# Lewis River Wildlife Habitat Management Plan
# Volume IV – Appendices 13-1 to 17-8

Federal Energy Regulatory Commission
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# LIST OF APPENDICES

**Appendix 13-1:**
**Washington State and Country Noxious Weed Control Board Noxious Weed Lists and Other Invasive Plant Species on Lewis River Wildlife Habitat Management Plan Lands**

**Appendix 13-1: Washington State and County Noxious Weed Control Board Noxious Weed Lists and other invasive plant species on Lewis River Wildlife Habitat Management Plan lands.**

| Scientific Name | Common Name | Washington Noxious Weed Board Classification | Clark County Classification | Cowlitz County Classification | Skamania County |
|---|---|---|---|---|---|
| *Artemisia absinthium* | Absinth wormwood | Class C | Class C | | |
| *Anchusa arvensis* | Annual bugloss | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Rorippa austriaca* | Austrian fieldcress | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Gypsophila paniculata* | Babysbreath | Class C | Class C | | |
| *Centaurea macrocephala* | Bighead knapweed | Class A | Class A | Class A | Class B designated to control |
| *Hyocyamus niger* | Black henbane | Class C | Class C | | |
| *Centaurea nigra* | Black knapweed | Class B Designate Region 8 except Clark County | Class B | Class B | Class B designated to control |
| *Alopecurus myosuroides* | Blackgrass | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Echium vulgare* | Blueweed | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Polygonum bohemicum* | Bohemian knotweed | Class B | Class B | | |
| *Pteridium aquilinum* | Bracken | | | | |
| *Egeria densa* | Brazilian elodea | Class B Designate Region 8 Lewis County Only | Class B | | |
| *Centaurea jacea* | Brown knapweed | Class B Designate Region 8 except Clark County | Class B | Class B | Class B designated to control |
| *Solanum rostratum* | Buffalobur | Class A | Class A | Class A | |
| *Cirsium vulgare* | Bull thistle | Class C | Class B | | Class C |
| *Buddleia davidii* | Butterfly bush | Class B | Class B | | |
| *Alhagi maurorum* | Camelthorn | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Cirsium arvense* | Canada thistle | Class C | Class B | Class C | Class C |
| *Secale cereale* | Cereal rye | Class C | Class C | | |
| *Salvia sclarea* | Clary sage | Class A | Class A | Class A | |
| *Anchusa officinalis* | Common bugloss | Class B Designate Region 8 | | Class B | Class B designated to control |
| *Arctium minus* | Common burdock | | | | |
| *Hypochaeris radicata* | Common catsear | Class B | Class B | | Class B |
| *Spartina anglica* | Common cordgrass | Class A | Class A | Class A | |
| *Crupina vulgaris* | Common crupina | Class A | Class A | Class A | |
| *Foeniculum vulgare* | Common fennel | Class B | Class B | Class B | Class B designated to control |
| *Senecio vulgaris* | Common groundsel | Class C | Class C | | |
| *Hieracium lachenalli* | Common hawkweed | Class C | Class C | | Class B designated to control |
| *Brassica rapa* | Common mustard | | | | |
| *Phragmites australis* | Common reed (non-natives) | Class B | Class B | | |
| *Tanacetum vulgare* | Common tansy | Class C | Class C | | Class C |
| *Potamogeton crispus* | Curly-leaf pondweed | Class C | Class C | | Class C |
| *Linaria dalmatica ssp. dalmatica* | Dalmation toadflax | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Taraxacum officinale* | Dandelion | | | | |
| *Spartina densiflora* | Denseflower cordgrass | Class A | Class A | Class A | |
| *Centaurea diffusa* | Diffuse knapweed | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Isatis tinctoria* | Dyers woad | Class A | Class A | Class A | |
| *Euphorbia oblongata* | Eggleaf spurge | Class A | Class A | Class A | |
| *Hedera hibernica and Hedera helix spp.* | English ivy | Class C | Class C | | Class C |
| *Myriophyllum spicatum* | Eurasion watermilfoil | Class B Designate Region 8 except within 200 feet of the Columbia River | Class B | Class B | Class B designated to control |
| *Hieracium sabaudum* | European hawkweed | Class A | Class A | Class A | Class B designated to control |
| *Rubus laciniatus** | Evergreen blackberry | | | | |
| *Cabomba caroliniana* | Fanwort | Class B Designate Region 8 except T8N, R3W of Cowlitz County | Class B | Class B | Class B designated to control |
| *Convolvulus arvensis* | Field bindweed | Class C | Class C | | |
| *Ludwigia peploides* | Floating primrose-willow | Class A | Class A | Class A | |

**Appendix 13-1: Washington State and County Noxious Weed Control Board Noxious Weed Lists and other invasive plant species on Lewis River Wildlife Habitat Management Plan lands.**

| Scientific Name | Common Name | Washington Noxious Weed Board Classification | Clark County Classification | Cowlitz County Classification | Skamania County |
|---|---|---|---|---|---|
| *Nymphaea odorata* | Fragrant water lily | Class C | Class C | | Class C |
| *Lysimachia vulgaris* | Garden loosestrife | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Alliaria petiolata* | Garlic mustard | Class A | Class A | Class A | Class A |
| *Hereacleum mantegazzianum* | Giant hawkweed | Class A | Class A | Class A | Class B designated to control |
| *Polygonum sachalinense* | Giant knotweed | Class B | Class B | | |
| *Galega officinalis* | Goatsrue | Class A | Class A | Class A | |
| *Ulex europaeus* | Gorse | Class B Designate Region 8, except Pacific County | Class B | Class B | Class B designated to control |
| *Sagittaria graminea* | Grass-leaved arrowhead | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Cardaria pubescens* | Hairy whitetop | Class C | Class C | | |
| *Epilobium hirsutum* | Hairy willow-herb | Class C | Class C | | |
| *Picris hieracioides* | Hawkweed oxtongue | Class B Designate Region 8 Except Skamania County | Class B | Class B | |
| *Torilis arvensis* | Hedgeparsley | Class B Designate Region 8 | | Class B | |
| *Rubus armeniacus* | Himalayan blackberry | | | | |
| *Polygonum polystachyum* | Himalayan knotweed | Class B Designate Region 8 Lewis County Only | Class B | | |
| *Berteroa incana* | Hoary alyssum | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Cardaria draba* | Hoary cress | Class C | Class C | | |
| *Cynoglossum officinale* | Houndstongue | Class B | Class B | | Class B |
| *Hydrilla verticillata* | Hydrilla | Class A | Class A | Class A | |
| *Amorpha fruticosa* | Indigobush | Class B Designate Region 8 except within 200 feet of the Columbia River | Class B | Class B | Class B designated to control |
| *Carduus pycnocephalus* | Italian thistle | Class A | Class A | Class A | Class B designated to control |
| *Polygonum cuspidatum* | Japanese knotweed | Class B | Class B | Class B | |
| *Sorghum halepense* | Johnsongrass | Class A | Class A | Class A | |
| *Aegilops cylindrica* | Jointed goatgrass | Class C | Class C | | |
| *Kochia scoparia* | Kochia | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Pueraria montana var. lobata* | Kudzu | Class A | Class A | Class A | |
| *Soliva sessilis* | Lawnweed | Class B | Class B | Class B | Class B designated to control |
| *Euphorbia esula* | Leafy spurge | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Lepyrodiclis holosteoides* | Lepyrodiclis | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Cenchrus longispinus* | Longspine sandbur | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Marah oreganus* | Manroot | | | | |
| *Salvia pratensis* | Meadow clary | Class A | Class A | Class A | |
| *Centaurea jacea x nigra* | Meadow knapweed | Class B Designate Region 8 except Clark County | Class B | Class B | Class B designated to control |
| *Salvia aethiopis* | Mediterranean sage | Class A | Class A | Class A | |
| *Silybum marianum* | Milk thistle | Class A | Class A | Class A | Class B designated to control |
| *Hieracium pilosella* | Mouseear hawkweed | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Carduus nutans* | Musk thistle | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Euphorbia myrsinites* | Myrtle spurge | Class B | Class B | | |
| *Clematis vitalba* | Old man's beard | Class C | Class C | | |
| *Hieracium aurantiacum* | Orange hawkweed | Class B Designate Region 8 Lewis County Only | Class B | | Class B designated to control |
| *Leucanthemum vulgare* | Oxeye daisy | Class B | Class B | | Class B |
| *Myriophyllum aquaticum* | Parrotfeather | Class B Designate Region 8 Pacific, Lewis, and Skamania counties only | Class B | | Class B designated to control |
| *Lepidium latifolium* | Perennial pepperweed | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Sonchus arvensis ssp. arvensis* | Perennial sowthistle | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Carduus acanthoides* | Plumeless thistle | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Conium maculatum* | Poison-hemlock | Class B | Class B | Class C | Class B |
| *Hieracium atratum* | Polar hawkweed | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Impatiens gladulifera* | Policeman’s helmet | Class B Designate Region 8 | Class B | Class B | Class B designated to control |

| Scientific Name | Common Name | Washington Noxious Weed Board Classification | Clark County Classification | Cowlitz County Classification | Skamania County |
|---|---|---|---|---|---|
| *Tribulus terrestris* | Puncturevine | Class B | Class B | | Class B designated to control |
| *Lythrum salicaria* | Purple loosestrife | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Centaurea calcitrapa* | Purple starthistle | Class A | Class A | Class A | Class B designated to control |
| *Hieracium glomeratum* | Queen-devil hawkweed | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Phalaris arundinacea* | Reed canarygrass | Class C | Class C | | Class C |
| *Glyceria maxima* | Reed sweetgrass | Class A | Class A | Class A | |
| *Schoenoplectus mucronatus* | Ricefield bulrush | Class A | Class A | Class A | |
| *Geranium robertianum* | Robert-herb | Class B | Class B | | Class B |
| *Chondrilla juncea* | Rush skeletonweed | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Acroptilon repens* | Russian knapweed | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Spartina patens* | Salt meadow cordgrass | Class A | Class A | Class A | |
| *Tamarix ramosissima* | Saltcedar | Class B Designate Region 8 in all of Region 8, unless intentionally established prior to 2004 | Class B | Class B | Class B designated to control |
| *Matricaria perforata* | Scentless mayweed | Class C | Class C | | |
| *Cytisus scoparius* | Scotch broom | Class B | Class B | | Class B |
| *Onopordum acanthium* | Scotch thistle | Class B Designate Region 8 | | Class B | Class B designated to control |
| *Solanum elaeagnifolium* | Silverleaf nightshade | Class A | Class A | Class A | |
| *Carduus tenuiflorus* | Slenderflower thistle | Class A | Class A | Class A | Class B designated to control |
| *Spartina alterniflora* | Smooth cordgrass | Class B Designate except bays and estuaries of Pacific County | Class B | Class B | Class B designated to control |
| *Hieracium laevigatum* | Smooth hawkweed | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Cuscuta approximata* | Smoothseed alfalfa dodder | Class C | Class C | | |
| *Spartium junceum* | Spanish broom | Class A | Class A | Class A | |
| *Hemizonia pungens* | Spikeweed | Class C | Class C | | |
| *Xanthanium spinosum* | Spiny cocklebur | Class C | Class C | | |
| *Centaurea streobe* [1] *(Centaurea biebersteinii)* | Spotted knapweed | Class B Designate Region 8 except that portion of Lewis County below the ordinary high water mark of the Tilton River from Hwy. 508 to Lake Mayfield | Class B | Class B | Class B designated to control |
| *Thymelaea passerina* | Spurge flax | Class A | Class A | Class A | |
| *Daphne laureola* | Spurge laurel | Class B | Class B | Class B | Class B designated to control |
| *Hypericum perforatum* | St. Johnswort | Class C | Class C | | Class C |
| *Potentilla recta* | Sulfur cinquefoil | Class B Designate Region 8 Lewis County Only | Class B | Class B | Class B designated to control |
| *Sphaerophysa salsula* | Swainsonpea | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Zygophyllum fabago* | Syrian bean-caper | Class A | Class A | Class A | |
| *Senecio jacobaea* | Tansy ragwort | Class B | Class B | Class B | Class B |
| *Helianthus cliaris* | Texas blueweed | Class A | Class A | Class A | |
| *Myriophyllum herophyllum* | Variable leaf milfoil | Class A | Class A | Class A | |
| *Abutilon theophrasti* | Velvetleaf | Class A | Class A | Class A | |
| *Centaurea nigrescens* | Vochin knapweed | Class A | Class A | Class A | Class B designated to control |
| *Lythrum virgatum* | Wand loosestrife | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Ludwigia hexapetala* | Water primrose | Class B Designate Region 8 except portions of Cowlitz County | Class B | Class B | |
| *Bryonia alba* | White bryony | Class B Designate Region 8 | Class B | Class B | |
| *Silene latifolia ssp. alba* | White cockle | Class C | Class C | | |
| *Daucus carota* | Wild carrot | Class B | Class B | | Class B |
| *Anthriscus sylvestris* | Wild chervil | Class B Designate Region 8 except Clark County | Class B | Class B | Class B designated to control |
| *Mirabilis nyctaginea* | Wild four o' clock | Class A | Class A | Class A | |
| *Lamiastrum galeobolon* | Yellow archangel | Class C | Class C | | Class C |

## Appendix 13-1: Washington State and County Noxious Weed Control Board Noxious Weed Lists and other invasive plant species on Lewis River Wildlife Habitat Management Plan lands.

| Scientific Name | Common Name | Washington Noxious Weed Board Classification | Clark County Classification | Cowlitz County Classification | Skamania County |
|---|---|---|---|---|---|
| *Iris pseudocorus* | Yellow flag iris | Class C | Class C | | Class C |
| *Nymphoides peltata* | Yellow floating heart | Class B Designate Region 8 | Class B | | Class B designated to control |
| *Hieracium caespitosum* | Yellow hawkweed | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Hieracium floribundum* | Yellow-devil hawkweed | Class A | Class A | Class A | Class B designated to control |
| *Cyperus esculentus* | Yellow nutsedge | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Centaurea solstitialis* | Yellow starthistle | Class B Designate Region 8 | Class B | Class B | Class B designated to control |
| *Linaria vulgaris* | Yellow toadflax | Class C | Class C | | Class C |

[1]Centaurea streobe is recognized as Centaurea biebersteinii in Washington and Cowlitz County weed lists

Highlighted species are invasive plant species that are known to exist on Lewis River Wildlife Habitat Management Plan lands.

**Washington Noxious Weed Board Classification:**

Class A: Non-native species that are limited in distribution in Washington. State law requires that these weeds be eradicated.
Class B: Non-native species that are either absent from or limited in distribution in some portions of the state but very abundant in other areas. The goals are to contain the plants where they are already widespread and prevent their spread into new areas.

Class C: Non-native plants that are already widespread in Washington State. Counties can choose to enforce control, or they can educate residents about controlling these noxious weeds.

**Clark County Noxious Weed List Classifications**

Class A weeds: non-native species whose distribution in Washington is still limited. Preventing new infest stations and eradicating existing infestations are the highest priority. Eradication of all Class A plants is required by law.
Class B weeds: Non-native species presently limited to portions of the State. Species are designated for control in regions where they are not yet widespread. Preventing new infestations in these areas is a high priority. In regions where a Class B species is already abundant, control is decided at the local level, with containment as the primary goal.
Class C weeds: Noxious weed which are already widespread in WA are of special interest to the state's agricultural industry. The Class C status allows counties to enforce control if locally desires. Other may chose to provide education or technical consultation

**Cowlitz County Noxious Weed List Classifications**

Class A weeds: are non-native species with a limited distribution in Cowlitz County. Preventing new infestations and eradicating existing infestations is the highest priority. Eradication of all Class A plants is required by law.

Class B weeds: are non-native species presently limited to portion of the state. Class B species are designated for control in regions where they are not yet widespread. Preventing investigating in these area is a high priority. In regions where a Class B species is already abundant, control is decided at the county level, with containment as the primary goal.

Class C weeds: are non-native weed found in Washington. Many of these species are widespread in the state. Long-term programs of suppression and control are a local option, depending upon local threats and the feasibility of control in local areas.

**Appendix 13-2:**
**Ground Disturbance Form**

# GROUND DISTURBANCE FORM

## Pre-Ground Disturbance Inspection

**Date:** ___________ **Observer:** ___________________________________________

**Project Area** (project area includes all soil disturbance areas, staging areas, and access roads. Attach map and photos):_________
___________________________________________________________________________
___________________________________________________________________________

**Project Action:** ______________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

**Project schedule:** ____________________________________________________________

**Describe vegetation** (height, density, and dominant cover): ___________________________________
___________________________________________________________________________
___________________________________________________________________________

| Percent Cover Invasive Plant Species | | | | | |
|---|---|---|---|---|---|
| **Species Code** | **Percent Cover** | **Distribution** | **Species Code** | **Percent Cover** | **Distribution** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Distribution (D) CL=Clumpy SP=Scattered Patchy SE=Scattered Even LI=Linear
Percent Cover (%) T=Trace (0-5%), L=Low (6-25%), M=Moderate (26-50%), MH=Moderate to High (51-75%) H=High (76-100%)

**Risk of invasive plant species establishing or spreading following the project:** ___________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

**Best Management Practices:** _____________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

**Comments:**______________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

## Year 1 Post-Ground Disturbance Inspection

**Date**: ____________ **Observer:** ________________________________________________

**Describe invasive plant species prevention and treatments** (date and method):__________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

| Percent Cover Invasive Plant Species | | | | | |
|---|---|---|---|---|---|
| **Species Code** | **Percent Cover** | **Distribution** | **Species Code** | **Percent Cover** | **Distribution** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Distribution (D) CL=Clumpy SP=Scattered Patchy SE=Scattered Even LI=Linear
Percent Cover (%) T=Trace (0-5%), L=Low (6-25%), M=Moderate (26-50%), MH=Moderate to High (51-75%) H=High (76-100%)

**Management Recommendations or Comments**: ________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

## Year 2 Post-Ground Disturbance Inspection

**Date**: ____________ **Observer:** ________________________________________________

**Describe invasive plant species prevention and treatments** (date and method):__________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

| Percent Cover Invasive Plant Species | | | | | |
|---|---|---|---|---|---|
| **Species Code** | **Percent Cover** | **Distribution** | **Species Code** | **Percent Cover** | **Distribution** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Distribution (D) CL=Clumpy SP=Scattered Patchy SE=Scattered Even LI=Linear
Percent Cover (%) T=Trace (0-5%), L=Low (6-25%), M=Moderate (26-50%), MH=Moderate to High (51-75%) H=High (76-100%)

**Management Recommendations or Comments**: ________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

## Year 3 Post-Ground Disturbance Inspection

**Date**: ___________ **Observer: ___________________________________________**

**Describe invasive plant species prevention and treatments** (date and method):_________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

| **Percent Cover Invasive Plant Species** | | | | | |
|---|---|---|---|---|---|
| **Species Code** | **Percent Cover** | **Distribution** | **Species Code** | **Percent Cover** | **Distribution** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Distribution (D) CL=Clumpy SP=Scattered Patchy SE=Scattered Even LI=Linear
Percent Cover (%) T=Trace (0-5%), L=Low (6-25%), M=Moderate (26-50%), MH=Moderate to High (51-75%) H=High (76-100%)

**Management Recommendations or Comments**: ______________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

# Appendix 13-3:
# Invasive Plant Species Monitoring Form

# INVASIVE PLANT SPECIES MONITORING

**Date:** ___________ **Observer:** ____________________________________________

**Invasive plant species population(s) location: (**Attach map**):** ___________________________________________
_____________________________________________________________________________________________

**Priority** (see below for definition)**:** __________

**Estimated Size of invasive plant species population:** _________

**Describe vegetation in the vicinity** (height, density, and dominant cover)**:** _________________________________
_____________________________________________________________________________________________

| Percent Cover Native Plant Species | | | | | |
|---|---|---|---|---|---|
| **Species Code** | **Percent Cover** | **Species Code** | **Percent Cover** | **Species Code** | **Percent Cover** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Percent Cover (%) T=Trace (0-5%), L=Low (6-25%), M=Moderate (26-50%), MH=Moderate to High (51-75%) H=High (76-100%)

**Percent of Bare Ground or Rock Cover :** __________

| Percent Cover Invasive Plant Species | | | | | |
|---|---|---|---|---|---|
| **Species Code** | **Percent Cover** | **Distribution** | **Species Code** | **Percent Cover** | **Distribution** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Distribution (D) CL=Clumpy SP=Scattered Patchy SE=Scattered Even LI=Linear
Percent Cover (%) T=Trace (0-5%), L=Low (6-25%), M=Moderate (26-50%), MH=Moderate to High (51-75%) H=High (76-100%)

**Sensitive areas** (wetlands, creeks, unique area)**:**_______________________________________________________
_____________________________________________________________________________________________
_____________________________________________________________________________________________

**Invasive plant species control treatment** (includes method, chemical, date)**:** ____________________________
_____________________________________________________________________________________________
_____________________________________________________________________________________________
_____________________________________________________________________________________________
_____________________________________________________________________________________________

**Best management practices:** _______________________________________________________________
_____________________________________________________________________________________________
_____________________________________________________________________________________________
_____________________________________________________________________________________________
_____________________________________________________________________________________________
_____________________________________________________________________________________________

**Comments:** _________________________________________________________________________________
_____________________________________________________________________________________________
_____________________________________________________________________________________________

**Year 1 Post Control Treatment Monitoring**

**Date: ___________** **Observer: _____________________________________________**

| Effects of Treatments on Vegetation | | | | | | |
|---|---|---|---|---|---|---|
| **Cover Type of invasive plant species** | **Uncertain** | **No Effect (1-20%)** | **Slight Reduction (21-40%)** | **Moderate Reduction (41-60%)** | **Significant Reduction 61-80 %** | **Eradication 81-100%** |
| Grasses | | | | | | |
| Forbs | | | | | | |
| Shrubs | | | | | | |
| Trees | | | | | | |
| Moss/Lichens | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**Future invasive plant species treatment and best management practices** (includes method, chemical, date)**:**________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________

**Comments**: ______________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________

**Year 2 Post Control Treatment Monitoring**

**Date: ___________** **Observer: _____________________________________________**

| Effects of Treatments on Vegetation | | | | | | |
|---|---|---|---|---|---|---|
| **Cover Type or invasive plant species** | **Uncertain** | **No Effect (1-20%)** | **Slight Reduction (21-40%)** | **Moderate Reduction (41-60%)** | **Significant Reduction 61-80 %** | **Eradication 81-100%** |
| Grasses | | | | | | |
| Forbs | | | | | | |
| Shrubs | | | | | | |
| Trees | | | | | | |
| Moss/Lichens | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**Future invasive plant species treatment and best management practices** (includes method, chemical, date)**:**________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________

**Best management practices or comments**: ______________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________

**Year 3 Post Control Treatment Monitoring**

**Date:** ___________ **Observer**: ___________________________________________

| Effects of Treatments on Vegetation | | | | | | |
|---|---|---|---|---|---|---|
| **Cover Type or invasive plant species** | **Uncertain** | **No Effect (1-20%)** | **Slight Reduction (21-40%)** | **Moderate Reduction (41-60%)** | **Significant Reduction 61-80 %** | **Eradication 81-100%** |
| Grasses | | | | | | |
| Forbs | | | | | | |
| Shrubs | | | | | | |
| Trees | | | | | | |
| Moss/Lichens | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**Future invasive plant species treatment and best management practices** (includes method, chemical, date)**:**_______________________________________________________________________________
_______________________________________________________________________________
_______________________________________________________________________________

**Best management practices or comments**: ______________________________________________
_______________________________________________________________________________
_______________________________________________________________________________
_______________________________________________________________________________

**Priority Definition**
Priority 1 – All Class A, Class B designated, and aggressive new species with the potential to cause significant ecological impact and invasive plant species in areas scheduled for a ground disturbance activity within the year.

Priority 2 – Class B, C, or non-listed invasive plant species with high potential to spread (e.g. open roads, parking lots, trailheads, campgrounds, borrow areas) or will negatively impact an area of special concern (e.g. fish bearing streams, unique areas, or designated big game forage areas).

Priority 3 - Control of existing large infestations (greater than 0.25 acres [0.10 hectares) of Class A and Class B designated noxious weeds.

Priority 4 - Containment of existing large infestations (greater than 0.25 acres [0.10 hectares]) of Class B, C, or other unlisted invasive plant species.

Priority 5 - Suppression of existing large infestations – when eradication/control or containment is very difficult and the invasive plant species population is relatively contained.

# Appendix 14-1:
# Limiting Operating Periods and Habitat and Disturbance Thresholds for Potentially Breeding Raptors on Wildlife Habitat Management Plan Lands

# Limiting Operating Periods, and Habitat and Disturbance Thresholds for Potentially Breeding Raptors on WHMP Lands

| Species | Habitat | Habitat Threshold | Limited Operating Periods | Disturbance Distance Threshold[1] |
|---|---|---|---|---|
| **American kestrel** (*Falco sparveius)* | Open to semi-open habitats [2]. Nest in cavities in large trees, as well as cut banks and cliffs [3] | 660 ft (201 m) | April 15 to August 1[4] | 660 ft (201 m) |
| **Bald eagle** (*Haliaeetus leucocephalus)* | Associated with large bodies of water that support ample prey[2] Nest is large prominent trees average between 42 to 67 in (107 to 170 cm) dbh[3] | Primary zone within 400 ft (120 m) of nest tree Secondary zone 400 to 800 ft (12 to 240m) of nest tree[5] | Nesting Jan 1 to Aug 31 Key Winter Period Nov 15 to Mar 31[6] | 1320 ft (400 m) or 2640 ft (800 m) line-of-sight |
| **Barn owl** (*Tyto alba* ) | Open to semi-open habitats: grasslands, meadows, clear-cuts, marshes, agricultural fields, and urban areas[2] Breeds in open buildings, nest boxes, and cut banks near open lands | 660 ft (201 m) | April 1 to September 15[7] | 660 ft (201 m) |
| **Barred owl** (*Strix varia* ) | Conifer to mixed-conifer deciduous forests[3]. Nest in cavities, tops of snags, and abandon raptor or corvid stick nests.[2] | 660 ft (201 m) | March 1 to August 30 | 660 ft (201 m) |
| **Cooper's hawk** (*Accipiter cooperii* ) | Coniferous, mixed-coniferous, and deciduous forests. Mature forests with widely spaced trees[3] | 660 ft (201 m) | April 1 to August 15[7] | 660 ft (201 m) |
| **Golden Eagle** *(Aquila chrysaetos)* | Associated with open areas. Nests generally on cliffs and occasionally in trees. More common east of the Cascades, but golden eagles have been found in mature and old-growth forests near the edges of clearcuts and other open areas in western Washington.[12] | 980 ft (300 m)[12] | February 15 to July [12] | 980 ft (300 m)[12] |

## Limiting Operating Periods, and Habitat and Disturbance Thresholds for Potentially Breeding Raptors on WHMP Lands

| Species | Habitat | Habitat Threshold | Limited Operating Periods | Disturbance Distance Threshold[1] |
|---|---|---|---|---|
| **Great-horned owl** (*Bubo virginianus* ) | All forest types, agricultural areas, and urban areas. Nest in platforms or tree cavities, or cliff ledges. May use stick nests built by hawks, eagles, and ravens [3] | 660 ft (201 m) | February 1 to July 31[7] | 660 ft (201 m) |
| **Merlin** *(Falco columbarius)* | Prefer open to semi-open habitats. In western Washington often found near estuaries, lakes, reservoirs because the areas provide breaks in the forest. Nest in old raven, hawk nest, or tree cavities, or cliff ledges. [3] | 660 ft (201 m) | April 15 to August 1 | 660 ft (201 m) |
| **Northern goshawk** (*Accipiter gentilis* ) | Home range consists of varied amount of forest age classes and conditions. Nest in coniferous trees in mature or old-growth stands that are greater than 20 acres in size Stands include large trees,> 50% canopy closure, multi-layered canopy, gaps in the canopy, abundance of large diameter crowns, and the presence of shade tolerant trees.[8] | Post-fledgling Area (PFA) equal to 420 ac (170 ha) centered around a nest or a 2415 ft (736 m) radius around a nest tree[8] | March 1 to September 30[8] | 2640 ft (800 m) from nest tree[8] |
| **Northern harrier** (*Cicus cyaneus* ) | Open to semi-open habitats grasslands, meadows, marshes, and agricultural fields. Nest on the ground in patches of tall dense vegetation.[3] | 660 ft (201 m) | March 21 to September 15[2] | 660 ft (201 m) |
| **Northern pygmy-owl** (*Glaucidium gnoma* ) | Coniferous and mixed coniferous forests.[2] Secondary cavity nester using woodpecker and flicker holes or natural cavities.[3] | 660 ft (201 m) | April 1 to July 15[3] | 660 ft (201 m) |
| **Northern Saw-whet owl** *(Aegolius acadicus)* | Coniferous and riparian forests. Secondary cavity nester using woodpecker and flicker holes or natural cavities.[3] | 660 ft (201 m) | April 1 to July 15[3] | 660 ft (201 m) |

## Limiting Operating Periods, and Habitat and Disturbance Thresholds for Potentially Breeding Raptors on WHMP Lands

| Species | Habitat | Habitat Threshold | Limited Operating Periods | Disturbance Distance Threshold[1] |
|---|---|---|---|---|
| **Northern spotted owl** (*Strix occidentalis* ) | Stands at least 16 in. (41 cm) average dbh with at least 4 tress per acre (10 trees per ha) that are $\geq$ 30 in. (76 cm) dbh or larger, Numerous large snags (typically > 2/ ac [5/ha]), numerous down logs (typically >15 tons/ac [33.6 metric tons/ha]), multi-layered canopy, greater that 40% canopy (typically >60%)[6] | 500 acres (202 ha) and 2,663 acres (1,078 ha) within 0.7-mile (1.1-km) and 1.82-mile radius (2.9 km), respectively, of an active northern spotted owl home range[6] | March 1 to August 31. Critical nesting period March 1 to June 30[9] | 360 ft (110 m)[6] |
| **Osprey** (*Pandion haliaetus* ) | Associated with bodies of water that support ample fish. Nest in large trees with broken tops or snags.[3] | 660 ft (201 m)[11] | April 1 to September 30[11] | 660 ft (201 m)[11] |
| **Peregrine falcon** (*Falco peregrinus* ) | Nest on cliff ledges ranging from 75 to 2000 feet (23 to 610 m) in height and within ¼ to ½ mile (0.40 to 0.80 km) of riparian or lacustrine habitat[10] | 0.5 mi. (0.80 km) between March 1 and July 31 and 0.25 mi. (0.40 km) August 1 to February 28[10] | March 1 to July 31[10] | 0.5 mi. (0.80 km) between March 1 and July 31 and 0.25 mi. (0.40 km) August 1 to February 28[10] |
| **Red-tailed hawk** (*Buteo jamaicensis* ) | Open to semi-open habitats, but will use woodlands. Constructs stick nests in tall trees and utility poles[3] | 660 ft (201 m) | March 1 to September 15[2] | 660 ft (201 m) |
| **Sharp-shinned hawk** (*Accipiter striatus* ) | Associated with coniferous forests, mixed coniferous deciduous forests, and riparian woodlands. Nest are built on a limb or in the fork of a limb[2] | 660 ft (201 m) | April 15 to August 31[3] | 660 ft (201 m) |
| **Turkey vulture** (*Cathartes aura)* | Open country with adequate roosts that include large and tall snags, rocks, or structures. Nests are highly inacessible, such as cliff faces or hidden in or under large structutres in wooded environments.[3] | 660 ft (201 m) | April 15 to August 31[3] | 660 ft (201 m) |

# Limiting Operating Periods, and Habitat and Disturbance Thresholds for Potentially Breeding Raptors on WHMP Lands

| Species | Habitat | Habitat Threshold | Limited Operating Periods | Disturbance Distance Threshold[1] |
|---|---|---|---|---|
| **Western screech-owl** (*Otus kennicotti* ) | Forest edges and riparian woodlands, especially those with older deciduous trees, adjacent to open pastures or fields.[3] Secondary cavity nester using woodpecker and flicker holes or natural cavities. Requires trees that $\geq$ to 12 inches (30 centimeters) in dbh[2] | 660 ft (201 m) | April 15 to August 31[3,7] | 660 ft (201 m) |

[1] For blasting with >2 lbs pound charge the disturbance distance threshold will be 1 mile.

[2] Csuti, B., A.J. Kimerling, T.A O'Neil, M.M. Shaughnessy, E.P. Gaines, and M.M.P Huso. 1997. Atlas of Oregon Wildlife. Oregon State University Press, Corvallis,

[3] Marshall, D.B, M.G. Hunter, and A.L. Conteras, Eds. 2003. Birds of Oregon: A General Reference. Oregon State University Press, Corvallis, OR. 769 Pp

[4] PacifiCorp. 1998. Merwin Wildlife Habitat Management Program Standard Operating Procedures. Portland, Oregon. July 1998.

[5] Watson, James. W. and E.A. Rodrick. 2001. Bald Eagle Haliaeetus leucocephalus. Pages 9-1 – 9-15 in Larsen, E. M., J. M. Azerrad, and N. Nordstrom, eds. 2004.

[6] PacifiCorp and Cowlitz PUD. 2006. Lewis River Wildlife Habitat Management Plan Standards & Guidelines Document. Hydroelectric Projects Technical Reports.

[7] Adamus P.R, K. K.Larsen, G.Gillson, and C.R. Miller. 2001. Oregon Breeding Bird Atlas. Oregon Field Ornithologists, P.O. Box 10373, Eugene, OR 97440. CD- R

[8] Desimone, S. and D. Hays. 2004. Northern Goshawk. Pages 6-1 to 6-17 in. E.M Larsen, J.M. Azerrad, and N. Nordstrom, editors. Management Recommendations

[9] U.S Department of Interior, U.S Fish and Wildlife Service. 2006. Biological Opinion for the Federal Energy Regulatory Commission Relicensing of the Lewis River

[10] Hays, D.W. and R.L. Milner. 1999. Peregrine Falcon. Pages 11-1 to 11-4 in. E.M Larsen, J.M. Azerrad, and N. Nordstrom, editors. Management

[11] Roderick, E. and R. Milner, editors. 1991. Management Recommendations for Washington's Priority Habitats and Species. May 1991. Washington Department of

[14] E. Larsen, J. M. Azerrad, N. Nordstrom, editors. 2004. Management recommendations for Washington's priority species, Volume IV: Birds. Washington

**Appendix 14-2:**
**Northern Goshawk Survey Protocol**

![USDA]

United States
Department
of Agriculture

Forest Service

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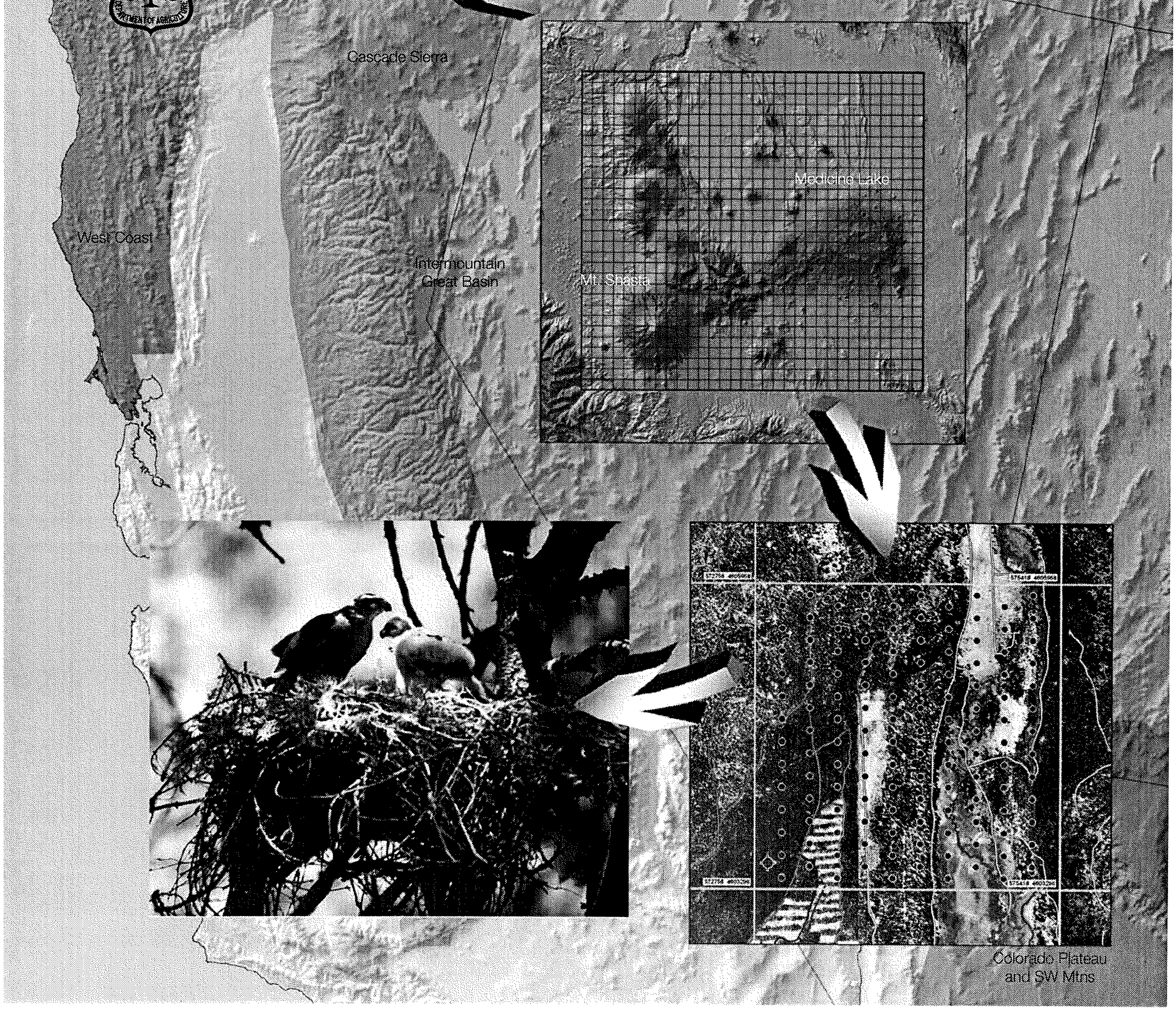
# Northern Goshawk Inventory and Monitoring Technical Guide



United States
Department
of Agriculture

Forest Service

Gen. Tech.
Report WO-71

July 2006

# Northern Goshawk Inventory and Monitoring Technical Guide

Brian Woodbridge and Christina D. Hargis

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Cover Photo: The concept of bioregional monitoring is conveyed through three photos superimposed on a digital elevation model of the Western United States, including portions of the Pacific Coast and Intermountain Great Basin bioregions. The overlaid images depict three levels of the bioregional monitoring design: a sample of contiguous PSUs in northern California (top), a PSU with call point transect lines (middle), and a northern goshawk nest (bottom). Photo credit: Brian Woodbridge. Composite image designed by Dave LaPlante.

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The bioregional monitoring design presented in chapter 2 was created by the Northern Goshawk Inventory and Monitoring Design Team, whose members are listed on the title page of this technical guide. We give special recognition to J.A. Baldwin for contributing substantial time toward developing the bioregional design and preparing all the statistical text in chapter 2. We are grateful to D. LaPlante and B. Allison for spatial analyses of primary sampling unit (PSU) size and for preparing figures and to J. Wilson and H. Wang for preparing the figure in Appendix C. We thank the following individuals who substantially improved the quality of this technical guide through their review of earlier versions: D.E. Andersen, P.H. Geissler, T.A. Max, A.R. Olson, M.G. Raphael, L.F. Ruggiero, H.T. Schreuder, and J.R. Squires.


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# Contents

# Chapter 3. Goshawk Survey Techniques

## 3.1 Objectives

This chapter describes the survey protocols adopted by the Forest Service for detecting goshawk presence, locating nests, and determining various stages of nesting and reproductive success. Most protocols described here are from published sources and are also used by other land management agencies and landowners throughout the range of the northern goshawk.

The primary objectives of this chapter are to describe—

- Protocols adopted by the USDA Forest Service for conducting goshawk surveys.
- Rationale for selecting certain protocols to effectively and efficiently meet specific objectives.

## 3.2 Planning and Design

### 3.2.1 Aspects of Goshawk Natural History Related to Survey Methodology

At the geographic scale, goshawks reproduce in a broad range of vegetative communities, ranging from extensive mature coniferous forest in coastal regions to small patches of aspen and pine in Great Basin shrubsteppe communities. At the landscape or home range scale, goshawks use a diverse array of habitat for foraging, both in vegetation type and degree of openness (Squires and Reynolds 1997). At the scale of nest-site selection, goshawks nest in the densest stands available, given the capability of the forest type; relatively high canopy closure also appears to be a uniformly important habitat characteristic across the range of the species (Hayward and Escano 1989). The size of forest patches used for nesting and the degree of forest heterogeneity within occupied landscapes appear to be highly variable across the species' range. Nevertheless, numerous habitat studies and modeling efforts have found nest sites to be associated with similar factors, including proximity to water or meadow habitat, forest openings, level terrain or 'benches' of gentle slope, northerly aspects, and patches of larger, denser trees.

Where forest habitats are well distributed, goshawk density is limited by territorial behavior, resulting in fairly regular spacing between the nests of breeding pairs. (See section 2.2.1.) Within territories, goshawks typically make between-year movements among several alternate nests up to 1.8 km apart (Squires and Reynolds 1997, Woodbridge and Detrich 1994). Although most alternate nests are grouped within a stand or cluster of adjacent stands, a search radius of 0.5 km is required to locate about 75 percent of alternate nests used over a period of several years, and a search radius of 1 km is required to locate about 95 percent of alternate nests (Reynolds et al. 2005).

Phenology of migratory movements, territory occupancy, and breeding exerts an important influence on survey timing and methods. Goshawk populations in boreal regions, the Great Basin, and portions of the Rocky Mountain region are at least partially migratory, whereas goshawks in Oregon, California, and the Southwest may remain in the vicinity of their territories year round (Keane 1999, Squires and Reynolds 1997). Adult goshawks typically return to nesting territories during March and early April (Squires and Reynolds 1997), and nest construction commences soon thereafter. Eggs are usually laid in mid-April to early May. Incubation lasts about 30 days, resulting in hatching dates from mid-May through early June. Nestlings remain in the nest for 36 to 42 days, typically fledging from late June through late July. Newly fledged goshawks remain close to the nest tree for 2 to 3 weeks and then begin making longer movements until dispersal in mid- to late August (Kennedy et al. 1994, Squires and Reynolds 1997).

Although notorious for their aggressive defense of nest sites, breeding goshawks are typically secretive and nest sites are often difficult to locate. At specific times, goshawks can be quite vocal in the vicinity of active nests, and this characteristic enables the use of taped vocalizations for locating them. Goshawks do not "sing," however, so surveyors cannot depend on stereotyped behavioral responses to territorial calls—a technique used successfully to census owls. For goshawks, broadcast calling methods depend on eliciting defensive responses from adults or food-begging responses from fledglings or the adult female. Compared with territorial song responses, these responses vary much more and depend highly on reproductive chronology and status.

Direct visual and auditory detectability of goshawks varies during the reproductive cycle. Before egg laying begins, detectability is high due to courtship vocalizations and over-canopy flights. During incubation and the early nestling stage, however, adult females are often unresponsive and detectability is very low. Defensive behavior by adult goshawks increases later in the nestling stage and throughout the fledgling stage, resulting in increased detectability. As fledglings reach 2 to 3 weeks of age, they begin to respond to food-begging calls, and their highly vocal responses account for most detections late in the season (July to August) (USDA Forest Service 2000).

Survey methods also depend on indirect detection of goshawks through signs such as old nest structures, molted feathers, feces, and remains of prey. Abundance of signs tends to increase steadily throughout the breeding season, and signs may be detected at territories occupied by nonbreeding goshawks.

Female goshawks begin molting primaries and secondaries during incubation; males molt later in the summer (Henny et al. 1985). Molting results in scattered feathers that are visible on the ground in the immediate vicinity of active nests or roost areas beginning in May and increasing through the breeding season. Detection of multiple feathers from an adult female goshawk is strongly indicative of an active nest site nearby. Molted feathers of male goshawks tend to be more widely scattered.

Goshawks forcefully eject their feces, resulting in long white streaks ("whitewash") on the forest floor and downed trees near favored perch sites and active nests. While these deposits are not reliably diagnostic of occupancy by goshawks, they do indicate regular presence of a large raptor and areas deserving focused searches. During incubation, female goshawks defecate from perch sites away from the nest; detectable accumulations of whitewash do not occur at the nest until the nestlings are about 10 days old and begin defecating over the nest edge (typically late May to early June).

Remains of prey items are another important source of signs used in goshawk surveys. Goshawks frequently pluck or dismantle their prey on exposed sites such as downed logs, stumps, or snags, leaving patches of feathers and fur. These sites, known as "plucking posts," can be scattered throughout the territory, but a few typically occur near nest areas, often upslope from the nest or in an adjacent opening. Detection of patches of feather or fur pulled from medium- to large-sized prey species such as squirrels, hares, grouse, woodpeckers, and jays is highly suggestive of goshawk presence, and such areas deserve focused surveys.

During courtship and early nest building, goshawks will add fresh material to multiple nests before settling on a single nest for the breeding effort. Dawn courtship vocalizations may occur at these extra nests, although the active nest may be hundreds of meters' distance. Detection of nests built-up with new sticks and green sprigs, in combination with other signs such as molted feathers and whitewash, indicates an occupied territory. Such nests are frequently misclassified as abandoned or failed nests during survey and monitoring efforts.

Largely silent outside of the breeding season, goshawks become quite vocal during courtship and nesting. At least four distinct vocalizations may be detected during goshawk surveys.

- Alarm call—a harsh kak-kak-kak repeated many times, typically directed toward intruders near the nest but occasionally used between pair members.
- Wail call—a loud, plaintive, drawn-out call used in communication between pair members. During nesting, female goshawks often wail from the nest, possibly a form of food begging.
- Food begging call—a thin, plaintive wail given by nestling and fledgling goshawks to solicit food delivery or express hunger.

- Food delivery call—a short, guttural *kuk,* usually given singly or widely spaced, given by the male goshawk upon entering the nest area with prey. This call typically elicits wailing and frantic begging from the female goshawk and older nestlings and from fledglings during the postfledging dependency period.

The ability of any particular survey method to determine territory occupancy or reproductive status is affected by the probability that a territory is occupied or by the probability of a territory having an active or successful nest. Work conducted to date indicates that northern goshawks exhibit high degrees of annual variation in reproduction (Keane 1999; Reynolds and Joy 1998, 2006). Less work has been conducted on determining annual variation in territory occupancy, largely because determining occupancy in territories without successful nests requires intensive and extensive surveys early in the breeding period and adult goshawks on territories without successful nests are difficult to detect. Representative data from the Sierra Nevada and Kaibab Plateau indicate the magnitude of annual variation observed (table 3.1) (Keane 1999, Reynolds and Joy 1998). The proportion of territorial pairs with active nests varied from 22 to 86 percent on the Kaibab Plateau in Arizona during the 1990s (Reynolds and Joy 1998). Annual variation in reproduction is associated with variation in prey and weather (Keane 1999).

Annual variation in reproduction can have a large impact on the outcome of surveys. For example, if a survey relies solely on Broadcast Acoustical Surveys conducted during the nestling and fledgling stages, such survey efforts could have very low probabilities of locating territories and/or determining occupancy and reproductive status because response rates of nonbreeding territorial adult goshawks or pairs with failed nests is unknown and probably lower and more variable than at territories with successful nests.

Table 3.1. *Variation in territory occupancy, nest activity, and nest success for northern goshawks observed in the Lake Tahoe Region, California, and Kaibab Plateau, Arizona, during 1992–96.*

| Variable | Lake Tahoe Region | | | | Kaibab Plateau | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1992 | 1993 | 1994 | 1995 | 1992 | 1993 | 1994 | 1995 | 1996 |
| Number of territories | 17 | 17 | 19 | 24 | 37 | 64 | 82 | 88 | 100 |
| Percent occupied[1] | 100.0 | 82.4 | 84.2 | 87.5 | 95.3 | 89.0 | 38.6 | 75.0 | 64.5 |
| Percent active nests | 100.0 | 76.5 | 47.4 | 70.8 | 86.5 | 76.6 | 22.0 | 48.9 | 39.0 |
| Percent successful nests[2] | 82.4 | 47.1 | 36.8 | 58.3 | 59.0 | 62.5 | 15.8 | 37.5 | 29.0 |

[1] Percentage of territories meeting criteria for "confirmed" occupancy. (See 3.5.2).
[2] Percentage of all occupied territories fledging at least one young.
Sources: Lake Tahoe Region data: Keane (1999). Kaibab Plateau data: Reynolds and Joy (1998).

During courtship and nest building, goshawks are highly susceptible to human disturbance and have been recorded to abandon nest areas following human intrusion. Incubating females often appear to be unmoved by human intrusion near their nest, but they may interrupt incubation for extended periods to defend the nest. Surveys involving physical entry into potential nesting habitat should not be conducted until late May to June. Early confirmation (but no earlier than May 15) of territory occupancy should be determined by Dawn Acoustical Surveys or rapid visual checks of known nests from a distance.

### 3.2.2 Sampling Designs

The survey methods described in this chapter are intended for a variety of purposes, and the design used for each purpose will vary. If the objective is to conduct an inventory over a large area, the sampling design can be a stratified random sample or systematic sample from a randomly selected start point within a predetermined inventory area. The importance of using a specific sampling design and ensuring randomization cannot be overemphasized for large area inventories. Convenience sampling in roaded areas and within proposed projects does not constitute an area inventory. The bioregional monitoring design described in chapter 2 provides a useful framework for large area inventories, because sample units are based on approximate size of goshawk territories and stratification provides an efficient use of inventory funds.

In general, a specific sampling design is needed if the objective is to obtain an estimate from a sample of goshawk nests or territories rather than to conduct a complete census. If the objective is to determine whether goshawks are actively nesting within a proposed project area, the design will be more in keeping with a census, because it will be necessary to survey all potential habitats with a variety of survey techniques to maximize the likelihood of finding an active nest. The rigor of a sampling design is less important than the survey outcome, and randomization is not needed. It is important, however, to ensure that habitats considered to be of marginal quality are included in the survey to minimize the probability of missing a nest.

If the objective is to map the distribution of goshawk territories within a prescribed area, such as a ranger district, the approach will depend on the amount of knowledge acquired before the mapping effort. If little is known about goshawk distribution and the area is large, a stratified random sample is recommended initially. After certain territories are known and mapped, the location of further surveys can be based on gaps between known territories, using approximate territory size and the physical layout of potential habitat in the unsurveyed area. See section 3.6.3 Large Area Survey Application for details.

## 3.3 Data Collection

### 3.3.1 Survey Methods

This section describes four basic methods for conducting surveys for northern goshawks. The relative advantages and disadvantages of each method depend on the objectives of a given survey. Dawn Acoustical and Intensive Search Surveys are time- and labor-intensive methods with high detection rates; they are most appropriate for surveys focused on known goshawk sites and patches of high-quality habitat. Broadcast Acoustical Surveys, on the other hand, are better suited for covering large areas efficiently. These methods can be used singly or in combination to achieve a variety of objectives. Examples of three common objectives and standardized survey approaches are described under section 3.6 Survey Applications.

**Dawn Acoustical Survey**

This method is based on detection of courtship vocalizations and flight displays of goshawks at their nest sites. It consists of establishing "listening stations" in close proximity to known nest stands or patches of suitable habitat and conducting 1½-hour listening periods at dawn during the early breeding season (Dewey et al. 2003, Penteriani 1999).

***Protocol***

**1. Establishment of survey stations.** Listening stations should be positioned within 150 m (meters) of all habitats to be surveyed. Use aerial photographs to determine point locations providing optimal coverage of suitable habitat within a radius of 150 m (7.1 ha [hectares]). To reduce attenuation of sound by surrounding vegetation or landforms, locate stations on slightly elevated positions, whenever possible, but not on ridges or in large openings. Efficiency may be increased by location of stations on roads; however, tradeoffs with position may occur within habitat patches. Stations must be clearly marked to allow for finding their location in darkness.

Whenever possible, establish multiple stations approximately 300 m apart to achieve simultaneous coverage of entire survey area by multiple observers.

**2. Timing of surveys**

*Seasonal timing.* To coincide with the peak of courtship vocalizations by goshawks at their nest sites, surveys should be conducted during the month preceding egg laying. Reproductive chronology likely varies between geographic regions and elevations, and local information should be used to estimate egg-laying dates. Backdating from estimated ages of nestlings can be used to determine reproductive chronology; use Boal (1994) to estimate ages of nestlings, and add 33 days incubation period. For example, if nestlings are typically 15 days old on June 15, surveys should be conducted in the area between March 15 and April 28. Note that during years with particularly cold or wet spring weather, onset of incubation may be delayed for up to 1 month.

If no detections of goshawks are heard during the first listening session, a repeat session should be conducted before May 1. Two sessions are required to assign "unoccupied" status to the area surveyed.

*Session timing.* The observer should arrive and be settled at the listening station *at least* 45 minutes before sunrise. The listening session should continue until 1½ hours after sunrise. Plan carefully so that the entire listening session can be conducted without interruptions for moving position, warming, eating, potty breaks, and other distractions.

**3. Listening session methods.** During each listening session, record start and stop time, actual sunrise onset, time and duration of goshawk vocalizations, type of goshawk vocalizations, and direction (bring compass) and estimated distance of goshawk vocalizations. To ensure consistency of data collection, a standard field data collection form (appendix D) should be used.

Dewey and others (2003) reported a variety of calls detected during dawn acoustical surveys in Utah. Calls included variations of the alarm call (*kak-kak-kak*) (Squires and Reynolds 1997) and plaintive wail call (Squires and Reynolds 1997). Length of vocalizations varied from short, one-note call segments to series of alarm calls and wails lasting up to 10 seconds.

**4. Locating nest sites.** Auditory detection of goshawks during courtship indicates occupancy of the surveyed forest patch; subsequent location of the nest should not be attempted until after the estimated date of hatching. Intensive Search Surveys should be employed to locate nests.

**5. Observer training.** The principal requirement of this method is familiarity with vocalizations of goshawks and other species likely to be detected during surveys. Taped examples of goshawk alarm and wail calls, as well as vocalizations of the pileated woodpecker (*Dryocopus pileatus*), northern flicker (*Colaptes auratus*), sapsuckers (*Sphyrapicus spp.*), and Cooper's hawk (*Accipiter cooperii*) should be memorized and reviewed before conducting surveys.

An important aspect of Dawn Acoustical Surveys is observer transportation during early spring when snow conditions may limit access to many survey areas. Safety and logistical feasibility are important concerns when using snowmobiles and skis before sunrise, often in rugged terrain. Prior experience with forest carnivore, great gray owl (*Strix nebulosa*), and goshawk surveys has shown, however, that safe, efficient access is possible under these conditions, particularly if observers work in pairs. Training in snowmobile use, winter travel safety, and communications is essential for employment of this method.

### *Rationale*

**Primary advantages.** Surveys can be conducted early (February to April), about 2 to 4 months before Broadcast Acoustical Surveys can be initiated, and these surveys have a *very* high probability of detecting goshawks if they are present (Dewey et al. 2003, Penteriani 1999). In addition, because surveys are conducted during early courtship, results are less affected by nest failure. Only one to two listening sessions are required to obtain detections (Dewey et al. 2003).

Penteriani (1999) reported detection rates of 100 percent at occupied goshawk nests in hardwood forests of southern France. Validation studies by Dewey et al. (2003) demonstrated a 90-percent detection rate at listening points less than 152 m from 20 occupied goshawk nests during March and April in conifer/conifer-aspen forests in Utah. Goshawks were detected during Dawn Acoustical Surveys at 19 of 20 (95 percent) occupied nest stands in northern California (Keane and Woodbridge 2002). Six of the occupied sites contained nonbreeding pairs.

**Primary disadvantages.** First, this method may be logistically difficult to apply in areas where access is limited by snow during the period when surveys would be conducted; however, prior success with forest carnivore surveys suggest that use of snowmobiles and skis need not represent an obstacle. Second, listening points survey a limited area (150-m radius); therefore, many stations may be required to cover large areas such as timber sales. If only 1 year of survey is used, this method may not identify nest stands that are unoccupied during the year of survey. Only one station (17.1 ha) can be surveyed per observer per day.

### Intensive Search Survey

This method combines visual searches for signs of goshawk presence (nests, whitewash, prey remains, molted feathers) along closely spaced (20 to 30 m) transects (Reynolds 1982), with Broadcast Acoustical Surveys. Goshawk calls are broadcast along within-stand transects simultaneously while visual searches are taking place. This method is best applied to smaller units of area (4 to 40 ha), following stratification of habitat quality (Reynolds 1982, USDA Forest Service 2000).

#### *Protocol*

**1. Transect routes and coverage.** Use aerial photographs and transportation maps to determine placement and direction of transects for optimal coverage of habitat to be surveyed. Determine compass bearing to be used in each survey. Number of observers (and simultaneous transects) is determined by size of habitat patch or unit to be surveyed; typically a minimum of three observers is required. Attempt to 'anchor' start and end points of transects on roads, trails, streams, or other features.

**2. Timing of surveys.** Intensive Search Surveys require presence of multiple observers within nesting habitat and are likely to cause excessive disturbance to breeding goshawks if conducted too early in the nesting period. Do not initiate surveys before the estimated hatching date.

The effectiveness of Intensive Search Surveys increases as the breeding season progresses, as nestling goshawks become more vocal, and as whitewash, molted adult feathers, and other signs accumulate in the vicinity of the nest. Intensive Search Surveys are most effective during late June through August. Searches may be conducted until snowfall; however, detections will increasingly depend on signs as adult and young goshawks move out of the nest area in the fall, and signs are lost due to precipitation and leaf fall.

**3. Number of surveys.** If conducted by experienced observers during late June, July, or August, a single Intensive Search Survey may be sufficient to determine goshawk presence within a habitat patch. If *any* sign of the presence of goshawks (feathers, old nests) is detected during searches, however, repeated surveys are necessary to determine nest core location (unless occupied territory status is assumed).

Data from Keane and Woodbridge (2002) indicate that single-visit detection rates obtained with this method are about 97 percent at goshawk sites with active nests, 73 percent at sites with occupied nonbreeding status, and 43 percent at unoccupied historical nest stands (table 3.1). If survey objectives require detection of sites with nonbreeding adults, then two visits are required to achieve detection rates greater than 90 percent.

**4. Equipment needed.** Broadcast system, self-sealing bags and labels, flagging, compass, and reference feather collection.

**5. Conducting intensive searches.** Following a predetermined compass bearing, observers should walk parallel transects spaced 20 to 30 m apart (30 m spacing may be used in open, tall-canopied stands where visibility is high). Mark the start point of each transect with individually marked flagging to allow retracing of the survey. The middle of the three observers should broadcast recorded goshawk vocalizations at points every 250 m along the transect, on every third transect line *(all observers follow procedure 3 under Broadcast Acoustical Survey).* Surveyors should attempt to maintain 250x250 m spacing of broadcast stations.

Searches should be conducted at a leisurely pace, allowing ample time for scanning the ground for signs, logs and low limbs for plucking sites, and *all* trees for nest structures. Any signs encountered (feathers, prey remains) should be collected in self-sealing bags labeled by transect location. Visual or auditory detections of goshawks should be recorded by transect location and detection type. Careful attention to the location of adjacent observers, especially the middle (broadcasting) observer, and to the compass bearing is important for maintaining consistent spacing of individual transects.

At the end of each individual transect, each observer should stop, flag the transect end point, and move to the start point of the next transect. If transects are directed back into the same habitat patch, the "hinge" or end observer should space the new transect no more than 20 m from the previous transect; this spacing reduces the potential of unsurveyed strips of habitat between transect groups. To ensure consistency of data collection, a standard field data collection form (appendix D) should be used.

**6. Postsurvey activity.** After completing a survey, the observers' notes, data forms, and collections should be immediately reviewed. Any collected feathers should be identified by comparison with reference samples. The USDA Forest Service guide, *Feathers of Western Forest Raptors and Look-Alikes,* located on the CD inside the back cover of this technical guide, can be used to aid in identifying feathers collected during surveys. Prey remains should be identified and the frequency of occurrence of each prey type should be assessed for each transect area. Any reports of whitewash and prey remains should be mapped, based on transect location notes. The entire area actually surveyed should be mapped.

Although whitewash and/or prey remains may indicate presence of other raptors, whitewash *and* remains of typical goshawk prey (e.g., snowshoe hare [*Lepus americanus*], Steller's jay (*Cyanocitta stelleri*), northern flicker, and various species of grouse and tree squirrel) are suggestive of goshawk presence and trigger "possible presence status" and followup survey of the suitable habitat surrounding (min. 300-m radius) the site. This need for a followup survey is particularly true if the initial survey was conducted early in the season, before July.

Because female goshawks molt during incubation and nest attendance, their molted flight feathers are typically found in the immediate vicinity of occupied nests. Male goshawks molt later in the season, and their feathers may be found over a larger area. Detection of goshawk feathers triggers "occupied status" and followup surveys of the suitable habitat surrounding the site (min. 300-m radius) to locate the active nest.

If visual or auditory detection of a goshawk is made during an Intensive Search Survey *and* signs are present in the stand surveyed, the area should be considered occupied. (See section 3.5.) To locate the nest, followup surveys of the suitable habitat surrounding the site (300-m radius) should be conducted 1 to 2 weeks after the initial survey.

Visual or auditory detection of a goshawk made during an Intensive Search Survey, *but with no signs encountered in the stand*, suggests that a nesting area may be located adjacent to the area searched. Broadcast Acoustical Surveys of the stand and adjacent stands should be conducted.

### *Rationale*

**Primary advantages.** Compared to the Broadcast Acoustical Survey, the Intensive Search Survey yields a higher probability of identifying nest stands when goshawks are not currently breeding or nests have failed (table 3.2), and it can detect alternate but inactive nest stands. If experienced observers conduct surveys, this method may be completed within one breeding season and provide high confidence that the area searched does not contain a goshawk breeding site. Conclusions drawn from searches conducted within a limited area during a single season, however, may not be applicable to surrounding habitat.

Table 3.2. *Comparison of detection rates of two survey methods for northern goshawks.*

| Method | Territory plot status | | |
|---|---|---|---|
| | Nesting | Occupied nonnesting | Unoccupied–old nests[1] |
| **Broadcast Acoustical Survey** | | | |
| One visit | 0.90 | 0.64 | 0.36 |
| Two visits | 0.94 | 0.87 | 0.59 |
| Three visits[2] | 1.00 | 0.96 | 0.73 |
| **Intensive Stand Search Survey** | | | |
| One visit | 0.97 | 0.74 | 0.43 |
| Two visits | 1.00 | 0.93 | 0.67 |
| Three visits | 1.00 | 0.98 | 0.81 |

[1] Rate is for detection of old nests at unoccupied territory plots.
[2] Three-visit probability calculated using binomial expansion of one-visit detection *p*.
Source: Keane and Woodbridge (unpublished data).

**Primary disadvantages.** Intensive Search Surveys are labor intensive and best suited to assessment of small patches of habitat 4 to 40 ha in size. A survey requires a minimum of three people to be effective. This method is not likely to detect goshawks if the nest is farther than 200 m from the area being surveyed. The effectiveness of this method also can vary depending on the time of the breeding period during which it is conducted. In general, the effectiveness of this method increases with time during the breeding season as more signs may be present in occupied nest stands later in the breeding period. Surveys conducted later in the breeding period, however, may be less effective in territories with early nest failures, particularly in regions where summer monsoons can reduce detection of whitewash.

This method depends highly on detection of signs and nest structures, but these signs may be present regardless of current goshawk reproductive status. For this reason, detecting signs or nests triggers an "occupied" status for the stand surveyed and surrounding area, regardless of current reproductive status. Additional surveys during 1 or more years may be required to locate the nest site and establish appropriate management zones.

## Broadcast Acoustical Survey

This method is based on broadcast of taped goshawk calls at points along transect routes to elicit responses from defensive territorial adult goshawks and their young. Often termed the "Kennedy-Stahlecker Protocol," it is currently the standard method used by the USDA Forest Service and many others. The efficacy of this method has been evaluated in terms of response rates at known successful nests (Joy et al. 1994, Kennedy and Stahlecker 1993, Watson et al. 1999), and recently at territories occupied by nonbreeding goshawks (Keane and Woodbridge 2002).

### *Protocol*

The protocol is based on the methods described by Kennedy and Stahlecker (1993), with refinements from Joy et al. (1994) and Watson et al. (1999). Adjustments to the number of surveys required and spacing of calling stations were made to optimize probability of detection and survey effort and cost.

**1. Establishment of survey transects and stations.** Before initiating surveys, use aerial photographs and topographic maps to determine optimal placement of survey transects. Draw detailed maps of survey routes and station location and provide them to crews conducting surveys. When possible, establish start and end points of transects along existing roads, trails, streams, or other landforms. The maximum distance between parallel transects should be 250 m. Minimize number of stations located on roads, unless roads are entirely within the habitat of interest.

Call stations should be located 200 m apart along each transect. To increase coverage, offset station locations on adjacent transects by 100 m. The most important factor in transect and station placement is completeness of coverage; to achieve acceptable confidence in survey results, all suitable habitat should be within 150 m of a calling station.

For project surveys, the survey area should include the proposed project area plus an additional buffer beyond the project boundary. For projects involving significant modification of forest structure (e.g., commercial thinning), the survey should extend 800 m beyond the project boundary. This distance corresponds to the mean radius of the postfledging area (about 200 ha) and will allow for detection of territories that overlap the project area. For projects that involve minor modification of forest structure (underburning, light underthinning, light salvage) surveys need extend only 400 m beyond the project boundary.

**2. Timing of surveys.** Surveys should be conducted during the nestling and fledgling stages, including early postfledging dependency. This period corresponds to June 1 to August 15 over much of the range of the northern goshawk. When possible, use local information on nestling ages and dates to estimate hatching dates. After August 15, many fledgling goshawks will have moved out of the immediate vicinity of the nest stand, making location of the actual nest more difficult. Survey results might be unreliable after August 30. Surveys may begin half an hour before sunrise and should cease half an hour before sunset.

**3. Calling procedure.** At each calling station, broadcast at 60 degrees from the transect line for 10 seconds, then listen and watch for 30 seconds. Repeat this sequence two more times, rotating 120 degrees from the last broadcast. Repeat the three-call sequence again. After the last sequence, move to the next station. Move (walk) between stations at an easy pace, listening and watching carefully for goshawk calls and signs. The majority of time will be spent walking between stations, so it is important to be alert for goshawks approaching, often silently, to investigate the surveyor. Do not survey from vehicles or use vehicles to move between stations. Use of two observers will likely enhance the probability of visual detections of goshawks; however, experienced surveyors may conduct surveys singly (unless it is part of the bioregional monitoring design, in which case two surveyors is mandatory). To avoid misidentifying broadcasts of coworkers, simultaneous surveys should be conducted no closer than two transect widths apart.

- During the nestling stage, broadcast the adult alarm call.
- During the late nestling and fledgling stages, broadcast the juvenile begging or wail call. This call is more likely to elicit responses from juvenile goshawks.

Do not survey under conditions such as high winds (greater than 15 mph) or rain that may reduce ability to detect goshawk responses.

Record the detection type, compass bearing, station number, and distance from transect of any responses detected. Attempt to locate the goshawk visually and determine the sex and age (adult versus juvenile/fledgling) of the responding individual. To ensure consistency of data collection, a standard field data collection form (appendix D) should be used.

**4. Number of surveys.** Surveys should be conducted at least twice during a given year. Detection rates of one-, two-, and three-visit surveys are given in table 3.1. Depending on the survey objective, surveys may need to be conducted during 2 consecutive years. See section 3.6 Survey Applications for discussion of multiyear surveys.

**5. Equipment.** Effective coverage of a survey area depends on the surveyor's ability to broadcast sound that can be detected at least 200 m from the source. Kennedy and Stahlecker (1993) and Fuller and Mosher (1987) recommend using equipment producing at least 80 to 110 dB output at 1 m from the source. Regardless of the type of equipment used, broadcast goshawk calls should be audible at least 200 m from the calling station.

Until recently, the most commonly used broadcast equipment has been a small personal cassette player connected to a small megaphone. Recent developments include CDs and MP3 players as storage media and improved digital amplifiers that store goshawk calls on internal chips.

Other equipment required for surveys include compass, binoculars, flagging or other station markers, and self-sealing bags and labels for feathers and prey remains.

**6. Preparation for survey.** Study the appearance and typical flight patterns of goshawks and similar species before conducting surveys. Recent field guides should be consulted to review the field marks of male, female, and juvenile goshawks, as well as those of Cooper's hawks and red-tailed hawks (*Buteo jamaicensis*).

Practice recognizing goshawks under field conditions before conducting surveys. Training sessions should include visits to a few known nests to enable survey personnel to develop familiarity with goshawk behavior and vocalizations. Identification of goshawk nests, plucking posts, feathers, whitewash patterns, and typical prey remains are also important aspects of survey preparation. The USDA Forest Service guide, *Feathers of Western Forest Raptors and Look-Alikes,* located on the CD inside the back cover of this technical guide, may be used to aid in identifying feathers collected during surveys.

Learn the typical vocalizations of goshawks and species with similar calls by listening to recorded examples. Examples of high-quality recordings of goshawks and sound-alikes are available from the Cornell Laboratory of Ornithology program, *Birds in Forested Landscapes,* and from the USDA Forest Service recording, *Voices of Western Forest Raptors*, included in the CD located inside the back cover of this technical guide. Field experience is important in learning to distinguish the vocalizations of goshawks from those of mimics such as gray jays (*Perisoreus canadensis*) and Steller's jays. These species are capable of producing excellent imitations of goshawk calls, particularly the female wail and juvenile begging call, and often respond to broadcast calls. Pileated woodpeckers, northern flickers, sapsuckers, and Cooper's hawks also have calls similar to those of goshawks.

**7. Interpretation of goshawk responses.** Surveyors should be aware of different types of responses likely to be encountered during surveys. Joy et al. (1994) classified responses into three categories: vocal nonapproach, silent approach, and vocal approach. The frequency of each response type varies between sexes, ages, nesting stage, and vocalization broadcasted.

- Vocal nonapproach—goshawks may respond by perching away from the surveyor, often at the nest, and vocalizing. This response is commonly elicited from older nestlings and juveniles as begging calls, in response to broadcast of either alarm or food-begging calls.
- Silent approach—goshawks, particularly adult males, will frequently fly silently in the direction of the surveyor to investigate and may be visible only briefly. Silent approach by female goshawks during the nestling and fledgling stages typically indicates an active nest within 200 m, but male responses may be long distances from the nest. Failure to detect this common response is a likely cause of false negative survey results.
- Vocal approach—commonly in response to broadcast of alarm calls, adult female goshawks (and, less often, males) frequently fly toward the surveyor while vocalizing alarm calls. This response typically indicates the active nest is within 200 m, particularly if the adult goshawk remains in the vicinity of the surveyor.

**8. Locating active nests.** Searches for active nests may be conducted immediately following goshawk detections (particularly vocal approaches or attacks); however, it is often necessary to review the results from multiple surveys and stations from a larger area to approximate the likely areas to search. Response type, distance and direction from transect, and distribution of habitat should be plotted on aerial photographs, and the Intensive Search Survey method should be employed.

***Rationale***

**Primary advantages.** The Broadcast Acoustical Survey is a commonly used, standardized protocol with estimates of effectiveness at breeding and nonbreeding sites and with a known rate of effort and cost (Joy et al. 1994, Watson et al. 1999). It is efficient (table 3.2) and applicable to large areas of land. In the protocol described here, minor adjustments to the number of surveys required and spacing of calling stations were made to optimize probability of detection and survey effort and cost.

**Primary disadvantages.** Effectiveness has been studied largely at active nests (Watson et al. 1999, Kimmel and Yahner 1990, Kennedy and Stahlecker 1993). Effectiveness is likely reduced at nonbreeding or failed sites (Keane and Woodbridge 2002) (table 3.2). Studies of territory occupancy, breeding, and success rates suggest that 20 to 80 percent of territories could be missed in a given year due to nonbreeding or failed reproductive status if detection rates are low at these sites. A high proportion of responses are from fledglings, which are not present at failed or nonbreeding sites. Multiple years of surveys may partially mitigate this factor. Recent work reported by Watson et al. (1999) suggest that increased numbers of surveys per year or closer spacing of sample points (compared to Kennedy and Stahlecker 1993) may be needed to increase probabilities of detecting active nest sites.

Watson et al. (1999) reported that the probability of detecting an active nest was affected by the distance from the call point and the number of broadcast samples conducted at a call point. They reported single-visit probability of detections of 42 percent at 100 m from active nests, 25 percent at 250 m, and 20 percent at 400 m. Based on cumulative response curves, they estimated that single visits to nests had probability of detections of 60 percent at 100 m and 38 percent at 250 m. Kennedy and Stahlecker (1993) reported detection rates of 73 percent during the nestling stage and 77 percent during the fledgling stage at 100 m from active nests based on single visits. Little is known about the probability of detecting nonbreeding adult goshawks at inactive territories or territories with failed breeding attempts (Kennedy and Stahlecker 1993, Kimmel and Yahner 1990, Watson et al. 1999). Keane and Woodbridge (2002) reported single-visit detection rates of 64 percent at occupied territories with failed nests or nonbreeding adults, compared with 90 percent at sites with active nests (table 3.1). Response rates are lower and more highly variable at territories with failed reproductive attempts, and particularly at territories with nonbreeding adults, relative to territories with active and successful nests.

Several issues require further consideration and research. First, further research is needed to evaluate the relationship between detection rates and distances between sample points. Second, given uncertainty regarding the efficacy of this method in detecting nonbreeding goshawks or failed nest attempts, multiyear surveys are required to have a high confidence in locating active nests (DeStefano et al. 1994). Third, this method is likely very sensitive to observer bias (observer experience and motivation). Finally, the method is labor intensive and can be difficult to fully implement in steep, rugged terrain.

### Aerial Nest Survey

***Primary advantages.*** In coniferous and mixed-forest ecosystems, visibility of goshawks is strongly limited by dense evergreen forest canopies, and survey methods require visual searches from beneath the canopy. Surveys from airplanes and helicopters, however, may be employed in some deciduous forest types in which nests are not concealed by vegetation. This method has been successfully used to locate occupied goshawk nests in pure stands of quaking aspen (*Populus tremuloides*) in the Great Basin (Herron et al. 1985, Younk and Bechard 1994). Studies of the effectiveness of aerial surveys for goshawks have not been conducted, and detection rates are unknown.

***Primary disadvantages.*** Aerial searches for tree-nesting raptors must be conducted at slow speeds (45 to 70 km/hr: Fuller and Mosher 1987) to allow visual access to the most trees within a stand. For this reason, helicopters and ultralight craft are probably best suited for goshawk surveys under typical conditions. Younk and Bechard (1994) used helicopters to survey widely spaced, relatively small stands of riparian aspen in Nevada. Their surveys were conducted before the emergence of aspen catkins in April and consisted of systematic searches for stick nests with signs of breeding activity. Foot searches were later employed to confirm goshawk presence and breeding status at nests identified from the air. It is unknown whether aerial surveys may be applicable in other deciduous forest systems, such as the Great Lakes Region, where stands of aspen may be intermixed with coniferous forest types.

## 3.3.2 Quality Control/Quality Assurance

### Method Validation

Protocols for goshawk surveys are well established, and standardized surveys have been conducted on this species for more than 12 years (Joy et al.1994, Kennedy and Stahlecker 1993, USDA Forest Service 2000).

No evaluations of the potential bias introduced from observer variation on northern goshawk survey methods and results have been conducted. Observer variation has been demonstrated to influence the effectiveness of wildlife surveys (Verner 1985, Verner and Milne 1989). Experience and motivational levels of observers conducting the fieldwork likely have significant effects on the efficacy of northern goshawk surveys.

Surveys are often conducted by seasonal technicians with little or no experience with northern goshawk behavior, identification, or survey methodologies. Keane and Woodbridge (2002) compared detection rates of experienced and inexperienced teams conducting Broadcast Acoustical and Intensive Search survey protocols.

Detection rates of inexperienced observers in this study were initially lower than those of experienced observers but rapidly improved to roughly the same levels by early July following visits to numerous occupied goshawk territories.

**Personnel Qualifications and Training**

Standardized training materials should be developed and provided to field personnel planning to conduct goshawk surveys. Training materials should include identification of vocalizations of goshawks and sound-alikes, identification of goshawks and other forest raptors, identification of molted feathers of forest raptors, and a detailed description of survey protocol implementation. *Voices of Western Forest Raptors and Sound-Alikes* and *Feathers of Western Forest Raptors and Look-Alikes* are two products distributed with this technical guide for the purposes of training and field survey use. Training sessions should be conducted in association with goshawk study sites where trainees can observe breeding goshawks.

Survey crews should consist of two people with one person assigned as crew leader. The survey crew leader should have field experience with goshawks and knowledge of goshawk vocalizations, signs, and behavior, and the ability to train inexperienced partners. At the completion of each survey visit, data entry forms and maps should be assembled and reviewed for inconsistencies or incomplete data by the survey crew leader.

## 3.4 Data Storage

All data on goshawk observations and surveys will be entered into the National Resource Information System (NRIS) Fauna application of the USDA Forest Service using NRIS Fauna version 1.3.1 or later versions as they become available. The Feature, Observation, and Survey tools are to be used for entering goshawk observation and survey data. Refer to the NRIS Fauna User Guide and Web site (http://www.fs.fed.us/emc/nris/fauna/) for instructions on how to enter data into NRIS Fauna. Both classroom and Web conference training sessions are available and may be tailored, on request, to specifically discuss entry of goshawk monitoring data. The capability of NRIS Fauna may be expanded in the future to include a Goshawk Observation and Survey Tool.

## 3.5 Data Analysis and Interpretation of Survey Results

Survey results (detections of goshawks and their signs) must be evaluated with specific criteria for determining the status of a territory or survey area. Even with clearly defined criteria, some ambiguity will always be present in status determinations because of the high mobility and secretive nature of nesting goshawks. Positive data such as vocal responses and molted feathers are easily interpreted, whereas negative or scant data are difficult to prove.

Status determinations are strongly influenced by the intensity and areal extent of survey efforts. Conducting a brief Intensive Search Survey may be adequate to determine lack of goshawk presence within a 50-acre nest stand; however, this determination cannot be extrapolated to an entire territory or watershed.

Status determinations are also influenced by the objectives of the survey. For project surveys, lack of detections may mean that goshawks do not inhabit the project area or that the surveys were conducted within a goshawk home range but not within the defended core area. It is important to establish *a priori* whether surveys are for simple presence or for occupied nest sites within some prescribed area. The following categories of area or territory status are used to describe outcomes of goshawk surveys and should be used in effects determination under the National Environmental Policy Act (NEPA).

### 3.5.1 Presence

Simple determination of whether goshawks are present or absent in a given area may be adequate for broad-scale monitoring (i.e., the Bioregional Monitoring Design) in which information on nest site location or reproductive status are not required. Presence is one criterion used to establish territory occupancy, but presence can also represent subadult or nonterritorial goshawks ("floaters").

The following types of evidence are used to determine presence:

- Goshawks seen or heard in the survey area.
- Presence of goshawk molts (feathers) in the survey area.

### 3.5.2 Occupancy

Occupancy is defined by the presence of territorial adult goshawks within a nesting area, regardless of reproductive status. Types of evidence used to determine occupancy are similar to those used for presence/absence, except that more evidence of consistent use is required to determine territorial occupancy. For demographic studies, Reynolds and Joy (2006) defined an occupied territory as (1) a territory in which goshawks were observed on two or more occasions or (2) a single observation of an adult goshawk combined with the presence of molted feathers, feces, and new nest construction in a season. These criteria are applied annually to survey results obtained at goshawk territories with a previous history of occupancy. In areas without a previous history of goshawk occupancy, however, determination of occupancy should include evidence that goshawks detected are in fact within a territory and did not originate outside of the survey area.

The following types of evidence indicate occupancy:

- Goshawks exhibiting defensive behavior in the survey area.
- Goshawks seen or heard in the survey area.
- Presence of goshawk molts in the survey area.
- New construction (greenery) and/or down on nest structure.
- Goshawk feces in the survey area.
- Presence of prey remains in the survey area.

Determination of confirmed occupancy requires at least one of the following:

- Detection of adult goshawks exhibiting defensive behavior (alarm calls, approaching observer while vocalizing).
- Any combination of three of the six evidence types listed above in the survey area.
- Combination of visual/auditory detection and molted feathers, visual/auditory detection and new nest construction, or molted feathers and new nest construction observed in the survey area.

Determination of possible occupancy requires at least one of the following:

- Location/observation of a visual/auditory detection, molted feathers, or new nest construction.
- Combination of prey remains and feces in the survey area.

Assignment of "nonoccupied" status to a survey area is problematic because of the intensive effort required to support this determination. If survey results are not compelling, it is preferable to categorize areas without detections as "surveyed with no detection." To determine occupancy status more precisely, see section 3.3.1 Survey Methods for the level of effort and detection rates used for determining occupancy status for each method.

### 3.5.3 Breeding

Breeding status is indicated by a nest that has supported a reproductive attempt in the current breeding year. Nonreproducing goshawks may reconstruct or add greenery to one or more nests during the courtship period; therefore, a determination of breeding requires evidence of egg laying.

Direct evidence of egg laying includes observation of the following:

- Eggs (during climb to nest, from upslope, or with a mirror).
- Nestlings.
- Fledglings in the nest tree or nest area.

Indirect evidence of egg laying includes the following:

- Observation of adult female in incubation posture (sitting low on the nest, often barely visible) on 2 or more separate days.
- Presence of eggshell fragments below nest or near nest tree (fragments may be from failed eggs as well as after hatching).
- Presence of dime-sized nestling feces below the nest tree (typically found when nestlings are more than 4 days old).

### 3.5.4 Successful Nest

Active nests are considered successful if one or more fledglings survive to the branching or fledging stage (more than 34 days old).

Direct evidence of fledged young includes the following:

- Observation of one or more young goshawks judged to be at least 34 days old on nest or within the nest area.
- Auditory detection of more than one goshawk giving begging calls near a nest with signs of recent fledging (copious feces on ground, down on nest) after the usual fledging date (early July to August).

Indirect evidence of fledged young includes the following:

- Observation of an active nest with signs of recent fledging (copious feces on ground, down on nest, molted feathers, prey remains).
- Observation of remains of predated fledglings (more than 34 days old based on length of primary or tail feathers) in the nest area.

If nest checks are made while nestlings are younger than 34 days old, the nest may be classified as "active with young," but nest success remains unknown.

### 3.5.5 Fledging Rate

Accurate determination of the number of fledglings produced at goshawks nests is made difficult by the variability in fledging dates and behaviors of male and female fledglings. Male goshawks may leave the nest up to 10 days earlier than females, and fledglings may or may not return to the nest to roost and feed. Recently fledged goshawks are often lost to predation and are likely to be overlooked in fledgling counts. Simple counts of late-stage nestlings (28 to 34 days old) have the potential to miss early-fledging males or individuals laying down low in the nest cup, especially in larger broods.

If productivity data are desired, it is preferable to use counts of large nestlings (24 to 30 days old) as a surrogate for actual number fledged. If counts are made from the ground (nest tree not climbed), they should be repeated at least once to increase the probability of detecting all individuals. At nests with limited visibility, such counts are unlikely to consistently provide accurate information.

## 3.6 Survey Applications

Goshawk survey protocols may be used individually or in combination to address a variety of objectives. It is often desirable to vary the intensity or areal extent of surveys to most efficiently achieve specific objectives, depending on the type of goshawk data required, timing of projects, budgetary constraints, and logistical considerations.

The most common objectives of goshawk surveys are territory monitoring, small-area surveys for forest management projects, and large-area surveys for assessments or broad-scale management projects. The survey protocol applications provided below are designed to increase efficiency by maximizing detection rates and focusing survey effort.

### 3.6.1 Territory Monitoring Application

This application is for monitoring territory occupancy, determining nest locations, and determining reproductive success and productivity. The application is a stepwise process, based on the use of three survey protocols that are described in detail in section 3.3.1. To maximize efficiency, the stepwise procedure uses intensive methods early in the season, on areas most likely to contain the active nest. If goshawks are not detected during the first survey steps, more extensive methods are employed to locate new, widely spaced alternate nests.

The periodic relocation of nest sites is an important and often overlooked aspect of goshawk-breeding behavior. Monitoring efforts focused on one or two known alternate nests are unlikely to accurately determine occupancy and breeding status of entire territories, which often encompass alternate nests scattered over an 800-ha area. If budgetary or logistical constraints limit survey efforts to a smaller area, the status determination must be made at that scale and not extrapolated to the entire territory.

***Protocol***

**Preparation.** Using recent aerial photographs or digital orthophotoquad maps, superimpose a grid (100x100 m cell size) over the "territory area"; a 0.6-km radius surrounding the last known nest or geometric center of all known alternate nests in a territory. In particular, this map should display roads, streams, drainages, and openings that will be helpful for locating plotted nests, areas to be searched, and broadcasting stations in the field.

**Level 1 Survey (option 1)**

Conduct the Dawn Acoustical Survey protocol at points within 200 m of known nest sites, starting with the last known nest.

- If goshawks are detected, status = occupied.
- Conduct the Intensive Search Survey around the detection area during the incubation or nestling stage to determine the breeding status.
- If goshawks are not detected, go to the Level 2 Survey.

**Level 1 Survey (option 2)**

Conduct the Intensive Search Survey protocol of all forested areas within a 100-m radius of all known nests with known territories. Start with the last known nest. The survey should be conducted after hatching through 3 weeks of postfledging or about late May through mid-August. Surveys may be conducted earlier (during incubation) but will likely be less effective due to lack of signs and lack of defensive behavior by incubating females.

- If an active goshawk nest is found (with an incubating hawk or nestlings), status = breeding. **Stop.**
- If goshawks or signs (minimum criteria for signs are molted feathers associated with multiple patches of whitewash and/or a nest showing signs of recent reconstruction) are found, but an active nest is NOT found, status = occupied. To locate an active nest, go to the Level 2 Survey.
- If the initial Intensive Search Survey protocol was conducted during the incubation period (late April to mid-May), observers may repeat the Level 1 Survey in 2 to 3 weeks instead of conducting the Level 2 Survey.
- If goshawks or signs are NOT found, go to the Level 2 Survey.

**Level 2 Survey**

Conduct the Intensive Search Survey protocol of all forest habitats within 500 m of last known nest.

- If an active goshawk nest is found, status = breeding. **Stop.**
- If goshawks or signs are found but an active nest is NOT found, status = occupied.

Repeat the survey in the area of detection in 2 weeks. If goshawks or signs are NOT found, go to the Level 3 Survey.

**Level 3 Survey**

Conduct the Broadcast Acoustical Survey protocol (two visits) within a 1,600-m (1-mile) radius of the last known nest. Delete from the Level 3 Survey those areas previously searched in the Level 1 & 2 Surveys. This technique is most effective after the eggs hatch, typically after late May or early June, depending on the location.

- If an active goshawk nest is found, status = breeding. **Stop.**
- If goshawks or signs are found but an active nest is NOT found, status = occupied nonbreeding. **Stop.**
- If goshawks or signs are NOT found, status = unoccupied. **Stop.**

***Rationale***

Effort-intensive methods such as Dawn Acoustical Surveys and Intensive Search Surveys have higher detection rates and may be conducted earlier in the breeding season than Broadcast Acoustical Surveys. Early-season surveys are critical for detecting breeding attempts that fail during incubation and before Broadcast Acoustical Surveys are typically implemented. If early failures are undetected, territories will incorrectly be classified as nonbreeding.

If intensive methods focused in known nest cores and high-priority habitat fail to detect goshawks or signs, more extensive methods must be employed to locate alternate nests, which may be up to 2 km from known nest sites. Without these extensive Broadcast Acoustical Surveys, determination of status cannot be made for the entire territory.

The status determinations made within this stepwise approach are not absolute; they have an associated confidence estimate based on field data. Long-term monitoring data from the Kaibab Plateau (Reynolds et al. 2005) indicate that searching a 0.5 km radius around known nests will capture about 75 percent of the alternate nests within a territory. A radius of 1 km yields around a 95 percent likelihood of capturing all alternate nests within a territory.

### 3.6.2 Small Area Survey Application

Many land management activities occur at scales considerably smaller than goshawk territories or home ranges. The analysis of environmental effects for such projects may require knowledge of goshawk nest site locations only within a limited area (4 to 160 ha). Project surveys typically are employed to address two information needs: location of territory "cores" for long-term habitat management and location of currently active nests for mitigation or avoidance of disturbance.

**Habitat management.** For projects that involve removal or adverse modification of goshawk nesting habitat, managers are interested in knowing whether the project area contains goshawk nest sites, regardless of whether they are active during the year of project implementation. Survey methods used in this case must be capable of detecting nonbreeding goshawks or signs and unused nests.

**Mitigation of disturbance.** For projects that do not involve significant modification of goshawk habitat, impacts to goshawks may still occur in the form of disturbance of nesting goshawks. For such projects, managers are often interested in knowing whether goshawks are actually nesting during the year of project implementation, so that seasonal restrictions may be applied to mitigate disturbance. Survey methods used in this case are geared toward efficiently locating currently active nests as early in the breeding season as possible.

For either survey objective, Dawn Acoustical Surveys provide a very high probability of detecting goshawks regardless of breeding status. If access to the survey area is feasible during early spring and the patches of suitable habitat to be surveyed are relatively small, Dawn Acoustical Surveys are the preferred method for early detection of occupancy by goshawks. Detections with this method are usually obtained in March and April, and a brief search of the detection area during the late incubation or (preferably) nestling stage is required to determine the location of an active nest.

If early spring access is not feasible, Intensive Search Surveys should be used during the nestling and/or fledgling stages. Compared with Broadcast Acoustical Surveys, single-visit detection probabilities are higher for this method (table 3.2), as is the likelihood of locating goshawk signs, unused nests, or other indications of a territory core.

### 3.6.3 Large Area Survey Application

Broad scale surveys for goshawks may be required for watershed analyses, population research projects, or analyses of environmental effects for extensive forest management projects. In most cases, information is available to enable managers to focus intensive surveys early in areas most likely to be occupied by goshawks, reducing the need for more extensive methods later in the breeding season. This application provides a step-down survey plan to reduce the area requiring physical surveys and maximize efficiency in surveying specific habitats.

Use data from known goshawk territories in the area (same bioregion, forest type) to create a descriptive model of suitable (likely to be occupied) habitat versus low-quality habitat. Model parameters should include forest structure (species composition, size class, density), as well as patch size, topographic features (slope, aspect), and hydrologic features (meadows, riparian habitats) that are often associated with goshawk nest areas. In a Geographic Information System, use this model to classify a vegetation data layer into high-priority survey areas (suitable nesting habitat) and low-priority survey areas.

Plot the locations of previously known goshawk territory centers (or last known nests) onto the habitat map and create a buffer of 1600-m radius around each point. The area requiring surveys can be reduced by deleting these buffers from the survey area. This radius is likely to contain the current nest site and is unlikely to contain an additional territory.

After removing known territory buffers from the survey area, develop a step-down survey plan for the remaining area. The selection of survey protocols and the timing of survey efforts should be based on the amount, distribution, and patch size of suitable nesting habitat and feasibility of early spring access.

**Step 1.** If access into the survey area is feasible in early spring, use Dawn Acoustical Surveys in patches of high-priority habitat, patches with past goshawk sightings, and historic nest areas. Focusing on these areas enables early deletion of newly discovered occupied areas from the survey area and allows early inclusion of goshawk management into project planning. If Dawn Acoustical Surveys are not feasible, use Intensive Search Surveys as early as possible in high-priority patches.

**Step 2.** Conduct Intensive Search Surveys in all high-priority habitat patches during the nestling stage (May to June). Start with habitat patches located 2.5 to 5 km from currently known territory centers. If detections are not obtained in areas of high-priority habitat, repeat the Intensive Search Survey in at least 2 weeks or move to the Broadcast Acoustical Survey in step 3.

**Step 3.** If large areas of suitable habitat remain to be surveyed, establish transects for Broadcast Acoustical Surveys to cover the entire area. Surveys should be conducted twice, once during the nestling stage and again during the fledgling stage.

## 3.7 Reporting

When reporting results of goshawk surveys and determination of territory or survey area status, it is important to describe the protocol or application employed, extent and intensity of survey efforts, and the criteria used to determine status. These descriptions are particularly important when decisions are based on negative survey results. These data should be considered as support for project design standards and for determinations of environmental effects. This information is frequently lacking in project files or, subsequently, the administrative record for projects that are assessed for NEPA or National Forest Management Act compliance.

Estimates of confidence in status determinations may be derived from detection rate information in table 3.2. For example, a timber sale unit receiving a single Broadcast Acoustical Survey visit (to protocol) would have a 64 percent probability of being correctly classified if occupied by goshawks.

# Appendix 14-3:
# Northern Spotted Owl Survey Protocol

# PROTOCOL FOR SURVEYING PROPOSED MANAGEMENT ACTIVITIES THAT MAY IMPACT NORTHERN SPOTTED OWLS

Endorsed by the
U.S. Fish and Wildlife Service

7 March 1991

REVISED - March 17, 1992

# PROTOCOL FOR SURVEYING PROPOSED MANAGEMENT ACTIVITIES THAT MAY IMPACT NORTHERN SPOTTED OWLS

## INTRODUCTION

The enclosed protocol was designed for surveying areas where Federal or non-Federal activities may remove or modify northern spotted owl habitat. The U.S. Fish and Wildlife Service (Service) endorses the use of this protocol for gathering information on spotted owl occupancy in proposed project areas for assessing affects of the proposed actions. Note that any information on owl presence within and/or adjacent to the proposed planning or activity areas is important, even if it does not meet the guidelines described below. However, if the only information available for a particular activity was acquired through less intensive surveys, the Service must conservatively assess (i.e. a worst-case analysis) the impacts of the action on northern spotted owls. It is always useful to document reasons for not adhering to the recommended protocol.

This protocol is based on several existing protocols and, when implemented, should serve two primary purposes: (1) provide adequate coverage and assessment of the area for the presence of spotted owls, and (2) ensure a high probability of locating resident spotted owls and identifying owl territories that may be affected by a proposed management activity, thereby minimizing the potential for unauthorized incidental take. It is not appropriate to use this protocol to monitor yearly trends of spotted owls or for many other research applications.

In this document, management activities are defined as those activities which may impact northern spotted owls. The most common activity is harvest or modification of spotted owl habitat. Also included under management activities are various types of disturbance not necessarily associated with timber harvest activities.

This protocol was peer-reviewed by scientists, biologists, and managers who work on various issues pertinent to the ecology and management of northern spotted owls. Reviewers included personnel from:

U.S. Fish and Wildlife Service
U.S. Forest Service
Bureau of Land Management
Humboldt State University
Oregon State University
California Department of Fish and Game
Oregon Department of Fish and Wildlife
Washington Department of Wildlife
National Council of the Paper Industry for Air and Stream Improvement
Timber Association of California
Private Timber Companies
Private Consultants

# APPLICATION OF THE NORTHERN SPOTTED OWL SURVEY PROTOCOL

## SURVEY AREA

- To the maximum extent possible, all spotted owl habitat within the specified provincial radius from the perimeter of the proposed activity area should be surveyed. The provincial radii are as follows:

| | |
|---|---|
| Washington Cascades | = 1.8 miles |
| Olympic Peninsula | = 2.2 miles |
| Oregon Cascades | = 1.2 miles |
| Oregon Coast Ranges | = 1.5 miles |
| Klamath Province | = 1.3 miles |

## DURATION OF SURVEYS

Previous survey data were analyzed to determine the number of visits needed to result in a high likelihood that territorial owls will be detected or that a lack of owl responses accurately reflects an absence of spotted owls. Preliminary analysis of the data provided the basis for determining the number of visits per year for both the 2-year and 1-year surveys. Two-year surveys provide more accurate results for an area because of the intermittent occupancy of spotted owls within particular areas. These 2-year surveys are more likely than 1-year surveys to accurately document the presence of owls or territories in these situations. Use the following instructions for surveys during 1992.

- 1-year (6-visit) surveys are acceptable. However, 1-year surveys provide a somewhat lower likelihood of determining the presence or absence of spotted owls. In addition, 1-year surveys will be valid only until the beginning of the following breeding season.

- 2-year (3 visits/year) surveys are preferable for surveying a management activity or planning area to determine the presence or absence of spotted owls. Surveys <u>may</u> be completed sooner if a response is obtained and status of the owl(s) is confirmed. However, we recommend that every effort be made to determine the highest status for a given site. 2-year surveys may be valid for 2 additional years.

- 2-year surveys are encouraged to provide a higher likelihood of accurately determining presence or absence of spotted owls. They may also be more economical, especially in cases where harvest will occur in more than one year.

In this document, a complete survey is defined as coverage of the survey area to the required number of visits and an overall inventory that meets the protocol guidelines.

- If a 2-year survey is completed (3 visits/year protocol), using the Service's survey protocol, and no responses are obtained, the negative results may be considered accurate for 2 additional years without conducting additional surveys.

Example: 2-year survey

| | |
|---|---|
| Year 1 (March - Sept.) | 3 visits with no response |
| Year 2 (March - Sept.) | 3 visits with no response |
| Year 3 | Harvest without additional surveys |
| Year 4 | Harvest without additional surveys |
| Year 5 | Suspend activities and resurvey the area during the breeding season if harvest is not completed before the start of the breeding season in Year 5 |

o If a 1-year survey is completed (6 visits), using the Service's survey protocol, and no responses are obtained, harvest could occur before the start of the next breeding season. If harvest is not completed within this time period, a 3-visit minimum survey would be needed prior to harvest in the second year. This is equivalent to 1 year of a 2-year survey. If harvest was not going to occur until after year 2, and the 3 visits in year 2 produced no responses, the negative results may apply for 2 more years without having to conduct additional surveys.

Example: 1-year survey

| | |
|---|---|
| Year 1 (March - Sept.) | 6 visits with no responses |
| Year 2 | Conduct 3 more visits as described below if harvest is not completed before the beginning of the breeding season. The 3 visits should be conducted prior to harvest. If no responses obtained, additional surveys not needed for 2 more years. |
| Year 3 | Harvest without additional surveys |
| Year 4 | Harvest without additional surveys |
| Year 5 | Suspend activities and resurvey the area during the breeding season if harvest is not completed before the start of the breeding season in Year 5 |

o If a nest site or activity center is located by a 1- or 2-year survey, and if harvest will take place in the area in years following the initial surveys, further surveys may be necessary, as follows:

If an owl site is located during a 1-year survey, and the project area is large enough to possibly support more than one site, remaining potential sites should be surveyed three times in the second year. Also, unless otherwise authorized under an incidental take statement or permit from the Service, the original nest site or activity center should be surveyed for occupancy in the year of the action. It is not unusual for owls to change their nesting location from year to year. If the owls are not at the original location, all areas inside harvest units and within 0.25 mile of harvest units should be surveyed each year of harvest according to a 3-visit protocol to eliminate the chances of disturbance to spotted owls during the breeding season.

## OVERLAP OF NEW AREAS WITH AREAS SURVEYED IN THE PREVIOUS YEAR

- In cases where a survey area overlaps all or part of a previous year's survey area, a minimum of 3 visits should be completed for those areas covered by the previous year's surveys, and the new areas should be surveyed with either the 1-year or 2-year protocol (see DURATION OF SURVEYS)

## DETERMINING UNOCCUPIED STATUS OF AN HISTORICALLY OCCUPIED SITE

- If no responses have been obtained from an historical site after 3 years of survey (using the guidelines established in this document), the site may be considered unoccupied, barring other evidence to the contrary.

## HABITAT TO BE SURVEYED

For purposes of surveying, spotted owl habitat is any habitat where you may expect to elicit a response from a resident owl or pair of owls. Descriptions of spotted owl habitat for the various areas and physiographic provinces should be available from the various state wildlife and forestry agencies.

## COORDINATION OF INFORMATION

The importance of coordination in conducting spotted owl surveys cannot be overemphasized. Appropriate coordination involves: 1) pre-season planning (including coordination of commitments by adjacent landowners on the areas to be surveyed by each party); 2) immediate communication of results, positive or negative, that may affect other landowners; and 3) exchange of post-calling season information summaries. Common mistakes, such as overlapping visits by more than one survey group, can be avoided through coordinated pre-planning. It is also advisable to inform adjacent landowners of all surveys near their ownership because new survey results may affect their management and logging operations.

The state agency or spotted owl database holder responsible for evaluating forest practice applications and analyzing survey data should be kept up to date with new survey results.

## SURVEY PERIOD

- All surveys of proposed management activity areas must take place between 15 March and 31 August. For areas where there is adequate biological information that birds are defending their established territories prior to 15 March, then earlier dates may be used as a starting time. Conversely, surveys should begin 1 April for the higher Cascades area where previous survey information has shown that birds return to their established territories later. Positive responses after 31 August are still valid, but negative results after this date do not count towards the number of visits required for completing the year's survey. Positive responses obtained only after 31 August also indicate that the area in question should be surveyed the following year.

## ESTABLISHING THE SURVEY AREA

- Develop transects and/or calling points to cover all spotted owl habitat within the delineated survey area.

- Establish calling stations and survey routes to achieve complete coverage of the area, preferably with coverage from more than 1 calling point. Calling stations should be spaced approximately 1/4 to 1/2 mile apart, depending on topography and background noise levels. Take advantage of prominent points within the survey area when establishing calling stations. If necessary to ensure complete coverage of the area, supplement the prominent points with intermediate calling stations.

Where known spotted owl activity centers exist within the survey area, survey areas may be adjusted to exclude habitat that would be within earshot of the activity center. However, consider the need to survey the known activity center for current status.

The intent is to obtain complete coverage of the area where owls will be able to hear the surveyor and the surveyor will be able to hear the owl.

- For each visit, whether results are positive or negative, record the following information on a survey form:

    1) Brief description of survey route.
    2) Survey start and stop time (total amount of time spent calling) and total time of survey.
    3) Weather conditions (including estimated wind conditions and precipitation).
    4) Survey results: note all spotted owl detections, including sex and age if possible, time of response and type of location (e.g. audio, visual, or both). For multiple or moving owls, list information and number each response or observation. This will allow more accurate determinations of management centers.

- It is recommended that all sightings of, or responses by, barred owls, great horned owls, northern goshawks, or any other raptor species be recorded. The presence of barred owls, great horned owls, and goshawks may affect spotted owl responses.

- For each visit, regardless of survey results, map (preferably on a USGS topographic, orthophoto, or some other high quality map), the following:

    1) Route surveyed and stations called; and

    2) All spotted owl response or observation locations. For multiple or moving owls, map all response or observation locations and number to correspond with survey results. Again, this will assist in determining activity centers.

    It is recommended that barred owl, great horned owl, and northern goshawk responses or observation locations be mapped.

## SURVEY METHODS

Two types of surveys are accepted: spot calling and leapfrog calling. Each is described below. Spot calling is the recommended method. Whatever method you use, be sure you cover all spotted owl habitat within the survey area.

1) <u>Spot calling</u>: Set up a series of calling points 1/4 to 1/2 mile apart along the road transects. When possible, pick prominent points which cover large areas. Spend at least 10 minutes at each point. Spend more time if the topography prevents you from hearing birds that might respond from the previous calling point (eg. you cross a major ridge). If the topography lends itself to fewer, prominent calling points, spend more time at each point. Be sure the entire survey area is adequately covered.

2) Continuous walking or leapfrog surveys: Walk the designated route playing the tape and pausing at prominent points and at regular intervals throughout the area to conduct informal stations of 10-minute duration. If two people are involved, you may use a leapfrog method (See Forsman 1983 - Methods and Materials for Locating and Studying Spotted Owls, USFS Gen. Tech. Rept. PNW-162).

The following instructions should be followed using either method:

- o It is recommended that a surveyor use a cassette tape with recorded spotted owl calls, a tape player, and a sound amplification device (e.g. a hand-held megaphone or loudspeaker). The use of a cassette tape, tape player, and sound amplification device enables surveyors to assure consistent and equitable calling methods. The amplified sound must be heard at least 1/4 mile. Surveyors must be stationed outside their vehicle. CAUTION: In areas of high owl density (e.g., California coastal area), over-amplification may confound survey results by eliciting responses from spotted owls representing multiple territories.

- o Start the tape and let it run for 3-7 calls, listen for a minute or two, then play another set of calls. It is recommended that the owl tape contain calls from both male and female owls. In particular, it should include male 4-note contact calls, and male and female agitated calls.

- o Continue this process for at least 10 minutes at each calling station.

- o Voice calling may be used by experienced surveyors at the discretion of the project leader (see SURVEYOR CREDENTIALS/QUALIFICATIONS). Negative results from inexperienced voice callers may not be adequate for evaluating spotted owl presence/absence.

- o Characterize behavioral observations as best you can. Make note of agitated calls, continuous responses, movement (toward you or away from you), or situations such as when one response is received and the owl is quiet thereafter. Recording this type of information may assist with the identification of activity centers.

- o Conduct night surveys between sunset and sunrise. Be sure not to call the same section of a survey route at the same time on each survey effort (i.e., vary time you start and the section of the route from which you start).

- o Do not survey under inclement weather conditions, such as high winds (> 10 mph), rain, heavy fog, or high noise levels (stream noise, machinery, etc.) which would prevent you from hearing responses. If weather conditions or noise levels are in doubt, be conservative. Survey visits conducted under marginal conditions will reduce quality of the overall survey effort. Negative results collected under inclement weather conditions may not be adequate for evaluating spotted owl presence/absence.

- o Systematically survey spotted owl habitat within each planning or activity area (as defined above in SURVEY AREA) until an owl responds, or if no response is heard, until a minimum of 3 complete night visits are conducted each year for a 2-year period or a minimum of 6 complete night visits are conducted for a 1-year period.

- The objective of a complete visit is to conduct a thorough survey of the entire area in one field outing; however, in some cases this may not be possible. A complete visit may be a combination of a day and a night field outing and, in addition, may include a daytime follow-up visit. If reasonable effort was made to cover the area (timber sale or planning) in one outing, but this was not accomplished, then the remaining unsurveyed area should be surveyed in the following field effort. To reduce the chance of owls moving between portions of the survey area and, as a result, being missed, complete the visit on consecutive days as much as possible. The entire area should be covered within 7 days in order to be considered as one complete visit.

- If the project area is too large to be surveyed in 7 days, it should be divided into smaller areas based on available habitat, topography, drainages, and other important factors. Survey areas need to be small enough to be completely surveyed within the specified time period.

- If a surveyor gets an owl response at night and conducts a daytime follow-up, the combination of the night outing and the daytime follow-up would be counted as 1 complete visit for that owl or pair of owls. If a surveyor goes out at night and does not get a response, a daytime follow-up would not be necessary. In this case, the night outing alone would be considered as 1 complete visit. Whether or not owls are heard, the entire area needs to be surveyed to count as a complete visit.

- Visits must be spaced at least 5 days apart. For example, assume a visit ends on the 3rd of May. Using a proper five-day spacing (4-8 May), the next possible visit date would be 9 May.

- At least 2 of the night visits per year must be conducted before 30 June for a 2-year survey and at least 4 of the night visits must be conducted before 30 June for a 1-year survey. To ensure the best coverage, at least 1 visit should be conducted in June. Survey effort should be spread out over 2-3 months, to avoid survey efforts concentrated in a short period of time, particularly at the beginning of the survey season. Concentrating visits early in the season may result in inaccurate assessments of nesting status; therefore such surveys may not be adequate for evaluating spotted owl presence/absence.

- Where survey seasons are restricted (due to snow, landslides, mud, bridge failures, etc.), the survey period may be adjusted to fit the conditions. Documentation should be provided to explain the modified survey period.

- Surveys may be conducted during the day where there are no roads or foot trails to traverse at night, or where there are other safety concerns. Documentation should be provided for specific safety concerns, etc.

o If birds are heard during a survey:

  - Estimate the bird's original and final location. One method is to triangulate on the owl's call, taking compass bearings from 2-3 locations. Make sure compass bearings are taken in as short a time-frame as possible. Record on the survey form the method used to estimate the location.

- Record the location(s) of the owl, preferably on a map or photo attached to the survey form.

The intent of the triangulation and mapping is to provide a means for verification of the location. Attempt to confirm the owl(s) with a daytime follow-up. Daytime locations are very important in determining more precise management (activity) centers.

o When a bird responds, record the required data. If no response is heard, proceed to the next calling point. Continue until the survey area is completely covered.

o If a bird(s) responds at night, return to the area during the day as soon as possible (daytime follow-up) to verify status as described below, unless status has already been determined.

  - The objective of the daytime follow-up is to locate spotted owls (pairs or singles) by conducting an intensive search within the general vicinity (approximately a 0.5-mile radius) of the original response location at night. Surveys may begin from roads closest to the night response area. However, if owls do not respond to road surveys, surveyors should conduct walking routes through the area. Surveyors should spend sufficient time within the stand to cover the area well. This may take several hours, depending on the terrain. Observers should watch for owls flying in without responding and other evidence of occupancy, such as pellets, whitewash, and molted feathers. Pellets, whitewash, or feathers alone are not sufficient to document spotted owl presence or residency. Mobbing jays are also a potential indicator of owl presence. The follow-up should be completed as soon as possible after presence was detected, as owls are more apt to be located near the previous night's location. A daytime follow-up is only the second part of a complete visit.

o If a response occurs during daylight hours and there is sufficient time to determine the status, do so.

DO NOT HOOT ANY MORE THAN IS NECESSARY. BY STIMULATING THE OWLS TO MOVE AROUND, YOU MAY INCREASE THEIR RISK OF PREDATION.

EXCESSIVE CALLING NEAR A NEST SITE MAY CAUSE HARASSMENT BY BRINGING THE FEMALE OFF THE NEST. EXCESSIVE USE OF THE AGITATED CALL IN HIGH OWL DENSITY AREAS (E.G., CALIFORNIA COASTAL AREAS) MAY ALSO CONFOUND SURVEY RESULTS BY ELICITING RESPONSES FROM OWLS REPRESENTING MULTIPLE TERRITORIES.

USE CONSERVATIVE JUDGEMENT AND HOOT ONLY AS MUCH AS IS NEEDED TO DETERMINE STATUS.

o Once a bird responds at night, complete the station to determine pair status and the remainder of the survey route. To avoid 'leading' a spotted owl through calling, we recommend that once an owl responds, the surveyor go to the other end of the survey route and complete the rest of the survey. If that is not practical, survey only the remaining points that are <u>beyond the earshot of the</u>

responding bird. Beyond earshot is generally over a ridge or at least 1/2 to 3/4 mile straight-line distance from the owl. Completing the route will provide an opportunity to detect any other owls.

- Continue to call for the duration of the station visit even after other species respond unless the surveyor believes that this will increase the potential for predation by great horned owls or goshawks, for example.

- If a single bird responds, and after 3 complete visits (2-year survey) or 6 complete visits (1-year survey) resident status has not been determined, then up to 3 additional visits may be necessary in that year. Additional visits are visits conducted beyond the number of complete visits required by the 2- or 1-year survey protocol and are conducted only in the general area of the response (a 0.5-mile radius around the site). If resident status is determined at any point during the additional visits, no more visits to that particular site are required that year. Other portions of the project activity area may require further surveys.

- For additional visits, maintain the standards (timing, intervals, weather condition limitations, etc.) outlined elsewhere in this document.

  - 2-year survey

    In a 2-year survey, the additional visits are to be conducted the same year as the response.

    If the last response occurs on:
    visit #1, conduct 1 additional visit
    visit #2, conduct 2 additional visits
    visit #3, conduct 3 additional visits
    OR
    until resident status is determined.

  - 1-year survey

    If the last response occurs on:
    visit #4, conduct 1 additional visit
    visit #5, conduct 2 additional visits
    visit #6, conduct 3 additional visits
    OR
    until resident status is determined

If 3 responses are not obtained, even after the additional visits, then the bird is not classified as a resident single.

STATUS

- Verify the status according to the following definitions (status visits can be day or night). These definitions may be somewhat different from the status definitions outlined in the density/demography survey guidelines due to the different objectives of the guidelines for surveying proposed management activities.

PAIR STATUS is established by any of the following:

1) a male and female are heard and/or observed (either initially or through their movement) in proximity (< 1/4 mile apart) to each other on the same visit; or

2) a male takes a mouse to a female (see "mousing" clarification under GUIDELINES FOR DETERMINING REPRODUCTIVE STATUS); or

3) a female is detected (seen) on a nest; or

4) one or both adults are observed with young. Young alone do not define a pair because young barred owls look like young spotted owls until late in the summer.

o When unidentified calls are heard in the vicinity of a known spotted owl do not assume species identification of the unknown owl. Daytime follow-ups should be used to clarify these situations.

RESIDENT SINGLE STATUS is established by:

1) the presence or response of a single owl within the same general area on 3 or more occasions within a breeding season, with no response by an owl of the opposite sex after a complete survey; or

2) Multiple responses over several years (i.e., 2 responses in year 1 and 1 response in year 2, from the same general area).

o A resident single may represent a succession of single owls within the same general area in a single or multiple years.

Determining if the responses occur within the same general area should be based on topography and the location of any other owls known for the surrounding area. This should be determined by the wildlife biologist for the particular area. Radio-telemetry and banding data can also be used to aid in determining status of singles.

TWO BIRDS, PAIR STATUS UNKNOWN is established by:

- The presence or response of 2 birds of the opposite sex where pair status cannot be determined and where at least 1 member must meet the resident single requirements.

STATUS UNKNOWN is established by:

- The response of a male and/or female which does not meet any of the above category definitions.

# PROTOCOL FOR DETERMINING REPRODUCTIVE STATUS

## REPRODUCTION SURVEYS

Determining reproductive success is not required to avoid "take" , if breeding season restrictions are applied to all harvest activity in order to protect owl reproduction during any given year. Restrictions may be dropped if, according to the protocol, surveys reveal that owls are non-nesting or that no young were produced.

The following is the recommended protocol for determining reproductive status of spotted owls. The protocol is designed for management purposes and may not meet all research goals. Reproduction surveys may provide information on nest tree locations which provide the most accurate management (activity) center locations.

- o There are 2 stages of reproduction surveys: nesting status and reproductive success.

## NESTING STATUS

- o Conduct nesting status surveys between 1 April and 1 June. The start date is based on nest initiation dates. If local data suggests a different date for nest initiation, adjust the start date accordingly. Young identified after 1 June would still confirm nesting.

- o Spread the surveys throughout the survey period. Do not conduct all nesting status surveys early in the breeding season.

- o Use a standard "mousing" procedure as described below to determine nesting status. However, DO NOT "MOUSE" BIRDS ANY MORE THAN IS NECESSARY TO DETERMINE NESTING STATUS. BY STIMULATING THEM TO MOVE AROUND DURING THE DAY, YOU MAY INCREASE THEIR RISK OF PREDATION. THE SAME GOES FOR HOOTING. EXCESSIVE CALLING NEAR A NEST SITE MAY CAUSE HARASSMENT AND ENDANGER EGGS OR YOUNG BY BRINGING THE FEMALE OFF THE NEST.

### MOUSING

- o Locate 1 or both members of a pair during the day and offer them mice or other small prey items.

- o Once the owl(s) take prey, or are found with natural prey, record the 'fate' of each prey item (e.g., eaten, cached, given to female or young). The fate of the prey is used to classify nesting status.

- o If the owl eats the prey item, continue to offer additional prey items until the owl caches the prey, sits on it for an extended period of time (30-60 minutes), refuses to take additional prey, or carries the prey away. If the bird flies with the prey, follow and try to determine the final disposition of the prey. For more details on mousing procedures, see Forsman (1983) Methods and Materials for Locating and Studying Spotted Owls. USDA Forest Service, Gen. Tech Rept. PNW-162.

- Field personnel should make a concerted effort to get the owl(s) to take mice. Be creative in placing a mouse where the owl can easily see and capture it and offer mice to the mate of an owl that has refused mice on that visit.

The site will be classified as nesting, non-nesting, or unknown nesting status based on your observations.

## NESTING

The owls will be classified as nesting if any of the following conditions are observed.

Two observations, at least 1 week apart, are required to determine nesting status if the first observation occurs before 1 May. This is necessary because the owls may show signs of initiating nesting early in the season without actually laying eggs and their behavior could easily be mistaken for nesting behavior. After 1 May, a single observation is sufficient.

Nesting is confirmed if, on 2 visits before 1 May, or 1 visit after 1 May:

1) the female is detected (seen) on the nest; or

2) either member of a pair carries natural or observer-provided prey to the nest; or

3) a female possesses a brood patch when examined in hand during mid-April to mid-June. <u>Only 1 observation is required</u>. Dates may vary with the particular areas. Be careful not to confuse the normal small area of bare skin (apteria) on the abdomen with the much larger brood patch. A fully developed brood patch covers most of the lower abdomen, extending to the base of the wings. Describe the brood patch on the field form, including length, width, color, and texture of the skin, and any evidence of regenerating feathers around the edge (NOTE - while a scientific research permit is not required by the Service for calling spotted owls, any capture or handling of spotted owls does require such a permit); or

4) young are detected in the presence of 1 or both adults. Because young barred owls look like young spotted owls until late in the summer, young alone are not sufficient.

## NON-NESTING

The site is classified as non-nesting if any of the following are observed. Again, <u>except for brood patch information</u>, 2 observations are required during the nest survey period, with at least 3 weeks separating these observations to ensure that late nesting attempts are not missed. The second observation should occur after 15 April. Because nesting attempts may fail before surveys are conducted, the non-nesting status includes owls that did not attempt to nest as well as those that have failed.

Non-nesting is inferred if:

1) the female is observed roosting for 60 minutes, particularly early in the season (1 April to 1 May). (Be aware that nesting females with large nestlings often roost outside the nest during warm weather. If in doubt, be sure to schedule 1 or more visits in mid-June to check for fledglings.);

2) the female does not possess a brood patch when examined in hand between mid-April and mid-June; or

3) you offer prey to 1 or both members of the pair and they cache the prey, sit with prey for an extended period of time (30-60 minutes), or refuse to take additional prey beyond the minimum of 2 prey items. To be considered a valid nesting survey, an owl must take at least 2 prey items.

Surveys where the bird(s) leaves the area with prey and you are unable to determine the fate of the prey cannot be classified as to nesting status and do not count toward the required 2 visits. Banded or radio-marked birds may be reluctant to take prey at all; therefore, nesting status should be inferred from other means (e.g., checking for fledglings later in the season).

### UNKNOWN NESTING STATUS

If nesting is not determined before 1 June, you CANNOT classify the owls as non-nesting using the criteria listed above.

- o If owls are found after 1 June, without young, nesting status is unknown.
- o If no owls are found after 1 June (at those sites where owls were present prior to 1 June), nesting status is unknown.

## REPRODUCTIVE SUCCESS (NUMBER OF YOUNG FLEDGED)

Once a pair is classified as nesting, conduct reproductive success surveys after the time the young leave the nest (fledge), usually in late May to late June. If local fledging times are available you may adjust the dates accordingly.

Schedule at least 2 visits to the site to locate and count fledged young, timing the visits so that the fledged young are observed as soon after leaving the nest as possible to reduce losses to predation.

- o Attempt to locate fledged young. Use visual searches and/or mousing. If young are present, the adults should take at least some of the prey to the young. The sight of an adult with prey will usually stimulate the young to beg, revealing their number and location.
- o If the birds take at least 2 prey items and eventually cache, sit with, or refuse further prey without ever taking prey to fledged young; on at least 2 occasions, separated by at least 1 week, 0 young are recorded.

If you wish to determine the true number of fledged young, do the following:

- o On the first reproductive success visit, count the number of fledged young seen or heard.

- o Conduct a minimum of 1 follow-up visit, 3 to 10 days after the first fledged young is seen. This is necessary because it is possible to miss some owlets on a single visit.

- o If you do not elicit a response on a minimum of 2 visits, separated by at least 1 week during the fledging period, then classify the production of young as unknown.

- o If you count young on 1 visit but do not get back for a second visit, or find no owls on the second visit, classify the number of young as 1+ or 2+ etc.

Opportunistic mousing late in the season (after July 30) may be useful for providing supplemental information about site productivity. However, mousing efforts late in the season must be considered inconclusive if they fail to provide positive information, because dispersal and/or mortality may have occurred.

# RECOMMENDATIONS FOR SPOTTED OWL SURVEYOR CREDENTIALS/QUALIFICATIONS

Surveyor qualifications are provided as recommendations for evaluation of personnel that would be involved in spotted owl surveys. <u>These recommendations are advisory</u>.

<u>Project Leader</u>:

Responsibility: Analyzes, draws conclusions from data, writes survey reports. Typically the Resource Area, District Biologist or Forest Biologist (Forest Service and BLM) or the Principal Investigator (University, Contractor, etc.) performs this function.

Minimum requirements:

- o A bachelor's degree in wildlife biology or related field; Certified Wildlife Biologist (by The Wildlife Society); or meets OPM Wildlife Biologist requirements, AND
  - one year/season of spotted owl survey experience or training in spotted owl survey techniques.

— OR —

- o Previous experience as a Project Leader as described above.

<u>Crew Leader</u>:

Responsibilities: Supervises survey crew, data collection, performs basic data summary, and coordinates with other surveyors. Additional responsibilities include supervision of: 1) survey route layout, and 2) determination of area coverage requirements.

Minimum requirements:

- o Normal hearing abilities are requisite. A crew leader must be able to hear the owl(s) if they were calling; AND
  - One year/season of spotted owl survey experience, plus training in spotted owl survey techniques; OR
  - Two years/seasons of spotted owl calling surveys.

<u>Owl Caller or Surveyor</u>:

Responsibility: conducts owl survey and collects data.

Minimum requirements:

- o Normal hearing abilities are requisite. An owl caller must be able to hear the owl(s) if they were calling; AND
  - Training in spotted owl survey techniques; OR
  - 1 year/season of spotted owl survey experience.

## Appendix 14-4:
## Peregrine Falcon Survey Protocol

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# PROTOCOL FOR OBSERVING KNOWN AND POTENTIAL PEREGRINE FALCON EYRIES IN THE PACIFIC NORTHWEST

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**Abstract**

Surveys of cliff sites are necessary to document the full extent of the recovery of peregrine falcon populations in the Pacific Northwest.

Methodology of observations of potential cliffs and known peregrine falcon eyries should follow a standard monitoring protocol to validate observations within the survey area. All field work should be coordinated between state and federal agencies to avoid duplication of survey efforts.

This document evaluates and details observation protocol recommended to be followed during searches for new peregrine falcon nest sites, or monitoring of known traditional nest locations.

## Introduction

The peregrine falcon is currently listed as **Endangered** on the Federal Threatened and Endangered Species list and the California, Oregon and Washington State Threatened and Endangered Species list. As mandated by the Endangered Species Act of 1973, recovery plans for this species were created to formulate guidelines for federal and state resource protection agencies to enact management and protection policies. In accordance to these specific laws, the Pacific Coast American Peregrine Falcon Recovery Team was designated and appointed in 1976 to create and initiate regional recovery programs and to assist cooperating agencies in site specific management of the few peregrine falcon eyries that exist.

Known peregrine falcon nest sites in California, Oregon and Washington are limited to less than 135 known eyries (B. Walton, 1989, Santa Cruz Predatory Bird Research Group, per. com.). This current Pacific States population is less than the known historic population. Bond (1946) notes that 136 nest sites were known in the western portion of the United States, but did not specify states or regions where eyries were located. Bond also believed that actual numbers of active peregrine eyries were possibly 2-5 times the known population of the time. Although Henny and Nelson (1981) have documented at least 42 historic (pre-1950) peregrine falcon eyries within Oregon. Fenske (per. com.) has data to support approximately 70 historic sites. It is unknown to what extent these historic eyries have been re-occupied in recent years.

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Peregrine falcons have been released from hack boxes, foster and cross foster sites located within California, Oregon and Washington. Birds re-introduced in this manner are banded with anodized U.S. Fish and Wildlife Service lock-on bands. Birds banded in the wild have silver (non-anodized) bands.

Peregrine falcons nest on sheer cliffs ranging in height from 23 to 610 m (75 to 2000 feet) (Hickey 1965, Porter and White 1973, Ratcliffe 1980, Cade 1982). Eyries are located at 40 to 80 percent of total cliff height on sheer faces and are usually inaccessible to mammalian predators. In northern California (Pagel notes) and Utah (Porter and White 1973) peregrine falcons have nested on cliffs less than 30 m (100 feet) in vertical height. This is contrary to descriptions of suitable nest substrate (Harvey 1983) and traditional perceptions of peregrine falcon cliff habitat.

Most eyrie cliffs in Oregon are 400 to 800 m (1/4 to 1/2 mile) from riparian, lacustrine, or marine habitat (Pagel notes), although further distances up to 1.6 km (1 mile) have been reported elsewhere (Call 1978). The streams in these riparian areas may be ephemeral, with last flow or spring runoff disappearing some time in June/July.

## Objectives

The primary objective of nest surveys such as this is to identify new active peregrine falcon eyries. Henny and Nelson (1981), and Mangan and Pagel (1988) speculate that more peregrine falcon eyries may currently exist in Oregon or northwest than have been noted to date. Expansion of nest surveys in the Pacific Northwest should include areas which contain smaller, non-monolithic and rimrock cliffs. Through identification of new peregrine falcon eyries, proper management and increased protection of habitat at nest sites by state and federal agencies may be attained.

Additional objectives of these surveys other than the above include:

1) Evaluate the recovery of peregrine falcons in the Pacific Northwest.
2) Observe forage and nesting behavior patterns at individual eyries.
3) Determine accurate nesting chronologies.
4) Document the fate and reproductive trends of known peregrine falcon eyries.
5) Document effects of forest and land management activities around active eyries.
6) Document and list suitable cliff habitat for future surveys and rechecks.
7) Identify potential reintroduction sites for hacking or fostering of peregrine falcons.

Eyries and potential nest cliffs should ideally be monitored from 15 April through at least 1 July of any calendar year. Mangen and Pagel (1988) used a quaternary system of rating, (High, Medium, Low or No potential), while Collins (1982) used consecutive enumeration (1-10 with 10 as high potential) to rate nesting potential of nest cliffs. Both methods effectively categorize future occupation/nesting potential of the cliff.

Observation priority, respectively will be given to:

1) Known nest sites.

2) Cliff sites rated High or 9-10, deemed high priority as the field season progresses due to sightings or probability of being affected by planned management activities.

3) Cliff sites rated Medium or 7-8, given medium priority as the field season progresses due to sightings or probability of being affected by planned management activities.

4) Cliff sites rated High or 9-10 with no planned management activities envisioned in the near future.

5) Cliff sites rated Medium or 7-8 with no planned management activities envisioned in the near future.

Known nest sites would be examined annually during the breeding season to ascertain occupancy and reproductive success. High priority potential nest sites, dependent upon location, access, and observation priority, would also be examined annually. Nest sites with medium to low observation priority would be monitored every 2nd or 3rd year, or as recommended by survey crews. New or previously unknown potential nest sites should be evaluated and placed within one of the above observation categories.

*Procedures for ground monitoring of potential peregrine cliff sites*

Peregrine falcons exhibit fidelity to cliff area and specific nest ledges annually. This eases nest search procedures.

Occupancy determination of specific cliffs is the most important goal of nest searches. A determination indicating that the cliffs are not occupied by peregrine falcons would be made only after at least 2 observation periods lasting 4 hours or more.

Observation periods should be scheduled during favorable weather conditions in April, May and June. Observation periods at cliff sites with numerous potential nest ledges may be expanded if deemed necessary by survey team. Viewing periods should occur at least 25-30 days apart during the field season.

Survey teams would decide, based upon the best available data, if further nest cliff monitoring time is necessary for full coverage of potential eyrie sites.

Fyfe and Olendorff (1976) write of "knowledgeable trespass or none at all." Thus, recommended reading for observers and managers would be Nelson (1970 and 1973), Fyfe and Olendorff (1976), Olsen and Olsen (1978) and Sherrod (1983) prior to undertaking any field observations. These papers contain basic behavior of adult and nestlings and field techniques regarding monitoring of peregrine falcons at or near their eyries. These should be considered the minimum required reading.

The following physical and biological factors should be considered prior to monitoring potential and known peregrine falcon nest sites. Failure to do so may result in undue harassment to the birds, physical endangerment to observers, and a frustrating and non-productive observation period. Nelson (1973), Johnson (1988) and Olsen and Olsen (1978) detail and point out further considerations for observers to remember during observations.

**Weather** Avoid searching potential nest locations during periods of heavy rain, snow, high wind or severe cold. Inducing an incubating peregrine to flush during the above conditions may result in the failure of the clutch, desertion of the nest site, or secretive behavior which would not assist the observers in discerning the chronology anyways. Precipitation or wind may mask vocalizations and cut down viewing distance, negating any efforts to determine occupation of remote cliffs. Poor weather monitoring is impractical, uncomfortable and unsafe to the birds and observers.

**Equipment** Suitable optical equipment including a good pair of binoculars (7 x 35 or 8 x 42 recommended) and a quality spotting scope mounted on a portable tripod are invaluable viewing aids. Auditory parabolic reflectors are often more trouble than they are worth for monitoring vocalizations, and sudden movement of the dish may attract the falcons attention and induce a territorial defense. Topographic maps and aerial photographs are necessary during the first visitations to a known or potential nest cliff, and may be used for route finding, as well as delineation of forage locations. An extra item which may sound luxurious is a simple foam pad. Observers of all experience levels are more attentive and tend to make better observations when they are comfortable. Foam pads also serve as excellent protective cushioning for transporting optical equipment.

**Time of year** Monitoring of potential nest cliffs should commence by mid-April, and last through June. A wide variety of courtship and nest behavior may be observed by staggering observation times as mentioned above. Observers should be prepared and knowledgeable of all normal nesting chronology behavior.

It is not yet possible to precisely predict the exact nest chronology for a given potential nest site prior to seasonal visitations. Nesting chronologies of specific falcons vary depending upon elevation, aspect, microclimate of nest cliffs and/or availability of prey. The optimal time of the year to search for new eyries is during the post-hatch period (April - August) of the nesting chronology. At this time, the adult peregrines will be shuttling many prey items into the eyrie and will be exchanging prey items in mid-flight. Additional amounts of whitewash (excrement) within inner eyrie wall, and below the opening to the eyrie are increasingly visible as the breeding season progresses. This whitewash may be found on favored perches and near cache points in quantities running up to six feet in length below these points, or in scattered drops. At some eyries though, there may be no visible whitewash at all.

By comparing known nesting chronologies of the present and past years of Oregon and northern California eyries (Fig. 1), a rough estimate of the range of time periods of courtship, incubation, hatch and fledge behavior is possible.

Nest failures, recycling of clutches, and asynchronous hatching of eyases (pre-fledge peregrine falcons) should be taken into consideration as potential anomalies to normal behavior and resulting nesting chronologies. Dates to be used as a cut off period for reporting of nesting failures or non-nesting status are divided roughly by elevation. These are to be used as guides, and should not be used as fail-safe nest site failure dates.

| | | |
|---|---|---|
| Low elevation | (0-2000, 0-610M) | 01 June |
| Medium elevation | (2000-4000 ft, 610-1220M) | 15 June |
| Upper elevation | (4000 ft., 1220M and above) | 30 June |

**Time of day** Although behavior indicative of nesting chronologies may be viewed by astute observers at all times of the day, prime observation periods are around dawn, or shortly thereafter.

Observers should keep in mind when planning nest or potential nest cliff visitations the angle of the sun in relation to the observation post and the eyrie, protective vegetative cover in regard to observation points, and known or suspected behavior of the individual peregrine falcons at that eyrie location. Some sites are plagued by morning fog, afternoon winds or heat waves which may deter accurate observations.

Behavior of peregrine falcons will vary slightly during the daytime, but can be roughly predicted. During afternoon breezes on ridgetops or cliff edges, peregrine falcons may be observed taking advantage of the steady winds and rising thermals to aid in their hunting. Cliff observers may expect falcon activity at that time. Other raptors in the area will also give the observers clues as to what the winds are doing aloft.

**Establishment and location of observation posts** Observation posts are to be established during initial reconnaissance of potential or known nest cliffs, or shortly thereafter. The primary concern of the observer is to minimize stress to the falcons which his/her presence at the observation post may induce.

Well placed observation posts allow unobstructed viewing of the eyrie. The observation point might be a mere break in vegetative cover 1000 m distant, or a broad panorama of the cliff and surrounding drainage systems. If the view of the cliff and surrounding airspace is maximized, observation quality may be increased.

Recent aerial photographs may assist in locating landslides, meadows, roadways, clearcut blocks, rock outcrops or other areas where viewing is possible. Observers should note the location of the sun, and areas where heat waves may hamper viewing conditions. Points that offer shade to the survey team are preferred during long periods of observation, as exposure to constant sunlight tends to fatigue observers, and induce undue strain on eyes.

Most observation posts are approximately 350 meters (1150 feet) from the cliff base (range 150-1700 meters). Accurate monitoring of nesting behavior and vocalizations is possible for most sites at these distances.

Observation posts located in front and below the nest cliff are best. Looking down into an eyrie is helpful to document progress of nesting attempts, but may invoke a territorial defense. Placement of observation posts below eyries reduces stress incurred by incubating peregrine falcons. Observers may choose to use an observation post looking down into an eyrie as a last resort when hours of observations from normal spots have revealed nothing. Stealth should be used to access these observation points, and they should be vacated if a territorial defense by nesting peregrine falcons is invoked.

If a territorial defense occurs (noticed by loud kaacking vocalizations and one or both of the adult peregrines circling over the area of disturbance), it is important to establish at whom the defense is being directed. Sometimes, defense flights by peregrines are directed at other raptors, mammals, falling rocks/trees, logging/mining equipment or aircraft.

If the territorial defense is directed at the observer, then is is important for immediate retreat (e.g., run, or walk as quickly as the terrain will allow). Keep in mind that data (eyrie or perch location, prey remains, bird identity-sex, age, and USFWS bird band presence and color) may be collected during your expedient departure. The peregrine falcon should not be induced to kaack for any longer than necessary, though the peregrine will most likely follow the observers by circling high over the forest canopy. Getting away from the eyrie location is crucial, as the observer will not know the stage of nesting chronology, and failure caused by chilling or overheating of eggs or young due the to adult being involved in a territorial defense must be avoided. Fyfe and Olendorff (1976) and Olsen and Olsen (1978) offer an overview of dangers to nesting raptors induced by survey teams and other human activities.

**Duration of stay at observation points** Potential eyries should be monitored for at least two 4-5 hour observation periods conducted under favorable viewing conditions. Observations of known eyries may take less time if viewing conditions and peregrine falcon behavior coincide. These viewing periods should occur at least 25-30 days apart during the months of April, May and June.

Olendorff (1971) identified several considerations when intraspecific interactions may occur which disrupt nesting activities. These were:

a. Mannerisms of intruder.
b. Size of intruder.
c. Stage of breeding cycle.
d. Topography and exposure of intruder in relation to nest

Olsen and Olsen (1978) write that the critical distance from disturbance depends on the familiarity of the individual pair of peregrines to the type of disturbance and individual variances of each particular disturbance. In other words, if the falcons are accustomed to the disturbance as a normal or common occurrence, and the disturbance offers no known direct threat, then the peregrine falcons will attempt "business as usual". If the disturbance is new, intermittent or unexpected within their nesting territory (defended portion of home range), then the peregrines are less tolerant of that disturbing factor. If the birds are accustomed to traffic, hikers, nest monitors, or distant climbers, and the falcons perceive no potential threat to their eyrie, then observed peregrine falcon behavioral patterns around the eyrie are "normal". When the peregrines have not experienced a human disturbance, or the activity is intermittent (e.g., log skidding, nest monitoring, aircraft, or distant rockfall) then the peregrines will become noticeably concerned (ranging from curiosity fly-overs to intense territorial defenses).

Peregrine falcons are most susceptible to disturbance during the onset of their courtship activities (Fyfe and Olendorff 1975). Land management activities (including peregrine falcon monitoring) which the falcons are not accustomed to during the preliminary phase of their nesting chronology could induce the desertion of the nest site.

Birds disturbed during early sequences of courtship may decide to abandon the nesting attempt. Peregrines incubate their clutches of eggs with their feet beneath and between the eggs, or small eyases. When startled, or induced to bolt by helicopter fly-overs, blasting, human visitations, etc., the eggs or young could be dislodged from the nesting scrape, or eggs could be punctured or broken by rough and swift changes of position by the adults.

Eggshell thinning and embryotoxicity of peregrine falcon eggs is still occurring throughout northwest California and Oregon. The end result of current measured increases in shell thinning and embryo death indicates that potential for peregrine falcons to fail in reproductive attempts may be at static or increasing levels. This in turn may increase the susceptibility for external forces to affect the behavior of peregrine falcons, thus reducing overall reproductive output.

Other direct effects on the falcons from proximal disturbance could be unnecessary energy expenditure by the adult falcons to defend against, or observe potential disturbance; thus losing hunting opportunities.

Observers should occasionally stop, look and listen for peregrine falcons which may be circling high overhead (i.e., an immature male who has "claimed" the cliff in question may not be induced into a full territorial defense, but may only circle very high overhead merely observing your actions). Remember to vacate the area or move to a non-intrusive observation post swiftly and quietly if a peregrine falcon is sighted.

### Helicopter surveys

Other documents are available to advise biologists of the particulars of the use of rotary and fixed winged aircraft to survey for raptors (White and Sherrod 1973, Carrier and Melquist 1976, and Smith et al. 1988). Helicopters have been used in Oregon to search nest cliffs for peregrine falcons (Boyce et al. 1979, Henny and Nelson 1981, Collins 1982, Collins 1987, Mangen and Pagel 1988, Pagel notes).

Aerial surveys of cliff habitat for peregrine falcon occupancy should be coordinated between USFWS and state wildlife agencies. Permits and coordination are necessary. Disturbance to new peregrine falcon nest sites is minimal if accepted practices and techniques are followed.

Helicopters can be an efficient means of monitoring known nest eyries if accomplished by competent and experienced observers, and if used as a compliment to ground observation. Too often rotary winged surveys are accomplished as the only means of determining cliff occupancy.

Surveys should be accomplished with the passenger doors removed. This may slow the ship down during flight between observation locations, but the visibility above, below and behind the aircraft is greatly enhanced. Through efficient observation at the site, removal of doors may save overall flight time. Video-taping of the surveyed cliffs for later analysis is easily accomplished and is strongly recommended.

Cliffs should be approached from the front, rather than abruptly flying over from behind or coming around corners or buttresses. Advance warning to potential incubating peregrines is necessary. If incubation is occurring the adult birds may step away from the clutch prior to taking flight. In most instances, peregrines will be seen flying away from the nest ledge. It is best to back away with the helicopter, while keeping the bird visible at all times. After several minutes, the falcon may fly back to its eyrie; disclosing the nest scrape if not already noted. Prior familiarity of the cliff by one of the aerial observers or photographs of the cliff(s) will save flight time.

The most important job of the helicopter visitation is to note the location of potential nest ledges and gather other important information (access, possible observation posts, potential falcon forage directions, etc.,) for the ground observers.

Visits to cliffs last anywhere from 15 seconds to 10 minutes. If a falcon is not seen, it does not mean that the cliff is unoccupied or that an eyrie has failed. It just means that you failed to see a falcon during your brief visitation. Keep in mind recycles, alternate cliffs or ledges, modification of nesting chronology due to weather or prey base, new adults at the site, etc.

*Procedures for monitoring traditional peregrine falcon eyries*

All ground observation procedures mentioned above should be considered prior to observation of traditional or known peregrine falcon eyries. Established observation points should be used during all monitoring.

Known eyries will be observed until the status and/or nesting chronology has been documented (Table 1). This may take only 10 minutes, or three or more separate 6-12 hour viewing periods.

Active eyries should be visited at least 3 times during the entire nesting chronology. Below is the minimum annual effort to be put forth in the documentation of occupancy, nesting chronology and reproductive success.

1) **Initial visit**. One or more visits may be necessary to determine occupancy of the site. Peregrine falcons may at times become secretive about their movements to and from the eyrie. Prey exchanges can occur quickly, with no prior notice to the observer. It is also important to consider that alternate eyries, or ledges previously unknown may be utilized for nesting. At least 10-15 hours of observation on different days throughout the months of April and May may be necessary just to determine occupancy. Then again, of course, it may only take 15 minutes. The eyrie will be considered inactive if no activity is observed during at least 3 optimum (see earlier described procedures) observation periods prior to the cutoff date (also listed previously) in this document.

2) **Determination of nesting chronology.** Via observation of the intricacies of behavior of the peregrines, it may be possible to ascertain the nesting chronology to within +/- 2-3 days. Confirmation and fine tuning of the estimate requires other observation periods on different days. Additional monitoring assists in determining habitat use, favored perch sites, and affect of disturbance or forest management activities. Observations will also help determine any nesting aberrations or disasters, such as predator invasion, insufficiency of prey base, recycle behavior, and adult or eyas mortality.

3) **Banding and eggshell collection**. When young are approximately 15-25 days of age (as determined through efficient monitoring) the eyrie may be entered by a qualified and licensed biologist-climber for the banding of young and collection of prey remains, addled eggs, and eggshell fragments. Contact prior to entry with USFWS and State agencies are required for procurement of proper permits and coordination of efforts.

4) **Determination of fledging success**. Visitations to the observation point(s) following the presumed fledging of eyases are necessary to ascertain fledging success. At least 8 hours of intensive survey should be accomplished to determine fledging success. Fledglings remain consistently around nest sites for at least several weeks.

5) **Additional monitoring**. Forest management activities proximal to nest management zones should be monitored on the first morning of anticipated disturbance. If observed behavior suggests that the management activities are altering the birds normal behavior patterns, all disturbing activities should cease immediately, and would be postponed until fledging of the eyases, or confirmation of natural failure.

Should it be determined that an eyrie has failed, a visit no sooner than 14 days following the discovery of a nesting failure is necessary to establish the success of a recycle attempt (a second attempt at nesting within a given nesting season). Peregrine falcons are known to commence any recycle attempt within 14 days after total failure (Ratcliffe 1980). Not all peregrine falcons will recycle. No entry to the nest area during the interim should be allowed as an abbreviated courtship may occur, and peregrine falcons could be disturbed by observers.

**Figure 1. Expected range of nesting chronologies of northern California and Oregon peregrine falcons. Adapted from Pagel (1 988a, 1988b, 1990). All elevational differences are included (0-6000 ft).**

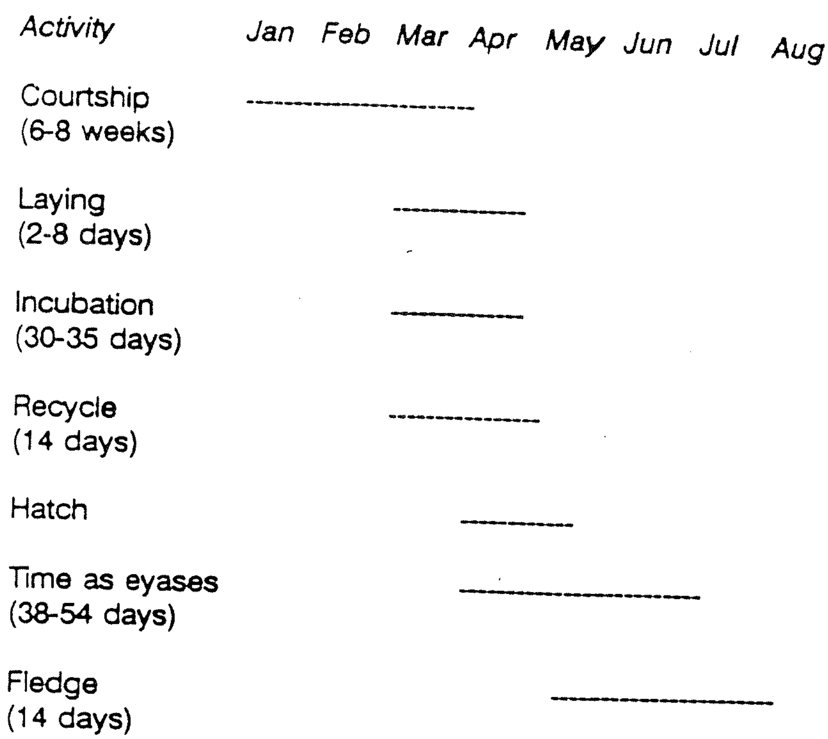


**Table 1. Minimum information collected at known peregrine falcon nest sites.**

1) Status (Occupied, unoccupied, or active)
2) Age of falcons present (adult or immature)
3) Nesting chronology (+/- 2-3 days)
   Date clutch complete
   Hatch date
   Fledge date
4) Reproductive success
   Number of eyases
   Sex of eyases
5) Presence or absence of USFWS lock-on bands (blue, silver, red, black or no bands discerned)
6) Forage directions of adults
7) Prey preferences (very difficult to accomplish from a distance, unless certain conspicuous species such as flickers, jays, some ducks and gulls are seen for brief instances prior to rendering).

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**Appendix 14-5:**
**Osprey and Bald Eagle Nest Occupancy and**
**Bald Eagle Nest Productivity Aerial Survey Form**

**(CONFIDENTIAL)**

**Appendix 14-6:**
**Bald Eagle Communal Roost Locations**

**(CONFIDENTIAL)**

**Appendix 14-7:**
**Guidelines for Hazard and Danger Trees**

United States
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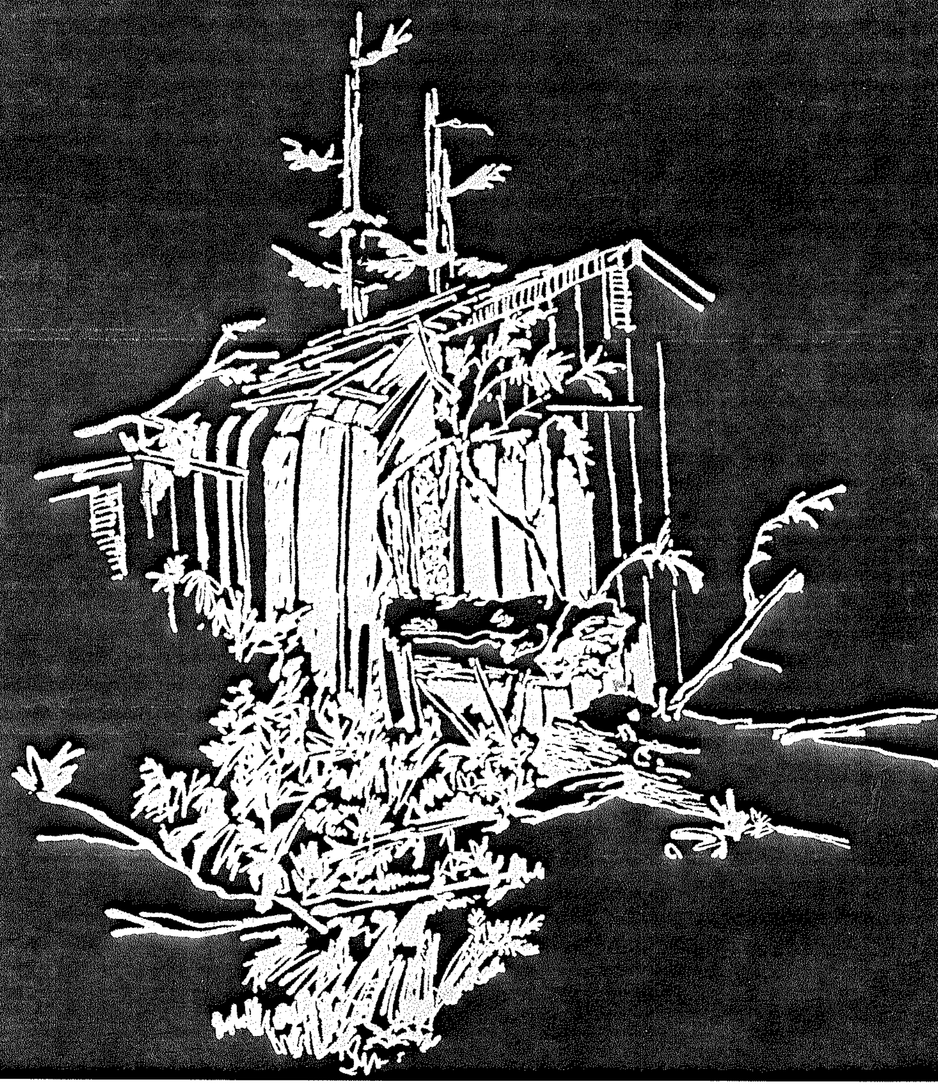
Forest Service

Pacific
Northwest
Region

# Long-Range Planning for Developed Sites in the Pacific Northwest:

## The Context of Hazard Tree Management



## Chapter 3

### Components of Tree Hazard Analysis

Hazard rating consists of inspecting potentially hazardous trees and estimating the probability of failure and striking targets during the time between examinations, then ranking by risk, from high to low, and prioritizing for treatment. Since it is not reasonable to eliminate all hazards (i.e. all trees) from a recreation site, line officers must decide what constitutes an acceptable level of risk, then treat or mitigate as necessary to achieve that level while minimizing disturbances and impacts on aesthetics and recreation enjoyment. This not only requires inspecting each tree in the context of its location in the unit, it also suggests some level of documentation or tracking is needed to maintain an ongoing record of tree condition and date of examination or re-evaluation. Tracking maximizes the economic efficiency of hazard monitoring programs in the long run since only those trees needing re-evaluation in a given year are evaluated. A systematic tracking system also minimizes program disruptions or discontinuities in the event of personnel changes.

The degree to which a tree is hazardous hinges on four factors:

(1) its **potential for failure;**

(2) its **potential for striking a target** in the event of failure;

(3) the **potential that serious damage will result**; and

(4) the **value of the potential target(s)**

Minimum value for any factor results in significantly reduced risk.

### Potential for Failure

The job of estimating the potential for tree failure (the likelihood of failure) is difficult because of the many interacting variables that come into play, but it can be done and with reasonable assurance. Tree size, age, form, species, condition, and location must all be considered along with plant association, successional stage, stand structure, stand species composition, climatic and soil conditions, and presence and extent of defect. Failure potential is estimated by examining a tree, determining the factors and conditions that contribute to failure or weakening, and estimating the likelihood that those factors and conditions will simultaneously occur before the next inspection period. Variables that are evaluated include:

1) the lean of a tree and factors that contributed to the lean;

2) whether a tree has recently been root-sprung (lateral root anchorage has been compromised);

3) whether trees that leaned over some time ago have righted their tops subsequently and have acceptable lateral anchorage;

4) the presence of forked tops or a recent weakening of a forked top;

5) the presence and extent of lethal or weakening root, stem, or branch disease or insect infestation;

6) the season of the year when high winds are likely and its relationship to the visitor-use season;

7) the direction of prevailing winds and the potential for wind eddies;

8) the presence of damage caused by recreationists, roadbuilding or maintenance activities, installation of septic systems and drainage fields, tree poisoning by effluent from waste disposal stations or restrooms;

9) the presence of dead, broken, or hanging branches;

10) the presence of basal scars, trunk injuries, lightning strikes, wind shake, frost cracks, cankering, dead tops, broken tops, V-shaped branch crotches, stem swellings, bear damage, undermined roots, excessive soil compaction, slime flux, basal resinosis, mechanical injury, crooked stem (old snow break), and;

11) evidence of root disease infection and mortality, species composition of adjacent trees, opportunities for lateral spread of the disease, presence of natural barriers to disease spread.

There are many others, but this abridged list reveals the types of variables considered in the evaluation of tree failure potential.

### Potential for Striking a Target

The potential that a tree or tree part will strike a target is determined by evaluating where trees or their parts will likely land in the event of a failure, and whether those places of impact will be occupied by targets at the time. This determination is more straightforward for sites with characteristic high and steady occupancy than where intermediate or low occupancy occurs. Variables that are evaluated include:

1) the location of designated parking areas and other undesignated areas where people are prone to park their vehicles;

2) the location of tent pads, fire rings, barbecue pits, water pumps, waste disposal stations, restrooms, historic buildings, information boards, interpretive stations, trailside rest stops, scenic viewing areas where hikers are prone to/invited to pause and view, children's play areas;

3) seasonal use patterns including timing of use, type of use (weekend car camping vs. established elk camps vs. off-season use for motor homes by retired couples), and extent of use; and

4) the location of all potential targets or target areas to identified tree hazards.

### Potential that Serious Damage will Result

The amount of damage resulting from partial or complete failure of a tree is dependent upon the size of the failed portion. Damage potential is estimated by rating the size of the tree part that will strike a target. In total, damage potential incorporates evaluation of the likelihood that a partial or complete tree failure will impact a target, the likelihood and amount of damage, and the value of the potential target.



### Value of Potential Target(s)

The value of a potential target is estimated by determining the maximum extent of loss in the event that it is struck by a failed tree or tree part. Financial and emotional losses resulting from the death, injury, or dismemberment of a person are far greater than for the loss of picnic tables, buildings, or vehicles. Values are expressed in relative terms (low, moderate, and high) and are factors considered in evaluating damage potential. For example, if the target is a person or their parked vehicle, the value would be high. A target of moderate value may be a building or other developed structure or convenience such as a water pump or waste disposal station. Garbage cans, dumpsters, and information boards may be examples of lower value targets.

### A Standard for Rating

The standard system suggested here incorporates two important components. The first component addresses the potential for tree failure within a specified time period. Failure potential is rated on a scale of 1 to 4 in order of increasing potential:

1 = VERY LOW FAILURE POTENTIAL.

Sound trees that will not likely be exposed to extremes of weather.

2 = LOW FAILURE POTENTIAL.

Trees with only minor defects (stem decay with more than an acceptable rind of sound wood), in areas sheltered from weather extremes, or sound trees that will likely be exposed to weather extremes (wind, snow loads).

3 = MEDIUM FAILURE POTENTIAL.

Trees with moderate defects (at or near the threshold of acceptable rind thickness), or that are growing in shallow soil, are shallow-rooted, or are exposed to high water table, and that will likely to be exposed to strong winds and snow, (extent of defect alone does not justify removal or hazard mitigation); or highly defective trees in areas well-sheltered from weather extremes; or highly defective trees exposed to weather extremes which only occur in the off season.

4 = HIGH FAILURE POTENTIAL.

Highly defective trees in unsheltered areas, or trees with root anchorage limited by erosion, excavation, undermining, or adverse soil conditions; dead trees, or those with root disease.

The second component of hazard rating addresses damage potential in the event of a failure. This portion of the rating must incorporate the likelihood that a failed tree or tree part will strike a target, the likelihood of damage, and an estimate of target value. Damage potential is rated on a scale of 1 to 4 in order of increasing potential:

1 = NO DAMAGE.

Target impact will involve only very small tree parts; or there is no chance that failed parts will cause damage when they impact a target.

6) the season of the year when high winds are likely and its relationship to the visitor-use season;

7) the direction of prevailing winds and the potential for wind eddies;

8) the presence of damage caused by recreationists, roadbuilding or maintenance activities, installation of septic systems and drainage fields, tree poisoning by effluent from waste disposal stations or restrooms;

9) the presence of dead, broken, or hanging branches;

10) the presence of basal scars, trunk injuries, lightning strikes, wind shake, frost cracks, cankering, dead tops, broken tops, V-shaped branch crotches, stem swellings, bear damage, undermined roots, excessive soil compaction, slime flux, basal resinosis, mechanical injury, crooked stem (old snow break), and;

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3) seasonal use patterns including timing of use, type of use (weekend car camping vs. established elk camps vs. off-season use for motor homes by retired couples), and extent of use; and

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Trees with moderate defects (at or near the threshold of acceptable rind thickness), or that are growing in shallow soil, are shallow-rooted, or are exposed to high water table, and that will likely to be exposed to strong winds and snow, (extent of defect alone does not justify removal or hazard mitigation); or highly defective trees in areas well-sheltered from weather extremes; or highly defective trees exposed to weather extremes which only occur in the off season.

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1 = NO DAMAGE.

Target impact will involve only very small tree parts; or there is no chance that failed parts will cause damage when they impact a target.

2 = MINOR DAMAGE.

Failure of only small tree parts, and impacts in occupied areas are indirect; or failures will likely occur when area is unoccupied; damage when it occurs, is to low value target(s).

3 = MEDIUM DAMAGE.

Failure involves small trees or medium-sized tree parts, and impacts will likely occur in areas with targets; impacts will be direct, and damage will likely be moderate, and target value is moderate.

4 = EXTENSIVE DAMAGE.

Failure involves medium to large tree parts or entire trees, and impacts will be direct in areas with targets; target value is high, and damage to property will likely be severe; or serious personal injury or death is the likely result.

The hazard classification for each individual tree is determined by combining the values from the two parts of the rating system. Seven risk classes ranging from 2 to 8 are possible. Treatment priorities by risk class are as follows:

| Risk Class | Treatment Priority |
|---|---|
| 8 | very high |
| 7 | high |
| 6 | moderate |
| 2-5 | low |

### Annual Site Examinations

Timing and frequency of examinations may vary, but all developed sites should be reconnoitered for new evidence of hazardous trees at least annually. Sites should be examined once the severe weather season(s) have passed. This translates to spring in many parts of the country because severe weather is most often associated with winter storms. When that is the case, examinations should be completed in the spring, after the snow is off and before new foliage emerges, to improve the sighting of branch, bole, and root defects. Winter storms often bring attention to the most severely defective trees or limbs, and the portions of stands with severe root disease or stem decay.

Annual site exams should be done systematically. They normally consist of a walk-through examination, where each tree and all areas of the developed site are observed for new evidence of hazard or defect. All trees within striking range of a target, either fixed or transitory, should be examined. Evaluations should begin at known or established reference points, and all trees in the near vicinity of those points systematically examined with pertinent observations recorded for each tree. Ideally, a benchmark or baseline hazard tree evaluation should already be completed for the site and notes from the walk-through examination can be used to modify or upgrade that information. If no such baseline evaluation exists for a site, one should be conducted.



### Establishing a Baseline Hazard Tree Evaluation

The development of a baseline evaluation requires a systematic approach that should be organized in planning sessions before going to the woods. The approach that follows is one we have used and modified over the years. We divide it into four stages:

1) identify and gather the necessary equipment;
2) determine the data needs and gather those data;
3) record the data and develop a permanent database; and
4) manage the unacceptable hazards.

### Equipment Needed for Baseline Hazard Tree Evaluations

| Equipment | Intended Use |
|---|---|
| Pulaski | Exposing roots and checking for decay, signs and symptoms |
| Cruisers axe | Sounding boles, inspecting stems for saprot, heartrot, evidence of insect attack |
| Binoculars | Examining stems for conks, punk knots, swollen knots and other indicators of stem decay, and for examining tree crowns for hazardous branches, dead, or forked tops, other defects |
| Diameter tape | Measuring tree diameter |
| Chain (trailer) | Measuring distances for stem mapping |
| Compass | Recording azimuths for stem mapping, and relationships to reference points |
| Relaskop/ Clinometer | Measuring tree heights |
| Cordless drill, batteries, drill bits | Estimating the rind thickness of sound wood in the bole, evaluating root soundness (drill bits are flexible steel, 11-12 inches long X 1/8" wide, 9-10" flute, drill is heavy duty, battery packs are rechargeable) |
| Hand lens (10X) | Examining advanced decay, other indicators |
| Field Ident. Guides | Aids for identification of defects by their indicators (timber cruiser and stand exam guides, this guide) |
| Data forms/pencils | Recording data |
| Tree tags | Provide a semi-permanent numbering system for trees that will be re-evaluated annually (Tags are aluminum, numbered in series) |
| Aluminum nails | To secure tree tags in trees |
| Tree paint or tree flagging | To identify trees that must be removed |

This equipment list can be modified to suit budgets and individual needs. We have routinely used these items to do a thorough job of recording a baseline evaluation to which subsequent annual evaluations and monitoring

USDA

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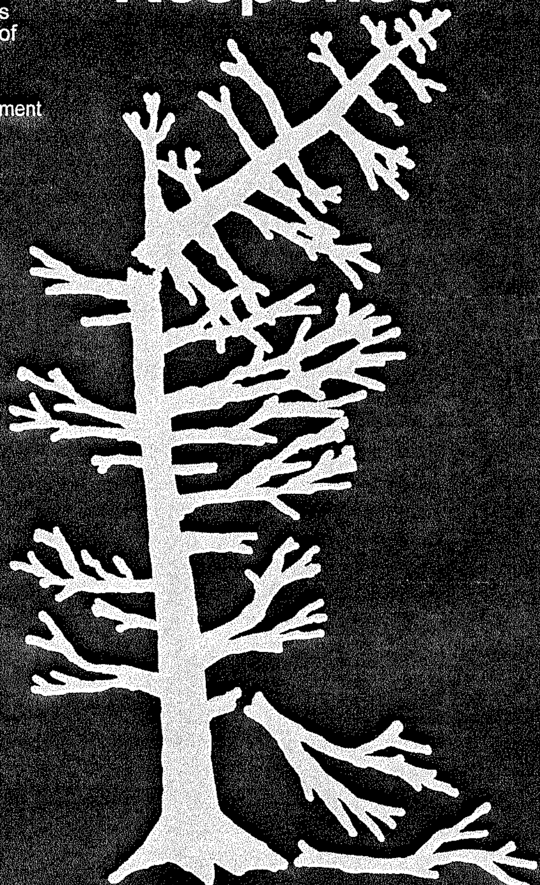
# Field Guide for Danger Tree Identification and Response



Oregon
OSHA

Associated Oregon
Loggers, Inc.

a work area to determine if they pose a danger to personnel. If they pose a danger they must be felled, or the work must be arranged to minimize danger to workers.

***Qualified Person***

When an employer is faced with danger trees, there needs to be people with sufficient knowledge, training and experience, to follow a process for dealing with them.

A **qualified person** is defined as a person who has knowledge, training, and experience in identifying danger trees, their potential failure zones, and measures to eliminate the danger.

## Process for Tree Evaluation and Action

These are the steps the qualified person should take when dealing with potential danger trees:

1. Determine the type of work activity.
2. Identify tree defects and determine the tree's potential to fail.
3. Determine the potential failure zones.
4. Determine if the tree poses a danger to workers.
5. Determine what action to take if the tree is a danger to workers.

### Step 1 – Determine the type of work activity.

***No worker exposure to a danger tree is allowed by state safety laws.***

What characteristics of work activities should the qualified person consider when determining if a tree presents a danger to workers?

There are three categories of work activities.

- Traffic on roads.
- Activities that do not impact the tree such as walking or conducting non-motorized activities that do not involve tree contact.



- Motorized activities near the tree or activities that may cause the tree to be contacted.

Road traffic may or may not influence tree failure. This category is included because trees may fail and fall on vehicles or people congregated along roads, or they may fail and fall on roads and be driven into at a later time.

Walking by a tree or other non-motorized, non-tree contact activities are not likely to induce the tree to fail. The tree may fail due to its condition or weather influences.

Motorized activities, or non-motorized activities that may contact the tree, include road maintenance activities such as running a grader, culvert work, road construction, logging (all types) including timber falling, site preparation, road construction, trail construction, and helicopter operations, may induce tree failure.

***Activity - Traffic on roads***

*Oregon OSHA Division 7, 437-007-0500 Roads (6). On those portions of roads under the direct control of the employer: (a) all danger trees that can fall or slide onto the roadways must be felled* (2).

*Washington 296-54-527 Truck roads (3) safe roadways. The following applies to roads under the control of the employer. All danger trees shall be felled a safe distance back from the roadway* (3)

The reality is there are many miles of roads that may have danger trees adjacent to them. It is not possible to solve the danger tree problem immediately, so it is necessary to prioritize the danger tree treatment workload. The treatment priority should be highest where workers are most likely to be impacted by danger trees. Consideration of exposure level and traffic frequency provides a way to prioritize the workload.

There are three types of exposure: intermittent, short duration, and long duration. Here are some examples. Intermittent exposure includes traffic driving by a defective tree. Short duration exposure includes people stopping next to a defective tree for a short time. It also includes people stopping at an intersection that is next to a defective tree. Long duration exposure includes people exposed to defective trees while parked at a trailhead, repairing a road, or working on a log landing.

Another aspect of exposure along roads is traffic frequency. Roads that have a higher traffic frequency expose more people to a danger tree than roads with a lower traffic frequency.

The longer workers are exposed to a tree, the more opportunity there is for the failed tree to impact them. If exposure duration and traffic frequency are reduced, the opportunity for the tree to impact the worker is also reduced. The qualified person should consider traffic frequency and exposure duration when prioritizing the treatment workload for danger trees.

If the tree's potential for failure is likely or imminent, and the potential failure zone overlaps the traveled portion of the road, the tree poses a danger to workers if it fails.

For specific direction, refer to agency or company policy about danger trees along roads. When developing the danger treatment priority, consider trees in the following situations:

- Trees with an **imminent** potential to fail along all roads utilized by workers on the project.
- Trees with a **likely** potential to fail along all roads utilized by workers on the project.
- Trees with an **imminent** potential to fail that overlap areas where people congregate such as landings, trailheads, parking areas, places where motorists can pull off to the side of the road, intersections, and areas where workers are repairing or maintaining a road.
- Trees with a **likely** potential to fail that overlap areas where people congregate such as landings, trailheads, parking areas, places where motorists can pull off to the side of the road, intersections, and areas where workers are repairing or maintaining a road.
- Trees with an **imminent** potential to fail that overlap the traveled portions of roads with a high traffic frequency.
- Trees with a **likely** potential to fail that overlap the traveled portions of roads with a high traffic frequency.



- Trees with an **imminent** potential to fail that overlap the traveled portions of roads with a low traffic frequency.

### *Activity – Non-motorized, non-tree contact*

These are activities that involve walking near trees without touching them. They are also non-motorized. The premise behind this activity type is that trees are much less likely to fail if they are not contacted, and workers are more likely to recognize tree dangers if they are not focused on operating vehicles or machinery.

Examples include tree planting, inventory (any type), surveying, walking to a jobsite along a trail, and designating timber.

With this type of activity, it is important to recognize trees that have an imminent failure potential. These trees may fail at any time so they are a danger to workers regardless of the activity type. Because these trees expose employees to dangers, only employees who are trained and experienced to remove the danger tree, and are under the direct supervision of the employer, should enter the tree's potential failure zone.

There will also be trees that have a likely potential to fail. In order to determine if the tree is a danger to workers, the qualified person needs to evaluate the tree condition, activity, and whether or not the worker will be within the potential failure zone. If the qualified person determines that the likely failure potential tree does not represent a danger, employees should work through the potential failure zone quickly so as to minimize exposure time and avoid tree contact. If the tree does represent a danger, it should be treated as a dangerous imminent failure potential tree.

### *Activity – Motorized, tree contact*

Motorized activities, or those activities that may contact the tree, include road construction, logging (all types), timber falling, tree climbing, site preparation, trail construction, and helicopter operations. The premise behind this activity type is that vibration due to machine operation, or air movement in the case of a helicopter, or tree contact by a machine, log, or operating line, may induce tree failure. As a result of noise, or worker focus on the job task, the worker might not recognize the danger, or notice the failure beginning to take place, and miss the opportunity to escape.

With this type of activity, it is important to recognize trees that have an imminent failure potential. Because these trees may fail at any time, they are a danger to workers. Only employees who are trained and experienced to remove the danger tree and are under the direct supervision of the employer, should enter the tree's potential failure zone.

There will also be trees that have a likely potential to fail. In order to determine if the tree is a danger to workers, the qualified person needs to evaluate the tree condition, activity, and whether or not the worker will be within the potential failure zone. If the qualified person determines that the likely failure potential tree does not represent a danger, employees should work through the potential failure zone quickly so as to minimize exposure time, and avoid unnecessary tree contact. If the tree does represent a danger, it should be treated as a dangerous imminent failure potential tree.



Attributes of activities that may induce tree failure:

**Table 1. Activities and Hazards**

| Activity | Hazards |
|---|---|
| Timber falling, manual | Felled trees may bump adjacent trees and cause them to fail. Trees felled through other trees or onto slash (especially dead, dry material), may cause material to be flung in many directions. Some trees are too dangerous to fall manually. Exposure duration may be long. |
| Timber falling, mechanical | Trees being felled may fail and fall on the machine. Adjacent trees may fail through contact and fall on the machine. The machine must comply with state code related to protective structures and use. Machines may be used to fall danger trees that are too dangerous to fall manually. |
| Skyline logging | In partial cutting, many things can contact a tree and cause it to fail; logs being yarded, operating lines, machine operation on landings, guy lines and support lines. Support trees or tail trees may fail. Exposure duration at landings can be long. |
| Mechanized, tractor, or shovel logging | Machines may contact trees, or trees they fell may contact trees causing them to fail. |
| Helicopter logging | In partial cuts the rotor wash or contact with lines or logs may cause trees, tops of trees, or hang-ups to fail. This effect may be delayed; the tree may fail when the helicopter is no longer over it. |
| Machine use in site prep, brush piling, or slash treatment | Machinery or material being moved may contact trees and cause them to fail. |
| Trail construction or maintenance | Machinery or people may contact trees and cause them to fail. Also the exposure duration may be long. |
| Road construction | Equipment or moving material may contact trees and cause them to fail. Exposure duration may be long. |
| Road maintenance | All maintenance activities including slide and debris removal and culvert maintenance. Machine operation may cause tree failure. Exposure duration may be long. |

## Step 2 – Identify tree defects and determine the tree's potential to fail.

Failure potential is a function of tree condition. There are three types of failure potential: **low, likely, or imminent**. Trees with likely or imminent potential to fail may be classed as danger trees depending on the work activity and whether the work activity is within the tree's potential failure zone.

In order to define the potential failure zones, it is necessary to determine which tree part is likely to fail: entire tree, tree top, branches or bark.

A tree may have a **likely potential to fail** if any of the following conditions exist (1, Pgs. 35-65). Appendix D contains a detailed listing of symptoms and indicators.

- Root diseased but still alive.
- Old lean that has not corrected itself.
- Some undermined or severed roots.
- Some heart, butt, or sap rot.
- Cracks or structural defect associated with some decay.
- Dead tops with some heart or sap rot.
- Dwarf mistletoe bole swellings if they have decay that extends to an area less than **half** the bole diameter.
- Fungus cankers on the bole when the canker width is less than **half** the bole diameter.
- Forked tops and crotches associated with decay, cracks, splits, or callus ridges. Pitch or resin is not always associated with likely failure potential. Pitch is often a sign in a healthy tree when it is defending itself against pathogen or insect attack.
- Dead trees that are still sound.
- Fire damaged or killed trees that are still sound.
- Hardwoods with sap rot approaching half their diameter.

A tree may have an **imminent potential to fail** if it is so defective or rotten that it would take little effort to make it fail during project implementation. Trees with an imminent failure



potential are much more likely to fall than those trees rated as likely to fail.

Trees with an imminent potential to fail include those that have the following conditions (1, Pgs. 35-65).

- Root sprung.
- Recent lean.
- Missing bole wood due to fire or damage.
- Significant heart or sap rot.
- Loose bark.
- Dwarf mistletoe bole swellings if they have decay that extends to an area **more than half** the bole diameter.
- Fungus cankers on the bole when the canker width is **more than half** the bole diameter.
- Dead tops with significant sap rot.
- Hung up tops, limbs, or hung up trees.
- Dead trees that are not sound.
- Fire damaged or killed trees that are not sound.
- Trees with multiple defects.

Trees with some of these conditions may have either a likely or an imminent potential to fail. For example, some dead tops, dead trees, and fire damaged or killed trees may be less stable than others. Trees with these conditions require an evaluation to determine which class to place them in.

For additional detail and indicators, refer to Appendix D and to the reference document (1).

***Wind or snow loading.***

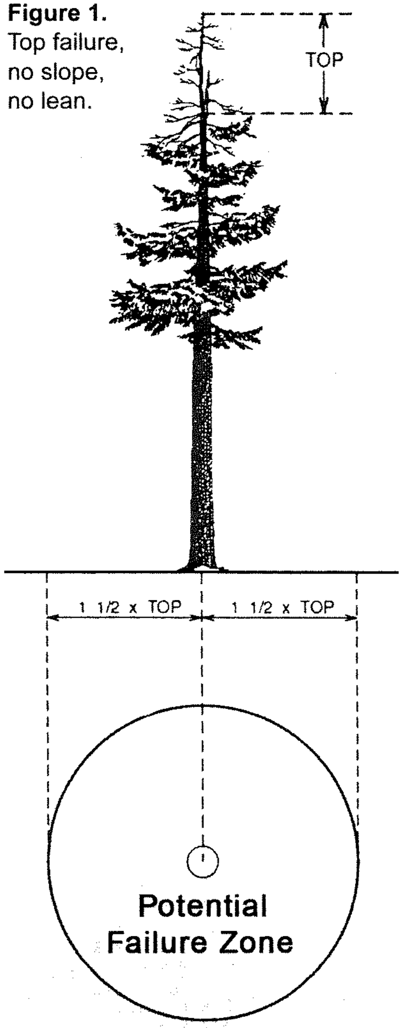
Wind or snow loading may increase the chances that a tree with decay or defect will fail. It is prudent to assume that as wind or snow loading increases, the potential for a tree to fail also increases.

## Step 3 - Determine the potential failure zone.

The potential failure zone is the area that could be reached by any part of a failed tree.

When a tree fails, the tree or its parts may strike other trees and cause them to fail as well. The parts may slide or roll. Also, when a tree is being felled, it may strike other trees or debris on the ground and fling material a considerable distance. This is especially true in dead timber. The qualified person needs to be aware of these situations when determining the potential failure zones.

**Figure 1.** Top failure, no slope, no lean.




***Top Failure - Potential Failure Zone***

The area on-the-ground that could be reached by a dislodged top, slab, or chunk is called the potential failure zone for a tree top failure.

When determining the zone, evaluate the following conditions:

- Ground slope.
- Amount and direction of lean.
- Length of the top portion that could dislodge.



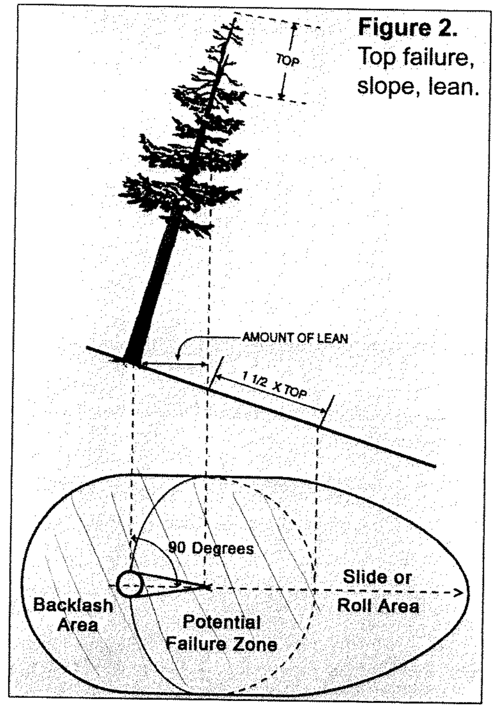
✣ **Level or sloped ground; no discernable lean. Figure 1.**

Determine the length of the top portion that could dislodge. The failure zone forms a circle around the tree with a radius equal to at least 1 ½ times the length of the dislodged portion. On sloped ground where the dislodged section may slide or roll down hill, the failure zone must be extended on the down-hill side for whatever distance is necessary to protect workers.

✣ **Level or sloped ground; lean in any direction. Figure 2.**

Determine the length of the top portion that could dislodge. Determine the amount of lean (horizontal distance from where the top portion could dislodge relative to the base). The failure zone is the distance determined by adding 1 ½ times the length of the dislodged portion to the lean amount. This distance would be applied to an area beginning at the tree base then extending towards the direction of the lean and out 90 degrees on either side of the tree from the lean direction.

**Figure 2.** Top failure, slope, lean.




The area behind the lean is not within the failure zone. Be aware, however, that if equipment, lines, moving logs, or falling timber contacts a likely or imminent failure potential tree, the contact could force a backlash opposite to the lean and create an additional danger during the time of impact beyond the potential failure zone. On sloped ground where the dislodged section may slide or roll downhill, the potential failure zone must be extended on the downhill side for whatever distance is necessary to protect workers.

***Total Tree Failure - Potential Failure Zone***

The failure zone is defined as the area on the ground that could be reached by any portion of the tree that may collapse.

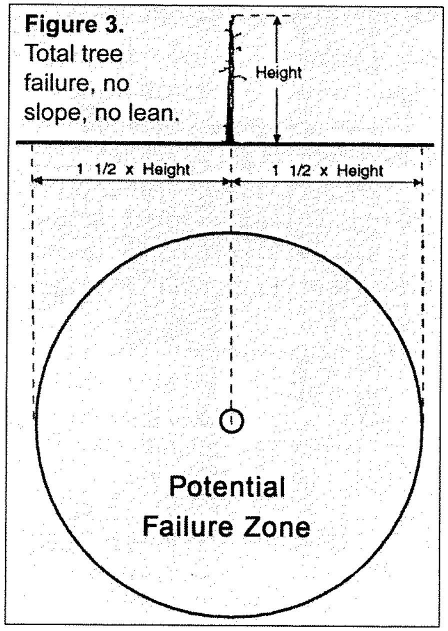



**Figure 3.** Total tree failure, no slope, no lean.

When determining the failure zone, the following conditions must be evaluated:

- Ground slope.
- Direction of lean.
- Height of the tree.

**❖ Level or sloped ground; no discernible lean. Figure 3.**

The failure zone is a circle around the tree with a radius of at least 1 ½ times the total tree height.

On sloped ground, the failure zone downhill of the tree may have to be extended whatever distance is necessary to protect workers.



**❖ Level or sloped ground; lean in any direction. Figure 4.**

The failure zone is an area at least 1 ½ times the tree height beginning at the tree base then extending towards the direction of the lean and out 90 degrees on either side of the tree from the lean direction.

The area behind the lean is not within the failure zone. Be aware that if equipment, lines, moving logs, or falling timber contacts a likely or imminent failure potential tree, the contact could force a backlash opposite to the lean and create an additional danger during the time of impact beyond the potential failure zone.

On sloped ground where the dislodged section may roll downhill, the potential failure zone must be extended on the downhill side for whatever distance is necessary to protect workers.

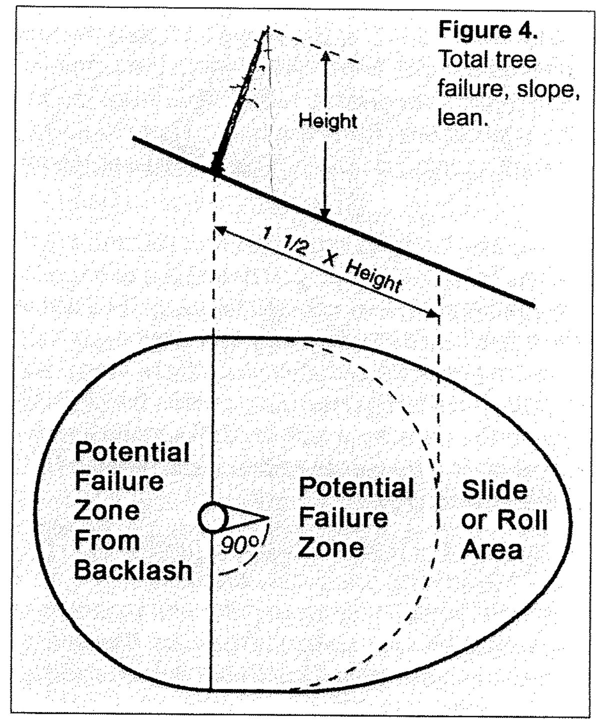



**Figure 4.** Total tree failure, slope, lean.

## Step 4 – Determine if the tree poses a danger to employees.

- Determine if the activity is likely to cause the tree to fail.
- Evaluate the tree. Determine the tree condition and its failure potential.
- Identify the potential failure zone.
- Make a judgment about whether or not the tree is a danger to employees.
- If the tree is a danger, remove the danger by taking the tree down, or arrange work so that employees are not in the potential failure zone.

The following three examples illustrate the process a qualified person should go through when evaluating trees.

***Example 1***

**Part 1**. Assume there is a skyline logging operation. You as the qualified person, notice that behind the landing, the standing trees look abnormally faded. There are conks around the base of several of the trees. There is some basal resin and bark staining on them. There has been some wind throw.

You conclude that the trees may have root rot, and have a likely potential for failure. Next, you determine that the landing is within the potential failure zone of the trees. The activity is motorized, and while it is not likely that anything will strike the trees, wind and vibration may induce them to fail. You recognize that the landing crew will be within the potential failure zone of the trees for a long time. Your conclusion is that the trees pose a danger to workers and need to be taken down, or the landing moved.

**Part 2.** Assume there is a tree planting operation in the unit logged near the landing previously discussed. You, as the qualified person, notice that around the unit boundary, many of the standing trees look abnormally faded. There are conks around the base of several of the trees. There is some basal resin and bark staining on them.



You conclude that the trees may have root rot and have a likely potential to fail. Next, you determine that the planting job site is within the potential failure zone of the root rot trees. The activity is tree planting, and it is not likely that anything will strike the trees and cause them to fail. Your conclusion is that the root rot trees do not pose a danger to workers, so the area around them can be planted. You require that the planting crew work rapidly through the area and avoid the area on a windy day.

***Example 2***

Assume that you are evaluating trees along a haul route road. You notice two very similar trees in two locations. These trees have one conk on the bole.

Tree condition

You conclude the trees have some heart rot and have a likely potential for failure. One tree is on the far side of a curve at the bottom of a long steep grade. The other is along a straight stretch of road. Exposure will be intermittent. Next, you determine the potential failure zone and realize that the portion of the road traveled is within the potential failure zone. You think that when the trees fail they may not actually hit any traffic, but that traffic may run into them, especially the one on the curve.

Condition zone

You conclude that the trees pose a danger to employees, and they need to be taken down.

potential

***Example 3***

You are evaluating a tree planting job. The unit being planted has many dead trees and a few large live trees left. You notice that most of the dead trees, even though they have only been dead for two years, have pouch fungus conks (sap rot) on them, and the bark looks loose. One of the green trees has a recent lean, and you suspect it is root sprung. You also notice that there are some dead trees that are hung up in some other trees. On the other side of the unit, there are a few trees standing straight with conks on the bole.

You conclude that the leaning tree, the trees with the hang-ups, and the sap rot trees with the loose bark have an imminent potential to fail. Because these trees have an imminent failure potential, and their potential failure zones include the area to be planted, you conclude that the trees present a danger to employees. The areas cannot be safely planted without removing the danger by taking the trees down.

The straight green trees with heart rot are different. While they have a likely potential for failure, the exposure under them will be short duration, and the activity is not likely to do anything to cause the trees to fail since there will be no vibration or tree contact. You decide to let a crew plant under them if they move through rapidly and do not linger under the trees.

***Record your results***

As a qualified person, when you examine trees, it is important to record your work. Appendix B has a tree evaluation form.

### Step 5 – Action if tree is a danger to workers.

Employees are not allowed to be exposed to danger trees. If upon considering the tree condition and activity, it is determined that the tree poses a danger to employees, the tree either needs to be taken down or the work arranged so that employees are not exposed to the danger.

## Literature Cited


1. Harvey, R. D. Jr., and P. F. Hessburg Sr. 1992. Long-Range Planning for Developed Sites in the Pacific Northwest: The Context of Danger Tree Management. USDA Forest Service. Pacific Northwest Region. FPM-TP039-92. 120p.
2. Oregon OSHA. Division 7 Forest Activities 2003. 437-007-0225(1).
3. Washington Safety Standards for Logging Operations 1997. Chapter 296-54-WAC.
4. 29 CFR 1960.8 General Duty Clause.
5. 1910 OSHA Guide. Federal OSHA 1995. 1910.266 Logging Operations.
6. Health and Safety Code Handbook 1999. Forest Service. FSH 6709.11. WO Amendment 670911-99-1.
7. BLM Manual 1112-1, Safety and Health Management.
8. BLM Handbook 1112-2, Safety and Health for Field Operations.


***Citation example: (1, Pg 15) means page 15 in Harvey.***



## Appendix A - Forest Service Road Maintenance Levels

**Table 2. Relationship between Forest Service road maintenance levels.**

| | Maintenance Level | | | | |
|---|---|---|---|---|---|
| Parameters | 1 | 2 | 3 | 4 | 5 |
| | | | | | |
| Traffic type | Open for non-motorized uses. Closed to vehicles licensed to be on the public road system. | Administrative, permitted dispersed recreation, specialized commercial haul. Maintained for high clearance vehicles | All National Forest Traffic, general use, commercial haul, maintained for passenger cars | | |

## Appendix B – Tree Evaluation Form

**Table 3. Tree evaluation form**

| **Tree, Site, Road Evaluation Form** | Location | | Date |
|---|---|---|---|
| Name | Species | | DBH |
| Tree # | Comments | | |
| Height | | | |
| Failure class (None, Likely, or Imminent). Describe tree condition. | Sketch of potential failure zone. | | |
| Identify the work activity. | Exposure (intermittent, short duration, long duration). | Could the work activity cause the tree to fail? Describe how. | |
| Will the activity put workers in the potential failure zone, or in the case of roads, will the potential failure zone overlap the road travel way? (Y/N) and explanation. | | | |
| Danger to employees (Y/N) | | | |
| Action | | | |

## Appendix C – Quick Reference Cards

**Process for Tree Evaluation and Action**
These are the steps the qualified person should take when dealing with potential danger trees:

- Determine the type of work activity.
- Identify tree defects and determine the tree's potential to fail.
- Determine the potential failure zones.
- Determine if the tree poses a danger to workers.
- Determine what action to take if tree is a danger to workers.

### Determine Work Activity

- Traffic on roads.
- Activities that do not impact the tree such as walking or conducting non motorized activities that do not involve tree contact.
- Motorized activities near the tree or activities that may cause the tree to be contacted.

**While developing the danger tree treatment priority along roads, consider trees in the following situations:**

- Trees with an imminent potential to fail along all roads utilized by workers on the project.
- Trees with an imminent or likely potential to fail that overlap areas where people congregate such as landings, trailheads, parking areas, places where motorists can pull off to the side of the road, intersections, and areas where workers are repairing or maintaining a road.
- Trees with an imminent or likely potential to fail that overlap the traveled portion of roads with a high traffic frequency.
- Trees with an imminent or likely potential to fail that overlap the traveled way on roads with a low traffic frequency.



**Identify tree defects and determine the tree's potential to fail - likely.**

A tree may have a **likely potential to fail** if any of the following conditions exist. (1, Pgs. 35-65). Appendix A contains a detailed listing of symptoms and indicators.

- Root diseased but still alive.
- Old lean.
- Undermined or severed roots but not severely.
- Some heart, butt, or sap rot.
- Cracks or structural defect associated with some decay.
- Dead tops with some heart or sap rot.
- Dwarf mistletoe bole swellings if they have decay that extends to an area less than **half** the bole diameter.
- Fungus cankers on the bole when the canker width is less than **half** the bole diameter.
- Forked tops and crotches associated with decay, cracks, splits, or callus ridges. Pitch or resin is not always associated with likely failure potential. Pitch is often a sign in a healthy tree when it is defending itself against pathogen or insect attack.
- Dead trees that are still sound.
- Fire damaged or killed trees that are still sound.
- Hardwoods with sap rot approaching half their diameter.

**Identify tree defects and determine the tree's potential to fail - imminent.**

A tree may have an **imminent potential to fail,** if it is so defective or rotten, that it would take little effort to make it fail during project implementation. It is much more apt to fail than those trees rated as likely to fail.

Trees with an imminent potential to fail include those that have the following conditions (1, Pgs. 35-65).

- Root sprung.
- Recent lean.
- Missing bole wood due to fire or damage.
- Significant heart or sap rot.
- Loose bark.
- Dwarf mistletoe bole swellings if they have decay that extends to an area **more than half** the bole diameter.
- Fungus cankers on the bole when the canker width is **more than half** the bole diameter.
- Dead tops with significant sap rot.

## Potential Failure Zones

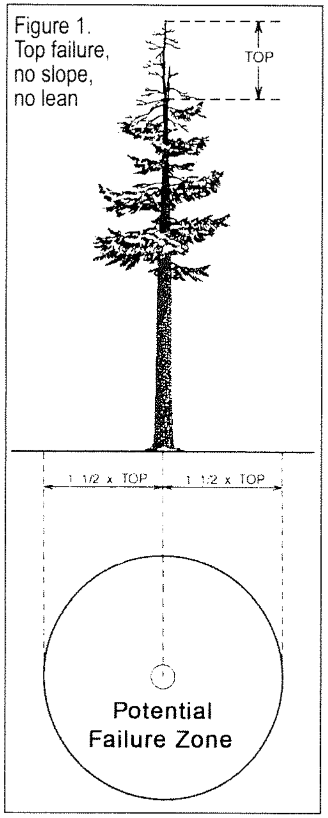


Figure 1. Top failure, no slope, no lean

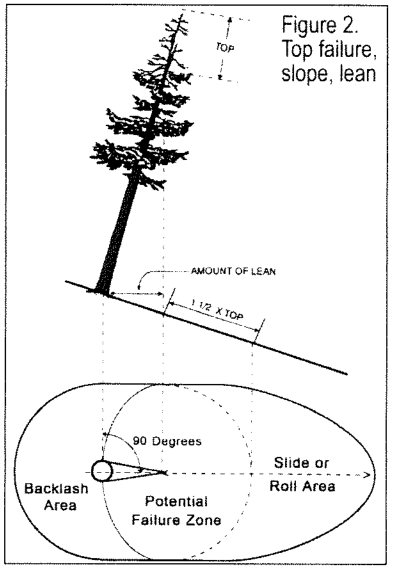


Figure 2. Top failure, slope, lean

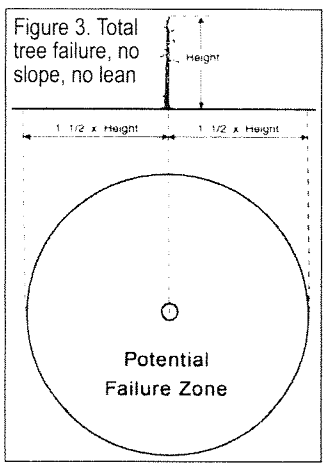


Figure 3. Total tree failure, no slope, no lean

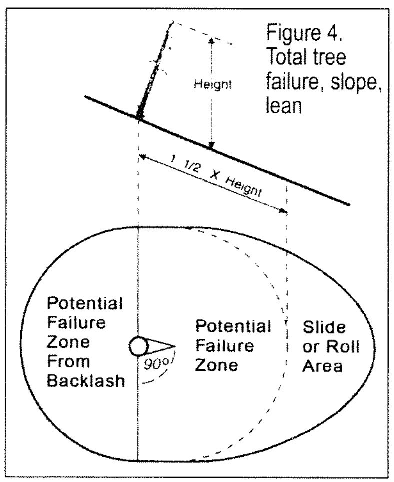


Figure 4. Total tree failure, slope, lean



### Motorized, tree contact activity attributes.

| Activity | Attributes |
|---|---|
| Timber falling, manual | Felled trees may bump adjacent trees and cause them to fail. Trees felled through other trees or onto slash (especially dead, dry material) may cause material to be flung in many directions. Some trees are too dangerous to fall manually. Exposure duration may be large. |
| Timber falling, mechanical. | Trees being felled may fail and fall on machine. Adjacent trees may fail through contact, and fall on machine. Machine must follow State code related to protective structures and use. Machines may be used to fall danger trees that are too dangerous to fall manually. |
| Skyline logging | In partial cutting, logs being yarded may contact trees and cause them to fail. Lines may contact trees and cause them to fail. Machines on landings may contact trees and cause them to fail. Guy lines and support lines may cause the trees they contact to fail. Support trees or tail trees may fail. Exposure duration at landings can be long. |
| Mechanized, tractor, or shovel logging | Machines may contact trees, or the trees they fell may contact trees, and cause them to fail. |
| Helicopter logging | In partial cuts, the rotor wash or contact with lines or logs may cause trees, tops of trees, or hang-ups to fail. This effect may be delayed; the tree may fail when the helicopter is no longer over it. |
| Machine use in site prep, brush piling, or slash treatment | Machinery or material being moved may contact trees and cause them to fail. |
| Trail construction or maintenance | Machinery or people may contact trees and cause them to fail. Also the exposure duration may be long. |
| Road construction, maintenance | Equipment or moving material may contact trees and cause them to fail. Exposure duration may be long. Includes slide and debris removal and culvert maintenance. Maintenance machine operation may cause tree failure. |

### Determine if the tree poses a danger to employees.

- Determine if the activity is likely to cause the tree to fail.
- Evaluate the tree. Determine the tree condition related to whether or not it will fail and whether it has a likely or imminent potential to fail.
- Identify the potential failure zones.
- After considering all these things, make a judgment about whether or not the tree is a danger to employees.
- If the tree is a danger, take it down it or arrange work so that employees are not in the potential failure zone.

**Appendix 14-8:**
**Northern Spotted Owl Management Areas on Wildlife Habitat Management Plan Lands**

**(CONFIDENTIAL)**

**Appendix 14-9:**
**Washington Administrative Code Sections Related to Bald Eagles, Spotted Owl, and Washington Department of Fish and Wildlife Spotted Owl Status Definitions**

## WDFW SPOTTED OWL SITE STATUS DEFINITION

**Status 1:** Pair or reproductive - a male and female heard and/or observed in close proximity to each other on the same visit, a female detected on a nest, or one or both adults observed with young.
**Status 2:** Two birds, pair status unknown - the presence or response of two birds of opposite sex where pair status cannot be determined and where at least one member meets the resident territorial single requirements.
**Status 3:** Resident territorial single - the presence or response of a single owl within the same general area on three or more occasions within a breeding season with no response by an owl of the opposite sex after a complete survey; or three or more responses over several years (i.e., two responses in year one and one response in year two, for the same general area).
**Status 4:** Single spotted owl detected, but site status unknown.
**Status 5:** Historic site deemed no longer suitable for owl use.

Source: Washington Department of Fish and Wildlife. 2006. Fish and Wildlife Geographic Information Systems Digital Date Documentation. Olympia, WA. August 2006. 115 pp.

## WASHINGTON ADMINISTRATION CODES RELATED TO SPOTTED OWLS

***WAC 222-10-041 Northern spotted owls.*** *[Effective 9/21/06]*

The following policies shall apply to forest practices subject to SEPA if the forest practices may cause adverse impacts to northern spotted owls.

(1) **In SOSEAs or areas of SOSEAs where the goal is demographic support,** suitable spotted owl habitat should be maintained either to protect the viability of the owl(s) associated with each northern spotted owl site center or to provide demographic support for that particular SOSEA as described in the SOSEA goals.

**(2) In SOSEAs or areas of SOSEAs where the goal is dispersal support**, either suitable spotted owl habitat should be maintained to protect the viability of the owl(s) associated with each northern spotted owl site center or dispersal habitat should be managed, over time, to provide the dispersal support for that particular SOSEA as described in the SOSEA goals. Dispersal support is provided by a landscape which includes dispersal habitat at the stand level interspersed with areas of higher quality habitat. Stands of dispersal habitat should be managed to reduce gaps between stands and to maintain a sufficient level of dispersal habitat to meet the SOSEA goals over time.

**(3) In SOSEAs or areas of SOSEAs where the goal is a combination of dispersal support and demographic suppor**t, either suitable spotted owl habitat should be maintained to protect the viability of the owl(s) associated with each northern spotted owl site center or a variety of habitat conditions should be provided which in total are more than dispersal support and less than demographic support. This can be accomplished by providing:

(a) Dispersal support as described in subsection (2) of this section;

(b) Areas of suitable spotted owl habitat that contain some opportunities for nesting as well as roosting and foraging habitat; and

(c) Connectivity between areas of SOSEAs designated for demographic support or adjacent federal lands which are designated as late successional reserves, congressionally reserved areas, or administratively withdrawn areas. Chapter 222-10 State Environmental Policy Act Guidelines 10-4

**(4) Within SOSEAs**, the following amounts of suitable habitat are generally assumed to be necessary to maintain the viability of the owl(s) associated with each northern spotted owl site center, in the absence of more specific data or a mitigation plan, as provided for in subsections (6) and (7) of this section respectively:

(a) All suitable spotted owl habitat within 0.7 mile of each northern spotted owl site center;

(b) Including the suitable spotted owl habitat identified in (a) of this subsection:

(i) For the Hoh-Clearwater/Coastal Link SOSEA - A total of 5,863 acres of suitable spotted owl habitat within the median home range circle (2.7 mile radius).

(ii) For all other SOSEAs - A total of 2,605 acres of suitable spotted owl habitat within the median home range circle (1.8 mile radius). The department shall first identify the highest quality suitable spotted owl habitat for this purpose. Consideration shall be given to habitat quality, proximity to the activity center and contiguity in selecting the most suitable habitat. Suitable spotted owl habitat identified outside 0.7 mile of a northern spotted owl site center may support more than one median home range circle.

(5) **Outside SOSEAs**, during the nesting season (between March 1 and August 31), seventy acres of the highest quality suitable spotted owl habitat surrounding a northern spotted owl site center should be maintained. The seventy acres for one site center shall not be utilized for meeting suitable habitat needs of any other site center.

(6) The assumptions set forth in subsection (4) of this section are based on regional data. Applicants or others may submit information that is more current, accurate, or specific to a northern spotted owl site center, proposal, or SOSEA circumstances or goals. The department shall use such information in making its determinations under this section where the department finds, in consultation with the department of fish and wildlife, that the information is more likely to be valid for the particular circumstances than the assumptions established under subsection (4) of this section. If the department does not use the information, it shall explain its reasons in writing to the applicant.

(7) The department shall consider measures to mitigate identified adverse impacts of an applicant's proposal. Mitigation measures must contribute to the achievement of SOSEA goals or to supporting the viability of impacted northern spotted owl site centers.

***WAC 222-16-080 Critical Habitats (State) of Threatened and Endangered species.*** *[Effective 7/1/05]*

(1) Critical habitats (state) of threatened or endangered species and specific forest practices designated as Class IV-Special are as follows:

(h) Northern spotted owl (*Strix occidentalis caurina*)

(i) **Within a SOSEA boundary** (see maps in WAC 222-16-086), except as indicated in (h) (ii) of this subsection, harvesting, road construction, or aerial application of pesticides on suitable spotted owl habitat within a median home range circle that is centered within the SOSEA or on adjacent federal lands.

(ii) **Within the Entiat SOSEA,** harvesting, road construction, or aerial application of pesticides within the areas indicated for demographic support (see WAC 222-16-086(2)) on suitable spotted owl habitat located within a median home range circle that is centered within the demographic support area.

(iii) **Outside of a SOSEA,** harvesting, road construction, or aerial application of pesticides, between March 1 and August 31 on the seventy acres of highest quality suitable spotted owl habitat surrounding a northern spotted owl site center located outside a SOSEA. The highest quality suitable habitat shall be determined by the department in cooperation with the department of fish and wildlife. Consideration shall be given to habitat quality, proximity to the activity center, and contiguity.

(iv) **Small parcel northern spotted owl exemption**. Forest practices proposed on the lands owned or controlled by a landowner whose forest land ownership within the SOSEA is less than or equal to 500 acres and where the forest practice is not within 0.7 mile of a northern spotted owl site center shall not be considered to be on lands designated as critical habitat (state) for spotted owls.

***WAC 222-16-085 Northern spotted owl habitats.*** *[Effective 6/18/05]*

(1) **Suitable spotted owl habitat** means forest stands which meet the description of old forest habitat, sub-mature habitat or young forest marginal habitat found in (a) and (b) of this subsection. Old forest habitat is the highest quality, followed in descending order by submature habitat and young forest marginal habitat.

(a) **Old forest habitat** means habitat that provides for all the characteristics needed by northern spotted owls for nesting, roosting, foraging, and dispersal, described as stands with:

(i) A canopy closure of 60% or more and a layered, multispecies canopy where 50% or more of the canopy closure is provided by large overstory trees (typically, there should be at least 75 trees greater than 20 inches dbh per acre, or at least 35 trees 30 inches dbh or larger per acre)
(ii)Three or more snags or trees 20 inches dbh or larger and 16 feet or more in height per acre with various deformities such as large cavities, broken tops, dwarf mistletoe infections, and other indications of decadence
(iii)More than two fallen trees 20 inches dbh or greater per acre and other woody debris on the ground.

(b) **Sub-mature habitat and young forest marginal habitat.** Sub-mature habitat provides all of the characteristics needed by Northern spotted owls for roosting, foraging, and dispersal. Young forest marginal habitat provides some of the characteristics needed by northern spotted owls for roosting, foraging, and dispersal. Sub-mature habitat and young forest marginal habitat stands can be characterized based on the forest community, canopy closure, tree density and height, vertical diversity, snags and cavity trees, dead and down wood, and shrubs or mistletoe infection. They are described in the following table:

| (i) Western Washington Spotted Owl Sub-Mature and Young Forest Marginal Habitat Characteristics | | |
|---|---|---|
| **Characteristics** | **Habitat Type** | |
| | **Sub-Mature** | **Young Forest Marginal** |
| **Forest Community** | Conifer-dominated or conifer-hardwood (≥ 30% conifer) | Conifer-dominated or conifer-hardwood (≥ 30% conifer) |
| **Canopy Closure** | ≥ 70% | ≥ 70% |
| **Tree Density and Height** | 115-280 trees/acre (≥ 4 in dbh) with dominants/codominants ≥ to 85 ft high or dominants/codominants ≥ 85 ft high with 2 or more layers and 25-50% intermediate trees | 115-280 trees/acre (≥ 4 in dbh) with dominants/codominants ≥ to 85 ft high OR dominants/codominants ≥ 85 ft high with 2 or more layers and 25-50% intermediate trees |
| **Vertical Density** | | |
| **Snags/Cavity Trees** | ≥ 3/acre (≥ 20 in. dbh and 16 ft in height) | ≥ 2/acre (≥ 20 in. dbh and 16 ft in height) or ≥ 10% of the ground covered with 4 in. diameter or larger wood, with 25-60% shrub cover. |
| **Dead, Down Wood** | N/A | |
| **Shrubs** | N/A | |

The values indicated for canopy closure and tree density may be replaced with a quadratic mean diameter of greater than 13 inches and a basal area of greater than 100.

(2) **Spotted owl dispersal habitat** means habitat stands that provide the characteristics needed by northern spotted owls for dispersal. Such habitat provides protection from the weather and predation, roosting opportunities, and clear space below the forest canopy for flying. Timber stands that provide for spotted owl dispersal have the following characteristics:

(a) **For western Washington**, timber stands 5 acres in size or larger with:

(i) 70% or more canopy cover; and
(ii) 70% or more of the stand in conifer species greater than 6 inches dbh; and
(iii) A minimum of 130 trees per acre with a dbh of at least 10 inches or a basal area of 100 square feet of 10 inch dbh or larger trees ; and

(iv) A total tree density of 300 trees per acre or less; and
(v) A minimum of 20 feet between the top of the understory vegetation and the bottom of the live canopy, with the lower boles relatively clear of dead limbs.

(b) **For eastern Washington,** timber stands 5 acres in size or larger with:

(i) 50% or more canopy closure; and
(ii) A minimum of 50 conifer trees per acre, with a dbh of 6 inches or more in even-aged stands or 4 inches or more in uneven-aged stands, and an average tree height of 65 feet or more; and
(ii) Total tree density of 200 trees per acre or less; and
(iv) A minimum of 20 feet between the top of the understory vegetation and the bottom of the live canopy, with the lower boles relatively clear of dead limbs; or
(v) Conifer stands with a quadratic mean diameter of 9 inches or more and a relative density of 33 or more or a canopy closure of 55% or more

(c) Suitable spotted owl habitat provides all of the required characteristics needed by spotted owls for dispersal.

(d) Landowners may submit information to support an alternate definition of dispersal habitat for review and approval by the department in consultation with the department of fish and wildlife

## WASHINGTON ADMINISTRATION CODES RELATED TO BALD EAGLES

***WAC 232-12-292 Bald eagle protection rules*** *[Effective 2002]*

### Purpose

1.1 The purpose of these rules is to protect the habitat and thereby maintain the population of the bald eagle so that the species is not classified as threatened, endangered or sensitive in Washington state. This can best be accomplished by promoting cooperative efforts to manage for eagle habitat needs through a process which is sensitive to the landowner goals as well. The following rules are designed to promote such cooperative management.

### Authority

2.1 These rules are promulgated pursuant to RCW 77.12.655.

### Definitions

3.1 "Communal roost site" means all of the physical features surrounding trees used for night roosting that are important to the suitability of the roost for eagle use. These features include flight corridors, sources of disturbance, trees in which eagles spend the night, trees used for perching during arrival or departure and other trees or physical features, such as hills, ridges, or cliffs that provide wind protection.

3.2 "Cultural activities" means activities conducted to foster the growth of agricultural plants and animals.

3.3 "Department" means department of fish and wildlife.

3.4 "Endangered" means a species which is seriously threatened with extirpation throughout all or a significant portion of its range within Washington.

3.5 "Government entities" means all agencies of federal, state and local governments.

3.6 "Landowner" means any individual, private, partnership, nonprofit, municipal, corporate, city, county, or state agency or entity which exercises control over a bald eagle habitat whether such control is based on legal or equitable title, or which manages or holds in trust land in Washington state.

3.7 "Nest tree" means any tree that contains a bald eagle nest or has contained a nest.

3.8 "Nest site" means all of the physical features surrounding bald eagle nests that are important to normal breeding behavior. These features include alternate and potential nest trees, perch trees, vegetative screening, foraging area, frequently used flight paths, and sources of disturbance. This site is also referred to as the territory defended by a breeding pair of eagles.

3.9 "Perch tree" means a tree that is consistently used by eagles. It is often close to a nest or feeding site and is used for resting, hunting, consumption of prey, mating display and as a sentry post to defend the nest.

3.10 "Predacides" means chemicals used to kill or control problem wildlife.

3.11 "Region" means an ecological/geographic area that forms a unit with respect to eagles, e.g., Hood Canal, lower Columbia River, outer coast and south Puget Sound.

3.12 "Sensitive" means any wildlife species native to the state of Washington that is vulnerable or declining and is likely to become endangered or threatened in a significant portion of its range within the state without cooperative management or removal of threats.

3.13 "Site management plan" means a legal agreement between the department and the landowner for management of a bald eagle nest or roost site. This plan may be a list of conditions on a permit or a more detailed, site-specific plan.

3.14 "Threatened" means a species that could become endangered within Washington without active management or removal of threats.

**Applicability and operation**

4.1 The department shall make available to other governmental entities, interest groups, landowners and individuals information regarding the location and use pattern of eagle nests and communal roosts.

4.2 The department shall itself and through cooperative efforts (such as memoranda of understandings pursuant to chapter 39.34 RCW) work with other government agencies and organizations to improve the data base for nest and communal roost site activity and productivity and to protect eagle habitats through site management plans.

4.3 The department's goal shall be to identify, catalog and prioritize eagle nest or communal roost sites. The department shall notify permitting agencies of nesting or roost site locations.

4.4 When a landowner applies for a permit for a land-use activity that involves land containing or adjacent to an eagle nest or communal roost site, the permitting agency shall notify the department.

If the department determines that the proposed activity would adversely impact eagle habitat, a site management plan shall be required. The department, a permitting agency, or wildlife biologist may work with the landowner to develop a plan. The department has final approval authority on all plans.

4.5 It is recognized that normal on-going agricultural activities of land preparation, cultivating, planting, harvesting, other cultural activities, grazing and animal-rearing activities in existing facilities do not have significant adverse consequences for eagles and therefore do not require a site management plan. New building construction, conversion of lands from agriculture to other uses, application of predacides and aerial pesticide spraying, may, following a conference with the department, be subject to the site management planning process described in these rules.

4.6 Emergency situations, such as insect infestation of crops, requires immediate action on the site management plan or special permission to address the impending crisis by the department.

**Site management plan for bald eagle habitat protection**

5.1 The purpose of the site management plan is to provide for the protection of specific bald eagle habitat in such a way as to recognize the special characteristics of the site and the landowner's property rights, goals and pertinent options. To this end, every land owner shall have fair access to the process including available incentives and benefits. Any relevant factor may be considered, including, but not limited to, the following:

5.1.1 The status of the eagle population in the region.

5.1.2 The useful life of the nest or communal roost trees and condition of the surrounding forest; the topography; accessibility and visibility; and existing and alternative flight paths, perch trees, snags and potential alternative nest and communal roost trees.

5.1.3 Eagle behavior and historical use patterns, available food sources, and vulnerability to disturbance.

5.1.4 The surrounding land-use conditions, including degree of development and human use.

5.1.5 Land ownership, landowner ability to manage, and flexibility of available landowner options.

5.1.6 Appropriate and acceptable incentive mechanisms such as conservation easements, transfer or purchase of development rights, leases, mutual covenants, or land trade or purchase.

5.1.7 Published recommendations for eagle habitat protection of other government entities such as the U.S. Fish and Wildlife Service.

5.2 The site management plan may provide for

5.2.1 Tailoring the timing, duration or physical extent of activities to minimize disturbance to the existing eagle habitat and, where appropriate, identifying and taking steps to encourage and create alternative eagle habitat; and

5.2.2 Establishing a periodic review of the plan to monitor whether:

a) The plan requires amendment in response to changing eagle and landowner circumstances
b) The terms of the plan comply with applicable laws and regulations,
c) The parties to the plan are complying with its terms.

5.3 The site management plan may also provide for implementing landowner incentive and compensation mechanisms through which the existing eagle habitat can be maintained or enhanced.

**Guidelines for acquisition of bald eagle habitat**

6.1 Real property interests may be acquired and agreements entered into which could enhance protection of bald eagle habitat. These include fee simple acquisition, land trades, conservation easements, transfer or purchase of development rights, leases, and mutual covenants. Acquisition shall be dependent upon having a willing seller and a willing buyer. Whatever interest or method of protection is preferable will depend on the particular use and ownership characteristics of a site. In discussing conservation objectives with private or public landowners, the department shall explore with the landowner the variety of protection methods which may be appropriate and available.

6.2 The following criteria and priorities shall be considered by the department when it is contemplating acquiring an interest in a bald eagle habitat.

6.2.1 Site considerations:

a) Relative ecological quality, as compared to similar habitats
b) Ecological viability -- the ability of the habitat and eagle use to persist over time
c) Defensibility -- the existence of site conditions adequate to protect the eagle habitat from unnatural encroachments
d) Manageability -- the ability to manage the site to maintain suitable eagle habitat
e) Proximity to food source
f) Proximity to other protected eagle habitat
g) Proximity to department land or other public land
h) Eagle population density and history of eagle use in the area
i) The natural diversity of native species, plant communities, aquatic types, and geologic features on the site.

6.2.2 Other considerations

a) Ownership
b) Degree of threat
c) Availability of funding
d) Existence of willing donor or seller and prior agency interest
e) Cost

In general, priority shall be given to the most threatened high quality eagle habitats with associated natural values which require the least management.

**Resolution of site management plan disputes**

30 days of the original notice to the department.

7.1 The department and the landowner shall attempt to develop a mutually agreeable site management plan within Penalties

7.2 Should agreement not be reached, the landowner may request an informal settlement conference with the department.

7.3 If the landowner chooses not to use the informal settlement conference process or if resolution is not reached, the department shall within 15 days provide a site management plan to the landowner.

7.4 Upon issuance of a final site management plan, the landowner may initiate a formal appeal of the department's decision. The appeal shall be conducted according to the Administrative Procedure Act, chapter 34.05 RCW and the model rules of procedure, chapter 10-08 WAC.

A request for an appeal shall be in writing and shall be received by the department during office hours within thirty days of the issuance of the final site management plan. Requests for appeal shall be mailed to Department of Fish and Wildlife, 600 Capitol Way N., Olympia, Washington 98501-1091, or hand delivered to 1111 Washington Street S.E., Wildlife Program, Fifth floor. If there is no timely request for an appeal, the site management plan shall be unappealable.

The written request for an appeal shall be plainly labeled as "request for formal appeal" and shall contain the following:

(a) The name, address, and phone number of the person requesting the appeal;

(b) The specific site management plan that the person contests;

(c) The date of the issuance of the site management plan;

(d) Specific relief requested; and

(e) The attorney's name, address, and phone number, if the person is represented by legal counsel.

The appeal may be conducted by the director, the director's designee, or by an administrative law judge (ALJ) appointed by the office of administrative hearings. If conducted by an ALJ, the ALJ shall issue an initial order pursuant to RCW 34.05.461. The director or the director's designee shall review the initial order and enter a final order as provided by RCW 34.05.464.

**Penalties**

8.1 Failure of a landowner to comply with the processes set forth in these rules or with the provisions of a site management plan approved by the department constitutes a misdemeanor as set forth in RCW 77.15.130.

**Appendix 14-10:**
**National Bald Eagle Management Guidelines**

# NATIONAL BALD EAGLE MANAGEMENT GUIDELINES

**U.S. Fish and Wildlife Service**

**May 2007**

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## INTRODUCTION

The bald eagle (*Haliaeetus leucocephalus*) is protected by the Bald and Golden Eagle Protection Act (Eagle Act) and the Migratory Bird Treaty Act (MBTA). The MBTA and the Eagle Act protect bald eagles from a variety of harmful actions and impacts. The U.S. Fish and Wildlife Service (Service) developed these National Bald Eagle Management Guidelines to advise landowners, land managers, and others who share public and private lands with bald eagles when and under what circumstances the protective provisions of the Eagle Act may apply to their activities. A variety of human activities can potentially interfere with bald eagles, affecting their ability to forage, nest, roost, breed, or raise young. The Guidelines are intended to help people minimize such impacts to bald eagles, particularly where they may constitute "disturbance," which is prohibited by the Eagle Act.

The Guidelines are intended to:

(1) Publicize the provisions of the Eagle Act that continue to protect bald eagles, in order to reduce the possibility that people will violate the law,

(2) Advise landowners, land managers and the general public of the potential for various human activities to disturb bald eagles, and

(3) Encourage additional nonbinding land management practices that benefit bald eagles (see Additional Recommendations section).

While the Guidelines include general recommendations for land management practices that will benefit bald eagles, the document is intended primarily as a tool for landowners and planners who seek information and recommendations regarding how to avoid disturbing bald eagles. Many States and some tribal entities have developed state-specific management plans, regulations, and/or guidance for landowners and land managers to protect and enhance bald eagle habitat, and we encourage the continued development and use of these planning tools to benefit bald eagles.

Adherence to the Guidelines herein will benefit individuals, agencies, organizations, and companies by helping them avoid violations of the law. However, the Guidelines themselves are not law. Rather, they are recommendations based on several decades of behavioral observations, science, and conservation measures to avoid or minimize adverse impacts to bald eagles.

The U.S. Fish and Wildlife Service strongly encourages adherence to these guidelines to ensure that bald and golden eagle populations will continue to be sustained. The Service realizes there may be impacts to some birds even if all reasonable measures are taken to avoid such impacts. Although it is not possible to absolve individuals and entities from liability under the Eagle Act or the MBTA, the Service exercises enforcement discretion to focus on those individuals, companies, or agencies that take migratory birds without regard for the consequences of their actions and the law, especially when conservation measures, such as these Guidelines, are available, but have not been implemented. The Service will prioritize its enforcement efforts to focus on those individuals or entities who take bald eagles or their parts, eggs, or nests without implementing appropriate measures recommended by the Guidelines.

The Service intends to pursue the development of regulations that would authorize, under limited circumstances, the use of permits if “take” of an eagle is anticipated but unavoidable. Additionally, if the bald eagle is delisted, the Service intends to provide a regulatory mechanism to honor existing (take) authorizations under the Endangered Species Act (ESA).

During the interim period until the Service completes a rulemaking for permits under the Eagle Act, the Service does not intend to refer for prosecution the incidental “*take*” of any bald eagle under the MBTA or Eagle Act, if such take is in full compliance with the terms and conditions of an incidental take statement issued to the action agency or applicant under the authority of section 7(b)(4) of the ESA or a permit issued under the authority of section 10(a)(1)(B) of the ESA.

The Guidelines are applicable throughout the United States, including Alaska. The primary purpose of these Guidelines is to provide information that will minimize or prevent violations only of *Federal* laws governing bald eagles. In addition to Federal laws, many states and some smaller jurisdictions and tribes have additional laws and regulations protecting bald eagles. In some cases those laws and regulations may be more protective (restrictive) than these Federal guidelines. If you are planning activities that may affect bald eagles, we therefore recommend that you contact both your nearest U.S. Fish and Wildlife Service Field Office (see the contact information on p.16) and your state wildlife agency for assistance.

## LEGAL PROTECTIONS FOR THE BALD EAGLE

### The Bald and Golden Eagle Protection Act

The Eagle Act (16 U.S.C. 668-668c), enacted in 1940, and amended several times since then, prohibits anyone, without a permit issued by the Secretary of the Interior, from “taking” bald eagles, including their parts, nests, or eggs. The Act provides criminal and civil penalties for persons who “take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle ... [or any golden eagle], alive or dead, or any part, nest, or egg thereof.” The Act defines “take” as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb.” “Disturb’’ means:

> "Disturb means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

In addition to immediate impacts, this definition also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle=s return, such alterations agitate or bother an eagle to a degree that injures an eagle or substantially interferes with normal breeding, feeding, or sheltering habits and causes, or is likely to cause, a loss of productivity or nest abandonment.

A violation of the Act can result in a criminal fine of $100,000 ($200,000 for organizations), imprisonment for one year, or both, for a first offense. Penalties increase substantially for additional offenses, and a second violation of this Act is a felony.

**The Migratory Bird Treaty Act**

The MBTA (16 U.S.C. 703-712), prohibits the taking of any migratory bird or any part, nest, or egg, except as permitted by regulation. The MBTA was enacted in 1918; a 1972 agreement supplementing one of the bilateral treaties underlying the MBTA had the effect of expanding the scope of the Act to cover bald eagles and other raptors. Implementing regulations define “take” under the MBTA as “pursue, hunt, shoot, wound, kill, trap, capture, possess, or collect.”

Copies of the Eagle Act and the MBTA are available at: http://permits.fws.gov/ltr/ltr.shtml.

**State laws and regulations**

Most states have their own regulations and/or guidelines for bald eagle management. Some states may continue to list the bald eagle as endangered, threatened, or of special concern. If you plan activities that may affect bald eagles, we urge you to familiarize yourself with the regulations and/or guidelines that apply to bald eagles in your state. Your adherence to the Guidelines herein does not ensure that you are in compliance with state laws and regulations because state regulations can be more specific and/or restrictive than these Guidelines.

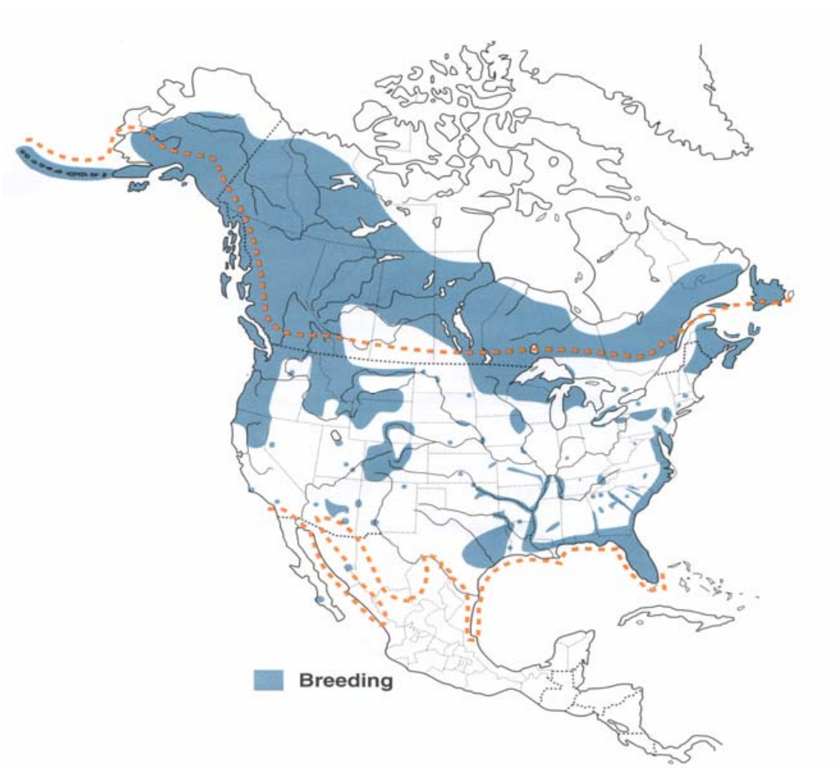
## NATURAL HISTORY OF THE BALD EAGLE

Bald eagles are a North American species that historically occurred throughout the contiguous United States and Alaska. After severely declining in the lower 48 States between the 1870s and the 1970s, bald eagles have rebounded and re-established breeding territories in each of the lower 48 states. The largest North American breeding populations are in Alaska and Canada, but there are also significant bald eagle populations in Florida, the Pacific Northwest, the Greater Yellowstone area, the Great Lakes states, and the Chesapeake Bay region. Bald eagle distribution varies seasonally. Bald eagles that nest in southern latitudes frequently move northward in late spring and early summer, often summering as far north as Canada. Most eagles that breed at northern latitudes migrate southward during winter, or to coastal areas where waters remain unfrozen. Migrants frequently concentrate in large numbers at sites where food is abundant and they often roost together communally. In some cases, concentration areas are used year-round: in summer by southern eagles and in winter by northern eagles.

Juvenile bald eagles have mottled brown and white plumage, gradually acquiring their dark brown body and distinctive white head and tail as they mature. Bald eagles generally attain adult plumage by 5 years of age. Most are capable of breeding at 4 or 5 years of age, but in healthy populations they may not start breeding until much older. Bald eagles may live 15 to 25 years in the wild. Adults weigh 8 to 14 pounds (occasionally reaching 16 pounds in Alaska) and have wingspans of 5 to 8 feet. Those in the northern range are larger than those in the south, and females are larger than males.

**Where do bald eagles nest?**
Breeding bald eagles occupy "territories," areas they will typically defend against intrusion by other eagles. In addition to the active nest, a territory may include one or more alternate nests (nests built or maintained by the eagles but not used for nesting in a given year). The Eagle Act prohibits removal or destruction of both active and alternate bald eagle nests. Bald eagles exhibit high nest site fidelity and nesting territories are often used year after year. Some territories are known to have been used continually for over half a century.

Bald eagles generally nest near coastlines, rivers, large lakes or streams that support an adequate food supply. They often nest in mature or old-growth trees; snags (dead trees); cliffs; rock promontories; rarely on the ground; and with increasing frequency on human-made structures such as power poles and communication towers. In forested areas, bald eagles often select the tallest trees with limbs strong enough to support a nest that can weigh more than 1,000 pounds. Nest sites typically include at least one perch with a clear view of the water where the eagles usually forage. Shoreline trees or snags located in reservoirs provide the visibility and accessibility needed to locate aquatic prey. Eagle nests are constructed with large sticks, and may be lined with moss, grass, plant stalks, lichens, seaweed, or sod. Nests are usually about 4-6 feet in diameter and 3 feet deep, although larger nests exist.






**The range of breeding bald eagles in 2000 (shaded areas). This map shows only the larger concentrations of nests; eagles have continued to expand into additional nesting territories in many states. The dotted line represents the bald eagle's wintering range.**

**When do bald eagles nest?**

Nesting activity begins several months before egg-laying. Egg-laying dates vary throughout the U.S., ranging from October in Florida, to late April or even early May in the northern United States. Incubation typically lasts 33-35 days, but can be as long as 40 days. Eaglets make their first unsteady flights about 10 to 12 weeks after hatching, and fledge (leave their nests) within a few days after that first flight. However, young birds usually remain in the vicinity of the nest for several weeks after fledging because they are almost completely dependent on their parents for food until they disperse from the nesting territory approximately 6 weeks later.

The bald eagle breeding season tends to be longer in the southern U.S., and re-nesting following an unsuccessful first nesting attempt is more common there as well. The following table shows the timing of bald eagle breeding seasons in different regions of the country. The table represents the range of time within which the majority of nesting activities occur in each region and does not apply to any specific nesting pair. Because the timing of nesting activities may vary within a given region, you should contact the nearest U.S. Fish and Wildlife Service Field Office (see page 16) and/or your state wildlife conservation agency for more specific information on nesting chronology in your area.

Chronology of typical reproductive activities of bald eagles in the United States.

| Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | March | April | May | June | July | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SOUTHEASTERN U.S. (FL, GA, SC, ~~NC~~, AL, MS, LA, TN, KY, AR, eastern 2 of TX)** | | | | | | | | | | | |
| Nest Building | | | | | | | | | | | |
| | Egg Laying/Incubation | | | | | | | | | | |
| | | Hatching/Rearing Young | | | | | | | | | |
| | | | Fledging Young | | | | | | | | |
| **CHESAPEAKE BAY REGION (NC, VA, MD, DE, southern 2 of NJ, eastern 2 of PA, panhandle of WV)** | | | | | | | | | | | |
| | Nest Building | | | | | | | | | | |
| | | | | Egg Laying/Incubation | | | | | | | |
| | | | | | Hatching/Rearing Young | | | | | | |
| | | | | | | | | Fledging Young | | | |
| **NORTHERN U.S. (ME, NH, MA, RI, CT, NY, northern 2 of NJ, western 2 of PA, OH, WV exc. panhandle, IN, IL, MI, WI, MN, IA, MO, ND, SD, NB, KS, CO, UT)** | | | | | | | | | | | |
| | | | Nest Building | | | | | | | | |
| | | | | | Egg Laying/Incubation | | | | | | |
| | | | | | | Hatching/Rearing Young | | | | | |
| | | | | | | | | | Fledging Young | | |
| **PACIFIC REGION (WA, OR, CA, ID, MT, WY, NV)** | | | | | | | | | | | |
| | | | | Nest Building | | | | | | | |
| | | | | | Egg Laying/Incubation | | | | | | |
| | | | | | | Hatching/Rearing Young | | | | | |
| | | | | | | | | | Fledging Young | | |
| **SOUTHWESTERN U.S. (AZ, NM, OK panhandle, western 2 of TX)** | | | | | | | | | | | |
| | Nest Building | | | | | | | | | | |
| | | | Egg Laying/Incubation | | | | | | | | |
| | | | | Hatching/Rearing Young | | | | | | | |
| | | | | | | | Fledging Young | | | | |
| **ALASKA** | | | | | | | | | | | |
| | | | | | Nest Building | | | | | | |
| | | | | | | | Egg Laying/Incubation | | | | |
| | | | | | | | | Hatching/Rearing Young | | | |
| Ing Young | | | | | | | | | | | Fledg- |
| Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | March | April | May | June | July | Aug. |

**How many chicks do bald eagles raise?**
The number of eagle eggs laid will vary from 1-3, with 1-2 eggs being the most common. Only one eagle egg is laid per day, although not always on successive days. Hatching of young occurs on different days with the result that chicks in the same nest are sometimes of unequal size. The overall national fledging rate is approximately one chick per nest, annually, which results in a healthy expanding population.

**What do bald eagles eat?**
Bald eagles are opportunistic feeders. Fish comprise much of their diet, but they also eat waterfowl, shorebirds/colonial waterbirds, small mammals, turtles, and carrion. Because they are visual hunters, eagles typically locate their prey from a conspicuous perch, or soaring flight, then swoop down and strike. Wintering bald eagles often congregate in large numbers along streams to feed on spawning salmon or other fish species, and often gather in large numbers in areas below reservoirs, especially hydropower dams, where fish are abundant. Wintering eagles also take birds from rafts of ducks at reservoirs and rivers, and congregate on melting ice shelves to scavenge dead fish from the current or the soft melting ice. Bald eagles will also feed on carcasses along roads, in landfills, and at feedlots.

During the breeding season, adults carry prey to the nest to feed the young. Adults feed their chicks by tearing off pieces of food and holding them to the beaks of the eaglets. After fledging, immature eagles are slow to develop hunting skills, and must learn to locate reliable food sources and master feeding techniques. Young eagles will congregate together, often feeding upon easily acquired food such as carrion and fish found in abundance at the mouths of streams and shallow bays and at landfills.

**The impact of human activity on nesting bald eagles**
During the breeding season, bald eagles are sensitive to a variety of human activities. However, not all bald eagle pairs react to human activities in the same way. Some pairs nest successfully just dozens of yards from human activity, while others abandon nest sites in response to activities much farther away. This variability may be related to a number of factors, including visibility, duration, noise levels, extent of the area affected by the activity, prior experiences with humans, and tolerance of the individual nesting pair. The relative sensitivity of bald eagles during various stages of the breeding season is outlined in the following table.

**Nesting Bald Eagle Sensitivity to Human Activities**

| Phase | Activity | Sensitivity to Human Activity | Comments |
|---|---|---|---|
| I | Courtship and Nest Building | Most sensitive period; likely to respond negatively | Most critical time period. Disturbance is manifested in nest abandonment. Bald eagles in newly established territories are more prone to abandon nest sites. |
| II | Egg laying | Very sensitive period | Human activity of even limited duration may cause nest desertion and abandonment of territory for the breeding season. |
| III | Incubation and early nestling period (up to 4 weeks) | Very sensitive period | Adults are less likely to abandon the nest near and after hatching. However, flushed adults leave eggs and young unattended; eggs are susceptible to cooling, loss of moisture, overheating, and predation; young are vulnerable to elements. |
| IV | Nestling period, 4 to 8 weeks | Moderately sensitive period | Likelihood of nest abandonment and vulnerability of the nestlings to elements somewhat decreases. However, nestlings may miss feedings, affecting their survival. |
| V | Nestlings 8 weeks through fledging | Very sensitive period | Gaining flight capability, nestlings 8 weeks and older may flush from the nest prematurely due to disruption and die. |

If agitated by human activities, eagles may inadequately construct or repair their nest, may expend energy defending the nest rather than tending to their young, or may abandon the nest altogether. Activities that cause prolonged absences of adults from their nests can jeopardize eggs or young. Depending on weather conditions, eggs may overheat or cool too much and fail to hatch. Unattended eggs and nestlings are subject to predation. Young nestlings are particularly vulnerable because they rely on their parents to provide warmth or shade, without which they may die as a result of hypothermia or heat stress. If food delivery schedules are interrupted, the young may not develop healthy plumage, which can affect their survival. In addition, adults startled while incubating or brooding young may damage eggs or injure their young as they abruptly leave the nest. Older nestlings no longer require constant attention from the adults, but they may be startled by loud or intrusive human activities and prematurely jump from the nest before they are able to fly or care for themselves. Once fledged, juveniles range up to ¼ mile from the nest site, often to a site with minimal human activity. During this period, until about six weeks after departure from the nest, the juveniles still depend on the adults to feed them.

**The impact of human activity on foraging and roosting bald eagles**

Disruption, destruction, or obstruction of roosting and foraging areas can also negatively affect bald eagles. Disruptive activities in or near eagle foraging areas can interfere with feeding, reducing chances of survival. Interference with feeding can also result in reduced productivity (number of young successfully fledged). Migrating and wintering bald eagles often congregate at specific sites for purposes of feeding and sheltering. Bald eagles rely on established roost sites because of their proximity to sufficient food sources. Roost sites are usually in mature trees where the eagles are somewhat sheltered from the wind and weather. Human activities near or within communal roost sites may prevent eagles from feeding or taking shelter, especially if there are not other undisturbed and productive feeding and roosting sites available. Activities that permanently alter communal roost sites and important foraging areas can altogether eliminate the elements that are essential for feeding and sheltering eagles.

Where a human activity agitates or bothers roosting or foraging bald eagles to the degree that causes injury or substantially interferes with breeding, feeding, or sheltering behavior and causes, or is likely to cause, a loss of productivity or nest abandonment, the conduct of the activity constitutes a violation of the Eagle Act's prohibition against disturbing eagles. The circumstances that might result in such an outcome are difficult to predict without detailed site-specific information. If your activities may disturb roosting or foraging bald eagles, you should contact your local Fish and Wildlife Service Field Office (see page 16) for advice and recommendations for how to avoid such disturbance.

## RECOMMENDATIONS FOR AVOIDING DISTURBANCE AT NEST SITES

In developing these Guidelines, we relied on existing state and regional bald eagle guidelines, scientific literature on bald eagle disturbance, and recommendations of state and Federal biologists who monitor the impacts of human activity on eagles. Despite these resources, uncertainties remain regarding the effects of many activities on eagles and how eagles in different situations may or may not respond to certain human activities. The Service recognizes this uncertainty and views the collection of better biological data on the response of eagles to disturbance as a high priority. To the extent that resources allow, the Service will continue to collect data on responses of bald eagles to human activities conducted according to the recommendations within these Guidelines to ensure that adequate protection from disturbance is being afforded, and to identify circumstances where the Guidelines might be modified. These data will be used to make future adjustments to the Guidelines.

To avoid disturbing nesting bald eagles, we recommend (1) keeping a distance between the activity and the nest (distance buffers), (2) maintaining preferably forested (or natural) areas between the activity and around nest trees (landscape buffers), and (3) avoiding certain activities during the breeding season. The buffer areas serve to minimize visual and auditory impacts associated with human activities near nest sites. Ideally, buffers would be large enough to protect existing nest trees and provide for alternative or replacement nest trees.

The size and shape of effective buffers vary depending on the topography and other ecological characteristics surrounding the nest site. In open areas where there are little or no forested or topographical buffers, such as in many western states, distance alone must serve as the buffer. Consequently, in open areas, the distance between the activity and the nest may need to be larger than the distances recommended under Categories A and B of these guidelines (pg. 12) if no landscape buffers are present. The height of the nest above the ground may also ameliorate effects of human activities; eagles at higher nests may be less prone to disturbance.

In addition to the physical features of the landscape and nest site, the appropriate size for the distance buffer may vary according to the historical tolerances of eagles to human activities in particular localities, and may also depend on the location of the nest in relation to feeding and roosting areas used by the eagles. Increased competition for nest sites may lead bald eagles to nest closer to human activity (and other eagles).

Seasonal restrictions can prevent the potential impacts of many shorter-term, obtrusive activities that do not entail landscape alterations (e.g. fireworks, outdoor concerts). In proximity to the nest, these kinds of activities should be conducted only outside the breeding season. For activities that entail both short-term, obtrusive characteristics and more permanent impacts (e.g., building construction), we recommend a combination of both approaches: retaining a landscape buffer *and* observing seasonal restrictions.

For assistance in determining the appropriate size and configuration of buffers or the timing of activities in the vicinity of a bald eagle nest, we encourage you to contact the nearest U.S. Fish and Wildlife Service Field Office (see page 16).

**Existing Uses**

Eagles are unlikely to be disturbed by routine use of roads, homes, and other facilities where such use pre-dates the eagles' successful nesting activity in a given area. Therefore, in most cases *ongoing* existing uses may proceed with the same intensity with little risk of disturbing bald eagles. However, some *intermittent, occasional, or irregular* uses that pre-date eagle nesting in an area may disturb bald eagles. For example: a pair of eagles may begin nesting in an area and subsequently be disturbed by activities associated with an annual outdoor flea market, even though the flea market has been held annually at the same location. In such situations, human activity should be adjusted or relocated to minimize potential impacts on the nesting pair.

## ACTIVITY-SPECIFIC GUIDELINES

The following section provides the Service=s management recommendations for avoiding bald eagle disturbance as a result of new or intermittent activities proposed in the vicinity of bald eagle nests. Activities are separated into 8 categories (A – H) based on the nature and magnitude of impacts to bald eagles that usually result from the type of activity. Activities with similar or comparable impacts are grouped together.

In most cases, impacts will vary based on the visibility of the activity from the eagle nest and the degree to which similar activities are already occurring in proximity to the nest site. Visibility is a factor because, in general, eagles are more prone to disturbance when an activity occurs in full view. For this reason, we recommend that people locate activities farther from the nest structure in areas with open vistas, in contrast to areas where the view is shielded by rolling topography, trees, or other screening factors. The recommendations also take into account the existence of similar activities in the area because the continued presence of nesting bald eagles in the vicinity of the existing activities indicates that the eagles in that area can tolerate a greater degree of human activity than we can generally expect from eagles in areas that experience fewer human impacts. To illustrate how these factors affect the likelihood of disturbing eagles, we have incorporated the recommendations for some activities into a table (categories A and B).

First, determine which category your activity falls into (between categories A – H). If the activity you plan to undertake is not specifically addressed in these guidelines, follow the recommendations for the most similar activity represented.

If your activity is under A or B, our recommendations are in table form. The vertical axis shows the degree of visibility of the activity from the nest. The horizontal axis (header row) represents the degree to which similar activities are ongoing in the vicinity of the nest. Locate the row that best describes how visible your activity will be from the eagle nest. Then, choose the column that best describes the degree to which similar activities are ongoing in the vicinity of the eagle nest. The box where the column and row come together contains our management recommendations for how far you should locate your activity from the nest to avoid disturbing the eagles. The numerical distances shown in the tables are the closest the activity should be conducted relative to the nest. In some cases we have included additional recommendations (other than recommended *distance* from the nest) you should follow to help ensure that your activity will not disturb the eagles.

**Alternate nests**
For activities that entail permanent landscape alterations that may result in bald eagle disturbance, these recommendations apply to both active and alternate bald eagle nests. Disturbance becomes an issue with regard to alternate nests if eagles return for breeding purposes and react to land use changes that occurred while the nest was inactive. The likelihood that an alternate nest will again become active decreases the longer it goes unused. If you plan activities in the vicinity of an alternate bald eagle nest and have information to show that the nest has not been active during the preceding 5 breeding seasons, the recommendations provided in these guidelines for avoiding disturbance around the nest site may no longer be warranted. The nest itself remains protected by other provisions of the Eagle Act, however, and may not be destroyed.

If special circumstances exist that make it unlikely an inactive nest will be reused before 5 years of disuse have passed, and you believe that the probability of reuse is low enough to warrant disregarding the recommendations for avoiding disturbance, you should be prepared to provide all the reasons for your conclusion, including information regarding past use of the nest site. Without sufficient documentation, you should continue to follow these guidelines when conducting activities around the nest site. If we are able to determine that it is unlikely the nest will be reused, we may advise you that the recommendations provided in these guidelines for avoiding disturbance are no longer necessary around that nest site.

This guidance is intended to minimize disturbance, as defined by Federal regulation. In addition to Federal laws, most states and some tribes and smaller jurisdictions have additional laws and regulations protecting bald eagles. In some cases those laws and regulations may be more protective (restrictive) than these Federal guidelines.

**Temporary Impacts**
For activities that have temporary impacts, such as the use of loud machinery, fireworks displays, or summer boating activities, we recommend seasonal restrictions. These types of activities can generally be carried out outside of the breeding season without causing disturbance. The recommended restrictions for these types of activities can be lifted for alternate nests within a particular territory, including nests that were attended during the current breeding season but not used to raise young, after eggs laid in another nest within the territory have hatched (depending on the distance between the alternate nest and the active nest).

In general, activities should be kept as far away from nest trees as possible; loud and disruptive activities should be conducted when eagles are not nesting; and activity between the nest and the nearest foraging area should be minimized. If the activity you plan to undertake is not specifically addressed in these guidelines, follow the recommendations for the most similar activity addressed, or contact your local U.S. Fish and Wildlife Service Field Office for additional guidance.

If you believe that special circumstances apply to your situation that increase or diminish the likelihood of bald eagle disturbance, or if it is not possible to adhere to the guidelines, you should contact your local Service Field Office for further guidance.

**Category A:**
Building construction, 1 or 2 story, with project footprint of ½ acre or less.
Construction of roads, trails, canals, power lines, and other linear utilities.
Agriculture and aquaculture – new or expanded operations.
Alteration of shorelines or wetlands.
Installation of docks or moorings.
Water impoundment.

**Category B:**
Building construction, 3 or more stories.
Building construction, 1 or 2 story, with project footprint of more than ½ acre.
Installation or expansion of marinas with a capacity of 6 or more boats.
Mining and associated activities.
Oil and natural gas drilling and refining and associated activities.

| | ***If there is no similar activity within 1 mile of the nest*** | ***If there is similar activity closer than 1 mile from the nest*** |
|---|---|---|
| ***If the activity will be visible from the nest*** | 660 feet. Landscape buffers are recommended. | 660 feet, or as close as existing tolerated activity of similar scope. Landscape buffers are recommended. |
| ***If the activity will not be visible from the nest*** | Category A:<br>330 feet. Clearing, external construction, and landscaping between 330 feet and 660 feet should be done outside breeding season.<br><br>Category B:<br>660 feet. | 330 feet, or as close as existing tolerated activity of similar scope. Clearing, external construction and landscaping within 660 feet should be done outside breeding season. |

The numerical distances shown in the table are the closest the activity should be conducted relative to the nest.

**Category C. Timber Operations and Forestry Practices**

- Avoid clear cutting or removal of overstory trees within 330 feet of the nest at any time.

- Avoid timber harvesting operations, including road construction and chain saw and yarding operations, during the breeding season within 660 feet of the nest. The distance may be decreased to 330 feet around alternate nests within a particular territory, including nests that were attended during the current breeding season but not used to raise young, after eggs laid in another nest within the territory have hatched.

- Selective thinning and other silviculture management practices designed to conserve or enhance habitat, including prescribed burning close to the nest tree, should be undertaken outside the breeding season. Precautions such as raking leaves and woody debris from around the nest tree should be taken to prevent crown fire or fire climbing the nest tree. If it is determined that a burn during the breeding season would be beneficial, then, to ensure that no take or disturbance will occur, these activities should be conducted only when neither adult eagles nor young are present at the nest tree (i.e., at the beginning of, or end of, the breeding season, either before the particular nest is active or after the young have fledged from that nest). Appropriate Federal and state biologists should be consulted before any prescribed burning is conducted during the breeding season.

- Avoid construction of log transfer facilities and in-water log storage areas within 330 feet of the nest.

**Category D. Off-road vehicle use** (including snowmobiles). No buffer is necessary around nest sites outside the breeding season. During the breeding season, do not operate off-road vehicles within 330 feet of the nest. In open areas, where there is increased visibility and exposure to noise, this distance should be extended to 660 feet.

**Category E. Motorized Watercraft use** (including jet skis/personal watercraft). No buffer is necessary around nest sites outside the breeding season. During the breeding season, within 330 feet of the nest, (1) do not operate jet skis (personal watercraft), and (2) avoid concentrations of noisy vessels (e.g., commercial fishing boats and tour boats), except where eagles have demonstrated tolerance for such activity. Other motorized boat traffic passing within 330 feet of the nest should attempt to minimize trips and avoid stopping in the area where feasible, particularly where eagles are unaccustomed to boat traffic. Buffers for airboats should be larger than 330 feet due to the increased noise they generate, combined with their speed, maneuverability, and visibility.

**Category F. Non-motorized recreation and human entry** (e.g., hiking, camping, fishing, hunting, birdwatching, kayaking, canoeing). No buffer is necessary around nest sites outside the breeding season. If the activity will be visible or highly audible from the nest, maintain a 330-foot buffer during the breeding season, particularly where eagles are unaccustomed to such activity.

**Category G. Helicopters and fixed-wing aircraft**.
Except for authorized biologists trained in survey techniques, avoid operating aircraft within 1,000 feet of the nest during the breeding season, except where eagles have demonstrated tolerance for such activity.

**Category H. Blasting and other loud, intermittent noises**.
Avoid blasting and other activities that produce extremely loud noises within 1/2 mile of active nests, unless greater tolerance to the activity (or similar activity) has been demonstrated by the eagles in the nesting area. This recommendation applies to the use of fireworks classified by the Federal Department of Transportation as Class B explosives, which includes the larger fireworks that are intended for licensed public display.

## RECOMMENDATIONS FOR AVOIDING DISTURBANCE AT FORAGING AREAS AND COMMUNAL ROOST SITES

1. Minimize potentially disruptive activities and development in the eagles' direct flight path between their nest and roost sites and important foraging areas.

2. Locate long-term and permanent water-dependent facilities, such as boat ramps and marinas, away from important eagle foraging areas.

3. Avoid recreational and commercial boating and fishing near critical eagle foraging areas during peak feeding times (usually early to mid-morning and late afternoon), except where eagles have demonstrated tolerance to such activity.

4. Do not use explosives within ½ mile (or within 1 mile in open areas) of communal roosts when eagles are congregating, without prior coordination with the U.S. Fish and Wildlife Service and your state wildlife agency.

5. Locate aircraft corridors no closer than 1,000 feet vertical or horizontal distance from communal roost sites.

## ADDITIONAL RECOMMENDATIONS TO BENEFIT BALD EAGLES

The following are additional management practices that landowners and planners can exercise for added benefit to bald eagles.

1. Protect and preserve potential roost and nest sites by retaining mature trees and old growth stands, particularly within ½ mile from water.

2. Where nests are blown from trees during storms or are otherwise destroyed by the elements, continue to protect the site in the absence of the nest for up to three (3) complete breeding seasons. Many eagles will rebuild the nest and reoccupy the site.

3. To avoid collisions, site wind turbines, communication towers, and high voltage transmission power lines away from nests, foraging areas, and communal roost sites.

4. Employ industry-accepted best management practices to prevent birds from colliding with or being electrocuted by utility lines, towers, and poles. If possible, bury utility lines in important eagle areas.

5. Where bald eagles are likely to nest in human-made structures (e.g., cell phone towers) and such use could impede operation or maintenance of the structures or jeopardize the safety of the eagles, equip the structures with either (1) devices engineered to discourage bald eagles from building nests, or (2) nesting platforms that will safely accommodate bald eagle nests without interfering with structure performance.

6. Immediately cover carcasses of euthanized animals at landfills to protect eagles from being poisoned.

7. Do not intentionally feed bald eagles. Artificially feeding bald eagles can disrupt their essential behavioral patterns and put them at increased risk from power lines, collision with windows and cars, and other mortality factors.

8. Use pesticides, herbicides, fertilizers, and other chemicals only in accordance with Federal and state laws.

9. Monitor and minimize dispersal of contaminants associated with hazardous waste sites (legal or illegal), permitted releases, and runoff from agricultural areas, especially within watersheds where eagles have shown poor reproduction or where bioaccumulating contaminants have been documented. These factors present a risk of contamination to eagles and their food sources.

## CONTACTS

The following U.S. Fish and Wildlife Service Field Offices provide technical assistance on bald eagle management:

| | | |
|---|---|---|
| Alabama | Daphne | (251) 441-5181 |
| Alaska | Anchorage | (907) 271-2888 |
| | Fairbanks | (907) 456-0203 |
| | Juneau | (907) 780-1160 |
| Arizona | Phoenix | (602) 242-0210 |
| Arkansas | Conway | (501) 513-4470 |
| California | Arcata | (707) 822-7201 |
| | Barstow | (760) 255-8852 |
| | Carlsbad | (760) 431-9440 |
| | Red Bluff | (530) 527-3043 |
| | Sacramento | (916) 414-6000 |
| | Stockton | (209) 946-6400 |
| | Ventura | (805) 644-1766 |
| | Yreka | (530) 842-5763 |
| Colorado | Lakewood | (303) 275-2370 |
| | Grand Junction | (970) 243-2778 |
| Connecticut | (See New Hampshire) | |
| Delaware | (See Maryland) | |
| Florida | Panama City | (850) 769-0552 |
| | Vero Beach | (772) 562-3909 |
| | Jacksonville | (904) 232-2580 |
| Georgia | Athens | (706) 613-9493 |
| | Brunswick | (912) 265-9336 |
| | Columbus | (706) 544-6428 |
| Idaho | Boise | (208) 378-5243 |
| | Chubbuck | (208) 237-6975 |
| Illinois/Iowa | Rock Island | (309) 757-5800 |
| Indiana | Bloomington | (812) 334-4261 |
| Kansas | Manhattan | (785) 539-3474 |
| Kentucky | Frankfort | (502) 695-0468 |
| Louisiana | Lafayette | (337) 291-3100 |
| Maine | Old Town | (207) 827-5938 |
| Maryland | Annapolis | (410) 573-4573 |
| Massachusetts | (See New Hampshire) | |
| Michigan | East Lansing | (517) 351-2555 |
| Minnesota | Bloomington | (612) 725-3548 |
| Mississippi | Jackson | (601) 965-4900 |
| Missouri | Columbia | (573) 234-2132 |
| Montana | Helena | (405) 449-5225 |
| Nebraska | Grand Island | (308) 382-6468 |
| Nevada | Las Vegas | (702) 515-5230 |
| | Reno | (775) 861-6300 |
| New Hampshire | Concord | (603) 223-2541 |
| New Jersey | Pleasantville | (609) 646-9310 |
| New Mexico | Albuquerque | (505) 346-2525 |
| New York | Cortland | (607) 753-9334 |
| | Long Island | (631) 776-1401 |
| North Carolina | Raleigh | (919) 856-4520 |
| | Asheville | (828) 258-3939 |
| North Dakota | Bismarck | (701) 250-4481 |
| Ohio | Reynoldsburg | (614) 469-6923 |
| Oklahoma | Tulsa | (918) 581-7458 |
| Oregon | Bend | (541) 383-7146 |
| | Klamath Falls | (541) 885-8481 |
| | La Grande | (541) 962-8584 |
| | Newport | (541) 867-4558 |
| | Portland | (503) 231-6179 |
| | Roseburg | (541) 957-3474 |
| Pennsylvania | State College | (814) 234-4090 |
| Rhode Island | (See New Hampshire) | |
| South Carolina | Charleston | (843) 727-4707 |
| South Dakota | Pierre | (605) 224-8693 |
| Tennessee | Cookeville | (931) 528-6481 |
| Texas | Clear Lake | (281) 286-8282 |
| Utah | West Valley City | (801) 975-3330 |
| Vermont | (See New Hampshire) | |
| Virginia | Gloucester | (804) 693-6694 |
| Washington | Lacey | (306) 753-9440 |
| | Spokane | (509) 891-6839 |
| | Wenatchee | (509) 665-3508 |
| West Virginia | Elkins | (304) 636-6586 |
| Wisconsin | New Franken | (920) 866-1725 |
| Wyoming | Cheyenne | (307) 772-2374 |
| | Cody | (307) 578-5939 |

National Office
U.S. Fish and Wildlife Service
Division of Migratory Bird Management
4401 North Fairfax Drive, MBSP-4107
Arlington, VA 22203-1610
(703) 358-1714
http://www.fws.gov/migratorybirds

### State Agencies

To contact a state wildlife agency, visit the Association of Fish & Wildlife Agencies' website at http://www.fishwildlife.org/where_us.html

## GLOSSARY

The definitions below apply to these National Bald Eagle Management Guidelines:

**Communal roost sites** – Areas where bald eagles gather and perch overnight – and sometimes during the day in the event of inclement weather. Communal roost sites are usually in large trees (live or dead) that are relatively sheltered from wind and are generally in close proximity to foraging areas. These roosts may also serve a social purpose for pair bond formation and communication among eagles. Many roost sites are used year after year.

**Disturb** – To agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.

In addition to immediate impacts, this definition also covers impacts that result from human-caused alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle=s return, such alterations agitate or bother an eagle to a degree that injures an eagle or substantially interferes with normal breeding, feeding, or sheltering habits and causes, or is likely to cause, a loss of productivity or nest abandonment.

**Fledge** – To leave the nest and begin flying. For bald eagles, this normally occurs at 10-12 weeks of age.

**Fledgling** – A juvenile bald eagle that has taken the first flight from the nest but is not yet independent.

**Foraging area** – An area where eagles feed, typically near open water such as rivers, lakes, reservoirs, and bays where fish and waterfowl are abundant, or in areas with little or no water (i.e., rangelands, barren land, tundra, suburban areas, etc.) where other prey species (e.g., rabbit, rodents) or carrion (such as at landfills) are abundant.

**Landscape buffer** – A natural or human-made landscape feature that screens eagles from human activity (e.g., strip of trees, hill, cliff, berm, sound wall).

**Nest** – A structure built, maintained, or used by bald eagles for the purpose of reproduction. An **active** nest is a nest that is attended (built, maintained or used) by a pair of bald eagles during a given breeding season, whether or not eggs are laid. An **alternate** nest is a nest that is not used for breeding by eagles during a given breeding season.

**Nest abandonment** – Nest abandonment occurs when adult eagles desert or stop attending a nest and do not subsequently return and successfully raise young in that nest for the duration of a breeding season. Nest abandonment can be caused by altering habitat near a nest, even if the alteration occurs prior to the breeding season. Whether the eagles migrate during the non-breeding season, or remain in the area throughout the non-breeding season, nest abandonment can occur at any point between the time the eagles return to the nesting site for the breeding season and the time when all progeny from the breeding season have dispersed.

**Project footprint** – The area of land (and water) that will be permanently altered for a development project, including access roads.

**Similar scope** – In the vicinity of a bald eagle nest, an existing activity is of similar scope to a new activity where the types of impacts to bald eagles are similar in nature, and the impacts of the existing activity are of the same or greater magnitude than the impacts of the potential new activity.  Examples:  (1) An existing single-story home 200 feet from a nest is similar in scope to an additional single-story home 200 feet from the nest; (2) An existing multi-story, multi-family dwelling 150 feet from a nest has impacts of a greater magnitude than a potential new single-family home 200 feet from the nest; (3)  One existing single-family home 200 feet from the nest has impacts of a lesser magnitude than three single-family homes 200 feet from the nest; (4) an existing single-family home 200 feet from a communal roost has impacts of a lesser magnitude than a single-family home 300 feet from the roost but 40 feet from the eagles' foraging area.  The existing activities in examples (1) and (2) are of similar scope, while the existing activities in example (3) and (4) are not.

**Vegetative buffer** – An area surrounding a bald eagle nest that is wholly or largely covered by forest, vegetation, or other natural ecological characteristics, and separates the nest from human activities.

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**Appendix 15-1:**
**Road Initial Evaluation Form**

## Initial Road Evaluation Form

| Road Number | Date Inspected | Access Type | Barrier Type | Barrier Effective | Road Use | | | Abandon or Orphaned Road (Yes or No) | OHV Trespass | Visual Screen Needed | Comments or Proposed Management Strategy |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | WHMP | Utility | Recreation | | | | |
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**Access:** OS= Open Seasonallly, OY= Open Year Round, CL= Closed

**Road Barrier Type:** B= Boulder and/or blocks, G= Gate, N= not applicable, O= Other (e.g slides, washouts), T = Trench and/or Berm, W = Wood (e.g down trees, root wads, or logs).

**OHV Trespass:** 0 = No OHV vehicle trespass noted

1 = OHV trespass noted as one to a few tracks. Tracks have a low frequency of use as evidenced by in tack vegetation in the OHV trail

2 = OHV trespass noted as one to a few tracks. Tracks have a moderate to heavy frequency of use as evidenced by OHV tracks being void of vegetation.

3 = OHV trespass noted as many (> 3) trails. Trails have a moderate frequency of use as evidenced by OHV tracks being void of vegetation.

4 = OHV trespass noted as many (>3) tracks. Tracks have a heavy frequency of use as evidenced by OHV tracks being void of vegetation and are rutted in many areas.

**Appendix 15-2:**
**Road Closure Inspection Form**

# Road Closure Inspection Form

| **Road Number** | **Date Inspected** | **Road Barrier Type** | **Road Barrier Effective** (Yes or No, if no describe) | **OHV Trespass** | **Comments or Proposed Management Strategy** |
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**Raod Barrier Type:** B= Boulder and/or blocks, G= Gate, O= Other (e.g slides, washouts), T = Trench and/or Berm, W = Wood (e.g down trees, root wads, or logs).

**OHV Trespass:** 0 = No OHV vehicle trespass noted

1 = OHV trespass noted as one to a few tracks. Tracks have a low frequency of use as evidenced by in tack vegetation in the OHV trail

2 = OHV trespass noted as one to a few tracks. Tracks have a moderate to heavy frequency of use as evidenced by OHV tracks being void of vegetation.

3 = OHV trespass noted as many (> 3) trails. Trails have a moderate frequency of use as evidenced by OHV tracks being void of vegetation.

4 = OHV trespass noted as many (>3) tracks. Tracks have a heavy frequency of use as evidenced by OHV tracks being void of vegetation and are rutted in many areas.

**Appendix 15-3:**
**Trail Inspection Form**

## Trail Inspection Form

| Trail | Date Inspected | Trail Location | Access Points | Public Access Controls | Appropriate Signs in place (Yes or No) | OHV Trespass | Comments or Proposed Management Strategy |
|---|---|---|---|---|---|---|---|
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**OHV Trespass:** 0 = No OHV vehicle trespass noted
1 = OHV trespass noted as one to a few tracks. Tracks have a low frequency of use as evidenced by in tack vegetation in the OHV trail
2 = OHV trespass noted as one to a few tracks. Tracks have a moderate to heavy frequency of use as evidenced by OHV tracks being void of vegetation.
3 = OHV trespass noted as many (> 3) trails. Trails have a moderate frequency of use as evidenced by OHV tracks being void of vegetation.
4 = OHV trespass noted as many (>3) tracks. Tracks have a heavy frequency of use as evidenced by OHV tracks being void of vegetation and are rutted in many areas.

**Appendix 16-1:**
**Lewis River Habitat Evaluation Procedure Study Memo**

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# Memorandum

**Date**: November 3, 2006

**To**: The Lewis River TCC

**From**: Colleen McShane

**Subject**: Lewis River HEP Study

At the TCC meeting in October PacifiCorp introduced the idea of having EDAW rerun the Habitat Evaluation Procedure (HEP) to show what might be expected in terms of habitat quality and quantity for the evaluation species under the Wildlife Habitat Management Plan (WHMP). There were a number of questions at the meeting related to the timing and intent of rerunning the HEP, and TCC requested that I prepare a memo providing the rational for conducting a new HEP analysis.

Over the past few weeks I have had several conversations with both the WDFW (Curt Leigh) and PacifiCorp (Kirk Naylor) regarding how the results of a new HEP would be used and the intent of the Settlement Agreement discussions related to this topic. <u>The general conclusion is that it is premature to conduct the HEP at this time.</u> So, the purpose of this memo is to explain why this is the case and to provide some documentation and background information that might be useful when the HEP is rerun in the future.

## Background

When the HEP was conducted in 2001, it was based on cover type mapping completed in 1995 for the Yale Project and 2000 for the rest of the developments. The study area for the HEP included utility property and other lands within 0.5-mile of the reservoirs (including private and USFS lands). The habitat quality values (HSIs) were based on field data collected in 2000 and 2001. The HEP was run for a "base case", and 2 alternatives.

- Base Case - assumed that Merwin lands would continue to be managed under the Merwin Wildlife Habitat Management Plan; other utility-owned lands would not be managed in any way.
- With Harvest Management Alternative – assumed that some level of harvest (thinning and clearcutting) would be used as a management tool;
- Without Harvest Management Alternative – assumed that harvest would not be used as a habitat management tool, but that there would be other management activities (i.e. shrub planting, snag creation, etc.)

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The HEP analysis included a set of rules to move acres between cover types based on succession and expected harvest rates for utility, private, and USFS lands. The results of the HEP showed what could be expected for the base case and each alternative in terms of Average Annual Habitat Units (AAHUs) over the license period. The assumptions and the HEP results were described in a technical report which was an appendix to the Preliminary Draft License Application (2004).

PacifiCorp was considering redoing the HEP at this point in time for 4 reasons:

- The cover type mapping for the Project has been recently revised and updated;
- There was a desire to run the analysis on utility-owned lands only (as opposed to the larger study area used for the original HEP);
- Revised assumptions affecting the Base Case, including new stream/riparian buffers under the Forest Practice Regulations, as well as restrictions related to bald eagle (roosts and nests) and spotted owl considerations (circles and the SOSEA);
- Revised assumptions affecting the management alternatives, including larger wetland and stream buffers (compared to Forest Practices), the potential for harvest in mid-successional stands, limitations on harvest within 2-miles of the SOSEA.

PacifiCorp's overall intent was to try to get a more accurate picture of the anticipated gains in Habitat Units (HUs) with management, given the updated mapping and WHMP goals and objectives, compared to the base case.

The purpose of the 2001 HEP was to determine habitat quantity and quality and identify some management actions that could result in improvements; it provided the essential guidance for developing the WHMP goals and objectives. However, it is now recognized that the 2001 HEP results are moot as a predictive tool for the WHMP. There is no base case nor are there management alternatives.

### Rational for Not Rerunning the HEP at this Time

In our conversation, Curt Leigh pointed out that, although a comparison between base case and alternative scenarios is traditionally how HEP results are used to evaluate a project or management plan, this is not how it is to be applied to the Lewis River projects. For the Lewis River, it was decided during the Settlement Agreement process that the HEP would not be used to quantify project impacts and mitigation benefits which would normally provide for a comparison between wildlife habitat losses and mitigation replacements. Instead the HEP would be used simply to monitor the success of the WHMP as applied to all utility-owned lands, including those that would be acquired. The HEP would be rerun when the WHMPs were complete and all the lands were acquired, resulting in predicted HUs for each species in TY17. These HUs would be the benchmark or target against which the success of WHMP will be evaluated. Seventeen years later (in TY17) the HEP would be run again using new field data and cover type mapping to compare with the predicted TY17 HUs. If the actual TY17 HUs are lower than the predicted HUs, it may be necessary to revise the WHMP goals, objectives, and/or management actions.

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Section 10.8.4.1 of the Settlement Agreement, Updating Existing Information, states:

> *"As PacifiCorp expends Fund assets to acquire lands that will be managed under its WHMP, PacifiCorp shall update the existing HEP data. This will require mapping and cover-typing the newly acquired lands, but assumes that Habitat Suitability Index ("HSI") values from the current HEP are applicable. If new or different habitat types are encountered, new HSI values will be determined*."

This assumes that "current" means the HSI values from 2001 for the cover types included in the 2001 HEP.

In summary, it is premature rerun the HEP at this time because it is stipulated in the Settlement Agreement and:

- The land acquisition is not complete;
- The evaluation process that will occur on WHMP lands over the next few years will most likely result in additional changes to the cover type acreages;
- The various harvest plans that are part of the WHMP have not yet been developed;
- It is not necessary to use the HEP to show how the WHMPs will or will not benefit certain species on current utility-owned lands and use this information to tweak the goals and objectives to produce results that match a 2001 or 2006 HEP.
- There is no need to worry about determining if there is a change in HUs over the next 17 yrs with the WHMP compared what was expected under the 2001 HEP or even a 2006 HEP. The HEP that is conducted when the land acquisition process complete and the WHNP is begin implemented will set the management targets.

## An Example

For me, an example is always useful. Assume that the land acquisition process is complete in 2011. Then, the HEP would be run in 2011 using the following:

TY0=2006 → HSI values from 2001; cover type acreages from 2006 (current ≈10,000 acres of utility land). TY0 is typically set as the year prior to implementing any management action. For hydroelectric projects it is often the year prior to the license, which would be 2006 for the Lewis River projects.

TY1=2007 → HSI values from 2001; cover type acreages from 2006 (current ≈10,000 acres of utility land). TY1 is usually the first year of management; for the Lewis River projects it would be the year that the WHMPs are implemented.

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TY5=2011 → HSI values from 2001; cover type acreages from 2011 (current ≈10,000 acres of utility land, revised to reflect 2011 conditions based on management actions implemented over the past 5 years + cover type acreages of newly acquired lands). This target year would change depending on exactly when the land acquisition is complete and the HEP is rerun. If all the lands are acquired by 2009, then instead of a TY5, there would be a TY3.

TY17=2023 → HSIs from 2001, revised, where needed to reflect effects of WHMP management actions affecting habitat quality (snag creation, shrub planting); acreages from 2011 redistributed to reflect a new set of assumptions based for succession and WHMP management actions (thinning, clearcuts). It may be necessary to develop a different set of assumptions for lands that are under a Conservation Easement and not owned outright by the utilities.

In TY17 (2023), all WHMP lands would be re-cover typed and field sampled, thus creating a new set of HSI values, acreages, and HUs. The results (HUs) of this new 2023 HEP would then be compared to the TY17 HUs from the HEP run in 2011 to see if there needs to be a change in management direction or objectives under the WHMPs for the remainder of the license period. The 2023 HEP would be run out through the end of the license period (TY50), with 1 or 2 target years between 2023 and 2057.

I hope that this memo provides some clarity to the HEP as it was and will be applied to the Lewis River projects. Please let me know if you have any questions.

**Appendix 16-2:**
**Summary of Habitat Suitability Index and Suitability Index Values in the Lewis River Habitat Evaluation Procedure Study Area**

**Summary of Habitat Suitability Index and Suitability Index values in the Lewis River Habitat Evaluation Procedure study area (Revised September 25, 2007).**

| | HSI/SI | Eagle Island | | Merwin | | Yale | | Swift | | Swift Canal | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] |
| **PFO** | **N** | 1 | | 3 | | 6 | | 2 | | 2 | |
| | B.C. CHICKADEE HSI | 0.87 | -- | 0.87 | 0.82--0.92 | 0.91 | 0.86--0.96 | 0.91 | -- | 0.90 | -- |
| | B.C. CHICKADEE SNAG DENSITY (v4) | 1.00 | -- | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | 1.00 | -- | 1.00 | -- |
| | B.C. CHICKADEE TREE COVER (v1) | 0.75 | -- | 0.85 | 0.67--1.00 | 0.84 | 0.75--0.93 | 0.82 | -- | 0.81 | -- |
| | B.C. CHICKADEE TREE HEIGHT (v2) | 1.00 | -- | 0.92 | 0.77--1.00 | 1.00 | 1.00--1.00 | 1.00 | -- | 1.00 | -- |
| | P. WOODPECKER HSI | 0.00 | -- | 0.18 | 0.00---0.46 | 0.08 | 0.00--0.20 | 0.25 | -- | 0.22 | -- |
| | P. WOODPECKER TREES > 51 CM DBH (v2) | 0.00 | -- | 0.00 | 0.00--0.01 | 0.00 | 0.00--0.00 | 0.26 | -- | 0.39 | -- |
| | P. WOODPECKER SNAGS > 51 CM DBH (v6) | 0.00 | -- | 0.33 | 0.00--0.96 | 0.17 | 0.00--0.41 | 0.00 | -- | 0.00 | -- |
| | P. WOODPECKER TREE COVER (v1) | 1.00 | -- | 0.66 | 0.20--1.00 | 0.75 | 0.56--0.95 | 0.60 | -- | 0.78 | -- |
| | P. WOODPECKER DBH OF SNAGS >51CM (v7) | 0.00 | -- | 0.33 | 0.00--0.96 | 0.17 | 0.00--0.41 | 0.00 | -- | 0.00 | -- |
| | P. WOODPECKER NO. LOGS/STUMPS (v3) | 1.00 | -- | 1.00 | 1.0--1.0 | 1.00 | 1.00--1.00 | 1.00 | -- | 0.93 | -- |
| | P. WOODPECKER SNAGS >10 IN. (v8) | 0.90 | -- | 0.97 | -- | 0.93 | -- | 0.95 | -- | 0.90 | -- |
| | P. WOODPECKER SNAGS >30 IN. (v9) | 0.90 | -- | 0.90 | -- | 0.92 | -- | 0.90 | -- | 0.90 | -- |
| | P. WOODPECKER PRESENCE OF REDCEDAR (v10) | 0.90 | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- |
| | Y. WARBLER HSI | 0.55 | -- | 0.67 | 0.52--0.82 | 0.57 | 0.51--0.62 | 0.54 | -- | 0.39 | -- |
| | Y. WARBLER HYDROPHYTIC SHRUB COVER (v1) | 0.92 | -- | 0.90 | 0.78--1.00 | 0.89 | 0.82--0.97 | 0.94 | -- | 0.96 | -- |
| | Y. WARBLER DECID. SHRUB COVER (v2) | 0.18 | -- | 0.40 | 0.20--0.60 | 0.30 | 0.23--0.38 | 0.35 | -- | 0.23 | -- |
| | Y. WARBLER SHRUB HT. (v3) | 1.00 | -- | 0.91 | 0.73--1.00 | 0.76 | 0.68--0.85 | 0.50 | -- | 0.35 | -- |
| | AMPHIBIAN HSI | 0.54 | -- | 0.51 | 0.49--0.52 | 0.28 | 0.18--0.38 | 0.52 | -- | 0.42 | -- |
| | AMPHIBIAN COVER SI | 1.00 | -- | 1.00 | 1.00--1.00 | 0.88 | 0.76--0.99 | 1.00 | -- | 0.98 | -- |
| | AMPHIBIAN REPROD. SI | 0.54 | -- | 0.51 | 0.49--0.52 | 0.28 | 0.18--0.38 | 0.52 | -- | 0.42 | -- |
| | MINK HSI | **0.95** | **--** | **0.90** | **--** | **0.90** | **--** | **0.94** | **--** | **0.81** | -- |
| | MINK SHRUB COVER **(v3)** | 0.23 | -- | 0.38 | 0.24-0.53 | 0.32 | **0.26-0.37** | **0.35** | -- | 0.27 | -- |
| | MINK TREE COVER **(v2)** | 1.00 | -- | **0.80** | **0.52-1.00** | **0.85** | **0.73-0.97** | **0.76** | -- | **0.87** | -- |
| | MINK TREE/SHRUB COVER <100M **(v5)** | **0.91** | -- | **0.80** | **--** | **0.80** | **--** | **0.90** | -- | **0.63** | -- |
| | **MINK EMERGENT VEGETATION (v4)** | **0.80** | **--** | **0.68** | **0.35-1.00** | **0.76** | **0.54-0.97** | **0.60** | **--** | **0.58** | **--** |
| **PSS** | **N** | 1 | | 2 | | 2 | | 1 | | 2 | |
| | Y. WARBLER HSI | 0.75 | -- | 0.87 | -- | 0.63 | -- | 0.95 | -- | 0.87 | -- |
| | Y. WARBLER HYDROPHYTIC SHRUB COVER (v1) | 0.99 | -- | 1.00 | -- | 0.55 | -- | 0.99 | -- | 1.00 | -- |
| | Y. WARBLER DECID. SHRUB COVER (v2) | 0.42 | -- | 0.65 | -- | 0.60 | -- | 1.00 | -- | 0.74 | -- |

**Summary of Habitat Suitability Index and Suitability Index values in the Lewis River Habitat Evaluation Procedure study area (Revised September 25, 2007).**

| | HSI/SI | Eagle Island | | Merwin | | Yale | | Swift | | Swift Canal | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] |
| | Y. WARBLER SHRUB HT. (v3) | 1.00 | -- | 1.00 | -- | 0.98 | -- | 0.85 | -- | 0.88 | -- |
| | AMPHIBIAN HSI | 0.56 | -- | 0.52 | -- | 0.54 | -- | 0.00 | -- | 0.29 | -- |
| | AMPHIBIAN COVER SI | 1.00 | -- | 0.93 | -- | 0.83 | -- | 0.80 | -- | 0.89 | -- |
| | AMPHIBIAN REPROD. SI | 0.56 | -- | 0.52 | -- | 0.54 | -- | 0.00 | -- | 0.29 | -- |
| | MINK HSI | **0.95** | -- | **0.90** | -- | **0.90** | -- | **0.95** | -- | **0.81** | -- |
| | MINK SHRUB COVER **(v3)** | 0.40 | -- | 0.76 | -- | 0.53 | -- | 0.91 | -- | 0.63 | -- |
| | MINK TREE COVER **(v2)** | 0.10 | -- | **0.10** | -- | **0.10** | -- | **0.10** | -- | **0.10** | -- |
| | MINK TREE/SHRUB COVER <100M **(v5)** | **0.91** | -- | **0.80** | -- | **0.80** | -- | **0.90** | -- | **0.63** | -- |
| | **MINK EMERGENT VEGETATION** | **1.0** | **--** | **1.0** | **--** | **0.97** | **--** | **1.0** | **--** | **0.51** | **--** |
| **RD** | **N** | 3 | | 2 | | 1 | | 4 | | 5 | |
| | B.C. CHICKADEE HSI | 0.98 | 0.94--1.00 | 0.90 | -- | 0.77 | -- | 0.19 | 0.00--0.51 | 0.68 | 0.41--0.95 |
| | B.C. CHICKADEE SNAG DENSITY (v4) | 1.00 | 1.0--1.0 | 1.00 | -- | 1.00 | -- | 0.25 | 0.00--0.66 | 0.80 | 0.49--1.00 |
| | B.C. CHICKADEE TREE COVER (v1) | 0.96 | 0.88--1.00 | 0.81 | -- | 0.60 | -- | 0.66 | 0.56--0.76 | 0.78 | 0.69--0.86 |
| | B.C. CHICKADEE TREE HEIGHT (v2) | 1.00 | 1.00--1.00 | 1.00 | -- | 1.00 | -- | 1.00 | 1.00--1.00 | 0.94 | 0.84--1.00 |
| | P. WOODPECKER HSI | 0.77 | 0.64--0.90 | 0.26 | -- | 0.37 | -- | 0.32 | 0.14--0.50 | 0.29 | 0.16--0.41 |
| | P. WOODPECKER TREES > 51 CM DBH (v2) | 0.56 | 0.11--1.00 | 0.19 | -- | 0.00 | -- | 0.49 | 0.14--0.84 | 0.34 | 0.08--0.61 |
| | P. WOODPECKER SNAGS > 51 CM DBH (v6) | 1.00 | 1.00--1.00 | 0.00 | -- | 1.00 | -- | 0.00 | 0.00--0.00 | 0.00 | 0.00--0.00 |
| | P. WOODPECKER TREE COVER (v1) | 0.80 | 0.59--1.00 | 1.00 | -- | 1.00 | -- | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 |
| | P. WOODPECKER DBH OF SNAGS >51CM (v7) | 0.43 | 0.28--0.58 | 0.00 | -- | 0.31 | -- | 0.00 | 0.00--0.00 | 0.00 | 0.00--0.00 |
| | P. WOODPECKER NO. LOGS/STUMPS (v3) | 1.00 | 1.0--1.0 | 1.00 | -- | 1.00 | -- | 1.00 | -- | 1.00 | 1.00--1.00 |
| | P. WOODPECKER SNAGS >10 IN. (v8) | 1.00 | -- | 0.90 | -- | 0.90 | -- | 0.93 | -- | 0.92 | -- |
| | P. WOODPECKER SNAGS >30 IN. (v9) | 0.90 | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- |
| | P. WOODPECKER PRESENCE OF REDCEDAR (v10) | 0.90 | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- |
| | Y. WARBLER HSI | 0.57 | 0.43--0.71 | 0.58 | -- | 0.81 | -- | 0.65 | 0.45--0.84 | 0.38 | 0.32--0.43 |
| | Y. WARBLER HYDROPHYTIC SHRUB COVER (v1) | 0.25 | 0.09--0.42 | 0.29 | -- | 0.81 | -- | 0.65 | 0.30--1.00 | 0.16 | 0.10--0.22 |
| | Y. WARBLER DECID. SHRUB COVER (v2) | 0.95 | 0.85--1.00 | 0.71 | -- | 0.78 | -- | 0.63 | 0.37--0.88 | 0.49 | 0.31--0.66 |
| | Y. WARBLER SHRUB HT. (v3) | 0.86 | 0.72--1.00 | 1.00 | -- | 0.85 | -- | 0.86 | 0.81--0.91 | 0.82 | 0.68--0.97 |
| **RM** | **N** | 1 | | 3 | | 2 | | 3 | | 1 | |
| | B.C. CHICKADEE HSI | 1.00 | -- | 0.87 | 0.75--1.00 | 0.90 | -- | 0.58 | 0.03--1.00 | 0.96 | -- |
| | B.C. CHICKADEE SNAG DENSITY (v4) | 1.00 | -- | 1.00 | 1.00--1.00 | 1.00 | -- | 0.67 | 0.04--1.00 | 1.00 | -- |

**Summary of Habitat Suitability Index and Suitability Index values in the Lewis River Habitat Evaluation Procedure study area (Revised September 25, 2007).**

| | HSI/SI | Eagle Island | | Merwin | | Yale | | Swift | | Swift Canal | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] |
| | B.C. CHICKADEE TREE COVER (v1) | 1.00 | -- | 0.78 | 0.55--1.00 | 0.81 | -- | 0.70 | 0.61--0.79 | 0.93 | -- |
| | B.C. CHICKADEE TREE HEIGHT (v2) | 1.00 | -- | 1.00 | 1.00--1.00 | 1.00 | -- | 1.00 | 1.00--1.00 | 1.00 | -- |
| | P. WOODPECKER HSI | 0.34 | -- | 0.57 | 0.15--0.99 | 0.74 | -- | 0.46 | 0.26--0.66 | 0.94 | -- |
| | P. WOODPECKER TREES > 51 CM DBH (v2) | 0.33 | -- | 0.29 | 0.00--0.75 | 0.91 | -- | 0.29 | 0.00--0.62 | 1.00 | -- |
| | P. WOODPECKER SNAGS > 51 CM DBH (v6) | 0.00 | -- | 0.33 | 0.00--0.96 | 0.50 | -- | 0.33 | 0.00--0.96 | 1.00 | -- |
| | P. WOODPECKER TREE COVER (v1) | 0.89 | -- | 0.92 | 0.78--1.00 | 1.00 | -- | 1.00 | 1.00--1.00 | 1.00 | -- |
| | P. WOODPECKER DBH OF SNAGS >51CM (v7) | 0.00 | -- | 0.61 | 0.03--1.00 | 0.50 | -- | 0.33 | 0.00--0.96 | 0.66 | -- |
| | P. WOODPECKER NO. LOGS/STUMPS (v3) | 1.00 | -- | 1.00 | 1.00--1.00 | 1.00 | -- | 1.00 | -- | 1.00 | -- |
| | P. WOODPECKER SNAGS >10 IN. (v8) | 0.90 | -- | 0.90 | -- | 0.95 | -- | 0.93 | -- | 1.00 | -- |
| | P. WOODPECKER SNAGS >30 IN. (v9) | 0.90 | -- | 0.90 | -- | 0.90 | -- | 0.93 | -- | 0.90 | -- |
| | P. WOODPECKER PRESENCE OF REDCEDAR (v10) | 0.90 | -- | 0.93 | -- | 0.95 | -- | 0.90 | -- | 1.00 | -- |
| | Y. WARBLER HSI | 0.69 | -- | 0.69 | 0.51--0.87 | 0.50 | -- | 0.45 | 0.43--0.48 | 0.56 | -- |
| | Y. WARBLER HYDROPHYTIC SHRUB COVER (v1) | 0.33 | -- | 0.58 | 0.25--0.90 | 0.26 | -- | 0.40 | 0.00--0.97 | 0.22 | -- |
| | Y. WARBLER DECID. SHRUB COVER (v2) | 1.00 | -- | 0.71 | 0.45--0.96 | 0.56 | -- | 0.69 | 0.11--1.00 | 0.92 | -- |
| | Y. WARBLER SHRUB HT. (v3) | 1.00 | -- | 0.89 | 0.77--1.00 | 0.92 | -- | 1.00 | 1.00--1.00 | 0.88 | -- |
| **RS** | **N** | 1 | | 2 | | 1 | | 1 | | 2 | |
| | Y. WARBLER HSI | 0.88 | -- | 0.96 | -- | 0.63 | -- | 0.92 | -- | 0.97 | -- |
| | Y. WARBLER HYDROPHYTIC SHRUB COVER (v1) | 0.83 | -- | 0.88 | -- | 0.90 | -- | 0.97 | -- | 0.96 | -- |
| | Y. WARBLER DECID. SHRUB COVER (v2) | 0.83 | -- | 1.00 | -- | 0.31 | -- | 0.81 | -- | 0.94 | -- |
| | Y. WARBLER SHRUB HT. (v3) | 1.00 | -- | 1.00 | -- | 0.92 | -- | 1.00 | -- | 1.00 | -- |
| **SH** | **N** | 1 | | 3 | | 2 | | 1 | | 1 | |
| | Y. WARBLER HSI | 0.46 | -- | 0.31 | 0.10--0.51 | 0.68 | -- | 0.42 | -- | 0.07 | -- |
| | Y. WARBLER HYDROPHYTIC SHRUB COVER | 0.10 | -- | 0.10 | 0.10--0.10 | 0.50 | -- | 0.30 | -- | 0.10 | -- |
| | Y. WARBLER DECID. SHRUB COVER | 1.00 | -- | 0.48 | 0.01--0.94 | 0.79 | -- | 0.48 | -- | 0.01 | -- |
| | Y. WARBLER SHRUB HT. | 1.00 | -- | 0.92 | 0.76--1.00 | 1.00 | -- | 0.53 | -- | 0.61 | -- |
| **UD** | **N** | 1 | | 6 | | 7 | | 4 | | 3 | |
| | B.C. CHICKADEE HSI | 0.79 | -- | 0.59 | 0.31--0.86 | 0.60 | 0.38--0.83 | 0.80 | 0.77--0.83 | 0.27 | 0.00--0.77 |
| | B.C. CHICKADEE SNAG DENSITY (v4) | 1.00 | -- | 0.67 | 0.36--0.98 | 0.71 | 0.45--0.98 | 1.00 | 1.00--1.00 | 0.33 | 0.00--0.96 |
| | B.C. CHICKADEE TREE COVER (v1) | 0.62 | -- | 0.73 | 0.64--0.83 | 0.79 | 0.71--0.87 | 0.65 | 0.60--0.70 | 0.61 | 0.59--0.64 |
| | B.C. CHICKADEE TREE HEIGHT (v2) | 1.00 | -- | 1.00 | 0.99--1.00 | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 |

**Summary of Habitat Suitability Index and Suitability Index values in the Lewis River Habitat Evaluation Procedure study area (Revised September 25, 2007).**

| | HSI/SI | Eagle Island | | Merwin | | Yale | | Swift | | Swift Canal | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] |
| | P. WOODPECKER HSI | 0.14 | -- | 0.13 | 0.04--0.21 | 0.55 | 0.41--0.69 | 0.28 | 0.00--0.58 | 0.27 | 0.08--0.45 |
| | P. WOODPECKER TREES > 51 CM DBH (v2) | 0.04 | -- | 0.07 | 0.01--0.13 | 0.24 | 0.08--0.40 | 0.13 | 0.01--0.26 | 0.29 | 0.00--0.75 |
| | P. WOODPECKER SNAGS > 51 CM DBH (v6) | 0.00 | -- | 0.00 | 0.00--0.00 | 0.71 | 0.45--0.98 | 0.25 | 0.00--0.66 | 0.00 | 0.00--0.00 |
| | P. WOODPECKER TREE COVER (v1) | 1.00 | -- | 0.98 | 0.94--1.00 | 0.95 | 0.88--1.00 | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 |
| | P. WOODPECKER DBH OF SNAGS >51CM (v7) | 0.00 | -- | 0.00 | 0.00--0.00 | 0.67 | 0.41--0.92 | 0.25 | 0.00--0.66 | 0.00 | 0.00--0.00 |
| | P. WOODPECKER NO. LOGS/STUMPS (v3) | 0.58 | -- | 1.00 | 1.00--1.00 | 0.98 | -- | 0.97 | -- | 1.00 | -- |
| | P. WOODPECKER SNAGS >10 IN. (v8) | 0.90 | -- | 0.92 | -- | 0.91 | -- | 0.93 | -- | 0.93 | -- |
| | P. WOODPECKER SNAGS >30 IN. (v9) | 0.90 | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- |
| | P. WOODPECKER PRESENCE OF REDCEDAR (v10) | 0.90 | -- | 0.92 | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- |
| **YRM** | **N** | 1 | | | | | | | | | |
| | B.C. CHICKADEE HSI | 1.00 | -- | -- | -- | -- | -- | 1.00[3] | -- | -- | -- |
| | B.C. CHICKADEE SNAG DENSITY (v4) | 1.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | B.C. CHICKADEE TREE COVER (v1) | 1.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | B.C. CHICKADEE TREE HEIGHT (v2) | 1.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER HSI | 0.27 | -- | -- | -- | -- | -- | 0.27[3] | -- | 0.27[3] | -- |
| | P. WOODPECKER TREES > 51 CM DBH (v2) | 0.19 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER SNAGS > 51 CM DBH (v6) | 0.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER TREE COVER (v1) | 0.81 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER DBH SNAGS >51CM (v7) | 0.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER LOGS AND STUMPS (v3) | 1.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER SNAGS >10 IN. (v8) | 0.90 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER SNAGS >30 IN. (v9) | 0.90 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER PRESENCE OF REDCEDAR (v10) | 0.90 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | Y. WARBLER HSI | 0.46 | -- | -- | -- | -- | -- | 0.46[3] | -- | 0.46[3] | -- |
| | Y. WARBLER HYDROPHYTIC SHRUB COVER | 0.10 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | Y. WARBLER DECID. SHRUB COVER | 1.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | Y. WARBLER SHRUB HT. | 0.97 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **AG** | **N** | | | 2 | | 2 | | | | | |
| | S. SPARROW HSI | -- | -- | 0.35 | -- | 0.52 | -- | -- | -- | -- | -- |
| | S. SPARROW FORB COVER (v4) | -- | -- | 0.58 | -- | 0.97 | -- | -- | -- | -- | -- |

**Summary of Habitat Suitability Index and Suitability Index values in the Lewis River Habitat Evaluation Procedure study area (Revised September 25, 2007).**

| | HSI/SI | Eagle Island | | Merwin | | Yale | | Swift | | Swift Canal | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] |
| | S. SPARROW FORB HT. (v3) | -- | -- | 0.50 | -- | 0.50 | -- | -- | -- | -- | -- |
| | S. SPARROW GRASS HT. (v7) | -- | -- | 0.42 | -- | 0.21 | -- | -- | -- | -- | -- |
| | S. SPARROW GRASS COVER (v5) | -- | -- | 0.98 | -- | 1.00 | -- | -- | -- | -- | -- |
| | S. SPARROW LITTER COVER (v2) | -- | -- | 1.00 | -- | 0.98 | -- | -- | -- | -- | -- |
| | S. SPARROW LITTER HT. (v1) | -- | -- | 1.00 | -- | 1.00 | -- | -- | -- | -- | -- |
| **M** | **N** | | | 4 | | 4 | | 5 | | | |
| | B.C. CHICKADEE HSI | -- | -- | 0.83 | 0.78--0.89 | 0.91 | 0.82--1.00 | 0.70 | 0.43--0.98 | 0.70[3] | -- |
| | B.C. CHICKADEE SNAG DENSITY (v4) | -- | -- | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | 0.80 | 0.49--1.00 | -- | -- |
| | B.C. CHICKADEE TREE COVER (v1) | -- | -- | 0.71 | 0.61--0.80 | 0.84 | 0.68--1.00 | 0.74 | 0.65--0.84 | -- | -- |
| | B.C. CHICKADEE TREE HEIGHT (v2) | -- | -- | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | -- | -- |
| | P. WOODPECKER HSI | -- | -- | 0.91 | 0.87--0.96 | 0.72 | 0.48--0.97 | 0.78 | 0.59--0.96 | 0.78[3] | -- |
| | P. WOODPECKER TREES > 51 CM DBH (v2) | -- | -- | 0.87 | 0.66--1.00 | 1.00 | 1.00--1.00 | 0.80 | 0.49--1.00 | -- | -- |
| | P. WOODPECKER SNAGS > 51 CM DBH (v6) | -- | -- | 1.00 | 1.00--1.00 | 0.50 | 0.03--0.97 | 0.80 | 0.49--1.00 | -- | -- |
| | P. WOODPECKER TREE COVER (v1) | -- | -- | 1.00 | 1.00--1.00 | 0.91 | 0.76--1.00 | 1.00 | 1.00--1.00 | -- | -- |
| | P. WOODPECKER DBH OF SNAGS >51CM (v7) | -- | -- | 0.77 | 0.49--1.00 | 0.50 | 0.03--0.97 | 0.75 | 0.45--1.00 | -- | -- |
| | P. WOODPECKER NO. LOGS/STUMPS (v3) | -- | -- | 1.00 | 1.0--1.0 | 1.00 | -- | 1.00 | 1.00--1.00 | -- | -- |
| | P. WOODPECKER SNAGS >10 IN. (v8) | -- | -- | 0.93 | -- | 0.93 | -- | 0.96 | -- | -- | -- |
| | P. WOODPECKER SNAGS >30 IN. (v9) | -- | -- | 0.90 | -- | 0.93 | -- | 0.90 | -- | -- | -- |
| | P. WOODPECKER PRESENCE OF REDCEDAR (v10) | -- | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- | -- | -- |
| **MD** | **N** | | | 4 | | | | 1 | | 1 | |
| | S. SPARROW HSI | -- | -- | 0.37 | 0.29--0.45 | -- | -- | 0.44 | -- | 0.38 | -- |
| | S. SPARROW FORB COVER (v4) | -- | -- | 0.43 | 0.22--0.65 | -- | -- | 1.00 | -- | 0.94 | -- |
| | S. SPARROW FORB HT. (v3) | -- | -- | 0.50 | 0.50--0.50 | -- | -- | 0.50 | -- | 0.50 | -- |
| | S. SPARROW GRASS HT. (v7) | -- | -- | 0.15 | 0.06--0.24 | -- | -- | 1.00 | -- | 0.10 | -- |
| | S. SPARROW GRASS COVER (v5) | -- | -- | 0.74 | 0.33--1.00 | -- | -- | 0.67 | -- | 0.82 | -- |
| | S. SPARROW LITTER COVER (v2) | -- | -- | 0.94 | 0.85--1.00 | -- | -- | 1.00 | -- | 1.00 | -- |
| | S. SPARROW LITTER HT. (v1) | -- | -- | 1.00 | 1.00--1.00 | -- | -- | 1.00 | -- | 1.00 | -- |
| **MS** | **N** | | | 11 | | 9 | | 5 | | 3 | |
| | B.C. CHICKADEE HSI | 0.86[3] | -- | 0.86 | 0.83--0.89 | 0.82 | 0.68--0.97 | 0.85 | 0.77--0.93 | 0.60 | 0.02--1.00 |
| | B.C. CHICKADEE SNAG DENSITY (v4) | -- | -- | 1.00 | 1.00--1.00 | 0.89 | 0.73--1.00 | 1.00 | 1.00--1.00 | 0.67 | 0.04--1.00 |

**Summary of Habitat Suitability Index and Suitability Index values in the Lewis River Habitat Evaluation Procedure study area (Revised September 25, 2007).**

| HSI/SI | | Eagle Island | | Merwin | | Yale | | Swift | | Swift Canal | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] |
| | B.C. CHICKADEE TREE COVER (v1) | -- | -- | 0.75 | 0.69--0.81 | 0.83 | 0.78--0.89 | 0.74 | 0.61--0.88 | 0.75 | 0.51--0.99 |
| | B.C. CHICKADEE TREE HEIGHT (v2) | -- | -- | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 |
| | P. WOODPECKER HSI | 0.69[3] | -- | 0.69 | 0.57--0.81 | 0.59 | 0.49--0.68 | 0.47 | 0.21--0.73 | 0.62 | 0.28--0.96 |
| | P. WOODPECKER TREES > 51 CM DBH (v2) | -- | -- | 0.84 | 0.72--0.97 | 0.91 | 0.84--0.99 | 0.43 | 0.17-0.69 | 0.83 | 0.50--1.00 |
| | P. WOODPECKER SNAGS > 51 CM DBH (v6) | -- | -- | 0.64 | 0.43--0.85 | 0.22 | 0.02--0.43 | 0.40 | 0.02--0.78 | 0.33 | 0.00--0.96 |
| | P. WOODPECKER TREE COVER (v1) | -- | -- | 0.83 | 0.70--0.95 | 0.99 | 0.97--1.00 | 0.94 | 0.84--1.00 | 0.99 | 0.97--0.99 |
| | P. WOODPECKER DBH OF SNAGS >51CM (v7) | -- | -- | 0.74 | 0.58--0.91 | 0.22 | 0.02--0.43 | 0.22 | 0.00--0.46 | 0.33 | 0.00--0.96 |
| | P. WOODPECKER NO. LOGS/STUMPS (v3) | -- | -- | 0.99 | 0.97--1.00 | 1.00 | -- | 1.00 | -- | 1.00 | 1.00--1.00 |
| | P. WOODPECKER SNAGS >10 IN. (v8) | -- | -- | 0.96 | -- | 0.93 | -- | 0.92 | -- | 0.93 | -- |
| | P. WOODPECKER SNAGS >30 IN. (v9) | -- | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- |
| | P. WOODPECKER PRESENCE OF REDCEDAR (v10) | -- | -- | 0.91 | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- |
| **MS-T** | **N** | | | 8 | | | | | | | |
| | B.C. CHICKADEE HSI | -- | -- | 0.72 | 0.49--0.94 | 0.72[3] | -- | 0.72[3] | -- | 0.72[3] | -- |
| | B.C. CHICKADEE SNAG DENSITY (v4) | -- | -- | 0.75 | 0.52--0.98 | -- | -- | -- | -- | -- | -- |
| | B.C. CHICKADEE TREE COVER (v1) | -- | -- | 0.94 | 0.88--1.00 | -- | -- | -- | -- | -- | -- |
| | B.C. CHICKADEE TREE HEIGHT (v2) | -- | -- | 1.00 | 1.00--1.00 | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER HSI | -- | -- | 0.47 | 0.37--0.56 | 0.47[3] | -- | 0.47[3] | -- | 0.47[3] | -- |
| | P. WOODPECKER TREES > 51 CM DBH (v2) | -- | -- | 0.76 | 0.60--0.92 | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER SNAGS > 51 CM DBH (v6) | -- | -- | 0.13 | 0.00--0.30 | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER TREE COVER (v1) | -- | -- | 0.77 | 0.64--0.90 | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER DBH OF SNAGS >51CM (v7) | -- | -- | 0.12 | 0.00--0.30 | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER NO. LOGS/STUMPS (v3) | -- | -- | 1.00 | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER SNAGS >10 IN. (v8) | -- | -- | 0.93 | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER SNAGS >30 IN. (v9) | -- | -- | 0.90 | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER PRESENCE OF REDCEDAR (v10) | -- | -- | 0.91 | -- | -- | -- | -- | -- | -- | -- |
| **OG** | **N** | | | 3 | | 3 | | 6 | | | |
| | B.C. CHICKADEE HSI | -- | -- | 0.94 | 0.90--0.99 | 0.92 | 0.85--1.00 | 0.85 | 0.80--0.90 | 0.85[3] | -- |
| | B.C. CHICKADEE SNAG DENSITY (v4) | -- | -- | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | -- | -- |
| | B.C. CHICKADEE TREE COVER (v1) | -- | -- | 0.89 | 0.81--0.97 | 0.86 | 0.72--1.00 | 0.73 | 0.64--0.81 | -- | -- |
| | B.C. CHICKADEE TREE HEIGHT (v2) | -- | -- | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | -- | -- |

**Summary of Habitat Suitability Index and Suitability Index values in the Lewis River Habitat Evaluation Procedure study area (Revised September 25, 2007).**

| | HSI/SI | Eagle Island | | Merwin | | Yale | | Swift | | Swift Canal | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] |
| | P. WOODPECKER HSI | -- | -- | 0.65 | 0.35--0.95 | 0.97 | 0.94--0.99 | 0.89 | 0.77--1.00 | 0.89[3] | -- |
| | P. WOODPECKER TREES > 51 CM DBH (v2) | -- | -- | 0.98 | 0.93--1.00 | 1.00 | 1.00--1.00 | 0.99 | 0.97--1.00 | -- | -- |
| | P. WOODPECKER SNAGS > 51 CM DBH (v6) | -- | -- | 0.33 | 0.00--0.96 | 1.00 | 1.00--1.00 | 0.83 | 0.59--1.00 | -- | -- |
| | P. WOODPECKER TREE COVER (v1) | -- | -- | 1.00 | 1.00--1.00 | 0.96 | 0.88--1.00 | 0.99 | 0.96--1.00 | -- | -- |
| | P. WOODPECKER DBH OF SNAGS >51CM (v7) | -- | -- | 0.33 | 0.00--0.96 | 0.93 | 0.86--1.00 | 0.81 | 0.57--1.00 | -- | -- |
| | P. WOODPECKER NO. LOGS/STUMPS (v3) | -- | -- | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | 1.00 | -- | -- | -- |
| | P. WOODPECKER SNAGS >10 IN. (v8) | -- | -- | 0.90 | -- | 0.97 | -- | 0.97 | -- | -- | -- |
| | P. WOODPECKER SNAGS >30 IN. (v9) | -- | -- | 0.90 | -- | 0.93 | -- | 0.92 | -- | -- | -- |
| | P. WOODPECKER PRESENCE OF REDCEDAR (v10) | -- | -- | 0.90 | -- | 0.90 | -- | 0.92 | -- | -- | -- |
| **OR** | **N** | | | 3 | | 2 | | | | | |
| | S. SPARROW HSI | -- | -- | 0.40 | 0.28--0.52 | 0.44 | -- | -- | -- | -- | -- |
| | S. SPARROW FORB COVER (v4) | -- | -- | 0.62 | 0.14--1.00 | 1.00 | -- | -- | -- | -- | -- |
| | S. SPARROW FORB HT. (v3) | -- | -- | 0.50 | 0.50--0.50 | 0.50 | -- | -- | -- | -- | -- |
| | S. SPARROW GRASS HT. (v7) | -- | -- | 0.28 | 0.19--0.37 | 0.40 | -- | -- | -- | -- | -- |
| | S. SPARROW GRASS COVER (v5) | -- | -- | 0.96 | 0.87--1.00 | 1.00 | -- | -- | -- | -- | -- |
| | S. SPARROW LITTER COVER (v2) | -- | -- | 1.00 | 1.00--1.00 | 1.00 | -- | -- | -- | -- | -- |
| | S. SPARROW LITTER HT. (v1) | -- | -- | 1.00 | 1.00--1.00 | 1.00 | -- | -- | -- | -- | -- |
| **OW** | **N** | | | 3 | | | | | | | |
| | S. SPARROW HSI | -- | -- | 0.34 | 0.13--0.55 | -- | -- | -- | -- | -- | -- |
| | S. SPARROW FORB COVER (v4) | -- | -- | 0.82 | 0.49--1.00 | -- | -- | -- | -- | -- | -- |
| | S. SPARROW FORB HT. (v3) | -- | -- | 0.80 | 0.51--1.00 | -- | -- | -- | -- | -- | -- |
| | S. SPARROW GRASS HT. (v7) | -- | -- | 0.74 | 0.26--1.00 | -- | -- | -- | -- | -- | -- |
| | S. SPARROW GRASS COVER (v5) | -- | -- | 0.32 | 0.01--0.63 | -- | -- | -- | -- | -- | -- |
| | S. SPARROW LITTER COVER (v2) | -- | -- | 0.40 | 0.33--0.46 | -- | -- | -- | -- | -- | -- |
| | S. SPARROW LITTER HT. (v1) | -- | -- | 1.00 | 1.00--1.00 | -- | -- | -- | -- | -- | -- |
| **P** | **N** | | | 8 | | 5 | | 6 | | 2 | |
| | B.C. CHICKADEE HSI | 0.40[3] | -- | 0.40 | 0.19--0.62 | 0.50 | 0.18--0.82 | 0.43 | 0.14--0.71 | 1.00 | -- |
| | B.C. CHICKADEE SNAG DENSITY (v4) | -- | -- | 0.50 | 0.23--0.77 | 0.80 | 0.49--1.00 | 0.50 | 0.17--0.83 | 1.00 | -- |
| | B.C. CHICKADEE TREE COVER (v1) | -- | -- | 0.66 | 0.63--0.70 | 0.68 | 0.59--0.77 | 0.70 | 0.64--0.75 | 1.00 | -- |
| | B.C. CHICKADEE TREE HEIGHT (v2) | -- | -- | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | 1.00 | 0.99--1.00 | 1.00 | -- |

**Summary of Habitat Suitability Index and Suitability Index values in the Lewis River Habitat Evaluation Procedure study area (Revised September 25, 2007).**

| | HSI/SI | Eagle Island | | Merwin | | Yale | | Swift | | Swift Canal | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] |
| | P. WOODPECKER HSI | 0.16[3] | -- | 0.16 | 0.05--0.28 | 0.26 | 0.00--0.55 | 0.18 | 0.00--0.36 | 0.31 | -- |
| | P. WOODPECKER TREES > 51 CM DBH (v2) | -- | -- | 0.14 | 0.01--0.27 | 0.27 | 0.00--0.56 | 0.06 | 0.00--0.12 | 0.02 | -- |
| | P. WOODPECKER SNAGS > 51 CM DBH (v6) | -- | -- | 0.13 | 0.00--0.30 | 0.20 | 0.00--0.51 | 0.17 | 0.00--0.42 | 0.50 | -- |
| | P. WOODPECKER TREE COVER (v1) | -- | -- | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | 0.83 | -- |
| | P. WOODPECKER DBH OF SNAGS >51CM (v7) | -- | -- | 0.13 | 0.00--0.30 | 0.00 | 0.00--0.51 | 0.17 | 0.00--0.41 | 0.41 | -- |
| | P. WOODPECKER NO. LOGS/STUMPS (v3) | -- | -- | 0.89 | 0.77--1.00 | 1.00 | -- | 1.00 | -- | 1.00 | -- |
| | P. WOODPECKER SNAGS >10 IN. (v8) | -- | -- | 0.91 | -- | 0.90 | -- | 0.90 | -- | 0.95 | -- |
| | P. WOODPECKER SNAGS >30 IN. (v9) | -- | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- |
| | P. WOODPECKER PRESENCE OF REDCEDAR (v10) | -- | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- |
| **P-T** | **N** | | | 4 | | 1 | | | | | |
| | B.C. CHICKADEE HSI | -- | -- | 0.25 | 0.00--0.66 | 0.00 | -- | -- | -- | -- | -- |
| | B.C. CHICKADEE SNAG DENSITY (v4) | -- | -- | 0.25 | 0.00--0.66 | 0.00 | -- | -- | -- | -- | -- |
| | B.C. CHICKADEE TREE COVER (v1) | -- | -- | 0.99 | 0.97--1.00 | 1.00 | -- | -- | -- | -- | -- |
| | B.C. CHICKADEE TREE HEIGHT (v2) | -- | -- | 1.00 | 1.00--1.00 | 0.73 | -- | -- | -- | -- | -- |
| | P. WOODPECKER HSI | -- | -- | 0.25 | 0.08--0.43 | 0.00 | -- | -- | -- | -- | -- |
| | P. WOODPECKER TREES > 51 CM DBH (v2) | -- | -- | 0.36 | 0.01--0.72 | 0.00 | -- | -- | -- | -- | -- |
| | P. WOODPECKER SNAGS > 51 CM DBH (v6) | -- | -- | 0.00 | 0.00--0.00 | 0.00 | -- | -- | -- | -- | -- |
| | P. WOODPECKER TREE COVER (v1) | -- | -- | 0.91 | 0.83--1.00 | 0.66 | -- | -- | -- | -- | -- |
| | P. WOODPECKER DBH OF SNAGS >51CM (v7) | -- | -- | 0.00 | 0.00--0.00 | 0.00 | -- | -- | -- | -- | -- |
| | P. WOODPECKER NO. LOGS/STUMPS (v3) | -- | -- | 1.00 | 1.0--1.0 | 0.58 | -- | -- | -- | -- | -- |
| | P. WOODPECKER SNAGS >10 IN. (v8) | -- | -- | 0.93 | -- | 0.90 | -- | -- | -- | -- | -- |
| | P. WOODPECKER SNAGS >30 IN. (v9) | -- | -- | 0.90 | -- | 0.90 | -- | -- | -- | -- | -- |
| | P. WOODPECKER PRESENCE OF REDCEDAR (v10) | -- | -- | 0.90 | -- | 0.90 | -- | -- | -- | -- | -- |
| **PEM** | **N** | | | 2 | | 3 | | 1 | | 2 | |
| | Y. WARBLER HSI | -- | -- | 0.00 | -- | 0.26 | 0.00--0.53 | 0.54 | -- | 0.20 | -- |
| | Y. WARBLER HYDROPHYTIC SHRUB COVER (v1) | -- | -- | 0.00 | -- | 0.37 | 0.00--0.97 | 0.97 | -- | 0.93 | -- |
| | Y. WARBLER DECID. SHRUB COVER (v2) | -- | -- | 0.00 | -- | 0.21 | 0.00--0.49 | 0.19 | -- | 0.02 | -- |
| | Y. WARBLER SHRUB HT. (v3) | -- | -- | 0.53 | -- | 0.63 | 0.29--0.98 | 0.83 | -- | 0.53 | -- |
| | AMPHIBIAN HSI | -- | -- | 0.27 | -- | 0.46 | 0.27--0.65 | 0.55 | -- | 0.26 | -- |
| | AMPHIBIAN COVER SI | -- | -- | 0.93 | -- | 0.75 | 0.29--1.00 | 1.00 | -- | 0.69 | -- |

**Summary of Habitat Suitability Index and Suitability Index values in the Lewis River Habitat Evaluation Procedure study area (Revised September 25, 2007).**

| | HSI/SI | Eagle Island | | Merwin | | Yale | | Swift | | Swift Canal | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] |
| | AMPHIBIAN REPROD. SI | -- | -- | 0.27 | -- | 0.57 | 0.54--0.59 | 0.55 | -- | 0.26 | -- |
| | MINK HSI | -- | -- | **0.96** | -- | **0.96** | **0.95-0.97** | **0.98** | -- | **0.69** | -- |
| | MINK SHRUB COVER **(v3)** | -- | -- | 0.10 | -- | 0.25 | **0.05-0.46** | 0.24 | -- | 0.11 | -- |
| | MINKEMERGENT **(v4)** | -- | -- | 1.00 | -- | 1.00 | **--** | 1.00 | -- | 0.71 | -- |
| | MINK TREE COVER **(v2)** | -- | -- | **0.14** | -- | **0.40** | **0.00-0.97** | **0.27** | -- | **0.10** | -- |
| | MINK TREE/SHRUB COVER <100M **(v5)** | -- | -- | **0.80** | -- | **0.80** | -- | **0.90** | -- | **0.63** | -- |
| **PUB** | **N** | | | 4 | | 6 | | 2 | | 4 | |
| | AMPHIBIAN HSI | -- | -- | 0.47 | 0.43--0.51 | 0.51 | 0.49--0.53 | 0.54 | -- | 0.53 | 0.52--0.53 |
| | AMPHIBIAN COVER | -- | -- | 0.90 | 0.74--1.00 | 0.87 | 0.79--0.96 | 0.90 | -- | 0.85 | 0.75--0.96 |
| | AMPHIBIAN REPROD. | -- | -- | 0.47 | 0.43--0.51 | 0.51 | 0.49--0.53 | 0.54 | -- | 0.53 | 0.52--0.53 |
| **ROW** | **N** | | | 6 | | 2 | | | | 2 | |
| | S. SPARROW HSI | -- | -- | 0.47 | 0.41--0.52 | 0.46 | -- | -- | -- | 0.51 | -- |
| | S. SPARROW FORB COVER (v4) | -- | -- | 0.80 | 0.65--0.95 | 0.60 | -- | -- | -- | 0.93 | -- |
| | S. SPARROW FORB HT. (v3) | -- | -- | 0.59 | 0.50--0.69 | 0.50 | -- | -- | -- | 0.50 | -- |
| | S. SPARROW GRASS HT. (v7) | -- | -- | 0.29 | 0.18--0.39 | 0.32 | -- | -- | -- | 0.28 | -- |
| | S. SPARROW GRASS COVER (v5) | -- | -- | 0.69 | 0.54--0.84 | 0.82 | -- | -- | -- | 0.91 | -- |
| | S. SPARROW LITTER COVER (v2) | -- | -- | 0.90 | 0.83--0.97 | 1.00 | -- | -- | -- | 1.00 | -- |
| | S. SPARROW LITTER HT. (v1) | -- | -- | 1.00 | 1.00-1.00 | 1.00 | -- | -- | -- | 1.00 | -- |
| **SS1** | **N** | | | 6 | | | | 2 | | | |
| | S. SPARROW HSI | -- | -- | 0.42 | 0.39--0.46 | 0.42[3] | -- | 0.33 | -- | 0.33[3] | -- |
| | S. SPARROW FORB COVER (v4) | -- | -- | 0.76 | 0.60--0.93 | -- | -- | 0.78 | -- | -- | -- |
| | S. SPARROW FORB HT. (v3) | -- | -- | 0.58 | 0.46--0.71 | -- | -- | 0.71 | -- | -- | -- |
| | S. SPARROW GRASS HT. (v7) | -- | -- | 0.50 | 0.31--0.68 | -- | -- | 1.00 | -- | -- | -- |
| | S. SPARROW GRASS COVER (v5) | -- | -- | 0.59 | 0.40--0.78 | -- | -- | 0.07 | -- | -- | -- |
| | S. SPARROW LITTER COVER (v2) | -- | -- | 0.83 | 0.66--1.00 | -- | -- | 0.57 | -- | -- | -- |
| | S. SPARROW LITTER HT. (v1) | -- | -- | 1.00 | 1.00-1.00 | -- | -- | 1.00 | -- | -- | -- |
| **UM** | **N** | | | 10 | | 5 | | 6 | | 2 | |
| | B.C. CHICKADEE HSI | 0.60[3] | -- | 0.60 | 0.42--0.78 | 0.68 | 0.42--0.95 | 0.71 | 0.50--0.93 | 0.89 | -- |
| | B.C. CHICKADEE SNAG DENSITY (v4) | -- | -- | 0.70 | 0.49--0.91 | 0.80 | 0.49--1.00 | 0.83 | 0.59--1.00 | 1.00 | -- |
| | B.C. CHICKADEE TREE COVER (v1) | -- | -- | 0.71 | 0.68--0.75 | 0.76 | 0.66--0.85 | 0.73 | 0.65--0.82 | 0.81 | -- |

**Summary of Habitat Suitability Index and Suitability Index values in the Lewis River Habitat Evaluation Procedure study area (Revised September 25, 2007).**

| | HSI/SI | Eagle Island | | Merwin | | Yale | | Swift | | Swift Canal | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] |
| | B.C. CHICKADEE TREE HEIGHT (v2) | -- | -- | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | 1.00 | -- |
| | P. WOODPECKER HSI | 0.63[3] | -- | 0.63 | 0.51--0.76 | 0.60 | 0.28--0.93 | 0.19 | 0.06--0.33 | 0.71 | -- |
| | P. WOODPECKER TREES > 51 CM DBH (v2) | -- | -- | 0.79 | 0.66--0.93 | 0.53 | 0.20--0.87 | 0.27 | 0.04--0.49 | 0.81 | -- |
| | P. WOODPECKER SNAGS > 51 CM DBH (v6) | -- | -- | 0.40 | 0.17--0.63 | 0.60 | 0.22--0.98 | 0.00 | 0.00--0.00 | 0.50 | -- |
| | P. WOODPECKER TREE COVER (v1) | -- | -- | 1.00 | 1.00--1.00 | 1.00 | 1.00--1.00 | 0.99 | 0.96--1.00 | 1.00 | -- |
| | P. WOODPECKER DBH OF SNAGS >51CM (v7) | -- | -- | 0.36 | 0.16--0.57 | 0.60 | 0.22--0.98 | 0.00 | 0.00--0.00 | 0.50 | -- |
| | P. WOODPECKER NO. LOGS/STUMPS (v3) | -- | -- | 1.00 | 1.00--1.00 | 0.86 | 0.65--1.00 | 1.00 | -- | 1.00 | -- |
| | P. WOODPECKER SNAGS >10 IN. (v8) | -- | -- | 0.94 | -- | 0.90 | -- | 0.92 | -- | 0.95 | -- |
| | P. WOODPECKER SNAGS >30 IN. (v9) | -- | -- | 0.90 | -- | 0.90 | -- | 0.90 | -- | 0.95 | -- |
| | P. WOODPECKER PRESENCE OF REDCEDAR (v10) | -- | -- | 0.91 | -- | 0.90 | -- | 0.92 | -- | 0.90 | -- |
| **UM-T** | **N** | | | 1 | | | | | | | |
| | B.C. CHICKADEE HSI | -- | -- | 0.00 | -- | 0.00[3] | -- | 0.00[3] | -- | 0.00[3] | -- |
| | B.C. CHICKADEE SNAG DENSITY (v4) | -- | -- | 0.00 | -- | -- | -- | -- | -- | -- | -- |
| | B.C. CHICKADEE TREE COVER (v1) | -- | -- | 0.88 | -- | -- | -- | -- | -- | -- | -- |
| | B.C. CHICKADEE TREE HEIGHT (v2) | -- | -- | 1.00 | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER HSI | -- | -- | 0.35 | -- | 0.35[3] | -- | 0.35[3] | -- | 0.35[3] | -- |
| | P. WOODPECKER TREES > 51 CM DBH (v2) | -- | -- | 0.33 | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER SNAGS > 51 CM DBH (v6) | -- | -- | 0.00 | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER TREE COVER (v1) | -- | -- | 1.00 | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER DBH OF SNAGS >51CM (v7) | -- | -- | 0.00 | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER NO. LOGS/STUMPS (v3) | -- | -- | 1.00 | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER SNAGS >10 IN. (v8) | -- | -- | 0.90 | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER SNAGS >30 IN. (v9) | -- | -- | 0.90 | -- | -- | -- | -- | -- | -- | -- |
| | P. WOODPECKER PRESENCE OF REDCEDAR (v10) | -- | -- | 0.90 | -- | -- | -- | -- | -- | -- | -- |
| **YUD** | **N** | | | 2 | | 1 | | 2 | | | |
| | B.C. CHICKADEE HSI | -- | -- | 0.80 | -- | 0.00 | -- | 0.39 | -- | 0.39[3] | -- |
| | B.C. CHICKADEE SNAG DENSITY (v4) | -- | -- | 1.00 | -- | 0.00 | -- | 0.50 | -- | -- | -- |
| | B.C. CHICKADEE TREE COVER (v1) | -- | -- | 0.64 | -- | 0.60 | -- | 0.60 | -- | -- | -- |
| | B.C. CHICKADEE TREE HEIGHT (v2) | -- | -- | 1.00 | -- | 0.77 | -- | 0.71 | -- | -- | -- |
| | Y. WARBLER HSI | -- | -- | 0.18 | -- | 0.00 | -- | 0.35 | -- | 0.35[3] | -- |

**Summary of Habitat Suitability Index and Suitability Index values in the Lewis River Habitat Evaluation Procedure study area (Revised September 25, 2007).**

| | HSI/SI | Eagle Island | | Merwin | | Yale | | Swift | | Swift Canal | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] |
| | Y. WARBLER HYDROPHYTIC SHRUB COVER (v1) | -- | -- | 0.10 | -- | 0.00 | -- | 0.10 | -- | -- | -- |
| | Y. WARBLER DECID. SHRUB COVER (v2) | -- | -- | 0.07 | -- | 0.00 | -- | 0.58 | -- | -- | -- |
| | Y. WARBLER SHRUB HT. (v3) | -- | -- | 0.87 | -- | 0.16 | -- | 0.83 | -- | -- | -- |
| **YUM** | **N** | | | 3 | | | | | | | |
| | B.C. CHICKADEE HSI | -- | -- | 0.65 | 0.04--1.00 | 0.65[3] | -- | 0.65[3] | -- | 0.65[3] | -- |
| | B.C. CHICKADEE SNAG DENSITY (v4) | -- | -- | 0.67 | 0.04--1.00 | -- | -- | -- | -- | -- | -- |
| | B.C. CHICKADEE TREE COVER (v1) | -- | -- | 0.94 | 0.88--0.99 | -- | -- | -- | -- | -- | -- |
| | B.C. CHICKADEE TREE HEIGHT (v2) | -- | -- | 1.00 | 1.00--1.00 | -- | -- | -- | -- | -- | -- |
| | Y. WARBLER HSI | -- | -- | 0.34 | 0.22--0.47 | 0.34[3] | -- | 0.34[3] | -- | 0.34[3] | -- |
| | Y. WARBLER HYDROPHYTIC SHRUB COVER (v1) | -- | -- | 0.10 | 0.10--0.10 | -- | -- | -- | -- | -- | -- |
| | Y. WARBLER DECID. SHRUB COVER (v2) | -- | -- | 0.50 | 0.14--0.85 | -- | -- | -- | -- | -- | -- |
| | Y. WARBLER SHRUB HT. (v3) | -- | -- | 0.92 | 0.76--1.00 | -- | -- | -- | -- | -- | -- |
| **LP** | **N** | | | | | 3 | | | | 3 | |
| | B.C. CHICKADEE HSI | -- | -- | -- | -- | 0.85 | 0.73--0.96 | 0.85[3] | -- | 0.92 | 0.87--0.97 |
| | B.C. CHICKADEE SNAG DENSITY (v4) | -- | -- | -- | -- | 1.00 | 1.00--1.00 | -- | -- | 1.00 | 1.00--1.00 |
| | B.C. CHICKADEE TREE COVER (v1) | -- | -- | -- | -- | 0.79 | 0.53--1.00 | -- | -- | 0.91 | 0.77--1.00 |
| | B.C. CHICKADEE TREE HEIGHT (v2) | -- | -- | -- | -- | 0.93 | 0.81--1.00 | -- | -- | 0.93 | 0.86--1.00 |
| | P. WOODPECKER HSI | -- | -- | -- | -- | 0.21 | 0.00--0.52 | 0.21[3] | -- | 0.00 | 0.00-0.00 |
| | P. WOODPECKER TREES > 51 CM DBH (v2) | -- | -- | -- | -- | 0.08 | 0.00--0.19 | -- | -- | 0.00 | 0.00--0.00 |
| | P. WOODPECKER SNAGS > 51 CM DBH (v6) | -- | -- | -- | -- | 0.33 | 0.00--0.96 | -- | -- | 0.00 | 0.00--0.00 |
| | P. WOODPECKER TREE COVER (v1) | -- | -- | -- | -- | 0.31 | 0.02--0.60 | -- | -- | 0.59 | 0.18--1.00 |
| | P. WOODPECKER DBH OF SNAGS >51CM (v7) | -- | -- | -- | -- | 0.17 | 0.00--0.50 | -- | -- | 0.00 | 0.00--0.00 |
| | P. WOODPECKER NO. LOGS/STUMPS (v3) | -- | -- | -- | -- | 1.00 | -- | -- | -- | 1.00 | 1.00--1.00 |
| | P. WOODPECKER SNAGS >10 IN. (v8) | -- | -- | -- | -- | 0.90 | -- | -- | -- | 0.93 | -- |
| | P. WOODPECKER SNAGS >30 IN. (v9) | -- | -- | -- | -- | 0.90 | -- | -- | -- | 0.90 | -- |
| | P. WOODPECKER PRESENCE OF REDCEDAR (v10) | -- | -- | -- | -- | 0.90 | -- | -- | -- | 0.90 | -- |
| **LUB** | **N** | | | **5** | | **2** | | **1** | | | |
| | MINK HSI | -- | -- | **0.45** | -- | **0.46** | **--** | **0.47** | **--** | **--** | **--** |
| | **MINK TREE/SHRUB COVER <100 M (v5)** | **--** | **--** | **1.0** | **--** | **1.0** | **--** | **1.0** | **--** | **--** | **--** |
| | **MINK SHORELINE (v6)** | **--** | **--** | **0.20** | **--** | **0.21** | **--** | **0.22** | **--** | **--** | **--** |

**Summary of Habitat Suitability Index and Suitability Index values in the Lewis River Habitat Evaluation Procedure study area (Revised September 25, 2007).**

| HSI/SI | | Eagle Island | | Merwin | | Yale | | Swift | | Swift Canal | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] | Mean | 80 percent C.I.[2] |
| **RUB** | **N** | **2** | | **1** | | | | | | **3** | |
| | MINK HSI | **0.69** | **--** | **0.47** | **--** | **--** | **--** | **--** | **--** | **0.65** | **--** |
| | **MINK TREE/SHRUB COVER <100 M (v5)** | **0.81** | **--** | **0.58** | **--** | **--** | **--** | **--** | **--** | **0.58** | **--** |
| | **MINK SHORELINE (v6)** | **0.59** | **--** | **0.38** | **--** | **--** | **--** | **--** | **--** | **0.75** | **--** |

[1] Original Table 5.2-6 may be found in PacifiCorp and Cowlitz PUD. 2004. Lewis River Hydroelectric Projects Technical Report 5.2 TER 2 Habitat Evaluation Procedures (HEP) Study. FERC Project Nos. 935, 2071, 2011, and 2213.

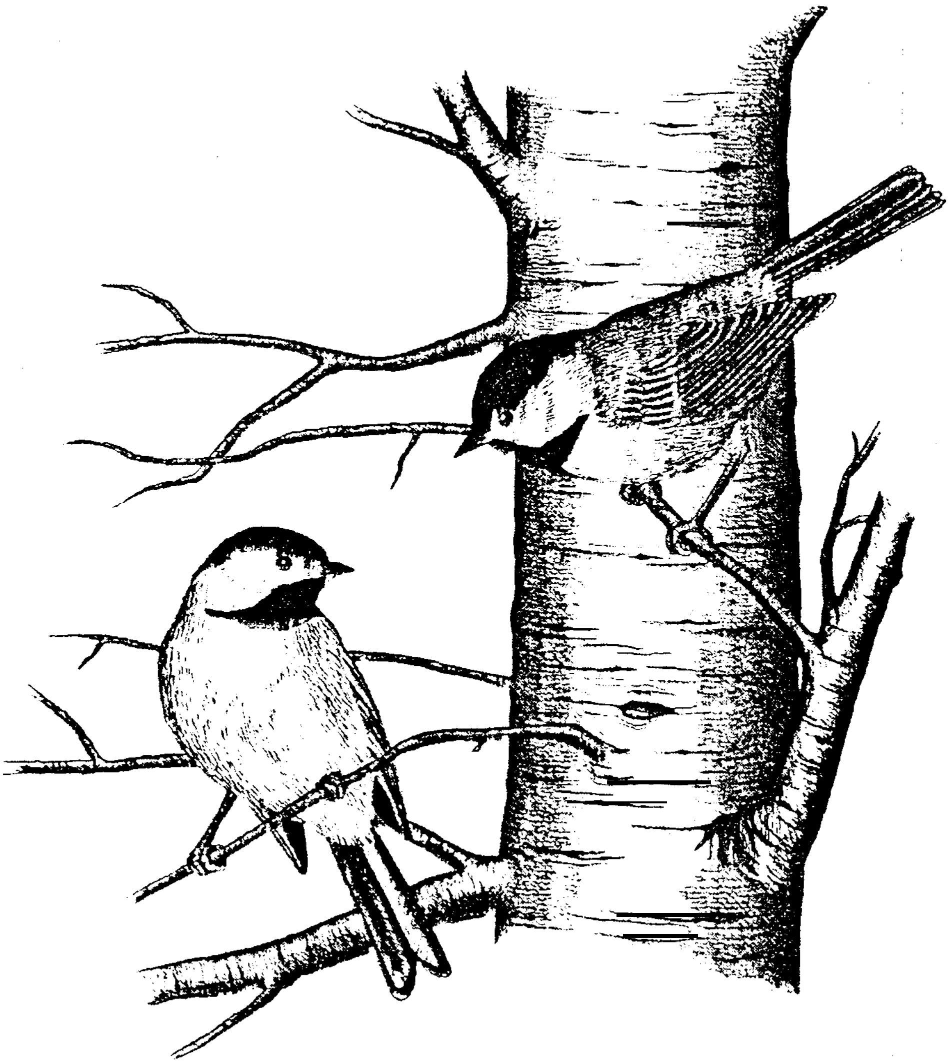
[2] C.I = Confidence Interval. Confidence intervals cannot be calculated if n < 3 or if the standard of deviation is = 0.

[3] These values are small amounts of the vegetation cover type that existed in other project segments that could not be sampled. The values were determined using relative data. (Lewis River HEP Team Meeting Notes November 16, 2001 and personal communication via email from Jim Keaney of EDAW on September 11, 2007).

# Appendix 17-1:
# U.S. Fish and Wildlife Service Black-Capped Chickadee Habitat Suitability Index Model

FWS/OBS-82/10.37
APRIL 1983

# HABITAT SUITABILITY INDEX MODELS: BLACK-CAPPED CHICKADEE



Fish and Wildlife Service

U.S. Department of the Interior

This model is designed to be used by the Division of Ecological Services in conjunction with the Habitat Evaluation Procedures.

FWS/OBS-82/10.37
April 1983

# HABITAT SUITABILITY INDEX MODELS: BLACK-CAPPED CHICKADEE

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## PREFACE

This document is part of the Habitat Suitability Index (HSI) Model Series (FWS/OBS-82/10), which provides habitat information useful for impact assessment and habitat management. Several types of habitat information are provided. The Habitat Use Information Section is largely constrained to those data that can be used to derive quantitative relationships between key environmental variables and habitat suitability. The habitat use information provides the foundation for HSI models that follow. In addition, this same information may be useful in the development of other models more appropriate to specific assessment or evaluation needs.

The HSI Model Section documents a habitat model and information pertinent to its application. The model synthesizes the habitat use information into a framework appropriate for field application and is scaled to produce an index value between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). The application information includes descriptions of the geographic ranges and seasonal application of the model, its current verification status, and a listing of model variables with recommended measurement techniques for each variable.

In essence, the model presented herein is a hypothesis of species-habitat relationships and not a statement of proven cause and effect relationships. Results of model performance tests, when available, are referenced. However, models that have demonstrated reliability in specific situations may prove unreliable in others. For this reason, feedback is encouraged from users of this model concerning improvements and other suggestions that may increase the utility and effectiveness of this habitat-based approach to fish and wildlife planning. Please send suggestions to:

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## CONTENTS

# ACKNOWLEDGMENTS

We gratefully acknowledge Peter Merritt for his review of this habitat model. Funds for the development of this model were provided by the U.S. Fish and Wildlife Service Regional Office in Portland. Publication costs of this model were partially paid for by the U.S. Army Corps of Engineers. The cover of this document was illustrated by Jennifer Shoemaker. Word processing was provided by Carolyn Gulzow and Dora Ibarra.

# BLACK-CAPPED CHICKADEE (*Parus atricapillus*)

## HABITAT USE INFORMATION

### General

The black-capped chickadee (*Parus atricapillus*) inhabits wooded areas in the northern United States, Canada, and the higher elevations of mountains in southern Appalachia (Tanner 1952; Brewer 1963; Merritt 1981). The black-capped chickadee nests in cavities in dead or hollow trees (Nickell 1956), in a variety of forest types (Dixon 1961).

### Food

Black-capped chickadees are insectivorous gleaners (Brewer 1963; Sturman 1968b) that select prey in proportion to its availability (Brewer 1963). Insect food is mostly gleaned from tree bark on twigs, branches, and boles; or from the foliage, fruits, and flowers of trees (Brewer 1963). Caterpillars are an important food for nestling chickadees (Odum 1942; Kluyver 1961; Sturman 1968a). Insect and spider eggs make up a large portion of the winter diet, and, although the use of plant material for food is low during much of the year, seeds of trees and shrubs may account for about half of the winter diet (Martin et al. 1961). Seeds of weedy plants, such as giant ragweed (*Ambrosia* spp.), are favorite winter foods (Fitch 1958).

Black-capped chickadees are versatile in their foraging habits and forage from the ground to the tree tops in a variety of habitats, although they prefer to forage at low or intermediate heights in trees and shrubs (Odum 1942). Chickadees in British Columbia showed a preference for foraging within 1.5 m (5.0 ft) of the ground (Smith 1967).

Black-capped chickadees in western Washington selected their territories before the amount of insect food (especially caterpillars) was apparent, and it appeared that canopy volume of trees was the proximate cue used by the chickadees to determine potential food supply, since chickadee abundance showed a strong positive correlation with canopy volume (Sturman 1968a). Caterpillars eat foliage and their abundance should vary directly with total foliage weight. There was a strong positive correlation between total foliage weight and canopy volume, and, hence, canopy volume provided a good estimate of potential insect abundance. The highest chickadee densities occurred at canopy volumes of about 10.2 $m^3$ of foliage/1 $m^2$ of ground surface (33.5 $ft^3/ft^2$).

## Water

Drinking water requirements are met with surface water and snow (Odum 1942).

## Cover

The black-capped chickadee occurs in both deciduous and evergreen forests in the eastern United States, although it is restricted to deciduous forests along streams in the Northern Great Plains, northern Rocky Mountains, and Great Basin areas (Dixon 1961). In some areas where the ranges of the black-capped chickadee and Carolina chickadee (P. carolinensis) come together, apparently suitable habitat exists where neither chickadee occurs (Tanner 1952; Brewer 1963; Merritt 1981). Deciduous forest types are preferred in western Washington (Sturman 1968a) and commonly used in Oregon (Gabrielson and Jewett 1940). Fall and winter roosts in New York were mostly on dense conifer branches, with some use of cavities (Odum 1942). Black-capped chickadees in Oregon and Washington excavated winter roost cavities in snags (Thomas et al. 1979). Winter roosts in deciduous forests of Minnesota were on the branches of trees and bushes that had retained their foliage (Van Gorp and Langager 1974).

Black-capped chickadee populations in Kansas tended to concentrate along edges between forest and early successional areas (Fitch 1958). The availability of suitable tree cavities for roosting may have been a limiting factor in this study area.

## Reproduction

The black-capped chickadee nests in a cavity, usually in a dead or hollow tree (Nickell 1956). The presence of available nest sites, or trees that could be excavated, appeared to determine the chickadee's choice of nesting habitat. Two important factors affecting the use of stub trees in Michigan were height and the suitability of the tree for excavation (Brewer 1963). Willows (Salix spp.), pines (Pinus spp.), cottonwoods and poplars (Populus spp.), and fruit trees of the genera Pyrus and Prunus are frequently chosen for nest sites (Brewer 1961).

Black-capped chickadees are only able to excavate a cavity in soft or rotten wood (Odum 1941a, b). Trees with decayed heartwood, but firm sapwood, are usually chosen (Brewer 1961). Black-capped chickadees almost always do some excavation at the nest site (Tyler 1946), although they will use existing woodpecker holes, natural cavities, man-made nest boxes, and open topped fence posts (Nickell 1956). The average tree diameter at nest sites was 11.4 cm (4.5 inches), and preferred tree stubs apparently ranged from 10 to 15 cm (3.9 to 5.9 inches) in diameter (Brewer 1963). The minimum dbh of cavity trees used by black-capped chickadees is 10.2 cm (4 inches) (Thomas et al. 1979). Heights of 18 nests in New York ranged from 0.3 to 12.2 m (1 to 40 ft), although only three nests were higher than 4.6 m (15 ft) and 11 nests were under 3.0 m (10 ft) (Odum 1941b).

Nests in New York were usually located in open areas, commonly in young forests, hedgerows, or field borders (Odum 1941a). Willow, alder (*Alnus* spp.) and cottonwood trees were common nest trees in Washington (Jewett et al. 1953). Black-capped chickadees used second growth alder for nesting sites in British Columbia (Smith 1967).

### Interspersion

Black-capped chickadees maintain a territory during the breeding season and flock in the winter months (Odum 1941b; Stefanski 1967). Territory size during nest building in Utah averaged 2.3 ha (5.8 acres) (Stefanski 1967).

Territory size in New York varied from 3.4 ha to 6.9 ha (8.4 to 17.1 acres), with an average size of 5.3 ha (13.2 acres) (Odum 1941a). The larger terri-tories were in open or sparsely wooded country; the size of the territory decreased as the nesting period progressed. The mean home range size of winter flocks was 9.9 ha (24.4 acres) in Kansas (Fitch 1958), 15.0 ha (37 acres) in Michigan (Brewer 1978), and 14.6 ha (36 acres) in New York (Odum 1942) and in Minnesota (Ritchison 1979).

Black-capped chickadees nesting on forest islands in central New Jersey did not nest in forests less than 2 ha (4.8 acres) in size (Galli et al. 1976). However, this apparent dependency on a minimum size forest may have been due to a lack of nesting cavities.

## HABITAT SUITABILITY INDEX (HSI) MODEL

### Model Applicability

Geographic area. This model was developed for the entire breeding range of the-black-capped chickadee.

Season. This model was developed to evaluate the breeding season habitat needs of the black-capped chickadee.

Cover types. This model was developed to evaluate habitat in Deciduous Forest (DF), Evergreen Forest (EF), Deciduous Forested Wetland (DFW), and Evergreen Forested Wetland (EFW) areas (terminology follows that of U.S. Fish and Wildlife Service 1981). It should be noted that, although the chickadee occurs in both deciduous and evergreen forests over much of its range, appar-ently there are geographic differences in use of cover types that limit the use of evergreen forests in parts of its range. Users should be familiar with the chickadee's major cover type preferences in their particular area before applying this model.

Minimum habitat area. Minimum habitat area is defined as the minimum amount of contiguous habitat that is required before an area will be occupied by a species. Although Galli et al. (1976) report that black-capped chickadees may be dependent on certain forest sizes, other studies state that these chickadees will nest in hedgerows and field borders. This model assumes that forest size is not an important factor in assessing habitat suitability for the black-capped chickadees.

<u>Verification level</u>. Previous drafts of this model were reviewed by Peter Merritt, and his specific comments have been incorporated into the current draft (Merritt, pers. comm.).

## Model Description

<u>Overview</u>. This model considers the ability of the habitat to meet the food and reproductive needs of the black-capped chickadee as an indication of overall habitat suitability. Cover needs are assumed to be met by food and reproductive requirements and water is assumed not to be limiting. The food component of this model assesses vegetation conditions, and the reproduction component assesses the abundance of suitable snags. The relationship between habitat variables, life requisites, cover types, and the HSI for the black-capped chickadee is illustrated in Figure 1.

| Habitat variable | Life requisite | Cover types | |
|---|---|---|---|
| Note: Use either the first two variables in combination, or the third alone, to determine food values. | | | |
| Percent tree canopy closure<br>Average height of overstory trees<br>Tree canopy volume/area of ground surface | Food | Deciduous forest<br>Evergreen forest<br>Deciduous forested wetland<br>Evergreen forested wetland | HSI |
| Number of snags 10 to 25 cm dbh/0.4 ha (4 to 10 inches dbh/1.0 acre) | Reproduction | | |

Figure 1. Relationship of habitat variables, life requisites, and cover types in the black-capped chickadee model.

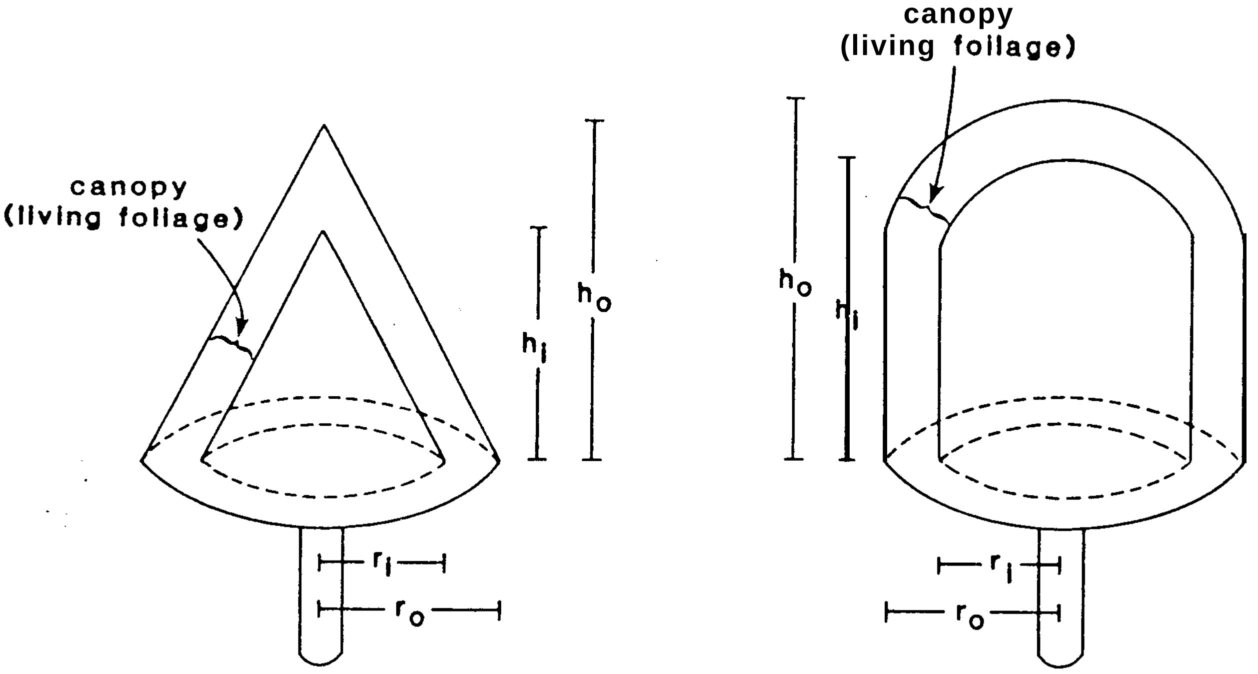
The following sections provide a written documentation of the logic and assumptions used to interpret the habitat information for the black-capped chickadee in order to explain the variables and equations that are used in the HSI model. Specifically, these sections cover the following: (1) identification of variables that will be used in the model; (2) definition and justification of the suitability levels of each variable; and (3) description of the assumed relationship between variables.

Food component. The majority of the year-round food supply of the black-capped chickadee is associated with trees. It is assumed that an accurate assessment of food suitability for the chickadee can be provided by a measure of either: (1) tree canopy closure and the average height of overstory trees; or (2) canopy volume of trees per area of ground surface. It is assumed that optimum canopy closures occur betwen 50 and 75%. A completely closed canopy will have less than optimum value due to an assumed lack of foliage in the middle and lower canopy layers. It is assumed that optimum habitats contain overstory trees 15 m (49.2 ft) or more in height. Habitats with a low canopy closure can provide moderate suitability for black-capped chickadees if tree heights are optimum. Likewise, habitats with short trees may have moderate suitability if canopy closures are optimum.

The canopy volume of an individual tree is equal to the area occupied by the living foliage of that tree, as shown in Figure 2 for deciduous and coniferous trees. Optimum canopy volume per area of ground surface exceeds 10.2 $m^3$ of foliage/$m^2$ of ground surface (33.5 $ft^3$ of foliage/$ft^2$ of ground surface). Suitability will decrease to zero as canopy volume approaches zero.

The field user should measure either: (1) tree canopy closure and tree height; or (2) tree canopy volume per area of ground surface. Tree canopy closure and tree height measurements are probably the most rapid method to assess food suitability. However, the suitability levels of these variables were not based on strong data sources. The suitability levels of tree canopy volume were based on data from Sturman (1968a).

Reproduction component. Black-capped chickadees nest primarily in small dead or hollow trees and can only excavate a cavity in soft or rotten wood. Therefore, reproduction suitability is assumed to be related to the abundance of small snags. It is assumed that snags between 10 and 25 cm (4 and 10 inches) dbh are required. Thomas et al. (1979) and Evans and Conner (1979) provide methods to estimate the number of snags required for cavity nesting birds. Assuming a territory size of 2.4 ha (6.0 acres) and a need for one cavity per year per chickadee pair, the method of Thomas et al. (1979) estimates that optimum habitats provide 5.9 snags/ha (2.4/acre), and the method of Evans and Conner (1979) estimates that 4.1 snags are needed per ha (1.67/acre) to provide optimum conditions. This model assumes that optimum suitability exists when there are five or more snags of the proper size per ha (2/acre), and that suitability will decrease to zero as the number of snags approaches zero.




**CONIFEROUS**

$$CV = \pi/3(h_o r_o^2 - h_i r_i^2)$$

**DECIDUOUS**

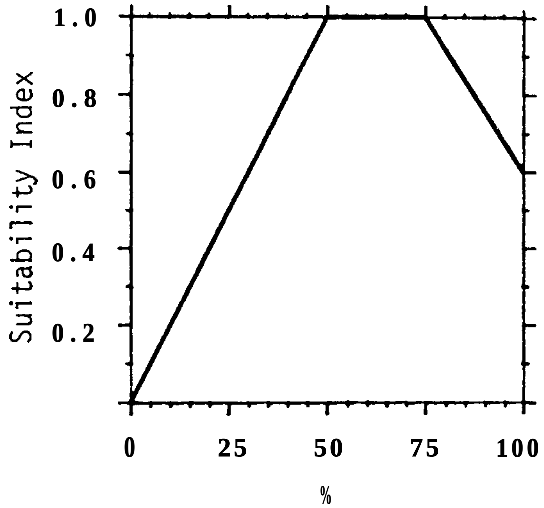
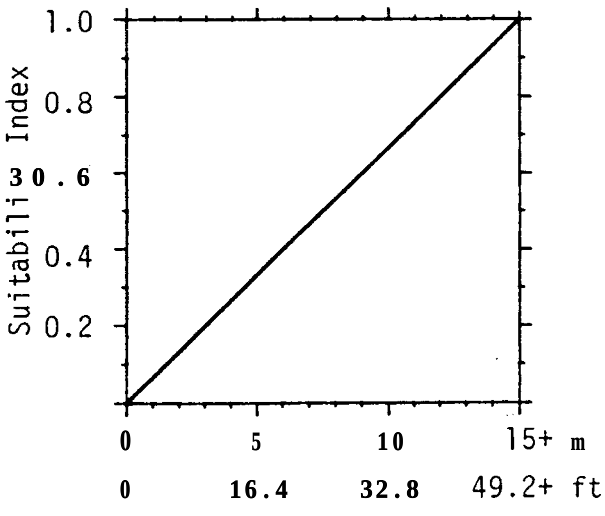
$$CV = 2\,\pi/3(h_o r_o^2 - h_i r_i^2)$$

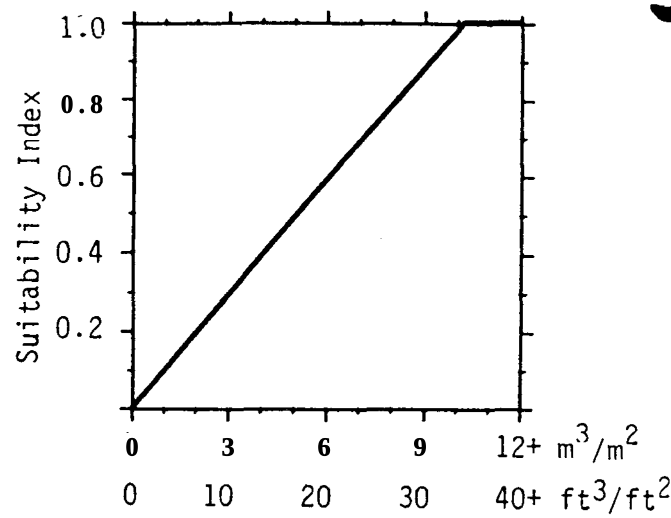
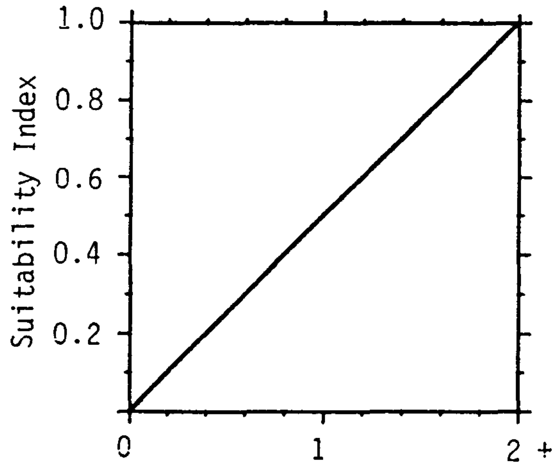
where: $h_i$ = inner height
$h_o$ = outer height
ri = inner radius
$r_o$ = outer radius

**Figure 2.** Tree shapes assumed and formulae used to calculate canopy volume (CV). (From Sturman 1968a).

Model Relationships

Suitability Index (SI) graphs for habitat variables. This section contains SI graphs that illustrate the habitat relationships described in the previous section.

| Cover type | Variable | | Suitability graph |
|---|---|---|---|
| DF, EF, DFW, EFW | $V_1$ | Percent tree canopy closure. |   |
| DF, EF, DFW, EFW | $V_2$ | Average height of overstory trees. |   |

| | | | |
|---|---|---|---|
| DF,EF, DFW,EFW | $V_3$ | Tree canopy volume/ area of ground surface. |  |
| DF,EF, DFW,EFW | $V_6$ | Number of snags 10 to 25 cm dbh/ 0.4 ha (4 to 10 inches dbh/1.0 acre). |  |





Equations. In order to determine life requisite values for the black-capped chickadee, the SI values for appropriate variables must be combined through the use of equations. A discussion and explanation of the assumed relationships between variables was included under Model Description, and the specific equations in this model were chosen to mimic these perceived biological relationships as closely as possible. The suggested equations for obtaining food and reproduction values are presented below.

| Life requisite | Cover type | Equation |
|---|---|---|
| Food | DF,EF,DFW,EFW | $(V_1 \times V_2)^{1/2}$ or $V_3$ (See page 5 for discussion on which to use) |
| Reproduction | DF,EF,DFW,EFW | $V_4$ |

HSI determination. The HSI for the black-capped chickadee is equal to the lowest life requisite value.

## Application of the Model

Definitions of variables and suggested field measurement techniques (from Hays et al. 1981, unless otherwise noted) are provided in Figure 3.

| Variable (definition) | | Cover types | Suggested technique |
|---|---|---|---|
| $V_1$ | Percent tree canopy closure [the percent of the ground surface that is shaded by a vertical projection of the canopies of all woody vegetation taller than 5.0 m (16.5 ft)]. | DF,EF,DFW,EFW | Line intercept |
| $V_2$ | Average height of overstory trees (the average height from the ground surface to the top of those trees which are ≥ 80 percent of the height of the tallest tree in the stand). | DF,EF,DFW,EFW | Graduated rod, trigonometric hypsometry |
| $V_3$ | Tree canopy volume/area of ground surface (the sum of the volume of the canopies of each tree sampled divided by the total area sampled). | DF,EF,DFW,EFW | Quadrat and refer to Figure 2 on page 6 |

Figure 3. Definitions of variables and suggested measurement techniques.

| Variable (definition) | | Cover types | Suggested technique |
|---|---|---|---|
| $V_4$ | Number of snags 10 to 25 cm dbh/0.4 ha (4 to 10 inches dbh/1.0 acre) [the number of standing dead trees or partly dead trees in the size class indicated that are at least 1.8 m (6 ft) tall. Trees in which at least 50% of the branches have fallen, or are present but no longer bear foliage, are to be considered snags]. | DF,EF,DFW,EFW | Quadrat |

Figure 3. (concluded).

## SOURCES OF OTHER MODELS

Sturman (1968a) developed a multiple regression model for the black-capped chickadee in western Washington in which the canopy volume of trees accounted for 79.6% of the variation in chickadee abundance. Canopy volume of bushes and canopy volume of midstory trees were the next two most important variables, and their addition into the regression accounted for over half of the residual variation remaining after the canopy volume of trees was entered.

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15. Supplementary Notes

16. Abstract (Limit: 200 words)

A review and synthesis of existing information was used to develop a habitat model for the black-capped chickadee (*Parus atricapillus*). The model is scaled to produce an index of habitat suitability between 0 (unsuitable habitat) and 1 (optimally suitable habitat) for areas of the continental United States. Habitat suitability indexes are designed for use with Habitat Evaluation Procedures previously developed by the U.S. Fish and Wildlife Service.

17. Document Analysis a. Descriptors

Mathematical models, Wildlife, Birds, Habitability.

b. Identifiers/Open-Ended Terms

Black-capped chickadee
*Parus atricapillus*
Habitat Suitability Indexes (HSI)

c. COSATI Field/Group

| | | |
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| 18. Availability Statement<br>Release Unlimited | 19. Security Class (This Report)<br>UNCLASSIFIED | 21. No. of Pages<br>12 |
| | 20. Security Class (This Page)<br>UNCLASSIFIED | 22. Price |

(See ANSI-Z39.18) See Instructions on Reverse

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## DEPARTMENT OF THE INTERIOR
### U.S. FISH AND WILDLIFE SERVICE

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

**Appendix 17-2:**
**Corrected Mink Habitat Suitability Index Data and Mink Riparian Habitat Evaluation Procedures Memo and U.S. Fish and Wildlife Service Mink Habitat Suitability Index Model**

PACIFICORP ENERGY
A MIDAMERICAN ENERGY HOLDINGS COMPANY

# MEMORANDUM

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**DATE:** October 10, 2007

**TO:** Terrestrial Coordination Committee

**FROM:** Kendel Emmerson

**SUBJECT:** Corrected Mink Habitat Suitability Index and Suitability Index Data and Mink Riparian Habitat Evaluation Procedures

---

The purpose of this memo is to provide corrections to the mink habitat suitability index (HSI) and suitability index (SI) values reported in the Habitat Evaluation Procedure (HEP) Study Table 5.2-6 (PacifiCorp and Cowlitz PUD 2004) and is to provide methods for assessing the mink HSI values for riparian vegetation cover types on Lewis River Wildlife Habitat Management Plan lands (WHMP lands).

Habitat Evaluation Procedures (HEP) is the standardized and collaborative process that was used to assess baseline wildlife habitat conditions on WHMP lands and to provide a framework for habitat management planning, implementation, and effectiveness monitoring. The Settlement Agreement (SA) Section 10.8.4.2 directs PacifiCorp and Cowlitz PUD to repeat the HEP for all WHMP lands in year 17 of the license using the same sampling density and methods as the original HEP to measure any changes in habitat (PacifiCorp et al. 2004). If the original HEP predictions are not met, the Lewis River Wildlife Habitat Management Plan (WHMP) will be modified to meet the habitat goals and objectives (PacifiCorp and Cowlitz PUD 2006).

To complete the HEP process, habitat suitability index (HSI) models developed by the United States Fish and Wildlife and Washington Department of Fish and Wildlife were used to estimate habitat quality for selected species. These models determine the HSI for each species by mathematically combining the quality of each habitat variable (suitability index [SI]) measured in the field.

Minks are associated with aquatic habitats; therefore the HSI model was applied to the Palustrine Forested (PFO), Palustrine Scrub-Shrub (PSS), Palustrine Emergent (PEM), Lacustrine Unconsolidated Bottom (LUB), and Riverine Unconsolidated Bottom (RUB) vegetation cover types. The palustrine wetland vegetation cover types (PEM, PFO, and PSS) are somewhat common on WHMP lands and were evaluated in each of the HEP analysis areas, except for PEM vegetation cover type which isn't on Eagle Island (PacifiCorp and Cowlitz PUD 2004 Table 5.2-3). The LUB cover type was evaluated at all three reservoirs, but only the shoreline surrounding Merwin Reservoir is considered to be LUB mink habitat. This is because Yale and Swift reservoirs water levels fluctuate too much to be suitable mink habitat (PacifiCorp and Cowlitz

County 2004 Table 5.2-2). The RUB habitat is limited on WHMP lands and was only evaluated in a few HEP Analysis Areas: Eagle Island, Merwin, and Swift Canal. The Swift Canal is not considered suitable mink habitat, therefore the only RUB habitat on WHMP lands is the area below Merwin Dam (PacifiCorp and Cowlitz County 2004 Appendix 1-3 November 22, 1999 Lewis River HEP Team Meeting Notes).

## Habitat Suitability Index and Suitability Index Values

In PacifiCorp's development of the WHMP, it was discovered that Table 5.2-6 in the Lewis River Hydroelectric Projects Technical Report 5.2 TER 2 HEP Study (Report 5.2) incorrectly reported tree cover and tree/shrub cover <100m SI values, and omitted the emergent vegetation cover SI values (PacifiCorp and Cowlitz PUD 2004). This resulted in significant changes in the overall HSI values for PFO, PSS, and PEM vegetation cover types. In addition, the SI values for LUB and RUB vegetation cover types were not reported. Table 1 below compares the reported values in Report 5.2 Table 5.2-6 to the corrected values. Because the HSI values reported in Report 5.2 will be used to determine the changes in habitat in year l7 of the license, the corrected values reported in the Table 1 below should be used as the mink HSI and SI values.

## Mink Riparian Habitat Evaluation Procedures

The Lewis River Wildlife Habitat Management Plan Standards and Guidelines designate the mink as a HEP evaluation species for Riparian Habitat (PacifiCorp and Cowlitz PUD 2006). The mink HSI values were not assessed at streams during the original HEP study, so there is no baseline mink HSI data for the riparian vegetation cover types: (riparian deciduous [RD], riparian mixed [RM], riparian deciduous shrubland [RS], riparian grassland [RG], and young riparian mixed [YRM]).

To determine baseline information for riparian vegetation cover types, the mink HSI model will be applied to perennial fish bearing streams on WHMP lands (Allen 1986). The HSI values will only be assessed at perennial fish bearing streams that extend greater than 100 m (328 ft) onto WHMP lands. This is to avoid assessing streams that are only fish bearing at the mouth of the stream or that have such a small portion on WHMP lands that mink habitat management would have little benefit to the species habitat. Table 2 identifies all of the perennial fish bearing streams on WHMP lands that the HSI model would apply too. Only five streams are less than 100 m (328 ft) onto WHMP lands, which would remove a total of 301 m (988 ft) from the HEP study.

The streams will be assessed using the assumptions, equations, and SI values that apply to riverine cover type (i.e. percent of year with surface water present, percent shoreline cover within 1 m [3 ft] of water's edge, and percent canopy cover of trees and shrubs within 100 m [328 ft] of the stream's edge) in the mink HSI model (Allen 1986 [Figure 6]). The Settlement Agreement Section 10.8.4.1 directs PacifiCorp to determine HSI values for newly acquired lands whose habitats are new or different from other WHMP lands (PacifiCorp et al. 2004). The mink HSI model will be applied to existing WHMP lands at the same time the HEP study is conducted on newly acquired lands.

## Table 1. Mink HSI and SI Values Reported Versus Corrected

| Cover Type | Values | | Eagle Island | | Merwin | | Yale | | Swift | | Swift Canal | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | C. I | Mean | C. I | Mean | C. I | Mean | C. I | Mean | C. I |
| Palustrine Emergent (PEM) | Mink HSI | Reported Value | -- | -- | 0.66 | -- | 0.69 | 0.65-0.70 | 0.63 | -- | 0.45 | -- |
| | | Correct Value | -- | -- | 0.96 | -- | 0.96 | 0.95-0.97 | 0.98 | -- | 0.69 | -- |
| | Mink Shrub Cover (v3) | Reported Value | -- | -- | 0.10 | -- | 0.25 | 0.05-0.45 | 0.24 | -- | 0.11 | -- |
| | | Correct Value | -- | -- | 0.10 | -- | 0.25 | 0.05-0.46 | 0.24 | -- | 0.11 | |
| | Mink Emergent Vegetation (v4) | Reported Value | -- | -- | 1.00 | -- | 1.00 | 1.00-1.00 | 1.00 | -- | 0.71 | -- |
| | | Correct Value | -- | -- | 1.00 | -- | 1.00 | -- | 1.00 | -- | 0.71 | -- |
| | Mink Tree Cover (v2) | Reported Value | -- | -- | 0.13 | -- | 0.42 | 0.00-0.97 | 0.30 | -- | 0.12 | -- |
| | | Correct Value | -- | -- | 0.14 | -- | 0.40 | 0.00-0.97 | 0.27 | -- | 0.10 | -- |
| | Mink Tree/Shrub Cover < 100m (v5) | Reported Value | -- | -- | 0.63 | -- | 0.63 | -- | 0.70 | -- | 0.50 | -- |
| | | Correct Value | -- | -- | 0.80 | -- | 0.80 | -- | 0.90 | -- | 0.63 | -- |
| Palustrine Forested (PFO) | Mink HSI | Reported Value | 0.47 | -- | 0.51 | 0.43-0.58 | 0.46 | 0.43-0.49 | 0.52 | -- | 0.38 | -- |
| | | Correct Value | 0.95 | -- | 0.90 | -- | 0.90 | -- | 0.94 | -- | 0.81 | -- |
| | Mink Shrub Cover (v3) | Reported Value | 0.23 | -- | 0.38 | 0.24-0.53 | 0.32 | 0.26-0.37 | 0.36 | -- | 0.27 | -- |
| | | Correct Value | 0.23 | -- | 0.38 | 0.24-0.53 | 0.35 | 0.26-0.37 | 0.35 | -- | 0.27 | -- |

**Table 1. Mink HSI and SI Values Reported Versus Corrected (Continued)**

| Cover Type | Values | | Eagle Island | | Merwin | | Yale | | Swift | | Swift Canal | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | C. I | Mean | C. I | Mean | C. I | Mean | C. I | Mean | C. I |
| **Palustrine Forested (PFO) (continued)** | Mink Tree Cover (v2) | Reported Value | 1.00 | -- | 0.75 | 0.49-1.00 | 0.78 | 0.62-0.93 | 0.81 | -- | 0.84 | -- |
| | | Correct Value | 1.00 | -- | 0.80 | 0.52-1.00 | 0.85 | 0.73-0.97 | 0.76 | -- | 0.87 | -- |
| | Mink Tree/Shrub Cover < 100m (v5) | Reported Value | 0.70 | -- | 0.63 | 0.63-0.63 | 0.63 | -- | 0.70 | -- | 0.50 | -- |
| | | Correct Value | 0.91 | -- | 0.80 | -- | 0.80 | -- | 0.90 | -- | 0.63 | |
| | Mink Emergent Vegetation (v4) | Reported Value | None | None | None | None | None | None | None | None | None | None |
| | | Correct Value | 0.80 | -- | 0.68 | 0.35-1.00 | 0.76 | 0.57-0.94 | 0.60 | -- | 0.58 | -- |
| **Palustrine Scrub Shrub (PSS)** | Mink HSI | Reported Value | 0.40 | -- | 0.36 | -- | 0.36 | -- | 0.40 | -- | 0.30 | -- |
| | | Correct Value | 0.95 | -- | 0.90 | -- | 0.90 | -- | 0.95 | -- | 0.81 | -- |
| | Mink Shrub Cover (v3) | Reported Value | 0.40 | -- | 0.76 | -- | 0.53 | -- | 0.91 | -- | 0.63 | -- |
| | | Correct Value | 0.40 | -- | 0.76 | -- | 0.53 | -- | 0.91 | -- | 0.63 | -- |
| | Mink Tree Cover (v2) | Reported Value | 0.50 | -- | 0.71 | -- | 0.32 | -- | 0.71 | -- | 0.50 | -- |
| | | Correct Value | 0.10 | -- | 0.10 | -- | 0.10 | -- | 0.10 | -- | 0.10 | -- |
| | Mink Tree/Shrub Cover < 100m (v5) | Reported Value | 0.70 | -- | 0.63 | -- | 0.63 | -- | 0.70 | -- | 0.50 | -- |
| | | Correct Value | 0.91 | -- | 0.80 | -- | 0.80 | -- | 0.90 | -- | 0.63 | -- |
| | Mink Emergent Vegetation (v4) | Reported Value | None | None | None | None | None | None | None | None | None | None |
| | | Correct Value | 1.00 | -- | 1.00 | -- | 0.97 | -- | 1.00 | -- | 0.51 | -- |

**Table 1. Mink HSI and SI Values Reported Versus Corrected (Continued)**

| Cover Type | Values | | Eagle Island | | Merwin | | Yale | | Swift | | Swift Canal | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | C. I | Mean | C. I | Mean | C. I | Mean | C. I | Mean | C. I |
| Lacustrine Unconsolidated Bottom (LUB) | Mink HSI | Reported Value | -- | -- | 0.36 | -- | -- | -- | -- | -- | -- | -- |
| | | Correct Value | -- | -- | 0.45 | -- | 0.46 | -- | 0.47 | -- | -- | -- |
| | Mink Tree/Shrub Cover < 100m (v5) | Reported Value | None | None | None | None | None | None | None | None | None | None |
| | | Correct Value | -- | -- | 1.0 | -- | 1.0 | -- | 1.0 | -- | -- | -- |
| | Mink Shoreline (v6) | Reported Value | None | None | None | None | None | None | None | None | None | None |
| | | Correct Value | -- | -- | 0.20 | -- | 0.21 | -- | 0.22 | -- | -- | -- |
| Riverine Unconsolidated Bottom (RUB) | Mink HSI | Reported Value | -- | -- | 0.63 | -- | -- | -- | -- | -- | -- | -- |
| | | Correct Value | 0.69 | -- | 0.47 | -- | -- | -- | -- | -- | 0.65 | -- |
| | Mink Tree/Shrub Cover < 100m (v5) | Reported Value | None | None | None | None | None | None | None | None | None | None |
| | | Correct Value | 0.81 | -- | 0.58 | -- | -- | -- | -- | -- | 0.58 | -- |
| | Mink Shoreline (v6) | Reported Value | None | None | None | None | None | None | None | None | None | None |
| | | Correct Value | 0.59 | -- | 0.38 | -- | -- | -- | -- | -- | 0.75 | -- |

| Table 2. Perennial Fish Bearing Streams on WHMP Lands | | | |
|---|---|---|---|
| **Stream Identification** | **WHMP Land Management Unit(s)** | **Total Length (meters [feet]) on WHMP lands** | **Apply HSI model** |
| Marble Creek | 1 and 2 | 124 (406) | Yes |
| Cape Horn Creek | 2 | 208 (684) | Yes |
| Unnamed Stream | 2 | 405 (1329) | Yes |
| Unnamed Stream | 2 | 303 (993) | Yes |
| Day Creek | 3 | 625 (2050) | Yes |
| Indian George Creek | 3 | 655 (2149) | Yes |
| Jim Creek | 3 | 556 (1823) | Yes |
| Unnamed Stream | 3 | 186 (610) | Yes |
| Unnamed Stream | 4 | 76 (249) | No |
| Rock Creek | 6 | 362 (1188) | Yes |
| Brooks Creek | 7 | 75 (246) | No |
| Speelyai Creek | 7 | 443 (1452) | Yes |
| Unnamed Stream | 7 | 396 (1300) | Yes |
| Cresap Creek | 8 | 509 (1671) | Yes |
| Unnamed Stream | 8 | 140 (460) | Yes |
| Frasier Creek | 9 and 10 | 1819 (5967) | Yes |
| Unnamed Stream | 12 | 541 (1776) | Yes |
| Unnamed Stream | 13 | 61 (201) | No |
| Buncombe Hollow Creek | 15 | 503 (1650) | Yes |
| Speelyai Canal | 17 | 1097 (3598) | Yes |
| Speelyai Creek | 17 | 188 (618) | Yes |
| Speelyai Creek | 17 | 1070 (3511) | Yes |
| Unnamed Stream | 18 | 504 (1652) | Yes |
| Dog Creek | 18 and 19 | 226 (740) | Yes |
| Cougar Creek | 20 | 2355 (7726) | Yes |
| Panamaker Creek | 20 | 4365 (14323) | Yes |
| Lost Creek | 21 | 220 (723) | Yes |
| Unnamed Stream | 22 | 499 (1636) | Yes |
| Unnamed Stream | 22 | 265 (869) | Yes |
| Unnamed Stream | 22 | 280 (920) | Yes |
| Unnamed Stream | 22 | 62 (204) | No |
| Unnamed Stream | 23 | 173 (569) | Yes |
| Unnamed Stream | 25 | 377 (1238) | Yes |

| Table 2. Perennial Fish Bearing Streams on WHMP Lands (continued) | | | |
|---|---|---|---|
| **Stream Identification** | **WHMP Land Management Unit(s)** | **Total Length (meters [feet]) on WHMP lands** | **Apply HSI model** |
| Unnamed Stream | 25 | 300 (984) | Yes |
| Unnamed Stream | 29 | 431 (1414) | Yes |
| Unnamed Stream | 31 | 27 (90) | No |
| Unnamed Stream | 31 | 36 (118) | Yes |
| **Total** | | **20, 462 (67, 136)** | |

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Allen, A.W. 1986. Habitat suitability index models: mink, revised. U.S.Fish Wildl. Serv. Biol. Rep. 82 (10.127). 23 PP. [First printed as: FWS/OBS-82/10.61, October 1983.]

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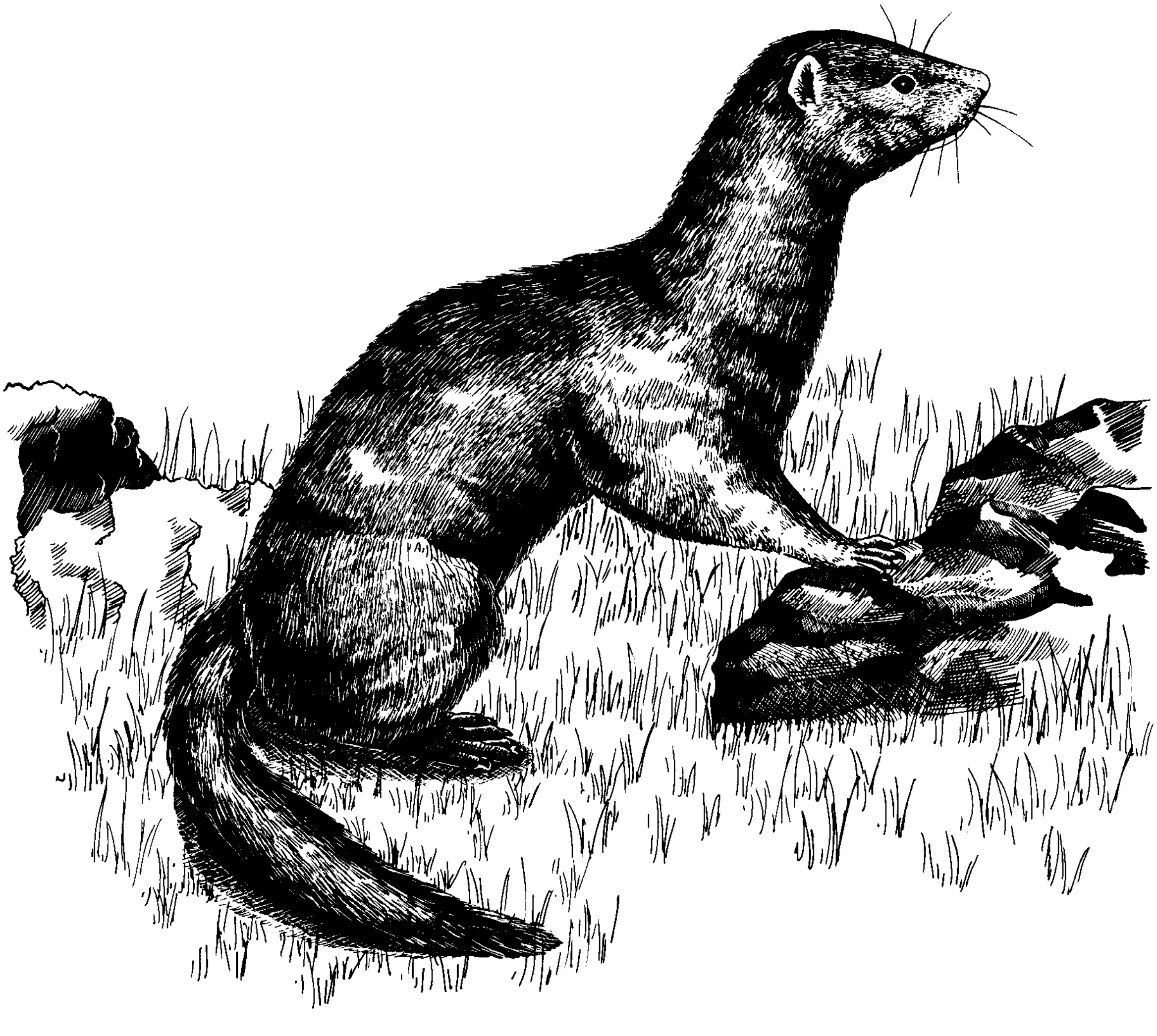
PacifiCorp, Public Utility District No. 1 of Cowlitz County, National Marine Fisheries Service, National Park Service, Bureau of Land Management, U.S. Fish and Wildlife Service, USDA Forest Service, Confederated Tribes and Bands of the Yakama Nation, Washington Department of Fish and Wildlife, Washington Interagency Committee for Outdoor Recreation, Cowlitz County, Cowlitz-Skamania Fire District No. 7, North Country Emergency Medical Service, City of Woodland, Woodland Chamber of Commerce, Lewis River Community Council, Lewis River Citizens At-Large, American Rivers, Fish First, Rocky Mountain Elk Foundation, Trout Unlimited, and the Native Fish Society. 2004. Settlement Agreement Concerning the Relicensing of the Lewis River Hydroelectric Projects, FERC Project Nos. 935, 2071, 2111, and 2213, Cowlitz, Clark, and Skamania Counties, Washington. November 30, 2004.

BIOLOGICAL REPORT 82(10.127)
NOVEMBER 1986 REVISED

# HABITAT SUITABILITY INDEX MODELS: MINK



Fish and Wildlife Service

. Department of the Interior

Biological Report 82(10.127)
November 1986 Revised

# HABITAT SUITABILITY INDEX MODELS: MINK

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## PREFACE

This document is part of the Habitat Suitability Index (HSI) Model Series (FWS/OBS-82/10), which provides habitat information useful for impact assessment and habitat management. Several types of habitat information are provided. The Habitat Use Information Section is largely constrained to those data that can be used to derive quantitative relationships between key environmental variables and habitat suitability. The habitat use information provides the foundation for HSI models that follow. In addition, this same information may be useful in the development of other models more appropriate to specific assessment or evaluation needs.

The HSI Model Section documents a habitat model and information pertinent to its application. The model synthesizes the habitat use information into a framework appropriate for field application and is scaled to produce an index value between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). The application information includes descriptions of the geographic ranges and seasonal application of the model, its current verification status, and a listing of model variables with recommended measurement techniques for each variable.

In essence, the model presented herein is a hypothesis of species-habitat relationships and not a statement of proven cause and effect relationships. Results of model performance tests, when available, are referenced. However, models that have demonstrated reliability in specific situations may prove unreliable in others. For this reason, feedback is encouraged from users of this model concerning improvements and other suggestions that may increase the utility and effectiveness of this habitat-based approach to fish and wildlife planning. Please send suggestions to:

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CONTENTS

## FIGURES

## ACKNOWLEDGMENTS

Dr. Johnny Birks, University of Durham, Durham, Great Britain; Dr. Paul Chanin, University of Exeter, Devon, Great Britain; Dr. Thomas Eagle, University of Minnesota, Minneapolis, MN; Mr. John Hunt, Maine Department of Inland Fisheries and Wildlife, Augusta, ME; Mr. Noel Kinler, Louisiana Department of Wildlife and Fisheries, New Iberia, LA; Mr. Ian Linn, University of Exeter, Hatherly Laboratories, Exeter, Great Britain; Mr. Greg Linscombe, Louisiana Department of Wildlife and Fisheries, New Iberia, LA; Mr. John Major, Maine Cooperative Wildlife Research Unit, University of Maine, Orono, ME; and Mr. Barry Saunders, Ministry of Environment, British Columbia, Canada; provided valuable critiques of earlier drafts of the HSI model for mink. The comments and suggestions of these individuals have added significantly to the quality of this HSI model, and their contributions are gratefully acknowledged. The cover of this document was illustrated by Jennifer Shoemaker. Word processing was provided by Carolyn Gulzow, Dora Ibarra, Elizabeth Barstow, and Patricia Gillis.

MINK (*Mustela vison*)

## HABITAT USE INFORMATION

### General

The mink (*Mustela vison*) is a predatory, semiaquatic mammal that is generally associated with stream and river banks, lake shores, freshwater and saltwater marshes, and marine shore habitats (Gerell 1970). Mink are chiefly nocturnal and remain active throughout the year (Marshall 1936; Gerell 1969; Burgess 1978). The species is adaptable in its use of habitat, modifying daily habits according to environmental conditions, particularly prey availability (Linn and Birks 1981; Wise et al. 1981; Birks and Linn 1982). The species is tolerant of human activity and will inhabit suboptimum habitats as long as an adequate food source is available; however, mink will be more mobile and change home ranges more frequently under such conditions (Linn, pers. comm.).

### Food

The mink's foraging niche is typically associated with aquatic habitats (Gerell 1969; Eberhardt and Sargeant 1977; Chanin and Linn 1980; Wise et al. 1981). The species exhibits considerable variation in its diet, according to season, prey availability, and habitat type (Burgess 1978; Chanin and Linn 1980; Melquist et al. 1981; Wise et al. 1981; Linscombe et al. 1982; Smith and McDaniel 1982). Habitat quality influences the distribution, density, and reliability of prey, which, in turn, directly affect mink population density and distribution (King 1983). Management practices intended to enhance mink populations should address the maintenance or improvement of habitat diversity to sustain or increase the abundance and diversity of prey, rather than attempting to manage prey species themselves (Casson and Klimstra 1983). Predation by mink in North Dakota appeared to be directed toward the most vulnerable individuals among available prey species (Sargeant et al. 1973). Preferred mink prey can be broadly categorized into three groups: (1) aquatic [e.g., fish and crayfish (*Cambarus* spp.)]; (2) semiaquatic [e.g., waterfowl and water associated mammals, such as the muskrat (*Ondatra zibethicus*)]; and (3) terrestrial [e.g., rabbits (Lagomorpha) and rodents (Rodentia)] (Chanin, pers. comm.). If prey in any of these categories is available throughout the year, the habitat may be suitable for mink.

Fish occurred more frequently (59%) in the mink's diet in Idaho than did any other prey category (Melquist et al. 1981). Unidentified cyprinids (Cyprinidae), ranging in length from 7 to 12 cm were the major group of prey fish. Larger fish, represented by salmonids (Salmonidae), accounted for 9% of the diet. These larger fish were believed too large for mink to prey on and were probably scavenged. Fish, shellfish, and crustaceans were the major food items of mink inhabiting coastal habitats of Alaska and British Columbia (Harbo 1958, cited by Pendleton 1982; Hatler 1976).

Eberhardt and Sargeant (1977) reported that birds, mammals, amphibians, and reptiles accounted for 78%, 19%, 2%, and 1%, respectively, of the vertebrate prey consumed by mink in North Dakota prairie marshes. Waterfowl accounted for 86% of the avian prey, with coots (Fulica americana), ducks (Anatidae), and grebes (Podicipedidae) comprising 70%, 11%, and 5% of the total. The relative amount of each prey species eaten closely paralleled the relative abundance of the species. The high use of avian prey in North Dakota prairie marshes was believed to be a result of high waterfowl densities and the scarcity of other prey species, particularly fish and crayfish. Talent et al. (1983) concluded that predation by mink was the principle cause of duckling mortality in their North Dakota study. Waterfowl were also an important component of the diet of mink in Idaho during spring and early summer when young ducks were abundant (Melquist et al. 1981). Fish, crayfish, rodents, and birds are the principal prey of mink in Sweden (Gerell 1969). Fish are preferentially consumed in winter and spring due to their increased vulnerability, resulting from low water levels and low temperatures. Crayfish occurred most frequently in the mink's diet during the summer months in Sweden (Gerell 1967). Crayfish were also the most important component of the mink's summer diet in Quebec (Burgess 1978). Crayfish are a prominent component of the mink's diet in Louisiana and, when abundant, support high mink populations (Lowery 1974; Linscombe and Kinler, pers. comm.). Mink populations in Louisiana are believed to cycle with, or slightly behind peaks in crayfish populations (Linscombe and Kinler, pers. comm.).

With the approach of fall, small terrestrial mammals play an increasingly important role in the mink's diet (Gerell 1967, 1969; Burgess 1978; Casson and Klimstra 1983). Small mammals associated with riparian habitats accounted for 43% of the mink's diet in Idaho (Melquist et al. 1981). Small mammals accounted for more than 20% of the fall/winter diet in North Carolina (Wilson 1954). Terrestrial prey species in Great Britain may be of equal importance in the mink's diet as are aquatic prey species (Birks, pers. comm.). Rabbits are of major importance in the mink's diet even in areas where aquatic prey is abundant (Birks and Dunstone 1984). Muskrats have been reported to be a notable part of the mink's diet throughout its range (Hamilton 1940). However, Errington (1943) believed that muskrats became a significant food source for mink only during periods of muskrat overpopulation, epidemic diseases of muskrats, or drought. Sealander (1943) reported that muskrats were a major component of the winter diet of mink in southern Michigan. Muskrats were the most important component of the mink's diet in Ontario (McDonnell and Gilbert 1981). Predation on muskrats increased during the fall months as marsh water level decreased. Melquist et al. (1981) believed that only adult male mink were large enough to consistently prey upon muskrats.

Female mink in Illinois consumed greater numbers of small mammals [e.g., mice and voles (Cricetidae)] than did males, which tended to prey on larger mammals, such as muskrats and rabbits (Casson and Klimstra 1983). Birks and Dunstone (1985) concluded that female mink, because of their relatively small size, predominantly prey on items that are small and of aquatic origin, whereas males are apparently large enough to specialze on larger prey, such as rabbits. Predation by female mink on rabbits did increase during summer when juveniles were available.

Water

The majority of mink activity in Quebec was within 3 m of the edges of streams (Burgess 1978). All of the mink observations in a Michigan study were within 30.4 m of the water's edge (Marshall 1936). The majority of mink den sites recorded in a British study were within 10 m of the water's edge (Birks and Linn 1982). Mink den sites in Minnesota were within 69.9 m of open water (Schladweiler and Storm 1969). Den sites in Idaho were 5 to 100 m from water, and mink were never observed further than 200 m from water (Melquist et al. 1981). Mink activity in Quebec dropped sharply as stream flow increased (Burgess 1978). Korschgen (1958) reported that the use of aquatic foods by mink in Missouri increased as water levels decreased.

Cover

Mink in Michigan (Marshall 1936) and Sweden (Gerell 1970) are most commonly associated with brushy or wooded cover adjacent to aquatic habitats. Mink in a Quebec study were normally most active in wooded areas immediately adjacent to a stream channel (Burgess 1978). During the latter part of the summer, when terrestrial foods became a more significant component of the mink's diet, this relationship became less well defined. In England, mink movements of up to approximately 200 m from water are not uncommon, particularly when aquatic prey is scarce (Linn and Birks 1981). When upland habitats are used by mink, ecotones receive most use due to increased cover and small mammal availability. Mink generally avoid exposed or open areas (Gerell 1970; Burgess 1978). Shrubby vegetation furnishing a dense tangle provides suitable cover for mink (Linn, pers. comm.). Grasses, even if very tall, usually do not provide adequate year-round cover for the species. However, harvest data in Louisiana suggest that marshes containing dense stands of sawgrass (Cladium jamaicense) support high densities of mink (Linscombe and Kinler, pers. comm.). Thick stands of sawgrass are believed to provide excellent cover, elevation above the water level, and prey for mink. However, significantly more mink are captured in southern Louisiana swamps than marshes (Nichols and Chabreck 1981). The greater abundance of mink in cypress-tupelo (Taxodium distichum - Nyssa aquatica) swamps is partially attributed to a greater abundance of food resources and potential den sites than are present in marsh habitats. These findings are consistent with the belief that cypress-tupelo swamps are Louisiana's best mink producing areas (St. Amant 1959, cited by Nichols and Chabreck 1981).

Gerell (1970) characterized mink habitat in Sweden as small, oligotrophic lakes with stony shores, and streams surrounded by marsh vegetation. The shores of wetland habitats with dense vegetation are the most suitable mink habitat in Michigan (Marshall 1936) and England (Linn and Stevenson 1980; Mason and MacDonald 1983). Virtually all mink locations recorded in a North Dakota study were within 20 m of emergent vegetation (Eagle, pers. comm.). Evaluating duckling mortality in North Dakota, Talent et al. (1983) found that predation by mink typically occurred in semipermanent wetlands. Based on a lower rate of predation and less mink sign associated with seasonal wetlands, they believed that semipermanent wetlands provided more suitable mink habitat than did less permanent wetland types.

Wetlands with irregular and diverse shorelines provide more suitable mink habitat than do wetlands with straight, open, exposed shorelines (Croxton 1960; Waller 1962; Gray and Arner 1977). Rapid declines in mink activity along Ontario lake shores were recorded where relatively small increases in human development had taken place (Racey and Euler 1983). The construction of cottages adjacent to lake shorelines typically resulted in reduced vegetative cover and diminished shoreline complexity due to the removal of snags, large rocks, aquatic vegetation, and the development of sand beaches. The decreased complexity of shoreline habitats was believed to reduce the amount of shelter available to crayfish resulting in decreased availability of mink prey.

Decreased diversity in shoreline configuration, elimination of aquatic vegetation, and decreased abundance and diversity of riparian vegetation caused by channelization reduced habitat quality, prey availability, and mink use of riverine habitats in Mississippi and Alabama (Gray and Arner 1977). Casson and Klimstra (1983) concluded that the abundance of suitable mink prey is reduced when shallow, detritus-rich, sloughs associated with meandering streams are replaced with an abrupt, monotypic, interface between aquatic and terrestrial cover types as a result of channelization. Habitats associated with small streams are preferred to those associated with large, broad rivers (Davis 1960). Mink are most common along streams where there is an abundance of downfall or debris for cover and pools for foraging. Log jams provide excellent foraging cover for mink because they provide shelter for aquatic organisms and security for mink (Melquist et al. 1981). Burgess (1978) recorded a 52.5% increase in mink activity along a stream reach in Quebec that had undergone habitat improvement. Stream alterations consisted of the creation of pools up to 1 m deep in 50% of the stream channel and the placement of logs and other cover within the channel. Dunstone and O'Connor (1979) attributed the mink's use of stream and lake edges to the inability of mink to efficiently forage in open water. Cover associated with aquatic ecotones allowed a stealthier approach and development of specific search strategies by mink (Dunstone 1978). Open water was believed to provide potentially suitable foraging areas only during periods of reduced water volume or high fish density. Shallow water depth and low flow rates contribute to effective aquatic foraging by mink (Dunstone 1983). Smith and McDaniel (1982) recorded greater use of fish by mink in Arkansas during drought, which tended to concentrate prey as a result of decreasing water levels.

The availability of suitable dens may limit the ability of a habitat to support mink (Errington 1961; Gerell 1970; Northcott et al. 1974; Birks and Linn 1982). The absence of dry den sites may limit the mink's use of some wetlands (Linn, pers. comm.). Mink typically select den sites that are close to preferred foraging areas or concentrations of prey items (Linn and Birks 1981; Melquist et al. 1981; Birks and Linn 1982). Mink use several dens within their home range for concealment, shelter, and litter rearing (Marshall 1936; Schladweiler and Storm 1969; Gerell 1970; Eberhardt 1973; Eberhardt and Sargeant 1977; Linn and Birks 1981; Melquist et al. 1981; Birks and Linn 1982). Maximum consecutive days of occupation of single dens in North Dakota was approximately 40 days (Eberhardt and Sargeant 1977). After kits became more mature, individual dens were used briefly and irregularly. The majority of den stays in England were less than 1 day in duration (Birks and Linn 1982). The mean distance covered for 12 den moves in North Dakota was 234 m (Eberhardt and Sargeant 1977). The mean distance between dens used for two or more consecutive days in Sweden was 544 m (Gerell 1970). The mean interden distance recorded in England was 492 m (Birks and Linn 1982). Movements of male mink to new den sites tended to be greater than those recorded for females. New mink dens in Wisconsin were usually within 90 m of the previous den site (Schladweiler and Storm 1969).

The majority of interden movements are made at night and typically occur in, or along, linear habitat features, such as lake shores, river banks, stream courses, or hedge-rows (Birks and Linn 1982). Gerell (1970) reported that the most "commonly" used dens were located in cavities beneath tree roots at the water's edge. However, "more preferred," but less common, den sites were within cavities or piles of rocks well above the water line. Birks and Linn (1982) also identified cavities within, or beneath, waterside trees as being an important source of den sites for mink. More than 50% of den sites of mink inhabiting coastal habitats in Scotland were situated in rock scree and outcrops (Dunstone and Birks 1983). Slightly more than 87% of all dens located were <50 m from the high water mark of normal spring tides.

Mink dens adjacent to lake shorelines in Ontario were located in sites with higher than average numbers of deadfalls and stumps and greater shrub and tree stem densities (Racey and Euler 1983). Log jams accounted for 53% of the mink dens located in Idaho (Melquist et al. 1981). Fallen branches, brush, and other debris provided additional den sites. The use of log jams increased during December, probably as a result of decreased accessibility to other den sites due to increasing snow depth. All mink dens located in North Dakota were situated on marsh shorelines and appeared to be in abandoned or seldom used muskrat burrows (Eberhardt 1973; Sargeant et al. 1973; Eberhardt and Sargeant 1977). The availability of dens for mink use was believed to be related to the suitability of the wetland for muskrats and the amount of shoreline grazing by livestock. Active mink dens were not located on heavily grazed shorelines. Errington (1954) characterized prime mink habitat in the north-central region of the United States as being choice muskrat habitat. Extremely high mink harvests have occurred in association with high muskrat populations in Louisiana (Linscombe and Kinler, pers. comm.). The highest densities of muskrats in Louisiana occur in association with bulrush (*Scirpus olneyi*).

## Reproduction

No information relating specifically to habitat needs for reproduction was found in the available literature.

## Interspersion

The home ranges of mink tend to approximate the shape of the water body along which they live (Gerell 1970; Linn and Birks 1981). A mink's use of its home range varies in intensity due to varying prey availability. During daily activity periods, mink move back and forth in a restricted "core area," which typically does not exceed 300 m in shoreline length (Gerell 1970). Eventually, the mink will use another den within the home range as a base and will intensively forage within an associated core area. Linn and Birks (1981) found that the mink's home range in England typically contained one or two core areas that were associated with prey concentrations. Although core areas generally occupied a small proportion (mean = 9.3%) of the home range area, mink spent approximately 50% of their time within these areas (Birks and Linn 1982). When prey was abundant throughout the home range, the core areas were not as well defined. When the aquatic aspect of the habitat was nonlinear (e.g., marshes), the home range was smaller and less linear in shape.

The mink's use of its home range also shows variation in response to seasonal differences in prey availability (Birks and Linn 1982). Movements recorded in England indicated a general reduction in activity in winter relative to summer. Fewer den sites were used, occupancy at individual dens was of longer duration, and daily travel distances were shorter. Mink home range size in British Columbia was believed to be inversely related to the quality of forage areas (Hatler 1976). The overall mink population was believed to be limited by the number of high quality, year-long foraging areas. Harbo (1958, cited by Pendleton 1982) attributed higher mink populations and smaller activity areas along coastal Alaska to a relatively consistent year-round food supply in the intertidal zone. The smaller home range size of mink inhabiting coastal areas, in comparison to mink associated with inland freshwater habitats, may be a consequence of prey concentrations in tidal pools and the regular replenishment of prey as a result of the tidal cycle (Dunstone and Birks 1983). Over 68% of the observations of active mink were recorded in and within a 100 m band shoreward of the littoral zone.

Vegetative cover had a significant impact on mink home range size in Montana (Mitchell 1961). The home range size for female mink within a heavily vegetated area was estimated to be 7.7 ha, while the home range of a female within a sparsely vegetated, heavily grazed area was 20.1 ha. Female mink home ranges in Michigan did not exceed 8 ha (Marshall 1936). Mink in Idaho were believed to be able to sustain themselves in a 1 to 2 km section of stream length (Melquist et al. 1981). Mink population densities along the coast of Vancouver Island, British Columbia, ranged from 1.5 to more than 3 animals/km of shoreline (Hatler 1976). Mink home range size in the prairie pothole region of North Dakota ranged from 2.59 $km^2$ to 3.8 $km^2$ and typically included numerous wetlands (Eagle, pers. comm.).

Female mink have the smallest and most well defined home ranges, while those of males tend to be more extensive and less well defined (Marshall 1936). The home range size for female mink in England was, on an average, 85.4% of a male's home range size (Birks and Linn 1982). Intrasexual and intersexual home range overlap was rare in a North Dakota study except during the 2- to 3-week breeding season in April (Eagle, pers. comm.). Female mink in Sweden were found to be more restricted to riparian habitats, while males transiently exploited upland areas (Gerell 1970). Male mink in England tended to forage away from aquatic habitats, while females typically remained near water (Birks and Linn 1982). Mink concentrating on aquatic prey tended to utilize larger core areas than individuals exploiting terrestrial prey species. Solely terrestrial foraging was exclusively a male activity and typically occurred where aquatic prey and prey associated with riparian habitats were scarce.

## HABITAT SUITABILITY INDEX (HSI) MODEL

### Model Applicability

Geographic area. This HSI model has been developed for application within inland wetland habitats throughout the range of the species. Figure 1 displays the approximate geographic distribution of mink in North America.

Season. This HSI model was developed to evaluate the potential quality of year-round habitat for the mink.

Cover types. This model was developed to evaluate the quality of mink habitat in the following wetland cover types (terminology follows that of Cowardin et al. 1979): Riverine (R), Lacustrine (L), and Palustrine Forested (PFO), Palustrine Scrub/Shrub (PSS), and Palustrine Emergent (PEM) wetlands.

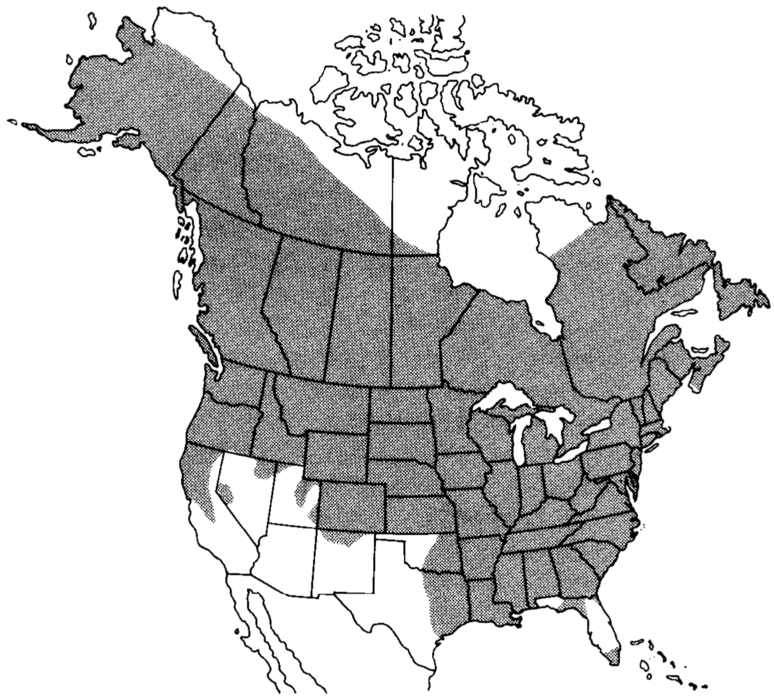


Figure 1. Approximate distribution of the mink in North America (adapted from Linscombe et al. 1982).

Minimum habitat area. Minimum habitat area is defined as the minimum amount of contiguous habitat that is required before an area will be occupied by a species. Information on the minimum habitat area for the mink was not found in the literature. The size and shape of mink home ranges vary in response to topography, food availability, and sex. Although home ranges of female mink are smaller than those of males, home ranges of both sexes tend to parallel the configuration of a body of water or wetland basin. Based on this information, it is assumed that any wetland, or wetland associated habitat, large enough to be identified and evaluated as such, has the potential to support mink.

Verification level. This HSI model provides habitat information useful for impact assessment and habitat management. The model is a hypothesis of species-habitat relationships and does not reflect proven cause and effect relationships. Earlier drafts of this model were reviewed by the following individuals:

Dr. Johnny Birks, University of Durham, Durham, Great Britain.
Dr. Paul Chanin, University of Exeter, Devon, Great Britain.
Dr. Thomas Eagle, University of Minnesota, Minneapolis.
Mr. John Hunt, Maine Department of Inland Fisheries and Wildlife, Augusta.
Mr. Noel Kinler, Louisiana Department of Wildlife and Fisheries, New Iberia.
Mr. Ian Linn, University of Exeter, Hatherly Laboratories, Exeter, Great Britain.
Mr. Greg Linscombe, Louisiana Department of Wildlife and Fisheries, New Iberia.
Mr. John Major, Maine Cooperative Wildlife Research Unit, University of Maine, Orono.
Mr. Barry Saunders, Ministry of Environment, British Columbia, Canada.

Improvements and modifications suggested by these individuals have been incorporated into this model.

## Model Description

Overview. The year-round habitat requirements of mink can be satisfied within wetland cover types if sufficient vegetation or cover is present to support an adequate prey base. Although not totally restricted to wetland or wetland-associated cover types, the mink usually is dependent on aquatic organisms as a food source for a large portion of the year. Transient use of upland cover types may occur, particularly during the fall and winter months, when terrestrial prey plays an increasingly important role in the mink's diet. The majority of mink activity (foraging, establishment of dens, and litter rearing) occurs in close proximity to open water. This model assumes that sufficient cover must be interspersed with, or adjacent to, relatively permanent surface water in order to provide the maximum number and diversity of prey species. It is assumed in this model that potential food availability and cover for the mink can be described by the same set of habitat characteristics. The reproductive habitat requirements of the mink are assumed to be identical to its cover requirements.

The following sections provide documentation of the logic and assumptions used to translate habitat information for the mink to the variables and equations used in the HSI model. Specifically, these sections identify important habitat variables, define and justify the suitability levels of each variable, and describe assumed relationships between variables.

Water component. Mink are not totally dependent on aquatic or wetland-associated prey species. However, these species typically form the largest portion of the annual diet. It is assumed that surface water must be present for a minimum of 9 months of the year to provide optimum foraging habitat and prey availability for mink (Figure 2). Cover types with less permanent surface water are assumed to be indicative of less suitable mink habitat as a result of lower prey diversity and availability when considered on an annual basis. Wetland cover types consisting only of saturated soils, or lacking surface water, are assumed to be of no value as year-round mink habitat, due to the assumed absence of an adequate aquatic prey base.

The value calculated using Figure 2 is used in equation 1 to represent the water suitability index (SIW) for mink.

$$SIW = SIV1 \qquad (1)$$

Equation 1 and the relationships between the permanence of surface water (SIV1) and habitat quality for mink are based on the following assumptions. Cover types that have surface water present <25% of the year are assumed to be unsuitable year-round mink habitat due to the absence of aquatic prey species. Abundance and availability of aquatic prey are assumed to increase as the permanence of surface water increases. Cover types that maintain surface water for >75% of the year are assumed to provide conditions conducive to maximum availability of aquatic prey.

Several reviewers of this model have commented that eutrophic lakes have greater potential productivity than do oligotrophic lakes. Eutrophic lakes may be capable of supporting larger populations of mink due to a more diverse and abundant aquatic prey base. The primary productivity of a lake depends in part upon the nutrients received from the surrounding drainage, geological age, and water depth. Oligotrophic lakes are typically deep, with the hypolimnion larger than the epilimnion, littoral zone vegetation is scarce and organic content and plankton density are low. In contrast, eutrophic lakes are typically shallow and have high concentrations of plant nutrients (e.g., nitrogen, phosphorus), high organic content, and abundant littoral zone vegetation. Although this model does not take into account a specific evaluation of a lake's potential ability to produce food organisms, it should be realized that a lake's ability to provide abundant aquatic prey for mink may vary based on its' physical and chemical characteristics.

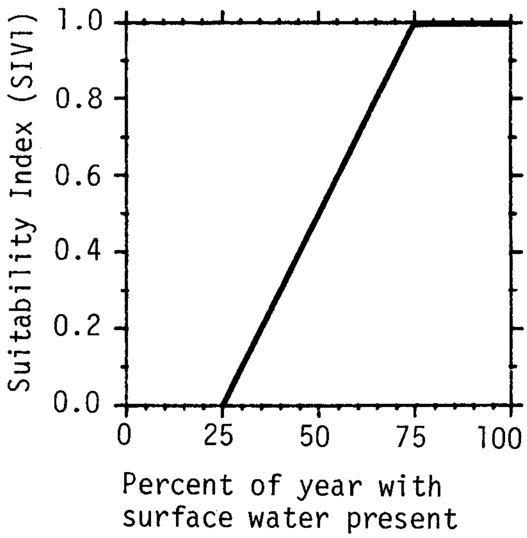



Figure 2. The relationship between percent of the year with surface water present and a suitability index of mink habitat quality.

Cover component. Although mink will use upland cover types, they are most often found in close association with wetlands and the vegetative communities immediately adjacent to streams, rivers, and lakes. Small terrestrial mammals become an important component of the mink's diet during the fall and winter months. Terrestrial mammals may be an important component in the diet of male mink throughout the year. Sufficient vegetative cover interspersed with, or immediately adjacent to, water is assumed to provide an adequate source of prey species to supplement the aquatic portion of the mink's diet. Dense woody cover of trees and shrubs provides the mink with potential den sites, escape cover, and foraging cover. Persistent herbaceous vegetation also may provide mink with sufficient cover for foraging and shelter. It is assumed that nonpersistent herbaceous vegetation, by itself, will not provide sufficient cover for mink during winter.

a. Palustrine forested and scrub/shrub wetlands. Suitable cover conditions for mink within forested and scrub/shrub wetlands are assumed to be a function of the total canopy closure of trees (Figure 3a), shrubs (Figure 3b), and emergent herbaceous vegetation (Figure 3c). Optimum conditions for cover, denning, and foraging are assumed to occur when the combined canopy cover of woody or persistent herbaceous vegetation is ≥75%. Forested or scrub/shrub wetlands with lower vegetative canopy closures are assumed to be less suitable mink habitat as a result of lower cover availability for both mink and their prey. Woody vegetation ≤100 m from a wetland's edge also is assumed to

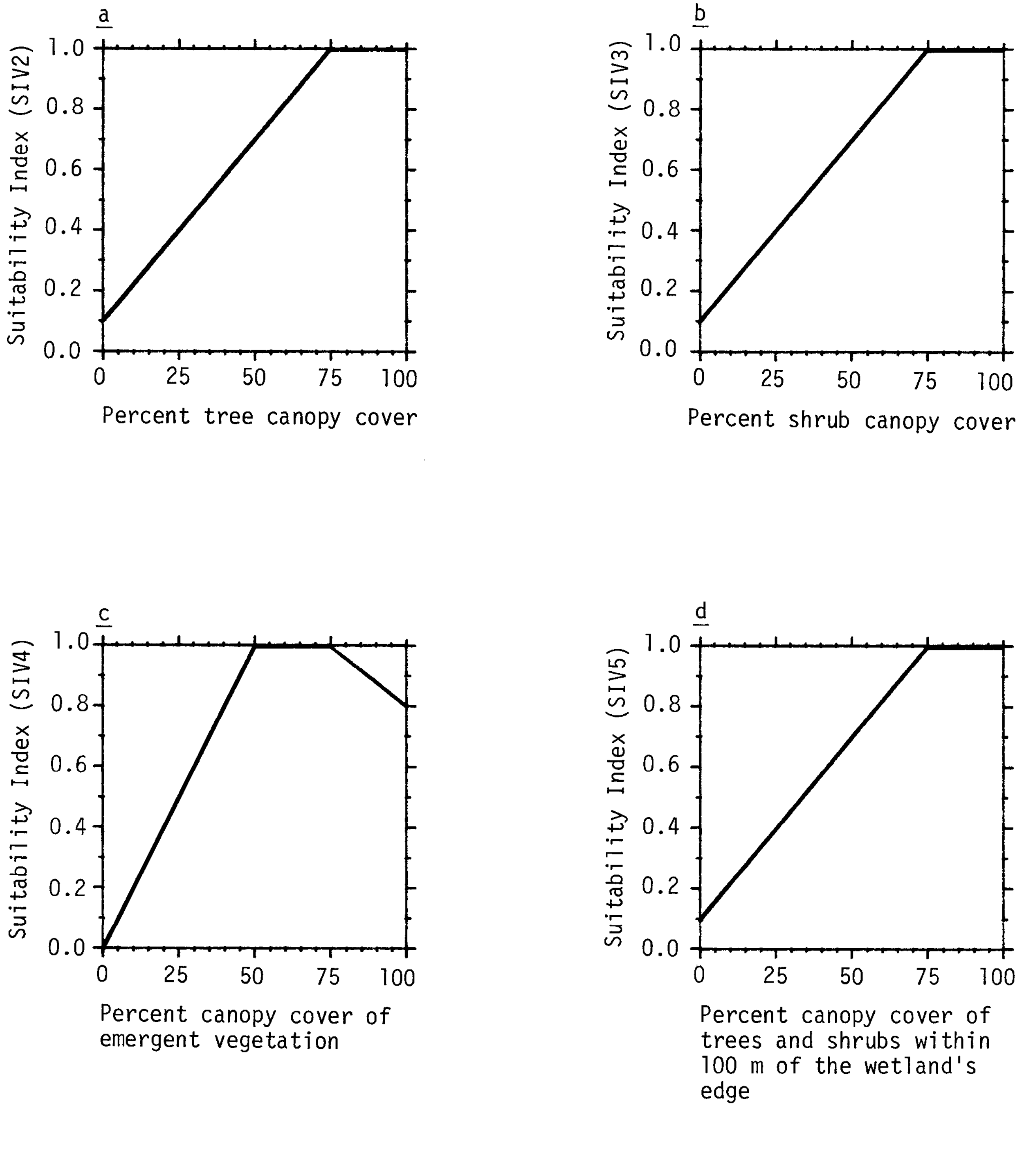



Figure 3. The relationships between tree, shrub, and emergent herbaceous vegetation canopy closure and suitability indices of mink habitat quality.

influence mink habitat quality. However, the degree to which vegetative cover in a 100 m band surrounding forested or scrub/shrub wetlands influences habitat quality for mink depends on the size of the wetland basin. In small forested or scrub/shrub wetlands the adjacent upland cover is assumed to play a relatively important role in defining overall habitat quality for the species. In contrast, the majority of mink inhabiting large, expansive forested or shrub wetlands probably are not influenced to a great degree by the quality of adjacent upland cover types.

In large forested or scrub/shrub wetlands cover quality for mink is assumed to be a function only of the amount of woody and emergent herbaceous vegetation present within the wetland basin. In small, or linear, forested and scrub/shrub wetlands cover quality is assumed to be a function of the canopy cover of woody and emergent herbaceous vegetation in the wetland basin and the canopy cover of woody vegetation in a 100 m band adjacent to the wetland (Figure 3d). Trees and shrubs adjacent to a wetland are believed to enhance the value of the wetland basin by providing cover for prey species and foraging cover for mink. Downfall and debris provided by woody vegetation also provides den sites in close association with the wetland cover type. Ideal conditions are assumed to occur when the canopy cover of trees or shrubs is ≥75%. Lower density of trees and shrubs is assumed to be indicative of less suitable cover conditions. However, the complete absence of woody cover adjacent to forested and scrub/shrub wetlands will not indicate totally unsuitable conditions since herbaceous vegetation, rocks, and other nonvegetative features may provide for mink and their prey.

For the purposes of this model large wetland basins are assumed to be ≥405 ha (1,000 acres). However, this is an arbitrary figure used to separate small and large wetlands for application of the model. Users may wish to redefine this value based on experience with regional cover type classifications.

The suitability index values from Figure 3 are used in equation 2 to determine a cover index (SIFS1) for mink in palustrine forested and scrub/shrub wetlands ≥405 ha. Equation 3 is intended for determination of a cover index for forested and scrub/shrub wetlands <405 ha.

$$SIFS1 = MIN(1.0; SIV2 + SIV3 + SIV4) \qquad (2)$$

$$SIFS2 = \frac{MIN(1.0; SIV2 + SVI3 + SIV4) + SIV5}{2} \qquad (3)$$

Equations 2 and 3 are based on the following assumptions. The suitability of canopy cover of trees (SIV2), shrubs (SIV3), and emergent vegetation (SIV4) are assumed to have equal weight in defining cover quality within forested and scrub/shrub wetlands. Ideal cover conditions may be provided by ≥75% canopy cover of trees, ≥75% canopy cover of shrubs, or 50% to 75% canopy cover of herbaceous vegetation. A combined canopy cover of trees shrubs, and emergent herbaceous vegetation also is assumed to be indicative of ideal cover conditions when total density is ≥75%. In situations where the sum of index values for SIV2, SIV3, and SIV4 is >1.0 the value used in the equation is 1.0.

Within forested and scrub/shrub wetlands <405 ha, the density of trees and shrubs <100 m from the wetland's edge (SIV5) is assumed to have equal influence in defining cover quality as does the density of vegetation within the wetland basin. Forested and scrub/shrub wetlands lacking woody cover adjacent to the basin reflect lower cover quality for mink, regardless of vegetative cover within the basin, than do wetlands surrounded by dense woody vegetation.

b. Palustrine emergent wetlands. Suitable cover for mink in palustrine emergent wetlands is assumed to be a function of the amount of the wetland basin supporting emergent herbaceous vegetation (Figure 3c) and, to a lesser extent, the amount of woody cover immediately adjacent to the wetland basin (Figure 3d). Ideal cover conditions are assumed to occur when the wetland basin supports 50% to 75% canopy cover of emergent herbaceous vegetation. Emergent wetlands with <50% canopy cover of emergent vegetation are assumed to be indicative of less suitable habitat as a result of lower cover availability for mink and prey species. Wetlands totally devoid of vegetation are assumed to have minimum value as year-round mink habitat due to the absence of suitable cover in the wetland basin. The cover value for mink in palustrine emergent wetlands may be enhanced if woody vegetation (trees and shrubs) is present within 100 m of the wetland's edge. Tree and shrub cover adjacent to the wetland basin is assumed to enhance prey diversity and increase cover and den sites for mink.

The suitability index value from Figures 3c and 3d are used in equation 4 to determine a cover index (SIPE) for palustrine emergent wetlands.

$$\mathrm{SIPE} = \frac{4\mathrm{SIV4} + \mathrm{SIV5}}{5} \qquad (4)$$

Equation 4 is based on the following assumptions. The abundance of emergent herbaceous vegetation (SIV4) is assumed to be the major characteristic defining the quality of cover for mink in palustrine emergent wetlands, and has been weighted in the equation to reflect this assumption. Wetlands surrounded, or bordered, by trees and shrubs will reflect higher cover quality than will wetlands with equivalent amounts of emergent vegetation but lacking adjacent woody cover. Conversely, palustrine emergent wetlands with little to no emergent vegetation are assumed to be indicative of cover conditions of low quality regardless of the amount of woody cover adjacent to the wetland basin.

c. Riverine and lacustrine wetlands. Within riverine and lacustrine cover types, suitable cover for mink is assumed to be related to the density of woody vegetation within 100 m of the water's edge and the availability of foraging and security cover at the land/water interface. Ideal cover conditions are assumed to exist when tree canopy cover and shrub canopy cover either singly or in combination account for ≥75% canopy cover (Figure 3d). Less dense vegetative cover adjacent to lakes and river or stream channels characterize less suitable cover conditions for mink as a result of decreased foraging cover, den sites, and cover for prey species. Riverine and lacustrine wetlands lacking adjacent woody vegetation are assumed to have low value as mink habitat due to the absence of cover for both mink and their terrestrial prey.

Mink foraging activity in riverine and lacustrine cover types is concentrated along the shoreline or land/water interface as compared to palustrine forested or emergent wetlands, where foraging activity may occur throughout the wetland basin. Therefore, the amount of cover or vegetative and structural diversity along shorelines has a major influence on the definition of habitat quality for mink inhabiting these cover types. Shorelines with a high degree of cover, which may be provided by overhanging or emergent vegetation, exposed roots, debris, log jams, undercut banks, boulders, or rock crevices, provide cover for prey species as well as secure foraging cover for mink. Conversely, shorelines that are straight, open, exposed, have little structural cover, and have an abrupt, monotypic edge between water and land provide virtually no cover for mink or their prey. It is assumed that ideal cover for mink is present where 100% of the shoreline provides dense foraging and security cover (Figure 4). As the amount of shoreline cover decreases cover quality for mink in riverine and lacustrine cover types is assumed to diminish. Shorelines devoid of vegetative or structural cover are assumed to have extremely low value as mink habitat, as a result of decreased prey availability and less than ideal foraging conditions.

The suitability index values from Figure 3d and Figure 4 are used in equation 5 to determine a cover index (SIRL) for riverine and lacustrine cover types.

$$SIRL = (SIV5 \times SIV6)^{1/2} \qquad (5)$$

Equation 5 is based on the following assumptions. The suitability of the abundance of woody vegetation within 100 m of the water's edge (SIV5) and the suitability of the percentage of the shoreline with suitable cover (SIV6) are assumed to have equal value in defining cover quality for mink in riverine and lacustrine cover types. These variables are assumed to be compensatory in that a low value for one variable may be offset by a higher value for the remaining variable. Optimum conditions in terms of cover for prey species and mink foraging will be obtained only when the tree and shrub canopy cover within 100 m of the water's edge is ≥75%, and 100% of the shoreline provides cover within 1 m of the water's edge. Lower values for either variable will result in a SIRL of <1.0.

<u>HSI determination</u>. The calculation of an HSI for the mink considers life requisite values for water and cover. The HSI is equal to the lowest value calculated for either life requisite.

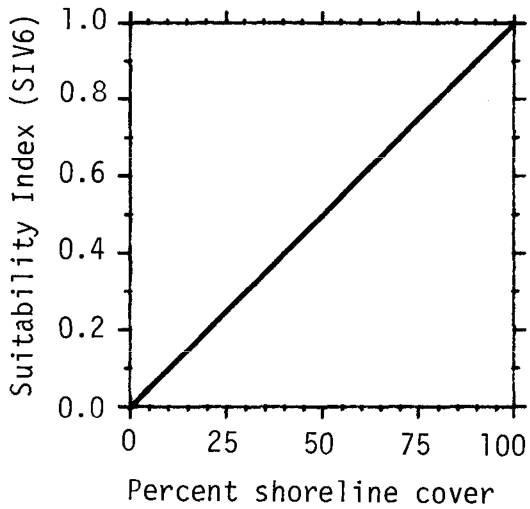



Figure 4. The relationship between shoreline cover and the suitability index for mink cover quality in riverine and lacustrine cover types.

## Application of the Model

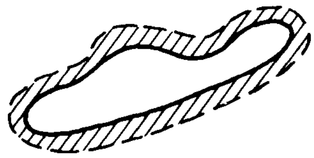
Delineation of cover types. Potential mink habitat must contain a relatively permanent source of surface water. Because of the mink's use of upland cover types for denning and foraging, optimum habitat must also support suitable cover adjacent to the water body or wetland. Therefore, application of this model and determination of Habitat Units (U.S. Fish and Wildlife Service 1980) is based on an evaluation of the quality of the wetland cover type and a 100 m band surrounding the wetland. Figure 5 illustrates the relationship of wetland cover types and suggested evaluation area.

Summary of model variables. Six habitat variables are used in this model to evaluate water and cover conditions for mink. Not all variables are used to evaluate each cover type. The relationships between habitat variables, cover types, life requisite values, and HSI are summarized in Figure 6. Definitions and suggested measurement techniques (Hays et al. 1981) for the variables used in the mink HSI model are provided in Figure 7.

Cover type | Area for evaluation

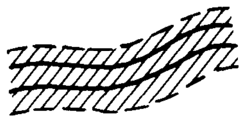
Lacustrine

HSI determined only for area contained within 100 m (328 ft) band around lake.



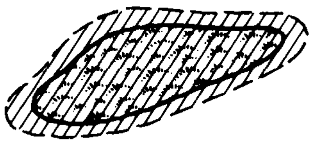
Riverine

HSI determined for area within 100 m band on both sides of river plus area of river.



Palustrine [emergent wetlands forested wetlands, or scrub/shrub wetlands less than 405 ha (1,000 acres) in size].

HSI determined for area contained within cover type plus area within 100 m band around wetland cover type.



Palustrine [forested wetlands or shrub wetlands ≥405 ha (1,000 acres) in size]

HSI determined for area contained only within cover type.

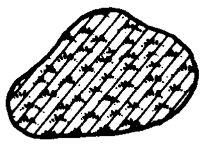


Figure 5. Guidelines for determining the area to be evaluated for mink habitat suitability in various wetland cover types.

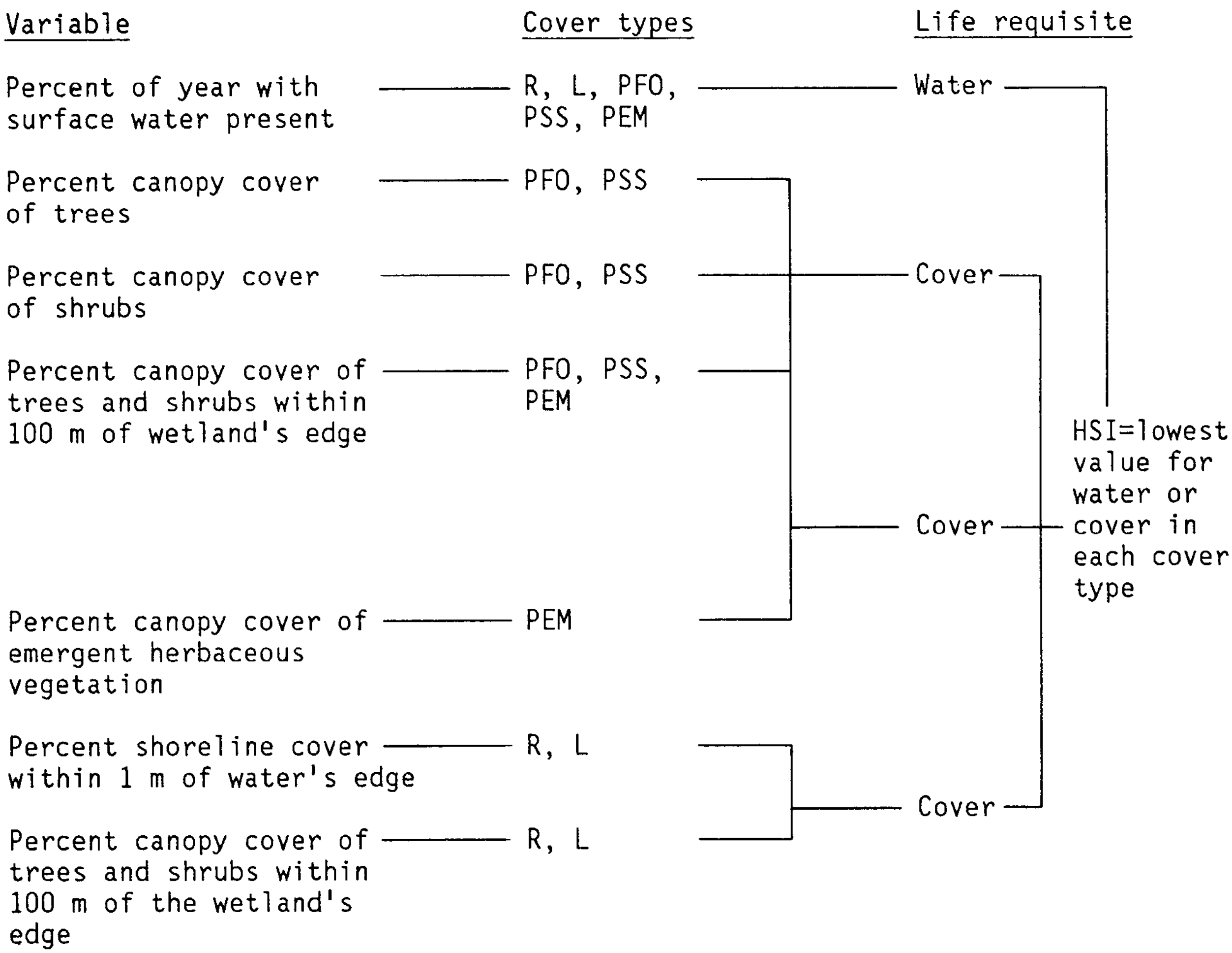



Figure 6. Relationships of habitat variables, cover types, life requisite values, and HSI in the mink HSI model.

| Variables (definition) | Cover types | Suggested technique |
|---|---|---|
| Percent of year with surface water present (the percent of the year in which wetland cover types have surface water present). | R, L, PFO PSS, PEM | On site inspection, historical records |
| Percent canopy cover of trees [the percent of the ground surface that is shaded by a vertical projection of the canopies of all woody vegetation ≥6 m (20 ft) tall]. | PFO, PSS | Line intercept, quadrat, remote sensing |
| Percent canopy cover of shrubs [the percent of the ground surface that is shaded by a vertical projection of the canopies of woody vegetation <6 m (20 ft) tall]. | PFO, PSS | Line intercept, quadrat, remote sensing |
| Percent canopy cover of emergent herbaceous vegetation (the percent of the water surface shaded by a vertical projection of the canopies of emergent herbaceous vegetation, both persistent and nonpersistent). | PFO, PSS PEM | Line intercept, quadrat, remote sensing |
| Percent canopy cover of trees and shrubs within 100 m (328 ft) of the wetlands edge [the percent of the terrestrial ground surface within 100 m (328 ft) of a wetland's edge that is shaded by a vertical projection of the canopies of all woody vegetation]. | PFO <405 ha PSS <405 ha PEM, R,L | Line intercept, quadrat, remote sensing |
| Percent shoreline cover within 1 m (3.3 ft) of water's edge [An estimate of the vegetative and structural complexity at the land/water interface (≤1 m from water's edge). Cover may be provided by overhanging or emergent vegetation, undercut banks, logjams, debris, exposed roots, boulders or rock crevices]. | R, L | On-site inspection, line intercept, quadrat |

Figure 7. Definitions of variables and suggested measurement techniques.

Model assumptions. The mink HSI model is based on the following key assumptions.

1. Mink habitat use is centered around wetland cover types. Surface water must be present for a minimum of 9 months per year to provide optimum habitat conditions.

2. Cover furnished by vegetation and structural diversity provides shelter and habitat for prey species as well as foraging and security cover for mink. Relatively dense vegetative cover must be present within wetlands and adjacent upland cover types in order to provide maximum prey diversity, foraging opportunities, and cover for mink. The density of woody vegetation in upland cover types is assumed to have no influence on mink habitat quality in extensive (≥405 ha) forested and scrub/shrub wetlands.

3. The availability of surface water and cover are assumed to indirectly address the availability of suitable mink prey and to directly address cover quality for mink.

## SOURCES OF OTHER MODELS

No other habitat models for mink were located in the literature.

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16. Abstract (Limit: 200 words)

A review and synthesis of existing information were used to develop a Habitat Suitability Index (HSI) model for the mink (Mustela vison). The model consolidates habitat use information into a framework appropriate for field application, and is scaled to produce an index between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). HSI models are designed to be used with Habitat Evaluation Procedures previously developed by U.S. Fish and Wildlife Service.

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**Appendix 17-3:**
**Classification of Vegetation Cover Types as Suitable Northern Spotted Owl Habitat**
**Lewis River Wildlife Habitat Management Area**

PACIFICORP ENERGY
A MIDAMERICAN ENERGY HOLDINGS COMPANY

# MEMORANDUM

**DATE:** October 10, 2007

**TO:** Terrestrial Coordination Committee

**FROM:** Kendel Emmerson

**SUBJECT:** Classification of Vegetation Cover Types as Suitable Northern Spotted Owl Habitat - Lewis River Wildlife Habitat Management Area

Suitable habitat for northern spotted owls is described as an "area of forest vegetation with the age-class, species of trees, structure, sufficient area, and adequate food source to meet some or all of the life needs [i.e., nesting, roosting, and foraging] of the spotted owl" (U.S. Fish and Wildlife Service 2007). In general, mature forests provide the structure and characteristics required for suitable northern spotted owl (NSO) habitat. Because the specific age-class, species of trees, structure, area, and food sources vary throughout the range of the species, suitable habitat specifications are generally developed by the local agencies and landowners and in the State of Washington in consideration of the Forest Practices Act.

Lewis River Wildlife Habitat Management Plan (WHMP) vegetation cover types were not developed in recognition of existing agencies definitions for suitable NSO habitat. Specifically, the cover type definitions did not specify the number of trees per acre, tree height, and understory layers that make definitions directly convertible. This has lead to confusion as to what vegetation cover types meet suitable NSO habitat. The Terrestrial Coordinating Committee (TCC) seeks to clarify and document which of the vegetation cover types meet suitable NSO habitat based on existing agency definitions.

This memo identifies the vegetation cover types that are considered to be suitable NSO habitat and further classifies cover types into nesting, roosting, foraging, and dispersal habitat. Both the Washington Department of Natural Resources (DNR) Forest Practice Act and the U.S.F.S. Gifford Pinchot National Forest suitable NSO habitat definitions have been used in determining which vegetation cover types meet suitable NSO habitat specifications. The goal of this classification is to provide a broad scale perspective and overall quantification of NSO habitat on WHMP lands. However prior to conducting habitat modifying activities, the proposed project areas will be field verified to confirm whether or not it is NSO habitat and to determine the overall habitat condition.

## Vegetation Cover Type

In 2000 and 2001 all WHMP lands and adjacent areas had existing vegetation mapped as cover types using a classification system that was based upon the Integrated Landscape Management plan (WDFW 1998) and National Wetlands Inventory wetland/deepwater classification (Cowardin et al. 1979). The classification system was modified to meet the vegetation cover type needs for Habitat Evaluation Procedure target species and developed as a decision-making key to classify the vegetation cover types (Table 1.1).

**Table 1.1 Cover Type Mapping Decision-making Key for the Lewis River Study Area[1]**

| Classification Description | Cover Type or Group | Cover Type Code |
|---|---|---|
| 1a. Site characterized by upland vegetation types. | Upland | go to 2 |
| 2a. Greater than 10% forested (20 ft) canopy coverage. | Forested | go to 3 |
| 3a. Greater than 70% of canopy coverage is composed of conifer. | Conifer Forest | go to 4 |
| 4a. Site composed of Lodgepole Pine. | Lodgepole Pine | LP |
| 4b. Site is not on lava flow; canopy composed of conifer species. | Mixed Species Conifer Forest | go to 5 |
| 5a. Avg. stand diameter > 26" dbh. Stands forming a multi-layered canopy with occasional small openings. Greater than 4 snags/acre > 20" dbh. Greater horizontal and vertical canopy structure than is generally found in mature conifer stands. | Old-Growth Conifer Forest | go to 6 |
| 6a Stand has not been thinned[2]. | Old-Growth Conifer | OG |
| 6b. Stand has been thinned since late 1980s. | Old-Growth Conifer--thinned | OG-T |
| 5b. Avg. stand diameter 21"-26" dbh. Canopy structure has a relatively uniform vertical and horizontal texture. | Mature Conifer Forest | go to 7 |
| 7a Stand has not been thinned[2]. | Mature Conifer | M |
| 7b Stand has been thinned since late 1980s | Mature Conifer-thinned | M-t |
| 5c. Avg. stand diameter 16"-20" dbh. Even-aged stands with relatively uniform structure. | Mid-Successional Conifer Forest | go to 8 |
| 8a. Stand has not been thinned[2]. | Mid-Successional Conifer | MS |
| 8b. Stand has been thinned since late 1980s. | Mid-Successional Conifer-thinned | MS-t |
| 5d. Avg. stand diameter 8"-15" dbh. Even-aged stands with relatively uniform structure. | Pole Conifer Forest | go to 9 |
| 9a. Stand has not been thinned[2]. | Pole Conifer | P |
| 9b. Stand has been thinned since late 1980s. | Pole Conifer--thinned | P-t |
| 5e. Avg. stand diameter < 8" dbh. | Seedling/Sapling Conifer Forest | SS |
| 5f. Very recent clearcut with no more than seedlings. | New Clearcut | SS1 |
| 3b. Greater than 30% and less than 70% conifer or deciduous forest. | Mixed Conifer/Deciduous Forest | go to 10 |
| 10a. Mixed forest with trees > 10" dbh located outside of riparian zone[3]. | Upland Mixed Conifer/Deciduous Forest | go to 11 |
| 11a. Stand has not been thinned[2]. | Upland Mixed | UM |
| 11b. Stand has been thinned since late 1980s. | Upland Mixed--thinned | UM-t |
| 10b. Mixed forest with trees < 10" dbh located outside of riparian zone[3]. | Young Upland Mixed Conifer/Deciduous Forest | YUM |
| 10c. Mixed forest with trees > 10" located within riparian zone[3]. | Riparian Mixed Conifer/Deciduous Forest | go to 12 |
| 12a. Stand has not been thinned[2]. | Riparian Mixed | RM |
| 12b. Stand has been thinned since late 1980s. | Riparian Mixed--thinned | RM-t |
| 10d. Mixed forest with trees < 10" dbh located within riparian zone[3]. | Young Riparian Mixed Conifer/Deciduous Forest | YRM |
| 3c. Greater than 70% deciduous canopy coverage. | Deciduous Forest | go to 13 |
| 13a. Deciduous forest with trees > 10" dbh located outside of riparian zone[3]. Not oak dominated. | Upland Deciduous Forest | go to 14 |
| 14a. Stand has not been thinned[2]. | Upland Deciduous | UD |
| 14b. Stand has been thinned since late 1980s. | Upland Deciduous--thinned | UD-T |
| 13b. Deciduous forest with trees < 10" dbh located outside of riparian zone[3]. Not oak dominated. | Young Upland Deciduous Forest | YUD |
| 13c. Deciduous forest located within riparian zone[3]. | Riparian Deciduous Forest | go to 15 |
| 15a. Stand has not been thinned[2]. | Riparian Deciduous | RD |
| 15b. Stand has been thinned since late 1980s. | Riparian Deciduous --thinned | RD-T |
| 13d. Deciduous shrubs located within riparian zone[3]. | Riparian Deciduous Shrubland | RS |
| 13e. Upland site dominated by oak. | Oak Woodland | OW |

| Table 1.1 Cover Type Mapping Decision-making Key for the Lewis River Study Area (cont.) [1]. | | |
|---|---|---|
| **Classification Description** | **Cover Type or Group** | **Cover Type Code** |
| 2b. Less than 10% forested canopy coverage. | Non-Forested | go to 16 |
| 16a. Comprised of >30% vegetation cover. | Vegetated | go to 17 |
| 17a. Ground cover consists of greater than 50% shrub species. | Shrubland | SH |
| 17b. Ground cover consists of greater than 50% grass species. | Dry Meadow/Grassland | MD |
| 17c. Riparian area dominated by forbs and grasses. | Riparian Grassland | RG |
| 16b. Ground area is comprised of >70% exposed rock. | Non-Vegetated | go to 18 |
| 18a. Ground area consists of rock rubble. | Rock Talus | RT |
| 18b. Ground area consists of solid rock cliffs and slopes | Rock Outcropping | RO |
| 18c. Area is exposed bare ground due to natural disturbance events. | Unvegetated | UV |
| 1b. Site characterized by open water or wetland vegetation, soils, and hydrology. | Wetland/Deepwater | go to 19 |
| 19a. Channel that contains moving water. | Riverine | go to 20 |
| 20a. Riverine habitat with unconsolidated substrate and < 30% vegetative cover. | Unconsolidated Bottom (open water) | RUB |
| 20b. Riverine habitat intermittently flooded or exposed with unconsolidated substrate and < 30% vegetative cover, except pioneering plants | Unconsolidated Shore (gravel bars) | RUS |
| 19b. Topographic depression exceeding 20 acres is size with less than 30% areal cover of trees, shrubs, and emergent vegetation. | Lacustrine | Go to 21 |
| 21a. Lacustrine habitat with unconsolidated substrate and < 30% vegetative cover. | Unconsolidated Bottom (lake-limnetic zone) | LUB |
| 21b. Lacustrine habitat intermittently flooded or exposed with unconsolidated substrate and < 30% vegetative cover, except pioneering plants. | Unconsolidated Shore (lake-littoral zone) | LUS |
| 21c. Wetlands dominated by submerged, trees, shrubs, and emergent vegetation or less than 20 acres in size. | Palustrine | go to 22 |
| 22a. Palustrine habitat with unconsolidated substrate and < 30% vegetative cover. | Unconsolidated Bottom (pond-open water) | PUB |
| 22b. Palustrine habitat with > 30% submerged or floating-leaf hydrophyte cover. | Aquatic Bed | PAB |
| 22c. Palustrine habitat with emergent herbaceous hydrophytes present throughout most of the growing season. | Emergent Wetland | PEM |
| 22d. Palustrine habitat dominated by woody shrubs and stunted trees, less than 20 ft tall. | Scrub-Shrub Wetland | PSS |
| 22e. Palustrine habitat dominated by woody vegetation greater than 20 ft tall. | Forested Wetland | PFO |
| 1c. Site characterized by human disturbance, development, or modification. | Disturbed/Modified | go to 23 |
| 23a. Area is within the cleared transmission line right-of-way corridor. Type code is used as a modifier to other cover type categories. | Transmission Line ROW | ROW |
| 23b. Within the boundary of recreation facility. | Recreational | REC |
| 23c. Area is annually seeded or planted with row crops and harvested for commercial agricultural use. | Agriculture | AG |
| 23d. Area is dominated by grasses and forbs and is managed as a pasture . | Pasture | PA |
| 23e. Agricultural land composed of cultivated fruit trees. | Orchard | OR |
| 23f. Developed with commercial buildings and/or facilities that are not PacifiCorp owned. | Developed | DV |
| 23g. Developed with buildings and/or facilities that are part of project. | Project Facility | PF |
| 23i. Exposed bare ground due to human caused activities or contains non-native invasive shrub species. | Disturbed | DI |

[1] PacifiCorp and Cowlitz PUD 2004 (Figure 5.1-1)
[2] Thinned stands are those that have undergone a selected harvest of codominant or subdominant trees, resulting in a reduction in total tree canopy coverage.
[3] Riparian zone has variable width and contains elements of aquatic and terrestrial ecosystems which mutually influence each other (Knutson and Naef 1997).

The decision-making key grouped all areas that were greater than 10 percent forested based on canopy coverage and greater than 20 feet in height into forested habitat. The forested habitats were further grouped by the following criteria:

- Conifer Forest = greater than 70 percent of canopy coverage and is composed of conifer
- Mixed Conifer/Deciduous Forest = greater than 30 percent and less than 70 percent conifer or deciduous forest
- Deciduous Forests = greater than 70 percent deciduous canopy

Because northern spotted owls are strongly associated with coniferous forest, only the vegetation cover types that are within the Conifer Forest and Mixed Conifer/Deciduous Forest groups are considered potential suitable NSO habitat. The vegetation cover types and their associated spotted owl habitat are listed in Table 1.2.

## Washington Department of Natural Resources Forest Practices Act

The DNR Forest Practices Act (FPA) regulates timber harvest activities on private lands throughout the state of Washington. The Washington Forest Practices Board is responsible for creating rules (Washington Administrative Codes [WAC]) to protect the state's public resources while maintaining a viable timber industry. WAC 222-16-085 Northern Spotted Owl Habitats describes the stand characteristics that provide nesting, roosting, foraging (i.e., suitable NSO habitat), and dispersal habitat for northern spotted owls. This description is in Table 1.2.

## Gifford Pinchot National Forest

The Gifford Pinchot National Forest uses a nesting, roosting, and foraging habitat definition from the Judge Dwyer decision of March 29, 1993. This defines suitable NSO habitat as stands with a multi-layered canopy, numerous large snags and down wood, and a canopy closure that is greater than 40 percent (PacifiCorp and Cowlitz PUD 2006). Table 1.2 provides the specifications.

## United States Fish and Wildlife Service

As part of relicensing, PacifiCorp consulted with the United States Fish and Wildlife Service (USFWS) under the Section 7 of the Endangered Species Act of 1973 on the actions required for relicensing of the Lewis River Hydroelectric Projects and the actions contained in the Settlement Agreement (PacifiCorp et al. 2004). This included consulting on the WHMP Standards and Guidelines Document (PacifiCorp and Cowlitz PUD 2006). Consultation on the WHMP's Forestlands Chapter required the utilities to identify the Conifer Forests and Mixed Conifer/Deciduous Forest cover types that meet suitable NSO habitat and dispersal habitat. These vegetation cover types are identified in Table 1.2.

## Management of Suitable NSO Habitat per the Biological Opinion

As a result of the Section 7 consultation, the USFWS issued a Biological Opinion that determined that the level of incidental take is not likely to jeopardize the continued existence of the spotted owl (USFWS 2006). In complying with the Biological Opinion and implementing WHMP standards and guidelines, the utilities agree to comply with the

Washington's FPA and to protect identified NSO sites and suitable NSO habitat through the following conservation measures (USFWS 2006):

*NSO Nesting Habitat (Old-growth Conifer [OG and OG- t] and Mature Conifer [M and M-t] Stands)*

- The only forest management activity that would occur in NSO nesting habitat would be snag creation
- Snags would be created outside of the critical nesting period (March 1 to July 15) to prevent disturbance to nesting spotted owls.

*NSO Roosting and Foraging Habitat (Old-growth Conifer [OG and OG- t], Mature Conifer [M and M-t], Mid-successional [MS and MS- t], Riparian Mixed [RM and RM-t], and Upland Mix [UM and UM- t] stands)*

- To achieve the goals of promoting late-successional stand structure, snag creation may occur in all nesting, roosting and foraging cover types.
- Commercial thinning may occur in mid-successional, riparian mixed, and upland mixed cover types without degrading the habitat.
- To provide a mosaic of big game hiding cover and forage clearcut harvesting (10 to 30 ac in size) may be conducted in NSO roosting and foraging habitat, excluding old growth and mature conifer cover types. No more than 65 acres of mid-successional and upland mix vegetation may be harvested per year. This equates to 3,283 acres or 63 percent of the 5,238 acres of the extant of suitable NSO roosting and foraging habitat on PacifiCorp-owned lands being harvest over the next 50 years.
- To prevent disturbance to nesting spotted owl, the noise and smoke Limited Operating Periods (LOPs) would apply to these activities (USFWS 2006 Page 114 Objective G and PacifiCorp and Cowlitz PUD 2006 Page 56 Objective G).

*NSO Dispersal Habitat (Old-growth Conifer [OG and OG- t], Mature Conifer [M and M-t], Mid-successional [MS and MS- t], Upland Mix [UM and UM- t], Riparian Mixed [RM and RM-t], and Pole Conifer [P and P- t] Stands)*

- Commercial thinning and snag creation may occur in pole conifer cover type without degrading the dispersal habitat. Commercial thinning will improve the habitat's dispersal function by allowing greater flying space between the trees and promoting understory. Snag creation will increase the stand structure and promote habitat for prey.
- To provide a mosaic of big game hiding cover and forage, clearcut harvesting may occur in pole conifer cover type as long as the Utility-owned lands maintain at least 50 percent of dispersal habitat or better at any point of time.
- To prevent disturbance to nesting spotted owl, the noise and smoke Limited Operating Periods (LOPs) would apply to these activities (USFWS 2006 Page 114 Objective G and PacifiCorp and Cowlitz PUD 2006 Page 56 Objective G).

**Table 1.2: A Comparison Between Washington Department of Natural Resources Forest Practice Act, Gifford Pinchot National Forests, and Lewis River Wildlife Habitat Management Plan Vegetation Cover Types for Northern Spotted Owl Suitable Habitat Definition**

**Washington Department of Natural Resource Forest Practices Act[1]**

| HABITAT TYPE | Suitable Habitat[2] | Habitat Type | Forestry Community | Canopy Closure | Tree Size, Density and Height | Snag and Cavity Trees | Down Wood |
|---|---|---|---|---|---|---|---|
| Old Forest Habitat | Yes | Nesting, Roosting Foraging, Dispersal | A layered, multispecies canopy | ≥ 60% | ≥ 50% of the canopy closure is provided by large overstory trees (typically, there should be at least 75 trees > 20 in. dbh per acre, or at least 35 trees ≥ 30 in. dbh per acre) | ≥ 3 snags or trees ≥ 20 in. dbh and 16 ft. in height with various deformities (e.g. large cavities, broken tops, dwarf mistletoe infections, and other indications of decadence) | ≥ 2 fallen trees ≥ 20 in. dbh per acre and other woody debris on the ground. |
| Sub-mature Habitat | Yes | Roosting, Foraging, Dispersal | Conifer-dominated or conifer-hardwood (≥ 30% conifer) | ≥ 70% | 115-280 trees/acre (≥ 4 in. dbh) with dominants/codominants ≥ to 85 ft. high or dominants/codominants ≥ 85 ft. high with 2 or more layers and 25-50% intermediate trees | ≥ 3 snags or cavity trees/acre (≥ 20 in. dbh and 16 ft. in height) | ––– |
| Young Forest Marginal Habitat | Yes | Roosting, Foraging, Dispersal | Conifer-dominated or conifer-hardwood (≥ 30% conifer) | ≥ 70% | 115-280 trees/acre (> 4 in. dbh) with dominants/codominants ≥ to 85 ft. high or dominants/codominants ≥ 85 ft. high with 2 or more layers and 25-50% intermediate trees | ≥ 2 snags or cavity trees /acre (≥ 20 in. dbh and 16 ft. in height)[3] | ≥ 10% of the ground covered with 4 in. diameter or larger wood with 25-60% shrub cover[3] |
| Dispersal Habitat | No | Dispersal | ≥ 70% conifer species and a minimum of 20 ft. between the top of the understory vegetation and bottom of the live canopy, with boles relatively clear of dead limbs | ≥ 70% | ≤ 300 trees per acre, > 70% of conifer species are ≥ 6 in. dbh, ≥ 130 trees per acre with ≥ 10 in. dbh or a basal area of 100 $ft^2$ of ≥ 10 in. dbh | ––– | ––– |

**USDA-Forest Service Suitable Nesting Habitat Definition[4]**

| Habitat Type | Suitable Habitat[2] | Habitat Type | Forestry Community | Canopy Closure | Tree Size, Density and Height | Snags and Cavity Trees | Down Wood |
|---|---|---|---|---|---|---|---|
| Nesting, Roosting, and Foraging Habitat | Yes | Nesting, Roosting, Foraging, Dispersal | Multi-layered canopy | ≥ 40% | Stands that are least 16 in. average dbh with at least 4 tree/acre that are ≥ 30 in. dbh or larger | Numerous large snags (typically > 2 per acre) | Numerous down logs (typically > 15 tons/acre |
| Dispersal | No | Dispersal | ––– | ≥ 40% | Average minimum stand dbh is 11 in. | ––– | ––– |

**Lewis River Wildlife Habitat Management Plan Vegetation Cover Type[5]**

| Habitat Type: Vegetation Cover Type – Group | Type | Code[5] | Suitable Habitat[2] | Habitat Type | Forestry Community | Canopy Closure | Tree Size, Density and Height | Snags and Cavity Trees | Down Wood |
|---|---|---|---|---|---|---|---|---|---|
| Conifer Forest | Lodgepole Pine | LP | No | None | > 70% of the canopy is composed of conifer and site is composed of lodgepole pine | > 70% | ––– | ––– | ––– |
| | Old-growth Conifer Forest | OG<br>OG-t[6] | Yes[7] | Nesting, Roosting, Foraging, Dispersal | > 70% of the canopy is composed of conifer stands forming multi-layered canopy with occasional small openings. Greater horizontal and vertical canopy structure then is generally found in mature conifer stands. | > 70% | Average stand diameter >26 in. dbh. | > 4 snags/acre >20 in. dbh | ––– |
| | Mature Conifer Forest | M<br>M-t[6] | Yes[7] | Nesting, Roosting, Foraging, Dispersal | > 70% of the canopy is comprised of conifer Canopy structure has a relatively uniform vertical and horizontal texture. | > 70% | Average stand diameter 21 in. to 26 in. dbh. | ––– | ––– |
| | Mid-Successional Conifer Forest | MS<br>MS-t[6] | Yes[7] | Roosting, Foraging, Dispersal | > 70% of the canopy is composed of conifer Even-aged stands with relative uniform structure. | > 70% | Average stand diameter 16 in. to 20 in. dbh. | ––– | ––– |

**Table 1.2: A Comparison Between Washington Department of Natural Resources Forest Practice Act, Gifford Pinchot National Forests, and Lewis River Wildlife Habitat Management Plan Vegetation Cover Types for Northern Spotted Owl Suitable Habitat Definition**

**Lewis River Wildlife Habitat Management Plan Vegetation Cover Type[4]**

| Habitat Type – Vegetation Cover Type: Group | Type | Code[5] | Suitable Habitat[2] | Habitat Type | Forestry Community | Canopy Closure | Tree Size, Density and Height | Snags and Cavity Trees | Down Wood |
|---|---|---|---|---|---|---|---|---|---|
| Conifer Forest | Pole Conifer Forest | P<br>P-t[6] | No | Dispersal | >70% of the canopy is composed of even-aged conifer stands with relative uniform structure. | > 70% | Average stand diameter 8 in. to 15 in. dbh. | —— | —— |
| Conifer Forest | Seedling/Sapling Conifer Forest | SS | No | None | >70% of the canopy is composed of conifer | > 70% | Average stand diameter < 8 in. dbh | —— | —— |
| Conifer Forest | New Clearcut | SS1 | No | None | >70% of the canopy is composed of conifer. very recent clearcut with no more than seedlings | > 70% | —— | —— | —— |
| Mixed Conifer/Deciduous Forest | Upland Mixed | UM<br>UM-t[6] | Yes[7] | Roosting, Foraging, Dispersal | >30% and <70% mixed conifer and deciduous forest and located outside of riparian zone | > 30% and < 70% | Trees > 10 in. dbh | —— | —— |
| Mixed Conifer/Deciduous Forest | Riparian Mixed | RM<br>RM-t[6] | Yes | Roosting, Foraging, Dispersal | >30% and <70% mixed conifer and deciduous forest and located within riparian zone | > 30% and < 70% | Trees > 10 in. dbh | —— | —— |
| Mixed Conifer/Deciduous Forest | Young Upland Mixed | YUM | No | None | >30% and <70% mixed conifer and deciduous forest and located outside of riparian zone | > 30% and < 70% | Trees < 10 in. dbh | —— | —— |
| Mixed Conifer/Deciduous Forest | Young Riparian Mixed | YRM | No | None | >30% and <70% mixed conifer and deciduous forest and located within riparian zone | > 30% and < 70% | Trees < 10 in. dbh | —— | —— |

[1] Source: Washington Administration Code WAC 222-16-085 Northern Spotted Owl Habitats
[2] Suitable habitat here is meant to be an area of forest vegetation with the age-class, species of trees, structure, sufficient area and adequate food source to meet some or all of the life needs of the spotted owl (U.S Fish and Wildlife Service 2007).
[3] Young Forest Marginal Habitat must meet either snag and cavity trees or down wood definitions, but not both.
[4] Source: PacifiCorp and Cowlitz PUD 2006
[5] Source: PacifiCorp and Cowlitz PUD 2004
[6] Code with a –t are areas that have been commercially thinned since the late 1980s.
[7] Source: U.S Fish and Wildlife Service 2006

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# Appendix 17-4:
# U.S. Fish and Wildlife Service Pileated Woodpecker Habitat Suitability Index Model and Revisions

FWS/OBS-82/10.39
APRIL 1983

# HABITAT SUITABILITY INDEX MODELS: PILEATED WOODPECKER

Fish and Wildlife Service

**U.S. Department of the Interior**

This model is designed to be used by the Division of Ecological Services in conjunction with the Habitat Evaluation Procedures.

FWS/OBS-82/10.39
April 1983

# HABITAT SUITABILITY INDEX MODELS: PILEATED WOODPECKER

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## PREFACE

This document is part of the Habitat Suitability Index (HSI) Model Series (FWS/OBS-82/10), which provides habitat information useful for impact assessment and habitat management. Several types of habitat information are provided. The Habitat Use Information Section is largely constrained to those data that can be used to derive quantitative relationships between key environmental variables and habitat suitability. The habitat use information provides the foundation for HSI models that follow. In addition, this same information may be useful in the development of bther models more appropriate to specific assessment or evaluation needs.

The HSI Model Section documents a habitat model and information pertinent to its application. The model synthesizes the habitat use information into a framework appropriate for field application and is scaled to produce an index value between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). The application information includes descriptions of the geographic ranges and seasonal application of the model, its current verification status, and a listing of model variables with recommended measurement techniques for each variable.

In essence, the model presented herein is a hypothesis of species-habitat relationships and not a statement of proven cause and effect relationships. Results of model performance tests, when available, are referenced. However, models that have demonstrated reliability in specific situations may prove unreliable in others. For this reason, feedback is encouraged from users of this model concerning improvements and other suggestions that may increase the utility and effectiveness of this habitat-based approach to fish and wildlife planning. Please send suggestions to:

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## CONTENTS

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# PILEATEO WOODPECKER (Oryocopus pileatus)

## HABITAT USE INFORMATION

### General

The pileated woodpecker (Oryocopus pileatus) inhabits both coniferous and deciduous forests, but is restricted to areas containing mature, dense, productive stands (Bock and Lepthien 1975). These woodpeckers-are widely distributed in eastern forests, but are confined in the West to Washington, Oregon, and northern California and, in the Rocky Mountains, to northern Idaho and northwestern Montana (McClelland 1979). Their absence in the central and southern Rocky Mountains is due to a lack of dense, highly productive forests with rapid maturation and decay (Bock and Lepthien 1975).

The critical components of pileated woodpecker habitat are large snags, large trees, diseased trees, dense forest stands, and high snag densities (Bull 1975).

### Food

Pileated woodpeckers depend heavily on carpenter ants (Camponotus spp.) and other wood-boring insects for food (McClelland 1979; Bull 1981). A study of the stomach contents of 80 pileated woodpeckers from across the United States, and over the entire year, showed that animal foods comprised about 73% of the diet and vegetable food the remainder (Beal 1911). Over one-half of the animal food was ants, with beetles the next most abundant food item. The majority of the vegetable food was wild fruits.

Pileated woodpeckers in Oregon fed by excavation (subcambial penetration) approximately two-thirds of the time, and by scaling bark, in search of insects, the remainder (Bull 1981). Woodpeckers in Virginia fed primarily by pecking (no subcambial penetration) and excavating during the breeding season, but used excavation techniques more than 70% of the time during the winter months (Conner 1979a). This seasonal variation and narrowing in breadth of foraging techniques is due to the availability and location of Prey items during winter months (Conner 1979a, 1981).

Pileated woodpeckers choose foraging habitats that contain high densities of logs and snags, dense canopies, and tall shrub cover (Bull and Meslow 1977). They forage on snags, stumps, and logs that exceed 18 cm (7 inches) in diameter (Bull and Meslow 1977), although they prefer logs greater than 25 cm (10 inches) in diameter and greater than 15 m (49 ft) in length (Bull 1981).

Bull (1981) reported that pileated woodpeckers in Oregon spent 36% of their feeding time foraging on logs, 35% on live trees, and 29% on snags. Foraging sites on the ground were in dead and decayed material, most of which had less than 25% of the bark, branches, and needles remaining. The majority of snags used for foraging were greater than 51 cm (20 inches) dbh, while only 46% of live trees used for foraging exceeded that diameter. Pileated woodpeckers in this study fed mostly on carpenter ants, which were more abundant *in* larger diameter dead wood.

Pileated woodpeckers in Virginia foraged mostly on dead wood in mature forest habitats (Conner 1980). Pileated woodpeckers foraged extensively on fallen logs in a recently burned pine forest in Mississippi (Schardien and Jackson 1978). Tree stumps greater than 0.3 m (1 ft) in height are used extensively as foraging sites in the East and West (Conner; pers. comm.). Use of snags for foraging increased during the winter months in Montana, as logs and stumps became snow covered (McClelland 1979). Winter food supply was probably the limiting factor for pileated woodpeckers in this northern study area. However, Bull and Meslow (1977) noted, in their Oregon study area, that feeding habitat was probably not as critical as nesting habitat.

Water

Pileated woodpeckers have been observed to drink water before roosting for the night (Kilham 1959). Pileated woodpeckers in Virginia did not nest farther than 150 m (492 ft) from water, and most nests were within 50 m (164 ft) of water (Conner et al. 1975). The average distance between water sources in this study area was 600 m (1,969 ft). The distribution of pileated woodpeckers in this area may have been due to the fact that mesic environments produce more large trees at a faster rate than xeric sites.

Cover

Cover requirements of the pileated woodpecker are very similar to their reproductive requirements. Therefore, cover requirements are included in the following section.

Reproduction

Pileated woodpeckers are primary cavity nesters that require large snags for their nest site (Bull 1981). In Oregon, these woodpeckers selected nest snags from groups of snags in areas of dense forest (Bull and Meslow 1977). They excavate a *new* cavity each spring and, therefore, need a continual supply of new snags (Bull 1975). Pileated woodpeckers have the strongest year-round pair bond of any North American woodpecker (Kilham 1979), and pairs appear to occupy the same location in successive years (Kilham 1959).

Pileated woodpeckers nest tree search image in Montana was summarized by McClelland (1979:291, 294) as: "a broken top snag [Western larch (Larix occidentalis), ponderosa pine (Pinus ponderosa), or black cottonwood (Populus trichocarpa)] at least 60 cm (24 inches) dbh, taller than 18 m (59 ft) (usually much taller), with heartwood substantially affected by decay, within a forest with an old growth component and a basal area of at least 23 $m^2$/ha (100 $ft^2$/acre)".

Pileated woodpeckers are strong excavators and can excavate in sound dead wood (Bull 1981). Most nest trees in Bull's Oregon study were dead at least 10 years, but showed little evidence of decay at the nest site.

Pileated woodpeckers require large, tall snags because their nest cavity is large and located high in the snag (Bull 1981). A summary of nest tree snag measurements from four studies is presented in Table 1. A dbh of 51 cm (20 inches) is considered to be the minimum size tree suitable for nesting in Oregon (Bull and Meslow 1977) and Montana (McClelland 1979). Forest stands in Virginia with trees 38 to 46 cm (15 to 18 inches) dbh wouid provide adequate nest sites if some trees were decayed (Conner et al. 1975). However, management for only minimum-sized trees may produce a suboptimum habitat, leading to low nesting success (Conner 1979b). Management to provide conditions in the range between the mean and one standard deviation below the mean of habitat variables is desirable for species such as pileated woodpeckers (Conner 1979b, pers. comm.). Snags used for roosting have similar diameters and heights as snags used for nesting (McClelland 1979).

Table 1. Nest tree and basal area measurements from four study areas.

| Type of measurement | Study area and reference: Oregon (Bull 1981) | Montana (McClelland 1979) | Virginia (Conner et al. 1975) | Oregon (Mannan et al. 1980) |
|---|---|---|---|---|
| Mean DBH of nest tree, cm (inches) | 76 (30) | 74.9 (29.5) | 54.6 (21.5) | 78 (31) |
| Mean height of nest tree, m (ft) | 28 (92) | 28 (92) | 20.3 (66.6) | |
| Mean height of nest hole, m (ft) | 15 (49) | 15.2 (49.9) | 13.6 (44.6) | |
| Basal area, $m^2$/ha ($ft^2$/acre) | | 25.1 (109.4) | 31.5 (137.3) | |

The majority of nest trees in Oregon had less than 25% of their original limbs and bark remaining (Bull 1981). Thirteen of eighteen nest trees in Virginia were dead, one had a living cambium but decayed inner core, and four nests were in dead parts of live trees (Conner et al. 1975). Pileated woodpeckers in Virginia were apparently able to detect the presence of heart rot in trees, and selected such trees as nest sites, thus reducing the energy expenditure required for excavation (Conner et al. 1976).

Several researchers have estimated the number of snags needed to support maximum pileated woodpecker populations. Bull and Meslow (1977) reported that optimum habitats in Oregon should contain sound snags greater than 51 cm (20 inches) dbh at a density of 0.35 snag/ha (0.14 snag/acre). Their estimate was based on the following assumptions: (1) a density of two pairs of pileated woodpeckers per 2.59 km' (1.0 $mi^2$); (2) a need for three snags per year per pair, one for nesting and two for roosting; and (3) a need for a reserve of 15 snags for each snag used because not all snags are immediately acceptable. Thomas et al. (1979) stated that optimum pileated woodpecker habitat contained snags greater than 50.8 cm (20 inches) dbh and taller than 9.5 m (31 ft) at a density of 0.32 snag/ha (0.13 snag/acre):. This estimate assumes a territory size of 122 ha (300 acres). Optimum pileated woodpecker habitat in the northeastern United States has been characterized as containing snags 45 to 65 cm (18 to 26 inches) dbh and 12 to 21 m (39 to 69 ft) tall at densities of 0.6 snag/ha (0.24 snag/acre) (Evans and Conner 1979). This estimate assumes the following: (1) a territory size of 71 ha (175 acres) Per pair of pileated woodpeckers; (2) a need for four snags per year per pair; one for nesting, two for roosting, and one for fledged young; and (3) a need for a reserve of 10 snags for each snag used to account for unusable snags, replacements, feeding habitat needs, and a snag supply for secondary users.

Pileated woodpecker densities in Illinois were positively correlated with the number of large trees [greater than 56 cm (22 inches) dbh) (Graber et al. 1977). Woodpecker densities were highest when there were about 50 large trees/ha (20/acre), and the approximate average dbh was 29 cm (11.5 inches). Woodpecker densities were lowest when there were only about 12.5 large trees/ha (5/acre) and the approximate average dbh was 27 cm (10.5 inches). [Note: Average dbh figures were estimated from graphics in Graber et al. (1977), using the median value of the size classes provided.] Conner (pers. comm.) stated that optimum suitability exists when habitats contain 30 or more trees greater than 51 cm dbh/0.4 ha (20 inches dbh/1.0 acre).

Pileated woodpeckers in Virginia preferred to nest in mesic stands near streams with the following characteristics: greatest basal area [27.1 $m^2$/ha (118 $ft^2$/acre)], greatest stem density [475.3/ha (1,174/acre)], and highest crown canopy height [24.2 m (79.4 ft)] available (Conner and Adkisson 1976). favored nesting habitat in Montana and Oregon was dense forests containing old growth western larch or ponderosa pine (McClelland 1979; Bull 1981). Douglas-fir (*Pseudotsuga menziesii*) was seldom used in either study, probably due to the fact that its sapwood decayed very rapidly (McClelland 1979; Bull, pers. comm.).

### Interspersion

The minimum forest size needed to support pileated woodpeckers is partially dependent on the availability of food (McClelland 1979). A minimum of 200 ha (494 acres) is probably needed in northern Rocky Mountain areas. Nesting pairs in Oregon ranged over 130 to 243 ha (320 to 600 acres), and a minimum requirement of 130 ha (320 acres) has been suggested (Bull and Meslow 1977). The winter foraging range of a pair of pileated woodpeckers in the southeastern United States was 70 ha (173 acres) (Kilham 1976).

### Special Considerations

The pileated woodpecker is a key indicator species for the retention of a complete community of hole nesting birds (McClelland 1979), and it is likely that, if the habitat needs of the pileated woodpecker are met, other woodpeckers also would benefit (Bull and Meslow 1977).

Habitat for the pileated woodpecker in the Rocky Mountains is diminishing as old growth forests are cut (McClelland 1979). Silvicultural thinning may negatively affect these woodpeckers due to a loss of decayed trees that provide woodpecker nest sites and habitat for carpenter ants (Conner et al. 1975). Pileated woodpecker habitat may also be threatened by intensive forest harvesting practices (Conner 1980). A cutting rotation in Eastern forests of 80 years would probably provide adequate foraging habitat (Conner 1980), but a 150 year rotation may be needed for nesting habitat (Conner 1978).

Unmanaged, mature stands usually have adequate numbers of snags for resident woodpeckers (Bull et al: 1980). In managed forest stands, snags can be maintained by killing trees or by leaving trees to die, and woodpeckers can then be managed at selected population levels.

## HABITAT SUITABILITY INDEX (HSI) MODEL

### Model Applicability

Geographic area. This model was devel'oped for application within the entire range of the pileated woodpecker with different variables included for snag diameters for the eastern and western portions of the range.

Season. This model was developed to evaluate the year-round habitat of the pileated woodpecker.

Cover types. This model was developed to evaluate habitat quality in the following cover types: Evergreen Forest (EF); Deciduous Forest (DF); Evergreen Forested Wetland (EFW); and Deciduous Forested Wetland (DFW) (terminology follows that of U.S. Fish and Wildlife Service 1981).

Minimum habitat area. Minimum habitat area is defined as the minimum amount of contiguous habitat that is required before a species will occupy an area. It is assumed that a minimum of 130 ha (320 acres) of habitat must exist or the HSI for the pileated woodpecker will equal zero.

Verification level. Previous drafts of this model were reviewed by Evelyn Bull and Richard Conner, and their comments were incorporated into the current draft (Bull, pers. comm.; Conner, pers. comm.).

## Model Description

Overview. The food, cover, and reproductive habitat needs of the pileated woodpecker are very similar. Large snags provide a source of food, cover, and nest sites. Mature, dense forest stands contribute to both the food and cover needs of the pileated woodpecker. Therefore, this model combines food, cover, and reproduction into a single component. It is assumed that the presence of water is related to the variables used to assess food, cover, and reproduction. Pileated woodpeckers use different size snags in the eastern and western portions of their range, and this model 'includes specific variables for each area.

The relationship between habitat variables, life requisites, cover types, and the HSI for the pileated woodpecker is illustrated in Figure 1.

The following sections provide a written documentation of the logic and assumptions used to interpret the habitat information for the pileated woodpecker in order to explain the variables that are used in the HSI model. Specifically, these sections cover the following: (1) identification of variables used in the model; (2) definition and justification of the suitability levels of each variable; and (3) description of the assumed relationship between variables.

Food/cover/reproduction component. Dense, mature forest stands with an abundance of logs and stumps, and large decayed snags provide food and cover for the pileated woodpecker. This model assumes that either the availability of dense, mature forests or the abundance of snags can be the limiting factor in determining habitat values for pileated woodpeckers.

The density and maturity of forest stands can be assessed by measuring the tree canopy closure, abundance of large diameter trees, and abundance of fallen logs and stumps. Pileated woodpeckers prefer dense stands, and it is assumed that optimum habitats have 75% or greater tree canopy closures and that stands with less than 25% canopy closure will have no suitability. Pileated woodpeckers are most abundant in forest stands with many large diameter trees. It is assumed that optimum habitats contain 30 or more trees greater than 51 cm dbh/0.4 ha (20 inches dbh/1.0 acre). Habitats with less than three such large trees per 0.4 ha (1.0 acre) are assumed to have no suitability. Optimum pileated woodpecker habitats contain an abundance of fallen logs and stumps, while habitats with no fallen logs or stumps may provide moderate suitability if other resources are available. It is assumed

| Habitat variable | Life requisite | Cover types | |
|---|---|---|---|
| Percent tree canopy closure | Food/Cover/ Reproduction | Evergreen Forest<br>Deciduous Forest<br>Evergreen Forested Wetland<br>Deciduous Forested Wetland | HSI |
| Number of trees > 51 cm (20 inches) dbh/0.4 ha (1.0 acre) | | | |
| Number of tree stumps > 0.3 m (1 ft) in height and > 18 cm (7 inches) diameter and/or logs > 18 cm (7 inches) diameter/ 0.4 ha (1.0 acre). | | | |
| Number of snags > 38 cm (15 inches) dbh/0.4 ha (1.0 acre) (eastern portion of range only). | | | |
| Average dbh of snags > 38 cm (15 inches) dbh (eastern portion of range only). | | | |
| Number of snags > 51 cm (20 inches) dbh/0.4 ha (1.0 acre) (western portion of range only). | | | |
| Average dbh of snags > 51 cm (20 inches) dbh (western portion of range only). | | | |

Figure 1. Relationship of habitat variables, life requisites, and cover types in the pileated woodpecker model.

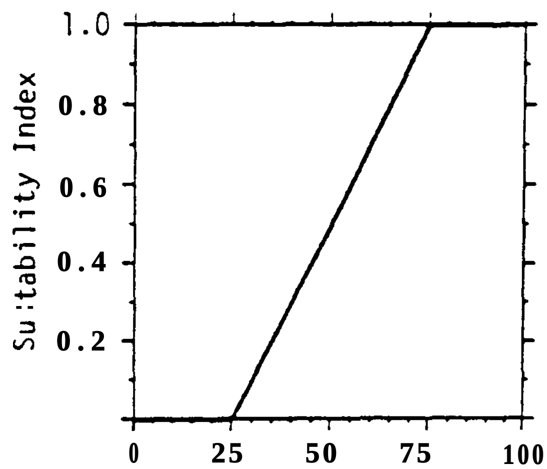
that maximum habitat values occur when there is a total of 10 or more logs greater than 18 cm (7 inches) diameter and/or stumps of the same diameter and greater than 0.3 m (1 ft) in height per 0.4 ha (1.0 acre). Overall suitability related to the density and maturity of forest stands is a function of the tree canopy closure, abundance of large trees, and abundance of 1 ogs and stumps. Tree canopy closure and large tree abundance are the most important variables, while log and stump abundance exerts less of an influence in determining habitat values.

Snag suitability is assumed to be related to the abundance of large diameter snags. It is assumed that pileated woodpeckers, in the Eastern portion of their range, require snags greater than 38 cm (15 inches) dbh for nesting and, in the West, they require snags greater than 51 cm (20 inches) dbh. Maximum suitability in both the East and West exists when 0.17 or more suitably sized snags occur per 0.4 ha (1.0 acre). Habitats with no suitably sized snags provide no suitability. These snag sizes represent the minimum dbh for a useable snag. It is assumed that optimum conditions occur when the average dbh of all snags that meet the minimum size requirement is equal to the average dbh of snags actually selected by pileated woodpeckers for nest sites (see Conner 1979b). In the East, it is assumed that optimum conditions occur when the average dbh of all snags greater than 38 cm (15 inches) dbh is 54 cm (21 inches). In the West, optimum habitats exist when the average dbh of all snags greater than 51 cm (20 inches) is 76 cm (30 inches). Habitats in the East or West with an average snag diameter equal to the minimum suitable size will provide one-half of optimum habitat suitability.

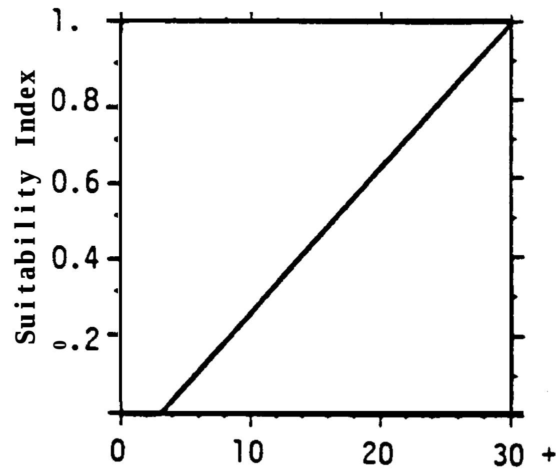
Overall habitat suitability for the pileated woodpecker is assumed to be limited by either the density and maturity of the forest or the abundance of snags.

## Model Relationships

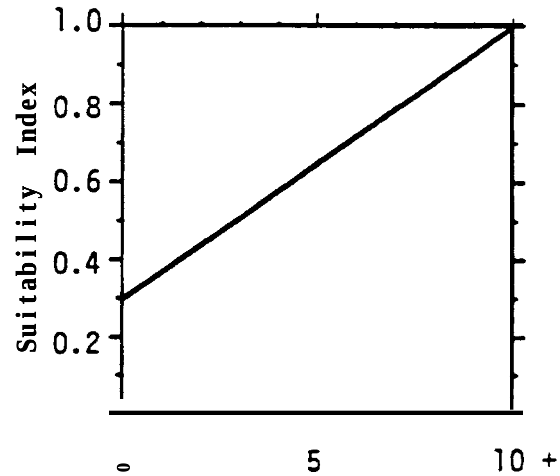
Suitabilty Index (SI) graphs for habitat variables. This section contains suitability index graphs that illustrate the habitat relationships described in the previous section.

| Cover type | Variable | | Suitability graph |
|---|---|---|---|
| EF, DF, EFW, DFW | $V_1$ | Percent tree canopy closure. |  |

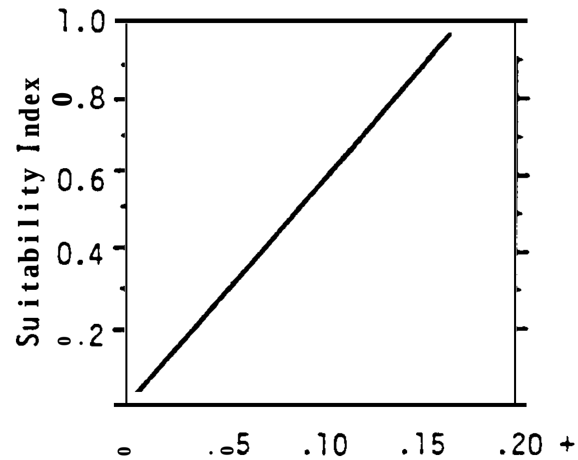
EF,DF, EFW,DFW | $V_2$ | Number of trees > 51 cm (20 inches) dbh/0.4 ha (1.0 acre).



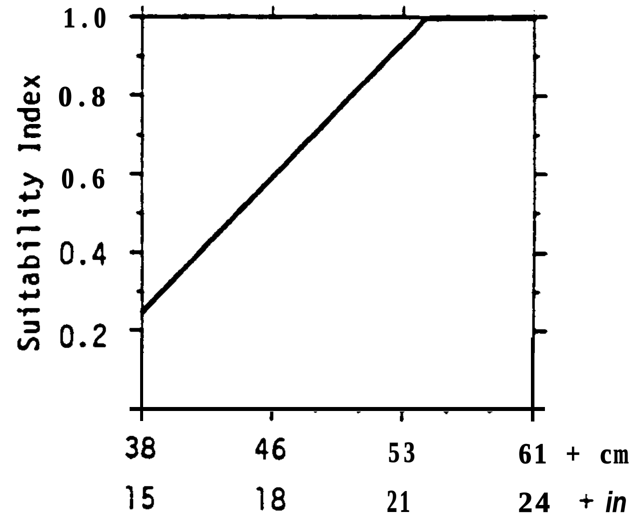

EF,DF, EFW,DFW | $V_3$ | Number of tree stumps > 0.3 m (1.0 ft) in height and > 18 cm (7 inches) diameter and/or logs > 18 cm (7 inches) diameter/ 0.4 ha (1.0 acre).



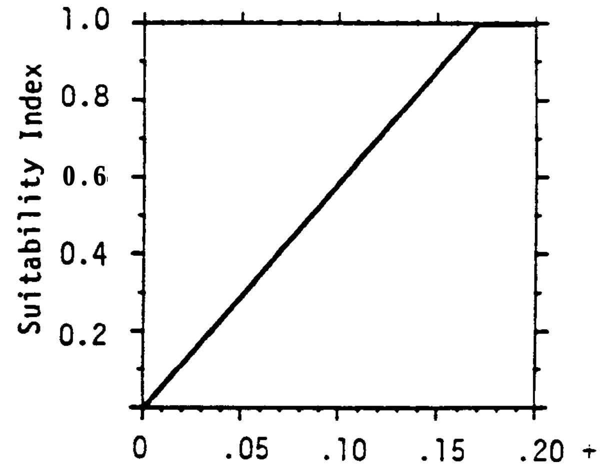

EF,DF, EFW,DFW | $V_4$ | Number of snags > 38 cm (15 inches) dbh/0.4 ha (1.0 acre).



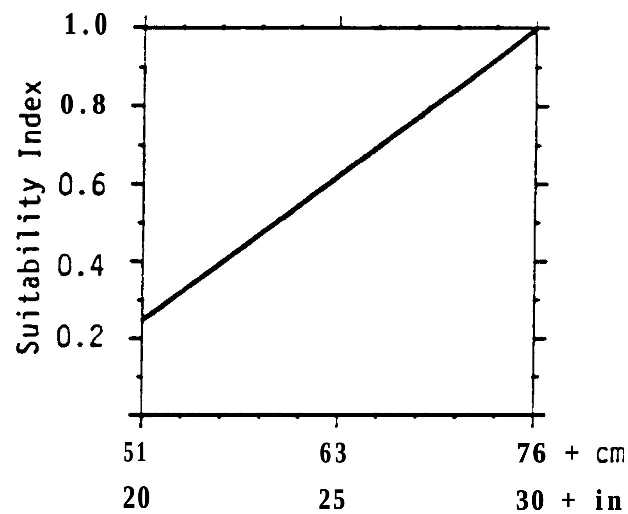
EF,DF, EFW,DFW | $V_5$ | Average dbh of snags > 38 cm (15 inches) dbh.




EF,DF, EFW,DFW | $V_6$ | Number of snags > 51 cm (20 inches) dbh/0.4 ha (1.0 acre).




EF,DF, EFW,DFW | $V_7$ | Average dbh of snags > 51 cm (20 inches) dbh.



Equations. In order to determine the life requisite value for the pileated woodpecker, the SI values for appropriate variables must be combined through the use of equations. A discussion and explanation of the assumed relationship between variables was included under Model Description, and the specific equations in this model were chosen to mimic these perceived biological relationships as closely as possible. The suggested equations for obtaining the food/ cover/reproduction value are presented below.

| Life requisite | Cover type | Equation |
|---|---|---|
| Eastern portion of range: Food/cover/reproduction | EF,DF,EFW,DFW | Lower of $(V_1 \times V_2 \times V_3)^{1/2}$ or $(V_4 \times V_5)^{1/2}$ |
| Western portion of range: Food/cover/reproduction | EF,DF,EFW,DFW | Lower of $(V_1 \times V_2 \times V_3)^{1/2}$ or $(V_6 \times V_7)^{1/2}$ |

HSI determination. The HSI for the pileated woodpecker is equal to the life requisite value for food/cover/reproduction.

## Application of the Model

Definitions of variables and suggested field measurement techniques (Hays et al. 1981) are provided in Figure 2. Note that $V_4$ and $V_5$ are to be measured only in the eastern portion of the range of the pileated woodpecker, and $V_6$ and $V_7$ in the western portion of the range.

| Variable (definition) | Cover types | Suggested technique |
|---|---|---|
| $V_1$ Percent tree canopy closure [the percent of the ground surface that is shaded by a vertical projection of the canopies of all woody vegetation taller than 5.0 m (16.5 ft)]. | EF,DF,EFW, DFW | Line intercept |

Figure 2. Definitions of variables and suggested measurement techniques.

| Variable (definition) | | Cover types | Suggested technique |
|---|---|---|---|
| $V_2$ | Number of trees > 51 cm dbh/0.4 ha (20 inches dbh/1.0 acre) [actual or estimated number of trees that are greater than 51 cm (20 inches) diameter at breast height (1.4 m (4.5 ft) per 0.4 ha (1.0 acre)]. | EF,DF,EFW, DFW | Quadrat |
| $V_3$ | Number of tree stumps > 0.3 m (1.0 ft) in height and > 18 cm (7 inches) diameter and/or logs > 18 cm (7 inches) diameter/ 0.4 ha (1.0 acre) [the actual or estimated number of tree stumps greater than 0.3 m (1.0 ft) in height and greater than 18 cm (7 inches) in diameter, and/or logs greater than 18 cm (7 inches) in diameter present per acre. Log diameter should be measured at the largest point]. | EF,DF,EFW, OFW | Quadrat |
| $V_4$ | Number of snags > 38 cm (15 inches) dbh/0.4 ha (1.0 acre) [the number of standing dead trees or partly dead trees, that are greater than 38 cm (15 inches) diameter at breast height (1.4 m/4.5 ft), and that are at least 1.8 m (6 ft) tall, per 0.4 ha (1.0 acre). Trees in which at least 50% of the branches have fallen, or are present but no longer bear foliage, are to be considered snags]. | EF,DF,EFW, DFW | Quadrat |

Figure 2. (continued).

| Variable (definition) | | Cover types | Suggested technique |
|---|---|---|---|
| $V_5$ | Average dbh of snags > 38 cm (15 inches) dbh [the average diameter of all snags that exceed 38 cm (15 inches) diameter at breast height (1.4 m/ 4.5 ft)]. | EF,DF,EFW, DFW | Quadrat; Biltmore stick or diameter tape |
| $V_6$ | Number of snags > 51 cm (20 inches) dbh/0.4 ha (1.0 acre) [the number of standing dead trees or partly dead trees, that are greater than 51 cm (20 inches) diameter at breast height (1.4 m/4.5 ft), and that are at least 1.8 m (6 ft) tall, per 0.4 ha (1.0 acre). Trees in which at least 50% of the branches have fallen, or are present but no longer bear foliage, are to be considered snags]. | EF,DF,EFW, DFW | Quadrat |
| $V_7$ | Average dbh of snags > 51 cm (20 inches) dbh [the average diameter of all snags that exceed 51 cm (20 inches) diameter at breast height (1.4 m/4.5 ft)]. | EF,DF,EFW, DFW | Quadrat; Biltmore stick or diameter tape |

Figure 2. (concluded).

## SOURCES OF OTHER MODELS

Conner and Adkisson (1976) have developed a discriminant function model for the pileated woodpecker that can be used to separate habitats that possibly provide nesting habitat from those that do not provide nesting habitat. The model assesses basal area, number of stems, and canopy height of trees.

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A review and synthesis of existing information was used to develop a habitat model for the pileated woodpecker (Dryocopus pileatus). The model is scaled to produce an index of habitat suitability between 0 (unsuitable habitat) and 1 (optimally suitable habitat) for areas of the continental United States. Habitat suitability indexes are designed for use with Habitat Evaluation Procedures previously developed by the U.S. Fish and Wildlife Service.

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Dryocopus pileatus
Habitat Suitability Indexes (HSI)

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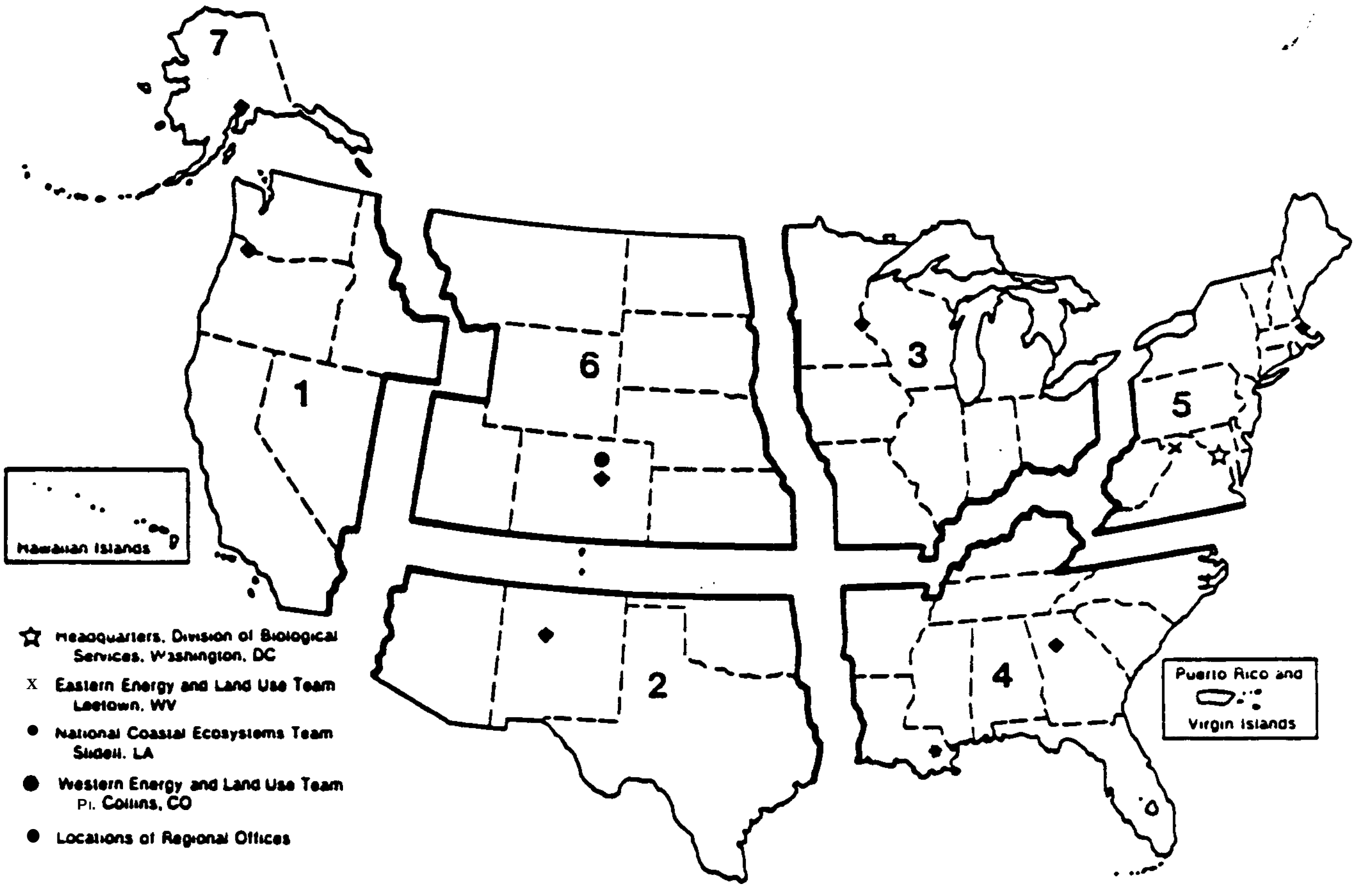


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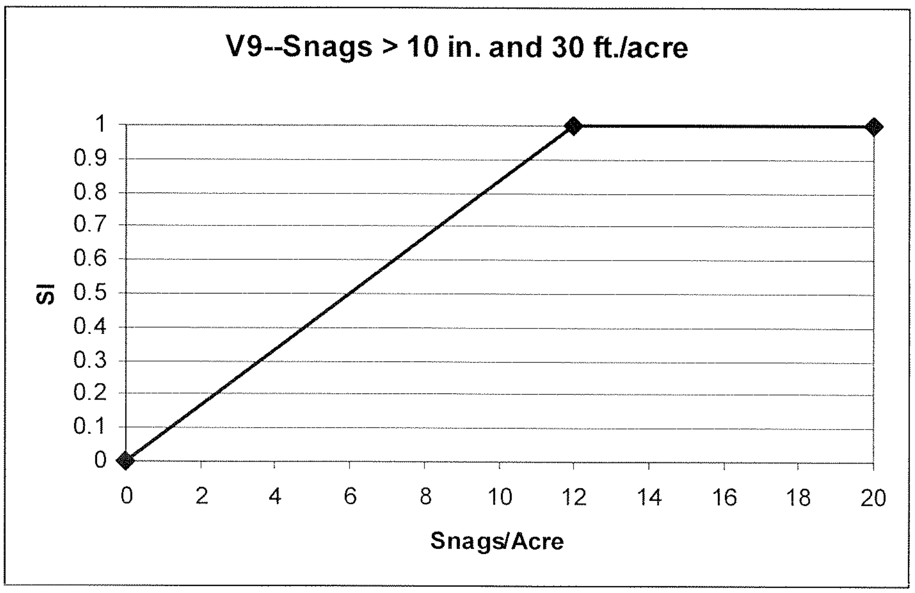
# DEPARTMENT OF THE INTERIOR

## U.S. FISH AND WILDLIFE SERVICE

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, Preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoymmt of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. admlnlstration.

**Pileated Woodpecker Model**

- V6 (no. snags > 51 cm) will be included as expressed in the published model.
- A new variable—V7—will reflect the presence or absence of snags > 30 inches dbh and 75 ft. tall. The SI function for V7 will be as follows: Abundance less than 0.0046 snags/acre—SI=0.9, Abundance equal to or greater than 0.0046 snags/acre—SI=1.0.
- A new variable—V8—will reflect the presence or absence of redcedar snags. If one or more snags are redcedar—SI=1.0, no redcedar snags—SI=0.9
- V9 will reflect abundance of snags/acre that are > 10 in. dbh and 30 ft tall. The V9 SI graph will be as follows.




- The final HSI will be calculated by taking the average the following two equations:
  $(V1 \times V2 \times V3)^{1/3}$
  and
  $(V6 \times V7 \times V8 \times V9)^{1/4}$
- This HSI calculation represents a change from the published version that uses the minimum of the two equations. The HEP Team agreed that the change was appropriate so that areas that may not represent breeding habitat but do provide foraging habitat receive habitat value.

**Appendix 17-5:**
**Washington Department of Fish and Wildlife**
**Habitat Suitability Index Model Pond Breeding Amphibian**
**and Cover Model (with Revisions)**

HABITAT SUITABILITY INDEX MODEL:
POND BREEDING AMPHIBIAN
AND COVER MODEL *

LEWIS RIVER RELICENSING HEP
WDFW DRAFT HEP MODEL, November 1997

This model addresses the habitat needs of selected amphibians occurring in standing water in riparian, agriculture and wetland habitats. In this particular model, the value of the standing water habitat is more important than surrounding habitat and is therefore weighted higher for native pond breeding amphibians. The focus of the model is on the following species:

Northwestern salamander (*Ambystoma gracile*)
Long-toed salamander (*Ambystoma macrodactylum*)
Roughskin newt (*Taricha granulosa*)
Red-legged frog (*Rana aurora*)
Pacific treefrog (*Hyla regilla*)
Oregon Spotted frog (*Rana pretiosa*)
Western toad (*Bufo boreas*)

## HABITAT USE INFORMATION

### Distribution/Elevation

#### Frogs and Toads

The **red-legged frog** (*Rana aurora)* is a common native ranid found west of the Cascade Mountains from southwestern British Columbia to northern California (Gordon 1939; Slater 1964; Dumas 1966; Nussbaum 1983; Stebbins 1985). This species ranges from sea level to 4680 ft (1427 m) in the Umpqua National Forest (Oregon) (Leonard et al. 1993). The **Pacific treefrog** (*Hyla regilla*) is the most widely distributed frog in Washington and Oregon and may be found at elevations ranging from near sea level to at least 5200 ft (1585 m) (Leonard et al. 1993). The **Western Toad** (*Bufo boreas*) can be found in all natural regions of Washington and Oregon with the exception of arid portions of the Columbia Basin, northern Coast Range in Oregon, and the Willamette Valley. They are known from near sea level to 7370 ft (2247 m) (Leonard et al. 1993). The **Oregon spotted frog** (*Rana pretiosa*) is currently found in southwest British Columbia, western Washington, and the Cascade Mountains of Washington and Oregon. Historically they were found in portions of the Puget Sound Lowlands and the Willamette Valley, and they appear to have been eliminated from most of this area (Leonard et al. 1993). They can be found at elevations ranging from near sea level to 4,900 ft (1500 m) (Hayes 1997).

#### Salamanders

The **northwestern salamander** (*Ambystoma gracile*) occurs along the Pacific coast from western British Columbia to northwestern California. In Washington and Oregon they are found from the coast to just over the Cascade crest (Leonard et al. 1993). They occur from sea level up to about 10,230 ft (3,100 m) elevation in humid coniferous forests and subalpine forests (Nussbaum et al. 1983). The **long-toed salamander** (*Ambystoma macrodactylum*) is distributed from southeast Alaska, British Columbia and western Alberta, through western Montana, Idaho, Washington, and Oregon into northern California (Leonard et al. 1993). They have the broadest distribution of any salamander in Washington and Oregon and occur in semiarid sagebrush deserts, dry woodlands, humid forests, alpine

meadows, and all kinds of intermediate habitats (Nussbaum et al. 1983). They occur from sea level to 6190 ft (2030 m) (Leonard et al. 1993).
The **roughskin newt** (*Taricha granulosa*) occurs primarily west of the Cascade Mountains from southeast Alaska through western British Columbia, Washington, and Oregon into northern California (Leonard et al. 1993). Habitats include: humid coastal forests and open grasslands within or near streams, lakes, ponds, and reservoirs (Stebbins 1954). They range from sea level up to 9240 ft (2800 m) (Nussbaum et al. 1983).

**Food**

Adult red-legged frogs prey on a variety of terrestrial invertebrates. Prey items include beetles (Coleoptera), caterpillars (Lepidoptera), sowbugs (Isopoda) (Stebbins 1972), earthworms (Annelida), and slugs (Gastropoda) (Lardie 1969). Tadpoles probably feed on decomposed plant and animal material, green algae, and bacteria (Morris and Tanner 1969). Adult red-legged frogs are primarily sit-and-wait predators. They forage in damp, well-shaded areas (Storm 1960). Dense shoreline vegetation is used during the breeding season; foraging areas during the non-breeding season include downed logs, ferns, and blackberry *(Rubus* sp.*)* thickets (Dunlap 1955; Porter 1961).

Insects are the main food of the Pacific treefrog. Beetles (Coleoptera) and flies (Diptera) composed 53% of the winter diet of this species in northern California (Johnson and Bury 1965).
During the breeding season, adult treefrogs forage primarily above water (Carl 1943; Brattstrom and Warren 1955).

Oregon spotted frogs are opportunistic feeders, and may forage to some extent under water (Nussbaum et al. 1983). Adult spotted frogs feed primarily on invertebrates, generally within one-half meter of shore on dry days. During and after rains, they may move away from permanent water to feed in wet vegetation or ephemeral puddles (Licht 1986).

Long-toed salamander larvae eat zooplankton, immature insects, aquatic snails, and occasionally they are cannibalistic. Terrestrial long-toed salamanders eat spiders, lepidopteran larvae, crickets, earthworms, flies, snails and slugs, aphids, springtails, fly and beetle larvae, amphipods, and a variety of other invertebrates, both terrestrial and aquatic (Nusssbaum et al. 1983).

**Water**

Breeding habitats for red-legged frogs include marshes, bogs, swamps, ponds, lakes, and slow- moving streams (Leonard et al. 1993). Spotted frogs require water as breeding, foraging, and wintering habitat. These species are closely associated with standing water during the breeding season. In the central Willamette Valley, Oregon, and the Puget Lowland, Washington, they frequently use temporary waters, usually ponds or overflows that will be dry by late May or early June. However, connections to more permanent water must be present, allowing tadpoles to continue to develop to metamorphosis. In southwestern British Columbia, researchers studied red-legged frogs in a temporary pond (dried up in July) where they bred sympatrically with Oregon spotted frogs, in the slow part of a river, and in a small overflow pond of a large lake (Licht 1971). Slow-moving streams and large ponds were used for breeding in British Columbia (Licht 1969); breeding occurred in marshes in Oregon (Storm 1960). Standing water must be present long enough for eggs to hatch and tadpoles to transform. The period from egg deposition to metamorphosis in the red-legged frog was estimated at 180 days in western Oregon (Storm 1960). In Oregon spotted frogs this period lasted 135-232 days in Utah (Morris and Tanner 1969) and from 87-111 days in Yellowstone National Park (Turner 1958) depending on water temperatures.

In the early spring, adult long-toed salamanders can be seen at night in ponds and lakes, often in considerable numbers (Leonard pers. comm.). Eggs of northwestern salamanders are laid in a variety of wetlands, lakes, ponds, and slow-moving streams (Leonard et al. 1993).

Non-breeding adult red-legged frogs can be found in damp microhabitats up to 1000 yds. (914 m) from standing water (Porter 1961; Dumas 1966). The species may also range widely at night during warm rains (Storm 1960). Western toads occupy many habitats from sea level into the mountains, frequenting relatively dry to humid situations (Stebbins 1954). They are nocturnal during dry weather, but forage during daylight on rainy or overcast days (Nussbaum et al. 1983).

**Cover**

Adult red-legged frogs use emergent aquatic and shoreline vegetation for cover during the breeding season. Sedges (*Carex* sp.), rushes (*Juncus* sp.), and submerged vegetation provide cover during breeding activities (Licht 1969). Riparian vegetation may be used as escape cover by resting red-legged frogs; one population of frogs in British Columbia responded to predators by seeking dense vegetation on streambanks (Licht 1972). Another British Columbia population, however, escaped by leaping into the water when disturbed by a predator (Gregory 1979).

Young red-legged frog tadpoles use both mud and vegetation for cover (Calef 1973a). Optimal tadpole habitat is characterized by emergent willow (*Salix* sp.) stems, grasses, cattails (*Typha* sp.), submerged weed stems, and filamentous algae (Wiens 1970).

Oregon spotted frogs are highly aquatic, inhabiting marshes, and marshy edges of ponds, streams, and lakes. They usually occur in slow-moving waters, with abundant emergent vegetation, and a thick layer of dead and decaying vegetation on the bottom. The frogs take refuge in this layer when disturbed (Nussbaum et al. 1983).

Aquatic vegetation provides cover for the breeding activities of adult Pacific treefrogs (Jameson 1957; Whitney and Krebs 1975).

Larvae of the northwestern salamander lie hidden in the mud or under leaves, logs, and other cover on lake and pond bottoms during the day, but emerge at night to feed (Nussbaum et al. 1983). When on land, the northwest salamander is usually found in damp places beneath surface objects near streams or ponds (Stebbins 1954). Long-toed salamander adults can be found under pond-side debris during early spring, and recently metamorphosed juveniles can be found in late summer and autumn in mud, and under debris beside drying ponds (Nussbaum et al. 1983).

**Reproduction**

Near sea level, egg laying by red-legged frogs occurs December through February, and at any given locality the majority of eggs are laid over a period of two to seven weeks (Olson and Leonard 1997). Timing is influenced by latitude, elevation, and weather (Dumas 1966). Breeding habitats include marshes, bogs, swamps, ponds, lakes, and slow-moving streams (Leonard et al. 1993).

Most red-legged frog breeding males in British Columbia were found in weedbeds of pondweed (*Potamogeton* sp.) and quillwort (*Isoetes* sp.) (Calef 1973b). The courtship behavior of males is somewhat unusual in that they call from beneath the water; they will also call from among surface vegetation (Leonard et al. 1993). Males usually remained within the same weed bed, but they sometimes moved over 327 yds (300 m) during one breeding season (Calef 1973b).

Red-legged frog oviposition sites were usually located in the same microhabitat as male calling sites (Calef 1973b). Egg masses are deposited in quiet water with little or no current (Licht 1969; Stebbins 1972). Eggs are usually found attached to vegetation near the surface in water depths ranging between 20 in (50 cm) and 40 in (100 cm). However, in deep prairie potholes on Fort Lewis, Washington, eggs are often attached near the surface in water approximately 6.6 ft (2 m) deep (Hallock and Leonard 1997) . The female lays from 750 to 1300 eggs in a large (about 8-12 in or 20-30 cm), gelatinous cluster (Leonard et al. 1993). Flexible, herbaceous, and thin-stemmed emergent plants are ideal oviposition sites for northwestern salamanders, red-legged frogs and many other wetland breeding species (Richter and Roughgarden pers. comm.).

Towards the end of embryonic development, red-legged frog egg masses deteriorate and float to the surface. The embryos develop and hatch from their jelly covering after about four weeks of development. Tadpoles grow and develop over a period of three to four months, and in June or July the swimming tadpoles metamorphose into terrestrial froglets approximately 3/4 in (17-21 mm) long, snout-vent length (Leonard pers. comm). Limited evidence from western Oregon studies indicates that red-legged frogs become sexually mature in their second year after metamorphosis when males are about 2 in (50 mm), and females about 2.4 in (60 mm) snout-vent length (Nussbaum et al. 1983).

Breeding by Oregon spotted frogs occurs between February and April in western Washington. Oregon spotted frogs use the same locations for egg-laying in successive years, which may indicate unique characteristics at egg-laying sites (Licht 1969). Female Oregon spotted frogs tend to deposit their eggs on, or immediately next to, other spotted frog egg masses (Leonard et al. 1993). The rounded and globular masses are unattached to vegetation, and are in only a few inches of water at the margins of the breeding pools (Licht 1971).

Breeding sites for Pacific treefrogs in western Oregon include seasonal and perennial wetlands, semipermanent ponds, roadside ditches, and quiet pools along mountain streams (Jameson 1957). Frogs seemed to prefer the shallow portions of these ponds where vegetation cover was highest. Breeding in California often occurred in grassy, water-filled depressions (Brattstrom and Warren 1955).

Red-legged frogs first become active when air has been at least 41°F (5°C) for several days. Most movement to breeding sites occurs at night and seems to be stimulated by cloud cover and precipitation (Licht 1969).

Water temperature is an important factor in reproductive success for pond breeding amphibians. Breeding for red-legged frogs throughout the Pacific Northwest occurs when the water temperature of breeding ponds is 46 to 64° F (8 to 18° C) (Dumas 1966). The temperature range for normal development of red-legged frog embryos is 39 to 70° F (4 to 21° C) (Licht 1971). For Pacific treefrogs the optimal water temperature for egg-laying in California 54 to 59°F (12 to 15°C). Development and growth rates of embryos and larvae increase at warmer temperatures. The breeding strategy of the red-legged frog is adapted to cool, and permanent breeding waters (Brown 1975). For both red-legged and Oregon spotted frogs, more than 6 months may elapse between egg deposition and metamorphosis (Storm 1960; Morris and Tanner 1969). Red-legged frogs are capable of relatively rapid embryonic development at low temperatures, but larval development is protracted, and larvae grow to a large size prior to transformation (Brown 1975).

Western toad eggs are deposited in masses of as many as 16,500 eggs which are extruded in two strings; ordinarily laid in shallow water, not deeper than 12 in (30 cm) and usually less than 6 in (15 cm) (Stebbins 1954). The larvae are usually restricted to areas over muddy bottoms where they feed by filtering suspended plant material or feed on detritus on the bottom (Nussbaum et al. 1983). Embryos develop and hatch in 3-10 days depending on water temperature (Leonard et al. 1993).

During the breeding season adult long-toed salamanders may be found under logs, rocks, and other objects near ponds and lakes or may be seined from the water (Stebbins 1954). The method of egg laying is variable. In some places eggs are deposited singly, attached to vegetation in shallow water, and in other places clusters of 5-100 eggs are deposited in shallow to deep water, either attached to vegetation or under the surface of logs. Eggs may be placed loosely on the bottom (Nussbaum et al. 1983). They hatch in 5-15 days and may transform at sea level in July, while in the high mountain ponds most of the larvae do not transform until the beginning of their second year (Slater 1936).

Northwestern salamander eggs are laid in wetlands, ponds, and slow-moving streams (Bishop 1943). Females lay their gelatinous egg masses under the surface of the water, attaching them to thin branches of shrubs, trees, or thin-stemmed emergent plants (Leonard et al. 1993; Richter pers. comm.). They vary in size from small clusters containing 25-30 eggs to large elongate masses containing as many as 270 (Bishop 1943). The larvae hatch after about one month when they measure from .56-.6 in (14-15 mm) in total body length (Watney 1941). Metamorphosis may occur in the second summer (Watney 1941) but in some populations a high percentage of individuals may remain neotenic (Logier 1932; Slater 1936) especially at high altitudes (Snyder 1956).

Roughskin newts breed in quieter parts of streams and in lakes, ponds, and reservoirs (Stebbins 1954). This animal lays its eggs singly (Olson and Leonard 1977). Eggs are attached to grass stems, twigs, and other objects in water (Stebbins 1954). Eggs hatch in 20-26 days; the hatchlings are about .72 in (18 mm) total length after the yolk is gone. Larvae typically metamorphose late in their first summer at .92-3 in (23-75 mm) total length, but they may over- winter where growing seasons are short, metamorphosing in their second summer (Nussbaum et al. 1983).

**Interspersion**

Red-legged frogs utilize moist upland cover adjacent to wetlands during the non-breeding season. There is no information in the literature on home range size of this species. Individuals have been observed in upland areas 1000 yds (914 m) from potential breeding areas (Dumas 1966), but no quantitative study of movements between breeding and post-breeding habitats has been made.

The Pacific treefrog inhabits a variety of upland cover types as long as wetland areas for reproduction are available nearby. Adults in western Oregon wintered up to 1 mi (1.6 km) from breeding areas (Jameson 1957).

**Special Habitat Requirements**

The red-legged frog, Pacific treefrog, western toad and Oregon spotted frog are all ectotherms; environmental temperature has a strong influence on their activity patterns. The red-legged frog may be active almost year around in the warmer portions of its range. It is reported to breed in December along the coast and may remain active year around (Leonard pers. comm). In British Columbia, this frog started breeding activities when water temperatures reached 41 to 43°F (5 to 6°C), but became inactive at temperatures of less than 50°F (10°C) during the non-breeding season (Licht 1969). Red-legged frogs seek protection in deep muck or silt at the bottom of permanent water; similar behavior has been described for the related spotted frog (Morris and Tanner 1969; McAllister pers. comm). May also overwinter in moist leaf litter, duff or beneath large woody debris in forested habitats, or at the muddy bottom of ponds (Leonard pers. comm.).

In Oregon spotted frogs, torpidity and hibernation occur at environmental temperatures below 41°F (5°C) (Middendorf 1957). Pacific treefrogs are active year-around along the coast of Washington and Oregon where winters are mild (Carl 1943; Cochran and Goin 1970). Elsewhere in the Pacific Northwest, treefrogs escape temperature extremes by hibernating in moist, well-protected sites, such as rock crevices, underground burrows, debris piles, and building foundations (Brattstrom and Warren 1955).

The tadpoles of the western toad seek out areas of warmer temperatures within a lake, and this behavior undoubtedly speeds up metamorphosis (Nussbaum et al. 1983).

Long-toed salamander adults spend most of the year underground or inside large rotting logs. Juveniles range from concentrating under debris, logs, and mats of dead vegetation on former pond bottoms to utilizing burrows as conditions change. Adults require heavy rainfall before emerging and moving to the breeding ponds (Anderson 1967). Northwestern salamanders are also found under bark and logs in damp situations, and utilize underground burrows (Bishop 1943; Leonard et al. 1993). Terrestrial forms are seldom seen except when they cross roads and trails on warm rainy nights (Nussbaum et al. 1983).

Roughskin newts are often found under logs, boards, rocks, and other surface objects or, in wet weather, crawling on the surface. During dry periods or at times of temperature extremes, they stay underground, in rotten logs, or in the water (Stebbins 1954).

**Special Considerations**

Severe water fluctuations in breeding areas may reduce hatching success, tadpole survival, and the quality of emergent vegetation, thereby, decreasing the success of lentic breeding amphibians. Northwestern salamanders, red-legged frogs, and roughskin newts were significantly absent from wetlands with high water level fluctuations in King County (Richter and Azous 1995).

Stream channelization, urbanization, logging, severe livestock grazing, and other alterations of stream courses and ponds may affect the availability of suitable oviposition sites, hibernacula, and cover (Olson and Leonard 1997). Red-legged frogs are sensitive to changes in environmental temperatures; water temperatures above 70° F (21°C) will cause high mortality among the young (Licht 1971).

In some instances, the red-legged frog may be absent from apparently suitable habitat in which there is a high population of bullfrogs (*Rana catesbeiana)* (Moyle 1973). This introduced species has similar habitat requirements and is an aggressive predator of frogs. Predation on all life stages of the red-legged frog may be high and is probably the strongest factor limiting population numbers (Licht 1974). Both common (*Thamnophis sirtalis*) and western terrestrial garter snakes (*Thamnophis elegans*) and bullfrogs are known to eat adult long-toed salamanders (Nussbaum et al. 1983). The more typical habitat for the bullfrog is exposed permanent shallow marshes with extensive emergent vegetation (Richter pers. comm). Bullfrogs are aquatic and require a permanent source of water, particularly in northern areas where larval development may take three years (Adams 1994).

Reed canarygrass (*Phalaris arundinacea*) is an introduced aquatic vascular plant that has become widespread and is difficult to control. It can eliminate all native plants where it grows by crowding them out. Its growth form is so dense as to be almost impenetrable and it tends to develop into a floating mat that displaces open water habitats. Reed canarygrass may significantly reduce the amount of cover and feeding habitat available for the larvae of native anurans (Adams 1994).

Recent research on the effects of fish introductions into the North Cascades ecosystem indicates that long-toed salamanders may be unable to coexist with introduced fish (larvae are preyed upon by the fish) (Liss et al. 1995). The introduction of exotic wildlife (i.e. , fishes, bullfrogs) may further degrade the suitability of waters for native amphibians (Olson and Leonard 1997).

## HABITAT SUITABILITY INDEX (HSI) MODEL

### Overview

This model has been developed to track changes in the quality of standing water and adjacent habitats of emergent, shrub-scrub, and forested wetlands used by pond breeding amphibians as reproductive and cover habitat. Breeding habitat of red-legged frogs include marshes, bogs, swamps, ponds, lakes, and slow-moving streams (Olson and Leonard 1997). Breeding sites for Pacific treefrogs in western Oregon include seasonal and perennial wetlands, semipermanent ponds, roadside ditches, and quiet pools along streams (Jameson 1957). Northwestern salamander eggs are laid in wetlands, lakes, ponds, and slow-moving streams (Leonard et al. 1993).

The successful breeding of amphibians is contingent on the following aquatic habitat elements: (1) water depth; (2) moderately dense emergent vegetation (excluding monotypic stands of reed canarygrass (*Phalaris arundinacea*) and purple loosestrife (*Lythrum salicaria*); (3) temporary and permanent bodies of water; (4) vegetative cover along wetland edge (5) water current and (6) associated habitats.

### Model Applicability

Geographic Area

This model is applicable to standing water habitats supporting red-legged frogs, northwestern salamanders, long-toed salamanders, roughskin newts, Pacific treefrogs, western toads and Oregon spotted frogs in low lying areas (elevations < 2000 ft) of western Washington and Oregon.

Season

This model addresses the breeding and larval development periods (December through July) and covers habitat needs of pond breeding amphibians.

Cover Types

This model encompasses the aquatic habitats used by pond breeding amphibians for life requisite activities, including breeding and feeding. On the Columbia River Channel Deepening Study, habitats include standing water and adjacent habitats of palustrine emergent wetland (PEM), palustrine shrub-scrub wetland (PSS), palustrine forested (PFO), and associated cover types. Associated cover types consist of land use practices or habitats adjacent to the wetland or standing water. On this project they include forest woodland and shrub-scrub wetland, unmanaged grassland/herbaceous, grazed pasture, row crops, and development. Dense woody cover of trees and shrubs surrounding a wetland or standing water provides cover, hibernation sites, attenuates ambient air and water temperature, and enhances prey diversity.

Verification Level

This model was developed using available literature, professional expertise, and knowledge of the study area to determine appropriate values and parameters. The pond breeding amphibian HSI model will provide habitat information useful for impact assessment and habitat management. Previous drafts were reviewed by Kelly McAllister, Bill Leonard and Klaus Richter and their comments were incorporated into the current draft.

**Habitat Components**

Water presence is based on pond breeder requirements for standing water during the breeding season. All native lentic-breeding northwest amphibians use permanently flooded wetlands (Richter pers. comm.). Quiet, cool, and relatively deep permanent water is preferred breeding habitat for the red-legged frog (Licht 1969; Stebbins 1972). Standing water must be present long enough for eggs to hatch and tadpoles to transform. The period from egg deposition to metamorphosis in the red-legged frog was estimated at 180 days in western Oregon (Storm 1960). Northwestern salamanders, Oregon spotted frogs, and roughskin newts also require water permanence for at least six months to successfully reproduce (Leonard pers. comm). Six to twelve consecutive months of permanent water equals a SI value of 1.0.

Extensive temporary bodies of water (dries up by July) as part of a larger water system are very important in minimizing predation from bullfrogs (Leonard and McAllister, pers. comm.). Semi-permanence is beneficial to many species because it precludes the establishment of predators including bullfrogs (Richter pers. comm.). Bullfrog eggs and larvae will become stranded in ponds that dry up during summer, killing bullfrog eggs and larvae, and hence improving conditions for native pond breeding amphibians. Oregon spotted frogs are known to use non-permanent water bodies for egg laying (Turner 1958). Fifteen to thirty-five percent of an area with permanent water present will equal an SI value of 1.0 and will optimize native-amphibian habitat while minimizing same for the introduced bullfrog.

The optimal time frame to survey standing water conditions is January through June depending on rainfall for the winter/spring. Standing water assessments should not be taken between July 1 and December 1. Measurements taken in late May or June may under represent the total area and therefore need to be adjusted accordingly. It is recommended surveyors refer to the following for specific hydrology information to supplement their data: National Wetland Inventory (NWI), aerial photographs, soil maps, and field indicators. Field indicators include assessing drift lines, water marks, algae scum, water-stained leaves, drainage patterns within wetlands and sediment deposits to determine the extent of seasonal standing water.

Lentic-breeding amphibians spawn only in vernal ponds, depressional wetlands, or in slow-moving or quiescent water of riverine backwaters and slope wetlands (Savage 1961; Nussbaum et at. 1983; Blaustein et al. 1995). Water current at breeding sites is based on published literature which indicates that slow-moving and zero-current water is optimal for pond breeding amphibians (Storm 1960; Licht 1969; Leonard and McAllister pers. comm.). Egg masses are deposited in quiet water with little or no current (Licht 1969; Stebbins 1972). Increased discharge to riverine and slope wetlands can increase current velocity preventing breeding, reducing the success of fertilization, dislodging eggs from oviposition sites, or physically damaging eggs with suspended silt, sediment and large floating debris (Lind et al. 1996; Richter pers. comm.). Velocities exceeding 2 in/s (5 cm/s) precludes breeding by both red-legged frog and northwestern salamander (Richter and Roughgarden pers. comm.). Slow-moving water equals an SI value of 1.0 for breeding.

Moderately shallow water is required for breeding Oregon spotted frogs (Storm 1960; Licht 1969). Oviposition by most temperate amphibian species occurs at depths between 4-40 in (10-100 cm) (Cooke 1975; Seale 1982; Waldman 1982). Percent of a wetland area covered by water 4 to 40 in. (10 to 102 cm.) deep December through March pertains to the aquatic requirements of these species (Leonard and McAllister, pers. comm.). Wetlands that are completely flooded by this optimal water depth (approximately 100% = 1.0 SI) are more suitable than wetlands that do not have standing water or water depths that are not suitable.

Floating-aquatic, emergent, and woody macrophytes are used for cover by adults and tadpoles (Licht 1969; Calef 1973a) and for egg attachment sites (Storm 1960; Porter 1961). Oregon spotted frogs usually occur in slow-moving waters, with abundant emergent vegetation (Nussbaum et al. 1983; McAllister and Leonard 1997). Emergent vegetation is used by Pacific treefrogs in foraging, thermoregulation, and breeding (Whitney and Krebs 1975; Brattstrom and Warren 1955). Vegetation cover of ≥50% equals a value of 1.0 SI. One exception is the presence of a non-native invasive species such as reed canarygrass, in this case ≥75% equals SI of .1.

Shoreline vegetation provides important cover for breeding amphibians. Adults frogs and salamanders are often found among downed logs, ferns, blackberry thickets, and other dense cover during the non-breeding season (Dunlap 1955; Porter 1961). Optimum ground cover along the water edge is ≥75% which provides escape and thermal cover, or SI of 1.0.

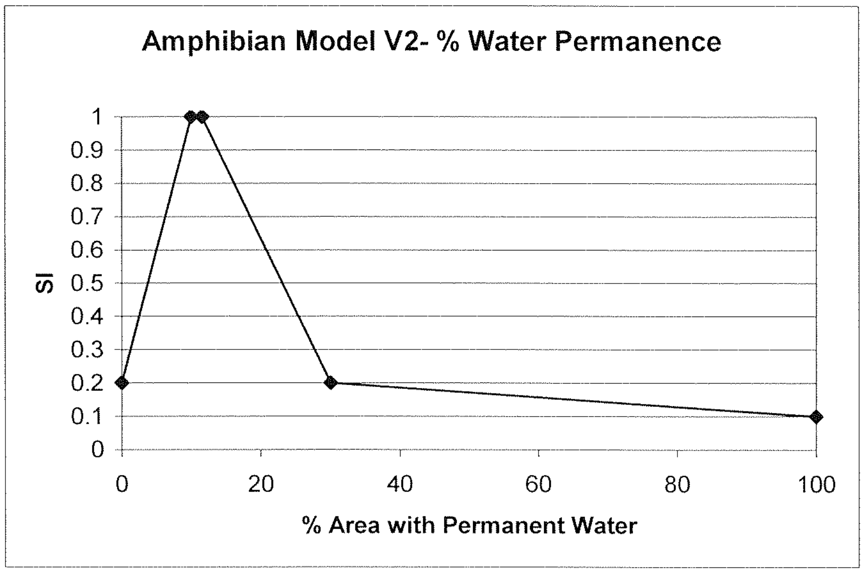
During the non-breeding season, red-legged frogs may occur at considerable distances from water. Nussbaum (1983), have encountered frogs in moist forest situations 656 to 984 ft (200 to 300 m) from any standing water. A measurement of 656 ft (200 m) surrounding the wetland should be adequate to measure the associated habitat value.

Habitat surrounding standing water and the value of the standing water influences the quality of the wetland system in terms of providing adequate cover and breeding habitat for native amphibians. Associated habitat on the Columbia River Channel Deepening Project would consist of either forested woodland/emergent wetland/shrub-scrub wetland (1.0 SI), unmanaged grassland/herbaceous (0.75 SI), grazed pasture (0.5 SI), row crops (0.1 SI) and/or development (0.0 SI). Forested woodlands and shrub-scrub wetlands provide the optimal habitat. This model assumes that sufficient cover must be adjacent to a water source in order to provide escape cover, thermal buffering, hibernation sites, and enhanced prey diversity. Because pond breeding amphibians use upland cover types during the non-breeding season, optimal habitat must also support suitable cover adjacent to the standing water. Application of this model and determination of habitat suitability index is based on evaluation of standing water quality for supporting pond breeding amphibians and associated habitats in a 656 ft (200 m) band surrounding standing water, and each will have a distinct HSI.

## Amphibian Model

<u>The Amphibian Model was revised as follows</u>
V7--adjacent land use.
Clearcuts, 2 years old = 0.75
Clearcuts > 2 years old = 1.0

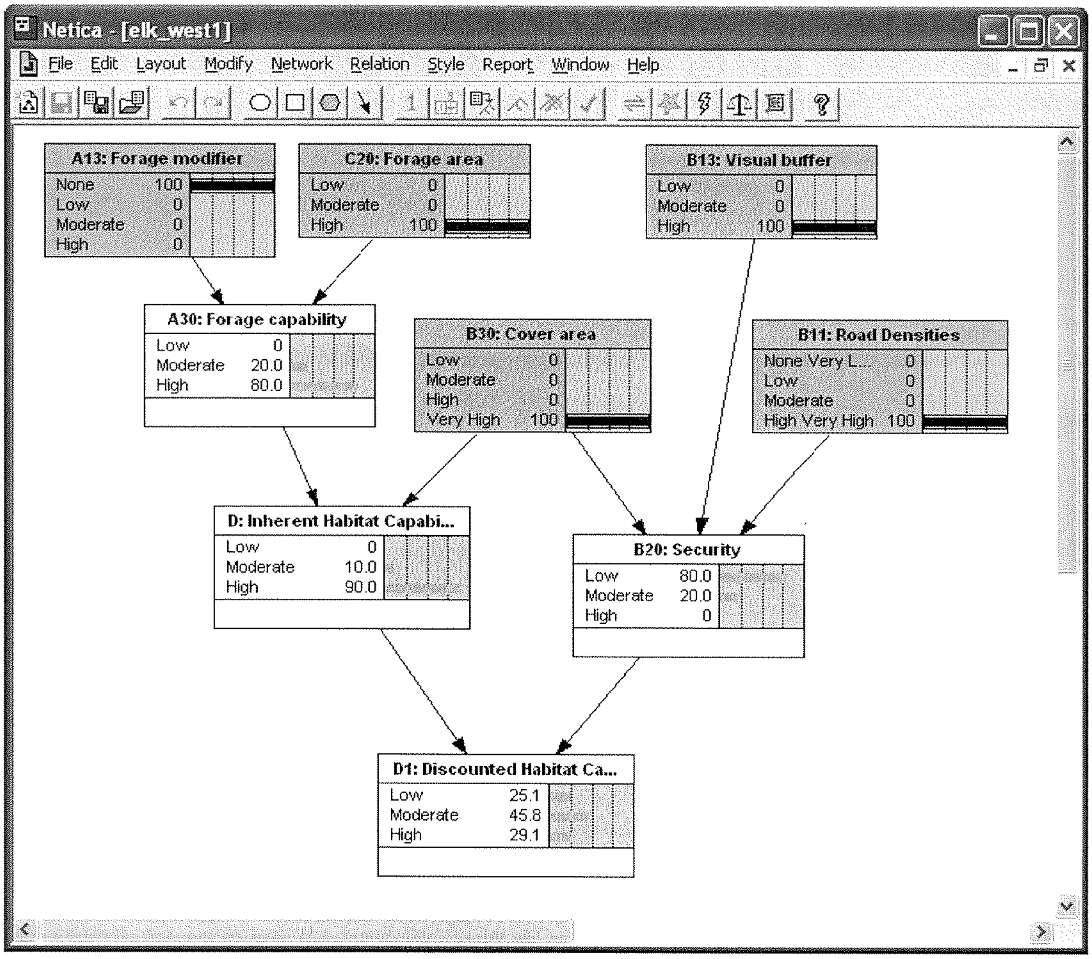
It was agreed that V2 be modified as depicted below.




The Team revised the water permanence graph so that a 12-month duration receives an SI of 0.2 and 11 months receives a 0.4 SI. It was felt that permanent ponds, although conducive to ranid frogs, also allow bullfrogs to establish, which is an undesirable outcome.

**Appendix 17-6:**
**Modified Washington Department of Fish and Wildlife Elk Model**

## WDFW Elk Model




A13--Forage enhancement variable. A proxy variable defined from GIS database to be a surrogate for the quality of forage present beyond "typical" conditions. The input is defined as the percentage of forage area in actively managed forage types (wildlife openings, fertilized cuts, and other areas actively managed for nutritional quality beyond natural revegetation):

NONE = 0%; LOW = <5%; MODERATE = 5 - 25%;
HIGH = >25%

C20--Forage habitat area calculated as a percentage of each subwatershed or other evaluation area. Forage habitat was estimated by summing the percentage of terestrial community types used as forage in each evaluation unit. Terrestrial community types were defined by grouping veg cover type and structural stage combinations. Forage habitat definitions vary for elk and deer.

Categories were defined as: LOW = <25%; MODERATE =
26 - 50%; HIGH = >50%.

B13--Vegetative screening or topographical screening variable. The proportion of open roads adjacent to unstocked or shrub/sapling stands/plantings with a vegetative screening or physcal obstruction sufficient to break up the sight profile.

Low = <25%
Moderate = 25-50%
High = >50%

A30--Forage habitat capability as a function of forage area (quantity) and the qualitative effects of forage enhancing practices.

B30--Cover habitat area calculated as a percentage of each evaluation unit.

Cover habitat was estimated by summing the percentage of terestrial community types used as cover in each evaluation unit. Terrestrial community types were defined by grouping veg cover type and structural stage combinations.

Cover habitat definitions vary for elk & deer.

Categories were defined as: LOW = <25%; MODERATE =
26 - 50%; HIGH = 51 - 75%; VERY HIGH = >75%.

The amount of cover influences the Inherent Habitat Capability and Security (from human disturbance) nodes in the model differently. See descriptions of those nodes for an explanation.

B11--Road Density Classes summarized from road density index, provided by the Landscape Team as follows:

None_Very_Low = <0.1 mi/sq mi

Low = 0.1-0.7 mi/sq mi

Moderate = 0.7-1.7 mi/sq mi

D--Inherent habitat capability for the analysis unit as a function of forage capability and cover area. Forage capability was generally weighted much greater than cover area. Cover was considered in terms of its security from predation value; security from human disturbance is modeled in the "Security" branch of the model.

In general, at low forage levels increasing cover had little influence. At moderate forage levels increasing cover increased habitat capability about 10% with each increment in cover. With high forage capability, cover had relatively little influence on habitat capability; habitat capability increased only with high to very high cover levels.

B20--Security from human disturbance. Cover area, open road density, and terrain complexity interact to determine the relative security of ungulates in a watershed from human disturbance, primarily vulnerability to and harassment from hunters. Increasing open road density was considered negative. Increasing cover and terrain complexity negated the effects of roads by increasing security in the presence of roads.

D1--Habitat capability as a function of inherent habitat capability and the relative security of elk from human disturbance within the watershed.

# Appendix 17-7:
# Modified Washington Department of Fish and Wildlife
# Savannah Sparrow Habitat Suitability Index

# SAVANNAH SPARROW
## Grassland/Agricultural Type

### General

Open grasslands are the preferred habitat of the savannah sparrow (Passerculus sandwichensis) (Gabrielson and Jewett 1940). Within this Ecoregion it occurs primarily as a summer breeder in the transition zone, and is commonly found in open fields, plains, and meadows at lower elevations throughout western Washington and Oregon (Larrison and Sonnenberg 1968).

### Food Requirements

The savannah sparrow eats mostly grass seed and insects (Norris 1960; Wiens 1969). Dragonflies (Odonata), butterflies (Lepidoptera), true bugs (Hemiptera), wasps, ants, and bees (Hymenoptera), aphids (Homoptera), spiders (Arachnida) and oligochaete worms were invertebrates eaten by the savannah sparrow in Wisconsin (Wiens 1969). Wiens (1973) stated that savannah sparrows concentrated their feeding around the perimeter of grass clumps and foraged primarily in low grass cover that was mostly under four inches (10 cm) in height (Wiens 1969). Cody (1968) found that savannah sparrows foraged on vegetation below 3 inches (7.6 cm) in height.

### Water Requirements

No specific drinking water requirements were found in the literature. Moisture seems to be a factor through its influence on the density of low vegetation (Wiens 1969).

### Cover Requirements

No specific information on cover requirements, other than for reproduction, was found in the literature. In most inland locations, cover needs seem to be satisfied by low-lying, moist, open grassy fields with scattered forbs in which the ground layer vegetation (grasses and accumulated litter) is fairly dense (Tester and Marshall 1961). Litter was found to be one of the most important features of savannah sparrow habitat. Linsdale (1938) concluded that the factor determining the local presence of the savannah sparrow in the Great Basin was the dense cover of low vegetation.

### Reproductive Requirements

Male savannah sparrows establish territories during the breeding season (Wiens 1973). Territory size on a Wisconsin field ranged from .4 to 4.3 acres (.2-1.7 ha) with a mean size of 1.7 acres (.7 ha) (Wiens 1969). The breeding territory must satisfy all of the life requirements of the mated pairs and their young throughout the nesting season, as they will not travel outside their territorial boundaries. Scattered tall forbs, low shrubs, or fence posts and fence lines, if available, are used by the male bird to advertise and defend his territory through singing displays. Where sufficiently tall forbs are not present, small deciduous shrubs may be used as song perches (Johnsgard and Rickard 1957).

Wiens (1969) found an average of 600 forbs per .01 acre (.004 ha) on the savannah sparrow territories in his Wisconsin study. The mean percentage of forb cover on savannah sparrow territories ranged from 20 to 35% depending on the time of territorial establishment with a range of approximately 15 to 42% (Wiens 1973). Wiens (1969) found that forb height within breeding territories ranged from 2.7 to 19.6 inches (7 to 50 cm) with a mean of 7.8 inches (20 cm). Savannah sparrow nests were constructed on the ground in dense grass vegetation and were well concealed. Nineteen of 27 nests were either partially domed or well placed under overhanging litter. All nests were located in areas having 100% litter cover. The entire nesting territory had greater than 64% litter coverage. The mean litter depth for nests was 3 inches (7.8 cm) with the majority of nest sites in litter greater than .4 inches (1 cm) in depth. The percentage of grass cover over most of the nesting territories ranged from 62 to 100% with a mean of 88%.

Special Habitat Requirements

No special habitat requirements were found in the literature.

Interspersion Requirements

Savannah sparrows remain within the grassland vegetation type throughout the year and they show no special need for any adjacent cover types.

Special Considerations

Hayfields and grain fields are utilized by savannah sparrows in place of natural grasslands (Larrison and Sonnenberg 1968). Of the three subspecies of the savannah sparrow that occur in western Washington, Brook's Savannah Sparrrow (*P. sandwichensis brooksi*) is the subspecies which breeds within the ecoregion. The three subspecies are listed as winter visitors West of the Cascades (Sonneberg and Larrison 1968).

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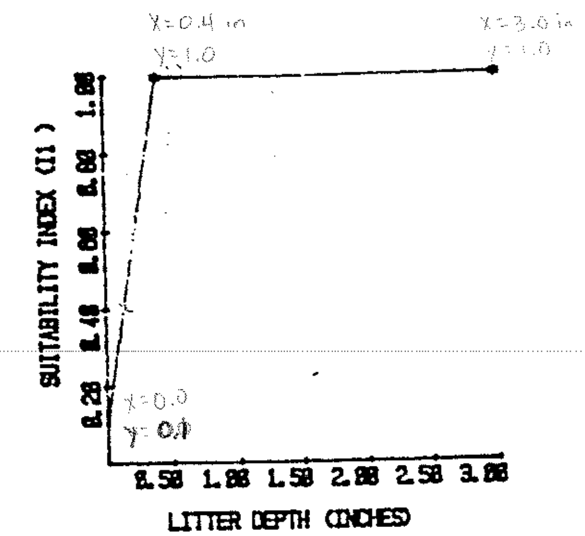
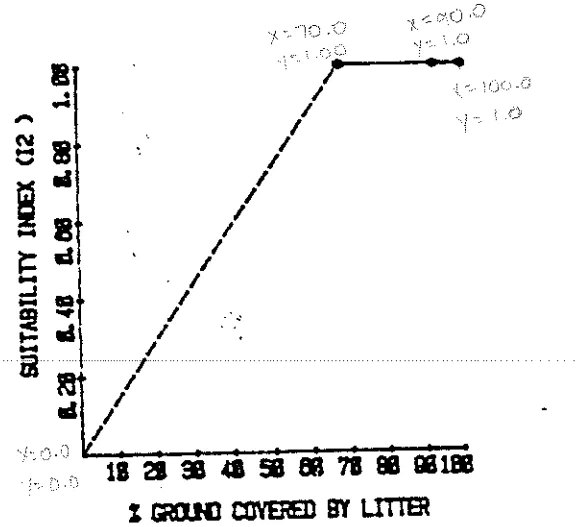
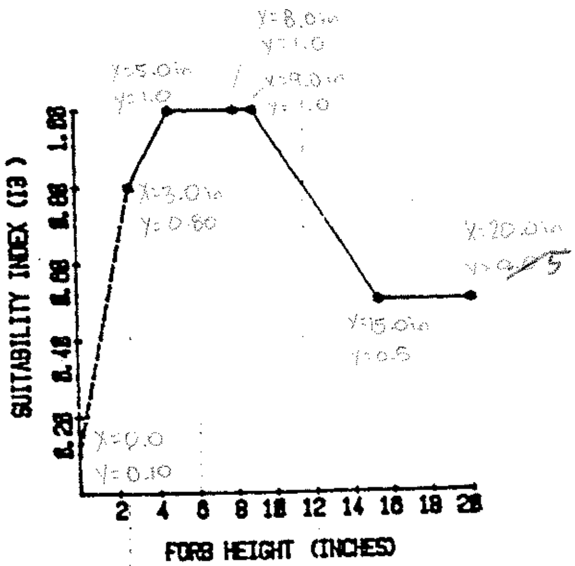
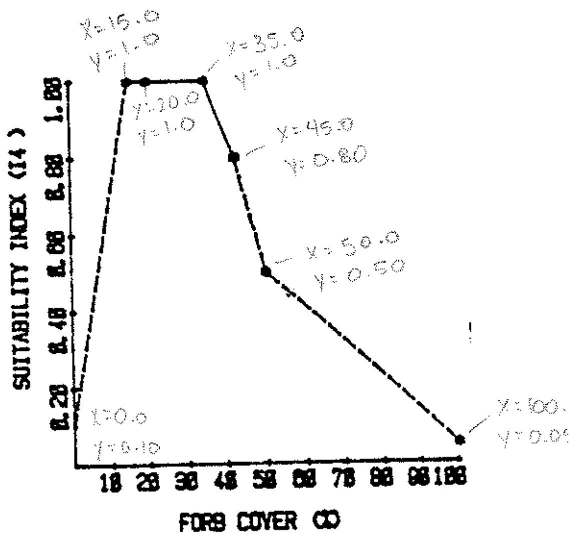
# SAVANNAH SPARROW

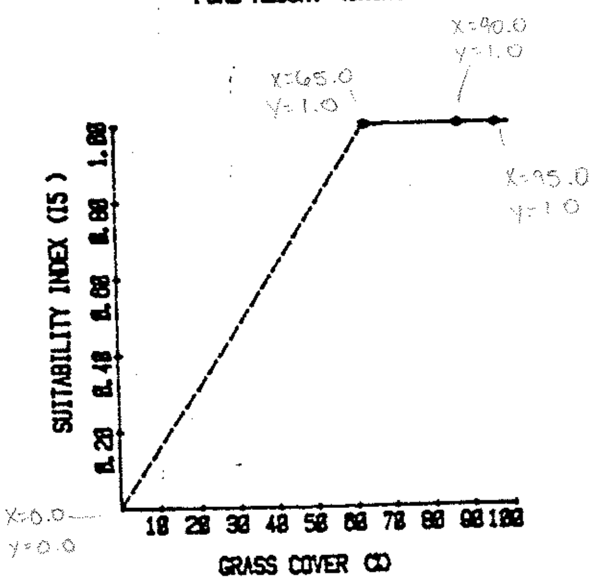
## GRASSLAND/AGRICULTURAL



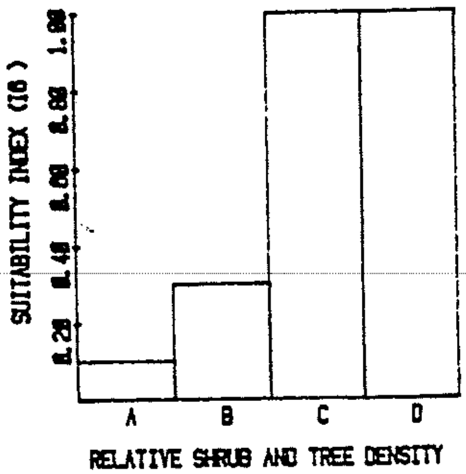





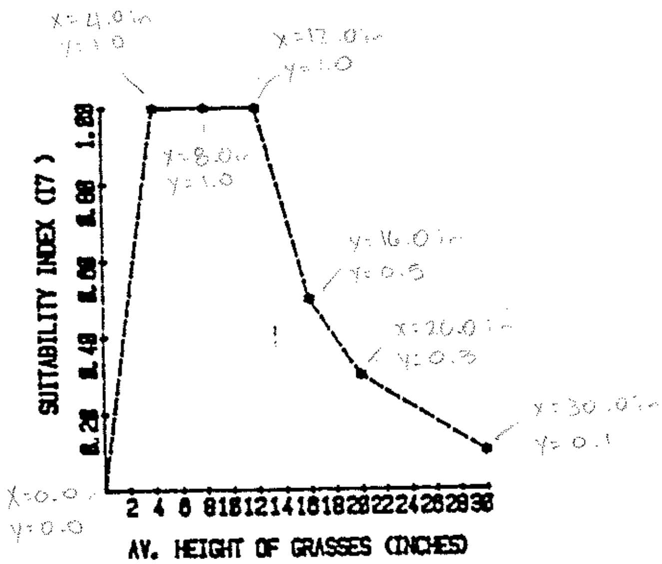

DRAF

# SAVANNAH SPARROW

## GRASSLAND/AGRICULTURAL




A=TREES OR SHRUBS PREVALENT THROUGHOUT SAMPLE SITE
B=WIDELY SCATTERED TREES OR SHRUBS THROUGHOUT SAMPLE SITE (SAVANNAH)
C=NO TREES OR TALL SHRUBS PRESENT; A FEW LOW SHRUBS SCATTERED THROUGHOUT SAMPLE SITE
D=NO TREES OR SHRUBS PRESENT ON SAMPLE SITE



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HABITAT SUITABILITY INDEX

Savannah Sparrow in Grassland/Agricultural Type

Ecoregion 2410

Reproductive Value * ($X_1$) = $$\left[\frac{(I_1 + I_2 + I_3 + I_4 + I_7)}{5} \times \frac{(I_5 + I_6)}{2}\right]^{1/2}$$

Where: $I_1$ = Suitability Index (SI) of litter depth.

$I_2$ = SI of percent of ground covered by litter.

$I_3$ = SI of forb height.

$I_4$ = SI of percent forb cover.

$I_5$ = SI of percent grass cover.

$I_6$ = SI of relative shrub and tree density.

$I_7$ = SI of average height of grasses.

* If reproductive needs are satisifed, all other food and cover needs will also be satisfied.

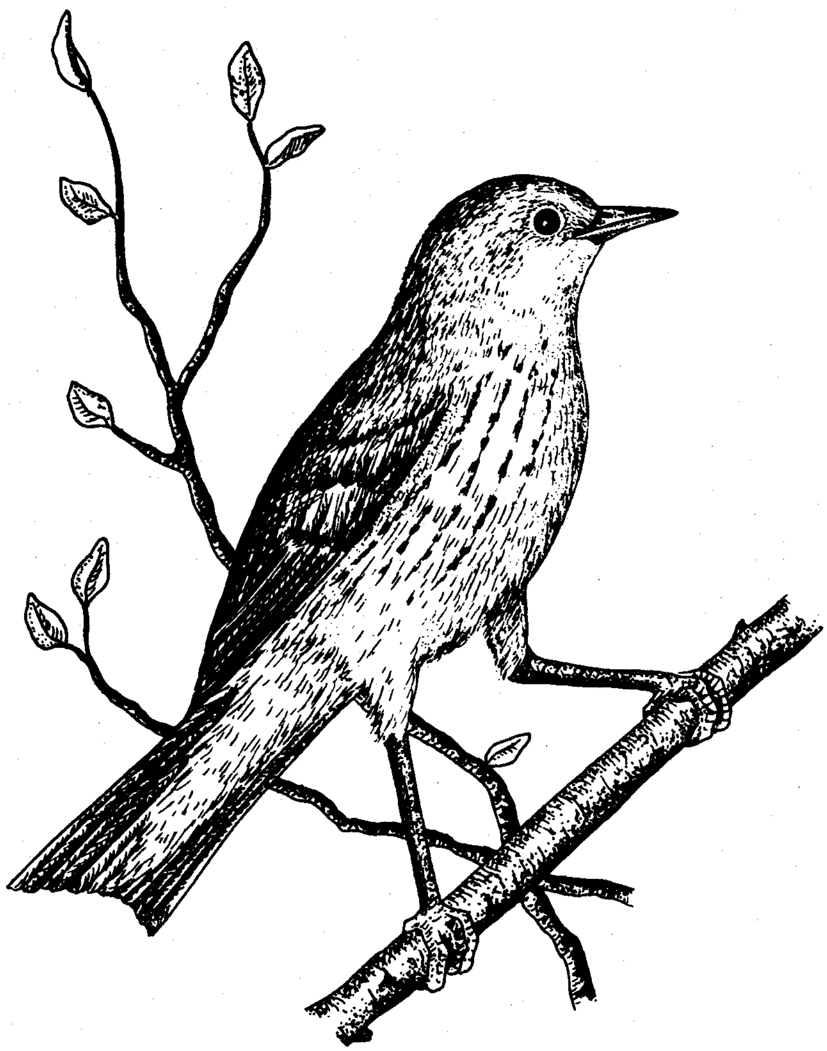
The Habitat Suitability Index is $X_1$.

**Appendix 17-8:**
**U.S. Fish and Wildlife Service**
**Yellow Warbler Habitat Suitability Index Model**

Biological Services Program
and
Division of Ecological Services

FWS/OBS-82/10.27
JULY 1982

# HABITAT SUITABILITY INDEX MODELS: YELLOW WARBLER



Fish and Wildlife Service

U.S. Department of the Interior

The Biological Services Program was established within the U.S. Fish and Wildlife Service to supply scientific information and methodologies on key environmental issues that impact fish and wildlife resources and their supporting ecosystems. The mission of the program is as follows:

- To strengthen the Fish and Wildlife Service in its role as a primary source of information on national fish and wildlife resources, particularly in respect to environmental impact assessment.

- To gather, analyze, and present information that will aid decisionmakers in the identification and resolution of problems associated with major changes in land and water use.

- To provide better ecological information and evaluation for Department of the Interior development programs, such as those relating to energy development.

Information developed by the Biological Services Program is intended for use in the planning and decisionmaking process to prevent or minimize the impact of development on fish and wildlife. Research activities and technical assistance services are based on an analysis of the issues, a determination of the decisionmakers involved and their information needs, and an evaluation of the state of the art to identify information gaps and to determine priorities. This is a strategy that will ensure that the products produced and disseminated are timely and useful.

Projects have been initiated in the following areas: coal extraction and conversion; power plants; geothermal, mineral and oil shale development; water resource analysis, including stream alterations and western water allocation; coastal ecosystems and Outer Continental Shelf development; and systems inventory, including National Wetland Inventory, habitat classification and analysis, and information transfer.

The Biological Services Program consists of the Office of Biological Services in Washington, D.C., which is responsible for overall planning and management; National Teams, which provide the Program's central scientific and technical expertise and arrange for contracting biological services studies with states, universities, consulting firms, and others; Regional Staffs, who provide a link to problems at the operating level; and staffs at certain Fish and Wildlife Service research facilities, who conduct in-house research studies.

This model is designed to be used by the Division of Ecological Services in conjunction with the Habitat Evaluation Procedures.

FWS/OBS-82/10.27
July 1982

# HABITAT SUITABILITY INDEX MODELS: YELLOW WARBLER

by

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Office of Biological Services
Fish and Wildlife Service
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Washington, DC 20240

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## PREFACE

This document is part of the Habitat Suitability Index (HSI) Model Series (FWS/OBS-82/10), which provides habitat information useful for impact assessment and habitat management. Several types of habitat information are provided. The Habitat Use Information Section is largely constrained to those data that can be used to derive quantitative relationships between key environmental variables and habitat suitability. The habitat use information provides the foundation for HSI models that follow. In addition, this same information may be useful in the development of other models more appropriate to specific assessment or evaluation needs.

The HSI Model Section documents a habitat model and information pertinent to its application. The model synthesizes the habitat use information into a framework appropriate for field application and is scaled to produce an index value between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). The application information includes descriptions of the geographic ranges and seasonal application of the model, its current verification status, and a listing of model variables with recommended measurement techniques for each variable.

In essence, the model presented herein is a hypothesis of species-habitat relationships and not a statement of proven cause and effect relationships. Results of model performance tests, when available, are referenced. However, models that have demonstrated reliability in specific situations may prove unreliable in others. For this reason, feedback is encouraged from users of this model concerning improvements and other suggestions that may increase the utility and effectiveness of this habitat-based approach to fish and wildlife planning. Please send suggestions to:

Habitat Evaluation Procedures Group
Western Energy and Land Use Team
U.S. Fish and Wildlife Service
2625 Redwing Road
Ft. Collins, CO 80526

CONTENTS

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YELLOW WARBLER (*Dendroica petechia*)

## HABITAT USE INFORMATION

### General

The yellow warbler (*Dendroica petechia*) is a breeding bird throughout the entire United States, with the exception of parts of the Southeast (Robbins et al. 1966). Preferred habitats are wet areas with abundant shrubs or small trees (Bent 1953). Yellow warblers inhabit hedgerows, thickets, marshes, swamp edges (Starling 1978), aspen (*Populus* spp.) groves, and willow (*Salix* spp.) swamps (Salt 1957), as well as residential areas (Morse 1966).

### Food

More than 90% of the food of yellow warblers is insects (Bent 1953), taken in proportion to their availability (Busby and Sealy 1979). Foraging in Maine occurred primarily on small limbs in deciduous foliage (Morse 1973).

### Water

Dietary water requirements were not mentioned in the literature. Yellow warblers prefer wet habitats (Bent 1953; Morse 1966; Stauffer and Best 1980).

### Cover

Cover needs of the yellow warbler are assumed to be the same as reproduction habitat needs and are discussed in the following section.

### Reproduction

Preferred foraging and nesting habitats in the Northeast are wet areas, partially covered by willows and alders (*Alnus* spp.), ranging in height from 1.5 to 4 m (5 to 13.3 ft) (Morse 1966). It is unusual to find yellow warblers in extensive forests (Hebard 1961) with closed canopies (Morse 1966). Yellow warblers in small islands of mixed coniferous-deciduous growth in Maine utilized deciduous foliage far more frequently than would be expected by chance alone (Morse 1973). Coniferous areas were mostly avoided and areas of low deciduous growth preferred.

Nests are generally placed 0.9 to 2.4 m (3 to 8 ft) above the ground, and nest heights rarely exceed 9.1 to 12.2 m (30 to 40 ft) (Bent 1953). Plants used for nesting include willows, alders, and other hydrophytic shrubs and trees (Bent 1953), including box-elders (Acer negundo) and cottonwoods (Populus spp.) (Schrantz 1943). In Iowa, dense thickets were frequently occupied by yellow warblers while open thickets with widely spaced shrubs rarely contained nests (Kendeigh 1941).

Males frequently sing from exposed song perches (Kendeigh 1941; Ficken and Ficken 1965), although yellow warblers will nest in areas without elevated perches (Morse 1966).

A number of Breeding Bird Census reports (Van Velzen 1981) were summarized to determine nesting habitat needs of the yellow warbler, and a clear pattern of habitat preferences emerged. Yellow warblers nested in less than 5% of census areas comprised of extensive upland forested cover types (deciduous or coniferous) across the entire country. Approximately two-thirds of all census areas with deciduous shrub-dominated cover types were utilized, while shrub wetland types received 100% use. Wetlands dominated by shrubs had the highest average breeding densities of all cover types [2.04 males per ha (2.5 acre)]. Approximately two-thirds of the census areas comprised of forested draws and riparian forests of the western United States were used, but average densities were low [0.5 males per ha (2.5 acre)].

### Interspersion

Yellow warblers in Iowa have been reported to prefer edge habitats (Kendeigh 1941; Stauffer and Best 1980). Territory size has been reported as 0.16 ha (0.4 acre) (Kendeigh 1941) and 0.15 ha (0.37 acre) (Kammeraad 1964).

### Special Considerations

The yellow warbler has been on the Audubon Society's Blue List of declining birds for 9 of the last 10 years (Tate 1981).

## HABITAT SUITABILITY INDEX (HSI) MODEL

### Model Applicability

Geographic area. This model has been developed for application within the breeding range of the yellow warbler.

Season. This model was developed to evaluate the breeding season habitat needs of the yellow warbler.

Cover types. This model was developed to evaluate habitat in the dominant cover types used by the yellow warbler: Deciduous Shrubland (DS) and Deciduous Scrub/Shrub Wetland (DSW) (terminology follows that of U.S. Fish and Wildlife Service 1981). Yellow warblers only occasionally utilize forested habitats and reported population densities in forests are low. The habitat requirements in forested habitats are not well documented in the literature. For these reasons, this model does not consider forested cover types.

Minimum habitat area. Minimum habitat area is defined as the minimum amount of contiguous habitat that is required before an area will be occupied by a species. Information on the minimum habitat area for the yellow warbler was not located in the literature. Based on reported territory sizes, it is assumed that at least 0.15 ha (0.37 acre) of suitable habitat must be available for the yellow warbler to occupy an area. If less than this amount is present, the HSI is assumed to be 0.0.

Verification level. Previous drafts of the yellow warbler habitat model were reviewed by Douglass H. Morse and specific comments were incorporated into the current model (Morse, pers. comm.).

## Model Description

Overview. This model considers the quality of the reproduction (nesting) habitat needs of the yellow warbler to determine overall habitat suitability. Food, cover, and water requirements are assumed to be met by nesting needs.

The relationship between habitat variables, life requisites, cover types, and the HSI for the yellow warbler is illustrated in Figure 1.

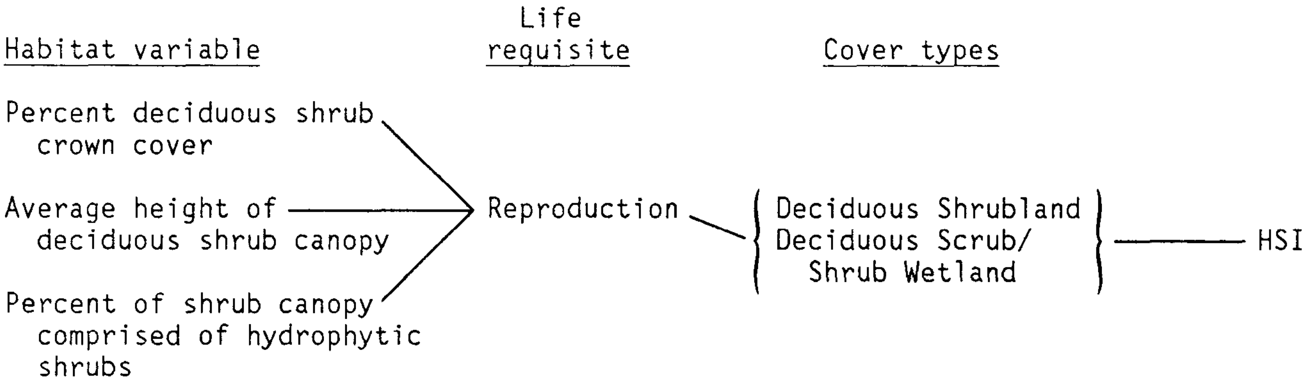



Figure 1. Relationship between habitat variables, life requisites, cover types, and the HSI for the yellow warbler.

The following sections provide a written documentation of the logic and assumptions used to interpret the habitat information for the yellow warbler and to explain and justify the variables and equations that are used in the HSI model. Specifically, these sections cover the following: (1) identification of variables that will be used in the model; (2) definition and justification of the suitability levels of each variable; and (3) description of the assumed relationship between variables.

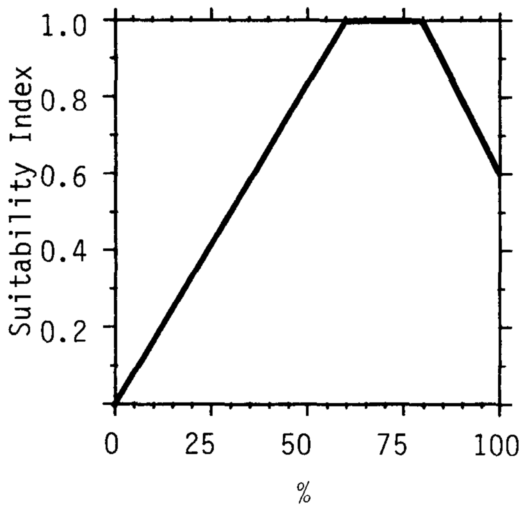
Reproduction component. Optimal nesting habitat for the yellow warbler is provided in wet areas with dense, moderately tall stands of hydrophytic deciduous shrubs. Upland shrub habitats on dry sites will provide only marginal suitability.

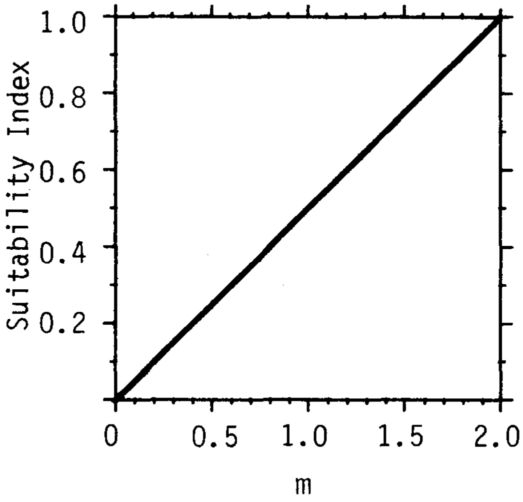
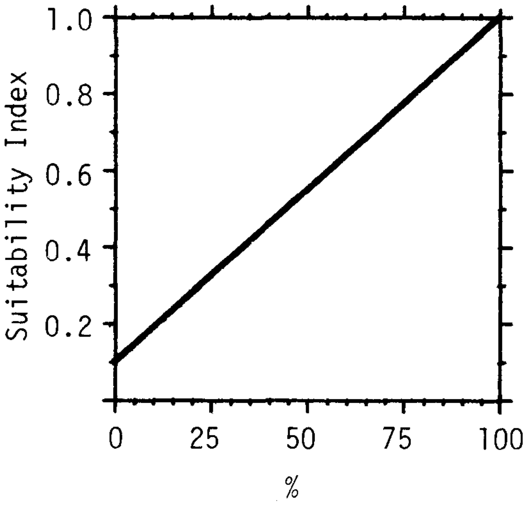
It is assumed that optimal habitats contain 100% hydrophytic deciduous shrubs and that habitats with no hydrophytic shrubs will provide marginal suitability. Shrub densities between 60 and 80% crown cover are assumed to be optimal. As shrub densities approach zero cover, suitability also approaches zero. Totally closed shrub canopies are assumed to be of only moderate suitability, due to the probable restrictions on movement of the warblers in those conditions. Shrub heights of 2 m (6.6 ft) or greater are assumed to be optimal, and suitability will decrease as heights decrease to zero.

Each of these habitat variables exert a major influence in determining overall habitat quality for the yellow warbler. A habitat must contain optimal levels of all variables to have maximum suitability. Low values of any one variable may be partially offset by higher values of the remaining variables. Habitats with low values for two or more variables will provide low overall suitability levels.

Model Relationships

Suitability Index (SI) graphs for habitat variables. This section contains suitability index graphs that illustrate the habitat relationships described in the previous section.

| Cover type | Variable | | |
|---|---|---|---|
| DS,DSW | $V_1$ | Percent deciduous shrub crown cover. |  |

| | | | |
|---|---|---|---|
| DS,DSW | $V_2$ | Average height of deciduous shrub canopy. |  |
| DS,DSW | $V_3$ | Percent of deciduous shrub canopy comprised of hydrophytic shrubs. |  |





Equations. In order to obtain life requisite values for the yellow warbler, the SI values for appropriate variables must be combined with the use of equations. A discussion and explanation of the assumed relationship between variables was included under Model Description, and the specific equation in this model was chosen to mimic these perceived biological relationships as closely as possible. The suggested equation for obtaining a reproduction value is presented below.

| Life requisite | Cover type | Equation |
|---|---|---|
| Reproduction | DS,DSW | $(V_1 \times V_2 \times V_3)^{1/2}$ |

HSI determination. The HSI value for the yellow warbler is equal to the reproduction value.

## Application of the Model

Definitions of variables and suggested field measurement techniques (Hays et al. 1981) are provided in Figure 2.

| Variable (definition) | | Cover types | Suggested technique |
|---|---|---|---|
| $V_1$ | Percent deciduous shrub crown cover (the percent of the ground that is shaded by a vertical projection of the canopies of woody deciduous vegetation which are less than 5 m (16.5 ft) in height). | DS,DSW | Line intercept |
| $V_2$ | Average height of deciduous shrub canopy (the average height from the ground surface to the top of those shrubs which comprise the uppermost shrub canopy). | DW,DSW | Graduated rod |
| $V_3$ | Percent of deciduous shrub canopy comprised of hydrophytic shrubs (the relative percent of the amount of hydrophytic shrubs compared to all shrubs, based on canopy cover). | DS,DSW | Line intercept |

Figure 2. Definitions of variables and suggested measurement techniques.

## SOURCES OF OTHER MODELS

No other habitat models for the yellow warbler were located.

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15. Supplementary Notes

16. Abstract (Limit: 200 words)

Habitat preferences of the yellow warbler (Dendroica petechia) are described in this publication. It is one of a series of Habitat Suitability Index (HSI) models and was developed through an analysis of available information on the species-habitat requirements of the species. Habitat use information is presented in a review of the literature, followed by the development of an HSI model, designed for use in impact assessment and habitat management activities.

17. Document Analysis a. Descriptors

Animal behavior
Birds
Wildlife
Habits
Mathematical models

b. Identifiers/Open-Ended Terms

Yellow warbler
Dendroica petechia
Habitat Suitability Index
Habitat use
Species-habitat relations
Impact assessment
Habitat management

c. COSATI Field/Group

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# DEPARTMENT OF THE INTERIOR
## U.S. FISH AND WILDLIFE SERVICE

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