Why Trees Need Salmon and Bears

Grizzly bears have a huge appetite. In the fall, they must consume 20,000 calories of food energy per day – equivalent to eating 40 hamburgers and 40 sundaes! The grizzlies in Alberta's Rockies receive the majority of their food energy from vegetation, like Canada buffaloberries. They aren't as lucky as the bears in British Columbia's temperate coastal forests, who can feast on a high protein and energy diet of spawning salmon. Here, grizzly bears will smash salmon against the riverbed or scoop them up the swipe of one claw and feast on the choicest parts of the salmon carcass. The coastal grizzly bears' annual salmon feed is critical to their health as they receive between 33-94% of their yearly protein from salmon (Klinka 2002). This in turn positively effects their body size, reproductive success, litter size and population density. It's easy to understand that bears benefit from these fish; however, researchers wondered if grizzly bears were the only species that benefited from spawning salmon.

University of Victoria professor, Dr. Tom Reimchen, investigated this over a decade ago and since then has learned that there are many linkages between marine and terrestrial ecosystems. Eagles, ravens, gulls and crows transfer salmon nutrients from water to land. However, Dr. Reimchen and his research team learned that both black and grizzly bears are the primary vectors for recycling salmon. In 40 days, (the average length of time for the salmon run), one bear can carry up to 700 salmon into the forest! (Baron 2000). Decaying salmon helps feed maggots and insects in the spring, which in turn feed warblers and flycatchers. The decaying salmon matter also serves as an important forest fertilizer by releasing nutrients such as nitrogen into the soil.

To prove that plants and trees were using the decaying salmon as a fertilizer, Dr. Reimchen traced a nitrogen isotope, N_{15}, that is found only in the deep waters of the Pacific Ocean (by comparison, our atmosphere consists of 78% N_{14}). He found that N_{15} appears in the growth rings of trees in the coastal rainforest. How did it get there? Dr. Reimchen concluded that when spawning salmon return to BC coastal rivers, their bodies carry large amounts of N_{15}, gathered during their years in the Pacific Ocean. Bears catch and devour the salmon, bringing the nitrogen-rich fertilizer into the forest (Coastal 2003).

By finding and measuring the concentration of N_{15} in various plants and trees, Dr. Reimchen confirmed that salmon are present in the forest. In fact, some studies show that N_{15} accounts for between 22 and 50% of the total nitrogen within the trees, demonstrating that salmon are directly contributing to the nutrient needs of coastal and terrestrial plants (Baron 2000, Helmfield 2001).

But the cycle doesn't stop there. It seems that by fertilizing forests, salmon are actually protecting their own habitat. Trees on the banks of salmon-filled rivers grow faster than those along salmon-free rivers. These larger trees clean and shade the water, enhancing salmon egg survival. Strong river currents cannot shift large fallen trees, leaving small fish somewhere to hide (Helmfield 2001). As these trees decompose, nitrogen is released back into the rivers and streams, feeding tiny insects and plants that new salmon depend on for survival (Baron 2000).

Discussion Questions

1. How would salmon populations be affected if grizzly bears were extirpated from this ecosystem?
2. What would happen to riparian (riverside) forests if salmon populations plummeted?
3. How could information about these types of ecosystem interactions affect land management?

References

Baron, N. 2000. Salmon Trees. Equinox. #110 April/May: 50-59.

Coastal rainforests: unlocking the mysteries. 2003, May 7. David Suzuki Foundation website. http://www.davidsuzuki.org/Forests/Forests_101/Science.asp

Helmfield, J and R. Naiman. 2001. Effects of salmon-derived nitrogen on riparian forest growth and implications for stream productivity. Ecology. 82(9): 2403-2409.

Klinka, D and T.E. Reimchen. 2002. Nocternal and diurnal foraging behaviour of brown bears (*Ursus arctos*) on a salmon stream in coastal British Columbia. Can. J. Zool. 80: 1317-1322.