The Ecological Role of Coyotes, Bears, Mountain Lions, and Wolves

The health of natural systems relies on the presence of predators, especially apex predators. Intact, healthy ecosystems provide benefits to humans such as clean water, forest regeneration, seed dispersal, natural pest control, disease regulation, improved nutrient cycling, climate regulation, healthy native plant communities in upland and riparian settings, which in turn contributes to soil fertility, stream bank stability, healthy fish and insect populations, and much more.[1] Literally thousands of studies have shown that when predators are removed from their food webs, the systems become unbalanced and unhealthy, triggering often-catastrophic alterations unlikely to ever be reversed. We simply cannot keep the current pace of species and habitat reduction/elimination if we want to remain healthy ourselves.

A coyote in Yellowstone. NPS

Coyotes (*Canis Latrans*)

Like other top predators, coyotes play a critical role in keeping natural areas healthy. In fact, coyotes are a keystone species, meaning that their presence or absence has a significant impact on the surrounding biological community.

Keystone species like the coyote can have a regulatory effect on smaller predator (mesopredator) populations, which allows prey of the smaller predator species to survive.[2] For example, since mesopredators consume eggs and small or young ground-nesting birds, an increase in the smaller predators can greatly affect bird populations.[3] Bird species diversity decreases with mesopredator abundance, especially fox, cats, opossum, and raccoon.[4] One study found that sage grouse benefit from the presence of coyotes, because coyotes reduce the number of nest predators; limit jackrabbit populations, which in turn limits the presence of eagles (which prey on sage grouse eggs and young); and reduce the number of competitors eating plants that sage grouse eat.[5]

By exerting a top-down regulation of other species, coyotes maintain the balance in the food web below and around them. When coyotes are absent or even just greatly reduced in a natural area, the relationships between species below them in the web are altered, putting many small species at risk.[6]

Bears (*Ursus Americanus, Ursus Arctos*)

As with wolves, the threat of or actual predation by bears of ungulates (elk, deer, moose) regulates the ungulate impacts on plant biomass, maintaining the health of rangelands as well as habitat for other species of animals. Both black and grizzly bears have been found to be co-regulators (with wolves and cougars) of elk populations in Idaho and

Montana by preying on calves.[7] Similarly, grizzly bears co-regulate moose populations, which allows woody shrubs and young aspen, willow, and cottonwood trees to grow, increasing bird species richness and nesting density.[8]

Black bear with cub. NPS

Mountain Lions (*Puma Concolor*)

The mountain lion is also known as cougar, puma, and catamount. NPS

The main prey of the mountain lion (also called cougar or puma) is deer, but cougars will kill and eat elk, moose, bighorn sheep, beavers, porcupines, rabbits, ground squirrels, mice, even skunks.[9] Like coyotes, bears, and wolves, cougars keep prey populations in check, helping to prevent overgrazing of rangelands and overbrowsing of trees and shrubs in riparian areas.[10]

William Ripple and Robert Beschta, biologists at Oregon State University who study the impacts of predators in ecosystems, have published seminal research on the effects of cougars on natural systems. In studies of Yosemite and Zion National Park cougar and ungulate populations, Ripple and Beschta found that the displacement of cougars (and resulting lack of predation) contributed to deer irruptions. In Zion, as the deer population exploded, managers started to kill deer, yet deer continued to destroy young cottonwood trees and area vegetation. Without cottonwoods, stream banks eroded, which then reduced cattails and other plants, wildflowers, amphibian species, lizards, and butterflies.[11] Fish species also declined because, as streams widened, water temperatures rose too high for fish.[12] Ripple and Beschta refer to such ecosystem alterations as catastrophic: While the loss of cottonwoods alone represents a major

impact to biodiversity; it signals other functional losses by the larger plant and animal community.[13]

In Yosemite, overbrowsing of young oak trees by deer severely reduced tree recruitment, creating similar trophic impacts.[14] Many species rely on acorns for food and oak trees for nesting and cover.[15] A lack of oak trees in the Yosemite Valley indicates a substantially altered ecosystem and decrease in biodiversity, such as shrubs, wildflowers, birds, and various invertebrates.[16]

Wolves (*Canis Lupus*)

The impacts of wolves on prey populations and surrounding natural areas is one of the most popular topics in ecology and conservation biology today. The recolonization of wolves in the Northern Rockies and other regions around the world has allowed for extensive study of how the absence or presence of wolves impacts ecosystem health and functioning.

In areas where wolves are absent, ungulate populations such as elk, deer, and moose tend to increase dramatically[17] leading to declines in native plant species as well as the general degradation of forests and ecosystems.[18] A series of studies has documented excessive overbrowsing by elk and moose in key riparian habitat including cottonwoods, willows, and aspens when wolves are absent.[19] In areas where wolves have returned, ungulates are reduced (by predation) and more vigilant and active (fear of predation), which takes browsing pressure off streamside trees and shrubs, allowing them to grow. This “landscape of fear” affects a prey animal’s behavior in food acquisition and thus modifies plant communities.[20] With the return of riparian habitat, beavers and many bird species are supported.[21] When woody species grow, expand in canopy cover, and increase in their spatial distribution, other benefits accrue, such as improved floodplain functioning, channel stabilization, increased shading, improved food web support, larger beaver populations, and an overall increase in biodiversity.[22]

Wolf presence and predation also affects the behavior and populations of other animal species. There is evidence that wolves reduce coyote populations, thereby boosting pronghorn antelope, sage grouse, and other bird and small mammal populations.[23] Wolves tend to remove weak, injured, or otherwise less-fit prey from prey herds.[24] Wolves also mitigate climate change impacts on scavenger species by increasing food availability.[25] Without the presence of top-down pressures exerted by apex predators such as wolves, natural areas become simplified, less diverse, and unstable.[26]

Finally, in another interesting ecological twist, wolves may benefit both cougars and deer that would otherwise be preyed upon by cougars. Cougars, as ambush predators, hunt in complex habitats with trees, rocks, and bushes. Wolves, on the other hand, are coursing predators that chase and take down their prey in more open terrain. Wolves may help cougars prey on elk by forcing elk into covered areas where cougars hunt.[27] This same activity saves the lives (at least temporarily) of the deer otherwise hunted by the cougars.[28]

For an excellent source on the ecological impacts of wolves as well as other species, read The Wolf's Tooth: Keystone Predators, Trophic Cascades, and Biodiversity, by Christina Eisenberg (Island Press, 2010).

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Sources

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[1] Zavaleta, E., J. Pasari, J. Moore, D. Hernandez, K. B. Suttle, C. C. Wilmers. 2009. Ecosystem Responses to Community Disassembly. The Year in Conservation Biology, 2009: Ann. N.Y. Acad. Sci. 1162: 311-333 (2009); Chapin, F. S., E. S. Zavaleta, V. T. Eviner, R. L. Naylor, P. M. Vitousek, H. L. Reynolds, D. U. Hooper, S. Lavorel, O. E. Sala, S. E. Hobbie, M. C. Mack, S. Díaz. 2000. Consequences of changing biodiversity. NATURE, Vol. 405, May 11, 2000, pp. 234-242; Beschta, R. L. and W. J. Ripple. 2009. Large predators and trophic cascades in terrestrial ecosystems of the western United States. Biological Conservation 142 (2009) 2401-2414.

[2] Henke, S. E. and F. C. Bryant. 1999. Effects Of Coyote Removal On The Faunal Community In Western Texas. Journal Of Wildlife Management 63(4):1066-1081.

[3] Id.

[4] Crooks, K. R. and M. E. Soule. 1999. Mesopredator release and avifaunal extinctions in a fragmented system. Nature, vol. 400 (Aug. 5, 1999).

[5] Mezquida, E. T., S. J. Slater, C. W. Benkman. 2006. Sage-Grouse And Indirect Interactions: Potential Implications Of Coyote Control On Sage-Grouse Populations. The Condor 108:747–759.

[6] Mitchell, B. R., M. M. Jaeger, R. H. Barrett. 2004. Coyote depredation management: current methods and research needs. Wildlife Society Bulletin, 32(4):1209-1218.

[7] White, C. G., P. Zager, M. W. Gratson. 2010. Influence of Predator Harvest, Biological Factors, and Landscape on Elk Calf Survival in Idaho. Journal of Wildlife Management 74(3):355-359; Hamlin, K. L. and J. A. Cunningham. 2009. Monitoring and assessment of wolf-ungulate interactions and population trends within the Greater Yellowstone Area, southwestern Montana, and Montana statewide: Final Report. Montana Department of Fish, Wildlife, and Parks, Wildlife Division, Helena, Montana, USA.

[8] Berger, J., P. B. Stacey, L. Bellis, M. P. Johnson. 2001. A Mammalian Predator–Prey Imbalance: Grizzly Bear And Wolf Extinction Affect Avian Neotropical Migrants. *Ecological Applications,* 11(4), 2001, pp. 947–960.

[9] Busch, R. H. 2004. The Cougar Almanac: A Complete Natural History of the Mountain Lion (The Lyons Press: Guildord, CT).

[10] Id.

[11] Ripple, W. J. and R. L. Beschta. 2006. Linking a cougar decline, trophic cascade, and catastrophic regime shift in Zion National Park. Biological Conservation 133 (2006) 397-408.

[12] Id.

[13] Id.

[14] Ripple, W. J. and R. L. Beschta. 2008. Trophic cascades involving cougar, mule deer, and black oaks in Yosemite National Park. Biological Conservation 141 (2008) 1249-1256.

[15] Id.

[16] Id.

[17] Licht, D. S., J. J. Millspaugh, K. E. Kunkel, C. O. Kochanny, R. O. Peterson. 2010. Using Small Populations of Wolves for Ecosystem Restoration and Stewardship. BioScience, February 2010, vol. 60 No. 2, pp. 147-153.

[18] Cote, S. D., T. P. Rooney, J. Tremblay, C. Dussaut, D. M. Waller. 2004. Ecological Impacts of Deer Overabundance. Annual Review of Ecology, Evolution, and Systematics, December 2004, Vol. 35, Pages 113-147; Rooney, T. P. 2001. Deer impacts on forest ecosystems: a North American perspective. Forestry, 74: 201-208; Rooney, T. P. and D. M. Waller. 2001. Direct and indirect effects of white-tailed deer in forest ecosystems. Forest Ecology and Management 181 (2003) 165–176.

[19] Ripple, W. J., E. J. Larsen, R. A. Renkin, D. W. Smith. Trophic Cascades among wolves, elk and aspen on Yellowstone National Park's northern range. Biological Conservation 102, 2001: 227-234; Ripple, W. J. and E. J. Larsen. 2000. Historic aspen recruitment, elk and wolves in northern Yellowstone National Park, USA. Biological Conservation 95: 361- 370; Beschta, R. L. 2003. Cottonwoods, elk and wolves in the Lamar Valley of Yellowstone National Park. Ecological Applications 13: 1295-1309.

[20] Halofsky, J. S. and W. J. Ripple. 2008. Fine-scale predation risk on elk after wolf reintroduction in Yellowstone National Park, USA. Oecologia (2008) 155:869-877; Laundre, J. W., L. Hernandez, W. Ripple. 2010. The Landscape of Fear: Ecological Implications of Being Afraid. The Open Ecology Journal, 2010, 3, 1-7.

[21] Berger 2001, Hebblewhite, M., C. A. White, C. G. Nietvelt, J. A. Mckenzie, T. E. Hurd, J. M. Fryxell, S. E. Bayley, P. C. Paquet. 2005. Human Activity Mediates A Trophic Cascade Caused By Wolves. Ecology, 86(8), 2005, pp. 2135-2144.

[22] Ripple, W. J. and R. L. Beschta. 2006. Linking wolves to willows via risk-sensitive foraging by ungulates in the northern Yellowstone ecosystem. Forest and Ecology Management 230 (2006) 96-106.

[23] Berger, K. M., E. M. Gese, J. Berger. 2008. Indirect Effects And Traditional Trophic Cascades: A Test Involving Wolves, Coyotes, And Pronghorn. Ecology, 89(3), 2008, pp. 818-828; Berger, K. M. and E. M. Gese. 2007. Does interference competition with wolves limit the distribution and abundance of coyotes? Journal of Animal Ecology (2007) 76, 1075–1085; Mezquida, E. T., S. J. Slater, C. W. Benkman. 2006. Sage-Grouse And Indirect Interactions: Potential Implications Of Coyote Control On Sage-Grouse Populations. The Condor 108:747–759.

[24] Licht, D. S., J. J. Millspaugh, K. E. Kunkel, C. O. Kochanny, R. O. Peterson. 2010. Using Small Populations of Wolves for Ecosystem Restoration and Stewardship. BioScience, February 2010, vol. 60 No. 2, pp. 147-153.

[25] Wilmers, C. C. and E. Post. 2006. Predicting the influence of wolf-provided carrion on scavenger community dynamics under climate change scenarios. Global Change Biology (2006) 12, 403-409; Wilmers, C. C., R. L. Crabtree, D. W. Smith, K. M. Murphy, W. M. Getz. 2003. Trophic facilitation by introduced top predators: grey wolf subsidies to scavengers in Yellowstone National Park. Journal of Animal Ecology (2003) 72, 909–916.

[26] O'Gorman, E. J., and M. C. Emmerson. 2009. Perturbations to trophic interactions and the stability of complex food webs. PNAS, August 11, 2009, vol. 106, no. 32, 13393–13398; Prugh, L. R., C. J. Stoner, C. W. Epps, W. T. Bean, W. J. Ripple, A. S. Laliberte, J. S. Brashares. 2009. The Rise of the Mesopredator. BioScience 59: 779-791; Beschta, R. L. and W. J. Ripple. 2009. Large predators and trophic cascades in terrestrial ecosystems of the western United States. Biological Conservation 142 (2009) 2401-2414; Ritchie, E. G., C. N. Johnson. 2009. Predator interactions, mesopredator release and biodiversity conservation. Ecology Letters (2009) 12: 982-998; Soule, M. E., J. A. Estes, J. Berger, C. Martinez del Rios. 2003. Ecological Effectiveness: Conservation Goals for Interactive Species. Conservation Biology vol. 17, No. 5, October 2003, pp. 1238-1250.

[27] Atwood, T. C., E. M. Gese, K. E. Kunkel. 2006. Comparative Patterns of Predation by Cougars and Recolonizing Wolves in Montana's Madison Range. The Journal of Wildlife Management 71(4) 1098-1106.

[28] Id.