

THE DISTRIBUTION OF THE LEAFHOPPERS OF  
PRESQUE ISLE, PA. AND THEIR RELATION  
TO PLANT FORMATIONS

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THE DISTRIBUTION OF THE LEAFHOPPERS OF  
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The relation existing between insects and plants and especially the synchronous changes in abundance and succession that accompanies changes in habitat conditions is of both interest and importance to workers in certain groups. It is interesting to know under what conditions an insect lives, and if the habitat and specific food plants are variable in different regions. But these data are usually very hard to obtain in disturbed areas as a complication of conditions and a mixture of food plants may occur. Presque Isle has furnished an ideal place for such a study because the zones and stages of plant associations, and their successions are so well defined. Consequently a record of specimens captured and a study of existing conditions there may be of interest to others.

The Island, or peninsula as it might better be called, is a projection extending some six miles north-east from the mainland at Erie, Pennsylvania, and is more than three miles wide at its broadest portion, the eastern extremity. The entire formation is the result of wave action, and since it has accumulated over a period of many years, all stages and conditions in plant successions of this region are found there. The older portion is covered with a deciduous forest, more recently constructed areas with pine forests, shrub stages, bog and heath, and the new portions with sand plains, dunes, marshes and numerous lagoons in various stages of succession. Although insects do not have such well defined successions of associations as do plants, they do have certain very definite relations with certain plant associations and as these constantly change from one stage to another, we find for the most part a different group of insects accompanying each successive plant association.

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The portion of this area which has been studied more thoroughly is the broad eastern extremity or sand plain area with its numerous lagoons and marshes in all successional stages. Some study was also made at the head where the peninsula connects with the mainland. Only a brief resume of these habitats will be given in the following pages together with their respective findings.

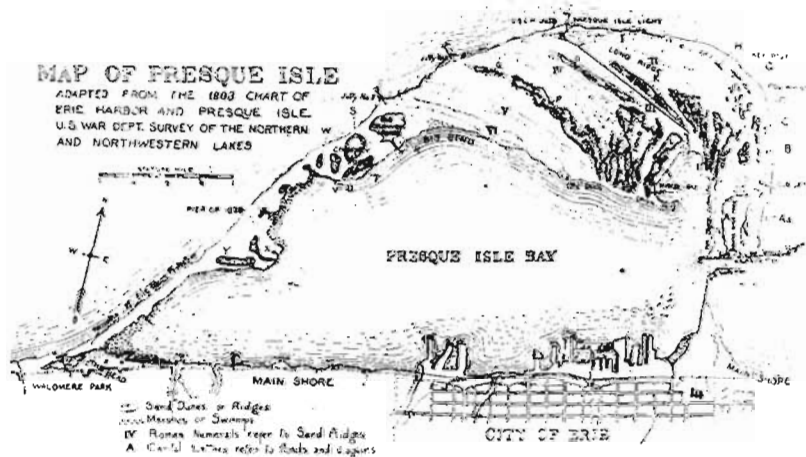


FIG. 1.

Map of Presque Isle, Pennsylvania, showing physiographic conditions.

A detailed study of the plants of Presque Isle has been made by Dr. O. E. Jennings and his excellent outline of the plant associations and successions has been followed in this report. Only the leafhoppers belonging to the Cicadellidæ (Homoptera) have been studied because of the author's familiarity with the group and also in order to obtain more specific results regarding their relationships to plant associations and formations. Although many other insects were collected in these habitats, no consideration is given to them at this time.

#### THE BEACH-SAND PLAIN-HEATH-FOREST SUCCESSION.

The beach is practically devoid of leafhoppers and although an occasional specimen of *Cicadula 6-notata* or some other cosmopolitan feeder may be found here, these are probably accidental records and the insects have no definite relationship to the meager vegetation that is able to withstand the storm and wave action.

The sand plain occupies large areas of the eastern extremity. The vegetation of the sand plain proper is very uniform and composed of a few predominant species. One of these grasses *Andropogon furcatus*, (a climax plant of the prairie) is abundant and usually found growing in clumps throughout this portion of the island (Plate XXXIV, Fig. 4). *Thamnotettix pallidulus* Osb. has been taken abundantly from this grass and seems to be restricted to it as a food plant. This is a western species described from Iowa in 1898. A recent citation from Kansas is the only record since its original description and it has not been reported previously east of the Mississippi River.

Large areas of scattered tufts of *Panicum* also occur on the sand plain (Plate XXXV, Fig. 3). Two species are especially abundant, *Panicum villosissimum* and *P. hauchucæ*, and are somewhat intermingled. Both of these appear to be food plants of *Deltocephalus apicatus* Osb. which was taken in abundance at various intervals during the summer both as adult and nymph. Other species commonly found on the sand plain are *Deltocephalus inimicus*, *sayi* and *misellus* and *Phlepsius irroratus*.

Dr. Jennings has shown that there may be a heath or a *Myrica* thicket association in the beach—forest succession. Where the *Arctostaphylos-juniperus* Heath Association occurs, only a few leafhoppers are found. *Gypona octolineata* and *rugosa* have both been taken from a uniform and pure society of *Arctostaphylos*. In case a *Myrica* thicket association follows the sand plain, another group of insects occurs. Such species as *Empoasca flavescens* and *Balclutha impictus* are found on the *Myrica*, *Graphocephala coccinea* is abundant as nymph and adult on species of *Rubus*, *Deltocephalus configuratus* on *Poa compressa* and usually *Empoasca atrolabes* and *Oncopsis variabilis* are always present on *Alnus*.

The *Quercus velutina* Forest formation has not been worked in detail for the leafhopper species. A few observations have been made however. Several species of *Erythroneura*, *Empoa* and *Empoasca* occur on *Quercus* and *Acer*. *Jassus olitorius* is apparently confined to *Sassafras* as its food plant. *Gypona pectoralis* and *Alebra albostriella* are very common on *Tilia americana*. *Erythroneura tricincta*, *vitis*, *vulnerata*, and *comes* are common on species of *Vitis*.

On the herbaceous layer many common species as *Scaphoides immistus* and *auroniteus*, *Balclutha osborni*, *Deltocephalus*

*sayi* and *inimicus*, *Phlepsius irroratus* and *Cicadula 6-notata* are found. Other species less abundant as *Mesamia vitellina* live on the herbaceous vegetation and *Scaphoideus lobatus* was found as nymph and adult feeding upon *Solidago caesia*.

The leafhopper species do not differ greatly from the preceding in the associations of the Dune-Thicket Forest Succession, undoubtedly due to the fact that about the same plants are found in these associations as those mentioned above. Many of the plants of the sand plain such as *Ammophila* and *Andropogon* are common on the dunes and numerous grass feeding forms mentioned above occur on these plants. Where dunes are built up by the cottonwood, *Populus deltoides*, the common poplar species are abundant, among which *Empoasca trifasciata*, *Idiocerus lachrymalis* and *I. suturalis* are usually present.

The *Rhus-Toxicodendron*-Thicket-Association is frequently so dense and entangled that it is very difficult to cut a path through it. Large areas of long ridge, especially, are covered with this dense growth. Several species of common insects were found in this habitat, many of them the same as those occurring on the sand plain.

#### THE LAGOON-MARSH-THICKET-FOREST SUCCESSION.

The areas by far the richest both in individuals and species are the moist areas in the marshes and along the lagoon margins. A great number of lagoons are present and represent all stages in development from a pool of clear water in the midst of a sandy expanse, bordered by practically no vegetation, to ponds of arrow weed and marshes entirely filled with sedges. It is surprising how these different types of lagoons will vary in their "Jassid" fauna.

The willows and poplars are apparently the first plants to come in at the margins of the lagoons. During their first few years no leafhoppers could be found upon them. Later, however, when the zones are greatly pronounced by the thick, shrubby growth, species like *Macropsis viridis*, *M. virescens* var. *graminea*; *Idiocerus pallidus*, *Empoasca obtusa*, and *E. flavescens* are found on the willows and *Idiocerus lachrymalis* is common on the poplar shrubs. Another group of plants which are submerged or float upon the water and belong to the *Potamogeton* Association begin to grow in the waters of the lagoon at about the same time. So far as records to date are

concerned, none of these insects are known to live upon the submerged or floating vegetation.

Lagoon Aa is comparatively young perhaps representing an early stage of the lagoon succession which is shown very definitely by the vegetation along the margins. A short tender growth of *Juncus*, *Eleocharis* and small sedges close to the water line furnishes ideal feeding places for *Phlepsioides fuscipennis* and *collitus*, *Euscelis parallelus*, *striolus* and *cuneatus* and *Cicadula 6-notata* which are found in abundance on the short vegetation in the narrow zone along the lagoon margin (Plate XXXIV, Fig. 5). Only a few feet from the water line of the lagoon the sand plain vegetation is found and as stated previously, a different group of species is present.

*Euscelis cuneatus* a very abundant and recently described species lives in company with *Cicadula 6-notata* and *Euscelis striolus* on a uniform mat of *Cyperus diandrus* on a newly formed portion of the island (Plate XXXV, Fig. 4).

In the case of older lagoons such as C. D. and G. representing later stages of the lagoon succession where a wider margin of vegetation occurs, many sedges and grasses grow in the *Typha-Scirpus* and especially the *Sabbatia-Linum* association and several species of *Juncus*, *Eleocharis* and *Scleria* abound. Here we can add to the lagoon species already mentioned, *Thamnotettix melanogaster* and *fitchii*, *Dræculacephala mollipes*, *Helochara communis* and *Phlepsioides irroratus*. A marshy area at the end of lagoon Aa contains *Chlorotettix spatulatus* and *Dræculacephala minor* in great abundance.

One of the most interesting captures was the securing of *Dorydiella floridana* in great abundance from *Scleria verticellata* in the *Eleocharis obtusa* association (Plate XXXV, Fig. 2). The nymphs were found feeding on the stems just above the surface of the ground and within the clump. This mode of living may explain the fact that this species is considered as very rare and has seldom been collected. Comparatively few specimens can be obtained with a sweep net but by pulling apart a clump of the sedge, frequently two dozen were secured from a single clump.

It was described in 1897 from Florida and although cited only twice in literature since it has been taken in very few numbers in Massachusetts, New Jersey, Illinois along Lake Michigan, and in a similar lake habitat in South Dakota.

Although found occasionally along the lagoon margin its optimum habitat apparently is on sandy areas far distant from the receding waters of the lagoon but within the old lagoon basin. The nymphs and adults were very abundant in this habitat during the past four seasons. *Phlepsius nebulosus* occurs in good numbers in the same type of place but apparently has a different food plant. *Phlepsius fuscipennis* and *Euscelis parallelus* are also very abundant in the old lagoon basins.

In lagoons E. F. and Fa representing the next stage there are only a few additions to the leafhopper species. More striking is the additional number of Fulgoridæ and Cercopidæ which are found here. Such species as *Pentagramma vittatifrons*, *Philaenus lineatus* and species of *Stenocranus* are quite common during July.

Perhaps the last stage is presented by the middle one of the three marshy areas just north of Horseshoe pond. Although water is still found in the center of this old lagoon, it has become very shallow and is composed mostly of a black soggy soil. It is rapidly approaching a true marsh condition. Two rather interesting species were added here to our list of lagoon species. *Cicadula poloria* was living on a mat of very short, fine, *Eleocharis acicularis* (Plate XXXV, Fig. 1) and further study on the island showed that it lived apparently under no other condition. This species was living so close to the soggy black soil that it was almost impossible to sweep specimens into a net. It was described from Iowa by Ball, and *Juncus* was given as the food plant. It has since been reported from Maine and New York. The other species of interest is *Thamnotettix smithi*, which was abundant on a large patch of *Spartina michauxiana*, forming an outer zone in the same marsh. (Plate XXIV, Fig. 3). It is apparently a northern and western species and the food plant has not been mentioned previously. *Cicadula slossoni* a *Juncus* species is another addition in this association.

The marsh stage of the lagoon succession is shown by lagoon B and marsh 3 just north of horseshoe pond. Although a little clump of *Typha* still remains, the lagoon basin is almost entirely filled with *Calamagrostis canadensis* (Plate XXXIV, Fig. 1). This is the so-called wet meadow and a large group of species live upon these grasses. The most abundant species found here are *Chlorotettix unicolor*, *spatulatus* and *tergatus*, *Phlepsius irroratus*, *Thamnotettix nigrifrons* and *melanogaster*, *Parabolo-*

*cratus major*, *Dræculacephala mollipes* and *noveborocensis*, *Deltocephalus inimicus*, *striatus* and *sayi*. *Platymetopius frontalis* and *acutus*, *Mesamia vitellina* and *Scaphoideus ochraceus* occur less abundantly. Perhaps the most interesting species occurring here are *Thamnotettix inornatus*, *Deltocephalus osborni* and *Dikraneura mali* which species do not occur on other plants on the island and are apparently restricted to this habitat. So these may be added to the species of the lagoon succession. In the wet meadow at the west of horseshoe pond *Cicadula pullida* and *Euscelis elongatus* were taken from short grasses in the marshy area (Plate XXXIV, Fig. 6).

A detailed study of these lagoons in various stages has shown that as the vegetation constantly changes in the older lagoons, new species of leafhoppers also work into the association especially where restricted to a single plant for food. The change is perhaps not so pronounced nor so permanent as in the case of the plants, but is nevertheless a different association.

#### THE BAY-MARSH-THICKET-FOREST SUCCESSION.

At the head of the peninsula between the narrow neck and the mainland, a large and very interesting swamp area is found with small patches of marsh and wet meadow at its margins. In this swamp on the *Typha-Scirpus* association, large numbers of *Dræculacephala angulifera* both as nymphs and adults occur on *Scirpus fluviatilis*, the river bulrush (Plate XXXIV, Fig. 2.) Also a large *Cicadula* (apparently undescribed) was present in abundance.

On the *Carex-Phragmites* association which merges with the wet meadow a large number of species of leafhoppers are found. The principal species here are *Dræculacephala mollipes*, *Chlorotettix unicolor*, *Thamnotettix fitchii*, *T. melanogaster* and *Phlepsius solidaginis*. The number and dominance of species, however, will vary with the season and the consequent life cycle. Other common species found here in more or less abundance during the summer are *Platymetopius frontalis* and *P. acutus*, *Euscelis striolus*, *Deltocephalus inimicus*, *D. striatus*, *D. balli*, *Phlepsius irroratus*, *Agallia 4-punctata* and *A. sanguinolenta*. During certain months *Thamnotettix cypraceus* is abundant as nymph and adult upon sedges in a grassy-*Solidago* association which is intermediate between the true wet meadow and the shrub zone. Also *Scaphoideus immistus* and *S. auronitens* are found



here. Several specimens of *Deltocephalus configuratus* were taken from *Poa compressa*.

Where the wet meadow is being invaded by the *Rhus-Alnus* shrub association other leafhoppers are found. Such species as *Oncopsis variabilis*, *Alebra albostriella*, *Empoasca atrolabes* and *Empoa tenerrima* are common and abundant upon *Alnus*.

The *Ulmus-Acer* association was not worked in detail for leafhopper species but two rather interesting observations were made. Where *Solidago cæsia* is found as a member of the ground layer, *Scaphoideus lobatus* was collected in abundance both as nymph and adult. Also on the *Linden*, *Gypona pectoralis* and *Alebra albostriella* were abundant. On the dunes and sand ridges where the poplars form an important part of the vegetation such species as *Idiocerus lachrymalis* and *I. suturalis* are abundant on *Populus deltoides*. *Idiocerus cognatus* is very common on *Populus alba* and the Lombardy poplar is apparently the food plant of *Idiocerus scurra*.

Where the *Salix* shrub zone follows immediately the *Scirpus americana* formation certain species are found feeding upon the willows. *Macropsis viridis*, *M. suturalis*, *M. virescens* var *graminea*, *Idiocerus pallidus*, *I. snowi*, *I. suturalis*, *Empoasca obtusa* and *E. smaragdula* are the principal species. Also *Empoasca flavescens*, *Thamnotettix clitellarius* and *Eutettix seminudus* are found in less abundance.

This study has been especially interesting for three reasons. First, because the vegetation is arranged in such a way as to give definite zonation, and great extremes of conditions are found in limited areas. Second, several interesting and valuable records of supposedly rare species have seemed to strengthen the theory that a species is considered rare only when its food plant is very scarce or more often when its habitat and mode of living are not known. Third, by studying a group of insects which are plant feeders and by taking only this one group with which study has been carried on for several years, more detailed results were obtained than in the case of a study of all insects or all animals present in a definite habitat, for frequently there is a failure in such cases to distinguish between valuable records and those of minor importance.

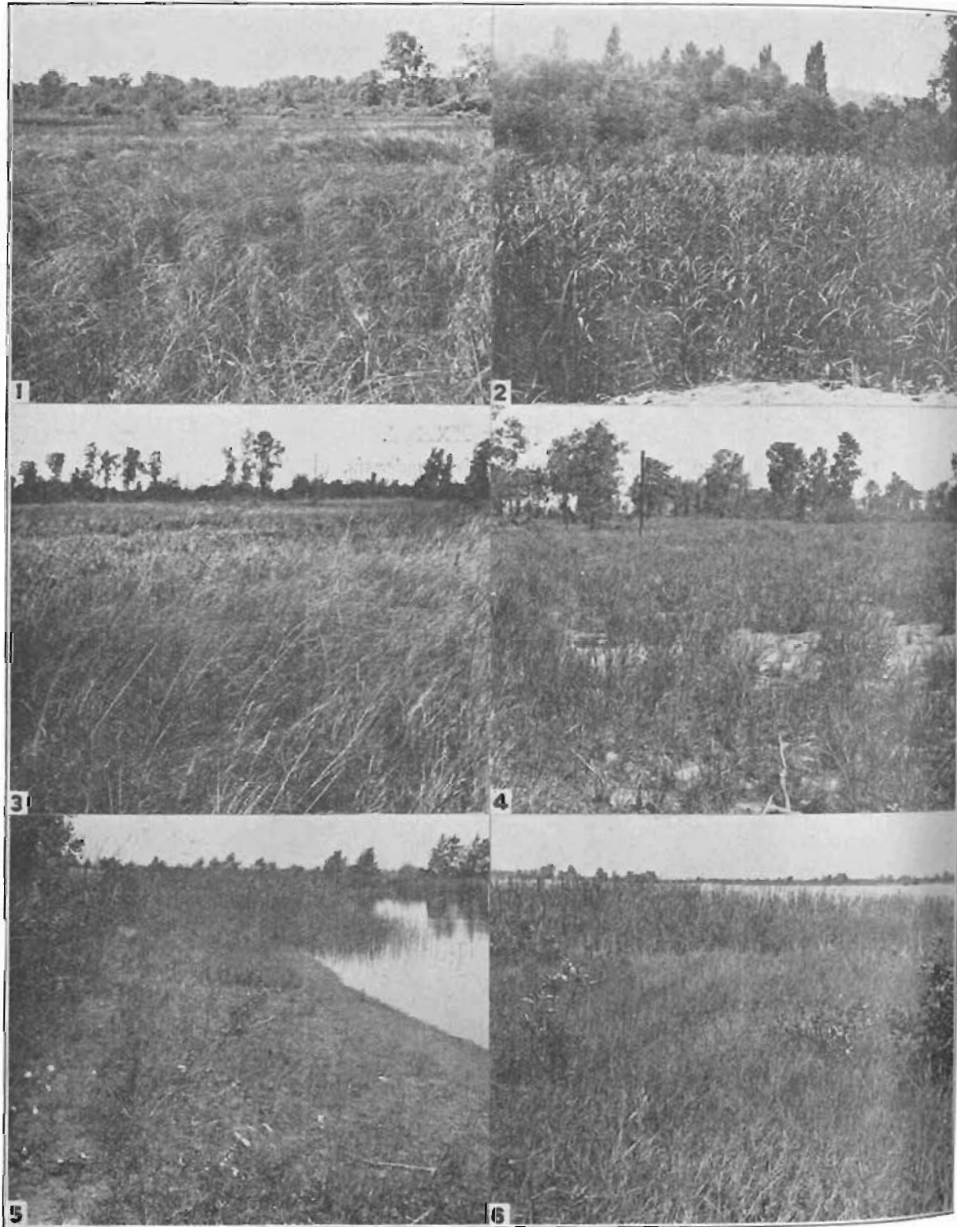
## EXPLANATION OF PLATES.

## PLATE XXXIV.

1. Wet meadow filled with *Calamagrostis canadensis*.
2. Association of *Scirpus fluviatilis* with *Salix* shrub zone in background.
3. Association of *Spartina michauxiana* in foreground, habitat of *Thamnotettix smithi*.
4. Sand Plain showing *Andropogon furcatus* association, food plant of *Thamnotettix pallidulus*.
5. Lagoon Aa showing short growth of *Juncus-Eleocharis* along margin.
6. Marshy area along horseshoe pond, showing *Typha-Scirpus* zone, also wet meadow with mixed vegetation containing young willows.

## PLATE XXXV.

1. Marsh area with *Eleocharis acicularis* association.
2. Association of *Scleria verticillata* and *Eleocharis obtusa*.
3. Sand plain showing patches of *Panicum villosissimum* and *P. hauchuciae*, food plants of *Deltocephalus apicatus*.
4. Association of *Cyperus diandrus*.



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