

Records of shrews from Panay and Palawan, Philippines, with the description of two new species of *Crocidura* (Mammalia: Soricidae)

Nálezy bělozubek z ostrovů Panaj a Palawan (Filipiny), s popisem dvou nových druhů rodu *Crocidura* (Mammalia: Soricidae)

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Abstract. Two new species of shrews are described from the Philippines; *Crocidura panayensis* sp. nov. from primary montane forest on Panay, and *C. batakorum* sp. nov. from secondary lowland forest on Palawan. Both taxa belong to different species groups and have different biogeographical relations. New specimens of *Suncus murinus* are reported from both islands, including an albinistic specimen from Panay.

INTRODUCTION

The Philippine Islands belong to the archipelagos in eastern Asia that house a diverse and unique mammal fauna, including endemic buffalo, deer, pigs, primate, pangolin, bats, rodents, hedgehogs and shrews (HEANEY et al. 1998). Despite a long history of mammal research and a continuous flow of discoveries and descriptions of new species, the mammal fauna of this archipelago is far from being completely known. Shrews form only a small part of the mammal fauna of the Philippines. HEANEY & RUEDI (1994) and HEANEY et al. (1998) recognized eight species, six of which are endemic, one is widespread in Asia, and one is a non-native species that often lives in and near houses. All native species belong to a single genus, *Crocidura*.

The mammalian fauna of Palawan Island was reviewed by ESSELSTYN et al. (2004). Among the 58 native species of mammals listed there are two species of shrews: the Palawan shrew *Crocidura palawanensis* Taylor, 1934, and a small unidentified species *Crocidura* sp. The latter record is based on a single humerus obtained by REIS & GARONG (2001) from Quaternary sediments during an archaeological survey of Palawan. The authors stated that their find is similar in size to *Crocidura monticola* Peters, 1870. As this bone was the only hint for an unknown species of shrew in this island, ESSELSTYN et al. (2004) recommended that the shrew “be sought by trapping with small snap-traps baited with live earthworms and pitfall traps.” The mammal collections of the Museum Bonn already house a complete specimen of such a small shrew from Palawan that most probably represents the species known from the Quaternary sediments. The extant species is described below.

Compared to Palawan, the mammal fauna of Panay is rather poor. HEANEY et al. (1998) listed 30 species, and CURIO (unpublished) and HUTTERER (2002, 2004) provided evidence for the occurrence of further species. Specimens collected in the highlands of the NW peninsula of

Panay included blackish-brown shrews of medium size that were not previously known from this island (HUTTERER 2002). These have been studied in more detail since and are now referred to a new species named and described below.

The house shrew, *Suncus murinus* (Linnaeus, 1758), is common in the archipelago but specific localities and measurements are not frequently available. New records from both islands are therefore also mentioned and discussed.

MATERIAL AND METHODS

The new specimens studied in this report were either found dead (on Palawan) or obtained as accidental deaths in pitfalls set for frogs during field work near the research station of the Philippine Endemic Species Conservation Project (RESCP) at Sibaliw, Municipality of Buruanga (11°49.188'N, 121°58.064'E), on the island of Panay. All specimens were preserved in ethanol, and external measurements (head and body length, HB, tail length, T, and hind foot length, HF) were taken subsequently from the preserved specimens. Hind foot measurements do not include the claw. Pilosity was calculated as the percentage of the tail portion covered with long bristle hairs (hairy part in mm \times 100 / total length of tail in mm). Skulls were extracted and measurements (in mm) taken with a calliper or with a micrometer attached to a binocular. Skull and tooth measurements are as defined in HUTTERER & KOCK (2002). Abbreviations used in Tables 1 and 5 include condyloincisive length, CIL, and upper tooththrow length, UTR. Cranial and dental nomenclature follows MEESTER (1963). Details on technical names of species mentioned in the text can be found in HUTTERER (2005).

Abbreviations of institutions used in the text are as follows: BMNH = British Museum, now the Natural History Museum, London, U.K.; SMNS = Staatliches Museum für Naturkunde Stuttgart, Germany; USNM = National Museum of Natural History, Washington, D.C., U.S.A.; ZFMK = Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany.

NEW RECORDS AND DESCRIPTIONS

Soricidae G. Fischer, 1814

Crocidura panayensis sp. nov.

HOLOTYPE. ZFMK 2003.1091, adult female, preserved in alcohol, skull extracted and cleaned, collected by E. CURIO on 13 May 2000; to be transferred to the Philippine National Museum, Manila.

PARATYPES. Further three specimens (ZFMK 2003.1092, 2003.1093, 2003.1094) from the type locality, 450–480 m a. s. l., obtained between 2001 and 2003.

TYPE LOCALITY. The Philippines, Panay, NW peninsula, Sibaliw, Municipality of Buruanga [11° 49.188' N, 121° 58.064' E], 450 m a. s. l., in primary montane forest.

DIAGNOSIS. Blackish-brown *Crocidura* of medium size; tail long (87% of head and body length), about half (47%) of tail covered by long bristles; hindfoot short (14.4–15.2 mm); skull large and robust (condyloincisive length CIL 22.9–23.2 mm), interorbit narrow; parastyle of P4 low, upper M3 short and wide.

MEASUREMENTS. External and cranial measurements are given in Tables 1 and 2.

DESCRIPTION (Figs 1–3). Medium size, head and body length 65–74 mm with a long tail ranging from 81–94% of head and body length. Head long and pointed (Fig.1), with numerous long vibrissae up to 22 mm in length. Ears large (6.5–9 mm) and covered with very short dark hairs. Dorsal pelage blackish brown, gradually fading into dusky brown on venter. Hairs short, on dorsum 4.2, on mid-venter 3 mm in length. Body hairs fairly uniformly coloured from base to

tip. The tail is as dusky-coloured as the body, with the ventral surface being only slightly paler. Long bristle hairs are present on the proximal half of the tail (33–60%). Dorsal and part of the ventral surfaces of the fore and hind feet are covered by dark short hairs, with the lateral surfaces slightly darker brown than the inner surfaces. Hind feet slender but comparatively short (length without claw 14.8–15.2 mm, including claw 16.2–16.6 mm), ventral surface with prominent plantar granulae. Female with two pairs of inguinal nipples.

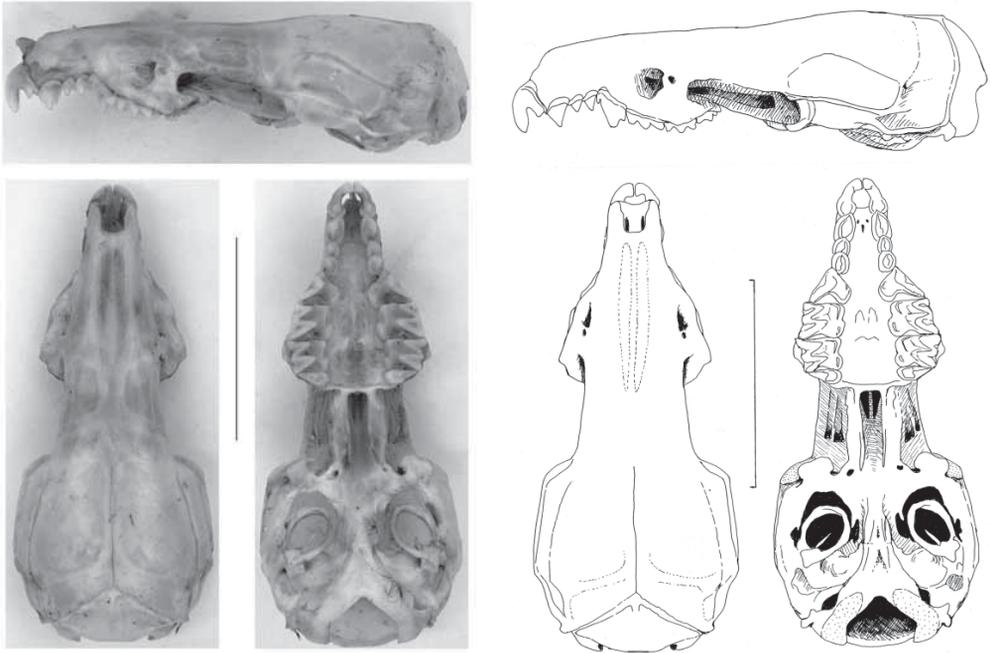
Skull (Figs 2, 3) robust, with a long and wide rostrum, moderately wide maxillary region, and a long and narrow interorbital region. Lateral borders of the interorbital (as seen in dorsal view) almost parallel and only slightly widening from anterior to posterior. Superior articular facets on braincase almost parallel to the long axis of the skull; braincase longer than wide; weak lambda crests present. Dorsal profile of skull (as seen in lateral view) inflated towards the braincase. Mandible relatively slender, condyle wider than high.

First upper incisor large and hooked, its height equal to rostrum height. Anterior tip pointing down in a right angle; talon short and pointed. First unicuspid large, its tip in line with the tip of the first upper incisor. Second and third upper unicuspid subequal in size and length. The



Fig. 1. *Crocidura panayensis* sp. nov., paratype ZFMK 2003.1094. Right: Detail of head to show the shape of the ear conch and the muzzle.

Obr. 1. Běložubka panajská (*Crocidura panayensis* sp. nov., paratypový jedinec, ZFMK 2003.1094). Vpravo: detail hlavy ukazující tvar ušního boltce a čenichu.



Figs. 2, 3. 2 – Skull of *Crocidura panayensis* sp. nov. (holotype ZFMK 2003.1091) in dorsal, ventral, and lateral view. Scale is 10 mm. 3 – Ink sketch of the holotype skull.

Obr. 2, 3. 2 – Lebka bělozubky panajské (*Crocidura panayensis* sp. nov.; holotypový jedinec, ZFMK 2003.1091) ve hřbetním, břišním a stranovém pohledu. Měřítko 10 mm. 3 – Perokresba lebky holotypového jedince.

parastyle of the fourth upper premolar (P4) is small and inconspicuous and shorter than the third upper unicuspid. Protocone well developed, posterior border of P4 concave and in contact with the first upper molar (M1). All molariform teeth are in contact and not spaced lingually (Fig. 4). The broad talon of P4 projects beyond the protocone of M1 but is at level with the hypocone of M1 and M2. First and second upper molar large with a massive talon that leaves only a small triangular space between the posterior border and the subsequent tooth. Third upper molar (M3) short and wide. The first lower incisor (i1) has a prominent cusp in the middle of the cutting blade; the anterior tip of i1 is strongly bended upwards. The first lower premolar (p1) is long and largely overlaps with the cingulum of the first lower incisor. The second lower incisor (p4) is larger than the first, its tip about in line with the tip of the first lower incisor. First (m1) and second (m2) molars large; third lower molar (m3) small, about equal in size to p1, with a reduced talonid and a small talonid basin.

GENETICS. DNA was extracted from preserved muscle tissue and a nuclear gene (Apo B) sequenced (573 bp) and analyzed by SYLVAIN DUBÉY (Lausanne). Preliminary results show that *C. panayensis* sp. nov. clusters with *C. beatus* Miller, 1910 (Mindanao), *C. brunnea* Jentink, 1888 (Java) and *C. nigripes* Miller & Hollister, 1921 (Sulawesi; see RÜEDI et al. 1998). The genetic

Table 1. Some external and cranial measurements of the larger species of *Crocidura* occurring in the Philippine Islands, based on measurements of the author taken from specimens in BMNH, USNM, ZFMK, or quoted from RABOR (1952)

Tab. 1. Něco vnějších a lebečních rozměrů větších druhů rodu *Crocidura* obývajících Filipíny. Založeno na rozměrech shromážděných autorem v BMNH, USNM, ZFMK, anebo převzatých z RABORA (1952). Legenda: HB = délka těla, T = délka ocasu, pilosity = osrstění, HF = délka zadní tlapy, CIL = kondylořezáková délka lebky, UTR = délka horní zubní řady

species	island	n	HB	T (% HB)	pilosity (%)	HF	CIL	UTR
<i>C. palawanensis</i>	Palawan	1	91.0	90.00 (99)	27.8	17.0	23.80	10.53
<i>C. grandis</i>	Mindanao	1	100.0	59.00 (59)	75.0	17.4	23.60	10.10
<i>C. panayensis</i> sp. nov.	Panay	4	70.0	60.75 (87)	47.1	14.9	22.97	10.28
<i>C. cf. palawanensis</i>	Balabac	2	86.5	63.00 (73)	24.8	15.0	22.80	9.80
<i>C. mindorus</i>	Mindoro	2	92.0	73.50 (80)	76.2	16.2	22.30	9.90
<i>C. negrina</i>	Negros	1	86.7	71.60 (83)	?	17.7	22.25	9.97
<i>C. beatus</i>	Mindanao	1	77.0	55.00 (71)	62.0	14.4	20.10	8.90

distance to *C. beatus* was c. 5%. None of the other large species of the Philippines (such as *C. grandis* Miller, 1911, *C. mindorus* Miller, 1910, *C. negrina* Rabor, 1952, *C. palawanensis*) were included in the analysis.

COMPARISONS. The new species forms part of the Philippine radiation of *Crocidura* (see HEANEY & RUEDI 1994 for a review). The structure of the hind foot (elongate shape, prominent plantar granulae, strong pigmentation) corresponds to those of most of the Philippine *Crocidura* studied by HEANEY & RUEDI (1994). In size, it is comparable to *Crocidura grandis*, *C. mindorus*,



Fig. 4. Left upper molar series (P4–M3) of *Crocidura panayensis* sp. nov. (holotype ZFMK 2003.1091); length of P4–M3 is 5.75 mm.

Obr. 4. Levá horní řada stoliček (P4–M3) bělozubky panajské (*Crocidura panayensis* sp. nov.; holotypový jedinec, ZFMK 2003.1091); délka zubní řady P4–M3 je 5.75 mm.

Table 2. Weight (in g), external and cranial measurements (mm) of *Crocidura panayensis* sp. nov.

Tab. 2. Hmotnost (v gramech), vnější a lebeční rozměry (v mm) bělozubky panajské (*Crocidura panayensis* sp. nov.). Legenda: sex = pohlaví, age = věk, weight = hmotnost, head and body length = délka těla, tail length = délka ocasu, pilosity = osrstění, hind foot length = délka zadní tlapky, ear length = délka ušního boltce, condyloincisive length = kondylořezáková délka lebky, maxillary breadth = šířka horní čelisti, interorbital width = meziočnicová šířka, greatest width = největší šířka lebky, height of braincase = výška mozkovny, postglenoid width = šířka za kloubními jámami, upper toothrow length = délka horní zubní řady, distance P4–M3 = délka horní řady stoliček (P4–M3), coronoid height = výška korunového výběžku

measurement \ specimen	ZFMK	ZFMK	ZFMK	ZFMK	means
	2003.1091	2003.1092	2003.1093	2003.1094	
	holotype				
sex	female	male	female	female	n = 4
age	ad.	y.ad.	y.ad.	y.ad.	–
weight	9.9	10.5	8.7	9.0	9.5
head and body length	65	70	74	71	70
tail length	61	58	60	64	60.75
pilosity (%)	52.5	60.3	33.3	42.2	47.1
hind foot length (s.u.)	14.8	15.2	15.4	14.4	14.95
ear length	7.8	8.9	6.4	7.1	7.55
condyloincisive length	22.89	23.27	22.97	22.76	22.97
maxillary breadth	7.37	7.55	7.27	7.59	7.44
interorbital width	4.73	4.62	4.81	4.92	4.77
greatest width	10.01	10.04	9.96	10.52	10.13
height of braincase	5.43	5.52	5.39	5.37	5.43
postglenoid width	7.25	7.01	7.04	7.31	7.15
upper toothrow length	10.21	10.52	10.35	10.06	10.28
distance P4–M3	5.75	5.85	5.74	5.87	5.80
coronoid height	5.64	5.56	5.63	5.76	5.65

C. negrina, and *C. palawanensis* (Table 1). Of these, all except *C. grandis* have longer tails, larger bodies and longer hind feet. Cranially, all except *C. palawanensis* differ by a broad or moderately broad interorbit. The Panay shrew has a very narrow interorbit, and for this reason it was previously assigned to *C. palawanensis* (HUTTERER 2002). Typical specimens of that species from Palawan have longer tails and a lower pilosity (Table 1), and also show differences in dental traits. Compared to the scanning electron micrographs of *C. palawanensis* shown by HEANEY & RUEDI (1994), *C. panayensis* sp. nov. differs in the shape of the P4 (parastyle small versus prominent; talon in close contact with M1 versus separated by lingual space) and M3 (short and reduced versus long and complex). Specimens from Balabac reported under the name *C. palawanensis* by HEANEY & RUEDI (1994) have shorter tails. It seems questionable whether the Balabac shrews belong to *C. palawanensis* or represent an undescribed taxon. I studied the two specimens from Balabac (USNM 477388, 477389; Table 1) in Washington and consider them as a possible new species.

Crocidura beatus, the species that seems to be genetically similar, has smaller external and cranial measurements (Table 1, and HEANEY & RUEDI 1994, Table 1). All cranial measurements are far below the range covered by *C. panayensis* sp. nov. The upper P4 has a different shape

(small talon, P4 almost not in contact with M1; see HEANEY & RUEDI 1994, Fig. 3D), and M3 is large and complex (not short and reduced). Although the genetic distance for the one gene analyzed is not very large (c. 5%), the morphological differences are obvious. *C. beatus* occurs also at higher elevations. HEANEY et al. (2006) reported it from Camiguin Island from 1000 to 1475 m, versus 450–480 m in *C. panayensis* sp. nov. However no attempts to find the shrew at higher elevations were made. At this moment, I prefer to treat both forms as allopatric species, rather than subspecies of a single species. The entire Philippine complex of *Crocidura* is not yet sufficiently known, and detailed morphological character descriptions in combination with molecular studies will have to be elaborated for all populations before a conclusive picture of the diversity and evolution of these shrews can be drawn.

DISTRIBUTION. The species is endemic to Panay and currently only known from the NW peninsula. Other Panay endemic mammals include the Panay giant fruit bat *Acerodon lucifer* (considered to be extinct), the Panay cloudrunner *Crateromys heaneyi* (GONZALES & KENNEDY 1986), and an unnamed species of *Apomys* (CURIO, pers. comm.).

HABITAT. The species was found on the ground surface of montane primary forest at elevations between 450 and 480 m. Specimens were captured in pitfall buckets put out for frogs.

ETYMOLOGY. The species epithet is derived from the island where it occurs. Panay Shrew is suggested as a common name for the new taxon.

***Crocidura batakorum* sp. nov.**

HOLOTYPE. ZFMK 96.411, old adult male (?) preserved in ethanol, skull extracted; skull in good condition except that part of the left braincase is damaged; found dead on the ground by Sven BÜCHNER on 10 March 1992.

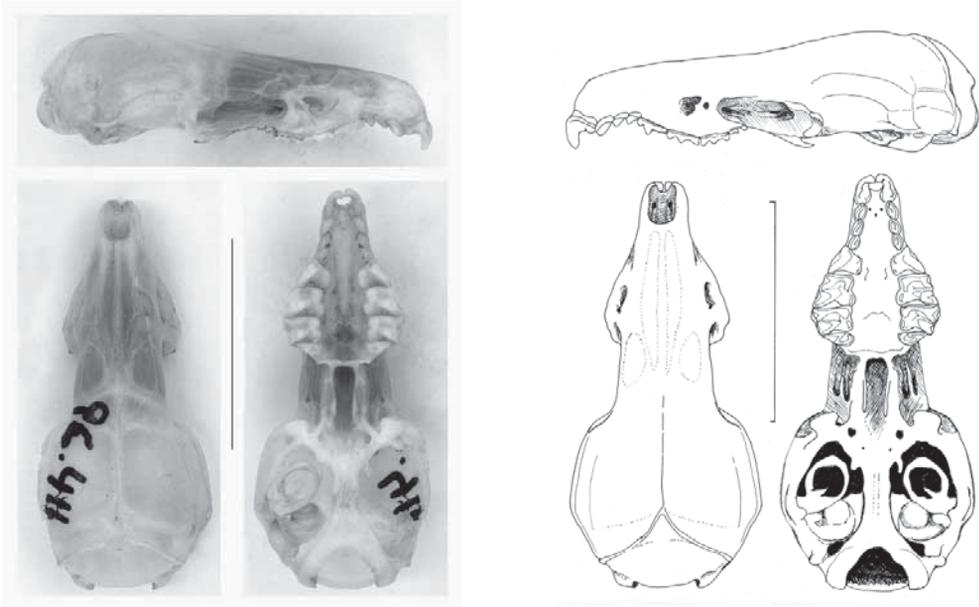
TYPE LOCALITY. The Philippines, Palawan, c. 60 km N Puerto Princesa, Tanabag River valley near village Kalabayog [09° 44' N, 118° 43' E], 200 m a. s. l., in secondary forest.

DIAGNOSIS. A species of *Crocidura* smaller than any other species known from the Philippine Islands. Tail short (68% of head and body length), hindfoot very short (11.5 mm). Skull elongate, with narrow maxillary and braincase. Dentition weak, upper unicuspid teeth narrow in occlusal view.

MEASUREMENTS. External and cranial measurements in Tables 3 and 4.

DESCRIPTION (Figs 5–8). Size small, head and body length 63.5 mm, tail 43 mm, of which the proximal 22 mm are sparsely covered by longer bristles (51% pilosity), hindfoot 12.4 mm (with claw) and 11.5 mm (without claw). Head short and pointed, with sparse vibrissae up to 14 mm in length. Ears prominent (7.6 mm), sparsely covered by short brown hairs. Dorsal and ventral pelage dark brown, the fresh colour not discernible due to preservation in ethanol. Hairs 4.8 mm on dorsum and 4.3 mm on mid-venter in length. Body hairs uniformly coloured from base to tip. Tail, limbs, ears and muzzle paler than the body; the creamy ventral surface of the tail contrasting against the brown dorsal surface. Few long bristle hairs are present on the proximal half of the tail. Dorsal surface of fore and hind foot thinly covered by fine short hairs, with the lateral surfaces only slightly darker than the inner surfaces. Hind foot short, ventral surface with some plantal granulae.

Skull (Figs 5, 6) slender and elongate, with a narrow maxillary region and a moderately long and wide interorbital region. Lateral borders of the interorbital (in dorsal view) almost parallel or even slightly convex. Braincase long and narrow, oval-shaped. No sagittal and only weakly



Figs. 5, 6. 5 – Skull of *Crocidura batakorum* sp. nov. (holotype, ZFMK 96.411) in dorsal, ventral, and lateral view. Scale is 10 mm. 6 – Ink sketch of the holotype skull. Lateral view reversed, damaged part of braincase completed.

Obr. 5, 6. 5 – Lebka běložubky batacké (*Crocidura batakorum* sp. nov.; holotypový jedinec, ZFMK 96.411) ve hřbetním, břišním a stranovém pohledu. Měřítko 10 mm. 6 – Perokresba lebky holotypového jedince. Stranový pohled otočen, poškozená část mozkovny doplněna.

developed lambdoid crests. Dorsal profile of skull (as seen in lateral view) slightly inflated; rostrum long and high. Mandible slender; condyle much wider than high, with the tip of the superior articular facet being bent laterally.

Dentition of the holotype heavily worn but generally weak. First upper incisor small (length about half of rostrum height). Anterior tip pointing down; talon weak. First unicuspid large,

Table 3. Some external and cranial measurements of the smaller species of *Crocidura* occurring in the Philippine Islands, based on measurements of the author taken from specimens in BMNH, USNM, and ZFMK

Tab. 3. Něco vnějších a lebečních rozměrů menších druhů rodu *Crocidura* obývajících Filipíny. Založeno na rozměrech shromážděných autorem v BMNH, USNM a ZFMK. Vysvětlení zkratk viz tab. 1

species	island	n	HB	T (%HB)	pilosity (%)	HF	CIL
<i>C. grayi</i>	Luzon	4	78.0	55.7 (71.4)	86.1	13.2	20.90
<i>C. grayi</i>	Mindoro	4	77.8	55.5 (71.3)	74.3	12.6	19.80
<i>C. batakorum</i> sp. nov.	Palawan	1	63.5	43.0 (67.7)	51.0	11.5	18.74
<i>C. cf. attenuata</i>	Batan	1	–	42.0 (–)	75.0	–	20.70

second and third upper unicuspid about equal in size and length. All three teeth overlap to some degree. In occlusal view (Figs 5, 6), the unicuspid row is narrow and shifted somewhat lingually. The parastyle of the fourth upper premolar (P4) is prominent and in line with the tip of the third upper unicuspid. Protocone weak, posterior border of P4 deeply indented and not in contact with the first upper molar (M1). Molariform teeth well spaced lingually (Fig. 7). The long and narrow talon of P4 projects far beyond the protocone and the hypocone of M1 and M2. Third upper molar (M3) moderately long and wide. The first lower incisor (i1) is much worn and shows no details of the dorsal surface. Lower molars (m1–m3) low-crowned; third lower molar (m3) small, with a reduced talonid but with a pronounced talonid basin.

The postcranial skeleton is shown in Fig. 8. Humerus 6.9 mm, ulna 6.6 mm, femur 9.6 mm, tibia 12.1 mm; 18 caudal vertebrae (based on x-ray).

GENETICS. DNA was extracted from preserved muscle tissue and a nuclear gene (Apo B) sequenced (377 bp) and analyzed by SYLVAIN DUBEY (Lausanne). Preliminary results show that *C. batakorum* is more closely related to *C. elongata* Miller & Hollister, 1921 and *C. lea* Miller & Hollister, 1921 (specimens from Sulawesi reported by RUEDI et al. 1998) than to any other species from the Philippines (*C. beatus*), Eastern Asia (*C. dsinezumii* (Temminck, 1842), *C. kurodai* Jameson & Jones, 1977, *C. lasiura* Dobson, 1890, *C. orii* Kuroda, 1924, *C. shantungensis* Miller, 1901, *C. suaveolens* (Pallas, 1811)), or Indomalaya (*C. attenuata*, *C. brunnea*, *C. horsfieldii* (Tomes, 1856), *C. nigripes*, *C. watasei* Kuroda, 1924, *C. wuchihnsensis* Shaw, Wang, Lu & Chang, 1966). The genetic distance between *C. batakorum* sp. nov. and *C. elongata* + *C. lea* is about 15% (S. DUBEY, P. VOGEL, in litt.).

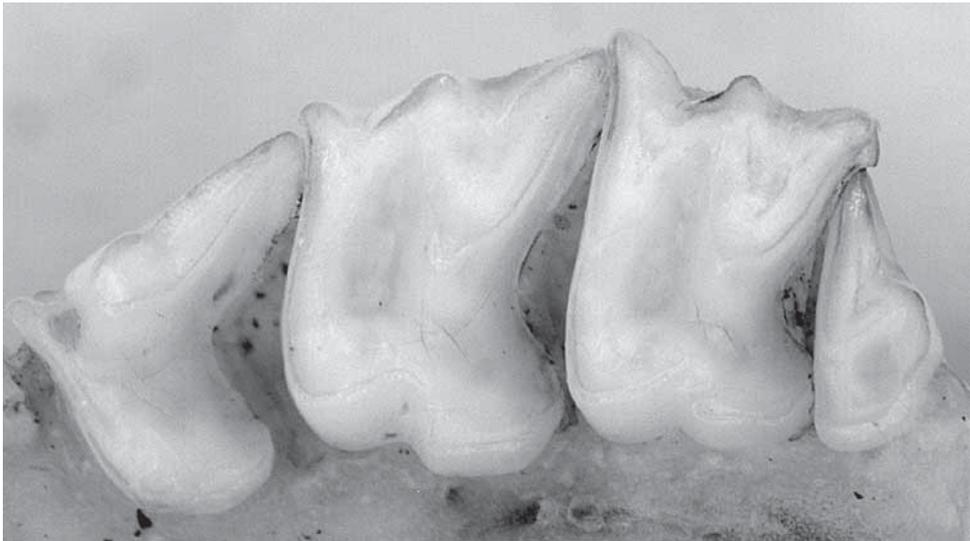


Fig. 7. Left upper molar series (P4–M3) of *Crocidura batakorum* sp. nov. (holotype, ZFMK 96.411); the length of P4–M3 is 4.58 mm.

Obr. 7. Levá horní zubní řada (P4–M3) běložubky batacké (*Crocidura batakorum* sp. nov.; holotypový jedinec, ZFMK 96.411); délka zubní řady P4–M3 je 4,58 mm.

Table 4. External and cranial measurements (mm) of *Crocidura batakorum* sp. nov. and measurements of similar-sized species of the genus *Crocidura*; * includes claws; † data in parentheses refer to specimen BMNH 97.5.2.9

Tab. 4. Vnější a lebeční rozměry (v mm) běložubky bataké (*Crocidura batakorum* sp. nov.) a rozměry druhů rodu *Crocidura* podobné velikosti; * včetně drápů; † údaje v závorce se týkají jedince BMNH 97.5.2.9. Vysvětlení zkratk viz tab. 2

character	<i>batakorum</i> sp. nov. holotype ZFMK 96.411	<i>lea</i> holotype USNM 217553	<i>lea</i> Sulawesi RUEDI 1995	<i>levicula</i> Sulawesi RUEDI 1995	<i>grayi</i> holotype BMNH 55.12.24†	<i>attenuata</i> Vietnam JENKINS et al. 2007	cf. <i>attenuata</i> Batan Is. USNM 526256
sex \ n	male?	male	n=3	n=4	male	n=14–17	?
age	old adult	y. adult	–	–	adult	–	adult
head and body length	63.5	60.0	62.7	60.2	(82)	74.9	–
tail length	43	51	55	37.5	(53)	66	42
pilosity (%)	51	49	c. 60	c. 60	–	–	75
hind foot length	11.5	14*	12.5	10.7	(13)	13.44	–
condyloincisive length	18.74	18.0	18.4	16.2	20.9	19.6+	20.7
maxillary breadth	5.74	5.5	–	–	6.7	5.91	6.8
interorbital width	3.98	4.1	4.1	3.8	4.5	4.74	4.9
greatest width	8.43	8.1	8.5	8.0	9.7	9.52	9.3
height of braincase	4.69	4.1	–	–	5.7	5.2	5.0
postglenoid width	5.81	5.5	–	–	6.3	6.14	6.6
upper toothrow length	7.93	8.0	7.8	6.9	9.4	8.75	9.3
distance P4–M3	4.58	–	4.5	4.1	–	–	–
lower toothrow length	7.18	7.2	–	–	8.6	8.14	8.6
coronoid height	4.38	4.1	–	–	5.2	–	5.0

COMPARISONS. Except for its small size, the holotype of *C. batakorum* sp. nov. exhibits few obvious morphological characters. The specimen was initially misidentified as *C. attenuata* and as such stored in the collection. Indeed, in the key to shrews of East Asia of JIANG & HOFFMANN (2001) one would arrive at *C. attenuata*. This, however, is due to the exclusion of many relevant species from this key. From *C. attenuata*, the new species is distinguished by smaller measurements, but the main difference is the shape of the skull. *C. batakorum* sp. nov. has an elongate skull with a narrow braincase (maxillary breadth 68% of greatest width of braincase), while *C. attenuata* has a wider braincase (MB 62% of GW), resulting in a wedge-shaped skull (in dorsal view). The same is true for the Philippine *C. beatus* and *C. grayi* Dobson, 1890 (Table 3) and other eastern Asian species such as *C. dsinezumii*, *C. orii*, *C. watasei*, *C. suaveolens*, *C. shantungensis* and *C. sokolovi* Jenkins, Abramov, Rozhnov & Makarova, 2007 (some of these species are figured in MOTOKAWA et al. 1996, MOTOKAWA 1998, JIANG & HOFFMANN 2001, and JENKINS et al. 2007).

Three species endemic to Sulawesi, *C. elongata*, *C. lea*, and *C. levicula* Miller & Hollister, 1921, share the elongate skull with *C. batakorum* sp. nov. The first is a large species with a very long tail (120 mm in the holotype USNM 217534) and a very long skull (condyloincisive length 25.0 mm in the holotype). The second is small, in the range of *C. batakorum* sp. nov. (see Table

4), but smaller than it in most cranial dimensions. Maxillary breadth in *C. lea* is also 68% of the greatest width. *C. lea* is a dark-bodied and black-footed shrew with a tail covered by numerous prominent bristles over at least two thirds of its length (RUEDI 1995). It is confined to NE and Central Sulawesi. *C. levicula* is smaller than both *C. lea* and *C. batakorum* sp. nov. (Table 4).

Other small species occurring in the Indomalayan Region are much smaller than *C. batakorum* sp. nov., with condyloincisive lengths between 15 and 16 mm. These include *C. monticola* (Java), *C. kegoensis* Lunde, Musser & Ziegler, 2004, *C. zaitsevi* Jenkins, Abramov, Rozhnov & Makarova, 2007 (both Vietnam), and *C. wuchihnsensis* (Hainan and Vietnam). Figures and measurements of these species are found in RUEDI (1995), LUNDE et al. (2003, 2004), and JENKINS et al. (2007).

DISTRIBUTION AND HABITAT. The species is only known from the holotype. A humerus from cave sediments referred to *C. monticola* by REIS & GARONG (2001) may belong to the new species. Both sites are within the primary forest that covered the island in former times (WIDMANN 1998). The holotype specimen was found dead on the ground in secondary forest near the (former) village Kalabyog in 1992. At that time, primary forest was still present in the close vicinity of the village (S. BÜCHNER, pers. comm.). It is therefore presumed that the species is an inhabitant of the primary lowland forest and endemic to Palawan. A record of *C. palawanensis* from near Puerto Princesa (SANBORN 1952) indicates that both species may occur in syntopy.



Fig. 8. Postcranial skeleton of *Crocidura batakorum* sp. nov. (holotype ZFMK 96.411) as shown in an x-ray. Length of tibia is 12.1 mm.

Obr. 8. Kostra běložubky bataké (*Crocidura batakorum* sp. nov.; holotypový jedinec ZFMK 96.411) rentgenově zobrazena. Délka holenní kosti 12,1 mm.

ETYMOLOGY. The species is named after the Batak, a vanishing people of Palawan which formerly lived in Kalabyog and the nearby primary forest (EDER 1987, HELLER 2002) completely logged now. Batak Shrew is suggested as a common name.

COMMENTS. *Crocidura batakorum* increases the number of mammals endemic to the Palawan faunal region to seven, in addition to *Crocidura palawanensis* (Insectivora), *Manis culionensis* (Elera, 1915) (Pholidota), *Mydaus marchei* (Huet, 1887) (Carnivora), *Chiropotomys calamianensis* (Taylor, 1934), *Sundasciurus rabori* Heaney, 1979, and *Hystrix pumila* (Günther, 1879) (Rodentia) (ESSELYN et al. 2004, GAUBERT & ANTUNES 2005).

***Suncus murinus* (Linnaeus, 1758)**

MATERIAL. **Panay** (6): Young adult male (USNM 175761, holotype of *occultidens*), Iloilo, August 1912; ad. female (ZFMK 2003.1097), Iloilo, 15 m, 28 July 1998; young male (ZFMK 2003.1095), Bulanao staffhouse, Antique, 1998; ad. female (ZFMK 2003.1098), Bulanao, Antique, 30 April 2001, dead in a house; ad. female (ZFMK 2003.1096), Bulanao staffhouse, 2 m a. s. l., 1 April 2000; 1 juv. (ZFMK 2003.1099), Mag-aba, Pandan, c. 5 m, 24 August 2003. **Palawan** (1): juv. male (ZFMK 96.412), Puerto Princesa City,



Fig. 9. Albino specimen of *Suncus murinus* from Panay (ZFMK 2003.1099).

Obr. 9. Albinotický jedinec běložubky hnědé (*Suncus murinus*; ZFMK 2003.1099) z Panaje.

Table 5. External and cranial measurements (mm) of eight *Suncus murinus* from Panay and Palawan; * holotype of *Pachyura occultidens*, external measurements taken from HOLLISTER (1913), hind foot measurement includes claw; † albinistic specimen;‡ holotype of *Pachyura palawanensis*, data from TAYLOR (1934), hind foot length includes claw

Tab. 5. Vnější a lebeční rozměry (v mm) osmi kusů bělozubky hnědé (*Suncus murinus*) z Panaje a Palawanu; * holotypový jedinec *Pachyura occultidens*, vnější rozměry převzaty z HOLLISTERA (1913), délka zadní tlapky zahrnuje dráp; † albinotický jedinec;‡ holotypový jedinec *Pachyura palawanensis*, údaje dle TAYLORA (1934), délka zadní tlapky zahrnuje dráp

measurement \ specimen	ZFMK 2003. 1095	ZFMK 2003. 1096	ZFMK 2003. 1097	ZFMK 2003. 1098	ZFMK 2003. 1099†	USNM 175761*	ZFMK 96.412	TC No.89‡
island sex , age	Panay m. y.	Panay f. ad.	Panay f. ad.	Panay f. ad.	Panay ? y.	Panay m. y.ad.	Palawan m. y.	Palawan ?
head and body length	80	90	100	80	75	115*	–	85
tail length	54	61	54	51	49	70*	52	54.5
hind foot length	15.6	16.6	16.3	15.4	17.5	19*	16.3	18‡
weight (g)	11	20.2	24	12	11	–	–	–
condyloincisive length	26.30	27.93	28.41	–	–	31.6	27.65	27
maxillary breadth	8.39	9.09	8.84	–	–	9.9	8.52	–
interorbital width	5.72	5.51	5.29	–	–	6.1	4.99	6
greatest width	10.66	11.30	11.63	–	–	13.6	11.11	11.6
upper toothrow length	12.05	11.89	12.30	–	–	13.5	11.82	12.2
coronoid height	6.52	6.95	6.80	–	–	8.2	6.19	7.8

27 September 1993. **Luzon** (1): ad. female (ZFMK 74.158), Manila, 16 July 1974. **Mindanao** (9): 7 males, 2 females (SMNS 41358–41366), Koronadal, South Cotabato, 10 July 1986.

COMMENTS. The species was already known from Panay (HOLLISTER 1913, TAYLOR 1934, HEANEY et al. 1998) and Palawan (ESSELSTYN et al. 2004) and is widespread in the archipelago. The species is regarded as non-native and may have been accidentally introduced by man during past centuries. However, HEANEY et al. (2006) found the species on Camiguin Island to be most common in montane primary forest, contrary to the conditions on other islands.

The population of Panay was named *Pachyura occultidens* by HOLLISTER (1913), but the character for which the taxon had been named (*occultidens* = hidden tooth, fourth unicuspid not visible from outer side of skull in the type series) is not shown by the newly collected specimens. Three other taxa were described from the Philippines, *Crocidura luzonensis* Peters, 1870 (Luzon), *Crocidura edwardsiana* Trouessart, 1880 (Sulu), and *Pachyura palawanensis* Taylor, 1934. Measurements from Panay and Palawan (Table 5) compared to measurements from other islands (Luzon: HOLLISTER 1913; Camiguin: HEANEY et al. 2006; Mindanao: material in SMNS) do not show much differences between islands but a high variability, an opinion already expressed by TAYLOR (1934). The hind foot seems to be shorter in Panay, but the measurements taken by American authors (HOLLISTER 1913, TAYLOR 1934, HEANEY et al. 2006) often include the claw and are therefore not comparable. *Suncus murinus* is a variable species with size differences between age classes and sexes. One adult female from Bulanao (ZFMK 2003.1098) with a body mass of 12 g was lactating.

A specimen with a completely white pelage was collected near Mag-aba, a beach in Pandan (Fig. 9). Such white specimens are not common, as HOLLISTER (1913) listed 179 house shrews from the Philippines, none of which was aberrant in colour.

CONCLUSIONS

The preceding notes add two further endemic species of mammals to the fauna of the Philippines. The new Batak shrew is of particular interest, as it appears to be related to some rainforest species of Sulawesi. This is interesting as it suggests at least two origins of the shrew fauna of the Philippines. The Batak shrew is related to *C. elongata* and *C. lea* of Sulawesi, while the Panay shrew and probably most other Philippine shrews (*C. beatus* and *C. mindorus* were studied) are more closely related to species occurring in Borneo (*C. foetida* Peters, 1870), Java (*C. brunnea* Jentink, 1888), or Sumatra (*C. lepidura* Lyon, 1908) (RUEDI 1996, RUEDI et al. 1998). A possible third invasion may have led to the unidentified population (*C. cf. attenuata*) of Batan Island.

The relationship of the Panay shrew to other populations in the Philippines cannot be properly resolved at this moment. *C. negrina* and *C. grandis* are only known by their holotypes, and *C. palawansis* and *C. mindorus* may be polytypic species. Only the latter species has been studied genetically so far (RUEDI et al. 1998). The soricid fauna of the Philippines is therefore far from being completely known. Several recently discovered island populations (HEANEY et al. 2006, WIDMANN et al. 2004) deserve a careful study, as do series of specimens already stored in museum collections. The Balabac shrew was already mentioned as such an example. Another problem is the shrew from Batan Island that HEANEY & RUEDI (1994) referred to *C. attenuata*. Cranial measurements (Table 4) and dental traits indicate that this population may belong to a different, yet unidentified, species.

New species of mammals are still found in the Philippine Islands, including extinct dwarf buffalo (CROFT et al. 2006), bats (ESSELYN 2007), or rodents (HEANEY & TABARANZA 2006, RICKART et al. 2002, 2003). This exciting increase in knowledge is accompanied by a loss of natural habitats upon which most of the endemic mammals depend. In the case of Palawan, WIDMANN (1998) has documented the dramatic loss of primary forest over the past decades. The Batak shrew and other animals of the primary forest may still find some natural habitat, but their long-term survival will depend on the preservation of larger tracts of native forest.

SOUHRN

Dva nové druhy bělozubek byly popsány z Filipín: *Crocidura panayensis* sp. nov. z primárního horského pralesa ostrova Panaj a *C. batakorum* sp. nov. ze sekundárního nížinného pralesa ostrova Palawan. Oba taxony náležejí rozdílným skupinám druhů a mají rozdílné biogeografické vztahy. Jsou též uvedeny nové nálezy z jedinci bělozubky hnědé (*Suncus murinus*), včetně albinotického kusu za Panaje.

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