

Svalbard Rock Ptarmigan (*Lagopus mutus hyperboerus*)

- Evolutionary adaption to the extreme climate at Svalbard.

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Svalbard Rock Ptarmigans revolutionary adaption to the extreme climatic and photoperiodic conditions on Svalbard is impressive. Not many animals are able to live in these environments all year long. The Svalbard rock ptarmigan is the only bird that can (article 2). Limited resources, rapid and drastic changes in temperature and weather have forced the bird to adapt. Energy saving when food access is limited was the key to success.

The Svalbard rock ptarmigan (*Lagopus mutus hyperboerus*), accruing to the name, lives on Svalbard. It is a subspecies of the rock ptarmigan (*Lagopus mutus*). They are heavier and show greater variations during the year compared to its close relatives; Rock ptarmigan (*Lagopus mutus*) and Willow ptarmigan (*Lagopus lagopus*), living on the mainland Norway. Svalbard rock ptarmigan show great morphological and physiological adaptations, due to hard living conditions on Svalbard. The vegetation on Svalbard is low on biomass (Article 2), so the bird is forced

to exploit the limited resources in the best possible way. To do this, the bird undergoes great seasonal changes in fat storing. The Svalbard rock ptarmigan is able to accumulate a fat ratio exceeding 30% of its body weight (article 2). It seems that these fat stores serve as emergency energy instead of long-term source of insulation. The fat accumulates mostly subcutaneously in the abdominal and pectoral girdle, around the sternum, which makes it also serve as heat insulation and protection. This ability to store large amounts of fat differentiates the Svalbard rock ptarmigan the most from its close relatives. (Article 2)



Female Svalbard rock ptarmigan in golden-brown summer plumage.

A combination of different factors result in this highly necessary fat deposition. Reduced locomotion in the autumn, higher food intake during summer and environmental changes of light and temperature on Svalbard contributes to

drive the physiological changes. (Article 3). During the summer the food is more available and nutritious, so weight gain is not a problem. Extreme seasonal variations in temperature and light occur at Svalbard. The sun is above the horizon from April to August, and below from October to mid February, resulting in 24 hours of daylight and darkness, respectively. (Article 2.) It has been suggested that the change in melatonin secretion from the pineal gland, due to variations of the light, triggers the weight gain. (Article 3). The effect via endocrine organs, and functional hormones as thyroid hormone and growth hormone is also affecting metabolism and fat deposition throughout the year.

In Svalbard there are mainly two seasons, summer and winter. Because the Svalbard Rock ptarmigan lives there all year, it has to adapt to the change between snowy and rocky environments as well. Both sexes will change to an all white winter plumage, except from black tips on the tail feathers. For better insulation they have a rich downy base with longer feathers on top. The feathers contain air-filled cavities, which have great insulating function. This adaption is not found in the Rock ptarmigan (*Lagopus mutus*) in the mainland Norway.

The only visible mark that differentiates the sexes from each other in the wintertime is a black line from the base of the beak back to the eye in the cocks. In the summertime the hen will change to golden-brown summer plumage earlier than the cock. They do also have heavily feathered feet during the winter, hence the name *Lagopus*, meaning "harefoot" (Article 2). This will reduce heat loss from the feet, equip the bird with "snowshoes" and thereby reduce the energy required to

walk on the snow. As mentioned the Svalbard rock ptarmigan is bigger and heavier than the Rock and Willow ptarmigan. This may be an adaption to the climate because larger body size has higher tolerance for colder climate than smaller. The heavy weight is not beneficial when flying, so the bird will walk most of the time during winter to minimize the energy cost of moving. Especially because there are few predators left at Svalbard during the winter, the bird is rarely disturbed and forced to fly.



Male Svalbard rock ptarmigan, in white winter plumage, with a strong red colored comb above the eye.

Behavioral adaption to the cold climate is necessary to survive. The purpose is to save energy. When the weather is especially hostile, the bird seeks shelter from wind and low temperatures by digging a snow burrow (Article 2). In this way a small microclimate with higher temperature is created. This way of seeking shelter may also have an anti-predator effect (Article 2).

If the temperature sinks really low, the bird might have to start heat production by increasing muscular activity, either by shivering thermogenesis or increased tonicity. It is usually more beneficial to stand still and shiver, but in extreme conditions larger muscle groups must be activated to maintain heat balance.

During wintertime it is hard to find food at Svalbard. Unstable and changing climate

may lead to rain that will freeze to ice on the tundra. The bird is not able to get through this ice to reach the food, but the reindeer is. The birds will seek areas where the reindeers have been, to benefit and eat of these snow and ice-free marks on the tundra. By not having to dig through the snow on its own, the bird saves a lot of energy.

To summarize why the Svalbard rock ptarmigan is able to survive the extreme conditions at Svalbard is because any adaption that can minimize the loss of energy is favorable for the bird. Energy conservation and saving is the key to survival in extreme arctic conditions.



Svaldbard rock ptarmigan.

Scientific articles

1) Title: "Reduced Metabolic Cost of Locomotion in Svalbard Rock Ptarmigan (*Lagopus muta hyperboea*) during Winter.

Authors: John Lees, Robert Nudds, Karl-Arne Stokkan, Lars Folkow and Jonathan Codd

Published: November 2010, Pennsylvania State University, United states of America.

2) Title: "Svalbard Rock Ptarmigan, (*Lagopus mutus hyperboerus*) – A status rapport"

Authors: Åshild Ønvik Pedersen, Øystein Overrein, Sigmund Unander and Eva Fuglei.

Published: Tromsø, Norway, 2005.

3) Title: Food intake, feeding rhythm, and body mass regulation in Svalbard rock ptarmigan.

Author: Stokkan K. A, Mortensen A. and A.S Blix.

Published: August 1986, American Physiological Society.