OREGON STATE UNIVERSITY EXTENSION SERVICE

Guide to Ground Beetles in Grass Seed Crops Grown in the Willamette Valley, Oregon

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Ground beetles are an integral component of biological control in agricultural fields, but information on the species that are present in Oregon and throughout the United States is surprisingly limited. This guide was created as a quick reference for common ground beetles found in grass seed crops in the Willamette Valley. It describes the general biology and ecology of these beetles and includes a straightforward, illustrated key and a profile for each of 26 species. Each species profile includes detailed images, identifying features and concise information on seasonality and abundance in annual ryegrass and tall fescue fields.

Ground beetle biology

Carabid beetles (Carabidae), known colloquially as ground beetles, are one of the largest insect families in the world, with roughly 40,000 species occurring globally and approximately 2,500 species in North America alone.

Ground beetles range in size from about 1.5 to 35 mm, and they are found in a variety of habitats, including agricultural fields. They spend most of their lives on the ground, where their typically long legs enable them to successfully pursue prey and avoid predators. However, some species (for example, *Calosoma* spp.) can also be found foraging on trees.

While most ground beetles are nocturnal (night-active), there are also many diurnal (day-active) species. Some species alter the timing of activities such as foraging and reproduction depending on the season, temperature, light intensity or humidity. Typically, diurnal ground beetles are smaller and display iridescent colors, while nocturnal species tend to be larger and darker colored.

The life cycle of a ground beetle consists of four distinct stages: egg, larva, pupa and adult. Eggs are typically laid in clusters of various sizes within soil crevices, under leaves and in other protected areas at the soil surface. Ground beetle larvae have well-developed legs, antennae and a flattened body, which enable them to forage actively, primarily beneath the soil surface.

Beetles undergo two or three larval stages (instars) before pupating in the soil. The pupa is an inactive, nonfeeding stage. Newly emerged adults (called tenerals) are

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still soft bodied and light in color until sclerotization, or hardening, occurs. Generally, development from egg to adult takes less than a year for most species.

Life cycles for many ground beetles are quite complex, with some species breeding during spring and others during fall. In addition, these beetles may undergo a period of suspended development (known as diapause), either as late-stage larvae or as adults, during periods of extreme or unfavorable conditions, such as hot summers or cold winters.

Ground beetles are capable of consuming close to their own body weight in food every day. Many species feed on a variety of prey, including small invertebrates, seeds or seedlings and, in some cases, rotting vegetable matter or ripe fruit. Ground beetles often feed opportunistically, meaning that they feed on whatever prey items are most abundant, or most likely to be encountered, in their habitat.

However, some species specialize in feeding on certain types of prey. Species of the genus *Loricera*, for example, have long setae (structures resembling hair or bristles) on their antennae, which aid in catching small invertebrates such as collembola. Others, such as the genera *Cychrus* and *Scaphinotus*, have morphological and behavioral adaptations for feeding on slugs and snails; their narrow heads can reach inside snail shells, where they bite their prey in a specific location, which paralyzes the snail and renders it unable to produce mucus.

Ground beetles often locate their food randomly, but there is evidence that some species hunt by sight or use chemical cues.

Ground beetles in agricultural systems

Ground beetles are generally considered beneficial insects in agricultural systems because they contribute to natural control of invertebrate pests and weeds. For example, the range of pest organisms consumed by ground beetles includes slugs, aphids, wireworms (larvae of click beetles) and weed seeds such as common lambsquarter. Thus, ground beetles can help reduce crop yield loss by maintaining low pest populations during the early stages of crop growth when plants are more vulnerable to damage. Having a more diverse carabid community within a field can improve biological control, as beetle species will be present at various stages of crop development, and different species will feed on a wider range of pests.

Management operations routinely carried out in agricultural fields, such as soil cultivation or pesticide applications, can negatively influence ground beetles. Broad-spectrum insecticides can kill beetles directly, through contact or ingestion, or indirectly when beetles feed on plant-eating invertebrates that have fed on treated crops. Sublethal doses of insecticides can interfere with beetles' reproductive success and/or increase beetle activity by reducing the availability of invertebrate prey. When prey are scarce, carabid beetles may move into adjoining areas in search of food. With fewer beetles in the field to provide biological control, pest populations may surge.

Applications of herbicides can also contribute to a decline in ground beetle species. Herbicides can reduce both weed seeds, which are consumed by some ground beetle species, and weed cover, which is used for shelter and provides habitat for invertebrates consumed by beetles.

Soil cultivation (for example, tillage) can have varying effects on carabids, depending on factors such as tillage type, intensity (or depth) and timing of cultivation in relation to the phenology, activity period and habitat/microclimate preferences of different carabid species. In general, direct mortality of ground beetles is lower in conservation tillage systems, and the retention of crop residue in the field can provide shelter from severe abiotic conditions as well as offer habitat for a variety of ground-dwelling species, including ground beetles and their prey.

Agricultural fields are a system in which frequent disturbances occur. Therefore, to retain these beetles, a permanent environment in which they can shelter, reproduce and find readily available food throughout the year is needed. To maximize the biological

control potential of carabid beetles, habitat can be enhanced in a way that is favorable for the species of interest. Beetle banks, for example, can serve as refuges and as places of alternative food sources in times of disturbance in neighboring agricultural fields. From these banks, beetles can recolonize fields once conditions improve. Beetle banks are raised mounds planted with native perennial grasses that run alongside or within agricultural fields. They can be several hundred meters long. The raised nature of the beetle bank ensures drier conditions during rainy periods, but even field margins containing a range of perennials offer valuable habitat if left undisturbed.

How to collect ground beetles

The easiest way to collect ground beetles is with pitfall traps (figure 1), which are cups buried in the ground, flush with the soil surface. Traps may contain a killing and/or preservative fluid if they are to be left out for an extended period of time before collection. The fluid can be, for example, ethylene/propylene glycol (antifreeze), rubbing alcohol, ethanol or a mixture of vinegar, salt and detergent, which is cheap, nontoxic and has been shown to be particularly attractive to ground beetles.

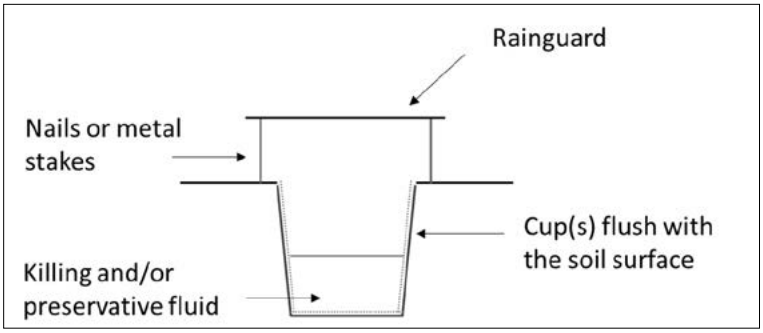


Figure 1. Cross section of a basic pitfall trap used to collect ground beetles.

Install a rain guard to protect the trap from rain and debris. Guards can consist of a sheet of corrugated plastic, metal or wood. The diameter should be at least equal to that of the cup. Suspend the guard over the trap using nails or metal stakes stuck into the ground.

Larger and more mobile ground beetle species have a greater probability of being captured than smaller species. For more details on pitfall traps, see supplementary figure 1 in Reich, et al. (2020).

How to use this key

The carabid beetles described in the following key consist of species trapped during two studies in the southern Willamette Valley, Oregon. All sites were located in Linn County, which is known as the Grass Seed Capital of the World. The first study was conducted for 15 months (April 2018–June 2019) using overnight pitfall trapping in 10 annual ryegrass (ARG) fields. The second study was conducted for 14 months (June 2018–July 2019) using both daytime and nighttime pitfall trapping in six tall fescue (TF) fields. Some species were commonly found, while others were confined to only a few sites or were collected in low numbers.

The key is based on Lindroth (1961) and the distinguishing features the authors have used when identifying carabid beetles. A generalized carabid beetle morphology (figure 2, page 5), other distinguishing features (figures 3 and 4, page 5) and a glossary (page 6) are provided. Technical terms used throughout the key are italicized and defined at the bottom of each page.

Following the key, each species (listed in alphabetical order) is described in more detail, including size, diet, abundance and temporal activity in the pitfall traps. The following general classification of abundance was used:

- Scarce: ≤ 10 individuals collected in total.
- Occasional: 11–50 total individuals.
- Abundant: > 50 total individuals.

Species were classified as "common" if more than 50 individuals were caught and beetles occurred in 80 percent of fields sampled for each study and "very common" if more than 200 individuals were caught and beetles occurred on all sites.

This key was designed as an aid to distinguish among only the 26 species discussed in this publication. Beetle identification should be cross-checked against the checklists provided in the species profiles (based on species descriptions in Lindroth, 1961). If possible, collected beetles should also be compared to a pinned reference specimen. (The author can provide access to pinned specimens.) Some things to note:

- Within a genus (for example, *Amara*), many species are very similar, and examination of genitalia may be required to confirm identification.
- Body length is measured from the tip of the mandibles to the end of the elytra or abdomen (whichever is longest). When carabids are collected in pitfall traps with a killing fluid, their abdomen can be artificially distended so that it pushes out below the elytra. In such cases, measurements should be made to the end of the elytra.
- Body size can differ greatly among individuals of the same species. Females are generally larger and broader than males, and some specimens may fall outside the size ranges given in the species profiles. The size range of the beetles given in the detailed species descriptions refers to those measured in our studies. If the sizes given in Lindroth (1961) fall outside our measurements, they are shown in parentheses.
- The color descriptions in the key refer to mature adult beetles. Newly emerged adults (tenerals) can be a lot paler and often feel rather soft.
- Metallic hues can be misleading, as they can exhibit a range of colors, depending on light or age of the specimen.
- Seta(e) (hairs or bristles) are used as identifying features in some couplets but sometimes can be broken off. Look instead for a pore, which indicates their position (figure 3c, page 5).
- For many species, differentiating males from females can be as easy as looking at the tarsi ("feet") on the first pair of legs; the presence of hairy pads indicates a male beetle (figure 4a, page 5). However, this is not the case for all species. Another, more reliable, approach to determining a beetle's sex is to carefully examine the genitalia, either by looking at the posterior end and identifying any extruding genitalia or by using forceps to carefully extract them. In males, genitalia consist of the aedeagus, which is a hooked structure (figure 4b). In females, the valvulae (external structures of the ovipositor, figure 4c) and ovipositor (figure 4d) are the main identifying characteristics. In most cases, morphology of the male genitalia can be used for species identification. This technique requires a microscope, however, so it is not included in this key.

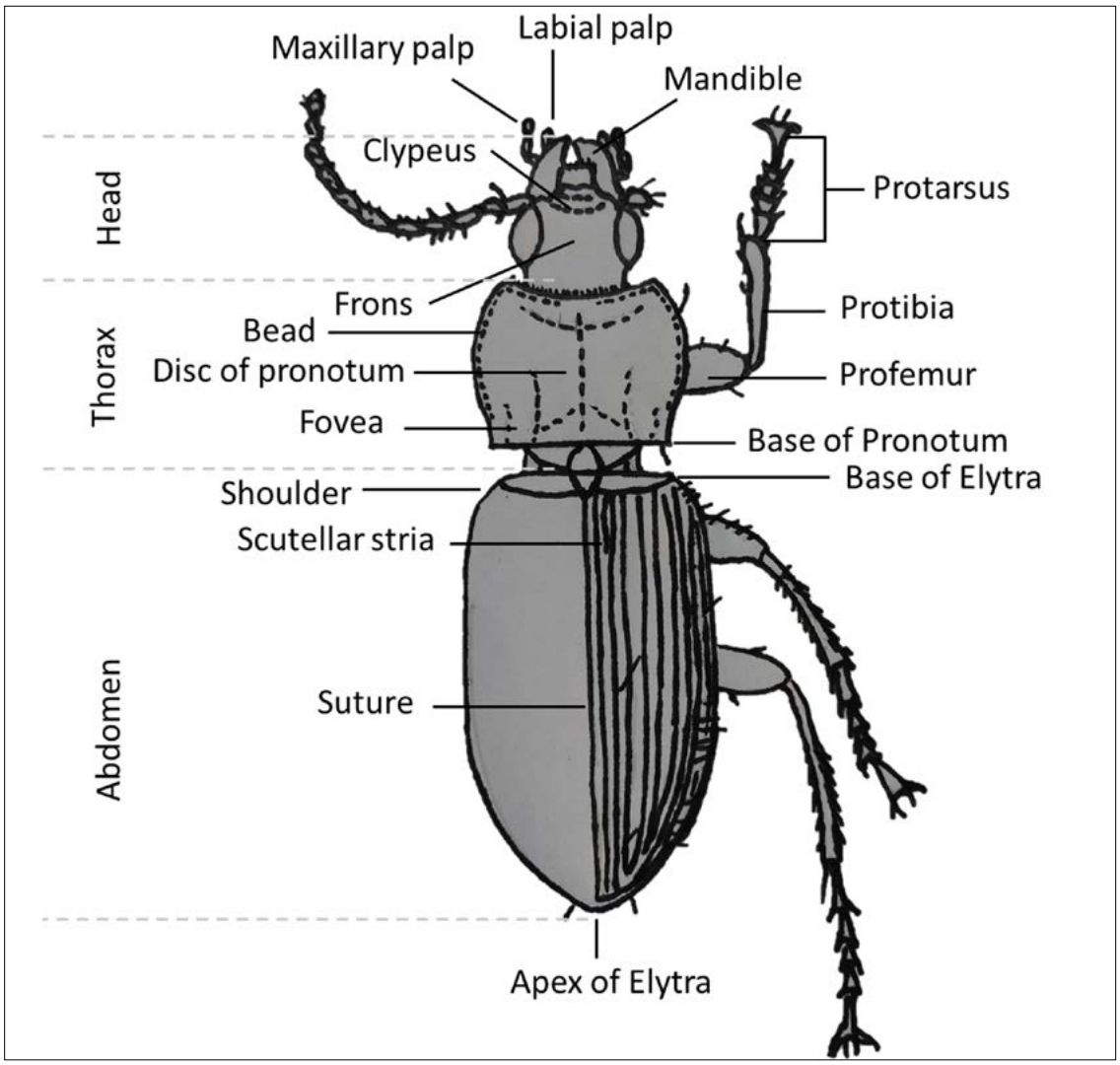


Figure 2. Schematic of a generalized carabid beetle showing main structures referred to in the key.

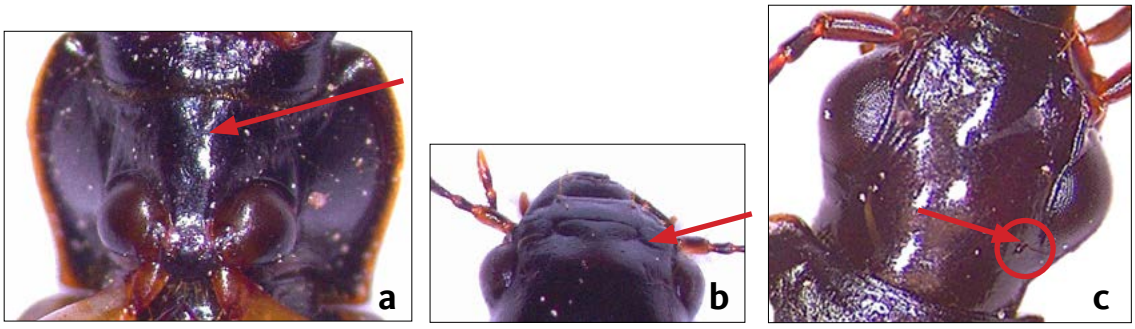


Figure 3. (a) Prosternum; (b) clypeo-ocular line; (c) supraorbital seta (circle) and pore (arrow).

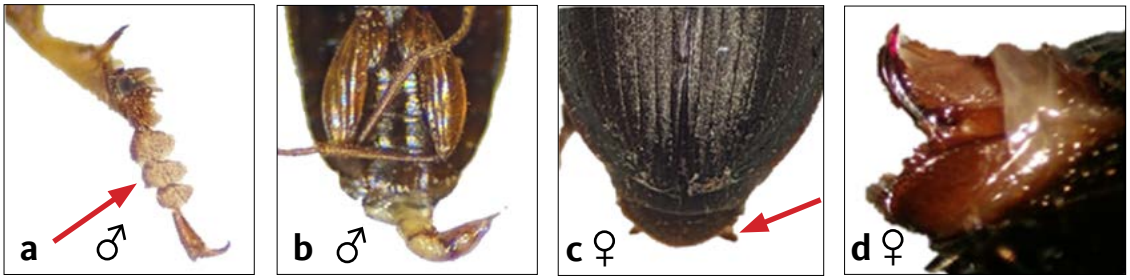


Figure 4. (a) Hairy pads; (b) aedeagus; (c) valvulae; (d) ovipositor.

Glossary

Abdomen	The third body segment of the beetle after the head and *thorax* (figure 2).
Acute	Less than a 90° angle.
Aedeagus	Male reproductive organ (figure 4b).
Aeneous	Brassy, golden-green.
Antenna(e); antennal	Segmented sensory appendage(s) projecting off the head. When counting antenna(e) segments, begin at the base of the antennae (for example, the second antennal segment refers to the second segment of the antenna from the head).
Antepenultimate	Third from the *base*.
Apex; apical(ly)	Endpoint; toward the end.
Base; basal(ly)	Nearest to the body of the beetle. For example, the base of the *elytra* is the top of the *elytra*, while the base of the *pronotum/antennae* is the bottom of the *pronotum/antennae*.
Bead	Elevated "rim" of the *pronotum* (figure 2). See *Agonum muelleri* profile (page 16) and *Agonum suturale* profile (page 17).
Carina(e); carinate	Keel(s), ridge(s); keeled, ridged. See Couplet 18 (figures a and b) and Couplet 19 (figure a).
Clypeo-ocular line	Line running from each compound eye across the *clypeus* (figure 3b).
Clypeus	"Nose": anterior head plate below the *frons* (figure 2).
Confluent	Flowing together.
Cordiform	Heart-shaped. See *Nebria brevicollis* profile (page 24).
Cupreous	Like copper.
Denticle; denticulate(d)	Toothlike projections; tooth(ed). See Couplet 19 (figure a).
Diaphanous(ly)	Translucent(ly).
Disc	The middle, more uniform, part of the *pronotum* or *elytra* (figure 2).
Dorsal	Referring to the back or upper side of the beetle.
Elytral epipleura	Side margins of the *elytra*. See Couplet 17 (figure a).
Elytrum, elytra	The modified (usually hardened) forewing(s) of the beetle (figure 2).
Femur, femora	The third segment of the leg, the "thigh(s)" of the beetle (figure 2).
Fovea(e); foveate	Usually demarcated dimple(s) or depression(s); dimpled.
Frons	"Forehead": the part of the head between the eyes and above the *clypeus* (figure 2).
Furrowed	Grooved, wrinkled.
Glabrous	Free from hairs or bristles, nonpubescent.
Infuscated	Darkened with a brownish tinge.
Lateral(ly)	Referring to the sides.

Mandible	Large, protruding mouthparts, “jaw” (figure 2).
Meso-	Referring to the middle of the three *thorax* segments. For example, the mesotibia is the “shin” of the second pair of legs.
Meta-	Referring to the last of the three *thorax* segments. For example, the metatibia is the “shin” of the third pair of legs.
Oblique	Slanting, sloping.
Obtuse	Greater than a 90° angle and less than a 180° angle.
Ocellate	Resembling an eye.
Ovipositor	Female reproductive organ. Can be extended outside the body cavity (figure 4d).
Palp(i)	Elongated, segmented appendage(s) near the mouth of the beetle. The maxillary palpi are the outermost pair followed by the labial palpi (figure 2).
Piceous	Glossy brownish-black.
Pro-	Referring to the first of the three *thorax* segments. For example, the protibia is the “shin” of the first pair of legs.
Pronotum	Dorsal (back) body plate of the prothorax (the first segment of the *thorax*), just behind the head and above the *elytra* (figure 2).
Pubescence; pubescent	Covering of hairs; hairy. See Couplet 13 (figure a).
Punctation; punctulate	Series of small indentations; marked with small dots.
Rufous	Reddish-brown.
Rufo-piceous	Reddish-brown-black.
Rufo-testaceous	Reddish-brownish-yellow.
Rugose(ly)	Full of wrinkles.
Rugulose	Finely wrinkled.
Scutellar stria	Shortened *stria* next to the first *stria* from the *suture*. See figure 2 and Couplet 16 (figure a).
Seta(e); setiferous	Bristle(s), hair(s) that arise(s) from a small indentation or pore (figure 3c); with bristle(s), hair(s). See Couplet 6 (figure a).
Sinuation; sinuate	Winding, bending in and out; wavy.
Sternite(s)	Sclerotized (hardened) plate(s) on the ventral side (the “stomach” or underside) of the beetle.
Sternum, sterna	The ventral portion (underside) of a segment of *abdomen* or *thorax*. Like the legs, sterna are divided into pro- (figure 3a), meso- and metasterna. See *Poecilus laetulus* profile, page 25.
Stria(e)	Linear impression(s) along the *elytron* (figure 2).
Subapical	Just above the *apex* (endpoint).
Suture; sutural	Meeting point of the two *elytra* (figure 2).
Tarsus, tarsi; tarsal	“Foot, feet”: consisting generally of five segments, the last one of which is clawed; regarding the foot (figure 2).
Tergite	Sclerotized (hardened) plate on the dorsal (upper) side of the beetle. See Couplet 2 (figures a, c).

Testaceous	Brownish-yellow.
Thorax	The second body segment, between the head and the *abdomen* (figure 2).
Tibia(e)	Fourth leg segment(s) of the beetle, “shin(s)” (figure 2).
Trifid	Split into three parts. See Couplet 15 (figure b).
Trochanter	Second leg segment of the beetle, visible only on the underside of the beetle. See Couplet 17 (figures c, d).
Truncate	Ending abruptly, cut off.
Tubercle	Small, rounded, projecting part. See Couplet 4 (figure a).
Unilaterally	One-sided.
Valvulae	The first pair of structures in the female *ovipositor*. In female carabid beetles, these are visible externally (figure 4c).

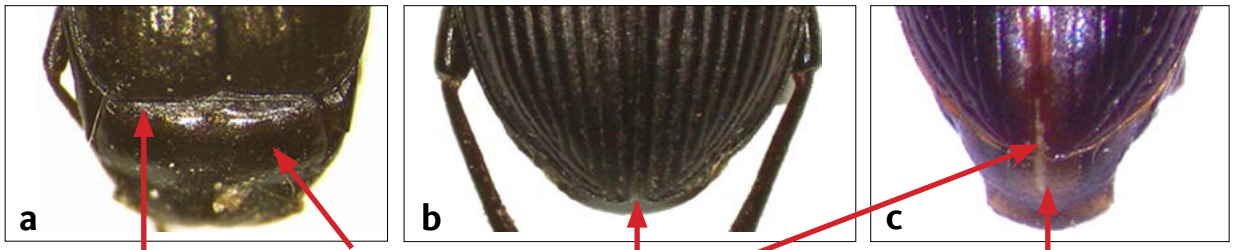
Key

1 Body length ≤ 5 mm (if about 5 mm, check both descriptions) **2**

Body length > 5 mm **4**

2 *Elytral apex truncate* (a), leaving most of the last *tergite* (or more) exposed ..... **p. 23 *Microlestes nigrinus***

Elytral apex entire (b, c), leaving at most parts of the last *tergite* free (for example, gravid females) **3**



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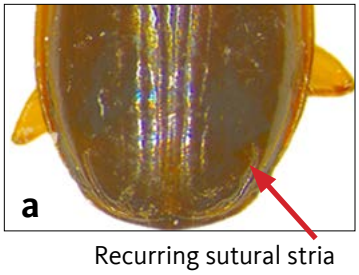
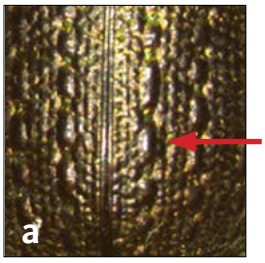


Two long, paired *supraorbital setae*; *sutural stria* recurring at *apex* (a); elytral *stria* after the fifth *stria* is only a series of unconnected dots that are at most faintly impressed ..... **p. 27 *Trechus obtusus***

Single long, paired *supraorbital seta*; *sutural stria* not recurring; all elytral *striae* well impressed ..... **p. 21 *Bradycellus congener***

4



Elytral *striae* indistinct or with rows of *tubercles* (a) **5**

Striae ± regular without *tubercles* **6**

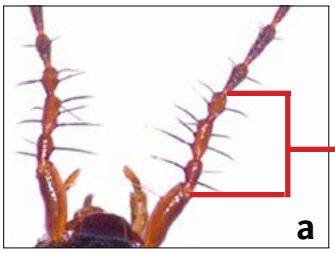
5 Very large and stout (≤ 23 mm); elytron with three *strial intervals* (fourth, eighth, twelfth) consisting of rows of elongated, raised *tubercles* ..... **p. 21 *Calosoma cancellatum***

Slender with long legs and narrow *prothorax*; elytra fused and covered in small punctures ..... **p. 24 *Omus audouini***

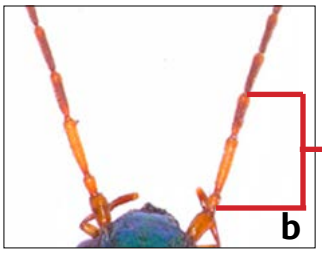
Apex: Endpoint
Elytral apex: Endpoint of the elytra (forewings)
Prothorax: First of the three thorax segments
Seta(e): Bristle(s), hair(s)
Stria(e): Linear impression(s) along the elytron
Strial interval: The space between two linear impressions on the elytron
Supraorbital seta(e): Bristle(s) over the eyes
Sutural: Referring to the meeting point of the two elytra
Tergite: Hardened plate on the upper side of the beetle
Truncate: Ending abruptly, cut off
Tubercle: Small, rounded, projected part

6 Antennae segments 2 through 4 with very long, stiff *setae* (a) **7**

Antennae without stiff *setae* (b) **8**



Long, stiff setae on segments 2–4



Segments 2–4 without long, stiff setae

7 *Femora* as pale as the *tibiae*; *striae* with small, sharp and regular but rather sparse punctures ..... **p. 23 *Loricera foveata***

Femora black or almost so, *tibiae* paler; *striae* with closer, more irregular *punctation* ..... **p. 22 *Loricera decempunctata***

8 One long, paired *supraorbital seta* **9**

Two long, paired *supraorbital setae* **14**

9 *Pronotum* with long *seta* at hind angle ..... **p. 24 *Nebria brevicollis***

Pronotum without *seta* at hind angle **10**

10 Body length < 8 mm (if about 8 mm, check both descriptions); elytra mostly dark; hind angles of *pronotum* rounded ..... **p. 27 *Stenolophus anceps***

Body length > 8 mm **11**

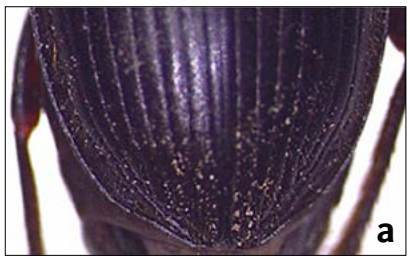
11 Legs and margins of *pronotum rufous* or pale **12**

Entire *pronotum* and legs dark **13**

12 Metallic with dark elytra; hind angles of *pronotum* not protruding; short *pubescence* on outer elytral intervals ..... **p. 22 *Harpalus affinis***

Nonmetallic; most of elytra (or at least margins) pale; hind angles of *pronotum* slightly protruding; no *pubescence* on elytra ..... **p. 20 *Anisodactylus sanctaecrucis***

13



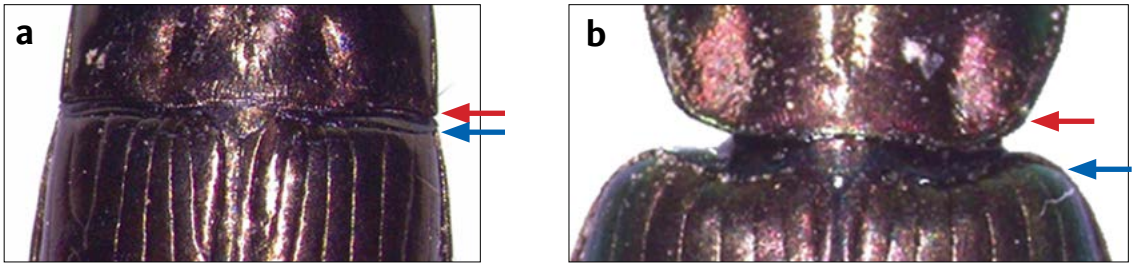
Short *pubescence* on outer and *apical* part of inner elytral intervals (a), as well as *laterally* on *base* and along side margin of *pronotum*; hind angles of *pronotum* with small *denticles* ..... **p. 19 *Anisodactylus binotatus***

Pronotum and elytra without *pubescence*; hind angles of *pronotum* without *denticles* ..... **p. 20 *Anisodactylus californicus***

Apical: Toward the end
Base: Nearest to the body
Denticle: Toothlike projection
Femora: Third segments or "thighs" of the leg
Laterally: Referring to the sides
Pronotum: Dorsal (back) body plate of the first segment of the thorax
Pubescence: Covering of hairs
Punctuation: Series of small indentations
Rufous: Reddish-brown
Seta(e): Bristle(s)
Stria(e): Linear impression(s) along the elytra
Supraorbital seta(e): Bristle(s) over the eyes
Tibia(e): Fourth leg segment(s) or "shin(s)"

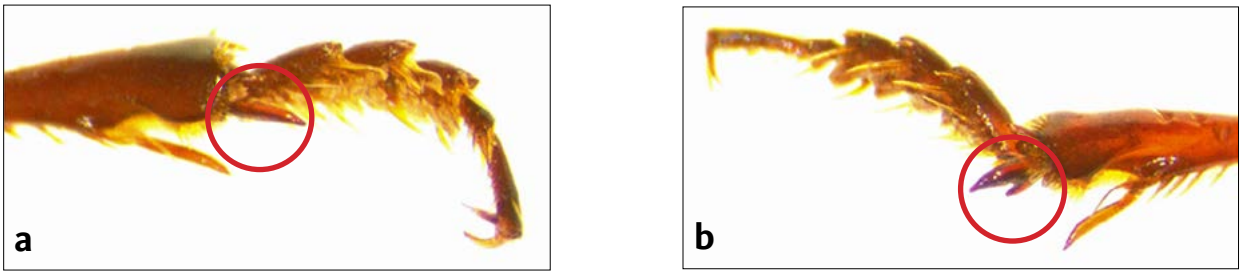
14 Posterior margin of *pronotum* (red arrows) as wide as elytral margin (blue arrows) (a) **15**

Posterior margin of *pronotum* narrower than elytral margin (b) **17**



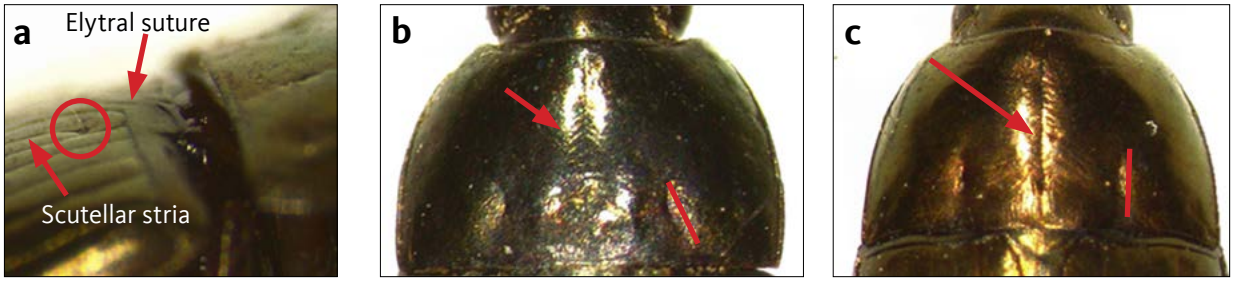
15 *Protibia* with simple terminal spur (a) **16**

Protibia with *trifid* terminal spur (b) ..... **p. 19 *Amara longula***



16 Eyes distinctly convex; elytron often with *ocellate* puncture (circle) at base of abbreviated *scutellar stria* (a); inner *basal foveae* (b) of *pronotum* at *oblique* angle (line) to median line (arrow) ..... **p. 18 *Amara littoralis***

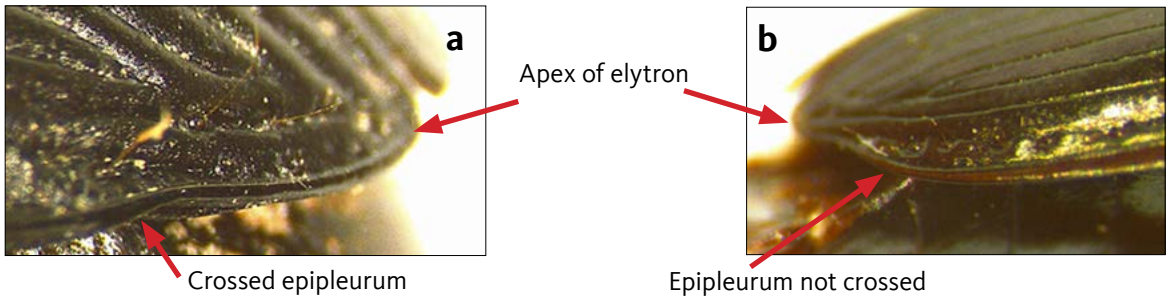
Eyes more or less flattened *laterally*; elytron without *ocellate* puncture at base of abbreviated *scutellar stria*; inner *basal foveae* of *pronotum* a short, sharp streak parallel (line) to median line (arrow) (c) ..... **p. 18 *Amara aenea***

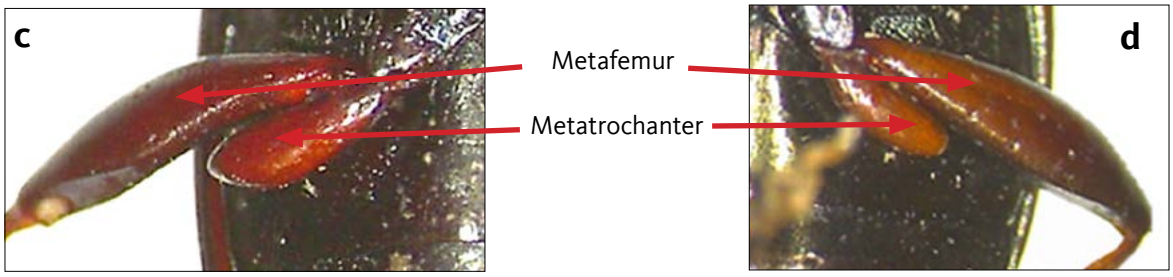


Basal fovea(e): Depression(s) at the bottom of the pronotum
Laterally: Referring to the sides
Oblique: Slanting, sloping
Ocellate: Resembling an eye
Pronotum: Dorsal (back) body plate of the first segment of the thorax
Protibia(e): The "shin(s)" of the first pair of legs
Scutellar stria(e): Shortened stria(e) next to the first stria from the suture
Trifid: Split into three parts

17 *Elytral epipleura* distinctly crossed (a); species stout with short appendages; *metatrochanter* half the length of *metafemur*, or nearly so (c) **18**

Elytral epipleura not or indistinctly crossed (b); species with long, slender appendages; *metatrochanter* at most one-third the length of *metafemur* (d) **20**





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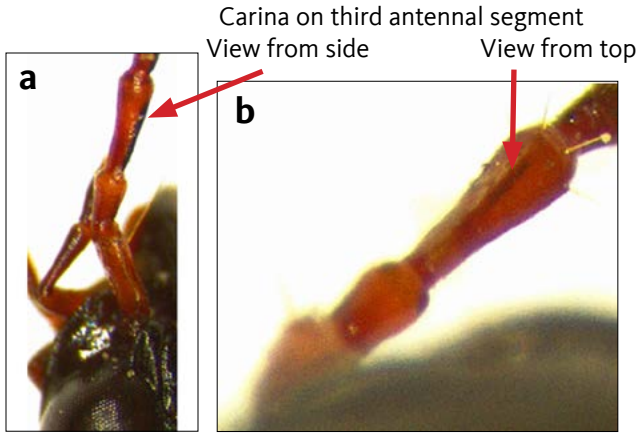


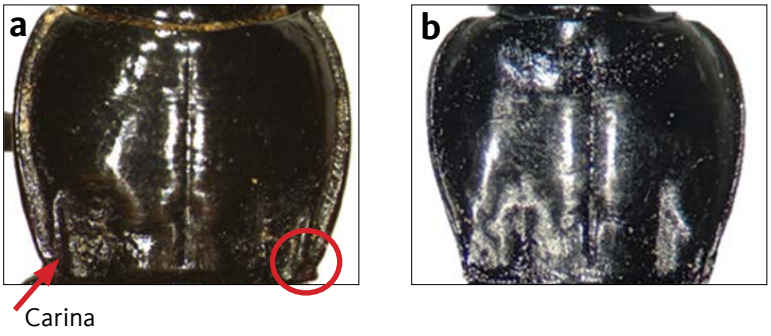
First and base of second and third antennal segment *carinate* (a, b); vividly blue-green metallic; legs, antennae *rufo-piceous*; < 12 mm ..... **p. 25 *Poecilus laetulus***

Antennae not *carinate*; black; ≥ 12 mm **19**

Carina(e), carinate: Keel(s), ridge(s); keeled, ridged
Elytral epipleura: Side margins of the elytra
Metafemur: Third leg segment ("thigh") on the third pair of legs
Metatrochanter: Second leg segment (lobelike projection) on the third pair of legs
Rufo-piceous: Reddish-brownish-black

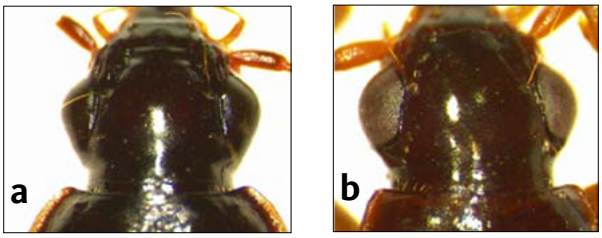
19 Hind angles of *pronotum denticulate* with thick *carinae* (a); elytron with two or three *dorsal setiferous punctures* on third elytral interval from the *suture* ..... **p. 26 *Pterostichus melanarius***

Hind angles of *pronotum* almost right angles but not *denticulate* (b); elytra without *dorsal* punctures ..... **p. 26 *Pterostichus algidus***



20 Head with constricted neck right behind the eyes (a); body length > 8.5 mm; *piceous* to almost black with paler appendages and no metallic luster ..... **p. 25 *Platynus brunneomarginatus***

Head not suddenly constricted behind the eyes (b); if > 8.5 mm then either entirely deep black or with metallic luster **21**



21 Elytron with four or more *dorsal* punctures; if, very rarely, less, then clearly *foveate* **22**

Elytron with three (rarely *unilaterally* or irregularly placed with four) rather small, never *foveate dorsal* punctures **23**

22 Elytra pale brown, contrasting with darker *prothorax* and head; hind angles of *pronotum* completely obsolete ..... **p. 15 *Agonum limbatum***

Piceous-black head and *prothorax*; greenish or bluish elytra with faint *aeneous* or bronzy reflection; *pronotum* with *obtuse* but evident hind angles ..... **p. 15 *Agonum decorum***

23 Legs entirely pale, *testaceous* ..... **p. 17 *Agonum piceolum***

At least *tarsi piceous* or black **24**

Aeneous: Brassy, golden-green
Carina(e): Keel(s), ridge(s)
Denticulate: Toothed
Dorsal: Referring to the back or upper side
Foveate: Dimpled
Obtuse: Greater than a 90° angle and less than a 180° angle
Piceous: Glossy, brownish-black
Pronotum: Dorsal body plate of the prothorax
Prothorax: First segment of the thorax, just behind the head
Setiferous puncture: Puncture with bristles or hairs
Suture: Meeting point of the two elytra
Tarsi: Fifth leg segment or "feet"
Testaceous: Brownish-yellow
Unilaterally: One-sided

24 Upper surface black without metallic hue ..... **p. 16 *Agonum melanarium***

Upper surface vividly metallic..... **25**

25 First antennal segment, *tibiae* and *elytral epipleura* more or less pale; metallic luster of elytra uniform..... **p. 16 *Agonum muelleri***

Appendages and *elytral epipleura* black or almost so; metallic luster usually different colors on center and sides of elytra..... **p. 17 *Agonum suturale***

Elytral epipleura: Side margins of the elytra
Tibea(e): Fourth leg segment(s) or "shin(s)"

Agonum decorum Say 1823

Size: 8 mm (7–9 mm) **Crop:** ARG **Occurrence:** April–May; *scarce*
Diet: animal matter

Coloration

- ✔ *Piceous*-black; *elytral epipleura* slightly paler.
- ✔ Forebody with metallic reflection (bluish or greenish).
- ✔ Mouthparts, first antennal segment and legs more or less *piceous*.

Pronotum characteristics

- ✔ Hind angles always evident, usually forming minute *denticle* at tip.
- ✔ *Base* faintly punctulate, at least in the *foveae*.
- ✔ *Foveae* usually delimited by a flat *tubercle*.

Elytra characteristics

- ✔ Long, parallel sided at middle.
- ✔ Fine but sharp *striae*, barely visible *punctulate*.
- ✔ Intervals flat.
- ✔ Five or six *dorsal* punctures.

Agonum limbatum Motschulsky 1845

Size: 5.5–7.5 mm **Crop:** ARG **Occurrence:** January and April; *scarce*
Diet: seeds, vegetal tissues, aphids, caterpillars

Coloration

- ✔ Black forebody with *aeneous* hue.
- ✔ Elytra *testaceous* and somewhat browned on *disc*.
- ✔ Appendages pale.

Pronotum characteristics

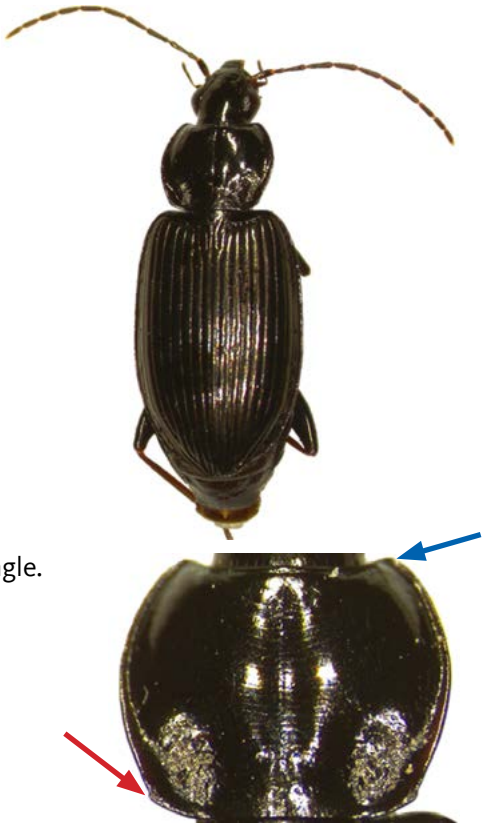
- ✔ Strongly rounded sides; hind angles completely obsolete.
- ✔ *Base laterally* with raised *bead*.
- ✔ Shallow *basal foveae*.

Elytra characteristics

- ✔ Very fine *striae* with flat intervals.
- ✔ Shoulders evident (red arrow).
- ✔ Usually six (three anterior on third *stria*, three posterior on second *stria*) but from four to seven deeply impressed *dorsal* punctures.

Agonum melanarium Dejean 1828

Size: 9–11 mm (8–11 mm) **Crop:** ARG **Occurrence:** early May; *scarce*
Diet: earthworms, flower beetle larvae (in captivity)



Coloration

- ✔ Deep black without metallic reflection, *elytral epipleura* slightly paler.
- ✔ Elytra faintly iridescent.
- ✔ Mouthparts, first antennal segment and at least *tibiae* of legs slightly paler.

Pronotum characteristics

- ✔ Broad, widest just before middle with protruding front angles (blue arrow).
- ✔ Hind angles evident with a small, blunt *denticle* (red arrow).
- ✔ *Fovea* large and *rugosely punctulate*.
- ✔ *Lateral bead* continued as a strongly widening reflection toward hind angle.

Elytra characteristics

- ✔ *Striae* deep and *punctulate* with convex intervals.
- ✔ Fifth *stria* not impressed at tip.
- ✔ Usually with three, rarely two or *unilaterally* four *dorsal* punctures.

Agonum muelleri Herbst 1785

nonnative, introduced from Europe

Size: 6.5–11 mm **Crop:** ARG, TF **Occurrence:** March–August; *common* in ARG, *occasional* in TF **Diet:** wireworms and other larvae, including leatherjackets and caterpillars

Coloration

- ✔ *Piceous* black; *elytral epipleura* paler.
- ✔ Forebody usually with greenish elytra with bronzy metallic reflection, rarely unicolorous.
- ✔ First antennal segment and *tibiae* paler.

Pronotum characteristics

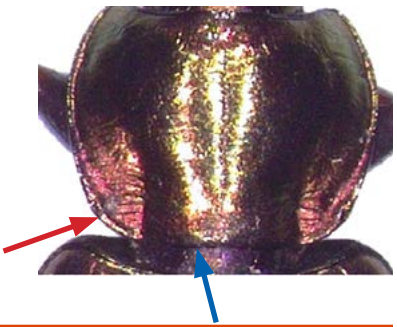
- ✔ Rounded, with suggested hind angles.
- ✔ *Lateral bead* always and *basal bead* usually present *laterally* (red arrow) but not behind *foveae* (blue arrow).

Elytra characteristics

- ✔ Angulate, prominent shoulders (black arrow).
- ✔ Very fine, virtually *impunctate striae*.
- ✔ *Dorsal* punctures, usually three, rarely four.

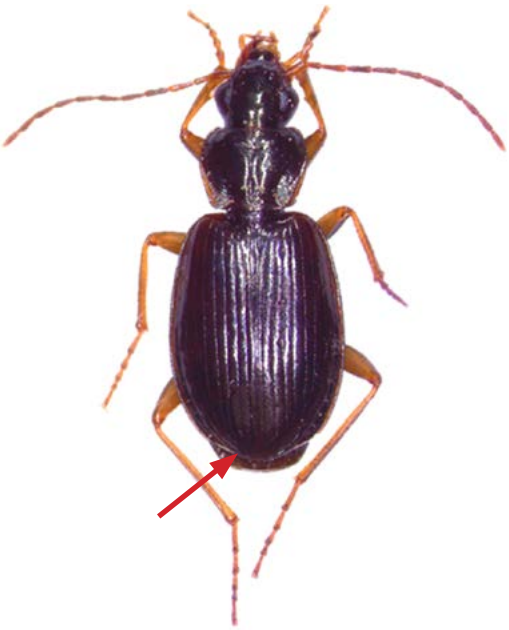
Other identifying features

- ✔ Broad head with prominent eyes.



Agonum piceolum LeConte 1879

Size: 6.5–8.5 mm (6–8.5 mm) **Crop:** ARG **Occurrence:** April–June; *occasional* **Diet:** unknown



Coloration

- ✔ *Piceous* to dark brown with nonmetallic *elytra*.
- ✔ First three antennal segments paler, second hardly darker than third.
- ✔ Legs pale.

Pronotum characteristics

- ✔ Broad, widening anteriorly.
- ✔ Pronounced depression along sides in *basal* half.

Elytra characteristics

- ✔ Shallow *subapical sinuation* (red arrow).
- ✔ Rather convex with narrow shoulders and rounded sides.
- ✔ Usually four, but between three and five small, *nonfoveate dorsal* punctures.

Agonum suturale LeConte 1863

Size: 9–12 mm **Crop:** ARG **Occurrence:** April–June; *abundant* **Diet:** unknown

Coloration

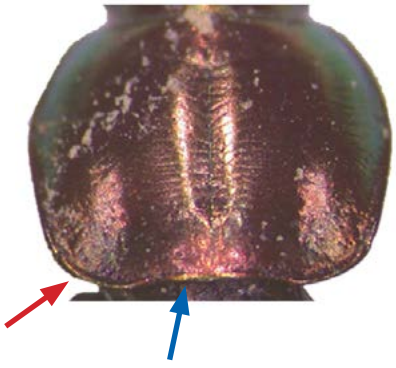
- ✔ Black with green metallic reflection.
- ✔ Main part of elytra often with *cupreous* or bronze metallic reflection with sharp limit against the greenish margins.
- ✔ Hardly paler appendages.

Pronotum characteristics

- ✔ Rounded, usually with suggested hind angles.
- ✔ *Basal foveae rugulose*.
- ✔ Thin but clearly defined *lateral bead* as well as *basal bead* (red arrow), also behind the *foveae* (blue arrow).

Elytra characteristics

- ✔ Shoulders broadly rounded, not prominent.
- ✔ *Subapical sinuation* quite pronounced.
- ✔ Usually three or *unilaterally* four *dorsal* punctures.



Amara aenea De Geer 1774

nonnative, introduced from Europe

Size: 7–9 mm (6.2–9 mm) **Crop:** ARG, TF **Occurrence:** May–July; *scarce* in ARG, *scarce* in TF **Diet:** seeds, insect eggs and larvae

Coloration

- ✔ Black upper surface with often quite bright brassy or green (rarely bluish) reflection.
- ✔ First[t] to third and base of fourth antennal segments *rufo-testaceous*.
- ✔ *Tibiae* ± *rufous*.

Pronotum characteristics

- ✔ Front angles protruding.
- ✔ Outer *basal foveae* obsolete, inner *foveae* consisting of a short, sharp streak parallel with the median line.

Elytra characteristics

- ✔ *Elytral striae* very fine.
- ✔ Seventh *stria* with three *subapical* punctures.

Other identifying features

- ✔ Small head with flat eyes.

Amara littoralis Mannerheim 1843

Size: 8–9 mm (6.2–9.3 mm) **Crop:** ARG **Occurrence:** May–June; *scarce*
Diet: unknown

Coloration

- ✔ Black upper surface with brassy, sometimes bluish or greenish reflection.
- ✔ First to third antennal segments pale; *palpi* usually entirely dark; *antepenultimate* segment of *maxillary* pair very seldom pale.
- ✔ Legs with clearly *infuscated femora*.

Pronotum characteristics

- ✔ Only slightly protruding front angles.
- ✔ Sides almost straight in *basal* half (red arrow).
- ✔ Inner *basal foveae* small but usually evident, outer *foveae* ± stretched and pointed diagonally toward hind angle.

Elytra characteristics

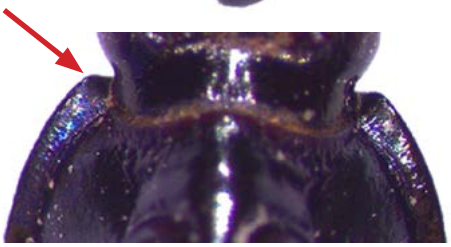
- ✔ *Apex* pointed.
- ✔ *Stria(e)* very fine with flat intervals, not or only slightly deepening toward *apex*.
- ✔ Seventh *stria* with three or four *subapical* punctures.

Other identifying features

- ✔ Third antennal segment (and sometimes decond) usually with ± pronounced darker *carina* at *base*.

Amara longula LeConte 1855

Size: 6.5–9.5 mm **Crop:** ARG, TF **Occurrence:** May–August; *abundant* in ARG, *common* in TF **Diet:** unknown



Coloration

- ✔ Black upper surface with *aeneous* or bronze luster.
- ✔ First to third and base of fourth antennal segments bright *rufous*.
- ✔ Legs *rufous*, but *tarsi* and *femora* often more or less *piceous*.

Pronotum characteristics

- ✔ Almost conical, front angles not at all protruding (red arrow).
- ✔ *Base sinuate* laterally (blue arrow).
- ✔ Hind angles ± acute.

Elytra characteristics

- ✔ Usually with, but sometimes without, *ocellate* puncture at *base*.
- ✔ *Striae* finely punctulate or virtually smooth.
- ✔ Generally three *subapical* punctures on seventh *stria*.

Other identifying features

- ✔ Head almost as broad as distance between front angles of *pronotum*.
- ✔ Male *metatibiae* without inside *pubescence*.

Anisodactylus binotatus Fabricius 1787

nonnative, introduced from Europe

Size: 10.5–13 mm (10–13 mm) **Crop:** ARG, TF **Occurrence:** April–June; *occasional* in ARG, *scarce* in TF **Diet:** worms, mollusks, strawberries

Coloration

- ✔ Black.
- ✔ One or two *basal* segments of antennae *rufous*; *palpi* slightly *infuscated*.

Pronotum characteristics

- ✔ Hind angles *denticulate*.
- ✔ Very short *pubescence laterally* on *base* and side margins.
- ✔ *Punctation* expanded on *base*, not reduced to *foveae*.

Elytra characteristics

- ✔ Outermost interval and *apex punctulate* and *pubescent*.
- ✔ Single *dorsal* puncture on third interval, seventh and sometimes fifth interval with one or more *(sub)apical* punctures.
- ✔ Stretched and parallel sided.

Other identifying features

- ✔ *Clypeus* with single pair of *setiferous* punctures.
- ✔ *Clypeo-ocular line* present.
- ✔ Prosternum *punctulate* and *pubescent* medially.

Anisodactylus californicus Dejean 1829

Size: 10.5–13 mm **Crop:** ARG, TF **Occurrence:** April–June and November; *abundant* in ARG, *scarce* in TF **Diet:** grasshopper nymphs, caterpillars, strawberries

Coloration

- ✔ Black and shiny.
- ✔ First antennal segment *rufous*.
- ✔ *Palpi* ± *infuscated*.

Pronotum characteristics

- ✔ Rather narrow.
- ✔ *Cordiform* with almost right hind angles.
- ✔ Deep ± linear *basal foveae*, separated from the side margin by a deep convexity.

Elytra characteristics

- ✔ Long and parallel sided at middle.
- ✔ *Punctation* of intervals very fine to almost disappeared.
- ✔ Single *dorsal* puncture on third interval; seventh interval with one *subapical* puncture

Other identifying features

- ✔ *Clypeus* with single pair of *setiferous* punctures.
- ✔ Red double-spot on *frons* evident.
- ✔ *Prosternum* smooth and *glabrous*.

Anisodactylus sanctaecrucis Fabricius 1798

Size: 9–10 mm (8.3–10.5 mm) **Crop:** ARG, TF **Occurrence:** April–June; *scarce* in ARG, *scarce* in TF **Diet:** vegetal matter (grass), caterpillars

Coloration

- ✔ *Frons* and *pronotum* black.
- ✔ Extreme margin of *pronotum rufous*.
- ✔ Elytra *testaceous* with dark cloud not reaching *base*.
- ✔ Legs pale.

Pronotum characteristics

- ✔ ± *cordiform*.
- ✔ Little protruding hind angles.

Elytra characteristics

- ✔ *Subapical sinuation* shallow.
- ✔ *Apically* and *laterally pubescent*.

Other identifying features

- ✔ *Clypeus* with two or three (sometimes four) pairs of *setiferous* punctures per side.

Bradycellus congener LeConte 1848

Size: 3.5–5 mm **Crop:** ARG **Occurrence:** April–October; *abundant* **Diet:** ladybirds

Coloration

- ✔ *Piceous* black.
- ✔ *Pronotum* ± *infuscated.*
- ✔ Usually only *suture*, *base* and margins of elytra pale.
- ✔ Appendages pale.
- ✔ Antennae, except *base* and, rarely, *femora*, somewhat darkened.

Pronotum characteristics

- ✔ Hind angles virtually rounded and disappeared.

Elytra characteristics

- ✔ *Subapical sinuation* very faint.

Other identifying features

- ✔ *Clypeo-ocular line* complete.
- ✔ Antennae *pubescent* from third segment.

Calosoma cancellatum Eschscholtz 1833

Size: 14.5–23 mm **Crop:** ARG, TF **Occurrence:** May–August; *common* in ARG, *common* in TF **Diet:** caterpillars, click beetles, flies, grasshoppers

Larvae: 10–19 mm, were trapped in one TF field between June and July

Coloration

- ✔ Black or dark *piceous*; upper surface usually with greenish reflection.
- ✔ Appendages *rufous*, *femora* ± darkened.

Pronotum characteristics

- ✔ Sides only slightly reflexed.
- ✔ Hind angles protruding backwards.

Elytra characteristics

- ✔ *Striae* with irregular sculpture and small, little-contrasting *foveae.*

Other identifying features

- ✔ Head very large with dense, *confluent punctation*.

Harpalus affinis Schrank 1781

nonnative, introduced from Europe

Size: 9–11 mm (8.5–12 mm) **Crop:** TF **Occurrence:** March–July; *scarce*
Diet: omnivorous, ranging from grass and legume seeds to aphids and flies

Coloration

- ✔ *Piceous* to black, strongly metallic (usually green, sometimes blue or copper).
- ✔ Legs *rufous* to *piceous*.
- ✔ Antennae pale, middle segments sometimes *infuscated*.

Elytra characteristics

- ✔ Outer intervals (rarely entire elytra) with *pubescence* and *punctation*, especially at *base*.
- ✔ Shoulders rounded.
- ✔ Typically, no punctures on elytra; occasionally third interval with one puncture.

Other identifying features

- ✔ *Frons* with single *supraorbital puncture*.
- ✔ *Tarsi glabrous dorsally*.
- ✔ *Abdomen punctulate* and *pubescent*.

Loricera decempunctata Eschscholtz 1833

Size: 6.5–8.5 mm **Crop:** ARG, TF **Occurrence:** March–June; *abundant* in ARG, *occasional* in TF **Diet:** springtails

Coloration

- ✔ Black with faint bronze luster.
- ✔ *Tibiae*, *mandibles* and *palpi* ± *piceous*.

Pronotum characteristics

- ✔ Sides strongly *sinuate* before the almost rectangular hind angles.

Elytra characteristics

- ✔ *Striae* with close, rather irregular *punctation*.
- ✔ Usually two (sometimes one, rarely none) *foveae* on seventh interval.

Loricera foveata LeConte 1851

Size: 6–8.5 mm **Crop:** ARG, TF **Occurrence:** year-round (peak April and May); *very common* in ARG, *occasional* in TF **Diet:** springtails

Coloration

- ✔ *Piceous* black.
- ✔ Elytra brown.
- ✔ Appendages pale.

Pronotum characteristics

- ✔ Small, narrowed *basally*.
- ✔ Hind angles *obtuse*.

Elytra characteristics

- ✔ *Striae* with small but sharp, rather sparse *punctation*.
- ✔ Always with three *foveae* on fourth and two *foveae* on seventh interval.

Microlestes nigrinus Mannerheim 1843

Size: 2.5–4.5 mm **Crop:** ARG, TF **Occurrence:** May–October and December; *occasional* in ARG, *abundant* in TF **Diet:** unknown

Coloration

- ✔ *Piceous* to almost black with faint bronze reflection.
- ✔ *Femora* only slightly or not at all *infuscated*.

Pronotum characteristics

- ✔ Hind angles evident.
- ✔ Front angles quite protruding.
- ✔ *Base* not widened marginally.

Elytra characteristics

- ✔ More widening toward the *apex*.
- ✔ Outer *stria* virtually disappeared.

Nebria brevicollis Fabricius 1792

nonnative, introduced from Europe

Size: 10–14 mm **Crop:** ARG, TF **Occurrence:** year-round (peaks April, May and October); *very common* in ARG, *very common* in TF **Diet:** small flies (including leatherjackets), springtails, mites, spiders, small earthworms, caterpillars

Larvae: 4–14 mm; ARG, TF; November–May (peak March and April); *common* in ARG, *abundant* in TF.

Coloration

- ✔ Dark *piceous* to almost black.
- ✔ Appendages *rufous*, *femora* ± darkened.

Pronotum characteristics

- ✔ Strongly *cordiform*.
- ✔ Hind angles *acute*.
- ✔ Coarse *punctation* at *base*.

Elytra characteristics

- ✔ *Striae* deep, densely and strongly punctured.

Other identifying features

- ✔ *Dorsal* surface of *meso-* and *metatarsi pubescent*.

Omus audouini Reiche 1838

Size: 14–17.5 mm **Crop:** AR, TF **Occurrence:** April–June; *scarce* in AR, *occasional* in TF **Diet:** predatory, feeds on a variety of invertebrates

Coloration

- ✔ Black, dull.

Pronotum characteristics

- ✔ Narrow *thorax* that constricts more toward *apex*.

Elytra characteristics

- ✔ Fused elytra without obvious *stria*.
- ✔ Covered in shallow punctures.

Other identifying features

- ✔ Large eyes.
- ✔ Large, sickle-like *mandibles*.
- ✔ *Clypeus* longer than distance between antennae.

Platynus brunneomarginatus Mannerheim 1843

Size: 9–11 mm (9–11.5 mm) **Crop:** ARG **Occurrence:** March–June; *abundant* but restricted to one field **Diet:** unknown

Coloration

- ✔ *Piceous* to almost black.
- ✔ Sides of *pronotum* and elytra *diaphanously rufo-piceous*.
- ✔ Appendages somewhat paler, antennae with fourth segment darker than the others.

Pronotum characteristics

- ✔ Sides *sinuate* before the sharp, almost right hind angles.
- ✔ *Base impunctate*.

Elytra characteristics

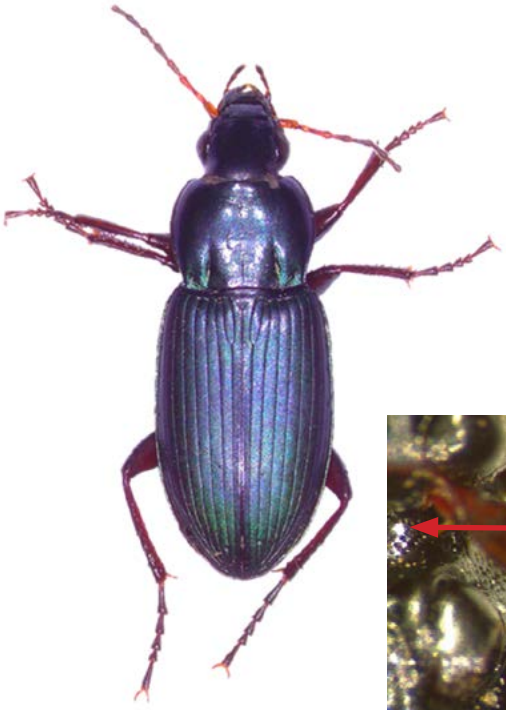
- ✔ *Striae* fine, virtually *impunctate*.
- ✔ Intervals (nearly) flat.
- ✔ Third interval with three *dorsal* punctures.

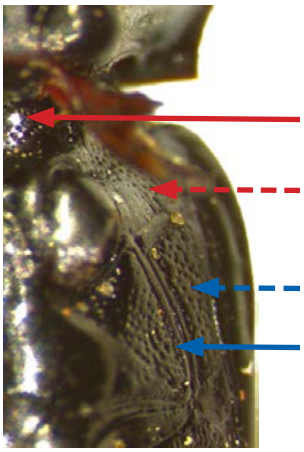
Other identifying features

- ✔ Third and fourth antennal segment equal in length.
- ✔ Segments 1–3 of *metatarsi* strongly *furrowed* on both sides.

Poecilus laetulus LeConte 1863

Size: 9–12 mm **Crop:** ARG, TF **Occurrence:** April–October; *common* in ARG, *common* in TF **Diet:** slugs, caterpillars





Coloration

- ✔ Black, entire surface with greenish or bluish luster
- ✔ Appendages slightly paler, *rufo-piceous*.
- ✔ Three *basal* segments of antennae *rufous*.

Pronotum characteristics

- ✔ Sides slightly *sinuate* before the nearly right hind angles.
- ✔ *Foveae* large, form "J" shape.

Elytra characteristics

- ✔ *Striae* shallow and virtually *impunctate*.
- ✔ Flat intervals.
- ✔ Two or more *dorsal* punctures.

Other identifying features

- ✔ *Meso-* and *metasterna* (red and blue solid arrows) and *episterna* (red and blue broken arrows) as well as sides of *abdomen* coarsely *punctulate*.

Pterostichus algidus LeConte 1852

Size: 14–15 mm (12–16 mm) **Crop:** ARG, TF **Occurrence:** June–October; *scarce* in ARG, *scarce* in TF **Diet:** fly eggs, tree seeds

Coloration

- ✔ Deep black and dull.
- ✔ *Palpi*, antennae and *tarsi* ± *piceous*.

Pronotum characteristics

- ✔ Sides with long, shallow *sinuation* behind and minute incision before almost right hind angles.
- ✔ Convex.
- ✔ Inner *lateral* impression long and deep, separated by a pronounced convexity from the small, round *lateral fovea*.

Elytra characteristics

- ✔ Deep, convex *striae*.
- ✔ Small shoulder tooth (red arrow).
- ✔ No *dorsal* punctures.

Other identifying features

- ✔ Stiff, erect *setae* underneath last *tarsal* segment.

Pterostichus melanarius LeConte 1852

nonnative, introduced from Europe

Size: 14–18 mm (12–19 mm) **Crop:** ARG, TF **Occurrence:** March–October; *occasional* in ARG, *abundant* in TF **Diet:** various invertebrates and their eggs, including slugs, caterpillars, leatherjackets

Coloration

- ✔ Deep black.
- ✔ Appendages in part *piceous*.

Pronotum characteristics

- ✔ Hind angles *denticulate*.
- ✔ *Basal foveae* with a ± pronounced *tubercle* in center.
- ✔ Strong *lateral carina*.

Elytra characteristics

- ✔ *Striae* moderately deep with rudimentary punctures.
- ✔ Intervals moderately convex.
- ✔ Usually two (sometimes three or four on one side) *dorsal* punctures.

Stenolophus anceps LeConte 1857

Size: 4–6 mm **Crop:** TF **Occurrence:** June–July; *scarce* in TF
Diet: unknown

Coloration

- ✔ Black to dark *piceous*.
- ✔ All margins of *prothorax* pale.
- ✔ First *elytral interval*, *epipleura* and *apex* of elytra *rufo-testaceous*.
- ✔ *Palpi*, *femora*, *apex* of *tibia*, *tarsi infuscated*.
- ✔ One or two *basal* segments of antennae pale.

Pronotum characteristics

- ✔ Hind angles suggested but rounded or strongly *obtuse*.
- ✔ *Foveae* shallow, with surrounding area flat.

Elytra characteristics

- ✔ *Subapical sinuation* evident.

Other identifying features

- ✔ *Metatarsi glabrous dorsally*.
- ✔ *Protibia* with two or three spines at outer margin near *apex*.
- ✔ *Abdominal sternites* with irregularly distributed *pubescence*.

Trechus obtusus Erichson 1837

nonnative, introduced from Europe

Size: 4 mm (3.6–4.1 mm) **Crop:** ARG, TF **Occurrence:** August–June; *scarce* in ARG, *abundant* in TF **Diet:** fly eggs

Coloration

- ✔ Greyish *testaceous* or brown; head almost black.
- ✔ Elytra somewhat iridescent.
- ✔ Legs yellow; antennae somewhat *infuscated*.

Pronotum characteristics

- ✔ Hind angles poorly developed.
- ✔ Depressed *base* limited toward the convex *disc* by an engraved line.
- ✔ *Basal* margin clearly *oblique* inside hind angles.

Elytra characteristics

- ✔ Outer *striae* obliterated.

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Photos: Couplet 17, c and d, *Stenolophus anceps* and *Trechus obtusus* by Andrew Colton; Figure 4, *Pterostichus algidus* (full beetle), *Omus audouini*, *Harpalus affinis* and *Calosoma cancellatum* larva by Casi Jessie; all others by Inga Reich.

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