

Protection of Habitat
for Rare Wetland
Fauna During
Timber Harvesting
in Massachusetts
(USA)

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ABSTRACT: The practice of harvesting timber is commonly thought of as conflicting with the protection of rare species habitat. In Massachusetts, over 5 years and more than 3,300 harvesting operations, rare wetland faunal habitat was involved 5.3% of the time (175 occurrences). The Massachusetts Natural Heritage and Endangered Species Program reviewed all proposed harvesting that involved habitat for rare wetland species and determined that operations would cause "no impact" in 58.9% of the cases, "possible impact" in 40% of the cases, and "definite impact" in 1.1% of the cases. Rare fauna whose habitat was most frequently involved were wood turtle (*Clemmys insculpta*), spotted turtle (*Clemmys guttata*), and spring salamander (*Gyrinophilus porphyriticus*). The Natural Heritage and Endangered Species Program recommended mitigating measures such as timing of the harvest, buffers around water bodies, improved stream crossing techniques, and other practices. In most circumstances, these were incorporated into the forest cutting plan and were made a requirement of the operation. When they were not required, the regulating agency had determined that the recommendations did not apply to the specific circumstances on the ground. In general, habitat of rare wetland faunal species is not impacted by timber harvesting in Massachusetts, and likewise, harvesting is not seriously impacted by habitat protection. Regulation of harvesting, an atlas of rare species habitats, and good communication result in protection of habitat that is compatible with harvesting.

Index terms: Massachusetts, rare wetland fauna, timber harvesting

INTRODUCTION

The protection of rare species in a landscape dominated by thousands of small, private non-industrial ownerships is a significant challenge. This paper reports on the activities of two state agencies to coordinate their efforts in protecting rare wetland animal species during timber harvesting operations on both public and private land.

On a national scale, considerable energy and concern are devoted to the conflict between the production of timber and the protection of endangered species. The most notable example of this discord is the protection of northern spotted owl (*Strix occidentalis*) habitat and the production of timber from old-growth Douglas-fir (*Pseudotsuga menziesii* Franco) forests in the Pacific Northwest (Sample and LeMaster 1992, Franklin 1993, McComb et al. 1993). Based on the attention that this issue has received, the protection of endangered species and the production of timber are generally perceived as mutually exclusive activities. The issue is complicated by ownership patterns in much of northeastern North America, where unlike the Northwest, the forest landscape is

dominated by thousands of non-industrial private properties.

BACKGROUND

Forests and Wetlands

Massachusetts is the third most densely populated state in the nation (Brooks et al. 1993). In spite of this, approximately 60–65% of its landscape is forested (2,027,370 ha total land area; Dickson and McAfee 1988). The vast majority of the state's forest is relatively young (60–100 years old), resulting from natural succession following the abandonment of agricultural land, or significant natural disturbance caused by hurricanes (Foster 1992, Boose et al. 1994). The predominant tree species in the forests of Massachusetts are red oak (*Quercus rubra* L.), eastern white pine (*Pinus strobus* L.), eastern hemlock (*Tsuga canadensis* (L.) Carr.), black birch (*Betula lenta* L.), and red maple (*Acer rubrum* L.) (Dickson and McAfee 1988).

In Massachusetts, 85% of all forested land is owned by roughly 235,000 private individuals. The average parcel size is 4.3 ha (Birch 1989).

Although largely urban or suburban in nature, Massachusetts has a small but active forest products industry. There are over 100 small sawmills, 500 licensed timber harvesters, and approximately 200 professional foresters in the state (Mawson and Kittredge 1990, Bond and Loud 1992). Timber harvesting is conducted on a small scale in terms of mechanization. Most loggers operate in crews of two or three with one rubber-tired skidder (Kittredge et al. 1996). The predominant form of harvesting is some variation on an intermediate silvicultural treatment or selection system (i.e., individual trees are selected for harvest based on value or potential to improve the quality of the stand; Massachusetts Department of Environmental Management 1992). Non-industrial private owners place high value on aesthetics and wildlife habitat, and consequently there is very little clearcutting (MacConnell and Archey 1982, Birch 1989, Massachusetts Department of Environmental Management 1992). In 1994, for example, there were 11 clearcuts statewide, ranging in size from 0.2 ha to 7.3 ha and averaging 3.3 ha (Massachusetts Department of Environmental Management, pers. com.). In comparison, in the same year, there were 753 commercial timber harvest operations statewide that involved some level of intermediate treatment, averaging 15.8 ha in size.

The best estimates of the extent of forested wetlands in Massachusetts indicate that there are approximately 133,600 ha (Foote-Smith et al. 1991). This represents roughly 56% of the state's entire wetland resource, and 10.2% of the forest area.

The varied wetland environments support a total of 104 species of rare vertebrate and invertebrate fauna, a subset of which occupies forested wetlands (Massachusetts Natural Heritage and Endangered Species Program 1992). The Massachusetts Natural Heritage and Endangered Species Program (NHESP), a part of the Massachusetts Division of Fisheries, Wildlife, and Environmental Law Enforcement, rates these species according to their relative level of rarity, using the terms Endangered, Threatened, and Special Concern.

To protect the listed wetland faunal spe-

cies, NHESP maps their estimated habitats throughout the state. Mapped habitats are based on an actual sighting of a species and interpretation on a topographic map of the extent of the likely habitat (wetland). These maps are produced at 1:25,000 scale and are made available to conservation commissions in each town. The estimated habitat maps are also presented at 1:60,000 scale in an atlas (Massachusetts Natural Heritage and Endangered Species Program 1992), which covers the entire state. The maps and atlas are updated annually.

Regulatory Protection

The Massachusetts Wetland Protection Act (WPA; Massachusetts General Law, Chapter 131, Section 40, regulation 310 CMR 10.00, first enacted in 1972, with changes in 1983, 1987, and 1995) recognizes that the habitats of rare wetland fauna are sensitive and require special protection, and, indeed, one of the important functions of wetlands is to serve as wildlife habitat. The WPA is under the jurisdiction of the Massachusetts Department of Environmental Protection (DEP), in cooperation with local conservation commissions in every community. Regulations promulgated under this Act stipulate that prior to any proposed project in a wetland resource area, the estimated habitat maps must be consulted. If the proposed project would alter a wetland resource area or buffer zone located within the boundaries of rare wetland wildlife habitat identified on the estimated habitat maps in the atlas, NHESP must be notified. A determination is made of the degree to which possible impact may adversely affect the habitat.

Timber harvesting on both public and private forestlands is regulated in Massachusetts by the Forest Cutting Practices Act (Massachusetts General Law, Chapter 132, Section 40-46, regulation 304 CMR 11.0, amended in 1982, revised in 1995). Regulations promulgated under this Act are under the jurisdiction of the Massachusetts Department of Environmental Management (DEM). These regulations represent some of the most stringent control over timber harvesting in the United States. Prior to any harvest greater than 87m³, a proposed forest cutting plan must be filed

with DEM. In most cases, this is an area equivalent to approximately 1-2 ha. Anything smaller is generally considered to be unprofitable.

The forest cutting plan must identify the location of the area to be harvested on both a locus map and, more specifically, on a map of the ownership. The presence of any stream (intermittent or otherwise), wetland, or other water body must be located on the map, and measures must be identified in the plan that will minimize nonpoint-source pollution (Kittredge and Parker 1989). The regulations stipulate which measures must be used (e.g., what kind of methods can be used to cross a brook, how many water bars must be used on skid trails to divert overland flow). The regulations also call for filter strips along water bodies, aesthetic buffer strips along roads, stabilization of disturbed soils, and removal of slash near water bodies, boundary lines, and roads.

A DEM county service forester reviews each submitted cutting plan that is proposed for her or his district to ensure that the activity will be in compliance with the regulations. Such a review involves a site visit prior to harvesting, interim visits during the operation to ensure compliance, and a final visit to ensure compliance and adequate nonpoint-source pollution protection at the end of the operation. Although a harvester must wait 10 business days after submitting the forest cutting plan before beginning to harvest, there may be no harvesting in a wetland prior to approval. There is a memorandum of understanding between the DEM and DEP concerning wetland protection during timber harvesting, when the operation is covered by an approved forest cutting plan. Both agencies agree that DEM and the Forest Cutting Practices Act shall have jurisdiction, and that sufficient protection of wetlands is provided by the Forest Cutting Practices Act and an approved forest cutting plan.

As part of the review process for a proposed forest cutting plan, the service forester refers to the *Atlas of Estimated Habitats of State-Listed Rare Wetlands Wildlife* (Massachusetts Natural Heritage and En-

dangered Species Program 1992) and determines whether or not harvesting will occur in a habitat area. If it will, the service forester sends a copy of the forest cutting plan to NHESP for review. NHESP makes a determination of the impact that the proposed harvesting will have on the habitat (i.e., no impact, possible impact, definite impact) and suggests mitigating measures. The service forester informs the landowner, timber harvester, and any other party (e.g., consulting forester or other agent of the landowner) of the determination and suggested mitigating measures. These measures are generally incorporated into the forest cutting plan and hence made a requirement for the operation to be in compliance with the regulations. If the mitigating measures are not incorporated into the cutting plan (i.e., not made a requirement) and not heeded, and an alteration of the wetland habitat results, the operation is deemed in violation of the Wetlands Protection Act.

Massachusetts DEP, DEM, and NHESP have been cooperating on the regulatory protection of forests, wetlands, and listed species habitat for at least five years. The objectives of this study were to investigate how often timber production occurred in wetland listed species habitat and to determine the outcome of the protection process. Is the production of timber impaired by the protection of listed wetland species? Is the habitat of listed wetland species impaired by harvesting? How compatible are the two goals—protection of listed wetland species and production of timber?

METHODS

Massachusetts provides an excellent “laboratory” in which to study this issue, since timber harvesting is regulated and monitored by DEM, and NHESP maintains the *Atlas of Estimated Habitats of State-listed Rare Wetlands Wildlife*. Exact locations of all harvests greater than 87 m³ on both public and private land are available, as are the estimated habitats of listed wetland faunal species. DEM service foresters and NHESP habitat specialists interact any time a proposed harvest overlaps an estimated habitat in the Atlas.

For this study, approved forest cutting plans over a 5-year period (Massachusetts Fiscal Years 1990–94) that involved “estimated habitat” were examined. Specifically, the assessment of impact to the habitat, the species involved, and the recommended mitigating measures were recorded. Also, the fate of the recommended mitigating measures was determined for each cutting plan by contacting all service foresters and ascertaining whether or not the recommendations were incorporated into the forest cutting plan as a requirement for approval.

RESULTS

Extent of Interaction

Over a 5-year period (1990–1994), DEM reviewed and approved 3,329 forest cutting plans. This represents an aggregate

area of 54,055 ha and timber volume of 1,429,720 m³. During this time, harvesting took place in “estimated habitats” 175 times, representing 5.3% of all forest cutting plans (Table 1a).

Harvesting was deemed by a NHESP specialist to have no impact in 58.9% of the cases. A judgment of possible impact was determined for 40% of the cases, and in two instances (representing 1.1% of all cases) harvesting was deemed to cause a definite impact to rare wetlands faunal habitat (Table 1b).

Listed Wetlands Species Habitat Involved

A total of 32 different species were determined to have habitat that overlapped areas of harvesting. The species whose hab-

Table 1a. Total occurrences of listed wetland faunal species habitat overlapping with forest cutting plans (FY 1990–94).

Fiscal Year	Total No Cutting Plans	Area Covered By Plans (ha)	Volume Harvested (m ³)	Total No of Occurrences	% of All Plans
1990	610	9,759	273,603	23	3.8
1991	639	10,729	275,054	37	5.8
1992	670	10,912	298,325	47	7.0
1993	657	10,767	276,714	36	5.5
1994	753	11,888	306,024	32	4.2
TOTAL	3,329	54,055	1,429,720	175	5.3

Table 1b. Occurrences of listed wetland faunal species habitat overlapping with forest cutting plans (FY 1990–94), by impact.

Fiscal Year	Total No of Occurrences	Impact ^a		
		1 No. (%)	2 No. (%)	3 No. (%)
1990	23	15 (65.2)	8 (34.8)	0 (0)
1991	37	28 (75.7)	9 (24.3)	0 (0)
1992	47	29 (61.7)	18 (38.3)	0 (0)
1993	36	16 (44.4)	20 (55.6)	0 (0)
1994	32	15 (46.9)	15 (46.9)	2 (6.2)
TOTAL	175	103 (58.9)	70 (40.0)	2 (1.1)

^a Impact 1 = no impact, impact 2 = possible impact, impact 3 = definite impact.

itat was most frequently found to overlap was the wood turtle (Table 2). Harvesting was deemed to have no impact on wood turtle habitat in 39% of the cases and possible impact in 61% of cases. Examples of species whose habitat was considered to be possibly impacted by proposed harvesting were spotted turtle (66.7% of cases), spring salamander (52.9% of cases), and Jefferson salamander (54.5% of cases). Only two species were judged to have their habitats definitely impacted by proposed harvesting: spotted turtle on one occasion and Appalachian brook crayfish on one occasion (Table 2).

Recommended Mitigation Measures

After assessing impact, NHESP specialists recommended that a variety of mitigating measures be incorporated into forest cutting plans to assure protection of the habitat. Out of 175 cases of cutting plan overlap with listed species habitat, no mitigating measures were recommended on 95 occasions (54.3%, Table 3). This is in agreement with the fact that in almost 60% of all cases, there was judged to be no impact to habitat due to proposed harvesting.

The most frequently recommended measure was the prevention of siltation, which is a requirement of the Forest Cutting Practices Act. Another frequently recommended measure was strict adherence to the buffers required by the Forest Cutting Practices Act.

Recommended mitigation measures could be grouped into four different categories: timing of the operation, buffers along a stream, stream crossings, and other measures (Table 3). Those involving timing stressed the importance of harvesting when the ground was frozen or intermittent streams were dry. In most cases, the buffers along streams provided for by the Forest Cutting Practices Act regulations (i.e., retention of 50% of the basal area of over-story trees within 15 m of a waterbody, and no machinery to operate within the filter strip unless using an approved stream crossing) were stressed as important measures. In 12 instances no harvesting whatsoever in the 15-m filter strip was recommended. In only four instances no cutting

Table 2. Occurrence of cutting plans overlapping listed wetland faunal species habitat, by species and projected impact (impact levels as in Table 1).

Species	Listed Status ^a	Total	Occurrences (No. and % of total)			
			Impact 1	Impact 2	Impact 3	
wood turtle (<i>Clemmys insulpta</i>)	SC	41	16 (39.0)	25 (61.0)	0	(0)
spotted turtle (<i>Clemmys guttata</i>)	SC	18	5 (27.8)	12 (66.7)	1	(5.6)
spring salamander (<i>Gyrinophilus p. porphyriticus</i>)	SC	17	8 (47.1)	9 (52.9)	0	(0)
common loon (<i>Gavia immer</i>)	SC	14	13 (93.0)	1 (7.0)	0	(0)
Jefferson salamander (<i>Ambystoma jeffersonianum</i>)	SC	11	5 (45.5)	6 (54.5)	0	(0)
four-toed salamander (<i>Hemidactylium scutatum</i>)	SC	11	7 (63.6)	4 (36.4)	0	(0)
bald eagle (<i>Haliaeetus leucocephalus</i>)	E	9	8 (88.9)	1 (11.1)	0	(0)
long-nose sucker (<i>Catostomus catostomus</i>)	SC	9	5 (55.6)	4 (44.4)	0	(0)
blue-spotted salamander (<i>Ambystoma laterale</i>)	SC	7	2 (28.6)	5 (71.4)	0	(0)
marbled salamander (<i>Ambystoma opacum</i>)	T	6	2 (33.3)	4 (66.7)	0	(0)
great blue heron (<i>Ardea herodias</i>)	WL	5	4 (80.0)	1 (20.0)	0	(0)
Appalachian brook crayfish (<i>Cambarus bartonii</i>)	SC	5	2 (40.0)	2 (40.0)	1	(20.0)
Blandings turtle (<i>Emydoidea blandingii</i>)	T	5	4 (80.0)	1 (20.0)	0	(0)
intricate fairy shrimp (<i>Eubbranchipus intricatus</i>)	SC	3	2 (66.7)	1 (33.3)	0	(0)
spotted salamander (<i>Ambystoma maculatum</i>)	WL	3	1 (33.3)	2 (66.7)	0	(0)
sharp-shinned hawk (<i>Accipiter striatus</i>)	SC	3	1 (33.3)	2 (66.7)	0	(0)
swollen wedgemussel (<i>Alasmidonta varicosa</i>)	E	3	1 (33.3)	2 (66.7)	0	(0)
water shrew (<i>Sorex palustris</i>)	SC	3	0 (0)	3 (100.0)	0	(0)
American bittern (<i>Botaurus lentiginosus</i>)	SC	3	3 (100.0)	0 (0)	0	(0)
dragonfly spp.	—	2	1 (50.0)	1 (50.0)	0	(0)
red-bellied dace (<i>Phoxinus eos</i>)	E	2	2 (100.0)	0 (0)	0	(0)
ebony bog-haunter (<i>Williamsonia fletcheri</i>)	E	2	1 (50.0)	1 (50.0)	0	(0)
ringed bog-haunter (<i>Williamsonia lintneri</i>)	E	2	2 (100.0)	0 (0)	0	(0)
bog lemming (<i>Synaptomys cooperi</i>)	SC	2	0 (0)	2 (100.0)	0	(0)
lake chub (<i>Couesius plumbeus</i>)	E	2	1 (50.0)	1 (50.0)	0	(0)

table continued →

Table 2, continued

Species	Listed Status ^a	Total	Occurrences (No and % of total)					
			Impact 1		Impact 2		Impact 3	
Coopers hawk (<i>Accipiter cooperii</i>)	SC	1	1 (100.0)	0 (0)	0 (0)	0 (0)	0 (0)	
coppery emerald (<i>Somatochlora georgiana</i>)	E	1	1 (100.0)	0 (0)	0 (0)	0 (0)	0 (0)	
Persius duskywing (<i>Erynnis persius persius</i>)	T	1	1 (100.0)	0 (0)	0 (0)	0 (0)	0 (0)	
copperhead snake (<i>Agkistrodon contortrix</i>)	E	1	1 (100.0)	0 (0)	0 (0)	0 (0)	0 (0)	
bog turtle (<i>Clemmys muhlenbergii</i>)	E	1	0 (0)	1 (100.0)	0 (0)	0 (0)	0 (0)	
eastern box turtle (<i>Terrapene carolina</i>)	SC	1	0 (0)	1 (100.0)	0 (0)	0 (0)	0 (0)	
frosted elfin (<i>Incisalia irus</i>)	WL	1	1 (100.0)	0 (0)	0 (0)	0 (0)	0 (0)	

^a E = Endangered (native species that are in danger of extinction throughout all or part of their range, or which are in danger of extirpation from Massachusetts)
T = Threatened (native species that are likely to become endangered in the foreseeable future, or that are declining or rare)
SC = Special Concern (native species that have been documented to have suffered a decline that could threaten the species if allowed to continue unchecked)
WL = Watch List

in a strip wider than the regulated filter strip was recommended.

In seven cases the use of a portable or temporary bridge was recommended for crossing streams with logging equipment. In four cases, NHESP recommended either no stream crossings or that logging trails be rerouted to avoid crossings.

On 11 occasions, NHESP recommended application of guidelines designed to protect vernal pool habitats during timber harvesting (i.e., no machinery in pool depressions, avoidance of ruts deeper than 15 cm within 60 m of a pool, no tops or slash in pools, maintenance of a shaded condition within 15 m of a pool, no exposed mineral soil within 15 m of a pool). These voluntary guidelines were developed cooperatively by a team of foresters, harvesters, and wetland wildlife biologists, and served as the basis of a series of five

one-day workshops, organized in 1991 by DEM, the University of Massachusetts, and NHESP, on vernal pool protection during timber harvesting.

In only a few instances did mitigation recommendations involve specific logging equipment or the prohibition of cutting specific trees.

Incorporation of the Mitigation Recommendations

Over 5 years and 175 cases in which proposed harvesting activities overlapped with habitat of listed wetland species, mitigating measures were recommended by NHESP on 80 occasions (45.7% of all cases). In 46 cases (57.5% of the total), DEM service foresters required that the recommendations be included in the forest cutting plan, making them necessary actions to be in compliance with the For-

est Cutting Practices Act (Table 4). In 31 cases (38.7%), recommended mitigating measures were deemed by the service forester to be not applicable, since these actions were already part of the proposed cutting plan. This discrepancy in interpretation between NHESP habitat specialists and DEM service foresters most often resulted from the fact that NHESP staff did not make field visits when they reviewed cutting plans. Their assessment was based solely on their office-interpretation of the plans. In some cases, for example, an NHESP recommendation would be to not harvest any timber within 15 m of a stream. In reality, there had been no timber proposed for harvest within this buffer, but that was not easily discernible from the cutting plan. In only three cases (3.8%) were recommended mitigating measures not required by service foresters as part of an approved cutting plan.

DISCUSSION

Impact of Timber Harvesting

Over a 5-year period and more than 3,300 timber harvesting operations in Massachusetts involving over 54,000 ha, the wetland habitat of listed faunal species was minimally impacted. Only 5% of all timber harvesting operations involved an identified habitat, and after these cases were assessed by a NHESP habitat specialist, no impact to habitat was projected in 59% of all cases. NHESP evaluation indicated possible impact in 40% of the cases and definite impact in only 1% of all cases (i.e., two operations in 5 years).

Species Involved

The listed wetland faunal species in Massachusetts whose habitats are most often impacted to some extent by timber harvesting are the wood turtle, spotted turtle, spring salamander, and Jefferson salamander (see Table 2 for nomenclature). The only two species whose habitat was judged to be definitely impacted were spotted turtle and Appalachian brook crayfish (one occasion each). All are considered species of Special Concern. In general, species whose habitat overlapped areas to be harvested are species that depend on

either cool, clear streams and small rivers or vernal pools for certain aspects of their life history (DeGraaf and Rudis 1986).

Mitigation

For the listed wetland fauna possibly impacted by timber harvesting, it is most important to prevent siltation and protect the local environment near streams, their banks, and vernal pools. Most recommended mitigating measures were in basic accordance with the protections afforded under the Forest Cutting Practices Act (e.g., prevention of siltation and use of stream filter strips as defined by this Act).

In some instances mitigating measures were called for that exceeded the standard requirements of the Forest Cutting Practices Act (e.g., a 15- or 30-m no-cut buffer). Put in perspective, compared to the total number of operations within "estimated habitat" of rare wetland species (175) and the total number of times that mitigating measures were recommended (80 times), the effect of rare species wetland habitat protection on timber harvesting is overall relatively minimal. This may not be the case at the level of the individual private property, however. A no-harvest buffer of 45 m, for example, for a distance of 0.4 km (on both sides of a stream) results in an area of roughly 3.6 ha. If the property owner foregoes harvesting in this area for the sake of habitat protection, income of perhaps \$5,400 is sacrificed (i.e., assuming a harvestable volume of 35 m³/ha and a value to the owner of \$43/m³). In cases such as this, individual private property owners are being asked to make sacrifices in order to protect wetland faunal habitat of rare species. At the state level, the number of times such sacrifices are called for are few in number. In general, it can be concluded that timber harvesting in Massachusetts, as it is most commonly practiced, does not represent a threat to wetland faunal habitat of listed species. Nor does rare wetland species habitat protection represent a threat to timber harvesting.

Table 3. Recommended mitigating measures by impact, sorted by activity.

Mitigating Measure	Impact			Total
	1	2	3	
none recommended	89	6	0	95
TIMING				
work performed when ground frozen	1	3	0	4
cross stream when dry	0	3	0	3
no work in summer	0	1	0	1
harvest preferably during fall or winter	0	1	0	1
do not begin work until 7/15 or later, when young eagles have left nest	0	1	0	1
do not cut between 5/15 and 7/15, during eagle nesting period	0	1	0	1
work performed when ground is dry	0	1	0	1
BUFFER STRIP ALONG STREAM				
buffers required by Ch. 132 should be adequate	7	13	0	20
15-m no-cut buffer	0	12	0	12
little or no cutting within 15 m of stream	0	5	0	5
selective rather than regeneration cutting between 5 and 90 m of the stream (i.e., no big openings)	0	5	0	5
30-m no-cut buffer	0	3	0	3
45-m no-cut buffer	1	0	0	1
no-cut buffer between 15 and 30 m of shoreline	0	1	0	1
limited harvest buffer between 15 and 30 m of stream	0	1	0	1
STREAM CROSSING				
use a portable or temporary bridge for a stream crossing	0	6	1	7
no stream crossings	1	1	0	2
re-route skid roads to avoid crossings	0	0	2	2
OTHER MEASURES				
prevent siltation	2	24	0	26
vernal pool guidelines ^a	1	10	0	11
screen area for wood turtle before work	0	2	0	2
limited wetland activity	0	1	0	1
avoid logging in vicinity of a specified wetland	1	1	0	2
do not log certain trees	0	0	1	1
use a forwarder and not a skidder	0	1	0	1
smooth ruts	0	1	0	1
remove no more than one-third of vegetation on steep slopes	0	1	0	1

^a vernal pool guidelines consist of the following: No machinery in vernal pools, no landings or skid roads in vernal pools, avoid ruts deeper than 15 cm within 60 m of a vernal pool, no tops or slash in vernal pools, maintain shaded condition within 15 m of vernal pools, no exposed mineral soil within 15 m of a vernal pool.

Table 4. Effect of NHESP review of forest cutting plans on the ultimate approved plans.

	Number of Plans	% of Total
Included	46	57.5
Not included	3	3.8
Recommendations not applicable	31	38.7
TOTAL	80	100.0

In fact, in a secondary way, harvesting can actually provide some level of protection. By providing a means of generating income, harvesting enables non-industrial private landowners to offset ownership expenses of property taxes. In so doing, an owner is perhaps less likely to sell or develop the property.

The Massachusetts Natural Heritage and Endangered Species Program habitat specialists are sensitive to owners' interests in harvesting timber and to the needs of timber harvesters to make their operations profitable. NHESP's review of forest cutting plans has not proven to be overly onerous, in that frequently no mitigating measures are recommended (and there is no assessed impact to the habitat). Also, 57.5 % of the time, the recommended mitigating measures are indeed incorporated into the forest cutting plans by the DEM service forester. Habitat is successfully protected and harvesting is successfully implemented.

A Regulatory Model

This balance of wetland habitat protection and implementation of profitable harvesting of forest products depends on several important factors:

- an atlas of "estimated habitats" of state-listed rare wetlands fauna
- a statewide Forest Cutting Practices Act and regulations overseen on the ground by professional foresters, who have ready access to the habitat information in the atlas, and who review all timber operations greater than a threshold level of activity
- NHESP habitat specialists who review individual proposed forest cutting plans

in a timely manner and recommend mitigating measures that are compatible with the goals of protecting habitat and operating a timber sale

- good communication/cooperation between NHESP and DEM personnel, to ensure clear interpretation and implementation of the recommended measures
- good communication and understanding among DEM service foresters and the timber harvesters, professional foresters, and the forest landowners who own, manage, or harvest the timber in these estimated habitats

Such a model of agency/private sector interaction and cooperation, habitat assessment, and oversight of harvesting operations should be considered by other states that wish to protect habitats of rare species. This approach would be particularly well suited to states where forested landscapes are dominated by private (and especially non-industrial) ownerships. It is presumably the charge of most public land management agencies to protect the habitat of rare species.

It is difficult to estimate the specific cost of this model to Massachusetts taxpayers, agencies, forest landowners, loggers, and foresters. Rather than dwell on dollar values, it is worthwhile to consider priorities or alternatives. Many other states, for example, have county forester programs conducted by their state forestry agencies. These county foresters traditionally have been providers of technical assistance to non-industrial private forest landowners. This responsibility stemmed originally from a lack of such private-sector professional expertise. In many states, however,

there is a well-developed contingent of private professional foresters prepared to offer technical assistance. Perhaps it is appropriate in these states to revisit the responsibilities of county foresters, and to consider some form of harvesting regulation and habitat protection. This may be highly applicable in light of public interest in water quality and rare species. Such a realignment of county forester responsibilities would not necessarily cost a state more in program dollars and may be more in tune with an agency mandate and public opinion.

Although this model has worked to date only with estimated habitats of listed rare wetlands fauna, an expansion of coverage is currently being considered in Massachusetts, to include delineated habitat areas of all state-listed rare flora and fauna and uncommon or exemplary natural communities (e.g., rich mesic forests, floodplain forests, New England pitch pine, scrub oak forests). An atlas identifying these elements already exists, and a memorandum of understanding should be written to formalize the relationship between the two agencies (NHESP and DEM) on this expanded issue.

Results of this analysis lead to the conclusion that timber harvesting and protection of rare wetlands faunal habitat are most often compatible in Massachusetts and only rarely result in restrictions to operation. Most of the time, these restrictions are incorporated into the forest cutting plan that is used as the basis for regulation of the operation.

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