FINAL REPORT - DECEMBER 1989

Project Title: A Systematic Inventory, Population Monitoring Program, and Ecological Study of Rare Lepidoptera at the Prairie Coteau Scientific and Natural Area (SNA), Pipestone County, Minnesota

Principal Investigator: Dr. David C. Glenn-Lewin

Field Investigator: Gerald Selby

I. INTRODUCTION

A study of rare butterflies was conducted during the summers of 1988 and 1989 at Prairie Coteau Scientific and Natural Area, Pipestone County, Minnesota. The principal objectives of the study were to (1) determine the presence and distribution of rare butterflies within Prairie Coteau; (2) develop a population monitoring scheme for selected rare species, including, but not limited to, Hesperia ottoe W.H. Edwards and Hesperia dacotae (Skinner); (3) examine distributional patterns of the selected rare species in relation to plant community associations, soils, topography, aspect and available moisture; and (4) examine local movement to determine population boundaries and the potential for recolonization. The primary foci of the study were objectives one and two. Objectives three and four will be addressed in a proposed continuation of the study.

Fieldwork consisted of (1) general surveys for all butterfly species present at Prairie Coteau during each of the major flight periods, (2) distribution mapping for selected rare butterflies, and (3) developing and testing population monitoring methodology for the rare butterflies. Hesperia dacotae (Skinner) was the focus of the study, but other rare species that were targeted for distribution mapping and monitoring included Atrytone arogos iowa (Scudder), Atrytonopsis hianna hianna (Scudder), Hesperia leonardus pawnee Harris, Hesperia ottoe W.H. Edwards, Oarisma poweshiek (Parker), and Speyeria idalia (Drury).

II. SITE DESCRIPTION

Prairie Coteau consists mostly of glacial till hill prairie, with small inclusions of gravel prairie, and mesic blacksoil prairie (unpublished DNR report). The prairie is restricted mostly to the steep slopes of the large rolling hills. Flat upland areas have either been converted to cropland, or have been degraded by past grazing. The drainageways and low-lying areas include mesic prairie and sedge meadow, but are fairly weedy in many cases. For the surveying and monitoring, the area was divided into five units based on the proposed management units (see Figure 1). (1) Unit 1 includes low-lying sedge meadow and disturbed fields on the south end of the original purchase (NW 1/4, SE 1/4 Sec 32). No monitoring was done here since there was no suitable habitat for H. dacotae. (2) Unit 2 includes upland prairie on the north end of the original purchase (NW 1/4, SE 1/4 Sec 32). (3) The south half of unit 3 (W 1/2, NE 1/4 Sec 32) was treated as a separate monitoring unit (3S). It has a sedge meadow valley running north and south through the middle, with upland prairie ridges on either side. This area has good potential for H. dacotae, but has been degraded by recent grazing. H. dacotae were found scattered throughout this area, but most of them were at the north end of it. (4) The south half of Unit 4 (E 1/2, NE 1/4 Sec 32) was also treated as a separate monitoring unit (4S). It included a combination of steep upland prairie ridges and somewhat disturbed valleys and draws. Much of the prairie was in good shape, and this area had a good population of H. dacotae. (5) The northern halves of units 3 and 4 were treated as one monitoring unit (3&4N). Unit 3N was similar to 3S, but with steeper topography and better quality prairie. Early surveys of area 3N indicated that there was a good population of H. dacotae throughout this area. Much of unit 4N was degraded, flat upland, with suitable habitat

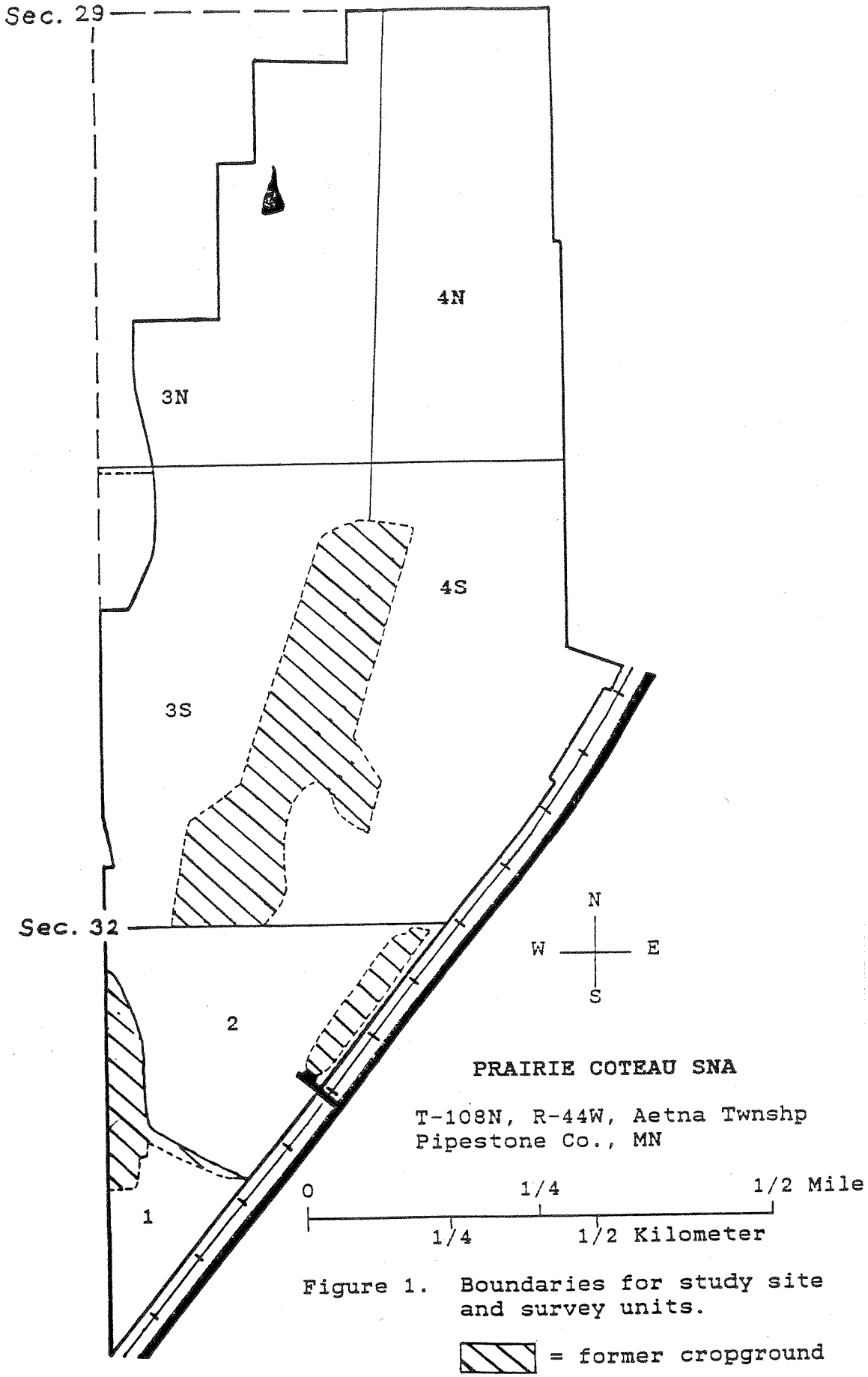


Figure 1. Boundaries for study site and survey units.

= former cropground

restricted to the slopes on the eastern edge of the unit, and on neighboring property to the east. The cropground (see Figure 1) was not surveyed, but the transects were set up in 1989 so they could be extended to include these area in the future.

III. METHODS

General Surveys

Surveys were conducted at intervals throughout each season to document the butterfly species which occur at Prairie Coteau, and their approximate flight periods. Coverage for early and late species is less complete since fewer visits were possible then, and many coincided with poor survey conditions. Data for 1988 are based on fewer days in the field than for 1989, and species lists for many of the surveys in 1988 were less complete.

Distribution Mapping

In conjunction with the surveys and monitoring, the distributions for A. a. iowa, A. h. hianna, H. dacotae, H. L. pawnee, H. ottoe, O. poweshiek, and S. idalia were mapped. For each survey the location of every individual observed was marked on a topographic map using a unique symbol for each species. During the 1988 field season an attempt was made to record the distribution of every individual observed. This resulted in some discrepancies between the number of observations recorded on the maps and the numbers shown in the tables for last years report, since observations that were out of the transect area were mapped but not included in the counts. Those observations have been incorporated into the tables for this years report. In 1989 mapping of individuals was limited to

those observed along the transects while conducting the monitoring surveys, and those recorded in the tables for general surveys. This makes interpretation of the maps easier since both the routes for the surveys and the intensity of the survey work in each area are known. Composite dot distribution maps were made for all the observations of those species for each season and are included in the results. The dots were placed as close as possible to the actual location without overlapping each other, but are sometimes displaced a considerable distance away from the transect because of the large number of sightings and the concentration of occurrences in certain areas. The number of dots might sometimes be less than the number of observations shown in the tables since some observations were not mapped. The concentration of occurrences in units 2 and 4S reflects the intensity of survey work in those areas.

Population Monitoring

Within each of the four monitoring units transects were selected at random which crossed the area in an east/west direction. To assure both complete coverage of the area and randomization of the exact route, each quarter section was divided into eight rectangular subunits and the endpoints for the transects were selected randomly within those subunits. For the 1988 surveys each individual transect began at a randomly selected point at the end of one rectangular subunit, and ended at a randomly selected point at the other end of the next subunit (see Figure 2). The next transect would start about ten paces from where the previous one ended to avoid overlap. In 1989 the transects were modified so that they would be independent of each other and eliminate the overlap of sampling areas at the ends (see Figure 3). The end points for each transect were selected at random within each of the rectangular subunits, and

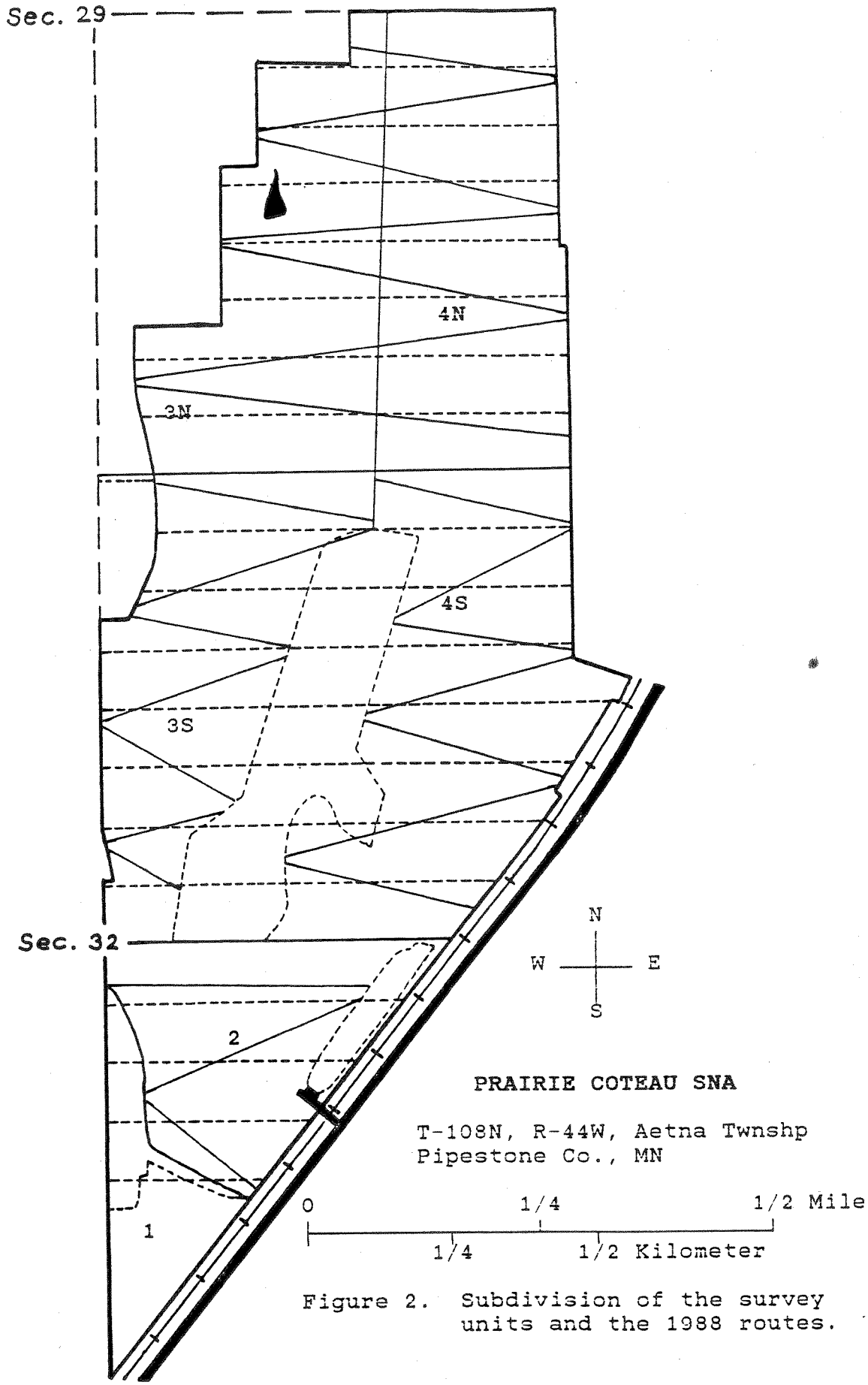


Figure 2. Subdivision of the survey units and the 1988 routes.

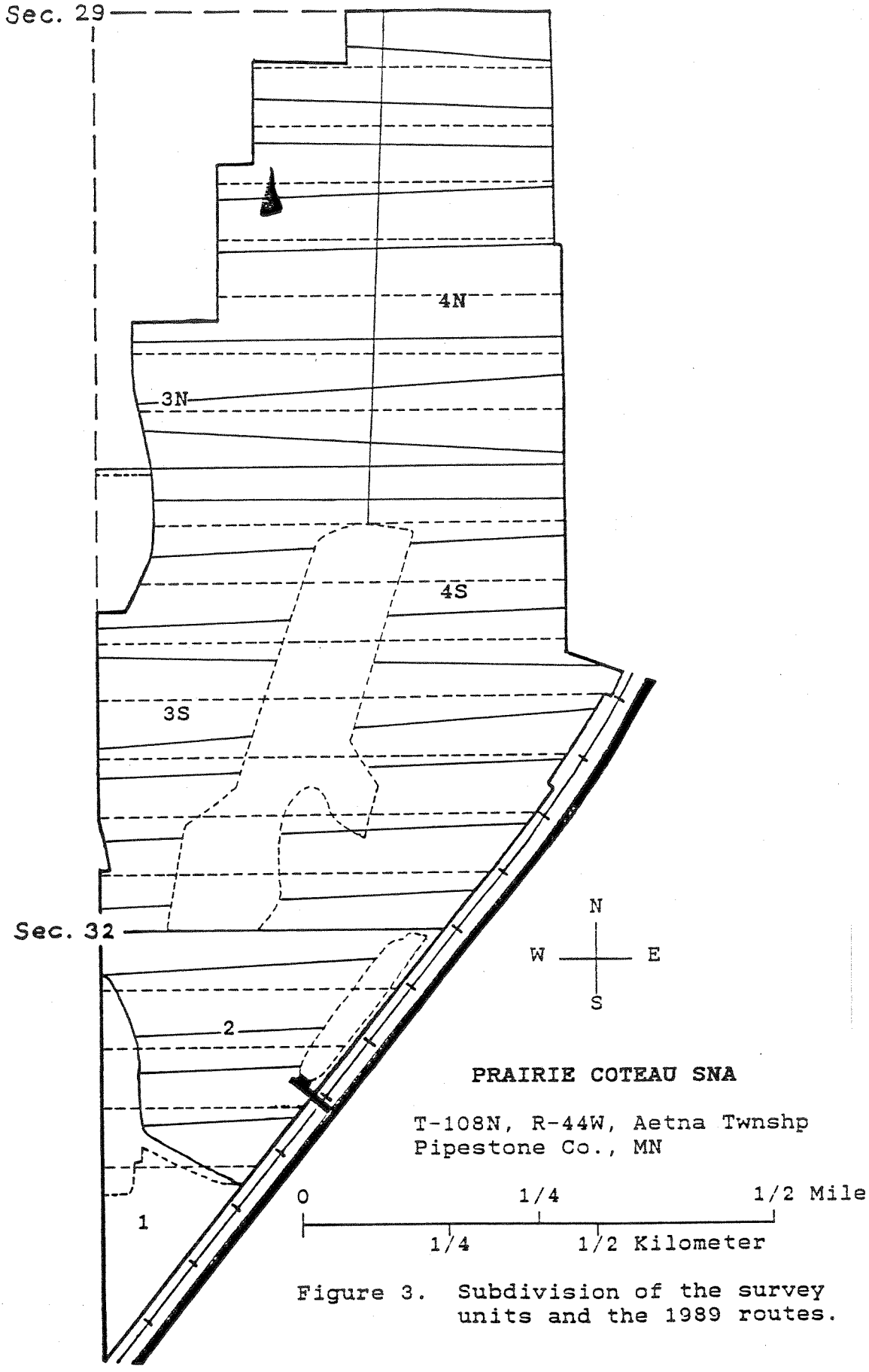


Figure 3. Subdivision of the survey units and the 1989 routes.

individual transects ran from the west to the east boundaries of the preserve. By doing this the survey routes can easily be extended to include the cropfields after prairie restoration has been completed in those areas, or to include areas to the east of unit 4N if additional purchases are made. The changes increased the number of transects in each survey unit by one. The routes were marked on topographic maps and then, using those maps, they were laid out in the field and temporarily marked with flags.

Standardized survey forms were used for recording the sex and condition rating for the individuals of each species that was being monitored (see Appendix 1). An attached topographic map with the route drawn on it was used to record the location for each individual, using different symbols for each species. The behaviors for those individuals were also recorded, and species lists were compiled for each survey. Additional information recorded on the forms included the date and time period for the survey, and for individual transects, temperature, wind speed, and cloud cover.

Transects were walked at a relatively steady pace, recording all individuals observed within five meters of either side of the transect. An attempt was made to catch and release each butterfly in order to confirm the sex and condition rating. For the skippers this worked quite well for isolated observations of perching individuals, but when several individuals were observed at the same time it was difficult to capture each one, and if they were observed in flight it was even more difficult. This seemed to pose the greatest problem during the early part of the flight period when there was more flight activity. For S. idalia it was not practical to capture each individual because their flight was much less localized. Complete sex and condition information was obtained for H.

dacotae, since it was the focus of the monitoring, but information for the other species monitored during that time period was not complete due to the time required to capture each individual, and less pronounced sexual dimorphism in some.

Species were targeted for population monitoring in each of three flight periods: (1) late May to the middle of June - A. h. hianna; (2) late June to the middle of July - A. a. iowa, H. dacotae, H. ottoe, O. poweshiek, and S. idalia; and (3) late August through September - H. l. pawnee, and S. idalia. Surveys for early and late season species were limited to a couple short visits, but population data were collected throughout the middle flight period so that the relationship between the population curve and the sex ratio or condition rating could be examined for H. dacotae.

In 1988 unit 4S was selected for regular surveys at the same time (early afternoon) each day at intervals during the flight period for H. dacotae. Other units were surveyed as time permitted, with most other work being done in unit 2. In 1989 surveys were conducted every day throughout the flight period for H. dacotae. Units 4S and 2 were selected for regular surveys on alternate days. Unit 4S was surveyed once a day in the early afternoon as it had been in 1988. Surveys in unit 2 were replicated five times per day so that the effect time of day had on the counts could be examined. The other units (3S and 3&4N) were each surveyed twice.

IV. RESULTS

General Surveys

A total of 43 species were recorded from the site, and 38 of these were vouchered (see Appendix 2 and 3). A summary of the species observed and the time periods during which they were observed is shown in Figure 4. The flight periods during which surveys were conducted are included to assist in interpreting the data. Complete coverage throughout the season would fill in the time line for many of the species.

Of the species recommended for monitoring by Robert Dana, the following were documented on the site during both summers: A. a. iowa, A. h. hianna, H. dacotae, H. L. pawnee, O. poweshiek, and S. idalia. H. ottoe was not found on in 1988, but a few individuals were observed in 1989. Other species of interest which were observed on the site include Coenonympha tullia inornata Edwards, Glaucopsyche lygdamus (Doubleday), Lycaeides melissa melissa, Polites mystic Scudder, Pontia protodice (Boisduval & Leconte), and Satyrodes eurydice fumosa.

Figure 4.

1988 & 1989 BUTTERFLY OCCURENCE RECORDS FOR PRAIRIE COTEAU

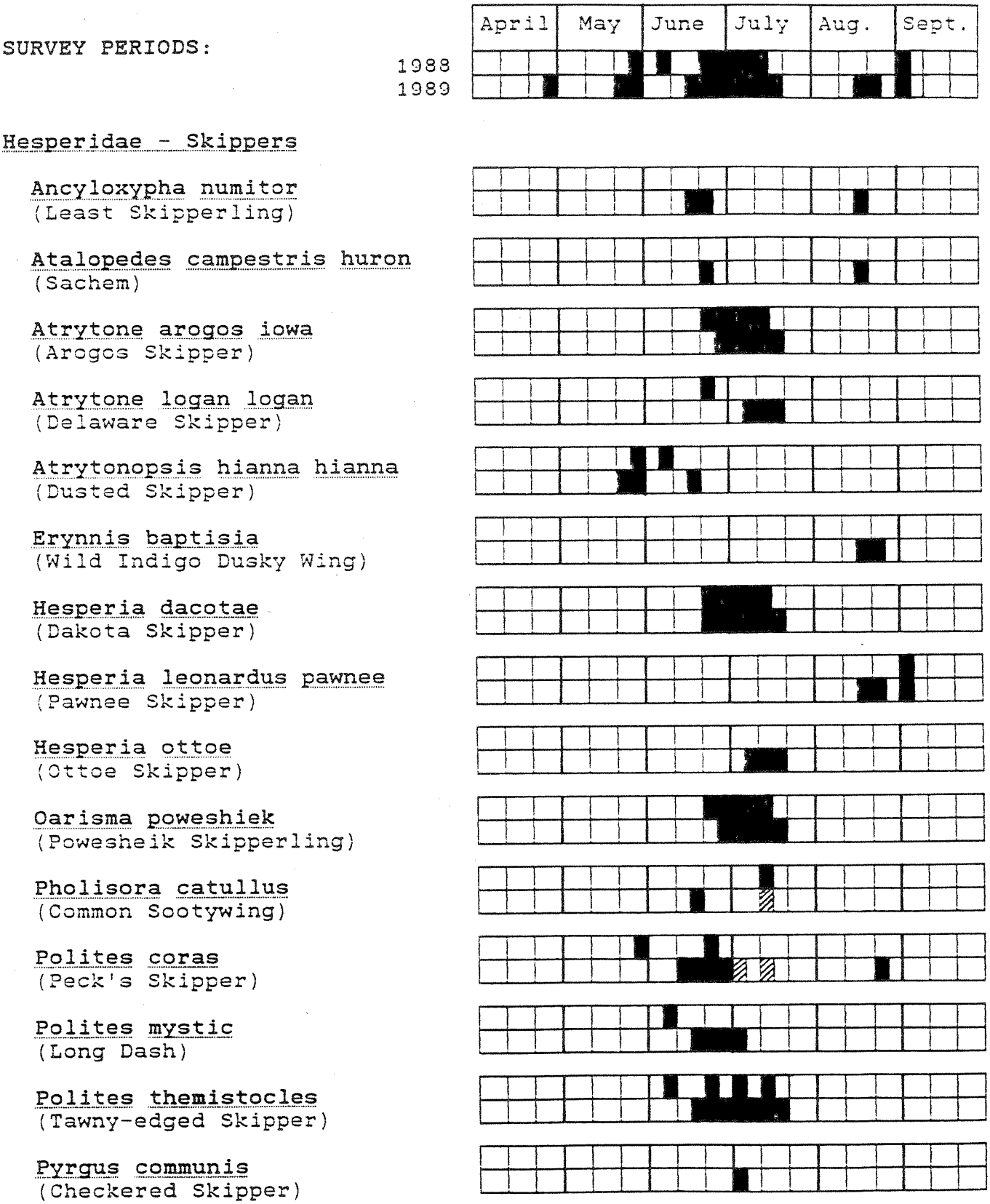
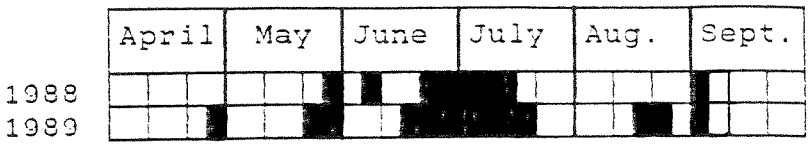


Figure 4. (cont'd)

SURVEY PERIODS:



Papilionidae - Swallowtails and Parnassians

Papilio polyxenes asterias
(Black Swallowtail)

Pterourus glaucus
(Tiger Swallowtail)

Pieridae - Whites and Sulfurs

Artogeia rapae
(Cabbage White)

Colias sp.
(Common & Orange Sulfurs)

Pontia protodice
(Checkered White)

Lycaenidae - Gossamer Wings

Celastrina argiolus ladon
(Spring Azure)

Everes comyntas
(Eastern Tailed Blue)

Gaeides xanthoides dione
(Great Copper)

Glaucopsyche lygdamus
(Silvery Blue)

Hemiargus isola
(Reakirt's Blue)

Hyllolycaena hyllus
(Bronze Copper)

Lycaeides melissa melissa
(Orange-Margined Blue)

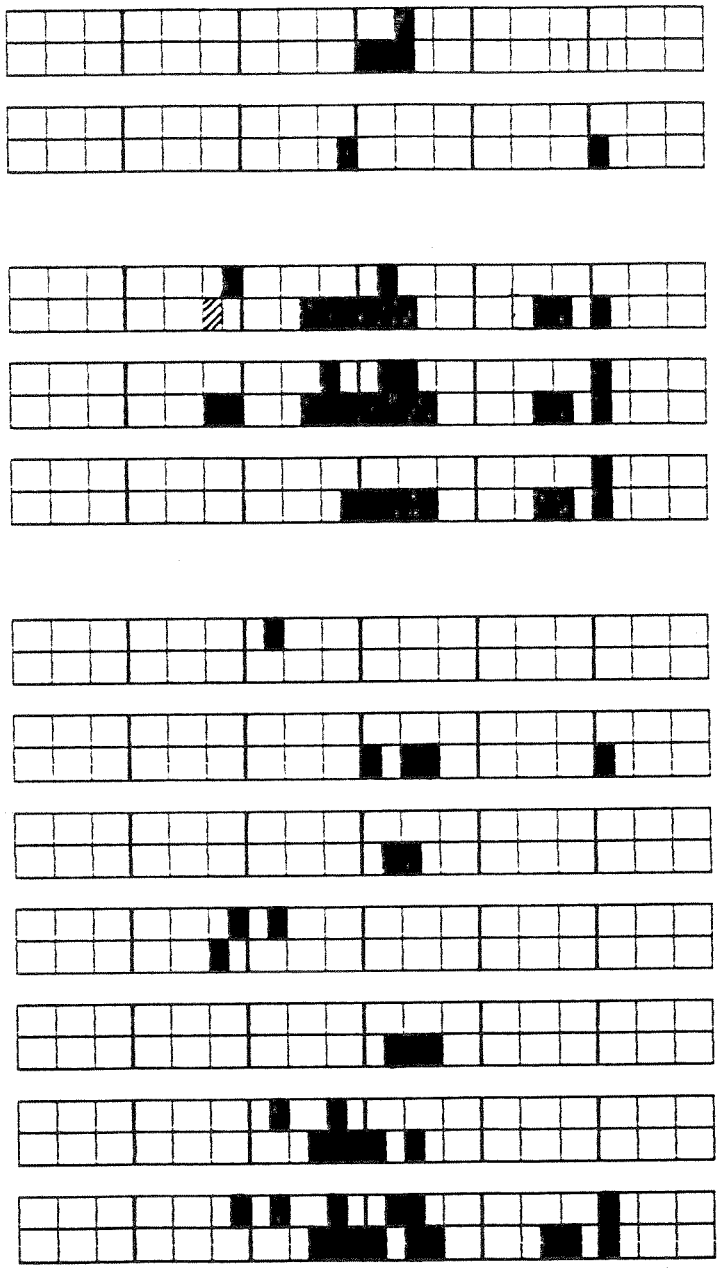
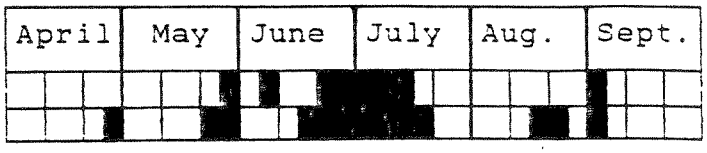


Figure 4. (cont'd)

SURVEY PERIODS:



Helicanidae - Brushfoots, Leafwings, Satyrs, Milkweeds

Cercyonis pegala
(Wood Nymph or Grayling)

Clossiana bellona bellona
(Meadow Fritillary)

Clossiana selene
(Silver-Bordered Fritillary)

Coenonympha tullia inornata
(Prairie Ringlet)

Danaus plexippus
(Monarch)

Euptoieta claudia
(Variegated Fritillary)

Junonia coenia
(Buckeye)

Nymphalis antiopa
(Mourning Cloak)

Phycoides tharos
(Pearl Crescent)

Satyrodes eurydice fumosa
(Eyed Brown)

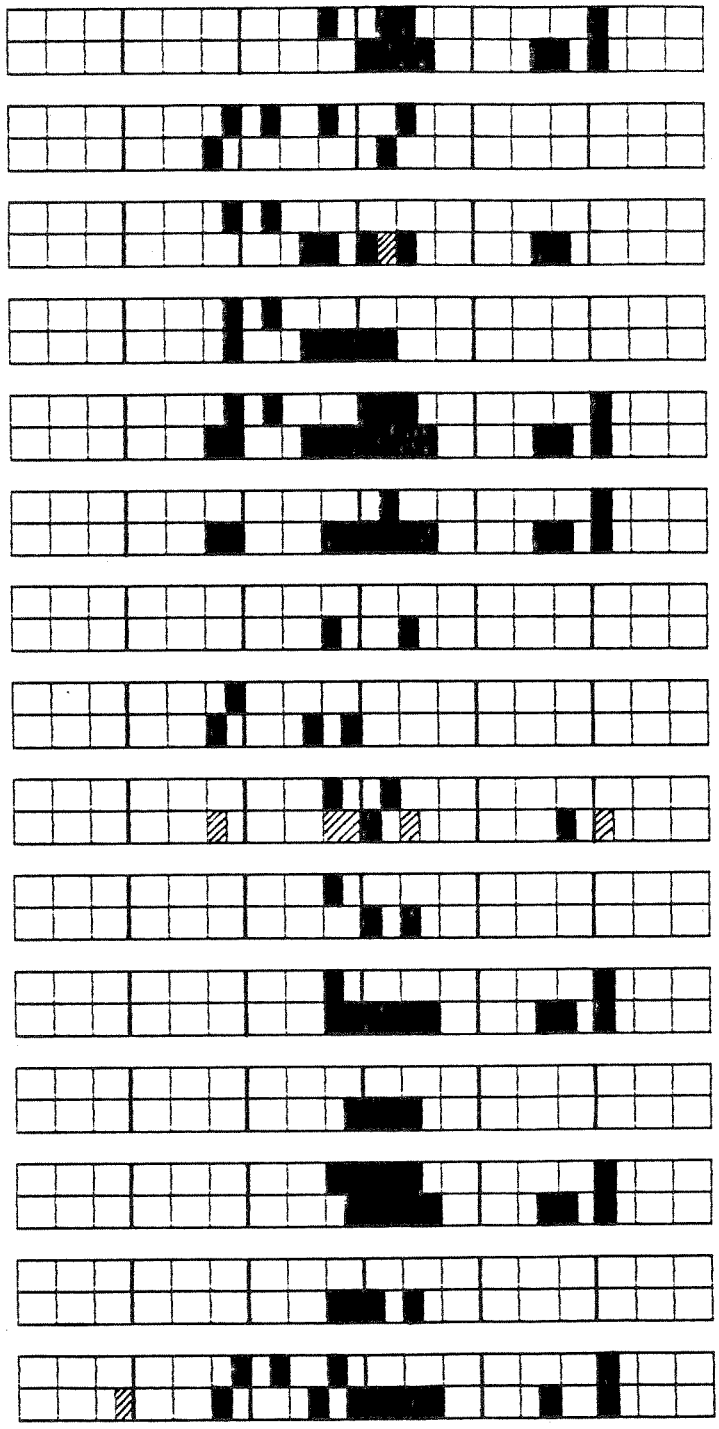
Speyeria aphrodite
(Aphrodite Fritillary)

Speyeria cybele cybele
(Great Spangled Fritillary)

Speyeria idalia
(Regal Fritillary)

Vanessa atalanta
(Red Admiral)

Vanessa cardui
(Painted Lady)



Distribution Mapping and Population Monitoring

Atrytonopsis hianna hianna

General surveys were conducted during the flight period for A. h. hianna in 1988 and 1989, but no quantitative transect surveys were conducted. In 1988 the survey routes had not been set up yet, and in 1989 the weather on the trips was not suitable for conducting quantitative surveys. The 1989 occurrence records are summarized in Table 1 and a distribution map for individual observations in 1989 is included in Figure 5. Despite poor conditions for the surveys individuals were found scattered throughout the preserve, and there is probably a good population there.

Table 1. 1989 general surveys for Atrytonopsis hianna hianna.

		Number Butterflies					Ave. Cond. Rating		
Date	Unit	Males	Females	???	Total	% Males	Males	Females	Total
5-24	2	1	0	0	1	100	1.0	---	1.0
5-29		(nothing; poor weather conditions)							
6-18		1	3	0	4	25	2.0	2.3	2.3
5-24	3S	1	0	2	3	---	1.0	---	---
6-18		1	2	4	7	---	3.0	2.0	---
5-24	4S	0	0	9	9	---	---	---	---
5-29		1	1	2	4	---	1.0	1.0	---
6-18		(brief survey; a few individuals observed)							
5-24	3&4N	1	0	0	1	100	1.0	---	1.0
5-29		2	0	0	2	100	1.0	---	1.0
6-18		0	0	0	0	---	---	---	---
Total Obs.		8	6	17	31	---	---	---	---

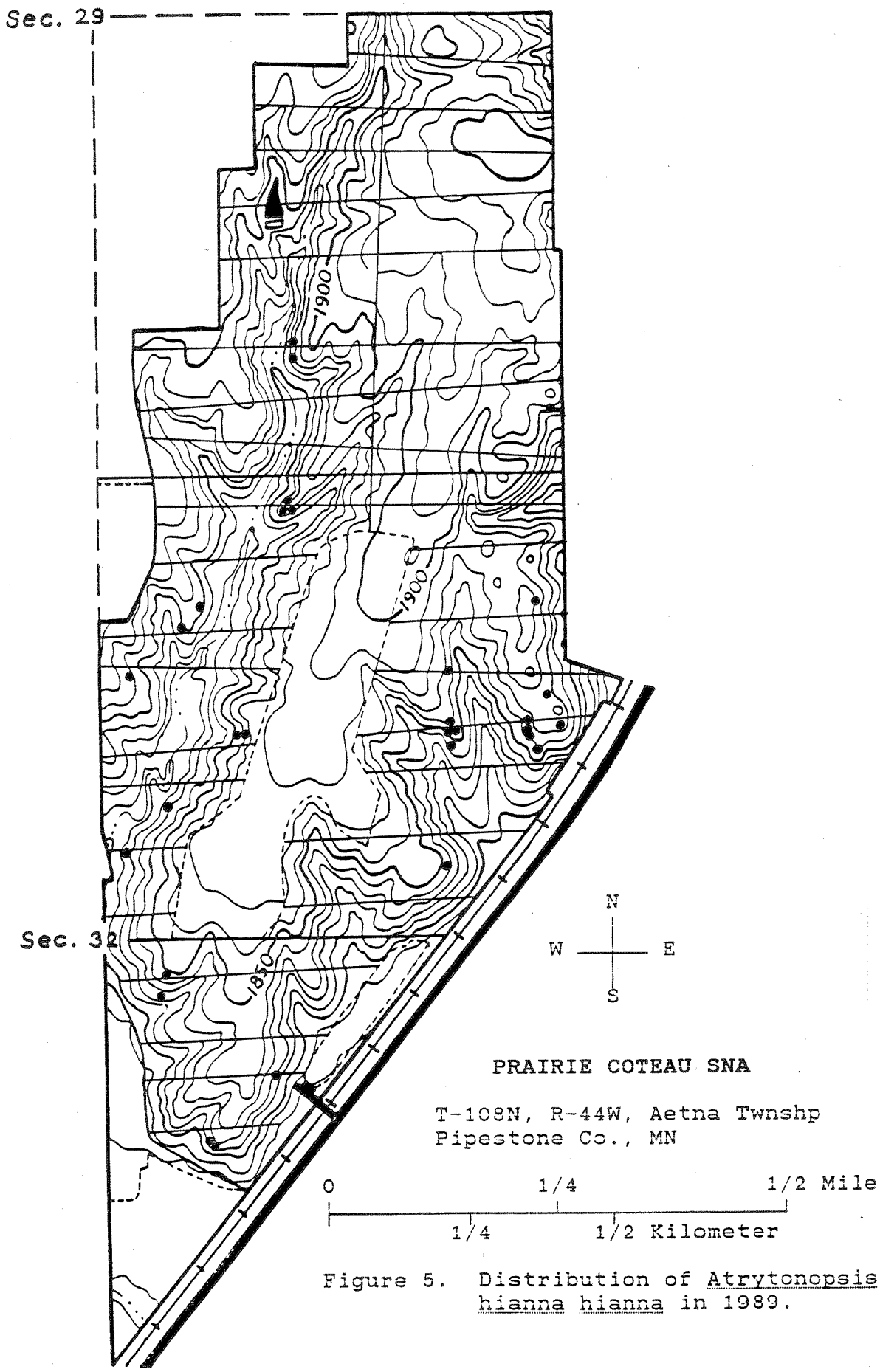


Figure 5. Distribution of Atrytonopsis hianna hianna in 1989.

Hesperia dacotae

Distribution maps for H. dacotae observations in 1988 and 1989 are included in Figures 6 and 7). The 1988 data for H. dacotae observations in each of the survey units are summarized in Tables 2 and 3, and the data for unit 4S are shown graphically in Figure 8. The data show some definite trends in population numbers, condition rating, and sex ratios, but they were not complete enough, and there were not enough replications, to accurately describe the population curve, and the relationship between it and the condition rating or sex ratio. The flight period was already in progress when the monitoring began on 24 June, so the first part of the curve is missing.

The flight period for H. dacotae started about one week later in 1989 than it had in 1988. One male specimen was collected 23 June, but the major hatch did not begin until 26 June. Setting up the new transects delayed starting transect surveys. Regular replicated surveys were not started in unit 2 until 1 July, but preliminary surveys did not show much activity in that unit prior to that date (see Table 4). Transect surveys were started in unit 4S on 28 June, after one general survey on 26 June. There seemed to be more activity in unit 4 at this time. Units 3S and 3&4N were each surveyed twice for H. dacotae, but only one good count was obtained for each of them (see Table 5).

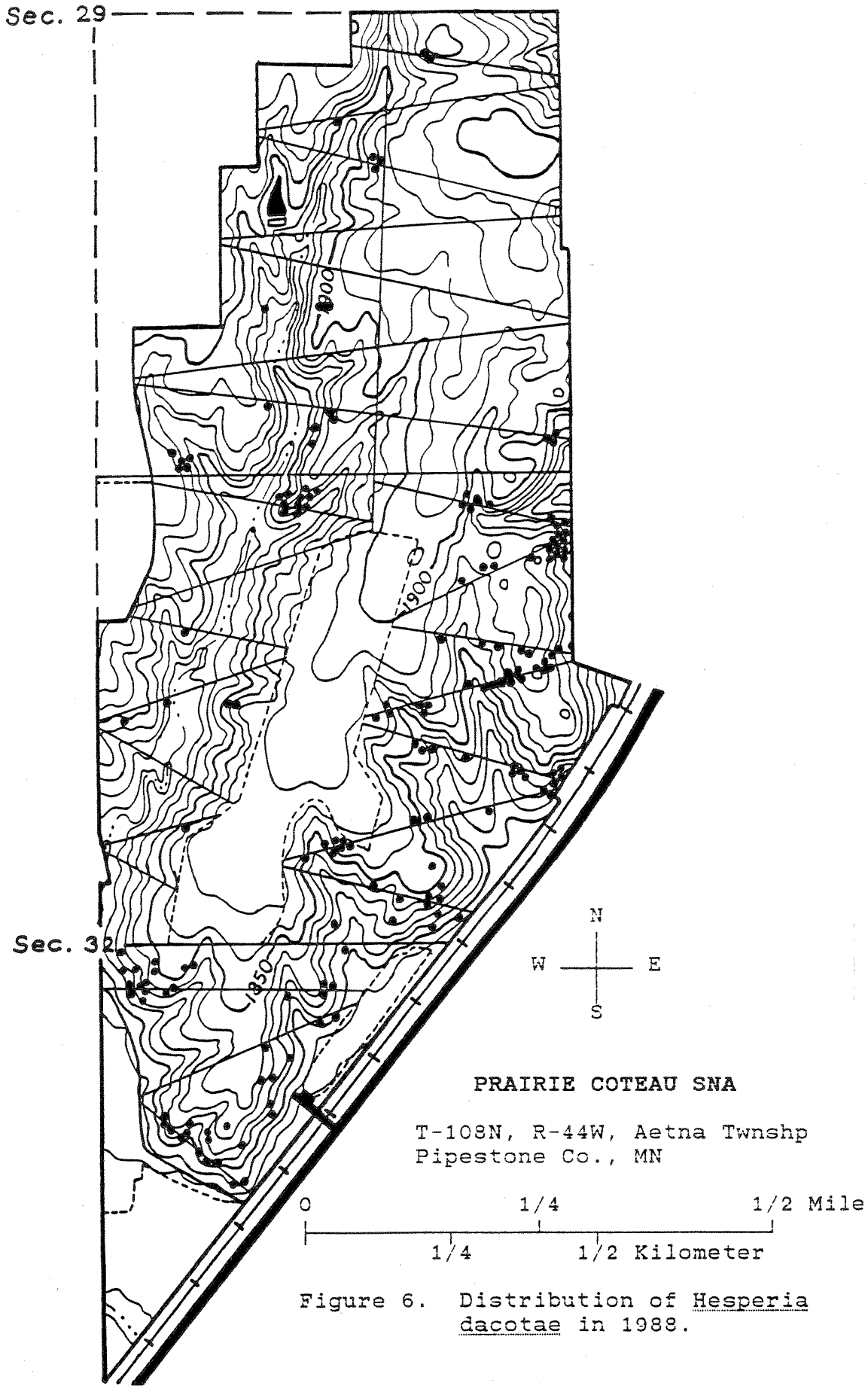


Figure 6. Distribution of Hesperia dacotae in 1988.

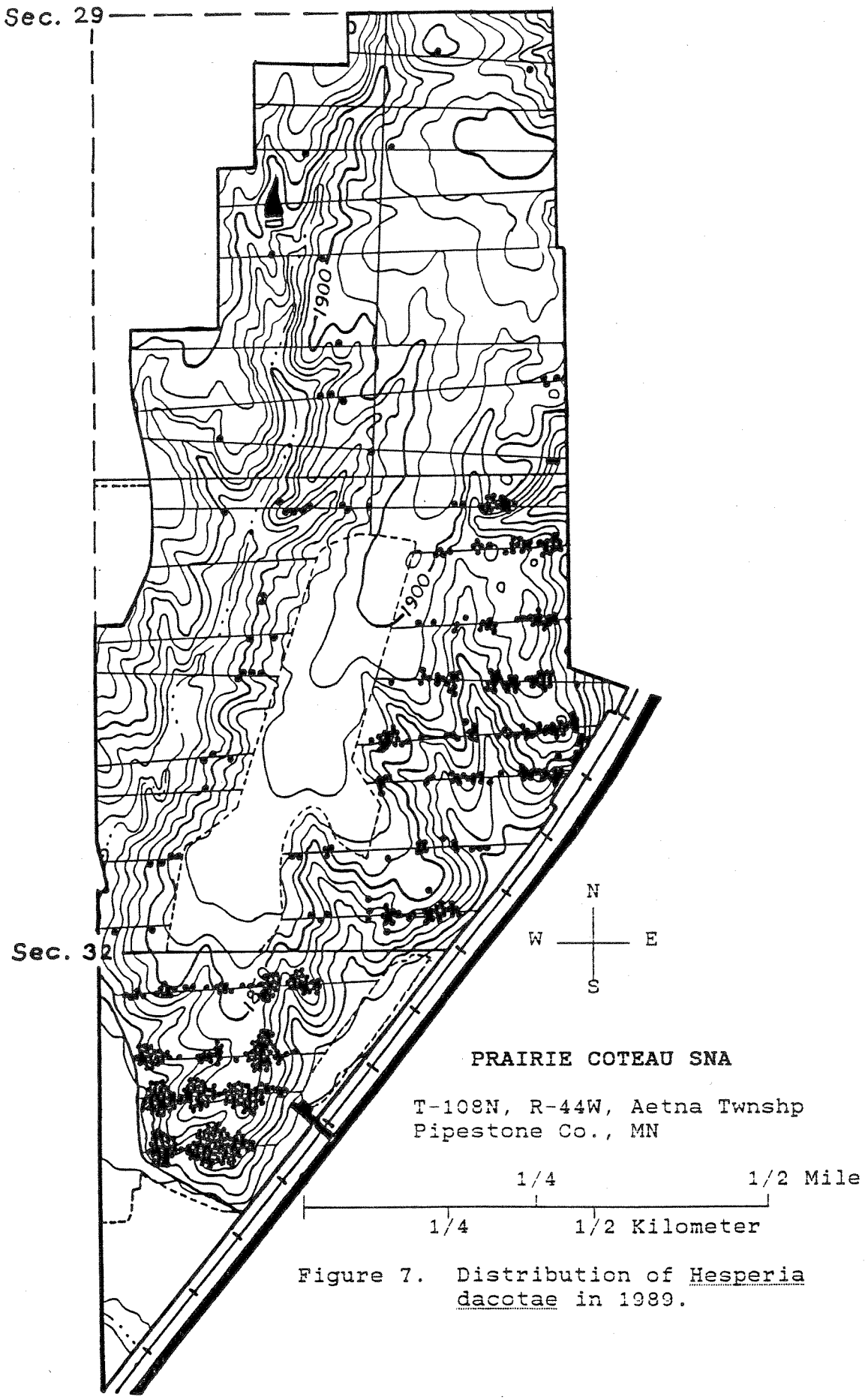


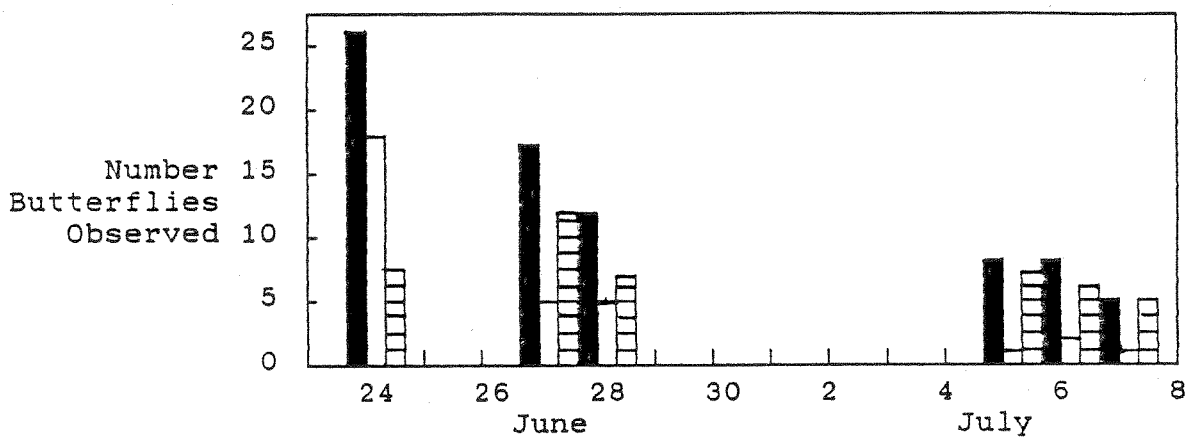
Figure 7. Distribution of Hesperia dacotae in 1989.

Table 2. 1988 transect surveys for Hesperia dacotae.

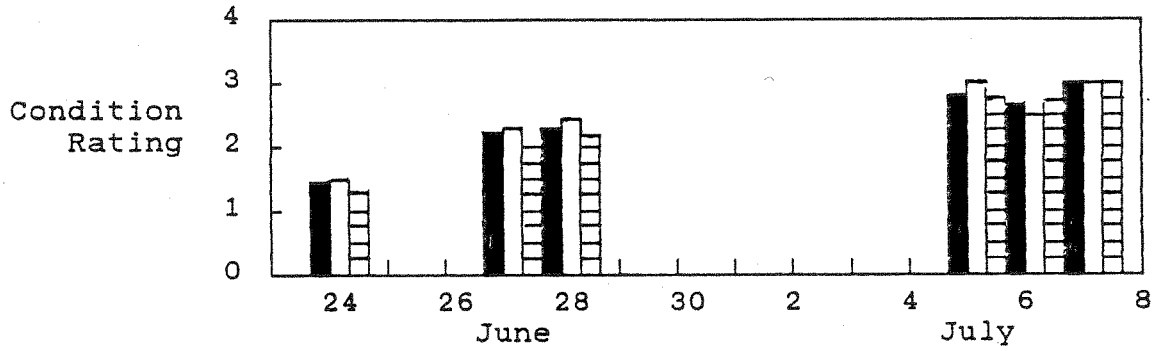
		Number Butterflies					Ave. Cond. Rating		
Date	Unit	Males	Females	Total	% Peak	% Males	Males	Females	Total
6-24	4S	18	8	26	100	69	1.5	1.4	1.5
6-27		5	12	17	65	29	2.0	2.3	2.2
6-28		5	7	12	46	42	2.4	2.1	2.3
7-05		1	7	8	31	13	3.0	2.7	2.8
7-06		2	6	8	31	25	2.5	2.7	2.6
7-07		1	4	5	19	20	3.0	3.0	3.0
6-28	3S	0	1	1	33	0	---	2.0	2.0
7-05		0	3	3	100	0	---	3.0	3.0
6-28	2	4	3	7	100	57	1.8	2.0	1.9
7-05		1	6	7	100	14	2.0	2.5	2.4
7-06		0	3	3	43	0	---	2.0	2.0
7-07		0	?2	?2	?29	?0	---	?2.0	?2.0
7-07		0	?4	?4	?57	?0	---	?2.5	?2.5
7-11		0	0	0	0	--	---	---	---

Table 3. 1988 general surveys and observations off the transects for Hesperia dacotae.

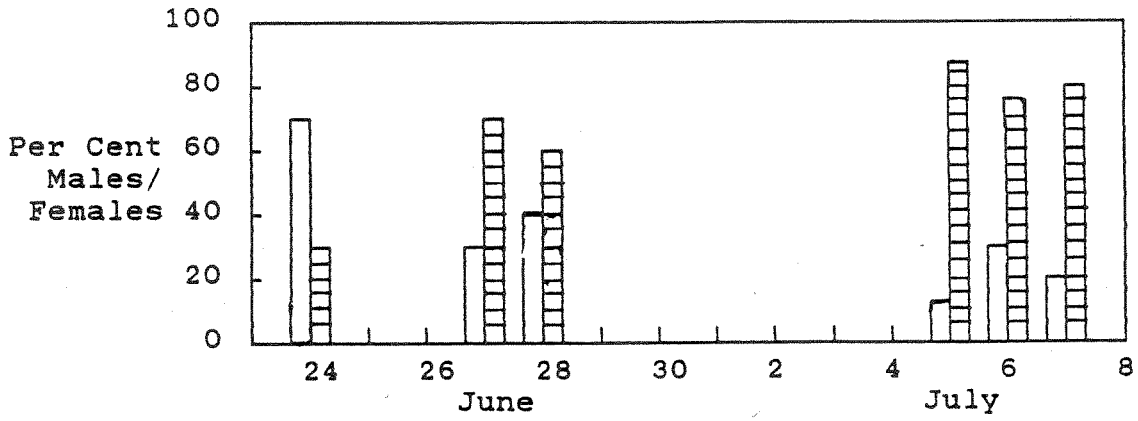
		Number Butterflies					Ave. Cond. Rating		
Date	Unit	Males	Females	???	Total	% Males	Males	Females	Total
6-22	2	4	6	0	10	40	1.8	1.2	1.4
7-05		0	1	2	3	0	---	2.0	2.0
7-06		1	0	1	2	100	2.0	---	2.0
7-07		0	0	6	6	---	---	---	---
7-11		0	1	0	1	0	---	---	---
6-23	3S	2	1	0	3	67	2.5	2.0	2.3
6-24		0	0	2	2	--	---	---	---
6-27		0	0	4	4	--	---	---	---
6-28		0	0	1	1	--	---	---	---
7-06		0	0	2	2	--	---	---	---
7-07		0	0	1	1	--	---	---	---
6-27	4S	0	0	1	1	--	---	---	---
7-05		0	3	0	3	0	---	2.5	2.5
7-06		0	0	3	3	--	---	---	---
7-07		0	0	1	1	--	---	---	---
6-22	3&4N	14	12	0	26	54	---	---	---
6-24		2	7	0	9	22	1.5	1.3	1.4
7-06		0	1	4	5	0	---	3.0	3.0
7-13		0	1	0	1	0	---	2.0	2.0



a) Number butterflies observed per day.



b) Condition rating
1 = fresh 2 = slightly worn
3 = worn 4 = very worn



c) Per cent males/females

Figure 8. Transect data for Hesperia dakotae in area 4S
total (males + females)
males females

Table 4. Preliminary 1989 Transect surveys for Hesperia dacotae in unit 2.

		Number Butterflies					Ave. Cond. Rating		
Date	Time	Males	Females	Total	% Peak	% Males	Males	Females	Total
6-27*	2:05	0	0	0	0	---	---	---	---
6-29	10:00	0	0	0	0	---	---	---	---
6-29	1:05	1	0	1	6	100	1.0	---	1.0
6-29	2:55	2	0	2	11	100	1.0	---	1.0

* used the old survey routes

Table 5. 1989 transect surveys for Hesperia dacotae in units 3S and 3&4N.

		Number Butterflies					Ave. Cond. Rating		
Date	Unit	Time	Males	Females	Total	% Males	Males	Females	Total
7-04	3S	9:35	15	9	24	63	1.6	1.1	1.4
7-12		10:00	0	0	0	---	---	---	---
6-23	3&4N	9:45	1	0	1	100	1.0	---	1.0
7-10		9:20	4	13	17	24	2.8	1.8	2.0
7-14		9:20	0	0	0	---	---	---	---

Data for the 1989 H. dacotae observations in unit 2 are summarized in tables 6-8. The population data for each time period were plotted to examine the effect of time of day on the counts (see Figure 9). Unfortunately there was considerable variation in the counts within a given day, and there did not seem to be a pattern to this variation that could be accounted for by the effect of time of day. The average number of butterflies observed per time period for the entire flight period was greatest at 1 p.m. for females and for males plus females (see Table 7), but it was not significant considering the considerable variation in the counts. The severe depressions in the curves on 11 and 17 July are the results of bad weather. It was overcast with light rain most of 11 July and only one survey was conducted at 3 p.m. It was overcast and windy with light drizzle in the early afternoon on 17 July. All of the surveys were conducted but there was almost no activity.

Table 6. 1989 transect surveys for Hesperia dacotae in unit 2.

		Number Butterflies					Ave. Cond. Rating		
Date	Time	Males	Females	Total	% Peak	% Males	Males	Females	Total
7-01	9:00	13	1	14	78	93	1.3	1.0	1.3
7-03	9:00	13	1	14	78	93	1.4	1.0	1.4
7-05	9:00	10	0	10	56	100	1.5	---	1.5
7-07	9:00	4	1	5	28	80	2.5	1.0	2.2
7-09	9:00	3	1	4	22	75	2.0	1.0	1.8
7-11	9:00	--	--	--	---	---	---	---	---
7-13	9:00	3	4	7	39	43	3.7	1.5	2.4
7-15	9:00	1	4	5	28	20	4.0	2.0	2.4
7-17	9:00	0	0	0	0	---	---	---	---
7-01	11:00	6	2	8	44	75	1.0	1.0	1.0
7-03	11:00	6	5	11	61	55	1.5	1.2	1.4
7-05	11:00	11	3	14	78	79	1.6	1.3	1.5
7-07	11:00	12	3	15	83	80	1.8	1.3	1.7
7-09	11:00	5	4	9	50	56	2.4	2.0	2.2
7-11	11:00	--	--	--	---	---	---	---	---
7-13	11:00	1	3	4	22	25	3.0	2.0	2.3
7-15	11:00	5	1	6	33	83	3.0	2.0	2.8
7-17	11:00	0	0	0	0	---	---	---	---
7-01	1:00	4	1	5	28	80	1.5	1.0	1.4
7-03	1:00	8	3	11	61	73	1.1	1.0	1.1
7-05	1:00	9	9	18	100	50	1.3	1.2	1.3
7-07	1:00	4	2	6	33	67	2.0	2.0	2.0
7-09	1:00	9	6	15	83	60	2.9	2.0	2.5
7-11	1:00	--	--	--	---	---	---	---	---
7-13	1:00	2	6	8	44	25	3.0	2.0	2.3
7-15	1:00	2	9	11	61	18	3.0	2.1	2.3
7-17	1:00	0	0	0	0	---	---	---	---
7-01	3:00	6	2	8	44	75	1.3	1.0	1.3
7-03	3:00	8	2	10	56	80	1.1	1.0	1.1
7-05	3:00	8	3	11	61	73	1.4	1.7	1.5
7-07	3:00	6	5	11	61	55	1.8	1.4	1.6
7-09	3:00	8	3	11	61	73	2.3	2.0	2.2
7-11	3:00	2	1	3	17	67	2.5	2.0	2.3
7-13	3:00	1	2	3	17	33	2.0	2.5	2.3
7-15	3:00	1	3	4	22	25	2.0	2.5	2.3
7-17	3:00	1	0	1	6	100	2.0	---	2.0
7-01	5:00	8	3	11	61	73	1.3	1.0	1.2
7-03	5:00	5	1	6	33	83	1.6	1.0	1.5
7-05	5:00	9	5	14	78	64	2.1	1.2	1.8
7-07	5:00	6	3	9	50	67	2.7	1.7	2.3
7-09	5:00	5	2	7	39	71	2.4	1.5	2.1
7-11	5:00	--	--	--	---	---	---	---	---
7-13	5:00	4	3	7	39	57	2.3	2.3	2.3
7-15	5:00	4	6	10	56	40	3.0	2.2	2.5
7-17	5:00	0	0	0	0	---	---	---	---
Total Obs.		213	113	326	---	66	1.8	1.7	1.8

Table 7. Averages per time period for the 1989 transect surveys for Hesperia dacotae in unit 2.

		Number Butterflies					Ave. Cond. Rating		
Date	Time	Males	Females	Total	% Peak	% Males	Males	Females	Total
Ave.	9:00	5.2	1.3	6.6	---	80	1.7	1.5	1.7
Ave.	11:00	5.1	2.3	7.4	---	69	1.8	1.5	1.7
Ave.	1:00	4.2	4.0	8.2	---	49	1.9	1.7	1.8
Ave.	3:00	4.6	2.3	6.9	---	66	1.7	1.7	1.7
Ave.	5:00	4.6	2.6	7.1	---	64	2.1	1.7	1.9

The flight curve was described, and the relationship between it and the sex ratio and condition rating were examined using the daily averages from the data in unit 2 (see Table 8), and the data from unit 4S (see Table 9). The daily averages for the population counts, sex ratios, and condition ratings for unit 2, and the data for unit 4 are plotted in Figures 10-16. The males emerge first and peak sooner than the females (see Figures 10 and 11). There is therefore a very strong relationship between the sex ratio (expressed here as per cent males/females) and the portion of the flight period (see Figure 12 for unit 4 data). Data for unit 2 are similar but the slopes of the lines are greatly reduced. The relationship between the population curve and the sex ratio can be expressed graphically by converting population counts to per cent peak population count, and plotting them together with the per cent males or females (see Figures 13 and 14). The average condition rating is also correlated with the portion of the flight period (see Figures 15 and 16), and could also be plotted together with the per cent peak population. These plots can then be used to determine the appropriate adjustment factor for converting counts to their expected values at the peak portion of the flight period.

Table 8. Daily averages for the 1989 transect surveys for Hesperia dacotae in unit 2.

		Number Butterflies					Ave. Cond. Rating		
Date	Time	Males	Females	Total	% Peak	% Males	Males	Females	Total
7-01	Ave.	7.4	1.8	9.2	69	80	1.3	1.0	1.2
7-03	Ave.	8.0	2.4	10.4	78	77	1.3	1.1	1.3
7-05	Ave.	9.4	4.0	13.4	100	70	1.6	1.3	1.5
7-07	Ave.	6.4	2.8	9.2	69	70	2.1	1.5	1.9
7-09	Ave.	6.0	3.2	9.2	69	65	2.5	1.9	2.3
7-11	Ave.	2.0	1.0	3.0	22	67	2.5	2.0	2.3
7-13	Ave.	2.2	3.6	5.8	43	38	2.8	2.0	2.3
7-15	Ave.	2.6	4.6	7.2	54	36	3.0	2.1	2.4
7-17	Ave.	0.2	0.0	0.2	1	100	2.0	---	2.0

Table 9. 1989 transect surveys for Hesperia dacotae in unit 4S.

		Number Butterflies					Ave. Cond. Rating		
Date	Time	Males	Females	Total	% Peak	% Males	Males	Females	Total
6-26	*3:30	8	1	**9	---	89	1.0	1.0	1.0
6-28	1:55	12	2	14	29	86	1.2	1.0	1.1
6-30	1:25	19	6	25	51	76	1.2	1.0	1.2
7-02	12:45	31	18	49	100	63	1.2	1.2	1.2
7-04	1:10	15	25	40	82	38	1.5	1.3	1.4
7-06	12:55	10	15	25	51	40	2.0	1.5	1.7
7-08	1:00	17	17	34	69	50	2.7	1.5	2.1
7-10	1:30	3	7	10	20	30	2.0	1.6	1.7
7-12	1:30	3	22	25	51	12	2.7	2.0	2.1
7-14	1:20	0	1	1	2	0	---	2.0	2.0
7-16	1:30	1	11	12	24	8	3.0	2.5	2.5
Total Obs.		119	125	244	---	49	1.6	1.6	1.6

* general survey
** total = 11 including 2 unsexed individuals

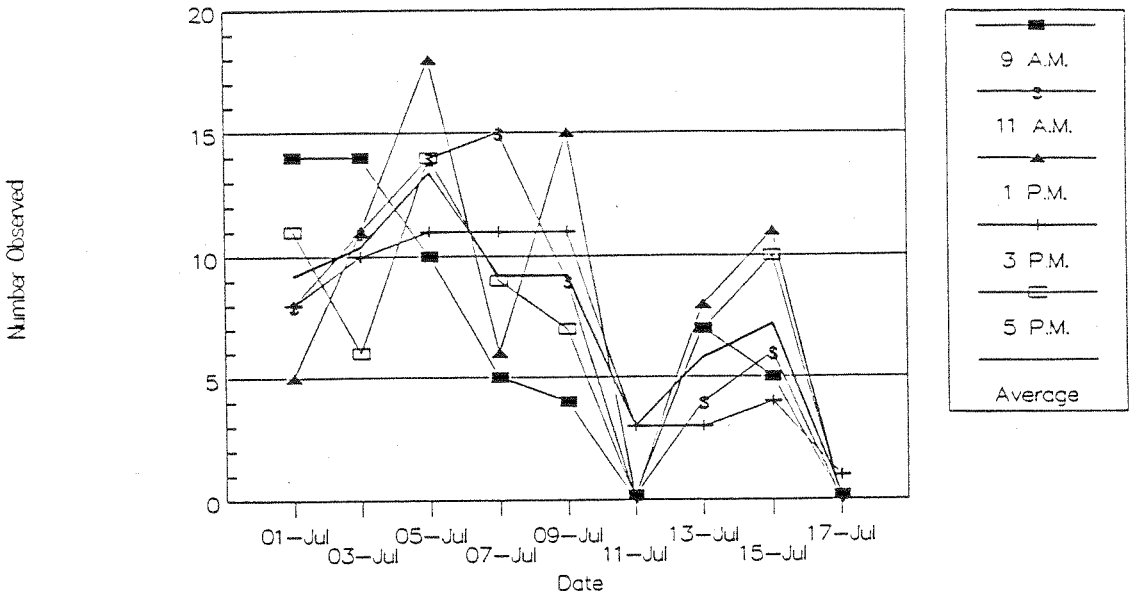


Figure 9. Number Hesperia dacotae observed per time period throughout the flight period in unit 2.

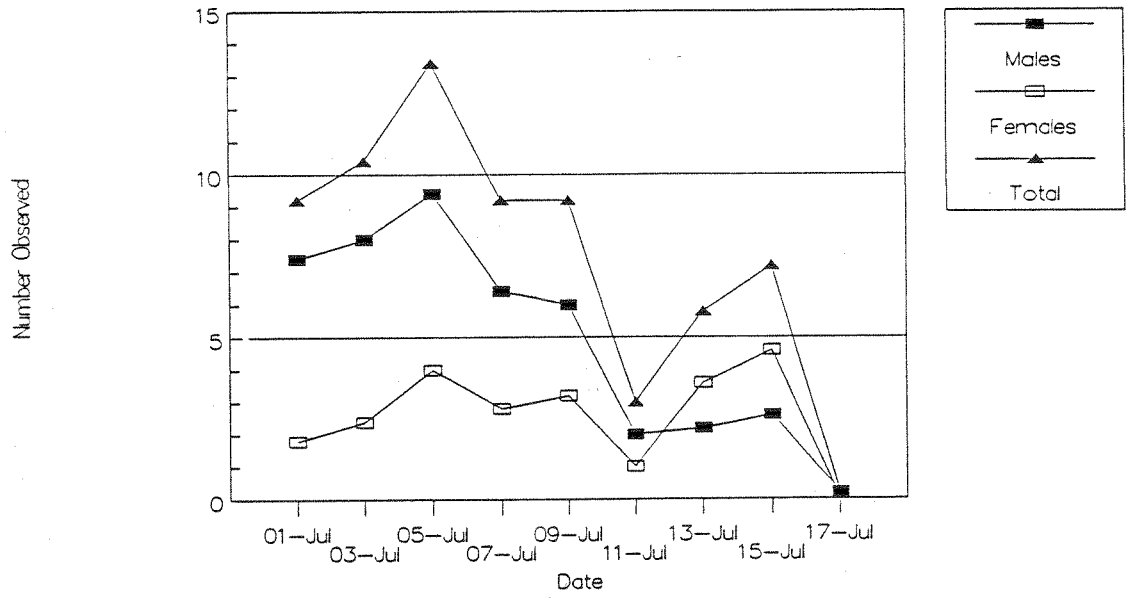


Figure 10. Average number Hesperia dacotae observed throughout the flight period in unit 2.

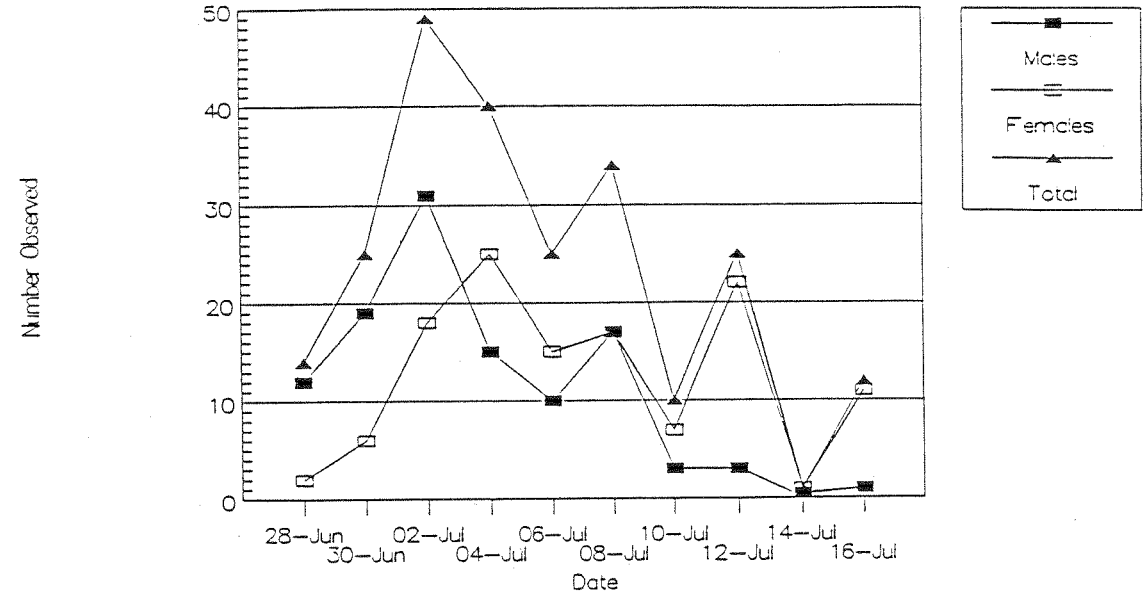


Figure 11. Number Hesperia dacotae observed throughout the flight period in unit 4S.

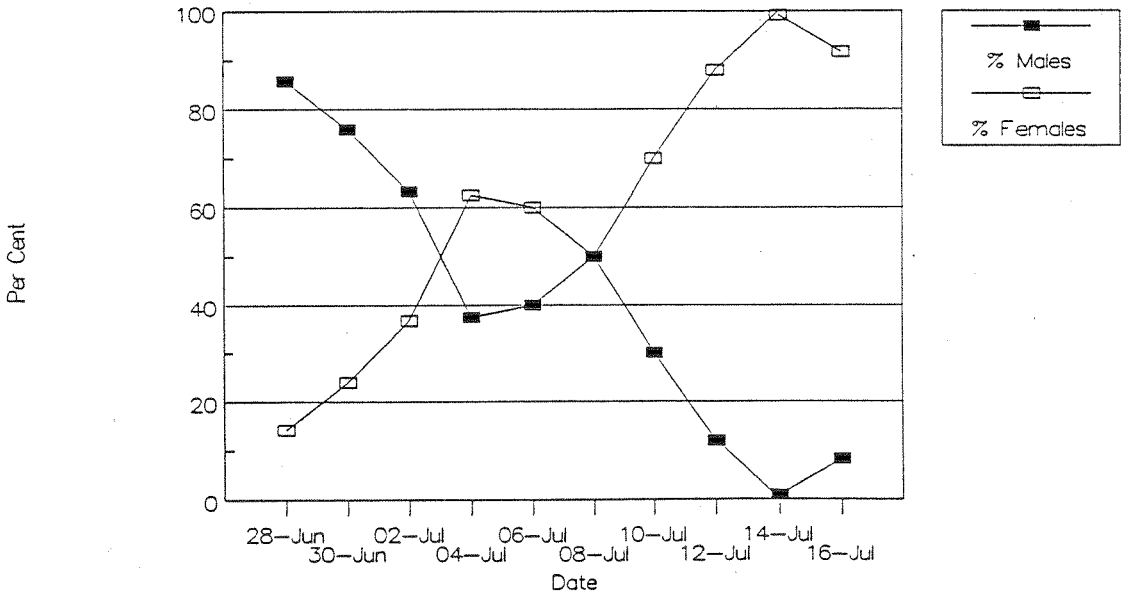


Figure 12. Per cent males/females for Hesperia dacotae throughout the flight period in unit 4S.

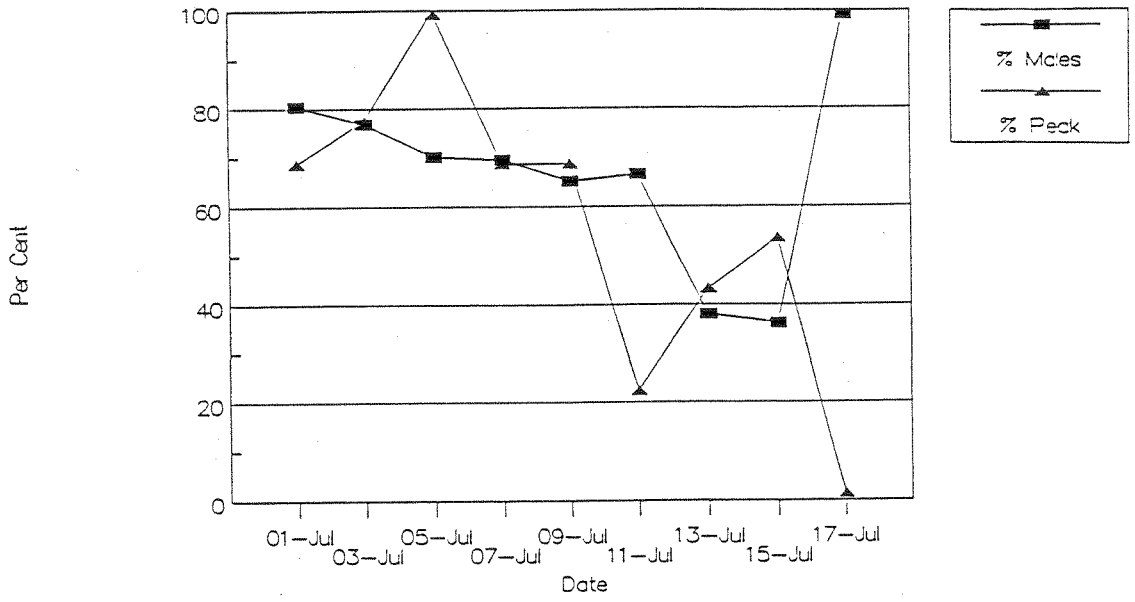


Figure 13. Relationship between per cent males and per cent peak population for Hesperia dacotae in unit 2.

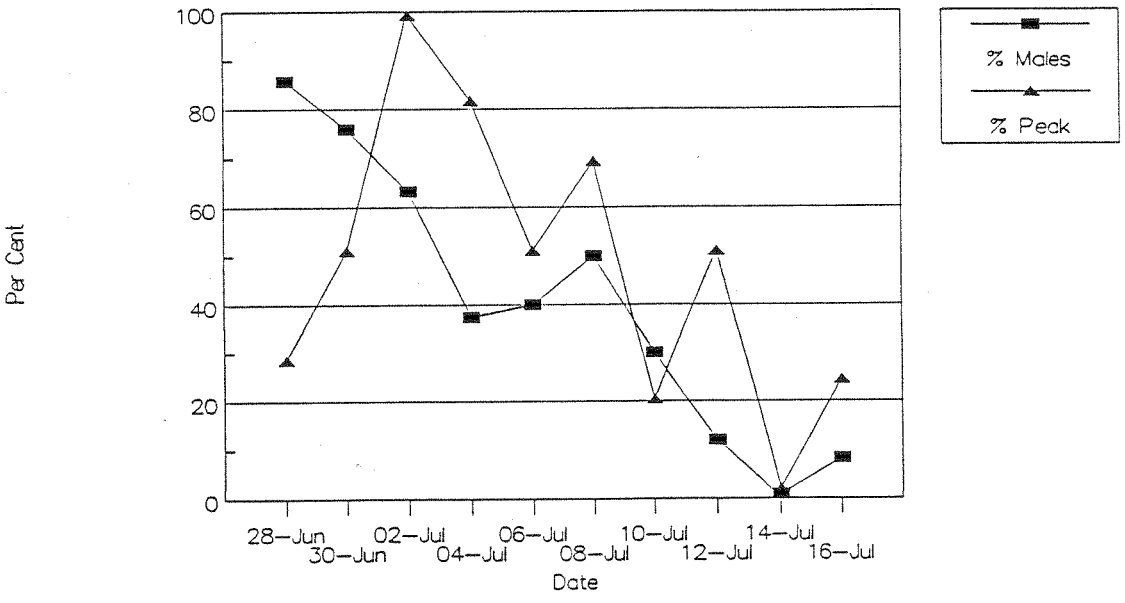


Figure 14. Relationship between per cent males and per cent peak population for Hesperia dacotae in unit 4S.

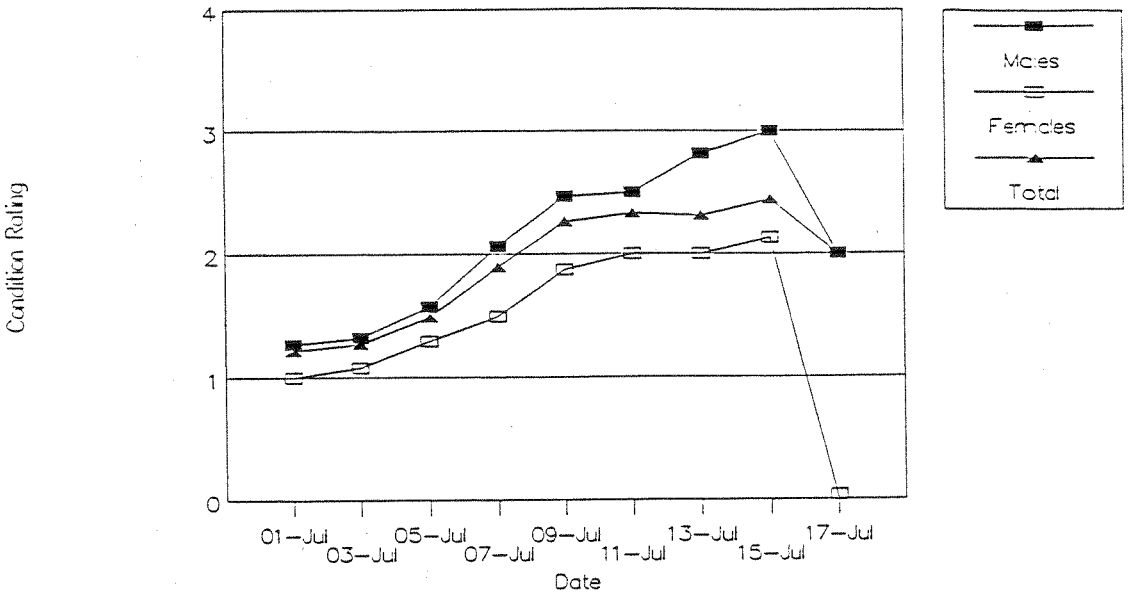


Figure 15. **Average condition rating for Hesperia dacotae throughout the flight period in unit 2.**

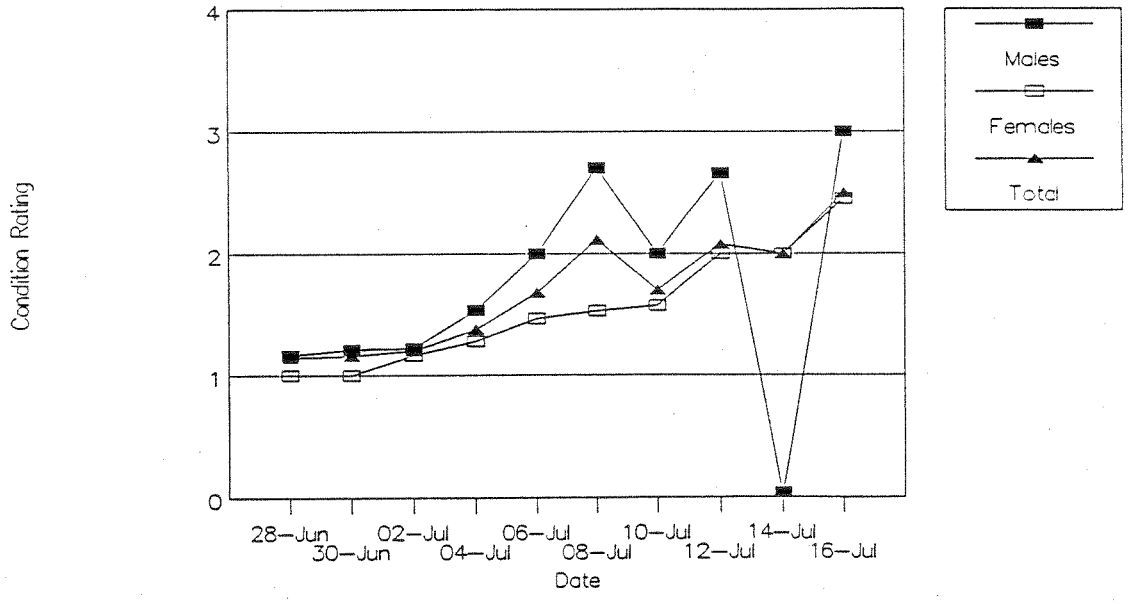


Figure 16. **Average condition rating for Hesperia dacotae throughout the flight period in unit 4S.**

H. ottoe

H. ottoe was not found at Prairie Coteau in 1988, but a few scattered individuals were observed in 1989 (see Table 10). The location for each sighting is given in Figure 17. It would appear to have a very small population, but it is also possible that it has a later flight period and surveys need to be done through the end of July.

Table 10. Occurrence records for H. ottoe in 1989.

Date	Unit	Sex	Cond.
7-06	4S	male	1
7-12	4S	male	1
		male	2
7-16	4S	male	2
7-15	2	male	1

Atrytone arogos iowa, Oarisma poweshiek, and Speyeria idalia

Distribution maps for observations of A. a. iowa, H. dacotae, O. poweshiek, and S. idalia in 1988 and 1989 are included in Figures 18-23. Complete sex ratio and condition rating data were not obtained for these species but population counts were made while conducting the surveys for H. dacotae. Their population data has been summarized along with that for H. dacotae so that they can be compared (see Tables 11-17).

The 1989 population curves for A. a. iowa, H. dacotae, O. poweshiek, and S. idalia in units 2 and 4S are shown in Figures 24 and 25. H. dacotae, O. poweshiek, and S. idalia all begin their flight periods at about the same time. Except for the one earlier record for H. dacotae, the first records for each of

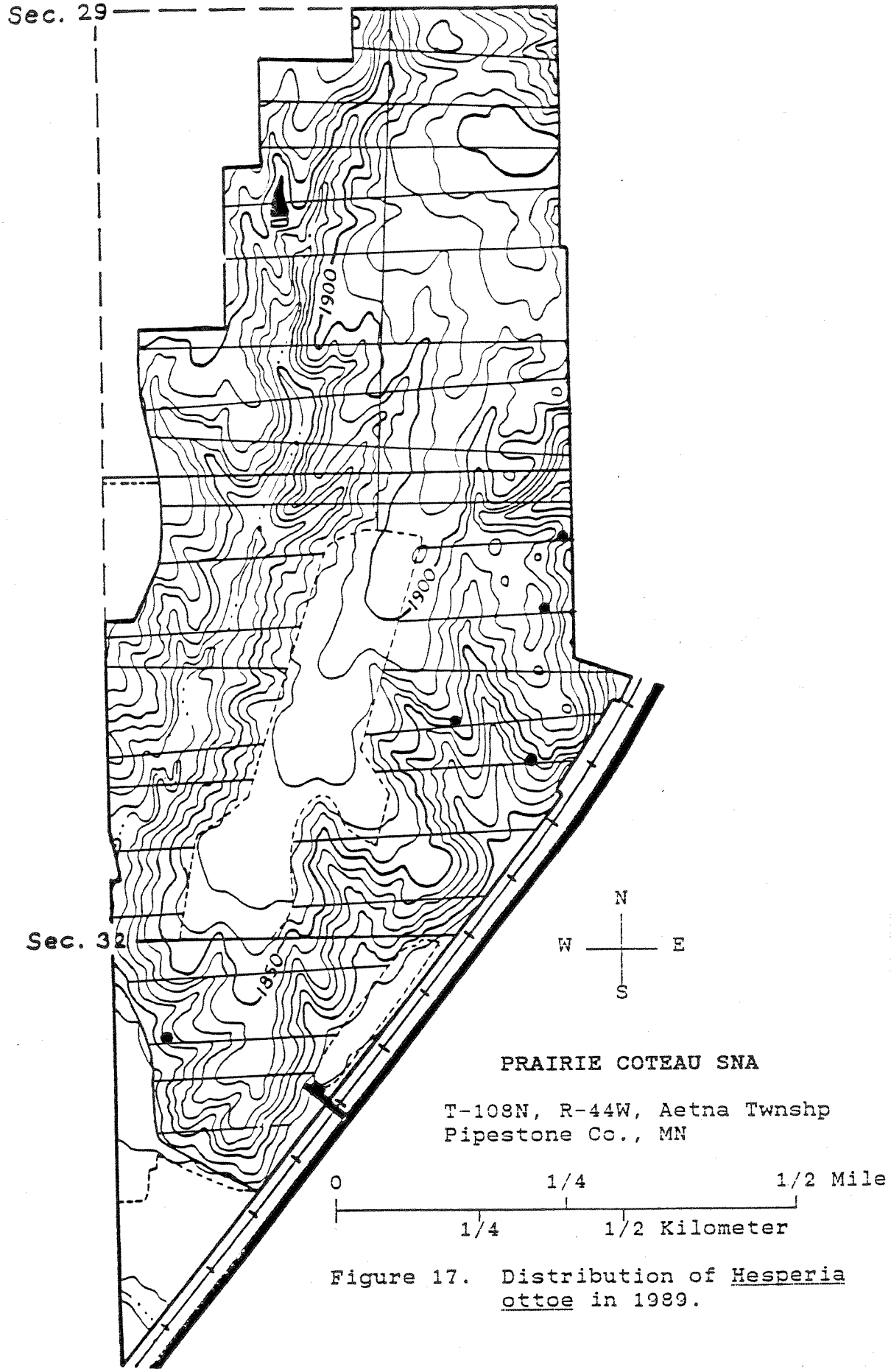


Figure 17. Distribution of Hesperia ottoe in 1989.

these species was 26 June in 1989. The population curves for H. dacotae and O. poweshiek are similar, but the flight period for S. idalia continues into September and the population curve appeared to still be increasing when the surveys were discontinued. A. a. iowa starts a little later and peaks after the other skippers have started to decline. If this relationship between the flight periods is consistent, then it might only be necessary to determine the portion of the flight period from sex ratios and condition ratings for one of the species, and then use this to determine the portion of the flight period for the other species.

There appeared to be good populations of each of these species at Prairie Coteau. S. idalia was doing exceptionally well in 1989, with four counts in excess of one hundred in unit 4S, and two counts of 429 and 341 respectively in unit 3&4N (see Table 17). The highest counts in 1988 were 20 in unit 4S and 30 in unit 2 (see Table 11). All of the species appeared to be doing better in 1989. This was probably in part due to a break in the drought in that part of the state.

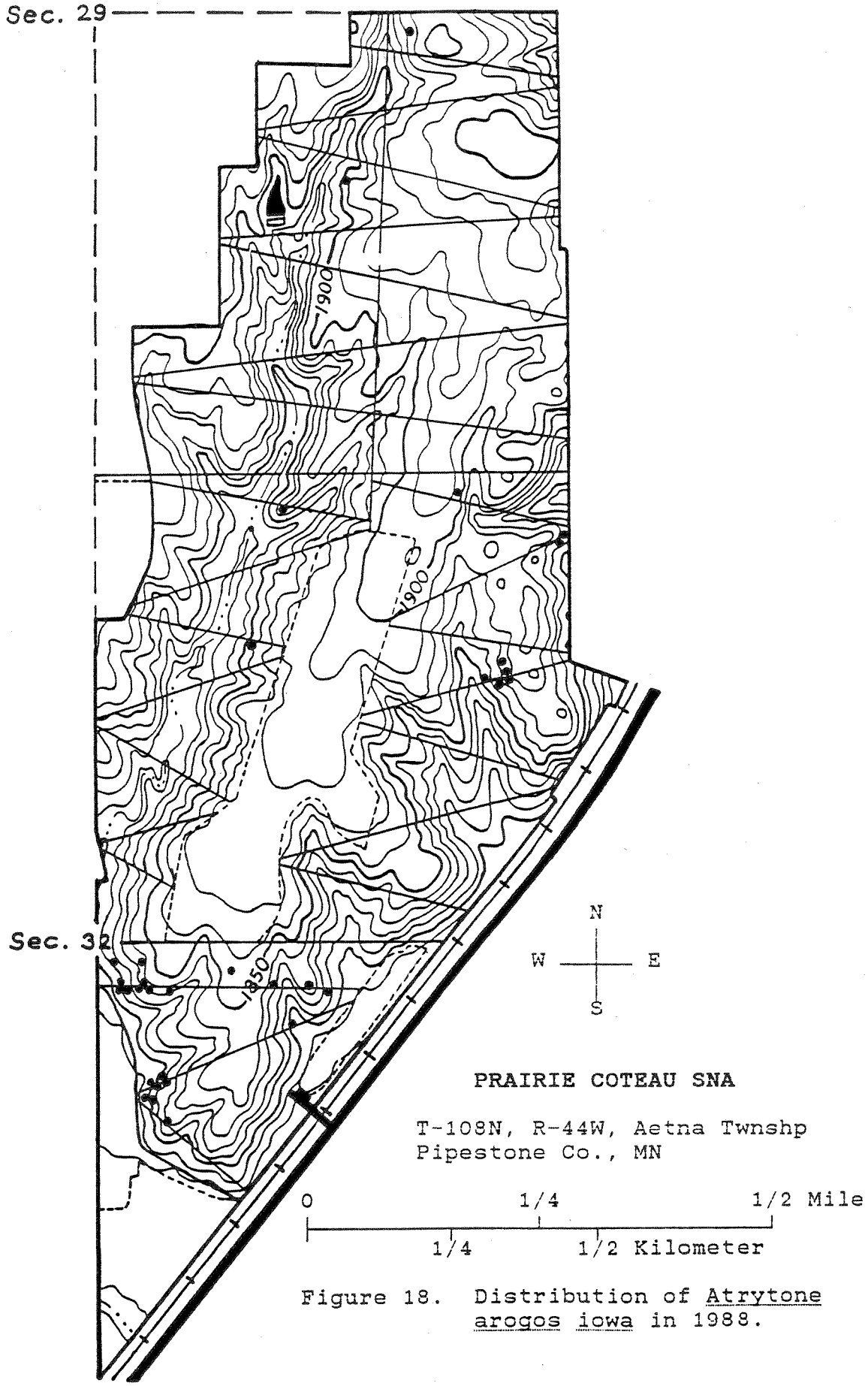


Figure 18. Distribution of Atrytone arogos iowa in 1988.

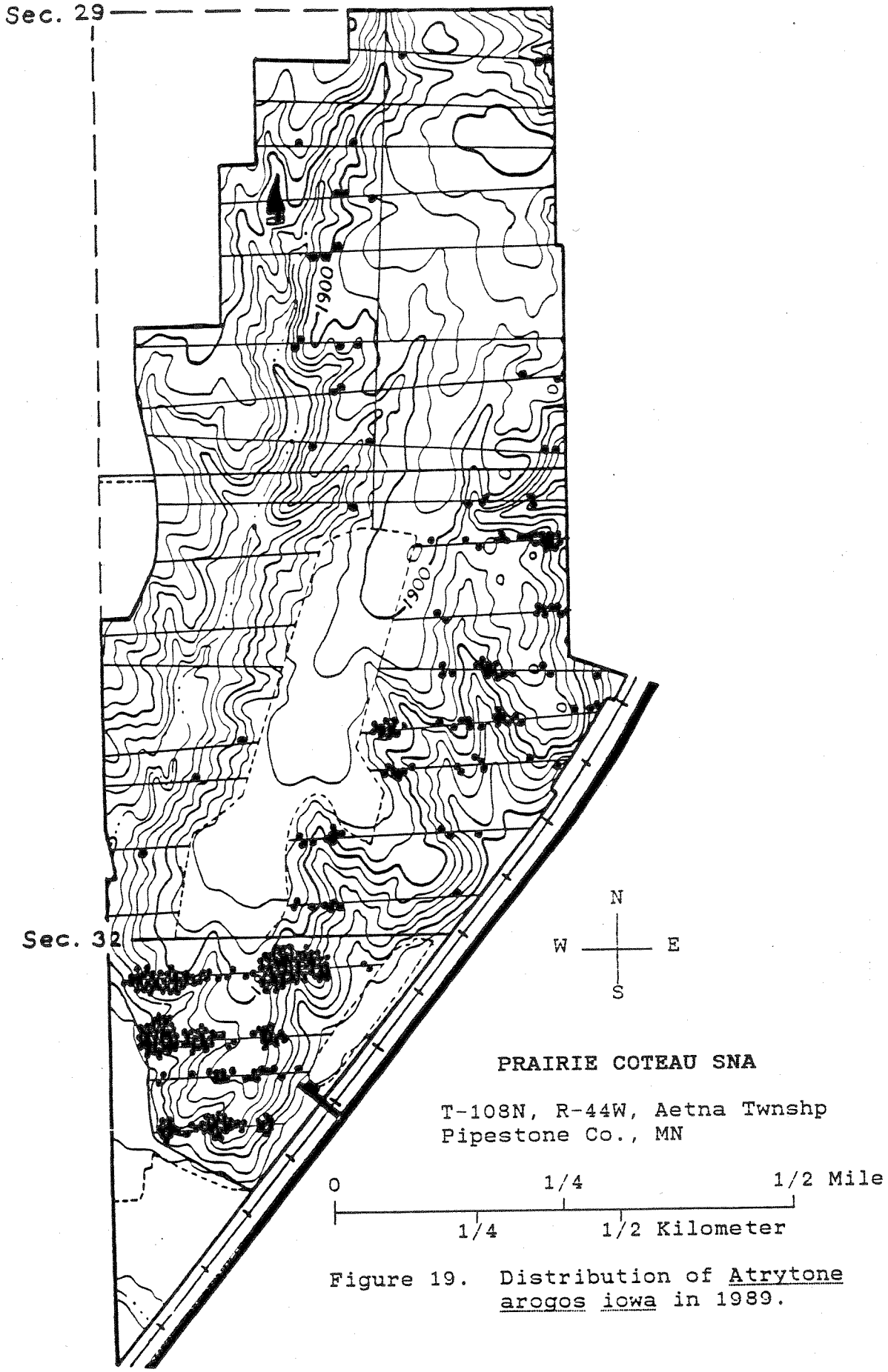


Figure 19. Distribution of Atrytone arogos iowa in 1989.

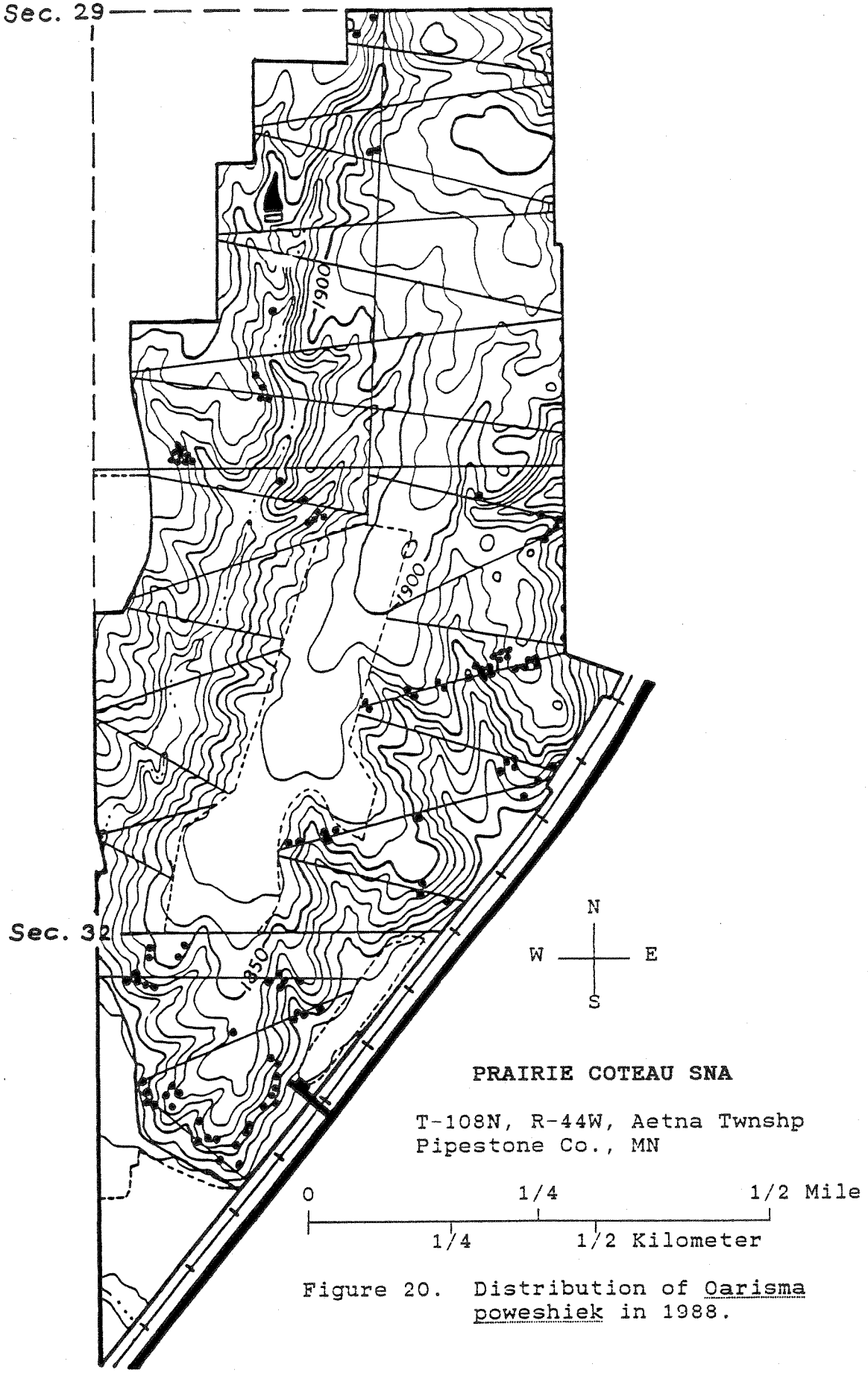


Figure 20. Distribution of Oarisma poweshiek in 1988.

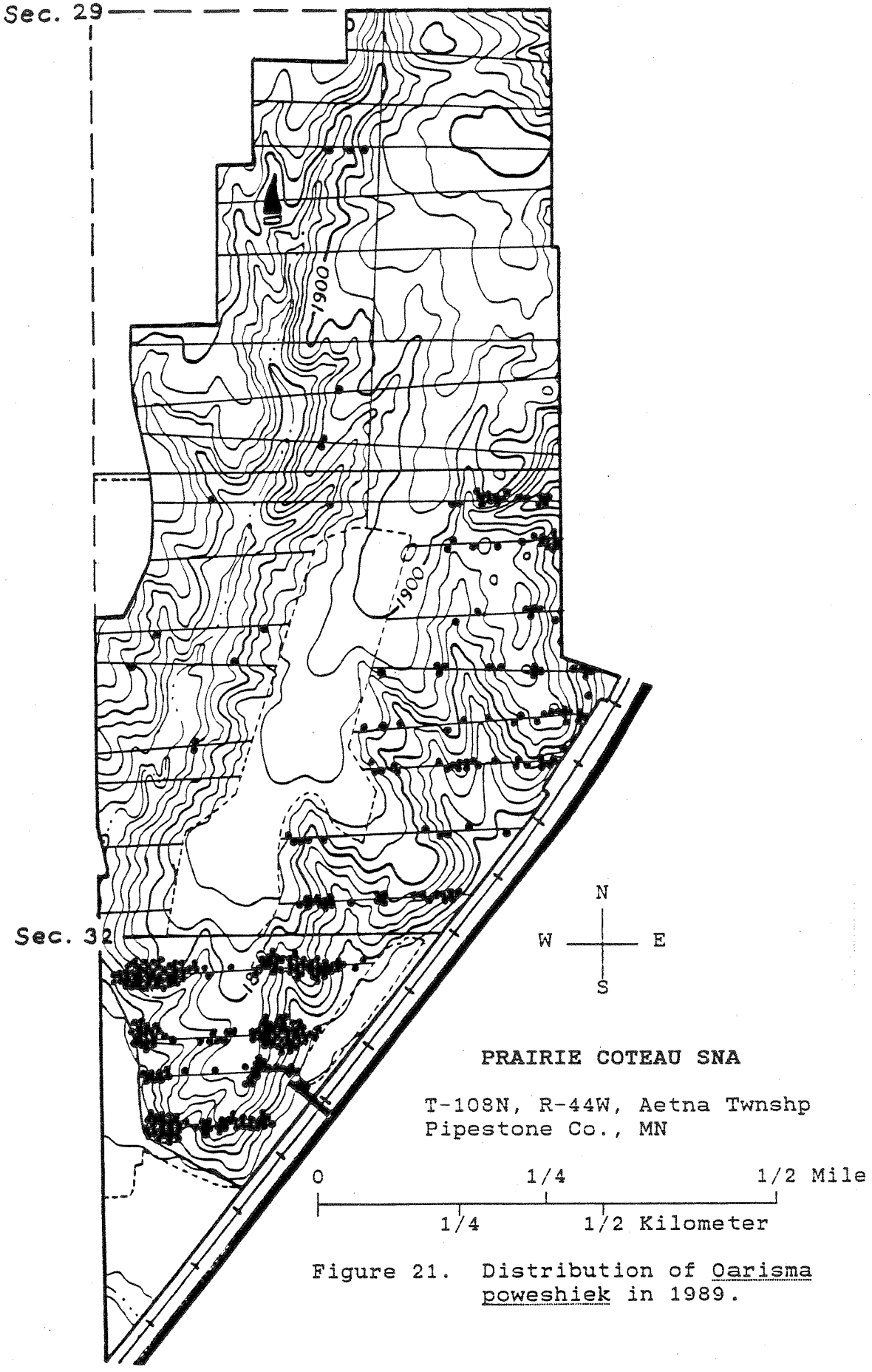


Figure 21. Distribution of Oarisma poweshiek in 1989.

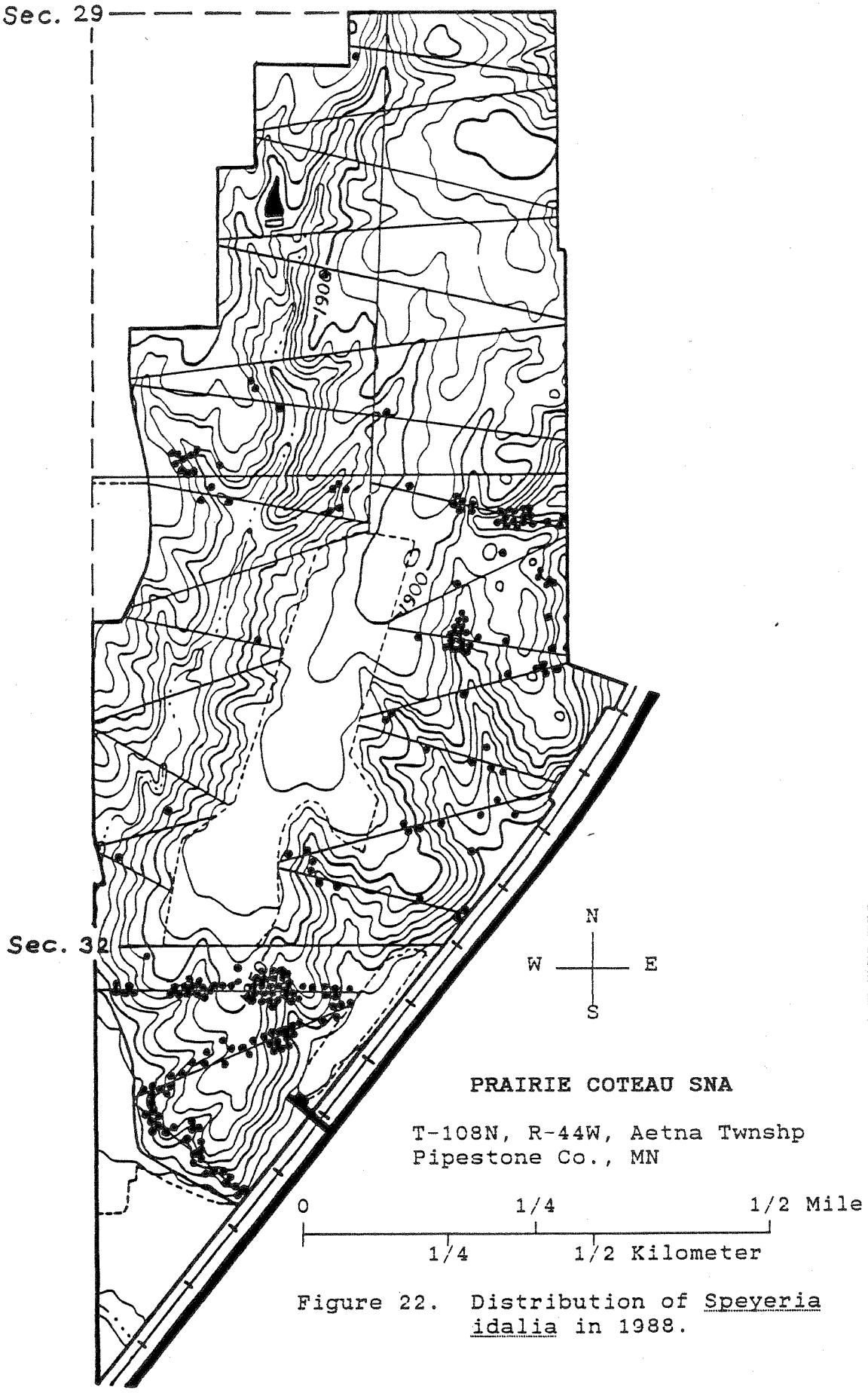


Figure 22. Distribution of Speyeria idalia in 1988.

Figure 23. Distribution of Speuyeria idalia in 1989.

Over 2,000 sightings scattered throughout the prairie. Mapping has not yet been done. An attempt will be made to map these in the future and the map will be sent to you for inclusion in the report.

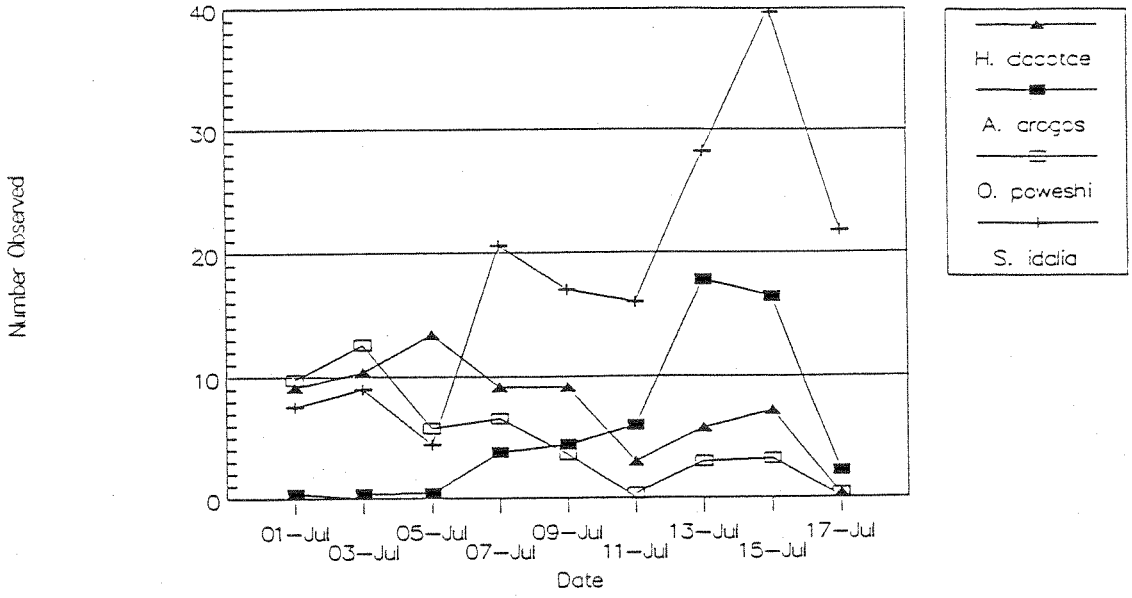


Figure 24. Totals for all species monitored during the Hesperia dacotae flight period in unit 2.

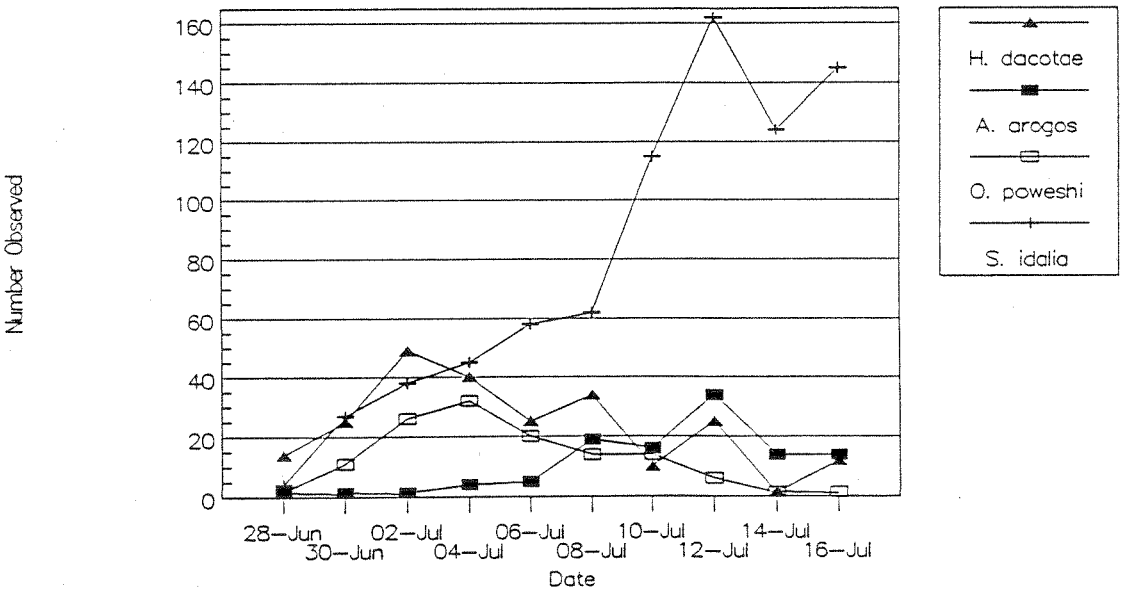


Figure 25. Totals for all species monitored during the Hesperia dacotae flight period in unit 4S.

Table 11. 1988 transect surveys for Atrytone arogos iowa, Hesperia dacotae, Oarisma poweshiek, and Speyeria idalia.

		A. a. iowa		H. dacotae		O. poweshiek		S. idalia	
Date	Unit	Total	Cond.	Total	Cond.	Total	Cond.	Total	Cond.
6-24	4S	1	---	26	1.5	14	1.0	2	1.0
6-27		1	1.0	17	2.2	12	1.6	17	1.0
6-28		0		12	2.3	9	1.1	16	1.0
7-05		1	2.0	8	2.8	3	2.0	8	1.1
7-06		2	2.0	8	2.6	1	2.0	8	1.6
7-07		1	2.0	5	3.0	0		20	1.7
6-28	3S	0	---	1	2.0	0	---	2	1.0
7-05		0	---	3	3.0	0	---	0	
6-28	2	1	---	7	1.9	15	2.0	9	1.2
7-05		6	2.2	7	2.4	7	2.0	26	1.2
7-06		1	2.0	3	2.0	3	2.0	0	
7-07		1	2.0	?2	?2.0	0	---	29	1.5
7-07		2	2.0	?4	?2.5	1	2.0	30	1.8
7-11		7	2.9	0	---	0	---	17	1.5

Table 12. 1988 general surveys for Atrytone arogos iowa, Hesperia dacotae, Oarisma poweshiek, and Speyeria idalia.

		A. a. iowa		H. dacotae		O. poweshiek		S. idalia	
Date	Unit	Total	Cond.	Total	Cond.	Total	Cond.	Total	Cond.
6-22	2	1	1.0	10	1.4	17	1.1	4	1.0
7-05		0	---	3	---	0	---	0	---
7-06		0	---	2	---	0	---	0	---
7-07		1	---	6	---	0	---	0	---
7-11		1	---	1	---	1	---	0	---
7-12		0	---	0	---	0	---	1	---
9-02		--	---	--	---	--	---	3	---
6-23	3S	0	---	3	2.3	4	---	0	---
6-24		0	---	2	---	0	---	2	1.0
6-27		0	---	4	---	1	---	2	---
7-06		1	---	2	---	0	---	0	---
7-07		1	---	1	---	1	---	5	---
6-27	4S	2	---	1	---	6	---	0	---
7-05		0	---	3	2.5	1	---	0	---
7-06		0	---	3	---	0	---	0	---
7-07		0	---	1	---	0	---	0	---
7-12		0	---	0	---	1	---	8	---
9-03		--	---	--	---	--	---	2	2.5
6-22	3&4N	0	---	26	---	>12	---	>5	---
6-24		1	---	9	1.4	12	---	9	---
7-06		1	2.0	5	3.0	0	---	2	---
7-13		2	---	1	2.0	0	---	5	1.6
9-02		--	---	--	---	--	---	2	4.0

Table 13. 1989 transect surveys for Atrytone arogos iowa, Hesperia dacotae, Oarisma poweshiek, and Speyeria idalia.

			A. a. iowa	H. dacotae	O. poweshiek	S. idalia
Date	Unit	Time	Total	Total	Total	Total
7-01	2	9:00	0	14	8	8
7-03		9:00	0	14	10	8
7-05		9:00	0	10	9	3
7-07		9:00	1	5	2	27
7-09		9:00	2	4	1	31
7-11		9:00	--	--	--	--
7-13		9:00	6	7	1	23
7-15		9:00	13	5	1	41
7-17		9:00	2	0	0	45
7-01		11:00	0	8	8	9
7-03		11:00	0	11	17	9
7-05		11:00	1	14	2	4
7-07		11:00	8	15	8	16
7-09		11:00	11	9	3	29
7-11		11:00	--	--	--	--
7-13		11:00	26	4	3	32
7-15		11:00	26	6	9	41
7-17		11:00	2	0	0	14
7-01		1:00	0	5	12	8
7-03		1:00	0	11	12	16
7-05		1:00	1	18	4	3
7-07		1:00	5	6	10	30
7-09		1:00	4	15	3	10
7-11		1:00	--	--	--	--
7-13		1:00	26	8	5	35
7-15		1:00	16	11	4	45
7-17		1:00	3	0	0	16
7-01		3:00	0	8	10	9
7-03		3:00	0	10	15	6
7-05		3:00	0	11	7	7
7-07		3:00	4	11	7	20
7-09		3:00	3	11	5	5
7-11		3:00	6	3	0	16
7-13		3:00	16	3	5	27
7-15		3:00	12	4	2	34
7-17		3:00	3	1	0	29
7-01		5:00	0	11	11	4
7-03		5:00	0	6	9	6
7-05		5:00	0	14	7	5
7-07		5:00	1	9	6	10
7-09		5:00	2	7	6	10
7-11		5:00	--	--	--	--
7-13		5:00	15	7	1	24
7-15		5:00	15	10	0	40
7-17		5:00	1	0	0	5
Total Obs.			231	326	223	760

Table 14. Additional 1989 transect data for Atrytone arogos iowa, Hesperia dacotae, Oarisma poweshiek, and Speyeria idalia in unit 2.

			A. a. iowa	H. dacotae	O. poweshiek	S. idalia
Date	Unit	Time	Total	Total	Total	Total
6-27	2	2:05	0	0	2	0
6-29		10:00	0	0	0	2
6-29		1:05	0	1	0	2
6-29		2:55	0	2	0	1
8-19		*1:35	--	--	--	6
8-21		4:15	--	--	--	2
8-22		11:05	--	--	--	11
8-22		12:35	--	--	--	13
9-03		4:05	--	--	--	1

* general survey

Table 15. Daily averages for the 1989 transect surveys for Atrytone arogos iowa, Hesperia dacotae, Oarisma poweshiek, and Speyeria idalia in unit 2.

			A. a. iowa	H. dacotae	O. poweshiek	S. idalia
Date	Unit	Time	Total	Total	Total	Total
7-01	2	Ave.	0.0	9.2	9.8	7.6
7-03		Ave.	0.0	10.4	12.6	9.0
7-05		Ave.	0.4	13.4	5.8	4.4
7-07		Ave.	3.8	9.2	6.6	20.6
7-09		Ave.	4.4	9.2	3.6	17.0
7-11		Ave.	6.0	3.0	0.0	16.0
7-13		Ave.	17.8	5.8	3.0	28.2
7-15		Ave.	16.4	7.2	3.2	40.2
7-17		Ave.	2.2	0.2	0.0	21.8

Table 16. Averages per time period for the 1989 transect surveys for Atrytone arogos iowa, Hesperia dacotae, Oarisma poweshiek, and Speyeria idalia in unit 2.

			A. a. iowa	H. dacotae	O. poweshiek	S. idalia
Date	Unit	Time	Total	Total	Total	Total
Ave.	2	9:00	2.7	6.6	3.6	20.7
Ave.		11:00	8.2	7.4	5.6	17.1
Ave.		1:00	6.1	8.2	5.6	18.1
Ave.		3:00	4.9	6.9	5.7	17.0
Ave.		5:00	3.8	7.1	4.4	11.6

Table 17. 1989 transect surveys for Atrytone arogos iowa, Hesperia dacotae, Oarisma poweshiek, and Speyeria idalia in units 4S, 3S, and 3&4N.

			A. a. iowa	H. dacotae	O. poweshiek	S. idalia
Date	Unit	Time	Total	Total	Total	Total
6-26	4S	*3:30	0	11	1	2
6-28		1:55	0	14 **9	2 **3	4 **4
6-30		1:25	1	25	11 **2	27 **2
7-02		12:45	1	49	26	38
7-04		1:10	4	40	32	45
7-06		12:55	5	25	20	58
7-08		1:00	19	34	14	62
7-10		1:30	16	10	14	115
7-12		1:30	34	25	6	162
7-14		1:20	14	1	1	124
7-16		1:30	14	12	1	145
8-19		*5:15	--	--	--	9
8-21		1:30	--	--	--	18
9-02		1:40	--	--	--	15
Total Obs. in 4S			108	255	133	830
7-04	3S	9:35	1	24	8	32
7-12		10:00	3	0	0	29
8-19		*3:55	--	--	--	5
8-21		10:15	--	--	--	4
9-02		10:30	--	--	--	5
Total Obs. in 3S			4	24	8	75
6-23	3&4N	9:45	0	1	0	0
7-10		9:20	19	17	7	429
7-14		9:20	6	0	0	341
8-20		3:40	--	--	--	51
9-01		2:40	--	--	--	14
		*1:40	--	--	--	1
Total Obs. in 3&4N25			18	7	836	

* general surveys
** observations off transects

Hesperia leonardus pawnee

One trip was made during the flight period for H. l. pawnee in 1988. Wind was a factor on both days, with gusts greater than 20 miles per hour, and the second day was cold and overcast so no counts were made along the transects. The results from the general surveys are summarized in Table 18. In 1989 two trips were made and quantitative surveys were conducted along the transects in each unit (see Table 19). Distribution maps are also included for both years (see Figures 25 and 26).

IV. SUMMARY

A species list for butterflies at Prairie Coteau was compiled, and the distribution maps were made for A. arogos, A. h. hianna, H. dacotae, H. l. pawnee, H. ottoe, O. poweshiek, and S. idalia. Populations of these species were found throughout the survey areas. With the exception of H. ottoe, there appear to be good populations of these and several other obligate prairie butterflies at Prairie Coteau.

The monitoring methodology developed worked well at Prairie Coteau, but the sampling scheme might need to be modified for different sites. To increase the number of observations per unit it may be necessary to restrict the survey routes to suitable habitat. In addition to the continued work at Prairie Coteau it would also be useful to begin testing the methodology on other areas.

Table 18. 1988 general surveys for Hesperia leonardus pawnee.

		Number Butterflies					Ave. Cond. Rating		
Date	Unit	Males	Females	???	Total	% Males	Males	Females	Total
9-02	2	4	0	5	9	---	2.0	---	2.0
9-02	3&4N &N3S	6	3	2	11	---	1.8	1.3	1.6
9-03	N3S	0	1	0	1	0	---	2.0	2.0
9-03	4S	0	0	0	0	---	---	---	---

Table 19. 1989 transect surveys for Hesperia leonardus pawnee.

		Number Butterflies					Ave. Cond. Rating		
Date	Time	Males	Females	???	Total	% Males	Males	Females	Total
Unit 2									
8-19	*1:35	6	0	1	7	100	1.0	---	1.0
8-21	4:15	1	0	0	1	100	1.0	---	1.0
8-22	11:05	7	0	7	14	100	1.0	---	1.0
8-22	12:35	4	0	2	6	100	1.3	---	1.3
9-03	4:05	2	1	6	9	67	2.0	???	???
Unit 3S									
8-19	*3:55	3	0	1	4	100	1.0	---	1.0
8-21	10:15	3	1	6	10	75	1.0	1.0	1.0
9-02	10:30	9	2	7	18	82	2.1	1.0	1.9
Unit 4S									
8-19	*5:15	3	0	0	3	100	1.0	---	1.0
8-21	1:30	13	1	2	16	93	1.1	1.0	1.1
9-02	1:40	8	0	6	14	100	2.1	---	2.1
Unit 3&4N									
8-20	**3:40	8	3	0	11	73	1.0	1.0	1.0
9-01	*1:40	3	0	2	5	100	1.0	---	1.0
9-01	2:40	15	3	2	20	75	1.9	1.0	1.8

* general surveys
** survey of transects 1-6 only

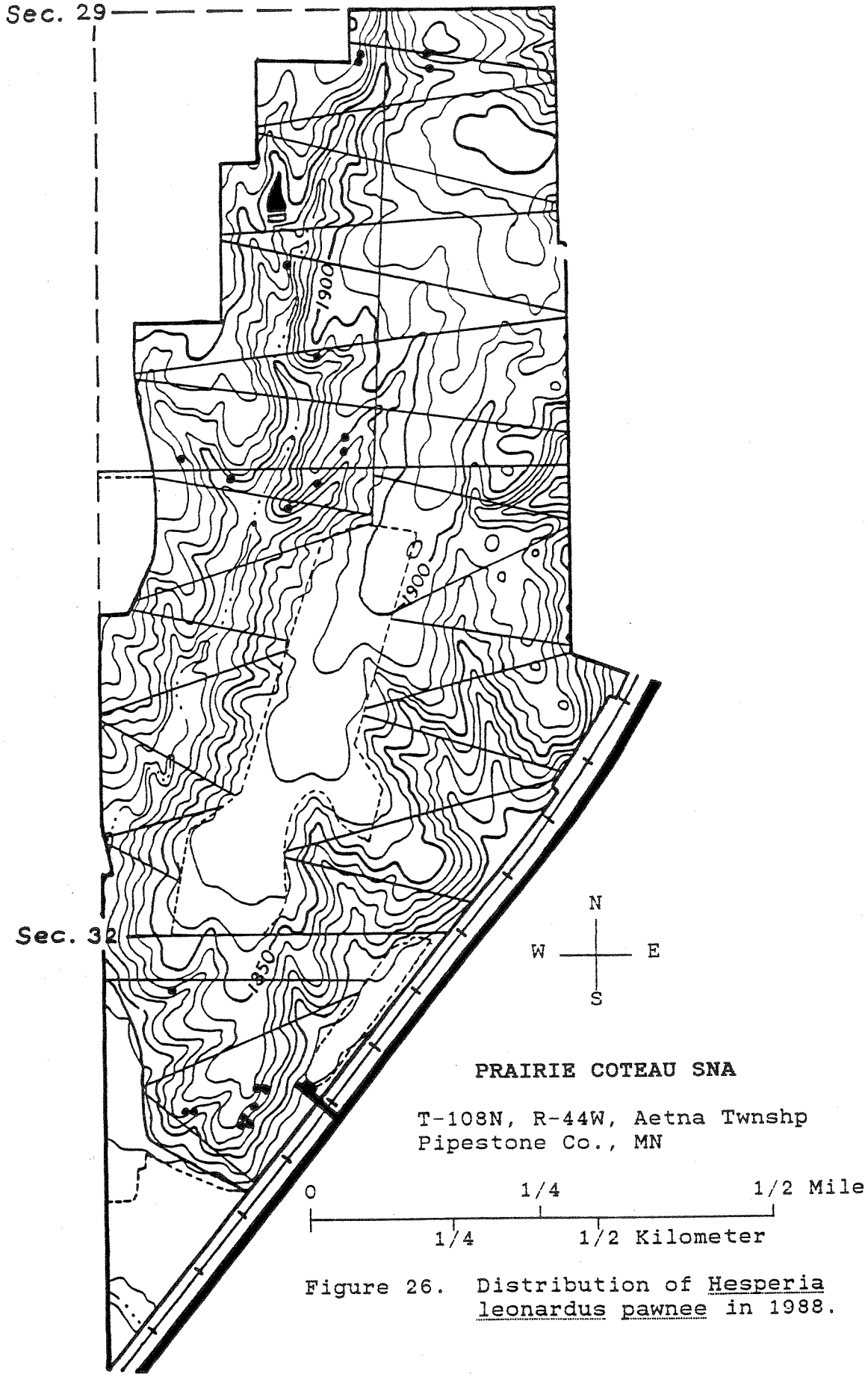


Figure 26. Distribution of Hesperia leonardus pawnee in 1988.

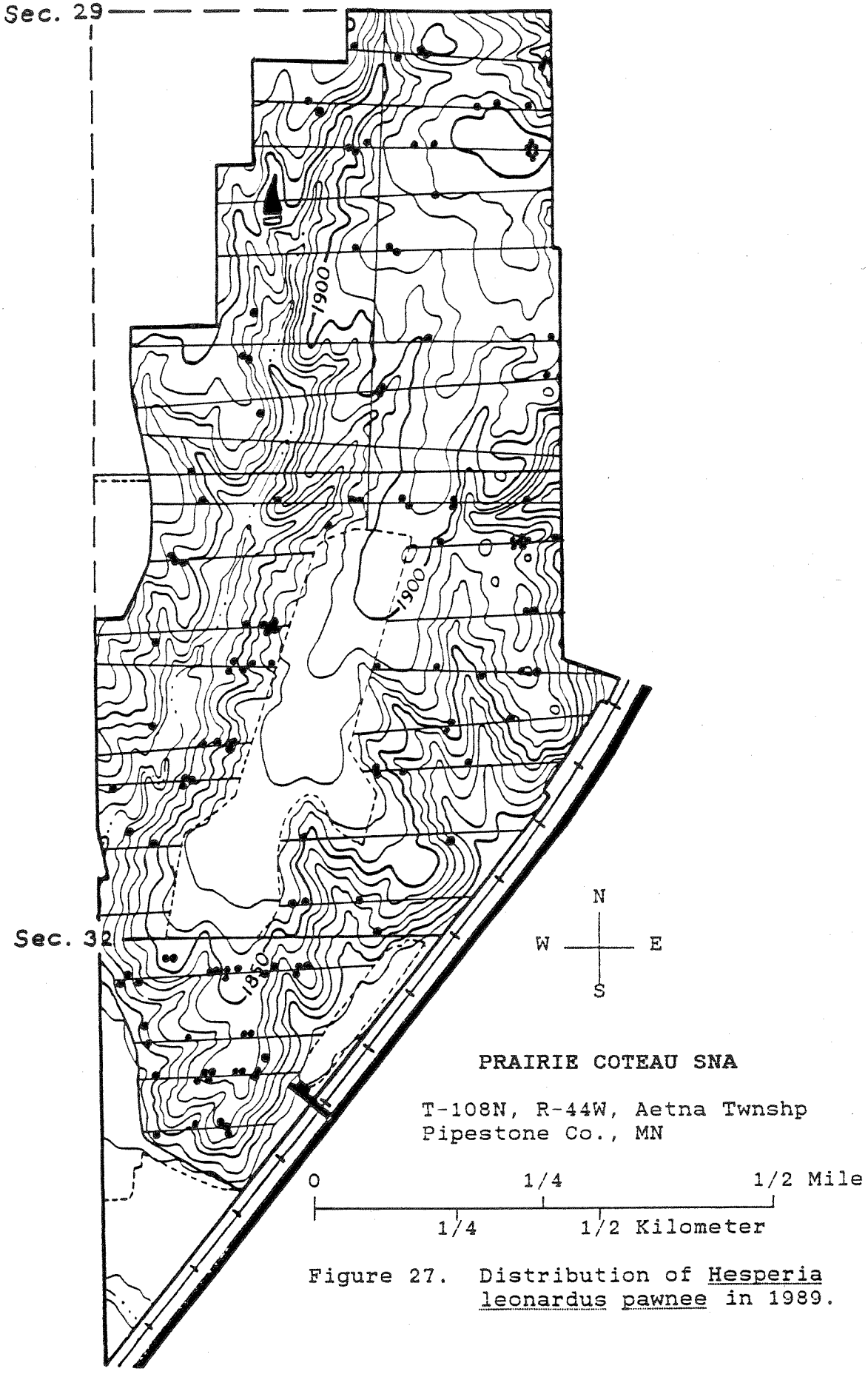


Figure 27. Distribution of Hesperia leonardus pawnee in 1989.

Both sex ratios and condition ratings are useful for estimating the portion of the flight curve and adjusting the population estimates, but variability in all of the parameters makes exact quantification of the relationship difficult. Based on the data for 1989 a different relationship would be obtained depending on whether unit 2 data or unit 4S data were used (see Figures 13 and 14). Population counts fluctuated considerably within a given portion of the flight period, especially in unit 2, which was a much shorter route. There was also variation in the observed sex ratios and condition ratings, so even if the relationship between the population curve and the sex ratio or condition rating were known, an incorrect adjustment might be made for a single count. This variability seems to be reduced by increasing the length of the survey route (see unit 4S vs unit 2 results for individual surveys). Variability might be partially accounted for by replicating the counts for short survey routes and averaging the results as was done in unit 2 (see Figures 9 and 10). Some factors that affect the population counts include temperature, wind and cloud cover. While these can be used to explain some of the variations in the data, it is difficult to quantify their effect.

The condition rating is subjective, so for species such as H. dacotae, in which it is easy to tell the sexes apart, sex ratios are probably a more dependable index. For other species which are more difficult to sex, such as A. h. hianna and O. poweshiek, the condition rating might be more useful. By using both it is possible to check to see if they both indicate the same portion of the flight period. For accurate estimates of either index it is best to catch and release each individual.

There will always be a significant amount of uncertainty associated with single counts due to the many factors that can effect them. For the best results surveys should be conducted during the peak portion of the flight period since the variability in all of the parameters decreases with an increase in sample. Overcast skies, strong winds, and cool or excessively hot temperatures are all factors which can reduce the activity of the butterflies.

Surveys should be conducted during each of the major flight periods since species might respond differently to management due to seasonal or other life-history differences. If this is not possible, the middle flight period includes the most species of interest with overlapping flight periods.

A proposal is being submitted to continue the work at Prairie Coteau for two more summers. The study will include continued butterfly monitoring at Prairie Coteau and application of the methodology to other sights, but the focus will be shifted to the ecology of the butterflies and their associated plant communities, and addressing management questions.