GOLDEN-CHEEKED WARBLER
POPULATION AND HABITAT VIABILITY ASSESSMENT
REPORT

Report of Workshop arranged by the U.S. Fish and Wildlife Service

Compiled and Edited by
Carol Beardmore, Jeff Hatfield, and Jim Lewis
in conjunction with the participants
of the PHVA workshop held in
Austin, Texas
August 21-24, 1995

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EXECUTIVE SUMMARY

The golden-cheeked warbler (*Dendroica chrysoparia*) nests in mixed evergreen-deciduous woodlands of central Texas and winters in high elevational, 4,417-7,905 ft, pine-oak woodlands of southern Mexico and northern Central America. This warbler was listed as endangered in 1990. The principal threats are destruction, modification, and fragmentation of nesting habitat and conversion of wintering habitat.

Forty biologists representing 27 agencies, organizations, universities, or companies met August 21-24, 1995, in Austin, Texas, to participate in a Population and Habitat Viability Assessment Workshop for the golden-cheeked warbler. The workshop was funded by a grant from the National Biological Service, U.S. Department of the Interior, and arranged by the U.S. Fish and Wildlife Service. The Service's goal for the workshop was development of population targets and conservation recommendations, through consensus-building by participants, that could be used by individuals, or groups of landowners and land managers, to develop and implement conservation strategies for the golden-cheeked warbler.

Workshop participants developed the following goals at the beginning of the 3.5-day-meeting.

1. Summarize all biological data about the golden-cheeked warbler.
2. Identify future research needs.
3. Identify population targets and current risk of extinction; define acceptable risk of extinction (Task 1.12 in the recovery plan).
4. Clarify and assess management strategies.
5. Clarify and assess conservation strategies and identify stakeholders.
6. Identify habitat needs for breeding.
7. Identify threats.

Participants identified the following four subgroups they felt were necessary to achieve the above goals: (1) Population Biology and Modelling, (2) Habitat Management Strategies, (3) Outreach and Partnerships, and (4) Distribution, Status, and Threats. These subgroups met during the workshop to develop subgroup reports, which became chapters of this report.

The Distribution, Status, and Threats subgroup reviewed the Golden-cheeked Warbler Recovery Plan, identified recently completed and ongoing studies that are sources of new information, summarized distribution as currently known, and enumerated counties that need distribution studies. They identified where new data modifies previous interpretations or adds to the understanding of diet, population threats, nesting ecology, habitat requirements, and research needs.

The Population Biology and Modelling subgroup assembled and analyzed data from golden-cheeked warbler banding and habitat mapping projects for inclusion in the modelling simulations. Various levels of fecundity (reproductive success), survivorship, carrying capacity, etc. were simulated to find population levels that had acceptable levels of survival. A carrying capacity of 3,000 breeding pairs of golden-cheeked warblers for each population was tentatively recommended to assure a probability of extinction less than 5% over 100 years.

The Habitat Management Strategies subgroup described the physical and biological characteristics of golden-cheeked warbler habitat and developed a checklist to identify such habitat. Recommended habitat management measures included preventing overuse by herbivores, habitat restoration, canopy maintenance, prevention of oak wilt, control of predators and brood parasites, managing human impacts, and landscape level planning.

The Outreach and Partnerships subgroup identified stakeholders and key players, described problems in communicating with the public, made recommendations for improving public outreach, noted disincentives and incentives affecting landowner cooperation, identified a need to assess all current policies and practices, and outlined future workshops intended to promote public and private sector partnerships by fostering communication and cooperation.

LITERATURE CITATION

Literature citations for this document should read as follows:

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I. INTRODUCTION

A Population and Habitat Viability Assessment (PHVA) workshop was held in Austin, Texas, August 21-24, 1995 to assess the current state of knowledge of the biology of the golden-cheeked warbler, attempt to predict its probability of extinction/survival under various management scenarios, and to reach group consensus about what constitutes a viable population and how to achieve these populations as described in the Golden-cheeked Warbler Recovery Plan (U.S. Fish and Wildlife Service 1992, recovery plan). The workshop was hosted by the U.S. Fish and Wildlife Service's (Service) Austin Ecological Services Office and was funded by a grant from the National Biological Service.

A group of biologists representing federal, state, county, and local governments, universities, consulting companies, and nongovernmental organizations were invited to participate in the workshop. These biologists have either direct research experience with the warbler in the field, direct association with managing warbler habitat on public lands, or are responsible for information/education projects that would benefit warbler recovery. The group was purposefully kept small to facilitate group discussion. One person per company, department/division, or group was encouraged to attend and represent the data or information held by that entity.

The format of the workshop was similar to workshops conducted by the IUCN's Conservation Breeding Specialist Group (CBSG). CBSG often includes as many stakeholders as possible in their workshops. However, because of the complexity and politicization of the golden-cheeked warbler's plight, the Service felt it would be beneficial to hold an initial workshop focussing on the biological needs of the species and how biology relates to the warbler's recovery strategy. Future workshops are envisioned (and are intended) to involve landowners and land managers and encourage their participation in developing and implementing recovery solutions.

The workshop was facilitated by Jim Lewis, Fish and Wildlife Service, who is trained and experienced in leading PHVA workshops in conjunction with CBSG. The consensus-building group discussion format was an important aspect of the workshop. The group suggested and agreed to the goals of the workshop, and the focus of the subgroups. Individuals chose the subgroup in which they participated. Each subgroup had its own internal dynamics. The entire group provided comment to each subgroup in plenary sessions. People with dissenting opinions could draft their ideas separately and submit them for inclusion in the report. Although the Fish and Wildlife Service organized and hosted the workshop, Service biologists in attendance functioned no differently from the rest of the participants. Critical to

the spirit of the workshop, the facilitator and participants put aside individual goals and objectively strove to meet the group's goals.

The following introductory material was presented. Phil Miller (IUCN-CBSG) presented an overview of small population biology. Dean Keddy-Hector (Texas Parks and Wildlife Department) and Tim Hayden (Army Corps of Engineers, Construction Engineering and Research Laboratory) presented biological data collected since the recovery plan was published. Carol Beardmore (Fish and Wildlife Service) discussed recovery strategies. Jeff Hatfield (National Biological Service) demonstrated the RAMAS-Metapop model.

The group brainstormed, refined, and agreed to a set of goals for the workshop. The goals were as follows:

1. Summarize all biological data about the golden-cheeked warbler.
2. Identify future research needs.
3. Identify population targets and current risk of extinction; define acceptable risk of extinction (Task 1.12 in the Golden-cheeked Warbler Recovery Plan).
4. Clarify and assess management strategies.
5. Clarify and assess conservation strategies and identify stakeholders.
6. Identify habitat needs for breeding.
7. Identify threats.

The group chose the following subgroups to address the goals: Population Biology and Modelling, Habitat Management Strategies, Outreach and Partnerships, and Distribution, Status, and Threats. The Population Biology and Modelling subgroup addressed goal #3; the Habitat Management Strategies subgroup addressed goals #4 and #6; the Outreach and Partnerships subgroup addressed goal #5; and the Distribution, Status, and Threats subgroup addressed goals #1 and #7. All subgroups identified future research needs (#2) for their topic.

Each subgroup developed their own way of addressing their goals. The subgroups' draft reports reflected the different ways of accomplishing their task. Subgroups worked independently for a time, reported to the entire group, and modified their report based on the plenary session comments. Subgroups again reported to the group and modified their draft report twice more in this fashion, then finalized a draft report, which became a chapter of a draft document.

Service participants compiled and edited these reports into a draft document. Editing was done not to change the content or intent, but to put the reports into similar format, check grammar, provide background information about the purpose of the workshop, and summarize information needs.

During the workshop, the participants requested that a follow-up meeting be held after the draft document was available for review. Participants wished to read the draft document, consider the ideas and recommendations, and then have the opportunity to discuss the results one more time before the report was finalized. The follow-up meeting was held on November 30, 1995. During the meeting, the entire group discussed several concerns they had with the draft report. Then subgroups worked on and submitted the final versions of their chapters. Service participants again compiled and edited the final versions of the chapters into this final report.

The Service also thought it important to summarize some of the general feelings expressed by participants, especially in regard to the use of the document. Some participants were concerned that the modelling effort was premature because scientific data collected on the warbler were insufficient to provide the accurate values necessary for the model. Only two projects have been in operation long enough to result in the survivorship data necessary for the model. Fort Hood Military Reservation has conducted their intensive warbler banding project for 4 years and Texas Parks and Wildlife Department has conducted a banding project at Balcones Canyonlands National Wildlife Refuge for 3 years. Fecundity (reproductive success) estimates are based on a relatively small sample size because of the difficulty in finding nests. Also, dispersal distances and rates are known only from a small number of instances. While it is true that shortcomings in the data and parameter estimations exist, the Service, other agencies, and people interested in conserving the warbler felt it important to convey to landowners and land managers more specifically what is needed for recovery. This document presents our current level of knowledge and management scenarios based on this knowledge. To delay management decisions another 5 years for data collection to be more complete would be insensitive to the uncertainty that many landowners and land managers feel.

A considerable amount of concern was expressed that the results of the workshop could be misinterpreted. Recent experience with misuse and/or misinterpretation of scientific articles, statements to the press, administrative and regulatory actions, etc., has made the workshop participants a rather cautious and cynical group. Some participants also felt that no matter how many caveats and assumptions are described herein, certain points would undoubtedly be misrepresented or misused. However, to not report the workshop's accomplishments would be scientifically irresponsible. **We, therefore, urge that care be taken in interpreting the document's statements; that is, they should not be taken out of context, because the assumptions and explanations surrounding them are very important to their use and understanding.**

Many participants felt that a valuable result of the workshop was the list of information and research needs. It is important to note that this list does not

include development of theory, but research that applies directly to recovery. The process of developing the information and research needs list resulted in an appreciation of the importance of long-term banding projects and the recommendation to add at least one more long-term banding project in the western part of the warbler's range. The recovery plan outlines research needs, but the PHVA exercise refocused our thinking and our commitment to collect and analyze data directly applicable to developing a population and habitat viability model and to address more specific recovery scenarios. The participants also felt that within 3 to 5 more years, when more data have been collected, the models should be run again. In other words, the group felt an interactive, adaptive process was indicated.

II. WHAT IS A POPULATION AND HABITAT VIABILITY ASSESSMENT?

Population and habitat viability **analysis** usually (and in the context of this document) refers to computer modelling of biological processes, whereas population and habitat viability **assessments** are an in-depth examination and synthesis of the species' life history, ecology, management, and other factors to determine courses of action to manage for viable populations. Assessments include consideration of model analysis, habitat management, captive breeding (if appropriate), genetic tracking (if appropriate), life history, status, threats, geographic distribution, education and information, other conservation efforts, human demography/dimensions, research, and any other component that is deemed necessary. By itself, model analysis would have little real world usefulness without consideration of the context in which the species lives. Habitat management, human influences, and other components are therefore assessed and added into the conservation/recovery equation, at least, qualitatively.

Population and Habitat Viability Assessments can be thought of as a tool to compile, evaluate, and synthesize data and build a framework for conservation action. The workshop process that was used for the golden-cheeked warbler PHVA recognized that much of the knowledge about a species is not published and is often in the heads of the experts. Group dynamics were important in obtaining information from individuals that would benefit the entire group's effort. Respecting the use of that information should be observed.

PHVA workshops are not intended to be the final answer, but are intended to be the beginning of a dynamic process. Groups often commit to meeting again, as did this group. When new information about processes, threats, and/or the species are found, a reassessment may be needed.

III. DISTRIBUTION, STATUS, AND THREATS

Keith Arnold, Mark Lockwood, Cal Newnam, Chuck Sexton, and Lee Sherrod

A. INTRODUCTION

The primary tasks of this subgroup were to (a) update distributional information, (b) determine what new information is available, (c) review ongoing studies that may contribute to answering research questions, and (d) to identify future research needs, in reference to information presented in the Golden-cheeked Warbler Recovery Plan (Fish and Wildlife Service 1992).

B. DISTRIBUTION AND STATUS

Breeding Distribution

Based on a review of Pulich (1976), available recent data, and personal communications with PHVA participants, the distribution of the golden-cheeked warbler among Texas counties appears to be as follows:

Counties w/GCWA*	Counties w/o GCWA**	Counties Needing Study
Bandera	Bastrop	Comanche
Bell	Dallas	Eastland
Bexar	Hill	Edwards
Blanco	Lee	Kinney
Bosque	Concho	Erath
Burnet	Tom Green	Hamilton
Comal	McLennan	Hood
Coryell		Mason
Gillespie		Menard
Hays		Mills
Johnson		Stephens
Kendall		Ellis
Kerr		
Kimble		
Lampasas		
Llano		
Medina		
Palo Pinto		

Counties
w/GCWA*

Real
San Saba
Somervell
Travis
Uvalde
Williamson

* GCWA is a notation for golden-cheeked warblers.

** Category of "w/o golden-cheeked warbler" includes counties where the species was previously recorded (e.g. Tom Green, Concho), as well as those with dubious reports (Bastrop and Lee counties), but where recent information indicates the species no longer occurs as a breeding bird.

Notwithstanding the table above, many of the counties listed as having golden-cheeked warblers have very little, if any, recent data on the numbers or distribution of warblers in the county. Only in a handful of the most intensively surveyed counties (e.g. Bexar, Travis, Bell, Coryell) can we have some confidence in our knowledge of the county. Similarly, the list of counties needing study should be taken as an important research focus; however, data on the presence or absence of warblers in this latter set of counties may exist outside of the realm of information available to workshop participants.

Migration and Winter Distribution

Significant new information on the status and ecology of the warbler in parts of its wintering range has recently appeared (Vidal et al. 1994; Lyons 1994; Thompson 1995). In addition to its previous known range, the species is now known to winter in Chiapas, Mexico (Vidal et al. 1994), and Arnold and Newnam (Texas A&M University, pers. comm.) report a 1 January 1974 sighting as far north as Querétaro. Further investigation of pine-oak habitats in southern Mexico is needed.

C. NEW INFORMATION

Recent Studies

We are aware of the following completed and ongoing studies that were mostly unavailable at the time of the final Recovery Plan, which will add to our knowledge of the distribution, status, and natural history of the golden-cheeked warbler:

Recently Completed/Published Research:

1. Beardmore, C.J. 1994. Habitat use of Golden-cheeked Warblers in Travis County, Texas. M.S. thesis, Texas A&M University.

2. DLS Associates. 1993. Golden-cheeked Warbler Population Study, Three-Year Data Analysis Bull Creek Watershed, Travis County, Texas. Submitted to: 3M Austin Center.

3. Engels, T.M. 1995. Conservation biology of the Golden-cheeked Warbler. Ph.D. dissertation, University of Texas at Austin.

4. Engels, T.M. and C.W. Sexton. 1994. Negative correlation of Blue Jays and Golden-cheeked Warblers near an urbanizing environment area. Conserv. Biol. 8(1):286-290.

5. Lyons, J.A. 1994. Recent observations of the Golden-cheeked Warbler (*Dendroica chrysoparia*) in Chiapas, Mexico. Bull. TX Ornith. Soc. 27:28-30.

6. Thompson, D.E. 1995. Observations of Golden-cheeked Warblers wintering in Guatemala and Honduras. Report to U.S. Fish and Wildlife Service, Austin, Texas.

7. Vidal, R.M., C. Macias-Caballero, and C.D. Duncan. 1994. The occurrence and ecology of the Golden-cheeked Warbler in the highlands of northern Chiapas, Mexico. Condor 96:684-691.

Known, Ongoing Research

(Brackets denote projects where the exact title is unknown.)

8. Bolsinger, J. [Vocalizations of Golden-cheeked Warblers.] M.S. research. University of Massachusetts.

9. Cornelius, J. [Ongoing monitoring and population biology studies at Ft. Hood.] [U.S. Army CERL contracts]

10. Fink, M. Nest predation on artificial nests in Golden-cheeked Warbler habitat. Texas A&M University. [TxDOT contract]

11. Gass, L. Behavioral observations of Golden-cheeked Warblers at nests. M.S. research, Southwest Texas State University.

12. Moses, M. The Effects of Land Use on Golden-cheeked Warblers: an Imagery Analysis of Habitat Alteration in Travis County from 1951 to 1991. Texas A&M University, Rangeland Ecology and Management Dept. [FWS contract]

13. Rappole, J. [Analysis of satellite imagery of Golden-cheeked Warbler wintering habitat in Honduras.] [NBS funded]

14. Texas A&M University. Golden-cheeked Warbler habitat parameters, land use, and avian predators in Travis County, Texas. Principal Investigator: K. Arnold. [TxDOT contract]

15. Texas A&M University. Invertebrate prey base in Golden-cheeked Warbler habitat in Travis County, Texas. Principal Investigator: Wharton et al. [TxDOT contract]

16. Texas A & M University. Vocalization variation in Golden-cheeked Warbler. Principal Investigator: R. Benson. [TxDOT contract]

17. Texas Dept. of Transportation. Distribution and biology of Golden-cheeked Warblers on state lands. Principal Investigator: C. Newnam.

18. Texas Parks & Wildlife Dept./Natural Heritage Program. [Population biology and habitat selection patterns by Golden-cheeked Warblers at Balcones Canyonlands National Wildlife Refuge] Section 6 project. Job No. 43. Principal Investigator: D. Keddy-Hector

19. Texas Parks & Wildlife Department/Natural Heritage Program. Remote Sensing and GIS of Golden-cheeked Warbler Breeding Habitat and Vegetation Types in the Balcones Canyonlands. Section 6 project, Job No. 39. Principal Investigator: Gareth Rowell.

The above publications and studies will be referred to in the text of this chapter by the number preceding each project.

D. HABITAT REQUIREMENTS

The Golden-cheeked Warbler Recovery Plan (U.S. Fish and Wildlife Service 1992) provides a good overall description of habitat preference and requirements for the golden-cheeked warbler. Since the publication of the recovery plan, several recent studies have been completed or are nearing completion that provide additional information on habitat requirements. Those studies are listed above in the Introduction to this chapter. The distribution and status subgroup provides the following comments regarding habitat use/requirements.

The use of the term "brakes" in reference to golden-cheeked warbler habitat is ambiguous and misleading and should be avoided. This term has different meanings to different people; for example, it can mean that only juniper is present, which is not warbler habitat.

The natural heterogeneity of warbler habitat may allow for a situation where a pixel of satellite imagery could display a signature for all deciduous or all Ashe juniper (i.e., not warbler habitat) that would be imbedded in warbler habitat. Satellite imagery analyses should be analyzed with this possible problem in mind (19).

Regarding the importance of edge and habitat patch size occupancy, information is available from Benson's (1990) earlier studies and Fort Hood's and Texas A&M University's (TAMU) new ongoing studies may provide needed data on occupancy rates and productivity by patch size.

Additional information about winter range and habitat use have recently been completed (5, 6, and 7).

E. NESTING ECOLOGY

Recent studies are providing new information on nesting and breeding behavior, territorial ecology, fecundity, fledging success, site fidelity, and dispersal of adults and juveniles. Most of these studies are ongoing (see Introduction of this chapter).

F. DIET AND FEEDING BEHAVIOR

Only a limited amount of quantitative information exists on golden-cheeked warbler feeding behavior, diet preferences, and relationship of habitat selection to food availability. Several recent studies listed above provide new quantitative and observational information. The golden-cheeked warbler is a dietary generalist within its limited foraging strategy, depending on the seasonal and spatial distribution and abundance of prey species (1, 15, Pulich 1976, Sexton 1987).

Sexton (1987) and Beardmore (1994) provide the first quantitative data on foraging behavior of the golden-cheeked warbler. Both of these studies also quantitatively compare the foraging efforts of golden-cheeked warblers in their respective study areas to the habitat structure and/or microhabitat availability.

G. POPULATION

Previous population estimates rangewide for the golden-cheeked warbler can benefit from reevaluation based on more current information regarding (1) average numbers of territories and territory sizes, (2) male-female ratios, (3) mated frequency, and (4) numbers of unmated males and females. In addition, caution should be used when interpreting Landsat data and satellite imagery because errors in interpretation can lead to underestimation and overestimation of suitable warbler habitat in portions of the warbler range. Better and more extensive ground-truthing throughout the golden-cheeked warbler range is needed to verify the satellite imagery. Additionally, new information on minimum patch size use and distribution (3, 9, 14, and 18) needs to be integrated into the interpretation of satellite imagery, and assessment of total population estimate. This may be of particular importance in the western and northern limits of the warbler range where topography and woodland structure differ from the current study areas.

The newest data from Ft. Hood show that approximately 87% of all territorial males are mated (T. Hayden, USA-CERL, pers. comm.). Observations in an intensive study area found a few males (<3 annually) for which territorial behavior could not be established, suggesting floater males may be present (Hayden pers. comm.).

H. THREATS

The potential threat of reservoir development should be reevaluated based on current water development projections and feasibilities. Many proposed reservoirs are being delayed or cancelled while others are being proposed or expanded.

The threat of oak wilt is certainly a real concern. The disappearance of golden-cheeked warblers has been documented at Kerrville State Park, which may be due in large part to oak wilt. More information should be gathered from oak wilt studies on the rate of spread and potential for future controls with new research.

Current research and observational data on brood parasitism (K. Arnold, C. Coldren, M. Fink, TAMU, pers. comm.) indicate that cowbird parasitism at their study sites may not be as significant as previously indicated by Pulich (1976).

Additional information on this subject will be provided by the TAMU and Texas Department Of Transportation (TxDOT) studies currently in progress.

Nest and/or fledgling predation needs more study. Such predation has been documented for scrub jays and possibly several snake species (TAMU, unpubl. data). Current studies by TAMU-TxDOT will be available by the end of the year. Mammalian predation by raccoons, opossums, and house cats is certainly possible, particularly for new fledglings. However, potential predation by house cats associated with urban development has perhaps been over-emphasized in the media and, in some cases, public documents. No documented occurrences of predation by house cats on the golden-cheeked warbler or any other high canopy wood warbler are known.

New information on habitat fragmentation and the potential effects of surrounding land use (e.g., as promulgated through increased blue jay populations) is provided in Engels and Sexton (1994) and Engels (1995). New data on patch size occupancy, surrounding land use/habitat, productivity of birds in small patches, etc., is or will be available (3, 9 and 14). Several recent and ongoing studies are measuring the effects of urbanization on warbler habitat (3, 4, and 14).

New information is available on warbler predators (3 and 4) and further manuscripts are in preparation (T. Engels, DLS and Assoc., pers. comm.). Also, TAMU studies will have new information to present on avian predators (14).

~~H.~~ I. INFORMATION AND RESEARCH NEEDS

We have identified below research needs relating to distribution, status, threats, and population parameters. We have set priorities based on what we feel will have the greatest impact on recovery of the species.

We also urge adoption of common methodologies for all parties involved in any of these research efforts. How spatial characteristics of habitat (e.g., size, configuration, relationship to other patches) are quantified is important in developing measurable management objectives and guidelines.

Priority	Topic
1	Refine knowledge of distribution and status in Texas.
1	Determine presence or absence of golden-cheeked warblers in "counties needing study".

1 Determine golden-cheeked warbler winter habitat distribution and characterize winter habitat.

1 Conduct population studies at the extremes of the breeding range, i.e., in the northern and southwestern portions.

1 Determine the ratio of mated to unmated territorial males.

1 Determine survival rates by age classes.

1 Determine reproductive success.

2 Refine knowledge of distributional status for all counties with breeding golden-cheeked warblers.

2 Investigate differences in territory size and population density over the species' range.

2 Determine the ratio of nonterritorial male "floaters" to territory holders.

3 Determine predation levels under various conditions.

3 Determine brood parasitism levels under various conditions.

IV. POPULATION BIOLOGY AND MODELLING

Carol Beardmore, Terry Cook, John Cornelius, David Diamond, Jeff Hatfield, Tim Hayden, Robert Melton, and Felipe Rameriz-Chavez

A. INTRODUCTION

Fundamental to any conservation effort is the development of a series of complimentary strategies designed to minimize the risk of population loss. Population viability analysis (PVA) is one quantitative technique that can be used to assess population responses to a number of life history parameters. Some of these parameters (e.g., reproduction, habitat carrying capacity) may be moderated with different management techniques.

PVA is essentially a set of computer simulations used to represent or characterize a biological population and estimate its probability of survival or extinction during a given time interval. A PVA is a simplification or abstraction of how we perceive the organization of the system. Primary properties and vital processes are incorporated into the structure of the model and those attributes considered secondary to the overall behavior and long-term dynamics of the population tend to be omitted.

PVA results should be viewed in terms of the assumptions and caveats that are inherent to model development and application. Additionally, results should also be viewed in terms of the robustness of the data that are used in the model. Frequently, data that are used for model development are geographically restricted, cover a very short time frame relative to the simulations, and/or are an extrapolation or inference based on data from a related species or derived from expert opinion. Thus, parameter estimates based on these data have assumptions associated with them and may be biased or imprecise due to sampling design or analysis.

One of the benefits of using PVA as a part of a conservation effort is that it allows a diversity of participants to formulate questions concerning the population and offers insights into possible population responses. Several common questions asked during the PVA process include:

1. How will the number of individuals in the population change over time?
2. How long will the population persist?
3. What is the probability of extinction over a period of time into the future, say 100 years?
4. What is the minimum viable population size?
5. How much habitat is required to maintain a population?

B. PVA METHODS

A number of general models exist in which the viability of populations can be assessed. The RAMAS metapopulation model (Akçakaya 1994) was used to analyze golden-cheeked warbler viability. RAMAS was chosen because it allows for ages (or stages) of individuals to have different vital rates, such as fecundity, survival, and variability of these rates over years (i.e., temporal variance) among age classes. This model will also allow, when more data and better parameter estimates become available in the future, for the development of simulations for a species that occupies multiple subpopulations, which when considered together define a metapopulation. RAMAS incorporates the spatial aspects of metapopulation dynamics, such as the configuration of the subpopulations, dispersal and recolonization among subpopulations, and similarity (or dissimilarity) of environmental patterns experienced by the subpopulations.

Simulation Model

A three-age-class, post-breeding-census model was used for the warbler, with the following age classes: hatch year (HY), second year (SY), and after second year (ASY). Only singing males (holding territories) were simulated because detailed information exists only for this class of individuals for the warbler. A total of 1,000 replications were used for each simulation and each replication was run for 100 years into the future. Our modelling philosophy was to simulate populations with a variety of carrying capacities (i.e., how many singing males a given area can support) and with a variety of assumptions about vital rates. We also included a declining trend in carrying capacity of 2% over 100 years to determine the effect of habitat loss [based on the conservative finding of habitat loss trends from Wahl et al. (1990)]. It should be noted that all of these simulations are sensitive to the vital rate estimates we used. If these estimates are imprecise or biased, then the results are affected accordingly. Future research should focus on refining the vital rate estimates we used in our simulations and developing more detailed PVA models (see information and research needs below).

Estimates of Vital Rates

Several on-going studies were used to provide estimates of fecundity (number of male fledglings per singing male, including males who had 0 fledglings per territory). Fort Hood data (Tim Hayden and Robert Melton, USACERL, in litt.) yielded estimates of fecundity for 1992-94 of 0.7535 for SY males and 1.0750 for ASY males, and these estimates were used throughout our simulations. The temporal variances of these fecundity rates were estimated to be 0.0240 and 0.0056, respectively, over the 3-year study period. These values were also used throughout the simulations. Other studies (e.g., Dean Keddy-Hector, TPWD, in litt.; Pulich 1976) found much lower fecundity and therefore, by using the Fort

Hood data, our simulations are likely to represent a "best case scenario" for fecundity.

For survival rate estimates (Table 1), mark-recapture data from Fort Hood for 1991-95 (Tim Hayden and Robert Melton, in litt.), data from Balcones Canyonlands National Wildlife Refuge (BCNWR) for 1992-94 (Dean Keddy-Hector, in litt.), and data for 1961-64 from Pulich (1976) were analyzed using standard mark-recapture methods (i.e., Jolly-Seber estimation, Jim Nichols and Jim Hines, NBS, pers. comm.). These methods do not distinguish between mortality and permanent emigration from the study area, which tends to underestimate actual survival rates. For Fort Hood (training area 13B), the estimate of mean yearly survival rate for HY birds (males and females combined) was 0.30 and for after-hatch-year (AHY) males 0.57. For Pulich (1976), the estimate for HY males was 0.42 and for AHY males 0.69. For BCNWR, these estimates were 0.00 and 0.61, respectively. For our simulations, the values of 0.30 and 0.50 were used for HY males in "low" and "high" survival scenarios, and 0.57 was used for both SY and ASY males. The high value for HY survival is consistent with estimates of HY survival for other species of warblers (e.g., Kirtland's warbler, Carol Bocetti, NBS, pers. comm.).

Table 1. Golden-cheeked warbler male survival rates from various study areas (with Kirtland's warbler male survival rates for comparison).

Study	HY	AHY
Golden-cheeked Warbler		
Fort Hood	0.30	0.57
Pulich	0.42	0.69
Balcones Canyonlands NWR	0.00	0.61
Kirtland's warbler	0.46	0.71

Temporal variance of survival rates could only be estimated for AHY males from Fort Hood because this was the best data set and the estimation procedure gave negative results for the other data sets. Equation 2 of Link and Nichols (1994) was used to yield an estimate of 0.0119 for the variance among years in survival rates of AHY males. This estimate was also used for HY males, and doubled for a "high" temporal variance scenario for HY males. We conducted a complete set of all simulations in which both HY and AHY males had constant survival rates over time (i.e., temporal variance = 0) although survival rates undoubtedly vary among years. The constant survival rate simulations produce overly optimistic population survival probabilities for comparison with variable survival rates.

Several technical assumptions relevant to vital rates, explained in detail in Akçakaya (1994), were used in our simulations. When fecundity and survival rates were assumed to vary over time, a log-normal (i.e., skewed) distribution was used to simulate this variability. Demographic stochasticity was used in all simulations. Demographic stochasticity is random fluctuation in population variables, which can cause random fluctuation in population size and can result in the extinction of small populations (Schonewald-Cox et al. 1983). For simulations in which fecundity and survival were both assumed to vary over time, they were assumed to vary independently. Furthermore, Equation 5 of Goodman (1960) was used to estimate the variance of the product of fecundity and survival for SY and ASY males when both survival and fecundity were variable.

Carrying Capacity

To investigate the effect of various carrying capacities, simulations were run with carrying capacities set at each of the following values, and with initial starting abundance of the simulations set at ½ these values: 100, 200, 300, 500, 1,000, 1,500, 2,000, and 3,000. Starting abundances were set at ½ carrying capacity to reflect observations that not all "suitable" warbler habitat appears to be occupied. However, if warblers are at or near carrying capacity, then the extinction probability would likely be slightly less. For each of the carrying capacities above, we also investigated the effect of a declining trend in carrying capacities. A linear trend of 2% loss per year over 100 years was used to model the decline in carrying capacity due to loss of habitat (2% per year was the most conservative habitat loss trend found by Wahl et al. 1990).

During the workshop, the modelling subgroup tried to estimate the carrying capacities and starting abundances of the various recovery units (Fish and Wildlife Service 1992) by using data obtained from Thematic Mapper (TM) satellite images classified for warbler habitat. However, by the end of the workshop, it became apparent to the group that these data could not be used to estimate warbler habitat and current abundances, even if good estimates of warbler densities were available, because the size of habitat patches and the quality of the habitat are not yet available from the TM images (David Diamond, TPWD, pers. comm.). When good estimates of these data become available in the future, along with information about dispersal rates of warblers among habitat patches of differing quality and different distances apart, along with data estimating the correlation among vital rates of these habitat patches, then it will be possible to develop a more detailed metapopulation model that attempts to model dispersal dynamics among subpopulations. Until that time the group decided to use the simpler, single population PVA model presented in this report.

The workshop group decided that a probability of extinction of greater than 5% in 100 years was unacceptable.

C. PVA RESULTS

A HY survival rate of 0.30 always resulted in rapid extinction over 100 years in all models investigated. Because 0.30 was the estimate for HY survival obtained from Fort Hood's area 13b (assuming mortality of any HY bird that was never recaptured or resighted), it is important that studies be designed to estimate the amount of dispersal in HY birds.

When HY survival was 0.50, the probability of extinction was fairly low for all but the smallest carrying capacities. The probabilities of extinction for carrying capacities (K) of 3,000 territorial males or fewer are given in Table 2 and are shown in Figure 1. These results should be interpreted with caution because they assume fecundity and survival rates and their temporal variances are similar to those found on Fort Hood. Other assumptions include no effect of patch size on fecundity and perfect dispersal among patches within a population that has a carrying capacity of size K at the present. However, if these assumptions are valid, then these results imply that the carrying capacity of a unit should not be allowed to fall below 3,000 to maintain a reasonable probability of persistence over 100 years, even with a linear loss in carrying capacity of 2% per year over the next 100 years.

If the HY survival rate is actually lower than 0.50, then the probability of extinction over 100 years would be higher than the results in Table 2 indicate. To demonstrate the sensitivity of HY survival the same simulations as were presented in Table 2 were run with a HY survival of 0.45 (Table 3). The probability of extinction in almost all simulations (the exceptions were those that remained at 0) was increased. These results imply that the carrying capacity of a unit would need to be more than 3,000 to maintain a reasonable probability of persistence over 100 years with the assumptions and conditions mentioned above for HY survival of 0.50.

These simulations emphasize the importance of HY survival rate. Two observations regarding HY survival are: (1) studies to determine more precisely what the HY survival rate is under various conditions will provide better data for the simulations and, thus, result in a better goal for recovery efforts and (2) land managers may be able to design habitat management schemes that increase HY survival, thereby reducing the need to provide habitat for additional territorial male warblers that would be needed to compensate for a lower HY survival rate.

We did not investigate the effect of catastrophes on the probability of extinction. However, catastrophes would likely increase the probability of extinction and reduce population size, especially if a given catastrophe affects all units in the

population. Catastrophes, such as oak wilt disease, wild fires, drought, etc., could affect relatively large portions of warbler habitat.

Table 2. Probability of extinction in 100 years (HY survival = 0.50, AHY survival = 0.57, SY fecundity = 0.7535, ASY fecundity = 1.0750, K = carrying capacity of the number of territorial males, initial abundance = ½K). Values in boldface represent an unacceptable risk of extinction.

K	A	B	C	D	E	F
100	.009	.032	**.372**	**.481**	**.471**	**.643**
200	.001	.001	**.194**	**.255**	**.297**	**.366**
300	.000	.000	**.120**	**.161**	**.245**	**.249**
500	.000	.000	**.060**	**.095**	**.155**	**.176**
1000	.000	.000	.024	.039	**.095**	**.086**
1500	.000	.000	.018	.024	**.068**	**.065**
2000	.000	.000	.010	.006	.039	**.052**
3000	.000	.000	.004	.005	.038	.030

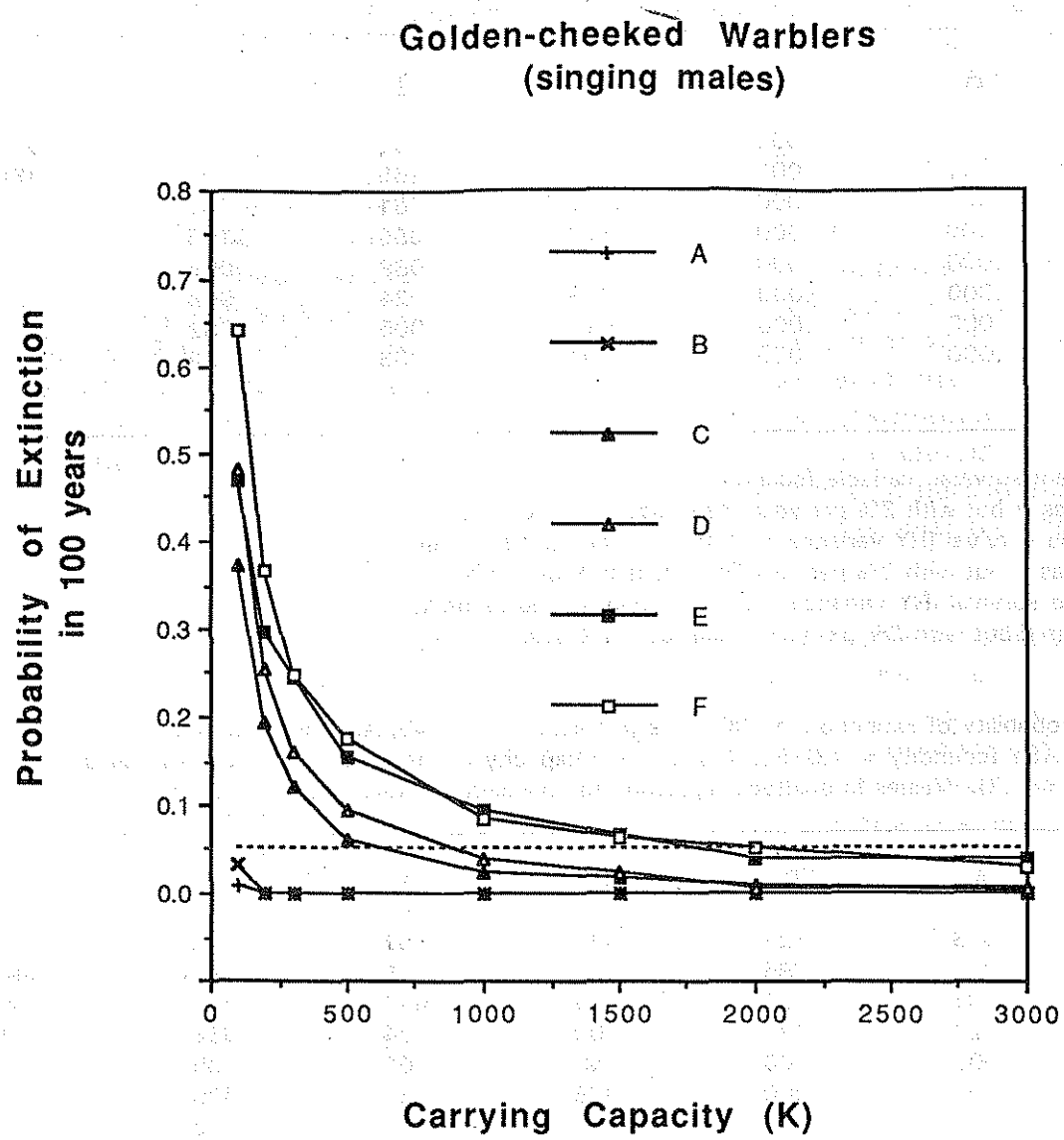
A = constant survival, variable fecundity
B = same as A but with 2% per year linear loss in K over 100 yrs
C = variable survival (HY variance = AHY variance) and fecundity
D = same as C but with 2% per year linear loss in K over 100 yrs
E = variable survival (HY variance =2AHY variance) and fecundity
F = same as E but with 2% per year linear loss in K over 100 yrs

Table 3. Probability of extinction in 100 years (HY survival = 0.45, AHY survival = 0.57, SY fecundity = 0.7535, ASY fecundity = 1.0750, K = carrying capacity of the number of territorial males, initial abundance = ½K). Values in boldface represent an unacceptable risk of extinction.

K	A	B	C	D	E	F
100	**.418**	**.521**	**.817**	**.857**	**.878**	**.913**
200	**.201**	**.196**	**.680**	**.715**	**.766**	**.804**
300	**.084**	**.093**	**.594**	**.651**	**.711**	**.734**
500	.027	.022	**.508**	**.504**	**.656**	**.652**
1000	.002	.000	**.349**	**.401**	**.508**	**.532**
1500	.001	.000	**.325**	**.321**	**.439**	**.436**
2000	.000	.000	**.251**	**.261**	**.398**	**.404**
3000	.000	.000	**.188**	**.208**	**.341**	**.348**

A = constant survival, variable fecundity
B = same as A but with 2% per year linear loss in K over 100 yrs
C = variable survival (HY variance = AHY variance) and fecundity
D = same as C but with 2% per year linear loss in K over 100 yrs
E = variable survival (HY variance =2AHY variance) and fecundity
F = same as E but with 2% per year linear loss in K over 100 yrs

Figure 1. Probability of extinction in 100 years versus carrying capacity (K) of the number of territorial male golden-cheeked warblers (HY survival = 0.50, AHY survival = 0.57, SY fecundity = 0.7535, ASY fecundity = 1.0750, initial abundance = ½K).



A = constant survival, variable fecundity
B = same as A but with 2% per year linear loss in K over 100 yrs
C = variable survival (HY variance = AHY variance) and fecundity
D = same as C but with 2% per year linear loss in K over 100 yrs
E = variable survival (HY variance =2AHY variance) and fecundity
F = same as E but with 2% per year linear loss in K over 100 yrs

D. DISCUSSION AND SUMMARY

The forms of the functional relationships of probability of extinction to carrying capacity shown in Figure 1 suggest that, in the present analysis, the risk of extinction for a golden-cheeked warbler population increases dramatically as carrying capacity drops below 1,000 breeding pairs (i.e., 1,000 singing males, assuming a 1:1 sex ratio). This suggests that a minimum habitat objective for management of this species should be creation or maintenance of enough habitat to support a potential population of 1,000 breeding pairs. If we use the maximum density seen for warblers on the intensive study area at Fort Hood (23.5 breeding pairs per 250 acres or 10.6 acres per breeding pair) as a definition of a dense warbler population, it would take at least 10,637 acres of such prime warbler habitat to provide the carrying capacity of 1,000 breeding pairs necessary to conserve the population for 100 years at a low probability of extinction. However, with the values simulated in "F" as shown in Figure 1, it would take a carrying capacity of 3,000 breeding pairs to assure a probability of extinction less than 5% over 100 years, which translates into a habitat requirement of 31,915 acres of prime warbler habitat. A target habitat area per warbler population of approximately 32,500 acres is therefore recommended, because it gives a low predicted probability of extinction under the worst case scenario simulated in this study, and because it provides a margin of safety over the predicted minimum safe population size of 1,000 breeding pairs, below which extinction risk rapidly increases. These estimates of habitat area requirements assume that the habitat is of good quality, and is sufficiently unfragmented to be usable by the warblers. These estimates also assume isolation of the warbler population from other similar populations. Inclusion of immigration from other population sources (i.e., recovery units) in the models may result in lower probabilities of extinction for a given population and therefore lower predicted habitat acreage requirements. However, data on the movement of fledgling (HY) warblers, which appear to do most of the dispersing in golden-cheek warbler populations, is insufficient to justify including a measure of dispersal among populations (i.e. metapopulation structure) in the PVA at present. (Note: Viable, self-sustaining populations in each recovery unit are listed as criteria for delisting in the recovery plan.)

E. INFORMATION AND RESEARCH NEEDS

Three major groups of information needs became apparent while performing the PVA. These needs are as follows:

1. Precise estimates of survival, fecundity, and temporal variances for each age class need to be determined for each recovery unit .

a. Dispersal (emigration) rates among patches and recovery units need to be determined for each age class, and survival rates need to be corrected to reflect true mortality apart from emigration. This is particularly critical for fledgling (HY) survival and emigration, because this seems to be the primary dispersing stage, for which very little data are presently available.

b. The proportion of territory-holding males (singing males) not actually mated with females needs to be determined, as does the proportion of non-territorial floaters present in populations, in order to improve the accuracy of fecundity estimates and population densities.

2. Precise density estimates and carrying capacities of warbler populations need to be determined for different recovery units and/or patches within each unit.

   a. The Thematic Mapper (TM) image classification of golden-cheeked warbler habitat needs to be verified for accuracy.

   b. More recent TM images should be classified to help determine trends in the abundance of woodlands suitable for warblers.

   c. Minimum patch size (and/or distance from other patches) needs to be determined.

   d. Identify rates of occupancy, territory densities, and vital rates within woodlands, given various patch sizes and landscape contexts.

   e. More verified locations of warbler territories are needed.

3. A spatially-explicit PVA should be developed that models dispersal among habitat patches of different sizes, and changes over time in these patches, among the recovery units.

   a. Identify age-specific dispersal rates and the distribution of dispersal distances traveled among habitat patches and recovery units. This information need is most critical for fledgling (HY) stage.

   b. Measure correlation over time in vital rates among the different patches and recovery units.

V. HABITAT MANAGEMENT STRATEGIES

Bill Armstrong, Mary Capperino, Jackie Davis, Chuck Hunter, Matt Judy, Jay Kane, Dean Keddy-Hector, Mike Krueger, Susan Rust, Doug Slack, and Rex Wahl

A. HABITAT DESCRIPTION

Vegetation supporting the golden-cheeked warbler is varied. This section describes the range of habitat variables as an aid to discriminating between what is, or may be, habitat from non-habitat. We describe the boundaries, where known, of important vegetation components. We answer the question: Do I have warbler habitat?

If I have habitat, how do I tell its relative value, especially when faced with a management decision? There is information relating warbler density to certain habitat variables. Some workers view greater warbler density as a measure of habitat quality. Where supported by data, we provide information on "greater quality" aspects of each component. Where there is the capability of soils, land use, and vegetation, the "greater quality" aspects of each variable should be favored for greatest conservation benefit. Land managers should weigh habitat quality as a factor when deciding to alter vegetation; for example, if the decision is between altering vegetation in good or poor quality habitat.

Golden-cheeked warbler habitat is broadly characterized by the following physical and biological characteristics.

(1) **Tree Species composition.** The Golden-Cheeked Warbler Recovery Plan (1992) provides a comprehensive listing of tree species associated with golden-cheeked warbler habitat. The most important generalization that can be derived from the recovery plan and the experience of our group is that habitat must have a combination of Ashe junipers (*Juniperus asheii*), also known as cedar, and broad-leaved trees (>10 ft in height). Data from the recovery plan and Dean Keddy-Hector (unpubl. data) show that these two groups of trees account for between 10% and 85% (broad-leaved trees) and between 10% and 90% (Ashe juniper). Resource managers should evaluate the entire stand for species composition, as any one golden-cheeked warbler territory within a stand may be relatively homogeneous for either broad-leaved or juniper trees. In addition, resource managers should recognize that, in some cases, habitat may cross property line boundaries.

(2) **Canopy height.** Wahl et al. (1990) and others in the subgroup agreed that trees should be **at least 10 ft** in height. Greater canopy volume above 10 ft is better.

(3) **Canopy cover (overstory).** Tree canopy cover must be at least 50%; greater than 50% cover provides more effective habitat. Some data available suggest that wooded areas with canopy cover between 35% and 50% is used by golden-cheeked warbler (Keddy-Hector, pers. comm.).

(4) Tree **Stem density.** Stem densities (of trees >10 ft in height) from studies of golden-cheeked warbler territories vary between 140 stems/acre (Wahl et al. 1990) to 776 stems/acre (Beardmore 1994).

(5) **Geology/soils.** Golden-cheeked warblers are typically found on shallow limestone soils. Geology and soil influence the development of plant communities.

(6) **Topography.** If the vegetation characteristics (composition, height, and stem density) are present, slope may not be a factor. However, over the range of golden-cheeked warblers today, most territories are associated with (on or adjacent to) steeper slopes.

(7) **Proximity to water.** Water is found at least seasonally, on or near most sites used by golden-cheeked warblers.

(8) **Size and Context of Patches.** For recovery purposes, the best available evidence indicates that core areas should be at least 250 acres (Wahl et al. 1990, and more recent observations of the decline of golden-cheeked warbler populations at Meridian State Park, Wild Basin, Kerrville-Shreiner S.P., and Mother Neff S.P). We define core areas as those sites where territorial birds persisted for at least 10 years. Larger blocks of habitat (>250 acres), within 3,100 ft of other blocks of habitat are likely to provide optimal conditions for the golden-cheeked warbler. Small patches of habitat (<12.5 acres) that are associated with or within 3,100 ft of core areas, or other small patches farther than 3,100 ft from core areas, also constitute suitable habitat.

The context within which patches occur also affects their suitability for golden-cheeked warblers. Urban development generally has a more pronounced negative impact than rural, agricultural uses (Engels and Sexton 1994, Benson 1990). The risk of extirpation from patches of suitable habitat increases as the size of the patch decreases and/or as the distance between habitat patches increases and/or as the distance of patches from a core area (source area) increases (MacArthur and Wilson 1967). Isolation of patches increases the likelihood that displaying males will not be able to attract females, that fledglings will not be able to disperse successfully, and that disturbance events (both within and surrounding the patches) may inhibit successful reproduction. See Engels (1995) for a more detailed discussion of the landscape-scale relationships in rapidly urbanizing areas.

Recognizing golden-cheeked warbler habitat

The following checklist is recommended as a guide to identify potential golden-cheeked warbler habitat. This checklist should be applied to an area not necessarily under one ownership. For example, if your wooded stand is contiguous with your neighbor's, the entire stand should be evaluated.

1. Is the site found in any of the following counties? (see p. 6, for list of counties) Yes_____No_____

2. Are Ashe juniper (cedar) and broad-leaved trees (such as Spanish oak, live oak, post oak, cedar elm, walnut) present in your wooded stand?
Yes_____No_____

3. Are most trees in the stand 10 ft or taller? Yes_____No_____

4. Is the total canopy cover (average of entire stand) greater than 50%?
Yes_____No_____

5. If the answer to 1 - 4 is Yes, then is the woodland stand greater than 12 acres in size? Yes_____No_____

If a landowner answers **Yes** to questions 1-5, then the site may contain golden-cheeked warbler habitat. If the landowner answers **No** to any question, then the landowner does not have golden-cheeked warbler habitat. **Woodland patches that are relatively isolated from similar patches may not be habitat, even though they may satisfy all criteria listed above. Only surveys during the breeding season will confirm whether a woodland patch is or is not warbler habitat.**

If the landowner/manager is uncertain, then he or she should contact Texas Parks and Wildlife Department, Central Texas Regional Biologist, (512) 912-7011; Natural Resource Conservation Service, State Biologist (817) 774-1291; Fish and Wildlife Service (512) 490-0057; or National Audubon Society, Conservation Corps (512) 327-1941 for assistance in determining whether he or she has golden-cheeked warbler habitat.

B. HABITAT MANAGEMENT CONSIDERATIONS

Maintenance of Habitat Structure

Habitat structure includes tree canopy, species composition, and stem density. Combinations of recommendations found below may be necessary.

Prevention of overbrowsing of woody vegetation. Domestic livestock grazing is not considered to be essential for maintenance or improvement of golden-cheeked warbler habitat. However, if livestock are desired, proper grazing management (deferred rotation grazing systems and proper stocking rates) is recommended to prevent overbrowsing. Management practices for native and exotic herbivores should be targeted to maintain proper numbers, which promote regeneration of hardwood species.

Habitat restoration. Private and public resource managers may wish to restore golden-cheeked warbler habitat where it has been degraded or does not currently occur. On sites with broad-leaved trees where junipers have previously been removed, land managers should allow the natural re-establishment of junipers. Such re-establishment can produce the appropriate mix of junipers and broad-leaved trees necessary for golden-cheeked warblers. Natural re-establishment can also be important in stabilizing erodible soils. On sites almost exclusively dominated by junipers (90% or greater Ashe juniper canopy), selective thinning may be employed to favor regeneration of oaks and other broad-leaved trees. The benefits of habitat restoration efforts may be negated if excessive use by browsing animals is not controlled at the same time.

Canopy maintenance. Mature Ashe juniper/broad-leaved tree woodlands with greater than 50% canopy coverage is desirable for golden-cheeked warbler habitat. Significant alterations in tree canopy coverage should be avoided. Normal land-management practices such as fence construction, small water pipelines, ranch-road construction, etc. should be planned to avoid warbler habitat. However, where these linear improvements can not be placed to avoid warbler habitat, alterations less than 16 ft. in width (measured stem to stem) are preferred because the canopy can partially close across these gaps. Where possible, habitat alterations should be linear in nature, thus minimizing detrimental effects on golden-cheeked warbler habitat. If a site has primarily large junipers as dominants, then selective removal of junipers may be used to encourage oak regeneration (assuming suitable soils and seed source).

Management of oak wilt disease to maintain woodland stand health. Resource managers should avoid creating injuries or otherwise stressing red and live oak

trees to prevent infection by oak wilt. A forester or arborist can be consulted about pruning practices that prevent oak wilt infection.

Control of Brood Parasitism and Predation

Brood parasitism. Cowbirds are known to parasitize golden-cheeked warblers' nests, although the extent of the impact on golden-cheeked warblers' productivity is unknown. Cowbird trapping is recommended on land with livestock operations with warbler habitat.

Predation. Predators, such as blue jays, cats, and raccoons, may have significant impacts on golden-cheeked warbler populations, especially in habitats near human development (Engels and Sexton 1994). Specific studies of the impact of fire ants on warblers have not been conducted; however, research demonstrates impacts by fire ants on arthropod diversity and abundances (Porter and Savignano 1990).

Consideration of Human Impacts

Human recreational activities may have a detrimental effect on golden-cheeked warblers in habitat with public access. These activities may include, but are not limited to: mountain biking, hiking, jogging, walking, camping, driving off-road vehicles, horseback riding, bird watching, and picnicking. The impact of these activities is a function of their timing, duration, and disturbance level. In public access areas, use of trails and roads should be controlled and minimized during the nesting season. Human use should be monitored for negative impacts on warbler behavior and habitat components. Hunting is considered to be a compatible activity.

Consideration of System or Landscape Scale

Planning on a regional scale is essential. Multiple levels of government cooperation and participation by private landowners are critical. Regional recovery goals should guide habitat recovery actions within a landscape context. An assessment of golden-cheeked warbler habitat distribution and apportionment is necessary (apportionment = patch size class allocation). Habitat incentive mechanisms across the different levels of government should be pooled.

Regional context and scale issues. Regional planning efforts should include spatial and temporal scales. For example, relationships among the core areas, regional populations, and smaller patches should be considered to meet total population and regional habitat targets. Planning should recognize that vegetation restoration and

changes occur in time frames measured in decades, for example Ashe juniper usually starts showing shredding bark at 20 years. In addition, planning must consider vegetation within the context of past land uses. Both private and public habitat planning efforts should be considered as part of a total recovery effort.

Monitoring implementation and assessment are important components to regional planning. Regional GIS (Geographic Information Systems) approaches should be used to integrate baseline monitoring of vegetation configuration and golden-cheeked warbler population status. Regional landuse analyses are recommended. Such planning should answer questions such as: What is the current land use by region? What is planned by region? What is the target?

C. SUMMARY

Golden-cheeked warbler habitat is characterized by canopy cover greater than 50% with a mixture of mature Ashe juniper and broad-leaved trees at least 10 ft tall. This habitat is typically (often but not always) found on shallow limestone soils and associated with steep slopes.

Habitat core areas typically consist of habitat patches 250 acres or larger often surrounded by smaller patches.

Proper grazing management, control of browsing, avoidance of canopy disturbance, control of predation and brood parasitism, and control of human disturbance are important habitat management considerations.

Habitat should be managed on local and landscape scales.

D. INFORMATION AND RESEARCH NEEDS

Using contemporaneous studies, determine the productivity across different portions of the birds' range.

Add to the knowledge about the use of understory structure in breeding habitat.

Determine relationships among insect abundance, plant species composition, warbler survival, and reproduction.

Evaluate the minimum size of patch in terms of extinction probabilities.

Evaluate warbler occupancy in relation to patch size using GIS.

Determine the relationship of limiting factors such as brood parasitism, predation, and fire ants to golden-cheeked warblers.

VI. OUTREACH AND PARTNERSHIPS

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A. INTRODUCTION

This chapter of the Golden-cheeked Warbler PHVA report attempts to address how human dimensions affect viability of the warbler's habitat and population through analysis of the outreach process: past, present, and future. The outreach subgroup decided upon five main goals to address in this section.

(1) Identify stakeholders and key players
(2) Define communication problems and suggest solutions
(3) Define and discuss incentives and disincentives to golden-cheeked warbler conservation
(4) Assess current policies affecting the warbler...What's working, what's not?
(5) Outline future workshops
(6) Define and discuss other outreach methods and tools

The overall goal in creating this chapter was to improve the current situation, since considerable tension and acrimony surrounds the conservation of not only the warbler, but many other endangered species as well. It is hoped that recommendations made in this chapter will assist all potential readers, be they agency personnel, landowner, urbanite, or other in the continued effort to recover or stabilize the golden-cheeked warbler. We must begin to find solutions together, no matter how philosophically divergent the groups may be, if we are to achieve down-listing or de-listing of this songbird. Sections pertaining to the goals listed above follow sequentially beginning with the identification of stakeholders and key players. A paper pertinent to understanding landowner perspectives on property rights and environmental issues is also included as an Appendix.

B. IDENTIFICATION OF STAKEHOLDERS AND KEY PLAYERS

In an attempt to create a fairly logical and complete outreach section, the group felt a list of stakeholders and key players should be created to define the audience. Therefore, we are using "stakeholders" to mean any people or entities potentially affected by golden-cheeked warbler conservation. "Key players" are any people or entities that can affect golden-cheeked warbler conservation on a local or regional

scale. The following list should not be interpreted as exhaustive, and we apologize for any omissions.

Stakeholders and Key Players

- Landowners
- Developers
- Elected government bodies
- Elected officials, state, federal, and local
- Government agencies
  - e.g., Texas Parks and Wildlife Department (TPWD)
    - Fish and Wildlife Service (Service)
    - Texas Agricultural Extension Service (TAEX)
    - Texas Department of Agriculture (TDA)
    - Texas Department Of Transportation (TxDOT)
    - Natural Resources Conservation Service (NRCS)
    - Department Of Defense (DOD)
    - Lower Colorado River Authority (LRCA)
    - Texas Forest Service (TFS)
- Utilities
- Environmental groups
- Property rights groups
- Universities
- Agricultural organizations (e.g., Farm Bureau, Texas and Southwestern Cattleman's Association, Southwestern Sheep and Goat Raisers Association)
- Sportsman's/recreation groups (e.g., Texas Wildlife Association, mountain bikers, horseback riders)
- Taxpayers

C. IDENTIFICATION OF PROBLEMS IN COMMUNICATING WITH THE PUBLIC - MYTHS, FACTS, AND PERCEPTIONS

Communication is one of the most important factors in recovering the golden-cheeked warbler. Without effective communication among interested parties, this species will probably decline because of habitat destruction. Good communication should enable coexistence between landowners and this endangered songbird.

Use of Jargon

It is important to use language that is easily understood by the target audience. Information should reflect local vocabulary and not alienate the public. For

example, Ashe junipers are more commonly referred to as cedar trees in the Texas Hill Country. Also, scientific terms should be avoided or explained when possible.

Perceived Exclusion of Landowners

Landowners express concern that the Service does not include their interests when developing endangered species policy. This perception results in negative public opinion directed at the Service when citizens are not adequately consulted. In Texas, private interests own over 97% of the land; thus, conservation cannot occur without landowner cooperation.

Rumors

Many rumors have significantly increased the controversy surrounding the golden-cheeked warbler. Landowners fear that they will no longer be able to clear fence-rows or cut another cedar on their own property. Conversely, agency personnel often hear that landowners are actively cutting cedar in order to rid their property of habitat. While some rumors may have a factual basis, all serve to increase distrust between affected parties.

Misinformation/Disinformation

Misinformation/disinformation is used to create controversy that acts as a rallying point for individuals. The emotional response, usually anger or fear, prevents effective communication and can lead to rash behavior. An example of this came about when the possible designation of critical habitat became known. It was widely reported that all of 33 counties were proposed to be designated as critical habitat. In reality, critical habitat designation was never proposed. The Service was considering designating critical habitat, which would have only included portions of warbler habitat within these 33 counties.

Inherent Uncertainties

Although several studies have been conducted on the golden-cheeked warbler, much is still unknown regarding its biology and habits. Continued research may answer many questions that scientists and landowners have regarding this species; however, limitations such as money, time, and science itself, restrict efforts.

Lack of Guidelines

Landowners are frustrated with the uncertainty regarding land management practices that are compatible with endangered species conservation. Guidelines are needed to assist both landowners and resource personnel in adequately identifying potential golden-cheeked warbler habitat and managing these areas to

simultaneously benefit man and species. Guidelines developed by TPWD and the Service are now available.

Trust/Cultural Differences

A lack of trust is evident on behalf of both landowners and government employees. Many times this distrust is rooted in cultural differences between rural and urban lifestyles. Rural people may feel pressure to conform to the viewpoints of urban residents at the expense of the desired use of their land. Texas landowners are intensely independent and feel threatened by attempts (perceived or actual) to dictate how they can make a living.

At the same time, many government employees feel that they are at risk from disgruntled people when performing job-related tasks. Threats to these employees, both verbal and physical, have increased tension and cut lines of communication to various degrees.

Buck Passing

Under current conditions, it is difficult for landowners to get the technical guidance they need when dealing with golden-cheeked warbler habitat. Many resource personnel are not able or willing to provide definitive answers on allowable management practices. This reluctance comes from fear of possible legal ramifications. Frustration builds and may result in a breakdown of vital communication between landowners and resource people.

Inconsistencies from Natural Resource Agencies

All agencies involved with golden-cheeked warbler conservation should provide landowners and all other interested parties with current and correct information. Communication within and between agencies is necessary to provide consistency in information to the public.

D. RECOMMENDATIONS TO IMPROVE PUBLIC OUTREACH

This section considers agency personnel and stakeholders as the two major parties involved in the dissemination and interpretation of information pertaining to the golden-cheeked warbler. For this reason, recommendations pertaining to these groups are divided into sub-sections directed at correcting the problems through agency and stakeholder communication efforts.

Recommendations to Agency Personnel

Given its responsibility to enforce the Endangered Species Act, the Service is typically viewed as the primary player among the agencies in providing factual guidance and coordination in golden-cheeked warblers conservation efforts. These recommendations are made with the understanding that many of the suggested actions may be in place or at least conceptual stages. The overall goal is to set forth these suggestions in a document that will be used by other agencies key to golden-cheeked warblers conservation (such as the TPWD, NRCS, TAEX, and TDA) in a concerted effort to assist the Service with "on-the-ground" guidance toward recovery or stabilization of this species population. The following suggestions are made in "bullet" fashion to hit the high points in a quick, readable fashion without belaboring any one issue.

- Coordination/Cooperation - No single agency has the resources or desire to handle this complex effort on their own. The Service should develop cooperative systems by which some aspects of golden-cheeked warbler consultations may be delegated to appropriate staff members within the TPWD, NRCS, and/or TAEX. Committees should be formed from logical groupings of recovery units to begin addressing goals, strategies and time-tables for recovery efforts. Suggested committee representatives would be: 1) an experienced, permanent Service employee, 2) TPWD Resource Protection and Wildlife Division personnel, 3) NRCS representatives familiar with range management practices and concerns in the area, and 4) the affected County Extension Agents and their respective livestock committee chair-people. The Service representative would primarily serve as an equal participant, but would also provide advice on legal issues pertaining to the Endangered Species Act (ESA) and should be prepared to defer to local agency personnel judgement for most aspects of regional status, needs, and direction. A trained, third party facilitator could help with the process. These committees should take the general approach that the golden-cheeked warbler and other endangered species issues are not going away and the only way to move toward recovery/stabilization and de-listing is to work together cohesively. In addition to formal methods, personnel from the various agencies should continue networking to initiate productive informal networks that will further the overall recovery goals. These networks should also include landowners/developers with large amounts of golden-cheeked warbler habitat and/or those that might be keenly interested in being a productive participant in the process.

- Public Relations - The majority of agency staff members have educational backgrounds in technical areas and are, therefore, not adept in public relations. For this reason, additional resources may need to be expended in this area of continuing professional education and/or hiring. Specific efforts should be directed to ensuring agency personnel genuinely understand and respect the

social make-up of rural Texas landowners, since they control the vast majority of golden-cheeked warbler habitat. The recovery or stabilization of golden-cheeked warbler populations depends upon their cooperation.

- Communication Tools

Effective Use of Media - Many of the rumors and misinformation surrounding the golden-cheeked warbler and other environmental issues are due to biased media coverage. Agencies should try to counter the spread of misinformation through the media by requesting equal representation on important issues. Agency personnel need to develop positive relationships with media representatives and be prepared to respond quickly and appropriately to media requests for information.

Guidelines/Fact Sheet - Agency personnel must be prepared to effectively deal with their constituency. It is recommended that a uniform set of guidelines or a fact sheet be prepared to provide agency personnel and, subsequently, landowners with guidance for typical land management and/or development activities in undeveloped portions of their region. TPWD and Service have developed golden-cheeked warbler management guidelines for this purpose. All affected agencies should reference these guidelines to ensure consistency, with the overall goal of creating a single source of correct information. It should be understood that the Service has the ultimate responsibility to ensure the guidelines comply with the ESA but are also sensitive to the needs of the people. In addition to guidelines, a video might be prepared to clarify habitat and land management issues. It should be understood that its application may vary slightly by region and that it is a dynamic tool that will be updated as new information on the golden-cheeked warbler emerges. Also, because activities can affect habitat for black-capped vireos and other endangered species, land managers are encouraged to learn about the habitat requirements of other species.

Demonstration Projects - Along with developing the guidelines and video, local TPWD, NRCS, and extension personnel should begin to target potential locations for demonstration projects in their region. These sites should be chosen as optimum examples of working agricultural or urban operations that are compatible with golden-cheeked warbler conservation. These localities would be used after the guidelines and video are completed for training of agency personnel first, then for possible landowner/developer outreach projects. The sites would be presented to the regional committees (mentioned above under "Coordination/Cooperation") and their use dependent upon the approval of the committee. If no sites are found in a region, the creation of

one should be prioritized as a medium to long-term goal and agency personnel from that region should travel to existing demonstration project sites in other regions to seek on-the-ground golden-cheeked warbler habitat identification training.

Formal Dispute Resolution Process - The Service might consider structuring a uniform mediation process for resolving disputes on potentially large-impact projects. Many stakeholders and agency personnel are uncomfortable in dispute resolution processes dealing one-on-one. The selection of a third party mediator should be mutually agreed upon. However, the Service currently negotiates with applicants via the section 7 consultation process or the section 10a permit process to find solutions that avoid, minimize, and/or compensate for the impact of a project on endangered species.

Recommendations to Stakeholders

Stakeholders should be aware that agency personnel are actively working toward bettering the communication process as it pertains to golden-cheeked warbler conservation. With that in mind, consultations should be approached in a diplomatic, fact-oriented, and mutually respectful manner. Stakeholders may work with the agency or consultant they are most comfortable dealing with, but the Service has the ultimate say in golden-cheeked warbler consultations. Stakeholders should politely request consistency in information (verbal and written) from the various agencies and personnel within individual agencies and back that up with consistent and open information from their side of the table. Before entering into consultations, individual(s) should become aware of all issues involved and arrive with appropriate decision-making tools such as maps, photos, plats, and project descriptions. Stakeholders should be prepared to honestly consider alternative methods to achieve their goals in the interest of working toward consensus. Consultations should begin as early in the planning stages of a project as possible. In most cases, consensus can be reached, projects can proceed and stressful, emotional interactions can be avoided with thoughtful preparation. Stakeholders should also be aware that recommendations may be updated as biologists learn more about the species' biology and habitat requirements.

E. IDENTIFICATION OF INCENTIVES AND DISINCENTIVES FOR LANDOWNERS

As noted, over 97 percent of Texas is in private ownership, so the golden-cheeked warbler's habitat--and the species' future--can not be secured without the support of private landowners (or at least their willingness to avoid extensive habitat modifications). The purpose of this section is to identify incentives that might gain

landowners' help in preserving warbler habitat; and, conversely, to identify disincentives that hinder that goal. Policymakers should strive to minimize disincentives while maximizing incentives.

A number of disincentives stand in the way of securing landowners' cooperation in protecting warbler habitat. Among these are:

1. Current landowner perceptions:

   a. A negative view of government intrusion.

   b. Uncertainty over the true intentions of outsiders.

   c. A perceived threat to landowners' independence and privacy.

   d. An unwillingness to submit to outside direction, from whatever source, in the management of private property (though more collaborative efforts might be acceptable--in the words of one rancher, "you can lead me a long way, but you can't shove me an inch").

   e. Anger that there's been insufficient recognition of current good land stewardship practices.

2. Economic disincentives:

   a. Lack of economic incentives to preserve or improve warbler habitat.

   b. Fear that the presence of endangered species might lead to legal restrictions on land use, and thence to declining property values.

   c. Fear of decreased income because of legal restrictions on land use.

3. Bureaucratic disincentives:

   a. Frustration over a cumbersome and expensive permit process.

   b. Frustration over the lack of clear answers to pressing questions.

   c. Concern that allowing regeneration of warbler habitat might result in unwanted government intrusion.

d. A belief that the development and implementation of endangered species policies has not taken landowners' interests sufficiently into account.

e. A perception that the Endangered Species Act is too inflexible.

The use of incentives might secure a greater willingness by landowners to help preserve warbler habitat. Unfortunately, many suggested incentives would require extensive funding--probably not a likely eventuality, given the current economic and political climate. More promising, perhaps, would be approaches that create tax or other economic benefits, as well as approaches that appeal to non-economic factors.

1. A November 1995 amendment to the Texas constitution grants tax relief to properties managed for wildlife habitat. This relief is equivalent to the current agricultural "exemption." Because relief will apply only to properties that already have agricultural exemptions, and have had them for a specified minimum number of years, there will be no additional negative impacts on local taxing districts. This is perhaps the most promising incentive, though to date it has been little publicized.

2. Revising the Federal inheritance tax to reduce pressures on heirs to subdivide properties. As a general rule, an extensive tract in single ownership is a more favorable situation for habitat conservation than the same land when subdivided (which often leads to development pressures).

3. Development of a Conservation Reserve Program for rangelands, similar to the CRP now in place for croplands.

4. Greater involvement of landowners in developing and implementing habitat conservation efforts.

5. Ecotourism already has a minor, though growing, role in warbler habitat protection (but market saturation may be a problem). Moreover, the development of other outdoor recreational activities might favor warbler habitat protection, since the aesthetic experience may be a significant component of those activities.

6. Conservation easements, arranged through either private or public entities, hold some promise (especially if combined with tax abatements).

7. Demonstration projects (such as the Kerr Wildlife Management Area or the Bamberger Ranch) might show skeptical landowners that habitat conservation can be compatible with positive financial returns.

8. Similar to demonstration projects, habitat management plans can be developed that would be compatible with warbler recovery and landowner objectives, for example, the enhancement of trophy deer production might incidentally benefit warbler habitat.

9. Private or public entities might develop grant programs for small landowners who wish to manage or restore warbler habitat.

10. New use of flexibilities in administration of the Endangered Species Act (e.g., Safe Harbor type programs) might reduce landowner concerns over allowing natural regeneration of endangered species habitat.

11. Awards programs recognizing good land stewardship and outstanding habitat management may have value.

Finally, several economic trends should be noted. These trends are neither incentives nor disincentives, but they do have implications for habitat conservation. These trends influence landowners' assessments of the economic situation. Incentives that consider these trends should be more effective than those that ignore them. Among these trends are:

1. The aging of the rural population, with the reluctance of younger generations to take up ranching as a lifetime occupation. Today, many prospective property buyers may be interested more in the aesthetic and recreational worth of properties than in purely economic concerns. Thus, they might be amenable to managing part of their lands as warbler habitat (or at least preserving habitat that now exists). And prospective sellers may find that enhancing the "eye appeal" of properties--including managing for the tree cover needed by warblers--may increase its value. From a habitat protection perspective there is a downside to the increasing use of land for recreation: as noted earlier, this can lead to relatively intensive development and consequent deleterious habitat modifications.

2. Increasing economic uncertainties in the beef and dairy cattle industries. The sheep and mohair goat industries also face hard times with the impending elimination of wool subsidies. The economic situation may be sufficient to compel landowners to consider alternative uses for their properties; this could, as an incidental result, benefit warbler habitat. Of

course, other alternative uses might have harmful impacts on that habitat (e.g., high density commercial/residential/industrial development).

3. Impending water shortages in much of Texas may result in substantial revisions to traditional water uses (e.g., the wholesale buyout of water rights is a possibility). Such revisions would be designed to ensure water supplies for urban areas, probably at the expense of rural counties. Though this trend has some potential for negative impacts on warbler habitat (e.g., juniper clearing in warbler habitat to enhance aquifer recharge), there could be countervailing benefits (e.g., the purchase of large sanctuaries for watershed protection).

F. ASSESSMENT OF CURRENT POLICY...WHAT'S WORKING, WHAT'S NOT

After an attempt to assess the range of current policies, laws and actions by federal, state, and local governments and private conservation groups that currently impact the population and survival of golden-cheeked warblers, the subgroup felt that too much material needed to be analyzed and too much information was not available to the group to allow this goal to be addressed. However, we felt that it would be worthwhile to pursue this topic so current efforts can be evaluated in terms of relative benefit to the warbler and minimizing adverse effects to landowners and other stakeholders. Therefore, we recommend an analysis of current policies with suggestions for improvement be a topic for future research.

G. FUTURE WORKSHOPS

A set of three regional workshops should be held to promote public and private sector partnerships by fostering communication and cooperation among government agencies, academic institutions, private organizations, biologists, and consultants concerned with golden-cheeked warbler recovery. The goal of these workshops is to share information and relay clear and consistent guidelines for private landowners and other interested parties on how to promote conservation of the golden-cheeked warbler.

One of these workshops should be located in each of the following areas: Recovery Units 1, 2, and 3; Recovery Units 4, 7, and 8; and Recovery Units 5 and 6. Groupings were made with the purpose of combining primarily rural areas and primarily urban areas. Actual locations of the workshops could be based on distance of travel for the regional participants.

The focus of the workshops should be on how to comply with the Endangered Species Act and what actions can be taken to help with the recovery of the warbler. Activities should include identifying and addressing the needs of private landowners, including developing guidelines that clearly describe what can and cannot be done by landowners or developers. One method of conveying consistent information may be to provide guidelines in the form of a fact sheet that provides answers to questions commonly asked by landowners and developers. Other educational material that might be developed at the workshops could include a directory of experts working on golden-cheeked warbler recovery.

Individual products of these workshops should be determined, in part, by the participants and based on their needs. While these products likely will be developed by committees of the participants, all participants should have the opportunity to review and comment on each product as they develop, and approval of final products should be based on consensus opinion. Each workshop should be lead by a professional facilitator.

Preparation

Preceding each workshop, representatives of agencies, private organizations, and institutions (the participants) should meet with their constituencies, or, individual committees or task forces of landowners or developers to identify important questions pertinent to the Endangered Species Act and the Golden-cheeked Warbler Recovery Plan. The needs assessment is vital to the success of the workshops and all efforts should be undertaken to ensure success of the process.

Other Workshops

Possible workshops involving landowners could be held if there is evidence suggesting they would help implement golden-cheeked warbler recovery.

H. ALTERNATIVE METHODS OF OUTREACH

This section describes methods by which the information, recommendations, guidelines, and measures developed during this workshop can be disseminated to the groups identified in Section B.

A principal goal of this program is to make the products of this and future workshops available to rural landowners. To date, and due to a variety of reasons (see Section C), many landowners have been uncertain how the presence of golden-cheeked warblers on their property affects their land management

decisions. Many of these landowners are far removed from the offices of the Fish and Wildlife Service. The information desired or needed by these people must be accessible at a local level. Fact sheets, which answer the most-asked questions regarding warblers and their habitat, and land management guidelines (e.g., what land use practices are compatible with the warbler) should be provided to County extension agents, local NRCS (formerly Soil Conservation Service) offices, speakers bureaus, real estate, local libraries, and offices of agricultural organizations such as the Farm Bureau and the Texas and Southwestern Cattle Raiser's Association. More in-depth information regarding the warbler and its habitat could be provided on videotape and made available at some of these same locations. Dispersal of this information should be accompanied by an "advertising" campaign to notify landowners of its availability. Some local newspapers may consider the distribution and availability of this information warrants coverage as a news story; therefore, in some instances actual paid advertising may not be required. The same information in the fact sheets and guidelines could be treated in more detail in technical papers that could be published in appropriate trade journals. A newsletter that reports on demonstration sites, activities, accomplishments, and also lists on-going or up-coming seminars and workshops that aid the recovery plan would be a useful method of public outreach.

Similar fact sheets and guidelines tailored for non-agricultural landowners should be developed and be distributed to real estate offices and local libraries. Both sets of information should be provided to local governmental bodies and elected officials and be made available at the U.S. Fish and Wildlife Service office, Texas Parks and Wildlife offices, and state parks that support golden-cheeked warblers.

It is anticipated that conservation organizations, such as The Nature Conservancy and National Audubon Society, and public land managers will participate in the future workshops discussed in Section G.

As described in Section B, other groups and individuals are affected by or have a stake in conserving the golden-cheeked warbler. Many of these, such as mountain biking clubs, hunting groups, or horseback riders, may not own land that supports warblers, but their use of such land could result in varying degrees of negative impacts to warblers or their habitat. Those groups need information about how they can minimize or eliminate the potential to cause such impacts. Such disparate groups may best be contacted through a general public relations campaign that would increase people's sensitivity to and pride in the warbler while providing basic information on the bird's natural history, distribution, and habitat needs. Information could be placed in newspapers and broadcast on radio or television. A relatively inexpensive technique for promoting the golden-cheeked warbler while providing information on everything from habitat management, natural history, and the permitting process, would be to set up a home page on the World Wide Web.

Many of the issues resulting from the listing of the golden-cheeked warbler received attention from metropolitan newspapers and television stations. The possibility of having some of these same media (most likely newspapers) treat the public outreach program or other results of the PHVA workshop as news stories should be explored.

I. RECOMMENDATIONS AND SUMMARY

The following is a summary of the recommendations made in the Outreach and Partnership Section:

1a Develop cooperative relationships with landowners through involvement of intermediaries, e.g. County extension agents.

1b Work with media to promote factual representation of biology, management needs, and conservation efforts for the golden-cheeked warbler.

1c Create regional workshop groups to address warbler conservation problems with specific attention to local concerns and issues.

2a Develop public information tools for distribution to interested parties.

2b Develop and enhance public outreach programs.

2c Form committees familiar with local issues to further overall recovery goals.

2d Establish dispute resolution processes.

2e Consider innovative alternative strategies for conserving the warbler.

3a Seek agricultural and development projects for use as demonstrations of land use compatible with golden-cheeked warbler conservation.

3b Provide cultural awareness training to agency personnel.

Approximately 3% of Texas lands are publicly owned. As a result a majority of warbler breeding habitat is privately controlled. Without public support and cooperation the warbler's future will remain at risk.

The Outreach and Partnerships subgroup identified stakeholders in warbler conservation. Stakeholders, especially landowners, must be involved in the planning and implementation of warbler conservation strategy. The subgroup also

identified a number of problems and disincentives that, to date, hinder cooperation among stakeholders.

A list of incentives was developed that could improve landowner cooperation. Some of these incentives are based on existing governmental regulation, policy, and programs, others would involve the creation of new programs or revisions to existing regulations. Only when incentives to stakeholders outweigh the disincentives will conservation efforts succeed.

Success also depends upon communication among stakeholders. Effective communication will help build trust, which is the first, and perhaps, the most important step towards successful recovery. Future warbler workshops are suggested to provide natural resource managers with current and consistent information. This information will also be shared with other stakeholders. Just as important as sharing information is listening to all concerns expressed by stakeholders. A cooperative atmosphere will decrease conflict that exists among affected parties while promoting recovery of the golden-cheeked warbler.

J. INFORMATION AND RESEARCH NEEDS

- Have an independent policy assessment group measure the success of current warbler conservation policies and make recommendations.

VII. RECOMMENDATIONS AND SUMMARY

The Distribution, Status, and Threats subgroup list 24 counties that have probable or definite occurrences of golden-cheeked warblers and 12 counties that need study to determine warbler presence. Citations for three recently completed studies on wintering distribution and/or ecology are provided. Nineteen studies completed or begun since the printing of the recovery plan are referenced and related to the recovery plan topics for which they provide more information. Information and research needs the subgroup identified include, investigation of the wintering and breeding distribution and determining predation and brood parasitism rates under various conditions.

The Population Biology and Modelling subgroup discuss for each model parameter used pertinent information such as from which study the data were obtained, what were the assumptions or caveats associated with it, and how the model behaved with that data. One of the most critical (if not the most critical) parameter of the model is hatch year survival. The model was run with 3 values of hatch year survival, 0.30, 0.45, and 0.50, yielding rapid extinction rates, mostly unacceptable extinction rates, and some acceptable extinction rates, respectively, for the scenarios simulated. The modelling effort indicates that 3,000 breeding pairs are necessary to conserve a population for 100 years at a low probability of extinction. The subgroup recommends that studies focusing on reproductive success, survival, and variation of these elements (i.e., the values needed for the model) be continued and another one added in the western part of the warbler's breeding range, a model specific to warbler life history be developed, and the viability analysis be conducted again in 3-5 years.

The Habitat Management and Strategies subgroup describe the characteristics of warbler habitat and provide a checklist to recognizing warbler habitat. Management strategies for maintenance of habitat structure, control of parasitism and predation, consideration of human impacts, and landscape or ecosystem level planning are given. For recovery purposes, core warbler habitat areas of 250 acres or more that are surrounded by smaller habitat patches are recommended. Research and information needs identified include the relationship of understory plants, plants species composition, patch size, predation, and brood parasitism to reproductive success and survival.

The Outreach and Partnerships subgroup identifies stakeholders and key players in warbler recovery. The subgroup's report discusses communication problems and makes recommendations for improving communication, including producing guidelines regarding land management in warbler habitat (this project is completed and available from TPWD), and providing consistent and current information from natural resource agencies involved in warbler conservation. Cooperative committees of logical groupings of recovery units to begin to address goals and

strategies for warbler recovery are recommended. Three regional workshops would promote public and private partnerships to foster communication on how to promote conservation of golden-cheeked warblers. Then, other workshops could be held if there is an indication that implementation of recovery strategies would be enhanced. The subgroup also recommends that an independent policy research group assess current policy regarding warbler conservation and make recommendations.

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VIEWPOINTS ON PROPERTY RIGHTS AND ENVIRONMENTAL ISSUES: AN OVERVIEW BASED ON TEN FOCUS GROUPS ACROSS TEXAS

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Viewpoints on Property Rights and Environmental Issues: An Overview Based on Ten Focus Groups Across Texas

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In December, 1994, ten focus groups on property rights and environmental policy issues were conducted in five locations across Texas.[1] In each of the five locations, we met separately with private landowners and with residents of mid-sized cities in close proximity to commercial agricultural areas. Our objective was to hear these groups[2] -- in their own words -- frame the most pressing issues regarding property rights and environmental policy. The first section is an overview of the most salient viewpoints from our discussions with the landowners.

Viewpoints on property rights and environmental regulations heard in the focus groups in mid-sized cities were similar to landowners' main points. Residents of mid-sized cities articulated a few additional concerns which are summarized in the second section of this overview. San Benito, Lubbock, San Angelo, Odessa and Tyler are not represented as constituting a representative cross-section of urban Texas. Familiarity and proximity with commercial agriculture were important in the viewpoints of these mid-sized city focus group participants. Because of the importance of urban perspectives on these topics, additional research is proposed in Texas cities such as Houston, Dallas/Fort Worth, San Antonio, El Paso, and Austin.

PRIVATE LANDOWNERS' VIEWPOINTS

Private landowners expressed a fierce pride in their **good stewardship**. They are quick to point out that **responsibilities** -- to neighbors and to future generations -- go hand-in-hand with private property rights.

- Farm and ranch families are frustrated when they are portrayed as anti-environment. Some call themselves "the original environmentalists." They have a direct stake in environmental protection: it affects their quality of life and their health.

- They emphasize the role of economic incentives: their land is their livelihood.

- In their view, good stewardship by private landowners is economically efficient. Land management options such as "central control" or managing resources as a "public trust" are seen as inferior to privately owned and managed property.

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[1]December 7-8: South Texas (Cameron, Hidalgo, and Willacy Counties and San Benito); December 8-9: South Plains (Lamb County and Lubbock); December 12-13: Edwards Plateau (Sutton County and San Angelo); December 13-14: West Texas (Brewster County and Odessa); and December 16: East Texas (Nacogdoches County and Tyler).

[2]No deliberate statistical design was employed in selecting the focus group participants nor the locations of the focus groups. Therefore, this qualitative assessment is offered as a profile, without claiming its representing viewpoints of all or other groups of landowners or urban residents. Approximately five to seven participants were involved with each focus group.

Farmers and ranchers **recognize a need for resource protection and conservation**, if it is reasonable and pragmatic. However, they view many environmental regulations as lacking "common sense" and lacking economic practicality, particularly in the policy implementation phase.

- Landowners are skeptical of "one-size-fits-all" environmental regulations from the federal or state level. They prefer **local control.**

- Landowners suggest designing environmental regulations specifying **"targeted"** levels for environmental quality objectives, and then giving the regulated community the flexibility to decide themselves how best to achieve them.

Private landowners do not understand or trust **environmental regulators**. They are viewed as being motivated to protect their jobs and promote growth of the bureaucracy, rather than as being genuinely concerned about pragmatic resource management. Regulators are seen as being under-informed about agricultural management, and neither interested nor concerned. Thus, before regulations are passed, they fail to effectively seek input from farmers and ranchers.

- Landowners view **educational programming** and **collaborative decision making** as more likely to achieve environmental policy objectives than mandatory, top-down rules. According to one rancher, "you can lead me a long way, but you can't shove me an inch."

Landowners emphasized two specific concerns about implementation of environmental policies:

- Landowners view **increasing acquisition of public land** for conservation and preservation as a poor use of public funds. Public managers are poor stewards. When private land is removed from tax rolls, local communities suffer. Land markets are adversely affected.

- Farmers and ranchers see disincentives for **protecting or creating wildlife habitat** because it makes them subject to increased scrutiny from environmental management agencies. Given positive incentives, landowners are willing to cooperate.

"Environmentalists" are viewed by landowners as prone to issuing edicts, rather than to negotiating. Farmers and ranchers see themselves as being on the defensive against emotional arguments driven by anecdotal evidence and perceptions. They believe scientific facts are often missing in discussions between environmentalists and landowners. Landowners say a key source of friction is **in-migration to traditionally agricultural areas by people who are not dependent on landownership for their incomes.**

Anxiety about changes in private property rights, however, is mostly in response to stories from other people and other places, rather than being based on landowners' own experiences or circumstances. Though concerned about how changes in property rights are likely to affect them and their neighbors, their overwhelming worries are about how increasing levels of environmental regulation will affect future generations' land management options -- "where things are headed."

Landowners support **educational programming** for urban and youth audiences. Key topics include the benefits of private land stewardship and the safety of our food and fiber system.

Landowners feel strongly about the need for **dialogue about policy options before legislation and environmental regulations become law**. They are interested in being part of a process to set environmental policy priorities. Too often, landowners feel they have not heard about environmental policy initiatives until too late to make a difference.

Some landowners see **a need for balance.** Currently, they see "two sides with no middle ground. They would welcome a dialogue where both sides have open minds about each other." Other landowners are **"skeptical about opportunities for compromise** because one side is interested in what the other has and the other side is interested in maintaining what they have." **"Somewhere we have to talk to each other and listen to each other."**

MID-SIZED CITY RESIDENTS

Generally speaking, mid-sized city residents commended private landowners for their stewardship of natural resources. They noted that there are "some renegades" -- notably, absentee landowners are exceptions to the rule.

Mid-sized city residents emphasized **family values** in their understanding of the property rights issue. They explained that children learn respect for each other and for others' property at home. They emphasized a general need for a stronger sense of community and for a higher level of respect and civility among community residents.

- "Children have been told they have rights. They have not been taught that with rights come responsibilities. There has been a failure."
- "Parents and families are the best teachers of fundamental rights and responsibilities. The schools cannot be expected to do it all."
- "It is difficult for non-property owners to respect and appreciate the property rights of others."
- "When kids don't feel like they belong as members of their family, they don't feel part of the community."

Mid-sized city residents understood **congestion and population growth** as exerting pressure on the current system of property rights and as damaging the environment.

- "In the past, we have taken a lot of our natural resources for granted. Just now we are seeing the results, we are learning the limits."

- In a discussion about nuisance odor associated with livestock farms, one participant commented that "your rights end where my nose begins. The more noses there are, the bigger the problems are."

- "Population growth in Texas makes change inevitable."

Like private landowners, mid-sized city residents expressed concerns about:

- **drinking water quality**.

- the **overuse of agrichemicals on urban lawns, golf courses and highways**. Some mentioned that farmers are trained to handle pesticides properly, and suggested such training as appropriate for all agrichemical users. "I'm worried about the playa lake two blocks from my subdivision being polluted by lawn chemicals -- more than pollution by farmers."

- the **implementation of the Endangered Species Act**. "Peoples' rights and interests should come before species protection."

- **how environmental policy is carried out**. "Everyone is in favor of clean air and clean water. Problems arise in how bureaucrats interpret and carry out the laws."

Mid-sized city residents mentioned some issues not raised in the discussions with private landowners.

- Advantages and disadvantages of **local zoning ordinances** were debated. On the one hand -- some mid-sized city residents wished for zoning to manage growth in the urban fringes. These residents were unhappy with the ramifications of unplanned growth for other community members. On the other hand, they were concerned about zoning restrictions pertaining to decisions which they saw as being up to the individual (such as where to park recreational vehicles in suburban neighborhoods).

- **Crime and personal safety** were seen as being related to a general eroding of respect for other peoples' rights and property. "Nobody will accept responsibility. We have torn down the heroes. There is no respect for government or authority."

- **Littering** was framed as an example of a problem stemming from a general lack of a sense of community. Taking care of those in need is a community responsibility: "if basic needs are not met, then there is no time to worry about littering."

- **Insufficient local landfill capacity** was mentioned by several focus group participants. There is strong but qualified support for recycling: "I would recycle more if it were easier."

- **Hazardous waste dumping** was a concern: "I don't know where they should put it, but I don't want it in Texas."