Aspects of the biology of *Apion striatum* Kirby (Coleoptera, Curculionidae)

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According to Hoffmann (1958: 1590), the larva of *Apion striatum* Kirby lives in twigs of broom, *Sarothamnus scoparius* (L.) Wimm., where it induces stem galls. Williams (1966) states that eggs are laid on the surface of twigs of *S. scoparius*.

The present study shows that the biology of *A. striatum* differs from that described in the literature. In the population studied here on the west coast of Jutland, oviposition and development of the larva took place in the flowers of *S. scoparius*.

The larva feeds on pollen, stamens and style. Larval life concludes in the formation of a case at the tip of the keel of the flower. The case is bitten free from the flower, falls to the ground, and is able to perform active jumping movements, which probably evolved as a mechanism for protection against enemies and extremes in temperature.

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Introduction

The broom *(Sarothamnus scoparius* (L.) Wimm.) in Denmark is the host plant for several species of weevils, whose biology and ecology I have been studying in the years 1973–77. *Apion striatum* Kirby is one of these species, and Hoffmann (1958: 1590) states that its larvae live in galls in the twigs of broom.

After hatching imagines of *A. striatum* from withered parts of broom flowers, which indicated that the species has a biology different from the one assumed so far, I collected material during the following years to elucidate the life story of *A. striatum*. The study was made on low shrubs of broom growing between Nymindegab and Hennestrand, West Jutland (UTM, Dania-MG 48).

Bionomics

Imago

In Denmark *A. striatum* lives monophagously on broom (Hansen, 1965), where it feeds on leaves and young twigs. It is rare in comparison with other species living on broom in this area *(Apion fuscirostre* Fabr., *Sitona griseus* Fabr. and *Thychius venustus* Fabr.).

The imago is found in early May on the upper parts of broom shrubs, and mating is believed to take place around this time. Oviposition takes place in mid-May. The female seeks out a 1,0–1,2 cm long, yellow-green flower bud, which she inspects closely by moving about while she "pats" its surface with antennae and forefeet. She then gnaws at the underside of the bud to produce a hole as deep as the length of her rostrum. This process (Fig. 1.) takes about 10 minutes. She places the extended tip of the abdomen in the hole and after about 15 seconds the egg is laid. Finally, the tip of the abdomen makes a few "patting" movements while a drop of clear fluid is secreted over the hole.

The egg probably hatches 4–5 days later (no observations).

Larva

The larva lives in the tip of the keel (see Fig. 2.), where it consumes the anthers, stamens and stigma. An important problem in this connection is the question of how the larva avoids being flung out of the flower when a pollinating insect presses down the keel, thereby releasing the spring mechanism of the style. The style lies stretched out in the bottom of the keel and is held in place by the tip of the keel, which is

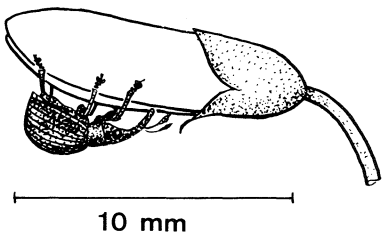

Fig. 1. Female of *Apion striatum* in the process of making an egg-hole.

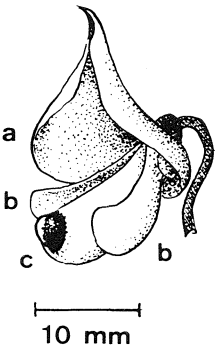

Fig. 2. Flower of broom, *Sarothamnus scoparius* (L.) Wimmer, showing: *a:* Flag (fane), *b:* Wings (vinger), *c:* Keel (båd). At the tip of the keel is shown the darkly coloured retreat of the larva of *A. striatum*.

closed. When the flower is pollinated by an insect, however, the style and stigma are pressed through the tip of the keel and the style rolls up explosively into a spiral.

In all flowers containing *A. striatum* larvae this spring mechanism is found to have been put out of function. How this happens has not yet been fully determined, but in some flowers it appears that the larva has been able to glue the style to the bottom of the keel, at least until it has eaten the first third of the style, after which the style has lost its elastic properties.

The presence of the larva in a bud or flower is indicated externally by a brown colouration of the distal 3 mm of the keel (Fig. 2.). The first faint brown colouration appears 4–5 days after oviposition, i. e. at about the time I assume the egg to hatch.

The brown part of the keel serves as a retreat where the larva rests between feeding periods. It does *not* contain gall-like tissue.

Flowers containing living *A. striatum* larvae have never been found to contain other parasites of the broom nor traces of any (gnaw marks, cocoons, or excrement). However, in some flowers dead *A. striatum* larvae have been found together with larvae of the Oecophorid moth, *Agonopterix scopariella* Heinemann.

Although buds containing two egg-holes have been found, I have never found more than one *A. striatum* larva in each flower.

14–21 days after oviposition the larva is about 2 mm long, plump and corn-yellow. It is now ready to withdraw into its retreat, which it seals off to form a case. Sitting in its retreat the larva extends its head out through the opening and uses its mandibles to tear off small pieces from the edges of the keel and those parts of the wings of the flower that it can reach, thus leaving very characteristic bite marks (Fig. 3.). Each bite is chewed and then deposited as a small curry-yellow lump between the retreat and the rest of the keel, where it quickly darkens to a dark brown colour. The sealing of the case takes 60–75 min and the seal consists of a ring-shaped elevation round the hole with a wall inside the elevation. The case-forming bites often result in the case being bitten completely free from the flower and falling off, or the case may remain hanging on a thin thread that soon withers, so that the case then falls off at the slightest movement.

Once the case has been closed, the larva immediately starts to jump with it. From my ob-

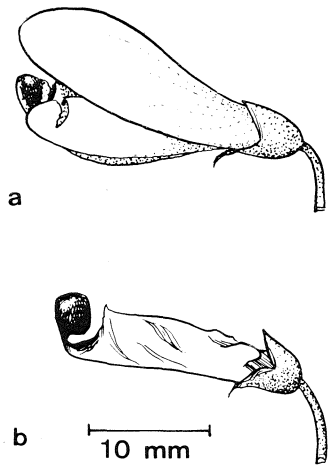

Fig. 3. a. Flower with a finished case of *A. striatum*. Note the characteristic bite marks. b. The same with flag and wings removed.

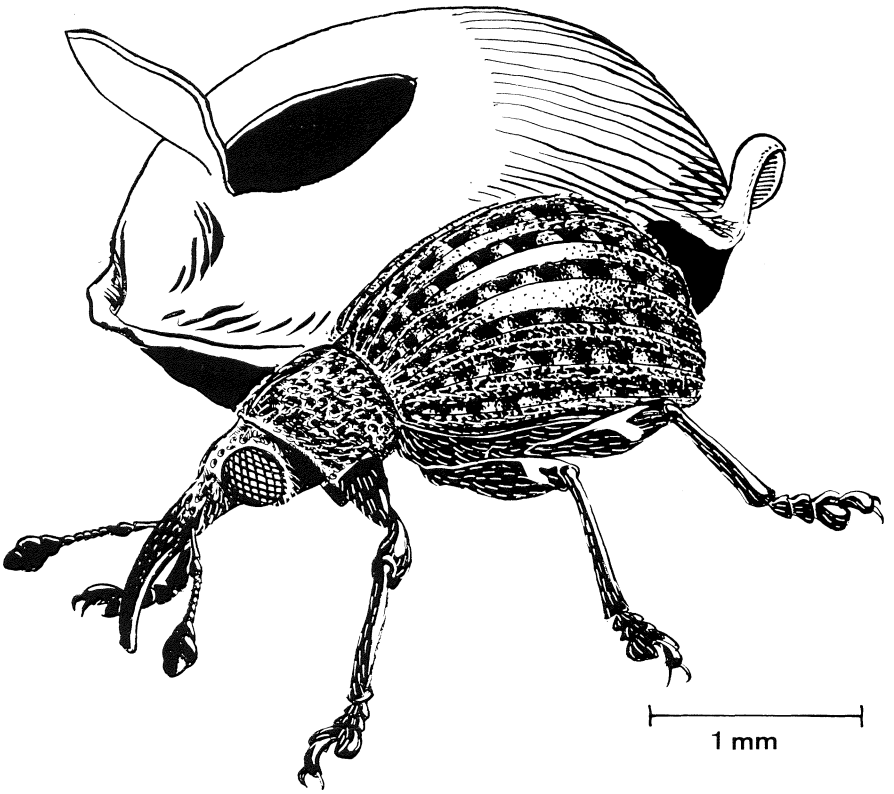

Fig. 4. Imago of *A. striatum* after hardening of the cuticle. In the background is shown the case with its trapdoor.

servations it seems that this is caused by the larva doubling up, catching hold off the wall of the case with its mandibles, straining its abdomen against the wall of the case, and then suddenly letting go with its mandibles. This results in the head and anterior segments of the body being flung back, hitting the opposite wall, and thus causing the case to jump.

The jumps vary in size; the longest jump observed covered 1 cm and the highest was 0,5 cm. The frequency of jumping is greatest just after the disengagement of the case from the flower, but the duration of this "initial jumping" varies from animal to animal, varying between 1 and 12 hours. After this the case does not move unless exposed to rapid changes in temperature or to mechanical stimuli, when "escape jumping" is elicited.

After 6–7 days, jumping can no longer be elicited. The larva has now begun to pupate inside the case (see Table 1).

Pupa

Pupation lasts 7–10 days, after which the emerging imago gnaws its way out through a "trapdoor" only about 1 mm in diameter. Immediately after emergence the imago is quite slender and the carapace has not hardened. It does not acquire its characteristic broad-bodied appearance until after 1–2 days (Fig. 4.).

Nothing in this study indicates that there is more than one generation per year. The imago hibernates.

Table 1. Approximate duration of the various stages of *Apion striatum* Kirby.

Egg stage	4–5 days
Larval stage in the flower	10–14 days
Larval stage in sealed case	6–8 days
Pupal stage	7–10 days
Total time of development	30–35 days

Discussion

According to Hoffmann (1958) the larva of *A striatum* lives in twigs of *S. scoparius,* where it induces gall formation. There is nothing in my observations to support this view; a possible explanation is that there has been confusion between the two closely similar species *A. striatum* and *A. immune* Kirby. The inducement of stem galls by *A. immune* has been reported by Lengerken (1941) and confirmed by Williams (1966).

P. Williams (1966) states that *Apion striatum* lays its eggs on the surface of branches of *Ulex* and *Sarothamnus scoparius.* Williams' observations may be due to the fact that the weevils did not get an opportunity to lay their eggs on flowers under the experimental conditions, and were thus forced to lay mature eggs in atypical places. This phenomenon is fairly frequently observed with animals in captivity, and has recently been observed in another weevil, *Chromoderus fasciatus* Müller, by dr. phil. E. Bro Larsen of the Royal School of Veterinary and Agricultural Sciences, Copenhagen (personal communication).

A review of the insects that form jumping cases at some stage in their development has been presented by Grønlund (1962). He pays particular attention to a weevil, *Anthonomus pedicularius* L., living on hawthorn *(Crataegus* sp.), whose larva lives in the flower bud. When the larva has eaten the bud's contents it forms a case, bites it off, and is able to jump about in it.

The larvae of *Apion striatum* and *Anthonomus pedicularius* have several features in common:

1. Both of them feed primarily on pollen and stamens.

2. There is only one larva in each flower, although several egg-holes may not uncommonly be found. This suggests that the first larva to hatch kills the others.

3. The pattern of jumping is very similar in the two species, jumping in both cases being induced by temperature changes or mechanical stimuli.

The main difference is the fact that *A. pedicularius* transforms the flower bud so that it does not unfold and the calyx then swells in a gall-like manner. Furthermore, the pupa of *A. pedicularius* is able to make the case jump, whereas the pupa of *A. striatum* is not.

I think that jumping in *A. striatum* has the purpose of avoiding enemies and excessively high temperatures. At the locality investigated, ants constitute a real danger. The case itself yields good protection, since it resembles other small, withered objects lying under the shrubs. Furthermore, jumping will often result in the case falling down between leaves and twigs, thus giving it even more protection from both predators and extreme fluctuations in temperature.

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Sammendrag

Aspekter af biologien hos *Apion striatum* Kirby (Coleoptera, Curculionidae).

Den danske gyvel *(Sarothamnus scoparius* L.) er værtsplante for en række snudebillearter, hvis biologi og økologi forfatteren har undersøgt i årene 1973–78. *Apion striatum* er en af disse arter og larven angives af Hoffmann (1958) at leve i stængelgaller i kviste af gyvel.

Efter i 1973 at have klækket imago af *A. striatum* fra visne dele af gyvelblomster, hvilket tydede på, at arten havde en anden biologi end den hidtil antagne, indsamledes de følgende år materiale til belysning af *A. striatum's biologi* på en lav gyvelbevoksning mellem Nymindegab og Hennestrand i Vestjylland.

Undersøgelsen viste at hele larveudviklingen foregår i blomsten. Medio maj opsøger hunner af *A. striatum* ca. 1 cm lange knopper af gyvel på hvis underside de borer et hul med snuden (fig. 1) i hvilket de lægger et æg. Indboringen tager ca. 10 min., selve æglægningen 15 sek. Larven lever af pollen, støvdragere og griffel og opholder sig mellem ædeperioderne i spid-

sen af båden, retræten. Udefra kan man se om der er larver af *A. striatum* i en blomst idet de yderste 3 mm af båden farves brun, visner (fig. 2).

På alle blomster med *A. striatum*-larver er den mekanisme, der normalt sikrer befrugtning af blomsten (nemlig at griflen springer spiralformet op om et besøgende insekt) ødelagt. Dette er meget hensigtsmæssigt, da larven ellers let kunne blive slynget ud og blive et bytte for myrer. Når larven er fuldvoksen, trækker den sig ind i retræten og lukker denne med tyggeklumper fra nogle karakteristiske gnav i båd og vinger (fig. 3), der samtidig løsner »huset« fra blomsten.

Larven er i stand til at hoppe med sit hus. Den bøjer sig sammen, bider sig fast i væggen i huset, stemmer bagkroppen mod væggen, – og giver så pludselig slip, hvorved hovedet og forryggen slynges bagud og får huset til at hoppe. Umiddelbart efter nedfaldet fra blomsten er hoppefrekvensen høj, initialhopning. Varigheden af initialhopningen er meget forskellig fra dyr til dyr, men strækker sig fra 1–12 timer efter nedfald. Derpå ligger dyrene stille, medmindre de udsættes for hurtige temperaturskift eller mekaniske påvirkninger. Fra lukningen af huset til klækningen af imago (fig. 4) hengår ca. 14 dage. (Om de enkelte stadiers varighed, se Tabel 1). Efter 6–7 dage, nemlig når larven har forpuppet sig, kan hopningen ikke mere fremkaldes.

Funktionen af hopningen hos *A. striatum* er antagelig at undgå fjender og for høje temperaturer. På lokaliteten er navnlig myrer en væsentlig fare. Alene huset yder en god beskyttelse, idet det ligner andre små visne genstande, der ligger under buskene. Dertil kommer at hopningen ofte vil resultere i, at huset falder ned imellem grene og blade og derved bliver endnu bedre beskyttet, dels mod fjender, dels mod for voldsomme temperatursvingninger.

En gennemgang af andre insekter, der på et eller andet stadie i deres udvikling danner hoppende huse, findes i Ib Grønlunds artikel (1962).