FINAL REPORT
2003 POPULATION MONITORING
OF THE
SAN CLEMENTE LOGGERHEAD SHRIKE
ON NALF, SAN CLEMENTE ISLAND, CALIFORNIA

August 2004

Environmental Department, Navy Region Southwest
and
Natural/Cultural Resources Specialized Operations Team,
Southwest Division Naval Facilities Engineering Command

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Cover Photo: Brian L. Sullivan

ABSTRACT

This report summarizes PRBO Conservation Science's monitoring efforts to determine the abundance, distribution, and productivity of the San Clemente Loggerhead Shrike *Lanius ludovicianus mearnsi* (SCLS) on San Clemente Island, California from January through December 2003. Based on final observation dates, 55 SCLS were known to have survived in the wild until January 2003. Deaths and disappearances in the first few months of the year resulted in a wild breeding population of 50 individuals. Based on individuals present in March, the minimum over-winter survivorship between 2002 and 2003 of wild shrikes and shrikes released in previous years was 46% for adults and 11% for hatching-year SCLS. For birds that bred or fledged in the wild in 2002, minimum survivorship was 49% for adults and 13% for hatching-year birds, and minimum survivorship of 2002 release birds was 0% for adults and 8% for hatching-year birds. One breeding female died during the breeding season and two wild juveniles were hit by vehicles and killed shortly after independence. At the official end of the breeding season, 15 August, we estimated the SCLS population in the wild to be 59 adults and 74 independent juveniles. Between 24 January and 8 July, 18 captive-reared SCLS were released to the wild via three methods: bonded pair releases (five adult pairs), a single male release (one adult male), and independent juvenile releases (seven juveniles).

San Clemente Loggerhead Shrikes established 23 breeding sites (including one territory established by a male-male pair and one site that was used by two successive pairs). Four new territories were established in 2003, one of which was in an area without prior SCLS nesting records (Wilson Cove). Five of 23 breeding sites (22%) were established south of the Shore Bombardment Area (SHOBA) safety boundary line. Home range sizes of breeding pairs were on average 13.6 ± 11.8 ha (n = 24).

Twenty-four pairs of SCLS initiated 47 nests containing at least 157 eggs. Nests were constructed in nine species of plants in 2003, including: Sagebrush *Artemisia* spp., Coyotebrush *Baccharis pilularis*, Morning Glory *Calystegia macrostegia*, California Lilac *Ceanothus megacarpus*, Nevin's Eriophyllum *Eriophyllum nevinii*, Toyon *Heteromeles arbutifolia*, Catalina Island Cherry *Prunus lyonii*, Lemonade Berry *Rhus integrifolia*, and Willow *Salix* spp. Nevin's Eriophyllum and Willow were new nest plants for this population. More than 60% of the nests constructed were built in cherry trees and Lemonade Berry shrubs. Eighty-five young fledged from 24 nests, and at least 65 (76%) attained independence (>40 days post-hatching), dispersing from natal sites an average of 58.2 ± 11.5 days post-hatching. Eighteen (75%) pairs successfully fledged young. Pairs fledged an average 3.5 ± 2.9 young, and raised an average 2.8 ± 2.4 independent juveniles. Dispersed independent juveniles settled on wintering sites on average 4.1 ± 2.9 km from their natal territory. Two pairs successfully fledged two broods from the same nest and four other pairs successfully fledged two broods from two different nests in 2003. Daily survival of nests was equal during all phases of the nesting cycle, 0.98 ± 0.01 SE (41 nests). Forty-nine percent of all nesting attempts with eggs failed. Predators were the suspected cause of failure at a minimum of 59% of the nests and a maximum of 85%. This included one case of likely depredation of a breeding adult and two instances of injuries to adults at the time of nest failure.

Release efforts were confined to the central part of the island, north of the administrative SHOBA boundary. Nine of 11 captive-reared adults released in 2003 attempted to breed this year. The remaining two released adults were observed a maximum

of seven days post-release. Four pairs of released adults initiated six nests containing at least 15 eggs. All nests of release pairs were constructed in cherry trees. Five young fledged from two nests, and at least four (80%) attained independence, dispersing an average of 62 ± 4 days post-hatching. Pairs released in 2003 fledged an average of 1.3 ± 1.5 young, and raised an average of 1.0 ± 1.4 juveniles to independence. Three juveniles were detected post-dispersal an average of 5.4 ± 0.2 km from their natal territories. One group of seven captive-reared juveniles, ranging in age from 65 - 67 days post hatching, were released in July, and dispersed an average 6.6 ± 7.9 days post-release. Released juveniles were detected using wintering areas an average 3.5 ± 2.0 km from the release site.

Total numbers of SCLS decreased between 2002 and 2003, although productivity was high. Low over-winter survivorship, possibly as a result of inclement winter weather and low prey density during the 2002 breeding season that left dispersing young in poor condition, likely contributed to the decrease in the breeding population. The effects of increased winter rainfall and the subsequent increase in prey abundance during 2003 probably increased the population's productivity. Pairs that received supplemental food tended to fledge more young. Future recovery efforts for the San Clemente Loggerhead Shrike should continue to focus on enhancing survival of the population in the wild via habitat restoration, predator management, research on foraging and habitat use throughout the year, supplemental feeding for breeding pairs when prey is scarce, and release of captive-reared shrikes, especially juveniles.

INTRODUCTION

Based on morphometric and plumage differences, Ridgway (1903) proposed that Loggerhead Shrikes on San Clemente Island (SCI) warranted listing as a distinct subspecies, *Lanius ludovicianus mearnsi*. Subsequent morphometric work (Miller 1931, Johnson 1972) and genetic research (Mundy *et al.* 1997a,b, Eggert *et al.* 2004) has supported this conclusion. Genetic data on San Clemente Loggerhead Shrikes (SCLS) suggest that there is significant genetic differentiation from the nearest populations of Loggerhead Shrikes (*L. l. gambeli* and *L. l. anthonyi*), and that the SCI population was founded within the last 350 years (Mundy *et al.* 1997b, Eggert and Woodruff 1999; but see Patten and Campbell 2000). Subsequent research into morphometrics suggests that the SCLS population may be subject to intergradation by immigrants from other subspecies (Patten and Campbell 2000). Further research into this possibility is on-going (A. Coxon, pers. commun.).

Population estimates of SCLS are lacking prior to the 1980s. In the late 1880s and early 1900s, SCLS were described as being "fairly well distributed", "tolerably common" and seen daily on the island (Linton 1908, Bent 1950). However, by 1977 numbers were so low that the SCLS was officially listed as "endangered" under the U.S. Endangered Species Act (U.S. Fish and Wildlife Service 1977). From 1980 through 1983, during partial surveys of the island, Hyde (1983) estimated the SCLS population at 20-30 birds. Scott and Morrison (1990) initiated more intensive work in the mid-1980s, and the population of shrikes was estimated from partial surveys of the island to range between 17-30 individuals. It has been speculated that predation by introduced cats *Felis sylvestris* and rodents contributed to the decline of the SCLS (Scott 1987), and that damage to nesting habitat by introduced herbivores (sheep *Ovis aries* and goats *Capra hircus*) and predation of young shrikes continued to hinder shrike recovery (Scott and Morrison 1990).

Beginning in 1992, attempts were made to reintroduce into the wild SCLS propagated in captivity by the Zoological Society of San Diego (ZSSD). Between 1992-1994, 32 captive-reared juveniles were released on SCI. With the exception of one individual, which was observed on SCI for eight subsequent months, none were re-sighted after approximately 90 days post-release (Juola *et al.* 1997c, Harvey *et al.* 1998). During 1995 and 1996, eight adults between 1-4 years old were released from the captive population and observed for an average of 30 ± 38 days (range 1-121 days) post-release (Juola *et al.* 1997c, Harvey *et al.* 1998). No releases were conducted in 1997 or 1998. Under the guidance of the Institute for Wildlife Studies (IWS), reintroductions of SCLS were attempted again in 1999 using "soft" release techniques and hack-site attendants (Sherrod *et al.* 1982). Three experimental "soft" release methods (Brubaker *et al.* 2000) were implemented using shrikes reared in captivity by the ZSSD. In 1999, for the first time, released shrikes successfully survived the winter and recruited into the population the following year. In subsequent years, these release efforts have been continued and expanded (Turner *et al.* 2001, 2002, 2003, in prep.).

Complete SCLS monitoring to determine distribution, abundance, and productivity began in 1991 (Mader *et al.* 2000). In March 1998, the Point Reyes Bird Observatory [renamed PRBO Conservation Science in 2002 (PRBO)] was contracted to oversee the island-wide monitoring of wild and reintroduced SCLS. The work by the PRBO monitoring team is done in collaboration with other members of the Shrike Working Group (SWG). This group is comprised of agencies, organizations, and individuals actively studying SCLS, and in 2003 consisted of the PRBO, IWS, ZSSD, U.S. Navy, and United States Fish and Wildlife Service (USFWS). The working group provides information on the status of the SCLS population to the U.S. Navy, who in turn disseminates information to the SCLS Recovery Team and other interested parties to determine guidelines for predator management (initiated in 1992), suggest research needs and directions, and set goals and guidelines for the introduction of captive-reared SCLS into the wild. This report summarizes PRBO's SCLS monitoring efforts during the 2003 breeding (1 January – 15 August) and winter (16 August – 30 November) seasons. Regular monitoring was not conducted during December, although sightings for December are included.

STUDY AREA

San Clemente Island (32°50'N, 118°30W), the southernmost California Channel Island, is located about 100 km northwest of San Diego, California. The island is 28-km-long (width 3-7 km, area 145 km^2) and rises abruptly to 599 m (Mount Thirst) on the eastern escarpment. The east side of the island falls steeply into the ocean and is cut frequently by deep, geologically young canyons (Jorgensen and Ferguson 1984). The west side slopes gradually through a series of marine terraces to the western shoreline. Numerous canyons, longer than those on the east side, transect the terraces on the southwestern part of the island. Island temperatures range from 7-35° C, precipitation from 12-20 cm/yr (mainly Nov-Mar), and fog is common, especially in summer months (Jorgensen and Ferguson 1984, Scott and Morrison 1990). Detailed information on the island's topography and geology can be found in Olmstead (1958) and Vedder and Howell (1980).

Prior to 1993, native vegetation was substantially altered by introduced herbivores including sheep, goats, and pigs *Sus scrofa.* Currently, the dominant plant community on the island consists of native and non-native grasses (including *Avena, Bromus* and *Nasella* spp.), interspersed with areas of recently recruited Coyotebrush *Baccharis pilularis*, covering approximately 33% of the flatter upper reaches of the island (USDoN, SWDIV 2001). Shrubs and trees on the island are mainly found in the canyons, where dominant species include: Lemonade Berry *Rhus integrifolia*, Catalina Ironwood *Lyonothamnus floribundus*, Catalina Island Cherry *Prunus lyonii*, oaks *Quercus tomentella* and *Q. chrysolepis*, Toyon *Heteromeles arbutifolia*, California Lilac *Ceanothus megacarpus*, and Sagebrush *Artemisia* spp.. Native vegetation, including Prickly-pear *Opuntia littoralis*, Cholla *O. prolifera*, Coyotebrush, bunchgrass *Nassella pulchra*, and Velvet Cactus *Bergerocactus emoryi,* are commonly found on the terraces of the island, especially on the west side (Jorgensen and Ferguson 1984). Additional information on the island's vegetation can be found in Raven (1963), Kellogg and Kellogg (1994), and the U.S. Department of the Navy, Southwest Division San Clemente Island Integrated Natural Resources Management Plan (USDoN, SWDIV 2001).

Common (seen daily) resident passerines on the island include Common Ravens *Corvus corax*, Horned Lark *Eremophila alpestris*, Rock Wren *Salpinctes obsoletus*, European Starling *Sturnus vulgaris*, Orange-crowned Warbler *Vermivora celata*, Western Meadowlark *Sturnella neglecta*, House Finch *Carpodacus mexicanus*, and House Sparrow *Passer domesticus*. Pacific-slope Flycatchers *Empidonax difficilis* are common breeders and large numbers of Say's Phoebes *Sayornis saya*, Yellow-rumped Warblers *Dendroica coronata*, Savannah Sparrows *Passerculus sandwichensis*, and White-crowned Sparrows *Zonotrichia leucophrys* are present in winter. Common resident raptors include Red-tailed Hawk *Buteo jamaicensis*, American Kestrel *Falco sparverius,* and Barn Owl *Tyto alba*

(Sullivan and Kershner, In prep.). The Burrowing Owl *Athene cunicularia* is a common winter resident, and White-tailed Kite *Elanus leucurus*, Northern Harrier *Circus cyaneus*, Sharp-shinned Hawk *Accipiter striatus,* Merlin *Falco columbarius*, Peregrine Falcon *Falco peregrinus*, and Short-eared Owl *Asio flammeus* are also seen regularly or irruptively during migration and winter. For a complete bird list, see Sullivan and Kershner (In prep.).

METHODS

General Field Procedures

In 2003, PRBO's work was overseen by Dr. Nils Warnock, a division director at PRBO. Suellen Lynn, project leader, oversaw fieldwork on the island and maintained computer databases and reports. Brian Sullivan, crew leader, coordinated the field crew and managed data on the island. The 2003 field biologists consisted of Heather Carlisle, Neil Chartier, Melissa Clemons, Dave Hof, Robb Kaler, and Khara Strum, whose duties focused on field monitoring activities. Ann Graham volunteered as a field biologist through the Student Conservation Association from 1 August – 20 October.

We conducted fieldwork daily from early morning to late afternoon (on foot, by motor vehicle, or by boat) from January through December, with exceptions caused by inclement weather and military operations. All observers used binoculars (models ranging from 7-10x) and spotting scopes (20-60x Kowa Prominar TSN). All field observations were recorded on location on data sheets containing topographic maps and were transcribed as soon as possible into electronic databases.

Nomenclature

Territory Nomenclature – The current nomenclature of SCLS territories originated in 1992 (Morrison *et al.* 1993) and follows the order in which territories within a canyon were occupied by breeding pairs or used as release sites. For example, the first occupancy in China canyon was named China 1. Once a territory has been named, it maintains its designation in future years regardless of occupancy. Sites that were occupied before 1993, but have not been occupied since, were designated as historic sites, and have "His" added to their names. When a historic site was reoccupied or used as a release site, it was renamed using the next available number in the canyon. For example, Norton His 1 was used as a release site and renamed Norton 5, as Norton sites 1 through 4 were already designated. See Appendix A for a complete list of site names, previous names, site abbreviations, and UTM coordinates.

Shrike Nomenclature – Throughout this report, "SCLS" refers to wild shrikes and shrikes released in previous years (1999–2002; i.e., all birds that survived through the previous winter in the wild). "2003 release SCLS" refers to shrikes released in 2003. Each SCLS was identified by its USFWS band number, studbook number, color band combination, or association with a current breeding territory (see previous section). Throughout their first winter, juveniles were identified in reference to their natal or release site (e.g., a Cave 2 juvenile).

Nest Nomenclature - Because SCLS may initiate nest-building at multiple locations prior to egg-laying, nesting attempts were designated and named only for nests that were assumed or known to contain eggs. Each nest was assigned a letter that corresponded to the order of attempts at that site for that year (e.g. China 9 Nest A & Nest B, where "A" was the first nesting attempt in the China 9 territory, "B" was the second, etc.). For further details and definitions on shrike nest site nomenclature see Everett *et al.* (1996).

Monitoring

Effort – From January through August, PRBO personnel were responsible for locating and identifying all shrikes in the wild (wild-born or captive-bred), mapping home ranges, and describing SCLS breeding phenology. We also monitored SCLS that were released in 2003. At least one location of each shrike was mapped in the field on a topographic map and afterward entered into a GIS database (Electronic Appendix 1). Locations of all potential predators and/or competitors were recorded in the same manner. Field notes were transcribed into Microsoft Word files specific to each site and/or individual (Electronic Appendix 2). From September to November, personnel continued to visit breeding territories to determine presence or absence of shrikes, and also surveyed canyons to locate dispersed individuals. During December, site visits were limited to shrikes that received supplemental food approximately once per week.

During the breeding season, PRBO monitors conducted daily observations of SCLS except when limited by weather or military operations. The length of each observation period varied as needed to determine the presence and breeding status of shrike pairs and to read band combinations. Most breeding areas were visited at least once per week, depending on reproductive status, site accessibility, and Navy operations. Sites at the base of the eastern escarpment were visited less regularly because of accessibility constraints. To avoid disturbing shrikes, observers watched from an observation point (OP) at least 100 m from the nest site or area of activity. As in previous years, the breeding status of shrike pairs was inferred from behavioral observations (Table 1). As juveniles began to disperse from natal sites, surrounding areas were surveyed to locate the shrikes.

Surveys

PRBO personnel conducted two island-wide surveys in 2003, with the assistance of skilled volunteers (Appendix B). The spring survey was conducted on 15 and 16 March and the fall survey was conducted on 18 and 19 October. For island-wide surveys, SCI was divided into 55 survey units that have been used to systematically census SCLS since the fall of 1995 (Juola *et al.* 1997a). One or more observers walked slowly through one or more survey units, periodically stopping to scan with binoculars and/or spotting scopes. To minimize double counting and/or missing shrikes and potential shrike predators and competitors, adjacent units were surveyed simultaneously whenever possible. Helicopter transportation was provided to cover all survey units as efficiently as possible. Information recorded included start and stop times, survey route, locations of shrikes, and potential competitors or predators detected. All data were subsequently entered and compiled with previous annual survey data (1999-2002) in a GIS coverage database developed in ArcView 3.2a (Electronic Appendix 3).

Table 1. Behavioral cues used to infer San Clemente Loggerhead Shrike breeding status.

Nesting status	Behavioral Cue
Paired	- Male displays to female, male feeds female, female begs at male
Nest-building	- Male and/or female carries nest material to a specific location >1x.
Egg-laying	- Copulation - Erratic visits to a known nest site by the female, sometimes without vegetation carries - Female sitting on nest for long periods (~30-45 min) followed by equally long periods off the nest
Incubation	- Female only visible for short periods of time (~5-10 min) and not visible (or visible sitting on a nest) for long periods (>30 min) - Male carries food to female on the nest (also seen during egg-laying) - Female stretches and preens extensively when in view - Female does not forage often and feeds primarily from food caches
Hatching	- Female is restless on the nest (i.e., shifting, ruffling feathers, looking down into nest cup frequently) - Male and/or female seen carrying eggshells from the nest
Nestling	- Both male and female carry food to the nest - Male and/or female seen carrying fecal sack from the nest - Female spends longer periods (> 15 min) away from nest - If nest is visible, female seen feeding nestlings in nest cup
Fledgling	- Fledglings visible - Juvenile begging heard away from the nest shrub or tree - Adults alarm call vigorously at the sight of any predator
Failure	- Female and/or male seen attending new nest site when old nest site should still be active (too early for a new nest) - Male sings frequently throughout territory

Former Site Surveys – For monitoring purposes, any territory not used during the 2003 breeding season, but occupied for at least one breeding season between 1980 and 2002, was considered a former site. Former sites are synonymous with historic sites in previous reports. Surveys of former sites were periodically conducted throughout 2003, as SCLS have been known to re-occupy these sites (Juola *et al.*1997a, Mader and Warnock 1999). During a visit, at least one observer monitored the site for a minimum of 30 minutes. Information recorded at each site included presence of shrikes (seen or heard) and potential predators and/or competitors. We also recorded time of day, cloud cover, temperature, and wind speed. The location for all shrikes and potential predators and competitors were mapped in the GIS database (Electronic Appendix 1).

Population Estimates

We estimated the number of SCLS alive at the beginning of the year from the total number of wild and released SCLS adults and SCLS seen throughout the year. The number of shrikes known to be alive in the wild in March represents our **minimum population estimate.** Our **estimated breeding population** represents the number of adult SCLS known to be alive when the first brood fledged (typically early April) plus any adults that were released into the wild and minus any adults that disappeared prematurely from a breeding attempt or were known to have died. Our **maximum population estimate** consists of the breeding population (including any adults discovered after the breeding season, fledglings that survived or may have survived to > 40-days-of-age (independence), and any other individuals released during the breeding season. This estimate excludes shrikes known to have died prior to 15 August, shrikes captured in the wild before 15 August and placed in the captive flock, and single members of pairs that permanently disappeared from active nest sites or at the time of nest failure. The maximum population estimate over-estimates the actual population but provides an index of productivity and growth potential. Minimum over-winter survivorship from 2002 – 2003 was calculated for adults that were detected in March 2003 divided by the maximum population estimate from 2002. Over-winter survivorship calculated by the ZSSD (Grant and Lynch 2004) was substantially higher than our calculations because their formula does not include adults and juveniles that were not seen again after they dispersed from breeding sites (T. Grant pers. comm.).

Breeding Sites

Shrike Locations and Home Range Estimates – During site visits, PRBO monitors recorded the behavior of individual shrikes, time and duration of the observation, weather, intra- and inter-specific interactions, potential nesting substrate, food items carried, and vocalizations. At least one location per shrike was mapped for each visit on a topographic map taken into the field. Locations of non-breeding and opportunistically observed shrikes were also recorded in the field and entered into the ArcView database (Electronic Appendix 1). Observations of SCLS by other SWG collaborators were documented and mapped when sufficiently detailed information was provided. These data were added to PRBO data sets. Home ranges for breeding pairs were generated with ArcView 3.2 Animal Movement extension (Hooge and Eichenlaub 1997), using all of the confirmed observations of each individual from the time of pairing through the end of its breeding attempt. The end of a breeding attempt was marked by the final observation of the pair together on-site or August 31 (whichever came first.)

Nest-site characteristics – Measures of nest placement and structure for all known and accessible nests were taken from August through November, after the conclusion of the breeding season. Data recorded included: plant species used for nesting, plant height, nest height (from ground), distance from nest to edge and center of plant, percent cover of nest above, below, and in each cardinal direction, total cover around the nest, and slope, aspect, and elevation of the immediate site (Ralph *et al.* 1993).

Breeding Data

Definitions - The sequential stages of the SCLS breeding cycle are: solitary, paired, nest-building, egg-laying, incubation, nestling, fledgling, and post-failure or post-fledging (for definitions see Everett *et al.* 1996). The breeding phenology of SCLS was quantified based on information from Scott and Morrison (1990). *Nest-building* typically lasts from 4 days to several weeks. *Egg-laying* takes 4-6 days, with one egg laid per day to clutch completion. *Incubation* typically begins with the penultimate egg (Yosef 1996) and lasts 16-18 days. The *fledgling* stage begins when nestlings leave the nest, normally at 16-20 days post-hatching. Adults feed the fledglings frequently, tending the juveniles for 25-95 days post-fledging. Following Scott and Morrison (1990), juveniles were considered independent after 40 days of age. During the fledgling stage, one or both members of the pair may initiate a new nesting attempt.

Success - SCLS nesting success was historically measured as the percent of nests (known to have eggs) from which at least one young fledged. Nests that failed before egg-laying were not included in these calculations because it is difficult to distinguish between nests in which birds did not lay eggs and those that were depredated early in the egg-laying stage. Nest success calculations for 2003 were based on these same assumptions to compare with past years. Daily nest survivorship was also calculated using the Mayfield method to account for nests found in various stages of completion (Mayfield 1961, 1975, Johnson 1979, Nur *et al.* 1999). Nest survival during egg-laying was estimated by back dating from nestling age at banding when available, but only if the nest was under observation during egg-laying. Nest survival during incubation was measured from the first date of confirmed incubation. Overall nest success was calculated from the first date that eggs were thought to be present in the nest.

Egg Pulling – Unhatched eggs found when nestlings were banded or after the end of nesting attempts were removed and taken to ZSSD personnel to determine the cause of egg death.

Predator Deterrence - After we found SCLS nests, the IWS Predator Research and Management team (PRM) established or verified the presence of Quintox® rodenticide bait stations near the nest (Kershner *et al*. 2004). Observations of potential predators made by PRBO at each breeding territory were recorded in field notes and communicated to PRM personnel.

Nest Checks - Following the failure of a nest, PRBO and PRM personnel examined the site to evaluate the potential cause of the nest failure as soon as logistically possible (1–7 days post-failure). Data were collected on the condition of the nest structure, remaining contents, the nest substrate condition (i.e. broken branches), and predator control methods that were in place (Electronic Appendix 4). Personnel from PRM also examined the surrounding area for mammal trails and scat. Eggshell fragments and any carcass remains were collected and further examined for egg viability and species identification. If the breeding pair was still using the area around the failed nest, or if entering the site to examine the nest would potentially disturb the pair, the nest was not inspected.

Supplemental Feeding – We continued to offer supplemental food weekly to SCLS at breeding sites where it was accepted. Supplemental diet was provided by the ZSSD and offered in clear 15-gallon plastic tubs. IWS personnel offered supplemental food to breeding pairs at current and previous release sites outside of the Navy's designated Shore Bombardment Area (SHOBA) and PRBO offered supplemental food to one pair in SHOBA (CH9) and two pairs outside of SHOBA (LT2 and BX4). Supplemental food was offered at breeding sites of individuals that had prior experience with feeding tubs (*i.e.*, released SCLS and others that had taken food at previous breeding and/or natal sites).

Before the breeding season, PRBO personnel provided supplementally fed SCLS with up to six domestic mice and varying amounts of crickets and mealworms (all live prey items provided by the ZSSD were single-sex to prevent incidental propagation). The food tub was placed near frequently used perches and removed at the end of each session, either when all food was taken by shrikes or after at least one hour had passed. During the breeding season, extra crickets and mealworms were added to the diet when nestlings and/or fledglings were present.

Released Shrikes – In 2003, 18 SCLS were released using three different techniques: single male, bonded pair, and juvenile release (Turner *et al.* in prep). The single male was reared in captivity and released by the ZSSD at their Arizone flight cages in January, in hopes that he would find a suitable, unoccupied breeding site. Other release sites were selected according to scoring criteria that ranked locations on overall suitability (Brubaker *et al*. 2000). For bonded pair releases, pairs were placed in the canyons together in a single cage for a period of time (generally less than one week) until their courtship and breeding behavior dictated their simultaneous release. For the juvenile release, multiple related and unrelated juveniles of similar ages were released from separate but adjacent cages after acclimating to the release site for one week. PRBO personnel monitored all captive-reared SCLS after they were released from their cages.

Predators and Competitors – The locations of potential predators and competitors were mapped using the same method used for mapping shrikes. All shrike interactions with potential predators and competitors were also recorded. Observers noted the shrike's band combination, breeding status, distance from nest, and behavioral responses (e.g. freezing, changing perches, hiding in cover, vocalizing, aggression/harassment, and/or fleeing from pursuit). We summarized the frequency at which we observed predators and competitors per hour of observation at breeding sites (occupied by SCLS from 1 Jan – 30 Nov), release sites (where SCLS were released in 2003), former sites, canyons (any major canyon surveyed for SCLS), and other (all remaining areas of SCI).

Survivorship and Dispersal – When data were available, post-breeding dispersal of adults and juveniles was analyzed. The age of juvenile dispersal was based upon the date that independent (>40-day-old) birds disappeared from the natal site. Dispersal distances were measured from the nest or release site to the first location where individuals settled (i.e., were present >1 day) after leaving the natal/breeding site.

Nest Mirroring, Trapping, and Banding

Nest Mirroring - In 2003, we continued to examine nests using a mirror pole to determine the age of nestlings, and ascertain whether or not the nest was accessible for banding (Blackford *et al.* 2003). Immediately following nest checks and banding visits, the site was monitored until we observed adults returning to the nest. For sites that regularly received supplemental food, we provided food immediately following any visit to the nest to encourage the return of the adults to the area. We checked each site on the day after a nest visit to confirm that our disturbance did not cause nest abandonment.

Trapping - PRBO personnel attempted to capture and band unbanded shrikes and SCLS with missing color bands. During 2003, the primary means of catching shrikes was a modified Potter trap developed by G. Santolo (CH2M Hill, Sacramento, CA) and first used on SCI in December, 2001 (Plissner *et al*. 2002). The "Santolo trap" has a trap door entrance on the top of the cage, suited for the drop-down approach of foraging shrikes. We also used a second type of trap, developed by S. H. Craig (Colorado Springs, CO): a round Potter trap that was triggered by a bird stepping on a treadle inside the trap (see Plissner *et al*. 2002 for details). We typically baited traps with a domestic mouse *Mus musculus* although we occasionally used crickets (provided by ZSSD) or wild side-blotch lizards *Uta stansburiana*.

Banding - Banding was performed by three senior PRBO shrike monitors (H. Carlisle, N. Chartier, and B. Sullivan), with the assistance of other biologists. All SCLS were banded with unique color band combinations. The bander first placed a size 1A USFWS band on one tarsus, followed by placement of three wrap-around Darvic color bands (A.C. Hughes Ltd., Middlesex, England), one on the leg with the aluminum band and two on the other leg. Darvic bands were heat-sealed with a portable soldering iron (Weller Cordless Pyropen Jr.) prior to releasing the bird. UV-resistant Darvic color bands were used instead of celluloid color bands to reduce color fading and band loss on shrikes, which are known to pick off split-ring bands (Lindsey *et al.* 1995). Overlapping ("wrap-around") color bands (Ward 2000), constructed from 22 mm x 5 mm strips of Darvic material (Plissner *et al.* 2002), were used on all SCLS banded in 2003. Between 1994 and 1999, SCLS were banded with anodized aluminum color bands with engraved alphanumeric sequences (Acraft Sign and Nameplate Co., Ltd., Edmonton, AB, Canada). The use of Acraft bands on SCLS was discontinued because they became unreadable after a few years; however, a few wild SCLS still wear Acraft bands. Shrikes slated for release were captured with hand nets and banded with a USFWS band and a full color combination.

At least two adult shrikes that were slated for release were intolerant of their newly administered bands. Therefore, we banded all captive nestlings with full color band combinations to acclimate them to wearing color bands upon release. Because of leg morphology during development, wild and captive nestlings were given band combinations with the USFWS band below the Darvic band. White Darvic bands were not used in nestling color band combinations because adults could mistake them for fecal sacs and potentially injure the young while attempting to remove the fecal sac from the nest.

Three to four contour feathers were removed from the breast of each shrike for gender analysis and for genetic analysis of relatedness, when required. Samples were also given to A. Coxon (Trent University) for a study examining subspecific status of SCLS. Each shrike was placed in a cloth bag and weighed with a Pesola spring scale to the nearest 0.5 g. Additional data collected during banding included date, time, location of capture, bander's name, and any additional noteworthy observations regarding the shrike or the capture. For captured adults, we recorded wing chord length, exposed culmen length, tail length, percent subcutaneous fat, and patterns of body and flight feather molt. Body measurements were not taken on nestlings or fledglings.

Based on estimated hatching dates and/or nestling ages during nest checks, we approached a nest to band nestlings when they were estimated to be 10 to 12-days-old. Because of logistic constraints and a wide range of nestling ages in one nest, banding ages of nestlings ranged from 5 to 16 days. When the nest was accessible the nestlings were removed and placed in a single cloth bag for transport to a nearby banding location, generally within 20 m of the nest. Each nestling was processed and then returned to the cloth bag while its siblings were processed. All nestlings were returned to the nest simultaneously. Unhatched eggs were removed and taken to ZSSD personnel to determine developmental stage.

If nests were inaccessible or approached when nestlings were at risk of prematurely fledging (typically >13-days-old), PRBO personnel retreated from the site and returned to the nest after observed behaviors indicated that the young birds were branching or had fledged.

Unbanded fledglings were then caught by hand or hand net, banded, and released in or near the nest substrate or vegetation where they were first observed.

Statistical Analyses

Means are reported ± 1 SD, significance was determined if $P \leq 0.05$, and all tests are two-tailed, unless otherwise reported. We used paired *t*-tests to analyze differences in breeding home range sizes between males and females and difference in home range size between years. We used Welch's approximate *t*-test to determine if home range size differed between wild and 2003-released adults, and between pairs that were given supplemental food and those that were not. We tested for differences in breeding success between types of nest bushes using Chi-squared tests, and used *t*-tests to determine if successful and failed nests were distinguishable by nest-site characteristics. We used Fisher's Exact test to determine if the age of breeding shrikes affected their reproductive success. When testing to see if age of breeding adults affected the number of fledglings and independent young produced per pair, sample sizes of second-year (SY) birds were small so we lumped all pairs that contained at least one SY bird into one group and compared that to a second group of all after-second-year (ASY) pairs using a *t*-test. After we combined data from 1998 – 2003, sample sizes were sufficient to use analysis of variance (ANOVA) by breaking breeding pairs into four age categories - ASY male with ASY female, SY male with ASY female, ASY male with SY female, and SY male with SY female - to determine if breeding age of adult shrikes affected the number of young fledged or the number of young raised to independence. We used Fisher's Exact test to determine whether or not the shrike's origin (wild or previously released) affected nesting success, and ANOVA to determine if shrike origin affected the number of young fledged or the number of young raised to independence. We tested for a relationship between rainfall and nest success, the number of fledglings per pair, and the number of young raised to independence per pair using Pearson's correlation. Daily and total nest successes were calculated by the Mayfield estimate (Mayfield 1975, Johnson 1979), with means reported ± 1 SE. We tested for differences in survival rates between nesting stages using Program Contrast (Sauer and Williams 1989). We used *t*-tests to analyze differences in dispersal distances from 2002 natal sites to 2003 breeding sites between all juvenile males and females, wild juvenile males and females, and 2002-released juvenile males and females. We also used *t*-tests to analyze differences in dispersal distances from 2003 natal areas to wintering areas between 2003-released juveniles and wild juveniles, and between juvenile males and females. We used Fisher's Exact test to determine if supplemental feeding affected nest success. We used *t*-tests to determine if supplemental feeding affected the number of young fledged, the number of young raised to independence, and the age that juveniles dispersed from natal sites. Analyses were done with Systat Version 9 (SPSS Inc., Chicago, IL) and Instat 3 (Graphpad Software Inc., San Diego, CA) unless otherwise indicated.

RESULTS

Monitoring Effort

Between 1 January and 31 December 2003, PRBO personnel spent 3,108 person-hours in the field, excluding travel time (Appendix C). Shrikes were monitored for 1,461 person-hours (47%), 862 person-hours (28%) were spent in other survey efforts, 71 person-hours were spent monitoring releases on release day (2%), and 714 person-hours (23%) were spent in various other field activities (e.g., trapping and banding efforts, nest site measurements, prey sampling).

Island Surveys – On 15 and 16 March, 36 volunteers (Appendix B) assisted PRBO personnel in conducting a survey of the entire island. Poor weather delayed surveys, thus the actual survey period was 14 - 21 March. Thirty-two shrikes were located and all but eight island units were surveyed (units 1, 2, and 3 were closed to access because of explosive ordnance concerns, units 5, 9, 22b, 40, and 53 were not surveyed because of weather and scheduling conflicts). A second island-wide survey was conducted on 18 and 19 October with the help of 45 volunteers (Appendix B) and 64 shrikes were located. All survey units were covered during the survey weekend.

Former Sites – Of 66 sites with former records of breeding pairs, 16 were used as breeding sites by SCLS in 2003. Shrikes did not re-occupy any former sites in 2003 that were vacant in 2002. Forty-three unoccupied former sites continued to be surveyed regularly between January and November. We did not regularly survey two former sites because of access restrictions due to live ordnance and proximity to training areas. Three other former sites were close enough to occupied sites that we did not consider them separate survey areas. We conducted former site visits to sites used for releases in previous years because birds have been attracted to them in the past. Four former breeding sites (Box 1, Middle Ranch 1, Norton 1, and Norton 5) were used as release sites in 2003. We performed surveys at these sites until shrikes were placed in cages on-site. All together, 58 former breeding and release sites were visited and surveyed on 432 occasions (at least 459 person-hours).

Population Size

Population Estimate – Between January and December 2003, 55 adult SCLS were observed in the wild, excluding 11 adult SCLS released in 2003 (Appendix D, for additional information and breeding phenology see Appendix E). Two shrikes were captured and banded in early 2003 and disappeared early in the year. We believe these were winter visitors from off-island (genetic haplotype C, never documented to breed on SCI; Grant 2004) and did not include them in the population total. Between 31 January and 1 March, five adult SCLS (two wild and three previously released) and one 2003 release SCLS disappeared. During March, 50 SCLS were known to be alive, representing the minimum population size for the year (Table 2). By the end of May, 10 more captive-reared adults were released and observed in the wild, nine of which attempted to breed. Excluding the two female SCLS and the released shrike that did not attempt to breed, the estimated breeding population size for the year was 57.

Table 2. 2003 SCLS population estimates. HY = hatching-year (2003), SY = second-year (HY = 2002), AHY = after hatching-year (HY $\geq$ 2001). Except for wild birds, ages represent the age at which the shrike was released.

	Wild Shrikes				Released Shrikes									
Population					1999	2000		2001		2002	2003			Grand
Estimate	HY	SY	ASY	Total	HY	HY	AHY	HY	AHY	HY	HY	AHY	Total	Total
Minimum		8	18[1]	**26**	2	4	1	13	1	3			**24**	**50**
Breeding[2]		8	18[1]	**24**	2	4	1	13	1	3		9	**33**	**57**
Maximum	67[3]	8	18[1]	**92**	2	4	1	13	1	2	7	10	**40**	**133**

[1]Includes two unbanded SCLS that are probably the same unbanded birds that bred at the same sites in 2002.
[2]Includes SCLS that did not attempt to breed in 2003.
[3]Does not include two wild independent juveniles that died prior to 15 August, or one juvenile from China 2 Nest C, for which sufficient data are lacking to determine independence.

By 15 August, 74 juveniles (67 wild and 7 release SCLS) were added to the population. A breeding pair of adult SCLS was discovered on 7 May (Burns 2) and was added retroactively to the minimum, and breeding population estimates. Between 31 March and 15 August, we know that one adult SCLS (Lemon Tank 2a female) and two independent juvenile SCLS (2 Lemon Tank 2b juveniles) died, bringing the maximum population to 133 shrikes (Table 2). Although 66 birds were observed in August, the end of the breeding season when the population was expected to be at its peak, the observed number of SCLS peaked at 115 in June (Fig. 1). The estimated number of SCLS alive, based on the last observation dates of individuals (Appendix F), also peaked in June at 126 (Fig. 1).

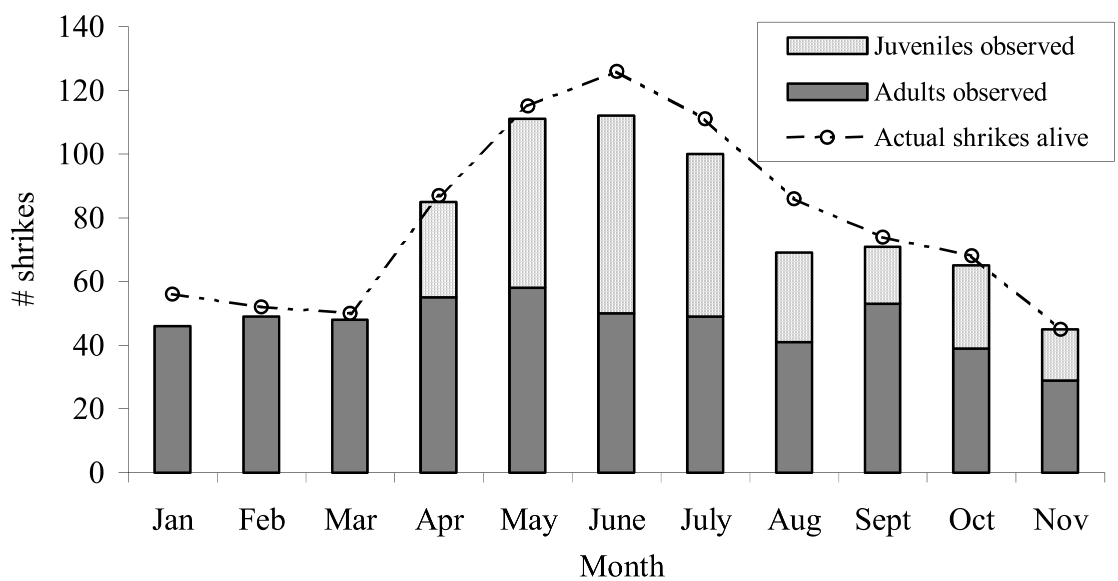

Figure 1. Monthly observed and actual estimated (based on the last date each individual was seen alive) population numbers of San Clemente Loggerhead Shrikes in 2003.

We were uncertain of the identity of four breeding SCLS in 2003. The Cave 3 male and the Thirst 1 male were both unbanded. We assumed that they were the same unbanded SCLS that bred at these sites in 2002. The Cave 2 female was assumed to be the same female that bred here in 2002 because the color bands that she retained were consistent with the 2002 Cave 2 female. The China 9 female was assumed to be the same bird that bred at

China 8, an adjacent territory, in 2002 because her retained color bands were also consistent with the known 2002 China 8 female. One other SCLS, the Lemon Tank 2b female, was assumed to be the female that bred at Chenetti 1 in 2002 because the type of color band on the Lemon Tank 2b female (dark blue butt-end Darvic) was only consistent with this SCLS that had been seen over the past year. Four other shrikes, the Box 2 male, Box 3 female, Cave 1 female and male, and Lemon Tank 1 female, all lost color bands, but band loss was gradual enough that we are confident of their identities (Appendix D).

In 2003, 58% of the breeding population (29 of 50, excluding 2003 releases) consisted of captive-reared individuals and their direct descendents, 32% were descended solely from wild-hatched individuals, 4% were of mixed heritage and 6% were of unknown heritage (unbanded, missing color bands, or banded as adults). Relative contributions of 2003 release birds to the total observed population number rose as high as 21% in August (Fig. 2).

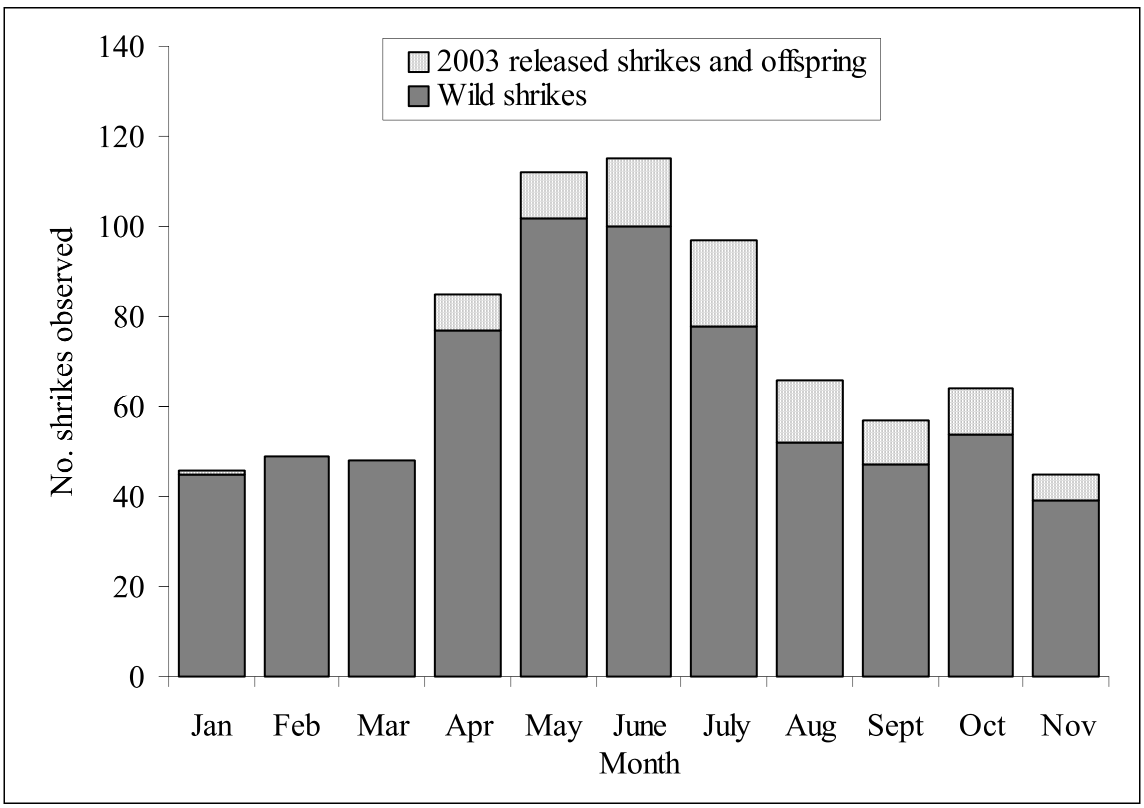

Figure 2. Contribution of 2003 release birds to the overall observed monthly population of San Clemente Loggerhead Shrikes throughout the year.

2002-2003 Winter Survivorship and Breeding Site Selection – Of the maximum of 184 SCLS identified in 2002, a minimum of 50 (38%) survived into March 2003 (Table 3), dropping from 67% in 2001 and 62% in 2002, but similar to minimum over-winter survivorship for 1999 (46%) and 2000 (41%; Mader *et al*. 2000, Blackford *et al.* 2001, Plissner *et al.* 2002, and Blackford *et al*. 2003). Breeding dispersal data were known for 36 SCLS that nested in 2002 and bred or attempted to breed in 2003, including shrikes that were unbanded or missing color bands and whose identities were assumed (see above). Twenty-two of the 36 individuals (5 females and 17 males) bred at the same site in both years. Four pairs bred together at the same site in both 2002 and 2003. Site-tenacious SCLS included 12 birds of wild origin (nine males and three females), four males and one female released in 2001, two males and one female released in 2000, and two males released in 1999. The 14 individuals that dispersed between years settled an average distance of 2.1 ± 3.2 km from their 2002 nest sites. Female dispersers moved 2.3 ± 3.4 km (n = 12; range 0.4–12.7 km) between years, and males moved 0.5 ± 0.2 km (n = 2; range 0.3–0.6 km). Dispersing adults included two females released in 2000, five females and one male released in 2001, and five females and one male of wild origin. A female that bred at Norton 4 in 2002 but apparently did not breed in 2003, and a female that apparently did not breed in either 2002 or 2003 were excluded from analyses. Five females and one male were not seen during fall, 2002 (Sep. – Dec.) but reappeared at breeding sites in 2003 and were included in dispersal analysis.

Table 3. Minimum over-wintering survival of San Clemente Loggerhead Shrikes 2002-2003.

	2003 minimum population / 2002 maximum population		
Origin	2002-hatching-year	Hatched < 2002	Total
Wild	8/62 (13%)	18/41 (44%)	26/103 (25%)
1999-released		2/3 (67%)	2/3 (67%)
2000-released		5/12 (42%)	5/12 (42%)
2001-released		14/24 (58%)	14/24 (58%)
2002-released	3/37 (8%)	0/5 (0%)	3/42 (7%)

Eleven SCLS juveniles that fledged in 2002 dispersed a mean distance of 3.4 ± 1.6 km from natal or release sites to their 2003 breeding territories (eight wild-hatched [3.1 ± 1.8 km] and three released as juveniles [4.2 ± 1.0 km]). We detected no significant difference in dispersal distances between females (n = 6, mean = 3.9 ± 2.0 km, range 1.3–6.0 km) and males (n = 5, mean = 2.7 ± 0.9 km; range 1.5–3.6 km) (t_9 = 1.24, P = 0.25).

Breeding Pairs - Shrikes initiated nests at 28 sites in 2003. Bonded pairs were released at and occupied four of the 28 sites (Box 1, Middle Ranch 1, Norton 1, and Norton 5). A fifth site (Box 5) was occupied by a 2003-released bonded pair male and a wild female. At one other site (Wilson Cove 1), at least two nests were started by a male-male pair. At one site (Lemon Tank 2), the female disappeared (was most likely depredated) from an early nest attempt and was replaced by a wandering female who subsequently bred with the resident male. Therefore Lemon Tank 2 was considered a single breeding site that hosted two successive pairs.

Eight of 24 pairs (excluding 2003 releases but including the male-male pair) consisted of shrikes of wild origin, seven pairs consisted of captive-reared birds from previous releases, and nine pairs included both wild and captive-origin individuals. Fifteen pairs were composed of experienced breeders, two pairs consisted of two SY birds (no previous breeding experience) and seven SY birds paired with older mates (Table 4). The median age (exact age unknown for three males) of birds in the 2003 breeding population was third-year (two-years-old) for males and females, which was also the most represented age class of both males and females (males: 9 of 22; females: 12 of 24) (Fig. 3; Appendix D). The oldest SCLS in the population continued to be the Cave 2 male (USFWS # 8061-14120) an eighth-year bird.

Of 39 pairs of shrikes that nested in 2002, four paired with the same mate and nested again in 2003, including the Box 3 pair consisting of the only surviving 2001-released adult female and the only surviving 2000-released adult male. None of the five adults released in 2002 survived and bred in 2003.

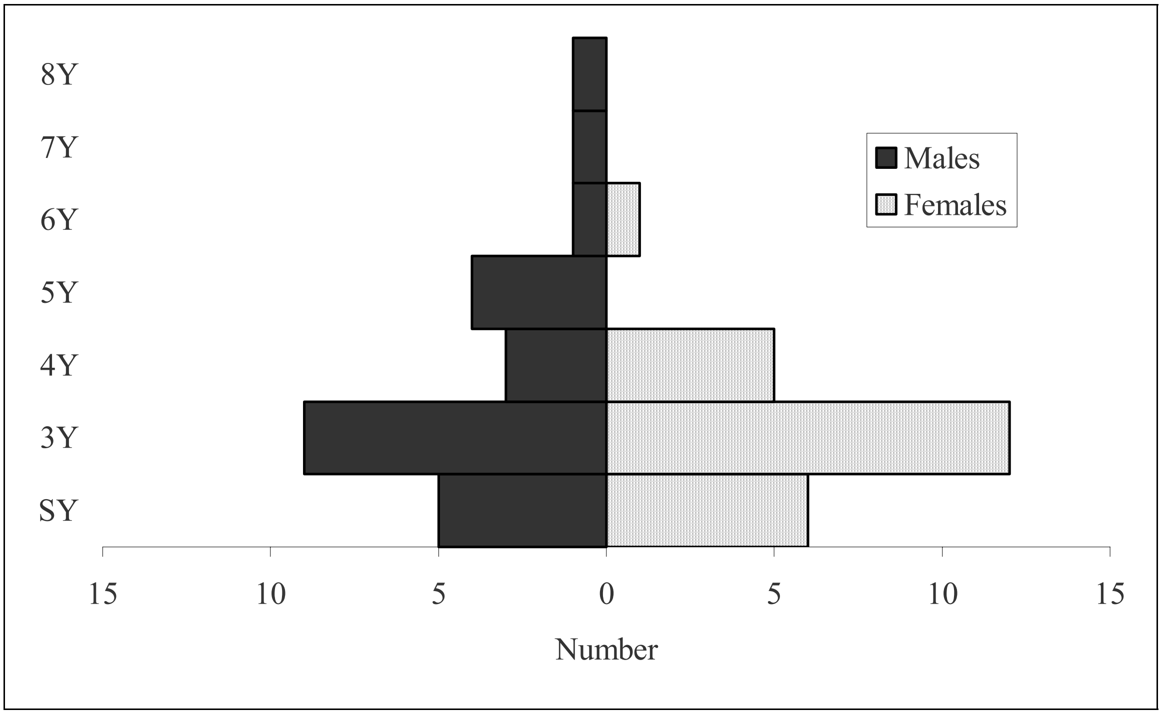

Figure 3. Age structure of the 2003 San Clemente Loggerhead Shrike breeding population.

Table 4. Origin and age of wild breeding shrike pairs in 2003 (excludes 2003-released shrikes). SY = second-year (2002-hatching-year), ASY = after-second-year.

		Male			
		Wild		Prior Years' Release[1]	
		SY	ASY	SY	ASY
Female	Wild				
	SY	1	2	-	2
	ASY	2	3	-	2
	Release[1]				
	SY	-	-	1[2]	1
	ASY	-	5	-	5

[1] 1999-, 2000-, 2001-, & 2002-released shrikes.
[2] Male-male pair.

Adult Released Shrikes – Eleven adult SCLS (one single male and five bonded pairs) were released from captivity in 2003. The single male was released from the Arizone flight cages on 24 January and was not seen after that date. Bonded pairs were released (four in April and one in May) at Norton 5, Box 1, Box 5, Norton 1, and Middle Ranch 1. Four of the five bonded pairs remained on site and attempted to breed. The Box 5 female left the site the day after release. A wild female, USFWS # 1681-08175, was observed at Box 5 the third day after the pair was released and remained to breed with the male.

2003 Hatching-year Shrikes – Ninety juveniles fledged naturally from SCLS nests monitored in 2003. Five of these fledged from 2003 bonded pair releases and one fledged from the 2003 released male-wild female pair at Box 5. Of these, at least 67 (76%) survived until independence, 18 (20%) disappeared before reaching independence, and the fates of another three (3%) were unknown. Seven juveniles, 65 - 67 days-old, were reared in the captive flock at the ZSSD breeding facilities and released at Waynuk 1 on 8 July. Five (71%) released juveniles were detected away from the release site.

Unbanded Shrikes - Between January and May 2003, unbanded Loggerhead Shrikes were observed on SCI 17 times (Appendix E). Two unbanded males bred on SCI, at Cave 3 and Thirst 1, accounting for six of the 17 sightings. Unbanded shrikes were observed on San Clemente Island 62 times between June and November. Due to brevity of sightings and variation in wear and molt in juveniles, we were unable to determine the age of 25 of these unbanded shrikes. Seven unbanded juveniles (three from Boulders South 1B, and one each from Burns 1A and B, Cave 2A, and Cave 3A) fledged from monitored nests, five of which reached independence, and may account for 45 observations of unbanded shrikes (26 identified as hatching-year birds, 19 of unknown age). One unbanded, suspected SCLS juvenile was trapped and banded on 4 October 2003 (USFWS # 1801-22175; genetic haplotype A; T. Grant pers. comm.). This juvenile was probably the same unbanded juvenile that had been seen in the same area at least five times previously. Unbanded shrikes were observed 10 times along SCI Ridge Road between Middle Ranch Road and Box Canyon Trail before one suspected off-island shrike was captured and banded here on 4 October (USFWS # 1801-22176; genetic haplotype C; T. Grant, pers. comm.). We continued to see unbanded shrikes in the same area at least six more times after this shrike was banded. We suspect that nine other unbanded shrike observations between June and November were dispersing shrikes from other subspecies (*L. l. gambeli* or *L. l. anthonyi*) due to their light and less-contrasting plumage coloration (three adults and six of undetermined age). Seven observations of unbanded shrikes near the REWS facility and at Thirst 1 between June and November were probably the adult SCLS males who bred at Cave 3 and Thirst 1, respectively.

Breeding Sites

Locations – SCLS bred on many parts of SCI in 2003 (Fig. 4a & b). Of 74 former nesting sites, 19 were used by breeding SCLS in 2003 (all of which were also used in 2002). Four new sites (Horse Beach 4, Horse 6, Lemon Tank 2, and Wilson Cove 1) that had no known former use by released or wild breeding SCLS were settled by shrikes in 2003. Seven sites used in 2003 had been used as release sites between 1999 and 2001 (Box 2, Box 3, Burns 1, Horse 3, Lemon Tank 1, Norton 4, and Warren 1). No release sites from 2002 were settled by breeding pairs in 2003.

Of 23 breeding sites (excluding 2003 bonded pair release sites), 14 (61%) were in canyons that drained south or southwest, only one of which (Box 3) was at the mouth of a canyon on the West Shore. Seven breeding sites were in canyons that drained north or northeast, three of which were at the base of the eastern escarpment (Boulders North 1, Boulders South 1, and Burns 1). The male-male pair attempted to breed in Wilson Cove (the Navy's "town"), the northernmost nesting site ever recorded for SCLS. The remaining pair bred at Stone Station, near the ZSSD's captive-rearing facility, a nesting site established in 2002. Five pairs bred in the restricted area south of the SHOBA gate, and five others were north of the SHOBA gate but within the official SHOBA boundary (Fig. 4b). Four pairs reoccupied the same site in 2003 where they bred in 2002. Thirteen males and one female reoccupied their breeding sites but paired with a different mate. Three other males occupied sites in 2003 that were adjacent to their 2002 breeding sites. Only one site, Thirst 1, was occupied in 2003 by a different pair than in 2002.

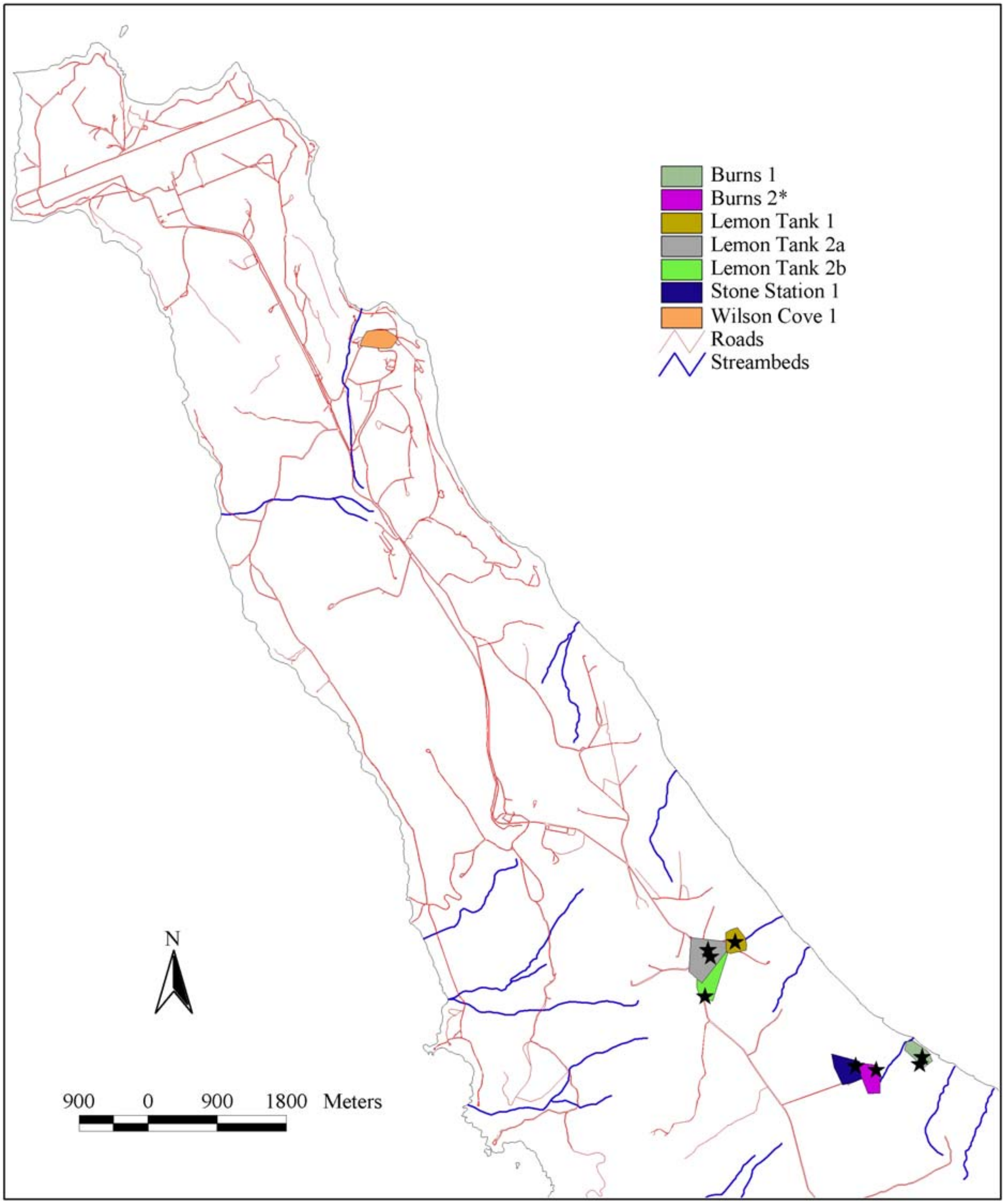

Figure 4a. Estimated 2003 SCLS breeding home ranges. Home range estimate for each pair includes confirmed sightings of paired adults. *Indicates home ranges generated with unconfirmed points due to small sample size. ★ Indicates nest locations.

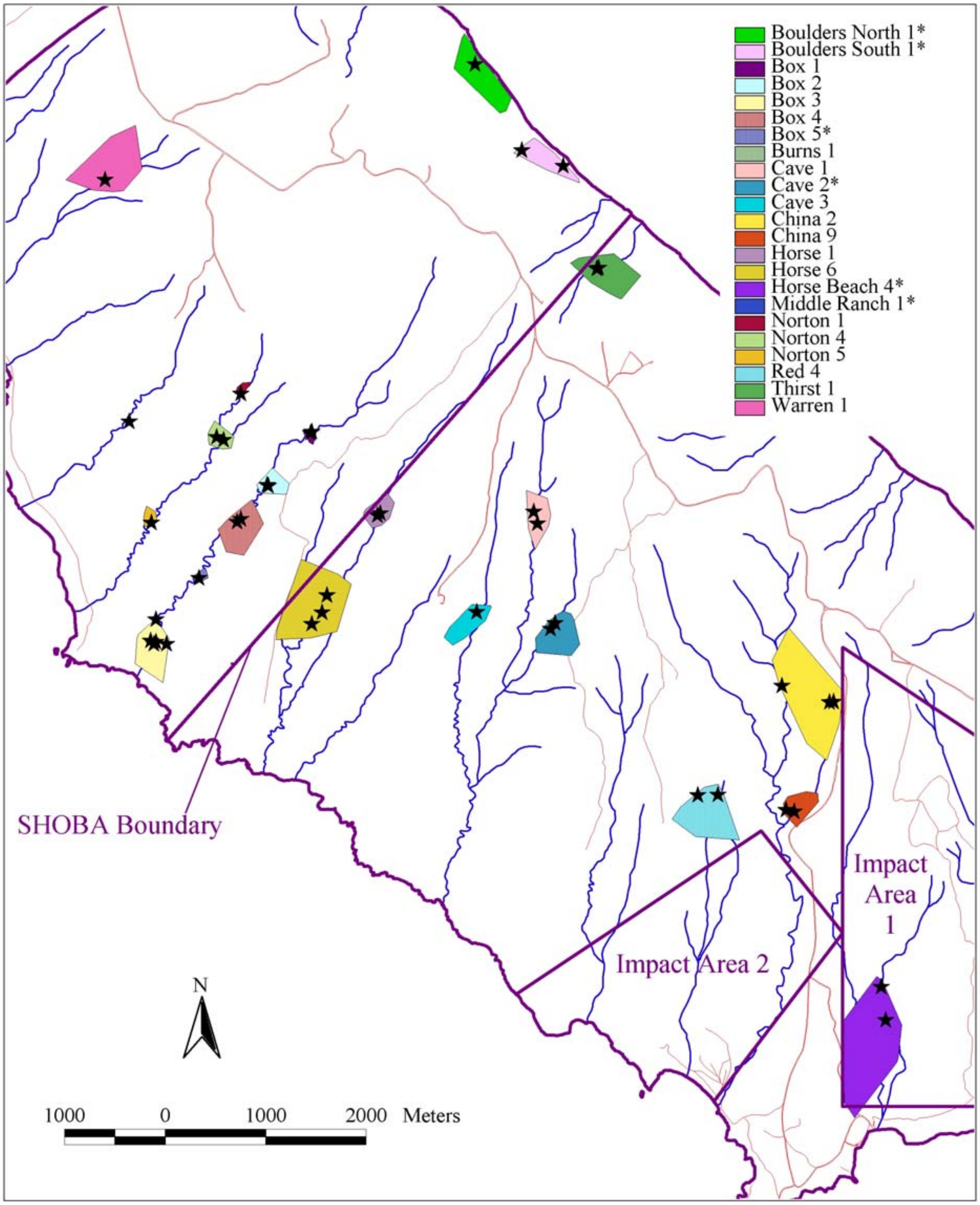

Figure 4b. Estimated 2003 SCLS breeding home ranges. Home range estimate for each pair includes confirmed sightings of paired adults. *Indicates home ranges generated with unconfirmed points due to small sample size. ★ Indicates nest locations.

Home Ranges – For breeding pairs of SCLS with adequate records (minimum of 30 recorded locations), home range sizes ranged from 1.04–47.1 ha (Table 5). For 22 pairs with a minimum of 30 observations for both individuals, home range size of males tended to be larger than home range size for females (paired *t*-test, $t_{21} = 0.053$, $P = 2.055$; Appendix E). As observed in previous years, released shrikes of the current year (bonded pairs at Box 1, Middle Ranch 1, Norton 1, and Norton 5, and the male at Box 5) had smaller home ranges than release birds that had over-wintered in the wild (males: Welch's approximate $t_{18} = 5.79$, $P < 0.001$; females: Welch's approximate $t_{19} = 4.24$, $P < 0.001$). However, we found no significant difference in home range size between shrikes that took supplemental food and those that did not (males: Welch's approximate $t_7 = 1.18$, $P = 0.28$; females: Welch's approximate $t_7 = 1.75$, $P = 0.12$; pairs: Welch's approximate $t_7 = 1.52$, $P = 0.17$). The breeding home ranges of individual over-wintering SCLS that bred in both 2002 and 2003 did not vary significantly among years (Table 6; paired $t_{29} = 0.72$, $P = 0.48$).

The average home range size for shrike pairs (1998 – 2003; Table 7) was inversely proportional to mouse abundance, as collected at Cave 2 by IWS ($r = -0.8$, $P = 0.05$; Fig. 5).

Table 5. Minimum convex polygon home range estimates (ha) for SCLS on SCI during the 2003 breeding season. *n* = number of points used to estimate home range size. * indicates pair took supplemental food. The mean is calculated from individuals with at least 30 points.

	Male	Female	Male and Female together	*n* Male	*n* Female
Wild Pairs					
Boulders North 1	12.9	2.8	13.0	27	15
Boulders South 1	5.9	6.2	8.7	18	33
Box 2*	4.4	2.1	5.2	113	94
Box 3*	13.7	6.0	13.7	115	81
Box 4*	12.1	5.6	14.0	74	55
Burns 1*	6.2	3.3	6.6	47	43
Burns 2	6.0	4.9	8.7	15	10
Cave 1	4.8	5.7	8.9	50	45
Cave 2	3.0	11.0	13.5	21	21
Cave 3	7.4	7.6	8.9	40	32
China 2[1] (Jan – May)	14.4	19.4	21.7	53	69
(Jan – Aug)	34.2	40.6	47.1	60	76
China 9*	6.0	4.7	7.5	64	55
Horse 1*	6.1	1.4	6.1	81	38
Horse 6	25.1	25.3	38.1	35	46
Horse Beach 4	27.5	20.9	34.0	20	21
Lemon Tank 1*	6.9	5.3	7.1	72	72
Lemon Tank 2a*	17.8	15.1	19.9	42	36
Lemon Tank 2b*	19.4	12.0	20.5	69	42
Norton 4*	3.3	2.2	4.7	81	58
Red 4	13.1	12.0	21.9	40	40
Stone Station 1*	8.4	8.1	11.1	264	118
Thirst 1	14.4	10.6	17.0	45	33
Warren 1*	14.3	17.4	27.7	57	32
Wilson Cove 1[2]	7.1	8.5	9.0	42	50
Wild Pair Mean ± SD	*11.8 ± 8.0*	*10.2 ± 9.5*	*15.5 ± 11.6*		
Bonded Pair Releases					
Box 1*	1.03	0.41	1.04	128	102
Box 5*[3]	0.94	0.76	1.32	24	9
Middle Ranch 1*	0.05	0.03	0.11	12	10
Norton 1*	0.66	0.78	1.2	49	40
Norton 5*	1.75	0.98	1.95	65	50
Bonded Pair Mean ± SD	*1.15 ± 0.55*	*0.72 ± 0.29*	*1.40 ± 0.49*		
Fed Mean (all pairs) ± SD	9.9 ± 5.4	6.9 ± 5.2	12.0 ± 7.4		
Not Fed Mean (all pairs) ± SD	15.1 ± 10.9	15.8 ± 12.7	21.5 ± 15.5		
Overall Mean ± SD	10.4 ± 8.3	8.9 ± 9.4	13.6 ± 11.8		

[1]Jan – May = area where the pair first bred in 2003. In June, the pair moved to a new breeding site and renested.
[2]Male = SB/RG, female = OY/SR of this male-male pair.
[3]Male released as a bonded pair with a captive female. This data represents the wild female who displaced the captive female shortly after the pair was released.

Table 6. Multi-year comparisons of breeding home range sizes (ha) for individual SCLS. Sources: Mader *et al*. 2000, Blackford *et al*. 2001, Plissner *et al.* 2002, Blackford *et al.* 2003, and this report. * indicates release year.

	1999		2000		2001		2002		2003	
USFWS #	Location	Size	Location	Size	Location	Size	Location	Size	Location	Size
Females										
752-19383							Box 1[1]	1.25	Horse 6	25.3
1681-08115					Middle Ranch 1[1]	4.2	Middle Ranch 1[1]	3.0	Box 4[1]	5.6
1681-08132							Stone 1[2]	1.12	Burns 2[2]	8.7
1681-08138					Cave 1	0.3	Cave 1	7.4	Cave 1	5.7
1681-08161					Box 2[1]	9.1	Box 2[1]	4.5	Horse 1[1]	1.4
1681-08156					Norton 6*[1]	0.2	Norton 5[1]	26.5	Box 3[1]	6.0
1681-08175							Thirst 2	9.6	Box 5[1,2]	0.76
8011-82605					Red 4	14.9	Red 4	5.53	Red 4	12.0
8031-04802							Middle Ranch 4	4.34	Norton 4[1]	2.2
8031-04832							Horse 3[1]	11.45	Box 2[1]	2.1
8031-04834							Burns 2	12.15	Burns 1[1]	3.3
8031-04854							Lemon Tank 1[1]	2.58	Lemon Tank 1[1]	5.3
8031-04861							Boulders North 1[2]	6.7	Boulders North 1[2]	2.8
Males										
961-95005					Boulders South 1[2]	2.6	Boulders South 1[2]	0.15	Boulders South 1[2]	5.9
1681-08131					Horse 1[1,3]	4.9	Horse 1[1,3]	4.9	Horse 1[1]	6.1
1681-08182							Burns 1[1]	0.57	Burns 1[1]	6.2
1681-08184							China 2	8.56	China 2	34.2
1781-54905							Cave 1	1.05	Cave 1	4.2
1781-54912							Burns 2	8.81	Burns 2[2]	6.0
8011-82601	China 2	25.0	China 2[1]	14.1	China 9[1]	14.2	China 9[1,3]	12.3	China 9[1]	6.0
8011-82602					Red 4	23.1	Red 4	8.27	Red 4	13.1
8011-82659			Box 2[1]	3.5	Box 2[1]	7.8	Box 2[1]	5.0	Box 2[1]	4.4
8011-82671			Box 3*[1]	0.6	Box 3[1]	21.6	Box 3[1]	4.1	Box 3[1]	13.7
8011-82684			Norton 1[1]	1.1	Norton 4[1]	7.2	Norton 4[1]	2.4	Norton 4[1]	3.3

Table 6. Cont.

	1999		2000		2001		2002		2003	
USFWS #	Location	Size	Location	Size	Location	Size	Location	Size	Location	Size
Males cont.										
8031-04818							Lemon Tank 1	12.0	Lemon Tank 2	29.3[2]
8031-04823							Box 4[1]	30.0	Box 4[1]	12.1
8031-04838							Stone Station 1[1]	13.8	Stone Station 1[1]	8.4
8031-04845							Warren 1[1]	150.7	Warren 1[1]	14.3
8031-04888							Boulders North 1[2]	8.9	Boulders North 1[2]	12.9
8061-14120	Cave 2	1.1	Cave 2	15.5	Cave 2	8.2	Cave 2[2]	3.0	Cave 2[2]	3.0

[1]Took supplemental food.
[2]Home range calculated with < 30 observation points.
[3]Home range of male with both females.

Table 7. Comparison of mean home range size and home range estimates (ha) for territories occupied in 2003 by over-wintering SCLS 1998-2003. Sources: Mader and Warnock 1999, Mader *et al*. 2000, Blackford *et al*. 2001, Plissner *et al.* 2002, Blackford *et al.* 2003, and this report.

Territory	1998	1999	2000	2001	2002	2003
Box 2	--	--	3.6[1]	13.1	8.6	5.2
Box 3				22.5	7.9	13.7
Box 4	--	--	--	4.2	82.7	14.0
Burns 1	--	--	--	--	271.1	6.6
Burns 2	--	--	--	--	16.8	8.7
Cave 1	--	--	--	22.1	8.8	8.3
Cave 2	1.1	44.1	23.2	16.0	6.9	13.5
Cave 3	--	--	--	--	9.3	8.9
China 2	42.4	27.0[1]	29.5	--	18.9	47.1
China 9	--	40.4	--	16.5	11.3	7.5
Horse 1	--	--	--	11.1[1]	4.7	6.1
Lemon Tank 1	--	--	--	--	12.7	7.1
Norton 4	--	--	--	7.9	2.6	4.7
Red 4	--	--	--	25.1	11.5	21.9
Stone Station 1	--	--	--	--	14.9	11.1
Thirst 1	--	--	--	5.3	18.0	17.0
Warren 1	--	--	--	--	214.4	27.7
All territories	13.2	42.1	16.3	16.7	26.2	13.6

[1]Single-female release pair.

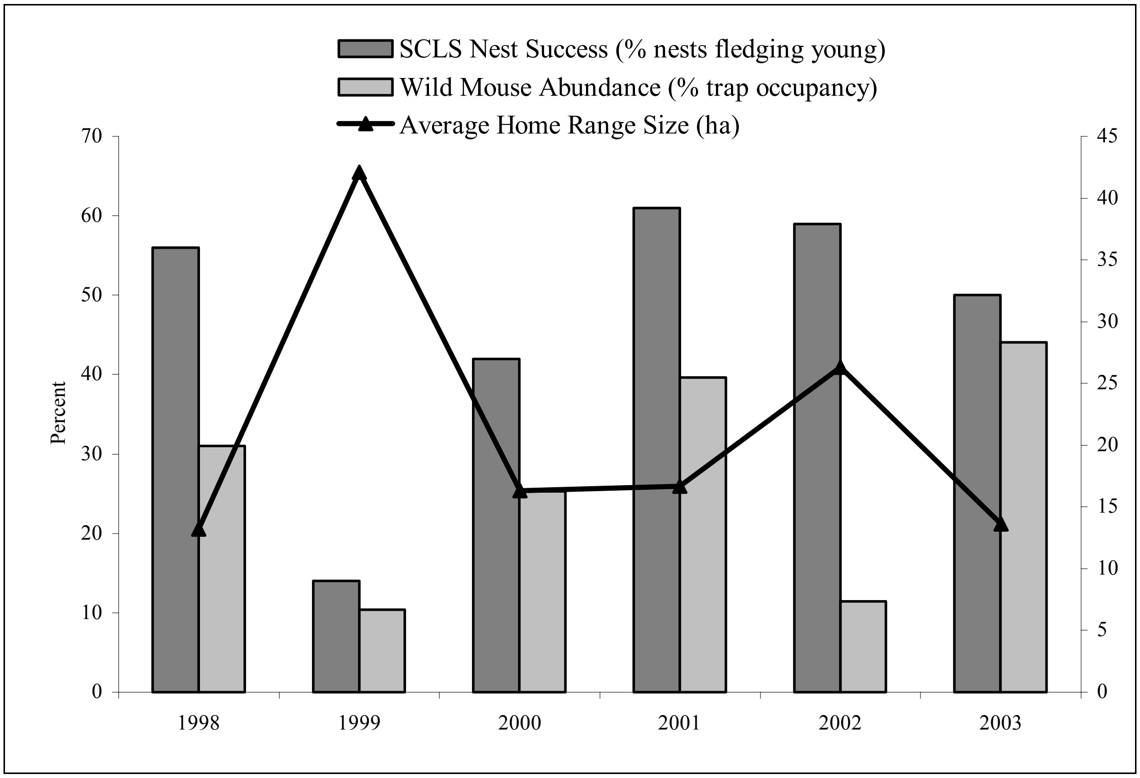

Figure 5. The relationship between nesting success, prey abundance (based on mouse abundance index derived at Cave 2 site in August/September), and the average home range size of SCLS (Lynn and Garcelon 2001, IWS unpubl. data).

Nest Placement – San Clemente Loggerhead Shrikes nested in nine species of plants in 2003, two of which were newly recorded nest substrates (Willow and Nevin's Eriophyllum). Of 51 completed nests (pairs reused nests at Red 4 and Stone Station 1), 39% were built in Lemonade Berry, 29% were built in Island Cherry, 12% in Toyon, 10% in Sagebrush, and 2% each in Coyotebrush, California Lilac, Morning Glory, Nevin's Eriophyllum, and Willow (Fig. 6). The male-male pair at Wilson Cove 1 constructed two nests in a stack of milk crates behind the Navy's store. Since 1998, we have documented SCLS nesting in 12 species of plants. In addition to the nine listed above, shrikes nested in oaks in 1998 and 2002, in Honeysuckle in 2002, and in Catalina Ironwood in 2002. We did not find any significant differences in success of nests placed in the four most common plant species (Island Cherry, Lemonade Berry, Sagebrush, and Toyon) from 1998 - 2003 (Chi-square = 2.73, $P = 0.44$, df = 3). However, when combining nest characteristic data from 1998 – 2003, we found that successful nests were significantly higher and further from the center of nest shrubs than failed nests (Table 8).

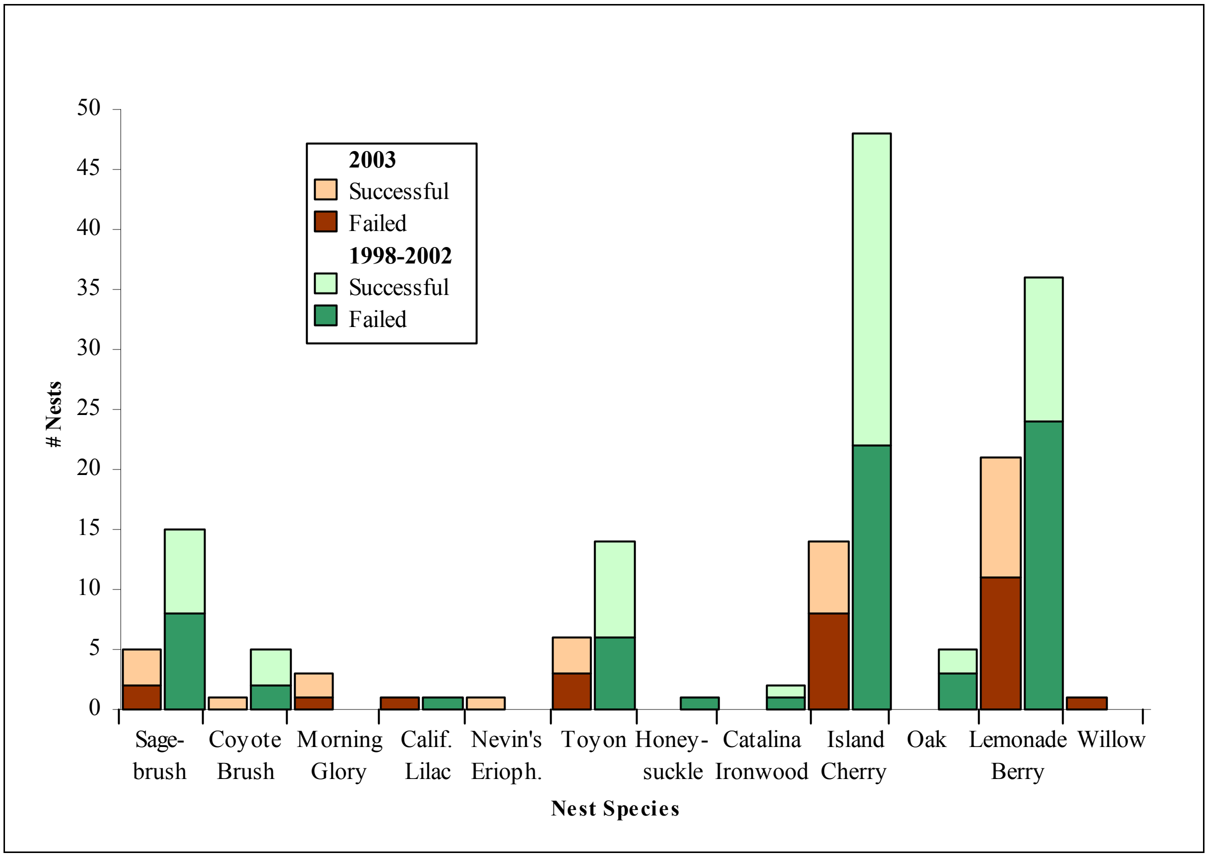

Figure 6. Plant species in which successful and failed SCLS nests were placed in 2003 compared to 1998 - 2002.

Table 8. Nest variables (mean ± SD) of failed and successful (fledged) SCLS nests in 2003 and cumulative data from 1998-2003. Data do not include nests that were inaccessible or those that could not be found during vegetation sampling.

	2003		1998 - 2003			
Nest Variables	Failed (*n* = 24)	Successful (*n* = 25)	Failed (*n* = 82-86)	Successful (*n* = 79-83)	Student's *t*	*P*
Nest height (m)	2.5 ± 1.9	2.2 ± 2.2	1.5 ± 1.6	2.6 ± 2.5	3.24	**< 0.01**
Plant height (m)	4.7 ± 3.0	3.8 ± 3.4	5.0 ± 2.7	4.8 ± 3.1	0.35	0.72
Distance to edge (m)	0.7 ± 0.5	0.7 ± 0.6	0.5 ± 0.7	0.6 ± 0.6	1.44	0.15
Distance to center (m)	1.6 ± 1.3	1.6 ± 1.4	1.4 ± 1.8	2.0 ± 1.8	2.15	**0.03**
Concealment above (%)	77 ± 25	79 ± 26	67 ± 27	68 ± 25	0.31	0.76
Concealment below (%)	49 ± 36	55 ± 38	41 ± 31	40 ± 32	0.13	0.89
Total concealment (%)	68 ± 21	73 ± 21	61 ± 23	63 ± 21	0.49	0.62

Breeding Data

Timing –Several female shrikes were observed moving between territories and interacting with potential mates in November and December 2002 (2002 females from Box 2, Box 3, China 1, Horse Beach 1, and Middle Ranch 4). But, unlike previous years, only one pair began forming before 1 January (Red 4). Nest building was first observed on 16 February (Red 4), and the median date of nest-initiation was 6 March. The last nest constructed that contained eggs (Box 1) was initiated approximately 11 June. Egg-laying commenced on 3 March, and the last clutch was initiated approximately 15 June. The median date for the initiation of first clutches in 2003 was 22 March (excludes 2003 releases). Pairs that were released in 2003 (including the Box 5 pair that contained a 2003 released male) initiated their first clutches 7-17 days (median = 10 days) post-release.

The median fledging date for first nests was 27 April (n = 13, range 15 April – 3 June; excluding 2003 release SCLS). The median initiation of egg-laying for renesting pairs (after successfully fledging one brood) was 13 May (range 20 April – 21 May), and the median fledging date was 23 June (range 30 May – 28 June). Four pairs successfully fledged young after their first nesting attempt failed. The median initiation of egg-laying date for these second attempts was 10 April, and the median fledging date was 27 May. One pair (Red 4) began a third nesting attempted after fledging two broods. The first egg laid in this third attempt was on 12 June and the nest failed by 5 July.

Reproductive Success – In 2003, 24 SCLS pairs (including the Box 5 pair consisting of a wild female and a 2003-released male, but excluding 2003-released bonded pairs and the male-male pair at Wilson Cove) built 47 nests that contained eggs (1-5 nests per pair) and produced a minimum of 157 eggs (Table 9). Eighty-five juveniles fledged from 24 successful nests (51% nest success) of 18 pairs. Ten pairs attempted another brood after successfully fledging young (Box 2, Box 4, Burns 1, Cave 2, China 2, China 9, Horse 1, Norton 4, Red 4, and Stone Station 1). Six of these pairs successfully fledged a second brood (Burns 1, China 2, China 9, Norton 4, Red 4, and Stone Station 1). The Lemon Tank 2 male bred with two females in 2003, pairing with the second after the first disappeared while she was laying eggs. A minimum of 65 fledglings survived to the age of independence (41 days). One fledgling from China 2 Nest C may have reached independence; however, observations during the dependent fledgling stage were inconclusive at this site. Unbanded juveniles were detected on the island beginning on 15 June at Spanish Corner (a sharp curve in SCI Ridge Road southwest of Twin Dams canyon). Based on the timing of this observation, the juvenile could have been an unbanded fledgling from Boulders South 1, Cave 2, or Cave 3. Observations of unbanded juveniles continued until 4 October, after which juveniles could not be distinguished from adults because of feather molt. Because we were unable to band seven juveniles, five of which reached independence, we do not believe the observations of unbanded juveniles represent young from an undetected breeding attempt, although we cannot rule that out.

Table 9. Summary of wild and 2003-released SCLS nesting attempts in 2003, and whether or not they accepted supplemental food. W = wild, R'XX = captive-reared, released in year XX ('99, '00, '01, '02, '03), UN = unknown. Nests with undetermined contents were assigned one egg.

Breeding Location	Origin		Nesting	Min. #	#	# Indep.	Suppl.
	Male	Female	Attempt	Eggs	Fledglings	Young	food
Boulders North 1	R'01	R'01	A	1	0	0	N
Boulders South 1	W	R'01	A	1	0	0	N
			B	4	3	2	N
Box 2	R'99	R'01	A	5	4	4	Y
			B	5	0[1]	0	Y
Box 3	R'00	R'01	A	1	0	0	Y
			B	2	0	0	Y
			C	2	0	0	Y
			D	1	0	0	Y
			E	1	0	0	Y
Box 4	R'01	W	A	5	5	4	Y
			B	1	0	0	Y
Box 5	R'03	W	A	3	1	1	Y
Burns 1	W	R'01	A	4	3	1	Y
			B	2	2[2]	1	Y
Burns 2	W	R'00	A	5	1	1	N
Cave 1	W	R'00	A	6	0	0	N
			B	6	4	2	N
Cave 2	W	UN	A	6	4	3	N
			B	1	0	0	N
Cave 3	W	W	A	5	5	5	N

Table 9. Continued.

Breeding Location	Origin Male	Origin Female	Nesting Attempts	Min. # Eggs	# Fledglings	# Indep Young	Suppl. food
China 2	W	W	A	6	2	2	N
			B	1	0	0	N
			C	3	3	0[3]	N
China 9	W	UN	A	6	5	5	Y
			B	5	5	2	Y
Horse 1	R'00	R'00	A	4	4	4	Y
			B	1	0	0	Y
Horse 6	W	W	A	3	0	0	N
			B	1	0	0	N
			C	1	0	0	N
Horse Beach 4	W	W	A	6	0	0	N
			B	1	0	0	N
Lemon Tank 1	W	W	A	3	0	0	Y
Lemon Tank 2a	R'01	R'02	A	2	0	0	Y
Lemon Tank 2b	R'01	W	A	1	0	0	Y
			B	4	3	2	Y
Norton 4	R'99	R'01	A	6	4	4	Y
			B	5	5	3	Y
Red 4	W	W	A	4	2	1	N
			B	6	1	1	N
			C	1	0	0	N
Stone Station 1	R'01	W	A	5	5	5	Y
			B	3	3	2	Y
Thirst 1	W	R'01	A	1	0	0	N
			B	5	4	4	N
Warren 1	R'01	W	A	6	6	6	Y
Box 1	R'03	R'03	A	2	0	0	Y
			B	1	0	0	Y
			C	1	0	0	Y
Middle Ranch 1	R'03	R'03	A	3	0	0	Y
Norton 1	R'03	R'03	A	5	3	3	Y
Norton 5	R'03	R'03	A	3	2	1	Y

[1]One nestling fledged early (~12 days old) and disappeared. Not considered a natural fledging.
[2]One injured fledgling taken into captivity.
[3]Insufficient observations to determine if one fledgling reached independence.

As in prior years, more ASY SCLS than SY SCLS bred in 2003 (Table 10), reflecting probable low over-winter survivorship of juveniles into their second year. Older males tended to be more successful in fledging their young than SY males in 2003, (statistical analysis is not appropriate due to the small number of SY males). When we combine data from 1998 through 2003, older males were confirmed to be more likely to fledge young than SY male SCLS (Fisher's Exact test, $P = 0.003$). In 2003, we failed to find a difference in fledging success between older and SY females (Fisher's Exact test, $P = 0.62$). When data from 1998–2003 were combined, we also failed to find a difference in fledging success between older and SY female SCLS (Fisher's Exact test, $P = 0.55$).

Table 10. Mean reproductive success of breeding SCLS by age-class (2003/combined 1998-2003). SY = second-year; ASY = after-second-year.

	Males		Females	
Age class	SY	ASY[1]	SY	ASY
n	3/32	19/68	6/42	18/57
Successful breeders	0/14	17/52	4/28	14/38
Fledglings produced	0/ 3.7 ± 1.6	4.2 ± 2.8/ 4.2 ± 1.9	4.0 ± 3.3/ 3.7 ± 1.8	3.3 ± 2.7/ 4.3 ± 1.8
Independent juveniles produced	0/ 2.5 ± 1.7	3.3 ± 2.3/ 3.1 ± 1.7	3.5 ± 3.0/ 2.6 ± 2.0	2.5 ± 2.2/ 3.1 ± 1.5

[1]Two males were unbanded and probably ASY because they bred where unbanded SCLS bred in 2002.

Age of parents (SY versus ASY) in 2003 was not related to numbers of young fledged ($t_{20} = 0.37$, $P = 0.71$; Table 10). However, combining data from 1998–2003, age of parents had a significant effect on the number of fledglings produced per pair ($F_{3,93} = 4.02$, $P = 0.01$). The main difference appears to be that ASY male-ASY female pairs produced more fledglings than did SY male-ASY female pairs (Tukey's test, $P < 0.05$). The number of fledglings attaining independence in 2003 was also independent of parent age ($t_{20} = 0.06$, $P = 0.95$). However, combining 1998–2003, age of parents had a significant effect on the number of young raised to independence per pair ($F_{3,93} = 3.63$, $P = 0.02$). No differences were evident between pairs with different age composition when we examined this using Tukey's post-hoc tests. All but one ASY shrike that bred in 2003 was an experienced breeder.

Forty-three percent of SCLS that bred in 2003 were released in previous years (excluding 2003 releases and the male-male pair) (Table 11). We ignored supplemental feeding as a factor confounding the effect of origin on shrike breeding success and productivity in these analyses. The effect of supplemental feeding alone is discussed in a following section, and a more complete treatment of the effect of supplemental feeding on can be found in Turner *et al*. (in prep). Males and females reared in captivity were as successful producing fledglings as were wild-hatched males and females (Fisher's Exact test, males: $P > 0.99$; females: $P > 0.99$). When data from 2000 through 2003 were combined (excluding years when released SCLS were not part of the wild population), SCLS reared in captivity and released in previous years were still as likely to produce fledglings as were wild-hatched SCLS (Fisher's Exact test, males: $P > 0.99$; females: $P = 0.96$). Origin of males and females was not significantly related to numbers of young fledged in 2003 ($F_{3,18} = 0.54$, $P = 0.66$), nor did origin of males and females affect the number of independent juveniles produced per pair ($F_{3, 18} = 1.03$, $P = 0.40$). When data from 2000–2003 were combined, parental origin did not affect the number of fledglings produced per pair ($F_{3,86} = 0.71$, $P = 0.55$) or the number of juveniles raised to independence ($F_{3,86} = 1.19$, $P = 0.32$).

Table 11. Mean reproductive success of breeding SCLS by origin (2003/combined 2000-2003; excluding 2003 releases).

	Males		Females	
Origin	Wild	Captive	Wild	Captive
n	13/50	9/39	13/43	11/45
Successful breeders	10/38	7/27	10/30	8/32
Fledglings produced	3.4 ± 2.8/ 4.2 ± 1.6	3.9 ± 3.2/ 3.9 ± 2.0	3.8 ± 3.1/ 4.6 ± 1.8	3.1 ± 2.7/ 3.6 ± 1.7
Independent juveniles produced	2.4 ± 2.1/ 3.0 ± 1.5	3.4 ± 2.8/ 2.8 ± 2.1	3.1 ± 2.6/ 3.4 ± 1.8	2.4 ± 2.2/ 2.5 ± 1.6

Average annual rainfall (1 July – 30 June) over the past six years was 203 ± 119 mm (Cal. State Northridge, Dept. of Geography, unpubl. data, collected on SCI at OP1, OP3, and Nursery weather stations), slightly below annual rainfall for 2002-2003 (Fig. 7). We failed to find a significant correlation between winter rainfall from 1997 to 2003 and shrike nest success ($r = 0.39$, $P = 0.39$), number of fledglings produced per pair ($r = 0.60$, $P = 0.15$), or number of independent young produced per pair ($r = 0.43$, $P = 0.33$) (Fig. 7).

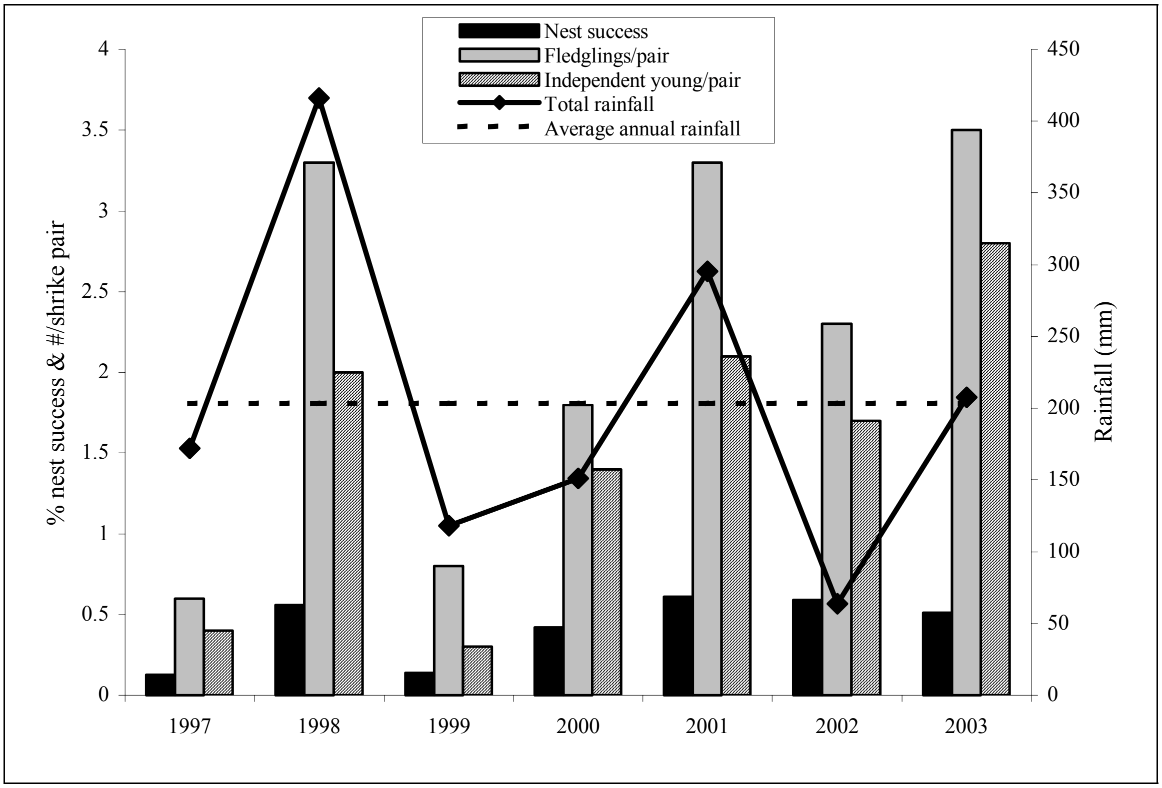

Figure 7. Relationship of annual rainfall (1 July of previous year – 30 June of noted year) with San Clemente Loggerhead Shrike breeding productivity. Average of rainfall data collected at OP1, OP3, and Nursery weather stations on San Clemente Island by California State University at Northridge, Department of Geography in cooperation with Navy Region Southwest, Natural Resources Office.

Breeding Success of 2003 Released Shrikes – Nine of the 11 SCLS released in 2003 attempted to breed. Four bonded pairs (Box 1, Middle Ranch 1, Norton 1, and Norton 5) remained together and built six nests (1 - 3 nests per pair) with a minimum of 15 eggs. Five juveniles fledged from two successful nests of two pairs (Norton 1 and Norton 5). Four juveniles reached independence. The Box 5 male paired with a wild female and their reproductive data is reported above. The female from the Box 5 release was not seen after 4 May. The single male that was released from the Arizone flight cages in January was not seen after the day of release and apparently did not breed in 2003.

Daily Nest Survival – The Mayfield estimate of daily nest survival for the 52 nesting attempts by over-wintering and 2003 released SCLS pairs that produced eggs (excluding Boulders North 1 and Wilson Cove 1) was 0.98 (Table 12). We excluded the Boulders North 1 nest because Mayfield analyses require observing a nest active at least twice to assign the number of exposure days (the number of days we know or assume the nest was active). We excluded Wilson Cove 1 from analyses because this male-male pair could not produce eggs. Daily survival during both incubation and nestling stages combined was 0.98 ($N = 49$, SE < 0.01), and the probability that any one nest would make it through both stages was 49%. All but one 2003 SCLS nest (China 2 Nest C) were discovered during or before incubation and were followed to conclusion. The Mayfield estimate for nest survival through all stages was 0.46 (SE < 0.01) (or 46% probability that any given nest will survive to fledging), slightly lower than our observed fledging rate of nests known to have eggs in 2003 (50%). Nests were significantly less likely to survive the nestling stage than incubation (Chi-square = 12.5, df = 1, $P < 0.01$). Reproductive success per pair in 2003 was higher than the average reported from 1998 – 2002, although lower than 2002, 2001 and 1998 (Table 13). Nest success in 2001 was higher than predicted by home range size and prey abundance (Fig. 5); however, a relationship still existed between home range size and nest success ($r = -0.7$, $P = 0.07$).

Table 12. Mayfield estimates of daily nest survival rate and total nest survival probability throughout each stage (mean ± SE) through the nestling stage from 1998-2003.

Nest Stage	1998[1]	1999	2000	2001[2]	2002	2003
Laying	0.85 ± 0.07	1.00 ± 0.00	0.98 ± 0.02	-[3]	0.99 ± 0.01	0.98 ± 0.01
	n/a	1.00 ± 0.00	0.91 ± 0.02		0.97 ± 0.01	0.93 ± 0.01
Incubation	0.99 ± 0.01	0.96 ± 0.02	0.97 ± 0.01	0.99	0.99[1]	0.98 ± 0.01
	n/a	0.46 ± 0.02	0.64 ± 0.01	0.81	0.83[1]	0.73 ± 0.01
Nestling	1.00 ± 0.00	0.95 ± 0.03	0.99 ± 0.01	0.99	0.98 ± 0.01	0.98 ± 0.01
	n/a	0.34 ± 0.03	0.83 ± 0.01	0.78	0.73 ± 0.01	0.68 ± 0.01
All stages	0.98 ± 0.01	0.96 ± 0.01	0.98 ± 0.01	0.99	0.99[1]	0.98[1]
	n/a	0.18 ± 0.01	0.44 ± 0.01	0.63	0.59[1]	0.46[1]

[1]Nest survival probabilities for each stage not calculated for 1998
[2]SE < 0.01.
[3]Not calculated due to imprecise estimation of egg-laying dates.

Table 13. A comparison of productivity measurements for SCLS 1997-2003. Bonded, family and juvenile release data not included. Sources: Juola *et al.* 1997c, Mader and Warnock 1999, Mader *et al.* 2000, Blackford *et al.* 2001, Plissner *et al.* 2002, Blackford *et al.* 2003, and this report.

Productivity Measurements	1997	1998	1999	2000	2001	2002	2003
Pairs[1] (male:female ratio)	9 (9:8)	7 (7:5)	9 (9:8)	8 (8:9)	21 (20:21)	39 (37:40)	24 (23:24)
Number of nests-							
Initiated	24	14	19	17	35	52	48
Known to have eggs	16	9	14	12	33	46	47
Producing fledglings	2	5	2	5	20	26	24
Dependent fledglings	5	20	7	14	66	86	85
Dependent fledglings/pair	0.6 ± 1.3	3.3 ± 2.2	0.8 ± 2.0	1.8 ± 2.2	3.3 ± 2.2	2.2 ± 2.0	3.5 ± 2.9
Independent juveniles	4	14	3	11	41	62	65
Independent juveniles/pair	0.4 ± 1.0	2.0 ± 2.1	0.3 ± 1.0	1.4 ± 1.6	2.1 ±1.8	1.6 ± 1.6	2.8 ± 2.4
Days juveniles remained on natal territories	43 - 71	64.0 ± 4.0	89 ± 0.0	57.7 ± 17.3	61.0 ± 13.6	59.4 ± 16.4	58.2 ± 11.5

[1] Includes individuals released on territories occupied by single wild shrikes, but does not include male-male pairs

Nest Failures and Predation – Fifty-one percent of all nesting attempts suspected to have eggs (n = 53, includes 2003 releases) failed prior to fledging (Table 14). Based on SCLS behavior and evidence collected during nest inspections, 10 nests failed while nestlings were present and 17 failed prior to hatching (either during egg-laying or incubation). We suspected that 16 (59%) of the failed nests were depredated: five potentially by rodents, three potentially by Common Ravens, one potentially by a mammal (possibly Island Fox), and seven by unknown predators (Table 14), based on evidence found at the nests after the nests failed. Four nests that we thought were depredated contained no evidence of disturbance. However, at three of these nests, predators were seen in the area around the time the nests failed (Common Ravens in the nest tree at two nests, an Island Fox near one nest), and may be responsible for failure. At the fourth nest, an injury to the female's left leg suggested that a predator had attacked her while she was incubating. No other clues to the identity of the responsible predator were found. The presence of eggshell fragments in two nests suggested rodent depredation but supporting evidence was lacking. Nest linings were pulled up or disturbed in three nests, commonly accepted as evidence of nest depredation by Common Ravens (D. Cooper, pers. comm.); however, supporting evidence was lacking. Two female SCLS sustained injuries that were probably incurred during nest depredation. A final nest was considered failed when the nestling refused to stay in the nest after banding. The premature fledgling was tended by the adults for a day and a half and then not seen again. No evidence of a responsible predator was found.

We suspect that poor weather and rain caused abandonment at Cave 1 Nest A and Cave 2 Nest B. Two other nests were abandoned, one with four eggs with no apparent cause (Horse 6), and one in response to intensive SCLS management activities (Lemon Tank 1; Appendix E), although the nest was not likely to succeed due to other, human-related factors (fiberglass nest-lining and abnormally developed eggs). Five nests were not inspected due to poor accessibility or continued breeding behavior in the vicinity of the failed nest.

Table 14. Summary of failed nesting attempts by SCLS in 2003. NB = nest building, EL = egg laying, IN = incubation, NE = nestlings, UN = unknown.

Site	Nest	Probable Stage	Probable Cause of Failure	Condition of nest	Likely Predator
BN1	A	EL	Unknown	Lining pulled up	Unknown
BS1	A	IN	Depredated	Lining slightly pulled up	Unknown
BX1	A	IN	Depredated	One intact egg in nest, raven nest with nestlings nearby	Common Raven
BX1	B	IN	Depredated	No evidence of remains, raven in nest tree	Common Raven
BX1	C	IN	Depredated	Lining slightly pulled up	Unknown
BX2	B	NE, post-banding	Depredated	12 day old nestling fledged early at banding, disappeared next day	Unknown
BX3	A	IN	Depredated	Rodent feces in nest	Rodent
BX3	B	IN	Depredated	Eggshell fragments under nest, lining slightly pulled up	Rodent
BX3	C	NE	Depredated	Eggshell fragments in nest	Rodent
BX3	D	EL	Unknown	Not checked	Unknown
BX3	E	IN	Unknown	Not checked	Unknown
BX4	B	IN	Depredated	Not checked, female with injured leg	Unknown
CV1	A	NE	Abandoned	No evidence of nest disturbance, poor weather preceding failure	Poor weather
CV2	B	NE	Abandoned	No evidence of nest disturbance, poor weather preceding failure	Poor weather
CH2	B	NE	Depredated	Downy feathers in nest, lining pulled up	Common Raven
HO1	B	IN	Unknown	Eggshells with small holes in the nest	Unknown
HO6	A	NE	Depredated	Eggshell fragment in nest	Unknown
HO6	B	IN	Unknown	Not checked	Unknown
HO6	C	IN	Abandoned	No evidence of disturbance, 4 whole eggs in nest	Unknown
HB4	A	NE, post-banding	Depredated	No evidence of nest disturbance, fox in area during nestling banding	Mammal (Island Fox?)
HB4	B	IN	Depredated	Rodent feces in nest	Rodent
LT1	A	IN	Abandoned	Fiberglass in lining, old nest replaced with new nest	Human disturbance
LT2a	A	EL	Depredated	Rat feces in and below nest, SCLS contour feathers below nest, whole eggshell fragments in nest, whole egg on the ground	Rodent
LT2b	A	EL	Unknown	Not checked	Unknown

Table 14. Cont.

Site	Nest	Probable Stage	Probable Cause of Failure	Condition of nest	Likely Predator
MR1	A	NE	Depredated	No evidence of nest disturbance	Unknown
RD4	C	IN	Depredated	Small eggshell fragments in nest	Unknown
TH1	A	IN	Unknown	Not checked	Unknown

Supplemental Feeding

PRBO regularly provided supplemental food to shrikes at three sites in 2003 (Table 9, 15). All sites where supplemental food was consumed had at least one SCLS with previous supplemental food tub experience. Both adults at all three sites took food from the supplemental food tub. At Box 4, supplemental food was increased after the female was injured, apparently during a nest depredation. The IWS release crew fed this pair every other day from 13 June through 7 July, then gradually cut back until PRBO took over weekly feeding after 4 August.

Table 15. Sites provided with supplemental food by PRBO in 2003.

Site	Duration	Number of Times Food Offered	Total Amount Offered/Accepted			
			Mice	Crickets	Mealworms	Other
Regular sites						
Box 4	1/14 – 10/15	44	45/24	3200/724	3200/762	*Uta*: 24/12 Anoles: 6/4
China 9	1/5 – 12/15	53	103/66	3750/2883	3750/2521	-
Lemon Tank 2[1]	2/27 – 11/25	28	56/45	1475/1124	1440/1070	-
Sites where shrikes did not accept offered food						
China 2	2/7 – 3/29[2]	4	7/0	145/0	145/0	-
Cave 3	2/28 – 3/19[2]	2	2/0	20/0	20/0	-

[1] Also fed by IWS Release crew approximately every 10 days.
[2] Shrikes at these sites also did not take offered food in 2002.

Supplemental food was offered to two SCLS pairs before the breeding season (China 2 and Cave 3). Although the females at each of these sites had experience foraging from a food tub at their natal sites, neither pair took supplemental food when offered in 2003.

IWS Release crew, with occasional assistance from PRBO, provided supplemental food on a regular basis to 12 breeding pairs (Box 1, Box 2, Box 3, Box 5, Burns 1, Horse 1, Lemon Tank 1, Middle Ranch 1, Norton 1, Norton 4, Norton 5, and Warren 1; Table 9; Turner *et al.* in prep.), and ZSSD personnel provided supplemental food to Stone Station 1. In addition, IWS assisted PRBO in feeding at Box 4 following the injury of the female, and at Lemon Tank 2 opportunistically. Including pairs fed by both IWS Release and PRBO, 57% of breeding pairs (including 2003 releases) received supplemental food (16 of 28 pairs, including Lemon Tank 2a and b; Table 9).

Unlike in 2002, pairs that received supplemental food were equally likely to fledge at least one young (8 of 11) as pairs that did not receive supplemental food (9 of 11; Fisher's Exact test, $P = 0.99$, excluding the male-male pair, the Lemon Tank 2a pair that dissolved, and all 2003 released pairs). All pairs that fledged young raised at least one to independence. However, pairs that received supplemental food tended to fledge more young (4.9 ± 3.3 juveniles) than shrikes that did not receive supplemental food (2.6 ± 2.0 juveniles; $t_{20} = 1.96$, $P = 0.06$), and to raise more young to independence (3.9 ± 2.7 juveniles) than shrikes that did not receive supplemental food (2.0 ± 1.7 juveniles; $t_{20} = 2.01$, $P = 0.06$). Due to confounding variables such as recent captivity, inexperience with the wild environment, and more frequent provisioning of supplemental food, the preceding analyses exclude current-year release pairs. See Turner *et al.* in preparation for reproductive success analyses accounting for origin with supplemental feeding.

The average age of dispersal for independent young from sites without supplemental food was 56 ± 12 days ($n = 21$). The average age of dispersal for fledglings at territories receiving supplemental food was 59 ± 12 days ($n = 43$). There was no significant difference in the age of dispersal for young fledged by supplementally fed pairs versus young fledged by shrikes that were not given supplemental food ($t_{21} = 0.76$, $P = 0.45$).

In 2003, a similar number of first-time breeders (SY birds) bred successfully whether or not they received supplemental food (2 of 9 were supplementally fed, 2 of 8 were not supplementally fed). In contrast, in 2002, 6 of 16 successful pairs that received supplemental food were comprised of two SY birds, while only 1 of 9 successful pairs that did not receive supplemental food were comprised of two SY birds.

Predators and Competitors

Site Monitoring - In 2003, we observed 15 species of potential predators or competitors, totaling 1,885 individual sightings, at current and former SCLS breeding and release sites while monitoring SCLS. Species observed were feral cat, Island Fox, Northern Harrier, White-tailed Kite, Osprey *Pandion haliaetus*, Bald Eagle *Haliaeetus leucocephalus*, Sharp-shinned Hawk, Red-tailed Hawk, American Kestrel, Merlin, Peregrine Falcon, Burrowing Owl, Common Raven, Northern Mockingbird *Mimus polyglottos*, and European Starling. Other potential predators and competitors were mostly likely present but not detected due to their size and/or nocturnal habits (e.g., rats).

On average, 0.47 (range 0.19 – 1.07) potential predators and competitors were observed per person-hour at SCLS breeding sites (Table 16). Predators and competitors were observed considerably more frequently at release sites with a mean of 1.11 per person-hour (Table 17). Common Ravens were the most frequently observed potential predator at breeding and release sites (range 0.06 – 1.13; Tables 16, 17). American Kestrels were recorded at all breeding and release sites in 2003 (range 0.02 – 0.65; Tables 16, 17). Red-tailed Hawks were observed at all breeding and release sites except Box 3, the Arizone Cages and Norton 5 (range 0.00 – 0.19; Tables 16, 17), and were detected at 45% of former sites (Appendix G).

Few non-breeding raptors were observed at SCLS breeding and release sites. Northern Harriers were recorded ten times by PRBO personnel, nine at Lemon Tank 1 and Lemon Tank 2 breeding sites, five of which were recorded in one day (25 November). Three White-tailed Kites were seen in 2003, all in the Lemon Tank and Tota areas. One sub-adult Bald Eagle was seen on 24 April at Boulders North. Seven of nine Sharp-shinned Hawks were observed at breeding sites in 2003. Six of seven Merlins were detected at breeding sites. Six of eight Peregrine Falcon sightings came from breeding or release sites. PRBO personnel detected Burrowing Owls three times during 2003, but only once at a breeding site: Cave 2 in late November.

Table 16. Number of predator and competitor observations per person-hour at shrike breeding sites in 2003. The highest abundance for each predator and competitor are in bold. AMKE = American Kestrel, CORA = Common Raven, FECA = feral cat, ISFO = Island Fox, NOMO = Northern Mockingbird, RTHA = Red-tailed Hawk. * = possible predation at ≥ 1 nest in 2003. Other: Bald Eagle, Burrowing Owl, Merlin, Northern Harrier, Osprey, Peregrine Falcon, Sharp-shinned Hawk, White-tailed Kite, and European Starling.

Breeding Sites	AMKE TOTAL	AMKE /HR	CORA TOTAL	CORA /HR	FECA TOTAL	FECA /HR	ISFO TOTAL	ISFO /HR	NOMO TOTAL	NOMO /HR	RTHA TOTAL	RTHA /HR	OTHER TOTAL	OTHER /HR	ALL TOTAL	ALL /HR	TOTAL HOURS
Boulders North 1	1	0.02	7	0.12	0	0.00	0	0.00	0	0.00	2	0.03	1	0.02	11	0.19	57.5
Boulders South 1*	13	0.18	9	0.13	0	0.00	0	0.00	5	0.07	4	0.06	0	0.00	31	0.44	70.75
Box 2*	4	0.05	21	0.29	0	0.00	0	0.00	1	0.01	4	0.05	0	0.00	30	0.41	73
Box 3*	13	0.16	27	0.33	0	0.00	**2**	**0.02**	0	0.00	0	0.00	0	0.00	42	0.51	83
Box 4*	13	0.15	17	0.20	0	0.00	1	0.01	0	0.00	4	0.05	1	0.01	36	0.42	86.25
Burns 1	22	0.40	16	0.29	0	0.00	0	0.00	0	0.00	3	0.05	0	0.00	41	0.75	54.75
Burns 2	**37**	**0.65**	10	0.18	0	0.00	0	0.00	0	0.00	**11**	**0.19**	3	0.05	**61**	**1.07**	56.75
Cave 1	6	0.05	54	0.49	0	0.00	0	0.00	1	0.01	2	0.02	1	0.01	64	0.58	110.5
Cave 2	18	0.16	28	0.24	0	0.00	1	0.01	0	0.00	3	0.03	2	0.02	52	0.45	115.75
Cave 3	2	0.02	24	0.22	0	0.00	1	0.01	2	0.02	3	0.03	2	0.02	34	0.32	107
China 2/China 1*	10	0.09	54	0.49	0	0.00	0	0.00	13	0.12	3	0.03	1	0.01	81	0.74	109.5
China 9	8	0.08	9	0.09	0	0.00	1	0.01	0	0.00	5	0.05	1	0.01	24	0.24	99.75
Horse 1	3	0.04	8	0.10	0	0.00	0	0.00	1	0.01	12	0.15	2	0.02	26	0.32	81.5
Horse 6*	4	0.04	11	0.11	0	0.00	0	0.00	0	0.00	6	0.06	0	0.00	21	0.21	99.75
Horse Beach 4*	3	0.04	6	0.07	0	0.00	**2**	**0.02**	5	0.06	5	0.06	0	0.00	21	0.26	80.5
Lemon Tank 1	6	0.07	27	0.33	0	0.00	**2**	**0.02**	1	0.01	8	0.10	7	0.09	51	0.63	81
Lemon Tank 2*	8	0.12	15	0.22	0	0.00	1	0.01	0	0.00	6	0.09	**7**	**0.10**	37	0.55	67.75
Norton 4	20	0.24	**44**	**0.52**	0	0.00	0	0.00	1	0.01	4	0.05	0	0.00	69	0.81	85
Red 4*	7	0.07	19	0.18	0	0.00	0	0.00	6	0.06	3	0.03	0	0.00	35	0.33	106
Stone Station 1	8	0.11	14	0.19	0	0.00	0	0.00	1	0.01	4	0.05	0	0.00	27	0.36	75
Thirst 1	12	0.11	7	0.06	0	0.00	0	0.00	0	0.00	7	0.06	2	0.02	28	0.25	113
Warren 1	13	0.18	27	0.37	0	0.00	0	0.00	5	0.07	1	0.01	0	0.00	46	0.62	73.75
Wilson Cove 1	2	0.05	6	0.15	0	0.00	0	0.00	**8**	**0.20**	2	0.05	0	0.00	18	0.44	41
Totals & Average	233	0.13	**460**	**0.23**	0	0.00	11	0.01	50	0.03	102	0.06	30	0.02	886	0.47	1928.75

Table 17. Number of predator and competitor observations per person-hour at SCLS release sites. The highest abundance for each predator and competitor are in bold. AMKE = American Kestrel, CORA = Common Raven, FECA = feral cat, ISFO = Island Fox, NOMO = Northern Mockingbird, RTHA = Red-tailed Hawk. * = possible predation at ≥ 1 nest in 2003. Other: Bald Eagle, Burrowing Owl, Merlin, Northern Harrier, Osprey, Peregrine Falcon, Sharp-shinned Hawk, White-tailed Kite, and European Starling.

Release Sites	AMKE TOTAL	AMKE /HR	CORA TOTAL	CORA /HR	FECA TOTAL	FECA /HR	ISFO TOTAL	ISFO /HR	NOMO TOTAL	NOMO /HR	RTHA TOTAL	RTHA /HR	OTHER TOTAL	OTHER /HR	ALL TOTAL	ALL /HR	TOTAL HOURS
Arizone Cages	2	0.27	6	0.80	0	0.00	0	0.00	**5**	**0.67**	0	0.00	0	0.00	**13**	**1.73**	7.5
Box 1*	10	0.20	**56**	**1.13**	0	0.00	0	0.00	0	0.00	**5**	**0.10**	0	0.00	71	1.43	49.75
Box 5	**26**	**0.47**	39	0.71	0	0.00	0	0.00	0	0.00	2	0.04	0	0.00	67	1.22	55
Middle Ranch 1*	11	0.31	9	0.26	0	0.00	0	0.00	0	0.00	2	0.06	0	0.00	22	0.63	35
Norton 1	19	0.37	29	0.57	0	0.00	0	0.00	3	0.06	1	0.02	1	0.02	53	1.03	51.25
Norton 5	4	0.08	17	0.35	0	0.00	0	0.00	2	0.04	0	0.00	0	0.00	23	0.47	49.25
Waynuk 1	9	0.34	18	0.69	0	0.00	0	0.00	4	0.15	1	0.04	**1**	**0.04**	33	1.26	26.25
Totals & Average	81	0.29	**174**	**0.64**	0	0.00	0	0.00	14	0.13	11	0.04	2	0.01	282	1.11	274

Feral cats were not observed while monitoring SCLS breeding and release sites in 2003; however, three cats were observed on road surveys. Island Foxes were observed at 35% of SCLS breeding sites, but were absent from release sites.

Predator abundance was not significantly different ($t_{26} = 0.27$, $P = 0.79$) at 2003 breeding sites where ≥ 1 nest may have been depredated (0.50 ± 0.34 predators per person-hour) than at sites where nests were not depredated (0.53 ± 0.31 predators per person-hour).

Potential predators were observed with similar frequency during the breeding (Jan – Aug) and non-breeding seasons (Sep – Nov) (Fig. 8). American Kestrels were the only predator that deviated from this pattern: they were observed approximately 3.5x more frequently during the non-breeding season.

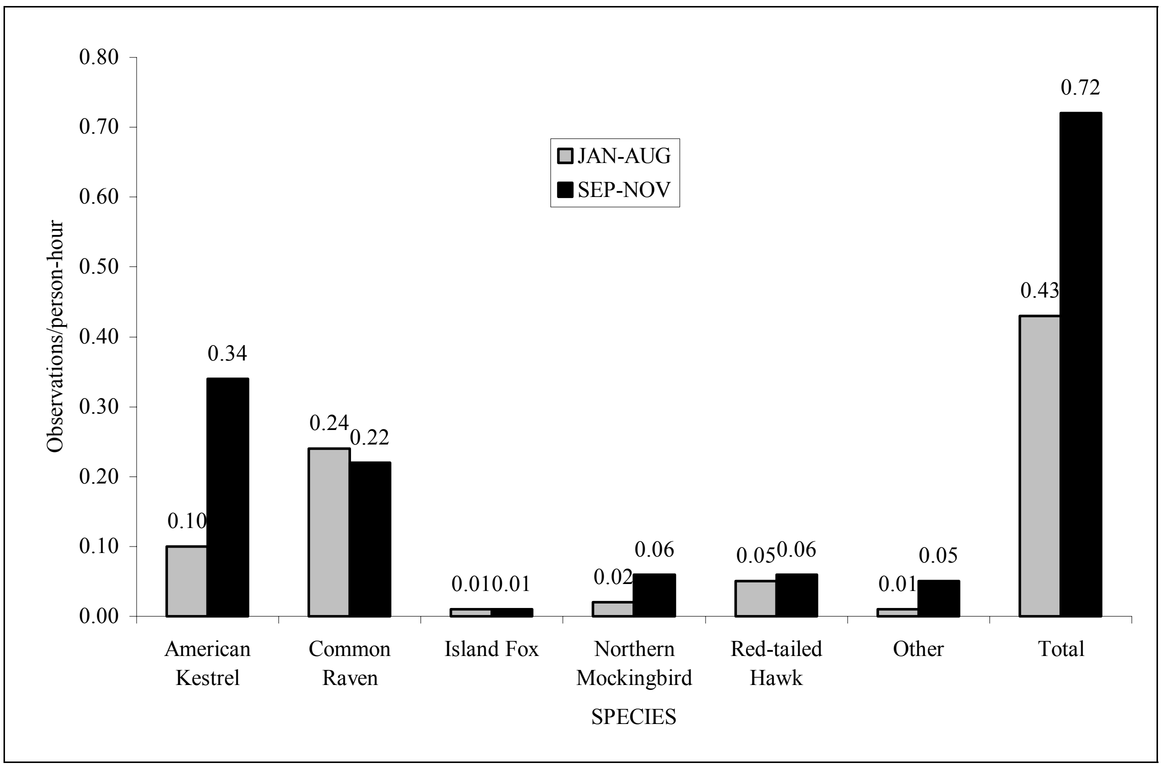

Figure 8. Seasonal variation in observations of potential predators/competitors at SCLS breeding territories by person hours spent at each site in 2003. Other includes: Barn Owl, Burrowing Owl, Merlin, Northern Harrier, Osprey, Peregrine Falcon, Sharp-shinned Hawk and White-tailed Kite.

In 2003, potential predators detected during our observations were most abundant at release sites followed by former sites and current SCLS breeding sites (Table 16, 17, and

Appendix G). Predator and competitor detections rates at SCLS breeding sites were approximately half that of detection rates at former and release sites (Table 17). The highest detection frequency for American Kestrels and Common Ravens were at former sites, whereas the highest detection frequency for Red-tailed Hawks was in Burns Canyon. At 14 sites, ≥ 1 predator or competitor was detected per person hour during ≥ 8 hrs of survey effort. Seven of these were former sites, three were canyons, three were release sites, and one was a breeding site (Burns 2). Among 2003 SCLS breeding sites, the highest detection frequency for American Kestrels and Red-tailed Hawks was at Burns 2.

Northern Mockingbirds and European Starlings were the only non-predatory SCLS competitors recorded in 2003. Northern Mockingbirds were observed at 12 breeding, 3 release, and 15 former sites, and were especially numerous at sites in SHOBA. At breeding sites, the highest rate of detection for Northern Mockingbirds was at Wilson Cove 1. One European Starling was reported from one former site.

All-island Surveys – Almost 500 predators and competitors were detected on the 2003 all-island SCLS surveys (Table 18). Approximately 150 predators and competitors were detected during the spring 2003 survey, whereas three times as many predators and competitors were detected during the fall 2003 survey. Common Ravens were the most frequently detected predator during spring, whereas American Kestrels were most numerous during fall. Observations of all three major predators and competitors on SCI, American Kestrel, Common Raven, and Red-tailed Hawk, were higher during fall than spring. Numbers of Northern Harriers were higher in spring than fall, whereas records of Peregrine Falcons were substantially higher during fall than spring. Numbers of mammalian predators were similar during both survey periods.

Table 18. Predator and competitor observations on 2003 all-island San Clemente Loggerhead Shrike surveys.

	Survey Period		
Species	Spring	Fall	Total
American Kestrel	45	121	166
Burrowing Owl	2	11	13
Common Raven	51	100	151
Feral cat	1	3	4
Island Fox	12	12	24
Merlin	1	2	3
Northern Harrier	3	1	4
Northern Mockingbird	8	31	39
Osprey		2	2
Peregrine Falcon	1	9	10
Red-tailed Hawk	27	51	78
Sharp-shinned Hawk	1	1	2
White-tailed Kite	1	1	2
Total	153	345	498

Interactions - During 2003, PRBO personnel observed 180 interactions among SCLS and nine species of potential predators or competitors and one interaction with a Navy helicopter (Table 19). The majority of interactions (41%) occurred between SCLS and American Kestrels. American Kestrels initiated 58% of the interactions with shrikes. Ten or more interactions were observed between SCLS and the following species: Northern Mockingbirds (22%), Common Ravens (14%), Red-tailed Hawks (11%), and Island Foxes (10%). Shrikes behaved most aggressively toward Northern Mockingbirds; in 90% of shrike-mockingbird interactions shrikes were the aggressors. Interactions between shrikes and Red-tailed Hawks and Common Ravens typically had no aggressor (Table 19). Males participated in 71% of all interactions involving adult SCLS (n = 204), females accounted for 16% (n = 46), and shrikes of unknown gender were involved in 13% of the interactions. Shrikes exhibited evasive behavior (flushed and flew away) from low flying military helicopters one time during 2003.

Table 19. Interactions among San Clemente Loggerhead Shrikes and potential predators and competitors.

			Aggressor		
Species	*n*	No aggression	Non-SCLS	Both species	SCLS
American Kestrel	74	7	43	4	20
Northern Mockingbird	39	2	2	.	35
Common Raven	25	15	4	.	6
Red-tailed Hawk	19	16	2	.	1
Island Fox	15	5	.	.	10
Peregrine Falcon	3	.	.	.	3
Sharp-shinned Hawk	3	3	.	.	.
Merlin	1	1	.	.	.
Osprey	1	1	.	.	.

Aggressive behaviors by SCLS involved pursing (chasing and attacking) and harassing (dive-bombing). Evasive behaviors involved fleeing from pursuit, dropping into cover, and flushing when approached. Shrikes also responded to predators and competitors by vocalizing (alarm calls and aggressive "kekking") (Table 20).

Table 20. Responses of SCLS to predators and competitors. AMKE = American Kestrel, CORA = Common Raven, MERL = Merlin, NOMO = Northern Mockingbird, OSPR = Osprey, PEFA = Peregrine Falcon, RTHA = Red-tailed Hawk, SSHA = Sharp-shinned Hawk.

Response	AMKE	CORA	MERL	NOMO	OSPR	PEFA	RTHA	SSHA	Fox
Aggressive									
pursued	20	4	.	34	.	.	1	.	2
harassed	9	4	.	.	.	.	.	.	7
Evasive									
flew to cover	16	11	1	1	.	.	6	3	.
fled	4	1	.	.	.	.	2	.	.
flushed	.	.	.	1	.	.	.	.	.
Moved	.	.	.	1	.	.	1	.	.
Vocalized	24	5	.	.	1	3	3	.	4
Watched	.	.	.	1	.	.	4	.	2
Unclassified	1	.	.	1	.	.	2	.	.

Seventeen percent (n = 30) of all interactions with predators and competitors occurred when young were present, either as nestlings or fledglings. Shrikes initiated 37% of the interactions during these stages (Table 21). Chasing was the most commonly noted interaction type, accounting for 31% of total interactions. SCLS were the aggressors in 78% of chases. Non-aggressive interactions, mostly of adult shrikes vocalizing, were evenly spread across the nesting stages and were noted in all phases of the nest cycle apart from post-failure when only four interactions were observed. Shrikes took cover from predators and competitors most often during the paired and solitary phases of the nest cycle (61% combined). When the nest was active (nest building to nestlings), interactions occurred on average 65.0 ± 36.3 meters from the nest. American Kestrels were the primary species with which shrikes interacted at most breeding stages, except during nest-building when Island Fox interactions were more common, and during the nestling phase when interactions were seen with Common Raven but interactions with American Kestrels were not observed (Fig. 9). During the dependent fledgling phase, interactions with Common Raven were most frequent and during the independent juvenile phase, interactions with Northern Mockingbird were most common. Interactions between predators and competitors and juvenile SCLS were observed 23 times, 48% occurring between Northern Mockingbirds and juvenile SCLS, with 100% initiated by SCLS. Juvenile SCLS took cover four times in 2003: three times from fly-over Common Ravens and once from an American Kestrel.

Table 21. Number and instigator of interactions between SCLS and predators or competitors by stages of the breeding cycle.

	Total No.	Number of Instigated Interactions (% of total)			
Breeding Stage	Interactions	Shrike	Other Species	Both	Neither
Solitary	48	27 (56%)	13 (27%)	0	8 (17%)
Pair	35	7 (20%)	16 (46%)	0	12 (34%)
Nest Building	22	8 (36%)	3 (14%)	0	11 (50%)
Incubating	14	5 (36%)	1 (7%)	4 (29%)	4 (29%)
Nestlings	11	2 (18%)	2 (18%)	0	7 (64%)
Fledglings	19	9 (47%)	7 (37%)	0	3 (16%)
Post Breeding	4	4 (100%)	0	0	0
Unknown	3	2 (67%)	1(33%)	0	0
<u>Fledglings</u>					
Dependent	8	0	3 (38%)	0	5 (63%)
Independent	16	11 (69%)	5 (31%)	0	0

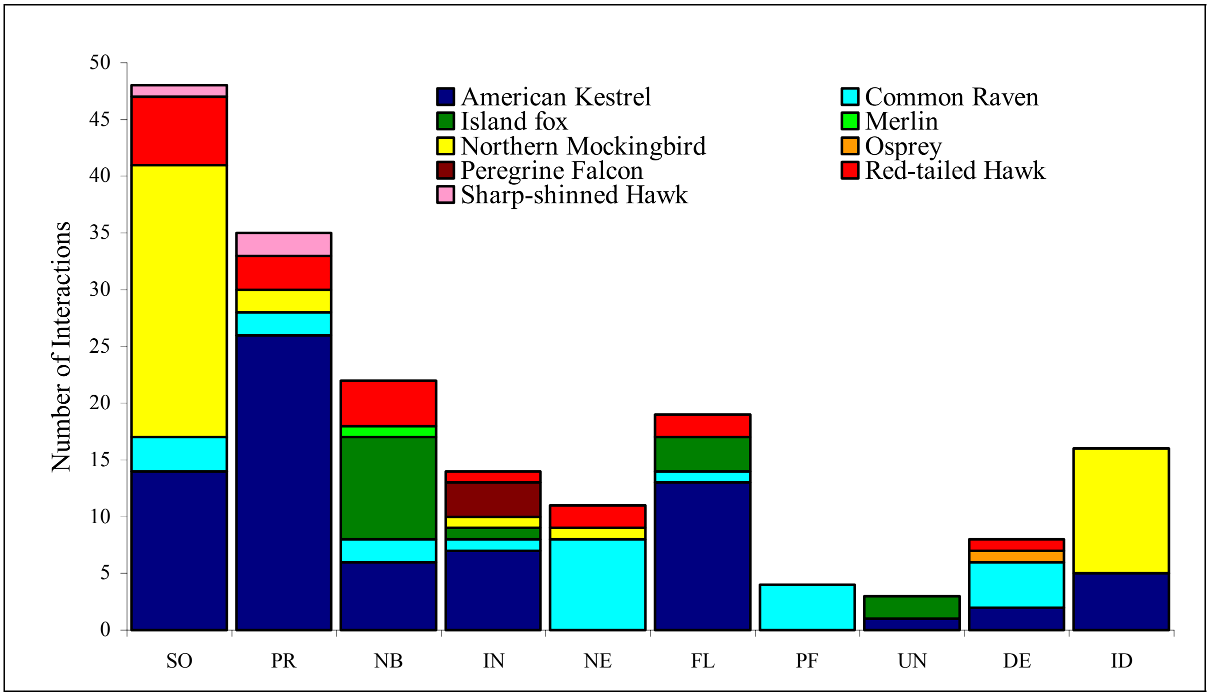

Figure 9. Number of predator and competitor interactions with SCLS during the different stages of the breeding cycle. SO = solitary, PR = pair, NB = nest building, IN = incubation, NE = nestlings, FL = fledglings, PF = post-failure, UN = unknown breeding stage, DE = dependent fledgling, ID = independent fledgling.

Other Interactions

Interactions between SCLS and ≥ 18 non-predatory bird species on SCI were observed 107 times in 2003 (Table 22). Shrikes were the aggressors 92% of the time. House Finches were the primary non-predatory species that interacted with shrikes, and were most frequently attacked or chased by SCLS. Aggression toward shrikes was seen from Barn Swallow, Anna's Hummingbird *Calypte anna*, Gambel's Quail *Callipepla gambelii*, Say's Phoebe, and an unidentified hummingbird species. Adult SCLS accounted for 99 interactions, 28% occurring during the paired or nest-building stages, and 21% occurring during egg-laying and nestlings. Nine percent (nine interactions) occurred following fledging, and solitary, post breeding, or unknown breeding stages accounted for 41% of the interactions. Adult males participated in 81% of interactions, females in 10%, and SCLS of unknown gender accounted for 9% of interactions.

Table 22. San Clemente Loggerhead Shrike interactions with non-predatory bird species.

	Aggressor		
Species	None	SCLS	Non-SCLS
Anna's Hummingbird			1
Barn Swallow			3
European Starling		5	
Gambel's Quail			1
Hermit Thrush *Catharus guttatus*		1	
House Finch		24	
House Sparrow *Passer domesticus*		1	
Hummingbird species		2	1
Mourning Dove *Zenaida macroura*		6	
Northern Flicker *Colaptes auratus*	1		
Orange-crowned Warbler		2	
Rock Pigeon *Columba livia*		2	
Rock Wren		9	
Say's Phoebe		10	2
Western Meadowlark		12	
Western Tanager *Piranga ludoviciana*		4	
Yellow-rumped Warbler		1	
Unid. passerine		19	
Total	1	98	8

Aggressive interactions were observed between SCLS 69 times, with 49 interactions involving at least one adult shrike. Interactions between adults and juveniles were observed 35 times, whereas encounters between adults were only observed 13 times. Antagonistic behavior within a pair was confirmed on one occasion at Norton 5, a site where supplemental food was offered. No interactions occurred prior to the breeding season. Territorial disputes between neighboring shrikes were observed twice and both altercations occurred at sites with supplemental food. Five interactions were noted between juveniles, all at the Waynuck 1 release.

Post-breeding Survivorship and Dispersal

Adult Post-breeding Dispersal: Wild SCLS – Six females (Boulders North 1, Boulders South 1, Cave 1, Cave 3, China 2, Thirst 1) were regularly observed on their breeding territories throughout the remainder of 2003. At all six sites, the males were seen using the same areas as the females, although not simultaneously. Three females (Burns 2, Horse 6, Stone Station 1) remained near their breeding territories, but had minimal contact with the territory-holding male. Two females (Burns 1, Norton 4) were absent from their breeding territories for extended periods, but returned and wintered on their breeding territory. Six females (Box 3, Box 4, Box 5b, China 9, Horse Beach 4, Lemon Tank 1) left their breeding territories between 17 May and 6 July, and established wintering territories an average of 3.6 km (range 0.4 – 12.9 km) from their breeding territories. Seven females (Box 2, Cave 2, Horse 1, Lemon Tank 2b, Red 4, Warren 1, and Lemon Tank 2a) disappeared from their breeding territories before 1 September and were not observed throughout the rest of the year, although birds with missing color bands were detected and may account for some of these females.

Fifteen males remained on their breeding territories following the breeding season. Of these, one (Boulders North 1) was sighted at a neighboring site (Boulders South 1); however, he was subsequently observed only at Boulders North 1. Four males (Box 4, Cave 2, Lemon Tank 2, and Warren 1) remained on site following the dispersal of the female but were not seen after 31 October. Three males (Cave 3, Horse Beach 4, and USFWS #1781-54968, one of the Wilson Cove males) disappeared from their breeding sites before their mates and were not detected again by the end of the year. One male (Burns 1) remained on his breeding site with the female and an independent juvenile until he was taken into captivity on 20 October.

Released Adults – Three females released in bonded pairs (Box 5, Middle Ranch 1, and Norton 5) disappeared by the end of October and were not seen again. The Box 1 female was seen dispersed from her breeding territory one time, then not detected again. Three males released in bonded pairs (Box 5, Middle Ranch 1, and Norton 1) disappeared from their breeding sites by the end of September and were not seen again in 2003. Only the Box 1 male, the Norton 1 female, and the Norton 5 male remained on their breeding territories through the rest of 2003.

Juvenile Dispersal – Including both 2003-released and wild SCLS, 47 of 76 independent juveniles were observed away from their natal and release sites at least once. Of these, 22 were observed multiple times in a similar area and we considered them settled on wintering ranges. As in 2002, dispersal distances to wintering sites were similar for released (3.6 ± 1.7 km) and wild (3.4 ± 2.9 km; t_{20} = 0.35, P = 0.73) shrikes. Also similar to 2002, juvenile females (n = 13) settled on winter territories 4.3 ± 2.7 km from natal/release sites, while males (n = 9) settled 3.5 ± 2.7 km from natal/release sites (t_{20} = 0.48, P = 0.73).

Wild Juveniles – Of the 90 wild nestlings fledged in 2003, 69 (77%) survived to independence. We detected the surviving juveniles on their natal territories an average of 58 ± 11 days after hatching (range = 42 – 109 days). As in 2002, the oldest juvenile to disperse (109 days old) was a Burns 1 juvenile who was observed eating regularly from the mealworm dispenser. Forty-two wild juveniles were resighted away from their natal territories, although we know of only 18 birds that established winter territories. Mean maximum distance that wild juveniles were re-sighted from their natal sites was 3.4 ± 2.9 km (range 0.2 – 11.6 km), and those that established winter territories settled an average of 4.1 ± 2.9 km (max = 10.8 km) from their natal territories.

Released Juveniles – Juveniles remained at their release sites 6.6 ± 7.8 days after release (range = 0 – 21 days; n = 7). Five juveniles were detected an average of 3.6 ± 1.7 km (range 1.7 – 6.4 km) away from their release sites. Of release juveniles that were relocated on wintering grounds (n = 4), the average dispersal distance was 3.5 ± 2.0 km.

Re-settlement and Pre-breeding Pairings – Several adults began exhibiting pairing behavior by the end of 2003. Due to the reduced field time in December, observations are biased towards supplementally fed pairs. Males at Box 3 (23 October), Norton 4 (29 November), Stone Station 1 (5 November), and Thirst 1 (18 November) were observed interacting non-aggressively (feeding, perching side-by-side) with the females with whom they bred in 2003. Also, potential pairs (both a male and female were present) were observed at Boulders North 1, Boulders South 1, Burns 2, Cave 1, China 1 (the 2003 China 2 pair) in October and November.

Nest Mirroring, Trapping, and Banding

Nest Mirroring – Eighteen nests were checked with mirrors prior to banding in 2003. Two nests (Cave 2 Nest A and Cave 3 Nest A) were inaccessible for banding, and one nest (Boulders South 1 Nest B) contained nestlings that were too old to disturb without causing them to fledge early, so the sites were not revisited for banding until nestlings had branched.

The remaining 15 nests contained eggs or nestlings that were too young to band (< 7 days). Four of these nests failed before we returned to band the nestlings. We observed each nest immediately after mirroring, and the adults returned to tend the nest after every intrusion.

Trapping – One SCLS that was missing color bands (the Burns 2 female) was recaptured in the wild in 2003 and confirmed as the Stone 1 female from 2002 (Appendix H-1). Attempts to catch five other shrikes missing color bands (Burns 1 female, China 9 female, Lemon Tank 1 female, Stone Station 1 female, and a shrike with service only on the right) were unsuccessful. We also unsuccessfully attempted to capture the Box 5 female to take into captivity, as she and her sibling (the Burns 1 male) were determined to be genetically important to the captive population. On 20 October, we captured the Burns 1 male (studbook #407) and transferred him to ZSSD personnel for inclusion in the captive population. Six other SCLS (Cave 3 female, China 9 male, Lemon Tank 1 male, Stone Station 1 male and female [before band-loss], and a Stone Station 1 juvenile) were trapped incidentally while trying to trap other shrikes with missing color bands.

Trapping Unbanded Shrikes – Two adult shrikes were captured and banded in March 2003 (Appendix H-2). Both of these shrikes appeared to have off-island origin according to their plumage characteristics (light back, gray chest and rump), and in genetic analysis, were determined to carry the "C" haplotype, which has not been found in breeding SCLS (Eggert *et al.* 2004, Grant 2004). Two juvenile shrikes were captured and banded in October 2003 (Appendix H-2). USFWS # 1801-22175, a male, carried the "A" haplotype, the most common haplotype for shrikes that breed on SCI (Eggert *et al.* 2004) and its plumage characteristics were consistent with the *L. l. mearnsi* population. Plumage characteristics of USFWS # 1801-22176 correspond to off-island populations and this male was discovered to carry the "C" haplotype (T. Grant, pers. comm.). We were unable to capture the unbanded males that bred at Cave 3 and Thirst 1. We unsuccessfully attempted to trap other unbanded shrikes at REWS Road, Chanchalagua Canyon, China Point, Pyramid Cove Road, VC3, and the juvenile at Burns 1.

Banding -- Wild SCLS - In 2003, we captured and banded 98 wild, hatching-year SCLS at their natal territories (Appendix H-2). Between 7 April and 23 June, 81 nestlings and 5 branchlings were banded. Although one nestling at Thirst 1 was noticeably smaller than the rest of the clutch, approximately five days behind in development, we banded it and left it in the nest with its siblings because it was not required to enhance the genetic diversity of the captive population. This nestling survived to independence and was seen regularly dispersed from its natal territory. Six nests were either inaccessible (Burns 1A, Cave 2, Cave 3) or the timing of our visits precluded banding young while still in the nest (Boulders South 1B, Burns 1B, China 2C). We attempted to capture and band the young after they had fledged but while their mobility was limited. We were able to capture and band all the fledglings at China 2C (3), and all but one fledgling at Burns 1A (1), Burns 1B (1), Cave 2 (3), and Cave 3 (4). The fledgling captured at Burns 1B had a wing injury and, because of its potential to contribute genetically to the captive population, was taken to the ZSSD and added to the captive flock. Two fledglings from Boulders South 1, and a single fledgling from Burns 1B, Cave 2, and Cave 3 dispersed before we were able to capture and band them. Two other unbanded fledglings (Boulders South 1 and Burns 1A) disappeared before reaching independence. Altogether, 11 fledglings between 17 and 22 days old (19.8 ± 2.0 days) were captured and banded post-fledging.

Banding -- Captive SCLS - Thirteen captive hatching-year SCLS were banded at the avian captive propagation facility on SCI (Appendix H-2). All individuals were banded with USFWS bands and full color band combinations. We added color band combinations to 12 adult captive SLCS that already had USFWS bands, in preparation for their release (Appendix H-1). We subsequently removed some or all of these bands from two shrikes (SB#373 and SB#208) because the shrikes injured their legs while picking at the bands. Studbook #208, did not tolerate bands on either leg in 2002 or 2003, and remained unbanded throughout 2003.

Band Loss - In 2003, 27 color bands were missing from 16 SCLS in the wild (Appendix H-3). Eight birds lost bands during the year, while the others were first identified in 2003 with bands already missing or were known to be missing bands from the previous year's observations. Nine birds removed wrap-around (over-lapping) Darvic bands and seven removed split-ring Darvic bands.

Other Banding Notes – At Box 2 Nest B, a single nestling was banded at estimated 10 days old. Upon review of the nest video, we amended the nestling's age to 12 days at banding, within our target range of banding ages. The nestling was returned to the nest, and the site was observed until adults were seen returning to the nest. On the follow-up visit the next day, we observed the adults tending the juvenile on the ground underneath some vegetation. We attempted to return the juvenile to its nest, but it jumped from the nest after every attempt. Upon consultation with NRO and the SWG, it was determined that this juvenile's genes were not crucial to the captive population, and thus the juvenile was left at the site with its parents attending. For additional details, see Appendix E.

DISCUSSION

Population Growth and Demography

Apparently as a result of low over-winter survivorship, the SCLS population decreased in 2003, although it remained above pre-2002 levels (Fig. 10). Productivity in 2003, as measured by the number of young fledged per pair, was the highest yet recorded (Fig. 7). This should serve as a reminder that, although recent increases in population size encourage optimism about future trends, the population still remains low with a high risk of extinction.

Similar to previous years, the 2003 wild adult shrike population in January was biased toward females (24:31, Appendix D), which facilitated the replacement of a missing female within 2 days of her disappearance from Lemon Tank 2. Interestingly, even though there was a surplus of females in the population, two males paired with each other and attempted to breed (Wilson Cove 1). Same-sex pairs have been documented by gender analysis using genetic material from feathers and positive band identification in 2000, 2001, and 2003 (Blackford *et al*. 2001, Plissner *et al*. 2002, this report), and presumed by behavior in 1996-1997 (both members of the pair were observed mounting the other individual; B. Rodrigues, pers. comm.). Homosexual copulation has been documented in wild bird populations (Lombardo *et al.* 1994, Birkhead *et al.* 1985), and same-sex pairings have been documented in captive populations (Nesterenko and Antonenkova 2000, Lumsden 1999), but there is little documentation of wild birds forming long-term same-sex pairs.

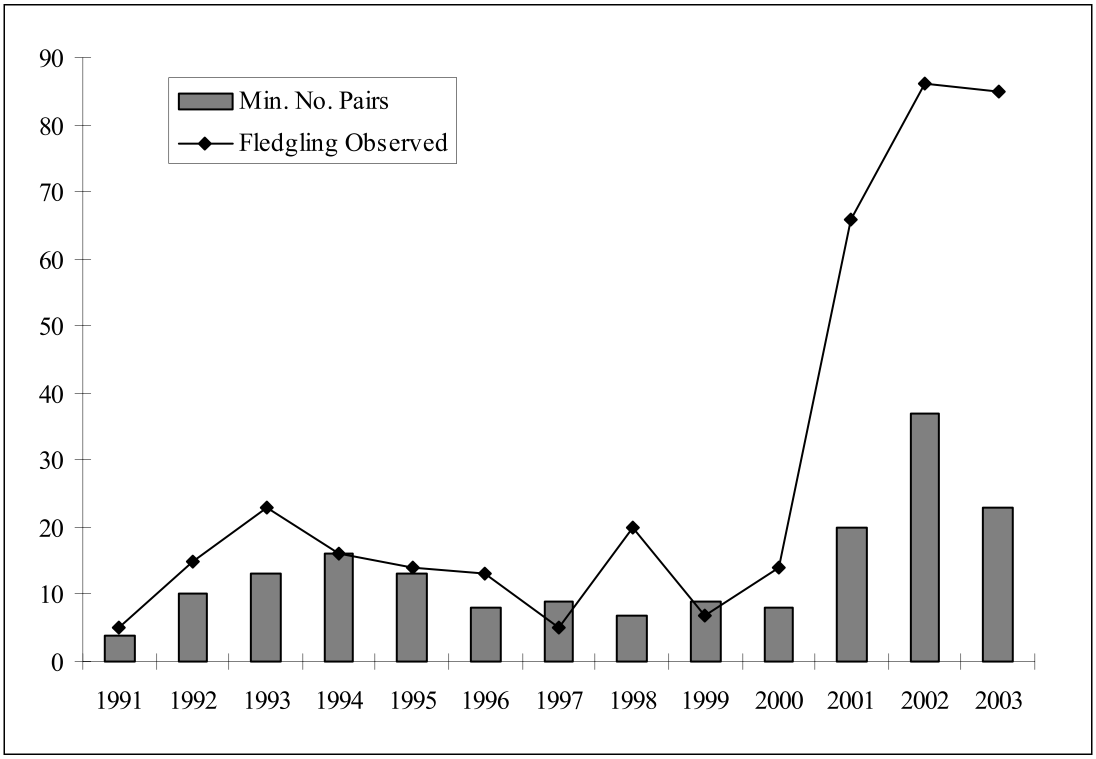

Figure 10. Recent population estimates and productivity of wild, adult San Clemente Loggerhead Shrikes. 2000-2003 numbers include all over-wintering SCLS in the population, including pairs with captive-reared single release adults from the current year. Data sources: Juola *et al.* 1997a,b,c, Mader and Warnock 1999, Mader *et al.* 2000, Blackford *et al.* 2001, Plissner *et al.* 2002, Blackford *et al.* 2003, and this report).

Nest success for wild SCLS continued to drop, from 61% in 2001, to 57% in 2002, to 51% in 2003 (Table 13; Fig.10), although 2003 nest success still exceeds the 13-year mean for the population (46% from 1991-2003; Juola *et al.* 1997c, Mader and Warnock 1999, Mader *et al.* 2000, Blackford *et al.* 2001, Plissner *et al.* 2002, Blackford *et al.* 2003, and this report), and approaches the mean nest success (56.1%) reported from studies of Loggerhead Shrikes throughout North America (Esely and Bollinger 2001). Although the number of SCLS fledglings produced per nest in 2003 (1.8) was less than the mean number of shrike fledglings produced per nest (2.8) reported from other North American studies (Esely and Bollinger 2001), the number of SCLS fledglings per pair (3.5) exceeded all prior nesting efforts for this population (Table 13). Successful nesting in 2003 may be attributed to several factors, including age and individual experience, predator control measures reducing the effects of predator pressure, supplemental feeding, and an abundant prey-base.

Reproductive success of passerines has been shown to increase with age and experience in a variety of species (see chapters in Clutton-Brock 1988). In our population over the past six years, this manifested as increased reproductive success and productivity of older males and older pairs. In her analysis of the wild and captive shrike population demographics, Grant and Lynch (2004) confirmed that fifth and sixth-year wild shrikes were the most fecund age classes, although they were poorly represented in the wild population. Shrikes on SCI were equally likely to breed successfully, and had similar productivity, regardless of whether or not they were given supplemental food or whether they were hatched in the wild or in captivity. This paradigm suggests that reintroduction is a viable means of augmenting the wild population, as long as reintroduced shrikes survive over the winter and recruit into the breeding population. Survival into their second breeding season also seems to be important.

Mayfield estimates of total nest survival have remained high for the past four years 2003 (Table 23). The proportion of nests that failed during incubation surged back to 50%, after having dropped to 35% in 2002 from 43% in 2001, but remained low compared to earlier years (67% in 1999 and 71% in 2000).

Table 23. Mayfield estimates daily and total nest survival from 1998 – 2003.

	1998	1999	2000	2001	2002	2003
Daily nest survival for all Nest Stages	0.98 ± 0.01	0.96 ± 0.01	0.98 ± 0.01	0.99[1]	0.99 [1]	0.98[1]
Total nest survival		0.17 ± 0.01	0.44 ± 0.01	0.64 ± 0.08	0.56 [1]	0.52[1]

[1]SE < 0.01.

Specific causes of nest failure remained elusive in most cases in 2003, although predators, either through the destruction of the nest or through death or injury of adults, probably accounted for a minimum of 59% (max = 85%) of all nest losses during the breeding season. Predation has been reported to be the primary cause of shrike mortality in all stages of the life cycle (Porter *et al.* 1975, Siegel 1980, Scott 1987, Scott and Morrison 1990, Poole 1992, Yosef 1996, Pruitt 2000, Yosef 2001). Feather remains of one breeding adult were found under a nest on her breeding territory (Appendix I). Evidence suggests a rat was either the predator or scavenger of the nest and the adult. In 2003, most evidence of predation found at the nest suggested mammalian predators (rodents, cats, and foxes). On SCI, mammalian predators, such as Island Foxes and feral cats, are known to prey on nesting SCLS (Juola *et al.* 1997b). Rats and mice also likely play a larger role in nest failure and disappearance of shrikes than is presently known, as current knowledge of rodent demography on SCI is deficient. In 2003, as in 2002, the most frequently suspected predators at depredated nests were rodents. Common Ravens have been implicated in nest failures in past years (Scott and Morrison 1990), and in 2003, were seen in or near nest trees at least three times during estimated times of shrike nest failure.

Rainfall has been shown to affect avian productivity in California (DeSante and Geupel 1987). Wet years on SCI (e.g. 1993, 1998, 2001, and 2003) tend to be good SCLS breeding years (T. Scott pers. comm., Mader and Warnock 1999, Plissner *et al*. 2002, and this report). However, annual rainfall totals on SCI (1997-2003; Cal. State Northridge, Dept. of Geography, unpubl. data) were only weakly correlated with productivity measurements on SCI (Fig. 7). This weak correlation may be attributed to the proportion of wild shrikes that were supplied with supplemental food throughout the year. Ignoring all other confounding factors (origin of shrike, presence of predators, habitat factors, etc.), shrikes that were given supplemental food tended to fledge more young than shrikes that were not given supplemental food. Supplementally fed shrikes also tended to raise more young to independence than did shrikes that did not take supplemental food. Therefore, supplemental food may increase shrike breeding productivity by compensating for years when low rainfall reduces the amount of available wild prey.

The timing of rainfall and stormy, cold weather is undoubtedly important to productivity of shrikes on the island. Porter *et al.* (1975) found that inclement weather was a major factor influencing the loss of clutches or broods via nest damage or by reducing food supplies for Loggerhead Shrikes in short grass prairies. In other species of shrikes, such as the Red-backed Shrike (*Lanius collurio*) in Sweden (Olsson 1995) and the Bull-headed Shrike (*L. bucephalus*) of Japan (Takagi 2001), rainfall and cold temperatures during the breeding season resulted in reduced productivity (see also LeFranc 1997). Two SCLS nest failures in 2003 were attributed to abandonment due to poor weather.

Human factors were directly responsible for the death of at least two wild juvenile shrikes during 2003. These juveniles were found dead on SCI Ridge Road at Lemon Tank, having been struck by a moving vehicle (see Appendix I). Collisions with vehicles have been identified as a significant source of mortality for Loggerhead Shrikes in several locations (Flickinger 1995, Pruitt 2000), especially for newly flying young birds (Novak 1989 cited in Pruitt 2000).

One other juvenile likely died as an indirect result of human disturbance. A juvenile (Box 2) refused to remain in its nest after banding, although it was too young to have fledged naturally (estimated 12 days old). We discovered the prematurely fledged juvenile on the canyon floor, being tended by the adults the day after banding. The juvenile was easily captured; however, logistical constraints and a placement of low genetic priority on this individual precluded its acceptance at the captive rearing facility. Attempts to return it to the nest failed, and it was left in the canyon bottom underneath cover where it survived at least two nights out of the nest. One other juvenile in 2003 (Box 5) was reluctant to return to the nest after banding, but was convinced by covering it with a hat until it quieted down. In both 2001 and 2002, similarly aged juveniles at Box 2 (same sire) were reluctant to return to their nests after banding (Plissner *et al.* 2002, Blackford *et al.* 2003). One juvenile died after jumping from a high nest. Biologists were able to entice the remaining juveniles to remain in nests in past years by covering them with a cloth until they quieted down (once in an artificial nest lower in the tree). In other bird populations, early fledging has been documented in response to the approach of nest predators, including humans (Hamilton and Orians 1965). Yosef and Pinshow (1988) documented the translocation of nestlings Northern Shrikes (*L. excubitor*) from a nest to a nearby sheltered location by the parents shortly after the nestlings were banded. Until 1999, SCLS monitors did not attempt to band hatching-year shrikes until after they had left the nest. These capture efforts caused disturbance at the site, had the potential to injure juveniles and biologists while chasing birds, and fledglings were frequently not captured. Therefore, monitors recommended banding nestlings between 8 – 12 days old in 1998 (Mader and Warnock 1999), as is commonly practiced in other bird populations (Collister and DeSmet 1997). Since 1998, 44 of 251 banded nestlings (17.5%) have disappeared from the nest before fledging age (Table 24). Eight of 71 nests failed after nestlings were banded (11%). Twenty-three of 71 nests lost at least one nestling before fledging (32%). To avoid causing nest failure during banding, in 2004 we will establish a detailed protocol for banding young shrikes.

Table 24. San Clemente Loggerhead Shrike nestlings that were banded and did not fledge, by year.

Year	Total Nestlings/ clutches banded	Banded nestlings that did not fledge	Nests with missing nestlings post-banding	Complete clutches lost	Days post-banding that failed nests were detected (site)
1999	1/1	0	0	0	-
2000	13/4	1	1	0	-
2001	78/24	12	8	3	6[1] (TH1), 6 (NT6), 6 (CH8)
2002	78/20	15	8	3	9 (CH10), 5 (NT5), 5 (VI1)
2003	81/22	16	6	2	2 (BX2), 1 (HB4)

[1]First visit post-banding.

Breeding Phenology

As in previous years, pair bonds for 2003 began to form late in 2002 (Table 25). One of the two pairs that formed prior to 1 January 2003 received supplemental food. Low prey abundance going into 2003 and the movement of many individuals to new breeding territories may have delayed the onset of breeding for many pairs. The first observed nest-building date in 2003 (2/16) was the median for the past 12 years.

Table 25. Summary of SCLS nesting date data 1992 - 2003. Earliest and latest dates (not averages) for pairing, nest-building, and egg-laying are given. Last nest-building calculated from initiation of nest. Egg-laying is extrapolated from behavior. Sources: Scott and Morrison 1990, Juola *et al.* 1997a, b, c, Mader and Warnock 1999, Mader *et al*. 2000, Blackford *et al.* 2001, Plissner *et al*. 2002, Blackford *et al.* 2003, and this report).

Year	Earliest Pairing	Earliest Observed Nest Building	Last Nest Building	Earliest Egg Laying	Last Egg Laying
1992	1/30/92	2/9	6/1	3/18	5/24
1993	1/19/93	2/6	5/27	3/12	5/28
1994	1/1/94	3/13	5/18	3/6	4/12
1995	1/14/95	2/30	6/10	3/3	6/11
1996	12/23/95	1/21	4/26	3/1	5/1
1997	12/17/96	1/27	5/11	3/1	5/20
1998	12/31/97	2/25	5/10	3/8	5/20
1999	1/1/99	2/2	5/31	3/18	6/2
2000	2/12/00	3/12	6/12	4/4	6/4
2001	11/29/00	3/8	6/11	3/22	6/12
2002	11/13/01	2/3	6/9	3/2	5/22
2003	11/24/02	2/16	6/11	3/3	6/15

Breeding Sites and Home Range Estimates

Shrikes continued to expand their breeding range on SCI by colonizing a new area at the north end of the island in 2003. Three other new territories were established in locations with no former breeding or release record. A single female was observed using the area around the confluence of the east and main branches of Cave canyon, an area she used in 2002. However, we have no evidence that she bred there either year.

In 2003, the Lemon Tank 2 pair nested successfully in coyotebrush on the upper plateau of the island, following last year's first successful breeding attempt in this area. While the use of this area and habitat has broad implications for estimates of SCLS carrying capacity and habitat restoration efforts (cf. Pulliam and Danielson 1991), the vehicular-related mortality of the juveniles that fledged in this area in 2003 compromises shrike habitat quality near roads. This hazard is likely to increase with the planned paving of the currently dirt-surfaced SCI Ridge Road (estimated completion in 5 - 10 years, K. Brock, pers. comm.). The U. S. Navy is currently in consultation with the U. S. Fish and Wildlife Service to minimize the hazard of bird collision with vehicles.

We found that over the past six years, successful shrike nests were placed higher in trees than failed nests, similar to Esely and Bollinger's findings (2001), but unlike Esely and Bollinger's data, successful SCLS nests were further from the trunk than failed nests. We did not find habitat differences between successful and failed nests when analyzing data within years.

The 2003 mean breeding home range size (approximately 14 ha) was greater than the combined mean (1998 – 2003), although within the range reported for other populations of Loggerhead Shrikes. Based on results from 18 studies, Dechant *et al.* (2001) reported typical shrike home range sizes of 6 - 9 ha, ranging from 2.7 ha in Alberta (Collister 1994) to 25.0 ha in Idaho (Yosef 1996). The largest home range size for SCLS in 2003 was the China 2 pair, which moved to and nested in a new breeding site (China 1) after their second nest failed. Home range estimates for wild shrikes in 2003 tended to be smaller than home range sizes reported in previous years on the same territories. As in previous years, released shrike home ranges were larger in years following release than during the year they were released.

Examination of data from 1998 – 2003 suggests that shrike home range size appeared to be weakly inversely correlated with SCLS nesting success and with prey abundance. Yosef and Grubb (1992) found that as territory size increased, the benefit-to-cost ratio of defending a territory declined, as did the shrike's nutritional condition (indexed by rate of feather regeneration). As discussed previously, supplemental feeding of shrikes at a large proportion of sites may increase their breeding productivity, thereby diluting the natural effect of low prey abundance in the wild.

While our home range estimates are useful for comparative purposes, they are biased and only provide an accurate measure of SCLS habitat use for the areas where we were able to observe them. Given the ruggedness of the terrain and the tendency of observers to use established observation points, the search effort of monitors was highly concentrated around nesting sites. Supplemental perches may bias estimates of home range size by increasing the visibility of the birds on supplemental perches relative to natural perches. Supplemental feeding also biased home range estimates because during feeding, a bird's activities were focused on the food tub. Also, supplementally fed individuals often modified their behavior in the presence of observers. Unfed shrikes tended to be secretive and less visible when observers were close to their territories, whereas supplementally fed birds often approached observers and remained nearby while observers monitored the site. Other factors that may influence home range estimates for SCLS include yearly and seasonal variation in time spent monitoring sites, variation in time that pairs and individuals occupied sites during the year, shifts in territories through the breeding season (e.g., the China 2 pair moved to the China 1 area mid-way through the breeding season), breeding success of pairs, and the choice of which data to include in the analysis. In future studies where accurate home ranges are required, radio-telemetry techniques will supply the least biased estimates.

Reintroduction Efforts and Release SCLS

In 2000, four SCLS released in 1999 attempted to breed (one successfully), becoming the first release birds to survive and recruit into the wild breeding population (Blackford *et al.* 2001). In 2003, release shrikes and their offspring represented 58% of the breeding population. Undoubtedly, the release of captive-reared shrikes has contributed to the growth of the SCLS population in the wild. The ultimate assessment of the success of release efforts on SCI is based on recruitment into the breeding population following the year of release. Survivorship of shrikes that were reared in captivity then released into the wild mirrored that of the wild population. However, survivorship of shrikes released in 2002 was poor compared to previous years (Table 26). No adults that were released in 2002 survived and recruited into the 2003 breeding population. This follows the trend set in previous years and suggests that juvenile shrike releases may be more efficient and successful than adult releases. Conversely, current year release efforts were relatively successful. Most of the adults that were released in 2003 remained on site and attempted to breed, and 45% bred successfully.

Table 26. Recruitment of released shrikes into the SCLS breeding population, by age and year. Adult and juvenile numbers are the percent of this age class released the previous year that attempted to breed the year following release.

Breeding Year	Adults	Juveniles	Source
2000	11% (1 of 9)	17% (4 of 24)	Brubaker *et al.* 2000 Blackford *et al*. 2001
2001	29% (6 of 21)	39% (9 of 23)	Turner *et al*. 2001 Plissner *et al*. 2002
2002	13% (2 of 16)	53% (19 of 36)	Turner *et al*. 2002 Blackford *et al.* 2003
2003	0% (0 of 5)	12.5% (3 of 24)	Turner *et al.* in 2003. Appendix D, this report

Supplemental Feeding of SCLS

PRBO continued to provide supplemental food to shrikes whose current or previous mates had previously accepted food from the tubs. Many studies have demonstrated a positive effect of supplemental feeding on productivity of breeding birds and increased survivorship of young in both endangered and non-threatened populations (Amakihi *Hemignathus virens*, Van Riper 1984; Song Sparrows *Melospiza melodia*, Arcese and Smith 1988; Black Robins *Petraica traversi*, Butler and Merton 1992, Magpies *Pica pica*, Hogstedt 1981, Stone and Trost 1991; Carrions Crows *Corvus corone*, Yom-Tov 1974, Richner 1992; European Starlings, Crossner 1977; Jackdaws *C. monedula*, Soler and Soler 1996; and Pink Pigeons *Columba mayeri,* Swinnerton *et al.* 2000). In 2003, we failed to find that breeding success was significantly effected by whether or not a pair received supplemental food.

However, pairs that received supplemental food tended to fledge more young and raise more young to independence. Unlike the past three years, supplemental feeding did not increase the age at which juveniles left their natal territories. Shrike prey was relatively abundant in 2003, which may have reduced intraspecific competition between adults and their offspring, allowing the juveniles to remain on site for a longer duration. Juveniles may benefit from an extended dependent stage, enabling them to remain in a familiar area while they continue to develop foraging and predator avoidance skills. In general, supplemental feeding appears to benefit SCLS by enhancing short-term survival, production of fledglings, and rearing of young. As the population of SCLS increases above a critically endangered level, the supplemental feeding protocol warrants further examination of potential costs and benefits. Currently, analysis of these costs and benefits is confounded by other management actions, such as captive-release of SCLS (IWS unpubl. data).

Predators and Competitors

We had no evidence that predators were more common where we suspect shrike nests were depredated. In fact, predators and competitors were half as common at breeding sites than they were at release sites and former sites. Unfortunately, our measure of predator abundance neglects small, inconspicuous nest predators such as rodents. Of the nine nests for which we found evidence of the responsible predators, five were attributed to rodent depredation.

The dearth of predator and competitor detections at breeding sites suggests that wild shrikes may select breeding sites at least partially based on predator and competitor abundance. Such a hypothesis argues for more rigorous evaluation of predator and competitor abundance at potential release sites. Alternatively, such a discrepancy in predator and competitor abundance between breeding sites and former sites may be an artifact of observer concentration. When observers were at shrike breeding sites, they tended to concentrate on shrike activity and may not have noticed predator activity away from the immediate vicinity of the shrike(s). At former sites, observers tended to scan the entire area more often because there was no focal shrike activity to concentrate attention. At release sites, predator and competitor activity may have been more frequently noted because naïve shrikes tended to react to their presence more conspicuously than wild shrikes that have become habituated to predators and competitors in the area. Predator and competitor activity was frequently elevated the day shrikes were released, when shrikes explored their new territories and disrupted resident predators' and competitors' normal activity. A third explanation for the discrepancy in predator and competitor detections at breeding and former sites may be a result of intensive predator control in the past at breeding sites. Predator control activities in 2003 were limited to rat and cat removal (Kershner *et al*. 2004), but have included removal, hazing, and nest destruction of American Kestrels, Common Ravens, and Red-tailed Hawks in previous years (Cooper *et al.* 2001, 2003a, b).

Post-breeding Survivorship and Dispersal

At least 68 SCLS survived until October 2003 (Fig. 1), 51% of the maximum population. Survivorship of shrikes until October was high compared to year-long survivorship of shrikes in recent years (Table 27). Released juveniles continued to survive as well or better than wild juveniles. Enhanced survival of release juveniles may be associated with increased detectability resulting from acclimation to human presence or the nonrandom distribution of release sites on the island, but it is also suggestive of the potential success of juvenile release techniques in supplementing the wild population.

Table 27. Percent survivorship of wild San Clemente Loggerhead Shrikes through the breeding season, by year (# alive at end of year/maximum alive in current year).

	Wild		Released		
Year	Adult	Second-year	Adult	Hatching-year	Source
1999	50	100	17	25	Mader *et al.* 2000
2000	67	21	35	39	Blackford *et al.* 2001
2001	53	13	25	20	Plissner *et al.* 2002
2002	44	31	0	10	Blackford *et al.* 2003
2003[1]	77	70	36	57	This report

[1]Survivorship through October.

Once again, females were more likely than males to move to new breeding territories in 2003. Females tended to move farther than males when dispersing between breeding sites. Typically, male SCLS are more sedentary than females, often remaining on the breeding territory throughout the year. Females often disperse from breeding sites shortly after the end of nesting activity, occasionally disappearing for the winter and reappearing the next breeding season. Shorter dispersal distances and greater philopatry to previous nest sites by males have been reported for migratory populations of Loggerhead Shrikes (Collister and de Smet 1997) and Red-backed Shrikes (Šimek 2001). Short-term dispersal of shrikes from their breeding sites was less evident this year than in the past. However, this is probably an artifact of reduced observer effort and the inability to visit sites frequently during the fall and winter to detect when sites were vacant.

Unlike previous years, and atypical for other passerine species (Greenwood and Harvey 1982), juveniles and adults dispersed similar distances from their nest sites to their wintering sites. It is currently unclear whether dispersal distances and patterns influence survivorship or reproductive success of individuals, either in terms of habitat selection mechanisms or by influencing factors such as inbreeding probabilities. Some shrikes avoided detection by monitors throughout the winter and reappeared on SCI at the onset of the subsequent breeding season. Whether or not such individuals remain on SCI or migrate off the island in the fall has never been determined, although the recovery of one release juvenile on Santa Catalina Island suggests that birds may sometimes leave the island. To better understand the significance of survivorship and dispersal for demographic trends of the population, it will be necessary to measure these parameters past the end of the calendar year until birds settle on breeding territories.

MANAGEMENT SUGGESTONS

1) Monitoring of all breeding San Clemente Loggerhead Shrikes should be continued, as data collected by the monitoring team are used extensively by the Shrike Working Group, the U.S. Fish and Wildlife Service, and the U. S. Navy to aid in management decisions associated with population recovery efforts and to determine the results of such efforts. Monitoring of breeding phenology, reproductive success, home range, and dispersal allows for comparisons with past years to ascertain long-term population patterns and to monitor changes that may be associated with population recovery. Consideration of a shift in

methodology towards sampling protocols rather than monitoring of the entire population should be developed for implementation after the population begins to stabilize.

2) Color-banding of San Clemente Loggerhead Shrikes should be continued, as the identification of individuals is critical to monitoring individual shrikes in the wild. We recommend the continued use of UV-resistant, heat-sealed, wraparound Darvic color bands tested during 2001 to increase detection and retention of bands. Consideration should be given to any novel solutions to the continued problem of band removal by shrikes.

3) We should increase our caution when banding older nestlings, particularly at Box 2, to avoid forcing the nestlings to fledge early in response to our disturbance. The Box 2 nestlings will be banded at 10-days-old or younger, and biologists will remain on-site after banding until they are confident that all nestlings have stayed in the nest and are being tended by the adults.

4) Visiting nests to mirror contents shortly after eggs are believed to have hatched should be continued. This provides a more complete measure of clutch size, more accurate estimates of hatch dates, and appropriate dates for banding nestlings. Such visits also enable monitors to determine accessibility of nests prior to banding, thereby increasing preparedness and reducing time spent at sites during banding.

5) During the mirroring of nests, photographs should be taken of nestlings so that a photo database can be created to help accurately assess the age of nestlings. Currently, only photographs of nestlings at banding age are maintained. A more complete library of photos would assist future monitors in the proper aging of nestlings, thereby improving the timing at which a nest is approached for banding.

6) Further efforts are needed to reduce SCLS mortality associated with human activities, particularly impacts with moving vehicles. The planned paving of SCI Ridge Road has the potential to increase overall traffic speed through shrike nesting habitat, decreasing the ability of a driver to respond to wildlife in the road. Methods of decreasing vehicular speed

should be explored, including movable speed bumps and barriers, warning signs, and more diligent traffic control by SCI Security. Also, because captive-reared shrikes in the wild have demonstrated a proclivity toward human-made structures and lack the wild characteristic of avoiding human activity, measures are needed to protect shrikes from harm around buildings, hazardous waste storage and dumping areas, and other areas of human activity. Hazardous waste, such as fiberglass, should be removed from shrike nesting areas and disposed of properly. Island personnel should be educated about potential hazards to shrikes (*e.g.*, glue traps set for rodents, open containers of water) that can be minimized.

7) Habitat restoration efforts should be continued to improve nesting habitat, provide protective cover, and mitigate the deterioration of habitat quality caused by anthropogenic disturbances such as military activities, overgrazing by feral goats, and consequent invasion of exotic species (USDoN, SWDIV 2001). In addition, further research is warranted for breeding and non-breeding habitat use by SCLS to determine the value of particular habitat types and vegetation components for nesting, cover, foraging, and caching. Availability of nesting sites has been identified as an important variable in habitat selection by breeding shrikes (Michaels and Cully 1998). Having suitable nesting habitat and foraging areas in canyons away from SHOBA will undoubtedly aid in efforts to establish SCLS breeding territories outside the bombardment range. On SCI, nesting sites have been mostly limited to canyon bottoms, and nesting trees are isolated from other substantial vegetation that provides safety and cover. DeGeus (1990) recommended increasing cover in linear habitats or adding larger blocks of habitat adjacent to nesting sites to make nests less susceptible to predation. We also recommend removing stands of tall thick grasses by means of fire, or some other method, to enhance SCLS foraging and nesting area, as we have recently seen shrikes nesting in native shrubs on the plateaus. The installation of supplemental perches in breeding territories also should be continued, as SCLS are known to forage from them regularly.

8) Supplemental feeding of wild SCLS should continue in 2004; however, further study is needed to determine the short and long term effects of such procedures and to develop protocols for weaning individuals from provisioning, if necessary.

9) We recommend continued investigation into prey abundance and availability. Years of low prey abundance could thereby be identified, with consequent adjustments to supplemental feeding. By increasing the provisions of supplemental food in years of low prey abundance we could increase breeding productivity and prevent large dips in the population.

10) We strongly encourage additional research on nest predation and mortality of adults and juveniles. Current predator control measures have been broadly distributed among potential predators; however, we lack quantitative data on the relative threat of various species to SCLS. We recommend camera surveillance of SCLS nests to identify primary predators and effectiveness of nest protection measures. We suggest radio telemetry or other methodologies be explored as means to gain information on predation of post-fledging and adult shrikes.

11) It is essential that effective predator management programs be continued and further developed to protect SCLS nests from predators. We advise gathering data on the ecology and population biology of feral cats, roof rats, and other rodents, because little is known about these introduced predators. Knowledge of the demography of these species would allow for more effective control and potentially lead to formulation of an effective eradication program. We also encourage continued use of tree guards and Quintox to reduce risks of nest predation by rats.

12) Shrikes released as bonded pairs and single releases should be experienced breeders. We believe that SY release birds are at a disadvantage because they experience both the wild environment and the nesting process for the first time. Over the past six years, older shrikes have had significantly more breeding success than SY birds, and no SY-SY pairs bred successfully bred in 2003.

13) Release efforts should continue to focus on releases that provide the most successful recruitment of the captive-reared birds into the breeding population. Currently juvenile release birds (from family or juvenile releases) have had higher over-winter survival rates

and higher recruitment into the breeding population than release adults. We recommend continuing to focus release efforts on juveniles.

14) Monitoring efforts in the non-breeding season should be continued to further elucidate the role of survivorship and dispersal in the fluctuation of the population. Monitoring in the non-breeding season would also provide information on seasonal patterns of survivorship, habitat use, predation risk, and foraging patterns. Techniques such as radio-telemetry should be considered to understand dispersal patterns, habitat use, and winter survivorship.

15) An inclusive fire management plan should be developed island-wide. It should include contingency plans for protecting active nests and important nest locations and should also include habitat restoration and management through controlled burning. Anecdotal evidence suggests that recently burned areas may provide important foraging habitat for SCLS, but further study is warranted.

16) Additional efforts should be made to publicize the entire SCLS recovery program, as recent increases in the population should be better recognized as a successful result of adaptive management techniques and intensive cooperative efforts among governmental agencies and non-governmental organizations. Publication of aspects of the SCLS program in scientific journals should be encouraged.

17) With multiple years of solid data accrued on the SCLS's productivity and survivorship, we recommend a population viability analysis (PVA). A PVA based on such extensive demographic data could serve as a tool for developing goals of the recovery program, measuring progress toward those goals, assessing the roles of various demographic factors in growth of the population, and predicting rates of population change with and without supplementing the wild population with captive-reared individuals. We also suggest the development of a GIS-based spatially-explicit model as a means for estimating carrying capacity of SCLS.

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