Population Status, Distribution, and Nesting Success of Loggerhead Shrikes in the Boardman Conservation Area, Boardman, Oregon, 2013

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INTRODUCTION

The Boardman Conservation Area (BCA) is an approximately 9,300 ha. area of grassland and shrub-steppe in Morrow County, Oregon. It is contiguous with the 19,020 ha. Naval Weapons Systems Training Facility Boardman (NWSTF), which together make up one of the largest remaining tracts of Palouse grassland and sagebrush shrublands in the region (Figure 1). The property was formerly owned by the state and was leased to the Boeing Company for aerospace development and testing, and later for agricultural production. It was subsequently sold and developed as Threemile Canyon Farms. The sale included an agreement that the BCA portion of the property would be managed as a protected area, and beginning in 2001 this has occurred under a lease by The Nature Conservancy (TNC). A Multi-Species Candidate Conservation Agreement with Assurances (MSCCAA) that provides conservation measures for several state- and federally-listed species was developed and finalized in 2004 (David Evans and Associates 2003). The MSCCAA provides conservation measures and requires monitoring for the Washington ground squirrel (*Spermophilus washingtoni*), Ferruginous Hawk (*Buteo regalis*), Loggerhead Shrike (*Lanius ludovicianus*), and Sagebrush Sparrow (*Artemisiospiza nevadensis*).

For Loggerhead Shrike the MSCCAA requires a population assessment to be conducted at 5-year intervals. This report details survey and monitoring efforts conducted during April through July 2013, and follows previous assessments conducted in 2003 (Omdal 2003) and repeated in 2008 (Plissner 2008). These efforts have focused on documenting plant community associations, the distribution of breeding pairs within the BCA, and to a lesser degree nesting success. Additionally, studies of shrikes have been conducted on the adjacent NWSTF (Holmes and Geupel 1998, Nur et al. 2004, Humple and Holmes 2006), and on the Portland General Electric Boardman Plant property (PGE 1996, PGE 1997, PGE 1999, PGE 2000, PGE 2001, PGE 2002, PGE 2003).

Loggerhead Shrike is considered a species of conservation concern within the Great Basin Bird Conservation Region (USFWS 2008) and is considered a vulnerable species by the Oregon Department of Fish and Wildlife within the Columbia Plateau (ODFW 2008). Breeding Bird Survey trend analysis (Sauer et al. 2012) for the Great Basin show stable or slightly declining populations between 1966 and 2011 (-0.8% annually with confidence intervals of -1.8% to 0.3%, n=152 routes). In Oregon, trend data from 31 routes suggest stable or slightly increasing populations during the same time period (1.3% increase annually with confidence intervals of -0.8% to 3.3%).

Although they breed in a variety of shrubland and open woodland habitats in Oregon, Loggerhead Shrike populations rely heavily on big sagebrush (*Artemisia tridentata*) plant communities (Holmes 2003). Loss of tall sagebrush plant communities through conversion to agriculture and fire remain the largest threats to breeding habitat in the Intermountain West (Knick et al. 2003, Knick et al. 2004). On the adjacent NWSTF, for example, the number of nesting pairs was approximately halved following a large wildfire that burned roughly half of the sagebrush shrublands on the facility in 1998. Surveys documented between 35 and 38 pairs each year during 1995 to 1997 but only 17 to 21 pairs in 2000 and 2001 (Humple and Holmes 2006). Multiple additional fires since 2001 have further reduced the available habitat, and as of 2013 the NWSTF appears to support only a handful of pairs of nesting shrikes (personal observation).

METHODS

We included all areas with sagebrush, juniper, or a mix of those in surveys for territories and nests. Communities dominated by bitterbrush (*Purshia tridentata*) and lacking a sagebrush or juniper component fell primarily north of the PGE coal plant and were not included in surveys. In total, approximately 1200 hectares were identified using a GIS layer containing vegetation polygons that was provided by TNC. This corresponded with the areas covered during the 2003 and 2008 assessments.

Searches for nesting activity began on April 11th and continued through the month of June. Nests that remained active after June continued to be checked by TNC personnel. The nest searching effort was conducted primarily by Brandt Thibodeaux with training and assistance provided early in the season by Aaron Holmes. In addition, a group of volunteers organized by TNC (Leslie Nelson) assisted with searches for shrike pairs on the 13th and 14th of April.

We searched within appropriate habitat by walking slowly through a pre-determined area, often using roads or fence lines as endpoints. We listened for shrike vocalizations and regularly stopped to scan the tops of vegetation for perched birds. Transects were chosen in the field to maximize visibility of surrounding vegetation. Upon reaching the end of the block of habitat to be covered, observers would double back with distances between roughly parallel lines determined by topography and vegetation. The goal was always of maximizing the likelihood of detecting shrikes if they were present, and to ensure complete coverage of suitable habitats. Perched birds were often detected at distances greater than 250m from the observer. A GPS track of routes walked was downloaded each day and provided visual confirmation that an area had been well covered or that it required more attention. As the season progressed and numerous active nests required follow up visits twice per week, observers would attempt to vary their walking routes to and from nests to increase chances of detecting additional territories that may have been missed upon initial searches.

Brandt Thibodeaux spent a total of 62 days on the BCA conducting searches, finding nests for known pairs, and checking on active nests. He was joined by one or more additional observers on 11 days. Rough notes on daily activities and personnel are provided in journal format (Appendix A). These are included here largely for posterity and because to some degree in conjunction with GPS tracks they document effort.

We located and monitored nests using methods outlined in Martin and Geupel (1993). Once an adult bird was located, observer(s) watched from a distance (typically >75m) in effort to determine pairing status and nest location. Single shrikes often hunt at significant distances from their nest site, but observing a pair spending time in close proximity typically indicates a nest location is nearby. Behavioral clues such as flights with nesting material or food being carried were the most productive means of locating a nest, but in many cases nests were located through systematic searches of areas where a pair had been observed repeatedly, or by searching patches of vegetation where a female had flown in but not emerged after 10-15 minutes. When a pair was observed and a nest was not located the location was revisited regularly until either a nest was located or the birds were no longer found using that particular area.

Once located, nests were checked at least once every 4 days in order to determine nest outcomes and to identify critical dates such as hatching, fledging, or nest failure. The number of eggs and chicks were recorded and notes were made on chick development to allow for estimating hatch day or the projected fledging date. Checks were conducted quickly and carefully to minimize disturbance to the adults that could result in alarm calling and potentially clue in predators to a nests location. Nests were not checked when Common Raven (*Corvus corax*), a known nest predator, were in the vicinity. In addition, "dummy checks" of other shrubs and trees were carried out anytime an active nest was inspected.

For each nest we recorded the location using Universal Trans Mercator (UTM) coordinates, the species that nests were built in, height of the nest substrate, the height of the nest to the top of the rim, and the azimuth from the center of the substrate to the nest. We estimated height to the closest 50 cm for juniper trees that were taller than 3m. One to 3 photos of each nest shrub or tree were taken and are being provided to TNC with this report. We calculated nest initiation dates through direct observation or by backdating from clutch completion date or hatching date. Fledge or failure dates were calculated as the midpoint between the last check where a nest was known to be active and the first check it was found empty. Where information on nestling age and projected fledging date allowed more precise estimates we employed those dates.

It has long been known that apparent estimates of nesting success may be biased based on lower detection rates for nests that fail prior to discovery. This is especially true when large portions of a sample of nests are located late in the nesting period. We calculated daily nest survival rates using the Mayfield method (Mayfield 1961, 1975) and calculated variance following Johnson (1979). Survival estimates for the different periods and total survival are calculated by compounding the daily survival rates by the number of days in each period of interest.

The formulas used to calculate daily survival, total survival and variance are presented in equations 1-4 (d = number of failures, exposure = exposure time in days at risk, t = duration of the study period, dsr = daily survival rate or the portion of nests expected to survive a single day, and S = total survival rate for the period of interest). To calculate confidence intervals for the total survival estimate the confidence intervals for the daily estimate are raised to the power of t.

Equation 1. Daily survival rate:

$$\hat{dsr} = 1 - \left(\frac{d}{exposure}\right)$$

Equation 2. Total survival rate for period of interest:

$$\hat{S} = (\hat{dsr})^t$$

Equation 3. Variance of daily survival rate:

$$var(d\hat{s}r) = \frac{(exposure - d) \times d}{(exposure)^3}$$

Equation 4. Confidence interval (95%) of daily survival rate:

$$d\hat{s}r \pm 1.96\left(\sqrt{var(d\hat{s}r)}\right)$$

RESULTS

Population size and distribution

We estimate the local breeding population of Loggerhead Shrikes on the BCA in 2013 as a minimum of 46 pairs. This estimate is based on 40 nests that were monitored and believed to be from unique pairs (13 additional nests were monitored but considered to be re-nesting attempts based on timing and proximity to failed nests), 5 nests that were located in the immediate vicinity of adults feeding recently fledged young but were not monitored, and a pair that was encountered regularly during May until they were observed with fledglings. The distribution of nest locations (and the one territory we did not locate a nest for) was similar to 2008 (Figure 2), with birds concentrated in an east to west band just south of the coal plant, reservoir, and circle pivot agriculture and stretching from the boundary with the NWSTF to Schoolhouse Canyon. Territories were located in sagebrush habitats with and without juniper trees as well as in juniper trees growing in areas where the sagebrush component has been lost to wildfire. We did not detect birds in the fingers of sagebrush that extend south into canyon bottoms and believe that shrub structure in those locations is inadequate to support nests. Likewise, we did not detect birds in the sagebrush flats to the east and north of Schoolhouse Canyon that were devoid of juniper trees, although portions of these areas appeared to contain suitable habitat.

Nesting

We located a total of 59 nests for what we believe to be 45 unique pairs (Figure 3). Of these, 6 were located after the nest had fledged or failed, and 53 were monitored during at least a portion of the time they were active. One nest was not revisited after June and has an unknown outcome. The earliest known clutch initiation date (first egg) in 2013 was the 4th of April and the latest was the 18th of June. Nests were constructed in sagebrush (n = 31, 52.5%) and juniper (n = 28, 47.5%) in roughly equal proportions (Table 1). The mean height of sagebrush plants used for nesting was 162 cm (SD = 33, range 114 – 260). Nests in sagebrush were built at a mean height of 80.3 cm (SD = 24.5, range 52 – 144). The mean height of juniper trees used for nesting was 395 cm (SD = 137, range 146 – 700), and the mean height of nests in trees was 136 cm (SD = 43, range 69 – 214).

Table 1. Nest identification code, UTM coordinates (WGS 84), plant species, height of plant, azimuth from the center of the canopy to the nest, and the percent of the nest substrate canopy which was alive for all Loggerhead Shrike nests located on the BCA in 2013. **THIS TABLE WAS REMOVED FOR PUBLICATION ON CONSERVATION GATEWAY.**

Nest success

For nests that were located during egg laying or early in the incubation period, and therefore provide the best data on clutch size (n = 38), the mean clutch size was 6.21 (SD = 0.78, range 5 – 7). Based on nests that were under observation prior to and after hatching (n = 30), the mean hatching rate was 95% (SD = 9.5%, range 60% - 100%). Fourteen of the 52 nests (27%) that we located while active and monitored until completion fledged young. Successful nests fledged an average of 4.9 young (SD = 1.8, range 2 – 7). Four nests failed during egg laying, including one that was apparently abandoned, although we cannot rule out the possibility that it was partially preyed upon and then abandoned. Six nests failed during incubation and were presumably preyed upon. Twenty-eight nests failed during the nestling phase and included one nest where 4 nestlings disappeared and the remaining two were found dead in the nest.

The Mayfield estimate of daily survival rate varied by nest stage (Table 2) and was significantly lower during the nestling stage than in the laying and incubation stage (calculated jointly). Total nest survival was estimated as 26.7% with a confidence interval of 17.4% to 40.9%. Nest survival estimates are a function of the daily survival rates and are calculated based on a 5.2 day laying interval, a 16 day incubation period, and a 17 day nestling period (total period of 38.2 days).

Table 2. Number of exposure days, nests, nest failures, and the corresponding daily survival rate (dsr), standard error, and 95% confidence intervals for Loggerhead Shrike nests monitored on the Boardman Grassland Conservation Area in 2013.

						95% Confidence Interval	
Period	Exposure days	# of nests	# of failures	dsr	SE	low	high
Laying and incubation	686	44	10	0.98542	0.00458	0.97627	0.99457
Nestling	433	42	28	0.93533	0.01182	0.9117	0.95897
Total	1119	53	38	0.96604	0.00541	0.95521	0.97687

DISCUSSION

Population size

Our estimate of 46 breeding pairs is greater than the 38 pairs documented 5 years prior (Plissner 2008), and greater than the estimate based on 24 nests located within the same area in 2003. The 2008 estimate was based on locating 36 nests and observations of 2 additional pairs during late March and throughout April. Data from the 3 assessments suggest a trend of increasing population size. The differences in effort, however, including the timing of effort, make comparisons among the 2003, 2008, and 2013 surveys problematic. For example, only 28 of the nests we located in 2013 were active during the survey window employed in 2008 (including building stage and based on a first egg date prior to 7 May), although we were aware of a greater number of pairs at that time and subsequently located nests were likely re-nesting attempts. Standardizing effort would be highly desirable for future monitoring years. Individually marking birds would improve confidence in population estimates based on territory mapping and nest locations but is likely prohibitively expensive. Another alternative, or supplement, to the current monitoring approach would be using either point or line-transect count data (Ralph et al. 1993) in conjunction with one of several available methods that estimate population size with confidence intervals.

Nesting

Habitats used for nesting in 2013 were similar to what has been previously reported for the BCA (Plissner 2008) and the NWSTF (Humple and Holmes 2006). Similar proportions of nests were built in sagebrush rather than juniper in 2013 (52.5%) and in 2008 (55.6%). This difference is small but may relate to habitat changes from a large wildfire that occurred after the nesting season in 2008. In portions of the burned area where shrikes were nesting the sagebrush was killed in the fire while the juniper trees did not suffer complete mortality.

Clutch initiation dates were similar to those found in previous work on the BCA and adjacent NWSTF (Plissner 2008, Holmes and Geupel 2008) and suggest that the nesting season typically begins in late March with the earliest pairs initiating nests, followed by the majority of pairs initiating nests in mid-April. Re-nesting occurs through mid- to late-June for pairs that have been unsuccessful or for those attempting a second clutch, and while most pairs have finished, active nests may be found through late July. We recommend that future assessments begin no later than the first week of April and continue at least through June.

Nest Success

Nest survival on the BCA, at 27%, is among the lowest survival estimates published for Loggerhead Shrikes. In numerous studies summarized by Pruitt (2000) and Yosef (1996) nest success was typically above 50% with only several notable exceptions. Collins (1996) reported a low nest success rate of 25% in Illinois. Humple and Holmes (2006) reported very low nest survival rates of 12% and 26% for the 2000 and 2001 breeding seasons on the NWSTF in Boardman, OR. An examination of daily survival rates for the 5 years that estimates are available from the NWSTF, which is contiguous with the BCA, show that

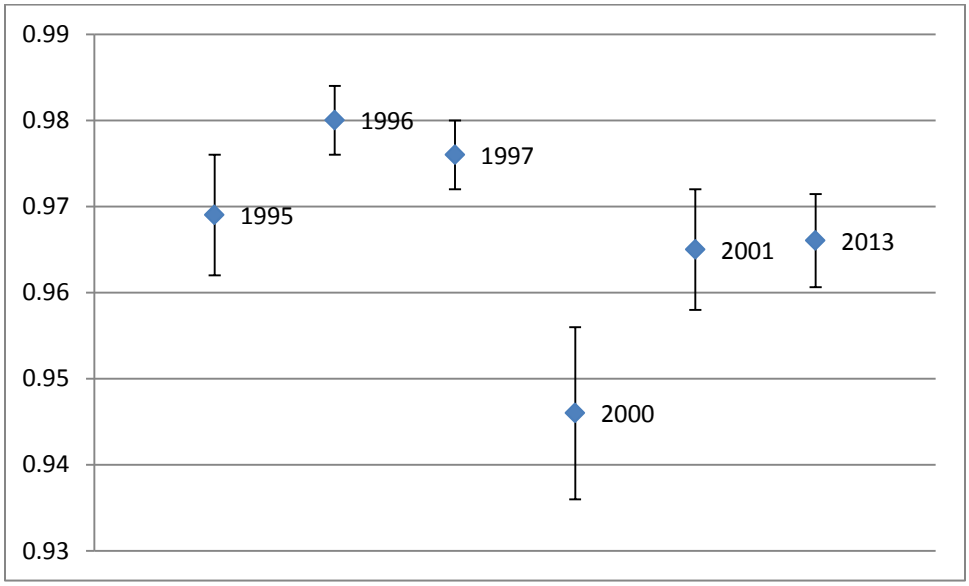
daily survival rates ranged from 0.946 to 0.980, and that survival rates for nests on the BCA in 2013 fall approximately in the middle of that range (Figure 1). Plissner (2008) monitored a subset of nests that were located on the BCA and concluded that nest success was below 50%. The mean number of young fledged from successful nests in 2013 was 4.9 which also falls within the range observed on the NWSTF (4.69 to 5.63).

Humple and Holmes (2006) suggest that high predation rates by Common Raven were responsible for the low success observed in 2000 and 2001 on the NWSTF. Sagebrush habitat had been fragmented by a wildfire in 2008 and many shrikes nested in remnant islands of sagebrush. They hypothesized that ravens had an easier time locating nests within smaller patches of shrubs. Similarly, Howe et al. (2014) found that ravens favored the edge between sagebrush and other, disturbed, habitat types over continuous sagebrush and believe this relates to their ability to detect prey. Vanader Haegen et al. (2002) found that artificial nests in fragmented sagebrush steppe were about nine times more likely to be preyed upon than those in continuous habitat and that differences were related to corvid predation rates. Although we did not analyze success as a function of patch size or proximity to grassland edge, successful nests in 2013 appeared to be located within core habitat areas with failed nests predominating along the edges of the polygons mapped as sagebrush and juniper (Map 2). Higher failure rates during the nestling period are consistent with temporal patterns of daily survival reported by Nur et al. (2004). This pattern suggests that principal nest predators are not opportunistic (i.e. snakes and rodents) but are using adult behavior to cue in on nest locations. Activity at the nest increases greatly following hatching. Both adults make more frequent trips to the nest while provisioning nestlings. They are also more likely to alarm call in the presence of human observers or corvids (personal observation).

Management Implications

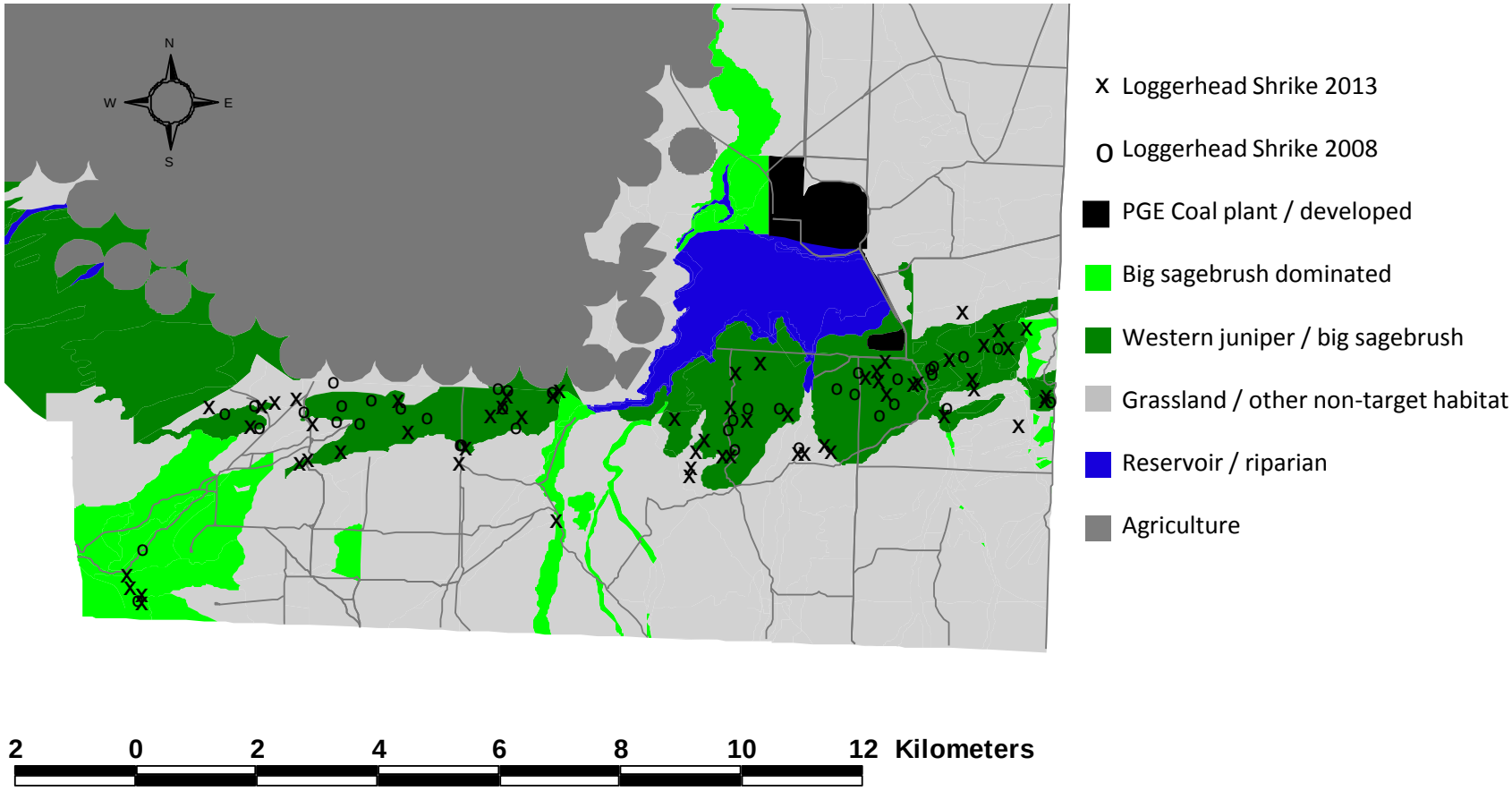
Management activities that foster the prevention of additional fragmentation in the sagebrush and juniper habitats on the BCA should benefit Loggerhead Shrikes. Recurrent wildfires on the NWSTF since the late 1990's have reduced the population size of Loggerhead Shrike (Humple and Holmes 2006, Holmes personal observation 2013). The large fire on the BCA in 2008 reduced available habitat but there was no decline in population size based on the 2008 and 2013 population assessments. Additional fires that remove shrub structure will likely further erode remaining nesting habitat.

Figure 1. Daily survival rates (SE) for Loggerhead Shrike nests on the Naval Weapons Systems Training Facility (1995-2001; Humple and Holmes 2006) and the Boardman Conservation Area (2013).

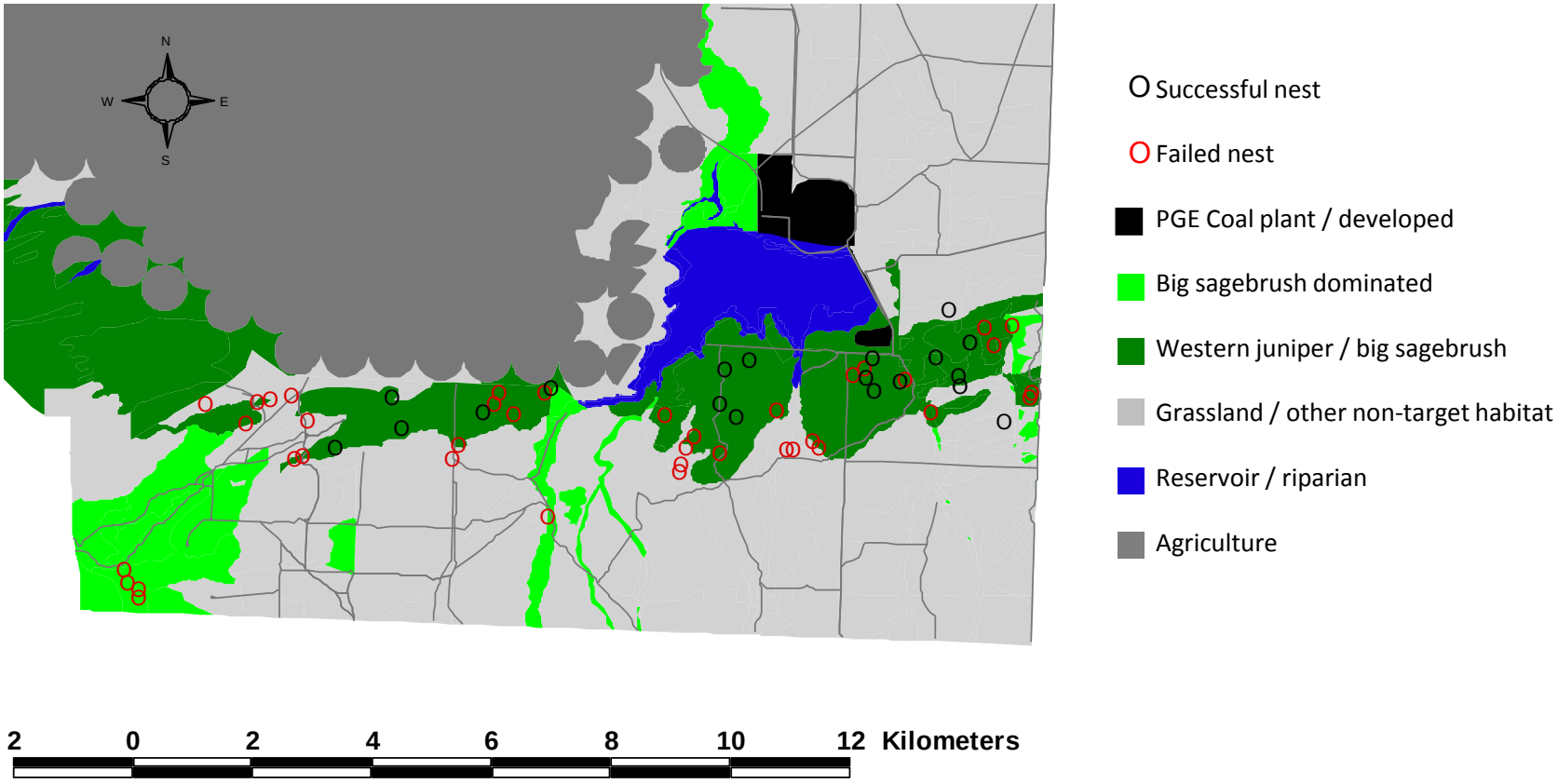


Map 1. Overview of the Boardman Conservation Area and Naval Weapons Systems Training Facility (reproduced from Kagan et al. 2011).

Map 2. Location of Loggerhead Shrike nests (and one territory for which a nest was not located) on the Boardman Grassland Conservation Area in 2013 and and 2008.



Map 3. Distribution of Loggerhead Shrike nests with known outcomes on the Boardman Grassland Conservation Area in 2013. Five nests that were located just after young fledged are included but were not monitored.



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