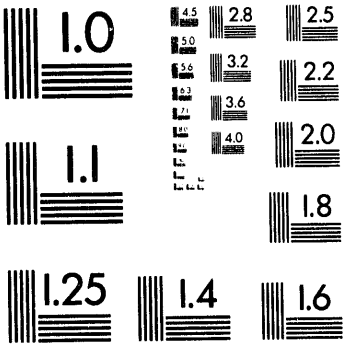
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1993 Study of Long-Billed Curlews on the Yakima Training Center

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Summary

Pacific Northwest Laboratory conducted a study for the U.S. Department of the Army on long-billed curlews (*Numenius americanus*) on the Yakima Training Center (YTC) in the spring and summer of 1993. Long-billed curlews are a Class IIIc federal candidate species and are listed as a "species of special concern" by the Washington Department of Wildlife.

The objectives of this study were to 1) locate major nesting areas, 2) locate brood rearing areas, 3) evaluate habitat requirements, 4) determine diet, 5) evaluate response to troop activities, 6) estimate population size, 7) estimate recruitment rates, and 8) establish a relative abundance survey method.

Curlews were first observed on the YTC in 1993 on 21 March and last sighted on 1 July. The YTC curlew population was estimated to be 77 birds using survey count data. One curlew (male) was captured and fitted with a radio transmitter and leg bands. Major nesting areas were identified by observing territorial and courtship displays and/or by locating nests. The Washout Gulch and Borden Springs areas had the highest curlew use. Brood rearing areas were identified by observing intense threat displays of parent birds and (late in the brood rearing period) sightings of juveniles. The areas used by broods were those where shrub cover occurred adjacent to the nesting areas. Three of four located nests hatched. The outcome of the fourth nest was unknown. More chicks were seen in the Borden Springs flock in 1993 (12 juveniles) than in 1992 (4 juveniles).

Information on curlew feeding behavior and diet was gained through general observations. Before and after the incubation period curlew pairs fed together. Most feeding occurred in the mornings on their territories, but birds also fed at other times of day and sometimes off their territories. Beetles and grasshoppers were the predominant prey items observed. Evaluating curlews' responses to troop activities was not possible because of the lack of radio-equipped birds.

Systematic surveys along specific routes were conducted during a 2-week time frame (25 March through 7 April 1993) following peak curlew arrival and before the onset of nesting. Morning surveys were best for sighting birds. Males were more detectable than females. A total of 47 birds (25 males, 10 females, and 12 unknown) were seen during 23 surveys. Surveys along the nine established routes can be compared in subsequent years to show relative abundance trends in the YTC curlew population.

Acknowledgments

Mr. Jim Reddick, Range Officer, and Margaret Taaffe-Pounds, Wildlife Biologist, provided assistance with the logistics of working on the YTC and provided information on curlew locations. Various Army personnel were supportive and provided information on curlew sightings. Valuable field assistance was given by Jason Klabon, Alan Leary, Colin Sveum, and Tom Kollasch. Special help in plant identification and vegetation sampling was given by Bill Rickard and Janelle Downs. This report is in memory of Les Eberhardt, who dedicated his life to the cause of wildlife and without whom this project would not have been started.

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Introduction

This report summarizes and discusses results obtained during the 1993 study of long-billed curlews (*Numenius americanus)* on the Yakima Training Center (YTC). Pacific Northwest Laboratory[a] conducted the research for the U.S. Department of the Army. Long-billed curlews are a U.S. Fish and Wildlife Service Class IIIc candidate species. The Washington Department of Wildlife considers them a "species of special concern."

The objectives of the 1993 study were to 1) locate major nesting areas, 2) locate brood rearing areas, 3) evaluate habitat requirements, 4) determine diet, 5) evaluate response to troop activities, 6) estimate population size, 7) estimate recruitment rates, and 8) establish a survey method.

Study Area

The 1,058-km^2 YTC is located in south-central Washington in Yakima and Kittitas counties approximately 11 km north of Yakima. The YTC is bordered by the Columbia River on the east, Interstate Highway I-82 on the west, the Saddle Mountains on the north, and the Moxee Valley on the south. Umtanum Ridge, which bisects the YTC east to west, reaches elevations of 1,249 m. The lowest elevation on the YTC is 183 m. Prominent physical features and training areas are shown on the Yakima Training Center map (Figure 1).

The climate of the area is characterized by hot, dry summers and cold, dry winters. The annual precipitation is approximately 20 cm per year. Temperatures range from -4°C in January to 40°C in July.

The YTC supports one of the larger contiguous tracts of native shrub-steppe vegetation left in Washington. Stands of big sagebrush (*Artemisia tridentata*) occur throughout the area. On relatively undisturbed areas bluebunch wheatgrass (*Agropyron spicatum*) is the dominant grass; however, cheatgrass brome (*Bromus tectorum*) and knapweed (*Centaurea* spp.) dominate heavily disturbed areas. Crested wheatgrass (*A. cristatum*) also occurs in certain sections, having been planted as a ground cover and forage plant.

(a) Pacific Northwest Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute.

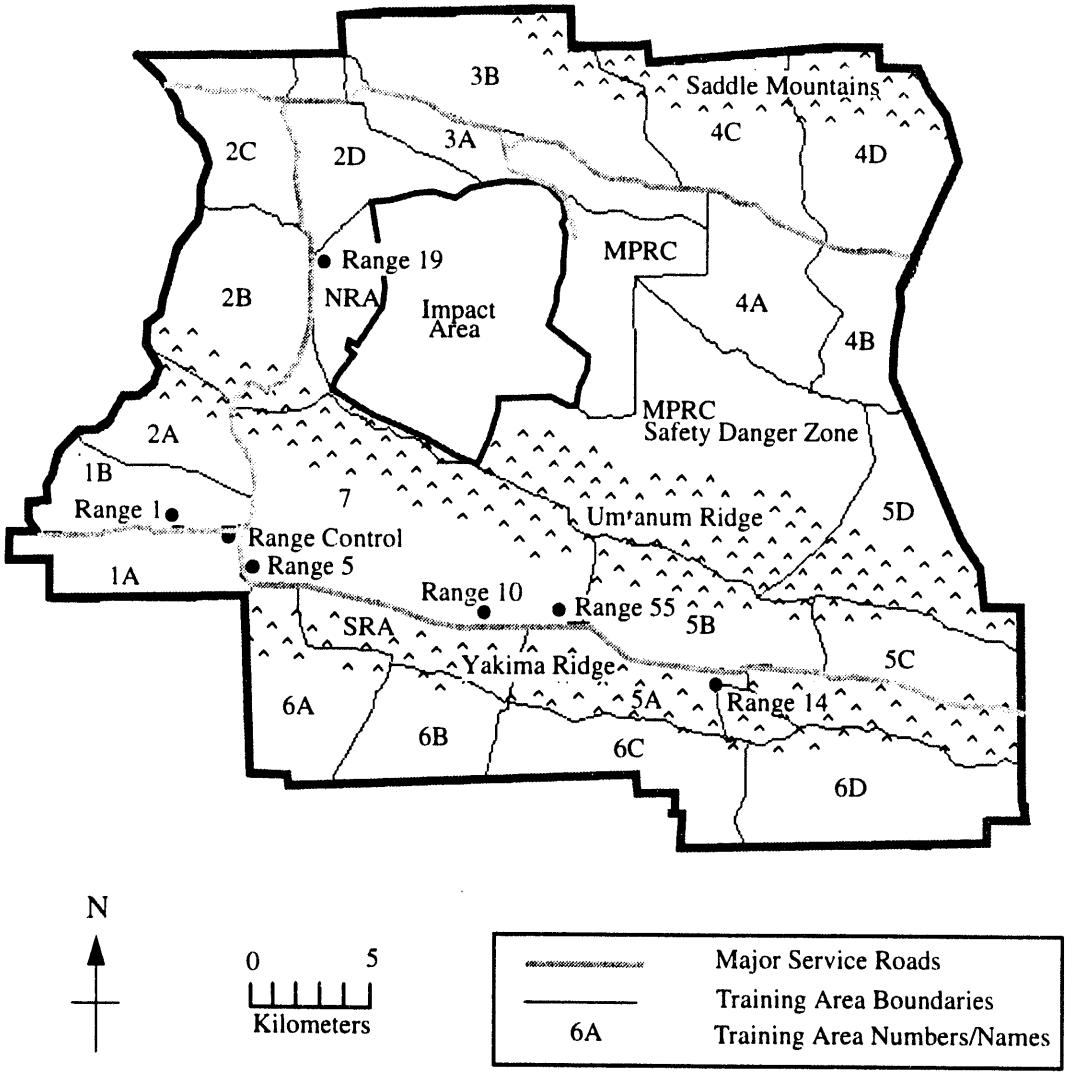

Figure 1. Location of Physical Features and Training Areas on the Yakima Training Center

Methods

Surveys

To check for curlew arrival and general distribution, we drove many roads on the YTC beginning in mid-March. These general surveys were conducted in areas that had previously been identified as curlew habitat and use areas (Hand et al. 1994). Locations of birds were obtained using a Global Positioning System (GPS) unit or were estimated using the Yakima Firing Center Special Map. The date, time, number, and sex of birds, and weather conditions were also recorded. Sightings by other researchers or YTC staff were recorded. The leveling off of the number of sightings following the initial increase was used as an indicator that most of the birds had arrived.

Once most of the birds had arrived, and prenesting activities had begun, surveys over nine specific routes were driven. The routes were established in areas regularly used by curlews. To avoid duplicate counts, the routes were established so that there was no overlap between 0.5-km strips on either side of the transects where possible (Redmond et al. 1981). For the Washout Gulch route, which contains a section that doubles back, curlews were counted only during the first pass along that section. These surveys took place during a 2-week period following arrival and before the onset of nesting. Curlews are very active during this period and are highly visible. Redmond et al. (1981) found that the most accurate censusing of territorial male curlews could be done during a 2-week time period beginning at the peak of curlew arrival. Because weather affects bird activity and count accuracy, routes were not driven in fog, heavy rain, or high winds. Thus both the weather and the short time window for accurate counts limited survey work. Three times were established for the surveys: morning (0530 to 1000 hr), mid-day (1000 to 1400 hr), and afternoon/evening (1400 hr to dusk).

Surveys were conducted as follows: The odometer reading was recorded at the start of each survey and at each bird location. The routes were driven slowly (approximately 5 mph) by one person, who would scan the area ahead and to the sides of the vehicle with the windows open. All observed birds (both flying and on the ground) were recorded. When a bird was heard, the observer would stop and locate it visually, using binoculars if necessary. Bird locations were recorded by referencing the odometer reading at the point along the route nearest the bird. The sex of the birds (when determinable) and their activity also were recorded.

Nest Area Identification and Nest Search

Major nesting areas were identified by observing behaviors specifically associated with nesting curlews and by locating several actual nests. No attempt was made to locate every nesting area on the YTC. Use areas identified during the general surveys were further observed for territorial and courtship displays. Allen (1980) states "Escape is the most usual reaction to disturbances outside the breeding season or away from the nesting territories. On the territories during the breeding season, reactions to humans or predators are different." When disturbed on the nesting territory, a curlew first becomes alert and may give a loud "wheet wheet" call. Avian intruders may be mobbed and chased in the air. Ground intruders, including humans, are threatened by repeated short flights around the intruder or with flights directly toward the intruder. A loud, shrill wavering call [the chirping call described by Allen (1980)] is given during intense threat displays. The loud calls serve to attract other curlews to the area who then assist in the displays (Allen 1980; Redmond 1984).

The most noticeable courtship display is described by Redmond (1984) as the undulating flight display. Male curlews perform this display around the perimeter of their territories or around a female if one is in the male's territory. In this display, the male flies rapidly and steeply upward, then curves its wings downward and glides slowly and gradually back down to within 0.3 to 15 m of the ground before ascending again. During the gliding portion of the display, the male often gives a low whistling call (Allen 1980; Redmond 1984). Observations of these displays (both territorial and courtship) in areas where curlews were regularly seen were used as the index for identification of nesting areas.

Most nests were located by using a rope drag technique to flush birds off of nests. A 100- to 300-ft length of 1/2-in. nylon rope was dragged across fields or open areas identified as potential nesting areas either by people on foot or by trucks. Areas of mostly open grassland where curlews had been seen displaying were used as potential nesting areas for the purpose of this technique. This technique was used in six areas ranging from approximately 50 to 100 ha each. The dragging rope flushed birds from the ground/nest when it passed over or near them. When a bird flushed, the nest was located and a compass bearing was taken to facilitate relocating the nest for future data collection. One nest was found by relocating a radio-equipped bird. The location of nests was further used to define nesting areas.

Reproductive Success

The outcomes of located nests were determined by examining the eggshell remains. Nests were recorded as successful if eggs showed membrane detachment from the shell. Counts of chicks at the Borden Springs flocking area were also used in determining reproductive success.

Brood Rearing Area Identification

Brood use areas were identified from observations of male/female pairs showing protective behaviors characteristic of adults with chicks. Threat displays and calls of adults with chicks are similar to the territorial displays described above, but are more intense and may take place away from nesting areas (Allen 1980; Jenni et al. 1982).

Capturing, Marking, and Measurements

Two capture methods were attempted. Ground-fired net launchers were set up at watering areas (stream fords and large puddles) used by curlews. Two sites were used in 1993: the Selah Creek ford adjacent to Range 15 tower (UTM 704686E 5175018N Zone 10) and a large water puddle on the tank trail near Range 55 (UTM 715993E 5168381N Zone 10). Capture attempts were made on warm afternoons with little wind. The net launcher used a 7.6-m x 7.6-m net by remote signal. When a curlew walked within range of the net, the net was launched by an observer located approximately 75 m away in a camouflaged blind. A spotlighting/hand-netting technique was attempted at night in the nesting fields.

Once captured, the bird was fitted with a battery-powered radio transmitter and leg bands placed around the tibiotarsus to be visible when the bird was standing. The transmitter (weighing 7 g) was glued to the feathers of the back between the wings using an epoxy developed for use on shorebirds. Two colored and numbered plastic leg bands were placed on the bird, one on each leg, in a unique

color combination. One U.S. Fish and Wildlife Service-numbered aluminum band was also placed on the bird. The sex of the bird was determined from bill length and shape, and age was estimated from bill length and general body size (Allen 1980). The bird was weighed using a 1-kg Pesola spring scale by suspending it with a Velcro and nylon strap harness. Three measurements were recorded: 1) tarsus (tarsometatarsus) length was measured from the point of the tibia/metatarsus joint to the point of the metatarsus/middle toe joint, 2) exposed culmen length was measured from the point where the feathers on the forehead end straight to the tip of the maxilla, and 3) bill length was measured from the corner of the mouth straight to the tip of the maxilla. These measurements were compared with those from the literature to confirm age and sex of the bird.

Monitoring Movements

The radio-equipped curlew was located from the ground using truck-mounted and hand-held antennae. The general locale of the marked bird was determined using a truck-mounted omni-directional antenna. The bird was then approached on foot using a hand-held H-element antenna. Locations were recorded using Universal Transverse Mercator (UTM) coordinates that were obtained with a single GPS unit or estimated from terrain features with the aid of the Yakima Firing Center Special Map, edition 4-DMA. Additional data recorded included date, time, total number of birds and their sex, activity of the bird(s), and weather conditions (air temperature, wind speed, and percent cloud cover). Attempts were made to locate the radio-equipped curlew several times each week.

Habitat Characterization

Vegetation measurements were taken at the nest sites and brood rearing sites during May and June (brood rearing period). Shrub density was determined with a modification of Canfield's (1941) line-intercept method. A 20- to 50-cm Daubenmire plot frame (Daubenmire 1959) was used to measure canopy cover of grasses and forbs. At each site, two 10-m transect lines, oriented perpendicular to each other, were measured. The direction of the first line was randomly chosen. Ten Daubenmire plots were used at each site (five spaced 2 m apart along each line) to measure grasses and forbs. For nest site measurements, the center of the transect was located on the nest, and an additional 1-m^2 plot surrounding the nest was measured for both grasses and forbs. For measurements at brood locations, the transect was placed centered where an adult curlew showing parental behavior had been observed. The following canopy coverage classes were used: 1) >0 to <1%, 2) 1 to 5%, 3) 6 to 25%, 4) 26 to 50%, 5) 51 to 75%, 6) 76 to 95%, and 7) 96 to 100%. For measurement of shrubs along the two transect lines, the percent of each shrub species intercepting each meter of line and the shrub height were recorded. Heights of grasses and shrubs were recorded. Also, distance to the nearest shrub cover from each nest site was estimated.

Feeding Behavior and Diet

Direct observation of curlews while they fed was the basis for information on feeding strategies and diet. Information on the vegetation cover type used, feeding methods, and type of prey were recorded. Analysis of feces was not planned because of difficulties in collecting fecal samples from such mobile birds.

Results and Discussion

Capturing, Marking, and Measurements

Capturing curlews was less successful in 1993 than in 1992 possibly because of differing weather conditions and resulting differences in bird use of water. During the dry spring of 1992, water sources were limited, and curlews tended to use predictable sites. The spring of 1993 was considerably wetter, and birds had more options for watering. Their time and location of water use was not predictable. Additional capture sites were not established due to the limited amount of equipment and manpower and because many areas had thick vegetation which hampered use of the net launcher.

One long-billed curlew was captured using the ground-fired net launcher. The bird was captured at the Range 55 site (UTM 715993E 5168381N Zone 10) on 14 April. The spotlighting/hand-netting method proved unsuccessful because the birds were difficult to locate and were alert enough to flush before we could get within netting range.

The one curlew that was captured was fitted with leg bands and a radio transmitter (frequency number 9.945). The captured bird was an adult male that weighed 545 g. We measured length of exposed culmen (130 mm), length of bill (134 mm), and length of tarsus (87 mm). The bird's nest, located on the eastern edge of Range 55, was found by radio tracking early in the morning before he switched nest duty with the female. The bird lost its radio in the vicinity of the nest approximately one and a half weeks after it was captured. The radio was recovered 11 days after the bird was captured.

One male curlew (#9.383) captured and marked in 1992 was resighted on 15 June 1993. The bird was seen on Range 55 (UTM 716650E 5169500N Zone 10), not far from where it nested in 1992. It was with a female, and both birds showed threat behavior characteristic of birds with chicks.

Breeding Chronology

The first long-billed curlews were observed on the YTC on 21 March 1993. Sightings increased over the next 2 weeks. From the leveling off of the number of sightings, it appeared that most birds had arrived on the YTC by 2 April. Figure 2 illustrates the breeding chronology of long-billed curlews on the YTC.

Courtship displays were observed from 26 March through 16 April. According to Allen (1980), egg laying on the nearby Hanford Site generally occurs during the first 2 weeks in April, and hatching takes place in mid- to late-May. Data from four located nests agree with what Allen found. Nest 1 was first found on 23 April with a complete clutch of four eggs. It was still being incubated on 29 April. The nest was found already hatched on 14 May. These dates indicate the earliest it could have hatched would have been 30 April and the latest 13 May. Backdating from the range of possible hatching dates [allowing 28 days for incubation and 6 days for laying (Allen 1980; Graul 1971)] indicates that the first egg was laid between 27 March and 9 April. The outcome of Nest 2 could not be determined because of lack of eggshell fragments. Nest 3 also hatched between 30 April and 13 May. Nest 4 hatched between 21 May and 25 May.

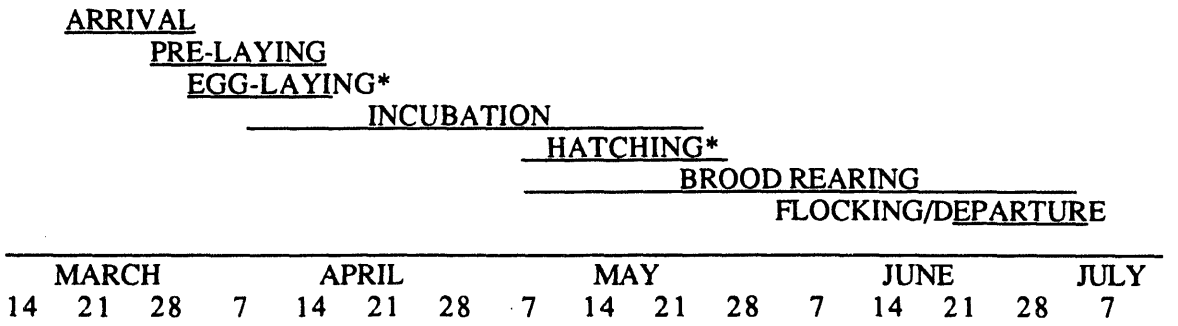

Figure 2. Breeding Chronology of Long-Billed Curlews on the Yakima Training Center, 1993. [*Information from YTC not available; taken from Allen (1980).]

Threat displays indicating the presence of chicks were observed from 14 May through 24 June. A flock made up mostly of chicks and males was observed on 24 and 28 June and 1 July in the Borden Springs area (UTM 728751E 5182369N Zone 10 and immediate vicinity).

On 1 July (the last sighting date for curlews on the YTC in 1993) some birds showed unusual flight behavior in the late afternoon. A group of approximately six birds flew up and circled high in the air. Then they swooped down and chased each other. After about 5 minutes of this flight they settled back down on the ground. Allen (1980) described similar flight behavior on the Hanford Site just prior to departure.

Distribution

The distribution of long-billed curlews within areas surveyed on the YTC in 1993 was similar to that in 1992. Most areas showed similar levels of use. One notable difference was the Borden Springs area. More birds regularly were seen in 1993 than in 1992. Curlews were sighted there during the flocking period in 1992, but were not observed during our surveys. Washout Gulch, Selah Creek, and Pozzuolana Mine showed somewhat higher use in 1993 than in 1992. Figure 3 shows the locations of all curlew sightings on the YTC in 1993 overlaid onto a potential habitat map (Hand et al. 1994). Figure 4 shows the locations of the single radio-equipped curlew. Table 1 lists the highest counts of males, females, and unknown sex birds in each use area. The table also lists the 1992 totals for comparison. Details of curlew sightings (date, time, UTM coordinates, number of birds, and activity) are listed in Appendix A.

The following Training Areas (revised 1992 boundaries) were searched for curlews in 1993. Several roads in each area were driven periodically throughout the study period:

1A and 1B
2A, 2B, 2C, and 2D
3A and 3B
4A and 4B
5A, 5B, 5C (north half), and 5D
6A, 6B, and 6C (west half)
7

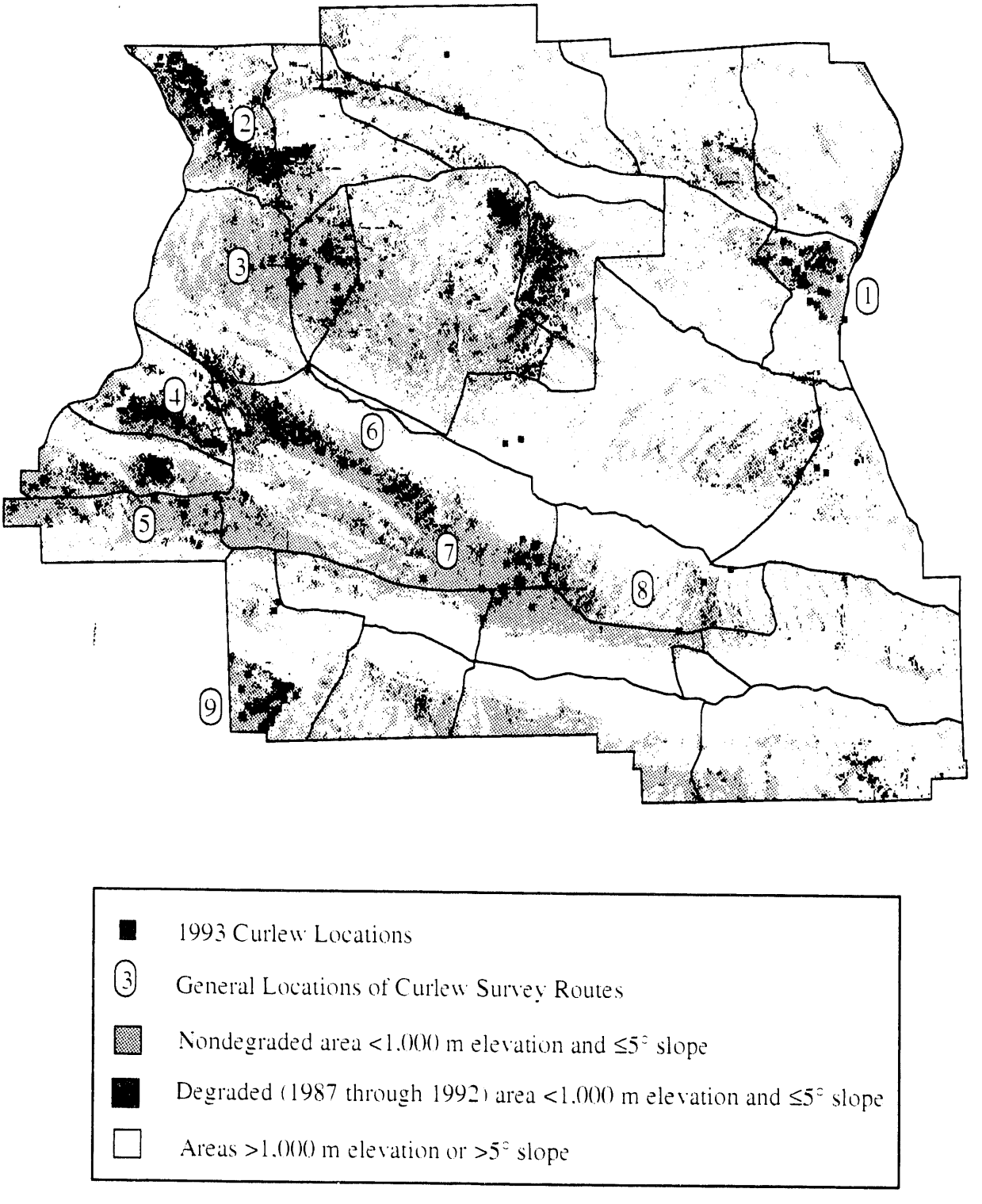

Figure 3. Locations of Long-Billed Curlews on the Yakima Training Center in 1993 and Potential Curlew Habitat. Location data are from surveys, researcher observations, radio-tracking, and general sightings.

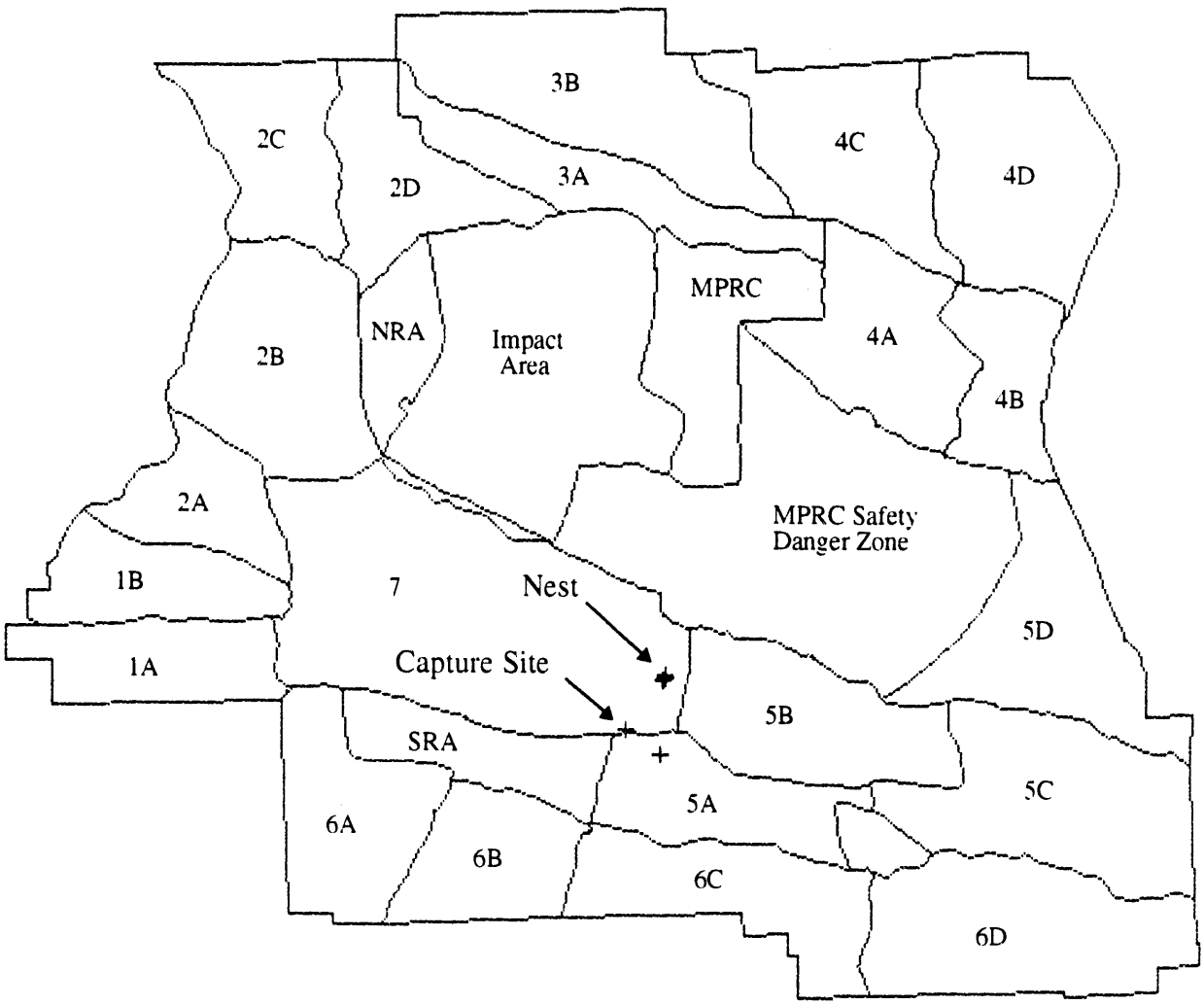

Figure 4. Locations of Curlew # 9.945

NRA
SRA
MPRC Safety Danger Zone

The following training areas were not searched during 1993 because of access limitations and time constraints:

4C and 4D (searched in 1992, habitat generally too steep and rocky for curlews)
5C (south half) (searched in 1992)
6C (east half) and 6D (6D was searched in 1992)
Impact Area
Range 14 Dud Area
MPR

Table 1. Curlew Population Size Based on the Maximum Number at a Single Count of Males, Females, and Unknown Sex Birds Observed in Each Use Area

General Area	1993 #Males	1993 #Females	1993 #Unk.	1993 Total	1992 Total
Borden Springs	8	6	3	17	2
McDonald Spring	0	0	3	3	-(a)
Badger Gap	0	0	0	0	2
Silica DZ	0	0	1	1	2
Range 19	2	1	2	5	3
Beller DZ	3	1	2	6	4
Range 1	0	0	0	0	2
Range 5	0	0	0	0	3
SW of Range Control	1	0	2	3	2
Selah Creek	2	1	4	7	-(a)
Ranges 10 & 55	2	2	4	8	5
North of Range 14	0	0	2	2	3
Pozzuolana Mine	3	0	5	8	1
Washout Gulch	8	5	4	17	9
Coyote Spring	0	0	0	0	1
Total Number of Birds	29	16	32	77	39

(a) Area was not searched in 1992.

Time and staffing did not permit extensive searches in all the checked areas; however, because major curlew use areas are quite conspicuous due to the birds' breeding activity, we are confident that all major use areas in the areas checked were identified. No curlews were seen in Training Areas 2D, 6B, or 6C in 1993, but some were seen there in 1992 (Hand et al. 1994). The training areas are shown in Figure 1.

Curlews have been known to shift their use of areas in response to habitat changes. On the Hanford Site, overall curlew use has shifted toward the southern end in response to denser vegetation growth in the north and fires in the south, which created more open habitats (Rickard, personal communication). Jenni et al. (1982) reported that in 1979, curlews in western Idaho shifted their foraging areas away from their breeding territories to nearby agricultural fields because of thick residual vegetation from the previous year's lush growth. Similar shifts could occur on the YTC as troop training activities, grazing, fire, and weather affect the vegetation structure.

Nesting Areas and Nests

Nesting areas were identified by observing territorial and courtship displays and/or by locating four nests. Details on the located nests are listed in Table 2. Information from survey counts indicate that the Washout Gulch and Borden Springs areas were the most highly used. Generally the 1993 nesting areas were similar to those located in 1992 (Hand et al. 1994). The numbers of pairs in 1992 and 1993 are compared in Table 1. Major nesting areas, as identified from high bird use and territorial/courtship displays, and the located nests from 1992 and 1993 data are shown in Figure 5.

Table 2. Location Methods, Location (UTM Coordinates), and Outcome of Nests Located on the Yakima Training Center in 1993

Nest Number	Date Located	Location Method	Number of Eggs	General Location	UTM Coord. Zone 10	Diameter (mm) Long Axis	Diameter (mm) Short Axis	Depth (mm)	Outcome
1	4-23-93	Flushed	4	Washout Gulch	705184E 5162853N	221	167	34	Hatched
2	4-26-93	Flushed	4	Selah Creek	709253E 5173718N	248	205	47	Unknown[a]
3	4-29-93	Flushed	4	Washout Gulch	704418E 5162502N	225	208	45	Hatched
4	5-19-93	Radio-tracked	Unknown[b]	Range 55	717439E 5170310N	225	200	28	Hatched

(a) Outcome could not be determined because of lack of eggshell fragments.
(b) Nest was not approached closely until after hatching.

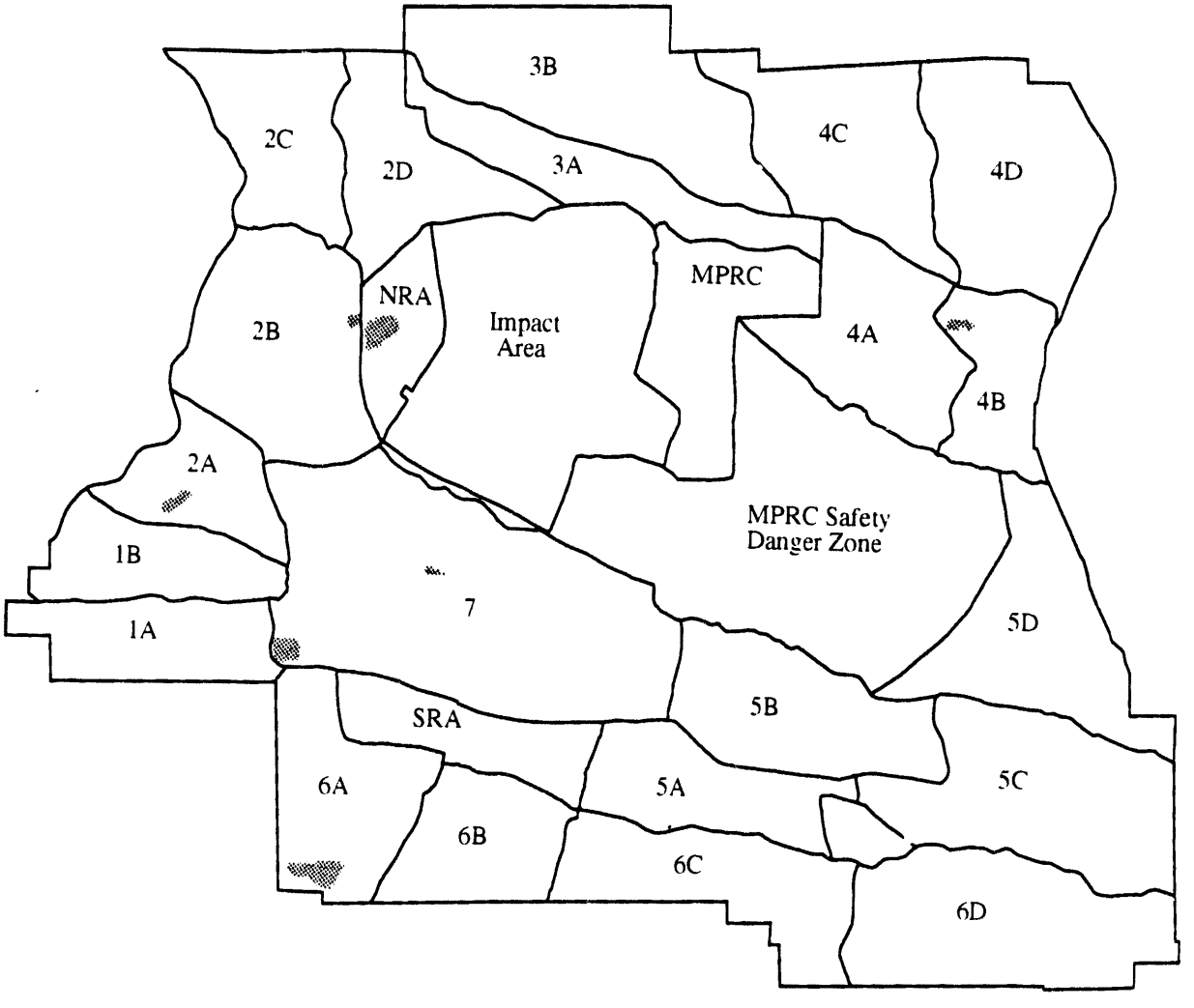

Figure 5. Areas Searched for Nests Using the Rope Drag Method

Six areas on the YTC ranging in size from 14 to 135 ha were searched for nests using the rope drag method. A total of 432 ha was searched in this manner. The six areas are shown in Figure 5. Two nests were found in the Washout Gulch area, and one was found along Selah Creek using this method. Range 5 was searched in the area where bird # 9.281's nest was located in 1992. No nests were found, and no birds were observed at Range 5 in 1993. The west half of Beller DZ was searched, but no nests were found. Open fields on and west of Range 19 and a small portion of the Borden Springs area also were searched. Much of these areas is not suitable for rope dragging because of remnant sagebrush stems, which catch and break the rope. No nests were found in these areas. Areas with dense shrubs were not searched because curlews do not use dense shrub habitat for nesting (Pampush 1980). Curlews do sometimes use areas with scattered shrubs; however, our rope drag method was not conducive for use in those areas.

Brood Rearing Areas

Curlew brood rearing areas tend to be adjacent to nesting areas. Adult curlews move away from open fields into areas of denser cover after their chicks hatch (Jenni et al. 1982). Adults believed to be tending broods (identified from mobbing/protective behavior) were observed in a stand of greasewood (*Sarcobatus vermiculatus)*, big sagebrush (*Artemisia tridentata*), and gray rabbitbrush (*Chrysothamnus nauseosus*) in the Washout Gulch area. Adults with chicks used big sagebrush stands adjacent to the nesting fields on and near Range 55 and in the Borden Springs area. Additional brood rearing areas are believed to have been used during 1993, but because no adults were radio-equipped during the brood rearing period, brood rearing areas could not always be identified. Identified brood rearing areas from 1992 and 1993 studies are shown in Figure 6.

Broods used the shrub stands on and near Range 55 and in the Borden Springs area in both 1992 and 1993. In 1992, parents tending broods were also observed near the Silica DZ, by the abandoned dam on Range 10, and on Yakima Ridge north of Washout Gulch. No broods were seen in these areas in 1993.

Population Size

The curlew population observed in 1993 was approximately twice that observed in 1992. Based on survey counts, we estimate the 1993 YTC long-billed curlew population to be 77 birds (Table 1), compared with the 1992 estimate of 39 birds. These are conservative estimates as some birds in the more inaccessible areas were probably missed. Allen (1980) reported the resident population of curlews on the Hanford Site west of the Columbia River to be approximately 100 birds.

Reproductive Success

At least three (1, 3, and 4) of the four located nests hatched. The outcome of Nest 2 could not be determined because of lack of eggshell fragments. Nesting success was determined by examining eggshell remains, but the number of chicks that hatched from each nest could not be accurately determined. The number of chicks seen in flocks in the Borden Springs area was much higher in 1993 than in 1992. Twelve juveniles were counted this year, compared with a high count of four in 1992.

Feeding Behavior and Diet

Observations of feeding birds occurred mostly in the morning (0653 hr to 1109 hr). Most of the observed morning feeding took place in grass cover types in or adjacent to the nesting areas/ territories. Early in the season, before nesting, male and female pairs fed together on their territories. During the incubation period, males were seen feeding in sagebrush cover types away from the nesting territories in mid-day. During the brood rearing period, males and females were again seen feeding together in sagebrush cover types. Allen (1980) reported that curlews fed both within and outside their nesting territories on the Hanford Site and in irrigated fields near the site. She found that pairs fed together before the onset of incubation and after the chicks hatched; during incubation, the unattending bird fed alone. She also found that all birds usually left their territories for several hours each day to feed and rest before the nesting period.

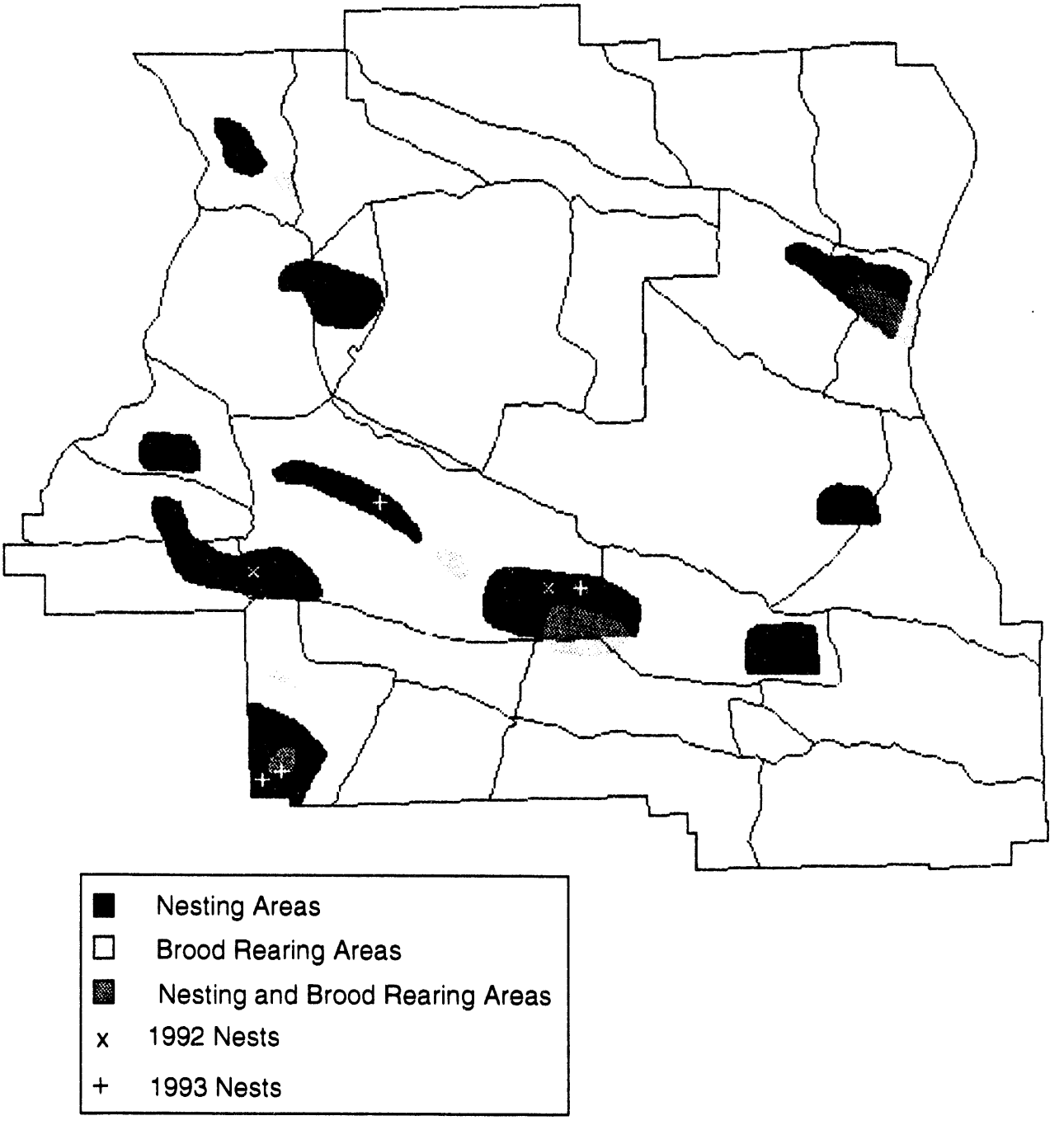

Figure 6. Major Long-Billed Curlew Nesting Areas and Identified Brood Rearing Areas on the Yakima Training Center, 1992 and 1993

Birds were observed to prey on beetles and grasshoppers. Other prey items could not be identified from a distance. While feeding, the birds walked and pecked or probed at the ground or in clumps of grass or shrubs. Often they would quickly run after something before pecking. Later in the season, when grasshoppers became abundant such chases were more common. When a prey item was caught, the bird raised its head and made several gulping motions with its open bill to move the prey into its mouth to swallow.

Response to Troop Activities

Monitoring the movements of curlews in response to troop training activities was not possible because of the lack of radio-equipped birds. No encounters between unmarked curlews and troop activities were seen during general observations.

Habitat Characterization

Curlew use of slope, elevation, and degraded areas was analyzed using GIS map layers. Vegetation measurements (composition, shrub density, and percent canopy cover) were used to characterize nest sites and brood locations. Table 3 lists the species found during vegetation sampling and provides their scientific and common names.

Use of Slope, Elevation, and Degraded Areas

The potential curlew habitat shown in Figure 3 (Hand et al. 1993) comprises 38.3% (40,846 ha) of the 106,502-ha YTC. Chi-square analysis using the 1993 location data shows curlews preferred land areas having elevations below 1,000 m and slopes less than 5° ($x^2 = 83.08$, 1 df, $p<0.005$). The degraded portion of the map has been expanded to include July 1992 degraded status. Within the elevation and slope criteria for potential curlew habitat, 8,667 ha (21.2% of potential habitat) have been degraded at some time between 1987 and 1992. Within the preferred elevation and slope, YTC curlews also selected for degraded habitat ($x^2 = 24.59$, 1 df, $p<0.005$). Because information on degraded status prior to 1987 is not available, some areas that were degraded in the past and have since been revegetated are not accounted for. However, it is likely that such areas now provide suitable curlew habitat. Curlews' preference for areas with less than 1,000 m elevation and less than 5° slope and for previously degraded areas can be seen in Figure 3 from the distribution of curlew locations. In general, these areas are also preferred military maneuver areas.

Nesting Area Vegetation

Three nests were located in annual grass habitat, and one was located in perennial bunchgrass habitat. The two nests in the Washout Gulch area were in cheatgrass (*Bromus tectorum*)-dominated habitat with canopy cover of 29.8 and 57.8% (Table 4). Planted crested wheatgrass (*Agropyron cristatum*) and Sandberg's bluegrass (*Poa sandbergii*) were also present. The third nest in annual grass habitat was located along Selah Creek. The dominant grasses there were Sandberg's bluegrass (26.4% cover) and cheatgrass (13.9% cover). This site was the most diverse in terms of grasses; needle and thread grass (*Stipa comata*) and Indian rice grass (*Oryzopsis hymenoides*) were also present. The nest located on Range 55 was in habitat dominated by the perennial grass bluebunch wheatgrass (*Agropyron spicatum*), which had a canopy cover of 42.4%. The only other grass present at this site was Sandberg's bluegrass.

Table 3. Vegetation Species on the Yakima Training Center Found in Curlew Nesting and Brood Rearing Areas (not a complete vegetation list for the Yakima Training Center)

Scientific Name	Common Name
Grasses	
Agropyron cristatum	Crested wheatgrass
Agropyron spicatum	Bluebunch wheatgrass
Bromus tectorum	Cheatgrass brome
Festuca bromides	Six-weeks fescue
Oryzopsis hymenoides	Indian ricegrass
Poa cusickii	Cusick bluegrass
Poa sandbergii	Sandberg's bluegrass
Sitanion hystrix	Squirrel tail
Stipa comata	Needle and thread grass
Forbs	
Centaurea spp.	Knapweed
Chorispora tenella	Blue mustard
Descurainea sophia	Flixweed
Draba verna	Spring whitlow-wort
Erodium cicutarium	Storksbill
Erigeron pumilus	Shaggy daisy
Holosteum umbellatum	Jagged chickweed
Lepidium perfoliatum	Clasping pepperwort
Medicago sativo	Alfalfa
Salsola kali	Russian thistle
Sisymbrium altissimum	Tumble-mustard
Shrubs	
Artemisia tridentata	Big sagebrush
Chrysothamnus nauseosus	Gray rabbitbrush
Sarcobatus vermiculatus	Greasewood

Table 4. Mean Canopy Cover (%) of Grasses at Nest Sites

Nest Number	General Location	Crested Wheatgrass	Bluebunch Wheatgrass	Cheatgrass	Indian Ricegrass	Sandberg's Bluegrass	Needle and Thread Grass
1	Washout Gulch	7.6	0	29.8	0	23.2	0
2	Selah Creek	0	0	13.9	1.4	26.4	3.1
3	Washout Gulch	3.1	0	57.8	0	9.8	0
4	Range 55	0	42.4	0	0	13.9	0

Grass heights (when measured soon after nest outcome was determined) did not differ greatly between nest sites. Average heights ranged from 21.0 cm in the cheatgrass-dominated area to 23.3 cm at the bluebunch wheatgrass site. Grass heights play an important role in nest site selection. Jenni et al. (1982) found curlew use to be negatively correlated with vegetation height during the pre-laying, laying, and incubation phases of the breeding cycle. Table 5 lists the heights of grasses at the nest sites.

Forbs were a small component of vegetation at all sites. Canopy cover of forbs is listed in Table 6. Tumble-mustard (*Sisymbrium altissimum*) was the most common forb, occurring on three sites. The Range 55 nest site contained few forbs, and none occurred within the area sampled. All four nest sites contained substantial bare ground (Table 7). The cheatgrass-dominated areas had the least bare ground (17.2 and 18.4%), whereas the nest site on Range 55 had the most bare ground (63.9%). No shrubs were present in the immediate vicinity of any of the nests. Distance to the nearest shrub from the nests ranged from approximately 60 to 800 m.

Brood Rearing Area Vegetation

Broods were located in three areas in 1993: Borden Springs, Range 55, and near Washout Gulch. These brood locations occurred in areas adjacent to, but distinct from, nesting fields. Two transects were sampled in both the Borden Springs and Washout Gulch areas, and three transects were sampled on Range 55. The most notable difference between the nesting areas and the brood rearing areas was the presence of shrubs at the brood locations (Table 8). Big sagebrush (*Artemisia tridentata*), gray rabbitbrush (*Chrysothamnus nauseousus*), and greasewood (*Sarcobatus vermiculatus*) were found at the sites.

The grass and forb cover at the brood sites was similar to that at the nest sites. The Borden Springs and Washout Gulch sites were dominated by cheatgrass brome and Sandberg's bluegrass (Table 9). The Range 55 site was the most diverse with seven grass species present within the sampled area. Most grass heights were similar at the nest sites and brood sites (Table 10). Tables 5 and 10 indicate that crested wheatgrass was approximately twice as tall at the brood sites as at the nest sites; however, because the brood sites were measured 1 month after the nest sites, this apparent difference is not related to site selection by the birds. The forb species and canopy cover values were much the same at the nest and brood sites (Table 11). Detritus and bare ground areas (Table 12) were not notably different in size.

Survey Method

General locations of the nine survey routes used to conduct prenesting counts of long-billed curlews on the YTC are shown in Figure 3. Detailed maps of the survey routes are included as Appendix B. Surveys along the routes were conducted between 25 March and 7 April 1993. A total of 23 surveys were conducted. Attempts were made to drive each route at least twice; however one route was surveyed only once because of poor weather and road conditions. Every route was surveyed at least once during the morning period, the best time for sighting birds.

Results of all surveys conducted are shown in Table 13. Morning was the most effective time for sighting and counting curlews. During the combined morning periods (10 surveys), 38 curlews were observed, compared with all other times combined (13 surveys), in which only 9 curlews were

Table 5. Mean Heights (cm) of Grasses at Nest Sites

Nest Number	Crested Wheatgrass	Bluebunch Wheatgrass	Cheatgrass Brome	Indian Ricegrass	Sandberg's Bluegrass	Needle and Thread Grass	Combined Average
1	21.5	-	16.4	-	29.1	-	22.3
2	-	-	12.9	25.0	22.7	25.0	21.4
3	22.7	-	19.9	-	20.4	-	21.0
4	-	32.7	-	-	13.9	-	23.3

Table 6. Mean Canopy Cover (%) of Forbs at Nest Sites

Nest Number	Knapweed	Blue Mustard	Spring Whitlow-Wort	Storksbill	Shaggy Daisy	Jagged Chickweed	Clasping Pepperwort	Russian Thistle	Tumble-Mustard
1	0	0	5.9	0	0	4.2	0	1.0	12.7
2	11.0	0	0	0	0.5	0	0.3	0	6.1
3	0	0.5	0.3	0.3	0	7.9	0	0	6.5
4	0	0	0	0	0	0	0	0	0

Table 7. Mean Cover (%) of Detritus and Bare Ground at Nest Sites

Nest Number	General Location	Detritus	Bare Ground
1	Washout Gulch	32.0	18.4
2	Selah Creek	9.8	44.4
3	Washout Gulch	10.7	17.2
4	Range 55	8.7	63.9

Table 8. Mean Canopy Cover (%) and Heights (cm) of Shrubs at Brood Rearing Sites

General Location	Big Sagebrush		Dead Big Sagebrush		Gray Rabbitbrush		Greasewood	
	Cover	Height	Cover	Height	Cover	Height	Cover	Height
Borden Springs	2.9	20.0	1.2	34.0	0.9	32.0	0	-
Washout Gulch	2.7	28.8	0	-	3.9	22.7	4.7	42.5
Range 55	1.7	51.5	0	-	0	-	0	-

Table 9. Mean Canopy Cover (%) of Grasses at Brood Rearing Sites

General Location	Crested Wheatgrass	Bluebunch Wheatgrass	Cheatgrass Brome	Six-weeks Fescue	Cusick Bluegrass	Sandberg's Bluegrass	Squirrel Tail
Borden Spring	0	0	34.5	8.2	0	18.0	0
Washout Gulch	7.0	0	24.8	0.1	0	27.1	0
Range 55	27.6	4.9	26.3	0.4	0.5	14.7	5.7

Table 10. Mean Heights (cm) of Grasses at Brood Rearing Sites

General Location	Crested Wheatgrass	Bluebunch Wheatgrass	Cheatgrass Brome	Six-weeks Fescue	Cusick Bluegrass	Sandberg's Bluegrass	Squirrel Tail
Borden Spring	-	-	19.7	10.1	-	22.8	-
Washout Gulch	41.6	-	20.5	9.0	-	24.5	-
Range 55	47.7	28.8	17.3	6.0	15.0	22.8	24.3

Table 11. Mean Canopy Cover (%) of Major[a] Forbs at Brood Rearing Sites

General Location	Knapweed	Blue Mustard	Spring Whitlow-Wort	Shaggy Daisy	Jagged Chickweed	Clasping Pepperwort	Russian Thistle	Tumble-Mustard
Borden Springs	0	0	1.5	0.8	0	1.1	2.1	0.3
Washout Gulch	0	0	0.1	0	1.2	0.5	4.6	4.0
Range 55	0.2	0.5	0.1	0	0.5	0.2	0	2.7

(a) Flixweed and alfalfa are not included. They occurred only in trace amounts (< 0.05%).

Table 12. Mean Cover (%) of Detritus and Bare Ground at Brood Rearing Sites

General Location	Detritus	Bare Ground
Borden Springs	12.8	30.4
Washout Gulch	19.0	26.6
Range 55	29.3	27.9

sighted. Curlews are most active in the morning when engaged in territorial and courtship displays and while feeding. Curlews often leave their territories during part of the day (Allen 1980); therefore, mid-day and afternoon/evening counts were low.

In their evaluation of census techniques in Idaho, Redmond et al. (1981) found male curlews to be more detectable than females during the prelaying and incubation periods because of the male's display flights. Our data support their findings; 25 males were counted during the 1993 surveys compared with 10 females.

Table 13. Results of Surveys Conducted for Long-Billed Curlews on the Yakima Training Center in 1993

Route Number	Transect Name	Date of Survey	Start Time	Number Males	Number Females	Number Unk. Sex	Total Number
1	Borden Springs	3-30	1130	1	0	2	3
		3-31	0630	5	1	3	9
2	Silica DZ	3-25	1336	0	0	0	0
		3-30	0725	0	0	1	1
		4-06	1838	0	0	0	0
3	Range 19	3-25	1248	0	0	0	0
		3-30	0558	2	0	0	2
		4-06	1748	0	0	0	0
4	Beller DZ	3-25	1148	0	0	0	0
		3-26	1017	0	0	0	0
		4-02	0550	3	1	0	4
5	Range 1	4-01	1745	1	0	2	3
		4-02	0720	0	0	0	0
		4-06	1220	0	0	0	0
6	Selah Creek	3-30	0545	2	1	1	4
		4-01	1515	0	0	0	0
		4-07	1052	1	1	0	2
7	Range 10-55	3-25	1020	0	0	0	0
		3-31	0550	1	1	0	2
		4-01	0625	1	0	0	1
8	Range 14	4-02	0610	0	0	2	2
9	Washout Gulch	3-25	1550	0	0	1	1
		3-26	0650	8	5	0	13
	Total			25	10	12	47

General Conclusions and Recommendations

Curlews were first observed on the YTC in 1993 on 21 March and last sighted on 1 July. One curlew (male) was captured and fitted with a radio transmitter and leg bands. Major nesting areas were identified by observing territorial and courtship displays and/or by locating nests. The Washout Gulch and Borden Springs areas had the highest curlew use. Most long-billed curlew nesting habitat on the YTC is characterized by annual grass (cheatgrass and bluegrass) habitat. Some nesting is also done in perennial bunchgrass (bluebunch wheatgrass and crested wheatgrass) habitat. Grass height in the nesting areas was generally less than 25 cm, or shorter than the height of adult birds.

Brood rearing areas were identified by observing intense threat displays of parent birds and (late in the brood rearing period) sightings of juveniles. Curlew brood rearing habitat is characterized by a mosaic of shrubs (sagebrush, rabbitbrush, and greasewood) and grasses (both annual and perennial). Both grasslands containing small, relatively dense patches of shrubs and areas with shrubs scattered thinly throughout were used. Quality curlew habitat has brood rearing areas that either occur in patches within the nesting areas or border the nesting areas. This provides protective cover for chicks as they leave the nest area. Habitat modifications from troop training that result in a mosaic of annual/perennial grassland (nesting) habitat and shrub/grassland (brood rearing) habitat is likely beneficial to long-billed curlews.

The YTC curlew population in 1993 was estimated to be 77 birds. This compared to 39 birds observed in 1992. This population estimate is conservative because not all potential curlew use areas were accessible (i.e., Impact Area). Troop training activity was nominal in breeding and brood rearing areas during the birds' seasonal use and negative impacts were not observed. Because nesting areas are located in prime maneuver areas, any increase in the level of troop training may increase the risk for nest damage or desertion. For protection of breeding curlews, it is recommended that training activities be limited in the nesting areas during the laying and incubation periods (April through May).

Three of the four located nests hatched on the YTC in 1993; however this is not a large enough sample size from which to draw conclusions concerning reproductive success. The number of chicks that hatched and their survival to fledgling was not determined, so conclusions about recruitment into the population cannot be drawn. Juvenile to adult ratios during flocking in the Borden Springs area in 1993 (12 juveniles:4 adults) compared with 1992 (4 juveniles:19 adults) indicate better reproductive success in 1993, though other factors such as timing of adult migration may have affected this count as well.

Information on curlew feeding behavior and diet was gained through general observations. Before and after the incubation period curlew pairs fed together. Most feeding occurred in the mornings on their territories, but birds also fed at other times of day and sometimes off their territories. Beetles and grasshoppers were the predominant prey items observed. Evaluating curlews' responses to troop activities was not possible because of the lack of radio-equipped birds.

Survey Recommendations

Surveys conducted in 1993 provided useful data on curlew numbers in the major use areas. Surveys were conducted from 25 March through 7 April 1993 following peak curlew arrival and before the onset of nesting. Morning surveys were best for sighting birds. Males were more

detectable than females. A total of 47 birds (25 males, 10 females, and 12 unknown) were seen during 23 surveys. We recommend these surveys be conducted every spring to monitor trends in curlew use of the YTC. Directions and guidelines for conducting the surveys are discussed below. An example data sheet is included in Appendix C.

Time of Year

Data from 1992 and 1993 indicate that curlews first arrive 19-21 March, and that most birds return by 31 March-2 April. Because surveys should be conducted during peak curlew arrival, and before nesting begins, the best time to conduct them would be 25 March through 7 April. However, because the timing of curlew arrival and nesting can vary somewhat from year to year because of weather, the beginning date of surveys should be left somewhat flexible. A useful starting date would be 5 to 7 days after the first curlew sighting. Surveys should be conducted daily and run no longer than 2 weeks.

Time of Day

Because curlews are most active on their territories in the morning, the recommended time for surveys is between 0600 and 0900 hours. Birds become active just prior to sunrise so the start time should be adjusted accordingly. Late afternoon/evening surveys are second best as curlews are generally back on their territories, though less active than in the morning. These surveys can be useful and should be conducted if time permits. Suggested time for evening surveys is between 1600 and 2000 hours; however, this activity period is much more variable than the morning period and is difficult to predict. Surveys should not be conducted during mid-day because curlews are less active and may be away from their territories. Surveys should not be conducted during fog, heavy rain, or high winds because of decreased visibility and activity.

Choice of Survey Routes

The highest-priority routes are Washout Gulch and Borden Springs area. These have the highest curlew use and, therefore, the greatest potential for quality counts. Mid-priority routes are Selah Creek, Beller DZ, Ranges 10-55, and Range 19. These areas have regular use, though fewer birds. These routes are valuable for surveys because they are located in areas of relatively high military activity, and any effects from disturbance could be monitored. The low-priority routes are Range 14, Range 1, and Silica DZ. Currently, these areas have fairly low use but appear to have potential for higher use because of their vegetation structure. As time allows, occasional surveys of these areas could detect shifts in curlew use areas. A route was not established at the Pozzuolana Mine area, but should be considered as a candidate if the survey program is expanded. Suitable vegetation structure and low human activity make it suitable for curlews, as indicated by the increased use observed in 1993.

Time Required

Table 14 lists the length of each route, the average time needed to actually survey each route, and the approximate round trip travel time to the starting and/or ending point of each route from Range Control. Surveys in high-use areas take longer than surveys of similar length in lower use areas because of the increased counting, sex identification, and data recording. At least two surveys should be conducted on each route to ensure typical counts. Conducting two morning surveys of each high- and mid-priority route will take 12 mornings. The extra two mornings of the 2-week survey period can be used to adjust the schedule because of poor weather or for extra surveys. An evening survey of each high-priority route is also recommended.

Table 14. Lengths, Average Time Required to Survey, and Approximate Round Trip Travel Time for Long-Billed Curlew Survey Routes on the Yakima Training Center. Travel time is estimated from range control.

Route Number	Route Name	Route Length (mi)	Average Survey Time	Approx. Round Trip Travel Time from Range Control
1	Borden Springs	2.5	1 hr 0 min	2 hr 30 min
2	Silica DZ	3.5	50 min	1 hr 20 min
3	Range 19	5.0	1 hr 0 min	1 hr 0 min
4	Beller DZ	2.1	35 min	30 min
5	Range 1	5.0	1 hr 0 min	10 min
6	Selah Creek	6.4	1 hr 35 min	40 min
7	Range 10-55	4.5	1 hr 35 min	1 hr 0 min
8	Range 14	5.5	1 hr 25 min	1 hr 30 min
9	Washout Gulch	5.5	1 hr 25 min	1 hr 30 min

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Appendix A

Location Data of Long-Billed Curlews Sighted on the Yakima Training Center in 1993

Table A.1. Location Data of Long-Billed Curlews Sighted on the Yakima Training Center in 1993

Date	Time	Bird Number	UTM Coordinates Easting	Northing	Zone	No. of Birds	Activity
930321	--	--	706500	5182600	10	-	Unknown
930321	0730	--	715900	5168250	10	1	Calling
930324	0530	--	712400	5168700	10	1	Flying
930324	0625	--	716100	5169400	10	1	Calling
930324	0730	--	715000	5168300	10	2	Flying
930324	0920	--	706550	5182800	10	1	Flying
930325	1613	--	704400	5163750	10	1	Flying
930326	0608	--	716700	5168500	10	1	Flushed
930326	0653	--	705500	5162100	10	2	Feeding
930326	0659	--	705700	5162300	10	1	Preening
930326	0708	--	705900	5162800	10	2	Feeding
930326	0719	--	705500	5162900	10	2	Feeding
930326	0726	--	704900	5162800	10	2	Feeding
930326	0806	--	706100	5163500	10	1	Feeding
930326	0823	--	705900	5163900	10	1	Feeding
930326	0845	--	704700	5164400	10	2	Courtship display
930330	0615	--	707700	5182300	10	1	Preening
930330	0632	--	707800	5174300	10	2	Flushed
930330	0640	--	706600	5182500	10	1	Flushed
930330	0701	--	709900	5173400	10	2	Flying
930330	0747	--	703400	5188700	10	1	Hiding
930330	1150	--	271100	5182750	11	3	Flying
930331	0611	--	717600	5169700	10	1	Unknown
930331	0619	--	717000	5169800	10	1	Unknown
930331	0631	--	728240	5183734	10	3	Threat display
930331	0703	--	728500	5182800	10	2	Flushed
930331	0710	--	729050	5183250	10	2	Threat display
930331	0740	--	272500	5182000	11	1	Flying
930331	0745	--	271900	5181400	11	1	Feeding
930401	0600	--	716700	5168500	10	2	Flushed
930401	0648	--	699900	5175800	10	1	Threat display
930401	0656	--	717400	5169700	10	1	Flushed
930401	1200	--	714197	5189091	10	2	Unknown
930401	1803	--	701800	5171400	10	1	Hiding
930401	1816	--	701900	5171900	10	2	Flying
930402	0553	--	701650	5175500	10	2	Preening
930402	0614	--	700400	5176000	10	1	Preening
930402	0633	--	699600	5175600	10	1	Preening
930402	0708	--	724800	5168700	10	1	Flying
930403	1658	--	718300	5169300	10	3	Flying
930405	1930	--	705500	5162300	10	2	Resting
930405	2000	--	704500	5162500	10	2	Flying
930405	2400	--	716800	5170500	10	1	Flushed
930406	1200	--	709600	5181500	10	1	Threat display
930406	1240	--	726000	5169250	10	1	Flying
930407	1035	--	707250	5177850	10	1	Flying
930407	1109	--	708900	5173650	10	2	Feeding
930407	1620	--	706800	5163500	10	1	Flushed
930407	1830	--	716000	5168000	10	1	Threat display

Table A.1. (contd)

Date	Time	Bird Number	UTM Coordinates Easting	Northing	Zone	No. of Birds	Activity
930408	1028	--	703250	5172200	10	1	Threat display
930408	1450	--	717550	5169450	10	1	Flushed
930411	0915	--	713300	5191800	10	1	Unknown
930413	0815	--	706550	5163900	10	2	Flying
930414	1025	--	715068	5166977	10	1	Flying
930414	1739	--	708600	5180950	10	2	Drinking, bathing
930414	1800	--	705821	5167220	10	2	Flushed
930415	--	--	700500	5172100	10	2	Unknown
930415	1400	--	723702	5166517	10	1	Flying
930416	0623	--	716700	5168500	10	1	Threat display
930416	0750	--	706300	5163300	10	1	Feeding
930416	0804	--	706050	5162900	10	1	Flushed
930416	0840	--	705300	5162100	10	2	Flying
930416	0850	--	705750	5162500	10	4	Courtship display
930416	0930	--	706600	5163900	10	1	Flushed
930421	1606	--	709400	5181800	10	2	Feeding
930423	0610	--	716000	5168000	10	1	Threat display
930423	0655	--	699800	5176100	10	2	Threat display
930423	0820	--	699600	5176150	10	1	Flying
930423	1200	--	705184	5162853	10	1	Incubating, flushed
930424	0917	--	716700	5174900	10	1	Threat display
930425	1423	--	705651	5182714	10	1	Flushed
930426	1450	--	706257	5174705	10	1	Flushed
930426	1505	--	708765	5173850	10	1	Flushed
930426	1525	--	709279	5173725	10	1	Incubating, flushed
930427	0630	--	716650	5168600	10	1	Flushed
930427	0729	--	706350	5182500	10	1	Flushed
930427	0735	--	700400	5176000	10	1	Preening
930427	1123	--	716200	5179300	10	1	Threat display
930427	1230	--	728300	5182925	10	2	Threat display
930428	1849	--	272600	5180200	11	2	Resting
930429	1115	--	704418	5162602	10	2	Incubating, flushed
930429	1155	--	705184	5162853	10	2	Incubating, flushed
930429	1345	--	706550	5181950	10	1	Flushed
930430	0815	--	706400	5181700	10	1	Threat display
930430	0820	--	706700	5182400	10	1	Threat display
930503	1029	--	729046	5173582	10	5	Threat display
930505	1200	--	708500	5181500	10	1	Flying
930507	0618	--	716800	5169500	10	1	Flushed
930507	0850	--	271300	5173500	11	6	Threat display
930507	1325	--	270900	5173750	11	3	Resting
930507	1730	--	706000	5167600	10	5	Unknown
930509	1647	--	707034	5183453	10	1	Drinking, bathing
930510	1930	--	716800	5168400	10	1	Threat display
930511	1545	--	715700	5167750	10	2	Flying
930511	1715	--	716550	5168600	10	1	Threat display
930511	1755	--	715993	5174700	10	8	Drinking, bathing
930513	1700	--	715993	5174700	10	2	Drinking, bathing
930513	1745	--	715993	5174700	10	4	Flying
930513	1900	--	715993	5174700	10	1	Drinking, bathing

Table A.1. (contd)

Date	Time	Bird Number	UTM Coordinates Easting	Northing	Zone	No. of Birds	Activity
930513	1915	--	715993	5174700	10	2	Flying
930514	0830	--	706700	5174700	10	1	Flushed
930514	1130	--	705488	5163101	10	5	Threat display
930514	1211	--	729046	5173582	10	1	Flying
930514	1730	--	715993	5168381	10	1	Drinking, bathing
930514	1735	--	715993	5168381	10	2	Flying
930514	1825	9.945	715993	5168381	10	2	Drinking, captured
930515	1535	9.945	717244	5167503	10	1	Flushed
930517	1805	--	717100	5169300	10	7	Unknown
930517	1835	--	715993	5168381	10	1	Hiding
930517	2120	9.945	717439	5170310	10	1	Incubating
930518	1200	--	705700	5163400	10	1	Threat display
930518	1645	--	704686	5175018	10	1	Flying
930518	1715	--	704686	5175018	10	2	Unknown
930518	1745	--	704686	5175018	10	1	Drinking, bathing
930519	0655	9.945	717439	5170310	10	2	Incubating
930521	0720	9.945	717439	5170310	10	2	Incubating
930521	1000	--	705500	5163200	10	1	Flying
930521	1020	--	705200	5163000	10	1	Hiding
930521	1218	9.945	717450	5170260	10	1	Threat display
930521	1645	--	715993	5168381	10	1	Flying
930521	1705	--	715993	5168381	10	3	Flying
930524	1734	--	704662	5175031	10	4	Resting
930524	1925	9.945	717400	5170250	10	1	Unknown
930524	1940	--	716800	5168700	10	1	Flushed
930525	1025	--	704700	5163000	10	6	Feeding
930525	1025	--	705100	5163200	10	1	Threat display
930525	1300	--	717950	5168500	10	2	Threat display
930525	1525	--	715993	5168381	10	1	Flying
930525	--	9.945	717387	5170172	10	-	Unknown
930525	1625	--	717300	5170200	10	1	Flying
930525	1645	--	717800	5168900	10	2	Hiding
930525	1725	--	717950	5168500	10	2	Threat display
930526	1930	--	729046	5173582	10	1	Threat display
930528	1645	--	718600	5168500	10	2	Threat display
930601	0800	--	716581	5169518	10	1	Flying
930601	1013	--	716581	5169518	10	3	Threat display
930615	1045	--	270900	5181900	11	6	Threat display
930615	1110	--	271600	5181500	11	4	Threat display
930615	1205	--	271400	5180900	11	2	Threat display
930615	1215	--	271100	5181100	11	2	Hiding
930615	1440	9.383	716650	5169500	10	2	Threat display
930624	0800	--	728751	5182369	10	21	Threat display
930626	1537	--	696700	5172200	10	1	Resting
930628	0930	--	271650	5181550	11	9	Hiding
930701	1010	--	728881	5182536	10	16	Feeding

Appendix B

Maps of Long-Billed Curlew Survey Routes Used on the Yakima Training Center in 1993

(Map Portions Were Taken from the Yakima Firing Center Special Map, Series V791S Edition 4-DMA.)

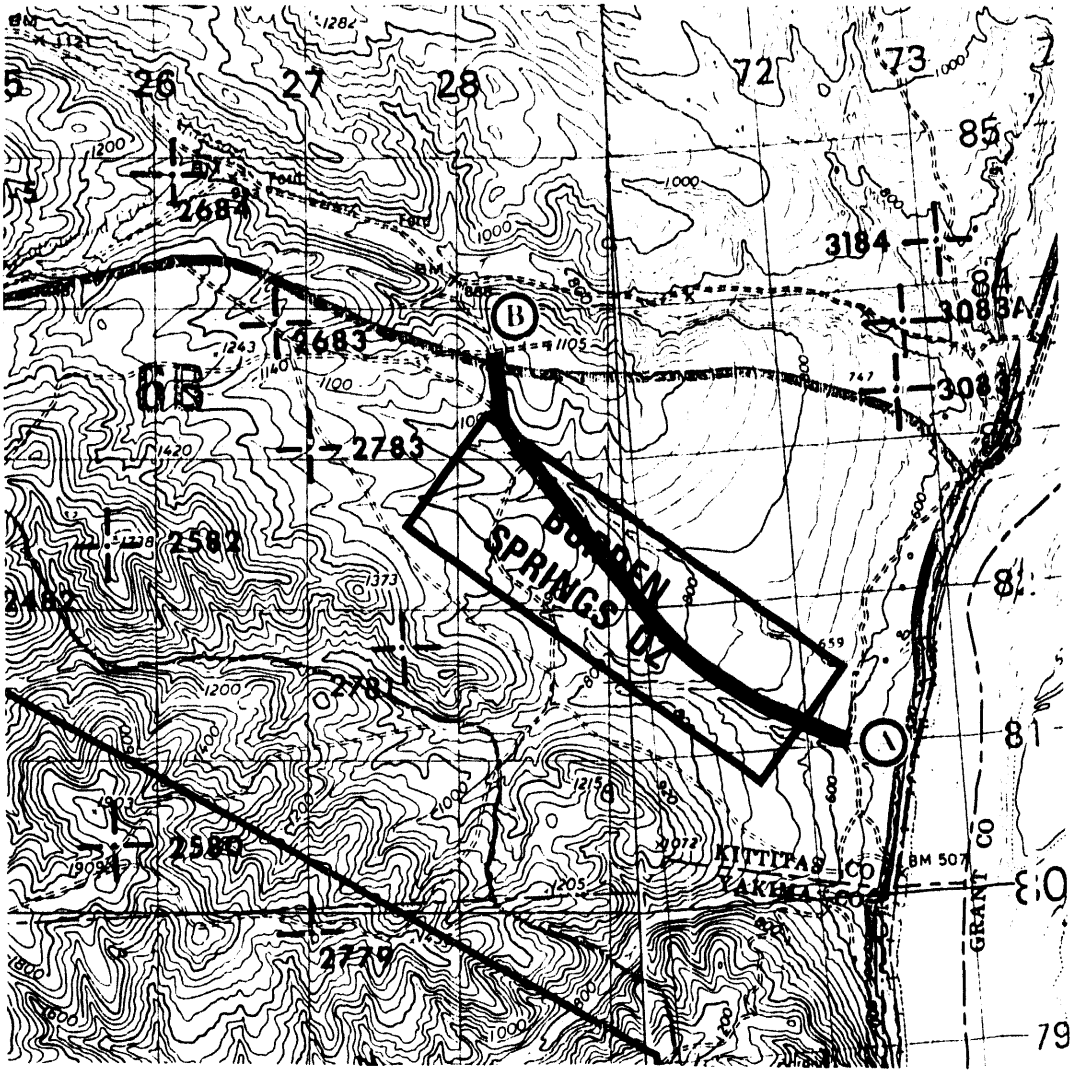

Figure B.1. Borden Springs Curlew Survey Route

Point	UTM Coordinates Easting	Northing	Zone
A	272248	5181018	11
B	728247	5183762	10

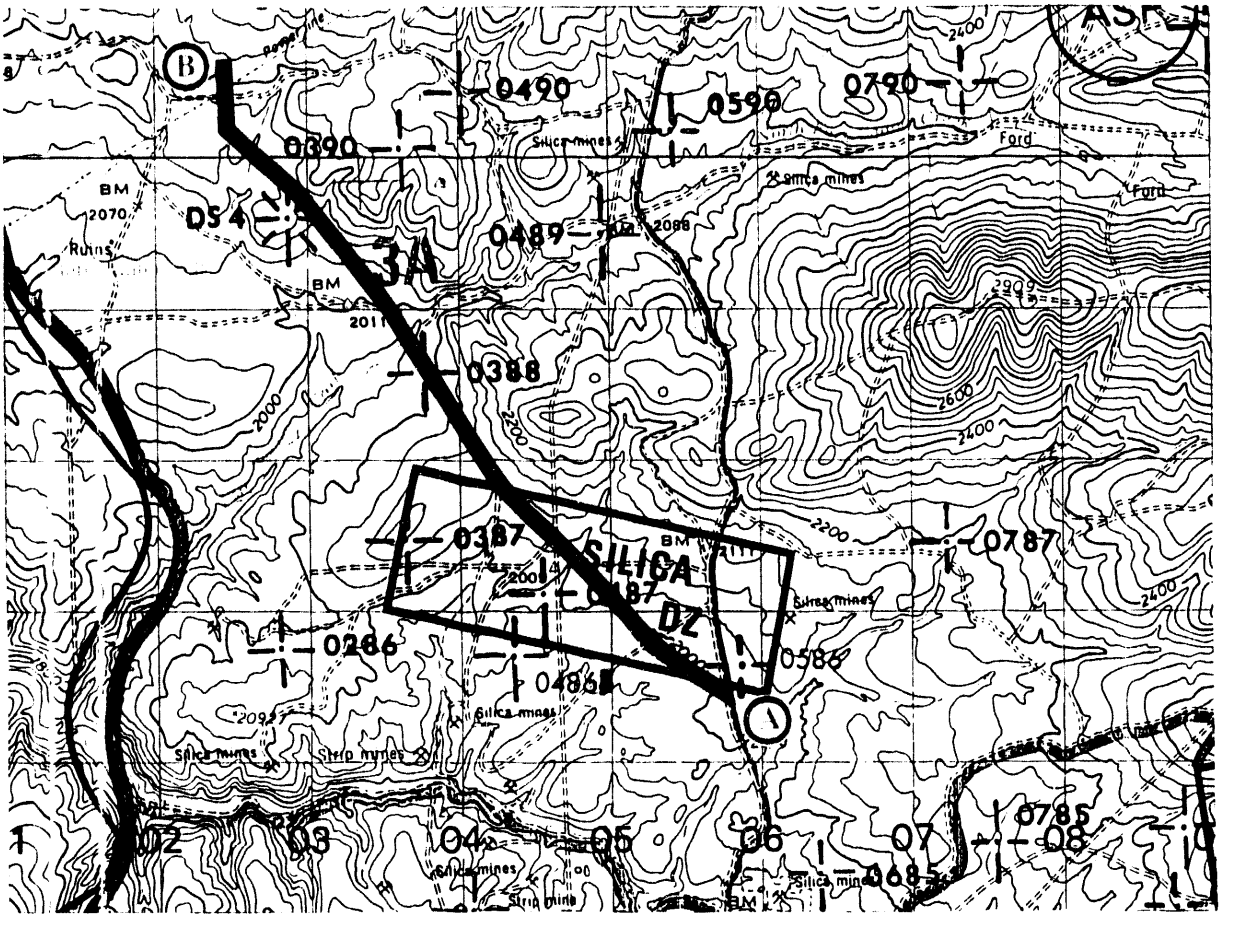

Figure B.2. Silica DZ Curlew Survey Route

Point	UTM Coordinates Easting	Northing	Zone
A	705802	5186505	10
B	702482	5190661	10

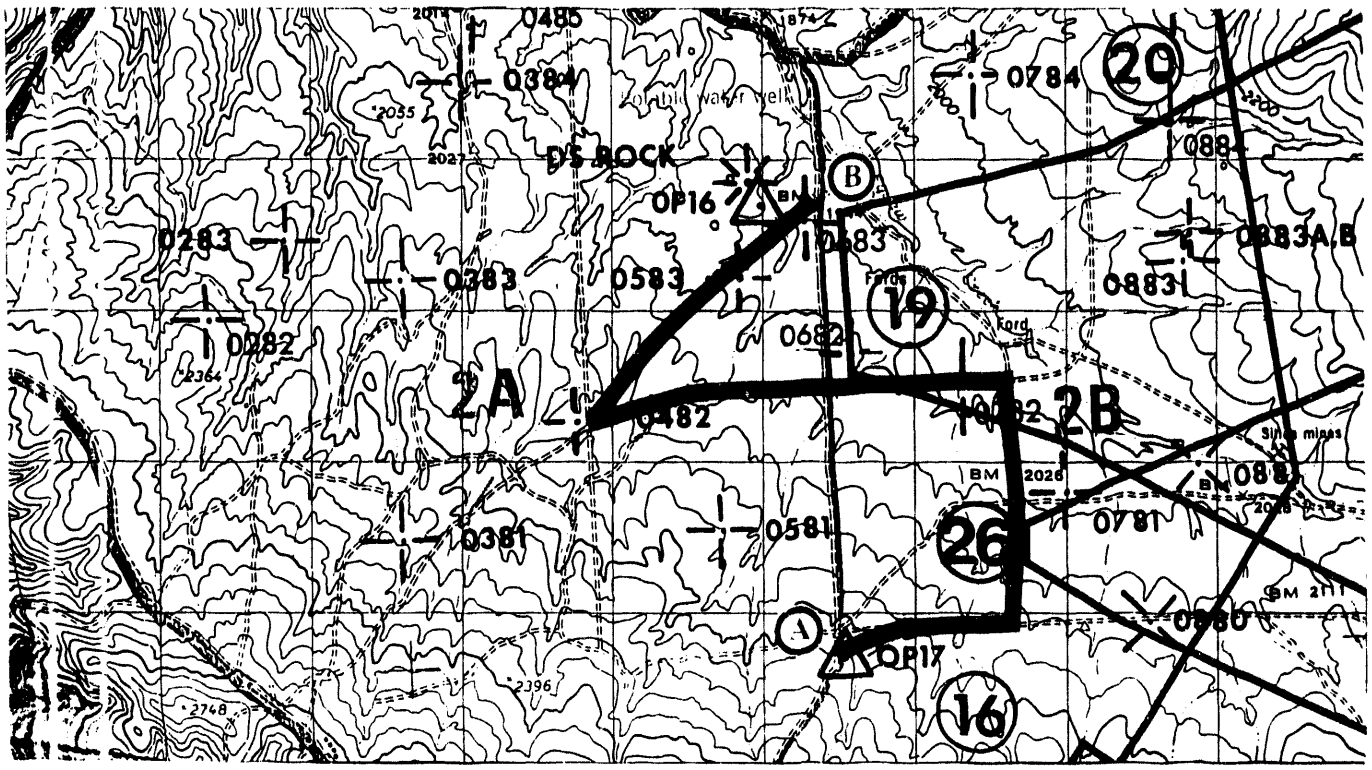

Figure B.3. Range 19 Curlew Survey Route

Point	UTM Coordinates Easting	Northing	Zone
A	706542	5180735	10
B	706398	5183783	10

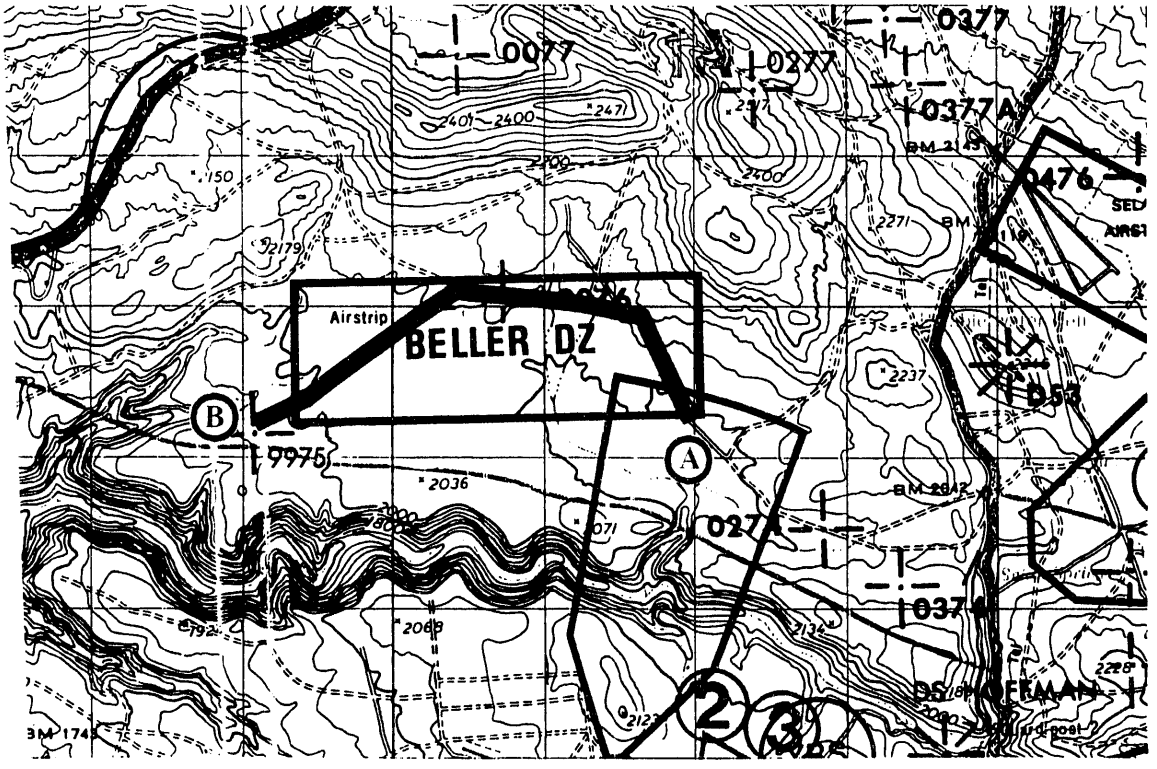

Figure B.4. Beller DZ Curlew Survey Route

Point	UTM Coordinates Easting	Northing	Zone
A	701971	5175354	10
B	699171	5175331	10

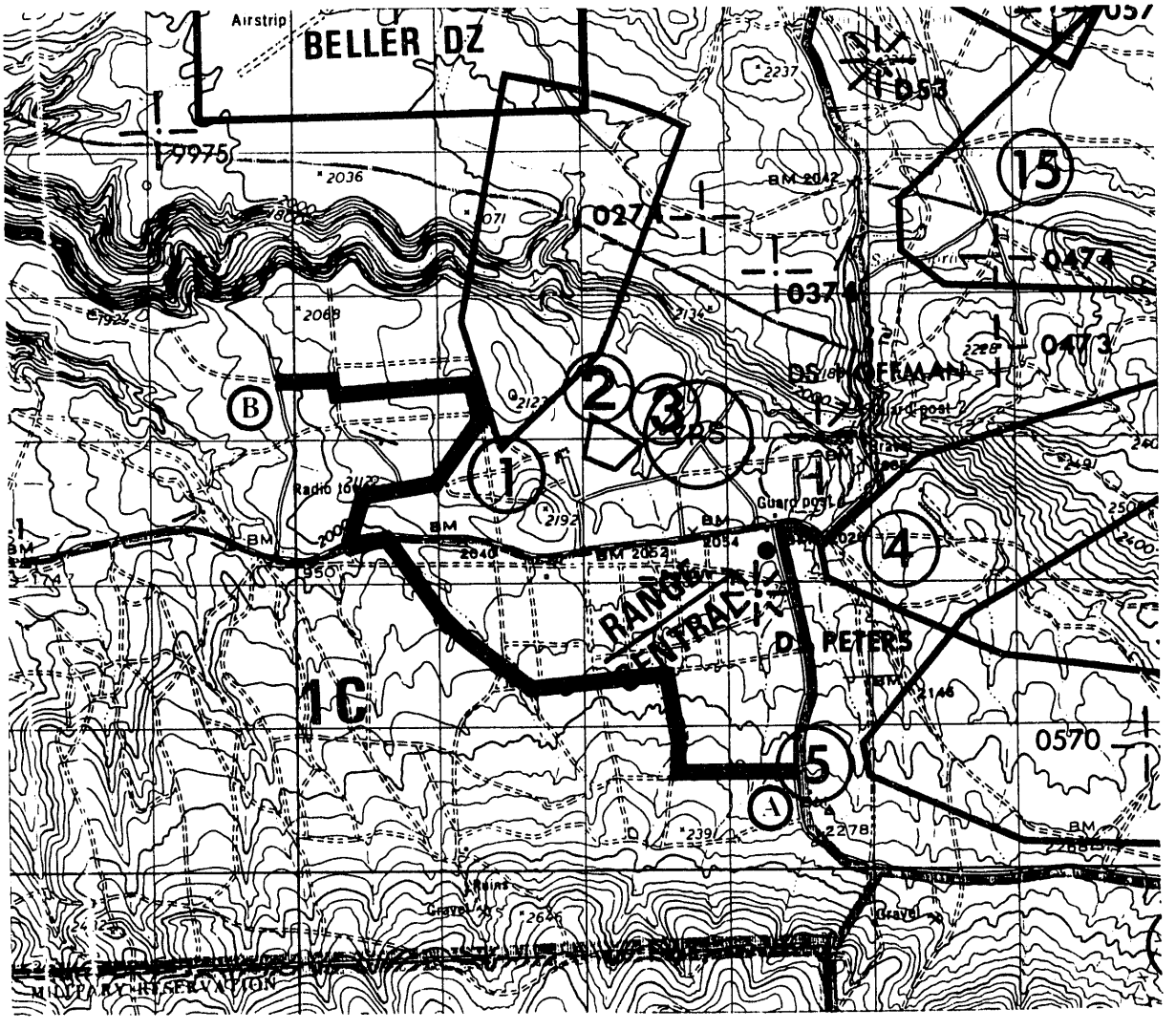

Figure B.5. Range 1 Curlew Survey Route

Point	UTM Coordinates Easting	Northing	Zone
A	703420	5170725	10
B	699915	5173430	10

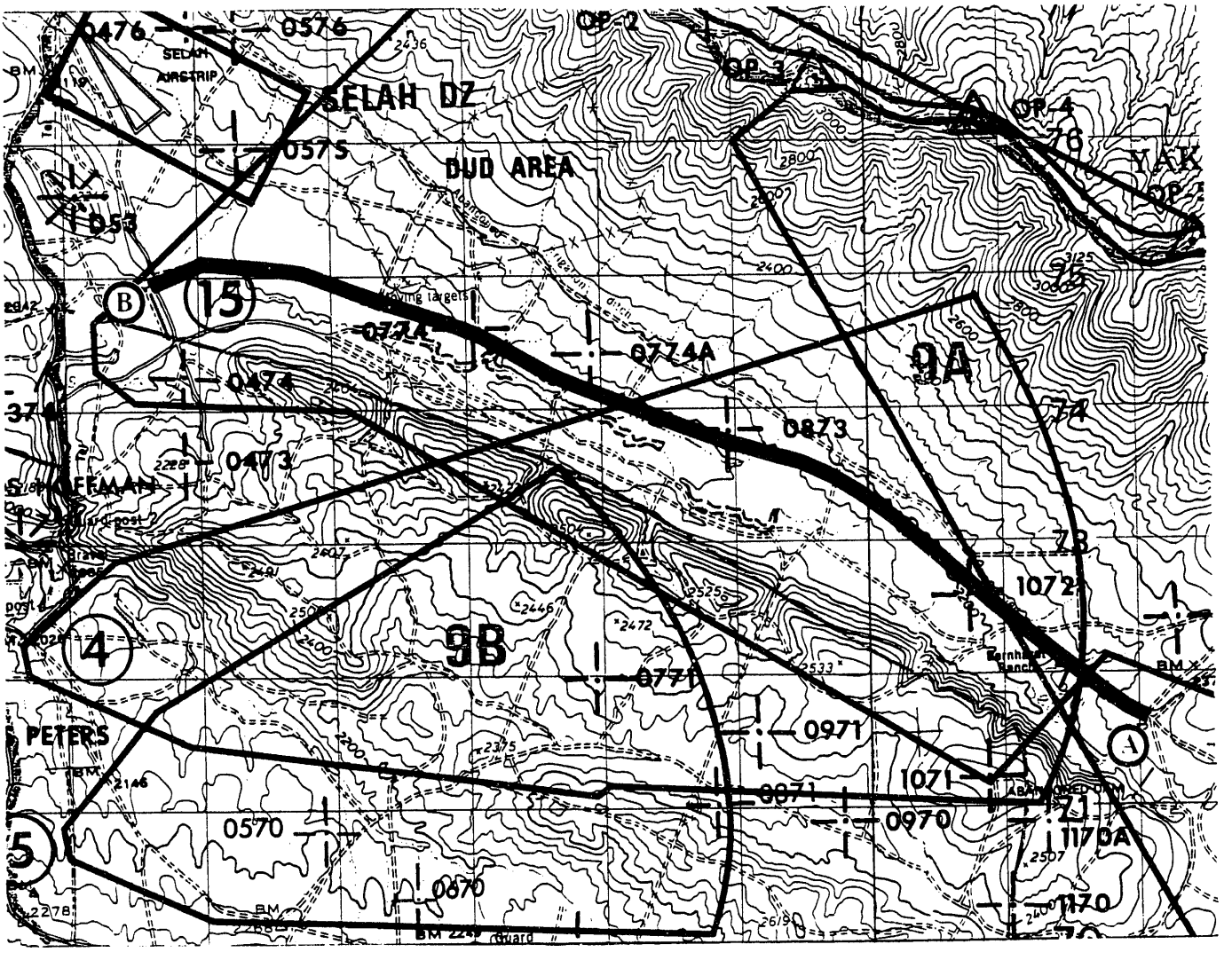

Figure B.6. Selah Creek Curlew Survey Route

Point	UTM Coordinates Easting	Northing	Zone
A	712140	5171689	10
B	704710	5174991	10

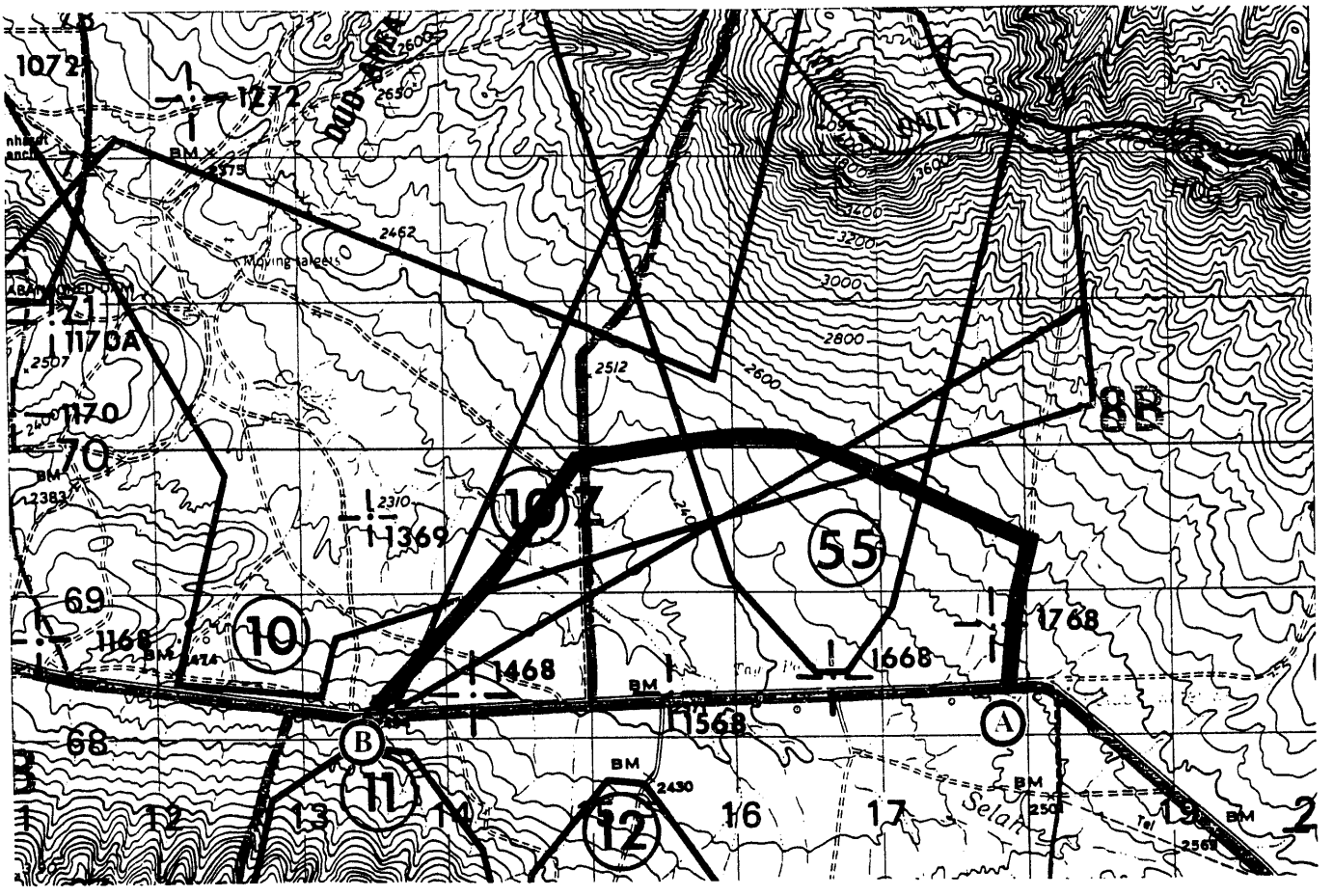

Figure B.7. Range 10-55 Curlew Survey Route

Point	UTM Coordinates Easting	Northing	Zone
A	717809	5168405	10
B	713409	5168275	10

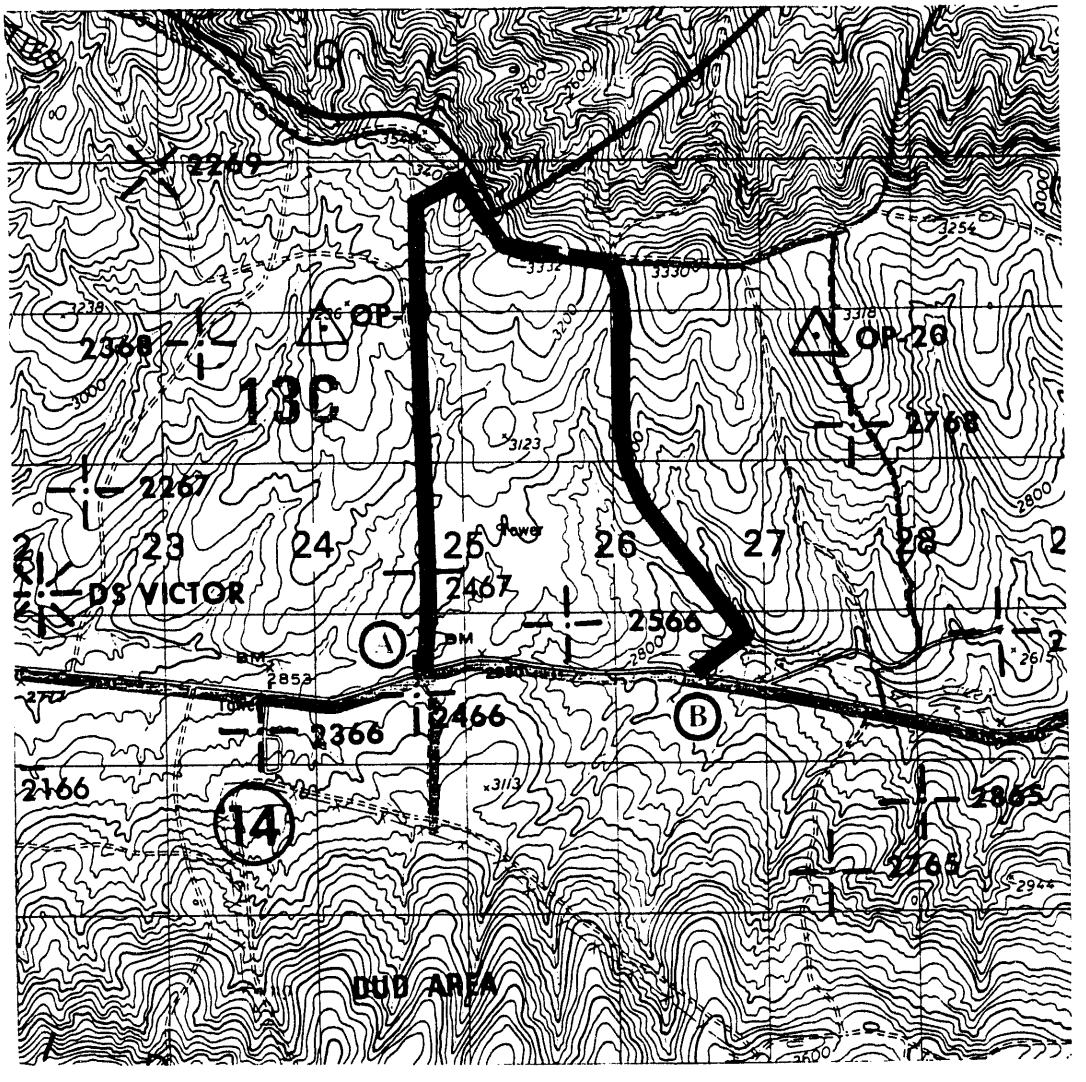

Figure B.8. Range 14 Curlew Survey Route

Point	UTM Coordinates Easting	Northing	Zone
A	724615	5166599	10
B	726531	5166579	10

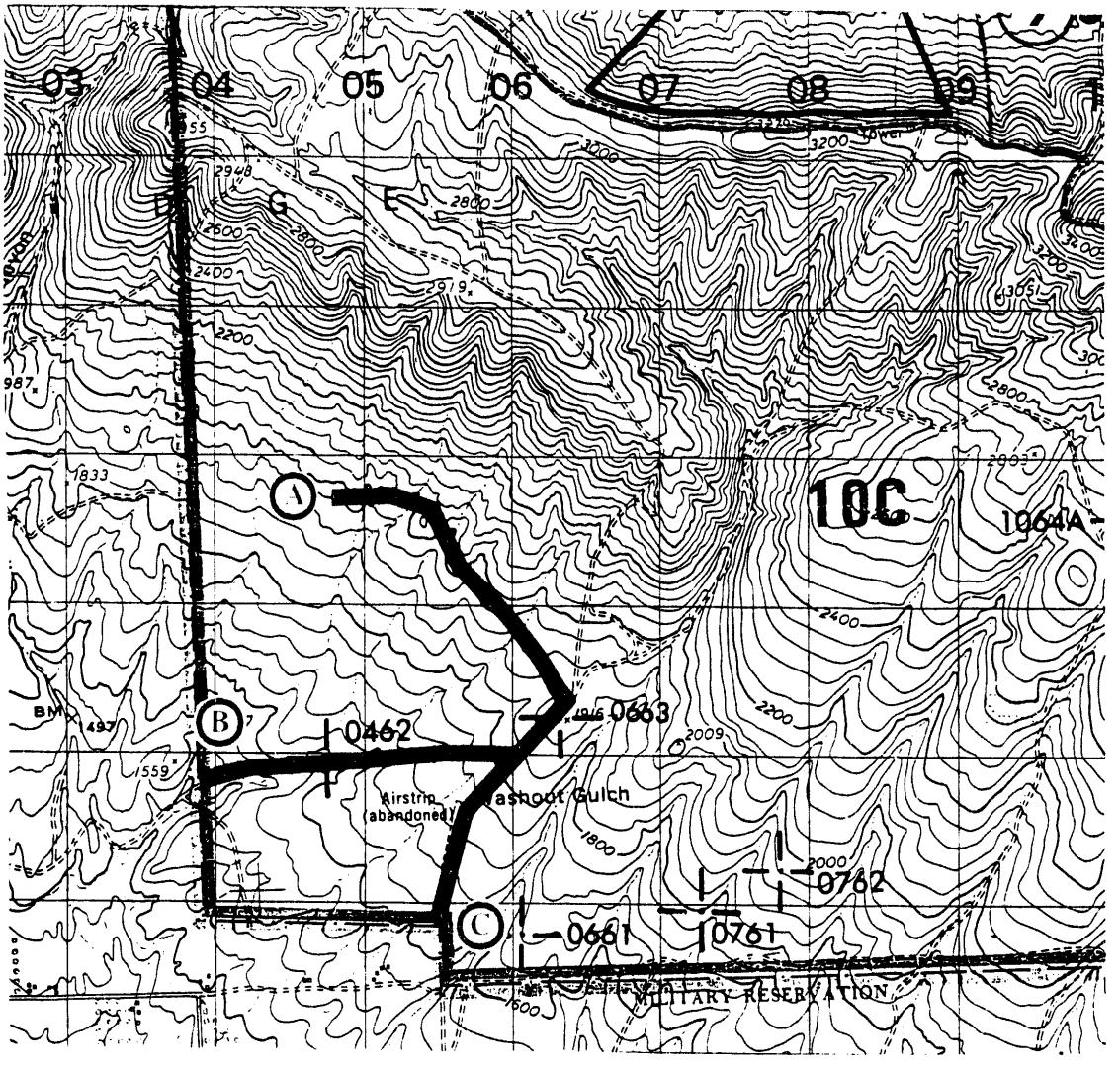

Figure B.9. Washout Gulch Curlew Survey Route

Point	UTM Coordinates Easting	Northing	Zone
A	704876	5164683	10
B	703862	5162793	10
C	705489	5161871	10

Appendix C

Example Data Sheet for Use in Surveys of Long-Billed Curlews

Long-Billed Curlew Survey

Date_____ Observer_____

Transect Name_____

Weather_____

Time: Start_____ End_____ Odometer: Start_____ End_____

Odometer Reading	Time	Birds (# & Sex)	Comments

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