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How many legs does it take to escape a predator?

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Abstract

Why do animals have such different shapes and sizes? Many animals are hunted by predators. Prey animals have features that help them escape these predators. For example, some animals like frogs have two powerful back legs to jump away from predators. Other animals, like deer, have four legs that help them run away to safety. Some rodents use two legs, while many other rodents use four legs. But which ones are better at avoiding predators?

We compared the bipedal kangaroo rat with the pocket mouse, woodrat, and ground squirrel. We created fake predator attacks and measured how each rodent responded. We found that pocket mice and kangaroo rats jumped away the fastest. This might be because both are small and have strong back legs. Woodrats and ground squirrels jumped lower and slower. So, rodents jumping with two legs were better at reacting to attacks. This means using two legs may be an advantage for rodents when avoiding predators.

Introduction

Predators have many different ways of capturing **prey**. Some predators chase their prey, while others wait and strike suddenly. It is important for prey animals to be able to avoid or escape predators. Prey can have different shapes, sizes, and speeds to help them. For example, a fly has wings that help it avoid a lizard's quick tongue. The number of legs an animal uses might also be important for avoiding predators. Do you think more legs or fewer legs help an animal escape?

Most mammals are **quadrupedal**, which means they walk on four legs. Cats, bears, and mice are all quadrupedal. Using four legs at once may help them run fast. But some mammals are **bipedal**. They walk on two legs. Bipedal animals usually have larger back legs and smaller front legs.

The kangaroo rat is bipedal and has strong back legs. It is even famous for its high jumps – like a kangaroo! Being bipedal may help the kangaroo rat jump really high. It

Kangaroo rats are small rodents from western North America. They get their name from their ability to use their hind legs to jump to avoid predators.
Photo: Herper47/iNaturalist, CC BY-NC 4.0

may even help them avoid predator attacks from animals like owls and snakes. But are bipedal rodents better than quadrupedal rodents at avoiding predators? To find out, we compared the jumping ability of kangaroo rats with three types of quadrupedal rodent.

Methods

We went to deserts in southwestern North America. We captured 150 rodents. These included bipedal kangaroo rats and quadrupedal pocket mice, woodrats, and ground squirrels. We gave them tags and fur dye so that we could identify them. We then released the rodents and allowed them to return to their home burrow.

At their home burrow, we used a rattlesnake strike simulator (Fig. 1) to scare each rodent. This fake snake is made out of a plastic tube, a spring, and an elastic string. We cut the string so the tube moved toward the rodent. We filmed the rodent's reaction. We later watched these videos to see:

1. how many of the rodents jumped (jump frequency),
2. how quickly each rodent reacted (reaction time),
3. how fast each rodent took off from the ground (takeoff time), and
4. how high each rodent jumped (jump height).

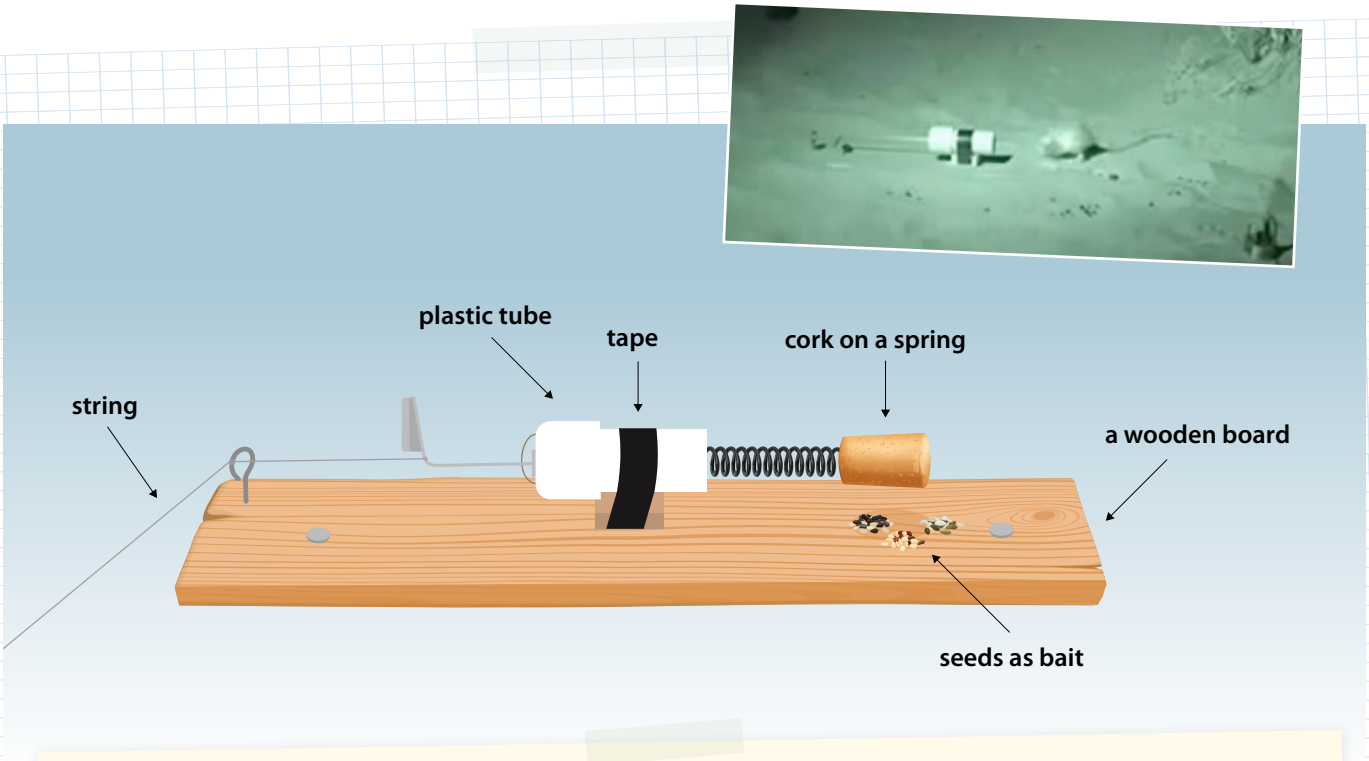

Figure 1:
A diagram of the rattlesnake strike simulator with a photo of the simulator in the desert with a kangaroo rat nearby.

Results

1. We found that almost all of the kangaroo rats and pocket mice jumped when the rattlesnake strike simulator scared them. Only a few woodrats or squirrels jumped. The rest of them "scrambled" or ran away.

2. We found that the desert kangaroo rat and the woodrat reacted faster to the fake snake than the other species on average.

3. We saw the rodents had different takeoff times. Pocket mice had the shortest takeoff time, followed by kangaroo rats. The woodrats and ground squirrels had a slower takeoff time (Fig. 2).

4. There were no large differences in jump heights. A few of the kangaroo rats did jump nearly half a meter (1.6 feet) high! But most kangaroo rats did not jump higher than the quadrupedal rodent species.

Which rodents are faster at taking off than the rattlesnake is at striking? Which rodents are slower than the rattlesnake?

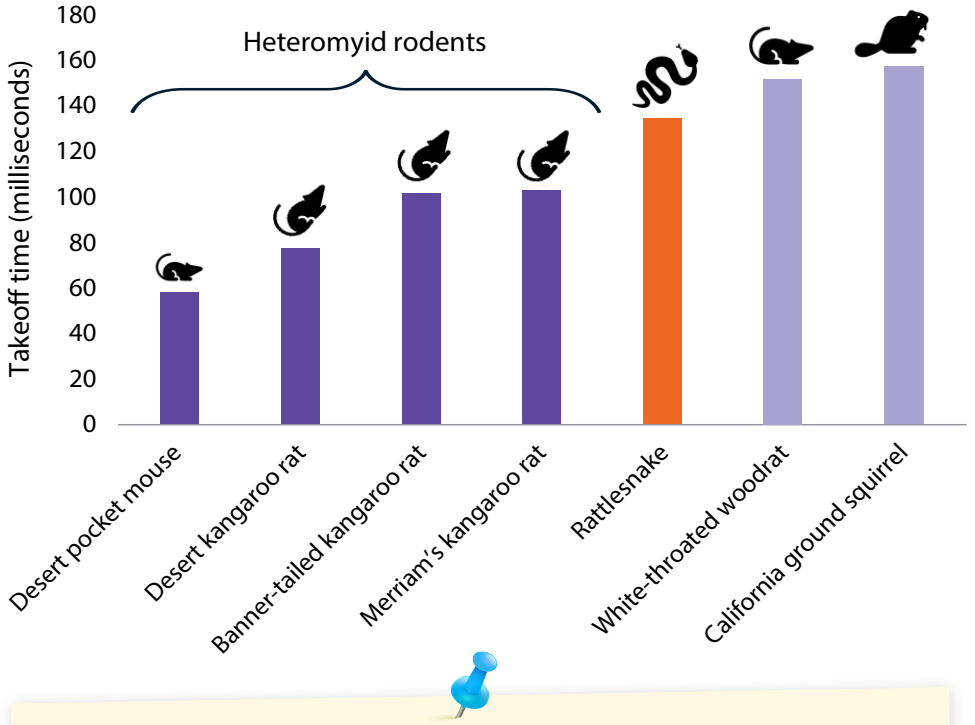

Figure 2: Comparison of the takeoff time between several kinds of rodents and the rattlesnake, a major predator in the desert.

Discussion

We saw that the bipedal kangaroo rats were good at reacting to the rattlesnake strike simulator. We were surprised to see that pocket mice were also good at jumping away quickly. This tells us it's possible to be a good jumper without being bipedal.

Kangaroo rats and pocket mice are both part of the **heteromyid** rodent **family**. This means they are closely related. Even though pocket mice are not bipedal, they have strong hind legs like kangaroo rats. Strong hind legs can help rodents jump away from predators.

Heteromyid rodents like kangaroo rats and pocket mice also have good ears. This helps them hear predators. This might explain why pocket mice and kangaroo rats jumped more often and took off faster than the other rodents. In contrast, woodrats and ground squirrels end up being slower than a rattlesnake strike as they take time to run away.

We know that time is important when prey responds to a predator attack. Even taking just a few milliseconds longer can be the difference between life and death! If jumping is so helpful, why don't other quadrupedal rodents like the woodrat and ground squirrel jump as much? One reason

is these rodents are also bigger, so they might not be as afraid of the snakes as the pocket mice and kangaroo rats are. They are also less sensitive to rattlesnake venom. We want to do more studies to figure out the details of why kangaroo rats are bipedal and why other rodents don't jump as well.

But traits like size and venom resistance must have advantages, too, right? Every animal has a unique combination of features. We can understand why these combinations exist when we look at how these features help the animal survive.

Conclusion

Looking at differences among animals can help us understand how and why a certain trait evolved. We saw how jumping ability may have evolved to help small rodents avoid predators. Now think about your own body. Why are humans bipedal? Why do we have an ear on each side of our head and two eyes facing forward? And why have humans developed the ability to read – like you're doing now?

You can use the same methods as we used for rodents to think about this. What challenges have humans faced? And what sets us apart from other similar animals with different skills or habitats?

Glossary of Key Terms

Bipedal - using two legs to walk. Humans and kangaroo rats are both bipedal.

Family - a group of species that are all closely related. For example, dogs, foxes, and wolves are all canids, part of the Canidae family.

Heteromyid - a family of rodents that includes kangaroo rats, pocket mice, and kangaroo mice. Heteromyids have long tails and strong hind legs.

Predator - an animal that naturally hunts or eats other animals (prey). Rattlesnakes and owls are both predators of kangaroo rats.

Prey - an animal that is hunted or killed by another animal (predator). The kangaroo rat is prey for the rattlesnake or owl.

Quadrupedal - using four legs to walk. Cats and mice are both quadrupedal.

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Check your understanding

1. Pocket mice and kangaroo rats are part of the same evolutionary family. Which family is this and what are its features?

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2. We discussed the benefits of being bipedal. Can you think of any advantages of being quadrupedal?

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3. Besides two strong jumping legs, what other characteristic of kangaroo rats and pocket mice might have helped them react to the threat of a rattlesnake?

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4. We used a rattlesnake strike simulator rather than a real snake in our study. What advantages did that offer us? How might this have influenced our results?

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5. Think of another predator-prey pair you know of. What features help the prey avoid the predator? Are there any other prey animals in that habitat without this feature? What could be a reason to explain this difference?

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