Community Ecology II: Predators - Crash Course Ecology #5

Crash Course: Ecology
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===== Introduction (0:00) =====

Of all the ways that species interact on this planet, maybe the one that fascinates us the most is predation, and why not? It's hard not to be captivated by, say, an Alaska Brown Bear, one of North America's apex predators, even though they get much of their nutrition from nuts and bugs and berries. But you can also tell that it's a pretty big fan of crushing the bones of other animals because of this amazingly pronounced sagittal crest, which is where its jaw muscles connect.

And maybe part of why we're so fascinated by predation is because we are, in many ways, the planet's top predator, at least for now. That's how most of these guys got here, but for hundreds of thousands of years, we were preyed upon as well, not just by bears and wolves, but by viruses and bacteria and parasites. Because predation isn't just animal eats animal, this musk-ox or this big-horned sheep can also be considered predators, even though they only eat plants.

But perhaps what's most important to understand about predation is the evolutionary pressures that come with hunting and being hunted for thousands of years. Because of these pressures, predation has driven all sorts of truly amazing adaptations that we see all around us. From the grizzlies enormous claws and teeth to the wolves' habit of hunting in packs as well as defensive adaptations, like the speed of the pronghorn, the fastest animal in North America.

In the end, the effect of predator-prey is an evolutionary arms race that results in the mind boggling amount of diversity we see in any ecosystem from the Northern Rockies all the way to the African Savanna. This arms race is known as co-evolution, the process by which the interactions between two species affect the evolutionary development of both. It's been going on since the Cambrian explosion more than half a billion years ago and it will continue spawning new bursts of diversity long after we humans have eaten ourselves into extinction, and maybe, we'll end up in a place like this.

[Title Sequence]

===== Herbivory (1:43) =====

We tend to think of predation in terms of animals--lions hunting zebras, wolves killing sheep, hawks eating mice--but predation is much more than just carnivores doing their thing, it applies to any number of interactions where one type of organism kills another for its energy. That's an important thing to note, because a lot of ecology comes down to the flow of energy through nature, and every living thing needs energy to meet its twin evolutionary goals of staying alive and making lots of babies.

Predators kill because they're hungry, but they're hungry because they need energy to survive and reproduce. For prey, these interactions are especially high-stakes, obviously, because nothing quite quashes your reproductive chances like being dead. But almost all energy on earth starts with plants, so consider bison eating grass, that's a type of predation called herbivory, where an organism eats plants or algae to capture their energy. It may not really seem like predation to you, but bison eating grass, manatees eating seaweed, and sea urchins munching on algae are all examples of organisms eating other organisms to ingest the energy of the sun.

===== Parasitism (2:41) =====

There's also parasitism, another form of predation in which organisms derive energy from the host usually harming it and sometimes killing it in the process. Hair worms, for example, devour the insides of grasshoppers and then brainwash them to make suicidal leaps into water. How exactly the waterborne worm finds its way to a grasshopper is a mystery, though larva carried by mosquitoes is a likely route.

Once inside the grasshopper, the worm eats everything non-essential to its host as it grows several times the length of its host's body. When only the grasshopper's head and legs remain, the hairworm is ready to reproduce, and that's when the brainwashing begins. See, hair worms breed in water, but grasshoppers can't swim, so hair worms pump their hosts full of chemicals that prompt an inescapable urge to leap into a body of water.

Once the grasshopper makes the leap, the hairworm is free to burrow out of the host and find a mate. Ew. Yeah, chasing and eating a gazelle is one thing, but turning your prey into, like, a suicidal zombie, that my friends, is predation.

===== Predatory Adaptation (3:37) =====

So clearly, predator and prey both have millions of years of tricks up their sleeves or stored in their DNA because everyone's ultimately playing by the same set of evolutionary rules, whether lion or zebra, grasshopper or hairworm, bison or grass, gaining energy while not being eaten is a prerequisite to reproductive success. So, the need to survive constantly forces predator and prey to adapt weapons and defense in a never-ending evolutionary arms-race.

On the predator side, hunting and feeding adaptations are obvious and familiar: a wolf's keen sense of smell and flesh ripping teeth and an eagle's sharp eyes and prey-gripping talons. Other creatures like rattlesnakes use heat-sensing organs to seek out small rodents and toxic venom to strike them dead, but this is where co-evolution takes the stage to give the prey a stake in the evolutionary arms-race, too.

===== Adaptation in Prey (4:25) =====

Since being caught by a predator is kind of terrible for anything that hopes to spread its genes, species have adapted to all sorts of ways to avoid getting killed. These can be broken up by what kinds of predatory behavior these adaptations are designed to avoid, namely, detection, capture, and handling.

To avoid detection, some prey adapt cryptic coloration, which we better know as camouflage, to help a species blend into the background. Stick insects that have adapted to look like sticks, leaf insects that look like leaves, snowshoe hares that turn white in the winter to blend in with the snow and brown in the summer to blend in with the grasses are all good examples.

Avoiding capture is, at times, pretty straightforward. Antelope, for example, flee predators with great leaping speed. Others find safety in numbers, such as bison forming a giant herds or herring grouping in schools. This kind of grouping certainly doesn't keep the prey from being detected, but it greatly reduces chances that any individual will get picked off by a predator, especially fit members of the group in the middle of the pack.

And finally, some of the coolest and most familiar adaptations are those that prevent handling. Plants are experts at these, think of a rose's thorns or tree sap that traps insects or the branches of an

African acacia tree, they're most thorny within the range of tree-munching giraffes, but above where the long-necks reach, there aren't as many thorns. Other plants also produce chemical weapons, such as the tobacco plants nicotine and the tannins produced by many plants like grapevines to fend off foragers.

===== Mullerian Mimicry (5:43) =====

But things get really weird when you see what animals do with this bag of chemical tricks, because often these critters not only have wicked toxic cocktails to defend themselves, many have also evolved aposematic, or warning coloration. The bright contrasting colors such as yellow and black splotches on the fire salamander or the red, yellow, and black bands of the coral snake make it clear to predators that eating them would be a serious mistake.

And when you think of it, nature is full of species that are black and yellow in color, or red and black; we tend to avoid them at all costs. We're smart that way, and so are most other predators. This, of course, is no coincidence, as German naturalist Fritz Muller noted in the 1870s, unpalatable species such as Cocobees, Yellowjackets--actually, almost every kind of bee and wasp resemble each other using similar colors and patterns.

He figured out that the more unpalatable prey there are that use the same color patterns, the more likely predators are to avoid all prey with that appearance in general. This defense technique is today known as Mullerian mimicry.

===== Batesian Mimicry (6:38) =====

But it turns out, unsurprisingly, some critters that look dangerous are getting the last laugh because many of them would actually be quite tasty to any predator; they just trick everyone by copying the looks of the truly dangerous species.

This technique is called Batesian mimicry, and to explain it to you, I'm going to need to sit down.

===== Ecolo-graphy: Henry Walter Bates (6:54) =====
[Ecolo-graphy Intro]

I'll give you one guess to figure out who first described Batesian mimicry. That's right, it was Bates--more specifically, it was Henry Walter Bates, a 19th century British naturalist and explorer. Bates was born in 1825 to a middle-class family that paid the bills by making hosiery. He spend most of his spare time reading often about bugs, and by the young age of 18 he was a budding entomologist with a publication on beetles already to his credit.

It was a few years later that he met the famed entomologist Alfred Russell Wallace. The two hit it off, and Wallace in 1847 proposed to take a trip to South America to collect insects. They would finance their travels by sending collected specimens back to England for sale to museums and private collectors. The pair set sail the following year, and after four years in the field Wallace moved on, but Bates, apparently not wanting to get into the hosiery business, stayed behind, spending the next eleven years in the jungle. All told, he collected nearly 15,000 species, about 8,000 of them new to science.

Just a few months after Bates arrived home in 1859, Darwin published his *On The Origin Of Species;* Bates read it and figured he could contribute evidence to support the new theory of natural selection from his insect collection. Two years later, he presented a paper that showed how different species of butterfly developed nearly identical color patterns on their wings.

For example, butterflies called Heliconiinae, which were slow-moving and abundant--but toxic--were nearly identical to Pieridae, which were more rare, but harmless. Bates concluded that natural selection had driven the harmless butterflies to mimic the patterns on the harmful butterflies for their individual bids to survive predation by birds.

The discovery helped launch Bates's career and reputation, and he went on to recount his adventures and other discoveries in a book, *The Naturalist on the River Amazon,* and later took a job as secretary to the Royal Geographic Society.

Though Bates died in 1892, the concept of Batesian mimicry continues to fascinate scientists today. Why, for example, are so many mimics not perfect imitations of their dangerous counterparts? Is it because perfect imitation isn't necessary to do the job, or because mimics lack the genes necessary to perfectly resemble their poisonous counterparts. Perhaps budding entomologists armed with 21st-century tools will finally unlock the answers.

===== Predatory Mimicry (9:12) =====

But don't think that prey are the only crafty mimics out there--in the arms-race, some predators have learned how to win food through imitation as well. You've heard me talk about snapping turtles with tongues that resemble wiggling worms to lure fish, and don't get me started about anglerfish! If predation teaches us anything, it's that nothing lasts forever, not just for prey but for every living thing, because the interaction between predator and prey keeps driving evolutionary change.

But the communities themselves that we've been talking about for the last two weeks don't stay the same either, of course. New tenants are always moving into a habitat and every now and again, a new landlord takes over, and that's part of what makes the living world such a dynamic and beautiful and exciting place--and it's what we'll be exploring next week.

===== Credits (9:50) =====

Thank you for watching this episode of *Crash Course: Ecology.* If you want to review anything there's a table of contents over there. Thanks to everyone who helped us put this episode of Crash Course together, and if you have any questions or comments or ideas you can leave them for us on Facebook or Twitter or, of course, down in the comments below. We'll see you next time.