

CONNECTICUT WARBLER

Oporornis agilis

*Original prepared by John M. Cooper
and Suzanne M. Beauchesne*

Species Information

Taxonomy

The Connecticut Warbler is a neotropical migrant songbird and one of three species of warbler in the genus *Oporornis* that breeds in British Columbia (Campbell et al. 2001). No subspecies of Connecticut Warbler are recognized (Pitocchelli et al. 1997; Cannings 1998).

Description

A small (13–15 cm) songbird, adapted for life on or near the forest floor, which is reflected in relatively long legs on a stout body. In breeding plumage, the male has a grey hood extending to the lower throat; a complete whitish eye ring; olive to olive brown, unstreaked upper parts; and yellowish under parts. Females are similar but duller, and immatures are duller still, with a brownish hood. The primary distinguishing feature, separating Connecticut Warbler from Mourning and McGillivray's warblers, is the complete whitish eye ring, which is present in both sexes, all age classes, and at all times of year (Pyle 1997). Males are distinguished from Mourning and McGillivray's warblers by lack of black on upper breast.

Distribution

Global

The Connecticut Warbler breeds in a narrow band across Canada from southwestern Northwest Territories (Machtans 2000) east to western Quebec and, in the United States, in northern Minnesota, Wisconsin, and Michigan (Godfrey 1986). Most of the breeding range is in Canada. This species winter range is poorly known; however, it has wintered in the Amazon River basin (Colombia to Brazil) (AOU 1983; Pitocchelli et al. 1997).

British Columbia

The Connecticut Warbler reaches the northwestern extreme of its breeding range in northeastern British Columbia where it occurs mainly in the Peace Lowland and Kiskatinaw Plateau ecosections of the Boreal Plains Ecoprovince (Campbell et al. 2001). Small numbers have been reported from the Fort Nelson Lowland near Fort Nelson (Erskine and Davidson 1976; Campbell et al. 2001).

Forest regions and districts

Northern Interior: Fort Nelson, Peace

Ecoprovinces and ecosections

TAP: FNL

BOP: CLH, HAP, KIP, PEL

Biogeoclimatic units

BWBS: mw1, mw2

Broad ecosystem units

BA, PR

Elevation

400–1100 m (Campbell et al. 2001)

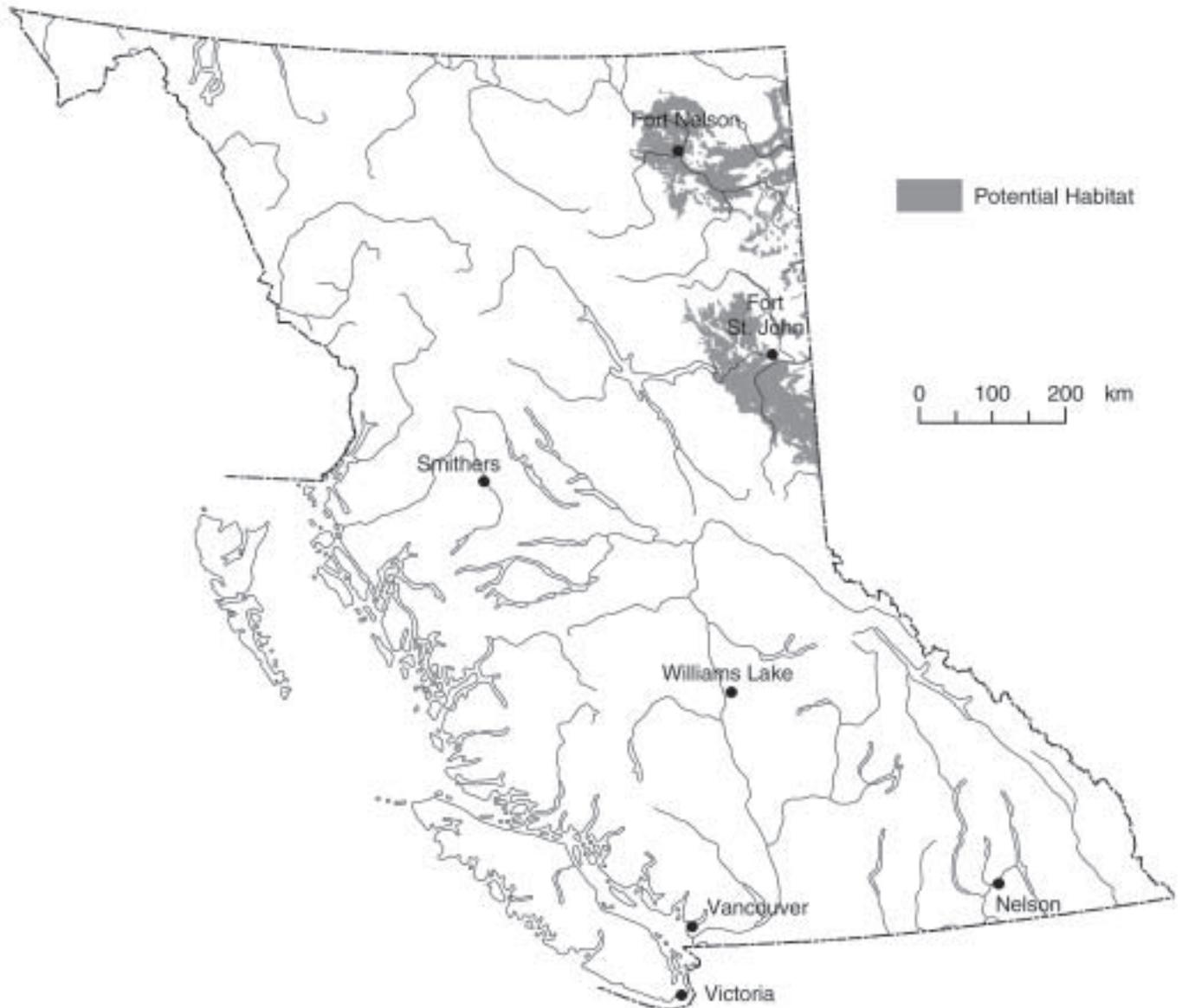
Life History

Very little is known about the specifics of the ecology of the Connecticut Warbler in British Columbia and many details are lacking from elsewhere in its range. Much of the following information is inferred from observations from eastern North America, except where noted.

Diet and foraging behaviour

The Connecticut Warbler is primarily an insectivorous bird that eats a variety of small insects, spiders, snails, eggs of spiders and insects, berries, and seeds (Bent 1953). It feeds mainly by gleaning prey from the ground, along fallen logs, and from

Connecticut Warbler (*Oporornis agilis*)



Note: This map represents a broad view of the distribution of potential habitat used by this species. The map is based on several ecosystem classifications (Ecoregion, Biogeoclimatic and Broad Ecosystem Inventory) as well as current knowledge of the species' habitat preferences. This species may or may not occur in all areas indicated.

foliage of low shrubs and herbs (Bent 1953; Griscom and Sprunt 1957; Curson et al. 1994). In British Columbia, most foraging is done within the shrub layer or along the ground (Enns and Siddle 1992).

Reproduction

Upon arriving on the breeding grounds, males select nesting territories and defend them from other conspecific males. Pairs form soon after and are presumably monogamous (Ehrlich et al. 1988; Pitocchelli et al. 1997). Information is lacking on nest construction (Pitocchelli et al. 1997). Nests are compact, deep cups of fine grass and rootlets lined with finer grass and hair (Baicich and Harrison 1997). Clutches contain three to five eggs (Bent 1953; Baicich and Harrison 1997). Egg-laying likely occurs mainly in mid- to late June in northeastern British Columbia (Campbell et al. 2001). The female alone incubates the eggs for an estimated 12–13 days (Bent 1953; Baicich and Harrison 1997). The nestling period is unknown, but is probably similar to the Kentucky Warbler, whose nestlings leave the nest after 8–10 days (Bent 1953; Baicich and Harrison 1997). Both parents feed the nestlings, landing with food 10–15 m from the nest and walking through the underbrush the remaining distance. Fledglings probably cannot fly for the first week and are cared for by both parents for at least 2 weeks (Bent 1953; Pitocchelli et al. 1997). A single brood is probably raised each year in British Columbia, a widespread pattern in warblers (Morse 1989). There are no data for Connecticut Warblers on hatching success, survival of nestlings, or fledging success anywhere in its range (Pitocchelli et al. 1997). The first nest found in British Columbia (spring 2002) contained five eggs on June 19, five well-feathered chicks on July 8 which left the nest by July 10.

Site fidelity

No data but likely return to same areas. There are no data to suggest that populations expand and contract in response to changes in prey availability (Cooper et al. 1997).

Home range/territory size

Data on breeding territory size is limited, however one study in Minnesota found territory sizes to range from 0.24 to 0.48 ha (Niemi and Hanowski 1984). In west-central Alberta, density of territorial males in 30-year-old aspen forest was 4.4/100 ha (Westworth and Telfer 1993). Lance and Phinney (1994) reported 4 pairs in one 32 ha study plot in northeastern British Columbia.

Dispersal and movements

Connecticut Warblers winter further south than most other North American warblers and so have a longer distance to travel during migration. They arrive in Canada later and leave earlier than most other warblers except for Mourning and Canada warblers (Cowan 1939; Salt 1973; Francis and Cooke 1986). Males probably arrive slightly earlier than females, a general pattern in many bird species. Spring migrants enter the province through northern Alberta, beginning in the last few days of May, with most probably arriving in early June (Campbell et al. 2001).

After nesting is completed, adults probably begin to migrate south in mid- to late July and juveniles probably follow in mid-August (Cooper et al. 1997).

Habitat

Structural stage

- 5: young forest
- 6: mature forest
- 7: old forest

Important habitats and habitat features

Nesting

Connecticut Warbler populations in different geographic regions may occupy somewhat different forest types, but all habitat descriptions from the western limit of its range (Saskatchewan, Alberta, and British Columbia) include deciduous, mainly aspen, forest (Johns 1993). In British Columbia, Connecticut Warblers generally breed in deciduous, often in pure trembling aspen (*Populus tremuloides*) stands, although aspen and spruce (*Picea* spp.), and balsam poplar (*Populus balsamifera*) and white spruce (*Picea glauca*) forests are also used.

There is some disagreement as to the preferred forest age in British Columbia. Although recent clearcuts are not used, breeding territories have been documented in forests from pole stage to old forest (>80 years old) (Westworth and Associates Ltd. 1984; Enns and Siddle 1992; Westworth and Telfer 1993; Lance and Phinney 1994). Pole age forests are probably the minimum growth stage suitable for this warbler as it has not been found in recent clearcut slash, sapling, or early pole seral stands (Lance and Phinney 1993, 1994; Westworth and Telfer 1993). It is not known whether pole stage forests are suitable or are possibly population sinks. Since this species nests on the ground or near the ground, structure may not be as important as development of appropriate herbaceous and understorey layers.

The herbaceous and shrub layers are probably the most important habitat features as this warbler forages almost exclusively on, or very near, the ground. Only one nest has been found in British Columbia (Campbell et al. 2001; M. Phinney, pers. comm.), however, the presence of singing males suggests breeding occurs at various localities. The one nest in British Columbia was found in a patch of pole-stage aspen trees within a larger multi-aged aspen mosaic. The nest was on the ground, situated under a dead stick and concealed from above by dead grasses and lush greenery (grasses, rose, peavine, columbine) (M. Phinney, pers. comm.) Some common characteristics of reported Connecticut Warbler nesting habitat in British Columbia include variable-aged forest with plenty of free mid-canopy level space, noticeable gaps in cover between the dense, shrubby understorey and the even, high canopy.

Nest site microhabitat seems to be relatively constant throughout its range (Baicich and Harrison 1997). The ground cover at nest sites can be characterized as richly vegetated and an overstorey of late pole or older stage forest is required. Nests are placed on the ground among herbs and grass or at the base of a sapling, in mossy hummocks, or a few inches off the ground in the base of a shrub (often wild rose), and are usually well concealed by overhanging vegetation

(Bent 1953; Baicich and Harrison 1997). In northeastern British Columbia, most breeding territories seem to be on “warm” (south- or west-facing slopes) sites (M. Phinney, pers. comm.).

Associated species include tall bluebell, white geranium, baneberry, rose, northern bedstraw, red-osier dogwood, willow, bluegrass, wildrye, timothy, paintbrush, junegrass, bunchberry, soopolallie, fireweed, American vetch and purple peavine, spruce are often interspersed sporadically throughout the stand (McTaggart-Cowan 1939; Penner 1976; Siddle 1992; Enns and Siddle 1992; Lance and Phinney 1993, 1994).

Habitat patch size seems critical as Connecticut Warblers do not seem to occupy aspen groves <4 ha in size (Johns 1993). In northeastern British Columbia, suitable habitat <5 ha may be used if it is within a larger forested area (Phinney, pers. comm.).

Low intensity spring ground fires may be important in maintaining suitable habitat (i.e., promotes herb layer and reduces shrub layer).

Foraging

Birds probably forage mainly within the nesting habitat, therefore feeding and nesting habitat requirements are the same.

Conservation and Management

Status

The Connecticut Warbler is on the provincial *Red List* in British Columbia. Its status in Canada has not been determined (COSEWIC 2002).

Summary of ABI status in BC and adjacent jurisdictions (NatureServe Explorer 2002)

BC	AB	Canada	Global
S2B, S2N	S4B	N5B	G4

Trends

Population trends

There are no data on population trends for Connecticut Warbler in British Columbia. Recent studies in northeastern British Columbia have shown conflicting results. Some authors reported Connecticut Warblers to be one of the least common warbler species in the northeast (Siddle 1992; Enns and Siddle 1992), while others suggest it may be more widespread and numerous (but still of local occurrence) than currently documented (Lance and Phinney 1993, 1994; Phinney 1998; Bennett et al. 2000). Data from the Fort Nelson Lowland are few, but Connecticut Warblers may occur there more frequently than is currently known as well (Cooper et al. 1997). Flack (1976) also suspects that, throughout its range, the Connecticut Warbler is more locally common and widely distributed than generally thought.

However, some authors believe all northeastern warblers are in decline (Siddle 1992). Rappole (1995) lists Connecticut Warbler amongst the neotropical migrants with a high probability of population decline in the next decade due to loss of winter habitat. This may be important because low-density breeding populations, particularly those at the edge of a species range, as in British Columbia, are usually the first to decline when overall numbers decline (Wilcove and Terborgh 1984). A comprehensive analysis of Breeding Bird Surveys from eastern North America revealed no significant population trends for the Connecticut Warbler between 1966 to 1988 (Hagan and Johnston 1992).

Considering the widespread population declines of neotropical migrants (Morton and Greenberg 1989; Terborgh 1989; Finch 1991), the overall lack of records for Connecticut Warblers in British Columbia, and the fact that this species relies on habitat in decline, it is probable that populations are stable or decreasing, and improbable that populations are increasing (Cooper et al. 1997).

Habitat trends

Trends in nesting habitat quantity for Connecticut Warblers are directly linked with harvesting of aspen stands (Cooper et al. 1997). An estimated 1800–4000 ha of aspen mixedwood forest is being harvested annually in the northeast (MOF 1994). Forests on flat, rolling topography, which may contain some of the best habitat, are being harvested at the greatest rate because of easy access (Cooper et al. 1997).

Threats

Population threats

The impact of nest parasitism by Brown-head Cowbirds is thought to be severe on neotropical migrant songbirds, especially in fragmented forests (Brittingham and Temple 1983; Askins et al. 1990; Hagan and Johnston 1992; Finch and Stangel 1993). Connecticut Warblers are known to be parasitized by cowbirds; however, the extent of parasitism has not been documented because of lack of nesting records (Pitocchelli et al. 1997). However, it is likely that the rate of parasitism will increase with increasing fragmentation of northeastern forests.

Forest fragmentation also increases edge habitat favoured by predatory species such as jays, crows, and magpies. Although there are no data for predation on Connecticut Warblers, all forest songbirds face greater predation intensity as forests are cleared (Wilcove 1985; Yahner and Scott 1988; Askins et al. 1990).

Migration is typically the period of highest mortality for both adult and juvenile warblers with hazards including natural environmental factors such as inclement weather and human-related factors such as collision with light towers (Pitocchelli et al. 1997).

Habitat threats

The primary threat to the Connecticut Warbler in British Columbia is the harvesting of aspen stands in northeastern British Columbia. Loss or deterioration of forest habitat has been widely blamed for declines in breeding populations of many warbler species

(Burgess and Sharpe 1981; Askins and Philbrick 1987; Terborgh 1989; Saunders et al. 1991; Hagan and Johnston 1992; Maurer and Heywood 1993). Research within northeastern British Columbia suggests that this warbler will be eliminated in the short term from clearcut blocks of aspen forest and will not recolonize these areas unless it is allowed to regenerate to the late pole stage (>10 cm dbh and >35–40 years; Cooper et al. 1997).

Timber harvest and shortening of harvest rotation cycles (Peterson et al. 1989) is rapidly reducing the amount of mature aspen and mixedwood forest within this species range. As a result, the age-class distribution of deciduous forests in the northeast is expected to change dramatically. In the Dawson Creek Timber Supply Area (TSA), it is projected that age-class distribution will be primarily <50 years of age in 50 years. In the early 1990s, there were approximately 112 000 ha of deciduous forest >80 years of age. However in 100 years, less than 12 000 ha of deciduous forest is forecast to be >80 years of age. Only aspen stands that are difficult to access, often due to a steep slope location, or reserved for other reasons, are not targeted for harvest (MOF 1994). It is not known if these areas are suitable for Connecticut Warblers.

Fragmentation effects are very important for this species as well. In Saskatchewan, there was a significant negative trend of occurrence with increasing isolation of suitable habitat (Johns 1993). Therefore, as habitat becomes increasingly fragmented, Connecticut Warblers are less able to use isolated suitable patches of habitat.

Silvicultural techniques that alter the shrub component, debris structure, and the eventual plant species distribution in mixedwood stands may also reduce the suitability of habitat for Connecticut Warblers (Cooper et al. 1997). Application of herbicides to eliminate deciduous forest and understoreys would reduce habitat availability (Cooper et al. 1997). Large-scale spraying of insecticides in deciduous forest habitat would inevitably reduce their insect prey base and therefore the quality of habitat available (Freedman et al. 1981).

Fire suppression may also be detrimental to Connecticut Warbler nesting habitat. Occasional fire may play a role in creating the habitat features, specifically the herbaceous and shrub development required by this species. However, regular prescribed burning to create ungulate winter range eliminates forest and potential Connecticut Warbler habitat (M. Phinney, pers. comm.).

In the Dawson Creek TSA, many of the pure stands of large aspen occur on private land adjacent to agricultural fields. Harvesting is currently taking place on private land, with an unknown area being converted to agricultural fields. This area is unlikely to revert to a mixedwood forest in the future (Cooper et al. 1997).

Grazing by domestic animals affects the herbaceous and shrub vegetation layers, which are important habitat features for this species. The precise impacts of grazing are not known but heavy grazing is likely very negative and light grazing may be compatible. Heavy grazing is bound to be detrimental to habitat quality (M. Phinney, pers. comm.).

Habitat is also lost or fragmented by other activities such as clearing for road building, transmission lines, and oil and gas exploration. For example, breeding territories in Minnesota were found to be farther from power lines than control plots with similar characteristics, suggesting that power line rights-of-way created unfavourable edge habitat (Niemi and Hanowski 1984).

Loss of winter habitat is expected to reduce the continental population, which may then be reflected in British Columbia's breeding population (Rappole 1995).

Legal Protection and Habitat Conservation

The Connecticut Warbler, its nests, and its eggs are protected from direct persecution in Canada by the *Migratory Birds Convention Act*. In British Columbia, the same are protected under the provincial *Wildlife Act*.

Like most warblers, this species is widely scattered on the breeding grounds. In British Columbia, small numbers are likely protected in various reserves and parks but data are generally lacking. Siddle (1992) lists Gundy, north of Tupper, and Cecil Lake as areas of consistent occurrence, but densities of birds and status of lands are uncertain. Class A parks such as Taylor Landing (2.4 ha), Kiskatinaw River (154 ha), and Beatton (312 ha) are within the known range and habitat type of this species, although records may be lacking. Belcourt River, Peace Boudreau Protected Area, and other proposed protected areas also have suitable habitat (Cooper et al. 1997).

Most other nesting habitat is on Crown land; therefore, habitat conservation may be partially addressed by the old forest retention targets (old growth management areas) riparian reserves and wildlife tree retention area recommendations as required under the results based code.

In addition, forest structure and species composition, especially the herbaceous and understorey layers, may be addressed by guidelines in the *Range Management Guidebook*. However, typical range management practices for livestock in the Dawson Creek area seem to preclude use of grazed areas by Connecticut Warblers (M. Phinney, pers. comm.). Grazing typically removes or damages the structural integrity of herbaceous and shrub layers. Light grazing may not be detrimental, but grazing in the northeast tends to be heavy where it occurs (M. Phinney, pers. comm.).

Identified Wildlife Provisions

The habitat for Connecticut Warblers is unique among northeastern songbirds at risk; therefore, habitat must be specifically managed for this species.

Sustainable resource management and planning recommendations

- ❖ Maintain suitable nesting habitat (deciduous leading stands). Consider greater mature or old retention in areas where this species is known to occur.

- ❖ Incorporate stands of pure trembling aspen and mixedwood forest within the Boreal Plains Ecoprovince into (1) old growth management areas; (2) areas constrained for other management objectives (e.g., visual quality, recreation, ungulate winter range, terrain concerns); or (3) stand level reserves such as wildlife tree retention areas and riparian management areas.
- ❖ Wildlife tree retention areas (WTR areas) and old growth management areas (OGMAs) may be suitable alternatives to wildlife habitat areas if centred on habitat used by Connecticut Warblers and at least 5–10 ha. Consider wildlife tree and old forest retention objectives for this species in the BWBSmw1, BWBSmw2 in Fort Nelson, and Peace forest districts. Blocks should be assessed to identify potentially suitable WTR areas. The following attributes (Table 1) should be used to design suitable WTR areas or OGMAs for this species.

Table 1. Preferred WTR area characteristics for the Connecticut Warbler

Attributes	Characteristics
Size (ha)	≥5 ha
Location	BWBSmw1, BWBSmw2; flat to gently sloping sites with southerly to westerly aspects
Features	herbaceous and shrub layers
Tree species	aspen; deciduous species
Age/structure	≥40 years; structural stages 5–7

- ❖ Maximize interior forest conditions of reserves, restrict salvage or harvest, maintain over the long term, and avoid insecticide use.
- ❖ Maintain corridors of forest habitat suitable for Connecticut Warbler where possible to reduce the impact of harvesting on this species (Cooper et al. 1997). Habitat corridors that connect patches of forest are proving to be an important factor in retaining bird community diversity in isolated patches (MacClintock et al. 1977), especially for ground-dwelling migratory birds such as Connecticut Warbler.

Wildlife habitat area

Goal

Maintain suitable nesting habitats. Consider size and shape of the WHA to minimize edge habitat.

Feature

Establish WHAs only within highly suitable nesting habitat (i.e., deciduous-leading forests) where concentrations (>3 pairs/10 ha) of Connecticut Warblers occur.

Size

Typically between 20 and 40 ha but will depend on site-specific factors.

Design

WHAs should include aspen or mixedwood stands with lush understoreys of herbs, within a larger undisturbed tract of forest. Consider locating in mesic or riparian sites and close to other protected forest areas or constrained areas (e.g., riparian reserve zones, sites with sensitive slopes, or soils). Minimize edge habitat wherever possible.

General wildlife measure

Goals

1. Ensure WHA is windfirm.
2. Maintain the herbaceous community.
3. Minimize disturbance during the nesting season (1 June to 31 July).
4. Minimize disturbance to nests.

Measures

Access

- Do not construct roads, trails, or other access routes.

Harvesting and silviculture

- Do not harvest.

Pesticides

- Do not use pesticides.

Range

- Plan livestock grazing (i.e., timing and browse utilization) to minimize negative impacts to this species. The “desired plant community,” including seral stage mix, species composition (i.e., aspen and deciduous species), and structural characteristics (i.e., understorey vegetation) should be maintained.
- Grazing after the nesting season (after 31 July) is preferable.
- Limit grazing of herb/forb species by livestock to no more than 50% utilization.
- Do not place livestock attractants within WHA.

Additional Management Considerations

Avoid prime Connecticut Warbler habitat when planning seismic explorations, transmission lines, and other access routes.

Information Needs

1. Distribution, population size, and trends.
2. Habitat suitability, especially the minimum suitable “desired plant community,” forest age class, and minimum patch size.
3. Effects of timber harvest, silviculture practices, and range management practices on populations and habitat.

Cross References

Black-throated Green Warbler, Bay-breasted Warbler, Cape May Warbler

References Cited

- American Ornithologists' Union (AOU). 1983. Checklist of North American birds. Lawrence, Kans. 877 p.
- Askins, R.A., J.F. Lynch, and R. Greenberg. 1990. Population declines in migratory birds in eastern North America. *Curr. Ornith.* 7:1–57.
- Askins, R.A. and M.J. Philbrick. 1987. Effect of changes in regional forest abundance on the decline and recovery of a forest bird community. *Wilson Bull.* 99:7–21.

- Baich, P.J. and C.J. Harrison. 1997. A guide to the nests, eggs, and nestlings of North American birds, second edition. Academic Press, London, U.K. 347 p.
- Bennett, S., P. Sherrington, P. Johnstone, and B. Harrison. 2000. Habitat use and distribution of neotropical migrant songbirds in northeastern British Columbia. *In Proc. Conf. on the biology and management of species and habitats at risk*. L.M. Darling (editor). Kamloops, B.C., Feb. 15–19, 1999. B.C. Min. Environ., Lands and Parks, Victoria, B.C., and Univ. Coll. Cariboo, Kamloops, B.C., pp. 79–88.
- Bent, A.C. 1953. Life histories of North American wood warblers. Smithsonian Inst., Washington, D.C. Bull. 203. 734 p.
- B.C. Ministry of Forests (MOF). 1994. Dawson Creek Timber Supply Area timber supply analysis. Victoria, B.C. 67 p.
- Brittingham, M.C. and S.A. Temple. 1983. Have cowbirds caused forest songbirds to decline? *Bioscience* 33:31–35.
- Burgess, R.L. and D.M. Sharpe (editors). 1981. *Forest island dynamics in man-dominated landscapes*. Springer-Verlag, New York, .N.Y.
- Campbell, R.W., N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser, A.C. Stewart, and M.C.E. McNall. 2001. The birds of British Columbia. Vol. IV: Passerines. Wood Warblers through Old World Sparrows. Royal B.C. Mus., Victoria, B.C., and Can. Wildl. Serv., Delta, B.C.
- Cannings, R.J. 1998. The birds of British Columbia: a taxonomic catalogue. B.C. Min. Environ., Lands and Parks, Wildl. Br., Victoria, B.C. WB-86.
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2002. Canadian Species at Risk. www.speciesatrisk.gc.ca
- Cooper, J.M., K.A. Enns, and M.G. Shepard. 1997. Status of the Connecticut Warbler in British Columbia. B.C. Min. Environ., Lands and Parks, Wildl. Br., Victoria, B.C. WR-83.
- Curson, J., D. Quinn, and D. Beadle. 1994. *Warblers of the Americas: an identification guide*. Houghton Mifflin, New York, N.Y. 252 p.
- Ehrlich, P.R., D.S. Dobkin, and D. Wheye. 1988. *The birder's handbook*. Simon and Schuster Inc., New York, N.Y. 785 p.
- Enns, K.A. and C. Siddle. 1992. The distribution, abundance and habitat requirements of selected passerine birds of the Taiga and Boreal Plains. Report prepared for B.C. Min. Environ., Lands and Parks, Victoria, B.C. Unpubl. 68 p.
- Erskine, A.J. and G.S. Davidson. 1976. Birds in the Fort Nelson lowlands of northeastern British Columbia. *Syesis* 9:1–11.
- Finch, D.M. 1991. Population, ecology, habitat requirements, and conservation of neotropical migratory birds. U.S. Dep. Agric. For. Serv., Fort Collins, Colo. Gen. Tech. Rep. RM–205.
- Finch, D.M. and P.W. Stangel. 1993. Status and management of neotropical migratory birds. U.S. Dep. Agric. For. Serv., Fort Collins, Colo. Gen. Tech. Rep. RM–229.
- Flack, J.A.D. 1976. Bird populations of aspen forests in western North America. *Ornith. Monogr.* 19.
- Francis, C.M. and F. Cooke. 1986. Differential timing of spring migration in wood warblers (Parulinae). *Auk* 103:548–556.
- Freedman, B., C. Beauchamp, I.A. McLaren, and S.I. Tingley. 1981. Forestry management practices and populations of breeding birds in Nova Scotia. *Can. Field-Nat.* 95:307–311.
- Godfrey, W.E. 1986. *The birds of Canada*. Revised ed. Natl. Mus. Can., Ottawa, Ont. 595 p.
- Griscom, L. and A. Sprunt, Jr. 1957. *The warblers of America*. Devin-Adair Co., New York, N.Y. 356 p.
- Hagan, J.M. III and D.W. Johnston. 1992. *Ecology and conservation of neotropical migrant landbirds*. Smithsonian Inst. Press, Washington, D.C. 609 p.
- Johns, B.W. 1993. The influence of grove size on bird species richness in aspen parklands. *Wilson Bull.* 105:256–264.
- Lance, A.N. and M. Phinney. 1993. Bird diversity and abundance following aspen clearcutting in the Boreal White and Black Spruce biogeoclimatic zone. FRDA report prepared for B.C. Min. For., Victoria, B.C. Unpubl. 40 p.
- _____. 1994. Bird diversity and abundance following aspen clearcutting in the Boreal White and Black Spruce biogeoclimatic zone. FRDA Report prepared for B.C. Min. For., Victoria, B.C. Unpubl. 40 p.
- MacClintock, L., R.F. Whitcomb, and B.L. Whitcomb. 1977. Evidence for the value of corridors and minimization of isolation in preservation of biotic biodiversity. *Am. Birds* 31:6–13.
- Machtans, C.S. 2000. Extra-limital observations of Broad-winged Hawk, *Buteo platypterus*, Connecticut Warbler, *Oporornis agilis*, and other bird observations from the Liard Valley, Northwest Territories. *Can. Field-Nat.* 114:671–679.
- Maurer, B.A. and S.G. Heywood. 1993. Geographic range fragmentation and abundance of neotropical migratory birds. *Conserv. Biol.* 7:501–509.

- McTaggart-Cowan, I. 1939. The vertebrate fauna of the Peace River district of British Columbia. B.C. Prov. Mus., Victoria, B.C. Occas. Pap. No. 1. 102 p.
- Morse, D.H. 1989. American warblers. Harvard Univ. Press, Cambridge, Mass. 406 p.
- Morton, E.S. and R. Greenberg. 1989. The outlook for migratory songbirds: "future shock" for birders. *Am. Birds* 43:178–183.
- NatureServe Explorer. 2002. An online encyclopaedia of life. Version 1.6. NatureServe. Arlington, VA. Available at <http://www.natureserve.org/explorer/>
- Niemi, G.J. and J.M. Hanowski. 1984. Effects of transmission line on bird populations in the red lake peatland, northern Minnesota. *Auk* 101:487–498.
- Penner, D.F. 1976. Peace River Sites C and E environmental impact studies: wildlife resources. Report prepared by Thurber Consultants Ltd. for B.C. Hydro, Vancouver, B.C. Unpubl. 307 p.
- Peterson, E.B., A. Kabzems, R.D. Kabzems, and N.M. Peterson. 1989. Boreal mixedwood forest management challenges: a synopsis of opinions from 1988 interviews. *For. Can., North. For. Res. Centre, Edmonton, Alta. ENFOR Proj. P-353*. 39 p.
- Phinney, M. 1998. Spring and summer birds of Dawson Creek 1991–1995. Wild Bird Trust of B.C., North Vancouver, B.C. Wildl. Rep. No. 4. 60 p.
- Pitocchelli, J., J. Bouchie, and D. Jones. 1997. Connecticut Warbler (*Oporornis agilis*). In *The birds of North America*, No. 320. A. Poole and F. Gill (editors). Acad. Natl. Sci., Philadelphia, Penn., and Am. Ornith. Union, Washington, D.C. 16 p.
- Pyle, P. 1997. An identification guide to North American birds: Part 1. Slate Creek Press, Bolinas, Calif. 732 p.
- Rappole, J.H. 1995. The ecology of migrant birds: a neotropical perspective. Smithsonian Inst. Press, Washington, D.C.
- Salt, W.R. 1973. Alberta vireos and wood warblers. *Prov. Mus. Arch. Alberta, Edmonton, Alta. Publ.* 3. 141 p.
- Saunders, D.A., R.J. Hobbs, and C.R. Margules. 1991. Biological consequences of ecosystem fragmentation: a review. *Conserv. Biol.* 5:18–32.
- Siddle, C. 1992. The declining populations of warblers in northeastern British Columbia. In *Community action for endangered species: a public symposium on B.C.'s threatened and endangered species and their habitat*. S. Rautio (editor). Vancouver, B.C., Sept. 28–29, 1991. Fed. B.C. Naturalists and Northwest Wildl. Preserv. Soc., Vancouver, B.C., pp. 143–151.
- Terborgh, J.W. 1989. *Where have all the birds gone?* Princeton Univ. Press, Princeton, N.J. 207 p.
- Westworth, D.A. and Associates Ltd. 1984. Impact on wildlife of short-rotation management of boreal aspen stands. *Can. Wildl. Serv., Edmonton, Alta. ENFOR Project P-203*. 148 p.
- Westworth, D.A. and E.S. Telfer. 1993. Summer and winter bird populations associated with five age-classes of aspen forest in Alberta. *Can. J. For. Res.* 23:1830–1836.
- Wilcove, D.S. 1985. Nest predation in forest tracts and the decline of migratory songbirds. *J. Ecol.* 66:1211–1214.
- Wilcove, D.S. and J.W. Terborgh. 1984. Patterns of population decline in birds. *Am. Birds* 38:10–13.
- Yahner, R.H. and D.P. Scott. 1988. Effects of forest fragmentation on depredation of artificial nests. *J. Wildl. Manage.* 52:158–161.

Personal Communications

- Phinney, M. 2000. Louisiana-Pacific Canada Ltd., Dawson Creek, B.C.