

## BIOL 121 Optional worksheet on species concepts and speciation

There are four species of marmot in British Columbia. Marmots are the largest member of the squirrel family (Family Sciuridae). The Hoary Marmot (*Marmota caligata*) is found on the mainland in the coastal mountains. They are commonly referred to as ‘whistlers’ or “whistle-pigs’ because of their high pitched warning call. The town of Whistler gets its name from their call. The Vancouver Island Marmot (*Marmota vancouverensis*) is the only marmot found on Vancouver Island. The Vancouver Island marmots likely represent the descendants a small population of Hoary marmots that became isolated after sea levels rose at the end of the last ice age, approximately 6000 years ago.

The table below has information on the characteristics of both species.



Vancouver Island Marmot (*Marmota vancouverensis*)



Hoary Marmot (*Marmota caligatas*)

Factor	Vancouver Island Marmot	Hoary Marmot
Fur Colour	Chocolate Brown with white patches	Silver Gray
Weight	Up to 5 kg (adult)	Up to 10 kg (adult)
Length	Up to 47 cm (adult)	Up to 82 cm (adult)
Range	Vancouver Island	Coastal Mountains – Alaska to Washington
Habitat	High alpine meadows and rocky slopes	High alpine meadows and rocky slopes
Diet	Herbivore – eat plant material such as ferns, mosses, grasses, berries	Herbivore – eat plant material such as leaves, flowers, grasses, mosses, grasses and berries
Predators	Golden eagle, cougars, wolves	Golden eagles, bears, cougars, wolves, foxes, coyotes

a. Which species concept (choose only one) would justify the classification of the Vancouver Island Marmot and the Hoary Marmot as one species? Explain your answer using only the information provided.

Ecological species concept

– occur in the same type of habitat (high alpine meadows, treeless slopes); eat the same food items (herbivorous)

b. Under which species concept (choose one only) would Vancouver Island Marmots and Hoary Marmots be considered two different species? Explain your answer using only the information provided.

Morphological species concept

-observe morphological differences in body size, mass, or fur colour.

c. What specific evidence would a biologist need to determine that the Vancouver Island Marmot and the Hoary Marmot were different species using the phylogenetic species concept? Explain how this evidence would allow them to make their decision.

- a phylogenetic tree
- evidence that can be used as unique defining characteristics (or synapomorphies) (DNA, morphology, ecology, behavior)
- this allow the biologist to determine if the VIM and HM formed different clades

d. Describe the evolutionary steps that would result in the Vancouver Island Marmot populations and the Hoary Marmot populations becoming two distinct species. Explain what could happen during each step to cause this result. Use the biological species concept and include references to appropriate evolutionary mechanisms in your answer. Be as specific as possible.

Step 1

1) Identify the fact that there would need to be a lack of gene flow between the VIM and HM  
e.g., The populations became physically isolated from one another due to the rise in sea level, which prevented gene flow between population.

Step 2

2) Propose an evolutionary mechanism that would cause the populations' allele frequencies to diverge from one another  
e.g., Allele frequencies might change due to genetic drift. The original VIM population was a small population, and genetic drift has a stronger effect on small populations; therefore, allele frequencies could diverge between the two populations.

- other answers are possible, e.g. frequencies of alleles changed in the VIM and HM populations due to natural selection. The isolated populations diverged in morphology/behaviour/physiology over time because of different selection pressures in the two environments. Would need to provide a plausible scenario.

Step 3

3) Describe a reproductive isolating mechanism that could evolve between VIM and HM  
e.g., Difference in allele frequencies might lead to gamete incompatibilities / or behavioural differences / between VIM and HM/ poor survival and/or fitness of hybrids /.  
If VIM and HM can no longer mate or produce any viable offspring with members of the other group, then they would be considered separate species according to the biological species concept.