Northern Goshawk Forest Type Preference in the Chippewa National Forest

Travis W. Ludwig
Department of Resource Analysis, Saint Mary's University of MN, Winona, MN 55987

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Abstract

The Chippewa National Forest has large expanses of land that are densely forested and largely uninhabited providing excellent habitat for Northern Goshawk (*Accipiter gentiles*). The Chippewa National Forest is currently updating its forest management plan and one of the issues is the importance of goshawk habitat. The goshawk is a listed Sensitive Species in the Eastern Region for the U.S. Forest Service. This study used a geographic information system to assess which forest types are important as goshawk habitat. Since limited knowledge exists concerning goshawk habitat, three habitat estimations (minimal convex polygons, Kernel 95% and Forage Buffer) were used to determine which forest stands occur within goshawk utilization areas. While quaking aspen plays a vital role in goshawk habitat in the Chippewa National Forest, goshawks there are opportunistic and take advantage of many other forest types.

Introduction

The Chippewa National Forest, hereafter called Chippewa NF, encompasses 1.6 million acres. Of this, 666,325 acres are managed by the USDA Forest Service. The forest consists of aspen, birch, pine, balsam fir, and maple species. The Chippewa NF contains approximately 1300 lakes, 900 miles of rivers and streams, and 400,000 acres of wetlands. The Chippewa NF is the largest national forest east of the Mississippi (Chippewa National Forest Website, 2002). The Chippewa NF is located in northern Minnesota between the cities of Grand Rapids to the east and Bemidji to the west (Figure 1). The Chippewa NF supervisor's office is located in Cass Lake, Minnesota.

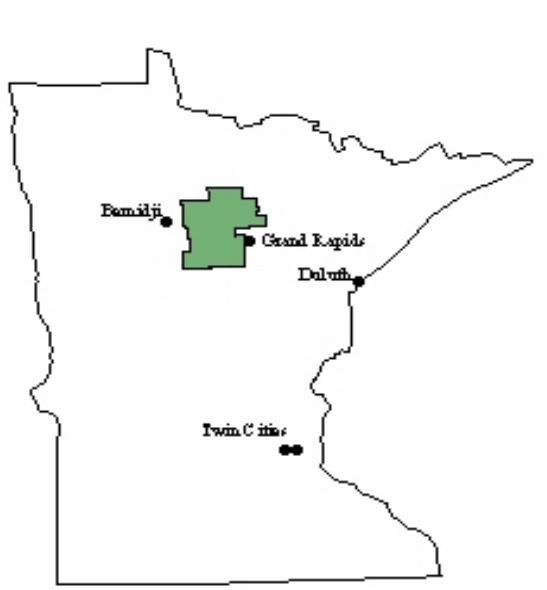

Figure 1. Location of the Chippewa National Forest within Minnesota

The Northern Goshawk (*Accipiter gentiles*) is the largest of three North American accipiters.

Accipiters are hawks characterized with short rounded wings and long tails. These traits are useful because these species prefer wooded habitat. The other accipiters are the Cooper's hawk and the Sharp-Shinned hawk (Squires and Reynolds 1997). Goshawks are well known for aggressive pursuit of prey in thick forest conditions.

The goshawk is a hawk with broad wings and a long, rounded tail. These morphological adaptations allow it to move efficiently through forest stands that are much too dense for its open-forest avian counterparts, providing it with a competitive advantage (Lilieholm, Kessler, and Merrill 1993). Females are larger than males: males average 21 inches, females average 24 inches in length (Wood 1938). The wing span of the male is approximately 40 inches and the female wingspan is greater by 2 inches (Wheeler and Clark 1995). The weight of goshawk males ranges from 631 g to 1099 g and the much heavier female from 860 g to 1364 g. Goshawks are heavy bodied with dark blue-gray backs, black crowns, pale underparts finely barred with grey and conspicuous white eyebrows. Young goshawks are similar in pattern but are brown above and streaked below (Bull and Farrand, Jr. 1977).

Goshawks are opportunistic predators and prey on a wide variety of animals, depending on region, season and availability (Squires and Reynolds 1997). The goshawk's method of hunting involves the use of tall trees as perches from which it surveys the lower branches and forest floor for small birds and mammals. It relies on substantial canopy closure to conceal it from its prey (Reynolds and Meslow 1984). Upon observation of a suitable prey species, the bird takes flight and pursues the animal (Palmer 1988) in short flight (Kenward 1982). In general, foraging individuals travel through the forest in a series of short flights, with brief periods of 'prey searching' from elevated hunting perches (short duration 'sit and wait' predatory movements) (Squires and Reynolds 1997). Goshawks hunt by flying rapidly along forest edges, across openings and through dense vegetation to surprise prey (Johnsgard 1990); they may also attack prey in mid-air (Kenward 1982). They may stalk prey on foot, using the surroundings to hide from their prey (Bergstrom 1985, Backstrom 1991). Prey that may be hunted and consumed by goshawks in Minnesota are: gray and red squirrels, chipmunks, rabbits and hares, ruffed grouse, pheasants, woodpeckers, blue jays, crows, flickers, robins, and sapsuckers. Occasionally goshawks feed on carrion (Squires and Reynolds 1997).

In the United States, goshawks hunt in diverse areas. They have adapted to pursuing prey in forests. Their broad wings with elongated wing tips are also adapted for ambushing prey in open habitats (Wattel 1973). Much remains to be learned about actual foraging preferences for goshawks. Though acquired prey may change with the seasons, preferred hunting habitat has been shown to remain constant throughout the year (Widen 1989). The presence of tall trees and snags from which the search for food begins is essential. Research has shown that stands become suitable as goshawk habitat once the trees have reached an average height of 25 m (Lilieholm, Kessler, and Merrill 1993), though trees of 16 m will often suffice. Stands with trees of less than 8 m height are generally avoided (Schaffer 1995). In a

study in northern Arizona, foraging sites were not observed to be selected on the basis of prey abundance but were selected by goshawks on the basis of forests with greater canopy closure (Beier and Drennan 1997). In contrast, a Nevada study showed that goshawks foraged in open sagebrush for ground squirrels (Younk and Bechard 1992).

Small forest openings seem to have a negative impact on the nesting efficiency of goshawks but these gaps are important to prey (Squires and Reynolds 1997). In one study in Pennsylvania, goshawks were observed to avoid nesting near light traffic dirt roads but often nested near woodland trails (Kimmel and Yahner 1994). In Oregon, goshawks were observed to nest near forest openings and trails (Squires and Reynolds 1997).

Territorial goshawks will attack and kill other raptors, and they may even kill other goshawks. Goshawks are extremely aggressive during nesting and have been known to attack humans if threatened. Goshawks often patrol nesting boundaries by soaring around them high enough so other birds will recognize the boundaries (Squires and Reynolds 1997).

Female goshawks are often observed repairing nests early in the season, as they select suitable nest sites (Schnell 1958). Nests are built in a variety of trees. Deciduous trees may be preferred in the Midwest for nest choice, but insufficient data exist to validate this observation. Goshawks nest in the largest tree in the stand and are often in the lower third of the tree. The size and structure of nest trees may be more important than the species (Squires and Reynolds 1997). Nests are bowl-shaped and are constructed of thin sticks, lined with greenery (moss, leaves etc.) and tree bark (Saunders 1982). Water is usually present near nests but is not a key requirement (Squires and Reynolds 1997). Hawks bathe and wade in water but any benefit to nesting is unknown (Brown and Amadon 1968). The requirements for foraging habitat are not as stringent as those for nesting. It is essential that prey is both available and accessible and that tall perch trees are present (Benson 1979).

This study examines what, if any, forest types are preferred by goshawks for foraging in the Chippewa NF and what importance the dominant forest type has on the goshawk habitat. Human activity is the greatest threat to goshawk survival. The best way to protect the goshawk is to keep researching and accumulating data to better understand the species. This project attempts to provide more information about goshawk habitat so that conservation planners and wildlife managers can protect this valuable raptor habitat.

Data Collection

Data for this study were acquired from John Rickers, GIS Coordinator of the Chippewa NF. All forest stand data were created and maintained by the Chippewa NF. All goshawk telemetry and habitat data were created by the Minnesota Cooperative Fish and Wildlife Research Unit.

Stand Data

The forest stand layer graphically displays and describes natural or artificial created vegetation which exhibits sufficient homogeneity to make it distinguishable from surrounding areas. ‘Stands’ are both forested and nonforested. The data were created from

1:15,840 data sources including rectfied base photography, and district compartment maps. This data also meets national map accuracy standards. The forest stand data file was an ESRI ArcInfo© coverage converted to a shapefile in ArcView©.

Goshawk Data

The Minnesota Cooperative Fish and Wildlife Unit produced the goshawk data for this study. Goshawks were captured using traps, lured by live or plastic replicas of a great horned owl. Once captured, the goshawks were fitted with radio transmitters. Researchers then tracked the goshawks for one to two breeding seasons, depending on the mortality of the goshawks during the study. Males were targeted because they do most of the foraging from courtship through at least the early nestling stage (Squires and Reynolds 1997) and often through the fledgling dependency period (Younk and Bechard 1994).

A few females were radio-tracked because they sometimes will forage during the nestling stage (Boal and Mannan 1996).

Radio-located points were plotted on DOQs by hand, and UTM coordinates were calculated for each point. The researchers used the Movement 1.1 ArcView Spatial Analyst Extension to create GIS coverages. The home range sizes were estimated with the minimum convex polygon (MCP) method (Figure 2). This is like stretching a rubber band around the located points. Figure 2 shows that ranges were calculated for female and male home ranges and a pooled home range, which will be used in this study.

The Fixed Kernel method of home range estimation using a 95% contour (K95) is shown in figure 3. This method is best described as a buffer that is created to incorporate 95% of all located points and the probability of other points where they may be located.

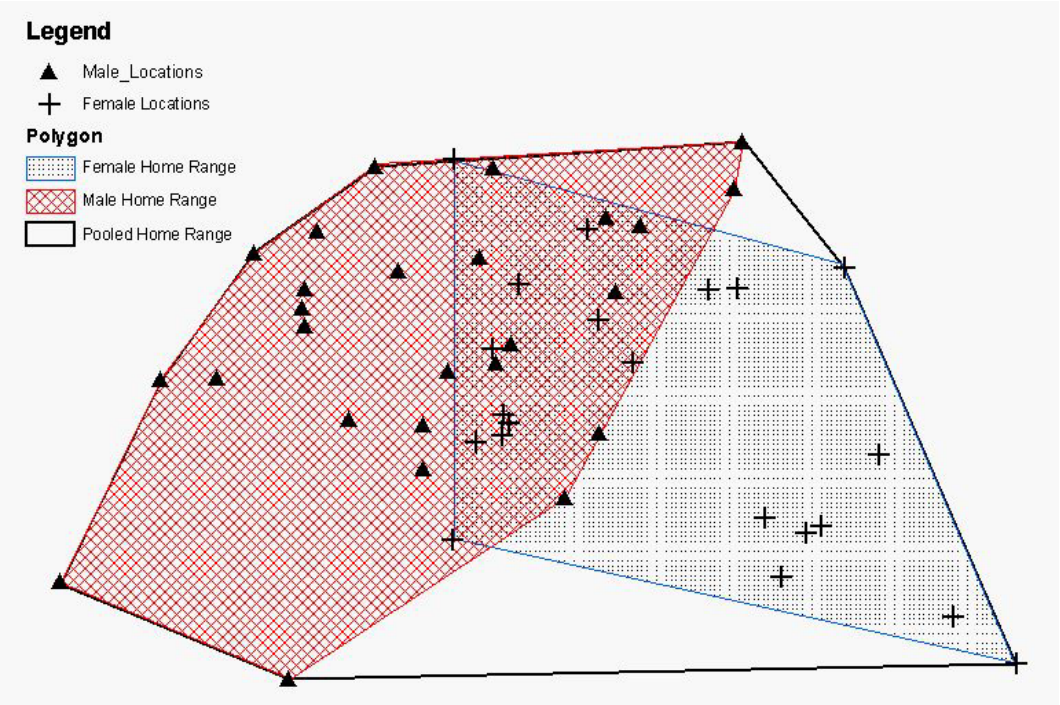

Figure 2. Example of Minimal Convex polygons. The female's home range is crosshatched. The male's home range is white dotted. The pooled area is the outside boundary.

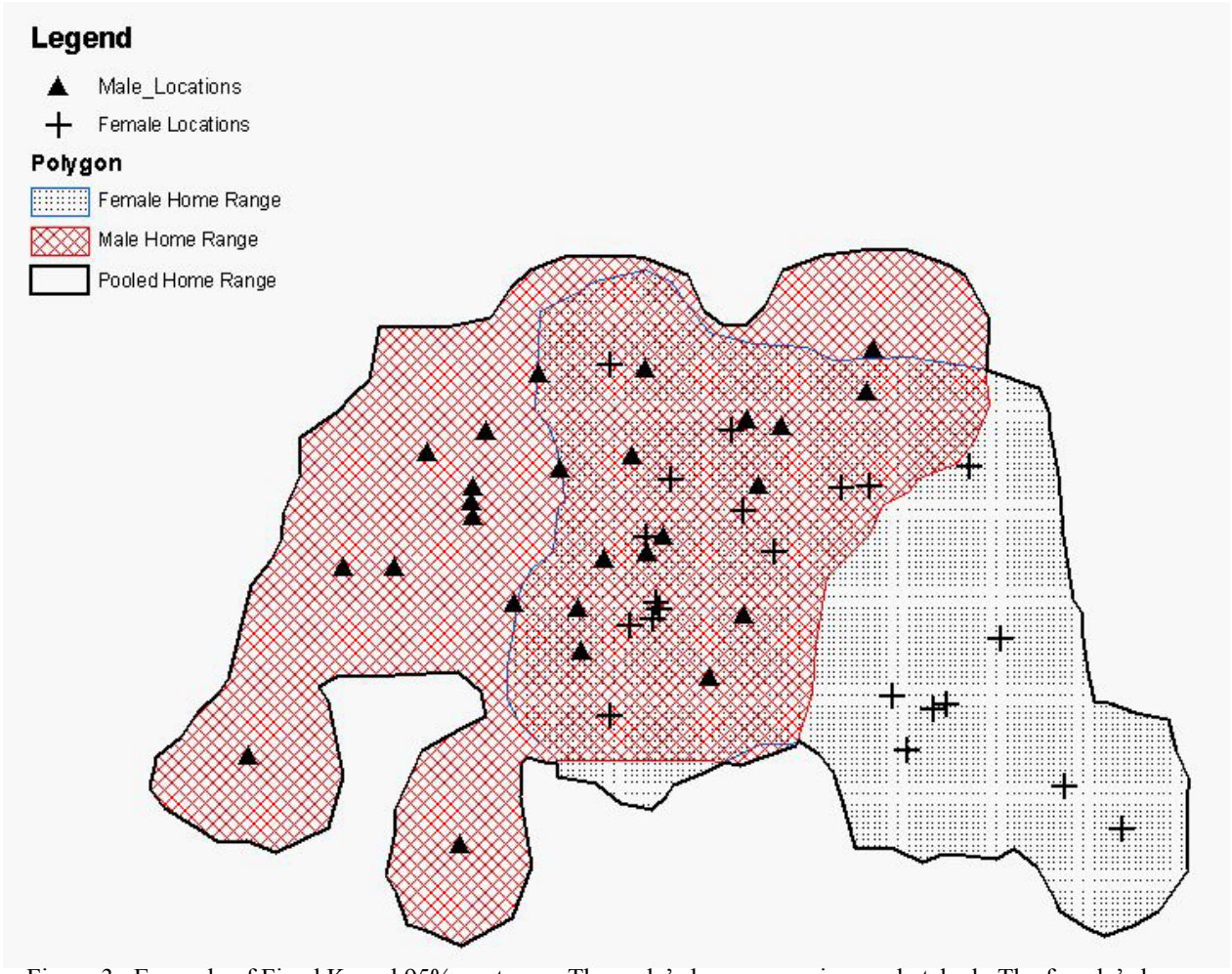

Figure 3. Example of Fixed Kernel 95% contours. The male's home range is crosshatched. The female's home range is dotted. The pooled area has the bold black border.

The K95 method is a good estimator because it describes the relative amount of time an animal spends in a given area (Andersen, Boal and Kennedy 2001). Researchers also created a simple coverage for forage areas. This was created by buffering active nest sites by 5.5 miles.

Methods

In this study a total of 14 goshawk nest areas were examined. From these sites forage buffer areas were created. Some of the goshawks from the above nest sites were deemed to be in poor health by field researchers and were not fitted with radio transmitters for further study. The remaining seven were fitted with radio transmitters and their movements monitored. These data were used to produce MCP and K95 polygons. It is the analysis of these three methods (forage buffer areas, MCP polygons and K95 polygons) of goshawk habitat use that were used in this study to determine overall forest type preference by goshawks.

The goshawk habitat data and forest stand data were converted into shapefiles using ArcView 3.2. Subsets were created by clipping forest stand layer with the three habitat layers. Summary tables were then created from

the clipped forest stand tables in ArcView using the "summarize table" option. These tables were summarized on forest type to show the quantity of forest stands that comprised goshawk habitat. These tables were exported to Microsoft© Excel to create graphs to display percentages of forest types within goshawk habitat.

Results

Quaking aspen makes up the majority of the Chippewa NF (Figure 4). The average stand age of quaking aspen in the Chippewa NF was 41 years. This is significant, because quaking aspen stands are considered to deteriorate after 80 years. After 80 years the stands tend to convert to a different forest type and the old aspen create valuable snags. This would mean that the average quaking aspen stands are middle-aged. This could benefit goshawk habitat and could continue to improve habitat into the foreseeable future with the maturation of the quaking aspen forests. The average aspen stand size was 17 acres, while the largest stand was 460 acres.

Red pine stands made up 8 percent of the forest (Figure 4), and is the second largest portion of the forest, when compared to other species. The average year of origin for red pine stands was 1938. The largest stand of red pine

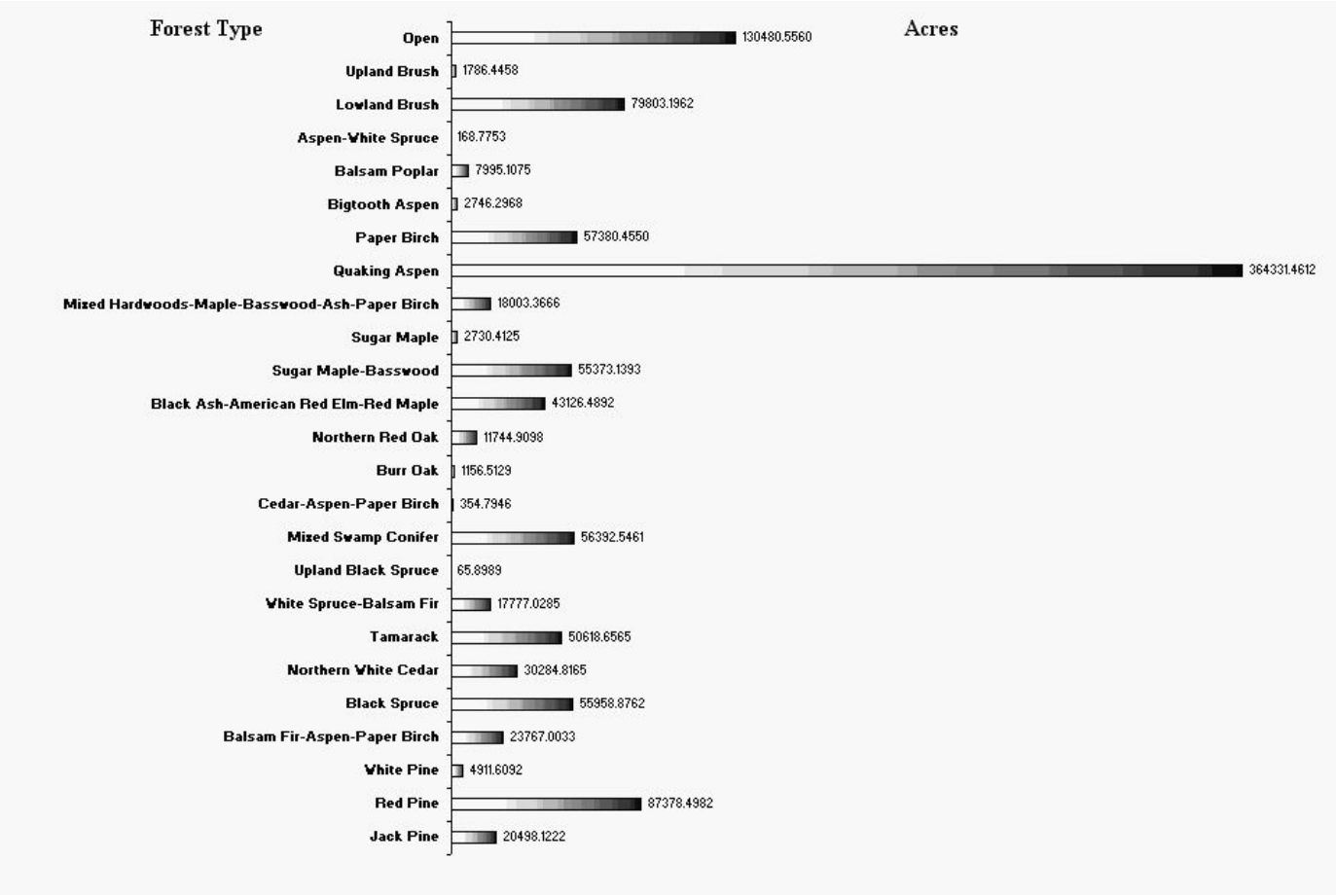

Figure 4. Forest stand summary of the entire Chippewa National Forest

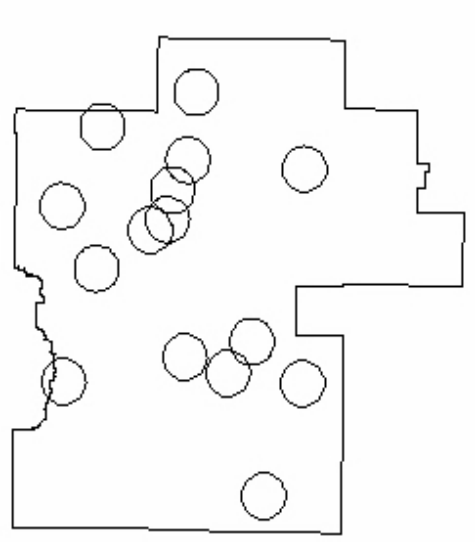

Figure 5. Goshawk forage areas surrounding nest sites

was 355 acres and the average size of red pine stands was 19 acres.

Lowland brush also covered a large amount of the Chippewa NF. These large stands of lowland brush would not have an important role in foraging. This brush lacks both high perches for goshawks to search for prey and clear flight lanes to pursue prey.

The large amount of open area in goshawk habitat is accounted for by the many lakes that are present in the Chippewa NF. While this type of habitat is important to general ecology it is has little significance to goshawks.

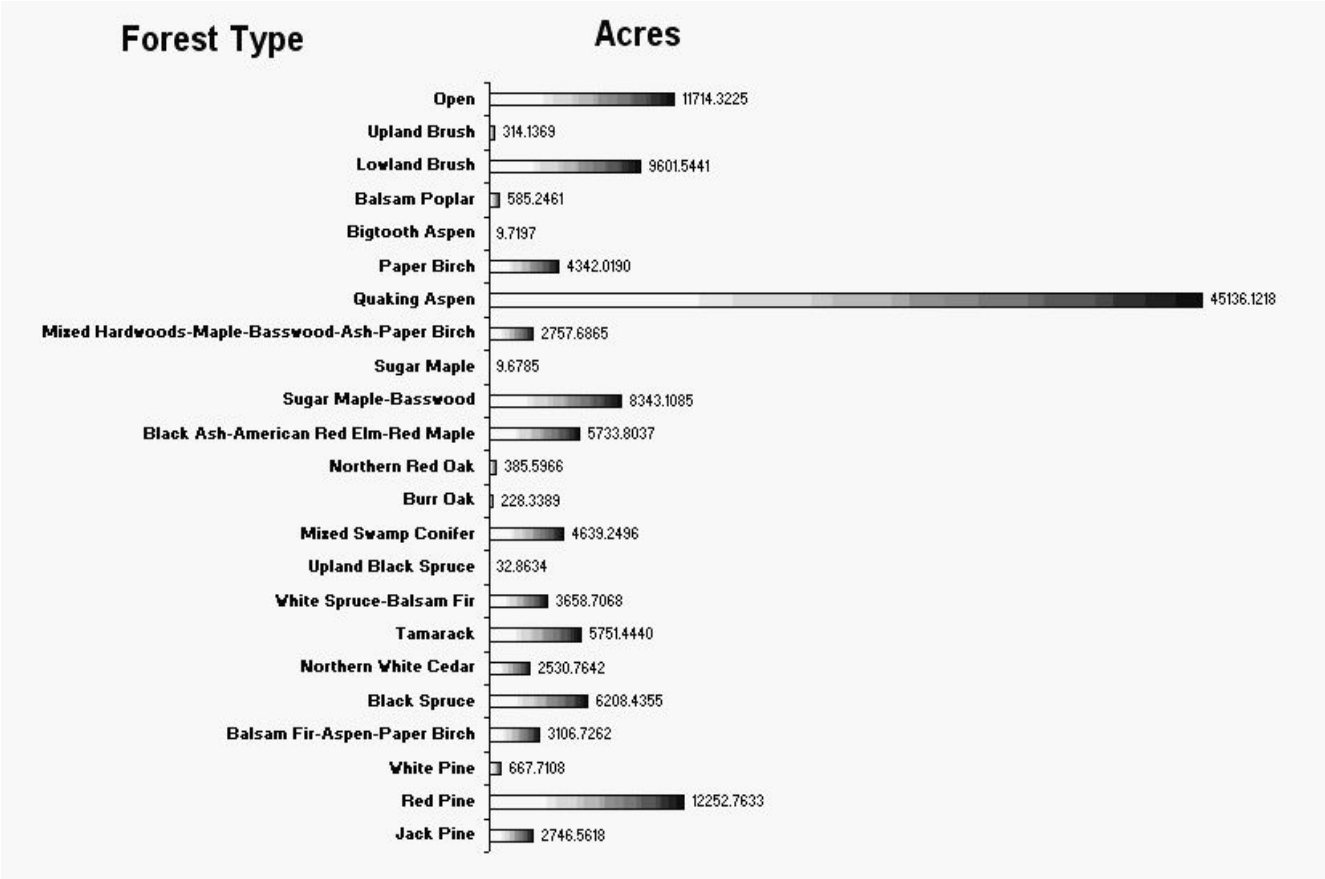

Figure 6. Goshawk forest stand summary using the Forage Buffer Areas

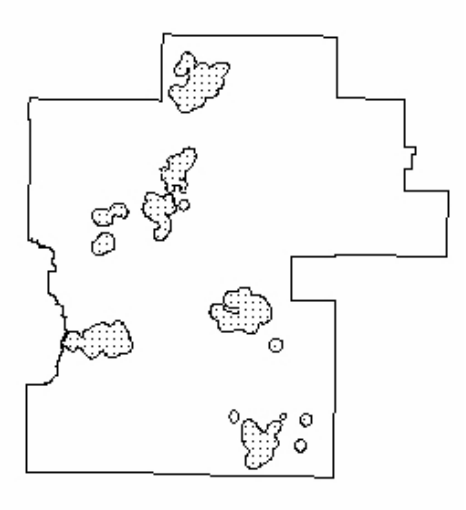

Figure 7. K95 Habitat Areas

The forest type that comprised the majority of the goshawk habitat was always quaking aspen at 34 to 35 percent depending upon the habitat survey method. The forage buffer area (Figure 5) which took into account more acreage than the K95 and the MCP survey method indicated that 35 percent of the forest included in the buffer areas was quaking aspen; this was followed by red pine at 9 percent (Figure 6).

The K95 habitat area (Figure 7) was similar to the MCP. The percentages by species varied slightly from the forage areas compared to K95 and MCP because there was more acreage included and this increased forest diversity in the summary. The added acreage was because there were 14

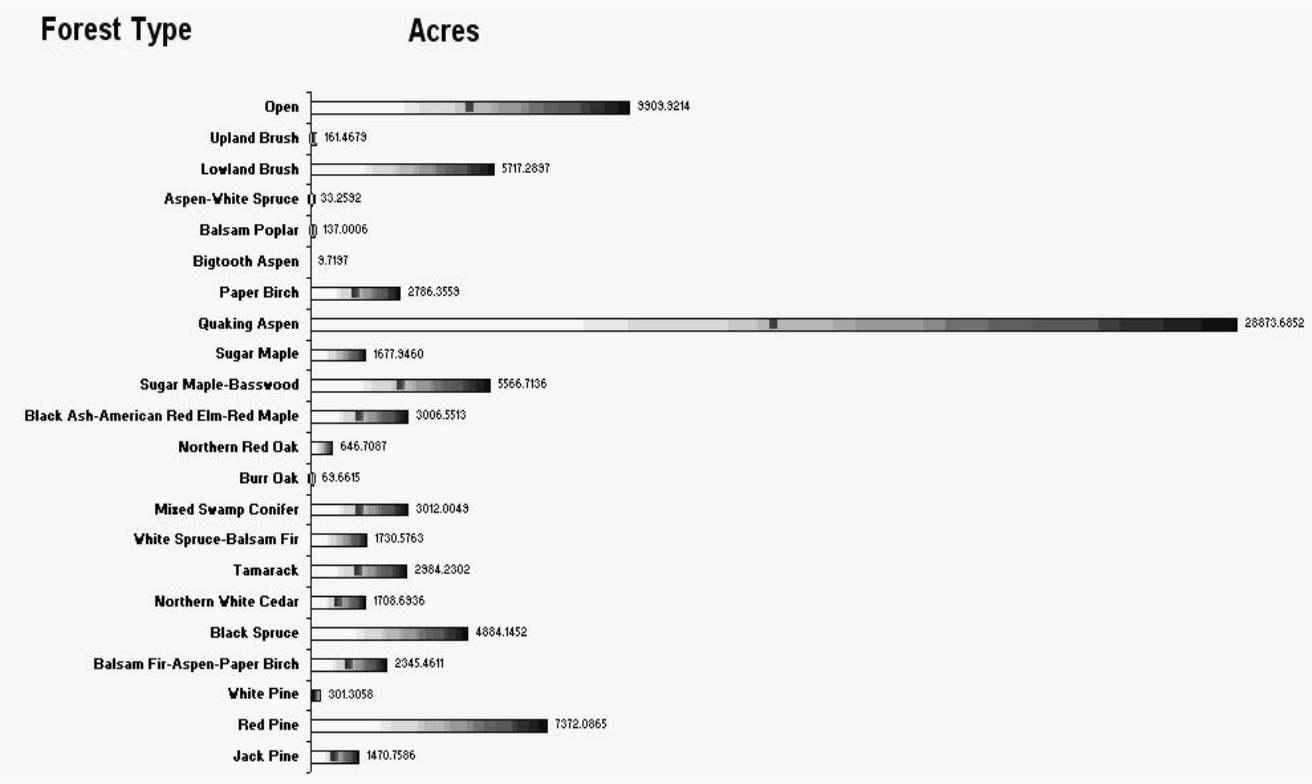

Figure 8. Goshawk forest type summary using K95 survey method

nest sites used here but only 7 in the K95 and MCP habitat estimations as noted earlier.

The results of the K95 forest summary (Figure 8) show very little variation compared to the previous forest summary. Recall that this survey method is the best estimator of the relative time an animal spends in a given area. This survey method is important because the time a goshawk spends in a given area could be related to prey abundance in various types of forest. It could also mean the goshawks are more comfortable in surroundings of certain forest types as they are better able to hide from prey and predators.

The goshawk's high position in the food chain limits its predators to large birds such as the great horned owl and carnivorous mammals such as the fisher (Erdman, Brinker, Jacobs, Wilde, and Meyer 1998). Canopy closure for protection from predators and concealment from prey is necessary and particularly so during nesting.

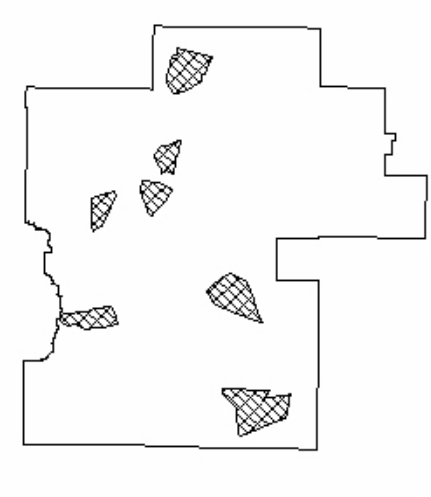

Figure 9. MCP Habitat Areas

MCP habitat estimation (Figure 9) does not take into account the time a goshawk spends in a given area like K95

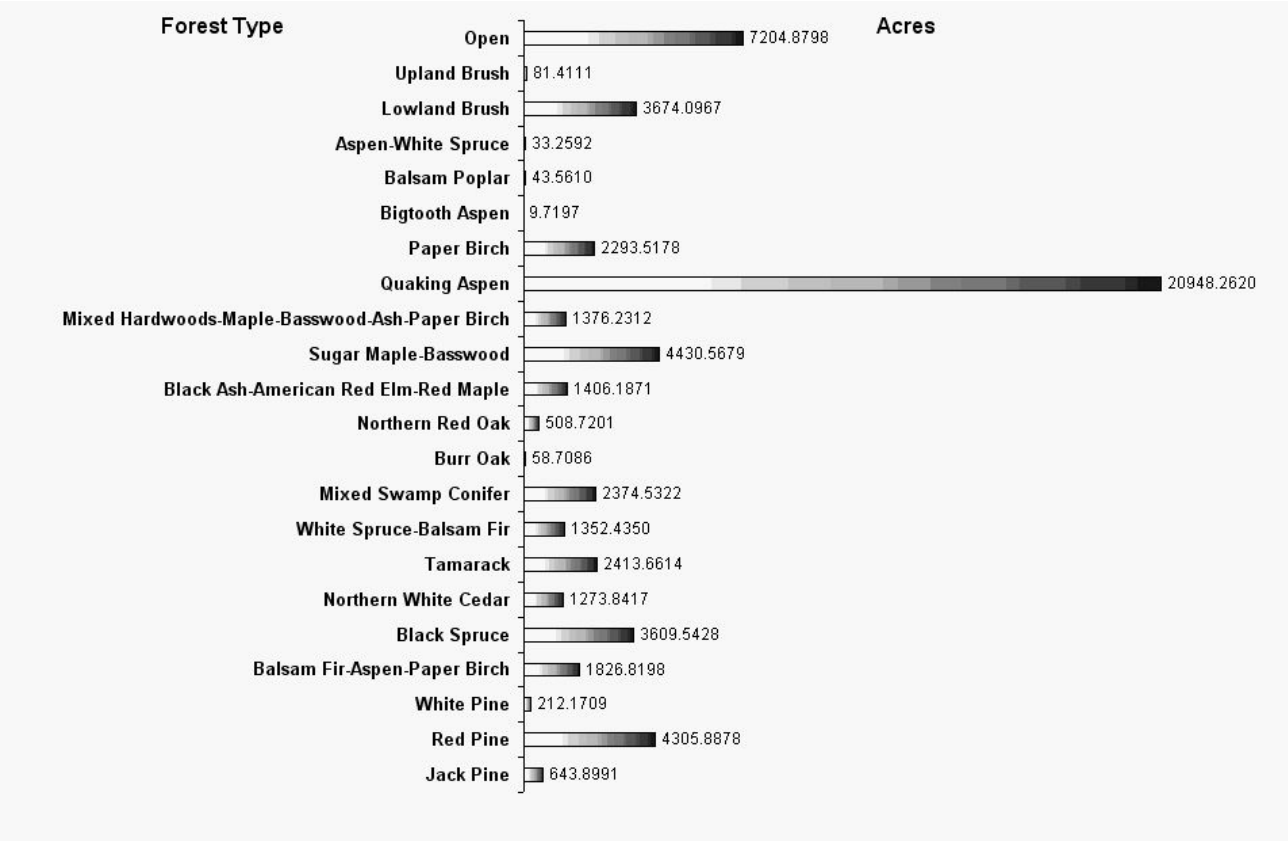

Figure 10. Goshawk forest stand summary using Minimal Convex Polygons

habitat estimator does.

MCP habitat is based purely on located goshawk points. MCP forest summary (Figure 10) also show very little variation compared to the two previous survey methods.

These goshawk forest type summary tables support two observations. First, that goshawk habitat in the Chippewa NF is intricately tied to quaking aspen stands and secondly, that the overall make up of the Chippewa NF is largely quaking aspen.

The result of the forest stand summary (Figure 4) of the whole forest is very similar to that of the three goshawk forest habitat bar charts. The variation by forest species among the three habitat estimation methods varied minimally and no species has variation of more than 5 percentage points from one method to another.

Discussion

The reason for using the three different methods was to accumulate more forest home range possibilities. This study used three different methods of calculating home range because so little is known about goshawk home range size. To narrow the focus of this study the three methods were not compared but were all accepted as legitimate estimates of goshawk home range.

The goshawk forest habitat in the Chippewa NF seems to be a reflection of the entire Chippewa NF. Diversity of goshawks habitat throughout the United States makes it difficult to determine if the management plan of the Chippewa NF is beneficial or detrimental to goshawk habitat. Different forest management practices influence the tree species composition and age class structure of the forest in different ways. Foresters must be aware of the conditions considered optimal for this species if its habitat is to be protected or enhanced (Crocker – Bedford 1990). The indications of goshawk habitat across the U.S. make it possible to manage for several different forest habitat types within the Chippewa NF that could be beneficial to the goshawk. Some areas could be managed for coniferous forest and others for deciduous forest. Management strategies could be assessed through reproduction success by surveying nest sites yearly either by a successful nest attempt (females observed in the incubation position) or nestlings that make it to a predetermined age. This could be done over a period of years or until there is evidence that the population of goshawks is stable. If it is determined that the population is not stable or is in decline or incline, this data would help indicate what caused the population change.

Management plans that are directly beneficial to goshawk prey could also increase understanding of goshawk biology. There are many questions of the effect of human pressure on goshawk habitat. The impact of logging on goshawk habitat should be assessed, as well as recreational stress. It should be determined if recreational trails have the same bearing on Minnesotan goshawks as they do on Pennsylvanian goshawk where they are negatively impacted by light human pressure. In contrast, they might be more like the goshawks of Oregon, where light human pressure has little influence.

Conclusion

Goshawk forest habitat use in Chippewa NF is similar to the proportion of forest

stand types that make up the entire forest. Quaking aspen makes up 32 percent of the forest stands of the entire forest and 34 to 35 percent of all goshawk habitat in the Chippewa NF. Quaking aspen is of primary importance to goshawks in the Chippewa NF. The goshawk is a forest dwelling bird and quaking aspen is important to them but other forest types are also important. Compared to coniferous forests, aspen stands have a rich understory of shrubs and herbaceous species (Gruell and Loope 1974). An aspen canopy typically allows more sunlight to reach the forest floor than do conifers, and stands are renowned for the wildflowers found within them (Alban 1991). Aspens offer more structural habitat diversity than conifers (lodgepole pine or spruce). The forage in a stand of aspen can be up to 6 times as rich as that under coniferous forests (DeByle 1981). The importance of quaking aspen is found in the amount of prey that is present within these stands. It is vital that appropriate prey species be both available and accessible. Prey is most easily accessed in mixed wood stands with relatively clear understories, allowing goshawks to quickly pursue prey. In addition, competing open forest raptors with lesser agility and maneuverability are discouraged from foraging in the area (Crocker – Bedford 1990).

While quaking aspen plays a vital role, the other forest types should not be over looked in their importance. Diversity in the forest is important in disease control. Some forest species are pioneer species after wildfire. Different forest types offer prey diversity which is crucial in year around prey availability.

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