Silviculture in Cooperation With Hunters: The Kinzua Quality Deer Cooperative

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Abstract—*The long history of deer overabundance in Pennsylvania is associated with very high reforestation costs and substantial threats to diversity and sustainability. In response to this legacy, several landowners and agency personnel formed the Kinzua Quality Deer Cooperative (KQDC) in partnership with the Sand County Foundation. This Cooperative focuses on about 74,000 acres in the northeast corner of the Allegheny National Forest (ANF), the setting for the Sugar Run Project under planning by the ANF at present. The goals of the KQDC are to develop a quality deer herd in quality habitat through cooperation with local sportsmen and sportswomen. In this paper, we discuss the actions proposed in the Sugar Run project to use improved hunter access and hunter success as silvicultural tools, given a definition of silviculture as "controlling the establishment, growth, competition, health, and quality of forests." These include the scheduling of regeneration activities to provide a stable level of forage production, increases in road quality, layout and development of skid trails as hunter access trails, creation of viewing pull-outs to stimulate hunter interest, and development of a demonstration of the use of silviculture and the interaction of deer and silviculture in shaping habitat.*

Introduction

In his 1996 textbook, Ralph Nyland (1996) defines silviculture as "establishing and maintaining communities of trees and other vegetation that have value to people." The Society of American Foresters (1998) provides a similar definition, used by Russ Graham in this proceedings, saying that silviculture is "the art and science of controlling the establishment, growth, competition, health, and quality of forests and woodlands" for an ever-widening array of management objectives. Thus, practicing silviculture grows more diverse and complex with every new understanding that we develop of the growth and establishment of forests. In this paper we tell the story of increasing cooperation with hunters as a silvicultural tool in order to achieve objectives of forest regeneration and renewal—establishing and growing diverse communities of trees and other vegetation—in one corner of the Allegheny National Forest (ANF) where white-tailed deer (*Odocoileus virginianus*) have been overabundant for more than 70 years. The area in question is about 74,000 acres in the northeast corner of the National Forest, a landscape owned by a municipal watershed, a timber investment management organization, two different timber companies, and the American people. These landowners and managers have been cooperating for decades to change deer management in Pennsylvania and are now cooperating to engage hunters to achieve healthy deer in a healthy habitat. The name of both the shared landscape and the cooperative efforts to

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restore both habitat and herd quality is the Kinzua Quality Deer Cooperative (KQDC) (figure 1). Within the area, managers on the ANF have been cooperating with the public in planning a project for the Sugar Run Analysis Area, the only management project likely to occur on National Forest land within the KQDC during the current decade.

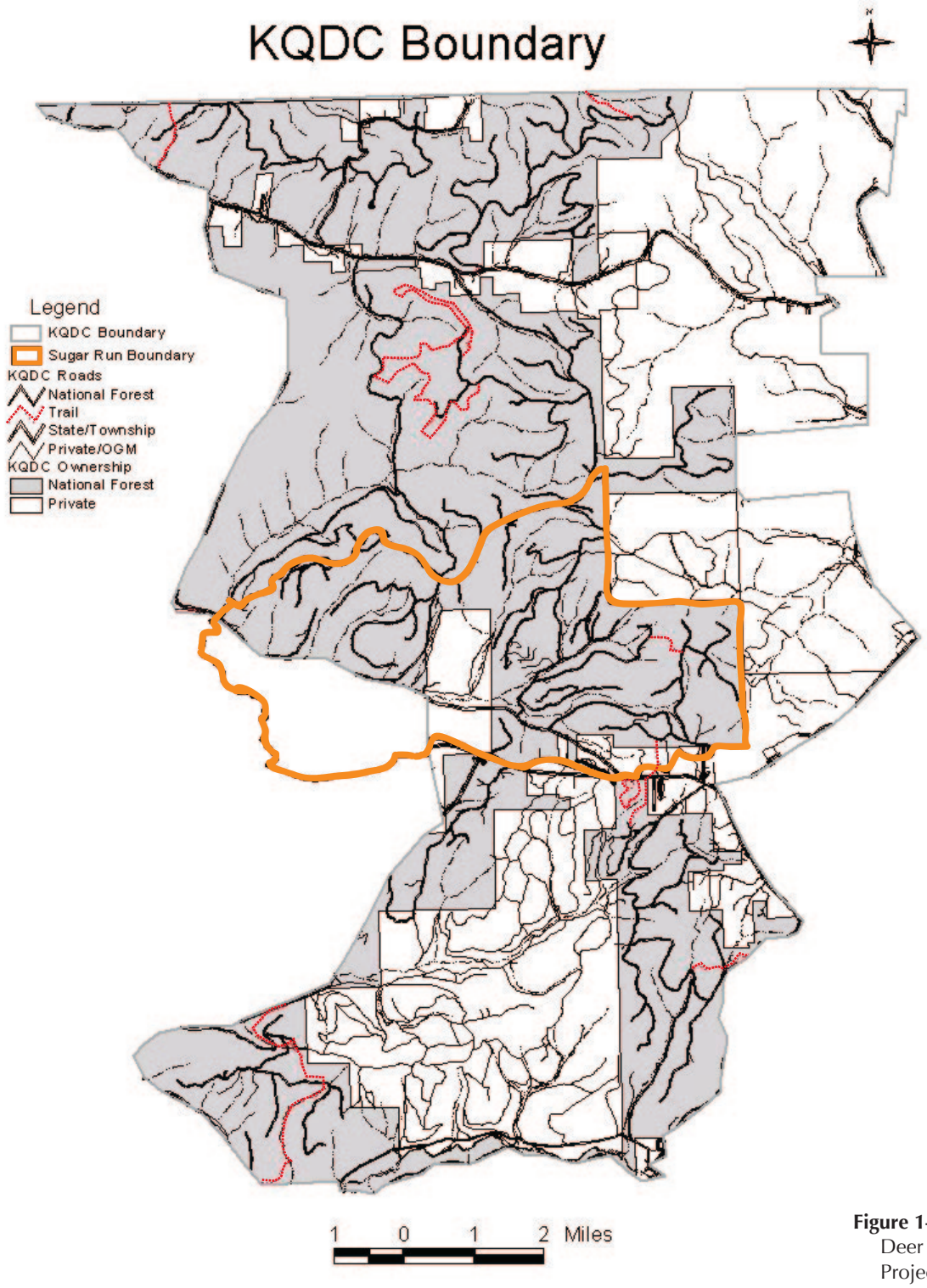

Figure 1—A map of the Kinzua Quality Deer Cooperative. The Sugar Run Project Area is outlined near the narrowest portion of the KQDC.

The activities described in this paper are designed to change forest regeneration and renewal at the landscape level. The intent is to alter responses to more familiar stand-level silvicultural activities by changing the context within which they occur. Those who believe that silviculture occurs strictly at the single stand level may question whether activities like cooperating with hunters to reduce deer impact are silviculture. Surely if deer impact is reduced in one stand, it is also reduced in adjacent stands. Those people who believe that all silviculture occurs strictly at the stand level suggest that these activities should more accurately be described as "forest management" rather than silviculture. Similarly, those who believe that silvicultural activities lend themselves to precise quantification are likely to be disappointed at the imprecision with which hunters change silvicultural outcomes. Our contention is that the intent of these activities is to change stand-level responses related to the "establishment, growth, competition, health, and quality of forests and woodlands," and that they are, therefore, "silviculture." We hope that this paper will advance the discussion of whether and which activities that occur at scales larger than the stand are still appropriately characterized as silviculture.

History of Deer Impacts on the Allegheny Plateau

The Northern Unglaciated Allegheny Plateau Section (Keys and others 1995) of Pennsylvania has long been notorious for the heavy deer impacts borne by its plant and wildlife communities (Hough 1965; Leopold 1943; Redding 1995; Marquis 1981; Marquis and Brenneman 1981; Tilghman 1989; deCalesta 1994; Rooney 1997; Horsley and others 2003). Estimates of deer densities during the period when the region was occupied only by Native Americans range from 8-15 deer per square mile (McCabe and McCabe 1997). As European settlers moved into the region, hunting pressure, including hunting for urban markets, increased substantially. After near extirpation of the Pennsylvania herd in the late 19th Century, the Pennsylvania Game Commission (PGC) was established in 1895 in large part to protect what was perceived as a precious and scarce resource--the white-tailed deer. With strict regulation of hunting seasons, early prohibitions against harvesting does, and small-scale reintroductions from Michigan and Virginia coinciding with the creation, statewide, of nearly perfect deer habitat through heavy forest harvesting[3], herd size sky-rocketed. By the early 1920s, farmers sought relief from overabundant deer in some parts of the state, and against protests by hunters, doe seasons were launched in selected agricultural counties. By the late 1920s, foresters, too, were noticing the negative consequences of local overabundance, including on the territory of the newly created ANF, and the first statewide doe harvest was scheduled in 1928. The idea was met with stiff opposition from hunting clubs, local newspapers, and politically active hunters, but went forward (Kosack 1995). By 1943, after a visit to Pennsylvania, Aldo Leopold (1943) warned of an impending crisis in Pennsylvania deer management. Through the intervening years, there have been periodic reductions in average deer density. These usually occurred when a PGC policy change to reduce herd density coincided with two bad winters in a row, as in the early 1940s and the late 1970s (figure 2). Often these reductions have resulted in politically effective backlash from hunters and sportsmen, and initiatives to control

[3]Marquis (1975) describes the harvests that occurred at this time: "Between 1890 and 1920, the virgin and partially cut forests were almost completely clearcut in what must have been the highest degree of forest utilization that the world has ever seen in any commercial lumbering area."

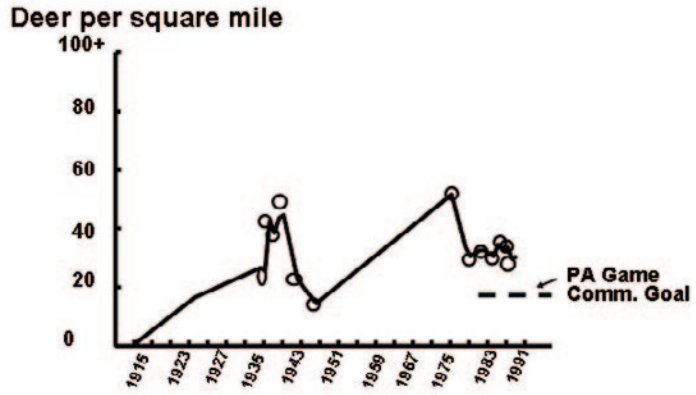

Figure 2—Deer densities through the 20th century in the four-county area of the Allegheny National Forest (from Redding 1995). Circles represent actual data points from studies conducted on the ANF. Bad winters occurred in sequence in the early 1940s and in the late 1970s. The PGC initiated habitat-based population goals in 1979.

overabundance have failed. In general, until recent years, spokespeople for hunting organizations have sought to have deer managed for maximum huntable numbers, while foresters and farmers have lobbied for reductions in herd numbers. Both groups turned primarily to the semi-independent PGC as the arbiter of this profound and long-standing dispute. Data collected over the years in the Northern Unglaciated Allegheny Plateau Section suggest that the deer herd has not been at levels now established by the Game Commission as compatible with multiple-use management (18-21 deer per square mile) in this region for most of the last 60 years (Redding 1995).

Ecological Consequences of Deer Abundance

The ecological consequences of this overabundance are many. Detailed research concerning the impact of white-tailed deer on forest resources has also been a hallmark of this region. Early researchers noticed the loss of shrubs, especially the once-common hobblebush (*Viburnum alnifolium*) (Hough 1965, Kosack 1995) from both old-growth and second-growth forests. Marquis (1981) studied the many factors that would influence the outcome of regeneration harvest treatments on the ANF. Deer browsing explained 87 percent of the regeneration failures that occurred in the study, and the presence of abundant advance regeneration, even very small seedlings, was the single factor that best predicted which areas were likely to succeed (Marquis 1981). Later studies showed that the dynamics of vegetation development differed sharply at different deer densities. Species diversity, height growth, and stocking of trees and raspberry bushes decreased as deer density increased; stocking with ferns and grasses increased. So did the dominance of a single tree species relatively less preferred by deer: black cherry (*Prunus serotina*) (Tilghman 1989, Horsley and others 2003). Forest structure varied with deer density as well; in thinned stands in the lowest deer density enclosures, a midstory formed that housed a community of birds absent at higher deer densities (deCalesta 1994). Finally, the study also showed that the *impact* of deer on vegetation in managed forests was a joint function of their density and the forage available in the landscape surrounding a management area (figure 3) (Marquis and others 1992, deCalesta and Stout 1997). One implication of this study is that there is no universally "right" number of deer.

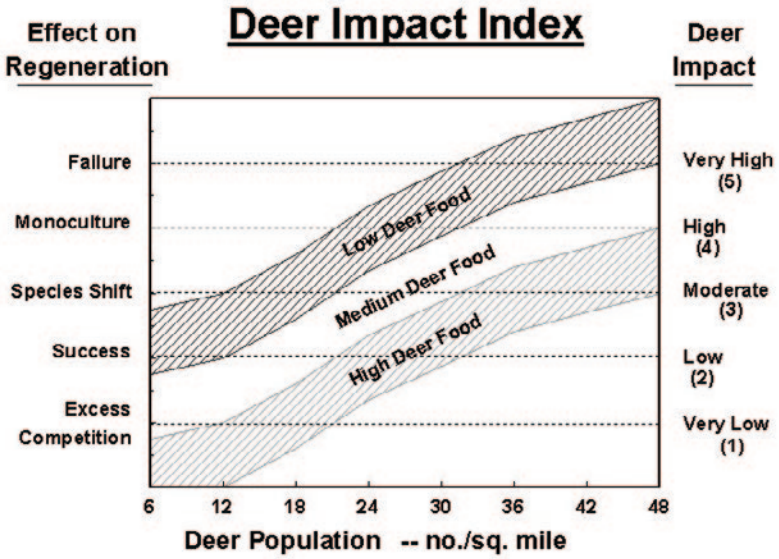

Figure 3—Conceptual framework showing that the *impact* of deer on the outcome of silvicultural regeneration harvests is a joint function of the density of deer and the amount of forage found on the surrounding landscape (from Marquis and others 1992).

The cumulative effects of such pressures on vegetation dynamics, sustained over 60 years, can be seen everywhere in the landscape. When a 1985 tornado blew over 800 acres of remnant old growth in the Tionesta Scenic and Research Natural Areas, advance regeneration was dominated by the browse-resilient American beech (*Fagus grandifolia)* and striped maple (*Acer pennsylvanicum*). The moderately preferred birches (*Betula lenta* and *B. alleghaniensis*) blew in, established on the exposed mineral soil, and became the most numerous seedlings; eastern hemlock (*Tsuga canadensis*), a preferred winter food, benefited from the exposed mineral soil, but only those seedlings that became established near the top of tip-up mounds, where deer could not reach them, persisted (Peterson and Pickett 1995, Long and others 1998). A 1991 study of the most intensive timber management zone on the ANF showed that 46 percent of that area had interfering levels of fern in the understory. The same survey showed that black cherry seedlings were the most common tree seedling, representing 47 percent of all seedlings measured in the survey (Allegheny National Forest 1995), even though black cherry represented only 28 percent of the overstory. The statewide 1989 Forest Inventory and Analysis survey of Pennsylvania forests found that more than 30 percent of analyzed plots statewide had fern cover at or above the level that interferes with the establishment and growth of seedlings, while only 4.2 percent of the analyzed samples had sufficient tree seedlings to ensure reforestation after a disturbance at high deer density (McWilliams and others 1995). The first vegetation survey in the KQDC area, conducted during the summer of 2001, revealed that 43 percent of the sampled plots had interfering levels of fern, 71 percent had beech or striped maple taller than other understory plants, and 88 percent of the understory sample plots had interfering levels of beech, striped maple, fern, or both (unpublished data on file at the Forestry Sciences Laboratory, Irvine, PA).

History of Deer Hunting in the KQDC Area and Beyond

For the last 40 years, Pennsylvania deer hunting seasons have included a two-week antlered deer season, followed by a three-day antlerless season.

Up through the mid 1980s, many hunters utilizing lands that are now included in the KQDC came from areas where the deer population was low, particularly western Ohio and southwest and central Pennsylvania. Because of the distance many hunters traveled, they often hunted for long periods of time and stayed for a week or more in local hunting camps, as well as large tent camps on the National Forest. Many hunters stayed for two weeks and hunted through the antlerless season. In the last 10 to 15 years, deer numbers have increased in other parts of the state and the east, and many hunters who formerly hunted on the KQDC now hunt in other areas, closer to home. Cultural changes—dual career couples, loss of jobs with extended vacation benefits—have also had an impact. Many out of area hunters only stay for the first two days of deer season, and based on roadside vehicle counts (unpublished data on file at the Bradford Ranger District, ANF), hunter use has declined by 50 percent in the KQDC area since 1993.

Although the overall trend in deer abundance in many parts of the state throughout the 20th century was up, there were localized reductions in deer abundance on the Allegheny Plateau after 1980. Antlerless permits were periodically increased, and where hunter access was good, this led to reductions. The continued use of a three-day antlerless season coming after the two-week buck season limited the effectiveness of the increased antlerless permits. Where access was poor, however, decreased hunter use was observed. This situation was confounded on the Allegheny National Forest by reductions in timber harvesting as a result of appeals and litigation, with an associated reduction in forage supply.

In an effort to increase the doe harvest, encourage hunter use, balance the herd's sex ratio and increase overall hunter success, the PGC has been issuing large numbers of antlerless permits, added early season rifle hunts for junior and senior hunters, and, starting in 2001, changed from the separate antlered and antlerless seasons to a 2 week concurrent rifle hunt, during which either sex can be harvested.

During the same period, many forest landowners in northwestern Pennsylvania became aware of the work of the Sand County Foundation (SCF), a Madison, Wisconsin, foundation dedicated to promotion of Aldo Leopold's land ethic and focused on issues on which Leopold had worked during his career (http://www.sandcounty.org/). One SCF program is Quality Hunting Ecology. The philosophy underlying Quality Hunting Ecology is that management of deer herds and deer habitats must be coordinated to ensure the long-term health of both. The landowners who initiated the KQDC effort, in partnership with SCF, recognized that collaborative efforts to interest, engage, and increase the effectiveness of hunters through a Quality Hunting Ecology program in the KQDC area could be a valuable tool for restoring these forests.

The average deer density for the KQDC is 28.3 deer per square mile. The deer impact study described above (Tilghman 1989; deCalesta 1994; Horsley and others 2003) suggested that in managed forests like KQDC, a deer density of about 18 deer per square mile would be compatible with management objectives to sustain diverse mixed forests. For the fall 2003 hunting seasons, the PGC launched a Deer Management Assistance Program for landowners and public lands whose property is open to public hunting. Through this program, landowners can make additional antlerless licenses available to hunters for use on properties with an approved Deer Management Plan, and the KQDC Leadership Team requested, received, and has distributed coupons for 5,000 additional antlerless licenses. With decreasing numbers of hunters, legacies of overabundant deer such as high

fern cover across the landscape, and deer numbers about 50 percent above those compatible with diverse regeneration of Allegheny Plateau forests, the efforts of the KQDC Leadership Team and the silvicultural efforts of forest managers across the area are an important complement to additional licenses in the effort to promote healthy deer and healthy habitat.

The Landscape of the Kinzua Quality Deer Cooperative

The 74,350 acres of the KQDC are special not because they are different from the surrounding landscape, but because they are very similar. Lessons learned about hunter involvement, about silvicultural strategies that increase hunter access and success, and about forest restoration, can be applied to the larger landscape.

The landowners and managers of the KQDC share a commitment to sustainable management of this forest, although the management emphases vary. The National Forest lands within the KQDC fall primarily into two management zones. One emphasizes production of high-value sawtimber, management for compatible wildlife species including deer, and dispersed, roaded recreational opportunities like hunting and scenic driving. The other zone features management for species that prefer primarily high forest cover, like turkey and bear, and mature forest conditions. The KQDC and surrounding area provides habitat for threatened, endangered, and sensitive species including the Indiana bat and bald eagle. An unroaded 10,000 acre Congressionally designated National Recreation Area is adjacent to the northern half of the KQDC. Three of the private landowners have a major focus on production of high-value sawtimber products, and two of these have achieved third party verified certification, through the Forest Stewardship Council and the Sustainable Forestry Initiative. The municipal watershed is managed by a consultant that is also third-party certified, and its management objectives include a primary focus on watershed protection, with a secondary emphasis on income from timber production.

All KQDC landowners and land managers are interested in improving the balance of age classes on their respective ownerships, and they are actively working to regenerate diverse forests within the KQDC area. All use a variety of expensive techniques to overcome the impacts of overabundant deer in reaching management objectives. These frequently include broadcast herbicide treatment of interfering fern, beech and striped maple, erection and maintenance for 3 to 10 years of 8-foot woven wire fencing in conjunction with either shelterwood seed cuts or removal cuts, and sometimes broadcast application of nitrogen and phosphorous fertilizer to speed the growth of seedlings out of the reach of deer. All have found that even-age silvicultural systems are the only ones sustainable in the face of high deer herds – the slower growth of seedlings in uneven-aged systems dooms them to failure (Marquis and Gearhart 1983). Per acre expenditures to achieve successful regeneration using these techniques can easily run to $800. These landowners have tried a variety of approaches for encouraging hunter use and success on their KQDC and other lands, ranging from encouraging public hunting and open access with road plowing and other services through lease-hunting arrangements that require the lessees to harvest specific numbers of does in order to retain the lease. All are eager to reduce the expense associated with successful regeneration of diverse species.

The Sugar Run Project

At present, the ANF is cooperating with its publics to plan projects for the 11,604-acre Sugar Run Management Area, the only projects likely to occur on National Forest land within the KQDC area during the current decade. As part of the Sugar Run Project analysis and public involvement, a special mailing soliciting input and comments was sent to hunters who have participated in KQDC activities, and ANF managers have also given special thought to silvicultural and other strategies to ease hunter access and improve hunter success as part of the Sugar Run Project.

The Sugar Run Project Area is broadly similar to the entire KQDC landscape, and as this paper focuses on the silvicultural and management strategies to be applied to improve hunter access and success within this project area, we will present details about its landscape characteristics. The project area is covered by second growth forests that originated after very heavy timber harvesting at the turn of the 19th century. Four major forest types dominate the project area—Allegheny hardwoods, mixed upland hardwoods, northern hardwoods, and red maple—which together occupy 89 percent of the project area. Tree species commonly found in the project area include black cherry, white ash (*Fraxinus americana*), tulip poplar (*Liriodendron tulipifera*), red and sugar maple (*Acer rubrum* and *saccharum*), black birch, American beech, oaks (*Quercus* spp.), and hemlock. Table 1 displays the vegetation types and age-class distribution of National Forest System lands currently within the Sugar Run project area.

Almost all (98 percent) of the project area consists of forest cover. Permanent openings, including pipelines, roads, and openings for wells, make up about 2 percent of the National Forest area and generally consist of lowland shrubs, upland shrubs, sparsely stocked riparian bottoms, or ferns and grasses. Roughly 78 percent of the Sugar Run project contains stands that are 51 to 110 years old. Stands that have been recently regenerated, between 0 to 10 years old, account for 3 percent of the National Forest land in the project area.

Stands in the Sugar Run project area have experienced a variety of forest health challenges in recent decades. The project area was defoliated by insects, on average, two to three times between 1984 and 1998. Portions of the project area were defoliated as many as 5 times during this same time period (Morin and others 2001). Insects include both natives and exotics. Outbreaks of cherry scallopshell moth, elm spanworm, forest tent caterpillar, oak leaftier, gypsy moth, and beech bark disease have all occurred on the ANF and have affected the project area. There have also been six years

Table 1—Distribution of forest types and age classes within the Sugar Run Project Area.

	Age class (acres)						
Forest type	0-10	11-20	21-50	51-110	111+	Total acres	% of total USFS ownership
Other		19	95	963	13	1090	10
Northern hardwoods	52	6	161	2,839	434	3,492	30
Allegheny hardwoods	363	560	305	2,173	123	3,524	30
Red maple				1,118	28	1,146	10
Mixed upland hardwoods		11	161	2,106	74	2,352	20
Total FS lands	415	596	722	9,199	672	11,604	100
% of total USFS land	3	5	6	78	6		

with drought conditions for a portion of the year during this time period. Disturbances such as defoliation episodes, particularly when concurrent with droughts, may cause mortality that otherwise would not be expected (Morin and others 2001). Recent forest health monitoring completed across the ANF indicated that among the shade-tolerant species, 18.2 percent of the standing sugar maple basal area and 7.3 percent of the beech basal area are dead. Of particular concern is the fact that nearly half of the large beech trees (greater than 20 inches diameter) measured were dead, most likely due to the impacts of beech bark disease complex. Among the more shade-intolerant or shade mid-tolerant species, black cherry was found to have 6 percent, and red maple 7.1 percent, of the standing basal area dead (Morin and others 2001). Among the five most abundant tree species on the ANF, dead trees are proportionally greatest for sugar maple (Morin and others 2001).

In the absence of deer overabundance, this mortality would stimulate the development of diverse advance regeneration, but in the Sugar Run Project Area, it has instead stimulated the development of dense layers of understory plants less preferred by deer or resilient to deer browsing. Approximately 72 percent of the stands considered for treatment, and 75 percent of forested stands in the project area as a whole have interfering understory vegetation of some type.

Deer in the Sugar Run Project Area

Deer are a landscape level species whose distribution is affected by the availability of forage, thermal and hiding cover conditions and seasonal mast availability. As a result, deer use and density varies spatially and seasonally across the project area. In order to better characterize and assess deer and deer related impacts, the project area was broken down into three sub-analysis areas (figure 4). Since deer numbers and impacts are largely determined by hunting and forage availability, existing deer habitat is addressed by looking at a combination of deer density, estimated forage production, and hunter access.

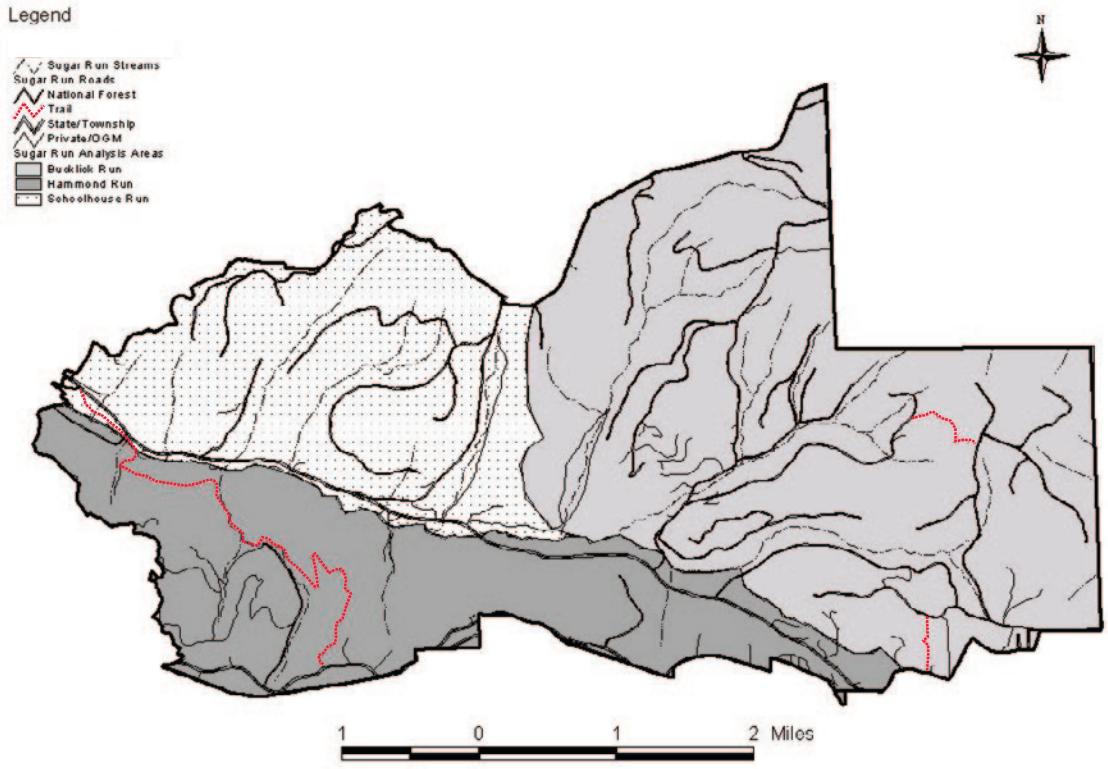

Figure 4—The Sugar Run Project Area and its sub-analysis areas.

Table 2—Winter deer densities in Sugar Run Project Area analysis units. Each estimate is based on three early spring pellet group counts, each conducted over five mile-long transects within a randomly selected mile-square unit.

Analysis area	2002 winter deer density (deer/mi²)	2003 winter deer density (deer/mi²)
Bucklick Run (6173 NF acres)	Average = 28.7 Range = 13.3-37.5	Average = 23.3 Range= 12.5-37.9
Schoolhouse Run (2702 NF acres)	Average = 20.1 Range = 13.0-32.4	Average = 34.5 Range = 30.8-41.7

Deer Density

An estimate of deer density was collected from 24 transects across the KQDC in 2002 and 2003. The PGC deer density goal for McKean Co is 20 deer per square mile but the northern half of the KQDC (including the Sugar Run project areas) had winter deer densities of 23.9 and 25.1 deer per square mile respectively in 2001 and 2002, including several "hot spots" ranging from 33 to 41 deer per square mile. Six of the KQDC transects were located in the Sugar Run project area, including three in the Schoolhouse Analysis Area and three in the Bucklick Analysis Area (table 2). Between 2002 and 2003, deer densities in the Schoolhouse area have increased by 70 percent and decreased by 12 percent in the Bucklick Area. During both years, both areas had hot spots, or areas of deer density in excess of 30 deer per square mile. While no deer density measurements were taken in the Hammond Run Area, the lack of tree regeneration, combined with browsing of beech and striped maple indicate high deer density there.

Road Density and Access

The Kinzua Quality Deer Cooperative lands are divided into a north and south zone by a state highway. The northern zone (about 52,000 acres) is about 70 percent National Forest System lands and includes the Sugar Run Project Area. Total road density is 2.5 miles per square mile, including 2.8 miles per square mile on private land and 1.7 miles per square mile on National Forest System lands. Compared to the southern zone, the northern zone has better access from State Highways and paved roads, is larger, and has lower overall road densities on both private and National Forest System lands. Also, 66 percent of the Forest System roads are built to a lower standard and are not open to the public during the late fall/early winter deer seasons (October 1 to January 25). Over 50 percent of National Forest System lands within the north zone are more than ¼ mile from an open road; present road management is not considered adequate to effectively disperse deer hunters.

Forage Availability

Marquis (1987) suggested an index of relative forage availability based on the proportion of forested area in a few broad forage production classes. Marquis (1987) suggested that seedling stands (those 0 to 10 years of age) should be assigned an index value of 10, representing an average forage production of 1000 pounds per acre; thinned stands of older classes (> 50 years) should be assigned an index value of 2.25, representing an average forage production of 225 pounds per acre; and unthinned mature stands should be assigned an index value of 1, representing an average forage production of

Table 3—Recent past, present, and projected future carrying capacity and proportion remote area. Carrying capacity is calculated according to Marquis (1987) as an index of forage production based on stand age class.

	Index of carrying capacity				% remote area	
Analysis area	**1993**	**2003**	**2013**	**2018**	**2003**	**2005**
Bucklick	12,570	7274 (-43%)[1]	8841 (+22%)[2]	7018 (-4%)[2]	42%	23%
Schoolhouse	3,728	3989 (+7%)[1]	5483 (+15%)[2]	3884 (-3%)[2]	84%	39%
Hammond	2,747	2930 (+7%)[1]	3517 (+20%)[2]	3144 (+7%)[2]	52%	26%

[1] % change from 1993
[2] % change from 2003

100 pounds per acre. Sapling and pole stands (ages 10 to 49) are undergoing stem exclusion and produce little forage so are assigned index values of 0 as are fenced stands. Using these indices and site-specific estimates of the past, current, and future age and treatment class within the project area, we can estimate changes in relative forage availability (table 3).

By looking at changes in forage availability over time, this information can also be used to help predict potential deer impacts to understory vegetation within the project area. Table 3 displays past and present forage production resulting from silvicultural activities within each of the sub-analysis areas, as well as reductions in remote areas (>.25 miles from open road) that will result from proposed road management changes.

While available forage in the Schoolhouse and Hammond Run areas have not changed signficantly in the last decade, available forage in the Bucklick area has decreased 40 to 50 percent during the last two decades as a result of fencing new regeneration treatments and growth of previous regeneration units. Considering the present deer density, the reduction in available forage within the Bucklick area, and documented deer impacts, management recommendations included maintaining or improving available deer forage within all three analysis areas, as well as providing strategies to more effectively manage hunters and improve hunter success. This combination of increased hunting success and increased landscape forage should reduce deer impact.

Proposed Actions in the Sugar Run Project

The treatments listed here may raise some eyebrows in a proceedings focused on silviculture. The focus provided by the KQDC project helped planners for the Sugar Run project recognize that many activities not traditionally considered to fall within the "silviculture" toolkit are, in fact, essential to "controlling the establishment, growth, competition, health, and quality of forests" (Society of American Foresters 1998) in this area so heavily affected by deer overabundance. If these activities succeed in reducing deer impact across the project area, they will change the outcome of other silvicultural activities stand-by-stand.

Road Management Changes

Road management changes proposed include (1) opening an additional 8.5 miles of existing Forest System road in the Bucklick and Schoolhouse

Analysis Areas and (2) construction of approximately 1 mile of new road into the Hammond Run Area. These activities will reduce the amount of National Forest System land greater than ¼ mile from a road open to hunters. Changes by Analysis Area are shown in table 3.

Silvicultural Prescriptions

The concept of deer impact as a joint function of forage availability and deer density (figure 3) suggests that both increases in forage availability and decreases in deer density will result in reductions in deer impact. That is, silvicultural treatments that stimulate advance seedling growth simultaneously increase forage on the landscape and provide advance growth for future regeneration treatments. Because increased forage availability has been shown to increase recruitment into the deer herd, it is possible to initiate a vicious cycle. A key assumption of the KQDC leadership team is that forage production increases will be accompanied by increases in hunting pressure and success, resulting in an accelerated reduction in deer impact and development of desirable vegetative communities.

Silvicultural treatments proposed in the Sugar Run project area emphasize even-aged silvicultural systems, a continuing supply of early-successional habitat, and hunter access for the project area to meet KQDC goals. Shelterwood regeneration harvests have several advantages during the transitional effort to increase hunter success while reducing deer impact. Stands that have received the seed cut of a shelterwood sequence have good visibility for hunters, as well as skid trails available to ease hunter movement. Use of shelterwood sequences allows managers to spread forage production over an extended period, using the high forage production capacity of stands that have received removal cuts to reduce deer pressure on stands that are in the seed cut stage of the sequence. Initially, new even-aged regeneration treatments are proposed in the northwestern portion of the project area. Others would be delayed in the eastern portion of the project area to provide a more continuous supply of seedling habitat over a longer time. The delayed shelterwood seed cut treatments would occur when second entry shelterwood removal cuts occur. The second entry shelterwood removal cuts would increase available forage throughout the area, thus reducing deer impacts on the delayed shelterwood treatments, enhancing diverse seedling and herbaceous vegetation development. Reforestation activities needed to ensure the successful establishment of seedlings in both even-aged and uneven-aged treatment areas are also proposed. In addition to the even-aged regeneration treatments, some intermediate thinning treatments, uneven-aged management, non-commercial thinning, and oak and conifer release are proposed.

One contrast between the silvicultural treatments proposed for the KQDC area and silvicultural treatments typically proposed in ANF projects with similar management objectives is restrained use of fencing. While fencing can eliminate deer impact in stands that are directly protected, fencing in large proportions of a forest region has the unintended consequence of increasing deer impact on the unfenced portion of the forest, by reducing the effective, high-forage-producing-area through which a deer can search for forage within its home range. Within the KQDC, managers will try to use well-timed seed and removal cuts with increased hunter access and success to reduce deer impact across the study area.

Under the alternative discussed here, 25 acres would be converted to permanent non-forested openings. Later, when deer impact has been reduced,

Table 4—Acres proposed for regeneration.

	Treatment areas (acres)[1]
Previously initiated even-aged regeneration sequence	220
New even-aged regeneration initiated	312
Total acres proposed for even-aged regeneration	532
Previously initiated uneven-aged regeneration	61
New uneven-aged regeneration initiated	32
Total acres proposed for uneven-aged regeneration	93
Total acres proposed for regeneration	625

[1] Does not include 5 acres proposed for regeneration as part of KQDC Demonstration Area.

regeneration systems such as single-tree and group selection that have been shown to fail under high deer impact may be able to succeed.

Table 4 displays the acres of regeneration proposed and the amount of these treatments that consist of followup on previously initiated regeneration sequences. Changes in forage availabilty and remote area resulting from proposed silvicultural activities are displayed in table 3.

Footbridge Across Sugar Run

State Route 321N forms the northern boundary of the Hammond Run area and serves as a primary hunter access. Sugar Run, a large stream that parallels SR 321, presently restricts hunter access into this analysis area. In order to provide better hunter access from the north, a footbridge across Sugar Run and associated hunter parking lot on SR 321 are proposed. This is expected to facilitate hunter access into many of the lower slopes in the central portion of the analysis area and complement existing crossings to the east and west.

Provide Hunter Access Trails

While SR 59 provides good vehicle access along the southern boundary of the Hammond Run analysis area, there is a nearly impenetrable wall of mountain laurel along SR 59 that makes access by foot very difficult. Additionally, experience on the ANF has shown that hunters will walk farther if they have an old road or trail to follow. As a result, all skid trails from proposed thinnings in Hammond Run will be seeded and laid out in a manner to facilitate hunter movement through the laurel and to provide better access onto the plateau tops north of SR 59.

Develop Openings Along Open Roads for Hunters to View Deer

A total of 25 acres of savannah and opening construction are proposed on nine sites across the project area. All of these areas will provide cool season grasses and legumes and seasonal forage for deer. While six of these sites will be constructed away from existing roads, three acres on two sites will be constructed along open Forest Roads that provide primary access into the Bucklick Area. These sites are being constructed close to roads in order to provide hunters with an opportunity to view deer that are attracted to these openings. Local experience has shown that hunters are more likely to use or hunt in an area where they have seen deer (John Dzemyan, PGC, personal communication). Since many hunters will drive prospective areas throughout the summer and fall in an effort to locate an area that contains deer, these

openings are expected to attract deer that currently use the area, so that hunters can view them. This validation that deer are in the area is expected to increase hunter use within the Bucklick Area

Hunter and Harvest Map

Many non-local hunters don't scout the area prior to season and frequently ask about potential areas to hunt as well as local information on deer densities and access. For the last 10 years, the ANF has made a hunter map available that identifies roads, areas of recent timber harvest, campgrounds, and areas of higher deer density.

In order to make hunters more effective at harvesting deer, the KQDC is preparing a deer hunter map. While the present forest map provides general information about the area, the KQDC map will provide very site-specific information that will aid hunters. Information provided on the map will include specific deer density estimates, roads open to hunting in the area and the location of foot access trails, the locations of seasonal food sources such as apple orchards and areas with oak and hickory, openings, and the location of fences (often hunted by muzzleloaders). In addition to the hunting map, a deer harvest map will also be made available that provides the exact locations in which deer were harvested on the KQDC in the past. Like the openings that permit hunters to view deer, a harvest map serves as a "validation" that deer are in the area and can significantly help to generate interest in the area.

Demonstration Area

KQDC was identified as a priority interpretive site in the Master Interpretive Plan recently completed for the ANF[4]. The KQDC was recognized as including federal and private industrial landowners working together to implement a comprehensive management program to improve deer quality, hunter satisfaction, forest ecosystem health, and deer habitat through quality hunting ecology. The KQDC Interpretive site focuses on the hunter and public education role in effective deer management. The overall theme of the KQDC site is "Lands That Everybody Wants—Managing Multiple Uses" and focuses on the topic of deer herd management in relationship to sustainable forest ecosystems. The audience is the general public and hunters. The objectives of this interpretive site are for visitors to:

- Understand the connection between maintaining healthy deer populations and native plant and animal diversity.
- Gain an appreciation of the importance of special hunting regulations to regulate deer herds.
- Understand that managing the deer population is important to meeting ANF stewardship and management objectives.

The Demonstration Area provides easy public access off a state highway, and is located directly across from the Bradford Ranger District. Activities to demonstrate both even-aged (three acres) and uneven-aged (two acres) management including various combinations of associated reforestation treatments are proposed. Specific features associated with the KQDC Demonstration Area include a trail, a parking area/bus turn-around, a brochure, an interpretive kiosk, and signs to identify nine alternative treatments applied to one-acre plots that show the interaction of deer impact and silviculture in sustaining quality deer habitat. The treatments include single-tree selection

[4]USDA Forest Service, Rocky Mountain Region, Center for Design & Interpretation. 2001. Master Interpretive Plan for the Allegheny National Forest. Available from the Allegheny National Forest.

cuts, shelterwood seed cuts, shelterwood removal cuts, and areas with no cutting. Associated treatments include site preparation, herbicide application, fertilization, shelterwood removal cuts, and, in most cases, a contrast between a fenced and an unfenced example of each treatment.

Summary and Management Implications

The success of these silvicultural initiatives in the Sugar Run Project Area will only be known after they've been implemented, and still only if the PGC sustains its current direction of facilitating landowner/hunter coalitions to develop healthy local deer herds in healthy local habitats. But while we wait for the overall outcomes of the KQDC project from an ecological perspective, there are some lessons for silviculture.

First, partnerships represent a good stimulus for creative interdisciplinary thinking about silviculture. In the KQDC project, we benefit from landowner and interagency cooperation at the project level, and from interdisciplinary and land manager-hunter cooperation at the planning and implementation level. Many nontraditional tools, from skid trails through laurel to the concept of creating a "sustained" supply of forage producing condition on the landscape, have emerged from these partnerships.

Second, managing deer impact on silvicultural outcomes is complex and includes a number of tradeoffs, some of which are poorly understood. Fencing, a frequently used silvicultural tool for managing deer impact, gives relatively precise control, but has negative consequences for the condition of the unmanaged forest. A combination of timing the availability of high-forage producing stands with increasing hunter pressure has fewer negative consequences on the landscape but provides much less control to the silviculturist. The reduced costs of using timed forage production and hunting, compared to fencing, to achieve regeneration objectives is an important benefit of this approach, but the risk of failure—hunters aren't interested in the area, PGC policies change—are high.

On balance, we believe that the opportunities to try "new silviculture" and to demonstrate the interaction of deer impact and silviculture to the public are important benefits of the Kinzua Quality Deer Cooperative--a special place.

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