



Special Section

Regional Credit Market for Species Conservation: Developing the Fort Hood Recovery Credit System

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ABSTRACT In 2005, Fort Hood Military Reservation (Fort Hood, TX, USA) staff sought assistance from the Texas Department of Agriculture and several partner organizations to develop a mitigation approach that included the ability to mitigate temporary impacts to habitat through temporary mitigation agreements with private landowners. Fort Hood, which is home to the largest known population of the federally endangered golden-cheeked warbler (*Setophaga chrysoparia*; warbler), was at that time facing increased demands for military training activities that had the potential to disturb, but not likely destroy warbler habitat. Texas Department of Agriculture assembled an advisory committee and 3 stakeholder committees (science, economics, and policy), and tasked them with developing a cost-efficient system that provided the desired mitigation, while also contributing to the recovery of the warbler. The resulting Recovery Credit System (RCS) enabled Fort Hood to purchase both permanent and temporary credits that represent habitat conservation actions from private landowners for use to mitigate impacts on the installation. We describe our experiences developing and implementing the RCS and briefly discuss new regional credit markets now underway or in development in Utah, USA, for the Utah prairie dog (*Cynomys parvidens*); in Texas for the dunes sagebrush lizard (*Sceloporus arenicolus*), golden-cheeked warbler, black-capped vireo (*Vireo atricapilla*), and lesser prairie chicken (*Tympanuchus pallidicinctus*); and in Colorado, USA, for the greater sage grouse (*Centrocercus urophasianus*). © 2012 The Wildlife Society.

KEY WORDS biodiversity credit, conservation bank, conservation reserve program, endangered species, endangered species act, incentives, landowners, market, recovery, Section 7.

The endangered species act (ESA) prohibits take of endangered species; to “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb” is to take under the ESA (16 U.S.C. § 1531–1544 [1988]). However, both federal and non-federal entities often have a desire, and in some cases a need, to conduct activities that could result in take. Consequently, Sections 10 and 7 of the ESA were developed to provide pathways for permitting incidental take incurred as an unintentional consequence of other actions, while also requiring efforts to mitigate for the resultant take.

Section 10 of the ESA requires non-federal entities, such as commercial developers, to obtain an incidental take permit prior to conducting activities that are expected to adversely affect a listed species and requires that the entity consider 1) avoiding the impact (e.g., changing the timing or location of the project), 2) minimizing the impact (e.g., reducing project size), 3) rectifying the impact (e.g., re-vegetation), 4) reduc-

ing or eliminating the impact over time (e.g., through monitoring and adaptive management), or 5) compensating for the impact (e.g., conducting habitat restoration or protection on- or off-site (USFWS and NMFS 1996). Minimization typically only reduces, but does not eliminate, take for many activities; thus, compensatory mitigation is commonly required. Compensatory mitigation can include actions to preserve existing habitat, enhance or restore degraded habitat, create new habitat, establish buffer areas around existing habitat, modify land-use practices, and restrict access (USFWS 2012). Preservation or protection of existing habitat has historically been done by permanent acquisition through conservation easements or fee simple purchase. More recently, purchase of credits from a conservation bank has been developed as an additional option for conserving and managing habitat in perpetuity (USFWS 2011), but to date it has had limited use outside of California, USA (Fox and Nino-Murcia 2005). Section 7 of the ESA requires federal agencies to conduct conservation activities that benefit federally listed species and to consult with the Service on actions that may adversely affect these species to ensure that agencies avoid actions that might jeopardize their existence (USFWS and NMFS 1998). Efforts to

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comply with Section 7 requirements while meeting the land-use needs of the agency have led to the development and use of new approaches to meet conservation goals and mitigate impacts, including fee-based mitigation arrangements (e.g., buying land outside the project area or buying credits from a conservation bank; USGAO 2001).

Often, the largest expanses of endangered species habitats exist on military installations (Tazik and Martin 2002, Boice 2006). Given that ≥ 355 listed species occur on Department of Defense lands (Stein et al. 2008), the military faces significant challenges in balancing their military training needs with ESA compliance (Gutzwiller and Hayden 1997, Tazik and Martin 2002). Fort Hood Military Reservation (Fort Hood) encompasses 87,890 ha in central Texas, USA, and is the most active U.S. Army installation in terms of assigned personnel (Cornelius et al. 2007). Approximately 50,000 soldiers are assigned to Fort Hood, where training activities include mechanized maneuver, live fire, small-unit, and combined arms training. Fort Hood contains an estimated 22,591 ha (roughly 25% of the total area of the installation) of habitat suitable for the federally endangered golden-cheeked warbler (*Setophaga chrysoparia*; warbler), which supports between 4,482 and 7,236 territorial male warblers (USFWS 2010). Regulatory requirements under Section 7 of the ESA created substantial challenges to military trainers at Fort Hood (USACE 2012), including a range of military training restrictions in warbler habitat (USFWS 2005, 2010). As the demand for training increased with the wars in Afghanistan and Iraq, officials at Fort Hood began discussions with agency and non-governmental partners to identify alternative strategies to meet Section 7 requirements.

The Texas Department of Agriculture convened a working group to assist in developing an innovative mitigation strategy for the warbler in late 2005 and, over the next 6 months, the working group created the Recovery Credit System (RCS). The RCS enables the Department of Defense to purchase credits in the form of habitat protection and management activities for the warbler on private lands offsite, and is the first mitigation system to employ term agreements with private landowners to offset temporary impacts for an endangered species under Section 7. Credits are available for use to mitigate adverse impacts to habitat on the installation due to planned activities, such as training exercises, and unplanned events, such as wildfires.

The RCS approach was modeled after the Conservation Reserve Program of the Farm Bill (USDA 2012). Participating landowners had to meet eligibility criteria and then participate in a reverse auction to sell their credits. Successful bidders then executed contracts with a third party program administrator, which coordinated all aspects of program participation, including management activities and compliance and results monitoring. During the 3-year proof-of-concept, 20 landowners had their bids accepted and entered into contracts to enhance, expand, and manage 2,201 acres (891 ha) of warbler habitat.

During the 3-year proof-of-concept (2006–2009), participation was limited to landowners in 6 counties around Fort

Hood (Bell, Bosque, Coryell, Hamilton, Lampasas, and McLennan counties) to facilitate monitoring and evaluation of the program (Fig. 1). Given the success of the proof-of-concept, the working group is now expanding the RCS concept by developing a regional credit market that will encompass the 34-county breeding range of the warbler in central Texas. The new regional market will also include credit development and trading for the federally endangered black-capped vireo (*Vireo atricapilla*; vireo). If successful, this future regional market will enable credits generated on private lands through management and protection of warbler and vireo habitat to be sold to energy transmission companies, the Department of Defense, and other private and public entities that need to mitigate impacts to warbler and-or vireo habitat. Landowners are eager to participate in the generation and sale of credits. The working group has a list of 25 landowners representing $>5,000$ acres (2,023 ha) of warbler habitat who are waiting to participate (J. Tatum, Texas Watershed Management Foundation, personal communication).

BACKGROUND

The warbler was placed on the endangered species list in 1991, with habitat loss identified as one of the primary threats. Soon thereafter, concern and debate regarding regulatory impacts, conservation, and land-use conflicts emerged (Robison 1994, USDA 1994, Smith 1995). For many years following listing, Fort Hood was considered to have one of the largest expanses of warbler habitat within the breeding range, but recent data indicate that an estimated 96% of warbler habitat occurs on private lands, and the largest expanses of habitat occur in the southwestern portion of the range (Groce et al. 2010).

Following listing, Fort Hood staff faced challenges in minimizing impacts and contributing to warbler conservation while meeting their mission of military readiness (Boice 2006). Cattle-grazing and other land management practices, such as brush clearing and cutting of ashe juniper (*Juniperus ashei*) trees on the installation and neighboring private lands, presented potential conflicts with warbler habitat conservation. Given these challenges, Fort Hood became increasingly interested in exploring opportunities for off-site mitigation on private lands. The Leon River Restoration Project, a prior watershed management program, found that some private land owners with ranches around Fort Hood were open to, interested in, or willing to participate in management beneficial to endangered species, particularly in conjunction with improving land conditions for grazing or other land uses. These landowners responded positively to both monetary and non-monetary incentives for land stewardship (Dietz et al. 2003, Shaffer et al. 2006). Some saw potential economic opportunities through wildlife conservation (e.g., bird watching) that could supplement income from grazing or other land uses. However, many landowners had concerns about conducting activities on their lands that might result in increased regulatory responsibilities under the ESA. While incurring land-use prohibitions is improbable, these concerns regarding land-use conflicts and possible punitive

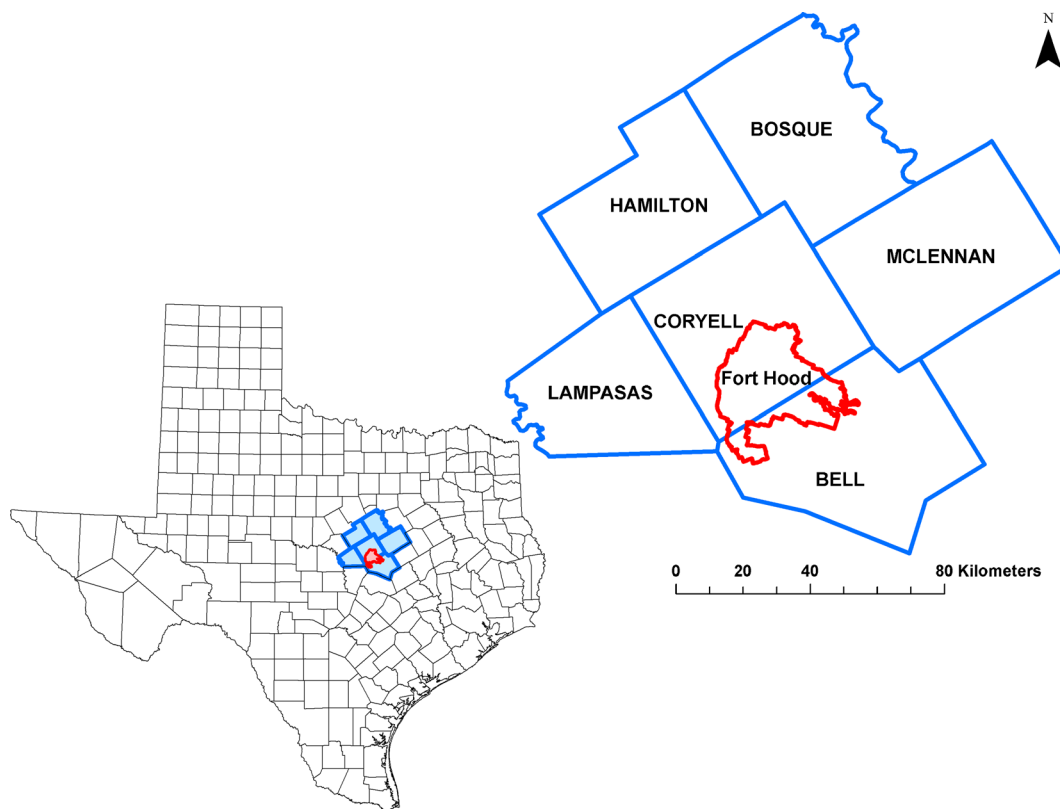


Figure 1. Texas (USA) map and illustration of the 6-county proof-of-concept area for the Fort Hood Recovery Credit System instituted for the federally endangered golden-cheeked warbler.

actions for impacts to endangered species (Michael 1999, Norris 2004) indicated that non-monetary incentives, including assurances against regulation or punitive actions, were desirable (Heal 2000).

A further challenge in implementing actions to benefit endangered species on private lands has been the lack of sufficient conservation options that appeal to, and result in, substantial participation by a broad range of landowners. Prior to RCS, compensatory fee-based mitigation under Section 7 had primarily relied on direct simple fee title land acquisition or perpetual easements, or payment into a fund that a third party will use later to buy and manage habitat through traditional conservation banking systems (Hill 2001). Landowners in the proof-of-concept region around Fort Hood were largely reluctant to enter into perpetual conservation easements (Sorice and Conner 2010, Sorice et al. 2011); thus, there was a need to develop an alternative approach that provided acceptable conservation options.

There is growing interest in achieving desired conservation outcomes through the development and application of ecosystem service markets. In the past few years landowner-based organizations such as Partners for Western Conservation and the Texas Watershed Management Foundation have been established primarily to facilitate the development and implementation of these markets. At a time when public funding for conservation is on the decline and pressure on species and habitats from energy extraction

and other forms of development are increasing, new approaches to funding and sustaining biodiversity conservation are needed. And, although some have argued that nature conservation should be framed as a moral, rather than a financial, issue (McCauley 2006), there is increasing evidence that payment for ecosystem service approaches result in enhanced conservation funding and are better at accommodating working landscapes as compared with traditional buy-and-protect conservation approaches (Goldman et al. 2008). Our experience with the Fort Hood RCS is consistent with this recent evidence, but we also believe that building and cultivating a greater conservation ethic within the general public is essential for achieving and sustaining conservation goals.

DEVELOPMENT OF THE FORT HOOD RECOVERY CREDIT SYSTEM

Recent natural resource, wildlife management, and conservation policy research and development have found that successful strategies require consideration of multiple spheres. Ecological information is essential for designing effective conservation and management, but consideration and input from political, ethical, social, and economic stakeholders and spheres are also essential for an effective policy strategy (Latour 2004, Wilhere 2012). The RCS working group assembled 3 stakeholder committees: science, economics, and policy, as well as an advisory committee, and tasked them with building the components and processes

necessary to 1) create a functioning 6-county credit market for the warbler, and 2) develop U.S. Fish and Wildlife Service (Service) policy guidance to support this innovative approach to mitigating impacts to endangered species habitat on public land and creating a net benefit to the species. The committees were staffed by a diversity of individuals representing state and federal agencies, academia, and non-governmental organizations. All of these individuals had some form of interest and expertise in the scientific, policy, economic, and-or conservation aspects of the warbler.

The science committee used available information on the natural history and habitat requirements of the species to determine the appropriate unit to serve as a commodity representative of habitat to be valued and traded, and to provide guidelines for habitat management and monitoring. The science committee defined 20 acres (8 ha) as a conservation unit, an area of adequate size to potentially contain multiple warbler territories, and assigned this conservation unit a credit value of 1. Based on available information about warbler habitat quality, the science team identified additional characteristics of a conservation unit that conveyed additional value: if it were part of a relatively large block of habitat, near other populations of the warbler, or in an area of high priority for recovery of the species. The credit value for the conservation unit was given additional value using multipliers to incorporate these characteristics. The science committee also developed management and monitoring guidelines that were applied to each participating ranch.

Quantification of debits or adverse effects to habitat on Fort Hood was calculated in a manner similar to credits. However, to consistently ensure that the acres protected were greater than those negatively affected, for every transaction, acres to be conserved were rounded down and acres to be impacted were rounded up. So, if a landowner had between 20 and 39 acres (8–16 ha) of habitat, this counted as 1 unit of credit (defined as 20 acres). If they had between 40 and 59 (16 and 24 ha) acres, this counted as 2 credits, and so on. Conversely, an impact of 1–20 acres (0.4–8 ha) counted as 1 unit of debit, and an impact on 21–40 acres (8–16 ha) counted as 2 units of debit, etc.

The economics committee was tasked with creating a market-based approach to the purchase of credits and to identify ways of creating a net benefit for the warbler. For the proof-of-concept period, landowner performance contracts were for 10–25 years, in 5-year increments, because these terms were deemed sufficient by the advisory committee to offset anticipated temporary training impacts (e.g., soldiers training on foot in warbler habitat), as well as being acceptable to a large percentage of landowners in the proof-of-concept area. Given the absence of data on the response of the warbler to relatively short-duration training impacts, the advisory committee relied on conservative estimates provided by the science committee, with the recognition that these estimates will likely need to be adjusted in the future as more information becomes available. The economics committee recommended that qualified landowners sell their credits through a reverse-auction process (i.e., all else being equal,

the low bidder wins the auction) in a manner similar to that which is used for participation in the Conservation Reserve Program of the Farm Bill. Landowners in the proof-of-concept area were familiar and comfortable with using this approach. The commodity for which landowners were basing their bids was recovery credit years (RCY), which represented the credit value calculated for their property, multiplied by the term that they were willing to participate. The financial basis for establishing a bid required an assessment by the landowner of the costs of management prescribed for their property (and required for program compliance) and any additional funds desired by the landowner in the form of yearly payments. In order to ensure sustained commitment to the program, landowners were required to provide a minimum of 10% cost-share for the management component of their bid (this was increased to a minimum of 25% beginning with the third bid round) and their bid also had to include a minimum of US\$ 500/year in annual payments so as to help ensure ongoing compliance with the provisions of their contract. The goal of using this competitive bidding process and the associated bid requirements was to maximize the cost-efficiency, or number of RCYs received per dollar invested by Fort Hood.

The policy committee was tasked with developing a contract template for landowner participation, identifying how RCS would fit within the framework of the endangered species act, working with the Service to develop new policy as needed, and addressing private landowner confidentiality concerns. The committee developed a contract template that was relatively simple and easy to understand, and borrowed heavily from the language that is used by the U.S. Department of Agriculture for Conservation Reserve Program contracts. Similar to the Conservation Reserve Program, the RCS contract includes strong financial penalties if the landowner fails to comply with the provisions of the contract. Working in collaboration with the Service, the policy committee deemed it important to gain experience with RCS implementation so as to inform the development of specific Service guidance for the future establishment and implementation of RCS. During the second year of the proof-of-concept, Service staff took a lead role in drafting this guidance, which was published as a draft in the Federal Register on 2 November 2007 (USFWS 2007) and as final guidance on 31 July 2008 (USFWS 2008). The guidance 1) enables federal agencies to utilize RCS as a means to offset their impacts to endangered species through conservation actions on private lands that results in a net-benefit to the species; 2) promotes the use of habitat credit-trading systems for this purpose; and 3) allows for term agreements to offset temporary impacts and permanent agreements to offset permanent impacts.

Confidentiality of information is a significant issue to many private landowners in Texas who are considering participation in a program to benefit an endangered species (K. Brown, Texas Wildlife Association, personal communication). The policy committee was keenly aware of this landowner concern and the fact that lack of confidentiality assurances would likely preclude participation of a large

percentage of landowners. On the other hand, it is essential for species and habitat data to be made available from participating ranches in order to verify that benefits are being achieved and funds are being spent as intended. To create a balance between these 2 competing concerns, the policy committee decided that all data related to habitat assessments, habitat maps, credit calculations, and management plans for landowners' ranches would be made available to the Service, but the landowner and ranch name and specific details on location would remain confidential. This approach was facilitated by the fact that each enrolled property received a TPWD-approved wildlife management plan and, under Texas state law (Parks and Wildlife Code, Section 12.0251), the information in these plans is confidential.

A key goal of the advisory committee was to design RCS such that there were always more acres being actively managed for the benefit of the warbler than were being negatively affected by training activities on Fort Hood. This goal was achieved through the acreage rounding process described earlier, as well as by the fact that 10% of the credits accrued by Fort Hood each year were immediately retired and unavailable for debiting.

IMPLEMENTATION OF THE FORT HOOD RECOVERY CREDIT SYSTEM

Texas A&M Institute of Renewable Natural Resources was contracted by the Department of Defense to implement a 3-year proof-of-concept phase in July 2006 and to monitor the results. The Institute of Renewable Natural Resources sub-contracted with various entities to conduct various RCS activities. Texas Watershed Management Foundation, a non-profit organization, served as the overall program administrator and manager. Texas Watershed Management Foundation staff conducted landowner outreach, met with landowners to describe the system, coordinated site visits for the purposes of determining credit score and conducting management-plan development, conducted reverse auctions to purchase credits, executed contracts with landowners, conducted prescribed management activities, and performed yearly compliance monitoring. Environmental Defense Fund staff assessed habitat on private ranches, determined associated credit score, and developed warbler-specific management plans for each ranch. TPWD staff developed or approved overall wildlife management plans of which the warbler-specific management plan was a priority component. Texas Watershed Management Foundation staff visited with landowners who expressed an interest in participation to describe the program and make an initial assessment of whether the landowner's property met the screening criteria for participation. For landowners that met screening criteria, Environmental Defense Fund staff would use the most recently available color infrared aerial photography to confirm that the property met the screening criteria and perform an initial delineation of potential qualifying habitat. Environmental Defense Fund staff would then visit the property and walk transects through potentially qualifying habitat to determine whether it met the criteria for habitat

types where warblers are expected to occur as defined by TPWD (Campbell 1996). These areas were generally considered to be high-quality breeding habitat. Areas that met these criteria were delineated, the acreage was measured, and credits were calculated based on the ranking criteria in the online "Appendix." Additionally, for each property, Environmental Defense Fund staff delineated areas considered supporting habitat. These were areas with the potential to meet the breeding habitat criteria in the future with appropriate management, but that currently may serve as a buffer, as well as foraging and dispersal habitats. Environmental Defense Fund developed reports for each property with descriptions and delineations of qualifying and supporting habitat, associated maps, credit calculations, and a management plan for enhancing, expanding, and conserving warbler habitat. This information was provided to each landowner and formed an essential part of their bid package.

ASSESSING THE RESULTS OF THE FORT HOOD RECOVERY CREDIT SYSTEM

Approximately 40 landowners participated in 8 bid rounds over the course of the 3-year proof-of-concept. Twenty contracts were awarded, representing 2,201 acres (891 ha) of warbler habitat. Due to the acreage rounding process, only 1,980 acres (801 ha) were used to calculate credits; the balance of 221 acres (89 ha) contributed to the net benefit criterion. In addition, the 10% set-aside requirement resulted in 198 (80 ha) of the 1,980 acres retired during the 3-year proof-of-concept period that were not available for debiting. To date, Fort Hood has used RCS to mitigate training impacts to 237 acres (96 ha) of habitat.

Clear benefits have been achieved in terms of acres under conservation management for the species. Less clear is what other biological objectives have been met. Due to funding limitations, monitoring on participating private ranches and on debit locations on Fort Hood was limited to the 3-year proof-of-concept period, and therefore data are insufficient to determine other impacts resulting from the program. Clear biological goals were not established *a priori*, for which biological monitoring could have been specifically designed to assess. Future crediting programs, whether RCS or otherwise, should specify biological goals that are appropriate to the species, system, and management approach of interest. In the case of golden-cheeked warblers, protection of existing habitat is unlikely to generate large increases in warbler abundance or productivity; thus, monitoring may need to focus on assessing whether occupancy and abundance is maintained in areas under contract and/or to determine whether habitat debits and credits across the region result in a sustained, increasing, or decreasing regional abundance of warblers. For species and systems where management may include more substantial restoration or habitat creation, monitoring metrics may include colonization, increases in abundance, reproductive success, or other ecological parameters. Additionally future programs should include a financially viable strategy for ensuring long-term biological

monitoring sufficient to determine the net impacts to the species. We suggest that, for market-based crediting programs, this could be achieved by applying a monitoring fee to each transaction, specifying biological goals *a priori*, and developing specific monitoring plans to be implemented to assess whether such goals are being met.

Substantial progress has been made in the area of identifying appropriate metrics for the establishment of biodiversity credit values (Willamette Partnership 2011). The process of calculating Fort Hood RCS credit and debit values was relatively simple, but it resulted in numbers that were difficult to relate directly to the acreage of habitat being credited, as well as to on-the-ground habitat conditions. The current trend in design of credit and debit values is to use the functional-acre credit concept (K. Halsey, Parametrix, personal communication). Using this concept, the calculated value reflects the percentage of optimum that is possible for the assessed site. For example, if a 100-acre (40-ha) site is at 70% of optimum conditions, then the calculation process would result in a value of 70 functional-acre credits. This approach results in values that are relatively easy to relate to existing and future desired on-the-ground conditions. However, the extent to which the relative conditions of a site can be quantified is driven by the extent and quality of ecological information available about the needs of the target species and the factors that drive or predict habitat quality for that species. The less ecological information available, the greater the uncertainty in the metrics that define credit and debit values, which in turn diminishes our ability to establish and measure meaningful biological outcomes. Given that we can almost always improve credit and debit values with more information, it is essential that crediting programs allow for adaptive modification of these values as new information becomes available.

The reverse auction process generally rewarded the bidder offering the lowest cost per RCY, 44% of the bids placed were successful, and 56% were unsuccessful. The competitive nature of the bidding resulted in increased cost-efficiency for Fort Hood: over the 8 bid rounds, the cost per RCY for all bids decreased from approximately US\$ 1,600 to just over US\$ 600, which equated to an average cost per acre of US\$ 888. Landowners quickly discovered they could increase the competitiveness of their bid by increasing the length of their contract term. In the first bid round, the majority of landowners chose a 10-year term; by the final bid round, all landowners chose the 25-year term.

Clearly, the design and application of the reverse auction process was successful in driving costs down and in incentivizing longer-term commitments by landowners. The relative simplicity of the Fort Hood RCS (one credit buyer, a relatively small number of participating landowners, and a distinct and limited number of bid rounds) lent itself to highly structured, in-person reverse auctions. This approach may not be suited to more complex, regional credit markets with multiple credit buyers and large numbers of competing landowners; in these cases, some form of online credit-trading platform may be necessary to enable transactions to occur in a timely and efficient manner.

THIRD PARTY EVALUATION OF THE RECOVERY CREDIT SYSTEM

In late 2009, the Department of Defense contracted with Robertson Consulting Group, Inc. to provide an objective and thorough evaluation of the 3-year proof-of-concept for both the process and the intended impact and to assess the utility of RCS. Robertson produced a report in March 2010 (Robertson and Rinker 2010), which found the RCS model to be viable and feasible. The Robertson report noted the RCS model provided the following:

- A quantifiable and consistent credit and debit determination method was established and implemented.
- Landowners and other stakeholders found the process to be efficient.
- Partnerships with landowners were enhanced.
- Training flexibility was increased for Fort Hood.
- The program met its goals for habitat conservation. These goals included a) maintaining an annual 10% reserve of credits; b) overestimating debits and underestimating credits; c) reporting annually on status of credit properties; d) continuing maintenance of a self-sustaining viable population and habitat protection; and e) using site selection criteria that target high-quality habitats for credits and low-quality habitat for debits. Robertson indicated that those items that could be assessed at the time of evaluation were met. However, the data they collected indicated that enhancements to the model, as described in the recommendations below, would improve endangered species conservation.

They also noted that substantial new scientific information, including several peer-reviewed journal articles and multiple publications, was generated that could facilitate or inform more effective conservation and recovery strategies for the warbler, as well as other species. The report provided several recommendations for continuation and expansion of the RCS model including the following:

- Establish metrics for recovery and baselines, if possible, so as to more effectively measure improvements to the baseline and progress toward recovery.
- Develop a clearer link between the management actions prescribed for each property and the recovery metrics.
- Allow landowners to receive some form of credit for supporting habitat so as to create a stronger incentive for enhancing the quality of this habitat.
- Allow for term contracts beyond 25 years so as to increase the applicability of term agreements for mitigation purposes.

EXPANSION OF THE RCS CONCEPT TO THE ENTIRE BREEDING RANGE OF THE GOLDEN-CHEEKED WARBLER

Given the success of the Fort Hood RCS, the interest in program participation from landowners across central Texas, and the need for mitigation options by various development interests, the working group is now creating an expanded, breeding-range-wide regional credit market for the warbler,

as well as the federally endangered vireo. The working group is concurrently developing a General Conservation Plan (GCP), following the HCP model (ESA § 16 U.S.C. § 1539(a)(1)(B) [2000]), which will support use of the market. A GCP is a regulatory document that defines conservation actions to benefit the target species, identifies likely adverse impacts to habitat from development, and describes how mitigation will be conducted so as to offset adverse impacts and create a net benefit to the species. A regional credit market will serve as an efficient and effective means for mitigation. The GCP and associated market will encompass ≥34 counties in central Texas and will facilitate protection and management of warbler and vireo habitats across the landscape on private lands. It will also enable entities to mitigate their impacts to these habitats in a cost-efficient and conservation-effective way.

The working group organized and conducted the first stakeholder committee meetings for the GCP in December 2011. These committees will develop the elements of the GCP and the associated regional credit-trading market. The market will award credits for actions on private lands designed to restore, enhance, and conserve habitat for one or both birds. Private landowners will have the ability to generate and sell permanent credits based on the conveyance of perpetual easements and term credits for participating in term contracts, which may extend for several decades.

APPLICATIONS TO OTHER SPECIES

The Fort Hood RCS has served as a model for the development of other species-based regional credit markets. Although the ability for private landowners to sell credits for endangered species conservation has been theoretically feasible for many years through the mechanism of conservation banking, the reality is that the expense and administrative burdens of establishing a conservation bank are beyond the resources of most landowners. The process of establishing a regional credit market includes development of a regional conservation-bank-like agreement with the Service, which effectively removes the financial and administrative hurdles from the individual landowner and greatly simplifies their participation in conservation action and associated credit generation. In addition, our experience in Texas indicates that many landowners are willing to participate in term agreements for endangered species conservation (including multi-decade agreements), but not permanent easements. While the life histories and habitat requirements of some species are best suited to permanent conservation, there are many species that will clearly benefit from term agreements that restore, enhance, and expand habitat. And, given the uncertainties in the impacts of climate change on species and their habitats, the ability to shift priority conservation areas over time through the strategic application of term agreements is likely to become increasingly important to conservation practitioners. We describe below some recently completed or under-development regional credit markets that have applied lessons learned from the Fort Hood RCS.

Utah Prairie Dog

In October 2007, Environmental Defense Fund, in cooperation with the Utah Farm Bureau, assembled a working group to initiate development of a range-wide credit trading market for the federally threatened Utah prairie dog (*Cynomys parvidens*). Participants in the Fort Hood RCS working group shared experiences and lessons learned from development of the RCS with the Utah working group at the initial meeting. Over a period of 18 months, the Utah group developed the Utah Prairie Dog Habitat Credits Exchange (UPDHCE), which is described briefly below.

Through the UPDHCE, a program administrator purchases conservation actions (e.g., conservation easements and-or habitat management) from private landowners and in doing so accrues conservation credits. Once accrued, the program administrator sells the credits to the entities required to offset their impacts to prairie dogs. Thus, the UPDHCE trades impacts on prairie dogs and their habitat for conservation targeted to high-value habitat elsewhere. Unlike current options, the UPDHCE enables developers to mitigate in a way that provides a net benefit to the species by incorporating private lands. Current mitigation options miss the opportunity to help recover the species by focusing restoration activities mainly on public lands and avoiding the opportunity to recover the species on private lands. The primary difference between the UPDHCE and individual conservation banks is that conservation credits accrued through a series of individual conservation banks are aggregated by a program administrator and sold in blocks to entities in need of mitigation credits.

Dunes Sagebrush Lizard

In June 2010, the Texas Interagency Task Force for Endangered Species and Economic Development assembled a working group to create a range-wide credit-trading market for the dunes sagebrush lizard (*Sceloporus arenicolus*; lizard), which is a candidate species for federal listing. The lizard occupies dune complexes in the Permian Basin of West Texas, which supplies approximately 20% of the nation's oil supply. The resulting credit system, which awards credits for actions on private lands designed to restore, enhance, and conserve habitat, was an integral part of a combined Candidate Conservation Agreement with Assurances/Habitat Conservation Plan (CCAA/HCP), which is the first of its kind in the nation, and which was developed concurrently with the credit system (Texas Ahead 2012). This CCAA/HCP enables private landowners to generate credits through conservation actions benefitting the lizard and to receive assurances that they will not be obligated to implement additional conservation measures beyond their existing commitments should the lizard be listed. The CCAA/HCP also provides an incentive to oil and gas developers to purchase credits from landowners as a pro-active conservation measure because, if enough credits are purchased, it offers the potential opportunity to avoid federal listing. If the Service ultimately decides that listing is still necessary, then oil and gas developers that are participants in the CCAA/HCP are assured that their

operations and development plans can continue without disruptions.

Lesser Prairie Chicken and Greater Sage Grouse

Environmental Defense Fund, in collaboration with the Texas Watershed Management Foundation and Partners for Western Conservation, is currently meeting with stakeholders to lay the groundwork for establishment of regional credit markets for the lesser prairie chicken (*Tympanuchus pallidicinctus*) and greater sage grouse (*Centrocercus urophasianus*). Both of these grouse species are candidates for federal listing (listing proposals to occur in 2012 for the chicken and 2015 for the sage grouse). We envision regional credit markets for both species that are (eventually, if not initially) multi-state, enable the generation and trading of both permanent and term credits, and facilitate pro-active participation by energy companies and other development and conservation interests.

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LITERATURE CITED

- Boice, L. P. 2006. Defense and conservation: compatible missions. *Endangered Species Bulletin* 31:4–7.
- Campbell, L. 1996. *Endangered and threatened animals of Texas—their life history and management*. Texas Parks and Wildlife Press, Austin, USA.
- Cornelius, J. D., T. Hayden, and P. A. Guertin. 2007. *Endangered species management plan for Fort Hood, Texas: FY06–10*. U.S. Army Corps of Engineers, Engineer Research and Development Center. Construction Engineering and Research Laboratory, Champaign, Illinois, USA.
- Dietz, T., E. Ostrom, and P. C. Stern. 2003. The struggle to govern the commons. *Science* 302:1907–1912.
- Fox, J., and A. Nino-Murcia. 2005. Status of species conservation banking in the United States. *Conservation Biology* 19:996–1007.
- Goldman, R. L., H. Tallis, P. Kareiva, and G. C. Daily. 2008. Field evidence that ecosystem service projects support biodiversity and diversify options. *Proceedings of the National Academy of Sciences* 105:9445–9448.
- Groce, J. E., H. A. Mathewson, M. L. Morrison, and R. N. Wilkins. 2010. Scientific evaluation for the 5-year status review of the golden-cheeked warbler. Submitted to U.S. Fish and Wildlife Service, Region 2, Albuquerque, New Mexico, USA.
- Gutzwiller, K. J., and T. J. Hayden. 1997. A literature review of actual and potential effects of military maneuvers on avian behavior, reproduction, and community structure. U.S. Army Construction Engineering Research Laboratories Technical Report 97/98, Champaign, Illinois, USA.
- Heal, G. M. 2000. *Nature and the marketplace: capturing the value of ecosystem services*. Island Press, Washington, D.C., USA.
- Hill, B. T. 2001. *Endangered species act fee-based mitigation arrangements*. U.S. General Accounting Office, Washington, D.C., USA. <http://www.purl.access.gpo.gov/GPO/LPS49142>. Accessed 1 Mar 2012.
- Latour, B. 2004. *Politics of nature*. Harvard University Press, Cambridge, Massachusetts, USA.
- McCauley, D. 2006. Selling out on nature. *Nature* 443:27–28.
- Michael, J. 1999. *The endangered species act and private landowner incentives*. Dissertation, North Carolina State University, Raleigh, USA.
- Norris, S. 2004. Only 30: a portrait of the endangered species act as a young law. *Bioscience* 54:288–294.
- Robertson, S., and H. B. Rinker. 2010. Third party evaluation of the Recovery Credit System proof-of-concept. Robertson Consulting Group, Sarasota, Florida, USA.
- Robison, C. 1994. Texas sues agency over enforcement of wildlife protections/“War is not yet over,” Morales says. *Houston Chronicle*. 1 December 1994; section A: 29.
- Shaffer, M. L., L. H. Watchman, S. Vickerman, F. Casey, R. Dewey, W. J. Snape, M. Senatore, and R. M. Ferris. 2006. Proactive habitat conservation. Pages 286–295 in D. D. Goble, J. M. Scott, and F. W. Davis, editors. *The endangered species act at thirty*. Island Press, Washington, D.C., USA.
- Sorice, M. G., and J. R. Conner. 2010. Predicting private landowner intentions to enroll in an incentive program to protect endangered species. *Human Dimensions of Wildlife* 15:77–89.
- Sorice, M. G., W. Haider, J. R. Conner, and R. B. Ditton. 2011. Incentive structure of and private landowner participation in an endangered species conservation program. *Conservation Biology* 25:587–596.
- Smith, E. E. 1995. Environmental issues for the 90s: golden-cheeked warblers and yellowfin tuna. *Maine Law Review* 47:345–363.
- Stein, B., C. Scott, and N. Benton. 2008. Federal lands and endangered species: the role of military and other federal lands in sustaining biodiversity. *Bioscience* 58:339–347.
- Tazik, D. J., and C. O. Martin. 2002. Threatened and endangered species on U.S. Department of Defense lands in the arid west, USA. *Arid Land Research and Management* 16:259–276.
- Texas Ahead. 2012. *Economic resources for growing and governing Texas*. Texas conservation plan for the dunes sagebrush lizard. Texas Comptroller of Public Accounts. http://www.texasahead.org/texasfirst/resources/task_force/priority/dsl.php. Accessed 21 Mar 2012.
- U.S. Army Corps of Engineers [USACE]. 2012. Fact sheet: Fort Hood endangered species management plan. <http://www.cecer.army.mil/td/tips/product/print1.cfm?ID=306&TOP=1>. Accessed 20 Feb 2012.
- U.S. Department of Agriculture [USDA]. 1994. Hearing before the Subcommittee on Department Operations and Nutrition of the Committee on Agriculture, House of Representatives, 103rd Congress, 2nd session. <http://www.archive.org/details/departamentofagri00unit>. Accessed 20 Oct 2006.
- U.S. Department of Agriculture [USDA]. 2012. Farm Service Agency. Conservation programs, Conservation Reserve Program. <http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp>. Accessed 20 Mar 2012.
- U.S. Fish and Wildlife Service [USFWS]. 2005. Biological opinion on the U.S. Department of Army's (Army) ongoing and proposed military training activities at Fort Hood Military Installation in Bell and Coryell Counties, Texas. U.S. Fish and Wildlife Service, Arlington, Texas, USA.
- U.S. Fish and Wildlife Service [USFWS]. 2007. Draft guidance on recovery crediting for the conservation of threatened and endangered species. Federal Register 72:212. <http://www.fws.gov/endangered/esa-library/pdf/recovery%20crediting.pdf>. Accessed 20 Mar 2012.
- U.S. Fish and Wildlife Service [USFWS]. 2008. Endangered and threatened wildlife and plants; recovery crediting guidance. Federal Register 73:148. <http://www.fws.gov/policy/library/2008/E8-17579.pdf>. Accessed 20 Mar 2012.
- U.S. Fish and Wildlife Service [USFWS]. 2010. Biological opinion on the U.S. Department of Army's (Army) ongoing and proposed military training activities at Fort Hood Military Installation in Bell and Coryell counties, Texas. U.S. Fish and Wildlife Service, Arlington, Texas, USA.
- U.S. Fish and Wildlife Service [USFWS]. 2011. Endangered species program for landowners. Conservation banking. <http://www.fws.gov/endangered/landowners/conservation-banking.html>. Accessed 20 Mar 2012.
- U.S. Fish and Wildlife Service [USFWS]. 2012. Endangered species permits fact sheet: habitat conservation plans. Section 10 of the ESA. http://www.fws.gov/midwest/endangered/permits/hcp/hcp_wofactsheet.html. Accessed 9 Mar 2012.
- U.S. Fish and Wildlife Service [USFWS] and National Marine Fisheries Service [NMFS]. 1996. *Habitat conservation planning and incidental take*

- permit processing handbook 3–19. U.S. Department of the Interior and U.S. Department of Commerce, Washington, D.C., USA.
- U.S. Fish and Wildlife Service [USFWS] and National Marine Fisheries Service [NMFS]. 1998. Final ESA Section 7 Consultation Handbook 4–50. U.S. Department of the Interior and U.S. Department of Commerce, Washington, D.C., USA.
- U.S. General and Accounting Office [USGAO]. 2001. Endangered species act fee-based mitigation arrangements, GAO-01-287R. <http://www.gao.gov/new.items/d01287r.pdf>. Accessed 1 Feb 2012.
- Wilhere, G. F. 2012. Inadvertent advocacy. *Conservation Biology* 26: 39–46.
- Willamette Partnership. 2011. Measuring up: synchronizing biodiversity measurement systems for markets and other incentive programs. A report funded by the U.S. Department of Agriculture Office of Environmental Markets. Willamette Partnership, Hillsboro, Oregon, USA.

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