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BIOL*1070 – Discovering Biodiversity
Winter 2013
Inquiry Case Exam 2

Instructors: Drs. Pat Wright, Steven Newmaster, Aron Fazekas

INSTRUCTIONS

(1) Make sure you have all 11 exam pages (including this cover page) and 1 scantron answer sheet.

(2) Print your name, student number, and sign at the top of this cover sheet.

(3) Use PENCIL to enter your name and student number on the answer sheet.

(4) There are 15 questions for a total of 15 marks.

(5) You have 45 minutes to complete the exam. **This includes filling out the answer sheet.**

(6) Read the questions carefully before answering.

(7) Answer all multiple choice questions in PENCIL on the answer sheet.

(8) **Hand in the test scoring sheet and this cover sheet at the end of the exam**. You may keep the exam question pages as a souvenir.

(9) Out of respect for your peers, please remain seated quietly until the exam time is over.

GOOD LUCK!

1. The unique properties of populations (i) and communities (ii) are best described by:

A) i) Species diversity, geographic distribution. ii) Biotic interactions, density of individuals, and abiotic factors.

B) i) Number of individuals, area and growth ii) Richness, trophic levels and interactions.

C) i) Composition, density of individuals and evenness. ii) Number of individuals, area and growth.

D) i) Competition, carrying capacity and growth. ii) Species tolerance, individual growth and interactions.

E) i) Abiotic variables, and beta diversity. ii) Richness, immigration and emigration.

2. You and your assistants conduct a count of the number of individuals of 10 tree species in the woodlots. Here are the results:

Tree species	Arboretum Site #1	Arboretum Site #2	Dairy Bush
Species A	11	3	0
Species B	11	4	0
Species C	11	4	0
Species D	11	69	0
Species E	11	3	50
Species F	11	2	0
Species G	11	3	0
Species H	11	2	0
Species I	11	2	50
Species J	11	9	0

Which of the following statements is INCORRECT?

A) α diversity is the same in Arboretum Site #1 and Arboretum Site #2, but evenness is lowest in Arboretum Site #2.

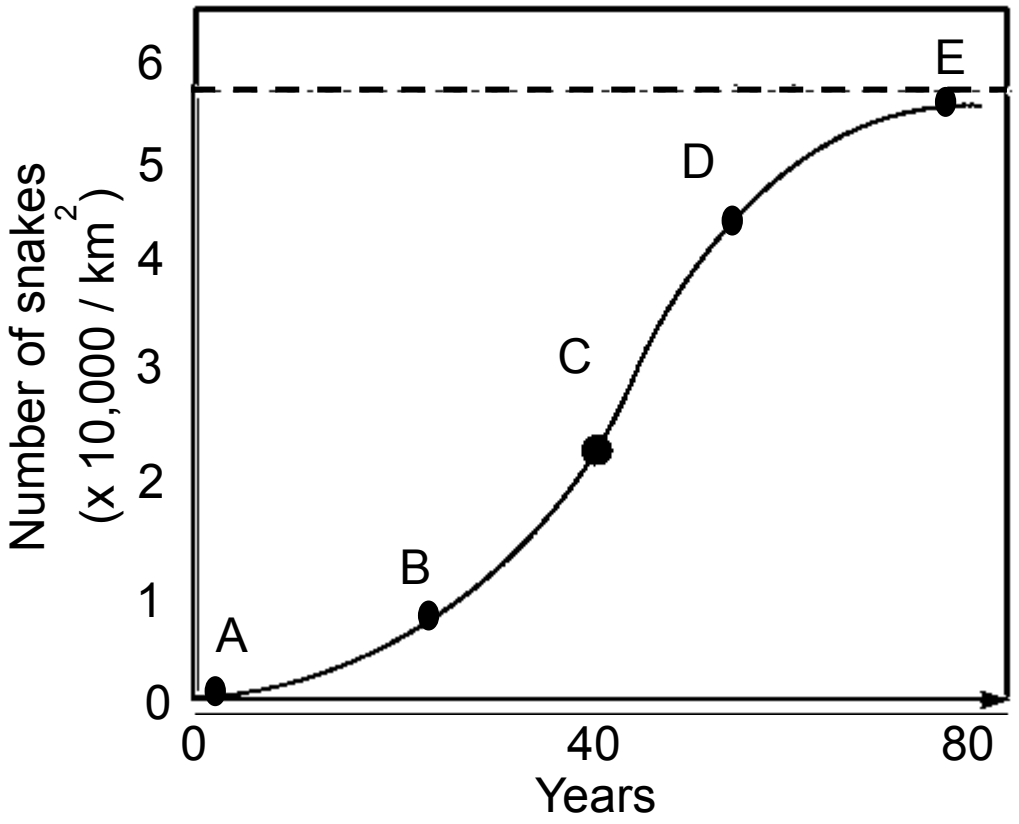
B) α diversity and evenness are lowest in the Dairy Bush.

C) α diversity is 5 times higher in Arboretum Site #1 relative to the Dairy Bush, whereas evenness is higher in both Arboretum Site #1 and the Dairy Bush, relative to Arboretum Site #2.

D) α diversity is the same in Arboretum Site #1 and Arboretum Site #2, but evenness is higher in both Arboretum Site #1 and the Dairy Bush relative to Arboretum Site #2.

E) α diversity is lowest in the Dairy Bush, but evenness is higher in both Arboretum Site #1 and the Dairy Bush, relative to Arboretum Site #2.

There has been a major increase in the number of snakes observed on Guam Island, a small island in the Pacific. The snakes have caused significant loss of bird biodiversity because they prey on bird eggs. You have been asked to interpret data collected by biologists in the affected areas and to provide feedback on a suitable course of action for controlling the snake population.



3. The graph above presents data from an 80-year study of snakes on the entire island. Examine the graph, and choose the most plausible interpretation.

A) The carrying capacity of the snake population is where population growth is exponential.
B) The growth rate of the snake population is positive between point A and C, but negative between C and E as resources are limiting.
C) Point C represents the refraction point.
D) Between point B and C the bird population continues to grow at a very high rate due to low abundance of snakes.
E) Between point D and E the snake population experiences limitations to growth, possibly due to competition for resources.

4. **As part of your summer job, you have spent two months camping in a woodlot in order to conduct a basic biodiversity survey. You decide to look for the presence of Emerald Ash Borer and discover it is present in your woodlot. You suggest to your manager to control the insect by releasing a large number of parasitoid wasps that you heard about in your biology 1070 class. However, your manager tells you that long-term control can be achieved using a pesticide that has been developed specifically to control Emerald Ash Borer, and that releasing parasitic wasps would be an expensive temporary solution. You explain to your manager that: (choose the CORRECT statement below)**

A) Introducing a biotic interaction such as parasitism could change the fundamental niche of the Emerald Ash Borer.
B) Spraying pesticides will disrupt the obligate mutualism between the ash trees and the Emerald Ash Borer.
C) Introducing biological controls is much cheaper and much less likely to have unintended side effects as compared to using expensive, toxic pesticides.
D) The use of a pesticide will impose a density-independent effect on population size in the Emerald Ash Borer.
E) Spraying pesticides will change the carrying capacity of the Emerald Ash Borer and cause the population to crash to a low level.

5. **The following sentences describe organisms within different levels of organization. Choose the statement that is CORRECTLY matched with the level of organization.**

A) Deer mice born in the spring or summer are dead by the first of October in the Kananaskis Valley, South Western Alberta (=community)
B) Pitcher plants found in acidic bogs depend on nitrogen-rich arthropod prey (eg. ants, flies), although they often share this food source with a host of bacteria, protozoa and midges present in the water at the base of the pitcher (=population).
C) The nesting population of loggerhead sea turtles (*Careetta caretta*) in Japan is estimated to be less than 3000 females (=individual).
D) Large zooplankton tend to eat phytoplankton of all sizes, so that when large zooplankton are abundant they significantly impact the abundance of phytoplankton in a lake, lowering the primary productivity (=population)
E) Researchers working in the White Mountain National Forest measured precipitation and nutrients flowing into a watershed, an area of land that drains into a stream, to understand the amount of nutrients taken up by the vegetation and the flow of energy through the forest (=ecosystem).

6. There is a progression or development of ecological niches in a forest over time. For example: bare field → grassland → grass – shrub → pine forest → oak-hickory forest. Ecologists usually describe these changes in terms of vegetation, but what would happen to the pattern of <u>animals</u> present in the niches over time in the example above? Choose the best prediction.

A) Soil organisms → herbivorous insects → carnivorous insects → insectivorous birds → diversity of birds and mammals
B) Carnivorous mammals → herbivorous birds → carnivorous insects → carnivorous birds
C) Soil microbes → deer → racoons → birds
D) Bivalves → carnivorous birds → herbivorous insects → mammals
E) Rock → lichens/mosses → grasses → herbs → shrubs → trees

7. The desert melon (*Cucumis humifructus*) and the aardvark, *Orycteropus afer*, may be symbiotic. Researchers have observed that aardvarks sometimes eat *C. humifructus*, seeds and all. Aardvarks are known to bury their dung, thereby planting and fertilizing the melon seeds.

Which of the following <u>hypotheses</u> is most plausible?

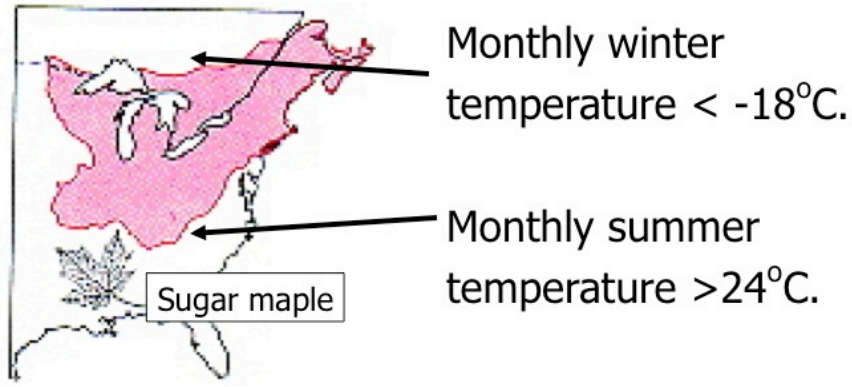
A) The survival of *C. humifructus* depends on *O. afer* and vice versa.
B) The survival of *C. humifructus* depends on *O. afer* but not vice versa.
C) *C. humifructus* and *O. afer* have a parasitic relationship.
D) *C. humifructus* and *O. afer* represent a classic predator – prey relationship.
E) *O. afer* would become extinct if the *C. humifructus* population declines or becomes extinct.

8. Biomes are ecosystems on a global scale. Match the biome with the CORRECT abiotic factors.

Biome	**Mean annual temperature**		**precipitation**
1. temperate	A $^{-}7$ to $^{-}15$°C	and	< 75 cm
2. boreal	B $^{+}15$ to $^{+}27$°C	and	> 250 cm
3. tropical	C $^{+}2$ to $^{-}7$° C	and	50 - 150 cm
4. tundra	D $^{+}2$ to $^{+}15$° C	and	75 - 225 cm

A) 1-D, 2-C, 3-B, 4-A
B) 1-B, 2-A, 3-D, 4-C
C) 1-D, 2-C, 3-A, 4-B
D) 1-C, 2-D, 3-B, 4-A
E) 1-A, 2-B, 3-C, 4-D

9. Choose the statement below that does NOT describe the influence of abiotic factors on the distribution of sugar maple in eastern North America.



A) Sugar maples are limited in their northern distribution by mean monthly temperatures less that -18°C, and are typically found north of areas that have a mean summer temperature greater than 24°C.
B) Heavy metal toxins in the soils near industrial operations limits the growth of sugar maple seedlings
C) White oak competes with sugar maple for light and moisture, limiting the distribution of sugar maple in some areas.
D) In terms of soil minerals, sugar maples prefer soils rich in nitrogen, phosphorous and potassium.
E) Sugar maples, along with other deciduous trees require a significant amount of moisture and drop their leaves in the winter when soils are frozen.

10. Crocodiles are found in many mangrove habitats. Researchers on Long Caye, Belize studied crocodile population dynamics between 2008 and 2012. Below is a data table of their observations. Select the <u>most plausible</u> explanation of the trends they observed.

Year	2008	2009	2010	2011	2012
Original population size	30	30	18	21	21
Final population size	30	18	21	21	10

A) Birth rates and/or emigration exceeded death rates and/or immigration in 2010.
B) Emigration was lower than immigration in 2009 and 2012.
C) A population increase in 2010 may have resulted from increased developmental rates (ontogeny).
D) Population crashes in 2008 and 2011 may have been partly due to sampling error.
E) Death and/or emigration may explain the decrease in population size in 2009 and 2012.

11. Select the CORRECT statement below based on the Woodlot Herbs key.

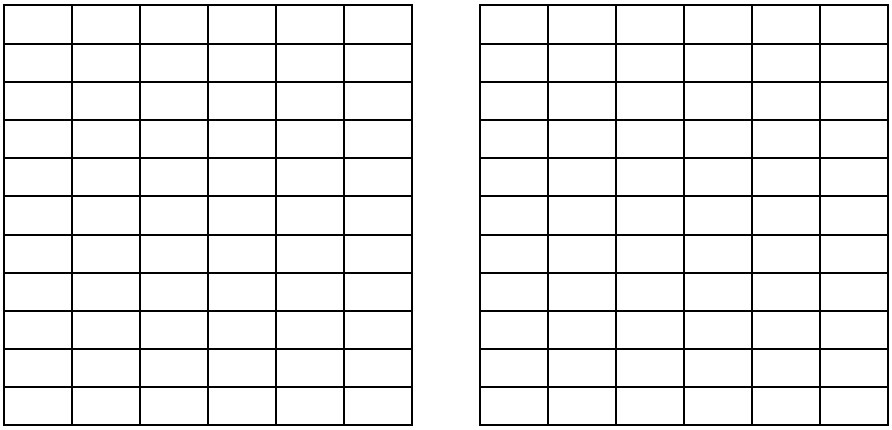
A) *Cornus canadensis* and *Cardamine diphylla* share simple leaves.
B) *Alliaria petiolata* is the only herb with alternative leaves.
C) *Cardamine diphylla* and *Ranunculus arbortivus* share regular flowers.
D) *Maianthemum canadense* have leaves opposite.
E) *Ranunculus recurvatus* and *Geum allepicum* both have glabrous leaves.

An Identification key to Woodlot Herbs

1. Flowers regular.....2
2. Four or five regular parts.....3
3. Four regular parts.....4
4. Leaves opposite.....5
5. Leaves simple.....***Cornus canadensis***
5. Leaves divided.....6
6. Leaves ternately compound.....***Cardamine diphylla***
6. Leaves deeply divided.....***Cardamine concatenata***
4. Leaves alternate.....7
7. Lvs. serrate.....***Alliaria petiolata***
7. Lvs. entire.....***Maianthemum canadense***
3. Five regular parts.....8
8. Leaves alternate.....9
9. Flowers yellow.....10
10. Leaves simple.....***Caltha palustris***
10. Leaves divided.....11
11. Leaves glabrous, basal lvs. simple, cauline lvs. divided .....***Ranunculus abortivus***
11. Leaves hairy, all leaves divided.....12
12. Sepals recurved, leaflets of a similar size.....***Ranunculus recurvatus***
12. Sepals ascending, leaflets of 2 different sizes.....***Geum allepicum***

Below is a table of data from a forest ecologist who has been studying the diversity of 2 woodlots. Plot a species-area curve for each woodlot and complete the following question.

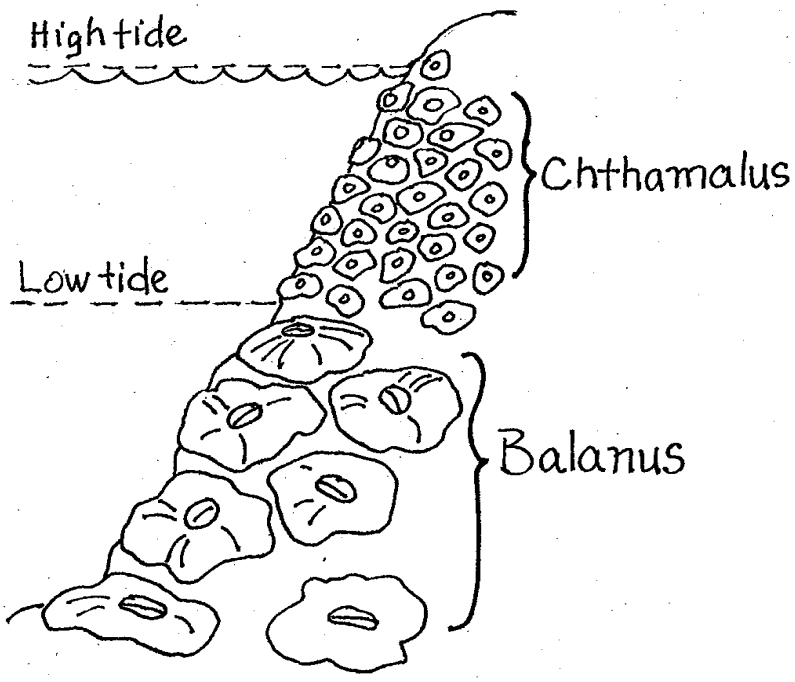
	Woodlot 1		Woodlot 2
Plot	**Species (frequency)**	**Plot**	**Species (frequency)**
1	White birch (1), cherry (1), honeysuckle (1)	1	White birch (1), sugar maple (2)
2	Black locust (1), cherry (2)	2	White birch (3), sugar maple (1)
3	Trembling aspen (1), Virginia creeper (1), black locust (1)	3	Japanese maple (2), sugar maple (1)
4	Virginia creeper (1), honeysuckle (1), white birch (1)	4	Honeysuckle (1), sugar maple (1)
5	Sugar maple (1), alternate-leaved dogwood (2)	5	White birch (2)
6	Black locust (2), cherry (1), butternut (1)	6	Sugar maple (1), white birch (1)



12. From the data above, which of the following statements is TRUE.

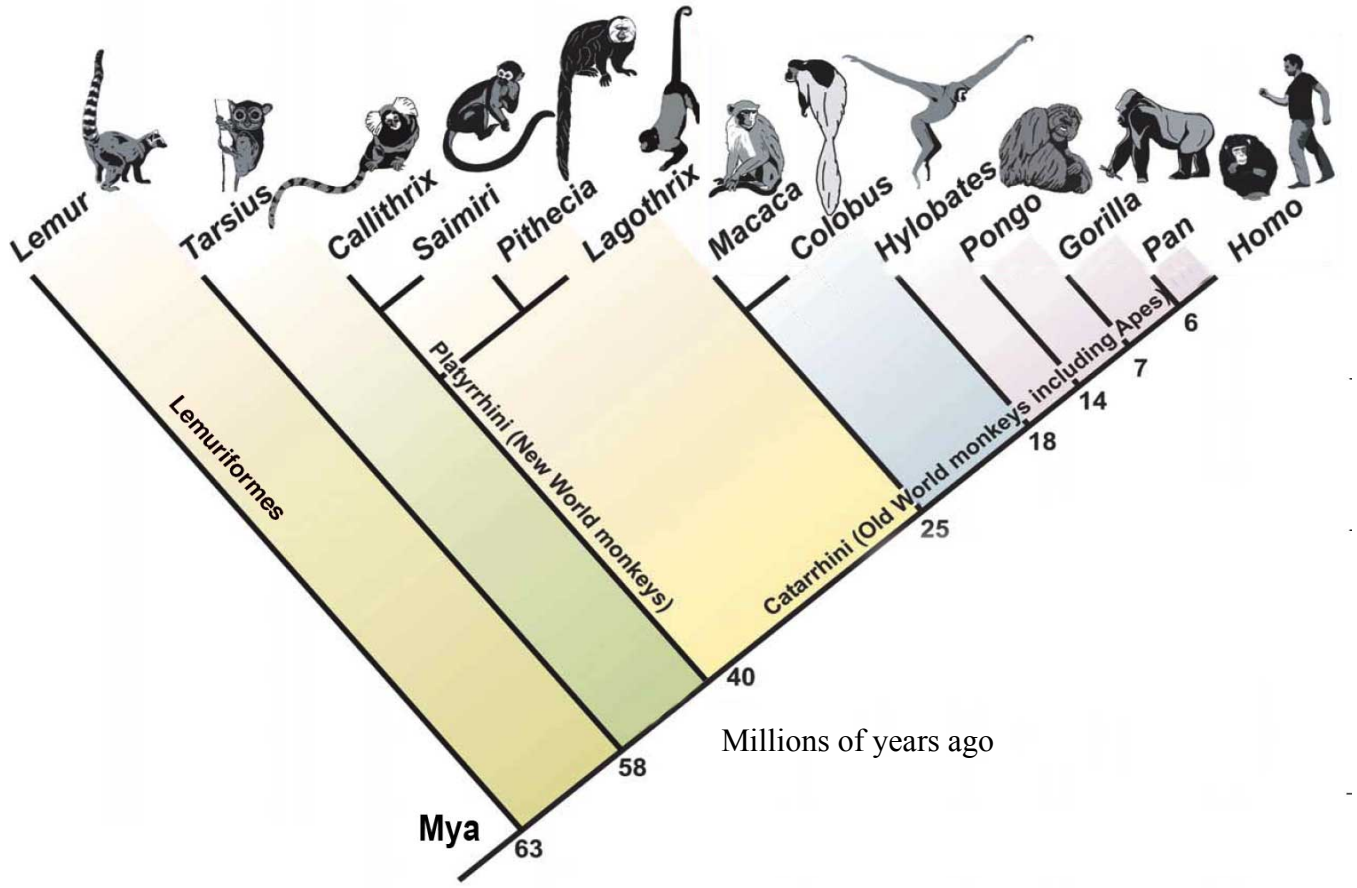
A) Sampling intensity is almost saturated in Woodlot 1.
B) The species-area curve for Woodlot 1 has higher sampling density relative to Woodlot 2.
C) The carrying capacity of Woodlot 2 is saturated.
D) Woodlot 1 species diversity will never plateau because it is on a regional scale.
E) Woodlot 2 species diversity is lower than Woodlot 1 diversity.

13. Two barnacle species occupy different zones within the tidal shore line. *Chthamalus* is found above the low tide mark and *Balanus* is found below the low tide mark. How could you best determine the <u>fundamental niche</u> of *Chthamalus*?



A) Place *Balanus* above the low tide mark within the *Chthamalus* niche.
B) Place both *Balanus* and *Chthamalus* below the low tide mark to demonstrate competition.
C) Remove *Balanus* from below the low tide zone, and observe whether the *Chthamalus* population expands into the area below the low tide zone.
D) Remove *Chthamalus* from above the low tide zone and observe whether the *Balanus* population expands into the area above the low tide zone
E) There is no need to alter the two species location because *Chthamalus* is already occupying its fundamental niche.

Lemurs are only found on the island of Madagascar. Prior to 160 million years ago, this landform was attached to the super continent Gondwana, but as Gondwana broke apart Madagascar separated from what would become the mainland of Africa. The first lemur-like primates in the fossil record appeared roughly 60 million years ago on mainland Africa and then appeared on Madagascar shortly thereafter. On the African mainland, highly adaptive Old World monkeys out -competed the lemur-like primates restricting the evolution of this lineage to small nocturnal species. On the island of Madagascar, the lemur-like primates diversified into numerous species, adapting to a wide range of habitats.



14. Which of the following statements is <u>TRUE</u>, given the information above and your knowledge of historical biogeography?

A) Lemurs were extirpated from mainland Africa.
B) According to the figure above, Lemurs have given rise to many present day primate species.
C) According to the figure above, Lemurs are more closely related to the New World monkeys than the Old World monkeys.
D) Lemurs are endemic to Madagascar.
E) 63 million years ago Gondwana separated away from Laurasia.

15. Global landforms can be subdivided into several Biogeographic regions: Nearctic, Palearctic, Neotropical, Antarctic, Ethiopian, Oriental, and Australasian. Only two of these are found in the Northern Hemisphere whereas the rest are found in the southern Hemisphere reflecting a relatively greater amount of diversity. This observation is best explained by:

A) More biogeographic regions and greater diversity are found in the southern hemisphere due to the warmer temperatures in this part of the world that make it easier for animals to thrive.
B) More biogeographic regions and greater diversity are found in the southern hemisphere due to the greater precipitation in this part of the world, which increases the plant diversity.
C) The bioregions in the southern hemisphere broke apart from Gondwana, 140 million years ago and have had a longer period of time to diversify than bioregions in the northern hemisphere which are formed from Laurasia which broke apart 65 million years ago.
D) The bioregions in the southern hemisphere broke apart from Pangea, about 290 million years ago and have diversified over a greater time period than Gondwanan bioregions.
E) The bioregions in the southern hemisphere formed from Africa, which was the most diverse part of the planet, whereas the bioregions in the northern hemisphere formed from Laurasia, which was comparatively species poor.