

Appendix H – Management Indicator Species

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Appendix H – Management Indicator Species

Direction for Management Indicator Species

The National Forest Management Act (NFMA) 1982 planning regulations mandate the use of Management Indicator Species (MIS) in Forest Plans as a means of monitoring the effect management activities are having on species viability. The use of the 1982 planning regulations is permitted by 36 CFR 219.14(e) and (f) of the 2005 Forest Planning Rule.

Planning regulations state that:

Each alternative shall establish objectives for the maintenance and improvement of habitat for management indicator species selected to the degree consistent with overall multiple use objectives of the alternative. To meet this goal, management planning for the fish and wildlife resource shall meet the requirements. The following are the most directly tied to MIS:

1. To estimate the effects of planning on fish and wildlife populations, certain vertebrate and/or invertebrate species shall be selected as MIS. These species are to be selected because their population changes are believed to indicate the effects of management.
2. Planning alternatives must be evaluated in terms of both amount and quality of habitat and of animal population trends of MIS.
3. Biologists from state fish and wildlife agencies and other federal agencies shall be consulted in order to coordinate planning for fish and wildlife, including opportunities for the reintroduction of extirpated species.
4. Population trends of the MIS will be monitored and relationships to habitat changes determined.

Both native and desired non-native plants were added to the viability requirement in a 1983 Department of Agriculture regulation (9500-4), meaning they could be considered as MIS. Forest Service Manual amendment (2600-91-5) added communities and habitats as acceptable indicators (termed management indicators [MI] or ecological indicators [EI]) beyond the MIS system.

NFMA regulations suggest several categories of species that can be selected as MIS, but they do not specify that all must be represented. The categories include:

- Endangered and threatened plant and animal species on state and federal lists;
- Species commonly hunted, fished, or trapped;
- Non-game species of special interest;
- Species with special habitat needs that may be influenced significantly by planned management programs;

- Additional plant or animal species selected because their population changes are believed to indicate the effects of management activities on other species of selected major biological communities or on water quality.

There are scientific criticisms of the use of MIS (Neimi et al. 1997). There are a number of specific criticisms, but they boil down to the fact that animals and plants often do not respond to their environment in a simple manner, and the relationship between management activities and population changes is not necessarily a direct one. Another criticism is that the regulations mix monitoring the indicators with managing to improve the habitat of the species being monitored.

Under the 1986 Forest Plan, the Ottawa National Forest (the Ottawa) had 13 MIS species (northern goshawk, bald eagle, osprey, barred owl, American bittern, blackburnian warbler, common loon, ruffed grouse, white-tailed deer, black bear, brook trout, northern pike, and smallmouth bass). There were concerns with the feasibility of monitoring some of these species, and the utility of the data. For example, osprey occurs too rarely on the Ottawa to provide useful data. The annual monitoring and evaluation reports completed provide information on past MIS data collected and interpretations (e.g., USDA Forest Service 2003g).

Direction from the Forest Service Eastern Region for Forest Plan revision was to limit the number of MIS to a few that can reasonably and effectively be monitored, given the concerns noted above with the MIS concept, expected funding levels, and availability of credible protocols. Note that MIS represent one type of monitoring tool with specific requirements for habitat provision and monitoring. However, other species, habitats, and National Forest features can and will be monitored on the Forest as part of the final Forest Plan's (herein referred to as 2006 Forest Plan) monitoring and as part of other programs (i.e., Endangered Species Act). See Chapter 4 of the 2006 Forest Plan for more information.

Selection Process and Criteria

A total of 52 species (Table H-1), including MIS from the 1986 Forest Plan, game species, non-game species, plants, aquatic species, and invasive species were evaluated for their potential to be MIS. Species were chosen for consideration based on the ability of their population trends to reflect management impacts and to represent the trends of other species in similar habitats. Species were also chosen based on recommendations from the Michigan Department of Natural Resources (Michigan DNR), tribal governments and public comments.

Species were not chosen for evaluation based on their rarity (although some rare species were suggested in comments and therefore were screened). Rare species generally make poor MIS for a number of reasons. First, they usually have small, scattered, populations making them difficult to monitor (Niemi et al. 1997). Second, many species are naturally uncommon or rare, and for them, low numbers, or restricted range, do not point to management related problems. Third, changes in the populations of rare species can be difficult to interpret because small populations are more vulnerable to random events, such as weather. This becomes a confounding factor when trying to determine if changes are due to local management activities or to natural causes or causes in other parts of their range (e.g. loss of winter habitat for neo-tropical migratory birds). Therefore, when possible, more common species are preferred for evaluation over rare species. For example, the fatmucket mussel, which is relatively common on the Ottawa, was

chosen over the creek heelsplitter which is rare. (Note that rare species may still be monitored, just not as MIS; see Chapter 4 of the 2006 Forest Plan.)

Table H-1. Species Evaluated in the MIS Selection Process and Ranking Score¹

Mammals/Reptiles/ Amphibians	Birds	Aquatics	Plants
American marten (27)	American bittern (16)	Brook trout (33)	Bloodroot (36)
Black bear (38)	Bald eagle (33)	Brown trout (31)	Blueberry (25)
Snowshoe hare (35)	Barred owl (29)	Caddisflies (30)	Blue cohosh (36)
Gray wolf (35)	Blackburnian warbler (22)	Fatmucket mussel (27)	Braun's holly fern (36)
Green/mink frog (31)	Chestnut-sided warbler (31)	Native crayfish (33)	Canada yew (23)
Red-backed salamander (27)	Chimney swift (24)	Northern pike (28)	Eastern hemlock (40)
White-tailed deer (41)	Common loon (35)	Sculpin (26)	Ginseng (30)
Wood turtle (31)	Gray jay (25)	Smallmouth bass (33)	Male fern (30)
	Northern goshawk (24)	Stoneflies (EPT ²) (40)	Melic grass (34)
	Osprey (26)		Northern holly fern (26)
	Pileated woodpecker (27)		Princess pine (25)
	Raven (21)		Purple loosestrife (44)
	Red-shouldered hawk (24)		Spotted knapweed (45)
	Ruffed grouse (42)		Spring beauty (36)
	Woodcock (36)		Cutleaf toothwort (36)
			Trillium (35)
			Trout lily (33)
			White birch (35)
			White cedar (40)
			White pine (42)
			Wild rice (34)

¹Ranking score in parentheses is the sum of scores for all evaluation criteria and stressors for that species.

²EPT is the acronym used for the Ephemeroptera-Plecoptera-Trichoptera monitoring index.

Twenty-three criteria were used to evaluate each species. The criteria were developed and given numeric scores based on the professional judgment of the Ottawa's wildlife, fisheries, botany, and aquatics personnel. The scores were totaled for each species, stressor scores added (see the Evaluation Criteria) and generally, species with higher scores were chosen for recommendation as the new management indicator species. Several species scored higher than some that were chosen, such as eastern hemlock, white cedar, white-tailed deer, purple loosestrife, and spotted knapweed, but because they would be monitored for other reasons, they were not included as MIS. Hemlock and white cedar would be monitored as part of silvicultural monitoring, and have had management direction added to the 2006 Forest Plan designed to increase their abundance on

the Ottawa. White-tailed deer would be monitored by the State of Michigan. Spotted knapweed and purple loosestrife would be monitored as part of the non-native invasive species program. The species scores for each criterion are included in the project record. Rationale for selection or non-selection by taxon screened is shown at the end of this appendix.

The Ottawa currently lists four federal threatened or endangered species. Both the bald eagle and gray wolf were evaluated for their suitability as MIS, but since they would be monitored, and protected under the Endangered Species Act, they were not included as MIS. In the case of Kirtland's warbler and Canada lynx, it was impossible to consider them for MIS because they have no known populations on the Ottawa at this time.

It must be emphasized that other species and habitats would be monitored, but not as MIS (see 2006 Forest Plan Chapter 4). These include threatened and endangered, Regional Forester's Sensitive Species, some game species, and other species of interest. This monitoring could include routine pre-project surveys (i.e., raptor surveys or mammal tracking); taxon-specific efforts (i.e., Breeding Bird Census, amphibian surveys, dragonfly surveys, or *Botrychium* surveys); surveys outside project areas (i.e., plant surveys focusing on wetlands or rock outcrops); threatened and endangered species recovery plan monitoring; fisheries surveys; Michigan DNR surveys and more.

Evaluation criteria

The following section describes the 23 criterion used to evaluate each species and the score attached to each criteria.

Resident: Whether species is found year round within the Ottawa. Scale: 1=resident, 0=non resident migratory. This criterion looks at whether trends in population might be confounded by actions off-Forest, in the wintering or summering part of a species' range. For example, some neotropical migratory birds are experiencing population declines due to habitat loss in Central and South America. These species are less useful for monitoring management effects on the Ottawa.

Easy to monitor/sample/access: Is it easy for the Ottawa to do the monitoring? This criterion is an estimate of how easy a species would be to monitor. It is broken into two categories, ease of monitoring estimated populations and ease of monitoring population trends. Scale: 1=very difficult, 2=difficult, 3=moderate, 4=easy, 5=very easy. This criterion looks at feasibility of monitoring. Funding for monitoring is limited, and if a hard-to-monitor species is selected, there is less funding for monitoring other species. Also, if a species is difficult to monitor, the monitoring protocol may be difficult to apply.

Does the Ottawa have population data: Self explanatory. Scale: 0=no data, 1=some data, and 5=good data set. This criterion looks at past investment in data collection. If there is existing data, it may be feasible to observe trends sooner than if there are no existing data for comparison. Also, population cycling that occurs regardless of management activities (such as documented ruffed grouse population cycles) may be visible in an existing data set, facilitating future data review and interpretation.

Data available from sources other than the Ottawa: If the Ottawa does not have the data, is it available somewhere else, such as from State of Michigan, at a reasonable price. Scale: 0=no data, 3=data available. The purpose of this criterion is similar to the previous criterion based on the Ottawa's data.

Sensitive to stresses: These are stresses beyond the control of the Ottawa (e.g. weather, disease, altered habitats or loss of habitats in other locations in the case of migratory species, intra- and interspecies competition, population cycles and others). Scale: 5=low sensitivity, 3=medium sensitivity, 1=high sensitivity. The scale is oriented in this direction because species sensitive to stresses outside Forest Service control would show effects or reactions that would be difficult to distinguish from effects of Forest Service's actions.

Represents specific habitats/ecosystems: Is this species a habitat generalist or specialist on the Ottawa? For this purpose a habitat specialist is found in three or fewer, primarily non-marginal habitats (and is often found in only one habitat), and a habitat generalist is found in more than three primarily non-marginal habitats. Scale: 0=generalist, 1=intermediate and 2=specialist. The scale is oriented in this direction because a habitat specialist is likely to indicate more about effects of management actions than a generalist. Also, it may be difficult to determine where the management effects occur if a species uses many habitats.

Sensitive to Ottawa management actions: These management actions include vegetation management, habitat improvement projects, roads, recreation, and others. The species' response to these actions can be positive or negative. Scale: 1=low sensitivity, 3=medium sensitivity, and 5=high sensitivity. The scale is oriented in this direction since species highly sensitive to management actions (either positive or negative response) would be more effective indicators of Forest Service management effects.

Represents other species: The species is a good surrogate for other species in similar habitats. Scale: 1=represents other species, 0=does not represent other species. Since monitoring time and funding are limited, a species that can "stand for" other species is a more useful indicator than one which does not.

Well-known biology: How much is known about the species. Scale: 0=no information on species biology, 1=some knowledge, 2=well known generally, 3=well known generally and well known on the Ottawa. If little is known about a species, it can be difficult to interpret population trends or determine habitat needs. It would also be difficult to assess management effects if species needs are poorly understood.

Particular trophic level: Representation of higher trophic levels can imply that structure, function and composition of lower trophic levels are maintained. Herbivore=1, omnivore/autotroph=0, carnivore=1, top carnivore=2. A top carnivore is one not preyed upon by other carnivores.

Long persistence time: "k" or "r" selected. "k" selected generally means a species has a long life span and low reproductive rate (e.g. black bear), and "r" selected species generally means a short life span, but high reproductive rate (e.g. snowshoe hare). Scale: k=0 and r=3. This factor

is important to MIS selection in that species with “r” selected reproductive strategies are more likely to show responses to effects in a shorter period of time than “k” selected species with long life spans.

Indicator type: Umbrella (u), flagship (f), keystone (k). Definitions: umbrella species are used to specify the size and type of habitat to be protected rather than its location (i.e. provide enough habitat for a wolf, and coincidentally provide habitat for many other species that co-exist with wolves). Flagship species are used to attract and educate visitors on ecological and conservation issues (i.e., bald eagles, gray wolves). Keystone species are species that have impacts on habitats or other species far beyond their abundance (for example, beavers, which can create new habitats or deer which, in large numbers, can greatly affect habitat composition). Score: f=1, u=2, k=1. Umbrella species may be more useful indicators because they are surrogates for other species. An indicator that is all three types may also be more useful as an MIS.

Does the trend info help us to manage better: How well does trend information for a species assist in management decisions? Or how well does trend information affect management decisions? Scale: 0=poor, 2=moderate, 5=well. If trend information cannot be translated into management recommendations, the information is of little value and the species would not be as useful an indicator.

Is species a TES: (i.e., federally listed/Regional Forester’s Sensitive Species). Scale: 0=no 1=yes. These species are of strong viability concern and monitoring their populations is important (although likely to occur outside the MIS program anyway).

Definitions of Stressors

Stressors were not ranked. Species were awarded one point for each stressor that affects them, and this was added to their score from the criteria described above. The more stressors (e.g., management-related items) affecting a species, the more information we may be able to extract from monitoring a species.

Timber harvest: This includes harvest types, extent of treatment (acres), frequency of harvest entry, season on harvest (i.e. summer, winter only).

Road construction, reconstruction, and maintenance: Includes road/stream crossings, culvert installation, etc.

Spread of non-native invasive species: Spread of invasives impacts the native species by reducing habitat quality and quantity, competition with natives for food and cover, and in other ways.

Water quality and riparian function: Changes in water chemistry, temperature, sedimentation/siltation, rates of flow, timing of flows, and riparian vegetation condition.

OHV/snowmobile use: Miles of trails, amount of use (total numbers), frequency of use (i.e. daily, weekly), season of use, noise, facilitating spread of invasives/competitors/predators, and barriers to passage.

Hunting/fishing (Ottawa provides access): Hunter walking trails, boat landings, could be either new access developments or closure of roads and trails to certain types of use, or seasonal restrictions.

Hazardous fuels reduction/burning: Could have positive and negative effects, could improve seed bed conditions, recycle some nutrients, reduce litter layer, volatilize nitrogen, increase forage quality, and reduce ground cover.

Forest pest outbreak (insect and fungal): Self-explanatory.

MIS Species Chosen

In accordance with the regulations outlined and the screening process, four MIS species were recommended to be chosen as they represent key habitat types that experience the majority of management activity on the Ottawa. These are the conifer habitat types, early seral habitat (such as aspen), cold water streams, and northern hardwood habitat types. Other habitats, such as wetlands, comprise a substantial portion of the Ottawa, but they receive little, if any, management, and therefore require less intensive monitoring. The same holds true for more restricted, or uncommon, habitats such as rock outcrops. The four MIS selected are described briefly below. More information is found in the MIS section of the FEIS (see Chapter 3, Wildlife).

The American marten (*Martes americana*) is recommended for selection to represent conifer habitats and coarse woody debris (both standing snags and large down wood). It also represents trends in furbearer populations and trapping use. Monitoring martens also gives some information on status of small mammal populations (such as squirrel, chipmunk, snowshoe hare, vole, and mouse species), which are common prey items for martens, and on prey availability for larger animals which eat marten (such as great-horned owl, bald eagle, black bear, fisher, fox, and bobcat).

The ruffed grouse (*Bonasa umbellus*) is recommended for selection to represent early successional forested communities (e.g., aspen, paper birch) which provide habitat for a number of species. Availability of early seral habitats is a concern in the Upper Peninsula, since amounts have declined, and continue to decline on private lands. The grouse also represents a commonly hunted species, and prey availability for predators (such as northern goshawk, coyote, fox, fisher and bobcat). Ruffed grouse has been a MIS since the 1986 Forest Plan, so data is readily available. While ruffed grouse populations are known to cycle from high years to low years, this cycle is well-documented, which means the cyclic effects can be “subtracted” from trends when assessing impacts from management activities. Ruffed grouse trend information may also be useful in assessing habitat availability for American woodcock, which is a priority species for Partners in Flight and the North American Bird Conservation Initiative and a focus species for the USDI Fish and Wildlife Service.

The Mayfly – Stonefly – Caddisfly index is recommended for selection to represent cold-water streams. This is commonly called the EPT index, standing for the scientific names of the three genera of insects: Ephemeroptera-Plecoptera-Trichoptera. EPT (herein referred to as the mayfly–stonefly–caddisfly index) is commonly used across the US and in other countries to assess water quality, where water samples are screened for the numbers of insects in each of these three genera. Because the insects only need identification by family, the process is more easily accomplished. The index also represents other aquatic insects, freshwater mussels and trout, riparian corridor and dam management, and angler pressure. Proposed changes in road miles available to OHVs may result in additional road-stream crossings and culverts; effects of these crossings on stream quality may be reflected in the EPT monitoring index. The index may also reflect pressures from aquatic invasive species such as rusty crayfish, which are of increasing concern in the Upper Peninsula.

Cutleaf toothwort (*Dentaria laciniata*) is recommended for selection as an indicator species for management in northern hardwoods. Several researchers (for example, Verheyen et al. 2003; Miller et al. 2002; McLachlan and Bazely 2001, and others cited within those three papers) appear to agree that the plants with short flowering times, large seeds, and unassisted dispersal have the lowest ability to recolonize a forest following disturbance. Therefore, a representative of this group—the spring ephemerals—can act as a surrogate for others to assess potential effects of management activities in hardwoods. Other spring ephemerals could have been selected. Reasons for recommendation of the cutleaf toothwort are:

- It is a true spring ephemeral vs. a longer cycle plant such as trillium (*Trillium grandiflorum*, *T. cernuum*) or rosy bells (*Streptopus roseus*).
- It has short seed dispersal distances: seeds are explosively released from the pod (Miller et al. 2002). Generally, this equates to poor colonization ability as compared to hardwoods short-season species with dispersal assisted by animals (Verheyen et al. 2003), such as jack-in-the-pulpit (*Arisaema triphyllum*), Solomon's seal (*Polygonatum pubescens*), or rosy bells (*Streptopus roseus*).
- Toothworts are hosts for the Regional Forester's Sensitive West Virginia white butterfly (*Pieris virginianensis*), so ensuring toothwort abundance will help this butterfly.
- Of the two common toothworts on the Ottawa, cutleaf and two-leaved toothwort (*D. diphylla*), cutleaf is slightly more hardwood-habitat specific and more upland-specific, and upland hardwoods are the target habitat for this MIS.
- Toothwort is not particularly sensitive to deer herbivory, so deer effects should not confound data trends.

Management Objectives

The following goals and objectives in the 2006 Forest Plan address the maintenance of habitat for MIS: Goal 1 and Objectives 1b-1e; Goal 2 and Objectives 2a-2d, 2f; Goal 3 and Objectives 3a, Goal 20 and Objective 20e; Goal 23, Goal 27 and Objective 27a; Goal 31 and Objective 31a; Objective 32a and Goal 34 (see Chapter 2 of the 2006 Forest Plan). A number of standards and guidelines also address the maintenance of habitat for American marten, cutleaf toothwort, and ruffed grouse (Chapter 2 and in some cases, Chapter 3 of the 2006 Forest Plan). The habitat maintenance for

mayfly-stonefly-caddisfly is covered by aquatic and riparian standards and guidelines (Chapter 2 of the 2006 Forest Plan).

Rationale for Selection or Non-selection by Taxon

The following species were screened and are listed in their score order, highest to lowest. In addition to scoring, reasons for selecting or not selecting each species for recommendation as MIS is provided. The recommended MIS are shown in boldface type.

Spotted knapweed (score 45). Non-native invasive species had the highest rank in the Ottawa MIS list selection process. Spotted knapweed was not selected for recommendation as a MIS for the following reasons: Non-native invasives will be monitored under the Invasive Species Program, with standards and guidelines established in another part of the 2006 Forest Plan. Also, using this species as MIS would require a “negative” habitat objective, which does not meet the intent of the MIS direction.

Purple loosestrife (score 44). Same reasons as knapweed for non-selection.

Ruffed grouse (score 42). The ruffed grouse was a management indicator species for the 1986 Forest Plan. As stated, this species is recommended for selection as a MIS for the Ottawa. The ruffed grouse is tied to the aspen forest habitat type. Changes in the amount and distribution of aspen affect grouse populations. The amounts and spatial arrangements of the age class structure within the aspen forest type also affects grouse populations. Aspen is part of the vegetation revision topic.

White pine (score 42). This species was not selected for recommendation as a MIS for the following reasons: the amount and distribution of white pine, age class structure, and recruitment is tracked through the Forest silvicultural exam program; and the data is entered in the CDS database. Management direction is included in the 2006 Forest Plan to maintain this species on the Forest.

White-tailed deer (score 41). The white-tailed deer was a management indicator species for the 1986 Forest Plan. This species was not selected for recommendation as a MIS for the following reasons: The white-tailed deer is considered a habitat generalist, and because this species is successful in many habitats it is difficult to separate effects of management actions in a specific habitat to population trends at a project specific level. Many factors influence deer populations beside habitat effects (i.e. changes in winter severity, length of winter seasons, snow depth, early spring vs. late spring, hunting, harvesting activity on other ownerships with accompanying changes in habitat). White-tailed deer populations are extensively monitored by the Michigan DNR.

Eastern hemlock (score 40). Same reasons as white pine for non-selection.

Northern white cedar (score 40). Same reasons as white pine for non-selection.

Ephemeroptera-Plecoptera-Trichoptera (EPT) = Mayfly-stonefly-caddisfly index (score 40). This group of insect orders is recommended as a MIS for cold water stream/river habitats. Changes in either the number of mayfly-stonefly-caddisfly taxa or the percent of the taxa relative to all other insect taxa in the stream can be used to measure effects of management actions (such as in-stream fisheries habitat improvement projects; riparian vegetation management; road construction, reconstruction, maintenance and culvert/bridge installation; as these actions may contribute to stream sedimentation).

Black bear (score 38). This species was not selected for recommendation as a MIS for the following reasons: The black bear is considered a habitat generalist with a moderately large sized home range. Because this species is successful in utilizing many habitats it is difficult to assign effects of management actions in a specific habitat to population trends at a project specific level. Many factors influence black bear populations beside habitat effects (i.e., changes in winter severity as in the length of winter seasons or early spring vs. late spring, as these factors influence food supply, growth rates, and litter size and survival, hunting mortality; and timber harvesting activity on other ownerships with accompanying changes in habitat). Black bear populations are extensively monitored by the Michigan DNR.

Braun's holly fern (score 36). This species was not selected for recommendation as a MIS for the following reasons: On the Ottawa, this fern mainly occurs near shaded streams and rocky areas in colder microsites. These fern habitats are commonly protected under management direction in the 2006 Forest Plan (e.g. riparian buffer zones), and few management actions occur in these areas. A MIS that represents habitats with more management actions is more desirable.

Blood root (score 36). This species was not selected for recommendation as a MIS for the following reasons: Although it would serve well for many of the same reasons as cutleaf toothwort, it did not possess quite as many compelling factors as toothwort, and only one spring ephemeral was needed for the suite of MIS.

Cut leaf toothwort (score 36). This species is recommended for selection as a MIS for management in northern hardwoods. Reasons for selecting cutleaf toothwort are: It is a true spring ephemeral. It has short seed dispersal distances. It is a host for the Regional Forester's Sensitive West Virginia white butterfly (*Pieris virginiensis*). Of the two common toothworts on the Ottawa, cutleaf and two-leaved toothwort (*D. diphylla*), cutleaf is slightly more hardwood-habitat specific and more upland-specific, and upland hardwoods are the target habitat for this MIS. Toothwort is not particularly sensitive to deer herbivory, so deer effects should not confound data trends.

Spring beauty (score 36). This species was not selected for recommendation as a MIS for the following reasons: Although it would serve well for many of the same reasons as cutleaf toothwort, it did not possess quite as many compelling factors as toothwort, and only one spring ephemeral was needed for the suite of MIS.

Blue cohosh (score 36). This species was not selected for recommendation as a MIS for the following reasons: Although it would serve well for many of the same reasons as cutleaf

toothwort, it did not possess quite as many compelling factors as toothwort, such as not being a true spring ephemeral. Only one plant of this type was needed for the suite of MIS.

American woodcock (score 36). This species was not selected for recommendation as a MIS for the following reasons: Some of the habitats used by the woodcock are covered by selection of the ruffed grouse. Management actions affecting grouse habitat (i.e., aspen) would also affect the woodcock in the same way. Some of the habitats used by the woodcock (i.e., alder wetlands) seldom receive any direct habitat treatments. Principle factors of woodcock population decline (e.g., loss of breeding habitat and wintering habitat) are taking place in areas outside the Ottawa. Measurement of local effects of management actions may be offset by large scale effects occurring outside and beyond the control of the Forest Service.

Common loon (score 35). This species was a management indicator for the 1986 Forest Plan. The common loon was not selected for recommendation as a MIS for the following reasons: It is currently on the state threatened list and populations and population trends will be watched. Few vegetative treatments would produce effects on loons and loon populations. There is no specific tie to any revision topic. Factors potentially affecting loon population and productivity include forage fish abundance, effects of boating and fishing, recreation interactions with breeding loons, and mortality and impaired reproductive effort due to mercury and lead poisoning.

Snowshoe hare (score 35). This species was not selected for recommendation as a MIS for the following reasons: Aspen habitats are covered by the ruffed grouse MIS and conifer habitats are represented by the American marten. These are the main places where hares occur. Snowshoe hare population trends would be monitored (outside of the MIS monitoring process) as a part of assessing effects of management activities on Canada lynx habitat.

Gray wolf (score 35). This species was not selected for recommendation as a MIS for the following reasons: The wolf has a large home range, and is not directly associated with specific habitats or forest types. Prey base or forage base has a larger affect on wolf abundance and distribution than management actions. The Ottawa would have to monitor individual animals or single packs to evaluate the effects of management actions on wolf populations and population trends at the project level, which is difficult and costly. The same would be true for effects of roads and dispersed recreation. Home ranges are generally larger than the typical vegetation management project. Wolf trends are watched by the Michigan DNR and partners.

Trillium (score 35). This species was not selected for recommendation as a MIS for the following reasons: Although it would serve well for many of the same reasons as cutleaf toothwort, it did not possess quite as many compelling factors as toothwort. It is not a true spring ephemeral, and only one of this plant type was needed for the suite of MIS.

White birch (score 35). Same reasons as white pine for non-selection.

Smith's melicgrass (score 34). This species was not selected for recommendation as a MIS for the following reasons: On the Ottawa, this grass is relatively common in hardwoods. Cutleaf toothwort would serve as the MIS for hardwoods. As a spring ephemeral, toothwort would be more responsive to management actions than melicgrass.

Wild rice (score 34). This species was not selected for recommendation as a MIS for the following reasons: Wild rice abundance would be watched by tribal partners and as part of the restoration program. The 2006 Forest Plan includes specific management direction to maintain and increase rice beds.

Bald eagle (score 33). The bald eagle was a MIS for the 1986 Forest Plan. The bald eagle was not selected for recommendation as a MIS for the following reasons: The current types and amounts of management actions as modified and mitigated do not have any noticeable affect on individual bald eagle or bald eagle productivity on the Ottawa. The Ottawa would have to monitor individual nest sites in order to determine effects of management actions on eagle population trends. The Michigan DNR currently conducts the nest occupancy and nest productivity surveys for bald eagles on the Ottawa (and the entire state). As a federally listed species, the eagle warrants monitoring outside the MIS program.

Brook trout (score 33). The brook trout was a MIS for the 1986 Forest Plan. The brook trout was not selected for recommendation as a MIS for the following reasons: Use of the mayfly-stonefly-caddisfly index as an MIS can replace brook trout, because use of the monitoring index will be similarly effective, and can be accomplished more efficiently. The brook trout would be a duplicate of this effort.

Smallmouth bass (score 33). The small mouth bass was a MIS for the 1986 Forest Plan. The smallmouth bass was not selected for recommendation as a MIS for the following reasons: few Forest management activities would affect Smallmouth bass habitat (i.e., rock lakes and cool water streams), and the Michigan DNR manages game fish populations.

Native crayfish (score 33). Native crayfish was not selected for recommendation as a MIS for the following reasons: Populations of native crayfish would be monitored as populations of the non-native invasive rusty crayfish are monitored. Stream water quality would be monitored through the use of the mayfly-stonefly-caddisfly index.

Trout lily (score 33). This species was not selected for recommendation as a MIS for the following reasons: Although it would serve well for many of the same reasons as cutleaf toothwort, it did not possess quite as many compelling factors as toothwort. It is less habitat-specific, and only one spring ephemeral was needed for the suite of MIS.

Wood turtle (score 31). The wood turtle was not selected for recommendation as a MIS for the following reasons: The wood turtle is a Regional Forester's Sensitive Species (RFSS) and would be monitored outside of the MIS process. The 2006 Forest Plan includes management direction which would mitigate management effects on wood turtle foraging, breeding, and hibernating habitats. Rare species are poor MIS.

Green frog or Mink frog (score 31). These frogs were were not selected for recommendation as a MIS for the following reasons: The Ottawa has very little baseline information about these species, these species are being monitored state-wide by the Michigan DNR, and the Ottawa is cooperating by conducting some frog and toad surveys within the Forest. The species population

trends are not driving development of Forest Plan alternatives. Much of the habitat for these species is not actively managed and not subjected to effects that would influence populations. The 2006 Forest Plan has standards and guidelines to conserve habitat for these species.

Chestnut-sided warbler (score 31). The chestnut-sided warbler was not selected for recommendation as a MIS for the following reasons: For seven months of the year, this species resides off the Ottawa and the Forest Service has no control over management actions or habitat changes that affect the chestnut-sided warbler populations off Forest. Therefore, it is difficult to interpret population trends on the Forest. This species is covered by the ruffed grouse MIS.

Brown trout (score 31). This species was not selected for recommendation as a MIS for the following reasons: Use of the mayfly-stonefly-caddisfly index as an MIS can replace brown trout, because use of the index will be similarly effective, and can be accomplished for less money. Monitoring the brown trout would be a duplicate effort.

Caddisflies (score 30). Caddisflies was not selected for recommendation as a MIS for the following reasons: Caddisflies are included in the mayfly-stonefly-caddisfly MIS index. The use of the three genera as an index is more effective than using the caddisfly genus singly.

Male fern (score 30). This species was not selected for recommendation as a MIS for the following reasons: Male fern is relatively rare on the Forest (it is listed as state special concern) and rare species are poor MIS. It is generally restricted to rocky habitats which receive few management impacts. It is inventoried and protected under the rare plant program.

Ginseng (score 30). This species was not selected for recommendation as a MIS for the following reasons: Ginseng is very rare on the Ottawa (it is a RFSS) and rare species are poor MIS. It occurs at the top of its range on the Ottawa, is preferred by deer, and is harvested for medicinal purposes, meaning multiple factors affect its abundance, in addition to management impacts. It is inventoried and protected under the rare plant program.

Barred owl (score 29). The barred owl was a MIS for the 1986 Forest Plan. It was not selected for recommendation as a MIS for the following reasons: The barred owl occurs in a wide variety of habitats including: northern hardwoods, riparian and floodplain forests, mixed deciduous/conifer forests, and conifer forests. A large portion of barred owl habitat occurs in habitats not subject to management activities. Management impacts in this habitat type will be monitored using cutleaf toothwort, which is expected to be more responsive to impacts than the owl.

Northern pike (score 28). The northern pike was a MIS for the 1986 Forest Plan. The northern pike was not selected for recommendation as a MIS for the following reasons: Most Ottawa management actions do not affect pike habitat (i.e. shallow, weedy lakes), and the Michigan DNR manages game fish populations.

Pileated woodpecker (score 27). This species was not selected for recommendation as a MIS for the following reasons: It would be difficult to monitor and its habitat is northern hardwoods,

particularly sawtimber sized stands of northern hardwoods and mixed conifer/deciduous forest stands. It was decided to use cut-leaf toothwort to monitor this habitat.

American marten (score 27). The American marten is recommended for selection as a MIS for the 2006 Forest Plan. The reasons for selecting the marten are as follows: It has a relatively small home range, at least a size that would fit within a project area. Vegetation management can affect prey base, marten movements and use of habitats. Management actions can also change forest compositions, structures and landscape arrangements, factors which can affect marten populations (i.e. distributions and abundance). The marten is associated with conifer habitats and management actions which affect the amount, kinds, and structure and landscape arrangements of conifer habitats will in turn affect distribution and population trends of the marten on the Ottawa.

Fatmucket (score 27). This freshwater mussel species was not selected for recommendation as a MIS for the following reasons: The life history requirements and habitat relationships of this species are incompletely known for the Ottawa. The distribution of this species is not well documented for the Ottawa. Limitations on understanding the dynamics of this species on the Forest would restrict its useful application as a management indicator species. The mayfly-stonefly-caddisfly index would be used for water quality impacts. Few management actions by the Ottawa affect fatmucket habitat.

Red-backed salamander (score 27). This species was not selected for recommendation as a MIS for the following reasons: An inhabitant of closed canopy hardwood forests, the life history requirements and habitat relationships of this species are incompletely known for the Ottawa. The distribution of this species is not well documented for the Ottawa. Limitations on understanding the dynamics of this species on the Ottawa would restrict its useful application as a management indicator species.

Osprey (score 26). The osprey was a MIS for the 1986 Forest Plan. The osprey was not selected for recommendation as a MIS for the following reasons: The osprey is present on the Ottawa at very low, but apparently stable numbers, fluctuating around 6-10 nesting pairs per year for the last 20 years. Much of the nesting habitat on the Ottawa is not actively managed, thus osprey population numbers do not seem to be greatly affected by current vegetation management actions. Reasons for the lack of population increase of ospreys on the Ottawa may be due to reasons beyond the control of the Forest Service. This prevents the osprey from functioning well as a management indicator.

Sculpin (score 26). This species was not selected for recommendation as a MIS for the following reasons: The sculpin would be better covered by the mayfly-stonefly-caddisfly index. **Northern holly fern** (score 26). This species was not selected for recommendation as a MIS for the following reasons: It occurs mainly in rocky habitats on the Forest, and few Forest activities affect these areas. The 2006 Forest Plan includes management direction to protect these areas.

Gray jay (score 25). This species was not selected for recommendation as a MIS for the following reasons: The gray jay would be better covered by the American marten. Monitoring the gray jay would be a duplicate effort.

Princess pine (score 25). This species group was not selected for recommendation as a MIS for the following reasons: Princess pines are harvested and would therefore be evaluated under the special forest products program. The 2006 Forest Plan includes management direction to ensure sustainable harvest of special forest products. Princess pine occurs in hardwoods and aspen stands, as well as other habitats. Cutleaf toothwort and ruffed grouse would be used as MIS for these species' habitats.

Blueberries (score 25). This species group was not selected for recommendation as a MIS for the following reasons: Blueberries mainly occur in openings and wetlands. Wetlands are protected by management direction and receive few actions. Openings also receive few activities, although fire suppression and periodic maintenance affects them. Openings and wetlands are not priority habitats needing MIS since few activities occur there.

Northern goshawk (score 24). The Northern goshawk was a MIS for the 1986 Forest Plan. The goshawk was not selected for recommendation as a MIS for the following reasons: The goshawk is on the RFSS list and is therefore already monitored. The species is present on the Ottawa at a relatively low population density, and is not easily detected with current survey protocols, making it a poor MIS. Individual pairs may not use the same nest site in consecutive years, and we are not certain that all goshawks breed every year. These characteristics make it difficult to use the goshawk as an indicator of management effects.

Chimney swift (score 24). This species was not selected for recommendation as a MIS for the following reasons: The distribution, abundance, and habitat relationships of this species on the Ottawa are not well understood at this time. The lack of this information would largely limit the chimney swift's usefulness as an indicator of management effects.

Red-shouldered hawk (score 24). This species was not selected for recommendation as a MIS for the following reasons: This species is on the RFSS list and is therefore already monitored. Red-shouldered hawks on the Ottawa are on the very northern extent of their range. The habitat relationships for this species are not completely understood for the Ottawa. The red-shouldered hawk population on the Ottawa may be constrained or regulated by lack of habitat, limited number of wetlands within a forest setting, competition from niche conspecific competitors, or other factors that are beyond the capability of the Ottawa to change or affect. These factors would render the red-shouldered hawk inappropriate as a management indicator species.

Canada yew (score 23). This species was not selected for recommendation as a MIS for the following reasons: Yew is uncommon on the Ottawa, mainly limited to low deer/high snow areas, and to specific locations such as near Lake Superior. High palatability to deer means it would be difficult to separate management impacts from deer impacts on this shrub.

Blackburnian warbler (score 22). This species was not selected for recommendation as a MIS for the following reasons: This species would be better covered by the American marten.

Raven (score 21). This species was not selected for recommendation as a MIS for the following reasons: The raven does not appear to be closely tied to any specific forest habitat type for food,

cover or shelter. It feeds on a very wide range of foods, and it is adaptable in nest site selection. These reasons make it very difficult to connect the affects of management actions to changes in raven populations on the forest. The raven population is much more likely to be affected by things like the West Nile virus than timber harvesting.

American bittern (score 16). This species was not selected for recommendation as a MIS for the following reasons: Active management generally does not occur in its habitat. The Ottawa has limited amounts of suitable habitat. The 2006 Forest Plan includes management direction to conserve and protect bittern habitat.