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THE THIMBLEBERRY GALLMAKER, *DIASTROPHUS KINCAIDII* (HYMENOPTERA: CYNIPIDAE), IN THE GREAT LAKES REGION

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ABSTRACT

Diastrophus kincaidii, a gall wasp previously known only from California and the Pacific Northwest, is reported from the Great Lakes Region. It is present on thimbleberry, *Rubus parviflorus*, in three counties in the Upper Peninsula of Michigan and in Duluth, Minnesota. It may have arrived on the Keweenaw Peninsula of Upper Michigan within the past ten years. Information about its biology, distribution, and abundance is presented.

On the Keweenaw Peninsula of Upper Michigan, thimbleberry, *Rubus parviflorus* (Rosaceae), is very abundant. Jam made from the tart red berries is a popular local delicacy. In 1988, several Houghton County, MI, residents told us their favorite thimbleberry patches, which once were waist or chest high and produced many berries, were now ankle or knee high and producing few or no berries. We found these patches had many conspicuous stem galls (Fig. 1) made by the cynipid wasp *Diastrophus kincaidii* Gillette. Thimbleberry is the only host of this gallmaker (Weld 1957).

Thimbleberry has a disjunct distribution, occurring in cool moist areas of western North America from southern Alaska to northern Mexico, in the Black Hills, and along the shores of the Upper Great Lakes in Ontario, Minnesota, Wisconsin, and Michigan (Fassett 1941, Marquis and Voss 1981).

Wangberg (1975) reported the known distribution of *D. kincaidii* as California, Oregon, Washington, British Columbia, and Idaho. We report its presence in Baraga, Houghton, and Keweenaw counties in the Upper Peninsula of Michigan and in Duluth, Minnesota, and present initial findings about its distribution, history, effect on thimbleberry plants, and biology in the Great Lakes Region.

METHODS

We sampled thimbleberry stands in Houghton and Keweenaw counties, Michigan, to determine the percent of stems with galls; displayed thimbleberry galls at the Houghton County Fair and asked people when and where they had first seen such

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Figure 1. Drawing of a thimbleberry stem gall caused by *Diastrophus kincaidii*. Galls ranged in length from 10 to 90 mm.

galls; asked in letters to high school and college biology teachers, in newspaper and magazine articles, and at scientific meetings, for people to examine 20 thimbleberry stems in a stand in the Great Lakes Region and report the percent with galls; and dissected and reared insects from thimbleberry galls. The gallmaker was determined from the form of the gall and the host plant and by comparing adults reared from Michigan galls with those reared from California galls. Voucher material was placed in the insect collection of Michigan Technological University.

RESULTS AND DISCUSSION

Distribution. We received reports from forty people about the distribution of thimbleberry galls. Most told of the presence of galls in Houghton, Keweenaw, and Baraga Counties in Michigan. However, W. Beck (pers. comm.) wrote that thimbleberry galls were abundant along the Lester River in Duluth, MN. All who reported seeing thimbleberry galls in Michigan said they first noticed them in the 1980s. The earliest report was from R. Beaudoin (pers. comm.), a commercial berry picker from Calumet, MI, who first saw the galls on the west shore of the Keweenaw Peninsula in 1982 and said that in subsequent years the infestation had spread and increased in intensity. J. Adler (pers. comm.), a botanist who moved to Houghton, MI in 1984, said the galls were abundant in Houghton when he came. Several people who had lived all their lives in Houghton County said they first observed the galls in the mid-1980s.

Five reports were from areas east or south of Baraga County and all said galls were not present: P. Cattelino (pers. comm.) reported that thimbleberry was well represented in plots at ELF study sites in Marquette and Iron counties, MI, but in 1989, when the plants were examined for the presence of galls, none were found; E.

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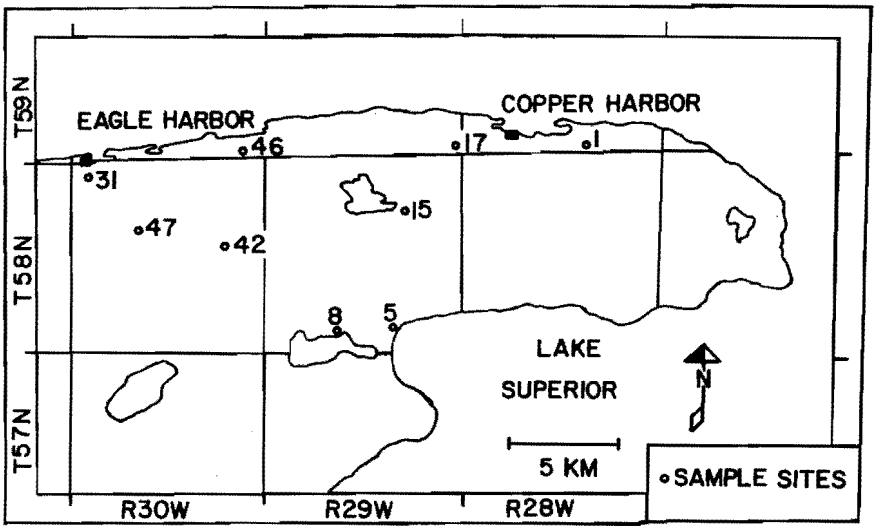

Figure 2. Sites examined 14 Nov. 1989. The number by a site is the mean percent of stems with galls rounded to the nearest whole number.

Jepson (pers. comm.) said she had previously lived in Houghton County and was familiar with the galls and now lived in Marquette, MI, where she picked thimbleberries every year and saw no galls; W. Loope and F. Young (pers. comm.) examined stands of thimbleberry at Sand Point and Miner's Beach in Pictured Rocks National Lakeshore in Alger County, MI in October 1989 and found no galls; C. Davis (pers. comm.) reported that in 1989 he examined several hundred stems in a large thimbleberry patch at Sand Bay on the north shore of Lake Superior about 90 km west of Sault Ste. Marie, Ontario and found no galls; and E. Voss, a botanist who frequently visits Great Lake shoreline areas in the northern Lower Peninsula of Michigan, reported in 1989 (pers. comm.) that he had never seen galls on thimbleberry plants there.

Infestation Rates. On November 14, 1989 a survey was made to determine if there was a west to east gradient in gall infestation rates on the Keweenaw Peninsula. Thimbleberry stands at nine locations in northern Keweenaw County were examined (Fig. 2). At each location, nine or ten groups of 20 stems were examined for galls and samples of galls collected. Each group of stems was 4 to 10 meters from the next. There was a conspicuous difference in infestation rates from west to east (Table 1 and Fig. 2).

We obtained gall infestation rates for 21 additional localities in Baraga, Houghton and Keweenaw counties in 1989 (Table 2). We collected some of the data, but the majority came in response to our requests. The 27 groups of 20 stems from Houghton County had a mean gall infestation rate of 64.8% (SD = 18.1) and a range of 35 to 100%; the 11 groups of 20 stems from Baraga County had a mean of 36.4% (SD = 13.1) and a range of 20 to 50%; and the 108 groups of 20 stems from Keweenaw County (Tables 1 and 2) had a mean of 25.0% (SD = 21.2) and a range of 0 to 94%.

Seasonal History and Habits. Galls developed in late May or early June on first-year stems and on new growth of second-year stems. Sharp bends often formed

Table 1.—Mean percent of thimbleberry stems with one or more galls, 1 standard deviation in parentheses, range of infestation rates at the site, and N, the number of groups of 20 stems examined at nine Keweenaw County sites on 14 Nov. 1989.

Location	Mean Percent with Galls (1 S.D.)	Range	N
T58N R30W Sec 6	30.5 (10.1)	10–40	10
T58N R30W Sec 16	47.0 (9.5)	35–65	10
T58N R30W Sec 14	42.0 (13.2)	25–60	10
T59N R30W Sec 36	46.0 (17.1)	20–70	10
T58N R29W Sec 33	8.0 (4.8)	0–15	10
T58N R29W Sec 27	4.5 (3.7)	0–10	10
T58N R29W Sec 11	15.0 (13.5)	0–40	10
T59N R29W Sec 36	16.5 (10.9)	5–35	10
T59N R28W Sec 34	1.1 (2.2)	0– 5	9

at galls, apparently because eggs were not inserted evenly around the stems, causing one side to grow faster than the other. This resulted in stems growing horizontally and being over-topped by neighboring plants for a time. Stems seemed to be structurally weakened where the galls developed. In the fall and winter, animals often pecked or gnawed on galls to reach the insects, and this further weakened the stems. We observed many stems broken off at galls. Flowers develop on healthy two-year-old stems, but the broken stems appeared to produce no flowers. Wangberg (1973) reported dieback of heavily infested stems caused by interruption of vascular tissue by the galls.

There was a marked contrast in the size of galls at different locations. In 1989, the largest galls, 30 mm wide and 90 mm long, were from Eagle River on the west shore of the Keweenaw Peninsula where the gall infestation rate was high. The smallest galls, 11 mm wide and 10 mm long, were from Elo, MI, where the gall infestation rate was low. Wangberg (1973) stated that in northern California it was common for two or three female gallmakers to oviposit in the same general area on a stem. The large galls at Eagle River were probably the result of group oviposition on stems in an area with high wasp density, and the small galls at Elo, the result of only one female ovipositing on a stem in an area where the wasp population was sparse.

We reared adult wasps from galls in the laboratory but did not observe them in the field in 1989. Wangberg (1973) indicated they emerge synchronously in spring, mate, lay eggs, and die. The following gallmaker life history events were observed in 1989 in a thimbleberry patch near Chassell, MI: by 23 June, the green galls appeared to be full-grown when the tiny larvae were only 0.25 mm long; on 6 July, 10 larvae averaged 1.35 mm long (SD = 0.19); on 24 July, 10 larvae averaged 2.44 mm long (SD = 0.14); on 26 July, 10% of the larvae were in the prepupal stage which is marked by defecation and immovable mandibles; early in the prepupal stage, compound eye pigment became visible; on 1 August, 10 larvae averaged 2.64 mm long (SD = 0.14) and 1.38 mm wide (SD = 0.05); on 14 August, 19% were in the prepupal stage; and on 28 August, 93% were in the prepupal stage and ten prepupae averaged 2.55 mm long (SD = 0.33), 1.25 mm wide (SD = 0.12), and the head capsule 0.69 mm wide (SD = 0.04). Over the summer, the galls changed from green, soft, and moist, to brown, hard, and dry.

The gallmaker overwintered in the prepupal stage. Galls brought indoors in January 1990 and held at four different temperatures showed the prepupae had a developmental threshold of 9.5 degrees C and a thermal constant for prepupa to adult of 150 degree days. Based on temperatures in 1989 at the Houghton County Airport, adults would have emerged there about 1 June.

In future studies we hope to answer the following questions. Has this gallmaker only recently reached Michigan? What is its present range, and direction and rate of

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Table 2.—Mean percent of thimbleberry stems with one or more galls, 1 standard deviation in parentheses, range of infestation rates at the site, and N, the number of groups of 20 stems examined at 21 additional sites in Baraga, Houghton, and Keweenaw Counties in 1989.

Location	Mean Percent with Galls (1 S.D.)	Range	N
Baraga County			
T50N R33W	44.2 (7.4)	35–50	6
T51N R35W	26.7 (16.1)	20–45	3
T52N R31W	20.0		1
T48N R34W	35.0		1
Houghton County			
T55N R33W Sec 9	60.0 (17.8)	35–90	12
T56N R33W Sec 5	85.0 (0.0)	85	2
T55N R34W Sec 3	45.5 (0.7)	45–46	2
T55N R34W Sec 36	82.5 (24.7)	65–100	2
T53N R34W Sec 1	62.0 (16.2)	48–77	4
T55N R33W Sec 18	100.0		1
T55N R33W Sec 4	65.0		1
T55N R34W Sec 8	75.0		1
T55N R33W Sec 20	90.0		1
T54N R35W Sec 19	60.0		1
Keweenaw County Mainland			
T57N R32W Sec 35	59.0 (19.0)	35–90	10
T59W R29W Sec 36	40.0		1
T59N R28W Sec 32	0.0		1
T58N R30W Sec 6	40.0		1
T57N R33W Sec 27	94.0		1
Isle Royale			
T66N R34W SEC 18	10.0 (5.0)	5–15	3
T64N R38W SEC 28	12.5 (3.5)	10–15	2

spread? Is it accompanied by all the natural enemies present in the West? To date we have reared three primary parasite species, whereas Wangberg (1975) reported seven. If this gallmaker has been here for hundreds of years, unnoticed because of low densities, what has caused it to become so abundant in the past few years? What can be done to reduce its numbers?

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