Aquatic Beetles of the Grensgebergte and Kasikasima Regions, Suriname (Insecta: Coleoptera)

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Chapter 4

Aquatic Beetles of the Grensgebergte and Kasikasima Regions, Suriname (Insecta: Coleoptera)

Andrew Short

SUMMARY

An extensive survey of aquatic beetles was conducted between 9–26 March 2012 in the Grensgeberge and Kasikasima regions of the Upper Palumeu River Basin, Suriname. More than 2500 specimens were collected representing 157 species in 70 genera. Twenty-six species and 8 genera are confirmed as new to science, with an additional 10–15 species likely being undescribed. Surprisingly, more species were recorded here than during the Kwamalasamutu Region RAP despite less collecting effort. Additionally, there was a high species turnover between these RAP sites: 40% of the species recorded here were not found in the Kwamalasamutu Region. The families Lutrochidae, Hydroscaphidae, and Torridincolidae are recorded from Suriname for the first time. While a broad range of habitats contributed to the high species and lineage diversity, hygropetric habitats on granite outcrops in particular provided a wealth of new and interesting taxa. Two of the new species in the family Hydrophilidae are described herein: *Tobochares kasikasima* Short sp. n. and *Tobochares striatus* Short sp. n. A key to the species of *Tobochares* is provided.

INTRODUCTION

Aquatic beetles—loosely defined as beetles that require aquatic habitats for at least one life stage—represent a significant portion of freshwater aquatic macroinvertebrate diversity with approximately 13,000 described species found worldwide (Jäch & Balke 2008). These species are distributed across approximately 20 beetle families in four primary lineages: Myxophaga, Hydradephaga, aquatic Staphyliniformia (Hydrophiloidea and Hydraenidae) and the Dryopoidae (or aquatic byrroids). Members of Myxophaga are small beetles that feed largely on algae as larvae and adults. The Hydradephaga (including the diving and whirligig beetles) are largely predators as adults and larvae; the aquatic Staphyliniformia are largely predators as larvae but scavengers as adults; the dryopoids are largely scavengers or eat algae as both larvae and adults.

Aquatic insects in general (including several groups of aquatic beetles) are often used to assess water quality in freshwater rivers and streams. The dryopoids are most frequently used for this purpose because they are most commonly found in these habitats and often have high-oxygen needs. Aquatic beetle communities are also effectively used to discriminate among different types of aquatic habitat (e.g. between lotic and lentic; rock outcrops, substrate, etc.).

The only prior survey to have focused on aquatic beetles in Suriname was a prior RAP survey in the Kwamalasamutu Region (Short and Kadosoe 2011). Overall, the fauna of the country and broader region is very poorly known, with the exception of recent work in Venezuela where the number of known species has literally more than doubled in just a few years.

METHODS AND STUDY SITES

I collected aquatic beetles at three of the four primary sites on the RAP (Site 1: Upper Palumeu; Site 2: Grensgebergte; Site 4: Kasikasima).

Field methods

I used a variety of passive and active collecting techniques to assemble as complete a picture of the aquatic beetle communities as possible. Passive techniques are advantageous because they often allow large amounts of material to be collected in quantitative ways at one time and with little effort, but provide little ecological or habitat data; we do not gain

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— LEA, THL, August 2013

new insights into the water quality requirements of insects collected in this manner. In contrast, active collecting methods (i.e. by hand) provide a richer source of information on the microhabitat and water quality requirements of species, but are more time intensive, qualitative, and may suffer from collector bias.

Traps and other passive methods. During one night at Site 1, and four nights at Site 4, I collected in the evening hours until approximately 11 p.m. at a UV light mounted on a white sheet erected on the periphery of the camp. I also used flight intercept traps (FITs) to sample the beetle fauna. These traps collect flying insects, including dispersing aquatic beetles. At site 1, three FITs were used, each composed of a 2-meter wide by 1.5- meter high screen, with aluminum pans filled with soapy water as a collecting trough. No FITs were constructed by me at 2 or 4, but residues in traps at these sites by T. Larsen were saved and picked for aquatic beetles. Dung trap sample residues collected by T. Larsen were also were also examined for specimens of Hydrophilidae.

Active methods. For collection of actively swimming insects, I used a large aquatic insect net to survey forest pools, swamps, and the margins of rivers and streams. To collect poorly swimming insects that float to the water's surface when disturbed, I employed a small metal strainer to collect in detrital micropools and marginal areas. At Sites 1, 2, and 4, I collected in hygropetric habitats (waterfalls and rock seepages). This was done by "washing" the wet rock surface with a scrub brush into a small net, and examining the algae and debris for beetles. I also submerged moist leaf packs in a tub of water and collected the insects that floated to the surface.

Because most aquatic beetles are very small (generally <5 mm, although a select few reach 50 mm) and many require examination under a microscope for species identification, I collected and preserved samples of these insects from each camp to take back to the laboratory for processing.

Site 1: Upper Palumeu, (Juuru Camp) N 2.47700°, W 55.62941°, 277 m, 9–18 March 2012.

Most collecting was done along a cut trail south that continued to the Brazilian border, and in the immediate (<1 km) vicinity of basecamp. Along the trail a few kilometers south

Figure 4.1. Selected collecting event photographs, with field numbers given in brackets. A) Camp 1, detrital pool along floodplain of small upper Palumeu tributary [SR12-0311-01A], B) Camp 1, tributary of the upper Palumeu [SR12-0314-01A], C) Camp 2, typical seepage habitat on the Grensgebergte summit [SR12-0312-01A], D) Camp 4, large flowing seepage near the base of Kasikasima [SR12-0324-01C].

of basecamp was a large cascade on a tributary of the Palumeu River with large expanses of wet rock on the border of the river channel. The stream on which the waterfall was located has a mostly sand and detritus substrate (Figure 4.1B). Some forested low-lying areas along both this stream and the Palumeu held water when the survey began, forming shallow detrital pools (Figure 4.1A). Following rains and flooding of the Palumeu River, these areas became completely submerged and united with the main river as the water level rose approximately 2 meters in less than three days. The heavy rains and subsequent flooding of productive habitats reduced the overall collecting done at this site. Approximately three days of accumulated specimens were lost from two of the three FIT traps, as the traps were submerged by rising floodwaters.

Habitats of note: Sandbars and leaf packs along the above-mentioned Palumeu tributary proved very fruitful for some less common taxa (e.g. *Laccodytes*, *Hydrodessus*) until the rivers flooded. Some large *Megadytes* specimens were collected directly from the margin of Palumeu River itself, and could be seen by headlamp swimming at night. Hygropetric habitats at the cascade yielded unique taxa, including *Oocyclus* and some other rare water scavenger beetles.

Site 2: Grensgebergte, N 2.46554°, W 55.77034°, 790–820 m, 12–13 March 2012.

All collecting was done on a variety of seepage habitats on the granite rock (Figure 4.1C). These hygropetric areas were expansive in some areas, covering hundreds of square meters. While the entire rock becomes wet and slippery following rains, certain "drainage" areas (channels in the rock and areas below water-absorbing vegetation) form more "perennial" seepages, although these are still likely seasonal. These more permanent seepage areas had large amounts of filamentous algae and liverworts in addition to the cyanobacterial films and lichens that were nearly ever-present on the outcrop.

With the exception of a few small depressions that held water only during rains, no streams, forest pools, or other aquatic habitats were observed along the cut transect or its vicinity. I did not descend from the ridge, although there are surely streams nearby.

Habitats of note: As described above, the site contained enormous swaths of hygropetric habitats, and while not rich in total number of species, many were rare or new to science.

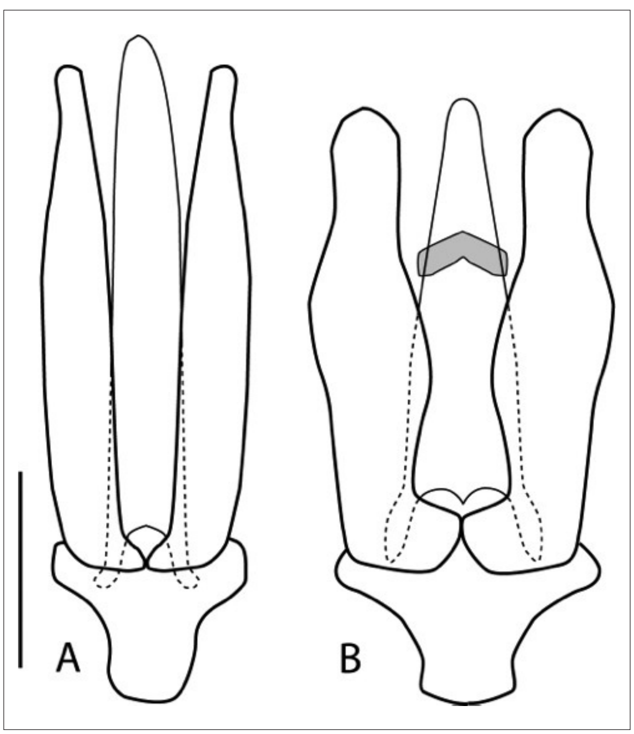

Figure 4.2. Aedeagi of *Tobochares* spp., ventral view. A) *kasikasima* sp. n., B) *striatus* sp. n. Scale bar = 0.1 mm.

Site 4: Kasikasima, N 2.97731°, W 55.38500°, 201 m, 19–26 March 2012.

Collecting at the Kasikasima site was divided into two primary areas: the lowland basecamp (c. 200 m) situated on the Palumeu River, and the Kasikasima rock formation itself (with collections made at 400 and 515 m). In the lowland area, I collected along trails between basecamp and a METS tourist lodge, and between basecamp and Kasikasima. Both trails crossed several small streams (c. 1–4 m in width), and had various combinations of mud, detritus, and/or sand as substrate. One stream originated at the base of Kasikasima and flowed over several collections of large boulders, creating a small area of hygropetric habitat. I also collected along the banks of the Palumeu River itself, as well as some flooded forest areas along its margin.

Habitats of note: At the lowland basecamp, there were no particularly unusual habitats. As is typical, the smaller, sandier streams yielded the most interesting and less commonly collected taxa. Along the trail ascending Kasikasima, there was a broad seepage at 400 m with moderate, perhaps semi-permanent, flow (Figure 4.1D; 2°58.613'N, 55°24.683'W), such that it was sustained even days after a rain event and also created a small stream channel when it left the rock. It appears this seepage captures and drains rainwater from a broad expanse of rock. This seepage was densely populated with many new and "rare" taxa, all restricted to hygropetric habitats. At the terminus of the trail (at a low summit of 515 m), there were also several localized seepage habitats, although these were ephemeral, and only present during and shortly after rain events; Nevertheless, several *Fontidessus* were collected here.

Sample & Specimen Processing

I made 27 separate collections over the course of the expedition. Specimens collected by hand and bulk trap samples were all placed directly into 95% ethanol. Following fieldwork, all samples were sorted, mounted, labeled and databased. In some cases where there were long series common species from a single sample, only a portion was prepared and the remainder was stored and archived in ethanol. Only mounted specimens are reflected in specimen counts given in this report, thus abundances of the most common taxa are underreported. The morphospecies numbering system used in the Kwamalasamutu RAP (Short and Kadosoe 2011) is employed here so that the taxonomic diversity between expeditions can be directly compared (e.g. *Copelatus* sp. 3 refers to the same taxon in both reports).

RESULTS AND DISCUSSION

In total, 157 species in 70 genera of aquatic beetles were collected from the three RAP camps (Table 4.1; Figure 4.3). While the two primary camps (Upper Palumeu and Kasikasima) had similar numbers of taxa (92 and 105 species respectively) they were surprisingly dissimilar in composition, with each possessing ca. 50% site-unique species. Only 10 species in 8 genera were recorded from the Grensgebergte camp, but this was due to the lack of habitat diversity on the ridge—only hygropetric seepages were present, no trapping was conducted, and only limited time (2 days) were spent at the site collecting.

There were almost 10% more species collected during this RAP than the previous one around Kwamalasamutu, on which 144 species were recorded (Short and Kadosoe 2011). This is striking because far fewer overall specimens were collected (c. 2500 vs. >4000), in large part because of reduced manpower (one collector vs. two for Kwamalasamutu). Amazingly, more than 40% of the species (69) collected during this RAP were not collected at Kwamalasamutu. Some species that were extremely abundant in Kwamalasamutu (e.g. *Enochrus* sp. 1, *Notomicrus*, *Thermonectus*) were generally rare on this RAP. In some cases, such as with the majority of seepage taxa, this can be attributed to availability of suitable habitat. In other cases, it may be due to seasonality differences (October vs. March). For most, however, there is no clear answer.

By far the most significant result of the expedition was the discovery of large Myxophagan communities at sites 2 and 4. This represents the first known collection of the families Hydroscaphidae and Torridincolidae in Suriname. Several species of Torridincolidae were abundant at both sites; comparatively few specimens of an unknown number of Hydroscaphidae taxa were present only at site 2. At least three genera of Torridincolidae were recognized, all undescribed, but also known to me from similar habitats in western Venezuela. Due to their small size (under 2 mm), further characterization of these exciting groups must wait detailed examination in the laboratory.

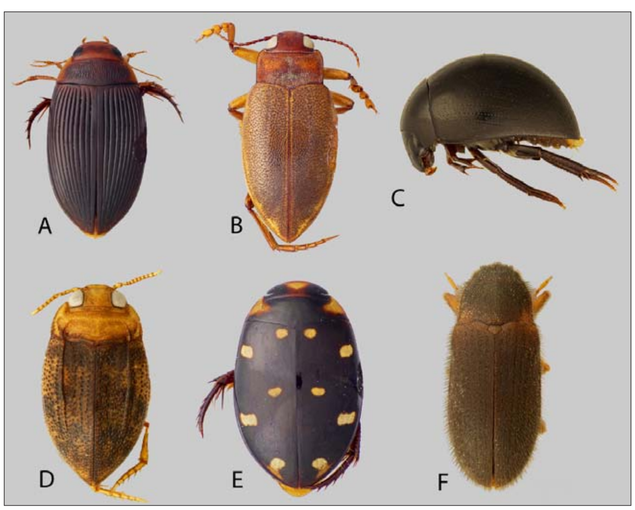

Figure 4.3. Selected habitus images of aquatic beetle taxa collected in the Grensgebergte and Kasikasima regions. A) *Copelatus* sp., B) *Vatellus grandis*, C) *Derallus* sp., D.) *Anodocheilus* sp., E) *Platynectes* sp., F) *Dryops* sp.

Table 4.1. Summary of aquatic beetle diversity among sites.

	# Specimens	# Genera	# Species	# Site-Unique species
Camp 1/ Upper Palumeu	1065	50	92	46
Camp 2/ Grensgebergte	155	8	10	3
Camp 4/ Kasikasima	1336	53	105	53
TOTAL	**2556**	**70**	**157**	-

Taxa of Note

Hydroscaphidae & Torridincolidae: This is the first report of either family and the suborder Myxophaga from Suriname (they are not yet known from either Guyana or French Guiana). With regard to Hydroscaphidae, a few individuals of a new species of *Scaphydra* were collected on an algae-covered seepage on the Grensgebergte rock summit. This is a typical habitat for hydroscaphids, and the family can be common in similar granite outcrops on the western edge of the Guiana Shield region in Venezuela (Short et al. 2010, unpub. data). Numerous new species of Torridincolidae (most in undescribed genera) were found on both the Grensgebergte summit as well as on a larger seep on the side of Kasikasima. As with Hydroscaphidae, this is a typical habitat for the family. While the genera are new, they are also known (but unpublished) from a variety of localities in southern Venezuela, also on granite seepages.

Hydrophilidae gen. nov. 3, sp. 1: This undescribed genus and species was also found on both the Grensgebergte summit and seep on the side of Kasikasima. As with the Myxophaga, the genus is known (but unpublished) from southern Venezuela, however, the Surinamese taxon reported here is confirmed as distinct from those species.

Lutrochus sp.: This is the first report of the family Lutrochidae from Suriname (Maier and Short 2013), and the taxon collected represents a new species.

Oocyclus spp.: Three species of this genus were found, all of which are already described. All three records represent significant eastern range extensions, as all three were previously known only from Venezuela (Short and Garcia 2010). Interstingly, *Oocyclus trio* was not encountered, which was described from the Kwamalasamuto RAP.

DESCRIPTION OF NEW SPECIES

Genus *Tobochares* Short & Garcia, 2007

The genus *Tobochares* currently contains two species known only from a handful of sites in the Guiana Shield region of Venezuela and Suriname. Two additional new species were discovered during the RAP. Like the previously described species, both new taxa are also apparently restricted to hygropetric habitats.

***Tobochares kasikasima* Short, sp.n.**

Type Material: Holotype (male): "SURINAME: Sipaliwini District/ N 2°58.613', W 55°24.683', 400m/ Camp 4 (high) Kasikasima/ leg. A. Short; main seepage area/ 24.iii.2012; SR12-0324-01C/ 2012 CI-RAP Survey", "[barcode]/ SEMC1088588/KUNHM-ENT". (Deposited in the National Zoological Collection of Suriname).

Diagnosis. Elytra not sulcate (sulcate at least in basal half of all other known species) Maxillary palps uniformly yellow (darkened at apex in *T. sulcatus* and *T. striatus*). Aedeagus with parameres straight along inner and outer margins (sinuate in other all other known species).

Description. *Size and form*. Body length = 1.7 mm. Body elongate oval, weakly dorsoventrally compressed. *Color and punctation*. Dorsum of head very dark brown, almost black; anterolateral margins of clypeus without paler preocular patches; maxillary palps yellow, with apical palpomere slightly darkened at apex. Pronotum and elytra brown, becoming slightly paler at lateral margins. Meso- and metathoracic ventrites and visible abdominal ventrites dark brown, with prosternum, epipleura, and legs distinctly paler. Ground punctation on head, pronotum and elytra moderately fine. *Head*. Antennae with scape and pedicel subequal in length, and their combined length subequal to antennomeres 3–8. Maxillary palps with palpomeres 2 and 4 subequal in length with palpomere 3 slightly shorter. *Thorax*. Elytra with indistinct rows of serial punctures which are subequal to slightly larger than the ground punctures; most rows feebly impressed into grooves in posterior quarter. Elevation of mesoventrite forming a lateral carina which is raised into a very low, bunt tooth. Metaventrite with distinct median narrowly ovoid glabrous area that three-quarters as long as the length of the metaventrite. *Abdomen*. Abdominal ventrites uniformly and very densely pubescent. Apex of fifth ventrite evenly rounded. Aedeagus (Figure 4.2A) with basal piece very short, less than one-third as long as parameres. Parameres subparallel in basal two thirds, tapering to a blunt tip in anterior. Median lobe long, parallel sided and tapering at the tip; distinctly protruding beyond the apex of the parameres; gonopore not apparent.

Habitat. The single known specimen was collected on a flowing seepage over granite.

Etymology. Named for the inselberg on which it was found, Kasikasima in southwestern Suriname.

***Tobochares striatus* Short, sp.n.**

Type Material: Holotype (male): "SURINAME: Sipaliwini District/ N 2.24554°, W 55.77000°, 800m/ Camp 2 (Grensgebergte Rock/ leg. A. Short; rock seepages/ 12.iii.2012; SR12-0312-01A/ 2012 CI-RAP Survey". (Deposited in the National Zoological Collection of Suriname). **Paratypes (11): SURINAME: Sipaliwini District:** Same data as holotype (3 exs.); Camp 1, Upper Palumeu, 10.iii.2012, leg. A. Short, small forest pool by boulders, SR12-0310-02A (1 ex.); Camp 4 (Kasikasima), 24.iii.2012, leg. A. Short, main seepage area, SR12-0312-01C (7 exs.). Paratypes are distributed between the National Zoological Collection of Suriname and the University of Kansas.

Diagnosis. Elytra sulcate along entire length (only sulcate in basal half in *T. sipaliwini*, and not sulcate in *T. kasikasima*). Maxillary palps darkened at apex (uniformly pale in *T. sipaliwini* and *T. kasikasima*). Aedeagus sinuate along inner and outer margins (straight in T. *kasikasima*). Size smaller (larger in *T. sulcatus*).

Description. *Size and form*. Body length = 1.9–2.0 mm. Body elongate oval, moderately dorsoventrally compressed. *Color and punctation*. Dorsum of head very dark brown, almost black; anterolateral margins of clypeus with distinctly paler preocular patches; maxillary palps yellow, with apical palpomere slightly darkened at apex. Meso- and metathoracic ventrites and visible abdominal ventrites dark brown, with prosternum, epipleura, and legs slightly paler. Ground punctation on head, pronotum and elytra very fine. *Head*. Antennae with scape and pedicel subequal in length, and their combined length subequal to antennomeres 3–8. Maxillary palps with palpomeres 2 and 4 subequal in length with palpomere 3 slightly shorter. *Thorax*. Elytra with ten rows of serial punctures which are strongly depressed into grooves along entire elytral length; serial punctures very coarse and distinct, 4–5 time large than ground punctures. Elevation of mesoventrite forming a lateral carina which is raised into a low tooth elevated to the same plane as the ventral surface of mesocoxae. Metaventrite with distinct median ovoid glabrous area that is nearly two-thirds as long as the metaventrite length. *Abdomen*. Abdominal ventrites uniformly and very densely pubescent. Apex of fifth ventrite evenly rounded. Aedeagus (Figure 4.2B) with basal piece short, ca. one-third as long as parameres. Parameres strongly sinuate on both inner and outer margins in apical half; median lobe extended past the apex of parameres; gonopore situated distinctly below apex of the dorsal strut.

Habitat. Most specimens were collected on a flowing seepage on granite. A single specimen was collected in a small forest pool near Camp 1 on the upper Palameu River, although this pool was situated directly beneath a group of large granite boulders.

Etymology. Striatus, in reference to the grooved elytra.

Key to the Species of *Tobochares*

1 Elytra sulcate along entire length…2
- Elytra sulcate on posterior half or less, or almost appearing without grooves…3

2 Size larger (2.2–2.5 mm). (Venezuela)…*sulcatus* Short & Garcia
- Size smaller (1.9–2.0 mm). (Suriname)…*striatus* Short sp. n.

3 Apical maxillary palpomere uniformly yellow, not darkened at apex. Clypeus with preocular pale spots. Size larger (1.8–2.0 mm). Elytra sulcate on posterior half. (Suriname)…*sipaliwini* Short & Kadosoe
- Apical maxillary palpomere with apex darkened. Head uniformly dark brown to black. Size smaller (1.7 mm). Elytra only feebly sulcate on posterior quarter to fifth. (Suriname)…*kasikasima* Short sp. n.

CONSERVATION ISSUES & RECOMMENDATIONS

The water beetle diversity found at each camp was reasonable given the types of aquatic habitat present. The high number of genera and species, which cover a variety of ecological and habitat types, suggest the area is largely undisturbed. Some of the difference in species diversity between Camps 1 and 4 are likely due to stochastic sampling biases, although presence of some taxa at Camp 1 but not 4 (e.g. *Cybister* and *Berosus)* is unexplained. The large degree of site-specific taxa between Camp 1 and 4 (ca. 50% for each site) is rather exceptional, and cannot be explained by the presence of more seepage habitats at Camp 4 alone. No differences in the water beetle communities between the sites could be attributed to anthropogenic disturbance. The small number of species at Site 2 is attributable to the very reduced number of habitats (e.g. only rock seepages).

The hitherto virtually unknown diverse hygropetric fauna found at Camps 2 and 4, including several new family records, underscores how little we know about this area of Suriname. More work is necessary in other similar comparable habitats in Suriname and the region to determine how endemic these seepage taxa may be, and to better understand the full diversity of this evolutionarily and ecologically significant group. Between both RAP expeditions, 213 species of aquatic beetles were collected…more than had been recorded from all of the Guianas combined in the last 250 years. The high turnover between this expedition and the Kwamalasamutu RAP survey, combined with the high turnover between camps in a single RAP survey, suggest a highly diverse and very localized or patchily distributed water beetle community in southern Suriname. The findings of dozens of species new to science on both RAP surveys, while not unexpected given the paucity of collecting in the region, reinforces how much further we have to go before we have an understanding of the biological diversity of southern Suriname.

ACKNOWLEDGMENTS

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Appendix 4.1. Water beetles collected during the 2012 RAP survey of Southeastern Suriname

Taxon	Upper Palumeu	Grensgebergte	Kasikasima
DYTISCIDAE			
Agaporomorphus sp. 1	-	-	X
Amarodytes sp. 3	X	-	-
Anodocheilus sp. 1	-	-	X
Anodocheilus sp. 2	X	-	-
Bidessodes charaxinus Young, 1986	X	-	X
Bidessodes semistriatus Regimbart, 1901	X	-	X
Bidessodes sp. 3	X	-	-
Bidessonotus sp. 1	X	-	-
Celina sp. 2	-	-	X
Copelatus geayi Regimbart, 1904	X	-	X
Copelatus sp. 2	X	-	X
Copelatus sp. 3	X	-	X
Copelatus sp. 5	X	-	X
Copelatus sp. 6	X	-	-
Copelatus sp. 7	X	-	X
Copelatus sp. 8	-	-	X
Copelatus sp. 9	X	-	X
Copelatus sp. 10	X	-	X
Copelatus sp. 11	X	-	X
Copelatus sp. 12	X	-	-
Copelatus sp. 17	X	-	X
Copelatus sp. 18	X	-	X
Desmopachria sp. 1	-	-	X
Desmopachria sp. 3	X	-	-
Desmopachria sp. 4	-	-	X
Desmopachria sp. 5	-	-	X
Desmopachria sp. 8	-	-	X
Desmopachria sp. 9	-	-	X
Desmopachria sp. 10	X	-	X
Desmopachria sp. X	X	-	X
Fontidessus sp. 1*	-		X
Fontidessus sp. 2*	-	X	X
Hydaticus fasciatus LaPorte, 1835	X	-	-
Hydaticus sp. 2	X	-	-
Hydrodessus sp. 1	X	-	-
Hydrodessus sp. 4	X	-	-
Hydrodessus sp. 5	X	-	-
Hydrodytes sp. 1	-	-	X
Hypodessus sp. 1	X	-	X
Hypodessus sp. 2	X	-	-
Laccodytes apalodes Guignot, 1955	X	-	-

table continued on next page

Appendix 4.1. continued

Taxon	Upper Palumeu	Grensgebergte	Kasikasima
Laccodytes sp. 4	X	-	-
Laccophilus sp. 1	X	-	-
Laccophilus sp. 2	X	-	-
Laccophilus sp. 3	X	-	X
Laccophilus sp. 5	X	-	X
Laccophilus sp. 6	X	-	X
Laccophilus sp. 7	-	-	X
Laccophilus sp. 8	-	-	X
Laccophilus sp. 9	X	-	-
Laccophilus sp. 10	X	-	X
Laccophilus sp. 11	-	-	X
Megadytes sp. 1	X	-	-
Megadytes sp. 2	X	-	-
Microdessus sp. 1	-	-	X
Neobidessus spangleri Young, 1977	-	-	X
Pachydrus sp. 2	-	-	X
Platynectes sp. 1	-	-	X
Platynectes sp. 2	-	-	X
Thermonectus sp. 2	X	-	-
Vatellus grandis Buquet, 1840 [=sp. 2]	X	-	X
Vatellus tarsatus (LaPorte, 1835)	X	-	-
DRYOPIDAE			
Dryops sp. 1	X	-	X
Pelonomus sp. 1	-	-	X
Pelonomus sp. 2	X	-	-
ELMIDAE			
Cylleopus sp. 1	X	-	-
New Genus 1, sp. 1	X	-	-
Hintonelmis	X	-	-
Macrelmis sp. 1	X	-	-
Neoelmis sp. 1	X	-	-
Phaenocerus sp. 1	X	-	-
Phaenocerus sp. 2	-	-	X
EPIMETOPIDAE			
Epimetopus sp. 3*	-	-	X
GYRINIDAE			
Gyretes sp. 1	X	-	X
Gyretes sp. 2	-	-	X
Gyretes sp. 3	-	-	X

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Appendix 4.1. continued

Taxon	Upper Palumeu	Grensgebergte	Kasikasima
HYDRAENIDAE			
Hydraena sp. A	X	-	-
Hydraena sp. B	X	-	-
Hydraena sp. C	X	-	-
HYDROCHIDAE			
Hydrochus sp. 1	-	-	X
Hydrochus sp. 3	-	-	X
Hydrochus sp. 6	X	-	-
Hydrochus sp. 7	X	-	-
HYDROPHILIDAE			
Anacaena cf. *suturalis*	-	-	X
Anacaena sp. 2	X	-	-
Anacaena sp. 3	-	-	X
Australocyon sp. 1	X		X
Australocyon sp. 2	X	-	X
Berosus sp. 1	X	-	-
Cercyon sp. 2	X	-	-
Cercyon sp. 3	-	-	X
Cercyon sp. 4	X	-	-
Cercyon sp. 5	-	-	X
Cercyon sp. 6	-	-	X
Cercyon sp. 7	X	-	X
Cetiocyon incantatus Fikacek & Short, 2010	X	-	X
Chasmogenus sp. X*	X	-	X
Cyclotypus sp. 1*	X	-	-
Derallus intermedius Oliva, 1995	X	-	X
Derallus perpunctatus Oliva, 1983	-	-	X
Derallus sp. 2	-	-	X
Derallus sp. 3	-		X
Enochrus sp. 1*	X	-	X
Enochrus sp. 4	-	-	X
Enochrus sp. 6	-	-	X
Enochrus sp. 7	-	-	X
Globulosis sp. 1*	X		X
Guyanobius sp. 1	-		X
Helochares sp. 1*	X	-	-
Helochares sp. 2	X	-	X
Helochares sp. 4	-	-	X
Helochares sp. 6*	-	-	X
Hydrobiomorpha sp. 1	X	-	-
Moraphilus sp. 1	X	-	X

table continued on next page

Appendix 4.1. continued

Taxon	Upper Palumeu	Grensgebergte	Kasikasima
Gen. Nov. 1, sp 1*	-	-	X
Gen. Nov. 1, sp 2*	X	-	X
Gen. Nov. 2, sp. 1*	-	-	X
Gen. Nov. 3, sp. 1*	-	X	X
Gen. Nov. 4, sp. 1*	-	X	-
Gen. Nov. 4, sp. 2*	-	X	X
Notionotus shorti Queney, 2010	X	-	-
Notionotus sp. 2*	-	-	X
Notionotus sp. 3*	X	-	-
Oocyclus coromoto Short & Garcia, 2010	-	X	X
Oocyclus floccus Short & Garcia, 2010	X	-	X
Oocyclus petra Short & Garcia, 2010	-	X	-
Oosternum sp. 2	X	-	X
Oosternum sp. 3	X	-	X
Oosternum sp. 4	X	-	X
Pelosoma sp. 1	-	-	X
Pelosoma sp. 3	X	-	-
Pelosoma sp. 4	X	-	-
Pelosoma sp. 5	X	-	X
Pelosoma sp. 6	-	-	X
Pelosoma sp. 7	X	-	-
Phaenonotum sp. 3	-	-	X
Phaenostoma sp. 2	X	-	-
Phaenostoma sp. 4	-	-	X
Quadriops sp. 1	X	-	-
Quadriops sp. 2	-	-	X
nr. *Quadriops* sp. 1*	X	-	-
nr. *Quadriops* sp. 2*	-	-	X
Sacosternum sp. 1	-	-	X
Tobochares sipaliwini Short & Kadosoe, 2011	-	-	X
Tobochares striatus sp.n.	X	X	X
Tobochares kasikasima sp.n.	-	-	X
Tropisternus chalybeus LaPort, 1840	X	-	X
Tropisternus setiger Germar, 1824	X	-	-
HYDROSCAPHIDAE			
Scaphydrus sp. 1*	-	X	-
NOTERIDAE			
Notomicrus sp. 1	-	-	X
Notomicrus sp. X	X	-	X
Siolius bicolor Balfour-Browne, 1969	-	-	X
Suphisellus sp. 1	X		X

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Appendix 4.1. continued

Taxon	Upper Palumeu	Grensgebergte	Kasikasima
LUTROCHIDAE			
Lutrochus sp. 1*	-	-	X
TORRIDINCOLIDAE			
Gen. Nov. 1, sp. 1*	-	X	X
Gen. Nov. 2, sp. 2*	-	X	X
Iaper sp. 1*	-	-	X
TOTAL:	**92**	**10**	**105**

[*=new species]