Guide for identification of food items in droppings and regurgitated samples of birds

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Introduction

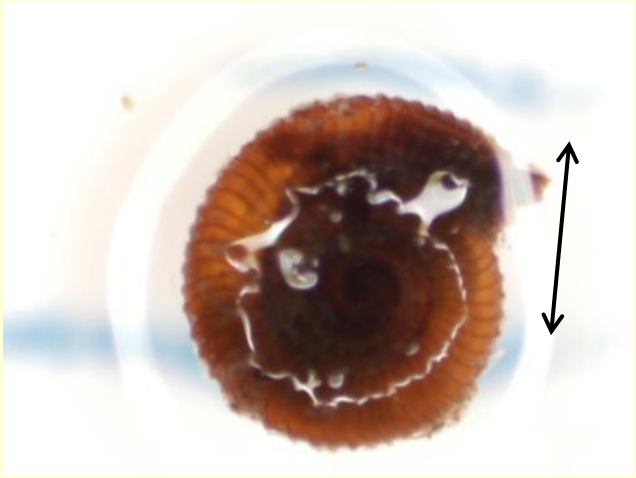
Emetics causing regurgitation of stomach contents, can be useds uccessfully with birds as the source of dietary information. In very small birds, droppings could be used as well, as emetics could kill them or make them very weak. During our study, we were successful in collecting of regurgits (and/or droppings) from nearly 800 bird individuals and we identified food items from them. We stored food samples in ethanol and identified items under the microscope. We identified about 95% insect items into orders and few items into families or species. We did not use any speciall method to disolve the samples, as described elsewhere (e.g. Ralph 1985). For examiantion the samples were poured into small Petri dish and ethan was added. We dispersed the items by gently pushing on hardened parts only. Then we examined samples by binocular dissecting microscope. Items belonging to one order were counter and minimal number of individuals was counted after that. Sometimes, we were able to distinguis different species within one order eaten by bird.

The variety of fragments recognizable in the finely ground matrix of droppings was at first overwhelming. To identify the origins of these well-illustrated entomology text books and web databazes were useful. Some fragments such as wings and heads, posed only minor problems in identification. Others, the smaller or internal structures required systematic dissection or serendipity to match with their owners. Following text illustrate and describe some of these less obvious structures. These are structures that are diagnostic, and usually found separetelly in regurgits from our area.

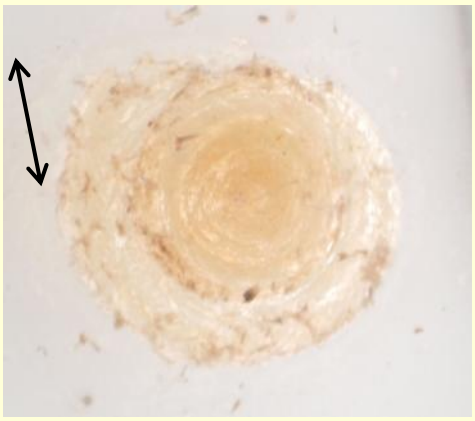
Ralph, CP, Nagata, SE, Ralph CJ 1985. Analysis of droppings to describe diets of small birds.Journal of Field Ornithology 56(2): 165-174

Gastropoda

The class Gastropoda includes snails and slugs of all kinds and all sizes from microscopic to quite large.



Gastropoda were found only occasionally. Shells of different sizes were swallowed by birds. Upper part of shell is found most probably as it is stronger than the rest of animal. Sometimes whole shells were found.



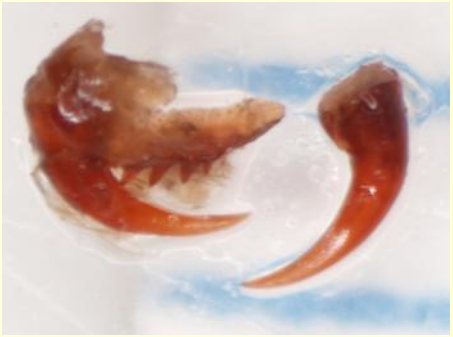
Isopoda

Head and cephalic shield, uropods and sternits are recognizable. Also individual legs were sometimes found. All pereopods are lacking exopodes. Antennas were also found but usually separated from cephalic shield.

Araneae

Spider of different sizes were the most common food items found in samples.

They could be recognized bazed on chelicers, fangs, legs and pedipalps. Chelicers could be recognized even when fangs were absent, chelicerae were distinguishable by their slightly asymmetric but conical shape and sometimes an arrangement of spines. Fangs are curved and sharp, this piece sometimes resembled tarsal claws.



Chelicera

Also cephalothorax is very typical. Usually the area aroud eyes stayed undamaged.

Leg segments end to be straight-sided, whereast hose of insects usually taper at the joints. Spiders' also are usually hairy. Usually hairs are broken or lost but their bases are still visible. Simple tarsus with two claws is diagnostic.

Coxae were also recognizable

Prosoma with eyes is very typical and can be found very often, however broken.

Male genitalia in the spherical or eggshaped terminal segment occurred frequently.

Ixodida

Included soft and hard ticks. Whole individuals found everytime.

Diplopoda

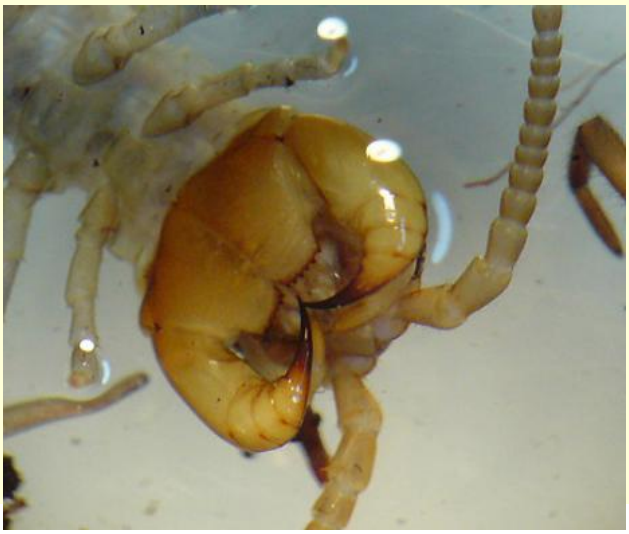
Heads of multipedes were usually found, or the second collum was found separatelly.

Individual segments from trunk could be recognized according to shape and two legs (usually broken – missing).

Chilopoda

Head of Chilopoda is recognizable and usually stays non-broken.

Only ocassionaly, the whole body is found. To find one segment is more common. It can be identified according to shape and one pair of leg.

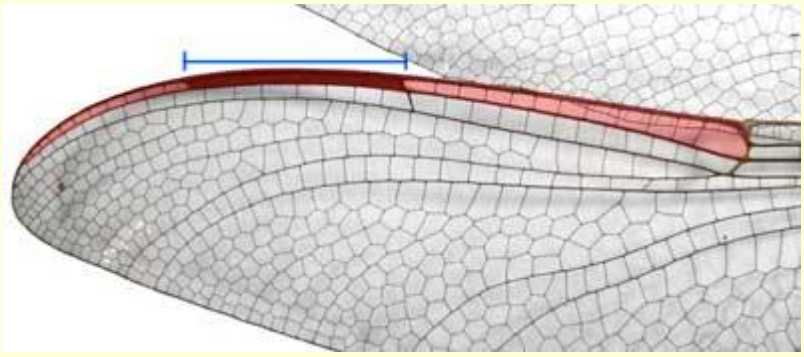


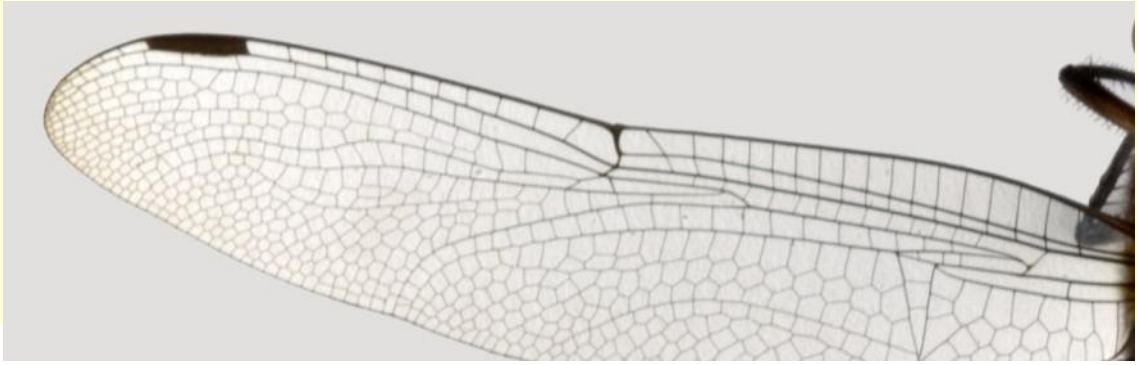
Ephemeroptera

Ephemeroptera was found only few times and recognized according to 2 long cerci at the tip of abdomen. Once a larvae was found and recognized according to 3 long cerci and external gills.

Odonata

These insects characteristically could be recognized in samples by rounded heads covered mostly by well-developed, compound eyes and two pairs of long, transparent wings and elongated abdomens. They have three ocelli and short antennae. The mouthparts are on the underside of the head and include simple chewing mandibles in the adult. In wings there is a structure on the leading edge near the tip of the wing called the pterostigma that is characteristic.

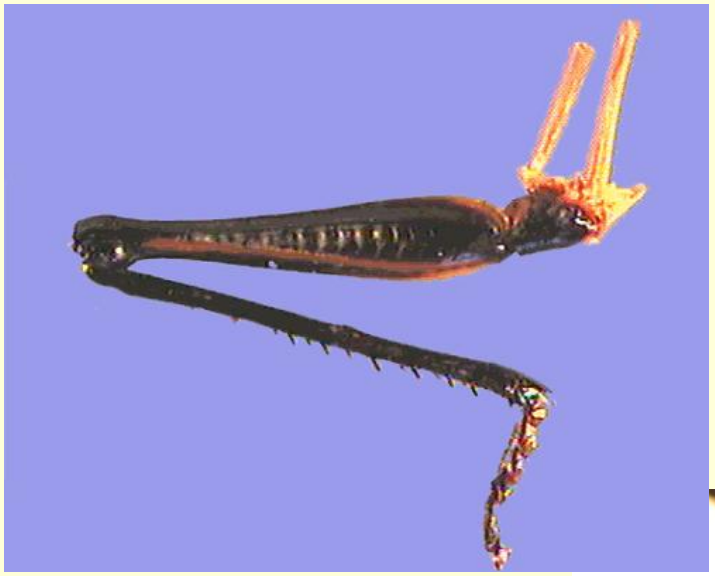


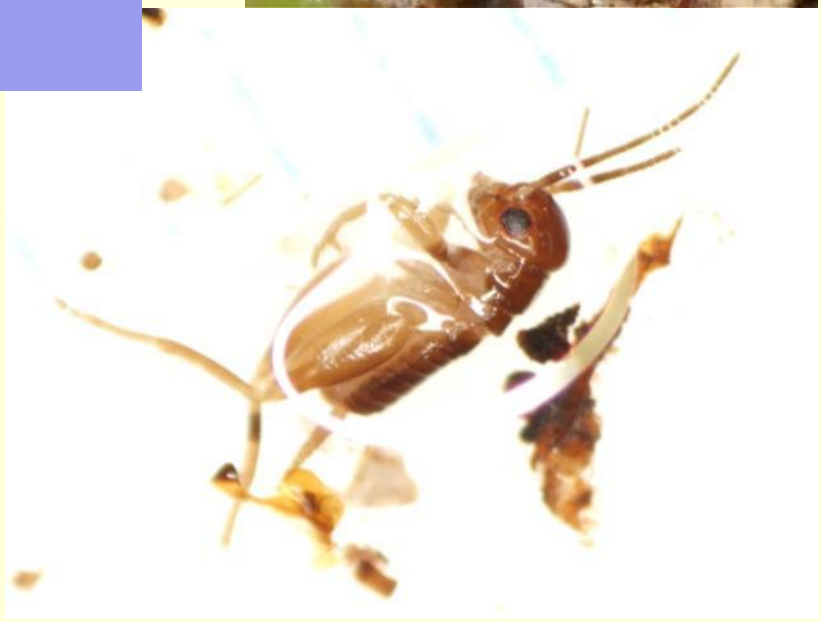


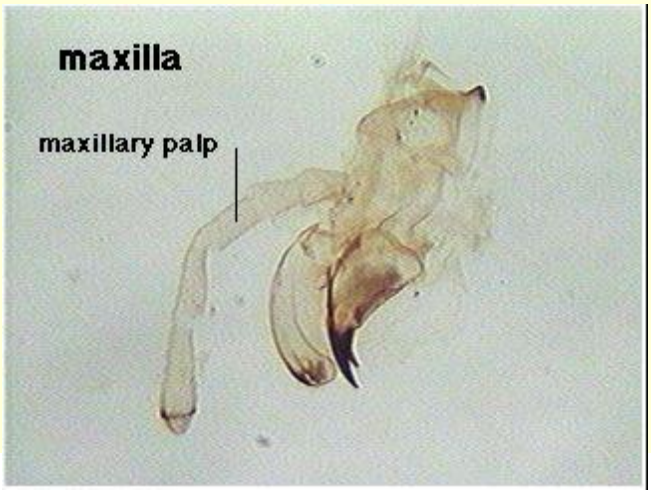

(c) A. Bockoven

Orthoptera

Orthopthoptera were usually recognized according to mouth parts. Maxilla was usually connected to palp and galea. Sometimes small whole individuals of grashoppers was found. Labium and labial parts were usually connect and founf together. Prothorax is typical but usually found broken into few parts. Grasshoppers and crickets are also the classic example of the sartorial jumping leg that is typical.

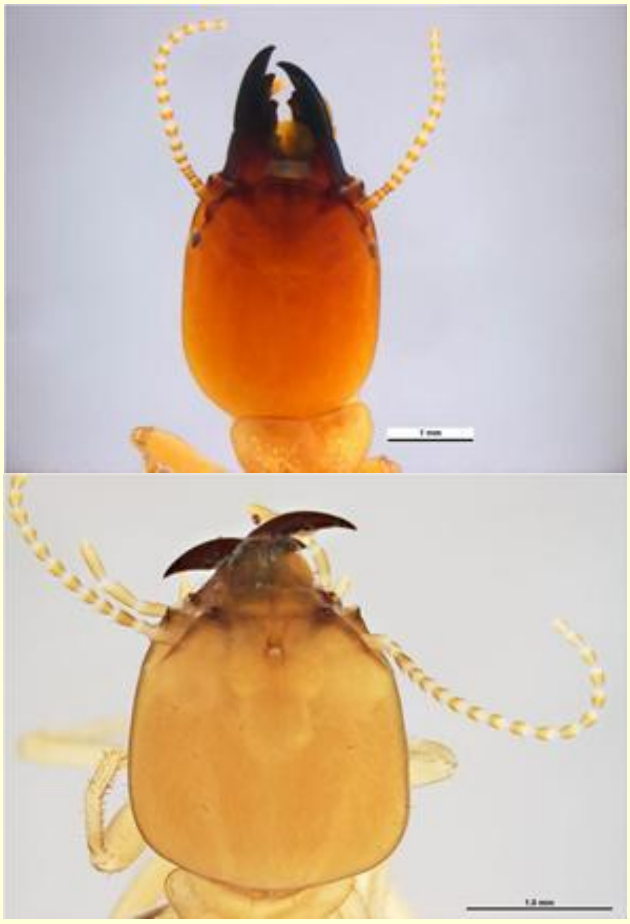






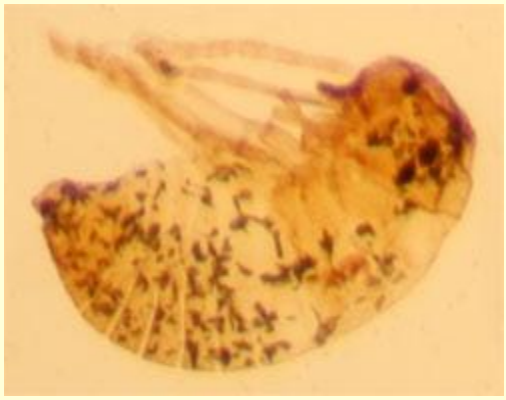
Isoptera

Isoptera were found as whole individual. Soft bodies were sometimes somehow crumpled.



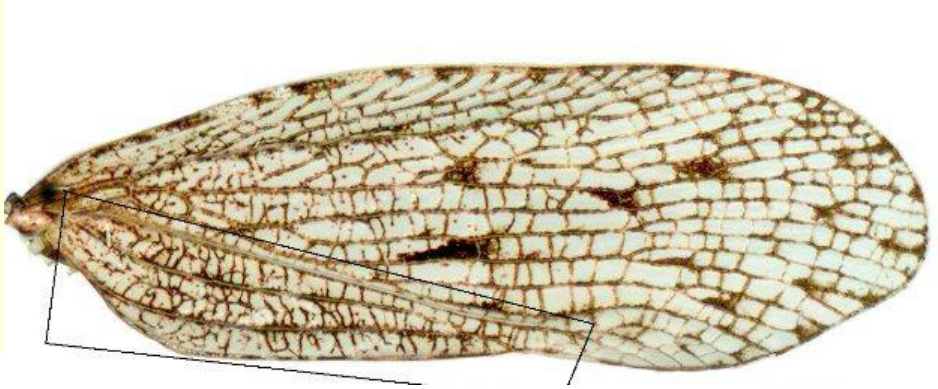
Psocoptera

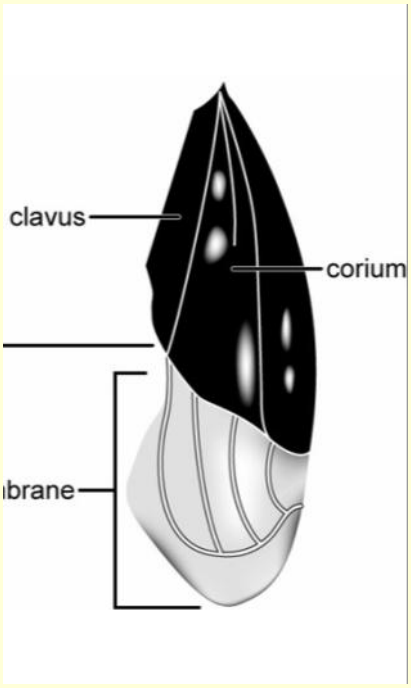
Not so often in samples. Recognizable according to mandible that is small, translucent, but dark on the two points.



Hemiptera

Adults of Hemiptera could be recognized according to wings with calvus and clavum on forewing.



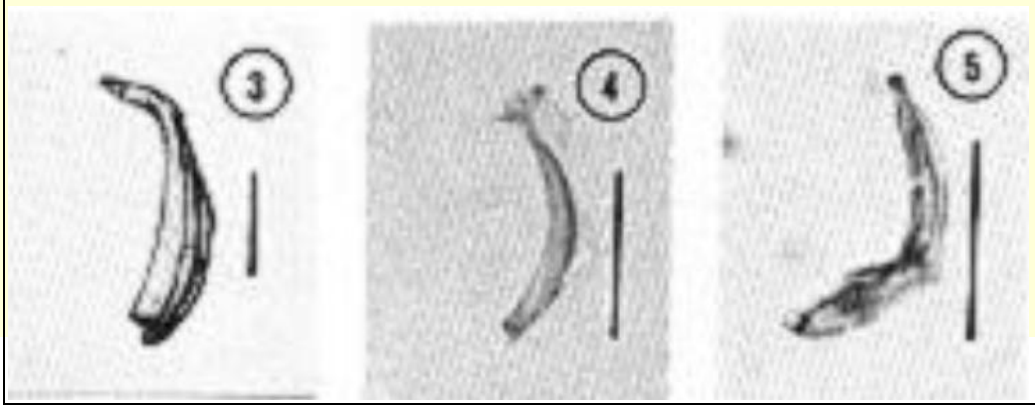


Family Nabidae could be recognized according to slightly raptorial forehead or the male's clasper.

Head of Hemiptera is also very typical.

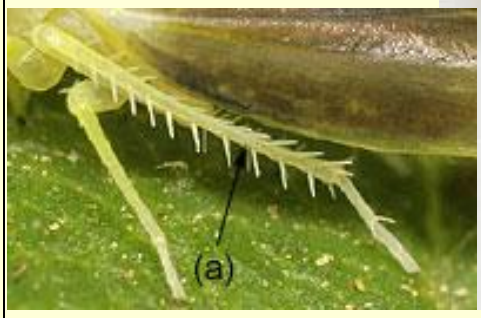
Homoptera

The strong, curved apodeme (an internal ridge of the exoskeleton) associated with the hind leg was distinctive for each family (nymphal psyilids lack this).



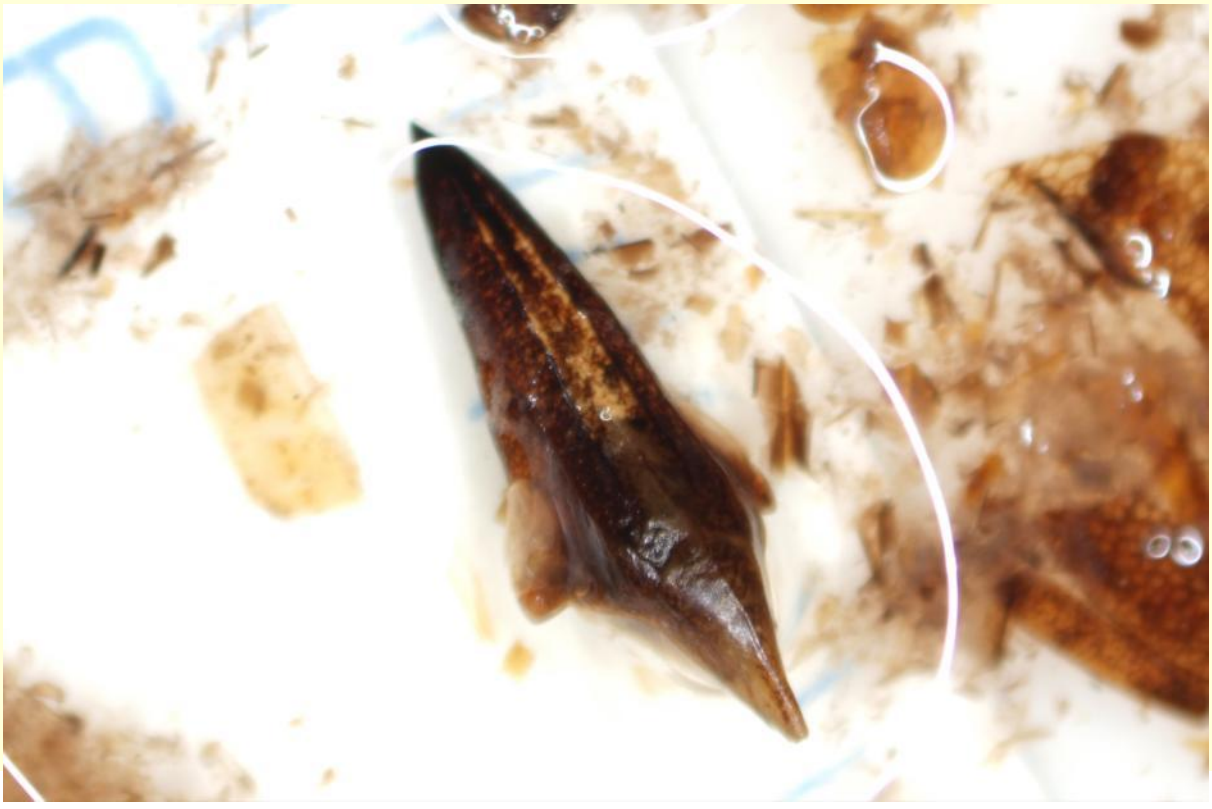
3. Delphacid "rib."
4. Cicadellid "rib."
5. Psyllid "rib."

Cacadellidae - hindleg - Tibia has rows of prominent spines, marked by dark bumps where the spine has been knocked off. Spines usually stayed attached on leg.



Delphidae – hindleg – (a) Tibia has a large, toothed, movable spur, or calcar, at apex. Tibia and tarsals egmentsh ave severall arge apical teeth. (b) On the head, antenna inserted under eye.

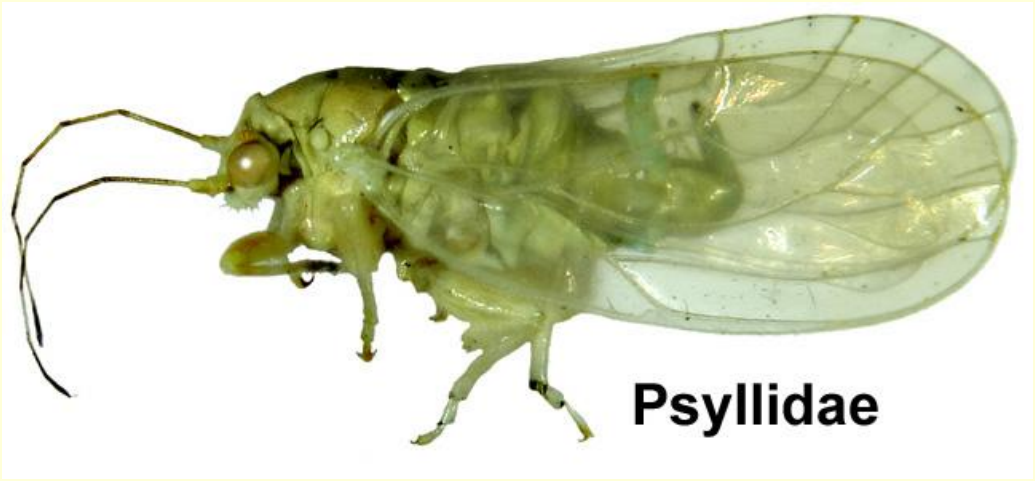
Cixiidae – hindleg - Similar to deiphacid's, but tooth pattern distinguishable and caicar lacking.



Head of Cicadelidae leafhopper

Legs were very distinctive but broken to individual segments usually. Hind legs of planthoppers. A Delphacidae, tibia with calcar B Acanaloniidae, tibia without spines C Caliscelidae, tibia with 1 spine D Issidae, tibia with 2 spines E Dictyopharidae, second tarsal segment with row of teeth F Acanaloniidae, second tarsal segment with pair of spines.

Psyllidae – Adults were recognized according to wing structure and head. Free living nymphs were numerous in samples.



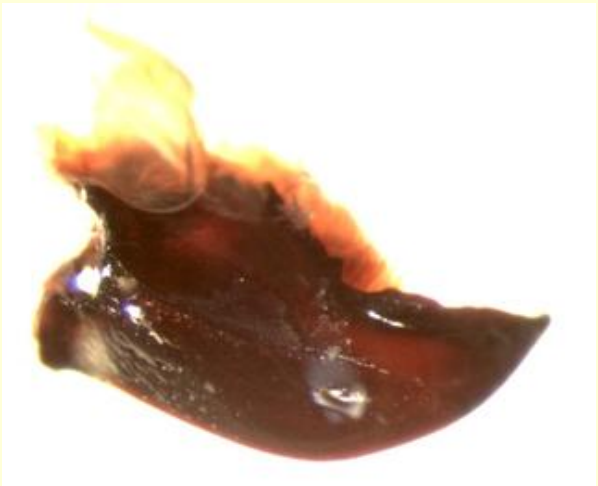
Neuroptera

Chrysopidae – mandible, maxilla - This smooth, sickle-shape pdiece(4 per individual) occurs alone, showing the fiat surface that matches its dorsal or ventral mate, as well as attached to its mate, forming a rounded sickle.

Neuroptera larvae – usually found undamaged. Sometimes with head separates.

Coleoptera

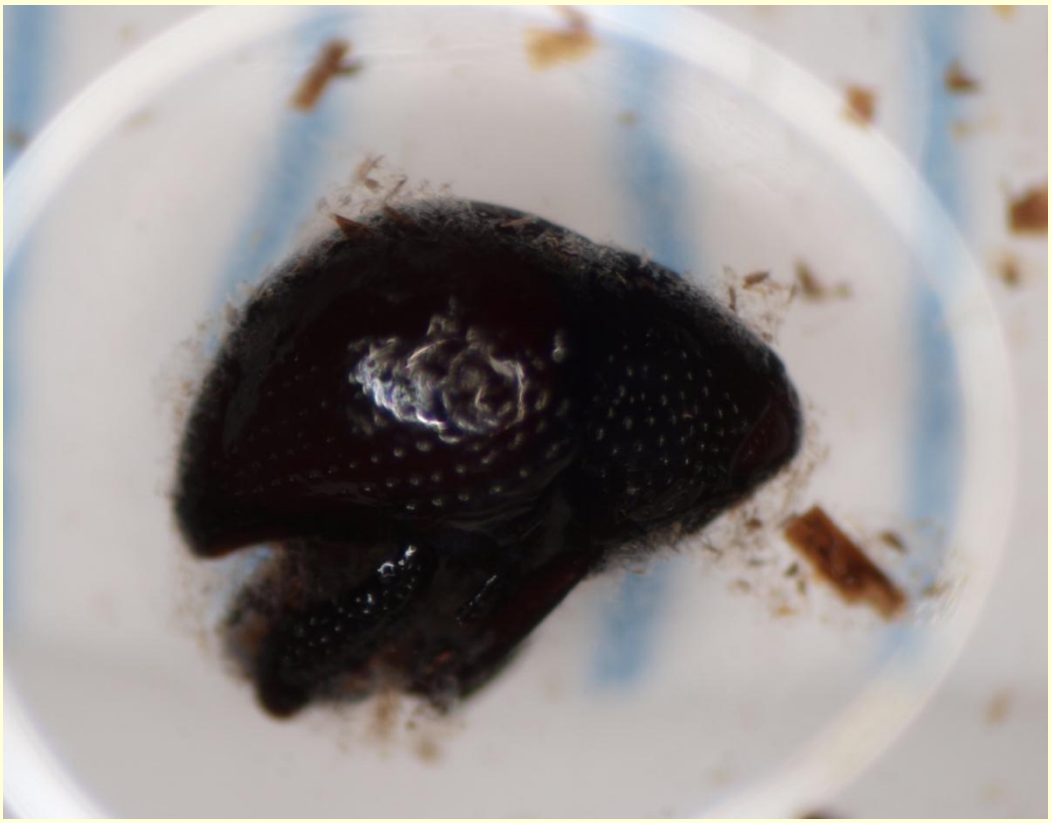
Body was usually broken to pieces. Beeltles could be thus identified according to legs, and mandibles that were usually found separatelly. Beetle mandibles are so diverse as to defy generalization. They sometimes differ between adult and larva of the sames pecies. They differ from larval Lepidoptera in being usually more elongate and bearing teeth or grinding surfaces somewhere besides the apical edge. They must also be distinguished from Hymenoptera and Lepidoptera.

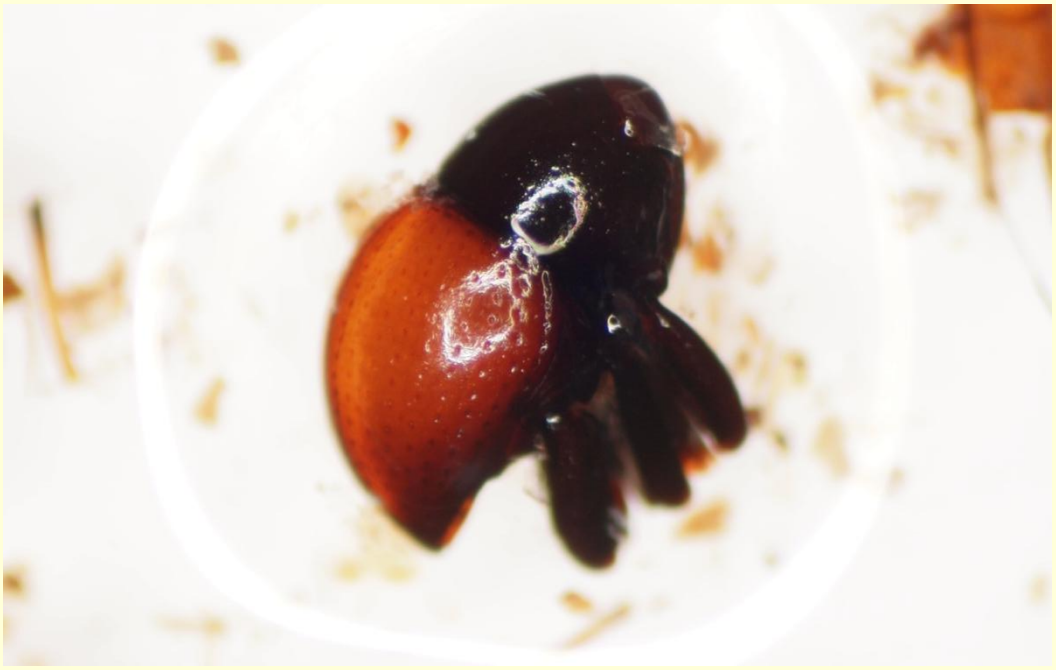


Carabidae – foreleg - Tibia of our species was distinctively notched. Trochanter of hindleg usually found separate,as well as attached to the coxa.

Curculionidae – were the most common Coleaoptera in our conditions. We recognized them according to tersus, legs and heads.

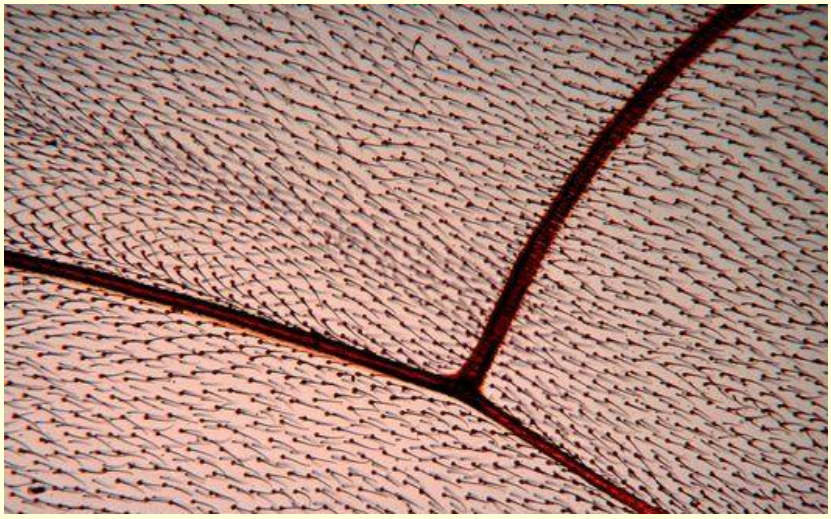
Small beetles were usually found undamaged or with head separated only.





Diptera

Adult – antenna – Apical segment is acorn-shaped was often encountered. Leading edge has small but stout, curved bristles. Wings - these are numerous, sometimes found still attached to legs. Bristles - they are strong, black, slightly curved, tapered.



Egg / larvae – they were surprisingly present in samples too. Found usually undamaged, or with few cracks only.

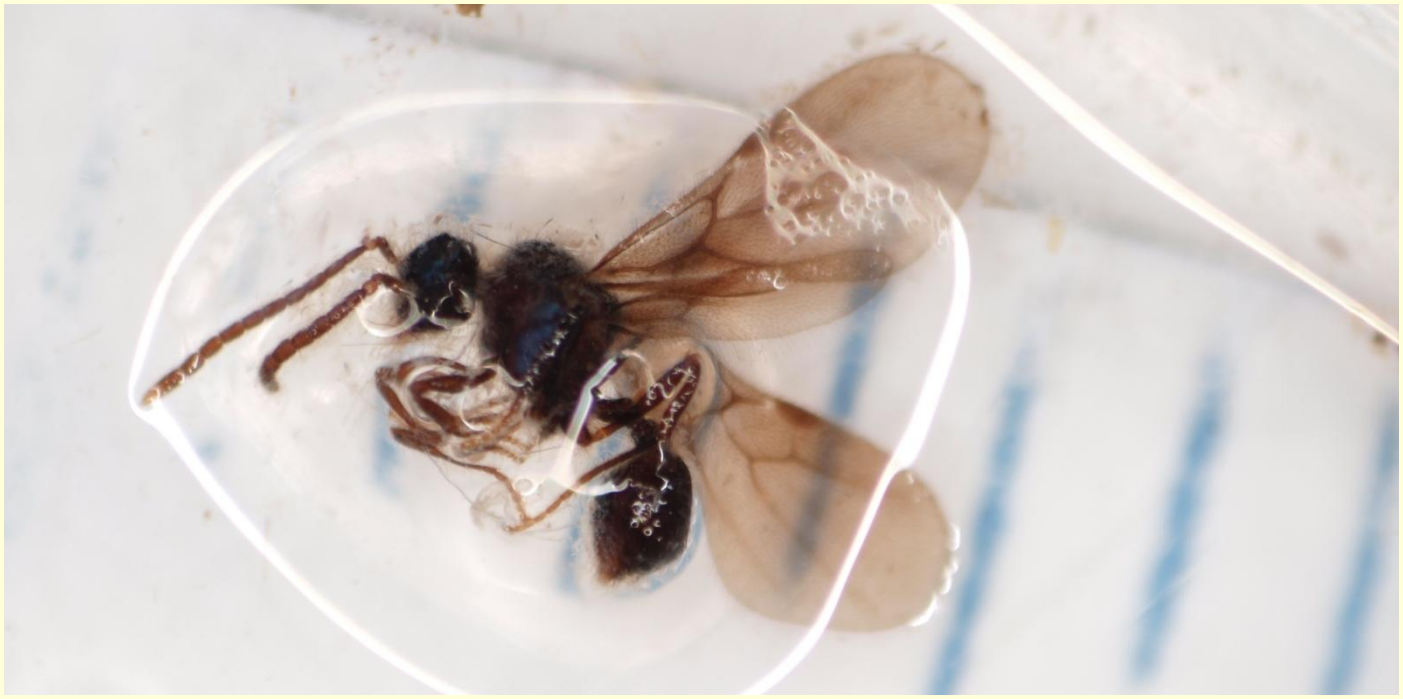
Hymenoptera

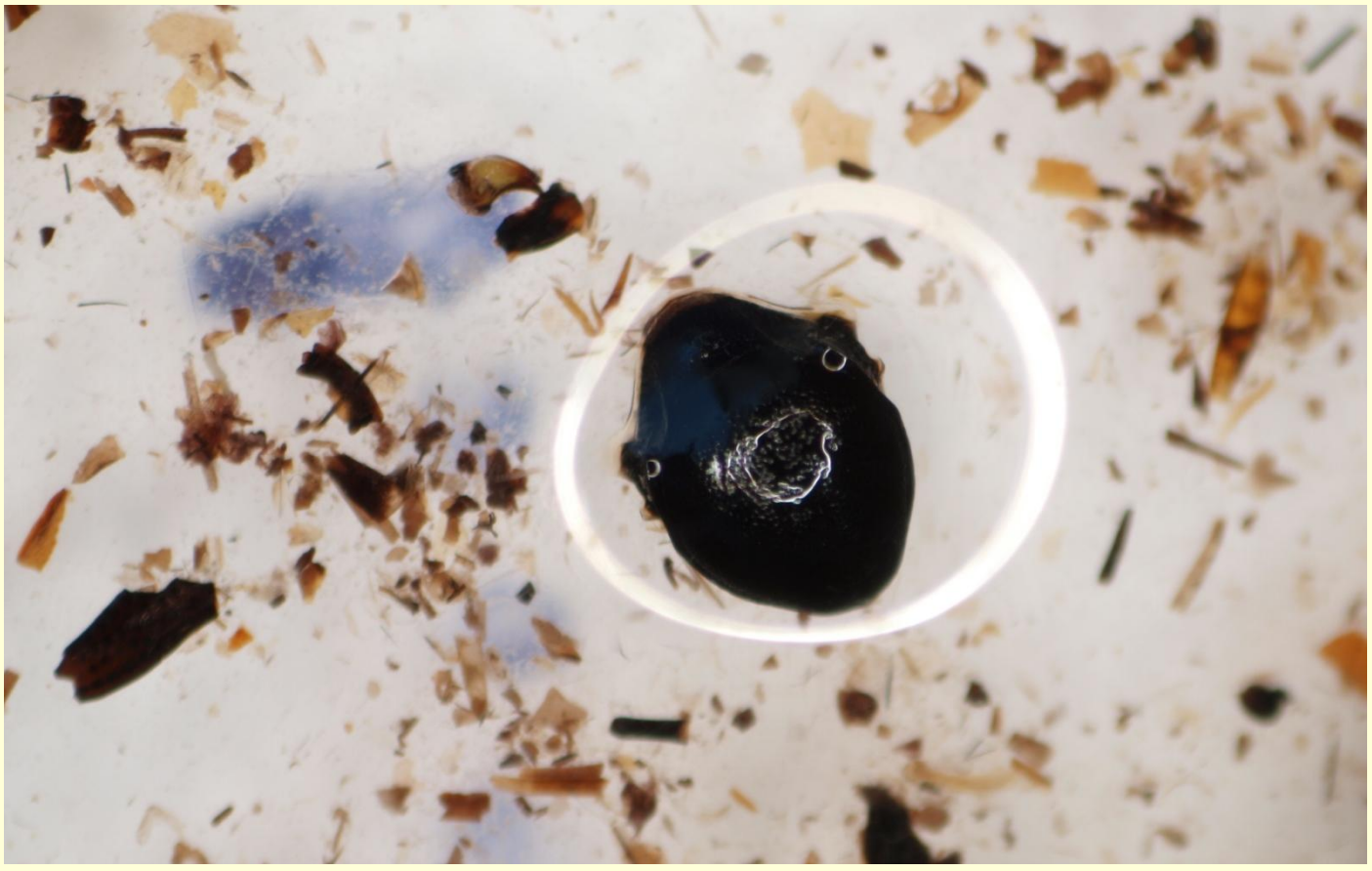
Ants – thorax - The hump or node on the "waist" is distinctive. Heads were also distinctive in many individuals.

We used: http://www.newguineants.org as reference collection.

Wasps

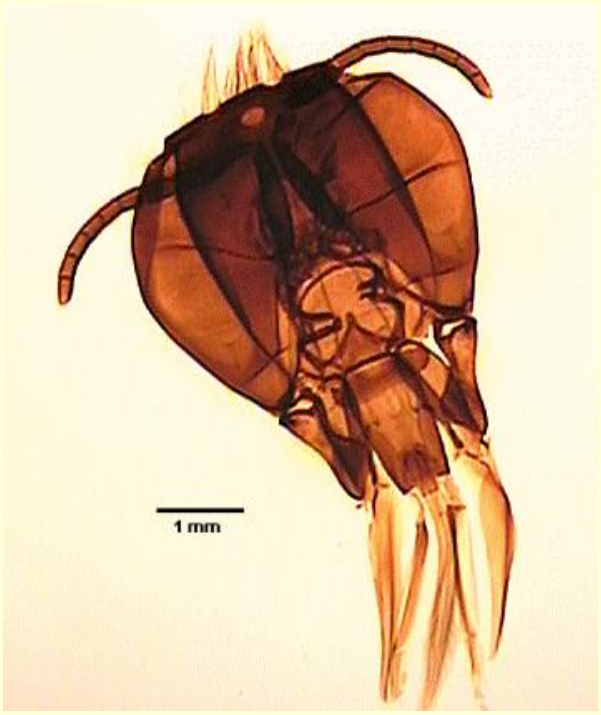
Wasps were recognized mainly according to head. Head is hard, hypognathous with a distinct, round foramen where it connects with thorax. Generally longer and slenderer than those of Coleoptera or Lepidoptera, with two apical teeth.

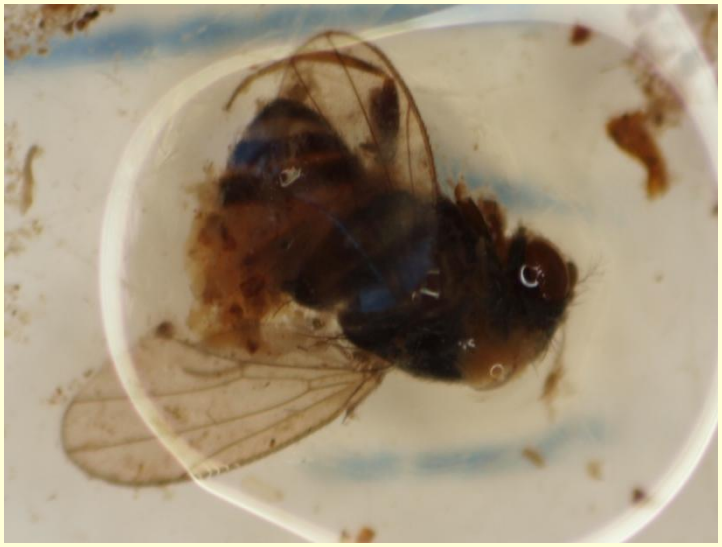




Bees

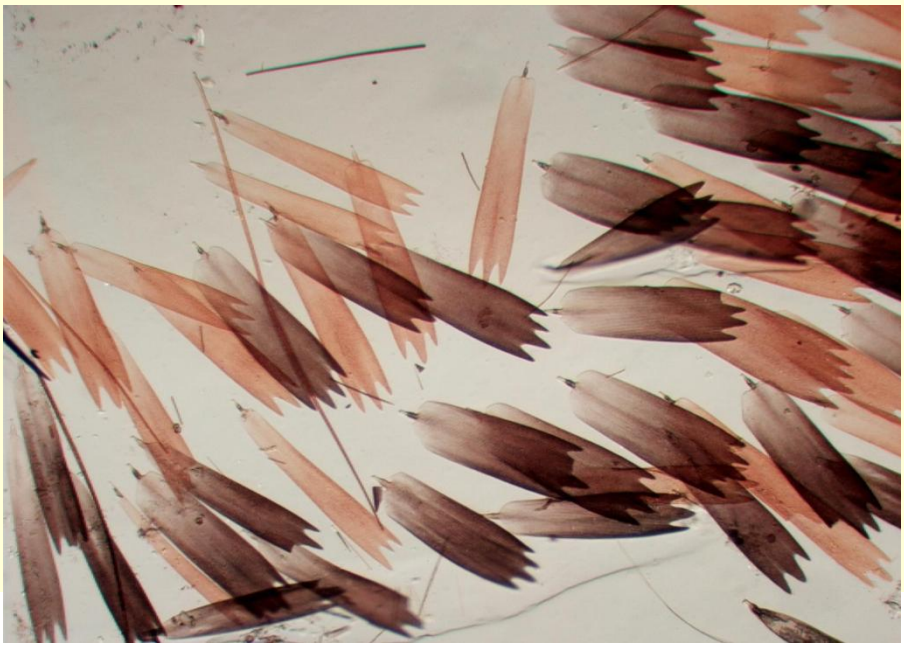
Bees were recognizable according to heads mainly. Usually tiny bees were present undamaged in food samples.





Lepidoptera

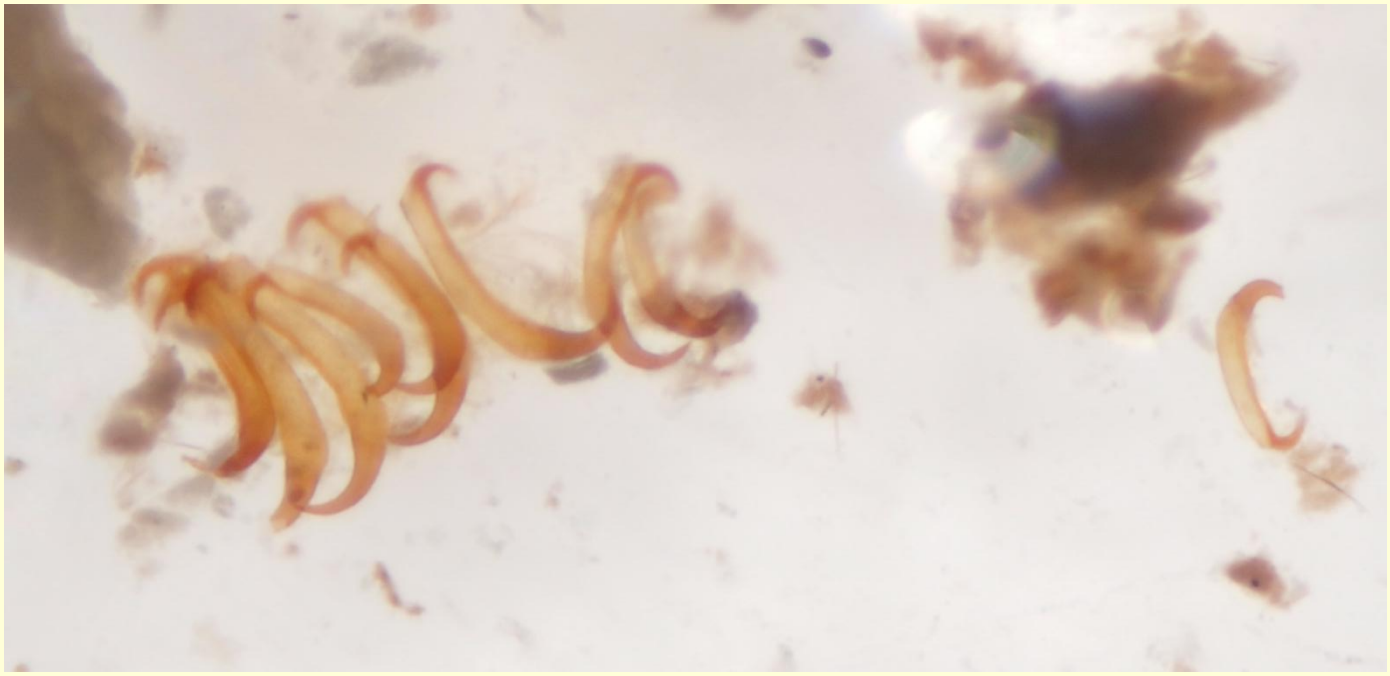
Presence of adult Lepidotera was most often confirmed based on presence of scales from wings. Wings itsef were usually broken a cramped.



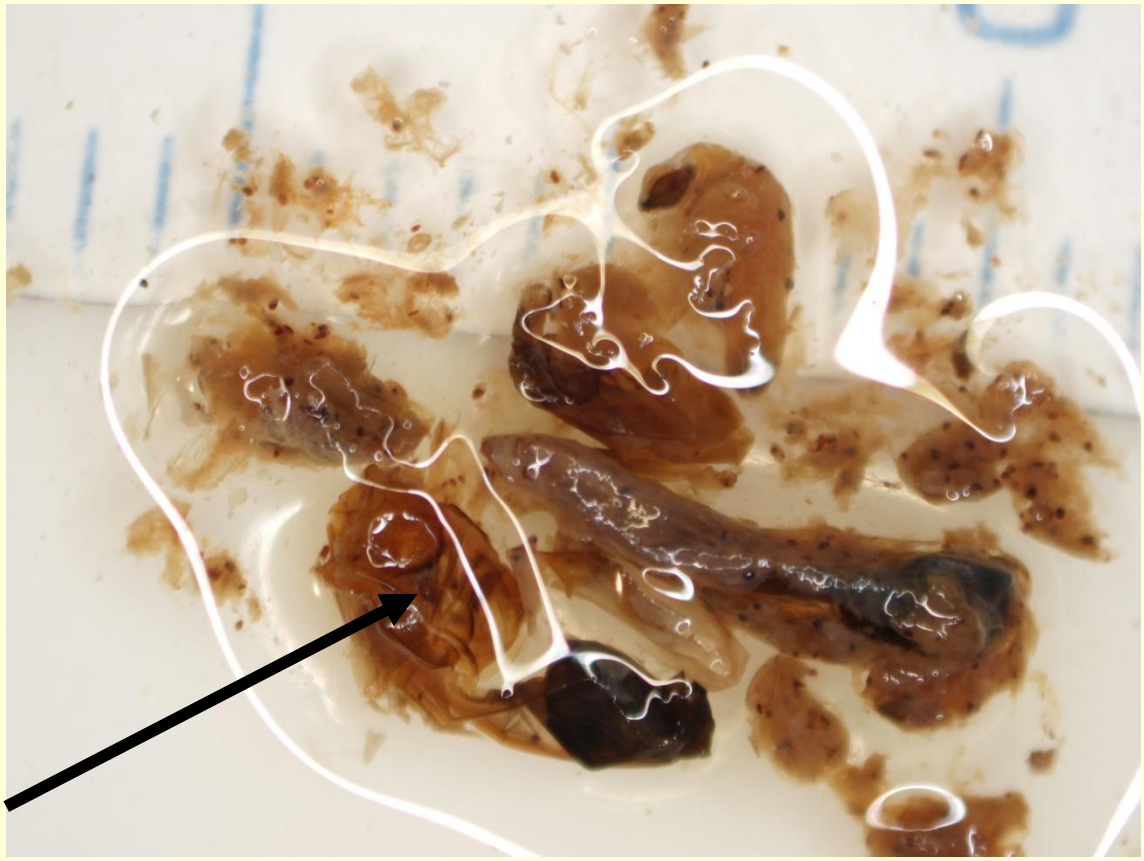
Wings are covered with countless mall scales which may be swallowed even

if the bird tears off the wings.

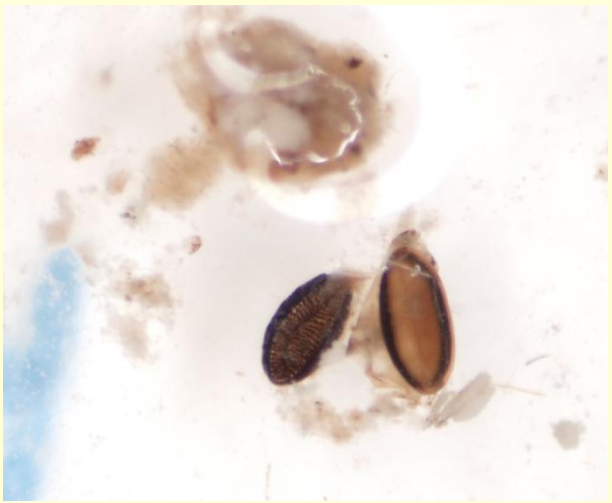
Head of adult butterfly surrounded by scales.



Larvae – were only occasionally found undamaged. Hard pieces of soften body were preserved most often only. Mandible - most commonly shaped like baseball glove or broad scoop with one or more teeth along the cutting edge and a sphericalk nob at one of the basal corners. Front part of head - a triangular sclerite on the front of the head. Sclerite - a dark, elliptical ring. Crochets – many of them is present on every leg, but only few of them was found in every samples containing caterpillar.



Whole caterpillar broken into pieces. Head mask visible. Usually only the triangle is preserved.



Sclerites – exist with/without inner structure

Sometimes, skin of caterpillar could be recognized according to different spines or combs.

Crochets

Crustacea

In few samples obtained from kingfishers, some crabs were present. They were easy to recognize according to legs and head. All eaten individuals were not larger than 5 cm.

Also small crustacean were found in few samples, but they were rare.

Vertebrates

Occasionally, bones and vertebrae from vertebrates were found. Long bones were preserved but broken on the ends and filled with some tissues. Individuals were small and their vertebra were only 1 mm long.

Other common items:

Insect eggs: It was sometimes difficult to distinguish insect egg or pupae from plan material/seed. It was useful to break the egg/seed and look inside. Eggs of spiders were easy to recognize as they were numerous, clumped together, looking like glassy balls.

Plant seeds: Usually hard to break, surrounded by some plant tissue.