A TAXONOMIC AND DISTRIBUTIONAL STUDY OF THE ADULT CADDISFLIES OF THE FAMILY LEPTOCERIDAE (INSECTA: TRICHOPTERA) OF WEST VIRGINIA

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ABSTRACT

A survey of the adult Leptoceridae of West Virginia revealed 27 species, 25 of which were state records. The most abundant genus in the state was Ceraclea which had ten different species. Triaenodes had six different species, while Oecetis had five. The most common species in the state included C. cancellatus, C. maculata, O. avara, and O. inconspicua. Species that were abundant only in the larger rivers of the western portion of the state included C. flava, C. maculata, Nectopsyche pavida, and T. ignita. C. neffi seemed to be most abundant in the higher elevations of the east. Ceraclea ophioderus, C. slossonae, and C. wetzeli were important range extensions into West Virginia. Many species emerged throughout the summer suggesting multi-cohort populations.

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CHAPTER I

INTRODUCTION

The order Trichoptera is very large and diverse and relatively little research has been conducted on it until recent years. Betten (1934) reported 568 species occurring in North America while Ross (1944) reported 750 species north of the Mexican border. Harris and Laurence (1978) indicated about 1250 species in North America. With new species being described every year, it is clear that more research is needed in this area. The seventh largest insect order is well represented in West Virginia. They comprise most of the adult insects collected in light traps and during the peak of their emergence, traps literally become black by their swarming masses.

Both immature and adult caddisflies are important in several aspects. The larvae are involved in the food chains of most types of freshwater habitats and along with adults are important in the diets of fish and birds (Harris and Laurence, 1978). These insects are also an important tool in the assessment of pollution. Insects have long been used in the detection of pollution (Forbes, 1928). Van Horn (1949), Bartsh and Ingram (1959), and Hynes (1970), along with many others, have documented their use as indicators of water pollution. The knowledge or the availability of keys, descriptions and illustrations are therefore extremely important for any scientist who undertakes any ecological project.

Caddisflies are a very diverse group. The members of the family Leptoceridae are no exception. Species, even within the same genus,

may have wide ecological requirements. This thesis is the first in-depth study of the adult Leptoceridae in West Virginia. The overall objectives of this study were:

1. To provide a complete list of caddisflies in the family Leptoceridae from West Virginia,
2. To report range extensions of leptocerid caddisflies into West Virginia,
3. To write a key to the adult Leptoceridae from West Virginia, and
4. To determine the emergence periods of the leptocerid caddisflies from West Virginia.

CHAPTER II

REVIEW OF THE LITERATURE

Early papers regarding the order Trichoptera dealt mainly with classification and distribution of the various species. Hagen (1861), Walker (1852), Vorhies (1909), and Banks (1895, 1899, 1914) were pioneers in this field and provided illustrations and descriptions used by later workers. They developed the classification which provided the basis for what is used today.

The first major work on Trichoptera was "The Caddis Flies or Trichoptera of New York State" (Betten, 1934). The work was actually written in 1906-1917, but due to delays was not published until 1934. This work provided keys, geographic distributions, notes on morphology, descriptions and illustrations of the various species.

While in Illinois, Ross (1938a,b) published his first major works on caddisflies with descriptions of new species and revisions of nomenclature. This led to his classic work, "The Caddis Flies, or Trichoptera, of Illinois," published in 1944. This study gave descriptions, illustrations, notes on morphology and geographic distribution of 182 species found in Illinois. This work is still considered the trichopterologists' handbook.

Major advances toward the understanding of the immature stages of Trichopteras were made by Wiggins (1977) in his publication "The Larvae of the North American Caddisfly Genera (Trichoptera)." This work made possible the identification to genus of the larvae caddisflies.

The classification of the family Leptoceridae proposed by Ross (1944) remained unchanged until the 1970's. During this time Leptocella was synonymized with the genus Nectopsyche (Flint, 1974) while Morse and Wallace (1976) proposed that Ceraclea, which had been considered a synonym of Athripsades for nearly 100 years, should actually be recognized as a separate genus. Morse (1975) was the second to do an in depth study of a single genus in the family Leptoceridae. After eight years of research and as part of his doctoral dissertation he published "A Phylogeny and Revision of the Caddisfly Genus Ceraclea (Trichoptera, Leptoceridae)." In this work keys and descriptions and illustrations are provided for the 89 worldwide species of the genus Ceraclea.

Yamamoto and Wiggins (1964) compared three species in the genus Mystacides. They provided keys to the larvae, pupae, and adults while also discussing the ecology of the species. Haddock (1977) described 12 North American species in the genus Nectopsyche. Holzenthal (1982) reviewed the taxonomy of the six recognized North American species in the genus Setodes. In addition, two new species were described and illustrated.

In the 1970's Vincent Resh emerged as one of the chief authorities of leptocerid caddisflies. In 1975 he published a study on the distribution of Kentucky caddisflies, naming the families Hydropsychidae, Hydroptilidae, and Leptoceridae as the most abundant. Resh (1976a) also provided a larval key for 23 species in the genus Ceraclea, the first since Ross (1944), and described seven larval species in the genus. Resh (1976b, 1977) provided an in-depth discussion of the life histories of Ceraclea transverse and Ceraclea ancylus. Tozer and workers (1981)

published an ecological study of Nectopsyche albida which was the first in-depth behavioral study on a species in this genus. Richardson (1986) studied the phenology on nine species of caddisflies (seven of which were leptocerids) in a boreal stream in Canada.

Many distributional studies have been made on caddisflies for individual eastern states. Parker and Voshell (1981) provided a list of Trichoptera from Virginia, while Masteller and Flint (1979) provided records from Ohio and Pennsylvania. Tarter (1976) wrote a key to the larvae of Trichoptera in West Virginia. Applin (1976), Hill (1978), Nugen (1981) and Phillips (1982) conducted taxonomic and distribution research on Rhyacaphilidae (larvae), Limnophilidae (adults), Hydropsyche/Symphitopsyche (larvae), and Hydropsychidae (adults), respectively, in West Virginia. Only two records of species of West Virginia leptocerids have been published (Ross, 1944; Haddock, 1977).

CHAPTER III

MORPHOLOGY AND PHENOLOGY

Morphology

The caddisfly larva is quite unusual. It is generally contained within a case constructed of sand grains, gravel, small pieces of leaves, grass, detritus, or twigs. The head and thorax are often heavily sclerotized while the abdomen is generally soft and lightly colored. The antennae are relatively small and most larvae have chewing mouthparts. There are three thoracic segments which are never fused. The shortest and stoutest legs located on the prothorax are usually used for case building rather than for mobility. The legs generally consist of five segments. In most trichopterans there are three tubercles located on the first abdominal segment and these maintain a space between body and case. Posteriorly, there are a pair of small or large prolegs containing hooks which anchor the larvae to the substrate. Most larvae have abdominal tracheal gills. Leptocerid larvae range in length from 7 to 15 mm. The antennae are six to eight times as long as wide for the leptocerids. The cases of caddisfly larvae are composed of a variety of materials, and this is true for the different genera of leptocerids. Each genus has a specific case type and many are unique. In Ceraclea the case is often composed of silk with a fresh water sponge incorporated within it (Resh, 1976b), while Leptocerus americanus' case is always made entirely of secretions. Other species build cases made of a variety of materials (Fig. 1).

The adult caddisfly is much different than the larva. It ranges from 5 to 20 mm in length and the typical leptocerid ranges from 7 to 12 mm. The antennae are usually long and threadlike, and even for the Leptoceridae are held directly forward while in flight and at rest (Betten, 1934). In some genera of the family Leptoceridae the antennae are three times as long as the body and are generally longer for the males than females. These extremely long antennae are the key features in distinguishing leptocerids from the other families (Fig. 2). Most of the mouthparts are reduced so that the pair of palpi are easily seen. The maxillary palps of most trichopterans are generally composed of five segments with the fifth segment typically longer than the rest combined, but in the family Leptoceridae the segments are always the same length. This is the second distinguishing family characteristic. There are always two pair of wings present which are covered with setae which may be hairlike or modified into scales and are folded rooflike over the body (Ross, 1944). The membranous wings are simple with a reduced number of crossveins.

The abdomen is composed of 10 segments, the tenth being modified into a small structure located above the genitalia. The wing veination pattern is typically the feature most used in generic diagnosis. The male genitalia is the most commonly used feature in identifying adult males to the specific level. Usually females can only be identified to the genus level. Figures 3 and 4 illustrate a typical male genitalia and wing for a leptocerid caddisfly.

The order Lepidoptera is the most closely related order to the Trichoptera (Ross, 1944).

Phenology

Oviposition occurs by the leptocerid female either releasing an egg mass on the surface of the water or by attaching egg masses to submerged vegetation or stones (Brigham, 1982). For caddisflies in general egg number ranges from 300 to 1,000 per female (Ross, 1944). Some families will lay a string of eggs on submerged stone rather than a mass.

Most species of Leptoceridae appear to have five larval instars (Brigham, 1982). Caddis larvae are mostly omnivorous (Pennak, 1978). Leptocerids are generally classified as grazers - feeding on algae, fungi, detritus, small invertebrates and sometimes fresh water sponges (Resh, 1976b). Some leptocerids such as Oecetis, however, are predators (Ross, 1944).

Just prior to pupating, the larva may shorten its case while some leptocerids overwinter as prepupae, with the final instar larva inside the pupal case. None appear to overwinter as pupae. When pupation is complete, the pupae will break from their case, swim to the surface and shed their skin. The adults will emerge on stones or bridges and dry their wings.

While most leptocerids are nocturnal, some are diurnal. Yamamoto and Wiggins (1964) noted that Mystacides adults are rarely taken in light traps since they are daytime flyers. Haddock (1977) found that some species have peaks of activity at dusk and dawn. Adults of Ceraclea and Oecetis are among the first to appear in early-evening light trap collections (Resh, 1976b). In the genus Ceraclea the flight of the males often precedes that of the females.

Most authors believe leptocerids to have a one-year life cycle, while some believe them to be multi-cohort population. Ross (1944) indicated numerous species likely exhibit multi-cohort populations. Resh (1976) described the life cycles of Ceraclea species and found that Ceraclea ancylus exhibited a single cohort population while Ceraclea transversa appeared to have two distinct cohorts. Marshall (1939) found Oecetis inconspicua to have an extended flight period possibly indicating a multi-cohort population.

The adult mouthparts are adapted only for liquid foods. Adults normally live one or two months and probably all species live at least one month (Ross, 1944).

CHAPTER IV

MATERIALS AND METHODS

In order to provide the most complete list of caddisflies in the family Leptocerid from West Virginia, records and/or specimens were obtained from the following sources: 1) literature records, 2) West Virginia Department of Agriculture (WVDA), 3) U. S. Army Corps of Engineers (USACE), 4) West Virginia Benthological Survey (WVBS), 5) Ross' personal collections, and 6) individual collection efforts.

A review of the literature provided very few records of Leptocerid caddisflies from West Virginia. Specimens from the WVDA, the USACE and the WVBS contributed equally to the final collection. In addition to the collecting stations established by the above sources, seven additional stations were personally sampled approximately every two weeks from May to October 1987 (Fig. 5). The seven stations included the following:

1. Durbin - Greenbrier River,
2. Fort Gay - Big Sandy River,
3. Hinton - New River,
4. Seneca Rocks - North Fork of the South Branch of the Potomac River,
5. Spruce Knob - Spruce Knob Lake,
6. Summersville - Summersville Lake, and
7. Sutton - Sutton Lake.

Since one of the objectives of this study was to determine the relationship between elevation and adult phenology, sites were selected that provided differing elevational ranges. Additional criteria for sample site selection included drainage basin locality, county locality and accessability to the stream or lake.

Although the collection method is not known for all sources, such as literature records, the West Virginia Department of Agriculture generally collected with a Malaise trap. Personal collections were made with a Ward's ultraviolet light trap operated on power pack batteries. The trap was filled approximately 5 cm deep with 70 percent ethanol and placed near the stream or lake. Insects of many kinds were attracted to the light, flew into the panels, fell into the trap, and were killed in the ethanol. The insects were then placed into glass vials, labelled and brought back to the laboratory for identification.

The leptocerids were picked from the vials and transferred to other vials containing 70 percent ethanol. The male leptocerids were identified to the specific level using keys by Ross (1944) and Morse (1975).

The male genitalia is the character most often used for identification to the specific level and females could generally be identified only to the generic level. Confirmations of identifications were made by Dr. Oliver S. Flint, Jr., United States National Museum.

CHAPTER V

DESCRIPTION OF STUDY AREA

West Virginia, known as the "Mountain State," lies between 37 12' 7.8" and 40 38' 17.1" north latitude, and between 77 43' 11.2" and 82 38' 48.3" west longitude (Price et al., 1937). Pennsylvania, Maryland, and Ohio are bordering states to the north, while Kentucky and Virginia are the southern bordering states. With an average elevation of 457 meters above sea level, West Virginia has the highest average elevation of any state east of the Mississippi (Janssen, 1973). The highest point in West Virginia is Spruce Knob in Pendleton County where the summit is 1481 meters. Harpers Ferry, in Jefferson County, is the lowest point with an elevation of only 75 meters. In the winter the average temperature is .56°C; in the spring it is 11°C; in the summer it is 21°C; and in the autumn it is 12°C (Core, 1966). The coldest part of the state is the Cheat River basin, while the Tug Fork basin is the warmest. The average precipitation in West Virginia is quite variable. The western part of the state averages below 116.84 cm per year while the highlands may have above 142.24 cm.

West Virginia is known for its rough and rugged surface (Janssen, 1973). Geologically, the surface of the state is described as a plateau that has been cut up by the erosive action of streams and rivers into its present pattern of ranges, hills, and valleys. The manner in which the plateau was carved accounts for the large variation of

scenery in the state. The Appalachian Mountains, which have long parallel ranges with nearly level skyline summits, lie to the east. To the west there is a region of rounded hilltops and wider valleys. The eastern part of the state has a trellised drainage system with steeply flowing mountain streams running into the larger rivers at nearly right angles. The western section's drainage system is referred to as dendritic with the tributaries entering the main rivers at less than right angles.

Janssen (1973) divided the state into seven major drainage systems (Fig. 6). Each drainage system is named for the major river that drains that area. Area 1 is the Ohio River drainage system. It consists of the Northern Panhandle and part of the western section of the state. The Ohio River is characterized by considerable industrialization along its banks, which presents a pollution problem regarding water quality. Farming also occurs along its floodplains which could also contribute to the poor water quality.

Area 2 is the Monongahela drainage system that drains the northeastern part of the state south of the Mason-Dixon line. Major rivers of this area include Cheat River, Monongahela River, Tygart River, and West Fork River. Streams in this area are fast flowing and generally unpolluted. The Monongahela National Forest protects much of this area from pollution.

Area 3 is the Potomac River drainage basin. This area consists of the Eastern Panhandle of the state. Major rivers include Cacapon, Lost, Potomac (North and South Branches), and Shennandoah. Streams in this area are clean, cold, and swift. Although there are many farms in

this area, the streams and rivers remain relatively unpolluted and this is a prized area for trout fishermen.

Area 4 is the Little Kanawha River drainage system. This section is located in the north central part of the state and the Little Kanawha River drains the area as it empties into the Ohio River to the west. Like Area 3, this is primarily a farming area and the streams are relatively unpolluted.

Area 5 is the Kanawha River drainage system which is the largest in the state. It extends as far east as Pocahontas County and as far south as Mercer County. Streams in this area flow west toward the Kanawha River, which empties into the Ohio. Major rivers include Bluestone, Coal, Elk, Gauley, Greenbrier, Kanawha, and New River. This is an area which is highly industrialized. Chemical plants are numerous along the Kanawha River and dumping of waste causes a serious pollution problem in this area. Coal mining is also a major industry in this area and acid mine drainage often causes fish kills.

Area 6 is the Guyandotte River drainage system. It is located in the southwestern portion of the state. Like most of southern West Virginia, coal mining is the major industry and acid mine water drainage is of major importance to the quality of the water.

Area 7 is the Big Sandy River drainage basin. It is the southern-most section of the state and runs westward toward the Ohio River. Again, this area has many coal mines which causes poor water quality in the streams.

The variation in elevation, temperature, and precipitation leads to a large variety of plants and vegetation. Strausbaugh and Core

(1979) divided the state into three sections in regard to the types of vegetation (Fig. 7). They include the Western Hill Section (Central Hardwood Forest), the Allegheny Mountain and Upland Section (Northern Forest), and the Eastern Ridge and Valley Section (Oak-Pine Forest).

The Central Hardwood Forest is difficult to define because of the variety of plants found in this area. However, it can generally be classified as Oak-Pine and Oak-Chestnut communities (xeric), Cove Hardwoods or Mixed Mesophytic Forest (mesic), and Flood Plain communities (hydric). These three sections contain blackjack oak (Quercus marilandria), scarlet oak (Q. coccinea), black oak (Q. velutina), chestnut oak (Q. prinus), and red oak (Q. rubra). Pines include pitch pine (Pinus rigida), table mountain pine (P. pungens), and scrub pine (P. virginiana). Also dominant in this area are redbud (Cercis canadensis), black locust (Robinia pseudoacacia), sassafras (Sassafras albidum), dogwood (Cornus florida), and a wide variety of maple (Acer spp.), hickory (Carya) and elm (Ulmus). In the flood plains, black willow (Salix nigra), sycamore (Platanus occidentalis), and silver maple (Acer saccharinum) are the major trees.

The Northern Forest consists of the Northern Evergreen Forest and the Northern Hardwoods. In the higher elevations red spruce (Picea rubens) is the major representative of the Evergreen Forest. The Northern Hardwoods consist mainly of sugar maple (Acer saccharum), beech (Fagus grandifolia), and yellow birch (Betula alleghaniensis).

Finally, the Ridge and Valley province could be referred to as Oak-Hickory-Pine, although chestnut was once the dominant species before the blight.

CHAPTER VI

RESULTS AND DISCUSSION

The family Leptoceridae in West Virginia consists of 27 species and seven genera. A checklist of the leptocerids in West Virginia represents a systematic listing of the species (Table 1). Many species not included in this list have been reported from surrounding states and are likely to be found in West Virginia with more extensive collecting.

The following generic and specific keys and illustrations have been adapted from Betten (1934), Haddock (1977), Holzenthal (1982), Morris (1975), Ross (1944, 1965), Yamamoto and Wiggins (1964), and personal sketches and observations of West Virginia material.

KEY TO THE GENERA OF CADDISFLIES IN THE FAMILY LEPTOCERIDAE:

1. Front wings with stem of M atrophied, leaving only two main veins between convex R1 and convex Cu1 (Fig. 8).....Triaenodes

   Front wings with stem of M present, so that three main veins are present between convex R1 and convex Cu1.....2

2. Veins of the fore wings markedly straight and nearly parallel. M vein not branched (Fig. 9).....Oecetis

   Veins of the fore wings not markedly straight and parallel. M vein obviously branched (Fig. 10).....3

3. Epicranial stem distinct (Figs. 11, 12).....4

   Epicranial stem absent or indistinct (Fig. 13).....5

4. Dorsal triangle of head large, epicranial stem short (Fig. 11). Color very dark brown or bluish-black.....Mystacides

   Dorsal triangle of head small, epicranial stem long (Fig. 12). Color not at all bluish-black.....Setodes

Table 1. Checklist of the Family Leptoceridae in West Virginia.

Phylum Arthropoda
Subphylum Mandibulata
Class Insecta
Subclass Pterygota
Division Exopterygota
Order Trichoptera
Family Leptoceridae
Subfamily Leptocerinae

Genus *Ceraclea*
- *C. cancellata* (Betten)
- *C. diluta* (Hagen)
- *C. flava* (Banks)
- *C. maculata* (Banks)
- *C. neffi* (Resh)
- *C. ophioderus* (Ross)
- *C. slossonae* (Banks)
- *C. tarsipunctata* (Vorhies)
- *C. transversa* (Hagen)
- *C. wetzeli* (Ross)

Genus *Leptocerus*
- *L. americanus* (Banks)

Genus *Mystacides*
- *M. sepulchralis* (Walker)

Genus *Nectopsyche*
- *N. candida* (Hagen)
- *N. exquisita* (Walker)
- *N. pavida* (Hagen)

Genus *Oecetis*
- *O. avara* (Banks)
- *O. cinerascens* (Hagen)
- *O. inconspicua* (Walker)
- *O. nocturna* (Ross)
- *O. persimilis* (Banks)

Table 1. Completed.

Genus *Setodes*	
	S. incerta (Walker)
Genus *Triaenodes*	
	T. flavescens (Banks)
	T. ignita (Walker)
	T. injusta (Hagen)
	T. marginata (Sibly)
	T. perna (Ross)
	T. tarda (Milne)

5. Hind wings broadest at the base.....Leptocerous

   Hind wings broadest at or near the middle.....6

6. Mesoepimeron almost entirely membranous, transverse sclerotized bridge near apical end not as wide as membranous area posterior to bridge (Fig. 14). Spurs not 2,2,2.....Nectopsyche

   Mesoepimeron with a wide sclerotized bridge between membranous area and ventral margin (Fig. 15). Spurs 2,2,2.....Ceraclea

Ceraclea, the largest North American leptocerid genus, is also the most abundant genus in West Virginia. Ten species have been collected so far in the state and judging by records from surrounding states several others should be collected in years to come. Worldwide there are 89 species known, with 34 of these occurring in North America (Morse, 1975). The adults of this genus are usually brown or black with wide hind wings. The following is a key to the adult male caddisflies in the genus Ceraclea occurring in West Virginia.

SPECIES KEY TO THE CERACLEA MALES:

1. Claspers with a basal projection nearly as long as height of clasper (Figs. 16 and 17).....2

   Claspers with a relatively short basal projection or none at all.....3

2. Basal projection of claspers evenly rounded (Fig. 17).....neffi

   Basal projection of clasper appearing straight and parallel ventrally the spurs mesally angled (Fig. 18).....flava

3. Tenth tergite longer than cerci and somewhat hooded, and with a pair of long, sclerotized arms arising at its base and reaching almost midway to apex (Fig. 15).....tarsipunctata

   Tenth tergite either no longer than cerci or without such a pair of arms.....4

4. Claspers with apical segment bent at right angles to basal segment (Fig. 19).....transversa

   Claspers with apical segment at most slightly angled from basal segment.....5

5. Claspers with basal segment long and slender (Figs. 20 and 21)...6

   Claspers with a relatively basal segment.....7

6. Ventral margin of base of clasper produced into a pointed lobe, aedeagus with two parallel spines (Fig. 20).....wetzeli

   Ventral margin of base not produced into a distinct lobe, spines of aedeagus at right angles (Fig. 21).....diluta

7. Tenth tergite much longer than wide with long neck (Figs. 22 and 23).....8

   Tenth tergite nearly as wide as long, shaped somewhat like a cleaver (Figs. 24 and 25).....9

8. Tenth tergite with a somewhat hood-shaped head (Fig. 22).....
   .....ophioderus

   Tenth tergite slightly longer and without hood-shaped head (Fig. 23).....slossonae

9. Base of claspers with ventral margin produced into a lobe (Fig. 24).....maculata

   Base of claspers with ventral margin rounded (Fig. 25).....
   .....cancellatus

Of the 12 United States species in the genus Nectopsyche, there are three species located in West Virginia. This genus has the largest members in the family, some reaching the length of 18 mm. The adults are white with distinctive wing patterns and can be readily identified in the field. The following is a key to the adult male caddisflies in the genus Nectopsyche.

SPECIES KEY TO NECTOPSYCHE MALES:

1. Apex of ninth sternite produced into a spoon-shaped lobe situated beneath aedeagus (Fig. 26).....pavida

   Apex of ninth sternite without such a structure.....2

2. Claspers almost as long as tenth tergite, tenth tergite with a pair of long processes, wings with transverse yellowish bars in membrane (Fig. 27).....exquisita

Claspers much smaller than tenth tergite, without such long processes on ninth sternite (Fig. 28).....candida

There are about 20 species of Oecetis in the United States, five have been identified in West Virginia. Members of this genus are often quite numerous and along with Ceraclea are the most abundant leptocerids collected. The adults are usually a straw or light brown color with wings that run parallel from apex to base. The following is a key to the adult male caddisflies in the genus Oecetis.

SPECIES KEY TO THE OECETIS MALES:

1. Claspers somewhat kidney-shaped, almost transparent, forewings with numerous brown spots (Fig. 29).....avara

   Claspers elongate, longer than high, forewings without spotting.....2

2. Apical finger of claspers diverging, abdomen with none of the tergites reticulate, aedeagus circular (Fig. 30).....inconspicua

   Apical finger of claspers converging at apex, some abdominal tergites may be reticulate.....3

3. Tenth tergite twice as long as cerci, tergite heavily reticulate (Fig. 31).....persimilis

   Tenth tergite at most slightly longer than cerci.....4

4. Tenth tergite about as long as cerci, some tergites lightly reticulate, aedeagus robust, not at all circular (Fig. 32).....cinerascens

   Tenth tergite slightly longer than cerci, no tergites reticulate, aedeagus somewhat circular (Fig. 33).....nocturna

There are about 25 species of Triaenodes found in the United States. So far six species have been collected in West Virginia. Members of this genus are usually straw or light brown in coloration. The veination in the wings is usually weak and hard to detect under a microscope. Although reported to be abundant in many states, all species are quite rare in West Virginia. The following is a key to the adult male caddisflies in the genus Triaenodes.

SPECIES KEY TO TRIAENODES MALES:

1. Claspers with no postero-lateral or mesal projection (Fig. 34).....perna

   Claspers with postero-lateral and mesal projections.....2

2. Tenth tergite forming a long fork, with basal stalk.....3

   Tenth tergite single, appearing as a tail from the dorsal view...4

3. Arms of tenth tergite wide, short and divergent (Fig. 35)..injusta

   Arms of tenth tergite narrow, long parallel and curved to left at tip (Fig. 36).....ignita

4. Tenth tergite long, thin and curved, claspers with mesal projection as long as apex (Fig. 37).....flavescens

   Tenth tergite clavate, apex of claspers much longer than mesal projection.....5

5. Apex of claspers straight, tenth tergite pointed (Fig. 38)...tarda

   Apex of claspers bent mesad at an angle tenth tergite spatulate (Fig. 39).....marginata

Discussion of the Species

The following is a discussion of the 27 species of leptocerid caddisflies found in West Virginia, including the United States distribution, West Virginia distribution, description of the species, and general remarks. Table 2 (Appendix) is a tabular summary of the emergence dates for each species. The code for the various collectors is found in the acknowledgments.

Genus Ceraclea Stephens, 1829

Athripsodes Billberg, 1820:94

Ceraclea cancellata (Betten)

Leptocerus cancellatus Betten, 1934:256
Athripsodes cancellatus (Betten); Ross, 1944:233
Athripsodes improcerus Edwards, 1956:15. NEW SYNONYM
Ceraclea cancellata (Betten); Morse, 1975:30

United States Distribution:

Arkansas, Georgia, Illinois, Indiana, Kentucky, Minnesota, Missouri, New York, Ohio, Pennsylvania, Tennessee, Wisconsin (Ross, 1944), Delaware (Lake, 1984), Massachusetts (Neves, 1979), Michigan (Leonard and Leonard, 1949), New Hampshire (Morse and Blickle, 1953), North and South Carolina (Brigham et al., 1982), Virginia (Parker and Reese, 1981) (Fig. 43).

West Virginia Distribution:

Boone County:	Coal River 07/10/76 CU
Braxton County:	Burnsville Lake 06/22/81 RMM
	Sutton Lake 07/22/79 RFK BCP
	07/15/81 RFK
	06/18/87 JBG
	07/01/87 JBG
Grant County:	North Fork of the South Branch of the Potomac River 07/12/87 JBG
Hancock County:	Newel 07/07/79 JDH
Jackson County:	Ripley 07/09/76 JDH
Jefferson County:	Harpers Ferry 08/22/77 PH BC
	Kearneysville 08/01/77 JDH
	08/22/77 JDH
	Shanandoah Junction 06/23/84 JDH
	07/11/84 JDH
Kanawha County:	Charleston 06/19/78 JDH
	Coal River 06/22/80 BB
	06/29/80 BB
	07/29/80 BB
	09/14/80 BB
	London Locks 07/23/81 RFK
	08/02/81 RFK
	06/23/82 RFK
	Marmet Locks 07/02/81 RFK
Mason County:	Flatfoot Creek 07/13/77
	Gallipolis 07/18/78 RFK
	Ohio River 07/24/75 MH
Monroe County:	Hollywood 08/16/77 JDH
	08/22/77 JDH
Pendleton County:	Seneca Rock 07/12/87 JBG
Pocahontas County:	Durbin 07/12/87 JBG
	Greenbrier River 06/04/80 MSS
	Marlington 06/23/81 RFK
Putnam County:	Hurricane 09/05/77 JDH
Raleigh County:	Beckley 08/15/77 JDH
Summers County:	Hinton 07/10/78 RFK BCP
	07/04/81 GJW
	06/07/87 JBG
	06/18/87 JBG
	07/08/87 JBG
Wayne County:	Dickson Dam 06/14/79 KDB

Description: Length 10-12 mm. Color dark brown with few markings. Male genitalia similar to those of C. maculata, differing chiefly in the basal segment of the claspers, which lack the ventral projection (Ross, 1944).

Remarks: The occurrence of Ceraclea cancellata in West Virginia does not represent an important range extension. It does fill in a missing part to the existing United States distribution. This is the first report of this species from West Virginia. The emergence period extended from June 4 to August 14 which was a fairly lengthy flight period compared to other species in this family. Along with the similar C. maculata, C. cancellata was one of the most frequently collected species. These two species were often collected together and their flight periods were similar. There were 1064 male specimens of C. cancellata collected from 25 locations in West Virginia (Fig. 44).

Ceraclea diluta (Hagen)

Leptocerus dilutus Hagen, 1861:277
Leptocerus recactus Banks, 1914:263. NEW SYNONYM
Athripsodes dilutus (Hagen); Ross, 1944:231
Ceraclea diluta (Hagen); Morse, 1975:40

United States Distribution:

Georgia, Illinois, Indiana, Minnesota, New York, Ohio, and Wisconsin (Ross, 1944), Delaware (Lake, 1984), New Hampshire (Morse and Blickle, 1953), North and South Carolina (Brigham et al., 1982), Pennsylvania (Masssteller and Flint, 1979), Tennessee (Etnier and Schuster, 1979), Virginia (Parker and Voshell, 1981) (Fig. 45).

West Virginia Distribution:

Pocahontas County: Durbin 07/12/87 JBG

Description: Length 6 mm. Color dark brown, the wings with a few patches of light hair. Cerci of male genitalia short, almost completely fused at base with genital capsule; tenth tergite fairly long, divided at apex into a pair of short, rounded lobes; claspers with basal segment

very long, produced into a short ventral projection, apical segment short and elliptic; mesal process short, narrow at base and widened into a spatulate apex; aedeagus with two long, black internal spines situated one behind the other (Ross, 1944) (Fig. 21).

Remarks: Although the occurrence of Ceraclea diluta in West Virginia does not represent an important range extension, it does fill in a portion of the Appalachians that previously had no specimens reported. Not having been reported from Kentucky, this species can be considered rare in this area. Not much can be concluded about its flight periods since only one male specimen was collected. This specimen was collected from the eastern part of the state in the head waters of a small stream in early July (Fig. 46).

Ceraclea flava (Banks)

Leptocerus flavus Banks, 1904:212
Athripsodes flavus (Banks); Ross, 1944:228
Ceraclea flava (Banks); Morse, 1975:44

United States Distribution:

Illinois, Indiana, Kentucky, Minnesota, Pennsylvania, and Wisconsin (Ross, 1944), Delaware (Lake, 1984), Michigan (Leonard and Leonard, 1949), New Hampshire (Morse and Blickle, 1953), North and South Carolina (Brigham et al., 1982), Tennessee (Edwards, 1966), Virginia (Parker and Voshell, 1981) (Fig. 47).

West Virginia Distribution:

Kanawha County:	Charleston 06/08/87 MCT
	06/14/87 MCT
	Guthrie 07/15/87 MCT
	London Locks 07/02/81 RFK
	06/23/82 RFK
Mason County:	Lakin 06/06/87 USDA
Nicholas County:	Summersville 07/23/79 RFK

Description: Length 9 mm. Color various shades of light brown without conspicuous markings or white shades. Male genitalia distinguished by the long basal projection of the clasper, which in this species is sharply angled at the base (Ross, 1944) (Fig. 17).

Remarks: Like many species of leptocerid caddisflies, C. flava has been reported from most of the northeastern states and its occurrence in West Virginia was expected. This species was relatively uncommon with only ten males being collected from five different stations. It is interesting to note that this species was collected almost exclusively from large, warm, rivers such as the Kanawha and the Ohio. The flight periods ranged from June 6 to July 23, but most individuals were captured in early June. On the July 23 date a single male was captured from Summersville Lake where the elevation is higher and the temperature is lower. The short emergence period indicates a single cohort per year which agrees with the findings of Ross (1944) (Fig. 48).

Ceraclea maculata (Banks)

Leptocerus maculatus Banks, 1899:214
Leptocerus inornatus Banks, 1914:263
Athripsodes transversus (Hagen); Ross, 1944:233
Ceraclea maculata (Banks); Morse, 1975:30

United States Distribution:

Arkansas, District of Columbia, Georgia, Illinois, Indiana, Iowa, Kentucky, Minnesota, Missouri, Ohio, Oklahoma, Pennsylvania, Tennessee, Texas, Wisconsin (Ross, 1944), Delaware (Lake, 1984), Massachusetts (Neves, 1979), North Carolina, South Carolina (Brigham et al., 1982), Virginia (Parker and Voshell, 1981) (Fig. 49).

West Virginia Distribution:

Braxton County:	Burnsville Lake 06/22/81 RMM
	Sutton Lake 06/18/87 JBG
Hancock County:	Newel 07/07/79 T
Jackson County:	Ravenswood 06/18/79 T
	Ripley 07/09/76 JDH
Jefferson County:	Harpers Ferry 08/22/77 PH
	Kearneysville 08/01/77 JDH
	08/22/77 JDH
Kanawha County:	Charleston 06/08/87 MCT
	06/14/87 MCT
	Coal River 06/29/80 BB
	Guthrie 07/15/87 MCT
	08/10/87 MCT
	London Locks 06/23/81 RFK
	07/23/81 RFK

	Marmet Locks 08/10/81 RFK
	Winfield Locks 07/03/81 RFK
Mason County:	Flatfoot Creek 06/30/77 BC
	07/13/77 BC
	Lakin 06/08/87 BEH
	Ohio River 07/24/75 MH
Monongalia County:	Triune 09/01/79 Butler
Monroe County:	07/08/87 EB
	Hollywood 08/16/77 JDH
	07/05/78 PH
	Union 06/24/85 JDH
Putnam County:	Hurricane 07/20/77 JDH
	08/02/77 JDH
	09/05/77 JDH
	09/15/77 JDH
Summers County:	Hinton 08/11/80 KDB
	06/18/87 JBG
	07/08/87 JBG
Wayne County:	Dickson Dam 06/28/79 KDB
	Fort Gay 06/24/87 JBG
	07/03/87 JBG
	09/10/87 JBG
	Prichard 07/21/87 RFK

Description: Length 10 mm. Color varying from bright reddish brown to lighter or darker shades of brown. Cerci of male genitalia, fairly long, pointed at apex; tenth tergite with somewhat bulbous base and finger-like apex; claspers with basal segment short, provided with a short, stout ventral projection, apical segment long and straight, mesal process slender and much shorter than apical segment (Ross, 1944) (Fig. 24).

Remarks: Like C. cancellata, this species is one of the most common leptocerid caddisflies. It has been reported from many different eastern states and its presence in West Virginia is not a range extension. It was collected only from lakes and large rivers and was very abundant in the western part of the state. It was not found in the high eastern mountains. It was very abundant in the Ohio and Kanawha Rivers where it occurred in great numbers. Emergence periods extended

from June 8 to September 15. A multi-cohort population, therefore, most likely exists for this species. There were 787 males collected from 24 different stations throughout the state (Fig. 50).

Ceraclea neffi (Resh)

Athripsodes neffi Resh, 1974:269
Ceraclea neffi (Resh); Morse, 1975:45

United States Distribution:

Kentucky (Resh, 1975), Ohio (Huryn and Foote, 1981), Tennessee (Etnier and Schuster, 1979), Virginia (Parker and Voshell, 1981) (Fig. 51).

West Virginia Distribution:

Braxton County:	Little Kanawha River 07/22/79 RFK BCP
	Sutton Lake 07/21/79 LB
	06/18/87 JBG
	07/01/87 JBG
Pendleton County:	North Fork of the South Branch of the Potomac River 07/12/87 JBG
Pocahontas County:	Durbin 07/12/87 JBG
Summers County:	Bluestone 08/81 RMM
	08/26/87 USDA
	Hinton 07/04/81 GJW
	06/07/87 JBG
	07/08/87 JBG
	Pipestem 08/17/87 USDA
	08/19/87 USDA

Description: Similar in many respects to C. ancylus (for description of C. ancylus see Ross, 1944), but differing in that the tenth tergite is narrower in lateral view, with greatest width about 1/3 its length (greatest width about 1/2 in C. ancylus). Ventral aspect of ventral lobes of coxopodites angled posteriorly rather than curved mesad as in C. ancylus. Harpago of C. neffi shorter and broader (Morse, 1975) (Fig. 16).

Remarks: Although Ceraclea neffi has been reported previously from only four other states, its occurrence in West Virginia is not a significant range extension. Being a relatively recently described species and being very similar to C. ancylus, it probably has been misidentified in

many surrounding eastern states. This species is also very similar to C. flava, both having an extremely long basal projection. C. neffi, however, was collected almost exclusively from smaller, cooler, fast-flowing streams compared with C. flava which was found in only the larger, western rivers. Emergence periods extended from June 6 to August 26 which is a much longer flight period than for C. flava. The extended flight period may indicate a dicohort population. One hundred and twenty-one males were collected from seven different locations (Fig. 52).

Ceraclea ophioderus (Ross)

Athripsodes ophioderus Ross, 1938b:157
Ceraclea ophioderus (Ross); Morse, 1975:33

United States Distribution:

Illinois (Ross, 1944), North and South Carolina (Brigham et al., 1982) (Fig. 53).

West Virginia Distribution:

Summers County: Hinton 06/18/87 JBG
08/22/87 JBG

Description: Length 10 mm. Color reddish brown, the wings with a few indistinct whitish spots. Cerci of male genitalia short but pointed at apex; tenth tergite elongate with a small, round, basal portion bearing a short cone of stout setae near apex, the tergite beyond this prolonged into a slender neck bearing a small hoodlike portion at tip; claspers with basal segment large, with an angular ventro-mesal elongation, the apical segment fairly long, the mesal process slender and curved (Ross, 1944) (Fig. 22).

Remarks: Since being described by Ross (1938b) in Illinois, this species has only been described from North and South Carolina. The occurrence of Ceraclea ophioderus in West Virginia, therefore, does represent a

significant range extension. Six males were collected from the New River on two different dates. Five males were collected on June 6 and one male was collected on August 22. This species probably exhibits a multi-cohort population (Fig. 54).

Ceraclea slossonae (Banks)

Athripsodes slossonae Banks, 1938:77
Athripsodes daggyi Denning, 1948c:254; Flint, 1966:382
Ceraclea slossonae (Banks); Morse, 1975:33

United States Distribution:

Florida (Banks, 1938), Virginia (Parker and Voshell, 1981) (Fig. 55).

West Virginia Distribution:

Hampshire County: Romney HHR

Description: Color light brown. Tenth tergite very long. Vestigal extra lateral processes of tenth tergum short, triangular, directed anteriorly or dorsally. Ear-like lateral lobes moderately conspicuous with stout setae. Subanal plate long. Mesal ridge of coxopodite small with scattered setae. Phallobase ventral projection spoon-shaped. Parameters each thick, narrowed apically or sometimes a short distance subapially to acute downcurved terminus (Morse, 1975) (Fig. 23).

Remarks. Although this species has been reported from Virginia its occurrence in West Virginia is still noteworthy since the only other record is one from Florida. Three males were collected from Romney, which is in the Eastern Panhandle of the state. Not much can be said about its flight periods since it was collected on only one date and, like C. ophioderus which it is closely related, is obviously rare (Fig. 56).

Ceraclea tarsipunctata (Vorhies)
Leptocerus tarsi-punctatus Vorhies, 1909:694
Athripsodes tarsi-punctatus (Vorhies); Ross, 1944:229
Ceraclea tarsipunctata (Vorhies); Morse, 1975:37

United States Distribution:
Arkansas, Georgia, Illinois, Indiana, Kentucky, Maine, Michigan, Minnesota, Missouri, New York, Pennsylvania, South Dakota, and Wisconsin (Ross, 1944), Delaware (Lake, 1984), Massachusetts (Neves, 1979), New Hampshire (Morse and Blickle, 1953), Ohio (Petersen and Foote, 1980), Oregon (Anderson, 1976), Tennessee (Edwards, 1966), and Virginia (Parker and Voshell, 1981) (Fig. 57).

West Virginia Distribution:

Braxton County:	Falls Mill 07/22/79 KDB
Jefferson County:	Shanandoah Junction 06/23/84 JDH
Kanawha County:	Charleston 06/08/87 MCT
	06/14/87 MCT
	Coal River 06/22/80 BB
	06/29/80 BB
	Guthrie 07/15/87 MCT
	London Locks 06/23/82 RFK
Summers County:	Hinton 07/10/78 RFK BCP
	07/04/81 GJW
	06/07/87 JBG
Wayne County:	Dickenson Dam 07/08/79 KDB
	Fort Gay 07/03/87 JBG
	Prichard 07/21/87 RFK

Description: Length 11 mm. Color chocolate brown, the base of the tarsi ringed with white. Cerci of male genitalia long, the apex slender; tenth tergite very long, the extreme apex slightly downcurved, a stout sclerotized spur arising from the base and extending three-fourths distance to apex; clasper with a very long basal projection, its apical segment curved, the mesal projection stout and curved (Ross, 1944) (Fig. 18).

Remarks: Having been reported from 19 different states, C. tarsipunctata is one of the most common species of leptocerids known. Its presence in West Virginia is, therefore, not surprising. Although it is fairly common in this state, it was not collected in large numbers as was C. maculata and C. cancellata. This species emerged from June 7 to

July 22 and probably exists as a single generation. With the exception of the New River collections, this species was collected in the lower elevations in large, slow-moving rivers. Fifty-nine males were collected from ten different sites in the state (Fig. 58).

Ceraclea transversa (Hagen)

Leptocerus transversus Hagen, 1861:279
Leptocerus angustus Banks, 1914:263. NEW SYNONYM
Athripsodes angustus (Banks); Ross, 1944:231
Ceraclea transversa (Hagen); Morse, 1975:28

United States Distribution:

Illinois, Maine, Michigan, Minnesota, New York, Ohio, Oklahoma, Pennsylvania, Wisconsin (Ross, 1944), Arkansas (Unzicker et al., 1970), Delaware (Lake, 1984), Kentucky (Resh, 1975), Massachusetts (Neves, 1979), Oregon (Anderson, 1976), New Hampshire (Morse and Blickle, 1953), North Carolina, South Carolina (Brigham et al., 1982), Tennessee (Edwards, 1966), Virginia (Parker and Voshell, 1981) (Fig. 59).

West Virginia Distribution:

Braxton County:	Falls Mill 07/22/79 RFK BCP
Kanawha County:	Coal River 06/29/80 BB
	07/29/80 BB
	09/01/80 BB
	London Locks 07/18/78 RFK
	07/23/81 RFK
Mason County:	Gallipolis Locks 07/18/78 RFK
Monroe County:	Hollywood 08/06/77 JDH
Nicholas County:	Summersville 07/23/79 RFK
Pocahontas County:	Durbin 07/12/87 JBG
Summers County:	Hinton 07/10/78 RFK BCP
	08/14/80 KDB

Description. Length 13 mm. Color brown with scarcely any markings. Male genitalia with long apical segment of clasper, uniform tenth tergite, and long fusiform spine on the inner lobe of the clasper (Ross, 1944) (Fig. 19).

Remarks: Ceraclea transversa is found in almost all of the eastern states so its occurrence in West Virginia is certainly not a range extension. Although it is one of the most common species reported throughout the United States, it is only moderately abundant as far as

total numbers of individuals collected in West Virginia. Resh (1976) reported a detailed compilation of the life history for this species. It was reported that C. transversa exhibited two distinct larval cohorts. The first emerged in early May and laid its eggs until June while the second would emerge from mid-July and continue until September. The flight periods were reported to be tightly tied into the freshwater sponge on which it feeds. This dicohort population is not likely to occur in West Virginia. The emergence period went from June 29 to September 1 with the majority of the collections being in mid and late July. A possible explanation for this could be that West Virginia has a higher average elevation than Kentucky and is somewhat farther north. One hundred and thirteen males were collected from eight different locations in the state. Unlike other species in this family, C. transversa was collected from a wide variety of lentic and lotic environments (Fig. 60).

Ceraclea wetzeli (Ross)

Athripsodes wetzeli Ross, 1941:94
Ceraclea wetzeli (Ross); Morse, 1975:39

United States Distribution:

Michigan (Leonard and Leonard, 1949), and Pennsylvania (Ross, 1941) (Fig. 61).

West Virginia Distribution:

Pendleton County: Smoke Hole Camp 05/14/64 OSF

Description: Superior appendages broad, slightly narrowed subapically, shorter than tenth tergite. Tenth tergite nearly truncate apically in lateral view, acute from above. Pair of lateral processes arise from sides of base of tergite rather than from lower edges as is usual in most of subgenus. Inferior appendage with short, rounded ventral lobe. Harpago small (Morse, 1975) (Fig. 20).

Remarks: With C. wetzeli having been reported only as far south as Pennsylvania, its occurrence in West Virginia is a range extension. Having been reported from only one other state, it is probably a rare species. Not much concerning its flight period has been reported. In West Virginia only one male was collected on May 14. It was collected at a high elevation in a rather small stream (Fig. 62).

Genus Leptocerus Leach

Leptocerus Leach, 1815:136

Leptocerus americanus (Banks)

Setodes americana Banks, 1899:215
Setodes grandis Banks, 1907a:128
Leptocerus americanus (Banks); Ross, 1944:212

United States Distribution:
Arkansas (Unzicker, 1970), Delaware (Lake, 1984), Illinois (Ross, 1944), Massachusetts (Neves, 1979), Michigan (Leonard and Leonard, 1949), Minnesota (Etnier, 1965), New Hampshire (Morse and Blickle, 1953), North and South Carolina (Brigham et al., 1982), Ohio (Petersen and Foote, 1980), Pennsylvania (Masteller and Flint, 1979), Tennessee (Etnier and Schuster, 1979), Virginia (Parker and Voshell, 1981), Wisconsin (Longridge and Hilsenhoff, 1973) (Fig. 63).

West Virginia Distribution:
Ritchie County: Hughes River 07/14/79 DCT

Description: Length 8 mm. Body very slender, dark brown in color. Both wings narrow and pointed. Male genitalia with tenth tergite long and bladelike, aedeagus irregular; claspers short, narrow at base and expanding rapidly into a large, spatulate structure (Ross, 1944) (Fig. 40).

Remarks: The occurrence of Leptocerus americanus, the only North American species in this genus, in West Virginia does not represent a range extension. It occurs in many surrounding states and has been reported in great numbers from some states. This species is a rarity in this state since only one male was collected. This specimen consists

only of the abdomen and part of the wings. It was collected on July 14 and not much more can be determined about its flight period (Fig. 64).

Genus Mystacides Berthold

Mystacides Berthold, 1827:437

Mystacides sepulchralis (Walker)

Leptocerus sepulchralis Walker, 1852:70
Mystacides sepulchralis (Walker); Betten, 1934:281

United States Distribution:

Arkansas, Connecticut, Georgia, Indiana, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, South Dakota, Tennessee, Vermont, Virginia, West Virginia, Wisconsin (Yamamoto and Wiggins, 1964), Delaware (Lake, 1984), Illinois (Ross, 1944), Kentucky (Resh, 1975), North and South Carolina (Brigham et al., 1982) (Fig. 65).

West Virginia Distribution:

Berkeley County:	Berkeley Springs August ROM
Braxton County:	Sutton Lake 07/01/87 JBG
Hampshire County:	Romney 08/17/80 TAP

Description: Length 9 mm. Color blue-black, the wings and thorax with an iridescent metallic sheen. Male genitalia with apical process of ninth sternite divided at base into a pair of slender long processes; claspers short and stocky; tenth tergite subdivided into a group of intricate sinuate blades (Fig. 41).

Remarks: Along with O. avara this species is the only one to have been previously reported from West Virginia. This species is the only one in the genus Mystacides that has been captured in the state. Most members of this group are diurnal and are rarely recovered in light traps (Yamamoto and Wiggins, 1964). Three males and one female were collected from two different stations. One of our records was close to the one in the literature while the other came from Sutton Lake in the central part of the state. The two collections were made in early July and August (Fig. 66).

Genus Nectopsyche Muller

Nectopsyche Muller, 1879:38
Leptocella Banks, 1899:213
Nectopsyche Muller; Flint, 1974

Nectopsyche candida (Hagen)

Setodes candida Hagen, 1861:280
Leptocella candida Milne, 1934:14
Nectopsyche candida (Hagen); Flint, 1974

United States Distribution:
Alabama, Arkansas, Florida, Georgia, Illinois, Indiana, Michigan, Mississippi, Missouri, Ohio, Oklahoma, South Carolina, Tennessee, Virginia, Wisconsin (Haddock, 1977), Kentucky (Resh, 1975), North Carolina (Brigham et al., 1982) (Fig. 67).

West Virginia Distribution:
Mason County: Gallipolis 07/18/78 RFK

Description: Adult males similar to those of N. exquisita but can be distinguished by the following characters: the elongate filaments, excluding the apical setae, arising medioventral to the base of the claspers are not more than one-fourth the length of the claspers; the transverse brown bars in the proximal 2/3 of the forewing are in no instance wider than the white bars interspersed between them (Haddock, 1977) (Fig. 28).

Remarks: This species is found over most of the eastern part of the country and does not represent a range extension. It is apparently rare in West Virginia with only one specimen being collected from the western part of the state. Ross (1944) reported a flight period from June to late August. Our specimen was taken in July (Fig. 68).

Nectopsyche exquisita (Walker)

Leptocerus exquisita Walker, 1852:72
Leptocella exquisita (Walker); Ross, 1944:217
Nectopsyche exquisita (Walker); Flint, 1974:33

United States Distribution:

Arkansas, Florida, Georgia, Illinois, Maine, Maryland, Michigan, Minnesota, Missouri, Nebraska, New Hampshire, New York, North Carolina, Oklahoma, Pennsylvania, South Carolina, Tennessee, Vermont, Wisconsin (Haddock, 1977), Delaware (Lake, 1984), Kentucky (Resh, 1975), Ohio (Petersen and Foote, 1980), Virginia (Parker and Voshell, 1981) (Fig. 69).

West Virginia Distribution:

Braxton County:	Sutton Lake 06/05/87 JBG
	06/18/87 JBG
	07/01/87 JBG
Cabell County:	Guyandotte River 07/08/81 RFK TAP
Jefferson County:	Kearneysville 08/01/81 JDH
Kanawha County:	Guthrie 08/10/87 MCT
Mason County:	Ohio River 07/24/75 MH
Monroe County:	Hollywood 08/16/77 JDH
	06/08/87 EB
Pendleton County:	Seneca Rock 08/10/87 JBG
Summers County:	Hinton 06/01/79 LB
	08/11/80 KDB
	06/07/87 JBG
	06/18/87 JBG
	Pipestem 08/17/87 USDA
Wayne County:	Dickson Dam 08/08/78 PH
	Fort Gay 06/24/87 JBG

Description: Length 17 mm. The female usually not over 11 mm. Head and thorax tawny, covered with white hair. Front wings with a very conspicuous pattern, composed of cross bands of brownish yellow and a series of four quadrate black spots on posterior margin near apex; the bands are actually pigmented areas in the wing membrane with hair following this pattern closely. Male genitalia with structures typical for genus, the claspers with only a small basal projection and with a pair of long styles tipped with long setae arising between bases of claspers (Ross, 1944) (Fig. 27).

Remarks: Nectopsyche exquisita is the most abundant species in this genus in West Virginia. Found in many eastern states and surrounding states, it does not represent a range extension into West Virginia. Ross (1944) reported that it existed in a single generation in Illinois

due to the short flight period of late June to mid July. In West Virginia emergence lasted from June 1 to August 10. Most of the collections, however, were made in June and the few August collections were at higher elevations in the eastern part of the state. Since wing pattern is a good characteristic in speciation of females, those in good condition could be identified. Sixteen males and 42 females were collected from 11 different stations across the state (Fig. 70).

Nectopsyche pavida (Hagen)

Setodes pavida Hagen, 1861:282
Leptocella pavida Banks, 1907:46
Oecetina pavida Banks, 1914:213
Nectopsyche pavida (Hagen); Flint, 1974

United States Distribution:

Arkansas, Florida, Georgia, Massachusetts, Michigan, Mississippi, New Hampshire, New Jersey, Ohio, Texas, Wisconsin (Haddock, 1977), Kentucky (Resh, 1975), Minnesota (Etnier, 1965), North and South Carolina (Brigham, 1982), Tennessee (Edwards, 1966) (Fig. 71).

West Virginia Distribution:

Braxton County:	Little Kanawha River 07/22/79 RFK BCP
Jefferson County:	Harpers Ferry 08/22/77 PH
Mason County:	Ohio River 07/24/75 MH
Putnam County:	Hurricane 08/02/77 JDH
Wayne County:	Fort Gay 07/03/87 JBG

Description: Length 10 mm. Color very pale yellow, including both the front wing membrane and the hairs on the wing; front wing, in addition, with a scattering of small and very black dots arranged in rows but all well separated. Male genitalia, general structure typical for genus; diagnostic are the claspers, which have a basal flap, and the large scoop-shaped sclerite beneath the base of the claspers and extending to the end of the basal lobe of the claspers (Ross, 1944) (Fig. 26).

Remarks: Since this species occurs in Ohio, its occurrence in West Virginia is not a range extension. This species was mostly taken in

the western part of the state along large, slow rivers. This finding supports Haddock's (1977) observations. This species seems to be more of a southern insect, as some of the other leptocerid species occurring in large numbers in Florida lakes. In West Virginia seven males were collected from five different stations. It seems to be a rather late emerger with flight period extending from July 3 to August 22 (Fig. 72).

Genus Oecetis McLaachlan, 1877:329

Oecetis avara (Banks)

Setodes avara Banks, 1895:316
Oecetis avara (Banks); Ross, 1944:240

United States Distribution:

Alabama, Georgia, Idaho, Illinois, Indiana, Kentucky, Maine, Maryland, Michigan, Minnesota, Missouri, Montana, New Mexico, New York, Ohio, Oklahoma, Oregon, Pennsylvania, Tennessee, Texas, West Virginia, Wisconsin, Wyoming (Ross, 1944), Arkansas (Unzicker et al., 1970), Delaware (Lake, 1984), Massachusetts (Neves, 1979), New Hampshire (Morse and Blickle, 1953), North Carolina, South Carolina (Brigham et al., 1982), Virginia (Parker and Voshell, 1981) (Fig. 73).

West Virginia Distribution:

Braxton County:	Falls Mill 07/22/79 RFK BCP
	Sutton Lake 06/05/87 JBG
	06/18/87 JBG
	07/01/87 JBG
	09/06/87 JBG
Grant County:	South Branch of the Potomac River 08/23/77 JDH
Hardy County:	Wardenville 08/21/23 M
Jefferson County:	Harpers Ferry 08/23/77 RFK BCP
Kanawha County:	Charleston 05/29/87 MCT
	Guthrie 07/15/87 MCT
	London Locks 06/23/82 RFK
Monroe County:	06/24/87 EDB
	06/28/87 EDB
	07/06/87 EDB
	07/08/87 EDB
	Hollywood 08/16/77 JDH
	08/27/79 JDH
Nicholas County:	Gauley River 08/31/81 EDB
	Summersville Lake 06/18/87 JBG
Pendleton County:	Smoke Hole Camp 08/28/63 OSF
	North Fork of the South Branch of the Potomac River 07/12/87 JBG

Summers County: Bluestone River 08/26/87 USDA
Hinton 07/10/78 RFK
08/11/80 KDB
08/13/80 KDB
08/14/80 KDB
08/19/80 KDB
08/23/80 RFK
07/04/81 GJW
08/11/85 KDB
06/07/87 JBG
06/18/87 JBG
07/08/87 JBG
08/23/87 JBG
Pipestem 08/81 RMM
06/25/87 USDA
08/14/87 USDA
08/17/87 USDA
08/19/87 USDA
08/24/87 USDA
08/28/87 USDA
08/31/87 USDA

Description: Length 10-11 mm. Color straw-yellow to light brown, the forewings with numerous dark spots in the membrane. Tenth tergite of male genitalia short, slender and curved, consisting of only a single mesal piece; cerci short and ovate; claspers somewhat kidney shaped; aedeagus short and tubular, the apex slightly expanded ventrad (Ross, 1944) (Fig. 29).

Remarks: Along with O. inconspicua, this species is one of the most common North American caddisflies. It occurs throughout the United States and is extremely common in the eastern part of the country. O. avara is one of the few species of leptocerids that is not a state record, having been reported by Ross (1944). This was one of the most abundant species collected from West Virginia. There were 1365 individuals collected from 16 different locations throughout the state. Of the different locations, 1199 or 88 percent were collected from the area near and around the New River. Ross (1944) reported this species

from fairly rapid streams similar to the New River. The New River was the most productive stations in the state as far as species richness was concerned, yielding 14 species. O. avara, however, was the most common at this area being collected at almost every collection date and sometimes being the only species taken. The emergence period extended from June 5 to September 20 (Fig. 74).

Oecetis cinerascens (Hagen)

Setodes cinerascens Hagen, 1861:282
Oecetina fumosa Banks, 1899:216
Oecetis cinerascens (Hagen); Ross, 1944:241

United States Distribution:

Arkansas, Georgia, Illinois, Maine, Massachusetts, Michigan, Minnesota, Missouri, New York, Ohio, Oklahoma, Pennsylvania, South Dakota, Tennessee, Texas, Virginia, Wisconsin (Ross, 1944), Delaware (Lake, 1984), Kentucky (Resh, 1975), New Hampshire (Morse and Blickle, 1953), North and South Carolina (Brigham et al., 1982) (Fig. 75).

West Virginia Distribution:

Jefferson County:	Harpers Ferry 08/22/77 PH CW BC
Mason County:	Ohio River 07/24/75 MH
Randolph County:	Valley Bend 08/23/77 JDH
	10/17/80 JDH
Wayne County:	McClintic Pond #16 09/20/87 JBG

Description: Length 11-13 mm. Color medium shades of brown in life somewhat hoary due to the pale hair; the wing membrane with several dark spots situated at the vein forks. Tenth tergite of male genitalia consisting of a single stylelike projection; cerci fairly long and parallel sided, apex rounded; claspers with a wide basal portion which tapers suddenly to a long apical curved filament; aedeagus fairly long, the apex produced into a projecting beak (Ross, 1944) (Fig. 32).

Remarks: Oecetis cinerascens is one of the most common leptocerid caddisflies in the United States. Its occurrence in West Virginia does not represent a range extension. The species, however, is not abundant

in the state with only 14 males being collected from only four different stations. The species does not seem to have any geographical preference which was collected in many different regions. This species is a late emerger in the state with flight periods extending from July 7 to October 17 (Fig. 76).

Oecetis inconspicua (Walker)

Leptocerus inconspicuus Walker, 1852:71
Setodes sagitta Hagen, 1861:284
Setodes micans Hagen, 1861:283
Setodes flaveolata Hagen, 1861:282
Oecetina paravula Banks, 1899:215
Oecetina flavida Banks, 1899:216
Oecetina floridana Banks, 1899:216
Oecetina apicalis Banks, 1907a:129
Oecetina inornata Banks, 1907a:128
Oecetis inconspicua (Walker); Ross, 1944:242

United States Distribution:

Alabama, Arkansas, California, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Hampshire, New York, Ohio, Oklahoma, Oregon, Pennsylvania, South Carolina, South Dakota, Texas, Utah, Virginia, Wisconsin (Ross, 1944), Delaware (Lake, 1984), North Carolina (Brigham et al.), Tennessee (Edwards, 1966) (Fig. 77).

West Virginia Distribution:

Boone County:	Coal River 07/10/76 CU	
	Madison 08/24/76 CU	
Braxton County:	Sutton Lake 07/21/79 LB	
	07/24/79 RFK BCP	
	07/15/81 RFK	
	06/18/87 JBG	
	08/01/87 JBG	
	09/06/87 JBG	
Cabell County:	Greenbottom Swamp 04/30/78 MR	
	Ona 09/20/78 CN	
	Salt Rock 07/08/81 RFK BCP	
Grant County:	South Branch of the Potomac River	08/23/79 JDH
		07/12/87 JBG
Hampshire County:	Romney 08/27/80 KDB TAP	
Hardy County:	Howards Lick Run 07/02/74 WDW	
	Lost River 07/07/74 WDW	
Harrison County:	Bridge Port 06/06/79 CS	
	East View 09/04/79 CS	
Jefferson County:	Harpers Ferry 08/22/77 PH	
	Kearneysville 08/01/77 JDH	
	08/22/77 JDH	
	Shenandoha Junction 07/11/84 JDH	

Kanawha County:	Coal River 06/15/80 BB
	06/22/80 BB
	06/29/80 BB
	07/01/80 BB
	09/01/80 BB
	09/10/80 BB
	09/14/80 BB
	Guthrie 05/29/87 MCT
Mason County:	Flatfoot Creek 07/13/77 CU
	Ohio River 07/24/75 MH
	Point Pleasant 06/02/75 JDH
McDowell County:	Iaeger 09/05/76
Monongalia County:	Triune 06/17/79 LB
Monroe County:	Hollywood 08/01/77 JDH
	08/16/77 JDH
	08/22/77 JDH
	09/13/77 JDH
	Union 06/11/84 JDH
	06/18/84 JDH
	07/26/84 JDH
Nicholas County:	Summersville 08/17/87 JBG
Pendleton County:	Seneca Rocks 07/12/87 JBG
	08/10/87 JBG
	Smoke Hole Camp 08/28/63 OSF
Pocahontas County:	Cranberry Glades 08/19/76 PH
Preston County:	Cranesville 09/23/79 LB
Putnam County:	Hurricane 07/21/77 JDH
	08/02/77 JDH
	08/11/77 JDH
	09/05/77 JDH
Raleigh County:	Beckley 08/15/77 JDH
	Daniels 07/27/77 KA
Randolph County:	Valley Bend 08/01/77 JDH
	08/11/77 JDH
	08/23/77 JDH
Summers County:	Hinton 07/10/78 RFK BCP
	06/01/79 LB
	08/11/80 KDB
	08/14/80 KDB
	08/20/80 RFK TAP
	07/04/81 GJW
	06/18/81 JBG
	07/08/87 JBG
	08/07/87 JBG
	Pipestem 08/17/87 USDA
	08/19/87 USDA
Taylor County:	Tygart River 06/07/77
Tyler County:	Middlebourne 08/27/77 JDH
Wayne County:	Twelvepole Creek 08/08/76 S
	Dickson Dam 06/08/79 KDB
	Fort Gay 09/16/87 JBG
	McClintic Farm Pond #16 09/20/87 JBG

Description: Length 10-12 mm. Color brown with reddish cast, without distinct markings; specimens in liquid showing a conspicuous dark bar across the cord. Position of crossveins forming the cord extremely variable, ranging from a condition in which the three crossveins form an almost straight line to one in which they are removed and steplike. Tenth tergite forming a single, straight, fairly long rod; cerci short and ovate; claspers with dorsal margin incised to form a conspicuous angulate at the base; aedeagus almost circular with short beak (Ross, 1944) (Fig. 30).

Remarks: O. inconspicua is the most common North American caddisfly (Ross, 1944). It has been reported in many different states across the country and its presence in West Virginia is expected. West Virginia was no exception to Ross' statement being also the most common caddisfly in this state. Although it did not occur in the extremely large swarms as did O. avara and Ceraclea maculata, it did occur at almost every station that was set up in the state and at least one male could be expected at almost every collection date. Five hundred and seventy-three males were collected from 41 different stations in the state. Flight periods extended from April 30 to September 23 with many records scattered in between. Richardson and Clifford (1986) also found this species to have this extended flight period suggesting a multi-cohort population (Fig. 78).

Oecetis nocturna Ross

Oecetis nocturna Ross, 1965:11

United States Distribution:
Alabama, Arkansas, Illinois, Indiana, Missouri, Ohio, Oklahoma, Pennsylvania, Tennessee (Ross, 1965), Kentucky (Resh, 1975), North and South Carolina (Brigham et al., 1982), Virginia (Parker and Voshell, 1981) (Fig. 79).

West Virginia Distribution:

Grant County:	Smoke Hole Camp 07/12/87 JBG
Kanawha County:	Coal River 07/15/80 BB
	09/10/80 BB
	London Locks 07/02/81 RFK
Mason County:	Flatfoot Creek 06/30/77 DCT
Pendleton County:	North Fork of the South Branch of the Potomac River 06/26/87 JBG
Pocahontas County:	Durbin 06/26/87 JBG
Wayne County:	Prichard 07/21/87 RFK

Description: Length from tip of head to end of folded wings, 9 mm. Color brown with reddish cast, the ventral areas of body and the legs lighter, almost straw color. Wings also lighter brown with a distinct darker bar across the cord. General structure typical for genus. Genitalia similar in general shape to those of O. inconspicua, diagnostic characters being present in the claspers and the aedeagus. Cerci, tenth tergite, and shape of ninth segment as in O. inconspicua. Clasper with a narrow profile; mesal aspect with a broad base tapering rapidly to an almost tubular long apical portion; the bases of the two claspers almost meeting on the meson and slightly overlapped by a small, wide, membranous projection of the eighth sternite. Aedeagus deep and in general somewhat ovoid, its apex projecting ventrally into a down-pointed beak whose tip is pointed in posterior view; internal curved spine large and heavily sclerotized (Ross, 1965) (Fig. 33).

Remarks: Although O. nocturna is a relatively recently described species, it has been reported from several eastern states and does not represent a range extension. Being similar to the common O. inconspicua, Ross (1965) suspected that this species is masquerading under this name

in many collections. Unlike the transcontinental range of O. inconspicua, the range of this species is restricted to the central part of the eastern temperate deciduous forest. The individuals collected in West Virginia were for the most part collected in the eastern mountains and the large western rivers. None were collected from the central lakes and rivers. Thirty-one individuals were collected from seven different stations from the state. Flight periods extended from June 26 to September 10 although most collections were made in June and early July which makes this species a relatively early emerger in the state (Fig. 80).

Oecetis persimilis (Banks)

Oecetina persimilis Banks, 1907a:129
Oecetis persimillis (Banks); Ross, 1944:243

United States Distribution:

Georgia, Illinois, Kentucky, Maryland, Ohio, Tennessee, Virginia, Wisconsin (Ross, 1944), Arkansas (Unzicker et al., 1970), Delaware (Lake, 1984), Massachusetts (Neves, 1979), Michigan (Leonard and Leonard, 1949), Minnesota (Etnier, 1965), New Hampshire (Morse and Blickle, 1953), North and South Carolina (Brigham et al., 1982), Pennsylvania (Masteller and Flint, 1979) (Fig. 81).

West Virginia Distribution:

Braxton County:	Sutton Lake 06/18/87 JBG
	07/01/87 JBG
Cabell County:	Ona 08/12/78 CN
Jackson County:	Ravenswood 06/18/79 T
Pocahontas County:	Durbin 06/26/87 JBG
Summers County:	New River 06/01/79 LB
	Hinton 07/04/81 GJW
	Pipestem 07/01/87 USDA
	08/17/87 USDA
Wayne County:	Dickson Dam 07/06/79 KDB

Description: Length 7-8 mm. Color light brown, venter and legs straw color; wings uniformly smoky, with long brown hair and dark shading along the cord. Abdomen of male with seventh and eighth tergites heavily sclerotized, and covered with minute and lacelike fenestrations.

Tenth tergite consisting of a long stylelike projection twice as long as cerci; cerci ovate, wide and rounded at tip; claspers with a wide, long basal portion suddenly narrower to an apical elongation; the apices of the two claspers curved mesad; aedeagus large, with a greatly expanded bulbous base which narrows to a ventral beaklike spatula above which extrude several membranous folds which enclose three short hooks, a curved sclerotized rod twice as long as these hooks and another curved sclerotized rod stouter and longer than the preceding (Ross, 1944) (Fig. 31).

Remarks: This species along with Oecetis cinerascens is widely distributed across the eastern part of the country. However, it is not frequently found in collections. Ross (1944) suggested that it has a scattered distribution pattern. In West Virginia, the emergence period extends from June 1 to August 17. From this time 16 males were collected from eight different stations (Fig. 82).

Genus Setodes Rambur

Setodes Rambur, 1842:515

Setodes incerta (Walker)

Leptocerus incertus Walker, 1853:71
Setodes vernalis Banks, 1907:127
Setodes autumnalis Banks, 1907:128. NEW SYNONYM
Setodes incerta Ross, 1944:302

United States Distribution:
Connecticut, Georgia, Kentucky, Maine, Maryland, Michigan, New York, North Carolina, Pennsylvania, South Carolina, Virginia, Wisconsin (Holzenthal, 1982), Minnesota (Etnier, 1965), New Hampshire (Morse and Blickle, 1953), Tennessee (Etnier and Schuster, 1979) (Fig. 83).

West Virginia Distribution:

Summers County:	Hinton	07/04/81 GJW
		08/81 RMM
		08/26/81 USDA
	Pipestem	06/25/87 USDA
		08/17/87 USDA
		08/19/87 USDA

Description: Intermediate appendages of male long, straight and pointed; extending beyond tips of lyrate preanal appendages. A pair of small protuberances present at base of intermediate appendages (Holzenthal, 1982) (Fig. 42). Length 5-6 mm. Color light straw.

Remarks: Like all species of Setodes, this one is rare (Ross, 1944). It has been reported in Virginia near the area where our specimens were collected so this does not constitute a range extension. Eight males and 102 females were collected from two different stations near the New River. Flight period extended from June 25 to August 26 although most were collected in August (Fig. 84).

Triaenodes McLachlan

Triaenodes McLachlan, 1865:110
Triaenodella Mosely, 1932:308
Ylodes Milne, 1934:11
Triaenodes McLachlan; Ross, 1944:244

Triaenodes flavescens Banks

Triaenodes flavescens Banks, 1900a:257

United States Distribution:
Illinois, New Jersey, New York, Ohio, Pennsylvania (Ross, 1944), Kentucky (Resh, 1975), Minnesota (Etnier, 1965), Tennessee (Etnier and Schuster, 1979), Virginia (Parker and Voshell, 1981) (Fig. 85).

West Virginia Distribution:

Harrison County:	Richwood 07/30/87 USDA
Monroe County:	Hollywood 08/16/77 JDH
Summers County:	Pipestem 08/31/87 USDA

Description: Length 12 mm. Color tawny with a cream and brown wing pattern. Male genitalia similar in general structure to T. tarda, differing in the long bladelike tenth tergite and the claspers with the shorter, pointed lateral projection and the larger mesal lobe (Ross, 1944) (Fig. 37).

Remarks: Triaenodes flavescens has been reported from many of the eastern states and its occurrence in West Virginia does not represent a range extension. Like most Triaenodes species recovered in the state, there were few specimens collected in the traps. This species was a late emerger with flight period extending from July 30 to August 31. Only three males were collected from three different stations. It was only collected in the southeastern part of the state from areas of high elevation (Fig. 86).

Triaenodes ignita (Walker)

Leptocerus ignitus Walker, 1852:72
Triaenodes dentata Banks, 1914:261. NEW SYNONYM
Triaenodes ignita (Walker); Ross, 1944:252

United States Distribution:

Alabama, Georgia, Illinois, New York, Oklahoma, Tennessee (Ross, 1944), Arkansas (Unzicker et al., 1970), Delaware (Lake, 1984), Kentucky (Resh, 1975), Massachusetts (Neves, 1979), Michigan (Leonard and Leonard, 1949), New Hampshire (Morse and Blickle, 1953), North and South Carolina (Brigham et al.), Ohio (Petersen and Foote, 1980), Virginia (Parker and Voshell, 1981), Wisconsin (Longridge and Hilsenhoff, 1973) (Fig. 87).

West Virginia Distribution:

Cabell County: Greenbottom Swamp 04/30/78 MR
Wayne County: Dickson Dam 06/06/79 KDB

Description: Length 11-12 mm. Color tawny with a cream and brown pattern. Tenth tergite of male genitalia divided near base into a pair of very long, slender filaments which curve sharply to the left near apex; cerci very long and slender; claspers with the lateral projection slightly curved and sharp, the mesal projection large and quadrate from the lateral view, with small swellings on the dorsal margin, the basal filament ribbon-like at base, filamentous on the apical portion; aedeagus U-shaped, slender in the middle, and with long, ventral portion (Ross, 1944) (Fig. 36).

Remarks: Having been reported from most of the eastern states, T. ignita does not represent a range extension into West Virginia. This species was collected from only two locations in the state with three males represented. It was found only in the western part of the state and was an early emerger being collected on the earliest date of any leptocerid in the state, April 30 and June 6 (Fig. 88).

Triaenodes injusta (Hagen)

Setodes injusta Hagen, 1861:283
Triaenodes injusta (Hagen); Ross, 1944:252

United States Distribution:

Arkansas (Unzicker et al., 1970), Delaware (Lake, 1984), Illinois (Ross, 1944), Kentucky (Resh, 1975), Massachusetts (Neves, 1979), Michigan (Leonard and Leonard, 1949), Minnesota (Etnier, 1965), New Hampshire (Morse and Blickle, 1953), North and South Carolina (Brigham et al.), Ohio (McElray and Foote, 1978), Pennsylvania (Masteller and Flint, 1979), Tennessee (Edwards, 1966), Virginia (Parker and Voshell, 1981), Wisconsin (Longridge and Hilsenhoff, 1973) (Fig. 89).

West Virginia Distribution:

Kanawha County:	Guthrie 05/29/87 MCT
Putnam County:	Hurricane 08/02/77 JDH
Randolph County:	Valley Bend 06/20/78 JDH
Summers County:	Hinton 07/04/81 GJW
	06/07/87 JBG

Description: Length 12 mm. Color tawny with a cream and brown pattern. Tenth tergite of male genitalia divided near base into a pair of wide, fairly short, heavily sclerotized divergent arms; cerci long and slender, dorsal projection large (Ross, 1944) (Fig. 35).

Remarks: Triaenodes injusta is one of the more common species in this genus of leptocerids. It has been reported from most of the eastern states and its occurrence in West Virginia fills in a gap in the records. It was the most commonly collected Triaenodes species from West Virginia, although there were still only seven males collected from four different locations throughout the state. Flight periods extended throughout the

year emergence occurring from June 20 to August 2. Ross (1944) reported that the number of generations is unknown although this extended flight period would suggest that there were more than one. There did not seem to be any trend toward certain regions in the state with specimens being recovered throughout (Fig. 90).

Triaenodes marginata Sibley

Triaenodes marginata Sibley, 1926a:80

United States Distribution:

Arkansas, Illinois, Michigan, New Jersey, New York, South Dakota (Ross, 1944), Delaware (Lake, 1984), Massachusetts (Neves, 1979), Minnesota (Etnier, 1965), Ohio (McElravy and Foote, 1978), Tennessee (Etnier and Schuster, 1979), Virginia (Parker and Voshell, 1981), Wisconsin (Longridge and Hilsenhoff, 1973) (Fig. 91).

West Virginia Distribution:

Summers County: New River 07/01/79 LB
Pipestem 08/19/87 USDA

Description: Length 12-13 mm. Color tawny with a black and cream pattern. Male genitalia similar in structure to T. tarda, differing chiefly in the spatulate tenth tergite and long lateral projections of the claspers, these processes curved sharply mesad at apex (Ross, 1949) (Fig. 39).

Remarks: This species has been reported from some surrounding eastern states and does not represent a range extension. Triaenodes marginata was collected only at the area at or near the New River which was rich in aquatic insects of all types. This unique area in West Virginia provided several records for the state and 14 of the 28 species of leptocerids were collected here. Four males from two different stations were collected on July 1 and August 19 (Fig. 92).

Triaenodes perna Ross

Triaenodes perna Ross, 1938:159

United States Distribution:
Illinois, Ohio, Oklahoma (Ross, 1949), Arkansas (Unzicker et al., 1970), Delaware (Lake, 1984), New Hampshire (Morse and Blickle, 1953), North and South Carolina (Brigham et al.), Virginia (Parker and Voshell, 1981) (Fig. 93).

West Virginia Distribution:
Summers County: Hinton 06/18/87 JBG

Description: Length 9 mm. Color tawny, front wing with a definite pattern of cream and brown; in repose the insect has a dorsal light stripe, a large light area along middle of front margin of wings, a dark brown area across wing at stigma, and a golden brown area beyond this along the apical margin. Tenth tergite of male genitalia long and hairlike with a slight thickening at apex; beneath this there is a long, membranous, curved process extending beyond the tenth tergite, claspers flat, the ventral aspect somewhat triangular, and the apico-mesal side with a row of black spines; basal whiplike process of claspers very long, the right one convoluted and bladelike, the left one filamentous (Ross, 1944) (Fig. 34).

Remarks: Although this species of Triaenodes does not represent a range extension, it has not been reported in as many surrounding states as some of the other species in this genus. Like T. marginata this species is quite rare in West Virginia having been collected only from the New River at Hinton. Not much can be mentioned about its flight period since only one male was collected. It possibly is an early emerger, since the specimen was collected on June 18 (Fig. 94).

Triaenodes tarda Milne

Triaenodes marginata tarda Milne, 1934:12
Triaenodes vorhiesi Betten, 1934:286. NEW SYNONYM
Triaenodes mephita Milne, 1936:59. NEW SYNONYM

United States Distribution:

Arizona, Arkansas, Illinois, Minnesota, New York, Ohio, Oklahoma, Pennsylvania, Wisconsin (Ross, 1944), Delaware (Lake, 1984), Kentucky (Resh, 1975), Massachusetts (Neves, 1979), Michigan (Leonard and Leonard, 1949), New Hampshire (Morse and Blickle, 1953), Oregon (Anderson, 1976), Tennessee (Etnier and Schuster, 1979) (Fig. 95).

West Virginia Distribution:

Putnam County: Hurricane 09/05/77 JDH

Description: Length 12-13 mm. Color tawny with a conspicuous cream and brown pattern. Tenth tergite of male genitalia long and fusiform; cerci fairly short and lanceolate; claspers with base bulbous, lateral angle produced into a long, sharp point, mesal portion produced into a knobbed lobe set with short, stout setae; aedeagus U-shaped and cleft at apex (Ross, 1944) (Fig. 38).

Remarks: Triaenodes tarda is found in many of the eastern states and its occurrence in West Virginia does not represent a range extension. Ross (1944) reported collecting this species in large numbers only from glacial lakes in northern Illinois. In West Virginia this species was quite rare with only two males from one location having been collected. Flight period for this species cannot be determined but the one collection came in early August. Ross' (1944) collections in Illinois extended from May to October and he suggested more than one generation existed for this species (Fig. 96).

CHAPTER VII

SUMMARY AND CONCLUSIONS

A distributional survey of the caddisflies in the family Leptoceridae revealed 27 species and seven North American genera. All but two species, Oecetis avara and Mystacides sepulchralis, were state records. The total number of leptocerids identified was 9,136 - 4,364 males and 4,772 females. The females in most cases could be identified to only the generic level.

Keys were written to the generic level for both males and females. Species keys were also written for the seven genera of male leptocerids.

The most abundant genus in the state was Ceraclea which had 2,064 males that were classified into ten different species. Oecetis was third with regard to total number of species but was just as common with regard to total number of individuals. There were five different species of Oecetis confirmed but 1,999 males identified. Triaenodes had six different species confirmed but was always rare with only 19 males identified. The most common species of any caddisfly in North America is also the most common in West Virginia. Oecetis inconspicua was found at 41 different stations throughout the state. With regard to total number of individuals collected, Oecetis avara was the most common with 1,365 individuals being identified. A large percentage of these, however, came from only one area in the state. Females could also be keyed for this species leading to the large number that was

identified to the specific level. Ceraclea cancellatus was also extremely abundant having 1,064 males identified.

Species that were collected in more than one area and that seemed to prefer the larger rivers of the western portion of the state included C. flava, C. maculata, Nectopsyche pavida, and T. ignita. The only species with more than one individual collected that was confined to the smaller rivers in the higher elevations of the east was C. neffi. The New River was the area with the most abundant number of leptocerids both in number and richness. Fourteen species were collected here, four of which were found only in this area. They included C. ophioderus, Setodes incerta, T. marginata, and T. perna. Extensive collections of the area in and around Hinton would surely produce many state records of aquatic insects.

The only species that emerged exclusively in the early part of the year was T. ignita. Late emergers with flight periods starting in July included C. transversa, M. sepulchralis, N. pavida, O. cinerascens. T. flavescens, and T. marginata. Some species had extended flight periods beginning in May and extending into September suggesting these species exhibited a multi-cohort population.

The family Leptoceridae contains many species that are exceedingly common throughout the United States. Most species collected in West Virginia have been reported in several eastern states. Notable exceptions include C. ophioderus, C. slossonae, and C. wetzeli. All these species exhibited important range extensions into West Virginia.

This study of the taxonomy of aquatic insects and all organisms is extremely important. Being able to readily identify organisms of all types or having good workable keys which are easy to obtain is

essential to biologists in almost every discipline. It is hoped that this thesis will aid in a better understanding of aquatic insects in West Virginia and will help complete the puzzle of trichopteran systematics throughout the state.

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APPENDIX

Table 2. Flight period for the caddisflies in the Family Leptoceridae based on West Virginia collections.

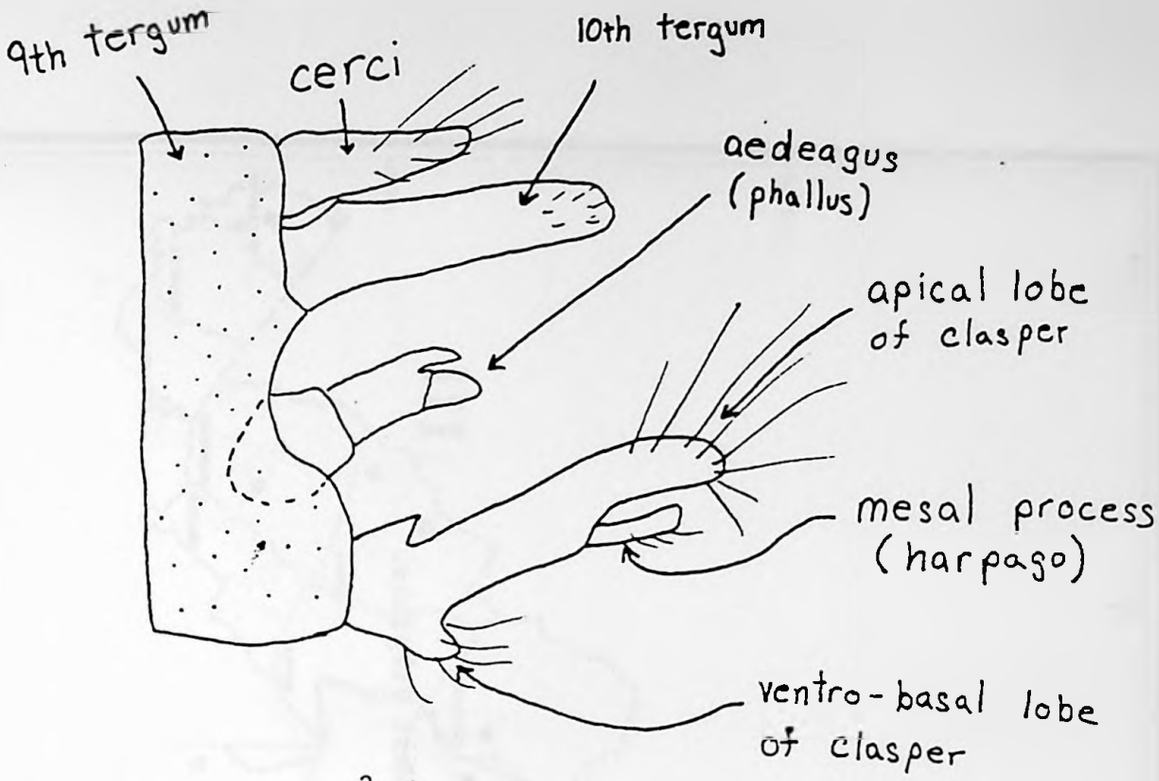
SPECIES	NO.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.
C. cancellata	1064						
C. diluta	1						
C. flava	10						
C. maculata	787						
C. neffi	121						
C. ophioderus	6						
C. slossonae	3						
C. tarsipunctata	59						
C. transversa	113						
C. wetzeli	1						
L. americanous	1						
M. sepulchralis	4						
N. candida	1						
N. exquisita	58						
N. pavida	7						
O. avara	1365						
O. cinerascens	14						
O. inconspicua	573						
O. nocturna	31						
O. persimilis	16						
S. incerta	110						
T. flavescens	3						
T. ignita	3						
T. injusta	7						
T. marginatus	4						
T. perna	1						
T. tarda	1						

Figure 1. Case of a typical trichopteran larva.

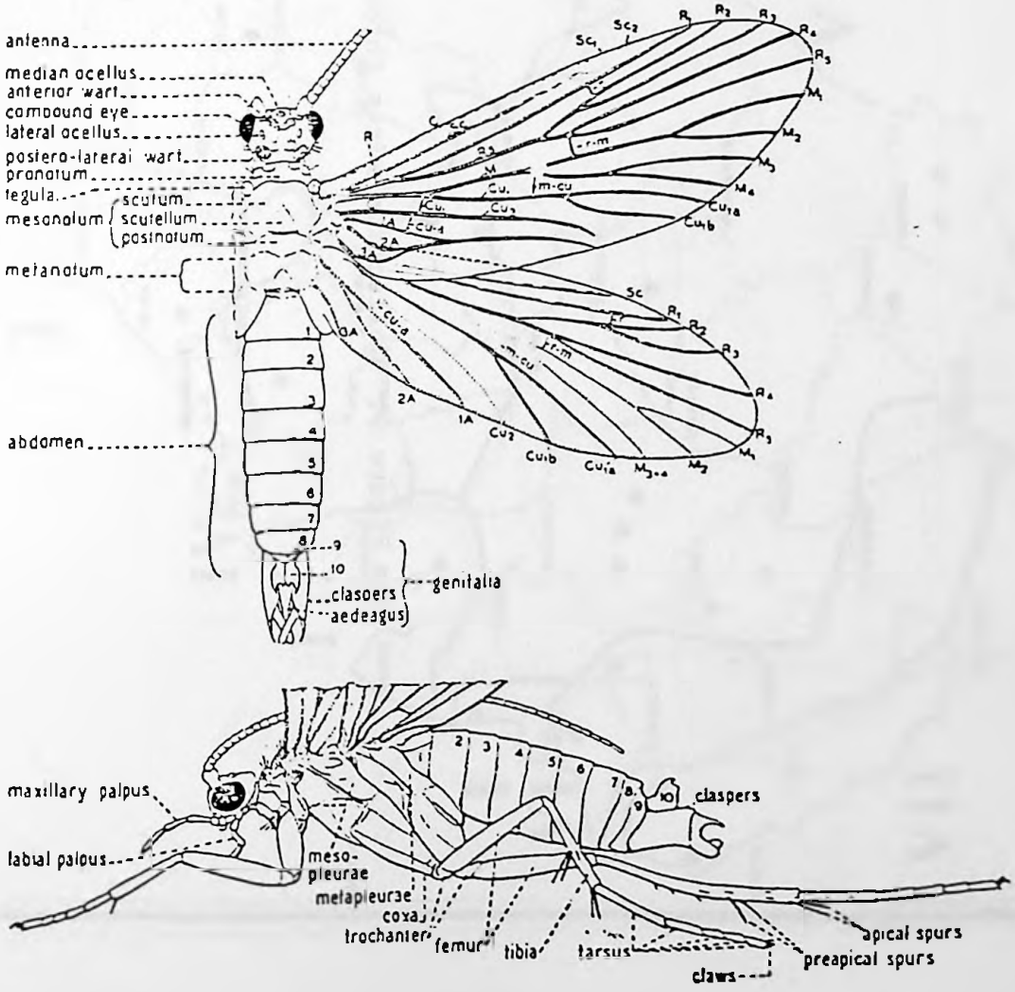
Figure 2. Typical leptocerid adult.

Figure 3. Morphology of a typical adult trichopteran male genitalia.

Figure 4. Morphology and terminology for an adult trichopteran wing and body.


9th tergum
cerci
10th tergum
aedeagus
(phallus)
apical lobe
of clasper
mesal process
(harpago)
ventro-basal lobe
of clasper

3


antenna
median ocellus
anterior wart
compound eye
lateral ocellus
posiero-laterai wart
pronotum
tegula
mesonotum
scutum
scutellum
postnotum
metanotum
abdomen
cerci
aedeagus
genitalia
maxillary palpus
labial palpus
meso-
pleurae
metapleurae
coxa
trochanter
femur
tibia
tarsus
claws
claspers
apical spurs
preapical spurs

4

Figure 5. Collection sites throughout West Virginia.

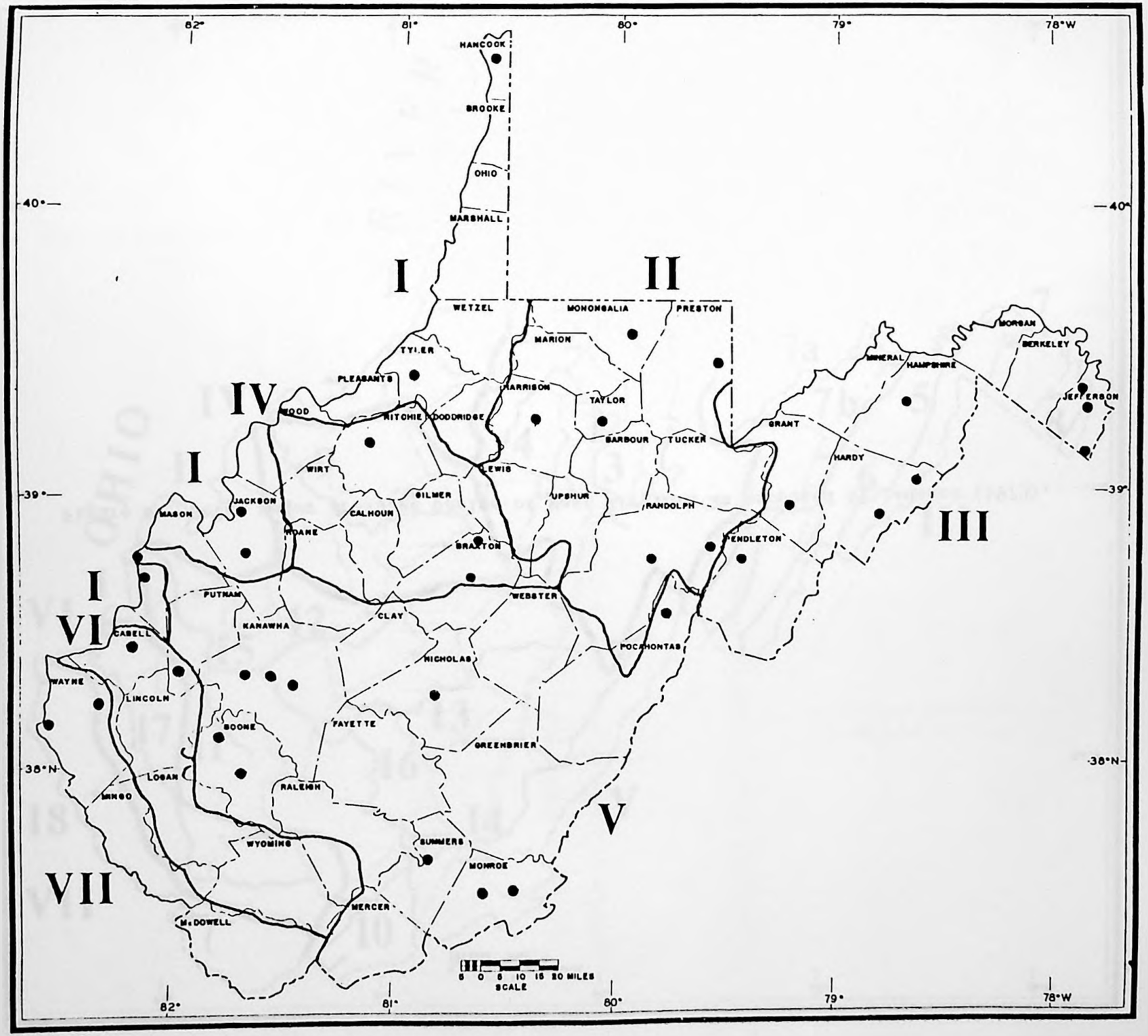
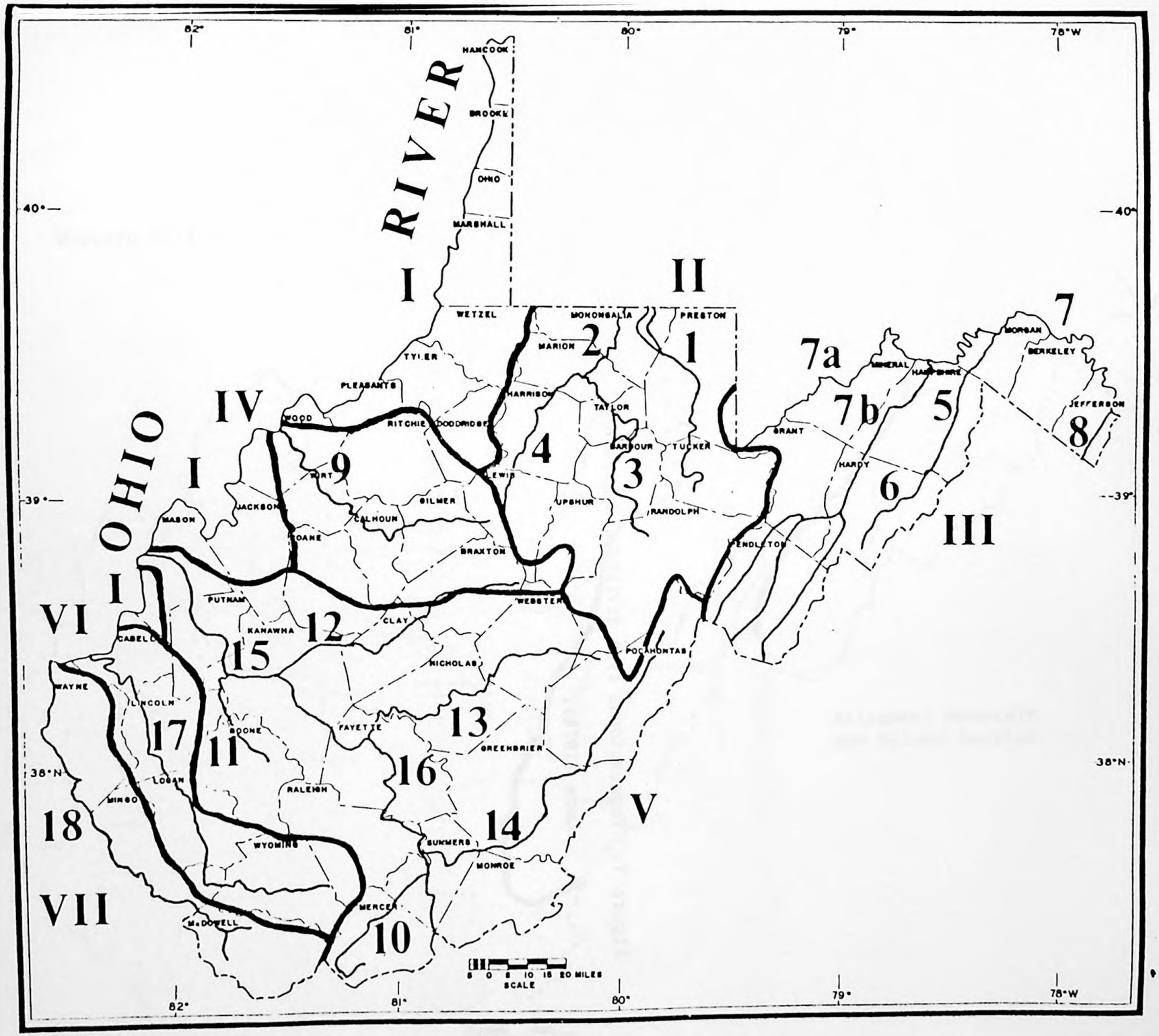

82°
81°
80°
79°
78°W
40°
39°
38°N
HANCOCK
BROOKE
OHIO
MARSHALL
WETZEL
MONONGALIA
PRESTON
MARION
TYLER
PLEASANTS
HARRISON
TAYLOR
WOOD
RITCHIE
DODDRIDGE
BARBOUR
TUCKER
WIRT
LEWIS
UPSHUR
RANDOLPH
JACKSON
MASON
CALHOUN
GILMER
ROANE
BRAXTON
PENDLETON
PUTNAM
WEBSTER
CLAY
KANAWHA
CABELL
POCAHONTAS
NICHOLAS
WAYNE
LINCOLN
BOONE
FAYETTE
GREENBRIER
LOGAN
MINGO
RALEIGH
WYOMING
SUMMERS
MONROE
MERCER
McDOWELL
GRANT
HARDY
MINERAL
HAMPSHIRE
MORGAN
BERKELEY
JEFFERSON
I
II
III
IV
V
VI
VII
5 0 5 10 15 20 MILES
SCALE

Figure 6. Seven major drainage basins of West Virginia as proposed by Janssen (1973).


82°
81°
80°
79°
78°W
40°
39°
38°N
HANCOCK
BROOKE
OHIO
MARSHALL
WETZEL
MONONGALIA
PRESTON
MARION
TYLER
PLEASANTS
WOOD
RITCHIE
DODDRIDGE
HARRISON
TAYLOR
BARBOUR
TUCKER
LEWIS
UPSHUR
RANDOLPH
GRANT
HARDY
PENDLETON
MINERAL
HAMPSHIRE
MORGAN
BERKELEY
JEFFERSON
MASON
JACKSON
CALHOUN
WIRT
GILMER
ROANE
BRAXTON
PUTNAM
KANAWHA
CLAY
WEBSTER
POCAHONTAS
CABELL
WAYNE
LINCOLN
BOONE
NICHOLAS
FAYETTE
GREENBRIER
LOGAN
MINGO
RALEIGH
WYOMING
SUMMERS
MONROE
MERCER
McDOWELL
I
II
III
IV
V
VI
VII
1
2
3
4
5
6
7
7a
7b
8
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13
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15
16
17
18
OHIO RIVER
0 5 10 15 20 MILES
SCALE

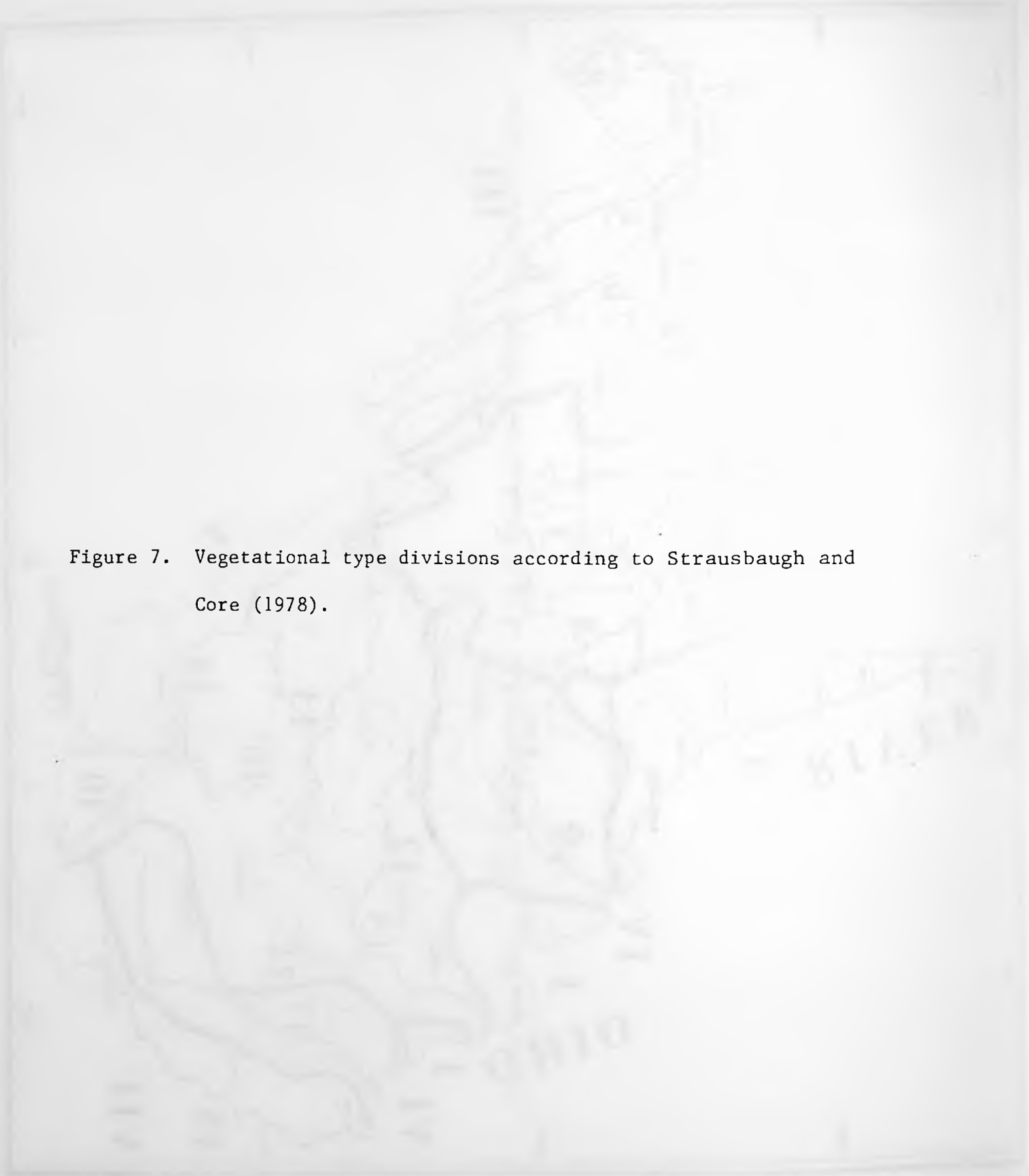


Figure 7. Vegetational type divisions according to Strausbaugh and Core (1978).


Western Hill Section
Eastern Ridge and Valley Section
Allegheny Mountain and Upland Section
WETZEL
MONONGALIA
PRESTON
MARION
TAYLOR
BARBOUR
TUCKER
PLEASANTS
HARRISON
UPSHUR
RANDOLPH
WEBSTER
POCAHONTAS
MINERAL
HAMPSHIRE
MORGAN
BERKELEY
JEFFERSON
GRANT
HARDY
40
—40
—39
38°N
81
80°
79°
78 W
MILES
SCALE

Figure 8. Forewing of Triaenodes.

Figure 9. Forewing of Oecetis.

Figure 10. Forewing of Ceraclea

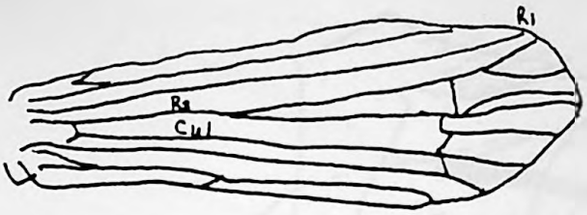
Figure 11. Head of Mystacides.

Figure 12. Head of Setodes.

Figure 13. Head of Ceraclea.

Figure 14. Mesopleuron of Nectopsyche.

Figure 15. Mesopleuron of Ceraclea.



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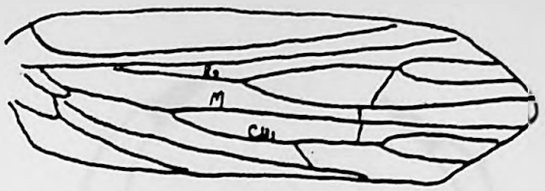

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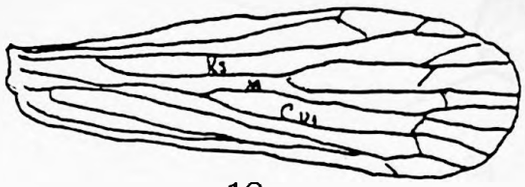

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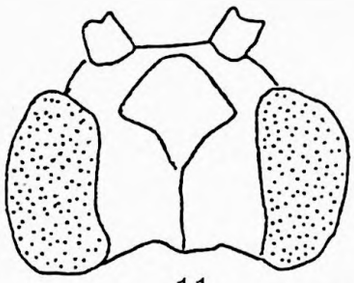

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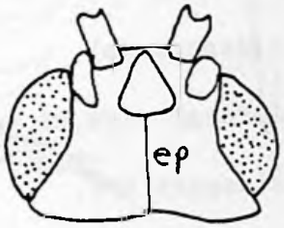

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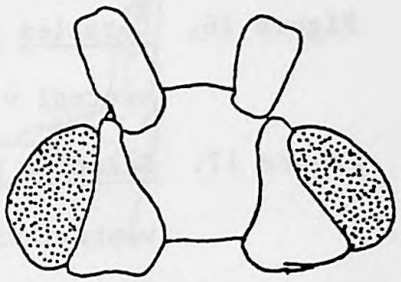

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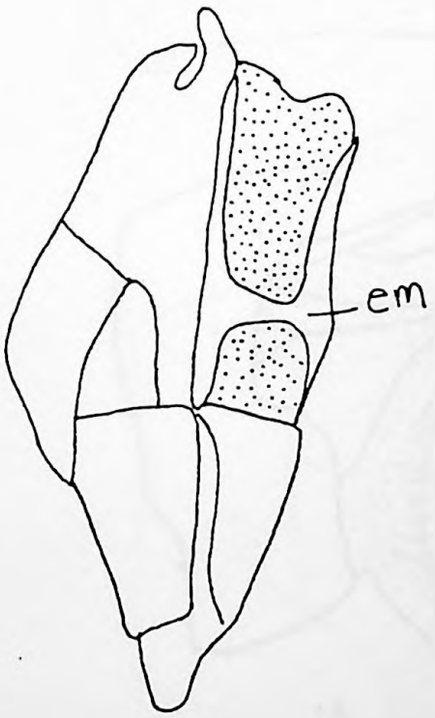

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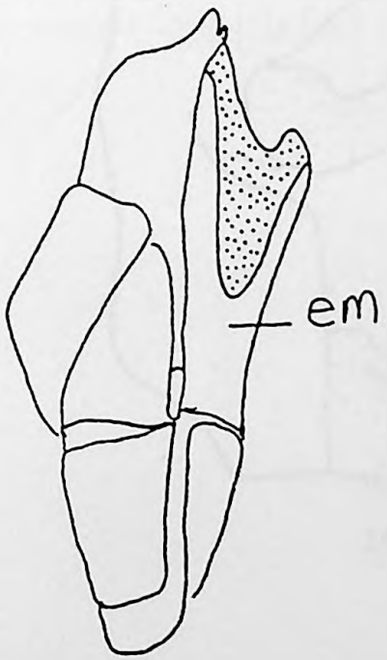


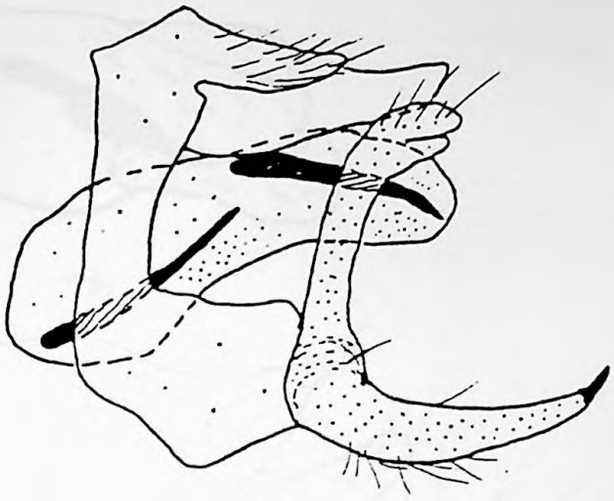
15

Figure 16. Ceraclea neffi, lateral view of male genitalia (a) and ventral view of claspers (b).

Figure 17. Ceraclea flava, lateral view of male genitalia (a) and ventral view of claspers (b).

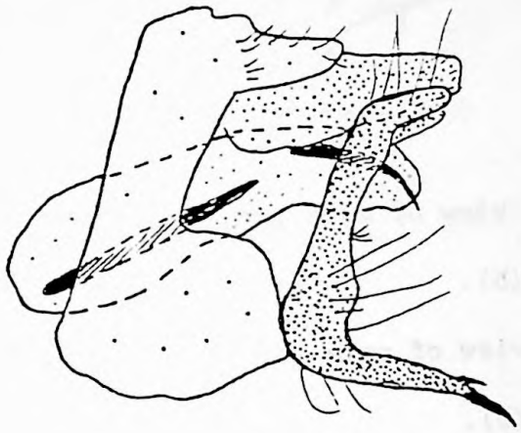
Figure 18. Ceraclea tarsipunctata, lateral view of male genitalia.

Figure 19. Ceraclea transversa, lateral view of male genitalia.



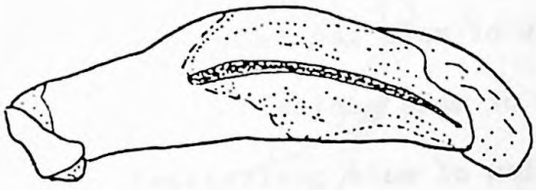
16a

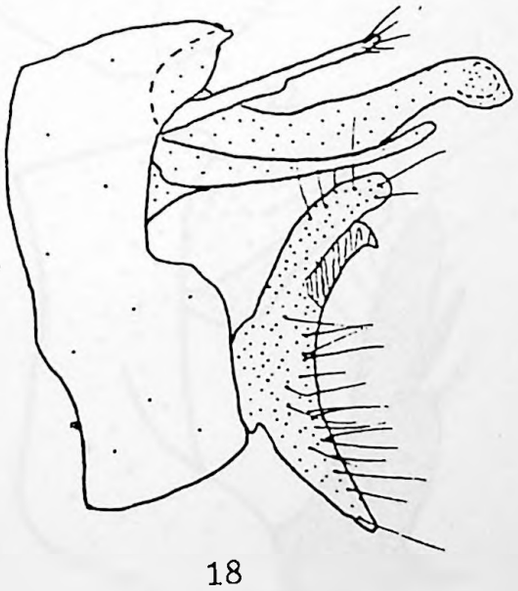
16b



17a

17b





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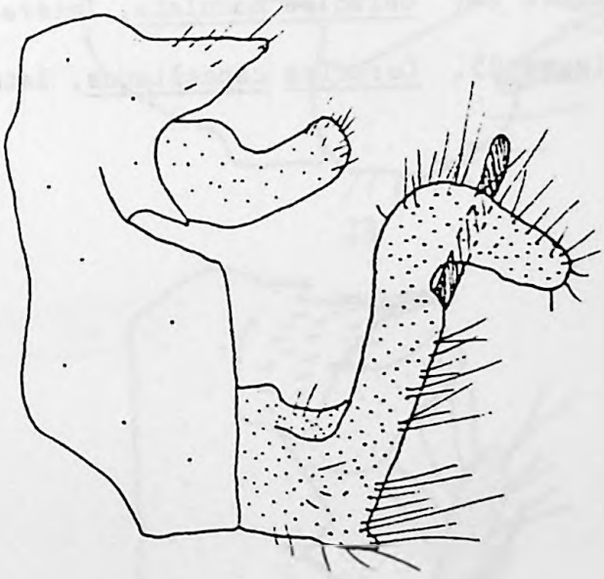

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Figure 20. Ceraclea wetzeli, lateral view of male genitalia (a) and lateral view of aedeagus (b).

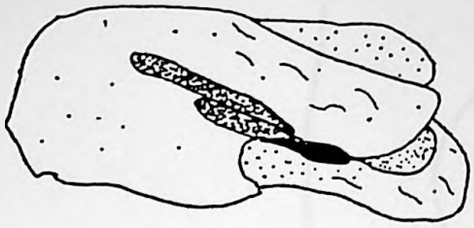
Figure 21. Ceraclea diluta, lateral view of male genitalia (a) and lateral view of aedeagus (b).

Figure 22. Ceraclea ophioderus, lateral view of male genitalia.

Figure 23. Ceraclea slossonae, lateral view of male genitalia.

Figure 24. Ceraclea maculata, lateral view of male genitalia.

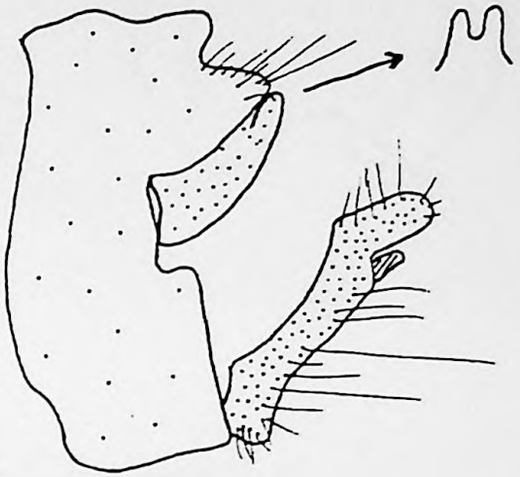
Figure 25. Ceraclea cancellatus, lateral view of male genitalia.



20b

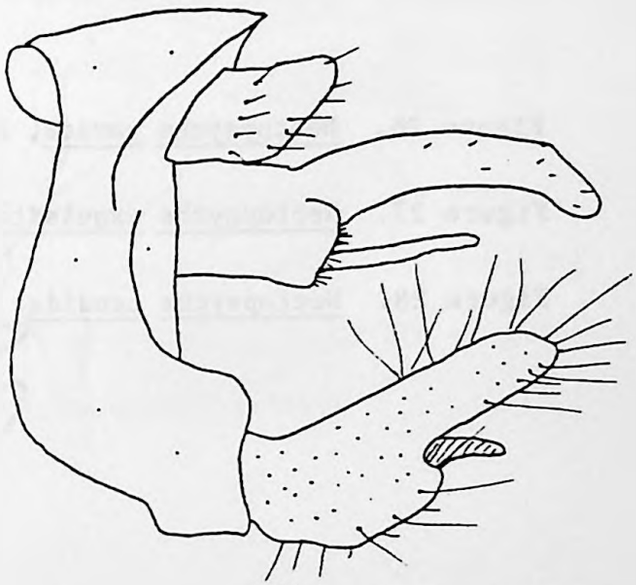
21b

20a



21a

22



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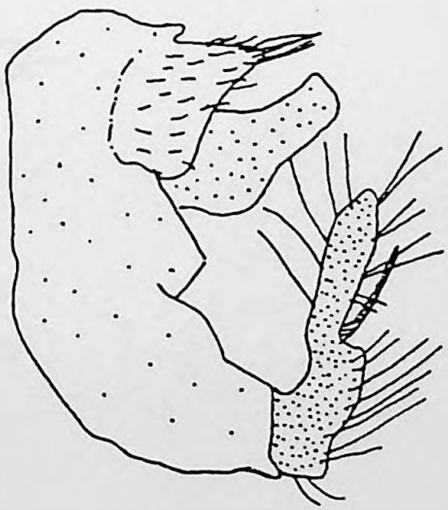

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Figure 26. Nectopsyche pavida, lateral view of male genitalia.

Figure 27. Nectopsyche exquisita, lateral view of male genitalia.

Figure 28. Nectopsyche candida, lateral view of male genitalia.

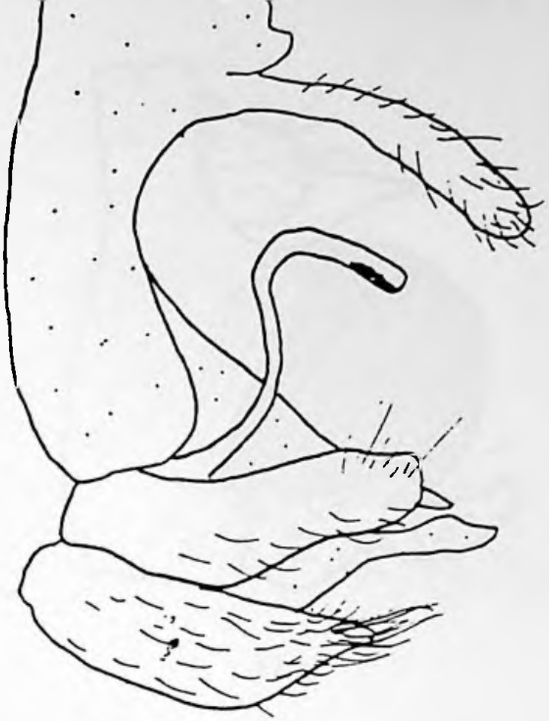

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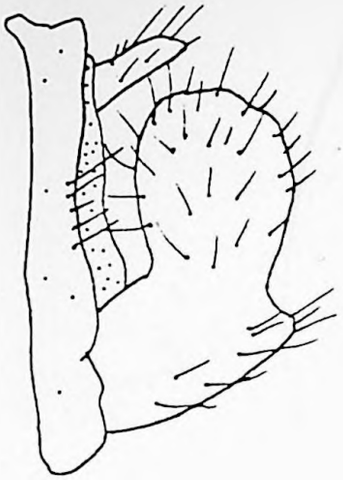
Figure 29. Oecetis avara, lateral view of male genitalia.

Figure 30. Oecetis inconspicua, lateral view of male genitalia (a) and ventral view of claspers (b).

Figure 31. Oecetis persimilis, lateral view of male genitalia.

Figure 32. Oecetis cinerascens, lateral view of male genitalia.

Figure 33. Oecetis nocturna, lateral view of male genitalia (a) and ventral view of claspers (b).



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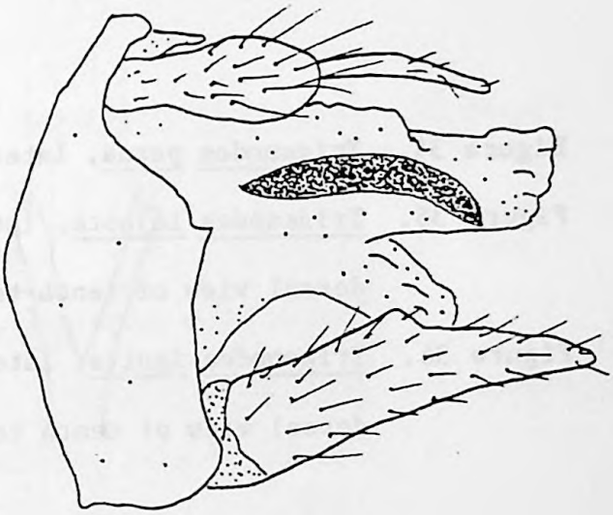

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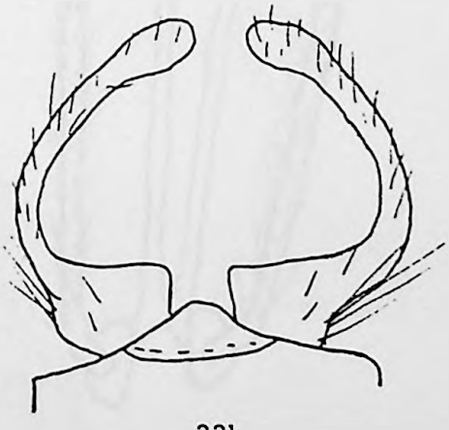
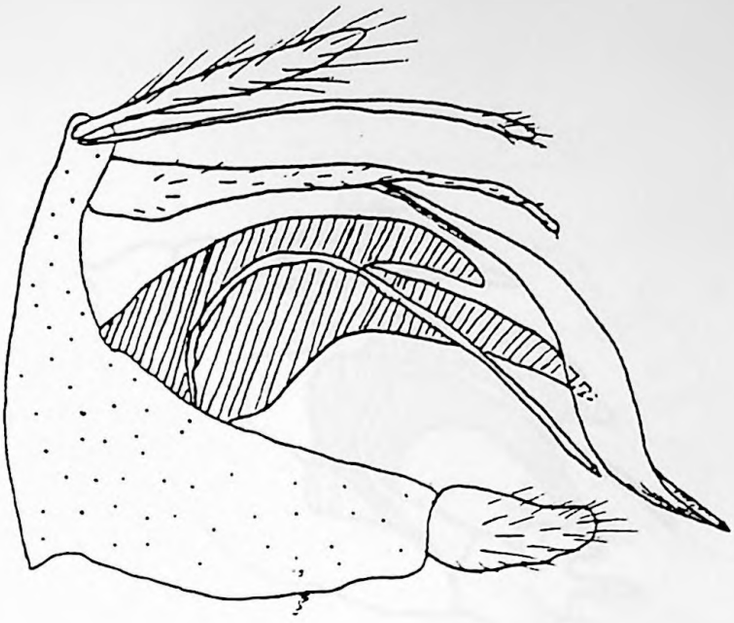


33b

Figure 34. Triaenodes perna, lateral view of male genitalia.

Figure 35. Triaenodes injusta, lateral view of male genitalia (a) and dorsal view of tenth tergite (b).

Figure 36. Triaenodes ignita, lateral view of male genitalia (a) and dorsal view of tenth tergite (b).



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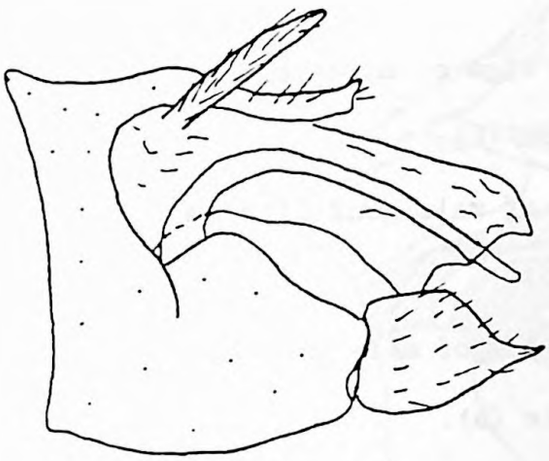

35a

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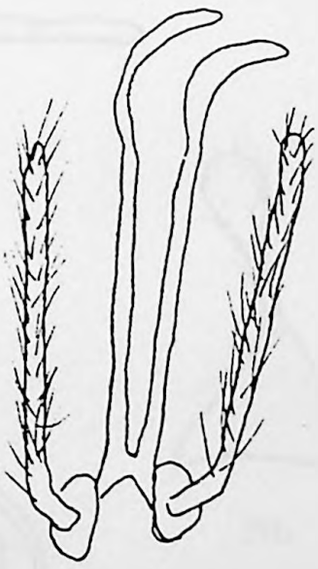


36b

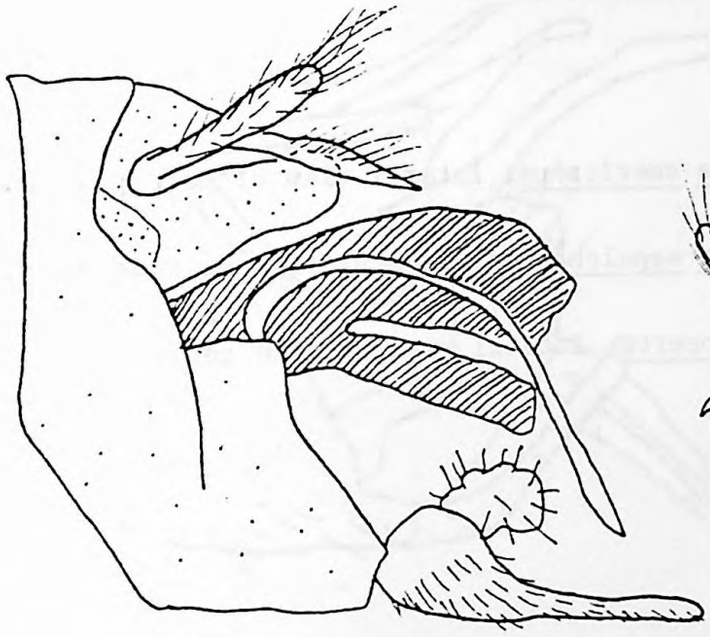
Figure 37. Triaenodes flavescens, lateral view of male genitalia (a) and dorsal view of tenth tergite (b).

Figure 38. Triaenodes tarda, lateral view of male genitalia (a) and dorsal view of tenth tergite (b).

Figure 39. Triaenodes marginata, lateral view of male genitalia (a) and dorsal view of tenth tergite (b).

37a

37b



38a

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39a

39b

Figure 40. Leptocerus americanus, lateral view of male genitalia.

Figure 41. Mystacides sepulchralis, lateral view of male genitalia.

Figure 42. Setodes incerta, lateral view of male genitalia.

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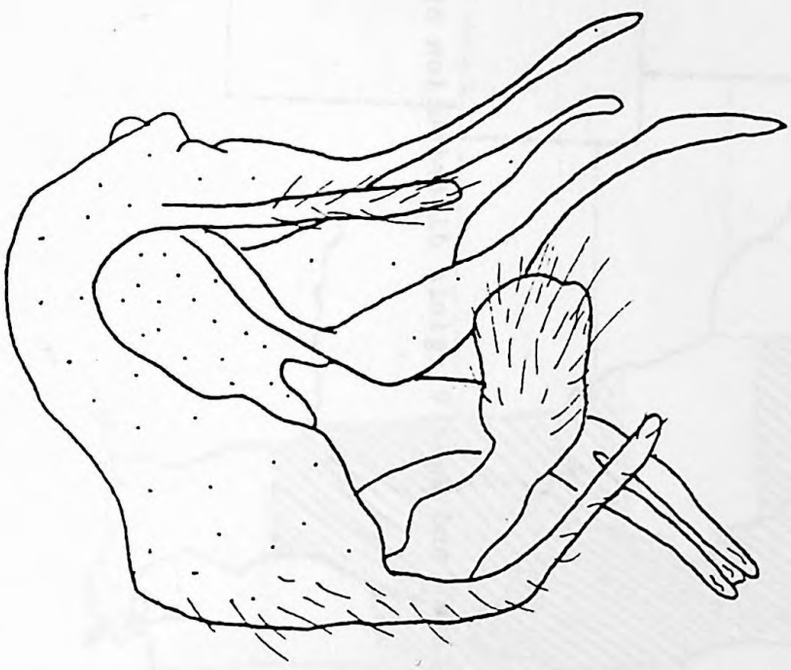

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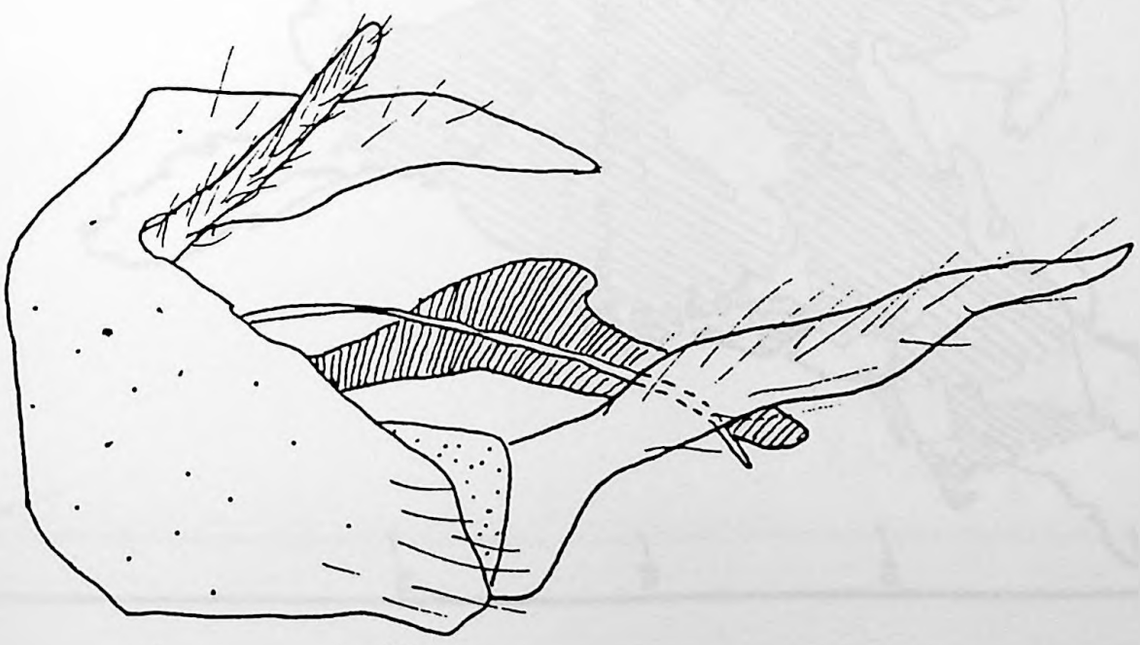

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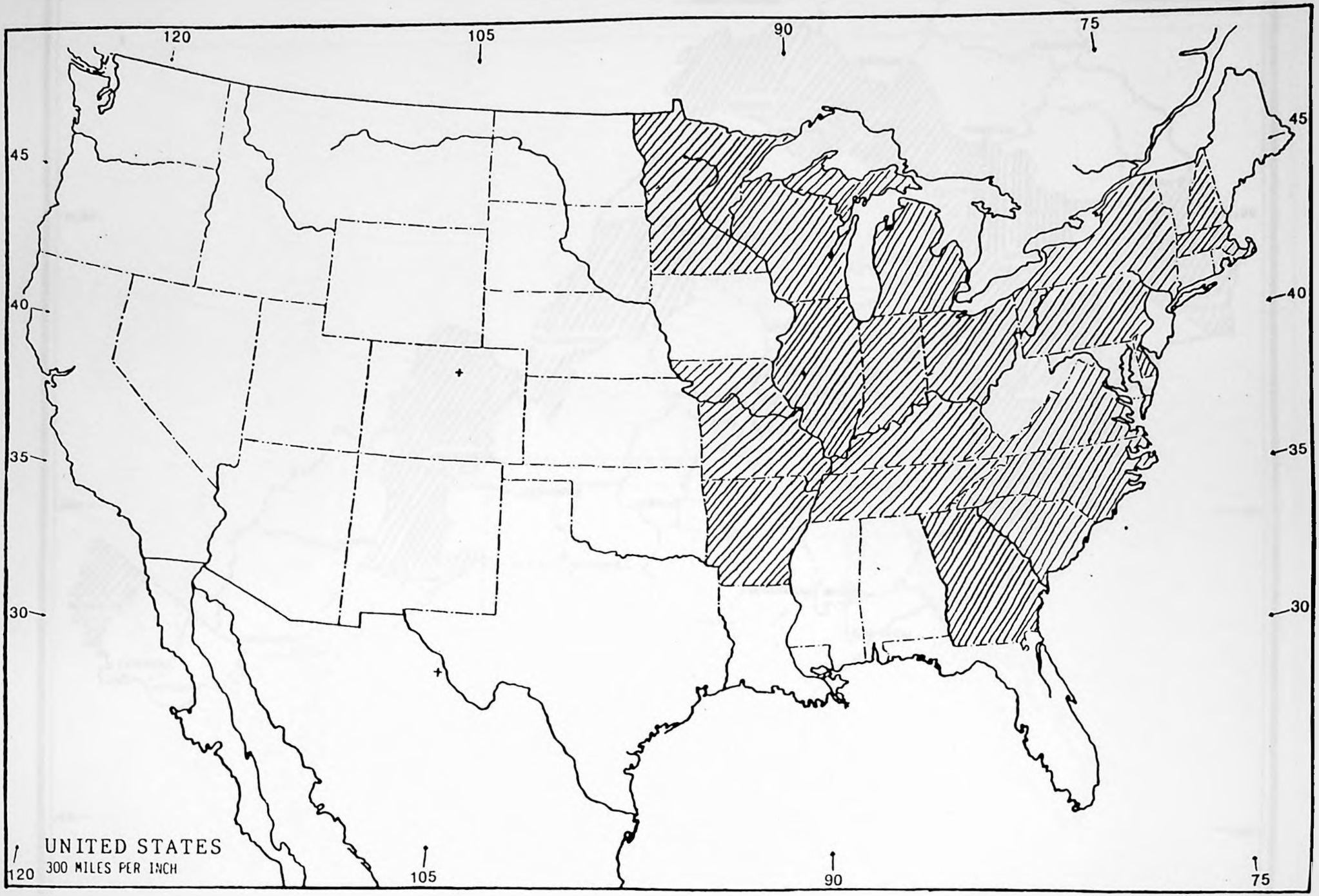
Figures 43-44. United States and West Virginia distribution of Ceraclea cancellata.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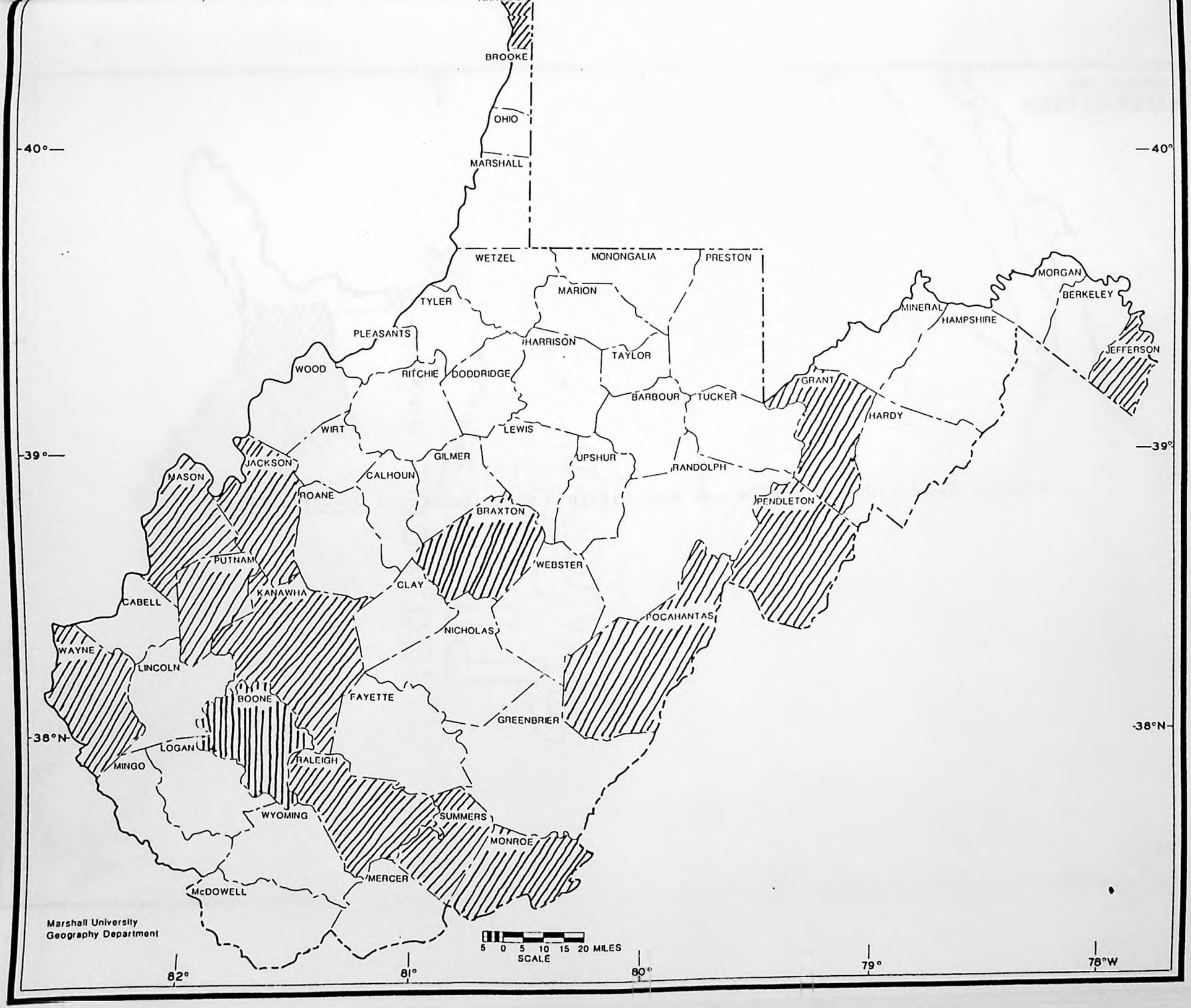
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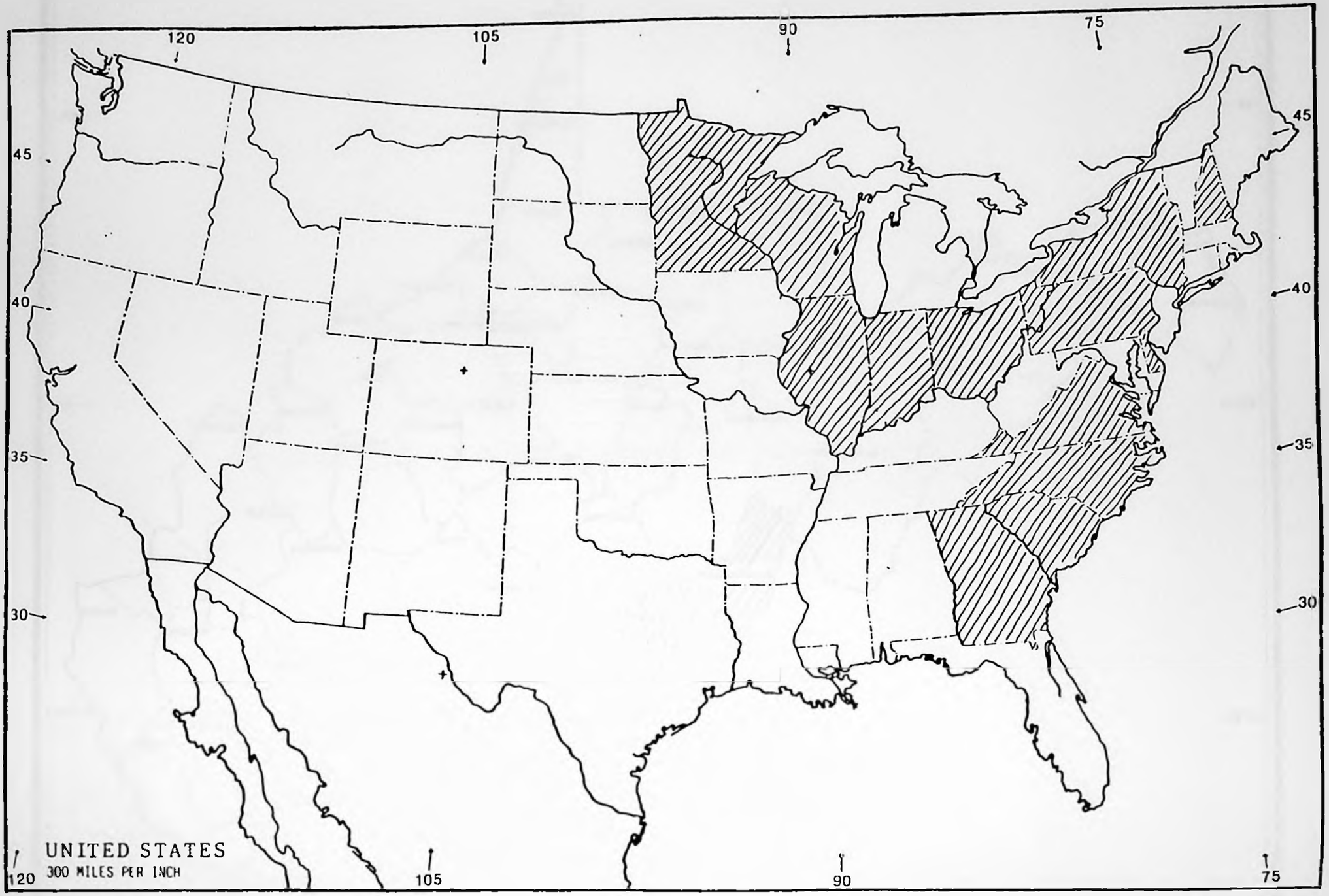
Figures 45-46. United States and West Virginia distribution of Ceraclea diluta.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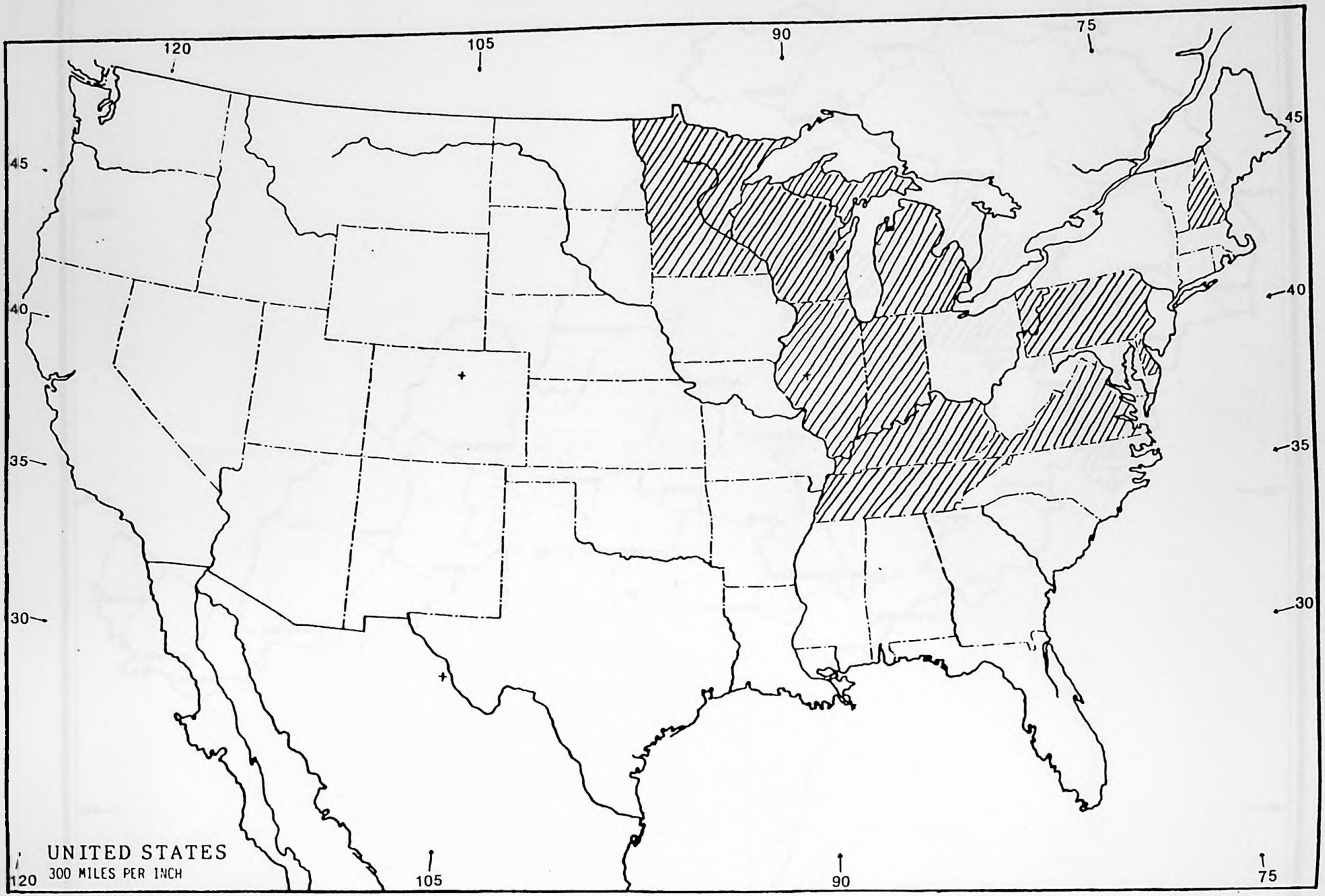
Figures 47-48. United States and West Virginia distribution of Ceraclea flava.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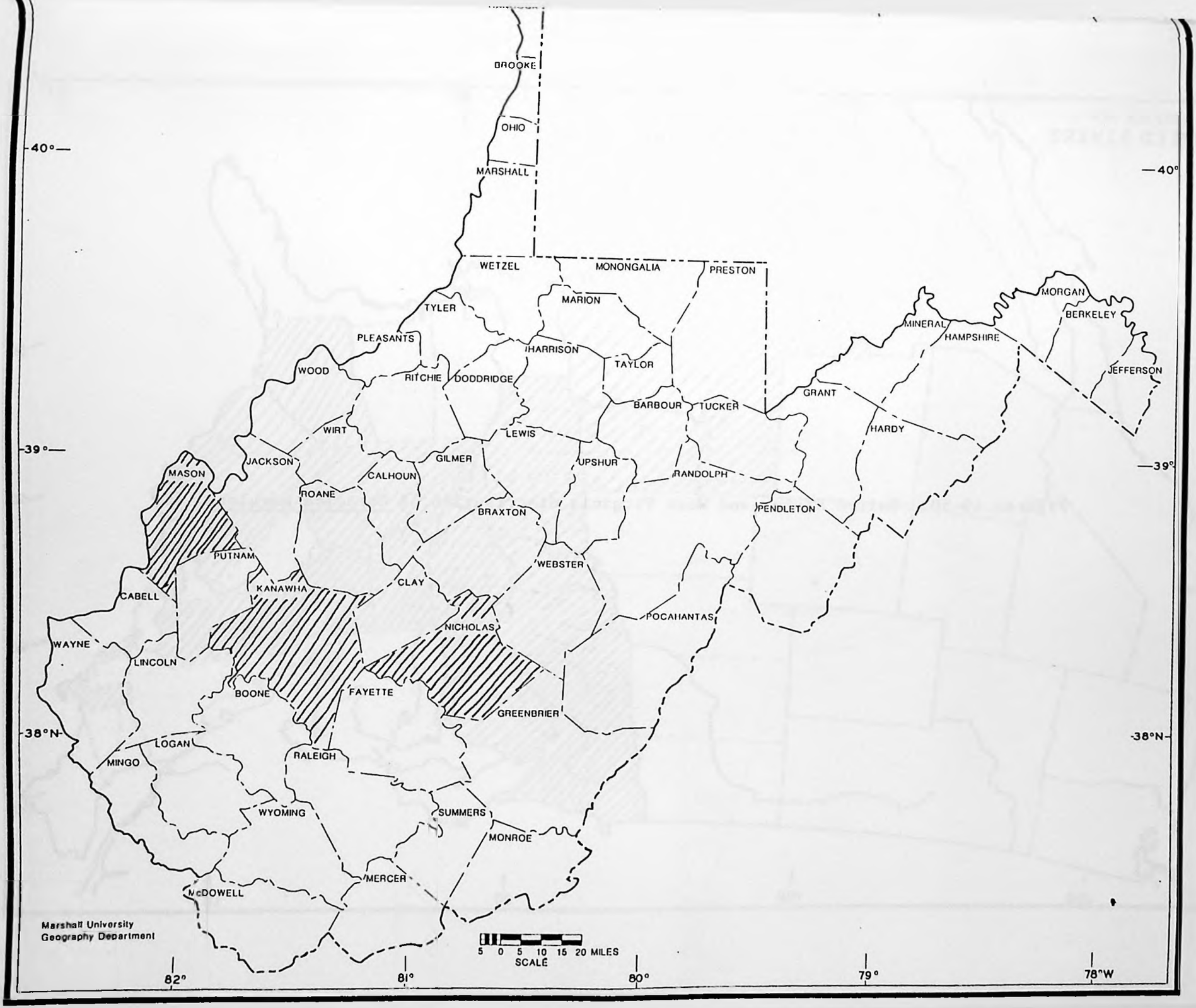
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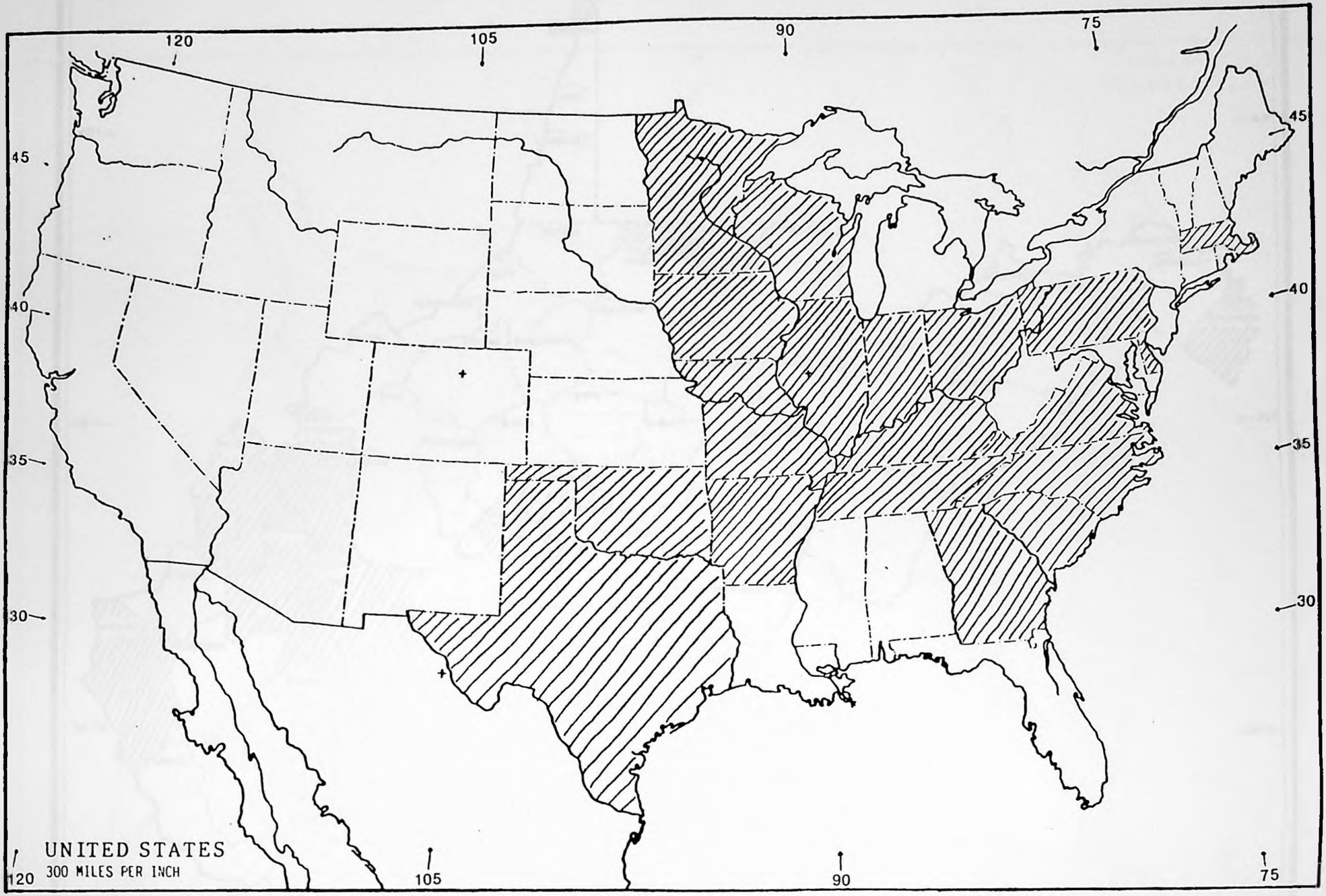
Figures 49–50. United States and West Virginia distribution of *Ceraclea maculata*.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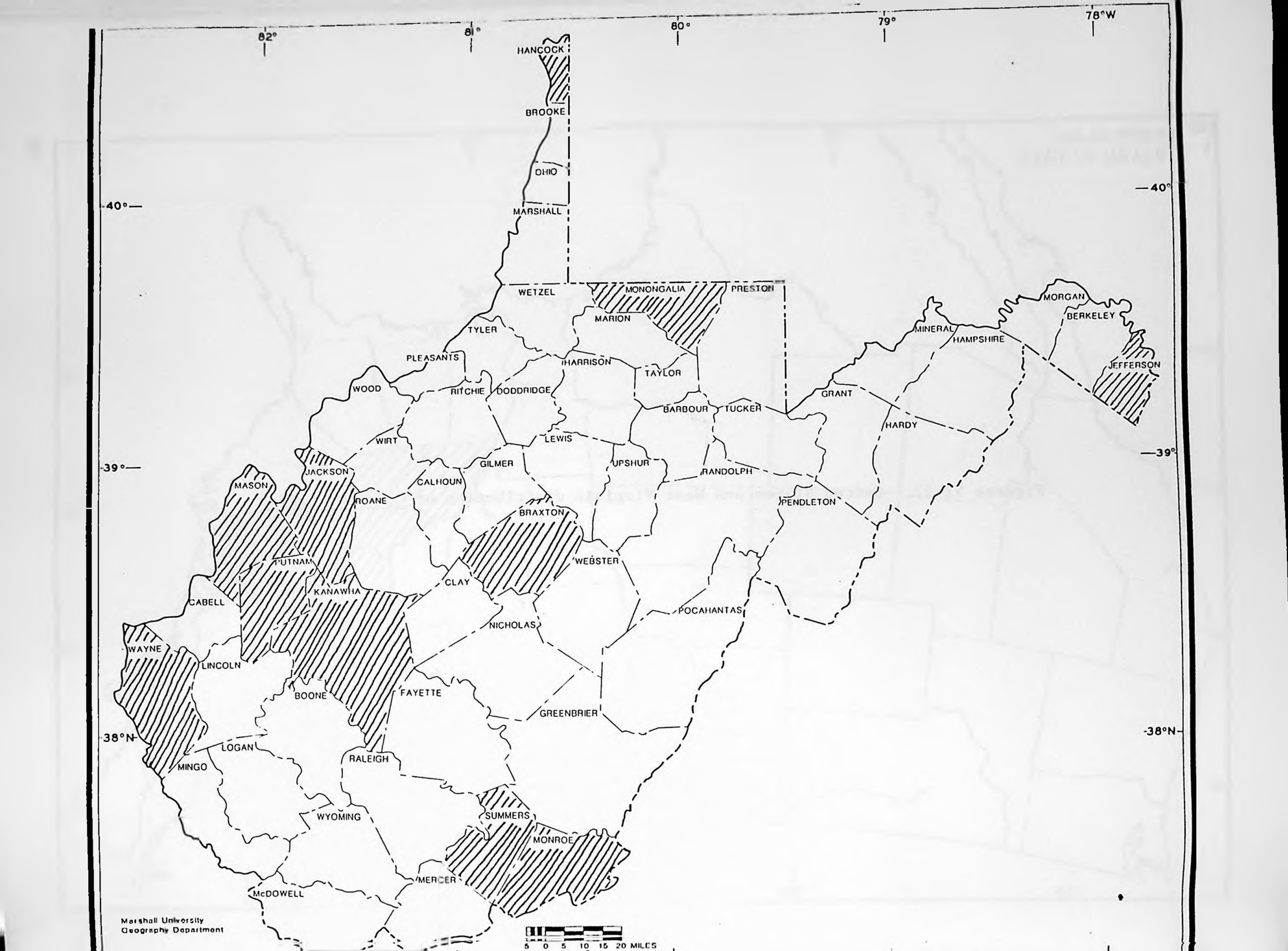
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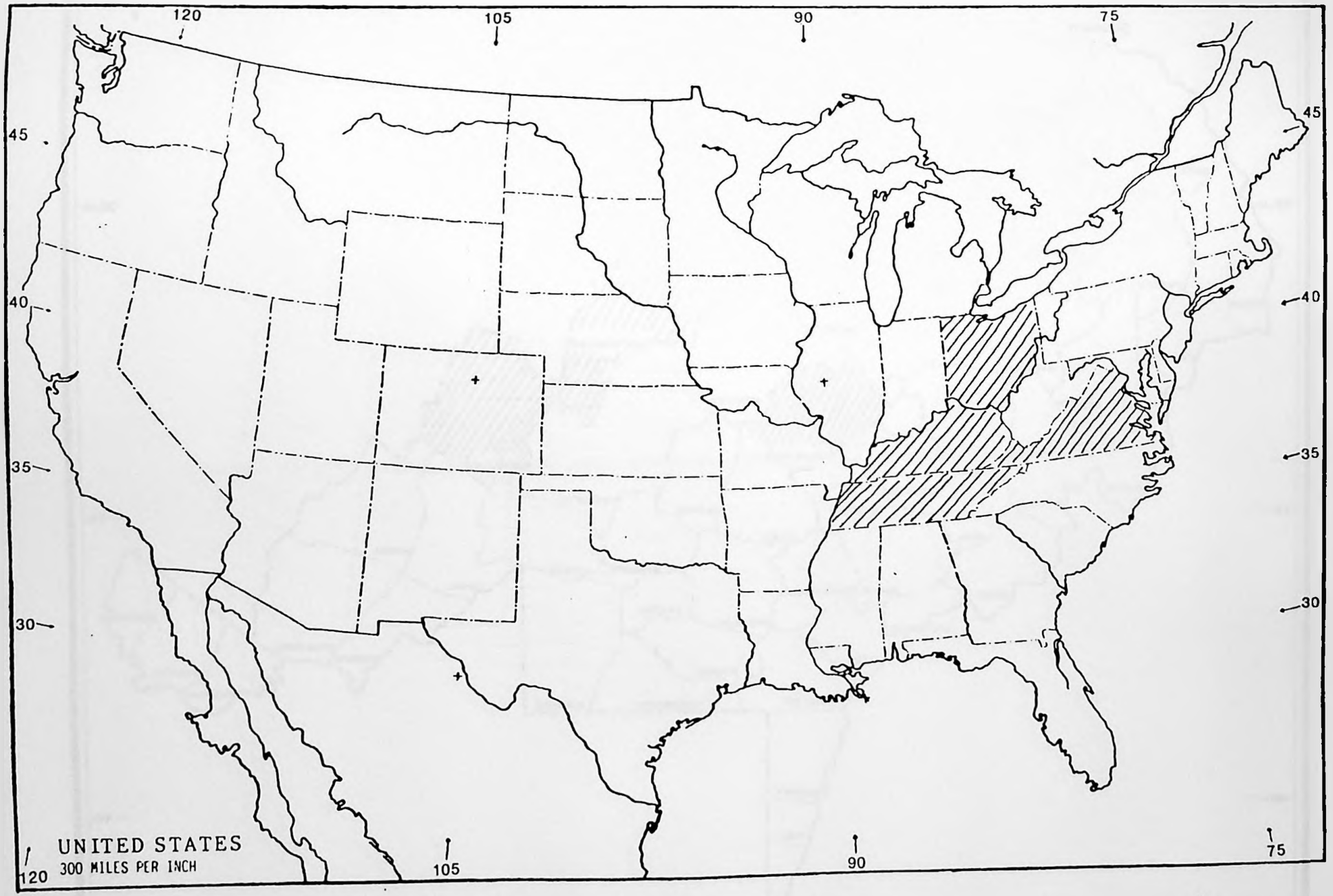
Figures 51-52. United States and West Virginia distribution of Ceraclea neffi.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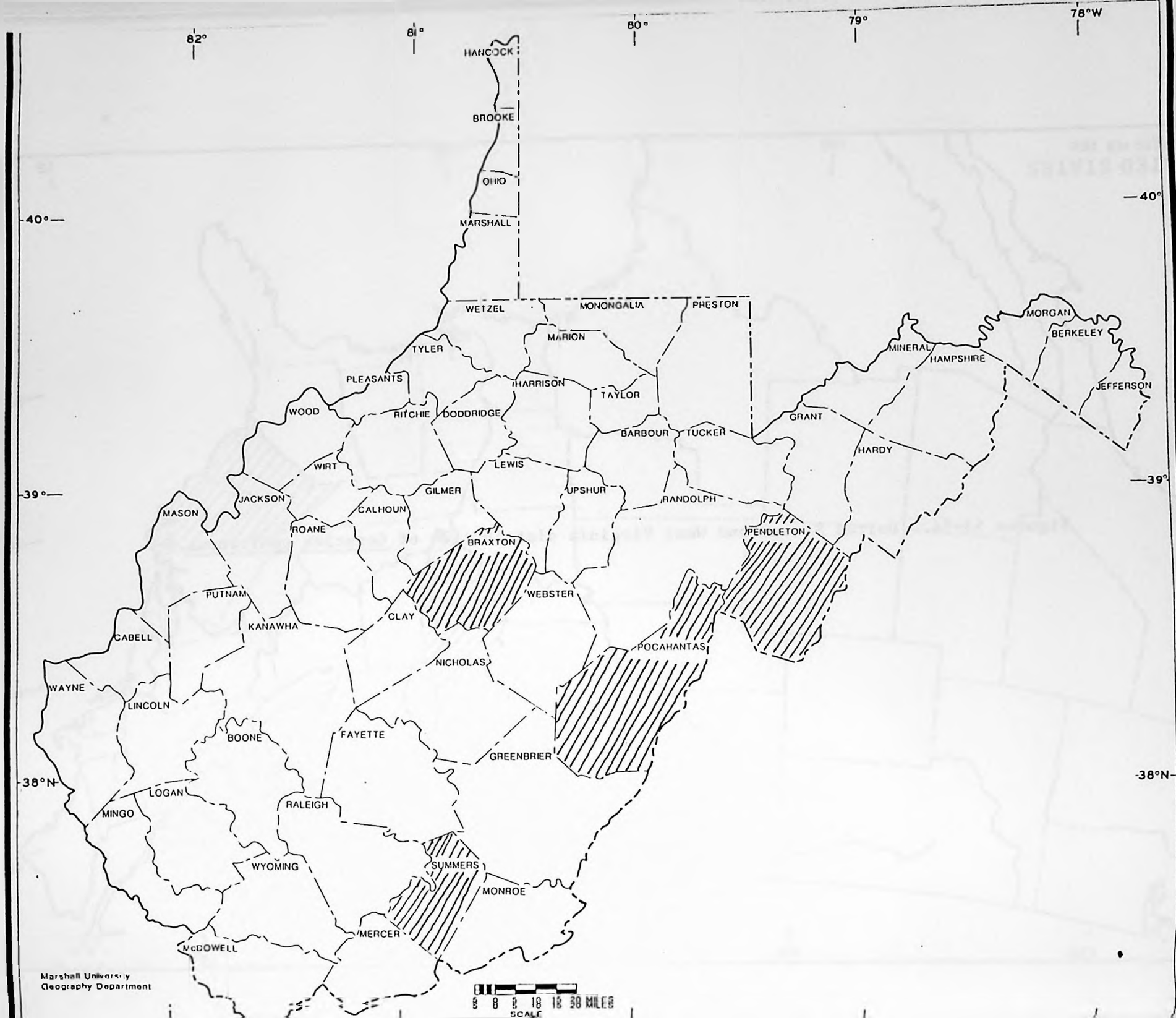
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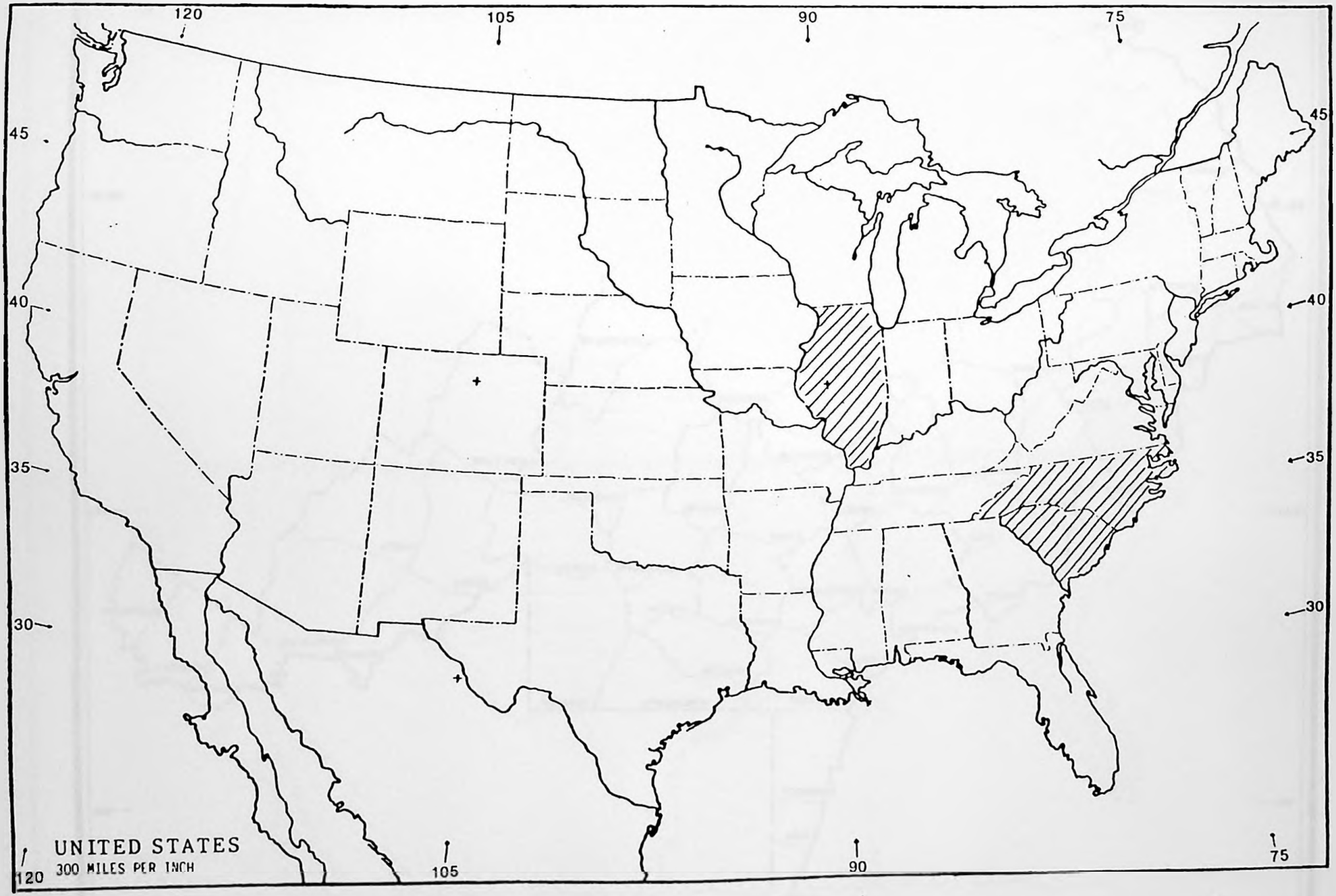
Figures 53-54. United States and West Virginia distribution of Ceraclea ophioderus.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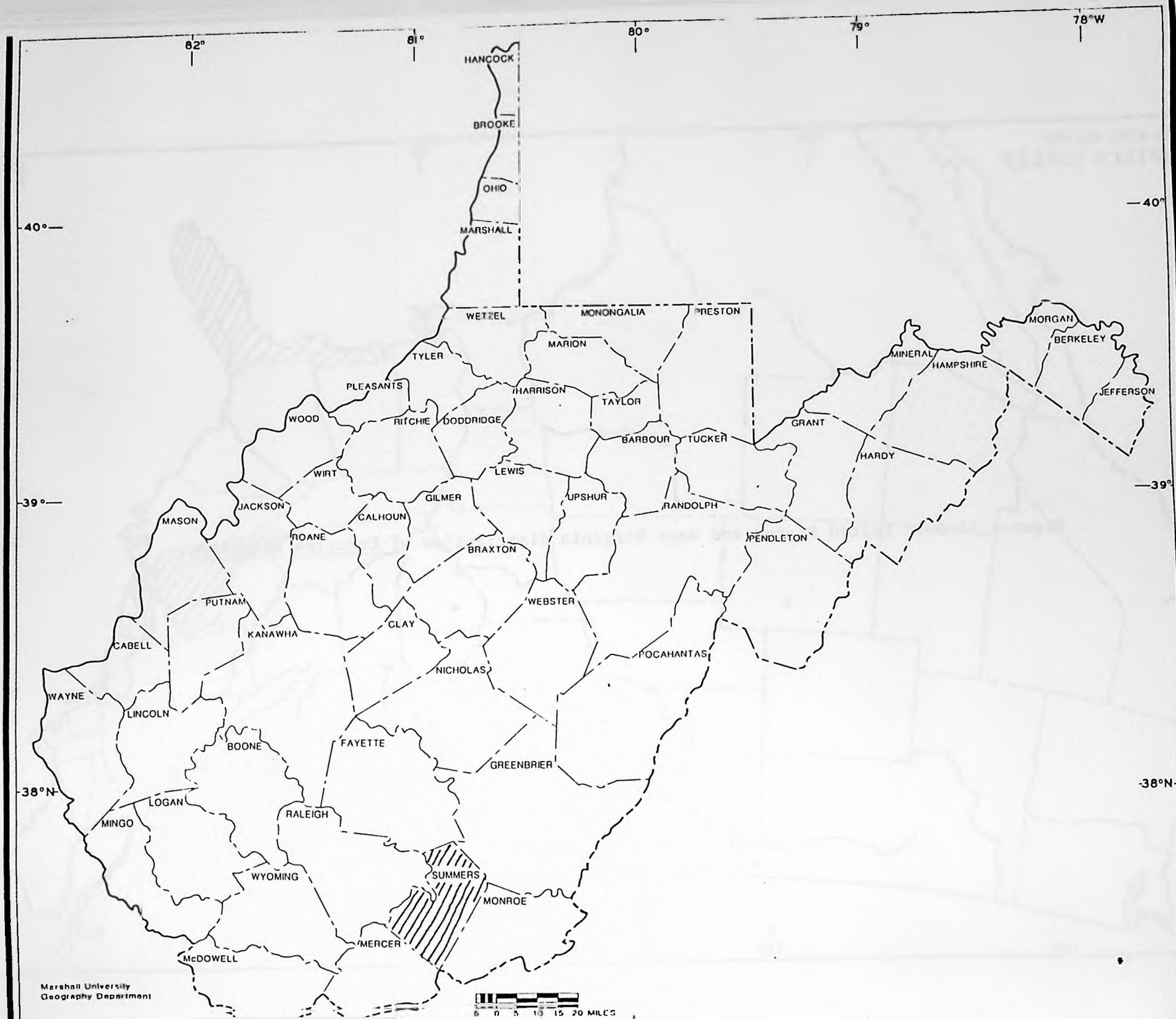
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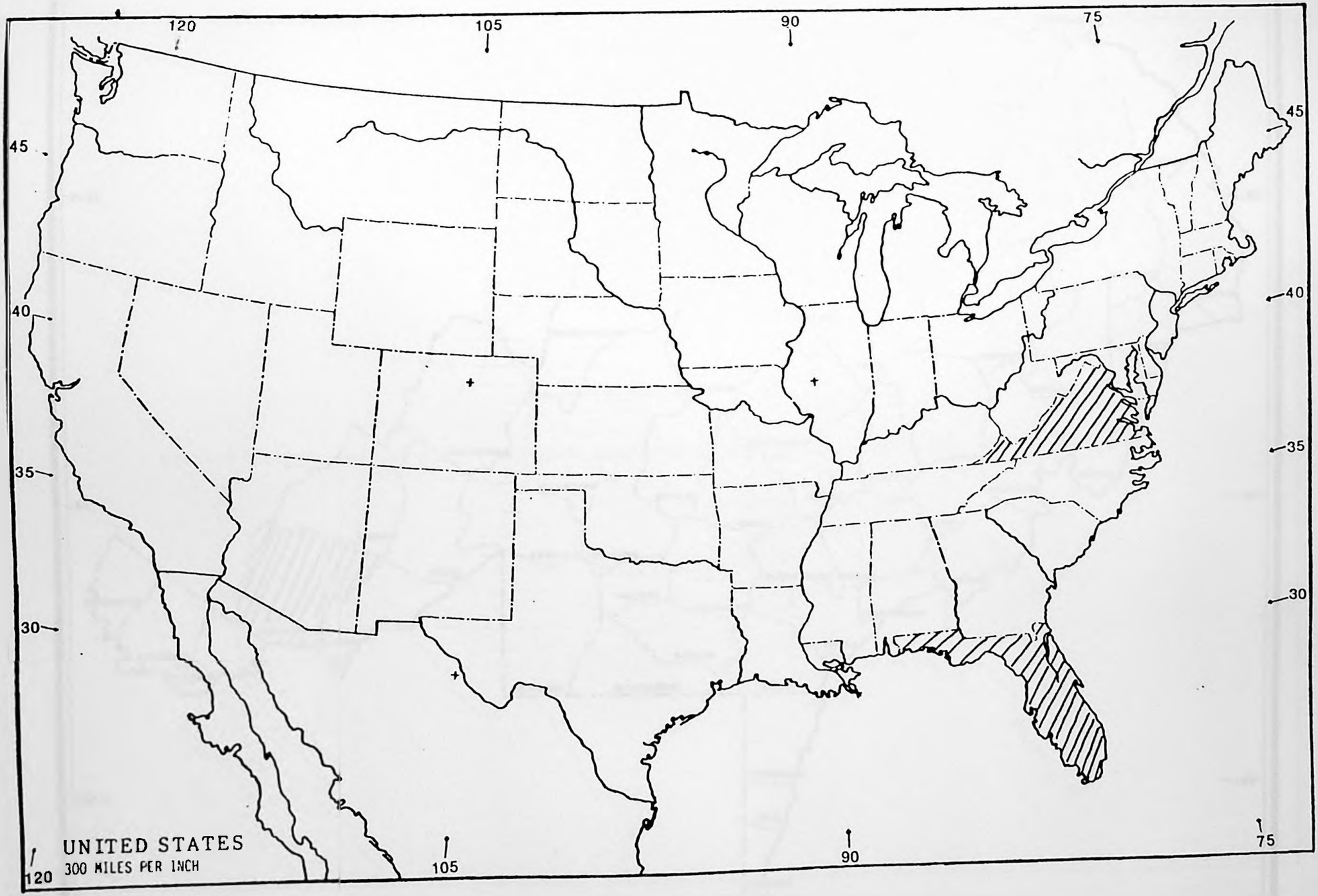
Figures 55-56. United States and West Virginia distribution of Ceraclea slossonae.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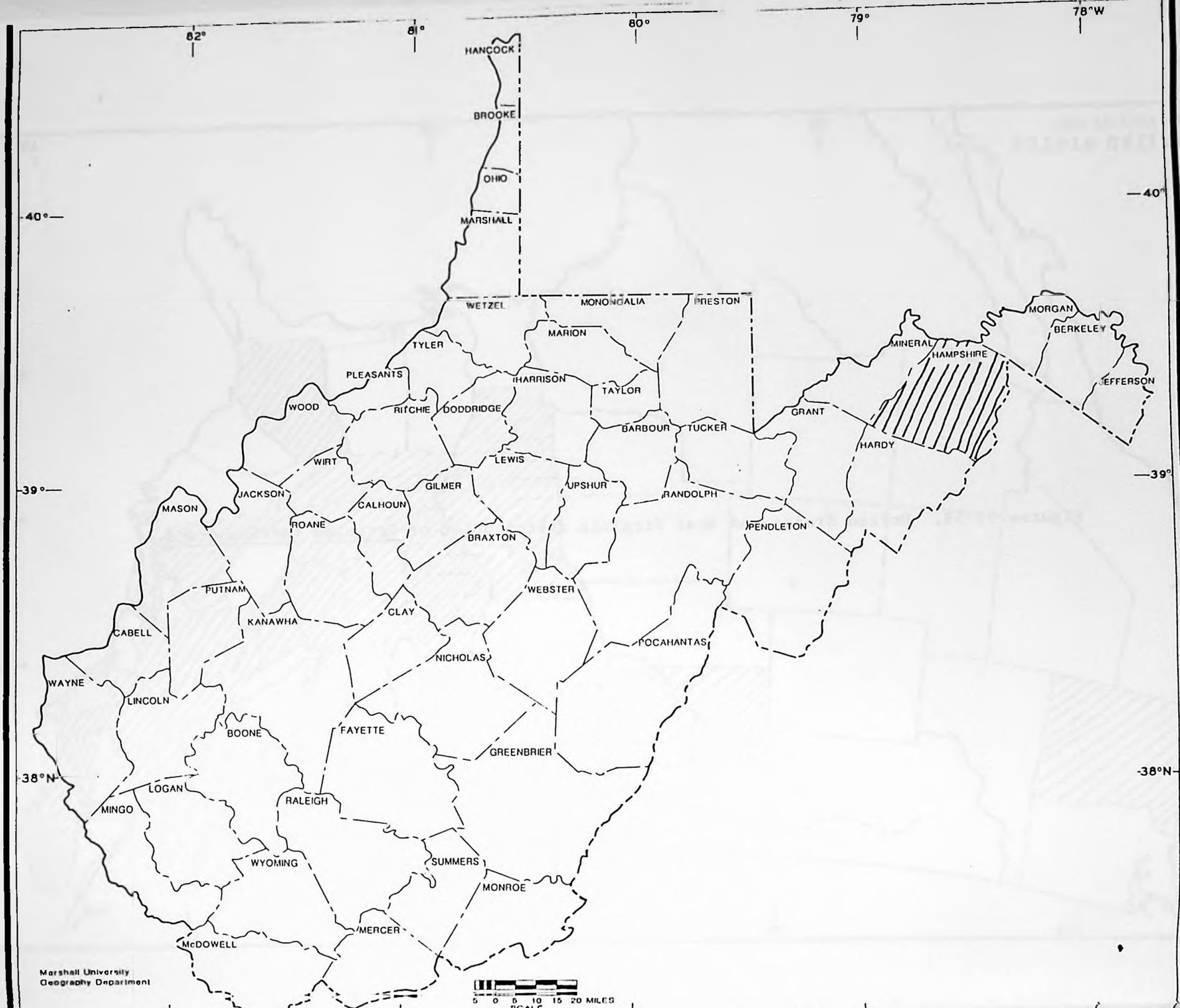
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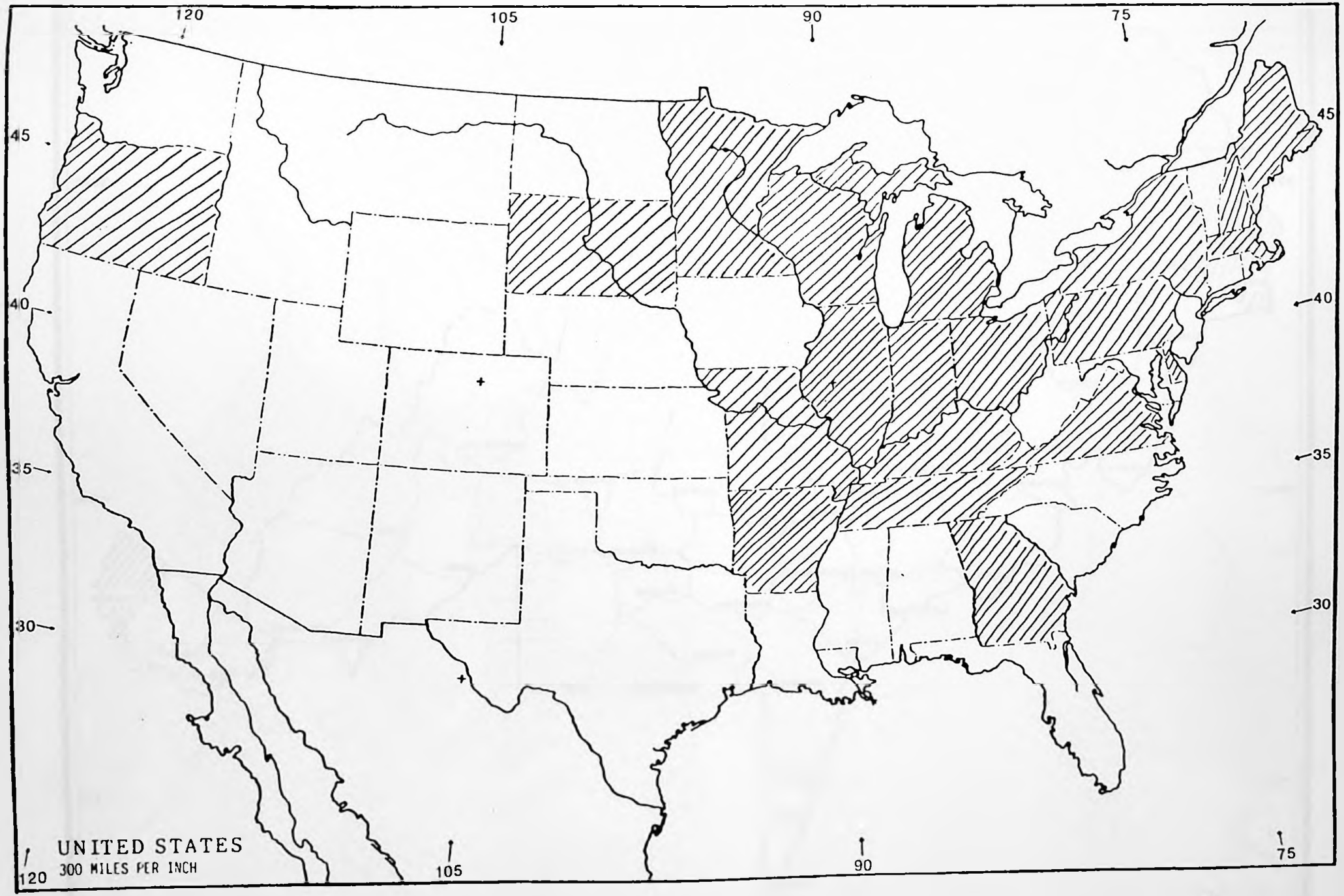
Figures 57-58. United States and West Virginia distribution of Ceraclea tarsipunctata.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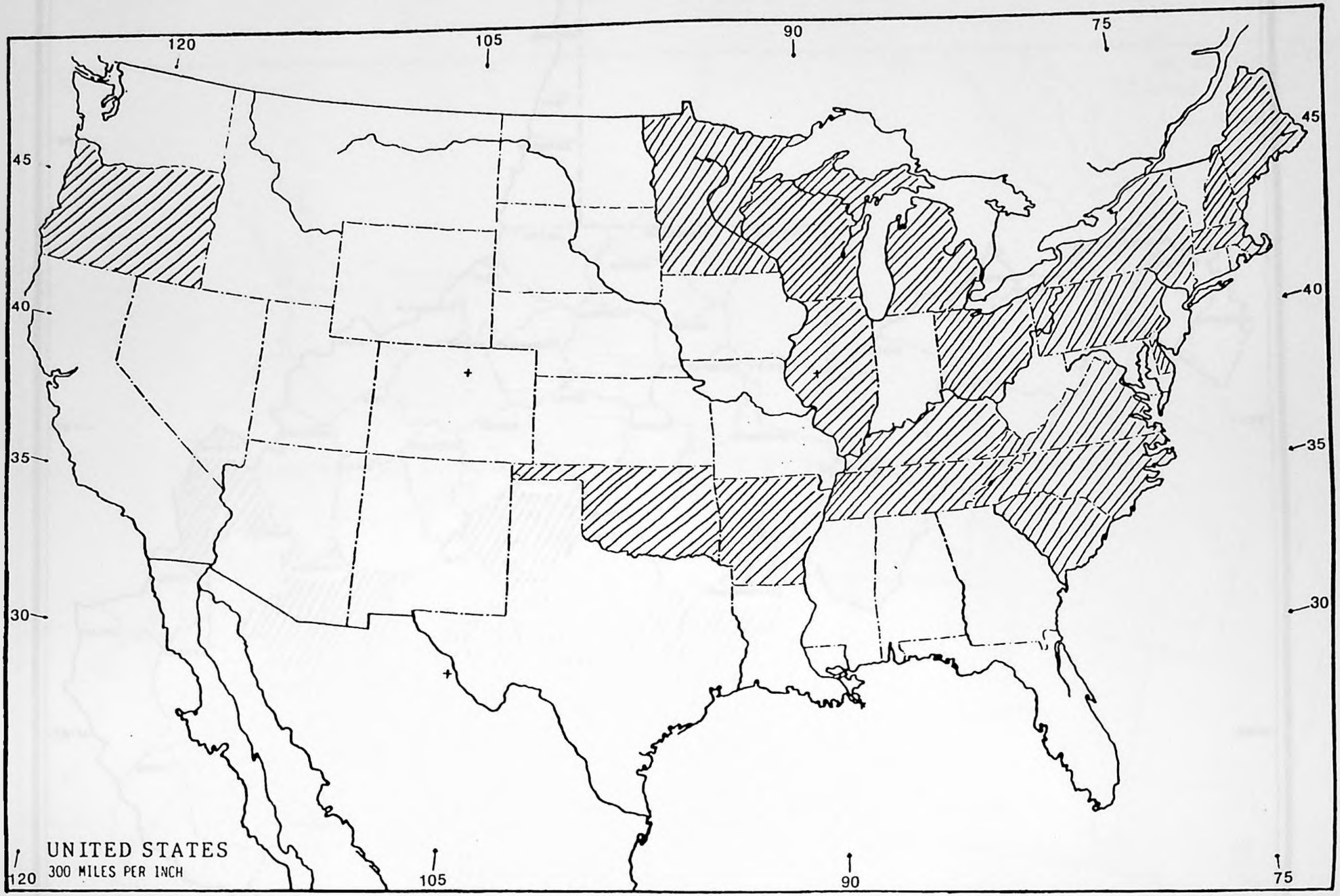
Figures 59-60. United States and West Virginia distribution of Ceraclea transversa.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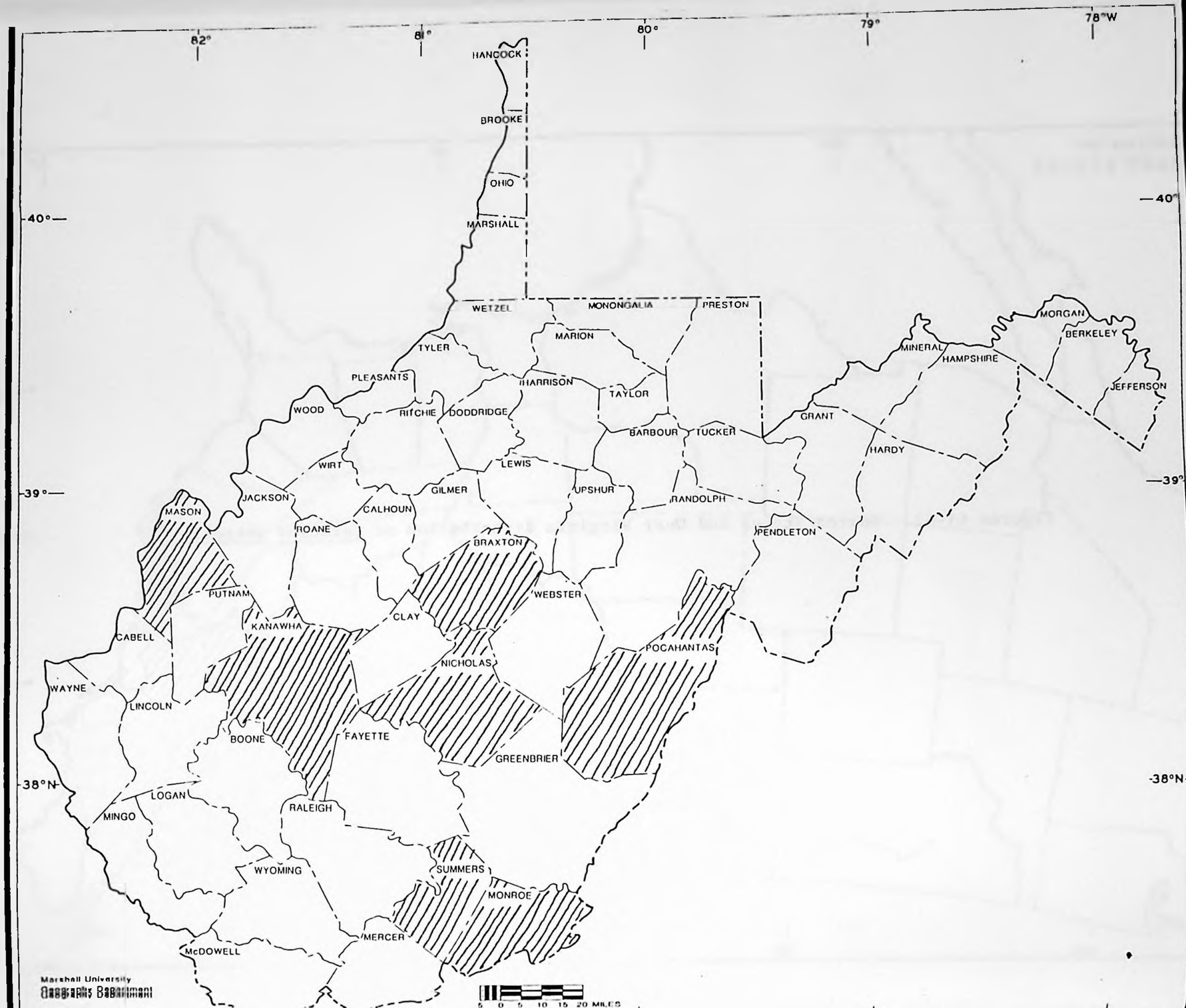
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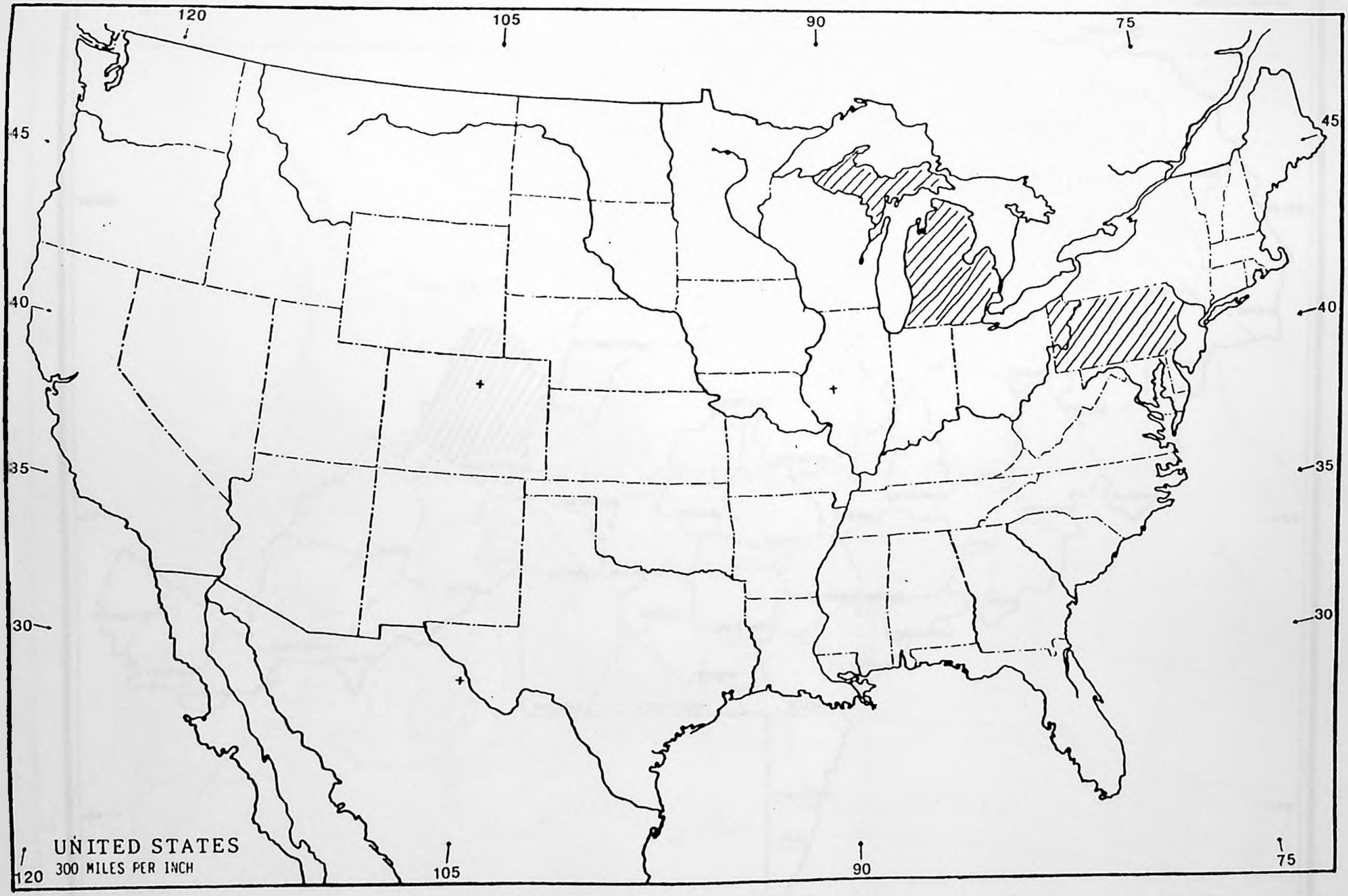
Figures 61-62. United States and West Virginia distribution of Ceraclea wetzeli.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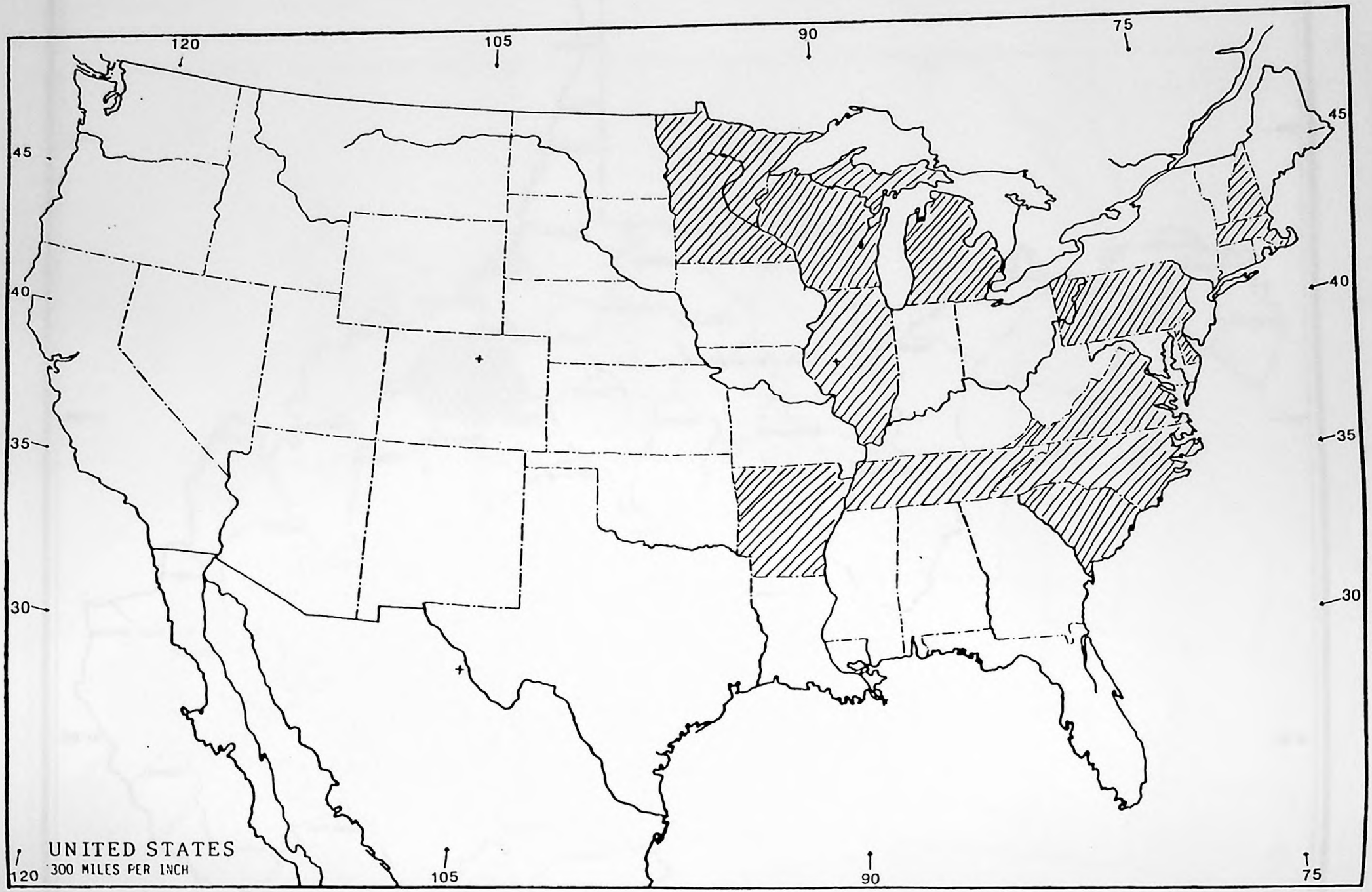
Figures 63-64. United States and West Virginia distribution of Leptocerus americanus.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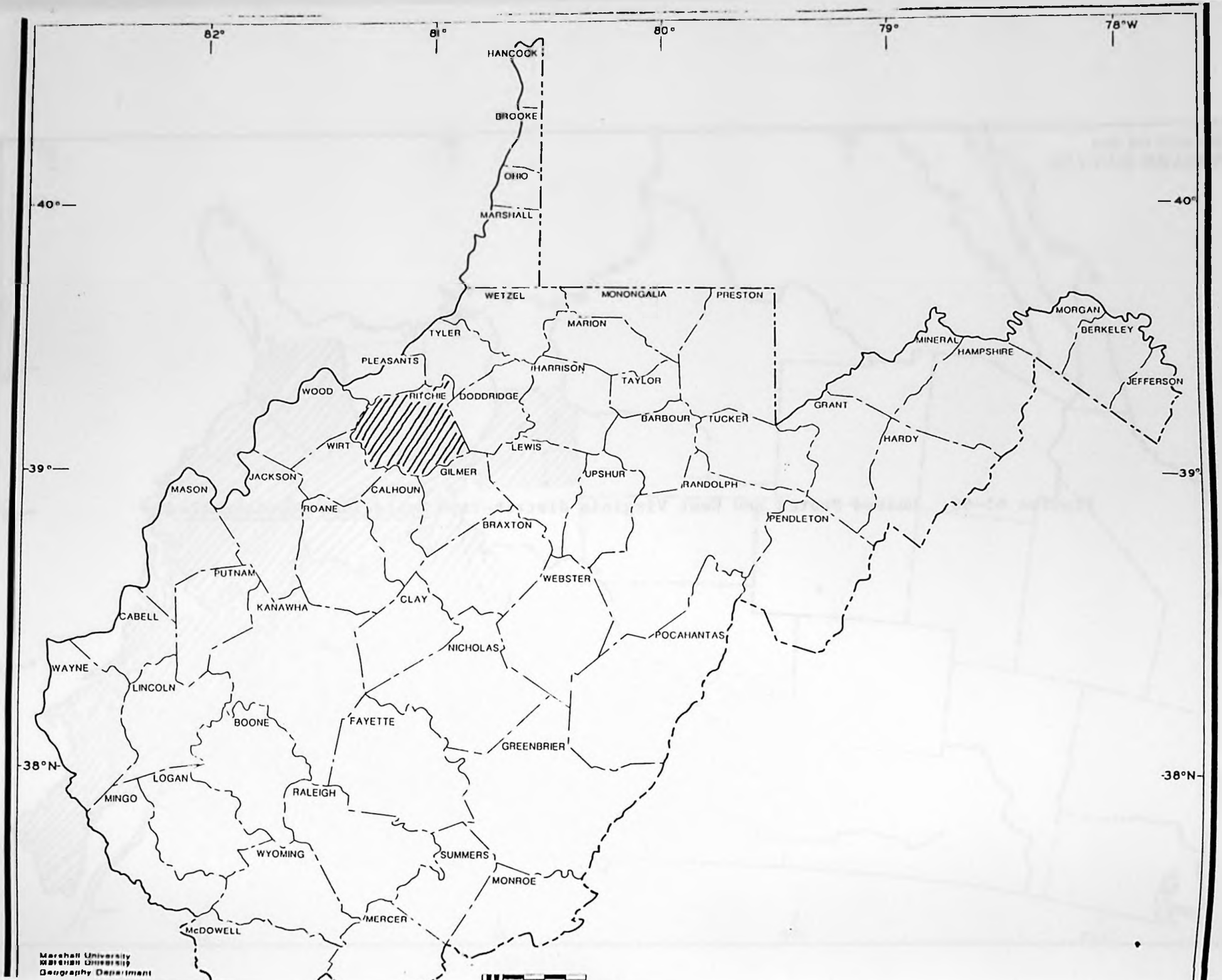
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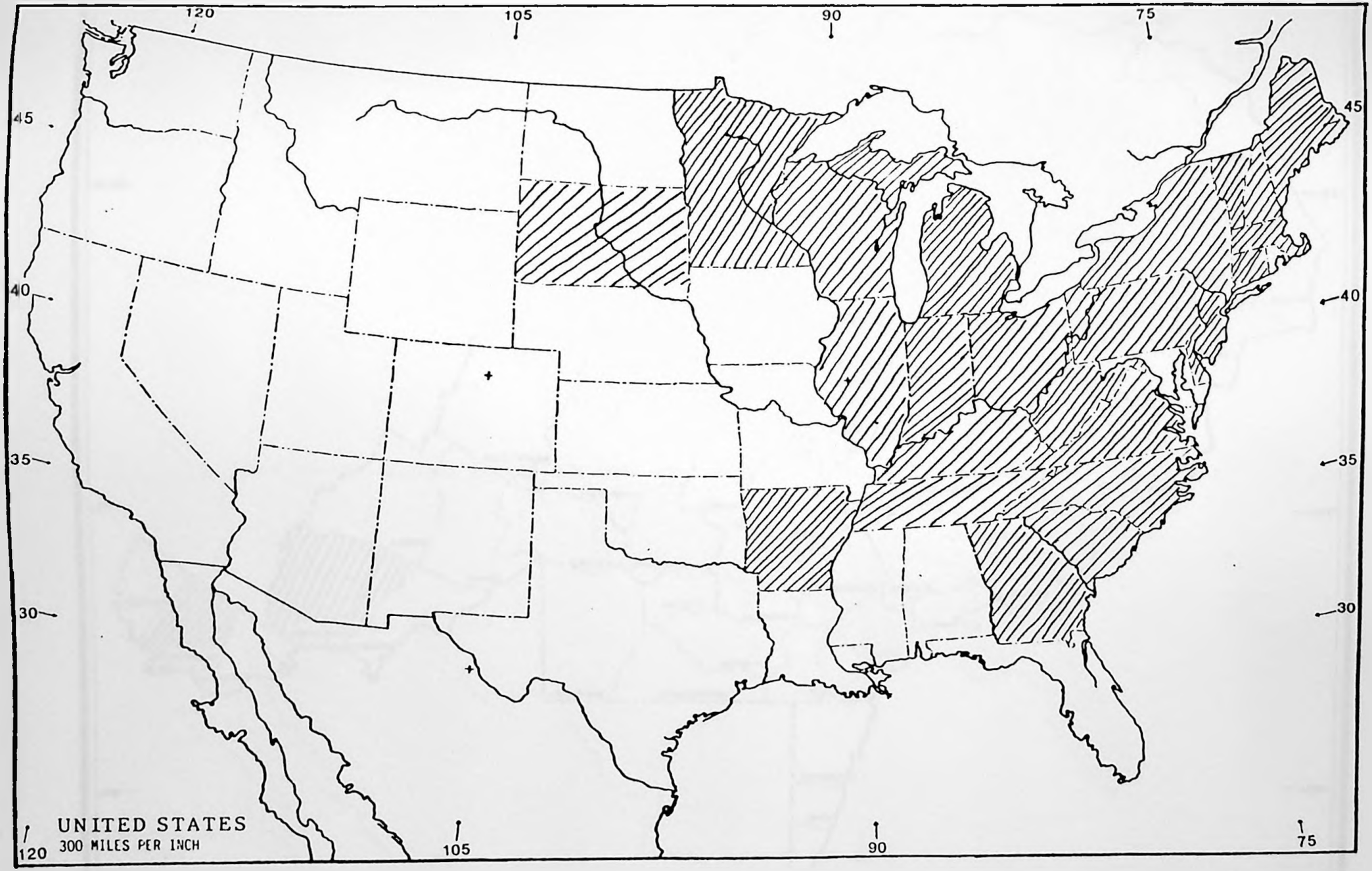
Figures 65-66. United States and West Virginia distribution Mystacides sepulchralis.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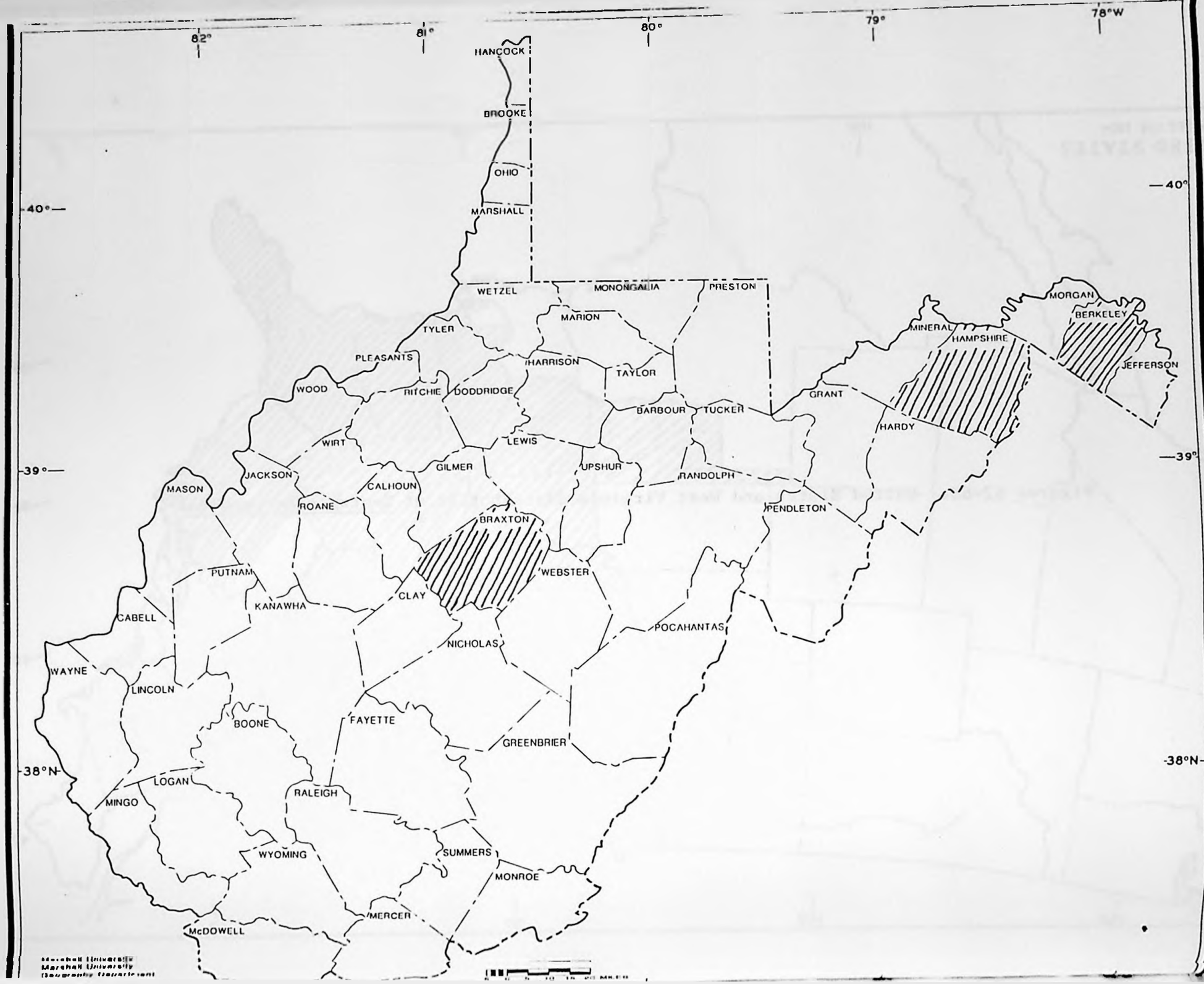
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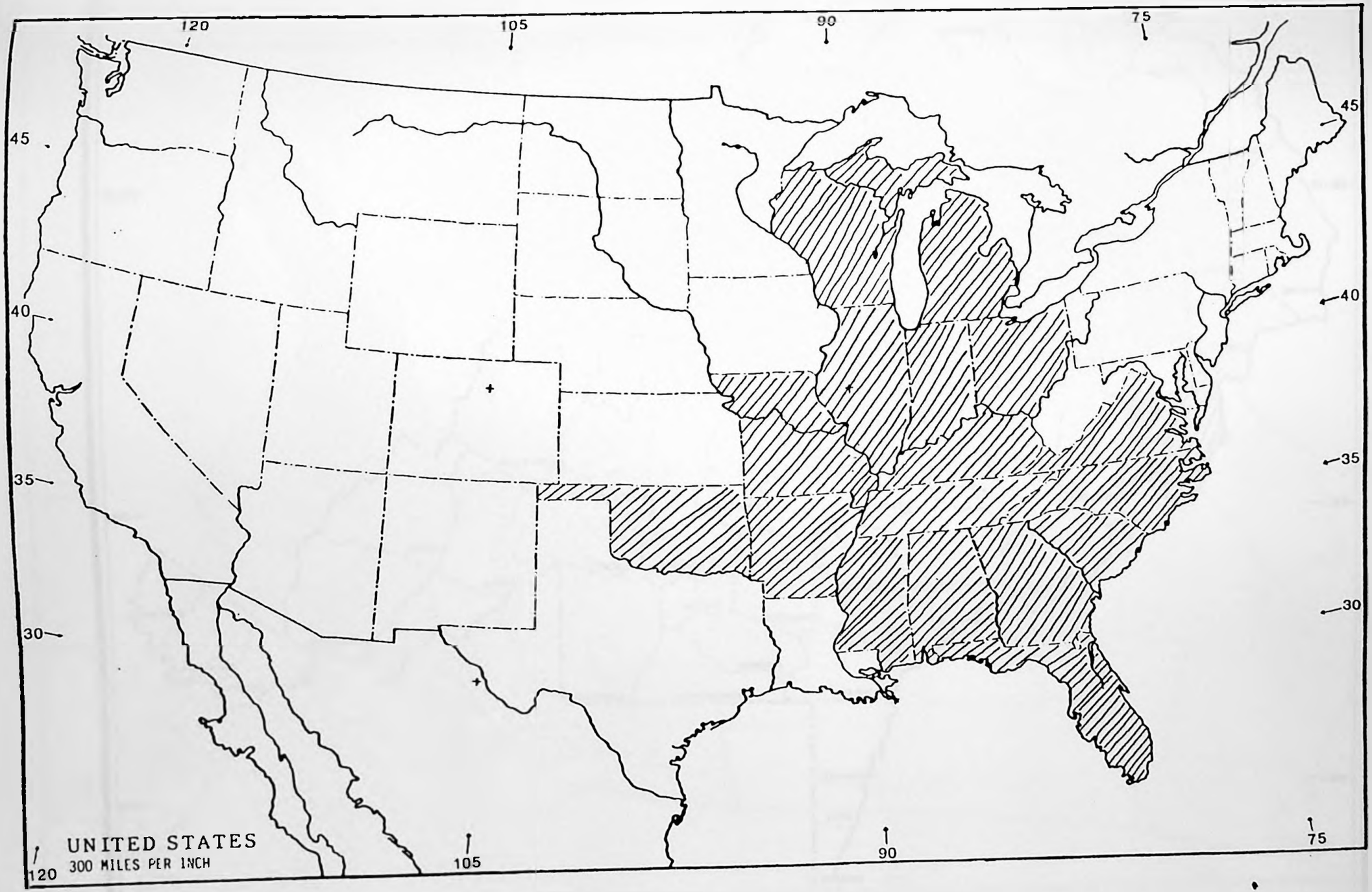
Figures 67-68. United States and West Virginia distribution of Nectopsyche candida.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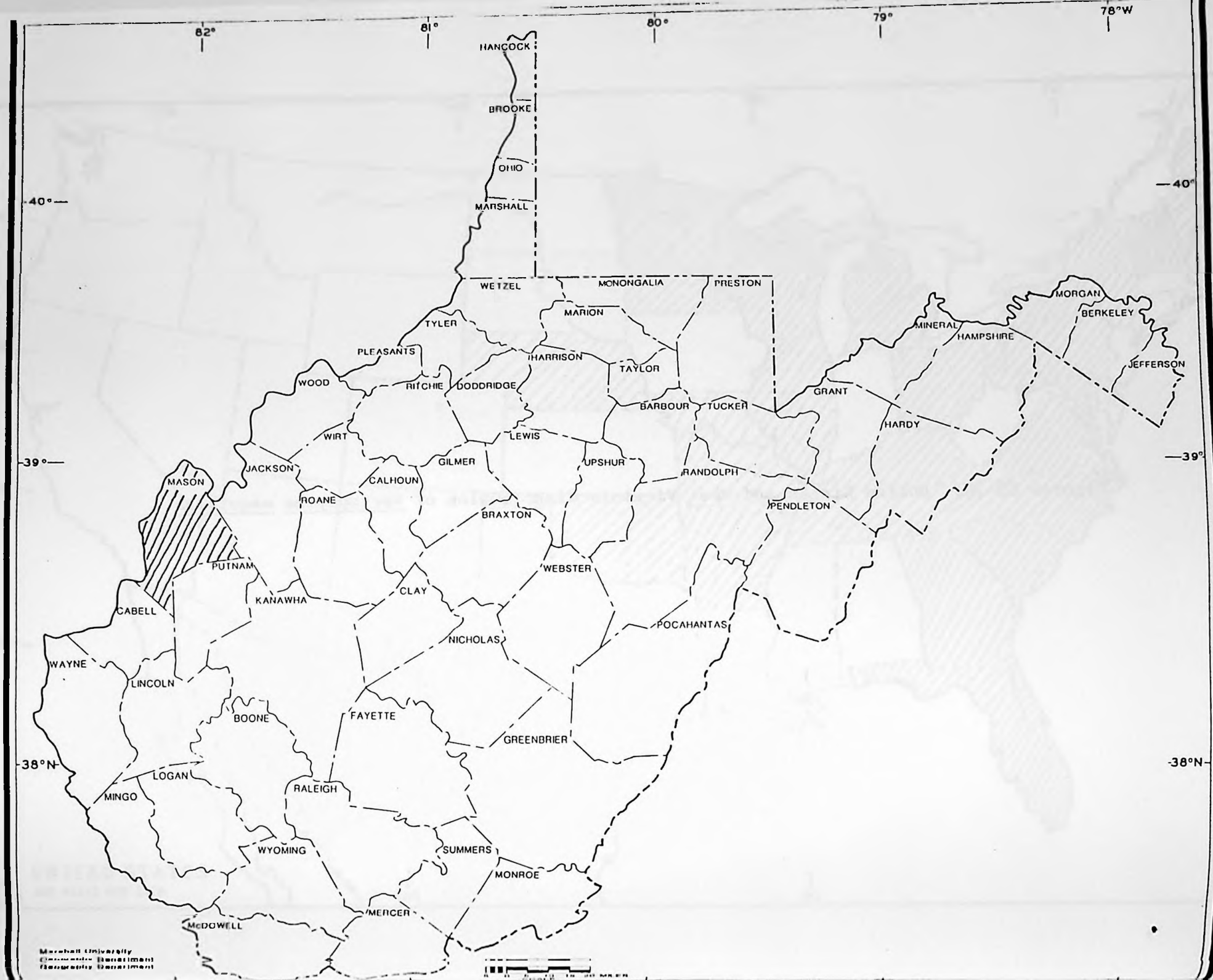
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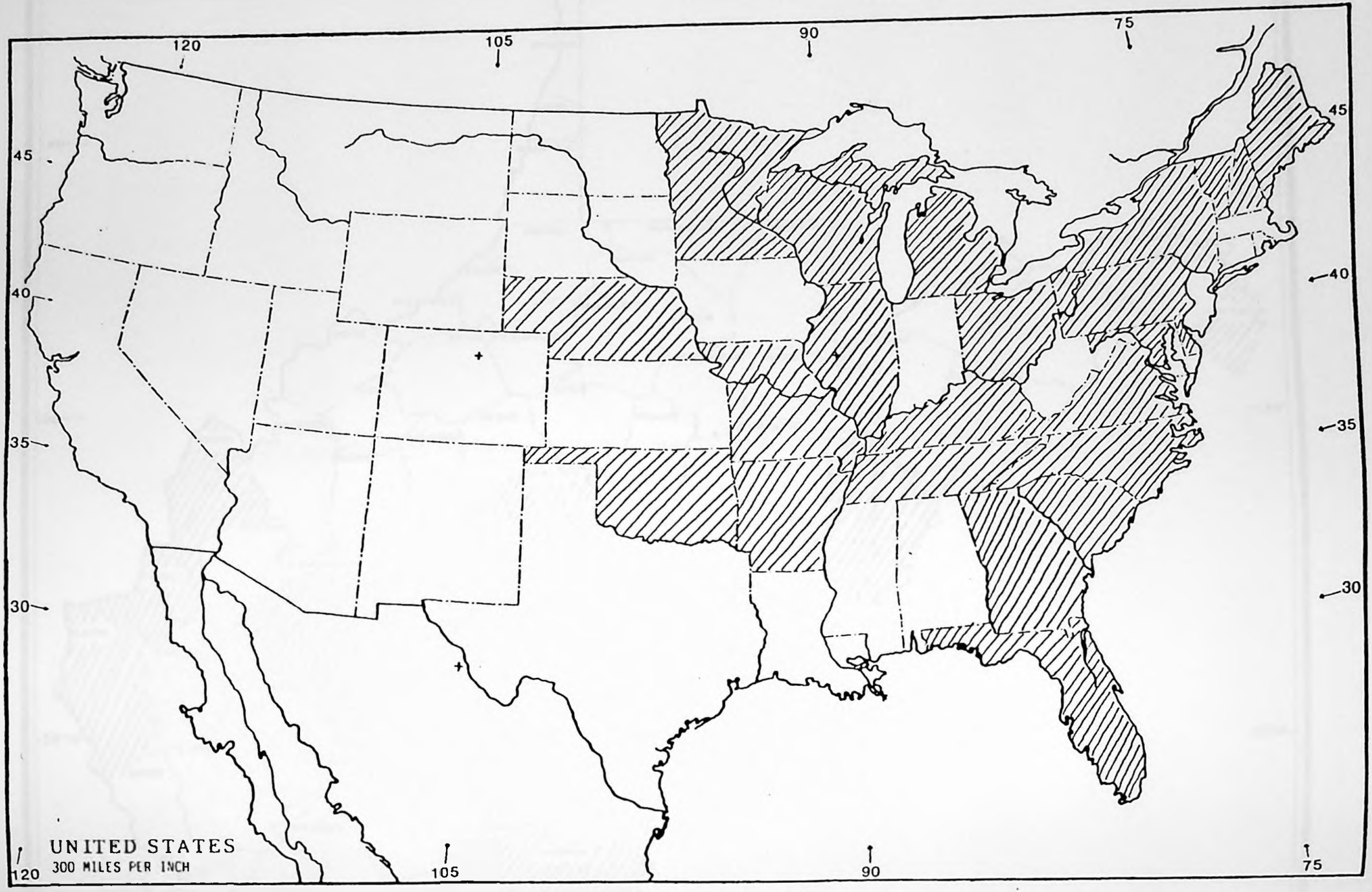
Figures 69-70. United States and West Virginia distribution of Nectopsyche exquisita.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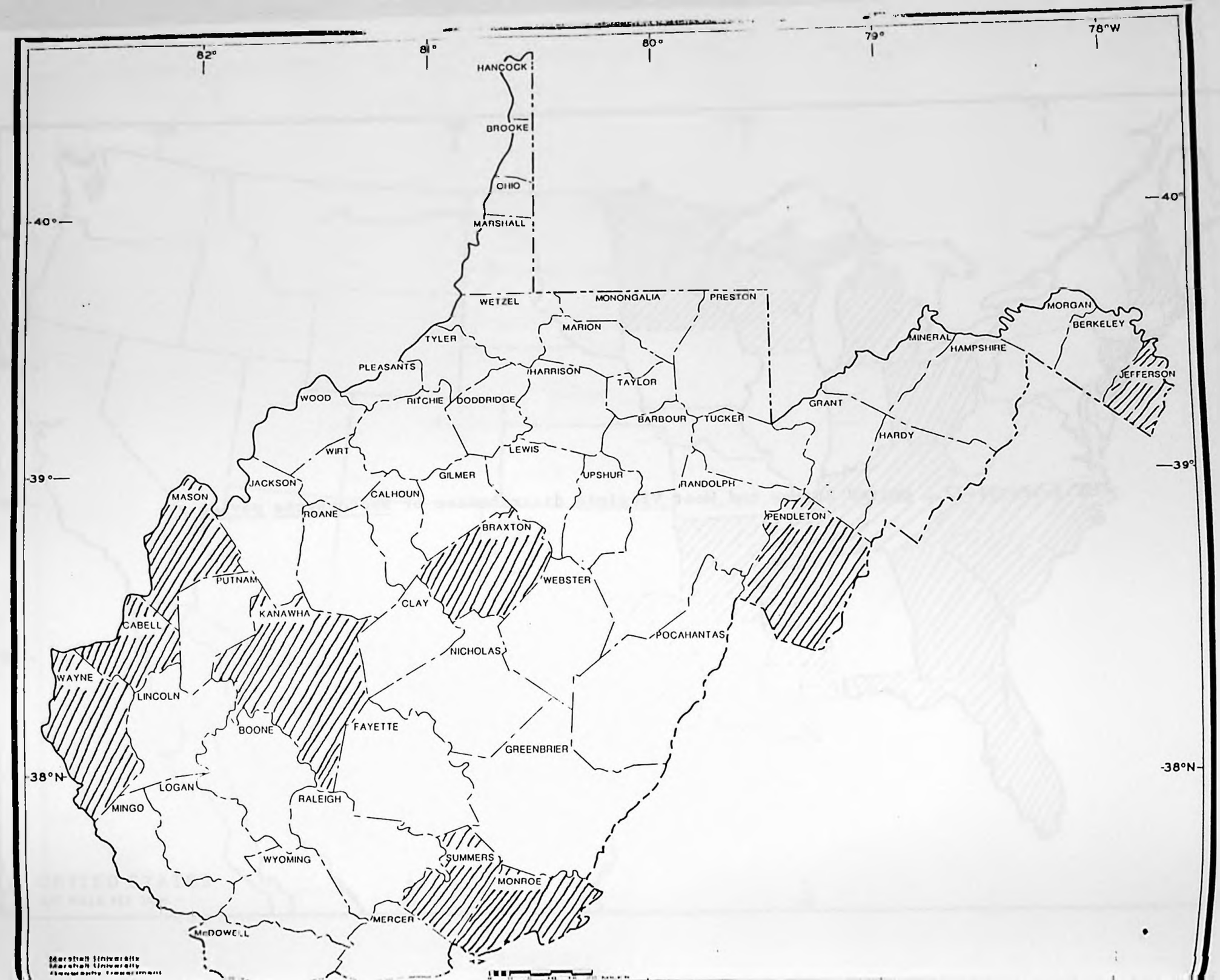
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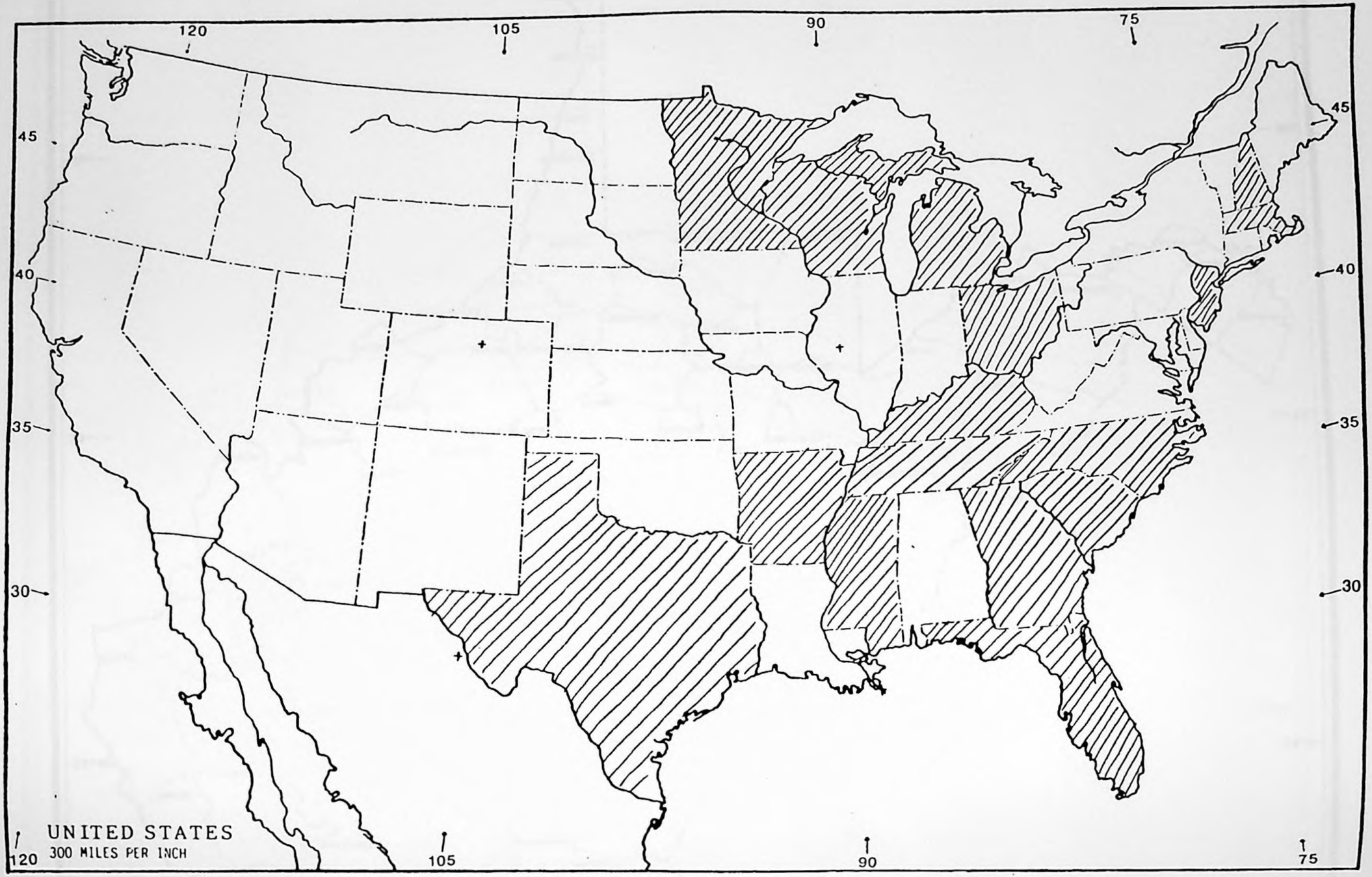
Figures 71-72. United States and West Virginia distribution of Nectopsyche pavida.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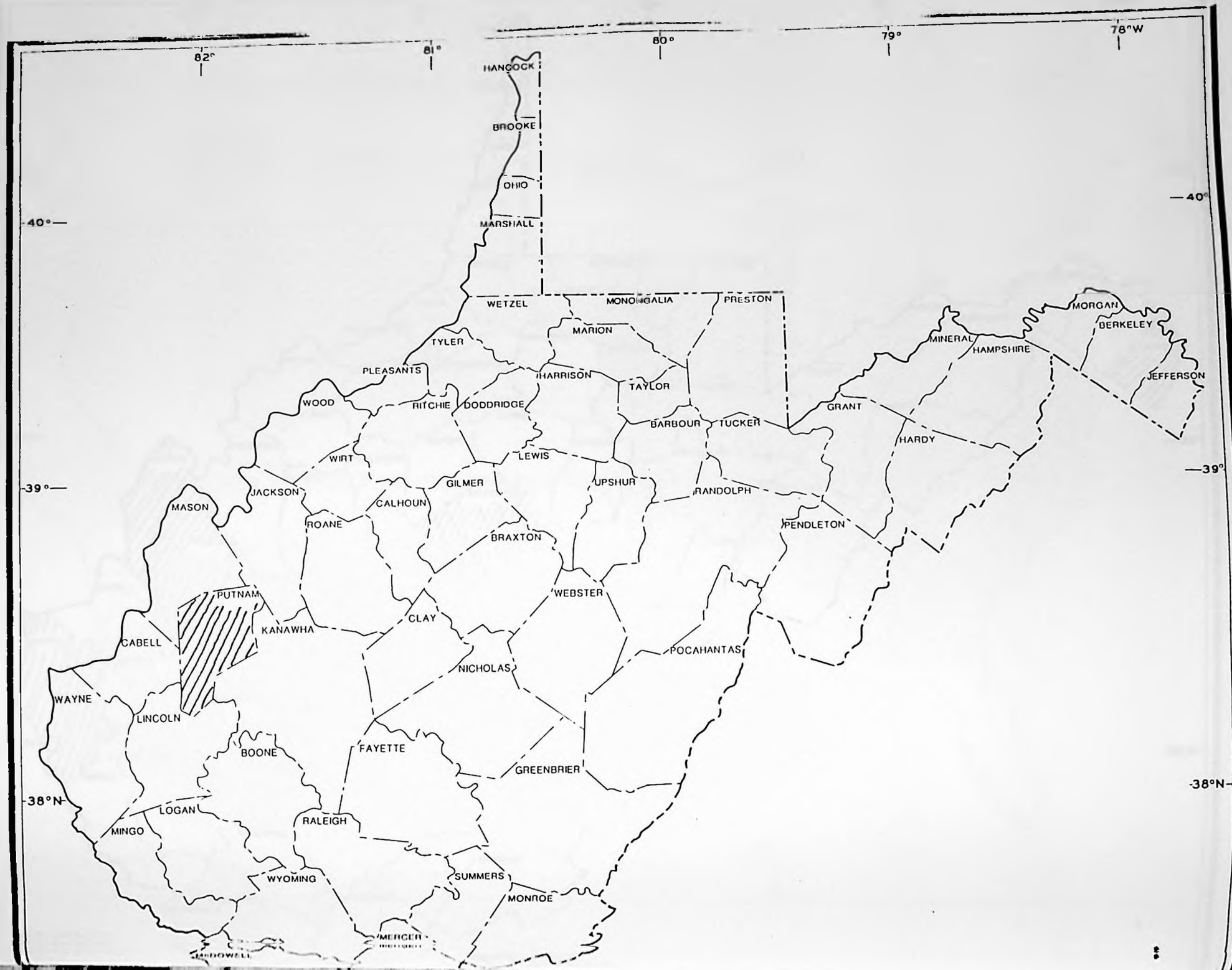
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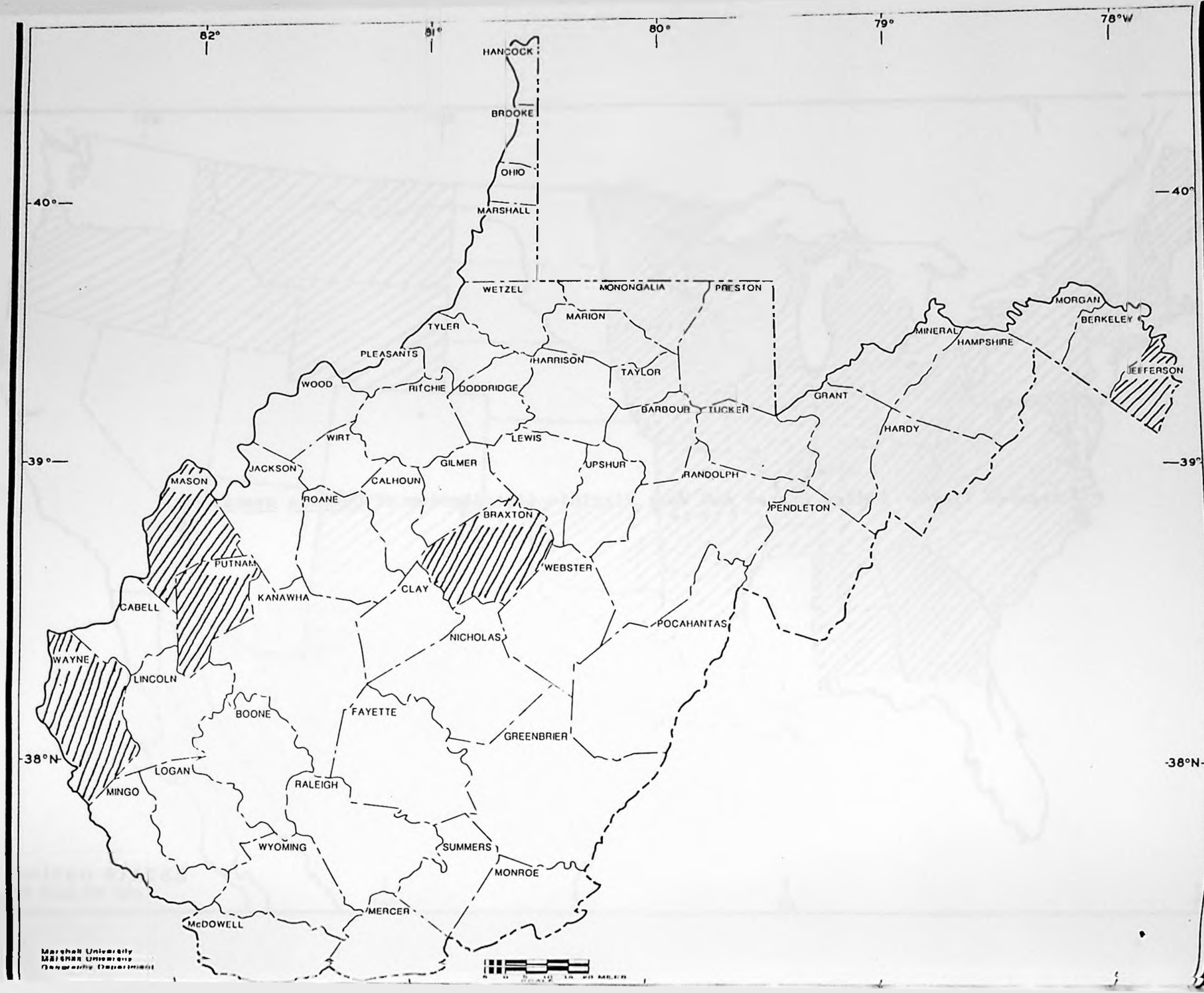
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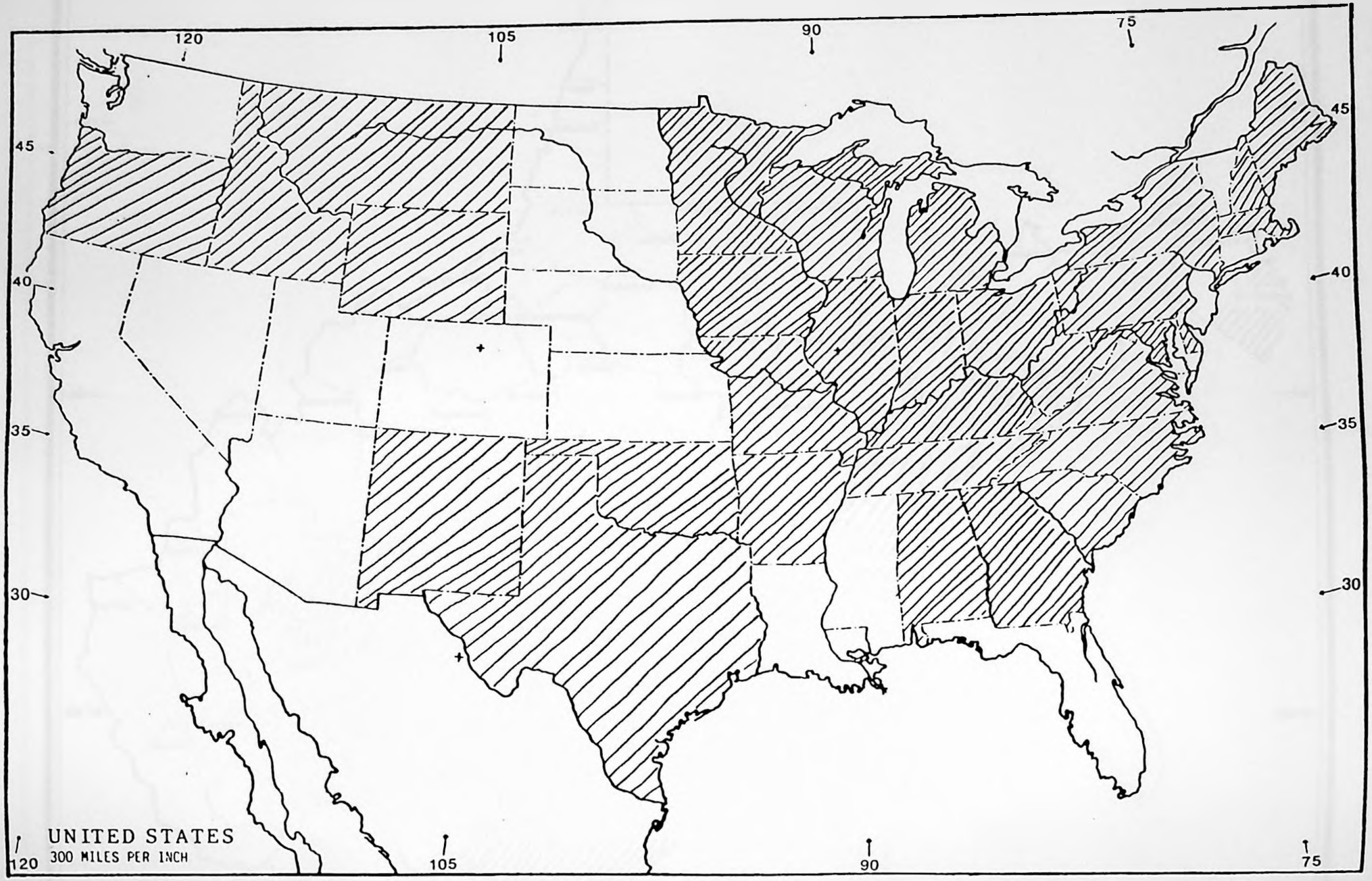
MARSHALL University
Geography Department

Figures 73-74. United States and West Virginia distribution of Oecetis avara.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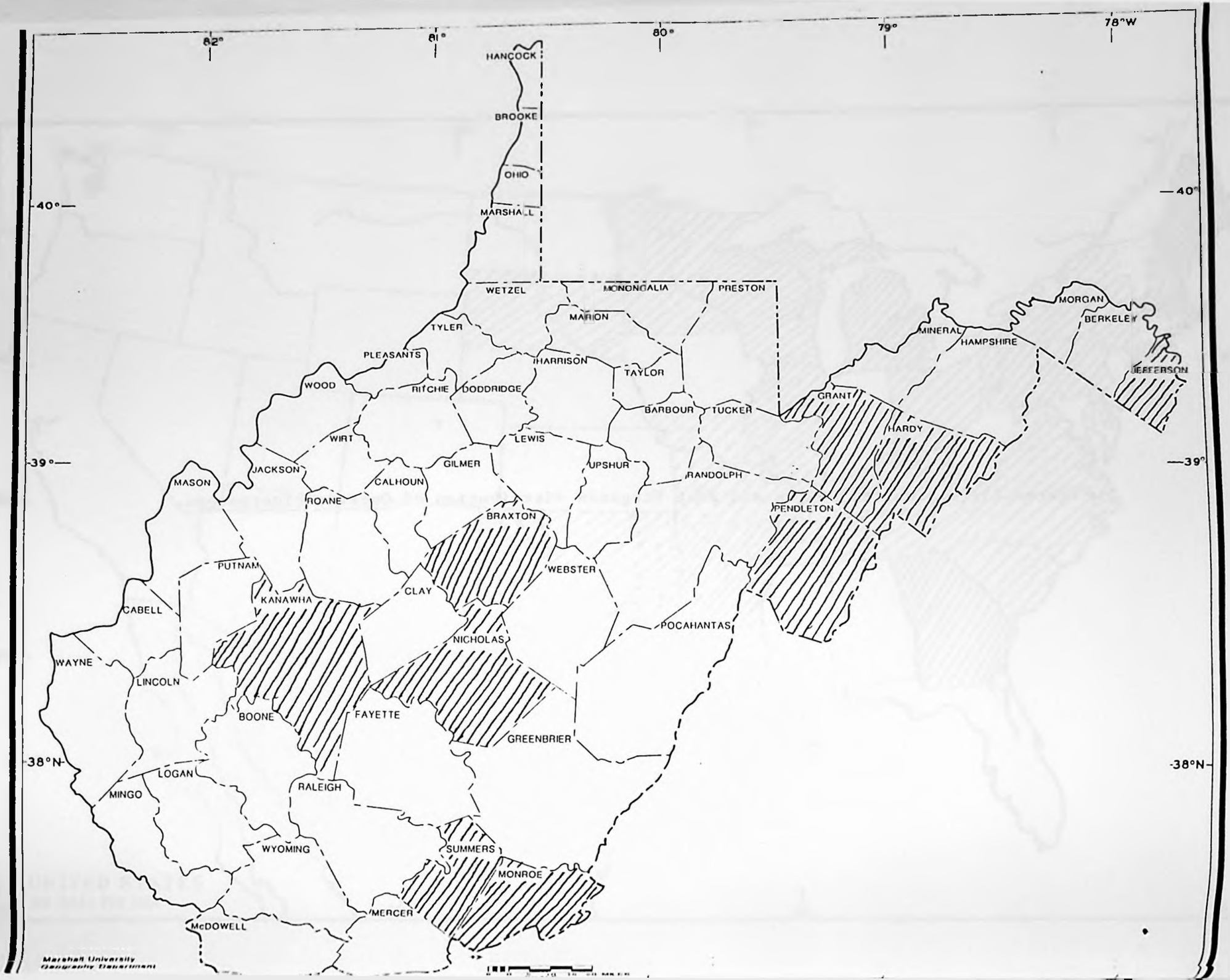
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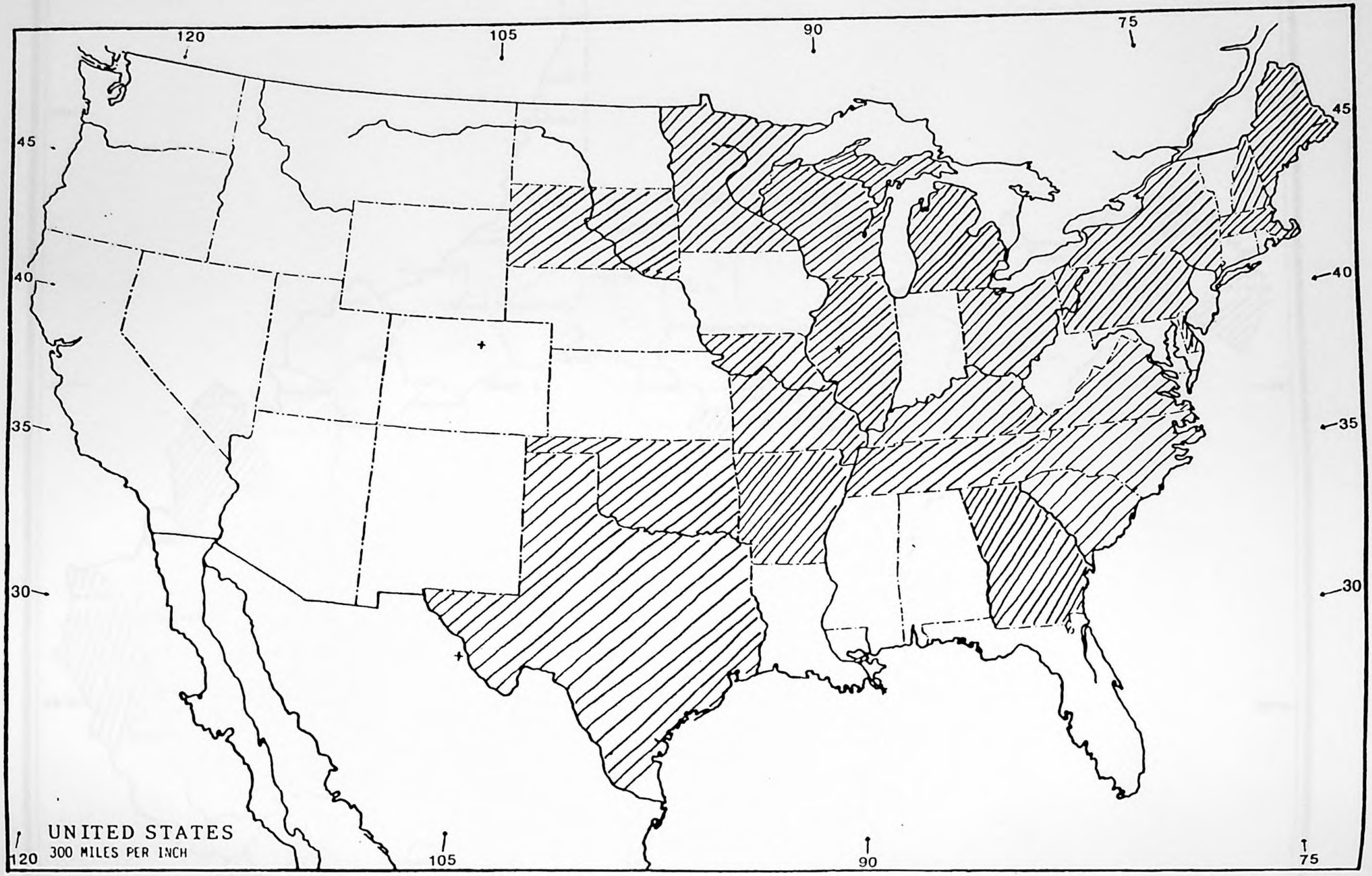
Geography Department

Figures 75-76. United States and West Virginia distribution of Oecetis cinerascens.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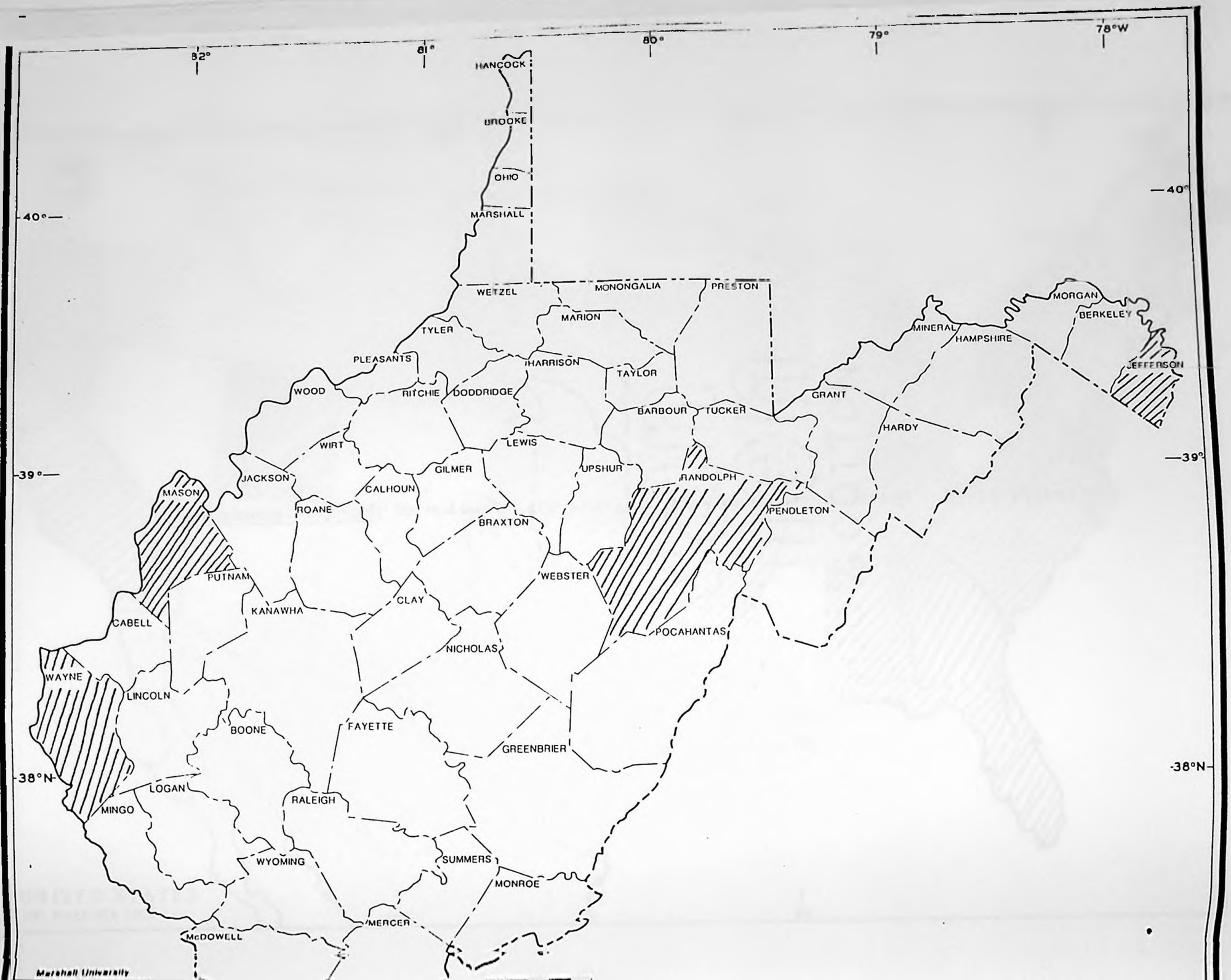
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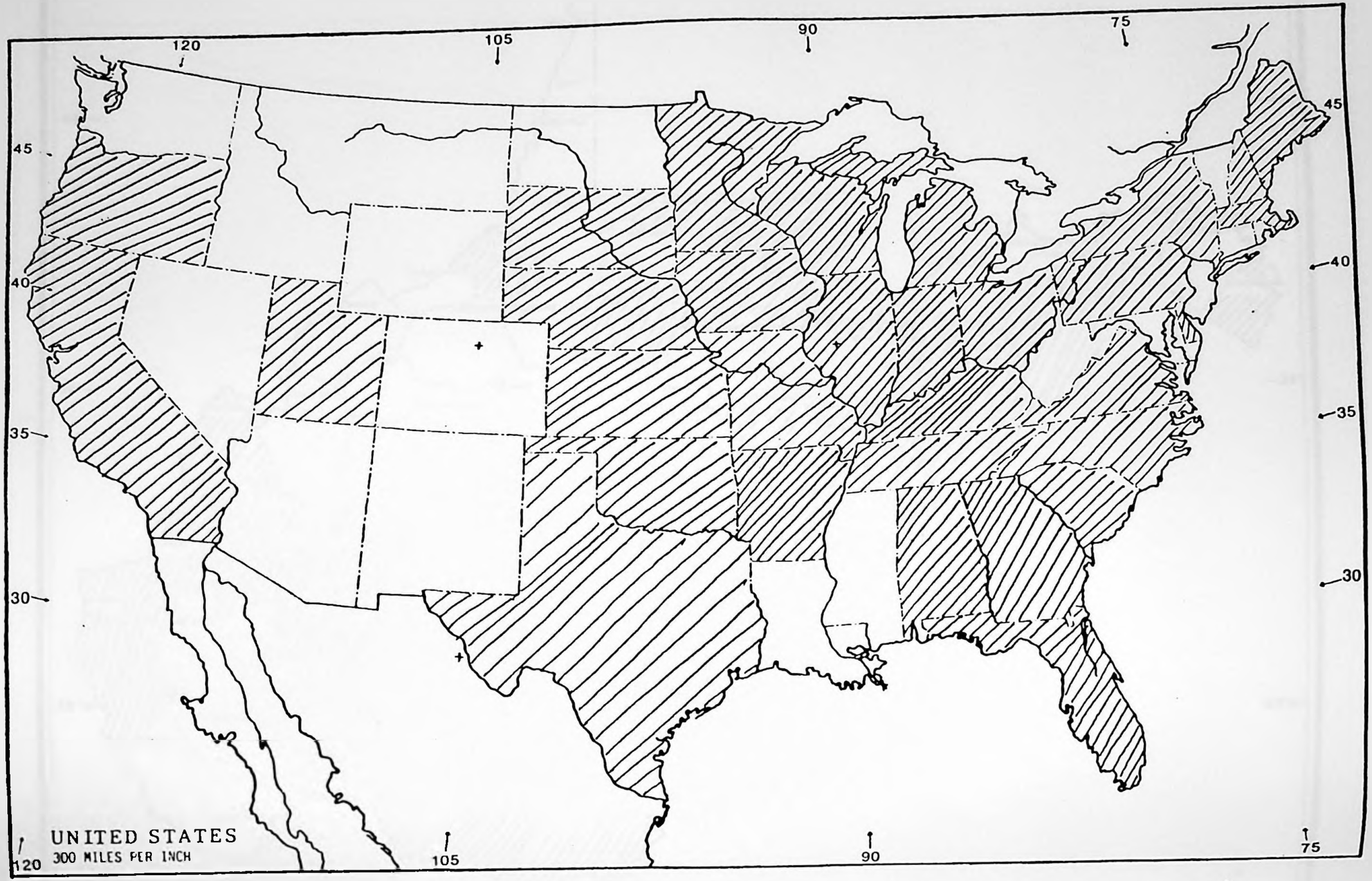
Figures 77-78. United States and West Virginia distribution of Oecetis inconspicua.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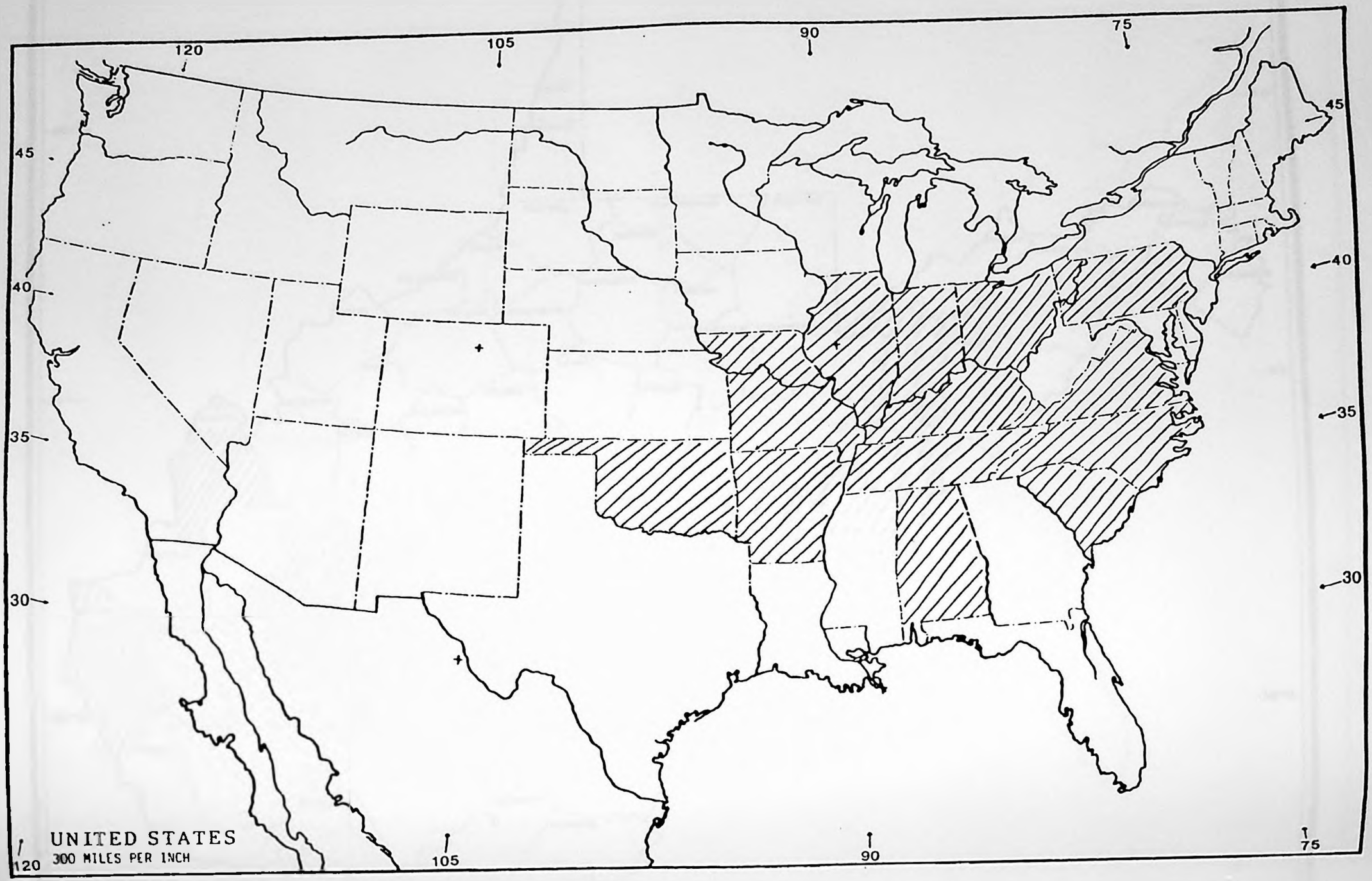
Figures 79-80. United States and West Virginia distribution of Oecetis nocturna.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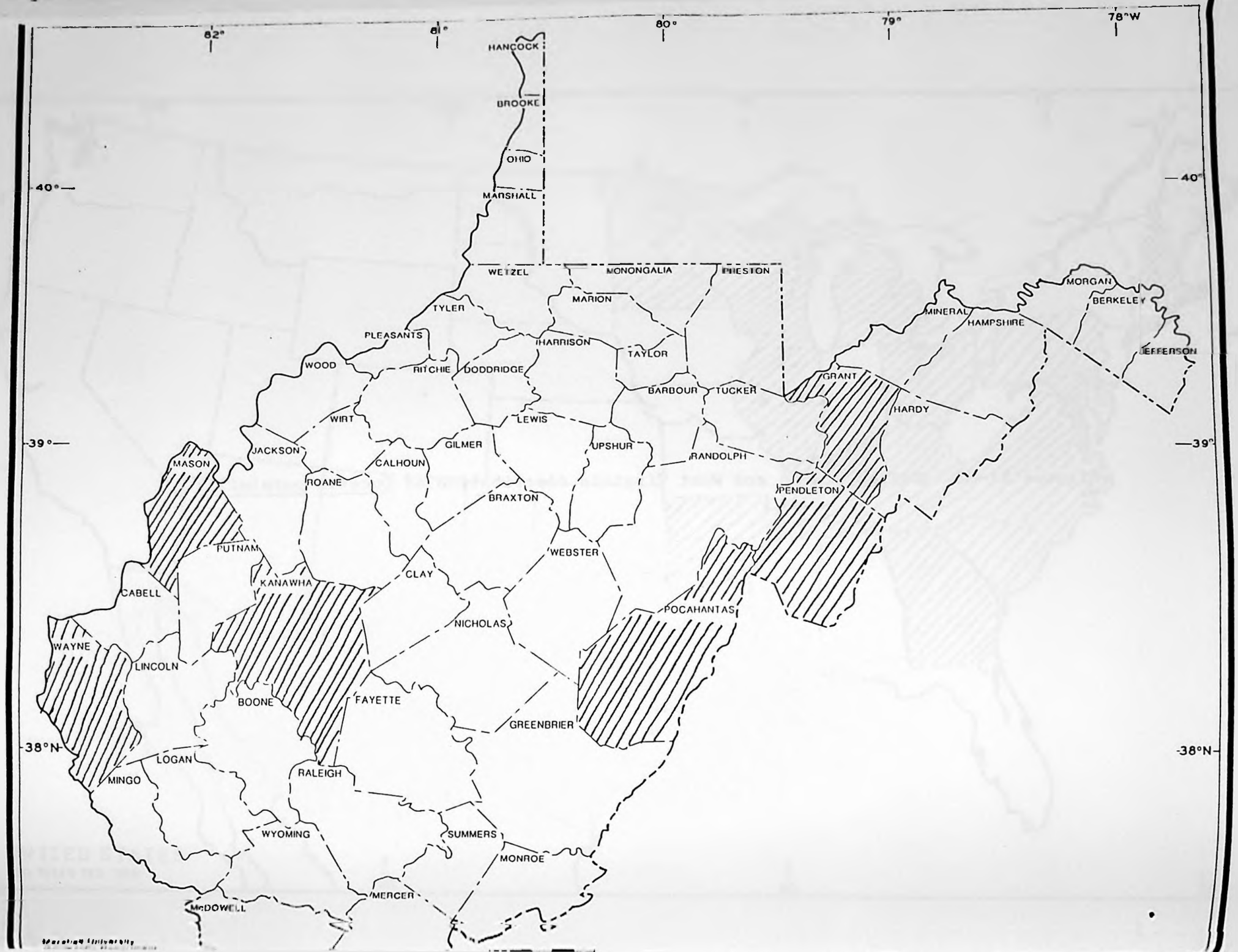
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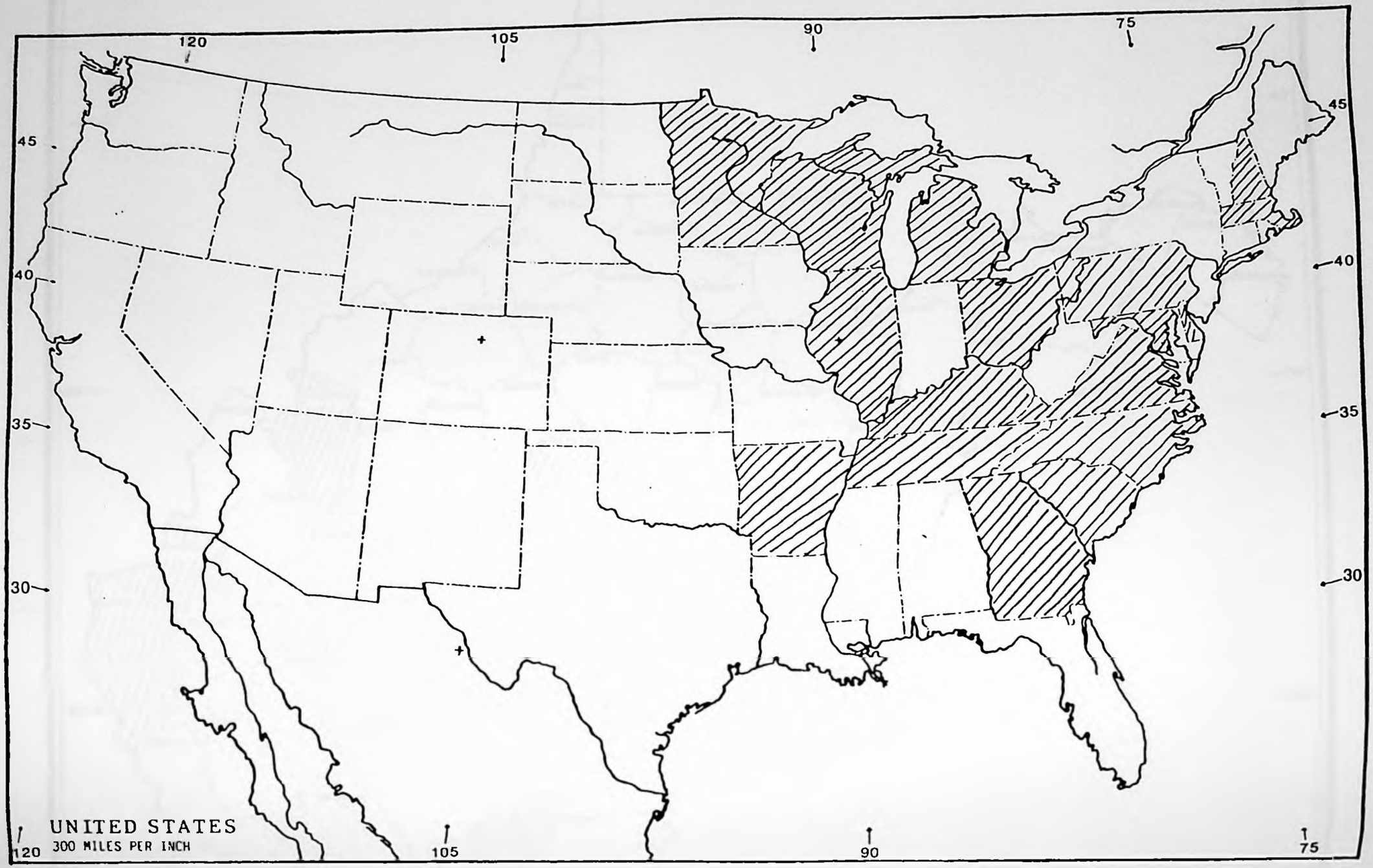
Figures 81-82. United States and West Virginia distribution of Oecetis persimilis.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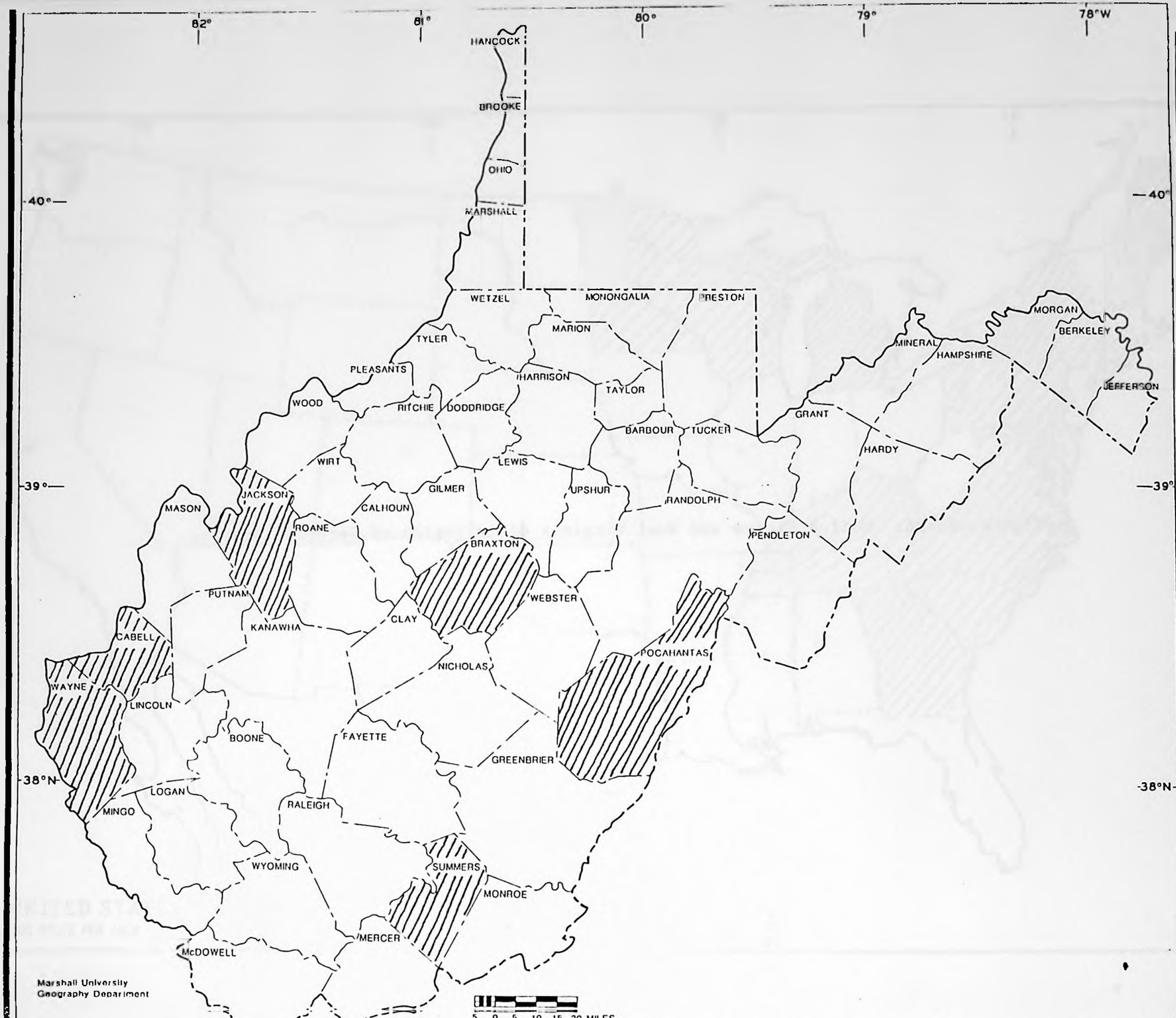
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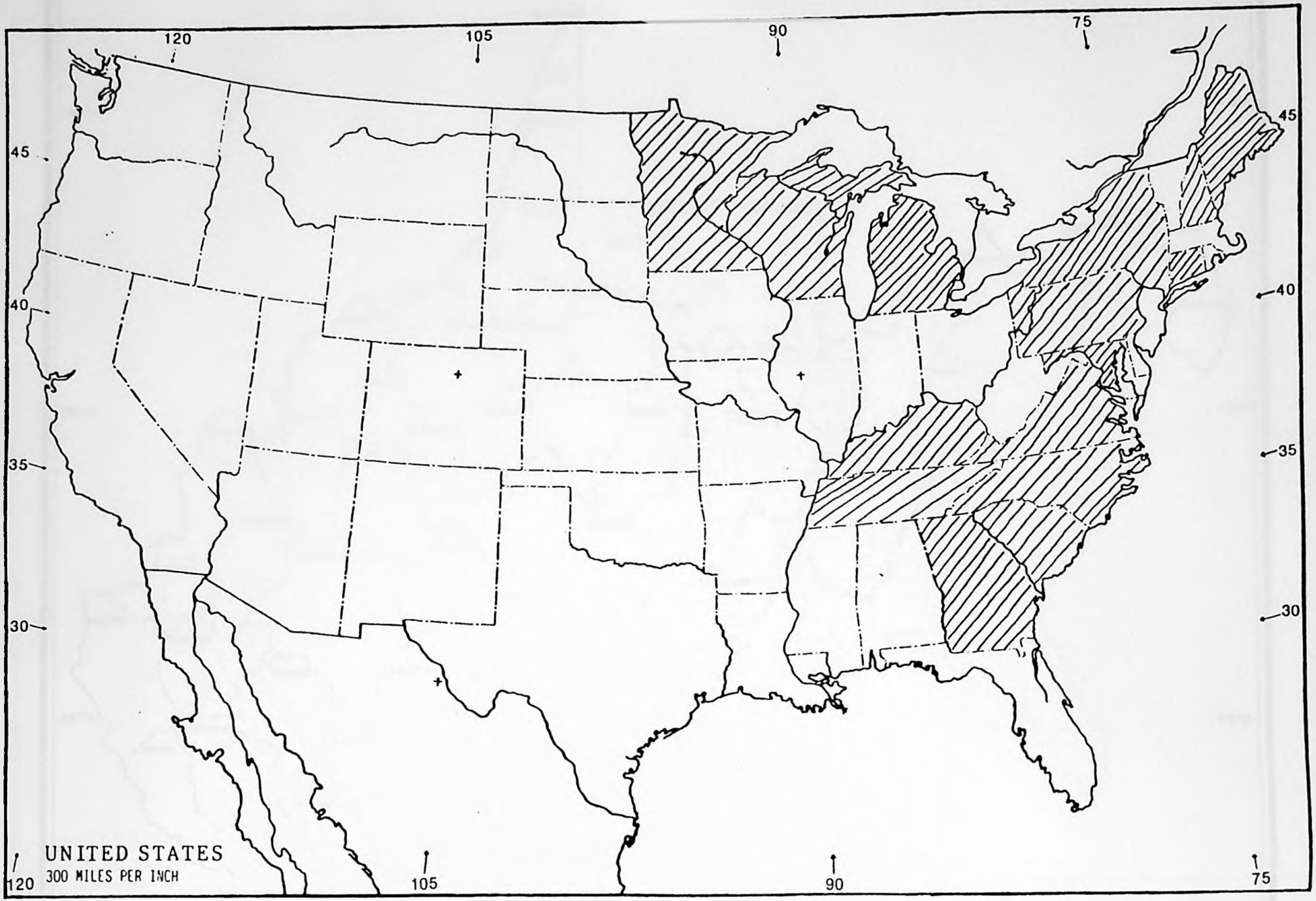
Figures 83-84. United States and West Virginia distribution of Setodes incerta.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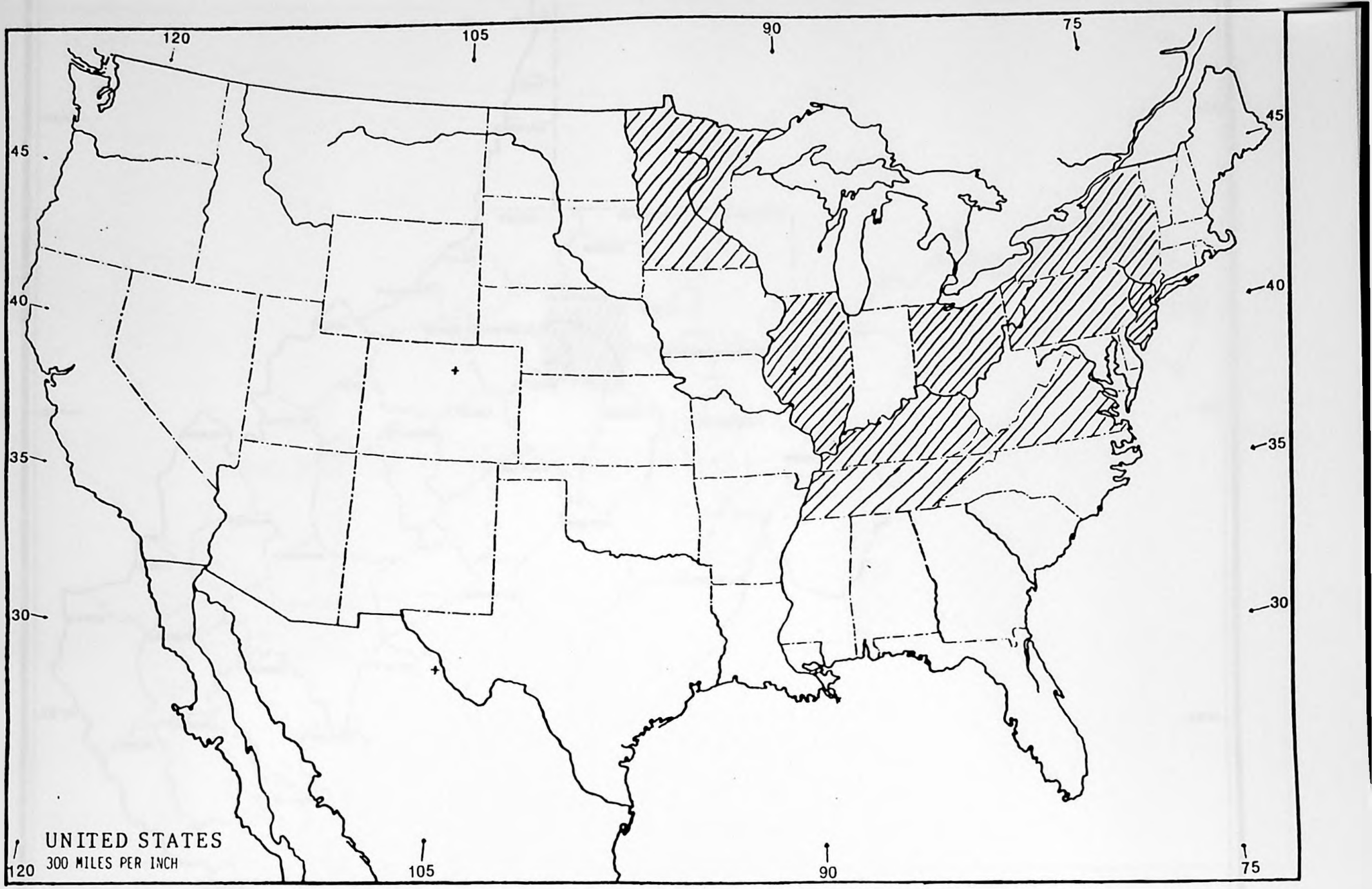
Figures 85-86. United States and West Virginia distribution of Triaenodes flavescens.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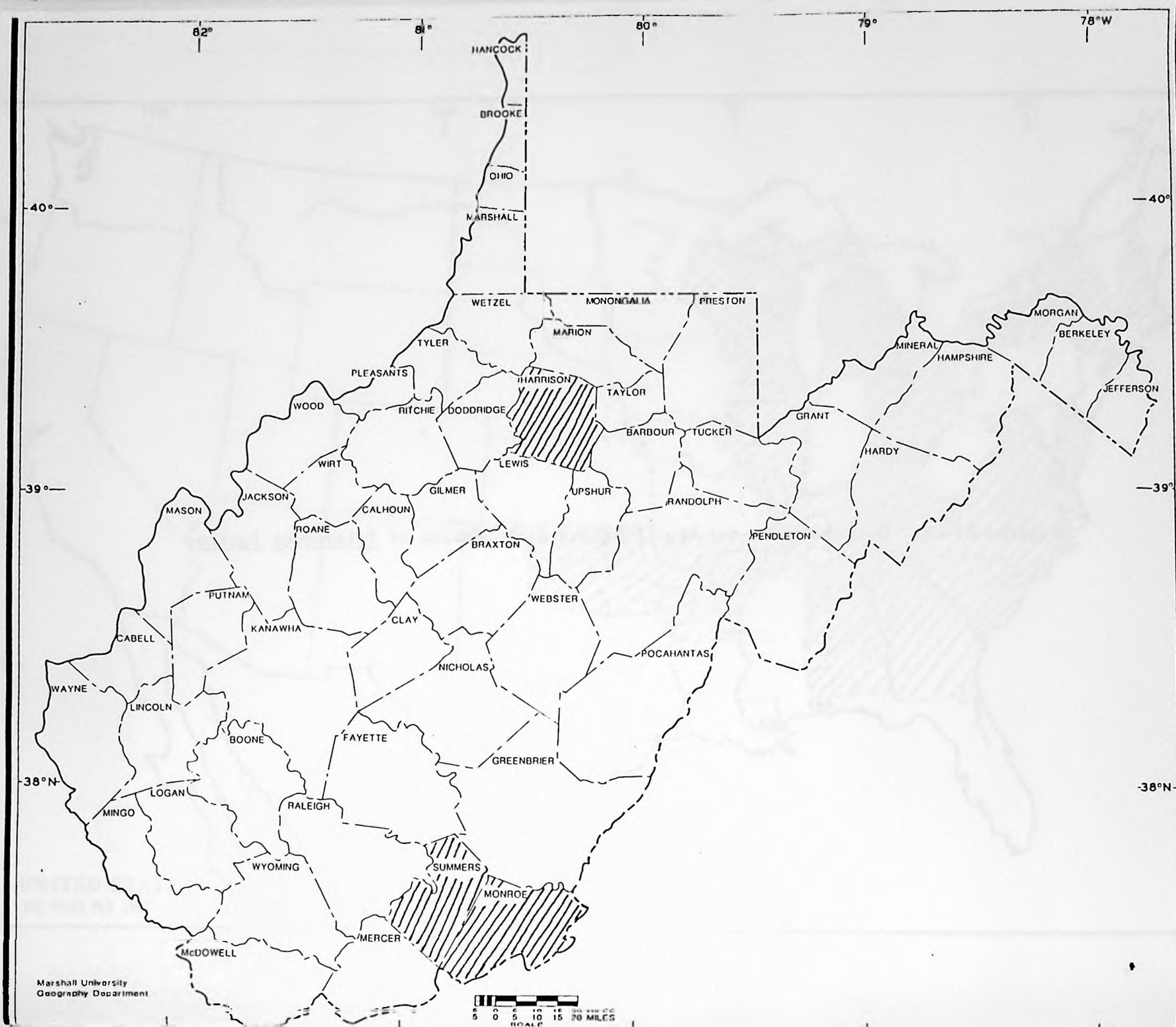
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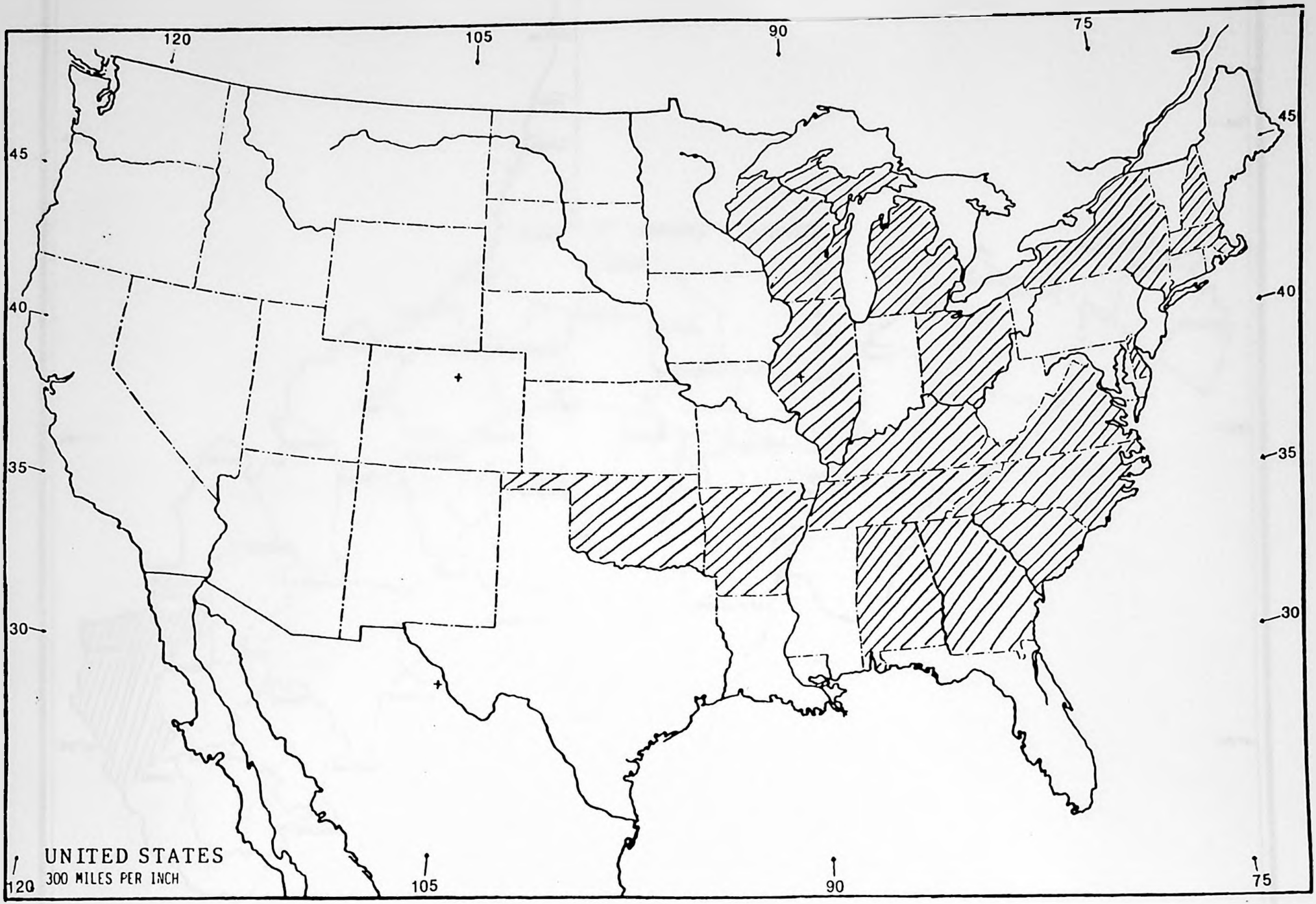
Figures 87-88. United States and West Virginia distribution of Triaenodes ignita.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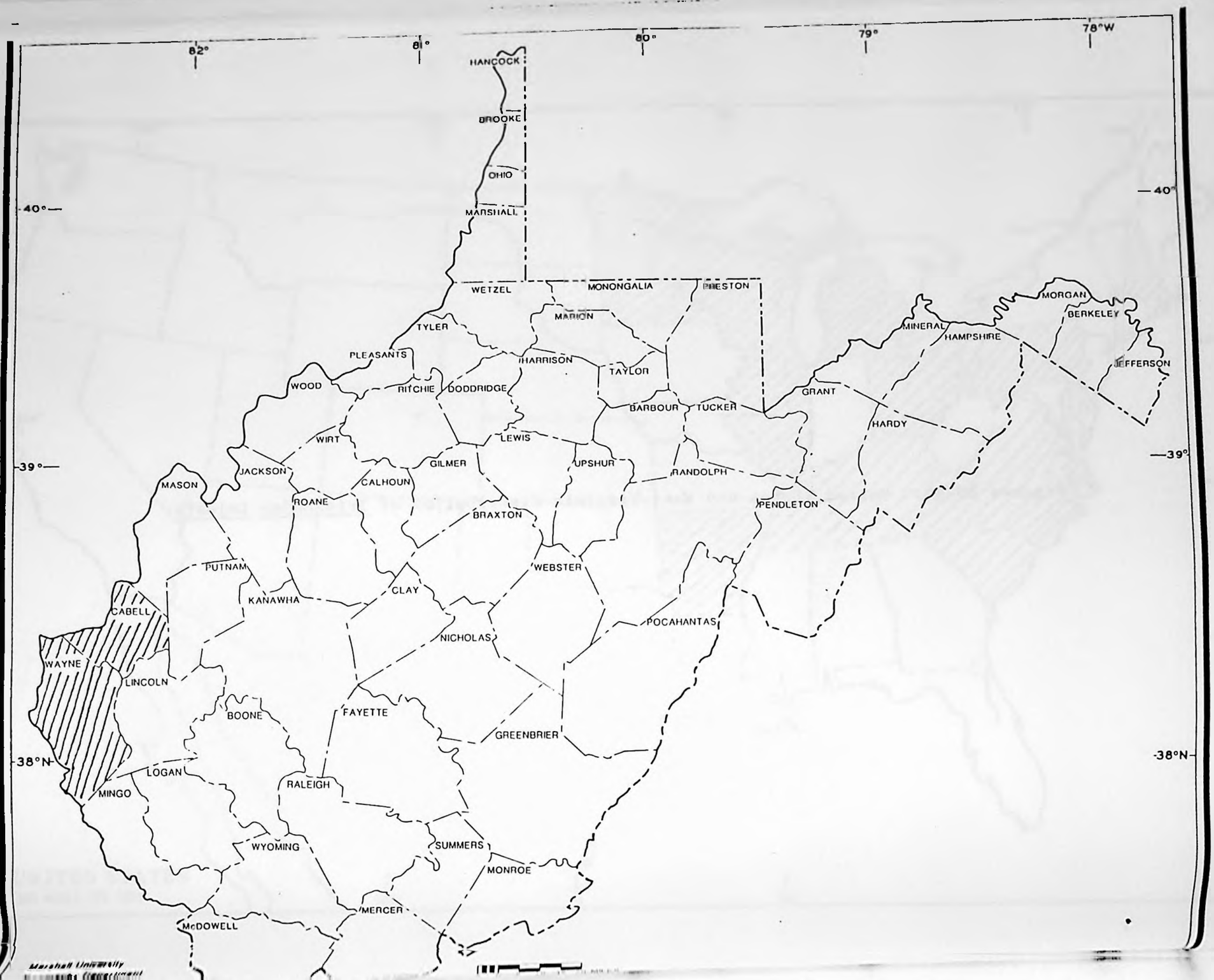
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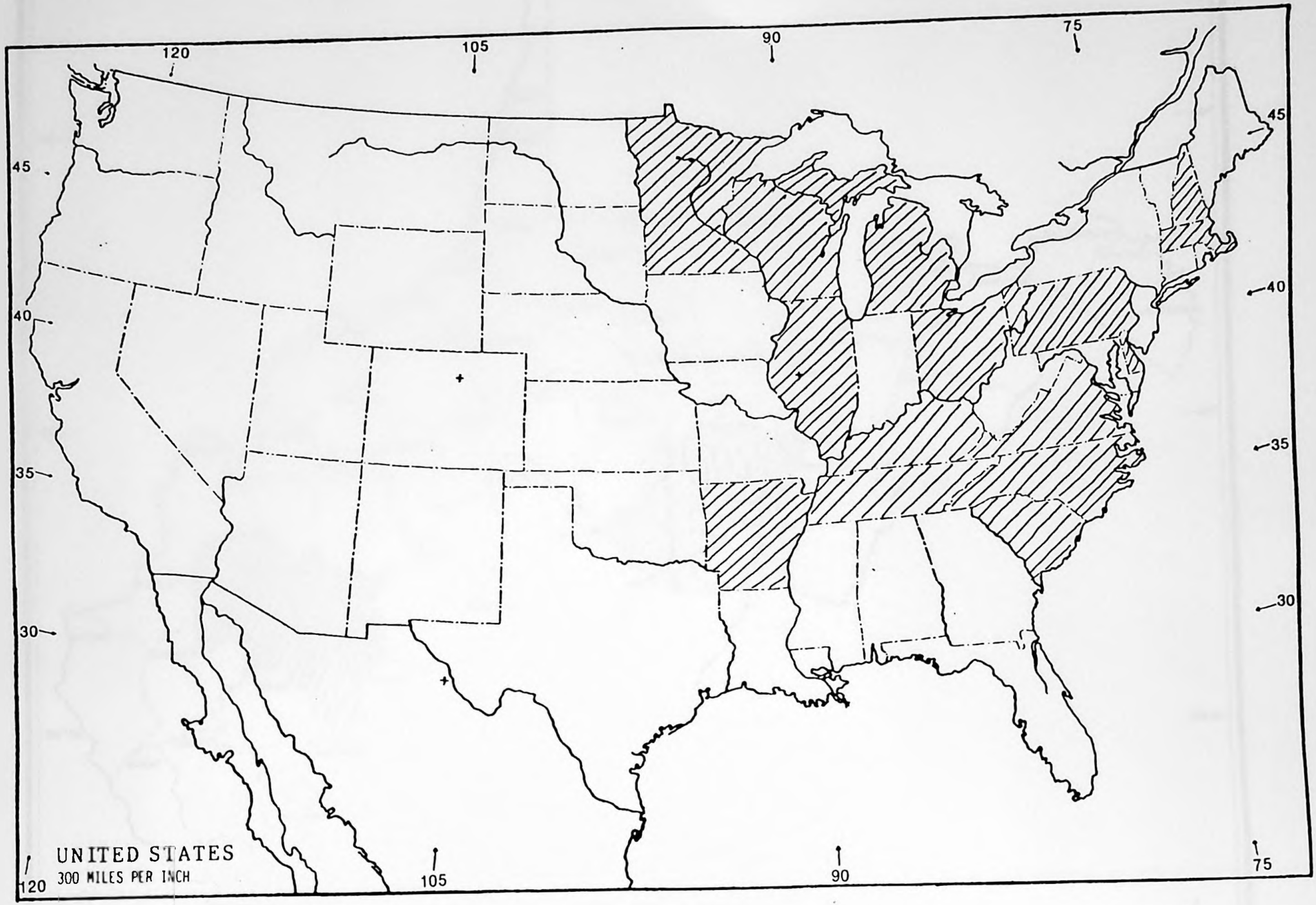
McDOWELL

Figures 89-90. United States and West Virginia distribution of Triaenodes injusta.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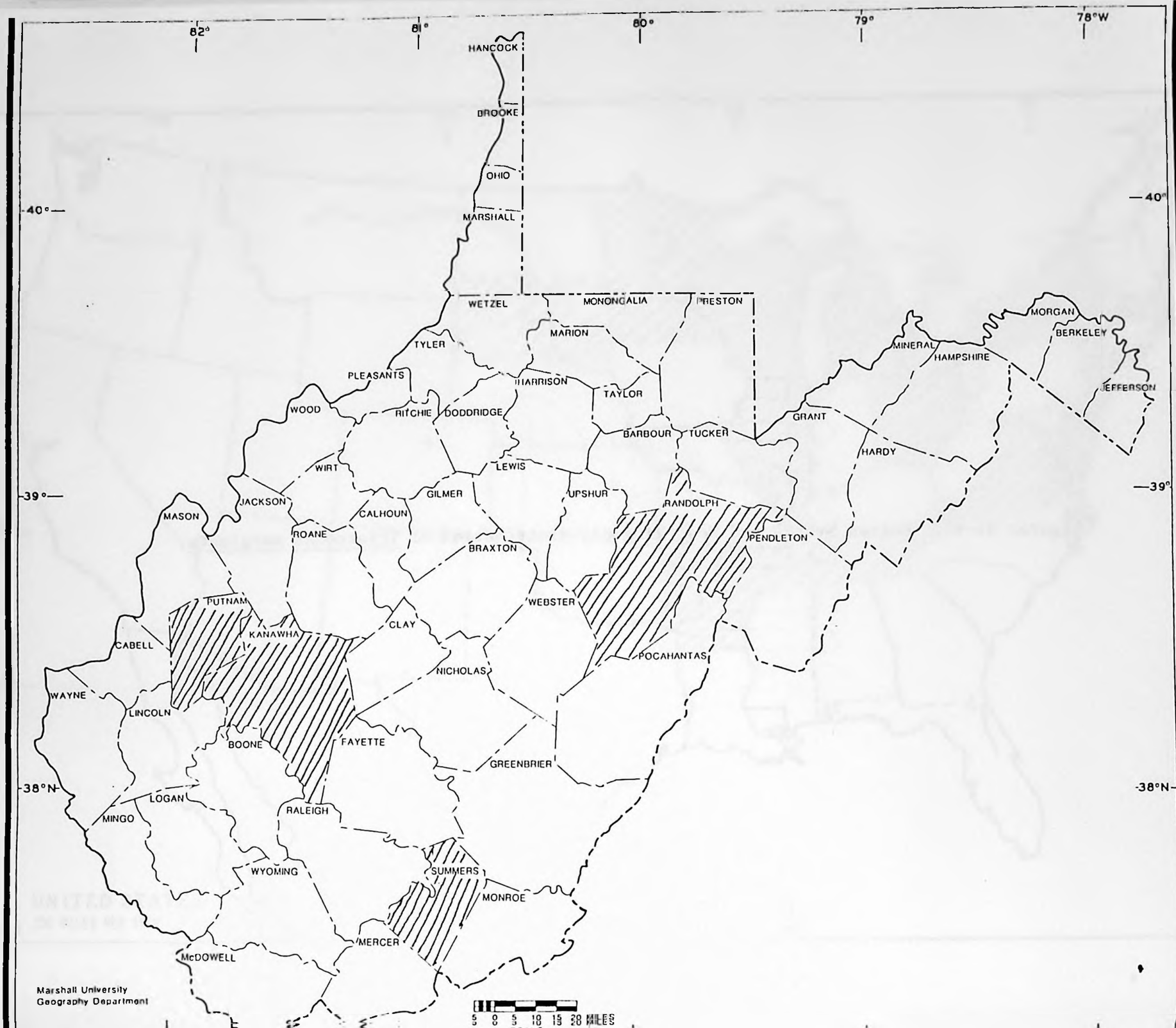
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MINGO
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SUMMERS
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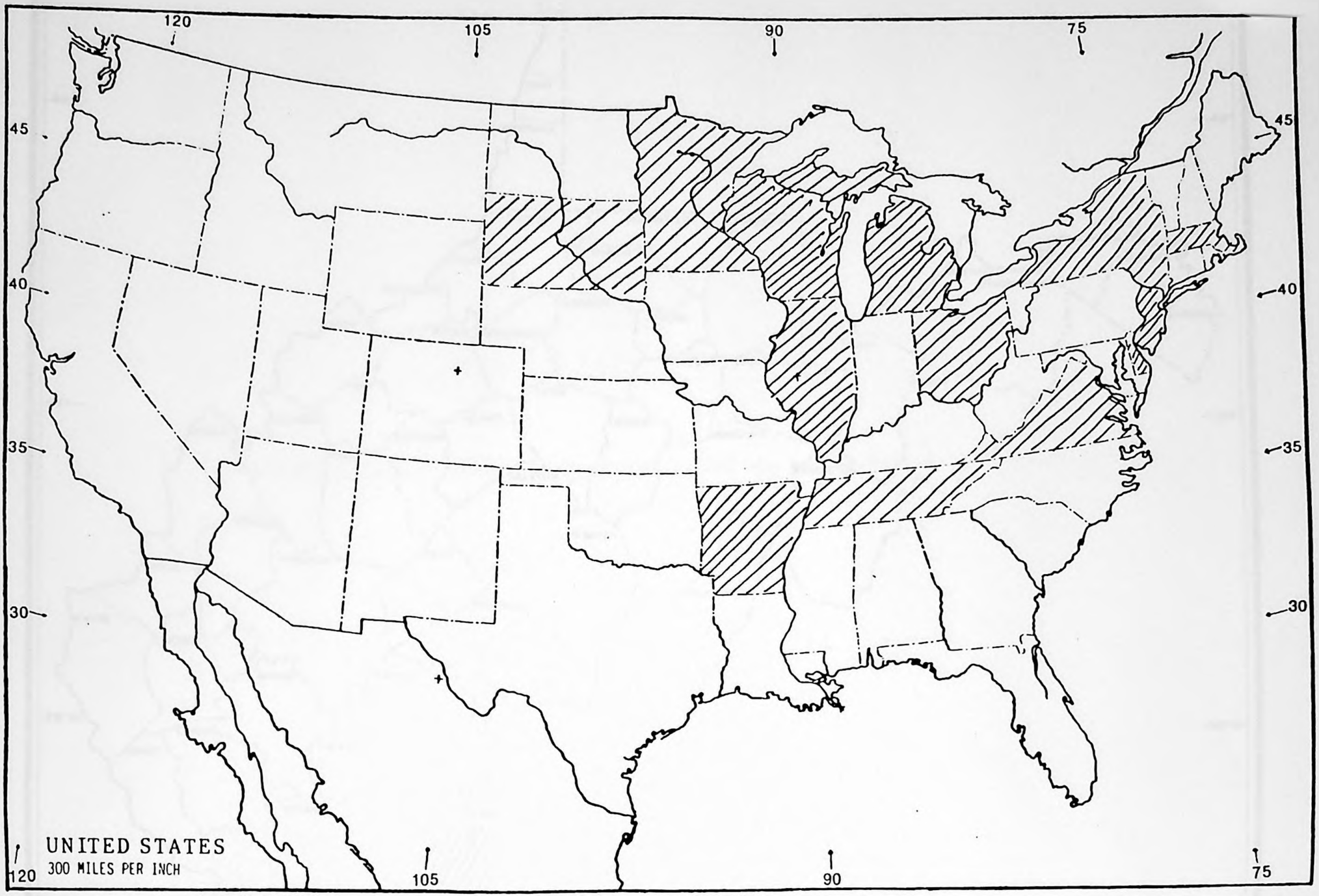
Marshall University
Geography Department
5 0 5 10 15 20 MILES

Figures 91-92. United States and West Virginia distribution of Triaenodes marginata.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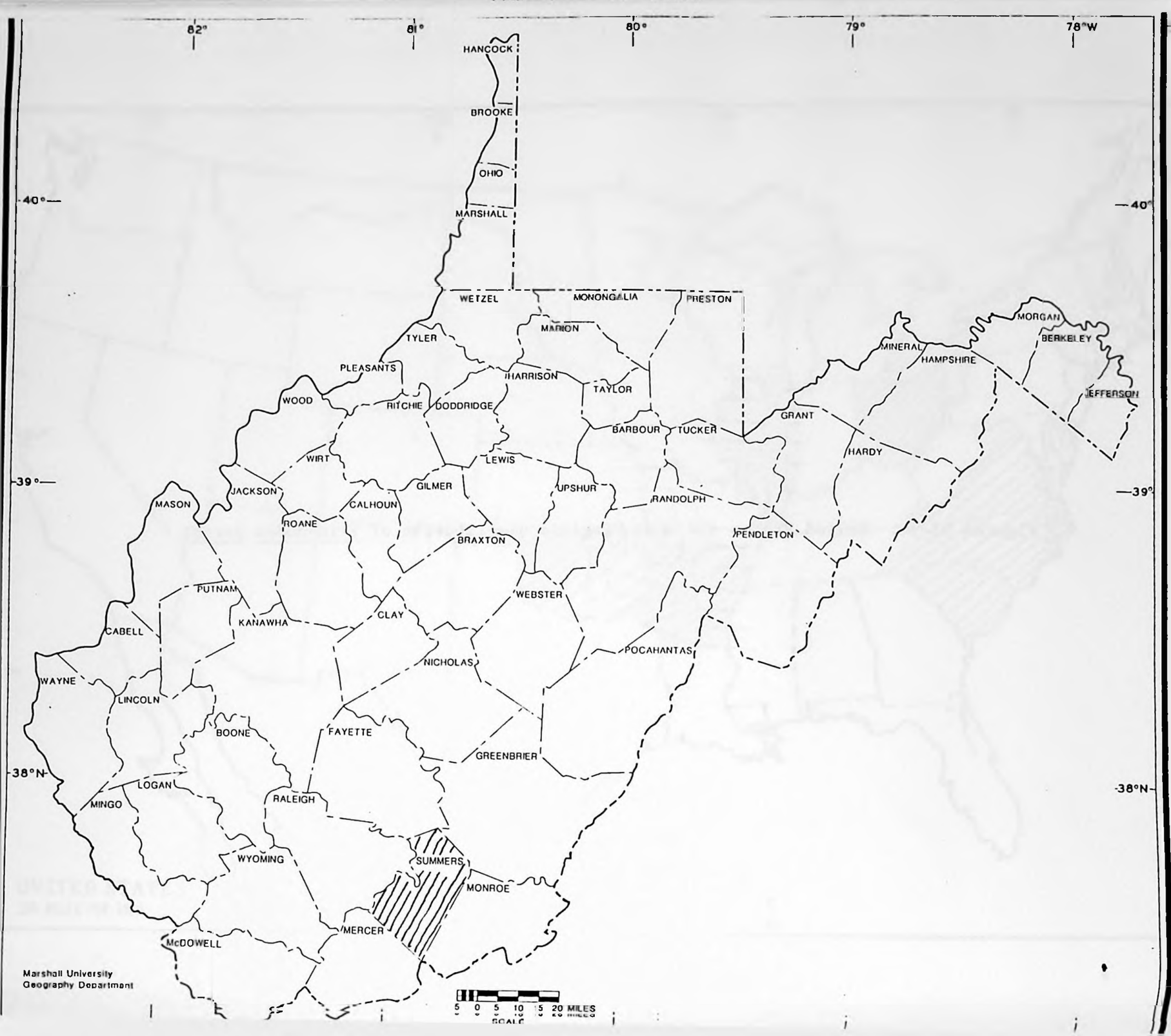
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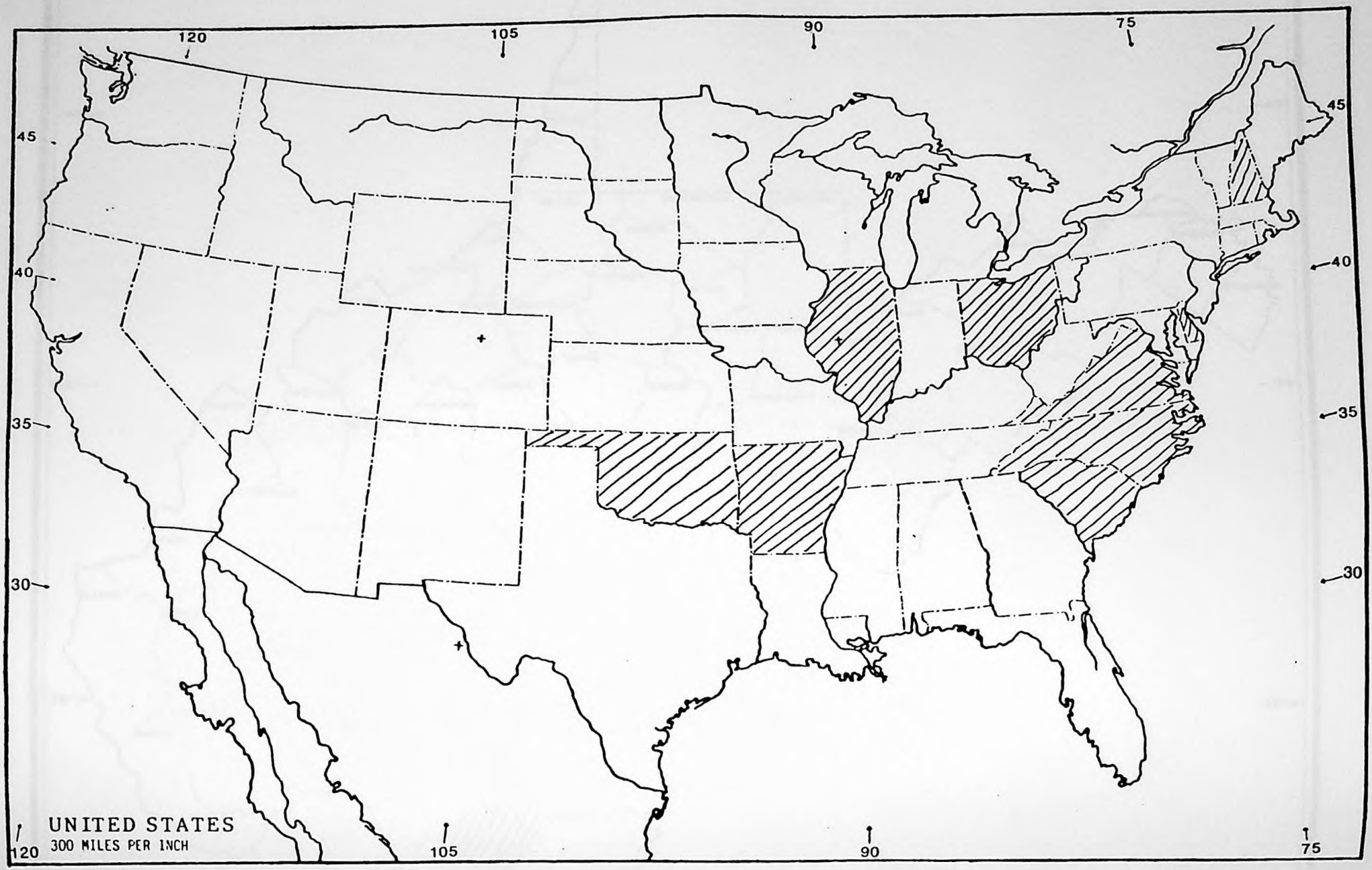
Marshall University
Geography Department
5 0 5 10 15 20 MILES
SCALE

Figures 93-94. United States and West Virginia distribution of Triaenodes perna.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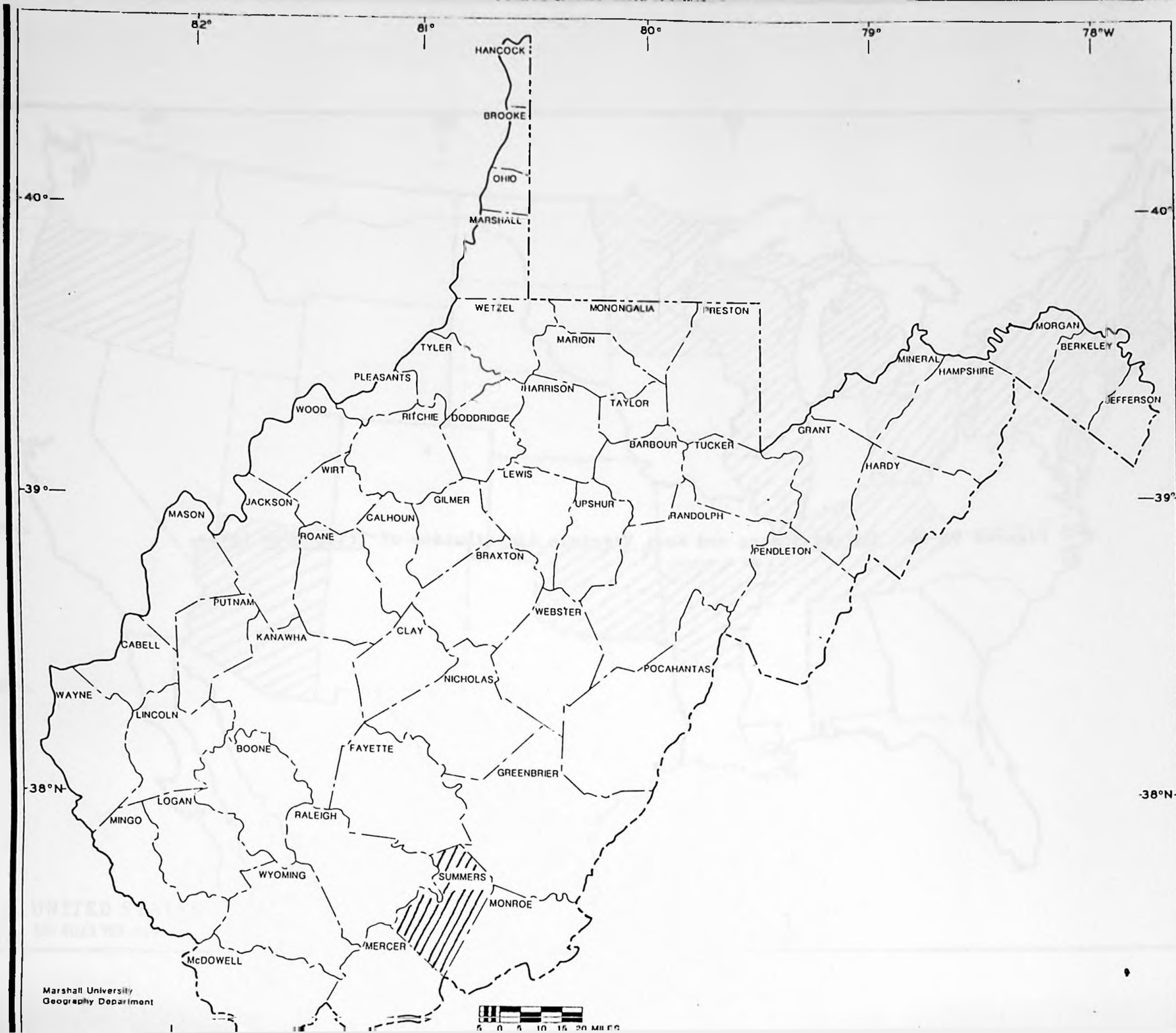
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Marshall University
Geography Department
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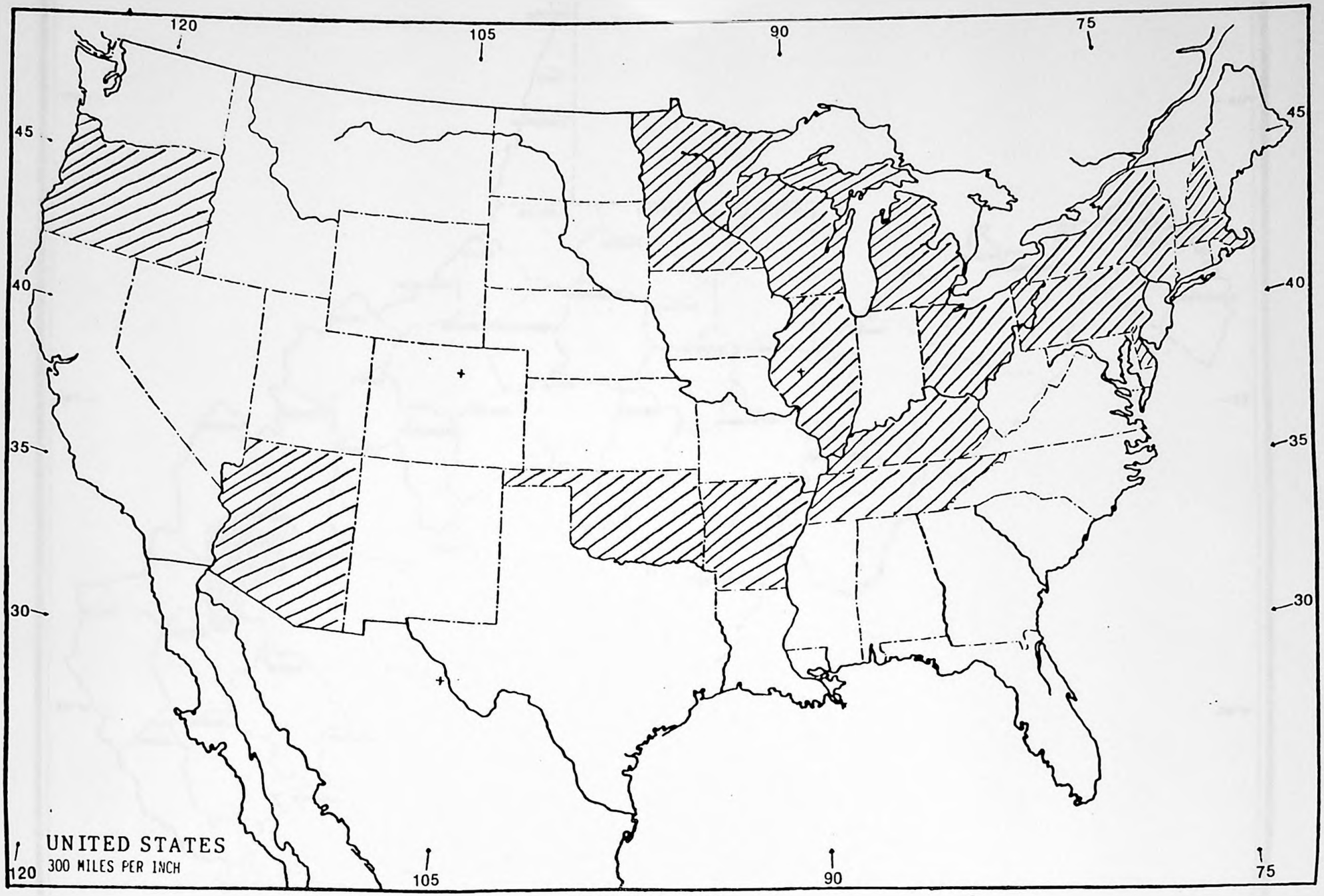
Figures 95-96. United States and West Virginia distribution of Triaenodes tarda.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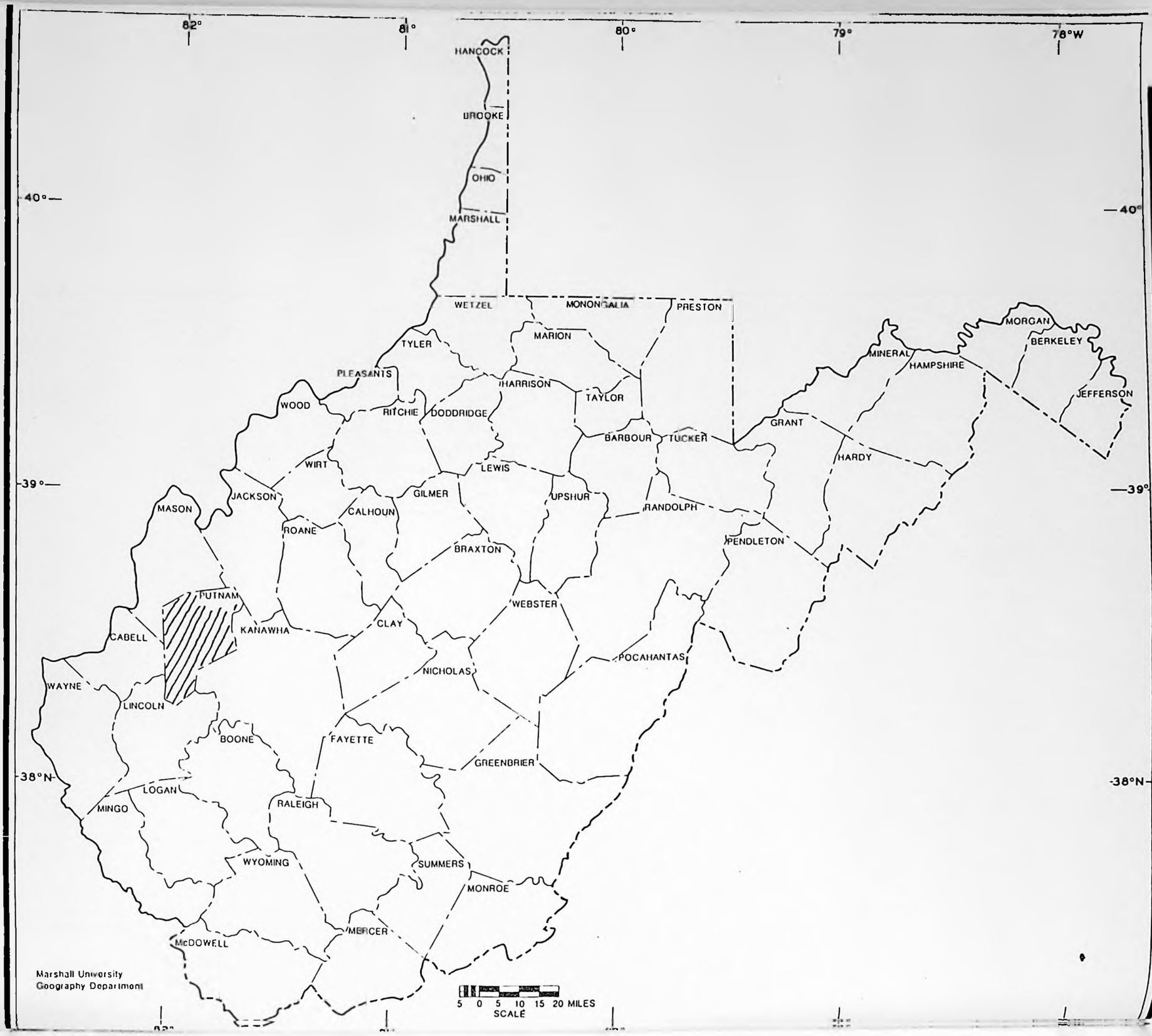
300 MILES PER INCH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