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FACTORS ASSOCIATED WITH LITTERING BEHAVIOR IN THE BOUNDARY WATERS CANOE AREA^{1/}

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Introduction

Recent estimates indicate that cleanup of trash and litter on highways and in recreation areas costs 500 million dollars annually (1). The presence of litter substantially reduces the amenity values of park and recreation areas established to preserve scenic resources. Reduction of the littering problem would release funds for other urgent management needs. Determination of who litters and why is an effective first step in the development of efficient anti-littering campaigns. A recent nationwide survey (2) has shown that sex and age are two significant variables associated with littering behavior. Males and younger adults were found to litter more than females and older adults, respectively. Additionally, small families and residents of large communities litter less than large families and residents of small communities. Knowledge gained in similar studies at local levels can help agencies evaluate their anti-littering efforts and make more efficient use of scarce funds.

Since 1966, the U. S. Forest Service has been conducting an anti-littering campaign for the Boundary Waters Canoe Area (BWCA) in northeastern Minnesota. The BWCA is a one million acre Congressionally-established wilderness area; it is America's only canoe wilderness. Cleanup of the area by the Forest Service is particularly difficult because no roads are allowed and travel is primarily by canoe. Because soils are not deep enough for garbage pits and lake water quality is sensitive to sewage, regulations require campers to carry out non-burnable litter. The Forest Service provides all entering campers with litter-bags when they receive their Travel Permits. Nearby canoe outfitters, patronized by nearly 50% of BWCA campers, cooperate in the campaign. As part of an overall study (3) investigating outfitter-camper communication patterns in the BWCA, camper attitudes toward littering and compliance with littering regulations were studied to determine effectiveness of the program.

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Method

A total of 499 interviews were conducted with group spokesmen (16 years of age and older) returning from overnight camping trips into the BWCA. Interviews were conducted during the summers of 1968 and 1969 at twelve access points and one portage within the BWCA according to a sampling procedure explained in (3).

Results

Data collected in the study indicated that group spokesmen from the local area (northeastern Minnesota) were least sensitive to litter and complied least with littering regulations although they were equally likely to be aware of the regulations as spokesmen from other regions.

Organized groups (Boy Scouts, YMCA, church groups) reported noticing litter more frequently than non-organized groups (families, friends). Although awareness of littering regulations was about equal, organized groups more frequently carried out their non-burnable trash than non-organized groups (Table 1). Outfitted groups who interacted with the outfitter on campsite cleanup were more likely to comply with littering regulations than non-interactors or groups only contacting the managing agency.

Travel method had no apparent consistent effect on either awareness of or compliance with littering regulations (Table 2). Paddling canoeists, however, appeared to be most sensitive to presence of litter.

Occupation of the respondent apparently was strongly related to these variables. Using U. S. Census occupation categories, the data indicated that operatives (for example, meat cutters, welders, truck drivers) and craftsmen (for example, pipe fitters, carpenters, electricians) were least aware of the presence of litter. Nearly all occupational groups, however, seem equally likely to be aware of littering regulations. Regulation compliance, as indicated by carrying non-burnable trash out of the BWCA, was greatest with managers, professionals, and students, and least with craftsmen, salesworkers, and operatives.

Since respondents were asked only if they carried out their trash, the data do not reveal how efficient the groups were in picking up all their trash at the campsite. A key to this problem is disclosed by the proportion of groups noticing litter that complied with the rules. Over 79% of those respondents noticing litter complied with the regulations as opposed to less than 58% of those not noticing litter. Thus, groups sensitive to the presence of litter are more likely to comply with the regulations and probably do a better job of cleaning up the campsite than groups not sensitive to litter. Other variables, such as age and education, were not significantly and consistently related to compliance with BWCA littering regulations.

Table 1. Abundance of tree reproduction and shrubs by forest cover types and site units in St. Croix State Park, Minnesota

| Site units and cover types | Number of stands | Tree reproduction and shrubs in stems per acre | | | |
|--|-------------------|--|---------------------|-------------------|--------|
| | | Pine | Spruce-fir-tamarack | Hardwoods | Shrubs |
| 1. Very dry, nutrient-poor, sandy to loamy sand soils supporting the following types: | | | | | |
| Jack pine | 1 | 170 JP* | 50 BF | 2,100 A,RO | 34,200 |
| Red pine | 2 | 2,000 WP | 0 | 1,600 RO,A | 22,800 |
| Aspen | 1 | 780 JP | 0 | 1,600 BgtA,BO | 22,700 |
| Red oak | 1 | 60 JP | 0 | 1,900 RO | 4,600 |
| 2. Dry, medium nutrient, loamy sand to loam soils supporting the following types: | | | | | |
| Aspen | 3 | 0 | 0 | 2,300 A,RO | 28,100 |
| Paper birch | 1 | 0 | 0 | 3,100 RO,BA | 5,000 |
| Red and bur oak | 1 | 0 | 0 | 7,100 BB,IW,BO | 17,900 |
| Red and white pine | 2 | 600 WP | 0 | 10,100 IW,BB,A | 22,500 |
| 3. Moist, medium nutrient, loamy sand to sandy loam soils supporting the following type: | | | | | |
| Aspen | 3 | 0 | 0 | 6,100 RM,BB,A | 30,500 |
| 4. Dry to moist, medium to nutrient-rich, sandy loam to sandy clay loam soils supporting the following type: | | | | | |
| Aspen | 4 | 0 | 0 | 6,500 RM,IW,A | 20,500 |
| 5. Dry to moist, nutrient-rich, loam to silt loam soils supporting the following type: | | | | | |
| Northern hardwoods | 3 | 0 | 0 | 12,800 AE,BB,IW | 9,100 |
| 6. Moist, nutrient-very rich, loam to silty clay loam soils supporting the following type: | | | | | |
| Floodplain hardwoods | 1 | 60 WP | 0 | 3,000 BB,BA,IW | 7,000 |
| 7. Wet, nutrient-rich, fine textured mineral, and well decomposed organic soils supporting the following type: | | | | | |
| Black ash-elm | 1 | 0 | 280 BF,WS | 3,600 BA,AE | 7,900 |
| 8. Wet, medium nutrient, fine textured mineral and moderately well decomposed organic soils supporting the following type: | | | | | |
| Tamarack-black ash | 3 | 0 | 2,700 BF,T | 3,600 RM,BA,AE | 17,600 |
| 9. Very wet, nutrient deficient, poorly decomposed organic (sphagnum peat) soils supporting the following type: | | | | | |
| Tamarack-black spruce | 1 | 0 | 7,900 BS,T | 0 | 2,900 |
| * Main reproduction species | | | | | |
| JP - Jack pine | WS - White spruce | BgtA - Bigtooth aspen | BO - Bur oak | BB - Blue beech | |
| WP - White pine | BS - Black spruce | A - Aspen | RM - Red maple | AE - American elm | |
| BF - Balsam fir | T - Tamarack | RO - Red oak | IW - Ironwood | BA - Black ash | |

Northern hardwood reproduction, varying in abundance and composition, is also present in aspen, birch, and oak communities on dry to moist, medium nutrient sites. Distribution of northern red oak and bur oak is widespread over the entire range of upland forest conditions, varying from 200 to 700 stems per acre. Occurrence of young aspen sprouts, primarily quaking aspen (*Populus tremuloides*, Michx.), is common on uplands. Paper birch (*Betula papyrifera* Marsh.) and bigtooth aspen (*Populus grandidentata* Michx.) reproduction is occasional. Red maple is the most abundant species in aspen communities on moist, medium nutrient sites, averaging about 3,500 stems per acre and accounting for over 50 percent of the total hardwood reproduction. It is common throughout the park forest except for extreme site conditions.

Black ash and elm reproduction attain maximum abundance in black ash-elm and northern hardwood types. The usual associate on wet, medium to nutrient-rich sites is red maple. Hardwood reproduction is scarce in tamarack-black spruce bogs.

Shrubs

Shrubs are most abundant in aspen stands on moist, medium nutrient sites (Figure 1). Beaked hazel (*Corylus cornuta* Marsh.), panicked dogwood (*Cornus racemosa* Lam.) and holly (*Ilex verticillata* (L.) Gray) are the major species in this type averaging about 7,500, 5,500, and 4,500 stems per acre, respectively. This constitutes about 70 percent of the total number of tall shrubs. The shrub layer reaches seven feet in height.

Beaked hazel is the most abundant shrub species in the park forest, except for very dry and wet sites. On medium to nutrient-rich uplands the usual associates are panicked dogwood, chokecherry (*Prunus virginiana* L.), American hazel (*Corylus americana* Walt.), juneberry (*Amelanchier* spp.), and arrow-wood (*Viburnum rafinesquianum* Schult.). Locally common are nannyberry (*Viburnum lentago* L.) and

prickly ash (Xanthoxylum americanum Mill.). On medium to nutrient-rich lowlands beaked hazel is associated with holly, mountain maple (Acer spicatum Lam.), speckled alder (Alnus rugosa (Du Roi) Spreng.), dwarf alder (Rhamnus alnifolia L'Her), and red-osier dogwood (Cornus stolonifera Michx.).

American hazel is dominant on very dry, nutrient-poor sites with about 13,000 stems per acre. Juneberry and prairie willow (Salix humilis Marsh.) are the usual companion species. In this type, the distribution pattern of shrubs is in distinct clusters. Depending on stand density the shrub cover is from 10 to 60 percent and averages only three feet tall as a result of heavy browsing by deer.

Bog birch (Betula pumila L.) is the characteristic shrub species on very wet, nutrient-poor sites. Average height of the shrub layer is three feet.

In the low shrub group, bush honeysuckle (Diervilla lonicera Mill.) on upland sites and Ribes spp. on lowlands (except tamarack-black spruce bogs) are the most common species, approaching 20 percent of the total number of shrubs in types of their maximum occurrence.

Successional Implications

1. Shrubs with scattered oaks will predominate in old growth jack pine and aspen stands on very dry to dry, nutrient-poor sites spatially occupying a large portion of the park. Pine reproduction is scarce, and most of the seedlings are growing slowly. In view of the former abundance and high aesthetic value of red and white pines, management efforts should be directed to encourage their establishment.
2. Northern hardwoods will prevail in the post-fire and post-logging stabilization process now underway in the aspen-northern hardwood communities on dry to moist, medium to nutrient-rich sites.
3. Northern and floodplain hardwood communities are self-perpetuating. Sugar maple is not as abundant in these northern hardwood communities as in more typical stands elsewhere in the state.
4. The presence of all ages and sizes of black ash and elm reproduction on wet, medium to nutrient-rich sites assures the continuity of these stands. The proportion of tamarack will decline.
5. Tamarack-black spruce communities on very wet, nutrient-poor sites are reproducing satisfactorily.