ANIMAL IMPACTS

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The aspen ecosystem is rich in number and species of animals, especially in comparison to associated coniferous forest types. This natural species diversity and richness has been both increased and influenced by the introduction of domestic livestock. The high value of the aspen type as a forage resource for livestock and as forage and cover for wildlife makes the subject of animal impacts important to understanding and management of this ecosystem.

This chapter examines both individual and compound influences of mammals and birds on the aspen ecosystem. Knowledge of other forms of animal life in this ecosystem (except for insects, which are discussed in the INSECTS chapter) is too limited to warrant inclusion. Information about forage production, effects of the aspen ecosystem on animals, and consideration of values or production of wildlife, is presented in the FORAGE and the WILDLIFE chapters.

Single Impacts

Grazing

The aspen type annually produces an abundance of forage, often more than 1,800 pounds per acre (2,000 kg per ha) (Houston 1954). This is as much as many grasslands and more than 10 times that produced under associated conifers (Reynolds 1969). Especially heavy and virtually uncontrolled livestock use of many mountain ranges during the first half of the 20th century caused negative, long-term changes to this ecosystem (Croft and Bailey 1964). Although almost all of this abusive use has been halted, grazing continues. Cattle and sheep grazing the aspen understory has been the primary consumptive use of the aspen forest type in the West.

Most grazing occurs only during summer and early autumn. Although there is some additional consumption of above-ground herbaceous material during winter by pocket gophers and other rodents burrowing under the snowpack and by wild ungulates pawing away the snow, winter grazing is poorly quantified. In contrast, summer forage consumption is well documented.

Wild ungulates shift from browse to herbaceous plants during summer (Deschamp et al. 1979, McCaffery et al. 1974, Smith 1953). This shift to succulent food occurs when these animals usually are scattered over their summer range, making their impact on the forage resource minimal to moderate, and often not even measurable. In contrast, many domestic livestock are allowed to graze on aspen-covered ranges during the peak of the growing season. They commonly use at least 50% of the annual production of palatable forage. On ranges in good condition, this is considered acceptable.[1]

Other vegetation types in the elevational zone occupied by aspen also are grazed. Movement from one type to another is free and uninhibited; the animal chooses the type that furnishes the best forage, comfort, and security. For that reason, the aspen type cannot be viewed as a discrete entity when animal impacts, especially grazing and browsing, are considered. The size of vegetation units, and the relative amount of each type in the animal's home range or in the grazing allotment or pasture controls the amount, season, and nature of use and impacts in the aspen type.

Ellison and Houston (1958) noted that livestock grazing an aspen-grassland mix apparently preferred open grasslands; but, if aspen groves are isolated and comprise only a small portion of the range, this relationship may be reversed,[1] probably because the livestock use the groves for shade. Aspen groves in the conifer forest in Arizona produced 15 times as much forage and were used much more by cattle, elk, and deer than the surrounding conifers were used (Reynolds 1969). A summary paper by Turner and Paulsen (1976) discusses in detail the mountain grasslands, their association with aspen and other vegetation types, and their management.

Direct effects of grazing include removal of plant cover (an immediate impact but usually of only seasonal duration) and alteration of the plant community by selective grazing pressure on the species mix (Ellison 1960). If excessive, the former may contribute to erosion potential. Both may alter wildlife habitat. For example, movement of grouse broods from grazed to ungrazed aspen range has been documented (Robertson 1976). Any ground-nesting bird can be adversely affected by heavy grazing during the nesting season. Small mammal habitat above ground is severely depleted by livestock grazing. Cover for all animals and forage for the grazers in the small mammal community are reduced. Predation also is made easier. These effects of grazing by livestock may alter populations and relative species abundance in the small mammal and bird communities. Pocket gophers, however, maintain abundant populations even on heavily grazed ranges (Ellison 1946); but they are essentially subterranean.

Weatherill and Keith (1969) found the aspen overstory in Alberta was little affected by grazing for 10 or fewer years; but, in the understory, taller herbaceous plants were replaced by shorter, often exotic species.

[1] *U.S. Department of Agriculture, Forest Service. 1970. Range environmental analysis handbook. U.S. Department of Agriculture, Forest Service, Intermountain Region, Ogden, Utah.*

Livestock grazing tends to shift plant species composition in the understory to those of lower palatability; and, if excessive, *Rudbeckia* spp. and many annual plants gain in importance (Ellison 1960)[2] (fig. 1). Pocket gophers graze disproportionately more on forbs (Ward and Keith 1962); this results in grasses increasing and forbs decreasing on ranges heavily populated by these rodents (Laycock and Richardson 1975). Excessive grazing pressure by cattle often will produce a range dominated by forbs, whereas excessive grazing by sheep will result in one dominated by grasses (Ellison 1954).

Sampson (1919) concluded that grazing by cattle to a level at which 50-60% of the palatable forage was cropped was acceptable in both mature stands and in young sucker stands of aspen. But similar levels of grazing by sheep damaged or killed most of the aspen suckers.

[2]*Gruell, G. E. and L. L. Loope. 1974. Relationships among aspen, fire, and ungulate browsing in Jackson Hole, Wyoming. U.S. Department of Agriculture, Forest Service, Intermountain Region, and U.S. Department of the Interior, National Park Service, Rocky Mountain Region. 33 p.*

Figure 1.—Western coneflower is endemic on much of the aspen range in the West. Because it is not palatable to livestock, it is an increaser under grazing pressure. An understory dominated with this species usually indicates past or currently heavy grazing.

Figure 2.—An aspen sucker that was repeatedly browsed by livestock or wild ungulates, thus restricting its height to about 1 foot, even though it is at least 10 years old.

Browsing

Browsing has a direct impact on aspen trees in this forest community. Through the early sapling stage, browsing reduces aspen growth, vigor, and numbers (fig. 2). Heavy browsing by sheep can eliminate aspen sucker regeneration (Houston 1954, Sampson 1919, Smith et al. 1972) (fig. 3). Deer browsing, during a time of high population density, prevented aspen regeneration on small clearcuts as well as in the untreated aspen forest of southern Utah (Mueggler and Bartos 1977). Suckers can be drastically reduced or eliminated by big game browsing on their winter range (Graham et al. 1963, Krebill 1972, Packard 1942). Elk can be particularly damaging where they are concentrated on winter ranges near feed grounds[2] (Krebill 1972, Packard 1942), where they effectively can prevent successful aspen regeneration and eventually may eliminate aspen from the landscape (fig. 4).

In contrast, observations in western Wyoming and southern Idaho indicate that browsing by large populations of moose may markedly retard or even prevent subalpine fir regeneration in some areas.[3] Peek (1974b) cited selective browsing on subalpine fir trees; some seedlings or saplings were almost stripped by repeated browsing by moose, while other firs nearby were left untouched. Because subalpine fir is one of the major conifers to invade and ultimately replace seral aspen

[3]*Personal communication from George Gruell, Intermountain Forest and Range Experiment Station, Missoula, Montana.*

stands, the presence of moose in these stands may retard conifer succession. However, moose can damage aspen stands, also. Where heavy browsing occurs on the same areas, moose have a height advantage over other herbivores. Moose also will obtain browse beyond the usual maximum height of their reach (8 feet (2.4 m)) by breaking down saplings of selected species. Telfer and Cairns (1978) documented breakage of aspen, balsam poplar, birch, and willow stems up to 4 inches (10 cm) d.b.h. by moose in Alberta. They cited similar moose behavior in Minnesota and Sweden.

Both browsing and grazing have seasonal impacts; browsing is seasonal by animal species, whereas grazing is seasonal because of forage availability. Domestic livestock browse the aspen with increasing pressure through summer and early fall. This browsing can be very severe, especially on young and succulent sprouts (fig. 5), and especially by sheep. But much of the browsing is incidental to grazing; if grazing is light to moderate, the browsing will be, also. This is particularly true for cattle, but less so for sheep and wild ungulates. Domestic sheep readily browse aspen suckers within their reach (Sampson 1919).

Deer predominantly browse during much of the year; but in summer, they primarily eat herbaceous material (Collins and Urness 1983, McCaffery et al. 1974, Smith 1952). Broad averages for the diets of mule deer in the West are 60%, 74%, and 49% composed of trees and shrubs in fall, winter, and spring, respectively (Kufeld et al. 1973).

In large numbers, elk can have a greater impact than deer on aspen because (1) elk are larger, eat more per animal, and are able to reach higher than deer; (2) elk may remain in the aspen zone throughout most winters, whereas snowpack depth in this zone usually forces deer to lower elevations for much of the winter and early spring; and (3) elk chew the bark off large aspen trees.

Figure 3.—Mature aspen stands that are heavily used by domestic sheep, such as this one in central Utah, do not regenerate successfully as the old trees mature and die.

Figure 4.—Aspen stands on heavily used elk winter range, illustrated here in western Wyoming, do not regenerate successfully when the overstory dies unless they are given protection.

The physiological effect on woody plants may be different if they are repeatedly browsed during the growing season than if browsed while dormant. Removal of a significant portion of the plant early in the growing season, just after full leaf growth, would have the greatest impact on a shrub or tree seedling. Carbohydrate reserves are lowest then (Schier and Zasada 1973). Repeated browsing of regrowth later in the same growing season would further weaken the plant. In contrast, browsing during winter may affect growth form and size but is less likely to kill. Winter browsing is a pruning process. Often, it appears that stored food reserves are used in the remaining portion of the plant for augmented growth during the next growing season.

Fortunately, browsing is least when it would have the greatest impact, because other succulent herbaceous forage is most abundant at the same time. Dormant season browsing, the pruning process, often causes shrubby growth forms to develop, a form that ultimately produces the maximum available browse annually (Willard and McKell 1978) for the animals during this season of greatest need. Repeated heavy browsing produces dense, hedged, shrubs out of most deciduous woody plants, including aspen. However, when browsed, aspen suckers will maintain better growth form than many hardwoods, because aspen usually sends up a single dominant shoot from the lateral bud immediately below the browsed terminal (Graham et al. 1963).

The impacts of browsing are greatest on shrubs and on trees less than approximately 13 feet (4 m) tall. In much of the West, most browsing pressure on aspen is from domestic livestock. Terminals of aspen sprouts are effectively out of their reach when they are only 5 feet (1.5 m) tall (Smith et al. 1972). Sheep will browse up to 45 inches (114 cm), cattle up to 5 feet (1.5 m) (Sampson 1919). When pressed for browse, white-tailed deer, at

least, will break off stems that are 0.8 inch (2 cm) diameter at the height they can reach (Graham et al. 1963).

Dense even-aged stands of aspen can withstand considerable tree loss during these early years, as long as approximately 400 well-formed stems per acre (1,000 per ha) remain when they reach the 13-foot (4-m) height. Sampson (1919) recommended at least 2,500 sprouts per acre (6,200 per ha) after 3 years, or when about 3 feet (1 m) tall. In New Mexico, it took 6 to 8 years growth before aspen suckers stimulated by fire outgrew the reach of deer and elk (Patton and Avant 1970). After bigtooth aspen were clearcut in Michigan, Westell (1954) estimated young sucker stands of approximately 10,000 stems per acre (25,000 per ha) could yield 100 to 150 deer days use per acre (250 to 375 per ha) per year for the first 3 years without undue damage to the developing forest. However, sucker stands in the Lake States grow about twice as fast during early development than do aspen in much of the mountain West.

Advanced regeneration in uneven-aged aspen stands usually is sparse and comparatively slow-growing. An equal browsing pressure will impact these sucker stems more severely and for a longer time than it would a dense stand of fast-growing, even-aged suckers that resulted from fire or clearcutting (figs. 3 and 4). Yet, the uneven-aged aspen stand is dependent for its perpetuation on these low-density, slower-growing suckers in the understory. In Wyoming, for example, wild ungulate browsing in mature aspen stands effectively prevented regeneration even as the stands broke up[2] (Beetle 1974, Krebill 1972).

Animals other than ungulates browse aspen and associated woody plants. Snowshoe hares and cottontail rabbits nip off young suckers. Their effects have not been quantified in much of the aspen type in the West; but their impacts appear to be incidental in the southern Rocky Mountains. This may not be so in Canada and Alaska, where snowshoe hare abundance at cyclic peaks may exceed the winter food supply. More than 50% of available browse (less than 0.5 inch (1.5 cm) diameter) was removed in winter by hares during population highs in Alberta (Pease et al. 1979).

Beaver, pocket gophers, and perhaps porcupines also may "browse." Again, the impacts of this browsing have not been adequately measured. Pocket gophers may feed on young aspen sprouts and may be destructive locally, especially if their populations increase after clearcutting (Marston and Julander 1961).

Barking

Among the hardwoods, aspen is especially susceptible to gnawing or stripping of its bark by several species of mammals. In the West, elk are the primary barkers of mature aspen stems (fig. 6). Most of this damage is restricted to elk winter ranges. Where the animals are concentrated, such as near artificial feed grounds, bark damage or removal can be quite severe and can adversely affect the aspen stand (Krebill 1972, Packard 1942). Other members of the deer family, particularly moose, may chew bark from aspen trees. Evidence of moose barking aspen trees on their summer range has been observed in both Wyoming and Utah.[4] Such damage must be incidental, because reports in the literature are lacking.

[4]Personal communications from George Gruell, Intermountain Forest and Range Experiment Station, Missoula, Montana; and Philip Urness, Utah State University, Logan, Utah, respectively.

Figure 5.—Cattle were excluded from the area to the left of the fence since herbicide spraying in 1965. Grazing continued on the right. After 18 years, within the exclosure profuse aspen suckers are likely to develop into trees despite light browsing by both deer and elk. Only aspen skeletons and severely browsed aspen suckers are found on the outside.

All native members of the deer family may use small trees, often aspen, to rub the velvet from their antlers in late summer. This strips off much of the bark. Although this can be disastrous for the individual tree, the impact to the forest as a whole is insignificant.

Rabbits and hares may remove bark for food. This may girdle small trees. A high population density and a shortage of other palatable foods can result in damage to aspen sprouts and saplings. Dickmann (1978) found marked differences in the amount of winter bark damage by rabbits among poplar clones in Michigan. Rabbits and hares feed upon buds, twigs, and bark in winter; then, like the ungulates, they switch to more succulent plant material in the growing season.

Mice and especially voles may eat large patches of the surface bark from aspen trees in winter. The damage can extend from ground level up through the entire snowpack depth (see figure 2 in the MORPHOLOGY chapter). This barking may be extensive on most stems in a stand when these rodent populations are at a peak. It can kill sprouts and small saplings (Baker 1925, Sampson 1919); but on larger trees, most of the damage is superficial, because only the periderm is removed. However, subsequent drying and cracking of this damaged bark could provide a source of entry for disease organisms (Krebill 1972).

Porcupines readily remove the bark from aspen. Where both hardwoods and softwoods are available, porcupines appear to prefer the smooth barked hardwoods and hemlock as food sources (Curtis 1941, Krefting et al. 1962). Lynch (1955) reported aspen bark removal by porcupines and snowshoe hares in the grovelands of northwestern Montana. Graham et al. (1963) stated that porcupine injury was restricted to locations where they are especially numerous. In summer, their feeding on leaves and twigs was incidental. But, in winter, porcupines fed on the smooth bark of the trunk and branches; they removed the periderm, and exposed the inner bark and cambium to desiccation and possible death, thereby girdling trees. Graham et al. (1963) reported extensive destruction of merchantable aspen by porcupines on restricted areas of Michigan.

Budding

Aspen buds are an important winter food source for wildlife. Hares, rabbits, and small rodents may feed on the buds and twigs near ground level. Birds may remove buds at any level. Ruffed grouse particularly depend on aspen buds as a winter food. In Utah, aspen buds made up 85% of the volume in the crops of winter-harvested grouse (Phillips 1967). In the Lake States, they feed almost exclusively upon male aspen floral buds during the winter (Svoboda and Gullion 1972). The total impact of budding on the aspen forest has not been assessed; but it does not appear to be a significant ecological impact on the plant community.

Figure 6.—Elk chew the bark from aspen trees on their winter range. On heavily used range, this can have a significant impact on the mature trees. Although girdling is not common, the damage provides entry for pathogens.

Cutting

Only beaver, among the animals, has the ability to cut and, in part, remove saplings to mature sized aspen trees. Throughout most of their range, beaver are virtually dependent upon the willow family, of which aspen is a part, for their sustenance. However, they will use other hardwoods and shrubs for food, notably cherry (*Prunus* spp.), alders (*Alnus* spp.), maple (*Acer* spp.), and serviceberry (*Amelanchier* spp.) (Bailey 1922).

They cut aspen of all diameters, feed on the bark and small branches of the felled trees, and utilize stems of medium diameter in their dams (fig. 7). Trees more than 3 feet (1 m) in diameter have been cut; but seldom are those greater than 4-6 inches (10-15 cm) diameter cut into bolts and moved from where they fall (Bailey 1922). This results in clearcut, and often flooded, areas in the vicinity of each beaver dam. The cutting progressively will extend away from the stream. The distance away depends upon the area flooded by the dam, the ability of beaver to extend canals beyond the stream or flooded area, and the courage or success of beaver while exposing themselves to predation while on land.

Typically, beaver activity extends about 300 feet (100 m) from the water, except where steep slopes facilitate skidding (Graham et al. 1963). Often, about 1 acre (0.4 ha) is included in the ponded and clearcut area around a colony; the area may be larger where slopes are gentle. Usually, a series of dams are built in the stream, and the aspen along the entire reach are used.

The meadows adjacent to many mountain streams in the West probably were caused by high beaver populations in the past. Graham et al. (1963) lamented that some of the finest aspen growing along streams and lakes in Michigan in 1920 was cut by beavers and later replaced by other vegetation, such as bracken fern, conifers, grass, and brush. Flooding for several years kills aspen roots in the inundated areas. When the dams fail, willows and grasses invade the floodplains. The willows alone may support later beaver colonies (Hall 1960, Packard 1942). Reinvasion of these formerly inundated areas by aspen suckers is a very slow process that is dependent upon the growth of roots from aspen adjacent to the meadow. Also, after a dam fails, it may be several years before the previously flooded soil will again support a vigorous forest stand (Wilde et al. 1950).

In summary, beaver effects can be placed into two categories: that from cutting alone, and that from dam building and flooding. Cutting alone stimulates abundant suckering. If beaver abandon that section of the stream for a sufficient time (15 or more years) and ungulate use is not excessive, a new stand of aspen will develop (fig. 8). Flooding changes the entire plant community and, to some extent, even the landscape. Siltation behind beaver dams results in a series of benches, each relatively flat and wet (often too wet for aspen to develop), along the stream course. These benches may remain dominated by other vegetation for centuries.

Trampling

Virtually all of the trampling damage in the aspen type is associated with grazing and browsing by ungulates, usually sheep and cattle. Sometimes elk do equal damage immediately after snowmelt, where they are concentrated on and near their winter ranges (Packer 1963). Humans trample much vegetation in areas of critical concern to managers, such as developed campgrounds, where soil and plant cover may be markedly altered (Wagar 1964).

Figure 7.—Beavers clearcut aspen within range of their lodges. Bark and twigs are used as food; branches and small stems are used for construction of lodges and dams.

Figure 8.—Successful aspen regeneration several years after beavers clearcut the parent stand, exhausted the food supply, and then abandoned the site.

Trampling smashes vegetation that is stepped on, crushes the litter cover on the soil surface, and compacts the mineral soil immediately underneath (Lull 1959). Although research has seldom effectively separated the effects of trampling from those of grazing or browsing (Laycock and Harniss 1974), for practical purposes, they do not need to be separated. It is impossible for grazing or browsing to occur without trampling. Their combined effects on the plant community and related soil-watershed conditions usually are reported as effects of grazing.

Marston (1952) and Meeuwig (1970) both reported that a ground cover (plants, litter, and rock) of 65% or more was necessary on most aspen covered range in the mountainous West to control overland runoff and erosion. Excessive grazing, browsing, and trampling will readily reduce cover below this threshold level. Downstream damage may be dramatic and severe, such as along the Wasatch front during the 1920s and 1930s (Bailey et al. 1934, 1947). (Watershed effects are discussed more fully in the WATER AND WATERSHED chapter).

Some plant communities can be damaged by trampling, whether or not the plants are grazed or browsed. This applies particularly to the aspen type, where an abundance of species grow in a loose, friable, soil that usually is completely covered with litter and is high in organic matter. In most aspen communities, the mix of plant species that occupies a surface after years of severe trampling likely will be much different than that on an undisturbed surface.

Unless severe enough to decrease stocking at stand maturity, trampling of aspen suckers by livestock would only reduce initial growth, perhaps setting it back 2 to 4 years in a heavily impacted stand. Sampson (1919) considered trampling effects by both sheep and cattle on

aspen suckers to be light in his Utah studies. Cattle trampled fewer than 10% of the sprouts on several cut sites in Utah; snow damage probably was greater (Smith et al. 1972). However, there is serious concern that this damage provides entry for disease and stain-producing organisms. Hinds[5] found staining was especially common in the wood of aspen suckers growing on sites that had received moderate to heavy livestock grazing during the first few years after clearcutting, during the time that the suckers were young, were less than 9-10 feet (3 m) tall, and were easily damaged by cattle.

Digging

Pocket gophers cultivate aspen soils by burrowing immediately beneath the soil surface during the snow-free season, and at the surface during winter and spring. The material moved by underground burrowing is pushed to the surface as small mounds of mineral soil. After snowmelt, the soil surface activity under a snowpack leaves what appears to be the equivalent of giant-size worm castings of mineral soil lying atop the litter layer (fig. 9).

Pocket gopher activity has been studied on many western range sites. Much of this research has emphasized the gopher's effect on the plant community, especially the impact on forage production, and adverse effects on conifer regeneration (Crouch 1982). Pocket gophers may consume up to 23% of the net belowground plant productivity in the aspen type (Andersen and MacMahon 1981). Gopher activity may turn over 5 tons of soil per acre (11 metric tons per ha) per year; this soil then covers about 3.5% of the surface (Ellison 1946). Fresh mounds and castings provide new microsites for invading, seral understory plant species, especially annuals and aggressive perennials, such as western coneflower. The important invading species in northern Utah were: *Nemophila breviflora, Polygonum douglasii, Veronica biloba, Bromus carinatus, Rudbeckia occidentalis, Agropyron trachycaulum,* and *Senecio serra* (McDonough 1974). Succession occurs, and these species give way to a preponderance of perennials after 3 to 4 years. It appears that pocket gopher activity may contribute to plant species diversity within the aspen understory by providing a continuous series of microsites for plant establishment and succession (Laycock 1958, McDonough 1974). Thus, there is always a niche for plants at all stages in the aspen understory sere.

Pocket gopher digging may be severe enough, especially if plant cover is depleted by other causes, to further destroy cover and expose soil to overland flow and erosion (Ellison 1946, Marston and Julander 1961).

Several other mammals dig in the aspen forest type. Their combined effects probably are less than that from pocket gophers alone. Individually, their effects probably are insignificant. Some of these animals are: beaver, small burrowing rodents and shrews, and the predators that pursue these burrowing creatures—skunk, badger, coyote, bear, and others. The digging by all except beaver is scattered throughout the aspen type. Canal digging and bank burrowing by beavers is concentrated, as noted earlier, to a relatively narrow zone adjacent to streams and the inundated zone behind each beaver dam.

Digging directly affects the soil itself. Organic matter is mixed into the mineral soil. If enough is turned over annually, as it is in much of the aspen forest, a mineral soil horizon rich in organic matter forms beneath a relatively thin litter layer (Tew 1968). Digging by all creatures, from earthworms to mammals, decreases soil bulk density and provides an abundance of macropores in the disturbed soil. Laycock and Richardson (1975) found pocket gopher activity to apparently increase noncapillary porosity, organic matter, nitrogen, and phosphorus in the mineral soil. This increases the amount and rate of water infiltration and percolation, and alters the rooting media for plants. Some plant species may be favorably affected, others unfavorably. Large pores in a well aerated and dry soil will kill some plant roots by desiccation. In other instances, these pores may provide root passages through dense and virtually impermeable clays.

[5]*Personal communication from Thomas E. Hinds, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.*

Figure 9.—Pocket gophers turn over and expose a significant amount of mineral soil in many stands. Winter activity under the snow leaves soil castings on the litter surface. Summer activity leaves small conical mounds of soil.

Other Impacts

The remaining impacts on the aspen ecosystem by animals are relatively minor; but some are visually significant. These include nest construction and related activity by birds, cavity building or enlarging by birds, and feeding activities by woodpeckers and sapsuckers.

Nest building and related breeding activities of all avian species that do not nest in cavities have no apparent effect on the plant ecosystem. (However, the converse is very significant—plant community structure, for the most part, controls what bird species will be found in the aspen ecosystem.)

Cavity nesting birds include more than 40 species in the Southwest alone, most of which inhabit the aspen

and mixed conifer types (Scott and Patton 1975). Some, such as flickers, excavate their own nest cavities. Others, such as the small owls, use natural or abandoned nest cavities. When cavities are made in live trees, damage may occur, usually by entry of decay organisms (fig. 10). However, most cavity excavation in aspen occurs in dead portions of trees or in trees that already have heartrot. The beneficial effects of the cavity nesters in controlling forest insect pests far outweighs any possible damaging effects from occasional cavity construction in live trees.

Woodpeckers remove insects from beneath the bark of infested trees. They rid the tree of damaging larvae and, at times, adult insects; but their feeding also provides portals for disease organisms to enter the tree. Most biologists and foresters feel that the balance is positive for a healthy forest. The removal and control of insect pests more than compensates for the risk of disease or decay at a later time.

Feeding on the sap or cambial layer of aspen and other hardwoods by sapsuckers has a direct impact on the tree (fig. 11). Sapsucker holes provide many ports for microorganisms to enter the tree, thus changing what is probably an innocuous impact into a potentially important one. Packard (1942) reported sapsucker damage on trees larger than 2 inches (5 cm) diameter was common in Rocky Mountain National Park, in Colorado. Almost all trees with sapsucker holes were infected with *Cytospora* fungus. Yet, with the exception of local damage, sapsuckers apparently are not numerous enough to have a significant negative impact on aspen in the West. The negative aspects of sapsucker feeding on aspen trees is partially offset by their consumption of insects.

Figure 10.—Woodpeckers excavate nest cavities in live aspen trees.

Figure 11.—The yellow-bellied sapsucker feeds on insects in aspen, leaving horizontal lines of holes in the bark, which may become portals for pathogen entry.

Combined Influences

There are interactions and interspecific competition among the animals inhabiting the aspen ecosystem. There are also coactions by these species upon the supporting plant community. The coactions are considered here, with competition and interactions among animals discussed only as they influence the aspen plant community. Most past research deals with livestock versus big game, with different species of livestock, and with pocket gophers versus livestock.

Cattle and Sheep

Most of the western aspen type is grazed by cattle and/or sheep. Generally, the low- to mid-elevation aspen lands are predominantly grazed by cattle, and the forage on high elevations is grazed by sheep. However, because cattle prefer grass, those ranges with an abundance of grass, either in the understory or as extensive mountain grasslands and meadows, are often reserved for cattle, and the aspen lands with a predominance of forbs in the understory are used for sheep. Sometimes, especially on private lands, both graze. If grazing is heavy, the combined effect of both can be disastrous to the aspen community. The sheep remove the forbs and browse; the cattle remove the grass and some forbs and trample the remainder; and only the large trees remain undamaged.

In most instances, cattle and sheep grazing are separated by space or time. Generally, sheep pass through an area at the height of the growing season, devour half or more of what is available and palatable, and then move on. Although the grazed area appears denuded of desirable forage immediately afterwards, the rest of the summer remains for vegetation recovery. Cattle, in contrast, may have much less of an immediate impact; but they usually remain on an area for much of the growing season. Although the grasses keep regrowing and provide a continuous forage supply, the impact of cattle grazing on the rest of the plant community is cumulative. Especially near water supplies, where cattle tend to congregate, most palatable plants, other than large trees and sod-forming grasses, are virtually removed from heavily grazed ranges by the end of most growing seasons.

When grazed at similar intensities, sheep were four times more destructive to aspen suckers than cattle (Sampson 1919). They readily browsed to more than a 3- to 4-foot (1-m) height, whereas cattle selected herbaceous material, if available. Sampson (1919) felt that sheep grazing should be prevented in aspen clearcuts for 4 or 5 years after harvest to permit the sucker stand to grow out of their reach, but that light grazing by cattle was acceptable.

Cattle and Elk

Cattle and elk compete because they both graze and both prefer grasses when succulent forbs are not available. The summer ranges of cattle and elk overlap, although the elk commonly retreat to the steeper, higher, and more inaccessible areas. Where they overlap, there is some competition for choice forage. After the impact of livestock, the additional impact of elk scattered over their summer range is seldom even measurable.

There is real potential for competition and for compounded impact by cattle and elk on the elk winter range that is grazed by cattle during summer. If snow depth is not excessive, elk will paw it away and feed on the grasses and forbs that remain. If these were removed by cattle during the previous growing season, the elk will be forced to rely upon any available browse or upon supplementary feed. Available browse often includes aspen sprouts and understory shrubs in the aspen ecosystem.

Cattle, Sheep, and Deer

Deer summer range and cattle grazing areas overlap throughout the aspen type in the West. If grazing is light to moderate, there appears to be little competition. The cattle graze principally grass; the deer browse and graze principally forbs. Deer use is scattered and light. If grazing by cattle is heavy, especially on overstocked deer range, severe competition for choice browse and forbs can occur (Julander 1955). Deer winter range generally is below the aspen zone.

Sheep and deer compete, especially for forbs, on the summer range. But, again, comparatively speaking, deer use is scattered and light, and probably has little additional impact on the plant community after moderate to heavy grazing by sheep.

Sheep and Elk

Sheep grazing upon elk winter range can have greater impact upon the available forage for elk and upon the plant community than does cattle grazing. With proper management, however, that need not be true. For example, late spring and early summer grazing by sheep on a big game range in northern Utah was mostly on herbs and, therefore, had a negligible impact on browse production (Jensen et al. 1972).

Sheep use of forage under aspen on the elk summer range influences the use of that range by elk, at least temporarily. Both then prefer forbs (Jensen et al. 1972, Mackie 1970). Without available succulent forage, and without appreciable cover at ground level, the elk will literally move on to "greener pastures." On summer ranges, domestic sheep use usually predominates, and the scattered use by elk is barely discernible.

Deer and Elk or Moose

The large wild ungulates compete with each other to some degree. In large numbers, elk will adversely impact deer ranges. Elk are less selective than deer. Their ability to utilize a greater variety of forage give elk a competitive advantage (Collins and Urness 1983, Mackie 1970). However, most of the important competition is on the winter range, where both species plus moose may be concentrated during severe winters on critical but relatively small areas. Most of these areas are in the brushlands below the aspen elevational zone. If aspen is present, and two or three of these species simultaneously browse it, a severe and lasting impact on the aspen sucker and sapling stand is likely.

Gophers and Grazers

Pocket gophers and grazing ungulates directly compete for many of the same plant species. If pocket gopher populations are high and grazing pressure is heavy, the combined impact can reduce plant cover below acceptable levels, can change composition to a less productive seral stage, and can have an impact on range carrying capacity.