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**Summary of a Regional Workshop on
Monitoring Programs for the Interior Least
Tern (*Sternula antillarum*) – Tulsa, Oklahoma,
15-16 November 2005**

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Abstract: This technical report summarizes a regional workshop on monitoring programs for the Interior Least Tern (ILT) (*Sternula antillarum*) in Tulsa, Oklahoma in November, 2005. Discussions focused on: 1) defining goals and objectives for local, regional, and range-wide monitoring programs; 2) deciding what information to collect during monitoring programs; 3) standardizing data collection and analysis protocols among programs; 4) integrating local efforts into regional or range-wide approaches; and 5) evaluating the effects of management actions on ILT within the context of regional or range-wide recovery. This summary reviews existing monitoring programs and suggests a course of action for developing a range-wide monitoring plan to better evaluate the effects of management on ILT. Consensus was that annual range-wide counts of adults during a standard survey window would be advisable to track long-term changes in ILT population trends and distribution. Participants agreed that data on reproductive success (and how this relates to management) are also necessary to evaluate population health. However, many participants were concerned that estimates of fledglings per pair for Least Terns may be highly inaccurate. Participants agreed on ways to pursue monitoring of nest success (and nest fates) as indices to reproductive performance that could be analyzed versus factors associated with management issues (e.g., flooding on dam controlled rivers, recreation impacts). Two monitoring committees were formed to advise the ILT Working Group in this process.

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Preface

The workshop was organized by the American Bird Conservancy with support from the U.S. Army Engineer Research and Development Center — Environmental Laboratory (ERDC-EL), the U.S. Geological Survey, and the U.S. Fish and Wildlife Service. The meeting took place at the offices of the U.S. Army Corps of Engineers Tulsa District in Tulsa, Oklahoma. The workshop was attended by 38 participants from multiple agencies, organizations, and stakeholders (Appendix E). Discussions were facilitated by Casey A. Lott and David Pashley of American Bird Conservancy following the outline of a series of short PowerPoint presentations that followed a meeting agenda (Appendix A).

The authors wish to thank Sandy Stiles and Stephen Nolan of the Tulsa District and Kevin Stubbs of the USFWS, Oklahoma Field Office, for their help in organizing the logistics of this meeting. The authors would also like to thank all participants for their lively participation in discussions at this workshop. Mark Sherfy and Terry Shaffer of the USGS-Northern Prairies Wildlife Research Center and Eileen Kirsch of the USGS-Upper Midwest Environmental Sciences Center provided helpful comments on an earlier version of this summary.

Point of contact at ERDC-EL is Dr. Richard A. Fischer.

COL Richard B. Jenkins was Commander and Executive Director of ERDC.
Dr. James R. Houston was Director.

1 Introduction and Background

The U.S. Fish and Wildlife Service (USFWS) needs information about Interior Least Terns (ILT) for both endangered species recovery considerations and for project consultations. There is definitely not enough for the former, and the latter is often compromised by a lack of information regarding the status of birds upstream and downstream of project sites, making it difficult to assess project impacts. There is not currently an active Recovery Team for ILT, although an active ILT Working Group may evolve into a Recovery Team over time. The Working Group is a multi-agency group that is dedicated to improving the collection, storage, analysis, and dissemination of high-quality monitoring data regarding ILT populations. Representatives of this group come from four U.S. Fish and Wildlife Service regions, eleven U.S. Army Corps of Engineers Districts, the U.S. Army Engineer Research and Development Center, several U.S. Geological Survey science centers, twelve State wildlife agencies, several universities, and several non-government organizations (Appendix C). The Working Group is currently improving the collection of data on population size and trend, reproductive success, and habitat conditions to provide information that will be needed for any future revision of a recovery plan. The Working Group mission statement and a complete list of members are included in appendices at the end of this document. Contact Casey A. Lott at clott@abcbirds.org for more information or for consideration as a Working Group member.

During the 2005 breeding season, a large number of collaborators contributed to the first-ever, complete, range-wide survey for Interior Least Terns, providing important information regarding the current distribution and abundance of the species. Within a two-week window during late June, all historic nesting areas for ILT were visited to count the total number of adult birds present and document the location of breeding colonies. The results of this survey are being summarized by Casey A. Lott in a report that will place the 2005 range-wide count within the context of historic counts and ongoing efforts to monitor Interior Least Tern populations (Lott 2006). This summary will be published as a technical report by the U.S. Army Corps of Engineers and distributed to the ILT working group via e-mail. Please note that this survey represents only a

single snapshot in time count; numbers for individual survey segments may vary within and among seasons or years.

Casey A. Lott gave a brief summary of the results of the range-wide survey at the workshop. Approximately 17,500 adult ILT were counted more than 50 miles from the Gulf Coast (following the USFWS recovery plan definition of the “Interior” population). Nearly 64 percent of all these adult birds were counted on the Mississippi River between Cape Girardeau, MO, and Baton Rouge, LA. Other important river systems for ILT were the Arkansas (12.1 percent of all birds), the Red (10.4 percent of all birds), the Missouri (7.1 percent of all birds), and the Platte (4.3 percent of all birds). Colonies were generally large (an average of 119 birds) on the Mississippi River and small (means of <30 birds per colony) elsewhere within the Interior. Approximately 17,500 ILT were distributed among ~480 colonies within the Interior population. Only 87 of these colonies were on the Mississippi River. The Arkansas River (25.9 percent of all colonies) and the Red River (25.5 percent) accounted for >51 percent of all ILT colonies within the Interior.

Counts during 2005 in the Interior were compared with recent Least Tern counts (2003–2005) on the Gulf Coast (from the Texas/Mexico border to the eastern portions of the Florida Panhandle). An estimated total of 11,150–12,000 Least Terns breed on the Gulf Coast in approximately 80–120 colonies on beaches and near-coastal rooftops. If Gulf Coast and Interior Least Tern populations are considered as a single population with uncertain rates of exchange among breeding areas, this population would include approximately 28,650–29,000 adults with about 11,000 adults breeding in 70–90 colonies on the Lower Mississippi River; about 11,000–12,000 adults breeding in 80–100 colonies on the Gulf Coast from Texas to Florida; and about 6,600 adults breeding in approximately 400 small colonies on the other river systems of the Interior, primarily the Arkansas, Red, Upper Missouri, and Platte.

The total number of birds counted in the 2005 rangewide survey exceeded overall recovery plan targets for the Interior, but the distribution of those birds comes short of meeting some regional recovery goals. The little that we know about ILT dispersal suggests that most ILT population segments are not distinct — indeed, the entire described range of the Interior Least Tern plus all Gulf Coast birds from Texas to the Florida panhandle could be a single population. An ongoing population genetics study at Oregon

State University (OSU) may help to describe how much exchange there is among Least Tern population segments from the Gulf Coast throughout the Interior (Hope Draheim, OSU, personal communication). Future analyses of ILT population size and trend may need to be framed within a metapopulation analysis that includes information about Gulf Coast birds.

The paucity of historical information about ILT distribution and abundance makes it impossible to understand differences between current ILT population size and ILT population size from any other time period (ranging from historic populations to the time period when the recovery plan was written in the late 1980s). Lack of long-term survey information from many sites makes it impossible to document range-wide population trends. Apparent population increases since the recovery plan was written could be largely due to increased survey effort. Also it is unknown to what extent immigration of terns from the Gulf Coast has contributed to the apparent increase on the lower Mississippi River, where approximately 64 percent of all ILT are detected.

A time series of data with the same level of survey coverage as the 2005 survey is needed to assess range-wide population trends. The 2005 range-wide survey is the only useful data point to date from which range-wide trends could potentially eventually be assessed (although this survey was only comprehensive for the Interior population, as Gulf Coast Least Tern surveys have incomplete coverage). Although extensive historic data are lacking, there almost surely have been local (or regional) ILT extirpations resulting from the creation of navigation systems in some rivers, such as the Lower Missouri and the Middle Mississippi. Given the lack of historic data from many areas, it is almost impossible to say whether there have been range expansions in the past or if the current distribution of ILT is the same as the historic distribution.

Gulf Coast Least Tern populations are apparently doing poorly. Heavy disturbance from humans, dogs, and beach vehicle traffic is a huge problem that leads to low reproductive success (and possible abandonment of breeding areas). Historic data for the entire Gulf Coast have not been consolidated; however, Least Tern numbers in coastal Mississippi have decreased from approximately 12,500 adults in 1983 to counts of 2,000–3,000 adults in 2005. Recent increases in birds on the Mississippi River could be due to birds abandoning the coast and moving inland. Recent Gulf Coast survey data are reasonably good for Texas, Louisiana,

Mississippi, and Florida (and poor for Alabama). However, extensive historic survey data are available only for Texas and Mississippi. The effects of Hurricanes Katrina and Rita on Least Terns are completely unknown and post-hurricane surveys should be undertaken to describe any changes in the distribution and numbers of Gulf Coast Least Terns.

On interior rivers, flooding can have beneficial impacts on ILT by scouring vegetation, creating new sandbars, spreading ILT breeding colonies around and making it more difficult for predators to find them, and by enhancing ILT prey base. Artificial flooding via high dam releases may not have the same effects as natural floods because such flows typically do not bring suspended and bed-load sediment from upstream, but rather just move and redistribute in situ bed-load sediment, which is a finite resource that may not sustain tern habitat in the long term. In fact, floods in sediment-poor systems may increase erosion of ILT habitat. Regular flooding of nesting areas during the breeding season on regulated rivers is a widespread cause of reproductive failure for ILT.

Disturbance of birds on many river systems as a result of recreational activity is a significant problem in some areas, although again adequate data do not exist to suggest how big this problem is compared to other problems or to suggest where there are disturbance hotspots that need to be addressed by management. All-terrain vehicles (ATVs) are a huge problem in places, and cattle are known to have damaged some nesting areas as well. Enforcement to prevent disturbance is very difficult, and will require greater cooperation among the Corps of Engineers (Corps), FWS, state wildlife agencies, and others. Education of the general public may be a better tool than enforcement to reduce human disturbance, but even enforcement officers need to be educated about ILTs. The prevalence of human disturbance in some areas clearly illustrates that ILT conservation is the responsibility of many agencies beyond the Corps.

Coordination between tern biologists and water managers can help to avoid take of ILT due to flooding related to water releases from dams. Near real-time availability of data on water levels relative to tern nest elevations and regular meetings between tern monitoring crews and water control personnel have helped to reduce the effect of flooding on the Missouri River. This level of data collection and communication between tern monitoring programs and water control should be improved in many areas to reduce take of ILT. Coordination among multiple districts is particularly

important in regions where water control decisions in one district have impacts on terns in a downstream district (for example, Tulsa District water release decisions have impacts on ILT on the Arkansas River in the Little Rock District, and on the Red River in the Vicksburg District).

Adaptive management is not really being applied to ILT conservation in most locations, in part because monitoring programs are not designed to provide relevant information on how management actions affect terns and also because monitoring data are not effectively communicated (and used) by managers at the appropriate time scales to achieve positive results for terns. In order to support adaptive management for ILT, monitoring programs should collect data based on hypotheses about the effects of different management actions. These data should be regularly evaluated to assess and update evidence for the various hypotheses and to modify management actions accordingly.

2 Monitoring Program Data Collection

Most existing monitoring programs collect data on total numbers of adults to describe ILT distribution, abundance, and/or population trends. Since nearly all ILT are unmarked, counts are made of total numbers of adults, not known breeding pairs. The relationship between the total number of adults and the total number of breeding pairs (or breeding population size) is unknown. In addition to adult counts, many (but not all) monitoring programs collect more intensive data about reproductive success. The types and quality of data collected regarding reproductive success vary tremendously among programs, and both field and analysis protocols need to be standardized among programs to provide better and more comparable data on reproductive success that will be more useful to understanding the health of ILT populations and/or how management actions may be affecting reproduction.

Adult counts

On most river reaches, adult counts are conducted by small crews of two to four individuals that locate colonies and then count birds at colony sites. Birds counted on the river away from colony sites are then added to this total to come up with a total adult count for a river reach. Programs vary in the methods that are used to locate colonies, to count birds at colony sites, to locate birds away from colonies, and to add birds counted away from colonies to colony totals. Variation in methods among programs should be better described and, if possible, standardized protocols should be adopted. In general, multiple surveyors on each crew conduct independent counts and then confer with each other to agree on a number counted. For some river reaches, several surveys are done per year, with the peak number reported as the annual adult count. For other reaches only a single annual adult count is done. In many cases, this adult count occurs within a standard survey window. In other cases, single adult counts are scheduled to coincide with water levels conducive to counting birds.

Timing of counts is critical. Ideally, counts should take place when the maximum numbers of adults are incubating eggs. This is the time period where breeding populations are most stable, movements of adults among survey segments should be minimal, and counts should be of breeding birds and not migrants. The timing of peak incubation varies among areas

and years depending on water levels. There is even variation in timing of peak incubation, up to several weeks, within a stretch of river within a year. Counts on the Mississippi River are scheduled to take place at intermediate water depths. When water levels are too high, nesting sandbars are flooded. When water levels are too low, large sandbar areas make access to sandbars difficult and full survey coverage of all sandbars impossible.

For the sake of documenting range-wide population size and trends, holding all counts within a specified window is the best way to minimize the chance of double-counting birds that may move from one survey segment to another. This is complicated for ILT because ILT counts on the Mississippi River must often happen later in the season than counts at all other locations. A survey window in mid to late June would capture peak incubation for most population segments in most years; however, approximately 64 percent of all ILT nests on the Mississippi River, and on sandbars, are often not exposed on the Mississippi until mid to late July (by which time reproduction on most other rivers is finished). It may be advisable to conduct adult counts on all locations other than the Mississippi during a standard two-week survey window in late June and to conduct ILT counts on the Mississippi whenever water levels drop below a certain threshold that allows for effective surveys. This may coincide with the range-wide survey window in some years, but not others.

Ground surveys are more accurate than aerial surveys, and helicopter surveys are more accurate than those from fixed-wing aircraft (but are also prohibitively expensive). The accuracy of aerial surveys by fixed-wing aircraft could be assessed by comparing ground-based counts of a sample of colonies with counts of the same colonies from the air. This could allow for calibration of aerial counts using ground-based counts. This is particularly important relative to counts on the Upper Red River (above Lake Texoma), the Canadian River (above Eufaula Lake), and the Cimarron River (above Keystone Lake) if long-term ground-based counts on these three rivers turn out to be cost-prohibitive. If calibrated aerial counts from fixed-wing aircraft can be considered roughly comparable to ground-based counts on other rivers (within some target range of accuracy), these areas could be covered much more cost-effectively from the air than by ground-based counts. This is an important area for future work.

Some important reaches of rivers are not currently covered by annual survey efforts. From north to south, the most important river stretches that need additional survey effort are the Niobrara River in Nebraska from HWY 137 to Spencer Dam; the Loup and Elkhorn Rivers in Nebraska; the Cimarron River and associated salt flats in Oklahoma; the Canadian River in Oklahoma (upstream of Eufaula Lake); and the Red River in Oklahoma and Texas (above Lake Texoma). These areas should be ideally covered by annual (or every other year at a minimum) adult counts to assess range-wide population trends. Some combination of financial and logistical support from the Corps, the FWS, states, and all working group partners will be necessary to get these sites covered. In some states, State Wildlife Grant support or Section 6 grants may help get this done.

Count protocols (detailed methods) for adult counts will be submitted to Casey A. Lott by investigators responsible for adult counts of the most important population segments for ILT. Casey will send a standard form to investigators to document count methods. He will then synthesize these write-ups into a single adult count protocol document that will help reduce variation among Districts and other participants in counts. Protocols clarify what has been done in the past, and may offer recommendations for improvements. Suggested changes to existing protocols should be clearly separated from descriptions of work that has and is being conducted using current protocols. Protocol write-ups for current survey work should include explicit and detailed information about all aspects of adult counts, including how the entire survey area is covered, how colonies are located, how counts are done in colonies, how data are reported, and how data are managed. These detailed write-ups may be based on methods descriptions that have been provided in past reports, but many will need to add more detail because past reports generally lack sufficient detail to evaluate differences in protocols among programs. This exercise will help to document some methods that have never been expressed in detail and should allow for a comparison of count methods among sites. This is a necessary first step towards the creation of a standard protocol. A protocol manual for adult counts can be downloaded at <http://el.erd.usace.army.mil/leasttern/>.

Detailed protocols will be requested from Greg Pavelka for the Missouri, Jim Jenniges for the Central Platte, Renae Held for the Lower Platte, Kevin Stubbs and Jerry Sturdy for the Arkansas and Canadian in Oklahoma, Tom Nupp and Erin Knoll for the Arkansas in Arkansas, Howard

Nass for the Red River in Oklahoma, David Oliver for the Red River in Louisiana, John Rumancik and Ken Jones for the Mississippi, and Roger Boyd (for aerial surveys). These protocol descriptions will be synthesized and reviewed by the ILT Executive Committee prior to implementation.

Adult counts are an important element of ILT monitoring, but are not sufficient by themselves to assess the status of ILT populations. Additionally, measures of reproductive success, data regarding the factors that affect reproductive success, and assessments of how these factors interact with local and regional habitat and management actions will also be needed to assess population stability or health. Any future revision of recovery goals will need to include some reliable data on reproductive success as well as how adult numbers and reproductive success are affected by management.

Reproductive success

Reproductive success is comprised of several stage-specific measures (e.g., number of nesting attempts, clutch size, egg success, nest success, and chick survival to fledging are some of these). Ultimately, reproductive success is defined by the number of fledglings produced per pair. However, given existing levels of monitoring effort, perhaps the most attainable measure of reproductive success for Interior Least Terns is nesting success: the percentage of nests from which at least one chick is hatched. Many monitoring programs attempt to collect data on the number of fledglings produced per breeding pair across the entire breeding season (often referred to as a “fledge ratio”). However, most workshop participants agreed that while accurate monitoring of nest success is possible, accurate monitoring of fledgling production for ILTs is doubtful. This is primarily due to the difficulty of locating chicks once they leave the nest bowl and the infrequency of typical monitoring visits to colonies. It is often not possible to know what percent of chicks that are actually present are detected during monitoring visits to colonies. This situation is improved slightly by using mark-recapture methods to estimate chick survival (however, this can require large sample sizes that may not be present at many ILT colonies). Radio telemetry of chicks may be an effective technique to study chick survival. However, it can be expensive, invasive, and the miniaturization technology of transmitters may not be sufficiently advanced for this method to be effective for Least Terns. Because most current programs count unmarked chicks or fledglings, measurements of fledging success or chick survival are imprecise and biased to some unknown degree. Chick survival data are probably biased particularly low

on islands that are partially vegetated or large islands with abundant driftwood where chicks and fledglings are difficult to locate. In all cases, the magnitude of bias in chick survival studies probably varies among programs and is difficult to estimate. Although reproductive success is the parameter of interest for population modeling, it is so difficult to measure accurately that most previous studies that claim to have measured this quantity are viewed with skepticism.

Nest success is an important component of reproductive success that has been shown in Mallards (*Anas platyrhynchos*) to explain much of the variation in overall reproductive success (Johnson et al. 1992). Although it is possible in some parts of the range and in some years that variation in chick survival may be the most important factor in overall reproductive success (i.e., Kirsch 1996), monitoring nest success at a number of sites throughout the range of ILT is possible and can provide more reliable data than current indices of reproductive success — “fledge ratios.” Furthermore, fledge ratios cannot be compared across sites and are difficult to relate to habitat management actions. It was agreed by the group to pursue development of a standard protocol to collect and analyze nest success data.

Monitoring nests, estimating nest success, and assigning causes for nest failure may help to understand what factors limit reproduction. Nest fates are much easier to assign (because nest locations do not change) than chick fates. However, the ability to accurately determine causes of nest failure from evidence left at the nest is often overstated and diminishes rapidly with increases in the amount of time between nest visits. It is even more difficult to collect reliable data on causes of chick mortality because chicks that are alive are difficult to find, and finding dead chicks is difficult even if carcasses are still present.

Nest success data may be easier to collect in the field, but sophisticated analyses of field data are necessary to produce unbiased results that are comparable across studies. ILT with failed nests will continue to re-nest until they succeed or it becomes too late in the season. Renesting pairs may move to a different colony site or a different geographic area, however. Calculations of nest success for individual females will most likely need to incorporate model-based estimates of re-nesting rates. In general, successful nests are more likely to be located than unsuccessful nests, as adults are not present to provide visual cues at unsuccessful nests and

evidence for unsuccessful nests often disappears quickly. Because of this, the frequency of visits to a colony influences the proportion of initiated nests that are actually detected. Therefore, any measure of nest success that is derived by dividing the number of observed successful nests by the number of observed successful and unsuccessful nests (often referred to as “apparent nest success”) is likely to be an overestimate, particularly when colonies are visited irregularly. Greater precision in estimates of nest success is achieved through more frequent visits. It has been recognized for many years that the periodicity of visits to check the status of marked nests must be factored into calculations of nest success. This can be done via Mayfield methods, or more effectively using logistic exposure models, which better allow for results to be compared among studies with varying regularity of nest visits (Shaffer 2004).

Calculations of nest success are also affected by the exact definition of a nest. “Nest success” is usually defined as the probability of surviving the interval that begins with laying of the first egg and ends with hatching of the first egg. Deciding what to include as a nest in calculations of nest success is not as straightforward as one might imagine. After a lengthy discussion, the group provisionally defined a nest as “A bowl containing one or more eggs or chicks, or evidence of having had eggs or chicks. Such evidence includes egg shells in the nest.” The group noted that only nests that are active when found (which excludes nests that have already “hatched” or been destroyed or abandoned) are typically used in estimating nest survival. The group did not explicitly define “hatched nest” but it is typically defined as a nest in which one or more eggs hatched.

For purposes of counting the number of initiated nests the group did not come to agreement on how to treat broods that were found without previous evidence of a nest. Although no group conclusion was reached, a conservative interpretation could read: “Additionally, a nest may be inferred from chicks found that cannot positively be traced back to previously identified nests. The number of nests represented by each brood of chicks is the number of such chicks divided by three, unless there is evidence based on different age classes or different parentage suggesting that the number of nests should be higher.”

The above definitions and analysis protocols for calculating nesting success will need to be refined and standardized across programs during nest success monitoring protocol development. A committee was formed to

develop a protocol for collecting data on nest success and assigning nest fates in the field. This will also include data management strategies and an explicit analysis protocol for calculating nest success from field data.

Greg Pavelka described the intensive nest monitoring program of the Corps' Omaha District. ILT arrive on the Upper Missouri in the third week of May, and nests tend to be initiated in the first two weeks of June, with birds departing by the third week of August. There are seven days between each visit to a nesting colony. Nests are visited throughout the season until they either fail or hatch and nest fates are assigned to each nest based on criteria defined in a monitoring manual (e.g., predated, flooded, weather-related failure, fate unknown, etc.). Chicks are monitored from hatching through fledging to calculate a fledge ratio for each colony. In addition to intensive monitoring of reproductive success throughout the season, an adult census is taken in the third week of June to count all adult terns on the Missouri River. This monitoring program is done by a crew of about 40 permanent and seasonal staff, all of whom undergo a 1½- to 2-day training session based on a manual. Data analysis procedures are not documented as yet. Scientists from the USGS, Northern Prairie Wildlife Research Center, are currently performing an independent evaluation of field data collection and analysis protocols to provide an updated set of procedures for the Omaha Districts' monitoring program. This program, plus the USGS evaluation, will provide much useful information towards developing a range-wide protocol for monitoring ILT nest success.

Many ILT on the Platte River, Nebraska, nest on sand pits. Monitoring on the Platte is done by a large number of people following two related protocols, the Platte River Cooperative Agreement protocol and the Tern and Plover Conservation Partnership protocol. In general, intensive monitoring is done only on sand pits, which are visited by truck every third day. Colonies are observed from a distance using a spotting scope causing very little, if any, disturbance to the colony. These methods may not be applicable elsewhere within the range of ILT where field conditions do not allow for such easy regular access where full colonies can be seen from a distance.

Currently, nest success or fledgling success is not being robustly monitored on the Mississippi River, the Arkansas River and tributaries, or the Red River. Several reaches of the Arkansas and Red Rivers do three surveys a year and calculate a fledge ratio from these surveys based (roughly)

on the number of fledglings counted during the final survey of the year divided by the maximum number of adults observed on any one survey (see USFWS 2005 for more detail). Although this method provides a minimal index of reproduction (with an unknown amount of bias) over time, it is of uncertain accuracy and is viewed by many as potentially very imprecise. More robust and regular monitoring of nest success would be very useful both upstream and downstream of Corps projects on each of these river systems. It is recommended that future studies of reproductive success on these rivers take place within the context of efforts of the ILT working group (described herein) to develop range-wide monitoring protocols.

Flooding of nests is relatively frequent on rivers in the southern part of the ILT's range and is often related to nest elevation: specifically, the height of the nest above stream levels throughout the entire breeding season. Good data to address the frequency of nest failure due to flooding or other causes on the Arkansas and Red River systems are rarely available, and collection of these data (including nest elevations) is advisable. If habitat is to be constructed for ILT with these regions, regional data on nest success and the frequency of flooding (as well as nest elevation data) from both created and natural islands would be very useful to evaluate the regional effectiveness of habitat creation.

Conclusions

The group agreed on the following ASSUMPTIONS:

1. Current regional recovery plan targets for adult population size will not be met in some areas because targets for several river stretches are unattainable.
2. The two options, therefore, are for the ILT to be listed for the foreseeable future under the current recovery plan, or for recovery objectives to be rewritten based on the improved understanding of ILT biology that has occurred since ILT were originally listed.
3. However, new objectives that are based solely on population size without consideration of some measure of population health will not be acceptable.
4. Currently, recovery plan objectives for population health and habitat stability are not explicitly defined.
5. There are various measures of population health that can be assessed, including elements of habitat conditions, management-based threats, reproductive success, and survivorship.

6. The group agrees that nest success is the most attainable and potentially the most accurate component of reproductive success about which we can hope to gather information.
7. Comparative, standardized data on nest success would help to evaluate local, regional, and range-wide reproductive success and population health.
8. This evaluation will be more effective if nest fates (and causes for nest failure) can be assigned.
9. Nest success data will be even more informative if additional data on habitat parameters (such as nest elevation) and hydrology are collected.
10. Models may be constructed using nest success as a surrogate for annual productivity (fledgling production) by incorporating data from targeted, site-specific, intensive estimates of chick survival.

The group then agreed upon the following STEPS:

1. A protocol will be developed to standardize annual adult count methods. This protocol will be built from existing count methodologies and will attempt to reconcile major differences. Summaries of existing count methods will be sent to Casey A. Lott for him to take a first cut at a standard protocol, which will be reviewed and revised by monitoring program personnel. Casey A. Lott will work with Virginia Dickerson of ERDC to develop a range-wide database for storing long-term annual count data during the winter of 2005–06. This restricted access database is now operational at <http://el.erd.c.usace.army.mil/leasstern/>.
2. A committee (listed below) will develop field and analysis protocols for measuring nest success. This protocol can be used to standardize ongoing and future programs.
3. A second committee (listed below) will work towards constructing a model (perhaps following an analysis approach that was taken by Johnson et al. (1992) with ducks) to deconstruct the various components of ILT reproductive success. This model will most likely be simple and have little predictive value. However, it would synthesize available information to identify crucial information gaps that have the most influence on our ability to understand ILT population dynamics during the breeding season. The process of building the model will help to distinguish between what is known about ILT and what is being assumed. This model will help to determine if collecting data only on nesting success will provide an adequate comparative index of reproductive success to evaluate the effects of management on reproduction, or if we also will need to collect data on

- chick survival. Research needs will be identified on the basis of discussions of what model assumptions need testing. Final creation of the model, after discussion of model structure and inputs by the committee, may require the dedication of additional resources or contracting with a consultant.
4. The ILT working group executive committee will work to determine how much additional data from what localities are needed to assess local, regional, and range-wide patterns in nest success. There are no assumptions at this point as to sources of funding for additional work that will ultimately be required. However, we believe that there are sources within the Corps and with other partners to make significant progress. Partnership building through the ILT working group will help us to achieve the goal of effective range-wide monitoring.

As immediate FIRST STEPS, two small groups were formed to continue key discussions:

- NEST SUCCESS PROTOCOL
 - Greg Pavelka, Corps, Omaha District
 - Mark Sherfy, USGS, NPWRC
 - Terry Shaffer, USGS, NPWRC
 - Tom Nupp, Arkansas Tech University
 - Casey A. Lott, American Bird Conservancy
 - Kevin Stubbs, USFWS, Oklahoma
 - Sandy Stiles, Corps, Tulsa District
 - Jim Jenniges, Nebraska Public Power District
 - Chip Leslie,¹ Oklahoma State University?
 - Rochelle Renken,¹ Missouri Department of Conservation
 - Richard Fischer,¹ Corps, Engineer Research and Development Center, Environmental Lab
- MODELLING
 - Terry Shaffer, USGS, Northern Prairie Wildlife Research Center (NPWRC)
 - Jennifer Stucker, USGS, NPWRC
 - Eileen Kirsch, USGS, Upper Midwest Environmental Sciences Center
 - Mark Sherfy, USGS, NPWRC
 - Tom Nupp, Arkansas Tech University

¹ These people did not attend the Tulsa meeting. Their inclusion on these committees was suggested by other meeting participants, but each of these individuals still needs to be consulted for their involvement to be confirmed.

- Casey A. Lott, American Bird Conservancy
- Coral Huber, Corps, Omaha District
- Greg Pavelka, Corps, Omaha District
- Rich Fischer,¹ Corps, Engineer Research and Development Center, Environmental Lab
- Katie Dugger,¹ Oregon State University
- Joanna Whittier,¹ Kansas State University

¹ These people did not attend the Tulsa meeting. Their inclusion on these committees was suggested by other meeting participants, but each of these individuals still needs to be consulted for their involvement to be confirmed.

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- Shaffer, T. L. 2004. A unified approach to analyzing nest success. *Auk* 121 (2) 526-540.
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Appendix A: Meeting Agenda

Tuesday, November 15, 2005 (0900–1700)

- 0900–0910 Welcome. Meeting background and structure (slides 1–3)
- 0910–0920 Participant introductions
- 0920–0930 Short presentation: Range-wide monitoring considerations for Interior Least Terns (slides 4–7)
- 0930–1015 Discussion 1: Monitoring goals and objectives (slides 8–9)
- 1030–1200 Discussion 2: Counting adults to provide data on distribution, abundance, and population trends (slides 10–12)
- 1315–1430 Discussion 2 (continued) Counting adults to provide data on distribution, abundance, and population trends
- 1445–1700 Discussion 3: Monitoring nest success and causes of nest failure

Wednesday, November 16, 2005 (0900–1500)

- 0900–1015 Discussion 4: Monitoring reproductive success: Nest success or chick survival? Can we collect accurate and comparable data to compare reproductive success among sites? (slides 13–16)
- 1030–1200 Discussion 4 (continued): Monitoring reproductive success: nest success or chick survival? Can we collect accurate and comparable data to compare reproductive success among sites?
- 1315–1500 Synthesis (coming to consensus on topics discussed and deciding what topics need further discussion)

Appendix B: ILT Working Group Mission Statement

Interior Least Tern Working Group Mission Statement

The Interior Least Tern (ILT) Working Group (WG) is a multi-agency group that is dedicated to improving the collection, storage, analysis, and dissemination of high-quality monitoring data regarding ILT populations. Representatives of this group come from four U.S. Fish and Wildlife Service regions, eleven U.S. Army Corps of Engineers districts, the U.S. Army Engineer Research and Development Center, several U.S. Geological Survey science centers, twelve State wildlife agencies, several universities, and the American Bird Conservancy, a non-government organization. A full list of WG members with their affiliations is included below. This working group has received letters of support from the U.S. Fish and Wildlife Service Regional Director for the recovery lead region for Interior Least Tern and the U.S. Army Corps of Engineers Chief of Operations.

The three guiding principles of this group are 1) inclusiveness; 2) open communication, and 3) dedication to a high standard of scientific credibility. The WG will work together over the next several years to create a range-wide ILT monitoring program. The goal of this program will be to provide high-quality monitoring data to allow for the accurate assessment of regional and range-wide ILT population numbers and trends. ILT monitoring takes place at a large number of different scales and locations and for a range of purposes (e.g., minimizing take under the Endangered Species Act [ESA], scientific research, evaluating the effects of a specific management action). Therefore, a range-wide ILT monitoring program will not replace local monitoring programs, but rather incorporate them into a larger-scale effort so that results of local monitoring programs can be better evaluated in a regional or range-wide context.

An ILT Monitoring Program Coordinator will work closely with a nine-member Executive Committee that comprises WG members to design and implement a range-wide ILT Monitoring Plan (the Plan). There will be mechanisms for incorporating comments from the entire WG throughout this process. The Plan will be developed over the next few years and will be an iterative process. The Plan will provide goals and objectives for a

range-wide monitoring program and will synthesize all information regarding current and historic range-wide monitoring data collection. This will require the assistance of WG members to connect the Coordinator with all contacts engaged in the collection of monitoring data. A final draft of the Plan (incorporating comments from the entire working group) will receive independent peer review coordinated by the U.S. Monitoring Working Group of the North American Bird Conservation Initiative (NABCI).

A Web-accessible database will be developed to centralize storage of range-wide monitoring program data, greatly improving the availability of data and ease of analyses. This database will be designed to meet the needs of diverse monitoring programs and it is hoped that by the 2006 (or 2007 at the latest) breeding season all parties collecting monitoring data for ILT will be contributing their data to this centralized data repository. This database will be designed to store spatially explicit data so that results can be summarized and presented using geographic information systems (GIS).

After the breeding season of 2005, the Coordinator will begin producing annual reports that summarize range-wide monitoring program results. The first of these reports will summarize the results of the first-ever range-wide ILT census that was conducted during the 2005 breeding season. More detailed analyses of range-wide status and trends will be performed at five-year intervals. All WG members will have one month to review and provide comments on the annual report and two months to provide comments on five-year synthesis reports. Once these comments have been incorporated, final reports will be produced and provided to the WG for dissemination across networks of contacts with interests in ILT population status and trends. Five-year synthesis reports will also receive independent peer review through NABCI.

Given the strong agency representation of the WG, it is expected that range-wide analyses of ILT monitoring program data will be consulted and that monitoring program data will be available for future agency activities such as 1) revision of the ILT recovery plan if this is necessary, 2) range-wide status assessments for ILT, 3) ESA consultations regarding specific projects, and 4) the preparation of biological assessments and biological opinions.

Appendix C: Interior Least Tern Working Group Member List

As of December 1, 2005, the working group consisted of 73 members representing 11 Corps districts, 4 USFWS regions, 12 state wildlife agencies, 8 academic institutions, 4 USGS science centers, 3 Joint Ventures, and several non-profits.

Executive committee: 10 people

- Carol Aron, USFWS Region 6/South Dakota Game, Fish, and Parks
- Rich Fischer, U.S. Army Engineer Research and Development Center
- Eileen Kirsch (Chair), USGS - Upper Midwest Environmental Sciences Center
- Casey Kruse, USACE Omaha District
- Jane Ledwin, USFWS Region 3 (recovery lead office)
- Lindsey Lewis, USFWS - Region 4 – Arkansas
- Casey A. Lott, American Bird Conservancy (ILT monitoring coordinator)
- David Pashley, American Bird Conservancy
- Sandy Stiles, USACE Tulsa
- Kevin Stubbs, USFWS Region 2

Working group- 63 people

- Lindsay Addison, Florida Gulf Coast University
- Kari Andresen, Nebraska Game and Parks Commission
- Eric Baka, Louisiana Department of Wildlife and Fisheries
- Jonathan Bart, USGS - Snake River Field Station
- Roger Boyd, Baker University
- Jeanette Boylan, Dallas Zoo
- Christopher Brantley, USACE New Orleans District
- John Cannon, USACE St. Louis District
- John Castrale, Indiana Division of Fish and Wildlife
- Glenn Covington, USACE Kansas City District
- Mark Czaplewski, Central Platte Natural Resources District
- Arnold Dood, Montana Fish, Wildlife, and Parks
- Mark Doles, USACE Fort Worth District
- Hope Draheim, Oregon State University

- Wade Eakle, USACE South Pacific Division
- Aron Flanders, Texas Parks and Wildlife - Cooper Lake
- Champe Green, USACE Albuquerque District
- Michael Guilfoyle, USACE Engineer Research and Development Center
- Sue Haig, USGS Forest and Rangeland Ecosystem Science Center
- Renae Held, University of Nebraska – Lincoln
- Hubert Hervey, Louisiana – LSU - Museum of Life Sciences
- Mark Howery, Oklahoma Department of Wildlife Conservation
- Coral Huber, USACE Omaha District
- John Hughes, USFWS - Canadian, TX Field Office
- Jerry Jackson, Florida Gulf Coast University
- James Jenniges, Nebraska Public Power District
- Ken Jones, Dyersburg State Community College
- Andy Kasner, Lamar State University – Texas
- Patty Kelly, USFWS - Panama City – Florida
- Bob McFarlane, MacFarlane and Associates
- Larry Marcy, USACE Vicksburg District
- Lynn Martin, USACE - Institute for Water Resources
- Johnny Mclean, USACE Little Rock District
- Allan Mueller, USFWS - Region 4 – Arkansas
- Thomas Nupp, Arkansas Tech University
- Kate O'Brien, USFWS - Rachel Carson National Wildlife Refuge
- David Oliver, USACE Vicksburg District
- Brent Ortego, Texas Parks and Wildlife Department
- Brainard Palmer-Ball, Kentucky Department of Fish and Wildlife Resources
- Greg Pavelka, USACE Omaha District
- Mark Peyton, Nebraska Public Power and Irrigation District
- Rochelle Renken, Missouri Department of Conservation
- Bruce Reid, Audubon Mississippi
- Karen Rowe, Arkansas Game and Fish Commission
- John Rumancik, USACE Memphis District
- Christopher Rustay, Playa Lakes Joint Venture
- Monica Schwalbach, South Dakota Game, Fish, and Parks
- Terry Shaffer, USGS - Northern Prairies Wildlife Research Center
- Ron Shepperd, USFWS Salt Plains NWR
- Mark Sherfy, USGS - Northern Prairies Wildlife Research Center
- Marsha Sovada, USGS - Northern Prairies Wildlife Research Center
- Maryetta Smith, USACE Mississippi Valley Division
- Jerry Sturdy, USACE Tulsa District

-
- Matt Tanner, HDR Inc.
 - Bob Van Hoff, USACE Louisville District
 - Bill Vermillion, USFWS - Gulf Coast Joint Venture
 - Michael Watkins, USACE Kansas City District
 - Sandy Williams, New Mexico Department of Game and Fish
 - Erika Wilson, University of Nebraska – Kearney
 - Randy Wilson, USFWS - Lower Mississippi Joint Venture
 - Stephen Wilson, National Park Service: Niobrara National Scenic River and Missouri National Recreational River
 - Nick Winstead, Mississippi Wildlife, Fisheries, and Parks
 - Margo Zdravkovic, National Audubon Society

Appendix D: State and Federal Agencies within Range of ILT

Bold entries are offices with representatives.

U.S. Army Corps of Engineers: five Divisions, eleven Districts (All eleven Districts with Current Representation)

- Northwest Division
 - **Omaha: Casey Kruse, Greg Pavelka, Coral Huber**
 - **Kansas City: Michael Watkins, Glenn Covington**
- **South Pacific Division: Wade Eakle**
 - **Albuquerque: Champe Green**
- **Southwest Division: Gary Earls**
 - **Ft. Worth: Mark Doles**
 - **Little Rock: Johnny Mclean**
 - **Tulsa: Sandy Stiles, Jerry Sturdy**
- **Mississippi Valley Division: Maryetta Smith**
 - **St. Louis: John Cannon**
 - **Memphis: John Rumancik**
 - **New Orleans: Chris Brantley**
 - **Vicksburg: Larry Marcy, David Oliver**
- Great Lakes and Ohio River Division
 - **Louisville: Bob Van Hoff**

State Agencies: eighteen States (twelve with Current Representation)

- **Montana Department of Fish, Wildlife, and Parks: Arnie Dood**
- North Dakota Game and Fish Department
- **South Dakota Game, Fish, and Parks Department: Carol Aron**
- **Nebraska Game and Parks Commission: Kari Andresen**
- Iowa Department of Natural Resources
- Colorado Division of Wildlife
- Kansas Department of Wildlife and Parks
- **Missouri Department of Conservation: Rochelle Renken**
- Illinois Department of Natural Resources
- **Indiana Division of Fish and Wildlife: John Castrale**

- **Kentucky Department of Fish and Wildlife Resources: Brainard Palmer-Ball**
- Tennessee Wildlife Resources Agency
- **New Mexico Game and Fish Department: Sandy Williams**
- **Texas Parks and Wildlife Department: Brent Ortego, Aron Flanders**
- **Oklahoma Department of Wildlife Conservation: Mark Howrey**
- **Arkansas Game and Fish Commission: Karen Rowe**
- **Mississippi Department of Wildlife, Fisheries, and Parks: Nick Winstead**
- **Louisiana Department of Wildlife and Fisheries: Eric Baka**

Fish and Wildlife Service: four Regions (All four Regions with Current Representation)

- Region 3: Great Lakes-Big Rivers (HQ: Minneapolis): Jane Ledwin
 - Iowa
 - Illinois
 - Missouri (ILT Recovery Lead Office**)
 - Indiana
- Region 6: Mountain-Prairie Region (HQ: Denver): Carol Aron
 - Montana
 - Wyoming
 - Colorado
 - North Dakota
 - South Dakota
 - Nebraska
 - Kansas
- Region 4: Southeast (HQ: Atlanta): Lindsey Lewis
 - Kentucky
 - Tennessee
 - Arkansas
 - Mississippi
 - Louisiana
- Region 2: Southwest (HQ: Albuquerque): Kevin Stubbs
 - Oklahoma
 - New Mexico
 - Texas

Appendix E: Workshop Attendees

| Last | First | Affiliation | E-Mail Address | Phone Number |
|-----------|---------|---|--|-------------------|
| Becker | Randy | Little Rock District, Corps | Randall.J.Becker@swl02.usace.army.mil | 501-324-5824 |
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| Covington | Glenn | Kansas City District, Corps | William.G.Covington@usace.army.mil | 816-983-3141 |
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| Laney | Everett | Tulsa District, Corps, Environmental Branch | everett.laney@usace.army.mil | 918-669-7411 |
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| Last | First | Affiliation | E-Mail Address | Phone Number |
|----------|----------|---|--|--------------|
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| Rowe | Karen | Arkansas Game and Fish Commission | krowe@agfc.state.ar.us | 877-873-9651 |
| Rumancik | John | Memphis District, Corps | john.p.rumancik@mvm02.usace.army.mil | 901-544-3975 |
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| 14. ABSTRACT This technical report summarizes a regional workshop on monitoring programs for the Interior Least Tern (ILT) (<i>Sternula antillarum</i>) in Tulsa, Oklahoma in November, 2005. Discussions focused on: 1) defining goals and objectives for local, regional, and range-wide monitoring programs; 2) deciding what information to collect during monitoring programs; 3) standardizing data collection and analysis protocols among programs; 4) integrating local efforts into regional or range-wide approaches; and 5) evaluating the effects of management actions on ILT within the context of regional or range-wide recovery. This summary reviews existing monitoring programs and suggests a course of action for developing a range-wide monitoring plan to better evaluate the effects of management on ILT. Consensus was that annual range-wide counts of adults during a standard survey window would be advisable to track long-term changes in ILT population trends and distribution. Participants agreed that data on reproductive success (and how this relates to management) are also necessary to evaluate population health. However, many participants were concerned that estimates of fledglings per pair for Least Terns may be highly inaccurate. Participants agreed on ways to pursue monitoring of nest success (and nest fates) as indices to reproductive performance that could be analyzed versus factors associated with management issues (e.g., flooding on dam controlled rivers, recreation impacts). Two monitoring committees were formed to advise the ILT Working Group in this process. | | | | | |
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