On the Bionomics of the Larger Black-Male Saw-Fly, *Dolerus harukawai* Waterston.

By

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[August 22, 1930.]

1. Introduction.

In 1925, the senior author published a preliminary note on a species of the genus *Dolerus* which is injurious to the cultivated rush-plants[1]. More than twenty-five years ago, WATANABE stated that two injurious species of saw-fly which presumably belonged to the genus *Dolerus* were found in Hyôgo and Fukuoka Prefectures[2]. It is questionable whether the species found by him in Hyôgo was really *Dolerus harukawai* or not. But, there is no doubt that the species in Fukuoka referred by him, may be identical with the present species. At any rate it was probably the first note on *Dolerus harukawai* in Japan.

The injury caused by the larvae of *Dolerus harukawai* seems to have attracted the attention of the rush-growers already a long time ago. Thus, the larva has been known by such Japanese names as "*i-mushi*", "*ikiri-mushi*" or "*hōjō-mushi*".

The junior author was in Fukuoka Prefecture many times in order to study on this saw-fly. According to what the rush-growers told him, this saw-fly has not yet caused any serious damage. This seems to be due, at least partly, to the circumstance that the cultivation of the rush has not been practiced over much extended area. Therefore, it can not be said that this insect will never cause a severe damage in future when the cultivation of the rush may become an important industry in Fukuoka Prefecture.

Since the authors have been engaged in the study of an another species of saw-fly[3] which is also injurious to the rush-plants, they are interested in the present species of the genus *Dolerus*. The present paper is a report on the results of observations and experiments which have been conducted on this injurious saw-fly.

2. Scientific and Common Names.

Several species of the genus *Dolerus* have been recorded in Japan[4, 5], among which *Dolerus japonicus* KIRBY resembles the present species closely.

The distinction between these two seemed very difficult. Accordingly, the authors sent the specimen of the species which they are studying to Dr. WATERSTON of the British Museum for identification. Dr. WATERSTON found that the species is new and he described it as *Dolerus harukawai*[3].

Dolerus japonicus has been known in Japan as "*Osu-guro-habachi*" meaning that the male is black. *Dolerus harukawai* resembles *Dolerus japonicus* fairly closely and the male is also black. It differs, however, from *D. japonicus* in that it is markedly larger than *D. japonicus*. Accordingly, the authors proposed a new common name "*Ō-osu-guro-habachi*" meaning "larger black-male saw-fly".

Dolerus harukawai and *Dolerus japonicus* are compared as follows:

Dolerus harukawai (♀).

Propleurae and prosternum black or greyish black. Clypeus, also black. Almost all parts of the front legs black. Abdomen dark red or ferruginous. Length of body 11 mm.; expansion, 22 mm.

Dolerus japonicus (♀).

Prothorax orange yellow all over. Distal portion of clypeus also orange yellow. Distal portion of front legs yellow beyond the middle of tibia. Abdomen orange yellow slightly tinged with red. Length 8.5—9 mm.; expansion, 17—18 mm.

According to WATERSTON[6], *Dolerus anticus* KLUG is also very closely allied to *D. harukawai*. But, these two species can be separated by the external characteristics as follows:

"*Dolerus harukawai* (♀).

Prosternum, propleurae and scutellum black. Pronotum, mesopleurae, scutum and parapsides entirely ferruginous. Head distinctly contracted behind eyes. Metanotum with a few (4—6) large punctures only.

Dolerus anticus (♀).

Prothorax entirely, mesoscutum (except narrowly at apex, which is black like scutellum) and parapsides anteriorly and laterally ferruginous; mesopleurae, black. Head behind as wide as across the eyes. Metanotum medianly with numerous small punctures (up to 40 or more). One needs only to add that in *D. anticus* KLUG ♂ abdomen is extensively red."

Besides the characteristics described above, WATERSTON pointed out the differences in the structure of saw in these two species of saw-fly. In regard to this point, the readers are requested to consult his original paper.

3. Distribution.

Dolerus harukawai has been found nowhere other than Japan. The distribution in Japan has not been definitely ascertained yet. Besides its type locality, Fukuoka, the species seems to be found in Ishikawa Prefecture according to KATSUMATA.*

Whether the present species is found in Hyôgo Prefecture or not is still in doubt. The junior author was in Hyôgo several times in search of this species, but as yet he failed to collect it. The present species has not been recorded in no other rush growing locality in Japan.

4. Description.

i. *Adult Insects.* (Plate XXXXIII, Fig. 3.)

The following description is cited from the original paper published by WATERSTON.

"♀ **Colour.**—The following parts reddish or ferruginous, viz. pronotum, mesoscutum and parapsides, mesopleurae and abdomen, except the shining first segment (propodeum), anal stylets, base and movable (distal) portion of the ovipositor valves—all of which are black. For the rest dull black, including the neuration. Wings subhyaline, infumated near apical edge, but with no definite band or cloud there.

Structure.—*Head:* Labrum and face densely punctate—the punctures growing larger between the toruli and ocelli. Clypeal emargination deep and broad, with very divergent sides, and occupying about one-third of the distal (ventral) breadth of the sclerite. Post-ocellar furrows well defined. Post-ocellar area nearly square, more sparsely punctate than the face. Lateral areas smooth and shining, with a few larger punctures and others more closely placed towards the occipital margin. Oculo-mandibular space and postgenae punctured like the face. Antennae rather short, about equal to the length of the head and thorax up to the mid-scutellum. Third joint (first funicular) nearly twice (9 : 5) the fourth. *Thorax:* Pronotum dull, deeply and densely rugose punctate. Mesonotum shining, with numerous small punctures; on scutellum fewer, larger, deeper; sides of axillae roughened, but without major punctures. Postnotum (belonging to the scutellum) smooth; metanotum (middle area) with a few large punctures. Mesosternum like mesonotum, shining, punctate; mesopleurae like pronotum, but the pattern coarser, with very large punctures. Sutures between mesopleurae and metapleurae shining, narrow, wedge-shaped,

* A few years ago Mr. KATSUMATA sent to the authors some specimens of *Dolerus* larvae which are probably the larvae of *Dolerus harukawai* WATERSTON.

mesepimeron and metapleurae like face. *Abdomen:* Smooth and shining; ovipositor (Fig. 1 b.).*

Length about 11 mm.; expanse about 22 mm.

♂ **Colour.** Practically all black, for the most part dull, with a moderately large pleural spot below the forewing, and the mesoscutum indistinctly on each side, ferruginous.

Structure. *Head:* Antennae—the third joint is only a little over half as long again as the fourth, i. e. shorter than in the ♀, but the whole antenna is relatively longer in the ♂. *Abdomen:* Dorsally shining, with one or two scattered punctures on tergite 1 (propodeum) and the three succeeding tergites; tergites 5 and 6 more densely punctate, especially at the sides; rest of dorsal surface duller and more pilose, but without definite punctures. *Length* about 8 mm.; expanse about 16 mm."

The male is slightly smaller in size than the female, and the abdomen of the former is more slender than that of the latter.

ii. *Larva.* (Plate XXXXIV, Fig. 1.)

Colour. Green all over the body. Head pale green with brown flecks and streaks, viz., vertex brown behind the ocelli along the epicranial suture; upper half of frons brown; a fairly dark brown band on each side of the head along the vertical furrows; margin of ocellus black; tip of mandible also black.

Structure. Head seen from the dorsal side nearly elliptical. Mouth opening directed rather backwards; labrum deeply emarginate and asymmetrical, namely, the right part is always larger than the left as YUASA pointed out[7]. Abdominal segments consist of 6 annulets. Spiracles much compressed anterio-posteriorly and found on the first thoracic and the first to the eighth abdominal segments. Thoracic legs rather long. Abdominal legs on the second to the eighth abdominal segments and a pair of prolegs on the tenth abdominal segment.

iii. *Pupa.* (Plate XXXXIV, Fig. 2.)

Colour. The colouration of pupa is somewhat variable according to the age of pupa. The female pupa green almost all over the body immediately after pupation; but, several days later colouration becomes pale reddish brown; shortly before the emergence of adult insect, the head of the pupa black; antennae also black. Mesoscutellum and metathorax black; the ventral surface of thorax and the legs also black; the other parts of thorax pale reddish. The first abdominal segment black; the rest of abdomen yellowish red; the ventral surface of abdomen reddish all over except the small basal portion of ovipositor, which is black.

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* The figures in the paper by WATERSTON are not reproduced here.

The male black all over the body except the two sides of mesoscutum which are dark red. The wing-sheaths very pale yellowish red in both of the female and of the male.

Structure: The pupa is a so-called "free pupa", so that the chief external parts of the adult insect can be recognized. The female pupa nearly spindle-shaped in its outline, the anterior part being larger. The male nearly cylindrical. The width of thorax as well as that of abdomen smaller in the male than in the female, so that the male pupa appears more slender than the female.

The results of measurements are as follows: for the female, body length 12 mm.; width of head 2.7 mm.; length of thorax 3.7 mm.; width 4.7 mm.; length of abdomen 7 mm.; width about 3 mm. at the widest part. For the male, body length 11—12 mm.; width of thorax 3 mm.

iv. *Egg.* (Plate XXXXIII, Fig. 2.)

Ellipsoid; pale yellowish white immediately after oviposition. When the time of hatching approaches, the egg becomes light grey in colour. Major axis measures 1.15 mm. and minor, 0.39 mm.

The egg increases in size gradually after it is laid in the rush stem. The following is the average of several measurements made.

	Immediately after oviposition	6 days after oviposition	11 days after oviposition
Major axis	1.09 mm.	1.23 mm.	1.49 mm.
Minor axis	0.36	0.43	0.53

Swelling is quite conspicuous as it is evident from the measurements shown above.

5. Seasonal Life History.

i. *Field Observation in Fukuoka Prefecture.*

According to the observation made by the junior author, the larger black male saw-fly begins to appear about the middle of April and the emergence seems to continue until about the beginning of May.

The larvae may be seen feeding on the rush after the fifth of May. By the middle of June, the majority of the larvae seem to become fullgrown and go into the soil to make cocoon.

ii. *Appearance of Adult Insect in the Spring.*

Larvae were captured in Fukuoka Prefecture and brought black to Kurashiki to rear them in the insectary. These larvae were fullgrown and

overwintered in the soil. Emergence in the following spring occurred as shown in Table I.

Table I.

Emergence of Adult in the Spring.

Date	Number of Adults Emerged	
	In 1927	In 1929
March 31	0	5
April 1	2	
// 2	4	5
// 3	4	4
// 4	0	5
// 5	0	10
// 6	2	10
// 7	2	7
// 8	14	0
// 9	2	6
// 10	8	0
// 11	0	0
// 12	4	0
// 13	2	4
// 14	0	0
// 15	0	0
// 16	0	1

According to the result in Table I, *Dolerus harukawai* which overwintered in the insectary began to appear as an adult insect about the end of March and the emergence ended about the middle of April. The period of the maximum emergence is somewhere about April 8th.

When this result is compared with that of the field observation in Fukuoka Prefecture, it is found that the beginning of appearance of the adult in Kurashiki is about two weeks earlier than in Fukuoka.

One of the important factors which made this saw-fly appear earlier in Kurashiki is that the air temperature in the insectary is slightly higher than that in Fukuoka Prefecture, namely, the mean monthly temperature in February and March in Fukuoka is 5.2°C and 8.2°C, respectively, while the mean temperature in these two months in the insectary in Kurashiki is 6.9°C and 10.5°C, respectively. The sum of the mean daily temperature in February and

March in Kurashiki is larger than the corresponding sum in Fukuoka by about 120 degree-days. Since the mean daily temperature at the beginning of April in Fukuoka is about 9—10°C, it may be expected that the emergence would begin about 10 days later in Fukuoka than in Kurashiki. The result of the field observation in Fukuoka agrees with this statement based upon the result of observation in the insectary.

iii. *Results of Rearing.*

The larvae were reared separately placing one larva in each rearing vial. Some of the records obtained are shown in the following table:

Table II.

Results of Rearing.

Oviposition	Hatching	Cocooning	Emergence	Remarks
April 8	April 29	June 11	—	1929. Died.
〃 〃	〃 〃	—	—	〃 〃
〃 12	〃 30	June 6	—	〃 〃
〃 〃	〃 〃	〃 〃	—	〃 〃
〃 〃	〃 〃	〃 11	—	〃 〃
〃 〃	〃 〃	〃 14	—	〃 〃
〃 13	May 1	〃 17	—	〃 〃
〃 〃	〃 〃	〃 16	March 28, 1930.	〃 〃
〃 15	〃 2	—	—	〃 Died.
〃 20	〃 7	June 28	April 4, 1930.	〃
〃 〃	〃 〃	〃 11	—	〃 Died.
〃 〃	〃 〃	〃 13	March 29, 1930.	〃
〃 〃	〃 〃	〃 14	〃 27, 〃	〃
〃 〃	〃 〃	〃 16	—	〃 Died.
〃 〃	〃 〃	〃 27	March 29, 1930.	〃
〃 〃	〃 6	〃 12	—	〃 Died.
〃 〃	〃 7	〃 14	—	〃 〃
〃 〃	〃 6	〃 9	—	〃 〃
〃 〃	〃 7	〃 23	—	〃 〃
〃 〃	〃 7	〃 14	—	〃 〃
〃 〃	〃 6	〃 18	—	〃 〃
〃 〃	〃 7	〃 19	—	〃 〃

Number of Generations in a year. As it is evident from the results of field observation as well as from those of rearing in the insectary shown in Table II, *Dolerus harukawai* appears only once in a year.

Durations of the Egg, the Larval and the Pupal Periods. Besides the records shown in Table II, many larvae were reared separately. However, a considerable number of them died either before they were fullgrown or during the overwintering period. The records on these larvae, also, were used in calculating the durations of the three stages which will be considered below.

a) *Egg Period.* The results obtained from the rearing in the net-house are shown in Table III. The net-house is roofed with glass so that the temperature in the net-house may be slightly higher than the outdoor temperature. However, the outdoor temperature was substituted for the temperature in the net-house in calculating the mean temperature in the egg period, since the temperature in the net-house was not observed.

Table III.

Egg Period.

Time of the Year	Egg Period in Days	Number of Eggs
April 12 — April 29, 1929	18	5
〃 20 — May 6, 〃	17	9
〃 〃 — 〃 7, 〃	18	8
〃 8 — April 28, 〃	21	6
〃 10 — 〃 29, 〃	20	4
〃 13 — 〃 30, 〃	18	9
〃 20 — May 6, 〃	17	14

Average egg period ... ... 17.6 Days.

Mean temperature in the period from April 8 to May 7 ... ... 12.9°C

The egg period was slightly less than 18 days when the mean temperature during the egg period was about 13°C. Since the mean temperature in April in Fukuoka Prefecture is 13.2°C the egg period in that prefecture would be about 16—17 days judging from the results shown in Table III.

b) *Larval Period.* The fullgrown larva of *Dolerus harukawai* goes into the soil and makes an earthen cell in which it pupates. The larval period in the cocoon, i. e. the duration from cocooning to pupation, was not determined. Therefore, the term "larval period" is not used here in the strict sense of the words, but it is used to designate the growth period of the larva.

The *growth period* as observed in the rearing experiments are shown in Table IV.

Table IV.

Growth Period of the Larva.

A. Result obtained in Net-House.

Time of the Year	Growth Period in Days	Number of Larvae
April 30 — June 4	36	1
〃 〃 — 〃 6	38	1
〃 〃 — 〃 9	41	1
〃 〃 — 〃 11	43	1
〃 〃 — 〃 14	46	1
May 6 — 〃 12	38	2
〃 〃 — 〃 13	39	1
〃 〃 — 〃 14	40	1
〃 〃 — 〃 9	35	1
〃 〃 — 〃 18	44	1
〃 7 — 〃 12	37	1
〃 〃 — 〃 14	39	1
〃 〃 — 〃 9	34	1
〃 〃 — 〃 19	44	1
〃 〃 — 〃 23	48	1

Average growth period ... ... 39.7 days.

Mean temperature ... ... 17.9°C.

B. Result obtained in Insectary.

Time of the Year	Growth Period in Days
May 1 — June 11	42
〃 〃 — 〃 13	44
〃 〃 — 〃 16	47
〃 〃 — 〃 17	48
〃 7 — 〃 11	36
〃 〃 — 〃 13	38
〃 〃 — 〃 14	39
〃 〃 — 〃 16	41
〃 〃 — 〃 26	51
〃 〃 — 〃 27	52

Average growth period ... ... 43.8 days.

Mean temperature ... ... 20.5°C.

As it is evident from the table, the duration of growth period varies rather conspicuously, namely, it varied from 34 to 52 days. Obviously the variation was not solely due to the individual variation. Certain unknown factors must have been a part of the causes of the variation.

The mean growth period of larva in the insectary was about 44 days at a mean temperature of about 20°C. In the net-house, it was about 40 days.*

The mean temperature in May in Fukuoka Prefecture is 17.2°C and that of June, 21.4°C. Therefore, the growth period of larva in that prefecture would be about 40 to 45 days. If hatching of egg occurs about the beginning of May in Fukuoka, the larva would be fullgrown by the middle of June. The emergence of the adult occurs under the natural conditions in the field during a quite long period, so that the time, when all the larvae are fullgrown, would be about June 20—25th in Fukuoka Prefecture. The results of the field observation in that prefecture agree quite well with what has been stated here.

iv. *Hibernation.*

The larva of *Dolerus harukawai* overwinters in the cocoon. As to the state in which this insect overwinters, the following experiments were conducted.

In 1928, the cocoons of the overwintering insects were examined on October 27th and found that all of them were in the pupal state. In 1929, the overwintering insects were examined on October 4th and then they all were still in the larval state. When they were examined on November 4th, all of them were in the pupal state. However, it seemed that they must have transformed to pupae only a few days previously, judging from the colouration of the pupae.

These results indicate that the larvae in cocoon pass the hot summer season in the larval state and transform to pupae about the end of October. The overwintering occurs in the pupal state and the pupae transform to the adult insects only in the following spring.

6. Habits and Biological Notes.

i. *Adult Insect.*

a) · *Oviposition.* Mating and oviposition occur immediately after emergence since the adult insect has many mature eggs in the ovaries when it emerges.

The adult insect prefers young, soft and growing stems of rush for ovipositing. It makes a small longitudinal cut in the stem and places an egg into the tissues. This process is repeated several times and several eggs are laid in a row on the stem. Usually the eggs are laid quite near the tip of the stem.

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* The mean temperature in the net-house was not available so that the mean outdoor temperature was substituted for it in Table IV, A. Probably the true mean temperature in the net-house was higher than 17.9°C judging from the result that the growth period in the net-house was slightly shorter than in the insectary.

The slits through which eggs are introduced into the tissues remain as whitish dashes after oviposition is over. Since the eggs swell markedly after they are laid in the stem, the slits made by the saw of the adult insect are forced open so that the eggs in the stem can be seen from outside. Moreover, the stem becomes swollen at the place where the eggs are situated and presents a peculiar appearance. (Plate XXXXIII, Fig. 2.)

The stem which bears eggs in it grows rapidly in length after the eggs are laid and usually it attains to a considerable height before the eggs hatch.

b) *Number of Eggs laid by one Female.* A number of female insects were killed before they began to oviposit and the number of mature eggs in the ovaries were counted. The average number of mature eggs was found to be about 50 per female.

It was not possible to examine many females in regard to the number of eggs which were actually laid. The results of observations on a few females showed that the average number of eggs laid by one female was about 45. But, these females still had 30 to 40 mature eggs in their ovaries when they were dissected after they died. These observations indicate that a female may lay 70 to 80 eggs.

c) *Ratio of the Male to the Female.* In *Dolerus harukawai*, the female insects by far outnumber the males according to the results of the collecting the adults in the field as well as those of the rearing in the insectary.

Although the total number of the adults is rather limited, the figures in Table V indicate that the number of the females is markedly larger than that of the males.

Table V.

Comparative Numbers of the Males and the Females.

Lot No.	Number of Females	Number of Males	Remarks
i	9	2	Reared from the larvae captured in 1924.
ii	36	4	Adults captured in field 1926.
iii	21	1	Reared from the larvae captured in 1926.
iv	8	4	〃 〃 〃 〃 〃 〃 1927.
v	51	13	〃 〃 〃 〃 〃 〃 1928.
Total Number	125	24	
Ratio	5.28	1	

Why the females are so markedly more numerous than the males may be explained in a similar way as in the case of the pear slug saw-fly[8]. Probably, the parthenogenetic reproduction occurs frequently in *Dolerus harukawai* and

the individuals which develop from the unfertilized eggs must be the females just as in the case of the pear slug saw-fly.

d) *Longevity of Adult Insect.* The adult insect of *Dolerus harukawai* does not leave the cocoon immediately after it has emerged from the pupa. A close observation has shown that it stays in the cocoon for 5 or 6 days after emergence. Therefore, this period must be added to the duration of adult life after the appearance of the adult from the cocoon, in order to obtain the true longevity of adult insect.

The figures shown below are not the longevity in the strict sense, but the duration of adult life after the appearance from the cocoon.

	minimum	maximum	Average
Longevity in Days	11	26	20.6

These are the results of observations in the insectary where the adults were fed on honey. Therefore, they may differ slightly from the longevity under the natural conditions in the field.

ii. *Larva.*

The newly hatched larva is pale grey and its head is almost colourless. Shortly afterwards the body becomes green and the peculiar colouration of the head appears.

The young larva which has just hatched out of the egg feeds on the green tissues longitudinally leaving the white pith uninjured. Therefore, the injured portion of the stem appears as a long white streak on the surface of the stem. After the larva has attained the third or fourth stadium, it eats the green tissues as well as the pith from the tip downwards. Consequently, the upper part of the stem appears as if it were cut away. (Plate XXXXIII, Fig. 1.)

The food plant of *Dolerus harukawai* thus far observed is the cultivated rush, *Juncus effusus* L. *var. decipiens* BOUCH.

The number of moulting of this larva seems to be influenced by certain unknown conditions. Thus, some larvae moult five times before they are fullgrown while most of them moult six times and still some others moult seven times. However, the larvae which moult six times are the most numerous and those which moult seven times are very scanty.

The larva goes into the soil and makes its cocoon when it is fullgrown. The cocoon is an earthen cell, and it is located about 7 to 10 cm. below the surface of the ground. The shape of its cavity is elliposoid, but the external form of the cocoon varies quite markedly. (Plate XXXXIV, Fig. 3.)

Preferred Habitat. According to the observation in Fukuoka Prefecture, the larvae of this saw-fly occur more abundantly in such rush-fields as are near a farm-house, an embankment or a road than in the other location. The time of cocooning falls in "*baiu-ki*" (梅雨期) or the rainy season in the summer and

the rush-field is flooded with water. Therefore, the fullgrown larvae have to migrate to the ground around a neighbouring farm-house or to a bank which is not submerged by water, since they can not make cocoons in the soil under the water.

iii. *Effect of Low Temperature on Pupation and Emergence.*

The larva of this saw-fly is fullgrown by June 20th to June 25th, and goes into the soil to make the cocoon. Pupation occurs about the end of October or the beginning of November and the adult insect appears in the spring of the following year. Thus, the larva remains in the larval state during the hot part of summer and transforms to pupa only when the air temperature becomes markedly lower. The authors were interested in this fact, and the following experiments were conducted:

Some pupae were placed in an incubator of 20°C. near the end of December, 1926, and after a short period they were transferred to an incubator of 15°C. The result was that the adults appeared at the end of January of the following year.

Another experiment of a similar nature was conducted in 1928, namely, the cocoons were placed in an incubator of 15°C. near the end of July shortly after they had been made. Pupation occurred about the middle of September and the adult insects appeared about the middle of January of the following year.

In these two experiments, both the pupation and emergence occurred strikingly earlier than under the natural conditions. These results indicate that the pupation and emergence may be induced to occur much earlier if the cocoons are exposed beforehand to a low temperature of 15°C. and also that it is not necessary for the insect to pass either the summer or the winter.

7. Summary.

1. A species of saw-fly which is injurious to the cultivated rush is found in Fukuoka Prefecture. The species was found to be a new species and named *Dolerus harukawai* by WATERSTON.

The authors have given this saw-fly a new common Japanese name "*Ō-osu-guro-habachi*" meaning *larger black-male saw-fly.*

2. The species resembles *Dolerus japonicus* KIRBY, but it differs from it in size being larger. *Dolerus anticus* KLUG also resembles the present species quite closely, but it differs in colouration and in the structure of saw.

3. The species has been found in Fukuoka and Ishikawa.

4. The species produces one generation a year. The adult appears about the middle of April and the larvae are found between the beginning of May and the middle of June.

5. The adult lays 70 to 80 eggs.

6. The only food plant thus far observed is the cultivaled rush.

7. The fullgrown larva makes its cocoon in the soil. But, the soil of the rush-field which is flooded with water is not suitable. Therefore, this saw-fly occurs more abundantly in such rush-fields which are located near a farm-house, an embankment or a road, where it can find a suitable place for cocooning.

8. The fullgrown larva which is in cocoon passes the summer in the state of arrested development. The development is resumed if the larva is exposed to a low temperature below certain degree.

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Acknowledgments.

Dr. J. WATERSTON of the British Museum has kindly studied and described the specimen which the authors sent. The authors are much obliged to him for his assistance.

The authors are much indebted to Mr. K. IKEGAMI who kindly assisted them in carrying out the field observation.

The authors' thanks are also due to Dr. A. ITANO of this Institute for kindly looking over the manuscript.

Explanation of Plates.

The figures are magnified except Fig. 1, Plate XXXXIII. Magnification is not the same in all the figures.

Plate XXXXIII.

Fig. 1. Larvae feeding on the rush.

Fig. 2. Eggs in the rush stem.

Fig. 3. Adult insects. Female on the left side and male on the right.

Plate XXXXIV.

Fig. 1. Fullgrown larvae.

Fig. 2. Pupae. Two on the left side are females and two on the right, males.

Fig. 3. Cocoons. Insides are shown in some cocoons while, in the others, the emergence holes are shown.

PLATE XXXXIII.

Fig. 1.

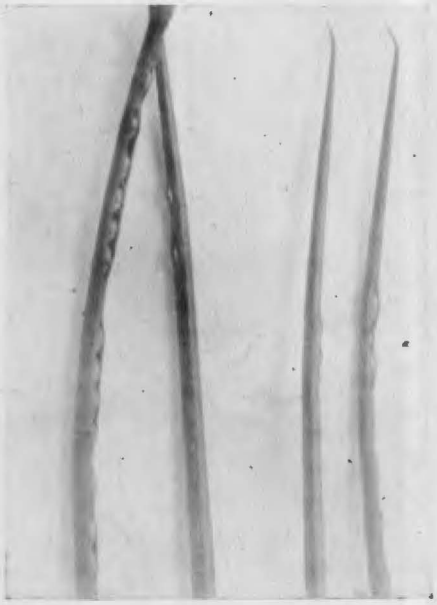

Fig. 2.

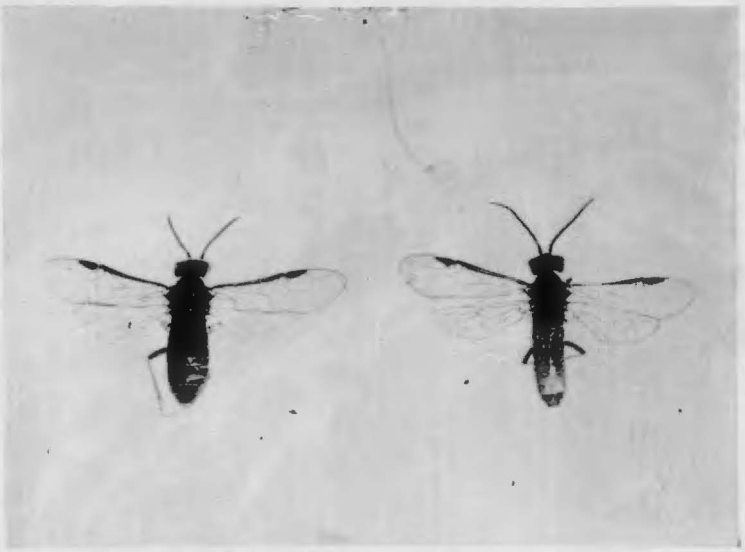

Fig. 3.

PLATE XXXXIV.

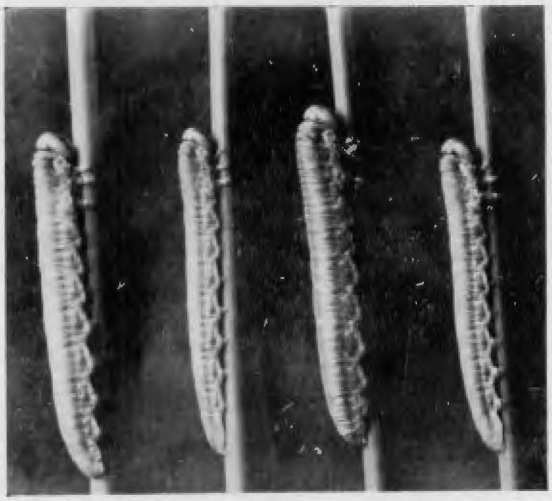

Fig. 1.

Fig. 2.

Fig. 3.