SPIDERS ON ISLE ROYALE, MICHIGAN

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ABSTRACT

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During the summer of 1965, the author collected 2,100 adult and immature specimens of 153 species, 85 genera, and 17 families from Isle Royale National Park. Pitfall trap and sweep samples yielded semi-quantified data to show the relative abundance of the common species. Collections were made from all habitats represented on Isle Royale with a concentrated effort on a transect running from Daisy Farm to the high central ridge. Data from each habitat yielded a set of ecological parameters for most of the common species; it also shows the interaction of the species with each other from one habitat to another. Though there is much overlap in species composition, each habitat showed a distinct set of dominant and subdominant forms, which changed with the habitats. It was concluded that the spider fauna of Isle Royale shows a successional change which corresponds closely with the plant succession and the subsequent change in microclimates.

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By

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INTRODUCTION

Isle Royale has had a long history of biological investigation. Ruthven (1906) and Adams (1908) of the Michigan Geological Survey are notable among the early investigators. Their research was an early attempt to study the ecology of Michigan. The published lists of species of plants and animals of Isle Royale, included a report on the invertebrates prepared by Nathan Banks. The vegetation has been given special attention by several investigators. Wheeler (1901) was the pioneer among the botanical studies. Brown (1935) published a list of the plants for the island. The forests were studied by Cooper (1913) in which he described the climax forest types. Cooper (1928) and Linn (1952, 1959) conducted studies on forest succession.

This paper is a systematic study of the spider relationships which exist between various gross communities, with qualitative analyses based on several different types of stratified collecting. It is the authors intention to show the gross community structure (see Duffey 1966) of each major spider habitat. This is possible when dealing with the abundant species but it is difficult to detect the ecological parameters of the uncommon species.

The author collected large numbers of samples from various habitats; by comparing the interplay among the species from one site to another it is possible to detect some of the important ecological parameters of those species involved, and to range the species according to their relative abundance in a given habitat.

THE STUDY AREA

Isle Royale National Park located on Lake Superior is fifty miles northwest of Michigan's Keweenaw Peninsula (89° west longitude, 48° north latitude) and is 20 miles southwest of the Canadian shore (see fig. 3). The nearest shore location is Prince Location, Ontario, 15 miles from the southeast end of the island. Isle Royale is 47 miles long, through its long axis which is orientated in a northeast-southwest direction, and nine miles at the widest point. This wilderness park has no roads or automobiles. Each end of the island has a center of visitor use--Rock Harbor on the northeastern end and Windigo on the southwestern end. The interior is maintained in its wilderness state by the National Park Service.

Physiography

Isle Royale is a partially submerged cuesta formed from Precambrian lava beds which have been faulted and tilted upward, with the dip slope facing southeast. Erosion has carried away the soft sediments which alternate between beds of resistant lava, leaving a series of parallel ridges. There are five major ridges, one of which forms a chain of small islands off Isle Royale's southern shore. The southeast slopes of the ridges dip at angles between 5° and 40°; the scarp slope facing northwest, forms almost vertical slopes in many places on the island. Because of this southeast dip, the southwestern end of the island is highest (figure 1-A).

Land Use

Isle Royale has been a National Park since 1940; before this, the island has known a long history of disturbance by man. Prehistoric Indians mined native copper by burning off the vegetation to expose the veins of copper near the surface. Copper was commercially mined by white man in the 1840's and again in the 1870's but competition from the mainland resulted in failure in each attempt. Mining activity had, however, a profound influence on the flora and fauna. The grazing and stabling of mine horses, mules, and cattle may be observed today in what might be termed an "old field type vegetation" in areas adjacent to the mines. The grazing prevented reforestation and aided in the establishment of a thick turf. At least two mining towns were built with local timber at Wendigo and McCargo Cove; removal of the timber formed clearings which were used as pastures. Such disturbed areas are particularly evident at Minong mine and at the Windigo mine sites.

Other interests have altered the environment; pulpwood cutting, hunting, fishing, trapping, and recreation. Also, most areas of the island have been burned over several times within historic times. Lastly, the pressures for expanding recreational facilities is a constant threat to wilderness preservation.

Climate

Weather records for Isle Royale are incomplete but summer records have been taken at Mott Island, off shore of Isle Royale from 1940 to the present. Table 1 shows a ten year weather summary. Temperatures are moderated by Lake Superior; daily low temperatures

average several degrees warmer than on the mainland during the winter and several degrees cooler during the summer. Spring, summer, and fall are cool with frequent storms and cloudy weather; clouds and drizzle may last for several days at a time--especially during the spring and fall. Only during the last week of July through mid August can one predict fair weather.

TABLE 1.--Weather records from Mott Island, Isle Royale, 1951-60 (U.S. Department of Commerce 1964)

	May	June	July	Aug.	Sept.	Oct.
Average precip. (in.)		2.83	2.79	2.99	3.25	2.02
Average temp.	46.3	53.3	59.7	62.3	53.9	45.2
Period	6	9				8
Average max. T. (6 yr. record)	55.6	63.2	69.2	70.3	61.0	52.0
Average min. T. (6 yr. record)	37.0	43.3	50.1	54.2	46.8	38.4
Max. T. (6 yr. record)	75	87	86	83	82	70
Min. T. (6 yr. record)	23	33	41	34	33	12

Mech (1966) describes the winters as being milder than the mainland with heavy snow, averaging two feet in protected areas, and three to six feet in drifts.

The microclimates are variable from one end of the island to the other and on portions of a given ridge. The higher southeast end of the island is warmer and dryer than the lower northwest end. The summits of the ridges are warmer and dryer than their bases. Also

the summits of the ridges show greater temperature fluctuations than their cool, moist bases which are under more direct lake influence (figure 1). Linn (1952 and 1957) has pointed out that these two climatic patterns express themselves in the two different climax vegetation types whose local distribution is determined by these microclimatological gradients.

Soils

The soil is not well developed on Isle Royale; mature soil is almost non-existent. Most of the forested portions of the island have an AC soil profile. Linn (1952) reports a B layer in an area of the southwestern slopes of the central Greenstone ridge. Where soil has developed, it is usually not suitable as a substrate for burrowing spiders.

The central ridge (Greenstone, R #3, see fig. 1) has poor soil development on the northeast end, but humification is well developed at the southeast end, where there is a mature yellow-birch, sugar maple forest. In general, humification develops as you proceed toward the base of a ridge, a rich black soil being formed at the bottom. The AO horizon is almost lacking in the Isle Royale profile.

The summits of the ridges show remarkable variation in soil development. The southernmost ridge (R #1, figure 1) at the Ojibway transect (see fig. 1 & 2) is the lowest and has a well developed sub-climax forest with an AC profile. The second ridge (R #2) has poorly developed soil and supports an open aspen forest. The Greenstone (R #3) has little soil development and supports scrub growth and pioneer plants.

Vegetation

Isle Royale is situated in a zone between the hardwood and coniferous forest biomes. The vegetation forms a mosaic whose patterns are determined by the subtle variations in the microclimates on the various ridges (figure 2). The frequency of burn has not permitted extensive stands of climax vegetation to develop. Consequently, Isle Royale's forests form a complex system of subclimax forests. The most extensive of these is the birch-aspen (white birch, Betula papyrifera, and aspen, Populus tremuloides) subclimax forest which has extensive conifer reproduction in the understory (balsam fir, Abies balsamea and white spruce, Picea glauca). In many areas, conifer reproduction has advanced to the point of being a dominant in the community but birch are still abundant. This type of forest is adapted to the cooler, damper regions close to the lake and at the bases of the ridges. It covers approximately two-thirds of the island.

The warmer, dryer areas at the southeast end of the island on the high central ridge (Greenstone R #3) support a sugar maple, Acer saccharum, and yellow birch, Betula lutea, climax forest. This forest covers about one-tenth of the island and is the only extensive climax vegetation type. The tension zone, where the birch-aspen forest meets the maple-birch climax forest, forms a transition forest, which is composed to varying degrees, of elements of the two forest types.

The spruce-fir climax occurs only in patches where fire apparently was not able to do its damage. There are several examples of this along the small streams--especially where streams have cut deep trenches.

Open areas have the following vegetation types: beaver meadows, outcrops with various pioneer plants, the burn areas, and old field vegetation associated with the mines.

MATERIALS AND METHODS

The author collected spiders and other associated data on the island during the summer of 1965, from June 18 to August 25. Base camp was set up at Daisy Farm from which collecting forays originated.

Figure 3 shows the areas of concentrated collecting. A line transect was established along the Mount Ojibway trail for collecing purposes. The trail roughly makes a cross-section of the island from the shore to the summit of the highest ridge. This transect covered most of the habitats and served as an area of concentrated collecting. The habitats which were not represented in the Ojibway transect were collected by means of other special trips to those areas. Since hiking was the only means of transportation available, the areas around Daisy Farm tended to be well collected while less accessible areas received less concentrated collecting efforts.

The author's objective was to obtain stratified samples of spiders from all major habitats. Thus, many types of collecting techniques were employed. Two semi-quantitative sampling techniques were employed in all habitats--sweeping vegetation and pitfall trapping. These techniques, when combined with hand picking and personal observations, give a fairly accurate idea of the relative abundance and biotic associations of the spiders within a particular gross habitat at a given time.

A fifteen inch hoop beating net was used in most areas because of the woody nature of the herb layer. A medium sweep net with a

fifteen inch hoop was used in grassy areas. The net load, after sweeping, was dumped into an ethyl acetate killing jar and was sorted in an enamel pan that evening at camp. Specimens remain fresh in the ethyl acetate killing jar for a day or more in the cool climate of Isle Royale. Once sorted, the specimens were transferred to 70% ethyl alcohol. A record was maintained in a notebook of the habitat and particular strata from which each sample was collected. Two sweep samples of 50 sweeps were taken weekly from each of the habitats along the Ojibway transect for ten weeks beginning 22 June. This semi-quantitative technique shows relative abundance, of the large spiders of a given habitat.

Pitfall traps consisted of standard plastic cottage cheese cartons, four and one-half inches in diameter and three inches deep (inch and one-half depth traps were used in a pilot project and proved to be too shallow and useless in retaining larger spiders). Ethylene glycol was placed in the traps to a depth of one quarter to one half inch; this liquid has advantages over other mixtures since it is relatively non-volatile (see Greenslade, 1964).

Six or twelve traps were placed on the summits and at the bases of the major ridges, in the bogs, lake and stream margins, and the various forest areas. All traps were placed in a "typical" area for that habitat in a line transect with the traps thirty to several hundred paces apart. No attempt was made at randomization since my intentions were for relative data and not quantified samples. The traps were collected every other day and rough sorted in an enamel pan in strong sunlight. Trapping tended to be sporadic since trips to various other areas of the island may take a week or more; also many

areas could only be trapped for a few days during a special trip to that area.

Much of the daylight hours were spent hand picking and observing; during this time, detailed ecological notes were taken with each specimen. This method is used as a basis for interpreting the pitfall and sweep sample data. Several habitats could only be collected in this manner. Most of the hand-picked specimens were collected with the hands to avoid specimen injury. However, an aspirator was used for small species.

Two other methods of capture were employed which, unfortunately, proved useless on Isle Royale. The first was sifting litter through graded sieves. As mentioned in the discussion on soil, the A0 horizon is almost non-existent and there was little to sift. The second device which failed was the Berlese funnel. The samples which were placed in the funnel failed to dry out due to the humid conditions and the frequency of rain and drizzly days.

At the end of the summer, the samples were sorted in the laboratory and specific determinations were made. Immature specimens were routinely discarded except under unusual circumstances, because their specific identity cannot be determined with certainty.

THE BIOTIC ASSOCIATIONS OF THE ISLE ROYALE SPIDERS

Collecting and field observation have demonstrated an ecological successional change in the Isle Royale spider fauna which corresponds to plant succession. Lowrie (1948) has shown similar successional changes in the Great Lakes dune successional sequence. Delong (1965) has shown similar change in leafhoppers for the Great Lakes area.

Many studies have been made of individual communities. Since they deal with a single community, they do not show succession, but they do show the community structure over a period of time. Notable among these studies is the work of Barnes, Muma, and Turnbull. Barnes (1953, et Barnes 1955) studied the spider populations in non-forest maritime communities and (1955) the spider populations associated with an abstract broomsedge community--any habitat where broomsedge was the dominant. Muma (1949) studied the populations of spiders from a 320 acre tract of virgin Nebraska prairie. Turnbull (1960) made studies of spider populations in a stand of English oak woods and (1966) the spider populations of an overgrazed pasture, in central Ontario. Also notable is the recent book of Elton (1966) dealing with community structure.

I will present some semi-quantified data to show the relative abundance and community structure of the various gross habitats of Isle Royale. Successional change can most clearly be shown when making a comparison from one community to another. Figure 3 shows the

relationships among the thirteen gross habitats recognized in this study.

I will show where possible the dominant species of each habitat and their associated niches. A dominant is the most abundant species of a niche, thus a habitat may have several ecologically isolated dominants corresponding to the various niches. The principle of competitive exclusion permits only a single dominant of a given size class or ecological behavioral type in a niche. Niche as used here is a set of ecological parameters common to a species or a group of very similar (ecologically and behaviorally) species (i.e. under logs or leaf litter forms).

Pebble Beach Biotic Association

Thirty-one species were collected in this habitat. This is remarkable since this habitat averages five feet wide and about 600 yards long. The only place this beach occurs is at Daisy Farm and at Huginnin Cove.

The beach consists of cobbles ranging from six inches in diameter downward to small pebbles. These are underlaid by gravel. Spiders run in the spaces between the cobbles or underneath the larger stones. Food is relatively abundant; Collembola are in profusion. Also present are carabid beetles (Bembidion sp.), various shore dwelling hemipterous insects, butterflies, and many types of flies.

This habitat is very wet; waves from the frequent storms may wash across the entire area. The spiders are apparently able to weather these storms since they are actively running about immediately following them.

Eight species of three families of spiders (Table 2-A) have been collected consistently in large numbers. Of these eight species, four dominants are apparent; these fill three distinct niches. Neoantistea radula dominates the spaces between the cobbles where they construct delicate sheet webs. Though seldom seen they are extremely abundant. Pardosa groenlandica is found running among the rocks during the day. Even to the most casual observer, these large spiders are immediately apparent. Pardosa moesta and P. lapidicina are the dominant small class hunters. They tend to be more secretive and because of their smaller size are not as conspicuous as the larger P. groenlandica.

Four species of the rather flattened spiders are also abundant in this habitat. Two Gnaphosids, Drassodes neglectus and Zelotes subterraneus are commonly found under stones presumably feeding on the collembola. These two species are the larger spiders found under stones. Two species of clubionids form the small class spiders which spend most of their activity under the stones: Phrurotimpus borealis and Micaria montana.

Three species which are yet smaller can be found under these cobbles and among the pebbles: Chocorua cuneata, Erigone atra, and Erigone zoographica. These species limit their activity to the moist areas.

Enoplognatha tecta was found consistently under driftwood with egg sacs. Also associated with beach debris were two minute jumping spiders, Telavera minuta and Neon nelli, although only a few specimens were captured they were seen on many occasions but escaped my attempts to collect them.

Sphagnum Bog Biotic Association

Bogs occur between the ridges in many areas. They are especially common between the second ridge and the Greenstone ridge (R #3). The tree cover consists of white cedar, Thuja occidentalis, which is predominant in the centers of the bogs, and black spruce, Picea mariana, which is most abundant around the margins of the bogs. This forms an open bog forest which allows profuse growth in the understory. The understory is composed of a 15 foot layer of alder, Alnus incana, and a herb layer which is waist high. The herb layer is dominated by woody shrubs, grasses, and sedges. The ground is very wet and soggy, but in some areas grasses and sedges have formed a solid mat underfoot.

Most of the ground fauna of the surrounding forest does not enter the bog. Tarentula aculeata and Trochosa pratensis were collected only once each in the bogs--these two species are extremely abundant just a few feet away in the surrounding forest. Thus, the bog has a unique spider fauna.

The ground is apparently too wet to support large populations of spiders. Two species of wolf spider were consistently captured in small numbers. Pirata insularis has been observed in the sphagnum moss. From visual observation I conclude that this species is very abundant but is not easily collected. Only a few specimens were collected by pitfall trap. The second species is a larger wolf spider, Arctosa quinaria. This species eluded the pitfall trapping and visual searching until August when the females constructed large tube webs in the sphagnum moss (figure 4). These webs were made from several layers of dry silk, which were spun into a verticle tube and closed

at both ends. The tube extended into the moss 9-12 inches and had a diameter corresponding to the relative size of the spider which inhabited it; the average diameter was about one inch. The web also extended two inches above the moss where it was anchored to a convenient structure. During August these webs were occupied by a female with an egg sac. They were fairly common and in some areas they may be only five feet apart.

This web may serve at least two functions. It disguises the reproductive female as a prey item; secondly the silk may prevent parasitic Hymenoptera and Diptera from attacking the eggs. I was unable to detect any evidence that the spider left the web--unless a new web was constructed each time. Since no web remnants were found, this seems unlikely.

The herb layer is an ideal spider habitat since the large trees offer shelter from the wind and the many shrubs, bushes and grasses offer optimun conditions for web construction and climbing. The aerial fauna shows much similarity to the forest, thus the bog is not as much of a barrier to the web spinners as it seems to be for ground spiders. The diversity was very high in this strata having 28 species. Two species are found abundantly in this strata. Linyphia marginata is extremely common on labrador tea, Ledum groenlandicum; one cannot sweep without collecting these in nuisance numbers. Theridion aurantium and T. ornatum was common in herbs. The webs of theridiids seem to require a fairly stable structure for support which is not subject to blowing in the wind, the woody nature of the herb layer of this habitat offers the necessary stability in many local areas.

On the other hand where the herb layer consists of sedges or young saplings which are blown by the wind and in more or less constant motion, the linyphiids are able to construct webs. One major ecological isolating factor between this family and the Theridiids seems to be this requirement for web construction. The webs of these spiders apparently have a high degree of flexibility--that is, saplings, tree branches, or herbaceous foliage are extensively utilized to construct webs. Bathyphantes pallida, B. pullatus, Linyphia pusilla, L. marginata, and Pityohyphantes costatus are abundant in this niche.

Epeira patagiata is common in August on the alder saplings of the bog.

Birch-Aspen Subclimax Forest Biotic Association

The birch-aspen subclimax forest has a wide range of ecological parameters. In general it is moist and cool but subject to great change from one local area to another. The forest ranges from mixed birch and aspen with a small amount of conifer reproduction to a maturing conifer forest with only the older birch trees standing. (The birch and aspen are unable to reproduce in the shade of the conifers). Light intensity is reduced as the conifers mature, the humidity increases with this increase in insulation and the temperature drops.

In most cases, conifer reproduction is more developed at the bases of the ridges than near the dryer summits where soil development is not as advanced. Birch apparently needs a richer more moist soil than the aspen, since as one approaches the poorer, drier soil profiles, aspen becomes more abundant and the birch seems to drop out. Thus, these poor soil areas near the summits of the ridges form an open dry forest which forms a border around the major outcrops; dry forest

areas also occur on the tops of some of the low ridges where soil development has not yet advanced very far (for example, the open forest on R #2 of the Ojibway transect). In these dry open portions of the birch-aspen subclimax the dominant ground spiders are Pardosa distincta, of which an average of thirty specimens per trap were collected during the ten week collecting period (90% frequency), and Tarentula aculeata, of which an average of sixteen specimens per trap were collected during the ten week collection period (60% frequency). These two species are in different size classes, P. distincta, being smaller. These frequency-density figures are from a set of eight traps on R #2 of the Ojibway transect. One dominant species from the perched habitat was also collected--Neoantistea agilis. This species constructs its tiny web on the fairly extensive grassy areas (thimbleberry is not well-developed in the open forest areas). The herb layer is not developed in the open forest, however, scattered shrubs do occur and have a mixed fauna--elements from the outcrops and the forests. Aranea trifolium, which prefers open areas, is a good example of a non-forest species and Epeira cornuta is an example from the forest.

Those portions of the subclimax forest which are not on the immediate summits of the higher ridges are cool and moist with a damp black soil. The herb understory is dominated by thimbleberry which grows about waist high. From the frequency-density diagram (Table 2-B) we can see that Linyphia marginata is dominant throughout the summer. During August the webs of Araneus diadematus are very abundant on thimbleberry and tree saplings.

A perched habitat (about 1 foot above the ground) is developed in local areas where thimbleberry has not extensively developed. This

perched habitat is extensively used by Agelenopsis utahana where its webs will be found among the grasses, broadleaf aster, Aster macrophyllus, and the large leaves of the yellow beadlily, Clintonia borealis. Neoantistea radula is also extremely abundant in the perched habitat and on structured material laying on the ground. These two species are not in competition because of considerable difference in size--N. radula being much smaller.

The ground fauna of the birch-aspen subclimax forest is the most highly developed species complex of any habitat on Isle Royale. Forty-five species of ground dwelling spiders were collected. The absence of Schizocosa was an unexpected Isle Royale faunistic phenomena; this genus is found in Michigan, Wisconsin, and Ontario. Also absent is Geolycosa which is not surprising since a habitat with a suitable burrowing substrate does not exist on Isle Royale. The two dominant species of larger lycosids are Tarentula aculeata and Trochosa pratensis (Table 2-C). The dominance of two closely related large species presumes a significant biological difference. Observations made by the author suggests that T. pratensis prefer the wet areas whereas T. aculeata is more abundant in the drier forests; only a few specimens of T. pratensis were found in the dry open forests but T. aculeata was a dominant. Both species occur in approximately equal numbers in the mesic areas of this forest; but where it is wet, such as along the creeks, T. pratensis is more abundant. The small class running spiders of the litter layer are Pardosa mackenziana and Pardosa moesta--P. mackenziana being the most abundant. Table 4 shows hypothetical relationships of the various ground spiders, based on pitfall trap data and the observations of the author.

The large number of logs on the forest floor is one very striking feature of the birch-aspen subclimax forest. Amaurobius bennetti is very common under these logs. Four other species were found consistently under logs, Xysticus elegans, Drassodes neglectus, Enoplagnatha tecta, and Steatoda borealis.

Paper birch bark provides a high degree of structural material and supports fairly high populations of spiders. A single trunk from one foot off the ground to as high as a man can reach have produced as many as forty-five specimens representing seven species. Five species were consistently captured on birch bark; Icius similis, Clubiona canadensis, Steatoda borealis, Pityohyphantes phrygianus, and Amaurobius bennetti. The birch bark also served as retreats for Araneus and Epeira when a web was constructed between the birch and a nearby sapling--a very common web placement. Amaurobius bennetti also uses a curl of bark for a retreat and builds an irregular web which radiates from the opening of the curl.

Saplings and shrubs hold an array of webs; the web of Linyphia marginata is most common except in August when the large orb weavers, especially Araneus diadematus, are so abundant. The conifer saplings are especially well suited for the webs of linyphiids. The webs of Pityohyphantes phrygianus are very common in these conifer saplings.

Web size seems to be an ecological isolation mechanism, since the dominant species will tend to be selected by the nature of the herb layer at a given site. This mechanism, seems to alleviate inter-species competition and to explain the fact that several abundant species are found in the same gross habitat or vegetation type though not necessarily of the same site. Both linyphiids and epeirids will

build webs on wind blown herbs--their silk and web type presumably withstands a certain amount of stretching. However, where a stable web site occurs Steatoda borealis may be found in the subclimax forest.

Transition Forest Biotic Association

The author was unable to find substantial differences between this habitat and the birch-aspen subclimax forest.

Spruce-Fir Climax Forest Biotic Association

This habitat yielded no significant results; pure stands of mature spruce-fir are very local and tend to be so small that they are under direct influence from the surrounding subclimax forest. The herb layer is absent, there are few saplings (since tree reproduction is checked in the climax forests), and the litter consists of a thin layer of needles and sticks. This complete absence of structured material makes this unsuitable for habitation by most spiders. However, Cyclosa conica was found consistently in the fir trees. Of the other species found, all seem to be wanderers from the subclimax forest.

Sugar Maple-Yellow Birch Biotic Association

This habitat was not adequately sampled due to lack of supplies and transportation. All collecting material must be carried inland several miles and up the ridge. This limited collecting to several trips of hand picking.

The herb layer is poorly developed--consisting of sugar maple seedlings and tall sugar maple saplings. The seedlings and saplings are constantly in motion due to the wind and are thus highly unsuitable

for web construction. Sweeping the seedlings yielded little diversity--an occasional Linyphia marginata or Pityohyphantes phrygianus and little else. The saplings occasionally contained Araneus diadematus which utilized a nearby tree for part of its web attachment. Ammaurobius bennetti is found occasionally on the bark of yellow birch.

In areas where there was a break in the forest canopy, a perched layer was developed similar to that of the subclimax forest. Clubiona canadensis, Coras montanus, and Agelenopsis utahana are found in this microhabitat.

The ground spiders seemed to be the same as would be found in the subclimax forest, with Trochosa pratensis and Pardosa mackenziana being most common. Tarentula aculeata was not collected in this habitat. Logs are not as common in this forest type but stumps are frequently encountered. These stumps consistently yielded Amaurobius bennetti, Enaplognatha intrepedia and Steatoda borealis.

The effect of the wind and relative lack of solid structured material is dramatized when a solid man-made structure is introduced into the habitat. Cabins and outbuildings were covered with webs. Every conceivable inch of usable space was occupied by typical forest web spinning species--Araneus diadematus, Epeira cornuta, Araniella displicata, Steatoda borealis, and Theridion to name but a few. Buildings in the subclimax forest were not covered to this degree with webs. A wood pile in the climax forest yielded large numbers of climbing species: Dolomedes tenebrosus, Evarcha hoyi, and Gnaphosa muscorum.

A few specimens of the following species were also collected in the climax forest: Araneus nordmanni, Cyclosa conica, Meioneta sp. B, Misumena calycina, Callioplus tibialis..

Outcrop Biotic Association

Outcrops are characteristically dry, open, rocky areas supporting a variety of plants. The vegetation ranges from chest-high thickets of beaked hazelnut, Corylus cornuta, to a few scattered grasses in the cracks of rocks. With the exception of the hazelnut thickets, blueberries, Vaccinium sp., and ground juniper, Juniperus communis, the vegetation is sparce--most often, too sparce for sweeping. The woody shrubs usually occur in clumps or patches which are scattered throughout the open areas of the outcrops where grasses, hawkweed, Hieracium canadense, and harebell, Campanula rotundifolia grow.

The spider fauna of the outcrops are dependent on three factors; the extensiveness of the outcrop, its proximity to forests and its water relationships. The only extensive outcrops are the Greenstone ridge (R #3) and the burn area. The large area, of R #3 and the burn combined, keep the forest influence to a minimum and higher elevation gives it poor water relations. The other outcrops fall into two categories; the forest outcrops (i.e. those on R #1 of the Ojibway transect) which are characteristically small rocky openings in the subclimax forest (none were observed in climax forests) and the shore outcrops which are on the dip slope of the ridges at the shore (these, too, are surrounded by subclimax forest).

The damp shore outcrops have a great deal of forest influence (Table 3-A). The large class wolf spider is Tarentula aculeata;

Neoantistea radula is the dominant in the perched microhabitat among the grasses and rock crevices. The small class wolf spider niche is shared by Pardosa hyperborea and Pardosa distincta. Pardosa mackenziana, common in the forest, is absent in this habitat; to the author's knowledge, these species do not occur in areas where the forest canopy is not closed; the sun-loving P. distincta occupy this niche in their absence. The shore outcrop is the only habitat where the rare Pardosa hyperborea occurs. Trochosa pratensis is uncommon in open areas--it prefers the dark, moister forest habitats.

The dry forest outcrops have less forest influence due to their poor water relations. Tarentula aculeata, however, seems to tolerate these conditions and is the large hunting spider dominant (Table 3-B). Neoantistea radula is no longer the dominant, apparently due to the dry conditions and the poorer development of the perched microhabitat when compared with the shore outcrop. Pardosa distincta, is the dominant small hunting spider in the dry open areas.

The extensive outcrops (and the burn areas, as classified in this study) have a similar community structure to the forest, but with some modification due to drier conditions. Pardosa distincta becomes very abundant--more than T. aculeata. Neoantistea agilis dominates the perched microhabitat where it replaces the wet-loving species N. radula.

The appearance of Lycosa frondicola should be noted. It is a sun and vegetation-loving species which prefers mesic to dry areas. The author has observed this species as a dominant in old fields in southern Michigan.

The vegetation is too poorly developed in most areas to support

large populations of aerial spiders. The hazelnut harbors occasional Araneus trifolium, Xysticus elegans, Tibellus oblongus and Paraphidippus marginatus. The rocks and blueberry bushes contain jumping spiders in moderate numbers. Collecting difficulties in this microhabitat prevented the author from collecting a large sample. Many specimen were hand-picked, however. Icius similis and Phidippus purpuratus seem to be fairly common in this microhabitat.

Beaver Meadow Biotic Association

This hydric habitat is primarily an aerial spider habitat since the ground is extremely wet and soggy. Pardosa moesta can be found in moderate numbers in the drier areas, however.

The vegetation is dominated by sedges and grasses with an occasional clump of hazelnut bushes. The spider fauna is very similar to that of the damp old fields of southern Michigan. The dominant climbing species are Paraphidippus marginatus and Tibellus oblongus. The web spinners were represented by Tetragnatha laboriosa, and Singa variabilis as the dominants; Tetragnatha straminea and Xysticus canadensis were also abundant.

Species densities were too low to make semi-quantified sampling worthwhile in this habitat.

Old Field Biotic Association

These fields occur at the Windigo and the Minong mine sites. As mentioned, these are the result of grazing by the mine livestock. In general, they are quite similar to those fields of mainland Michigan. Metaphidippus protervus, Paraphidippus marginatus, Tibellus oblongus, and Tetragnatha laboriosa occur with tiring

monotony. Pardosa moesta is the dominant ground spider in this habitat.

Succession

The following four diagrams Table 4 show the relationships of the spiders of the ground and perched microhabitats in the major habitats along the Ojibway transect. No numbers are included since it is based on semi-quantitative pitfall trap data, personal observation, and is meant to be relative rather than quantitative.

The data is in agreement with the principle of competitive exclusion in that there are no two dominant species in a microhabitat. The dominant ground dwelling species on Isle Royale are the wolf spiders with a small class and a large class dominant in most habitats. The dominants of the perched microhabitats are the agelenids (Agelenopsis) and the hahniids (Neoantistea). The dominants in the aerial microhabitats are linyphiids and during August the epeirids. There is only a single species which is dominant in each ecological niche of each habitat--which is controlled by a complex of environmental factors. As one proceeds from one habitat to another, the relative abundance of these various species change in response to the various changing ecological parameters and to the physical structure of the habitat locally.

The data from typical sites in each habitat have yielded a complex of dominant species for that habitat. There is much overlap of species, but in most habitats there is a high degree of dissimilarity. In all habitats examined, the complex of dominant species and their relationships, to one another, changed from one habitat to another

(where adequate collecting allowed a conclusion to be made). Thus the Isle Royale spider fauna shows successional change.

SPECIES ACCOUNT

Approximately 2,100 specimens, adult and immature, representing 153 species, 85 genera, and 17 families were represented in the collection from Isle Royale. In addition, 150 spiders collected by R. W. Hodges in 1954 were examined. I have been unable to locate the spiders reported in the Adams report of 1908, which were determined by Nathan Banks. In most cases, where a taxonomic discrepancy occurs synonymes have been provided. This systematic list follows Kaston (1948) for convenience and because it is the most familiar system to the non specialist.

Superfamily Epeiroidea

Family Theridiidae

Ctenium fusca (Emerton)

A single male was taken from the pebble beach at Daisy Farm, 25 June.

C. riparius (Keyserling)

A single female was collected in a pitfall trap at R #2, Daisy Farm, 19 July.

Enoplognatha intrepedia (Sørensen)

Five females were collected--four from curled bark of birch trees and one from the herb layer of the birch-aspen subclimax forest.

Collecting dates ranged from 29 June to 1 August. One female had two spherical egg sacs (30 July, Washington Creek), one containing 38 spiderlings and the other with 27 eggs. One sac measured 4.0 milimeters in diameter and the other 4.8 milimeters (containing the spiderlings). The eggs are spherical and range between .55 and .6 milimeters in diameter. The egg sacs had two layers; the outer layer was composed of course strands which were stuck together at points of contact as if they were sticky at one time. The inner layer was composed of fine strands which were approximately one-fourth the diameter of the course strands of the outer layer.

E. tecta (Keyserling)

Twelve specimens were collected in a variety of wet situations. It occurs under driftwood on beaches and on the herb layer sphagnum bog and birch-aspen subclimax forest). Collection dates ranged from 20 June to 23 August. Five egg sacs were found with two females. One female had two spherical sacs of very loose curly silk (5.5 mm. sac, 62 eggs, .15 mm. diameter; 6.0 mm. sac; 30 spiderlings). A second female had three sacs (8 mm. sac, 100 eggs, .6 mm. diameter; 5 mm. sac, 70 eggs, .6 mm. diameter; 5 mm. sac, 30 eggs, .7 mm. diameter). Presumably several sacs are made during the season.

Euryopis argentea Emerton

One male specimen from an outcrop on the Greenstone R #3 ridge, 20 June.

Steatoda borealis (Hentz)

This species, collected throughout the summer, inhabits dark, damp forest situations where a sturdy structure is available for web

construction (subclimax and climax forest types and beaches). I have found them in dead curled leaves of shrubs, under logs and bark, during early August. In every instance these spiders were found in wet situations. Although only 20 specimens were collected many more were observed. One female was collected with two egg sacs (109 eggs; 101 eggs) during the first week of August. A parasitized specimen was collected with an unidentified hymenopterous larvae attached to the dorsum of the abdomen. Females outnumbered males three to one in the collections.

Theridion aurantium Emerton

Fifty specimens were collected where the herb layer is well developed--forests, old fields at the mines, bogs, and outcrops. The herb layer may be coarse and include the woody shrubs of the bogs and the subclimax forests or it may consist of fine grasses as in the old fields at the mine sites and the beaver meadows. It apparently has a wide range of humidity and temperature tolerance, and does not seem to show any preference for shaded or sunlit areas.

The specimens show a wide range of color variations but predominantly black. Large numbers of the specimens were parasitized with an unidentified hymenopterous larvae on the dorsum of the abdomen. Males and females are equally common. This species is common during June and July.

T. differens Emerton

Six specimens, five being females, were taken from beaver meadows in late June through July.

T. glaucescens Becker

One female from the Hodges collection, 22 July, 1957.

T. montanum Emerton

One male specimen from the Hodges collection, 10 July, 1957.

T. murarium Emerton

Two females and a male were collected from buildings in the subclimax forest, 24 July to 5 August.

T. ornatum Hahn

Twelve specimens were collected from the herbs of bogs and wet areas of the subclimax forests. Immatures were collected in June and July; adult ♀♀ were collected during August; two mature males were collected 30 June.

T. sexpunctatum Emerton

Two females and a male were collected on the herbs of a subclimax forest, beaver meadow, and an outcrop, 20 June to 11 August.

T. zelotypum Emerton

One male specimen from the Hodges collection, 9 July, 1957.

Theridula emertoni Levi (Walckenaer)

One female from the herbs of a bog, 7 July.

T. opulenta (Walckenaer)

One male from the herbs of a beaver meadow, 17 July.

Family Linyphiidae

Bathyphantes concolor (Wider)

Four females were collected the last week of June by sweeping in wet habitats--beaver meadow, subclimax forest herb layer, herb layer of bog. All specimens from Daisy Farm area.

B. pallida (Banks)

This species, like the preceeding, prefers wet areas. It probably wanders since it has been found in a great variety of habitats including: herbs, sphagnum of bogs, in pitfall traps on the pebble beach and shore outcrops. Nine specimens (5♂, 4♀) were collected, 29 June to 21 August.

B. pullatus (Cambridge)

Twenty-seven specimens were collected in herb layer of the subclimax forest, bogs, and beaver meadows. This species was not taken in the pitfall traps. Two males were collected 20 June and 17 July; females were collected 20 June to 30 July.

Bathyphantoides brevis (Emerton)

A single male from the herbs of the bog on the Ojibway transect, 17 August.

Lepthyphantes bihamata (Emerton)

A single female from the bark of white birch in the transition forest near Windigo, 30 July.

L. leprosa (Ohlert)

A single male from a shore outcrop near Daisy Farm, 3 July.

L. nebulosa (Sundevall)

One female in the Hodges collection, 11 July, 1957.

L. subalpina (Emerton)

This species builds its webs on the bark of white birch trees. Six specimens (2♂, 4♀) were collected from birch bark curls, 30 June to 17 August.

L. triramus Chamberlain and Ivie

One female from a building at Daisy Farm, 12 August.

Linyphia maculata Emerton

One male from the herbs of the bog on the Ojibway transect, 7 July.

L. marginata (C. L. Koch)

This species is a dominant in all the forest areas examined; 50 specimens were collected as a representative sample. Males and females were seen sharing the same web throughout the summer. One male was parasitized by an undetermined hymenopterous larvae on the dorsum of the abdomen. Very common June through August.

L. pusilla Sundevall

Seven specimens were collected from the herbs bogs, damp sub-climax forest, and beaver meadow, 25 June - 17 July.

Meioneta sp. A.

One male from a pitfall on the first ridge, R #1, of the Ojibway transect, 3 July.

M. sp. B. (near simplex, det. W. Ivie)

One male from a pitfall in a stand of balsam fir on the Ojibway transect, 20 June.

Microneta viaria (Blackwell)

One male from a pitfall trap on the shore outcrop near Daisy Farm, 3 July.

Pityohyphantes limitaneus (Emerton)

One male from a white spruce with its web ten feet off the ground, 10 August, Daisy Farm. A female, from a white cedar, with its web six feet off the ground, 14 August, Baker Point.

P. costatus (Hentz)

Twenty-five specimens were collected in forests, bogs on buildings, rock piles, and damp meadows. It builds its flattened sheet-webs on herbs, saplings and shrubs or any other structured material. It seems to show a preference for a position near the ground. Two males were collected, 22-3 June; females were taken 22 June to 23 August.

Stemonyphantes lineatus (Linn.)

One male from an outcrop on R #1 of an Ojibway transect pitfall trap, 3 July.

Family Micryphantidae

Centromerus persoluta (Cambridge)

One male and female from the shore outcrop at Daisy Farm, 3 July.

Ceraticelus atriceps (O. P. Cambridge)

One male and female sweeping herbs in transition forest at Windigo, 28 July.

C. bulbosa (Emerton)

One female from herbs of transition forest at Windigo, 30 July.

C. emertoni (O. P. Cambridge)

One male from the Hodges collection, 11 August, 1957.

C. fissiceps (O. P. Cambridge)

This species is associated with well developed herb layers of old field type vegetation. Twenty-two specimens were collected in the old fields at the Wendigo and Minong mine, 30 June to 30 July. Only two males were collected, 10 and 30 July.

Chocorua cuneata Emerton

Eight specimens (4♂, 4♀) were taken in beach pitfall traps near Daisy Farm, 24 June through 3 July.

Dismodicus decemoculatus (Emerton)

This species prefers the birch-aspen subclimax forest and the herbs of the bogs. Both sexes are abundant. Thirty-three specimens were collected 19 to 30 June in the Ojibway transect (sweeping herbs).

Erigone atra Blackwell

One male and female from a pitfall trap on the Daisy Farm pebble beach, 25 June.

E. zographica Crosby and Bishop

Nine females and four males from the pebble beach, pitfall traps at Daisy Farm, 23 August.

Eperigone sp. (aff. index--det. w. Ivie)

Two males; 12 July, sphagnum bog and 25 June, pebble beach.

Grammonata gigas (Banks)

One male from the bog on the Ojibway transect, 12 July.

Hypselistes florens (O. P. Cambridge)

Fifteen females were collected in damp forests and bogs. Collection dates ranged from 30 June through 28 July.

Pocadicnemis pumila Blackwell

One male and two females from the bog on the Ojibway transect (Pitfall trap), 12 July.

Sisicottus montanus (Emerton)

One male and two females from pitfall traps at the shore outcrop at Daisy Farm, 3 July.

Wubana sp.

One female from the shore outcrop pitfall traps at Daisy Farm, 3 July.

Family Epeiridae

Subfamily Epeirinae

Araneus diadematus Clerck

This species lives in the subclimax forests. Thimbleberry is

a favorite plant on which to build a web. Retreats are usually in a curled leaf or a roll or birch bark. Thirty females were collected in the subclimax forest during August as a representative sample of this common species.

A. nordmanni (Thorell)

Ten females and one male were collected from the herbs of the subclimax forest during 7 to 24 August.

A. sachimau Archer (Det. W. Ivie)

One male from the birch-aspen subclimax forest, August.

A. trifolium (Hentz)

Five females and one male from the following open areas: birch-aspen forest (R #2), outcrops, and swampy areas around lakes, 3 to 22 August.

Araniella displicata (Hentz)

Four females from herbs of outcrops and birch-aspen subclimax forest, 25 June to 20 July. Five specimens in the Hodges collection, 22 July to 14 August.

Cyclosa conica (Pallas)

Two females and twelve immatures from climax and subclimax forests, 30 June to 1 August.

Epeira cornuta (Clerck)

Eighty-three females and 15 males were collected as a representative sample of this species; it is a dominant in all damp forested areas and on buildings throughout the summer. It shows remarkable

variation in color--having forms which range from almost white to nearly black. One egg sac examined (14th August) contained 33 spiderlings.

E. patagiata (Clerck)

Twenty females and eight males were collected as a representative sample of this common species. It is more cosmopolitan than the preceeding species. It was collected in the mine-old fields, subclimax forest, and in the bogs. It is common June 19 to 24 August.

E. raji (Scopoli)

One male in the Hodges collection, 28 July, 1957.

Eustala anastera (Walckenaer)

One female from the bark of white birch near the water at Baker Point, 14 August.

Neoscona arabesca (Walckenaer)

A male and a female was collected in open subclimax forest habitats, 15 August, Daisy Farm; 3 August, Feldtman ridge.

N. minima (F. O. P. Cambridge)

Three females from an outcrop, beaver meadow, and the old field vegetation at Windigo, 17 July to 18 August.

Singa variabilis Emerton

A male and three females from a beaver meadow at Lake Ojibway, 21 August. One female from R #3 outcrop, 20 June.

Zygiella nearctica Gertsch

Males and females from buildings in the birch-aspen subclimax

forest, 22 June to 24 August.

Family Tetragnathidae

Subfamily Tetragnathinae

Tetragnatha caudata Emerton

One male from the shore outcrop at Daisy Farm, 17 July.

T. elongata Walckenaer

Two females from the subclimax forest, one on a log over Benson Creek (30 June) and one from a pier at the Siskiwit Camp (6 August).

T. extensa (Linnaeus)

Two males and three females from open wet habitats--bogs, lake shore, beaver meadow, piers on the lake, 20 June through 6 August. Hodges collection had six males and two females, 11 July to 14 August.

T. guatemalensis O. P. Cambridge

Nine females from open, wet areas; beaver meadows, old field vegetation, and one specimen from the subclimax forest, 5 July to 11 August.

T. harrodi Levi

Two males and four females were collected in the subclimax forest and bog forest, 30 June to 11 August.

T. laboriosa Hentz

Very common in open areas during 20 June to 30 July--beaver meadows, outcrops, and in the old field vegetation at the mine sites. Thirty females and eighteen males were collected.

T. straminea Emerton

Six males and eleven females were collected from herbs of bogs, 20 June to 1 August.

T. versicolor Walckenaer

Four females were collected in the birch-aspen subclimax forest, 25 June to 28 July. Hodges collection had four males and five females, 9 July to 9 August.

Family Theridiosmatidae

Theridiosoma radiosum (McCook)

One male from the transition forest at Windigo, 30 July.

Family Mimetidae

Mimetus puritanus Chamberlain

One female from the bog on the Ojibway transect, 10 August.

Superfamily Lycosoidea

Family Agelenidae

Agelenopsis utahana Chamberlain and Ivie

Thirty-five males and twenty-eight females were collected from forested areas. Juveniles are common in July and mature around

5 August. During August both sexes may be found in the same web, presumably to mate.

Cicurina arcuata Keyserling

A female with eggs is recorded in the Adams (1908) report. Their specimen was from under a rock at the Rock Harbor Lighthouse, July.

Cicurina brevis Emerton

A single female from an outcrop near Daisy Farm, 25 June.

Cryphoeca montana (Emerton)

Nine males and one female were collected from the pebble beach at Daisy Farm, and subclimax forests, 20 June to 30 July.

Coras montanus (Emerton)

Four females from paper birch bark curls in the subclimax forests, 3 July to 1 August. A female was collected with an egg sac which contained 160 eggs (1.2 mm. diameter).

Tegenaria domestica (Clerck)

One specimen reported by Adams (1908) from the transition forest at Washington Harbor.

Family Hahniidae

Antistea brunnea (Emerton)

A single female from the bog forest pitfall traps on the Ojibway transect, 10 August.

Neoantistea agilis (Keyserling)

This species is dominant in the open birch-aspen subclimax forest (R #2 of the Ojibway transect), the maple-birch subclimax forest (R #3 of the Ojibway transect), and is occasionally found in other open areas such as the pebble beach and outcrops. Sixty-three females and four males were collected, 25 June to 24 August.

N. radula (Emerton)

This species is dominant in the subclimax forests, pebble beach, and in other open wet areas such as shore outcrops, and beaver meadows. Approximately 180 females and 100 males were collected throughout the summer.

Family Pisauridae

Dolomedes striatus Giebel

Four specimens were collected; two males and a female from the bog forest (Ojibway transect) pitfall trap, 7 July; one female in an open transition forest near Windigo. This female had an egg sac with about 350 spiderlings.

D. tenebrosus Hentz

Although only three specimens were captured, the author believes that this species is common. Many of the rangers have reported them in large numbers in certain areas. They are large, fast, and very difficult to catch. Two females were from the subclimax forest at Daisy Farm and Chickenbone Lake. Another specimen was taken at Sugar Mountain in the maple-birch climax. All records were females, 9 July to 15 August.

Family Lycosidae

Subfamily Lycosinae

Arctosa quinaria Emerton

Six females, four of which were from the sphagnum bog, one from a low damp spot on the central ridge, and one from the pebble beach at Huginnin Cove. All specimens were collected 1-23 August. One egg sac contained 65 spiderlings (13 August). Three of the sacs were parasitized with hymenopterous prepupae (tentatively identified as Ichneumonidae). The spiderlings in these sacs were shriveled and dried up. One female had a pupal case attached to her spinneretts as if it were an egg sac.

Lycosa frondicola Emerton

Thirteen females and one male from the open birch-aspen subclimax forest on the second ridge, the maple subclimax forest on the Greenstone ridge and on outcrops, 21 June to 24 August. It was also found in beaver meadows, open areas along the forest trails and within the birch-aspen subclimax forest. One egg sac contained 46 spiderlings, 10 July.

L. gulosa Walckenaer

Adams (1908) lists this species as common at the Rock Harbor lighthouse during July.

Pirata insularis Emerton

Sixteen males and six females were trapped in the sphagnum of the bogs, 7-12 July.

Tarentula aculeata (Clerck)

The dominant ground spider in all wet forests, the open aspen forest, and the pebble beach. It is also abundant on outcrops and in beaver meadows. Egg sacs were spherical and about 9 mm. in diameter and usually had about 150 eggs which ranged from 110-180 eggs per sac for thirty sacs examined. Ten sacs were examined with spiderlings--all had between 50-100 spiderlings per sac. Approximately 900 females and 700 males were collected (also numerous uncounted juveniles).

Trochosa pratensis (Emerton)

Four hundred-fifty females and about ninety males were collected. This species shares the same general habitat as T. aculeata. Egg counts averaged 117 from eleven sacs; egg size was about 1 mm. in diameter. Ten sacs with spiderlings had less than 100 individuals. Most specimens had three cheliceral teeth on the retromargin. Two or four, however, were not uncommon. Tibia three and four frequently had the basal spine replaced with a bristle. Several females were observed to have a small hole in the posterior wall of the atrium.

Subfamily Pardosinae

Pardosa distincta (Blackwell)

This is the dominant ground spider in open, dry habitats. Sixty females and forty males were collected, 20 June to 24 August. Lens shaped egg sacs averaged 2.5 mm. in diameter and 1.5 mm. thick from 15 sacs examined. One sac with 26 eggs was 4.1 mm. in diameter. The number of eggs ranged from 9 to 26 eggs which were about 1 mm. in diameter. Two sacs were examined with spiderlings; one contained 19 and the other 34 spiderlings (the sac was 3.5 x 3.5 mm.).

P. glacialis Thorell

Adams (1908) reports this species from the sphagnum bogs and on beaches.

P. groenlandica (Thorell)

This species was limited to the pebble beach habitat. Only two beaches suitable for its habitation occur on Isle Royale--at Daisy Farm and at Huginnin Cove. Lens shaped egg sacs (8 mm. diameter and 5 mm. thick) have a tough outer layer and a cotton-like lining. The number of eggs ranged from 79 to 125) and are about one millimeter in diameter. Sacs with spiderlings ranged from 60 to 125 individuals. One sac contained parasitic prepupae (probably dipterous). Males and females were collected 20 June to 18 August.

P. hyperborea (Thorell)

Eleven males and six females of this species were collected on the outcrops. Two males were also collected in the birch-aspen subclimax forest. Collection dates ranged from 26 June to 24 August. Adams (1908) reports P. Sternalis; the author believes this species was confused with P. hyperborea.

P. lapidicina Emerton

Thirty females and twelve males were collected from the pebble beach, 20 June to 24 August.

P. mackenziana (Keyserling)

Forty-five females and ten males were collected in wet forests and the open forest at R #2. A few specimens were collected from outcrops and beaches. Males were only collected 20 June to early July

but females were abundant during the entire summer. The lens shaped egg sacs ranged from 5.5 mm. to 6.0 mm. in diameter; egg numbers ranged from 48 to 90. The eggs were about a millimeter in diameter.

P. moesta Banks

Fifty-two females and forty-eight males were collected from shore outcrops, pebble beaches, and beaver meadows. The number of eggs in each of four sacs was 17, 19, 39, and 59; eggs ranged in size from .8 to 1.25 mm. in diameter.

P. xerampelina (Keyserling)

Twenty females and two males were collected in outcrops, old fields, and beaches, 25 June to 13 August. Five lens type egg sacs (4.5 mm. diameter X 3 mm. thick) contained from 41 to 109 eggs in diameter.

Superfamily Gnaphosoidea

Family Gnaphosidae

Subfamily Gnaphosinae

Callilepis imbecilla (Keyserling)

One male from a crevice on the side of an open pit mine site at the Minong mine, 10 July.

Gnaphosa muscorum (L. Koch)

This species was found in a number of habitats; under logs in subclimax forests and the open forest on the second ridge; the pebble beach; a wood pile at the Island Mine in the maple-birch climax forest.

Ten mature females were collected from 29 June through 20 July; twelve males were collected from 3 July through 10 August.

Subfamily Drassodinae

Castianeira descripta (Hentz)

One female from the Hodges collection, 29 July, 1954.

Drassodes neglectus (Keyserling)

Thirty-one males were collected from 27 June to 10 August and nine females from 1 July to 15 August, on the pebble beach and subclimax forests. One egg sac was collected; this lens type sac was parasitized by a hymenopterous parasite.

Drassyllus depressus (Emerton)

One female from an outcrop R #3, 24 August.

Haplodrassus hiemalus (Emerton)

Two females were collected the last week of July; one on the pebble beach and the other on a building.

Haplodrassus signifer (C. L. Koch)

Four females were collected; two on an outcrop, and two from the birch-aspen subclimax forest. Collection dates were from 20 June to 17 August.

Zelotes hentzi Barrows

A female was collected in the open aspen forest R #2, 12 July. A male was collected on a shore outcrop, 13 August.

Z. puritanus Chamberlain

One male was taken on a shore outcrop, 30 June. Three females were present in the Hodge's collection, 9 and 10 July, 1957.

Z. subterraneus (C. L. Koch)

Nine males and nine females were collected in the subclimax forests and the pebble beach. It also occurs in beaver meadows and the open aspen forest. Females were collected during July and August; males were collected in August.

Superfamily Clubionoidea

Family Clubionidae

Subfamily Clubioninae

Clubiona abbotii (Emerton)

One male (3 August) and one female (1 July) from the birch-aspen subclimax forest.

C. canadensis Emerton

Thirty-two females and nine males were collected in the subclimax forest. Females are common throughout the summer, but males were collected in August.

C. furcata Emerton

Three females were collected from the birch-aspen subclimax forest at Daisy Farm (20 June), the pebble beach at Daisy Farm (3 July) and the beaver meadow at Lake Ojibway (17 July).

C. kulcznskii de Lassert

Six specimens (3♂, 3♀) were collected from the birch-aspen subclimax forest, outcrops, and beaver meadow, 29 June to 13 July.

C. norvegica Strand

One male from shrubs in the beaver meadow at Lake Ojibway, 13 July.

C. riparia L. Koch

Two females and a male from old field vegetation at the Minong Mine, 10 July; one female from the herbs of the sphagnum bog on the Ojibway transect, 20 June.

Subfamily Liocraninae

Agroeca ornata Banks

Nine females were collected from 3 July to 12 August from shore outcrops, sphagnum bog, and the birch-aspen subclimax forest.

A. pratensis Emerton

One female from the birch-aspen subclimax forest, 27 June.

Phrurotimpus borealis Emerton

Two males from the birch-aspen subclimax forest and a shore outcrop at Daisy Farm, 3 July. Two females from the pebble beach at Daisy Farm (23 June) and the birch-aspen subclimax forest (30 June).

Subfamily Micariinae

Micaria elizabethae Gertsch

One female from the pebble beach at Daisy Farm, 25 June.

M. montana Emerton

Four males and three females were collected in the subclimax forests, shore outcrops, and the pebble beach. Collection dates ranged from 7 July to 17 August for males and 30 June to 5 August for females.

M. tetonia Levi (det. W. Gertsch)

Seventeen females were collected from the birch-aspen subclimax forest and the open aspen forest on R #2, 3 July through 5 August.

Superfamily Thomisoidea

Family Thomisidae

Subfamily Misumeninae

Misumena calycina (Linnaeus)

Twenty-five specimens were collected in old field vegetation, beaver meadows, and the subclimax forests. Females were common throughout the collecting season, but males are uncommon.

Xysticus canadensis Gertsch

Three females and a male from the beaver meadow at Lake Ojibway, 30 June.

X. elegans Keyserling

Four males and eight females were collected in open areas where the herb layer was developed--outcrops and the open aspen forest. Males were collected in late June - early July; females throughout the collection period.

X. triguttatus Keyserling

A male (2 July) and a female (11 August) were present in the Hodge's collection.

Subfamily Philodrominae

Ebo latithorax Keyserling

Adams (1908) reports this species on the pebble beach at the Rock Harbor lighthouse during July.

Philodromus aureolus (Olivier)

One male from old field vegetation at the Minong Mine, 10 July; one female from the Windigo mine area, 3 August.

P. rufus Walckenaer

Nine females were collected on herbs of old field vegetation, herbs of the bogs and subclimax forests, and herbs of outcrops, 20 June to 10 July. One male was taken in old field vegetation, 24 June.

P. pernix Blackwell

Three specimens were taken from old field vegetation at the Minong mine, and the herbs of the subclimax forest, 1 July to 8 August.

Rhysodromus alascensis Keyserling (det. C. Dondale)

A single female from the herbs of the sphagnum bog on the Ojibway transect, 30 June.

Thanatus formicinus (Olivier)

Nine females were collected from the herbs of the subclimax forest, pebble beach, and an outcrop, 27 June to 10 August.

Tibellus maritimus (Menge)

One male from herbs in the birch-aspen subclimax forest at Daisy Farm, 24 June. One female (28 July) and one male (27 June) from the Hodge's collection were also examined.

T. oblongus (Walckenaer)

Twelve males and twenty-eight females were collected in open areas where the herb layer is developed--outcrops, old field vegetation, and beaver meadows. It is most common 20 June to 30 July but a few specimens were taken the first two weeks of August.

Superfamily Salticoidea

Family Salticidae - Jumping spiders

Evarcha hoyi (Peckham)

Nine males and fourteen females were collected in the herbs of subclimax forests, old field vegetation, and bog herbs. Both sexes were collected from 20 June through 24 August.

Habronattus calcaratus (Banks)

Two males were collected on an outcrop on the first ridge near

Daisy Farm, 25 June and 17 August.

Icius similis Banks

Two males and fourteen females were collected in herbs of outcrops, beaver meadows, open forests, and in rolls of birch bark, 3 July to 21 August.

Metaphidippus insignis (Banks)

One female from the birch-aspen subclimax forest near the shore, 29 June.

M. protervus (Walckenaer)

Eighteen females, one male, and numerous juveniles were collected in old field vegetation and beaver meadows. Most of the specimens collected were immature; collection dates ranged from 20 June to 17 August.

Neon nelli Peckham

One male from the open forest R #2 on the Ojibway transect (19 July); one male from the pebble beach at Daisy Farm (25 June); one female from an outcrop (8 August).

Paraphidippus marginatus (Walckenaer)

This species shares the same habitat as M. protervus. Ten males, sixteen females, and numerous juveniles were collected, 1 July to 21 August.

Phidippus princeps (Peckham)

One female from the Hodge's collection, 8 August, 1957.

P. audax (Hentz)

One immature from the Hodge's collection, 8 July, 1957.

P. purpuratus Keyserling

Three specimens were collected from outcrops by hand catching. None fell into pitfall traps in the area. The Adams (1908), and the Hodge's collections contained specimens of this species. Records are 20 June to 28 July.

Sitticus palustris (Peckham)

Three specimens were collected 1 to 12 July in herbs of sphagnum bogs and beaver meadows. The Hodge's collection contained two late July specimens.

Telavera minuta (Banks)

Two males were collected on the pebble beach at Daisy Farm during the last week of June.

Section Cribellatae

Superfamily Dictynoidea

Family Dictynidae

Dictyna altamira Gertsch and Davis

One male from Daisy Farm, 20 June.

D. brevitarsus Emerton

One male in the Hodge's collection, 3 July, 1957.

D. coloradensis Chamberlain

One female (22 July), and one male (3 July) from the Hodge's collection.

D. foliacea Hentz

Two males and a female sweeping herbs on an outcrop R #3, 20 June.

D. hentzi Kaston

One male (5 July) from herbs in a sphagnum bog; one male from a building in the subclimax forest (24 June).

D. maxima Banks

One male and two females sweeping herbs of the birch-aspen subclimax forest, 25 June.

Family Amaurobiidae

Subfamily Amaurobiinae

Amaurobius bennetti (Blackwell)

Forty-five males and thirty-six females were collected under logs of damp forests, among the rocks of outcrops, in rolls of birch bark, and on the pebble beaches under stones, 20 June to 24 August.

Subfamily Ixeuticinae

Callioplus tibialis (Emerton)

One female from a maple stump in the maple birch climax forest on Sugar Mountain, 1 August.

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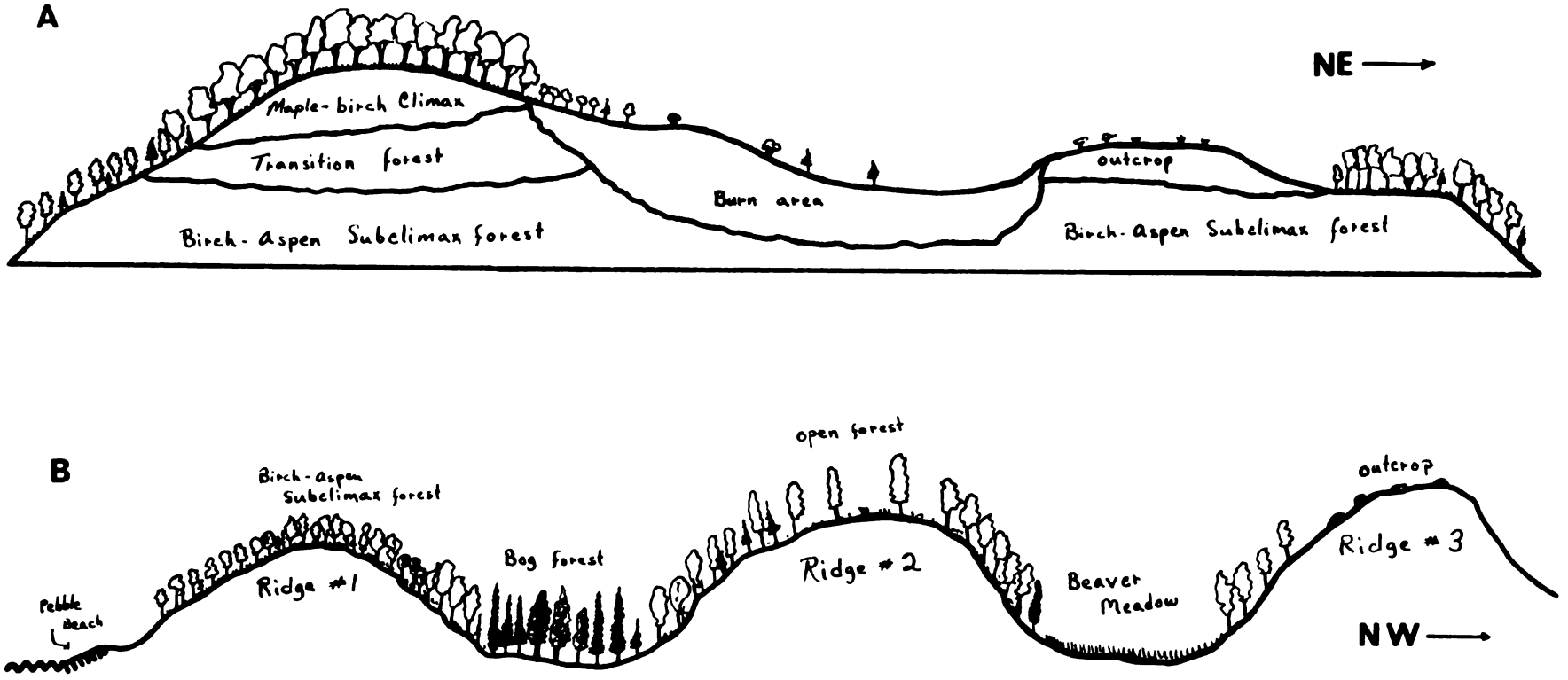
A
NE
Maple-birch Climax
Transition forest
Birch-Aspen Subclimax forest
Burn area
outcrop
Birch-Aspen Subclimax forest
B
Birch-Aspen Subclimax forest
Pebble Beach
Ridge #1
Bog forest
open forest
Ridge #2
Beaver Meadow
outcrop
Ridge #3
NW

Fig. 1

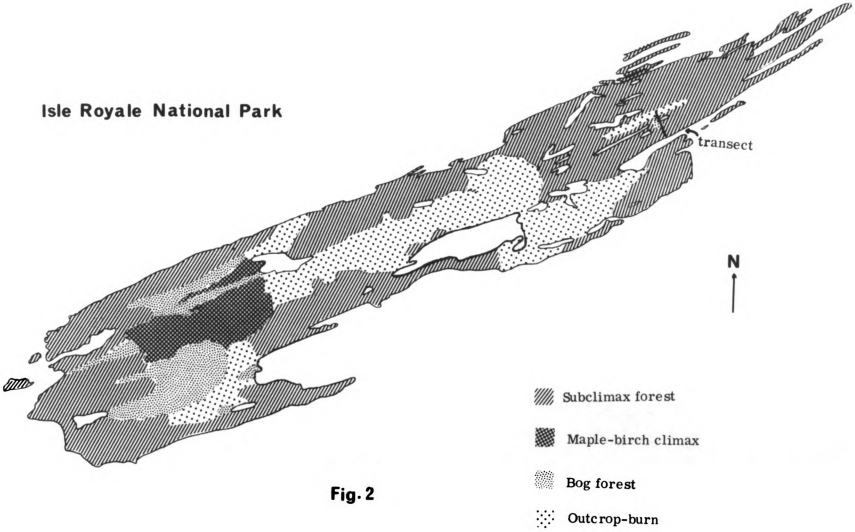
Isle Royale National Park
transect
N
Subclimax forest
Maple-birch climax
Bog forest
Outcrop-burn

Fig. 2

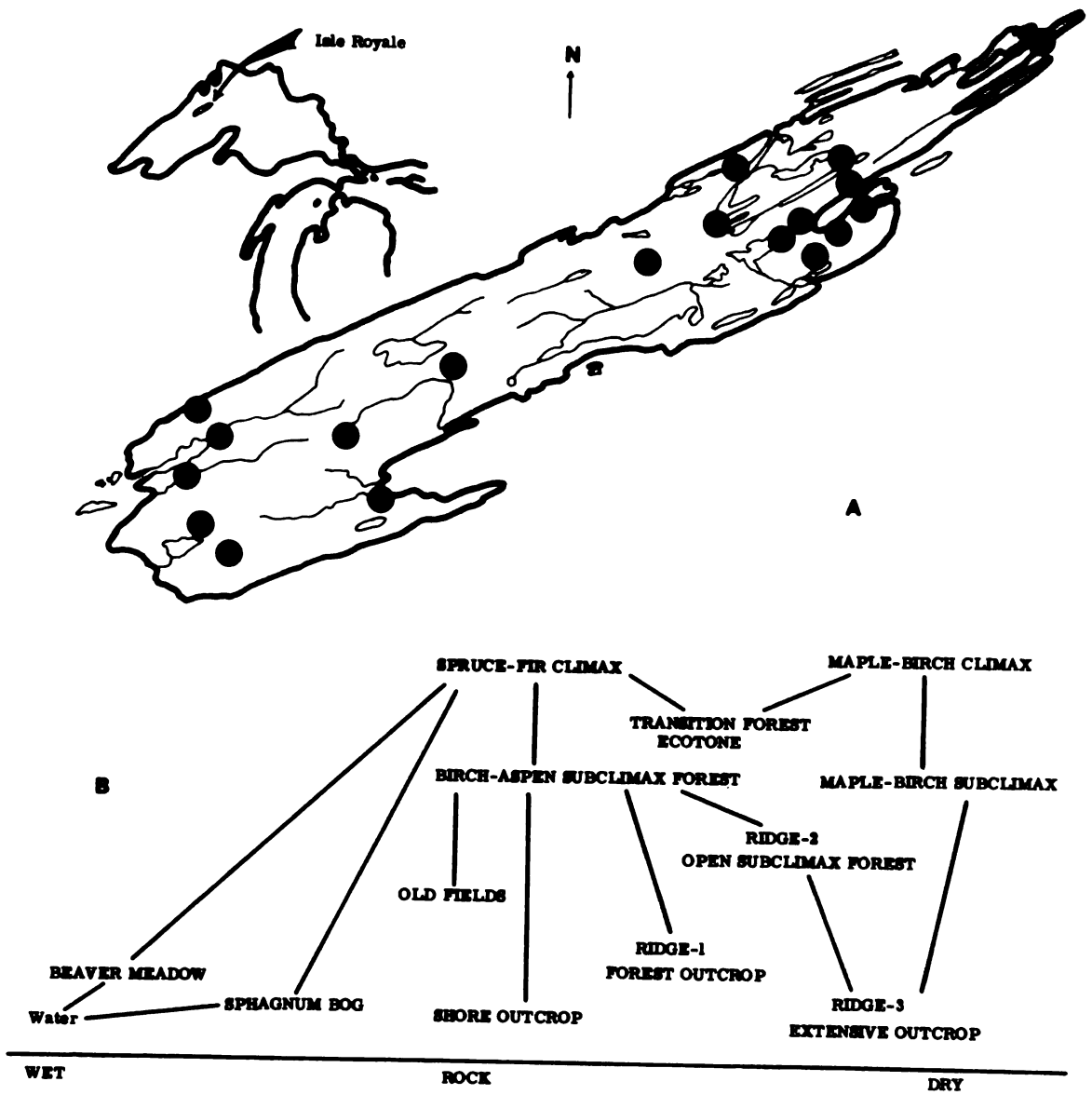
Isle Royale
N
A
B
SPRUCE-FIR CLIMAX
MAPLE-BIRCH CLIMAX
TRANSITION FOREST
ECOTONE
BIRCH-ASPEN SUBCLIMAX FOREST
MAPLE-BIRCH SUBCLIMAX
RIDGE-2
OPEN SUBCLIMAX FOREST
OLD FIELDS
RIDGE-1
FOREST OUTCROP
BEAVER MEADOW
Water
SPHAGNUM BOG
SHORE OUTCROP
RIDGE-3
EXTENSIVE OUTCROP
WET
ROCK
DRY

Figure -3

fig.4

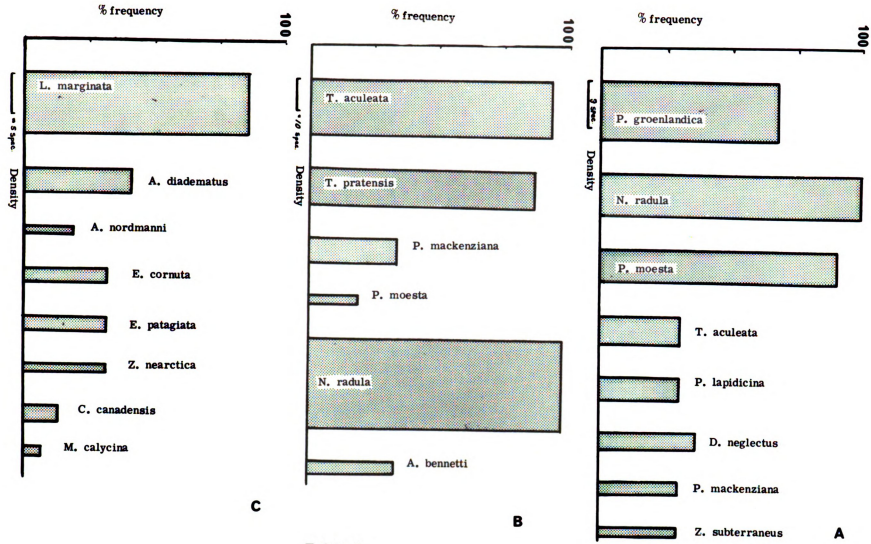
% frequency
100
L. marginata
A. diadematus
A. nordmanni
E. cornuta
E. patagiata
Z. nearctica
C. canadensis
M. calycina
Density
C
% frequency
100
T. aculeata
T. pratensis
P. mackenziana
P. moesta
N. radula
A. bennetti
Density
B
% frequency
100
P. groenlandica
N. radula
P. moesta
T. aculeata
P. lapidicina
D. neglectus
P. mackenziana
Z. subterraneus
Density
A

Table 2

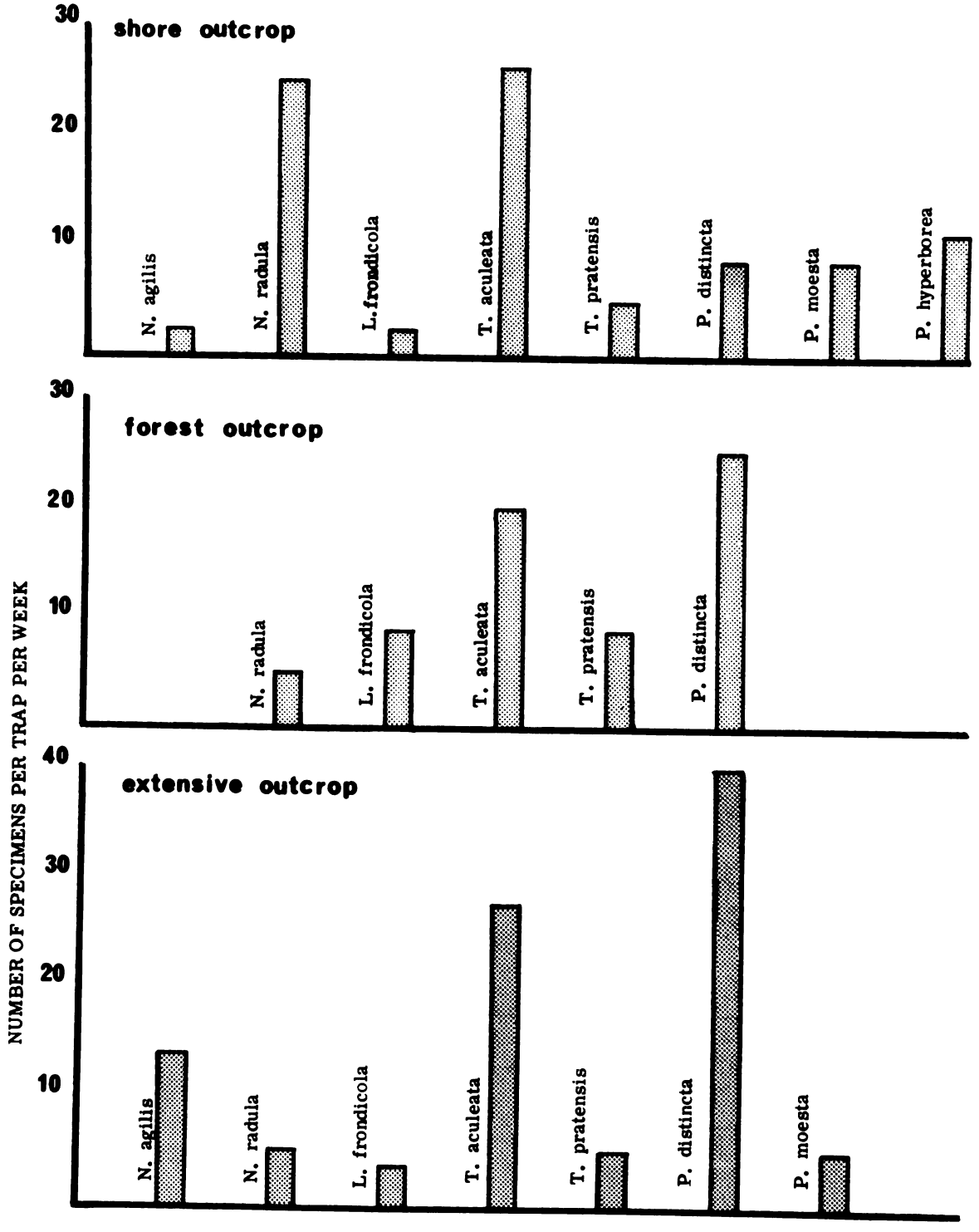
shore outcrop
30
20
10
N. agilis
N. radula
L.frondicola
T. aculeata
T. pratensis
P. distincta
P. moesta
P. hyperborea
forest outcrop
30
20
10
N. radula
L. frondicola
T. aculeata
T. pratensis
P. distincta
extensive outcrop
40
30
20
10
N. agilis
N. radula
L. frondicola
T. aculeata
T. pratensis
P. distincta
P. moesta
NUMBER OF SPECIMENS PER TRAP PER WEEK

Table 3

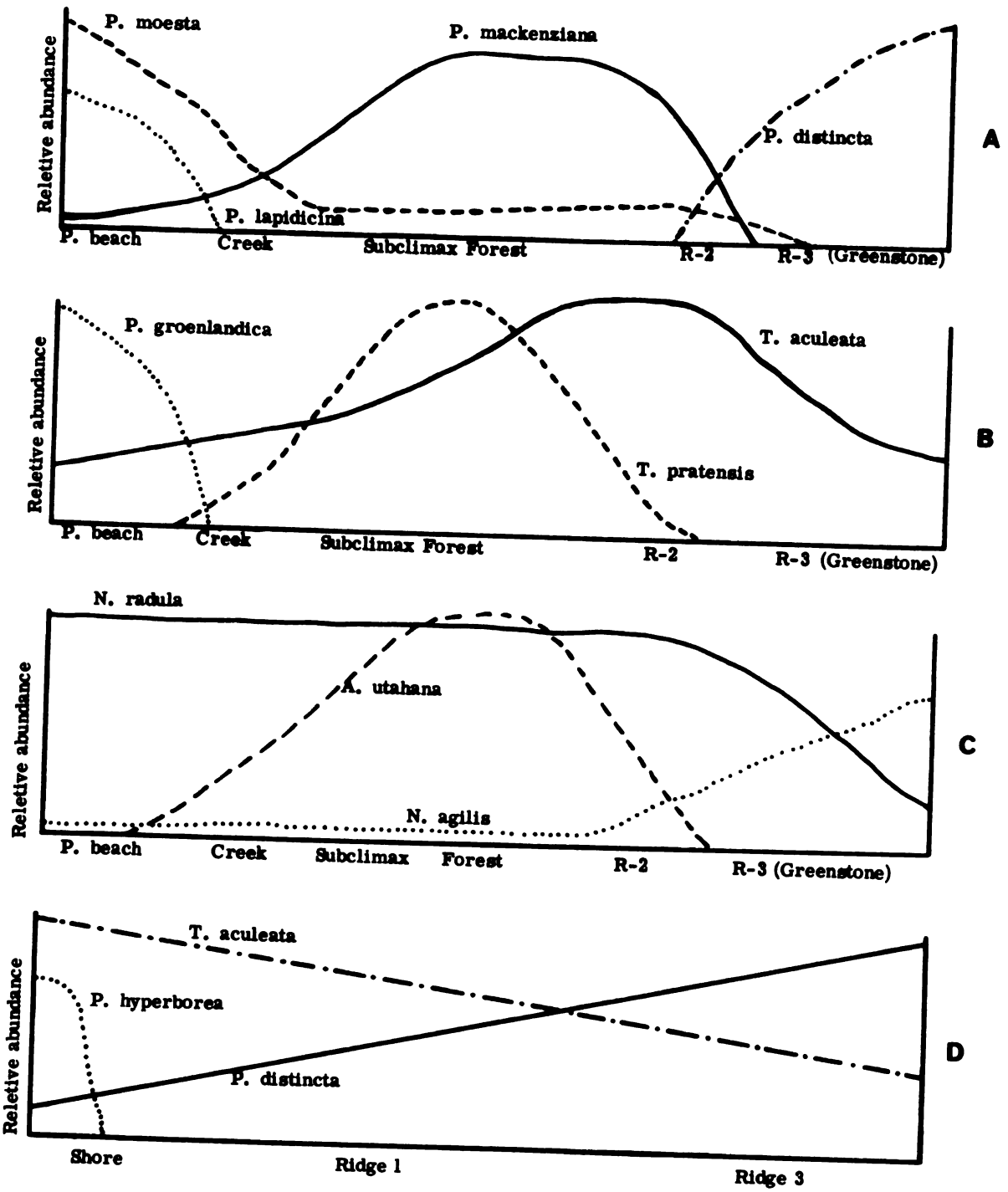
Reletive abundance
P. moesta
P. mackenziana
P. distincta
P. lapidicina
P. beach
Creek
Subclimax Forest
R-2
R-3 (Greenstone)
A
Relative abundance
P. groenlandica
T. aculeata
T. pratensis
P. beach
Creek
Subclimax Forest
R-2
R-3 (Greenstone)
B
Reletive abundance
N. radula
A. utahana
N. agilis
P. beach
Creek
Subclimax
Forest
R-2
R-3 (Greenstone)
C
Reletive abundance
T. aculeata
P. hyperborea
P. distincta
Shore
Ridge 1
Ridge 3
D

Table 4