Arctic Woolly Bear Moth - Facts

Gynaephora groenlandica

Distribution: Northern Canada on the mainland and northern islands, also found on Greenland.

What are Arctic Woolly Bear Moths like? How are they adapted to survive?

The Arctic Woolly Bear Moth is fairly non-descript looking small drab moth. It lives its whole life in the far north of the Arctic on the mainland and northern islands of Canada and around the vegetated coastal strip of Greenland.

It is notable for living a stop-go life whereby the caterpillar takes around seven years to build up enough resources to finally pupate into the adult moth. It was previously thought to take fourteen years to do this, though revised estimates now make seven a typical though not absolute length of time reference.

As a small terrestrial invertebrate the moth has a major problem to deal with in that it is frequently too cold for it to be active. Before it can become active it needs to reach a warm enough temperature for the chemical processes in its cells to enable it to move around and feed, this happens when they get to 15°C-30°C. This temperature is one that is often just not possible for the caterpillar to achieve for the majority of the year, so most of the time it just sits and waits.....

This aspect of the lifestyle alone is not actually so unusual, there are other insects that spend several years as a larva and just a few weeks or months as an adult. Dragonflies can spend up to five years as an aquatic larva before emerging while some cicada species can go for thirteen or seventeen years at the larval stage. There are also many other polar invertebrates that have a stop-go lifestyle dependent on the temperature.

Arctic woolly bear caterpillars spend most of their lives actually frozen just thawing out for a short time in the summer. Only the caterpillar is resistant to freezing, they pupate in their final summer in just two weeks and then the adult moth dies after a short summer of finding a mate and laying eggs. The eggs then hatch quickly so that the cold resistant caterpillars can overwinter. Like many other adult flying insects, the adult moths don't feed at all.

Over its lifetime, they will freeze and thaw seven times (typically).

What is notable about the Arctic Woolly Bear Moth is the difficulty of the environment that it faces along with it's range of adaptations:

- Basking to warm up (behavioural) - The caterpillars spend up to 60% of their time while active basking in the sunlight to reach a temperature where they can feed and grow. This happens mainly around midday when the caterpillars can reach a temperature of up to 30°C, around 20°C above the surrounding air temperature in ideal conditions. They usually also bask after feeding before feeding again or moving onto a new site. reference They spend around 5% of their lives actually feeding almost entirely during the month of June.
- Most of their life is spent in hibernation in a hibernaculum (behavioural) - A hibernaculum is a light silk overwintering structure not as dense or complete as a cocoon that the caterpillar spins prior to its eleven month dormancy. The caterpillars spend about 90% of their life hidden away usually amongst rocks, this gives them protection from the parasites that are responsible for the deaths of around 75% of the caterpillars. For much of this time, they are actually frozen. Being surrounded by cold rocks means that their temperature is more stable than the surrounding soil, so they don't suffer so much from the potentially harmful effects of cycles of thaw and freezing without becoming warm enough to become active. In the spring, rocks may also absorb heat better than vegetation so speeding up snow melt and allowing early emergence. reference
- A covering of hairs or setae that conserve heat (anatomical) - The source of the Woolly Bear caterpillars name is also one of its adaptations to living in a harsh environment. Once warmed up by basking, the hairs help to retain the heat so allowing the caterpillar to remain active for longer and also to allow its metabolic processes such as digestion to take place more efficiently.

- The production of cryoprotectants in the blood and body tissues (physiological) - This is a vital part of the cold adaptations that allow this cold blooded creature to survive even though it may be frozen solid down to -70°C. There are a number of different chemicals that the caterpillar produces to this end such as glycerol and others that are more exotic. An aspect of the production of these chemicals is that it results from the breakdown of the mitochondria in the cells, these are then re-synthesized again the following year when the caterpillars become active again.

Arctic wooly bear moth caterpillar, basking in the sun on a rock. Rocks warm up more quickly and effectively than surrounding soil or vegetation so they make a much better place to warm up to become active. In such conditions the caterpillar can reach a temperature of 20°C above ambient, especially if there is snow or ice nearby to reflect more sunlight.