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## Iowa's Changing Forest Resources

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## Iowa's Changing Forest Resources

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After a period of decline in area extending from the 1850s to 1974, Iowa's forest area increased between 1974 and 1990. Although the area increase is encouraging, it may be fleeting. In addition, changes in forest stand structure and forest ownership patterns along with other pressures may make it difficult to maintain healthy forest ecosystems in the future. Notes from the original land survey in Iowa coupled with information from U.S. Forest Service forest inventories make it possible to look at changes in forest area and forest tree types. Unfortunately, similar long-term data do not exist to make possible a comparison of changes in other species associated with the forest. For that reason, this paper looks primarily at those commercial and non-commercial tree species that have been assessed during U.S. Forest Service inventories conducted in Iowa.

INDEX DESCRIPTORS: forest area, forest change, forest ownership.

It is impossible to know how many hectares of forest land actually existed during the early settlement years of Iowa. Ambiguity of what was considered forest land in the 1850s, coupled with the fact that there was no effort to systematically inventory existing forests at that time, make estimates of "original" forest area subjective at best. One estimate of area, reported by Thomson and Hertel (1981), was based on determining the proportion of each section line that was identified as falling in woodland when the original Government Land Office (GLO) survey was made. When this technique was used, estimated area of the state's original woodland is 2,703,734 ha.

More recently, efforts have been underway to construct a geographic information system (GIS) data base of all of the original surveyors' maps that were produced as the original survey was conducted during the period extending from 1832 to 1859. This work has produced a composite map from which area can be determined (Anderson 1996). While one might expect that such a map would give a definitive answer for forest area in the state, the fact that there were 39 different land cover categories used by numerous different surveyors over a period of 27 years still leaves room for debate as to actual area. "Lacking any specific definition of forest or a directive to draw in boundary lines for forest, almost everything that was not prairie or swamp was called forest if there was woody, perennial vegetation of any sort present" (Thomson 1987).

The GIS composite map does, however, provide a very useful estimate of what the upper and lower bounds of forest area probably were during that time. If one aggregates all of the land cover categories that would probably be classified as forest land by today's U. S. Forest Service standards, a reasonable lower bound for what was forested is obtained. Such an aggregation gives an estimate of 1,833,240 ha. Other land cover categories that were possibly forest cover (e.g. savanna) give an additional 878,036 ha. If probable forest cover types and possible forest cover types are combined, an upper bound on forest area of 2,711,276 ha is obtained (Table 1).

During the 20th century, the U. S. Forest Service started a program to provide forest inventory estimates for each state. The ultimate goal of the Forest Service is to re-inventory each state every 10 years. The interval between inventories has been decreasing, but to date, the inventories are not being conducted on a 10 year interval. Iowa's first inventory conducted by the Forest Service occurred in 1954 (Thornton and Morgan 1959). The second was conducted in 1974 (Spencer and Jakes 1980), and the most recent was completed in 1990 (Brand and Walkowiak 1990). The Forest Service inventory process not only brought statistically sound estimation techniques to bear, but also began to standardize definitions so that comparisons over time are more meaningful. Further standardization of forest categories reflecting species composition and percent canopy closure is currently being addressed through the national GAP program using vegetation types defined by The Nature Conservancy. However neither the nomenclature nor the GAP quantification of forest types is yet completed for Iowa. Thus, the best comparative data on Iowa forest vegetation now available are through the U.S. Forest Service inventories. These inventories, however, do not provide detail about non-tree species present in Iowa's forests. For that matter, no statewide data exist to make it possible to discuss change in other forest species. Consequently, this paper focuses primarily on changes related to the tree species inventoried by the Forest Service.

In order to better understand the discussion of forest area that follows, it should be pointed out that current forest assessments do not necessarily reveal the character of Iowa's settlement-era treed lands, which probably bore little resemblance to our current notion of a forest. Current assessments also do not consider the probable wide gradation of settlement-era "forest" in Iowa, which likely ranged from a scattering of oaks in prairies, to savanna, to open woodland, to a true closed-canopy forest. The great majority of treed areas are thought to have been more open than our current wooded areas, due to fires that regularly burned through woodlands as well

Table 1. Area of selected land cover types from original survey maps.

| PROBABLE FOREST COVER TYPES                       | POSSIBLE FOREST COVER TYPES  | COMBINED     |
|---|--|--------------|
| Grove, Island, Ravine,<br>Rough, Timber, Windfall | Barrens, Oak Barrens, Openings,<br>Part Prairie/Timber, Scattering-<br>Trees,<br>Thicket, Timber Barrens,<br>Timber/Scattering/Barrens,<br>Timber/Scattering/Opening<br>(probable savanna) |              |
| 1,833,240 ha                                      | 878,036 ha   | 2,711,276 ha |

as prairies. Current thought also states that settlement-era lands with any density of trees, from savanna to forest, did not possess the dense shrub and sapling understory of today's woodlands, again because of regular wildfire. The U. S. Forest Service defines three land cover categories in their surveys: forest land, timberland, and non-forest with trees. Each is described in the paragraph that follows.

The U. S. Forest Service defines forest land as land that is at least 16.7% stocked with forest trees or land that formerly had such cover and is not now developed for nonforest use. This level of stocking translates to about 242 trees per hectare if the trees are approximately 13 cm in diameter (measured at 1.3 meters above ground), or 42 trees per hectare if the trees are 30 cm in diameter. In addition, areas classified as forest land must be at least 0.4 hectares in size and they must be at least 37 meters wide measured from outer edge to outer edge of tree crown (Brand and Walkowiak 1990). Timberland has much the same definition as forest land, with the added restriction that timberland must be capable of producing more than 1.4 cubic meters of wood per hectare per year when managed (Brand and Walkowiak 1990). There is a third category of land which the Forest Service does not consider to be forested, but which might be considered forest by other agencies. This is the category of non-forest land with trees. This category contains land that has never supported enough trees to be classified as forest but averages 2.5 or more trees per hectare that are at least 12.7 cm diameter when measured outside the bark at 1.3 meters above the ground. Many of these lands would be classified as woodland or savanna in The Nature Conservancy nomenclature.

The Forest Service also considers any timber where management is precluded by some other development as non-forest with trees. Because of the amount of cattle grazing that takes place in Iowa and because of the fact that many landowners allow their cattle to graze in what would otherwise be considered forest land or timberland, this category is important to the understanding of the dynamics of Iowa forest area. If the primary use of the woods is for grazing rather than wood production, then the U.S. Forest Service considers cattle grazing to be a development which precludes timber management. Consequently, this practice removes areas of otherwise forested land from the forest land and timberland categories.

#### CHANGES IN FOREST COVER

The first U. S. Forest Service inventory in Iowa, conducted in 1954, showed 1.05 million hectares of what was then referred to as commercial forest (timberland by the definitions used in the 1990 inventory (Brand and Walkowiak 1990)). The decline in forest area that started in the 1850s continued into the 1970's with the 1974 Forest Service inventory showing only 0.65 million hectares of timberland in the state. However, the 1990 inventory showed that timberland area had increased from the 1974 low to 0.81 million hec-

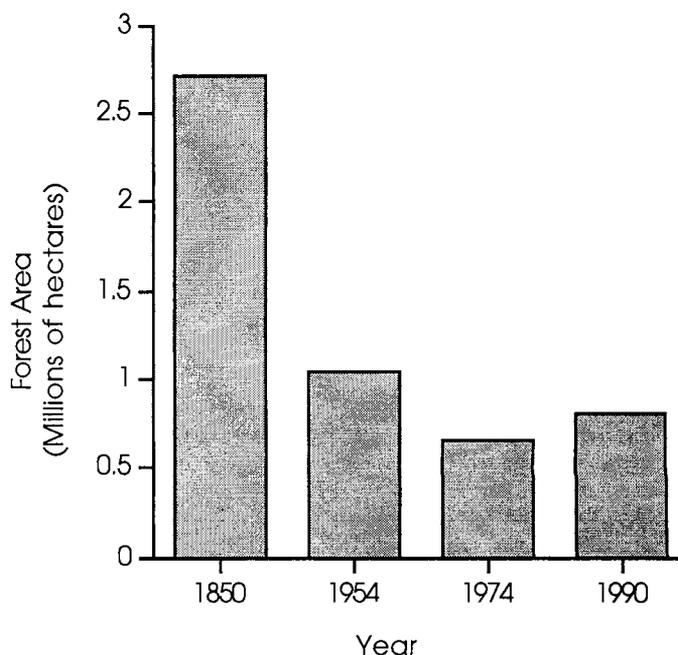


Fig. 1. Change in forest area.

tares, an increase of approximately 162,000 hectares during that 16 year period (Fig. 1).

Further analysis of the increase, however, shows that the increase was probably not due entirely to reforestation efforts. Between 1974 and 1990, 81 counties experienced increases in forest area ranging from below 405 hectares to as high as 8,900 hectares. To better understand how this increase came about, it is important to recognize that within the "non-forest with trees" category used by the Forest Service, there are several sub-categories. These sub-categories are cropland with trees, wooded strips, idle farmland with trees, marsh with trees, urban and other trees, windbreaks, improved pasture with trees, and wooded pasture. Changes in the last two sub-categories are responsible for much of the change in timberland area in the state between 1974 and 1990.

Between 1974 and 1992, the cattle industry in Iowa declined appreciably. In 1974, there were 6,674,000 cattle in the state (U.S. Department of Commerce 1974), but by 1992, that number had dropped to 3,964,000, a decrease of 2,710,000 cattle (U. S. Department of Commerce 1992). Much of the decrease in cattle number came during the early part of the 16 year period from 1974 to 1990. Only one county (Dubuque County) experienced an increase during

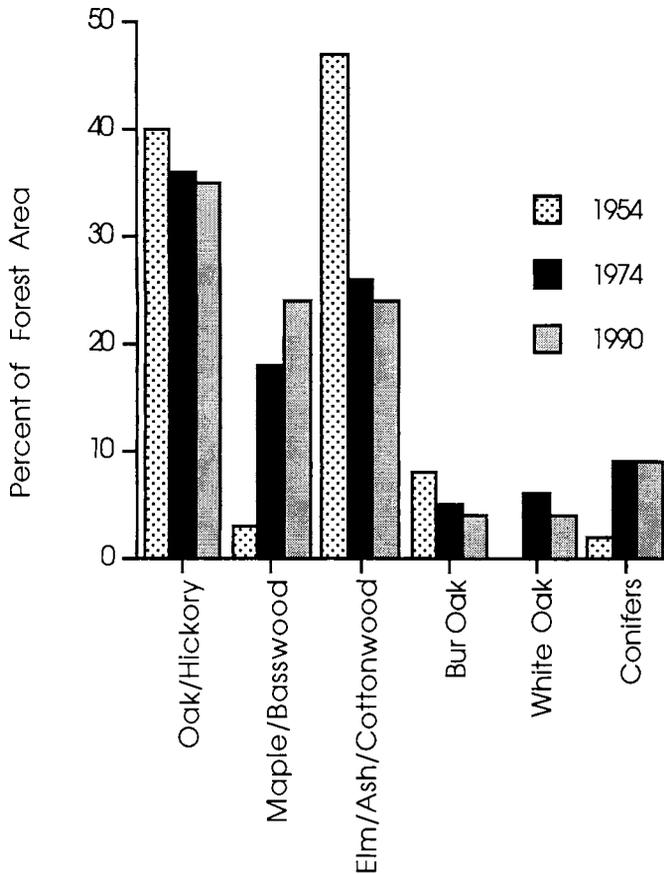


Fig. 2. Change in forest cover types.

that time, gaining some 12,000 head of cattle. All of the other 98 counties experienced decreases in cattle herds with some counties reporting losses as high as 66,000 head. With the decrease in cattle herds came a reversion of wooded pasture and improved pasture with trees to forest land or timberland categories. Comparison of the 1974 and 1990 Forest Service reports on the state's forest inventory show that wooded pasture decreased from 76,487 hectares in 1974 to 70,417 hectares in 1990. Improved pasture with trees decreased from 127,074 hectares in 1974 to 47,349 hectares in 1990. The combined decrease in these two categories is 85,795 hectares, nearly all of which, the Forest Service concludes, reverted to timberland (Leatherberry et. al. 1992).

In addition to changes in overall area of forest land and timberland, there are also some interesting changes in predominant species groups that make up forest land in the state. Figure 2 shows the changes that have occurred based on the three Forest Service inventories.

It is apparent from the graph that all of the oak types are declining in area while the maple/basswood type has shown a significant increase. Since the oak types require some form of disturbance (fire, harvesting, etc.) in order to have the necessary sunlight for reproduction while the maples and basswood do not, it is not surprising that this shift is taking place. Reasons for this change undoubtedly relate to the nature of Iowa's pre-settlement forests.

Early accounts of midwestern forests support the 1885 description by Thomas MacBride (as quoted by Thomson and Hertel, 1981) of Iowa forests. "There were wooded areas, but these were generally disconnected and limited to particular regions, such as the banks of

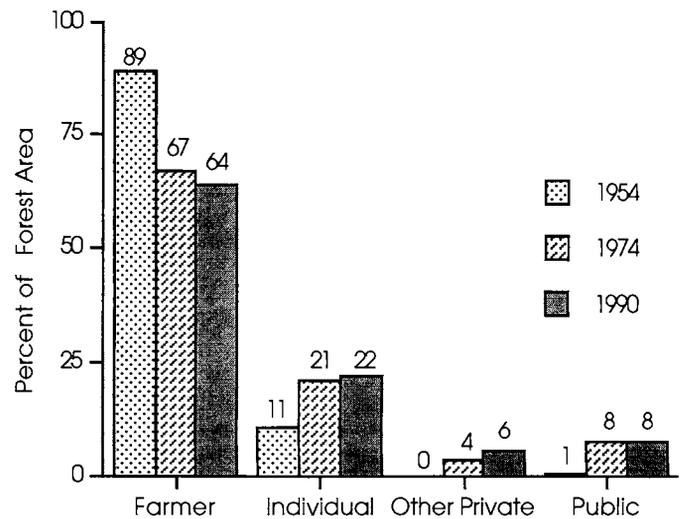


Fig. 3. Percent of forest area by ownership category.

the perennial streams, clay hills, sandy and rocky ridges. . . . As far as trees were concerned, one could drive or ride anywhere through the primeval woods of Iowa, except, perhaps, immediately along the borders of streams. . . .the trees opened on every hand as in a royal park." In now densely forested areas of the Missouri Ozarks, Henry Schoolcraft in 1818 noted that "some good bottomlands are found on its (the Meramac River) banks, but the adjoining hills are stony [sic] and barren, covered with little timber and high grass," and on the "highland plain" near the current river, he observed "scarcely an object deserving the name of a tree" (Nigh and Houf 1993). These descriptions give further understanding of the terms "barrens, brush, thickets, and scattering trees" used by GLO surveyors in the mid-nineteenth century. These upland vegetation types as well as the park-like nature of more stately forests surely were the result of frequent surface fires set by lightning and by Native Americans for a variety of purposes. With fire-intolerant maple and basswood restricted to the most fire-protected sites, regenerating oaks would not have faced immediate competition from these or other species when settlement brought an end to recurrent fires. Now, after a century or more of spread unchecked by fire, a well established understory of maple and basswood stands ready to quickly replace canopy oaks as these are harvested or die of natural causes.

Whether the shift is viewed with alarm depends on the way one values the various tree species. From the standpoint of wood value, the oaks are of considerably more economic value than the maples and basswood. Also, the mast produced by the oaks is a highly desirable food source for a number of Iowa's wildlife species. Consequently, many individuals are as concerned with the shift in forest types as they are with the decline in overall forest area since the 1850s.

The third shift that is apparent from Forest Service data is that of changes in ownership (Fig. 3). Iowa's forests have always been predominantly in private ownership. Only 8% of Iowa's forest land is in public ownership, with that percentage holding constant between the 1974 and 1990 inventories (Spencer and Jakes 1974, Brand and Walkowiak 1990). However, there has been a noticeable change in the categories of private ownership. In 1954, 84% of Iowa's forests were owned by farmers. By 1990, that percentage had declined to 64%. Individual non-farmer private ownership went from 11% to 22% during that time, and other private ownership increased from 4% to 6%. As ownership shifts toward non-farmer individuals, there is some concern that this will lead to a decrease

in the amount of timber available for harvest in the state as well as an acceleration of the shift to more shade tolerant species under the assumption that non-farm individuals may be less inclined to create the site disturbances necessary to maintain oak types. When one looks at Forest Service demographic information associated with the state inventories, it is apparent that more people own forest land for aesthetic reasons than ever before. Further, over the next 20 years, nearly half of Iowa's forest resources can be expected to change ownership, perhaps further accelerating the shift of ownership away from farmers (Brandrup pers. obs.).

## FUTURE AGENTS OF CHANGE

### Benign Neglect and Restoration Concerns

Iowa's forests are dynamic, both because they are living ecosystems and because of the outside pressures imposed upon them by society. With the current concern for the environment, it seems unlikely that the area of forest land will decline significantly in the future, and it is possible that there will continue to be some increase in forest area in the state. Although extensive land clearing doesn't pose the problem for Iowa's remaining forests that it once did, there are other factors that could lead to a change both in area and in forest cover type.

Much of Iowa's forest land suffers from benign neglect. Once the need for "on farm" wood passed, woodlots associated with farms have, in many cases, simply been ignored. They have produced whatever recreational opportunities and wildlife habitat they could naturally, and they have been allowed to flourish or decline with little or no intervention. While that may have been sufficient for undisturbed forests in Iowa's early history, in today's environment of disturbed forests and invasive weed species, it often has resulted in forests that could be made considerably more diverse and more productive if active management was involved. Perhaps the most active forest managers in the state are a relatively small group of people who enroll their forest land in the Tree Farm system. However, as of February, 1998, there were only 1,033 forest land owners in the system with a combined area of approximately 33,000 hectares.

A different estimation of active management may be given by looking at the number of hectares of forest land in Iowa's forest reserve program. One could argue that individuals who are knowledgeable enough to be aware of the tax advantages of the reserve program may also be those who are actively involved in forest management. A total of approximately 202,347 hectares of forest land is currently enrolled in the forest reserve system. However, enrollment in the reserve system does not require active management. Perhaps a better measure of active management is given by the number of forest management plans on file with the Iowa Department of Natural Resources (IDNR). A review of the number of management plans 10 years or less in age on file with IDNR shows approximately 7,700 forest land owners with such plans. Combined area for those plans totals 101,174 hectares, only half of the acreage enrolled in the forest reserve system.

No matter what measure is used, it is apparent that the majority of Iowa's forest land is not as actively managed as it could be. Furthermore, the roughly 161,800 hectares that came into the forest reserve system between 1974 and 1990 did so relatively easily, in part through economic changes that reduced the size of the cattle industry in the state. It seems reasonable to believe that the area that came into the system so easily could go out of the system just as easily with future changes in the economic situation and farming practices in the state. The benign neglect that characterizes so much of the attitude toward Iowa's forests will make it easier for forest area to decline than would be the case if more active management were in place, regardless of whether that management is for recrea-

tion, aesthetics, wildlife habitat, erosion control, or fiber production. One promising development is the concept of ecosystem restoration, which is starting to extend from restoration of prairies into restoration of woodlands and savannas. Efforts are focused on the use of fire and other thinning tools to produce a more open canopy that allows regeneration of oaks, as well as proliferation of wildflowers and other herbs. Notable efforts include the establishment of Walnut Creek National Wildlife Refuge, which states the restoration of savannas (as well as prairies) as the basis for its existence, and the commencement of managed burns on public and private lands—a practice that has been used in Missouri for many years, and is now proceeding in Iowa on a trial basis. These concepts are advancing hand in hand with our growing understanding of Iowa's savanna ecosystem (DeLong and Hooper 1996).

### Shifting Ownership

Shifting ownership patterns will almost certainly lead to change in Iowa's forests in the future. Whether that change is good for the forests or bad is highly dependent on the attitude of the new owners toward forests. To the extent that forest property is subdivided for housing, the change in ownership can certainly be viewed as bad for the forest ecosystem. Such fragmentation will cause a change to a much more sterile and less dynamic forest than would exist either naturally or under intensive management. Furthermore, people who own forest land purely for aesthetics may be unwilling to create the disturbances in the forest that are necessary to aid in the regeneration of oak species. The result will be a shift in forest cover types to favor the more shade tolerant species such as the hard maples and basswoods.

### Wildlife Imbalances

The third agent of change likely to impact Iowa's forests during the next decade is that of wildlife imbalance. Specifically, continuing increases in the size of the whitetail deer (*Odocoileus virginianus*) herds does not bode well either for the health of natural forests or for attempts to actively manage and reforest areas.

The U. S. Forest Service has conducted a 10 year study in the northeastern United States to assess the impacts of deer herd size on several measures of forest health (Jones et. al. 1993). In general, the findings indicate that once the size of the deer herd reaches 9 to 10 deer per square mile, forest health, as measured by diversity, begins to decline. Figures 4 through 6 show the impact of deer herd size on seedlings per acre, number of songbird species, and wildflowers respectively.

Iowa's post-harvest deer herd numbers about 200,000 deer. Based on the total square miles of rural area, the deer herd averages about 9 deer per square mile which is near the bottom of the deer density presented in Figures 4 through 6. If the density is calculated based only on forest area (the deer's preferred habitat), the herd averages about 64 deer per square mile. Because deer in Iowa can easily spread out into non-forested areas for some of their foraging, their impact on the forest is almost certainly less than depicted by the upper densities in Figures 4 through 6, but more than indicated by the lower densities. If the size of the total deer herd continues to grow as it has in the past, there is little doubt that deer will have significant impact on Iowa's forest ecosystem.

To give a better indication of the current impact of whitetail deer on Iowa's forest, preliminary data were collected in Ledges State Park. Oak seedlings were examined on a number of sample plots in the park and the extent of deer browse was categorized. Forty-one percent of the seedlings had been browsed during the 1996–1997 winter; 78% showed signs of having been browsed by deer at one

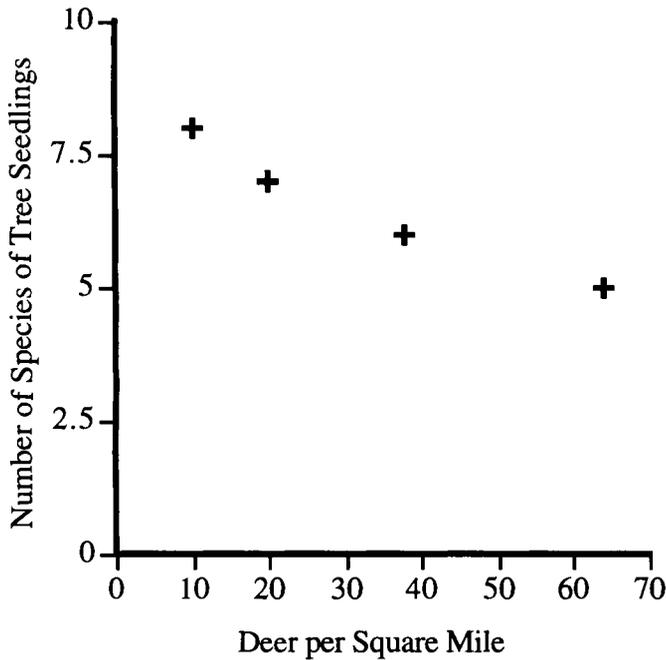


Fig. 4. Number of species of tree seedlings vs. number of deer per square mile.

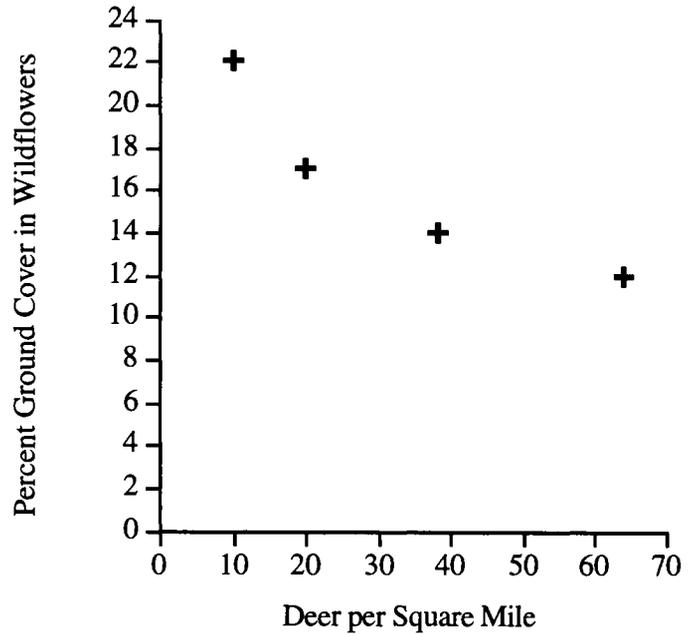


Fig. 6. Percent ground cover of wildflowers vs. number of deer per square mile.

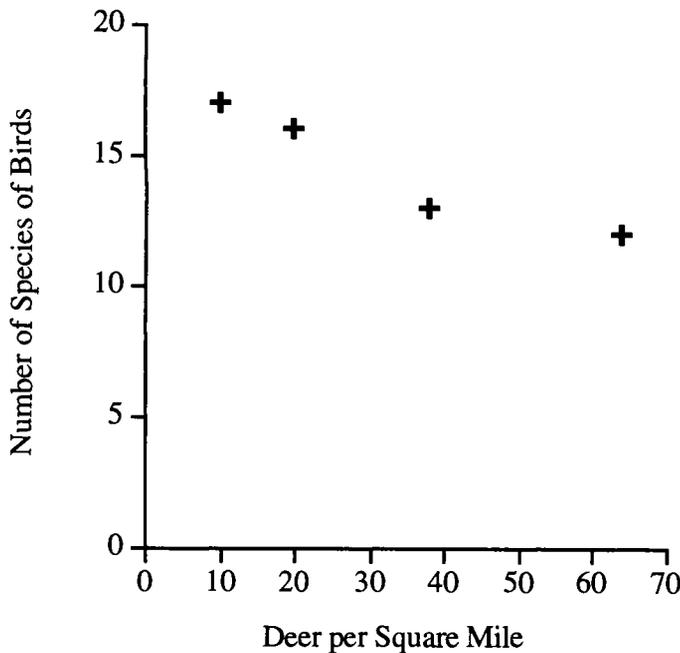


Fig. 5. Number of species of birds vs. number of deer per square mile.

time during their life span (up to 4 years). Only 22% of the seedlings examined showed no signs of deer browse.

These high levels of browse can ultimately lead to death of the seedling. At best, seedlings that are browsed by deer may develop a less desirable form than non-browsed seedlings, and the rate of growth of the seedlings is reduced as a result of the browsing. The implications for healthy growth of natural stands or for reforestation

efforts are discouraging. The longer-term impact of high density deer herds on forests will be a changed distribution of cover types and a reduction in species diversity in the forest ecosystem.

### CONCLUSIONS

The changes in Iowa's forests reported here refer primarily to species of the forest canopy. Current research in Iowa is generating methods for measuring total plant diversity in forest communities, both as species present and vegetation structure as well as the "naturalness" of each. Comparisons of forests with different management histories are documenting effects of pasturing, prescribed burning, and "benign neglect" on herbaceous and small woody vegetation. The role of forest type in determining usage by birds is also under investigation. In the future, we can expect results of these studies and others to allow a more complete analysis of the biodiversity of Iowa's forests and to provide insight into the best methods for restoring and maintaining the health of our forest resource.

Regardless of whether one accepts an original forest cover in Iowa on the order of 1.6 million hectares or 2.4 million hectares, there has been a significant decrease in forest area since the 1850s. The decrease was continuous through 1974, but the decline was reversed somewhat between 1974 and 1990. Evidence suggests that at least half of the increase in forest area between 1974 and 1990 was due the decline in the cattle industry during that time period. For whatever reason, the increase in forest area is welcomed by those who value forest land in Iowa.

Concern remains, however, that a combination of benign neglect, changing ownership patterns, and wildlife imbalances will reduce the quality of Iowa's forest resource. If forest area is to continue its increase, and if current forests showing lack of diversity are to be restored, some form of active management will be necessary. This will be particularly true if the state's more shade-intolerant species are to be maintained and promoted. Recommended strategies notwithstanding, there is little consensus among forest biologists as to a sure method of maintaining or regenerating oak-dominated forests.

The most consistent component of successful management for oak regeneration is reduction of competition through removal of non-oak understory species. Physical removal of these species is a costly process that must be repeated until oak seedlings (if they exist) are sufficiently large to outgrow competing species. The most economical and broadscale tool for understory thinning may be prescribed surface fires, and programs for this are being widely tested.

Before any such management practices can be utilized, forest land owners in the state must be convinced of the importance of active management. In a state where 98% of the forest land is privately owned, no significant increase in forest area or improvements in existing areas can be accomplished without widespread participation of private landowners. Convincing landowners, who value their forests largely for esthetics, to conduct such management activities on their woodlands may prove to be the biggest barrier to increasing and improving forest area.

Finally, the questions of balance and diversity need to be addressed. Species diversity is an important part of the state's forests. Whether that diversity has been disrupted as a result of previous grazing by domestic animals or by current foraging by wildlife, the problem is much the same. If Iowans can find a way to create balance and diversity, the future of Iowa's forests can be a good one. Failure to create balance and diversity will only continue the erosion of a valuable resource that started over 100 years ago.

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