Report on Biological Studies at Capulin Mountain National Monument during the Late Spring, Summer, and Early Fall of 1979

by

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INTRODUCTION

The Natural History Museum of Eastern New Mexico University (ENMU) began a grassland monitoring program on Capulin Mountain National Monument, New Mexico in May 1974. The purpose and detailed methods involved in that program were described by Gennaro (1974). Gennaro and Trujillo (1975), Gennaro et al. (1976), and Gennaro (1977, 1978) continued biological studies and the grassland monitoring program during 1975-1978, respectively. A grazing permit held by Carlos Cornay expired 1 March 1978; therefore, the grassland was not monitored during 1979. Research projects conducted that year included a floral survey and an insect survey.

METHODS

Plants were collected within the Monument throughout the summer of 1979. Specimens were prepared for storage on herbarium sheets and

identified. Prepared specimens were stored within the ENMU Natural History Museum and within the Herbarium in the Capulin National Monument Visitor Center.

Insects were collected along a transect shown in Fig. 1. The letter A refers to sample sites within plant communities (see page 6 in Results and Discussion section of this report for community descriptions); the letter B refers to sample sites within transition areas between two communities. Five insect survey periods were conducted over an eight week period with surveys separated by two week intervals. Dates, survey sites, and meteorological conditions are shown in Table 1.

Insects were collected with the use of pitfall traps and sweep net. Nine ounce, cold, plastic cups were employed as pitfall traps. The cups were placed in the ground with the brim even with the soil surface. At each station five cups (pitfall traps) were placed in the ground 1 m apart with their line of orientation running in a southwest to northeasternly direction. New cups were exposed for collections from 1 to 3 days during each survey period. Locality descriptions of the 23 sampling stations along the transect line are as follows:

1A - 25 m west of the sewage pond on the southwest section of the Monument.

1B - approximately 70 m east of the second cement marker on the Monument road just as you enter the Monument gates.

2A - small grassland area 12 m west of road entering picnic area.

2B - 120 m due north of station 2A.

3A - located approximately 210 m north of picnic area where restrooms are located.

3B - located approximately 200 m northward up south facing

slope of cone, directly above the beginning of the new high wall.

4A - located approximately 200 m down from marker 2 on the crater rim trail. Situated on southwest facing slope.

4B - located approximately 250 m northeast of station 4A and 170 m east of marker 2 on crater rim trail.

5A - located within the crater approximately 295 m northeast of station 4B.

5B - located within the crater just east of the crater pit, approximately 50 m from crater podium.

6A - located on east slope of crater approximately 220 m due east of 5B.

6B - located approximately 275 m down from marker 12 on crater rim trail and situated on the east slope of the crater. This station deviates to the east because the best ecotone habitat occurs there.

7A - located approximately 100 m down from marker 16 on crater rim trail. This station deviates widely to the west from 6B.

7B - located approximately 200 m northeast of marker 16 on crater rim trail.

8A - located approximately 200 m north of marker 18 on crater rim trail and 120 m west of station 7B. This transect deviation was necessary in order to place the station within the best section of the plant community.

8B - located approximately 300 m due north - northeast of station 8A.

9A - located 280 m up Monument road from the podium.

9B - located 55 m down the north slope from Monument road, in line with 9A.

10A - located approximately 400 m down from Monument road on Monument's northeast slope.

10B - located approximately 750 m northeast of station 10A on the northeast slope of the Monument.

11A - located 600 m northeast of station 10B.

11B - located 600 m northeast of station 11A, approximately 25 m from fire road.

12A - located within the middle of the grassland community on Monument's northeast corner, approximately 470 m from fence corner.

The sweep net technique entailed a swing of the net with subsequent return. That procedure was performed five times at each sampling station while walking in a northeasternly direction along the transect line. Those insects collected via the pitfall traps or sweep net were placed in cyanide kill jars bearing the appropriate station number. After approximately 1 hr, the insects were transferred from the kill jars to plastic vials bearing an identical locality label. Adult insects were pinned or mounted on labels. Larval forms were placed in vials containing 70% ethanol. All specimens were identified with locality, date, and station labels and are currently stored in the ENMU Natural History Museum.

At the onset of classification it was observed that many of the insect specimens (less than 200) were in such poor condition that they simply could not be identified. Consequently, those specimens were discarded and their numbers were not reflected in the total specimen count reported in the Results and Discussion section.

Identification to family was done using the following works: R. H. Arnett 1968, D. J. Borrer et al. 1976, and C. H. Curran 1965. Where appropriate, the insects were identified to subfamily, as was the case with the order Orthoptera. Once identification was complete, the members of each family or subfamily were separated on the basis of station labels. The total number of individuals from each station were

then tabulated and a very unauthoritative attempt was made to assess approximate species numbers from each collection site. This involved a cursory, visual examination of surface morphology and coloration patterns. At times, it became very difficult to distinguish species from ecological variants, especially among the dipterans.

RESULTS AND DISCUSSION

PLANTS: A checklist of plants collected from May through August 1979 is in Table 2. Table 3 contains a checklist of plants available within the Visitor Center prior to the 1979 collection. A list of plants collected from the various plant communities are shown in Table 4. Plant communities within the Monument were described by Gennaro (1977). He designated communities as G - grassland, S - shrub, PJ - Pinyon-Juniper, PJS - Pinyon-Juniper-Shrub, and PJSG - Pinyon-Juniper-Shrub-Grassland as shown in Fig. 1. Each community was subdivided (G-1, G-2, etc.) wherever plant compositions required such subdivisions. Within communities plants were listed in order of trees, shrubs, forbs, and grasses, with the most common species being listed first, the second most common second, etc. Plant species within the communities were as follows:

Community Compositions:

G-1:	ARTE	S-1:	Pied	PJ-1:	Pied	PJS-1:	Pied	PJS-8:	Pied
	CHEN		Cemo		Jumo		Jumo		Atca
	Bogr		QUER		Cemo		QUER		Rgar
	Pofe		Rhar		Prvi		Rhar		Cemo
	Silo		RIBE		Quer		RIBE		QUER
	Agsm				Rhar		Rune		ARTE
		S-2:	QUER		RIBE				Rune
G-2:	ARTE		Cemo		Rune	PJS-2:	Pied		
	CHEN		Rhar				Rhar	PJS-9:	Pied
	HELI		Prvi	PJ-2:	Pied		QUER		Jumo
	Bogr		RIBE		Jumo		Rune		Cemo
	Scsc				Cemo		RIBE		QUER
	Pofe	S-3:	QUER		Rhar		ARTE		Rhar
	Agsm		RIBE		Prvi				
	Silo		Prvi		Rune	PJS-3:	Jumo	PJSG-1:	Pied
			Rhar				QUER		Cemo
G-3:	Saki		Cemo				Cemo		QUER
	ARTE						ARTE		Rhar
	CHEN	S-4:	Cemo						RIBE
	Bogr		Prvi			PJS-4:	Jumo		Pofe
	Silo		Mavo				Pied		Bogr
	Bocu		OPUN				QUER		
			Bogr				Rhar	PJSG-2:	Pied
G-4:	ARTE						Cemo		Cemo
	CHEN	S-5:	QUER				RIBE		Rhar
	Pofe		RIBE				Rune		QUER
	Bogr		Prvi						Prvi
	MUHL		Cemo			PJS-5:	Pied		Rune
			Rune				Jumo		Pofe
G-5:	YUCC		Rhar				Cemo		Bogr
	ARTE						QUER		
	Saki						Rhar		
	Bogr						RIBE		
	Ange								
	Bocu					PJS-6:	Pied		
	Scsc						Jumo		
							QUER		
							Rhar		
						PJS-7:	Pied		
							Jumo		
							Cemo		
							Phar		
							QUER		

Abbreviations for plants within the above list were taken from or written as shown in the Big Game Browse Analysis Techniques for New Mexico

as follows:

GRASSES:

Pofe, Mutton Grass, Poa fendleriana (Steud.) Varez

Agsm, Western Wheatgrass, Agropyron smithii Rydb

Silo, Squirrel-tail, Sitanion longifolium J. G. Smith

Scsc, Little Bluestem, Schizachyrium scoparium (Michx.) Nash.

Ange, Big Bluestem, Andropogon Gerardi Vitman

MUHL, Muhlenbergia spp.

Bogr, Blue Grama, Bouteloua gracilis (H. B. K.) Griffiths

Bocu, Side-oats Grama, Bouteloua curtipendula (Michx.) Torr.

FORBS:

Saki, Russian Thistle, Salsola Kali L.

CHEN, Goose Foot, Chenopodium spp.

HELI, Sunflower, Helianthus spp.

ARTE, Artemisia spp.

SHRUBS:

YUCC, Spanish Bayonet, Yucca angustifolia Pursh.

QUER, Quercus spp.

Atca, Four-wing Saltbush, Atriplex canescens (Pursh.) Nutt.

RIBE, Ribes spp.

Rune, Thimbleberry, Rubus neomexicanus Gray

Cemo, Mountain Mahogany, Cercocarpus montanus H. B. K.

Prvi, Common Chokecherry, Prunus virginiana L.

Rhar, Polecat Bush, Rhus aromatica Ait.

OPUN, Opuntia spp.

Maru, Common Horehound, Marribium vulgare L.

TREES:

Pied, Pinyon Pine, Pinus edulis Engelm.

Jumo, One-seeded Juniper, Juniperus monosperma (Engelm.) Sarg.

INSECTS: Collections conducted along the transect netted over 1000 specimens which are represented by 9 orders, 72 families, and 7 subfamilies (Table 5). All taxa will be discussed according to the alphabetical arrangement shown in that table. Information presented will include notes on their biology and potential economic impact within the Monument.

Coleoptera. This order represents the largest assemblage of arthropods belonging to the class Insecta. Over 40% of all insects belong to this order; therefore, it is not surprising that nearly half of all specimens taken in this study were beetles. The members of the order are most easily recognized by their hardened, outer pair of wings. The order itself is largely beneficial; however, members may be found in almost every conceivable habitat and are known to feed upon an equally diverse variety of foods.

The family Cantharidae, also known as the soldier beetles, are found most frequently on the flowers of plants where they feed on pollen. Consequently, the adults may serve some benefit in acting as pollinators. The larval forms are predaceous and, therefore, may also be of some benefit since they may feed on less desirable forms of ground dwelling arthropods. The family is a relatively small one within the order Coleoptera and likewise was of minor importance in the present study (Fig. 2). Members within this family represented only 1.3% of the beetles collected.

The family Carabidae, known as ground beetles, are predaceous as adults and larvae. This is the second largest family of beetles in North America and also was the second largest family of beetles represented in this study (Fig. 3). For example, 25% of the beetles taken in this study were ground beetles. The adults are largely nocturnal and rarely fly when disturbed. During the day they hide beneath rocks, logs, and various other forms of debris. The larvae dwell mostly within burrows in the ground.

The family Cerambycidae, commonly referred to as the long-horned beetles, are pollenophagous as adults. Therefore, they could provide some benefit as pollinators of flowers. However, such benefits are heavily outweighed by the destructive habits of the larval forms. The larvae burrow within the wood of living or dead trees and shrubs and are also known to feed within the tissues of herbaceous plants. The 1979 summer census indicated that they are of minor significance within the Monument, representing only 0.8% of the beetles collected. The majority of this percentage, as seen in Fig. 1, was taken at station 1A which is mostly grassland.

The family Cleridae, the checkered beetles, are a very beneficial group of beetles. Both adults and larvae are predaceous and many adults also act as pollinators of flowers. Adults forage on insects known to frequent bark or trees, especially bark beetles, while certain larval forms parasitize the eggs of grasshoppers. The poor representation of this family (0.8%) and the bark beetle family (Scolytidae, Fig. 2) may have been due to the type of collecting technique employed.

The leaf beetles belong to the family Chrysomelidae (Fig. 2). This

is one of the largest families of beetles whose benefits are only associated with the pollen feeding behavior of the adults. The phytophagous larvae feed upon the foliage of plants. Certain larval forms also bore into the stems and roots of plants which will ultimately destroy the plant. The adults, representing 5.5% of the beetles collected in this study, are easily recognized by their convex, brightly covered exterior.

The family Coccinellidae (Fig. 2), known as the ladybird beetles, are a very beneficial group of insects. Their beneficial behavior is associated with the predaceous feeding habits of both adults and larvae. Both life stages feed upon aphids, scale insects, and other small plant sucking insects. Moreover, adults may act as pollinators. Only 2.5% of the beetles collected were members of this family.

The family Curculionidae (Fig. 2), better known as the snout weevils or beetles, are easily recognized by their characteristically decurved snout. The family is the largest family of beetles but fortunately was represented by only 1.3% of the beetles taken. Both adults and larvae are extremely harmful. The adults chew holes in leaves or flower buds, within which eggs are laid, and the emerging larvae devour the remains of the bud. Larval forms attack plants at almost any location (roots, stems, or leaves) and feed mostly within the plant tissue, Their activities usually lead to the destruction of the host plant.

The family Elateridae, the click beetles, is so named because of their ability to flip onto their ventral side when placed on their backs. The family is primarily harmful since the adults feed on plant foliage while certain larval forms feed upon the roots of grasses, shrubs, and

tree seedlings. However, certain larvae may feed upon other insects known to inhabit dead, decaying wood. Only five specimens were taken in this study (Fig. 2), which represents 0.9% of the beetles collected.

The family Nitidulidae are known as the sap beetles. They represent an obscure group both as a family and as individuals. They appear to be of no economic significance since the larvae and adults feed mostly upon dead, fermenting plant materials. Adults are also pollenophagous and are known to feed upon flowing tree sap, hence the common name. Larvae are also known to feed upon the carcasses of dead animals. Only 0.2% of the beetles taken were members of this family (Fig. 2).

The family Scarabaeidae, the scarabs, may become serious pests when the larval forms feed upon the roots of grasses and shrubs which the adults forage upon the foliage and flowers of many plant types. All serve important ecological roles Others, however, serve important ecological roles by disposing of dung and rotting plant materials. Nearly 8% (Fig. 2) of the beetles taken in this study belong to this family.

The bark or engraver beetles belong to the family Scolytidae. This family (Fig. 2) is of extreme economic importance in timber growing regions because both adults and larvae tunnel beneath the bark of trees (primarily conifers). Such activities accelerate the spread of parasitic fungi and also disrupt the flow of sap to roots of the tree. Again, the low percentage of representation (0.2%) of this family may be a reflection of the type of collecting technique employed. Perhaps the bark of trees within the Monument should have been more closely examined.

The family Silphidae, carrion beetles, are beneficial in that both the adults and larvae, of most species, feed upon the decaying flesh of

dead animals. Adults will either bury a small animal or flesh fragments of large animals in the ground and lay eggs upon the material. Larvae feed upon the buried food source. A surprising percentage (2.8%) of the beetles were members of this family (Fig. 2), indicating the presence of dead carcasses near the transect line.

The family Tenebrionidae, known as the darkling beetles, represent a group of beetles with a highly variable preference for food. In most cases, their feeding habits appear to be of little economic significance. Most adults and larvae act as scavengers, feeding on decaying vegetation and animal products (chiefly dung) and carcasses. However, certain species may become severe economic pests when feeding upon stored seeds, cereals, and flour. Certain species within the Monument could reach pest status by feeding excessively upon the roots, tubers, and flowers of plants. This family is the fifth largest known family of beetles and the largest family taken during this study (51%, Fig. 3). Nearly all specimens were of the ground dwelling type and, therefore, the adults and larvae would likely feed upon decaying organic material and upon the roots of grasses. Tenebrionids are most easily recognized by their black color and characteristic ability to elevate the tip of the abdomen when disturbed.

Diptera. This is one of the largest orders of insects, being represented by individuals which occupy almost every conceivable habitat. The adults are most easily recognized by their single pair of membranous wings. Members collected in this study were largely phytophagous, saprophytic, parasitic, predaceous, and scavengers. Approximately one tenth of the collected specimens were members of this order. However,

without the Coleoptera, they represent about 40% of the remaining specimens.

The leaf miners, belonging to the family Agromyzidae, were the most common fly encountered in this study (21%, Fig. 4). The adults are nearly cosmopolitan in distribution and appear to be indiscriminant in their selection of herbaceous host plants. Eggs are laid on the leaves of grasses and deciduous plants and the emerging larvae penetrate and burrow within the leaf tissue. Certain of these species are easily identified by the shapes of their burrows. The adults are attracted to the nectar of flowers and therefore may offer benefit as pollinators, whereas the larvae, because of their parasitic behavior, may inflict considerable damage on a variety of host plants. Because of the activities of the larval stage, agromyzids must be considered harmful within the Monument.

The anthomydid flies (family Anthomyiidae) were not well represented (5%, Fig. 4). The adults are largely nectiferous and, therefore, may act as pollinators while the larvae may act as miners within leaves or as borers within the roots of host plants. The larvae of certain species are also found in dung. Within the Monument, the family appears to be of little economic significance.

The family Asilidae (Fig. 4), better known as the robber flies, is primarily a very beneficial family. The adults usually perch in the open on rocks, sticks, and other debris. When disturbed, they fly short distances to another perch. Their food, captured in flight, usually consists of wasps, grasshoppers, dragonflies, and other flies. Their 1% representation in this study may be interpreted on the basis of the continuous sweeping technique employed. Rapid or swift movements tend to frighten them away. The larvae are also predaceous, feeding upon

larval forms in decaying wood or in the soil.

The family Bibionidae is referred to as the March flies because of their early periods of emergence, being most abundant in spring or early summer. Even in the areas of dense swarms their impact is insignificant. Therefore, within the Monument, their 5% (Fig. 4) representation appears to be of minimal importance. The beneficial activities of this family would seem to outweigh its harmful effects since the adults act as pollinators while the larvae, inflicting minimal damage, feed upon plant roots.

The family Calliphoridae, called the blow flies, is ubiquitous and contains members which have achieved considerable economic importance (e.g. the screwworm fly, Cochliomyia hominvorax), especially in the Southwest. Of the four specimens (4%) collected, none appears to be a screwworm fly (Fig. 4). Therefore, this family could be of benefit within the Monument. The adults are attracted to aromatic flowers and thus would become involved in pollination while the larvae act as scavengers, feeding upon the decaying flesh of animal carcasses. The adults are easily recognized by their greenish or bluish metallic appearance.

The gall midges belong to the family Cecidomyiidae which was represented by three specimens, representing 3% (Fig. 4). Members of this family may achieve pest status by reducing the vitality of host plants. Most larval forms mature within galls formed within the leaves of deciduous plants.

The family Chironomidae (Fig. 4) includes the midges and is mostly a beneficial group of insects. The adults are easily recognized by their

bushy antennae and their mosquito-like appearance. Only two specimens (2%) were taken, indicating a lack of abundance within the Monument. The adults are harmless and the larvae feed on decaying organic matter in or among moist places within the Monument.

The chloropids (family Chloropidae) are small flies which are easily recognized by two longitudinal, yellow strips on the dorsal surface of the thorax. They are an economically important family. The adults, commonly called eye gnats, are attracted to eye secretions and therefore may spread diseases associated with the eye. Most larvae feed within the stems of grasses and may cause considerable damage. Two percent (Fig. 4) of the dipterans belonged to this family.

The notorious fruit flies belong to the family Drosophilidae (Fig. 4). They appear to be beneficial on the Monument. The adults act as pollinators while the larvae may act as scavengers feeding on decaying plant material. Only three specimens (3%) were collected, indicating low density within the Monument.

The grass flies, members of the family Leptogastridae, appear as miniature robber flies. The adults frequent grassy areas where they feed upon soft bodied, plant sucking insects. Hence, they appear to be of some benefit. Little is known of the larval habits, except that they live in decaying plant materials or in the soil. Two specimens were collected, representing 2% (Fig. 4) of the dipterans.

Six percent (Fig. 4) of the flies collected were members of the family Muscidae. They are both economically and ecologically important. The face fly and horn fly belong to the family and may be represented among the specimens collected. If so, considerable damage could be

sustained to big game within the Monument. From an ecological viewpoint, muscids may breed and feed upon almost any kind of filth, thereby fulfilling the roll of scavengers. Adults may also act as pollinators since they display nectivorous habits.

The fungus gnats (family Mycetophilidae, Fig. 4) are mosquito-like in appearance and are of no economic importance. Both adults and larvae act as scavengers. The adults are found in damp places feeding on decaying vegetation, and the larvae feed upon fungi and rotting plant materials. One specimen was collected.

The big-headed flies belong to the family Pipunculidae (Fig. 4) and appear to offer potential benefit within the Monument because of their parasitic habits. Adults congregate most frequently where potential hosts may be found. Adults lay eggs upon leafhoppers, primarily, while other Homoptera and Hemiptera (especially Miridae) have been suggested as possible hosts. The larvae hatch and develop within these hosts. Only two specimens (2%) of this beneficial insect were collected.

The flesh flies are members of the family Sarcophagidae; they ranked third among the dipterans in terms of numbers collected (12%, Fig. 4). The adults are attracted to sugar solutions (e.g., nectar, fermenting fruits, and sap). Within the Monument, the larvae fill ecologically important roles as scavengers and parasites. As scavengers, they expedite the removal of animal carcasses, and as parasites, they help regulate populations of grasshoppers and beetles.

The black scavenger flies (family Sephidae) are saprophagous as adults and larvae. They represented the second most abundant group of flies at the Monument (19%, Fig. 4). The larvae feed upon animal

excrement and decaying plant tissue, and the adults are most easily collected near those areas.

The flower flies belong to the family Syrphidae. Most adults mimic the appearance of bees and wasps and are commonly associated with the latter while feeding upon the nectar of flowers. They, therefore, act as important pollinators. The larvae may be predaceous (feeding upon aphids), saprophagous, or they may act as scavengers. Syrphids are an important group of flies; unfortunately, only two specimens were collected (Fig. 4).

The family Tachinidae is the second largest family within the dipteran order. Tachinids are extremely beneficial and almost all species are parasitic on other insects. The adults are attracted to secretions rich in sugar and, consequently, are important pollinators while the larvae develop within the larvae and adults of other flies, orthopterans, hemipterans, homopterans, hymenopterans, coleopterans, and other insects as well as spiders. Only five specimens were collected (Fig. 4).

The family Tephritidae (Fig. 4) is a second group called fruit flies (Drosophilidae), but they are also referred to as peacock flies. Most species have patterned wings which they flutter while resting on flower heads. The adults are of non-economic importance, acting as pollinators and scavengers. Most larvae act as scavengers, feeding on decaying plant materials, but certain species form galls on goldenrod while others act as leaf miners within other host plants. See Fig. 4 for numbers and locations of specimens collected.

The stiletto flies belong to the family Therevidae. Adults are not frequently collected and somewhat resemble medium sized robber flies. Adults and larvae are predaceous, and both appear to be important in the

control of certain pest insects. Within the Monument, the larvae are likely found in decaying wood while the adults prefer open, sandy, or grassy areas. Two specimens were collected (Fig. 4).

Hemiptera. This order includes true bugs. Members are most easily recognized by their wings which have a leathery basal half and a membranous distal half. At rest, the wings are laid to rest over the flat back where the distal membranous ends overlap. Members of this order also possess piercing-sucking mouthparts. Most members are parasitic on other insects, plants, animals, and man.

The family Lygaeidae (Fig. 5) includes the seed bugs. Thirty-three percent of the bugs collected belong in this family. Both adults and nymphs suck juices of plants. They can become serious pests by sucking excessive juices from the host plant. The host plant is then subject to secondary infectious organisms, such as fungi.

The plant bugs or leaf bugs are members of the family Miridae (Fig. 5). The entire family is largely pestiferous. They are cosmopolitan in distribution and suck the juices of host plants often to the extent of killing the host plant. They could become a problem within the Monument were it not for the tachinids, pipunculids, hymenopterans, and certain coleopterans.

Members of the family Tingidae are called lace bugs because of the rather beautiful, lace-like sculpturing on the dorsum of the body. Tingids prefer to suck juices of deciduous trees and shrubs. Excessive feeding will cause the leaves to develop a yellow mottled appearance, and if feeding persists, the leaf will eventually drop. Only 13% (Fig. 5) of the bugs collected belong to this family; therefore, it is doubtful that

serious damage could occur within the Monument as a result of the lace bugs.

Homoptera. Members of this order are closely related to the hemipterans. All but a few members are economically important pests. Their mouthparts are of the piercing-sucking type and for those which have wings, they are positioned like a tent over the abdomen. Members of this order represented 9% of the insects collected. However, if the coleoptera are excluded their numbers swell to 20% of the insects collected. Densities for families within this order are included in Fig. 6.

The aphids or plantlice are of extreme importance and belong to the family Aphididae (Fig. 6). These minute, pear-shaped insects which frequent the shady sides of leaves and stems are capable of profound damage when present in sufficient numbers. The fact that only four specimens were collected does not necessarily indicate a low density, for they are extremely hard to dislodge from leaves once the mouthparts have been inserted into the plant tissue. They are pests of both conifers and deciduous trees and shrubs and, therefore, could easily become a problem within the Monument.

The family Cercopidae includes the froghoppers or spittlebugs. The immatures are noted for their ability to form a frothy foam which conceals them while they feed upon the juices of grasses and other plants. Adults and immatures are capable of inflicting substantial damage upon the flora of the Monument. Their numbers represented 28% of those collected (Fig. 6).

Like the Ceropidae, the leafhoppers, (family Cicadellidae) are also serious but host specific pests. They represented 55% (Fig. 6) of the

specimens collected that belong to this order. They are indiscriminate in their selection of host plants, attacking anything with foliage rising above ground surface. Over 10% of all insects collected in this census were members of this family. Therefore, it is entirely possible for these insects to attain pest status within the Monument.

The treehoppers are members of the family Membracidae. Unlike other members of this order, their damage is inflicted upon trees and shrubs by their egg laying behavior. The eggs are placed in slits within the bark of twigs, thereby causing the tree or shrub to loose sap and to acquire secondary fungal infections. Their low numbers (Fig. 6) would seem to rule out a potential problem within the Monument.

The family Psyllidae includes the jumping plant lice or psyllids. They are of extreme economic importance, for they are known to spread infectious, lethal viruses among plants. Moreover, they may form galls (e.g. on hackberry) or simply overcome the host plant by sucking excessive juices. The nymphs are often confused with the woolly aphid, but the adults are easily distinguished by their strong jumping ability when disturbed. Ten percent (Fig. 6) of the homopterans collected were members of this family. Within the Monument, concern should be expressed on the basis of numbers of the specimens collected.

Hymenoptera. This order includes the greatest assemblage of insects known to benefit man. Their predatory and parasitic habits are of extreme importance, as are their abilities to pollinate flowers and produce honey. They are most easily distinguished by the presence of four membranous wings with the hind pair somewhat reduced in size. When

the number of potential pests within the Monument are considered, it is surprising that so few (excepting Formicidae) specimens were collected.

The bumble bees are included within the family Apidae. Their nests are located in the ground in vacated nests of small rodents. Their nests are provisioned with pollen and honey. They are effective pollinators of many flowers because of their elongated tongue. Within the Monument, they are of great value as pollinators. However, only 4 specimens were collected (Fig. 7) which represented 4.5% of the hymenopterans.

The family Braconidae represents one of the largest assemblages of beneficial parasitic insects. The adult lays the egg on a variety of hosts, and the emerging larva bores through the body wall of the host and matures within the host, ultimately leading to the destruction of the host. Some of the insects which serve as hosts and also are found within the Monument include: Tephritidae, Agromyzidae (Diptera), Noctuidae (Lepidoptera), Scolytidae (Coleoptera), many of the Hemipterans and Homopterans, and Formicidae (Hymenoptera). Consult Fig. 7 for numbers of specimens collected. Members of this family represented 10% of the hymenopterans collected.

The family Cephidae includes the stem sawflies. They are primarily a destructive group of insects because of their larval habits. The larvae bore within the stems of grasses and deciduous, berry producing shrubs such as currents. Their pithophagous habits will ultimately lead to the destruction of the host plant. Although few specimens were collected (4, Fig. 7), they do represent one of the largest groups of Hymenoptera within the Monument.

The plasterer bees and yellow faced bees belong to the family

Colletidae. Their benefit is associated with their ability to pollinate. Their nests, provisioned with pollen and honey, are located either in the ground or in cavities within the plant stems. A single specimen was taken during the survey (Fig. 7).

Another small group (Fig. 7) of wasps are the gall wasps included in the family Cynipidae. Their common name is somewhat misleading in that many members act as important parasites of other insects (e.g. many of the phytophagous dipterans). Certain members do, however, hyperparasitize beneficial parasites such as the Braconidae (Hymenoptera). Therefore, they are capable of doing some harm. Their common name arises from their ability to form characteristic galls in the leaves of certain plants, such as oak. Their numbers (Fig. 7) would seem to indicate that they are of no concern within the Monument.

Six percent of the hymenopterans collected (Fig. 7) belong to the family Encyrtidae. They are very beneficial in that most members are parasitic on the Aphidae (Homoptera). Because of their parasitic habits, they would appear to be of great value within the Monument.

The family Eucharitidae is a rather uncommon group of wasps. They are parasitic upon the pupae of ants. Considering the numbers of ants collected (Fig. 7), it is not surprising that these small wasps were found within the Monument. The adult female is attracted to ant trails by the scent of formic acid liberated by the ants. The eggs are laid either on vegetation or on the ground, and the emerging larva waits until an unsuspecting ant walks by. It clings to the ant and is phoretically carried into the ant burrow by the worker. Once inside, it assumes residence with the larval ants and ultimately burrows into the pupating

ant within which it develops. It would seem that they provide some benefit by buffering the excessive growth of the ant populations within the Monument.

Members of the family Eulophidae (Fig. 7) represent a very important group of parasites within the Monument. They actively parasitize aphids (Homoptera), psyllids (Homoptera), and many photophagous lepidopterans. As with other small parasitic wasps, they display a much broader range of host preference than most other groups of wasps and, therefore, may be more beneficial within the Monument. They attack many of the homopterans, hemipterans, dipterans, and lepidopterans. Some are even known to parasitize spiders.

Fifty-eight percent (Fig. 7) of the hymenopterans collected belong to the family Formicidae. The feeding habits of ants are highly variable. Some are carnivorous or saprophagous while other are phytophagous, fungivorous, or nectivorous and yet others are scavengers. The high percentage of ants taken in this study is not surprising when one considers their colonial behavior which enhances the concentration of thousands of individuals within a small geographical area. Because of the parasitic pressure imposed by many insects (e.g. Braconidae and Eucharitidae: Hymenoptera), it is doubtful that the ants could achieve pest status within the Monument.

The gasteruptiids (family Gasteruptiidae) are pollenophagous as adults while the larvae are parasitic on the immature stages of certain bees and wasps. The adults appear frequently upon the flowers of certain plants, especially wild parsnip, wild carrot, and other closely related species. Because of the parasitic habits of the larvae, they could

become problematic but considering their low density (Fig. 7), little, if any, concern should be expressed by their presence within the Monument.

Bees within the family Halictidae are often recognized by their bright metallic coloration. Because certain species are attracted to the sweat of humans, they are sometimes referred to as sweat bees. As a group, they are very important as pollinators of a wide variety of plants. Consequently, they are of benefit within the Monument. They nest in the soil, and both adults and larvae are pollenophagous. Again, few specimens were collected (Fig. 7).

The family Ichneumonidae (Fig 7) is one of the largest and most beneficial groups of insects known to man. Their benefits are almost entirely associated with their parasitic behavior. They are active in the biological control of a variety of potential pests belonging to several different orders. Those within the Monument include: Cerambycidae (Coleoptera), Curculionidae (Coleoptera), and several different families of Lepidoptera. Certain species are hyperparasitic on other ichneumonids and on the Braconidae. Their presence within the Monument is a definite asset.

The leaf cutter bees (family Megachilidae) are so named because they line their nests with pieces of foliage cut from leaves. Any damage which they may cause is uaually outweighed by their success at pollinating plants of the family Leguminosae. Therefore, their presence (Fig 7) should be welcomed within the Monument. Certain species may also act as parasites on other members of this family. They provision their nests (located in the ground or in a wood cavity) with pollen, upon which both adults and larvae feed.

Members of the family Sphecidae parallel the beneficial contributions to mankind by the Ichneumonidae. They are commonly called solitary wasps because of their nesting behavior. Nests are provisioned with specific types of prey insects. Pestiferous insects within the Monument known to act as prey for the sphecids include: Chrysomelidae, Curculionidae (Coleoptera); Lygaeidae (Hemiptera); Cercopidae, Cicadellidae, Aphididae, and Psyllidae (Homoptera); various grasshoppers and crickets (Orthoptera); and several species of flies (Diptera). The nests of some species are constructed of mud and are visible while those of others are situated in the ground or are found in natural wood cavities. As with the ichneumonids, their presence within the Monument is a definite asset. Unfortunately, their population densities appear to be low (Fig. 7).

Lepidoptera. The butterflies and moths are included within this order. Members are most easily recognized by the presence of scales on the wings. The order is of tremendous economic importance. Most adults have siphoning mouthparts and consequently are nectivorous while most larval stages are phytophagous. The manner in which they feed is diagonistic. The microlepidopteran (small moths) larvae feed upon the surface of the leaf, thus skeletonizing the leaf or leaving it spotted or mottled in appearance. The macrolepidopterans (large moths and butterflies) usually forage at the margin of the leaf, devouring large pieces. Other larvae are known to form galls, to mine within leaves and stems, and to be parasitic.

Eight percent of the lepidopterans collected belong to the family Arctiidae, better known as the tiger moths. Their larvae (sometimes referred to as woolly bears) can become serious pests by devouring large

portions of the foliage of trees and shrubs. Grasses are also a favored food type for certain larval species. A site which is not uncommon in New Mexico is the presence of massive webs within the foliage of trees. These are colonies of the fall webworm, a member of this family. There are several other serious pests within this family. However, the two specimens (Fig. 8) collected in this study do not indicate a problem within the Monument.

The ethmiids (family Ethmiidae) are a small group of moths whose larvae feed mostly upon plants within the plant family Boraginaceae. Their numbers (Fig. 8) do not seem to indicate any problem within the Monument.

The family Leparidae (Fig. 8) includes the tussock moths and was the predominant lipidopteran collected within the Monument. Approximately 25% of the non-microlepidopteran moths were tussock moths. These can become serious pests to most deciduous fruit and shade trees. The larvae are easily recognized by a combination of characters which include: red head capsule and three projecting, pencil-like tufts of black hairs. Two of these project forward above and to the sides of the head capsule while the third tuft projects from the tip of the abdomen. They also have four heavy tufts of short white hairs projecting dorsally from the back and two bright red spots on the back toward the end of the abdomen. This pest should be monitored at the Monument.

There were two (Fig. 8) lasiocampids (family Lasiocampidae) collected. They are commonly referred to as tent caterpillars. They also construct nets which are much smaller than those of the fall webworm. Their webs are most commonly located at the forks of twigs and

small branches. The larvae reside within these nets when not feeding on the foliage of a variety of trees. They can also become serious pests.

The gossamer-winged butterflies (family Lycaenidae) are easily recognized by the swollen, elongate tip of their antenna. The antennae are also recognized by a full length series of white, concentric rings. The larva of the single collected specimen (Fig. 8) likely feeds upon the foliage of plants within the genus Rumex. Lycaenids should be of minimal concern within the Monument.

The family Noctuidae (Fig. 8) was represented by two specimens. Their scarcity may be a reflection of their nocturnal habits. All larval forms are phytophagous feeding either upon the exposed foliage or on the roots or within the stems. Certain serious pests belong to this order, but they were not collected. Consequently, members of this family are probably responsible for minimal damage within the Monument.

The brush-footed butterflies belong to the family Nymphalidae. Their larvae feed upon the foliage of a variety of small annuals. However, their low numbers (Fig. 8) would seem to negate any concern within the Monument.

The plume moths (family Pterophoridae) are small moths with deeply bilobed, or trilobed, feather-like fore and hind wings. Their larvae feed primarily upon leaves but certain species are also stem borers. Although two (Fig. 8) specimens were collected, it is doubtful that they are responsible for much damage.

The snout moths are members of the family Pyralidae (Fig. 8). Some very serious pests exist within this family, but none was collected within the Monument. Some larvae act as leaf rollers while others

feed within stem tissues of a variety of plant types.

The cropia moth belongs to the family Saturniidae. These are very large insects as adults and larvae. According to Peterson (1962), larval host plants include the following: apple, ash, boxelder, cottonwood, maple, plum, willow, and other deciduous fruit trees, shade trees and shrubs. As indicated in Fig. 8, there were very few specimens collected; therefore, concern need not be expressed about their presence at the Monument.

The microlepidopterans are a diverse assemblage of uneasily recognized, small moths. Because of their taxonomic difficulty and the lack of suitable keys, they were simply lumped together in this category. The larvae of most microlepidopterans feed upon the leaves while others bore within the stems and roots of host plants. Their low numbers (Fig. 8) would seem to indicate the absence of a problem within the Monument.

Neuroptera. The Neuroptera (Fig. 9) represent a very beneficial order of insects. They are commonly referred to as antlions because of the small sand pits created by the larva stages of certain species. Unsuspecting ants slide to the bottom of the sand pits where the exposed mandibles of the antlion pierce the body wall of the ant and withdraw the body fluids. From an economic viewpoint their notoriety comes from the notorious green lacewing which is used so frequently as an agricultural biological control agent. They are medium to large insects with a net-like arrangement of veins in the wings.

The only family (Fig. 9) represented in this order is the family Hemerobiidae. They are referred to as the brown lacewings which are common in forested areas. Both adult and larval stages are extremely

predaceous on soft bodied insects. Within the Monument, aphids, psyllids, immature cercopids, immature cicadellids (Homoptera), and many of the immature lygaeids and mirids (Hemiptera) are preyed upon by this insect. Its presence within the Monument is definitely a positive feature. It is unfortunate, however, that their presence was not indicated by more than one specimen.

Orthoptera. Members of this order are easily recognized because of their cricket or grasshopper-like appearance. Most species are phytophagous, with some species becoming serious economic pests. Others act as scavengers while a few species are predators. Most species, regardless of their food preference, will cannibalize their own kind. The orthopterans represent just 7% of the insects collected in this survey and indicate low but stable population levels (Fig. 11). Therefore, it is doubtful that they will become problematic within the Monument, i.e., unless optimum conditions occur in which case rapid population explosions develop within short periods of time.

Within the family Acrididae (short-horned grasshoppers), there were four subfamilies represented. They included the: Acridinae, Cyrtacanthacridinae, Oedipodinae, and the Romaleinae. As seen in Fig. 11, this family includes the largest representation of orthopterans. Unfortunately, all are potential pests. Below, each of the subfamilies will be discussed alphabetically.

The Acridinae are referred to as the slant-faced grasshoppers. In addition to their slanted face, they are also recognized by a spur-like projection in the throat region. They rarely exceed members of the other three subfamilies in abundance, but they seem to have done so

during the 1979 survey. They normally feed upon grasses and are located most heavily in open meadows or stands of grass. It is doubtful that they would cause much harm within the Monument.

The Cyrtacanthacridinae are the true spur-throated grasshoppers. Like the acridines, they possess the spine in the throat region, but most forms lack the slanted face which characterizes the former group. Populations of this group may reach catastrophic levels, and in so doing, may inflict extreme economic damage. Judging from the numbers collected at the Monument (Fig. 11), it appears doubtful that locust plagues will develop. The only generalized statement which may be made, with regard to food preference, is that they prefer other plants to conifers.

The Oedipodinae include the banded-winged grasshoppers. They are easily recognized in flight by their bright colored hind wings and crackling sounds. They frequent bare hillsides where the female will deposit the eggs in the soil. They normally prefer grasses but will devour the foliage of deciduous plants if populations reach plague levels. The twenty-four collected specimens (Fig. 11) do not substantiate concern at this time.

The lubber grasshoppers (subfamily Romaleinae) are easily recognized by their large, bulky, pinkish bodies which are incapable of flight because of their conspicuously reduced wings. They are frequently observed on highways in New Mexico. They normally prefer the foliage of low growing annuals, but like other acridids may achieve pest status, in which case they readily climb anything in search of food. Only two specimens (Fig. 11) were collected; therefore, no concern should be

expressed by their presence within the Monument.

The family Gryllacrididae (Fig. 11) includes the wingless long-horned grasshoppers. Their unique characters are depicted in their common name. They have no wings, and their antennae are, in most cases, exceedingly long.

The only gryllacridid collected (Fig. 11) belongs to the subfamily Rhaphidophorinae. They are recognized by their arched back and dark, brownish-red color. They are commonly known as the camel or cave crickets. They are normally found under rocks, logs or sticks, or other debris. They have also been found in caves and rodent burrows. They are nocturnal during which time they feed upon other smaller ground dwelling arthropods and worms and may even feed upon fungi or plant foliage. They are of minimal economic concern but on occasion will enter human habitations where they may cause some distress.

The crickets belong to the family Gryllidae. They are best known for their ability to produce aesthetically appealing songs during afternoon, evening, and night hours. Only two subfamilies were represented (Fig. 11) in the collections, and they included the Gryllinae and the Oecanthinae.

The house or field crickets are members of the subfamily Gryllinae. They are most frequently encountered beneath sticks, rocks, and other debris in open meadows, along roadsides or along the foundation of buildings. They are omnivorous and at times cannibalistic. At the Monument (Fig. 11) they could become a problem by feeding excessively upon cultivated flowers and shrubs near the Monument center. In certain regions of the country they are notorious for this. See Fig. 11 for numbers collected along the transect.

The subfamily Oecanthinae (tree crickets) are frail, white or green insects which produce a high pitched, continuous noise. Their song is most frequently heard during the day time and may provide the only means of locating these cryptically colored orthopterans. The adults and nymphs both forage on aphids and other soft bodied homopterans and hemipterans. Unfortunately, the female causes considerable damage by depositing eggs in the tissues of small twigs on shrubs and trees. Her ovipositional behavior will ultimately kill that part of the plant (Little 1963). Within the Monument (Fig. 11), their advantages would appear to outweigh their disadvantages.

Thysanoptera. Members of this order (Fig. 10) are commonly called thrips. Thrips are small to microscopic in size. They are winged or wingless and have sucking mouthparts. Most species suck the juices of plants and may be located anywhere upon the plant surface. On occasion certain species are known to bite humans. There is little if any benefit associated with this order since the plant feeders are known to spread infectious deseases among plants.

The single thysanopteran specimen collected at the Monument (Fig. 10) belongs to the family Phlaeothripidae. Their small size had a impact upon the number of specimens taken, especially when sweep nets and pitfall traps were the only collecting devices utilized. The specimen was unofficially identified as Haplothrips leucanthemi (Shrank), which frequents the flowers of daisies. They are known to suck the juices from the buds and flowers of daisies. Because of the type of collecting devices employed, it is impossible to access the probable economic impact of this species, or order, within the Monument.

Finally, numerous beneficial insects which act either as parasites or predators of the less desirable insect species were collected. They occur mostly within the orders Coleoptera, Diptera, Hymenoptera, and Neuroptera. Their population densities should also be monitored and every attempt should be made to encourage their development within the Monument. From every indication, the beneficial insects are too scarce to function as effective biological control agents.

Occasionally certain species are used as indicators of potential problems within an ecosystem. Such an arrangement may exist in the present study. Many studies, dealing with the engraver beetles (Scolytidae: Coleoptera) indicated that they are most frequently collected in aerial traps just above the tops of trees or on the foliage. Trees were not adequately surveyed for insect specimens during the study; therefore, it is possible that this pest is present in larger numbers than indicated in Fig. 2. Thus, a substantial percentage of the conifers within the Monument could become infested with this pest.

A close correlation appears to exist between species densities, individual densities, and community composition. Unfortunately, the correlations appear to be the result of the type of equipment and techniques employed in collected the specimens rather than the floral composition.

Substantial confidence exists in the use of the pitfall traps, as indicated by the number of ground dwelling insects collected (Fig. 3). The problem exists with the use of the sweep net. This device is effectively used to sweep areas of light vegetation where mixtures of grasses, forbs, and small shrubs exist. Hence, the highest species and

and individual densities (Fig. 12) were taken in area 2A. According to Gennaro (1977), Russian thistle, goose foot, sagebrush, blue grama, squirrel-tail, and side-oats grana are the predominant vegetation types in that area. He catagorized all of the above as either forbs or grasses. On the other hand, the lowest species and individual densities (Fig. 12) occured in area 10A where trees (pinyon pine, one-seeded juniper) and shrubs (mountain mahogany, polecat bush, common chokecherry, thinbleberry) were the predominant vegetative types. The use of a De-Vac would certainly provide a more useful accessment of the insect fauna in those areas where shrubs and trees predominate.

Insect flight also made it impossible to establish a reliable association between insect(s) and host plant(s). Therefore, if phytophagous species cannot be linked to their hosts, ecological relationships between fauna and flora become impossible.

This study does indicate the presence of several potential pest species, most of which are found in the following orders: Hemiptera, Homoptera, Lepidoptera, and Orthoptera. They are represented by moderate to low population densities. However, should suitable environmental conditions develop, a definite hazardous outbreak is likely, if not certain. Consequently, such potential pest species should be monitored periodically to ascertain population growth levels.

RECOMMENDATIONS: Several recommendations regarding the insect survey have been stated within the Results and Discussion section. Others about both plants and insects are as follows:

1. Continue random collection of plants from May through August, with particular emphasis on spring and fall grasses.

2. Initiate studies of the relationships between detrimental and beneficial insects and certain plant species on the Monument, especially conifers.

3. Initiate idenfification of oak species on the Monument. This will involve extensive collections of acorns on all areas of the Monument when acorns are available.

4. Initiate population studies of small mammals and relate such studies to floral-mammal relationships and food habits.

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Table 1. Dates, collecting stations, and meteorological conditions for each insect survey period during the 1979 summer.

Date	Collecting Stations	Meteorological Conditions
23 May	1A - 9B	Cloudy and cold with afternoon rain
24 May	10A - 12A	Cloudy and cold with morning fog
6 June	1A - 5A	Clear, reasonable warm and windy
7 June	5B - 8B	Clear and warm
8 June	9A - 12A	Clear and warm with overcast afternoon
22 June	1A - 5A	Sunny and warm
23 June	5B - 8B	Sunny and warm
24 June	9A - 12A	Warm with slight overcast
8 July	1A - 4B	Sunny and warm
9 July	5A - 8B	Sunny and warm
10 July	9A - 12A	Sunny and warm
24 July	1A - 4B	Cool and slightly windy
25 July	5A - 8B	Sunny and warm
26 July	9A - 12A	Sunny and warm

Table 2. Checklist of plants collected within the Capulin Mountain National Monument from May through August 1979.

Family	Common Name	Scientific Name	Author
Pinaceae	pinyon	Pinus edulis	Englm.
Cupressaceae	one-seeded juniper	Juniperus monosperma	(Englm.) Sarg.
Cupressaceae	Rocky Mountain juniper	Juniperus scopulorum	Sarg.
Gramineae	littleseed ricegrass	Oryzopsis micrantha	(Trin. & Rupr.)
Gramineae	Indian ricegrass	Oryzopsis hymenoides	(R. & S.) Ricker
Gramineae	needle-and-thread	Stipa comata	Trin. & Rupr.
Gramineae	smooth brome	Bromus inermis	Leyss.
Gramineae	no common name	Bromus lanatipes	(Shear.) Rydb.
Gramineae	nodding brome	Bromus anomalus	Rup. ex Fourn.
Gramineae	Japanese chess	Bromus japonicus	Thurb.
Gramineae	downy chess	Bromus tectorum	L.
Gramineae	Arizona fescue	Festuca arizonica	Schreb.
Gramineae	six-weeks fescue	Vulpia octoflora	(Walt.) Rydb.
Gramineae	mutton-grass	Poa Fenderliana	(Steud.) Vasey
Gramineae	Kentucky bluegrass	Poa pratensis	L.
Gramineae	crested wheatgrass	Agropyron cristatum	(L.)
Gramineae	western wheatgrass	Agropyron Smithii	Rydb.
Gramineae	longleaf squirreltail	Sitanion longifolium	J. G. Sm.
Gramineae	June grass	Koeleria pyramidata	(Lam.). Beauv.
Gramineae	big bluestem	Andropogon Gerardi	Vitman
Gramineae	blue grama	Bouteloua gracilis	(H. B. K.) Lag.
Gramineae	side-oats grama	Bouteloua curtipendula	(Michx.) Torr.
Liliaceae	nooding onion	Allium cernuum	Cockerell
Liliaceae	Spanish bayonet	Yucca angustifolia	Pursh.
Fagaceae	gambel oak	Quercus gambelii	Nutt.
Fagaceae	no common name	Quercus undulata	Torr.
Polygonaceae	antelope-sage	Eriogonum Jamesii	Benth.
Chenopodiaceae	no common name	Chenopodium hians	Standl.

Table 2. (Cont.)

Family	Common Name	Scientific Name	Author
Chenopodiaceae	pigweed	Chenopodium album	L.
Nyctaginaceae	four o'clock	Mirabilis linearis	(Pursh.) Heimerl.
Papaveraceae	no common name	Argemone platyceras	Link & Otto
Fumariaceae	scrambled eggs	Corydalis aurea	Willd.
Cruciferae	no common name	Thelypodium lilacinum	Greene
Cruciferae	tansy mustard	Descurainia Sophia	(L.)
Cruciferae	no common name	Arabis hirsuta	(L.) Scop.
Cruciferae	western wallflower	Erysimum asperum	(Nutt.) DC
Cruciferae	no common name	Erysimum capitatum	Greene
Capparidaceae	clammy-weed	Polanisia dodecandra	(T. &. G.) Iltis
Saxifragaceae	no common name	Heuchera parvifolia	Nutt. ex T. & G.
Saxifragaceae	no common name	Ribes cereum	Dougl.
Saxifragaceae	no common name	Ribes leptanthum	A. Gray
Rosaceae	mountain ninebark	Physocarpus monogynus	(Torr.) Coult.
Rosaceae	thimbleberry	Rubus neomexicanus	Gray
Leguminosae	no common name	Petalostemum purpureum	(Vent.) Rydb.
Leguminosae	no common name	Thermopsis rhombifolia	Nutt. ex Rich
Leguminosae	no common name	Lupinus plattensis	Wats.
Leguminosae	no common name	Lupinus sp.	
Leguminosae	no common name	Psoralea tenuiflora	Pursh.
Leguminosae	no common name	Vicia americana	Nuhl.
Leguminosae	no common name	Oxytropis sericea	Nutt.
Geraniaceae	no common name	Geranium caespitosum	James
Anacardiaceae	polecat bush	Rhus trilobata	Nutt. ex T. & G.
Malvaceae	scarlet globe-mallow	Sphaeralcea coccinea	(Pursh.) Rydb.
Loasaceae	no common name	Mentzelia multiflora	(Nutt.) Gray
Onagraceae	scarlet gaura	Gaura coccinea	Pursh.
Onagraceae	no common name	Oenothera caespitosa	Nutt.
Onagraceae	no common name	Oenothera Hookeri	T. & G.

Table 2. (Cont.)

Family	Common Name	Scientific Name	Author
Onagraceae	no common name	Oenothera coronopifolia	T. & G.
Apocynaceae	no common name	Sibiricum apocynum	Jacq.
Polemoniaceae	no common name	Ipomopsis candida	Wherry
Polemoniaceae	no common name	Gilia calcarea	M. E. Jones
Hydrophyllaceae	no common name	Phacelia denticulata	Osterhout
Hydrophyllaceae	no common name	Phacelia heterophylla	Pursh.
Boraginaceae	no common name	Cynoglossum officinalis	L.
Boraginaceae	no common name	Lappula Redowskii	(Horneum)
Boraginaceae	no common name	Mertensia lanceolata	(Pursh.) DC
Boraginaceae	no common name	Cryptantha thyrsiflora	(Greene) Payson
Boraginaceae	no common name	Cryptantha sp.	
Verbenaceae	Dakota vervain	Verbena bipinnatifida	Nutt.
Labiatae	common horehound	Marrubium vulgare	L.
Labiatae	no common name	Monarda menthifolia	Grah.
Scrophulariaceae	flannel mullein	Verbascum Thapsus	L.
Scrophulariaceae	no common name	Penstemon barbatus	(Cav.)
Scrophulariaceae	no common name	Penstemon Jamesii	Benth.
Scrophulariaceae	no common name	Penstemon angustifolius	Nutt. ex Pursh.
Scrophulariaceae	no common name	Castilleja integra	Gray
Scrophulariaceae	no common name	Orthocarpus luteus	Nutt.
Plantaginaceae	no common name	Plantago patagonica	Jacq.
Compositae	no common name	Liatris punctata	Hook
Compositae	green thread	Heterotheca villosa	(Pursh.) Shinners
Compositae	no common name	Grindelia aphanactis	Rydb.
Compositae	no common name	Solidago altissima	L.
Compositae	no common name	Erigeron divergens	Rydb.
Compositae	Mexican hat	Ratibida columnifera	(Nutt.) Woot. & Standl.
Compositae	common sunflower	Helianthus annuus	L.
Compositae	cowpen daisy	Verbesina enceliodes	(Cav.) Benth. & Hook.

Table 2. (Cont.)

Family	Common Name	Scientific Name	Author
Compositae	no common name	Thelesperma megapotamicum	(Spreng.) O. Ktz.
Compositae	common yarrow	Achillea millefolium	L.
Compositae	prairie-sagewort	Artemisia frigida	Willd.
Compositae	no common name	Senecio mutabilis	Greene
Compositae	no common name	Stephanomeria Wrightii	Gray
Compositae	goat's beard	Tragopogon dubius	Scop.

Table 3. Checklist of plants maintained within the Visitor Center Herbarium on the Capulin Mountain National Monument prior to the 1979 summer vegetative survey.

Family	Common Name	Scientific Name	Author
Pinaceae	ponderosa pine	Pinus ponderosa	Laws.
Pinaceae	pinyon	Pinus edulis	Englm.
Cupressaceae	one-seeded juniper	Juniperus monosperma	(Englm.) Sarg.
Cupressaceae	Rocky Mountain juniper	Juniperus scopulorum	Sarg.
Gramineae	littleseed ricegrass	Oryzopsis micrantha	(Trin. & Rupr.)
Gramineae	Indian ricegrass	Oryzopsis hymenoides	(R. & S.) Ricker
Gramineae	needle-and-thread	Stipa comata	Trin. & Rupr.
Gramineae	smooth brome	Bromus inermis	Leyss.
Gramineae	no common name	Bromus lanatipes	(Shear.) Rydb.
Gramineae	nodding brome	Bromus anomalus	Rup. ex Fourn.
Gramineae	no common name	Bromus frondosus	(Shear Wooton & Standl.
Gramineae	Japanese chess	Bromus japonicus	Thurb.
Gramineae	downy chess	Bromus tectorum	L.
Gramineae	Arizona fescue	Festuca arizonica	Schreb.
Gramineae	six-weeks fescue	Vulpia octoflora	(Walt.) Rydb.
Gramineae	mutton-grass	Poa Fenderliana	(Steud.) Vasey
Gramineae	Kentucky bluegrass	Poa pratensis	L.
Gramineae	crested wheatgrass	Agropyron cristatum	(L.) Gaertn.
Gramineae	western wheatgrass	Agropyron Smithii	Rydb.
Gramineae	no common name	Elymus virginicus	L.
Gramineae	longleaf squirreltail	Sitanion longifolium	J. G. Sm.
Gramineae	June grass	Koeleria pyramidata	(Lam.) Beauv.
Gramineae	witchgrass	Panicum capillare	L.
Gramineae	barnyard grass	Echinochloa crusgalli	(L.) Beauv.
Gramineae	no common name	Setaria lutescens	(Weigel) F. T. Hubb
Gramineae	big bluestem	Andropogon Gerardi	Vitman
Gramineae	no common name	Munroa squarrosa	(Nutt.) Torr.
Gramineae	hairy dropseed	Blepharoneuron tricholepis	(Torr.) Nash

Table 3. (Cont.)

Family	Common Name	Scientific Name	Author
Gramineae	wolftail	Lycurus phleoides	H. B. K.
Gramineae	mountain muhly	Muhlenbergia montana	(Nutt.) Hitchc.
Gramineae	ringgrass muhly	Muhlenbergia torreyi	(Kunth.) Hitchc.
Gramineae	blue grama	Bouteloua gracilis	(H. B. K.) Lag.
Gramineae	side-oats grama	Bouteloua curtipendula	(Michx.) Torr.
Gramineae	no common name	Aristida longiseta	Steud.
Liliaceae	nodding onion	Allium cernuum	Cockerell
Liliaceae	no common name	Calochortus gunnisonii	Watson
Liliaceae	Spanish bayonet	Yucca angustifolia	Pursh.
Liliaceae	no common name	Smilacina stellata	(L.) Desf.
Salicaceae	quaking aspen	Populus tremuloides	Michx.
Fagaceae	gambel oak	Quercus gambelii	Nutt.
Fagaceae	no common name	Quercus undulata	Torr.
Polygonaceae	antelope-sage	Eriogonum Jamesii	Benth.
Polygonaceae	no common name	Rumex mexicanus	Meisn.
Polygonaceae	black bindweed	Polygonum convolvulus	L.
Chenopodiaceae	no common name	Chenopodium graveolens	Willd.
Chenopodiaceae	no common name	Chenopodium pallescens	Standl.
Chenopodiaceae	no common name	Chenopodium hians	Standl.
Chenopodiaceae	pigweed	Chenopodium album	L.
Chenopodiaceae	four-wing saltbush	Atriplex canescens	(Pursh.)
Chenopodiaceae	Russian thistle	Salsola Kali	L.
Amaranthaceae	careless weed	Amaranthus Palmeri	Wats.
Nyctaginaceae	four o'clock	Mirabilis linearis	(Pursh.) Heimerl.
Caryophyllaceae	no common name	Stellaria sp.	
Ranunculaceae	no common name	Pulsatilla ludoviciana	(Nutt.) Heller
Ranunculaceae	no common name	Clematis hirsutissima	(Porter) Erickson

Table 3. (Cont.)

Family	Common Name	Scientific Name	Author
Papaveraceae	prickle-poppy	Argemone platyceras	Link and Otto
Fumariaceae	scrambled eggs	Corydalis aurea	Willd.
Cruciferae	no common name	Lesquerella intermedia	(Wats.) Heller
Cruciferae	rock cress	Arabis hirsuta	(L.) Scop.
Cruciferae	tansy mustard	Descurainia Sophia	(L.)
Cruciferae	no common name	Erysimum capitatum	Greene
Cruciferae	no common name	Erysimum inconspicuum	(Wats.) Mac M.
Cruciferae	no common name	Erysimum asperum	(Nutt.) DC
Cruciferae	no common name	Thelypodium lilacinum	Greene
Capparidaceae	clammy-weed	Polanisia dodecandra	(T. & G.) Iltis
Saxifragaceae	no common name	Heuchera parvifolia	NUtt. ex T. & G.
Saxifragaceae	cliff bush	Jamesia americana	T. & G.
Saxifragaceae	no common name	Ribes cereum	Dougl.
Saxifragaceae	no common name	Ribes leptanthum	A. Gray
Rosaceae	mountain ninebark	Physocarpus monogynus	(Torr.) Coult.
Rosaceae	thimbleberry	Rubus neomexicanus	Gray
Rosaceae	mountain mahogany	Cercocarpus montanus	Raf.
Rosaceae	no common name	Rosa neomexicana	Cockerell
Rosaceae	common chokeberry	Prunus virginiana	L.
Leguminosae	no common name	Petalostemum candidus	Michx.
Leguminosae	no common name	Petalostemum purpureum	(Vent.) Rydb.
Leguminosae	no common name	Thermopsis rhombifolia	Nutt. ex Rich.
Leguminosae	no common name	Lupinus plattensis	Wats.
Leguminosae	no common name	Lupinus argenteus	Pursh.
Leguminosae	scurfy pea	Psoralea tenuiflora	Pursh.
Leguminosae	American vetch	Vicia americana	Muhl.
Leguminosae	white sweet clover	Melilotus alba	Desr.
Leguminosae	yellow sweet clover	Melilotus officinalis	(L.) Lam.
Leguminosae	no common name	Oxytropis sericea	Nutt.

Table 3. (Cont.)

Family	Common Name	Scientific Name	Author
Geraniaceae	no common name	Geranium caespitosum	James
Geraniaceae	no common name	Geranium richardsonii	Fish. & Trautv.
Euphorbiaceae	no common name	Euphorbia dictyosperma	F. & M.
Euphorbiaceae	show on the mountain	Euphorbia marginata	Pursh.
Euphorbiaceae	no common name	Euphorbia fendleri	T. & G.
Anacardiaceae	poison ivy	Rhus radicans	L.
Anacardiaceae	polecat bush	Rhus trilobata	Nutt. ex T. & G.
Vitaceae	virginia creeper	Parthenocissus inserta	Kerner
Malvaceae	scarlet globe mallow	Sphaeralcea coccinea	(Pursh.) Rydb.
Malvaceae	no common name	Callirrhoe involucrata	(T. & C.) A. Gray
Loasaceae	no common name	Mentzelia multiflora	(Nutt.) Gray
Cactaceae	no common name	Opuntia polyacantha	Haw.
Onagraceae	scarlet gaura	Gaura coccinea	Pursh.
Onagraceae	no common name	Oenothera Jamesii	T. & G.
Onagraceae	no common name	Oenothera Hookeri	T. & G.
Onagraceae	no common name	Oenothera caespitosa	Nutt.
Onagraceae	no common name	Oenothera coronopifolia	T. & G.
Primulaceae	no common name	Androsace septentrionalis	St. John
Gentianaceae	deer's ears	Swertia radiata	(Kell.) O. Ttze.
Apocynaceae	no common name	Sibiricum apocynum	Jacq.
Asclepiadaceae	butterfly weed	Asclepias tuberosa	L.
Convolvulaceae	bush morning glory	Ipomoea leptophylla	Torr.
Polemoniaceae	no common name	Ipomopsis candida	Wherry
Polemoniaceae	no common name	Gilia calcarea	M. E. Jones
Hydrophyllaceae	no common name	Phacelia denticulata	Osterhout
Hydrophyllaceae	no common name	Phacelia heterophylla	Pursh.
Boraginaceae	no common name	Cynoglossum officinalis	L.
Boraginaceae	no common name	Lappula Redowskii	(Horneum)
Boraginaceae	no common name	Myosotis verna	Nutt.

Table 3. (Cont.)

Family	Common Name	Scientific Name	Author
Boraginaceae	no common name	Mertensia lanceolata	(Pursh.) DC
Boraginaceae	no common name	Cryptantha thyrsiflora	(Greene) Payson
Verbenaceae	New Mexico vervain	Verbena Macdougali	Heller
Verbenaceae	Dakota vervain	Verbena bipinnatifida	Nutt.
Labiatae	Rocky Mountain sage	Salvia reflexa	Hernem.
Labiatae	no common name	Monarda menthifolia	Grah.
Labiatae	common horehound	Marrubium vulgare	L.
Solanaceae	no common name	Physalis sp.	
Solanaceae	buffalo bur	Solanum rostratum	Duval
Solanaceae	no common name	Solanum nigrum	L.
Solanaceae	no common name	Solanum sarachoides	Sendt. ex Mart.
Scrophulariaceae	no common name	Mimulus glabratus	H. B. K.
Scrophulariaceae	flannel mullein	Verbascum Thapsus	L.
Scrophulariaceae	no common name	Penstemon barbatus	(Cav.)
Scrophulariaceae	no common name	Penstemon Jamesii	Benth.
Scrophulariaceae	no common name	Penstemon angustifolius	Nutt. ex Pursh.
Scrophulariaceae	no common name	Castilleja integra	Gray
Scrophulariaceae	no common name	Orthocarpus leuteus	Nutt.
Orobanchaceae	no common name	Orobanche multiflora	Nutt.
Orobanchaceae	no common name	Orobanche fasiculata	Nutt.
Plantaginaceae	no common name	Plantago patagonica	Jacq.
Rubiaceae	no common name	Galium bifolium	Wats.
Caprifoliaceae	no common name	Symphoricarpos sp.	
Compositae	no common name	Liatris punctata	Hook.
Compositae	no common name	Brickella brachyphylla	A. Gray
Compositae	no common name	Brickella californica	(Hook.) Nutt.
Compositae	no common name	Kuhnia rosmarinifolia	Vent.
Compositae	green thread	Heterotheca villosa	(Pursh.) Shinners
Compositae	no common name	Grindelia aphanactis	Rydb.

Table 3. (Cont.)

Family	Common Name	Scientific Name	Author
Compositae	no common name	Grindelia squarrosa	(Pursh.) Dunal
Compositae	no common name	Grindelia acutifolia	Steyermark
Compositae	snakeweed	Xanthocephalum Sarothrae	(Pursh.) Britt. & Rusby
Compositae	no common name	Machaeranthera australis	(Greene) Shinners
Compositae	no common name	Machaeranthera pygmaeus	(T. & G.) Gray
Compositae	no common name	Solidago ciliosa	Greene
Compositae	no common name	Solidago altissima	L.
Compositae	no common name	Solidago lepida	DC
Compositae	no common name	Aster tanacetifolius	H. B. K.
Compositae	no common name	Aster rubrotinctus	Blake
Compositae	no common name	Erigeron divergens	T. & G.
Compositae	no common name	Erigeron subtrinervis	Rydb.
Compositae	no common name	Berlandiera lyrata	Benth.
Compositae	Engelmann daisy	Engelmannia pinnatifida	T. & G.
Compositae	no common name	Ambrosia coronopifolia	Torr.
Compositae	no common name	Xanthium italicum	Moretti
Compositae	no common name	Zinnia grandiflora	Nutt.
Compositae	Mexican hat	Ratibida columnifera	(Nutt.) Woot. & Standl.
Compositae	prairie coneflower	Ratibida tagetes	(James) Barnh.
Compositae	no common name	Viguiera longifolia	(Robins. & Greenm.) Blake
Compositae	no common name	Helianthus Nuttalli	T. & G.
Compositae	common sunflower	Helianthus annuus	L.
Compositae	cowpen daisy	Verbesina encelioides	(Cav.) Benth. & Hook.
Compositae	no common name	Thelesperma megapotamicum	(Spreng.) O. Ktze.
Compositae	no common name	Dyssodia papposa	(Vent.) Hitchc.
Compositae	no common name	Pectis angustifolia	Torr.
Compositae	no common name	Pericome caudata	A. Gray
Compositae	no common name	Bahia dissecta	(A. Gray) Britt.

Table 3. (Cont.)

Family	Common Name	Scientific Name	Author
Compositae	common yarrow	Achillea millefolium	L.
Compositae	prairie-sagewort	Artemisia frigida	Willd.
Compositae	Western mugwort	Artemisia ludoviciana	Nutt.
Compositae	no common name	Senecio multicapitatus	Greenm. ex Rydb.
Compositae	no common name	Senecio longilobus	Benth.
Compositae	no common name	Senecio uintahensis	(A. Nels.) Greenm.
Compositae	no common name	Senecio mutabilis	Greene
Compositae	no common name	Cirsium undulatum	(Nutt.) Spreng.
Compositae	chicory	Cichorium intybus	L.
Compositae	no common name	Lygodesmia juncea	(Pursh.) D. Don
Compositae	goat's beard	Tragopogon dubius	Scop.

Table 4. List of plants collected during the 1979 summer from plant communities (Gennaro 1977) within Capulin Mountain National Monument.

Community	Family	Scientific Name	Date
G1	Gramineae	Oryzopsis micrantha	23 May
G1	Gramineae	Bromus inermis	1 July
G1	Gramineae	Bromus japonicus	22 June, 2 July, 8 July
G1	Gramineae	Agropyron Smithii	8 July
G1	Gramineae	Sitanion longifolium	24 July
G1	Cruciferae	Erysimum asperum	24 July
G1	Leguminosae	Lupinus sp.	23 May
G1	Leguminosae	Vicia americana	6 June, 22 June
G1	Scrophulariaceae	Pebstemon Jamesii	15 June
G1	Scrophulariaceae	Castilleja integra	13 June
G1	Plantaginaceae	Plantago patagonica	8 July
G1	Compositae	Senecio mutabilis	23 May, 6 June, 22 June
G1	Compositae	Heterotheca villosa	24 July
G1	Compositae	Erigeron divergens	1 June
G1	Compositae	Artemisia frigida	23 May
G2	Geraniaceae	Geranium caespitosum	2 July
G2	Onagraceae	Gaura coccinea	2 July
G2	Onagraceae	Oenothera coronopifolia	2 July
G3	Cupressaceae	Juniperus monosperma	6 June, 24 July
G3	Gramineae	Poa Fenderliana	23 May
G3	Gramineae	Poa pratense	6 June
G3	Gramineae	Sitanion longifolium	20 June
G3	Gramineae	Koeleria pyramidata	8 July
G3	Gramineae	Bouteloua gracilis	23 May, 6 June
G3	Fagaceae	Quercus gambelli	23 May, 22 June
G3	Chenopodiaceae	Chenopodium hians	8 July
G3	Cruciferae	Arabis hirsuta	22 June
G3	Leguminosae	Vicia americana	23 May

Table 4. (Cont.)

Community	Family	Scientific Name	Date
G3	Onagraceae	Gaura coccinea	8 July
G3	Onagraceae	Oenothera caespitosa	2 July
G3	Onagraceae	Oenothera Hookeri	6 August
G3	Apocynaceae	Apocynum sibiricum	3 July
G3	Hydrophyllaceae	Phacelia denticulata	19 June
G3	Boraginaceae	Lappula Redowskii	19 June, 20 June, 21 June, 8 July
G3	Boraginaceae	Cryptantha sp.	22 June
G3	Labiatae	Marrubium vulgare	22 June
G3	Scrophulariaceae	Penstemon barbatus	24 July
G3	Plantaginaceae	Plantago patagonica	21 June
G3	Compositae	Ratibida columnaris	24 July
G3	Compositae	Achillea millefolium	23 May, 24 July
G3	Compositae	Artemisia frigida	23 May, 6 June
G4	Pinaceae	Pinus edulis	23 May, 7 June, 23 June, 9 July, 23 July, 25 July
G4	Gramineae	Oryzopsis micrantha	23 May
G4	Gramineae	Bromus anomalus	24 July
G4	Gramineae	Festuca arizonica	23 June, 9 July
G4	Fagaceae	Quercus gambelli	23 June
G4	Chenopodiaceae	Chenopodium hians	9 July, 25 July
G4	Nyctaginaceae	Mirabilis linearis	25 July
G4	Cruciferae	Erysimum asperum	23 June, 25 July
G4	Rosaceae	Cercocarpus montanus	23 May, 7 June
G4	Leguminosae	Thermopsis rhombifolia	7 June
G4	Boraginaceae	Cryptantha thyriflora	9 July, 25 July
G4	Boraginaceae	Cryptantha sp.	23 June
G4	Scrophulariaceae	Verbascum Thapsus	7 June, 8 July, 9 July 25 July
G4	Scrophulariaceae	Penstemon angustifolius	23 June
G4	Compositae	Achillea millefolium	8 July, 9 July

Table 4. (Cont.)

Community	Family	Scientific Name	Date
G4	Compositae	Artemisia frigida	23 May, 7 June. 9 July
G4	Compositae	Senecio mutabilis	14 June
G5	Pinaceae	Pinus edulis	24 June, 26 July
G5	Gramineae	Oryzopsis micrantha	24 May
G5	Gramineae	Stipa comata	24 June, 3 July, 10 July, 26 July
G5	Gramineae	Bromus japonicus	6 August
G5	Gramineae	Vulpia octoflora	21 June
G5	Gramineae	Agropyron cristatum	6 August
G5	Gramineae	Andropogon Gerardi	8 June
G5	Liliaceae	Yucca angustifolia	24 May, 8 June, 24 June
G5	Chenopodiaceae	Eriogonum Jamesii	23 July, 6 August
G5	Chenopodiaceae	Chenopodium album	10 July, 26 July
G5	Fumariaceae	Corydalis aurea	20 June
G5	Cruciferae	Erysimum asperum	1 June, 24 June, 10 July
G5	Rosaceae	Rubus neomexicanus	16 June
G5	Leguminosae	Petalostemum purpureum	23 July
G5	Leguminosae	Thermopsis rhombifolia	2 June
G5	Leguminosae	Lupinus plattensis	24 June, 10 July
G5	Leguminosae	Oxytropis sericea	24 May
G5	Malvaceae	Sphaeralcea coccinea	16 June
G5	Verbenaceae	Verbena bipinnatifida	2 June
G5	Scrophulariaceae	Penstemon angustifolius	21 May, 8 June, 23 June, 10 July, 26 July
G5	Scrophulariaceae	Castilleja integra	24 May, 29 May
G5	Compositae	Liatris punctata	6 August
G5	Compositae	Heterotheca villosa	23 July
G5	Compositae	Grindelia aphanactis	28 July
G5	Compositae	Solidago altissima	6 August
G5	Compositae	Artemisia frigida	24 June, 26 July

Table 4. (Cont.)

Community	Family	Scientific Name	Date
G5	Compositae	Senecio mutabilis	6 August
G5	Compositae	Stephanomeria Wrightii	6 August
G5	Compositae	Thelesperma megapotamicum	23 July
S3	Pinaceae	Pinus edulis	23 May, 6 June, 24 July
S3	Gramineae	Oryzopsis micrantha	23 May, 7 June
S3	Gramineae	Festuca arizonica	8 July
S3	Gramineae	Poa Fenderliana	6 June
S3	Gramineae	Koeleria pyramidata	24 July
S3	Gramineae	Andropogon Gerardi	6 June
S3	Gramineae	Bouteloua gracilis	23 May
S3	Fagaceae	Quercus gambelii	22 June, 8 July
S3	Chenopodiaceae	Chenopodium hians	23 June
S3	Capparidaceae	Polansia dodecandra	6 August
S3	Saxifragaceae	Ribes cereum	23 May, 7 June
S3	Saxifragaceae	Ribes leptanthum	23 July
S3	Leguminosae	Vicia americana	22 June
S3	Hydrophyllaceae	Phacelia denticulata	2 July, 8 July
S3	Hydrophyllaceae	Phacelia heterophylla	9 July, 25 August
S3	Boraginaceae	Mertensia lanceolata	23 May
S3	Boraginaceae	Cryptantha thyrsiflora	1 July
S3	Labiatae	Monarda menthifolia	25 July
S3	Scrophulariacea	Penstemon Jamesii	6 June
S3	Compositae	Achillea millefolium	8 July
S3	Compositae	Artemisia frigida	23 May, 22 June, 24 June
S4	Pinaceae	Pinus edulis	23 May, 23 July, 25 July
S4	Gramineae	Oryzopsis micrantha	23 May
S4	Gramineae	Bromus lanatipes	25 July
S4	Gramineae	Bouteloua gracilis	23 May
S4	Fagaceae	Quercus gambelii	22 June, 23 June, 8 July, 9 July

Table 4. (Cont.)

Community	Family	Scientific Name	Date
S4	Cenopodiaceae	Chenopodium hians	9 July
S4	Saxifragaceae	Ribes cereum	23 May, 7 June
S4	Saxifragaceae	Ribes leptanthum	23 July
S4	Rosaceae	Physocarpus monogynus	22 June, 8 July
S4	Rosaceae	Cercocarpus montanus	23 May, 7 June, 23 June 9 July, 25 July
S4	Leguminosae	Vicia americana	22 June
S4	Hydrophyllaceae	Phacelia denticulata	2 July, 8 July
S4	Hydrophyllaceae	Phacelia heterophylla	25 July
S4	Compositae	Artemisia frigida	24 May, 7 June, 23 June 25 July
PJ1	Pinaceae	Pinus edulis	23 May, 7 June, 23 June 9 July, 23 July, 25 July
PJ1	Gramineae	Oryzopsis micrantha	23 May
PJ1	Gramineae	Bromus anomalus	25 July
PJ1	Gramineae	Festuca arizonica	9 July
PJ1	Fagaceae	Quercus gambeli	23 May, 23 June, 9 July
PJ1	Chenopodiaceae	Chenopodium hians	23 JUne, 9 July
PJ1	Cruciferae	Erysimum asperum	9 July
PJ1	Rosaceae	Cercocarpus montanus	23 May, 23 June, 9 July
PJ1	Hydrophyllaceae	Phacelia heterophylla	25 July
PJ1	Compositae	Artemisia frigida	24 May, 9 July
PJ2	Pinaceae	Pinus edulis	23 May, 24 May, 6 June, 8 June, 22 June, 24 June, 10 July, 26 July
PJ2	Gramineae	Oryzopsis micrantha	24 May, 8 June, 22 June, 26 June
PJ2	Gramineae	Oryzopsis hymenoides	3 July
PJ2	Gramineae	Poa Fenderliana	24 June
PJ2	Gramineae	Koeleria pyramidata	22 June
PJ2	Gramineae	Bouteloua gracilis	8 June

Table 4. (Cont.)

Community	Family	Scientific Name	Date
PJ2	Chenopodiaceae	Chenopodium hians	3 July, 25 July, 25 July
PJ2	Chenopodiaceae	Chenopodium album	10 July
PJ2	Cruciferae	Thelypodium lilacinum	6 August
PJ2	Saxifragaceae	Heuchera parvifolia	24 June
PJ2	Rosaceae	Cercocarpus montanus	8 June
PJ2	Anacardiaceae	Rhus trilobata	24 June
PJ2	Loasaceae	Mentzelia multiflora	6 August
PJ2	Polemoniaceae	Gilia calcarea	3 July
PJ2	Hydrophyllaceae	Phacelia denticulata	6 August
PJ2	Hydrophyllaceae	Phacelia heterophylla	3 July, 26 July
PJ2	Scrophulariaceae	Penstemon barbatus	26 July
PJ2	Compositae	Verbesina enceliodes	6 August
PJ2	Compositae	Artemisia frigida	23 May, 24 May, 6 June, 19 July, 6 August
PJS1	Pinaceae	Pinus edulis	24 May, 6 June, 22 June, 8 July, 10 July, 24 July, 26 July
PJS1	Cupressaceae	Juniperus monosperma	23 May, 6 June, 8 July, 24 July
PJS1	Gramineae	Oryzopsis micrantha	22 June, 23 June, 24 June
PJS1	Gramineae	Bromus japonicus	8 July, 24 July
PJS1	Gramineae	Bromus tectorum	30 June
PJS1	Gramineae	Festuca arizonica	8 July
PJS1	Gramineae	Poa Fenderliana	23 May
PJS1	Gramineae	Agropyron cristatum	3 July
PJS1	Gramineae	Sitanion longifolium	24 July, 6 August
PJS1	Gramineae	Koeleria pyramidata	22 June, 1 July
PJS1	Gramineae	Bouteloua curtipendula	6 August
PJS1	Fagaceae	Quercus gambeli	23 May, 24 May, 6 June
PJS1	Fagaceae	Quercus undulata	22 June
PJS1	Polygonaceae	Eriogonum Jamesii	6 August

Table 4. (Cont.)

Community	Family	Scientific Name	Date
PJS1	Chenopodiaceae	Chenopodium hians	24 June
PJS1	Chenopodiaceae	Chenopodium album	8 July
PJS1	Papaveraceae	Argemone platyceras	6 August
PJS1	Cruciferae	Descurainia Sophia	30 June
PJS1	Cruciferae	Erysimum capitatum	6 August
PJS1	Leguminosae	Psoralea tenuiflora	6 August
PJS1	Leguminosae	Vicia americana	23 May, 6 June
PJS1	Anacardiaceae	Rhus trilobata	26 July
PJS1	Malvaceae	Sphaeralcea coccinea	22 June
PJS1	Polemoniaceae	Ipomopsis candida	6 August
PJS1	Hydrophyllaceae	Phacelia heterophylla	24 July
PJS1	Boraginaceae	Lappula Redowskii	30 June
PJS1	Labiatae	Monarda menthifolia	25 July
PJS1	Compositae	Heterotheca villosa	6 August
PJS1	Compositae	Achillea millefolium	22 June, 1 July
PJS1	Compositae	Artemisia frigida	23 May, 6 June
PJS1	Compositae	Stephanomeria Wrightii	6 August
PJS2	Gramineae	Festuca arizonica	10 July
PJS3	Cupressaceae	Juniperus monosperma	6 June, 22 June
PJS3	Cupressaceae	Juniperus scopulorum	23 May
PJS3	Fagaceae	Quercus gambeli	23 May, 6 June
PJS3	Anacardiaceae	Rhus trilobata	24 July
PJS3	Labiatae	Monarda menthifolia	24 July
PJS3	Scrophulariaceae	Orthocarpus luteus	6 August
PJS3	Compositae	Artemisia frigida	23 May
PJS4	Apocynaceae	Apocynum sibiricum	3 July
PJS6	Pinaceae	Pinus edulis	22 June, 8 July
PJS6	Cruciferae	Descurainia Sophia	30 June
PJS6	Boraginaceae	Cynoglossum officinalis	3 July

Table 4. (Cont.)

Community	Family	Scientific Name	Date
PJS6	Plantaginaceae	Plantago patagonia	21 June
PJS7	Pinaceae	Pinus edulis	23 May, 24 May, 6 June, 7 June, 22 June, 23 June, 9 July, 23 July, 25 July, 26 July
PJS7	Cupressaceae	Juniperus scopulorum	7 June, 25 June, 26 July
PJS7	Gramineae	Oryzopsis micrantha	23 May, 8 June, 22 June, 26 June
PJS7	Gramineae	Festuca arizonica	23 June, 10 July
PJS7	Gramineae	Poa Fenderliana	6 June, 24 June
PJS7	Gramineae	Koeleria pyramida	22 June
PJS7	Gramineae	Bouteloua gracilis	6 June, 7 June
PJS7	Chenopodiaceae	Chenopodium hians	9 July, 25 July, 26 July
PJS7	Cruciferae	Thelypodium liliacinum	6 August
PJS7	Saxifragaceae	Heuchera parvifolia	24 June
PJS7	Anacardiaceae	Rhus trilobata	24 June, 25 July
PJS7	Scrophulariaceae	Penstemon barbatus	26 July
PJS7	Compositae	Achillea millefolium	9 July
PJS7	Compositae	Artemisia frigida	6 June, 7 June, 10 June, 6 August
PJS9	Pinaceae	Pinus edulis	24 May, 6 June, 8 June, 22 June, 24 June, 26 July
PJS9	Gramineae	Oryzopsis micrantha	24 May
PJS9	Gramineae	Stipa comata	24 June, 10 July, 26 July
PJS9	Gramineae	Festuca arizonica	10 July
PJS9	Gramineae	Bouteloua gracilis	8 JUne
PJS9	Fagaceae	Quercus gambeli	8 June
PJS9	Chenopodiaceae	Chenopodium album	10 July, 25 July
PJS9	Fumariaceae	Corydalis aurea	20 June
PJS9	Cruciferae	Erysimum asperum	26 July
PJS9	Rosaceae	Cercocarpus montanus	8 June, 24 June, 10 July, 26 July

Table 4. (Cont.)

Community	Family	Scientific Name	Date
PJS9	Leguminosae	Lupinus plattensis	8 June, 10 July
PJS9	Hydrophyllaceae	Phacelia heterophylla	26 July
PJS9	Boraginaceae	Cynoglossum officinalis	8 June
PJSG1	Pinaceae	Pinus edulis	23 May, 6 June, 8 July, 24 July
PJSG1	Gramineae	Oryzopsis micrantha	7 June, 22 June
PJSG1	Gramineae	Festuca arizonica	22 June, 8 July
PJSG1	Gramineae	Poa Fenderliana	23 May
PJSG1	Gramineae	Koeleria pyramidata	24 July, 26 July
PJSG1	Gramineae	Andropogon Gerardi	6 June
PJSG1	Liliaceae	Allium cernuum	6 August
PJSG1	Liliaceae	Yucca angustifolia	23 May
PJSG1	Fagaceae	Quercus gambeli	23 May, 6 August
PJSG1	Nyctaginaceae	Mirabilis linearis	8 July
PJSG1	Saxifragaceae	Ribes cereum	23 May
PJSG1	Rosaceae	Cercocarpus montanus	23 May, 9 July
PJSG1	Leguminosae	Lupinus sp.	24 July
PJSG1	Anacardiaceae	Rhus trilobata	6 June
PJSG1	Hydrophyllaceae	Phacelia heterophylla	9 July, 24 July, 25 August
PJSG1	Labiatae	Monarda menthifolia	25 July
PJSG1	Scrophulariaceae	Penstemon barbatus	25 July, 26 July
PJSG1	Scrophulariaceae	Penstemon Jamesii	6 June
PJSG1	Compositae	Helianthus annuus	25 July
PJSG1	Compositae	Achillea millefolium	8 July, 25 July
PJSG1	Compositae	Artemisia frigida	23 May, 7 June
PJSG1	Compositae	Tragopogon dubius	1 July

Table 5. Alphabetical list of the orders, families, and subfamilies collected within the Capulin National Monument.

Order	Family	Subfamily
Coleoptera	Cantharidae	
Coleoptera	Carabidae	
Coleoptera	Cerambycidae	
Coleoptera	Cleridae	
Coleoptera	Chrysomelidae	
Coleoptera	Coccinellidae	
Coleoptera	Curculionidaè	
Coleoptera	Elateridae	
Coleoptera	Nitidulidae	
Coleoptera	Scarabaeidae	
Coleoptera	Scolytidae	
Coleoptera	Siliphidae	
Coleoptera	Tenebrionidae	
Diptera	Agromyzidae	
Diptera	Anthomyiidae	
Diptera	Bibionidae	
Diptera	Calliphoridae	
Diptera	Cecidomyiidaè	
Diptera	Chironomidae	
Diptera	Chloropidae	
Diptera	Drosophilidae	
Diptera	Leptogastridae	
Diptera	Muscidae	
Diptera	Mycetophilidae	
Diptera	Pipunculidae	
Diptera	Sarcophagidae	
Diptera	Sepsidae	
Diptera	Syrphidae	

Table 5. (Cont.)

Order	Family	Subfamily
Diptera	Tachinidae	
Diptera	Tephritidae	
Diptera	Therevidae	
Hemiptera	Lygaeidae	
Hemiptera	Miridae	
Hemiptera	Nabidae	
Hemiptera	Tingidae	
Homoptera	Aphididae	
Homoptera	Cercopidae	
Homoptera	Cicadellidae	
Homoptera	Membracidae	
Homoptera	Psyllidae	
Hymenoptera	Apidae	
Humenoptera	Braconidae	
Hymenoptera	Cephidae	
Hymenoptera	Chalcididae	
Hymenoptera	Colletidae	
Hymenoptera	Cynipidae	
Hymenoptera	Encyrtidae	
Hymenoptera	Eucharitidae	
Hymenoptera	Eulophidae	
Hymenoptera	Eupelmidae	
Hymenoptera	Formicidae	
Hymenoptera	Gasteruptiidae	
Hymenoptera	Halictidae	
Hymenoptera	Ichneumonidae	
Hymenoptera	Megachilidae	
Hymenoptera	Sphecidae	

Table 5. (Cont.)

Order	Family	Subfamily
Lepidoptera	Arctiidae	
Lepidoptera	Ethmiidae	
Lepidoptera	Liparidae	
Lepidoptera	Lasiocampidae	
Lepidoptera	Lycaenidae	
Lepidoptera	Noctuidae	
Lepidoptera	Nymphalidae	
Lepidoptera	Pterophoridae	
Lepidoptera	Pyralidae	
Lepidoptera	Saturniidae	
Neuroptera	Hemerobiidae	
Orthoptera	Acrididae	Acridinae
Orthoptera	Acrididae	Cyrtacanthacridinae
Orthoptera	Acrididae	Oedipodinae
Orthoptera	Acrididae	Romaleinae
Orthoptera	Gryllacrididae	Rhaphidophorinae
Orthoptera	Gryllidae	Gryllinae
Orthoptera	Gryllidae	Oecanthinae
Thysanoptera	Phlaeothripidae	

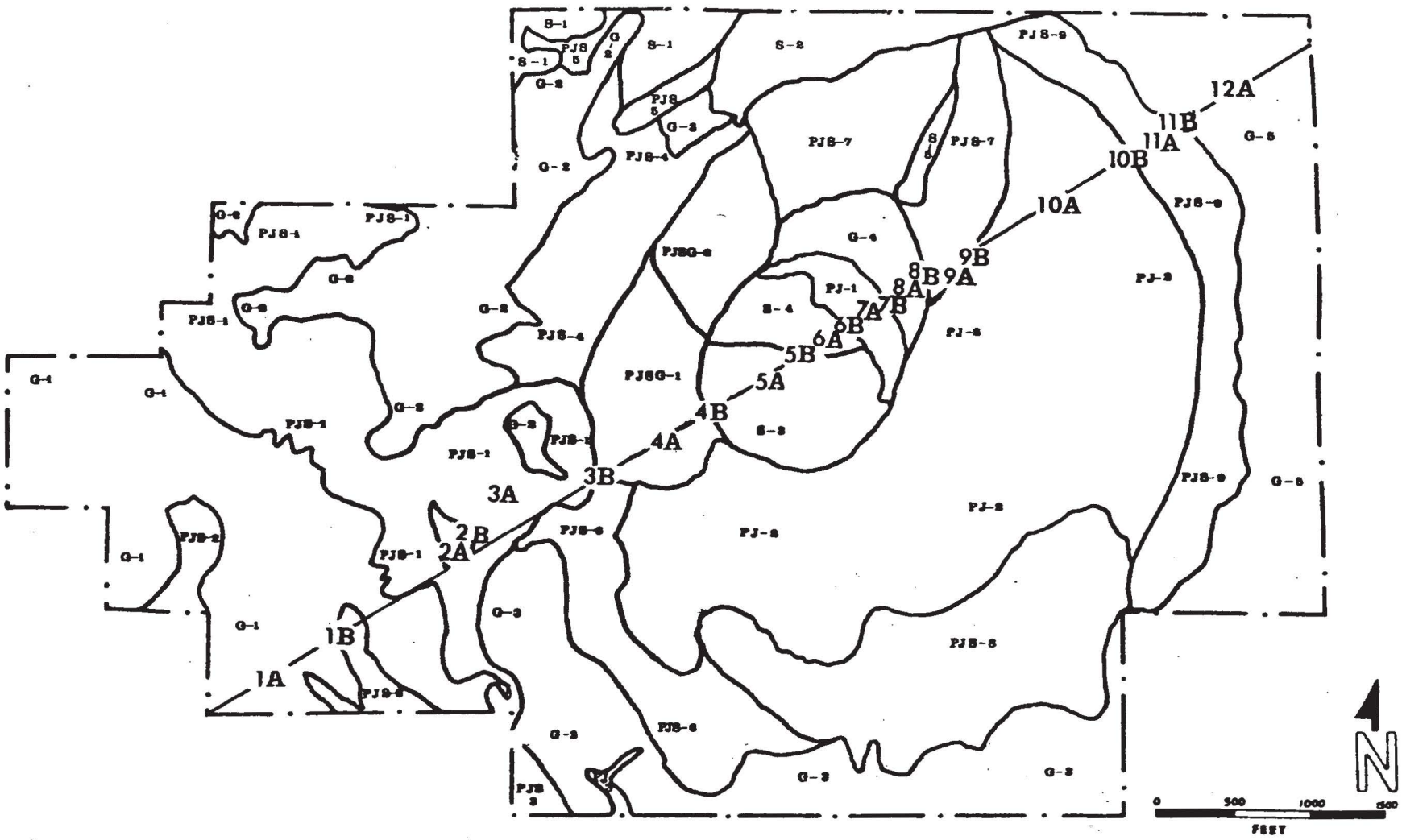

Fig. 1. Topographical map of Capulin National Monument showing transect and locality of collecting stations. The letter A refers to stations within plant communities; the letter B to stations within transition areas between two communities. Plant communities are designated: G - Grassland, S - Shrub, PJ - Pinyon-Juniper, PJS - Pinyon-Juniper-Shrub, and PJSG - Pinyon-Juniper-Shrub-Grassland.

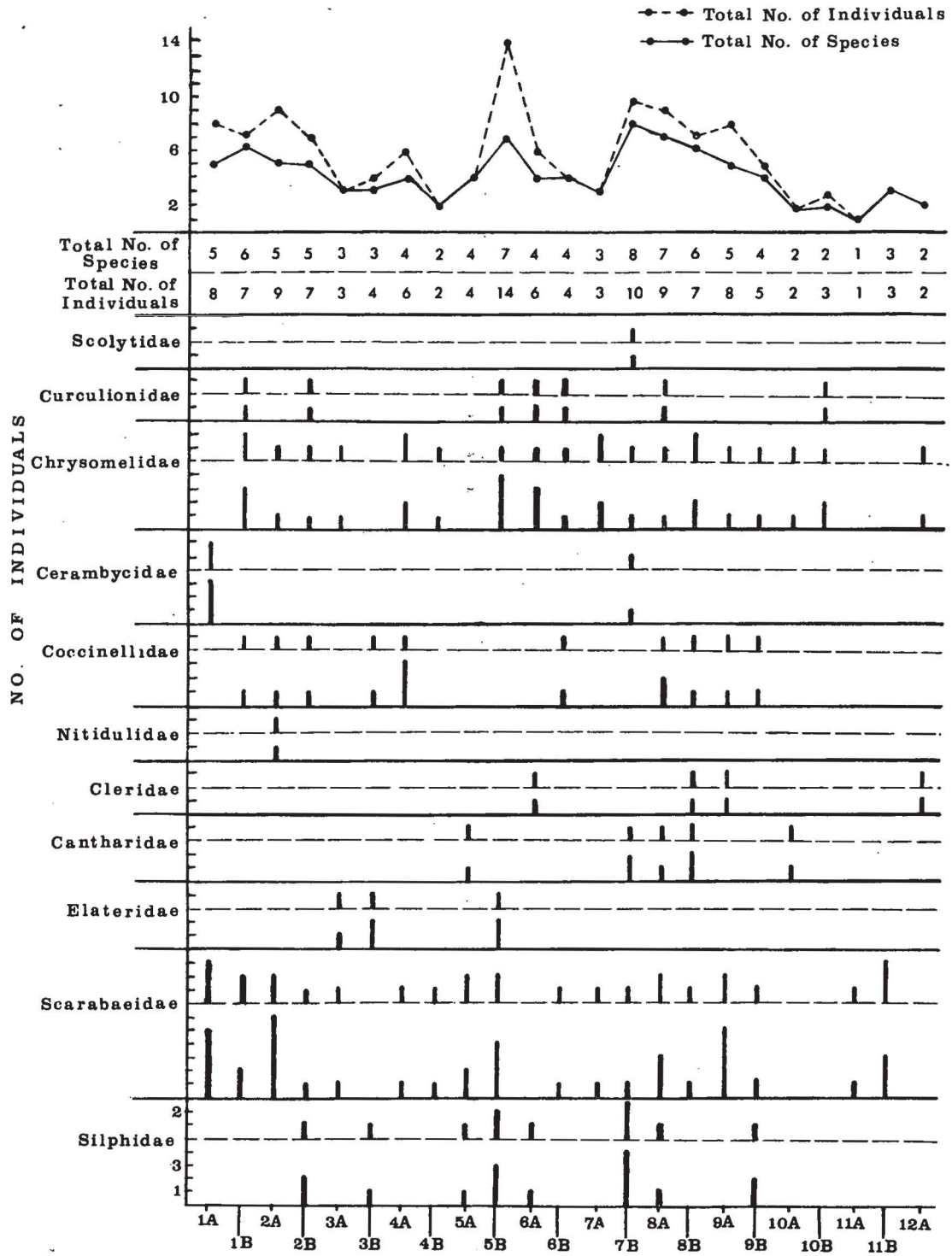

Fig. 2. Relative population, probable species numbers, and relative densities of several coleopteran families at each collecting station. For each family, bars above dashed line refer to species numbers; bars below dashed line refer to individual numbers within families.

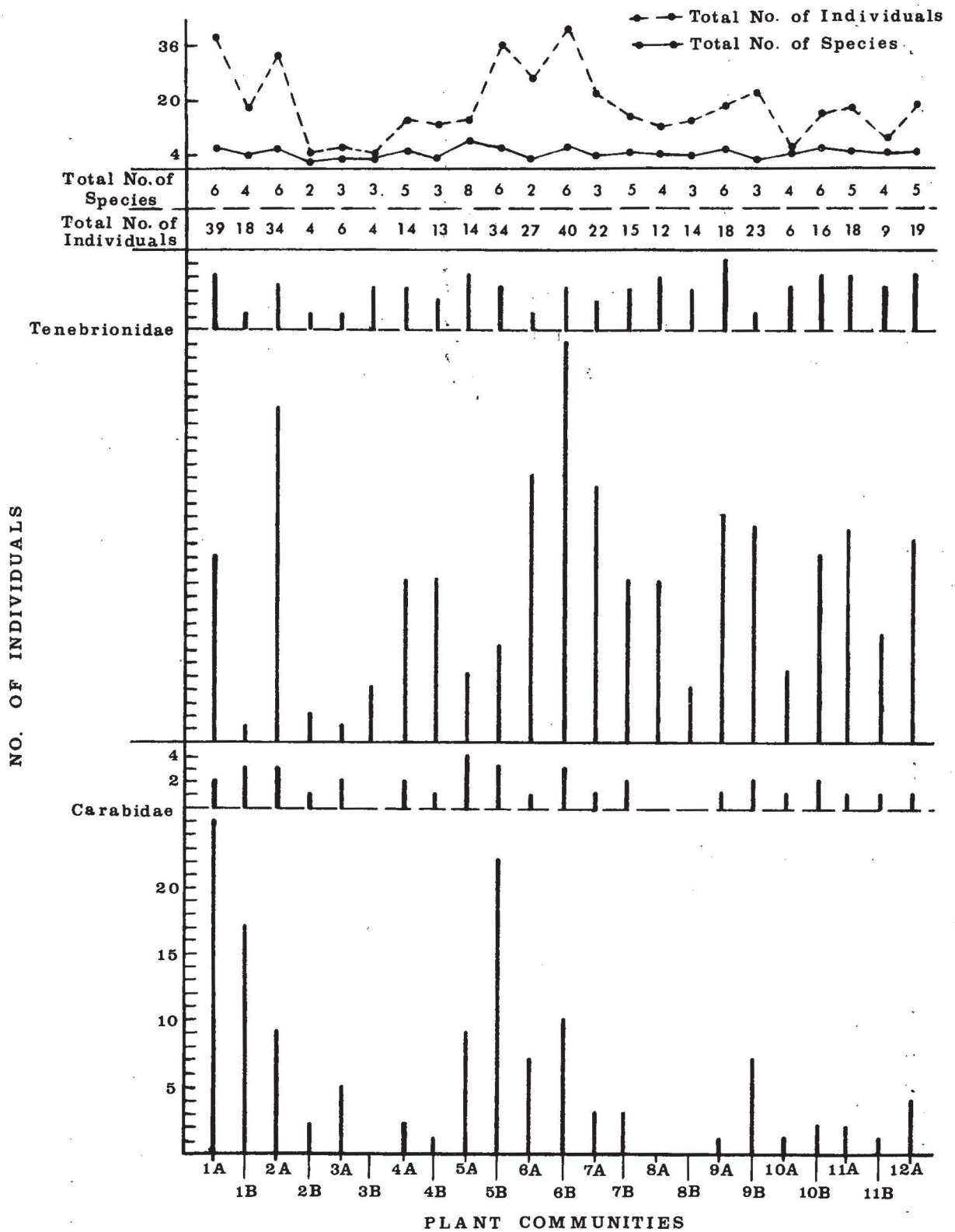

Fig. 3. Relative population, probable species numbers, and relative densities of the two largest coleopteran families at each collecting station. For each family, bars above dashed line refer to species numbers; bars below dashed line refer to individual numbers within families.

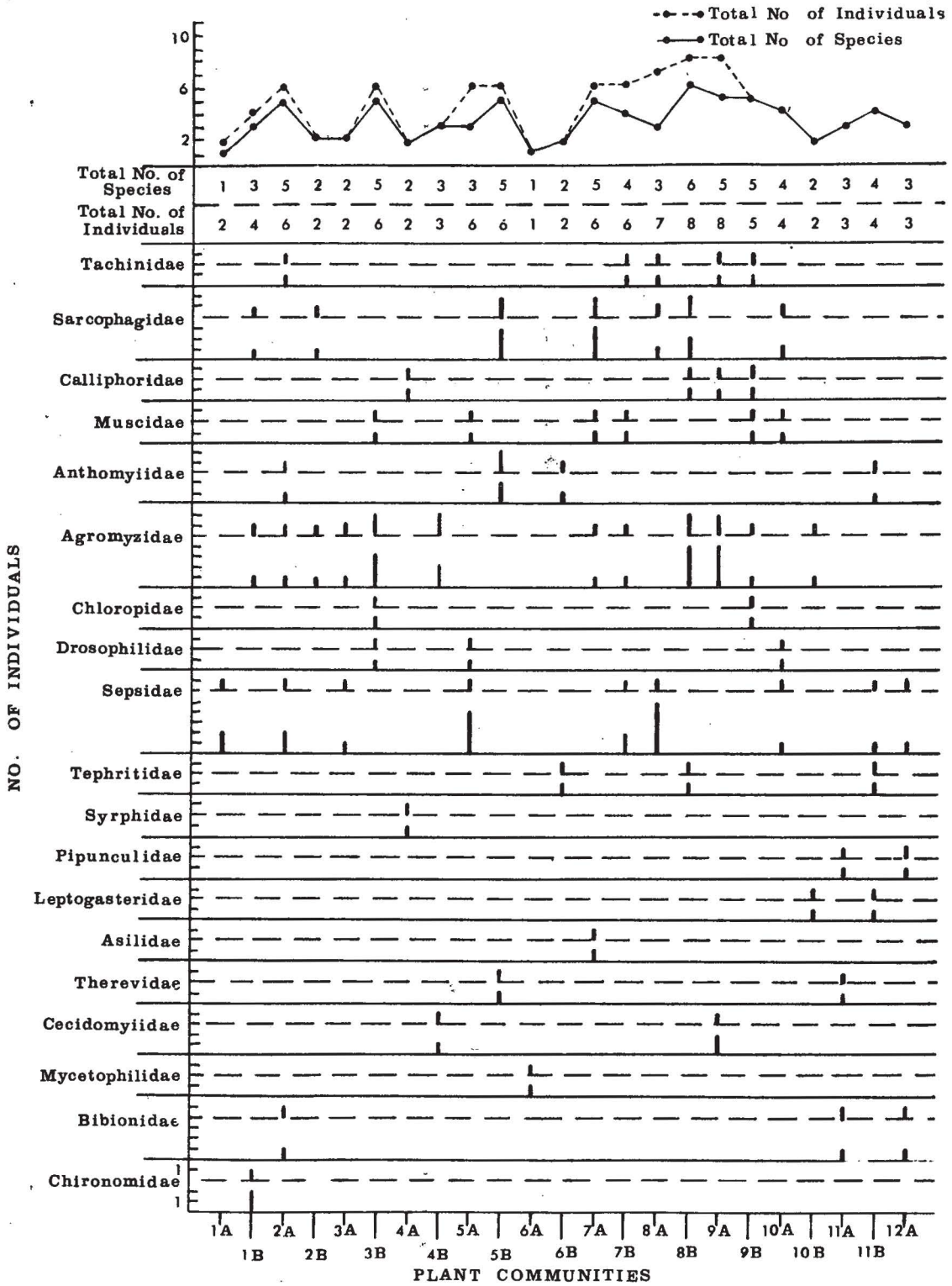

Fig. 4. Relative population, probable species numbers, and relative densities of the families of Diptera located at each collecting station. For each family, bars above dashed line refer to species numbers; bars below dashed line refer to individual numbers within families.

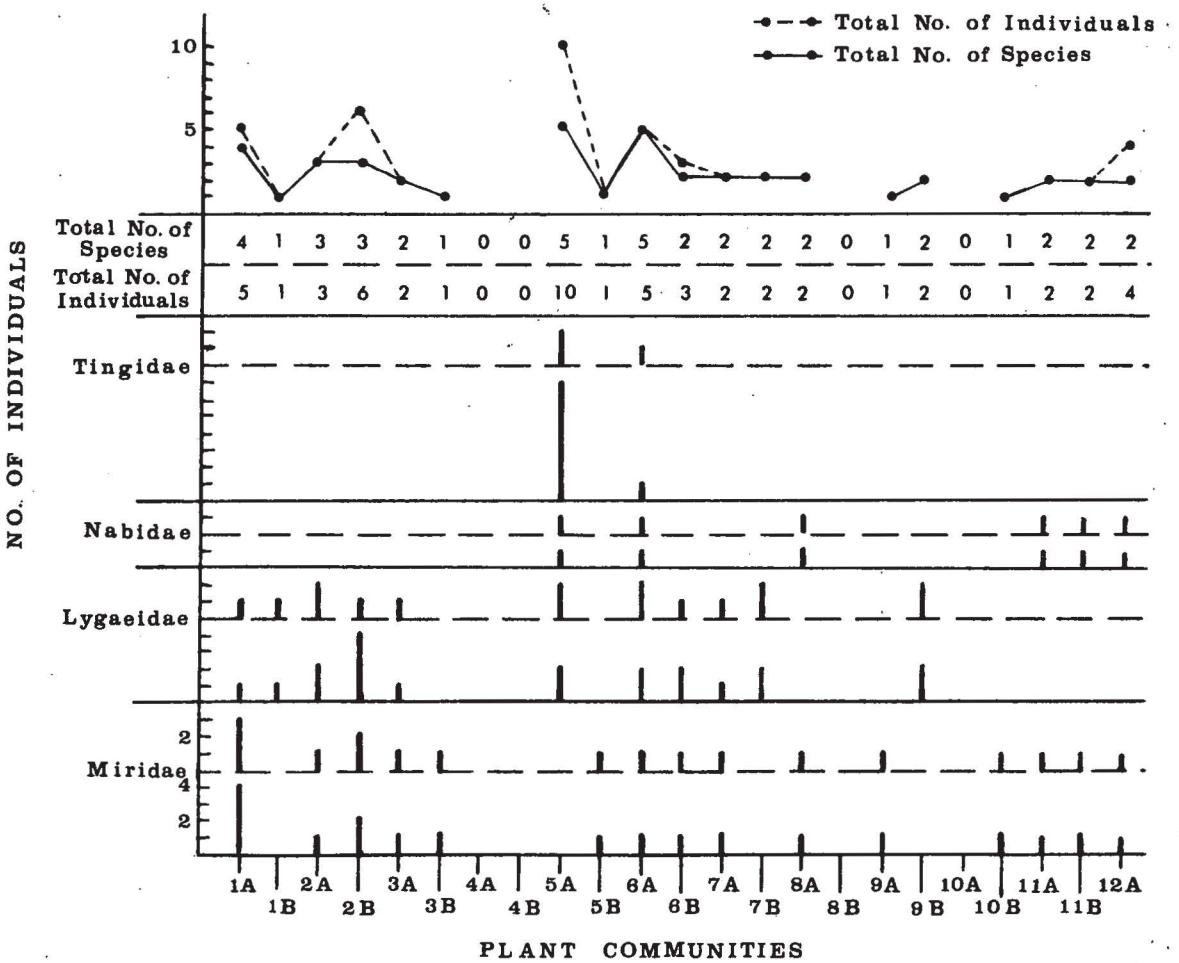

Fig. 5. Relative population, probable species numbers, and relative densities of the families of Hemiptera located at each collecting station. For each family, bars above dashed line refer to species numbers; bars below dashed line refer to individual numbers within families.

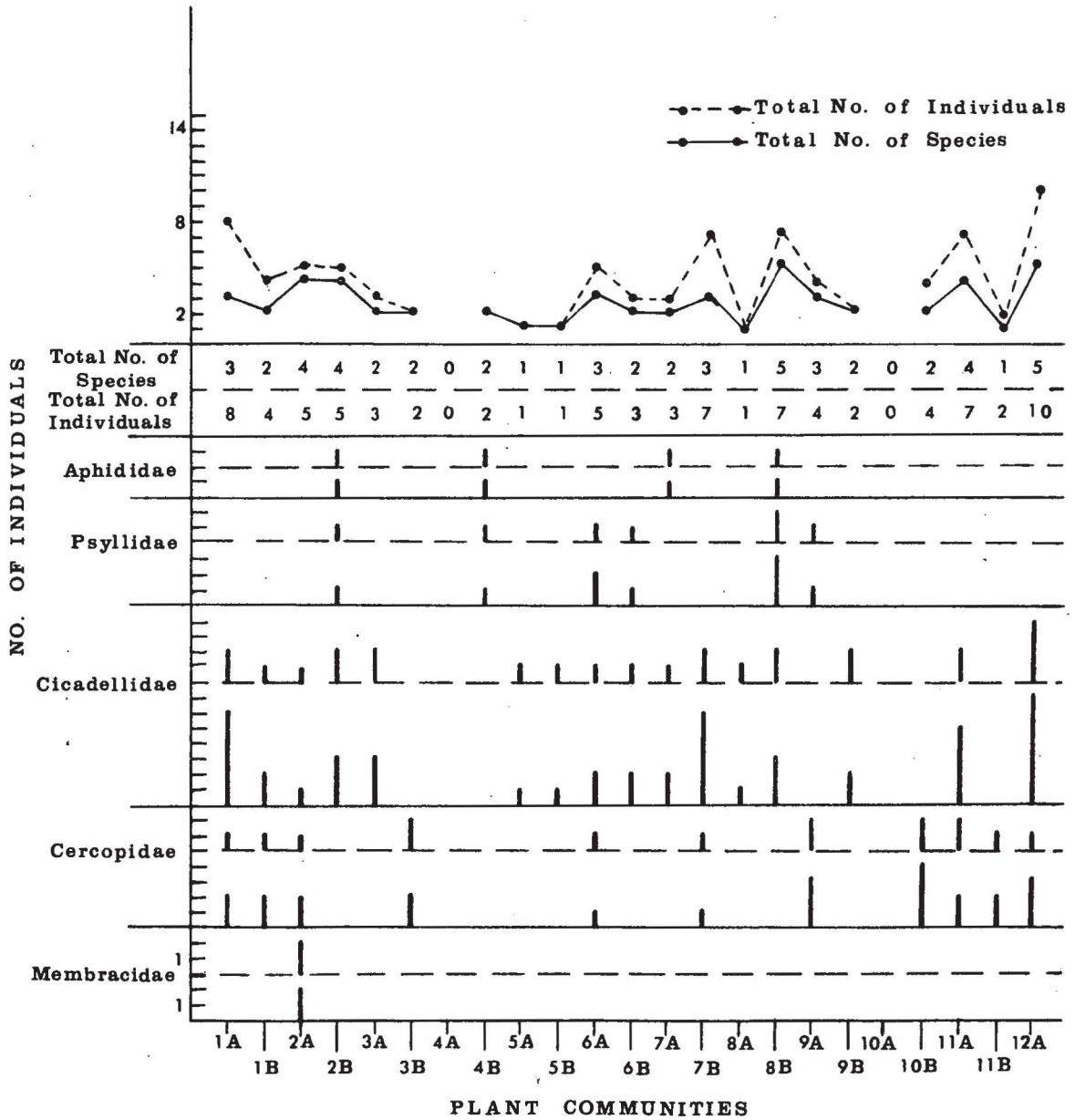

Fig. 6. Relative population, probable species numbers, and relative densities of the families of Homoptera located at each collecting station. For each family, bars above dashed line refer to species numbers; bars below dashed line refer to individual numbers within families.

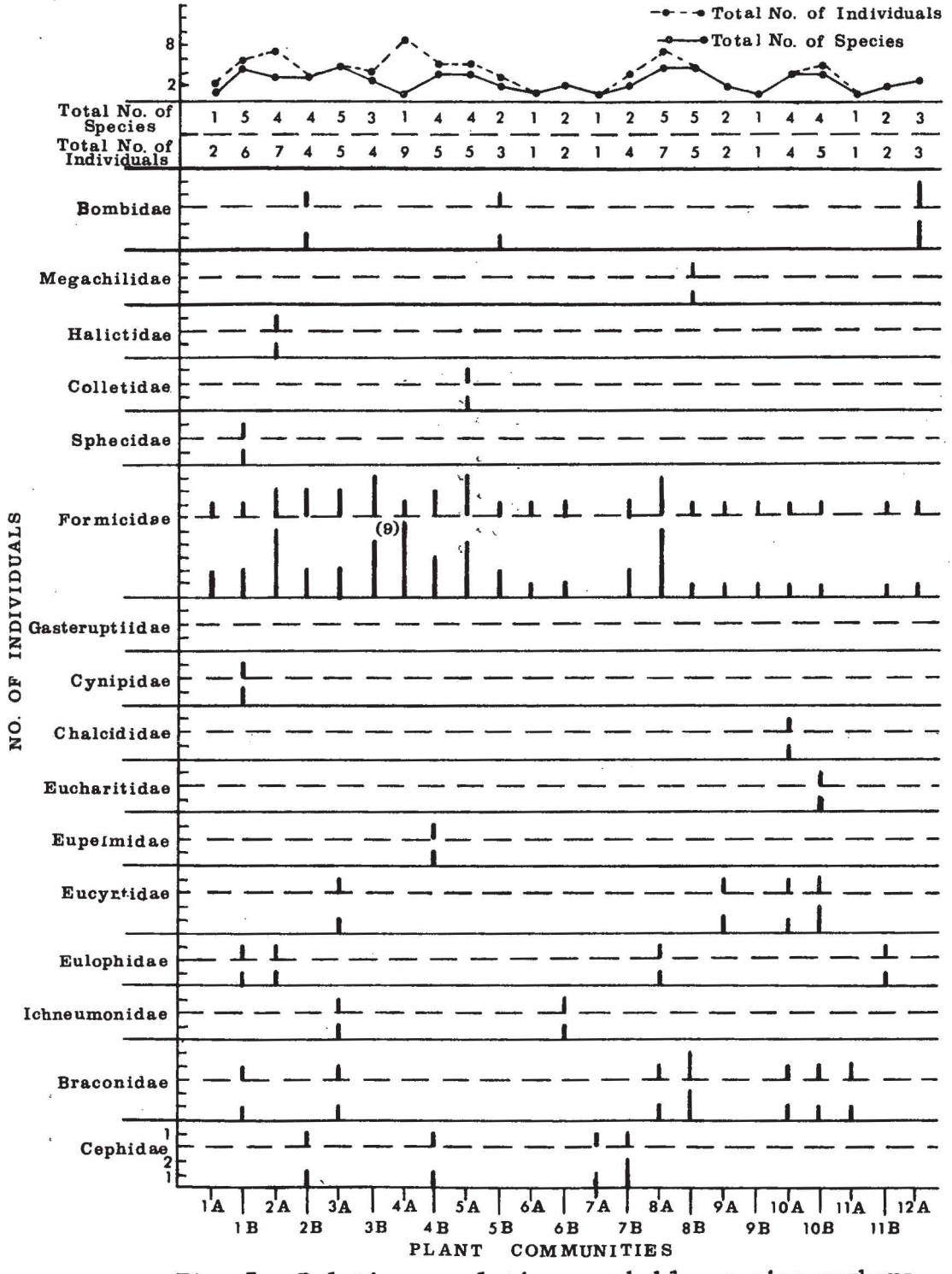

Fig. 7. Relative population, probable species numbers, and relative densities of the families of Hymenoptera located at each collecting station. For each family, bars above dashed line refer to species numbers; bars below dashed line refer to individual numbers within families.

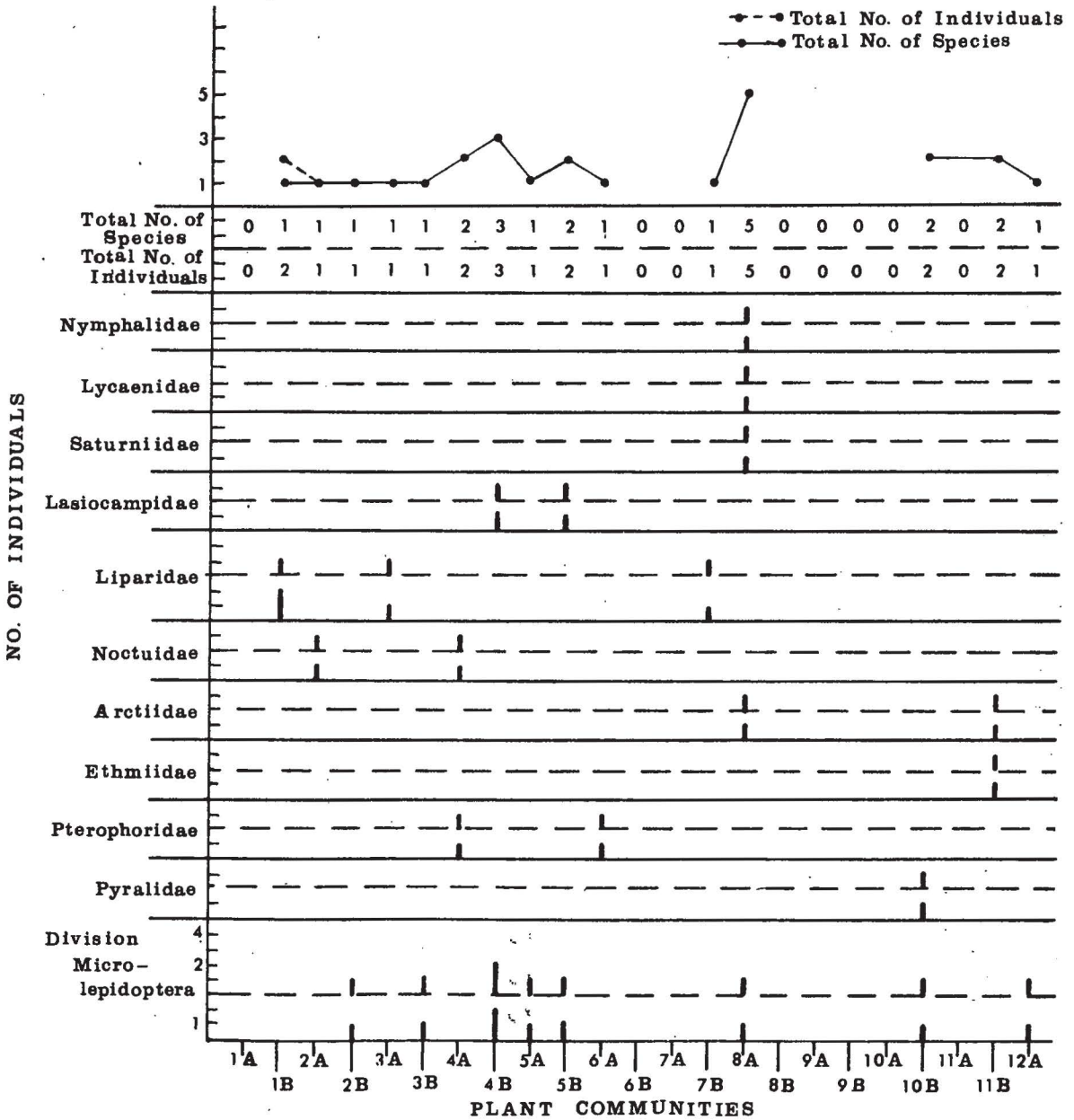

Fig. 8. Relative population, probable species numbers, and relative densities of the families of Lepidoptera located at each collecting station. For each family, bars above dashed line refer to species numbers; bars below dashed line refer to individual numbers within families.

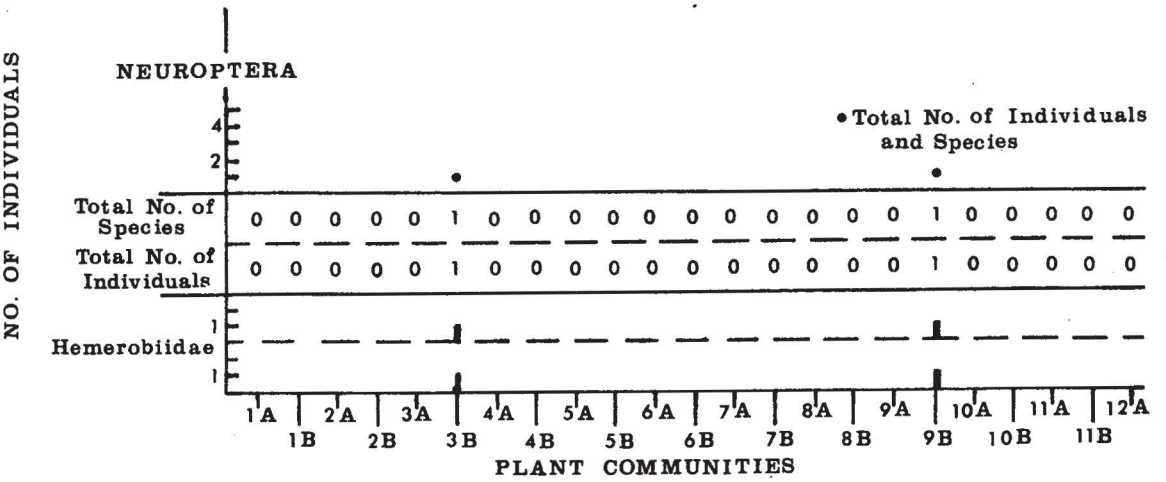

Fig. 9. Relative population, probable species numbers, and relative density of one neuropteran family at each collecting station. Bars above dashed line refer to species numbers; bars below dashed line refer to relative densities of individual numbers within families.

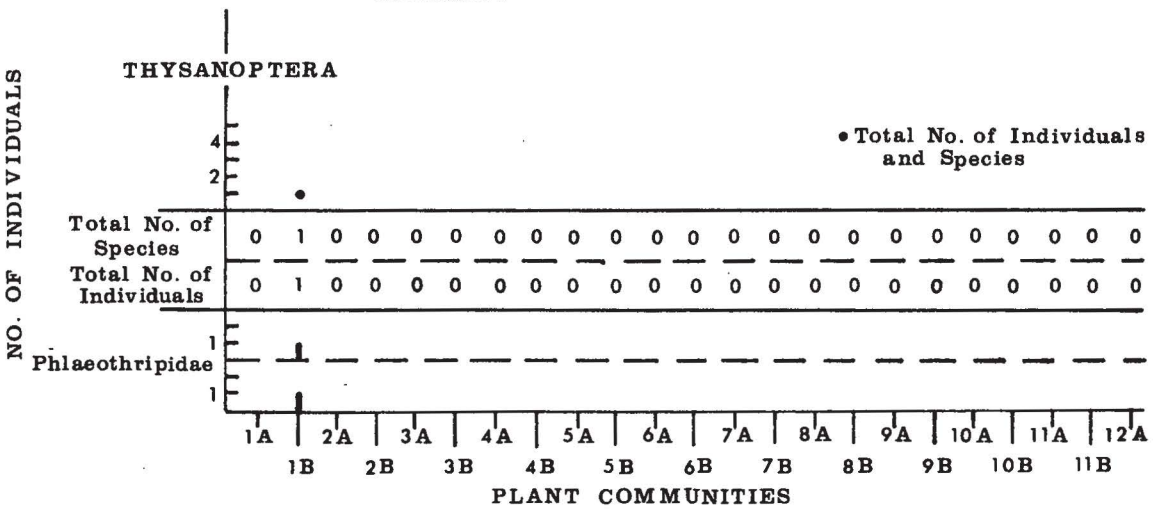

Fig. 10. Relative population, probable species numbers, and relative density of one thysanopteran family at each collecting station. Bars above dashed line refer to species numbers; bars below dashed line refer to relative densities of individual numbers within families.

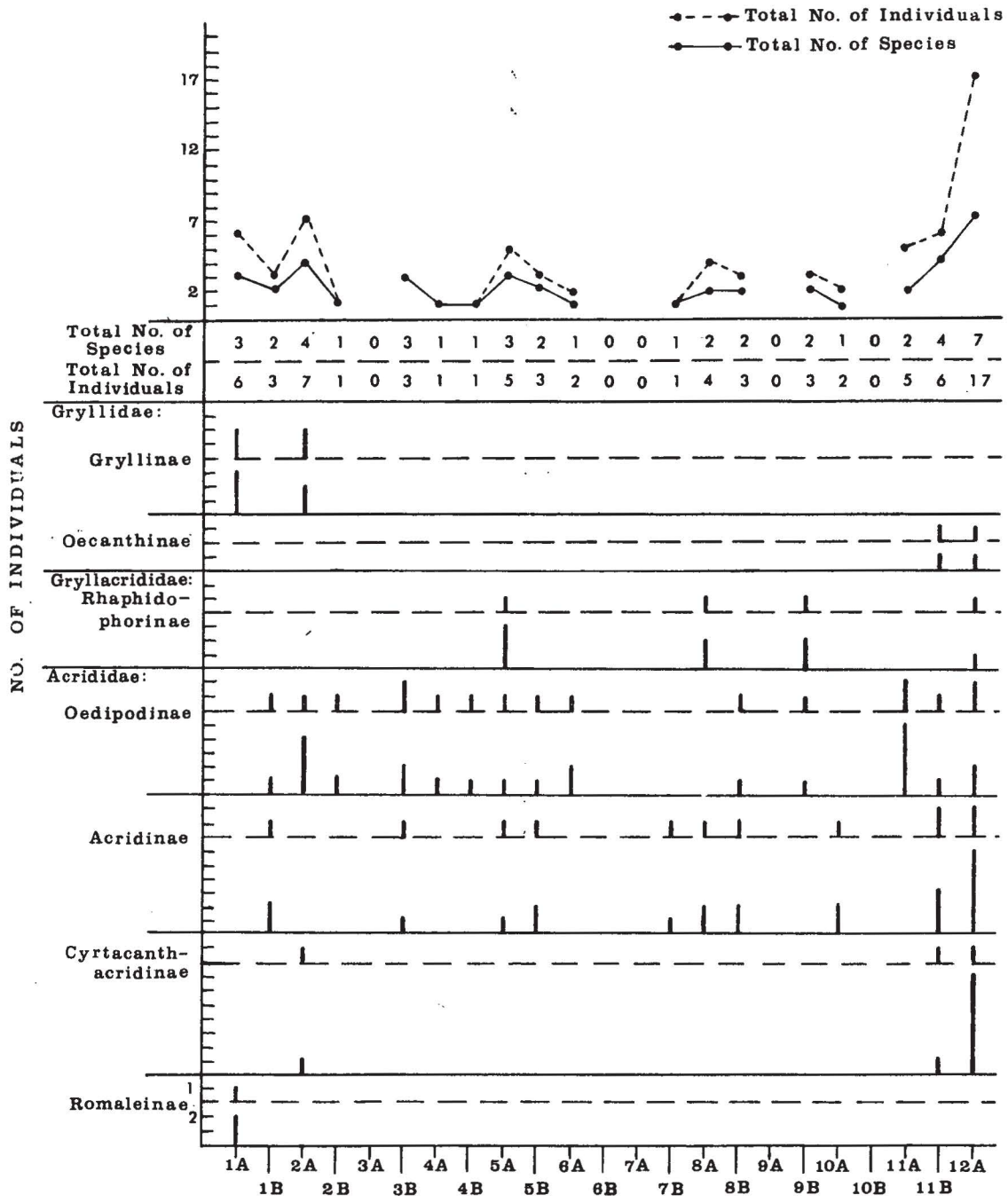

Fig. 11. Relative population, probable species numbers, and relative densities of the orthopteran subfamilies at each collecting station. For each family, bars above dashed line refer to species numbers; bars below dashed line refer to relative densities of individuals within families.

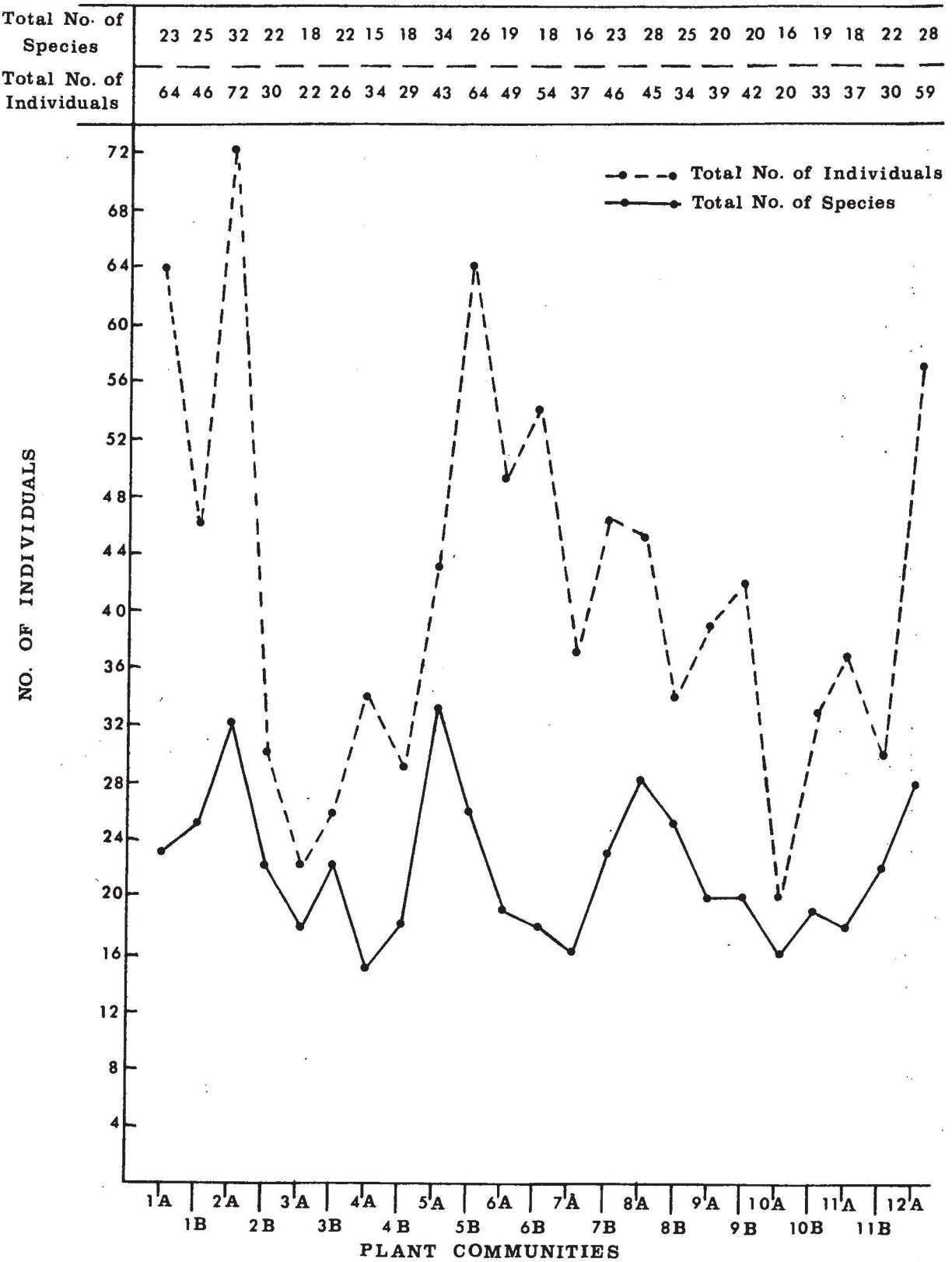

Fig. 12. A demographic representation of total individual and probable species numbers at each collecting station.

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