Coyotes (*Canis latrans*)

in Maryland

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Background

During the 2021 legislative session Joint Chairmen's Report included the following statement:

> "The budget committees are concerned that the coyote has fully colonized Maryland and that the coyote population is threatening both domestic and wild animals as well as public health, safety, and welfare. Therefore, the budget committees request that the Department of Natural Resources (DNR), in cooperation with stakeholder groups, conduct an impact assessment study of Maryland's coyote population and report on the findings. The study shall include the following: an assessment of the coyote population statewide in terms of range and subspecies, including fertile hybrids; a determination of the socioeconomic impact of unchecked growth in the coyote population; and identification of strategies and policies to control coyote population growth and mitigate attendant ecological impacts."

Introduction

The coyote (*Canis latrans*) is one of the newest additions to Maryland's diverse suite of modern fauna. Less than half a century after arriving in 1972, coyotes have expanded their range to every county within Maryland and currently thrive in a diverse range of habitats in the state today. Despite sharing the distinction of apex predator with bobcats (*Lynx rufus*) and black bears (*Ursus americanus*) in the mid-Atlantic region, coyotes have proved tolerant enough of humans to occupy even the most developed and fragmented habitats in the state while remaining largely unseen by the general public. Speculation regarding the origin and habits of the state's coyotes often fuels unfounded panic or theories, which this document seeks to address or dispel. The report also details the status of the coyote in Maryland and other management implications.

Arrival in Maryland

The arrival of the coyote to Maryland and the broader mid-Atlantic region is a relatively recent, multi-faceted biological phenomenon. Pennsylvania preceded Maryland with the arrival of coyotes in 1946 (Bovard et al. 2011). Coyotes were first documented in Maryland in 1972. The extraordinary adaptability of the coyote has undoubtedly aided the colonization of previously unoccupied territories in recent history.

Prior to European colonization, eastern North America hosted several species of wolf (*Canis spp*.), the red fox (*Vulpes vulpes*), and the grey fox (*Urocyon cinereoargenteus*). Coyotes are considered to have originally been inhabitants of plains and short grass prairies, occupying what are today the Midwest and Great Plains regions (Timm and Baker 2007). Large scale expansion out of these territories was likely borne of contiguous forest to the north and the east supporting populations of larger carnivores hostile to coyote occupation (Hody and Kays 2018).

Initial clearing of forests in the east and the following conversion of the land to agriculture coincided with the persecution and subsequent extirpation of large carnivores. Timbering intensity shifted west towards as initial virgin timber resources of the Northeast were depleted, connecting the Midwest to previously converted land in the east. This process, along with predator removal and suppression, was well underway in the 19th century and drawing to a close by the turn of the 20th century.

Coyotes are documented to have colonized the east via a northern and southern route (Parker 1995). Waterways such as the Ohio and Mississippi rivers are theorized to have been barriers to dispersal, separating the two source coyote populations (Dennis 2010). Coyote populations in Tennessee and Kentucky are more genetically similar to those in southern states, endorsing the hypothesis that they were more recently colonized by populations from Alabama and Mississippi, despite the proximity of other populations to the North (Dennis 2010).

Coyotes are central to academic discussions about the genetic origin and taxonomic separation of wolves in the East. Curiously, early insight into canid taxonomy was derived from fossil remains that closely resemble the skull morphology of modern day coyotes taken from Cumberland Cave, located in Corriganville, Maryland (Gidley and Gazin 1938). These fossil remains were described in 1938 as *Canis prisolatrans* and predates modern wolves and coyotes.

The two dominant theories regarding the origin of North American *Canis* species contend one of two hypotheses: 1.) coyotes and wolves are two distinct species, and 2.) all eastern wolf variants (including red wolves, eastern wolves and great lakes wolves) are resultant from varying degrees of hybridization over time and space, or that eastern wolves (*Canis lycaon*) form a third, distinct line (Rutledge et al. 2015). These insights provide historical context into the role of coyotes in Maryland's ecosystems; though coyotes were not present in Maryland during the time of European colonization, precursors and related species likely filled similar niches and acted as analogs to present day coyotes.

There is strong evidence that over the course of the coyote range expansion, widespread interbreeding with other *Canis* species occurred (Kyle et al. 2006, Chambers 2010, Monzón et al. 2014). Interspecific territoriality between coyotes and wolves is well documented in their original range (Benson and Patterson 2013). In this setting, reproductive isolation between the two species is theorized to have been historically sustained by diet specificity (Kyle et al. 2006). Morphological traits needed to successfully predate large ungulates such as elk (*Cervus canadensis*) are thought to create selective pressure against smaller hybrid animals.

Barriers to reproduction between coyotes and wolves were likely removed by the suite of human activities accompanying westward settlement (Kyle et al. 2006). Hybrid zones are well documented in Ontario and the Great Lakes region, and suspected in areas where coyotes and red wolves (*Canis rufus*) overlap (Benson and Patterson 2013).

Hybridization in source populations has created general patterns in eastern coyotes that have resulted in outwardly recognizable phenotypes and detectable genetic signatures. Adaptations such as larger body sizes and more robust skull features resulting from hybridization may have facilitated expansion into both converted agricultural lands and intact eastern deciduous forests (Kays et al. 2008). However, eastern coyote dietary preferences, including big game content, remain significantly different from larger *Canis* species.

Coyote hybrids are often dubbed ‘coywolves’ in media and colloquial speech. This title may be somewhat disingenuous and itself the source of confusion; the portmanteau created by combining ‘coyote’ and ‘wolf’ may imply 50/50 coyote-wolf parentage, though this is not the case. Furthermore, ancestry is not a reliable indicator of size or demeanor; a Maine study that sampled 100 coyotes documented a coyote with 89% eastern Canadian wolf ancestry that weighed only 27 lbs. (Wilson et al. 2003).

Pervasive conspiracy theories contending that coyote introductions were carried out by government agencies and/or private parties persist, and have been researched in Pennsylvania (Bovard et al. 2011). Common theory variants include collusion between state fish and game agencies and auto-insurers to stock coyotes and thereby reduce deer densities, with the overall effect of reducing insurance claims related to deer-car related collisions. Hunters surveyed in this study were more likely to view coyotes as dangerous and to overestimate the gross danger represented by coyotes on a statewide scale.

Rare incidences of human-assisted dispersal east of the Mississippi of coyotes have been historically documented, with animals either escaping captivity or being intentionally released to facilitate hunting activities (Hill et al. 1987). This is a possible contributor to popular theories regarding coyote stocking.

Coyote Predation

For more than three decades coyotes, and the American black bear and bobcat, have assumed the role of apex predators in the state. The coyote can kill prey the size of an adult white-tailed deer, but evidence suggests it rarely does. As omnivores, coyotes are opportunistic and have a diverse diet consisting of both plant and animal material. This diet shifts seasonally based on food availability. Small mammals, including rabbits, squirrels, and rodents, constitute much of the coyote’s daily food intake, along with scavenging carrion such as road-killed deer. When available, white-tailed deer fawns are also preyed upon, as are birds, insects, fruits, nuts, and berries.

While coyotes can be detrimental to some wildlife, predator-prey interactions are complex and not easily understood (Ballard 2011). Although hunters are often concerned about coyote effects on white-tailed deer and Eastern Wild Turkey populations, prey species such as these have developed

physiological and morphological adaptations over thousands of years that enable them to survive. Likewise, coyotes can actually enhance some wildlife populations by removing other predators. Coyote predation on domestic cats and mammals such as raccoons (*Procyon lotor*), skunks (*Mephitis spp.*), and opossums, can improve songbird and other ground nesting bird populations by targeting those species responsible for destroying eggs and young of important ground nesting bird populations.

Coyotes are relatively new to the mid-Atlantic region, and are growing in number; evidence to-date suggests they have limited impact on native wildlife and the severity of these impacts depends largely on local habitat conditions. For example, in areas where the habitat is favorable for deer (i.e., early successional forests with abundant ground cover for fawns to hide in), coyote impacts will be much less than where habitats are unfavorable (i.e., late successional mature forests with limited ground cover). Coyotes in the central Appalachian range display a preference for recently cut forests, likely due to presence of ground cover harboring prey resources (Crimmins et al. 2012). Likewise, areas with higher deer densities can often tolerate higher fawn predation than areas with depressed deer densities.

Research data supports that there is minimal impact to deer and turkey populations from coyotes in the region. Vreeland et al. (2004) reported that predation was responsible for 46% of fawn mortality in a Pennsylvania study. Bears and coyotes were nearly equally responsible for the majority of the predation, but the researchers found no evidence that the survival rate of fawns was impacting population growth of the species. In Delaware, researchers found that fawn mortality in the absence of any predators was no different than rates reported from areas where predators were abundant (Dion et al. 2020). In Virginia, a coyote scat study found no evidence of turkeys being consumed by coyotes (Michael Fies, Virginia Department of Game and Inland Fisheries, personal communication). Coyotes display minimal differences in dietary preference for cervids (white-tailed deer), despite significant levels of sexual dimorphism between genders (Metzger et al. 2017).

Scat and stomach content analysis are commonly used methods to study coyote diet preferences. In stomach content studies, organic materials in the digestive system (bone, hair, feathers, and vegetable matter) are typically identified to the highest taxonomic level possible and binned into categories (Cervids, small rodents, birds, plants, etc.) (Metzger et al. 2017). This method can indicate dietary proportions on a seasonable basis, but does not offer the means by which the coyote subject procured its food. For example, a researcher could tell that a coyote ate a squirrel, but cannot discern whether that squirrel was killed by a vehicle first then consumed by the coyote; or killed and then consumed by the coyote. Scat analysis research works in a similar way, with coyote feces being collected across the landscape and processed and analyzed (Crimmins et al. 2012). Both studies mention uncertainty over the origin of deer prey, citing carrion consumption as a possible influence over coyote diets.

In the southeastern United States, coyotes have had a demonstrable effect on white-tailed deer populations in some areas. Kilgo et al. (2012) reported high predation rates of fawns by coyotes in South Carolina that impacted a local deer population. Elsewhere in the southeast, high fawn predation rates have also been observed, although overall deer population effects are largely unreported (Saalfeld and Ditchkoff 2007, Chitwood et al. 2014, Gulsby et al. 2015, Nelson et al. 2015). Habitat condition, deer density, and predator density largely determined the rate of fawn predation and its impact on local deer populations.

In Maryland, at this time, coyote impacts to native wildlife are considered to be minimal. While coyote predation of adult and fawn deer does occur in the state, it is not at a level that controls the deer population. The Maryland Department of Natural Resources (DNR) manages the deer population through regulated hunting. For several decades, the department has instituted very liberal seasons and bag limits to reduce the deer population to levels more compatible with humans. Should predator numbers rise to a level that creates population level consequences for deer, the department can manipulate hunting seasons and bag limits to offset the increased predation.

Conflicts with Domestic Animals

The Nuisance Wildlife Information Line (877-463-6497) is a collaborative effort between the United States Department of Agriculture Animal and Plant Health Inspection Service (APHIS) and DNR to provide professional guidance to citizens who have concerns and problems with wildlife. The information line is toll-free and receives a significant proportion of wildlife-related calls generated by the general public within the state. Data going back to 2012 is summarized in the text below, and split into two categories: damage threats and tangible losses. Damage threats can be characterized by the absence of direct conflict between coyotes and domestic animals; a coyote sighting in the vicinity of livestock or companion animal enclosures typifies a damage threat. Tangible losses are defined as cases where a coyote and a domestic animal come into direct contact and include predation events, direct damage and injuries. Monetary losses are estimated by the reporting party or generated based upon standardized values in the database.

Companion Animals

Pets and companion animals are subjective designations and include dogs, cats, and rabbits. Additionally, owners may consider animals otherwise designated as livestock species as pets/companion animals. Over a 10-year period (2012-2021), coyote-pet related incidents remained stable and generated a total of 207 calls (average 21 calls per year) to the nuisance wildlife information line. Estimated monetary losses over the recorded period were $9,050 (average $905 per year). This figure includes total losses, veterinary costs associated with treating injuries, and costs associated with damage threat incidents. The majority of calls generated (182/207 = 87.9%) involved damage threats, where no direct loss occurred and only $300 of

associated costs were reported. Twenty-five direct conflicts with companion animals were reported, including five injuries, 17 predation events, and three damage events totaling $8,750 in losses.

Estimating the value of companion animals is often difficult and highly subjective, but the total evaluation of an individual pet's value is capped in Maryland law at $7500 (CJP § 11-110). In this context, monetary losses over the 10-year observation period are relatively minor.

Livestock

Livestock is a broader designation, and for the purposes of this report includes cattle, swine, equines, fowl (chickens, ducks, etc), goats, sheep, alpacas and llamas. Livestock losses are more easily quantifiable due to a tangible market value that can be assigned to individual animals. During the same observation period, the number of reported livestock-coyote incidences remained stable and totaled 150 calls (average 15 calls per year). Losses due to coyote damage totaled $21,552 average $2,155.00 per year). The largest proportion of the 150 livestock related calls involved chickens (91/150= 61.7%). Of these, 49 were damage threats and 42 involved tangible losses totaling $9,199. Cattle-related losses totaled $6,355, and cumulative sheep and goat losses totaled $4,491.

Agriculture is essential to Maryland's economy, with the value of all agricultural products produced within the state totaling $2.17 billion in 2019. At this time, yearly losses of livestock due to coyote-specific predation do not represent a statistically significant portion of yearly production costs on a statewide scale. However, predation is not equally distributed on a landscape level and may impart concentrated economic costs onto some producers. Additionally, perceived threats and intangible factors such as decreases in productivity due to coyote presence may also constitute unquantifiable losses.

While coyotes do not appear to be a major threat to livestock or pets at this time, and the total economic cost of coyote-domestic animal conflicts is not expected to significantly increase in the foreseeable future, DNR will continue to cooperate with APHIS and closely monitor coyote conflict trends.

Conflicts with Humans

Coyote attacks on humans are extremely rare. The perception of the danger posed by coyotes to human safety is often greatly exaggerated by the general public. Coyotes are naturally wary of humans, and are of too modest a size to pose a significant threat to a person. Virtually all cases involve animals that are diseased or have become accustomed to human presence by feeding. There have only been two documented attacks within the last decade in Maryland, with both cases involving rabid animals and occurring in 2020. In both incidents, the animal was recovered and

tested positive for the disease. The Center for Zoonotic and Vector-Borne Diseases is the responsible party for education, prevention, and facilitation of treatment in Maryland.

The potential for coyotes to impact the transmission rates of rabies within Maryland are doubtful. Rabies Vector Species (RVS) within Maryland are defined in law as bats, foxes, raccoons and skunks. Bats are the largest group of animals that are submitted for testing, and domestic companion animals (dogs and cats) comprise the majority of terrestrial animals that are tested for rabies within the state on a yearly basis. Compared to the other terrestrial RVS species, coyotes are less prolific and are found at lower densities, diminishing their capacity to contract and spread the rabies virus.

Coyote attacks involving feeding/conditioning are also extremely rare; there are no confirmed incidences of coyote contact with people due to feeding in Maryland. Animals that routinely receive food from humans directly and indirectly (food left for outdoor pets) can learn to associate people with food, leading to aggressive behavior. In states that have documented incidents, repeated interactions with tourists in high traffic natural areas are frequently cited sources of initial conditioning. This behavior is preventable through education of the applicable segments of the public.

Wildlife and Heritage Service Emergency Response

Wildlife emergency response represents a significant portion of the regional operations duties of DNR. Wildlife emergency response calls are conducted in response to threats toward health and human safety and include, but are not limited to, scenarios such as rabid animal attacks, entrapped animals, car collisions, venomous snakes and livestock depredations. Response protocols can vary in areas with active animal control offices. All wildlife response incidents are recorded, and since 2019 have been maintained digitally.

Since 2019, 18 calls regarding coyotes have been recorded. Of these, only five required in person responses. During the same period, other wildlife species such as white-tailed deer (*Odocoileus virginianus*), and black bear generated 797 and 468 calls, respectively (Figure 1). Small carnivores (red fox and raccoon) that occupy similar niches were included for their similarity in life history and habitat selection, and generated 476 and 155 calls, respectively. Of the calls represented in Figure 1, coyotes account for less than 1% percentage of all wildlife emergency calls related to coyotes is even smaller and is likely to remain low into the foreseeable future.

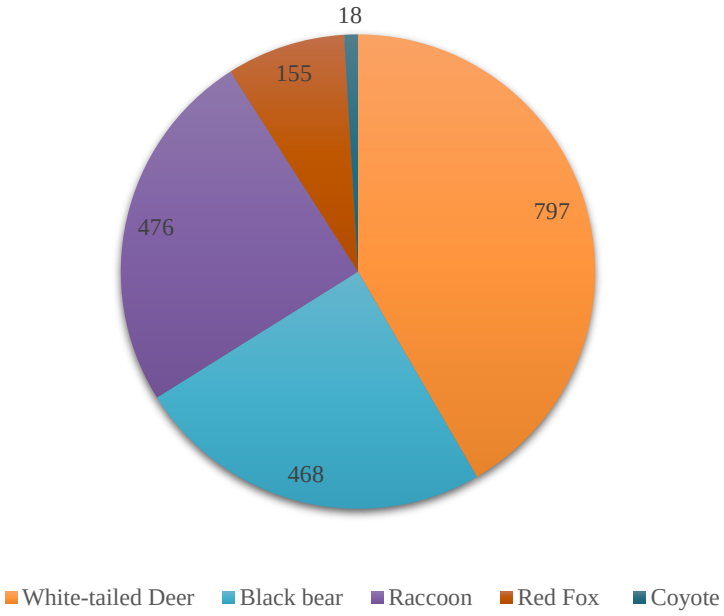

Figure 1. Wildlife emergency responses by species.

Coyote Hunting and Trapping seasons

Coyotes, along with other furbearers are managed as renewable fur resources in the State of Maryland. Participants of hunting activities must be licensed and purchase the appropriate stamps and permits to participate. In order to hunt terrestrial furbearers, both a valid hunting license and a furbearer permit are required. Trapping participants must also comply with a mandatory educational course and pass an exam demonstrating knowledge of applicable regulation, trapping techniques and fur-bearing species.

The coyote hunting season runs continuously throughout the year, and is only prohibited during the opening day of deer firearm season. Coyote hunting during nighttime hours was expanded from a limited season to year-round in the 2020-21 season due to public input. Coyote hunting is an increasingly popular pursuit, and is typically conducted by using manual or electronic calling devices to simulate prey noises or coyote vocalizations. The nearly continuous nature of the season is designed to provide opportunities to hunters concurrently with other hunting season periods, and to help alleviate predation concerns during the fawning/calving/lambing season of the spring and early summer.

The coyote trapping season runs from November through February, with the exact dates dictated by the management zone within the state (East/West of the Susquehanna River). Foothold devices, cable restraints and snares are most commonly used to trap coyotes, due to their wary nature and their hesitancy to enter a box or cage style trap. Controversy surrounding trapping is largely based on opinion and emotional appeal; modern traps are safe, efficient and humane devices that are

continually improved through the development of best management practices. Highly regulated recreational trapping is an important wildlife management tool that historically facilitated the reintroduction efforts of fur-bearing species (northern river otter and fisher) to Maryland, and continues to play a role in the management of wildlife resources within the state.

Coyote and Furbearer Survey

In an effort to gain insight into furbearer and other wildlife populations across Maryland, the Archery Hunter Survey was established in 2002 and has been conducted annually since then. Participation is relatively constant, and averages 300 respondents per yearly survey period. The use of archery hunters as casual observers is an effective method of capturing sightings of otherwise cryptic species due to a hunter's use of natural areas and the quiet, discrete nature of the activity.

Survey participants are asked to complete the survey and record any observations of wildlife while they are archery hunting. They are also asked a myriad of other questions, including number of hours hunted, county hunted, if the hunt occurred on public or private land and if bait, cover scent, an elevated stand or lure were used. Survey participants record information at the county level. Counties are then split into their respective physiographic provinces.

The Appalachian Plateau Province consists of Garrett County and a portion of Allegany County west of Dan's Mountain. The Ridge and Valley Province includes Allegany, Frederick and Washington counties. The Piedmont Province comprises Baltimore, Carroll, Cecil, Harford, Howard and Montgomery counties. The Western Coastal Plain Province consists of Anne Arundel, Calvert, Charles, Prince George's and St. Mary's counties. The Eastern Coastal Plain Province includes Caroline, Dorchester, Kent, Queen Anne's, Somerset, Talbot, Wicomico and Worcester counties.

The resulting survey data are tabulated and reduced to a standard unit of measurement (observations per 100 hours of hunting). This standard unit of measurement is used to analyze a number of different variables (e.g., elevated stand, lure, month, region, etc.). Standard errors are calculated using ratio estimates and provide a measure of variability in the results.

Pertinent observation data from the last decade regarding *Canid* species are shown in Figures 2, 3, and 4. Coyotes were found statewide and were observed in every province during the 2020-21 survey period. The highest observation rates have historically and continue to occur in the Appalachian Plateau, followed by the Ridge and Valley (Fig. 2).

Low observation rates in the coastal provinces, especially the Eastern Shore, suggest that coyote densities are lower in these physiographic regions. Relative geographic isolation caused by limited

overland dispersal routes, as well as differing land use patterns may represent a bottleneck in the establishment of higher densities in this region.

Aside from the Appalachian Plateau, coyote observations over time have remained generally lower than both fox species (Figs. 3, 4). Given that all species have sympatric distributions within the state, this is likely due to coyotes existing at lower densities than red and grey fox. Differences in life history traits of coyotes, such as larger home range size, wider dispersal radii and dietary preferences, when compared to smaller mesocarnivores like foxes, help to contextualize disparities in density among species within the state.

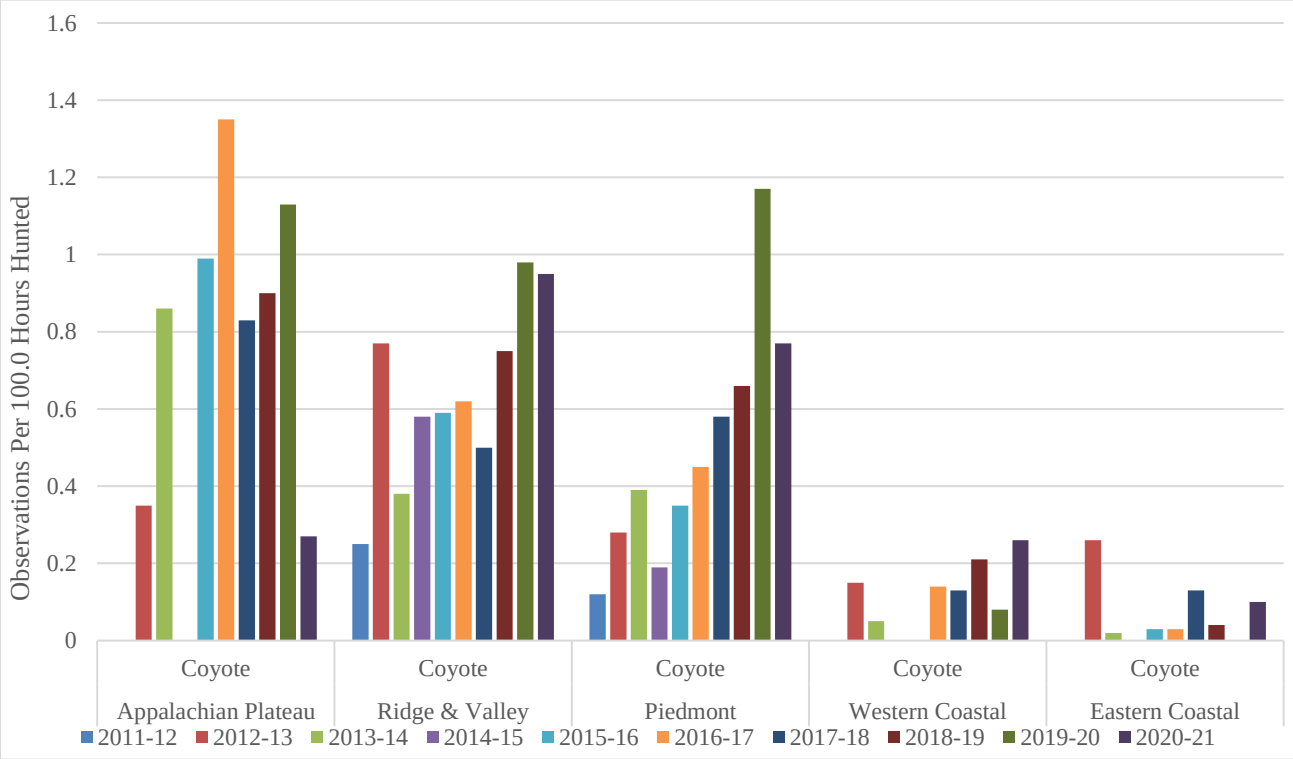

Figure 2. Coyote observation rates by archery hunters in the five Maryland physiographic provinces during the Maryland archery seasons (2011-12 – 2020-21).

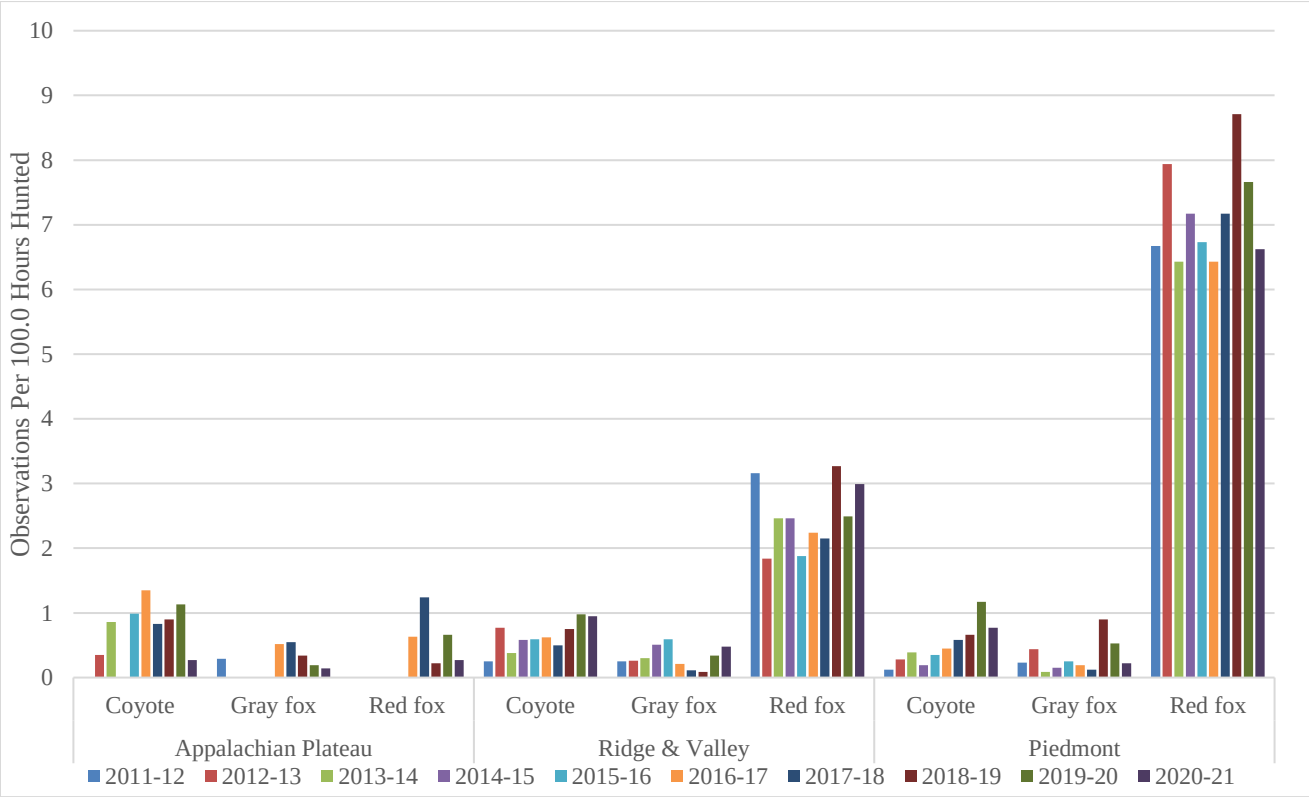

Figure 3. Canine observation rates by archery hunters in three Maryland physiographic provinces during the Maryland archery seasons (2011-12 – 2020-21).

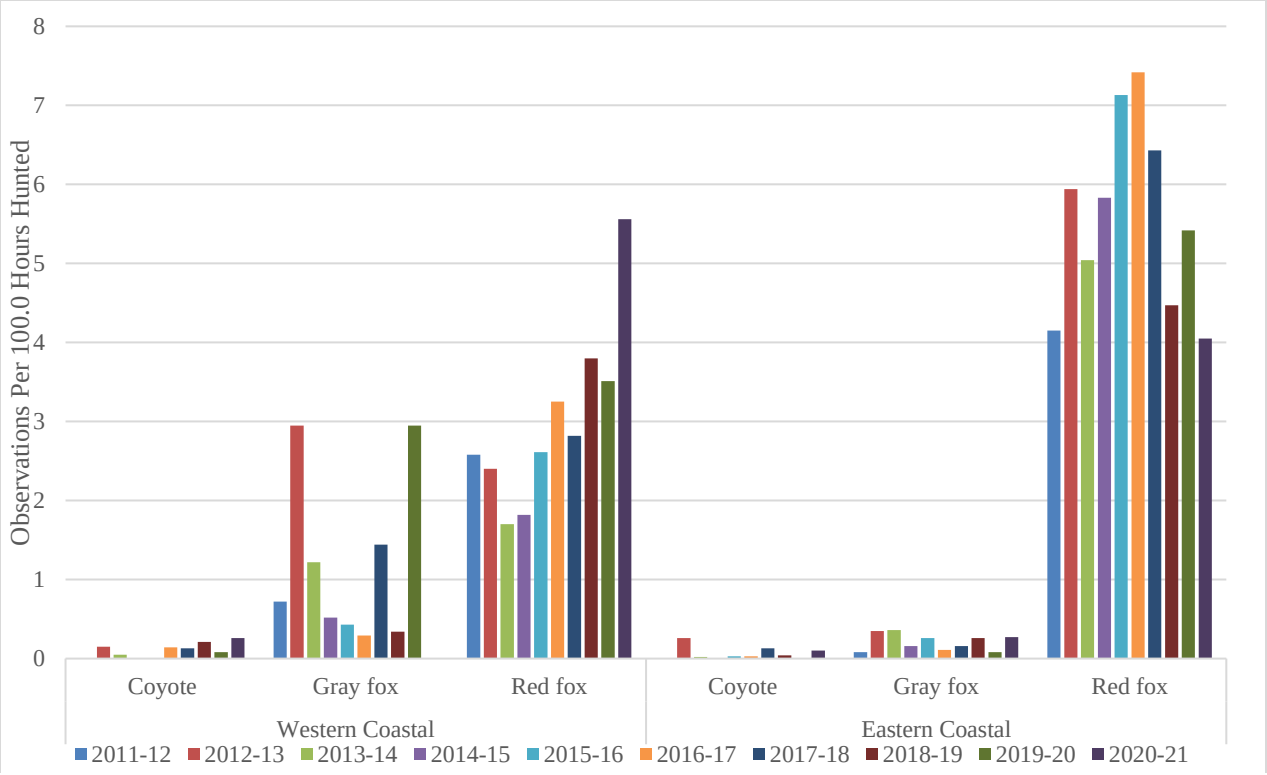

Figure 4. Canine observation rates by archery hunters in the two Maryland coastal physiographic provinces during the Maryland archery seasons (2011-12 – 2020-21).

Conclusion

Coyotes are classified in Maryland as furbearers. There is some interest in managing them as a 'nuisance' or 'varmint' species. History demonstrates that classifying wildlife species as 'varmints or nuisance' species effectively undermines the value of the species. Coyotes, like most wildlife, are public trust resources and an integral part of the state and regional natural system. They provide renewable fur resources and recreational opportunities to many hunters, and they serve important ecological functions to the ecosystem. DNR will continue to monitor coyote density and distribution trends closely and will continue to use regulated hunting and trapping to effectively manage the species in the future. DNR will also continue to monitor coyote conflicts with their human neighbors, domestic pets and livestock.

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Applicable webpages

Maryland furbearer management webpage:
https://dnr.maryland.gov/wildlife/Pages/hunt_trap/furbearer_management.aspx

Annotated code containing Rabies Vector Species language:
https://dnr.maryland.gov/wildlife/Documents/wdco_regs.pdf

Rabies testing and positivity rate in Maryland 2011-2020:
https://health.maryland.gov/phpa/OIDEOR/CZVBD/Shared%20Documents/2011%20to%202020%20Animal%20Rabies%20Percentages.pdf

Maryland house bill 293, 2021: *https://legiscan.com/MD/bill/HB293/2021*

Maryland senate bill 200: *https://legiscan.com/MD/bill/SB200/2021*