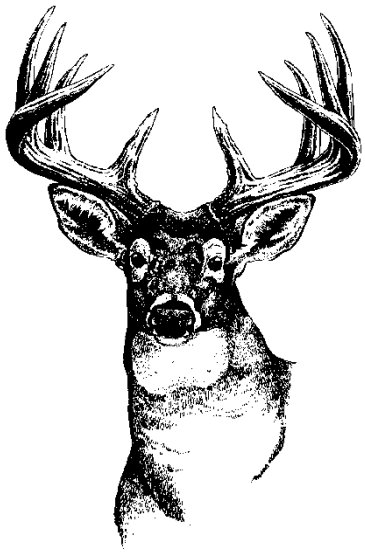
New Hampshire

WHITE-TAILED DEER ASSESSMENT

2015



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Introduction

The white-tailed deer is the most widespread, most abundant, most admired and most despised big game species in North America (with one or two possible exceptions). Its long history in New Hampshire and the diverse opinions and desires relative to deer populations and utilization make it necessary to have a consensus plan for guiding future management in the state. As human populations increase and society's desire for, and intolerance of, interactions with wildlife change, established management goals and objectives within the context of biological reality become even more critical. A population that is managed to remain between upper and lower limits that reflect both biological and social constraints is most likely to provide public satisfaction and ecological balance. Having said this, the difficulty in achieving it should not be underestimated (Woolf and Roseberry 1998).

Establishing plans and settings goals is now common practice in most jurisdictions and the processes and outcomes have changed a great deal in recent years. "The days of the lone biologist facing hundreds of angry hunters… are thankfully gone in most jurisdictions" (Williamson 2003). Although various agencies use different processes to arrive at a final product, ultimately a plan that benefits the resource and satisfies "constituents" is the desired outcome. However, the management agency "must still choose the responsible action" and public desires are "not a substitute for making hard decisions" (Williamson 2003).

The purpose of this assessment is to provide basic background information on deer and deer management in New Hampshire and to provide some insight into past, present and future issues that will likely impact deer management in the next decade. This information, as well as information derived from a wide variety of other sources will hopefully be of some assistance in planning for New Hampshire's future deer management efforts.

Natural History

The following information is largely derived from Halls (1984) unless otherwise noted. Deer are perhaps the most studied and written about wildlife species in North America. The scientific and technical literature, as well as popular books and articles associated with deer biology, ecology, behavior and management abound. It is the intent of this section to provide a broad overview of some of the pertinent information.

A. Evolution, Distribution and Description

White-tailed deer (*Odocoileus virginianus*) are the most widely distributed North American member of the deer family (Cervidae) that includes 17 genera and approximately 37 species worldwide. The genus *Odocoileus* appears to be of New World origin and today includes two species, *O. virginianus* and *O. hemionus* (mule deer and black-tailed deer).

The approximate range of white-tailed deer extends from the north shore of the Saint Lawrence westward to just north of Lake Winnipeg, into northern Alberta and British Columbia and to the Pacific Northwest. Southward its range extends through Central America into South America to about 15 degrees south latitude. In the U.S., white-tailed deer densities are generally highest east of the Mississippi River and they become less common to absent in the desert and Rocky Mountain west. Over this range there are approximately 30 sub-species with *O. v. borealis* present in the northeastern U.S. and Canada, including New Hampshire. New Hampshire's only other cervid species at the present time is the moose (*Alces alces*). Historically, caribou (*Rangifer tarandus*) and elk (*Cervus elaphus*) may have occasionally occurred in New Hampshire but these are thought to have been transients from the northeast and southwest respectively (Silver 1957).

The physical appearance of white-tailed deer is perhaps the most recognized of any North American wildlife species and needs little description. The spotted coat of fawns and reddish-brown coat of adult deer during summer give way in late summer to the more brownish-gray winter hair with its long guard hairs and shorter underfur for winter. White hair, in addition to being characteristic of the tail, is commonly found on the belly, chin and around the eyes and muzzle. In some individuals, and more rarely in some closed populations, additional white may occur in the pelage resulting in "piebald" deer. Rarely true albinos and melanistic individuals occur. Deer have evolved as prey species and their senses of sight, hearing and smell are acutely developed, as are various predator avoidance behaviors.

In white-tailed deer, like most cervids, adult males possess deciduous antlers that are shed each year in December and January and re-grown each spring beginning in March and April. Not only is this secondary sexual characteristic important to deer (and deer hunters), it is also of interest to deer managers in that antler development is related to deer age, nutritional intake and habitat quality (see next section). Deer breeding (the rut) in New Hampshire usually peaks about the second or third week of November with fawns typically weighing 4-8 pounds

being born in late May to early June following a 200-day gestation period. Female deer may become reproductively mature at about 6 months of age and be bred in their first fall although this is the exception rather than the rule in New Hampshire. Based on fall harvest biological check station information, about 10% of yearling does are lactating indicating that they were bred as fawns the previous fall. On average adult does have about 1.8 fawns per year in New Hampshire.

In general, the average dressed weights of adult females and males in New Hampshire are about 112 and 139 pounds respectively. Live weights are estimated to be approximately 30% higher than dressed weights. The weight of individual deer is dependant on age and nutrition but deer in excess of 200 pounds dressed weight are quite common in New Hampshire.

B. Habitat Use, Food Habits and Nutrition

As reflected by their widespread distribution, white-tailed deer are adapted to a wide variety of habitat types. While generally associated with and dependent on forests of one type or another, active and abandoned agricultural lands can contribute to deer habitat quantity and quality. One of the key characteristics of deer habitat use in the northern portions of white-tail range is the potential for distinctly different summer and winter ranges as deer move to deer wintering areas when snow depths increase and winter conditions become severe. Deer wintering areas are typically characterized by mature softwoods of various species (see Habitat Assessment below). Deer movements from summer/fall range to winter range may begin when snow depths approach 15 inches and can occur very rapidly, within 24 hours (Tierson et al. 1985). Work in New Brunswick has indicated that ambient temperatures may also influence movements to winter range. In the central Adirondack Mountains of New York, conditions which are similar to northern New Hampshire, movements between summer and winter range of 4-5 miles were common (Tierson et al. 1985) but range from less than 0.5 miles to over 25 miles (Lavigne 1999). Deer are strong swimmers and water poses little barrier to their comings and goings.

Home range size in deer is quite variable across their range and depends on habitat quality. Summer home ranges can vary from 100 to 2000 acres (0.15 to 3.13 square miles) while winter ranges tend to be smaller but more variable (Lavigne 1999). In the Adirondacks (Tierson et al. 1985), female home ranges were reported to average 546 acres (0.85 square miles) in summer and 326 acres (0.51 square miles) in winter. Male ranges tended to be larger and

averaged 576 acres (0.90 square miles) in summer and 371 acres (0.60 square miles) in winter. Adult males showed an increase in range size during the fall, likely related to breeding, and home ranges from October until movement to wintering areas occurred averaged 843 acres (1.32 square miles). The social structure of deer is matrilineal with female offspring generally establishing home ranges near their mothers while yearling male offspring disperse, and establish home ranges near unrelated deer minimizing the genetic problems associated with inbreeding.

Generally deer are crepuscular and exhibit activity peaks in the morning and evening. They are adaptable however and will change activity patterns seasonally and in response to many environmental variables or human activities. Environmental extremes, such as extreme cold, heat or wind tend to reduce activity levels. While the results of various studies of the impacts of human outdoor recreational activity on ungulate species including deer are mixed, winter activities such as snowmobiling and cross-country skiing should avoid deer wintering areas to minimize stress at that energetically critical time of year. During severe winters when deer remain confined to wintering areas into late winter and early spring, human disturbances such as shed hunting should be avoided until deer are able to disperse to summer range with the spring "green-up" (Joslin and Youmans 1999).

Deer are ruminants with the characteristic four-chambered "stomach" and its associated microbial symbionts that enable deer and other ruminants to digest and utilize fairly low quality forage including woody vegetation. While deer are considered to be primarily browsers, they are highly selective feeders and choose the most palatable and nutritious food sources available including herbaceous vegetation and mast of various types in addition to the buds, leaves and twigs of woody shrubs and trees. In spring with the flush of new growth, 67% of deer foraging may occur on herbaceous vegetation while only 10% is on woody browse. In summer the leaves of woody plants may comprise 46% of deer forage while herbaceous material can decrease to 17%. As winter approaches, the diet shifts more toward woody browse, with mast and fruit commonly used when available. Daily dry matter consumption varies greatly with animal age, sex and seasonal forage quality but nutritional demands are generally highest for females in the last trimester of pregnancy and while lactating. Both males and females increase forage consumption in the fall as they prepare for winter by "fattening up." There is a natural reduction in forage intake in the winter when food resources are of lower quality and generally scarcer.

This natural reduction in intake is offset by catabolism of the fat reserves deposited in the fall. Deer may enter winter with 25% of their body mass being fat reserves.

Nutritional problems for otherwise healthy deer are generally rare although in some areas of the country, such things as sodium, iodine or selenium may be scarce in some soil types. However, deer seem able to meet their requirements through selective foraging. Under-nutrition resulting from long confinement in deer wintering areas and exhaustion of fat reserves is the most common nutritional problem for deer. Body fat reserves below 5% indicate poor physical condition and impending "starvation". This may occur after about 100 days for fawns but adult deer, with their larger fat reserves and relatively lower energy demands, can survive longer.

C. Behavior And Physiology

Fawns tend to remain with their mothers for about a year with males typically dispersing at between 12 and 23 months of age. Females usually remain in the vicinity of their mother's summer range. Young bucks tend to associate with older mature bucks for much of the year forming bachelor groups or remain by themselves. Deer establish a dominance hierarchy when resources (particularly food) are limited. Mature bucks dominate the social hierarchy due to their greater size and strength and aggressive adult does rank next. Younger and/or less aggressive individuals are lower yet on the social ladder and fawns are typically least dominant. While this hierarchy may exhibit itself during confinement in deer wintering areas, even then animals are usually sufficiently dispersed to avoid serious problems. Under conditions where deer are competing for limited resources in very small areas, such as around deer feeders, serious aggressive interactions among deer may limit food availability to only the most dominant individuals.

The reproductive physiology of deer is primarily regulated by day length (photoperiod) but also by the physical condition of individual does. While breeding by deer may take place from October to January the peak of breeding activity in New Hampshire is typically about the second or third week in November. Younger does, especially female fawns, are rarely mature enough to be bred before mid-December or January if they breed at all. Females that are for some reason not bred during their first estrus will re-cycle at approximately 25-30 day intervals. However a recent study conducted by New Hampshire Fish and Game and the University of

New Hampshire indicates nearly 80% of adult does are bred during a three week period starting around mid-November (Fortin 2013).

The physiological basis of antler development is also tied to photoperiod and is primarily regulated by serum testosterone levels. Antler growth begins in spring (March-April) with males beginning to grow their first antlers at about 10 months of age. Antler, in contrast to horn, is composed of true bone and while growing is full of blood vessels and nerves and is covered by a hairy skin known as velvet. Antler growth continues through August-September when the bone hardens and the velvet dries up and is shed or rubbed off. Antler size is affected by numerous factors including a buck's age, genetics and habitat quality (primarily summer habitat). As mentioned elsewhere, the antler beam diameter on yearling bucks is a good indicator of deer population densities in relation to habitat quality. After the breeding season, testosterone levels decrease and the antlers are shed in December-January. About 1 in 900 does may also develop antlers due to congenital birth defects or hormone imbalances. These does are generally fertile and live normal female lives. More rarely true hermaphrodites (possessing both testicular and ovarian tissue) may occur but these individuals are almost always sterile.

D. Population Dynamics

Deer are capable of living about 15 years but rarely do in the wild. In New Hampshire, estimates suggest that for adult males, annual mortality rates average 40-50% and for adult females, 20-30%. Adult deer mortality factors include predators, diseases, vehicle collisions, winter related under-nutrition, hunting, old age and various other accidents or injuries. Fawn mortality rates, including neonatal mortality can be quite high. In Maine it is estimated that on average between one-third and one-half of all fawns born die between June and November (Lavigne 1999). Following severe winters, nutritionally stressed does may lose a high proportion of newborn fawns (reportedly as high as 93% in extreme cases) through a variety of factors. Stillborn fawns become more common, as do fawns which are too weak to stand, too small to reach teats or are simply abandoned by their mother. Predation on neonatal fawns can also be high with bears, coyotes, fox, fisher, bobcat and domestic dogs present in New Hampshire. In the absence of these various fawn and adult mortality factors, deer productivity is such that populations could increase at rates in excess of 30% per year and result in populations that could double in size in approximately 3 years.

Deer are considered to have some inherent density dependent population regulatory mechanisms. These are associated with decreases in fertility and survival as deer densities increase to levels high enough to negatively impact habitat quality. It is under these overpopulated conditions that other physiological indices such as yearling antler beam diameters begin to show serious declines as well. The main problem with these density dependent population regulatory mechanisms is that they are not effective at stopping deer population growth until considerable damage has been done to the habitat and habitat quality has been reduced or destroyed for a wide variety of species. Vegetative components of the ecosystem can be dramatically impacted as preferred browse species are reduced or eliminated and forest regeneration may be negatively affected. The issue of deer overabundance, and the biological, ecological, cultural, and management implications are reviewed in depth by McShea et al. (1997).

In New Hampshire, deer populations are controlled primarily through regulated hunting, winter mortality and predation. While regulated hunting typically accounts for the majority of deer mortality in New Hampshire, during very severe winters mortality can exceed 30% (Lavigne 1999). Other mortality factors are at work but play little role in population regulation. A summary of reported miscellaneous and accidental deer mortality in New Hampshire for 1987 through 2013 is given in Table 1. Over this period, the reported non-hunting mortality has remained relatively stable, at least in recent years. Vehicle collisions with deer (recently 1200-1400 per year statewide) have resulted in 3 human fatalities in the past 10 years (2005-2014). Two of the collisions involved passenger cars while one involved a motorcycle (G. Wilder, NH Dept. of Safety, Pers. Comm.).

Because deer have such high potential population growth rates while at the same time are subject to substantial and largely unpredictable mortality factors such as severe winters, efforts to manage deer populations, whether to increase them or decrease them, should be done cautiously and gradually to avoid unexpected or undesirable outcomes.

E. Diseases, Parasites and Competition

Like all animals, deer are subject to diseases and parasites although in New Hampshire and other northern areas of the country, these tend to be of less importance than in areas further south. The most commonly reported deer disease in New Hampshire is fibromas or skin tumors.

These growths can occur anywhere on the body but are most common on the head and neck. They are the result of a deer-specific viral infection and pose no threat to humans and only rarely cause the deer problems, especially in cases where they affect vision or feeding. Other viral diseases that can affect deer but have not been reported in New Hampshire deer include hemorrhagic disease (discussed further below), rabies and foot-and-mouth disease. Bacterial diseases do not have a significant effect on New Hampshire's deer although in other places anthrax and tuberculosis have been or are of significant concern. Not surprisingly other infections can occur as a result of various injuries and deer are also subject to various cancers.

Deer have their share of parasites although for the most part, these infections have little effect on the deer population and pose no risk to human populations. Most common in New Hampshire's deer are the meningeal helminth worm *Parelaphostrongylus tenuis* or brainworm. While potentially fatal to moose, deer are normal hosts for this parasite and are unaffected. Helminth muscle worms including *P. andersoni* also commonly infect deer. A third helminth parasite of deer in New Hampshire that is often reported by hunters is the large American fluke, *Fasioloides magna*, which is common in the livers of older deer. Deer are subject to a great variety of other helminth worms including various lungworms, stomach worms and intestinal worms but none of these helminth parasites render venison unsafe for handling or human consumption.

Deer can also carry numerous external parasites and while none of these affects deer populations, one of them is of special concern for its possible implications for human health. The black-legged tick, *Ixodes scapularis*, also known as the deer tick, is a known vector in the transmission of Lyme disease. While dog ticks (*Dermacentor variabilis*) are the most common tick in New Hampshire, black-legged ticks are found in much of southern and central portions of the state and appear to be expanding north. Black-legged ticks are only about half the size of dog ticks with adults being only about one-sixteenth of an inch long. Small mammals and birds are also competent hosts for black-legged tick larvae and nymphs although adult ticks most commonly parasitize large mammals, especially deer. While numerous factors are involved (including weather and alternate host populations), in general areas with higher deer densities are more likely to exhibit greater black-legged tick abundance and higher Lyme disease incidence rates in humans.

Hemorrhagic disease (HD) has been described as the most important viral disease of white-tailed deer. Outbreaks of HD often result in large-scale die-offs. The disease is caused by an orbivirus and is spread through biting flies or midges in the genus *Culicoides*. Because of the mode of transmission the disease does not appear to be density dependent and is not passed from animal to animal. Clinical signs of the disease vary and are dependent on the form of the disease (peracute, acute, or chronic). Death can occur within 1-3 days but often takes longer. Symptoms include lameness, loss of appetite, emaciation and lesions. Lesions vary and include severe fluid swelling (edema) of the head, neck, tongue, eyelids and lungs; hemorrhages in the heart, lungs, mouth, "stomach" or intestines; erosions or ulcers in the tongue, palate, and "stomach". Other signs include growth interruptions of hooves and sloughing of the hoof walls and rarely antler malformations occur. Deer are often found dead near water due to a high fever and dehydration. Fortunately, New Hampshire has had no confirmed cases to date. However, the disease has continued to spread over time. In 2001 HD had been documented in 27 U.S. states, presently it has been found in 43. The disease occurs seasonally in late summer and fall and coincides with periods of high midge abundance. Onset of freezing temperatures typically brings a sudden stop to HD outbreaks. Severity of the disease varies across its range. In some areas deer show signs of previous infection, but clinical disease and large die-offs are rare. It is believed that abundant midge populations in these areas and annual virus activity have resulted in immunity. In northerly states the disease is less common, but results in more large-scale outbreaks and die-offs. The disease has yet to be confirmed in any New England state. Die-offs are typically well below 25% of the population, but have been as high as 50% or more. Because NH has relatively low deer abundance, die-offs at even the lower end of the spectrum could have a large impact on deer numbers and/or recreational opportunities. There are currently no effective management options for prevention or control of HD.

A final potential disease threat to New Hampshire's deer is chronic wasting disease or CWD. A transmissible spongiform encephalopathy (TSE) related to mad cow disease, scrapie (in sheep), and Creutzfeldt-Jakob disease (in humans), CWD is known to produce always fatal infections in white-tailed deer, moose, mule deer, elk and a number of exotic cervids (deer). Current science indicates CWD is transmitted by an abnormal protein, called a prion, present in the nervous system and lymphatic tissue of infected animals. These abnormal proteins are very stable and may persist in the environment for several years, posing a risk to animals that come

into contact with them. These prions have been found in nervous system tissue, lymph nodes, saliva, urine, and feces among other places. The disease is believed to be spread through animal to animal contact and through contact with contaminated environments. CWD has been found as far east as New York and has been found in wild or captive deer or elk in 23 states and 2 Canadian provinces. New Hampshire Fish and Game is involved in cooperative efforts with the State Agriculture Department and the U.S. Department of Agriculture, Wildlife Services to prevent CWD from getting to New Hampshire through deer importation restrictions and monitoring and surveillance efforts. Since testing began in 2002 a total of 4,776 deer (1,736 females and 3,040 males) have been tested in New Hampshire statewide. None of these samples have tested positive for CWD. While not known to be a human health risk, CWD is considered by many deer managers to be the biggest potential threat to deer health. Other potential risks associated with the spread and transmission of CWD will be discussed further in the "Deer Management" section under "D. Current Management".

Competition between deer and other species in New Hampshire is limited to potential interactions with moose and snowshoe hare (*Lepus americanus*). This competition takes place in the form of overlapping food habits, particularly in the fall and winter (Pruss and Pekins 1992) when all three species primarily utilize woody browse. Moose heavily utilize woody browse in fall and winter and concentrate their activity in young regenerating stands and forest edges that in northern New Hampshire frequently occur in and near deer wintering areas. Because deer are confined to these areas in the winter, heavy moose utilization of browse can reduce its availability for deer. Pruss and Pekins (1992) estimated that moose browsing reduced wintering area browse availability for deer by 0% to 33% but the effect of moose browsing was contingent upon local moose and deer densities and was not impacting deer populations. Moose may even increase or prolong the availability of browse for deer by browsing at levels higher than deer can reach, or by breaking off the tops of saplings and hence stimulating re-sprouting of hardwood species (Lavigne 1999). It is unlikely that snowshoe hare have much impact on browse availability except perhaps in cases of extremely high local hare abundance (Lavigne 1999). The potential competition between moose and deer in more southern portions of the state is probably much reduced given lower moose densities and differences in the structure and location of deer wintering areas.

Deer Management

Deer have been perhaps the most important game species in New Hampshire since pre-colonial days. The reliance of Native Americans and the early colonists on deer for food and clothing greatly enhanced the early subsistence lifestyle of these first New Hampshire residents. Saunderson (1876) as quoted in Silver (1957) recognized that "hunting, in the infancy of our country, was the most profitable employment of its inhabitants" and while unstated this "profit" probably included aspects of subsistence, recreation, and "the market". Because of the general need of and desire for deer, they became one of the first wildlife species in New Hampshire to be managed in the conservation sense. However, deer management as it is known today took a long time to evolve and occurred in fits and starts over the course of the past 360 years or so.

A. Regulatory Authority

No clear regulatory authority exerted itself in New Hampshire during the early colonial period. Before 1641, "all evidence indicates that the right to make laws, or govern, was invested in no body…" (Silver, 1957). But by 1641, when incorporated with the Massachusetts Bay Colony (MBC), the four existing NH towns (Piscataqua, Dover, Strawberry Bank or Portsmouth, and Hampton) did have some form of local government. The Province of New Hampshire was established in 1679 with regulatory authority in the hands of a General Assembly. Wildlife "management" was among the first orders of business for this Assembly when it enacted bounties on wolves the very year it was created. While the Massachusetts Bay Colony imposed a deer season in 1698, New Hampshire was not at that time under MBC jurisdiction (Silver, 1957). However, the province of New Hampshire again reverted back under the jurisdiction of the governor of Massachusetts between 1689 and 1741. In that year (1741) it once again returned to Provincial status with its own governor. New Hampshire declared its independence from England in 1774 and statehood was officially established in 1788 when the Governor and General Court became the "regulatory authority" for the state.

During most of the period of statehood, regulatory authority rested with local and state government (the legislature and governor). The Fish and Game Department was officially established by enabling legislation in 1877 and a Fisheries Commission that had been established in 1866 was reorganized in 1880 as the "Commission of Fisheries and Game." Its purpose was primarily enforcement of laws passed by the legislature with an early emphasis on fish, and to

assist in revising fish and game laws. Deer seasons were set annually by legislative action (with biological input) up through 1979 when deer season setting authority was granted to the Fish and Game Department. This law however required re-adoption every 2 years until 1991, when the biennial re-adoption requirement was dropped.

Current regulatory authority for deer management in New Hampshire stems from Title XVIII (Fish and Game) of New Hampshire's Revised Statutes Annotated (RSA) and the following excerpts and discussion are drawn from New Hampshire Fish and Game Laws Annotated: 2012-2013 Edition (2013). The Fish and Game Department (henceforth the Department) as currently structured is generally described under RSA 206. The Department is established under RSA 206:1 and the responsibility of the Executive Director of the Department "… to protect, propagate and preserve the fish, game and wildlife resources of the state…" is established in RSA 206:10. This responsibility includes the "power and authority to adopt and enforce rules, pursuant to RSA 541-A, for the adequate and effective control, management, restoration, conservation and regulation of the fish, game, bird and wildlife resources of the state." This includes "the right to open and close the season for taking fish, game, birds and wildlife, the right to fix the size, number and weight limits, and other conditions governing the method and manner of taking…."

Perhaps more than any other species, numerous specific chapters of state law enable, influence or regulate current deer management authority in New Hampshire. The Department's authority to specifically manage deer in New Hampshire is derived from RSA 208:2 which gives the Executive Director "… the authority to open and close the seasons for the taking of wild deer, to fix the number and sex limitations for wild deer, and any other conditions governing the methods and manner of taking and reporting of the same…." The degree of interest in deer management is hinted at by the fact that the history of this section of New Hampshire's statutes, which are documented back to 1935, reveal that this section has been amended 18 times since 1935. Table 2 provides a brief summary of some additional state statutes which effect current deer management authority in New Hampshire.

In many cases, the state laws outlined in Table 2 are simply enabling legislation which grants various aspects of the authority for deer management to the Executive Director under the state's rulemaking process (see RSA 541-A). These administrative rules, promulgated under the authority of the Executive Director of the Department, more often than not contain the detailed

information that implements deer management efforts in New Hampshire. The administrative rules that regulate deer management in New Hampshire are generally contained in Chapter Fis 300 of the New Hampshire Code of Administrative Rules. Part Fis 301, Sections Fis 301.03 through Fis 301.041 provide the majority of rules regulating the hunting aspects of deer management in New Hampshire. Part Fis 304 addresses "Wildlife Damage" in general with Sections Fis 304.02 to Fis 304.06 at least mentioning deer in one context or another. Part Fis 307 addresses "Baiting Wildlife" in general with Section Fis 307.03 specifically addressing baiting of deer. Part Fis 309 addresses issues associated with "Wildlife Disease" and Section Fis 309.01 specifically addresses the threat posed to New Hampshire's cervid populations (including white-tailed deer) by chronic wasting disease (CWD) due to the importation of potentially infected cervid carcasses or parts thereof from other jurisdictions.

The combination of state statutes (of legislative origin) and administrative rules (of Department origin, under the authority of the Executive Director) which implement them serve as the legal means of deer management, or perhaps more accurately, hunter management in New Hampshire.

B. Past Goals And Objectives

Existing historical records suggest that in the past 40 years (i.e., since 1975), six (6) management plans for white-tailed deer have been developed, at least to the "draft" stage. The approximate dates for these plans were 1975, 1980, 1987, 1990, 1997, and 2006. It is unclear whether any of these plans were ever formally adopted or implemented (except the 1997 and 2006 plans). The author cannot find an extant copy of the 1975 or 1987 plan, and the 1990 plan only reached the "draft" stage before the planning process was apparently abandoned. In spite of this, at least limited information on the contents of these plans was found in various sources. The 1997 plan was implemented following acceptance by the Commission and Executive Director and guided deer management from 1997 through 2005. The 2006 plan was implemented following acceptance by the Commission and Executive Director and has guided deer management through its goals and objectives from its approval in 2006 and will be in effect through 2015.

The objectives of the 1975 plan were not deer population oriented but rather were oriented toward deer management information needs and were reviewed in the 1990 Draft Deer

Management Plan (NHF&G 1990). Specifically the plan called for up-to-date "inventories" of deer information including deer populations, hunting pressure, harvest, habitat and the impact of deer hunting on New Hampshire's economy. These objectives were "achieved" by developing specific Jobs within the deer federal aid project to address these information needs.

The "Management Plan for White-tailed Deer" completed in 1980 (NHF&G 1980), was written at a time when deer harvest had fallen rather dramatically from in excess of 12,000 in 1967 and 1968 to fewer than 5,000 in 1979 and hunter dissatisfaction was likely high. This report's "Situation Analysis" succinctly, if not under-states this by recognizing that "in recent years, New Hampshire's deer harvest has been decreasing", although from a deer harvest point of view, the worst was yet to come. The introduction to this plan clearly states that it is a draft plan and following a period of review, public input and revision, will be endorsed as Department policy. It is unknown just how far this process of review, public input, revision, endorsement, and implementation as Department policy actually got. At that point in time, deer seasons, bag limits and methods of taking among other things associated with the deer season(s) were still under the control of the legislature.

The "Objectives" of the 1980 draft plan (based on today's terminology, this highest level of criteria would more appropriately be referred to as goals) included the following: "1) to maintain a healthy and productive deer population at a density compatible with the carrying capacity of the habitat and changing land use patterns, 2) to provide an annual harvest surplus of deer compatible with the existing deer densities, 3) to influence land use to maintain winter habitat in good condition to winter a herd of 40,000 deer." In a nutshell, the "Situation Analysis" concludes that deer harvest had decreased in the last 13 years, the number of hunters, while variable, had remained relatively constant, that hunter success had declined greatly and that deer populations around the state ranged from "good" in some southern and eastern sections to "poor" in the northern section.

More specifically, the situation analysis pointed out that: 1) deer densities were lowest (as measured by kill per square mile) in Coos, Grafton and Hillsborough Counties, 2) deer habitat was being lost through "excessive" cutting of winter cover, development, and other construction activities, 3) the public was not adequately informed regarding the deer situation, 4) hunting opportunities continued to decrease and 5) free-running dogs were a serious problem. Many of the "objectives" from the previous paragraph, as well as the previously mentioned specifics from

the situation analysis from the 1980 draft deer plan likely sound familiar to those acquainted with today's wildlife management issues in New Hampshire.

The proposed 1980 goals (or objectives in today's usage) were: A) to provide an annual harvest of 9,000 deer annually with a 10% success rate by increasing the deer herd in Coos, Carroll and Grafton counties and maintaining deer populations in other counties, and B) expand efforts to communicate deer research findings and management techniques to the public. Several strategies and management techniques were outlined to aid in reaching those goals. These are briefly summarized under the following headings: 1) seek legislative changes and support, 2) improve habitat, 3) continue deer monitoring programs, 4) expand information and education program, 5) acquire land, 6) increase Conservation Officer time related to deer issues, 7) "manipulate" deer seasons and 8) review existing programs. Many of the components of these strategies and management techniques appear to have become reality over the past few decades, although it's not clear that this draft plan was the primary impetus for these changes.

A copy of the 1987 plan could not be found but its major objectives were described in the 1990 Draft Deer Management Plan (NHF&G 1990). These objectives included: 1) maintain a healthy productive population compatible with habitat carrying capacity, 2) provide an annual harvest of antlered deer compatible with existing deer densities, 3) provide an annual harvest of antlerless deer compatible with existing deer densities and deer density goals. The main strategy for the achievement of these objectives was the regulation of antlerless kill on a Wildlife Management Unit (WMU) basis. This plan was likely developed in response to drastic decreases in the deer harvest (and population). The total statewide deer kill in 1983 was 3,280, the lowest documented harvest since 1937. Undoubtedly, public pressure and recognition of antlerless deer overharvest led to significant changes in the deer management program including such things as "either-sex days" and WMUs. While the specific population goals mentioned in objective 3) above are unknown, the most probable goal was to increase deer numbers to previous (or at least higher) levels.

The 1990 Draft Deer Management Plan (NHF&G 1990) is incomplete and portions remain in outline form. In all likelihood, this plan received little public input at best and was never formally accepted and implemented. The deer population management goal was to "allow deer populations to stabilize at desired densities by regulating antlerless kill though any-deer season length." At that "desired density" the estimated deer harvest was projected to be as given

in Table 3 on a WMU specific basis, resulting in a statewide annual harvest of 9,468 (5,917 male and 3,551 female). A habitat related goal was to maintain and promote recovery of deer wintering areas. Several problems or issues were also identified in this draft plan as well. These included the need for understanding the interaction and effects of winter severity, harvest rate and predation on deer populations; the effect of development on deer and deer hunting; public health concerns (especially Lyme disease) and potential nuisance issues.

The 1997 plan, "1997-2005: Managing Deer, Moose and Bear in New Hampshire" (NHF&G 1997) was the first long term and operational plan for deer and other big game species management in New Hampshire. Several assumptions were included in this plan as guidelines for deer management and in brief included 1) deer populations will be scientifically managed to achieve population goals considering Department and public input, 2) recreational hunting will be the primary population management tool, 3) a regulated antlerless harvest will be used to achieve population management goals and 4) an "equitable or balanced allocation" of the deer resource among hunting interests will be an objective. WMU specific deer population management goals for deer were developed in terms of a target adult buck kill, an efficient index to deer population. These targets were constrained within upper and lower limits (or "sideboards") to insure that goals did not jeopardize a viable and genetically secure population at the lower level or exceed the estimated habitat carrying capacity or cultural carrying capacity (the public's willingness to tolerate deer). Table 4 presents the WMU specific goals from this plan. When at goal, the statewide adult buck harvest would reach 7,568.

The state's current deer management plan, "New Hampshire Big Game Plan: 2006-2015" (NHF&G 2006) incorporated many of the same assumptions as listed in the 1997-2005 plan above. As in previous plans public input was incorporated in its development. A public working group of 30 key wildlife stakeholders was formed, and with input and guidance by department staff, the group identified key management issues and regional species goals and objectives. Population objectives were designed with the goal to "regionally manage white-tailed deer populations by balancing and incorporating social, economic, ecological and public safety factors using the best available science/knowledge". As in the 1997 plan these regional population objectives were set in terms of a target adult buck kill, constrained within upper and lower limits. However, these sideboards were mathematical limits set due to variation in the data rather than biological or social constraints. When the adult buck kill for a specific WMU falls

within these "sideboards" the population is considered "at objective". Table 5 presents the WMU specific objectives for this plan. When all WMU specific objectives were met, the statewide adult buck harvest would reach 7,265.

While expressed in various terms over the years, there has been a general tendency for succeeding plans to strive for somewhat higher deer numbers (and harvests), at least on average statewide with the exception of the current plan (NHF&G 2006). The 1980 plan (NHF&G 1980) called for the achievement of a statewide deer harvest of 9,000 while the 1990 plan (NHF&G 1990) established a total harvest objective of 9,468, 5,917 males and 3,551 females. The 1997 plan (NHF&G 1997), expressed in similar terms and if objectives were achieved, would result in a total statewide harvest of about 14,032, 9,084 males (7,568 adult bucks) and 4,948 females. The 2006 plan was the first plan with a lower overall population goal than preceding plans with a statewide adult buck kill of 7,265. However, over the course of the plan (2006-2015) the objective in nearly all WMUs was to increase deer populations from current levels. All of these plans operate under the assumption that if and when objectives are achieved, they would be sustainable, recognizing that local and annual variations are unavoidable, and given no dramatic long-term changes in non-harvest mortality rates or habitat quality.

C. Past Management

The material in this section has been primarily adapted from Silver 1957 and/or NHF&G 1990. Other information has been drawn from various Federal Aid reports.

The pre-colonial Indians of New Hampshire undoubtedly altered their environment and deer habitat through their removal of trees for agriculture and firewood. Some evidence exists that Native Americans cleared land specifically to improve habitat for deer. Early forms of deer population management have also been ascribed to the Indians although at least some of them were incidental. A family hunting-ground system reportedly served to "regulate killing so as not to deplete the stock" and hunting of young animals, i.e. in summer, was uncommon, although this arose mostly because summers were spent fishing. Some have even suggested Indian antlerless harvest restrictions in that some Indian middens have been found to contain the skulls of predominantly male deer.

The colonial period saw deer management in New Hampshire slowly develop. Figures 1 and 2 illustrate the "deer seasons" in Coos County and the rest of New Hampshire respectively

from 1739 through 1948. It was not until 1740 that New Hampshire saw the first closed seasons on the taking of deer, and while these regulations varied over time during the colonial period, season closures were easy to ignore. The deer season closure of 1740 however makes deer the first "protected" species in New Hampshire. This closed season also resulted in the establishment of the first "conservation officers" in the state by requiring that towns hire deer inspectors, called reeves, to search houses for the illegal possession of fresh venison or deer hides. There is no existing evidence however that the reeves ever exercised their powers of search and seizure or that anyone paid much attention to the closed deer season.

Deer seasons were established, modified and repealed repeatedly throughout the early to mid-1800's but there was no enforcement unless taken up by local authorities. The reasons for these shifting seasons are largely unknown but were likely tied to changing deer numbers and/or changing politics. Ironically, in 1783, during a period of restricted seasons (Figure 2), the town of Andover was paying a $5.00 bounty for each deer killed by a town resident. In another case, 1830 saw the reappearance of wolves in Coos county and it was determined that the best way to get rid of the wolves was to eliminate the deer, and hence from 1831-1856 all season restrictions were removed, leading to "unprecedented slaughter." The New Hampshire Fish and Game Department was originally created in 1865 as the Fisheries Commission, but was reorganized as the Commission of Fisheries and Game in 1880 and 169 wardens were elected in 1883 to enforce fish and game laws. By that time however, most game, including deer, was so rare that it was hard to find anything to kill, even out of season. Additionally, the new Fish and Game Department placed an emphasis on fish, not the welfare of game.

During the period they were under legislative control, changing the deer seasons was "a favorite political pastime" and no matter how good or bad the existing laws were, they would likely be changed the next legislative session. The net result was that no regulations remained in effect long enough to do much good or much harm. The rate of change and confusion was so great that for 8 years, separate laws both permitted and prohibited deer hunting in Cheshire County at the same time, "a policy which, for once, must have satisfied everyone." In spite of this, and largely the result of factors not related to deer management per se, deer numbers gradually began to increase.

Throughout the mid- to late 1800's the only real deer management revolved around the length of the seasons, there were no other limits on the taking of deer. This began to change in

the late 1800's. The state Fish and Game Department began to take an interest in game law enforcement in 1891 with the hiring of "detectives" to prevent the killing of deer in deep snow. The first bag limit for deer was established in 1891 and set at 3 deer per year. This same year saw hunting deer with the aid of dogs limited to September 15 through November 1 and hunting deer with the aid of dogs was prohibited 4 years later in 1895. In 1897, jacks (lights used to aid in night hunting), snares and traps were prohibited for the taking of deer and in 1899 the bag limit on deer was reduced to 2 per year.

The first hunting licenses in New Hampshire were legislatively mandated in 1903 with the requirement that non-resident deer hunters purchase a $10.00 license. Not surprisingly, at least in retrospect, while non-residents continued to hunt in New Hampshire, very few seemed to be hunting deer that fall and the law was amended in the next legislature to require that licenses be purchased by all non-resident hunters, regardless of species hunted. Resident licenses were required in 1909 ($1.00). While the funds generated were by no means all used for fish or game management (most went to the state), the Fish and Game Department did see increased budgets through legislative appropriations. In 1911 the bag limit for deer was reduced to 1 per year in the southern 7 counties while it remained at 2 per year in Carroll, Coos and Grafton Counties. This was further restricted in 1921 when Grafton County joined the other 7 southern counties with a bag limit of 1 (while Carroll and Coos remained at 2). Mandatory reporting (via a mail in card) of deer killed by hunters was first required in 1922. This same year saw the establishment of what would later become known as the "deer line", a moving boundary which was used to distinguish northern and southern portions of the state for the purposes of deer hunting regulations. The bag limit was reduced again in 1925 with the establishment of a 1 deer general bag limit statewide. Little changed (with the exception of season dates) until after World War II.

Table 6 summarizes the general breech loading firearm deer seasons from 1949 to present. The period from 1949 through 1963 saw relatively consistent firearm deer seasons, the month of November in the north and December in the south, with the exception of 1963 in which the season lengths were modified somewhat when a statewide season was added. Although variable, the "deer line" which divided north from south generally placed Coos, Carroll and Grafton Counties in the north and the rest of the state in the south. The period from 1964-1971 saw perhaps the simplest deer seasons the state had seen since the early colonial days (open or closed) with a statewide season that ran from 22 to 26 days starting in mid-November. In 1967,

the mandatory reporting of harvest by mail was replaced by mandatory registration and sealing at a series of deer registration stations. About this time a series of severe winters, particularly the winters of 1969-70, 1970-71 and 1971-72, resulted in higher winter deer mortality and lower productivity (of fawns) and, combined with unrestricted antlerless harvests, led to reductions in deer numbers statewide.

The north/south split was brought back in 1972 and seasons were shortened. The period from 1973 through 1978 saw the replacement of the north/south split with a resident/non-resident split, with resident hunters getting a few extra days of deer hunting at the end of the season. The winter of 1977-78 was again unusually severe and deer numbers again declined. North/south and resident/non-resident season splits were in effect in 1979 and 1980 and seasons were again somewhat shortened. Throughout this period, going back to colonial days, no regulations regarding the age or sex of the kill were instituted, with the exception of a short lived prohibition on killing fawns from 1901 through 1904. It seems to have finally become apparent that some method of limiting the kill of does through regulation of the antlerless harvest was necessary to protect the "productive" portion of the deer population and stimulate population growth and recovery. The 1980 and 1982 seasons saw the establishment of a "permit area" in southern Grafton County (Table 6) in which antlerless deer could be taken by permit only. The north/south split remained in effect in the rest of the state with rather short "any deer" seasons. By 1982, the "deer line" had migrated north and the north area included Coos County and only the northern portions of Grafton and Carroll Counties.

The winter of 1981-82 was again severe and resulted in high deer mortality. The 1983 season saw an increasing effort to limit the antlerless harvest by limiting the north and south areas to 5 days of "either-sex" hunting followed by antlered bucks only for the remainder of the season. This year (1983) saw the lowest documented deer kill in the state since 1937. While this was in part due to restrictions on antlerless harvest, the estimated adult buck kill of 1,670 in 1983 was the lowest since 1939 (1,641) indicating a real bottoming out of the state's deer population. The north/south split was eliminated for the 1984 season and seasons from 1984 through 1986 were statewide with limited numbers of either-sex days followed by bucks-only hunting till the end of the season. The 1987 season saw the beginning of the existing management methods and is taken up in the section on Current Management below.

It is important to note that since 1949, only the period from 1949 to 1963 saw distinctly different seasons with different opening dates in different portions of the state (i.e. north/south). The multiple opening day "phenomena" can substantially increase hunting pressure in both areas. Since 1964, opening dates for the regular firearm deer seasons have been the same statewide, only closing dates differed between north/south or resident/non-resident splits.

Along with the regular breech loading firearm deer seasons described above, 1949 saw the state's first archery season and 1963 saw the creation of a muzzleloader season. Since their inception, the archery season has permitted the taking of a second deer through the issuance of a deer tag which comes with the archery license while the muzzleloader license has required the use of the deer tag which comes with a regular hunting (or combination) license and hence does not permit the taking of a second deer.

From 1949 through 1959, the archery season was also split along the north/south "deer line" and ran for 10 days, in late October in the north and late November in the south. The period from 1960 through 1962 saw a similar framework with the season lengthened to 20 days. In 1964 to 1966 the archery season was statewide and 20 days in length beginning in late October and was lengthened to 40 days beginning October 1 in 1967. The October 1 opening remained in effect through 1980 with the season being shortened to 31 days between 1973 and 1980. The opening of the statewide archery season was changed to mid-September in 1981 and ran from 83 to 96 days between 1981 and 1986. The archery season from its inception in 1949 through 1986 was an "any deer" season. Seasons from 1987 to present are discussed in the Current Management section that follows.

The muzzleloader season has also varied a great deal over the years. In 1963 and 1964, it was 1 day, the 11th of November. The period from 1965 through 1968 saw the season open in early November and run for 3 days. Beginning in 1969, the season was lengthened to 10 days and opened in early October from 1969 to1972 and late October from 1973 to 1980. A statewide split season was put in place in 1981 and ran for 5 days in late October through early November, and then opened again for 5 days in mid-November. The season began opening in late October in 1982 and ran 11 days that year, 7 days in 1983, and went back to 11 days in 1984. Like the archery season, the muzzleloader season from 1963 through 1986 allowed the taking of "any deer". The recent seasons (1987 to present) will be discussed in the Current Management section.

The general history of past deer management in New Hampshire has been one of struggling to maintain or increase deer numbers in the face of periodic severe winters and over-harvest of antlerless deer. Mercifully, this spared New Hampshire the more serious problem (from a deer management perspective) of over-population and the resultant habitat degradation and public complaints. In the past (prior to 1987) there have been limited cases of deer over-populations that were variously dealt with. While over-population concerns are discussed in more detail in the next section, a brief summary of past efforts will be given here. The first "problem area" to be addressed appears to have been Bear Brook "Refuge" (now state park). This was dealt with through lengthened archery seasons from 1956 through 1966. Seasons there were generally 10 to 11 days longer than in the rest of southern New Hampshire. Long Island in Lake Winnipesaukee became an issue in the mid-1960's and special archery seasons were held in 1966 (6 days) and 1967 (2 days). Rattlesnake Island (also in Winnipesaukee) saw a 4-day archery season and a 4-day muzzleloader season in 1968.

It's probably a reasonable bet that hunter (and perhaps public) satisfaction with deer management bottomed out about 1983 or shortly thereafter with the decline in deer harvest. This likely resulted in the changes in deer management from 1983 through 1987 and ushered in what could be considered the current deer management program.

D. Current Management

Information for this section has been drawn primarily from various Federal Aid reports or represents information provided by the author unless otherwise noted.

Among the many changes made in deer management for the 1987 season was the establishment of Wildlife Management Units (WMU). In 1987 there were 13 of them across the state (labeled A through M). They were established using definite and easy to locate boundaries (that were necessary for law enforcement purposes) and the 13 original WMUs were designed to encompass areas of similar potential deer range, at least to the extent possible. The boundaries of these WMUs have shifted somewhat over the years and in some cases WMUs have been split when habitat, deer populations or other factors made this desirable for effective deer management. At present, there are 20 WMUs around the state (see Figure 3) that range in size from 116.4 square miles (total land area) in WMU-D2E to 929.3 square miles in WMU-J2.

Prior to discussing current management in detail, it's necessary to briefly explain the use of harvest to regulate deer populations, at least in a general sense. It is the adult doe segment of the deer population that is the driving force behind deer population change. The number of fawns a doe produces depends on such factors as doe age, habitat quality and winter severity, it is these fawns which are "recruited" into the adult population and result in increasing deer numbers and densities. The harvest of adult bucks has little if any long term effect on deer numbers, provided adequate numbers are around to insure does are bred. Harvest of adult does is necessary to reduce herd productivity and cause populations to stabilize or decrease over time (assuming winter mortality and predation are insufficient to do the job). As outlined in the current management plan, strategies for most WMUs around the state are designed to encourage slow population growth in an effort to reach the existing population objectives. Slow growth generally requires some harvest of adult does.

Deer are handy in that antlers provide a secondary sexual characteristic that allows hunters to identify adult males (most of the time). Because adult females cannot readily be distinguished from fawns (both sexes lack visible antlers at 6 months of age), managers typically regulate the "antlerless" harvest (which will include male and female fawns in addition to adult does) in an effort to control the adult doe kill. This "antlerless" harvest regulation is also far easier from a law enforcement perspective. Hence, adjusting the antlerless harvest in relation to the adult buck harvest allows managers to reduce, stabilize or increase deer populations.

Current New Hampshire deer seasons (regular firearm, archery and muzzleloader) are now generally generic with the antlerless harvest regulated by various numbers of either-sex hunting days at the beginning of each season. Although the reasons are unclear, the permit method of regulating the antlerless kill, as was used in the "permit area" in 1981 through 1983 was abandoned in favor of either-sex days. As attempts have been made to achieve existing deer population objectives by limiting antlerless harvest, the problems associated with either-sex days have become increasingly apparent. The desired antlerless deer harvest necessary to regulate population growth is difficult to accurately achieve with limited either-sex days due to the uncertainties associated with hunter movement and hunting conditions during these brief periods of time. This tendency to over- or under-harvest antlerless deer results in greater variability in harvests and increased difficultly in achieving management objectives.

It is interesting to note that Maine was facing a similar desire to reduce antlerless harvests in an effort to increase populations and also implemented either-sex day restrictions during the 1983-1985 Maine deer seasons. While it was found effective in reducing doe harvests "this management practice failed to produce consistent results" (Lavigne 1999). By 1985 Maine had abandoned either-sex day management and its resultant uncertainties and implemented an any-deer permit system for antlerless harvest regulation in 1986 that is still in use today (Lavigne 1999). In New Hampshire, this transition to a more predictable system of regulating antlerless harvests either was not or could not be made and either-sex days have persisted to the present time. While deer permit systems tend to be more accurate and predictable from a management standpoint than either-sex day systems they can be met with resistance from the public and are not without uncertainties of their own. Many hunters view permit systems as "unfair" as they are often implemented by a lottery system of some sort and not all hunters are guaranteed to obtain a permit every year in the WMU of their choice. Also, in WMUs that currently have limited either-sex hunting opportunity permit issuance would likely be minimal with permits numbering less than 100. From a pure cost-benefit perspective, while permit systems provide many benefits over either-sex days, the latter can be implemented at little to no cost.

As noted above, managers use regulation of the antlerless harvest to control the adult female harvest. While it varies somewhat, adult females comprise a relatively constant proportion of the antlerless harvest. Experience has led to estimates of the adult harvest sex ratio (AHSR), or the number of adult females harvested per 100 adult bucks harvested, that will stabilize populations. A harvest of adult does in excess of this stabilization AHSR will result in population decreases while a harvest of adult does less than the stabilization AHSR will result in population increases. Each WMU has its own estimate of stabilization AHSR, since the adult doe harvest necessary to stabilize the population is dependent on local factors such as productivity (fawns born per female), the impact of non-harvest mortality on recruitment (survival of fawns to adulthood) and adult survival. Precise attainment of the desired ASHR to achieve the management goals, whether they be to increase, stabilize, of decrease the population, is difficult using either-sex days since short-term local changes in hunting pressure and hunting conditions (such as weather and food availability) can greatly affect the antlerless (and consequently the adult doe) harvest over a period of a few days in unpredictable ways.

The regular breech loading firearm seasons since 1981 have begun on the first or second Wednesday of November and have been 26 days in length since 1984. The season was standardized in 1995 to 26 days beginning the second Wednesday in November. This consistency enabled hunters to better plan for the upcoming deer season while allowing administrative rules to be written in a generic way, reducing rulemaking effort. Since 1987, seasons have included various numbers of either-sex hunting days starting at the beginning of the season (this has ranged from 0 to 12 days in various WMUs and years).

The archery seasons from 1987 through 1992 were either-sex statewide and varied from 86 to 93 days beginning in mid-September. In 1993 the length of the season was established at 92 days beginning on 15 September statewide and was either-sex. From 1996 through 1999 however, three Wildlife Management Units (C1, E and F) were made bucks-only in an effort to stimulate population growth (all seasons were bucks-only for this 4 year period in these WMUs). A statewide either-sex season was again reinstated in 2000 but beginning in 2001, following a severe winter, various WMU specific restrictions on either-sex days were put into effect during the 92-day season and were in place through 2003. The 92 day statewide either-sex season was reinstated from 2004 through 2006, then in 2007 the season in WMU A was shortened by one week (85 days) to address adult buck age structure concerns. A 2-point minimum (on one side) antler point restriction (APR) was also instituted in WMU A throughout all seasons from 2007 through 2009. Concerns over the genetic consequences of the 2-point minimum APR in WMU A resulted in its removal for the 2010 season. In recent years, the buck age structure has again returned to normal level. From 2010 through 2011 various WMU specific restrictions on either-sex days were again put into effect during the archery season due to a severe winter in 2007-08 and its residual effects which further reduced deer populations below objectives. In 2012 the season was returned to either-sex for its entirety, statewide, till the present.

The muzzleloader season since 1984 has been the 11 days immediately preceding the regular firearm season and was either-sex statewide between 1987 and 1995. The muzzleloader season was bucks-only in WMUs C1, E and F between 1996 and 1999 and since 2000, either-sex days have varied between 0 and 11 on a WMU specific basis.

Additional opportunities for hunters have also been provided in recent years. In 1997, a special archery permit was made available that allowed the taking of an additional deer of either-sex statewide. Historically, the success rate of bowhunters was low and this second permit

provided increased recreational opportunity, had negligible impact on the deer population, and provided revenue that the Department needed to offset wildlife damage payments. These permits were either-sex through 2000. Following a severe winter in 2000-2001, the permits were changed to buck-only and have remained this way through the present. Since these permits became buck-only in 2001 roughly 9,000 permits are sold each year on average with an average total kill of about 460 deer per year. This equates to roughly a 5% success rate for hunters who purchase a special archery permit. Of the 5% of successful hunters only about 2% fill both their archery and special archery tags.

A second opportunity for taking an additional deer came about in 1997 in WMU-M. Efforts to stop deer population growth in that Unit, as prescribed in the 1997 deer management plan (NHF&G 1997), had previously been unsuccessful, in spite of either-sex hunting through the entire archery and muzzleloader seasons, as well as the first 10 days of the regular firearm season. In 1993, 12 days of either-sex firearm hunting were permitted but complaints arose as a result of high hunter pressure on the 11th and 12th day (a Saturday and Sunday). Additional antlerless harvest was necessary in this part of the state to stop population growth and in 1997, 400 Special Unit M Antlerless Permits were issued by lottery to increase the doe kill. As experience with these permits was gained, their numbers were increased to 1000 in 1998 and 1999, 3000 in 2000, and 5000 from 2001 through 2003. From 2004 through 2005 permits were reduced to 3,250 after a slight decline in the Unit M deer population. As the Unit M population began to grow again permits were increased to 5,500 from 2006 to 2007 and to 6,000 from 2008 to 2009. This higher number of permits led to concerns over increasing hunter density in Unit M and associated safety issues as well as a potential increase in posting of land. Starting in 2010, a total of 4,000 hunters were allowed to purchase Special Unit M permits. At the time of purchase, hunters had the option of purchasing permits with 1 or 2 tags. This method of permit issuance was implemented in an effort to reduce the number of hunters with permits from 6,000 to 4,000, while still issuing approximately 6,000 tags. This method of permit issuance was in place through 2013. These special permits have somewhat stabilized the Unit M deer population. However, the population has exhibited slow growth since 2010. Starting in 2014 up to 4,000 permits were issued in Unit M, however, all permits now came with 2 tags and there was no longer a 1 or 2 tag option. This change was initiated in an attempt to further increase harvest levels without further increases in hunter density in the unit.

Another opportunity to take additional deer was initiated in WMU L in 2014. The deer population in this unit had been relatively stable at or near its objective for several years. However, within the last 4 years the population has grown substantially and is currently above objective. This rapid population growth was aided in part by several winters of well below average severity during this time period. In attempts to slow growth and return the population to objective up to 500 special antlerless only permits were issued in WMU L for the 2014 season. These permits are similar to the WMU M permits and were sold on a first come first served basis. Hunters had the option of purchasing either or both tags.

With few exceptions, deer overpopulation has not been an issue in New Hampshire. In 1996, ninety (90) deer were harvested on Long Island by sharpshooters in an effort to immediately reduce deer numbers to levels more in balance with long term habitat carrying capacity. Beginning in 1997, a regulated hunt was instituted requiring written landowner permission and entailing other requirements such as weapon and hunting method restrictions in an effort to maintain the island deer population at levels closer to the surrounding mainland. This hunt has been very successful as evidenced by a substantial decline in hunter observation rates, as well as, complaints from island residents. A similar hunt was initiated on Governor's Island in 2009. Relatively few deer are harvested on a yearly basis and hunter observation rates have remained relatively stable in part due to the fact that island residents have restricted hunting access to a small group of hunters and hunting is only allowed on the "common land" portion of the island. Portions of some towns have also experienced overpopulation issues. However, this is in large part due to the fact that large sections of these towns have historically been closed to hunting and local deer populations have been allowed to grow unchecked. In many cases adequate hunter opportunity is available to control populations, but hunter access must be increased.

A final note about the current deer management program involves the potential threat posed to New Hampshire's deer (and other members of the deer family or cervids) that is posed by chronic wasting disease (CWD). Chronic wasting disease is a contagious neurological disorder that is always fatal to white-tailed deer, moose, and a number of other cervids. There is no treatment or vaccine for CWD. Current information suggests CWD is transmitted by an abnormal protein (prion) present in the nervous system and lymphatic tissue of infected animals. These prions are very stable and persist in the environment for several years, posing a risk to

animals that come in contact with them. The abnormal proteins have been found in nervous system tissue, lymph nodes, saliva, and urine among other places.

Due to the mode of transmission, studies have shown that activities that unnaturally concentrate deer, such as feeding or baiting, increase the likelihood of spreading disease among animals once its present (Miller et al. 1998, Miller and Williams 2003, Miller et al. 2003). Also, since the infective prion has been found in urine there is concern that the use of natural urine based deer lures has the potential to spread CWD. Although there is no direct evidence linking urine based lures to the spread of CWD there are a number of studies that have shown the infective prion is present in urine, feces, and saliva of deer (Hamir et al. 2006, Mathiason et al. 2006, Safar et al. 2008, Haley et al. 2009). Urine for these lures is obtained from captive cervid farms, many of which are located in CWD positive states. In many cases the animals are held in pens over grates which collect a mixture of urine, feces, and saliva, the liquid portion is then strained out. In some cases urine may be collected from individual animals. These lures do not undergo any quality control, treatment that might inactivate or kill disease causing agents, and there is currently no testing of commercial lures for the presence of CWD prions. Most hunters use small amounts of these lures, however, the infective prion is extremely stable and can persist in the environment for years as a source of possible exposure. Therefore, there could be cumulative effects due to the continued application of urine based lures in the environment over time. Several Canadian provinces have already banned the use and possession of urine based lures as a result. Arizona has a ban on the use of urine based lures and Pennsylvania has banned there use in the state's CWD Disease Management Area. Many other states including New Hampshire have issued warnings about the potential risks associated with their use and recommend using synthetic lures in their place.

Prevention of CWD in New Hampshire in addition to CWD monitoring and surveillance is one of the primary objectives of current deer management. Beginning with the 2002 deer season, a sample of hunter killed deer have been tested annually as part of a nationwide CWD monitoring and surveillance effort. Since testing began in 2002 a total of 4,776 deer have been tested in New Hampshire statewide. To date none of these samples have tested positive for CWD. Currently CWD has been detected in 23 U.S. states and 2 Canadian provinces.

Current research has identified the captive cervid industry as a serious potential threat in the spread of CWD to native cervid populations (Williams et al. 2000, Miller and Wild 2004,

VerCauteren et al. 2007). In some states where CWD has been detected it has been identified in captive facilities before showing up in adjacent native populations (Miller and Wild 2004, NYDEC 2014). In Nebraska prevalence rates in wild deer decreased with distance from a captive facility where the disease was first identified suggesting the disease originated at this facility (VanCauteren et al. 2007, NGPC 2014). Chronic wasting disease has also "jumped" state and international boundaries and its spread has been traced to captive facilities through the movement of infected animals (SCWDS 2002, Kim et al. 2005). These facilities also have a history of animals escaping and potentially comingling with wild cervids. In New Hampshire it is illegal to import native cervids including both white-tailed deer and moose per Fis. 803.04. However, there are currently 19 locations permitted to poses captive exotic cervids in the state and Fish and Game works closely with the state Department of Agriculture to minimize potential diseases risks. Continued growth of this industry in NH may pose a potential threat to the states native deer (and moose) population as escaped animals are frequently documented and are often not claimed or not marked and in violation of permit requirements.

Habitat Assessment

Quantitative assessment of deer habitat availability and quality in New Hampshire is rather difficult given the lack of good historical information and the fact that deer tend to be rather general in their habitat requirements, with the exception of adequate wintering habitat in northern portions of their range. As one moves forward in time, the advent of remote sensing, including aerial photography and satellite imagery, along with the power of modern Geographic Information Systems (GIS) to process and display the information, has made quantitative analysis on a large scale more feasible. The detailed analyses associated with vegetative species composition, stand size class distribution, estimated browse productivity and associated impacts on habitat quality are beyond the scope of this effort. Due to limited soil fertility and severe winters, New Hampshire habitat quality is generally lower than states to our south and west. Given the pressures associated with land use in New Hampshire, primary focus will be placed on assessing habitat quantity.

A. Past Habitat

It's appropriate to begin the discussion of New Hampshire deer habitat about 18,000 years before present (B.P.). It was at that time (18,000 B.P.) that the Wisconsin glaciation reached its final maximum and what is now New Hampshire was covered by the Laurentide ice sheet (Pielou 1991). The Laurentide ice sheet extended from eastern Canada and the northern U.S. to just east of the Rocky Mountains and north to the Arctic Ocean. At its center, it may have been 5 kilometers (over 3 miles) thick. So much water was tied up in ice at that time the sea level was between 85 and 130 meters (279 and 427 feet) below current levels and much of what is now the coastal continental shelf, was then dry land (for example George's Bank), and largely unglaciated. While the Laurentide ice sheet melted slowly in fits and starts, by 10,000 B.P. New Hampshire was ice-free and by 7,000 B.P. the remaining ice was limited to northern Canada. White-tailed deer survived the glaciation not far south of the ice sheet and moved north as conditions (habitat and climate) allowed. Although vegetative communities were different in many cases than they are today, the progression of "habitats" after the retreat of the ice was likely tundra through taiga and boreal forest to northern hardwood and "modern" conditions as the climate warmed (Pielou 1991).

More detailed information on habitat conditions becomes available when New Hampshire was first colonized in the early 1600's. The following descriptions were extracted from NHF&G (1990). When the first settlement was made in 1623, New Hampshire was approximately 95% forested. Southern forests were composed of white pine (*Pinus strobus*), hemlock (*Tsuga canadensis*) and northern hardwoods. Important among the latter were oak (*Quercus spp*.), maple (*Acer spp*.), beech (*Fagus grandifolia*), birch (*Betula spp*.) and chestnut (*Castanea dentata*), the last never found north of northern Belknap and Merrimack Counties, and no longer present. Hemlock was somewhat more common than pine, and spruce grew on the higher elevations and in swamps.

In the northern forests, spruce (*Picea spp*.) and fir (*Abies balsamea*) occupied the higher mountains, and fir, cedar (*Thuja occidentalis*) and larch (*Larix larcinia*) the swamps. Northern hardwoods were found on the more fertile slopes, with white pine stands along the streams. Some hemlock may have extended as far north as Errol in the east and Northumberland in the west.

Clearing by the Indians and natural forces such as fires, hurricanes, ice storms and wind kept various successional stages present and only limited areas supported climax forest stands. Under this forest the shade tolerant ground cover and shrub species included witch hobble (*Viburnum alnifolium*), striped maple (*Acer pennsylvanicum*), blueberry (*Vaccinium spp*.), mountain maple (*Acer spicatum*), dockmakie (*Viburnum acerifolium*), fly honeysuckle (*Lonicera villosa*), nannyberry (*Viburnum lentago*), witch hazel (*Hammamelis spp*.), raspberry and blackberry (*Rubus spp*.), mountain holly (*Nemopanthus micronata*), gooseberry (*Ribes hirtellum*), elder (*Sambucus canadensis*) and yew (*Taxus canadensis*). Many of these constituted the most heavily used deer foods.

There were also clearings that resulted from beaver and Indian activity (and later from lumbering) and contributed to deer habitat. Some of these patches of cleared land were created with the notion of increasing deer numbers to improve hunting. The largest of these clearings, called "intervales", were present as far north as Conway on the eastern side of the state. Along the Connecticut River valley, a series of intervales extended approximately 75 miles, from Hanover to Lancaster. The so-called "Great Intervale" was over 20 miles long and 5 miles wide in some places. In these early years, the colonial human population was less than 11,000 and was concentrated in the southeastern 10% of the state. In 1750, New Hampshire was 82% forested and by 1800 it remained 75% forested (Silver 1957).

The 1800's saw a rapid expansion in occupied territory and human population. There were tremendous increases in cleared land and a shift from subsistence to commercial agriculture. All counties except Coos saw woodlands cleared to make way for crops and pastures, even lands that were only suitable for timber production. As the fertility of these fields failed, they were abandoned and new areas cleared. Farm abandonment was already underway in the oldest towns by the 1820's. While lands were continually being cleared and abandoned, the total farm acreage remained relatively constant though about 1880 when wholesale farm abandonment began. Maximum land clearing occurred in about 1850 when approximately 50% of the state had been cleared and 38% was in "improved" farmland (Silver 1957).

Colonization and clearing of land in northern New Hampshire lagged far behind the south with maximum agricultural clearing in Coos County not occurring until 1890, when it still amounted to only 13%. Large scale lumbering however, which began in the mid-1840's, had mixed effects on deer habitat. Summer and fall food availability increased due to forest

regeneration, but large-scale logging reduced winter habitat availability. The effect of these logging related habitat changes on the deer population was overshadowed by the simple demand for “camp meat”.

Since the 1800’s, farm abandonment continued and the scale of logging operations also decreased until by the 1950’s, the state was about 85% forested once again. It appears however as if New Hampshire’s experiment with extensive agriculture in the 1800’s reduced overall soil fertility and productivity (Silver 1957) with the result that underlying habitat quality is not what is was in colonial days. During the 1900’s, several natural “disasters” have at least temporarily modified deer habitat. The hurricane of 1938 “accelerated an already considerable increase in deer” (Silver 1957) through increased browse availability. An extensive outbreak of spruce budworm (*Choristoneura fumiferana*) in the mid-1970’s decimated 50% of mature spruce-fir stands, and when combined with the subsequent salvage cuts, greatly reduced the extent of northern deer wintering areas. These types of events will continue to affect New Hampshire’s deer habitat on an occasional, and unpredictable basis. The overall trend however remained one of increasing forestland and by 1983, 87% of the state was once again forested (Thorne and Sundquist 2001).

Somewhat more detailed habitat information was provided on a WMU basis in the 1990 draft plan (NHF&G 1990). While WMU boundaries may have changed somewhat over the years and some descriptions were based on groups of units with similar characteristics, the following summaries provide a generalized assessment from the 1990 plan (NHF&G 1990) which included information based on 1986 data with noted changes from similar information collected in1973.

WMU A, B, C1, and C2: Spruce/fir dominates many valleys, especially in A and B, and at high elevations. Northern hardwoods predominate on hillsides and at mid-elevations. A, B and C2 contain large tracts of industrial forestland, C1 is largely White Mountain National Forest. Forestland covers 95% of the area. Forest types include spruce/fir (46%), northern hardwoods (43%) and aspen/birch (9%). The area was only 86% forested in 1973. Significant decreases between 1973 and 1986 were noted in white/red pine (-16%) and various oak types (-4%) with corresponding increases in types that currently predominate.

WMU D and G: Northern hardwoods begin to mix with oak forest types as one moves south and in G, oak types predominate, especially at lower elevations. Hemlock also replaces spruce/fir as the dominant conifer type. WMU G has areas of higher elevation where spruce/fir

reappears with hemlock and pine at lower elevations. Forestland covers about 90% of the area. Forest types include white/red pine (18%), spruce/fir (16%), oak/pine and oak/hickory (6%), northern hardwoods (53%) and aspen/birch (7%). Forestland increased from 80% in 1973. Spruce/fir decreased from 1973 to 1986 while other types increased in abundance.

WMU E, F and J1: High elevations and infertile soils predominate in E and F. Most land is White Mountain National Forest. The highest elevations are dominated by boreal and alpine vegetation. Elevations decrease and fertility increases as one moves south. Northern hardwoods, hemlock and pine dominate J1 with some spruce/fir on its northern boundary. Forestland covers 93% of the area. Forest types include white/red pine (31%), spruce/fir (4%), pitch pine (5%), oak/pine and oak/hickory (7%), and northern hardwoods (52%). The area was only 86% forested in 1973. White/red pine increased from 16% to 31% while spruce/fir decreased from 24% to 4% and northern hardwoods from 72% to 52% between 1973 and 1986.

WMU H1 and H2: Oak is the dominant hardwood while hemlock/pine is the dominant softwood type. The area has a high proportion of open agricultural land. Forestland covers about 89% of the area. Forest types include white/red pine (31%), spruce/fir (2%), oak/pine and oak/hickory (18%) and northern hardwoods (47%). Forested land increased from 83% to 89%. Northern hardwoods increased while elm/ash/red maple types decreased from 24% to 3% of the area between 1973 and 1986.

WMU I1 and I2: These units are increasingly dominated by white pine types and greater development. Forestland covers 82% of the area. Forest types include white/red pine (40%), spruce/fir (2%), pitch pine (3%), oak/pine and oak/hickory (18%), northern hardwoods (34%) and aspen/birch (3%). Forestland increased only slightly from 80% in 1973. Northern hardwoods increased while softwood types remained stable between 1973 and 1986.

WMU K: Agricultural land, especially orchards, is a major land use. Developed land is increasing. Forestland covers 76% of the area. Forest types include white/red pine (59%), oak/pine and oak/hickory (19%) and northern hardwoods (22%). Forestland increased from 70% to 76% between 1973 and 1986. The white/red pine type and northern hardwood types increased in abundance with oak types decreasing.

WMU J2 and L: Northern hardwoods in the north give way to oak dominated hardwoods as one moves south through J2 with oak/pine types predominating in L. Elevations are low with diminishing topographical relief moving south. Open land is relatively high in occurrence and

developed land is increasingly common in L. Forestland covers 79% of the area. Forest types include white/red pine (41%) oak/hickory (7%), northern hardwoods (44%) and aspen/birch (8%). Forested land increased from 75% in 1973. The elm/ash/red maple types that existed in 1973 were replaced by northern hardwoods in 1986.

WMU M: A highly developed unit with minimal topography and low elevations. The remaining forests are dominated by white pine and oak. Forestland covers 72% of the area. Forest types include white/red pine (54%), oak/pine and oak/hickory (27%) and northern hardwoods (16%). Forestland remained little changed from 71% in 1973 and oak types increased in abundance between 1973 and 1986.

The 2006 plan assessment of deer habitat was based on analysis of the "2001 Land Cover Assessment" GIS data layer. This information was largely derived from the GIS analysis of Landsat Thematic Mapper satellite imagery. Appendix I provides metadata for this land cover assessment layer. Deer habitat was generally defined as agricultural land cover types and forestland cover types with additional detail on the categorization of various land cover classifications as habitat or non-habitat being given in Appendix II. All areas above 3400 feet in elevation were considered non-habitat since these areas are typically dominated by spruce/fir, grading into alpine and tundra vegetation types which are not utilized to any great extent by deer.

While this land cover data contains a residential/commercial/industrial or "developed" category, it only reflects areas with the most intensive urban or suburban development. Other areas with somewhat less intensive development such as suburban housing developments within a forested landscape, were likely classified as forestland by this analysis. These areas, while considered deer habitat since they can be and are utilized by deer, are of mixed value from a deer management perspective. The development associated with these areas in many cases is sufficiently great to preclude the use of recreational hunting as a deer population management tool and hence while they can serve as deer habitat, they may also serve as deer refuge areas. Since this form of suburban development has both positive and negative influences with regard to deer habitat and population management, an attempt was made to quantify its abundance through the use of a 300 foot wide road buffer area along each side of all class I to V roads. The majority of this type of suburban development occurs along road corridors throughout the state and hence the road buffer area can serve as an index to the degree of this development. A summary of deer habitat area by WMU based on this analysis is provided in Appendix III.

Detailed information on land cover classification areas and road buffer areas by WMU are provided in Appendices IV and V respectively.

Table 7 summarizes general results of the deer habitat analysis by WMU while Appendix IV provides additional detail by land cover classification. The following narrative summarizes the 2006 plan habitat assessment by WMU based on analysis of 2001 land cover assessment data.

WMU A: The land area is 569.9 square miles, of which 96.8% was classified as deer habitat (the highest proportion in the state). Deer habitat is comprised of 1.9% agricultural land, 92.4% forest and 5.7% other habitat types. Hardwood forest types comprise 44.6% of deer habitat with 6.8% being beech/oak, 4.2% being birch/aspen and 33.6% being other hardwoods. Softwood comprises 17.4% of habitat with 15.6% being spruce/fir, 1.2% being white/red pine and 0.7% being hemlock. Mixed and other forest types comprise 30.3% of deer habitat. Only a small amount of land in WMU A exceeds 3400 feet in elevation (<0.1%).

WMU B: The land area is 342.2 square miles, of which 95.4% was classified as deer habitat. Deer habitat is comprised of 2.0% agricultural land, 90.1% forest and 7.9% other habitat types. Hardwood forest types comprise 49.9% of deer habitat with 7.5% being beech/oak, 7.0% being birch/aspen and 35.4% being other hardwoods. Softwood comprises 16.4% of habitat with 13.8% being spruce/fir, 1.8% being white/red pine and 0.8% being hemlock. Mixed and other forest types comprise 23.8% of deer habitat. Only 0.8% of land in WMU B exceeds 3400 feet in elevation.

WMU C1: The land area is 204.9 square miles, of which 94.9% was classified as deer habitat. Deer habitat is comprised of 1.2% agricultural land, 95.2% forest and 3.7% other habitat types. Hardwood forest types comprise 62.1% of deer habitat (the highest proportion in the state) with 10.1% being beech/oak, 11.0% being birch/aspen and 41.0% being other hardwoods. Softwood comprises 13.4% of habitat with 11.0% being spruce/fir, 1.5% being white/red pine and 0.9% being hemlock. Mixed and other forest types comprise 19.7% of deer habitat. Unit C1 contains portions of the White Mountains and 2.5% of land exceeds 3400 feet in elevation.

WMU C2: The land area is 244.5 square miles, of which 93.0% was classified as deer habitat. Deer habitat is comprised of 1.2% agricultural land, 91.5% forest and 7.4% other habitat types. Hardwood forest types comprise 42.7% of deer habitat with 7.3% being beech/oak, 7.8% being birch/aspen and 27.6 % being other hardwoods. Softwood comprises 25.2% of habitat with

20.9% being spruce/fir, 2.9% being white/red pine and 1.3% being hemlock. Mixed and other forest types comprise 23.5% of deer habitat. Only a small amount of land in WMU C2 exceeds 3400 feet in elevation (<0.1%).

WMU D1: The land area is 234.4 square miles, of which 91.1% was classified as deer habitat. Deer habitat is comprised of 5.5% agricultural land, 79.0% forest and 15.6% other habitat types. Hardwood forest types comprise 35.1% of deer habitat with 4.6% being beech/oak, 12.1% being birch/aspen and 18.4% being other hardwoods. Softwood comprises 23.7% of habitat with 9.7% being spruce/fir, 10.1% being white/red pine and 3.9% being hemlock. Mixed and other forest types comprise 20.2% of deer habitat. None of WMU D1 exceeds 3400 feet in elevation.

WMU D2E: At 116.0 square miles of land area, D2E is the smallest deer WMU. Of the land area, 89.2% was classified as deer habitat. Deer habitat is comprised of 0.3% agricultural land (the lowest proportion in the state), 97.3% forest (the highest proportion in the state) and 2.4% other habitat types. Hardwood forest types comprise 53.9% of deer habitat with 11.1% being beech/oak, 13.1% being birch/aspen and 29.7% being other hardwoods. Softwood comprises 17.4% of habitat with 13.1% being spruce/fir, 2.7% being white/red pine and 1.6% being hemlock. Mixed and other forest types comprise 26.0% of deer habitat. Unit D2E contains portions of the White Mountain National Forest and 8.4% of land area exceeds 3400 feet in elevation.

WMU D2W: The land area is 357.2 square miles, of which 95.6% was classified as deer habitat. Deer habitat is comprised of 8.8% agricultural land (the highest proportion in the state), 83.2% forest and 7.8% other habitat types. Hardwood forest types comprise 45.0% of deer habitat with 8.7% being beech/oak, 18.8% being birch/aspen and 17.5% being other hardwoods. Softwood comprises 19.2% of habitat with 2.8% being spruce/fir, 10.6% being white/red pine and 5.9% being hemlock. Mixed and other forest types comprise 18.9% of deer habitat (the lowest proportion in the state). None of WMU D2W exceeds 3400 feet in elevation.

WMU E: The land area is 779.9 square miles, of which 88.1% was classified as deer habitat. Deer habitat is comprised of 0.9% agricultural land, 96.3% forest and 2.8% other habitat types (the lowest proportion in the state). Hardwood forest types comprise 48.6% of deer habitat with 12.4% being beech/oak, 11.2% being birch/aspen and 25.0% being other hardwoods. Softwood comprises 22.8% of habitat with 18.8% being spruce/fir, 2.0% being white/red pine

and 2.0% being hemlock. Mixed and other forest types comprise 24.9% of deer habitat. Unit E contains the Presidential Range and other high elevation areas of the White Mountains and 9.7% of land area exceeds 3400 feet in elevation (the highest proportion of the state).

WMU F: The land area is 479.0 square miles, of which 94.7% was classified as deer habitat. Deer habitat is comprised of 1.0% agricultural land, 95.3% forest and 1.8% other habitat types. Hardwood forest types comprise 50.4% of deer habitat with 18.6% being beech/oak, 9.6% being birch/aspen and 22.2% being other hardwoods. Softwood comprises 20.7% of habitat with 12.2% being spruce/fir, 4.2% being white/red pine and 4.3% being hemlock. Mixed and other forest types comprise 23.5% of deer habitat. Portions of the White Mountains lie in WMU F and 1.6% of the land area exceeds 3400 feet in elevation.

WMU G1: The land area is 418.7 square miles, of which 94.5% was classified as deer habitat. Deer habitat is comprised of 5.8% agricultural land, 89.8% forest and 4.4% other habitat types. Hardwood forest types comprise 36.4% of deer habitat with 17.6% being beech/oak, 2.5% being birch/aspen and 16.3% being other hardwoods. Softwood comprises 26.7% (the highest proportion of the state) of habitat with 10.1% being spruce/fir, 10.7% being white/red pine and 5.9% being hemlock. Mixed and other forest types comprise 26.7% of deer habitat. None of WMU G1 exceeds 3400 feet in elevation.

WMU G2: The land area is 231.2 square miles, of which 94.5% was classified as deer habitat. Deer habitat is comprised of 3.9% agricultural land, 92.1% forest and 4.0% other habitat types. Hardwood forest types comprise 45.8% of deer habitat with 25.7% being beech/oak, 2.4% being birch/aspen and 17.7% being other hardwoods. Softwood comprises 22.7% of habitat with 9.3% being spruce/fir, 7.3% being white/red pine and 6.1% being hemlock. Mixed and other forest types comprise 25.8% of deer habitat. None of WMU G2 exceeds 3400 feet in elevation.

WMU H1: The land area is 401.8 square miles, of which 94.2% was classified as deer habitat. Deer habitat is comprised of 8.5% agricultural land, 86.8% forest and 4.8% other habitat types. Hardwood forest types comprise 30.0% of deer habitat with 16.3% being beech/oak, 1.8% being birch/aspen and 11.8% being other hardwoods. Softwood comprises 24.4% of habitat with 6.6% being spruce/fir, 11.1% being white/red pine and 6.8% being hemlock. Mixed and other forest types comprise 32.4% of deer habitat. None of WMU H1 exceeds 3400 feet in elevation.

WMU H2: The land area is 697.3 square miles, of which 92.8% was classified as deer habitat. Deer habitat is comprised of 6.5% agricultural land, 89.9% forest and 3.6% other habitat

types. Hardwood forest types comprise 32.6% of deer habitat with 22.7% being beech/oak, 1.9% being birch/aspen and 8.0% being other hardwoods. Softwood comprises 19.2% of habitat with 3.3% being spruce/fir, 7.6% being white/red pine and 8.3% being hemlock. Mixed and other forest types comprise 38.1% of deer habitat. None of WMU H2 exceeds 3400 feet in elevation.

WMU I1: The land area is 358.0 square miles, of which 91.4% was classified as deer habitat. Deer habitat is comprised of 7.6% agricultural land, 87.1% forest and 5.3% other habitat types. Hardwood forest types comprise 33.3% of deer habitat with 24.9% being beech/oak, 1.0% being birch/aspen and 7.5% being other hardwoods. Softwood comprises 24.5% of habitat with 2.9% being spruce/fir, 14.7% being white/red pine and 6.9% being hemlock. Mixed and other forest types comprise 29.3% of deer habitat. None of WMU I1 exceeds 3400 feet in elevation.

WMU I2: The land area is 377.7 square miles, of which 94.3% was classified as deer habitat. Deer habitat is comprised of 4.1% agricultural land, 92.7% forest and 3.2% other habitat types. Hardwood forest types comprise 36.1% of deer habitat with 22.5% being beech/oak, 2.1% being birch/aspen and 11.5% being other hardwoods. Softwood comprises 23.9% of habitat with 7.9% being spruce/fir, 9.3% being white/red pine and 6.7% being hemlock. Mixed and other forest types comprise 32.8% of deer habitat. None of WMU I2 exceeds 3400 feet in elevation.

WMU J1: The land area is 471.8 square miles, of which 92.4% was classified as deer habitat. Deer habitat is comprised of 2.2% agricultural land, 90.9% forest and 6.9% other habitat types. Hardwood forest types comprise 35.3% of deer habitat with 17.8% being beech/oak, 4.2% being birch/aspen and 13.3% being other hardwoods. Softwood comprises 23.6% of habitat with 1.9% being spruce/fir, 15.4% being white/red pine and 4.9% being hemlock. Unit J1 is the only WMU in the state that shows a measurable amount of pitch (hard) pine that comprises 1.3% of deer habitat. Mixed and other forest types comprise 32.1% of deer habitat. None of WMU J1 exceeds 3400 feet in elevation.

WMU J2: With a land area 818.8 square miles, WMU J2 is the largest in the state. Of this area, 90.7% was classified as deer habitat. Deer habitat is comprised of 5.6% agricultural land, 86.8% forest and 7.7% other habitat types. Hardwood forest types comprise 32.0% of deer habitat with 22.2% being beech/oak, 0.4% being birch/aspen and 9.4% being other hardwoods. Softwood comprises 16.1% of habitat with 1.2% being spruce/fir, 12.1% being white/red pine and 2.8% being hemlock. Mixed and other forest types comprise 38.6% of deer habitat. None of WMU J2 exceeds 3400 feet in elevation.

WMU K: The land area is 637.1 square miles, of which 91.5% was classified as deer habitat. Deer habitat is comprised of 7.1% agricultural land, 87.7% forest and 5.3% other habitat types. Hardwood forest types comprise 27.7% of deer habitat with 23.3% being beech/oak, 1.0% being birch/aspen and 3.4% being other hardwoods. Softwood comprises 23.4% of habitat with 2.3% being spruce/fir, 14.7% being white/red pine and 6.4% being hemlock. Mixed and other forest types comprise 36.6% of deer habitat. None of WMU K exceeds 3400 feet in elevation.

WMU L: The land area is 494.0 square miles, of which 84.0% was classified as deer habitat. Deer habitat is comprised of 6.2% agricultural land, 80.6% forest and 13.2% other habitat types. Hardwood forest types comprise 23.7% of deer habitat with 15.4% being beech/oak, 0.1% being birch/aspen and 8.3% being other hardwoods. Softwood comprises 12.2% of habitat (the lowest proportion in the state) with 0.5% being spruce/fir, 10.1% being white/red pine and 1.5% being hemlock. Mixed and other forest types comprise 44.7% of deer habitat (the highest proportion in the state). None of WMU L exceeds 3400 feet in elevation.

WMU M: The land area is 690.2 square miles, of which 77.4%, the lowest proportion in the state, was classified as deer habitat. Deer habitat is comprised of 7.8% agricultural land, 73.2% forest (the lowest proportion in the state) and 19.0% other habitat types (the highest proportion in the state). Hardwood forest types comprise 21.8% of deer habitat (the lowest proportion in the state) with 13.8% being beech/oak, 0.4% being birch/aspen and 7.6% being other hardwoods. Softwood comprises 12.3% of habitat with 0.3% being spruce/fir, 11.0% being white/red pine and 0.9% being hemlock. Mixed and other forest types comprise 39.1% of deer habitat. None of WMU M exceeds 3400 feet in elevation.

As a further measure of the potential impact of development on deer and deer management, the area of each WMU within a 300 foot road buffer was also estimated as described in Appendix II. This area is the primary area in which development, including houses, stores etc. occur and while it can provide habitat for deer, also can limit the ability of managers to control deer populations, and can serve as an index to potential human/deer conflicts through such interactions as nuisance complaints and vehicle collisions. In more northern WMUs typically less than 10% of the land area is within 300 feet of a road (see Appendix III). Central portions of the state are considerably higher, ranging between 16% and 24%. The highest values are in the southern and eastern portions of the state which have seen the greatest development

pressure with 26.9% of the land area in WMU L being within 300 feet of a road, 27.9% in WMU K and a rather astounding 38.6% in WMU M.

As previously mentioned, some habitat changes that have occurred over time are due to natural disasters such as hurricanes, disease outbreaks, ice storms and so on. Most of it though has been and will continue to be associated with human activity and increasing demands on the land base of the state. Human population growth and its associated development have been and will continue to be the biggest threat to deer habitat and for that of other fish and wildlife species.

Trends in the human population of New Hampshire (going back to 1790) and housing unit construction (going back to 1939) by county and for the state as a whole are given in Figure 4 and are expressed on a per square mile basis to make comparisons easier. These data are from on-line sources including the "Statistical Abstract of the United States" at the U.S. Census Bureau web site (www.census.gov) and the New Hampshire Office of State Planning web site (www.nh.gov/osp). A fairly grim picture is painted in almost every county of the state. While the human population in most counties showed generally slow growth from the first U.S. census in 1790 through 1940, most counties began to exhibit rapid population increases about then or shortly thereafter. One exception to this general rule is Carroll County whose population declined or was steady from about 1840 through 1960 when it too started to exhibit rapid growth. The other exception to the general pattern was Coos County whose population increased steadily from 1790 through about 1930 and has slowly declined since.

Since 1940, Coos has been the only county to have exhibited a declining population, averaging -6.6 % per year from 1950 to 2010. Other counties have seen rates of population increase averaging (in increasing order) +8.2% per year in Sullivan, +10.0% per year in Grafton, +12.2% per year in Cheshire, +13.8% per year in Merrimack, +14.1% per year in Belknap, +16.0% per year in Hillsborough, +16.2% per year in Strafford, +18.4% per year in Carroll and +26.9% per year in Rockingham. Statewide, the average rate of human population increase has been +15.4% per year. At these population growth rates, populations on average would double every 9 years in Sullivan County to as quickly as every 7 years in Rockingham County. The current (2010) human population density in New Hampshire ranges from a low of 18.4 per square mile in Coos County to highs of 425.5 and 461.3 per square mile respectively in Rockingham and Hillsborough Counties.

Housing units (which includes homes, apartments and condominiums etc.) have been increasing in every county including Coos (except from 2000-2010), at an even faster rate than the population (Figure 4). Housing units may actually be a better reflection of the negative impacts of the human population on habitat since they are what actually occupies the landscape and results in habitat loss. The rate of increase in housing units has ranged from a low of +11.2% per year in Coos County to +31.0% per year in Rockingham County. The statewide average rate of increase has been +24.8% per year. Increases of this magnitude are simply not sustainable if there's to be any hope of maintaining a "wild New Hampshire". The fact that housing units have been increasing at a faster rate than the population, and that housing units have been increasing in Coos County while the population has been decreasing, suggests that second homes of one kind or another are contributing to the increased building and accompanying loss of habitat.

B. Current Habitat

The assessment of current deer habitat is based on analysis of the "USGS NLCD 2011 Land Cover" GIS data layer. Appendix VI provides metadata for this land cover assessment layer. Deer habitat was defined using the same methods as the 2004 habitat assessment. In general agricultural land and forestland were considered deer habitat. All areas above 3400 feet in elevation were considered non-habitat since these areas are not utilized to any great extent by deer. One noticeable difference between the 2001 land cover data and the 2011 data is that the 2011 data utilized improved mapping techniques for developed land cover and forested wetlands. These improved techniques were able to distinguish suburban housing within forested landscapes more effectively than the 2001 data and likely classified more of these areas as non-habitat. However, some of these areas may still have been classified as forestland by this analysis so the use of a 300 foot wide road buffer area along each side of all class I to V roads was again used to index the degree of this type of development since it can have both positive and negative influences with regard to deer habitat and population management. Additional detail on the categorization of various land cover classifications as habitat or non-habitat is given in Appendix II. A summary of deer habitat area by WMU based on this analysis is provided in Appendix VII. Detailed information on land cover classification areas and road buffer areas by WMU are provided in Appendices VIII and IX respectively.

Table 8 summarizes general results of the deer habitat analysis by WMU while Appendix VIII provides additional detail by land cover classification. The following narrative summarizes current conditions by WMU based on analysis of 2011 land cover data.

WMU A: The land area is 569.9 square miles, of which 97.6% was classified as deer habitat (the highest proportion in the state). Deer habitat is comprised of 1.3% agricultural land, 87.72% forest and 10.94% other habitat types. Hardwood forest types comprise 41.4% of deer habitat with 6.4% being beech/oak, 3.9% being birch/aspen and 31.1% being other hardwoods. Softwood comprises 15.4% of habitat with 13.7% being spruce/fir, 1.0% being white/red pine and 0.6% being hemlock. Mixed and other forest types comprise 30.9% of deer habitat. Only a small amount of land in WMU A exceeds 3400 feet in elevation (<0.1%).

WMU B: The land area is 342.2 square miles, of which 96.3% was classified as deer habitat. Deer habitat is comprised of 1.4% agricultural land, 85.0% forest and 13.6% other habitat types. Hardwood forest types comprise 45.5% of deer habitat with 6.6% being beech/oak, 6.6% being birch/aspen and 32.3% being other hardwoods. Softwood comprises 14.6% of habitat with 12.3% being spruce/fir, 1.6% being white/red pine and 0.7% being hemlock. Mixed and other forest types comprise 24.9% of deer habitat. Only 0.8% of land in WMU B exceeds 3400 feet in elevation.

WMU C1: The land area is 204.9 square miles, of which 95.0% was classified as deer habitat. Deer habitat is comprised of 0.6% agricultural land, 90.1% forest and 9.3% other habitat types. Hardwood forest types comprise 57.5% of deer habitat (the highest proportion in the state) with 9.2% being beech/oak, 10.3% being birch/aspen and 38.0% being other hardwoods. Softwood comprises 12.3% of habitat with 10.2% being spruce/fir, 1.3% being white/red pine and 0.9% being hemlock. Mixed and other forest types comprise 20.3% of deer habitat (the lowest proportion in the state). Unit C1 contains portions of the White Mountains and 2.5% of land exceeds 3400 feet in elevation.

WMU C2: The land area is 244.5 square miles, of which 94.8% was classified as deer habitat. Deer habitat is comprised of 0.4% agricultural land, 84.6% forest and 15.0% other habitat types. Hardwood forest types comprise 38.6% of deer habitat with 6.7% being beech/oak, 7.0% being birch/aspen and 24.9% being other hardwoods. Softwood comprises 20.0% of habitat with 16.4% being spruce/fir, 2.4% being white/red pine and 1.2% being hemlock. Mixed and

other forest types comprise 26.0% of deer habitat. Only a small amount of land in WMU C2 exceeds 3400 feet in elevation (<0.1%).

WMU D1: The land area is 234.4 square miles, of which 91.9% was classified as deer habitat. Deer habitat is comprised of 3.2% agricultural land, 79.0% forest (the lowest proportion in the state) and 17.8% other habitat types (the highest proportion in the state). Hardwood forest types comprise 33.1% of deer habitat with 4.4% being beech/oak, 11.3% being birch/aspen and 17.5% being other hardwoods. Softwood comprises 20.0% of habitat with 7.6% being spruce/fir, 8.6% being white/red pine and 3.6% being hemlock. Mixed and other forest types comprise 26.1% of deer habitat. None of WMU D1 exceeds 3400 feet in elevation.

WMU D2E: At 116.0 square miles of land area, D2E is the smallest deer WMU. Of the land area, 88.9% was classified as deer habitat. Deer habitat is comprised of 0.1% agricultural land (the lowest proportion in the state), 96.2% forest (the highest proportion in the state) and 3.7% other habitat types (the lowest proportion in the state). Hardwood forest types comprise 53.0% of deer habitat with 10.9% being beech/oak, 12.9% being birch/aspen and 29.2% being other hardwoods. Softwood comprises 17.0% of habitat with 12.9% being spruce/fir, 2.6% being white/red pine and 1.5% being hemlock. Mixed and other forest types comprise 26.2% of deer habitat. Unit D2E contains portions of the White Mountain National Forest and 8.4% of land area exceeds 3400 feet in elevation.

WMU D2W: The land area is 357.2 square miles, of which 95.1% was classified as deer habitat. Deer habitat is comprised of 6.4% agricultural land (the highest proportion in the state), 83.0% forest and 10.7% other habitat types. Hardwood forest types comprise 44.0% of deer habitat with 8.4% being beech/oak, 18.1% being birch/aspen and 17.5% being other hardwoods. Softwood comprises 17.9% of habitat with 2.6% being spruce/fir, 9.7% being white/red pine and 5.6% being hemlock. Mixed and other forest types comprise 21.1% of deer habitat. None of WMU D2W exceeds 3400 feet in elevation.

WMU E: The land area is 779.9 square miles, of which 87.4% was classified as deer habitat. Deer habitat is comprised of 0.5% agricultural land, 95.7% forest and 3.8% other habitat types. Hardwood forest types comprise 47.6% of deer habitat with 12.2% being beech/oak, 10.9% being birch/aspen and 24.4% being other hardwoods. Softwood comprises 22.4% of habitat with 18.6% being spruce/fir, 1.9% being white/red pine and 2.0% being hemlock. Mixed and other forest types comprise 25.7% of deer habitat. Unit E contains the Presidential Range

and other high elevation areas of the White Mountains and 9.7% of land area exceeds 3400 feet in elevation (the highest proportion of the state).

WMU F: The land area is 479.0 square miles, of which 94.7% was classified as deer habitat. Deer habitat is comprised of 1.0% agricultural land, 94.2% forest and 4.7% other habitat types. Hardwood forest types comprise 49.5% of deer habitat with 18.3% being beech/oak, 9.4% being birch/aspen and 21.8% being other hardwoods. Softwood comprises 19.9% of habitat with 11.9% being spruce/fir, 3.8% being white/red pine and 4.1% being hemlock. Mixed and other forest types comprise 24.9% of deer habitat. Portions of the White Mountains lie in WMU F and 1.6% of the land area exceeds 3400 feet in elevation.

WMU G1: The land area is 418.7 square miles, of which 93.9% was classified as deer habitat. Deer habitat is comprised of 3.0% agricultural land, 91.0% forest and 6.0% other habitat types. Hardwood forest types comprise 36.2% of deer habitat with 17.2% being beech/oak, 2.5% being birch/aspen and 16.5% being other hardwoods. Softwood comprises 23.8% (the highest proportion of the state) of habitat with 8.5% being spruce/fir, 9.6% being white/red pine and 5.6% being hemlock. Mixed and other forest types comprise 31.0% of deer habitat. None of WMU G1 exceeds 3400 feet in elevation.

WMU G2: The land area is 231.2 square miles, of which 95.0% was classified as deer habitat. Deer habitat is comprised of 2.0% agricultural land, 91.2% forest and 6.8% other habitat types. Hardwood forest types comprise 44.6% of deer habitat with 24.7% being beech/oak, 2.4% being birch/aspen and 17.5% being other hardwoods. Softwood comprises 20.8% of habitat with 8.4% being spruce/fir, 6.6% being white/red pine and 5.8% being hemlock. Mixed and other forest types comprise 25.8% of deer habitat. None of WMU G2 exceeds 3400 feet in elevation.

WMU H1: The land area is 401.8 square miles, of which 92.4% was classified as deer habitat. Deer habitat is comprised of 5.6% agricultural land, 88.6% forest and 5.8% other habitat types. Hardwood forest types comprise 30.0% of deer habitat with 16.0% being beech/oak, 1.9% being birch/aspen and 12.2% being other hardwoods. Softwood comprises 23.1% of habitat with 6.0% being spruce/fir, 10.4% being white/red pine and 6.7% being hemlock. Mixed and other forest types comprise 35.5% of deer habitat. None of WMU H1 exceeds 3400 feet in elevation.

WMU H2: The land area is 697.3 square miles, of which 92.1% was classified as deer habitat. Deer habitat is comprised of 3.7% agricultural land, 91.4% forest and 4.9% other habitat types. Hardwood forest types comprise 32.0% of deer habitat with 21.8% being beech/oak, 1.9%

being birch/aspen and 8.3% being other hardwoods. Softwood comprises 17.1% of habitat with 2.5% being spruce/fir, 6.8% being white/red pine and 7.7% being hemlock. Mixed and other forest types comprise 42.3% of deer habitat. None of WMU H2 exceeds 3400 feet in elevation.

WMU I1: The land area is 358.0 square miles, of which 90.0% was classified as deer habitat. Deer habitat is comprised of 4.4% agricultural land, 88.4% forest and 7.2% other habitat types. Hardwood forest types comprise 32.3% of deer habitat with 23.8% being beech/oak, 1.0% being birch/aspen and 7.6% being other hardwoods. Softwood comprises 21.8% of habitat with 2.3% being spruce/fir, 13.0% being white/red pine and 6.5% being hemlock. Mixed and other forest types comprise 34.3% of deer habitat. None of WMU I1 exceeds 3400 feet in elevation.

WMU I2: The land area is 377.7 square miles, of which 94.1% was classified as deer habitat. Deer habitat is comprised of 2.3% agricultural land, 92.2% forest and 5.5% other habitat types. Hardwood forest types comprise 34.8% of deer habitat with 21.2% being beech/oak, 2.1% being birch/aspen and 11.5% being other hardwoods. Softwood comprises 21.3% of habitat with 6.9% being spruce/fir, 8.2% being white/red pine and 6.3% being hemlock. Mixed and other forest types comprise 36.1% of deer habitat. None of WMU I2 exceeds 3400 feet in elevation.

WMU J1: The land area is 471.8 square miles, of which 92.4% was classified as deer habitat. Deer habitat is comprised of 0.9% agricultural land, 88.2% forest and 10.9% other habitat types. Hardwood forest types comprise 33.0% of deer habitat with 16.5% being beech/oak, 3.8% being birch/aspen and 12.6% being other hardwoods. Softwood comprises 20.5% of habitat with 1.5% being spruce/fir, 13.4% being white/red pine and 4.4% being hemlock. Unit J1 is the only WMU in the state that shows a measurable amount of pitch (hard) pine that comprises 1.1% of deer habitat. Mixed and other forest types comprise 34.7% of deer habitat. None of WMU J1 exceeds 3400 feet in elevation.

WMU J2: With a land area 818.8 square miles, WMU J2 is the largest in the state. Of this area, 88.8% was classified as deer habitat. Deer habitat is comprised of 3.2% agricultural land, 85.5% forest and 11.2% other habitat types. Hardwood forest types comprise 30.0% of deer habitat with 20.6% being beech/oak, 0.3% being birch/aspen and 9.1% being other hardwoods. Softwood comprises 14.0% of habitat with 0.9% being spruce/fir, 10.5% being white/red pine and 2.6% being hemlock. Mixed and other forest types comprise 41.5% of deer habitat. None of WMU J2 exceeds 3400 feet in elevation.

WMU K: The land area is 637.1 square miles, of which 89.8% was classified as deer habitat. Deer habitat is comprised of 4.4% agricultural land, 88.0% forest and 7.6% other habitat types. Hardwood forest types comprise 26.6% of deer habitat with 21.7% being beech/oak, 0.9% being birch/aspen and 3.9% being other hardwoods. Softwood comprises 20.4% of habitat with 1.6% being spruce/fir, 12.9% being white/red pine and 5.9% being hemlock. Mixed and other forest types comprise 41.1% of deer habitat. None of WMU K exceeds 3400 feet in elevation.

WMU L: The land area is 494.0 square miles, of which 77.7% was classified as deer habitat. Deer habitat is comprised of 4.0% agricultural land, 82.6% forest and 13.4% other habitat types. Hardwood forest types comprise 21.8% of deer habitat with 14.1% being beech/oak, 0.1% being birch/aspen and 7.7% being other hardwoods. Softwood comprises 10.9% of habitat (the lowest proportion in the state) with 0.4% being spruce/fir, 8.9% being white/red pine and 1.5% being hemlock. Mixed and other forest types comprise 49.9% of deer habitat (the highest proportion in the state). None of WMU L exceeds 3400 feet in elevation.

WMU M: The land area is 690.2 square miles, of which 66.1%, the lowest proportion in the state, was classified as deer habitat. Deer habitat is comprised of 4.8% agricultural land, 79.5% forest and 15.8% other habitat types. Hardwood forest types comprise 20.5% of deer habitat (the lowest proportion in the state) with 13.0% being beech/oak, 0.3% being birch/aspen and 7.3% being other hardwoods. Softwood comprises 11.0% of habitat with 0.2% being spruce/fir, 9.9% being white/red pine and 0.9% being hemlock. Mixed and other forest types comprise 47.9% of deer habitat. None of WMU M exceeds 3400 feet in elevation.

Overall, New Hampshire's 8,926.5 square miles of land area is estimated to be 89.5% deer habitat. All WMUs were estimated to be over 90% deer habitat with the exceptions of WMU D2E and E with significant areas above 3400 feet in elevation, WMU J2 which encompasses Lake Winnipesaukee, and WMUs K, L and M that have the highest degree of development. As one moves south, hardwood forest types become generally less common while mixed forest types become more common. Softwood forest types are more variable in their abundance but are generally less common in the north (where spruce/fir types predominate) and in the south (where pine types are more common). Agricultural land is generally rare throughout the state but is most abundant in southern and western portions of the state. Although general habitat patterns were similar between the 2001 and 2011 data there were a few notable changes. One is that with the exception of the 5 most northerly units (A, B, C1, C2, and D1) all WMUs

showed at least a slight decline in the percentage of the land area that was considered deer habitat. The largest decreases were seen in WMUs L (7.5%) and M (14.5%) and were likely due to increased development in these units. Decreases in other units are also, in part, likely due to increased development but may also be due to the improved mapping of suburban areas in forested landscapes in the 2011 data set. These areas were likely previously classified as forested habitat in the 2004 assessment. All units showed an increase in developed land of greater than 80%. Again, this likely represents both improved mapping techniques between the two time periods as well as an actual increase in development. There was also a decline in the percentage of habitat classified as agricultural land in all WMUs between the two time periods. There were slight declines in softwood and hardwood (with the exception of H1) cover types and increases in mixed and other forest cover types in all WMUs. These changes may in part be due to the more accurate mapping of forested wetlands in the 2011 cover data. The four most northerly WMUs (A, B, C1, and C2) all showed an increase in the other habitat cover type of nearly two fold. This cover type includes cleared and open habitat and may in part represent an increase in forestry operations between the two time periods. WMU M was the only unit to show a decrease in this cover type, which is likely due to increased development in that unit.

As in the 2004 assessment the area of each WMU within a 300 foot road buffer was also estimated as a further measure of the potential impact of development on deer and deer management. This area is the primary area in which development, including houses, stores etc. occur and while it can provide habitat for deer, also can limit the ability of managers to control deer populations, and can serve as an index to potential human/deer conflicts through such interactions as nuisance complaints and vehicle collisions. Interestingly, every WMU (with the exception of A and C1) showed a decline in the percentage of habitat within the 300 foot road buffer despite increases in development in all WMUs. This is most likely explained by the improved mapping of suburban housing developments in forested landscapes in the 2011 data. Many of these areas were likely classified as habitat within 300 feet of a road in the previous assessment and are now classified as developed areas and are considered non-habitat. However, general patterns are still the same as in the 2004 assessment with the more northern WMUs typically showing the lowest percentage of the land area within 300 feet of a road, central portions of the state generally being higher, with the highest values in the southern and eastern portions of the state which have seen the greatest development pressure (see Appendix VII).

Deer wintering areas (DWAs) or deer yards play a vital role in deer survival in New Hampshire. The area of DWAs necessary to support deer populations through the winter is dependent on winter severity, deer population density and yard quality. While these areas are more critical in more northern portions of the state, central and even southern New Hampshire deer need the shelter these areas can provide during severe winters. Over the years, efforts have been underway to map deer yards in New Hampshire and as part of the 2006 planning effort, existing deer wintering area maps were digitized, rectified and preliminarily analyzed using GIS capabilities (see Appendix III and VII). The basic procedure involved interpretation of aerial infrared photographs and field work by regional staff to delineate the approximate boundaries of deer wintering areas. Baseline maps were then digitized into a GIS system and as time allowed additional areas were added and previously mapped areas were verified. However, the majority of the information on these maps was collected primarily over the years from 1987 to 1998, with only moderate updates being made in more recent years. More attention was given to adding newly surveyed areas than in removing areas that were no longer acting as functional DWAs. Therefore some of the maps are likely to be somewhat dated due to the rapid pace of development. However, the data still provides critical information on this key deer habitat component. Typically, these efforts have been undertaken on a town-by-town basis with maps for 196 of New Hampshire's 259 towns available for this effort (maps do not necessarily reflect all or current DWAs in a town). Table 9 shows the area of mapped DWAs (in square miles) as of the 2004 and current deer assessment (2014). These numbers include all DWAs that have been mapped since the creation of the GIS database. The data in Table 9 give the appearance that there has been an increase in the amount of DWAs in all WMUs between 2004 and 2014. However, this increase is due to continuing survey efforts and addition of previously unmapped DWAs while other areas that may no longer act as functional DWAs have not been updated and removed from the database. Due to increasing development throughout the state it is likely that the amount of DWAs has actually decreased in many WMUs over the same time period. The Department is currently conducting an ongoing study in cooperation with the University of New Hampshire to reanalyze and update its existing DWA maps, consolidate data from annual DWA surveys into a GIS database, and create a GIS based model to identify potential DWAs on a regional basis. This updated data should help the Department to more effectively and efficiently monitor and manage this critical habitat type.

Deer wintering area surveys conducted by regional staff each winter suggest that for the most part, DWAs are not holding more deer than they can support. There is evidence that some DWAs in the northern part of the state (WMUs A and B) have exceeded the number of deer they can sustain on a long-term basis in the recent past when populations were above current objectives. There is also evidence that when these units are at current objectives, during winters of above average severity, deer have the ability to negatively impact some DWAs particularly in WMU A. Loss of deer wintering areas together with modest increases in deer numbers are both contributing factors. There is also concern over the threat of another spruce budworm outbreak reoccurring and some landowners are conducting "pre-salvage" cuts to extract the timber before another outbreak. While not holding more deer than they are capable of in most units, some yards in the southern part of the state, particularly in the southwest, are holding more deer than they have in many years. While winters in more southern portions of the state are often mild enough that deer are not "forced" to use DWAs, deer numbers have increased over the years and during severe winters, some deer wintering areas are being heavily used. Relatively large increases in the deer population and drastic increases in development in the southern part of the state have led to "overuse" of some DWAs during these severe winters.

Throughout the state, the feeding of deer in the winter is increasing in spite of Department efforts to discourage it. Feeding deer in winter may only marginally help some individual deer while there are numerous negative aspects, for example concentrating large numbers of deer in and around feeding sites, degrading habitat and creating nuisance issues, increases in deer/vehicle collisions, and an increased likelihood of disease transmission among deer and between deer and other species. In addition to the negative effects on the deer and habitat, feeding results in the notion that deer yards aren't necessary because the deer can simply be fed. This impression trivializes the protection and importance of deer wintering areas and encourages the cutting of valuable winter cover as deer move to artificial feeding areas.

In all cases, development poses the biggest threat to deer wintering areas. Timber harvest operations can be carried out in ways that minimize long-term impacts on and even enhance deer wintering areas but when these areas are cleared for development, the ability of the habitat to sustain healthy deer populations through severe winters is greatly reduced or completely removed.

C. Habitat Projections

Increases in human population and development are expected to continue, probably at close to present rates for at least the next 10 years. This will continue to result in habitat loss and degradation and increase the potential for deer-human conflicts. There is however at least some evidence that in the last decade (2000-2010), the rates of human population growth and housing unit construction have slowed somewhat, although they are still generally increasing. Table 10 compares average annual changes in human population and housing units over the last 5 decades to the most recent decade (2000-2010).

In all counties the rates of human population increase have declined in the last 10 years from what they averaged over the past 5 decades. Statewide, the human population of New Hampshire increased an average of 17.08% per year from 1960 to 2010 (ranging from –8.20% in Coos County to +25.35% in Rockingham County) and has increased an average of 7.08% per year from 2000 to 2010 (ranging from –32.60% in Coos County to +10.34% in Strafford County). The annual increase in the number of housing units in the last 10 years has also declined in all counties from the rate seen over the last 5 decades. Statewide, it has decreased from +24.59% per year (1960-2010) to +11.66% per year (2000-2010). All counties, except Coos, continue to exhibit increases over the last 10 years ranging from -25.86% per year in Coos County to +15.82% per year in Belknap County. While these trends are affected by numerous factors including the national economy, there's little evidence to suggest dramatic changes in these trends in the near future.

Vegetative types will likely remain similar, at least in the short term as soil conditions and climate are very unlikely to change sufficiently in the near future to have a noticeable effect. Potential outbreaks of diseases or pests, for example spruce budworm or hemlock wooly adelgid (*Adelges tsugae*), may affect individual species or groups of species and negatively impact habitat quality and/or quantity for deer. The two examples previously mentioned are of particular concern since they effect the softwood tree species that comprise the majority of deer wintering areas in the northern and southern portions of the state respectively and hence could dramatically impact this critical component of deer habitat.

The wood products industry and the associated timber harvests, including sawlogs, pulp, chips and firewood, can have both positive and negative impacts on deer habitat depending on the purpose of the cut and the sylvicultural practices employed. Timber harvest in a well

managed commercial forest or private woodlot can improve browse availability for deer with minimal negative impacts on other habitat components. The timber harvests associated with land clearing for development are simply an ancillary effect of human population growth and its associated negative impacts on habitat quality and quantity.

Population Assessment

White-tailed deer have been "residents" of New Hampshire since suitable habitat became available (see Habitat Assessment above). Quantitative information however is simply not available for early years and "population estimates" are just that, estimates. Recent estimates of deer populations are based almost exclusively on mathematical modeling efforts, primarily using information derived from the deer harvest. The models invariably make numerous technical assumptions about the relationships between model inputs and results, which while generally true, may not apply for particular areas in particular years. In addition, much of the harvest information used in population modeling is derived from harvest samples, which are frequently quite small, and hence subject to relatively high levels of imprecision. The net result is that population estimates should generally be viewed with some skepticism and it should always be born in mind that potential sampling error results in estimates that are in reality a range of likely or probable values, not a single accurate number.

While estimating the deer population in New Hampshire, or anywhere else, can be difficult, other information can provide a relatively accurate and easy to obtain index to the population. A good population index will track changes in the actual population (i.e. go up or down when the population does, and to the same degree). A good population index should also be useful and relatively easy to obtain. For deer in New Hampshire, the adult buck kill within each WMU tracks its population changes and is easily derived from harvest information. Consequently, it serves as our best index for assessing population levels and establishing population goals and objectives. With all this in mind, we'll now attempt to assess the deer population in New Hampshire over the past 360 years.

A. Historical Perspectives

Deer population assessments from pre-colonial and colonial times are the epitome of qualitative information. As reported by Silver (1957), the best possible interpretation of early

records results in “absent”, “scarce”, “common” and “plentiful” as the most accurate descriptors available. It is necessary to use caution even in interpreting these terms however since “plentiful” likely meant a deer population averaging between 10 to 15 per square mile, not the 100+ per square mile seen in some populations (not New Hampshire). Additionally, those estimates of 10-15 deer per square mile applied to southern New Hampshire, not the mountains and further north where habitat, winter weather, and predation constraints were more intense.

Deer appear to have been considered plentiful in southern New Hampshire, at least up through 1700 when increasing settlement with its increased land clearing and deer harvest pressure resulted in population declines. By 1850, land clearing was about at its maximum and for much of the preceding 150 years deer hunting had been a year-round pastime if not occupation. By the late 1800’s deer were considered scarce. At this time, improved management, law enforcement and farm abandonment all contributed to produce slow deer population increases until by 1950, they were once again considered plentiful. This increase was aided dramatically by the hurricane of 1938 that resulted in improved habitat conditions as forests began to regenerate.

Northern New Hampshire (i.e. Coos County) was settled approximately 100 years later than southern New Hampshire but from the earliest reports up through about 1800, deer were considered generally scarce up north. There appears to have been periods of time and places where deer were more abundant as populations fluctuated in response to winters and predators. Settlement in the north led to deer population increases due to the influence of several factors. “Perhaps the greatest influence in this direction was destruction of the wolves which the settlers prosecuted with great diligence.” Additionally, clearing of land for agriculture and timber harvest led to improvements in browse availability although these factors were thought to have had minimal impact. This increase in deer numbers occurred during the early 1800’s and appears to have peaked about 1830. The reappearance of the wolf and the notion that eliminating the deer would solve the wolf “problem” (see Past Management above), lumber camp meat hunting and other forms of market hunting decreased deer numbers to the point of scarcity by the late 1800’s. As in the south, curtailment of over-harvest through management and enforcement resulted in population increases through the early 1900’s. Since the extirpation of the wolf, northern deer populations are primarily influenced by hunting and winter severity.

B. Recent Status

As we enter the 20th century, deer harvest reporting, which began in 1922, and became a mandatory registration and sealing system in 1967, allows a more quantitative assessment of deer populations through the use of adult buck harvest estimates as an index to abundance. Figure 5 provides estimates of New Hampshire's deer harvest from 1922 through 2013 on a Wildlife Management Unit (WMU) and sex specific basis. Most WMUs around the state show a very similar pattern in deer harvest, increasing numbers from 1922 through about 1970 followed by rather precipitous declines through the 1970's and early 1980's resulting from the severe winters and high doe kills of that period. The exceptions to this generality are seen in the more southern WMUs, for example H2, K, J2, L and M. These units, while they exhibited highly variable harvests from year to year, were relatively more stable long-term and did not exhibit the dramatic decrease from 1970 to 1983. In all the graphs, note that the male and female harvests were very nearly equal (1:1) throughout the period from 1922 through the mid-1980's.

With the reduction in antlerless (i.e. doe) harvests in the mid-1980's, harvests have generally increased over the past 30 or so years, comprised mostly of increasing male harvests. Several WMUs, particularly those in the White Mountains (C1, E, and F), have not seen harvests increase to anywhere near former levels. This is likely due to the very low populations that were left in these areas by the mid-1980's and changes in habitat due to reduced timber harvests that have likely decreased browse availability and general deer habitat quality. Other units around the state have seen various degrees of harvest increase since 1987 but southern units (especially units K, L and M) have shown the most dramatic harvest increases. Harvests tended to decline somewhat from about 1997 to 2003 (period between previous two assessments) as antlerless harvests often exceeded desired levels and severe winters occasionally occurred. Since 2003 harvests have tended to increase or remain stable in nearly all units. All units show generally the same trend of increasing harvest from 2003 to 2007, then declining harvest due to a severe winter during the winter of 2007-08. In the last few years harvest levels have rebounded near or above 2003 levels in nearly all units. The two units showing the largest declining trend (A and B) are both currently at their 2006 population objectives.

While not apparent in Figure 5, there has been a general shift in the deer population across the state from the north to south, at least in relative terms, over the past 80 years as indexed by the adult buck kill (see Table 11). While adult buck kills have increased dramatically

over the past 80 years, and again since populations reached a recent minimum in the decade from 1974 to 1983, this increase has generally been more pronounced in the southern portions of the state, and particularly the southeast. The northernmost units (A, B and C2) accounted for an average of 27.8% of the adult buck kill during the first roughly 2 decades of records (1922-1943). In the past 2 decades (1994-2013) this percentage has dropped to 8.3%. The southeastern portion of the state (units J2, K, L and M) accounted for an average of 21.1% of the harvest during the first 2 decades and 44.8% in the last 2 decades. The White Mountain area (units C1, E and F) accounted for an average of 8.8% of the adult buck kill in the first 2 decades and 3.4% in the last two. This indicates a shift in relative deer abundance from the northerly areas to the southern portion of the state over the years.

In absolute terms (the number of adult bucks killed), almost half of the state's WMUs have achieved record high adult buck kills (and by implication, populations) during the last decade (2004 to 2013). These units include D2W, G1, H1, H2, I2, J2, K, L, and M. Units A and D1 achieved peak adult buck harvest in the previous decade (1994 to 2003). The remainder achieved peak adult buck harvests in the decade from 1954 to 1963 (units B and I1) or in the decade from 1964 to 1973 (units C1, C2, D2E, E, F, G2 and J1). In many cases those units that peaked in the periods 1954-1963 or 1963-1974, while not back to previous levels are close (for example units B, C1, I1 and J1). Other units, primarily those in and around the White Mountains, have not exhibited the same degree of recovery, likely due to their very low densities in the 1970's and 1980's as well as higher predation rates and decreases in deer habitat quality owing to forest maturation.

The WMU specific estimates of 2-year running mean adult buck kill in relation to the adult buck kill objectives established by the 2006 Deer Management Plan are given in Figure 6. Many units are at or approaching the existing objectives including units A, B, D2W, E, H1, H2, and J1. A few units are above the existing objectives including units G1, J2, L, and M. The objective for unit M was to decrease the population (adult buck kill), however, population growth has only been slowed in this unit with the only significant reductions following winters of above average severity. Other units have exhibited slow and somewhat erratic increases toward the population objectives; these units include C1, C2, D1, F, G2, I1 and I2. While these units have not successfully reached their objective many of them have increased substantially since the 1980s and some are approaching record adult buck kills (I1 and I2). In the case of unit

D2E, efforts to increase the adult buck kill toward the established objective has met with little to no success. However, it is important to note that this unit was split as of 2012 from D2 to D2E and D2W. When this unit was split a simple split of the objective was also performed. As you can see from Figure 6 the current objective is set well above the peak adult buck kill experienced in the late 1960s and is likely unrealistic. Note that the goals for many of the units that have yet to reach objective (C1, C2, D1, F, G2, I1, and I2) were set at, near, or above the peak levels of adult buck kill seen in the late 1960's. As previously mentioned, these may not be realistically attainable due to changes in mortality pressures and habitat quality.

In terms of actual deer population density in New Hampshire, estimates indicate that deer numbers have been, are and will continue to be on the low side compared to other jurisdictions to our south and west. Maine has an estimated pre-hunt population averaging 9.9 deer per square mile of habitat (K. Ravana, MDIFW, Pers. Comm.). Recent estimates from New Hampshire (which are derived from similar data using similar modeling methodology) are 12.3 deer per square mile of habitat (100,118 deer in 8,140 square miles of deer habitat). Current density estimates in Maine and New Hampshire are based on harvest data including the sex and age composition of the kill in addition to estimates of productivity and non-hunting mortality. Because of the reliance on harvest data however, populations can be under-estimated in areas with limited hunter access or in areas of very low hunter pressure. Moving south and west from New Hampshire, states with less severe winters, higher overall soil productivity, and in some cases limited ability to control populations, can see deer populations averaging 30-40 per square mile and locally in excess of 100 per square mile.

While past methods for estimating the deer population in New Hampshire are unknown, the 1980 plan (NHF&G 1980) called for maintaining a winter (post-hunt) herd of 40,000 deer statewide. Given the desired annual harvest of 9,000 at that time, the pre-hunt population would be estimated at about 49,000. If deer habitat were of roughly the same extent (about 8,140 square miles), the statewide pre-hunt density would have been about 6.0 per square mile of habitat. The 1990 draft plan (NHF&G 1990) for deer estimated the statewide pre-hunt population at about 40,000 (4.9 per square mile of habitat) and established the goal of harvesting about 9,500 deer (see Table 3) from a population of 75,000 (about 9.2 per square mile of habitat). Recent population density estimates from around the state range from generally less than 4 deer per square mile of habitat in the White Mountains to 18-24 per square mile in more southern

WMUs and as mentioned above have been averaging about 12 per square mile statewide. At more local levels, densities may be considerably higher or lower than WMU averages, particularly where legal harvest is unable to control populations in the former case or where the effects of legal hunting and/or other mortality exceeds average. These local variations in deer density can be very difficult to address from a deer management perspective, and yet have significant influence on hunter and public opinion.

As both deer and human populations have increased since the early 1980's, the potential for human-deer conflict has increased. Increasing deer numbers as well as the permeation of deer range by suburbia, has set the stage for residents who have previously not faced deer problems to be exposed to that potential. Figure 7 gives the number of calls for assistance related to deer damage received by Wildlife Services in New Hampshire from 1988 through 2013. These data indicate a strong upward trend from 1988 through 1993 likely reflecting increasing deer and human populations as well as increased awareness of a program to provide assistance. Subsequent data suggest no trends over time and only indicate annual variation likely influenced strongly by local food availability and winter severity. Information on the type of request for assistance, agricultural or non-agricultural, is available from 1993 through 2013. Over that 21-year period, the percentage of annual requests which are agriculture related have ranged from 38.8% to 87.1% and exhibit no clear pattern over time. On average over the 21 years from 1993 to 2013, 60.1% of requests have been agriculture related while 39.9% have been non-agriculture related.

C. Future Potential

Potential deer population growth in New Hampshire is subject to numerous constraints, both biological and sociological. Deer densities in excess of 20 per square mile have resulted in social intolerance in neighboring states due to the increasing safety (i.e., from a vehicular collision perspective) and nuisance concerns (NHF&G 1997). This is particularly true for areas such as New Hampshire in which deer densities over the past 25 years have in general been much below this level. In addition to social intolerance playing an increasing role in limiting deer density as deer densities increase toward 20 per square mile, the availability of high quality deer wintering habitat would play a crucial role in attaining and maintaining these densities. Severe winters have and will continue to play an important role in regulating deer density.

Habitat and deer populations are somewhat similar in Maine and New Hampshire and estimates of biological carrying capacity in Maine's deer management units based solely on summer habitat quantity and quality (Lavigne 1999) averages 63 deer per square mile. However, given estimates of wintering habitat quality and quantity in Maine and under "normal" winter severity, an average of 19 deer per square mile could be sustained, ranging from about 5 deer per square mile in some northern areas to upwards of 60 deer per square mile in some southern areas that are only rarely subject to severe winters (Lavigne 1999). It is these southern areas in Maine and New Hampshire that, while they have the highest biological potential to support greater deer densities, also have the highest human densities and greatest intolerance for deer "overpopulation." In past planning efforts in Maine, maximum desired pre-hunt deer densities did not exceed 24 deer per square mile. This is also probably about the upper limit of long-term biological and cultural carrying capacity for deer in New Hampshire's "best" deer habitat as well. Based on New Hampshire data, this density (24 deer per square mile) would equate to an adult buck kill of approximately 1.8 per square mile [refer to Table 5 for the 2006 goals in terms of adult buck kill per square mile (range 0.15 to 1.27)]. Currently WMU M is the only unit at this level with an adult buck kill of 1.7 per square mile. However, other southeastern units are approaching this level (J2, K, and L).

Any estimate of the future potential of deer in New Hampshire has to consider the loss of both summer and winter deer habitat. So long as development is the primary political and economic objective for land use in New Hampshire, deer habitat quantity and quality (and that for other wildlife) will only continue to decline, as will hunter access as suburbanization continues to increase.

Use and Demand Assessment

Use and demand have both consumptive and non-consumptive components and almost always involve both quantitative and qualitative perspectives with regard to desires and satisfaction. In addition, demand can have both positive and negative aspects and can rapidly change in accordance with changing human values or desires. For the most part though, deer are usually perceived in a positive light by the majority of people, most people like them, whether for aesthetic and/or pragmatic reasons. While deer are an important part of New Hampshire's

fauna and ecosystem, the use of and demand for deer from a societal and cultural perspective will likely be a major component of deer population management decision making.

A. Historical Perspectives

The use of and demand for deer and the products they provided during pre-colonial and colonial times have already been touched upon in the sections on "Deer Management" and "Population Assessment." Reliance on deer for food, clothing and other materials made early "use" a necessity for survival and "demand" a simple matter of taking advantage of what nature provided. The use and demand of early subsistence gave way through the 1800's to the use and demand associated with market hunting and recreation in addition to subsistence. Deer management and law enforcement interests in the late 1800's and early 1900's placed limitations on market hunting, making hunting for food and recreation the primary factors associated with use and demand.

It wasn't until hunting licenses were required in New Hampshire that some quantifiable estimate of demand could be made. Use estimates associated with legal harvest became available beginning in 1922 with mandatory registration. While not all hunting license holders are deer hunters, the majority of them are. For the purposes of this historical discussion, no distinction will be (or can be) made between licensed hunters and deer hunters. In the following section on "Recent Hunter Participation and Effort", this will be discussed in greater detail. Hunting license sales are given in Figure 8. While license sales began in the early 1900's, actual license sales figures are not available prior to 1926 (Silver 1957). License sales for the period 1926 through about 1940 remained relatively stable between 50,000 and 60,000 with the clear majority being purchased by residents. The period of the mid- to late 1940's saw hunting license sales increase rapidly as the generation of the WW II era began to enter the hunter pool. A similar phenomenon was observed in Maine as hunting license sales increased dramatically in the 15 years following WW II (Lavigne 1999).

New Hampshire's hunting license sales peaked at about 112,000 in 1951, and then exhibited a precipitous decline in 1952. This decline was not due to a dramatic change in the number of hunters but rather was related to a change in the types of licenses being sold as well as fee increases. Before 1952, residents could only buy a combination license, good for both hunting and fishing. Without doubt some of these were being purchased by anglers that did not

hunt. In 1952, resident combination licenses were still available, but a resident hunting license was also made available for the first time. Consequently, license sales figures for 1952 on reflect individuals who are likely hunters and anglers (combination license holders) and those who are hunters (hunting license holders). A similar change in non-resident license availability occurred in 1948 but no noticeable change in sales resulted. A peak in license sales was again reached in 1969 at approximately 99,000 followed by a rather slow but steady decline over the next 35 years, although considerable annual variation has occurred. Over the last decade or so license sales have begun to stabilize. Since 2004 license sales have ranged from 55,027 to 59,987 and averaged 57,471.

An archery license was first made available in New Hampshire in 1949 and 136 archery hunters took advantage of the new opportunity (see Figure 9 for archery license sales from 1949 to 2013). Numbers remained low throughout the 1950's and early 1960's when increasing opportunity (i.e., longer seasons) and improved equipment began a dramatic and continuous increase in archery license sales through the mid-1990's. The year 1996 saw a pronounced spike in archery license sales (reaching 28,177) due to the "grandfathering" of bow hunter education requirements for the 1997 archery season. Subsequent declines in license sales from 1997 through 2003 likely reflect reductions in opportunity due to either-sex hunting limitations and/or license fee increases. Archery license sales have stabilized since 2003 and even experienced slight increases, likely due to increases in either-sex hunting opportunity throughout the state during the archery season.

A muzzleloader license and season were established in New Hampshire in 1963 when a mere 3 individuals bought licenses (see Figure 10). Like archery however, license sales began to increase rapidly in the 1970's, again, primarily in response to increased opportunity (i.e., season length). License sales continued to increase through the 1980's and 1990's while at the same time, again like archery, tremendous advances were being made in muzzleloading weapons and equipment. License sales peaked in 1999 at 31,024 and slowly declined till 2005. Similar to archery licenses, these declines are likely related to reductions in either-sex hunting opportunity and/or fee increases. Sales have been relatively stable since 2005, with only a small dip in 2009 and 2010; likely due to decreases in the deer population after a severe winter in 2007-08.

There are many ways to assess success in meeting hunter desires that include both the quality of the experience in addition to the outcome of the experience. Hunter success rates are

commonly used as a gauge to the latter. In New Hampshire, average success rates, while extremely variable, have generally increased over the years (Table 12). From the early 1960's through the mid-1980's, average success was generally 4-6%. Regular firearm hunters historically had the highest success rates, generally running 10-12% through much of the 1960's, falling during the late 1970's through mid 1980's before rebounding to roughly 10-12% from the mid 1990's through the early 2000's. The past decade (2004-2013) has experienced some of the highest success rates ranging from 12.3-16.0% and averaging 13.8%. Archery hunters have exhibited a more or less steady increase in success over the years due to increasing opportunity, improvements in equipment and probably, increasing deer numbers, especially in more southern areas. By the late 1990's archery success rates had become similar to (but were still below) firearm success rates. Since 2006 (with the exception of 2010) archery success rates have surpassed firearm success rates. This change has likely been due to advancements in archery equipment, as well as a substantially longer archery season with more either-sex hunting opportunity. Muzzleloader hunters are typically mid-way between archers and regular firearm hunters.

B. Recent Hunter Participation and Effort

While license sales, particularly archery and muzzleloader licenses, probably provide a reasonable index to participation, it's clear that not everyone who has a hunting license hunts deer, and not everyone who hunts deer hunts every year or every day of the season. Certain days of the various seasons see the majority of hunter effort. In 1991 the percentage of hunters in New Hampshire who hunt deer was estimated at 83% (U.S. Dept. of the Interior and U.S. Dept. of Commerce 1993). By 2001 this estimated percentage had changed little and was 86% (U.S. Dept. of the Interior and U.S. Dept. of Commerce 2003). In 2011 this number had dropped to 69% (U.S. Dept. of the Interior and U.S. Dept. of Commerce 2013). On average, over this time period, it appears that 79% of New Hampshire's licensed hunters are deer hunters. Additionally, our most recent estimates show that 20% of New Hampshire residents over 18 years old had hunted within the past 5 years when surveyed in 2014 (Duda 2014). Of this 20% however, participation was far from regular. Only 54% of these individuals had hunted all 5 years while 6% had hunted 80% of the time (4 of 5 years), 7% had hunted 60% of the time (3 of 5 years), 21% had hunted 40% of the time (2 of 5 years) and 9% had only hunted 20% of the time (1 of 5

years). This suggests that considerably more people consider themselves hunters than actually participate, and by implication, buy hunting licenses in any given year. Hunting license sales are discussed further in this section under "D. Projected Use And Demand".

The hunter effort associated with deer hunting in New Hampshire was estimated at 669,400 hunter days in 1991, 1,001,000 hunter days in 2001, and 936,000 in 2011 (U.S. Dept. of the Interior and U.S. Dept. of Commerce 1993, 2003, and 2011). The increase from 1991 to 2001 was probably the result of the increase in the number of reported individuals hunting deer, as well as expanded participation in the archery and/or muzzleloader seasons. Effort in 2011 was lower than 2001 and higher than 1991. These differences were likely the result of the decrease in the reported number of deer hunters from the previous two time periods and the continued expanded participation in the archery and/or muzzleloader seasons. Within seasons, estimates of hunter effort, at least in relative terms, can be estimated from various mail surveys conducted by the Fish and Game Department. There is always an opening day phenomenon associated with various seasons whether they are hunting, fishing or Major League Baseball. It seems that regardless of when these days fall, weekdays or weekend days, participation is always highest on the opening day.

Figure 11 gives the estimated percentage of regular firearm hunting effort (hunter trips) that occurred on each of the first 12 days of the season from 1994-2003 and 2004-2013. This information is based on "deer hunter mail survey" data and is limited to the first 12 days of the season because hunters are requested to return their survey cards after the 12th day of the season to insure data can be entered and made available for use in assessing season results and in season setting. The opening day of the regular firearms season is on a Wednesday and in excess of 15% of the hunting effort for the first 12 days of the season occurs on that day. During the remainder of the week, hunting effort steadily declines but on the 4th day, a Saturday, effort increases again to account for roughly 13-14% of the total. The 5th day, Sunday, remains relatively high at about 11% but on the 6th day, Monday, effort drops off dramatically and remains low until the following weekend (the 11th and 12th days of the season) when there is another increase, but not the of the same magnitude as on the first weekend. In addition to the opening day phenomena, hunting pressure is higher early in the season due to the general availability of either-sex hunting opportunities at that time. While good data are not available from the mail survey, evidence indicates that hunting pressure drops off dramatically on the Monday following the second

weekend of the season (the 13th day). There are however other small peaks in effort on subsequent weekends, particularly the 4-day Thanksgiving weekend when considerable hunting effort can occur, especially if hunting conditions are good, for example following fresh snow. The distribution of effort between the two time periods was nearly identical.

Muzzleloader effort shows a similar pattern during the 11-day season (Figure 12). The muzzleloader season opens on a Saturday and that day accounts for roughly 16% of the total effort. Sunday, the 2nd day of the season accounts for about 15%. On subsequent weekdays, days 3 through 7 of the season, effort drops off and ranges from about 5-8% each day. The second weekend sees another increase, followed by another decline on the final 2 days. As with firearms the distribution between the two time periods was nearly identical.

There are also considerable differences in hunting effort geographically. Figure 13 gives the percent of hunting effort occurring in each WMU during the first 12 days of the regular firearm season. Not surprisingly, southern WMUs account for the vast majority of hunting effort as they tend to be home to most hunters and deer. Additional areas which exhibit relatively high hunter effort are WMUs H1 and H2 along the Connecticut River in western New Hampshire, and WMU A, a popular spot for those wanting the "great north woods" hunting experience. Those units in the White Mountain and Central portions of the state exhibit the lowest percentages of hunting pressure. The distribution of muzzleloader hunting effort (see Figure 14) is nearly identical to the pattern exhibited during the regular firearm season. These distributions were also very similar between the two time periods with only minor fluctuations in some WMUs.

The archery season exhibits a somewhat similar pattern (see Figure 15) except the effort is somewhat more concentrated in southeastern WMUs and less so in more northern WMUs. The archery effort information was derived from the "bow hunter mail survey" (which was primarily designed to monitor small game and furbearer observation rates) and was limited to approximately the first 8 weeks (56 days) of the 92-day season. This was also the result of requesting that hunters return their cards in time to get the information entered and analyzed. This survey was discontinued after 2008 due to low response rates and high costs to the department. Also, no data exists for 2007 as the survey was not sent out that year. Available evidence indicates however that the majority of bow hunting effort occurs earlier in the archery season, prior to the opening of the muzzleloader season and firearms seasons.

Figures 13 through 15 illustrate the dramatic differences in the geographic distribution of hunting effort across the state, but a better sense of relative hunter density and the possible perception of crowding can be gained by looking at effort per square mile of habitat per day. This also allows the comparison of relative effort among the different seasons on a daily basis. Figure 16 gives the estimated hunter effort per square mile of habitat per day for the first 12 days of regular firearms season from 1994-2003 and 2004-2013. This is highest in the southeast (WMUs L and M) where effort is estimated at about 5-7 hunter trips per square mile per day. Because of variation at a more local level due to differences in access and habitat quality, hunter effort could be much higher or lower (in any given area). The muzzleloader effort per square mile of habitat per day (Figure 17) follows a pattern similar to the regular firearms season except the overall effort is generally about half as much. The highest values seen are again in WMUs L and M but these are only about 3-3.75 hunter trips per square mile per day. Lower muzzleloader effort reflects the fact that there are roughly half as many participants. The lowest values during both seasons occur primarily in the White Mountains and are generally less the 1 during the regular firearm season and less than 0.5 during the muzzleloader season. Patterns were again similar between time periods.

The archery hunting effort per square mile per day (Figure 18) is also highest in the southeast and particularly in WMUs L and M at about 1.2 to 1.4 hunter trips per square mile per day. While there are approximately similar numbers of archery hunters and muzzleloader hunters, generally the effort per square mile per day for archery hunters is roughly half as great as for muzzleloader hunters. One needs to bear in mind however that the muzzleloader effort per day is spread over an 11-day season while the archery effort per day is being estimated based on a 56-day time period. The total statewide effort expended by muzzleloader hunters is estimated to average about 118,000 hunter trips per year while archery hunters are estimated to average about 182,000 hunter trips for the 56 day period for which data are available. Hence estimated overall archery hunter effort is probably at least 1.5 times that of muzzleloader hunters, as the "recreational opportunity" associated with days afield is also much greater. Much of the total archery effort (about 60%) occurs in the southeast portion of the state, specifically WMUs J2, K, L and M (see Figure 15). Over the last 10 years total effort per year (statewide) for both firearms and muzzleloader hunters has remained relatively stable (Figure 19). It stands to reason that

archery hunting effort likely remained stable over this same time period. However, no survey data is available for 2007 and the survey was discontinued after 2008 so no trend is apparent.

It was estimated that in 2001 deer hunters generated a total of 1,001,000 hunter days of effort in New Hampshire (U.S. Dept. of the Interior and U.S. Dept. of Commerce 2003). This represented 88.8% of big game hunting effort and 68.6% of all hunting effort. By 2011 deer hunting effort was estimated to be 936,000 hunter days (U.S. Dept. of the Interior and U.S. Dept. of Commerce 2013) and represented 88.6% of total big game effort and 68.9% of all hunting effort in New Hampshire. All this effort directed at deer hunting doesn't come cheap. The most recent (for 2011) estimate of hunter expenditures in the state of New Hampshire was $57,317,000 (U.S. Dept. of the Interior and U.S. Dept. of Commerce 2013). Of this, 48.1% or $27,545,000 was related to big game hunting. This was 67.1% associated with trip related expenses including food, lodging and transportation and 32.9% associated with equipment purchases. Non-residents contributed $19,093,000 or 33.3% of these expenditures. These estimates exclude economic multipliers commonly used to calculate economic activity.

In 1991, 14.1% of hunters hunted on public land, 58.5% of hunters hunted on private land and the remaining 27.4% hunted on a mixture of both public and private land (U.S. Dept. of the Interior and U.S. Dept. of Commerce 1993). By 2001 these proportions had changed slightly with 12.2% of hunters hunting public land, 55.4% hunting private land and 32.4% hunting both (U.S. Dept. of the Interior and U.S. Dept. of Commerce 2003). By 2011 only 7.8% of hunters hunted on public land, while 72.5% hunted on private land, and 19.6% hunted on a mix of both. Over this time period there has been an overall decrease in the percentage of hunters hunting public land or a mixture of both and an increase in the percentage hunting private land only. The implications of this are unclear as it may represent a change in hunters, a change in land ownership or both. However the majority of land in New Hampshire is in private ownerships (~80%). Hunters tend to generally be more rural with 68% claiming rural residency versus 32% claiming urban residency in both the 1991 and 2001 surveys (U.S. Dept. of the Interior and U.S. Dept. of Commerce 1993 and 2003). By 2011 this had changed little to roughly 65% rural and 35% urban (U.S. Dept. of the Interior and U.S. Dept. of Commerce 2013). This contrasts sharply with the general population that was 45% urban and 55% rural in 1991 but had shifted to 56% urban and 44% rural by 2011 (U.S. Dept. of the Interior and U.S. Dept. of Commerce 1993 and 2013). Urbanization of the general population in New Hampshire increased by 11% from 1991 to

2011 while hunters continued to be predominantly rural (≈65%) over the same time period. This suggests that the decline in hunter numbers may be due (in part) to increasing urbanization of the population.

There is frequently demand for increased hunting opportunity on the part of some individuals or interest groups and while this frequently takes the form of demand for special seasons for specific weapons, 1999 saw the beginning of New Hampshire's youth hunt for young deer hunters. This youth hunt now occurs on the weekend before the opening of muzzleloader season. It was designed to introduce youngsters to New Hampshire's tradition of deer hunting at a time of year when legally licensed adult hunters could mentor youths prior to the increased hunting pressure associated with the muzzleloader and regular firearms seasons. The youth hunt allows the use of any legal weapon and is an either-sex hunt statewide.

The youth hunt began as a single day back in 1999 and resulted in a statewide harvest of 95 deer. The current "Youth Weekend" was established in 2000 and in that year 193 deer were taken statewide. Since 2000 the harvest has generally increased and has averaged 365 deer and comprised roughly 3% of the total harvest. 2006 saw the highest youth kill with 668 deer (6% of the total harvest). Since youth hunters are not required to have a license, it is not possible to directly measure participation in this season. If harvest alone is used as a measure of participation, the number of youth hunters participating on this weekend may have increased 150% between 2000 and 2013. It's possible to estimate a minimum number of participating youth by making some assumptions about their success rate. Assuming the youth hunters have a success rate of 5% (about half that of all New Hampshire deer hunters and likely an overestimate given they only have 2 days), the average estimated number of youths participating since 2000 would be 7,300.

C. Non-consumptive Use

The "use" of deer for non-consumptive purposes, like that for many other wildlife species has gained in popularity over the years. Viewing and photographing are typical non-consumptive uses but aesthetic and ecological values also influence demand from a non-consumptive point of view. In 1995, 92% of New Hampshire residents indicated that their interest in New Hampshire's wildlife was medium to high while only 1% indicated no interest (Duda and Young 1995). By 2004 this number had increased slightly to 98%, while still only 1% indicated no interest (Duda

2004). In 2014 this number had declined again to 91% of residents who indicated medium to high interest in wildlife while 2% indicated no interest (Duda 2014).

Additional detail on non-consumptive wildlife use and demand (but not specifically deer) is provided in U.S. Dept. of the Interior and U.S. Dept. of Commerce (1993). In 1991 it was estimated that 448,600 New Hampshire residents participated in non-consumptive wildlife related activities or about 52% of the population. At that time only 22% of the population were "sportspersons" (hunters or anglers) so participation in non-consumptive use was 2.4 times as high as hunting and fishing. Residential activities (within 1 mile of home) included observing wildlife (82% of participants), photographing wildlife (34%), feeding wildlife (91%) and the maintenance of wildlife plantings or natural areas (28%). Non-residential (over 1 mile from home) included observing wildlife (88% of participants), photographing wildlife (46%) and feeding wildlife (34%). There was a tendency for participants to be more rural (61%) than urban (39%), recalling that the general population in 1991 was 55% rural and 45% urban. Hunters participated in non-consumptive activities at a higher rate than did the general public (65% of hunters vs. 52% for the general public). The economic impacts were great with an estimated $117,910,600 spent by New Hampshire residents on non-consumptive wildlife related activity in 1991.

Similar information is available for 2001 (U.S. Dept. of the Interior and U.S. Dept. of Commerce 2003) when it was estimated that 450,000 New Hampshire residents participated. This is nearly identical to the 1991 figure. However, as a percentage of total population, participation decreased from 52% in 1991 to 47% in 2001. Similarly, the percentage of the population who were sportsmen decreased from 22% to 18% resulting in non-consumptive participants outnumbering sportsmen by about 2.6 times in 2001. Residential activities in 2001 included observing wildlife (74% of participants), photographing wildlife (29%), feeding wildlife (89%) and the maintenance of wildlife plantings or natural areas (29%). Non-residential participation in 2001 included observing wildlife (93% of participants), photographing wildlife (50%) and feeding wildlife (24%). There was still a tendency for participants to be more rural (58%) than urban (42%), but not as pronounced as in 1991. This reflects greater urbanization of participants and the general population trend that was 47% rural and 53% urban in 2001. This urbanization of New Hampshire is likely also involved in the overall decrease in percentage participation (from 52% in 1991 to 47% in 2001) while the actual number of participants

remained unchanged. In 2001, 70% of hunters engaged in non-consumptive wildlife related activities, up from 65% in 1991. This is a fairly large increase and while it was perhaps largely due to increased general interest in wildlife on the part of hunters, it may have in part been due to the marketing strategies and advertising associated with such things as “scouting cameras”, “wildlife food plot” planting, and wildlife feeding, especially in winter, non-consumptive activities that became increasingly popular with deer hunters.

Information for 2011 (U.S. Dept. of the Interior and U.S. Dept. of Commerce 2013) estimated that NH residents participating in non-consumptive activities had decreased to 388,000, and as a percentage of total population, participation continued to decreased from 47% in 2001 to 36% in 2011. Similarly, the percentage of the population who were sportsmen continued to decrease from 18% to 16% resulting in non-consumptive participants outnumbering sportsmen by about 2.3 times in 2011. Residential activities in 2011 included observing wildlife (75% of participants), photographing wildlife (45%), feeding wildlife (82%), the maintenance of wildlife plantings or natural areas (27%), and visit parks or natural areas near home (13%). Non-residential participation in 2011 included observing wildlife (99% of participants), photographing wildlife (67%) and feeding wildlife (sample size was too small to report data reliably). The percentage of rural (60%) versus urban (40%) participants was nearly identical to 2001. Continued urbanization of New Hampshire may be involved in the decrease in both the total number of participants from 2001 to 2011 and the continued decrease in percentage participation (from 52%, 47%, and 36% in 1991, 2001, and 2011 respectively). In 2011, only 26% of hunters engaged in non-consumptive wildlife related activities, down from 70% in 2001 and 65% in 1991. This shows a dramatic decrease in NH hunters participating in non-consumptive wildlife related recreation, the cause of which is unclear. It is important to note that the 2011 numbers were noted as being based on a small sample size and may be subject to inaccuracy. This trend was also not apparent in the national data or in data from surrounding New England states.

Additional detail on the economics of non-consumptive use is available for 2011 (U.S. Dept. of the Interior and U.S. Dept. of Commerce 2013) which indicates that New Hampshire residents spent $83,914,000 in New Hampshire while non-residents spent an additional $129,220,000 bringing the total expenditures on non-consumptive wildlife related activities in New Hampshire to $213,133,000 in 2011, down from $325,658,000 in 2001. While $31,400,000

was spent in New Hampshire on bird food in 2011, $3,705,000 was spent on "food for other wildlife", a lot of which is probably deer food. Both of these numbers were up slightly from 2001.

D. Projected Use And Demand

There has been a general nationwide decrease in the number of licensed hunters and this tendency is also seen in New Hampshire (see Figures 8, 9 and 10). Although New Hampshire has seen a slight increase in license sales in the past two years, license sales are still much lower than they were historically. Numerous factors are likely contributing to this trend nationally and in New Hampshire. One of these is a general urbanization and suburbanization of society and the resulting loss of contact with the land, its resources and its traditional values and uses. A second contributing factor is the extraordinary number of competing recreational activities and demands on people's time. In spite of an increasing population in New Hampshire, we can expect the number of hunters, including deer hunters will slowly decrease over time.

While the number of hunters may decline, not surprisingly there remains high demand for deer hunting opportunity on the part of those participating. This "demand" takes many forms but may include the desire to see more deer, to have an increased opportunity to harvest deer, or "bigger" deer (variously measured in terms of body weight or antler development). In addition to these general desires, there will also continue to be the occasional "niche market" demand for special seasons based on particular weapon types or user groups. At present, the harvest pressure is likely near the maximum sustainable level in most WMUs that is compatible with achieving the existing deer population goals while maintaining an adult buck population age structure that provides a respectable number of prime bucks in the annual harvest. For the most part however, New Hampshire deer hunters continue to be primarily interested in deer hunting for its recreational opportunities and the economic and health benefits of venison. If hunter numbers continue to decrease, those hunters remaining may need to be provided the opportunity to take additional deer (i.e., increased bag limits) in order to successfully control deer populations in some WMUs.

As the human population continues to increase and deer densities also approach levels that have not been seen in New Hampshire in decades, there will undoubtedly be increased human-deer conflicts in the future. While these have not reached levels of major concern at

present (with a few isolated exceptions), the potential for deer-vehicle collisions, nuisance and damage complaints, potential negative impacts to native vegetation and wildlife, and other issues such as Lyme disease need to be seriously considered in determining the future of deer management in New Hampshire since the costs in time and money needed to address them cannot be ignored.

Another critical consideration as human populations and deer densities increase is that the availability of huntable land will likely decrease much faster than will the number of hunters. This will have several consequences effecting deer management in the future. Through increased posting of land or simply through the loss of land to development, it will become more difficult for hunters to find huntable land. This will have serious repercussions for deer management as well since hunting is the most effective tool for controlling deer populations and the potential for deer overpopulations to arise may increase. The solution to this issue is going to require significant effort in attempting to educate the public and hunters to the benefits provided by hunters to the public and the responsibilities of hunters to the public, particularly the landowning public.

The non-consumptive use of wildlife in general will likely remain high and deer will remain one of the species people both enjoy and detest most. Most people are generally passive in their non-consumptive enjoyment of deer and will only make "demands" when deer become a real or perceived problem for them. Deer feeding is most likely to be the non-consumptive activity that will result in the greatest controversy and should be discouraged at every opportunity.

Potential spread of disease to New Hampshire's deer herd will continue to be of serious concern. New Hampshire and much of New England have been fortunate in having a lack of any serious diseases in our deer herds. However, diseases such as chronic wasting disease (CWD) and epizootic hemorrhagic disease (EHD) continue to spread across the country and in many cases "jump" large geographic areas. All preventative measures should be taken to protect the state's deer herd from such diseases and continued monitoring and surveillance will be critical in early detection and containment of these diseases as it is likely a question of when, not if, these diseases arrive.

Summary

Social and cultural factors along with biological and recreational considerations serve to define the "acceptable" range of deer population densities in New Hampshire. The low deer populations and harvests seen in the early 1980's were not acceptable to hunters at the time and would be unacceptable to both hunters and probably the non-consumptive public at present. Populations at that time were well below the biological carrying capacity of New Hampshire's deer habitat and yet were well above the net effective population size recommended for long-term conservation (Soule and Wilcox 1980).

New Hampshire's generally low soil productivity and increasing habitat loss results in an upper limit to potential deer populations that is variously constrained by social and/or biological considerations. As New Hampshire's wildlife habitat is lost to development, the potential for deer overpopulation to occur becomes increasingly likely as regulated hunting becomes potentially less effective as a management tool due to decreasing participation and access. The long-term costs associated with deer overpopulation can be ecologically and economically expensive as habitat for a variety of species is degraded and the costs associated with nuisance issues and damage mitigation increase.

A variety of points of view will undoubtedly be expressed during the course of developing a 10-year plan for deer management in New Hampshire. It is critical that those responsible for establishing deer management goals and objectives avoid extremes and recognize that consensus and slow change are essential for management success. In the previous 10-year management plan some of the objectives where set at or near historical population highs of the late 1960s and where likely unrealistic expectations due to changes in land use and habitat since that time period. It is important to remember that the establishment of goals and objectives that are unattainable or unacceptable serves little purpose. It is also important to note that when determining population objectives that much of the public often desires maximum levels for a number of different wildlife species (deer, bear, moose, etc.). However, these desires are often biologically unrealistic as one species often has the ability to impact population levels of another. For example it is unrealistic to manage for high abundance of both deer and moose within the same region. High deer densities negatively impact moose populations by increasing the incidence of brainworm in moose, a parasite that has little impact in deer but is fatal to moose. The future for deer in New Hampshire is as bright as ever before, provided the plan for their

management takes into account past mistakes and successes, present concerns and desires, and future potentials and limitations.

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Table 1. Summary of reported accidental and miscellaneous deer mortality in New Hampshire from 1987 to 2013.

YEAR	VEHICLE	DOGS	NUISANCE/ DAMAGE	ILLEGAL	OTHER	TOTAL
1987	662	39	3	49	86	839
1988	734	53	5	37	97	926
1989	934	24	1	51	180	1190
1990	1000	49	0	40	137	1226
1991	864	22	2	45	126	1059
1992	1054	21	2	38	170	1285
1993	965	67	1	28	91	1152
1994	998	60	0	14	114	1186
1995	1283	2	3	14	32	1334
1996	1183	34	41	11	34	1303
1997	1223	29	20	7	20	1299
1998	1228	3	38	4	43	1316
1999	1185	1	21	2	20	1229
2000	1334	1	37	4	44	1420
2001	1371	4	30	2	32	1439
2002	1226	1	29	0	27	1283
2003	1292	9	39	6	80	1426
2004	1188	0	30	5	27	1250
2005	1182	4	28	1	27	1242
2006	1388	0	30	0	17	1435
2007	1562	1	42	3	21	1629
2008	1467	0	62	0	61	1590
2009	1441	1	71	1	29	1543
2010	1175	0	29	0	13	1217
2011	1343	0	54	2	37	1436
2012	1337	0	50	5	16	1408
2013	1548	1	54	0	16	1619

Table 2. Summary of current state statutes specifically mentioning white-tailed deer. While these statutes specifically mention deer and impact deer management authority in New Hampshire, numerous additional laws also affect the taking and management of wildlife species in general, including deer. *This table should not be construed to be a complete listing of applicable laws.*

RSA	Summary of Effect(s)
207:10-c	Authorizes the Executive Director to issue crossbow permits to certain disabled persons for the taking of deer (and various other species).
207:22	While RSA 207:22 addresses "Wildlife Damage Control" generally, issuance of pre-damage deer kill permits is specifically authorized by RSA 207:22-c-III(b).
207:55I(b)	Sets the legal restitution for the illegal taking or possession of deer at $250.
208:2	Executive Director is "rulemaking authority" for deer seasons
208:3 I-V	Restricts the use of breech-loading rifles for deer hunting in various towns or portions thereof in Belknap, Hillsborough, Merrimack, Rockingham and Strafford Counties.
208:3-a	Restricts the use of breech-loading rifles and buckshot for deer hunting in various towns.
208:3-b	Restricts the use of breech-loading rifles and buckshot for deer hunting in Chester.
208:3-c	Restricts the use of breech-loading rifles and buckshot for deer hunting in Auburn.
208:3-d	Restricts the use of handguns for the taking of deer to certain calibers and capacities.
208:4	Prohibits the use of .22 caliber rimfire firearms for the taking of wild deer.
208:5	Authorizes the sale of archery licenses, the establishment of an archery season and the taking of deer with bow and arrow under such licenses.
208:5-a	Authorizes the sale of muzzleloader licenses and the hunting of deer with a single shot muzzleloading firearm.
208:5-b	Authorizes the Executive Director to issue special deer permits.
208:6-a	Authorizes the Executive Director to designate special hunting areas for deer.
208:7 I-III	Outlines general limitations on manner of take for deer.
208:7-a	Authorizes the Executive Director to promulgate rules regulating the use of crossbows for the taking of deer during the regular firearm season.
208:9	Restricts the possession of deer (and moose) carcasses and parts thereof.
208:9-a	Makes theft of a deer or bear or any part thereof a misdemeanor or felony.
208:10	Prohibits the possession of deer or deer parts at "lumber camps".
208:11	Limits the sale and purchase of deer, bear and moose.
208:12	Authorizes intra-state transport of a legally taken and registered deer by state residents.
208:13	Authorizes non-residents to transport a legally taken and registered deer "from within the state to a point outside the state."

Table 2 (continued). Summary of current state statutes specifically mentioning white-tailed deer. While these statutes specifically mention deer and impact deer management authority in New Hampshire, numerous additional laws also affect the taking and management of wildlife species in general, including deer. *This table should not be construed to be a complete listing of applicable laws.*

RSA	Summary of Effect(s)
208:14	Authorizes transportation of deer in certain cases not covered by RSA 208:12 or 208:13.
208:15	Makes possession of a deer or parts thereof except as described in RSA 208 prima facie evidence of a violation.
208:15-a	Requires the Executive Director to establish deer registration stations.
208:15-b	Outlines general registration procedure and authorizes registration station agent fees.
208:15-c	Authorizes the Executive Director to prescribe record keeping by deer registration agents and to inspect those records.
208:15-d	Describes requirement for presenting deer for registration.
208:15-e	Prohibits keeping or storing a deer for more than 24 hours (except at a registration station) unless legally registered.
208:15-f	Requires individuals killing a deer and leaving it at the kill location to notify a Conservation Officer within 12 hours.
208:15-g	Essentially requires registration of deer within 24 hours of taking.
208:16 I-V	Describes the possession and use of deer tags.
208:21 I-V	Describes penalties for various violations
212:14	Authorizes the Executive Director, by agreement with DRED, to permit deer hunting with bow and arrow on "Bear Brook Game Refuge."
212:30-d	Regulates the importation and sale of venison, excluding venison derived from white-tailed deer.
212:30-e	Regulates the sale of venison produced in New Hampshire, excluding venison derived from white-tailed deer.
466:34-36	Describes various penalties for the owners of "dogs at large" that are associated with pursing, maiming or destroying various wild and domestic creatures, including deer.

Table 3. Projected deer harvest by WMU and sex if 1990 deer population goals were achieved (modified after NHF&G 1990).

WMU	MALE KILL	FEMALE KILL	TOTAL KILL
A	233	140	373
B	137	82	219
C	187	112	299
D	438	263	701
E	156	94	250
F	191	115	306
G	394	236	630
H	806	484	1290
I	616	370	986
J	1400	840	2240
K	489	293	782
L	506	304	810
M	364	218	582
STATEWIDE	5917	3551	9468

Table 4. Deer Population Management Goals by WMU Expressed as Adult Buck Kill (modified after NHF&G 1997).

WMU	LOWER SIDEBOARD	UPPER SIDEBOARD	CURRENT LEVEL[1]	RECOMMENDED GOAL[2]
A	81	335	335	335 (0.61)
B	49	125	125	125 (0.38)
C1	29	103	42	99 (0.51)
C2	35	125	62	125 (0.55)
D	138	816	508	788 (1.20)
E	116	393	80	188 (0.27)
F	68	241	71	167 (0.37)
G	143	742	343	532 (0.86)
H1	102	464	362	464 (1.23)
H2	184	799	567	799 (1.23)
I1	69	412	213	331 (1.01)
I2	72	433	232	360 (1.01)
J1	126	539	314	487 (1.12)
J2	304	938	898	938 (1.26)
K	140	734	481	734 (1.26)
L	153	561	468	561 (1.35)
M	102	815	535	535 (1.00)
STATEWIDE	1911	8575	5636	7568 (0.93)

1 – Average of 1995 and 1996 adult buck kill [i.e. current in 1997]
2 – Goal is adult buck kill and (adult buck kill per square mile of habitat)

Table 5. Deer Population Management Objectives by WMU Expressed as Adult Buck Kill (modified after NHF&G 2006).

WMU	LOWER SIDEBOARD	UPPER SIDEBOARD	CURRENT LEVEL[1]	RECOMMENDED OBJECTIVE[2]
A	293	377	318	335 (0.61)
B	109	141	129	125 (0.38)
C1	88	113	55	100 (0.51)
C2	109	141	79	125 (0.55)
D1	228	293	130	260 (1.20)
D2E	109	140	9	124 (1.20)
D2W	359	461	410	410 (1.20)
E	88	113	69	100 (0.15)
F	131	169	103	150 (0.33)
G1	298	383	429	340 (0.86)
G2	166	214	93	190 (0.86)
H1	403	518	416	460 (1.21)
H2	656	844	589	750 (1.16)
I1	289	371	200	330 (1.01)
I2	315	405	224	360 (1.01)
J1	328	422	303	375 (0.86)
J2	823	1058	1061	940 (1.27)
K	643	827	703	735 (1.26)
L	459	591	689	525 (1.26)
M	468	602	912	535 (1.00)
STATEWIDE	6357	8173	6915	7265 (0.89)

[1] – Average of 2012 and 2013 adult buck kill [i.e. current in 2013]
[2] – Objective is adult buck kill and (adult buck kill per square mile of habitat)

Table 6. Summary of the Regular Breech Loading Firearm Deer Seasons in New Hampshire, 1949-2013.

YEARS	AREA(S)	SEASON(S)
1949-1962	North/South Split	November (30 days) in north, 21-31 days in December in south
1963	North/Statewide Split	November 1 to 9 in north, then mid-Nov. to mid-Dec. statewide
1964-1971	Statewide	22-26 days starting in mid-November
1972	North/South Split	19 days in north, 13 days in south, both beginning mid-Nov.
1973-1978	Resident/Non-resident Split - Statewide	Opened November 1 and ran 15-24 days with non-resident season closing 2-3 days prior to resident season
1979-1980	North/South – Resident/Non-Resident Split	Seasons started early November and ran 8-9 days in north and 13-22 days in south with non-resident season closing 3 days prior to resident season in south only
1981-1982	North/South/Permit Area* Split	Seasons started early November and ran 12 days in north and 22 days in south and the permit area*
1983	North/South/Permit Area* Split	Seasons started early November and ran 7 days in north and 21 days in south with limited (5) “either-sex days” in both followed by “bucks-only” hunting. Season ran 26 days in permit area*
1984-1986	Statewide	Seasons opened early November and ran 19-21 days with limited numbers (5-7) of “either-sex days” followed by “bucks-only” hunting
1987-2013	Based on Wildlife Management Units	Early to mid-November start with variable numbers of “either-sex days” followed by “bucks-only” hunting on a WMU specific basis each year.

* - The permit area allowed the taking of antlerless deer by permit only. It was located in the west-central portion of the state and approximately covered that portion of Grafton County south of Routes 112 and 302.

Table 7. Summary of 2004 Deer Habitat by Basic Habitat Type and WMU (all areas in square miles).

WMU	LAND AREA	HABITAT AREA	% OF LAND AREA THAT IS HABITAT	PERCENT OF HABITAT AREA THAT IS …					
				AGRICULTURE	HARDWOOD FOREST	SOFTWOOD FOREST	MIXED & OTHER FOREST	TOTAL FOREST	OTHER HABITAT
A	569.89	551.77	96.8%	1.9%	44.6%	17.4%	30.3%	92.4%	5.7%
B	342.17	326.47	95.4%	2.0%	49.9%	16.4%	23.8%	90.1%	7.9%
C1	204.94	194.51	94.9%	1.2%	62.1%	13.3%	19.7%	95.2%	3.6%
C2	244.52	227.37	93.0%	1.2%	42.7%	25.2%	23.5%	91.5%	7.4%
D1	234.43	213.67	91.1%	5.5%	35.0%	23.7%	20.2%	79.0%	15.6%
D2E	116.02	103.52	89.2%	0.3%	53.9%	17.4%	26.0%	97.3%	2.4%
D2W	357.20	341.52	95.6%	8.8%	45.0%	19.2%	18.9%	83.2%	8.0%
E	779.88	687.24	88.1%	0.9%	48.6%	22.8%	24.9%	96.3%	2.8%
F	479.05	456.75	95.3%	1.8%	50.4%	20.7%	23.5%	94.6%	3.6%
G1	418.70	395.54	94.5%	5.8%	36.4%	26.7%	26.7%	89.8%	4.4%
G2	231.16	220.63	95.4%	3.9%	45.8%	22.7%	23.7%	92.1%	4.0%
H1	401.83	378.63	94.2%	8.5%	30.0%	24.4%	32.4%	86.7%	4.8%
H2	697.33	647.40	92.8%	6.5%	32.6%	19.2%	38.1%	89.9%	3.6%
I1	357.98	327.37	91.4%	7.6%	33.3%	24.5%	29.3%	87.1%	5.3%
I2	377.66	356.13	94.3%	4.1%	36.0%	23.9%	32.8%	92.7%	3.2%
J1	471.76	436.13	92.4%	2.2%	35.3%	23.6%	32.1%	90.9%	6.9%
J2	818.84	742.35	90.7%	5.6%	32.0%	16.1%	38.6%	86.8%	7.7%
K	637.07	583.08	91.5%	7.1%	27.7%	23.4%	36.6%	87.7%	5.3%
L	494.02	415.18	84.0%	6.2%	23.7%	12.2%	44.7%	80.6%	13.2%
M	690.15	533.88	77.4%	7.8%	21.8%	12.3%	39.1%	73.2%	19.0%
ALL	8924.59	8139.11	91.2%	4.7%	37.5%	20.0%	31.0%	88.5%	6.8%

Table 8. Summary of Current Deer Habitat by Basic Habitat Type and WMU (all areas in square miles).

WMU	LAND AREA	HABITAT AREA	% OF LAND AREA THAT IS HABITAT	PERCENT OF HABITAT AREA THAT IS …					
				AGRICULTURE	HARDWOOD FOREST	SOFTWOOD FOREST	MIXED & OTHER FOREST	TOTAL FOREST	OTHER HABITAT
A	569.89	556.30	97.6%	1.3%	41.4%	15.4%	30.9%	87.7%	10.9%
B	342.17	329.52	96.3%	1.4%	45.5%	14.6%	24.9%	85.0%	13.6%
C1	204.94	194.63	95.0%	0.6%	57.5%	12.3%	20.3%	90.1%	9.3%
C2	244.52	231.83	94.8%	0.4%	38.6%	20.0%	26.0%	84.6%	14.9%
D1	234.43	215.35	91.9%	3.2%	33.1%	19.8%	26.1%	79.0%	17.8%
D2E	116.02	103.12	88.9%	0.1%	53.0%	17.0%	26.2%	96.2%	3.7%
D2W	357.20	339.57	95.1%	6.4%	44.0%	17.9%	21.1%	83.0%	10.7%
E	779.88	681.70	87.4%	0.5%	47.6%	22.4%	25.7%	95.7%	3.8%
F	479.05	453.69	94.7%	1.0%	49.5%	19.9%	24.9%	94.2%	4.7%
G1	418.70	392.96	93.9%	3.0%	36.2%	23.8%	31.0%	90.9%	6.0%
G2	231.16	219.56	95.0%	2.0%	44.6%	20.8%	25.8%	91.2%	6.8%
H1	401.83	371.46	92.4%	5.6%	30.0%	23.1%	35.5%	88.6%	5.8%
H2	697.33	642.33	92.1%	3.7%	32.0%	17.1%	42.3%	91.4%	4.9%
I1	357.98	322.01	90.0%	4.4%	32.3%	21.8%	34.3%	88.4%	7.2%
I2	377.66	355.38	94.1%	2.3%	34.8%	21.3%	36.1%	92.2%	5.5%
J1	471.76	435.80	92.4%	0.9%	33.0%	20.5%	34.7%	88.2%	10.9%
J2	818.84	727.53	88.8%	3.2%	30.0%	14.0%	41.5%	85.5%	11.2%
K	637.07	572.19	89.8%	4.4%	26.6%	20.4%	41.0%	88.0%	7.6%
L	494.02	384.03	77.7%	4.0%	21.8%	10.8%	49.9%	82.6%	13.4%
M	690.15	456.53	66.1%	4.8%	20.5%	11.0%	47.9%	79.5%	15.8%
ALL	8924.59	7985.50	89.5%	2.8%	36.1%	18.1%	34.0%	88.2%	9.0%

Table 9. Results of Deer Wintering Area (DWA) Analysis in New Hampshire by Wildlife Management Unit for 2004 and 2014 assessments (all areas in square miles).

WMU[1]	HABITAT AREA (2004)	AREA OF MAPPED DWAs (2004)	PERCENT OF HABITAT IN MAPPED DWAs (2004)	HABITAT AREA (2014)	AREA OF MAPPED DWAs (2014)	PERCENT OF HABITAT IN MAPPED DWAs (2014)
A	551.8	13.1	2.4%	556.3	19.8	3.6%
B	326.5	20.6	6.3%	329.5	21.1	6.4%
C1	194.5	2.8	1.4%	194.6	20.5	10.5%
C2	227.4	21.3	9.4%	231.8	25.1	10.8%
D1	658.7	67.1	10.2%	215.4	36.6	17.0%
D2E				103.1	7.5	7.2%
D2W				339.6	32.9	9.7%
E	687.2	0.4	0.1%	681.7	12.7	1.9%
F	456.7	31.6	6.9%	453.7	42.9	9.5%
G1	616.2	49.9	8.1%	393.0	29.0	7.4%
G2				219.6	27.7	12.6%
H1	378.6	33.1	8.7%	371.5	38.7	10.4%
H2	647.4	138.6	21.4%	642.3	146.2	22.8%
I1	327.4	2.5	0.8%	322.0	10.0	3.1%
I2	356.1	5.4	1.5%	355.4	12.9	3.6%
J1	436.1	29.1	6.7%	435.8	34.4	7.9%
J2	742.3	35.8	4.8%	727.5	40.1	5.5%
K	583.1	13.3	2.3%	572.2	20.7	3.6%
L	415.2	6.1	1.5%	384.0	11.5	3.0%
M	533.9	0.0	0.0%	456.5	4.4	1.0%
ALL	8139.1	470.7	5.8%	7985.5	594.5	7.4%

[1] – Since the 2004 assessment WMUs D and G were split into WMUs D1, D2E, D2W, G1 and G2. The 2004 data are given within the historical WMU D and G boundaries while 2014 data use current WMU boundaries.

Table 10. Average annual percent rate of change in human population and housing units over the last 5 decades and most recent decade by County in New Hampshire.

COUNTY	Average Annual Human Population Percent Change		Average Annual Housing Unit Percent Change	
	1960-2010	2000-2010	1960-2010	2000-2010
BELKNAP	+16.16%	+7.22%	+25.04%	+15.82%
CARROLL	+25.41%	+9.40%	+30.19%	+13.23%
CHESHIRE	+12.53	+4.99%	+17.97%	+8.76%
COOS	-8.20%	-32.60%	+8.95%	-25.86%
GRAFTON	+12.12%	+5.45%	+23.38%	+12.13%
HILLSBOROUGH	+18.06%	+6.24%	+24.66%	+10.50%
MERRIMACK	+17.06%	+8.92%	+23.44%	+13.20%
ROCKINGHAM	+25.35%	+6.96%	+30.31%	+11.09%
STRAFFORD	+15.82%	+10.34%	+22.80%	+12.73%
SULLIVAN	+9.49%	+8.64%	+19.91%	+10.27%
STATEWIDE	+17.08%	+7.08%	+24.59%	+11.66%

Table 11. Estimated Adult Buck Kill by WMU and Decade and Percent (%) in Each WMU.

WMU	1922 to 1933[1]	1934 to 1943	1944 to 1953	1954 to 1963	1964 to 1973	1974 to 1983	1984 to 1993	1994 to 2003	2004 to 2013	TOTAL
A	1390 16.32%	1846 11.68%	1733 4.98%	2066 5.54%	2345 6.54%	872 3.51%	2281 5.74%	3500 5.94%	2691 4.16%	18724 5.84%
B	693 8.14%	1328 8.40%	1152 3.31%	1671 4.48%	1621 4.52%	463 1.86%	843 2.12%	1296 2.20%	1211 1.87%	10278 3.21%
C1	174 2.04%	401 2.54%	471 1.35%	700 1.88%	728 2.03%	314 1.26%	349 0.88%	538 0.91%	541 0.84%	4216 1.32%
C2	450 5.28%	925 5.85%	914 2.63%	1126 3.02%	1190 3.32%	410 1.65%	458 1.15%	734 1.25%	827 1.28%	7034 2.19%
D1	249 2.92%	501 3.17%	727 2.09%	1453 3.90%	1695 4.73%	910 3.66%	992 2.49%	1721 2.92%	1470 2.27%	9718 3.03%
D2E	19 0.22%	75 0.47%	164 0.47%	248 0.67%	394 1.10%	203 0.82%	97 0.24%	148 0.25%	136 0.21%	1484 0.46%
D2W	187 2.20%	455 2.88%	1151 3.31%	1925 5.17%	2947 8.22%	1690 6.80%	1992 5.01%	4025 6.83%	4707 7.27%	19079 5.95%
E	300 3.52%	688 4.35%	1088 3.13%	1562 4.19%	1765 4.93%	659 2.65%	590 1.48%	690 1.17%	703 1.09%	8045 2.51%
F	192 2.25%	470 2.97%	923 2.65%	1075 2.89%	1434 4.00%	675 2.72%	553 1.39%	730 1.24%	949 1.47%	7001 2.18%
G1	335 3.93%	664 4.20%	1573 4.52%	2329 6.25%	2475 6.91%	1130 4.55%	1559 3.92%	2810 4.77%	3587 5.54%	16462 5.14%
G2	167 1.96%	368 2.33%	1032 2.97%	1357 3.64%	1363 3.80%	604 2.43%	690 1.73%	819 1.39%	949 1.47%	7349 2.29%
H1	343 4.03%	582 3.68%	1738 5.00%	1889 5.07%	1842 5.14%	1549 6.23%	2366 5.95%	3406 5.78%	4161 6.43%	17876 5.58%
H2	840 9.86%	1542 9.75%	3843 10.01%	2747 7.37%	2223 6.20%	2054 8.27%	4272 10.74%	5575 9.47%	6045 9.34%	28781 8.98%
I1	282 3.31%	412 2.61%	1694 4.87%	2051 5.50%	1166 3.25%	932 3.75%	1558 3.92%	1981 3.36%	2045 3.16%	12121 3.78%
I2	279 3.28%	407 2.57%	1831 5.26%	2254 6.05%	1386 3.87%	1059 4.26%	1643 4.13%	2060 3.50%	2398 3.70	13317 4.16%
J1	840 9.86%	1762 11.14%	2796 8.04%	2944 7.90%	3682 10.27%	2416 9.72%	2712 6.82%	2970 5.04%	2767 4.27%	22889 7.14%
J2	654 7.68%	1537 9.72%	4560 13.11%	3652 9.80%	3542 9.88%	4273 17.19%	6229 15.66%	8344 14.17%	9175 14.17%	41966 13.10%
K	403 4.73%	671 4.24%	3119 8.96%	3072 8.24%	1789 4.99%	1463 5.89%	3429 8.62%	5451 9.26%	6676 10.31%	26073 8.14%
L	430 5.05%	733 4.64%	2927 8.41%	1678 4.50%	1549 4.32%	2057 8.28%	3786 9.52%	5295 8.99%	5634 8.70%	24088 7.52%
M	291 3.42%	444 2.81%	1718 4.94%	1461 3.92%	699 1.95%	1118 4.50%	3372 8.48%	6804 11.55%	8065 12.46%	23972 7.48%
TOTAL	8518 100.00%	15811 100.00%	34794 100.00%	37260 100.00%	35835 100.00%	24851 100.00%	39771 100.00%	58896 100.00%	64737 100.00%	320473 100.00%

[1] – This "decade" includes 12 years of harvest data.

Table 12. Estimated success rates for firearm, archery and muzzleloader deer hunters in New Hampshire, 1960-2013.

	ESTIMATED SUCCESS RATE (%)			
YEAR	AVERAGE[1]	FIREARM[2]	ARCHERY[3]	MUZZLELOADER[4]
1960	5.6	10.1	1.1	---
1961	6.3	11.1	1.6	---
1962	5.9	11.1	0.6	---
1963	4.3	12.4	0.5	0.0
1964	9.4	10.3	1.2	16.7
1965	7.6	13.0	0.4	9.4
1966	6.8	12.2	1.9	6.4
1967	9.6	18.2	2.1	8.4
1968	8.3	16.1	1.9	6.9
1969	6.0	11.0	0.7	6.5
1970	5.3	9.1	0.8	6.0
1971	5.1	9.9	0.6	4.7
1972	5.7	9.9	1.0	6.2
1973	4.0	7.9	0.8	3.3
1974	5.4	9.9	0.7	5.7
1975	6.3	11.6	0.8	6.6
1976	6.1	12.7	0.5	5.2
1977	5.2	9.1	1.8	4.7
1978	4.8	7.8	1.5	5.1
1979	3.9	7.5	1.0	3.1
1980	4.3	8.0	0.7	4.2
1981	4.8	8.6	1.4	4.4
1982	3.8	6.7	1.1	3.6
1983	3.3	4.9	1.5	3.4
1984	4.2	6.2	1.3	5.1
1985	5.1	7.9	1.4	6.0
1986	5.7	8.9	2.1	6.0
1987	5.6	8.1	1.9	6.8
1988	5.6	7.8	1.5	7.5
1989	6.6	8.6	3.1	8.1
1990	7.3	10.5	3.0	8.4
1991	7.8	10.8	4.0	8.4
1992	9.0	11.5	5.7	9.9
1993	8.9	11.8	4.2	10.6
1994	7.2	9.6	4.2	7.8
1995	10.1	12.2	7.1	11.0
1996	9.0	10.4	5.2	11.5
1997	10.8	14.4	7.4	10.5
1998	9.1	10.1	6.9	10.3
1999	10.1	10.8	8.9	10.5
2000	10.1	12.2	8.8	9.2
2001	8.7	10.9	7.4	7.7
2002	11.0	13.6	9.3	10.0
2003	9.8	11.7	9.7	8.2
2004	10.7	12.9	11.5	7.9
2005	11.3	14.0	10.6	9.4
2006	13.0	14.3	15.7	9.0
2007	15.2	16.0	19.5	10.1
2008	12.1	12.8	13.6	9.9
2009	11.6	12.3	13.8	8.8
2010	10.8	13.3	10.6	8.5
2011	13.0	14.9	15.3	8.9
2012	13.9	13.5	16.4	11.7
2013	14.5	13.9	19.4	10.0

[1] - The average success rate of archery, muzzleloader and firearms hunters.
[2] – Based on firearm only hunters (34% of hunting licensees) plus 96% of unsuccessful muzzleloader hunters.
[3] - Archery deer kill divided by archery tags available (excluding special archery tags).
[4] - Muzzleloader deer kill divided by muzzleloader licenses.

Figure 1. Early deer seasons in Coos County New Hampshire (modified after Silver 1957).

DATE	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
- 1740												
1741 – 1764												
1765 – 1777												
1778 – 1797												
1798												
1799 – 1815												
1816 – 1830												
1831 – 1856												
1857 – 1872												
1873 – 1877												
1878 – 1880												
1881 – 1890												
1891 – 1894												
1895 – 1896												
1897 – 1898												
1899 – 1900												
1901 – 1902												
1903 – 1906												
1907 – 1912												
1913 – 1920												
1921 – 1930												
1931 – 1934												
1935 – 1938												
1939 – 1948												

Season Open Season Open in Part of Area

Figure 2. Early deer seasons in New Hampshire for counties except Coos (modified after Silver 1957).

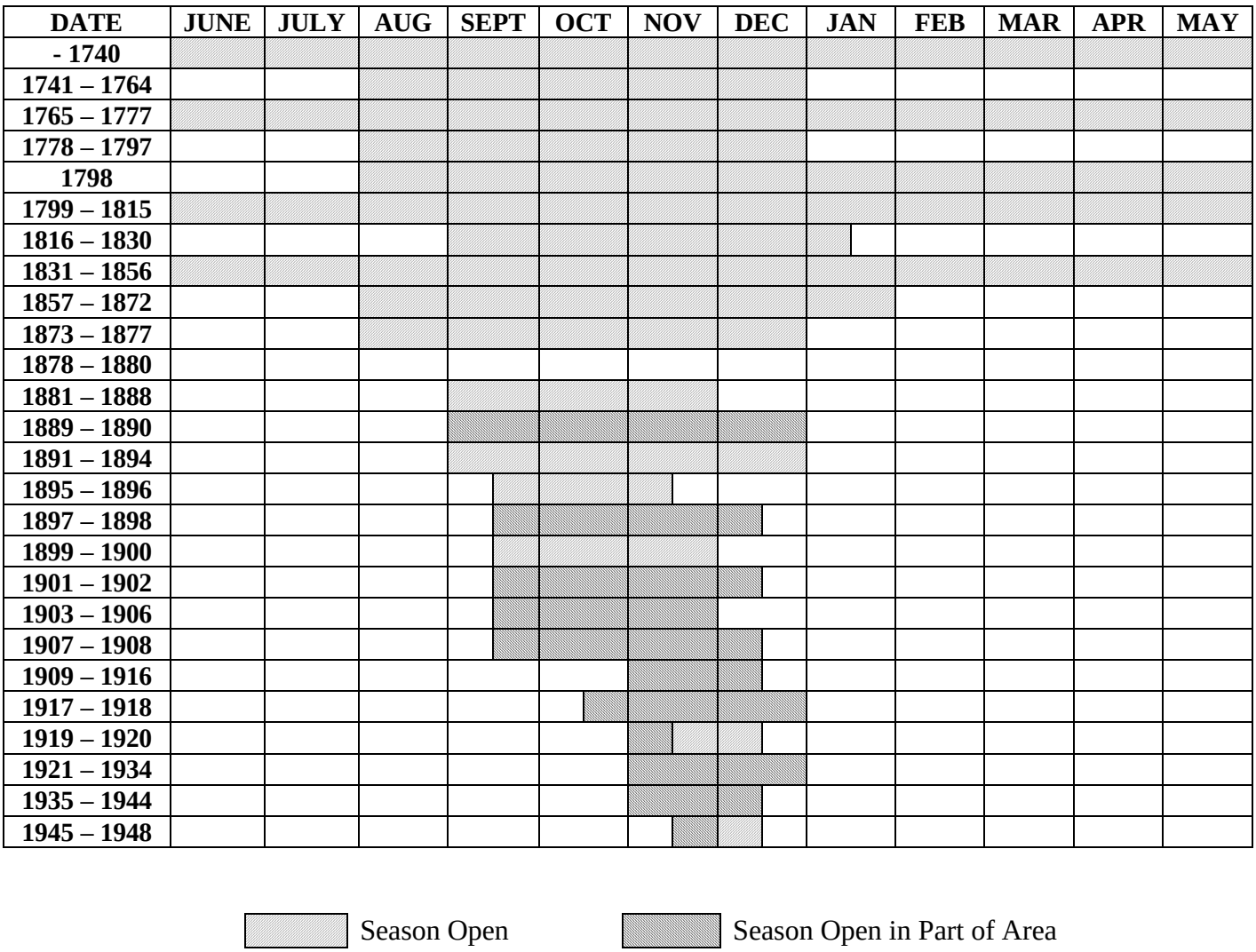
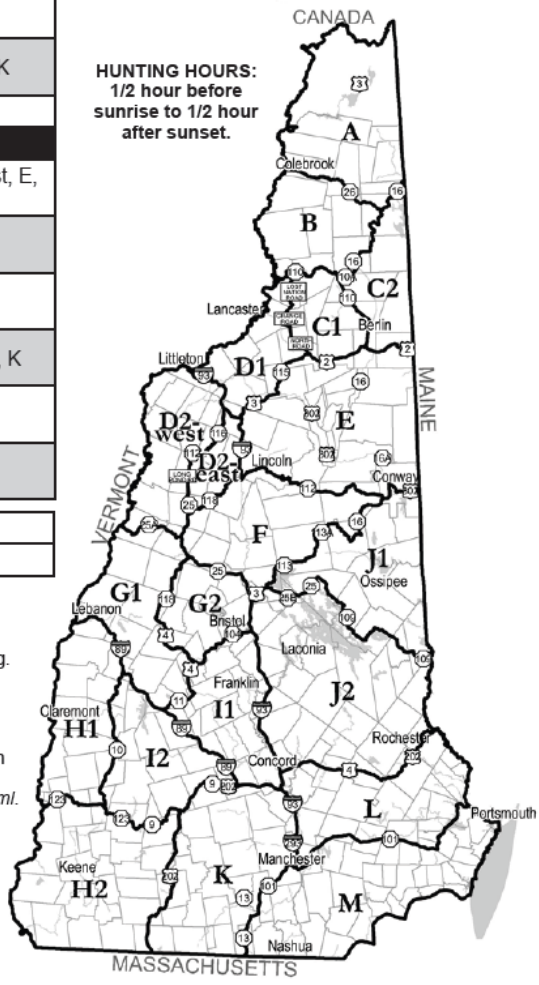


Figure 3. Current Deer Wildlife Management Units and Sample Season Framework From 2014.

2014 N.H. DEER SEASON

TYPE	INCLUSIVE DATES	WILDLIFE MGMT. UNITS
ARCHERY		
Any Deer	Sept. 15 – Dec. 8	A
Any Deer	Sept. 15 – Dec. 15	B – M
YOUTH WEEKEND**		
Any Deer	Oct. 25 – Oct. 26	STATEWIDE
MUZZLELOADER		
Antlered Only	Nov. 1 – Nov. 11	C¹, C², D¹, D²-East, E, F, G², I¹, I²
Any Deer Antlered Only	Nov. 1 Nov. 2 – Nov. 11	A, B, J¹
Any Deer Antlered Only	Nov. 1 – Nov. 2 Nov. 3 – Nov. 11	D²-West
Any Deer Antlered Only	Nov. 1 – Nov. 3 Nov. 4 – Nov. 11	G¹, H¹, H², J², K
Any Deer	Nov. 1 – Nov. 11	L, M
FIREARM		
Antlered Only	Nov. 12 – Dec. 7	C¹, C², D¹, D²-East, E, F, G², I¹, I², J¹
Any Deer Antlered Only	Nov. 12 Nov. 13 – Nov. 30	A
Any Deer Antlered Only	Nov. 12 Nov. 13 – Dec. 7	B
Any Deer Antlered Only	Nov. 12 – Nov. 13 Nov. 14 – Dec. 7	D²-West, H¹, H², K
Any Deer Antlered Only	Nov. 12 – Nov. 14 Nov. 15 – Dec. 7	G¹, J²
Any Deer Antlered Only	Nov. 12 – Nov. 21 Nov. 22 – Dec. 7	L, M
BAITING***	Oct. 22 – Nov. 19	A - L
	Sept. 15 – Dec. 15	M

HUNTING HOURS: 1/2 hour before sunrise to 1/2 hour after sunset.



DEFINITIONS –

Antlered Deer: A deer with at least one antler three (3) inches long.

Antlerless Deer: A deer without antlers or with antlers less than 3 inches long.

Any Deer: All deer regardless of sex or age.

** Nonresident youth hunters may participate provided N.H. youth can hunt during youth deer hunts in their state of residence.

***Further restrictions apply.** A full list of rules regarding baiting wildlife in N.H. can be found in the Fis 300 section of the N.H. Code of Administrative Rules or go online at *www.gencourt.state.nh.us/rules/state_agencies/fis.html*.

2015 FIREARM OPENING DAY: NOVEMBER 11, 2015

N.H. Fish and Game Department
11 Hazen Drive, Concord, NH 03301
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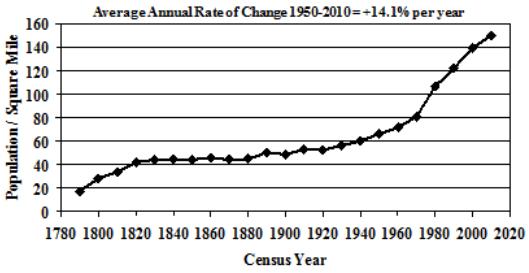
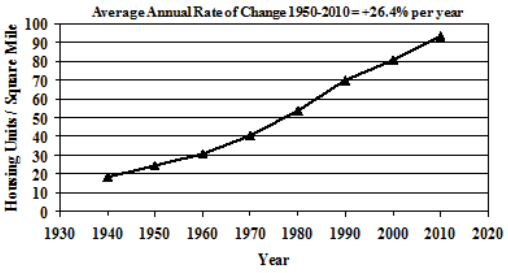
Figure 4. New Hampshire human population (1790-2010) and housing unit (1940-2010) data.

US Decennial Census Population Data for Belknap County, NH (1790-2010)

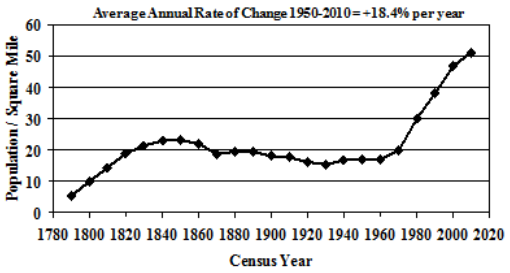


Note: 2010 Census indicated a population of 60,088

US Decennial Census Housing Unit Data for Belknap County, NH (1940-2010)

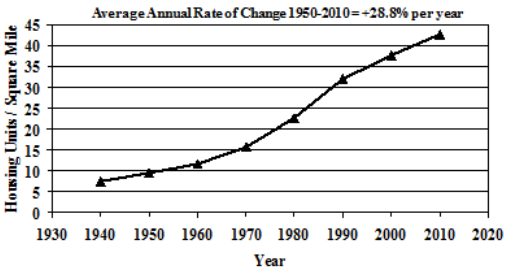


US Decennial Census Population Data for Carroll County, NH (1790-2010)

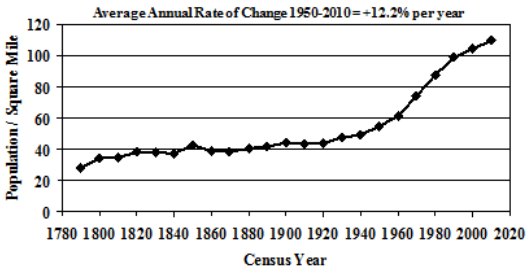


Note: 2010 Census indicated a population of 47,698

US Decennial Census Housing Unit Data for Carroll County, NH (1940-2010)



US Decennial Census Population Data for Cheshire County, NH (1790-2010)



Note: 2010 Census indicated a population of 77,117

US Decennial Census Housing Unit Data for Cheshire County, NH (1940-2010)

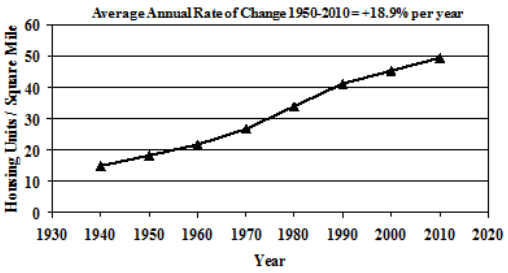
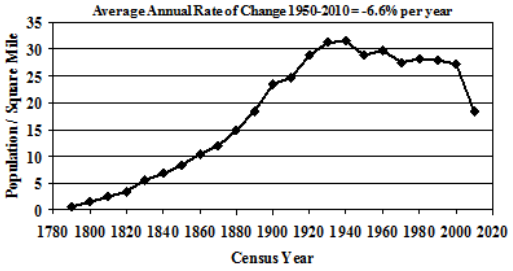


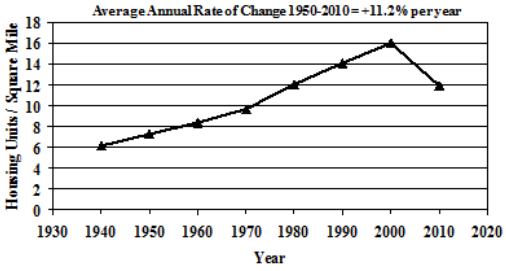
Figure 4 (continued). New Hampshire human population (1790-2010) and housing unit (1940-2010) data.

US Decennial Census Population Data for Coos County, NH (1790-2010)

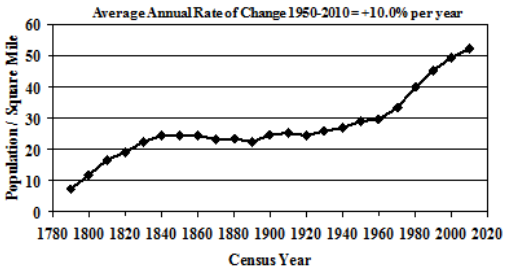


Note: 2010 Census indicated a population of 32,961

US Decennial Census Housing Unit Data for Coos County, NH (1940-2010)

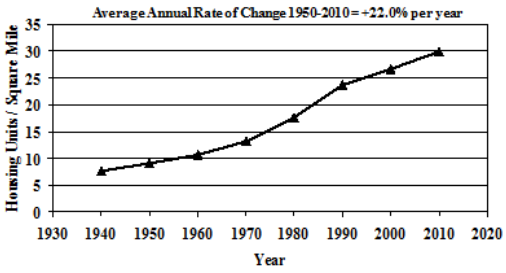


US Decennial Census Population Data for Grafton County, NH (1790-2010)

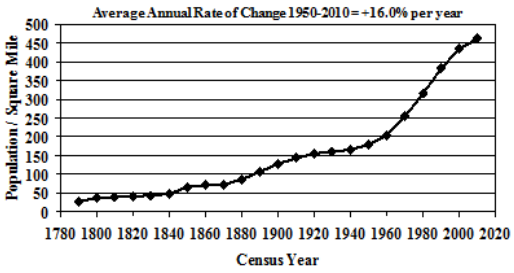


Note: 2010 Census indicated a population of 89,118

US Decennial Census Housing Unit Data for Grafton County, NH (1940-2010)



US Decennial Census Population Data for Hillsborough County, NH (1790-2010)



Note: 2010 Census indicated a population of 400,721

US Decennial Census Housing Unit Data for Hillsborough County, NH (1940-2010)

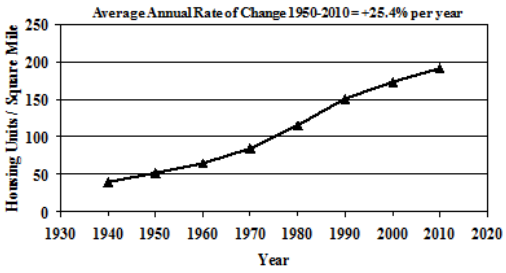
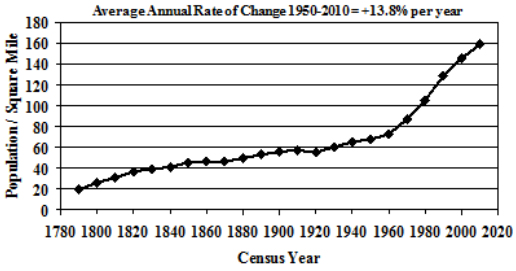


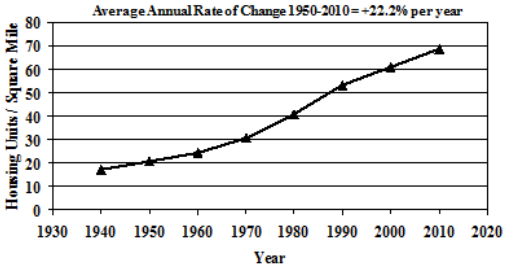
Figure 4 (continued). New Hampshire human population (1790-2010) and housing unit (1940-2010) data.

US Decennial Census Population Data for Merrimack County, NH (1790-2010)

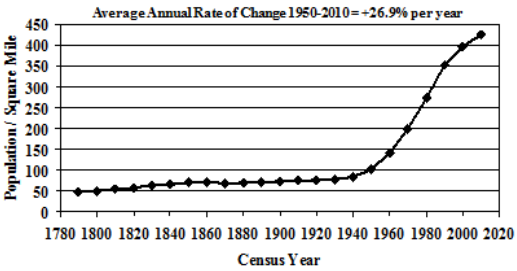


Note: 2010 Census indicated a population of 146,445

US Decennial Census Housing Unit Data for Merrimack County, NH (1940-2010)

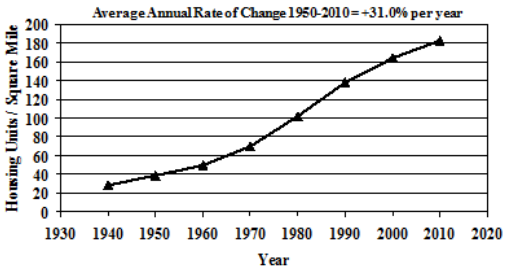


US Decennial Census Population Data for Rockingham County, NH (1790-2010)

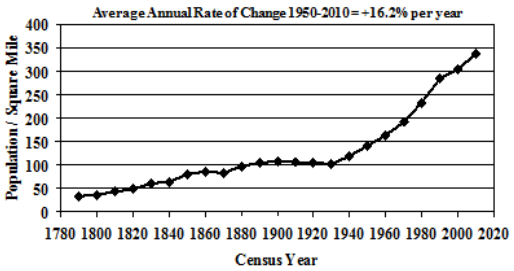


Note: 2010 Census indicated a population of 295,223

US Decennial Census Housing Unit Data for Rockingham County, NH (1940-2010)



US Decennial Census Population Data for Strafford County, NH (1790-2010)



Note: 2010 Census indicated a population of 123,143

US Decennial Census Housing Unit Data for Strafford County, NH (1940-2010)

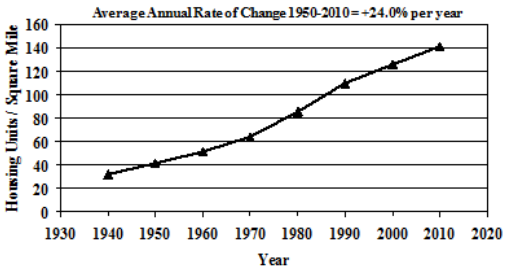
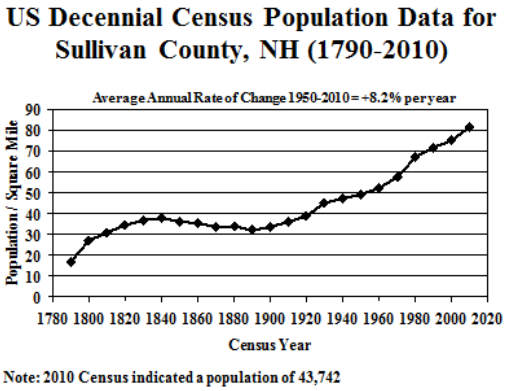
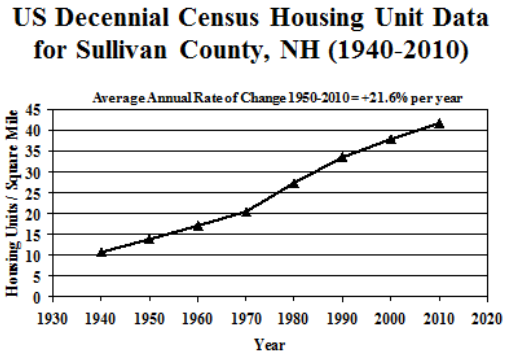
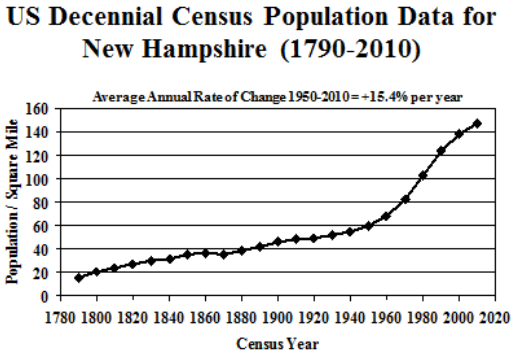


Figure 4 (continued). New Hampshire human population (1790-2010) and housing unit (1940-2010) data.



Note: 2010 Census indicated a population of 43,742





Note: 2010 Census indicated a population of 1,316,256

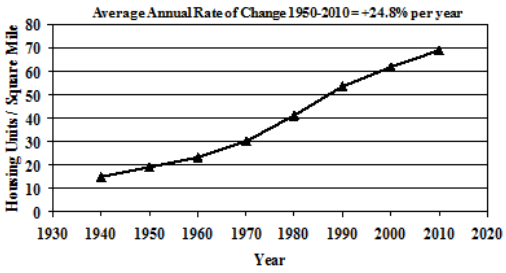
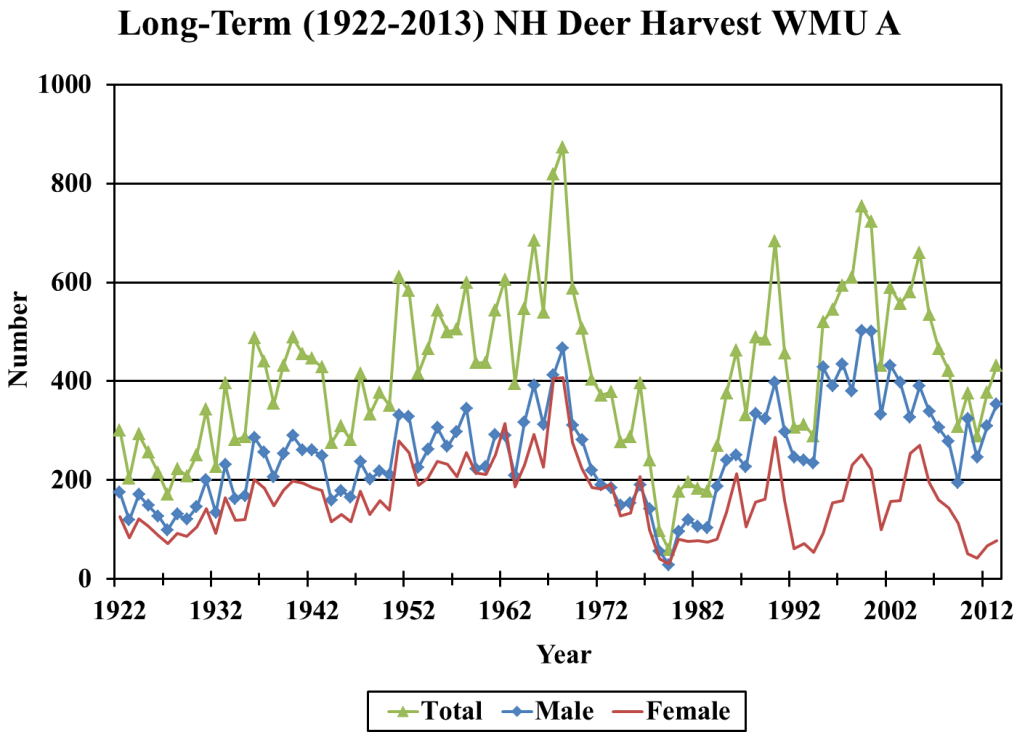


Figure 5. New Hampshire Deer Harvest by WMU and Sex from 1922 to 2013.



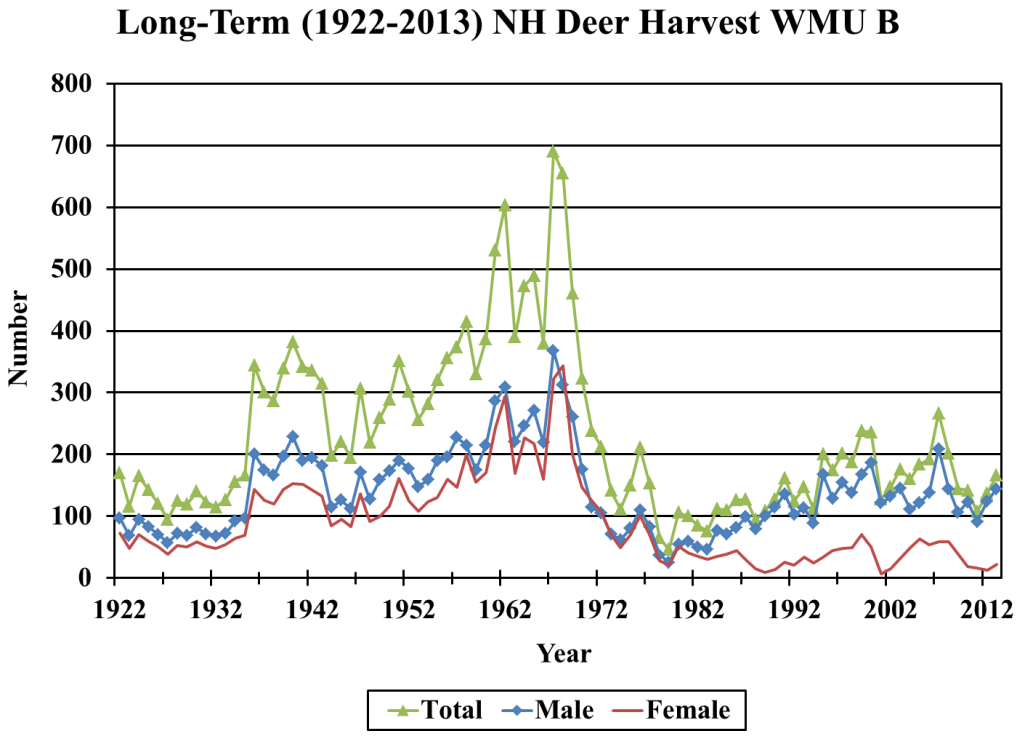
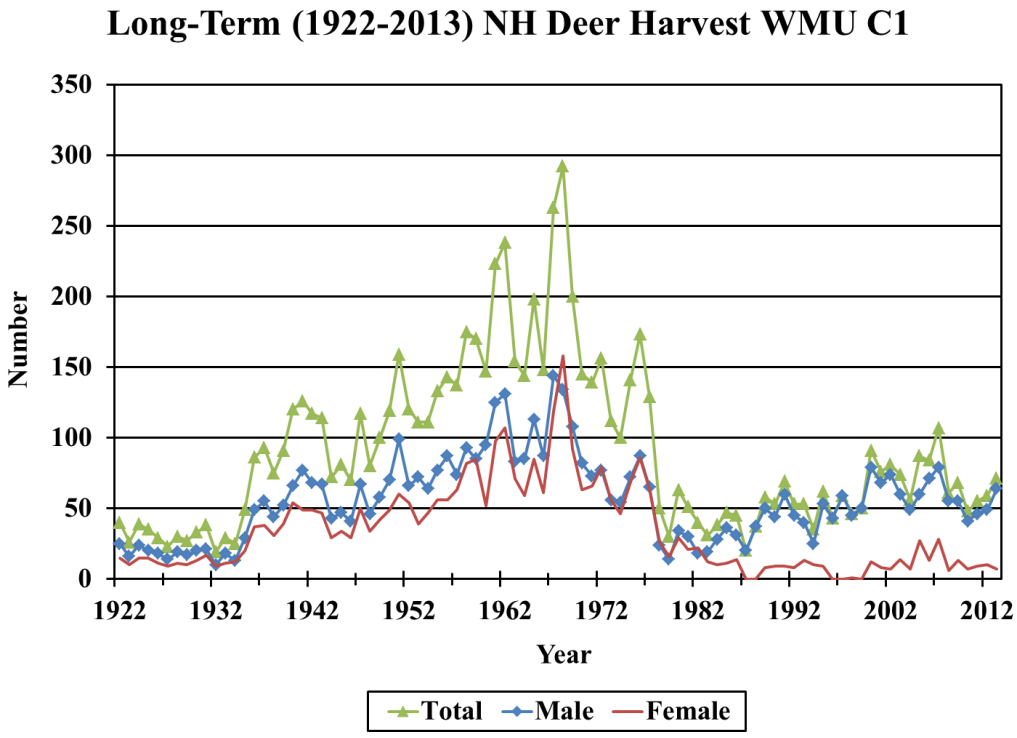


Figure 5 (continued). New Hampshire Deer Harvest by WMU and Sex from 1922 to 2013.



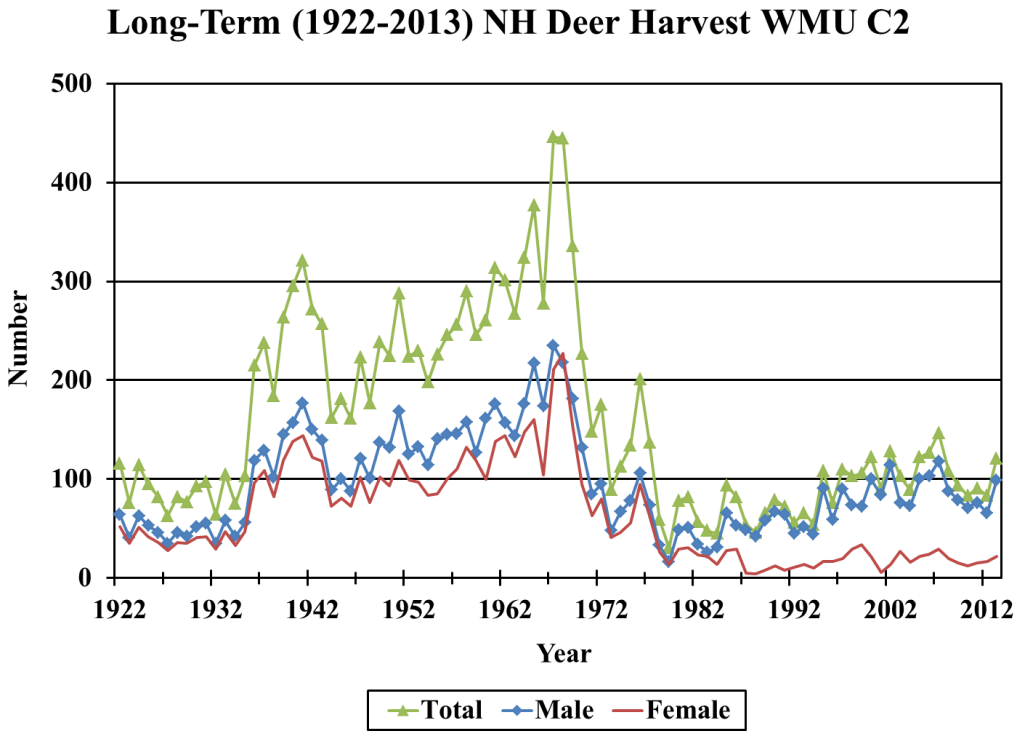
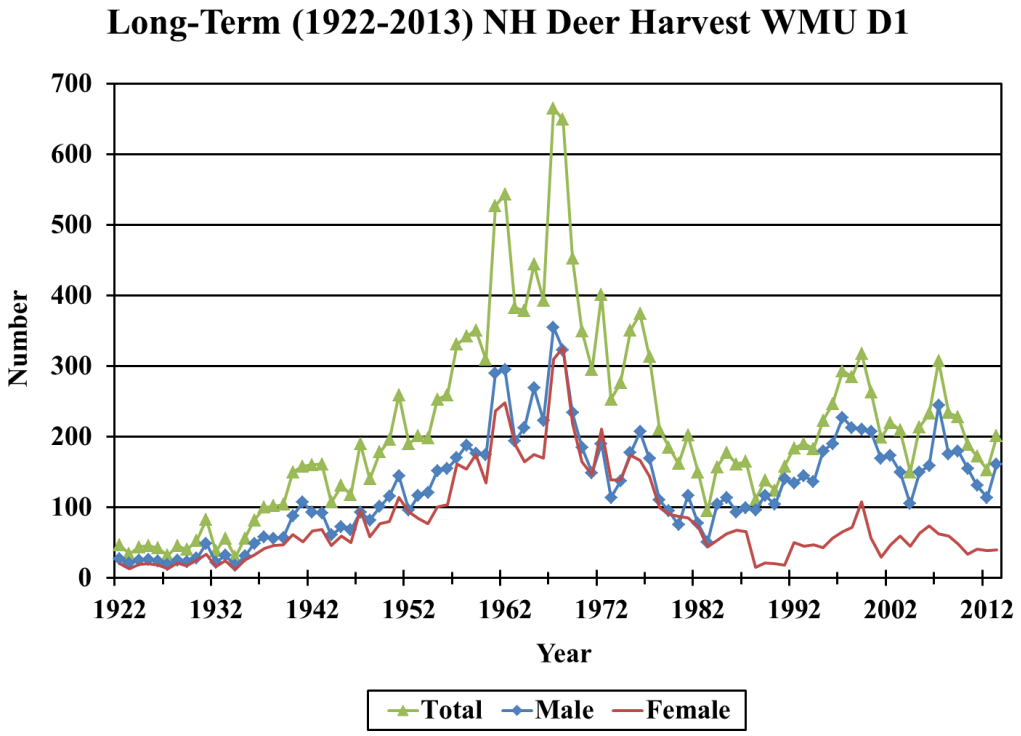


Figure 5 (continued). New Hampshire Deer Harvest by WMU and Sex from 1922 to 2013.



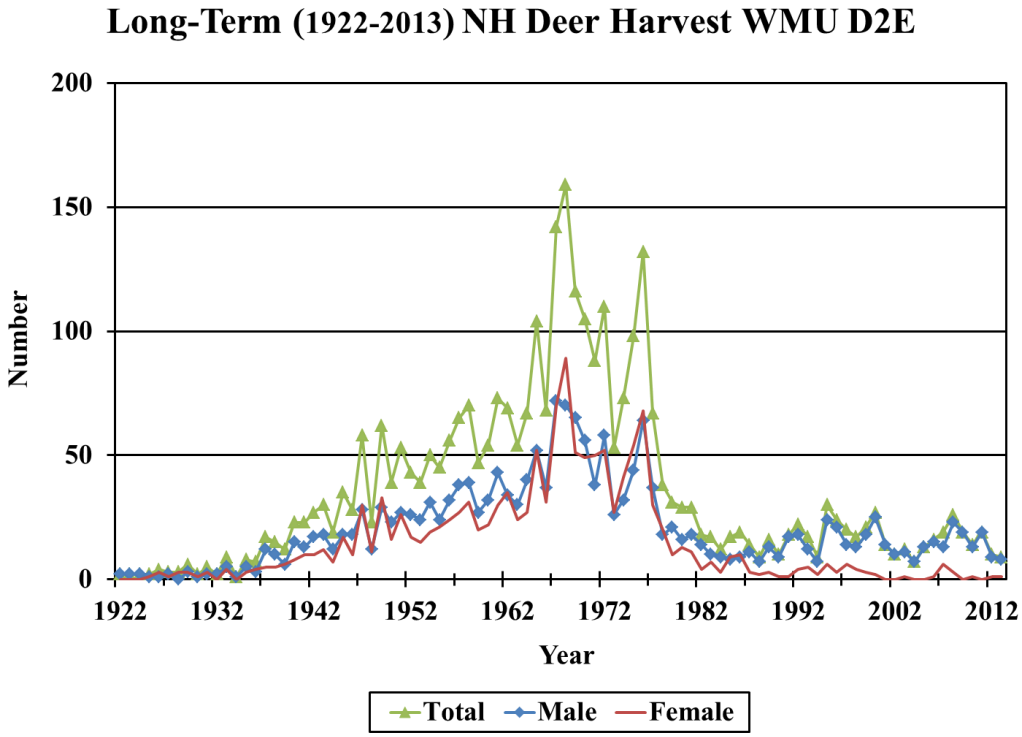
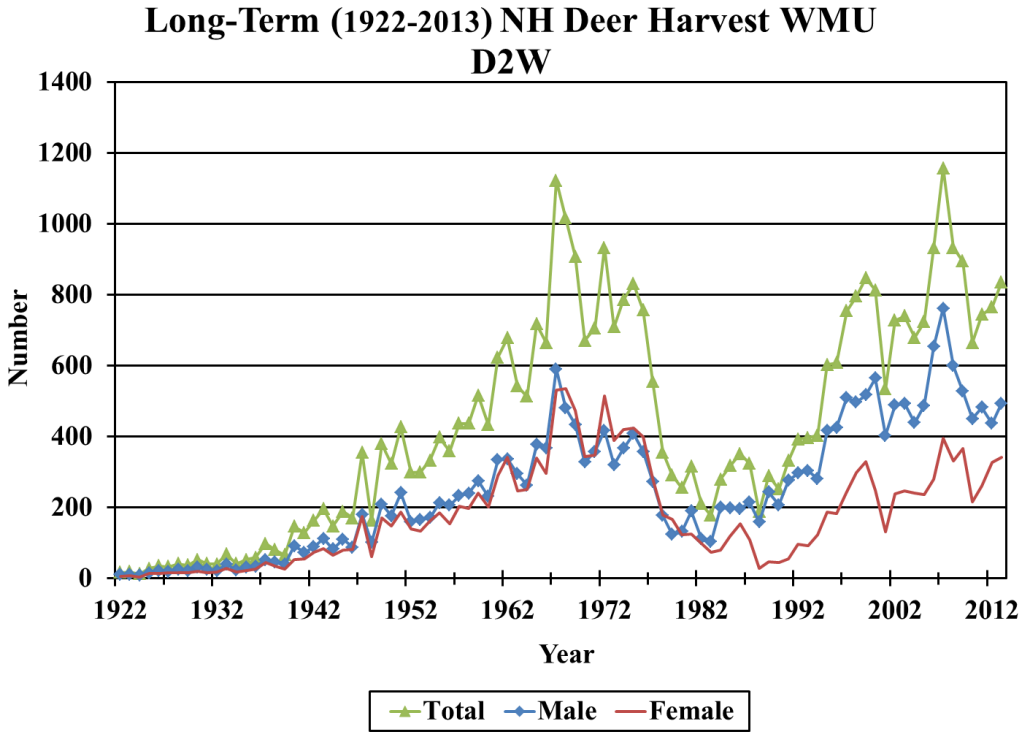


Figure 5 (continued). New Hampshire Deer Harvest by WMU and Sex from 1922 to 2013.



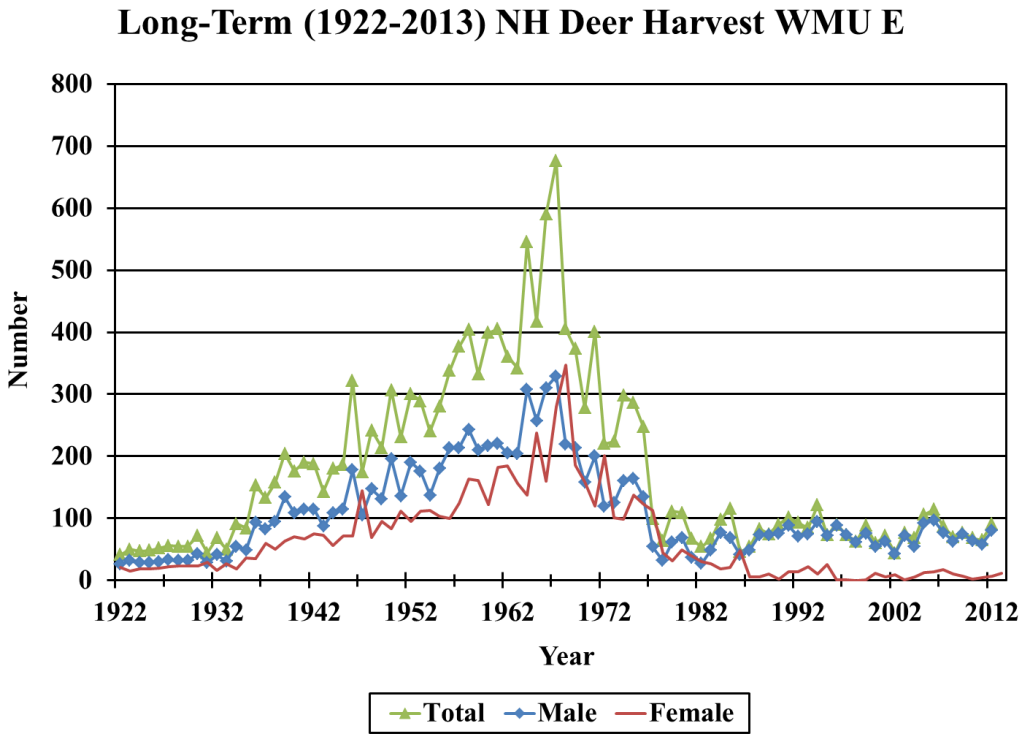
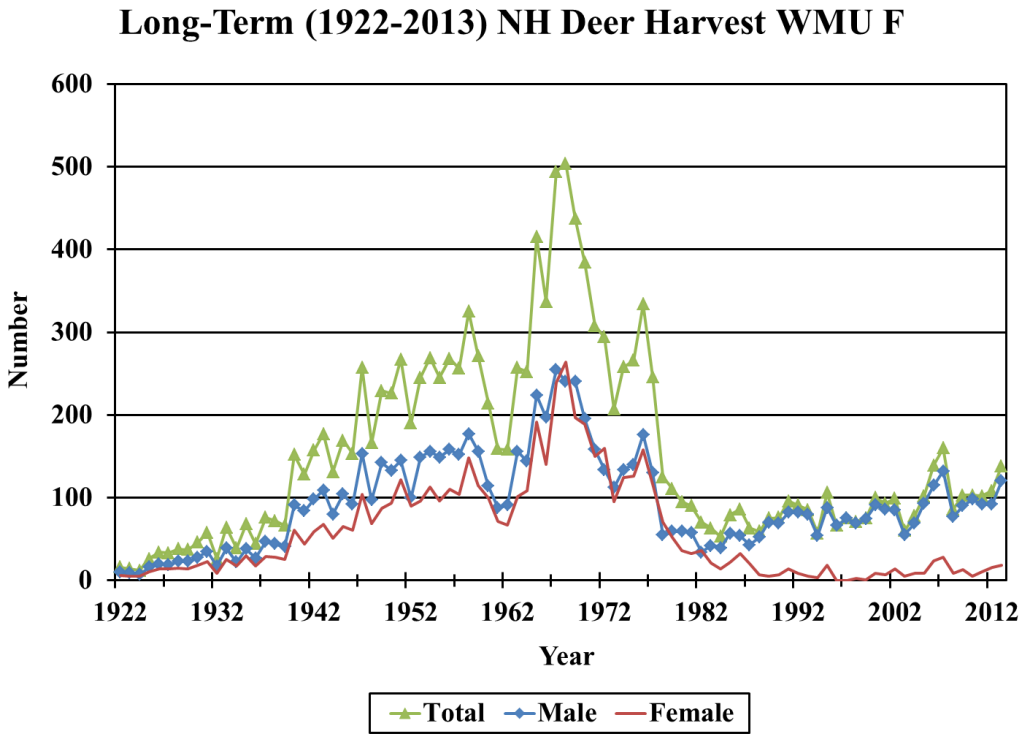


Figure 5 (continued). New Hampshire Deer Harvest by WMU and Sex from 1922 to 2013.



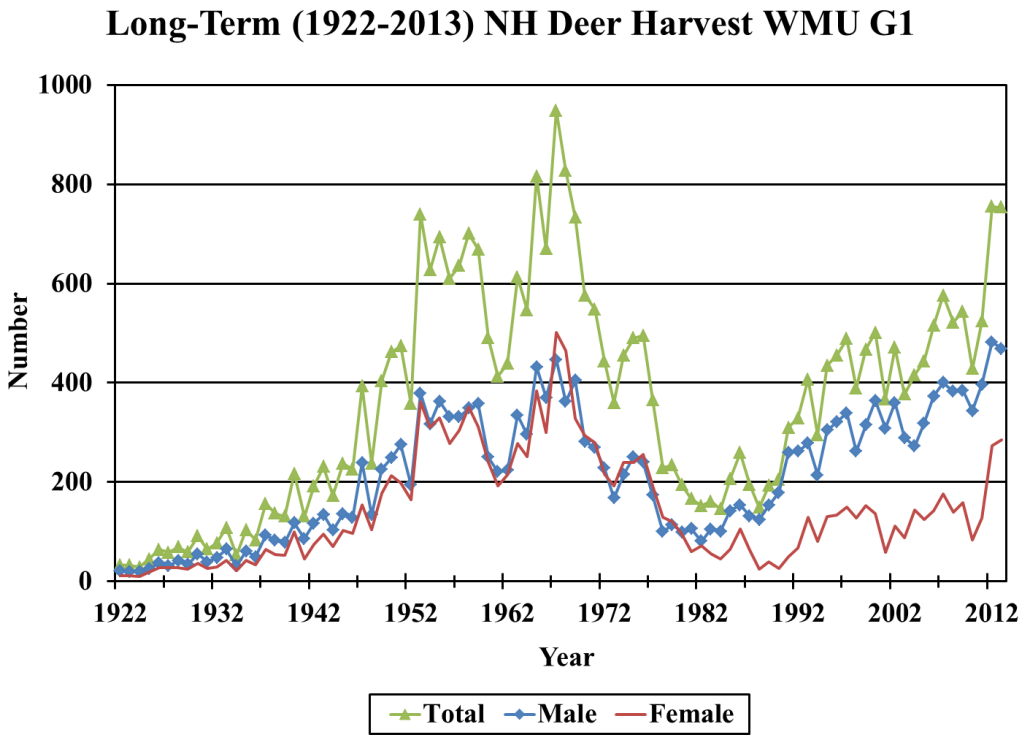
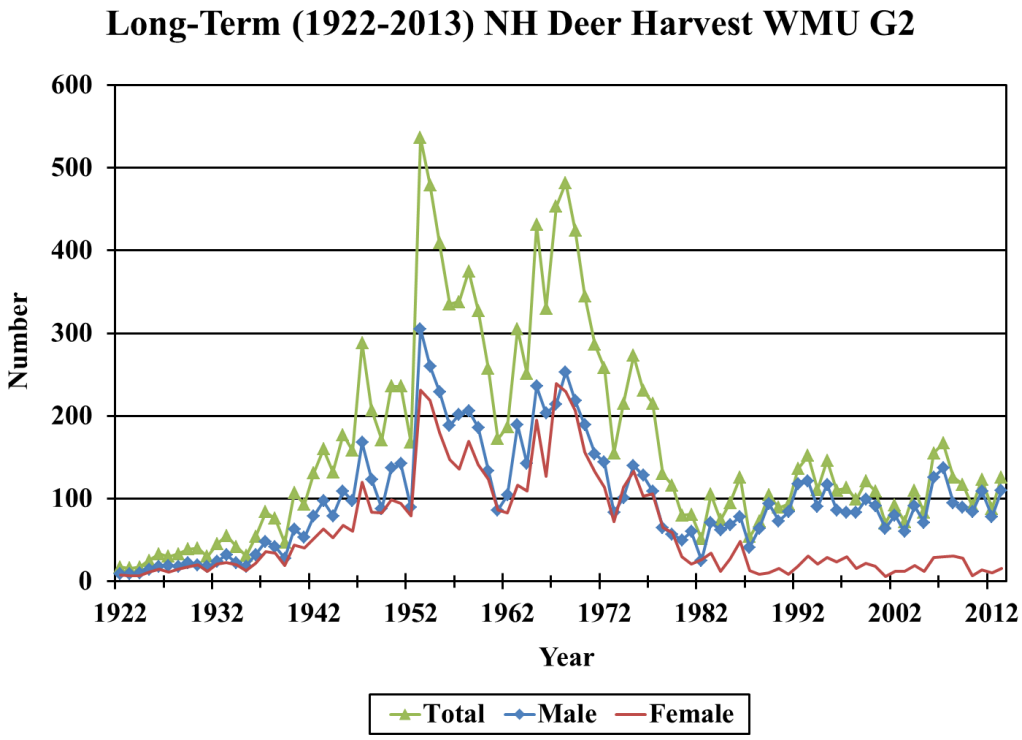


Figure 5 (continued). New Hampshire Deer Harvest by WMU and Sex from 1922 to 2013.



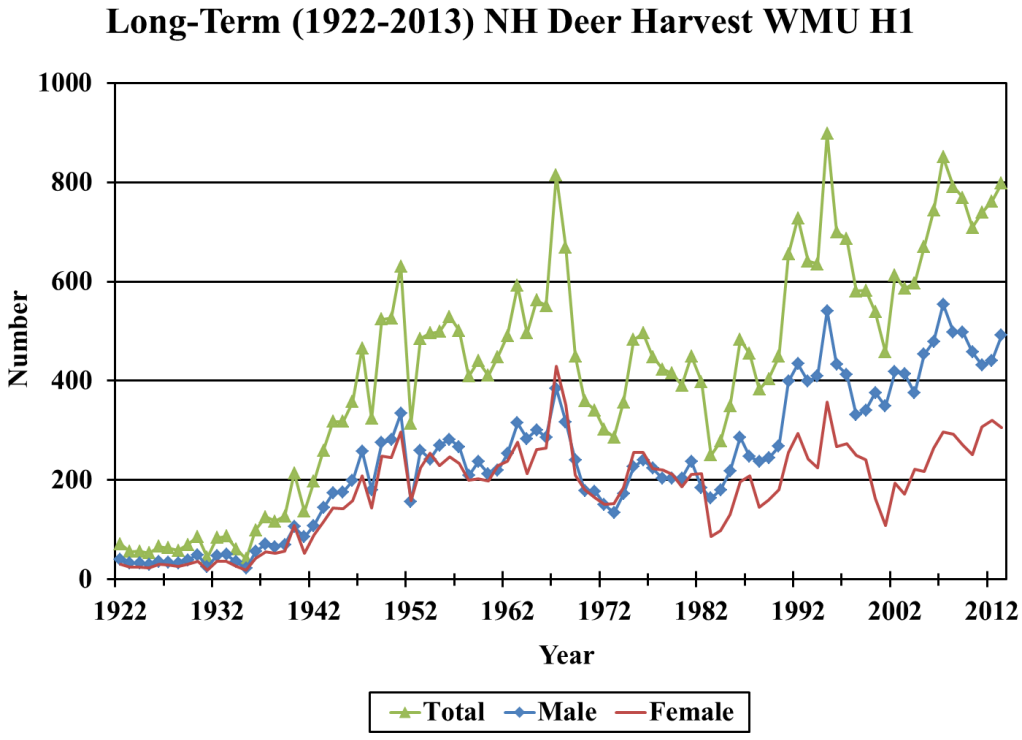
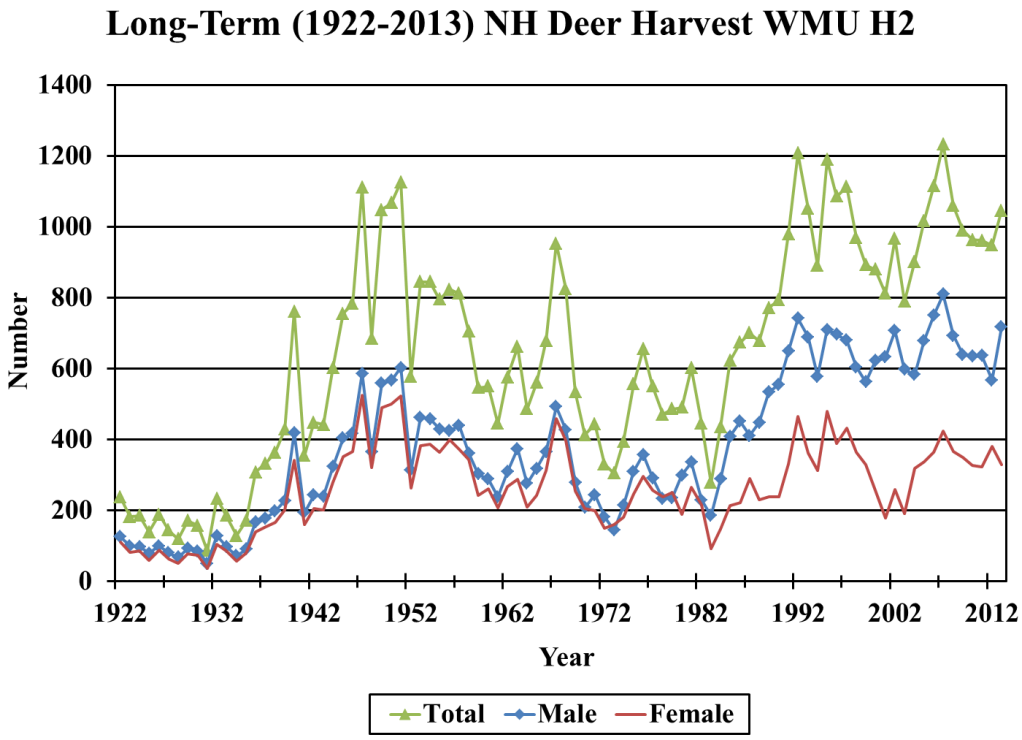


Figure 5 (continued). New Hampshire Deer Harvest by WMU and Sex from 1922 to 2013.



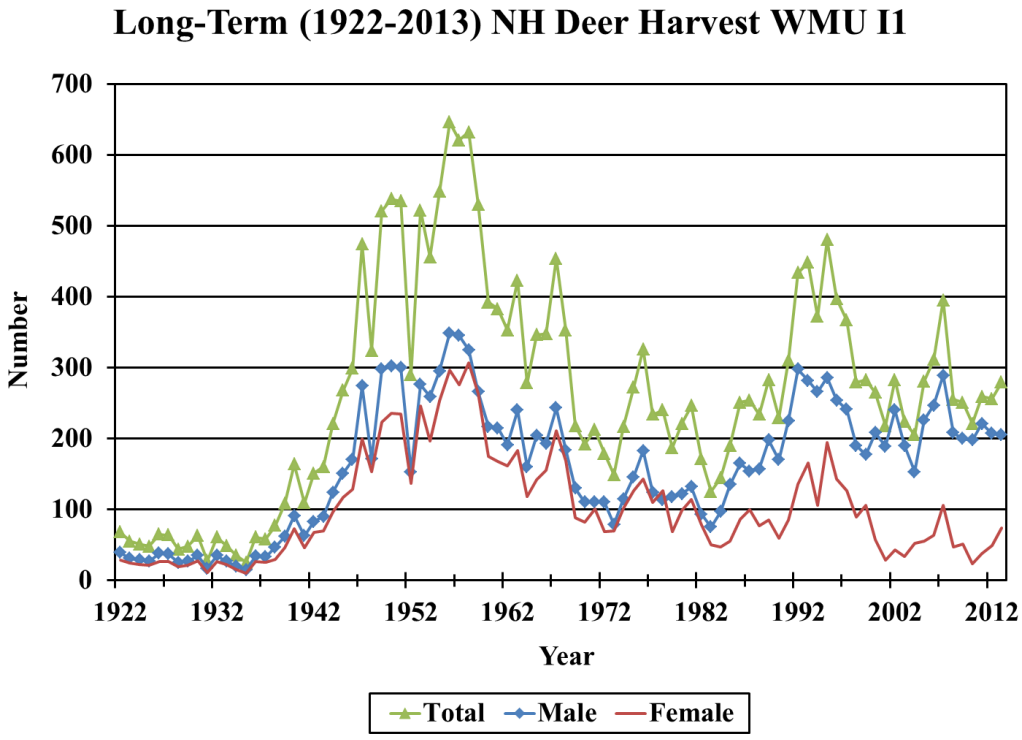
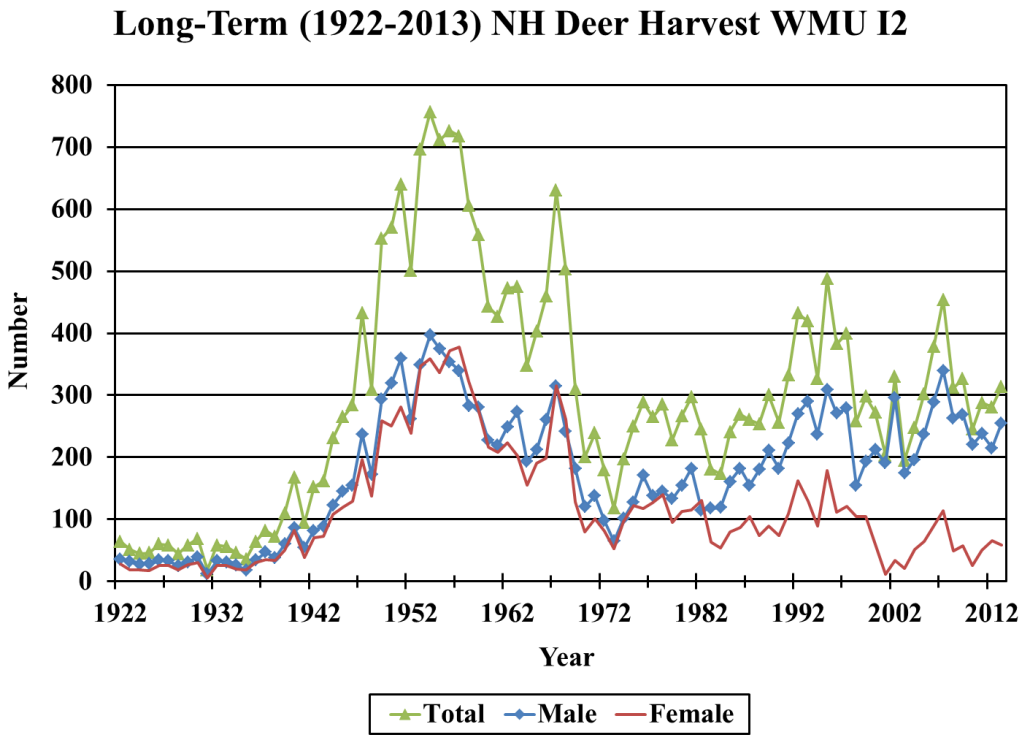


Figure 5 (continued). New Hampshire Deer Harvest by WMU and Sex from 1922 to 2013.



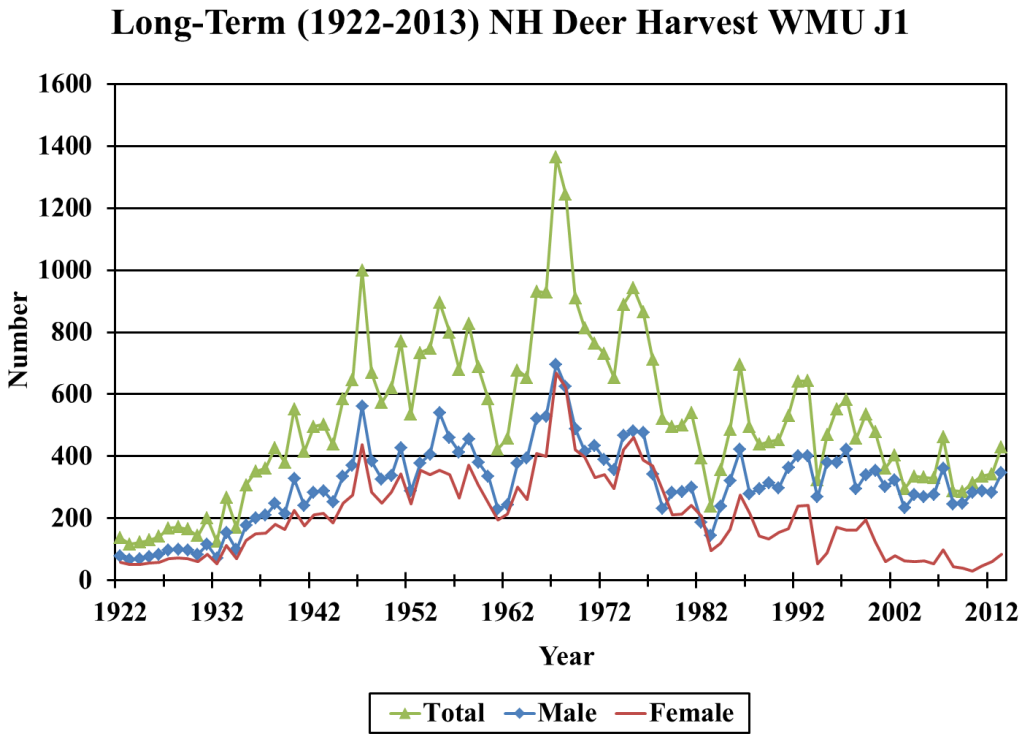
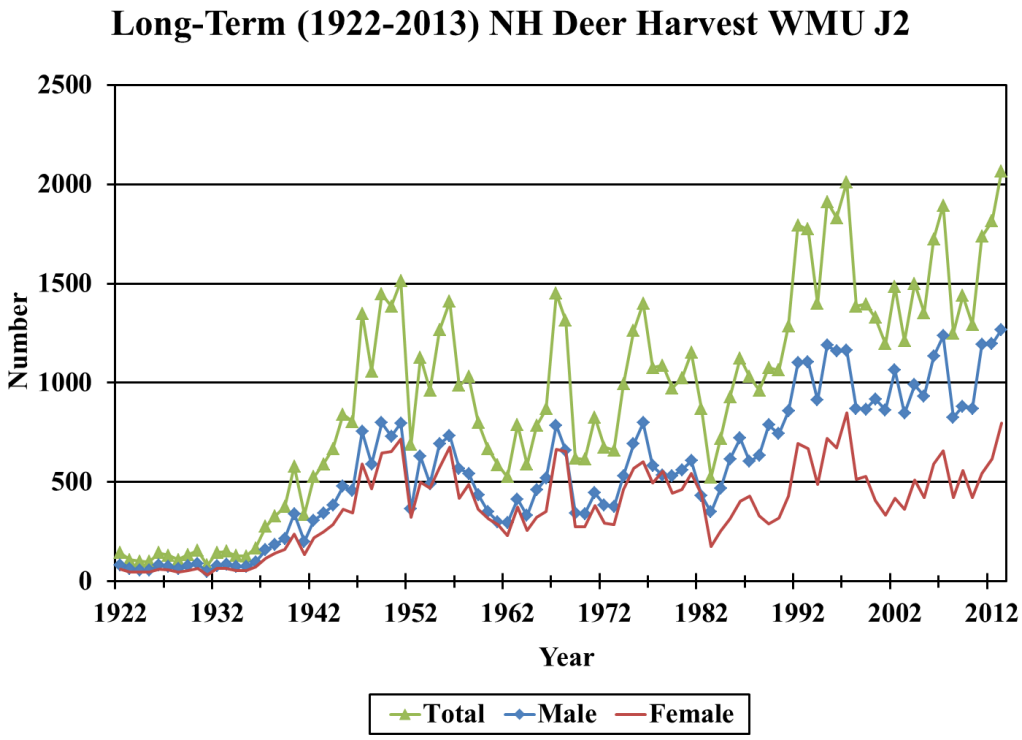


Figure 5 (continued). New Hampshire Deer Harvest by WMU and Sex from 1922 to 2013.



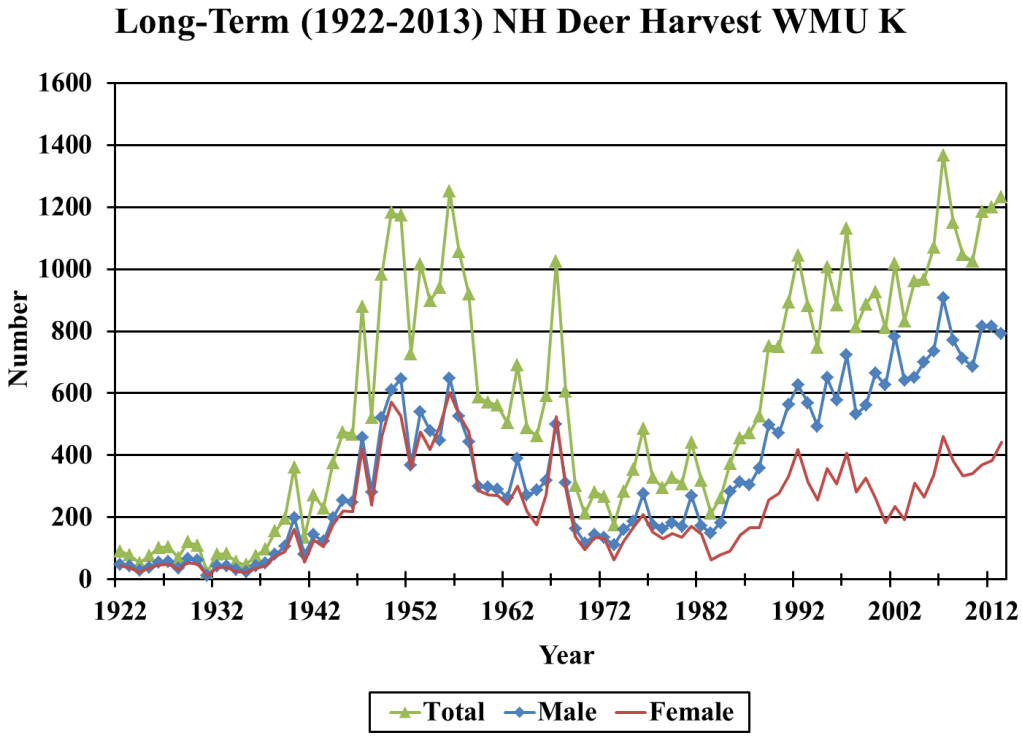
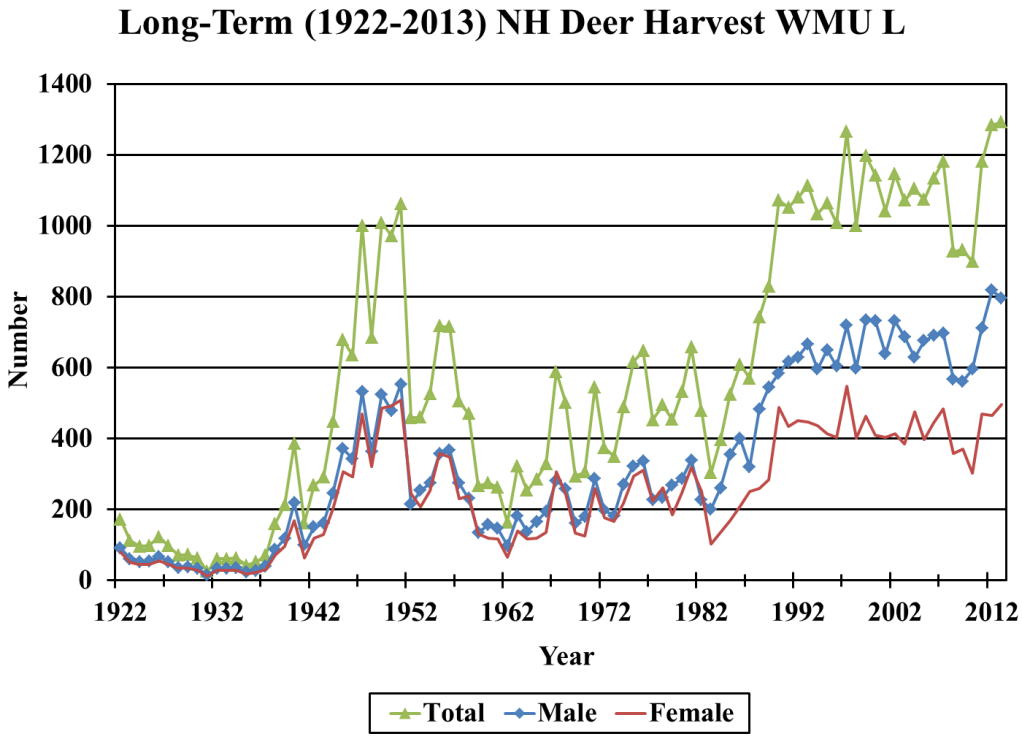


Figure 5 (continued). New Hampshire Deer Harvest by WMU and Sex from 1922 to 2013.



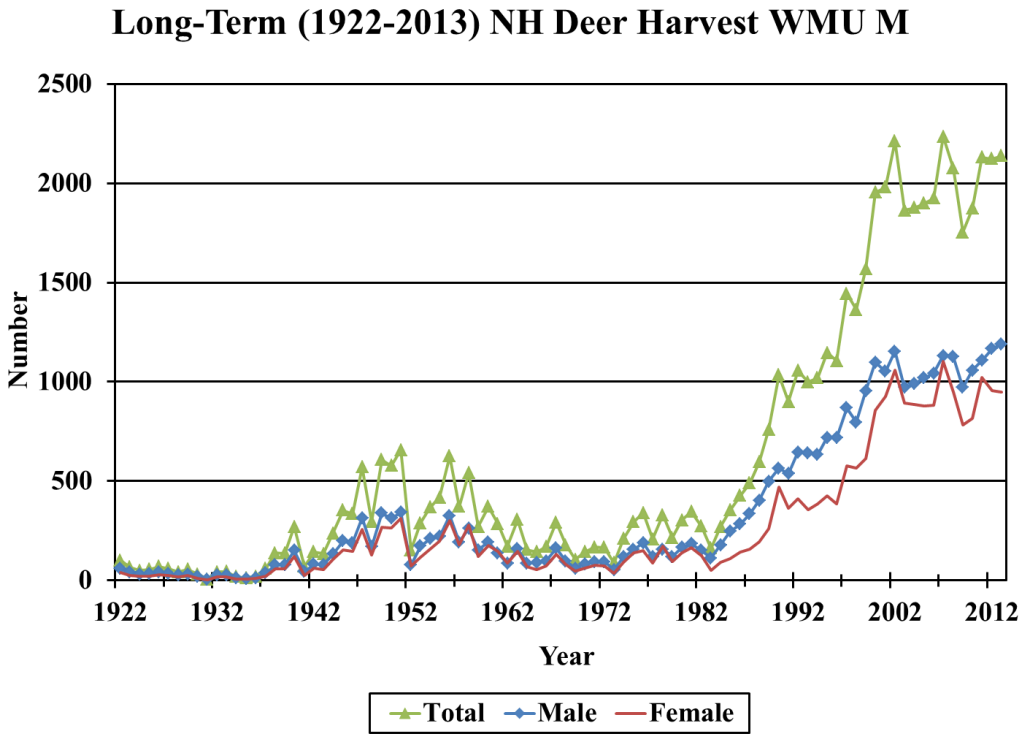


Figure 5 (continued). New Hampshire Deer Harvest by WMU and Sex from 1922 to 2013.

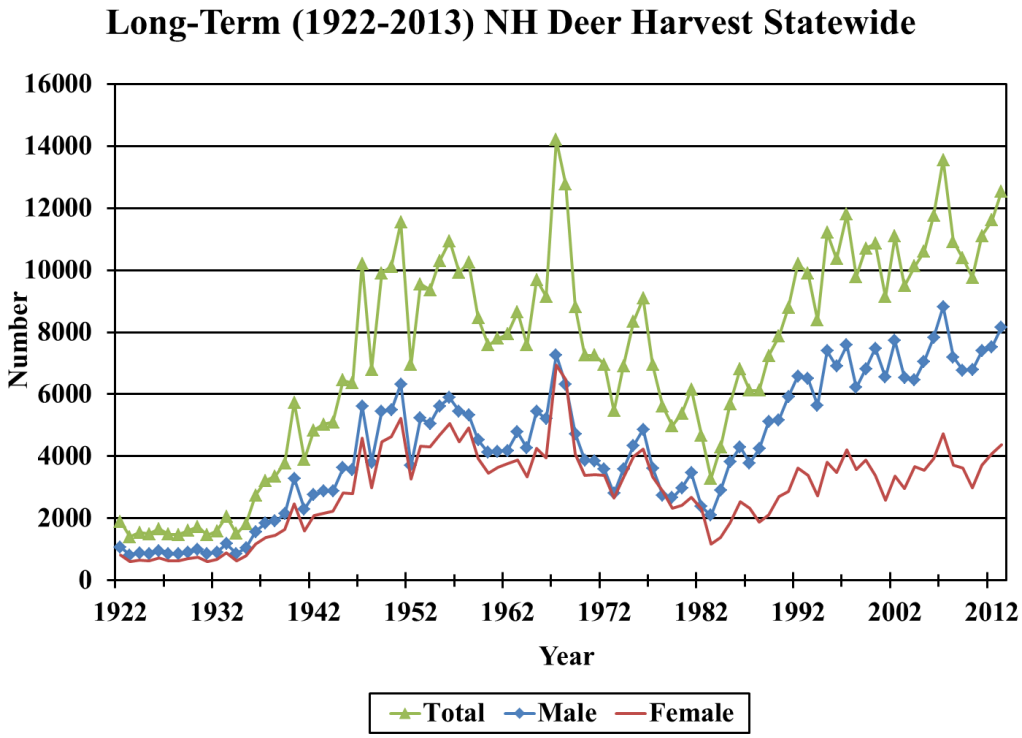
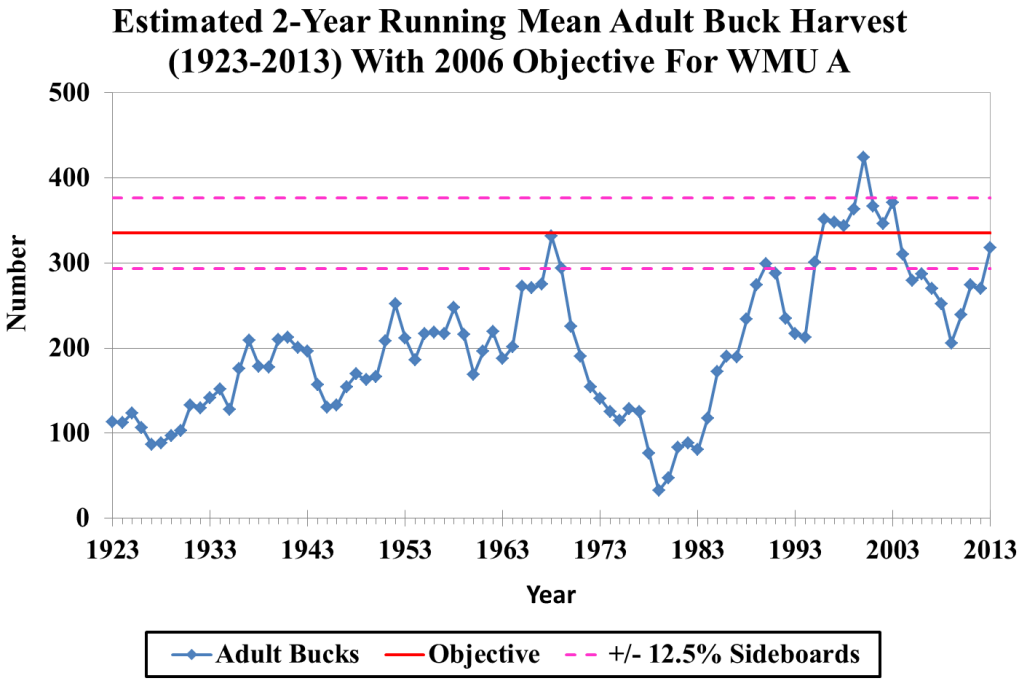
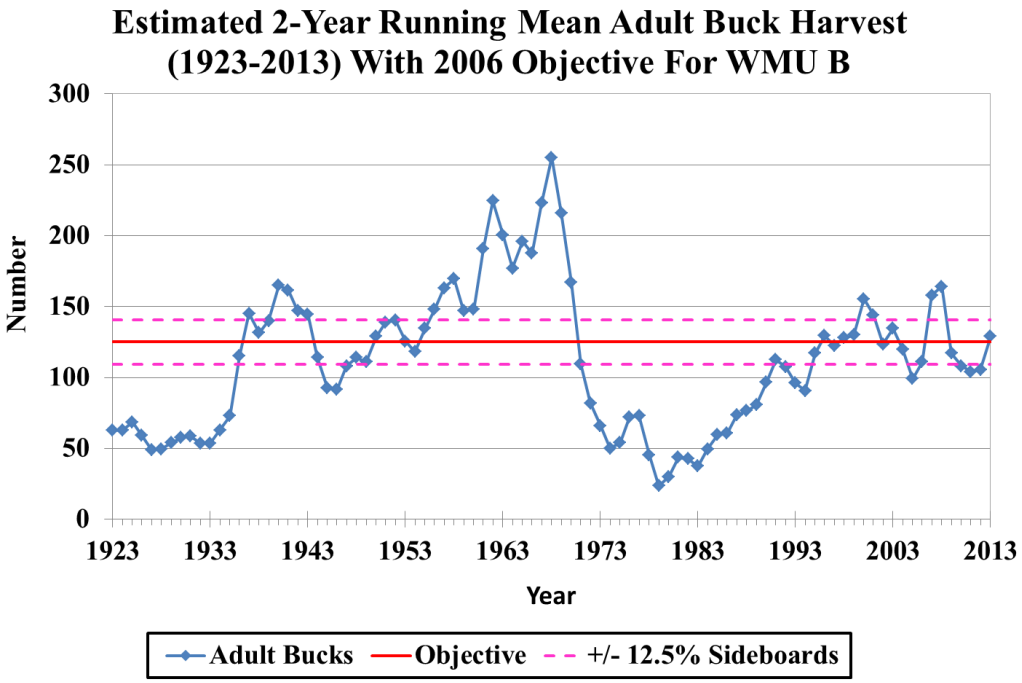


Figure 6. New Hampshire Adult Buck Kill by WMU from 1923 to 2013 with Objective from 2006 Deer Management Plan.

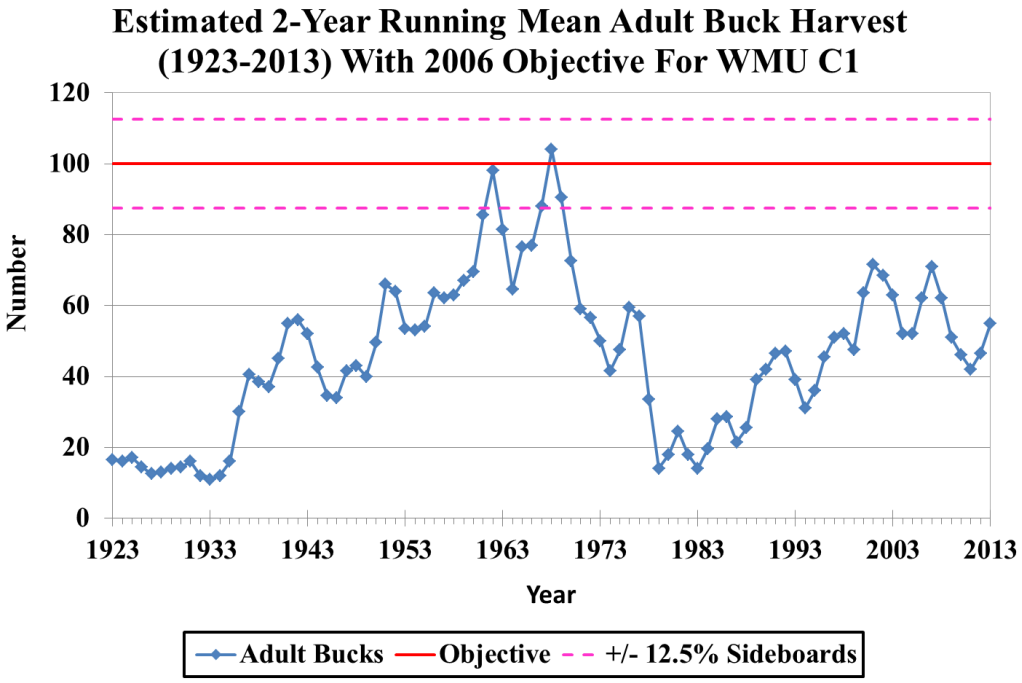


Note: 2006 Goal is 335 or 0.61 per square mile of habitat

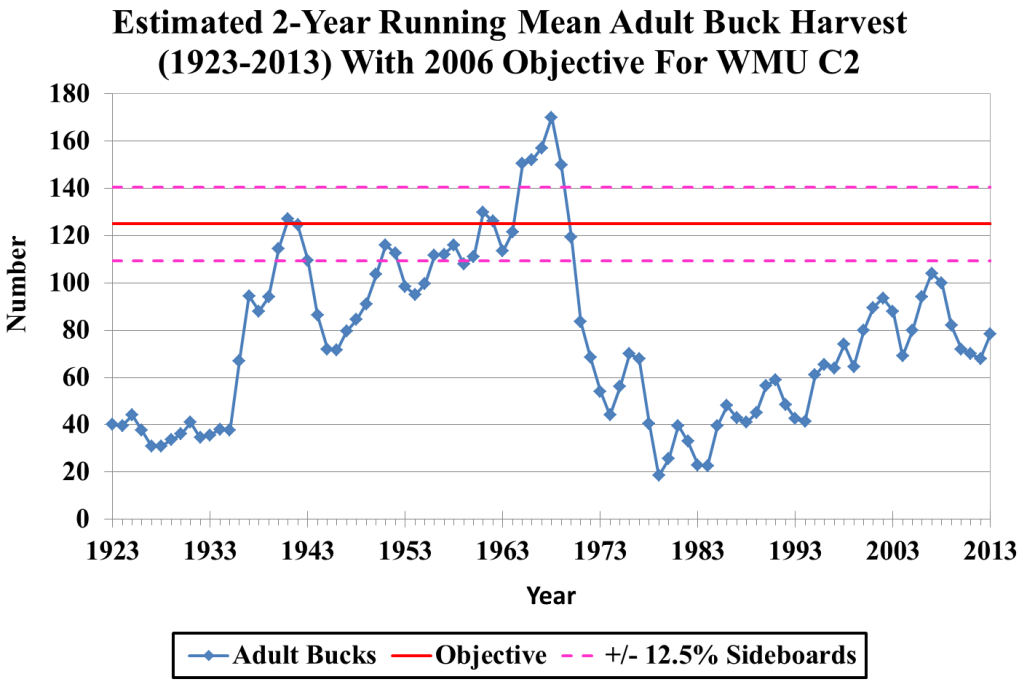


Note: 2006 Goal is 125 or 0.38 per square mile of habitat

Figure 6 (continued). New Hampshire Adult Buck Kill by WMU from 1923 to 2013 with Objective from 2006 Deer Management Plan.

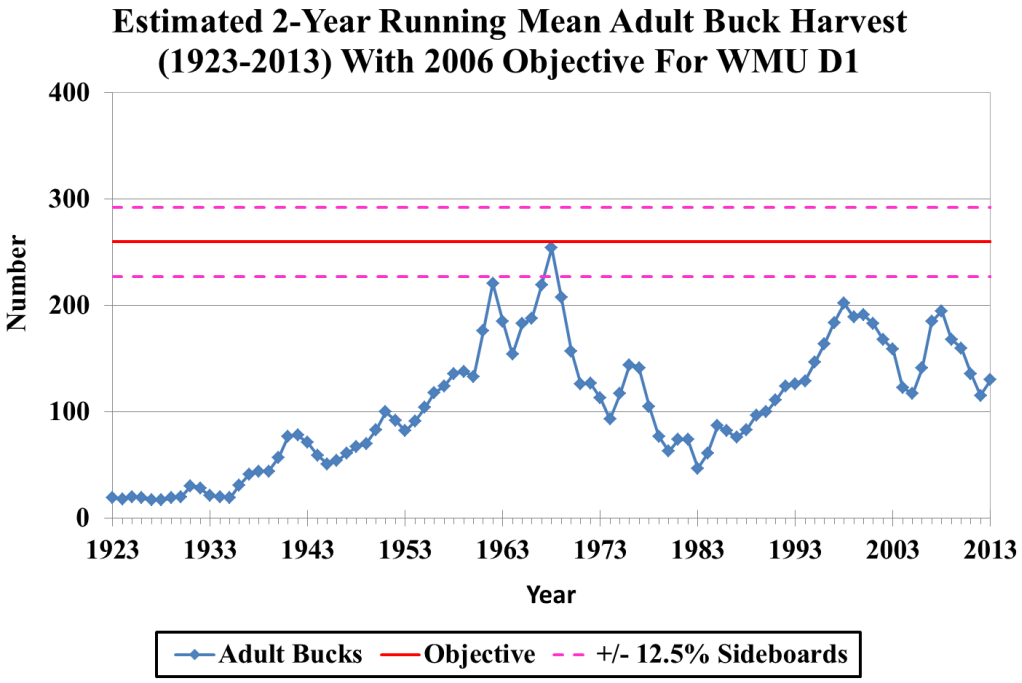


Note: 2006 Goal is 100 or 0.51 per square mile of habitat

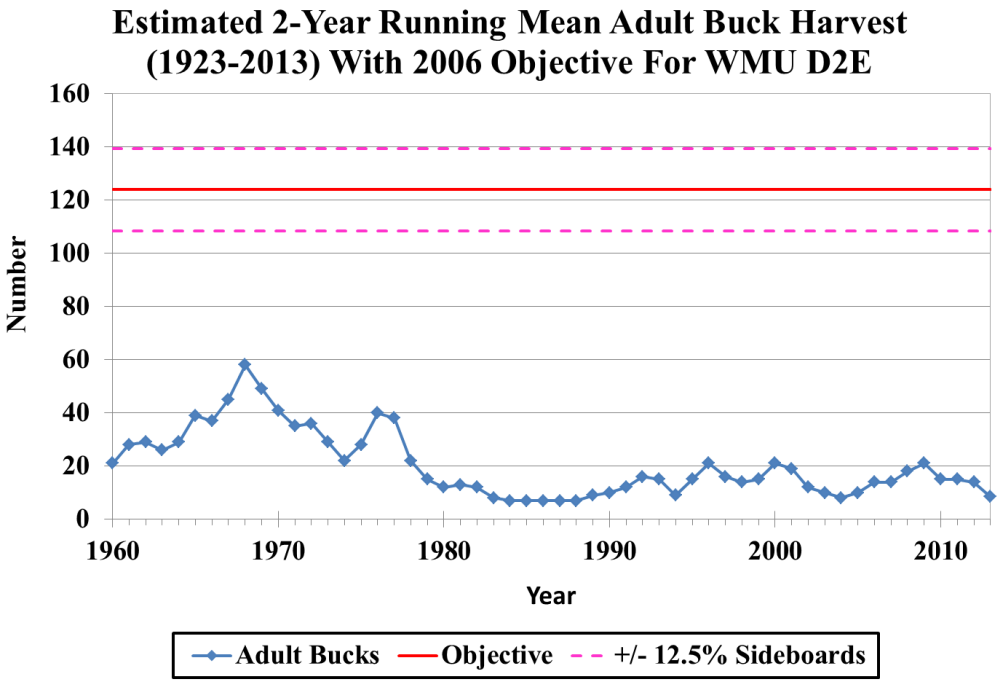


Note: 2006 Goal is 125 or 0.55 per square mile of habitat

Figure 6 (continued). New Hampshire Adult Buck Kill by WMU from 1923 to 2013 with Objective from 2006 Deer Management Plan.

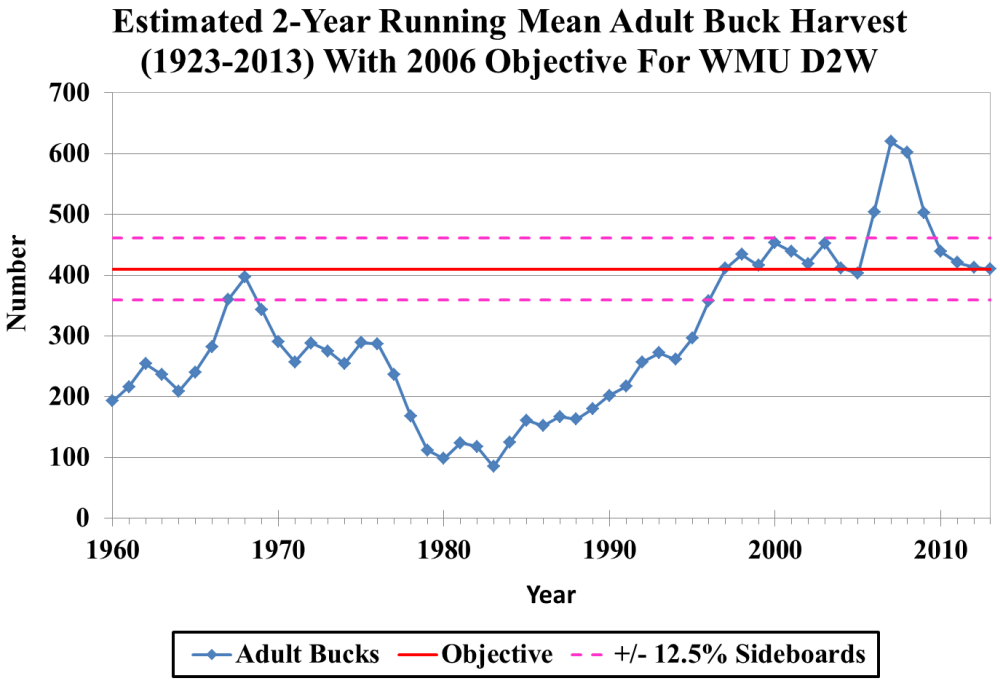


Note: 2006 Goal is 260 or 1.2 per square mile of habitat

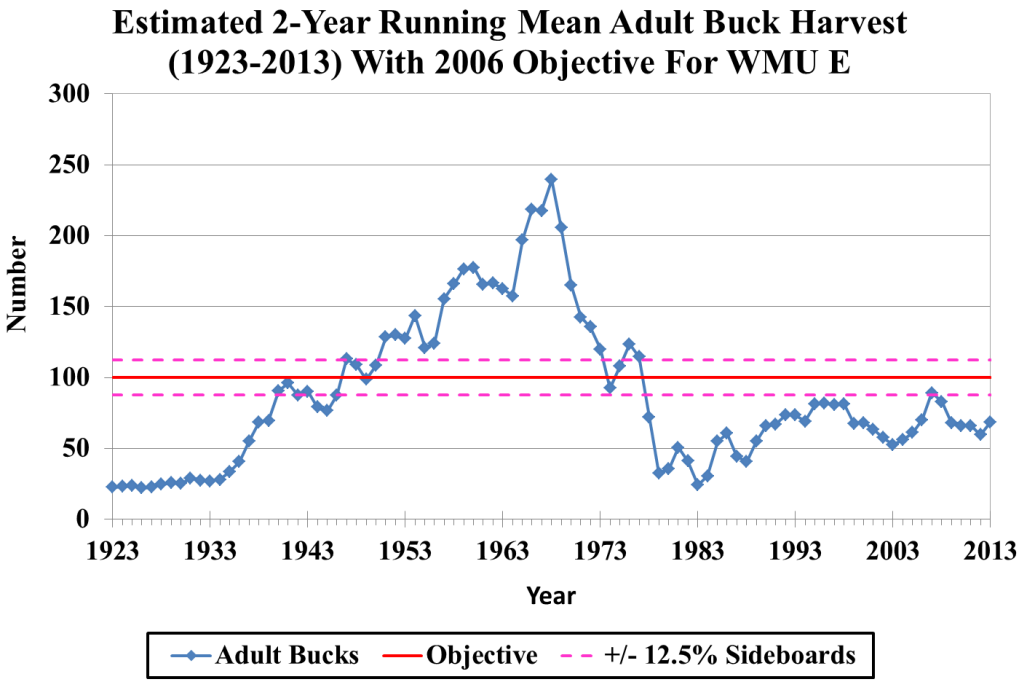


Note: 2006 Goal is 124 or 1.2 per square mile of habitat

Figure 6 (continued). New Hampshire Adult Buck Kill by WMU from 1923 to 2013 with Objective from 2006 Deer Management Plan.

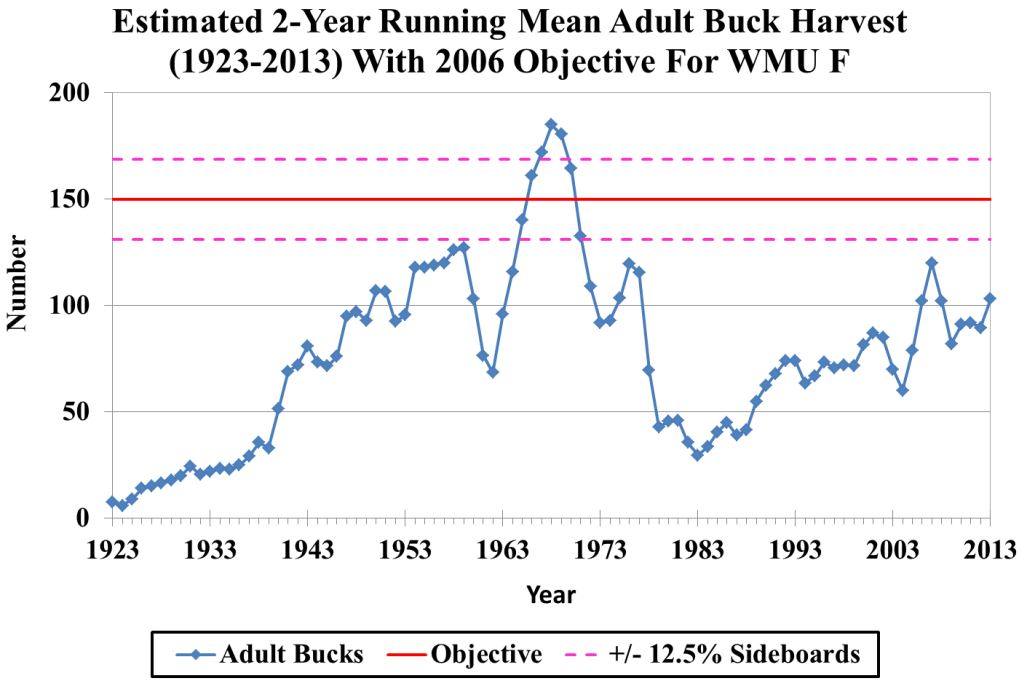


Note: 2006 Goal is 410 or 1.20 per square mile of habitat

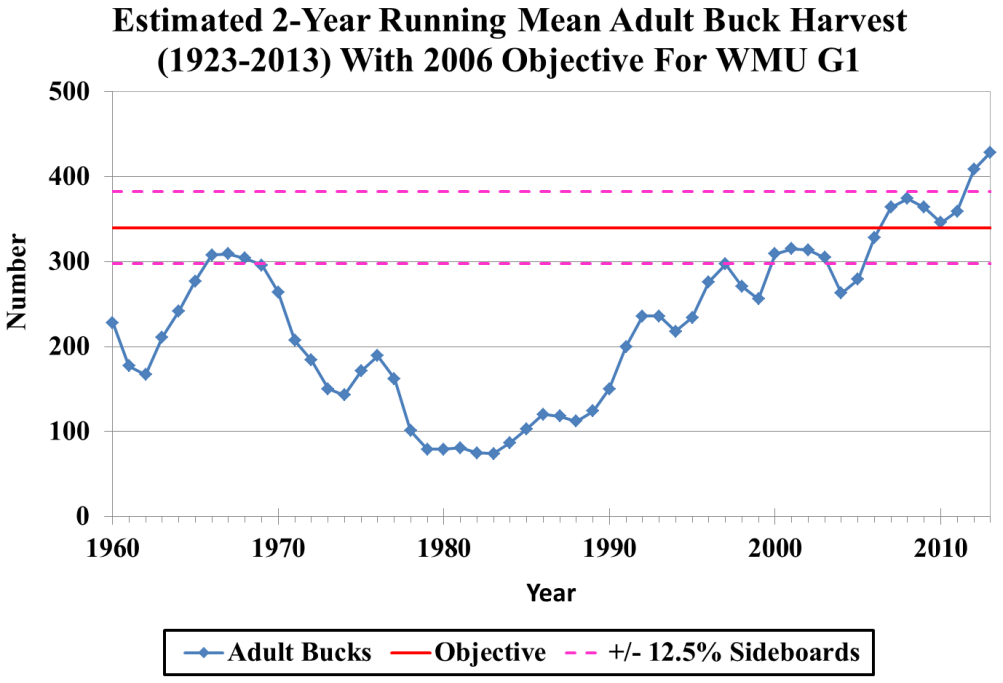


Note: 2006 Goal is 100 or 0.15 per square mile of habitat

Figure 6 (continued). New Hampshire Adult Buck Kill by WMU from 1923 to 2013 with Objective from 2006 Deer Management Plan.

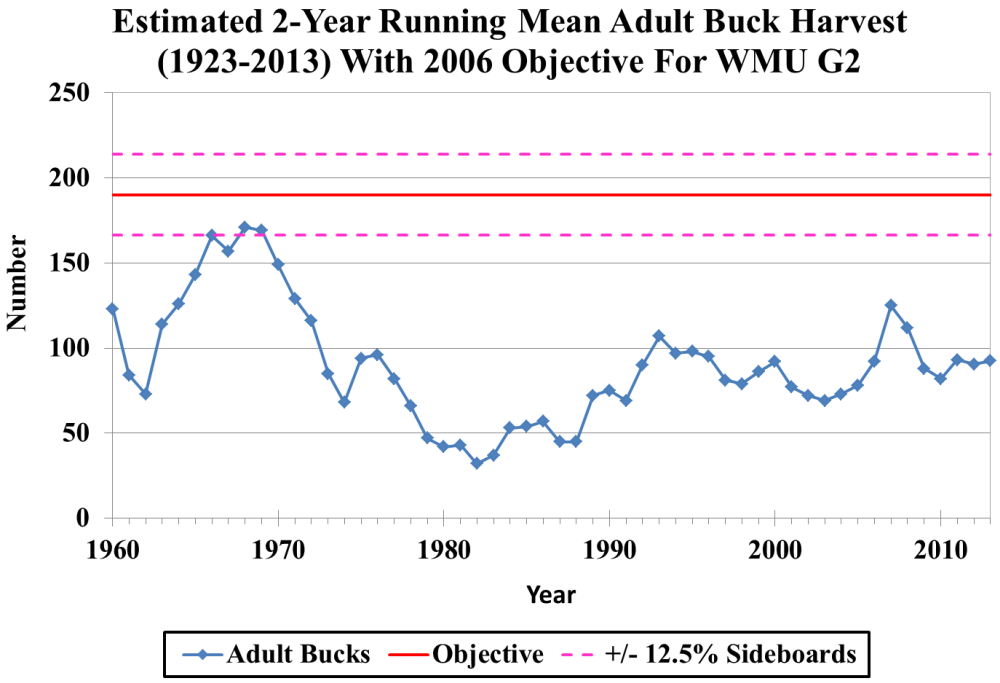


Note: 2006 Goal is 150 or 0.33 per square mile of habitat

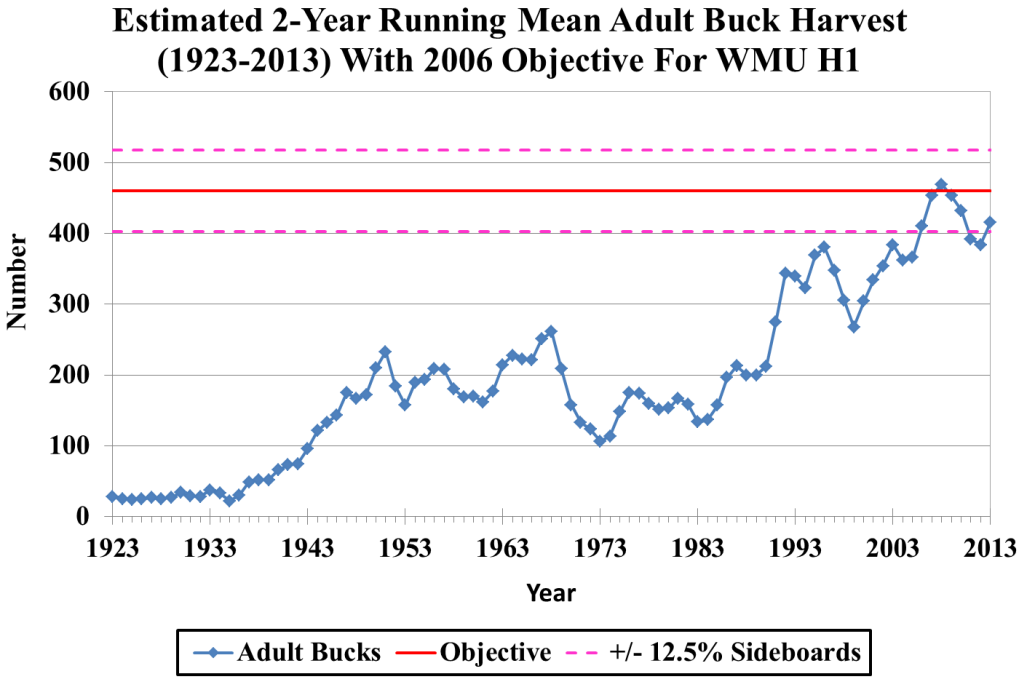


Note: 2006 Goal is 340 or 0.86 per square mile of habitat

Figure 6 (continued). New Hampshire Adult Buck Kill by WMU from 1923 to 2013 with Objective from 2006 Deer Management Plan.

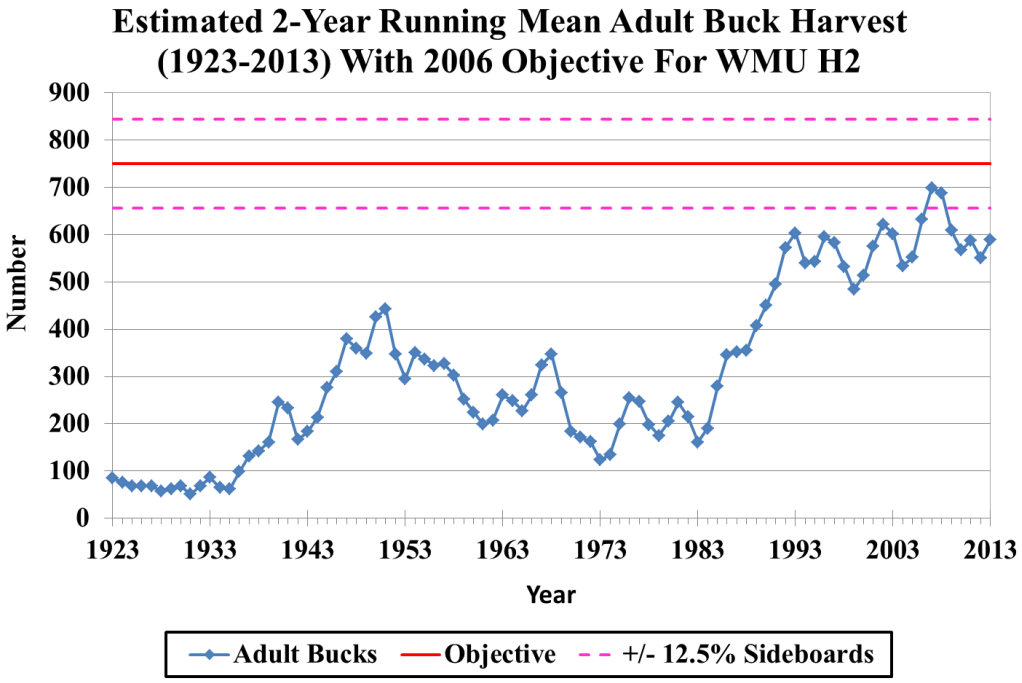


Note: 2006 Goal is 190 or 0.86 per square mile of habitat

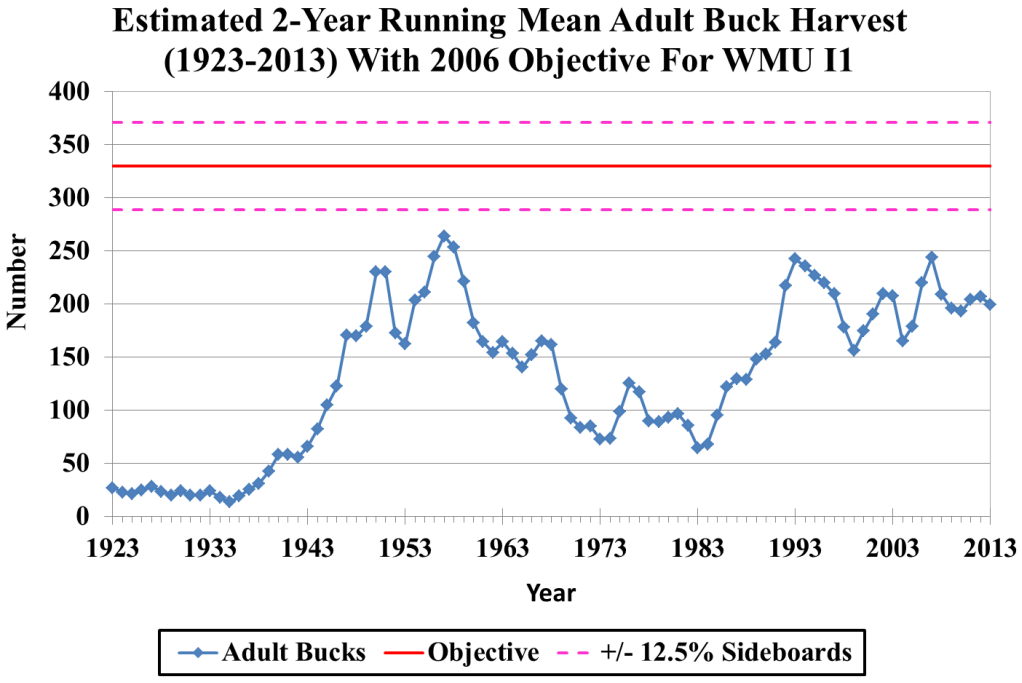


Note: 2006 Goal is 460 or 1.21 per square mile of habitat

Figure 6 (continued). New Hampshire Adult Buck Kill by WMU from 1923 to 2013 with Objective from 2006 Deer Management Plan.

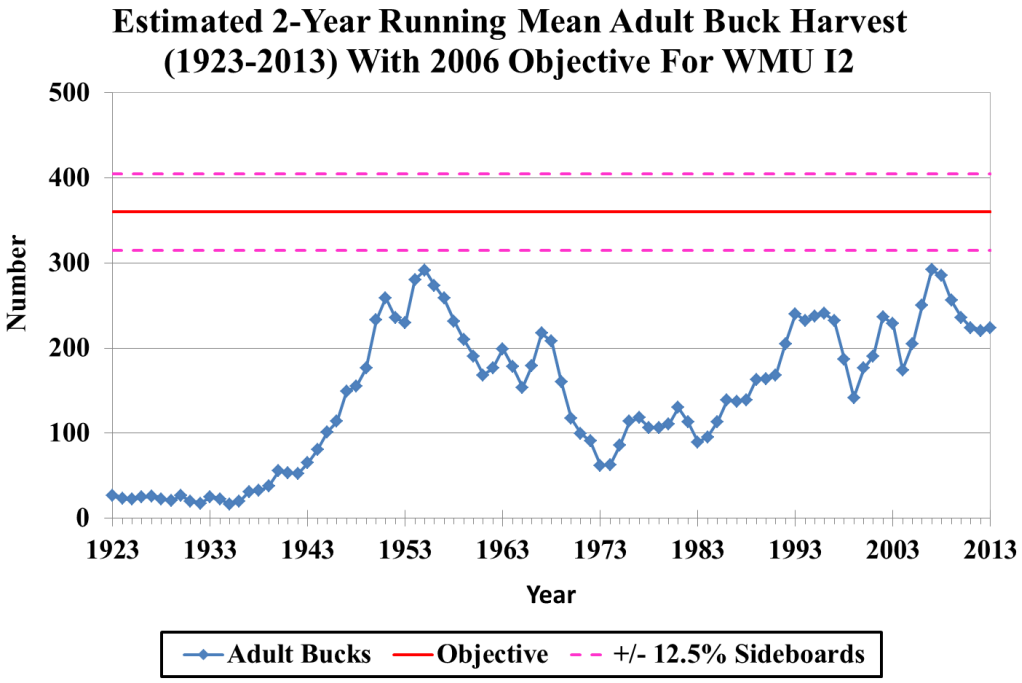


Note: 2006 Goal is 750 or 1.16 per square mile of habitat

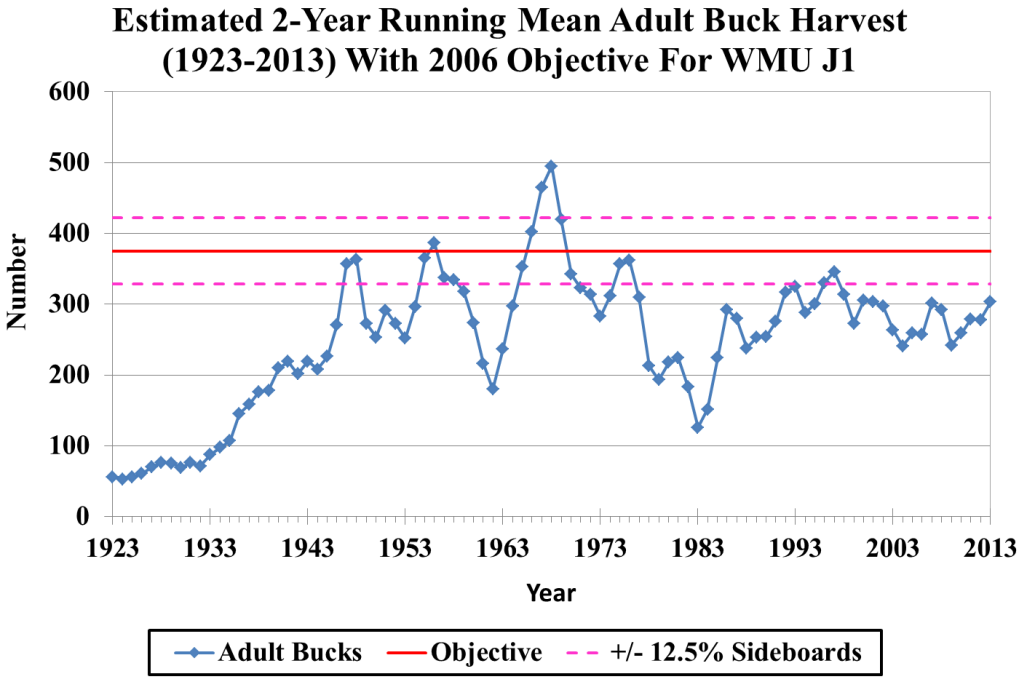


Note: 2006 Goal is 330 or 1.01 per square mile of habitat

Figure 6 (continued). New Hampshire Adult Buck Kill by WMU from 1923 to 2013 with Objective from 2006 Deer Management Plan.

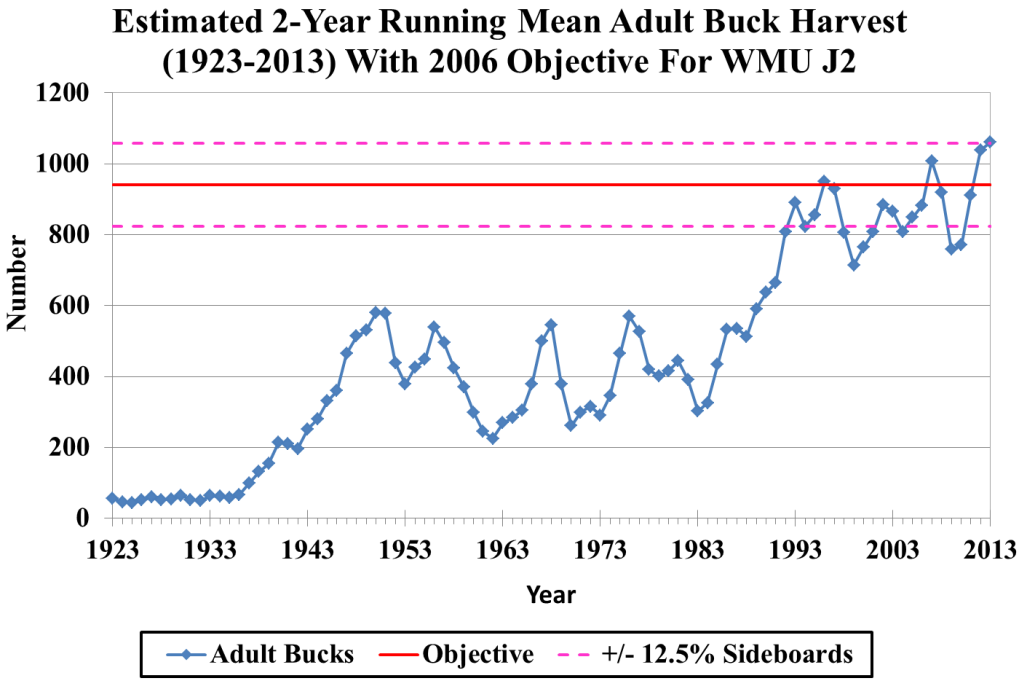


Note: 2006 Goal is 360 or 1.01 per square mile of habitat

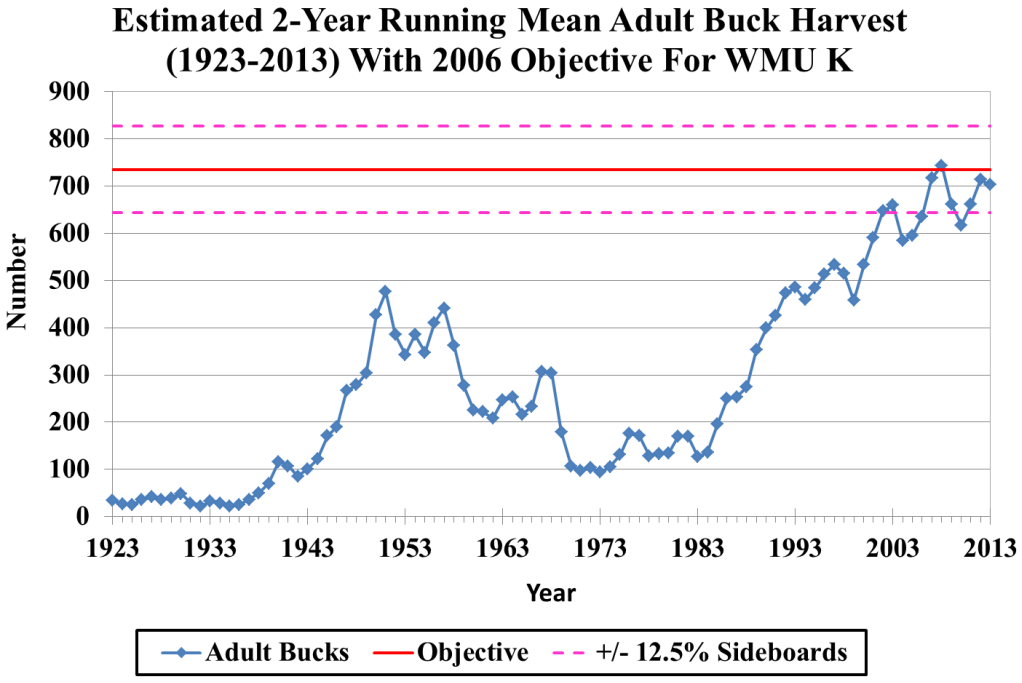


Note: 2006 Goal is 375 or 0.86 per square mile of habitat

Figure 6 (continued). New Hampshire Adult Buck Kill by WMU from 1923 to 2013 with Objective from 2006 Deer Management Plan.

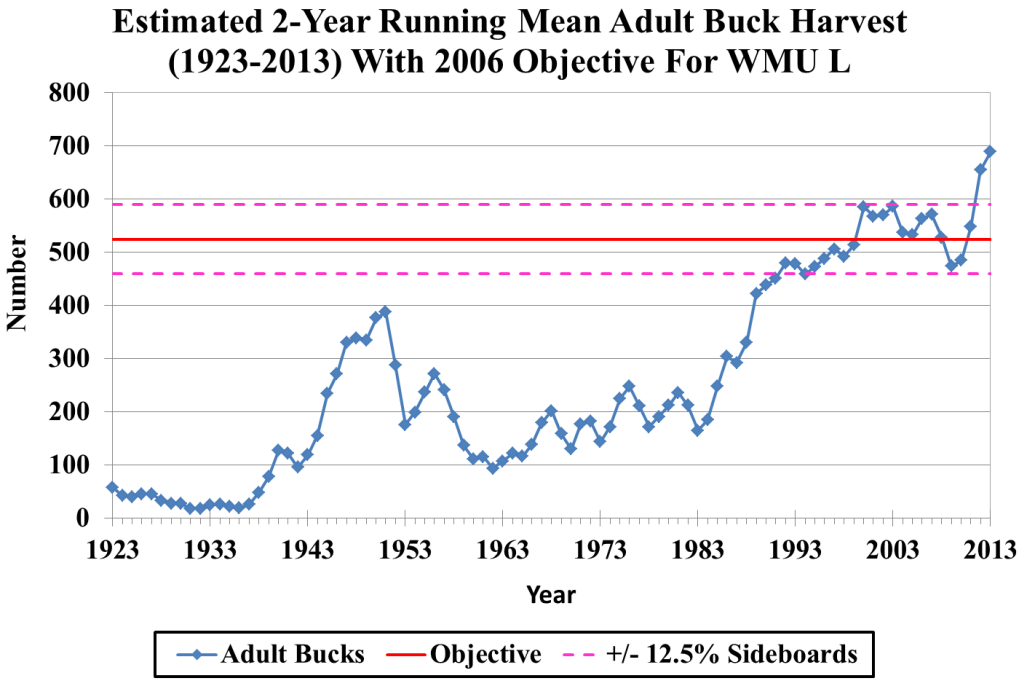


Note: 2006 Goal is 940 or 1.27 per square mile of habitat

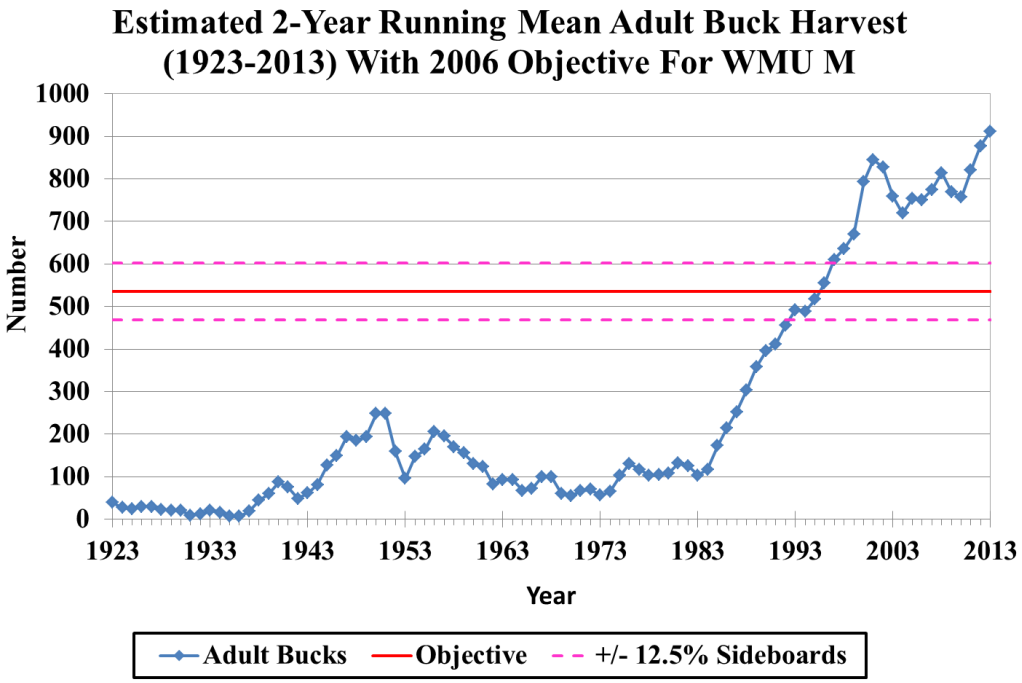


Note: 2006 Goal is 735 or 1.26 per square mile of habitat

Figure 6 (continued). New Hampshire Adult Buck Kill by WMU from 1923 to 2013 with Objective from 2006 Deer Management Plan.



Note: 2006 Goal is 525 or 1.26 per square mile of habitat



Note: 2006 Goal is 535 or 1.00 per square mile of habitat

Figure 6 (continued). New Hampshire Adult Buck Kill by WMU from 1923 to 2013 with Objective from 2006 Deer Management Plan.

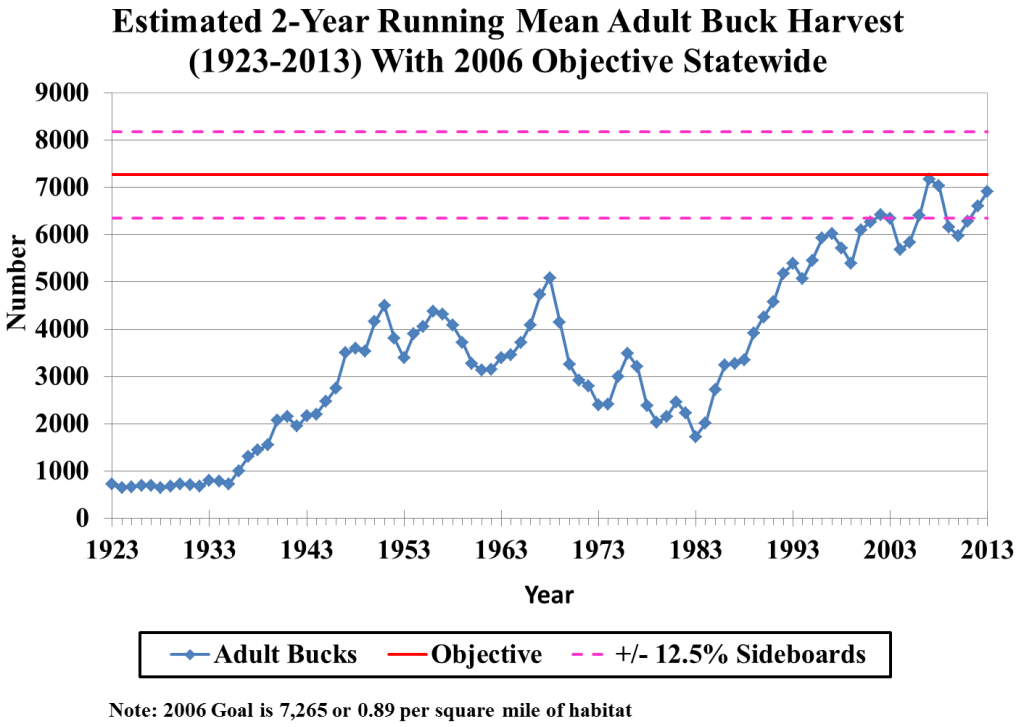


Figure 7. Requests for Deer Damage Assistance Reported to Wildlife Services in New Hampshire from 1988 to 2013.

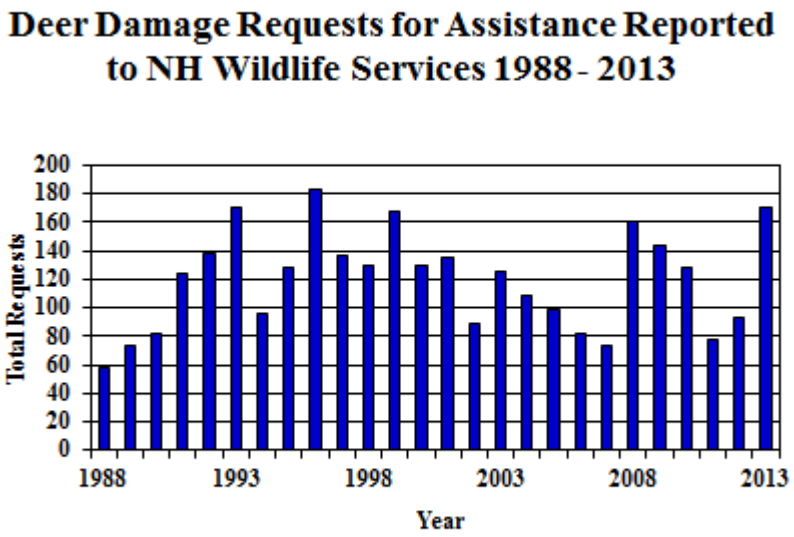
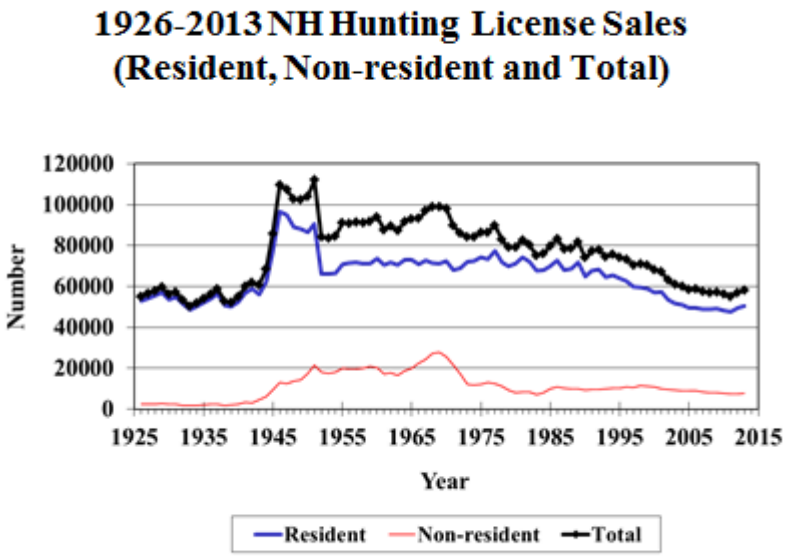
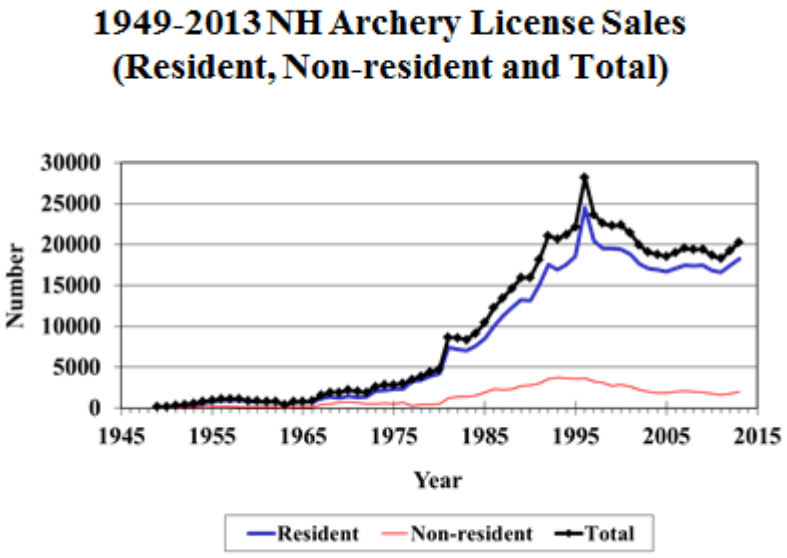


Figure 8. New Hampshire Hunting License Sales By Residency From 1926-2013.



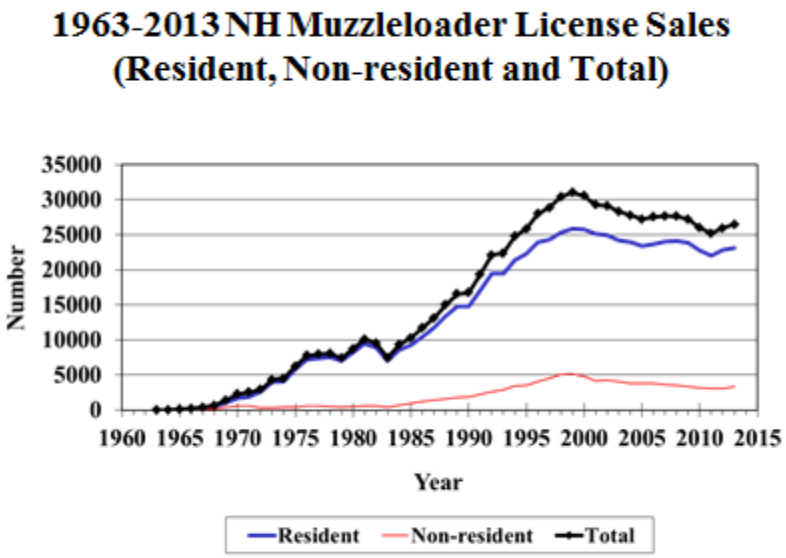
High: 112,036 (90,583 Resident and 21,453 Non-resident) in 1951
Low: 50,182 (48,417 Resident and 1,765 Non-resident) in 1933

Figure 9. New Hampshire Archery License Sales by Residency From 1949-2013.



High: 28,177 (24,560 Resident and 3,617 Non-resident) in 1996
Low: 136 (107 Resident and 29 Non-resident) in 1949

Figure 10. New Hampshire Muzzleloader License Sales by Residency From 1963-2013.



High: 31,024 (25,870 Resident and 5,154 Non-resident) in 1999
Low: 3 (1 Resident and 2 Non-resident) in 1963

Figure 11. Percent of regular firearm hunting effort occurring on each of the first 12 days of the season based on 1994-2003 and 2004-2013 deer hunter mail survey data.

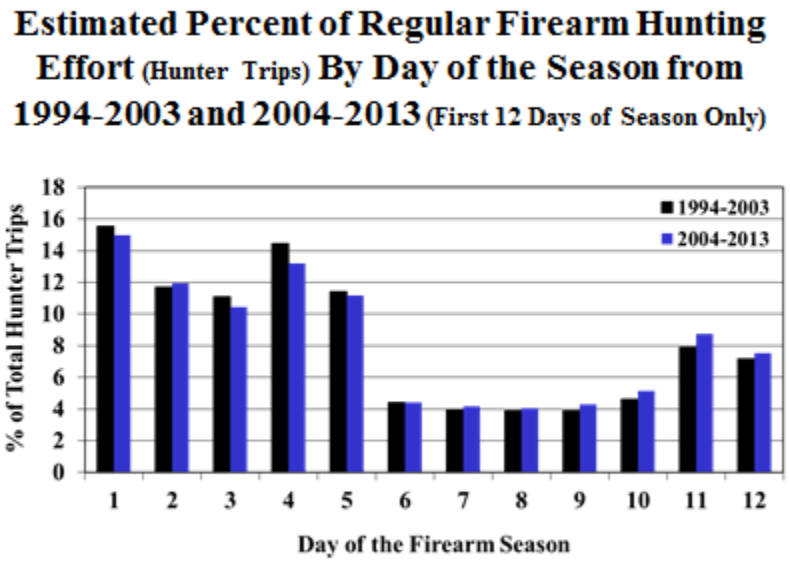


Figure 12. Percent of muzzleloader hunting effort occurring on each of the 11 days of the season based on 1994-2003 and 2004-2013 deer hunter mail survey data.

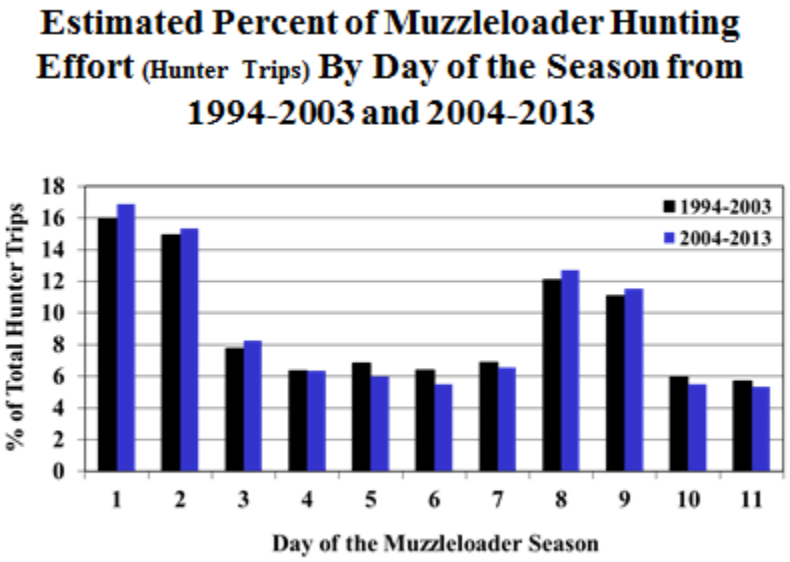


Figure 13. Percent of regular firearm hunting effort occurring in each Wildlife Management Unit for the first 12 days of the season based on 1994-2003 and 2004-2013 deer hunter mail survey data.

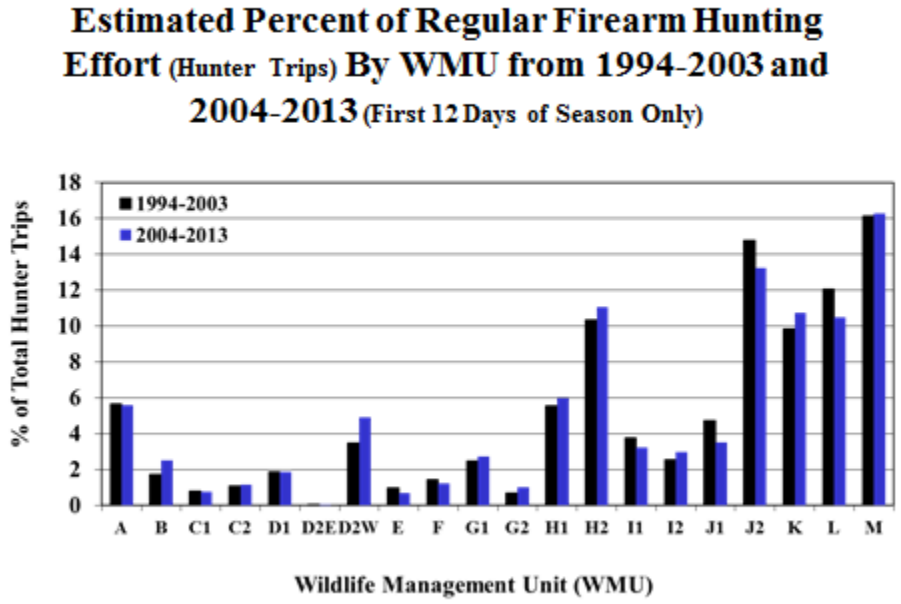


Figure 14. Percent of muzzleloader hunting effort occurring in each Wildlife Management Unit for all 11 days of the season based on 1994-2003 and 2004-2013 deer hunter mail survey data.

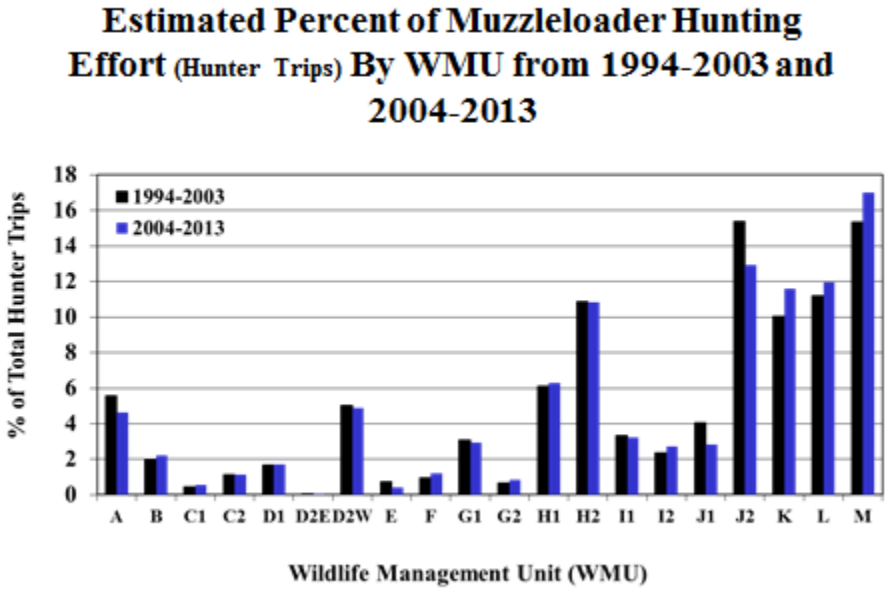


Figure 15. Percent of archery hunting effort occurring in each Wildlife Management Unit for the first 8 weeks of the season based on 1997-2003 and 2004-2008 bowhunter mail survey data.

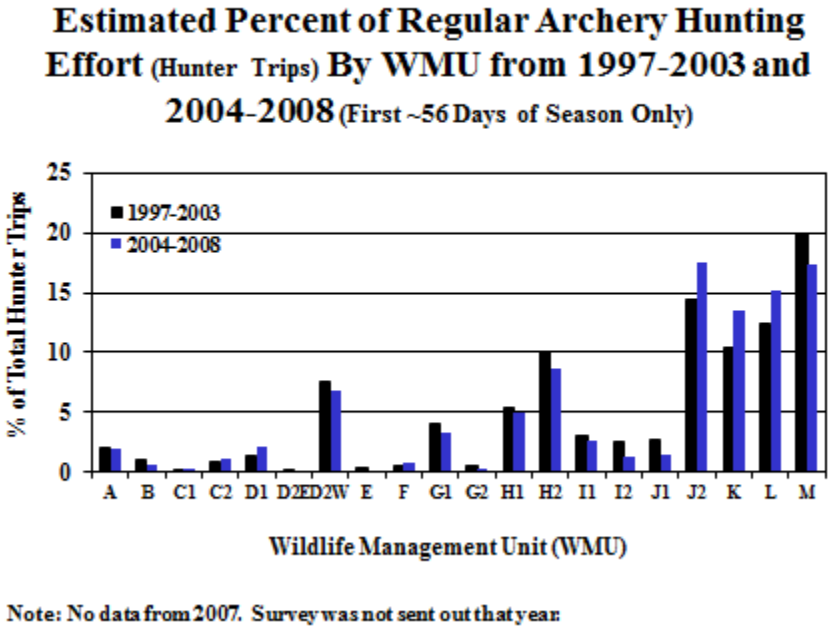


Figure 16. Regular firearm hunting effort per square mile of habitat per day for each Wildlife Management Unit for the first 12 days of the season based on 1994-2003 and 2004-2013 deer hunter mail survey data.

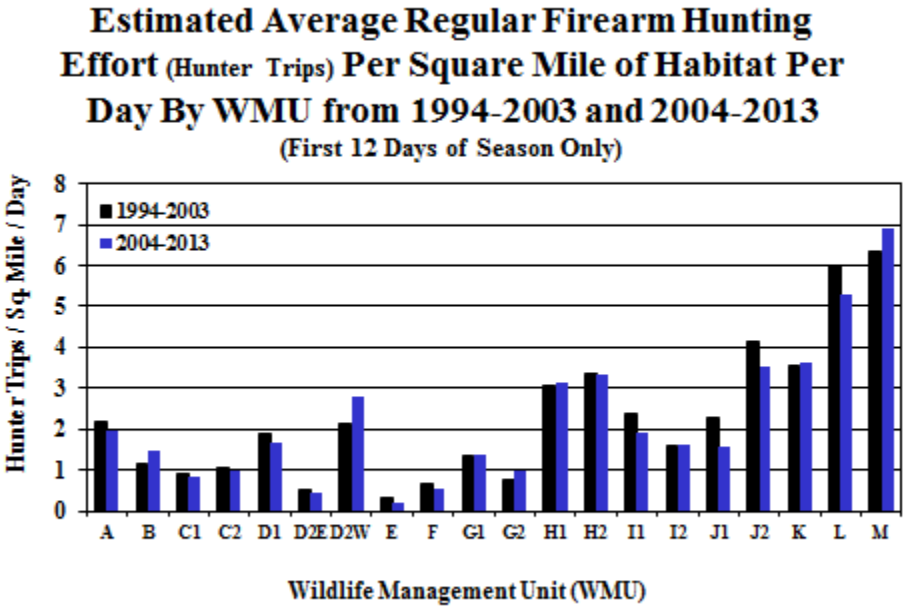


Figure 17. Muzzleloader hunting effort per square mile of habitat per day for each Wildlife Management Unit for all 11 days of the season based on 1994-2003 and 2004-2013 deer hunter mail survey data.

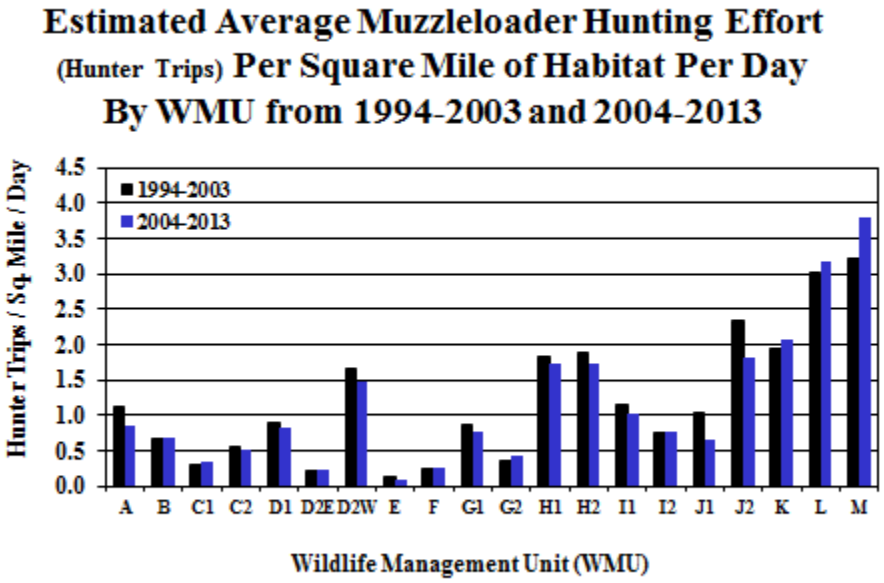
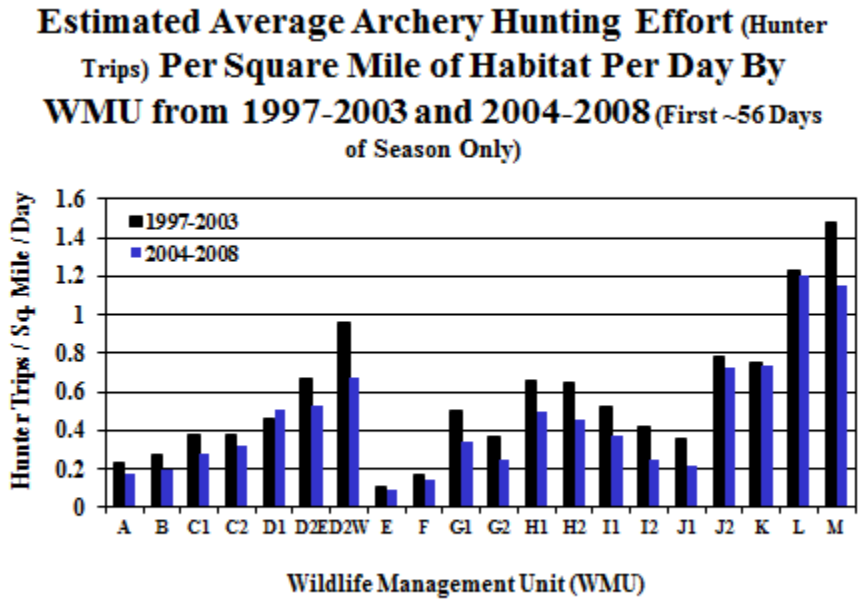
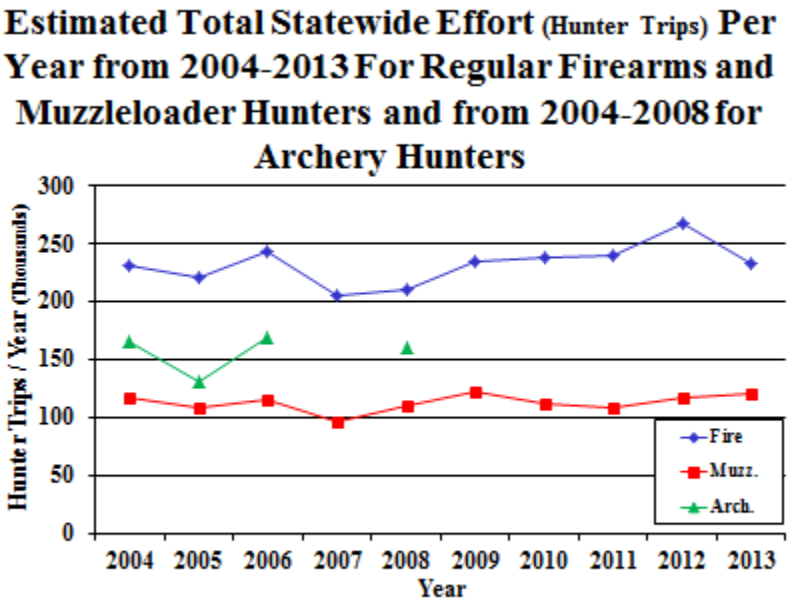


Figure 18. Archery hunting effort per square mile of habitat per day for each Wildlife Management Unit for the first 8 weeks of the season based on 1997-2003 and 2004-2008 bowhunter mail survey data.



Note: No data from 2007. Survey was not sent out that year.

Figure 19. Total statewide hunting effort per year based on 2004-2013 deer hunter mail survey data for firearms and muzzleloader hunters and 2004-2008 bowhunter mail survey data for archery hunters.



Note: Bowhunter survey not sent in 2007. No data for that year.

APPENDIX I. New Hampshire 2001 Land Cover Assessment GIS Metadata and Deer Habitat Assessment.

New Hampshire Land Cover Assessment - 2001

Metadata also available as - [Parseable text] - [SGML] - [XML]

Metadata:

Identification_Information:
Citation:
Citation_Information:
Originator: Complex Systems Research Center, University of New Hampshire
Publication_Date: 20020101
Title: New Hampshire Land Cover Assessment - 2001
Geospatial_Data_Presentation_Form: raster digital data
Publication_Information:
Publication_Place: Durham, New Hampshire
Publisher: Complex Systems Research Center, University of New Hampshire
Online_Linkage:
<URL:http://www.granit.sr.unh.edu/cgi-bin/nhsearch?dset=nhlc01/nh>
Larger_Work_Citation:
Citation_Information:
Originator: Complex Systems Research Center, University of New Hampshire
Publication_Date: 19860101
Title: NH GRANIT Database
Publication_Information:
Publication_Place: Durham, New Hampshire
Publisher: Complex Systems Research Center, University of New Hampshire
Online_Linkage: <URL:http://www.granit.sr.unh.edu>
Description:
Abstract:
The New Hampshire Land Cover Assessment categorizes land cover and land use into 23 classes, based largely on the classification of Landsat Thematic Mapper (TM) imagery.
Purpose:

The goal of the New Hampshire Land Cover Assessment is to provide a multi-purpose data set to support regional analysis. Particular emphasis is placed on delivering as much detail as possible in the forested and agricultural classes.
Supplemental_Information:
Data distribution tile: Statewide ascii grid. Users of ESRI software will need the Spatial Analyst extension or GRID. To import the ascii grid in ArcView 3.x, first enable the Spatial Analyst extension. Select "Import Data Source" from the FILE menu, and select "Ascii Raster" from the dialogue window that appears. To import the ascii grid in ArcGIS 8.x, select "ASCII to Grid" from the "Import to Raster" data conversion section of ArcToolbox, select the ascii file, name the output grid, and select "Integer" for Grid Type.
Development of the New Hamsphire Land Cover Assessment was made possible by financial support from the Cooperative Institute for Coastal and Estuarine Environmental Technology CICEET), USDA Forest Service, NH Department of Resources and Economic Development, NH Department of Fish and Game, USDA Natural Resources Conservation Service, NH Space Grant, and UNH Cooperative Extension.
Please cite as "New Hampshire GRANIT. 2001. New Hampshire Land Cover Assessment. New Hampshire GRANIT, Durham, NH."
Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 19900908
Ending_Date: 20011201
Currentness_Reference:
Dates of TM imagery, field data collection, and final classification
Status:
Progress: Complete
Maintenance_and_Update_Frequency: None planned
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -72.594653
East_Bounding_Coordinate: -70.664747
North_Bounding_Coordinate: 45.30723
South_Bounding_Coordinate: 42.693632
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Land Cover
Theme_Keyword: Land Use
Theme_Keyword: Remote Sensing
Theme_Keyword: Classification
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: United States
Place_Keyword: Northeast

Place_Keyword: New England
Place_Keyword: New Hampshire
Access_Constraints:
Acknowledgement of GRANIT would be appreciated in products derived from these data.
Use_Constraints:
Users must assume responsibility to determine the appropriate use of these data. Because of the nature of the source imagery (30m pixels), it is not recommended that the data be used at scales greater than 1:60,000. Consult the Attribute Accuracy Report for a more detailed description of the accuracy of these data.
Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Complex Systems Research Center
Contact_Person: GRANIT Database Manager
Contact_Position: GRANIT Database Manager
Contact_Address:
Address_Type: mailing and physical address
Address: Morse Hall, University of New Hampshire
City: Durham
State_or_Province: NH
Postal_Code: 03824
Country: USA
Contact_Voice_Telephone: (603) 862-1792
Contact_Facsimile_Telephone: (603) 862-0188
Contact_Electronic_Mail_Address: granit@unh.edu
Hours_of_Service: 8:30 AM - 5:00 PM, EST
Browse_Graphic:
Browse_Graphic_File_Name:
<URL:http://www.granit.sr.unh.edu/cgi-bin/load_file?PATH=/data/database/d-webdata/nhlc01/browse.gif>
Browse_Graphic_File_Description: gif image file
Browse_Graphic_File_Type: gif
Native_Data_Set_Environment: ESRI GRID (converted to ASCII grid for ease of transfer)

Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report:
The project achieved an overall accuracy of 82.2% at the full 23-class level. Below is a summary of User's and Producer's Accuracy for each of these classes.
CLASS - Code PRODUCER'S ACC. USER'S ACC.
Residential/Commercial/Industrial - 110 86.9% 88.3% Transportation - 140 100.0% 85.0% Row Crops - 211 94.6% 88.3% Hay/Pasture - 212 84.6% 91.7% Orchards - 221 97.4% 92.5% Beech/Oak - 412 68.1% 53.3% Paper Birch/ Aspen - 414 28.6% 28.6% Other Hardwood - 419 53.2% 70.0% White/Red Pine - 421 90.7% 81.7% Spruce/Fir -

422 93.8% 80.4% Hemlock - 423 95.1% 65.0% Pitch Pine - 424 100.0% 97.5% Mixed Forest - 430 39.7% 62.5% Alpine (Krumholz) - 440 100.0% 80.0% Water - 500 100.0% 100.0% Forested Wetland - 610 74.3% 86.7% Open Wetland - 620 88.2% 75.0% Tidal Wetland - 630 100.0% 100.0% Disturbed - 710 90.0% 90.0% Bedrock/ Veg. - 720 100.0% 100.0% Sand Dunes - 730 100.0% 100.0% Other Cleared - 790 82.4% 93.3% Tundra - 800 100.0% 100.0%
When the classification is collapsed to the 17-class level, the overall accuracy is 88.4%, and the User's and Producer's Accuracies are as follows:
CLASS - Code PRODUCER'S ACC. USER'S ACC.
Residential/Commercial/Industrial - 110 86.9% 88.3% Transportation - 140 100.0% 85.0% Crops/Pasture - 211-212 95.0% 95.8% Orchards - 221 97.4% 92.5% Deciduous Forest - 410-419 90.7% 94.8% Coniferous Forest - 420-429 97.3% 81.9% Mixed Forest - 430 39.7% 62.5% Alpine (Krumholz) - 440 100.0% 80.0% Water - 500 100.0% 100.0% Forested Wetland - 610 74.3% 86.7% Open Wetland - 620 88.2% 75.0% Tidal Wetland - 630 100.0% 100.0% Disturbed - 710 90.0% 90.0% Bedrock/ Veg. - 720 100.0% 100.0% Sand Dunes - 730 100.0% 100.0% Other Cleared - 790 82.4% 93.3% Tundra - 800 100.0% 100.0%
So that users can interpret the data most effectively, rules were created to develop broader ("fuzzier") categories of "right" and "wrong" and to assess the accuracy using these fuzzy sets. We applied the linguistic scale developed by Woodcock and Gopal (2000):
(1) Absolutely wrong: This answer is absolutely unacceptable. Very wrong. (2) Understandable but wrong: Not a good answer. There is something about the site that makes the answer understandable, but there is clearly a better answer. This answer would pose a problem for users of the map. Not right. (3) Reasonable or acceptable answer: May not be the best possible answer but it is acceptable; this answer does not pose a problem to the user if it is seen on the map. Right. (4) Good answer: Would be happy to find this answer on the map. Very right. (5) Absolutely right: No doubt about the match. Perfect.
Each accuracy assessment site was given a fuzzy rating (see fuzzyratings.pdf for definitions). The overall accuracy of the 23- class classification increases to 89.1% when the "good answers" are included as "right," and to 92.0% when "reasonable or acceptable answers" are included as well. Please see the project's final report for a full discussion of the accuracy assessment.
Logical_Consistency_Report: These data are believed to be logically consistent.
Completeness_Report:
These data are considered complete for the study area - the State of New Hampshire.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report:
The data were derived from the classification of several Landsat Thematic Mapper images (see citation details). Two of these images were georeferenced by the staff at the Complex Systems Research Center to SPOT panchromatic 10m resolution images, and the rest were georeferenced by the USGS or ImageLinks, Inc. RMS error for the data georeferenced by CSRC was less than 0.5 pixel.
Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: Vertical positional accuracy was not assessed.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: USGS and NASA
Publication_Date: 20010101
Title: Landsat Thematic Mapper imagery
Edition: One
Geospatial_Data_Presentation_Form: Image
Publication_Information:
Publication_Place: Sioux Falls, SD
Publisher: EROS Data Center, USGS
Other_Citation_Details:
The source data for this project were the following Landsat Thematic Mapper images: Image Type Path-Row Bands Date Georeferencing/ Terrain Correction performed by: Landsat 5 TM 12-30 1-7 8-Sep-90 CSRC Landsat 5 TM 12-30 1-7 14-May-94 USGS Landsat 5 TM 12-30 1-7 24-Oct-95 CSRC Landsat 5 TM 12-30 1-7 22-Jul-96 USGS Landsat 5 TM 13-29 1-7 13-May-91 USGS Landsat 5 TM 13-29 1-5, 7 6-Oct-92 USGS Landsat 5 TM 13-29 1-7 12-Oct-94 USGS Landsat 7 ETM+ 13-29 1-8 31-Aug-99 ImageLinks, Inc. Landsat 5 TM 13-30 1-5, 7 6-Oct-92 USGS Landsat 5 TM 13-30 1-7 28-Oct-94 USGS Landsat 5 TM 13-30 1-7 14-Apr-98 USGS Landsat 7 ETM+ 13-30 1-8 31-Aug-99 ImageLinks, Inc.
Ancillary data comprised numerous holdings from the GRANIT archive (the NH statewide GIS), including watershed boundaries, panchromatic Digital Orthophotoquads (DOQs), Digital Raster Graphics (DRGs), USGS Digital Line Graphs (DLGs) for hydrography, NH Department of Transportation road centerlines, Digital Elevation Models (DEMs), SPOT panchromatic (10 meter resolution) images, protected lands, and US Fish and Wildlife Service National Wetlands Inventory (NWI) maps.
Type_of_Source_Media: Image
Source_Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 19900908
Ending_Date: 19990831
Source_Currentness_Reference: Ground condition
Source_Citation_Abbreviation: TM
Source_Contribution: Basis of image processing for the classification
Process_Step:
Process_Description:
The NH Land Cover Assessment was conducted separately for each of three regions of the state: the coastal area, the southwest, and the north country. While each region was processed separately, the same general procedure was followed for each. Twelve Landsat Thematic Mapper images (see above) were selected as the basis for the initial classifications. The images were subset to comprise the geographic extent of three

primary study areas, and the 6 reflective bands (1-5, and 7) from a summer (leaf on) and spring (leaf off) image were "layer stacked" or combined into a single 12-band data set for each region. To minimize error due to shadows in the imagery (particularly problematic in steep sloped areas), the layer-stacked images were subset into slope categories (based on the DEMs) that were then processed separately.

The first product generated for each region was a generalized data set. Archived data from previous projects were used to create representative signatures, and a supervised, maximum likelihood classification was applied to each image subset. These classifications grouped each image subset into five broad categories: deciduous forest, coniferous forest, mixed forest, agricultural/cleared, and wetlands/water. The resulting classes were visually evaluated using DOQ's, other ancillary data sets, and local knowledge. Acceptable classes were carried through to the final data set, while unacceptable classes were used to mask various image band combinations and/or band transformations. This was followed by unsupervised classifications using the ISODATA cluster routine. At each iteration, the generalized classes were evaluated, and either archived for incorporation in the interim generalized product or retained for additional processing. As many as four supervised and unsupervised classification iterations using various image date/band derivatives were run on the resulting data sets. Finally, each of the general classifications was recoded to reflect the appropriate land cover value and mosaicked to generate the full, region-wide generalized land cover data set.

Class-specific classifications were accomplished through a series of image subsets, masks, and classification iterations to produce the final product. Each class-specific procedure was initialized by creating a layer-stack of various bands/band derivations. These were selected in part by applying the ERDAS Imagine signature separability tool to the layer stack and using the Transformed Divergence measure. Once bands were selected, the image composite was masked to retain pixels of interest (e.g., the forest-specific classification retained forested classes from the generalized land cover). This was followed by an iterative process of classifications using a combination of techniques (similar to that of the general classification) to derive the final data for that class.

The series of specific classifications typically began with a supervised classification, using both archived training sites and training sites collected for this project. Over 1,400 new data points were collected to supplement 1,200 archived sites from previous projects. A large number of non-forested sites were available from pre-existing sources, such as DOQ's, DRG's, NWI, and local knowledge. Forested sites, as well as some wetland and agricultural sites, required field sampling. Field crews navigated to each site using a Trimble Pro-XRS GPS receiver obtaining real time corrections, and at each forested location conducted two to four 10 BAF prism tallies to quantify the canopy composition.

In the southeast, the three forested classes (coniferous, deciduous, and mixed) from the generalized land cover were each processed independently, while in the north and southwest regions, the three classes were processed together because it was determined that there was no appreciable improvement in classification quality by separating the three.

As with the general classification, there was a series of iterative classifications from

which acceptable results were saved to a final data layer and unacceptable results were used to mask subsequent data sets. For the forested classes, 14 iterations were needed to achieve an acceptable data layer. A total of 2,794 training signatures were used in these classifications (though in some cases the same training site was used to produce signatures for multiple images). For the cleared sites, 542 signatures were used in 12 classifications, and 126 signatures were used in 6 wetlands classifications. Our use of NWI data and the ISODATA clustering routine reduced the number of signatures needed to classify wetlands.

Some ancillary data were applied in this process as well: NWI data were used as a mask in the North Country to help distinguish many forested wetlands from spruce/fir forests; orchards were screen digitized from DRG's and DOQ's; and other data sets such as DRG's and DOQ's were used to determine the reliability of classes. Elevation data from USGS digital elevation models were used to change forest classes based on certain thresholds. Beech/Oak above 2,500 feet and Other Hardwoods above 3,000 feet were converted to Paper Birch/Aspen; White/Red Pine above 1,500 feet and Hemlock above 2,400 feet were converted to Spruce/Fir; and any forested class above 4,200 feet was converted to Alpine (Krumholz).

Several post processing refinements were applied to the provisional land cover data in the ESRI Grid environment. NH Department of Transportation road data (resident in the GRANIT data base, 2001) were "burned in" to the land cover data set, effectively overwriting any coincident class. Also, DLG hydrography data were used to update double banked river, lake, and pond edges. Finally, several filters were applied to remove speckling and produce minimum map units of one acre. In order to maintain the integrity of linear features, filtering was preceded by the REGIONGROUP command, such that the majority filter applied would only operate on groups of pixels smaller than approximately one acre (five pixels). This filter was followed by a second REGIONGROUP and contiguous pixels in sets less than five were finally NIBBLED to eliminate those pixels that were not eliminated by the majority filter.

A total of 975 sites were evaluated for the accuracy assessment. More than 600 of these were field visited, and others were evaluated using ancillary data such as NWI maps, DOQ's, and TM imagery. All sites classified as forest or agriculture, and most classified as wetland, were field visited using Trimble Pro-XRS GPS units receiving real time differential correction. At forested sites, field crews recorded stand information and conducted up to five 10 BAF prism tallies to quantify stand composition.

As with the classification itself, the accuracy assessment was conducted separately for each of the three geographic regions. In each region, we attempted to sample 30 sites per land cover class, but in some cases we were unable to do so because of limited area covered by the class, post data-collection re-classification, or for other reasons. Conversely, some classes were over-sampled, because of post data-collection re-classification or because we decided to merge subclasses. In order to limit distortion due to disparate sample sizes among classes, we randomly selected 20 sites from each class in each region to tabulate in the error matrices. This yielded a total of 60 sites per class for the full state (though some classes, particularly those like Tundra that are regionally focused, still have fewer sample sites).

Error matrices were generated for the Level 3 (23 class), Level 2 (16 class) and Level

1 (7 class) classifications, and user's and producer's accuracy were calculated. Additionally, the Level 3 classification was assessed using fuzzy set rules. See the Attribute Accuracy report above and the project's final report for more information.
Source_Used_Citation_Abbreviation: TM
Process_Date: 20011201

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Grid Cell
Row_Count: 10174
Column_Count: 5311
Vertical_Count: 1

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Grid_Coordinate_System:
Grid_Coordinate_System_Name: State Plane Coordinate System 1983
State_Plane_Coordinate_System:
SPCS_Zone_Identifier: New Hampshire
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.999967
Longitude_of_Central_Meridian: -71.666667
Latitude_of_Projection_Origin: 42.500000
False_Easting: 984250.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 93.500000
Ordinate_Resolution: 93.500000
Planar_Distance_Units: survey feet
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222

Entity_and_Attribute_Information:
Overview_Description:
Entity_and_Attribute_Overview:
New Hampshire Land Cover Assessment Data Key Developed 110 Residential, commercial, or industrial 140 Transportation Active agricultural land 211 Row crops 212 Hay/rotation/permanent pasture 221 Fruit orchards Forested 412 Beech/oak 414 Paper birch/aspen 419 Other hardwoods 421 White/red pine 422 Spruce/fir 423

Hemlock 424 Pitch pine 430 Mixed forest 440 Alpine (Krumholz) Water 500 Open water Wetlands 610 Forested wetlands 620 Non-forested wetlands 630 Tidal wetlands Barren Land 710 Disturbed 720 Bedrock/vegetated 730 Sand dunes 790 Cleared/other open Tundra 800 Tundra

Entity_and_Attribute_Detail_Citation:

The following rules were used to determine forest type: Deciduous stands (41x) are forested stands comprising less than 25% coniferous basal area per acre. Coniferous stands (42x) are forested stands comprising greater than 65% coniferous basal area per acre. Mixed stands (430) are forested stands comprising greater than 25% and less than 65% coniferous basal area per acre. Alpine areas (440) contain stunted vegetation, either hardwood or softwood (usually paper birch or spruce/fir), and occur just below tree line in the White Mountains.

Beech/oak stands (412) are deciduous stands comprising at least 30% beech and oak. Paper birch/aspen stands (414) are deciduous stands comprising at least 20% paper birch and aspen. Other deciduous stands (419) are deciduous stands not meeting either the beech/oak or paper birch/aspen criteria.

White/red pine stands (421) are coniferous stands in which white and red pine constitute a plurality of the coniferous basal area. Spruce/fir stands (422) are coniferous stands in which spruce and fir constitute a plurality of the coniferous basal area. Hemlock stands (423) are coniferous stands in which hemlock constitutes a plurality of the coniferous basal area. Pitch pine stands (424) are coniferous stands in which pitch pine constitutes a plurality of the coniferous basal area.

Other class definitions are as follows:

Developed (110) - built-up areas. (Note that this class was coded as 100 in early releases of the data.) Active agriculture (200) - hay fields, row crops, plowed fields, etc. Water (500) - lakes, ponds, some rivers or any other open water feature. Wetlands (600) - areas dominated by wetland characteristics defined by the U. S. Fish and Wildlife Service National Wetlands Inventory. Basically hydric soils, hydrophytic vegetation and the hydrologic conditions that result in water at or near the surface for extended periods of the growing season. Disturbed (710) - gravel pits, quarries or other areas where the earth and vegetation have been altered or exposed. Bedrock/vegetated (720) - exposed bedrock or ledge (usually in the mountains) that may have some forms of stunted vegetation growing in cracks or lichens growing on the surface rock. Sand dunes (730) - areas along the seacoast that are dominated by sand. Cleared/other open (790) - clear cut forest, old agricultural fields that are reverting to forest, etc. Tundra (800) - areas dominated by short vegetation that occurs above tree line in the White Mountains (only mapped on Mt Washington). (Note that this class was previously coded as 810 in early releases of the data.)

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: Complex Systems Research Center

Contact_Person: GRANIT Database Manager

Contact_Position: GRANIT Database Manager

Contact_Address:
Address_Type: mailing and physical address
Address: Morse Hall, University of New Hampshire
City: Durham
State_or_Province: NH
Postal_Code: 03824
Country: USA
Contact_Voice_Telephone: (603) 862-1792
Contact_Facsimile_Telephone: (603) 862-0188
Contact_Electronic_Mail_Address: granit@unh.edu
Hours_of_Service: 8:30 AM - 5:00 PM, EST
Distribution_Liability:
Digital data in NH GRANIT represent the efforts of the contributing agencies to record information from the cited source materials. Complex Systems Research Center (CSRC), under contract to the NH Office of State Planning (OSP), and in consultation with cooperating agencies, maintains a continuing program to identify and correct errors in these data. OSP, CSRC, and the cooperating agencies make no claim as to the validity or reliability or to any implied uses of these data.
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Format_Name: ASCII Grid
Transfer_Size: 265 MB
Digital_Transfer_Option:
Offline_Option:
Offline_Media: CD-ROM
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APPENDIX II. Summary of Deer Habitat Delineation Criteria.

DEER HABITAT DELINEATION AND ASSESSMENT

KAG – 05/27/04, ***Revised 06/07/2004***

GENERAL DEER HABITAT DELINEATION

Deer habitat will be delineated on a WMU specific basis. For deer, 20 WMU's are defined and include A, B, C1, C2, D1, D2E, D2W, E, F, G1, G2, H1, H2, I1, I2, J1, J2, K, L, and M. The general assessment of deer habitat will make use of the 2001 GRANIT Land Cover layer for the 2004 assessment and the USGS NLCD 2011 Land Cover layer for the 2014 assessment with the 23 cover types considered as follows:

Developed
- 110 Residential, commercial, or industrial (NON-HABITAT)
- 140 Transportation (NON-HABITAT)

Active Agricultural Land
- 211 Row crops (HABITAT)
- 212 Hay/rotation/permanent pasture (HABITAT)
- 221 Fruit orchards (HABITAT)

Forested
- 412 Beech/oak (HABITAT)
- 414 Paper birch/aspen (HABITAT)
- 419 Other Hardwoods (HABITAT)
- 421 White/red pine (HABITAT)
- 422 Spruce/fir (HABITAT)
- 423 Hemlock (HABITAT)
- 424 Pitch pine (HABITAT)
- 430 Mixed forest (HABITAT)
- 440 Alpine (Krumholz) (NON-HABITAT)

Water
- 500 Open water (NON-HABITAT)

Wetlands
- 610 Forested wetlands (HABITAT)
- 620 Non-forested wetlands (NON-HABITAT)
- 630 Tidal wetlands (NON-HABITAT)

Barren Land
- 710 Disturbed (NON-HABITAT)
- 720 Bedrock/vegetated (NON-HABITAT)
- 730 Sand dunes (NON-HABITAT)
- 790 Cleared/other open (HABITAT)

Tundra
- 800 Tundra (NON-HABITAT)

APPENDIX II (continued). Summary of Deer Habitat Delineation Criteria.

In addition, all areas equal to or in excess of 3400ft elevation will be considered NON-HABITAT, regardless of cover type.

DESIRED PRODUCTS FOR GENERAL DEER HABITAT ASSESSMENT

A data set (in Excel) containing a quantitative summary of habitat and non-habitat areas (in acres or square miles) on a WMU specific basis. Each row would contain the following information for a WMU:

Column 1: WMU
Column 2: Area of type 110 less than 3400 feet in elevation. Small patches of what otherwise would be considered deer habitat types that occur within type 110 should be excluded from consideration as deer habitat and included as type 110 (non-habitat).
Column 3: Area of type 140 less than 3400 feet in elevation.
Columns 4-24 Areas of types 211 through 800 less than 3400 feet in elevation.
Column 25: Area greater than or in excess of 3400 feet in elevation (regardless of cover type).

The sum of columns 2 through 25 should equal the total WMU area.

In addition, it would be very helpful to have digital WMU specific maps (1 WMU per page) showing WMU boundaries, town boundaries, major roads, deer habitat, and non-deer habitat.

Revision 06/07/2004 - Medium to low density residential development likely has less direct effect on deer "habitat" per se than it does on the ability to effectively manage deer populations. Therefore it would be helpful to have a second (but very similar) analysis that would at least qualitatively address the potential relative impacts of "suburbanization" in New Hampshire using a 300 ft road buffer as an index to development. The definition of road should probably be limited to town and state maintained roads and not include private roads.

Column 1: WMU
Column 2: Area of type 110 less than 3400 feet in elevation, or outside 300ft road buffer. Small patches of what otherwise would be considered deer habitat types that occur within type 110 should be excluded from consideration as deer habitat and included as type 110 (non-habitat).
Column 3: Area of type 140 less than 3400 feet in elevation, or outside 300ft road buffer.
Columns 4-24 Areas of types 211 through 800 less than 3400 feet in elevation, or outside 300ft road buffer.
Column 25: Area greater than or in excess of 3400 feet in elevation (regardless of cover type).
Column 26: Area included in 300ft road buffer (regardless of cover type).

The sum of columns 2 through 26 should equal the total WMU area.

APPENDIX II (continued). Summary of Deer Habitat Delineation Criteria.

In addition, it would be helpful to have digital WMU specific maps (1 WMU per page) showing WMU boundaries, town boundaries, deer habitat, and non-deer habitat, and road buffer area.

DEER WINTERING AREA ASSESSMENT

Recognizing that the deer yard layer is in its early stages of development, it will still provide the best information as to the status of deer wintering areas in the state. For use in current planning efforts it would be helpful to have the following information from the deer yard layer.

The number of deer yards and the total area of deer yards (in acres or square miles) as currently mapped should be reported on a WMU specific basis. [Once the ongoing cooperative DWA research with UNH is completed we'll try to update, verify and improve this layer and the information associated with it.]

APPENDIX III. Deer Habitat Summary by Wildlife Management Unit Based on GIS Analysis of 2001 Land Cover Assessment Data (all areas in square miles and all percentages based on land area).

WMU[1]	TOTAL AREA	LAND AREA	HABITAT AREA	PERCENT HABITAT	ROAD BUFFER AREA[2]	PERCENT ROAD BUFFER	DWA (YARD) AREA[3]
A	584.6	569.9	551.8	96.8%	23.6	4.3%	13.1
B	346.2	342.2	326.5	95.4%	14.9	4.6%	20.6
C1	205.7	204.9	194.5	94.9%	7.8	4.0%	2.8
C2	257.4	244.5	227.4	93.0%	10.5	4.6%	21.3
D1	241.2	234.4	213.7	91.1%	37.6	17.6%	67.1
D2E	116.4	116.0	103.5	89.2%	7.1	6.9%	
D2W	367.4	357.2	341.5	95.6%	61.3	18.0%	
E	782.8	779.9	687.2	88.1%	36.5	5.3%	0.4
F	483.4	479.0	456.7	95.3%	43.8	9.6%	31.6
G1	432.5	418.7	395.5	94.5%	71.2	18.0%	49.9
G2	239.8	231.2	220.6	95.4%	35.3	16.0%	
H1	409.7	401.8	378.6	94.2%	75.4	19.9%	33.1
H2	720.0	697.3	647.4	92.8%	131.6	20.3%	138.6
I1	368.0	358.0	327.4	91.4%	70.8	21.6%	2.5
I2	395.6	377.7	356.1	94.3%	66.4	18.7%	5.4
J1	507.2	471.8	436.1	92.4%	80.7	18.5%	29.1
J2	929.4	818.8	742.3	90.7%	179.1	24.1%	35.8
K	658.3	637.1	583.1	91.5%	162.9	27.9%	13.3
L	513.9	494.0	415.2	84.0%	111.9	26.9%	6.1
M	722.4	690.2	533.9	77.4%	205.9	38.6%	0.0
ALL	9281.9	8924.6	8139.1	91.2%	1434.4	17.6%	470.7

[1] – Since the 2004 assessment WMUs D and G were split into WMUs D1, D2E, D2W, G1 and G2. 2001 land cover data was reanalyzed within these new unit boundaries. DWA area is presented within the historical WMU D and G boundaries.
[2] – Area within a 300 foot buffer on either side of the centerline of Class I-V roads.
[3] – Area of WMU identified as deer wintering area (DWA) or deer yards based on town specific deer wintering area survey maps (through 1998 updates).

APPENDIX IV. Land Cover Classification Areas and Deer Habitat Designation by Wildlife Management Unit Based on GIS Analysis of 2001 Land Cover Assessment Data (all areas in square miles).

WMU	LC-110 Non-Hab. Developed	LC-140 Non-Hab. Transport.	LC-211 Habitat Row crops	LC-212 Habitat Hay/pasture	LC-221 Habitat Orchards	LC-412 Habitat Beech/oak	LC-414 Habitat Birch/aspen	LC-419 Habitat Hardwoods	LC-421 Habitat White/red pine	LC-422 Habitat Spruce/fir	LC-423 Habitat Hemlock
A	1.02	2.24	0.29	10.34	0.00	37.32	23.25	185.70	6.43	86.12	3.69
B	1.15	2.44	0.84	5.75	0.00	24.47	22.77	115.67	5.96	45.00	2.64
C1	0.64	1.51	0.01	2.32	0.00	19.64	21.36	79.75	2.84	21.30	1.82
C2	1.48	2.85	0.12	2.53	0.00	16.58	17.82	62.77	6.67	47.57	3.07
D1	2.22	5.79	1.79	9.89	0.00	9.90	25.81	39.29	21.68	20.67	8.40
D2E	0.50	1.51	0.00	0.35	0.00	11.49	13.60	30.70	2.81	13.56	1.63
D2W	1.80	7.14	3.75	26.47	0.00	29.60	64.26	59.85	36.26	9.41	20.01
E	3.71	6.88	0.32	5.89	0.00	85.40	76.77	171.56	13.98	128.92	13.99
F	2.75	6.59	0.30	7.92	0.13	85.08	43.92	101.19	19.20	55.54	19.74
G1	5.17	9.02	0.90	22.09	0.09	69.81	9.81	64.34	42.34	39.88	23.23
G2	2.18	4.53	0.06	8.48	0.03	56.63	5.37	39.01	16.08	20.43	13.52
H1	7.41	10.12	3.49	28.59	0.06	61.77	6.97	44.81	41.97	24.80	25.56
H2	10.38	20.80	3.67	38.07	0.12	146.92	12.49	51.59	49.52	21.29	53.43
I1	7.31	13.32	2.98	21.17	0.84	81.36	3.19	24.46	48.16	9.37	22.67
I2	3.49	8.98	0.49	14.15	0.11	79.98	7.45	40.95	33.06	28.14	23.77
J1	5.06	10.06	0.14	9.26	0.03	77.56	18.36	57.98	67.36	8.20	21.45
J2	11.54	28.47	1.60	39.00	0.73	165.12	2.62	69.88	89.80	8.97	21.03
K	13.98	27.31	1.61	36.81	2.81	136.01	5.68	19.65	85.64	13.20	37.37
L	20.64	30.13	1.62	23.81	0.51	63.79	0.35	34.27	41.83	2.27	6.37
M	46.16	61.04	0.87	37.06	3.80	73.82	2.10	40.61	58.97	1.66	4.96
ALL	148.58	260.72	24.84	349.95	9.26	1332.27	383.96	1334.01	690.58	606.32	328.33

APPENDIX IV (continued). Land Cover Classification Areas and Deer Habitat Designation by Wildlife Management Unit Based on GIS Analysis of 2001 Land Cover Assessment Data (all areas in square miles).

WMU	LC-424 Habitat Pitch pine	LC-430 Habitat Mixed forest	LC-500 Non-Hab. Water	LC-610 Habitat Forested wetland	LC-620 Non-Hab. Open wetland	LC-630 Non-Hab. Tidal wetland	LC-710 Non-Hab. Disturbed	LC-720 Non-Hab. Bedrock/veg	LC-730 Non-Hab. Sand dunes	LC-790 Habitat Cleared	Above 3400 Feet Non-Hab.
A	0.00	157.60	16.15	9.81	13.00	0.00	0.01	0.03	0.00	31.38	0.23
B	0.00	72.98	4.80	4.68	8.56	0.00	0.09	0.11	0.00	25.71	2.62
C1	0.00	37.26	0.96	1.10	2.85	0.00	0.22	0.02	0.00	7.10	5.04
C2	0.00	42.19	15.42	11.36	9.51	0.00	0.57	0.07	0.00	16.76	0.11
D1	0.00	36.86	7.50	6.40	11.24	0.00	0.43	0.00	0.00	33.29	0.00
D2E	0.00	26.51	0.43	0.40	0.49	0.00	0.03	0.25	0.00	2.45	9.70
D2W	0.00	62.16	9.87	2.53	6.66	0.00	0.34	0.09	0.00	27.23	0.00
E	0.02	168.55	3.66	2.82	3.39	0.00	1.08	1.51	0.00	19.11	75.28
F	0.01	106.63	5.28	0.86	3.07	0.00	0.93	0.59	0.00	16.25	7.43
G1	0.00	102.80	15.51	2.88	6.98	0.00	0.28	0.00	0.00	17.36	0.00
G2	0.00	51.55	9.17	0.69	2.65	0.00	0.22	0.42	0.00	8.77	0.00
H1	0.00	121.83	8.66	0.73	3.73	0.00	0.31	0.88	0.00	18.04	0.00
H2	0.00	242.12	24.81	4.77	15.23	0.00	0.63	0.44	0.00	23.46	0.00
I1	0.00	93.96	11.75	2.02	7.65	0.00	0.60	0.03	0.00	17.20	0.00
I2	0.00	114.27	19.82	2.38	7.79	0.00	0.67	0.02	0.00	11.37	0.00
J1	5.77	129.12	40.98	10.85	11.61	0.00	3.24	0.07	0.00	30.10	0.00
J2	0.02	278.87	124.39	7.71	18.51	0.00	4.09	0.00	0.00	57.01	0.00
K	0.00	209.86	14.91	3.74	16.14	0.00	1.77	0.02	0.00	30.74	0.00
L	0.07	178.98	31.51	6.62	8.94	0.57	6.93	0.00	0.00	54.68	0.00
M	0.02	188.94	44.75	19.64	15.75	7.61	12.78	0.00	0.32	101.53	0.00
ALL	5.92	2423.02	410.33	101.99	173.75	8.18	35.21	4.56	0.32	549.54	100.41

APPENDIX V. Area Within 300 Foot Road Buffer on Class I-V Roads by Land Cover Classification, Deer Habitat Designation and Wildlife Management Unit Based on GIS Analysis of 2001 Land Cover Assessment Data (all areas in square miles).

WMU	LC-110 Non-Hab. Developed	LC-140 Non-Hab. Transport.	LC-211 Habitat Row crops	LC-212 Habitat Hay/pasture	LC-221 Habitat Orchards	LC-412 Habitat Beech/oak	LC-414 Habitat Birch/aspen	LC-419 Habitat Hardwoods	LC-421 Habitat White/red pine	LC-422 Habitat Spruce/fir	LC-423 Habitat Hemlock
A	0.53	2.12	0.07	4.09	0.00	0.52	0.72	2.78	1.24	4.25	0.24
B	0.79	2.38	0.12	1.80	0.00	0.22	0.78	1.55	1.36	1.93	0.23
C1	0.52	1.37	0.00	1.16	0.00	0.21	0.77	1.36	0.42	0.72	0.15
C2	1.15	2.85	0.02	1.26	0.00	0.19	0.68	1.19	0.81	1.70	0.21
D1	1.85	5.91	0.08	4.61	0.00	0.73	4.06	3.90	5.28	2.35	1.25
D2E	0.39	1.51	0.00	0.19	0.00	0.51	1.02	1.68	0.98	0.35	0.26
D2W	1.37	7.14	0.00	12.09	0.00	1.76	9.30	6.11	8.98	0.69	2.63
E	2.51	6.78	0.01	1.74	0.00	2.09	4.67	6.60	4.05	2.61	0.90
F	1.91	6.43	0.07	3.65	0.05	5.15	4.44	5.66	5.78	1.30	2.02
G1	3.67	8.97	0.17	11.09	0.03	9.02	0.60	5.09	12.37	5.26	2.73
G2	1.62	4.53	0.02	4.12	0.02	6.53	0.32	2.99	5.38	2.15	1.59
H1	5.25	10.05	1.00	14.48	0.04	9.65	0.58	5.32	10.66	2.60	2.98
H2	8.00	20.72	0.92	20.05	0.07	28.18	1.17	7.48	13.88	2.65	5.51
I1	5.91	13.32	0.63	10.76	0.34	12.94	0.32	3.51	13.41	1.43	2.27
I2	2.67	8.97	0.09	7.43	0.06	12.90	0.57	4.23	9.06	2.95	2.62
J1	3.41	9.95	0.02	4.38	0.02	9.40	3.21	7.48	16.86	0.71	2.41
J2	8.57	28.45	0.50	21.33	0.27	32.68	0.31	14.55	23.14	1.23	2.04
K	10.59	27.25	0.39	20.15	1.33	37.36	0.80	4.82	26.02	2.35	4.46
L	16.19	30.08	0.34	11.90	0.24	11.11	0.06	8.47	10.34	0.37	0.65
M	34.66	61.03	0.34	20.08	1.91	20.71	0.81	12.54	22.76	0.59	0.85
ALL	111.57	259.82	4.81	176.33	4.38	201.85	35.20	107.31	192.77	38.19	36.01

APPENDIX V (continued). Area Within 300 Foot Road Buffer on Class I-V Roads by Land Cover Classification, Deer Habitat Designation and Wildlife Management Unit Based on GIS Analysis of 2001 Land Cover Assessment Data (all areas in square miles).

WMU	LC-424 Habitat Pitch pine	LC-430 Habitat Mixed forest	LC-500 Non-Hab. Water	LC-610 Habitat Forested wetland	LC-620 Non-Hab. Open wetland	LC-630 Non-Hab. Tidal wetland	LC-710 Non-Hab. Disturbed	LC-720 Non-Hab. Bedrock/veg	LC-730 Non-Hab. Sand dunes	LC-790 Habitat Cleared
A	0.00	4.38	1.14	0.24	1.35	0.00	0.01	0.00	0.00	5.05
B	0.00	2.30	0.66	0.33	1.39	0.00	0.05	0.00	0.00	4.24
C1	0.00	1.09	0.04	0.05	0.29	0.00	0.07	0.00	0.00	1.84
C2	0.00	1.75	1.96	0.13	0.87	0.00	0.20	0.00	0.00	2.56
D1	0.00	5.52	1.09	0.32	1.57	0.00	0.15	0.00	0.00	9.53
D2E	0.00	1.01	0.16	0.05	0.15	0.00	0.02	0.00	0.00	1.09
D2W	0.00	7.46	1.78	0.29	1.96	0.00	0.19	0.00	0.00	11.17
E	0.00	6.56	0.78	0.14	0.54	0.00	0.33	0.00	0.00	7.01
F	0.00	8.65	1.21	0.06	0.51	0.00	0.26	0.00	0.00	6.87
G1	0.00	16.27	2.55	0.49	1.76	0.00	0.11	0.00	0.00	8.06
G2	0.00	8.44	0.92	0.14	0.73	0.00	0.07	0.00	0.00	3.57
H1	0.00	18.96	1.59	0.12	1.00	0.00	0.10	0.00	0.00	8.82
H2	0.00	39.61	3.86	0.60	2.81	0.00	0.15	0.00	0.00	11.18
I1	0.00	16.37	2.09	0.37	1.38	0.00	0.21	0.00	0.00	8.29
I2	0.00	20.59	2.96	0.40	1.85	0.00	0.23	0.00	0.00	5.36
J1	1.88	20.73	3.13	1.35	1.58	0.00	0.79	0.00	0.00	12.00
J2	0.00	50.86	9.14	1.21	3.60	0.00	1.16	0.00	0.00	30.50
K	0.00	48.49	2.49	0.60	3.08	0.00	0.43	0.00	0.00	15.75
L	0.01	35.78	4.58	1.07	1.98	0.06	2.10	0.00	0.00	31.22
M	0.00	57.17	7.22	4.02	4.60	1.12	4.44	0.00	0.24	63.49
ALL	1.90	371.98	49.36	11.97	32.98	1.17	11.05	0.01	0.24	247.61

APPENDIX VI. New Hampshire 2011 Land Cover Assessment GIS Metadata and Deer Habitat Assessment.

NLCD 2011 Land Cover (2011 Edition)
Metadata also available as - [Questions & Answers] - [Parseable text] - [XML]
Metadata:

Identification_Information:
Citation:
Citation_Information:
Originator: U.S. Geological Survey
Publication_Date: 20140331
Title: NLCD 2011 Land Cover (2011 Edition)
Edition: 2011
Geospatial_Data_Presentation_Form: remote-sensing image
Series_Information:
Series_Name: None
Issue_Identification: None
Publication_Information:
Publication_Place: Sioux Falls, SD
Publisher: U.S. Geological Survey
Other_Citation_Details:
References: (1) Jin, S., Yang, L., Danielson, P., Homer, C., Fry, J., and Xian, G. 2013. A comprehensive change detection method for updating the National Land Cover Database to circa 2011. Remote Sensing of Environment, 132: 159 – 175.
(2) Xian, G., Homer, C., Dewitz, J., Fry, J., Hossain, N., and Wickham, J., 2011. The change of impervious surface area between 2001 and 2006 in the conterminous United States. Photogrammetric Engineering and Remote Sensing, Vol. 77(8): 758-762.
(3) Coulston, J. W., Moisen, G. G., Wilson, B. T., Finco, M. V., Cohen, W. B., and Brewer, C. K. 2012. Modeling percent tree canopy cover: a pilot study. Photogrammetric Engineering & Remote Sensing 78(7): 715-727.
The USGS acknowledges the support of USGS and contractor NLCD 2011 Land Cover Mapping Teams in development of data for this map.
*Online_Linkage:*http://www.mrlc.gov
Description:
Abstract:
The National Land Cover Database products are created through a cooperative project conducted by the Multi-Resolution Land Characteristics (MRLC) Consortium. The MRLC Consortium is a partnership of

federal agencies (www.mrlc.gov), consisting of the U.S. Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Environmental Protection Agency (EPA), the U.S. Department of Agriculture (USDA), the U.S. Forest Service (USFS), the National Park Service (NPS), the U.S. Fish and Wildlife Service (FWS), the Bureau of Land Management (BLM) and the USDA Natural Resources Conservation Service (NRCS). The success of NLCD over nearly two decades is credited to the continuing collaborative spirit of the agencies that make up the MRLC. NLCD 2011 is the most up-to-date iteration of the National Land Cover Database, the definitive Landsat-based, 30-meter resolution land cover database for the Nation. The data in NLCD 2011 are completely integrated with NLCD 2001 (2011 Edition) and NLCD 2006 (2011 Edition). For NLCD 2011, there are 5 primary data products: 1) NLCD 2011 Land Cover; 2) NLCD 2006/2011 Land Cover Change Pixels labeled with the 2011 land cover class; 3) NLCD 2011 Percent Developed Imperviousness; 4) NLCD 2006/2011 Percent Developed Imperviousness Change Pixels; and 5) NLCD 2011 Tree Canopy Cover provided by an MRLC partner - the U.S.D.A. Forest Service Remote Sensing Applications Center. In addition, ancillary metadata includes the NLCD 2011 Path/Row Index vector file showing the footprint of Landsat scenes and change analysis pairs used to derive 2006/2011 spectral change. All Landsat scene acquisition dates are included in the attribute table. Also, as part of the NLCD 2011 project, NLCD 2001 and 2006 land cover and impervious data products have been revised and reissued (2011 Edition) to provide full compatibility with the new NLCD 2011 products. NLCD Tree Canopy Cover was created using MRLC mapping zones from NLCD 2001 (see Tree Canopy Cover metadata for additional detail). All other NLCD 2011 products were created on a path/row basis and mosaicked to create a seamless national product. Questions about the NLCD 2011 land cover product can be directed to the NLCD 2011 land cover mapping team at the USGS/EROS, Sioux Falls, SD (605) 594-6151 or mrlc@usgs.gov.
Purpose:
The goal of this project is to provide the Nation with complete, current and consistent public domain information on its land use and land cover.
Supplemental_Information:
Corner Coordinates (center of pixel, projection meters) Upper Left Corner: -2493045 meters(X), 3310005 meters(Y) Lower Right Corner: -177285 meters(X), 2342655 meters(Y)
Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 200040409
Ending_Date: 20111111
Currentness_Reference: ground condition
Status:
Progress: In work
Maintenance_and_Update_Frequency: Every 5 years
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -130.232828
East_Bounding_Coordinate: -63.672192
North_Bounding_Coordinate: 52.877264
South_Bounding_Coordinate: 21.742308
Keywords:
Theme:
Theme_Keyword_Thesaurus: None

Theme_Keyword: Land cover
Theme_Keyword: Image processing
Theme_Keyword: GIS
Theme_Keyword: U.S. Geological Survey (USGS)
Theme_Keyword: digital spatial data
Theme:
Theme_Keyword_Thesaurus: ISO 19115 Category
Theme_Keyword: ImageryBaseMapEarthCover
Theme_Keyword: 010
Theme:
Theme_Keyword_Thesaurus:
U.S. Department of Commerce, 1995, (Countries, dependencies, areas of special sovereignty, and their principal administrative divisions, Federal Information Processing Standard 10-4): Washington, D.C., National Institute of Standards and Technology
Theme_Keyword: United States
Theme_Keyword: U.S.
Theme_Keyword: US
Access_Constraints: None
Use_Constraints: None
Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: U.S. Geological Survey
Contact_Position: Customer Services Representative
Contact_Address:
Address_Type: mailing and physical address
Address: USGS/EROS
Address: 47914 252nd Street
City: Sioux Falls
State_or_Province: SD
Postal_Code: 57198-0001
Country: USA
Contact_Voice_Telephone: 605/594-6151
Contact_Facsimile_Telephone: 605/594-6589
*Contact_Electronic_Mail_Address:*custserv@usgs.gov
Hours_of_Service: 0800 - 1600 CT, M - F (-6h CST/-5h CDT GMT)
Contact_Instructions:
The USGS point of contact is for questions relating to the data display and download from this web site. For questions regarding data content and quality, refer to:http://www.mrlc.gov/mrlc2k.asp or email: mrlc@usgs.gov
Data_Set_Credit: U.S. Geological Survey
Security_Information:
Security_Classification_System: None
Security_Classification: Unclassified
Security_Handling_Description: N/A
Native_Data_Set_Environment:

Microsoft Windows 7 Version 6.1 (Build 7601: Service Pack 1); ESRI ArcCatalog 9.3.1.4000 (Service Pack 2)

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report:

A formal accuracy assessment has not been conducted for NLCD 2011 Land Cover, 2006-2011 Land Cover Change, NLCD 2011 Percent Developed Imperviousness or 2006-2011 Percent Developed Imperviousness Change products. For Canopy attribute accuracy, refer to Canopy metadata.

Quantitative_Attribute_Accuracy_Assessment:

Attribute_Accuracy_Value: Unknown

Attribute_Accuracy_Explanation:

This document and the described land cover map are considered "provisional" until a formal accuracy assessment is completed. The U.S. Geological Survey can make no guarantee as to the accuracy or completeness of this information, and it is provided with the understanding that it is not guaranteed to be correct or complete. Conclusions drawn from this information are the responsibility of the user.

Logical_Consistency_Report:

The NLCD 2011 final seamless products include: 1) NLCD 2011 Land Cover; 2) NLCD 2011 Percent Developed Imperviousness; 3) NLCD 2006/2011 Change Pixels labeled with the 2011 land cover class; 4) NLCD 2006/2011 Percent Developed Imperviousness Change; and 5)NLCD 2011 Tree Canopy Cover.

Completeness_Report: This NLCD product is the version dated March 31, 2014.

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report: N/A

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: N/A

Lineage:

Process_Step:

Process_Description:

Landsat image selection and preprocessing. For NLCD 2011 change analysis, two, two-date pairs of Landsat scenes were selected for each path/row to represent ground conditions in circa 2006 and 2011. One additional circa 2011 scene was selected to enhance modeling results for land cover labeling. In selecting the 5 scenes, the temporal range of the imagery was restricted to reduce the impact of seasonal and phenological variation. A pre-processing step was performed to convert the digital number to top of atmosphere reflectance using procedures similar to those established for the NLCD 2001 mapping effort (Homer et al., 2004). Reflectance derivatives, including a tasseled-cap transformation and a 3-ratio index, were generated for each scene to use in the modeling process as independent variables. Where present, clouds and cloud shadows were digitized and masked.

NLCD 2011 Percent Developed Imperviousness and Percent Developed Imperviousness Change Analysis. Because the four NLCD developed classes are derived from a percent imperviousness mapping product, an overview of steps required to update the NLCD 2001 imperviousness to reflect urban growth captured in 2006 era Landsat imagery is provided here (Xian et al., 2010). These same procedures were employed to produce NLCD 2011 Percent Developed Imperviousness and 2006-2011 Percent Developed Imperviousness Change. First, 2009 nighttime lights imagery from the NOAA Defense Meteorological Satellite Program (DMSP) was imposed on the NLCD 2006 impervious surface product to exclude low density imperviousness outside urban and suburban centers so that only imperviousness in urban core

areas would be used in the training dataset. Two training datasets, one having a relatively larger urban extent and one having a smaller extent, were produced through imposing two different thresholds on city light imagery. Second, each of the two training datasets combined with 2006 Landsat imagery was separately applied using a regression tree (RT) algorithm to build up RT models. Two sets of RT models were then used to estimate percent imperviousness and to produce two 2006 synthetic impervious surfaces. Similarly, the same two training datasets were used with 2011 Landsat imagery to create two sets of RT models that produce two 2011 synthetic impervious surfaces. Third, the 2006 and 2011 synthetic impervious surface pairs were compared using both 2006 impervious surface products to retain 2006 impervious surface area (ISA) in the unchanged areas. The 2009 DMSP nighttime lights imagery was then employed to ensure that non-imperviousness areas were not included and that new impervious surfaces emerged in the city light extent. After this step, two 2011 intermediate impervious surfaces were produced. Finally, the two intermediate products and 2006 imperviousness were compared to remove false estimates in non-urban areas and generate a 2011 impervious surface estimate. Imperviousness threshold values used to derive the NLCD developed classes are: (Class 21) developed open space (imperviousness < 20%), (Class 22) low-intensity developed (imperviousness from 20 - 49%), (Class 23) medium intensity developed (imperviousness from 50 -79%), and (Class 24) high-intensity developed (imperviousness > 79%). To improve NLCD imperviousness the 2011 project included a process to reduce omission and commission error in NLCD 2001, 2006, and 2011 products. This activity was completed for urban areas in most of the eastern ½ of the conterminous United States. High resolution (one-meter ground sample distance) National Aerial Imagery Program (NAIP - http//fsa.usda.gov/FSA/) imagery was used to verify imperviousness. Using hand-edits imperviousness was removed from areas incorrectly identified as developed and added to areas where developed land cover was missed. A modeling process was implemented to add missed imperviousness changes to the correct era and to fill areas where developed was removed with an appropriate non-developed land cover class. These improvements were incorporated with the derived developed classes in all areas of imperviousness and land cover versions released with NLCD 2011 editions. Revised products, NLCD 2001 and NLCD 2006 Impervious (2011 Editions) and NLCD 2001-2006 Impervious Change Pixels (2011 Edition) are included as part of the NLCD 2011 product release.

Land Cover Change Analysis. For the NLCD 2011 Land Cover Update, a variation of the Multi-Index Integrated Change Analysis (MIICA) used in NLCD 2006 spectral change analysis was refined to capture land cover disturbance and potential land cover change patterns for updating the National Land Cover Database 2011 (Jin et al. 2013). Four indices were integrated into one model to more accurately detect true spectral changes between two time periods. Within the model, normalized burn ratio (NBR), change vector (CV, Xian et al., 2009), relative change vector (RCV), and normalized difference vegetation index (NDVI) are calculated separately for the early date (circa 2006) and late date (circa 2011) scenes. The four pairs of indices for the two dates are differenced and then evaluated in a final model conditional statement that categorizes each pixel as either biomass increase, biomass decrease, or no change. For NLCD 2011, two image pairs of circa 2006 and circa 2011, ideally one leaf-on pair and one leaf-off pair are used interactively in each path/row. The integrated change result is clumped and sieved to produce a refined change/no-change mask used to identify potential change pixels that are then labeled with the NLCD 2011 class.

NLCD 2011 Land Cover Classification. Land cover mapping protocols used during NLCD 2011 processing are similar to those used to label the NLCD 2001 product (Homer et al., 2004), but applied on a path/row basis instead of multiple path/row MRLC zones (Xian et al., 2009). Classification was achieved using decision tree modeling that employed a combination of Landsat imagery, reflectance derivatives, and ancillary data (independent variables) with training data points (dependent variable)

collected from a refined version of the NLCD 2006 land cover product. Training points were randomly sampled and limited to those areas that were determined to be unchanged between 2006 and 2011 during the MIICA spectral change analysis process. Training data for pixels changed to developed land cover were not collected since the four classes in urban and sub-urban areas were mapped separately using a regression tree modeling method (described in the Imperviousness Change Analysis process steps above). Post classification modeling and hand-editing were used to further refine the decision tree output. Following classification, the 2011 land cover was masked with the change/no-change result (captured during the MIICA change analysis modeling) to extract a label for spectrally changed pixels. Labeled change pixels were then compared to the NLCD 2006 land cover base to exclude those pixels identified as spectral change, but classified with the same label as the corresponding 2006 pixel. NLCD 2011 percent developed impervious pixels, identified as changed, were extracted to NLCD developed class codes using NLCD 2011 legend thresholds for developed classes and added to the change pixel map. This intermediate change pixel product was generalized using the NLCD Smart Eliminate tool with the following minimum mapping units (mmu) applied: 1 acre (approximately 5 ETM+ 30 m pixel patch) for developed classes (class codes 21, 22, 23, and 24); 7.12 acres (approximately 32 ETM+ pixel patch) for agricultural classes (class codes 81 and 82); and 2.67 acres (approximately 12 ETM+ pixel patch) for all other classes (class codes 11, 12, 31, 41, 42, 43, 52, 71, 90, and 95). The smart eliminate aggregation program subsumes pixels from the single pixel level to the mmu pixel patch using a queens algorithm at doubling intervals. The algorithm consults a weighting matrix to guide merging of cover types by similarity, resulting in a product that preserves land cover logic as much as possible. During the NLCD 2011 analysis and modeling process, inconsistencies in the NLCD 2001 and 2006 land cover products were corrected with the revised products, NLCD 2001 and NLCD 2006 Land Cover (2011 Editions), included as part of the NLCD 2011 product release.

NLCD 2011 Land Cover (Final Product). Additional processing steps were implemented to create the final NLCD 2011 land cover map. Individual path/row change pixel results were assembled to form an intermediate seamless national product. This seamless change pixel map was reviewed and edited to remove regional inconsistencies. Refined NLCD 2011 change pixels were then combined with the re-issued NLCD 2006 Land Cover Version (2011 Edition), and the resulting image was smart-eliminated to a 5-pixel mmu. This final step eliminated single pixels and patches less than 5 pixels in extent that appeared as a result of combining the separate images.

NLCD 2011 Change Pixels (Final Product). A comparison of the NLCD 2006 (2011 Edition) base and the NLCD 2011 Land Cover was necessary to extract a final version of the NLCD 2011 Change Pixels. In a model, pixels that were labeled with the same land cover class code were removed and only those pixels that did not agree in the two classifications were retained as final NLCD 2011 Change Pixels.

NLCD 2006/2011 Percent Developed Imperviousness Change. The NLCD 2006 Percent Developed Imperviousness (2011 Edition)and the NLCD 2011 Percent Developed Imperviousness were compared in a model to provide the user community with a layer that depicts imperviousness change between 2006 and 2011.

Landsat data and ancillary data used for the land cover prediction -

For a list of Landsat scene dates by path/row used in this project, please see:
appendix3_nlcd2011_scene_list_by_path_row.txt

Data Type of DEM composed of 1 band of Continuous Variable Type.

Data Type of Slope composed of 1 band of Continuous Variable Type.

Data Type of Aspect composed of 1 band of Categorical Variable Type.

Data type of Position Index composed of 1 band of Continuous Variable Type.

Data type of 3-ratio index composed of 3 bands of Continuous Variable Type.

Source_Used_Citation_Abbreviation: Landsat ETM, Landsat TM, DEM, USGS/EROS
Process_Date: Unknown
Source_Produced_Citation_Abbreviation: USGS National Land Cover Database

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Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Pixel
Row_Count: 104424
Column_Count: 161190
Vertical_Count: 1

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Albers Conical Equal Area
Albers_Conical_Equal_Area:
Standard_Parallel: 29.500000
Standard_Parallel: 45.500000
Longitude_of_Central_Meridian: -96.000000
Latitude_of_Projection_Origin: 23.000000
False_Easting: 0.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 30.000000
Ordinate_Resolution: 30.000000
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: nlcd_2011_landcover_2011_edition_2014_03_31.img.vat
Entity_Type_Definition: NLCD Land Cover Layer
Entity_Type_Definition_Source: National Land Cover Database
Attribute:
Attribute_Label: ObjectID
Attribute_Definition: Internal feature number
Attribute_Definition_Source: ESRI

Attribute_Domain_Values:
Unrepresentable_Domain:
Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute_Label: Count
Attribute_Definition:
A nominal integer value that designates the number of pixels that have each value in the file; histogram column in ERDAS Imagine raster attributes table
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Integer
Attribute:
Attribute_Label: Value
Attribute_Definition: Land Cover Class Code Value.
Attribute_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 11
Enumerated_Domain_Value_Definition:
Open Water - All areas of open water, generally with less than 25% cover or vegetation or soil
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 12
Enumerated_Domain_Value_Definition:
Perennial Ice/Snow - All areas characterized by a perennial cover of ice and/or snow, generally greater than 25% of total cover.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 21
Enumerated_Domain_Value_Definition:
Developed, Open Space - Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 22
Enumerated_Domain_Value_Definition:
Developed, Low Intensity -Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-49 percent of total cover. These areas most commonly include single-family housing units.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:

Enumerated_Domain:
Enumerated_Domain_Value: 23
Enumerated_Domain_Value_Definition:
Developed, Medium Intensity - Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-79 percent of the total cover. These areas most commonly include single-family housing units.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 24
Enumerated_Domain_Value_Definition:
Developed, High Intensity - Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to 100 percent of the total cover.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 31
Enumerated_Domain_Value_Definition:
Barren Land (Rock/Sand/Clay) - Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 41
Enumerated_Domain_Value_Definition:
Deciduous Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species shed foliage simultaneously in response to seasonal change.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 42
Enumerated_Domain_Value_Definition:
Evergreen Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 43
Enumerated_Domain_Value_Definition:
Mixed Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75 percent of total tree cover.

Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 51
Enumerated_Domain_Value_Definition:
Dwarf Scrub - Alaska only areas dominated by shrubs less than 20 centimeters tall with shrub canopy typically greater than 20% of total vegetation. This type is often co-associated with grasses, sedges, herbs, and non-vascular vegetation.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 52
Enumerated_Domain_Value_Definition:
Shrub/Scrub - Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 71
Enumerated_Domain_Value_Definition:
Grassland/Herbaceous - Areas dominated by grammanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 72
Enumerated_Domain_Value_Definition:
Sedge/Herbaceous - Alaska only areas dominated by sedges and forbs, generally greater than 80% of total vegetation. This type can occur with significant other grasses or other grass like plants, and includes sedge tundra, and sedge tussock tundra.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 73
Enumerated_Domain_Value_Definition:
Lichens - Alaska only areas dominated by fruticose or foliose lichens generally greater than 80% of total vegetation.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 74
Enumerated_Domain_Value_Definition:
Moss - Alaska only areas dominated by mosses, generally greater than 80% of total vegetation.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions

Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 81
Enumerated_Domain_Value_Definition:
Pasture/Hay - Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 82
Enumerated_Domain_Value_Definition:
Cultivated Crops - Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 90
Enumerated_Domain_Value_Definition:
Woody Wetlands - Areas where forest or shrub land vegetation accounts for greater than 20 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 95
Enumerated_Domain_Value_Definition:
Emergent Herbaceous Wetlands - Areas where perennial herbaceous vegetation accounts for greater than 80 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute:
Attribute_Label: Red
Attribute_Definition:
Red color code for RGB. The value is arbitrarily assigned by the display software package, unless defined by user.
Attribute_Definition_Source: NLCD
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0
Range_Domain_Maximum: 100
Attribute_Units_of_Measure: Percentage
Attribute_Measurement_Resolution: 0.1
Attribute:
Attribute_Label: Green

Attribute_Definition:
Green color code for RGB. The value is arbitrarily assigned by the display software package, unless defined by user.
Attribute_Definition_Source: NLCD
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0
Range_Domain_Maximum: 100
Attribute_Units_of_Measure: Percentage
Attribute_Measurement_Resolution: 0.1
Attribute:
Attribute_Label: Blue
Attribute_Definition:
Blue color code for RGB. The value is arbitrarily assigned by the display software package, unless defined by user.
Attribute_Definition_Source: NLCD
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0
Range_Domain_Maximum: 100
Attribute_Units_of_Measure: Percentage
Attribute_Measurement_Resolution: 0.1
Attribute:
Attribute_Label: Opacity
Attribute_Definition:
A measure of how opaque, or solid, a color is displayed in a layer.
Attribute_Definition_Source: NLCD
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0
Range_Domain_Maximum: 100
Attribute_Units_of_Measure: Percentage
Attribute_Measurement_Resolution: 0.1
Overview_Description:
Entity_and_Attribute_Overview: Land Cover Class RGB Color Value Table
Entity_and_Attribute_Detail_Citation:
Attributes defined by USGS and ESRI. Value Red Green Blue 0 0.00000000000 0.00000000000 0.00000000000 11 0.27843137255 0.41960784314 0.62745098039 12 0.81960784314 0.86666666667 0.97647058824 21 0.86666666667 0.78823529412 0.78823529412 22 0.84705882353 0.57647058824 0.50980392157 23 0.92941176471 0.00000000000 0.00000000000 24 0.66666666667 0.00000000000 0.00000000000 31 0.69803921569 0.67843137255 0.63921568628 41 0.40784313726 0.66666666667 0.38823529412 42 0.10980392157 0.38823529412 0.18823529412 43 0.70980392157 0.78823529412 0.55686274510 51 0.64705882353 0.54901960784 0.18823529412 52 0.80000000000 0.72941176471 0.48627450980 71 0.88627450980 0.88627450980 0.75686274510 72 0.78823529412 0.78823529412 0.46666666667 73 0.60000000000 0.75686274510 0.27843137255 74 0.46666666667 0.67843137255 0.57647058824 81 0.85882352941 0.84705882353 0.23921568628 82 0.66666666667 0.43921568628

0.15686274510 90 0.72941176471 0.84705882353 0.91764705882 95 0.43921568628 0.63921568628 0.72941176471
Overview_Description:
Entity_and_Attribute_Overview: N/A
Entity_and_Attribute_Detail_Citation:
Attribute accuracy is described, where present, with each attribute defined in the Entity and Attribute Section.

Distribution_Information:
Distributor:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: U.S. Geological Survey
Contact_Position: Customer Service Representative
Contact_Address:
Address_Type: mailing and physical address
Address: National Center, EROS
Address: 47914 252nd Street
City: Sioux Falls
State_or_Province: SD
Postal_Code: 57198-0001
Country: USA
Contact_Voice_Telephone: 605/594-6151
Contact_TDD/TTY_Telephone: 605/594-6933
Contact_Facsimile_Telephone: 605/594-6589
*Contact_Electronic_Mail_Address:*custserv@usgs.gov
Hours_of_Service: 0800 - 1600 CT, M - F (-6h CST/-5h CDT GMT)
Contact_Instructions:
The USGS point of contact is for questions relating to the data display and download from this web site. Questions about the NLCD 2011 Land Cover (2011 Edition) can be directed to the NLCD 2001 land cover mapping team at the National Center, EROS, Sioux Falls, SD (605) 594-6151 or mrlc@usgs.gov.
Resource_Description: Downloadable data
Distribution_Liability:
Although these data have been processed successfully on a computer system at the USGS, no warranty expressed or implied is made by the USGS regarding the use of the data on any other system, nor does the act of distribution constitute any such warranty. Data may have been compiled from various outside sources. Spatial information may not meet National Map Accuracy Standards. This information may be updated without notification. The USGS shall not be liable for any activity involving these data, installation, fitness of the data for a particular purpose, its use, or analyses results.
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Format_Name: ERDAS
Format_Version_Number: Imagine 9.3
Format_Specification: .img
Transfer_Size: 1032

Digital_Transfer_Option:
Online_Option:
Computer_Contact_Information:
Network_Address:
*Network_Resource_Name:*http://www.mrlc.gov
Access_Instructions:
The URL http://www.mrlc.gov provides a download interface that allows for data downloads. The download page allows the customer to download a zipped file that can be saved on the customer's computer. The file can then be unzipped and imported into various user software applications.
Online_Computer_and_Operating_System: Not available for dissemination
Fees: None
Ordering_Instructions: Contact Customer Services
Turnaround: Variable
Custom_Order_Process: Contact Customer Services Representative
Technical_Prerequisites:
ESRI ArcMap Suite and/or Arc/Info software, and supporting operating systems.

Metadata_Reference_Information:
Metadata_Date: 20140321
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: U.S. Geological Survey
Contact_Person: Customer Service Representative
Contact_Position: Customer Services Representative
Contact_Address:
Address_Type: mailing and physical address
Address: USGS/EROS
Address: 47914 252nd Street
City: Sioux Falls
State_or_Province: SD
Postal_Code: 57198-0001
Country: USA
Contact_Voice_Telephone: 605/594-6151
Contact_TDD/TTY_Telephone: 605/594-6933
Contact_Facsimile_Telephone: 605/594-6589
*Contact_Electronic_Mail_Address:*custserv@usgs.gov
Hours_of_Service: 0800 - 1600 CT, M - F (-6h CST/-5h CDT GMT)
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Time_Convention: local time

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APPENDIX VII. Deer Habitat Summary by Wildlife Management Unit Based on GIS Analysis of 2011 Land Cover Assessment Data (all areas in square miles and all percentages based on land area).

WMU	TOTAL AREA	LAND AREA	HABITAT AREA	PERCENT HABITAT	ROAD BUFFER AREA[1]	PERCENT ROAD BUFFER	DWA (YARD) AREA[2]
A	584.6	569.9	556.3	97.6%	25.4	4.6%	19.8
B	346.2	342.2	329.5	96.3%	13.5	4.1%	21.1
C1	205.7	204.9	194.6	95.0%	8.7	4.5%	20.5
C2	257.4	244.5	231.8	94.8%	9.0	3.9%	25.1
D1	241.2	234.4	215.4	91.9%	26.1	12.1%	36.6
D2E	116.4	116.0	103.1	88.9%	6.3	6.1%	7.5
D2W	367.4	357.2	339.6	95.1%	43.4	12.8%	32.9
E	782.8	779.9	681.7	87.4%	33.8	5.0%	12.7
F	483.4	479.0	453.7	94.7%	38.0	8.4%	42.9
G1	432.5	418.7	393.0	93.9%	53.9	13.7%	29.0
G2	239.8	231.2	219.6	95.0%	27.9	12.7%	27.7
H1	409.7	401.8	371.5	92.4%	54.9	14.8%	38.7
H2	720.0	697.3	642.3	92.1%	97.8	15.2%	146.2
I1	368.0	358.0	322.0	90.0%	49.7	15.4%	10.0
I2	395.6	377.7	355.4	94.1%	53.4	15.0%	12.9
J1	507.2	471.8	435.8	92.4%	68.3	15.7%	34.4
J2	929.4	818.8	727.5	88.8%	138.1	19.0%	40.1
K	658.3	637.1	572.2	89.8%	123.9	21.6%	20.7
L	513.9	494.0	384.0	77.7%	75.4	19.6%	11.5
M	722.4	690.2	456.5	66.1%	138.1	30.2%	4.4
ALL	9281.9	8924.6	7985.5	89.5%	1085.5	13.6%	594.5

[1] – Area within a 300 foot buffer on either side of the centerline of Class I-V roads.
[2] – Area of WMU identified as deer wintering area (DWA) or deer yards based on town specific deer wintering area survey maps (through 2014 updates).

APPENDIX VIII. Land Cover Classification Areas and Deer Habitat Designation by Wildlife Management Unit Based on GIS Analysis of 2011 Land Cover Assessment Data (all areas in square miles).

WMU	LC-110 Non-Hab. Developed	LC-140 Non-Hab. Transport.	LC-211 Habitat Row crops	LC-212 Habitat Hay/pasture	LC-221 Habitat Orchards	LC-412 Habitat Beech/oak	LC-414 Habitat Birch/aspen	LC-419 Habitat Hardwoods	LC-421 Habitat White/red pine	LC-422 Habitat Spruce/fir	LC-423 Habitat Hemlock
A	3.29	2.24	0.20	7.26	0.00	35.65	21.54	173.22	5.74	76.45	3.21
B	2.69	2.44	0.56	3.97	0.00	21.78	21.65	106.56	5.24	40.53	2.40
C1	1.55	1.51	0.00	1.09	0.00	17.88	19.97	74.03	2.45	19.83	1.67
C2	3.50	2.85	0.06	0.95	0.00	15.56	16.33	57.68	5.57	38.08	2.71
D1	6.09	5.99	1.63	5.30	0.00	9.39	24.26	37.68	18.52	16.42	7.68
D2E	1.01	1.51	0.00	0.12	0.00	11.23	13.27	30.13	2.65	13.32	1.57
D2W	6.15	7.14	2.36	19.21	0.00	28.57	61.45	59.26	32.90	8.86	19.12
E	9.01	6.88	0.24	3.13	0.00	82.95	74.62	166.65	12.65	126.58	13.56
F	5.70	6.59	0.20	4.29	0.13	83.09	42.44	99.06	17.40	53.89	18.80
G1	10.64	9.02	0.45	11.42	0.08	67.60	9.69	64.85	37.89	33.52	21.93
G2	4.10	4.53	0.01	4.30	0.03	54.31	5.22	38.44	14.60	18.37	12.79
H1	14.06	10.09	1.23	19.54	0.06	59.28	6.92	45.39	38.69	22.21	24.87
H2	19.86	20.81	1.95	21.96	0.11	139.80	12.22	53.52	43.78	16.20	49.67
I1	14.34	13.32	0.96	12.56	0.80	76.49	3.08	24.45	41.92	7.34	20.91
I2	6.73	8.87	0.01	8.09	0.09	75.49	7.32	40.75	29.04	24.47	22.34
J1	9.61	10.06	0.00	3.84	0.03	72.10	16.74	54.93	58.54	6.64	19.11
J2	27.91	28.47	0.48	22.25	0.68	149.71	2.50	66.07	76.52	6.72	18.86
K	27.90	27.41	0.10	22.51	2.58	124.40	5.41	22.11	73.97	8.92	33.90
L	45.98	30.13	0.47	14.51	0.37	54.04	0.33	29.48	34.30	1.52	5.79
M	119.89	61.04	0.13	18.86	2.84	59.16	1.21	33.39	45.31	0.81	4.10
ALL	340.02	260.90	11.05	205.15	7.79	1,238.49	366.16	1,277.64	597.70	540.70	304.98

APPENDIX VIII (continued). Land Cover Classification Areas and Deer Habitat Designation by Wildlife Management Unit Based on GIS Analysis of 2011 Land Cover Assessment Data (all areas in square miles).

WMU	LC-424 Habitat Pitch pine	LC-430 Habitat Mixed forest	LC-500 Non-Hab. Water	LC-610 Habitat Forested wetland	LC-620 Non-Hab. Open wetland	LC-630 Non-Hab. Tidal wetland	LC-710 Non-Hab. Disturbed	LC-720 Non-Hab. Bedrock/veg	LC-730 Non-Hab. Sand dunes	LC-790 Habitat Cleared	Above 3400 Feet Non-Hab.
A	0.00	147.91	16.15	24.24	4.29	0.00	2.09	0.03	0.00	60.88	0.23
B	0.00	68.94	4.80	13.10	2.25	0.00	1.83	0.11	0.00	44.79	2.60
C1	0.00	35.50	0.96	4.02	0.90	0.00	1.11	0.02	0.00	18.17	5.06
C2	0.00	38.63	15.42	21.61	2.22	0.00	1.44	0.07	0.00	34.65	0.11
D1	0.00	35.29	7.62	20.82	3.08	0.00	3.04	0.00	0.00	38.36	0.00
D2E	0.00	26.01	0.43	1.02	0.14	0.00	0.27	0.25	0.00	3.79	9.71
D2W	0.00	62.05	9.87	9.49	2.03	0.00	2.57	0.09	0.00	36.31	0.00
E	0.01	166.05	3.66	9.10	1.20	0.00	3.55	1.51	0.00	26.15	75.30
F	0.00	105.11	5.28	7.77	1.17	0.00	2.95	0.59	0.00	21.50	7.43
G1	0.00	102.23	15.51	19.68	2.17	0.00	2.20	0.00	0.00	23.62	0.00
G2	0.00	50.37	9.17	6.19	0.83	0.00	1.18	0.42	0.00	14.95	0.00
H1	0.00	121.94	8.66	9.83	2.51	0.00	2.08	0.88	0.00	21.51	0.00
H2	0.00	233.67	24.80	38.10	8.07	0.00	3.40	0.44	0.00	31.35	0.00
I1	0.00	89.86	11.75	20.52	3.21	0.00	3.38	0.03	0.00	23.11	0.00
I2	0.00	108.64	19.88	19.66	4.42	0.00	1.60	0.02	0.00	19.49	0.00
J1	4.97	118.98	40.98	32.30	4.00	0.00	6.68	0.07	0.00	47.63	0.00
J2	0.02	251.84	124.39	50.07	7.66	0.00	13.39	0.00	0.00	81.81	0.00
K	0.00	194.48	14.88	40.38	9.77	0.00	5.06	0.02	0.00	43.43	0.00
L	0.06	150.57	31.51	41.08	5.68	0.54	16.02	0.00	0.00	51.52	0.00
M	0.01	142.51	44.75	76.29	12.06	7.28	20.51	0.00	0.32	71.92	0.00
ALL	5.07	2,250.56	410.48	465.28	77.69	7.83	94.34	4.57	0.32	714.92	100.43

APPENDIX IX. Area Within 300 Foot Road Buffer on Class I-V Roads by Land Cover Classification, Deer Habitat Designation and Wildlife Management Unit Based on GIS Analysis of 2011 Land Cover Assessment Data (all areas in square miles).

WMU	LC-110 Non-Hab. Developed	LC-140 Non-Hab. Transport.	LC-211 Habitat Row crops	LC-212 Habitat Hay/pasture	LC-221 Habitat Orchards	LC-412 Habitat Beech/oak	LC-414 Habitat Birch/aspen	LC-419 Habitat Hardwoods	LC-421 Habitat White/red pine	LC-422 Habitat Spruce/fir	LC-423 Habitat Hemlock
A	2.68	2.23	0.02	1.92	0.00	0.68	0.73	4.28	1.25	4.45	0.22
B	2.14	2.43	0.03	0.73	0.00	0.23	0.72	2.64	0.98	1.48	0.16
C1	1.31	1.50	0.00	0.38	0.00	0.35	0.81	2.81	0.37	0.74	0.12
C2	2.73	2.84	0.01	0.24	0.00	0.17	0.77	1.24	0.70	1.27	0.22
D1	5.25	5.96	0.01	1.38	0.00	0.54	2.97	3.21	3.97	1.74	0.84
D2E	0.90	1.50	0.00	0.04	0.00	0.41	0.96	1.65	0.77	0.31	0.20
D2W	5.21	7.11	0.21	5.23	0.00	1.36	6.93	5.38	6.39	0.50	1.80
E	6.70	6.83	0.03	0.60	0.00	2.62	4.41	6.99	3.83	2.80	0.87
F	4.52	6.56	0.02	1.18	0.04	4.84	4.33	6.41	4.98	1.07	1.50
G1	8.49	8.96	0.05	3.93	0.02	7.37	0.41	4.91	9.12	3.63	1.84
G2	3.35	4.51	0.00	1.60	0.01	5.27	0.21	2.79	4.13	1.54	1.05
H1	10.35	10.01	0.17	6.96	0.03	7.36	0.44	4.96	7.68	1.91	1.98
H2	15.56	20.68	0.21	8.38	0.04	21.94	0.90	7.68	10.14	1.73	3.61
I1	11.82	13.25	0.11	3.88	0.20	9.49	0.21	3.09	9.62	0.84	1.47
I2	5.58	8.77	0.00	3.47	0.03	10.47	0.45	4.16	6.94	2.50	1.76
J1	7.63	10.00	0.00	1.22	0.01	8.44	2.77	6.47	14.21	0.55	1.74
J2	22.08	28.33	0.06	8.08	0.17	25.51	0.20	11.90	19.39	0.82	1.44
K	22.90	27.29	0.02	9.14	0.92	28.55	0.58	5.49	18.58	1.38	3.01
L	37.06	29.97	0.06	4.31	0.11	8.20	0.04	6.27	7.48	0.22	0.54
M	96.85	60.77	0.04	6.93	1.06	16.26	0.46	10.20	15.63	0.31	0.61
ALL	273.12	259.51	1.07	69.59	2.63	160.06	29.30	102.53	146.15	29.80	24.98

APPENDIX IX (continued). Area Within 300 Foot Road Buffer on Class I-V Roads by Land Cover Classification, Deer Habitat Designation and Wildlife Management Unit Based on GIS Analysis of 2011 Land Cover Assessment Data (all areas in square miles).

WMU	LC-424 Habitat Pitch pine	LC-430 Habitat Mixed forest	LC-500 Non-Hab. Water	LC-610 Habitat Forested wetland	LC-620 Non-Hab. Open wetland	LC-630 Non-Hab. Tidal wetland	LC-710 Non-Hab. Disturbed	LC-720 Non-Hab. Bedrock/veg	LC-730 Non-Hab. Sand dunes	LC-790 Habitat Cleared
A	0.00	6.05	0.98	1.11	0.86	0.00	1.33	0.00	0.00	4.76
B	0.00	2.39	0.51	0.80	0.52	0.00	0.97	0.00	0.00	3.30
C1	0.00	1.27	0.10	0.24	0.15	0.00	0.39	0.00	0.00	1.59
C2	0.00	1.81	1.51	0.59	0.26	0.00	0.56	0.00	0.00	1.98
D1	0.00	4.22	0.82	1.23	0.54	0.00	2.15	0.00	0.00	5.96
D2E	0.00	1.05	0.11	0.15	0.05	0.00	0.24	0.00	0.00	0.73
D2W	0.00	6.13	1.35	1.34	0.55	0.00	2.12	0.00	0.00	8.17
E	0.00	6.23	0.72	0.86	0.23	0.00	1.89	0.00	0.00	4.50
F	0.00	7.92	0.83	0.81	0.22	0.00	1.76	0.00	0.00	4.94
G1	0.00	13.85	1.81	2.69	0.57	0.00	1.73	0.00	0.00	6.06
G2	0.00	6.92	0.69	0.97	0.23	0.00	0.66	0.00	0.00	3.36
H1	0.00	15.22	1.10	1.57	0.43	0.00	1.13	0.00	0.00	6.62
H2	0.00	30.48	2.83	4.42	1.22	0.00	1.81	0.00	0.00	8.28
I1	0.00	12.36	1.59	2.75	0.55	0.00	1.94	0.00	0.00	5.70
I2	0.00	15.98	2.26	2.72	0.82	0.00	0.96	0.00	0.00	4.94
J1	1.75	16.94	2.99	3.16	0.69	0.00	3.61	0.00	0.00	11.02
J2	0.00	40.66	7.56	5.80	1.61	0.00	7.83	0.00	0.00	24.05
K	0.00	36.08	2.11	5.85	1.44	0.00	2.26	0.00	0.00	14.26
L	0.02	26.40	3.88	4.37	0.95	0.02	8.83	0.00	0.00	17.39
M	0.00	41.86	5.89	11.69	2.49	0.47	11.63	0.00	0.21	33.05
ALL	1.77	293.82	39.64	53.11	14.39	0.50	53.79	0.00	0.21	170.68