# Golden-cheeked warbler
(*Setophaga chrysoparia*)

# 5-Year Review:
# Summary and Evaluation


Male (D. Lindsay)


Female feeding young (G. Eckrich)

U.S. Fish and Wildlife Service
Austin Ecological Services Field Office
Austin, TX
August 26, 2014

# 5-YEAR REVIEW
## Golden-cheeked warbler (*Setophaga chrysoparia*)

## 1.0 GENERAL INFORMATION

### 1.1 Reviewers:

**Lead Regional Office:** Southwest Regional Office, Region 2
Susan Jacobsen, Chief, Division of Classification and Restoration (505) 248-6641
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**Lead Field Office:** Austin Ecological Services Field Office (AESFO)
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### 1.2 Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing as endangered or threatened is based on the species' status considering the five threat factors described in section 4(a)(1) of the Act. These same five factors are considered in any subsequent reclassification or delisting decisions. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process including public review and comment.

### 1.3 Methodology used to complete the review:

The Service provides notice of status reviews via the Federal Register and requests information on the status of the species. No comments were received during the 90-day request for information period. This review was conducted by Timothy Breen from the Austin Ecological Services Field Office and relied heavily on a status review contracted through a grant under section 6 of the Act to Texas A&M University (TAMU). Additionally, we requested the Golden-cheeked Warbler Recovery Team review and provide comments on this document and have incorporated those comments into this review.

## 1.4 Background:

The GCWA is a small, insectivorous, migratory songbird that breeds only in the mixed Ashe juniper/deciduous woodlands of the central Texas Hill Country west and north of the Balcones Fault (Pulich 1976, p. 1). GCWA require the shredding bark produced by mature Ashe junipers for nest material (Pulich 1976, p. 1). Breeding and nesting GCWA feed primarily on insects, spiders, and other arthropods found in Ashe junipers and associated deciduous tree species (Pulich 1976). In July-August, GCWA migrate through Mexico and Central America to winter in the mountainous regions of southern Mexico, Guatemala, Honduras, El Salvador, and Nicaragua; they return to Texas from late February through April. It was originally listed as a member of the *Dendroica* genus; in 2011, the genus was changed to *Setophaga* (see section 2.3.1.4). In accordance with this current information, we officially accept the new scientific name of the GCWA as *Setophaga chrysoparia* in this 5-year review.

### 1.4.1 FR Notice citation announcing initiation of this review:

21 April 2006 (71 FR 20714), with 90-day request for information period.

### 1.4.2 Listing history

Original Listing

**FR notice:** Emergency listed 55 FR 18844 and final 55 FR 53153
**Date listed:** Emergency-listed as endangered on May 4, 1990; Final Rule published on December 27, 1990
**Entity listed:** Golden-cheeked warbler (*Dendroica chrysoparia*)
**Classification:** Endangered, without critical habitat

Revised Listing, if applicable: N/A; there have been no revisions.

### 1.4.3 Associated rulemakings: None.

### 1.4.4 Review History:

Prior to listing, in 1976, Pulich (pp. 1-128) completed a status review of the GCWA, which described the species, its life history, known breeding and wintering distribution, and habitat. Pulich (1976, p. 132) concluded at that time that if the rate of habitat clearing continued at the current rate, Ashe juniper trees, which are necessary for GCWA nesting/reproduction, could be eliminated by the turn of the century.

Additional status reviews of the GCWA were conducted in 1990 for the emergency and final listings (55 FR 18844, 55 FR 53153), in 1992 for the GCWA Recovery Plan (USFWS 1992, pp. 1-34), and in 2010 by TAMU (Groce et. al. 2010, pp. 1-193).

### 1.4.5 Species' Recovery Priority Number at start of 5-year review: 2C

A Recovery Priority Number of 2C indicates the taxon is a species, with a high degree of threat, high potential for recovery, and conflict exists with economic development or human resource use.

**1.4.6 Recovery Plan or Outline**
**Name of plan or outline**: Golden-cheeked Warbler Recovery Plan
**Date issued**: September 1992
**Dates of previous revisions, if applicable**: N/A

## 2.0 REVIEW ANALYSIS

### 2.1 Application of the 1996 Distinct Population Segment (DPS) policy

**2.1.1 Is the species under review a vertebrate?** Yes.

**2.1.2 Is the species under review listed as a DPS?** No.

### 2.2 Recovery Criteria

**2.2.1 Does the species have a final, approved recovery plan?** Yes.

**2.2.1.1 Does the recovery plan contain objective, measurable criteria?** Yes. The recovery plan contains objective, measurable delisting criteria; downlisting criteria have not been developed.

**2.2.2 Adequacy of recovery criteria.**

**2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?** No. Additional information has been collected since the recovery plan was published and warrants revision of the recovery plan. The Service is in the process of revising the recovery plan.

**2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?** No.

**2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:**

The GCWA recovery plan (USFWS 1992) contains the following recovery criteria:

(1) sufficient breeding habitat has been protected to ensure the continued existence of at least one viable, self-sustaining population in each of eight regions outlined in the plan;

(2) the potential for gene flow exists across regions between demographically self-sustaining populations where needed for long-term viability;
(3) sufficient and sustainable non-breeding habitat exists to support the breeding populations;
(4) all existing GCWA populations on public lands are protected and managed to ensure their continued existence and;
(5) all of these criteria have been met for 10 consecutive years (Service 1992, p. iv).

Although progress has been made towards these criteria, none have been achieved to date. Additionally, the existing criteria are only for delisting and the recovery plan lacks downlisting criteria. Changes in the GCWA's distribution, abundance, and threats have occurred since the recovery plan was published in 1992 (see Section 2.3. this document). Therefore, the criteria identified in the 1992 recovery plan do not adequately address all of the threats to the species nor do they reflect the current needs of the species based on the best available science. A revision to the recovery plan is warranted and a draft is being developed. The revised recovery plan will evaluate the utility of the eight recovery regions identified in the original plan, and it will also incorporate downlisting criteria, which will allow us to more accurately chart the progress toward threatened status and ultimately removal from the list.

## 2.3 Updated Information and Current Species Status

### 2.3.1 Biology and Habitat

#### 2.3.1.1 New information on the species' biology and life history:

In their breeding range, GCWA pairs have been found in habitat patches smaller than 10 hectares (ha) (24.7 acres [ac]); however, successful reproduction is more likely if patches of habitat exceed 15 ha (37 ac) (Arnold et al. 1996, p. 19; Butcher et al. 2010, p. 135-138). One study indicated that the probability of occupancy of a particular patch by GCWA increases with increasing patch size, reaching a probability of 100 percent between approximately 160 and 200 ha (400 and 500 ac) (Collier et al. 2010). Reproductive success of GCWA is higher in large, unfragmented patches of habitat as compared to small, fragmented patches, and reproductive success increases as forest edge decreases (Maas-Burleigh 1998, p. 16; Coldren 1998, pp. 74-75; Peak 2007, p. 632, Reidy et al. 2009, p. 410). Research on the wintering range found that GCWA prefer foraging in deciduous trees in pine-oak forests (Thompson 1995, p. 12; Rappole 1996, p. 15). In their wintering habitat, GCWA usually occur in mixed-species flocks that move within a home range that varies from 1.8 to 9.6 ha (4.4 to 23.7 ac) (Braun et al. 1986, p. 564; Vidal et al. 1994, p. 689; Rappole et al. 1999, p. 765; King and Rappole 2000, p. 667). Although as many as 12 GCWA have been seen in one flock, studies show that most mixed-species flocks contain a single GCWA (Kroll 1980 p. 64; Braun et al. 1986, p. 564; Vidal et al. 1994, pp. 686-688; Thompson 1995, p.11; Rappole et al. 1999, p. 764).

**2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends**:

Several studies have assessed GCWA abundance. The first, by Pulich (1976, pp. 9-12), was based on one site each in Dallas, Bosque, and Kendall Counties and estimated 14,950 individuals (Pulich 1976, pp. 10-11, 163). In 1990, Wahl et al. (1990, pp. 32-35, 55) estimated available habitat and determined there was a maximum carrying capacity of 4,822 to 16,016 pairs. Comparing Wahl et al.'s and Pulich's estimates, the Service (1992, pp. 18-20) estimated 13,800 territories. In 2007, SWCA Environmental estimated 20,445 to 26,978 pairs (SWCA 2007, pp. 34-43). Finally, Mathewson et al. (2012, pp. 1, 117) estimated the range-wide population of male GCWA to be 263,339. However, others have cautioned that this analysis may have over-predicted density estimates, resulting in inflated population estimates. For example, Mathewson et al. (2012) used point counts to estimate the number of GCWA on a portion of the Balcones Canyonlands Preserve in Travis County, Texas. The same area was intensively surveyed by City of Austin staff using territory-mapping, color banding, and nest monitoring (Reiner et al. 2013, p. 28). Abundance estimates from Mathewson et al. (2012) were 1.4 to 13 times the data generated by the City of Austin. Due to the size and geographic distribution of the breeding and wintering habitat, an actual count of GCWA individuals in any given year is not possible range-wide. However, the differences in individual population estimates listed above underscores the need for more accurate status and distribution information for the GCWA.

Since the GCWA was listed in 1990, there have been increased efforts to obtain survival and productivity data to better understand population trends. Several life history characteristics of the GCWA contribute to difficulties in obtaining accurate data including the elusive behavior of females (Hayden and Tazik 1991, pp. 40), the difficulty in locating and accessing nest sites (Hayden and Tazik 1991, pp. 48), and the high rate of juvenile dispersal (Jette et al. 1998, pp. 35). Therefore, much of the information available for population demographics on the breeding grounds is based on observations of the more conspicuous male. Accurate measures of reproductive success and survival for the species rely on the detection of females, nests, and fledglings. Survey techniques, such as point counts, that rely on detection of males do not detect whether males have successfully paired; therefore, reproductive success of the GCWA may be underestimated when based on counts of males (Weckerly and Ott 2008, p. 3).

**2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.)**:

Lindsay et al. (2008, p. 2123) examined population genetics of GCWA using 109 individuals across 7 sample sites. The authors found no evidence of genetic bottlenecks or genetic differentiation among populations, suggesting that gene flow among populations was unimpeded. The authors also suggested that there was no evidence of elevated risk of extinction resulting from the genetic mechanisms

examined (Lindsay et al. 2008, pp. 2130). However, Athrey et al. (2011, p. 1346-1348) used historical and recent samples to assess demographic changes on population genetics of the GCWA. They documented a steep decline in genetic diversity over a 100-year period, an increase in genetic differentiation in all 3 sample sites, and low effective sizes for current populations. They contribute the steep increase in genetic differentiation to increased habitat loss and fragmentation throughout the range of the GCWA and suggest that barriers to gene flow are recent phenomena (Athrey et al. 2011, pp. 1352).

**2.3.1.4 Taxonomic classification or changes in nomenclature**:

The GCWA was first described by Sclater and Salvin (1860, p. 298) from a specimen collected by Osbert Salvin in Guatemala. The American Ornithologists' Union Committee on Classification and Nomenclature transferred all species in genus *Dendroica* to the genus *Setophaga* (Chesser et al. 2011, pp. 600). In this 5-Year Review, the Service is adopting this change in nomenclature for the GCWA, and we refer to the species as *Setophaga chrysoparia* throughout this document. In accordance with this current information, we officially accept the new scientific name of the GCWA as *Setophaga chrysoparia*.

**2.3.1.5 Spatial distribution, trends in spatial distribution or historical range**:

Golden-cheeked warblers breed exclusively in the mixed Ashe juniper/deciduous woodlands of the Edwards Plateau, Lampasas Cut-Plain, and Llano Uplift regions of central Texas from March to August (Figure 1; Kroll 1974, p. 45; Oberholser 1974, p. 751; Pulich 1976, pp. 54, 67-68). In July GCWA begin migrating southward from Texas through the Sierra Madre Oriental mountain range and winter in the mountainous regions (highlands) of southern Mexico (Chiapas) and Central America (Guatemala, Honduras, El Salvador, and Nicaragua) (Figure 1; Ridgeway 1902, p. 566; Oberholser 1974, p. 750; Pulich 1976, pp. 55, 58, 62; Perrigo and Booher 1994, p. 15; Rappole et al. 1999, pp. 768-769; Komar 2008, pp. 2-3).

In Central America, the occurrence of GCWA in northern El Salvador and north-central Nicaragua during the winter has only been confirmed within the last 6 years (Morales et al. 2008, p. 30; King et al. 2009, p. 48; Komar 2008, pp. 2-3). In addition, several new areas with warbler occurrences have been documented since 2000 (Jones and Komar 2008a, pp. 169; Jones and Komar 2008b pp. 317). Eight sightings from Costa Rica (highlands of the Central Valley) and one from Panama suggest the warbler's wintering range may extend further south than Nicaragua (Jones 2005b, p. 1; Jones and Komar 2006, p. 155; Groce et al. 2010, p. 33).

The GCWA migrates north and south along the Sierra Madre Oriental of Mexico, through the Mexican states of Coahuila, Nuevo Leon, Tamaulipas, Queretaro, and Veracruz (Phillips 1911, p. 86; Pulich 1976, pp. 56-58; Johnson et al. 1988, p. 131; Lyons 1990, p. 48; Perrigo et al. 1990, p. 28). Sightings are typically at elevations above 1,100 meters (m) (3,609 feet [ft]) in the pine (*Pinus* spp.), pine-oak (*Quercus* spp.), and oak-sweetgum (*Liquidambar styraciflua*) woodlands of the

Sierra Madre Oriental (Braun et al. 1986, p. 564; Johnson et al. 1988, p. 131; Perrigo et al. 1990, p. 28; Perrigo and Booher 1994, pp. 14-15).

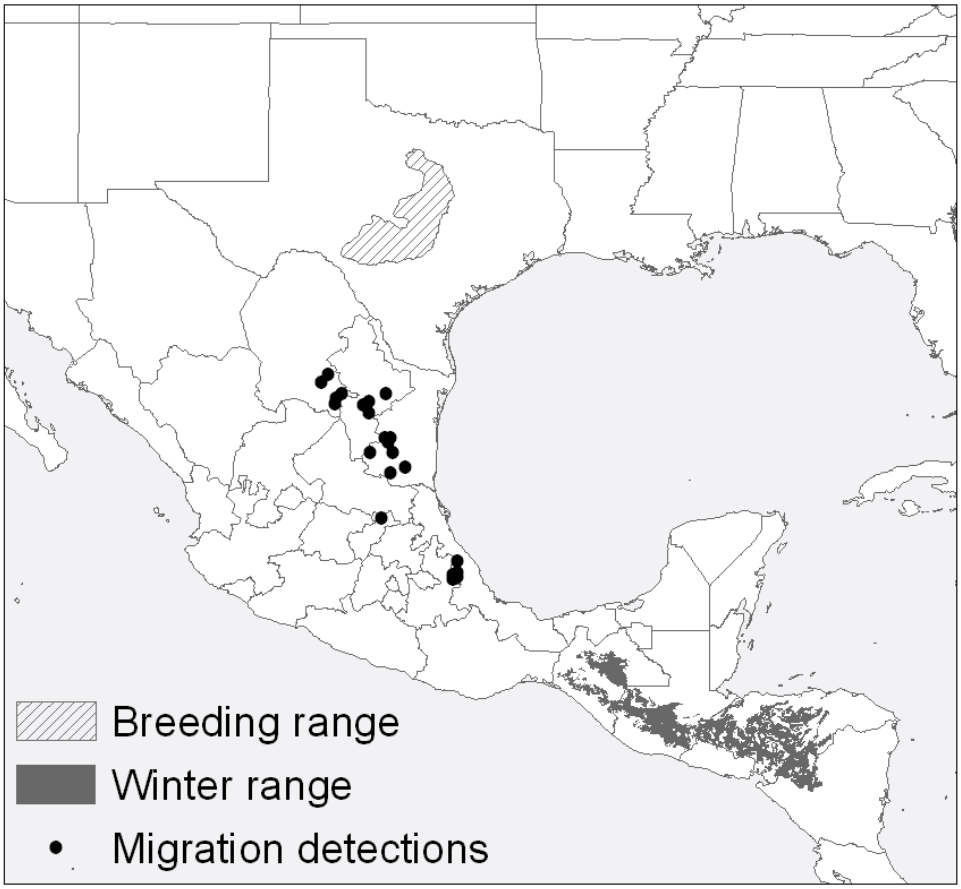


**Figure 1. Golden-cheeked warbler breeding, migration (Sierra Madre Oriental), and wintering range (Groce et. al 2010, p. 18)**

**2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem)**:

Several estimates of potential GCWA breeding habitat exist. The earliest estimate used the Soil Conservation Service's 1962 and 1974 vegetation surveys, which resulted in an estimate of 129,904 ha (326,000 ac) (Pulich 1976, p. 163). The next set of GCWA habitat estimates used satellite imagery from 1997 or earlier and range from 32,149 to 1,676,140 ha (78,441 to 4,141,832 ac) (Wahl et al. 1990, pp. 17-35, 55; Rowell et al. 1995, pp. 9-17; Diamond and True 2008, pp. 49-56; The Nature Conservancy 2002, pp. 4-8; Rappole et al. 2003, pp. 735-741). The most recent GCWA habitat estimates used 2001 Landsat imagery and range from 552,195 to 1,771,883 ha (1,364,504 to 4,378,418 ac) (Diamond 2007, pp. 1-27; SWCA 2007, pp. 22-24; Loomis Austin 2008, pp. 3-15; Groce et al. 2010, p. 101; Morrison et al. 2010, pp. 72-75). The differences in these numbers are

mainly due to the use of different vegetation types, different definitions of breeding habitat and patch size, and different parameters included or excluded from the habitat models. For example, the models used aerial imagery from different years, which reflect varying amounts of available habitat.

A recent habitat analysis concluded there had been an estimated 29 percent loss of existing breeding season habitat between 1999-2001 and 2010-2011 (Duarte et al. 2013, p. 7). The authors acknowledge that such a large estimated reduction in habitat is likely a function of the additive influence of direct GCWA breeding habitat loss, their minimum habitat patch size criterion, and their lack of consideration for creation of new warbler breeding habitat. Others have previously documented the loss of habitat within the breeding range of the GCWA as a result of residential and commercial development, highways, transmission corridors, reservoirs, and human population growth (Groce et al. 2010, p. 113-131).

The Alliance for the Conservation of Mesoamerican Pine-oak Forest (2008, p. 22; ACMPOF) developed a map of potential wintering habitat based on documented sightings (Pulich 1976, pp. 57-62; Vidal et al. 1994, pp. 685-687; Thompson 1995, pp. 13-49; and Rappole et al. 1999, pp. 763-765; ACMPOF 2008, p. 12). The area covered by pine-oak forests and pure oak stands (*Quercus* spp.) ranging from 900 to 2,200 m (2,953 to 7,218 ft) above sea level, and considered potential GCWA habitat, is approximately 19,500 $km^2$ (7529 $mi^2$) or 18.78 percent of the Mesoamerican Pine-oak Forest's total area (ACMPOF 2008, p. 21). A survey in Honduras indicated that GCWA have less specific habitat requirements in their wintering range as long as the habitat is forested and contains approximately 5.6 $m^2$/ha of encino oak basal area (King et al. 2012, pp. 7).

#### 2.3.1.7 Conservation Measures:

See discussion below, in section 2.3.2.1, covering Long-term Land Protection, Section 7 Consultations and Habitat Conservation Plans, and International Conservation in Migratory/Wintering Range.

### 2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

#### 2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

***Habitat Loss.*** The GCWA is threatened by ongoing and imminent habitat loss. Historically, the primary cause of habitat loss was juniper clearing to create pastures for cattle grazing (Pulich 1976, pp. 72-73). Other causes of habitat loss included cutting junipers for fence posts, furniture, and cedar oil. However, recent habitat loss in Travis, Williamson, and Bexar Counties is due to rapid suburban development (Biological Advisory Team 1990, p. 19; Groce et al. 2010,

p. 142). Further, the human population is projected to continue to increase throughout the GCWA's range (Groce et al. 2010, p. 118). This growth will continue to bring additional residential and commercial development, which will further reduce and fragment GCWA breeding habitat.

***Habitat Fragmentation.*** The loss of habitat through activities such as residential development often results in the fragmentation of larger contiguous patches of habitat and increased isolation of habitat patches which can prevent the interaction between nearby populations of the GCWA. Habitat fragmentation has been shown to influence habitat quality for woodland songbirds, such as the GCWA, in the following ways: (1) small patch size and thus small population size make extant populations more susceptible to random extinction or effects of inbreeding; (2) increased distance between patches reduces gene flow between populations and makes recolonization of vacant patches more difficult; and (3) increased proportion of habitat edge in small patches may alter patterns of insect abundance, vegetation structure, and songbird foraging activity (due to changes in the microclimate) (Brett 1989, pp. 7-8; Reville et al. 1990, p. 23; Saunders et al. 1991. p. 18, 22, 24). Fragmentation also heightens rates of nest parasitism and nest predation to the point at which the surviving songbird populations cannot maintain themselves (Lovejoy et al. 1986, p. 263; Wilcove et al. 1986, p. 248, 251).

Many GCWA populations may be impacted by the adverse effects of habitat fragmentation, particularly due to their dependence on mature forest habitat for foraging and nesting. Selection of nesting habitat is especially important, because nest location often affects reproductive success (Martin 1998, p. 656) and population viability. In addition, the fragmentation of large blocks of breeding habitat can reduce occupancy and breeding success (Peak 2007, p. 632; Groce et al. 2010, p. 10). For example, DeBoer and Diamond (2006, p. 186, 188) found that GCWA were more likely to occupy large contiguous patches of habitat that contained less edge.

***Reduced Oak Recruitment.*** Additional threats to the GCWA breeding habitat include reduced oak recruitment due to herbivory from native and non-native animals, death of mature oaks from oak wilt, and the potential for catastrophic wildland fires from increasing fine fuel loads and urban encroachment (Groce et al. 2010, pp. 137-139, 141).

***Pine-Oak Forest Conversion***. The ongoing destruction and fragmentation of pine-oak forests throughout the GCWA's migration and wintering habitat has been due to unsustainable forestry practices, fires from agricultural conversion, extraction of timber, and cattle ranching (Dinerstein et al. 1995, p. 87; Redo et al. 2009, p. 95; Groce et al. 2010, p. 131). While some countries have a legal framework that encourages sustainable forestry, they still allow clearcutting, which results in forest fragmentation, reduced species diversity, and soil loss (ACMPOF 2008, p. 34).

***Long-term Land Protection.*** Several properties have been acquired in the GCWA's breeding range that provide long-term protection. They include 77,198 ac (31,241 ha) of Department of Defense lands (Fort Hood, Camp Bullis, and U.S. Army Corps Engineers); 39,428 ac (15,956 ha) on Texas Parks and Wildlife Department lands; 2,844 ac (1,151 ha) on Lower Colorado River Authority properties; 14,789 ac (5,742 ha) on the Balcones Canyonlands National Wildlife Refuge; and over 50,000 ac (20,234 ha) of additional lands owned across the range by cities, counties, conservation organizations, and others (Groce et al. 2010, pp. 11, 151, 155-156). The land management practices vary on these lands; however, many are managed for the GCWA.

***Section 7 Consultations and Habitat Conservation Plans.*** According to the Service's consultations tracking database, there have been 56 formal consultations on the GCWA under section 7 of the Act. Over 98,000 acres of GCWA habitat were authorized to be impacted by these consultations. The result of these consultations is over 67,800 acres of GCWA habitat maintained on Department of Defense land and over 32,000 acres of private land preserved and/or maintained for the benefit of the GCWA. Additionally, since 2006 the Service has authorized impacts to over 24,700 acres of GCWA habitat through the development of five Habitat Conservation Plans (HCP) under section 10(a)(1)(B) of the Act. The result of all HCPs if fully implemented is over 59,000 acres of habitat protected and almost $1.3 million for the preservation and/or maintenance of land for the benefit of the GCWA.

***International Conservation in Migratory/Wintering Range.*** Since listing, there have been several efforts to encourage GCWA preservation in the winter range. The most notable effort is the ACMPOF, which was formed in 2003, and consists of eight institutions located in the United States, Mexico, Guatemala, El Salvador, Honduras, and Nicaragua. The ACMPOF (2008, p. 8) drafted a conservation plan for the ecoregion with the goal of conserving pine-oak forest habitat, which will help ensure GCWA survival. This conservation plan represents the first regional management, conservation, and sustainable development effort for pine-oak forests with the purpose of promoting and sustaining biodiversity, water, timber, recreation, and sustainable rural development (ACMPOF 2008, p. 11).

Although efforts to restore, create, and manage GCWA habitat are underway, habitat continues to be degraded or lost across the species' range. As stated above, a recent analysis suggests there may have been as much as a 29 percent loss of breeding season habitat just over the 12 year period between 1999 and 2011. Due to the ongoing declines in habitat area, and continuing habitat destruction and fragmentation, the magnitude of this threat is high.

**2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:** There is no evidence that GCWA are threatened by overutilization. Mist netting of the GCWA occurs for scientific purposes and is regulated by the

Service pursuant to section 10(a)(1)(A) of the Act, the Migratory Bird Treaty Act, and by Texas Parks and Wildlife Department (TPWD, Title 31, Part 2, Chapter 69, subchapter J). This activity rarely results in death or injury to the birds. Therefore, we do not consider this factor to be a threat to this species.

**2.3.2.3 Disease or predation:** No diseases in GCWA have been reported; therefore, we do not consider disease to be a threat to this species.

Red-imported fire ants (*Solenopsis invicta*), snakes, other bird species, and mammals have all been documented to prey on GCWA adults and/or young (Stake et al. 2004, p. 341; Reidy et al. 2008, pp. 462-463; Reidy et al. 2009, p. 418). Two separate studies have documented nest predation by red-imported fire ants (Stake et al. 2004, p. 341; Reidy et al. 2008, p. 462). Texas rat snakes have been observed preying on female warblers while on the nest (Stake et al. 2004, p. 341; Reidy et al. 2008, p. 462; Reidy et al. 2009, p. 418). Other likely or documented GCWA predators include western coachwhip (*Masticophis flagellum testaceus*), Great Plain's rat snake (*Elaphe guttata emoryi*), western scrub-jay (*Aphelocoma californica*), Cooper's hawk (*Accipiter cooperii*), American crow (*Corvus brachyrhynchos*), greater roadrunner (*Geococcyx californianus*), brown-headed cowbird (*Molothrus ater*), and mice (*Peromyscus* sp.) (Stake et al. 2004, p. 341; Reidy et al. 2008, p. 463).

Predation is a natural occurrence in GCWA habitat; however, increased fragmentation creates increased edge which can increase nest predation and reduce reproductive output (Peak 2007, pp. 632). Fragmentation of GCWA habitat can increase predation by opportunistic species, such as fox squirrels (*Sciurus niger*), blue jays (*Cyanocitta cristata*), grackles (*Quiscalus spp.*), and feral cats (*Felis domesticus*), which adapt well to fragmented and urban habitats. Most of these species have the potential to impact GCWA populations by destroying eggs, young birds, and adults. Avian predators are more abundant in GCWA habitat within 328 feet (100 meters) from edges (Arnold et al. 1996, p. 27), which may affect GCWA use and/or reproductive success (Fink 1996, p. 72, Coldren 1998, p. 77-79, 100, 103). For example, urban sprawl has resulted in an increase in the blue jay population, which feeds on eggs and nestlings and may have contributed to the warbler's extirpation from suburban areas where suitable habitat is found (Engels and Sexton 1994, p. 289; Engels 1995, p. 38-44).

Nest predation and parasitism likely varies annually and regionally (Groce et al. 2010, p. 60). Due to this variance, the magnitude of this threat is moderate. The GCWA continues to be affected by predation and nest parasitism and these threats can be exacerbated by the loss and fragmentation of habitat. Therefore, we believe the degree of this threat to be significant.

**2.3.2.4 Inadequacy of existing regulatory mechanisms:** The Migratory Bird Treaty Act of 1918 (MBTA) offers some protection to GCWA. This species is also listed by the State of Texas as an endangered species. However, neither of these protections prohibits habitat destruction, which is an imminent threat to the GCWA. In addition to being federally listed as endangered under the Endangered Species Act in the United States, both Mexico and El Salvador have national lists of threatened and endangered species which include GCWA. However, the species is not listed under CITES, nor is it listed in Honduras, Nicaragua or Guatemala.

**2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Climate change

According to the Intergovernmental Panel on Climate Change (IPCC), "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." Average Northern Hemisphere temperatures during the second half of the 20th century were very likely higher than during any other 50-year period in the last 500 years and likely the highest in at least the past 1,300 years (IPCC 2007, p. 1). It is very likely that over the past 50 years cold days, cold nights and frosts have become less frequent over most land areas, and hot days and hot nights have become more frequent (IPCC 2007, p. 1). It is likely that heat waves have become more frequent and the frequency of heavy precipitation events has increased over most areas (IPCC 2007, p. 1).

The IPCC (2013, pp. 15-16) predicts that changes in the global climate system during the 21st century are very likely to be larger than those observed during the 20th century. For the next two decades (2016-2035), a warming of 0.3°C (0.5°F) to 0.7°C (1.3°F) per decade is projected (IPCC 2013, p. 15). Afterwards, temperature projections increasingly depend on specific emission scenarios (IPCC 2007b, p. 6). Various emissions scenarios suggest that by the end of the 21$^{st}$ century, average global temperatures are expected to increase 0.3°C to 4.8°C (0.5°F to 8.6°F), relative to 1986-2005 (IPCC 2013, p. 15). By the end of 2100, it is virtually certain that there will be more frequent hot and fewer cold temperature extremes over most land areas on daily and seasonal timescales, and it is very likely that heat waves and extreme precipitation events will occur with a higher frequency and intensity (IPCC 2013, pp. 15-16).

Localized projections suggest the southwest may experience the greatest temperature increase of any area in the lower 48 States (IPCC 2007, p. 8). The IPCC also predicts that hot extremes and heat waves will increase in frequency and that many semi-arid areas like the western United States will suffer a decrease in water resources (IPCC 2007, p. 8). Others project a 10–30 percent decrease in precipitation in mid-latitude western North America by the year 2050 (Milly et al. 2005, p. 349).

***Increased Wildfire.*** Climate change projections indicate continued droughts and increased wildfire risk, which can further restrict existing breeding habitat (EPA 2009, p. 49). Throughout the GCWA's range, urban development encroaches into Ashe juniper woodlands and this alone contributes to the risk of catastrophic wildfires. As large wooded ranches are subdivided into smaller parcels, it becomes more challenging to defend against large wildfires (Hermansen-Báez et al. 2009, p. 1). Additionally, in the absence of naturally occurring fire, juniper needles can persist on the ground for 40 to 50 years (White et al. 2009, p. 9). This build-up of dry material contributes to the potential for large stand replacement fires that can burn so hot that they destroy the seed bank in the soil and lengthen woodland recovery time (Reemts and Hansen 2008, pp. 1062-1064; White et al. 2009, p. 9). Typically these large stand replacement fires occur during the mid-summer months when rain is lacking, which makes the air and trees very dry (White et al. 2009, p. 9).

In response to the 2000 fire season, Congress directed the Secretaries of the Interior (DOI) and Agriculture (USDA) to work with Governors to develop a 10-year comprehensive strategy for reducing wildfire risks to communities and the environment (Public Law 106-291). Despite the large scale nationwide efforts to reduce the potential for wildfires, annual acreages destroyed by wildfires in Texas have ranged from 35,044 acres (14,181 hectares) in 2002, to over 1.5 million acres (607,000 hectares) in both 2006 and 2009 (DOI and USDA 2006, pp. 1-2; DOI and USDA 2009, pp. 1-2; National Interagency Fire Center 2010, pp. 1-9), and close to 4 million acres in 2011 (The Texas Interagency Coordination Center 2011). We are unaware of the exact acreages burned within the GCWA's breeding range, but with the increasing fuel loads within forests and urban encroachment into GCWA habitat, catastrophic wildfires are a potential threat to the long-term survival and recovery of the GCWA.

***Range Shifts/Restrictions.*** The Environmental Protection Agency (EPA) developed an evaluation framework and assessment of the vulnerability of several species to the effects of climate change (EPA 2009, p. 1). The GCWA was classified as "critically vulnerable" to climate change due to the species' dependence upon Ashe juniper, the historical and continued loss of the species' breeding habitat, and the fact that the geographical extent of this habitat is probably limited by surface geology (EPA 2009, p. 50). Stands of mixed juniper-oak woodlands are restricted to areas in central Texas containing suitable geology, soil, precipitation, and land use practices (Diamond 1997, p. 1-4). Increased temperatures in the southern portions of the breeding range of many species is predicted to shift breeding ranges northward; however, GCWA are currently limited to the northern extent of their breeding range by distributional limits of their associated breeding habitat (EPA 2009. pp. 45-46). Expansion of juniper woodlands to the north is unlikely because just north of its current range the soil becomes deeper, more fertile, and more suitable for grasslands and deciduous trees. The land is also intensively farmed, creating unsuitable habitat for junipers. Further,

the Dallas-Ft. Worth metropolis lies on the northern edge of the species' range. This is an urban barrier approximately 90.5 kilometers (km) wide by 48 km deep (50 miles [mi] wide by 30 mi deep). Even if suitable soils and land-use patterns existed to the north, it is unlikely that Ashe juniper could expand through such a barrier (EPA 2009, p. 46).

Climate change models that focused on vegetation in Mexico indicate that with increasing temperatures and decreasing precipitation there could be a corresponding reduction in the geographic distribution of oaks and pines. Further, pines may be more vulnerable to fluctuations in temperature and precipitation (Gomez-Mendoza and Arriaga 2007 p. 1,545). One of the most vulnerable pines, ocote pine (*Pinus oocarpa*; Gomez-Mendoza and Arriaga 2007, p. 1,545), was described by Rappole et al. (1999, p. 765; 2000, p. 49) as the dominant canopy species in GCWA winter habitat in Honduras and Guatemala. The GCWA is already limited in its geographic distribution in Central America (Rappole et al. 2000, p. 48), and range restrictions may increase the species' vulnerability to climate change (EPA 2009, pp. 19-20).

Therefore, although we lack certainty about how climate change will affect this species, it is reasonable to expect that it will threaten GCWA due to their restricted distribution and reliance on specific habitat types in their wintering and breeding ranges. All possible impacts from climate change cannot presently be predicted. However, accelerating climate change will likely exacerbate existing threats and could result in future threats. Moreover, subtle but significant changes in the ecosystem supporting the GCWA could result in threats of high magnitude.

Recreation

There are few studies on the effects of recreation on GCWA. One study found no difference in GCWA relative abundance, return rate, male age structure, or productivity between a mountain biking area and a non-mountain biking area (Peak 2003, pp. 6-7). However, only one study site was used and sample sizes were small. Conversely, Davis and Leslie (2008, pp. 27-28, 30) found GCWA nest success was 50 percent less in mountain biking areas than in non- mountain biking areas, but direct cause-and-effect relationships could not be made. We are unaware of other specific studies on the effects of recreation on GCWA. However, studies on other forest birds have shown impacts from recreation can include, but are not limited to, increased potential for wildfire, soil compaction/erosion, and increases in edge-adapted predators and invasive plants (Sykes et al. 1989, p. 556; Hickman 1990, pp. 4-5; Miller et al. 1998, pp. 14-15; Leung and Marion 2000, p. 24.).

Therefore, although we lack certainty about how recreation impacts GCWA, limited data have shown that mountain biking may impact nest success. Because several local and state lands that support GCWA also allow public access (camping, hiking, biking, and horseback riding), additional research is needed on effects from recreation on GCWA.

## 2.4 Synthesis

The best available scientific information indicates that the threats to the GCWA include: (1) habitat destruction and fragmentation of breeding and wintering habitat; (2) a lack of reproduction of deciduous trees due to overbrowsing; (3) catastrophic wildfires; (4) nest predation and/or nest parasitism; and (5) potentially climate change and recreation. The loss of GCWA habitat is ongoing and significant due to the threats discussed above. The magnitude of impacts associated with these combined threats is high, because (1) the breeding range of the species is limited to central Texas and (2) habitat within the breeding and wintering ranges of the GCWA continues to be lost.

Given the ongoing, wide-spread destruction of its habitat, this species continues to be in danger of extinction throughout its range. Therefore, we recommend no change to the classification of the GCWA as endangered.

## 3.0 RESULTS

### 3.1 Recommended Classification:

**____ Downlist to Threatened**
**____ Uplist to Endangered**
**____ Delist**
____ *Extinction*
____ *Recovery*
____ *Original data for classification in error*
**__x__ No change is needed**

**3.2 New Recovery Priority Number**: No change needed; remain as 2C.

**Brief Rationale:** A listed species with a recovery priority number of 2C is one that has a high degree of threats; conflict with construction or development projects or other forms of economic activity; and, a high potential for recovery. The GCWA continues to be threatened by a high degree of habitat destruction, disturbance, and degradation across its range. However, we consider this species' potential for recovery to be feasible through the concerted efforts of Service personnel and our partners to restore, enhance, and protect habitat.

**3.3 Listing and Reclassification Priority Number: N/A**

## 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

The Service's Spotlight Species Action Plan for GCWA recommended five actions, which still remain important to the conservation of this bird:

(1) protect GCWA habitat in the breeding, migration, and wintering ranges;
(2) monitor GCWA throughout the breeding range to verify adult survival and productivity levels;
(3) manage habitat in the breeding, migration, and wintering ranges to ensure long-term survival of the habitat necessary to support viable GCWA populations;
(4) adapt monitoring and management strategies based on new information; and
(5) provide education and outreach on the GCWA throughout the breeding, migration, and wintering ranges.

An updated recovery plan that includes objective, measurable recovery criteria is needed and is being drafted for the GCWA. The Service has worked with the recovery team to develop a new recovery strategy for the GCWA, and the Service is currently drafting an updated recovery plan.

Since the greatest threat to GCWA is habitat loss, permanent protection of large blocks of contiguous habitat is necessary for the long-term survival and recovery of the GCWA. Enough habitat should be protected in the breeding, migrating, and wintering habitat to support viable GCWA populations. Habitat management throughout the range must occur such that woodland and forest regeneration occurs and persists over the long term.

To assist with the planning and recovery efforts, the following additional information is needed:

(1) identification of focal areas within breeding habitat;
(2) development of management guidelines for achieving recovery criteria;
(3) developing a monitoring protocol for verifying recovery criteria;
(4) determining the effects of recreation on GCWA and their habitat;
(5) determining the effects of climate change on GCWA habitat;
(6) identifying priority stopover sites within their migration corridor,
(7) identifying, promoting, and implementing sustainable forestry practices within the wintering range, and
(8) providing education and outreach on GCWA throughout their range.

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**U.S. FISH AND WILDLIFE SERVICE**
**5-YEAR REVIEW of the Golden-cheeked Warbler (*Setophaga chrysoparia*)**

**Current Classification**: Endangered

**Recommendation resulting from the 5-Year Review:**

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X_ No change needed

**Appropriate Listing/Reclassification Priority Number, if applicable**: N/A

**Review Conducted By**: Timothy Breen, Austin Ecological Services Field Office

**FIELD OFFICE APPROVAL:**

**Lead Field Supervisor, Fish and Wildlife Service**

Approve _____ Date August 15, 2014

**REGIONAL OFFICE APPROVAL:**

**Assistant Regional Director, Ecological Services, U.S. Fish and Wildlife Service, Region 2**

Approve _____ Date 8/26/14