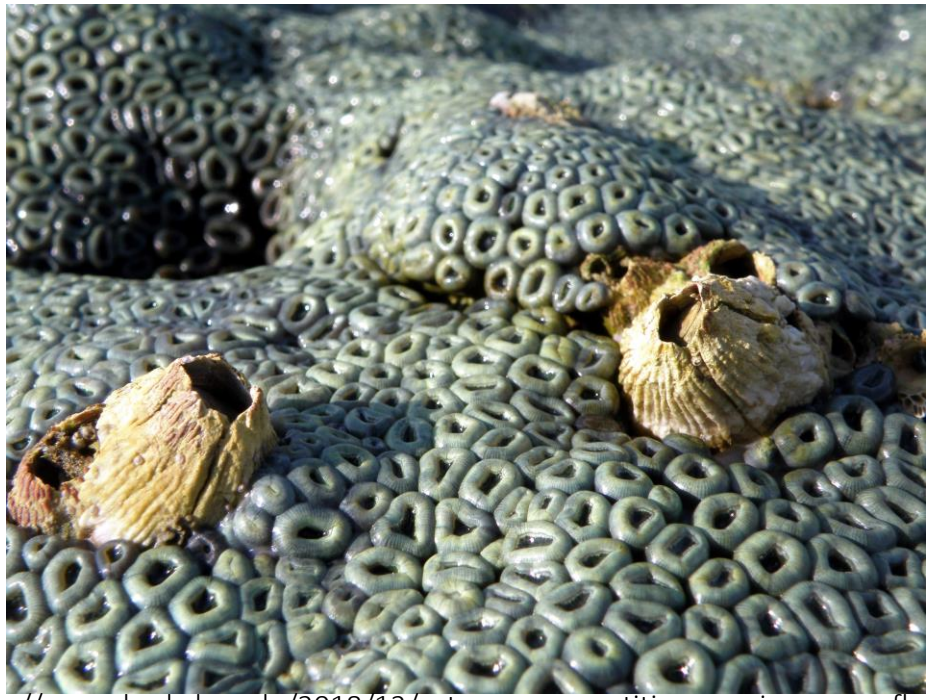
Today's Class

- Finish Population Ecology
- Start Community Ecology



https://ucmp.berkeley.edu/2018/12/extreme-competition-species-ocean-floor/

Station squabble by Sam Rowley, UK

Sam Rowley/Wildlife Photographer of the Year

Tentative plan for 4 remaining classes

Next Tuesday (April 4th):

- Community Ecology – Part II (Competition & Predation)
- Rory Macklin – guest lecture on his study of competition amongst birds.

Next Thursday (April 6th):

- Finish Community Ecology – Succession
- Start Ecosystem Ecology – Food Chains/Food Webs

Tuesday (April 11th)

- Finish Ecosystem Ecology (Nutrient Cycling)

Thursday (April 13th)

- If possible – review session

Plus, Dr. Pam Kalas will be coming to make an announcement about her Genetics Survey Part II sometime before the end of term (1% of grade)

Due this Sunday, April 2nd @ 11:59 pm

Group Project
- only one submission per group please
- projects accepted without penalty until Sunday, April 9th @ 11:59 pm
- optional peer evaluation

Quiz 10 – Population Ecology: Population Size and Growth

Quiz 11 – Population Ecology: Life History Traits (covered in Thursday's lecture) – only 4 questions

Worksheet #10 – Spotted Owl – Population Ecology

Note – I will also be opening up Quiz 9 – Species Concepts & Speciation. Due by the last day of classes.

2023 G.V.R. Science Fair is looking for student volunteers to assist on Friday, April 14th

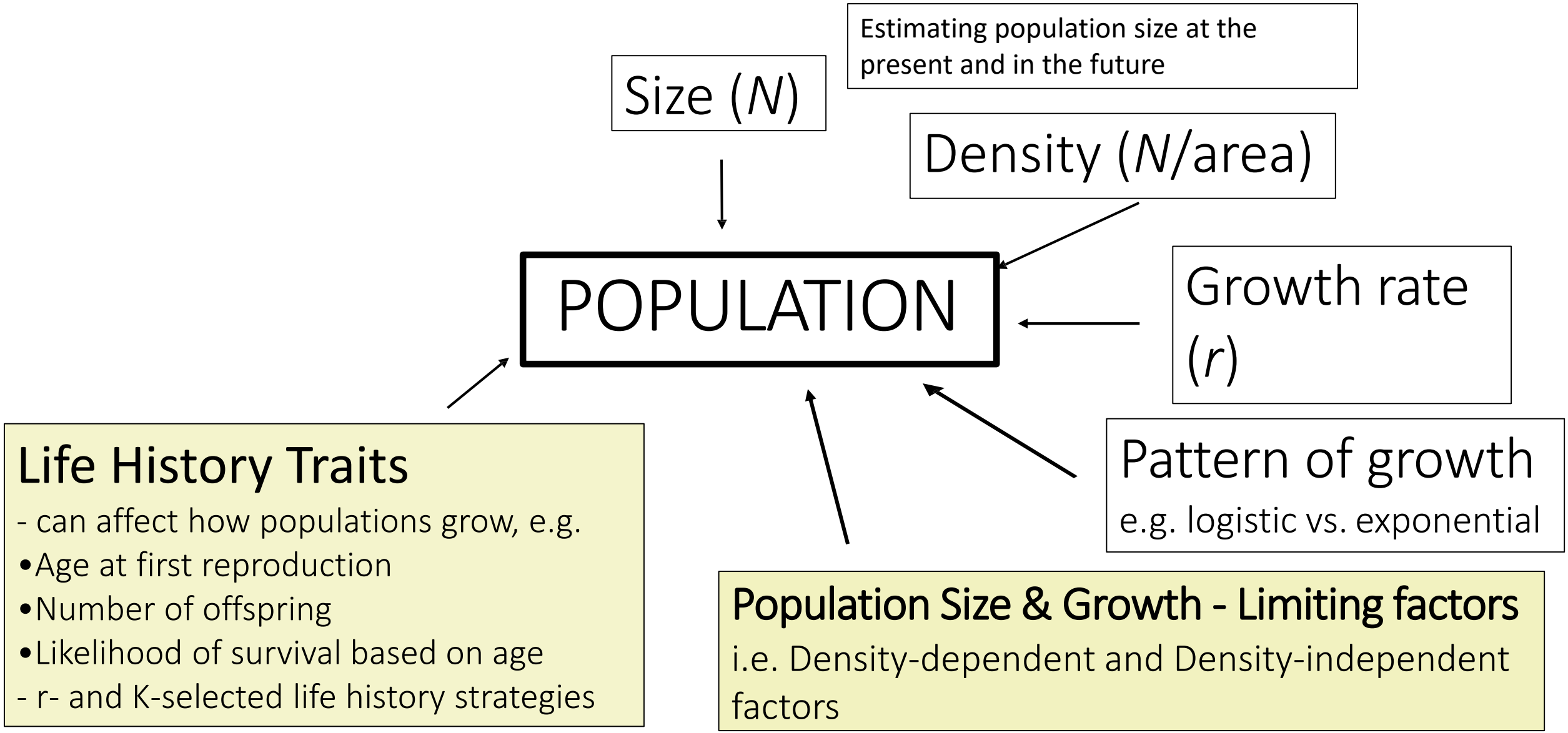
Volunteers would be responsible for leading high school students on tours of UBC labs and museums.

Sounds cool!

Deadline to apply is Friday, April 7th @ 11:59 pm.

Application link:
https://docs.google.com/forms/d/17gG3PUbL-zBIZaHD_HbwiWL6fGkPus4iw_5JyAwm4Yw/viewform?edit_requested=true

Final concepts in population ecology



Limiting factors

In the last class, we discussed exponential growth.

- Exponential growth occurs when critical resources are unlimited (so there is no competition for these resources).

No population can grow exponentially indefinitely.

At some point:

- population growth rates will slow and/or stop (logistic growth), or the growth rate may become negative
- population size will stop increasing at the carrying capacity (and may even decrease)

Why? **Limiting factors**

- Limiting factors are factors that constrain or limit a population's size and/or factors that slow or stop a population from growing.

Limiting factors are classified as either….

Density-dependent factors

- Examples are competition, predation, disease (often biotic factors).
- Effects of density-dependent factor on population size / growth is correlated with population size.

Density-independent factors

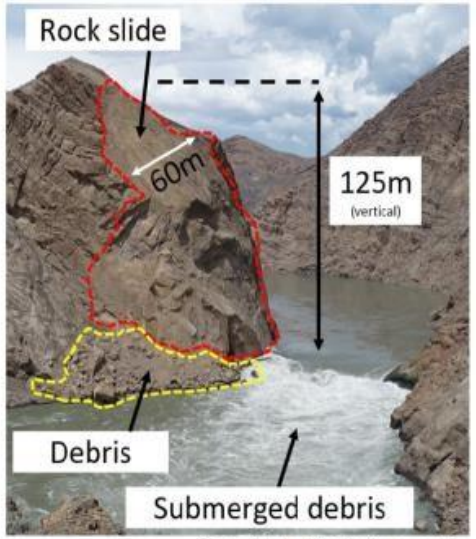
- Examples are hurricanes, cold snaps, pollutants, volcanic eruptions (often abiotic)
- Density-independent factors are not influenced by population size/density.

If it helps – ask yourself – is that factor more likely to happen if the population size gets larger? If the answer is no = likely density-independent factor

iClicker Question

In 2019, a massive landslide blocked a key migratory channel for salmon. In spite of conservation efforts (including shooting salmon through a cannon), 99% of young sockeye and 89% of young chinook died.

The rock prior to slide.



Scale of the landslide site, for perspective.

Would you classify the effect of the landslide on the salmon population size as….

A. Density-dependent factor
B. Density-independent factor
C. Not sure…

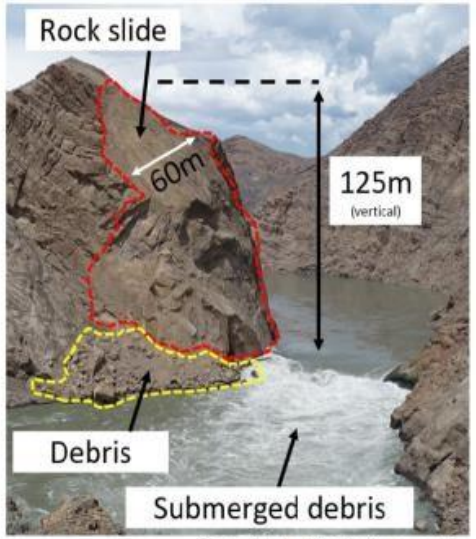
Was the landslide more likely to happen because the population size of the fish was large?

In case you have never seen a salmon cannon… https://www.youtube.com/watch?v=0nD1D0F7ujQ

Answer

In 2019, a massive landslide blocked a key migratory channel for salmon in the Fraser River. In spite of conservation efforts (including shooting salmon through a cannon), 99% of young sockeye and 89% of young chinook died.

The rock prior to slide.



Scale of the landslide site, for perspective.

Would you classify the effect of the landslide on the salmon population size as a….

A. Density-dependent factor

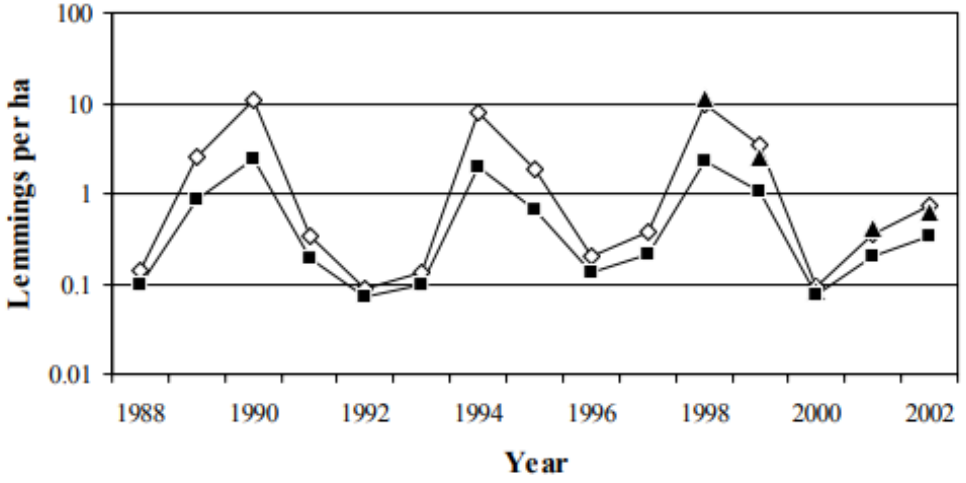
B. Density-independent factor

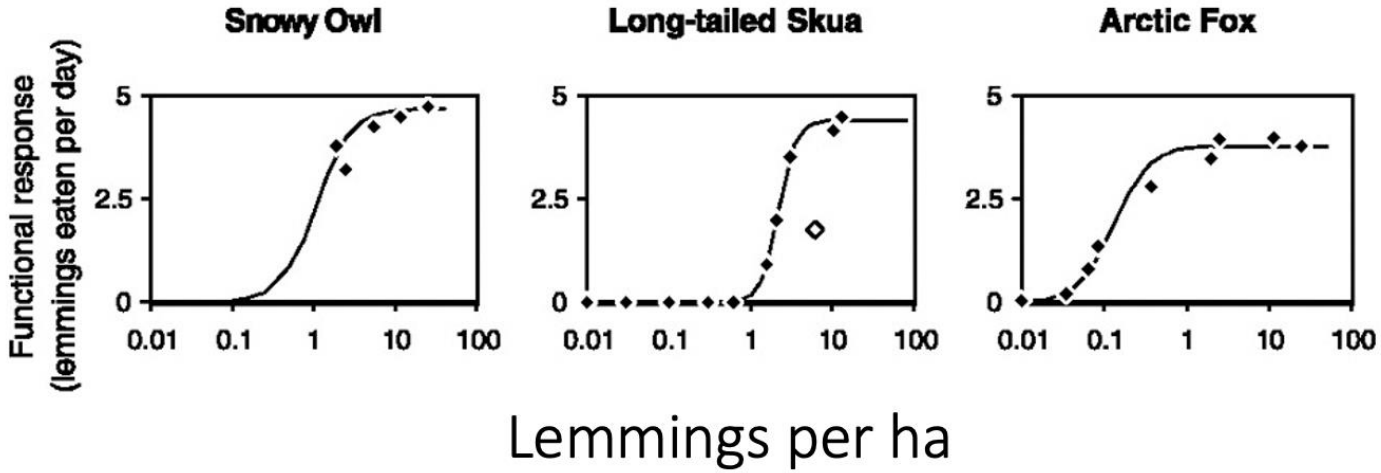
C. Not sure…

In case you have never seen a salmon cannon… https://www.youtube.com/watch?v=0nD1D0F7ujQ

iClicker Question

Gilg et al. 2003





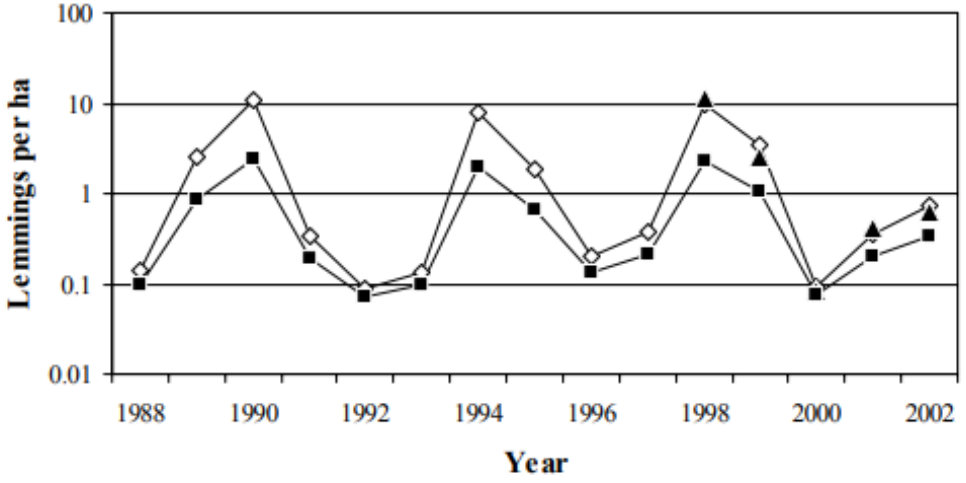
As lemmings become more abundant, nearby predators tend to switch to eating lemmings, causing lemming abundance to decrease. Once lemming population size has decreased, predators switch back to their preferred prey, and lemmings are able to increase in abundance again.

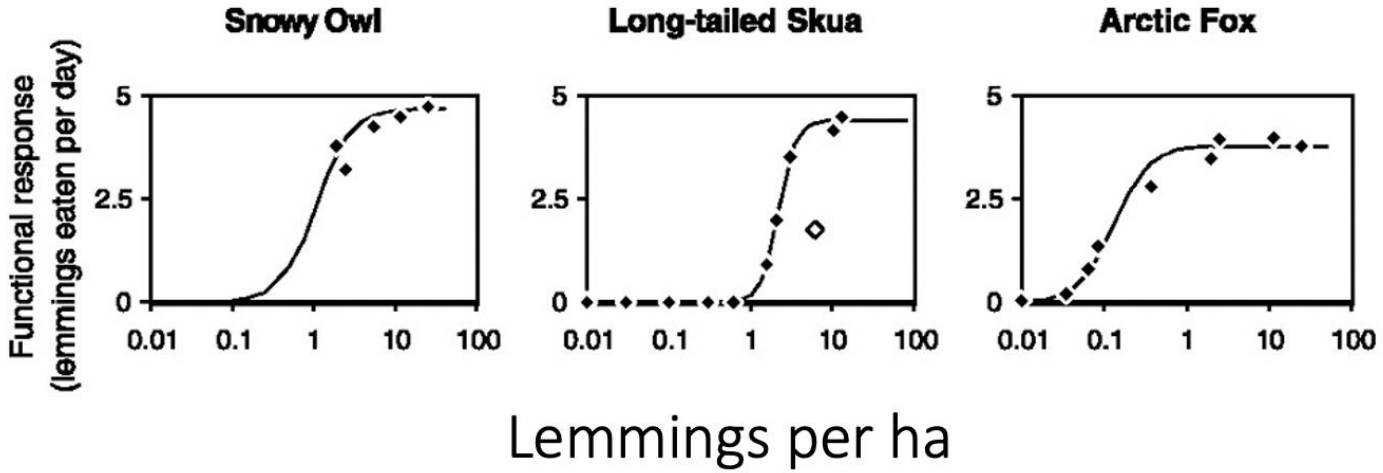
How would you classify the effect of predators on lemming population size?

A. Density-dependent factor
B. Density-independent factor
C. Not sure…

Answer

Gilg et al. 2003





As lemmings become more abundant, nearby predators tend to switch to eating lemmings, causing lemming abundance to decrease. Once lemming population has decreased, predators switch back to their preferred prey, and lemmings are able to increase in abundance again.

How would you classify the effect of predators on lemming population size?

A. Density-dependent factor

B. Density-independent factor

C. Not sure…

Another example of a density-dependent factor – food availability

- Wauters & Lens (1995) studied how food availability and population density combined to limit female red squirrel reproduction rates.

- Female red squirrels are territorial
- Findings: When squirrel densities were high, some females in the restricted to a lower quality habitat (in terms of food availability).
- The females in the lower quality habitat had reduced reproductive success compared to females in the higher quality habitat.
- Overall – this lead to a decrease in the per capita birth rate in the population.
- When squirrel densities were lower, no females occupied the lower quality territories.

EFFECTS OF FOOD AVAILABILITY AND DENSITY ON RED SQUIRREL (*SCIURUS VULGARIS*) REPRODUCTION[1]

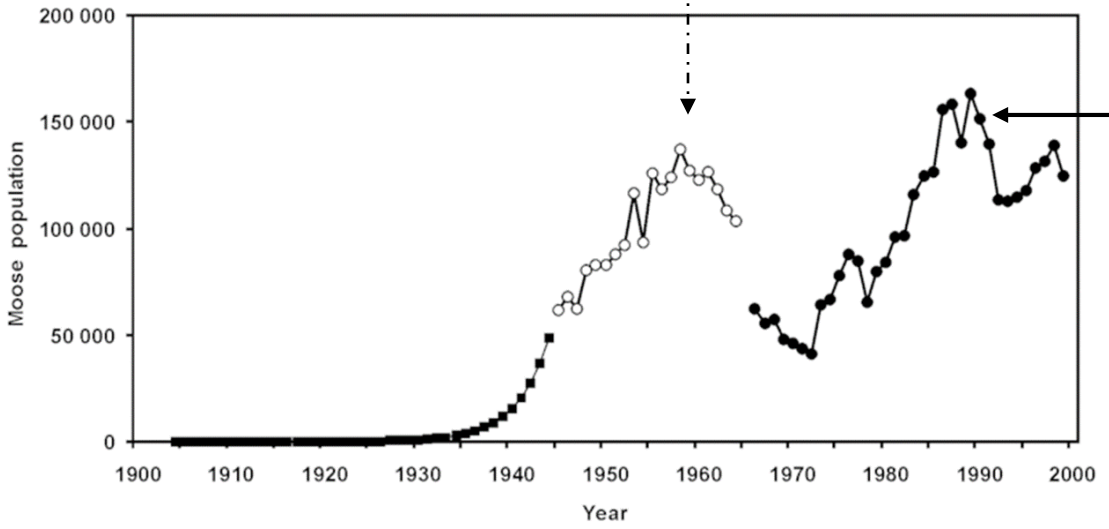
LUC A. WAUTERS AND LUC LENS
Department of Biology, University of Antwerp, Universitaire Instelling Antwerpen, B–2610 Wilrijk, Belgium

Moose example from last class

After being introduced to Newfound in late 1800's & 1904, the moose population grew exponentially – lots of food (leaves, twigs, herbs, aquatic plants) – so no competition, and no wolves (no predators). Per capita birth rate maximized, per capita death rate minimized

The moose population size reached a peak in the late 1950s – but began to decline. Why?

- Hunting introduced (increasing per capita death rate)
- Lower reproduction – due to less food available (= more competition) - so lower per capita birth rates.



Increased hunting quotas – so increasing per capita death rates

Also decline in food availability – negative effect on per capita birth rates

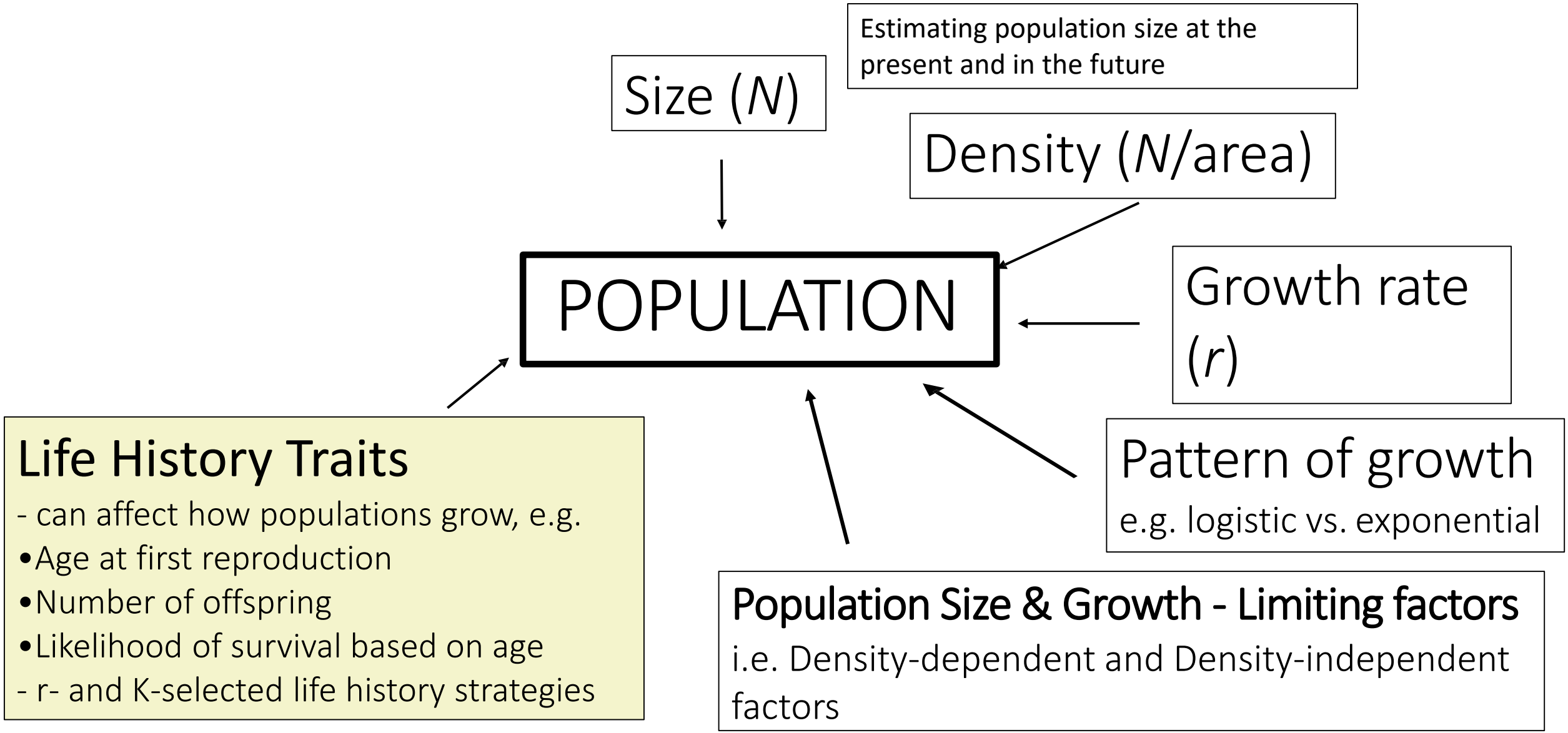
McClaren et al. 2004

Learning Objective

- If given a scenario be able to identify or describe a density-dependent or density-independent factor that may be influencing population size and/or population growth.

- If asked to explain the effect of a limiting factor on per capita growth rates, be able to describe the effect of that factor on the per capita birth rates and/or per capita death rates.

Life History Traits



What are life history traits?

An organism's life history refers to the stages it goes through in its lifetime:

birth → growth → reproduction → death

Life history traits are just a quantification of this life history:

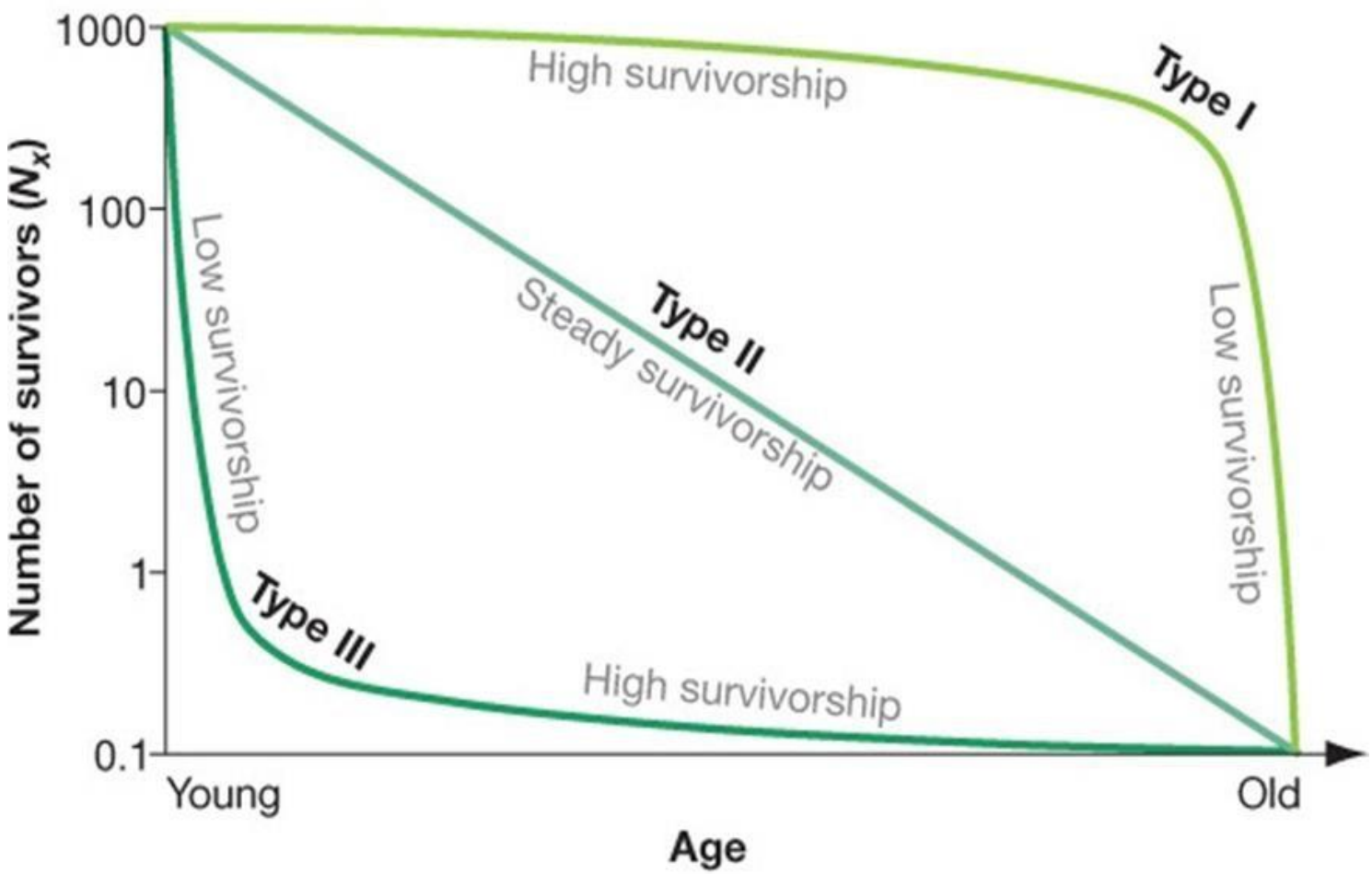
- **Age specific survivorship** (likelihood of surviving to the next age class based on age)
- Age at first reproduction
- Number offspring (fecundity)
- Size of offspring
- Sex ratio of offspring
- Amount of parental care
- Reproductive lifespan
- Growth rate

Life history traits: **survivorship curves (testable)**

Survivorship curves tell us how the probability of survival changes (or not) with age

Organisms can be broadly classified under three types of survivorship curves

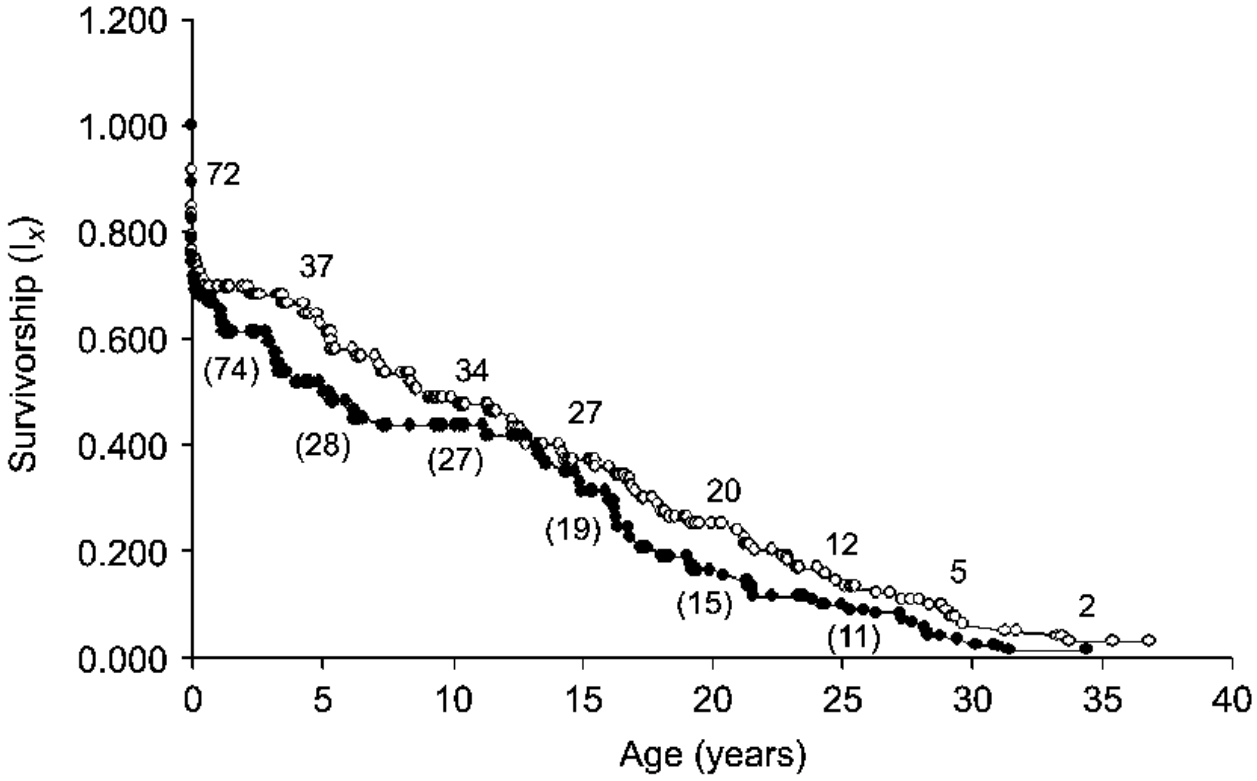
- Type I: most juveniles survive and live until they are old
- Type II: survivorship declines steadily with age
- Type III: most individuals live fast and die young, a few live long and die old



iClicker Question

Crows exhibit what type of survivorship curve?

A. Type I
B. Type II
C. Type III
D. Not sure



Ballou et al. (2006).

Answer

Crows exhibit what type of survivorship curve?

A. Type I
B. Type II
C. Type III
D. Not sure

Media reports put Canuck's age at four years old. "The probability of death is constant with age in birds beyond a couple of years in age. So still about 10% chance of death each year," says Marzluff.

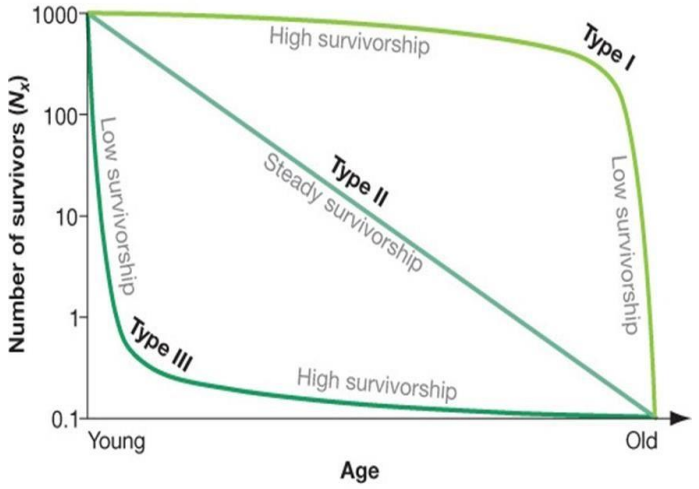
(2006).

iClicker Question

Pasqueflowers produce hundreds of seeds, yet only a few will successfully germinate (i.e. seed will sprout/grow). Once they germinate, they can live for several years.

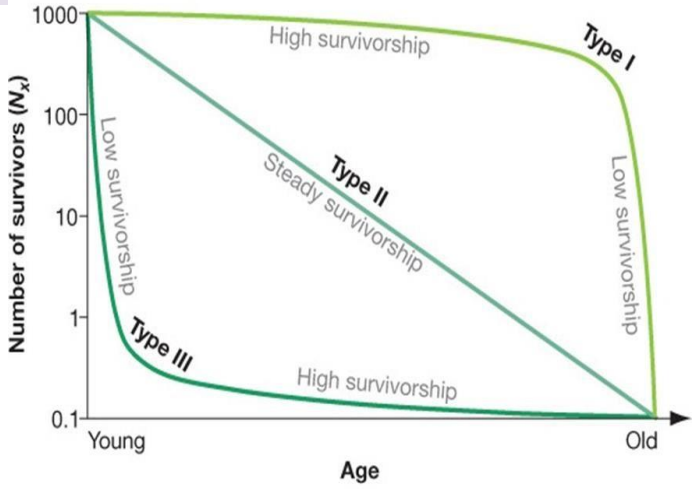
Which survivorship curve best describes the life history of pasqueflower?

A. Type I
B. Type II
C. Type III
D. No idea.



Answer

Pasqueflowers produce hundreds of seeds, yet only a few will successfully germinate (i.e. seed will sprout/grow). Once they germinate, they can live for several years.



Which survivorship curve best describes the life history of pasqueflower?

A. Type I
B. Type II
C. Type III
D. No idea.

Learning goal

If given a scenario and/or a figure be able to:

- identify the type of survivorship exhibited by a population.
- Justify your claim by referring to how survivorship changes with age class or not.

Life history traits can evolve through natural selection

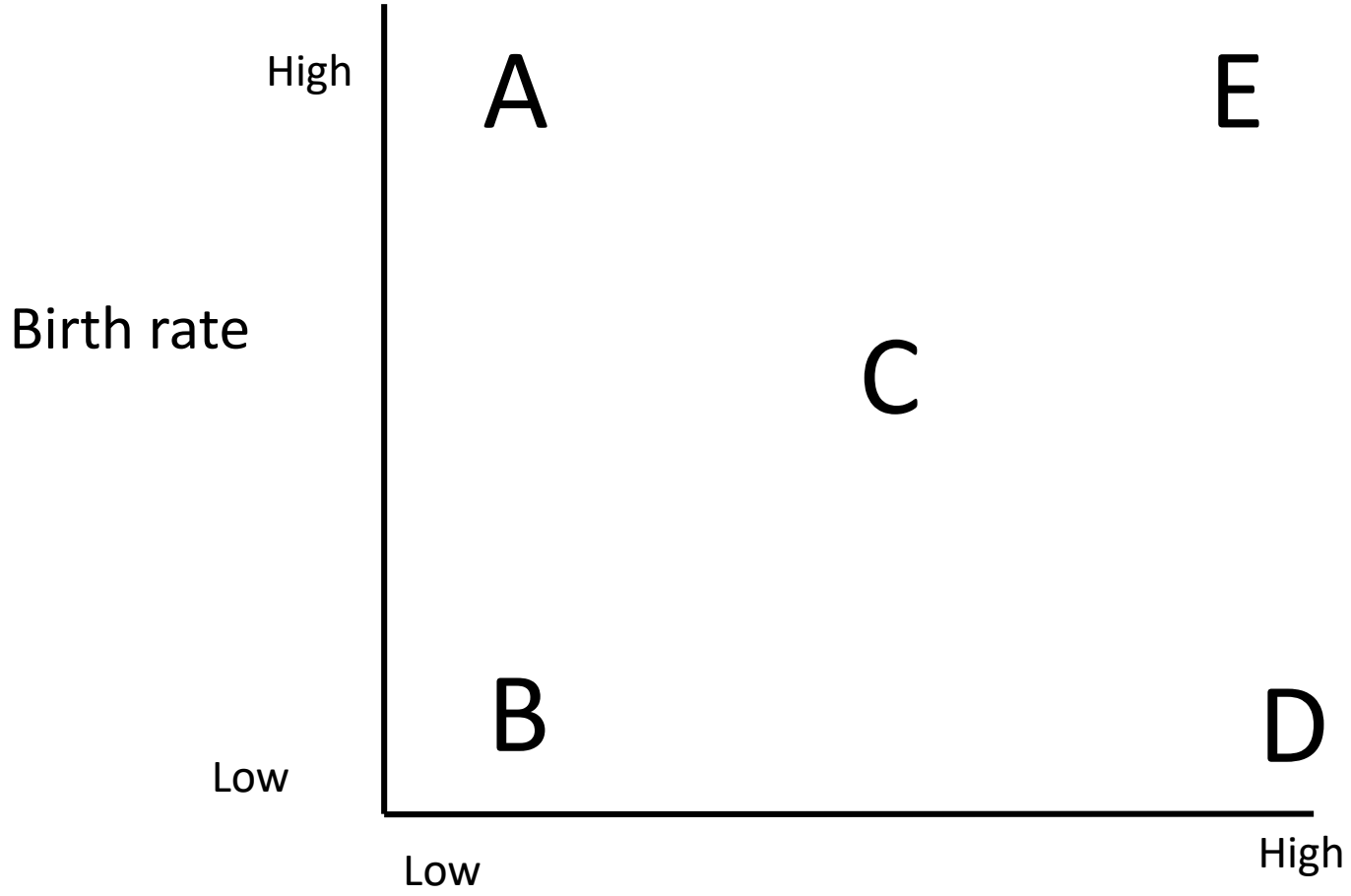
- Requirements for natural selection:
  - trait is heritable
  - there is variation in the population, and
  - there are differences in survivorship and reproduction (fitness) linked to trait

- Life history traits are linked to fitness:
  - the number and size of offspring
  - age at first reproduction
  - frequency of reproduction
  - reproductive life span

iClicker Question

Natural selection should favour individuals with high fitness, right?

Consider the following graph of survival rate and birth rate. Where on the graph would you place an organism in order to maximize its fitness?



Options:

A

B

C

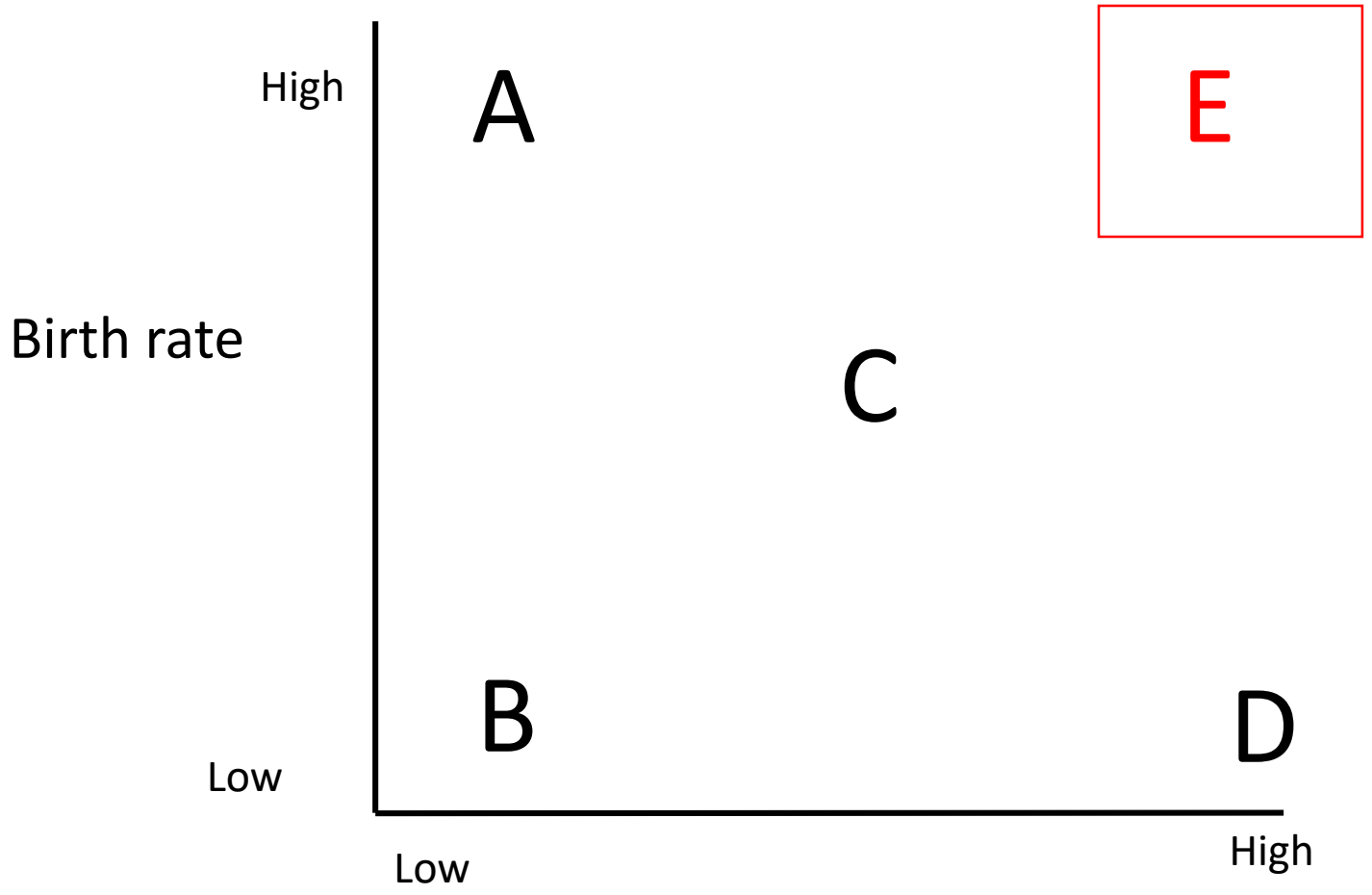
D

E

Answer

Natural selection should favour individuals with high fitness, right?

Consider the following graph of survival rate and birth rate. Where on the graph would you place an organism in order to <u>maximize</u> its fitness?



Options:

A

B

C

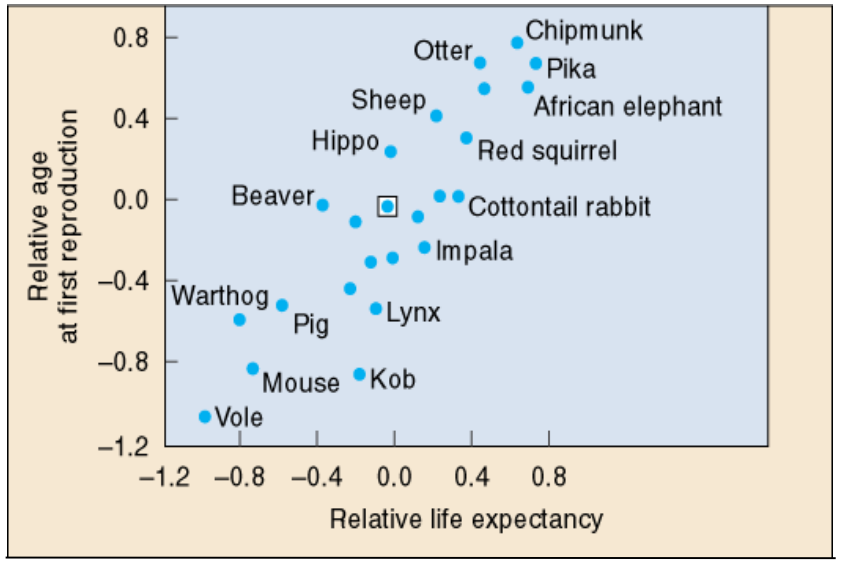
D

E

There are tradeoffs

- Natural selection cannot maximize ALL of the life history traits simultaneously.
- Why? Limited time and limited resources (e.g. energy, nutrients).
- If an organism is devoting energy/resources to one trait (e.g. a large number of offspring), that energy is not available for another trait (e.g. a high level of parental care).
- So there are trade-offs for different life history traits.

iClicker Question – Life History Trade-Offs



Relationship between life expectancy and age at first reproduction

What is the relationship between life expectancy and age at first reproduction?

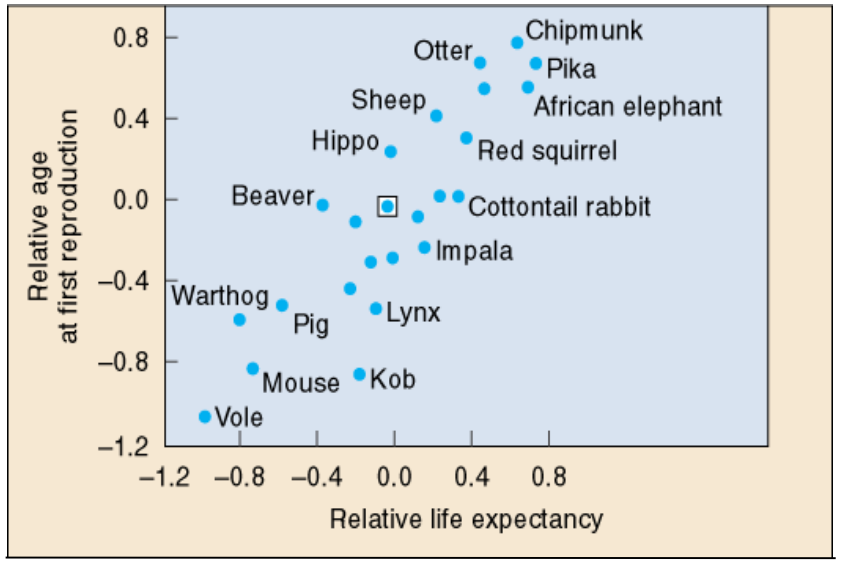
A. There is no relationship between these two variables.

B. Species that have a short life expectancy start reproducing later in life.

C. Species that have a longer life expectancy start reproducing later in life.

D. Not sure.

Answer - Life History Trade-Offs



Relationship between life expectancy and age at first reproduction

What is the relationship between life expectancy and age at first reproduction?

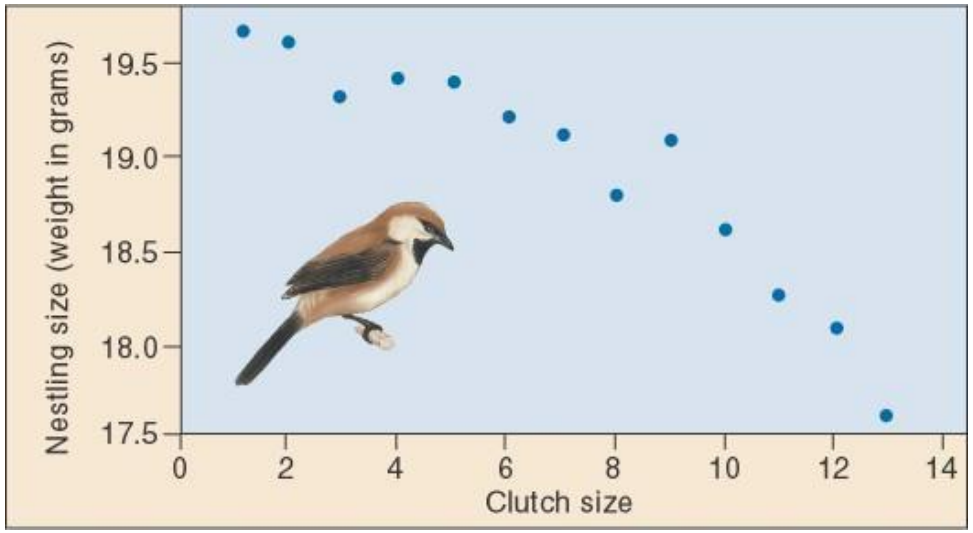
A. There is no relationship between these two variables.

B. Species that have a short life expectancy start reproducing later in life.

C. Species that have a longer life expectancy start reproducing later in life.

D. Not sure.

iClicker Question - Evidence of life history trade-offs



Relationship between clutch size (# eggs) and offspring size

What is the relationship between clutch size (# eggs) and offspring size ?

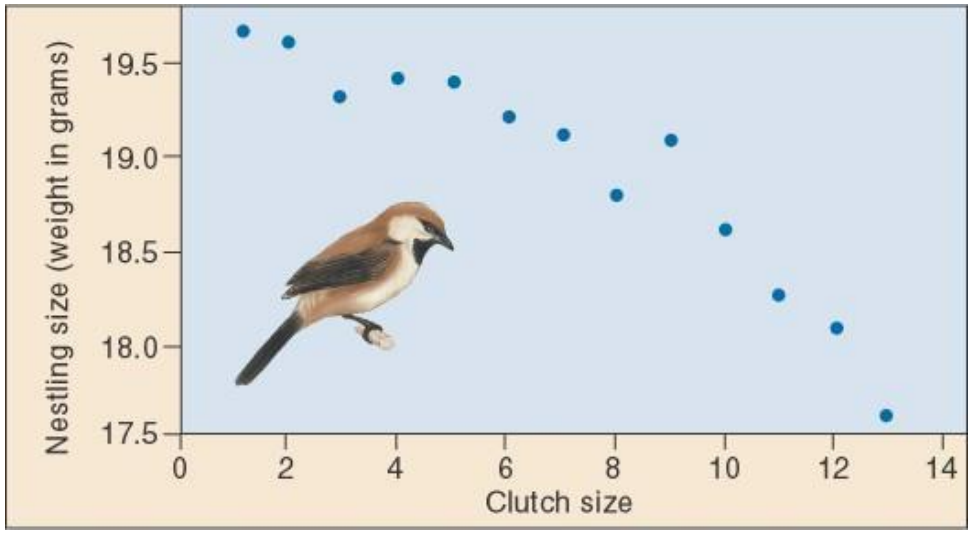
A. There is no relationship between these two variables.

B. Offspring size decreases with an increase in clutch size.

C. Offspring size increases with an increase in clutch size.

D. Not sure.

Answer



What is the relationship between clutch size and offspringsize?

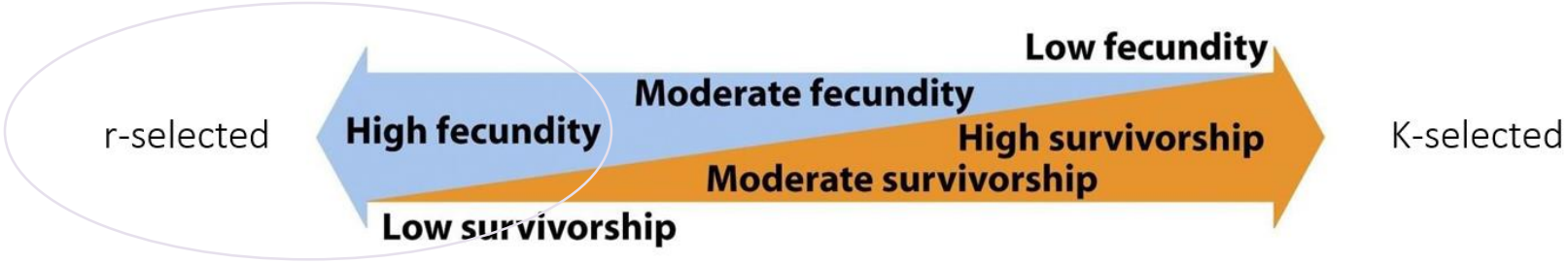
A. There is no relationship between these two variables.

B. Offspring size decreases with an increase in clutch size.

C. Offspring size increases with an increase in clutch size.

D. Not sure.

.r & K-selected life history strategies

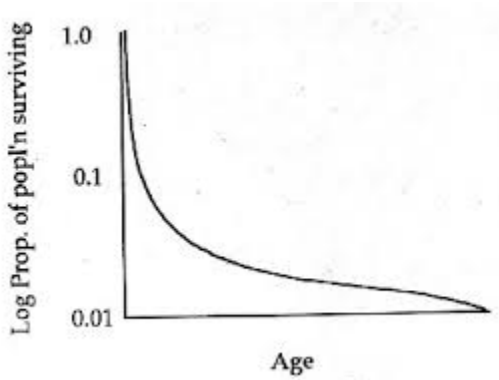


.r & K-selected life history strategies are two extremes of a continuum.

r-selected life history strategy (r=reproduction)

- a population with an r-selected life history strategy is maximizing reproduction
- Limited investment in offspring (little or no protection or nurturing)
- Young have a high probability of mortality.
- An r-selected life history strategy tends to be more common in less competitive, low-quality environments; and is more common amongst organisms with shorter lifespans.

Dandelions (r-selected)

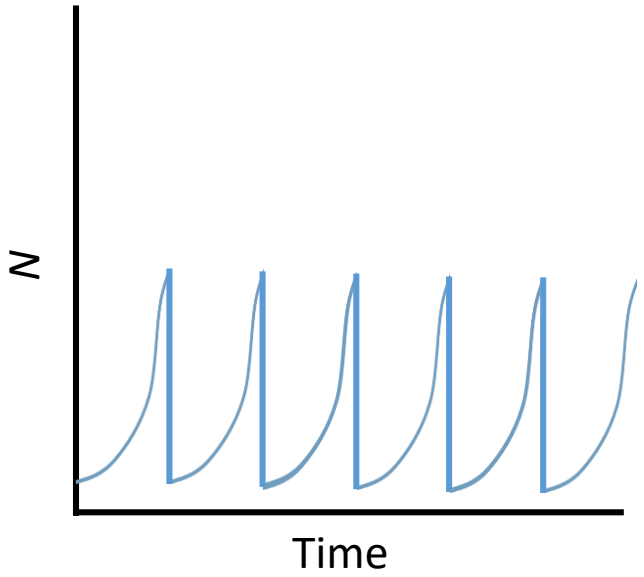


https://science.umd.edu/classroom/biol106h/L29/L29_demo.html

- Frequent target of herbivores
- Seeds particularly susceptible to mortality (i.e. seeds do not land in a spot suitable for germination, little energy stored)
- Need to become reproductively mature quickly
- And have LOTS of seeds (>5,000) because most will die!!

https://www.canadiangeographic.ca/article/lament-bear-148

Dandelions are an example of an "*r*-selected" species



Characterized by exponential growth and sudden crashes.

Frequent high often mortality prevents populations from reaching *K*

Over time, populations evolve traits that make them better at growing quickly and spreading fast

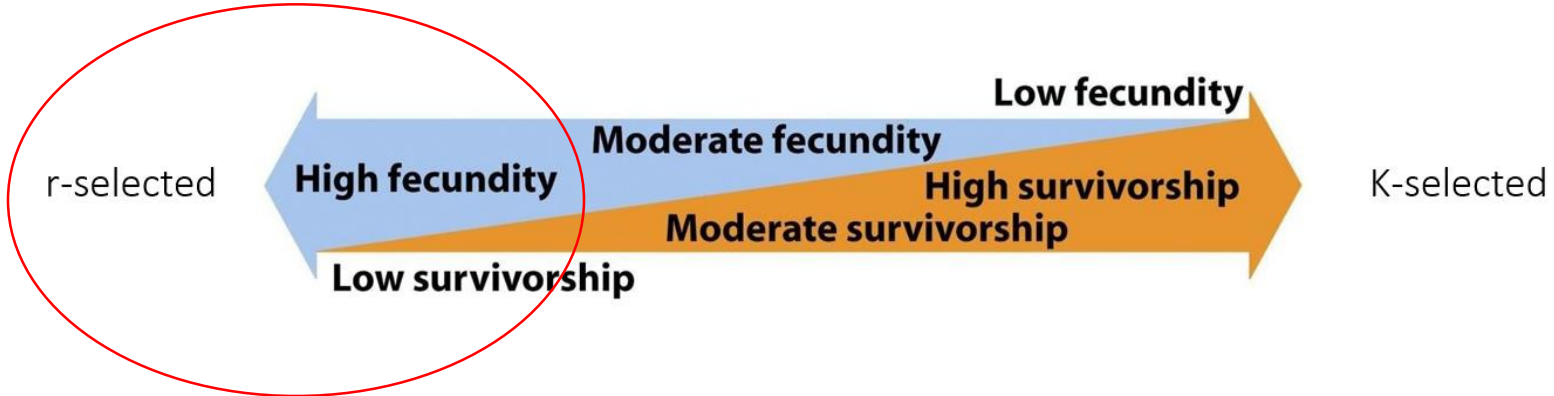
Maximize "*r*"

other r-selected species

- tend to organisms that are adapted to environmentally unstable/unpredictable environments
- will discuss this topic in more depth next week – ecological succession

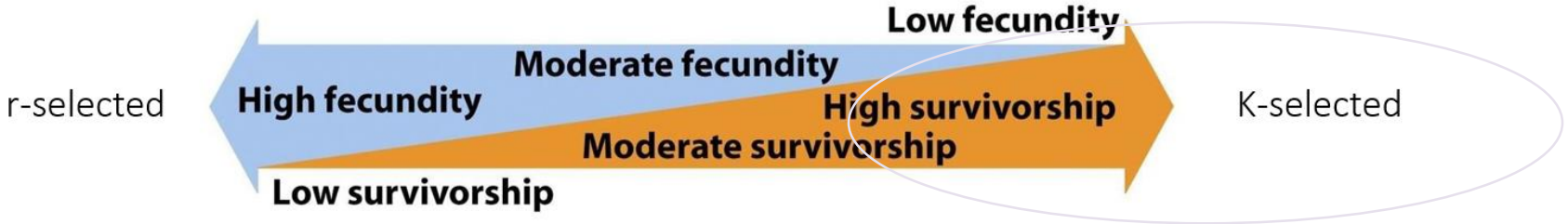
oysters

Insects/Arachnids



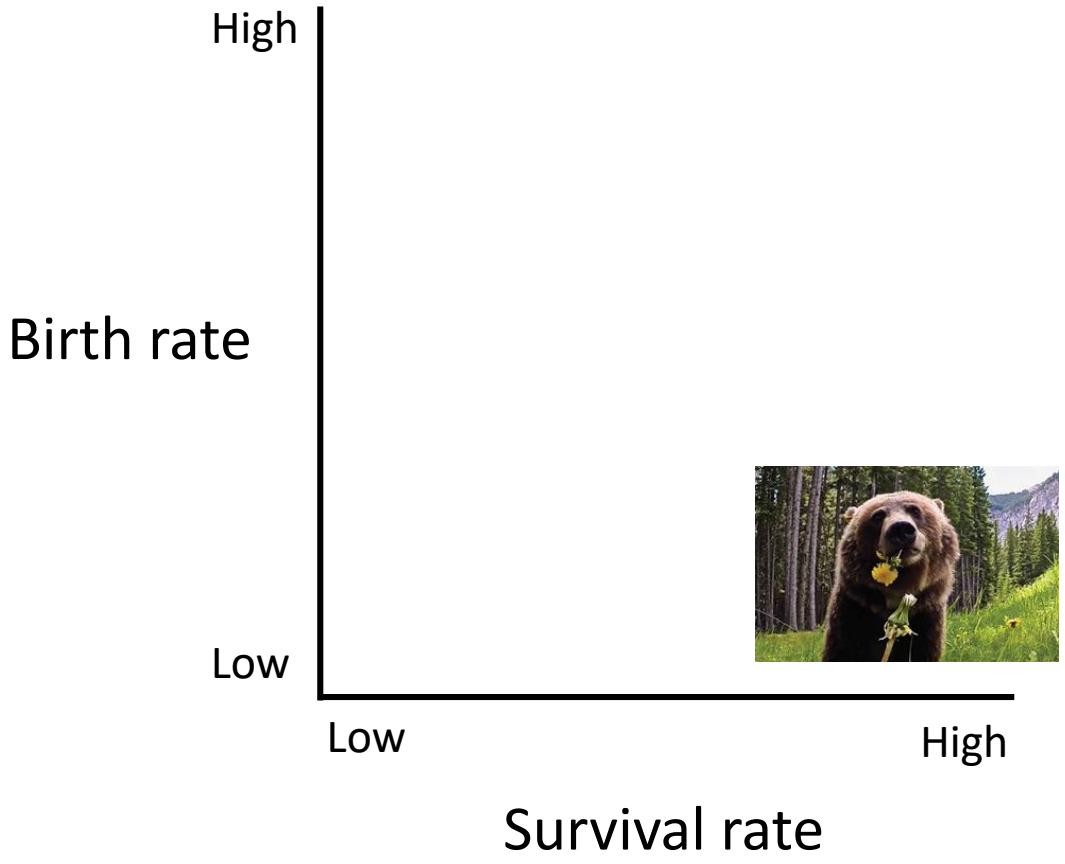
www.wikipedia.org
https://www.flickr.com/photos/52450054@N04/33077462365

K-selected life history strategy



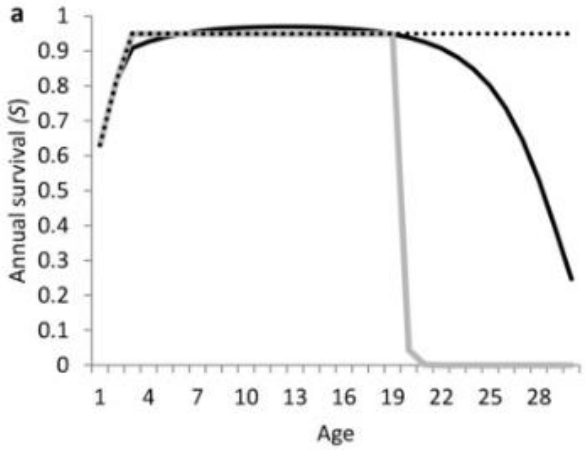
- a population with a K-selected life history strategy tends towards heavy investment in parental care.
- Often long-lived organisms with a long period of maturation before becoming reproductively mature.
- Offspring tend to have a higher probability of surviving to maturity than r-selected species.
- A K-selected life history strategy tends to be more common in competitive, higher-quality environments (but not always).

Grizzly Bear

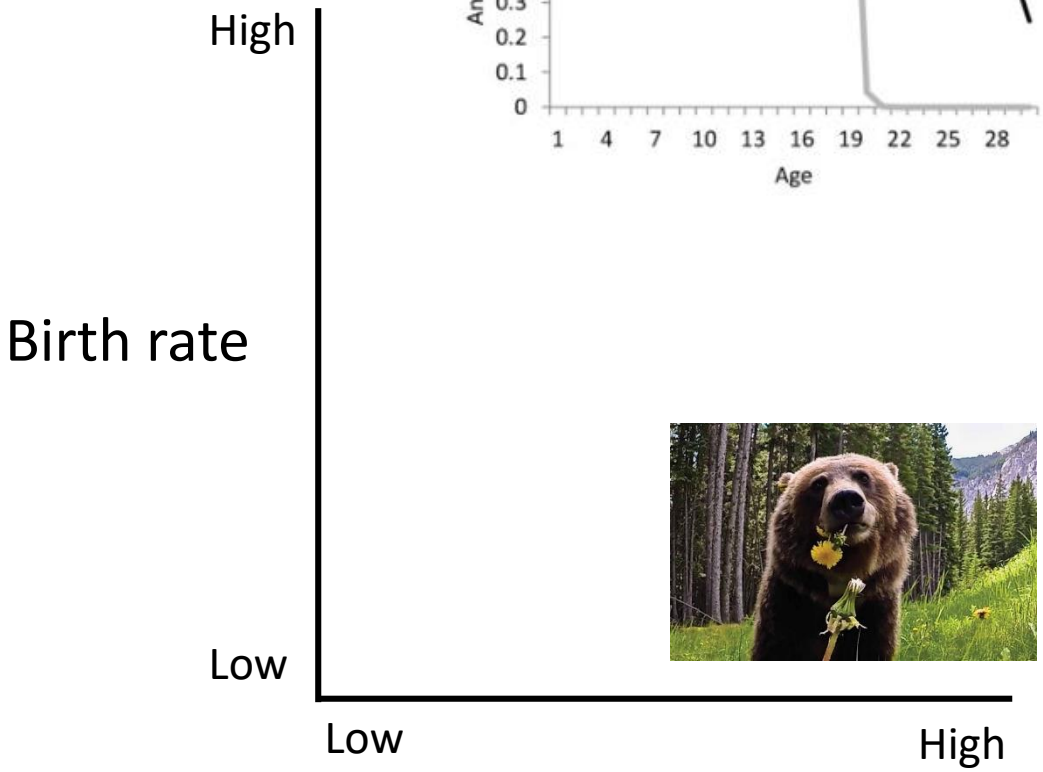


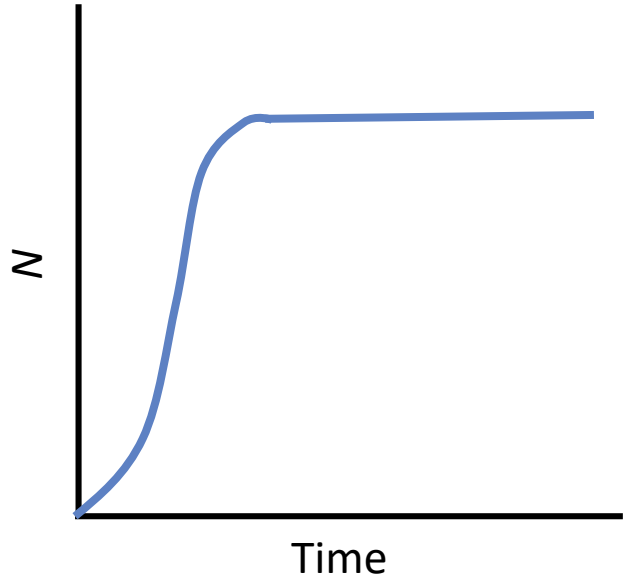
- Predation risk low
- Offspring receive good parental care
- Time and energy spent on parental care means fewer lifetime offspring, but offspring survivorship is high

Grizzly bears are an example of a "*K*-selected" species



Survivorship curve for Yellowstone grizzlies (solid black line) Source: vanManen et al. (2014)





High survivorship allows populations to reach and remain at *K*

Over time, populations evolve traits that make them better competitors (important when resources are limiting!)

Other K-selected species

Organisms adapted to stable environments, where competition is high. Populations tend to hover near “K”.

http://astar.tv/post/5-endangered-species-that-have-had-some-good-news/

https://www.flickr.com/photos/noaaphotolib/19156085084

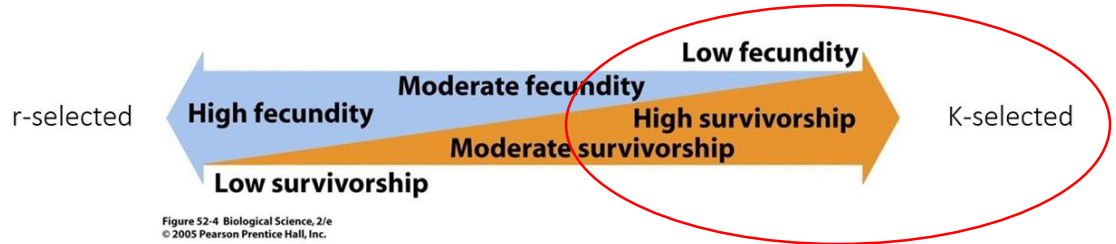
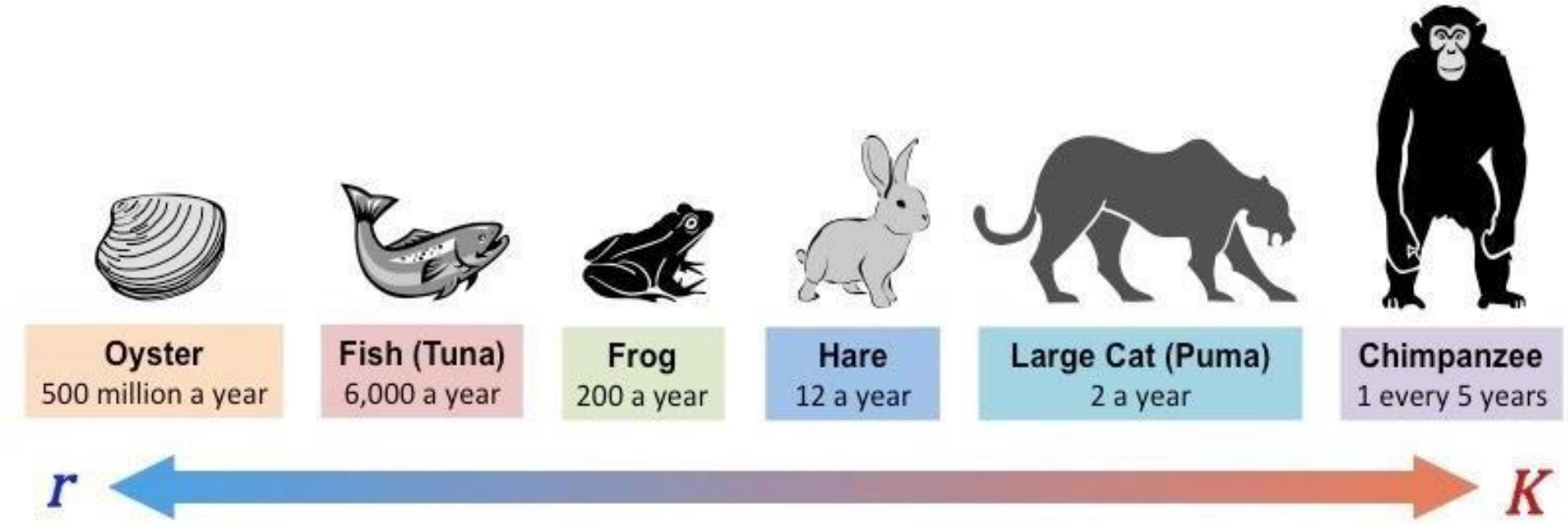


Figure 52-4 Biological Science, 2/e
© 2005 Pearson Prentice Hall, Inc.

Life history traits associated with *r*-selected and *K*-selected life history strategies

stable	*environment*	Unstable, unpredictable
"*K*"-selected species		**"*r*"-selected species**
long	*lifespan*	short
slow	*development time*	fast
low	*number of offspring per episode*	high
late	*onset reproductive maturity*	early
Type I	*survivorship*	Type III
high	*quality of offspring*	low
large	*body size*	small
high	*parental care*	low
smaller	*per capita growth rate (r)*	high

Most species fall somewhere in between the extremes.



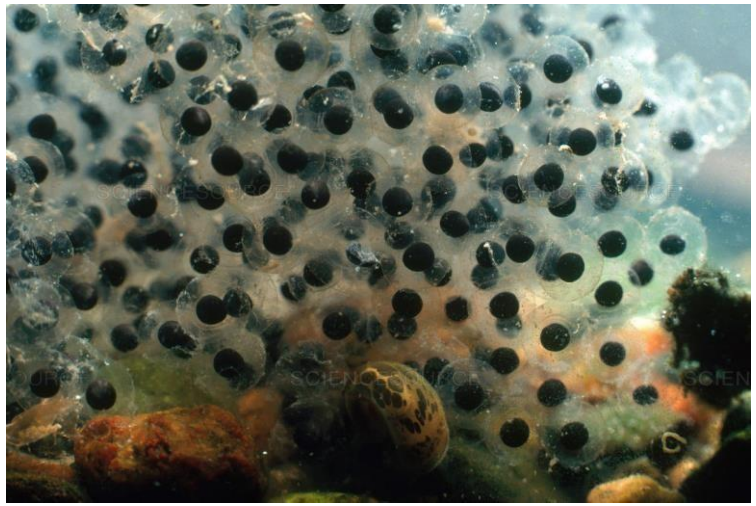
3 more learning goals

Understand/know:

- The characteristics of r- and k-selected species.
- In what environments/situations would you expect to find r- selected species? k-selected species? (more details in Community Ecology)
- Be able to apply your knowledge to new scenarios.

iClicker Question

Leopard Frog eggs (up to 5000 eggs)



wikipedia

Surinam toad (up to 100 eggs)

Which species is more strongly *r*-selected?

A. Leopard frogs

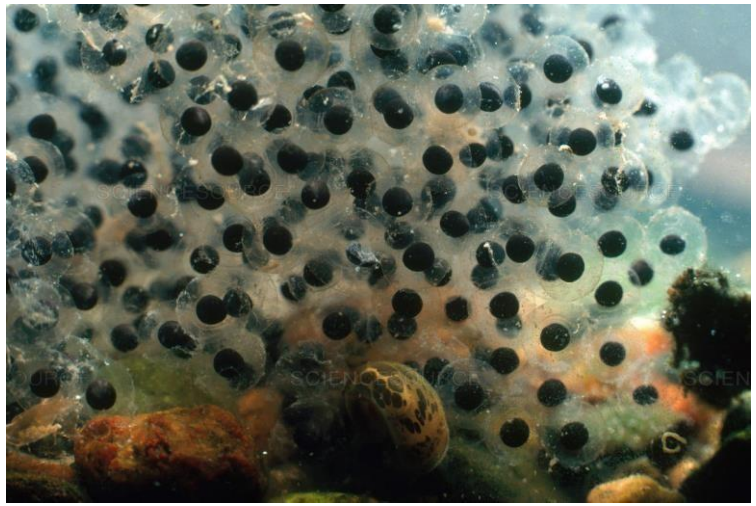
B. Surinam toads

C. Neither

reddit

Answer

Leopard Frog eggs (up to 5000 eggs)



wikipedia

Surinam toad (up to 100 eggs)

Which species is more strongly *r*-selected?

A. Leopard frogs

B. Surinam toads

C. Neither

reddit

Questions?

https://www.huffingtonpost.com/david-mizejewski/crossedeyed-opossum-becom_b_809151.html

4 minute-break

Opossum Case Study

- We expect natural selection to maximize TOTAL lifetime fitness

Opossums are super cool!!

- North America's only marsupial (north of Mexico)
- Immune to the venom of many snakes(e.g.rattlesnakes)
- Ancestor walked with dinosaurs 70 million years ago
- Smart – memory:tested higher than cats, dogs, and rats
- Eat ticks – lots and lots of them
- "Opposable thumbs" on rear feet
- Prehensile tails.

Opossum

- Mainland (U.S.) populations:
  - Lifespan is only 1.5-2 years; likely due to high risk of predation.

https://nature.mdc.mo.gov/discover-nature/field-guide/virginia-opossum

Opossum dangers

Predators: Fox, Coyote, Owls, Dogs, Bobcats

But “their greatest enemy in the modern world is the automobile.”

- They play dead when confronted with a predator

If your lifespan is short (<2 years) what should be your reproductive strategy?

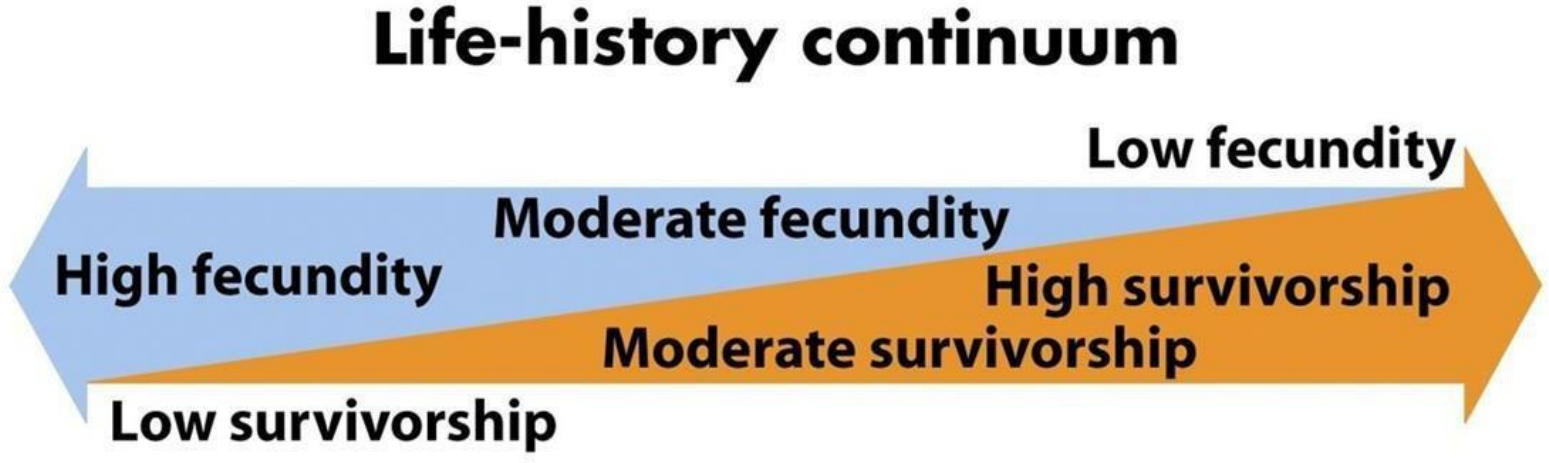
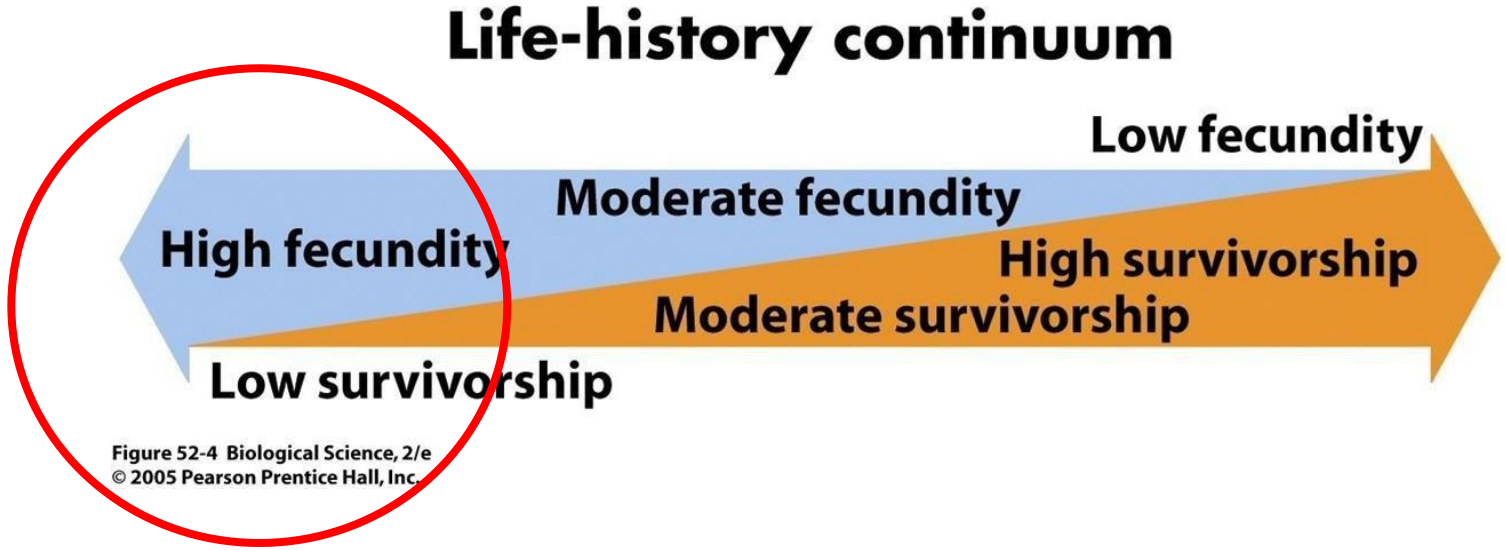


Figure 52-4 Biological Science, 2/e
© 2005 Pearson Prentice Hall, Inc.

Trade-off between survivorship and fecundity

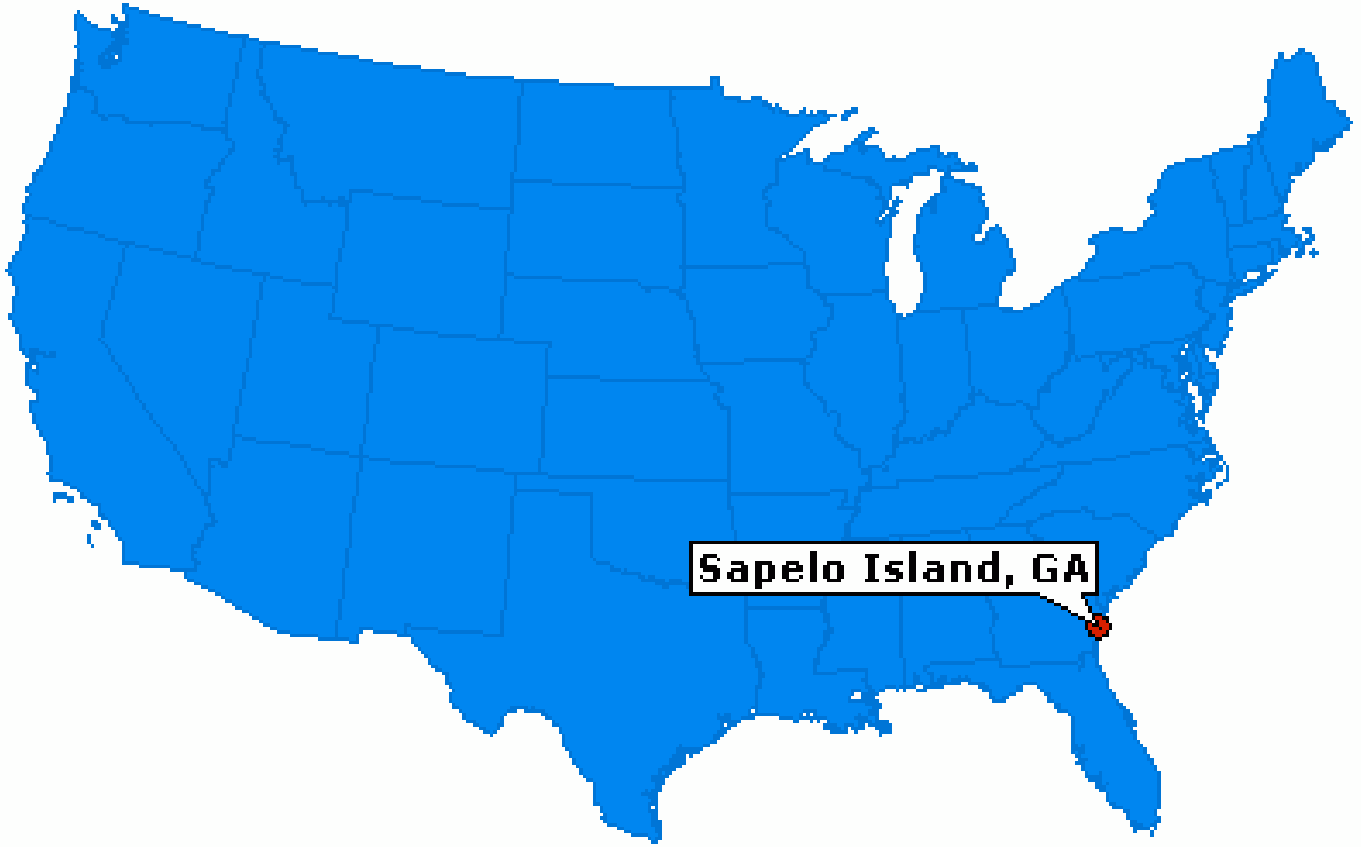


Evolutionarily speaking, if your lifespan is short, a good strategy is to have as many offspring as possible as soon as possible.

Even if that reduces energy levels and longevity, the organism is likely going to die from some other cause anyway.

Opossum - Sapelo Island Georgia

https://www.boredpanda.com/cute-possums-opossums/



http://kimsiegelson.blogspot.ca/2010/07/sapelo-island-library.html

- Opossums have been isolated on this island for ~4,500years (Dr. Steven Austad, University of Alabama)

https://www.boredpanda.com/cute-possums-opossums/

iClicker Question

- The opossums on Sapelo Island have a lower risk of predation compared to opossum on the mainland (fewer predators/fewer roads).
- Which population do you think has:
  - Greater survivorship (lives longer)?
  - Later onset of reproduction?
  - Smaller litter size?

A. Mainland opossums

B. Sapelo Island opossums

C. No difference

Answer

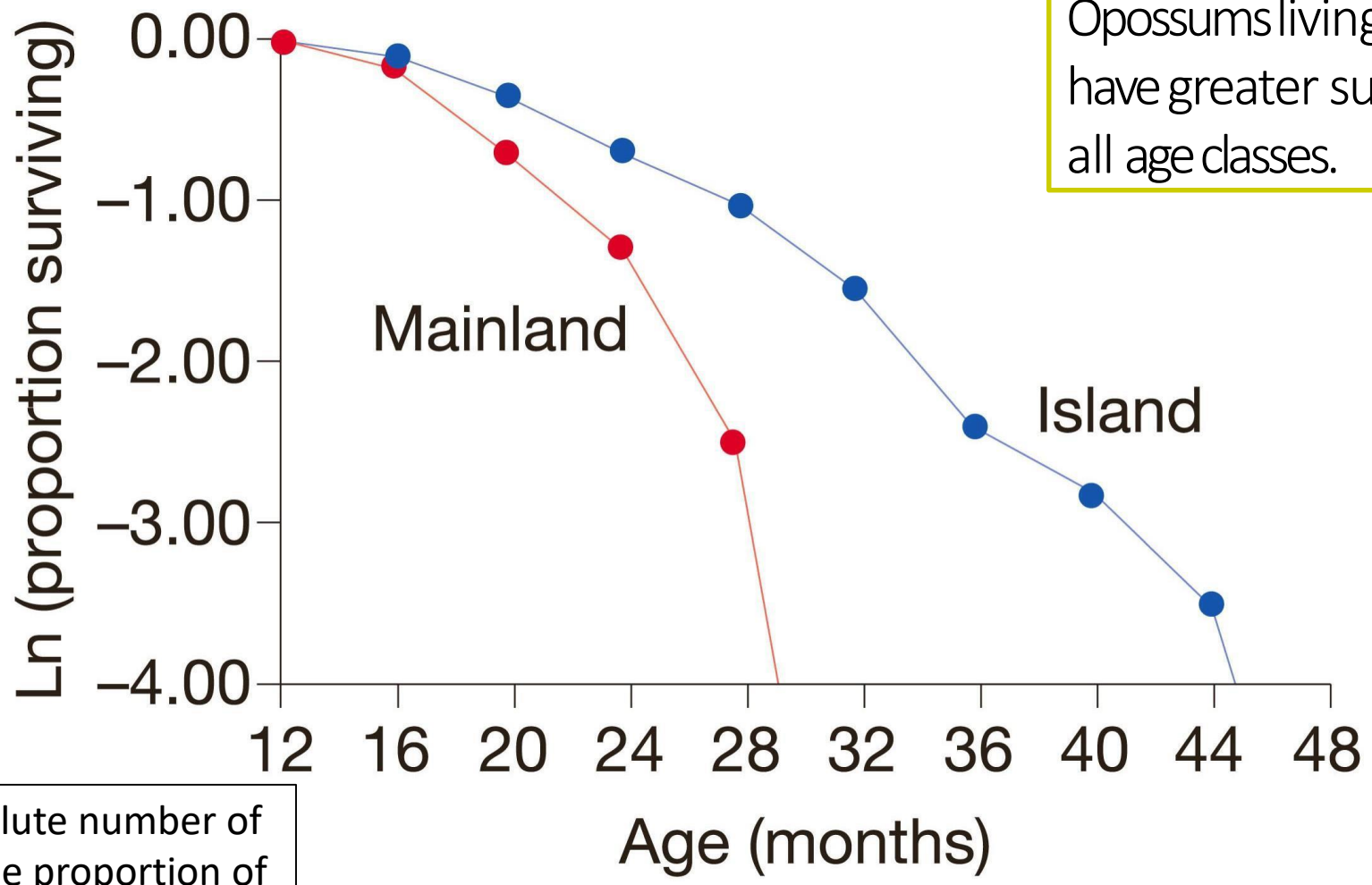
- The opossums on Sapelo Island have a lower risk of predation compared to opossum on the mainland (fewer predators/roads).
- Which population do you think has:
  - Greater survivorship (lives longer)?
  - Later onset of reproduction?
  - Smaller litter size?

A. Mainland opossums

B. Sapelo Island opossums

C. No difference

Survivorship on mainland (red) and Sapelo Island (blue)



Opossums living on the Island have greater survivorship across all age classes.

Note: y-axis is not absolute number of individuals alive, but the proportion of population surviving – to be clarified on Tuesday.

Island vs. Mainland Opossums

(Austad 1993)

TABLE I

Opossum life-history differences between island and mainland (mean with S.D. in parentheses).

Trait	Mainland	Island	*P*-value
Mean longevity (months)	20·0 (5·04)	24·6 (7·09)	0·002 ($t_{60} = 3·16$)
Maximum longevity (months)	31	45	—
Body mass index (kg/m^2)	8·30 (1·24)	8·22 (1·15)	0·767 ($t_{60} = 0·30$)
Age at first reproduction (months)	10·55 (2·45)	11·56 (1·75)	0·297 ($t_{18} = 1·07$)
Litter size (1st year)	7·63 (1·86)	5·86 (1·32)	0·002 ($t_{35} = 3·39$)
Litter size (2nd year)	7·58 (1·31)	5·36 (1·01)	<0·001 ($t_{24} = 5·00$)
Litter size (combined)	7·61 (1·62)	5·66 (1·22)	<0·001 ($t_{61} = 5·47$)

All *t*-tests are one-tailed.

Opposum in which population:

- Live longer, on average?
- Are slightly older at age of first reproduction?
- Have smaller litter sizes?

A. Opposums on the mainland

B. Opposums on the island

C. Neither

Answer

TABLE I

Opossum life-history differences between island and mainland (mean with S.D. in parentheses).

Trait	Mainland	Island	*P*-value
Mean longevity (months)	20·0 (5·04)	24·6 (7·09)	0·002 ($t_{69}=3·16$)
Maximum longevity (months)	31	45	—
Body mass index (kg/m^2)	8·30 (1·24)	8·22 (1·15)	0·767 ($t_{69}=0·30$)
Age at first reproduction (months)	10·55 (2·45)	11·56 (1·75)	0·297 ($t_{18}=1·07$)
Litter size (1st year)	7·63 (1·86)	5·86 (1·32)	0·002 ($t_{35}=3·39$)
Litter size (2nd year)	7·58 (1·31)	5·36 (1·01)	<0·001 ($t_{24}=5·00$)
Litter size (combined)	7·61 (1·62)	5·66 (1·22)	<0·001 ($t_{61}=5·47$)

All *t*-tests are one-tailed.

Opposum in which population:

- Live longer, on average?
- Are slightly older at age of first reproduction?
- Have smaller litter sizes?

A. Opposums on the mainland

B. Opposums on the island

C. Neither

Island vs. Mainland Opossums

(Austad 1993)

TABLE I

Opossum life-history differences between island and mainland (mean with S.D. in parentheses).

Trait	Mainland	Island	*P*-value
Mean longevity (months)	20·0 (5·04)	24·6 (7·09)	0·002 ($t_{60} = 3·16$)
Maximum longevity (months)	31	45	—
Body mass index (kg/m^2)	8·30 (1·24)	8·22 (1·15)	0·767 ($t_{69} = 0·30$)
Age at first reproduction (months)	10·55 (2·45)	11·56 (1·75)	0·297 ($t_{18} = 1·07$)
Litter size (1st year)	7·63 (1·86)	5·86 (1·32)	0·002 ($t_{35} = 3·39$)
Litter size (2nd year)	7·58 (1·31)	5·36 (1·01)	<0·001 ($t_{24} = 5·00$)
Litter size (combined)	7·61 (1·62)	5·66 (1·22)	<0·001 ($t_{61} = 5·47$)

All *t*-tests are one-tailed.

Opossums <u>living on the Island</u> have:

- >mean longevity*
- >maximum longevity (50%)*
- Are slightly older at age of 1st reproduction (but ns).
- Smaller litter sizes*

Compared to opossums living on the mainland.

Question?

Dr. Austad concluded that the Sapelo island population of opossums are more K-selected than r-selected (compared to the mainland population). Do you agree?

A. Yes
B. No
C. Not sure

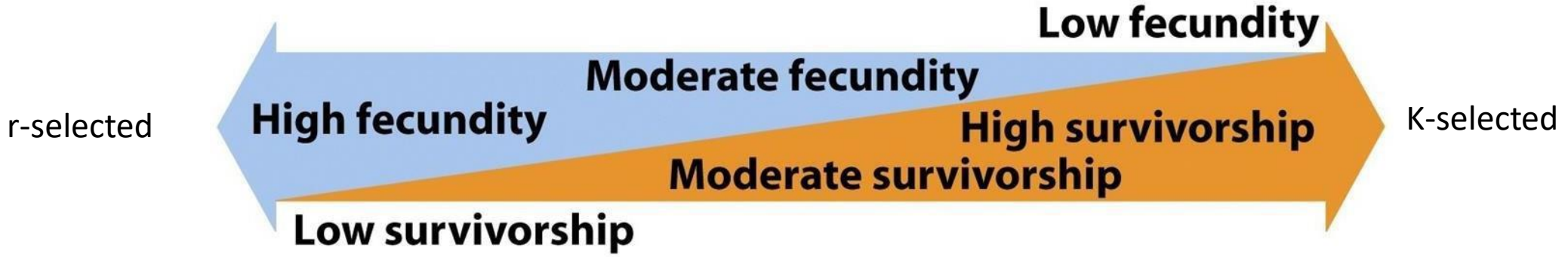


Figure 52-4 Biological Science, 2/e
© 2005 Pearson Prentice Hall, Inc.

Question?

- Dr. Austad concluded that the Sapelo island population of opossums are more K-selected than r-selected (compared to the mainland population).
- Do you agree?

A. Yes
B. No
C. Not sure

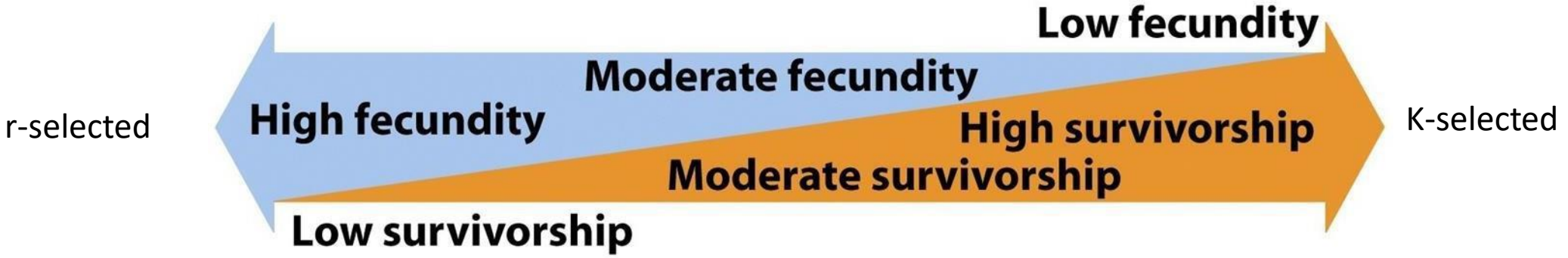


Figure 52-4 Biological Science, 2/e
© 2005 Pearson Prentice Hall, Inc.

Summary - Learning goals for population ecology

- Understand the difference between population size and population density.

Be able to:

- Estimate population size using Lincoln-Peterson Index. Know the assumptions of this index
- Estimate per capita birth and death rates, and the per capita growth rate a population (*r*).
- Estimate population size at a future point using per capita growth rate (*r*)
- Explain how the difference between exponential growth and logistic growth
  - How the pattern of growth is related to the per capita growth rate (*r*) and the
  - environment's carrying capacity (K)
- Identify or describe density-dependent and/or density dependent factors and their effects on population size and/or per capita growth rates
- Know life history traits are (e.g., survivorship and fecundity)
- How to interpret survivorship curves
- What are the characteristics of r- and k-selected species.
  - In what environments/situations would you expect to find r-selected species? k-selected species? (To be covered in more detail in Community Ecology – Succession)
- Be able to apply your knowledge to new scenarios.

Community Ecology

Source: New York Times

What is a community?

Community: All the species that interact with one another within a defined area

- Community ecologists primarily think about **biotic interactions**
  - How do species interact with each other?
  - What are the fitness consequences of these interactions?
  - How do these interactions change with time and location?

We can classify pairwise* biotic interactions based on fitness effects

Interaction	Description	Fitness effects
Amensalism	Occur when an organism inflicts harm to another without any fitness cost/benefit to itself.	– / 0
Commensalism	Occurs when one species benefits from the interaction, but the other species is unaffected	+ / 0
Mutualism	Occurs when two species interact in away that confers fitness benefits to both	+ / +
Consumption - Predation - Herbivory - Parasitism	Occurs when one organism eats (or absorbs the nutrients) from another. There is a positive fitness effect for the consumer, and a negative fitness effect on the "prey".	+ / –
Competition - Intraspecific - Interspecific	Occurs when individuals use the same limited resources. There are negative fitness consequences for both individuals.	- / -

* Pairwise = relating to a pair (in this context, 2 interacting organisms of different species)

1. Amensalism (- , 0)

Amensalism: fitness of one organism is negatively affected; the other's is unaffected

No effect (positive or negative on fitness (0))

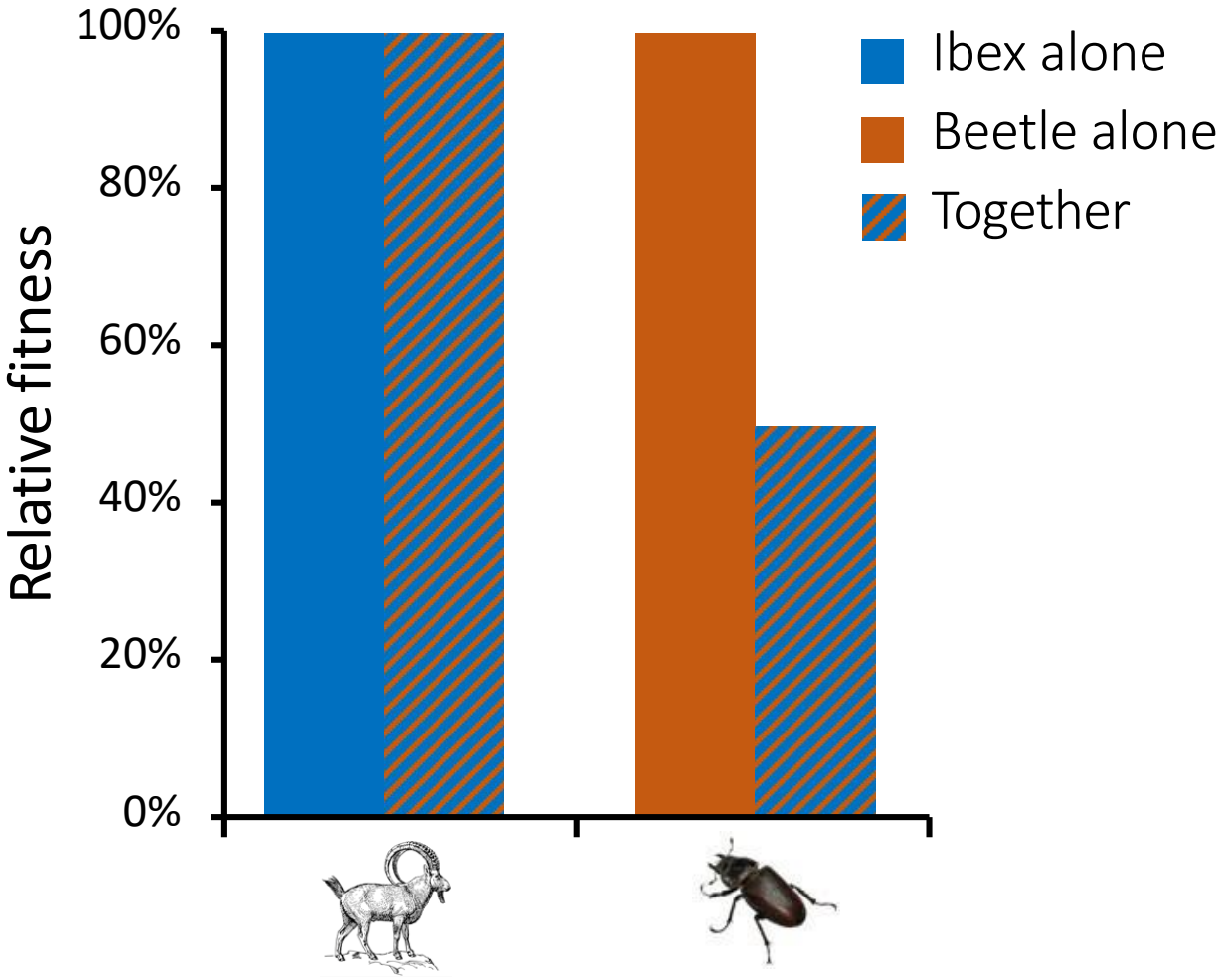
Negative effect on fitness (–)

1. Amensalism (– / 0)

Amensalism: fitness of one organism is negatively affected; the other's is unaffected

Example: Spanish ibex  often accidentally ingest leaf beetles  while grazing

- Ibex fitness unaffected when co-occurring with beetles
- Leaf beetle fitness negatively affected when co-occurring with ibex



Gómez & González-Megías (2002)

2. Commensalism (+ / 0)

Commensalism: fitness of one organism is positively affected; the other's is unaffected

Example: Pearlfish hiding in sea cucumber anuses (yes, seriously)

- Pearlfish are tiny and otherwise would be vulnerable to predation
- Sea cucumbers are usually unaffected
  - They sometimes will evict their unwanted tenants or attempt to prevent them from entering

Pearlfish

Sea cucumber

Respiratory organs, intestines and gonads expelled

Anal teeth

More on the relationship between pearlfish and sea cucumbers…

https://www.youtube.com/watch?v=o6NIG3KkwLE

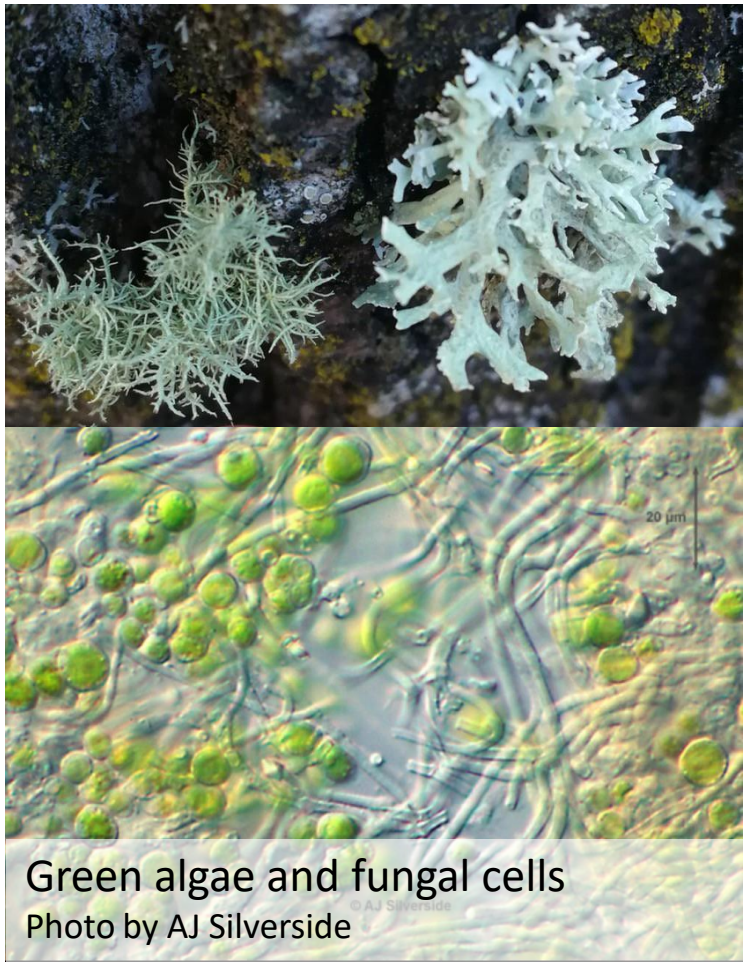
Another commensal relationship (+/0) ?

- You almost certainly have eye mites living on your skin in the sebaceous glands of hair follicles (e.g. base of eyelashes)
- *Demodex folliculorum* and *D. brevis*
- They are regarded as commensals.
- They emerge at night to feed on dead skin/sebum and to reproduce (on your face ☺)
- At no fitness cost to you
- It is possible they may be mutualistic (+ / +), i.e. help to keep your eyes healthy by ingesting bacteria, etc.
- But, the relationship can turn parasitic (+/-) (Lacey et al. 2011)

  - if host immune system is suppressed.

http://www.bbc.com/earth/story/20150508-these-mites-live-on-your-face

3: Mutualism (+ ; +)



Green algae and fungal cells
Photo by AJ Silverside

Mutualism: fitness of both organisms is positively affected

Example: “Lichens” are actually a symbiosis* involving <u>two</u> very different species

- Fungal partner provides shelter, water, and inorganic nutrients
- Photosynthetic partner (either cyanobacteria or green algae) fixes solar energy to supply carbohydrates

* A relationship characterized by close physical proximity

iClicker Question

- *Arctonoe vittata* is a species of scale worm that lives under the shell of keyhole limpets. *A. vittata* is a predator, but causes no harm to the limpet.

- What type of relationship do these two taxa have?

A. Amensal

B. Commensal

C. Mutualism

D. Predation

E. Competition

Answer

- *Arctonoe vittata* is a species of scale worm that lives under the shell of keyhole limpets. *A. vittata* is a predator, but causes no harm to the limpet.

- What type of relationship do these two taxa have?

A. Amensal

B. Commensal

C. Mutualism

D. Predation

E. Competition

iClicker Question

- *Arctonoe vittata* will protect its host (the limpets) from sea stars (a predator) by biting at the tube feet of the sea star, which drives the sea star away.

- What type of relationship do these two taxa have?

A. Amensal

B. Commensal

C. Mutualism

D. Predation

E. Competition

Answer

- *Arctonoe vittata* will protect its host (the limpets) from sea stars (a predator) by biting at the tube feet of the sea star, which drives the sea star away.

- What type of relationship do these two taxa have?

A. Amensal

B. Commensal

C. Mutualism

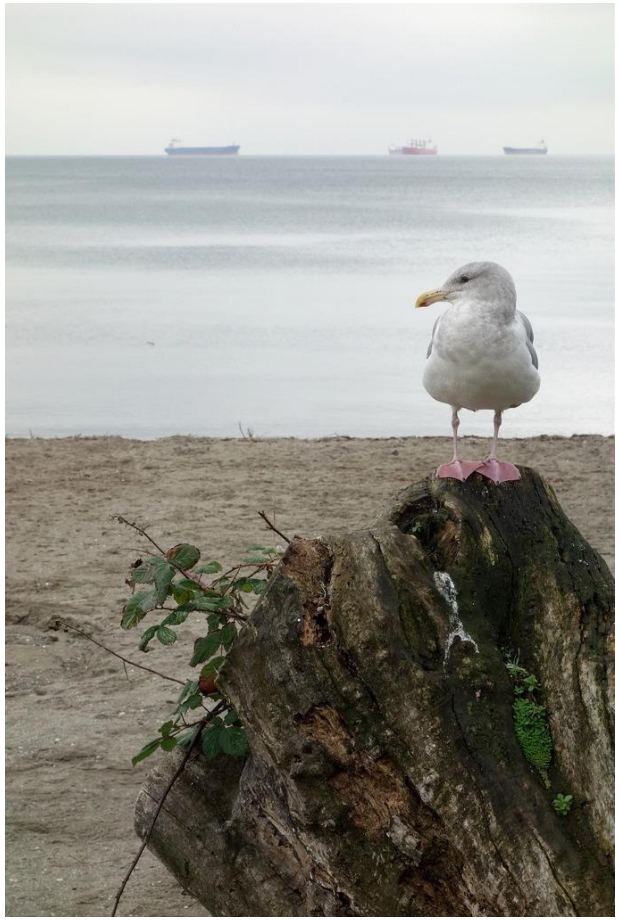
D. Predation

E. Competition

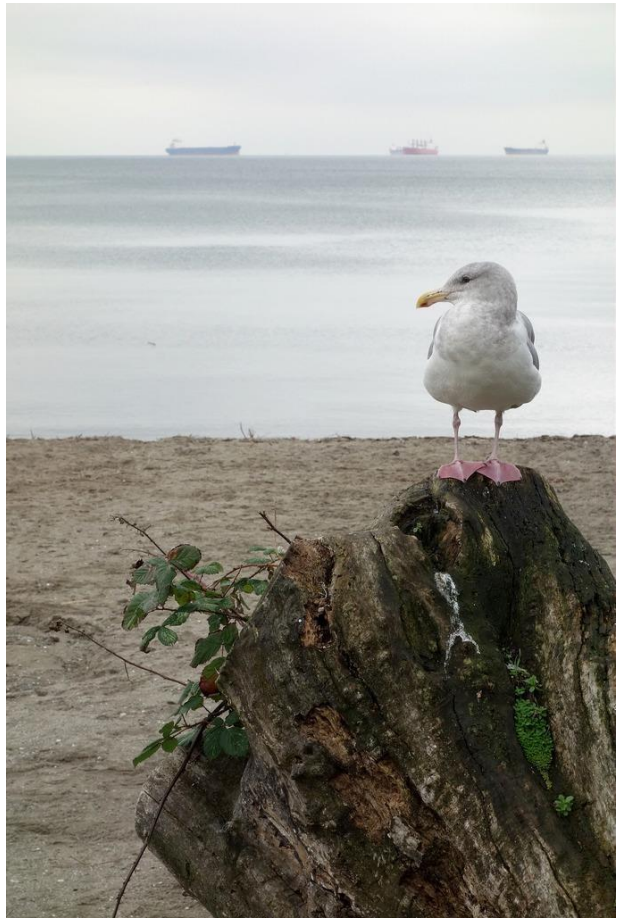
Next Class (Tuesday)

- Community Ecology Part II – Competition & Predation (if time)
- Rory's guest lecture (there will be a question on the final exam)

I came across this bird while walking near English Bay.
What type of bird is it?



So, it is not a bay gull……☺



https://www.flickr.com/photos/free-images-flickr/27272059009