

# 2013 Golden-cheeked Warbler Symposium

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### ***Helping People Help Texas Lands when Golden-cheeked Warbler Habitat is Present***

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The NRCS in Texas provides technical and financial assistance to landowners as they treat resource concerns on their land. At times, the landowners' objectives for their land may be incongruous with protections of the endangered Golden-cheeked warbler (GCWA). The paper will describe how we proceed when that happens, what options we have and how we prevent conflict. In many cases, the management recommendations we help the landowner implement have benefitted the bird. Activities discussed will include: NRCS policy regarding T&E species, partner groups, habitat management guidelines, training our workforce and our clients, how we recognize habitat, how we modify management activities to avoid adverse effects to habitat for GCWA and examples of successes and failures.

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### ***Adult and Juvenile Survival of Male Golden-cheeked Warblers on the Fort Hood Military Reservation***

Adam Duarte<sup>1\*</sup>, Jeff S. Hatfield<sup>2</sup>, James E. Hines<sup>2</sup>, James D. Nichols<sup>2</sup>, and Floyd W. Weckerly<sup>1</sup>.

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The USFWS Golden-cheeked Warbler Recovery Team is currently using population models to decide the amount of protected breeding habitat necessary to ensure viable warbler populations. However, previous warbler population models only dealt with the breeding habitat between the Fort Hood Military Reservation and San Antonio. No range-wide warbler population model has been constructed to date. Furthermore, demographic estimates used in previous warbler population models were calculated using relatively small data sets that are now a decade old. Therefore, our objective was to estimate updated, more precise estimates of juvenile and adult survival rates for male warblers in order to use these estimates to develop a range-wide population model for the species. We used the Cormack-Jolly-Seber model structure within program MARK to analyze capture-recapture data collected on the Fort Hood Military Reservation from 1992 to 2011. Average annual survival rate estimates for adult and juvenile male warblers were 0.48 (Temporal Variance = 0.0096) and 0.30 (0.0077), respectively. We will combine these estimates with newly published information concerning range-wide warbler abundance, productivity, and distribution to create a range-wide population model for the species, which will assist with recovery efforts.

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### ***Using LiDAR-derived Vegetation Metrics for High-resolution Distribution Models for Conservation Planning***

S. L. Farrell<sup>1\*</sup>, B. A. Collier<sup>1</sup>, K. L. Skow<sup>1</sup>, A. M. Long<sup>2</sup>, A. J. Campomizzi<sup>1</sup>, M. L. Morrison<sup>2</sup>, K. B. Hays<sup>1</sup>, R. N. Wilkins<sup>1</sup>. <sup>1</sup>Texas A&M Institute of Renewable Natural Resources and <sup>2</sup>Department of Wildlife and Fisheries Sciences, Texas A&M University. \*slfarrell@tamu.edu

Species distribution models [SDMs] are important tools for identifying habitats and focusing conservation and management efforts. Many SDMs for golden-cheeked warblers provide predictions of distribution based on coarse-grain metrics (e.g., patch size). However, habitat use and resulting distributions are driven by characteristics at multiple scales, including fine-grained vegetation structure and height across small spatial extents. Additionally, management is often planned, applied, and monitored over small spatial extents. Thus, coarse distribution predictions may be useful for some purposes but can fail to provide sufficiently precise predictions at a resolution relevant to much operational management decision-making, application, and monitoring. Advances in remotely-sensed data enable development of fine-grained SDMs that can make spatially-explicit predictions at resolutions relevant to most management. We investigated use of high-resolution LiDAR (Light Detection and Ranging) and avian point sampling data to develop a detection-corrected occupancy model to quantify habitat-occurrence relationships for the endangered Golden-cheeked Warbler (*Setophaga chrysoparia*) and Black-capped Vireo (*Vireo atricapilla*) on Fort Hood military installation in central Texas. We compared models that used only the more conventional, coarse remotely-sensed metrics to models that also incorporated high-resolution LiDAR-derived metrics for vegetation height and canopy cover to assess use for predicting distributions. Models including LiDAR-derived vegetation height and LiDAR-corrected canopy cover metrics were competitive for both species. Models without LiDAR-derived vegetation height had substantially lower model weights and explanatory strength. Area under curve estimates for the highest ranked models were high for warblers (0.864) and moderate for vireos (0.746). Using the best performing models, we predicted the occurrence distribution for each species. The resulting predictions provide a decision support tool that allows for accurate, standardized, high-resolution assessment of status, impacts, and mitigation for both warbler and vireo habitat on the installation. While previous species' distribution models have been created for our focal species, most fail to match the grain and extent of most management actions or include local, fine-grained metrics that influence distributions. We demonstrate that LiDAR used in conjunction with species occurrence data can provide spatially-explicit distribution models at a resolution that is both ecologically relevant and operational at the scale of most conservation and management actions.

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### ***Growth Rates of Trees in Golden-cheeked Warbler Habitat at Balcones Canyonlands National Wildlife Refuge, 1998-2010***

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In September of 1998, 16 vegetation plots were established at Balcones Canyonlands National Wildlife Refuge for monitoring vegetation in occupied and transitional habitat of golden-cheeked warblers. Each of these circular plots is 0.02 hectares in area (radius = 7.98 m). On 12 of these plots, up to 10 trees, saplings, or seedlings were tagged per plot to compare growth rates of tree species, and these individuals were measured every other September, 1998 - 2010. For stems > 10 cm in diameter at breast height (DBH, 1.3 m), a metal tag was nailed on with an aluminum nail 20 cm above breast height. For stems < 10 cm DBH, the tag was tied on with plastic tie-tape. DBH was measured for stems > 1 cm at

breast height. Height was also measured for most individuals using a carpenter's tape for trees < 2 m height or a plastic telescoping rod for trees < 9.1 m. Only the largest stem was measured for individuals with multiple stems. The species tagged and measured were *Juniperus ashei* ( $n = 44$ ), *Quercus buckleyi* ( $n = 17$ ), *Q. fusiformis* ( $n = 16$ ), and *Q. sinuata* var. *breviloba* ( $n = 23$ ). To analyze growth rates, we fit a growth model, separate for each species, which assumes that the growth rate of each individual depends on the DBH or height at the beginning of each 2 year interval, using a Bayesian approach. As expected, Ashe juniper had a higher growth rate than the oaks during this time period. Ultimately, we hope to use these growth rates to estimate age vs. DBH for each of these tree species, in order to predict the minimum time frame required to generate trees of sufficient size for golden-cheeked warbler habitat.

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### ***Change in Golden-cheeked Warbler Habitat through Time***

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The golden-cheeked warbler (GCWA) was placed on the Federal Endangered species list by means of an emergency rule on May 4, 1990 due to significant population decline, reductions in overall range, and escalating loss of nesting habitat. Since that time, habitat has been assessed at single points through time, but the overall trends in habitat loss or gain has not been investigated. Our goal was to identify and document change in Golden-cheeked warbler habitat over the last 3 decades using remote sensing and ESRI ArcGIS ModelBuilder. A supervised classification was conducted using ERDAS and a series of Landsat images. Results were input into three different habitat models that ranked Central Texas habitat quality from low to high. Model results were evaluated by comparing the predictions of habitat quality from each model to that of actual GCWA sightings in Balcones Canyonlands National Wildlife Refuge (BCNWR). Model 3, a Mixed and Evergreen habitat-based model most accurately predicted areas of GCWA habitat usage. The greatest loss of GCWA habitat occurred along the San Antonio – Austin corridor just west of I-35 while the greatest gains were NW of Austin including the BCNWR.

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### ***Toward a Stronger Foundation for Golden-cheeked Warbler Management Guidelines***

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Local environmental conditions recorded from a restricted portion of a species' range are often used to inform management guidelines. This approach may impede wildlife conservation efforts, as multiple sources of potential variability that could influence habitat quality may not be represented within a single locality. Prior to its listing as federally endangered, research conducted on the golden-cheeked warbler (*Setophaga chrysoparia*; warbler hereafter) was limited to descriptive studies on occurrence and nesting at a small number of sites. As such, management guidelines for the species were developed without a complete understanding of the suite of environmental conditions that could influence reproductive success across their breeding range. Since 2005, our research group has directly tested assumptions set forth by warbler management guidelines. Our broad-scale investigation regarding warbler reproductive success demonstrated that variables commonly associated with habitat quality, such as patch size and canopy cover, do not consistently predict warbler reproductive success across the warbler's breeding range. Contrary to current management guidelines, median patch size within the

Balcones Canyonlands Eco-Region was 152% greater for territories without fledglings than territories with fledglings. Additional studies by our group indicated that tree species composition might influence reproductive success. In 2009 and 2010, fledging success in the Limestone Cut Plain (LCP) Eco-Region was ~30% and ~20% greater in oak-juniper (*Quercus-Juniperus*) woodland dominated by Texas oak (*Q. texana*) than post oak (*Q. stellata*), though no previous studies indicated that a difference in productivity between woodland types might exist. Management guidelines also propose that higher quality habitat has >70% canopy cover. However, in 2012, canopy cover in the Edwards Plateau Woodland (EPW) Eco-Region was 20% lower than thought to be indicative of higher quality habitat and there was no difference in canopy cover between successful and unsuccessful territories. Similarly, in 2011 and 2012, ~90% and ~50% of territories had canopy cover  $\leq$ 70% in the LCP Eco-Region and, again, there was no difference in canopy cover between successful and unsuccessful territories. Additionally, percent juniper composition did not appear to be a better predictor of fledging success, regardless of woodland type. Rather, metrics related to tree height were important indicators of warbler reproductive success. Information gained from our program's research efforts will allow us to move beyond the static implementation of management practices initially developed without consideration of variation in habitat quality across the warbler's range, toward a more effective, comprehensive management strategy that can better aid warbler recovery.

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### ***Understory Thinning Enhances Breeding Habitat of the Golden-cheeked Warbler***

Michael Marshall<sup>1\*</sup>, Shannon Farrell<sup>1</sup>, Andrew Campomizzi<sup>1</sup>, Michael L. Morrison<sup>2</sup>, Neal Wilkins<sup>3</sup>, and Roel Lopez<sup>1</sup>. <sup>1</sup>Texas A&M Institute of Renewable Natural Resources, <sup>2</sup>Department of Wildlife and Fisheries Sciences, Texas A&M University, and <sup>3</sup>East Wildlife Foundation.

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Maintenance of forest understory is an important silviculture tool for modifying wildfire behavior, promoting recruitment of fire tolerant species, decreasing the impacts of insects and diseases, and maintaining wildlife habitats for many species that utilize open stand structures. Most studies on golden-cheeked warbler habitat have focused on the importance of canopy cover, but the role of understory vegetation has not been addressed. Fort Hood recently began supporting dismounted infantry training, which required juniper removal within warbler habitat to facilitate the creation of maneuver lanes via understory thinning. Our objective was to investigate potential effects of understory removal on the presence, pairing success, and fledging success of warblers at Fort Hood. We sampled pre- and post-treatment vegetation to quantify the amount of vegetation removed during the thinning process. We mapped and monitored 232 warbler territories across 5 breeding seasons to quantify abundance and reproductive success in 1 patch treated with understory thinning and 2 control patches with no vegetation manipulation. In the understory (0-3 m) of the treated patch, juniper cover was reduced by 5%, and hardwood cover was reduced by 2%. Warbler abundance did not change significantly from 2008-2012. Pairing and fledging success was up to 41% higher in the treated patch compared to both controls for 3 of 5 years. Results suggest understory thinning does not negatively impact golden-cheeked warblers. In fact, thinning may have enhanced warbler habitat, although more experimental replicates would be needed to verify the positive effects of the treatment. Land managers and soldiers at Fort Hood can benefit from this land management technique because it addresses 2 important issues: limits to training and wildfire risk. Understory thinning improved and increased training and operational capabilities by opening up over 2300 acres of previously unused land on Fort Hood for dismounted maneuvers. Wildfire on Fort Hood represents the highest risk to warbler habitat, and large sums of money are spent each year halting the spread of fires stemming from live fire artillery.

Because forests with high stem density and fuel loading combined with extreme fire weather conditions have led to severe and large wildfires in Texas, we suggest understory thinning can help produce forest structures and fuel characteristics that can reduce the likelihood of catastrophic wildfires in warbler habitat.

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### ***New Golden-cheeked Warbler Monitoring Protocol for Trend of Occupancy at Balcones Canyonlands National Wildlife Refuge***

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The Golden-cheeked Warbler (*Setophaga chrysoparia*) was listed by the U.S. Fish and Wildlife Service as Endangered in 1990. Balcones Canyonlands National Wildlife Refuge (BCNWR) was established in 1992 primarily to protect habitat for this species and the Black-capped Vireo (*Vireo atricapilla*), another federally listed species. We designed a new protocol to evaluate management of breeding habitat for Golden-cheeked Warblers at BCNWR. Using this protocol, trend in occupancy will be estimated based on surveys conducted every 3 to 5 years. In 2012, we surveyed 250 random points on the 9,600-ha refuge to measure occupancy (proportion of the refuge occupied) by singing males. Random points were generated with a minimum distance between points of 250 m (attempts to increase the minimum distance would not generate enough points) and no buffer between refuge tract boundaries and points. No stratification was used in the sample design because we anticipate vegetation types changing over time. Hearing tests were administered to surveyors to ensure normal hearing capability in the range of warbler song frequencies. Surveyors recorded detections of 7 species: Golden-cheeked Warbler, Black-capped Vireo, Western Scrub-Jay, Blue Jay, Brown-headed Cowbird, Northern Bobwhite, and Wild Turkey. Surveyors were trained on the protocol and species recognition for 1 week prior to surveying. Distances and times of initial detections were recorded to allow comparisons among different radii and with density estimators. Surveys lasted 10 minutes, had an unlimited radius, and were repeated 4 times over 8 weeks with at least 3 different observers surveying each point. Occupancy was 43.0% (SE = 4.2) for 75-m radius circles, 48.7% (SE = 3.7) for 100-m radius circles, and 57.4% (SE = 3.5) for 150-m radius circles. The area of a circle with a radius of 75 m is about the size of a typical territory as reported in the literature. Thus, a crude population estimate of territories for the refuge is the estimated area of occupied habitat on the refuge divided by the area of a 75-m radius circle; this approach yields an estimate of 2,340 territories (SE = 230). Density estimates based on Distance sampling will be compared. Additional habitat metrics are being developed with NAIP imagery (relative canopy cover by Ashe juniper [*Juniperus ashei*] and broadleaf trees) and LiDAR (canopy height) and will be used to evaluate correlations with occupancy and to guide management of juniper-oak woodlands for this species.

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### ***Estimating Golden-cheeked Warbler Abundance within the Balcones Canyonlands Preserve***

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The Balcones Canyonlands Preserve (BCP) is a 30,000-acre system of preserves that was established to protect high quality habitat and mitigate for habitat loss of eight endangered species and 27 species of concern in western Travis County. The BCP is the result of the first multi-species, multi-agency regional habitat conservation plan (HCP) in the country. The endangered Golden-cheeked Warbler (*Setophaga*

*chrysoparia*) has been called the “driving force” of this HCP, with concerns for the Warbler’s viability occupying center stage in the design and configuration of the BCP. In 2011, the BCP partners began a five-year project with the U.S. Forest Service to evaluate the current and predicted status of the Golden-cheeked Warbler within the BCP to help ensure its long-term survival and recovery. Determining Golden-cheeked Warbler abundance on the BCP is one of the fundamental questions being addressed as part of this project. While the Golden-cheeked Warbler was listed as endangered based on habitat loss and fragmentation and not on population size, carrying capacity and abundance are an integral part of population viability modeling. Methods to estimate abundance include a combination of point count sampling across the BCP and intensive territory monitoring on a series of plots. Additionally, point count sampling has been conducted on the BCP by researchers from Texas State University and Texas A&M University to estimate Golden-cheeked Warbler abundance at local and range-wide scales, respectively. While these three independent sets of count data were collected and analyzed using different methods, the predicted abundance estimates derived from them tend to be similar to abundance estimates derived from territory mapping in areas with high densities of Golden-cheeked Warblers, but greater than abundance estimates derived from territory mapping in areas with low Warbler densities. With the collection of additional data, the U.S. Forest Service will refine their point count estimation methods and continue to use intensive territory monitoring data to validate their abundance estimates derived from point counts. The ongoing research on the BCP presents a unique opportunity to evaluate the results of different point count methods, with the goal of generating reliable estimates of Golden-cheeked Warbler abundance.

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#### ***Golden-cheeked Warbler Response to Human Disturbances***

Dianne Robinson<sup>1\*</sup>, Anthony Locatelli<sup>1</sup>, Michael Marshall<sup>2</sup>, Heather Mathewson<sup>2</sup>, Michael Morrison<sup>1</sup>, R. Neal Wilkins<sup>3</sup>, and Roel Lopez<sup>2</sup>. <sup>1</sup>Department of Wildlife and Fisheries Sciences, Texas A&M University, <sup>2</sup>Texas A&M Institute of Renewable Natural Resources, and <sup>3</sup>East Wildlife Foundation. \*diannehd@gmail.com

Impact assessment study designs are a valuable tool for investigating the effects of both human-induced and natural disturbances on wildlife. The breeding range of the federally endangered golden-cheeked warbler (*Setophaga chrysoparia*) is threatened by increasing urban and residential development, road construction and maintenance, and changes due to natural disturbances such as wildfire and oak wilt. Although many of these disturbances are assumed to have deleterious effects on warbler productivity, little research exists that directly investigated the impacts of these activities. We conducted three impact assessment studies at different locations within the warbler range. We monitored warblers at two study sites, Real and Travis counties, Texas, from 2008-2012, investigating the effects of road construction noise on warbler productivity, behavior, and vocalizations prior to, during, and post road construction activity. We also monitored warblers on Fort Hood Military Installation from 2008-2012, investigating the effects of military training activities on warblers prior to, during, and post-training actions. We found no change in warbler productivity, behavior or vocalization due to human-induced disturbances. Some results from warbler song and ambient noise analyses at our study sites in Travis county and at Fort Hood suggest warblers were already acclimated to louder background noises prior to the impact of interest (from heavy vehicle traffic, and a nearby active live fire range, respectively). Based on our results, road construction noise and military maneuvers did not negatively impact golden-cheeked warblers. These findings provide valuable information to regulators and land managers interested in protecting this endangered species.

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### ***Spatial Analysis of Golden-cheeked Warbler Habitat on the Balcones Canyonlands Preserve to Evaluate Management Options and Achieve Permit Requirements***

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The Balcones Canyonlands Preserve (BCP) was created to mitigate for habitat loss in western Travis County for the Golden-cheeked Warbler (*Setophaga chrysoparia*), seven other endangered species, and 27 species of concern. The BCP is the result of an Incidental Take Permit and Habitat Conservation Plan (HCP) issued to the City of Austin and Travis County by the U.S. Fish and Wildlife Service in 1996. The HCP describes several specific GCWA habitat acreage, quality, and configuration requirements. For example, the HCP sets a minimum habitat goal of 28,428 acres to be managed for GCWA including 11,086 acres of existing habitat when the permit was issued, of which 7,152 acres must be high quality habitat. It also specifies that the edge-to-area ratio within each macrosite should not exceed 20 percent. To determine whether current and future Preserve configurations meet the specifications of this plan and to allow for effective prioritization and recovery planning, land managers must periodically evaluate the status of Preserve lands to identify, delineate and quantify areas that vary in regard to habitat quality for each focal species. To accomplish this, landscape variables such as stand age, species composition and vegetation structure may be derived and characterized from recent high resolution aerial imagery, historical imagery, and LiDAR. These data may then be compared with maps of territory density obtained from on-going annual surveys. Issues that pose challenges for long-term preserve planning include land-use changes due to development adjacent to existing preserve tracts, mitigating for the possibility of wildfire, trade-offs between the habitat requirements of co-occurring listed species, and possible long-term changes to the biotic community resulting from extreme weather events and climate change.

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### ***Fire Risk Management for the Golden-cheeked Warbler in the Wildland Urban Interface***

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Fire disturbance is pervasive in central Texas woodlands which poses significant challenges to maintaining golden-cheeked warbler habitat within reserves embedded in an urban matrix. Quantifying this risk is important to conservation managers and fire emergency response personnel in order to evaluate wildland urban interface (WUI) areas that may be deemed fire-prone for both sides of the interface. Risk is defined here as the combination of exposure and hazard. In the context of fire risk analysis, exposure is the potential return frequency of fire. For hazard, this is evaluated for warbler habitat assessed based on crown fire potential and human dwellings based on probability of house survival. Fire intensity, or energy released by fire, is an important characteristic of effective hazard for both situations. Crown fire may occur if surface fire intensity reaches a critical threshold value defined as a function of canopy base height and foliar moisture content. In residential areas, a house fire may be initiated through radiant combustion as a function of local fire intensity, building materials, and landscaping. For this study, I assess the fire risk for boundaries of the Balcones Canyonlands Preserve (BCP) based on fire behavior simulation-derived values of fire return probability and fire intensity. Based on a previous study of fire behavior modeling for this area, wind, topography, and fuel variation across the BCP present geographically unique settings with different risk levels. This modeling illustrates that fire exposure and hazards are not directly correlated to a particular fuel type, rather are affected by a suite of factors influencing fire spread in this complex landscape. This study also shows that fire risk is bi-directional with different factors influencing fire risk to both warbler habitat and urban areas. For

warblers, adjacency of fine fuels to refuge boundaries and ignition sources increase fire movement onto refuge property. Foliar moisture content of critical woodland vegetation such as juniper and oak are also important and may reach critically low levels depending on winter precipitation. Fire risk in the WUI is predominantly controlled by the topographic exposure and the presence of open juniper grasslands. Mature woodlands produce less frequent and intense burns as a function of lower surface fuels and canopy bulk density values. Any future modification of vegetation in the WUI to reduce fire risk should be scrutinized to assure that resultant fuels do not increase fire exposure with enhanced bi-directional fire risk.

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### **HABITAT CREDIT TRADING FOR THE GOLDEN-CHEEKED WARBLER**

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Conservationists have struggled for decades with how to achieve regional conservation goals. Many landscape-scale conservation plans have been written, but few have been effectively implemented. This challenge is currently being exacerbated by declines in public funding and increases in habitat degradation and fragmentation from a variety of development projects. New approaches to conservation and mitigation are needed if we are to be successful at restoring and protecting at-risk species and their habitats. One such approach is habitat credit trading (HCT) systems.

HCT systems are emerging across the country as a more efficient and effective way of achieving **quantifiable** conservation and mitigation outcomes. Existing compensatory mitigation options, which include species banking, in-lieu fee payments and permittee responsible approaches, all have characteristics that limit their utility for producing measurable conservation benefits across large landscapes in relatively short time periods. HCT systems were developed specifically to overcome these limitations, as well as to address the challenge of funding long-term management and monitoring for conserved properties.

The Texas Conservation Market (Market) is an HCT system that is currently being developed for the Golden-cheeked Warbler (warbler) and Black-capped Vireo. We will describe the development and implementation of this Market with respect to the warbler. The Market will provide a framework that enables credits (representing conservation actions benefitting the warbler) to be generated and quantified on private and public lands and sold to development interests that are creating debits (adverse impacts to warbler habitat) or other entities, such as federal agencies and conservation interests, that wish to invest in quantified conservation actions benefitting the warbler. The goal of establishing the Market is to insure that compensatory mitigation of adverse impacts to warbler habitat is conducted in a manner that is **consistent, transparent, fair** and **measurable** and to insure that **net benefits** result from every credit-debit transaction. In addition, the Market provides a means by which conservation interests can invest in quantified conservation outcomes that maximize conservation return for each dollar invested. The overarching goal is to insure the long-term viability and sustainability of the warbler throughout its range.

## ***Poster Abstract***

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### **Golden-cheeked Warbler habitat: a historical perspective**

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The endangered Golden-cheeked Warbler (*Setophaga chrysoparia*) breeds in mature Ashe juniper-oak woodlands of central Texas. Historical records provide clues regarding the historical distribution and extent of Golden-cheeked Warbler habitat. Eyewitness accounts spanning the time period from the early 1700s (prior to European settlement) through the early 1900s depict predominant vegetation communities of the Texas Hill Country, including areas of “cedar” and oak woodlands that likely supported Golden-cheeked Warblers. These historical documents, compiled from more than 20 years of research, also include photographs, maps, and field survey notes from original land grants, which are used to cross-reference and corroborate the written accounts. Approximate locations of the eyewitness accounts have been entered into a GIS database to provide spatial context with respect to major ecological regions and the Balcones Escarpment, a geologic fault zone that separates the Blackland Prairie from the Hill Country ecoregions. Land use changes that began during the mid to latter part of the 1800s, as documented by these eyewitness accounts, provide insight regarding how our perceptions of the Texas Hill Country have changed over the past 300 years. This research underscores the importance of historical ecology in making informed land management decisions, particularly with respect to habitat restoration and managing for endangered species and ecosystems.