



## Predators self-regulate their populations and help maintain ecosystem health and ecological diversity

The important role of predators in regulating ecosystems and sustaining biodiversity has long been understood. One of the early studies on predator-prey dynamics focused on the interaction of predators and the mule deer herd on the Kaibab plateau (Leopold 1943). Predators, including wolves, mountain lions, bobcats, and coyotes were hunted and trapped to scarcity based upon the idea that this would be beneficial to the deer herd. However, the deer herd quickly increased in size and outgrew the available forage. As a result, government hunters had to be employed to kill the deer. This situation became one of the first illustrations of how a healthy predator population can lead to a healthy ecosystem and was discussed in one of the first textbooks on ecology (Odum 1973).

Apex predators in Vermont include coyotes, black bear, bobcat, river otter, and to a lesser extent, fisher. Smaller predators in Vermont such as raccoons, foxes, opossums, skunks, and weasels are often termed mesopredators. Apex predators occupy the top trophic position in a community and are often larger bodied, specialized hunters. Mesopredators typically occupy the trophic position below apex predators and tend to be more trophic generalists, i.e., they tend to be more omnivorous than carnivorous, with the exception of weasels. Many apex predators, including those in Vermont, are now recognized as Keystone species (Wallach 2015). This is due to their profound impacts on ecosystems within which they affect the distribution, abundance, and diversity of their prey. This regulation of lower trophic level species in the food chain creates a process known as a trophic cascade. Also, by facilitating the dispersal of native seeds and nutrients, they also influence the structure and balance of ecosystems and landscapes.

Apex predators can suppress mesopredator populations in two ways: by killing them and by instilling fear, which motivates changes in their behavior and habitat use that can limit mesopredator distribution and abundance (Ritchie 2009).

The control of mesopredators by apex predators has a significant effect on the intensity of predation on smaller prey species like birds and small vertebrates. Consequently, the removal of apex predators from a system may result in a process known as mesopredator release and is symptomatic of fundamental ecosystem imbalance and loss of biodiversity (Ritchie 2009; Prugh 2009).

Apex predators are more effective and more economical at controlling mesopredators than are hunters or trappers. Recent studies indicate that it is impossible to replicate the full ecosystem effects of apex predation. Interactions between predators result not only in direct killing, but also in avoidance behavior and defensive group formation. Thus, fear of predation may have a stronger impact on a landscape scale than the killing itself (Ritchie 2009).

In addition to maintaining balance in an ecosystem by limiting the populations of their prey, apex predators are able to maintain relatively constant population densities despite differences in resource availability. In fact, the larger the predator, the more they are typically able to self-regulate populations. Smaller predators and mesopredators are more limited by the inconsistent food supply and predation. “Self-regulation” originates from social interactions and is therefore subject to the condition of social or pack stability. In apex carnivore populations subjected to human hunting, age at sexual maturity declines, reproductive rate increases, parental care shortens, and demography skews toward juveniles. In contrast, with non-exploited populations of large canids (e.g., coyotes), the offspring often remain with their natal group for several years, delaying breeding age, reducing litter production, and consequently slowing or stopping population growth rates (Wallach, 2015).

More studies are needed to fully understand and develop appropriate strategies to ensure populations of apex predators are sustainable so that ecosystems are resilient and biodiverse. Responsible conservation of apex predator populations is imperative to limit further environmental degradation. Habitat restoration and better public understanding/education, as well as compromises by those likely to have predator confrontations, must be priority wildlife management strategies (Prugh, 2009).

## Vermont’s apex species (See Elbroch and Rinehart, 2011 for species’ profiles)

### 1. Coyote (*Canis latrans*)

Coyotes are an apex predator in VT although they fill the role of mesopredator in other locations where they share habitat with wolves.

Approximately two-thirds of coyotes live in packs. Another one-third roam, waiting for an opportunity to join a pack. A stable pack consists of a monogamous breeding pair that only mates once a year. Other pack members do not breed. Litter size is on average 4-7 pups, depending on the available food sources. Of these pups, only 25% will survive to adulthood. The pack defends a home range of about 4-8 square miles.



Indiscriminate killing of a breeding male or female, forces the mate to leave to find a new mate. A roamer (or disperser) comes in and breeds with as many females as he can causing a ‘burst’ in the local population. This means more coyotes on the landscape. Additionally, without the leadership of the alpha pack members, the other pack members are likely unskilled at hunting and may cause problems with humans where there weren’t any before.

When exploited by hunting and trapping, coyotes have increased juvenile reproduction, larger litters, and pack dispersion, potentially resulting in more alpha breeder pairs.

## 2. North American River Otter (*Lontra canadensis*)

Otters are not traditionally thought of as apex predators, but by preying on fish, frogs, crayfish and insects, they regulate species’ populations in aquatic ecosystems. Their latrines contribute to the health of riparian plant communities by distributing aquatic nutrients into soils, increasing nitrogen content and growth rate of some native plant species. River otters require clean water to survive and are bioindicators of healthy aquatic systems. Threatened by habitat degradation, pollution, and human exploitation, river otters do not overpopulate their ranges and have slow reproductive growth. Females reach maturity around 2 years of age and give birth to one to three pups per year, between February and May. Males, who do not reach adult size until they are around 3 or 4, may not be successful at breeding until age 5-7.



River Otters are listed as a species of greatest conservation need in the Vermont Fish & Wildlife Department’s 2015-2025 Wildlife Action Plan. Under the “Research & Monitoring Needs” section of the Plan, a “high priority” is given to determining the impacts of heavy metals and contaminants on otter populations in each watershed.

## 3. Bobcat (*Lynx rufus*)

Bobcats are considered a keystone species for their ability to stabilize rodent populations. Prey availability, as well as available territory, are limiting factors for bobcats. Usually solitary and territorial animals, females never share territory with each other. Male territories, however, tend to overlap. Territories are established with scent markings and territory sizes are extremely varied—generally 25-30 square miles for males and about five square miles for females (U.S. Fish & Wildlife Service, 2018).



Mothers and their litters of 2-4 kittens are the basic social unit. They breed once a year, in February/March, and breeding success is directly linked to prey availability. Breeding rates vary from 92% of adult females down to 30% or less depending on food scarcity.

Bobcats live in varied habitats, depending on landscape connectivity and availability of prey and mates, denning sites, as well as protection from predators. Loss of habitat has resulted in greater competition for prey with other predator species, coyotes in particular, and impacts bobcat conservation.

Bobcats are listed as a species of greatest conservation need in the Vermont Fish & Wildlife Department's 2015-2025 Wildlife Action Plan. Under the "Research & Monitoring Needs" section of the Plan, a "high priority" is given to the following: habitat requirements as well as distribution and abundance (determine the location of source and sink populations and identify the habitat parameters associated with these populations).

#### 4. Black Bear (*Ursus americanus*)

Female bears (sows) only breed every two years and generally her first litter will be around the age of 3-4 years old. The average litter size is 2-3 cubs who stay with, and are dependent on, their mother for a year and a half. Black bears mate in June/July, but the process of delayed embryonic implantation postpones cub births until late winter when the female is safely in hibernation. Birth of cubs is regulated by the condition of the sow in the early winter (her nutritional status and age). Older and larger (fatter) sows produce larger litters. Younger bears produce fewer cubs. If in poor health, or lacking enough body fat to sustain lactation, a sow will not give birth (reabsorb fetuses). Thus, there is a strong correlation between a female black bear's body condition, environmental factors, and her reproductive success.



Hunting bears, especially sows who may be pregnant or have dependent cubs, can have a negative effect on population dynamics. Additionally, the use of hounds to hunt bears exerts tremendous stressors on bears, especially during the summer months when sows are nursing. Bears are also subject to hyperthermia when chased for long distances during the peak summer months.

## 5. Fisher (*Pekania (Martes) pennanti*)

Fisher are generally solitary except during mating season. The rest of the year they tend to be territorial. Fisher breed in March/April but delay implantation of embryos and give birth almost a year later in February/March. Due to this process—embryonic diapause—female fisher are pregnant for all but two weeks of every year. Litters are born in late winter to early spring and range from 1-5 young with an average of 2-3 kits. When kits disperse and are on their own in late summer or fall, there is a high chance of mortality. This is especially true if the local fisher population is growing and vacant territory is challenging to find and establish.



Fisher and American marten (*Martes americana*), an endangered species in VT, overlap in habitat, food sources, and behavior. Trapping of fisher can therefore negatively impact both fisher and marten populations, since marten are killed in legally set traps for fisher. Fisher populations are in decline in New England and the reasons are likely complex, from habitat loss and fragmentation, to the use of rodenticides and trapping (USDA, Forest Service, 1994).

## Literature Cited

Crooks, K.R. and Soule, M.E. 1999. Mesopredator release and avifungal extinctions in a fragmented system. *Nature* 400 (August 5, 1999): pp. 563-566.

Elbroch, M. and Rinehart, K. 2011. *Behavior of North American Mammals*. Houghton Mifflin Harcourt Publishing.

Odum, E. (1971) *Fundamentals of Ecology*, Saunders College Publishing. [describes the long running cycles observed in nature as well as experiments in the laboratory]

Leopold, A. (1943). *Deer Irruptions*. Wisconsin Conservation Bulletin, publication 321. [one of the original interpretations of the irruption and the role of predators]

Prugh, L.R. et al. 2009. The Rise of the Mesopredator. *BioScience*, 59 (9): pp. 779-791.

Ritchie, E.G. and Johnson, C. N. 2009. Predator Interactions, mesopredator release and biodiversity conservation. *Ecology Letters* 12 (9): pp.982-998. [Note: the Ritchie and Johnson source is an extensive Literature Review with a wealth of recent and relevant sources]

USDA, Forest Service. 1994 *The Scientific Basis for Conserving Forest Carnivores American Marten, Fisher, Lynx, and Wolverine in the Western United States*

U.S. Fish & Wildlife Service. 2018. *Basic Facts About Bobcats*

Wallach, A.D. et al. 2015. What is an apex predator? *Oikos* 124: pp. 1453-1461.

