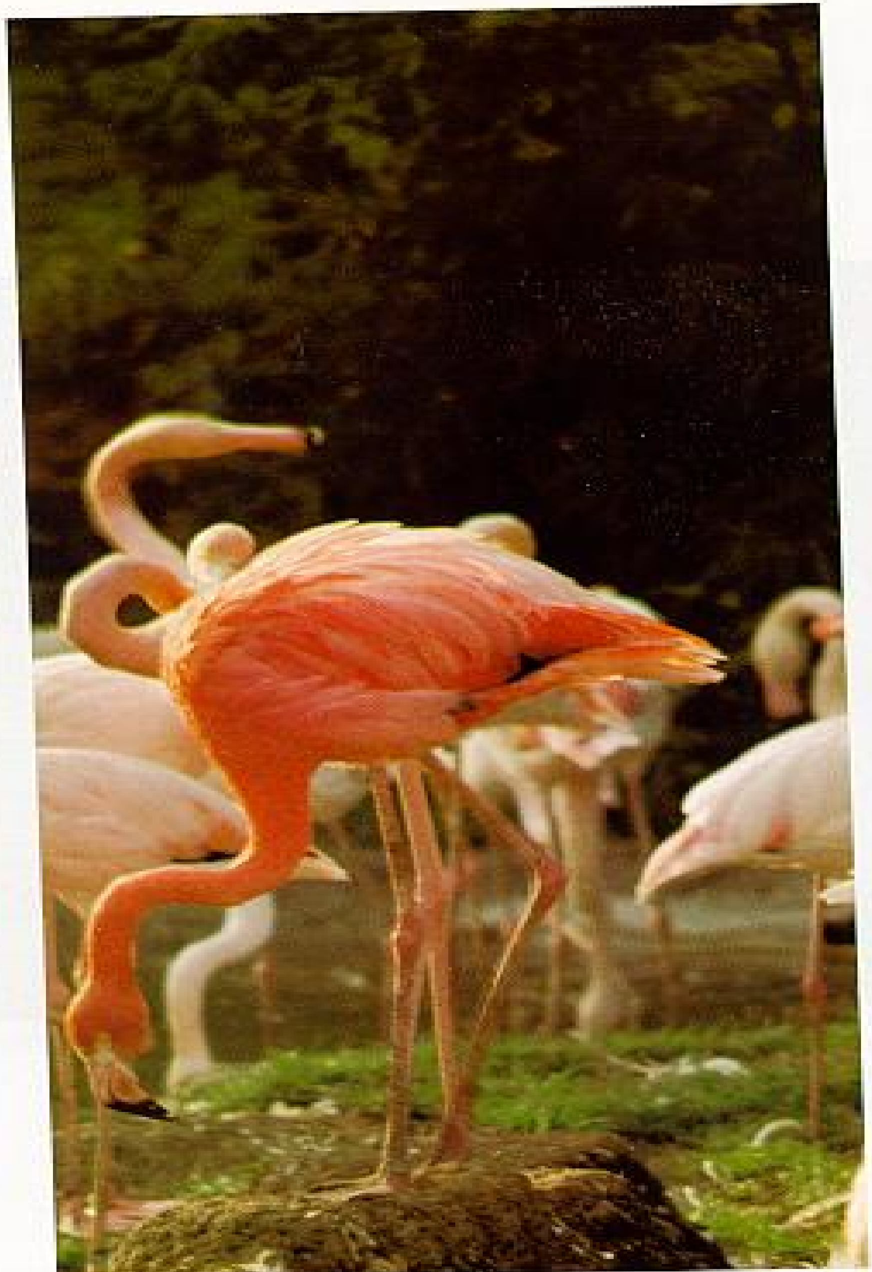

Energetics
Parental care
Toxicity
Immuno-ecology
Life history
Foraging / carotenoids
Mate choice - signals

Carotenoids, immunity and sex

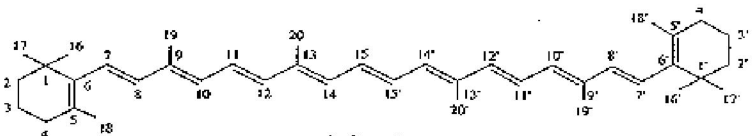
De novo

- What are carotenoids?
- Carotenoids and sexual selection: previous work
- Physiological effects of carotenoids
- Ecological implications
- Other avenues of research

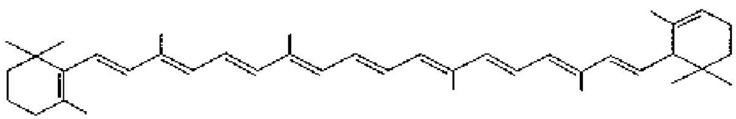




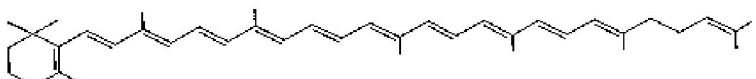
Major Carotenoids



ß-Carotene

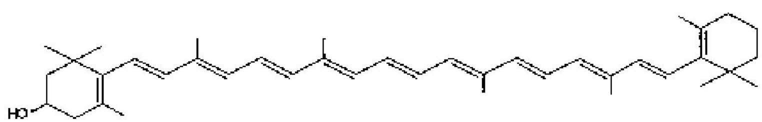


α-Carotene

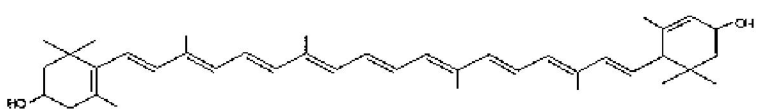


γ-Carotene

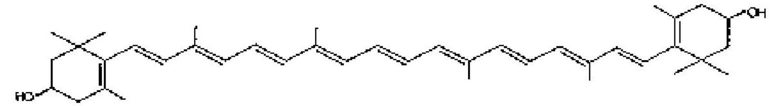
Lycopene



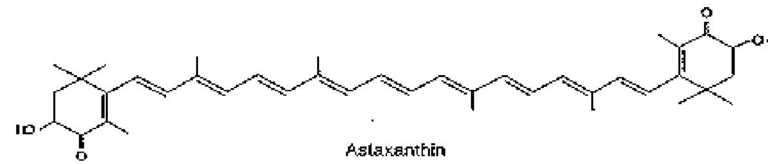
ß-Cryptoxanthin



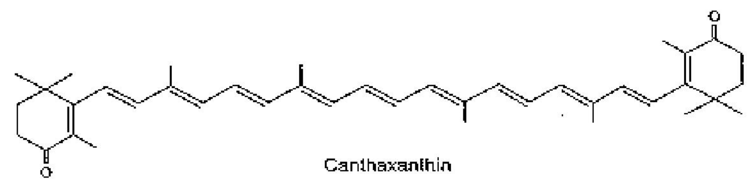
Lutein



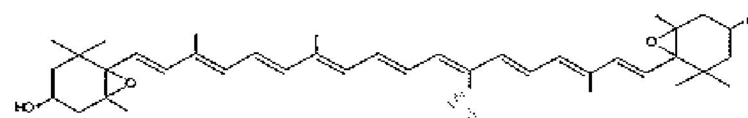
Zeaxanthin



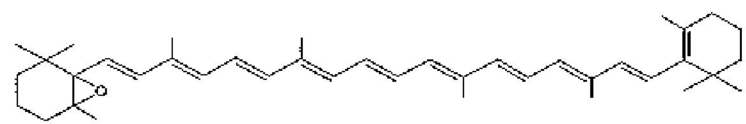
Astaxanthin



Canthaxanthin



Violaxanthin



ß-Carotene-5,6-epoxide

Carotenoids in Ecology – pre 1994

- Endler 1980, 1983
- Variable colours
- Red, orange – carotenoid
- Affected by predation risk
- Females prefer redder males
- Interpretation
  - Redness = foraging ability
  - Redness = predator evasiveness

Carotenoids in Ecology – pre 1994

- Endler's work with guppies (1980, 1983)
- More guppy work (A. Houde and others)
- House Finches (G. Hill and others)
- Jungle fowl (M. Zuk and others)
- Stickleback (M. Milinski, G. Fitzgerald…)

Carotenoids – physiological functions

Nutrition, immunology, and oncology.

1. Free-radical scavangers
2. Immunostimulants
3. Protect against cancer

1.- Free-Radicals Scavanging

They are produced by:

- Aerobic activity
- Metabolism of fats
- Air pollutants, such as ozone,nitrogen dioxide
- The immune system, as a way to fight viruses and bacteria.

Free Radicals Oxidize:

- Nucleic acids, leading to DNA damage.
- Lipids, including those in membranes.
- Enzymes and other proteins, including collagen in the skin
- *The free radical theory of aging.*

Free Radical Effects

- Cancer: prostate,cervical, breast, lung
- Heart disease – in humans
- Cataracts, age-related macular degeneration
- Memory and cognitive function
- Sun-damaged skin, wrinkles
- Immune system degeneration

2.- Immunostimulation

- Astaxanthin enhances T-helper cell activity.
- Astaxanthin and b-carotene enhance humoral immune responses.
- B- carotene enhances cell mediated immunity

- Adaptive and innate, cell mediated and humoral immunity, all improve with increased dietary carotenoids

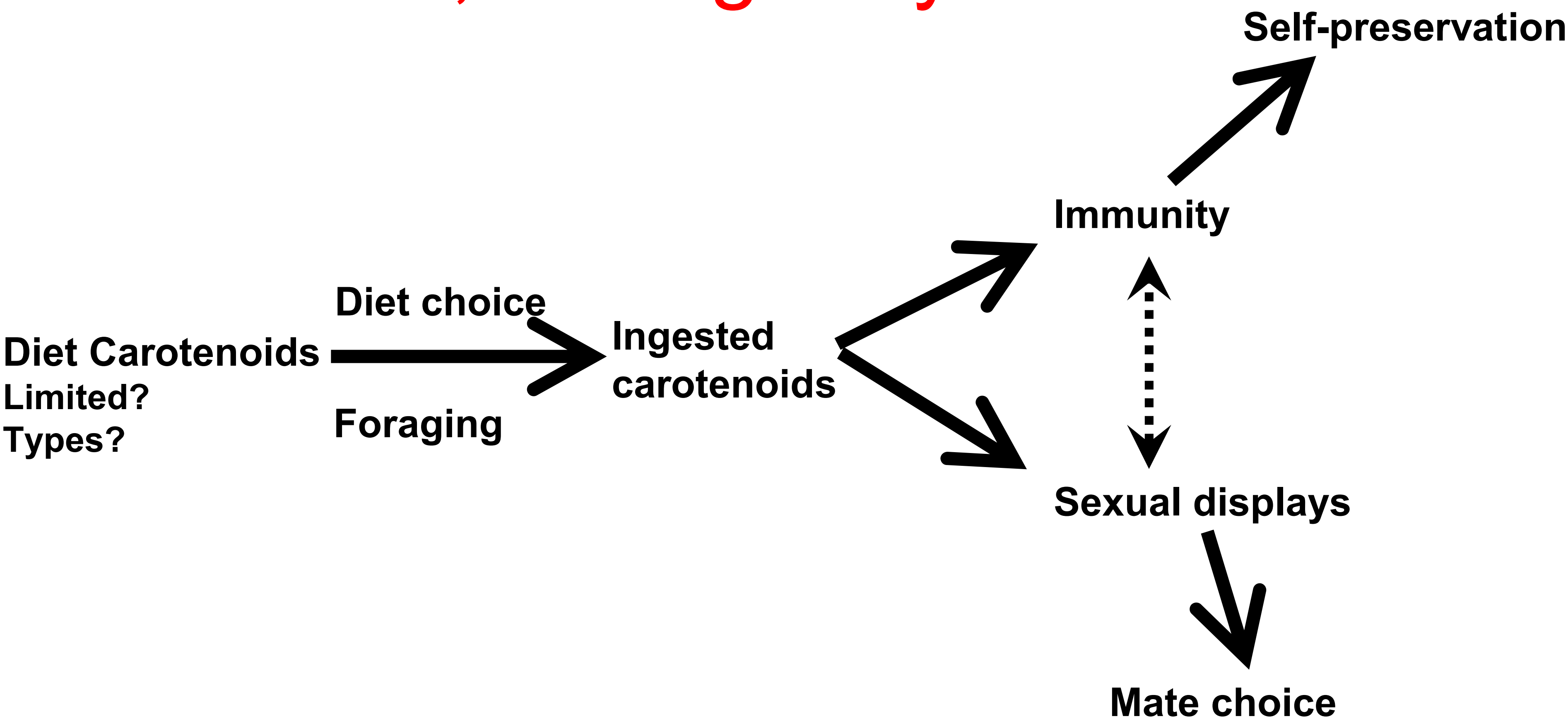
3.- Protection against cancer

- Antioxidant activity
- Inhibition of growth
- Inhibition of malignant transformation
- Enhances immune function

Types of cancer

- Lung
- Esophagus
- Stomach
- Colon
- Rectum
- Breast
- Cervix
- Larynx
- Ovary
- Endometrium
- Bladder
- Skin

So what?, ecologically



Lozano 1994. Carotenoids, parasites and sexual selection. Oikos 70: 309-311

Trade-offs in Ecology

- Offspring quality vs quantity (e.g., Wheelwright *et al.* 1991),
- Self-maintenance vs parental activities (e.g., Moreno *et al.* 1999),
- Reproduction vs predator avoidance (e.g., Candolin 1998).
- Immune condition vs. reproduction