This is Appendix D to the Felton Prairie Report

POPULATION ASSESSMENT

CALCARIUS ORNATUS

(Chestnut-collared Longspurs)

FELTON PRAIRIE

MINNESOTA

Ann Marie Wyckoff

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Consultant's Report prepared for the Natural Resources Dept/APPENDIX to Felton Prairie Study November 1985

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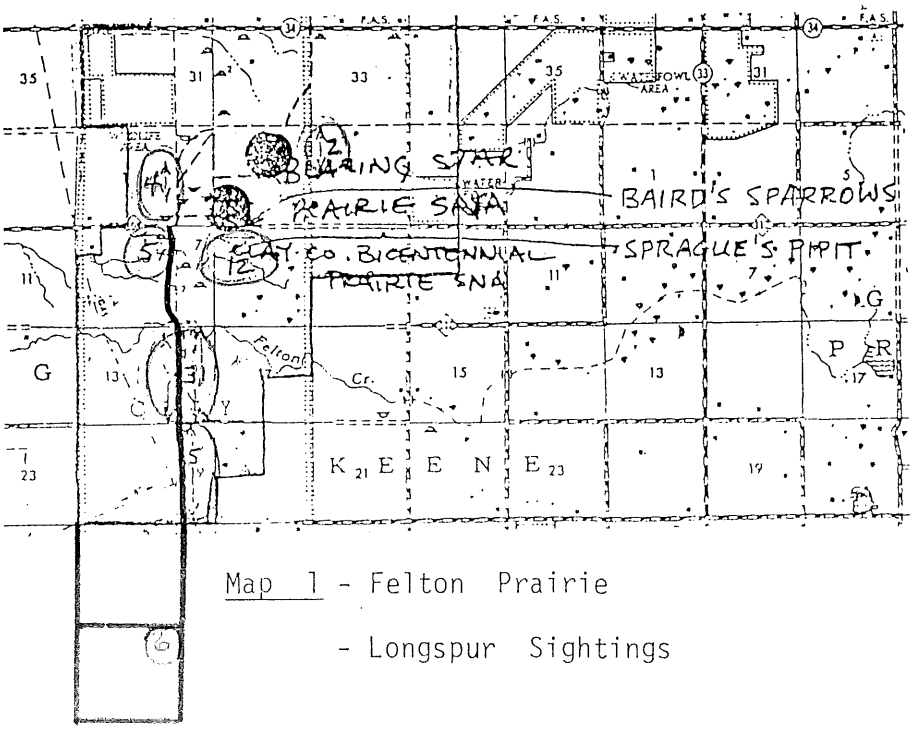
INTRODUCTION:

Calcarius ornatus, Chestnut-collared Longspurs, are ground-nesting prairie passerines whose reproductive range extends across the prairie provinces of Southern Canada and the northern prairie states. This species formerly occurred widely in Western Minnesota and throughout North Dakota, however, its population numbers have declined drastically in the eastern parts of its range since the early 1900's. Presently, this species is considered rare and endangered in Minnesota, with known persisting populations centered east and southeast of the Fargo area.

The largest population of Chestnut-collared Longspurs persisting in Minnesota is located at Felton Prairie, in Clay County, however, details regarding the species status at this site, were not known. An assessment of this population -- its specific location, size, and ecological needs -- was neccessary in order to make appropriate management decisions to insure future preservation of this breeding site.

POPULATION DISTRIBUTION AND SIZE:

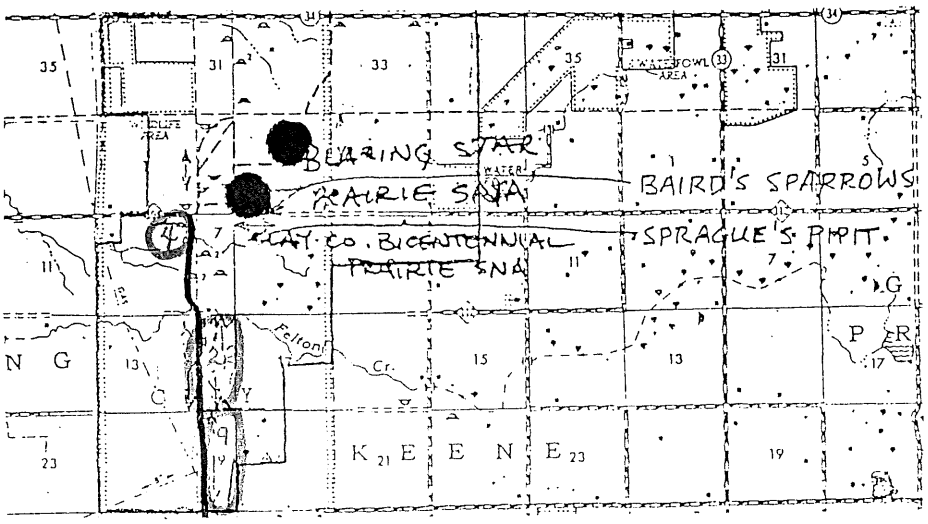
The Felton Prairie study site occupies 2 townships, Keene and Flowing, and includes pastures, cultivated fields, gravel pits, marshes, and ungrazed grasslands. In a previous survey of this area, conducted by the Department of Natural Resources, Chestnut-collared Longspurs were sighted in 8 different sections. A total of sixty-five birds were reported, with the following distribution: 5 longspurs in section 19 (Keene); 31 in the eastern portion of section 13 (Flowing) and section 18 (Keene); 12 in the northwest corner of section 8 (Keene) and the northeast corner of section 7 (Keene); 5 in the northeast corner of section 12 (Flowing); 4 in the eastern region of section 1 (Flowing); 2 in the northwest corner of section 4 (Keene); 6 in section 36 (Flowing), -- see map 1.



Map 1 - Felton Prairie

- Longspur Sightings

On July 10th, 1984, I conducted a preliminary census of longspurs along the major access road through Felton Prairie. A total of 35 males were observed. Nine territorial males were recorded in section 19 (Keene), 22 in section 18 (Keene), and 4 in the northeast corner of section 12 (Flowing). Extensive transects were also conducted at this time, on Blazing Star and Bicentennial Prairies (section 5, Keene), however, Chestnut-collared Longspurs were not present at either site. This census, however, greatly underestimated the number of longspurs present at Felton since complete transects were conducted only in sections 5 and 19 (Keene). In the latter, the location of the 9 longspur territories were mapped. The other reported sightings of Chestnut-collared Longspurs were made largely from the road. -- see map 2.



Map 2 - Felton Prairie

- Longspur Sightings

During the week of June 17th through the 22nd, 1985, I initiated an intensive survey of the Chestnut-collared Longspur population at Felton Prairie. A total of 131 male territories were mapped despite complications posed by poor weather conditions and cattle that restricted access to some areas. All of the territories were in pastures utilized by cattle and occurred in sections 12 and 24 (Flowing) and in sections 7, 8, 17, and 18 (Keene).

Females were observed in many of these areas, however, there was not sufficient time available in this study to establish the pairing status of all territorial males. Calcarius ornatus males are known to defend breeding territories through the first week of July even if they are unpaired. In my own studies on this species I have found that male pairing success can vary from 79% to 100% at a given site from year to year. On this basis, a population estimate, at least in the areas that were censused, would range from 234 to 262 birds.

These numbers, however, underestimate the total population of longspurs present in the Felton Prairie area since 1) section 4 (Keene) was not checked due to insufficient time, 2) sections 12 and 13 (Flowing) were not adequately censused due to cattle conflicts, and section 24 (Flowing)'s low-lying pasture was not examined due to lack of trespass permission. If these areas had been carefully checked, I feel that the population estimate for Calcarius ornatus would have been over 300.

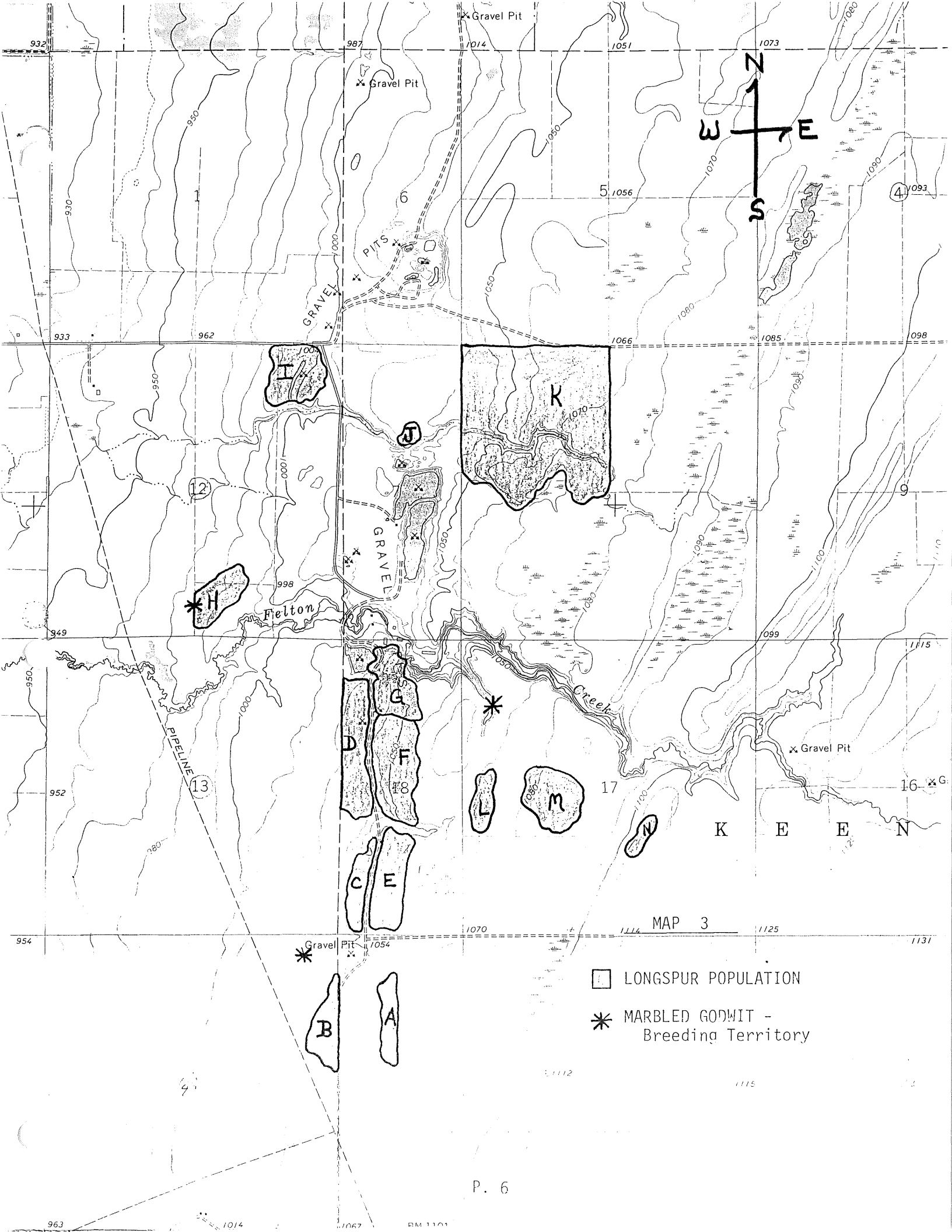
Section 19 (Keene):

The western half of section 19 is a grassland area that is sometimes grazed, while the eastern portion is used for agriculture. During the 1984 census, cattle were present in the pasture and 9 male longspurs were defending territories. The majority of these territories were along the eastern edge of the pasture and included part of the adjoining wheatfield. (region A, map 3)

In 1985, the agricultural field was plowed, but unplanted, the cattle were absent from the pasture, and the grass was taller and denser. Transects were conducted throughout the pasture, but only 1 male longspur was found. This individual came from the west (section 24, Flowing), did 2 aerial displays with vocalizations, and then returned to the west. This behavior is characteristic of a male that has shifted his territory to a new location, but returns infrequently to the former territory site to display, particularly when that site is being trespassed. Such territory shifts, based on my experience with the species, involve distances of less than one-half mile and typically occur when a male is unsuccessful in securing a mate or when the old territory is disjunct from other longspur territories.

Section 24 (Flowing):

This pastureland was severely grazed in some areas and had scattered stands of Euphorbia, Oxalis, and Lepidium intermixed with


Gravel Pit
Gravel Pit
N
W
E
S
PITS
GRAVEL
GRAVEL
Fielton
Creek
PIPELINE
Gravel Pit
Gravel Pit
K E E N
MAP 3
LONGSPUR POPULATION
MARBLED GODWIT - Breeding Territory
A
B
C
D
E
F
G
H
J
K
L
M
N

grasses and alfalfa. A large stock pond was located in the north-eastern corner and an elevated benchland occurred along most of the far-eastern portion of the section. Ten longspur territories were located on the northern half of this benchland -- see map 4. These territories were almost due west of the ones that had existed in section 19 (Keene) in 1984 and may represent a population shift.

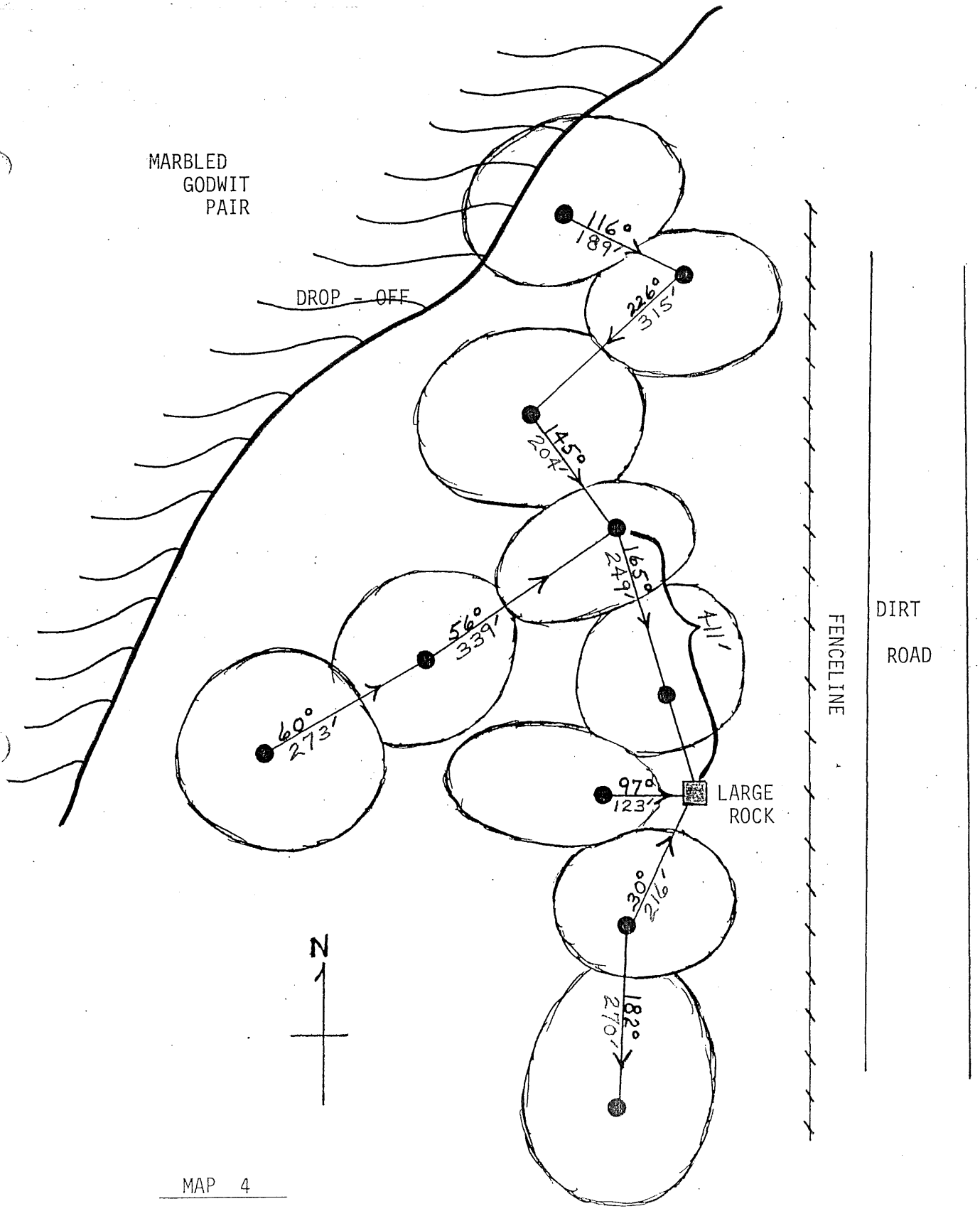
Two pairs of Upland Sandpipers, Bartramia longicauda, as well as several Western Meadowlarks, Sturnella neglecta, Bobolinks, Dolichonyx oryzivorus, and Savannah Sparrows, Passerculus sandwichensis, were present on this benchland.(region B, map 3)

Section 18 (Keene):

This partial section had the highest density of Calcarius ornatus at Felton Prairie, with 46 territorial males. The area is heavily grazed, however a diversity of plants are present and grasses are a major component. A dirt road bissects the area used by Chestnut-collared Longspurs in section 18.

On the west, a southern benchland drops off to a low-lying pasture in the north. Three longspur territories occurred on the benchland along with a pair of meadowlarks (region C, map 3). In territory 1 of this area, both adult longspurs as well as 2 dependent fledglings were observed --see map 5. Ground squirrel burrows as well as alarm calls occurred in the southern part of region C.

Seven longspur territories were being defended in region D



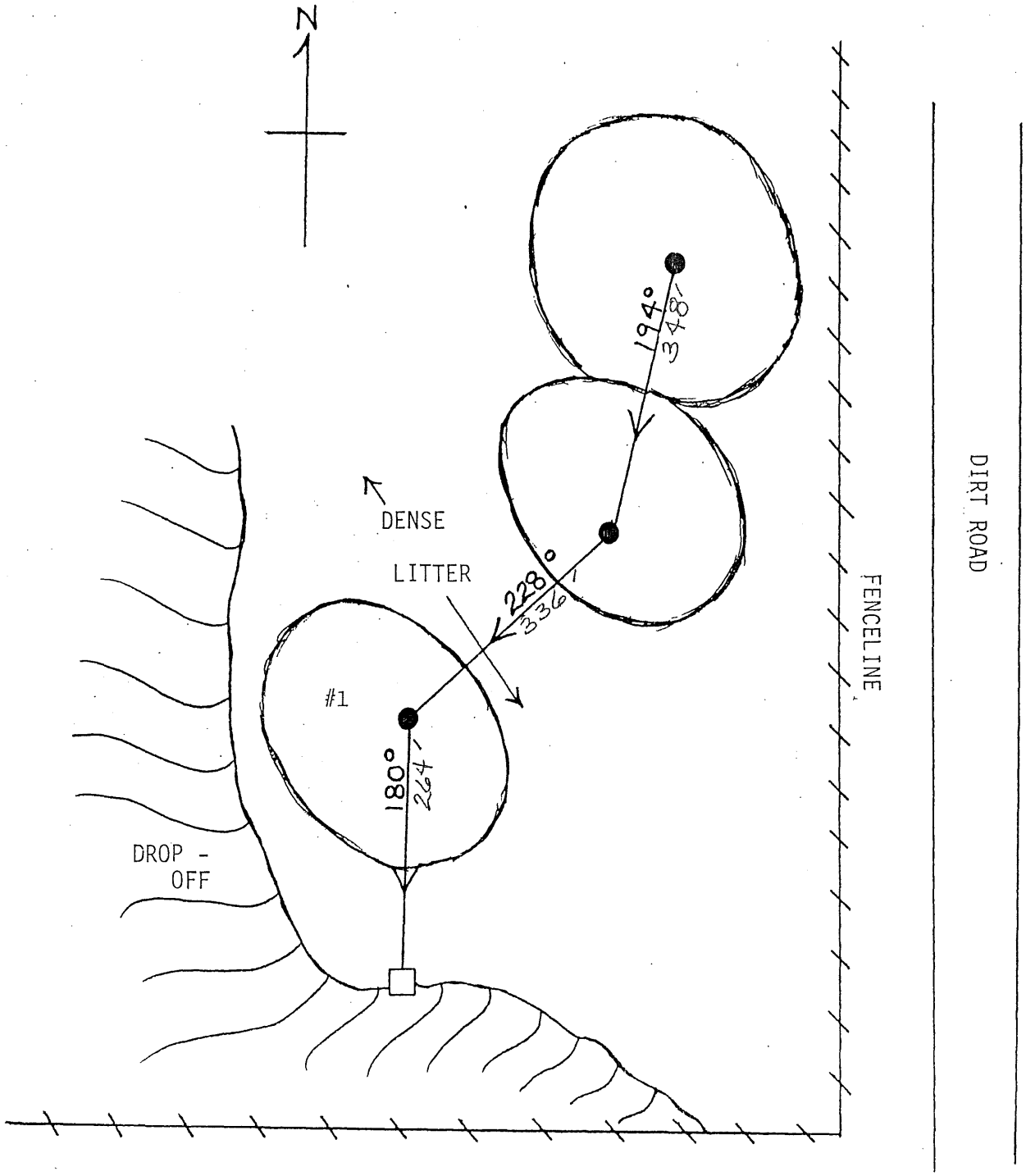
MAP 4

SECTION 24 - FLOWING

REGION B

(scale: one-half inch = 100 feet)

2 PAIRS - UPLAND SANDPIPERS
MEADOWLARKS
BOBOLINKS
GRASSHOPPER AND SAVANNAH
SPARROWS ON BENCHLAND



MAP 5

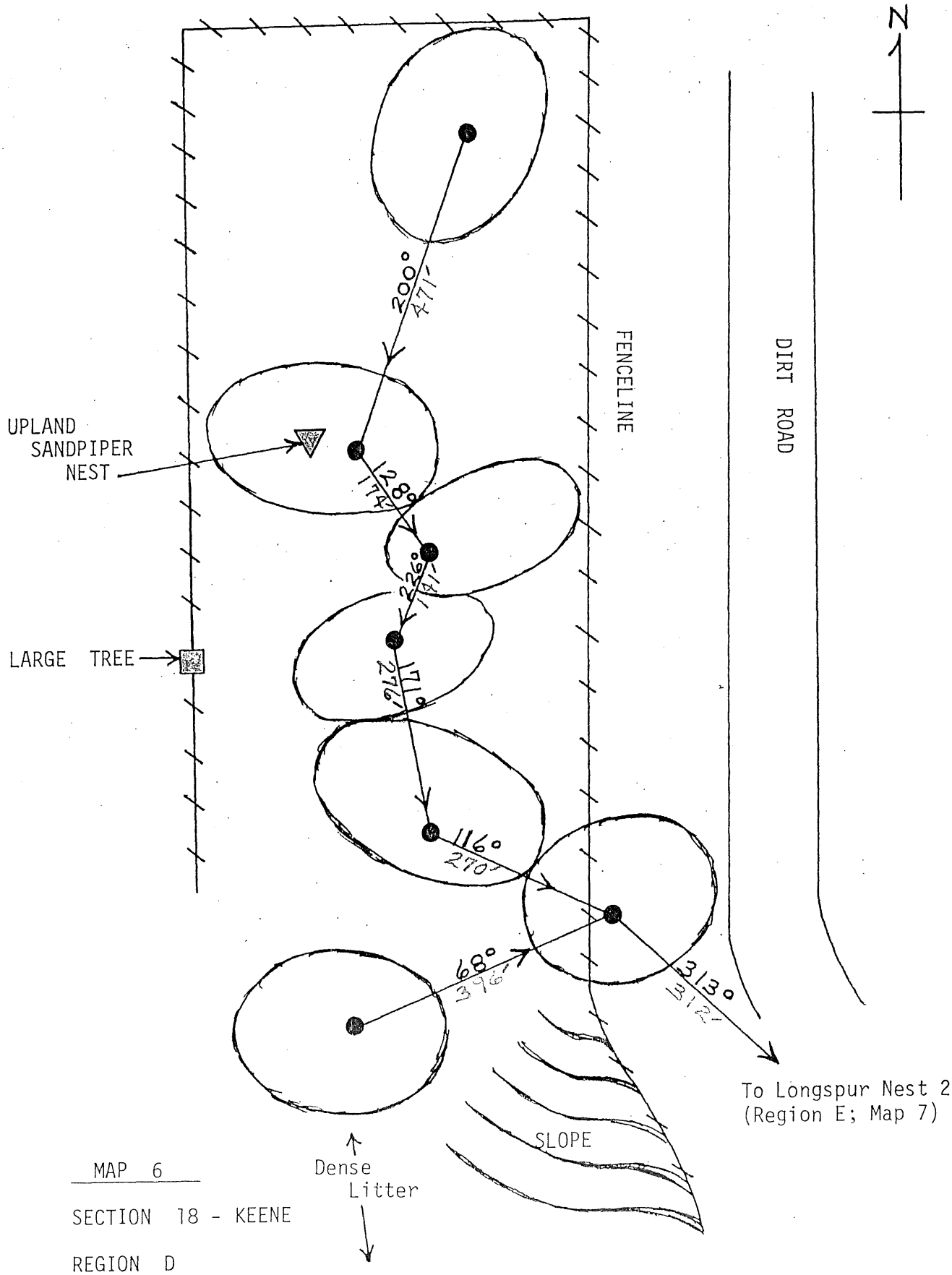
SECTION 18 - KEENE

REGION C

(scale: one-half inch = 100 feet)

(map 3), the low-lying pasture west of the main road but south of the gravel pit pond in the northwest. The distribution of these territories as well as the location of an Upland Sandpiper nest can be seen on map 6. The egg data for the Plover nest is as follows: egg 1) 23.5 grams, 33 mm X 44.85 mm; egg 2) 25.75 grams, 34.15 mm X 44.3 mm; egg 3) 26.5 grams, 34.5 mm X 45.9 mm; egg 4) 25.75 grams, 33.9 mm X 45.6 mm.

East of the main road, south of the big ravine (region E, map 3), 14 longspur territories were defended. Their distribution and the location of 2 longspur nests are indicated on map 7. Longspur nest 1 had an inside diameter of 6 cm, an outside diameter of 8 cm, and a cup depth of 4 cm. It contained 4 eggs, with the following dimensions: egg 1) 1.8 grams, 13.95 mm X 17.8 mm; egg 2) 1.7 grams, 13.75 mm X 17.3 mm; egg 3) 1.5 grams, 13.35 mm X 17 mm; egg 4) 1.8 grams, 13.35 mm X 18.45 mm. Longspur nest 2 had an inside diameter of 5 cm, an outside diameter of 7 cm, and a cup depth of 3 cm. It contained 3 eggs, with the following dimensions: egg 1) 1.7 grams, 13.8 mm X 17.75 mm; egg 2) 1.7 grams, 13.8 mm X 17.7 mm; egg 3) 1.8 grams, 13.9 mm X 18 mm. Meadowlarks, Savannah Sparrows, 2 pairs of Upland Sandpipers, and Grasshopper Sparrows (Ammodramus savannarum) also defended territories in this region. A nest containing 5 eggs of the latter species was located and is indicated on map 7. It measured 3.5 cm deep and had a 6 cm hood and inside

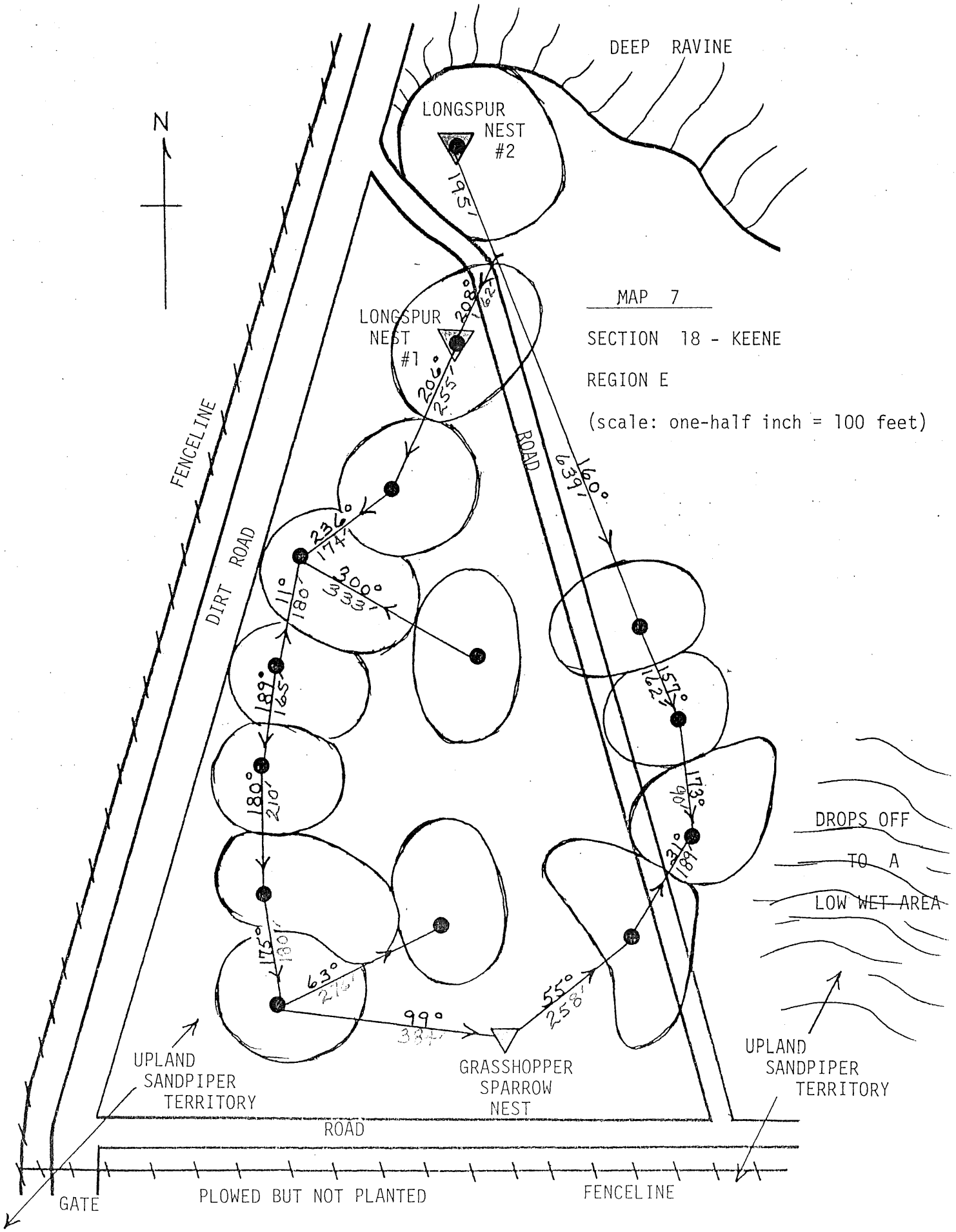


MAP 6

SECTION 18 - KEENE

REGION D

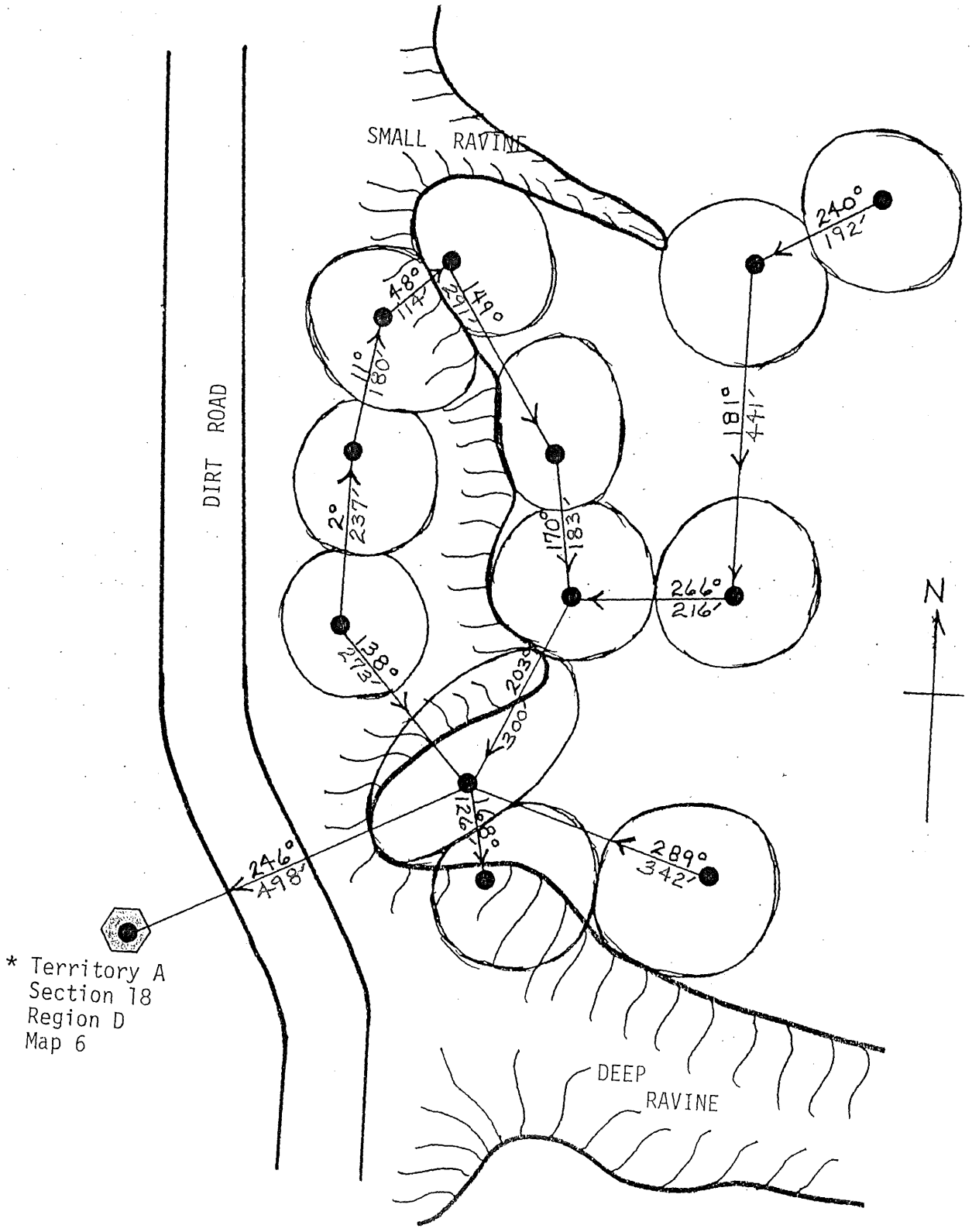
(scale: one-half inch = 100 feet)


DEEP RAVINE
N
LONGSPUR NEST #2
195'
LONGSPUR NEST #1
208°
162'
206°
255'
MAP 7
SECTION 18 - KEENE
REGION E
(scale: one-half inch = 100 feet)
FENCELINE
DIRT ROAD
ROAD
639'
160°
236°
174'
300°
337'
11°
180'
189°
165'
180°
210'
175°
180'
63°
216'
99°
384'
55°
258'
157°
162'
173°
90'
181°
189'
DROPS OFF TO A LOW WET AREA
UPLAND SANDPIPER TERRITORY
GRASSHOPPER SPARROW NEST
UPLAND SANDPIPER TERRITORY
ROAD
GATE
PLOWED BUT NOT PLANTED
FENCELINE

cup diameter. The egg data was: egg 1) 1.9 grams, 14.4 mm X 17.9 mm; egg 2) 1.9 grams, 14.4 mm X 17.25 mm; egg 3) 1.9 grams, 14.4 mm X 17.4 mm; egg 4) 2.0 grams, 14.8 mm X 17.45 mm; egg 5) 2.0 grams, 14.35 mm X 16.75 mm.

East of the main road, north of the big ravine but south of the large storage bins on the east (region F, map 3), 12 longspur territories were defended. Their distribution is indicated on map 8. These birds were observed to frequent the small stream in the deep ravine and travel to the large gravel pit pond to the northwest. Longspur territories were absent to the east where goldenrod (Solidago) and yarrow (Achillea) were abundant. A large flock of Mourning Doves, Zenaida macroura, frequented the area near the storage bins.

North of the storage bins and east of the large gravel pit pond (region G, map 3), 10 longspur territories were defended. Their distribution is indicated on map 9. Two male and 2 female cowbirds, Molothrus ater, were observed along the road in this region. This species had also been sighted near the road in region E, 3 males and 1 female, but no interaction with longspurs was observed during the study period. Three pairs of Horned Larks, Eremophila alpestris, 1 pair of Eastern Kingbirds, Tyrannus tyrannus, and 1 pair of Upland Sandpipers were defending territories in the heavily grazed and fenced pasture in the northeast but longspurs were absent there.



* Territory A
Section 18
Region D
Map 6

MAP 8

SECTION 18 - KEENE

REGION F

(scale: one-half inch = 100 feet)

353°
360'
144°
140°
262°
282'
2 HORNED
LARK
TERRITORIES
ROCK
420
145°
804'
UPLAND
SANDPIPER
PAIR
267'
177'
184°
201'
189°
237'
199°
**2 MALE AND
2 FEMALE COWBIRDS
BRUSH
AND
GRAVEL
WASTE
MAP 9
SECTION 18 - KEENE
REGION G
(scale: one-half inch = 100 feet)
N
DIRT
ROAD
180°
ROCKS

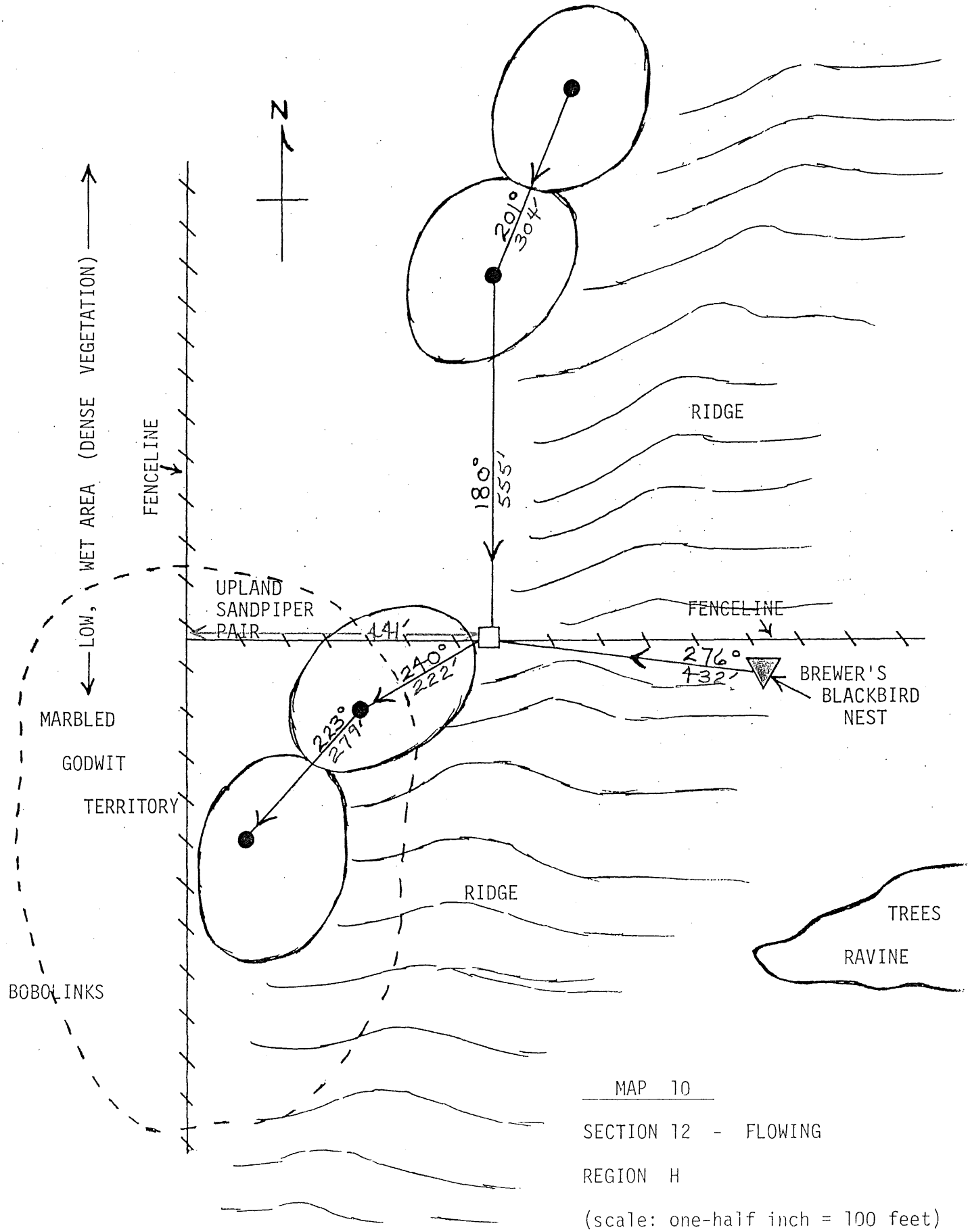
Section 12 (Flowing):

The eastern half of section 12 is pastureland, gradually dropping off to the west and becoming increasingly wetter. In the southern end (region H, map 3) 4 longspur territories occurred in conjunction with breeding pairs of Upland Sandpipers and Marbled Godwits, Limosa fedoa, see map 10. Bobolinks, Dolichonyx oryzivorus, defended the much wetter area to the west where the vegetation was taller and denser, and a group of Brewer's Blackbirds, Euphagus cyanocephalus, dominated the pasture region to the east that was adjacent to the woody draw. A nest of the latter, containing 2 eggs, was located and is indicated on the map.

In the northeast corner of this section (region I, map 3) 7 longspur territories were identified during a preliminary check on June 18th. The territories were clustered in the vicinity of a deep ravine that runs east and west and contains flowing water. These territories however, were not mapped and subsequent work in this section was not possible due to the presence of large numbers of cattle.

Section 7 (Keene):

Although sites potentially suitable for longspurs in this section existed in the north and southeast, only 1 territorial male was located (region J, map 3). This individual defended a relatively short grassland area, devoid of litter, directly north of the gravel pits.



MAP 10

SECTION 12 - FLOWING

REGION H

(scale: one-half inch = 100 feet)

Section 8 (Keene):

The northwest corner of this section had the second highest density of Calcarius ornatus at Felton Prairie, with 40 territorial males. The area used by the birds is heavily grazed and is bissected by a deep ravine running east-to-west. The land drops off sharply in the western half and is bordered on the east by wheatfields and to the southeast by marshes and trees.(region K, map 3)

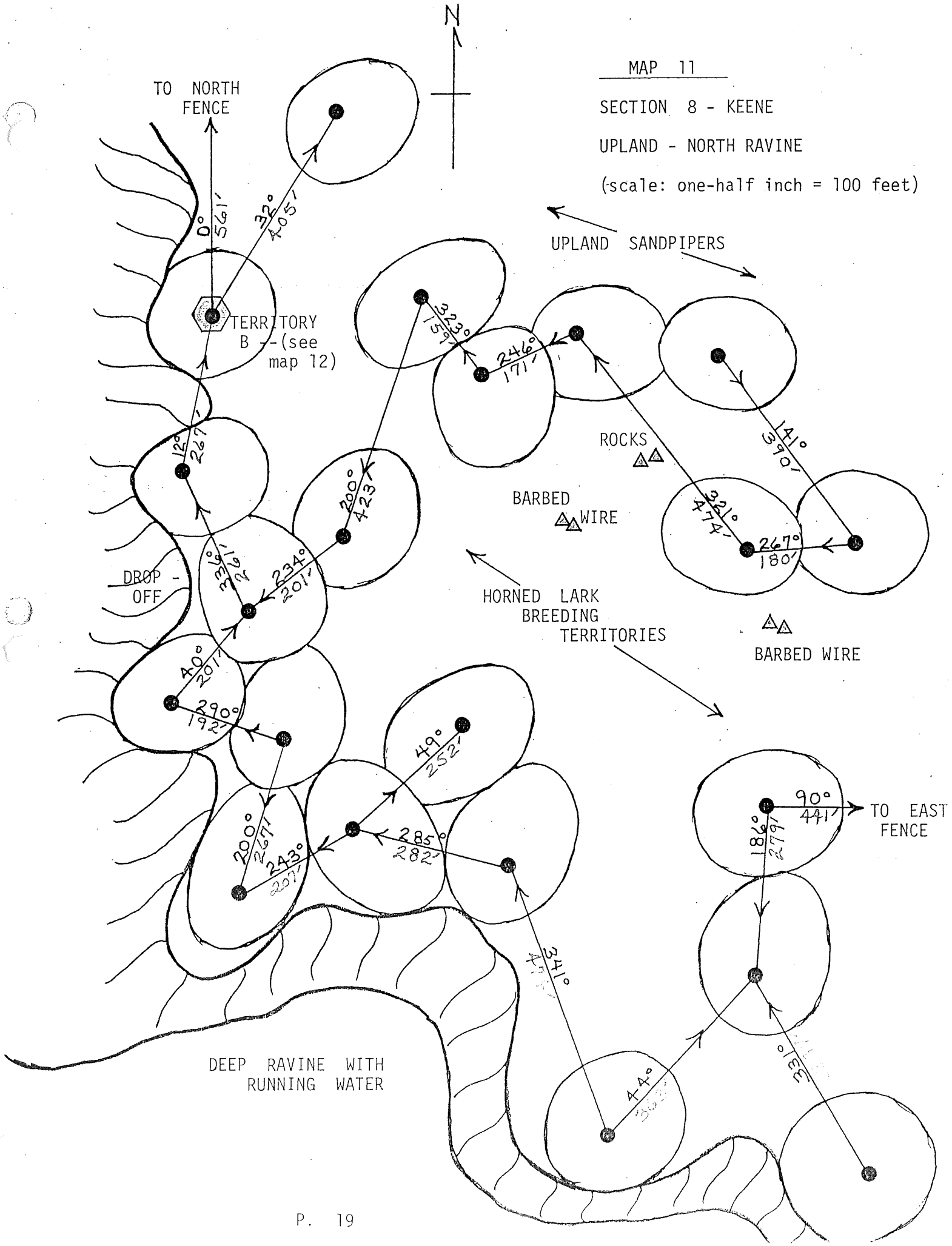
Twenty-one longspur territories were mapped on the benchland north of the ravine -- see map 11. Six Meadowlarks, 3 pairs of Horned Larks, and 1 pair of Upland Sandpipers were also observed in this area. A large number of coyote or fox dens also characterize this site.

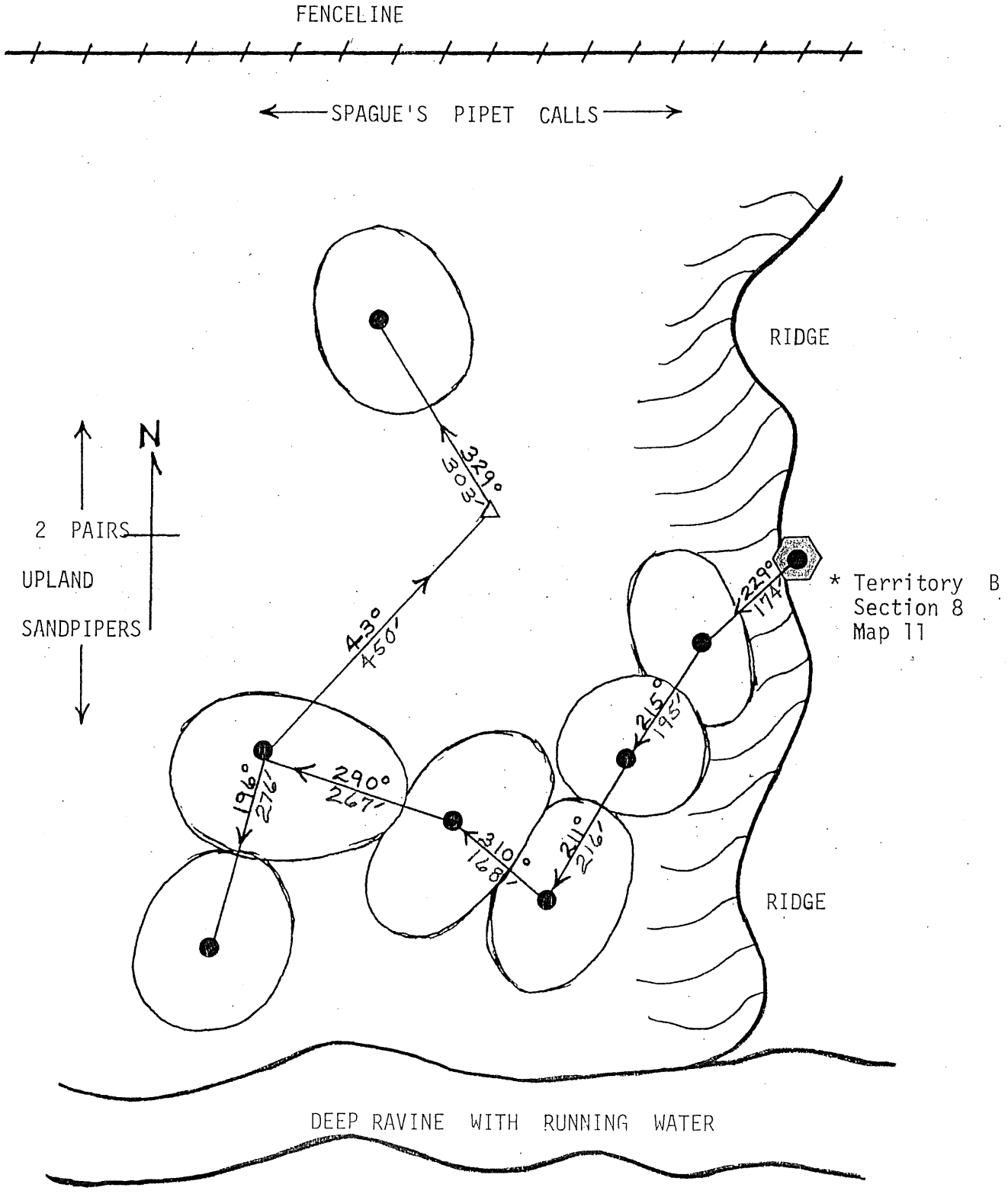
In the low-lying pasture region to the west, 7 longspur territories were active. Two pairs of Upland Sandpipers occurred in this area and the call of Spague's Pipet, Anthus spragueii, was repeatedly heard to the north, along the edge of the Bicentennial Prairie.(map 12)

South of the ravine, 12 male longspurs were territorial. Horned Larks, Meadowlarks, Savannah Sparrows, Grasshopper Sparrows, Upland Sandpipers, Eastern Kingbirds, and Killdeers, Charadrius vociferus, were observed. (map 13)

Section 17 (Keene):

The central region of section 17, south of Felton Creek but north of the fenced fields in the southern one-third, is used


N
MAP 11
SECTION 8 - KEENE
UPLAND - NORTH RAVINE
(scale: one-half inch = 100 feet)
TO NORTH FENCE
0° 561'
32° 405'
TERRITORY B - (see map 12)
UPLAND SANDPIPERS
323° 159'
246° 171'
ROCKS
141° 390'
BARBED WIRE
321° 474'
267° 180'
12° 267'
200° 423'
DROP - OFF
316° 321'
234° 201'
HORNED LARK BREEDING TERRITORIES
BARBED WIRE
40° 201'
290° 192'
49° 252'
200° 267'
243° 227'
285° 282'
90° 441'
TO EAST FENCE
186° 279'
341°
44°
331°
DEEP RAVINE WITH RUNNING WATER



MAP 12

SECTION 8 - KEENE

NORTHWEST - LOW LANDS

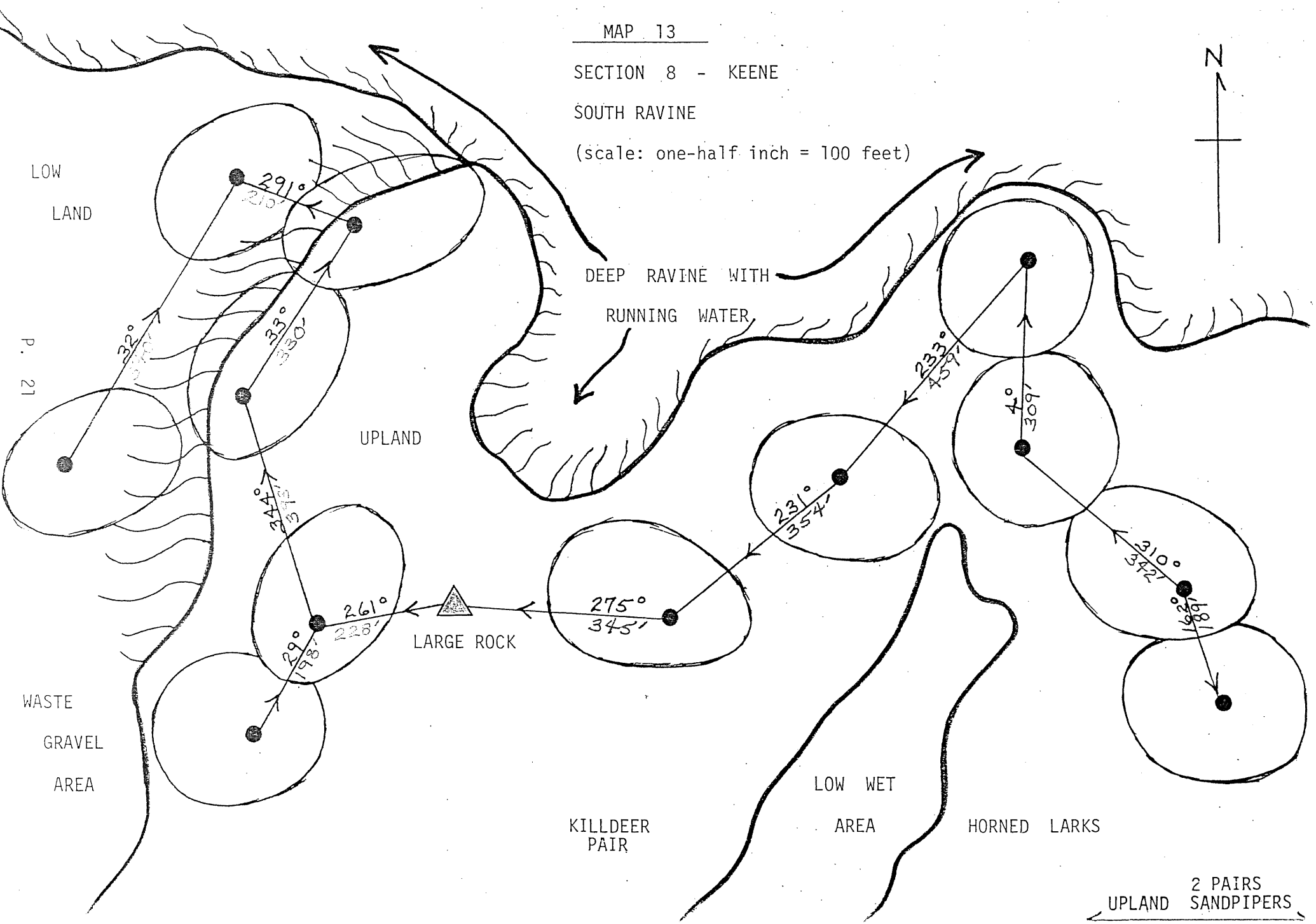
(scale: one-half inch = 100 feet)

MAP 13

SECTION 8 - KEENE

SOUTH RAVINE

(scale: one-half inch = 100 feet)



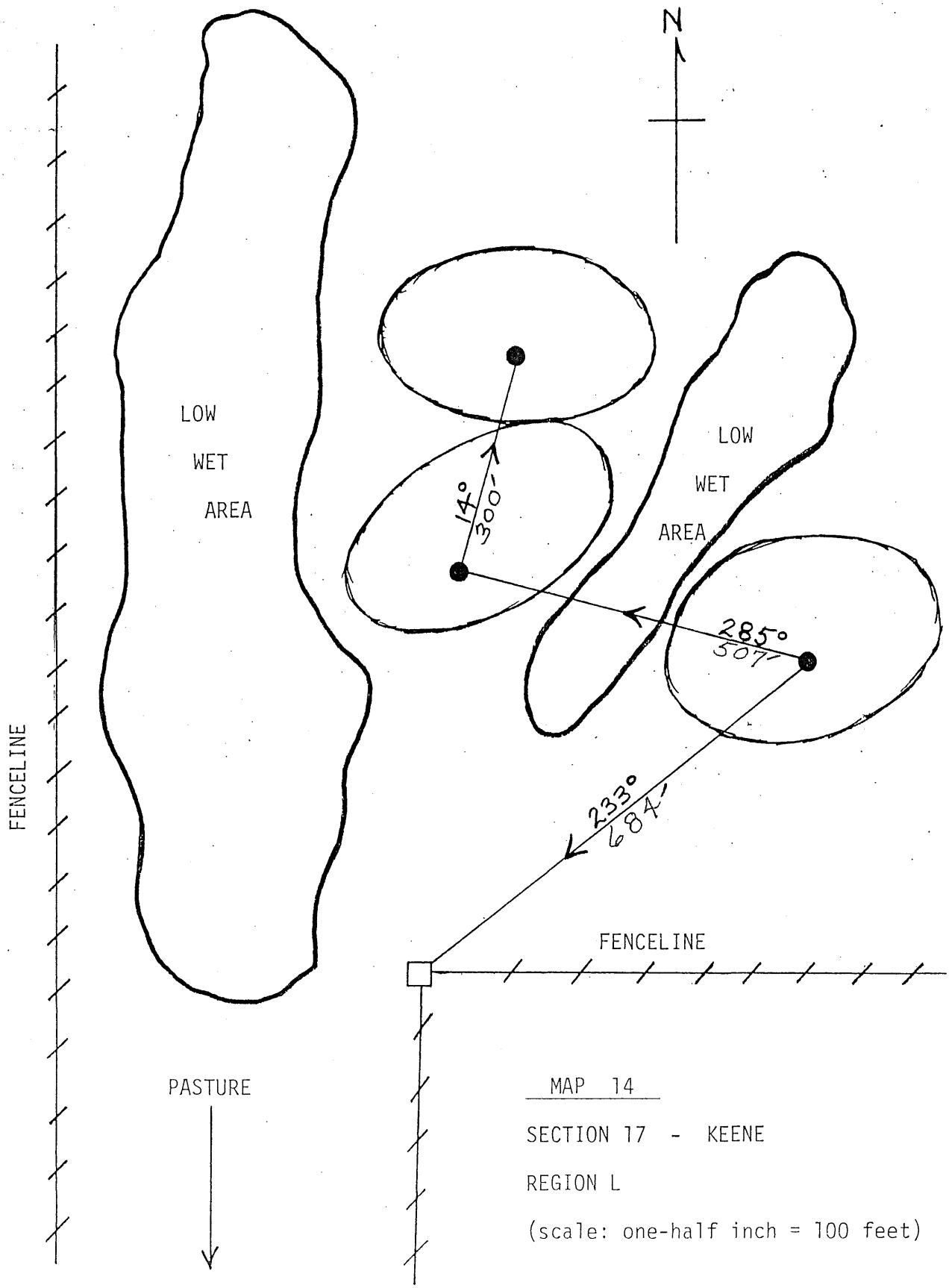
primarily for winter grazing. The vegetation was very short, with grasses predominating. Low, wet areas were common and interspersed with higher, well-drained sites. A pair of Marbled Godwits defended a breeding territory in the northwest (see map 3), and Meadowlarks and Horned Larks were observed throughout. A flock of American Goldfinch, Spinus tristis, were present in the northwest along the border of section 8. Three disjunct populations of Chestnut-collared Longspurs were located in this section -- see map 3.

Region L, near the eastern boundary, contained 3 territories of Calcarius ornatus. The majority of the land in this area was very low and wet. Longspurs were not present in the small, heavily grazed pasture that ran south of this region along the fenceline of section 17. (see map 14)

✓ anticipated that there would be birds here - low wet area to west which was good - so seemed it would be fine - perhaps not enough spillover

Region M, east of "L" and consisting of higher ground, included 16 longspur territories. This population was bordered on the south by a fenced field, dominated by Bromus, where Savannah and Grasshopper Sparrows were vocalizing. Longspurs were observed to frequent the Bromus field as well as the low-lying wetlands in this region. (see map 15)

Region N, east of "M" and located on the highest ridge, included 4 longspur territories. Low wet areas occurred west and east of the ridge and a fenced field, dominated by Bromus, was south of the population site. (see map 16)



MAP 14

SECTION 17 - KEENE

REGION L

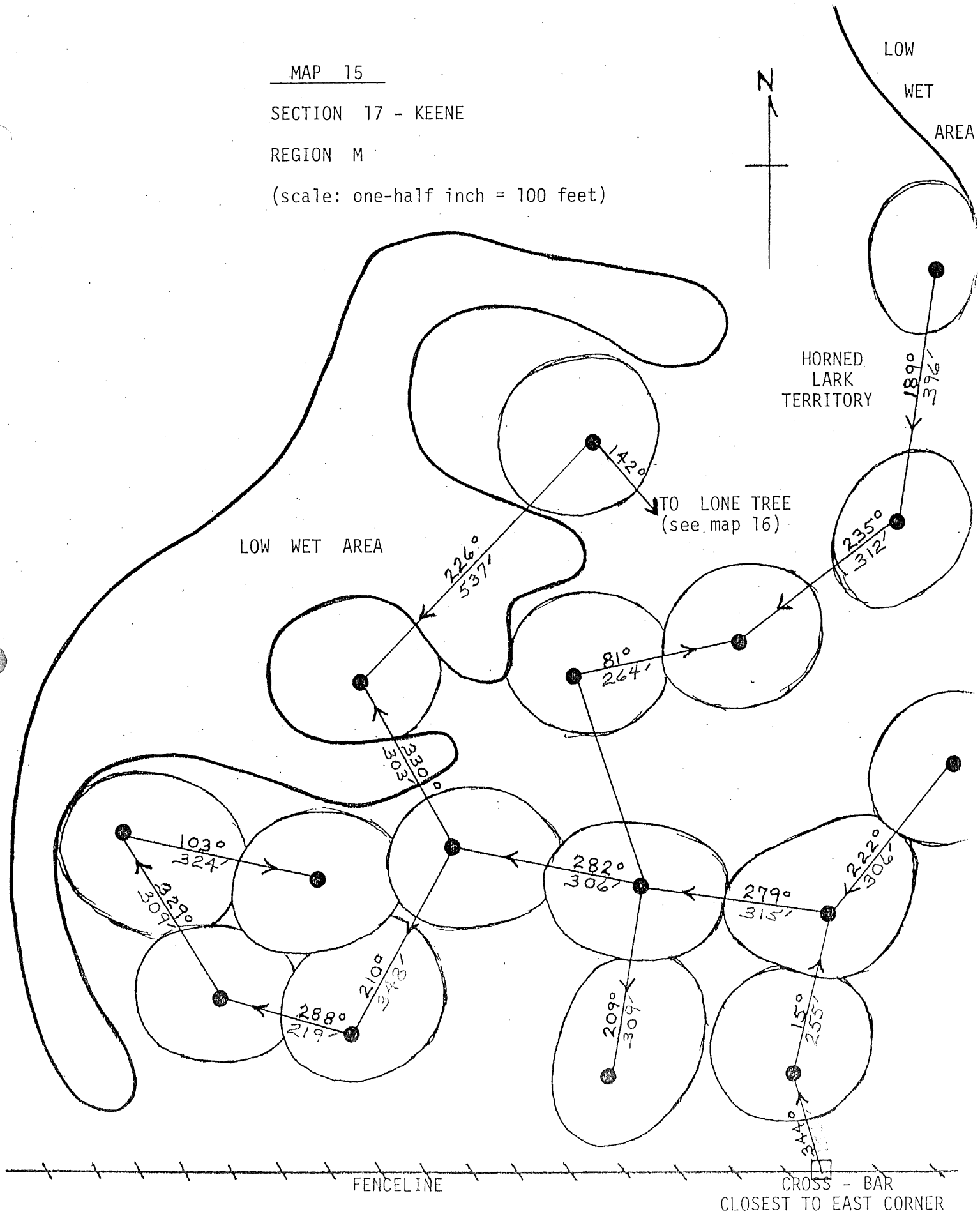
(scale: one-half inch = 100 feet)

MAP 15

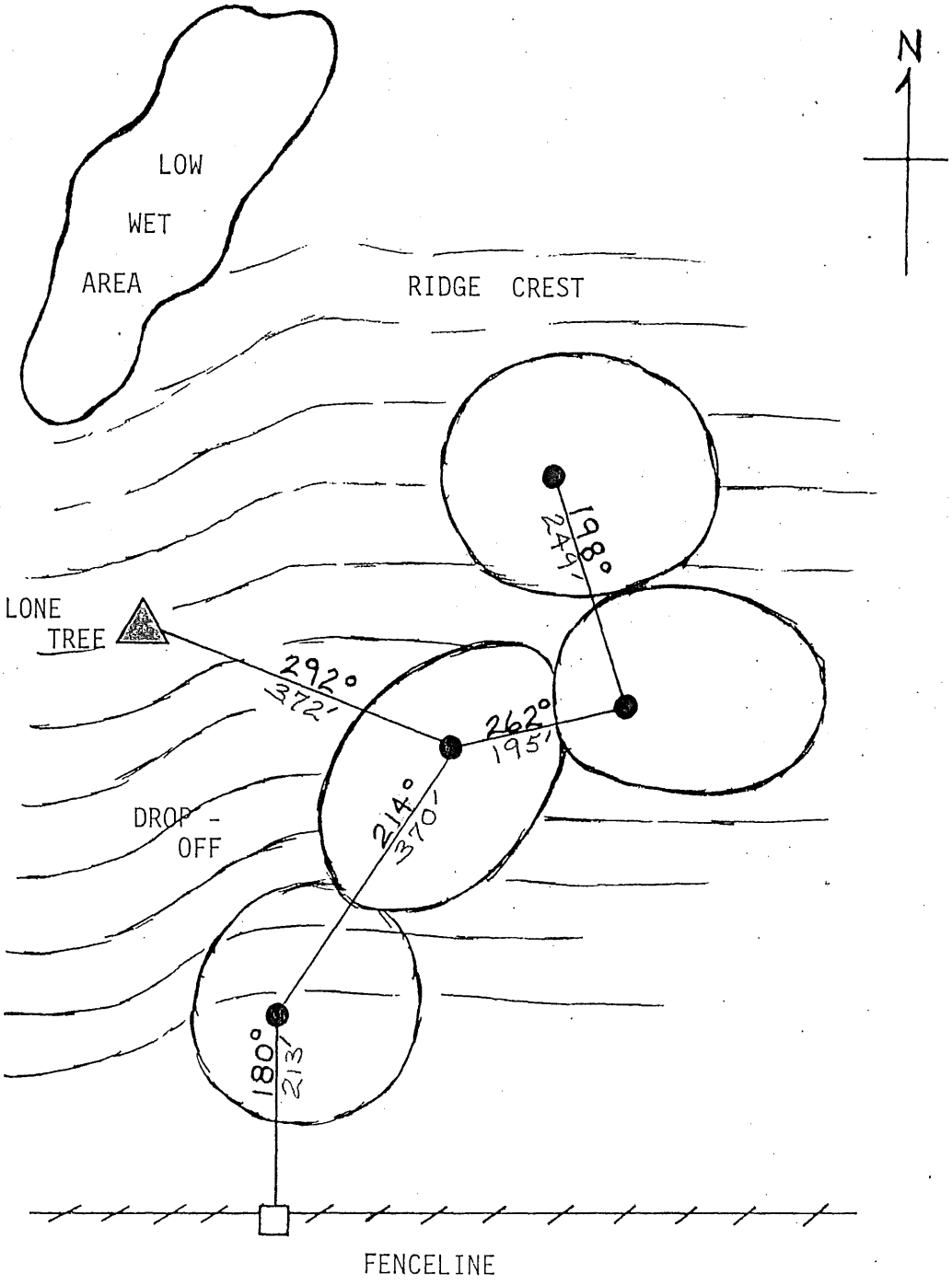
SECTION 17 - KEENE

REGION M

(scale: one-half inch = 100 feet)



** 74 FROM CORNER POST TO LONE TREE: 174 FEET (see map 16)



MAP 16

SECTION 17 - KEENE

REGION N

(scale: one-half inch = 100 feet)

HABITAT FEATURES:

Most birds show a definite preference for one breeding location over another. Chestnut-collared Longspurs are known to establish reproductive colonies in moderately-to-heavily grazed pastures, in sparsely-vegetated prairies, or in grassland areas that are regularly hayed. All of these sites provide a habitat in which litter accumulation and vegetation heighth, at least in the spring when the birds arrive, is minimal.

Calcarius ornatus is adapted to ground foraging, feeding primarily on graminoid seeds and arthropods. Litter accumulation not only impedes the foraging movements of the birds but reduces the vulnerability of the prey.

Since territories are established before insect foods are available the physical structure of a habitat may provide indirect cues to 1) potential food abundance, diversity, and vulnerability. 2) microhabitat temperatures affecting survival and fitness, and 3) predation vulnerability. In several comparative studies grasshoppers were found to be more abundant in areas with less vegetation. Bare areas, in general, are considered to be advantageous for insect breeding, and plants, kept at an earlier phenological stage by grazing, are considered to be more favorable for insect foraging.

The vegetation profile, height and density, is known to influence predation and nest parasitism. Nests and the activities of the adult birds in their vicinity are more obvious in short, sparsely-vegetated sites. Egg and hatchling losses, therefore, would be expected to be higher in such areas. Chestnut-collared Longspurs do not establish territories on prairie sites that are near trees or shrub areas. Nest-parasitism is reported to be higher in such areas and negative interactions between longspurs and avian species that frequent these sites, such as Brewer's Blackbirds and Crows, have been observed.

The temperature of the microhabitat can also be influenced by the vegetation characteristics. Birds nesting in denser vegetation where moisture would persist may be subjected to daily temperatures which are 9 degrees C. lower than those experienced by birds breeding in drier, more sparsely-vegetated sites. This temperature difference may influence the timing of clutch initiation and be critical for hatchling survival and growth, particularly in the early clutches.

Although Calcarius ornatus breeding territories are typically on well-drained sites they are always in close proximity to wet areas. Such areas are frequented by the birds and provide water as well as prey. At Felton Prairie all of the populations occurred in close proximity to water or wet areas. These sites included running water in ravines, marshland, and ponds associated with gravel pits.

Agricultural fields, particularly when planted in wheat or

sunflowers, also serve as important auxillary foraging areas for the birds when they are in close proximity. Unplanted fields are typically not used, except in the early spring when waste seed and associated arthropods are gleaned.

In summary, Chestnut-collared Longspurs prefer to establish breeding territories in well-drained sites away from trees and shrubs, in close-proximity to wet areas, where the vegetation is relatively short, sparse, and devoid of litter, and the graminoid and arthropod supply is abundant.

SURVIVAL THREATS:

Fire management practices, microclimatic shifts, changes in grazing regimes, an increase in agriculture, and an expansion of the Brown-headed Cowbird range have all been suggested as contributing factors in the decline of Calcarius ornatus. Surviving populations in the eastern portion of the species range are restricted to prairie remnants.

These relict populations are subjected to varying degrees of predation and nest parasitism that can have a major influence on the survival of the population. Brown-headed Cowbirds are known to parasitize longspur nests. They negatively influence reproductive success by removing individual longspur eggs from nests and replacing them with their own, or by destroying the entire clutch, thereby

forcing new clutch initiation. Brown-headed Cowbirds, however, do not appear to be a major concern at Felton Prairie at this time since only two sightings were made: 1) 2 males with 2 females were observed along the main road in section 18, region G (Keene) and 3 males with 1 female in the southern end of section 18, region E (Keene) near the gate. (see maps 7 and 9)

Garter snakes, ground squirrels, crows, marsh hawks, and American kestrels are known to be significant predators on longspur eggs and/or young in other areas. During my census of Felton, however, no garter snakes or crows were observed. A pair of kestrels with dependent young had a nest in section 7 (Keene) near the gravel pit operation and marsh hawks were observed over section 18, region E (Keene) and section 8 (Keene) south of the ravine -- see maps 3, 7, and 13. This latter species may have a significant influence on hatchling survival due to the low population of ground squirrels and because nests are more conspicuous, survival rates are lower, when cover is minimal. Marsh hawks typically locate young by cueing in on their vocalizations. In longspurs, such vocalizations increase with age or inadequate food supplies. Undernourished young can easily attract the attention of a hovering hawk and result in the predation of the entire clutch.

Food supplies at Felton Prairie may be limiting and should be assessed. The soil in the grazed pastures is compacted and few insects or spiders were observed. Minimal insect production

can adversely affect reproduction, resulting in fewer clutches produced within a season, smaller numbers of eggs per clutch, and/or smaller eggs. Hatchlings resulting from smaller eggs have a disadvantage in surviving periods of cool, wet weather or short-term starvation periods. The 2 longspur nests that were located at Felton Prairie contained small eggs. Nest 2 contained only 3 eggs (complete clutch) which is below the mean clutch size for the species and atypically small for a mid-June clutch when clutch size is usually maximal. The females associated with these 2 nests were not captured and weighed due to time constraints, but it would have been valuable to compare egg and clutch weights with a female fitness value based on weight/size. Female fitness is valuable in assessing how well the birds are doing reproductively in a population. The reproductive success of a population is important since females that have been unsuccessful fail to return to the same site in subsequent years.

The gravel operations that are currently being conducted in sections 7 and 6 (Keene) appear to pose no immediate threat to longspur populations. The native prairie tracts in section 6 were censused and although some areas were vegetatively favorable for longspurs they lacked the close proximity to water that is neccessary. Expansion of the gravel operations in these 2 sections is not of immediate concern for longspur survival. The one male that did vocalize in section 7 was most likely an example of a territory shift.

MANAGEMENT AND MONITORING:

In areas that support tallgrass prairie, such as Felton, moderate grazing and/or haying are recommended and probably required to provide a vegetation profile that will attract and maintain breeding populations of Chestnut-collared Longspurs.

Grazed sites are often preferred by longspurs, but extreme or long-term grazing pressure can be detrimental. Under such conditions, the plant species composition of an area can be changed, resulting in a shift to a more xeric community. Forbs tend to increase in predominance, replacing graminoids, and making the site less desirable for foraging. There are pasture areas at Felton, in close proximity to longspur populations, where this has occurred. Better management of these sites may result in population expansion.

Haying can also produce a favorable habitat for longspurs, but it must be done in such a way that the litter layer is removed. Mowing operations that leave the surface litter thatch intact will not promote population establishment. The timing of mowing operations is critical. Calcarius ornatus are known to initiate new clutches through mid-July if food resources and weather are favorable. These late clutches result in fledging dates of early to mid-August. After fledging the young are incapable of flight for several days and are vulnerable to mowing operations. It is recommended that haying be delayed until after August 20th in

sites where longspurs are breeding. Pasture areas that are poorly grazed such as some regions of section 18 (Keene) where dense litter has built up may be enhanced as longspur habitat by haying in late summer or early fall.

Burning can not be recommended as a management tool for Calcarius ornatus since not only is spring nesting cover lost but insects and seeds are drastically reduced. Longspurs have responded negatively to this practice in several studies and population recovery following a burn appears to take a number of years.

Management practices that attempt to establish longspur populations in new sites are best attempted in areas that are in close proximity to existing populations. Male longspurs exhibit a high degree of site fidelity and tend to return to the same site,and typically the same territory, in subsequent years. Population shifts do occur when a former site becomes less desirable and a nearby location is more favorable. This appears to have occurred with the move from section 19 to section 24. Section 19 in 1984 was grazed and the field to the east was planted in wheat. In 1985 the vegetation was taller and denser, ungrazed, and the agricultural field was fallow, while section 24 was grazed and was in close proximity to a water source. With proper management, longspur populations will shift short distances or expand into new areas if their

numbers increase.

Future work with the longspur population at Felton should include an accurate census of the remaining areas in sections 12, 13, and 24, when the cattle are not present, and an examination of section 4 and other potentially favorable areas in the region. The location of longspur territories should be mapped so that future comparisons can be made on population size and shifting patterns. This is particularly important in evaluating the effect of management practices. It is important to keep in mind however that longspur population size can vary two-fold in its normal fluctuations. Population assessments should be conducted no earlier than the last week of May and no later than the third week of June to achieve maximal territory numbers.

It may be desirable to examine the reproductive fitness of female longspurs at the site by comparing their weight/size index to egg and clutch weights. This information would indicate whether foraging resources are minimal, adequate, or abundant. Females that are nutritionally stressed are limited in their reproductive output. Low reproductive success can negatively influence breeding site continuance since unsuccessful females fail to return in subsequent years. Management activities that enhance arthropod numbers and graminoids should possibly be considered if these are found to be limited.