PREY MANAGEMENT FOR MIGRATING RAPTORS

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Abstract: Hunting and resting habitat for raptors is being lost through destruction and disturbance. Management of protected land offsets these losses by improving the availability of prey. The Delaware Bay water crossing and the Atlantic coast concentrate large numbers of raptors at the southern end of the Cape May peninsula. Higbee Beach Wildlife Management Area, at the point of the Cape May peninsula, is managed primarily for migrating raptors, songbirds and associated recreational uses. Transect surveys conducted in 1984 and 1986 on the entire peninsula indicated that bird-hunting raptor species concentrate at Higbee Beach. Surveys at Higbee Beach on fields ranging in size from 1.4 to 8.6 ha indicated raptor use varied significantly with field age, vegetative composition, and amount and type of human use. As a result, subsequent field management efforts focused on increasing the availability of avian prey by managing food and cover, and the opportunity to hunt prey by reducing the impact of disturbance. Management techniques used at Higbee Beach can be applied to similar raptor concentration areas.

Prey management is not likely to be a priority of most state raptor management programs. For most raptor populations, prey is not a limiting factor, especially in this era of toxic contaminants and habitat destruction. Additionally, the task of managing prey is not only cost-prohibitive, but an extremely challenging undertaking by even experienced wildlife managers. After an extensive literature review, Garton et al. (1989) found little evidence that prey management is a viable method of increasing breeding raptor populations.

The actions of most professionals in the Northeast support this conclusion. Without exception, all state programs place prey management as a minor concern. Other than winter feeding programs for eagles in Maine, Pennsylvania and Massachusetts, no states conduct prey management programs. The reasons are consistent; little direct return, low priority compared to other management efforts and inability to produce consistent and reliable improvements in prey populations.

The evidence is clear that prey management is impractical for most raptor management programs; however, this paper will concentrate on one method of prey management that may be of great use in managing regional raptor populations.

Since 1984, the New Jersey Division of Fish, Game and Wildlife (NJDFGW) has dedicated management of public lands on the Cape May peninsula, New Jersey to migrating raptors. Specifically the NJDFGW aims to improve conditions on the area for migrating raptors by improving prey availability. This work is one of the few feasible applications of prey management, and as such provides direction for those setting expectations for any prey management program.

The needs of migrating raptors are difficult to predict. Without nests or newly fledged young to rear, adult birds can easily avoid prey-poor areas and move to areas offering the best hunting opportunities. Nonetheless, mortality during the migratory period can be significant for most species. This is especially true for immature birds, because it is often their first experience without the benefit of parental care (Newton 1979).

Identifying the needs of migrant raptors is complicated by a lack of consensus on what factors concentrate them. A hypothesis based on prevailing winds concentrating birds at topographic features was first proposed by Allen and Peterson (1936), and later formalized by Mueller and Berger (1967). Murray (1964) proposed that birds migrate in broad fronts unaffected by wind. This broad front theory was later defended by Kerlinger (1984), Kerlinger and

Gauthreaux (1984) and Clark (1985). These authors argue that concentrations observed at water crossings may result from birds descending to lower altitudes rather than the real accumulation of individuals suggested by the wind drift hypothesis.

Enormous concentrations of avian prey are also found in coastal areas. Kerlinger (1989) suggests that prey availability is an alternative explanation for raptor concentrations, citing the large numbers of peregrine falcons, merlins, sharp-shinned hawks, Cooper's hawks, and ospreys at coastal leading lines and concentration areas. This hypothesis was suggested earlier by Mueller and Berger (1967) in defense of the wind drift theory.

There is little question that immature raptors take advantage of fatigued avian prey at Cape May Point, a well-known concentration site for passerine migrants. The disproportionate number of immatures in coastal banding studies has been well documented for most species. Clark (1985) found that immatures accounted for 96% of all sharp-shinned hawks banded at the Point. This biased ratio is not an artifact of trapping since more balanced ratios are found at northern New Jersey and eastern Pennsylvania banding stations (Heintzelman 1986:259). Holthuijzen et al. (1982) followed the activities of 34 radio-tagged sharp-shinned hawks, and found they spent most of their time hunting. More importantly, at least 56% of the 34 birds spent more than one day, and some up to four days, on the Point. They concluded that wildlands of the Point are used heavily by migrating sharp-shinned hawks and probably most bird-hunting species.

While the concentration of raptors is well documented by counts made each year by the Cape May Bird Observatory, empirical evidence of the concentration of other species on the peninsula is scant. Krohn et al. (1977) concluded that the peninsula concentrates woodcock (*Scolopax minor*) at almost three times the normal migratory woodcock densities. Gustafson (1985) mist-netted passerines, but made no conclusions about migrant activities or length of stay.

This evidence suggests that the availability of prey, as well as the availability of resting and roosting sites, are important reasons for raptor migrants staying on the peninsula. On Cape May and at other concentration areas, inexperienced and fatigued prey species may play a role in the survival of immature raptors during their first migration. This research focuses on habitat and human use management to improve migrating raptor use of Higbee Beach Wildlife Management Area (WMA) located at the tip of the Cape May peninsula. The combination of high raptor densities, high species diversity of both raptors and passerines, high human use, and pivotal location of key habitats provides a unique opportunity to study the effects of improving prey availability on raptor populations. Improving the quality and availability of habitats important to migrating birds on the peninsula is one method of avoiding the negative impacts of habitat destruction and disturbance caused by the increasing human population on the peninsula. This work is applicable to most areas where migrating raptors occur in large numbers.

NEED

Habitat Loss

Each autumn as many as 80,000 raptors migrate through the Cape May peninsula. Annual counts taken by the Cape May Bird Observatory in the last 10 years range from 47,550 to 88,957 individuals of 23 species (Dunne and Sutton 1986). The peninsula is approximately 25 km long, 16-km wide at the neck and 2-km wide at the point. Habitat composition varies along the peninsula from mostly marsh, upland forest and swamp forest in the northern portion to fields, upland forest, and marsh in the lower portions. Both Atlantic Ocean and Delaware Bay tidal marshes consist primarily of *Spartina alterniflora* and *S. patens*, but the bay marsh contains a greater proportion of *Phragmites communis*.

Both the amount of habitat and the amount of habitat available to wildlife decline from north to south on the peninsula. The two coastlines narrow the land mass of the peninsula, reducing the area at the lower end to less than a third of the area in the northern end (Fig. 1). This natural reduction is unevenly spread among the major habitat types and total undeveloped land area is also declining.

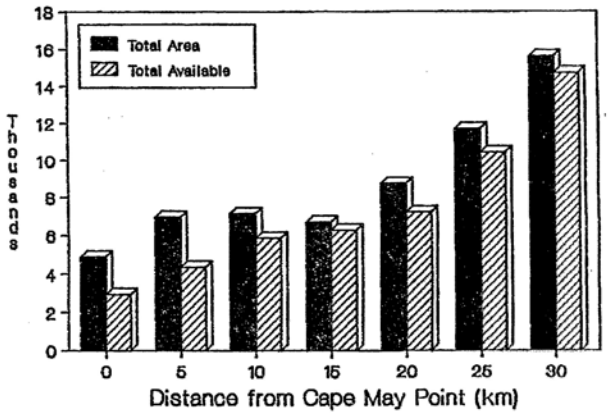

Fig. 1. Total area and available habitat on Cape May peninsula (ha) relative to distance from Cape May Point.

Human Population Growth

Not only is undeveloped habitat scarce at the Point, but remaining habitat is used heavily by people throughout the migratory period. The resident and tourist populations of Cape May are increasing steadily. Projections based on 1970 and 1980 censuses estimate the population of Cape May County to double within the next 15 years (Cape May County). Visitor use at Cape May Point State Park increases every year; the period of fastest growth coincides with the fall migratory period (P. Sutton, pers. commun.). The burden on the peninsula's wildlands is a source of concern for both public and private conservation land managers on the peninsula.

Human Disturbance

In 1978, the NJDFGW gained control of the largest area of undeveloped habitat at the point of the peninsula. The area known as Higbee Beach WMA was strategically positioned on the western edge of the Cape May Point and included 243 ha of various habitats including sweet gum (*Liquidambar styraciflua*)-maple (*Acer* spp.) and cedar (*Juniperus virginiana*), swamp, freshwater and tidal marsh, and upland forest and field typical of Cape May Point (Fig. 2).

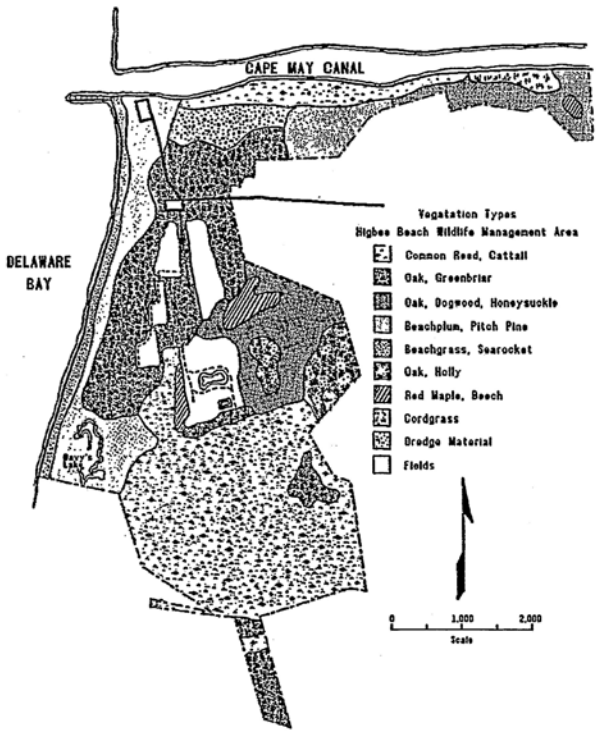

Fig. 2. Habitat types on Higbee Beach Wildlife Management Area, Cape May, New Jersey.

A management plan, developed in 1983, listed improvements for migratory bird use and recreation associated with the migration as major objectives. In 1983, the Endangered and Nongame Species Program began research on raptor use, human use, the impact of human use and a management program to improve raptor and songbird habitat.

These studies at Higbee Beach WMA demonstrated that intensive human use during migratory periods may render a prey-rich habitat unavailable to many raptor species. Clark and Niles (1986) found human use to have a significant impact on raptor use. Raptor densities in five

Table 1. Comparison of raptor use of closed and open fields, 1985.

Genus	Variable	Field Type Closed (*n*)	Open (*n*)
Accipiter	Height (ft)	42.30 (58)	45.23 (—)
	No. of indiv. (mean)	2.37	2.31
	No./ha	1.56*	0.42*
	No./perim. (ft)	0.0013*	0.0006*
Buteo	Height	35.09 (26)	52.28 (—)
	No. of indiv.	0.41**	0.23**
	No./ha	0.25*	0.02*
	No./perim.	0.0002*	0.00006*
Falco	Height	36.17 (29)	33.81 (—)
	No. of indiv.	0.41*	0.70*
	No./ha	0.25*	0.12*
	No./perim.	0.0002*	0.0002*

*Significant at $P < 0.01$
**Significant at $P < 0.05$

study fields on Higbee Beach WMA were affected by the total number of people and the number and size of groups (Table 1). This effect was significant even though people were restricted to trails.

Concentrations of Bird Hunting Raptors

In another study, Niles (1986) found that certain numbers of species' groups increased dramatically at the point of the peninsula. Surveys were conducted on transects spaced 5 km apart along the entire peninsula. Accipiters, falcons and ospreys increased significantly within 10 km of the point, whereas harriers and buteos were dispersed even-

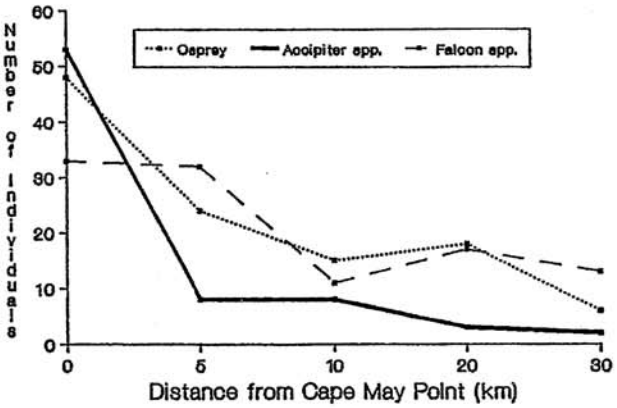

Fig. 3a. Transect counts of ospreys, accipiters and falcons along Cape May peninsula, 1984 and 1986 surveys, relative to distance from Cape May Point. (Accipiter numbers x 0.1)

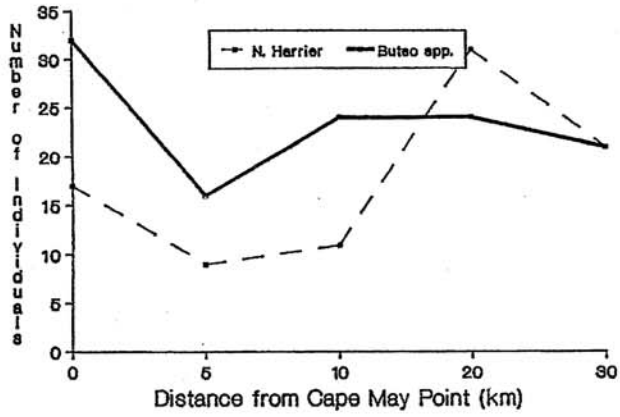

Fig. 3b. Transect counts of harriers and buteos along Cape May peninsula, 1984 and 1986 surveys, relative to distance from Cape May Point.

ly along all transects. The highest counts of accipiters, falcons and ospreys occurred at Higbee Beach (Figs. 3*a,b*).

The declining amount of available habitat and the obvious importance of Higbee Beach WMA to immature raptors provided the justification for an attempt at improving prey abundance. Through habitat and disturbance management the NJDFGW hoped to partly offset overall losses of habitat at Cape May.

TECHNIQUES

Techniques for increasing prey availability for migrant raptors fall into two categories: habitat management to increase the diversity and abundance of available foods, and managing the type and amount of human disturbance.

Habitat Management

Habitat management methods include: field maintenance, planting, and interspersion of escape and perch cover.

Field Maintenance.— If left undisturbed, fields will succeed into forested areas, so some form of periodic disturbance is necessary to maintain field vegetation. Variation of rotation or timing and intensity of the disturbance will produce different plant associations. Annual seed-producing plants are encouraged by plowing and disking yearly; perennial and annual herbaceous species benefit by plowing or disking every two to three years. Woody species develop in fields left undisturbed, but shrub and vine species (e.g., sumac [*Rhus* spp.], bayberry [*Myrica pennsylvanica*], poison ivy [*Toxicodendron radicans*], honeysuckle [*Lonicera* spp.]) are stimulated by annual mowing. Larger woody species (e.g., red maple [*A. rubrum*], black locust [*Robinia pseudoacacia*]) develop under longer mowing rotations of two to four years. In most cases if fields are not disturbed every four or five years woody species will become too large to manipulate easily.

Planting.— The planting of seed-producing annuals or pasture perennials may supplement or replace disturbance methods. Whole fields may be planted with a perennial pasture mix, and can be easily maintained by mowing every two or three years. In most cases large-scale planting is too expensive or conflicts with other objectives such as native plant management. In these cases, strategically placed plantings will attract migrant songbirds. Seed-producing annuals, such as millet and sorghum, planted along field perimeters and hedgerows provide ideal feeding conditions for seed-eating birds. Planting must take place early enough to establish seedlings before the mid-summer dry period, and late enough for plants to mature during the migration. A mixture of early- and late-maturing plant species guarantees seed availability from late summer to late fall.

Cover.— Cover must be interspersed with planted or natural foods to make them accessible to migrant birds. Cover can be created by allowing field vegetation to grow into a planned maze of hedgerows and islands within and between fields. Islands of cover enable more birds to feed throughout field interiors, and can be maintained at early vegetational stages with periodic mowing and disking. Hedgerows can be used to alter the shape or size of fields. Long narrow fields produce the highest ratio of field edge

to field area, thereby increasing the proximity of foods to cover.

Perches.— Increasing perch habitat increases prey availability to raptors in fields. Perch poles placed in field interiors, and snag development along field edges augment hunting opportunities. The ideal perch height is related to field condition, but 3 m is a convenient minimum for constructed perches. Snags can be created by girdling the cambium of live trees, although in most cases this is not an acceptable management alternative. A more desirable method is to prune branches of prominent trees overhanging field edges. Such trees can be located by observing raptors hunting the fields. Chosen branches should be nearly level, greater than 5 cm in diameter and have enough clearance for easy landing. Prevailing winds and human disturbance must be considered in choosing perch locations.

Human Use Management

Efforts to concentrate migrant birds will also concentrate people since the major portion of people come to observe birds (Clark and Niles 1986). As stated above, human activities can significantly affect raptor use of habitat regardless of prey abundance. Thus restrictions on human use must accompany management to increase abundance of migrant birds. Restrictions can be direct or passive.

Number Restrictions.— Restricting the number of people is a direct method of controlling human impacts. Limits placed on the total number of people will reduce disturbance but will require tremendous amounts of time to enforce, and may foster an adversarial relationship between managers and users. Restrictions on group size would have a similar effect, but if set high enough (e.g., five or six people/group), most users would accept the restriction.

Access Restrictions.— A preferable method for controlling human impacts is restricting access. Access can be controlled using trail restrictions, parking availability and vegetation.

Human use should be restricted to trails in areas where migrant birds concentrate. Trail systems should be balanced to provide access to the most interesting areas, such as planted fields, edges or special natural habitats, but should avoid sanctuary areas which provide total refuge from human use.

Hedgerows along main trails reduce disturbance to adjacent fields. Disturbance can also be significantly reduced by placing observation blinds on field edges. Blind entrances can be developed with a vegetation barrier at the entrance to each field. Islands of cover within fields provide small refuges for passerines, where they may still be observed. Last, the total amount and distribution of parking space provides an easy method of both restricting and distributing human use.

FEASIBILITY OF PREY MANAGEMENT

Field Management

The management of fields for migrating songbirds is clearly the most practical and beneficial method of improving conditions for migrating raptors. Managing fields for a variety of successional stages provides important habitat for many species of migrating birds and improves the diversity and abundance of resident species. Also, fields and field edges are preferred by most raptors and songbird species. Finally, the manipulation of existing agricultural fields provides a diverse mixture of habitats without impacting sensitive habitats.

Within Concentration Areas

Prey management for migrant raptors is possible along most migratory pathways but is most feasible in concentration areas, such as at water crossings or barriers. These areas provide vulnerable immatures with easily available prey species. Moreover, habitat destruction is often acute in such areas because of their attractiveness for development.

Outside Concentration Areas

Outside concentration areas, management will be more difficult, provide substantially less dramatic results, and be of far less consequence to the survival of migrant populations. Without physical features, such as water crossings and coastal leading lines, it would be difficult to concentrate passerine migrants. Providing food and cover along migratory pathways would attract birds but probably not in great enough concentrations to alter the migration schedule of passing raptors. Perhaps at a very large scale this would be possible, but the expense would be difficult to justify. Management on a limited scale for other objectives, such as improving the chance of observing migrant species, has been successful at Higbee Beach WMA.

Other Prey

Management for mammalian prey is not practical. Mammal densities are dependent on year round carrying capacity so numbers of those prey available to migrating raptors would be difficult to manage. This is particularly true in coastal habitats where marshes already carry huge numbers of rodents over large areas and very likely provide

a major source of food for species such as red-tailed hawks and northern harriers. Also, the species most likely to benefit from increased mammalian prey, such as red-tailed hawks, red-shouldered hawks, rough-legged hawks, golden and bald eagles, require less prey during migration than bird eaters (Newton 1979). These species are also the least likely to concentrate on the Cape May peninsula, perhaps because of their less urgent need for prey. These species benefit mostly from the availability of undisturbed resting and roosting locations provided through perch management and human use restrictions.

CASE STUDY: MANAGEMENT ON HIGBEE BEACH WILDLIFE MANAGEMENT AREA

Field Management

In 1983, a management plan was developed for Higbee Beach WMA with the expressed goal of managing for migratory birds while maintaining recreational uses related to migration. The focus of this management was 19 ha of fields.

The five fields vary in size from 1.5 to 8.5 ha. Prior to 1983, they were maintained only by periodic plowing. In 1983, a field management regime was established to assess various methods of increasing seed production. Each field was maintained using a different technique (e.g., plowing, disking, mowing) on differing schedules varying from one to three years (Table 2). In addition, two types of cover (hedgerows and islands of natural vegetation) were compared.

Results of a transect survey of vegetation indicated disturbed fields (i.e., those plowed and disked) yielded virtual monocultures of goldenrod (*Solidago* spp.) and camphorweed (*Heterotheca subaxillaris*), with large portions of bare ground. Results also indicated that mowed fields, left unmowed for more than two years, became nearly impossible to mow thereafter, and disking was not as effective as plowing in reducing successional stage. As a result, plowing became the preferred method, rotations were increased to every two to three years depending on the condition of the field, and woody mowed fields were mowed every one to two years.

Plantings were made next to areas of cover in four of the five fields at Higbee, starting in 1986. In May, 2.4-m wide strips were planted along field edges, hedgerows and islands with a mixture of sorghum and millet or buckwheat. This mixture yields a larger, late-maturing seed of sorghum, with earlier, smaller seed of millet or buckwheat, providing variety and availability throughout the migration season. In addition, sunflower was planted along one field edge in 1987, yielding large seed as well as a screen along a trail used heavily by people.

Table 2. Field management plan for Higbee Beach Wildlife Management Area, 1983-1988.

	Field (size in ha)				
Year	Field 1 (4.82)	Field 2 (8.56)	Field 3 (2.88)	Field 4 (1.44)	Field 5 (1.40)
1983	Mow north Plow south Leave hedgerow	Fallow	Mow all Leave islands	Disk	Plow
1984	Mow north Plow south	Fallow	Mow around islands	Disk	Plow
1985	Mow north Plow south	Fallow	Mow around islands	Disk	Plow
1986	Plant[a] edges of field, hedge Fallow	Fallow[b] Fallow	Plant edges of islands	Plant south, east edges Fallow	Plant south, east edges Fallow
1987	Plant edges of field, hedge Fallow	Fallow	Plant edge of islands Fallow	Plant south, east edges Fallow	Plant south, east edges Fallow
1988	Mow north Plant south to pasture	Mow north end	Mow, leave islands Plant south edge	Mow Plant south, east edges	Fallow Plant edge

[a]Field edges planted to sorghum-millet mix
[b]Fallow refers to no mowing, disking or plowing of field vegetation

Human Use Management

As mentioned above, it was found that human use affected raptor use of Higbee Beach. In 1985 all human use during the peak migration period was restricted to trails. By manipulating existing vegetation, hedges were added to fields along heavily traveled trails, and new trails were routed along planted areas to improve birding opportunities. Others were closed to establish refuge areas.

Effects on Raptor Use.— Our data suggest management increases raptor use, particularly by bird-hunting raptors, by improving the number and availability of prey and resting sites at Higbee. The number of raptors per ha was greater on the two managed fields when compared to the one unmanaged field (Fig. 4). A comparison of raptors observed before plantings began in 1985 and after planting began in 1986 indicates they increased an average of 256% beyond the observed change in the migration counts at the point (Fig. 5). The groups increasing the most were accipiters, falcons and ospreys. Ospreys used the field edges extensively for resting and roosting, whereas accipiters and falcons took advantage of the improved hunting opportunities.

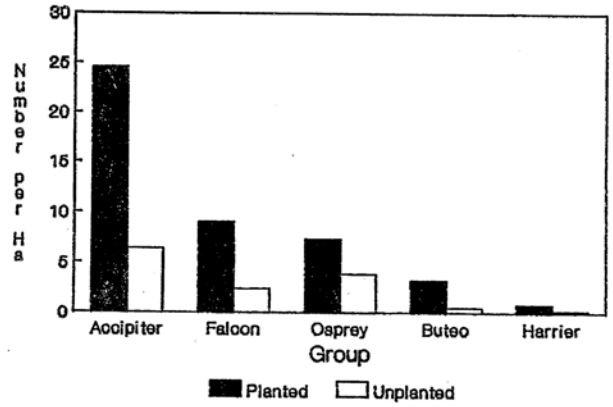

Fig. 4. Number of raptors observed in planted and unplanted fields, 1986.

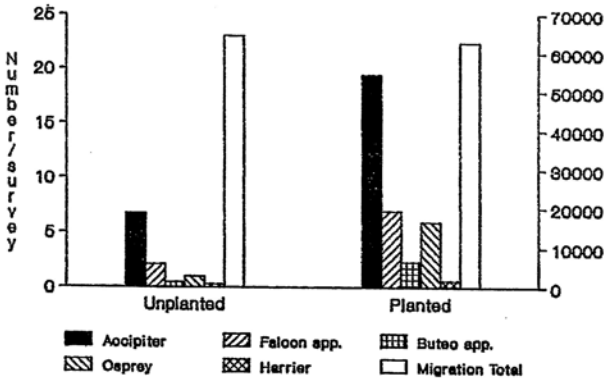

Fig. 5. Raptors observed in unplanted (1985) and planted fields (1986) on Higbee Beach Wildlife Management Area during fall migration.

The observed increase in raptor use and the significance of human-raptor interactions justifies the work at Higbee. Since the time of these studies, human use at the area has increased steadily without any negative impact on raptor use. The plan to restrict use and manipulate the fields initially met resistance by birders who disliked trail restrictions, and by protectionists who preferred no management. But overall, the groups using Higbee have accepted the restrictions and support the land management.

SUMMARY

Prey available to migrant raptors can be increased through land management and human use restrictions. Food and cover management for all migratory species provides increased hunting opportunities for migrant raptors. Using several methods of controlling field succession, and rotating fields on differing schedules, provides a diverse mixture of field and field edge habitats. The interspersion of cover and small plantings increases productivity and the availability of foods for migrating passerines that are prey for migrating raptors. Uncontrolled human use restricts the availability of prey-rich habitats to migrant raptors. Minor safeguards such as trail restrictions and maximum group sizes ameliorate the impacts of disturbance. Management is most feasible and provides the greatest benefit in concentration areas such as Cape May Point, New Jersey.

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