Linzer biol. Beitr.	47/2	1303-1309	30.12.2015

Hygrotus (*Coelambus*) *nubilus* (LECONTE, 1855) on Mauna Kea (Hawaii) – first record of the genus from the Pacific zoogeographical region (Coleoptera: Dytiscidae)

Hans FERY & Gil CHALLET

A b s t r a c t: A member of genus *Hygrotus* STEPHENS, 1828, subgenus *Coelambus* THOMSON, 1860 is recorded for the first time from Hawaii which belongs to the Pacific zoogeographical region: *Hygrotus nubilus* (LECONTE, 1855) which so far has been known only from the USA and Canada (and thus from the Nearctic zoogeographical region) was found on Mauna Kea Volcano on the Island of Hawaii. Collecting data of the specimens studied are given and the habitus as well as the male and female genitalia are illustrated. Possibilities for the source of introduction of this Nearctic species to Hawaii are discussed. The species has been also found for the first time in northern Mexico (Coyame, Chihuahua State) and, thus, in the Neotropical zoogeographical region.

K e y w o r d s: Coleoptera, Dytiscidae, Hygrotini, *Hygrotus nubilus*, Hawaii, Mexico, first record.

Introduction

The genus *Hygrotus* includes two subgenera *Hygrotus* (*Hygrotus*) STEPHENS, 1828, and *Hygrotus* (*Coelambus*) THOMSON, 1860. The former comprises 11 and the latter 62 species (one of them split into two subspecies) (NILSSON 2015). The species are distributed in the Palearctic and in the Nearctic zoogeographical regions and so far only four Nearctic species reached also the Neotropical region in northern Mexico.

While visiting the Bishop Museum in Honolulu in September 2011 and looking through the collection of Dytiscidae, the junior author came across a unit tray of unidentified *Hygrotus* specimens. In looking at the specimens and labels it was determined that these were collected in a very unusual site of the Hawaiian Islands: the specimens were collected at 13,000 ft elevation on Mauna Kea Volcano (Fig. 1).

It seemed to be very unlikely that any species of the genus *Hygrotus* might occur on the Hawaiian Islands and it was considered that specimens of any other genus might have been taken for *Hygrotus*. That such errors occur cannot be excluded shows for example (even in the same subgenus!) the description of *Coelambus thapsinus* GUIGNOT, 1955 from North America – finally it could be shown that the type specimens were found in Australia and belong to the genus *Paroster* SHARP, 1882 (FERY 2004).

The examination of 11 specimens loaned from the Bishop Museum, however, lead at

once to the result that these specimens belonged in fact to the subgenus *Coelambus*. The study of some fundamental works which include the genus *Hygrotus* (e.g. HILSENHOFF 1994, LARSON et al. 2000, FERY 2003), the dissection of some males and females of the Hawaiian material and a careful comparison with the figures in ANDERSON (1971, 1976, 1983) and LARSON et al. (2000) as well as comparison with material in the senior author's collection gave the final result: the specimens belong undoubtedly to the so far strictly Nearctic *Hygrotus* (*Coelambus*) *nubilus* (LECONTE, 1855).

Material and methods

The specimens were studied with an Olympus SZX16 stereomicroscope, their genitalia were studied wet. Photos were made with a Nikon Coolpix 995 camera attached to the stereomicroscope. Image stacks were produced by hand and processed by CombineZP Image Stacking Software. The final figures as well as the ink drawings were touched up with Adobe Photoshop CS5 software. Comments on label texts are given in square brackets.

The material studied is stored in the collection of the Bishop Museum (Honolulu, Hawaii), in the private collection of G. Challet and in the collection of H. Fery, which is property of the Naturhistorisches Museum Wien, Vienna, Austria.

The photo of Lake Waiau was made by T. Tunsch and is available under <http://www.panoramio.com/photo/81368979> (copyright: © CC BY-SA Thomas Tunsch (th-t.de) / www.panoramio.com/photo/81368979); for information about CC-licenses see: http://creativecommons.org/licenses/by-sa/4.0/deed.en.

Taxonomy

Hygrotus (*Coelambus*) *nubilus* (LECONTE, 1855)

Hydroporus nubilus LECONTE, 1855: 298 (orig. descr); CLARK 1862: 178.

Coelambus nubilus (LECONTE, 1855); SHARP 1882: 401; FALL 1919: 15 (designation of lectotype).

Hygrotus nubilus (LECONTE, 1855); BLACKWELDER 1944: 76 (new combination); WALLIS 1973:102; ANDERSON 1983: 189 (description); HILSENHOFF (1994: 283); LARSON et al. 2000: 178.

Hygrotus (*Coelambus*) *nubilus* (LECONTE, 1855); NILSSON 2001: 208; 2015: 180 (catalogue)

T y p e l o c a l i t y: USA, Wyoming, Goshen Co., Fort Laramie (ca. 42.21N 104.52W).

T y p e m a t e r i a l (not studied): male lectotype and single female paratype ("allotype") stored in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA (see ANDERSON 1983: 189).

M a t e r i a l s t u d i e d (material from Hawaii): 1♂, "Mauna Kea, Hawaii, Lake Waiau, 13,000'" [printed], "3970 M, 2.IX.1977" [handwritten], "F.G. Howarth, Collector, Bishop" [printed], "Hygrotus cf. medialis LeConte, GAS '04 [= G.A. Samuelson 2004]" [handwritten]; 1♀, same labels except the last one "Hygrotus sp., det. G.A. Samuelson '04" [handwritten in part] (both specimens in coll. H. Fery). Further nine specimens with similar label texts in Bishop Museum, Hawaii. Lake Waiau has co-ordinates 19.811N 155.477W and is situated in an altitude of about 3970 m (**first record from Hawaii**).

A d d i t i o n a l m a t e r i a l s t u d i e d: 32 exs from localities in Arizona, Colorado, Iowa, Maryland, New York, Oklahoma, Texas, Wyoming (all USA). Two females have been studied from Mexico (Chihuahua State, 1 mi E Coyame; specimens in coll. H. Fery and coll. G. Challet). BLACKWELDER (1944: 76) beside "U.S.A." included also "Mexico" in the distribution area, however, without providing any exact data. This is why we consider our data at least as **first "reliable" record** of *H. nubilus* from Mexico. Chihuahua State belongs formally to the Neotropical zoogeographical region (as defined in NILSSON 2001: 10 and 2015: 7), but is very close to the border with the USA and, thus, in a transitional zone between the Nearctic and Neotropical regions. Beside *Hygrotus* (*Coelambus*) *fraternus* (LECONTE, 1852), *H.* (*Coelambus*) *lutescens* (LECONTE, 1852), *H.* (*Coelambus*) *wardii* (CLARK, 1862) and *H.* (*Hygrotus*) *hydropicus* (LECONTE, 1852) this is the fifth species of the genus occurring in Mexico.

D e s c r i p t i v e n o t e s : The species belongs to ANDERSON's (1983: 184) species group VI. This author provides also a key to species of this group. We refrain from reproducing a detailed description of the species, but instead refer to the original description of LECONTE (1855: 298). Also in FALL (1919: 15), ANDERSON (1983: 189) and LARSON et al. (2000: 178) are given valuable descriptive details. The male genitalia are figured in ANDERSON (1983: 179, figs 26a,b) and LARSON et al. (2000: 178). A photo of the female gonocoxae is given in HILSENHOFF (1994: 280, fig. 8).

Nevertheless, we provide a photo of the habitus (Fig. 2) and want to point on the parameres which in the genus are unique in shape (together with those of *H. femoratus* (FALL, 1901); cf. ANDERSON 1983: 179, figs 25 and 26). Also the female gonocoxae and gonocoxosterna have shapes which are very helpful for identification. This is why we give our own illustrations of the male and female genitalia in Figs 3-6.

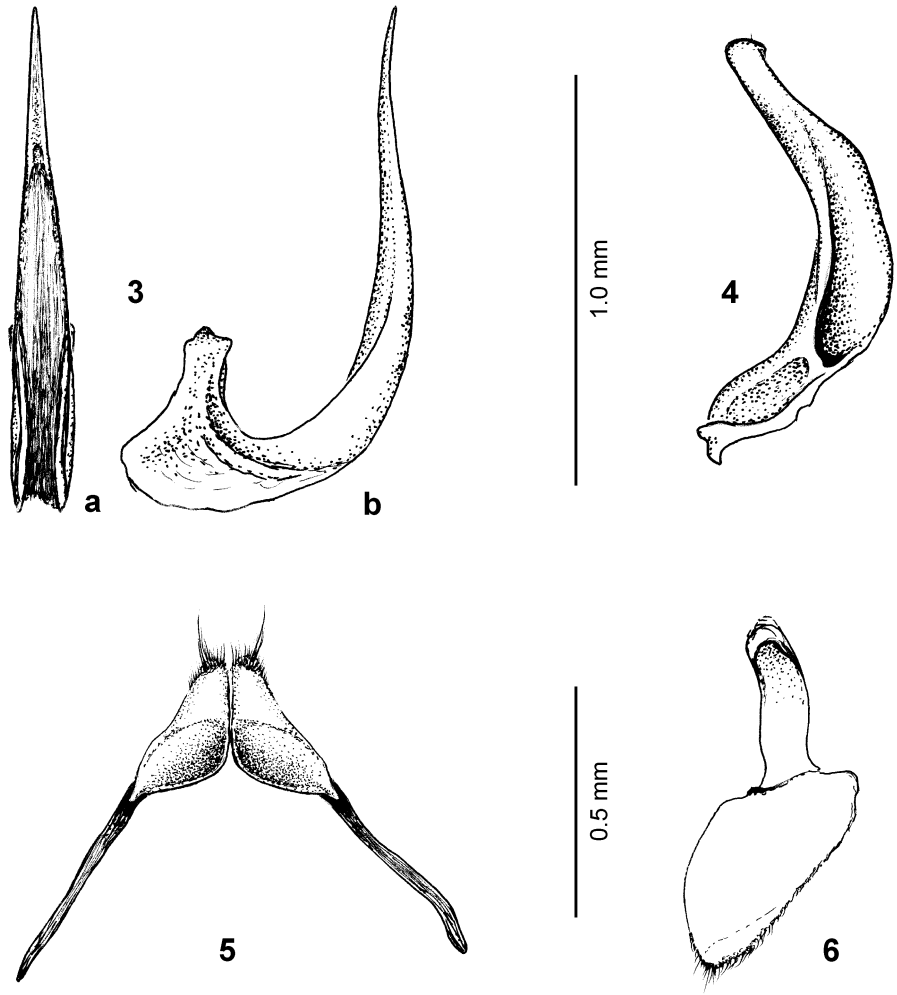
Hygrotus femoratus is extremely similar to *H. nubilus* (females of both are inseparable on morphological characters) and only two males and one female have ever been collected (see ANDERSON 1983: 188). This is why ANDERSON (l.c.) even suspected that both might be the same. The only difference can be found in the male tibiae and femora which have a normal shape in *H. nubilus*, but are deviating in *H. femoratus* (ANDERSON 1983: 180: "male femora with enlarged apical articulations, tibia pedunculate"; see also figs 38a,b on p. 185).

D i s t r i b u t i o n : According to ANDERSON (1983: 189; see also fig. 4 on p. 175) *Hygrotus nubilus* is a common species which is widely distributed in boreal America (USA and Canada) east of the Rocky Mountains (for names of USA states and Canadian provinces see ANDERSON 1983: 189). With the records given in the present paper the distribution area must be widened to northern Mexico and to Hawaii.

D i s c u s s i o n : The finding of *H. nubilus* on the Hawaii Islands is very surprising. We have no doubt that the species must have been introduced to Hawaii, but have no evidence for how this may have happened. It is also not clear when the species has been introduced because it seems to be very rare and collecting activities before 1977 may simply have failed although the species was already present on Mauna Kea or anywhere else.

Fig. 1: Lake Waiau, Mauna Kea Volcano on the Island of Hawaii; (photo by T. Tunsch; available under <http://www.panoramio.com/photo/81368979>) (copyright: © CC BY-SA Thomas Tunsch (th-t.de) / www.panoramio.com/photo/81368979)

Fig. 2: Habitus of *Hygrotus* (*Coelambus*) *nubilus* (LECONTE, 1855); male specimen from Lake Waiau, Hawaii.



Figs 3-6. *Hygrotus* (*Coelambus*) *nubilus* (LECONTE, 1855): (**3**) median lobe of aedeagus in ventral and in lateral view, (**4**) left paramere, (**5**) gonocoxae, (**6**) gonocoxosternum (both specimens from Lake Waiau, Hawaii).

In HÄNEL & JÄCH (2013: 275 ff) several possibilities are discussed for the introduction of alien species on the islands of the Tristan da Cunha Archipelago. Among these are any kinds of human activities, but also transport by birds is mentioned: "In considering the possible ways in which... invertebrates could be dispersed naturally, birds have been considered as favoured vehicles, especially young ones that still have downy patches, as these are prone to becoming contaminated with debris."

On the internet we found the website of DENNY (2006) where more than twenty species of ducks, geese, and shorebirds are listed which migrate to Hawaii each winter (on the northern hemisphere). Among these is the Pacific golden plover (= Kōlea in Hawaiian;

Pluvialis fulva (GMELIN, 1789)) which is known to fly regularly from Alaska to Hawaii and back. This bird has already been observed in California (which is west of the Rocky Mountains, while *H. nubilus* occurs only east of these mountains; see also COSTE & SALMON 1998). This shows that it cannot be excluded principally that birds are able to cover such an immense distance.

Another candidate is Taverner's goose (*Branta hutchinsii taverneri* DELACOUR, 1951) which has been reported from Kansas (where *H. nubilus* has been recorded from) as well as from Hawaii "...for all recent reports of extralimital Taverner's Geese, those we have reviewed suggest that this subspecies does occur as a vagrant in Hawaii and east of the Rockies..." (MLODINOW et al. 2008: 352).

Acknowledgments

We thank Shepherd Myers and Neal Evenhuis (both Bishop Museum, Honolulu, Hawaii) for letting us study the specimens. Thanks are also due to Thomas Tunsch (Berlin, Germany) for giving us hints on his photos and CC-licenses.

Zusammenfassung

Hygrotus (*Coelambus*) *nubilus* (LECONTE, 1855), welcher bis jetzt nur aus Nordamerika – und damit aus der zoogeographischen Region Nearktis – bekannt war, wurde vor einigen Jahren in mehreren Exemplaren im Waiau See auf dem Mauna Kea Vulkan auf Hawaii gefunden (Fig. 1), und damit in der pazifischen zoogeographischen Zone. Zusätzlich kann die Art erstmalig sicher aus dem Norden Mexikos und damit aus der neotropischen Region gemeldet werden. Die Sammeldaten werden angegeben und Habitus sowie männliche und weibliche Genitale werden abgebildet (Figs 2-6). Es erscheint unzweifelhaft, dass die Art von Nordamerika nach Hawaii eingeschleppt wurde. Eine Möglichkeit dafür könnte der Transport im Gefieder von Vögeln sein, wofür beispielhaft zwei Arten angeben werden.

References

ANDERSON R.D. (1971): A revision of the Nearctic representatives of *Hygrotus* (Coleoptera: Dytiscidae). — Annals of the Entomological Society of America **64** (2): 503-512.

ANDERSON R.D. (1976): A revision of the Nearctic species of *Hygrotus* groups II and III (Coleoptera: Dytiscidae). — Annals of the Entomological Society of America **69** (4): 577-584.

ANDERSON R.D. (1983): Revision of the Nearctic species of *Hygrotus* groups IV, V and VI (Coleoptera: Dytiscidae). — Annals of the Entomological Society of America **76** (2): 173-196.

BLACKWELDER R.E. (1944): Checklist of the coleopterous insects of Mexico, Central America, the West Indies, and South America. Part 1. — United States National Museum Bulletin **185**: 1-188.

CLARK H. (1862): On the Mexican species of Hydropori. — The Annals and Magazine of Natural History **10**: 173-184.

COSTE M. & F.E. SALMON Jr (illustrator) (1998): Kōlea: The story of the Pacific Golden Plover. — University of Hawaii Press, 30 pp.

DENNY M. (2006): Birds of Kaua'i. — Available on the internet under the URL <http://www.kauaibirds.com/migratorybirds.htm> (last access November 2015).

FALL H.C. (1919): The North American species of *Coelambus*. — Mount Vernon, New York: Privately printed, 20 pp.

FERY H. (2003): Taxonomic and distributional notes on *Hygrotus* STEPHENS, with emphasis on the Chinese fauna and a key to the Palearctic species, pp. 133-193. — In: JÄCH M.A. & L. JI (eds.): Water beetles of China, Vol. 3. — Wien: Zoologisch-Botanische Gesellschaft in Österreich and Wiener Coleopterologenverein, vi + 572 pp.

FERY H. (2004): On the identity of *Coelambus thapsinus* GUIGNOT, 1955 (Coleoptera: Dytiscidae). — Entomologische Zeitschrift **114** (4): 169-171.

HÄNEL C. & M.A. JÄCH (2013): Beetles of the Tristan da Cunha Islands: Poignant new findings, and checklist of the archipelagos species, mapping an exponential increase in alien composition (Coleoptera). — Koleopterologische Rundschau **83**: 257-282.

HILSENHOFF W.L. (1994): Dytiscidae and Noteridae of Wisconsin (Coleoptera). V. Distribution, habitat, life cycle, and identification of species of Hydroporinae, except *Hydroporus* CLAIRVILLE sensu lato. — The Great Lakes Entomologist **26** (4): 275-295.

LARSON D.J., ALARIE Y. & R.E. ROUGHLEY (2000): Predaceous diving beetles (Coleoptera: Dytiscidae) of the Nearctic Region, with emphasis on the fauna of Canada and Alaska. — Ottawa: NRC Research Press, 982 pp.

LECONTE J.L. (1855): Analytical table of the species of *Hydroporus* found in the United States, with descriptions of new species. — Proceedings of the Academy of Natural Sciences of Philadelphia **7**: 290-299.

MLODINOW S.G., SPRINGER P.F., DEUEL B., SEMO L.S., LEUKERING T., SCHONEWALD T.D., TWEIT W. & J.H. BARRY (2008): Distribution and identification of cackling goose (*Branta hutchinsii*) subspecies. — North American Birds **62** (3): 344-360.

NILSSON A.N. (2001): Dytiscidae (Coleoptera). World catalogue of insects. Vol. 3. — Stenstrup: Apollo Books, 395 pp.

NILSSON A.N. (2015): A world catalogue of the family Dytiscidae or the diving beetles (Coleoptera, Adephaga). — Update distributed as a PDF file via Internet; version 1.I.2015, 298 pp.; distributed by the author from the URL <http://www2.emg.umu.se/projects/biginst/andersn/>, being a corrected and updated version of the printed catalogue: NILSSON A.N. (2001). (last access October 2015).

SHARP D. (1882): On aquatic carnivorous Coleoptera or Dytiscidae. — The Scientific Transactions of the Royal Dublin Society (2) **2**: 179-1003 + pls. 7-18.

WALLIS J.B. (1973): An annotated list of the Hydroadephaga (Coleoptera: Insecta) of Manitoba and Minnesota. — Quaestiones Entomologicae **9**: 99-114.

Authors' addresses: Dr. Hans FERY
Räuschstr. 73
D-13509 Berlin, Germany
E-mail: hanfry@aol.com

Gil CHALLET
30 Celonova Place, Foothill Ranch
California, 92610 USA
E-mail: challet@cox.net