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## A Redefinition and Revision of the *Agabus optatus*-group (Coleoptera, Dytiscidae); an Example of Pacific Intercontinental Disjunction

by A. N. Nilsson

**Abstract:** The *Agabus optatus* Sharp, 1884, group is expanded to include also the former genus *Colymbinectes* Falkenström (except *Platynectes procerus* Régimbart, 1899, that is a junior synonym of *Agabus conspicuus* Sharp, 1873, n. syn.) and the two species in the Nearctic *Agabus obtusatus* (Say, 1823) group sensu Larson (1989). The following generic syn. n. are suggested: *Colymbinectes* Falkenström, 1936, and *Neoplatynectes* Vazirani, 1970 = *Agabus* Leach, 1817. Twelve species are recognized in the *optatus*-group, including the following n. sp.: *Agabus koreanus* and *A. ussuriensis* from South Primorye, and *A. ikedai* and *A. nakanei* from Japan. *Gaurodytes miyamotoi* Nakane, 1959, is synonymized with *Agabus optatus* Sharp, 1884, n. syn. The following n. comb. are suggested: *Agabus ater* (Falkenström, 1936), *A. coriaceus* (Régimbart, 1899), and *A. princeps* (Régimbart, 1888). The male of *A. coriaceus* is described for the first time. The instar II-III larvae of *A. koreanus* are described. The following new geographic records are presented: *Agabus insolitus* – China, *A. coriaceus* – Burma. The biogeography of the group is discussed.

**Key words:** Coleoptera Dytiscidae – *Agabus optatus* – group – taxonomy – distribution.

### Introduction

Within the Colymbetinae, the Agabini is characterized by the presence of a linear group of short, stout setae near the posterior ventroexternal angle of the metafemur (BRINCK, 1948). Another potential synapomorphy of this tribe is the presence of a “preoral comb” in the head of larvae (DE MARZO & NILSSON, 1988). However, this character has only been verified in relatively few species of the Agabini.

The generic classification of Agabini needs to be revised. The tribe Agabini can be separated into two major groups of genera (NILSSON, unpublished results): (1) those having a pair of elliptical, sublateral clypeal foveae, and female metatibia and -tarsus with ventral fringe of natatorial setae present, viz. *Andonectes* Guéorguiev, 1971, *Agametrus* Sharp, 1882, *Leuronectes* Sharp, 1882, and *Platynectes* Régimbart, 1878; (2) those having linear clypeal foveae near anterolateral angles or along entire anterior margin and having female metatibia and -tarsus without the ventral setal fringe, i.e. the rest. The only

contradiction to this pattern known to me is the female of *Ilybius discedens* Sharp, 1882, that has the ventral setal fringe (LARSON, 1987).

Within the second group, i.e. the *Agabus*-group of genera, a generic revision is badly needed. The chief problem being the large genus *Agabus* that so far has not been defined by a single synapomorphy. The current recognition of many small, often monobasic, genera has resulted in a concept of *Agabus* that surely is paraphyletic. In this situation, the classification of subgenera and species-groups within *Agabus* is problematic, and previous attempts have often failed to take account of the world fauna.

In his classification of *Agabus*, Sharp (1882) defined his third species-group chiefly on the broad, flat and polished prosternal process in combination with the widely separated mesocoxae. This group included the Nearctic *A. obtusatus* (Say, 1823), *A. planatus* Sharp, 1882, and provisionally *A. brevicollis* LeConte, 1857.

Excluding the third species, LARSON (1989) named this group the *obtusatus*-group, and noted also two characters first mentioned by FALL (1922), viz. the presence of central micropunctures in meshes of elytral reticulation and the yellow postmedial and subapical spots of the elytron.

SHARP (1884) described the two species *A. insolitus* and *A. optatus* from Japan. He mentioned the broad and flat prosternal process of *A. insolitus* and remarked on the aspect of this species being more like "a *Platynectes* or *Agabinus*".

RÉGIMBART (1899) described *A. stygius* from China, and mentioned its similarity to *A. optatus*. In the same work, Régimbart noted the presence of the two elytral characters mentioned above in *Platynectes coriaceus* Régimbart, 1899, and *P. princeps* Régimbart, 1888.

ZIMMERMANN (1934) placed *A. insolitus*, *A. optatus* and *A. stygius* in his *optatus*-group (of *Gauromyces*), having examined only a male of *A. optatus*. Two years later, FALKENSTRÖM (1936) described *Colymbinectes ater* n. gen., n. sp., from China, and mentioned in the description the two elytral characters referred to above.

VAZIRANI (1970) erected the new subgenus *Neoplatynectes* of *Platynectes* for the two oriental species *P. coriaceus* and *P. princeps*. The new subgenus differed from other *Platynectes* chiefly in the metacoxal lines that are divergent anteriorad and reaching metasternum. GUÉORGUIEV (1972) transferred these two species (plus *P. procerus* Régimbart, 1899) to the genus *Colymbinectes*, and reviewed the four species included.

NAKANE (1959) described *A. miyamotoi* from Japan and illustrated habitus and penis of all three Japanese *optatus*-group species. A more detailed review of the Japanese species was recently presented in a master thesis by HIKIDA (1990). This study is based on more than 700 specimens of the group from Japan and includes detailed illustrated descriptions of all species plus distribution maps. Hikida recognized three undescribed species in his material from Honshu, of which his "sp. A" is seemingly identical with my *ikedai*. It is also possible that his "sp. O" is identical with my *koreanus*. Hikida's thesis is written in the Japanese language and his results have so far not been published. As Hikida's work was made available for me very recently and his results have not been published, I have refrained from citing them further.

All species mentioned above, belong to the *Agabus*-group of genera. Consequently, the similarity with *Platynectes* in the structure of the prosternal process and the metasternum is homoplasious. In my opinion, these species are best placed in the same species-group. Giving priority to the oldest name, I refer to this group as the *optatus*-group. The generic assignment of this species-group is not straight-forward.

During the preparation of a generic revision of the Agabini, I have came to the conclusion that the genus *Agabus* is best defined on the presence of a more or less complete linear fovea on the clypeus, referred to as a continuous marginal bead (cf. LARSON, 1975). This synapomorphy is shared among all the *optatus*-group species. However, these species also share potential synapomorphies, e.g. the structure of the prosternal process, with species-groups excluded from *Agabus* under this definition. Until additional characters have been found that can solve this conflict I have chosen to place the *optatus*-group in *Agabus* to which most of its species belong in current classification (LARSON, 1989, MORI & KITAYAMA, 1993).

### Material and methods

The Asiatic species of the group were studied at a more detailed level than the Nearctic ones. This difference was motivated by the ongoing revision of Nearctic *Agabus* carried out by Dr D.J. Larson, St. John's.

The following abbreviations were used: Collections: BML = The Natural History Museum, London, CAS = California Academy of Sciences, San Francisco, CFB = Coll. Fery, Berlin, CNC = Coll. Na-

kane, Chiba-shi, CNU=Coll. Nilsson, Umeå, IBPV=Institute of Biology and Pedology, Vladivostok, MCSNG=Museo Civico di Storia Naturale, Genova, MHNP=Muséum d'Histoire Naturelle, Paris, NML=Naturhistorisch Museum Leiden, NMW=Naturhistorisch Museum Wien, NRMS=Naturhistoriska Riksmuseet, Stockholm, TBM=Természettudományi Múzeum, Budapest, USNM=United States National Museum, Washington DC, ZIS=Zoological Institute (Academy of Sciences), St. Petersburg, ZML=Zoological Museum, Lund. – Others: AV=anteroventral, D=dorsal, L1–L3=instars I–III, MW=maximum body width, TL-h=body length without head (corresponds in average to 92 % of total length), and WC/WS=ratio between width of metacoxa and width of metasternum (LARSON, 1975), measured inside bead.

In the larval description, additional leg spines refer to the ground plan of Agabini as described by Nilsson (1988).

### Definition of *optatus*-group

The characters used to describe the adult morphology of the *optatus*-group are here presented in their plesiomorphic state within the group, i.e. the ground plan is described. Characters were classified as: (1) apomorphic within *Agabus* (*sensu lato*) and unique to the *optatus*-group - these include the characters that provide evidence that the group is monophyletic; (2) apomorphic within *Agabus* but not unique to the *optatus*-group – these are the characters that should help me define the sister-group; and (3) plesiomorphic within the genus – these characters are of no use for the classification of *Agabus*.

*Unique apomorphy*: (1) mesocoxae separated by distance  $> 1.5 \times$  as long as minimum distance between procoxae.

*Shared apomorphies*: (1) clypeus with marginal bead more or less continuous; (2) elytral sculpture with meshes relatively large, not isodiametric and with micropunctures placed centrally in meshes; (3) metasternal wing relatively narrow; (4) metasternum with anteromedial emargination long; (5) elytron with submedial and subapical yellow spots; (6) metacoxal plate and basal abdominal sterna with longitudinal striae.

*Plesiomorphies*: (1) body with lateral outline continuous; (2) metacoxal plate with anterior margin not attaining level of hind margin of mesocoxa; (3) pronotum with anterior transverse row of punctures continuous and anterior bead absent medially; (4) hind leg slender; (5) metatibia with AV row of punctures absent; (6) metatarsus

without additional PV spines and with dorsal face impunctate; (7) male antenna not modified; (8) male protarsal claws not or slightly modified; (9) male pro- and mesotarsomeres 1–3 narrowly dilated and provided with ventral adhesive scales; (10) penis without ventral subapical spine and with dorsal groove narrow; (11) paramere straplike with apical appendage; (12) female ovipositor without lateral ridge.

My redefinition of the *optatus*-group results in the following new generic synonyms:

*Agabus* Leach, 1817: *Zool. Misc.* 3:69, 72 [Type species: *Agabus paykullii* Leach, 1817: *l.c.*:72 (= *Dytiscus serricornis* Paykull, 1799: *K. svenska Vetensk Akad. Handl.* 1:49), by monotypy].

*Colymbinectes* Falkenström, 1936: *Lingnan Sci. J.* 15:97 (Type species: *Colymbinectes ater* Falkenström, 1936: *l. c.*:97, by monotypy), n. syn.

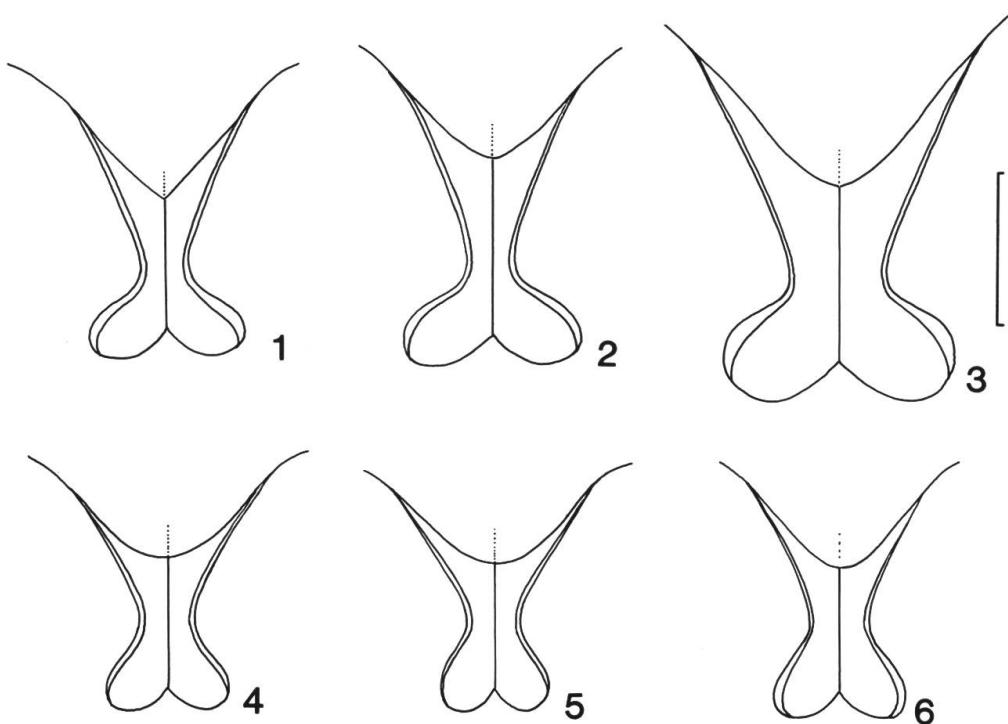
*Neoplatynectes* Vazirani, 1970: *Orient. Insects* 4:305, 340, 343 (as subgenus of *Platynectes* Régimbart) (Type species: *Platynectes princeps* Régimbart, 1888: *Annali Mus. civ. Stor. nat. Genova* 6:615, by original designation), n. syn.

#### Key to species of *optatus*-group for males

(Male of *A. stygius* is unknown)

1. Hind leg slender with tarsomeres 1–4 apically truncate and tarsal claws of same length. Body with maximum width near middle (Fig. 26); length < 8.5 mm . . . . . 2
- Hind leg robust with tarsomeres 1–4 ventrodistally lobed and with anterior claw shorter than posterior claw. Body with maximum width behind middle (Fig. 27); length > 9.2 mm. East Asiatic species (*ater*-subgroup) . . . . . 9
2. Metacoxae with intralinear space dilated medially (Figs 4–6); ratio of minimum width to width at posterior end 0.43–0.49 (measured inside bead). Penis with dorsal groove substraight and in most specimens with ventrodistal spiniform setae (Figs 12–24). East Asiatic species (*optatus*-subgroup) . . . . . 3
- Metacoxae with intralinear space of normal shape (Figs 1–2); ratio of minimum width to width at posterior end 0.30–0.38. Penis with dorsal groove twisted and without ventrodistal spiniform setae (Figs 7–8, 10–11). Nearctic species (*obtusatus*-subgroup) . . . . . 8
3. Penis strongly curved in lateral view (Figs 13, 15). Metasternal wing relatively broad, WC/WS < 3.2 . . . . . 4

- Penis moderately curved in lateral view (Figs 17, 19–20, 22, 24). Metasternal wing of various width, frequently narrower (Tab. 1) . . . . . 5
- 4. Penis broad in dorsal view with groove open; with about 10 ventrodistal spiniform setae (Figs 14–15). Metatibia without AV spines. Metasternal wing broader in average, WC/WS 2.6–2.9
  - A. nakanei** n.sp.
- Penis narrow in dorsal view with groove more or less closed; with 0–2 ventrodistal spiniform setae (Figs 12–13). Metatibia with 4–13 AV spines. Metasternal wing narrower in average, WC/WS 2.8–3.2
  - A. ussuriensis** n. sp.
- 5. Penis less strongly curved in lateral view, with dorsal groove open and apex pointed (Figs 16–17). Metasternal wing very narrow, WC/WS 4.9–5.3.
  - A. insolitus** Sharp
- Penis more strongly curved in lateral view, with dorsal groove more or less closed and apex rounded (Figs 18–24). Metasternal wing broader, WC/WS 2.6–4.4 . . . . . 6
- 6. Penis with less than 2 ventrodistal spiniform setae (Fig. 22). Metasternal wing narrow, WC/WS 4.1–4.4
  - A. ikedai** n.sp.
- Penis with about 10 ventrodistal spiniform setae (Figs 19–20, 24). Metasternal wing broader, WC/WS 2.6–4.1 . . . . . 7
- 7. Penis less robust with subapical constriction in lateral view (Figs 23–24). Metatibia without AV spines. Metasternal wing broader, WC/WS 2.6–2.9
  - A. koreanus** n.sp.
- Penis more robust without evident subapical constriction (Figs 18–20). Metatibia with 4–10 AV spines. Metasternal wing narrower, WC/WS 3.5–4.1
  - A. optatus** Sharp
- 8. Penis broad in lateral view (Figs 7–8). Pronotum with lateral bead narrow.
  - A. obtusatus** (Say)
- Penis narrow in lateral view (Figs 10–11). Pronotum with lateral bead broad.
  - A. planatus** Sharp
- 9. Penis robust (Figs 34–35). Elytral sculpture with small, not very deeply engraved meshes. Body length without head 9.8–10.4 mm.
  - A. ater** Falkenstöm
- Penis slender (Figs 28–33, 36–37). Elytral sculpture with meshes larger, or in some females very small and deeply engraved. Body length without head 8.8–10.0 mm . . . . . 10
- 10. Penis with very narrow apex (Figs 36–37); minimum distance from apex to base 1.4 mm.
  - A. coriaceus** Régimbart
- Penis with apex broader (Figs 28–33); minimum distance from apex to base 1.5–1.7 mm.
  - A. princeps** Régimbart



Figs 1–6: Metacoxae, ventral view. 1. *A. obtusatus* (Say). 2. *A. planatus* Sharp. 3. *A. princeps* (Régimbart). 4. *A. koreanus* n. sp. 5. *A. ussuriensis* sp. n. 6. *A. insolitus* Sharp. Scale bar 1.0 mm.

## REVIEW OF SPECIES

### The *obtusatus*-subgroup

**Diagnosis.** Metacoxal lines of normal shape (Figs 1–2). Hind leg slender with tarsomeres 1–4 apically truncate and claws of same length. Male metatarsomere 4 with ventral setae present. Penis with dorsal groove twisted and without ventrodistal spiniform setae (Figs 7–8, 10–11). Paramere with reduction of sclerotized portion intermediate (Fig. 9).

#### **Agabus obtusatus (Say)**

Figs 1, 7–9.

*Colymbetes obtusatus* SAY, 1823:99 (orig. descr.).

*Colymbetes nitidus* SAY, 1823:98 (orig. descr.; preoccupied by *Dytiscus nitidus* FABRICIUS, 1801:265).

*Gaurodytes obtusatus* (SAY, 1823): CROTCH 1873:421 (descr., syn.).

*Agabus obtusatus* (SAY, 1823): FALL 1922:12 (descr.); MATTA 1986:518 (descr. larva); LARSON & ROUGHLEY 1991:68 (cat.).

**Diagnosis.** Within subgroup recognized on broad penis and pronotum with lateral bead narrow.



Figs 7–11: Penis in dorsal (7, 11) and lateral view (8, 10), and paramere in external view (9). 7, 9. *A. obtusatus* (Say). 10, 11. *A. planatus* Sharp. Scale bar 0.5 mm.

Description. TL-h 6.5–6.6 mm, MW 3.9–4.0 mm, TL-h/MW 1.63–1.66. Metasternal wing narrow, WC/WS 3.88–4.41. Elytral microsculpture with almost all meshes larger than serial punctures and provided with one or more central micropunctures. Metatibia with 2–4 AV spines. Metatarsomere 1 with 2–3 PV spines. Penis broad in lateral view with dorsal groove broad and ending to the left in dorsal view (Figs 7–8).

Type locality. “Germantown” (Pennsylvania, USA).

Type material. Not seen.

Additional material. Canada: Nova Scotia, 8–10 km W Whycocomagh 12.viii.1983 leg. D. J. Larson 1♂ (CNU) USA: New Jersey, leg. Belfrage 1♀ NRMS.

Distribution. Canada: Ontario, Quebec, New Brunswick, and Nova Scotia; USA: North Carolina, West Virginia, Washington CD, Iowa, Pennsylvania, New York, Massachusetts, and Maine.

Natural history. This species is seemingly associated with smaller streams in which it inhabits the more stagnant parts.

### **Agabus planatus** Sharp

Figs 2, 10–11.

*Agabus planatus* SHARP, 1882:503 (orig. descr.); Fl 1922:12 (descr.).

Diagnosis. Within subgroup recognized on narrow penis and pronotum with lateral bead broad.

Description. TL-h 7.5 mm, MW 4.6 mm, TL-h/MW 1.64. Metasternal wing relatively narrow, WC/WS 3.26. Elytral microsculpture with almost all meshes larger than serial punctures and many meshes without central micropuncture. Metatibia without AV spines. Metatarsomere 1 with 1–2 PV spines. Penis narrow in lateral view with dorsal groove broad and ending to the left in dorsal view (Figs 10–11).

Type locality. “North America”.

Type material. Holotype (BML); not seen.

Additional material. USA: Maryland, Prince Georges County, Greenbelt Park 27.x.1991 leg. P. J. Spangler 1♂ (USNM).

Distribution. USA: Maryland, New York, and Massachusetts.

Natural history. It has been collected in a “nearly dry brook” (FALL, 1922) and in “small shaded spring gutter in wooded area” (label on studied male).

### **The *optatus*-subgroup**

Diagnosis. Metacoxal lines only slightly arched (Figs 4–6). Hind leg slender with tarsomeres 1–4 apically truncate and claws of same length. Male metatarsomere 4 with ventral setae reduced in most

specimens. Penis with dorsal groove substraight and with ventrodistal spiniform setae (Figs 12–24). Paramere with slight reduction of sclerotized portion (Fig. 25).

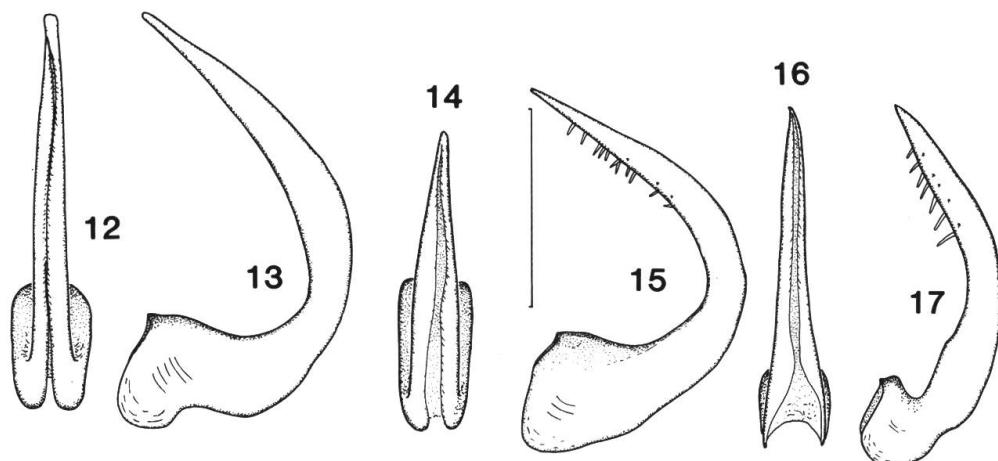
**Agabus insolitus Sharp**

Figs 6, 16–17.

*Agabus insolitus* SHARP, 1884:444 (orig. descr.); RÉGIMBART, 1899:279 (descr.); ZIMMERMANN, 1920:167 (cat.); KAMIYA, 1932:15 (cat.), 1938a:34 (descr.), 1938b:79 (descr.); NAKANE, 1989:23 (descr.), 1990:26 (cat.); SATÔ, 1985:193 (descr.); CHIN, 1989:239 (cat.); MORI & KITAYAMA, 1993:114 (descr.).

*Agabus stygius* RÉGIMBART, 1899:279 (misident., in part); FENG, 1933:113 (in part); WU, 1937:214 (in part).

*Gaurodytes insolitus* (SHARP, 1884): ZIMMERMANN, 1934:192 (descr.); ZAITZEV, 1953:241 (descr.); NAKANE, 1959:96 (descr.), 1963:59 (descr.), 1964:3 (descr.).



Figs 12–17: Penis in dorsal (12, 14, 16) and lateral view (13, 15, 17). 12–13. *A. ussuriensis* n. sp. 14–15. *A. nakanei* n. sp. 16–17. *A. insolitus* Sharp. Scale bar 0.5 mm.

**Diagnosis.** Within group recognized on very narrow metasternal wing and broad prosternal process. Penis almost straight in lateral view and with apex acute.

**Description.** Body small and of medium width (Tab. 1). Maximum width of prosternal process subequal to minimum width of metasternal wing. Metasternal wing very narrow (Tab. 1). Elytron with almost no meshes without central micropuncture and smaller than serial punctures; in female with meshes slightly deeper engraved than in male, or narrow, oblong and very deeply engraved. Metatibia without AV spines. Metatarsomere 1 with 0–3 PV spines. Metacoxae

with intralinear space wide; angle of line very obtuse (Fig. 6). Penis very weakly curved in lateral view and with apex acute; dorsal groove open; with about 10 ventrodistal spiniform setae (Figs 16–17).

Type locality. "Higo" (Kyushu, Japan).

Type material. Holotype ♂ (BML), labelled: "Agabus insolitus Type D.S. Higo. 1882", "Higo 1882", "Type H.T.", "Japan G. Lewis. 1910-320".

Additional material. Japan: Honshu: Kyoto pref., Kyoto City, Hanase Bessho, 19.x.1990 leg. H. Ashida 1♂1♀ (CNU); Miyagi pref., Sendai City, Akiho-cho, 21–24.vii.1992 leg. T. Hosoe 1♀ (CNU); Kyushu: Yamanashi: Mts. Daibosatsu, Hikawa Path, 1400 m, 10.v.1986 leg. T. Abe & A. Sasai 2♂2♀ (CNU); Makioka T., Yakeyama Path 1400 m 2.vii.1968 leg. Y. & T. Abe 1♂3♀ (CNU).

Distribution (Fig. 47). Japan: Honshu and Kyushu, and China: Hubei.

Natural History. This species is confined to mountains where it occurs in seepage or under stones and detritus in streams (MORI & KITAYAMA, 1993).

### Agabus nakanei n. sp.

Figs 14–15.

*Agabus optatus* SHARP, 1884: KAMIYA, 1938a:36, 1938b:82 (misident., in part); SATÔ, 1985:193 (misident.); NAKANE, 1989:22, 1990:26 (misident.); CHIN, 1989:239 (misident.); MORI & KITAYAMA, 1993:112 (misident.).

*Gauromyces optatus* (SHARP, 1884): NAKANE, 1959:95, 1963:59, 1964:3 (misident.).

Diagnosis. Within subgroup recognized on the strongly curved and relatively broad penis that is provided with about 10 ventrodistal spiniform setae. Metasternal wing broad.

Description. Body of large size, and of medium width (Tab. 1). Maximum width of prosternal process much less than minimum width of metasternal wing. Metasternal wing relatively broad (Tab. 1). Elytron with many meshes without central micropuncture and smaller than serial punctures; in female with meshes slightly deeper engraved than in male. Metatibia with 0–11 AV spines. Metatarsomere 1 without PV spines. Penis strongly curved in lateral view and relatively broad in dorsal view; dorsal groove open; with about 10 ventrodistal spiniform setae (Figs 14–15).

Type locality. Mt. Yamizosan, Daigo T., Kuji Co., Ibaraki, Honshu, Japan.

Type material. Holotype ♂ (BML), labelled: "Mt. Yamizosan, 900 m, Daigo T., Kuji Co., Ibaraki, Japan 29th. May, 1988 legit. T. Abe" and my holotype label. Paratypes 4♂1♀; 1♂1♀ with same original label as holotype in (CNU); 1♂ "(Tokara) Nakano-shima 12.vii.1960 M. Satô leg." (CNU); 2♂ "Memuro Hokkaido 8.ix.1992 S. Ohmomo" (CFB).

Additional material. Japan: Hokkaido: Daisetsu, Yukomanbetsu 11.viii.1970 leg. T. Nakane 1♂ (CNC); N. Yasuda, No. 58, Koshiji Pass 29.v.1974 leg. N.Y. 1♀ (CNC); Sapporo, Jyozankei, 26.x.1986 leg. M. Mori 1♂2♀ (CNU); Honshu: Hyogo pref., Mae Onsen-cho, 28.x.1992 leg. A. Kitayama 5♂7♀ (CNU).

**Etymology.** The specific epithet is a noun in the genitive case derived from the name of Prof. T. Nakane, Chiba-shi, who first recognized the specific status of *A. nakanei* and *A. optatus*.

**Distribution** (Fig. 47). Japan: Hokkaido, Honshu, Kyushu, Ryukyu Islands (Tokara).

**Natural history.** This species is confined to mountains, except on Hokkaido where it is known also from lower altitudes. The habitat is seepage or stream margins (MORI & KITAYAMA, 1993).

***Agabus ussuriensis* n. sp.**

Figs 5, 12–13.

*Gaurodytes optatus* (SHARP, 1884): ZIMMERMANN, 1934:191 (misident., in part);

ZAITSEV, 1953:240 (misident., in part); LAFER, 1989:244 (misident., in part).

*Agabus optatus* SHARP, 1884: YOON & AHN 1988:253 (misident.); LEE ET AL., 1992a:51 (misident.).

**Diagnosis.** Within subgroup recognized on the strongly curved and narrow penis that is provided with few or no ventrodistal spiniform setae.

**Description.** Body of medium size, and relatively narrow (Tab. 1). Maximum width of prosternal process much less than minimum width of metasternal wing. Metasternal wing of medium width (Tab. 1). Elytron with many meshes without central micropuncture and smaller than serial punctures; in female with meshes slightly deeper engraved than in male.

Metatibia with 4–11 AV spines. Metatarsomere 1 with 0–3 PV spines. Penis strongly curved in lateral view and relatively narrow in dorsal view; dorsal groove more or less closed; with 0–2 ventrodistal spiniform setae (Figs 12–13).

**Type locality.** Kaminushka, Ussuriysky Preserve, Primorye, Russia.

**Type material.** Holotype ♂ (ZIS) labelled: “Russia: Primorskiy Kr., Ussuriski Res. ponds Kaminushka 18-19.vii leg. AN Nilsson 1992” and with my holotype label. Paratypes 2♂4♀ with same original labels (CNU) and (NRS).

**Additional material.** Korea: Sujang-san at Hedzu 4.vi.1975 leg. Josifov 1♂1♀ (CNU);

Kangwon Prov., Kumgang-san, Onjong-ri 400 m 20.x.1987 leg. Z. Korsós & L. Ronkay 2♂ (TMB), 1♂ (CNU); Kanwon Prov., Kumgang-san, man-myil san 30.v.1970 leg. S. Mahunka & S. Steinmann 1♂ (CFB). China: Jilin prov., Baihe City,

19.viii.1994, 5 inds.; Liaoning prov., Yiwulshan, 5 km NW Beizhen, 22.viii.1994, leg. M.Jäch, JI & Wang, 22 inds. (NMW). Russia: Ural Mts. leg. Katov 1♂ (CAS) (this specimen was identified by Gschwendtner as *A. biguttulus* (Thomson); it is most probably mislabelled).

**Etymology.** The specific epithet is an adjective formed from the geographical name Ussuri.

**Distribution** (Fig. 47). Russia: South Primorye, Korea, NE China.

**Natural history.** In Ussuriskiy Preserve, specimens were found in small pools in a roadside ditch in forest.

***Agabus optatus* Sharp**

Figs 18–20, 26.

*Agabus optatus* SHARP, 1884:445 (orig. descr.); RÉGIMBART, 1899:279 (descr.); ZIMMERMANN, 1920:170 (cat.); KAMIYA, 1932:5 (cat.).

*Gaurodytes optatus* (SHARP, 1884): ZIMMERMANN, 1934:191 (in part).

*Gaurodytes miyamotoi* NAKANE, 1959:65 (orig. descr.) n. syn.; 1963:59 (descr.), 1964:3 (descr.).

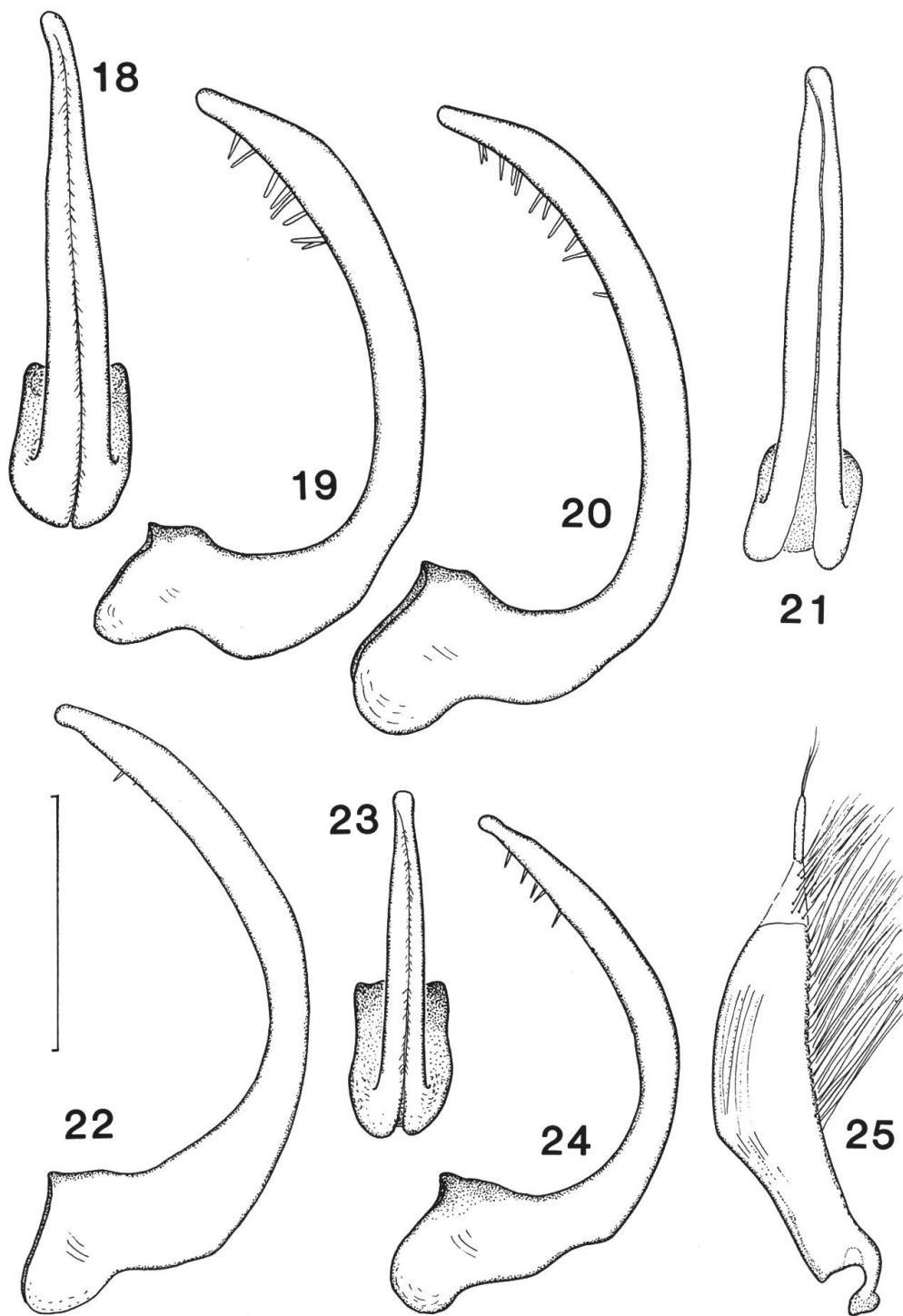
*Agabus miyamotoi* (NAKANE, 1959): SATŌ, 1985:193 (descr.); CHIN, 1989:239 (cat.); NAKANE, 1989:23 (descr.), 1990:26 (cat.); MORI & KITAYAMA, 1993:114 (descr.).

**Diagnosis.** Within subgroup recognized on moderately curved and relatively robust penis without evident subapical constriction and provided with about 10 ventrodistal spiniform setae. Metasternal wing relatively narrow.

**Description.** Body relatively large and of medium width (Tab. 1, Fig. 26). Maximum width of prosternal process much less than minimum width of metasternal wing. Metasternal wing relatively narrow (Tab. 1). Elytron with many meshes without central micro-puncture and smaller than serial punctures; in female with meshes slightly deeper engraved than in male, or meshes narrow, oblong and very deeply engraved. Metatibia with 5–12 AV spines. Metatarsomere 1 with 0–3 PV spines. Penis weakly curved and without evident subapical constriction in lateral view; dorsal groove more or less closed; with about 10 ventrodistal spiniform setae (Figs 18–20).

**Type locality.** Of *optatus* “Kiishiu” (Kishu, Honshu, Japan); of *miyamotoi* “Omogo, Shikoku, Japan”.

**Type material.** Holotype ♀ of *optatus* in BML, labelled: “Agabus optatus Type D.S. Kawatchi Lewis 1874”, “Kawatchi 1874”, “Type H.T.”, “Japan. G. Lewis, 1910-320”. Holotype ♂ of *miyamotoi* in CNC, not seen; paratypes 2♂ seen in CNC, labelled: “Omogo Shikoku 9.xi.1953 T. Nakane”.



Figs 18–25: Penis in dorsal (18, 21, 23) and lateral view (19–20, 22, 24), and paramere in external view (25). 18–20. *A. optatus* Sharp. 18–19. Shikoku. 20. Honshu. 21–22. *A. ikedai* n. sp. 23–25. *A. koreanus* n. sp. Scale bar 0.5 mm.

Additional material. Japan: Shikoku: Ehime Pref., Omogo-Kei 21.vii.1979 leg. M. Satô 3♂3♀ (CNU); Honshu: Ibaraki, Kuji Co., Daigo T., Mt. Yamizosan 900 m 29.v.1988 leg. T. Abe 1♂ (CNU); Aichi Pref., Nagoya, Moriyama, Tohkoku 20.viii.1975 leg. M. Satô 1♂1♀ (CNU); Okayama pref., Kawakami-V., 22.vii.1990 leg. M. Mori 5♀ (CNU); Nakahara, Hirusen, 8.vi.1991 leg. A. Kitayama 8♂1♀ (CNU); Shiga pref., Kouga-T., 23.iii.1990 leg. M. Mori 2♂ (CNU).

**Distribution** (Fig. 47). Japan: Honshu, Kyushu and Shikoku (Mori in litt.).

**Natural history.** This species is confined to the low mountain region. It occurs in seepage, in bogs or at stream margins (MORI & KITAYAMA, 1993).

**Note.** The geographical origin of the holotype is problematic. In the original description, Sharp gave the type locality as "Kiishiu", where it had been collected by Mr. Wada. However, according to the label on the holotype it was collected in "Kawatchi" (= Kawachi), which is situated in the SE corner of the Osaka Prefecture (in Honshu) and quite near the northern range of the Wakayama Prefecture, which used to be called Kii (= Kishu). Earlier authors have all interpreted Sharp's "Kiishiu" as referring to the Kyushu Island. It now seems more reasonable to read it as Kishu (T. Nakane, in litt.).

**Agabus ikedai n. sp.**

Figs 21–22.

**Diagnosis.** Within subgroup recognized on moderately curved and relatively slender penis with slight subapical constriction, and without or with less than 2 ventrodistal spiniform setae. Metasternal wing very narrow.

**Description.** Body relatively large (Tab. 1). Maximum width of prosternal process subequal to minimum width of metasternal wing. Metasternal wing very narrow (Tab. 1). Elytron with many meshes without central micropuncture and smaller than serial punctures; in female with meshes much deeper engraved than in male. Metatibia without or with a single AV spine. Metatarsomere 1 without PV spines. Penis weakly curved and with slight subapical constriction in lateral view; dorsal groove very narrow; with less than 2 ventrodistal spiniform setae (Figs 21–22).

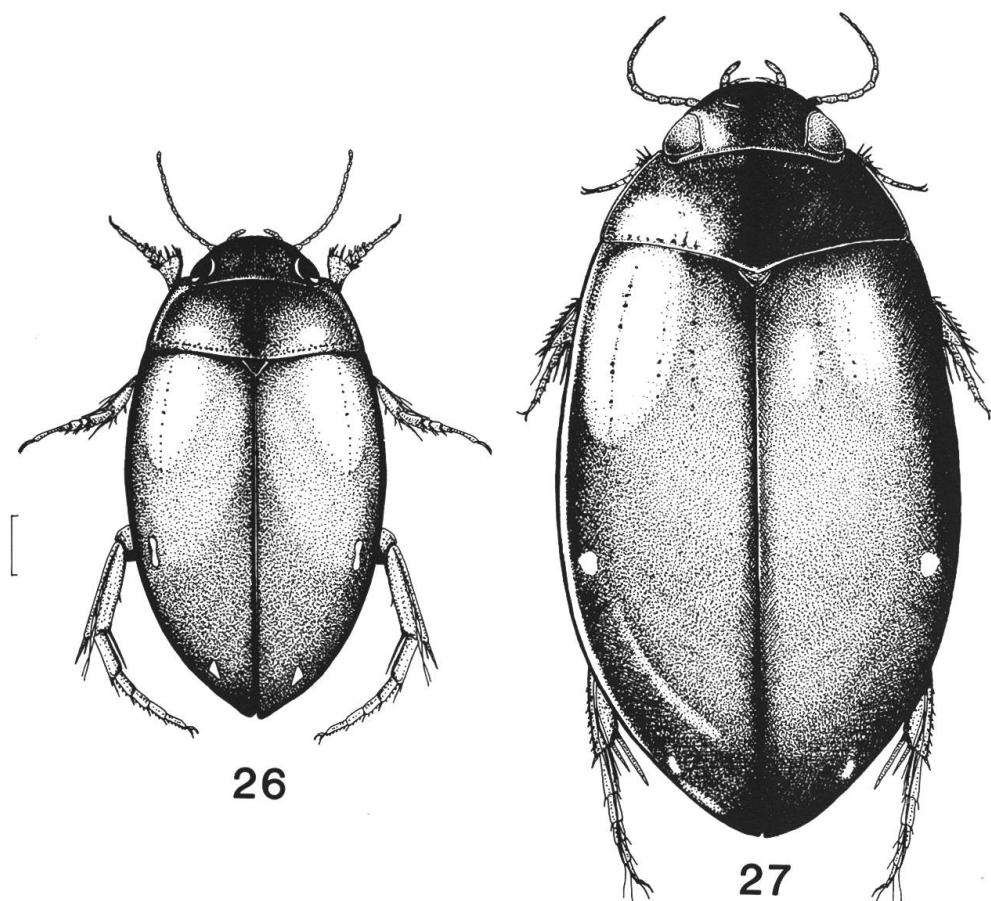
**Type material.** Holotype ♂ in NRMS labelled: "Japan Yamagata pref. Mt. Chokai 800 m leg. T. Ikeda 24.vii.1993" and my holotype label. Paratypes 1♂2♀ in CNU with same original labels and my paratype labels.

**Additional material.** 6♂5♀ from the type locality are deposited in the collections of M. Mori, A. Kitayama and M. Satô (Mori in litt.).

**Etymology.** The specific epithet is a noun in the genitive case derived from the name of Mr T. Ikeda who collected the type material.

**Distribution (Fig. 47).** So far, this species is known only from the type locality in North Honshu.

**Natural history.** This species was collected in seeping water at an altitude of 800 m.



Figs 26–27: Habitus. 26. *Agabus optatus* Sharp, ♂, Shikoku. 27. *A. ater* (Falkenström), ♀ paralectotype. Scale bar 1 mm. Del. G. Marklund.

***Agabus koreanus* n. sp.**

Figs 4, 23–25.

*Agabus miyamotoi* (NAKANE, 1959): LEE ET AL., 1992b:63 (misident.).

**Diagnosis.** Within subgroup recognized on moderately curved and relatively slender penis with subapical constriction. Metasternal wing relatively broad.

**Description.** Body of medium size and width (Tab. 1). Maximum width of prosternal process much less than minimum width of metasternal wing. Metasternal wing relatively broad (Tab. 1). Elytron with

many meshes without central micropuncture and smaller than serial punctures; in female with meshes slightly deeper engraved than in male. Metatibia in most specimens without AV spines. Metatarsomere 1 in most specimens without PV spines. Penis weakly curved and with subapical constriction in lateral view; dorsal groove more or less closed; with about 6 ventrodistal spiniform setae (Figs 23–24).

Type locality. 3 km SE of Ryazanovka, Khasansky Distr., Primorye, Russia.

Type material. Holotype ♂ in ZIS labelled: “Russia: Primorye, 3 km SE of Ryazanovka 16.vii.1992 # 19 leg. AN Nilsson” and my holotype label. Paratypes 16♂6♀ labelled: 10♂5♀ with same locality and date as holotype; 1♂1♀ same locality and date 12–14.vii.1992; 2♂ Russia: Primorye, Ussuriysky Reserve, Kaminushka 18–19.vii.1992; 3♂ Russia: Primorye, 10 km N Khasan Stn. 13.vii.1992, leg. AN Nilsson; and my paralectotype labels. Paratypes deposited in (CNU), (IBPV), and (NRMS).

**Etymology.** The specific epithet is an adjective formed from the geographic name Korea.

**Distribution (Fig. 47).** Russia: South Primorye, and Korea.

**Natural history.** Most specimens were collected in small bog pools on wet coastal slopes with a very sparse *Quercus* forest on drier parts. Water was seeping along the slopes and some pools were connected with small streams. In the Ussuriysky Reserve, a few specimens were collected along the margin of a forest pond.

### **Agabus stygius Régimbart**

Fig. 47.

*Agabus stygius* RÉGIMBART, 1899:279 (orig. descr.); FENG, 1933:113 (cat.); WU, 1937:214 (cat.).

**Diagnosis.** Within subgroup females of *A. stygius* are recognized on the combination of deeply engraved elytral sculpture with narrow, oblong meshes, and metasternal wing not very narrow.

**Description.** Body of medium size and width (Tab. 1). Maximum width of prosternal process much less than minimum width of metasternal wing. Metasternal wing relatively narrow (Tab. 1). Elytron of female with meshes oblong, narrow, and deeply engraved. Metatibia with 0–1 AV spines. Metatarsomere 1 without PV spines. Male unknown.

Type locality. “Thibet: Mou-Pin” (now Pao-hsing, Sichuan, China).

Type material. Lectotype ♀ (MHNP) here designated, labelled: “1051 70” (under yellow dish), “Mou-pin Thibet”, “Museum Paris coll. Maurice Régimbart 1908” and my lectotype label. – Paralectotypes 2♀ (MHNP) here designated, labelled: (1)

“Tàtsien Loû, Chasseurs indigènes 1894”, “Museum Paris coll. Maurice Régimbart 1908”; and (2) “Changyang Chine or.”, “Museum Paris coll. Maurice Régimbart 1908”; and my paralectotype labels.

Distribution (Fig. 47). China: Sichuan.

Natural history. Unknown.

Notes. As Régimbart mentioned male characters in the original description, the type material may include additional specimens. The type locality is the same as for *Amphizoa davidi* Lucas, previously thought to be situated in Tibet, but correctly located to Sichuan by KAVANAUGH (1986). Tà tsien Loû is situated slightly south of Pao-hsing, in the same river system. The two types from this area are no doubt conspecific, and the identity of this species cannot be settled until the male is known. The third paratype, that is from the Hubei prov. in east China, I have identified as *A. insolitus*. It differs from Japanese specimens only in the elytral sculpture that has small, deeply incised, oblong meshes. In my opinion, this difference may well represent female dimorphism.

#### Ambiguous literature records

*Agabus stygius* Régimbart, 1899: Feng, 1936:8 (China, Hebei: Nan Ye Li).

*Agabus optatus* Sharp, 1884: Zeng, 1989:6 (China: Hebei, Sichuan, Fujian and Shanxi); Li, 1992:35 (China: Liaoning).

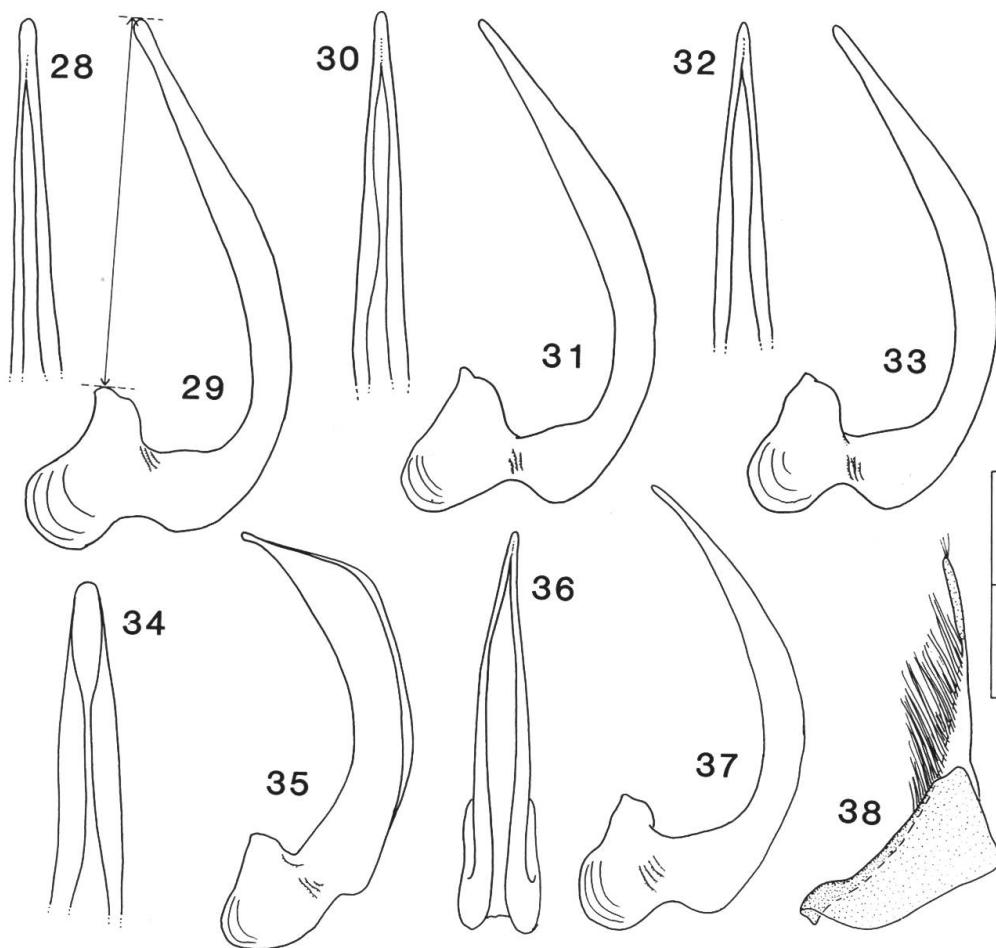
#### The *ater*-subgroup

Diagnosis. Body broadest in posterior half (Fig. 27). Metacoxal lines of normal shape (Fig. 3). Hind leg robust with tarsomeres 1–4 ventrodistally lobed and with claws of unequal length. Male protarsus with anterior claw slightly longer than posterior claw and with ventral margin subsinuate. Male metatarsomere 4 with ventral setae present. Penis with dorsal groove substraight and without ventrodigital spiniform setae (Figs 28–37). Paramere with strong reduction of sclerotized portion (Fig. 38).

**Agabus ater** (Falkenström) n. comb.

Figs 27, 34–35.

*Colymbinectes ater* FALKENSTRÖM, 1936:97 (orig. descr.); ZIMMERMANN & GSCHWENDTNER, 1939:48 (descr.); BRINCK, 1948:113 (class.); ZAITZEV, 1953:284 (descr.); GUÉORGUIEV, 1972:59 (descr.).



Figs 28–38: Penis in dorsal (28, 30, 32, 34, 36) and lateral view (29, 31, 33, 35, 37), and paramere in external view (38). 28–33, 38. *A. princeps* (Régimbart). 28–29, 38. Hong Kong. 29–30. Lectotype, Tenasserim. 32–33. Yunnan. 34–35. *A. ater* (Falkenström), Yunnan. 36–37. *A. coriaceus* (Régimbart), Katchin. Scale bar 1.0 mm. Line in Fig. 29 shows measurement of minimum distance between apex and base of penis.

**Diagnosis.** Within group recognized on elytral sculpture with meshes small and not deeply engraved, large body size, and robust penis.

**Description.** Body large and relatively broad (Tab. 1, Fig. 27). Metasternal wing narrow (Tab. 1). Elytron with meshes of micro-sculpture relatively small, without sexual dimorphism; many meshes smaller than serial punctures. Metatibia without AV spines. Metatarsomere 1 without PV spines. Penis robust and subapically truncated to narrow apex (Figs 34–35).

**Type locality.** “China, Szechwan, Giufu-Shan” (Sichuan Prov.).

**Type material.** Lectotype ♂ here designated (NRMS), labelled: “Giufu-Shan Szechuan Em. Reitter”, “Typus”, “Colymbinectes ater Falk. det. Falkenström” and my

holotype and identification labels. Paralectotype ♀ here designated in NRMS with same original labels, “Allotype”, and my paralectotype and identification labels.

Additional material. China: Yunnan, 1♂1♀; Guizhou: Kouy-Tchéou, R.P.J.R. Chaf-fanjon 1903 1♂ MHNP.

Distribution (Fig. 47). China: Guizhou, Yunnan and Sichuan Provinces.

Natural history. Unknown.

**Agabus coriaceus** (Régimbart) n. comb.

Figs 36–37.

*Platynectes coriaceus* Régimbart, 1899:282 (orig. descr.); Zimmermann 1920:149 (cat.); Zimmermann & Gschwendtner 1935:67 (descr.); Vazirani 1970:343 (descr., lectotype des.).

*Colymbinectes coriaceus* (Régimbart, 1899): Guéorguiev 1972:59 (class., descr.); Vazirani 1977:69 (cat.).

Diagnosis. Within group recognized on elytral sculpture with meshes large in male and small and deeply engraved in female, small body size, and a short and narrow penis.

Description. Body relatively small and broad (Tab. 1). Metasternal wing narrow (Tab. 1). Elytron with meshes of microsculpture relatively large in male with few meshes smaller than serial punctures; in female meshes very small and deeply engraved. Metatibia with 0–8 AV spines in basal half. Metatarsomere 1 without PV spines. Penis short and slender with dorsal groove relatively broad and distal part very narrow (Figs 36–37); minimum distance between base and apex 1.38 mm.

Type locality. “Assam” (India).

Type material. Lectotype ♀ in MHNP designated by Vazirani (1970), labelled: “Assam”, “coriaceus Rég.”, and lectotype and identification labels. Paralectotype ♀ (MHNP) here designated, labelled: “Khasia Hills VII.94”, “Ex Musaeo W. Rothschild, 1899”, “*Platynectes coriaceus* Rég.”, “Dr Régimb. vidit 1899” and my paralectotype and identification labels.

Additional material. India 1♀ MHNP; Burma: Catcin Cauri Nov. 1889 leg. Fea 1♂ (MCSNG).

Distribution (Fig. 47). India: Assam Province, and Burma: Kachin State.

Natural history. Unknown.

Notes. *Agabus coriaceus* (Régimbart) is a junior subjective homonym of *Gaurodytes coriaceus* J.Sahlberg, 1875 [= *Agabus thomsoni* (J. Sahlberg, 1871)]. If this homonymy remains after that the generic classification of the Agabini has been stabilized, the junior homonym should be conserved.

**Agabus princeps** (Régimbart) n. comb. Figs 3, 28–33, 38.

*Platynectes princeps* RÉGIMBART, 1888:615 (orig. descr.), 1899:282 (descr.); ZIMMERMANN, 1920:150 (cat.); FENG, 1933:108 (descr.); ZIMMERMANN & GSCHWENDTNER, 1935:68 (descr.); WU, 1937:212 (cat.); BRINCK, 1948:113 (class.); VAZIRANI, 1970:344 (descr.); ZENG, 1989:6 (cat.).

*Colymbinectes princeps* (RÉGIMBART, 1888): GUÉORGUIEV, 1972:59 (class., descr.); VAZIRANI, 1977:69 (cat.).

**Diagnosis.** Within group recognized on elytral sculpture with large meshes in both sexes, intermediate body size, and a relatively long and slender penis.

**Description.** Body of medium size and relatively narrow (Tab. 1). Metasternal wing narrow (Tab. 1). Elytron with meshes of micro-sculpture large without sexual dimorphism; few meshes smaller than serial punctures. Metatibia without AV spines in basal half. Metatarsomere 1 without PV spines. Penis relatively long and slender with dorsal groove narrow (Figs 28–33). Two penis morphs were recognized: (1) more evenly narrowed to apex and minimum distance between base and apex 1.54–1.58 mm (Figs 30–33); and (2) with slight subapical constriction and minimum distance between base and apex 1.60–1.70 mm (Figs 28–29).

**Type locality.** “Tenasserim: Plapoo” (Burma, Tenasserim Division).

**Type material.** Lectotype ♂ here designated in MCSNG, labelled: “Tenasserim: Plapoo Fea Apr. 1887”, “1200 m”, “*Platynectes princeps* Rég. det. Régimbart”, and my lectotype and identification labels. Paralectotype ♂ here designated in MCSNG, labelled: “Catcin Cauri Birmania Fea Ag. Nov. 1886”, “*Platynectes princeps* Régb. typus!”, “Typus”, and my paralectotype and identification labels.

**Additional material.** Hong Kong: 2♂ ZML; 3♂1♀; China: 2♂1♀; Yunnan 4♂2♀; Vietnam: 1♂; Muong Pak 6.3.1919 leg. V. de Salvaza 1♀; Chapa, Ht. Tonkin 25.v.1916 leg. Vitalis 1♂ MHNP.

**Distribution (Fig. 47).** Hong Kong, China: Yunnan Province, Vietnam, and Burma: Tenasserim Division.

**Natural history.** Unknown.

**Notes.** As the two former syntypes are not conspecific, I have selected the lectotype that best promotes stability of nomenclature. The paralectotype was identified as *A. coriaceus*.

The presence of two relatively distinct penis morphs within *A. princeps* indicates that this taxon may represent a species-complex. VAZIRANI (1970:341) provided illustrations of the two penis-morphs, but did not comment upon the difference in the text.

Moreover, his legend is erroneous, and for fig. 56 "*P. procerus*" should be read *princeps*. The morph to which the lectotype belongs was seen from Tenasserim, Yunnan and Vietnam, whereas the other morph is known from Hong Kong and Vietnam. Due to the poor morphological differentiation and sparse material available I have decided not to split this supposed complex at this stage.

The association of the male paralectotype of *A. princeps* with *A. coriaceus* females needs future verification. I have based this association on the geographical vicinity of the material and a general congruence in morphometric characters. The slightly larger size of the male fits into a general tendency in the *ater*-subgroup of males being larger than females.

Table 1. Selected measurements and ratios from the species of the *Agabus ater* and *optatus* subgroups. Measurements abbreviated as: (MW) maximum body width, (TL-h) total body length without head, (WC) width of metacoxal plate, and (WS) width of metasternum.

	TL-h			MW			TL-h/MW			WC/WS		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
<i>ater</i>	10.2	0.3	5	6.3	0.2	5	1.63	0.01	5	4.20	0.31	5
<i>coriaceus</i>	8.9	0.1	4	5.5	0.1	4	1.62	0.01	4	4.43	0.15	4
<i>princeps</i>	9.3	0.4	19	5.7	0.3	19	1.65	0.02	19	4.34	0.26	19
<i>insolitus</i>	5.3	0.3	11	3.2	0.2	12	1.68	0.03	11	5.06	0.32	7
<i>koreanus</i>	5.9	0.2	7	3.6	0.2	9	1.66	0.04	7	2.72	0.18	6
<i>nakanei</i>	6.5	0.2	21	3.9	0.1	21	1.66	0.03	21	2.75	0.12	19
<i>optatus</i>	6.4	0.2	27	3.9	0.1	27	1.67	0.03	27	3.50	0.24	22
<i>ikedai</i>	6.7	0.2	4	4.0	0.1	4	1.70	0.02	4	4.18	0.13	4
<i>stygius</i>	6.2		2	3.8		2	1.64		2	2.95		2
<i>ussuriensis</i>	6.1	0.3	10	3.6	0.2	12	1.70	0.03	10	2.98	0.12	9

### Species erroneously associated with *ater*-subgroup

#### *Agabus conspicuus* Sharp

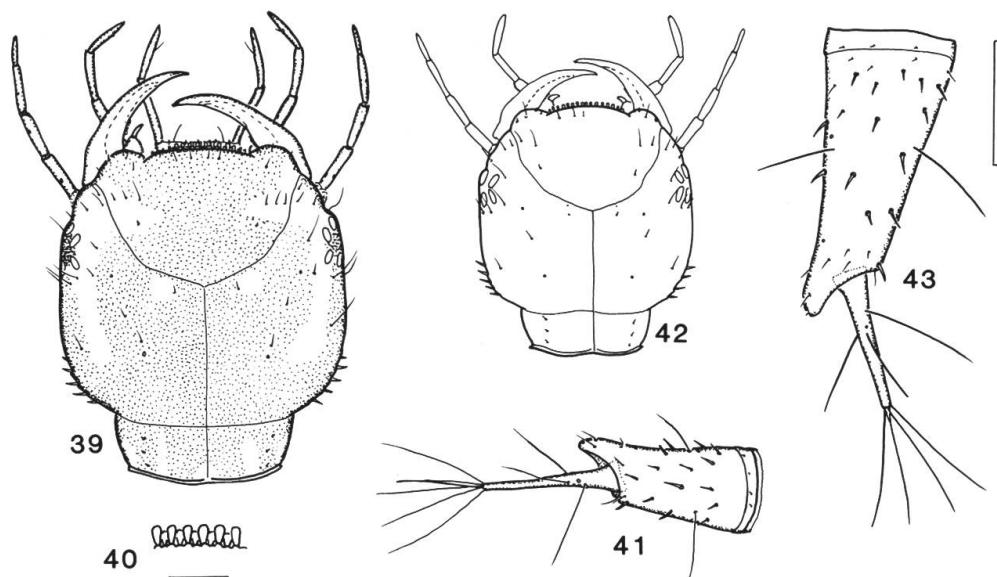
*Agabus conspicuus* Sharp, 1873:48 (orig. descr.).

*Platynectes procerus* Régimbart, 1899:282 (orig. descr.) syn. n.

*Colymbinectes procerus* (Régimbart, 1899): Guéorguiev 1972:58 (descr.).

The study of the holotype of *Platynectes procerus* Régimbart (NML) has shown that it is identical with *Agabus conspicuus* Sharp. As this species is confined to Japan, Korea, and the Far East of Russia, the holotype is most probably mislabelled ("Macklot, Java"). The holo-

type has been attacked by dermestids and the penis apex is partly destroyed. This fact may explain why the subapical spine of the penis is not seen on GUÉORGUIEV'S (1972:55) drawing. *A. conspicuus* belongs to the *arcticus*-group sensu LARSON (1989).



Figs 39–43: *Agabus koreanus* n. sp., larva. 39–41. Instar III. 39. Head, dorsal view. 40. Clypeolabral marginal lamelliform setae, dorsal view. 41. Last abdominal segment with right urogomphus, lateral view. 42–43. Instar II. 42. Head, dorsal view. 43. Last abdominal segment with right urogomphus, lateral view. Different scale bars for 40 (lower left, 0.1 mm) and rest (upper right, 0.5 mm).

### LARVAL MORPHOLOGY

*A. obtusatus* is the only *optatus*-group species of which the larva has been described (MATTA, 1986; instar III). I will here give a description of the two later instars of *A. koreanus*. Four instar III and two instar II larvae were collected together with adults 10 km N of Khasan Station in South Primorye 13.vii.1992.

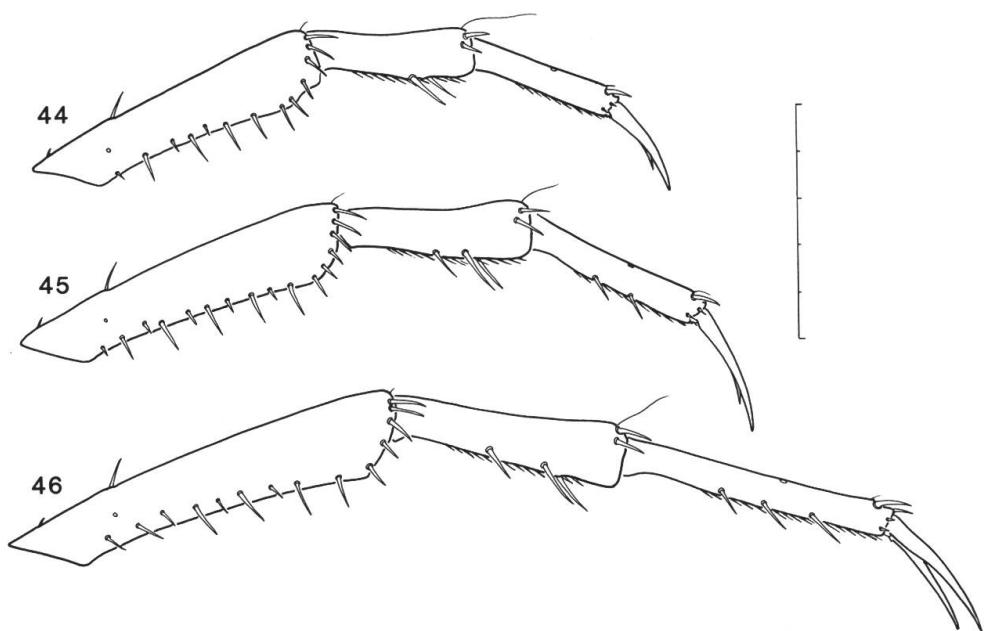
### Description

Total length (excl. urogomphi): L3 6.5–7.7 mm; L2 4.0 mm.

Head length (Figs 39, 42): L3 2.8–2.9 mm with and 2.3–2.4 mm without neck; L2 2.0 mm with and 1.6–1.7 mm without neck.

Head width: L3 2.4–2.6 mm; L2 1.7 mm.

Length of last abdominal segment (Figs 41, 43): L3 2.2–2.3 mm; L2 1.2–1.3 mm.



Figs 44–46: *Agabus koreanus* sp. n, instar III larva, femur, tibia and tarsus of left legs, anterior view. 44. Fore leg. 45. Mid leg. 46. Hind leg. Scale bar 0.5 mm.

Length of urogomphus: L3 1.3–1.6 mm with and 1.2–1.5 mm without segment 2; L2 2.0–2.1 mm with and 1.0–1.2 mm without segment 2.

Head (Fig. 39) in L3 with 4–6 temporal spines and 17 larger plus 16 smaller clypeal lamelliform setae (Fig. 40). Urogomphus without secondary setae (Figs 41, 43). Legs without swimming hairs and with the following additional spines (Figs 44–46): mesotarsus 2 AV, metatarsus 3 AV; meso- and metatibia 1 AV; femora 1 D; coxa 6 D. The total number of AV and PV spines on femur is: pro- 13+10, meso- 16+12, and meta- 14+13.

The larva of *A. koreanus* differs from that of *A. obtusatus* chiefly in its smaller size and less developed leg chaetotaxy with fewer additional tarsal and tibial spines. Both larvae possess relatively few derived characters relative to the presumed ground plan of *Agabus*.

### Discussion

The geographical distribution of the extended *optatus*-group (Fig. 48) mimics one of the best known and most often cited examples of Tertiary relict disjunctions among plants, i.e. that between eastern Asia and eastern North America (BOUFFORD & SPONGBERG, 1983).

This disjunction is generally thought to be the result of the fragmentation of a formerly continuous mixed mesotrophic temperate forest across northern to central Holarctica of Mid to Early Tertiary age (WU, 1983).

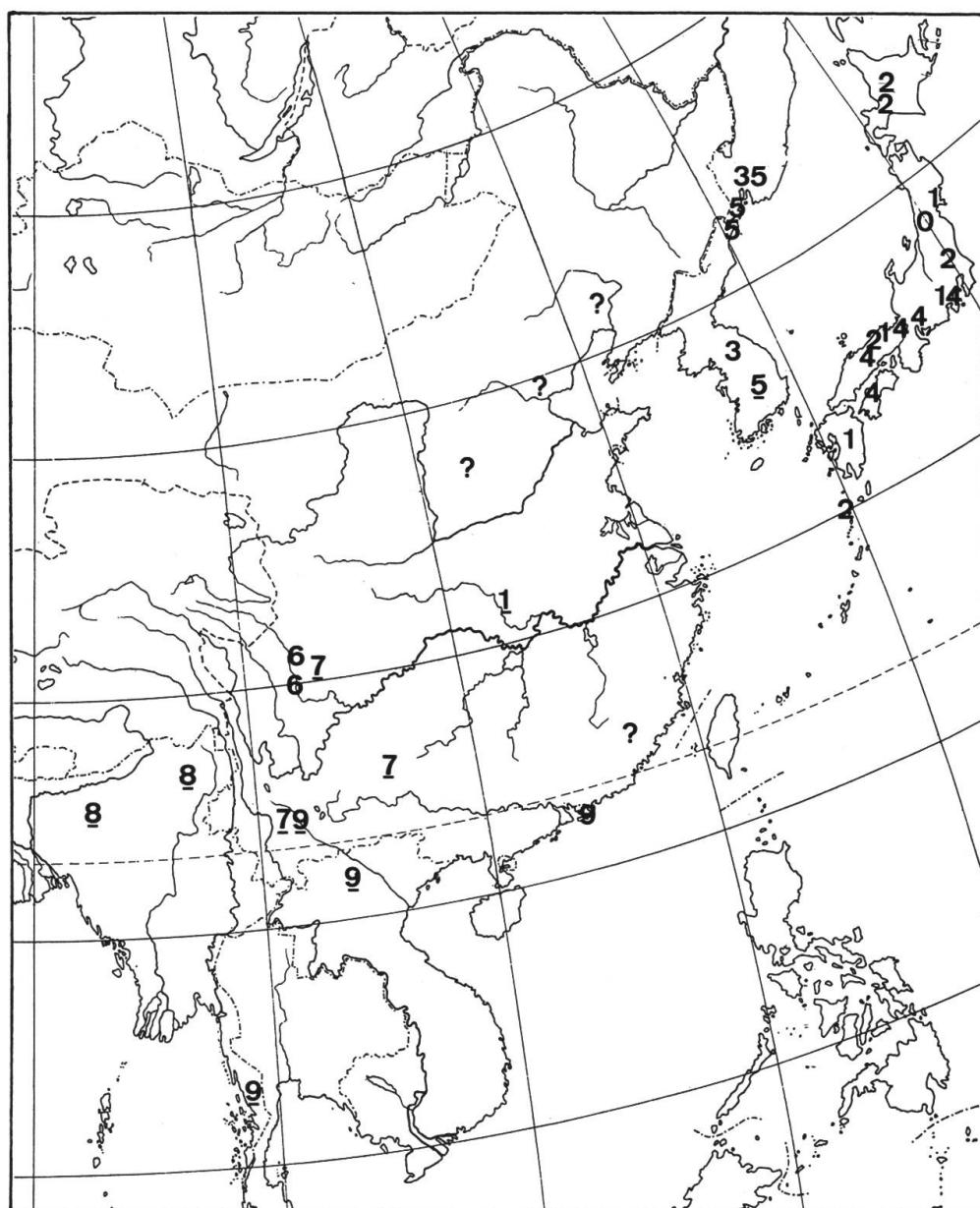


Fig. 47: Geographical origin of the studied material of the *ater*- and *optatus*-subgroups of the *Agabus optatus*-group. Species coded as: (0) *A. ikedai* n. sp., (1) *A. insolitus* Sharp, (2) *A. nakanei* n. sp., (3) *A. ussuriensis* n. sp., (4) *A. optatus* Sharp, (5) *A. koreanus* n. sp., (6) *A. stygius* Régimbart, (7) *A. ater* (Falkenström), (8) *A. coriaceus* (Régimbart), and (9) *A. princeps* (Régimbart). Records only located to province have been underlined, and questionmarks represent records of *optatus*-subgroup not identified to species.

The spreading of drought and cold over middle and higher latitudes that started in the Miocene caused large-scale extinctions of this flora and its associated fauna except in the regions in which favourable climatic conditions persisted (AXELROD, 1983). The climatic cooling and the subsequent break up of Beringia separated the Asian and American stocks of the *optatus*-group.

Among other Dytiscidae, the genus *Agabetes* provides another good example of this kind of disjunction, with one species in eastern North America, and one in the Caucasus (NILSSON, 1989).

The ten species here assigned to the *optatus*-group are relatively homogeneous in spite of their previous placement in two different genera. Several previous authors have associated *Colymbinectes* with the genus *Ilybius* Erichson (e.g. ZIMMERMANN & GSCHWENDTNER, 1939). However, the unmodified ovipositor of all *optatus*-group species provides evidence against this association, that was chiefly based on a similar habitus and the structure of the hind legs. The association of *Colymbinectes* with *Platynectes* (e.g. VAZIRANI, 1970) is contradicted by the structure of the clypeal foveae and the chaetotaxy of the female hind legs as mentioned in the introduction.

The three *optatus*-group species previously assigned to *Colymbinectes* (GUÉORGUIEV, 1972), i.e. the *ater*-subgroup, conform very well with the rest of the *optatus*-group. The most obvious autapomorphy of this subgroup is the robust hind legs with lobed tarsomeres and unequal tarsal claws. Excluding *Ilybius*, this character set is unique within Agabini and therefore cannot provide any phylogenetical evidence.

The only obvious autapomorphy of the *obtusatus*-subgroup is the twisted dorsal groove of the penis. Finally, the *optatus*-subgroup has the following three potential autapomorphies: (1) penis provided with ventrodistal spiniform setae, (2) male metatarsomere 4 with ventral setal fringe reduced, and (3) metacoxal lobes modified. As no synapomorphies have been found that are shared by two of the three subgroups, their phylogenetic relationship has to be viewed as an unsolved trichotomy. However, the geographical ranges of the subgroups (Fig. 48) suggest that the *ater*- and *optatus*-subgroups are sister-taxa.

The evidence of monophyly of the *optatus*-group is ambiguous, i.e. it depends on which phylogenetic hypothesis that is accepted for the entire Agabini. I have found two alternatives that are equally plausible based on the currently available characters. Accepting that the

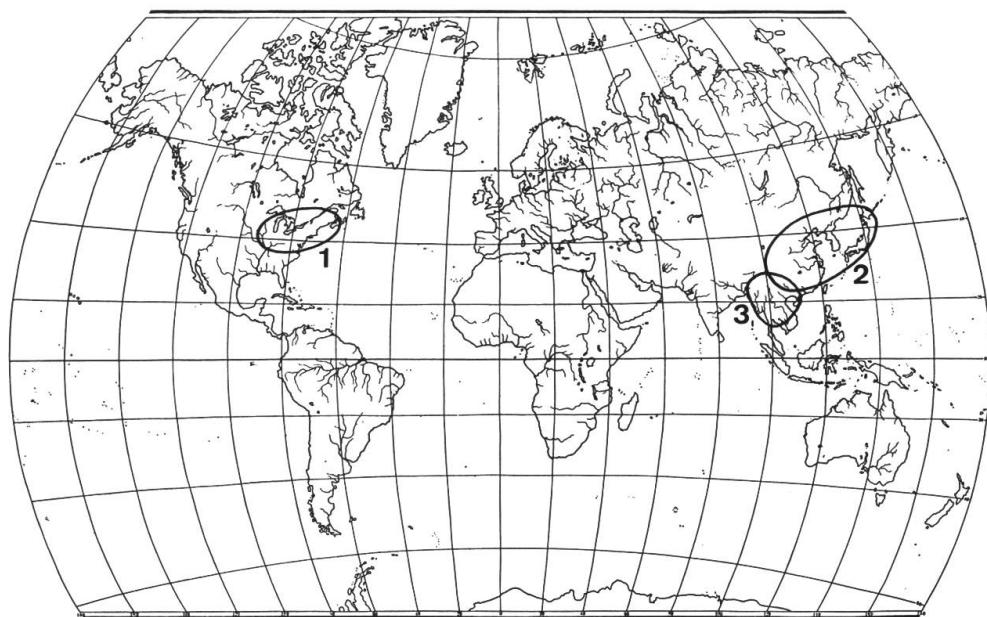


Fig. 48: Geographical distributions of the three subgroups of the *Agabus optatus*-group: (1) *obtusatus*-, (2) *optatus*-, and (3) *ater*-subgroup.

*optatus*-group belongs to *Agabus*, and defining this genus on the continuous bead of the clypeal margin, two potential synapomorphies have been found for this group: (1) prosternal process with lateral bead inflated posteriorad of procoxae, and (2) metacoxal separation wide.

On the other hand, accepting this character-complex as a synapomorphy defining a genus *Agabinus* Crotch (sensu NILSSON, unpublished work; including the current genus *Agabinus* plus the following species groups traditionally placed in *Agabus*: *americanus*-, *confusus*-, *optatus*-, *semivittatus*-, and *spinipes*-groups), the continuous clypeal bead becomes a potential synapomorphy of the *optatus*-group. This problem falls under a forthcoming generic revision of the Agabini (NILSSON, in prep.).

Biogeographically, the second hypothesis is attractive as it groups taxa with distributions that fall under classical Arcto-Tertiary relict patterns. Besides the *optatus*-group in eastern Asia and eastern North America, the resulting expanded genus *Agabinus* would include chiefly elements from western North America.

Within the Hydradephaga, the relict family Amphizoidae provides an example of an eastern Asia - western North America disjunction (KAVANAUGH, 1986). Such a distributional pattern may well reflect an Asiamerican ancestral stock dating back to Mid or Early Tertiary times (MATTHEWS, 1980, KAVANAUGH, 1986).

Viewed as a group of a redefined *Agabus*, the *optatus*-group has no obvious close relatives, although affinities with chiefly Palearctic groups seem the most attractive (NILSSON, in prep.).

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## ADDENDUM

In a recent paper, WEWALKA & BRANCUCCI (1995) have described two new species from China in the genus *Platambus*. However, it is evident from the descriptions that both species belong to the *Agabus optatus*-group, subgroup *optatus*, as here defined. I would like to add the following notes to my revision.

*Agabus schillhammeri* (Wewalka & Brancucci, 1995), comb. nov., should be added to the subgroup *optatus*. Based on the penis shape, it is not identical with any of the species listed in my revision. However, it is most likely that the female paratype of *Agabus stygius* Régimbart from Hubei, identified by me as *A. insolitus* Sharp, in fact belongs to *A. schillhammeri*, described from Hunan and later found also in Shaanxi. If this is the case, *A. insolitus* is seemingly restricted to Japan.

Judged from the original description, *Platambus jilanzhui* Wewalka & Brancucci, 1995, is seemingly a senior synonym of *Agabus nakanei* Nilsson, i.e. the species traditionally called *A. optatus*. If so, *A. jilanzhui* (comb. nov.) is distributed both in North China and Japan. Based on geographical distributions, it would have been more likely to synonymize *P. jilanzhui* with my *A. ussuriensis*. However, especially the penis as illustrated by WEWALKA & BRANCUCCI (1995; holotype?) is identical to that of *A. nakanei*, and not of *A. ussuriensis*. In my recent review of Chinese Dytiscidae (NILSSON, 1995), I have given records of *A. ussuriensis* from North China. The males have a few (2–5) ventral spines on the penis, and are in this respect somewhat intermediate between *A. nakanei* and *A. ussuriensis*. This variation should be studied more in detail now that additional material have became available.

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