Question 1 (1 point)

In the Northern Hemisphere, wind direction generated by the Ferrel cell at the earth's surface is from

- south to north
- west to east
- north to south
- east to west

Question 2 (1 point)

Dry seasons in tropical areas are caused by

- adjacent Hadley cells centred over the region
- adjacent Ferrell cells centred over the region
- the region receiving the most intense solar radiation during that period
- adjacent Hedley and Ferrell cells centred over the region

Question 3 (1 point)

In North America, temperate grasslands and temperate deciduous forest occur at the same latitude. These biomes differ proportionally the most with respect to

- mean precipitation during the winter
- mean precipitation during the summer
- mean temperature during the winter
- mean temperature during the summer

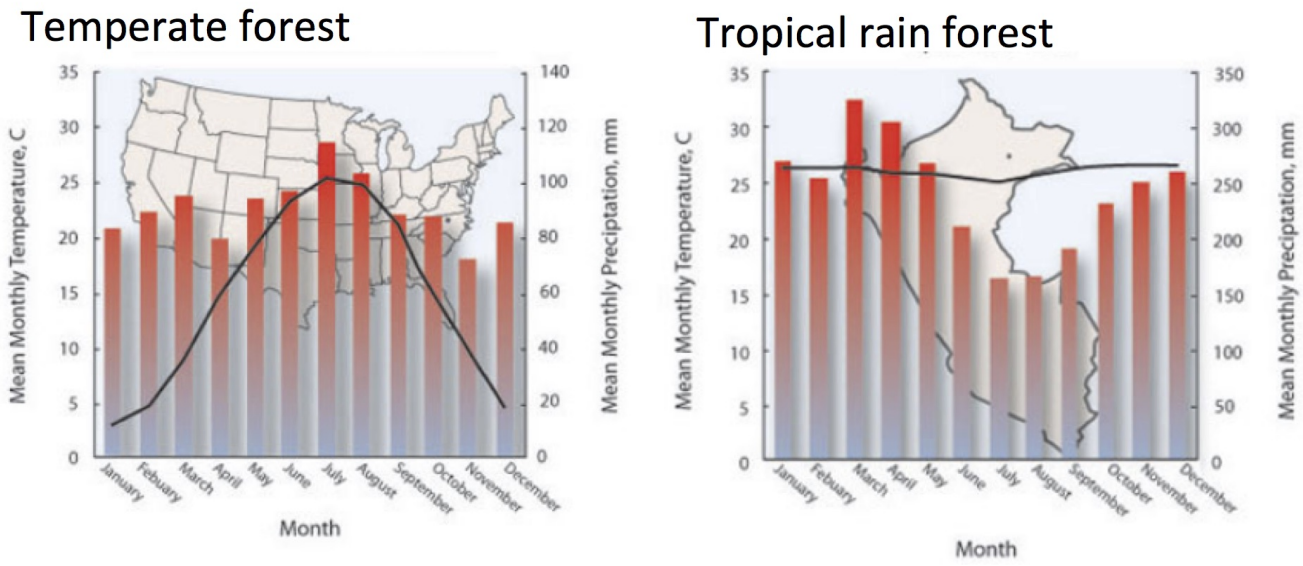
Question 4 (1 point)

Northern Chile and southern Mexico occur at similar latitudes relative to the equator. Yet, yearly climate along the west coast of Mexico is very different from Northern Chile. Reasons for this include

- [a] their location relative to Hadley and Ferrell cells
- [b] warm versus cold ocean currents nearby
- [c] the prevailing wind direction relative to the location of nearby mountainous terrain
- a, b & c
- b & c

Question 5 (1 point)

Below are climate diagrams for a temperate forest and a tropical rain forest.



- [a] there is a large fluctuation in monthly precipitation across a year in the temperate forest, and moderate fluctuations in temperatures, whereas there is relatively stable monthly precipitation across a year in the tropical rain forest, and moderate fluctuations in monthly temperatures
- [b] maximum monthly precipitation in the temperate forest is nearly equal to the stable level of precipitation in the tropical rain forest
- [c] there is a large fluctuation in monthly temperature across a year in the temperate forest, and moderate fluctuations in monthly precipitation, whereas there are relatively stable monthly temperatures across a year in the tropical rain forest, and moderate fluctuations in monthly precipitation
- a & b

Question 6 (1 point)

Warmer air

- holds less moisture than cold air.
- does not affect the potential level of moisture in the air.
- holds more moisture than cold air.

Question 7 (1 point)

Below is a list of properties of islands, which fall within the scope of prediction of MacArthur & Wilson's theory of island biogeography?

species number, turnover, speciation, ecological niche, optimal foraging theory, competition, adaptation

- species number, turnover
- species number, turnover, ecological niche, optimal foraging theory, competition
- all of the terms
- speciation, adaptation

Question 8 (1 point)

In the theory of island biogeography, what is the simplest explanation for why there is a higher extinction rate on a smaller versus larger island for the same number of species?

- On a smaller island there are fewer niches, so there is more intense competition, so there is a greater chance that a species goes extinct.
- On a smaller island, the population size of a species is more likely to be small, so there is a greater chance that a species goes extinct through demographic stochasticity.
- On a smaller island there are fewer prey, so if one prey goes extinct, it is more likely to cause a predator species to go extinct.
- On a smaller island there are fewer refugia, so when, for instance, a large storm such as a hurricane comes through, more species are likely to go extinct.

Question 9 (1 point)

Below are a list of statements:

[a] Rate of immigration of new species decreases monotonically with increasing number of species already present

[b] The immigration and extinction rates will equal the same value, corresponding to the turnover rate at equilibrium

[c] Near islands of the same size as far have more species

[d] Small islands have extinction rates higher than large, for the same number of species present

Which statements are assumptions of MacArthur & Wilson's Theory of Island Biogeography and which are predictions?

- ◯ Assumptions: a; Predictions: b - c
- ◯ Assumptions: c; Predictions: a, b & d
- ◯ They are all predictions
- ◯ Assumptions: a & d; Predictions: b & c
- ◯ They are all assumptions
- ◯ Assumptions: b & c; Predictions: a & d

Question 10 (1 point)

Below is a plot indicating a positive relationship between species number and habitat diversity.

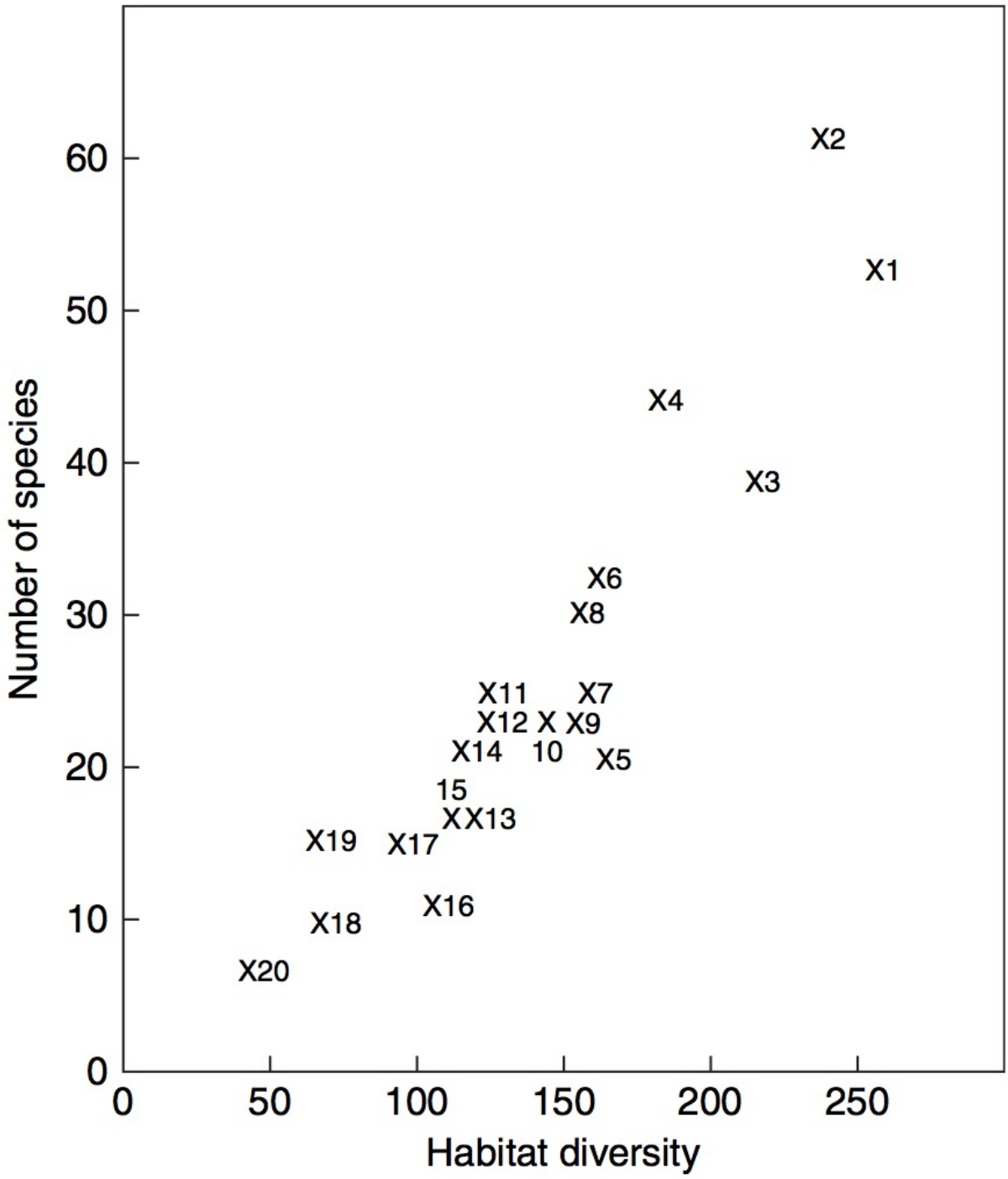


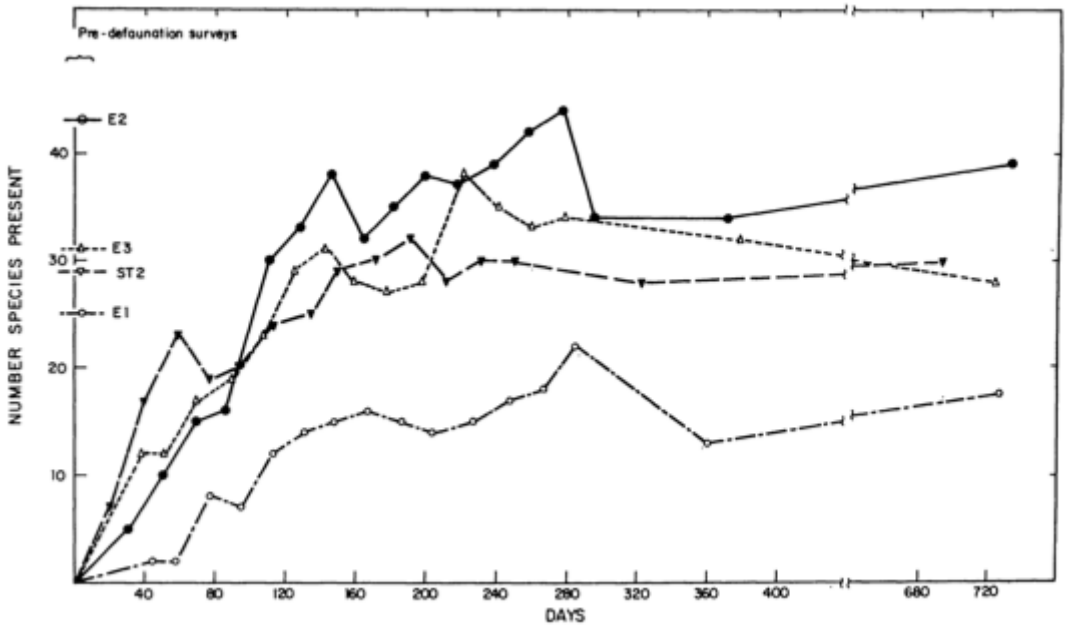
Figure 8 Breeding passerine birds on Aegean islands: Number of species vs habitat diversity. Reproduced from Watson GE (1964) Ecology and evolution of passerine birds in the islands of the Aegean Sea. PhD Dissertation, Yale University, with permission.

Which of the following statements is true?

- This figure rejects MacArthur and Wilson's theory of island biogeography because the theory did not account for habitat.
- This figure supports MacArthur and Wilson's theory of island biogeography because the theory because it predicts more species with more diverse habitats.
- This figure neither rejects nor supports MacArthur and Wilson's theory of island biogeography because the theory did not account for habitat.
- This figure neither rejects nor supports MacArthur and Wilson's theory of island biogeography because the figure does not include species turnover.

Question 11 (1 point)

Below is a figure from Simberloff and Wilson's experimental test of island biogeography theory. The figure plots the number of arthropod species present on a mangrove island as a function of the number of days since the island was fumigated. Islands are identified with symbols E2, E3, ST2 and E1. Note also the lines in the figure associated with each island.

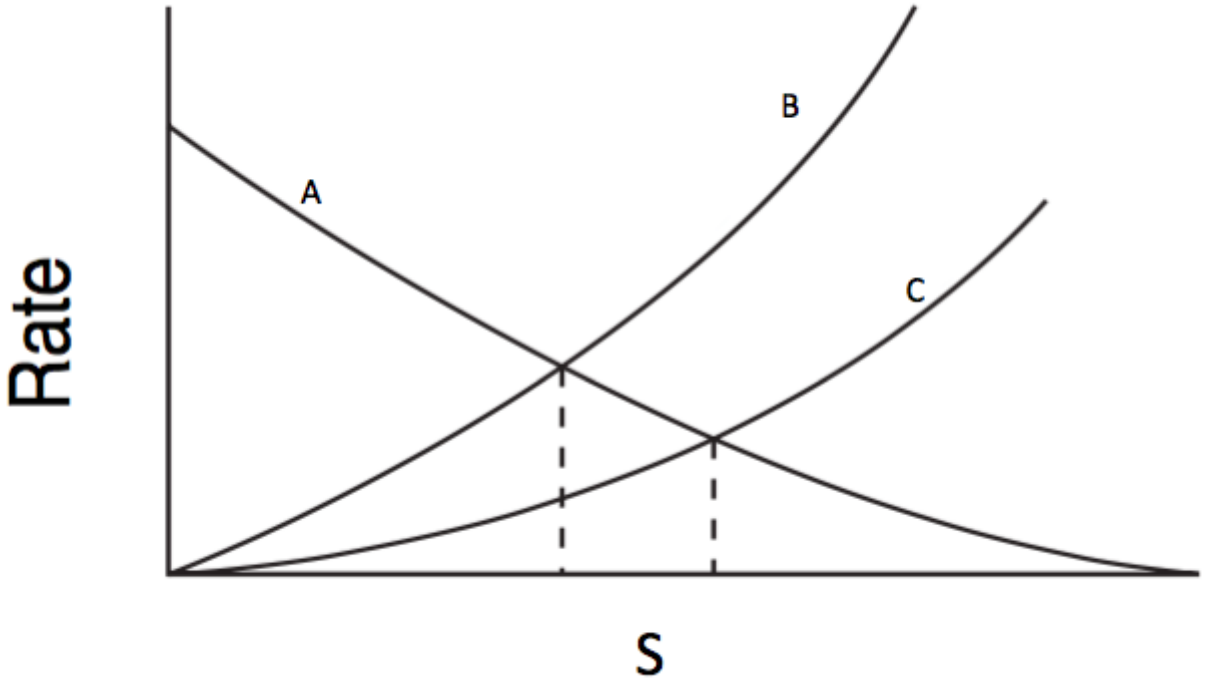


Based on the principles of island biogeography and the species accumulation curves in the figure, which island is the furthest away from a mainland source?

- E3
- ST2
- E1
- E2

Question 12 (1 point)

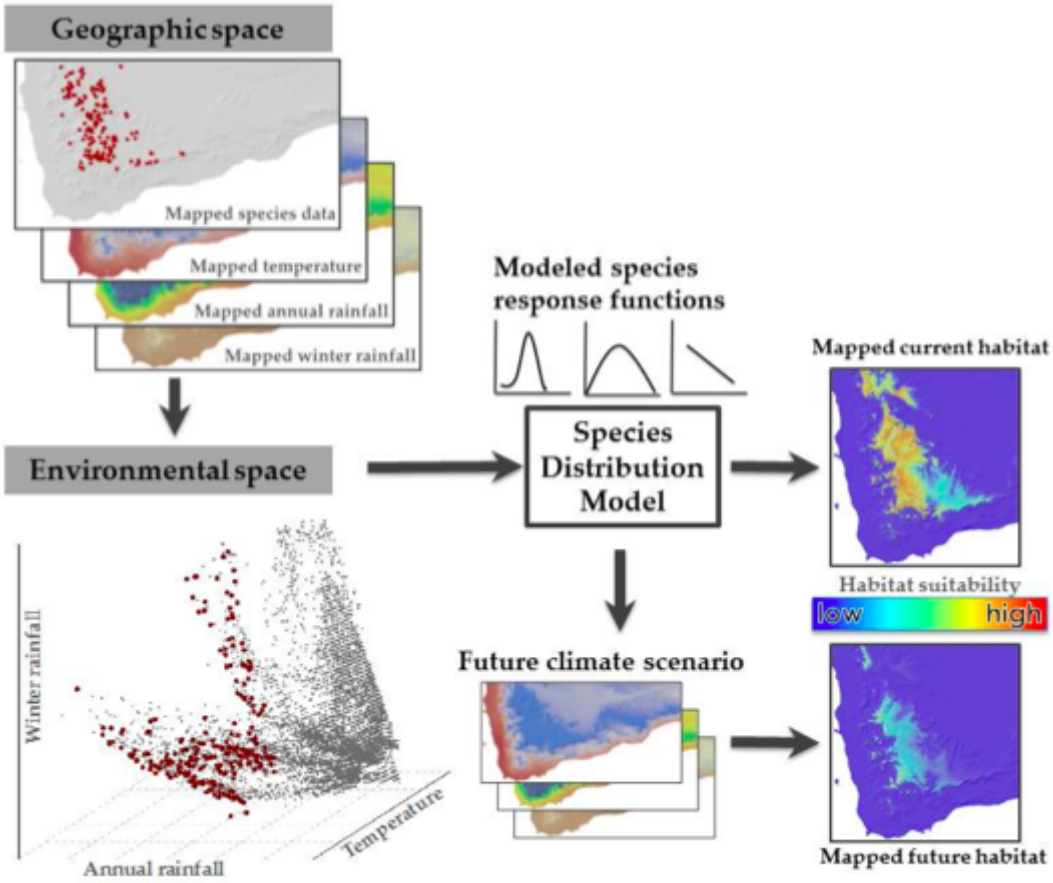
Below is a conceptual figure from the theory of Island Biogeography. Which curve corresponds to the extinction rate of an island of larger area?



- ◯ A
- ◯ B
- ◯ C

Question 13 (1 point)

Below is a figure that depicts “species distribution modeling” (SDM), whereby we seek to predict the future geographic distribution of a species under future climate scenarios. In this form of SDMs, the mapped location of individuals in a species is related to the environmental variables temperature and rainfall.



In the context of the Hutchinson niche, what is a key missing variable from this modelling approach?

- [a] a competing species
- [b] latitude
- [c] topographic elevation
- [d] vegetation
- a & d
- b & c

Question 14 (1 point)

Why in our knowledge map of Grinnell's niche is "place in nature" and "habitat" associated with its focal node, as opposed to food preferences?

- a species' food preferences determine, in part the habitat it occurs
- a species habitat determines, in part, its food preferences

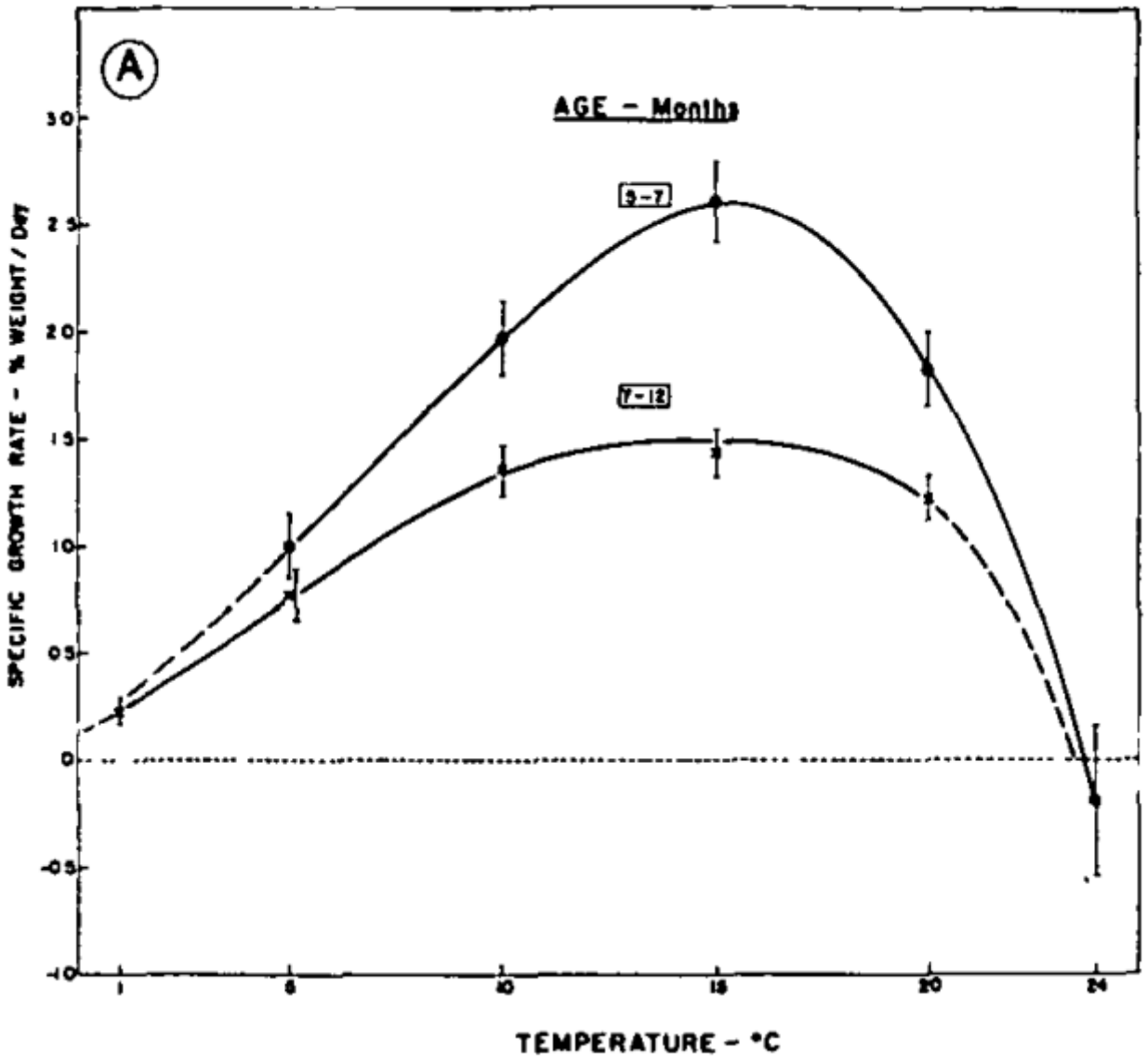
Question 15 (1 point)

Joseph Grinnell first proposed the "niche" concept based on his study of the California Thrasher. Which of the following properties of the Thrasher best support Grinnell's niche concept.

- That the Thrasher is an insectivore.
- That the thrasher occurs in a well-defined geographic area.
- That across an area with diverse vegetation, the Thrasher is typically found in dense chaparral.
- That the Thrasher competes with the Roadrunner for nest sites.

Question 16 (1 point)

Below is a plot of growth rate in body size of salmon as a function of temperature at two ages.



This study is informative with respect to what?

- Salmon's fundamental niche
- Salmon's realized niche
- Salmon reproduction
- Salmon natural history

Question 17 (1 point)

Below is a list of terms, which most directly determine the persistence of a species?

temperature, moisture, photosynthetic rate, reproduction, survival

- photosynthetic rate, reproduction, survival
- temperature, moisture, photosynthetic rate
- temperature, moisture
- all of them
- reproduction, survival

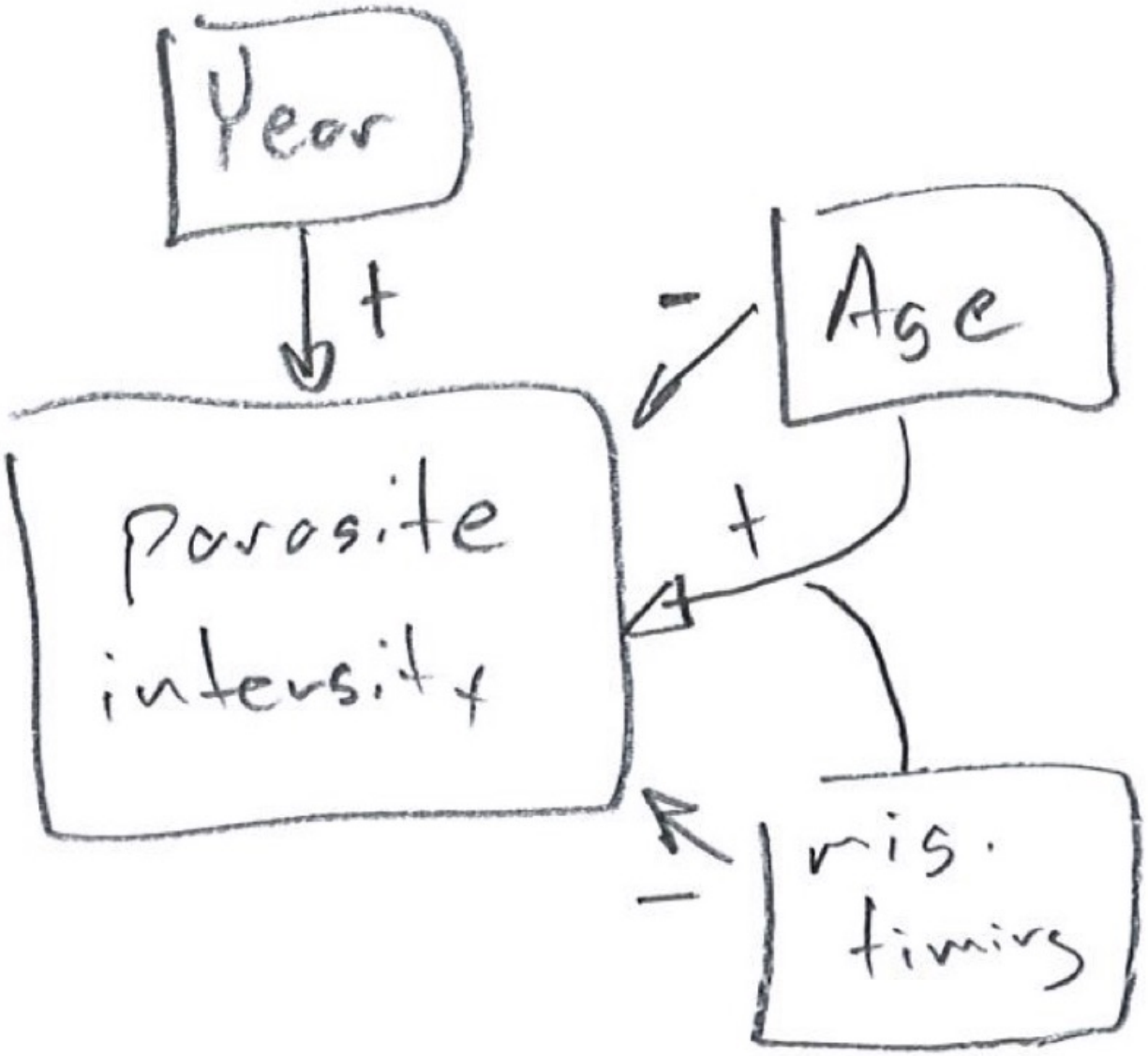
Question 18 (1 point)

Comparing Grinnell's versus Elton's versus Hutchinson's niche concepts, which allows for more dynamic change in its delineation?

- Hutchinson
- Elton
- None of the concepts allow for change
- Grinnell

Question 19 (1 point)

Below is the state of knowledge that came out of the DeGroote & Rodewald paper on parasite intensity in Magnolia Warblers.



Based on this knowledge map which of the following statements is correct?

- younger birds that arrive late have higher parasite loads
- older birds that arrive late have higher parasite loads
- younger birds that arrive early have higher parasite loads
- older birds that arrive late have lower parasite loads

Note, I should have left this option out. This can also be true with a positive interaction.

Question 20 (1 point)

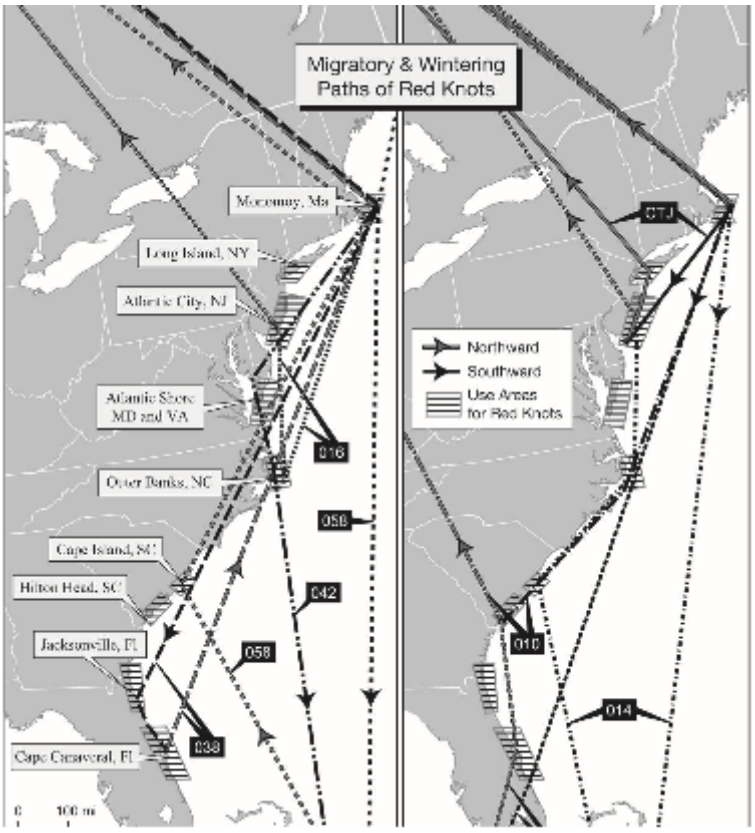
The Roitberg & Roitberg introduction to Foraging noted that a prediction of optimal foraging theory is that "high-ranked prey should always be preferred". What is the basis of ranking prey?

- [a] its energy content
- [b] the time it takes to find the prey
- [c] the time it takes to capture the prey
- a, b & c
- a & b
- a & c
- b & c
- a and either b or c, depending on context
- a and c, as well as b, depending on context

Note, the answer a, b & c is also correct. I forgot to delete that option.

Question 21 (1 point)

In lecture, migration routes of red knots were a motivating example to think about behavioural ecology. In the corresponding figure below, we noted that individuals differed in their migratory routes.

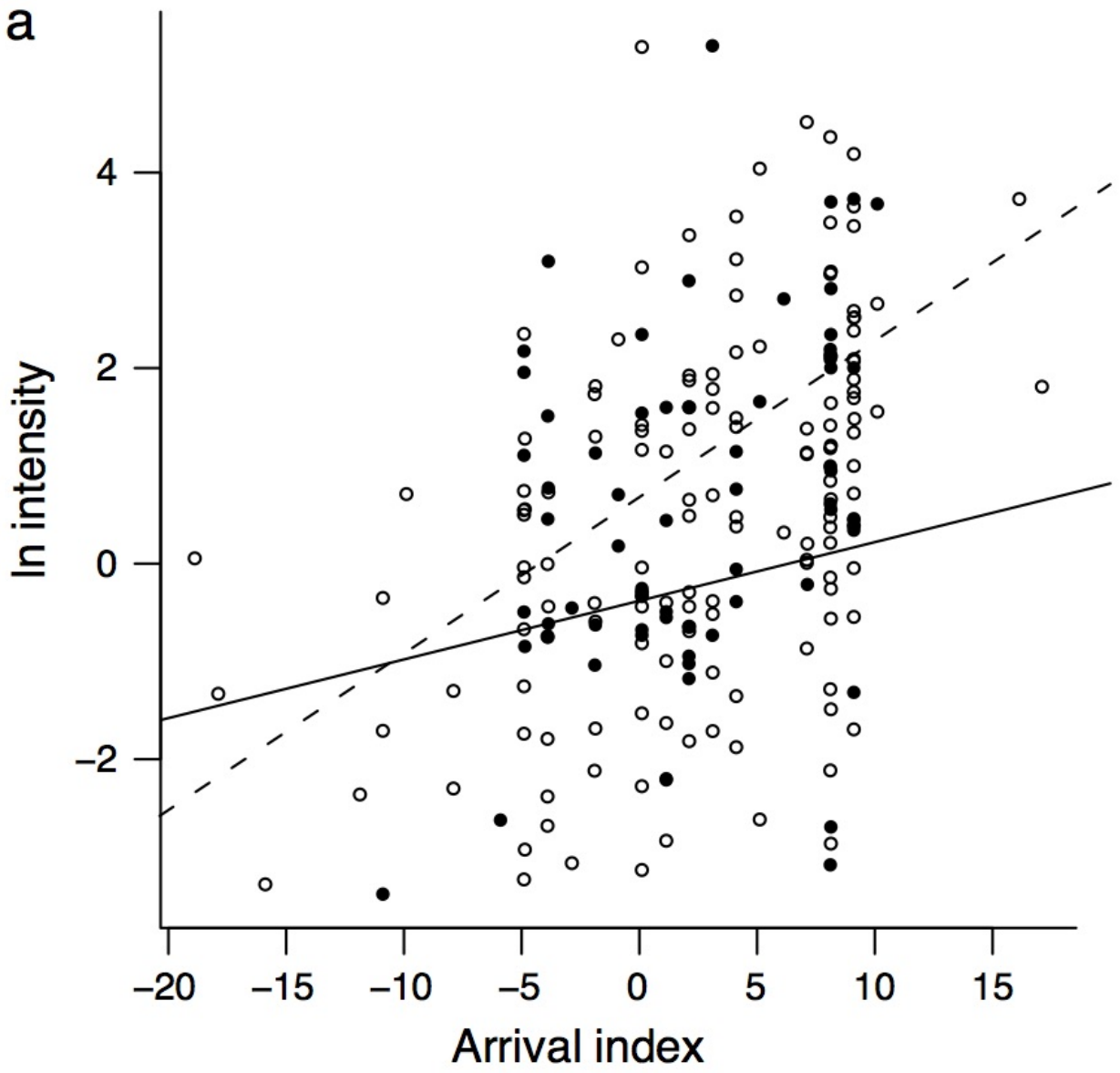


An important principle that shapes thinking in behavioural ecology is optimality. Is variation in a behaviour like migration route consistent with optimality? Why?

- ◯ No, under optimality there is only a single migratory route that is optimal.
- ◯ No, under optimality reproduction and survival are optimized and this cannot occur along different migratory routes.
- ◯ Yes, under optimality reproduction and survival are optimized and this can occur along different migratory routes.
- ◯ Yes, under optimality there is only a single migratory route that is optimal.

Question 22 (1 point)

Below is a figure from the DeGroote & Rodewald paper on parasitization of yellow-rumped warblers.



It plots parasite intensity as a function of arrival date for younger (dashed line) versus older (solid line) birds. Is this plot consistent with Table 3 (see below)? How?

Table 3. Averaged linear regression (Intensity) and logistic regression (Prevalence) models for magnolia and yellow-rumped warblers. Only models with $\Delta AIC_c < 7$ and $AIC_c <$ null model were used for averaging. Coefficients (beta hat), 95% CI, and relative variable importance (RVI) displayed for variables with RVI > 0.15.

Species	Variable	Intensity			Prevalence		
		Beta hat	95% CI	RVI	Beta hat	95% CI	RVI
Magnolia warbler	Intercept	1.25	0.37, 2.13		−1.31	−1.62, −1.00	
	year	0.06	−0.96, 1.09		0.55	0.19, 0.91	
	age	−0.88	−1.90, 0.14	0.51	0.66	0.30, 1.02	0.99
	day	−0.02	−0.10, 0.06	0.26	0.00	−0.01, 0.02	0.32
	age × day	0.08	−0.11, 0.27	0.26	0.00	−0.03, 0.04	0.32
Yellow-rumped warbler	Intercept	0.18	1.50, 2.44		−0.63	−0.91, −0.35	
	year	0.50	0.02, 0.98		0.76	0.44, 1.07	
	day	0.16	0.11, 0.20	0.98	0.09	0.06, 0.12	1.00
	cond	−0.35	−0.57, −0.15	0.98	−0.06	−0.20, 0.08	0.59
	age	−1.06	−1.59, −0.52	0.98			
	cond × age	0.49	0.05, 0.93	0.98			
	day × age	−0.10	−0.18, −0.01	0.98			

- No, intensity increases for both younger and older birds as a function of arrival date, but at a faster rate in young versus old birds, and correspondingly, the "Beta Hat" term in Table 3 is positive.
- Yes, intensity increases for both younger and older birds as a function of arrival date, but at a faster rate in young versus old birds, and correspondingly, the "Beta Hat" term in Table 3 is positive.
- No, intensity increases for both younger and older birds as a function of arrival date, so the corresponding "Beta Hat" term in Table 3 should be positive.
- Yes, intensity increases for both younger and older birds as a function of arrival date, but at a faster rate in young versus old birds, and correspondingly, the "Beta Hat" term in Table 3 is negative.

Question 23 (1 point)

The DeGroote & Rodewald paper on blood parasitism in wood warblers hypothesized ". . . that parasitization would be negatively related to current energetic status (refueling performance, energetic condition), and migration timing." What was their mechanism for the negative relationship between parasitism and migration timing?

- [a] parasitized birds would be functionally compromised, delaying their migration
- [b] earlier migrants would have better body condition and lower parasite loads than later birds
- [c] later migrants would have time to acquire resources that support both migration and immune response, lowering their parasite load
- a & b
- a - c

Question 24 (1 point)

Below is a table that summarizes the parasite (Philornis) intensity of Argentinean birds. parasite intensity was measured as the number of larvae per 10 nestlings. Variables measured to predict intensity were the level of precipitation, maximum temperature, host density (number of birds per area) and year of sampling. Below is a table that summarizes the model tested and results.

Table 2 Generalized linear model with a negative binomial response describing population-level factors associated with mean *Philornis* intensity

Model = larvae/10 nestlings $\sim$ precipitation$_{t_0}$ + host density$_{t_{-5}}$ + maximum temperature$_{t_0}$ + year + year $\times$ maximum temperature$_{t_0}$
$n = 50$

Term	Coefficients	Standard error	*P*-value	ΔAIC[a]
precipitation$_{t_0}$	0.017	0.004	0.0002	12.4
maximum temperature$_{t_0}$	0.964	0.148	<0.0001	–
host density$_{t_{-5}}$	−0.055	0.017	0.0014	6.9
Year	16.67	5.24	0.0015	–
Year × maximum temperature$_{t_0}$	−0.53	0.17	0.0021	6.2

[a]AIC value increment if the single term is dropped.

Based on information in the table, which of the following is true?

- Maximum temperature had the same effect on intensity, independent of year.
- Maximum temperature had less of an effect on intensity in later versus early years.
- Maximum temperature increased intensity more in later versus early years.
- There is no effect of maximum temperature across years.

Question 25 (1 point)

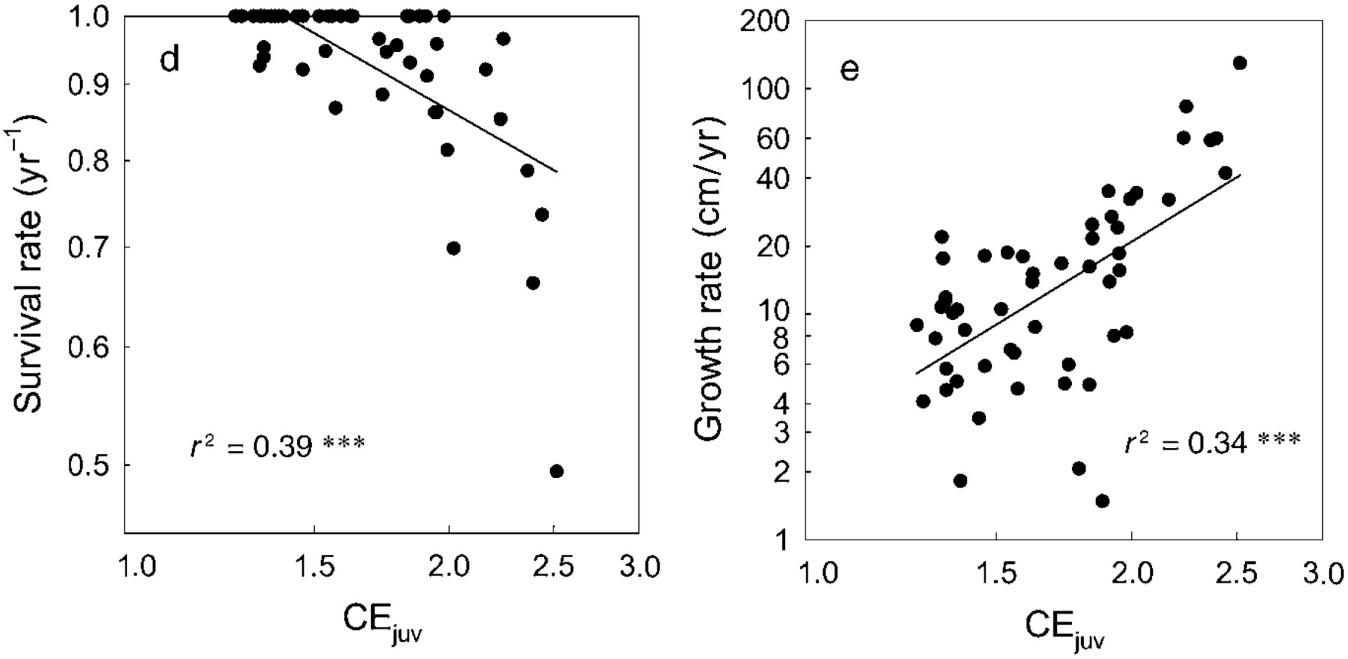
Below are pictures of two tree species from the central Bolivian tropical dry forest studied in Poorters & Bonger (2006).

Based on leaf characteristics how would you classify these trees?

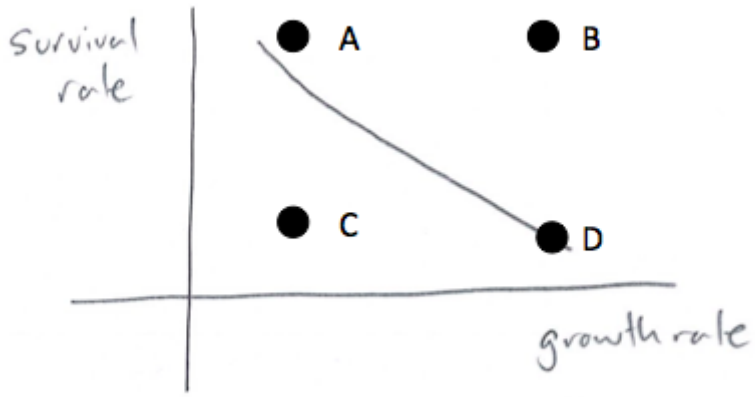
- ◯ the upper tree has low SLA, while the lower tree high SLA
- ◯ the upper tree has high SLA, while the lower tree low SLA
- ◯ both are examples of species with low SLA
- ◯ both are examples of species with high SLA

Question 26 (1 point)

Below are plots of survivorship and growth rate versus canopy exposure (CE).



Where in the plot of survivorship versus growth rate (below) would a species with high canopy exposure be expected to occur?



- A
- B
- C
- D

Question 27 (1 point)

Below is an imaginary table outlining the energy content, handling time and search time for two prey items.

Prey	Energy (kcal)	Handling time (min)	Search time (min)
Fuzzy critter	320	16	32
Smooth critter	240	4	36

Let's assume that the predator has found a smooth critter. What is the current energy accruement rate of a smooth critter, a fuzzy critter and lastly, which should the predator attempt to consume based on energy accruement rate?

- smooth: 60 kcal/min, fuzzy: 20 kcal/min, attempt to consume the smooth critter
- smooth: 60 kcal/min, fuzzy: 6.7 kcal/min, attempt to consume the smooth critter
- smooth: 240 kcal, fuzzy: 320 kcal, attempt to consume the fuzzy critter
- smooth: 40 min, fuzzy: 48 min, attempt to consume the smooth critter
- smooth: 6 kcal/min, fuzzy: 6.7 kcal/min, attempt to consume the fuzzy critter

Question 28 (1 point)

In Louisiana (a southern state in the US), older individuals in the bird species orchard orioles had higher parasite prevalence than younger birds. Given Table 3 below from a similar study on wood warblers, does the result for orchard orioles correspond to the magnolia warbler?

Table 3. Averaged linear regression (Intensity) and logistic regression (Prevalence) models for magnolia and yellow-rumped warblers. Only models with $\Delta AIC_c < 7$ and $AIC_c <$ null model were used for averaging. Coefficients (beta hat), 95% CI, and relative variable importance (RVI) displayed for variables with RVI > 0.15.

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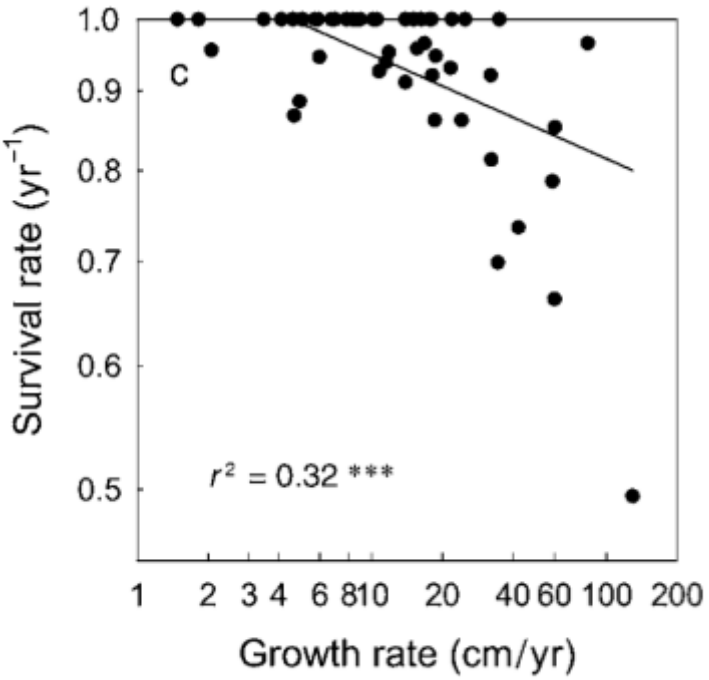
	day	−0.02	−0.10, 0.06	0.26	0.00	−0.01, 0.02	0.32
	age × day	0.08	−0.11, 0.27	0.26	0.00	−0.03, 0.04	0.32
Yellow-rumped warbler	Intercept	0.18	1.50, 2.44		−0.63	−0.91, −0.35	
	year	0.50	0.02, 0.98		0.76	0.44, 1.07	
	day	0.16	0.11, 0.20	0.98	0.09	0.06, 0.12	1.00
	cond	−0.35	−0.57, −0.15	0.98	−0.06	−0.20, 0.08	0.59
	age	−1.06	−1.59, −0.52	0.98			
	cond × age	0.49	0.05, 0.93	0.98			
	day × age	−0.10	−0.18, −0.01	0.98			

- Yes
- No
- Cannot be determined given information

Question 29 (1 point)

Below is a plot of tree survival versus growth rate.

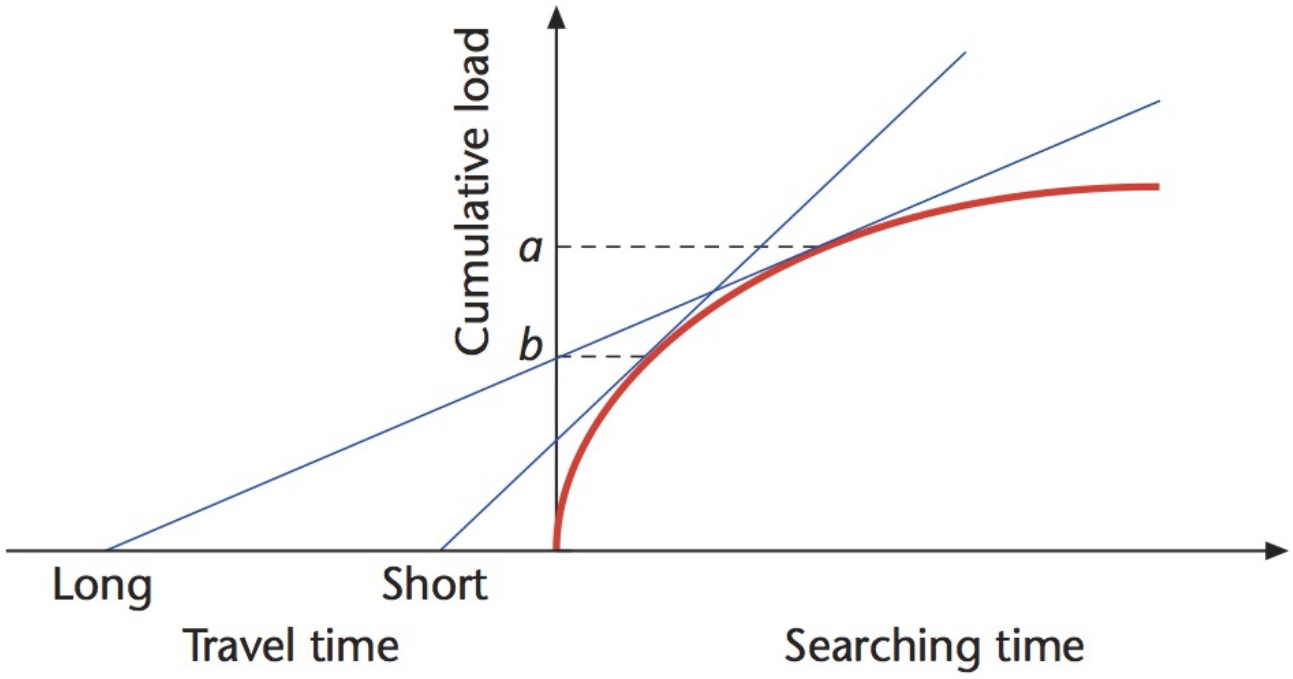


Based on this plot, we except

- In the long-term trees with higher survivorship to out compete trees with lower survivorship.
- In the long-term trees with lower survivorship to out compete trees with higher survivorship.
- In the long-term, trees with higher survivorship to coexist with trees with lower survivorship due, in part, to a positive relationship between survivorship and growth.
- In the long-term, trees with higher survivorship to coexist with trees with lower survivorship due, in part, to a trade-off in growth rate.

Question 30 (1 point)

Below is an approach based on the marginal value theorem that predicts the optimal time an individual spends in a patch foraging, and compares an individual who has to travel a long distance versus a short distance to get to the patch.



The reason the individual that travels a long distance is expected to spend a longer time in the patch foraging than an individual that travels a short distance is

- because the maximum rate of energy gain for the long-distance traveler is greatest for search time that is greater than the short-distance traveler
- because it is less likely that a short-distance traveler encounters predators, so it can make frequent short trips to the patch
- because the rate of energy gain is greater than the short-distance traveler
- because the long-distance traveler has used more energy to get to the patch, so has to replenish its energy reserves

Question 31 (1 point)

The figure below is representative of an underlying assumption of the marginal value theorem of foraging. What is that assumption?

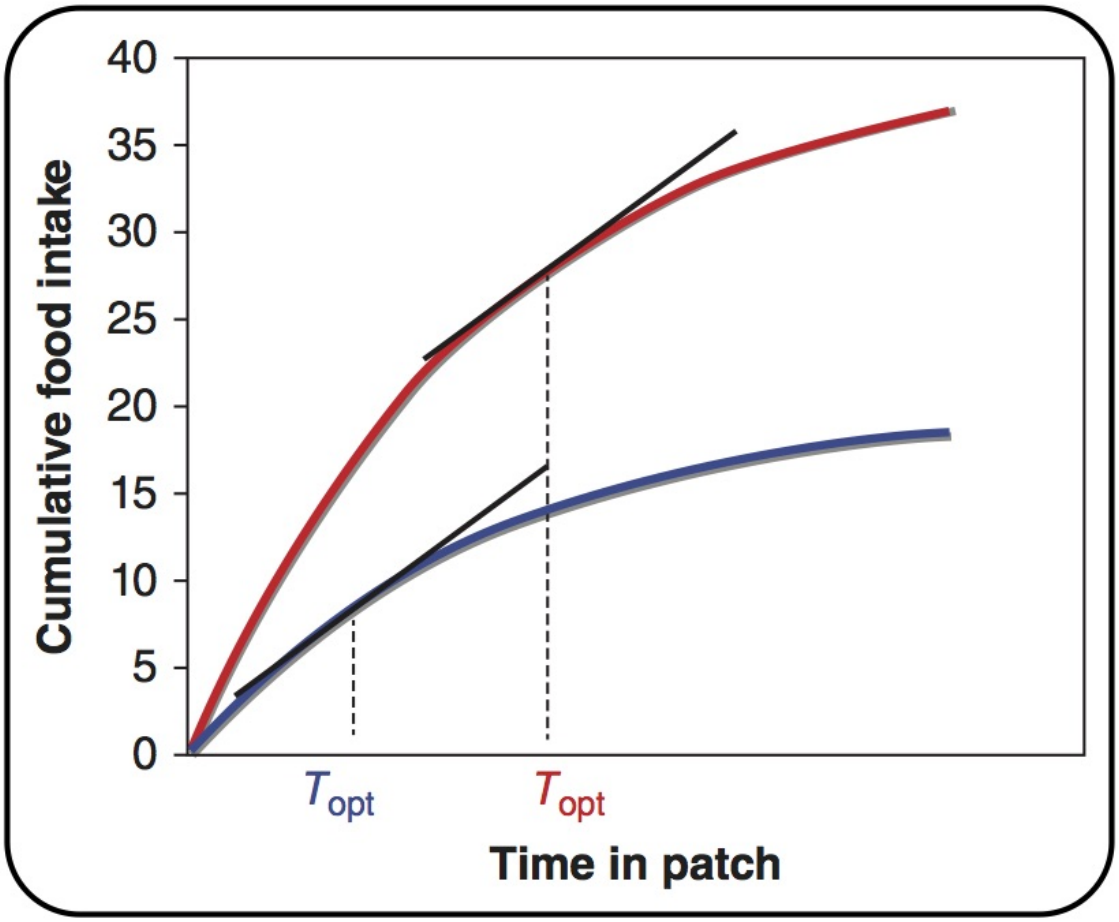
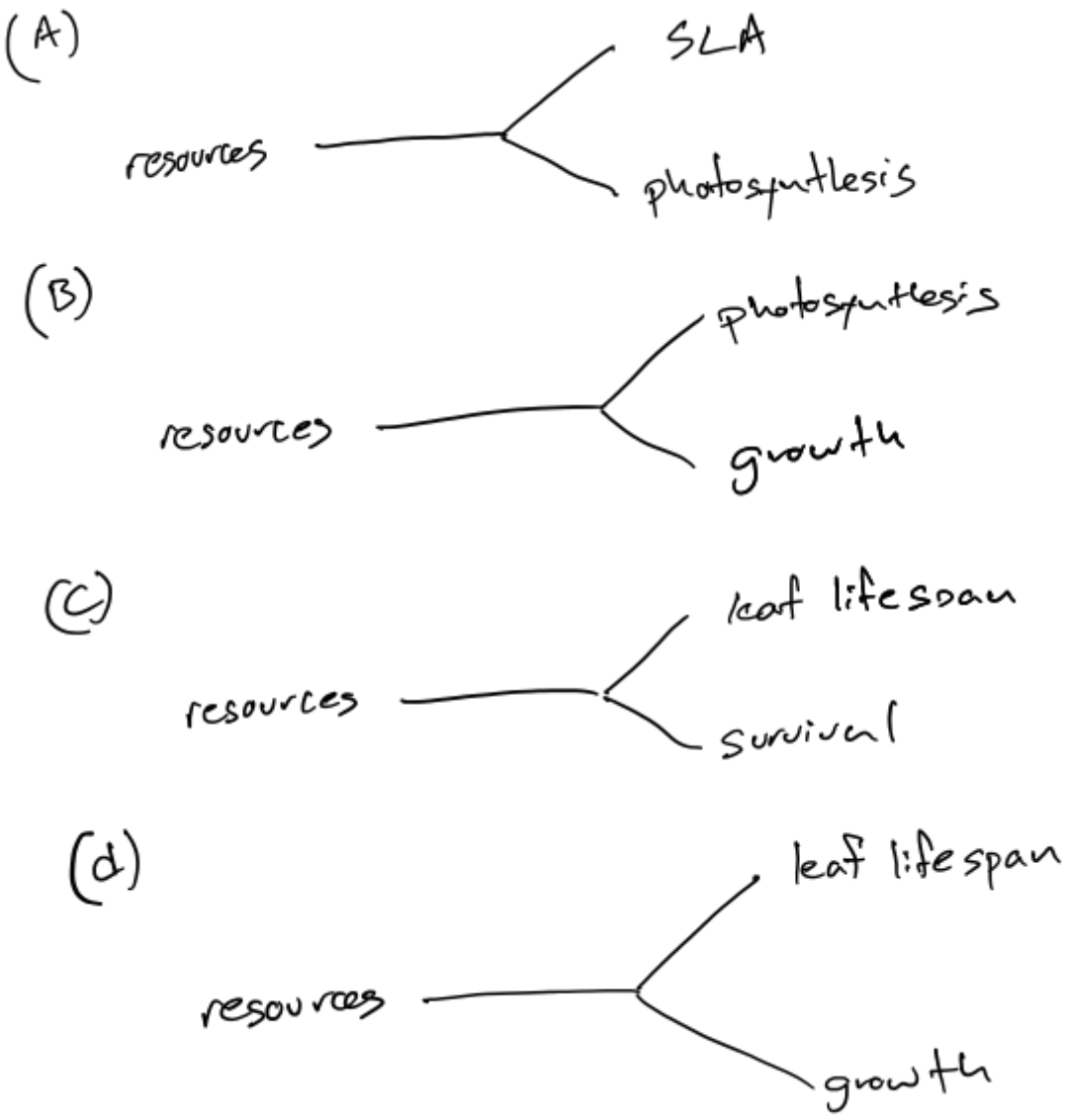


Figure 1 The MVT solution for the optimal residence time (T_{opt}) for a forager searching for food within a low- (blue) and high- (red) quality patch within the same environment.

- The rate of food intake increases with time in a patch
- The rate of food intake is constant as a function of time in a patch
- The rate of food intake decreases with time in a patch.
- None of the above

Question 32 (1 point)

Which of the following is an example of a tradeoff that occurs within a tropical dry forest of Bolivia?



- A
- B
- C
- D

Question 33 (2 points)

In Google Maps, enter the following two locations: [a] Sermenevo Серменево, Russia and [b] Sukhtelinskiy Сухтелинский, Russia. Identify and describe one combined physical and climatic process that causes a difference in vegetation between these two localities.

Format

Mountains – rising air from westerlies releases precipitation in Sermenevo Сермeнево, but correspondingly dries out air for Sukhtelinskiy Сухтелинский

Question 34 (2 points)

Identify two biomes and indicate the typical climate for each.

Format

Examples:
1) tropical rain forest – high rainfall (except for dry season) and warm temperatures year-round
2) tropical savanna – long dry season, with short high rainfall season, warm temperatures year round, with some seasonal variation
3) Mediterranean – cool wet winters, hot dry summers
4) tundra – extremely cold winters, cool short summers with permafrost

Note, biomes are well-differentiated by precipitation and temperature, so answer should include these variables.

Question 35 (2 points)

Identify and describe two predictions from island biogeography that would distinguish an island near a mainland source from an island farther from a mainland source, but both islands having the same area.

[1] Equilibrium species number on far island is lower

[2] Time to reach equilibrium species number on the far island takes longer

Question 36 (2 points)

A biological reserve is an area set aside to conserve biodiversity. In the context of Island Biogeography, is it expected that species composition will remain the same in a biological reserve into the future? Briefly explain.

Format

No, island biogeography predicts species turnover.

Question 37 (2 points)

An ecologist who contributed to niche theory in ecology was Joan Roughgarden. She noted that a niche can be distinguished by the following phrase “A habitat is an address; a niche is an occupation.” Why is this statement closer to Elton's than Hutchinson's niche concept?

Elton emphasized the place of a species in a food web or its role in a community, which corresponds to occupation. Hutchinson emphasized abiotic and biotic factors that support reproduction and survivorship which corresponds to habitat.

Question 38 (2 points)

Throughout the history of ecology and presently, a criticism of the "niche" concept is that it is based more on natural history and description, as opposed to a hypothesis-based and predictive science. Whether or not you agree with that criticism, provide a counter argument supported by a single example.

Answers will vary:

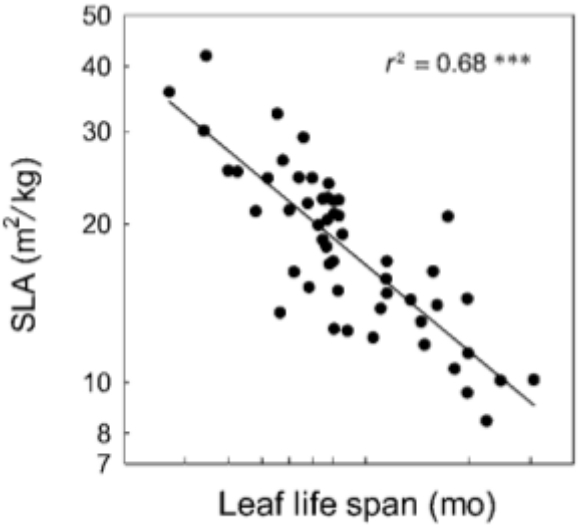
[1] Description has an important and useful role in ecology, and the niche concept is a way of formalizing description.

[2] By seeking to delineate a niche based on performance, one can make predictions about a species distribution in nature and test these predictions.

. . .

Question 39 (2 points)

Below is a plot of SLA versus lead life span for tropical forest trees in Bolivia.



Why is it that trees with high leaf life span and high SLA do not occur?

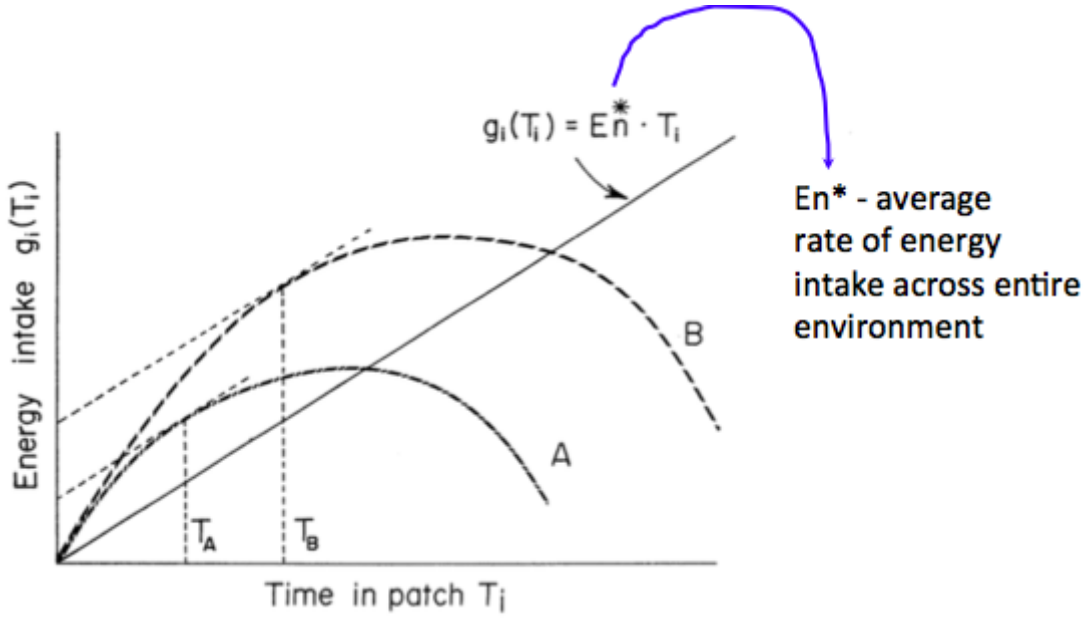
Leaves with high SLA likely have structural or biochemical limitations, such that their functionality is compromised more over time.

- or -

High SLA leaves are shed once they get shaded by the growth of the tree.

Question 40 (2 points)

Below is the classic figure that illustrates the marginal value theorem.



Let's take the example of a pika foraging for herbs in a landscape with patches of vegetation. In real-terms, describe a single piece of information that a pika may use to make a decision (or feel the urge) to leave the patch?

From your "Foraging" reading . . .

[1] Giving up time – the pika may leaves its patch when the time between capture of herbs exceeds that expected for the patch

[2] Decremental effects – each time an herb is collected or eaten item, the tendency to leave increases

. . .

Note, in the context of the marginal value theorem, what would be problematic with this answer: It's hunger is not being sufficiently replenished by the herbs it is intaking.

Question 41 (2 points)

Distinguish proximate versus ultimate causes of a behaviour.

Proximate - the combination of external and internal states of an organism that determine its behaviour. Ultimate - how alternate behaviours relate to fitness and that behaviours that have higher fitness will tend to be more common.

Question 42 (2 points)

Explain how the study of parasitism of wood warblers by DeGroote and Rodewald (2010) falls within the framework of ecological science.

Format

It studies the interaction between species, in this case birds and parasites. The context of the work is to understand processes that affect the abundance of bird species, particularly survivorship and reproduction.

Question 43 (2 points)

Are micronutrients less important than macronutrients? Briefly explain.

No. Both micro and macronutrients are essential. Micronutrients are just required in smaller quantities than macronutrients.

Question 44 (2 points)

In the context of the principle of a “trade-off” explain why a negative relationship between “level of parasitism” versus “condition” is predicted in the DeGroote and Rodewald study of parasitism of wood warblers.

Paragraph

A bird cannot necessarily allocate all of its resources to immune response because it also needs to allocate resources to other processes. When a bird is in poor condition, it will then be forced to allocated fewer resources to immune response than if it were in better condition.

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