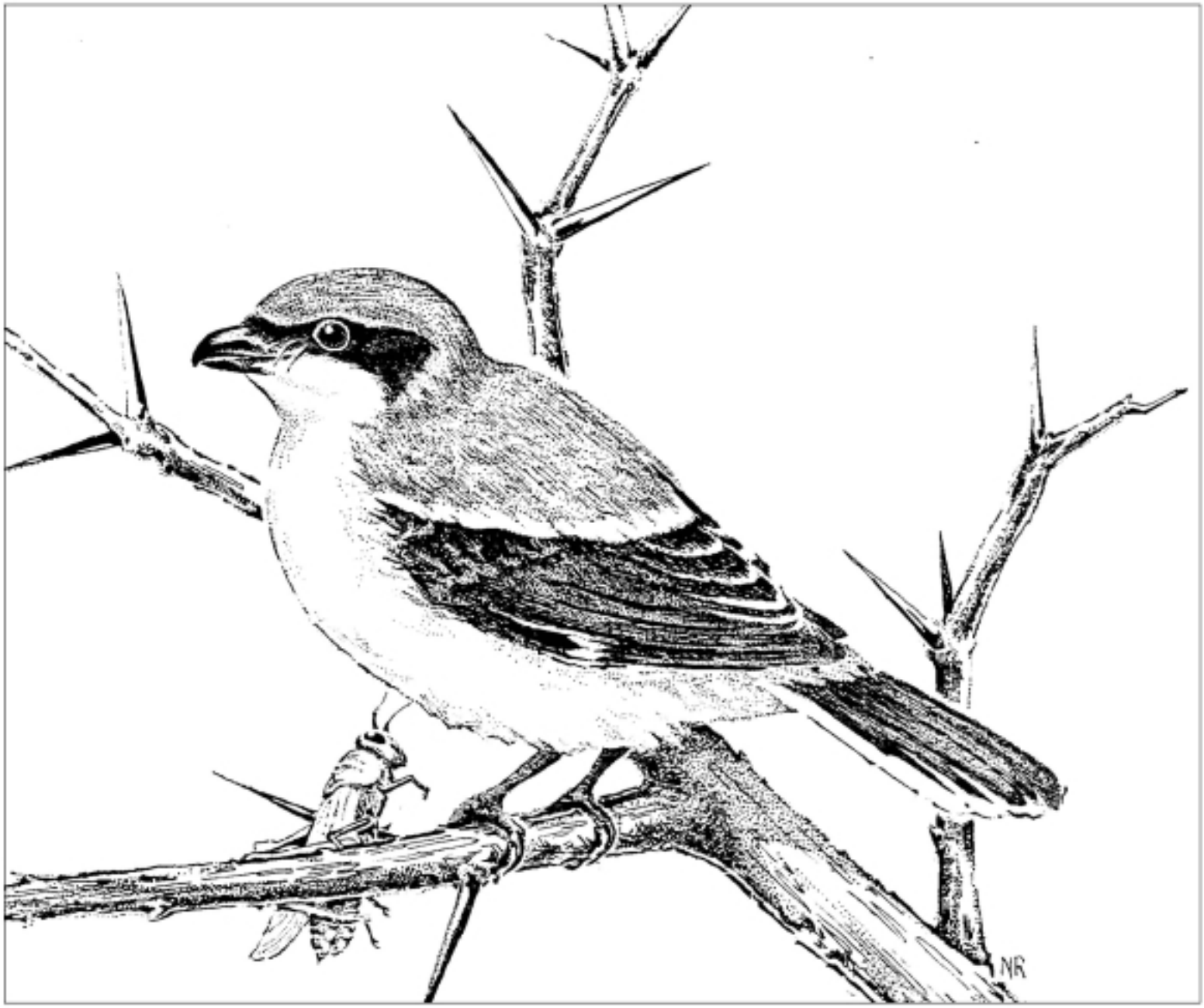
U.S. Fish & Wildlife Service

Loggerhead Shrike

Status Assessment

November 2000



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LOGGERHEAD SHRIKE STATUS ASSESSMENT

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ACKNOWLEDGMENTS

I gratefully acknowledge the efforts of many individuals who contributed to this status assessment. More than 100 people from State and Provincial agencies, the U.S. Fish and Wildlife Service (USFWS), the Canadian Wildlife Service, universities, and private organizations provided information for this status assessment, without which this report could not have been completed. Many individuals reviewed all or portions of the draft assessment, and their efforts resulted in significant improvements to the final document. I especially appreciate the efforts of James Herkert (Illinois Endangered Species Protection Board), Carola Haas (Virginia Polytechnic Institute), and Stephanie Jones (USFWS Region 6 Nongame Bird Coordinator) for their extensive review of the draft assessment. Georgia Parham (USFWS Region 3 Ecological Services Outreach Coordinator) provided valuable editorial advice. Richard Banks (National Museum of Natural History) was generous in sharing his expertise and assisted in the assessment of shrike systematics. All of the USFWS Regional Nongame Bird Coordinators provided assistance throughout the process of conducting this status assessment.

Special thanks to Steve Lewis (USFWS Region 3 Nongame Bird Coordinator) and Scott Pruitt (USFWS Bloomington Field Office Acting Supervisor) who provided input, review, and encouragement for over two years while this assessment was in progress.

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TABLES AND FIGURES

ACRONYMS USED

AOU . . . . . American Ornithologists' Union
BBA . . . . . Breeding Bird Atlas
BBS . . . . . North American Breeding Bird Survey
BLM . . . . . U.S. Bureau of Land Management
CBC . . . . . National Audubon Society Christmas Bird Count
CEC . . . . . Commission for Environmental Cooperation
COE . . . . . U.S. Army Corps of Engineers
COSEWIC . . . . . Committee on the Status of Endangered Wildlife in Canada
CRP . . . . . Conservation Reserve Program
ESA . . . . . Endangered Species Act of 1973
MBTA . . . . . Migratory Bird Treaty Act of 1918
NEPA . . . . . National Environmental Policy Act of 1969
PIF . . . . . Partners in Flight
USFWS . . . . . U.S. Fish and Wildlife Service
WC:TL . . . . . Wing-chord to tail-length ratio

SCIENTIFIC NAMES OF PLANTS REFERENCED IN TEXT

Wyoming big sagebrush	*Artemisia tridentata wyomingensis*
(big) sagebrush	*Artemisia tridentata*
caragana	*Caragana* spp.
(netleaf) hackberry	*Celtis reticulata*
hawthorn	*Crataegus* spp.
Russian olive	*Elaeagnus angustifolia*
honeylocust	*Gleditsia triacanthos*
juniper	*Juniperus* spp.
eastern red cedar	*Juniperus virginiana*
creosote bush	*Larrea tridentata*
osage orange	*Maclura pomifera*
apple	*Malus* spp.
white mulberry	*Morus alba*
mock orange	*Philadelphus lewisii*
spruce	*Picea* spp.
loblolly pine	*Pinus taeda*
slash pine	*Pinus elliottii*
cottonwood	*Populus deltoides*
mesquite	*Prosopis* spp.
American plum	*Prunus americana*
(antelope) bitterbrush	*Purshia tridentata*
shingle oak	*Quercus imbricaria*
multiflora rose	*Rosa multiflora*
(sawtooth) blackberry	*Rubus betulifolius*
cabbage palm	*Sabal palmetto*
willow	*Salix* spp.
greasewood	*Sarcobatus vermiculatus*
sassafras	*Sassafras albidum*
thorny buffaloberry	*Sheperidia argentea*
eastern white cedar	*Thuja occidentalis*
elm	*Ulmus* spp.
Chinese elm	*Ulmus pumila*
yucca	*Yucca* spp.

SUMMARY

This assessment was conducted by the U.S. Fish and Wildlife Service (USFWS) to evaluate the status of the loggerhead shrike (*Lanius ludovicianus*), a species which has experienced population declines throughout its range. Biological information on the species was compiled so that threats to the species could be evaluated, and conservation needs identified.

The loggerhead shrike belongs to the Order Passeriformes, and is the only member of the Family Laniidae that occurs exclusively in North America. Miller (1931) conducted the first comprehensive, rangewide, systematic treatment of *L. ludovicianus* and recognized 11 subspecies. However, some subspecies designations have been questioned and a modern biosystematic survey is needed.

At the maximum extent of the species' distribution, the breeding range of the loggerhead shrike extended from central and southern Canada, throughout the continental U.S., and through most of Mexico. The species no longer breeds with regularity in the northeastern U.S. or in the northern tier states of Michigan, Wisconsin, and Minnesota. A small, isolated breeding population of less than 50 pairs persists in southern Ontario. The loggerhead shrike is a partial migrant, with populations in the northern half of the breeding range being largely migratory, while populations south of 40^{o} N latitude are resident.

Shrikes, including the loggerhead, are the only passerines capable of killing vertebrate prey by biting the neck and disarticulating cervical vertebrae. Loggerhead shrikes are often characterized for their unique habit of impaling small vertebrates on thorns or other sharp objects. Nonetheless, food habits studies have repeatedly demonstrated that the species is primarily insectivorous.

Loggerhead shrikes breed in open areas dominated by grasses and/or forbs, interspersed with shrubs or trees and bare ground. The range of the loggerhead covers a broad area, but regardless of the geographic location, each occupied breeding territory includes nesting substrate (a tree or shrub); elevated perches for hunting, pair maintenance, and territory advertisement; and relatively short grass foraging areas. Loggerhead shrikes appear to occupy similar habitats in winter, although winter ecology of the species has not been thoroughly studied. Native habitats occupied by shrikes prior to European settlement of North America likely included longleaf pine-wiregrass grassland, prairie, savanna, pinyon-juniper woodland, and shrub-steppe. After settlement, the species expanded its range to include agricultural habitats, particularly pastures and hayfields. In the eastern and midwestern U.S., agricultural grasslands now comprise most of the suitable habitat for shrikes.

Once widespread and common, the loggerhead shrike has experienced continentwide population declines. It is one of the most persistently declining species surveyed by the North American Breeding Bird Survey (BBS); the species declined at an average rate of 3.7% per year, surveywide, during the period 1966-1998. Not only is the magnitude of decline cause for concern, but also the fact that declines are prevalent across most states, provinces, and physiographic strata. Among the regions surveyed by BBS, population declines have been greatest in the range of *L.l. migrans*, which is the breeding subspecies in the northeastern and

midwestern U.S. and in eastern Canada.

The USFWS designated the loggerhead shrike as a Migratory Nongame Bird of Management Concern in the United States in 1987 due to rangewide declines in populations. The species is State listed as threatened or endangered in 14 states, all within the range of the subspecies *L.l. migrans*. The only Federally-listed subspecies of loggerhead shrike in the U.S. is the San Clemente loggerhead shrike (*L.l. mearnsi*), which occurs only on San Clemente Island, California. In Canada, the eastern population of the loggerhead shrike is listed as endangered and the western population is listed as threatened.

The causes of declines in loggerhead shrike populations, and present threats to the species, are poorly understood. Loss and degradation of suitable habitat are generally accepted as the major underlying causes of declines, but habitat loss alone cannot account for the current status of shrike populations. Pesticides, fragmentation of suitable habitat, and low over-winter survival are frequently cited as potential limiting factors, but data are lacking. While the loggerhead shrike does not appear to be threatened with extinction as a species, there is concern that the species may be extirpated from portions of its range.

Conservation initiatives focused on the loggerhead shrike in the U.S. have been limited, with the exception of intensive recovery efforts for the San Clemente loggerhead shrike. In the Northeast and upper Midwest, where the shrike no longer breeds with regularity, many states expressed an interest in loggerhead shrike conservation, but a reluctance to implement conservation efforts in the form of habitat improvement. Avian ecologists have noted that there is suitable habitat that is unoccupied, and they cite this as evidence that factors other than breeding habitat have a role in limiting populations. Research to evaluate underlying factors limiting shrike populations is needed.

Considerable progress has been made on the implementation of the national recovery plan in Canada. Initiatives include research on the species' biology, outreach efforts to encourage shrike conservation on private lands, habitat management, and the maintenance of captive populations for a potential reintroduction effort. The extent to which these efforts will benefit shrikes is not yet known.

The loggerhead shrike was recently selected as 1 of 15 species that will be considered in a pilot project by the Commission for Environmental Cooperation aimed at enhancing collaboration among Canada, Mexico, and the U.S. on transboundary/migratory species of concern. This initiative will hopefully lead to increased communication and cooperation, both within the U.S. and internationally, to focus conservation attention on the loggerhead shrike.

INTRODUCTION

The loggerhead shrike is a widespread species, with a breeding range extending from central and southern Canada, throughout the continental U.S., and through most of Mexico. While still widespread, the loggerhead shrike has experienced continentwide population declines and no longer breeds with regularity in portions of its former range. In 1987, the USFWS designated the

shrike as a Migratory Nongame Bird of Management Concern in the United States. Populations in the range of the subspecies *L.l. migrans*, from southeastern Canada through the northeastern and midwestern U.S., have declined at a higher rate than in other portions of the species' range. Within the range of *L.l. migrans*, the loggerhead shrike is State listed as threatened or endangered in 14 states. *L.l. mearnsi*, an insular subspecies that occurs only on San Clemente Island, California, is listed as Federally endangered in the U.S. In Canada, the eastern population of the loggerhead shrike is listed as endangered and the western population is listed as threatened.

In light of continuing declines in shrike populations, the USFWS initiated a rangewide status assessment of the loggerhead shrike in 1998; this report contains the results of the assessment. There were two primary purposes for conducting the status assessment. One was to assess the status of the species and evaluate the need for conservation activities. The second was to gather information that will be needed by the USFWS to make a decision on whether or not the loggerhead shrike, or any subspecies, should be proposed for listing under the Federal Endangered Species Act (ESA). Information summarized in the assessment includes loggerhead shrike taxonomy, range, habitat requirements, biology, and population status and trends. Threats to the species were evaluated, and based on those threats, management and research needs were identified. Status information for each state and for Canada is summarized in Appendix I.

There were two major sources of information used in this assessment. Approximately 250 published and unpublished reports were reviewed and information relative to the assessment was summarized. In addition, more than 200 individuals from State and Provincial natural resource agencies, the USFWS, the Canadian Wildlife Service, colleges and universities, and private conservation organizations were sent a questionnaire soliciting information on loggerhead shrikes. (A copy of the questionnaire and a list of contacts is included in Appendix II). Nongame Bird Coordinators and Endangered Species Coordinators from each USFWS Region assisted in identifying individuals to be contacted.

DISCLAIMER

This document is a compilation of biological data and a description of past, present, and likely future threats to the loggerhead shrike. It does not represent a decision by the USFWS on whether this species should be designated as a candidate species for listing as threatened or endangered under the ESA. That decision will be made by the USFWS after reviewing this document; other relevant biological and threat data; and all relevant laws, regulations, and policies. The result of that decision will be posted on the USFWS's Region 3 Web site (http://www.fws.gov/r3pao/eco_serv/endangrd/lists/concern.html). If the loggerhead shrike, or any shrike subspecies, is designated as a candidate species, then the species (or the affected subspecies) will be added to the USFWS candidate species list that is periodically published in the Federal Register and posted on the Web (http://www.fws.gov). Candidate species receive no protection under the ESA. Rather, candidate status indicates that the USFWS has sufficient information to propose a taxon for threatened or endangered status, and intends to do so as higher priority listing actions are completed.

Even if the species (or any subspecies) does not warrant candidate status, it is the intent of the

USFWS that this status assessment will provide the impetus for research and conservation initiatives focused on the loggerhead shrike. Information in this document will be used by the USFWS to help prioritize shrike research and management activities.

SYSTEMATICS

The loggerhead shrike (*Lanius ludovicianus*) belongs to the Order Passeriformes, Family Laniidae. This family, as treated by Rand (1960), is comprised of 74 species. The subfamily Laniinae, the true shrikes, includes the genus *Lanius*. This genus includes the 2 species of North American shrikes: *L. ludovicianus* and *L. excubitor*. *L. ludovicianus* was first characterized by Linnaeus in 1766, based on birds that had been sent to France from the old Louisiana territory and described by Brisson several years earlier (as reported by Miller 1931). The breeding range of *L. ludovicianus* extends from southern Canada, throughout the U.S., and into southern Mexico (although it no longer breeds in portions of this range). It is the only exclusively North American member of the Family Laniidae and the only shrike which breeds in the continental U.S.

Miller (1931) conducted the first comprehensive, rangewide, systematic treatment of *L. ludovicianus*. The loggerhead shrike is a widespread species which exhibits considerable variation in plumage coloration and morphometrics across its range. Based on examination of 1,878 museum specimens, Miller evaluated differences in external characteristics of birds from across the range of the species. He recognized 11 subspecies (or races, he used the words synonymously), most of which had been previously described by other authors. He provided a detailed discussion of the differences in coloration and morphometrics among the subspecies. Subspecies and range for each subspecies are listed below in chronological order of their description (Miller 1931).

1) *L.l. ludovicianus* Linnaeus. This is the nominate subspecies. Permanent resident of the Gulf Coast and southern Atlantic states from middle Louisiana eastward through Mississippi and Alabama, to Florida and Georgia; northeastward through South Carolina, North Carolina, and Virginia, southeast of the Allegheny Mountains.
2) *L.l. excubitorides* Swainson. Breeding range from the Great Plains east of the Rocky Mountains from central Alberta, and southern Saskatchewan, southward through western Texas, east into Manitoba, North and South Dakota, Nebraska, Kansas, and Oklahoma. Winter range from eastern New Mexico and western Texas south into Mexico.
3) *L.l. mexicanus* Brehm. Permanent resident of central Mexico.
4) *L.l. gambeli* Ridgway. Breeding range from extreme southern British Columbia and western Montana south into western Wyoming and east through Idaho into eastern Washington and eastern Oregon. During winter, some birds may remain in southern portions of the breeding range, others migrate further south in the U.S. and into Mexico.
5) L.l. migrans W. Palmer. Breeding range from the eastern border of the Great Plains eastward, northwest of the Allegheny Mountains to Maryland, east to the Atlantic Coast and north to New Brunswick; south in the Mississippi Valley to Arkansas, northern Mississippi, and possibly northwestern Louisiana; north in Canada to southern Manitoba, Ontario, and Quebec. Winter range south to Virginia, North Carolina, Mississippi, Louisiana, eastern Texas, and in small numbers to South Carolina, Georgia, Alabama, and the eastern coast of Mexico.

6) *L.l. anthonyi* Mearns. Permanent resident of Santa Cruz, Anacapa, Santa Rosa, and Santa Catalina Islands, California.
7) *L.l. mearnsi* Ridgway. Permanent resident of San Clemente Island, California.
8) *L.l. nelsoni* Oberholser. Permanent resident of central and southern Baja California.
9) *L.l. grinnelli* Oberholser. Permanent resident of northern Baja California.
10) *L.l. sonoriensis* A.H. Miller. Permanent resident from southern California through southern Arizona, southern New Mexico, and south into northern Mexico.
11) *L.l. nevadensis* A.H. Miller. Breeding range from southeastern edge of Oregon south through Nevada and adjacent portions of California; east through northern Arizona to northwestern New Mexico and western Colorado. Some birds remain in the breeding range during winter, and some migrate further south.

Miller noted that there were "noticeable differences with regard to the magnitude of subspecific differentiation" and recognized broad bands of intergradation between subspecies (with the exception of the 2 island subspecies). He noted that, between some pairs of subspecies, gradual transition in the environment, lack of a sharp geographic barrier, and migration contributed to the broad zones of intergradation.

Miller's work provided the basis for most later treatments of the species. The American Ornithologists' Union (AOU 1957) listed 9 subspecies, excluding *L.l. mexicanus* and *L.l. nevadensis*, which had been listed by Miller. Subspecies were not revisited in subsequent revisions of the AOU check list (AOU 1983, AOU 1998). The "Distributional Check-list of the Birds of Mexico" (Cooper Ornithological Society 1957) included those subspecies listed by Miller (1931) as having either a breeding or wintering range which included, in part, Mexico.

Subsequent to Miller's work, *L.l. miamensis* was described by L.B. Bishop in 1933 as a resident subspecies from southern Florida. Rand (1957) provided a summary of Bishop's description, along with his conclusion that it was a valid subspecies.

Rand (1960) listed 11 subspecies, but differed from Miller in dropping *L.l. nevadensis* but including *L.l. miamensis.* Phillips (1986) recognized 6 subspecies, including the subspecies *L.l. miamensis*; he combined many of the subspecies recognized by Miller (1931). Behle (1995) provided a thorough discussion of taxonomy of Utah shrikes. He reexamined 111 specimens from the University of Utah collection and concluded that *L.l. nevadensis* was a "good" race. Numerous authors have questioned the validity of specific subspecies. For example, Bull (1974) did not recognize *L.l. migrans* because "supposed difference in bill size from that of the nominate race varies considerably." Stevenson and Anderson (1994) considered *L.l. miamensis* an invalid subspecies.

Monroe (1990) is his report to the AOU Committee on Classification and Nomenclature recognized 8 subspecies. *L.l. migrans* was not considered separate from *L.l. ludovicianus* (he cited evidence of clinal variation, a broad zone of intergradation, and much individual variation). He also did not consider *L.l. gambeli*, *L.l. sonoriensis*, and *L.l. nevadensis* as separate from *L.l. excubitorides* (citing too much overlap in purported differences to warrant subspecific distinction). Monroe (1990) did recognize *L.l. miamensis*.

Lefranc (1997) summarized the current status of systematics of the loggerhead shrike as follows: "The classification of races is based on sometimes slight differences in coloration and morphometrics.... The differences, if any, between a few of the established races are very slight indeed. The situation is all the more problematic because birds inside a resident population may show relatively large individual variations in both coloration and size." Lefranc concluded by listing 8 subspecies, but noted "undoubtedly the subject needs further research." Not only is the lack of clear differences among subspecies a valid concern, but the potential that changes in subspecies have occurred since they were originally characterized cannot be overlooked.

Other authors have also voiced concern over the lack of a modern biosystematic study on loggerhead shrikes. Collister and Wicklum (1996) evaluated intraspecific variation in loggerhead shrikes in southeastern Alberta, Canada. They evaluated measurements, including wing-chord to tail-length ratio (WC:TL) which was used by Miller (1931) as an important variable for the identification of subspecies. They found that variation in WC:TL within the population they studied precluded the use of this measure to assign a specimen to a subspecies. Haas (1987) reached a similar conclusion. She conducted limited statistical tests on measurements used by Miller (1931) and results suggested that Miller's subspecies characterizations may not stand up to statistical scrutiny. Haas further noted that measurements from museum specimens (the basis for Miller's work) are not directly comparable to those taken on live birds. If subspecific determination is to be made in the field, it must be based on measurements of live birds. Haas suggested that measurements on a series of live shrikes are needed to determine if the existence of a northeastern subspecies (*L.l. migrans*) can be confirmed, or if differences are better explained by clinal variation.

The loggerhead shrike is listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as a threatened species in western Canada and an endangered species in eastern Canada. Collister and Wicklum (1996) noted that legal protection has been extended to individual populations of loggerhead shrike, rather than listing by subspecies "... due to the difficulty in ascertaining subspecies."

Genetic work on the loggerhead shrike has been limited. Mundy and Woodruff (cited *in* Yosef 1996) supported the consideration of *L.l. mearnsi* (the subspecies on San Clemente Island, California) as distinct from mainland shrikes. They used a combination of genetic markers and demonstrated that there is substantial genetic differentiation between *L.l. mearnsi* and 2 other California subspecies (*L.l. gambeli* and *L.l. anthonyi*).

Vallianatos (1999) evaluated mitochondrial DNA variation among over 200 loggerhead shrike samples from different localities across central and eastern North America. (Sources of samples included road-killed shrikes, embryos from deserted nests, feathers of nestlings, and museum specimens). A significant amount of the genetic variation observed among her samples was differentiated among 4 geographic regions. Two of those regions corresponded with ranges of the subspecies *L.l. ludovicianus* and *L.l. excubitorides* (as defined by Miller 1931). However, her analysis suggested that the genetic variation in the subspecies *L.l. migrans* was best explained by dividing the subspecies into a western region (samples from Missouri, Wisconsin, Illinois, and Iowa) and an eastern region (samples from Ontario, New York, Connecticut, Massachusetts,

Maine, and Washington D.C.). She discovered a downward trend in genetic diversity in the eastern region of *L.l. migrans*, which is now restricted to a population in Ontario. Vallianatos' work supported the existence of the intergrade zone between *L.l. migrans* and *L.l. excubitorides*, as described by Miller (1931). Additional research on the genetic diversity of Canadian shrikes and characterization of the hybrid zone between *L.l. migrans* and *L.l. excubitorides* is underway (Stephen Lougheed, Queen's University, pers. comm.).

NAMES

The genus name *Lanius* (Latin for "butcher") is in reference to the shrikes' habit of impaling prey on thorns or other sharp objects, a behavior which has been compared to a butcher hanging meat on a hook. The species name *ludovicianus* is in reference to the Louisiana Territory, the type locality of the species (Terres 1980).

Loggerhead shrike is the most widespread common name applied to this species. The name "loggerhead" may refer to its relatively large head compared to its body size and to its undeserved reputation for stupidity, as it also means "blockhead" (Lefranc 1997). The word "shrike," derived from "shriek," also has a pejorative connotation in reference to reputedly unpleasant vocalizations (Graham 1993, Lefranc 1997). The common name butcherbird is also applied to the loggerhead shrike. Other common names include French or Spanish mockingbird and thornbird (Imhof 1976, Yosef 1996, Hall et al. 1997).

Bent (1950) applied the following common names, which were subsequently used somewhat widely, to specific subspecies of loggerhead shrikes: loggerhead shrike (*L.l. ludovicianus*); migrant shrike (*L.l. migrans*); white-rumped shrike (*L.l. excubitorides*); California shrike (*L.l. gambeli*); Nelson's shrike (*L.l. nelsoni*); and island shrike (*L.l. anthonyi*). The name San Clemente Island shrike is commonly applied to *L.l. mearnsi*.

The name "loggerhead shrike" will be used to refer to species *L. ludovicianus* in this document; specific subspecies will be indicated when relevant. "Shrike" will also refer to the species *L. ludovicianus*, unless otherwise noted. References to subspecies will follow Miller (1931), unless an alternative citation is provided.

DISTRIBUTION

BREEDING RANGE

At the maximum extent of the species' distribution, the breeding range of the loggerhead shrike extended from central and southern Canada, throughout the U.S., and through most of Mexico. The current breeding range of the species, while still extensive, is shrinking. Most notably, the species no longer breeds with regularity (i.e. fewer than 10 breeding pairs and/or no persistent breeding sites) in the northeastern portions of its former range (as far west as Ohio) or the northern tier states of Michigan, Wisconsin, and Minnesota. A small breeding population, estimated at 31 pairs in 1998 (CWS 1999), persists in southern Ontario.

Within this breeding range, suitable breeding habitats include a wide variety of plant associations and physiographic strata, but must include open grassland areas with scattered trees or shrubs. (Habitat requirements will be discussed in detail later in this assessment). Shrikes are absent from closed forests, grasslands without trees or shrubs, and generally at elevations greater than 2000 m (Lefranc 1997). However, they occur up to approximately 3000 m in Baja California, Mexico (Cade and Woods 1997).

WINTER RANGE

The loggerhead shrike has been described as a partial migrant, populations in the northern half of the breeding range being largely migratory while southern populations are resident. Four of the 11 subspecies recognized by Miller (1931) are partly or entirely migratory: *L.l. excubitorides*, *L.l. gambeli*, *L.l. migrans*, *L.l. nevadensis*. Miller (1931) described the winter ranges of these subspecies based on the locations at which various subspecies were collected during winter.

Miller (1931) suggested that permanent resident populations of loggerhead shrikes occupy areas where snow cover does not persist more than 10 days each winter. In regions where snow cover averages 10-30 days annually, wintering shrikes occur, but are much less abundant than during the breeding season. In regions with more than 30 days of snow cover annually, winter records are rare, and tend to be associated with winters when snow cover is below average. The winter range lies mainly south of 40° N latitude (Lefranc 1997).

Individual shrikes occasionally winter in the northern parts of the breeding range, but do not occur in any numbers in those areas (Miller 1931). Bent (1950) reported that loggerhead shrikes wintered occasionally as far north as southern New England. In the eastern half of the U.S., Miller (1931) noted that loggerhead shrikes were not found regularly north of Oklahoma, Arkansas, Kentucky and Maryland in winter. However, other authors have reported regular winter populations in southern Indiana (Burton and Whitehead 1990), southern Illinois (Graber et al. 1973; Collins 1996), and throughout Missouri, although densities are greater in the southern half of the state (Kridelbaugh 1981). Generally, it is not known whether the birds present in winter in these states are a non-migratory remnant of the breeding population, winter migrants which bred further north, or a combination of the two, although Kridelbaugh (1983) documented on his central Missouri study area that wintering shrikes did not remain on the study area to breed, and vice versa. It is also not known if these wintering populations were simply not documented by Miller (1931), or if these birds represent an actual shift northward in the winter range of the species. Hunter et al. (1995) suggested that a series of mild winters may have allowed loggerhead shrikes to shift their winter range northward into southern Pennsylvania. In the western half of the range, birds are found in winter from northern California, northern Nevada, northern Utah, central Colorado, and south and eastern Kansas, south through the southwest U.S. and through most of Mexico (Yosef 1996).

Burnside (1987) evaluated migratory movements of shrikes based on band returns. Specifically, he looked at records of 151 banded shrikes recovered in the U.S. and Canada during the period 1923-1983; 19 of the band recoveries were considered long distance movements (at least 100 km). All dispersal routes documented by Burnside were located east of the Rocky Mountains.

The majority of these represented records of birds banded at northern latitudes between March-September and recovered in southern states during October-February. Based on the capture location, most of these birds were either *L.l. migrans* or *L.l. excubitorides*. Burnside found that banded shrikes from northern mid-continental populations (*L.l. excubitorides*) were recovered during the winter in Texas, Arkansas, Oklahoma, Mississippi, Louisiana, Kansas, and Missouri. Birds banded on breeding grounds in the midwestern or northeastern U.S., and one bird banded in Quebec (*L.l. migrans*), were recovered during winter in Virginia, Alabama, Tennessee, Arkansas, and Louisiana. Yosef et al. (1993) presented evidence, based primarily on banding data, that suggested there was no movement of migrant shrikes into peninsular Florida during the winter. Stable isotope measurements of feathers are being used to link breeding and wintering sites of shrike populations, but the results of this work are not yet published (Keith Hobson, Canadian Wildlife Service, pers. comm.). The stable isotope approach has the potential to greatly enhance our understanding of the migratory movements of shrikes.

Movements documented by Burnside (1987) and others generally confirmed the winter range for *L.l. migrans* and *L.l. excubitorides* as described by Miller (see winter range descriptions for subspecies in the **SYSTEMATICS** section). The winter range of the partially migratory western subspecies is poorly documented (Woods 1994 cited *in* Yosef 1996). Miller (1931) suggested, based on observation of specimens, that the 2 partially migratory western subspecies (*L.l. gambeli* and *L.l. nevadensis*) winter primarily in the southwest U.S. (particularly central and southern California) and into Mexico.

There have been no detailed studies of the migration pathways used by loggerhead shrikes. Miller (1931) suggested that the migration of the subspecies *L.l. migrans* was mostly north and south, except the Allegheny Mountains deflected birds from Ontario and the Ohio River Valley toward the west during their southward course. The migration route of *L.l. excubitorides*, as described by Miller, was north or south along the east base of the Rocky Mountains. He noted that no eastward movement along the tributaries of the Mississippi River had been observed during fall migration. Similarly, Miller described the migration of *L.l. nevadensis* as following a north/south route along the east base of the Sierra Nevada and San Gabriel Mountains. The locations of stopover sites of loggerhead shrikes are poorly documented.

CHANGES IN DISTRIBUTION

Cade and Woods (1997) provided a thorough evaluation of the changes in distribution of the loggerhead shrike, which is the basis for the following discussion unless otherwise noted.

The loggerhead shrike is found in landscapes characterized by widely spaced trees and/or shrubs interspersed with areas of grass/forbs and bare ground. Prior to European settlement of North America, deserts, shrub-steppes, and southern savannas probably represented the core habitats of the loggerhead shrike. These habitats existed from what is now Florida across the Gulf states to Texas and throughout the arid regions of the West. Large-scale expansion of the range of the shrike began to occur in the late 1800s, as explained by Cade and Woods (1997): "A northeastward expansion in range occurred in the late 1800s in association with deforestation and agriculture. A similar north central expansion occurred in the 1900s with agricultural

development of the northern Great Plains and aspen parklands."

Cade and Woods (1997) noted that inferences about distribution of shrikes prior to settlement of North America by Europeans are speculative, based on what is known about the distribution of major plant communities at the time. They concluded that shrikes did not occur widely, if at all, in the northeastern U.S. prior to extensive deforestation for agriculture in the l800s. The perception that the northeastern U.S. had no significant grassland or shrubland habitat prior to European settlement is widespread. However, there is evidence that open grassland/shrubland habitats composed a significant component of the pre-European landscape in the Northeast (Marks 1983, Askins 1993, Rosenberg and Wells 1995). Some avian ecologists consider it likely that loggerhead shrikes occurred in the Northeast prior to European settlement (Carola Haas, Virginia Polytechnic Institute and State University, pers. comm.). Clearing of forests in the Northeast by settlers undoubtedly expanded the amount of habitat available for shrikes.

The shrike appeared to reach its peak abundance in the Northeast in the last 2 decades of the 1800s. Agricultural practices in the Northeast at the time provided small fields, abundant pasture, hay meadows, shrubby fencerows, and isolated clumps of trees. Range expansion into the Canadian prairie provinces, also associated with the development of agriculture, occurred later. By the 1950s, loggerhead shrikes were common breeders in central Saskatchewan where aspen forests had been cleared for agriculture. In the western U.S., there was no major expansion of breeding range for shrikes associated with agriculture because native plant communities already provided suitable habitats. However, agricultural practices no doubt influenced the distribution and numbers of shrikes, sometimes positively and sometimes negatively, in this region. For example, planting of trees and shrubs in the prairie states probably increased nesting opportunities for shrikes in areas that had previously been largely treeless.

The retraction of the loggerhead shrike from the northeastern portions of its range began in the 1930s. In the prairie provinces of Canada, a southward retraction of the range and reduction in numbers began in the 1960s. Cadman (1985) discussed changes in the distribution of loggerhead shrikes in Canada in detail. Range contraction is largely accounted for by successional changes in habitat (reforestation of abandoned agricultural lands), or loss of habitat due to human activities (e.g. intensive rowcrop production and urbanization). In the northeast portion of the range, the current limit of the shrike's breeding range lies well south of its maximum known breeding distribution. An isolated population of less than 50 pairs in southern Ontario is all that remains in the northeastern portion of the range; the species does not breed regularly north of Virginia in the eastern U.S. The loggerhead shrike still breeds throughout most of the remainder of its historic range, but is greatly reduced in number in many areas.

Cade and Woods (1997) noted: "The historical pattern of range expansion and contraction that has occurred in the Loggerhead Shrike indicates that both natural successional changes in vegetation and human-produced changes to the landscape have repeatedly created and destroyed these suitable conditions and that shrike populations have generally tracked these changes." However, they further noted that continued disappearance of shrikes in regions with apparently suitable habitat and patchy distribution in areas of apparently extensive suitable habitat are less easily explained, and more troubling. See the **POPULATION STATUS AND TRENDS** section

of this assessment for a discussion of population declines.

RANGES OF SUBSPECIES

The ranges of the 11 subspecies recognized by Miller (1931) were briefly described in the **SYSTEMATICS** section of this assessment. Figure 1 is a graphic depiction of the ranges of subspecies, including zones of intergradation between subspecies (as described by Miller 1931). With the exception of the range of *L.l. migrans*, most of the range as described by Miller is still occupied, although distribution is patchy in much of the range and numbers greatly reduced. *L.l. migrans* no longer occurs regularly in the northeastern portion of its range (except for a small population in Ontario), or in Michigan, Wisconsin, or Minnesota.

PHYSICAL DESCRIPTION, SONG, AND GENERAL BEHAVIOR

The loggerhead shrike is approximately 22 cm long and is often described as slightly smaller than an American robin (*Turdus migratorius*). Its head is large relative to its body compared to other passerines. Weight ranges from approximately 40-50 grams (varying across the range of the species and seasonally) and wingspan is approximately 33 cm (Terres 1980). Lefranc (1997) provided the following physical description:

> "Its upperparts are dark grey... A narrow, dull white supercilium is often apparent just over the black facial mask. The latter, continuous across the base of the upper mandible, also slightly extends just above the eyes. These details, visible from a short distance only, are diagnostic. The underparts are usually entirely white, sometimes washed greyish, possibly more often in females, which might also, more regularly, show traces of vermiculation. The juvenile shows brownish-grey upperparts, is paler and fairly distinctly barred overall."

The wings and tail are mostly black above and gray below. The primaries are black with white bases; the first through fourth are tipped with white. Secondaries are black with white tips. Wing coloration results in an apparent flash of white during flight when the wings are opened and closed. The tail is black with outer retrices tipped white and with white bases. The upper mandible extends slightly past the lower and terminates in a short hook. The bill is black except in late fall and early winter when the base of the lower mandible lightens to a flesh color. Legs and feet are black.

Miller (1931) provided descriptions of physical characteristics of loggerhead shrikes, including differences in coloration and morphometrics among the 11 subspecies which he recognized. He also discussed variation in physical characteristics based on age and sex of a specimen.

Adult males and females are similar in appearance and cannot be reliably sexed in the field based on external characteristics, except during nesting when females develop a brood patch. However, males are generally larger than females, and females tend to have browner primaries (Yosef 1996). Blumton (1989) concluded that the most accurate identification of sex can be made during the breeding period based on behavioral differences, and subadults are most accurately aged by

incomplete prebasic molt. She also provided a technique for sexing and aging of loggerhead shrike based on a model developed through discriminant analysis of morphometric characters. Collister and Wicklum (1996) discussed sexual dimorphism in shrikes on the Canadian prairie.

The post-juvenile molt begins when loggerhead shrikes are about 40 days old, and lasts about 3½ months. Birds in their first-winter plumage are similar in coloration to older birds, but will retain some buff-tipped, inner primary coverts which will distinguish them from adults. Adult shrikes, including first-summer birds, undergo a complete molt which may start after fledging of the young and typically lasts a little less than 3 months (Lefranc 1997). Adults also have a partial prenuptial molt in late winter/early spring. Miller (1931) discussed molt in the loggerhead shrike and Lohrer (1974) discussed natal plumage and development. Yosef (1996) provided an excellent summary of molts and plumages in the loggerhead shrike.

The loggerhead shrike is very similar in appearance to the northern shrike (*Lanius excubitor*), although the later is larger, paler gray above, has more white on the rump, and has a narrower black mask, not extending above the eye (Yosef 1996). Misidentification of these 2 species is potentially a problem, particularly in northern states in late spring and early fall when the species may temporarily inhabit common range during migration. See Zimmerman (1955) for a discussion of distinguishing between these 2 species, including useful notes on field identification and comparative behavior in winter.

The loggerhead shrike superficially resembles the northern mockingbird (*Mimus polyglottos*). However, these species are relatively quickly distinguished from each other because the mockingbird "lacks black face mask and contrasting black wings; large, hooked, black bill; rich gray color; and horizontal perching posture (Yosef 1996)."

Miller (1931) described 2 basic types of flight in shrikes. Typically when traveling short distances, shrikes abruptly drop from a perch, fly low to the ground, and then abruptly rise to the succeeding perch. When covering greater distances shrikes often fly higher above the ground in an undulating pattern. Very rapid wing beats are characteristic of the flight of this species. Loggerhead shrikes sometimes hover when foraging (Yosef 1996).

Peterson (1980) described the song of the loggerhead shrike as a series of repeated harsh, deliberate notes and phrases. As described by Lefranc (1997), the song consists of repeated double- and triple-note calls or trill, occasionally mixed with warbled notes, which gives a more melodic quality to the song. He noted that "a sharp call which has been transcribed as 'bzeek, bzeek' is heard when a possible conspecific intruder or a potential nest predator is in view; it can accompany an ensuing chase." Most vocalizations appear to be associated with breeding and nest defense; the species is markedly less vocal when not breeding (Yosef 1996). The development of vocalizations in young shrikes and the vocal array of the species was described in detail by Miller (1931) and summarized by Yosef (1996).

Shrikes, as a group, are unique among passerines in having a beak that is highly specialized for a predaceous and carnivorous mode of feeding. Shrikes are the only passerines capable of killing vertebrate prey by biting into the neck and disarticulating cervical vertebrae (Cade 1995). Shrikes

are well known for their habit of impaling prey on thorns, barbed wire, or other sharp objects. In spite of its ability to kill and handle vertebrate prey, the bulk of the diet of the loggerhead shrike is typically composed of insects. Shrikes of Genus *Lanius* are almost exclusively "sit-and-wait" predators that scan the surrounding ground and air from a variety of perches. They rarely search for prey on the wing and most prey items are caught on the ground.

Throughout the southern portions of its range the loggerhead shrike is a permanent resident, whereas it is considered migratory, or partially migratory, in the northern portions of its range. The species is generally considered to be seasonally monogamous, and may live in pairs on permanent territories in some portions of its range. Throughout the range, pairs are considered strongly territorial during the breeding season.

HABITAT

Loggerhead shrikes are associated with grassland habitats throughout their annual cycle. Specific habitats occupied by loggerhead shrikes have shifted over time. Temple (1995) noted that many species of shrikes now occupy habitats that are essentially artificial, in that they have been created or extensively altered by human activities. In the case of loggerhead shrikes, most of the "artificial" habitat occupied by the species is associated with agricultural landscapes. The fact that loggerhead shrikes have adapted to altered habitats in many portions of their range, in conjunction with the varying habitat conditions across the broad geographic range of the species, makes characterizing the "typical" habitat of this species difficult.

BREEDING SEASON HABITAT REQUIREMENTS

Loggerhead shrike breeding habitat is generally characterized as open areas dominated by grasses and/or forbs, interspersed with shrubs or trees and bare ground. The range of the loggerhead covers a broad geographic area, but regardless of the geographic location, each occupied breeding territory includes some common habitat features: 1) nesting substrate (a tree or shrub); 2) elevated perches for hunting, pair maintenance, and territory advertisement (natural and artificial perches, such as powerlines or fenceposts, are used); 3) foraging areas (generally, open short grass areas with scattered shrubs or perches and some bare ground); 4) impaling sites (dense multi-stemmed and/or thorny shrubs, or barbed wire fences). These habitat requirements may be met in a wide variety of habitats, including pasture, old field, prairie, savanna, pinyon-juniper woodland, and shrub-steppe. A general discussion of the habitats used by breeding shrikes throughout their North American breeding range, including specific habitat features within these habitats, is provided below. Additional discussion of how specific habitat features and habitat quality affect productivity and foraging behavior will be discussed in the **BIOLOGY** section of this assessment.

Characteristics of breeding habitat in specific areas were described by the following authors and can be referenced for additional detail: Brooks (1988) in Minnesota; Burton and Whitehead (1990) in Indiana; Smith and Kruse (1992) and Collins (1996) in Illinois; DeGeus (1990) in Iowa; Kridelbaugh (1982) in Missouri; Luukkonen (1987) and Blumton (1989) in Virginia; Gawlik and Bildstein (1990) in South Carolina; Porter et al. (1975) in Colorado; Woods and Cade (1996) in

Idaho; Prescott and Collister (1993) in Alberta; and Telfer (1992) in Alberta and Saskatchewan. Johnson et al. (1998) provided a tabular summary of loggerhead shrike habitat characteristics as described in 18 publications.

Throughout much of the eastern and midwestern portions of its range, the loggerhead shrike breeds primarily in agricultural areas, particularly in association with pastures and hayfields. In New York, Novak (1989) documented that pasture, with less than 20% cover of woody vegetation, was the preferred breeding habitat of the loggerhead shrike. In Oklahoma, 89% of 133 loggerhead shrike nests studied were associated with active pasture (Tyler 1994). Shrikes in Ontario (Cadman 1985) and Virginia (Luukkonen 1987) also appeared to prefer areas dominated by active pasture. In Missouri, breeding shrikes exhibited a preference for grasslands and old field habitat; areas in Missouri with the highest relative abundance of loggerhead shrikes also had a greater proportion of land in pasture or hay (Kridelbaugh 1982). Smith and Kruse (1992) found that pastures and hay meadows were the preferred habitat in southcentral Illinois, although yards associated with residential buildings were also used. Brooks (1988) found shrike nests most frequently in association with agricultural fields in Minnesota. Mossman and Lymn (1989) reported that most Wisconsin nests were associated with pasture. In Indiana, Burton and Whitehead (1990) noted that shrikes were usually associated with Amish farming communities. Farms in these communities tended to be small, highly diversified, and almost all included some pasture. In northcentral South Carolina, habitats with short grass (particularly pastures, but also hayfields and residential lawns) predominated the areas immediately surrounding shrike nests (Gawlik and Bildstein 1990). Of the potential habitats evaluated in northcentral Florida, shrikes used pasture significantly more than expected based on availability (Bohall-Wood 1987). Porter et al. (1975) studied loggerhead shrikes in northcentral Colorado where the species bred on native grassland pastures associated with the shortgrass prairie.

Loggerhead shrikes are often found breeding in linear strips of habitat along roadsides because these areas frequently provide foraging areas (grass), perches (overhead wires, utility poles, fences), and nesting substrate (scattered trees/shrubs or fencerows). In intensely farmed portions of the Midwest, roadsides may constitute a major portion of the remaining nesting habitat of loggerhead shrikes (DeGeus 1990). Similarly, Collister and Henry (1995) found that approximately one-third of Alberta's estimated 350 breeding pairs of loggerhead shrikes nested in a narrow railroad right-of-way corridor.

In some portions of its range, the loggerhead shrike has adapted to nesting in urban/suburban habitats. Use of urban/suburban settings may have implications for shrike productivity, which will be discussed later. In South Carolina, Cely and Corontzes (1986) found 25% of loggerhead shrike nests (of 34 nests located) were associated with residential yards. In south Texas, park-like settings with scattered trees and short grass (city parks, university campuses, cemeteries) appeared to be favored by nesting shrikes (Chavez-Ramirez 1998). In Florida, the loggerhead shrike appears to be adapting to urban/suburban habitat, breeding with increasing regularity in housing developments, orange groves, and golf courses (Susan Craig, pers. comm.). In contrast, western shrikes appear less likely to nest in suburban settings. Woods (1995a) noted that "sagebrush nesting shrikes tend to be shy and somewhat inconspicuous, and I have found these shrikes do not readily nest near human habitations." In Colorado, shrikes "diligently avoid populated or

residential areas during the nesting season" (S. Craig, pers. comm.). These regional differences in the extent to which loggerhead shrikes use suburban habitats may reflect differences in quality or availability of alternative habitats or may reflect true regional differences in habitat preferences.

In the western U.S., loggerhead shrike breeding habitat is associated with shrub-steppe, desert scrub, and pinyon-juniper woodlands (Lefranc 1997), which have not been studied as extensively as habitats in the eastern half of the range. Woods and Cade (1996) evaluated nesting habits of the loggerhead shrike in southwest Idaho's sagebrush rangelands and Poole (1992) studied nesting habitat in shrub-steppe communities of southcentral Washington.

Habitats used by breeding loggerhead shrikes in agricultural landscapes (e.g. pastures, hayfields) are created by human-induced changes in native vegetative communities; these habitats must be "maintained" to remain suitable for shrikes. In contrast, shrub-steppe habitats are more permanent communities and likely represent one of the historic core areas of the species, prior to European settlement (Fraser and Luukkonen 1986, Cade and Woods 1997). High densities observed by Poole (1992) and Woods (1995a) in relatively undisturbed shrub-steppe habitats suggest that these are high quality breeding habitats for loggerhead shrikes.

WINTER HABITAT REQUIREMENTS

Generally, winter habitat requirements of the loggerhead shrike do not appear to differ markedly from breeding habitat requirements (Bartgis 1992, Collins 1996, Yosef 1996). In fact, many non-migratory populations may occupy the same territory year-round (Miller 1931); however, there may be changes in habitat use within the territory. Several authors have also suggested that territory size increases in winter in non-migratory populations (Blumton 1989, Collins 1996). Bartgis (1992) noted that, in the Northeast, hayfields and idle pasture may be used more heavily in winter compared to summer. Blumton (1989) noted that non-migratory shrikes in Virginia moved from pasture to shrub-forest habitats in winter, particularly during periods of low temperatures and when the ground was snow covered. Gawlik and Bildstein (1993) found that shrikes increased use of cropland and decreased use of grassy habitats during winter in South Carolina.

BIOLOGY

MIGRATION

As previously discussed, the loggerhead shrike is a partial migrant; it is primarily migratory in the northern half of its breeding range, likely due to snow cover, but tends to be resident further south. However, as described by Miller (1931), migration is an "irregular and variable habit" in the loggerhead shrike. Even in primarily migratory populations, some individuals will overwinter on the breeding grounds. The extent to which a given population is migratory may vary from year-to-year, possibly in response to changes in food supply (Yosef 1996) or weather (Miller 1931). The nature of migration in the loggerhead shrike is not well understood. It is generally thought that shrikes migrate diurnally and individually (Miller 1931, Yosef 1996), but several may be observed at the same stopover site (Lefranc 1997).

Safriel (1995) noted that among shrikes, as a group, loop migration (using different routes in fall and spring) and step migration (more than one wintering site is used and individuals migrate between them) have been observed. The extent to which loop and step migration occur in the loggerhead shrike is unknown.

Migratory loggerhead shrikes typically leave their breeding grounds between September and November, and return between early March and late April (Yosef 1996, Lefranc 1997). However, timing varies considerably across the range of the species, and other references should be consulted to determine timing of migratory movements in specific locations. The timing of migration in loggerhead shrikes has been discussed in more detail by numerous authors (Miller 1931, Bent 1950, Yosef 1996, Lefranc 1997).

REPRODUCTIVE BIOLOGY

Courtship, Nesting, Incubation, Fledging

Current accounts document that male shrikes select territories in late winter and early spring (Kridelbaugh 1982), contrary to early accounts by Miller (1931) and others which suggested that males seek territories established by females. Male territorial displays include flashing white wing and tail markings and singing from a conspicuous perch. Territorial defense includes chasing intruding males from the territory, and a "flutter" display. Males perform an erratic, zigzagging nuptial flight and may also chase the female during courtship. As courtship proceeds, the male feeds the female as she performs a begging display, which involves crouching and fluttering the wings. Loggerhead shrikes are typically seasonally monogamous, but exceptions have been documented (Haas and Sloane 1989, Yosef 1992b). Yosef (1992b) suggested that loggerhead shrikes may be able to adopt alternate reproductive strategies depending on the abundance of food. Loggerhead shrikes generally breed as 1-year-old birds, during the first spring after hatching (Miller 1931, Yosef 1996).

Both males and females participate in selecting the nest site and gathering nesting materials, but the female constructs the nest (Miller 1931, Burton and Whitehead 1990), which takes 7-12 days. Kridelbaugh (1982 in Missouri) reported that males also assisted in nest construction. In southern portions of the range where shrikes are year-round residents, breeding typically begins in late winter or early spring. In mountainous areas and at higher latitudes, where breeding shrikes are migratory, clutches are initiated later. Across the broad breeding range of the species, egg-laying may commence as early as mid-February or as late as early July (Lefranc 1997). Overall, peak egg-laying occurs between mid-March and mid-June. Shrikes are typically one of the earliest nesting passerines in any given area. See Miller (1931), Kridelbaugh (1983), and Poole (1992) for detailed descriptions of nesting chronology. Miller (1931) provided a detailed description of loggerhead shrike eggs, including measurements.

Loggerhead shrikes are generally considered to be very aggressive in their territorial defense. Both males and females participate in defense of the nesting territory. Territories are defended against conspecifics, as well as other species (Blumton 1989). Novak (1989) provided detailed accounts of encounters of shrikes with American kestrels (*Falco sparverius*) and eastern kingbirds

(*Tyrannus tyrannus*). He noted that in encounters with a kestrel that the shrike was invariably the aggressor.

Generally, shrikes prefer to nest in an isolated tree (or shrub) or a clump of trees, as opposed to nesting in a continuous line of trees, such as a hedgerow or windbreak (Brooks 1988, Novak 1989, Smith 1990, Chabot et al. 1995b, Craig 1997). When shrikes do nest in fencerows, their nests are often associated with a break or gap in the row. Shrikes nesting in isolated trees generally experience higher nest success than birds nesting in fencerows (Lane 1989, Yosef 1994a). Shrikes in linear habitats frequently suffer high levels of nest predation (DeGeus 1990).

The height of the nest above the ground varies with the height of trees present in a given area. Average nest heights reported for loggerhead shrikes included: 3.7 m in southern Illinois (Collins 1996); 3.2 m in Missouri (Kridelbaugh 1982); 3.0 m in Oklahoma (Tyler 1994); and 2.2 m in Colorado (Porter et al. 1975). Woods and Cade (1996) found that the average height of nest shrubs was less than 2 m and nest height was less than 1 m in Idaho; they noted that this is low nest height compared to most other studies of the loggerhead shrike, but may be typical in sagebrush-scrub habitat. Several researchers reported that nest height was significantly greater for second nests compared to first nests (Lane 1989 and Collins 1996 in Illinois; Luukkonen 1987 in Virginia; and Burton and Whitehead 1990 in Indiana). Nest success does not appear to be related to nest height (Kridelbaugh 1983, Collins 1996).

The nests are frequently placed in the crotch of a tree, sometimes on top of an old shrike nest, or that of another species, such as the northern mockingbird (Bent 1950) or black-billed magpie (*Pica pica*) (Woods and Cade 1996). Nests are bulky and are constructed from coarse twigs and lined with plant material and animal hair (Kridelbaugh 1983, Fraser and Luukkonen 1986). Replacement clutches, by unsuccessful pairs, and second clutches, by pairs that successfully raised their first brood, are generally built relatively close (up to several hundred meters) from the first nest (Lefranc 1997); Miller (1931) and Kridelbaugh (1983) reported that second nests were invariably within the limits of the original nesting territory.

Loggerhead shrike nests have been found in a wide variety of trees and shrubs (Table 1). Short specimens with a tangle of protective branches, vines, or thorns may be preferred. The wide range of woody plants used for nesting suggests that the amount of cover provided by the plant is more important than species in nest site selection (Porter et al. 1975, Burton and Whitehead 1990). Nonetheless, certain species are used more frequently than others (for example, eastern red cedar in eastern agricultural landscapes, sagebrush in shrub-steppe habitats). Woods and Cade (1996) evaluated nesting habits of the loggerhead shrike in southwest Idaho's sagebrush rangelands and found that shrikes selected shrubs rather than trees for nesting, even though trees occurred sporadically in the study area.

Plant species that are frequently used are not necessarily preferred; high use may be a reflection of high availability. In New York, Novak (1989) found 16 of 17 shrike nests in hawthorn, but stated that hawthorn was not used selectively relative to its availability. Some studies cited in Table 1 evaluated use relative to preference, others did not. Most studies on nest site selection have concluded that nesting success is not affected by the plant species chosen as a nest substrate

(Luukkonen 1987, Burton and Whitehead 1990, Collins 1996), but there have been exceptions (Siegel 1980 cited *in* Collins 1996, Kridelbaugh 1983, Gawlik and Bildstein 1990).

Several studies have documented changes in nest site selection for spring nests compared to nests later in the nesting season. Burton and Whitehead (1990) found that the percentage of nests placed in evergreens or thorny plants was higher for spring nests compared to summer nests. Most deciduous plants in their Indiana study area provided insufficient nesting cover prior to leaf out, which did not occur until after spring nests had been initiated. Gawlik and Bildstein (1990) also noted that in South Carolina early in the nesting season eastern red cedar may be preferred because it provides nest cover prior to leaf-out of deciduous trees. However, DeGeus (1990) noted that white mulberry was the most frequently selected tree in Iowa and it is among the last to leaf out. He suggested that shrikes may choose nest sites that facilitate detection of potential predators because they are a species that aggressively defends their nest.

Shrikes typically lay a clutch of 5-6 eggs (Table 2). Lefranc (1997) reported that clutches of 5-6 eggs accounted for 70% of all known historical records, although clutches ranging from 1-9 eggs were recorded. There appears to be a latitudinal cline in clutch size, with northern clutches tending to be larger (Yosef 1996). One egg is laid per day, and incubation begins with the next to the last egg. The female incubates the eggs, and is fed by the male during incubation.

Males defend the nesting territory during incubation (Miller 1931). Eggs hatch asynchronously, with incubation lasting 16-18 days. Brood reduction has been reported, possibly associated with adverse weather conditions (Kridelbaugh 1983) or limited availability of food (Luukkonen 1987, Blumton 1989). Poole (1992) found no evidence of brood reduction in Washington. Females brood the young while males continue to supply food both for the female and the young. Female participation in food gathering increases as the nestlings grow. The brooding period is long compared to most open cup passerines; nestlings fledge at 17 to 20 days of age. Miller (1931) and Lohrer (1974) provided detailed accounts of growth of young.

During the first few days post-fledging, young shrikes typically stay concealed in dense foliage. Attempts to follow foraging adults begin within a week, and fledglings begin to capture food for themselves about 2 weeks after leaving the nest. Adults continue to feed fledglings for another 2 weeks. By this time, adults and young begin foraging in areas away from the nesting territory (Novak 1989). Juvenile shrikes moved from the parents' territory at approximately 10-13 weeks of age in Virginia (Blumton 1989). Blumton (1989) observed that resident shrikes frequently chased these dispersing subadults from their natal areas.

Productivity and Survival

There is geographic variation in the number of broods raised annually by a pair of loggerhead shrikes. Renesting after a failed first nest appears to be relatively common at all latitudes, particularly for nests which fail early in the nesting season. The species is sometimes double-brooded; that is, pairs with successful first nests may also initiate second nests. Double-broodedness is likely related to latitude, being less common in the north, and to weather conditions in a given year (Lefranc 1997). James Herkert (Illinois Endangered Species Protection

Board, pers. comm.) cautioned that renesting rates reported in the literature are frequently based on the assumption that shrikes do not move a long distance between nesting attempts; renesting rates may be underestimated if shrikes move farther than anticipated between nesting attempts. Porter et al. (1975) found no evidence of loggerhead shrikes being double-brooded in Colorado, but renesting following a failed first nest was common. Collins (1996) found that 20-40% of shrikes renested following a failed first nest in southern Illinois; she found no indication that pairs that successfully fledged a first nest would attempt a second. In Missouri, 29% of pairs with a failed first nest attempt renested (Kridelbaugh 1983). Reported rates of renesting by successful pairs attempting a second nest included 7% in Virginia (Blumton 1989), 18% in Missouri (Kridelbaugh 1983), 22% in Iowa (DeGeus 1990), and 56% in Florida (Yosef 1994a). Burton and Whitehead (1990) reported that some pairs in Indiana also initiated a second nest after successfully fledging their first brood. Fraser and Luukkonen (1986) and Yosef (1992a) reported that southern birds may attempt to rear up to 3 broods in a year. The persistence with which shrikes replace destroyed nests was noted early in the 20th century by egg collectors (Miller 1931). Records of a single pair producing up to 6 sets of eggs as a result of repeated collection of their eggs have been recorded.

Female shrikes have been observed to desert their mates during the fledging period (Kridelbaugh 1982, Novak 1989, Burton and Whitehead 1990) and in some cases raise a second brood with another male (Haas and Sloane 1989). In these cases, the male is left to feed a brood by itself (Kridelbaugh 1982, Novak 1989). On 2 occasions, Craig (1997) observed female shrikes attending fledglings from their first brood while incubating their second.

Nest success for loggerhead shrikes is highly variable from year-to-year (Porter et al. 1975, Kridelbaugh 1983), but is high compared to most other passerine birds. Ricklefs (1973) noted that nest success of temperate zone passerines with open nests averaged 47%. Table 2 summarizes the productivity of loggerhead shrikes as documented in studies across the species' range; 14 of 19 studies (74%) documented nest success of 50% or greater for loggerhead shrikes. There is variation among studies in how productivity parameters were measured. Some studies included only first nests, while others included renesting attempts. For example, Woods (1995a) documented 61% nest success for Idaho shrikes, but 76% of pairs actually nested successfully when he accounted for renesting following nest failure. Another source of variation among studies is that some studies were conducted during a single nesting season, while others included data from 2 or more years. Collins (1996) reported average nest success of 25% for loggerhead shrikes in southern Illinois; this is the lowest nesting success reported among the studies summarized in Table 2. However, she noted that this is the average success over a 2-year study. In the first year of her study, the 12 nests she evaluated had 44% success, and in the second year none of the 9 nests evaluated were successful. Some studies combined data from more than one habitat type. Caution should be exercised in comparing data across studies and the reader is encouraged to reference the original work. Nonetheless, the table demonstrates that loggerhead shrikes typically experience high nest success.

In addition to generally high nest success, loggerhead shrikes also typically produce more fledglings per nest compared to other altricial species. Productivity for loggerhead shrikes at the fledging stage per nesting pair ranged from 2.0 to 5.3 in a 15-year study in Saskatchewan and

averaged 3.5 young per nest over 5 years in Manitoba (Johns et al. 1994). These fledging success rates compare favorably with the mean of 2.2 fledglings per nest reported for a large number of altricial species by Nice (1957 cited *in* Johns et al. 1994). Table 2 summarizes the number of young loggerhead shrikes fledged per successful nest as documented in 15 studies across the species' range; 10 of the 15 studies (67%) reported an average of 4 or more fledglings per successful nest.

Relatively little information is available on post-fledging survival. Woods (1995a) detailed the difficulty associated with locating and identifying loggerhead shrikes post-fledging. High rates of post-fledging mortality have been documented in several studies. Luukkonen (1987) estimated that an average of 4.0 shrikes were fledged per successful nest, but only 2.6 survived to independence (≥40 days). Burton and Whitehead (1990) estimated fledgling survival through the first week after fledging at only 54%. Collister (1994 cited *in* Lefranc 1997) found that mortality during the first 10 days after fledging varied between 33-53% in 2 successive years in southeast Alberta. Leu and Manuwal (1996) found that the median fledgling survival to independence (35-40 days) varied from 50-67% during their 2-year study in Washington. They noted that at 19-25 days old, fledgling loggerhead shrikes are very poor fliers, and they found that fledglings were particularly vulnerable to predation during this period. In contrast, Blumton (1989) found that the survival rate of 19 radio-tagged fledglings through the establishment of fall home ranges was 100%, although the ultimate fate of the subadults could not be determined because of limited life of radio transmitters. She documented movements of fledglings up to 900 m from the nest. She cautioned that such movements may result in inability of a researcher to find fledglings, and may be misinterpreted as mortality. Haas (1995b) also documented long distance movements of fledgling shrikes (up to 7.7 km) on her North Dakota study area. Generally, results of studies suggest that post-fledging mortality in loggerhead shrikes may be high (Novak 1989, Poole 1992) and that estimates of reproductive success based solely on fledging rates may be positively biased.

Data on survival beyond the fledgling stage are very sparse. Miller (1931) noted that mortality is high in young birds, and estimated that the average life expectancy of young upon fledging is only about 4 months. He also evaluated the proportion of first-year birds, compared to adult birds (second-year or older) in loggerhead shrike populations. Proportion of first-year birds in most winter and spring populations he evaluated averaged 50%, but he noted geographic variability; proportion of first-year birds varied from 35%-65% among loggerhead shrike subspecies. Brooks and Temple (1990a) estimated annual adult survival of a migratory population of loggerhead shrikes at 47%, which was the reoccupancy rate of banded individuals at the previous year's breeding territories. However, other authors questioned the validity of estimating survival based on reoccupancy (Haas and Sloane 1989, Burton and Whitehead 1990, Woods 1995a, Collister and DeSmet 1997). Based on band returns, the oldest known wild loggerhead shrike lived to 12.5 years (Klimkiewicz et al. 1983 cited *in* Hands et al. 1989).

Predation and weather are frequently cited as major causes of loggerhead shrike nest failure. In Missouri, Kridelbaugh (1982) noted that in a 2-year study, predation was the major cause of nest failure one year and adverse weather the next. He reported lower fledging success during a cold/wet breeding season compared to a warm/dry year. Breeding can be delayed (Collins 1996) and reproductive failures occur as the result of inclement spring weather (Blumton 1989).

Predation accounted for 93% and 95% of nest failures in 2 studies in Washington (Poole 1992 and Leu and Manuwal 1996, respectively), 86% in Florida (Yosef 1994a), 79% in southern Illinois (Collins 1996), 54% in Idaho (Woods 1995a), 50% in Virginia (Luukkonen 1987), and was also the most significant cause of nest failure in Indiana (Burton and Whitehead 1990). Porter et al. (1975) reported that predation accounted for 52% of nest failures in Colorado, but weather was a more important factor in some years. Predation of nests and nestlings appeared to be a problem for urban-nesting shrikes in south Texas; nest predation was 40%, with feral cats one of the most significant predators (Felipe Chavez-Ramirez, Texas A&M University, pers. comm.). Poole (1992) found that loggerhead shrikes did not nest in riparian areas in Washington, even though habitat appeared suitable. She hypothesized that high predator densities, specifically corvids, may render these areas unsuitable for nesting shrikes. However, Leu and Manuwal (1996) found no relationship between nest success and distance to corvid nests. Luukkonen (1987) noted that while predation is commonly cited as the major cause of nest failure in shrikes, that this is common among passerines; high predation rates do not necessarily indicate that nest predation is a limiting factor for shrikes. He further noted that the importance of predation may be overestimated if factors such as limited food resources or nest abandonment are the underlying cause of predation.

Loggerhead shrike nests in linear habitats appear to suffer higher rates of predation compared to those in non-linear habitats, presumably because linear habitats serve as major travel lanes for predators. In Florida, Yosef (1994a) found higher nest success in shrikes nesting in pastures (60%) compared to those associated with fencelines (33%), due to greater predation in fenceline nests. High rates of predation were also found in loggerhead shrike nests associated with linear roadside habitats in Illinois (Lane 1989) and Iowa (DeGeus 1990). DeGeus (1990) concluded that roadside habitats served as sinks for breeding loggerhead shrikes in Iowa; birds were attracted to these seemingly suitable habitats but predation limited production to levels below those needed for replacement. Yosef (1994a) similarly noted that fenceline habitats in Florida may be sinks. Lane (1989) found that nests in isolated trees had higher nest success compared to fencerow nests. Luukkonen (1987) also found that nests in isolated trees were more likely to be successful.

Limited food availability may also limit shrike productivity (Luukkonen 1987, Woods 1995a). Woods (1995a) compared productivity at nests which were supplemented (with mice) versus control nests which were not supplemented. He found that food supplementation resulted in improved nestling condition, particularly that of the smallest nestlings, and in decreased nestling mortality. He noted that the addition of supplementary food may buffer the influence of limited prey availability on the nutritional condition of nestlings. Another effect of food supplementation may have been increased nest attendance by adults, which potentially would result in a reduction in nest predation.

Territory Size

Loggerhead shrike territory size is highly variable, both among different populations and within a given population. On one Florida study area territory size ranged from 0.8-17.6 ha (Yosef and Grubb 1994). Average breeding territory size for other studies included 4.1 ha in South Carolina

(Cely and Corontzes 1986), 4.6 ha in Missouri (Kridelbaugh 1982), 6.7 ha in New York (Novak 1989), 8-25 ha in Montana (Eric Atkinson, Marmot's Edge Conservation, pers. comm.), 13.3 ha in Alberta (Collister 1994 cited *in* Yosef 1996), and 34.0 ha on San Clemente Island, California (Scott and Morrison 1990 cited *in* Yosef 1996). Note that some of the variation among studies is the result of differences in techniques used to measure territory size. Kridelbaugh (1982) reported that territory size in Missouri varied during the breeding season; territories were larger during incubation (8 ha) than during the nestling stage (3 ha). Other authors (Yosef 1992a in Florida; Collister 1994 in Alberta cited *in* Yosef 1996) found no seasonal difference in territory size.

Densities of breeding shrikes reported for roadside surveys include: 0.62 pairs/km in Alabama (Siegel 1980 cited *in* DeGeus and Best 1995), 0.29 birds/km in South Carolina (Cely and Corontzes 1986), 0.18 pairs/km in eastern Washington (McConnaughey and Dobler 1994), 0.17-0.21 birds/km in eastern Texas (Bildstein and Grubb 1980), 0.11-0.14 pairs/km in southwestern Iowa (DeGeus 1990), and 0.11-0.15 pairs/km in Minnesota (Brooks and Temple 1990a). In Virginia, Luukkonen (1987) noted that the average distance between shrike nests when pairs occupied adjacent territories was 546 m.

Miller (1931) observed variability in territory size in breeding shrikes which he attributed to differences in habitat and concomitant variation in food availability. Kridelbaugh (1982 in Missouri) and Yosef and Grubb (1994 in Florida) also documented that territory size was related to foraging habitat quality. Miller (1931) noted that in dense populations in high-quality habitat that individual territories were generally bounded on all sides by territories of other shrikes. In less dense populations and/or populations in lower quality habitats, territories were less likely to be bounded by the territories of other shrikes. For example, Porter et al. (1975) reported that in Colorado occupied nests were never closer than 400 m to each other, but that territories were much smaller, suggesting that breeding density was not regulated by territorialism in that population.

In shrub-steppe habitats in Washington, Poole (1992) documented that the density of nesting shrikes was highly variable, which she attributed to differences in habitat quality. She found that the density of nesting shrikes at the Hanford site (U.S. Department of Energy) was 12-19 times greater than in other shrub-steppe habitats in eastern Washington, and that nesting habitat there appeared to be saturated. The quality of the relatively undisturbed shrub-steppe habitat at this site was high compared to other sites. Most of shrub-steppe remaining in Washington had been converted to agriculture, and what hadn't been converted was dominated by steep slopes, poor soils, and had been modified by fire suppression, livestock grazing, introduction of exotic species and habitat fragmentation. Woods (1995a) also documented high densities of nesting shrikes in relatively undisturbed shrub-steppe habitats in Idaho.

Some avian ecologists suggest that there is a degree of social facilitation in territorial establishment in loggerhead shrikes (C. Haas, pers. comm.). Territories tend to be clumped within suitable habitat (Burton and Whitehead 1990 in Indiana; Woods 1994 in Idaho cited *in* Cade and Woods 1997; E. Atkinson in Montana, pers. comm.; John Castrale, Indiana Dept. of Natural Resources, pers. comm.; and Paul Novak, New York Naural Heritage Program, pers. comm.), leading observers to suggest that the presence of other territorial shrikes may increase the

probability that a shrike will establish a territory in a given area. Burton and Whitehead (1990) found that most Indiana shrike nests occurred in fairly dense clusters. Only 13% of 117 nest sites were isolated from other sites by more than 5 km even though wide areas of seemingly suitable habitat between clumps were not used. Cade and Woods (1997) discussed the tendency of territorial shrikes to attract conspecifics in more detail. However, note that an analysis of the distribution of shrikes in Oklahoma revealed that the clumped distribution of breeding shrikes was associated with the distribution of vegetation (Matthew Etterson, Mountain Lake Biological Station, pers. comm.).

Site Reoccupancy and Site Fidelity

Early accounts concluded that shrikes were highly faithful to their nesting territory from the previous breeding season (Miller 1931, Bent 1950), but these conclusions were based on unmarked individuals. Reoccupancy of nesting sites from year to year by different individuals may have been misinterpreted as site fidelity, if the observer assumed that the same individual was reusing the nest site. More recent studies suggest that while reoccupancy of nest sites may be high, site fidelity by individual shrikes is generally lower. Reported rates of return of banded adult shrikes to the previous year's nesting territories included 14% (10/69) in North Dakota (Haas and Sloane 1989), 16% (22/140) in southwestern Manitoba (Collister and DeSmet 1997), 23% (7/30) in Missouri (Kridelbaugh 1982), 32% (31/96) in southeastern Alberta (Collister and DeSmet 1997), and 41% (17/41) in Indiana (Burton and Whitehead 1990). Novak (1989) found that none of the 4 adults he banded in New York returned. Breeding site fidelity does not appear to be contingent on nesting success; however, Collister and DeSmet (1997) did find that adults that raised young to banding age were slightly more likely to return to the same nesting territory the following year (7% return) compared to adults that failed to raise young (2% return). Collister and DeSmet (1997) noted that loggerhead shrikes that were previously trapped became trap-wary, which may lead to bias in evaluating return rates.

Haas and Sloane (1989) found that rates of return of banded adult loggerhead shrikes were much lower than those reported for migratory birds that are considered to exhibit site fidelity; they made this conclusion based on their estimate of 14% return rates for shrikes in North Dakota. However, they reported return rates for other migratory birds, ranging from 31-48%, that they considered "site faithful." Return rates for shrikes in some study areas (e.g. southeastern Alberta and Indiana, as reported above) fall within this range.

Studies of banded individuals have indicated that adult male shrikes are more likely to return to the previous year's nesting territory than adult females. This is true for most species of birds (Collister and DeSmet 1997), but Haas and Sloane (1989) noted that the degree of bias toward male site fidelity is even more pronounced in shrikes compared to most other species. Kridelbaugh (1983) found that 7 of 15 (47%) of adult male shrikes banded in Missouri in 1980 returned to the same territory in 1981; none of the 15 banded females returned. Haas and Sloane (1989) reported a 28% (8/29) return rate in males compared to 5% (2/38) in females in North Dakota. Burton and Whitehead (1990) found that return rates for adult males and females were 55% (12 of 22) and 26% (5 of 19), respectively in Indiana. Three of 7 banded adult males (43%) returned to their previous year's nesting territory in Minnesota (Brooks and Temple 1990a);

apparently no banded females returned, but this was not specifically reported. In southwestern Manitoba, 23% of males and 9% of females returned to the study area (Collister and DeSmet 1997). In southeastern Alberta, Collister and DeSmet (1997) noted that 38% of banded males and 27% of banded females were relocated within 4 km of the banding location the following year; the difference in rates between the sexes was not statistically significant. Haas and Sloane (1989) noted that mate desertion and mate switching, within a given breeding season, have been observed in female loggerhead shrikes. The fact that female shrikes are not faithful to a territory within a given breeding season, suggests that they would be unlikely to exhibit site fidelity between breeding seasons.

Return rates for shrikes banded as nestlings or fledglings are lower than those for adults. In Missouri, only 1 of 90 banded nestlings was relocated as an adult, and it was located 3.75 km from where it fledged (Kridelbaugh 1982). In Virginia, 2 of 56 banded nestlings returned in one study (Luukkonen 1987) and 4 of 236 returned in a second study (Blumton 1989). Only 2 of 243 shrikes banded as nestlings or fledglings returned to an 8,000 ha North Dakota study area, and those 2 were found an average of 3.5 km from their natal sites (Haas 1995b). Only 1 of 41 banded nestlings returned in Indiana (Burton and Whitehead 1990). Brooks and Temple (1990b) banded 196 shrikes as nestlings in Minnesota and none were either trapped or observed in subsequent years. In Canada, return rates of banded nestlings the year following banding were 1.2% (3 of 249) in southeastern Alberta and .85% (27 of 3,176) in southwestern Manitoba (Collister and DeSmet 1997). Collister and DeSmet (1997) noted that the observed pattern of dispersal in shrikes, a higher tendency of adults to return to the previous year's territory compared to first-year birds, is a common pattern in birds.

Collister and DeSmet (1997) cautioned that the size of the study area can bias studies involving dispersal and site fidelity in birds. The smaller the study area, the more likely that a banded bird returning to the same general area, but not necessarily the same territory, will be overlooked. Collister and DeSmet (1997) evaluated long-distance dispersal of banded shrikes over large areas of southeastern Alberta and southwestern Manitoba, which allowed them to quantify long-distance dispersal up to 80 km. They noted that even in their very large study areas, average dispersal distances were 20-58% less in the smaller study area in Alberta compared to the Manitoba study area; this finding may represent a bias associated with the size of the study area.

Compared to return rates, rates of reoccupancy of the previous year's nesting territories by shrikes are high. Based on observations of banded birds, it is known that frequently territories are reoccupied by a different individual in consecutive years. Reported rates of territory reoccupancy include 15 of 28 (54%) territories reoccupied in 2 consecutive years in Missouri (Kridelbaugh 1983), 47% of breeding territories reoccupied in Minnesota (Brooks and Temple 1990a), 38 of 54 (70%) in Indiana (Burton and Whitehead 1990), and 49 of 77 (64%) in Washington (Leu and Manuwal 1996). (Note that Leu and Manuwal felt that improved nest searching techniques in the second year of their 2-year study resulted in an underestimate of the true rate of reoccupancy). The highest rate of reoccupancy was reported by Poole (1992); she found that 96% of 113 territories occupied in 1988 in her southcentral Washington study area were reoccupied in 1989. She noted that the high reoccupancy rate was potentially due to high adult survival rates or saturation of suitable nest sites at Hanford. Reoccupancy of successful nest sites has not been

observed to differ from reoccupancy of unsuccessful nest sites (Burton and Whitehead 1990, Collister and DeSmet 1997).

FORAGING ECOLOGY

Impaling Behavior

The loggerhead shrike is well known for its unique and complex impaling behavior. Impaling is one of the adaptations in shrikes in the genus *Lanius* associated with their raptorial mode of feeding, unique among passerines. Shrikes cannot hold large prey in their feet as raptors do. Instead, they employ impaling and wedging to anchor prey that is too large to swallow whole (Cade 1995). After impaled prey are securely anchored, shrikes are able to tear off bite-sized pieces.

Impaling probably evolved to facilitate prey handling, but other functions have also developed. In addition to prey manipulation, other functions of impaling that have been suggested include: 1) food cache or larder, as a buffer against food shortage; 2) impaled food serves as a display of the male shrike's quality; and 3) chemically-protected prey are impaled to be detoxified with time and consumed later, when safe to eat (Safriel 1995, Lefranc 1997). Examples of all of these functions have been observed in loggerhead shrikes. Yosef and Whitman (1992) provided an example of a chemically-protected grasshopper which the loggerhead shrike can consume after it has been impaled for 24-48 hours. Adams and McPeek (1994) noted that caching is done primarily by males and most frequently early in the breeding season, suggesting that this may be a way for males to advertise that they are holders of good territories and will be good providers. They further noted (citing Yosef and Pinshow 1989) that experimental manipulations of cached items revealed that males with larger caches mated first and sired more offspring. The use of larders for food storage was discussed by Applegate (1977); he suggested that prey caching by the male is a method of conserving the female's energy, allowing the female to invest more time in incubation and brooding. The use of larders for long term food storage has been suggested, but not documented. Woods (1995a) observed shrikes' larders being raided by neighboring shrikes (and suspected raiding by other species as well) in shrub-steppe habitat in Idaho. He noted that intraspecific and interspecific kleptoparasitism may limit the use of larders for food storage in that population.

A wide variety of substrates are used as impaling stations by shrikes; thorny plants (e.g. osage orange, hawthorn, cacti), barbed wire, and sharp ends of broken branches are frequently used (Miller 1931). Alternatively, items may be wedged in a crotch or crevice. Although impaling is an essential behavior for shrikes, availability of impaling stations is not likely to limit habitat suitability for shrikes. Miller (1931) noted that impaling devices are so varied as to be available in some form in almost any type of habitat.

Vegetation Height in Foraging Areas

Loggerhead shrikes are almost exclusively "sit-and-wait" predators that scan the surrounding ground and air from a variety of perches. Most prey items are caught on the ground. Studies of

foraging habitat in agricultural landscapes have demonstrated that shrike productivity, net energy gains, and ability to detect prey are often greater in areas associated with short grass (DeGeus 1990, Gawlik and Bildstein 1993). Luukkonen (1987) cited numerous studies that demonstrated that short, sparse vegetation provided quality foraging habitat for a variety of predatory birds. Shrikes are frequently associated with active pastures, where short grass is presumed to increase hunting efficiency (Kridelbaugh 1982, Luukkonen 1987, Novak 1989, Smith and Kruse 1992). Yosef and Grubb (1993) evaluated the effect of vegetation height on hunting behavior and diet of loggerhead shrikes by observing shrikes foraging in territories before and after mowing (on a cattle ranch in southcentral Florida). They found no difference in the rate of prey capture, that is, tall grass did not appear to limit the rate of capture. However, shrikes in taller grass almost doubled the amount of time spent in flight (hovering, aerial chases, frequent perch changes). Shrikes were apparently able to adjust to changes in vegetation height by altering their hunting behavior. However, net energy gain from foraging in high vegetation may have been lower, compared to mowed foraging habitat.

Blumton (1989) found that reproductive success was significantly higher in nest territories that included bare soil areas. She hypothesized that habitats with numerous bare soil areas may provide increased accessibility and visibility of prey items. Gawlik and Bildstein (1990) studied reproductive success and nesting habitat of loggerhead shrike in northcentral South Carolina. They found that the area within 10 m of a nest was generally short vegetation, which they suggested increased hunting efficiency. They noted that adult shrikes provided approximately 165 food items per day to their nests, and that maximizing hunting efficiency during the period when adults were feeding young was especially important.

In natural grassland habitats, shrikes have not been documented to exhibit a preference for short grass areas. Prescott and Collister (1993) found nest sites had higher coverage of tall grass and greater percent bare ground in natural grasslands in Alberta. They noted that shrikes almost invariably avoided habitats that contained shorter grass. [However, Johnson et al. (1998) noted that Prescott and Collister's study area had naturally short vegetation; the term "tall grass" is relative]. They suspected that, while short grass may enhance prey capture, such areas may harbor low densities of invertebrate prey. Many areas of short grass in their study area were the result of heavy grazing, and it appeared that birds foraged most frequently in areas where grass was relatively undisturbed. In Kansas, Michaels (1997) observed that loggerhead shrikes frequently used areas of prairie grasses and forbs for foraging and perching. She noted that the structure of herbaceous vegetation in areas of extensive agriculture and grazing is relatively simple and homogenous. Shrike habitat in natural grasslands may exhibit greater structural heterogeneity, and shrikes may reveal different or more complex habitat selection patterns. Chavez-Ramirez et al. (1994) also noted greater structural heterogeneity of natural grassland habitats used by wintering shrikes in Texas, compared to agricultural habitats, and concomitant differences in foraging and perching behavior.

Perches

Miller (1931) noted that high quality foraging habitat must provide a shrike with the opportunity to forage while at the same time observing and defending its territory. Shrikes hunt almost

exclusively from perches, which effectively limits the foraging area that can be used by shrikes to concentric circles centered around perches in its territory. The radius of the circle is a function of perch height, vegetation height, and vegetation density (Yosef and Grubb 1994). When not hunting from low perches, a shrike will typically mount a high exposed perch within its territory, where it cannot only observe its territory (for predators and other shrikes) but also advertise its possession of that territory.

A wide variety of perches, both man-made (e.g. powerlines, utility poles, fence posts) and natural, are used by loggerhead shrikes. Perch availability might influence habitat selection by shrikes depending on the density and distribution of perches. In Iowa, DeGeus (1990) found that shrikes were largely confined to roadside habitats and, because all occupied habitat included fences and powerlines, perch availability was not a limiting factor. In contrast, Yosef and Grubb (1994) found that availability of perches was a limiting factor in their Florida study area. Bohall-Wood (1987) noted that man-made perches were used significantly more often than natural perches in Florida; 62% of all shrikes observed in her study area were perched on powerlines, and an additional 20% were perched on other man-made perches. However, she also noted that natural perches frequently were not available in the large open pastures on her study area. In Texas, 98% of all perched shrikes observed were on powerlines (Bildstein and Grubb 1980). In shrub-steppe habitats of southcentral Washington, loggerhead shrikes preferred bitterbrush and dead sagebrush for perching (Poole 1992).

Yosef (1996) noted that low perches (less than 5.5 m tall) were generally preferred by shrikes, at least in Florida. He suggested that low perches allowed shrikes to see more prey and a wider size range of prey compared to high perches, or that it may not be as energetically efficient to attack small prey from higher perches. Lefranc (1997) reported that shrikes generally perch 2-10 m from the ground when foraging, depending on the structure of the habitat. Bartgis (1992) also noted that shrikes generally perch close to the ground when actively hunting. In several studies, shrikes were observed most often on high perches (Bildstein and Grubb 1980, Bohall-Wood 1987), possibly reflecting that shrikes do not spend most of their time actively hunting. However, it should also be noted that these were roadside surveys and may have been biased in that the likelihood of detecting a shrike on a high perch was probably greater.

Research in Florida has demonstrated that nutritional condition, territory size, and productivity of shrikes is directly related to the density of hunting perches. Yosef and Grubb (1992) used ptilochronology to demonstrate that nutritional condition of loggerhead shrikes resident in southcentral Florida was related to density of hunting perches. As the density of perches declined, loggerhead shrike territory size increased and nutritional condition declined. They further demonstrated that the density of perches ultimately affects productivity of shrikes (Yosef and Grubb 1994). They supplemented hunting perches in loggerhead shrike territories on a cattle ranch in southcentral Florida, and compared supplemented territories to control territories with no supplemental perches. No difference existed between territory size of control and manipulated groups prior to the experiment. However, after the introduction of additional perches, 11 manipulated territories decreased significantly in size, from an average of 10.1 ha prior to manipulation to 2.3 ha after addition of supplemental perches. Shrikes in territories with supplemented perches constricted their territories an average of 76.6%. Significantly more young

were fledged in manipulated territories. Six new territorial pairs of shrikes settled in areas along fencelines that were vacated by shrikes in perch-supplemented territories. The results supported the previous finding that reduced territory size and associated increase in nutritional condition of adults (Yosef and Grubb 1992) leads to increased reproductive success.

In natural grasslands, availability of perches may not be a limiting factor for shrikes. Chavez-Ramirez et al. (1994) studied wintering loggerhead shrikes in Texas and found that elevated perches were not required by shrikes because of greater structural heterogeneity of a natural grassland. Shrike winter use of natural grasslands did not decline in areas where fence posts were removed, compared to control areas where fence posts were left. Shrikes perched frequently on lower nonwoody vegetation. Also, shrikes did not utilize mowed patches more than unmowed patches. Chavez-Ramirez et al. (1994) suggested that reduced density of perches in agricultural habitats diminished the amount of available foraging habitat because shrikes restricted their use of foraging substrate to within 10 m of elevated perches (as noted by Yosef and Grubb 1992). Thus, much potential foraging substrate is unusable in areas where perch density is low. In contrast, natural grasslands have relatively small habitat patches that occur at the scale of several meters with nonwoody perches distributed throughout. Chavez-Ramirez et al. (1994) concluded that while providing supplemental perches may increase shrike populations in agricultural ecosystems, such alterations may not be appropriate in less disturbed, more natural settings.

Food Habits

Studies on loggerhead shrike food habits have demonstrated that the species is opportunistic, primarily insectivorous, and is able to exploit a wide array of animal foods. Seasonal, annual, and geographic variations in the species' diet have been noted. Miller (1931) provided a discussion of variations in food habits both seasonally and across the range of the species.

Craig (1978) analyzed the predatory behavior, particularly seasonal variation in behavior, of the loggerhead shrike. He concluded that shrikes use an effective and conservative search method to gain their energetic requirements. From their perches they can survey their territory for predators and conspecifics, display for conspecifics to advertise an occupied territory, and hunt. He found that prey whose size was in the upper range of the shrike's capacity to capture (e.g. mice) were not a major component of the diet; he noted that the loggerhead shrike territory would have to be much larger to utilize these large items exclusively, because such animals tend to be more widely dispersed.

Typically, insects make up the bulk of the diet of the loggerhead shrike, particularly during the breeding season. Vertebrates are taken more frequently in winter, when insect availability is low. Graber et al. (1973) examined the stomachs of 62 adult and 9 juvenile shrikes collected in southern Illinois. Dominant food items (based on percent of items found in the stomach) year-round were insects belonging to the orders Coleoptera, Lepidoptera (caterpillars only), and Orthoptera. Vertebrates accounted for 5-6% of the items found in fall, winter, and spring, but were not found in summer samples. Kridelbaugh (1982 in Missouri) studied food habits based on analysis of regurgitated pellets and Burton and Whitehead (1990 in Indiana) based on items impaled in larders. Both of these studies also documented that beetles (Coleoptera) and

grasshoppers (Orthoptera) dominated the diet of loggerhead shrikes. In both studies, vertebrates were taken infrequently compared to insects; small mammals were taken more frequently than birds or reptiles. Bailey (1928) reported that grasshoppers accounted for 89% of the loggerhead shrike diet (summer/fall) in New Mexico, although the method of study was not reported. Based on examination of 88 loggerhead shrike stomachs, Howell (1928) found that grasshoppers and crickets make up most of the summer diet in Alabama; these prey items were found in 75% of stomachs examined, and were the only prey items found in 14 of the 88 stomachs. He found that mice were taken year-round, and in winter composed half the food taken. All references in this paragraph provide more detailed information on food habits.

Scott and Morrison (1995) studied food habits, based on regurgitated pellets, of the San Clemente Island loggerhead shrike, *L.l. mearnsi*. They also stressed the opportunistic nature of foraging in the loggerhead shrike, but found that on their study area vertebrates were taken more frequently compared to other studies. Of all food items identified, 10% were reptiles and 3% were mammals. From the standpoint of biomass, 53% of the diet was reptiles and 18% mammals. They cautioned that studies based on the frequency with which various prey species are taken by loggerhead shrikes provide an inaccurate estimate of the energetic importance of the individual prey items.

Shrikes kill small vertebrates by striking them with the bill at the back of the head. The tomial teeth (toothlike projections on each side of the cutting edge of the upper half of the bill) are used to disarticulate cervical vertebrae (Lefranc 1997). The feet of shrikes have no function as weapons, but may be used to hold relatively small prey items against a perch to pull them apart. Larger items, including small vertebrates, are transported to an impaling station where they are either impaled or wedged. Yosef (1993) discussed transport of prey items of varying size. Small prey (19-58% of shrike body weight) are transported in the beak, intermediate prey (50-92% of body weight) are carried in the beak during take-off but are transferred to the feet during flight, and heavy prey (61-131% of body weight) are transported in the feet. As reported above, most studies have found that mammals and reptiles are the most frequent vertebrate prey items, with birds taken less frequently. A bird banding station in Oklahoma maintained records of birds killed by loggerhead shrikes in banding traps (between October and March) over an 18-year period (Baumgartner and Baumgartner 1992). Of 27 songbirds killed by shrikes, only 4 were adults.

Reynolds (1979) evaluated the impact of loggerhead shrikes on nesting birds in two 4-ha study areas in sagebrush habitat in Idaho; each study area was studied for 2 years, and in the second year each had 1 shrike nest. He found that both nesting success and nesting density for other passerines were lower in his study areas in the year when shrikes nested in the areas. He suggested that shrikes may affect local populations of passerines within their territories directly, through predation, and indirectly, by making an area less attractive to other passerines seeking to establish territories.

WINTER ECOLOGY

The winter ecology of the loggerhead shrike is poorly understood. Loggerhead shrikes which breed in the northern half of the species' range are largely migratory, while southern shrikes are

year-round residents. Neither migrant nor resident shrikes have been thoroughly studied in winter. In the case of migrant populations, even the wintering locations are not well documented.

Miller (1931) observed that individuals of resident populations of western shrikes maintained solitary feeding territories during winter. Blumton (1989) also observed territorial defense in resident wintering shrikes in Virginia. Yosef (1996) suggested that resident pairs may maintain joint territories during winter in some portions of the range, but that pairs may be more likely to maintain separate territories in winter if food availability is limited.

Habitats occupied by loggerhead shrikes in winter are similar, at least in structure, to habitats occupied during the breeding season. Resident populations that occupy the same range year-round may expand their range in winter in response to changes in prey availability and detectability, and to exploit better cover. Blumton (1989) found that resident shrikes in Virginia expanded their winter ranges to include shrub/forest habitats during severe weather. In South Carolina, Gawlik and Bildstein (1990) found that most shrikes (probably residents) observed during roadside surveys were observed on utility wires throughout the year, but that shrikes increased their use of trees and shrubs for perching during winter. They noted increased use of cropland (which had been harvested) by shrikes in fall, which they attributed to a seasonal shift in food availability. In Florida, Bohall-Wood (1987) observed no difference in the use of 5 different habitat types by resident shrikes between winter and summer. In contrast, some shrikes migrate long distances and occupy different vegetation communities on winter range compared to summer, although in both seasons they occupy landscapes dominated by open grass with scattered trees and/or shrubs. For example, shrikes that breed in the northwestern U.S. in shrub-steppe habitats (*L.l. gambeli*) are thought to winter as far south as central Mexico (Miller 1931).

It has been suggested that migrant shrikes, particularly of the subspecies *L.l. migrans*, experience low over-winter survival. Brooks and Temple (1990a) suggested that shrikes that breed in Minnesota experience low over-winter survival because suitable grassland habitats in the winter range have been lost and remaining habitats are degraded. They speculate that resident populations within the winter range of migrants occupy the best remaining habitat and force migrants into marginal habitat. While there is no conclusive evidence to support this theory, it merits study. Investigation of the winter ecology of migrant populations is widely recognized as a research need.

Blumton (1989) studied winter ecology, and specifically winter mortality, in a resident population of loggerhead shrikes in Virginia. She found that wintering shrikes expanded their home ranges in winter; winter home range size averaged 52 ha compared to 18 ha average fall home range size. Movements into shrub/forest habitats during inclement weather accounted for the increase in winter home range size. She suggested that shrub/forest habitats provided shelter and food during inclement weather. Other passerines also moved into shrub-forest habitats for cover, and shrikes were observed preying on passerines in these habitats. However, raptors also moved into these habitats during severe weather and raptor predation accounted for 57% of shrike mortality during winter. Vehicle collisions accounted for an additional 29% of mortality, and 14% of radio-harnessed shrikes died of unknown causes. Only 3% of radio-harnessed shrikes survived the winter. In contrast, estimated minimum winter survival based on return rates of banded shrikes to

breeding territories between years was 50%. Blumton concluded that winter survival estimates based on radio-harnessed birds were biased and that transmitters likely affected predation rates. Nonetheless, it appears likely that winter survival is low compared to survival during other seasons, and that shrikes may be particularly vulnerable to raptor predation during inclement winter weather, at least in a portion of the species' range.

POPULATION STATUS AND TRENDS

Once widespread and common, the loggerhead shrike has experienced continentwide population declines. Palmer (1898 cited *in* Fraser and Luukkonen 1986) wrote that the loggerhead shrike "is considered a fairly common bird over most of the region between Maine and Florida and Ohio and Illinois to Louisiana." Bent (1950) cited accounts from the early 1900s which described loggerhead shrikes as one of the most common breeding species in the southeastern U.S., and it was widely cited as a common species in other portions of its range as well (Miller 1931). As early as 1910, ornithologists in Illinois began to express concerns regarding the effects of the loss of hedgerows and other suitable agricultural habitat on shrikes (Graber et al. 1973) and by the 1930s concern was widespread (Miller 1931, Fruth 1988). With the initiation of the North American Breeding Bird Survey (BBS) in 1966, it became possible to begin to assess the magnitude of decline in loggerhead shrike populations. The loggerhead shrike was included on the National Audubon Society's "Blue List" of birds thought to be declining from the time the list first came into existence in 1972 until it was last published in 1986 (Tate 1986). Arbib (1977) edited the 1978 Blue List and considered the shrike to be the most critically declining species on the list. He stated that the species had declined slowly and steadily for many years, dropping from common to uncommon over much of its range.

The loggerhead shrike is just one of many species of shrikes that are declining. Of the 30 species of shrikes in the Family Laniidae, there are concurrent declines in many species around the world. Temple (1995) suggested that these declines may indicate that many species may be responding to similar problems generated by human activities. Yosef (1994b) evaluated the global decline in the true shrikes and noted that regional extirpations of some species have already occurred. He also discussed potential causes of decline.

NORTH AMERICAN BREEDING BIRD SURVEY

The loggerhead shrike is a wide-ranging species, and no one has attempted historic or current estimates of the size of the rangewide population. However, BBS, which is designed to estimate population trends in North American breeding birds, does provide us with indices to abundance and trends in the population. Robbins et al. (1986) and Peterjohn (1994) provided details on BBS methodology, which will not be repeated here. BBS data (Sauer et al. 1997; Sauer et al. 1999) serve as the basis for most of the discussion on population trends presented here. The loggerhead shrike is one of the most persistently declining species surveyed by BBS; the species declined at an average rate of 3.7% per year surveywide (U.S. and Canada) during the period 1966-1998. Declines were estimated at 3.6% and 10.8% annually in the U.S. and Canada, respectively. The rate of decline has lessened in recent years; the surveywide rate of decline for the period 1966-1979 was 4.1% annually, compared to a 2.0% decline for the period 1980-1998. This decrease

may represent some lessening in the intensity of factors responsible for the decline in shrikes (Cade and Woods 1997), or may simply be an artifact of biases associated with sampling a declining population. Large-scale shrike declines likely began before 1966; therefore population trends estimated by BBS are probably conservative figures for overall declines during the past century (The Nature Conservancy 1992).

Not only is the magnitude of decline cause for concern, but also the fact that declines were prevalent across most states, provinces, and physiographic strata. BBS trends are listed by state in Table 3. Note that BBS state trends are only reported for states where shrikes were observed on a minimum of 14 routes (considered a minimum for statistical validity). Of the 48 states in the continental U.S., 30 have adequate data to estimate trends on BBS routes. (Of the remaining 18 states, 7 have no BBS records for loggerhead shrikes and 11 have inadequate data for estimating trends). During the period 1966-1998, 27 of the 30 states for which trends were estimated showed negative population trends, 19 of which were statistically significant. Only 2 of the 30 states (Colorado and Utah) showed positive trends, neither of which were significant. In Canada, the only provinces with adequate data to estimate population trends were Alberta and Saskatchewan, where shrikes declined 3.4% and 9.8% annually, respectively, during the period 1966-1998. Peterjohn and Sauer (1995) summarized BBS data from 1966-1993 for physiographic strata and BBS regions: Eastern, Central, and Western (see Robbins et al. 1986 for a description of BBS regions). Most strata had declining populations. Only one physiographic strata, the Edwards Plateau of Texas, supported a significantly increasing breeding population of loggerhead shrikes. All 3 BBS regions had significantly declining populations ($P<0.01$). The loggerhead shrike is one of the few species to exhibit significant declines in BBS trends in all regions (Robbins et al. 1986).

The reliability of BBS data varies among species, partially because BBS routes are run along roads. Generally, because loggerhead shrikes are conspicuous and frequently occupy roadside habitats, the species is probably adequately sampled by BBS (Peterjohn and Sauer 1995). While it is recognized that inherent biases are associated with BBS data, it is generally accepted that BBS data accurately reflect that there have been large-scale widespread declines in loggerhead shrike populations over the course of the surveys. BBS survey results were correlated with the results of a more intensive roadside survey in Illinois (Smith 1990). Yosef et al. (1993) analyzed trends in numbers of loggerhead shrikes in southcentral Florida based on roadside counts conducted along 505 km of roads from 1974 to 1992. They documented rates of decline that exceeded estimates of decline for southcentral Florida based on BBS data.

Sauer et al. (1995) evaluated geographic patterns in relative abundance of loggerhead shrikes based on BBS data. They noted difficulty in interpreting higher abundance categories, but noted that several physiographic strata consistently supported higher relative abundance of shrikes, including the Osage-Plain-Cross Timbers; Rolling Red Prairies; East Texas Prairies; Rolling Red Plains in the central U.S.; the Upper Coastal Plain in Georgia, Alabama, and South Carolina; the Coastal Prairies; and the Floridian and Subtropical Regions in Florida (see Sauer et al. 1995 for a map of physiographic strata). Cade and Woods (1997) noted that these strata, which support relatively higher abundance of shrikes, are associated with open scrub and grassland formations. BBS trend data for these strata for the period 1966-1998 demonstrate that, although these strata

have relatively high abundance of shrikes, the populations are declining. In all but 2 of the strata listed, shrike populations declined significantly. The exceptions were the Coastal Prairies, where the decline was not significant, and the Subtropical region of Florida, for which data were inadequate to estimate population trends.

NATIONAL AUDUBON SOCIETY CHRISTMAS BIRD COUNTS

The National Audubon Society Christmas Bird Count (CBC), first conducted in 1900, is a source of information on populations of birds wintering in North America. CBC data represent the only population trend data available for loggerhead shrikes on winter range. However, CBCs were not designed to be a statistical sample of North American birds or their trends. Locations of counts are biased by the preferences of bird watchers. Sauer et al. (1996) discussed potential biases associated with CBC data as well as analytical considerations and urged caution in the interpretation of CBC trends. Refer also to Butcher (1990) and Butcher and McCulloch (1990) for details on sampling methodologies and biases associated with CBCs.

CBC trends for loggerhead shrikes reveal that wintering populations of the species, like breeding populations, are declining. During the period 1959-1988, the loggerhead shrike declined at a rate of 1.7% annually ($P<0.01$) surveywide. Of 31 states with CBC trend data (Sauer et al. 1996), 27 states show negative trends, of which 16 are statistically significant (Table 3). Four states show non-significant increases. Seventeen states in the continental U.S. had no CBC records or inadequate records to estimate CBC trends. The states with the highest relative abundance of wintering loggerhead shrikes on CBCs were Texas, followed by Louisiana, Florida, Mississippi, and Oklahoma. With the exception of Louisiana, all of these states experienced significant population declines during the period 1959-1988.

Butcher and Lowe (1990) analyzed CBC data for the 20 Migratory Nongame Birds of Management Concern (as designated in USFWS 1987) that winter in the U.S. Based on this evaluation, 7 species, including the loggerhead shrike, had relatively large population declines demonstrated by CBC data. CBC data for the 25-year period (1962-1963 through 1986-1987) were analyzed. The winter range of the loggerhead shrike, as depicted by CBC data, did not change over the 25-year period (Lowe and Butcher 1990). However, 14 states showed statistically significant population declines and an additional 12 showed non-significant declines. Decreases were documented across the country, but were most severe in the East, especially North Carolina, Maryland, Virginia, and South Carolina (Lowe and Butcher 1990). Butcher (1989) noted: "The Loggerhead Shrike is an enigma. It is the most widespread of the seven troubled species, and it seems to be declining throughout its range. The reason is uncertain..." While the other 6 species appeared to be habitat limited, the decline in loggerhead shrike populations seemed "steeper than can be accounted for by habitat loss alone" (Butcher and Lowe 1990).

STATUS OF LOGGERHEAD SHRIKE SUBSPECIES

The only subspecies of the loggerhead shrike for which status has been thoroughly assessed is the San Clemente loggerhead shrike (*L.l. mearnsi*). The San Clemente loggerhead shrike, which

occurs only on San Clemente Island, California, was listed as Federally endangered in 1977 (42 FR 40685; August 11, 1977), at which time the population was estimated at approximately 30 individuals (USFWS 1984). Predation by native and feral predators and habitat degradation were identified as major threats to the species. Morrison et al. (1995) outlined the design of the recovery program. In spite of intensive management efforts, the status of this subspecies remains precarious. Winegrad (1998) summarized status in March of 1998: "At best, only 18 wild Shrikes remain and there are 13 birds in the captive breeding program on San Clemente Island."

Peterjohn and Sauer (1995) evaluated population trends for the loggerhead shrike in 3 geographic regions that corresponded with subspecies (as defined by the AOU 1957) or subspecies groups: 1) *L.l. migrans* - breeding subspecies in the northeastern and northcentral U.S., 2) *L.l. ludovicianus* - resident subspecies in the southeastern U.S., and 3) 7 western subspecies, which occur from the central Great Plains, westward. They demonstrated that, among these 3 subspecies groups, population declines have been greatest in the range of *L.l. migrans*. During the period 1966-1993, *L.l. migrans, L.l. ludovicianus*, and western subspecies declined at rates of 5.7%, 2.6%, and 2.4% annually, respectively.

The loggerhead shrike has been largely eliminated as a breeding species from the northeastern U.S. (defined here as the states in USFWS Service Region 5; see Table 3). The Northeast Endangered Species and Wildlife Diversity Technical Committee (1997) listed the loggerhead shrike as a species of regional conservation concern due to declining populations that have put the species at high risk for disappearing from the Northeast. They further identified the loggerhead shrike as a species "warranting federal attention by the U.S. Fish and Wildlife Service for possible endangered species listing." The largest remaining population in the Northeast is in Virginia, where a 1996 status survey documented 12 pairs of shrikes (see Virginia account in Appendix I). Virginia is the southern edge of the range of the subspecies *L.l. migrans*, and breeding birds in that state may represent *L.l. ludovicianus*. Luukkonen (1987) demonstrated that in southeastern coastal states (Virginia, North Carolina, South Carolina, Georgia, and Florida) rates of decline in populations of breeding shrikes were higher at more northerly latitudes, specifically Virginia and North Carolina. This finding suggested that the decline of *L.l. migrans* in the Northeast was potentially proceeding southward into the range of *L.l. ludovicianus*.

Milburn (1981) commented on the migratory and wintering status of the loggerhead shrike in the Northeast. She noted that in the mid-1900s, so many loggerhead shrikes passed through northeastern states in the fall that reports often did not include numbers of birds seen. By the 1960s a decline was noticeable, and the 1970s brought a drastic reduction in migrant shrikes. In 1979, no shrikes were reported in New England's Bird Observer, which reported current bird records. The decline in migrants corresponded with a decline in the breeding population in the Northeast. The loggerhead shrike was never considered a wintering species in Maine, New Hampshire, or Vermont, and was considered a rare winter visitor in Massachusetts and Rhode Island. However, farther south, in Delaware, Maryland, West Virginia, and Virginia, the loggerhead shrike was once considered a regular winter resident, but these states experienced dramatic declines in numbers of wintering shrikes after 1970.

The purported breeding range of *L.l. migrans* extends from the northeastern U.S. as far west as

eastern edge Nebraska, eastern Kansas and eastern Oklahoma, and as far south as northeastern Texas and northwestern Louisiana (Figure 1). Compared to the northeastern portions of the range, the status of this subspecies improves somewhat in the southern and western portions of its breeding range (although densities are still relatively low and declines have been documented throughout the range). Without exception, the states that still support breeding populations of *L.l. migrans* are also states where loggerhead shrikes are known to overwinter in at least portions of the state (including southern Indiana, southern Illinois, Kentucky, Tennessee, northern Alabama, Arkansas, Missouri, eastern Oklahoma, eastern Kansas, and southern Iowa). However, it is not known if the shrikes which breed in these states are the same birds that overwinter there, or if the wintering birds are migrants from farther north. It appears that the subspecies *L.l. migrans* may no longer breed with regularity in those portions of its range where it was migratory. The only known migratory population of the *L.l. migrans* is the small population (less than 50 pairs) that breeds in southern Ontario. Other than the Ontario birds, records of breeding individuals in the states where shrikes are not known to overwinter are scattered and unpredictable.

Based on BBS data and information provided by the states (see state summaries in Appendix I), Tennessee, Arkansas, Missouri, eastern Oklahoma, and eastern Kansas may support the largest remaining breeding populations of shrikes of the subspecies *L.l. migrans*, assuming that the range of the subspecies defined by Miller (1931) is accurate.

Other than *L.l. mearnsi* and *L.l. migrans*, the status of individual subspecies of loggerhead shrikes has not been evaluated. The only rangewide information available for the species is BBS data, and biases based on the roadside survey method, regional differences in habitat availability, and sample distribution (Sauer et al. 1995) dictate caution in comparing the status of subspecies based on BBS data. However, BBS data do reflect that relative abundance indices tend to be higher for subspecies in the western portion of the species' range, that is, those subspecies which occur from the central Great Plains, westward. For the period 1966-1998, there are 7 BBS physiographic strata with a relative abundance index of 4.0 or greater; 6 of the 7 are within the ranges of western subspecies and one is in the range of *L.l. ludovicianus*. The 7 strata, in order of relative abundance, (and the subspecies present in that strata) are: 1) Coastal Prairie on the Gulf Coast of Texas and Louisiana (*L.l. excubitorides* potentially intergrading with *L.l. ludovicianus*); 2) Floridian in central Florida (*L.l. ludovicianus*); 3) Central Valley of California (*L.l. gambeli*); 4) Osage Plain - Cross Timbers in central Texas, Oklahoma, and Kansas (*L.l. excubitorides*, potentially intergrading with *L.l. migrans*); 5) Chihuahuan Desert in west Texas, New Mexico, and Arizona (*L.l. sonoriensis*); 6) Mohave Desert in southern California and Nevada (*L.l. nevadensis*); and 7) Rolling Red Prairies in central Texas, Oklahoma, and Kansas (*L.l. excubitorides*).

Poole (1992) and Woods (1995a) documented high densities of breeding loggerhead shrikes (*L.l. gambeli*) in relatively undisturbed shrub-steppe habitats of eastern Washington and Idaho, respectively; these habitats are considered a stronghold for the species. These concentrations are apparently not detectable at the scale of BBS physiographic strata.

LEGAL STATUS IN THE U.S., CANADA, AND MEXICO

The only Federally-listed subspecies of loggerhead shrike in the U.S. is the San Clemente loggerhead shrike (*L.l. mearnsi*), which was listed as endangered in 1977 (42 FR 40685; August 11, 1977). A Recovery Plan has been developed for this subspecies (USFWS 1984) and implementation has been initiated, but the number of birds in the wild has decreased since listing.

The USFWS also recognizes that rangewide declines in shrike populations signal conservation concern for other subspecies as well. In 1987, the USFWS identified the loggerhead shrike as 1 of 30 Migratory Nongame Birds of Management Concern in the United States (USFWS 1987). Loggerhead shrike was also included when the list was revised in 1995 (USFWS 1995). Widespread population decline was cited as the cause for concern. The loggerhead shrike subspecies *L.l. migrans* was added to the Category 2 candidate list for review for possible addition to the Federal endangered or threatened species list in 1982 (47 FR 58454-58460; December 30, 1982). This was the first Candidate Notice of Review that included animal taxa. *L.l. migrans* remained on the list until use of the Category 2 list was discontinued in 1996 (61 FR 7596-7613; February 28, 1996).

The loggerhead shrike is listed as State endangered, threatened, or a species of special concern in at least 26 states (Table 3). In 14 of those states, all within the range of the subspecies *L.l. migrans*, the species is State listed as threatened or endangered. (Note, the loggerhead shrike is listed as State threatened in Virginia, where both *L.l. migrans* and *L.l. ludovicianus* are thought to occur). A summary of the status of the loggerhead shrike in each of the 48 states in the continental U.S. and in Canada is presented in Appendix I.

The loggerhead shrike is listed by the COSEWIC as a threatened species in western Canada and an endangered species in eastern Canada. In 1986, the species was designated as threatened across Canada. The eastern population was reevaluated in 1991 and uplisted to endangered (Cadman 1985), reflecting the more precarious status of the species in eastern Canada. The loggerhead shrike is also on provincial endangered species lists in Ontario, Manitoba, and Saskatchewan (Brian Johns, Canadian Wildlife Service, pers. comm.) and is expected to be classified as threatened in Quebec (Michel Robert, Canadian Wildlife Service, pers. comm.).

The loggerhead shrike is not listed in Mexico (Commission for Environmental Cooperation 2000). We were unable to gather any additional information on the status of the species in Mexico.

THREATS

BBS, CBC, and other survey data clearly document a declining trend in loggerhead shrike populations, but survey data do not provide insight into the underlying cause-effect relationships which produce this trend. The following discussion summarizes our current understanding of the potential causes of declines in loggerhead shrike populations.

In accordance with the Endangered Species Act of 1973, 5 factors are used to determine whether a species is endangered or threatened:

(A) the present or threatened destruction, modification, or curtailment of its habitat or range;
(B) overutilization for commercial, recreational, scientific, or educational purposes;
(C) disease or predation;
(D) the inadequacy of existing regulatory mechanisms;
(E) other natural or manmade factors affecting its continued existence.

Based on literature available on the species and input provided by the states, known threats to the loggerhead shrike will be summarized according to these listing factors.

PRESENT OR THREATENED HABITAT LOSS

There is widespread documentation that grassland birds as a group have suffered widespread habitat loss. Samson and Knopf (1994) noted that "grassland bird species have shown more consistent and steeper, geographically widespread declines" than any other group of North American wildlife species. These widespread declines of many grassland bird species provide strong empirical evidence that loss and deteriorating quality of grassland habitats are underlying causes for population declines. The loggerhead shrike is no exception.

Breeding Habitat

There is general agreement among most species experts that loss and degradation of suitable habitat are the major underlying causes of declines in loggerhead shrike populations (see discussion in Cade and Woods 1997). Of the 48 states in the continental U.S., 34 states indicated that habitat loss had contributed to declines in loggerhead shrike populations in their state; only 2 states indicated that habitat loss was not a factor (Table 4). (Eleven states did not provide information on whether or not habitat loss was a factor or it was unknown, and the question was considered not applicable in one state).

Throughout the range of the loggerhead shrike, there is information to suggest that on a large scale, population trends have mirrored trends in availability of suitable habitat. How we view current habitat conditions for shrikes relative to historic conditions depends on the time scale we choose for comparison. Maps produced by Cade and Woods (1997) suggest that the loggerhead shrike currently occupies a range that is similar, potentially somewhat broader, than the estimated range prior to European settlement. (Note that these maps did not include the northeastern U.S. as part of the presettlement range. See discussion in the **CHANGES IN DISTRIBUTION** section for a contrasting view). However, the species' range is currently much smaller than the maximum historic range, which occurred during the last 2 decades of the 1800s (Cade and Woods 1997). On a broad scale, these range expansions and contractions were the result of changes in the distribution of suitable habitat for the species.

In those areas where the shrike is primarily associated with pastureland and hayfields, several trends have contributed to habitat loss for the species, including: loss of agricultural habitats to urbanization or development; conversion of pasturelands and hayfields to rowcrop production; "clean" farming practices that result in the loss of hedgerows and isolated trees; and abandonment of farmland and subsequent reversion to forest. Researchers have documented that declines in

loggerhead shrike populations generally have been coincident with declines in suitable agricultural habitat in many portions of the species' range:
1) Bollinger and Gavin (1992) estimated that area in hay in the eastern U.S. has declined 45% since the early 1900s and much less land is used for permanent pasture.
2) New York State was 74% farmland in 1900 compared to 30% farmland in 1982. Land in pasture, the primary habitat for shrikes in the state, declined 69% between 1930 and 1982 (Novak 1989).
3) From 1950-1980, the amount of farmland in Indiana decreased by 13%; this included a 53% loss of open pastureland. During the same period, average farm size increased by 64% (Burton and Whitehead 1990).
4) Kridelbaugh (1981) noted that areas of Missouri where pastures and hayfields were abundant supported the highest relative abundance of loggerhead shrikes. Regions where a high proportion of pastureland and hayfields had been converted to rowcrops experienced steeper declines in shrike numbers.
5) In Illinois, Herkert (1994) estimated that area in hay declined over 50% between 1960 and 1989, and area in pasture declined more than 75% since 1906.
6) Smith (1990) suggested that intensive rowcropping in the northern two-thirds of Illinois decreased habitat suitability for shrikes to the point that the species was largely eliminated as a breeding species. In the southern third of the state there was also a trend toward increased rowcropping, but enough pastureland and hayfields remained to support a viable shrike population.
7) Gawlik and Bildstein (1993) noted that indices of shrike abundance were correlated with percent of pastureland nationwide, and particularly in the southeastern coastal states.
8) Burnside and Shepherd (1985) noted that declines in loggerhead shrike populations in Arkansas were coincident with several agricultural trends including decreasing number but increasing size of farms, more intensive management of farms, and clearing of hedgerows.
9) Cadman (1991) noted that loggerhead shrike declines in eastern Canada were coincident with loss of pasture. Between 1921-1986, there was a 65% decline in pasture in Ontario, and between 1941-1990, there was an 85% decline in pasture in Quebec.
10) Telfer (1992) evaluated habitat change as a factor in the decline of the loggerhead shrike in western Canada (Alberta and Saskatchewan). He found that regions of Alberta and Saskatchewan which experienced the most severe declines in shrike numbers had a 39% decline in unimproved pasture between 1946-1986. This compared to a 12% decline in pasture in regions that retain substantial numbers of nesting shrikes (southwest and northwest Saskatchewan and southern Alberta).

Most assessments of impacts of habitat loss have focused on long-term trends in land use. However, J. Herkert (pers. comm.) noted that these impacts are ongoing and can be dramatic even in the short term. In a nest study in Illinois conducted in 1995-1996, he noted that approximately 20-30% of nest sites used in 1995 were destroyed prior to the 1996 breeding season.

While the decline in loggerhead shrikes associated with loss of pastureland and hayfields is well documented, the impacts of loss and degradation of native habitats are less well known. While the nature of these impacts varies, there is no doubt that conversion of native grassland/shrubland

habitats (e.g. prairie, native pine/grassland ecosystems, shrub-steppe, desert scrub, pinyon-juniper woodlands) for agriculture and development has impacted loggerhead shrike populations.

Saab and Rich (1997) conducted a large-scale conservation assessment for neotropical migratory land birds in the interior Columbia River Basin. They noted that 9 of 15 bird species of high management concern, including the loggerhead shrike, used shrub-steppe habitats as their primary nesting habitat. Shrub-steppe habitats experienced the greatest loss of all habitats within the interior basin, and were predicted to continue to decline. Woods (1995a) indicated high rates of loss of shrub-steppe habitat in the Snake River Plain as well, where 65% of the big sagebrush habitat that historically covered the plain had been lost. Large-scale loss of shrub-steppe has resulted primarily from conversion to agriculture, as well as conversion to exotic forbs and annual grasses (Rich 1997). Marshall (1996) noted that in shrub-steppe habitat in southeast Oregon, no decline in shrike populations had been noted over the past 15 years. He attributed apparent stability in shrike populations to relatively low rates of conversion of shrub-steppe to agriculture in southeast Oregon, as compared to many other areas.

Rich (1997) noted that conversion of native shrub-steppe vegetation to exotics is exacerbated by the susceptibility of annuals to increased frequency of wildfire and by improper grazing practices. Invasion of shrub-steppe and pinyon-juniper habitats by exotics was cited as a threat to loggerhead shrikes by species experts in several states including Montana (E. Atkinson, pers. comm.), Idaho (Charles Harris, Idaho Fish and Game Department, pers.comm.), Oregon (Marshall 1996), Utah (Frank Howe, Utah Division of Wildlife Resources, pers. comm.), and Washington (Leu and Manuwal 1996).

While the majority of researchers throughout the range of the loggerhead shrike concur that loss of breeding habitat has been a factor in the decline of shrike populations, there is also widespread evidence that breeding habitat is not the sole factor currently limiting shrike populations. Throughout the eastern portion of the range of the loggerhead shrike, avian ecologists have noted that there is suitable loggerhead shrike habitat that is unoccupied, and they cite this as evidence that factors other than breeding habitat have a role in limiting populations (Novak 1989 and New York State Endangered Species Working Group 1993 in New York; Burton and Whitehead 1990 in Indiana; Robbins 1991 in Wisconsin; Cadman 1991 in Ontario and Quebec; Nicholson 1997 in Tennessee; Rick Reynolds, Virginia Department of Game and Inland Fisheries, pers. comm.; John Cely, South Carolina Department of Natural Resources, pers. comm.). Brooks and Temple (1990a) quantitatively evaluated habitat availability and suitability for loggerhead shrikes in Minnesota and found substantial area of suitable unoccupied shrike breeding habitat. They concluded that breeding habitat was not limiting the shrike population in Minnesota. Availability of suitable unoccupied habitat in western portions of shrike range has been noted (Bill Busby, University of Kansas, pers. comm.; Jerry Horak, Kansas Wildlife and Parks, pers. comm.; Doug Backlund, South Dakota Department of Game, Fish and Parks, pers. comm.; and E. Atkinson, pers. comm. in Montana), but less frequently than in the eastern U.S.

While much apparently suitable habitat for loggerhead shrikes remains unoccupied, Prescott and Collister (1993) cautioned that the suitability of unoccupied sites is not usually quantitatively assessed. They evaluated characteristics of occupied and unoccupied loggerhead shrike territories

in southeastern Alberta and concluded that the population they studied was limited by the availability of high-quality breeding habitat, although the study area contained unoccupied habitat that was "visually suitable." Other researchers have also cautioned that shrikes may have more specific habitat requirements than currently realized, and that apparently suitable habitat may, in fact, not be suitable (Brewer et al. 1991; Johns et al. 1994).

Specifically, the potential that habitat fragmentation may play a role in suitability of habitat for breeding shrikes is frequently noted (Novak 1989; Bartgis 1992; Cade and Woods 1997; E. Atkinson, pers. comm.). Not only has the overall quantity of habitat declined, but also the average patch size of remaining grassland habitats has declined dramatically. The impacts of declining patch size and increasing patch isolation on loggerhead shrike populations are not known. Fragmentation of habitat may exacerbate strains on already declining populations. Loggerhead shrike populations, at least in portions of the species' range, are slow to colonize new nesting habitat if previously-occupied habitat is destroyed. It has been suggested that behavioral mechanisms, such as social facilitation of breeding in shrikes, may be a barrier to colonization of seemingly suitable patches of habitat (E. Atkinson and R. Reynolds, pers. comms.). Johns et al. (1994) also discussed the possibility that shrike populations in some portions of the species' range may have declined below a minimum viable population size.

Wintering Habitat

Winter habitat requirements of the loggerhead shrike do not appear to differ markedly from breeding habitat requirements. In fact, non-migratory populations may occupy the same territory year-round (Miller 1931). Brooks and Temple (1990a) noted that non-migratory populations of shrikes in the southeastern U.S. defend year-round territories in the winter range of migratory populations of shrikes that breed in the upper Midwest. These migrant populations (which belong to the subspecies *L.l. migrans*) have suffered greater rates of population decline than resident populations of shrikes. Brooks and Temple (1990a) concluded that low over-winter survival is the key factor in the steep declines of migratory populations of shrikes which breed in the upper Midwest: "If resident shrike populations are being limited by habitat availability, migrant shrikes wintering in the same area are almost certainly being forced to occupy marginal habitats that are not being held by territorial residents, and this reduces over-winter survival to inadequately low levels." Brooks and Temple's theory has been questioned, in part because of their technique for estimating annual adult survival (see discussion in the **Productivity and Survival** section). Nonetheless, there have been high rates of habitat loss in the winter range of migratory populations, as outlined below. How these losses impact wintering migrants compared to resident populations has not been evaluated.

Large scale loss and degradation of grassland habitats in the winter range of the loggerhead shrike, as well as the breeding range, have been documented. Threats to winter habitats include: conversion of native pine/grassland ecosystems to agriculture and pine plantations; exclusion or reduction of frequency of fire in native grassland habitats; and urbanization, among others. Frost et al. (1986) summarized the status and management of fire-dependent savannas and prairies of the southeast and estimated that less than 10% remains of the area once occupied by these grasslands. Lymn (1991 cited *in* Herkert 1994) demonstrated that suitable habitat for wintering

grassland birds in the Southeast declined substantially between 1950 and 1987 due to conversion to rowcrops and pine plantations. McFarlane (1995) evaluated the status of tallgrass coastal prairies in Louisiana and Texas, important wintering habitat for numerous grassland birds including loggerhead shrikes. He documented a 99.99% loss of tallgrass prairie in Louisiana and 99.6%-99.8% loss in Texas.

Lymn and Temple (1991) evaluated land-use changes in the Gulf Coast region specifically with reference to loggerhead shrike habitat suitability. They noted that between 1964-1987 Louisiana lost 2.1 million acres and Mississippi 2.7 million acres of suitable habitat. Since 1954, suitable habitat in Alabama declined by 1.5 million acres, and 1.2 million acres of suitable habitat were lost in Georgia since 1969. Conversion of land in southeastern coastal prairies of Texas and southwestern Louisiana for rice cultivation began in the early 1940s. Conversion of pastures and old fields to commercial forestry (mostly slash pine monocultures) has been common practice in the South over the past few decades. The Gulf States, with exception of Texas, are planting most Conservation Reserve Program (CRP) land to trees. All of these land-use trends have a negative impact on shrike habitat.

Lymn and Temple (1991) also suggested that the introduction of red fire ants (*Solenipis invicta*) in the 1930s potentially was a factor which lowered habitat suitability for loggerhead shrikes in Gulf Coast states. They suggested that fire ants had the potential to negatively impact shrikes in several ways, including: direct mortality of young shrikes killed by fire ants; reduced abundance and diversity of potential shrike prey; and insecticides used to control ants may reduce prey base and poison shrikes directly. However, results of research conducted by Yosef and Lohrer (1995) did not substantiate claims that grasslands in the Gulf Coast region are of reduced value to wintering bird species because of fire ant infestation. They concluded that the relationship between bird populations and fire ants should be reevaluated.

Even though migratory pathways are not well known and habitat use during migration has not been studied, it is reasonable to assume that suitable habitat for migrating shrikes has declined, as grassland habitats have declined. Migratory populations of shrikes would be disproportionately affected by the loss of habitat along migration routes, compared to resident populations that occupy the same habitat year-round.

Future Habitat Conditions for Loggerhead Shrikes

The future of grassland habitats is uncertain. In those portions of its range where the shrike is primarily associated with agricultural habitats, which is true of almost the entire range of *L.l. migrans* as well as portions of the range of other subspecies, it is unlikely that there will be any large-scale reversal of trends that have led to current habitat conditions. This includes those portions of loggerhead shrike range, the Northeast and upper Midwest, where the shrike has largely been eliminated as a breeding species. The loss of pastureland and hayfields, along with the removal of hedgerows and isolated trees in agricultural areas, are considered the key factors in the decline of shrikes in these areas. These losses are likely to be permanent. Certainly, there will be no return to habitat conditions that existing when shrikes reached their maximum distribution in the late 1800s. The extent to which we can influence habitat enhancement on agricultural lands

will largely dictate the future of loggerhead shrike habitat in agricultural regions.

In portions of their range shrikes occupy more permanent vegetative communities compared to agricultural grasslands. These include deserts, shrub-steppe, and southern savannas (Cade and Woods 1997), among others. As already discussed, there has been loss and degradation of these habitats. Saab and Rich (1997) documented that shrub-steppe cover types, prime habitat for loggerhead shrikes, experienced the greatest loss of all habitats within the interior Columbia River Basin. They also projected the future of shrub-steppe habitats under 4 different "management themes" for the next 100 years. They predicted that, regardless of the management theme, shrub-steppe habitats will continue to decline. We are not aware of similar analyses for the future of desert and southern savanna habitats occupied by shrikes.

OVERUTILIZATION

Susceptibility of loggerhead shrikes to human disturbance is not well documented, but disturbance is not generally considered a limiting factor for the species. Cadman (1985) suggested that the loggerhead shrike appeared to be "fairly tolerant of human disturbance at or near the nest," and noted that rates of nest desertion by adults resulting from disturbance associated with 3 research projects varied from 1-16%. It has been noted that shrikes nesting in shrub-steppe habitat appeared to be less tolerant of disturbance than shrikes in other portions of the species' range (Woods 1995a). Leu and Manuwal (1996) evaluated the influence of military activities on the ecology shrikes breeding in shrub-steppe habitat at the Yakima Training Center in southcentral Washington. Activities that took place within 50 to 150 m of nests (none of the activities disturbed nests directly) resulted in increased predation. Leu and Manuwal (1996) suggested that the activities influenced nesting success in 2 possible ways: 1) induced flushing of females from the nest which may have revealed the nest location to predators; and/or 2) induced females to abandon nests which were subsequently preyed upon.

In portions of the range where the shrike has become very rare, the potential for disturbance has increased. Pennsylvania was the only state which indicated that disturbance from recreational birders is a potential limiting factor for shrikes; the current population of shrikes in the state is 1-3 breeding pairs annually.

Historically, shrikes were frequently shot because of their predatory nature and their habit of impaling prey, resulting in the colloquial name "butcher bird" (Yosef 1996). Graham (1993) reported that during the 1800s "lovers of sparrows and other song-birds shot shrikes on the Boston Common." Yosef (1996) reported that animosity toward shrikes was even expressed in scientific journals by some ornithologists. Shrikes are now legally protected from shooting and it is not likely a significant source of mortality. However, many individuals still express disdain for the shrike, primarily because it preys on songbirds (Little 1987b; Johns et al. 1994; S. Craig, pers. comm.). Johns et al. (1994) noted that some landowners appreciate the loggerhead shrike as a predator of insects and rodents, and with the general public's increasing level of ecological understanding, the reputation of the loggerhead shrike is improving.

DISEASE OR PREDATION

To our knowledge, no diseases of loggerhead shrikes have been reported. Only one state, North Carolina, indicated that disease was suspected as a potential limiting factor in shrikes, although there are no data to support this (Harry LeGrand, Jr., North Carolina Natural Heritage Program, pers. comm.). Known ectoparasites and internal parasites of loggerhead shrikes are summarized by Miller (1931) and Yosef (1996); both commented that known parasites were not likely a significant source of mortality.

DeGeus and Best (1991) reported the first documented records of cowbird parasitism of loggerhead shrike nests. Of 261 loggerhead shrike nests initiated by 110 pairs in 1987-1989 in southwestern Iowa, they encountered 3 nests parasitized by cowbirds. In the same study area, Frawley (1989) found that 49% of passerine nests in 6 alfalfa fields were parasitized. DeGeus and Best (1991) suggested that the low incidence of parasitism in shrikes may be due to lack of overlap between the loggerhead shrike nesting season and those of other passerine cowbird hosts; shrikes nest weeks before many other passerine species. Shrikes are also known to actively defend their nests from approaching cowbirds (DeGeus and Best 1991; Hall et al. 1997).

Predation is generally considered the leading cause of nest failure in loggerhead shrikes (see discussion in **Productivity and Survival** section). Predators that have been implicated in shrike nest failures include domestic and feral cats (*Felis catus*), coyotes (*Canis latrans*), badgers *(Taxidea taxus*), least chipmunk (*Tamias minimus*), Townsend's ground squirrel (*Spermophilus townsendii*), sharp-shinned hawks (*Accipiter striatus*), common ravens (*Corvus corax*), blue jays (*Cyanocitta cristata*), house wrens (*Troglodytes aedon*), black-billed magpies, black rat snakes (*Elaphe obsoleta*), gopher snakes (*Pituophis melanoceucus*), and western rattlesnakes (*Crotalus viridis*) (Luukkonen 1987, Novak 1989, Gawlik and Bildstein 1990, Yahner 1995, Leu and Manuwal 1996). However, passerines typically experience high rates of nest predation, and there is no indication that rates experienced by shrikes are generally a limiting factor for the species (Luukkonen 1987, Bartgis 1992). The exception may be loggerhead shrikes nesting in linear habitats, where they may suffer higher rates of predation compared to those in non-linear habitats, presumably because linear habitats serve as major travel lanes for predators (Lane 1989, DeGeus 1990, Yosef 1994a). DeGeus (1990) concluded that roadside habitats served as sinks for breeding loggerhead shrikes in Iowa; birds were attracted to these seemingly suitable habitats but nest predation limited production to levels below those needed for replacement. In areas, such as Iowa, where remaining shrike habitat is limited to roadsides, nest predation may be a limiting factor to shrike populations. Information from 3 states (Texas, Indiana, Iowa) indicated that nest predation may be a threat to loggerhead shrikes. In Indiana and Iowa, it was noted that the association of shrikes with roadside habitats exacerbates nest predation.

Lefranc (1997) noted that predation is a major source of mortality in shrikes, as a group. He noted that adult shrikes are often in full view when hunting or, in the case of males, advertising their territory. However, predation on adult loggerhead shrikes during the breeding season is infrequently reported (Lefranc 1997), and is not suspected as a major source of mortality. Predation during winter may be more significant. Blumton (1989) studied winter ecology, and specifically winter mortality, in a resident population of loggerhead shrikes in Virginia. She found

that during inclement weather shrikes moved into shrub/forest habitats, where they suffered high rates of predation by raptors. Rates of winter mortality were high, and raptor predation accounted for 57% of shrike mortality during winter. However, she cautioned that her study was conducted on radio-harnessed birds, and transmitters apparently affected predation rates. Nonetheless, shrikes may be particularly vulnerable to raptor predation during inclement winter weather, at least in this portion of the species' range.

INADEQUACY OF EXISTING REGULATORY MECHANISMS

The Lacey Act, Convention for the Protection of Migratory Birds, Migratory Bird Treaty Act of 1918 (MBTA), and Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere were attempts to halt the unregulated killing, import, and/or sale of migratory birds (USFWS 1991). The MBTA established Federal responsibility for protection of the international migratory bird resource. The MBTA makes it "unlawful at any time, by any means or in any manner, to pursue, hunt, take, capture, kill... any migratory bird, any part, nest, or egg of any such bird... included in the terms of the conventions...".

The MBTA provides the loggerhead shrike protection from direct take throughout its range. However, current regulatory mechanisms to protect the grassland habitats on which the species depends are limited in scope. Section 404 of the Clean Water Act and the National Environmental Policy Act of 1969 (NEPA) may, in some cases, provide limited protection for habitats used by loggerhead shrikes.

Wetlands are regulated by the U.S. Army Corps of Engineers (COE) under Section 404 of the Clean Water Act. Section 404 prohibits the discharge of dredged or fill materials into waters of the U.S., including wetlands. Any activity that involves placement of dredged or fill material in a wetland requires a permit from the COE. Grasslands adjacent to wetlands may be used by breeding and wintering shrikes, thus Section 404 probably results in the protection of a limited amount of habitat for the species.

NEPA requires all Federal agencies to consult with each other on proposals for legislation or other major Federal actions significantly affecting the quality of the human environment. Significant fish and wildlife habitats, including grassland habitats, are afforded some protection through NEPA.

The loggerhead shrike is listed as endangered or threatened in 14 states and a species of special concern (or similar designation) in 12 additional states (Table 3). State endangered species laws vary; they generally prohibit direct take of endangered and threatened species, but do not extend to the protection of habitat. Biologists in Illinois, Indiana, and Pennsylvania specifically noted that (even though the shrike is listed as endangered in those states) there is no regulatory mechanism to protect shrike habitat in those states. In Michigan (where the shrike is endangered), state law provides for protection of occupied shrike habitat. However, it was noted that the protection of habitat has little significance for shrike recovery in the state because there are so few current or recent nest sites to protect (Mary Rabe, Michigan Natural Features Inventory, pers. comm.). In Wisconsin, (where the shrike is listed as endangered), state law protects listed species from

incidental take. Draft incidental take protocol (for state agencies) has been developed for the loggerhead shrike and is currently under review (Sumner Matteson, Wisconsin Department of Natural Resources, pers. comm.).

Information from several states indicated that habitat is not considered the current limiting factor for shrikes in their state (Little 1987b in Michigan; Brooks and Temple 1990a in Minnesota; Robbins 1991 in Wisconsin; New York State Endangered Species Working Group 1993; Thomas Hodgman, Maine Department of Inland Fisheries and Wildlife, pers. comm.; R. Reynolds pers. comm. in Virginia). If shrikes are not habitat limited, then regulatory mechanisms to protect habitat are unlikely to provide benefit to shrikes in those states.

OTHER NATURAL OR MANMADE FACTORS

Other natural and manmade factors have also been implicated as potential threats to loggerhead shrikes. These factors include pesticides, collisions with vehicles, changing weather patterns, and interspecific competition. Each of these potential factors will be discussed.

Pesticides

Nineteen states cited pesticides as a potential factor in the decline of loggerhead shrikes (Table 4). Other than habitat loss and degradation, this was the factor most frequently noted by states as a potential cause of loggerhead shrike decline. Many of the states that cited pesticides as a potential problem did so in spite of the fact that there were no data on the impacts of pesticides on shrikes in their state, or the data that had been collected were inconclusive.

One line of evidence that points to pesticides as a potential factor in the decline of loggerhead shrikes is largely circumstantial. Blumton et al. (1990) noted that widespread declines in loggerhead shrike populations coincided with widespread use of organochlorine pesticides, which began in the late 1940s and was prevalent into the 1970s. However, other authors have noted that organochlorine pesticides have been largely banned since the early 1970s and populations of many other predatory birds that had been negatively affected by these chemicals have recovered, at least in part (Luukkonen 1987; Brooks and Temple 1990b; Burton and Whitehead 1990). Shrike populations, on the other hand, have continued to decline. Potentially, these pesticides had a role in the decline of shrike, but other factors are limiting the ability of shrike populations to recover. Alternatively, Luukkonen (1987) suggested that modern pesticides, which largely replaced organochlorines, may be limiting shrike populations. The impacts of these chemicals on shrikes are largely untested.

Cadman (1985) noted that sharpest declines in populations have occurred in agricultural areas, even though in many of these areas seemingly suitable habitat is unoccupied. Potential direct exposure of shrikes to pesticides, particularly in those portions of the species' range where it occupies agricultural habitats, is high, and the prey base of the species is impacted by these chemicals (Blumton et al. 1990). In Indiana, remaining shrike populations are found primarily on Amish farms, where use of chemicals is limited (Burton and Whitehead 1990). Grubb and Yosef (1994) used ptilochonology to demonstrate that nutritional condition of loggerhead shrikes

resident in southcentral Florida was related to habitat. Specifically, nutritional condition of shrikes in pasture was superior to that of birds in citrus groves. Mitacide/insecticide compounds used in citrus groves may, directly or indirectly, affect the condition of shrikes occupying that habitat. S. Craig (pers. comm.) also noted that pesticides may be impacting loggerhead shrike populations in Florida where the species is often found in areas of high pesticide use including, residential lawns, orange groves, and golf courses.

Spraying of pesticides to control grasshoppers has specifically been cited as a potential threat to loggerhead shrikes (Campbell 1975 cited *in* Cadman 1985; Gary Herron, Nevada Division of Wildlife, pers. comm.; Todd Grant, USFWS in North Dakota, pers. comm.; Bill Howe, USFWS Region 2, pers. comm.), although data are lacking. George et al. (1995) studied the effects of grasshopper control programs on rangeland breeding birds in 5 western states. They found no changes in bird community parameters resulting from grasshopper control treatments. Effects on the 5 most abundant species were analyzed separately; only one, the western meadowlark (*Sturnella neglecta*), was found at lower densities on treated compared to untreated sites. No specific information on impacts on loggerhead shrikes was available.

Anderson and Duzan (1978) conducted investigations in southern Illinois in 1971 and 1972 which documented that loggerhead shrikes had accumulated DDE and that the species had experienced eggshell thinning. Mean concentrations of DDE were 21.89 ppm in fat of 69 birds and 3.09 ppm in the contents of 104 eggs. A negative correlation was found between concentrations of DDE and eggshell thickness. The mean value for the shell thickness index was 2.57% less for eggs collected during the study than for eggs in archival collections (collected between 1875-1895). However, nesting success in the population was high. Anderson and Duzan did not dismiss DDE as a factor in the decline of shrikes in Illinois, but suggested that the toxicant may have been affecting survival of fledged juveniles or adults rather than directly affecting productivity.

J. Herkert (pers. comm.) conducted additional analyses of pesticide residues in Illinois shrike eggs. Between 1995-1996, he collected 21 eggs from 12 shrike nests in 6 Illinois counties. He found detectable levels of p,p'-DDE in 17 of the 21 egg samples (81%) collected. Detectable levels of p,p'-DDT were found in 9 eggs. No other organochlorine compounds were detected in the 21 shrike eggs evaluated. Average p,p'-DDE residual levels in 1995-1996 eggs were 0.66 ppm. These levels were significantly lower than the levels reported for Illinois shrikes by Anderson and Duzan (1978). Specifically, the mean and median DDE levels found in the current study were 79% and 81% lower, respectively than the levels Anderson and Duzan (1978) found in their sample of Illinois eggs collected in 1971-1972.

Morrison (1979) evaluated loggerhead shrike eggshell thickness in eggs collected in California (1948-1976) and Florida (1950-1968). These eggs were compared to eggs collected prior to 1947 (pre-DDT). No significant difference was found in shell thickness indices between pre- and post-DDT eggs. However, the author noted that while pesticide accumulation may have been insufficient to cause eggshell thinning, that pesticides could be affecting reproduction in other ways.

Blumton et al. (1990) evaluated pesticide and PCB resides in loggerhead shrikes in the

Shenandoah Valley, Virginia. They removed eggs from 8 nests that had been abandoned during incubation or failed to hatch from 1985-1987. Oxychlordane and pp'-DDE were present in all samples. Residues of pp'-DDE varied almost 600% among the 8 clutches; the highest concentration was 26.00 ppm, which was considered critically high. Pesticide residues were also detected in 7 radio-tagged shrikes that died during the study, but the results did not suggest pesticide or PCB related mortality.

A study in California (Rudd et al. 1981 cited *in* Cadman 1985) documented high levels of DDT-R (mostly DDE) in shrikes in areas sprayed with that chemical. They found that levels of the contaminant in shrike tissue could reach levels 200-400 times higher than in insects in the sprayed area. They also documented long-term accumulation and storage of DDT-R in the skin and brain tissue; 2 years after application, levels in 2 shrikes were 820.93 ppm and 293.43 ppm. In spite of the level of contamination, the authors did not note a direct affect on population density or reproduction.

Busbee (1977) documented delayed development of hunting skills in loggerhead shrike nestlings fed at least 2 ppm of dieldrin per day; he noted that this dose could be obtained by shrikes feeding in some agricultural areas. Further, all shrikes treated with this dose died within 103 days. These impacts would not show up in a study assessing productivity within a given nesting season. Several authors have suggested that even if direct impacts of pesticides on productivity of shrikes within a given breeding season are not detectable, that delayed impacts may ultimately lower over-winter survival of first-year birds (Anderson and Duzan 1978; Fraser and Luukkonen 1986; Hall et al. 1997). Even at sublethal doses, birds may have increased susceptibility to other forms of mortality. Migratory shrikes, because of the stresses associated with migration, could be particularly susceptible to pesticide impacts.

The loggerhead shrike, with a diet consisting only of animal matter, is more vulnerable to pesticide ingestion than most other passerines (Kridelbaugh 1981; Stevenson and Anderson 1994). This point was demonstrated in an area of Florida where bird surveys were conducted before and after treatment with Heptachlor. The shrike was the only species which had been present pre-treatment that was not found post-treatment (Stevenson and Anderson 1994). Collins et al. (1974) also suggested loggerhead shrikes may be particularly susceptible to the toxic effects of pesticides. They evaluated residue accumulation in selected vertebrates following a single aerial application of mirex bait (to control fire ants) in Louisiana in 1971. Fifty-five vertebrate species, including 23 birds, were evaluated for one year following application of the bait. Loggerhead shrike had the highest residue accumulations of any species sampled 3, 6, and 9 months post exposure (8.48 ppm 3.56 ppm, and 3.67 ppm, respectively). Lymn and Temple (1991) noted that insecticides used to control ants may reduce the prey base and may poison shrikes directly.

Several loggerhead shrike researchers noted potential impacts of pesticides on shrikes. S. Craig (pers. comm.) noted that approximately 15% of shrikes she captured in Florida in November-December 1996 had bill and leg deformities. While such deformities would not necessarily be associated with pesticides, the high incidence of deformity bears further investigation. Reproductive failure and behavioral anomalies observed in Montana shrikes could also be related

to pesticides (E. Atkinson, pers. comm.), although data are lacking.

In conclusion, while the exact impacts of pesticides on loggerhead shrike populations have not been determined, direct effects on both adults and juveniles have been observed. However, studies to date have not documented a direct effect of pesticides on nesting success. Potentially, pesticides result in mortality during migration or other times of stress, when the impact would be difficult to detect. There is evidence to implicate pesticides as a potential problem and there is a general consensus that additional research is needed.

Collisions with Vehicles

Six states cited collisions with vehicles as a potential threat to shrikes (Table 4). As early as the 1920s, researchers reported a high frequency of road-killed shrikes compared to other common species (Robertson 1930 cited *in* Flickinger 1995, Miller 1931). Flickinger (1995) suggested that shrike mortalities have likely increased dramatically since the increase in road construction and traffic following World War II. Increasing average speed of vehicles also contributes to increased mortality.

Flickinger (1985) counted road-killed birds on a 6.4 km section of a U.S. highway on the coastal plain of south Texas for 14 years between 1970-1987. Depending on the year, loggerhead shrikes ranked 3rd to 6th in the number of mortalities; 101 of 1,320 avian fatalities were shrikes. Shrikes were over-represented among highway fatalities relative to their abundance. The number of dead shrikes decreased markedly after 1975; the decline in the number of dead shrikes corresponds with a documented decline in shrike population. Hall et al. (1997) noted that a number of studies have documented that collisions with vehicles may contribute up to 18% of known shrike mortality, but did not provide details. Blumton (1989) found that road-killed shrikes accounted for 29% of mortality in the fall/winter shrike population in Virginia; these losses were second only to predation as a source of winter mortality. Flickinger noted that losses of shrikes along highways may be high throughout much of the range of the species (however, he provided exceptions), but may not be detected because systematic surveys of road-killed birds are uncommon. High road-kill mortality rates may threaten the viability of some declining populations.

Researchers have suggested reasons why shrikes appear to be unusually vulnerable to collisions with vehicles. In portions of the species' range, most of the remaining shrike habitat occurs along roadsides (Bohall-Wood 1987, Burton and Whitehead 1990, DeGeus 1990). Shrikes frequently perch on utility poles or powerlines along the road and have the habit of flying just above the ground, frequently just above the road, when flying from one perch to another (Flickinger 1995) or when foraging (Novak 1989). Shrikes also have been observed foraging on insects on the road surface (Bull 1974; Novak 1989). Stevenson and Anderson (1994) noted that loggerhead shrikes often visit roadways to pick up insects killed by cars at night. Fledglings with poorly developed flying skills appear particularly susceptible to collisions (Novak 1989). Andrle and Carroll (1988) and Novak (1989) cited several examples of high rates of fledgling loss along roadways, including a site in Ontario where all 3 fledglings from a single clutch were killed on the road.

Shrikes in roadside habitats are known to experience high rates of nest predation, and the added losses associated with vehicle collisions may threaten population viability. These observations raise the issue of whether or not roadside habitats should be modified to discourage shrike nesting; this will be discussed further in the **MANAGEMENT AND RESEARCH** section of this assessment.

In addition to collisions with vehicles, shrikes are also killed by collisions with stationary objects, such as towers. Bird mortality due to strikes with towers has received increased attention in recent years because of the rapid proliferation of towers. We are unaware of any data which suggest that loggerhead shrikes are disproportionately affected by tower strikes compared to other species, but to our knowledge this has not been investigated.

Loggerhead shrikes are known to readily use man-made perches, and this habit may increase their risk of electrocution on electric fencing or powerlines. Fisher (1998) reported that 3,000 birds, including 111 loggerhead shrikes, were found electrocuted on prison fences in California in the 5 years since the fences had been installed. Steps to protect birds from the fences were being implemented. B. Howe (pers. comm.) noted that electric fencing is used extensively in shrike habitat in the southwestern U.S., and that potential impacts of electric fencing on shrikes should be investigated.

Weather

There are no conclusive data documenting weather as a major limiting factor for loggerhead shrikes. However, shrikes are one of the earliest nesting passerines (DeGeus 1990), and as a result, their eggs and young may be subject to harsh weather. Harsh spring weather conditions have been cited as the primary cause of nest mortality in some years (Porter et al. 1975, Kridelbaugh 1983). Nonetheless, weather has not been reported as a major negative influence on shrike nesting success in most studies (DeGeus 1990). Nest losses due to harsh spring weather may become more significant as populations decline.

Long-term climatic trends, specifically a purported trend toward cooler, wetter summers, has been cited as a major cause of the decline of the red-backed shrike (*Lanius collurio*) in Britain (Bibby 1973 cited *in* Cadman 1985). Lefranc (1997) summarized evidence of climatic fluctuations as a causal factor in the decline of several species of shrikes in Europe. It has been suggested that long-term climatic trends may also play a role in the decline of loggerhead shrike populations in North America (Cadman 1985), although no data have been presented in support of this suggestion.

Peterjohn and Sauer (1995) presented evidence that severe winter weather may have contributed to declines in loggerhead shrike populations, as documented by BBS. They analyzed BBS data for 3 periods: 1966-1976, 1976-1979, and 1979-1993. They noted that the subspecies *L.l. ludovicianus* (in the southeastern U.S.) experienced a significant decline only during 1976-1979 when severe winter weather decimated populations of several species of short-distance migrants. They further noted that shrike populations have not recovered from this decline, suggesting other factors may currently be limiting those populations.

Interspecific Competition

Interspecific competition, specifically with the American kestrel, European starling (*Sturnus vulgaris*), and eastern kingbird, has been suggested as a potential limiting factor to loggerhead shrikes (Cadman 1985, New York State Endangered Species Working Group 1993). All of these species, along with the red fire ant which has also been suggested as a potential competitor (Yosef 1996), utilize the same prey base as shrikes to some extent. Yosef (1996) noted that these competitors appear to be better adapted to continuing human-induced changes in the landscape compared to the shrike. For example, the starling has expanded its range and increased in numbers since its introduction in New York in the 1800s, and is now abundant through much of the shrike's range (Cadman 1985). As prime shrike habitat has been lost and degraded, interspecific competitors may have gained a competitive advantage over shrikes in portions of the range.

The only competitor of the loggerhead shrike that has been specifically studied with reference to its interactions with shrikes is the American kestrel. In eastern Texas, Bildstein and Grubb (1980) found that while kestrels and loggerhead shrikes occupied generally similar habitat, the species exhibited spatial segregation. The habitat parameters along which the 2 species partitioned resources, and whether the partitioning was affected by interspecific social dominance was not determined. Gawlik and Bildstein (1995) noted that while the loggerhead shrike and American kestrel appear to occupy similar habitats, most shrike populations are declining while those of kestrels are increasing. They developed habitat models for eastern South Carolina which indicated that shrikes and kestrels exhibit substantial habitat separation. In general, shrikes inhabited areas dominated by short, grassy vegetation while kestrels were found in large, open areas of cropland. Their work suggested that differences in habitat conditions for the 2 species, not interspecific competition, were the primary reason that kestrels were thriving while shrikes were declining.

The degree to which interspecific competition affects loggerhead shrikes may vary among subspecies. It was suggested that interspecific competition was a potential threat to the endangered subspecies *L.l. mearnsi* (USFWS 1984), which was described as being shy and wary compared to mainland conspecifics. With regard to competition with kestrels, the recovery plan for *L.l. mearnsi* stated: "Competition between the two seems especially pronounced with regard to perch and food preferences, to the extent that shrike behavior is notably impaired."

CONCLUSIONS REGARDING THREATS TO LOGGERHEAD SHRIKES

The causes of declines in loggerhead shrike populations, and present and future threats to the species, are poorly understood. The species occupies a large geographic range and a wide variety of habitats. It seems likely that all of the threats discussed have affected the species in some portion(s) of its range, and the relative importance of the threats varies across the range.

There is general agreement among most species experts that loss and degradation of suitable habitat are the major underlying causes of declines in loggerhead shrike populations. A combination of factors, which have not been defined, are limiting the ability of shrike populations

to recover from those declines. Limiting factors are likely interrelated, making the task of defining those factors all the more difficult. Carefully designed studies will be required to understand the interactions among factors affecting shrike populations.

Even though threats to loggerhead shrike populations are poorly defined, we must still address the question of whether or not the continued existence of the species is threatened. With reference to this issue, Cade and Woods (1997) stated: "It has been extirpated from some of its range and is currently in decline in other areas. However, when it is viewed over its entire distribution in North America, and when its historical expansions and contractions of range associated with habitat changes are considered, the Loggerhead Shrike does not appear to be threatened with foreseeable extinction as a species."

However, Cade and Woods (1997) concluded that the subspecies *L.l. mearnsi* and *L.l. migrans* were in need of immediate and hands-on conservation attention. Such attention has already been focused on *L.l. mearnsi*. *L.l. migrans*, while it has been the focus of considerable research, has not been the focus of extensive conservation efforts. (The exception is eastern Canada, where the species is listed as endangered). Biologists from several states in the range of *L.l. migrans* commented that the outlook for the loggerhead shrike in their state was bleak. There is a reluctance to implement conservation efforts in the form of habitat improvement, because the perception is that suitable unoccupied habitat already exists. The range of the loggerhead shrike has already contracted in the northeastern U.S., as well as the upper Midwest. Unless we make progress in elucidating underlying limiting factors to loggerhead shrike populations in these areas, regional extirpations seem likely.

MANAGEMENT AND RESEARCH

Habitat conditions for the loggerhead shrike will never again approach the conditions that existed when the species reached its maximum distribution and numbers in the late 1800s. The patchwork of small family farms which almost invariably included some pasture, hayfields, wooded hedgerows, and minimal use of chemicals will not return to the eastern U.S. Likewise, restoring vast tracks of unbroken, pristine shrub-steppe, desert scrub, pine savannas, and other native ecosystems in which the loggerhead shrike likely thrived is not a realistic management goal. Instead, habitat management for the loggerhead shrike needs to focus on: 1) Protection and restoration of key patches of high quality loggerhead shrike habitat in native ecosystems; and 2) Programs to enhance non-native grassland habitats. Potential enhancements include increasing the size and connectivity of grassland patches, planting shrub/tree patches if these are lacking, and, if possible, reduced use of chemicals, in agricultural and other grassland habitats. Habitat manipulation to benefit the loggerhead shrike should not be viewed in isolation. Many species of wildlife would benefit from programs to enhance habitat for the loggerhead shrike. However, in some cases, habitat enhancement for shrikes may result in the loss of habitat for other species. The entire suite of species that will be affected by habitat manipulation should be considered.

In those portions of loggerhead shrike range where the species occupies agricultural habitats or other seral stages of vegetation, succession must be controlled to maintain grassland habitats for loggerhead shrikes. Prescribed burning, mowing, and grazing may be viable management

alternatives. However, the frequency of management should allow for medium, and in some cases tall, grasses to dominate sites managed for shrikes (Yosef 1996). Johnson et al. (1998) summarized literature on levels of grazing and mowing needed to attain appropriate grass heights for loggerhead shrikes. Guidelines for managing habitat for grassland birds, including the loggerhead shrike, are discussed by Herkert et al. (1993) and Sample and Mossman (1997) and will not be discussed in detail here. Hands et al. (1989) cautioned that grassland management plans that concentrate on early successional habitat will not benefit shrikes, because scattered trees and shrubs required by the species will not be provided. Herkert et al. (1995) noted that many grassland species begin to decline with woody encroachment, but that loggerhead shrikes are dependent on the presence of woody vegetation in a grassland context for habitat suitability. Management programs specifically targeting mid-successional grasslands are needed to maintain the suite of species that occupy these habitats, including the loggerhead shrike.

The major impediment to restoring loggerhead shrike populations in those portions of the range where the species no longer breeds, and to stabilizing declining populations in much of the occupied range, is that the causes of population decline are not understood. At least in the Northeast and upper Midwest, it appears that loggerhead shrike populations are not likely to respond to habitat restoration alone. Research is needed to assess the threats to the species, particularly in these areas where the shrike no longer breeds with regularity. Only when the threats are defined, can management to eliminate or reduce threats be initiated.

MANAGEMENT NEEDS AND ISSUES

Management in the Eastern and Midwestern U.S.

In the eastern and midwestern U.S., shrike habitat is found primarily on privately-owned land (primarily agricultural grasslands), so protection of habitat through acquisition of key parcels is often precluded (Hall et al. 1997). States along the East coast and as far west as Texas, Oklahoma, Kansas, South Dakota, North Dakota, and portions of Colorado, Montana, and Wyoming indicated that shrike habitat is predominately on private land. (See state summaries in Appendix I; Minnesota and Wisconsin indicated that shrike habitat occurs on public and private land, all other states east of the Rocky Mountains indicated predominately private land). Initiatives aimed at managing for shrike habitat on private lands are needed.

A key element of management on private lands is to maintain brush with a tree component along fencelines and scattered individual or clumps of trees/shrubs in pastures and fields (Yosef 1996). Creating continuous linear strips of woody vegetation should be avoided (Yosef 1992a). Johnson et al. (1998) suggested that linear habitats could be improved by planting multiple rows of trees in shelterbelts and adding larger blocks of habitat adjacent to strips of woody vegetation. Kridelbaugh (1982) recommended thorny, native shrub species for planting (e.g. hawthorn, honeylocust); he cautioned against planting multiflora rose. Yahner (1995) recommended maintaining a minimum of 100 m of fencerows in addition to at least 5 isolated trees/shrubs of suitable species per ha in Pennsylvania pastures being intensively managed for loggerhead shrikes. Novak (1989) recommended that optimal shrike habitat in New York should include tall (>2 m) isolated shrubs at densities $\geq$ 3 shrubs/ha, including at least one isolated hawthorn, apple, eastern

red cedar or white cedar for a nest site. Telfer (1992) provided management recommendations based on research in western Canada (Alberta and Saskatchewan). In native prairie or pasture habitats, he recommended the planting of at least one patch of suitable nesting shrub/tree species per 65 ha (specifically willow, thorny buffaloberry, or caragana) if suitable clumps are not already available. Managers should consider fencing old shelterbelts and existing shrub/tree clumps to protect them from cattle grazing and rubbing if appropriate (Yosef 1996).

Yosef and Grubb (1994) enhanced habitat for loggerhead shrikes in Florida pastures by adding perch sites (wooden fence posts). Perches were added to areas of occupied shrike territories that were not used by foraging shrikes, supposedly because the areas lacked hunting perches. They demonstrated that the addition of hunting perches: 1) resulted in a decrease in territory size of loggerhead shrikes; 2) allowed for additional territorial pairs of shrikes to move into the study area; and 3) improved shrike productivity. The potential for enhancing shrike habitat suitability by introducing hunting perches should be further evaluated. If density of hunting perches is a potential limiting factor in a managed area, augmentation of hunting perches should be considered (and results monitored to evaluate effectiveness of the technique).

Reduced use of pesticides, as well as other chemicals, may also enhance the value of agricultural, and other grassland habitats, for loggerhead shrikes (Hands et al. 1989, Yahner 1995). As previously discussed, pesticides can have direct toxic effects on shrikes as well as affecting them indirectly though reducing the prey base of the species.

Mechanisms to affect changes in private land management for the benefit of loggerhead shrikes have been the focus of considerable discussion, but actual attempts at implementing shrike habitat management on private land have been limited. In our survey of states, no state indicated that any large-scale habitat management programs focused on loggerhead shrike habitat had been initiated. Two states (Missouri and Wisconsin) have statewide grassland management initiatives underway, which are expected to benefit many grassland-dependent species including the loggerhead shrike. Three states (Indiana, Georgia, and Virginia) indicated that management initiatives for game species (particularly the northern bobwhite, *Colinus virginianus*) likely improve habitat conditions for loggerhead shrikes; this may be true in other states as well. In New Hampshire, management for several other State-listed species was considered conducive to producing loggerhead shrike habitat, although it was considered unlikely that shrikes would return as a breeding species in the state in the foreseeable future.

Agricultural incentive programs, such as CRP and Sodbuster, have been suggested as potential mechanisms to enhance agricultural lands for loggerhead shrikes (Hands et al. 1989; Hunter 1990; Johnson et al. 1998). The potential for development of wildlife habitat on CRP lands was discussed by Allen (1994) and issues specifically related to CRP and grassland birds were considered by Delisle and Savidge (1995). To our knowledge, the extent to which the CRP program has benefited or has the potential to benefit the loggerhead shrike, specifically, has not been evaluated. The suitability of CRP land for loggerhead shrikes, particularly in the eastern and midwestern U.S., may be limited. Typically, grasses in CRP fields areas are taller than is considered optimal for shrikes, grazing and mowing are precluded, and there is insufficient woody vegetation for shrikes (J. Herkert, pers. comm.). Many species of grassland birds require tall grass

and are most productive in areas with little, if any, woody vegetation; CRP management practices are more likely to provide habitat for these species than for loggerhead shrikes.

Any effort to protect or enhance loggerhead shrike habitat on private lands will have to include an educational/outreach component. Several landowner incentive and public education initiatives related to the loggerhead shrike are underway in Canada. Over 270 landowners with loggerhead shrike habitat in Ontario have been sent information encouraging them to protect habitat (CWS 1999). Public education campaigns are also underway in Alberta and Saskatchewan. It is too early to evaluate the outcome of these efforts. "A Landowner's Resource Guide: Endangered Loggerhead Shrikes and Other Grassland Birds" was produced by the Long Point Bird Observatory (1997) to educate Ontario landowners regarding loggerhead shrikes. The Minnesota Department of Natural Resources (1996) also produced an educational leaflet for landowners entitled "Landowners Guide for Maintaining and Encouraging Loggerhead Shrikes." Both of these publications provided information on the status of the loggerhead shrike, recommended management for the species, and how a landowner could get additional information or help in managing shrike habitat, including incentive programs. Other states (Kentucky and North Carolina) indicated that State biologists encourage landowners to implement habitat management beneficial to shrikes, specifically, maintaining and planting trees/shrubs in agricultural grasslands. Burton and Whitehead (1990) advocated educational outreach to landowners in occupied shrike habitat in Indiana.

The fact that eastern and midwestern shrikes are primarily found on private land does not preclude the need for management on public lands. If grassland habitats potentially suitable for shrikes exist on public lands in the East and Midwest, consideration should be given to whether enhancing the habitat for shrikes is a viable management alternative. Management efforts directed at enhancing shrike habitat on public lands should be accompanied by monitoring of shrike populations, both before and after habitat manipulation, to determine whether or not shrikes respond to management. All habitat enhancement programs for shrikes need to be documented, regardless of the outcome of the efforts. Hopefully, information compiled from management efforts on public lands can be used to refine management recommendations for private landowners. Examples of public land management for shrikes in the eastern U.S. are limited:

1) Bartgis (1992) reported that Antietam National Battlefield (Maryland) and Presquisle National Wildlife Refuge (Virginia) planned shrike habitat management. Management efforts at Antietam were abandoned in 1994 when nesting shrikes did not return to the area (Ed Wenschhof, National Park Service, pers. comm.). Management at Presquisle was apparently never initiated, or was very limited in scope (Dave Olsen, USFWS, pers. comm.).

2) The Eisenhower National Farm (Department of Interior) in Pennsylvania is being actively managed for shrikes. These efforts, initiated in 1998, involved planting hawthorn and cedar in suitable pasture habitat in the vicinity of recent nesting records; results are not anticipated for several years.

3) Some habitat management for shrikes occurs at the Midewin National Tallgrass Prairie (U.S. Forest Service) in Illinois. Specific management activities that benefit shrikes include: a) maintain short grass habitat with grazing, b) clear overgrown pastures to restore short grass habitat, and c) maintain some short (less than 4.6 m) thorny trees (usually osage orange) when restoring overgrown pastures (J. Herkert, pers. comm.).

While most shrike habitat in the eastern and midwestern U.S. is associated with agricultural habitats, potential benefits of initiatives to restore native grassland ecosystems should not be overlooked. Restoration of longleaf pine-wiregrass communities, which may have been the native habitat of loggerhead shrikes throughout much of the southeastern U.S., are likely to benefit the species (J. Cely, pers. comm). Similarly, prairie and savanna restoration efforts may also benefit the species. Monitoring to determine if shrikes respond to these restoration efforts should be a priority.

Management in the Western U.S.

Management considerations for shrikes in the western U.S. differ from those in agricultural habitats in the East. Information provided by states indicated that west of the Rocky Mountains shrikes are most often found on public lands. (See Appendix I state summaries for details). Most shrike habitat is managed by the U.S. Bureau of Land Management (BLM) or the U.S. Forest Service and is typically grazed. Compared to the eastern U.S., there has been relatively little research done on western shrikes and limited discussion of shrike habitat management. Of all western shrike habitats, shrub-steppe has received the most research and management attention.

Undisturbed shrub-steppe habitats have been shown to support relatively high densities of shrikes, and are considered important to the conservation of the species. Saab and Rich (1997) conducted a large-scale conservation assessment for migratory land birds in the interior Columbia River Basin and documented that among all cover types in the basin, shrub-steppe habitats have suffered the most drastic declines, and populations of bird species that depend on this habitat type have also declined. They provided a detailed assessment of land management activities and considerations within the basin. They noted that there are few examples of shrub-steppe habitat that have not been impacted by grazing. They recommended the establishment of 2 large (1,000 ha) protected shrub-steppe areas, where ecological integrity is still high. Leu and Manuwal (1996) and Rich (1997) presented management recommendations for shrikes in shrub-steppe habitat.

Some efforts to preserve shrub-steppe habitat have already been initiated. The Arid Lands Ecology Reserve on the Hanford Site (Department of Energy) in southeastern Washington includes some of the best shrub-steppe habitat remaining in the state. Management for western sage grouse (Centrocercus urophasianus phaios) includes efforts to protect and restore shrub-steppe habitat on the Yakima Training Center (Department of Army) and Yakama Indian Nation lands, also in southern Washington. These initiatives are expected to benefit shrub-steppe dependent species, including the loggerhead shrike.

In responses from the states, several issues (many interrelated) were widely considered important to management of shrike habitat in the western U.S.:
1) Large-scale conversion of shrub-steppe and other native plant communities to agriculture has resulted in loss of habitat for loggerhead shrikes, and the conversion is ongoing.
2) The need for long-term research on the impacts of livestock grazing. Several individuals cited properly regulated grazing as potentially beneficial to shrikes.

3) The invasion of native shrub-steppe and pinyon-juniper communities by exotics is a problem which needs to be investigated.
4) Increased frequency of fire was frequently cited as detrimental to shrikes. Ron Lambeth (BLM, pers. comm.) noted that the BLM has adopted a full fire suppression policy on desert lands in some areas; this policy should preserve fire-sensitive shrubs and thus benefit loggerhead shrikes.
5) Maintaining healthy riparian areas in western grassland and shrubland communities was considered critical to shrikes in many areas.
6) The potential role of habitat fragmentation in the decline of western shrike populations has not been adequately addressed.

Concentrate Management Efforts on Occupied Sites

Loggerhead shrikes tend to nest in previously used nest sites, even if sites that appear equally suitable remain unoccupied. Site fidelity by individual shrikes is low in many portions of the range, but site reoccupancy tends to be high in most populations. As noted by Johns et al. (1994), "shrikes seem to be attracted to previously used sites by fidelity, by the intrinsic characteristics of the sites, or by the evidence of previous occupation." Therefore, it is considered important to conserve habitat in areas where shrikes are known to nest. In those portions of the range where very few breeding pairs remain, protecting individual sites may be necessary. For example, the breeding population in Pennsylvania has been 1-3 pairs annually since 1992, and recovery efforts are centered around known nest sites. In Michigan, only 4 breeding pairs of shrikes were found statewide in 1987. Little (1987b) noted: "Each of the four pairs was within four miles of either Lake Michigan or Lake Huron, suggesting they migrated up the shoreline until they found suitable habitat and/or mates." She concluded that management efforts in Michigan may be best directed to the migratory pathways associated with Great Lakes, and specifically to areas with recently breeding pairs. Burton and Whitehead (1990) also recommended protection of known nest sites in Indiana.

Management of Roadside Habitats

As previously discussed, loggerhead shrikes frequently suffer high rates of mortality in roadside habitats due to increased nest predation rates in these habitats and the species' apparent susceptibility to collisions with vehicles. DeGeus (1990) suggested that roadside habitats may act as "ecological traps" for loggerhead shrikes, and may actually be contributing to the decline of the species, at least in the midwestern U.S. Therefore, the question arises whether the management of roadside vegetation for shrikes is desirable.

There is no consensus in the literature on whether management of roadside habitats is desirable. Hands et al. (1989) recommended that roadside habitats be incorporated in shrike management plans in the Midwest, and that State transportation departments should be encouraged to leave shrubs along roadsides. Bjorge and Prescott (1996) also recommended that roadside shrub plantings would benefit shrikes in southeastern Alberta. Other authors have been more cautious in recommending roadside habitat enhancement. Bartgis (1992) addressed the issue for the northeastern U.S. He suggested that in areas considered important potential nest sites for shrikes

that landscape features that attract shrikes to roadways, such as potential nest trees, should be eliminated if similar features occur away from the roadway. Rich (1997), addressing management in the interior Columbia River Basin, stated: "Habitat enhancement will be most beneficial if conducted in areas away from roads." In a landowner's guide for managing for loggerhead shrikes in Ontario, the Longpoint Bird Observatory (1997) recommended: "Reducing roadside mowing during the breeding season will discourage shrikes from hunting too close to roads."

Caution in managing roadsides for shrikes is well advised. Concern regarding vehicle collisions may be less on lightly traveled roads and roads with relatively low speed limits. However, even if the risk of vehicle collisions is low, the issue of increased nest predation associated with linear habitats remains. Yosef (1992a) clearly demonstrated that loggerhead shrikes nesting away from linear habitats suffered fewer nest losses. General recommendations to use in assessing whether or not to enhance roadside habitat for shrikes include: 1) If practical, management away from roadsides will probably provide greater benefits to shrikes than roadside management; 2) Attempt not to limit woody plants to the roadside; clumps of suitable trees/shrubs away from the roadside will be of greater benefit to shrikes; 3) If nesting habitat for shrikes is limited to roadsides, avoid creating linear strips of woody vegetation; clumps of woody vegetation or isolated trees with breaks between them are preferable; and 4) If foraging habitat for shrikes is not limited to roadsides, leaving roadside vegetation unmowed may discourage shrike foraging and reduce the risk of vehicle collisions. Yahner (1995) recommended reduced speed limits and other signage on rural roads associated with loggerhead shrike nest sites in Pennsylvania, where only 1-3 pairs nest annually. Ontario has implemented efforts to reduce vehicle speed on roads through shrike breeding habitat (CWS 1999).

RECOVERY PLANNING AND IMPLEMENTATION

The loggerhead shrike is listed as endangered in eastern Canada and threatened in western Canada. In the U.S., only 1 subspecies, the San Clemente loggerhead shrike, is listed as Federally endangered. In addition, the species is State listed as threatened or endangered in 14 states, all within the range of the subspecies *L.l. migrans*. The status of recovery planning and implementation in Canada, the U.S., and in individual states is discussed briefly below.

San Clemente Loggerhead Shrike Recovery Plan

The San Clemente loggerhead shrike, which occurs only on San Clemente Island, California, was listed as Federally endangered in 1977, at which time the population was estimated at approximately 30 individuals (USFWS 1984). The "California Channel Islands Species Recovery Plan" (USFWS 1984), which includes the San Clemente loggerhead shrike, noted that the specific causes of the decline of the shrike were not known. Habitat degradation caused by a large feral goat population was suspected as a major cause of decline. Predation on eggs and young by native and exotic predators was also identified as a threat to the species (Morrison et al. 1995). The population had declined to 5 pairs by 1988 (Morrison et al. 1995).

Morrison et al. (1995) outlined the design of an intensive recovery program developed in 1990-1991, which included: 1) removal of feral herbivores; 2) reduction of predators; 3) initiation of a

captive breeding flock; and 4) removal of eggs from wild nests to induce double-clutching, and subsequent hand-rearing and release of young. In spite of intensive management efforts, the status of this subspecies remains precarious. Winegrad (1998) noted that at most 18 wild shrikes remained, in addition to 13 birds in the captive breeding program on San Clemente Island.

Research has demonstrated that shrikes can be captively reared, and that captively-reared young can be successfully released in the wild. Captive breeding is being used as a recovery tool for the San Clemente loggerhead shrike and for the endangered population of shrikes in eastern Canada, discussed below. However, the contribution of captively-reared shrikes to recovery of wild populations has not yet been demonstrated. Cade (1992) reported on hand-reared loggerhead shrikes taken from nests in northeastern Colorado (presumably *L.l. excubitorides*) which subsequently bred in captivity. Artificial rearing techniques for eggs and chicks removed from wild nests of the San Clemente loggerhead shrike were detailed by Kuehler et al. (1995) (see also Azua and Lieberman 1995). Protocols and techniques were first tested using the mainland subspecies *L.l. gambeli* as a surrogate. Morrison et al. (1995) reported that 8 captively-raised shrikes were released on San Clemente Island at approximately 40 days of age in 1992. Unfortunately, they were unable to conduct the necessary monitoring to confirm survivorship of released birds.

State Recovery Efforts

State recovery plans for the loggerhead shrike have been prepared for Pennsylvania and Wisconsin; the species is State listed as endangered in both states. The subspecies present in both states is *L.l. migrans*. A brief summary of recovery efforts in those states follows.

Pennsylvania's loggerhead shrike population has consisted of 1-3 nesting pairs since 1991, when a single nesting pair was observed. This was the first documented nesting in the state in more than 50 years (Daniel Brauning, Pennsylvania Game Commission, pers. comm.). Though small and tenuous, this population is significant; Pennsylvania is the only northeastern state that reported that shrikes were reestablished as a breeding species after having been lost. The goal of the "Pennsylvania Recovery and Management Program for the Loggerhead Shrike" (Yahner 1995) was to achieve a breeding population of at least 30 nesting pairs in 10 years. The focus of the program is a 4-county area (Adams, Crawford, Erie, and Franklin) which has recent shrike nesting records. Habitat enhancement is centered around areas of active pasture.

The loggerhead shrike was listed as threatened in Wisconsin in 1979 and reclassified to endangered status in 1982. The most recent statewide population estimate for the loggerhead shrike in Wisconsin was 6 breeding pairs in 1987. The "Wisconsin Loggerhead Shrike Recovery Plan" (Fruth 1988) focused on research, monitoring, and increased public awareness. The plan stated that lack of understanding of the factors limiting shrike populations in the state precluded the development of habitat management recommendations. While some local monitoring has occurred in the state since the preparation of the recovery plan, systematic surveys of all likely shrike nesting habitat has not occurred nor has management specifically targeting shrikes (S. Matteson, pers. comm.). The status of the species has not changed appreciably since listing. The population, consisting of 1-5 known breeding pairs reported irregularly during the 1990s, is

characterized as unstable (S. Matteson, pers. comm.). Statewide ecoregional planning initiatives as well as implementation of Partners in Flight (PIF) conservation plans are expected to benefit habitat conditions for grassland/shrub dependent species, including the loggerhead shrike.

A loggerhead shrike recovery plan was drafted for New York State in the 1980s, but was never implemented (Peter Nye, New York State Department of Environmental Conservation, pers. comm.). Apparently suitable habitat was unoccupied by shrikes and the factors precluding the recovery of the species in the state were not understood. However, efforts to restore the shrike population in Ontario, including planned release of captively-reared birds, has renewed interest in shrike restoration efforts in New York (P. Nye, pers. comm.).

The PIF Bird Conservation Planning Process is expected to attract conservation attention to the loggerhead shrike in many states. Six states (Nevada, Wisconsin, North Carolina, Montana, Utah, and Wyoming) specifically noted that PIF initiatives in their state had the potential to benefit the loggerhead shrike. The loggerhead shrike is considered a high priority in 3 PIF physiographic regions (based on PIF species prioritization at the national level) including Peninsular Florida, the Osage Plains, and the Central Valley of California. The shrike is also a priority species in many PIF state planning efforts.

Canada's Recovery Plan

The loggerhead shrike is listed by COSEWIC as a threatened species in western Canada and an endangered species in eastern Canada. Johns et al. (1994) reported the following population estimates by province: Quebec - only 2 breeding pairs found in 1991; Ontario - exhaustive search in 1992 resulted in estimate of 100 individuals; Manitoba - approximately 500 breeding pairs; Saskatchewan - probably several thousand breeding pairs; Alberta - estimated at 400 breeding pairs, but difficult to evaluate. Note that Bjorge and Prescott (1996) estimated the population in the core breeding areas of southeastern Alberta in 1993 at approximately 2,500 pairs. Canada's "National Recovery Plan for the Loggerhead Shrike" (Johns et al. 1994) provided a detailed strategy for recovery of the species. Actions considered essential to recovery were summarized as follows:

> "determination of the cause of the species' decline; determination of the habitat requirements of the species and the availability of that habitat during the breeding and winter seasons; protection and management of breeding habitat; development of contingency plans for major disruptions to the species; investigation of intensive management techniques such as captive rearing and release; establishment of working groups for both the eastern and western populations of the Loggerhead Shrike; and establishment of cooperative conservation programs to protect existing grasslands, especially native prairie."

Considerable progress has been made on the implementation of Canada's recovery plan. The Canadian Wildlife Service (CWS 1999) reported the following progress on recovery objectives (for eastern and western populations):

Eastern population:

- continued studies of population status, reproductive success, and fledgling survival;
- maintained 2 captive populations of loggerhead shrikes (a total of 44 founder birds), analyzed genetic variability in captive populations, and developed protocol for release of captive-reared birds (possibly in 2000);
- implemented efforts to reduce traffic speed on rural roads in shrike nesting areas and monitored effectiveness of those efforts;
- implemented outreach efforts for landowners that own shrike habitat in Ontario;
- studied toxicological studies of road dust suppressant "Dombind";
- evaluated 60 recent loggerhead shrike nest sites for Ontario's Conservation Land Tax Incentive Program;
- limited habitat management was implemented.

Western population:

- conducted a prairiewide population survey and other monitoring efforts;
- conducted stable-hydrogen isotope analysis of feathers to determine wintering locations of birds that breed in western Canada;
- initiated a nest site database for use in GIS applications;
- habitat management accomplished through "Operation Grassland Community."

No major changes in the population status of Canada's loggerhead shrikes since listing were reported. A population status report for the western population will be prepared during 2000. The number of breeding pairs in eastern Canada increased to 31 pairs in 1998 from 18 pairs in 1997 (CWS 1999); the status of this populations remains precarious. If the population in eastern Canada can be stabilized, it could potentially provide a source of birds to recolonize adjoining areas in the northeastern portion of the species' range.

International Cooperation

Considering that the range of the loggerhead shrike extends from southern Canada, throughout the continental U.S., and into southern Mexico, the species is a candidate for comprehensive international planning effort. To date international cooperation has been limited to localized projects. Current projects involving international cooperation include: 1) Stable-hydrogen isotope analysis of feathers was used to determine the U.S. wintering grounds of shrikes breeding in Canada; results of this work are not yet published (K. Hobson, pers. comm.). Additional analyses will include samples from Mexico if funding can be procured; and 2) A study to evaluate genetic diversity among Canadian populations of loggerhead shrikes was recently (partially) funded. This project will involve international cooperation, as project objectives include using genetic markers as an aid in identification of shrike wintering grounds, and evaluating Canadian populations within the context of the rangewide genetic landscape of the species.

The loggerhead shrike was recently selected as 1 of 15 species that will be considered in a pilot project by the Commission for Environmental Cooperation (CEC) aimed at enhancing collaboration among Canada, Mexico, and the U.S. on transboundary or migratory species of concern, ultimately with the goal of conserving the biodiversity of North America. The CEC is

currently compiling profiles of all 15 species for the Trilateral Committee for Wildlife and Ecosystem Conservation and Management, which will then confer on international priorities for the conservation of each of the species.

PRIORITIES FOR RESEARCH AND CONSERVATION

In reviewing published literature and information provided by state natural resource agencies and species experts for this status assessment, several research and conservation priorities emerged.

Underlying Causes of Shrike Declines

Many state agencies, particularly within the range of *L.l. migrans*, indicated that a lack of understanding of the underlying causes of declines in loggerhead shrike populations precludes the development of conservation strategies for the species. Specific research needs include:

- The potential role of pesticides (particularly insecticides) in shrike declines was frequently cited as an area requiring additional research. Insecticides used for grasshopper control are of particular concern in portions of shrike range.
- The high reproductive potential of shrikes has been clearly demonstrated; future research should evaluate productivity relative to habitat characteristics. For example, Yosef (1994a) evaluated productivity of shrikes nesting in linear fenceline habitats versus those nesting in clumps of trees away from fencelines.
- High productivity of shrikes through the fledging stage has been documented in many areas, including some areas where populations are declining. The apparent low rate of recruitment of young birds into breeding populations in many areas suggests that post-fledging mortality must be high. Research is needed to evaluate mortality rates throughout the annual cycle of shrikes.
- Biologists from many state agencies, particularly in the Northeast, indicated that suitable shrike habitat is unoccupied in their state. It has been suggested that in some cases patches of suitable habitat have become too isolated to support breeding shrikes. The potential role of habitat fragmentation in the decline of shrikes needs to be investigated.
- All remaining concentrations of *L.l. migrans* should be monitored to the extent possible, and should be the focus of research. These populations have the potential to serve as a source of birds to recolonize areas where shrikes no longer breed. For example, the small breeding population in Ontario probably has the greatest potential for providing birds to recolonize adjoining states in the northeastern U.S.

Ecology of Shrikes Outside the Breeding Season

The winter ecology of loggerhead shrikes is poorly understood. Populations of migrant shrikes in the eastern U.S. (and eastern Canada) have suffered higher rates of decline than most other populations. Brooks and Temple (1990b) concluded that low over-winter survival is the key factor in the steep declines of migratory populations of shrikes which breed in the upper Midwest.

- Additional work is needed to determine wintering locations of migratory populations of shrikes.
- Differences in habitat quality and the degree of competition between resident shrikes and

migratory shrikes on the wintering grounds need to be evaluated.
- Research is needed to determine if migratory populations of shrikes are experiencing lower rates of over-winter survival compared to resident populations.

Biosystematic Analysis

The current classification of subspecies of loggerhead shrikes is considered inadequate by many species experts. The need for a modern biosystematic study on loggerhead shrikes has been demonstrated. Particularly, the validity of the northeastern subspecies (*L.l. migrans*), and whether or not this subspecies is distinct from the nominate subspecies (*L.l. ludovicianus*), has been questioned. Mechanisms to implement conservation activities in the U.S., such as potential listing of additional subspecies under the ESA, are complicated by the lack of reliable taxonomic information for this species. Lack of good taxonomic data has also been an issue in conservation of the species in Canada.

Communication Network

The loggerhead shrike occupies a broad geographic area and a wide variety of habitats. The fact that the species is declining rangewide suggests that at least some of the factors affecting the decline are not restricted to a given habitat type (e.g. agricultural grasslands) or to a given geographic region. A communication network is needed, both within the U.S. and internationally, to facilitate the exchange of information on loggerhead shrikes throughout the species' range. Government agencies and private conservation organizations that are initiating programs to encourage landowners to manage private land for shrikes and to build public support for shrike conservation should be working together. Research efforts should be coordinated to maximize the amount of information that can be collected and to make the most efficient use of research funds. Impacts of habitat management on shrike populations, whether or not those efforts are designed to affect shrikes, need to be evaluated and reported. The CEC's initiative will hopefully provide the basis for increased international communication and cooperation on shrike conservation among Canada, Mexico, and the U.S. However, unless a concerted effort is made to increase communication within the U.S., the benefits of increased international cooperation will be limited. Shrike research and conservation priorities could be better defined and more effectively coordinated if a communication network was in place to facilitate compiling and exchanging information among government agencies, private conservation organizations, researchers, and species experts.

Table 1. Primary habitat and the species of woody plants selected for nest sites by the loggerhead shrike, as documented in studies across the species' range.

STUDY	STATE/ PROVINCE	PRIMARY HABITAT USED	PRIMARY NESTING SUBSTRATE(S)
Brooks 1988	Minnesota	agricultural, grasslands	44% eastern red cedar, 21% thorn-bearing trees, 12% spruce. (N=48 nests)
Burton and Whitehead 1990	Indiana	short grass, agricultural	142 nests in 34 plant species: 40% eastern red cedar; 12% multiflora rose; 9% sassafras
Campbell 1975 (cited in Novak 1989)	Ontario	agricultural/pasture	111 of 167 nests in hawthorn
Cely and Corontzes 1986	South Carolina	residential lawns	26% eastern red cedar, 24% evergreen oaks, 21% loblolly pine. (N=34 nests).
Chavez-Ramirez 1998	Texas	urban park-like settings	90% in oaks or hackberry. (N=28 nests).
Collins 1996	Illinois	old field, grassland	27% multiflora rose, 15% eastern red cedar, 12% shingle oak. (N=26 nests)
DeGeus 1990	Iowa	roadsides in agricultural landscape	58% white mulberry, 20% American plum, 16% eastern red cedar. (N=159 nests)
Gawlik and Bildstein 1990	South Carolina	pasture, hay field, lawn	63% eastern red cedar. (N=49 nests)
Graber et al. 1973	north/central Illinois	roadside hedges in agricultural area	88% osage orange. (N=89 nests)
Graber et al. 1973	southern Illinois	roadside hedges in agricultural area	55 nests in 16 plant species: 20% eastern red cedar; 13% multiflora rose; 11% osage orange
Kridelbaugh 1982	Missouri	pasture, old field	58% eastern red cedar, 12% multiflora rose. (N=60 nests)

Table 1 (continued). Primary habitat and the species of woody plants selected for nest sites by the loggerhead shrike, as documented in studies across the species' range.

STUDY	STATE/ PROVINCE	PRIMARY HABITAT USED	PRIMARY NESTING SUBSTRATE(S)
Leu and Manuwal 1996	Washington	ravines in shrub-steppe	76% Wyoming big sagebrush, 8% greasewood, 7% mock orange. (N=108 nests)
Luukkonen 1987	Virginia	active pasture	47% eastern red cedar, 25% hawthorn. (N=75 nests)
Michaels 1997	Kansas	tallgrass prairie with scattered woody vegetation	8 nests: 4 in osage orange; 2 in eastern red cedar; 2 in white mulberry
Mossman and Lymn 1989	Wisconsin	roadside, railroad right-of-way, pasture, old field	½ of Wisconsin nest records from 1980-1989 in eastern red cedar
Novak 1989	New York	agricultural/pasture	16 of 17 nests in hawthorn
Poole 1992	Washington	shrub-steppe	big sagebrush and antelope bitterbrush most frequently used
Porter et al. 1975	Colorado	shortgrass prairie, pasture	77 nests: 70% in elm, willow, cottonwood, Russian olive
Smith 1990	Illinois	pasture, hay field	32 nests in 14 plant species; most used species was eastern red cedar (18% of nests)
Tyler 1994	Oklahoma	pasture	133 nests in 23 plant species: 31% osage orange; 13% hackberry; 11 % Chinese elm
Woods and Cade 1996	Idaho	shrub-steppe	65% sagebrush, 20% bitterbrush, 12% greasewood. (N=162 nests)
Yosef 1992a	Florida	pasture, fencelines	36% cabbage palm, 36% blackberry. (N=64 nests).

Table 2. Productivity of loggerhead shrikes as documented in studies across the species' range.

STUDY	STATE/ PROVINCE	TOTAL # OF NESTS	AVERAGE CLUTCH SIZE (N)[1]	% NEST SUCCESS[2] (N)[1]	YOUNG FLEDGED/ SUCCESSFUL NEST (N)[1]
Anderson and Duzan 1978	Illinois	13	5.2	72	3.9
Blumton 1989	Virginia	32	5.2	55 (19)	3.6 (19)
Brooks and Temple 1990b	Minnesota	46	5.7	73 (61)	NA[3]
Burton and Whitehead 1990	Indiana	107	5.7	57	4.6
Cely and Corontzes 1986	South Carolina	34	NA[3]	68	4.5 (23)
Chavez-Ramirez 1998	Texas	28	5.5	60	2.9
Collins 1996	Illinois	21	5.3	25	NA[3]
DeGeus 1990	Iowa	222	5.6	35	4.7
Gawlik and Bildstein 1990	South Carolina	49	5.3	65	4.7
Kridelbaugh 1982	Missouri	55	5.7	69	4.4
Leu and Manuwal 1996	Washington	110	median=6	66	NA[3]
Luukkonen 1987	Virginia	57	5.1 (53)	62	4.0 (46)
Novak 1989	New York	5	5.6	50	3.5
Poole 1992	Washington	59	5.9 (35)	57 (59)	5.1 (17)
Porter et al. 1975	Colorado	77	6.4	66	5.4
Siegel 1980	Alabama	37	5.0	43	4.0
Smith 1990	Illinois	32	NA[3]	44	3.2
Woods 1995b	Idaho	120	6.1 (84)	61 (112)	5.1 (65)
Yosef 1992a	Florida	64	3.8	42 (28)	NA[3]

1 N=sample size; indicated if different from "Total # of Nests."
2 Nest success was generally % of nests which successfully fledged at least one young. Note that not all authors indicated how nest success was calculated, and technique may differ among studies.
3 NA=Not Available

Table 3. State status, Breeding Bird Survey (BBS) trends, and Christmas Bird Count (CBC) trends for the loggerhead shrike in the continental United States.

STATE	STATE STATUS[1]	BBS TREND 1966-1998				CBC TREND 1959-1988			
		TREND[2]	P[3]	N[4]	RA[5]	TREND[2]	P[3]	N[4]	RA[5]
U.S. FISH AND WILDLIFE SERVICE REGION 1									
California	SC	-2.0	*	106	2.91	-1.3	**	130	3.49
Idaho	SC	-8.8	0.22	14	1.08	NA			
Nevada	Protected	-7.9	***	32	2.18	NA			
Oregon	SC	-3.4	**	21	0.83	1.5		27	0.23
Washington	Candidate	NA				-4.2	**	14	
U.S. FISH AND WILDLIFE SERVICE REGION 2									
Arizona		-4.5	*	42	2.16	-2.3	**	46	2.96
New Mexico		-6.9	***	50	3.50	-0.8		28	2.68
Oklahoma	SC	-4.9	***	57	3.34	-1.5	**	25	4.59
Texas		-3.7	***	124	2.66	-1.3	**	124	8.97
U.S. FISH AND WILDLIFE SERVICE REGION 3									
Illinois	T	-5.4	*	34	0.46	0.3		43	0.92
Indiana	E	NA				-0.7		23	0.10
Iowa	SC	-10.0	***	19	0.54	0.4		20	0.19
Michigan	E	NA				-0.6		16	0.02
Minnesota	T	NA				NA			
Missouri	WL	-7.0	***	48	1.74	-2.0	***	36	1.50
Ohio	E	NA				-0.5		28	0.04
Wisconsin	E	NA				NA			
U.S. FISH AND WILDLIFE SERVICE REGION 4									
Alabama		-7.6	***	71	1.90	-4.4	***	23	3.69
Arkansas		-7.5	***	28	1.49	-2.4	***	21	4.53
Florida		-3.2	***	73	5.55	-2.9	***	62	5.55
Georgia		-1.3	0.39	53	2.36	-2.0		29	4.43
Kentucky		-6.4	***	29	0.95	-0.6		17	1.07
Louisiana		-0.7	0.53	45	5.90	-0.6		23	8.38
Mississippi		-4.8	**	33	2.38	-2.0	*	18	4.79
N. Carolina	SC	-15.2	***	24	0.95	-6.6	***	44	2.03
S. Carolina	SC	-3.5	***	24	1.89	-4.3	***	18	3.26
Tennessee		-7.4	***	35	1.52	-1.2		29	3.01

Table 3 (continued). State status, Breeding Bird Survey (BBS) trends, and Christmas Bird Count (CBC) trends for the loggerhead shrike in the continental United States.

STATE	STATE STATUS[1]	BBS TREND 1966-1998				CBC TREND 1959-1988			
		TREND[2]	P[3]	N[4]	RA[5]	TREND[2]	P[3]	N[4]	RA[5]
U.S. FISH AND WILDLIFE SERVICE REGION 5									
Connecticut	(1 nest record)	NR				NA			
Delaware	(1 nest record)	NR				NA			
Maine	SC (last rec. 1963)	NA				NA			
Maryland	E	NA				-2.4	***	21	
Massachusetts	E (last rec. 1971)	NR				NA			
New Hampshire	E	NR				NA			
New Jersey	E	NR				-1.0		16	
New York	E	NA				-0.2		21	0.15
Pennsylvania	E	NA				0.5		21	0.08
Rhode Island	(no nest records)	NR				NA			
Vermont	E (last rec. 1978)	NR				NA			
Virginia	T	-6.3	0.31	18	0.21	-4.0	***	52	0.66
West Virginia	SC	NA				NA			
U.S. FISH AND WILDLIFE SERVICE REGION 6									
Colorado		3.7	0.11	42	1.75	-2.6	***	20	0.35
Kansas		-2.3	**	39	3.42	-1.1		39	1.16
Montana		0.00	0.99	24	1.46	NA			
Nebraska		-0.9	0.79	42	1.77	NA			
North Dakota		-0.7	0.71	26	0.97	NA			
South Dakota		-0.5	0.70	36	1.71	NA			
Utah		4.7	0.28	29	1.35	-1.4	**	16	0.88
Wyoming		-1.4	0.53	60	1.21	NA			

1 STATE STATUS: E=endangered, T=threatened, SC=special concern, WL=watch list. A blank indicates no specific designation in the state. Notations in parenthesis refer to the total number of nesting records or the last nesting record.
2 TREND: average percent annual change; NA=inadequate sample size; NR=no BBS records
3 P: statistical significance of the trend (probability that the trend is equal to zero):
* = $0.05 \leq P < 0.10$; ** = $0.01 \leq P < 0.05$; *** = $P < 0.01$
Blank indicates that $P > 0.10$ for CBC; for BBS trends, P values ≥ 0.10 are reported.
4 N: number of routes (counts) used in the analysis
5 RA: relative abundance (mean number of birds recorded per route per year)

Table 4. Threats to loggerhead shrike populations reported by state natural resource agencies and/or species experts. (Note that an answer of yes does not necessarily indicate that the factor is a documented threat to the continued existence of the species in the state, but that the factor has been or is potentially a cause of population declines). "Not noted" indicates that a particular threat was not noted; "not reported" indicates that no information was provided regarding threats. See Appendix I for details.

STATE	HABITAT	OVER-UTILIZATION	DISEASE/ PREDATION	REGULATORY	OTHER
U.S. FISH AND WILDLIFE SERVICE REGION 1					
California	yes	unknown	unknown	unknown	unknown
Idaho	yes	not noted	not noted	not noted	not noted
Nevada	not noted	not noted	not noted	not noted	pesticides
Oregon	yes	not noted	not noted	not noted	not noted
Washington	yes	not noted	not noted	not noted	not noted
U.S. FISH AND WILDLIFE SERVICE REGION 2					
Arizona	yes	unknown	unknown	unknown	pesticides
New Mexico	unknown	no	no	no	pesticides
Oklahoma	yes	no	no	no	vehicles
Texas	yes	no	predation[a]	not noted	pesticides/vehicles
U.S. FISH AND WILDLIFE SERVICE REGION 3					
Illinois	yes	no	no	yes[b]	pesticides
Indiana	yes	no	predation[a]	yes[b]	yes[c]
Iowa	not noted	not noted	predation[a]	not applicable	not noted
Michigan	yes	no	no	no	low density[c]
Minnesota	yes	no	no	no	pesticides
Missouri	yes	no	no	no	no
Ohio	yes	not noted	not noted	not noted	not noted
Wisconsin	yes	no	no	no	pesticides
U.S. FISH AND WILDLIFE SERVICE REGION 4					
Alabama	yes	not noted	not noted	not noted	pesticides
Arkansas	yes	not noted	not noted	not noted	not noted
Florida	yes	no	no	not noted	pesticides/vehicles
Georgia	yes	not noted	not noted	not noted	pesticides
Kentucky	no	no	no	no	no
Louisiana	yes	not noted	not noted	not noted	pesticides
Mississippi	not reported	not reported	not reported	not reported	not reported
N. Carolina	yes	no	disease	not applicable	pesticides
S. Carolina	yes	not noted	not noted	not noted	not noted
Tennessee	yes	not noted	not noted	not noted	not noted

Table 4 (continued). Threats to loggerhead shrike populations reported by state natural resource agencies and/or professionals. (Note that an answer of yes does not necessarily indicate that the factor is a documented threat to the continued existence of the species in the state, but that the factor has been or is potentially a cause of population declines). See Appendix I for details.

STATE	HABITAT	OVER-UTILIZATION	DISEASE/ PREDATION	REGULATORY	OTHER
U.S. FISH AND WILDLIFE SERVICE REGION 5					
Connecticut	not noted	not noted	not noted	not noted	not noted
Delaware	not applicable	not applicable	not applicable	not applicable	not applicable
Maine	yes	not noted	not noted	no	not noted
Maryland	yes	not noted	not noted	not noted	vehicles
Massachusetts	not reported	not reported	not reported	not reported	not reported
New Hampshire	not noted	not noted	not noted	not noted	not noted
New Jersey	not reported	not reported	not reported	not reported	not reported
New York	yes	no	no	no	yes[c]
Pennsylvania	yes	yes	no	yes[b]	not noted
Rhode Island	not noted	not noted	not noted	not noted	not noted
Vermont	not reported	not reported	not reported	not reported	not reported
Virginia	yes	no	predation[a]	no	unknown
West Virginia	yes	not noted	predation[a]	not noted	pesticides
U.S. FISH AND WILDLIFE SERVICE REGION 6					
Colorado	yes	not noted	not noted	not noted	pesticides/weather
Kansas	yes	not noted	not noted	not noted	not noted
Montana	yes	no	no	no	pesticides
Nebraska	not reported	not reported	not reported	not reported	not reported
North Dakota	yes	not noted	not noted	not noted	pesticides
South Dakota	yes	not noted	not noted	not noted	pesticides
Utah	yes	no	no	no	no
Wyoming	no	no	no	no	no

a: Texas - predation may be a problem for urban shrikes
Indiana, Iowa - predation may be exacerbated because shrikes favor linear roadside habitats
Virginia, West Virginia - predation by raptors in winter may be a major cause of mortality
b: No existing regulatory mechanism to protect habitat, even though the species is state endangered
c: Indiana - vehicles, pesticides, inter-specific competition
Michigan - shrike population density too low for males to find mates
New York - vehicles, pesticides, weather

Figure 1. Breeding ranges of 11 subspecies of loggerhead shrike (Lanius ludovicianus) based on Miller (1931). Areas between adjacent subspecies are potential zones of intergradation.

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APPENDIX I

SUMMARIES OF RESPONSES TO THE LOGGERHEAD SHRIKE STATUS ASSESSMENT QUESTIONNAIRE IN THE UNITED STATES (ARRANGED BY U.S. FISH AND WILDLIFE SERVICE REGIONS) AND CANADA

North American Breeding Bird Survey (BBS) trends reported are average % change/year
P: measure of statistical significance of the trend (actual P values reported)
N: number of routes used in calculating the trend

Christmas Bird Count (CBC) trends reported are average % change/year
Significance (corresponding P values): * :P < 0.10, ** :P < 0.05, *** :P < 0.01
"NO" indicates CBC trend is not statistically significant
N: number of circles (counts) used in calculating the trend

U.S. FISH AND WILDLIFE SERVICE REGION 1

California, Idaho, Nevada, Oregon, Washington

CALIFORNIA

Historic and Current Range of the Loggerhead Shrike

Grinell and Miller (1944) mapped distribution of loggerhead shrike in California as statewide, except at some high elevations. A comparison with a range map produced by the California Department of Fish and Game in 1989 indicates little change in the distribution of the species. The species is resident year-round, except for northern California where some of the breeding population is migratory (Grinell and Miller 1944).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -2.0 P=0.06 N=106
BBS Trend 1966-1979: -6.5 P=0.01 N= 79
BBS Trend 1980-1998: -0.7 P=0.50 N= 92

BBS sample sizes are adequate to estimate statewide trends.

Other than BBS data, no trend information is available for breeding population.

CBC Trend 1959-1988: -1.3 Significance ** N=130

State Legal Status

California Bird Species of Special Concern, an administrative designation assigned to those species which are experiencing, or have experienced, a population decline or range contraction. The California Department of Fish and Game is in the process of revising this list, and preliminary review suggests loggerhead shrike may no longer warrant special concern status in the state (John Carlson, Jr., California Department of Fish and Game, pers. comm.).

Current Research and Monitoring

The California Department of Fish and Game has issued 6 Scientific Collecting Permits for individuals conducting research on the species since 1992; however, the nature of the research was not noted (J. Carlson, Jr., pers. comm.).

Some information is gathered through the Monitoring Avian Productivity and Survivorship program, but loggerhead shrike is not a targeted species and most of the program's sampling stations are located outside of grassland or open shrubland habitats.

Considerable research has been conducted on the Federally-endangered subspecies *L.l. mearnsi* (San Clemente Island loggerhead shrike), which occurs on San Clemente Island, California.

J. Carlson, Jr. (pers. comm.) noted that a status assessment has been conducted on *L.l. anthony*i (citation

not provided).

Threats to the Loggerhead Shrike in the State

J. Carlson, Jr. (pers. comm.) noted: "The lack of research activities in California, coupled with the perception of abundance in the birding community, have led to a lack of research and management focus on this species. Consequently, with the exception of habitat loss, the relative importance of threat factors is unknown."

Habitat Requirements and Condition

The California Department of Fish and Game maintains the California Wildlife Habitat Relationship System, a computerized database of predictive habitat models for terrestrial vertebrates, including loggerhead shrike. Habitat types rated as having medium to high value for breeding loggerhead shrikes include: Blue Oak Woodland, Coastal Oak Woodland, Desert Riparian, Joshua Tree, Juniper, Pinyon-Juniper, and Valley Oak Woodland. J. Carlson, Jr. (pers. comm.) further noted that loggerhead shrikes use a variety of open to sparsely-vegetated habitats, including urban and commercial areas. For example, shrikes have been observed nesting in ornamental trees associated with business parks provided that adjacent open grasslands are available.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), 3 continental and 2 island subspecies occur in California. *L.l. gambeli* (California loggerhead shrike) inhabits the northeastern plateaus, central valley, and southern and central coastal plains. *L.l. nevadensis* (Nevada loggerhead shrike) inhabits the Mojave Desert Region. *L.l. sonoriensis* (Sonora loggerhead shrike) occupies the southeast Sonoran Desert Region. *L.l. mearnsi* (San Clemente Island loggerhead shrike) and *L.l. anthonyi* (Island loggerhead shrike) are found on islands off the coast of Southern California.

Subspecific taxonomic designations by Miller (1931) were based on morphometrics. J. Carlson, Jr. (pers. comm. *citing* Mundy and Woodruff in press) noted that DNA analysis supported the treatment of *L.l. mearnsi* as a separate taxon. However, he further noted that some ornithologists have demonstrated a loss of the morphometric characteristics originally separating *L.l. mearnsi* from *L.l. anthonyi*, presumably the result of interbreeding between these subspecies.

Loggerhead Shrike Conservation Activities in the State

No large scale activities are known, but designation with State Special Concern status since 1992 may have resulted in more consideration of shrike habitat (J. Carlson, Jr., pers. comm.).

IDAHO

Historic and Current Range of the Loggerhead Shrike

The loggerhead shrike breeds throughout the Snake River Plain of southern Idaho in suitable habitat (Groves et al. 1997). Historic range was probably coextensive with the distribution of big sage shrub-steppe habitat, the preferred habitat in Idaho (Tom Cade, Peregrine Fund, pers. comm.). Woods (1995a) observed that loggerhead shrikes breeding in southern Idaho may be confined to areas below 1,675 m, and usually below 1,525 m. Most Idaho loggerhead shrikes migrate south in fall, but a few overwinter in

woody, protected valleys (T. Cade, pers. comm.).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: - 8.8 P=0.22 N=14
BBS Trend 1966-1979: trend not available
BBS Trend 1980-1998: -14.8 P=0.08 N=14

BBS sample sizes are adequate to estimate statewide trends.

Idaho Department of Fish and Game (1992) noted that of 119 migratory landbirds found in Idaho, that BBS trends indicated significant declines for 7, including the loggerhead shrike.

Other than BBS data, there are no statewide data available to estimate population trends. Woods (1995a) estimated population densities for 2 study areas in southern Idaho.

State Legal Status

Species of Special Concern (Charles Harris, Idaho Fish and Game Department, pers. comm.).

Current Research and Monitoring

No known research since work conducted by Woods (1995a) in 1991-1992.

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Destruction of shrub-steppe habitat has contributed to declines in loggerhead shrike populations in Idaho (Woods 1995a; C. Harris and T. Cade, pers. comms.). Idaho's sagebrush habitats have been altered by increased frequency of wildfire and subsequent invasion by exotic plants, which displace native bunchgrasses and shrubs (C. Harris, pers. comm.). In 1992, it was reported that nearly 2 million acres, approximately 20% of Idaho's shrub-steppe rangelands, had burned in the previous decade (Idaho Department of Fish and Game 1992). Conversion of shrub-steppe habitats for grazing, agriculture, and development has also resulted in the loss of habitat for loggerhead shrikes (Woods 1995a; C. Harris and T. Cade, pers. comms.). Woods (1995a) estimated that over 65% of the big sagebrush habitat historically covering the Snake River Plain has been lost.

No other threats were noted.

Habitat Requirements and Condition

In Idaho, loggerhead shrikes are primarily associated with sagebrush habitats in the Snake River Plain. Most shrike habitat occurs on public land, much of it on Bureau of Land Management (BLM) lands.

Woods and Cade (1996) evaluated nesting habits of the loggerhead shrike in southwest Idaho's sagebrush rangelands. Overall, they described loggerhead shrike as being somewhat general in selection of nest sites, and suggested that variables other than nest sites, such as foraging perches, may be more important in defining suitable habitat in sagebrush-scrub habitat.

High densities of loggerhead shrikes documented by Woods (1995a) in relatively undisturbed shrub-

steppe habitats in Idaho point to importance of protection of remaining high quality shrub-steppe areas. Woods and Cade (1996) concluded that the preservation of Idaho's sagebrush rangelands will be important to the long-term survival of the loggerhead shrike in the state. Saab and Rich (1997) also considered protection of shrub-steppe habitats as critical for conservation of migratory land birds in the interior Columbia River Basin.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrikes in Idaho are *L.l. gambeli*, possibly with intergradation with *L.l. nevadensis* along the southern boundary. C. Harris (pers. comm. *citing* Burleigh 1972) noted that specimens typical of *L.l. excubitorides* have been collected in northern Idaho.

Loggerhead Shrike Conservation Activities in the State

C. Harris (pers. comm.) noted that implementation of the sage grouse conservation strategy is likely to benefit loggerhead shrike. Idaho Partners in Flight (PIF) is developing a shrub-steppe habitat conservation plan. Bird species associated with shrub-steppe habitats in Idaho, including loggerhead shrike, Brewer's sparrow, and vesper sparrow, are experiencing population declines in the state (Idaho Department of Fish and Game 1992).

NEVADA

Historic and Current Range of the Loggerhead Shrike

Loggerhead shrike occurs statewide in Nevada; northern populations are migratory (Gary Herron, Nevada Division of Wildlife, pers. comm.).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: - 7.9 P=0.00 N=32
BBS Trend 1966-1979: -11.9 P=0.03 N=17
BBS Trend 1980-1998: - 1.9 P=0.57 N=20

BBS sample sizes are adequate to estimate statewide trends. However, G. Herron (pers. comm.) noted that BBS data may not accurately reflect the status of the species in the state. Numerous areas with relatively high population densities are not represented by existing BBS routes. Additional routes are being established in northern Nevada.

State Legal Status

Loggerhead shrike is listed as "Protected" under State law; this confers protection from take of adults, young, or eggs. However, this designation provides no protection of nesting habitat, nor does it require any special consultation with regard to land use (G. Herron, pers. comm.).

Current Research and Monitoring

G. Herron (pers. comm.) noted that automobile survey routes were established in northern Nevada from 1993 through 1995, but have not been resurveyed since they were established. Based on these surveys, it was noted that northeastern Nevada supported a "healthy" population of loggerhead shrikes, although the

species was sparsely distributed.

The 1999 field season was the third year for the Nevada Breeding Bird Atlas (BBA), which will provide additional information on loggerhead shrikes in the state.

Threats to the Loggerhead Shrike in the State

Other natural or manmade factors affecting its continued existence: G. Herron (pers. comm.) noted: "Large acreages of Nevada are periodically sprayed with pesticides to control grasshoppers and crickets. It is suspected that these large scale pesticide applications are affecting shrikes and numerous other birds that feed heavily on these insects when they are available."

No other threats were noted.

Habitat Requirements and Condition

Shrikes occur in shrubland habitats in valley bottoms and alluvial fans up to mountain range fault lines; these habitats occur primarily on public lands. Habitat condition is highly variable due to differences in land use and grazing management (G. Herron, pers. comm.).

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrikes in Nevada are *L.l. nevadensis*, with a zone of integration with *L.l. gambeli* at the northern edge of the state. G. Herron (pers. comm. *citing* Linsdale 1951) noted that *L.l. sonoriensis* has also been documented in the state.

Loggerhead Shrike Conservation Activities in the State

The loggerhead shrike is under consideration as a Species of Concern under the Nevada PIF program; this designation would result in additional management consideration for the species in the state (G. Herron, pers. comm.).

OREGON

Historic and Current Range of the Loggerhead Shrike

Marshall et al. (1996): "The loggerhead shrike occurs in lowland steppe habitats east of the Cascade Range in Oregon; rare west of the Cascade Range but recorded annually. Uncommon in winter; most Oregon birds suspected to winter in California and Mexico."

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -3.4 P=0.02 N=21
BBS Trend 1966-1979: 0.2 P=0.93 N= 9
BBS Trend 1980-1998: -1.8 P=0.44 N=18

BBS state trends are typically estimated for species observed on a minimum of 14 routes. Note that the trend for Oregon for the 1966-1979 period is based on an inadequate sample.

BBS data indicate a decline in Oregon since initiation of the survey. However, in shrub-steppe habitats of southeastern Oregon, no decline is evident since roadside counts were initiated in 1975; these counts indicate a fluctuating population (Marshall et al. 1996). Unpublished data suggest variability may be related to weather, specifically rainfall (Marshall et al. 1996).

CBC Trend 1959-1988: 1.5 Significance: NO N=27

State Legal Status

Special Concern (Marshall et al. 1996).

Current Research and Monitoring

Marshall et al. (1996) discussed roadside counts in Oregon which included loggerhead shrike, but we are not aware of any report on these counts.

Threats to the Loggerhead Shrike in the State

No specific information was provided, although loss and degredation of shrub-steppe habitats in the interior Columbia River Basin has been documented (Saab and Rich 1997).

Habitat Requirements and Condition

Loggerhead shrike in eastern Oregon is found mainly in sagebrush and juniper-steppe (Marshall et al. 1996). Csuti et al. (1997) noted that loggerhead shrikes occur in most open vegetation types provided that occasional tall shrubs or trees are present, including very open pine or oak woodlands.

Marshall et al. (1996) wrote: "The apparent stabilization of populations in southeast Oregon may reflect the relatively small proportion of shrub-steppe habitat that has been converted to cropland there as compared to eastern Washington and other areas."

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), loggerhead shrikes breeding in Oregon would be assigned to *L.l. gambeli*, with a zone of intergration with *L.l. nevadensis* in the southeast corner of the state.

Loggerhead Shrike Conservation Activities in the State

None

WASHINGTON

Historic and Current Range of the Loggerhead Shrike

Eastern Washington is the northwestern edge of the range of the loggerhead shrike. The species breeds east of the Cascade Mountains, but is rare west of that mountain range. Smith et al. (1997) noted that the species was more widespread in eastern Washington prior to massive conversion of shrub-steppe habitats to agriculture.

Loggerhead shrikes were present year-round at Poole's (1992) southcentral Washington study area (Hanford Site, U.S. Department of Energy), but were less abundant in winter. It appeared that the breeding population was migratory, and that the loggerhead shrikes present in winter were migrants from elsewhere.

Smith et al. (1997) described the species as a common nester in protected shrub-steppe habitats at the Hanford Site and Yakima Training Center.

Historic and Current Population Estimates and/or Trends

Between 1966-1996, loggerhead shrike was represented by 270 birds on 19 BBS routes in Washington. Data are inadequate to estimate state trends.

Saab and Rich (1997) reported a 2.7% annual decline ($P<0.05$) between 1968-1994 based on BBS data for the interior Columbia River Basin.

Project Shrike (1993-94) developed baseline data on loggerhead shrike breeding density in shrub-steppe habitat of eastern Washington (McConnaughey and Dobler 1994). A repeated survey of this nature will be required to document shrike population levels and trends in eastern Washington (Matthew Vander Haegen, Washington Department of Fish and Wildlife, pers. comm.).

CBC Trend 1959-1988: -4.2 Significance ** N=14

State Legal Status

State Candidate (Washington Department of Fish and Wildlife 2000).

Current Research and Monitoring

Project Shrike was initiated by the Washington Department of Fish and Wildlife in 1993 to: 1) develop survey techniques for loggerhead shrike; 2) obtain baseline loggerhead shrike population data in shrub-steppe habitat of eastern Washington; and 3) locate breeding territories for future research. Surveys were conducted in 1993 and 1994; results are reported by McConnaughey and Dobler (1994).

Leu and Manuwal (1996) studied the breeding and foraging ecology of loggerhead shrike in the shrub-steppe habitat on the Yakima Training Center in southcentral Washington. Nesting habitat was thoroughly characterized. Foraging habitat of both adults and juveniles was also characterized. Recommendations for conservation of loggerhead shrike at the site were provided.

Poole (1992) studied reproductive success and nesting habitat of loggerhead shrike in the shrub-steppe habitat on the Department of Energy's Hanford Site in southcentral Washington. She characterized nest sites and nest success based on an analysis of 297 nesting territories. She found loggerhead shrike densities at Hanford were 12-19 times greater than in the remainder of eastern Washington and concluded that the nesting habitat at the site was saturated. Recommendations based on research results were provided.

Vander Haegen et al. (2000) documented the abundance of shrub-steppe passerines relative to landscape and habitat variables in Washington. Loggerhead shrikes were significantly more abundant in sandy soil shrub-steppe communities compared to loamy and shallow soil shrub-steppe communities. Shrikes did not vary in abundance among sites in good, fair, and poor range condition (an index of the proportion of

exotic versus native plants in the herbaceous understory).

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: M. Vander Haegen (pers. comm.) noted: "Conversion of shrub-steppe to agriculture and urban/suburban development is likely the dominant cause of habitat loss for shrikes in eastern Washington. Shrub-steppe communities on loamy and sandy soils have been converted at a disproportionally high rate (a trend that will likely continue), indicating greater loss of habitat for species that prefer communities on these soil types."

No other threats were noted.

Habitat Requirements and Condition

Poole (1992) characterized shrub-steppe habitat used by loggerhead shrike at the Hanford site.

Vander Haegen et al. (2000) documented that loggerhead shrikes were significantly more abundant in sandy soil shrub-steppe communities compared to loamy and shallow soil shrub-steppe communities.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrikes in Washington are *L.l. gambeli*.

Loggerhead Shrike Conservation Activities in the State

None noted.

U.S. FISH AND WILDLIFE SERVICE REGION 2

Arizona, New Mexico, Oklahoma, Texas

ARIZONA

Historic and Current Range of the Loggerhead Shrike

The loggerhead shrike breeds nearly statewide in suitable habitat. Historic and current range are considered similar. Throughout most of its range in the state, the species is a year-round resident, except that numbers are reduced in winter in the northern third of the state (primarily above 5,000 ft).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -4.5 P=0.07 N=42
BBS Trend 1966-1979: -8.6 P=0.56 N=20
BBS Trend 1980-1998: -5.4 P=0.00 N=38

BBS data for Arizona suggest that the population is declining. Troy Corman (Arizona Game and Fish

Department, pers. comm.) characterized the population as stable.

1993-1997 data from the Arizona BBA confirm widespread distribution of the species.

CBC Trend 1959-1988: -2.3 Significance ** N=46

State Legal Status

None

Current Research and Monitoring

None

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Factors contributing to loss and degradation of habitat include: urban sprawl and development; agriculture; local nest tree damage by wild burros, especially in drought years; and wild fires in Sonoron desert habitat (T. Corman, pers. comm.).

Other natural or manmade factors affecting its continued existence: Pesticide use for agriculture may be a problem (T. Corman, pers. comm.).

Other threats to the species were characterized as unknown.

Habitat Requirements and Condition

T. Corman (pers. comm.) noted that loggerhead shrike nest success in Arizona is highly variable; nesting conditions are much more favorable during years with higher precipitation during fall and winter.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), the subspecies *L.l. nevadensis* breeds in northern Arizona, *L.l. sornoriensis* breeds in southern Arizona, and there is a broad zone of intergradation between the 2 subspecies across the central portion of the state. *L.l. gambeli* winters statewide (T. Corman, pers. comm.).

Loggerhead Shrike Conservation Activities in the State

No perceived need for conservation activities directed at loggerhead shrikes in the state (T. Corman, pers. comm.).

NEW MEXICO

Historic and Current Range of the Loggerhead Shrike

The check-list of the birds of New Mexico (Hubbard 1978) listed the loggerhead shrike as: "Resident statewide (less numerous and less widespread in winter in the north); rare to fairly common in more open habitats ... at lower and (locally) middle elevations. Casual at higher elevations." Ligon (1961) noted

that the species breeds at elevations up to 7,000 feet in the state. Generalized distribution information is reliable and current (Sartor Williams, New Mexico Dept. of Game and Fish, pers. comm.).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -6.9 P=0.00 N=50
BBS Trend 1966-1979:-10.4 P=0.01 N=22
BBS Trend 1980-1998: -3.8 P=0.00 N=46

BBS sample sizes are considered adequate to estimate state trends. No statewide population estimates are available (S. Williams, pers. comm.). BBS trends indicate that populations have steadily declined since initiation of the survey.

CBC Trend 1959-1988: -0.8 Significance: NO N=28

State Legal Status

The species is not State-listed as threatened or endangered, but songbirds are specifically protected from being "trapped, killed or injured" by state regulations (S. Williams, pers. comm.).

Current Research and Monitoring

None (S. Williams, pers. comm.).

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Degree of habitat loss is unknown. Suitable habitat does not currently appear limiting (S. Williams, pers. comm.).

Overutilization for commercial, recreation, scientific, or educational purposes: No

Disease or predation: No indication of a problem.

Inadequacy of existing regulatory mechanisms: No.

Other natural or manmade factors affecting its continued existence: Possibly pesticides, including herbicides used to control brush on rangelands (S. Williams, pers. comm.).

Habitat Requirements and Condition

Loggerhead shrikes breed in a variety of habitats in New Mexico, including mesquite grasslands, desert grasslands, open riparian area, juniper savannahs, rows of trees in agricultural areas, yucca grasslands, and creosote bush deserts (S. Williams, pers. comm.). Bailey (1928) noted that thorny trees were favored nest sites, including yucca, mesquite, and osage orange.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), *L.l. excubitorides* breeds along the eastern border of New Mexico, *L.l. nevadensis* breeds in the northwest corner, *L.l. sornoriensis* breeds in the southwest; there is potential for intergradation among the 3 subspecies across most of the state. However, note that *L.l. nevadensis* is not

widely recognized (AOU 1957, Rand 1960) and many authorities include *L.l. sonoriensis* with *L.l. excubitorides*.

Loggerhead Shrike Conservation Activities in the State

No conservation activities have targeted shrikes. However, New Mexico PIF considers it a priority species and this may result in increased management attention for the species (S. Williams, pers. comm.).

OKLAHOMA

Historic and Current Range of the Loggerhead Shrike

Both historic and current breeding distribution of loggerhead shrikes in Oklahoma are statewide; the species is well distributed in the western half of the state and has patchy distribution in the more heavily forested eastern half. The species also winters throughout the state, although individuals are not necessarily resident at a given location (Mark Howery, Oklahoma Department of Wildlife Conservation, pers. comm.).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -4.9 P=0.00 N=57
BBS Trend 1966-1979: -3.1 P=0.01 N=33
BBS Trend 1980-1998: -4.7 P=0.00 N=55

BBS sample sizes are adequate to estimate statewide trends. A statewide monitoring program would likely yield additional information (M. Howery, pers. comm.).

BBS data are the only state population trend data available. M. Howery (pers. comm.) noted that the population decline documented by BBS probably reflects the population trend for the eastern half of the state, but that western Oklahoma has "not experienced a significant population change."

CBC Trend 1959-1988: -1.5 Significance ** N=25

State Legal Status

Special Concern. Designation does not afford the species any additional protection beyond MBTA protections, but it does raise the funding priority of shrikes by the Oklahoma Wildlife Diversity Program (M. Howery, pers. comm.).

Current Research and Monitoring

The Oklahoma Wildlife Diversity Program is currently providing partial funding for a study of loggerhead shrike breeding territory mapping and distribution in Comanche County, where the species is fairly common.

Tyler (1994) studied nest site selection by loggerhead shrike in southwestern Oklahoma from 1985-1988; 133 shrike nests were located in 23 species of woody plants.

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Forest land is increasing in eastern Oklahoma as a result of fire suppression and abandonment of "family farms." "Many of the pastures previously occupied by shrikes were the result of forest clearing. The declines we are now experiencing in eastern Oklahoma may be a return to the presettlement shrike distribution and population size (M. Howery, pers. comm.)."

Other natural or manmade factors affecting its continued existence: Increased mortality as a result of increased vehicular traffic and speed may be an overlooked human-created source of mortality.

Other potential threats were not considered limiting to shrikes.

Habitat Requirements and Condition

Loggerhead shrikes occur in tallgrass, mixed grass and shortgrass prairies, as well as mesquite and shinnery oak savannahs in Oklahoma. Much of the mixed and shortgrass prairie has been converted to cropland. Most remaining shrike habitat is privately owned ranchland. Shrikes occur in several man-made habitats, including airports, but the number of birds in these habitats is small.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), *L.l. migrans* breeds throughout most of Oklahoma, with intergradation to *L.l. excubitorides* in the western half of the state.

Loggerhead Shrike Conservation Activities in the State

No management projects have targeted shrikes.

TEXAS

Historic and Current Range of the Loggerhead Shrike

The loggerhead shrike is a widespread year-round resident in Texas. With the exception of extreme southern Texas, the species breeds, or has bred, throughout the state (Mark Lockwood, Texas Parks and Wildlife Dept., pers. comm.).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -3.7 P=0.00 N=124
BBS Trend 1966-1979: -2.2 P=0.17 N= 78
BBS Trend 1980-1998: -3.3 P=0.00 N=115

While BBS sample sizes are considered adequate to estimate statewide trends, coverage is not uniform across the state and there are gaps in coverage, particularly in south and west Texas (Felipe Chavez-Ramirez, Texas A&M University, pers. comm.).

BBS documents significant statewide population declines for loggerhead shrike in Texas; however, trends are not uniform across the state. Peterjohn and Sauer (1995) analyzed BBS trends by

physiographic strata for the period 1966-1993; they noted that (continentwide) the Edwards Plateau of Texas was the only strata that supported shrike breeding populations that were significantly increasing (average rate of 7.0% annually, P>0.01).

Texas PIF evaluated loggerhead shrike population trends in 9 physiographic regions in Texas (Riley 1996). Shrike populations were considered stable in 7 and declining in 2.

CBC Trend 1959-1988: -1.3 Significance ** N=124

State Legal Status

No State status.

Current Research and Monitoring

F. Chavez-Ramirez (pers. comm.) has initiated a broad survey of shrike ecology in south Texas. Components of this study include: 1) evaluating nest success and productivity in urban areas; 2) conducting year-round monthly road surveys on coastal grasslands and south Texas brushlands; 3) evaluating wintering ecology of loggerhead shrike in coastal grasslands relative to perch use and competitive interactions with American kestrels; and 4) trapping and banding shrikes to determine the proportion of migratory versus resident birds during winter months.

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Changing land use practices have no doubt affected shrikes in Texas, but changes have not been sufficient to be considered a threat to the continued existence of the species in the state (M. Lockwood, pers. comm.).

Overutilization for commercial, recreation, scientific, or educational purposes: Not considered a factor (F. Chavez-Ramirez, pers. comm.).

Disease or predation: Predation of nests and nestlings appears to be a problem for urban-nesting shrikes in south Texas. In Kingsville, Texas, nest predation at all stages combined was 40% during the spring and summer of 1997; feral cats appear to be one of the most significant predators (F. Chavez-Ramirez, pers. comm.). S. Craig (pers. comm.) noted that in her shrike research she noted markedly fewer young shrikes (relative to the number of adults) along the Gulf Coast of Texas, compared to other populations she had studied. She suggested that nest and fledgling predation by great-tailed grackles (*Quiscalus mexicanus*) may contribute to the low young:adult ratio, but noted that documentation was needed.

Inadequacy of existing regulatory mechanisms: Not noted.

Other natural or manmade factors affecting its continued existence: Pesticide impacts considered likely (F. Chavez-Ramirez, pers. comm.).

Collisions with vehicles may also be a significant threat. Flickinger (1995) counted road-killed birds along a 6.4 km stretch of road in the coastal plain of southern Texas between 1970-1987. Shrikes accounted for 101 of the 1,329 avian fatalities, and, depending on year, ranked third to sixth in frequency of mortality among all species. F. Chavez-Ramirez (pers. comm.) has also observed large numbers of dead shrikes on roads in south and west Texas.

Habitat Requirements and Condition

Shrikes use a wide range of vegetation associations in Texas, ranging from deserts to coastal grasslands. Potential habitat is widespread and occurs mostly on private land. In south Texas, park-like settings with scattered trees and short grass (city parks, university campus, cemeteries, etc.) appear to be favored by nesting shrikes (F. Chavez-Ramirez, pers. comm.). S. Craig (pers. comm.), based on research conducted in Texas, also commented that shrikes in that state appear to be "adapting to life in suburbia." During winter months, shrikes appear to be more evenly distributed between urban park-like settings and natural vegetation associations.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrikes in most of Texas are assigned to *L.l. excubitorides*, with intergradation with *L.l. migrans* in the east and with *L.l. sonoriensis* in the west. M. Lockwood (pers.comm.) noted that in addition to these 3 subspecies, *L.l. ludovicianus* and *L.l. gambeli* have been identified (based on specimens) in the state; the season in which these specimens were collected was not indicated.

Loggerhead Shrike Conservation Activities in the State

None noted.

U.S. FISH AND WILDLIFE SERVICE REGION 3

Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, Wisconsin

ILLINOIS

Historic and Current Range of the Loggerhead Shrike

Historic data indicate that the loggerhead shrike was once distributed statewide in Illinois, but had disappeared from the northern and central portions of the state between 1965-1972 (Graber et al. 1973). Roadside surveys in 1990 confirmed that loggerhead shrike was largely confined to the southern third of the state and had not changed substantially since the early 1970s. Graber et al. (1973) described the loggerhead shrike as a regular winter bird in southern Illinois, but noted that it is not known if these birds represent a nonmigratory remnant breeding population, winter migrants, or a combination. James Herkert (Illinois Endangered Species Protection Board, pers. comm.) noted that the loggerhead shrike is still relatively common in southern Illinois in winter, and occasional elsewhere in the state.

The Illinois BBA (1986-1991) found loggerhead shrikes to occur as confirmed or probable breeders in 187 of 1,287 (14.5%) atlas blocks statewide, including records in 69 of the state's 102 counties. J. Herkert (pers. comm.) noted that BBS data suggest that loggerhead shrike populations in northern Illinois were unusually high during the BBA period; a result which does not accurately reflect loggerhead shrike distribution in the state. Since the BBA ended, there have been fewer breeding loggerhead shrikes in northern Illinois.

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -5.4 P=0.07 N=34
BBS Trend 1966-1979: -5.6 P=0.38 N=20
BBS Trend 1980-1998: -3.1 P=0.14 N=29

Reports that shrike populations in northern and central Illinois were declining began as early as 1910 (Graber et al. 1973). Graber et al. (1973) reported that the number of shrikes observed on a roadside survey of a 36 square-mile agricultural area in central Illinois declined from 13 pairs of shrikes in 1957 to zero in 1966. J. Herkert (pers. comm.) noted that while the species does still occur in northern and central Illinois, it is at much lower densities than in the southern part of the state.

BBS data confirm that shrike populations have continued to decline in recent years. In 1996, Illinois recorded only 10 shrikes on BBS routes in Illinois, the fewest ever recorded. The 1996 total is about 66% below the 30 year average of 30 birds for the state's core 64 routes. Range and population estimates are reasonably reliable and current; additional surveys are not needed to determine the status of the species in the state (J. Herkert, pers. comm.).

CBC Trend 1959-1988: 0.3 Significance: NO N=43

CBC data document declines in wintering shrikes in Illinois. Preliminary trend analysis of CBC data show loggerhead shrikes to be declining at a rate of nearly 4% per year between 1966-1995 (J. Herkert, pers. comm.).

State Legal Status

State Threatened. Take of individuals is prohibited, but habitat protection is limited (J. Herkert, pers. comm.).

Current Research and Monitoring

Breeding shrike populations are monitored at Midewin National Tallgrass Prairie (Will County) and at Prairie Ridge State Natural Area (Jasper County). At Midewin, nest success of 6-15 pairs of shrikes has been monitored annually since 1994 (J. Herkert, pers. comm.).

Threats to the Loggerhead Shrike in the State

Source of information on threats is J. Herkert (pers. comm.) unless otherwise noted.

The present or threatened destruction, modification, or curtailment of its habitat or range: Graber et al. (1973) noted that there were 2 phases in the disappearance of shrikes from northern and central Illinois. A relatively slow decline beginning around 1900, probably related to the removal of hedgerows, and a very rapid decline from 1957-1965 from unknown causes.

J. Herkert stated that habitat loss is "undoubtedly the biggest problem for nesting shrikes in Illinois." He noted that in a 1995-1996 study, approximately 20-30% of nest sites used in 1995 were destroyed prior to the 1996 breeding season.

Overutilization for commercial, recreation, scientific, or educational purposes: Not a factor.

Disease or predation: Probably not a factor. However, Collins (1996) evaluated breeding and wintering ecology of the loggerhead shrike in southern Illinois and documented that predation was the most common cause of nest failure.

Inadequacy of existing regulatory mechanisms: There is no existing regulatory mechanism to protect the habitat of the species.

Other natural or manmade factors affecting its continued existence: Anderson and Duzan (1978) evaluated DDE residues and eggshell thinning in loggerhead shrikes in Illinois and concluded:

> "Investigations in southern Illinois in 1971 and 1972 suggest that the Loggerhead Shrike has been contaminated with DDE and that the species has experienced eggshell thinning. Mean concentrations of DDE were 21.89 ppm in fat of 69 birds and 3.09 ppm in the contents of 104 eggs. A negative correlation was found between concentrations of DDE and eggshell thickness, and the mean value for the shell thickness index was 2.57% less for eggs collected during the study than for eggs in archival collections. However, nesting success was high, suggesting that the factor -- DDE or other -- causing the recent decline of the shrike population in Illinois was more closely associated with survival of fledged juveniles or adults than with reproduction."

J. Herkert analyzed pesticide residues in Illinois shrike eggs between 1995-1996. He found that current DDE residue levels in Illinois loggerhead shrike eggs are significantly lower than levels reported by Anderson and Duzan (1978).

Habitat Requirements and Condition

Smith (1990) found that loggerhead shrikes preferred pasture and hay meadows in southcentral Illinois. More than two-thirds of active nests were in solitary trees, and the remainder were in hedgerows. Smith and Kruse (1992) found that Illinois loggerhead shrikes were most common near pastures, hedgerows, cornfields, and residential lawns.

Lane (1989) studied 30 nests along a 130 km roadside route in southcentral Illinois in 1986. Nests in isolated trees had higher nest success than fencerow nests, probably because fencerows provide travel lanes for predators. Four variables were considered crucial to nest site selection of loggerhead shrike in southcentral Illinois: a suitable nest tree; short grass for foraging; close proximity to a high utility lines; and an impaling site.

Loggerhead shrike occurs primarily on private land in Illinois. Illinois Natural Heritage Database shows that 132 of 145 (91%) known shrike nesting locations tracked by the database occur on private land (J. Herkert, pers. comm.).

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrikes in Illinois are *L.l. migrans.* Graber et al. (1973) verified this identification based on 75 specimens in the Illinois Natural History Survey collection. Graber et al. (1973) further stated that 14 winter specimens examined were all assigned to *L.l. migrans*.

Loggerhead Shrike Conservation Activities in the State

Some habitat management for shrikes occurs at Midewin National Tallgrass Prairie. Specific management activities that benefit shrikes include: 1) maintain short grass habitat with grazing; 2) clear

overgrown pastures to restore short grass habitat; and 3) maintain some short (less than 15 ft) thorny trees (usually osage orange) when restoring overgrown pastures (J. Herkert, pers. comm.).

INDIANA

Historic and Current Range of the Loggerhead Shrike

During presettlement times most of the state was forested, and the loggerhead shrike was probably absent from exclusively forested areas. By the early 1900s, much of the state had been cleared for agriculture. Butler (1898) considered the loggerhead shrike a common summer resident in Indiana. Burton and Whitehead (1990) contrasted county nest records prior to and after 1980 and noted a drastic reduction in range. Rabenold (1987) also noted a sharp decline in the number of Indiana counties with loggerhead shrike breeding season records since 1970. Surveys in the late 1980s revealed that loggerhead shrike is restricted to southern Indiana, primarily in the southwestern portion of the state (Burton and Whitehead 1990). Indiana's BBA, conducted from 1985-1990, confirmed that breeding records for the species were concentrated in southwest Indiana. Recent records in northern Indiana are widely scattered.

BBA (1985-1990): Probable or confirmed nesting of loggerhead shrike was detected in 22 of Indiana's 647 Priority Blocks (Whitehead 1998).

Historic and Current Population Estimates and/or Trends

Between 1966-1996, loggerhead shrike was represented by 44 birds on 10 BBS routes in Indiana. Data are inadequate to estimate state trends.

Burton and Whitehead (1990) conducted a study in 1988-1989, in part to determine the breeding distribution and status of loggerhead shrikes in Indiana. They found an estimated 172 adult shrikes in 17 counties in 1988, and 249 adults in 16 counties in 1989. (They attributed the increase in sightings from 1988 to 1989 to coverage of additional areas). These should be viewed as minimum population estimates. Core populations were likely all located, but some individual pairs were missed (John Castrale, Indiana Department of Natural Resources, pers. comm.). Results suggested that Indiana's shrike population was larger than was previously believed, and that it was confined almost entirely to the southern third of the state. The 3 southwestern counties of Daviess, Dubois, and Spencer accounted for 77% of confirmed nest sites.

CBC Trend 1959-1988: -0.7 Significance: NO N=23

State Legal Status

State Endangered. Protects individuals from harm and taking, but does not protect habitat (J. Castrale, pers. comm.).

Current Research and Monitoring

A resurvey of areas where Burton and Whitehead (1990) found the greatest densities of loggerhead shrike was conducted during 1999 and 2000 breeding seasons. During 2000, shrikes were found at 44 sites in 2 counties (Daviess and Dubois); during 1989, shrikes had been found at 88 locations in the same counties (J. Castrale, pers. comm.).

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: A variety of practices and land use changes may negatively impact breeding loggerhead shrike populations: residential development in rural areas; clearing of shrubs and trees along roadsides and field borders; natural succession to more forested conditions; preponderance of rowcrop fields; and loss of grasslands and pastures. Sharp declines in shrike numbers were coincident with a 53% loss of open pastureland in the state between 1950-1980 (Burton 1993).

Overutilization for commercial, recreation, scientific, or educational purposes: Few, if any, taken for commercial, recreation, scientific, or educational purposes (J. Castrale, pers. comm.).

Disease or predation: No disease problems have been implicated in the decline of loggerhead shrikes. Predation of eggs, nestlings, and fledglings is common. Several species of mammals, bird, and snakes are potential predators of loggerhead shrike. Predation may be exacerbated because loggerhead shrikes favor linear habitats for nesting (J. Castrale, pers. comm.).

Inadequacy of existing regulatory mechanisms: Inability to regulate land uses and practices hampers efforts to provide and maintain habitat for loggerhead shrike (J. Castrale, pers. comm.).

Other natural or manmade factors affecting its continued existence: Potential factors include collisions with vehicles, pesticides, and competition with American kestrels and European starlings for food (J. Castrale, pers. comm.).

Habitat Requirements and Condition

Grasslands, pastures, shrublands, and shrubby or tree-lined field borders are good shrike habitat. Reclaimed mineland offers potential for loggerhead shrike. Burton and Whitehead (1990) showed that rural roads, utility lines, fencelines, pastures, and lawns were important features in Indiana shrike territories. They also found that shrike territories appeared to be associated with Amish communities in Indiana. They discussed specific qualities of Amish communities (e.g. low pesticide and fertilizer use, minimal automobile traffic, self-sufficient farms necessitate maintenance of pasture for livestock, etc.) that may benefit shrikes.

Subspecies of Loggerhead Shrike Occurring in the State

According to Miller (1931), Indiana shrikes are *L.l. migrans.* Burton and Whitehead (1990) concluded, based on wing-chord measurements, that both *L.l. migrans* and *L.l. ludovicianus*, or an intergrade between the 2 subspecies, may be present.

Loggerhead Shrike Conservation Activities in the State

None specific to loggerhead shrike. Retention of fencerows and roadside habitat favorable to game animals has been a priority of many Indiana Department of Natural Resource programs, and these should directly benefit loggerhead shrike (J. Castrale, pers. comm.).

IOWA

Historic and Current Range of the Loggerhead Shrike

During the Iowa BBA (conducted 1985-1990), loggerhead shrikes were reported in 186 blocks (26%) throughout Iowa, except for the northeastern part of the state. Approximately 51% of the observations were rated possible, 15% probable, and 32% were confirmed (Hemesath 1996).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -10.0 P=0.00 N=19
BBS Trend 1966-1979: -9.2 P=0.02 N=12
BBS Trend 1980-1998: -8.2 P=0.00 N=15

Historically, the loggerhead shrike was considered a common summer resident in all parts of the state, but less common in northern Iowa. At present the loggerhead shrike nests statewide but is most common in southern Iowa, where the species also overwinters. Of the 288 fall and winter reports from 1960 to 1981, 93% were from southern Iowa (Hemesath 1996).

CBC Trend 1959-1988: 0.4 Significance: NO N=20

State Legal Status

Special Concern (Hands et al. 1989).

Current Research and Monitoring

DeGeus (1990) evaluated productivity and habitat preferences of loggerhead shrikes inhabiting roadside habitat in Iowa. Nest success (35%) and productivity (2.2 young/pair) were low compared to most other studies of the species. High rates of nest predation (86% of all losses) were observed. The researcher speculated that linear habitats attracted birds to areas where heavy predation limited production to levels that were below those needed for replacement and concluded that "hedgerows and fencelines are not necessarily optimal or even adequate nesting habitat, contrary to some earlier assumptions."

Threats to the Loggerhead Shrike in the State

Other natural or manmade factors affecting its continued existence: DeGeus (1990) found that most of the remaining shrike habitat in Iowa was along roadsides. High rates of nest predation in roadside habitats limit productivity; roadside habitats may be a population sink for the species in the state.

No additional information on threats was provided.

Habitat Requirements and Condition

The loggerhead shrike is found in areas with hedgerows and scattered trees and bushes. They tend to build their nests in low, shrubby plants (Hemesath 1996). Much of the remaining habitat in the state occurs along roadsides (DeGeus 1990).

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrikes in Iowa are *L.l. migrans.*

Loggerhead Shrike Conservation Activities in the State

No response.

MICHIGAN

Historic and Current Range of the Loggerhead Shrike

Brewer et al. (1991) cited historical accounts which suggested that the loggerhead shrike probably bred in the oak openings of southern Michigan prior to European settlement, and greatly increased its numbers and range as pastures and hedgerows spread across the land. Accounts from around Chicago, southwestern Michigan, and southeastern Michigan during the late 1800s and early 1900s all described the species as common.

The loggerhead shrike currently breeds sporadically statewide, and is occasionally found wintering in the southern third of Michigan (Mary Rabe, Michigan Natural Features Inventory, pers. comm.).

BBA (1983-1988): Only 21 of 1,896 townships in Michigan reported evidence of breeding shrikes; 48% of records (a total of 10) were probable or confirmed (Brewer, McPeek, and Adams 1991). Records are scattered throughout the Lower Peninsula, with a concentration of breeding pairs within 16 km of a Great Lakes shoreline.

Historic and Current Population Estimates and/or Trends

Between 1966-1996, loggerhead shrike was represented by 13 birds on 6 BBS routes in Michigan. Data are inadequate to estimate state trends.

Adams and McPeek (1994) wrote: "Early writings indicate that the Loggerhead Shrike was once a fairly common summer resident in Michigan's Lower Peninsula, with nesting records from most counties. Reduced numbers were apparent in the 1960s and 1970s, but it was not until the Breeding Bird Atlas (1983-88), when fewer than 10 pairs were found, that the full extent of the decline was realized."

Little (1987a) noted that Michigan's loggerhead shrike population showed a steady decline since the 1960s, and that shrike distribution was shifting from the southeastern counties to the western and northern parts of the state.

Intensive statewide searches in 1986 and 1987 resulted in finding 1 breeding pair (Little 1987a) and 4 breeding pairs (Little 1987b), respectively. M. Rabe (pers. comm.) noted: "We have no current population estimates... Clearly the population is decreasing and has reached a threshold level where new pairs are less likely to be reported because they are so rare and widespread."

The Michigan Audubon Society tracks known and former nesting locations. Because of low population densities, new locations of breeding pairs could not be found without intense searching. A larger scale monitoring program is probably not justified at this time.

CBC Trend 1959-1988: -0.6 Significance: NO N=16

State Legal Status

State Endangered. When proposed development projects are located near current or former nest sites, the Michigan Department of Natural Resources works through the environmental review process to limit or mitigate their impact. However, there is no practical way to protect suitable habitat that is not occupied, especially when several years have passed since the date of last known nesting at a site (M. Rabe, pers. comm.).

Current Research and Monitoring

None noted.

Threats to the Loggerhead Shrike in the State

M. Rabe (pers. comm.) noted the following threats: natural succession of grasslands; conversion of farmland; reduction in pasture and hay acreage as practice of confining cattle to feedlots increases; removal of hedgerows from farmlands; inability of males to attract mates at low population densities.

Habitat Requirements and Condition

Little (1987b) found Michigan shrikes (4 pairs located in 1987 statewide search) in habitats with low vegetation for foraging, multiple perches, and protective trees for nesting. Specific habitats used included a hedgerow adjacent to an agricultural area and scattered trees on a golf course, yard, and abandoned field. Most sites are on private land. Given current land use practices, it is not likely that new suitable habitat will be generated in the landscape (M. Rabe, pers. comm.)

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrikes in Michigan are *L.l. migrans.*

Loggerhead Shrike Conservation Activities in the State

No conservation activities reported. Adams and McPeek (1994) commented:

> "The outlook for this species in Michigan is bleak. Breeding since the mid-1980s has been verified only at isolated locations in Allegan, Huron, Alcona, Benzie, and Grand Traverse counties, and pairs have not been consistently present at most of these locales. Biologists are unable to institute any specific management programs in the absence of information pinpointing the cause of their demise. Land-use changes which have reduced the amount of short-grass habitats and tree fencerows are one possible factor. So, too, is the widespread use of pesticides in areas where shrikes are likely to forage... At present, conservation efforts in Michigan need to be directed toward research, surveys, monitoring, and protection for all remaining breeding pairs and their habitats."

MINNESOTA

Historic and Current Range of the Loggerhead Shrike

Once considered a common breeding bird of the agricultural region of Minnesota, loggerhead shrike populations have sharply declined and the species is now considered rare, even in seemingly suitable habitat. Most recent (post-1990) records are concentrated in the southeastern portion of the state, particularly Dakota County (Eliason 1996).

Loggerhead shrike does not winter in Minnesota (Miller 1931).

Historic and Current Population Estimates and/or Trends

Between 1966-1996, loggerhead shrike was represented by 86 birds on 15 BBS routes in Minnesota. Data are inadequate to estimate state trends.

As part of a research project in 1986 and 1987, Brooks (1988) found 29 nesting pairs of loggerhead shrikes in 12 counties in 1986, and 19 pairs in 1987. In the same counties a 1995-1996 survey located 18 nest attempts in 1995 and 10 nest attempts in 1996 (Eliason 1996). Population concentration areas were observed to shift between 1986 and 1995. For example, Sherburne County had 9 nest attempts in 1986, and only 1 in 1995, whereas Dakota County had 2 nest attempts in 1986, and 9 nest attempts in 1995.

CBC Trend 1959-1988: no trend reported

State Legal Status

State Threatened (Eliason 1996)

Current Research and Monitoring

A statewide project was conducted in 1995-1996. The statewide totals in the 1995-1996 survey were 24 nest attempts in 1995 and 13 in 1996. One objective of the project was to compare 3 survey methods to determine the most efficient method for monitoring the loggerhead shrike population in Minnesota. Eliason (1996) concluded: "Population numbers are so low and most of the birds so widely dispersed that none of the methods tested in this study are practical tools for tracking population changes. Strategies that would increase the probability of detecting shrikes when they are present are needed."

Threats to the Loggerhead Shrike in the State

The decline of loggerhead shrike in Minnesota is attributed to a combination of factors, including loss of habitat resulting from the conversion of pasture and grasslands to houses or cropland; the encroachment of forest and brush on pasture and grasslands; and changing farming practices that have resulted in larger fields with fewer trees, shrubs and fences. Increasing use of pesticides may also play a role in the decline of shrikes (Minnesota Dept. of Natural Resources 1996).

Habitat Requirements and Condition

Shrikes use grassy, open areas with scattered trees and shrubs such as pastures, prairie patches and grassy roadsides (Minnesota Dept. of Natural Resources 1996). Habitat occurs in areas with interspersed private and public land ownership.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931) the subspecies breeding in Minnesota would be *L.l. migrans*.

Loggerhead Shrike Conservation Activities in the State

The Minnesota Department of Natural Resources (1996) produced a fact sheet entitled: "Landowners Guide for Maintaining and Encouraging Loggerhead Shrikes." The fact sheet was published in the Dakota County Extension Service newsletter, which is distributed to over 20,000 households in the county. From 1997 to present, it has been distributed to landowners in Dakota County with shrike habitat or known territories on their land. The fact sheet has also been used statewide in public education efforts (Bonita Eliason, Minnesota Department of Natural Resources, pers. comm.).

MISSOURI

Historic and Current Range of the Loggerhead Shrike

The loggerhead shrike occurs year-round throughout Missouri, but is less numerous in the more forested Ozark Natural Division than in other parts of the state. Jacobs and Wilson (1997) noted that the loggerhead shrike may be one species that is currently more common in the Mississippi Lowlands than it was historically. In the early 1900s, the loggerhead shrike population in the Mississippi Lowlands was described as scarce; at that time the area contained extensive forests and swamps. Rowcrop fields and pastures that predominate in that area now are more appropriate for shrikes.

Winter distribution is shifted southward compared to breeding distribution. The source of wintering information is a roadside survey of 17-20 routes statewide conducted annually in January. CBCs also indicate a statewide winter distribution (James D. Wilson, Missouri Dept. of Conservation, pers. comm.).

BBA (1986-1992): Loggerhead shrike was reported in 672 (55.7%) of 1,207 blocks. Probable or confirmed nesting accounted for 62% of these reports (Jacobs and Wilson 1997).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -7.0 P= 0.00 N=48
BBS Trend 1966-1979: -6.6 P= 0.01 N=35
BBS Trend 1980-1998: -4.2 P= 0.15 N=41

Kridelbaugh (1981) evaluated the population trend of loggerhead shrikes statewide and in 5 ecological strata using 1967-1979 BBS data for Missouri. The statewide population exhibited a significant decline from 4.2 birds/route in 1969 to 1.7 birds/route in 1979, but declines did not occur in all ecological strata. The most significant decline occurred in northwest Missouri, and a decline also occurred in the southeast corner (bootheel) of the state.

J. Wilson (pers. comm.) noted that BBA and BBS surveys for Missouri provide current data on loggerhead shrike in the state and that "accuracy is favored by the conspicuousness of the species."

CBC Trend 1959-1988: -2.0 Significance *** N=36

Kridelbaugh (1982) noted that population declines have also been documented in the wintering

population of loggerhead shrikes in the state.

State Legal Status

Watch list (J. Wilson, pers. comm.).

Current Research and Monitoring

No efforts aimed specifically at loggerhead shrike. BBS, BBA, CBC and the statewide winter roadside survey conducted annually in January all provide information on this species.

Threats to the Loggerhead Shrike in the State

J. Wilson (pers. comm.) noted that grasslands have been reduced by rowcropping, succession, and urbanization. He cited increasing prevalence of fescue and the linear pattern of nesting cover (i.e. grown up fencerows) as factors in the deterioration of habitat conditions for loggerhead shrike in Missouri. There is no evidence that disease, overutilization, or predation are factors in the reduction of shrike numbers.

Habitat Requirements and Condition

Kridelbaugh (1982) noted that areas in Missouri with relatively high populations of loggerhead shrike were dominated by grasslands (Osage Plain, southern Ozarks). Where there had been a decline in pasture and hayfields and an increase in rowcrops, the number of breeding shrikes had declined (northwest and southeast Missouri). Most shrike habitat is on private land.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931) the subspecies breeding in Missouri is *L.l. migrans*; however, J. Wilson (pers. comm.) noted that no subspecies is recognized in the state.

Loggerhead Shrike Conservation Activities in the State

It is anticipated that the "Open Lands Initiative," an ongoing project in northern Missouri, will benefit grassland birds including shrikes. Monitoring is a component of this project (J. Wilson, pers. comm.).

OHIO

Historic and Current Range of the Loggerhead Shrike

Peterjohn (1989) noted: "When Ohio was initially settled, the virgin forests with few scattered openings did not support Loggerhead Shrikes. As these forests were cleared and replaced by open farmlands, Loggerheads quickly took advantage of the newly created habitats. They apparently invaded during the mid-1800's, becoming widely distributed before the turn of the century."

Trends toward intensive agricultural production in the mid 1900s led to contraction of the range of the loggerhead shrike in the state. The species is now considered an accidental to rare summer resident, with most records from the western half of the state.

BBA (1983-1987): Probable or confirmed nesting of loggerhead shrike was detected in 9 (1.2%) of Ohio's 764 atlas blocks.

The loggerhead shrike has always been considered an accidental to casual winter resident in Ohio. Most recent winter records are from the southern half of Ohio. Wintering loggerhead shrikes are not necessarily the same individuals that breed in Ohio (Peterjohn 1989).

Historic and Current Population Estimates and/or Trends

Between 1966-1996, loggerhead shrike was represented by 25 birds on 10 BBS routes in Ohio. Data are inadequate to estimate state trends.

The largest statewide populations were present between 1900 and 1930. Beginning in the 1930s, the trend toward intensive agricultural production led to deteriorating habitat conditions for loggerhead shrike in Ohio. Widespread declines were noticeable by the late 1940s, and populations continued to shrink throughout the 1950s and 1960s. By 1970, only a few widely scattered pairs remained (Peterjohn 1989).

Peterjohn and Rice (1991) noted that if BBA (1983-1987) reports were representative of the number of shrikes remaining in Ohio, then the statewide population probably did not exceed 10-20 pairs.

CBC Trend 1959-1988: -0.5 Significance: NO N=28

State Legal Status

State Endangered (David Scott, Ohio Division of Wildlife, pers. comm.).

Current Research and Monitoring

None

Threats to the Loggerhead Shrike in the State

Peterjohn (1989) and Peterjohn and Rice (1991) cite changing land-use patterns.

Habitat Requirements and Condition

Only isolated, widely scattered, pockets of suitable habitat for loggerhead shrikes remain in Ohio (D. Scott, pers. comm.).

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931) the subspecies breeding in Ohio is *L.l. migrans*.

Loggerhead Shrike Conservation Activities in the State

None known.

WISCONSIN

Historic and Current Range of the Loggerhead Shrike

Fruth (1988) provided a discussion of the historic and current (through 1987) range of the loggerhead shrike in Wisconsin. Records are concentrated in the southern two-thirds of the state. Robbins (1991) confirmed that the range of the species has not changed in the state, although numbers have declined sharply. The species does not winter in the state.

Historic and Current Population Estimates and/or Trends

Between 1966-1996, loggerhead shrike was represented by 27 birds on 10 BBS routes in Wisconsin. Data are inadequate to estimate state trends.

The Wisconsin BBA (1995-1999) documented records of confirmed breeding of shrikes from 11 sites in 10 counties, with a probable record from another county. All but 2 of these records were from the northern half of the state (David Sample, Wisconsin Department of Natural Resources, pers. comm.).

The loggerhead shrike was considered a common summer resident in Wisconsin in the early 1900s; population declines apparently began in the 1930s (Sumner Matteson, Wisconsin Department of Natural Resources, pers. comm.). The Wisconsin Society of Ornithologists (WSO) 1942 Checklist of Wisconsin birds listed the loggerhead shrike as a fairly common summer resident; the 1960 revised checklist listed the species as uncommon (Fruth 1988). Additional population declines occurred in the 1970s leaving the remaining breeding population scattered and unstable.

Based on WSO and Wisconsin Department of Natural Resource records, Fruth (1988) provided the following estimates of the Wisconsin breeding population:

1960-1967: average of 5.3 known breeding pairs per year
1968-1977: average of 1.7 known breeding pairs per year
1978: a peak of 11 breeding pairs was recorded
1979-1987: average of 4.0 known breeding pairs per year.

The apparent increase in the 1979-1987 period may be more indicative of an increase in search effort than an improvement in breeding status of the species.

Mossman and Lymn (1989) reported on a statewide loggerhead shrike survey based on nest sites that had been active in the previous decade. A total of 4 breeding records was recorded for the state. They concluded: "The Loggerhead Shrike appears to be continuing its long-term decline in Wisconsin. There is no indication that nest success is a problem, although data remain scant." In the 1990s, 1-5 breeding pairs have been reported annually (S. Matteson, pers. comm.).

The range of the species is accurately documented, but the population estimate is considered inadequate. Long-term systematic surveys in suitable breeding habitat are needed (S. Matteson, pers. comm.).

CBC Trend 1959-1988: no trend reported

State Legal Status

The loggerhead shrike was listed as threatened in Wisconsin in 1979 and reclassified to endangered status in 1982 (Fruth 1988). State law protects listed species from incidental take in Wisconsin; draft

incidental take protocol (for state agencies) has been developed for the loggerhead shrike and is currently under review (S. Matteson, pers. comm.).

Current Research and Monitoring

In 1999 Wisconsin completed the fifth year of a statewide BBA project, which provided information on distribution and numbers of shrikes in the state. However, this effort did not constitute a systematic survey of all shrike habitat. Shrike monitoring efforts will continue, but are typically local in nature (S. Matteson, pers. comm.).

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Some changes in habitat in the state may have negatively impacted shrikes. Area in pasture is currently only 37% of what it was in 1950. General trends toward clean farming have led to the removal of brush and hedgerows. Succession of brushland to young forest is also a factor in habitat loss (D. Sample, pers. comm.). Although there may be some adverse modifications to breeding habitat for loggerhead shrikes in Wisconsin, this is not generally considered a limiting factor (S. Matteson, pers. comm.).

Overutilization for commercial, recreation, scientific, or educational purposes: Not a factor; the species is protected from these threats by its state endangered status (S. Matteson, pers. comm.).

Disease or predation: S. Matteson (pers. comm.) stated: "Currently, there are no known disease or parasites that cause significant mortality for loggerheads. Research in this area, however, is limited. Shrikes do face natural predation pressure from hawks and owls, although this is not considered to be a significant threat." Fruth (1988) suspected that feral cats are probably a major predator of shrikes.

Inadequacy of existing regulatory mechanisms: A recovery plan for loggerhead shrikes in Wisconsin is in place (Fruth 1988), but additional research on breeding ecology is needed for effective management (S. Matteson, pers. comm.).

Other natural or manmade factors affecting its continued existence: Pesticides are a potential threat to the species, but the effects of pesticides on loggerhead shrikes are not well studied (Fruth 1988).

Habitat Requirements and Condition

Typical habitats in Wisconsin include pasture, old fields, and crop fields with adjacent hedgerows (Fruth 1988). Nests occur on both public and private land (S. Matteson, pers. comm.).

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931) the subspecies breeding in Wisconsin is *L.l. migrans*.

Loggerhead Shrike Conservation Activities in the State

Fruth (1988) discussed the Recovery Strategy for loggerhead shrike in Wisconsin, although the status of implementation of the plan was not reported. The Wisconsin Department of Natural Resources anticipates that ecoregional planning initiatives and PIF conservation plans in the state will result in landscape-scale as well as localized management efforts for loggerhead shrikes and other grassland/shrub-dependent species (S. Matteson, pers. comm.).

U.S. FISH AND WILDLIFE SERVICE REGION 4

Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee

ALABAMA

Historic and Current Range of the Loggerhead Shrike

Howell (1928) described loggerhead shrike as a fairly common, locally distributed, resident in the southern half of the state; he recorded migrant shrikes as occurring in "moderate numbers" during fall and winter throughout the state. Stevenson (1950) described the breeding range as the entire state, except in the mountains. Imhof (1976) noted that loggerhead shrike had been a common and well distributed breeding species throughout the state, even in the mountains associated with farms; the species was more abundant in winter. However, he noted a decline beginning approximately in 1960 that rendered the species uncommon, where formerly common.

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -7.6 P=0.00 N=71
BBS Trend 1966-1979: -3.5 P=0.30 N=40
BBS Trend 1980-1998: -6.5 P=0.00 N=65

BBS sample sizes are adequate to estimate statewide trends. Other than BBS data, no trend information was available for the state.

CBC Trend 1959-1988: -4.4 Significance *** N=23

State Legal Status

None (Bob McCollum, Alabama Game and Fish Division, pers. comm.).

Current Research and Monitoring

None (B. McCollum, pers. comm.).

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Paul Kittle (University of Northern Alabama, pers. comm.) noted the elimination of fencerows and hedgerows as a potential factor in the decline of loggerhead shrikes.

Other natural or manmade factors affecting its continued existence: P. Kittle (pers. comm.) provided information based on his personal observations in northwest Alabama over a period of more than 20 years. In an intensively farmed (primarily cotton) portion of western Lauderdale County shrikes were not common but occurred regularly until the late 1990s, when he observed an abrupt decline in sightings. The decline coincided with a period of intense pesticide use as part of a boll weevil eradication program,

which may have contributed to the decline.

No other threats were noted.

Habitat Requirements and Condition

No information provided.

Subspecies of Loggerhead Shrike Occurring in the State

Howell (1928) considered breeding restricted to the southern half of the state, and attributed all breeding to *L.l. ludovicianus*. Based on Miller (1931), breeding loggerhead shrikes in the southern half of Alabama are *L.l. ludovicianus*, with a zone of intergradation with *L.l. migrans* in the northern half of the state. Stevenson (1950) reported breeding records for northern Alabama and considered it likely that these birds represented *L.l. migrans*, but noted that the records were not based on specimens.

Loggerhead Shrike Conservation Activities in the State

None (B. McCollum, pers. comm.).

ARKANSAS

Historic and Current Range of the Loggerhead Shrike

The breeding range of the loggerhead shrike in Arkansas is likely statewide (although specific information on distribution was not available). The species also winters in the state; data collected by Kellner et al. (1999) suggested that most shrikes wintering in Arkansas also breed in the state.

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -7.5 P=0.00 N=28
BBS Trend 1966-1979:-11.0 P=0.00 N=26
BBS Trend 1980-1998:-10.7 P=0.04 N=25

BBS sample sizes are adequate to estimate statewide trends.

Using BBS data, Burnside and Shepherd (1985) noted a significant decline in numbers of breeding loggerhead shrikes between 1967-1983; statewide decline was most influenced by declines in the West Gulf Coastal Plain. The Interior Highlands region also showed significant decline. They suggested that the trend toward larger more intensively managed farms may have contributed to the decline.

CBC Trend 1959-1988: -2.4 Significance *** N=21

State Legal Status

None (Karen Rowe, Arkansas Game and Fish Commission, pers. comm.).

Current Research and Monitoring

Kellner et al. (1999) are studying patterns of population stability and habitat use by shrikes in northeastern and central Arkansas.

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Burnside and Shepherd (1985) suggested that the trend toward larger more intensively managed farms may have contributed to the decline of loggerhead shrikes in the state.

No additional information on threats was provided.

Habitat Requirements and Condition

In northeastern Arkansas, habitat is dominated by rice, soybean, and wheat fields bordered by drainage ditches, isolated woodlots, and grassy roadsides. In central Arkansas, shrike habitat is dominated by pasture and hayfields (Kellner et al. 1999).

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrikes in Arkansas are *L.l. migrans*.

Loggerhead Shrike Conservation Activities in the State

No information provided.

FLORIDA

Historic and Current Range of the Loggerhead Shrike

Stevenson and Anderson (1994) described loggerhead shrike as a permanent resident throughout most of mainland Florida. Winter distribution was described as fairly common in north and central Florida except coastal areas, rare in extreme southern Florida, and casual on the Keys.

Yosef et al. (1993) presented evidence, based primarily on banding data, that suggested there is no movement of migrant shrikes into penisular Florida during the winter.

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -3.2 P=0.00 N=73
BBS Trend 1966-1979: -0.6 P=0.80 N=33
BBS Trend 1980-1998: -2.1 P=0.16 N=66

BBS sample sizes are adequate to estimate statewide trends.

Robertson and Woolfenden (1992) considered loggerhead shrike as fairly common to common in suitable habitat in the panhandle and northern peninsula; rare to uncommon and apparently decreasing in much of southern Florida.

Yosef et al. (1993) analyzed trends in numbers of loggerhead shrikes in southcentral Florida based on roadside counts conducted along 505 km of roads in summer and winter from 1974 to 1992. During that period, the winter population declined 37% and the summer population by 41%. Using the annual mean counts method, they estimated an annual rate of decline of 8.9% per year between 1976-1981, and a continued decline at the rate of 5.5% per year between 1981-1992. These rates of decline exceed estimates of decline for southcentral Florida based on BBS data (3.5% annual decline between 1986-1989).

CBC Trend 1959-1988: -2.9 Significance *** N=62

State Legal Status

None (John Milio, USFWS, pers. comm.).

Current Research and Monitoring

None known (Fred Lohrer, Archbold Biological Station, pers. comm.).

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Fred Lohrer (Archbold Biological Station, pers. comm.) noted the following activities as contributing to loggerhead shrike habitat destruction: conversion of agricultural areas and fallowland to residential developments; conversion of old fields to pine plantations; and conversion of pine flatwoods to open pasture with no woody vegetation.

Overutilization for commercial, recreation, scientific, or educational purposes: Not considered a factor (F. Lohrer, pers. comm.).

Disease or predation: Not considered a factor (F. Lohrer, pers. comm.).

Inadequacy of existing regulatory mechanisms: No comments received.

Other natural or manmade factors affecting its continued existence: Road kills are a potential threat (F. Lohrer, pers. comm.).

S. Craig (pers. comm.) noted that loggerhead shrikes in Florida are frequently associated with suburban habitat, including lawns, citrus groves, and golf courses. Loggerhead shrikes in these "artificial" habitats experience increased exposure to pesticides. A high incidence of leg and bill deformities were observed in birds captured in Florida in 1996; possible causes of deformities may merit further investigation.

Grubb and Yosef (1994) used ptilochonology to demonstrate that nutritional condition of loggerhead shrikes resident in southcentral Florida was related to habitat. Specifically, nutritional condition of shrikes in pasture was superior to that of birds in citrus groves. Mitacide/insecticide compounds used in citrus groves may, directly or indirectly, affect the condition of shrikes occupying that habitat.

Habitat Requirements and Condition

In Florida, loggerhead shrikes occupy a variety of open habitats with scattered trees and shrubs, these include prairies, pastures, open pine flatwoods, roadsides, and even urban parks and vacant lots

(Stevenson and Anderson 1994). Suitable habitat occurs primarily on private land (F. Lohrer, pers. comm.).

S. Craig (pers. comm.) noted a loss of natural nesting habitat in Florida, but observed that as natural habitat was lost, shrikes moved into suburban settings, including lawns, citrus groves, and golf courses.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrikes in Florida are *L.l. ludovicianus; L.l. migrans* may occur in the northern portion of the state during winter (Stevenson and Anderson 1994). Both Rand (1960) and Phillips (1986) considered *L.l. miamensis* (described after Miller's work) as the breeding subspecies in extreme southern Florida. However, Stevenson and Anderson (1994) examined specimens and concluded that the subspecies *L.l. miamensis* was invalid.

Loggerhead Shrike Conservation Activities in the State

None noted.

GEORGIA

Historic and Current Range of the Loggerhead Shrike

Accounts from the early 1900s indicated that the loggerhead shrike occurred as a breeding and wintering species throughout the state, except in the Blue Ridge Mountains. The current range is similar, with the exception that the species does not occur in some local areas (Todd Schneider, Georgia Department of Natural Resources, pers. comm.).

The Georgia BBA documented shrikes in 117 of 159 counties in the state; many of the counties where shrikes were not found were inadequately sampled (T. Schneider, pers. comm.).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -1.3 P=0.39 N=53
BBS Trend 1966-1979: -4.5 P=0.08 N=44
BBS Trend 1980-1998: -0.7 P=0.66 N=51

BBS sample sizes are adequate to estimate statewide trends.

Loggerhead shrikes are considered common with stable populations in the Coastal Plain of Georgia and declining but still fairly common in the Piedmont (T. Schneider, pers. comm.).

CBC Trend 1959-1988: -2.0 Significance: No N=29

State Legal Status

None (EJ Williams, Georgia Department of Natural Resources, pers. comm.).

Current Research and Monitoring

No current activities noted, but a winter bird atlas is planned that would provide information on wintering shrikes (T. Schneider, pers. comm.).

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Loggerhead shrike habitat has been lost to conversion (to unsuitable habitats) and to natural succession (T. Schneider, pers. comm.).

Other natural or manmade factors affecting its continued existence: Pesticides are a potential threat in the Coastal Plain and locally in the Piedmont, although there is no information to assess the potential impacts of pesticides (T. Schneider, pers. comm.).

No other threats were noted.

Habitat Requirements and Condition

Most shrike habitat occurs on private land (T. Schneider, pers. comm.).

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrikes in most of Georgia are *L.l. ludovicianus*.

Loggerhead Shrike Conservation Activities in the State

Georgia has an active Farm Bill program as well as a program aimed at increasing bobwhite quail habitat. Both of these programs have emphasis on more open early successional habitat and should benefit shrikes (T. Schneider, pers. comm.).

KENTUCKY

Historic and Current Range of the Loggerhead Shrike

Loggerhead shrikes occupy a range throughout most of the western two-thirds or Kentucky, primarily west of the Cumberland Plateau (Mengel 1965); this range was confirmed by the Kentucky BBA (Palmer-Ball 1996). The status of the loggerhead shrike in presettlement Kentucky is unclear. Palmer-Ball (1996) noted that loggerhead shrikes may have occurred in the prairies and savannas of presettlement Kentucky, but potentially the grasses in these habitats were too tall and thick to be suitable for the species; outside of these areas the species was likely absent. The conversion of vast forested areas of the state to agriculture and settlement resulted in expansion of loggerhead shrikes to many areas.

Loggerhead shrikes are permanent residents of the state. The population may be augmented in fall and winter by the presence of migrants (Mengel 1965).

BBA (1985-1991): Loggerhead shrikes were recorded in almost 32% of priority blocks; almost 55% of priority block records were for probable or confirmed breeding (Palmer-Ball 1996).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -6.4 P=0.00 N=29
BBS Trend 1966-1979: -8.2 P=0.13 N=26
BBS Trend 1980-1998: -7.6 P=0.00 N=29

BBS data are still considered adequate to estimate state trends; however, Brainard Palmer-Ball, Jr., Kentucky State Nature Preserves Commission (pers. comm.) noted that sample sizes are somewhat a concern.

B. Palmer-Ball (pers. comm.) described loggerhead shrike as a never common but regularly occurring species in open farmland of southern and western Kentucky.

CBC Trend 1959-1988: -0.6 Significance: NO N=17

State Legal Status

None

Current Research and Monitoring

None

Threats to the Loggerhead Shrike in the State

B. Palmer-Ball (pers. comm.) noted no significant threats to loggerhead shrike in Kentucky, noting that the species is probably more numerous now compared to presettlement status.

Habitat Requirements and Condition

Kentucky loggerhead shrikes use open to semi-open farmland, one of the most abundant habitats in the state. Shrikes are rare to absent in extensive reclaimed surface mines of western Kentucky; potentially, grasses on the reclaimed mines are too tall and/or thick to provide preferred habitat (B. Palmer-Ball, pers. comm.).

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), *L.l. migrans* is the subspecies breeding in Kentucky. Mengel (1965) noted that, based on color and other characteristics, all Kentucky specimens were *L.l. migrans*. In spite of references to the contrary, it was his opinion that *L.l. ludovicianus* did not occur in the state.

Loggerhead Shrike Conservation Activities in the State

No efforts specific to shrikes noted. Sunni Lawless, Kentucky Department of Fish and Wildlife Resources (pers. comm.), noted that the State recommends to private landowners the benefits of planting/maintaining tree clumps as opposed to fencerows for wildlife habitat. Based on results of work conducted by Yosef (1994a), scattered tree clumps would be more beneficial to shrikes than trees/shrubs occurring along fencerows or other linear habitats.

LOUISIANA

Historic and Current Range of the Loggerhead Shrike

The loggerhead shrike is a statewide breeder in suitable habitat. BBA (field work completed in 1996) results indicated that the species was more common in the southwestern corner of the state and in agricultural areas along the Mississippi and Red Rivers than in central and northern Louisiana. Migrants augment the population in winter (Bill Vermillion, Louisiana Natural Heritage Program, pers. comm.).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -0.7 P=0.53 N=45
BBS Trend 1966-1979: -0.5 P=0.82 N=23
BBS Trend 1980-1998: -0.3 P=0.78 N=40

BBS sample sizes are adequate to estimate state trends.

CBC Trend 1959-1988: -0.6 Significance: NO N=23

State Legal Status

No protection specifically for loggerhead shrike. However, loggerhead shrike, although not specifically referenced, is protected under State laws that prohibit illegal take of wild birds, nests or eggs.

Current Research and Monitoring

None

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: "Clean" agricultural practices result in much open habitat being unsuitable for loggerhead shrikes.

Other natural or manmade factors affecting its continued existence: No specific information available, but effects of agricultural chemicals are potentially a factor in decline that should be investigated.

No other threats were noted.

Habitat Requirements and Condition

Loggerhead shrikes are most often seen in fencerows along pastures and fields, roadsides, parks with scattered trees and large open areas, and airports. Most suitable habitat occurs on private land.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrikes in the southeastern corner of Louisiana are assigned to *L.l. ludovicianus* and *L.l. migrans* breeds along the northern boundary with Arkansas. Intergradation between the subspecies occurs throughout most of the state.

Loggerhead Shrike Conservation Activities in the State

None

MISSISSIPPI

Historic and Current Range of the Loggerhead Shrike

No information provided.

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -4.8 P=0.03 N=33
BBS Trend 1966-1979: -0.7 P=0.76 N=20
BBS Trend 1980-1998: 0.1 P=0.97 N=31

BBS sample sizes are considered adequate to estimate state trends.

CBC Trend 1959-1988: -2.0 Significance * N=18

State Legal Status

Not listed (based on January 21, 2000 phone inquiry to the State Museum).

Current Research and Monitoring

No information provided.

Threats to the Loggerhead Shrike in the State

No information provided.

Habitat Requirements and Condition

No information provided.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrikes in the southern half of Mississippi are assigned to *L.l. ludovicianus*, breeding birds in the northern third of the state are assigned to *L.l. migrans*, and intergradation between the 2 subspecies would occur throughout most of the central portion of the state.

Loggerhead Shrike Conservation Activities in the State

No information provided.

NORTH CAROLINA

Historic and Current Range of the Loggerhead Shrike

The loggerhead shrike apparently first bred in North Carolina in the early 1900s. The species reached the peak of its range in the state in the 1950s and 1960s, when it nested over most of the state. It has always been rare or absent in the northeastern corner as well as in the mountains. The current range has contracted; the species no longer breeds on the eastern border. It is found mainly in the Piedmont and western Coastal Plain (Harry LeGrand, Jr., North Carolina Natural Heritage Program, pers. comm.). Loggerhead shrike is a permanent resident, although some migratory movement occurs.

Irvin (1991) noted that North Carolina is near the northern boundary of present-day breeding populations of loggerhead shrikes in the eastern U.S..

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -15.2 P=0.00 N=24
BBS Trend 1966-1979: -19.6 P=0.00 N=15
BBS Trend 1980-1998: -2.8 P=0.76 N=16

BBS state trends are only estimated for species observed on a minimum of 14 routes. Note that trends for North Carolina for the 1966-1979 and 1980-1998 periods approach the route minimum. However, H. LeGrand, Jr., (pers. comm.) noted that large-scale declines documented by BBS and CBC trends are an accurate reflection of population trends in the state.

CBC Trend 1959-1988: -6.6 Significance *** N=44

State Legal Status

Special Concern

Current Research and Monitoring

No intensive statewide efforts.

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Development and abandonment of former pasture have resulted in habitat loss.

Overutilization for commercial, recreation, scientific, or educational purposes: Not considered a factor.

Disease or predation: H. LeGrand, Jr. (pers. comm.) suspects that disease may be an issue, but notes that he has no data to support this.

Inadequacy of existing regulatory mechanisms: There is currently no regulatory authority to protect shrike habitat.

Other natural or manmade factors affecting its continued existence: Pesticides are suspected as a problem. The American kestrel and eastern kingbird, which use similar food resources, are also

declining.

H. LeGrand, Jr. (pers. comm.) noted that shrike decline has been geographic from north to south; he feels this issue should be investigated.

Habitat Requirements and Condition

Loggerhead shrike habitat is associated with agricultural areas, with pastures favored over cropland. As previously noted, much suitable habitat has been lost. Most habitat is associated with private land.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrikes in the North Carolina are *L.l. ludovicianus*, with intergradation with *L.l. migrans* possible in the northern half of the state. Hall and LeGrand (undated) discussed distribution of the 2 subspecies in the state.

Loggerhead Shrike Conservation Activities in the State

Mark Johns (North Carolina Wildlife Resources Commission, pers. comm.) noted that North Carolina PIF is focusing on loggerhead shrike as a key species in declining early successional, open habitats. He noted that landowners are encouraged to implement management practices conducive to shrikes, such as maintaining hedgerows and red cedar restoration in pastures. (No details provided on how information is provided to landowners, or anticipated results).

SOUTH CAROLINA

Historic and Current Range of the Loggerhead Shrike

Loggerhead shrikes range throughout South Carolina, with the exception of the mountainous northwestern portion of the state. They are more abundant on the inner Coastal Plain than the Piedmont, especially since many of the small farms in the Piedmont have reverted to second growth forest. While shrikes have declined throughout South Carolina, the species is still fairly common in the inner Coastal Plain (John Cely, South Carolina Department of Natural Resources, pers. comm.).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -3.5 P=0.00 N=24
BBS Trend 1966-1979: -8.6 P=0.03 N=17
BBS Trend 1980-1998: 3.5 P=0.27 N=17

J. Cely (pers. comm.) noted that the decline of loggerhead shrike documented by BBS is one of the steepest rates of decline noted for any bird in the state.

CBC Trend 1959-1988: -4.3 Significance *** N=18

State Legal Status

Special Concern

Current Research and Monitoring

During 1986, a roadside survey route along 44.8 km was conducted in Lower Richland County (located in the inner Coastal Plain), an area with "apparently healthy shrike populations." Thirty-four nests were located; density of shrikes per route was .29 birds/km (Cely and Corontzes 1986).

Gawlik and Bildstein (1990) studied reproductive success and nesting habitat of loggerhead shrike in northcentral South Carolina; seasonal habitat use and abundance of loggerhead shrike in the state (Gawlik and Bildstein 1993); and differential habitat use by sympatric loggerhead shrikes and American kestrels (Gawlik and Bildstein 1995).

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: J. Cely (pers. comm.) considers habitat loss as the primary cause of loggerhead shrike declines throughout much of the species range, but notes that some areas of suitable habitat are unoccupied.

Cely and Corontzes (1986) documented changes in land use between 1939 and 1981 in Lower Richland County, the site of their 1986 loggerhead shrike study. They demonstrated that hedgerows declined and woodlands increased during that period, noting that both of these habitat changes would be detrimental to shrikes.

No additional threats were noted.

Habitat Requirements and Condition

Cely and Corontzes (1986) documented that loggerhead shrikes in Lower Richland County, the site of their 1986 loggerhead shrike study, were closely associated with residential dwellings. Twenty-five of 34 shrike nests located were found in yards. Loggerhead shrikes are also found associated with agricultural lands in the state, if suitable conditions exist.

Gawlik and Bildstein (1990) evaluated reproductive success and nesting habitat in northcentral South Carolina. Red cedar was the preferred nesting tree. Nests were associated with short-grass habitats (pastures, hayfields, lawns).

Gawlik and Bildstein (1993) demonstrated that in coastal South Carolina shrikes used disturbed grassy habitats, particularly pasture, during the breeding season, and occupied areas of cropland in autumn.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrikes in the South Carolina are assigned to the nominate subspecies (*L.l. ludovicianus).*

Loggerhead Shrike Conservation Activities in the State

J. Cely (pers. comm.) noted that the longleaf pine-wiregrass ecosystem may have been the presettlement habitat of the loggerhead shrike in South Carolina. Efforts to restore that ecosystem may benefit shrikes.

TENNESSEE

Historic and Current Range of the Loggerhead Shrike

The loggerhead shrike occurs throughout Tennessee in low-elevation grasslands, croplands, and old fields, provided that scattered tree/shrubs or fencerows are available. It is present year-round, but is most common during winter. Breeding populations increase from east, where it is rare to uncommon, to west, where it is more common. The loggerhead shrike was probably uncommon and locally distributed in presettlement Tennessee, occurring in prairies in northcentral and northwest portions of the state (Nicholson 1997).

BBA (1986-1991): Loggerhead shrike was found in 57% of priority blocks (59% of these records were probable or confirmed breeding), most frequently in the Ridge and Valley, Central Basin, northcentral and southcentral Highland Rim, and the Loess Plain (Nicholson 1997). Nicholson (1997) noted that some local concentrations in Middle Tennessee were the result of special searches for shrikes.

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -7.4 P=0.00 N=35
BBS Trend 1966-1979: -4.8 P=0.00 N=34
BBS Trend 1980-1998: -6.7 P=0.00 N=28

BBS sample sizes in Tennessee are considered adequate to estimate trends.

Loggerhead shrike numbers probably peaked in the state between the 1940s and 1960s. The 7.3% annual decline documented by BBS between 1966-1996 is one of the largest declines for any species nesting in the state, but the species is still considered widespread (Nicholson 1997).

CBC Trend 1959-1988: -1.2 Significance: NO N=29

State Legal Status

Robert Hatcher (Tennessee Wildlife Resources Agency, pers. comm. in March 1998) noted that the loggerhead shrike was to be considered for “In Need of Management” listing in Tennessee (equivalent to “Special Concern” in many states) in late 1998; the outcome of this consideration is not known.

Current Research and Monitoring

None noted.

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Nicholson (1997) suggested habitat loss was probably the major factor, but noted that much seemingly suitable habitat is unoccupied.

No other threats were noted.

Habitat Requirements and Condition

No specific habitat characteristics noted, but occurs primarily on private land (R. Hatcher, pers. comm.).

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrikes in Tennessee are assigned to *L.l. migrans*.

Loggerhead Shrike Conservation Activities in the State

None (R. Hatcher, pers. comm.).

U.S. FISH AND WILDLIFE SERVICE REGION 5

Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia

CONNECTICUT

Historic and Current Range of the Loggerhead Shrike

The loggerhead shrike is considered a rare fall migrant in Connecticut, mostly along the coast. Historic records also indicate that the shrike was present in the state only as a migrant, with the frequency of visits decreasing in the 1970s and 1980s (Zeranski and Baptist 1990). The only documented nesting record from the state was from an apple orchard in 1893 (Zeranski and Baptist 1990).

Loggerhead shrike was not included in the state's BBA because it is not considered a breeding species (Dawn McKay, Connecticut Dept. of Environmental Protection, pers. comm.).

Historic and Current Population Estimates and/or Trends

BBS: No records of loggerhead shrike

State Legal Status

None, not considered a resident species.

Current Research and Monitoring

None (D. McKay, pers. comm.).

Threats to the Loggerhead Shrike in the State

No threats were noted.

Habitat Requirements and Condition

Not applicable.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), loggerhead shrikes migrating through Connecticut would be *L.l. migrans*.

Loggerhead Shrike Conservation Activities in the State

None.

DELAWARE

Historic and Current Range of the Loggerhead Shrike

There have been sporadic occurrences of loggerhead shrike in Delaware, most often in winter, throughout the last century. The species occasionally is found during the nesting season, but the only documented nest record is from 1924 (Christopher Heckscher, Delaware Department of Natural Resources and Environmental Control, pers. comm.).

Historic and Current Population Estimates and/or Trends

BBS: No records of loggerhead shrike.

Considered by the Delaware Natural Heritage Program as an historic nesting species. There are no currently known populations.

With only 1 known nest record, discussion of state population estimates or trends is not applicable. Surveys, particularly in coastal scrub-shrub environments, might find evidence of breeding. If present as a breeding species, loggerhead shrike is in very low numbers and probably not persistent from year to year (C. Heckscher, pers. comm.).

State Legal Status

None.

Current Research and Monitoring

None.

Threats to the Loggerhead Shrike in the State

Not applicable as there are no known populations.

Habitat Requirements and Condition

Coastal shrub-scrub communities, present on public and private land, represent potential habitat. Invasion by *Phragmites australis* could affect the potential suitability of these habitats.

Subspecies of Loggerhead Shrike Occurring in the State

L.l. migrans (Miller 1931).

Loggerhead Shrike Conservation Activities in the State

None.

MAINE

Historic and Current Range of the Loggerhead Shrike

As recently as 1963, the loggerhead shrike bred in Maine. Historic winter records are thought to be misidentified northern shrikes. Palmer (1949) classified loggerhead shrike as a "regularly uncommon and local" summer resident in the state, absent from islands and most of eastern Maine. It was probably also absent from the northern interior portion of the state, which was not cleared for agriculture (Thomas Hodgman, Maine Department of Inland Fisheries and Wildlife, pers. comm.).

BBA (1978-1983): Loggerhead shrike was reported on only 4 atlas blocks; the only evidence of breeding was 1 record of 3 shrikes together in July 1981 (Adamus 1987).

Historic and Current Population Estimates and/or Trends

Between 1966-1996, loggerhead shrike was represented by 1 bird on 1 BBS route in Maine.

There are too few reliable records for this species to consider population size or trend. Palmer (1949) reported that the species was declining in Maine.

If loggerhead shrike is as rare and widely scattered as suspected, even an intensive monitoring effort targeting this species may yield extremely few records (T. Hodgman, pers. comm.).

State Legal Status

Special Concern, which confers no legal authority for protection (T. Hodgman, pers. comm.).

Current Research and Monitoring

None known, and no permits have been issued for capture or banding of this species (T. Hodgman, pers. comm.).

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Loss of farmland in southern and central Maine has probably been the most significant threat to loggerhead shrike in the state over the past century. Given extremely low numbers and spatial unpredictability of breeding occurrences, regulatory protections alone would be unlikely to benefit loggerhead shrike in Maine (T. Hodgman, pers. comm.).

Habitat Requirements and Condition

In spite of large losses of suitable habitat in historically occupied areas, apparently suitable (but unoccupied) habitat exists in Maine. Most potentially suitable habitat is on private land (T. Hodgman, pers. comm.).

Subspecies of Loggerhead Shrike Occurring in the State

L.l. migrans (Miller 1931).

Loggerhead Shrike Conservation Activities in the State

None specific to loggerhead shrike.

MARYLAND AND DISTRICT OF COLUMBIA

Historic and Current Range of the Loggerhead Shrike

Milburn (1981) reported confirmed and potential breeding records from 13 Maryland counties and the District of Columbia.

Four confirmed breeding records, all from Washington County or Frederick County, were documented during the BBA (1983-1987). In addition, there were 9 probable or possible breeding records recorded during the BBA; 6 of these records were also from Washington County or Frederick County (Glenn Therres, Maryland Department of Natural Resources, pers. comm.).

Milburn (1981) noted that the loggerhead shrike was considered a regular winter resident in Maryland. Bartgis (1992) reported that most winter reports of loggerhead shrike in Maryland were from the Great and Frederick Valleys and nearby areas of the Piedmont.

Historic and Current Population Estimates and/or Trends

Milburn (1981) reported that there were no loggerhead shrikes breeding records in Maryland prior to 1910. Breeding appeared to peak between 1910-1930, and then underwent a decline during the mid-1900s.

Between 1966-1996, loggerhead shrike was represented by 4 birds on 3 BBS routes in Maryland. Data are inadequate to estimate state trends. The species is currently considered potentially extirpated from the state (G. Therres, pers. comm.).

A marked decline in the number of loggerhead shrikes reported during CBCs has been noted since the early 1970s; declines have been most severe in coastal areas.

CBC Trend 1959-1988: -2.4 Significance: *** N=21

State Legal Status

State Endangered in Maryland.

Current Research and Monitoring

Loggerhead shrikes have not been actively monitored or studied in Maryland since 1996. Prior to that, research/monitoring included: searches for breeding localities; nest monitoring; and color banding. These efforts ceased primarily due to lack of active breeding sites (G. Therres, pers. comm.).

Threats to the Loggerhead Shrike in the State

Causes of population decline and possible extirpation are uncertain. A combination of factors may have contributed to the decline, including: habitat loss (e.g. development); alteration of habitat (e.g. farm abandonment, overgrazing of pastures); collisions with vehicles, especially juvenile shrikes; and landscape level habitat fragmentation (G. Therres, pers. comm.).

Habitat Requirements and Condition

Shrike habitat in the state is typically, lightly to moderately grazed pasture with scattered small trees, saplings, and shrubs, especially eastern red cedar. Also, nearby infrequently mowed hayfields for foraging are important. Presence of fences, utility wires, and other perches may be important as hunting perches (G. Therres, pers. comm.).

Subspecies of Loggerhead Shrike Occurring in the State

L.l. migrans (Miller 1931).

Loggerhead Shrike Conservation Activities in the State

None at present (G. Therres, pers. comm.).

MASSACHUSETTS

Historic and Current Range of the Loggerhead Shrike

Milburn (1981) reported verified and potential breeding records from 10 scattered counties in Massachusetts; no nests have been found since 1971. The species used to be considered an irregular and local breeder in the state, but was a regular migrant along the coast.

Historic and Current Population Estimates and/or Trends

BBS: No records of loggerhead shrike

State Legal Status

State Endangered.

Current Research and Monitoring

No information provided.

Threats to the Loggerhead Shrike in the State

No information provided.

Habitat Requirements and Condition

No information provided.

Subspecies of Loggerhead Shrike Occurring in the State

L.l. migrans (Miller 1931).

Loggerhead Shrike Conservation Activities in the State

No information provided.

NEW HAMPSHIRE

Historic and Current Range of the Loggerhead Shrike

Loggerhead shrike moved into New Hampshire in the late 1800s and was an uncommon and local summer resident for several decades. Milburn (1981) reported that there were 5 historic nest records; the last documented nesting was in 1910 (Foss 1994). Occasional sightings of individuals, primarily migrants, are recorded.

BBA (1981-1986): 3 sightings of individual birds were recorded during the atlas project.

Historic and Current Population Estimates and/or Trends

BBS: No records of loggerhead shrike.

There are too few records for this species to consider population size or trend. Current information suggests that the species no longer breeds in the state.

State Legal Status

State Endangered (Sara Cairns, New Hampshire Department of Resources and Economic Development, pers. comm.).

Current Research and Monitoring

None (John Kanter, New Hampshire Fish and Game Department, pers. comm.).

Threats to the Loggerhead Shrike in the State

No threats noted.

Habitat Requirements and Condition

New Hampshire is currently more than 85% forested; little suitable shrike habitat remains in the state (J. Kanter, pers. comm.).

Subspecies of Loggerhead Shrike Occurring in the State

L.l. migrans (Miller 1931).

Loggerhead Shrike Conservation Activities in the State

None specific to loggerhead shrike. Several State-listed species are associated with successional habitat; monitoring and habitat management conducted for these species could potentially benefit loggerhead shrike (J. Kanter, pers. comm.). However, Foss (1994) noted that it is unlikely that loggerhead shrike will become reestablished as a breeding bird in New Hampshire in the foreseeable future.

NEW JERSEY

Historic and Current Range of the Loggerhead Shrike

Two loggerhead shrike nests were confirmed in New Jersey in the 1890s; breeding season records since that time are limited to scattered observations, probably of migrant birds (Milburn 1981). In the early 1900s, the loggerhead shrike was described as a regular transient in the fall (Milburn 1981).

Historic and Current Population Estimates and/or Trends

BBS: No records of loggerhead shrike.

CBC Trend 1959-1988: -1.0 Significance: NO N=16

State Legal Status

State Endangered.

Current Research and Monitoring

No information provided.

Threats to the Loggerhead Shrike in the State

No information provided.

Habitat Requirements and Condition

No information provided.

Subspecies of Loggerhead Shrike Occurring in the State

L.l. migrans (Miller 1931).

Loggerhead Shrike Conservation Activities in the State

No information provided.

NEW YORK

Historic and Current Range of the Loggerhead Shrike

Loggerhead shrike was first reported in New York State in 1869 (Eaton 1914). It was a fairly common breeding species in central and western New York at the turn of the century (Eaton 1914). Bull (1974) noted a progressive decline in loggerhead shrike numbers in the 1930s and 1940s. The decline continued through the 1980s; the last known breeding in the State occurred in 1988 (Novak 1989). Historically, loggerhead shrike was also a relatively common migrant in New York, but in recent years only a handful of migrants have been reported during spring and fall (Peter Nye, New York State Department of Environmental Conservation, pers. comm.). There are occasional reports of loggerhead shrikes in winter, some of which may represent misidentification of northern shrikes.

BBA (1980-1985): Loggerhead shrike was recorded in 24 of New York's 5,335 atlas blocks. Probable or confirmed nesting of loggerhead shrike was detected in 13 blocks (Andrle and Carroll, 1988).

Historic and Current Population Estimates and/or Trends

Between 1966-1996, loggerhead shrike was represented by 7 birds on 5 BBS routes in New York. Data are inadequate to estimate state trends.

In 1993, the New York Endangered Species Working Group (1993) noted that there had been no confirmed nesting in the state since 1988. This group categorized the loggerhead shrike as declining in New York.

No recent surveys have been conducted specifically for loggerhead shrike, but New York has a good network of bird watchers looking for rare species. It is likely the species would be detected if present in the state (P. Nye, pers. comm.).

CBC Trend 1959-1988: -0.2 Significance: NO N=21

State Legal Status

State Endangered. Protects individuals from taking, but does not protect habitat (P. Nye, pers. comm.).

Current Research and Monitoring

No current efforts known (P. Nye, pers. comm.).

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: P. Nye (pers. comm.) noted:

"A strong preference for pasture-land was shown by both historical records and more recent studies.

> Novak found that tall, isolated hawthorn shrubs were the most important nest sites. The timing of the shrike decline in New York State appears to coincide with a decline in pasture land. Novak states that the amount of optimal breeding habitat (pasture) has been reduced by 69% from 1920-1978. Abandoned farmland has become overgrown and unsuitable. Hedgerows have been removed."

Novak (1989) noted that while suitable habitat currently remains unoccupied, this finding does not negate the evidence that loss of breeding habitat is involved in the decline of the loggerhead shrike. However, factors other than the lack of available breeding habitat may be currently limiting the population.

Other natural or manmade factors affecting its continued existence: Other potential factors include: collisions with vehicles; pesticides; weather (cold, wet weather negatively affects reproduction). "Low return rates for banded birds provide evidence that post-fledging mortality is limiting the population (P. Nye, pers. comm.)."

Other threats were not considered limiting to shrikes in New York (P. Nye, pers. comm.).

Habitat Requirements and Condition

Apparently suitable, unoccupied loggerhead shrike habitat exists in New York, although it has declined. Novak (1989) developed a preliminary model of optimal shrike habitat in New York; active or recently active pastures at least 5.5 ha in size with trees/shrubs suitable for nesting and perching were the basis for the model. Potential shrike habitat occurs primarily on private land.

Subspecies of Loggerhead Shrike Occurring in the State

L.l. migrans (Miller 1931).

Loggerhead Shrike Conservation Activities in the State

P. Nye (pers. comm.): A New York recovery plan was drafted in the late 1980s, but was not implemented. Surveys of possible nesting areas were conducted until 1994, but no nesting has been documented since 1988. Restoration efforts are being considered in light of Ontario's plans to release captively-bred loggerhead shrikes.

PENNSYLVANIA

Historic and Current Range of the Loggerhead Shrike

Historically (late 1800s, early 1900s), loggerhead shrike nesting was concentrated in northwestern Pennsylvania; the species was probably regular but uncommon. Across the rest of the state, shrikes were a rare and irregular migrant. The last western Pennsylvania nesting record was in 1937 (Daniel Brauning, Pennsylvania Game Commission, pers. comm.).

Evidence of breeding was not observed in the state for over 50 years when a pair was observed carrying nesting material in Adams County (southcentral Pennsylvania) in 1990. Between 1992-1997, 1-3 pairs of nesting loggerhead shrikes were observed per year in southcentral Pennsylvania (D. Brauning, pers. comm.). It appeared that these birds were year-round residents. Hunter et al. (1995) suggested that milder winter weather conditions since 1960 may have facilitated the return of shrikes to southcentral Pennsylvania, and may allow the birds to stay in the area during the winter.

Yahner (1995) noted that loggerhead shrike sightings (probably not breeding birds) were recorded in only 4 counties in the Valley and Ridge physiographic province during the 1984-1988 atlas period.

Historic and Current Population Estimates and/or Trends

Between 1966-1996, loggerhead shrike was represented by 4 birds on 3 BBS routes in Pennsylvania. Data are inadequate to estimate state trends.

Current population is 1-3 pairs nesting annually. Population is too small to identify a trend (D. Brauning, pers. comm.). Annual surveys are conducted in areas of known nesting. Core populations are likely all located, but some individual pairs may be missed (D. Brauning, pers. comm.).

CBC Trend 1959-1988: -0.5 Significance: NO N=21

State Legal Status

State Endangered. Yahner (1995) noted that loggerhead shrike was once listed as extirpated in Pennsylvania, but was upgraded to Endangered in 1992. Because of the species status as State Endangered, funds are expended on monitoring and protection of nest sites, and some habitat enhancement. USFWS section 6 funds have also been used for monitoring and habitat enhancement (D. Brauning, pers. comm.).

Current Research and Monitoring

The Pennsylvania Game Commission annually monitors known nest sites to determine nesting success and productivity (D. Brauning, pers. comm.).

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Several farms supporting nesting shrikes have been sold and sub-divided for housing in recent years (D. Brauning, pers. comm.).

Overutilization for commercial, recreation, scientific, or educational purposes: As a rare species, disturbance from recreational birding is a potential problem but has not been documented (D. Brauning, pers. comm.).

Disease or predation: Not documented in Pennsylvania.

Inadequacy of existing regulatory mechanisms: Inability to regulate land uses limits protection of nest sites (D. Brauning, pers. comm.).

Other natural or manmade factors affecting its continued existence: None noted.

Habitat Requirements and Condition

D. Brauning (pers. comm.) noted: "Shrike habitat in Pennsylvania includes pasture with hawthorns and/or cedar trees. Brushy edges and hedgerows are used. Shrikes have nested in trees and bushes in suburban yards, but their success in that setting is uncertain. Large suburban lots (big yards) and some agricultural area is used."

Subspecies of Loggerhead Shrike Occurring in the State

L.l. migrans (Miller 1931).

Loggerhead Shrike Conservation Activities in the State

In 1998, loggerhead shrike habitat improvement, specifically planting hawthorns and eastern red cedars, was implemented on the Eisenhower National Farm and 2 other sites (Siefken and Brauning 1998). These activities were directed by the Pennsylvania recovery and management plan for loggerhead shrike (Yahner 1995).

RHODE ISLAND

Historic and Current Range of the Loggerhead Shrike

Historically, loggerhead shrike was an uncommon but regular migrant in Rhode Island in fall, and an uncommon but regular winter resident. Since the 1970s sightings have become increasingly rare, the species being entirely absent in some years. There are no nesting records for the state (Chris Raithel, Rhode Island Division of Fish and Wildlife, pers. comm.).

Historic and Current Population Estimates and/or Trends

BBS: No records of loggerhead shrike

Population estimates and trends not applicable to Rhode Island.

State Legal Status

No State status.

Current Research and Monitoring

None

Threats to the Loggerhead Shrike in the State

None noted.

Habitat Requirements and Condition

No comments provided on habitat requirements.

Subspecies of Loggerhead Shrike Occurring in the State

The subspecies found during migration and winter in Rhode Island is *L.l. migrans* based on Miller (1931).

Loggerhead Shrike Conservation Activities in the State

None noted.

VERMONT

Historic and Current Range of the Loggerhead Shrike

A total of 23 nesting records of loggerhead shrike are known from Vermont. Most nesting occurred in the Lake Champlain Valley during the late 1800s and again in the 1950s. The most recent Vermont nesting record occurred in 1978. Few records of migrating loggerhead shrikes exist for Vermont, and no winter records are noted (Milburn 1981).

BBA (1976-1981): Breeding was confirmed twice, with 3 other possible breeding records (Bartgis 1992 *citing* Kibbe 1985).

Historic and Current Population Estimates and/or Trends

BBS: No records of loggerhead shrike

Based on records reported by Milburn (1981), loggerhead shrike was historically a rare breeding bird in Vermont. No shrikes were found during intensive searches in the 1980s and the species is no longer considered to breed in the state (Bartgis 1992 *citing* Kibbe 1985 and Fitchel 1988).

Bartgis (1992) noted that intensive searches were conducted during the 1980s, and no evidence of breeding was recorded. No more recent information is available.

State Legal Status

State Endangered (Bartgis 1992).

Current Research and Monitoring

No information provided.

Threats to the Loggerhead Shrike in the State

No information provided.

Habitat Requirements and Condition

No information provided.

Subspecies of Loggerhead Shrike Occurring in the State

L.l. migrans (Miller 1931).

Loggerhead Shrike Conservation Activities in the State

No information provided.

VIRGINIA

Historic and Current Range of the Loggerhead Shrike

Loggerhead shrike historically was widely distributed in Virginia, occurring in all 5 physiographic provinces, and in 54 of the state's 95 counties. By 1970, Clark (1970) described loggerhead shrike as a rare, local breeder in the Piedmont of northern Virginia. During the BBA (1984-1989), the species was found in 26 counties. Bartgis (1992) noted that approximately 100 records (confirmed, possible, or potential) were reported during the first 4 years of the BBA. The current range of the loggerhead shrike in Virginia is the Ridge and Valley and Piedmont Physiographic Provinces (Rick Reynolds, Virginia Department of Game and Inland Fisheries, pers. comm.).

Blumton (1989) noted that Virginia's loggerhead shrikes are year-round residents.

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -6.3 P=0.31 N=18
BBS Trend 1966-1979: -12.1 P=0.08 N=12 (note inadequate sample size)
BBS Trend 1980-1998: -12.6 P=0.22 N= 6 (note inadequate sample size)

Luukkonen (1987) analyzed BBS data for the period 1968-1983 and documented a 94% overall decline in the number of shrikes counted per BBS route. In 1996, the Virginia Department of Game and Inland Fisheries contracted Dr. Carola Haas to conduct a status survey of loggerhead shrike in Virginia. R. Reynolds (pers. comm.) provided the following summary of her report:

> "We surveyed 95 sites in 18 counties between June 5 and July 23, 1996, and found 19 loggerhead shrikes. Thirteen additional shrikes were reported by other observers in spring or summer of 1996. Of the combined total of 32 shrikes reported, 12 were in pairs, 9 individuals were fledglings, and age could not be determined for 10. One dead fledgling was found hit by a car. Only 1 pair and a fledgling were found at 48 breeding sites surveyed by Luukkonen and Blumton approximately ten years ago. The low number of birds surveyed indicates a continuing trend of population decline in Virginia."

R. Reynolds (pers. comm.) noted that the declines noted by both BBS and other surveys are reliable and accurate. Intensive monitoring of remaining birds would only confirm the declining trend. BBS can no longer provide trend data for this species in Virginia, due to the low number of routes on which it is detected.

In spite of the large-scale declines in the breeding population of loggerhead shrike in Virginia, the state remains the stronghold for the species in the Northeast (i.e. USFWS Region 5), where the shrike has been largely eliminated as a breeding species.

CBC Trend 1959-1988: -4.0 Significance: *** N=52

State Legal Status

State Threatened.

Current Research and Monitoring

A status survey was conducted in 1996. Luukkonen (1987) evaluated the status and breeding ecology of the species and Blumton (1989) evaluated factors affecting mortality. Blumton's work indicated that predation during winter may be a major cause of mortality; plans for additional research on this topic were abandoned because not enough shrikes could be located to warrant study (R. Reynolds, pers. comm.).

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: The consensus is that habitat loss and modification have contributed to loggerhead shrike decline in Virginia. Specifically, "clean farming" practices including the removal of fencerows and associated vegetation, generally followed by crop planting, has resulted in the loss of previously suitable habitat (R. Reynolds, pers. comm.).

Overutilization for commercial, recreation, scientific, or educational purposes: Not considered a factor in Virginia (R. Reynolds, pers. comm.).

Disease or predation: Research by Blumton (1989) indicated that predation by accipiters may be a major cause of mortality during winter months.

Inadequacy of existing regulatory mechanisms: Not considered a factor in Virginia (R. Reynolds, pers. comm.).

Other natural or manmade factors affecting its continued existence: R. Reynolds (pers. comm.) noted that habitat loss alone does not account for the magnitude of decline in loggerhead shrike populations in Virginia; seemingly suitable habitat is unoccupied. No specific additional causes were noted.

Habitat Requirements and Condition

Primary loggerhead shrike habitat in Virginia is closely grazed pastures with trees and shrubs, usually along fencerows. Most is on private land.

Blumton (1989) noted that shrikes moved into shrub-forest habitat during severe weather in winter.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), both *L.l. migrans* and *L.l. ludovicianus* occur in Virginia; he noted intergradation between the 2 subspecies in the state.

Loggerhead Shrike Conservation Activities in the State

Implementation of the "Virginia Bobwhite Quail Management Plan" (Capel et al. 1996) may benefit shrikes. Restoration of native grasslands and "old farm" habitats are components of the plan. However, R. Reynolds (pers. comm.) noted that until the cause for loggerhead shrike decline in Virginia can be

identified, conservation efforts for the species are unlikely to be effective.

WEST VIRGINIA

Historic and Current Range of the Loggerhead Shrike

Milburn (1981) reported that there were 23 records of loggerhead shrike nests in West Virginia between the period 1950-1979. These records were concentrated in eastern and southeastern West Virginia, in counties on or near the Virginia border. She found no historic records prior to 1950, but concluded that the species was likely present but not recorded.

By the late 1970s, loggerhead shrikes were considered very difficult to find in the state (Milburn 1981). Bartgis (1992) reported that 14 confirmed breeding pairs of loggerhead shrike were found in or near the Great Valley in 1991. He also reported that there have been occasional winter reports of shrikes in West Virginia from southwestern and eastern counties.

BBA (1984-1989): Loggerhead shrike was recorded in 20 of the state's 516 atlas blocks; 13 of the records were probable or confirmed (Buckelew and Hall 1994). BBA records confirmed that the distribution of loggerhead shrike in West Virginia is confined to areas bordering Virginia.

Historic and Current Population Estimates and/or Trends

Between 1966-1996, loggerhead shrike was represented by 15 birds on 6 BBS routes in West Virginia. Data are inadequate to estimate state trends.

Hall (1983) reported that by the early 1980s, the loggerhead shrike had almost completely disappeared from many of its "usual locations" in West Virginia.

Surveys during 1999 turned up few, if any, nesting records for loggerhead shrikes from known (previous) nesting sites in West Virginia. The species is considered to be declining in the state (Barbara Sargent, West Virginia Division of Natural Resources, pers. comm.).

State Legal Status

Vertebrate Species of Concern (Buckelew and Hall 1994).

Current Research and Monitoring

Surveys during 1999 turned up few, if any, nesting records for loggerhead shrikes from known (previous) nesting sites in West Virginia (B. Sargent, pers. comm.).

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Loss of breeding and wintering habitat as the result of changing agricultural practices have contributed to the decline of the loggerhead shrike in West Virginia (Buckelew and Hall 1994).

Most of the remaining shrike habitat in West Virginia is in the eastern panhandle, an area that is rapidly being developed because of its proximity to Washington, D.C. (B. Sargent, pers. comm.).

Overutilization for commercial, recreation, scientific, or educational purposes: Not noted.

Disease or predation: Predation on wintering shrikes may have contributed to population decline (Buckelew and Hall 1994).

Inadequacy of existing regulatory mechanisms: Not noted.

Other natural or manmade factors affecting its continued existence: Pesticides may have contributed to population decline (Buckelew and Hall 1994).

Habitat Requirements and Condition

The shrike occurs primarily on open pastureland with scattered trees for perching and nesting (Buckelew and Hall 1994).

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), the subspecies of loggerhead shrikes in West Virginia is *L.l. migrans*, with some intergradation to *L.l. ludovicianus* on the border with Virginia.

Loggerhead Shrike Conservation Activities in the State

No conservation activities have been undertaken; according to Buckelew and Hall (1994) "there seems to be little that can be done to improve the status of this species" in West Virginia.

U.S. FISH AND WILDLIFE SERVICE REGION 6

Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota, Utah, Wyoming

COLORADO

Historic and Current Range of the Loggerhead Shrike

Historic accounts (late 1800s, early 1900s) described the loggerhead shrike as common, chiefly on the plains which were then dominated by shortgrass prairie (Kingery 1998). The Colorado BBA (conducted 1987-1995) showed a statewide distribution for loggerhead shrikes, but with a distinct concentration in the plains of eastern Colorado. Of blocks with more than 10 breeding pairs, 85% were in the eastern plains (Kingery 1998). Statewide, confirmed breeding of shrikes was documented in 57% of atlas blocks. In winter, the species is considered rare to uncommon in western valleys north to Mesa County and southeastern plains north to southern El Paso County; accidental on northeastern plain (Andrews and Righter 1992). Ed Hollowed (BLM, pers. comm.) noted no winter use in BLM's White River Resource Area in northwest Colorado.

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: 3.7 P=0.11 N=42

BBS Trend 1966-1979: 0.4 P=0.94 N=10 (note inadequate sample size)
BBS Trend 1980-1998: 4.1 P=0.09 N=42

BBS sample sizes are currently considered adequate to estimate statewide trends.

Craig (1997) noted fluctuating numbers and breeding success rates of loggerhead shrikes in eastern Colorado; these findings are similar to those of Porter et al. (1975). Overall, her observations suggested that shrike populations, at least in her eastern Colorado study area, were stable.

E. Hollowed (pers. comm.) reported that populations in BLM's White River Resource Area in northwest Colorado have been stable since 1977.

CBC Trend 1959-1988: -2.6 Significance *** N=20

State Legal Status

No State status.

Current Research and Monitoring

S. Craig has an ongoing banding and demographic study.

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: S. Craig (pers. comm.) noted that loss of habitat is not an immediate threat in her eastern Colorado study area. National Grasslands and grazing areas offer some stable refuge for breeding shrikes in this area.

E. Hollowed (pers. comm.) anticipates that habitat conditions for loggerhead shrike will not change appreciably in the next 15 years on BLM's White River Resource Area in northwest Colorado.

R. Lambeth (pers. comm.) noted:

> "The most obvious threat to nesting loggerhead shrikes is wildfire and inadequate appreciation of the wildlife values of the greasewood and, to a lesser extent, lower elevation sagebrush and scattered juniper habitats. Wildfire in the desert is seen by some land managers as good. It burns the shrubs bringing in solid stands of herb cover, usually annuals, that make good winter forage for livestock in most years."

Other natural or manmade factors affecting its continued existence: Porter et al. (1975) noted that breeding success in plains shrikes is highly variable depending on weather conditions. Pesticides are considered a potential problem (S. Craig, pers. comm.).

Other threats were not noted.

Habitat Requirements and Condition

Andrews and Righter (1992) described the habitat of the loggerhead shrike in Colorado: "Open riparian areas, agricultural areas, grasslands, and shrublands, especially semidesert shrublands, and sometimes open pinyon-juniper woodlands. Breeding birds are usually near isolated trees or large shrubs."

In the plains of eastern Colorado, Craig (1997) observed high densities of breeding loggerhead shrikes in an area with short cropped grass and short isolated trees. (She also noted the presence of barbed wire fences). Of all shrikes observed during the BBA, 47% occupied habitat classified as "rural," usually abandoned farmyards with untended trees, and shortgrass prairie accounted for 15% of all records (Kingery 1998). Much of the habitat in eastern Colorado is on private land (Kenneth Giesen, Colorado Division of Fish and Wildlife, pers. comm.).

In northwestern Colorado, loggerhead shrike nesting is generally associated with shrubs in salt desert habitats (E. Hallowed, pers. comm.). The tall desert shrub black greasewood is the most consistently used habitat in western Colorado (R. Lambeth, pers. comm.). Most habitat in western Colorado is on BLM and U.S. Forest Service lands (K. Giesen, pers. comm.).

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), *L.l. excubitorides* breeds in eastern Colorado and *L.l. nevadensis* in western Colorado, with intergradation between the 2 subspecies throughout the central portion of the state. S. Craig (pers. comm.) commented that based on morphometric characteristics of birds banded in eastern Colorado, *L.l. excubitorides* appeared to be the most common subspecies.

Loggerhead Shrike Conservation Activities in the State

BLM has adopted a full fire suppression policy on desert lands in some areas; this policy should preserve fire-sensitive shrubs and thus benefit loggerhead shrikes (R. Lambeth, pers. comm.).

KANSAS

Historic and Current Range of the Loggerhead Shrike

Historic and current breeding range of the loggerhead shrike in Kansas is statewide. The species is less abundant in winter, when it is found primarily in eastern and southern Kansas (Thompson and Ely 1992). It is unknown if the birds present in winter are year-round residents, or migrants from northern breeding ranges (Bill Busby, University of Kansas, pers. comm.). Kansas BBA data (1992-1997) confirm a statewide breeding distribution for loggerhead shrike. The species was found in 585 of a total 780 blocks surveyed (75%); breeding evidence was probable or confirmed for 70% of these records (B. Busby, pers. comm.).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -2.3 P=0.01 N=39
BBS Trend 1966-1979: -4.3 P=0.07 N=34
BBS Trend 1980-1998: -3.9 P=0.00 N=38

While species accounts for the state typically characterize loggerhead shrike as a common breeding species in Kansas, B. Busby (pers. comm.) noted that population densities of loggerhead shrike in Kansas are low. The species is encountered frequently, relative to its abundance, due to its conspicuous behavior.

Range data are considered reliable; population trend data based on BBS are reliable but limited due to the relatively low number of routes on which the species is found. Additional BBS routes were planned for

1999 (B. Busby, pers. comm.).

CBC Trend 1959-1988: -1.1 Significance: NO N=39

State Legal Status

No State status.

Current Research and Monitoring

Michaels and Cully (1998) concluded that loggerhead shrikes at Fort Riley Military Reservation in Kansas were associated with scattered trees and shrubs at the landscape scale and with structurally heterogenous herbaceous vegetation at the fine-scale. In agricultural areas, short grass for foraging and adequate perch sites, in the form of powerlines, fences or woody vegetation, are considered essential for loggerhead shrikes. In natural grasslands, these considerations may not apply (Michaels and Cully 1998) .

B. Busby (pers. comm.) noted that research on habitat characteristics of loggerhead shrike in northeast Kansas is being conducted by Jack Cully at Kansas State University. Reports are not yet available.

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Acreage of rangeland in Kansas is shrinking at a slow pace, but this may be offset by establishment of new grasslands through the CRP program (B. Busby, pers. comm.). Increasing efforts to remove hedgerows and to discourage woody vegetation in pastures, practices detrimental to shrike habitat, were noted (Jerry Horak, Kansas Wildlife and Parks, pers. comm.). However, habitat is not considered limiting, as apparently suitable habitat is unoccupied (B. Busby and J. Horak, pers. comms.).

No other threats were noted.

Habitat Requirements and Condition

Loggerhead shrike occur in open areas interspersed with trees and shrubs (Thompson and Ely 1992), often associated with rangeland in Kansas. The species occurs primarily on private land.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), *L.l. migrans* breeds in eastern Kansas and *L.l. excubitorides* in the western half of the state. Intergradation between the 2 subspecies occurs in central portions of the state.

Loggerhead Shrike Conservation Activities in the State

No information provided.

MONTANA

Historic and Current Range of the Loggerhead Shrike

The Montana Bird Distribution Committee (1996) indicated that the loggerhead shrike is a widely distributed breeding species in Montana, possibly breeding throughout the state, but confirmed breeding records are rare along the western boundary. Winter records are rare.

There is little information on historic range, but historic records suggest that the species was never abundant in the state (Eric Atkinson, Marmot's Edge Conservation, pers. comm.).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: 0.0 P=0.99 N=24
BBS Trend 1966-1979: -13.5 P=0.26 N=10 (note inadequate sample size)
BBS Trend 1980-1998: 0.4 P=0.84 N=21

BBS sample sizes are currently considered adequate to estimate statewide trends, however, the applicability of BBS data to determine accurate population trends for Montana is questionable (E. Atkinson, pers. comm.). Vast roadless areas of Montana are not represented in the survey (Dwain Prellwitz, USFWS, pers. comm.).

BBS data suggest a relatively stable long-term population trend for loggerhead shrike statewide in Montana. Peterjohn and Sauer (1995) analyzed BBS trends by physiographic strata for the period 1966-1993; they noted that (continentwide) only 2 strata supported shrike populations that were not decreasing. One of these was the High Plains and Great Plains Roughlands strata, which extends along the western portion of the Great Plains from Montana and western South Dakota to eastern Colorado; the population in this strata was fairly stable.

State Legal Status

No State status (Ryan Rauscher, Montana Fish, Wildlife, and Parks, pers. comm.).

Current Research and Monitoring

Montana Fish, Wildlife, and Parks is currently conducting a study to monitor productivity, on a minimum of 30 nests, and characterize breeding habitat of loggerhead shrike (R. Rauscher, pers. comm.). One objective is to evaluate nesting success in farmyards versus shrub/grassland habitats.

E. Atkinson (pers. comm.) has also initiated a demographic study of loggerhead shrike.

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Conversion of native grasslands, shrublands, open juniper woodlands, and small farms to large-scale agriculture adversely impacts loggerhead shrike habitat (E. Atkinson and R. Rauscher, pers. comms.).

Invasion by exotic annuals and pesticides have probably contributed to degradation of some loggerhead shrike habitat in Montana (E. Atkinson, pers. comm.).

Overutilization for commercial, recreation, scientific, or educational purposes: Not considered a threat to shrikes in Montana (E. Atkinson, D. Prellwitz, and R. Rauscher, pers. comms.).

Disease or predation: Predation on nests and young is common, but is not considered as threat to the species (E. Atkinson, D. Prellwitz, and R. Rauscher, pers. comms.).

Inadequacy of existing regulatory mechanisms: Not considered a threat to shrikes in Montana (E. Atkinson, D. Prellwitz, and R. Rauscher, pers. comms.).

Other natural or manmade factors affecting its continued existence: Pesticides may negatively affect shrikes in Montana (E. Atkinson, pers. comm.), but data are lacking.

Habitat Requirements and Condition

Loggerhead shrike habitat has been lost, and continues to be lost, as native prairies, open juniper woodlands, and small farms are converted to other land uses (E. Atkinson, pers. comm.). However, habitat may be created on CRP lands if trees/shrubs suitable for nesting are present (D. Prellwitz, pers. comm.).

Much habitat occurs on private land in shelterbelts and other plantings around old homesteads and farms. Other suitable habitat occurs in areas where there is a mixture of private and public lands (including lands managed by BLM, USFWS, and the Bureau of Indian Affairs). Vast areas of grasslands in Montana have scattered shrubs and fencelines which may provide suitable habitat (Stephanie Jones, USFWS, pers. comm.). Habitat also occurs along draws and coulees where suitable nest shrubs are found in conjunction with foraging habitat (E. Atkinson, pers. comm.).

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrikes in the eastern Great Plains portion of the state are *L.l. excubitorides*, and *L.l. gambeli* breeds in the shrub-steppe habitat western Montana. Intergrades between the 2 subspecies may occur through much of the central portion of the state.

Loggerhead Shrike Conservation Activities in the State

Montana PIF is developing population objectives and conservation strategies for loggerhead shrike (E. Atkinson, pers. comm.).

The current study being conducted by Montana Fish, Wildlife and Parks will result in management guidelines for loggerhead shrike in the state (R. Rauscher, pers. comm.).

NEBRASKA

Historic and Current Range of the Loggerhead Shrike

No information provided.

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -0.9 P=0.79 N=42

BBS Trend 1966-1979: -5.2 P=0.24 N=29
BBS Trend 1980-1998: 6.3 P=0.49 N=35

BBS sample sizes are considered adequate to estimate state trends.

State Legal Status

None (based on State World Wide Web site checked January 21, 2000).

Current Research and Monitoring

No information provided.

Threats to the Loggerhead Shrike in the State

No information provided.

Habitat Requirements and Condition

No information provided.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrike throughout western Nebraska are *L.l. excubitorides*, with intergradation with *L.l. migrans* in the eastern half of the state.

Loggerhead Shrike Conservation Activities in the State

No information provided.

NORTH DAKOTA

Historic and Current Range of the Loggerhead Shrike

Loggerhead shrike breeds statewide in North Dakota. The species is most abundant west of the Missouri River and least common in the Red River Valley and Northeastern Drift Plain (Stewart 1975; Todd Grant, USFWS, pers. comm.). The species does not winter in the state (Miller 1931).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -0.7 P=0.71 N=26
BBS Trend 1966-1979: -4.8 P=0.16 N=14
BBS Trend 1980-1998: 5.3 P=0.00 N=27

BBS sample sizes are considered adequate to estimate state population trends.

Igl and Johnson (1997) compared breeding bird populations in North Dakota using surveys conducted in 1967 and 1992-1993. Their study suggested an increase in the population of loggerhead shrikes between the 2 survey periods. However, sample sizes were small with 8, 16, and 15 pairs of shrikes detected in

1967, 1992, and 1993, respectively. During the same period (1967-1993), the population trend based on BBS data was an estimated 0.41% annual decline (not statistically significant).

Haas (1995a) monitored nests of loggerhead shrikes in shelterbelts in an approximately 8,000 ha study area in Sioux County, North Dakota for a 10-year period beginning in 1984. The number of breeding pairs fluctuated between 9 and 19 (averaging 12) but showed no consistent trend over time. Fledging success was high but return rates were low; low return rates were attributed to low site fidelity.

State Legal Status

No State status.

Current Research and Monitoring

None noted.

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: In the past 30 years, the acreage of hayland in North Dakota has declined 50%. The loss of this potentially suitable loggerhead shrike habitat may be offset, to some extent, by shelterbelt plantings and invasion of woody vegetation into remaining grassland habitats (T. Grant, pers. comm.).

Other natural or manmade factors affecting its continued existence: Widespread pesticide use in years of grasshopper outbreaks is a potential concern (T. Grant, pers. comm.).

No other threats were noted.

Habitat Requirements and Condition

The loggerhead shrike is considered an open-country edge species in North Dakota, inhabiting thickets of small trees/shrubs in or adjacent to crop fields or prairie. Scattered natural thickets and woody vegetation associated with altered landscapes (shelterbelts, cemeteries, farmsteads) are used (Stewart 1975).

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrike throughout western North Dakota are *L.l. excubitorides*, with intergradation with *L.l. migrans* in the eastern half of the state.

Loggerhead Shrike Conservation Activities in the State

No conservation activities specific to shrikes were noted. North Dakota has approximately 3 millions acres of cropland enrolled in CRP, which provides some shrike habitat. State and Federal programs encourage tree plantings for wildlife habitat and erosion control (T. Grant, pers. comm.).

SOUTH DAKOTA

Historic and Current Range of the Loggerhead Shrike

The loggerhead shrike is considered a fairly common breeding bird in South Dakota; less common in the eastern fourth of the state and rare in the Black Hills. The species does not regularly winter in the state, although there are undocumented winter records (South Dakota Ornithologists' Union 1991). The BBA (conducted from 1988-1993) confirmed widespread distribution for loggerhead shrike in South Dakota; the species was documented in 49% of 124 random blocks surveyed and was found in 16 of 17 "ecological regions" (Peterson 1995). Probable or confirmed breeding accounted for 36% of all reports.

Historical information is limited, but the range of the species has probably not changed (Doug Backlund, South Dakota Department of Game, Fish and Parks, pers. comm.).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -0.5 P=0.70 N=36
BBS Trend 1966-1979: 4.6 P=0.18 N=23
BBS Trend 1980-1998: -1.5 P=0.50 N=29

BBS data are considered adequate to estimate state population trends. D. Backlund (pers. comm.) noted that additional surveys are not needed.

State Legal Status

No State status.

Current Research and Monitoring

None (D. Backlund, pers. comm.).

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Loss of grassland habitat has probably affected loggerhead shrike in the state, but abundant suitable habitat is still available (D. Backlund, pers. comm.).

Other natural or manmade factors affecting its continued existence: Pesticides likely affect loggerhead shrike, but impacts apparently aren't severe as the species is doing well in the state (D. Backlund, pers. comm.).

No other threats were noted.

Habitat Requirements and Condition

Loggerhead shrike occurs on grasslands with scattered trees or shelterbelts; most occur on private land (D. Backlund, pers. comm.).

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), breeding loggerhead shrike throughout western South Dakota are *L.l. excubitorides*, with potential intergradation with *L.l. migrans* in the eastern half of the state.

Loggerhead Shrike Conservation Activities in the State

None noted.

UTAH

Historic and Current Range of the Loggerhead Shrike

The loggerhead shrike is a common permanent resident statewide in lower valleys and foothills where there is desert shrub habitat and pinyon-juniper forest. Less common statewide in winter, but more abundant in the south than the north (Behle et al. 1985). Historic distribution was also statewide (Frank Howe, Utah Division of Wildlife Resources, pers. comm.).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: 4.7 P=0.28 N=29
BBS Trend 1966-1979: trend not available
BBS Trend 1980-1998: 13.0 P=0.10 N=30

BBS data are considered reliable (F. Howe, pers. comm.).

Population is considered stable (F. Howe, pers. comm.).

CBC Trend 1959-1988: -1.4 Significance ** N=16

State Legal Status

No State status. Species was considered for listing as "State Sensitive" in 1993 (based on evidence of rangewide decline), but was not listed since the population appeared stable and the species was considered a common breeder in the state (F. Howe, pers. comm.).

Current Research and Monitoring

There is no activity specifically focusing on shrikes. The Utah Division of Wildlife Resources and the U.S. Department of Defense (Dugway Proving Grounds) initiated a study in 1998 which will focus on the effects of military activities and wildfires on pinyon-juniper associated landbirds, including loggerhead shrike (F. Howe, pers. comm.).

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: Loggerhead shrike habitat, including shrub-steppe and pinyon-juniper, is lost to chaining and "rehabilitation" projects, but this loss does not affect a large portion of available habitat. Also, these practices have been reduced in recent years. The most recent and potentially more significant threat is from catastrophic

wildfire. Recent invasions of non-native grasses (primarily cheatgrass) have changed fire frequency and intensity in shrub-steppe and pinyon-juniper habitats (F. Howe, pers. comm.).

Overutilization for commercial, recreation, scientific, or educational purposes: Not considered a threat in Utah (F. Howe, pers. comm.).

Disease or predation: Not considered a threat in Utah (F. Howe, pers. comm.).

Inadequacy of existing regulatory mechanisms: Not considered a threat in Utah (F. Howe, pers. comm.).

Other natural or manmade factors affecting its continued existence: Land management agencies are attempting to reduce the risk of catastrophic fires in shrubland and woodland habitat, but given the widespread invasion of cheatgrass it is not clear if these efforts will be effective. "In addition, the practice of planting non-native plants in burn restoration areas (often with the exclusion of native shrubs) does present a threat to shrike habitat (F. Howe, pers. comm.)."

Habitat Requirements and Condition

Shrike habitat in Utah occurs primarily on public lands in shrub-steppe or pinyon-juniper habitats.

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), there is potential for 3 breeding subspecies of loggerhead shrikes in Utah. *L.l. nevadensis* breeds statewide with potential intergradation with *L.l. gambeli* in extreme northern Utah and with *L.l. excubitorides* in the northeastern corner. Behle (1985) reviewed various treatments of loggerhead shrike systematics in Utah; based on his examination of 111 specimens from the University of Utah collection he concluded that *L.l. nevadensis* is a "good" race and is the breeding form throughout the state. *L.l. nevadensis* also occurs, along with *L.l. gambeli*, in winter.

Loggerhead Shrike Conservation Activities in the State

The Utah PIF Conservation Plan will focus on pinyon-juniper habitats; conservation and management of these habitats would benefit loggerhead shrike.

WYOMING

Historic and Current Range of the Loggerhead Shrike

The historic breeding distribution included the entire state below 7,000 feet elevation, where loggerhead shrikes were considered locally common (Mary Jennings, USFWS, pers. comm. *citing* McCreary 1937). The breeding distribution remains relatively unchanged. The state's breeding population migrates south for winter, although occasional winter records occur (Katy Duffy, Grand Teton National Park, pers. comm.).

Historic and Current Population Estimates and/or Trends

BBS Trend 1966-1998: -1.4 P=0.53 N=60
BBS Trend 1966-1979: -1.8 P=0.55 N=16
BBS Trend 1980-1998: 4.1 P=0.01 N=58

The species is, qualitatively, considered a common summer resident, although no population estimate is available (M. Jennings, pers. comm.). BBS data, which suggest a relatively stable population in the state, are considered adequate to estimate statewide trends. BBS routes are distributed throughout the state, although coverage is not adequate in some areas (M. Jennings, pers. comm.).

State Legal Status

No State status.

Current Research and Monitoring

None

Threats to the Loggerhead Shrike in the State

The present or threatened destruction, modification, or curtailment of its habitat or range: The oil and gas industry is undergoing rapid expansion in field exploration and development in the state. This has not led to intensive habitat conversion, but could potentially affect loggerhead shrikes in the future (M. Jennings, pers. comm.).

Other factors were not considered a threat to loggerhead shrikes in the state (M. Jennings, pers. comm.).

Habitat Requirements and Condition

Loggerhead shrike breeds in any non-forested habitat in the state if suitable nest substrate is present. In north and east Wyoming, this includes shortgrass prairie, and in the western part of the state the Great Basin shrub-steppe. The main management impact is grazing, but the species is found even in heavily grazed areas. Shrub removal through chaining, disking, burning and herbicide application is a widespread range improvement technique with unknown impacts on loggerhead shrike. Approximately 50% of available habitat is Federally owned, primarily by BLM (M. Jennings, pers. comm.).

Subspecies of Loggerhead Shrike Occurring in the State

Based on Miller (1931), *L.l. excubitorides* breeds in eastern Wyoming and *L.l. gambeli* breeds in the west, with potential for intergradation between the subspecies throughout most of the state. These subspecies may also intergrade with *L.l. nevadensis* in southern Wyoming.

Loggerhead Shrike Conservation Activities in the State

No activities specific to loggerhead shrike were noted. Wyoming PIF is currently developing a statewide conservation plan for all nongame birds, which will include management recommendations for each species. Loggerhead shrike is currently listed as a Level II species by Wyoming PIF; this designation indicates a need for population monitoring (M. Jennings, pers. comm.).

CANADA

The loggerhead shrike is listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as a threatened species in western Canada and an endangered species in eastern Canada. Eastern Population: Quebec, Ontario, eastern Manitoba

Western Population: Alberta, Saskatchewan, western Manitoba

Historic and Current Range of the Loggerhead Shrike

(Adapted from Cadman 1991). The breeding range of the loggerhead shrike has changed considerably in Canada since the late 1800s. Prior to opening of forests for agriculture in eastern Canada, the loggerhead shrike was restricted to prairie-like and parkland habitat in northwestern and southwestern Ontario. With the clearing of forests for cultivation, the species range extended throughout southern Ontario, and into southern Quebec and the Maritimes. A smaller range expansion took place in the Prairie Provinces, where cultivation opened areas of aspen parkland to the north of the prairies. Known breeding range continued to expand until the middle of the twentieth century. Its range in eastern Canada has been shrinking since that time; there has been a retraction from the northern edge of the breeding range in Ontario and Quebec, and the species no longer breeds in the Maritimes. The breeding range in eastern Canada is now restricted to southwestern Quebec, southern Ontario, and southeastern Manitoba. There was also a retraction from the northern edge of the range in the Prairie Provinces. Campbell et al. (1997) reported that there were no nesting records for the species in British Columbia, although there were rare sightings in portions of the province in all seasons. Cadman (1985) provided a detailed discussion of changes in loggerhead shrike breeding range in Canada. Robert and Laporte (1991) provided a detailed history of the loggerhead shrike in Quebec.

The Ontario BBA (Cadman 1987), conducted from 1981-1985, resulted in a provincial population estimate of 50 to 100 breeding pairs annually, with all but a few concentrated in southern Ontario. Loggerhead shrike was reported in 21 (15%) of 137 blocks; 18 of those records were probable or confirmed breeding. The BBA of southern Quebec, conducted from 1984-1989, reported loggerhead shrike in only 7 atlas squares, and never more than 1 pair was reported in a square (Robert et al. 1996).

Loggerhead shrike does not winter in Canada (Miller 1931). Limited band recoveries suggest that individuals that breed in western Canada winter in eastern Texas and adjacent regions (Johns et al. 1994). It is assumed that eastern Canada's breeding population winters in the southeastern U.S. (Johns et al. 1994).

Historic and Current Population Estimates and/or Trends

Alberta:
BBS Trend 1966-1998: -3.4 P=0.45 N=17
BBS Trend 1966-1979:-10.8 P=0.04 N= 7 (note inadequate sample size)
BBS Trend 1980-1998: 10.4 P=0.20 N=14

Saskatchewan:
BBS Trend 1966-1998: -9.8 P=0.01 N=30
BBS Trend 1966-1979:-15.6 P=0.00 N=19
BBS Trend 1980-1998: -0.6 P=0.77 N=22

BBS sample sizes are adequate to estimate provincewide trends only in Alberta and Saskatchewan.

Johns et al. (1994) reported the following population estimates by province (see Johns et al. 1994 for additional detail on the sources of data for estimates):

Quebec - only 2 breeding pairs found in 1991 in spite of extensive search. There were no sightings in Quebec in 1996 or 1997 (M. Robert, pers. comm.).

Ontario - exhaustive search in 1992 resulted in estimate of 100 individuals.
Manitoba - approximately 500 breeding pairs. However, the eastern Manitoba population was estimated at less than 50 pairs in 1998 (Ken DeSmet, Manitoba Dept. of Natural Resources, pers. comm.).
Saskatchewan - probably several thousand breeding pairs. BBS data suggest that the population in Saskatchewan declined from 1966-1979, but that is has since stabilized at the lower level.
Alberta - population estimated at 400 pairs, but the population is thinly distributed over large areas making the status difficult to evaluate. Based on surveys conducted in 1993, Bjorge and Prescott (1996) estimated the population in the core breeding areas of southeastern Alberta at approximately 2,500 pairs.

Johns et al. (1994) noted: "The remaining strongholds of the Loggerhead Shrike are in portions of southwestern Manitoba, southern Saskatchewan, and southeastern Alberta."

Cadman (1985) provided a detailed discussion of population size and trends by province.

A considerable amount of monitoring has been conducted for loggerhead shrike in Canada; reliability of population estimates is generally considered good.

Legal Status

The loggerhead shrike is listed by COSEWIC as a threatened species in western Canada and an endangered species in eastern Canada. In 1986, the species was designated as threatened across Canada. The eastern population was reevaluated in 1991 and uplisted to endangered (Cadman 1985), reflecting the more precarious status of the species in eastern Canada. The eastern population includes birds breeding in Quebec, Ontario, and eastern Manitoba. The western population includes birds breeding in Alberta, Saskatchewan, western Manitoba.

The loggerhead shrike is also on provincial endangered species lists in Ontario, Manitoba, and Saskatchewan (B. Johns, pers. comm.). These listings protect the species, as well as nests and eggs; in Ontario habitat is also protected. Cuddy (1995) provided a discussion of the legal definition of habitat in Ontario. The species will soon be legally classified as threatened in Quebec (M. Robert, pers. comm. 1998).

Current Research and Monitoring

The "National Recovery Plan for the Loggerhead Shrike" (Johns et al. 1994) details research and monitoring needs, as well as some discussion of ongoing work. Periodic monitoring is conducted in all provinces where shrikes occur, or recently occurred.

Telfer et al. (1989) evaluated status and distribution in the Prairie provinces of western Canada based on roadside counts. Telfer (1992) evaluated habitat change as a factor in the decline of the loggerhead shrike in western Canada (Alberta and Saskatchewan). He also looked at habitat condition in south Texas, the presumed winter range of western Canada's shrikes. He found that regions of Alberta and Saskatchewan which experienced the most severe declines in shrike numbers had a 39% decline in unimproved pasture between 1946-1986. This compared to a 12% decline in regions that retained substantial numbers of nesting shrikes (southwest and northwest Saskatchewan and southern Alberta). On the presumed winter range in Texas, pasture area had also declined. In Alberta and Saskatchewan native prairie is prime loggerhead shrike habitat and its preservation is considered important for shrike conservation efforts. Pasture, while not as good as native prairie habitat, is better than crop fields or fallow land. Telfer (1992) recommended the planting of at least 1 patch of suitable nesting shrub/tree species per 65 ha, if suitable clumps are not available.

Nineteen nestling shrikes were collected in 1992 by the Avian Science and Conservation Centre of McGill University in Quebec and a captive breeding colony was established. "The colony was established to learn more about shrike biology, to develop propagation techniques, to be used as a management tool to help determine why shrike populations are declining in the wild, and to assess the feasibility of captive propagation and release (Johns et al. 1994)."

Prescott and Collister (1993) evaluated characteristics of occupied and unoccupied loggerhead shrike territories in southeastern Alberta. Bjorge and Prescott (1996) estimated population size and evaluated habitat associations of the loggerhead shrike in southeastern Alberta.

Collister and Wicklum (1996) evaluated intraspecific variation in loggerhead shrikes in southeastern Alberta. They found no significant sexual dimorphism in loggerhead shrikes on Canadian Prairies. They also found that variation in wing chord:tail length ratios within the population they studied precluded the use of this measure to assign a specimen to a subspecies; this was a measure used by Miller (1931) to differentiate among subspecies.

Shrike surveys are conducted every 5 years in western Canada. The third of the 5-year surveys was scheduled to be conducted in 1998 (B. Johns, pers. comm. 1998).

Vallianatos (1999) evaluated mitochondrial DNA variation among over 200 loggerhead shrike samples from different localities across central and eastern North America. A significant amount of the genetic variation observed among her samples was differentiated among 4 geographic regions. Her work supported the existence of the intergrade zone between *L.l. migrans* and *L.l. excubitorides*, as described by Miller (1931). Additional research on the genetic diversity of Canadian shrikes and characterization of the hybrid zone between *L.l. migrans* and *L.l. excubitorides* is planned (Stephen Lougheed, Queen's University, pers. comm.).

Threats to the Loggerhead Shrike

In Canada's recovery plan, Johns et al. (1994) noted: "The principal drawback to recovery efforts for the Loggerhead Shrike is that the cause of its population decline is unknown." Suspected causes are outlined below.

The present or threatened destruction, modification, or curtailment of its habitat or range: Declines in Canada's breeding populations of loggerhead shrike parallel the loss of native habitat both on the breeding and wintering range (Johns et al. 1994). Conversion of pasture to cropland and removal of shelterbelts and hedges have reduced nesting opportunities for shrikes. The area of pasture in Ontario decreased 65% between 1921-1986; in Quebec, area of pasture decreased 85% between 1941-1990 (Cadman 1991). Remaining populations in eastern Canada are primarily associated with 3 core areas in eastern Ontario, each associated with a limestone plain (Chabot et al. 1995a). Gravel extraction operations, in at least 1of these core areas, are a threat to the shrike population (Cadman 1991). Habitat is also being lost to industrial and housing development (Cadman 1991).

Cadman (1985) noted that shrike numbers decreased more rapidly than the rate of decrease in habitat in eastern Canada; apparently suitable habitat is unoccupied. While it is generally accepted that habitat loss led to the slow reduction in shrike numbers through the mid 1900s, continued widespread decline probably involves other factors.

While it is frequently noted that much apparently suitable habitat for loggerhead shrikes remains unoccupied, Prescott and Collister (1993) cautioned that the suitability of unoccupied sites has not been

quantitatively assessed in most situations. They quantitatively evaluated characteristics of occupied and unoccupied loggerhead shrike territories in southeastern Alberta and concluded that the population they studied was limited by the availability of high-quality breeding habitat. Telfer (1992) also concluded that habitat loss was a factor in the decline of loggerhead shrike in Alberta and Saskatchewan.

Overutilization for commercial, recreation, scientific, or educational purposes: Not noted.

Disease or predation: Not noted.

Inadequacy of existing regulatory mechanisms: The most effective regulatory mechanisms available in Canada are already in place. The loggerhead shrike is listed by COSEWIC as a threatened species in western Canada and an endangered species in eastern Canada. The species is also on provincial endangered species lists in Ontario, Manitoba, and Saskatchewan. The species will soon be legally classified as threatened in Quebec.

Other natural or manmade factors affecting its continued existence: Pesticides or other contaminants are considered a potential threat. Shrike declines in the 1950s and 1960s corresponded with widespread use of DDT. Declines of prairie shrikes corresponded with application of dieldrin to control grasshopper outbreaks (Johns et al. 1994). Cadman (1985) provided anecdotal evidence that suggested roadside spraying of herbicides may have resulted in local reductions in shrike numbers in Ontario.

Collisions with automobiles are also considered a potential threat, particularly when shrike numbers are low (Johns et al. 1994).

Competition from resident shrikes on winter range may be a limiting factor (Johns et al. 1994), although no information is available to evaluate this threat.

Habitat Requirements and Condition

Remaining populations in eastern Canada are primarily associated with 3 core areas in eastern Ontario, each associated with a limestone plain (Chabot et al. 1995a). Most breeding shrikes are found in actively grazed pastures. Cuddy (1995) noted that all known nesting in Ontario was on private land.

In the Prairie Provinces of western Canada, loggerhead shrike is found chiefly in the arid shortgrass or desert savanna and plains areas (Cadman 1985).

Most shrike habitat in Canada is associated with agricultural land and little is under government ownership (Cadman 1985).

Subspecies of Loggerhead Shrike in Canada

Following Miller (1931), it is generally considered that *L.l. migrans* breeds in eastern Canada, *L.l. excubitorides* breeds in western Canada, and the 2 subspecies intergrade in eastern Manitoba (Johns et al. 1994). However, Collister and Wicklum (1996) noted that loggerhead shrikes in Canada are listed based on an eastern and western population, rather than based on subspecies, due to the difficulty in ascertaining subspecies.

Loggerhead Shrike Conservation Activities in Canada

A "National Recovery Plan for the Loggerhead Shrike" was prepared in 1994 (Johns et al. 1994). The recovery plan outlines specific recovery goals and objectives.

The Canadian Wildlife Service (CWS 1999) reported the following progress on recovery objectives for the eastern population: 1) continued studies of population status, reproductive success, and fledgling survival; 2) maintained 2 captive populations of loggerhead shrikes (a total of 44 founder birds), analyzed genetic variability in captive populations, and developed protocol for release of captive-reared birds; 3) implemented efforts to reduce traffic speed on rural roads in shrike nesting areas and monitored effectiveness of those efforts; 4) implemented outreach efforts for landowners that own shrike habitat in Ontario; 5) studied toxicological studies of road dust suppressant "Dombind"; 6) evaluated 60 recent loggerhead shrike nest sites for Ontario's Conservation Land Tax Incentive Program; and 7) limited habitat management was implemented.

The Canadian Wildlife Service (CWS 1999) also reported the following progress on recovery objectives for the western population: 1) conducted a prairiewide population survey and other monitoring efforts; 2) conducted stable-hydrogen isotope analysis of feathers to determine wintering locations of birds that breed in western Canada; 3) initiated a nest site database for use in GIS applications; and 4) habitat management accomplished through "Operation Grassland Community."

APPENDIX II

LOGGERHEAD SHRIKE STATUS ASSESSMENT QUESTIONNAIRE

The original request for information was mailed in March 1998; as additional contacts were identified, additional mailings were made. Requests were personally addressed when mailed (the attached version is addressed to "Dear Colleague"). The version of the letter sent to Canada was slightly modified, primarily to eliminate references to "states."

MAILING LISTS FOR EACH U.S. FISH AND WILDLIFE SERVICE REGION AND CANADA FOLLOW THE LETTER

March 16, 1998

Dear Colleague:

The U.S. Fish and Wildlife Service (FWS) is currently conducting a status assessment for the loggerhead shrike (*Lanius ludovicianus*). The purpose of the status assessment is to synthesize existing information on the biology, population status, and conservation of the loggerhead shrike. Research, monitoring, and conservation needs will be identified. Information from this assessment will assist us in determining if the species, or any of its subspecies, should be added to the Federal List of Threatened and Endangered Species.

We would appreciate any information you can provide regarding loggerhead shrike. In particular, we request that you provide information in response to the 9 questions that follow, if available:

1. Historic and current range of loggerhead shrike (indicate breeding, wintering, or year-round range) in your state. What is the source of this information?

2. Historic and current population estimates and/or trends in your state. If possible, please characterize the population as increasing, stable, or decreasing. What is the source of this information?

3. Are state range and population estimates for this species reliable and current? If not, what surveys or monitoring programs are needed to determine the status of this species in your state?

4. What is the current protective status of the loggerhead shrike under state laws and regulations? What are the practical ramifications of this status?

5. Are you aware of any current loggerhead shrike research and/or monitoring efforts in your state?

6. Summarize any threats to the loggerhead shrike in your state. Specifically, please assess the following 5 categories of threats:

    A. The present or threatened destruction, modification, or curtailment of its habitat or range. (Please be as specific as possible).
    B. Overutilization for commercial, recreation, scientific, or educational purposes.
    C. Disease or predation.

D. Inadequacy of existing regulatory mechanisms.
E. Other natural or manmade factors affecting its continued existence.

7. How would you characterize loggerhead shrike habitat requirements and habitat condition in your state? Does shrike habitat occur primarily on public or private lands?

8. What subspecies of loggerhead shrike occur in your state? What is the basis for this subspecies determination?

9. Describe any past, current, and anticipated conservation activities undertaken for the benefit of loggerhead shrikes in your state. What has been or is the anticipated result of these activities?

Please note that these questions request state-specific information because we anticipate that most individuals responding to this request will have information in this format. However, if you have information on loggerhead shrikes which is more general or regional in nature, do not limit yourself to responding to our questions. Please provide any information which you feel may be relevant to this assessment.

We would also appreciate references (published or unpublished) which you can provide or recommend which discuss the biology and/or habitat requirements of this species. If there is a published account for birds in your state (e.g. The Birds of Indiana) and/or a Breeding Bird Atlas account, we would appreciate copies of the sections on loggerhead shrikes.

Please provide any additional comments which you feel may be relevant to the loggerhead shrike status assessment. Include comments or suggestions on issues you believe need to be addressed in this assessment. Please contact us if new data become available after you respond to this request. If additional data are available in your state which are not provided in your reply to this request, please supply the name, address, and phone number of the individuals we should contact. (For your information, a list of all individuals who have already been contacted is attached).

This is going to be a big job for a large team of partners and we thank you in advance for your help in preparing the loggerhead shrike status assessment. We hope to compile information that will be useful to all contributors to the assessment, as well as the FWS, so that we can work together to develop effective conservation strategies for loggerhead shrikes.

Please provide your comments and recommendations to me at the Bloomington, Indiana Field Office by April 30, 1998. If you can not respond by that date, please let us know. If you have any questions or suggestions you may reach me at (812) 334-4261, extension 211, or through e-mail at lori_pruitt@mail.fws.gov.

Sincerely yours,

Lori Pruitt

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