VI.4h. The Hydracarina

CLAUDE DEJOUX

The first collections of Hydracarina from Lake Titicaca were made by the Percy Sladen Expedition and were studied by Viets (1955), to whom we owe the greater part if not the totality of the existing information on this group of animals. Previously, the only collections to have been made were those taken from the Andes and which gave rise to the works of Walter (1919) and of Lundblad (1924, 1930 and 1944).

The species present and their distribution

The species currently recorded from Lake Titicaca are shown in Plates 1 and 2, and below a few lines are given on each, indicating their status in this habitat. Former and recent collection sites are given on the map (Fig. 1).

Hydrachna (Scutohydrachna) miliaria Berlese (Plate 1, Fig. 1a–c)

The presence of this large globular species in the lake is uncertain: a single male may have been collected at a depth of 1.2 m at Sucune (Viets, 1955).

Eylais crawfordi Viets, 1953 (Plate 1, Fig. 2a–c)

Known from various lacustrine habitats bordering the lake and in running waters of the Altiplano, this species has been recorded from beds of *Myriophyllum* on the shores of Campanario Island. One of the main characters enabling it to be distinguished from other species of the genus is the presence of almost fused ocular capsules.

C. Dejoux and A. Iltis (eds.), Lake Titicaca, 357–364.

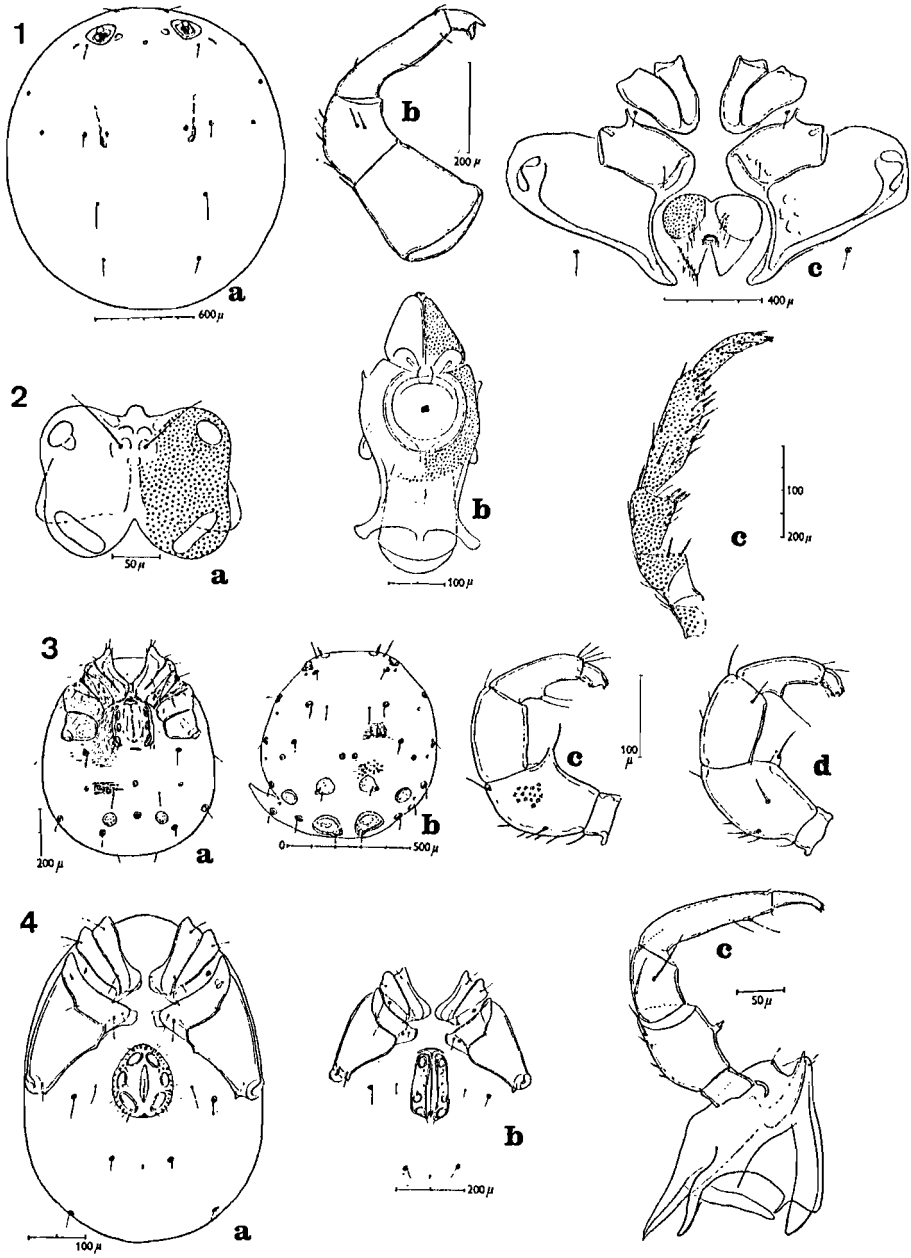

Plate 1. Fig. 1. *Hydrachna* (*Scutohydrachna*) *miliaria* Berl.: 1a, dorsal view; 1b, right palp; 1c, epimera of the male genital area. 2. *Eylais crawfordi* Viets: 2a, eyes of male; 2b, maxilla; 2c, right palp. 3. *Sperchonopsis pauciscutata* Viets: 3a, ventral view; 3b, dorsal view; 3c, right palp; 3d, left palp. 4. *Limnesia minuscula minuscula* Viets: 4a, ventral view of the female; 4b, right palp; 4c, leg IV. (all figures from Viets, 1955)

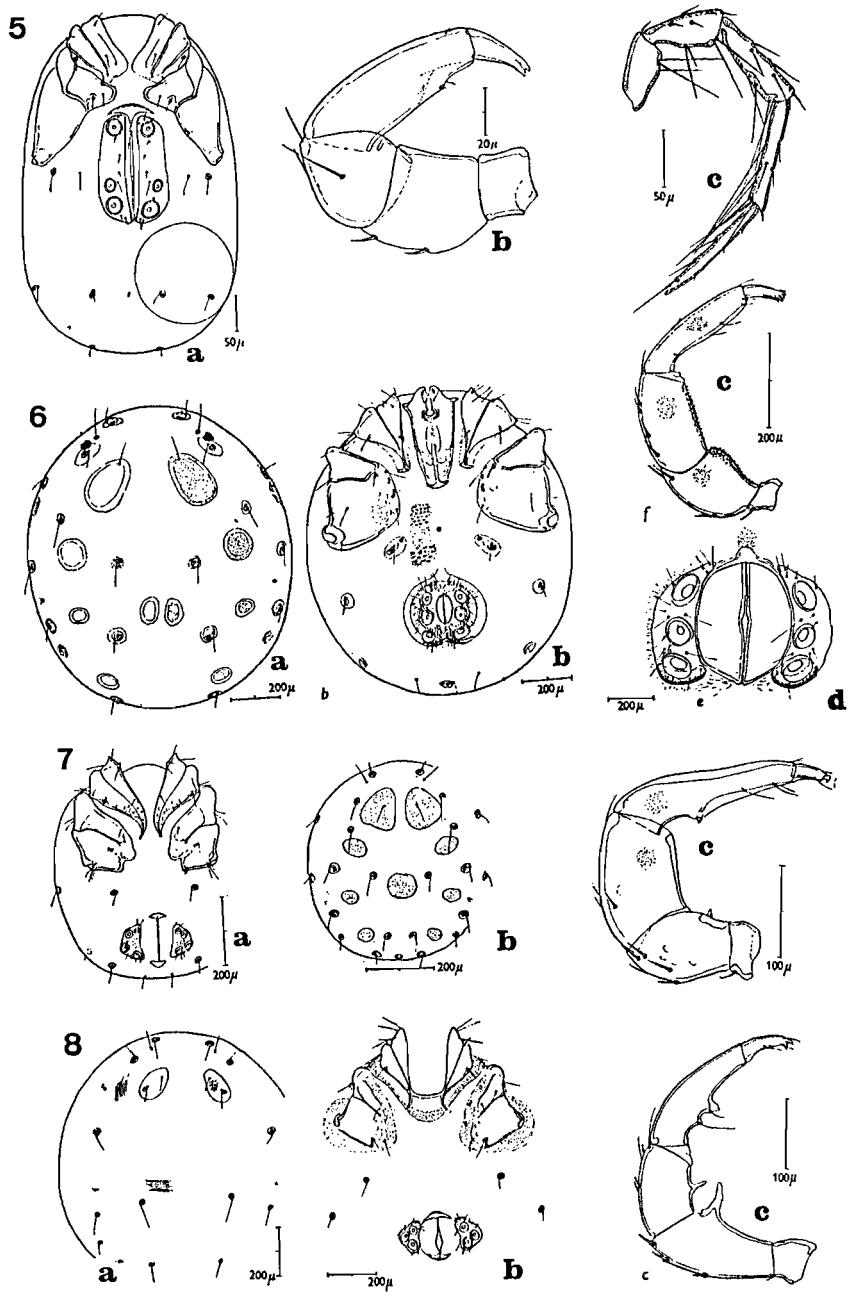

Plate 2. Fig. 5. *Limnesia longivalvata* Viets: 5a, ventral view of the female; 5b, right palp; 5c, leg IV. 6. *Neohygrobates puberulus coriaceus* Viets: 6a, dorsal view of the male; 6b,ventral view of the male; 6c, female right palp; 6e, genital area of the female. 7. *Corticacarellus* (*Tetracorticacarellus*) *incurvatus* Viets: 7a, ventral view of the female; 7b, dorsal view of the female; 7c, female right palp. 8. *Atractidella porophora* Viets: 8a, dorsal view of the female; 8b, ventral view of the female and genital area; 8c, female right palp. (all figures from Viets, 1955)

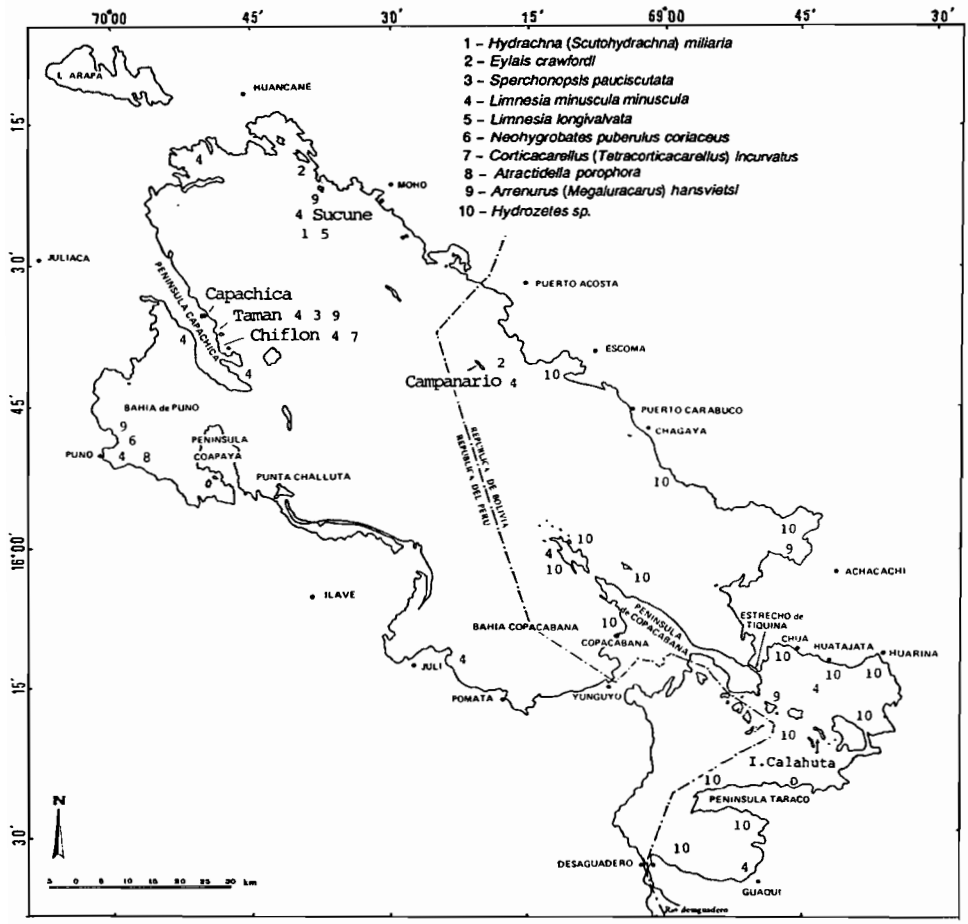

Figure 1. Known distribution of the different species of Hydracarina recorded from Lake Titicaca

Sperchonopsis pauciscutata Viets, 1953 (Plate 1, Fig. 3a–d)

Recorded in very shallow water along the shoreline in Taman Bay, this is a medium-sized species (880 μm long), slightly oval in shape and characterised by the presence of chitinous spines on the anterior part of the back, transformed into rounded papillae on the posterior part. According to Cook (pers. comm.), this species has now been placed in the genus *Notosperchonopsis*.

Limnesia minuscula minuscula Ribaga, 1902 (Plate 1, Fig. 3a–c)

As its name suggests this is a very small species, measuring scarcely more than half a millimetre. It has a wide distribution in South America, being

recorded from Peru, Brazil, Paraguay and Venezuela. According to Viets (1955) it used to be common throughout Lake Titicaca, where it occurred at depths of down to 50 metres; it even occurred in the plankton. In contrast, from our recent observations, it has become very rare.

Limnesia longivalvata Viets, 1953 (Plate 2, Fig. 1a–c)

This, the second species of *Limnesia* recorded from the lake, is almost the same size as the previous species, but is more regularly oval in shape. It has short palps with very broad segments and a genital plate very large in comparison with the size of the body. The known specimens come from Sucune, in the Lago Grande.

Neohygrobates puberulus coriaceus Viets, 1953 (Plate 2, Fig. 6a–d)

Males reach almost 1500 μm in length and 1300 μm in width and the females are even larger. Again this is a large species frequently encountered in the running waters and lakes of the Altiplano and generally occurring among aquatic vegetation. It has been recorded from Puno Bay, but we have never encountered it in our extensive study of the benthic fauna of the lake.

This brown-coloured species is characterised by the presence of numerous chitinised plates arranged symmetrically on the body surface.

Corticacarellus (Tetracorticacarellus) incurvatus Viets, 1953 (Plate 2, Fig. 7a–c)

This small species, which hardly exceeds half a millimetre in length, is characterised by the presence of four pairs of pitted dorsal plates and one central plate. Only known from Chiflon Bay in the Lago Grande (Viets, 1955), it was collected on a small silurid fish: *Trichomycterus rivulatus*.

Atractidella porophora Viets, 1953 (Plate 2, Fig. 8a–c)

A. porophora is a small globular species about 1 mm in diameter, that has been collected in shallow water amongst vegetation in Puno Bay. Two oblique pitted plates present anteriorly on the back, and spurs on the inner face of the palp segments are the characters that make this species easy to recognize.

Arrenurus (Megaluracarus) hansvietsi Viets, 1953 (Plate 3, Fig. 9a–e)

This species, also recorded from aquatic vegetation in Puno Bay and from aquatic habitats bordering Lake Titicaca, is distinguished by its generally elliptical and unequally flattened shape. The posterior part of the body forms a characteristic sort of flattened tail, lower than the rest of the body. The palps are short and broad.

Hydrozetes sp. (Plate 3, Fig. 10a–g)

This very small hydracarian measuring about 800 μm belongs to the group Oribatei and does not possess differentiated mouthparts. This is at present the most common species over the whole of Lake Titicaca. It is found almost everywhere down to depths of about 20 metres, inhabiting stony shorelines, all of the aquatic vegetation and bottoms made up of bare sediments. It is dark brown in colour, the legs being short and broad.

Discussion

Viets (1955) only had the collections made by the Percy Sladen Expedition on which to describe the distribution of Hydracarina in Lake Titicaca. These collections did not cover all of both basins, so it was difficult for him to give an exact picture of the populations of these organisms. However it was clearly apparent that these were dominated by *Limnesia minuscula minuscula*, which occurred at 24 different stations, whereas the other species were frequently only represented by a single individual found in a single locality. Only *Arrenurus hansvietsi* and *Sperchonopsis pauciscutata* were found in two different localities.

Given such a type of distribution, the exact status of all the species is therefore questionable. It is known, for example, that the larvae of Hydracarina are capable of being widely disseminated by aquatic insects during their aerial ecophase (Chironomidae are particularly involved in this activity) and that aquatic birds are also a non-negligible means of transport for these small organisms. Hydracarina also constitute a regular and often important component of the biological drift in running waters. All these factors make it likely, that with the exception of *Limnesia minuscula minuscula* at the beginning of the century and of *Hydrozetes* at the present day, the presence of the other species is perhaps simply "accidental", in that they are always rare in all samples collected from Lake Titicaca.

We have almost never found *L. minuscula minuscula* in the numerous benthic fauna samples we have taken in the Bolivian part of the lake, (only 4 individuals have been found out of 13 500 Hydracarina collected, but in contrast *Hydrozetes* sp. has been found practically everywhere. If in addition,

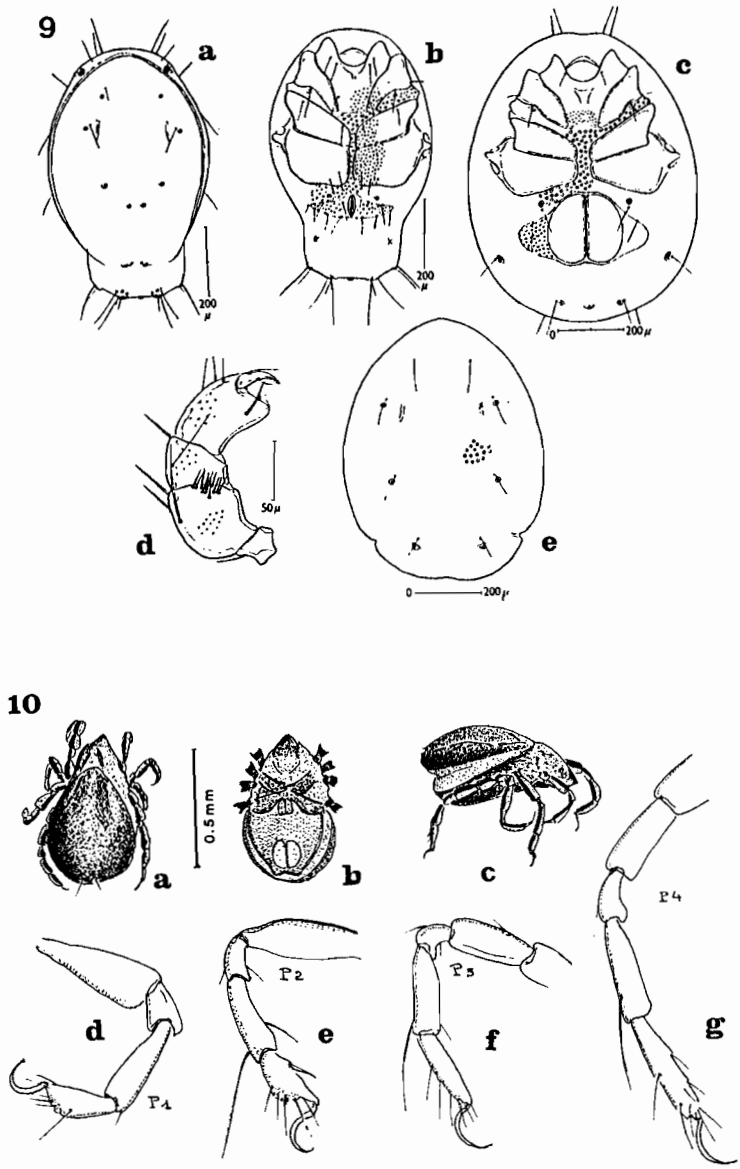

Plate 3. Fig. 9. *Arrenurus* (*Megaluracarus*) *hansvietsi* Viets: 9a, dorsal view of the male; 9b, ventral view; 9c, ventral view of the female and genital area; 9d, male left palp; 9e, dorsal view of the female. (from Viets, 1955) 10. *Hydrozetes* sp.: 10a,b,c, dorsal, ventral and lateral views; 10d,e,f,g, legs I to IV.

account is taken of the fact that we have only found 2 individuals of *Arrenurus hansvietsi*, a few examples of *Sperchonopsis pauciscutata* and one as yet unidentified species (2 individuals!), we have a faunal spectrum similar to that described by Viets (*op. cit.*), with one largely dominant species ubiquitous throughout the lake and a series of rare species, usually restricted to a few sites around the shorelines and always in small numbers. Similar work conducted in other high altitude lakes in the Andes, not far from Lake Titicaca (Dejoux and Wasson, in press) have in contrast shown that the Hydracarina populations in these water bodies are often very dense and especially very diverse, with more than twenty taxa having been recognized, each in sufficient numbers to rule out the possibility of their occurring accidentally. Until more information comes forth, it can therefore be concluded that few species occur at great abundance in Lake Titicaca, and only a few other taxa are encountered there at low densities. At present, no endemic species of Hydracarina are known from Lake Titicaca.

Nothing is known of the biology of *Limnesia minuscula minuscula* and our work only gives a few indications on the ecology of *Hydrozetes* sp. (Dejoux, 1991). The distribution of this species is clumped and its populations are especially dense in the beds of Characeae in the Huiñaimarca where densities of more than 20 000 individuals per square metre have been encountered. Bare bottoms are clearly much less suitable, but it is not rare to find concentrations of several hundreds of individuals per square metre. *Hydrozetes* sp. is a species particularly preferring to live amongst macrophytes, and is more numerous where the vegetation structure is complex and intricated, offering good feeding conditions and shelter. For example over an area of a few tens of square metres off of Calahuta Island, we recorded mean densities of the species which vary from a few individuals per 10 g dry weight of vegetation on the smooth stems of *Schoenoplectus tatora* and *Elodea*, to nearly 500 in *Chara*, with intermediate values of 150 and 270 respectively among the roots of *Ranunculus* and a small species of Cruciferae.

It is evident that these few results are very rudimentary and, as is the case with many other groups of benthic organisms, much work remains to be done, especially on the biology and ecology of the species present.

References of chapter VI.4

ANNANDALE (N.), 1913. An account of the Sponges of the Lake Tiberias with observations on certain genera of Spongillidae. *Journ. proc. Asiatic Soc. Bengal.*, 9: 57–88.

ARNDT (W.), 1937. *Ochridaspongia rotunda* n.g., n. sp. Ein neuer Süsswasserschwam aus dem Ochridasee. *Arch. Hydrobiol.*, 31: 636–677.

BACHMANN (A.O.), 1961. Notas sobre Corixidae (Hemiptera) (2a seria). *Neotropica*, 7: 19–24.

BACHMANN (A.O.), 1962. Clave para determinación de las subfamilias, géneros y especies de las Corixidae de la República de Argentina (Insecta, Hemiptera). *Physis*, 23: 21–25.

BATE (J.), 1862. *Allochertes knickerbrockeri*. Cat. Amph. Crust. Brit. Mus., p. 136.

BAVAY (A.), 1904. Mission de Créqui-Montfort et Sénéchal de la Grange en Amérique du Sud. Mollusques terrestres et fluviatiles récoltés par le Dr. Neveu-Lemaire. *Bull. Soc. Zool. Fr.*, 29: 152–156.

BAVAY (A.), 1906. Mollusques. *In*: Les lacs des hauts plateaux de l'Amérique du Sud. Neveu-Lemaire. Imprimerie nationale, Paris: 142–147.

BEAUCHAMP (P. de), 1939. 5. Rotifères et Turbellariés. *In*: The Percy Sladen Trust Expedition to Lake Titicaca in 1937. *Trans. Linn. Soc. London*, ser. 3, 1 (1): 44–79.

BLUME (W.), 1958. Littoridinen aus dem Titicacasee (Mollusca). *Op. Zoologica*, 25: 1–8.

BRIEN (P.), 1958. A propos de deux éponges du lac Tanganyika. *Mém. Acad. r. Scienc. colon.*, 8 (1): 1–43.

BRIEN (P.), 1972. *Malawispongia echinoides* n.g., n. sp. Eponge Céractinelle Haplosclérideafricaine du lac Malawi (Formation de la spongine périspiculaire). *Rev. Zool. Bot. Afr.*, 86 (1–2): 65–92.

BRIEN (P.), 1973. *Malawispongia echinoides* Brien. Etudes complémentaires. Histologie. Sexualité. Embryologie. Affinités systématiques. *Rev. Zool. Bot. Afr.*, 87 (1): 50–76.

BRULLE (G.A.), 1837. Insectes de l'Amérique méridionale recueillis par Alcide D'Orbigny. *In* : Voyage dans l'Amérique méridionale. A. D'Orbigny. Pitois-Levrault et Cie., Paris, 2 (2): 17–56.

BRUNDIN (L.), 1956. Die bodenfaunistischen Seetypen und ihre Anwendbarkeit auf die Sudhalbkugel. Zugleich ein Theorie der produktionbiologischen Bedeutung der glazialen Erosion. Rep. Inst. Freshw. Res., Drottningholm, 37: 186–235.

BULLA (L.A.), 1972. La ninfa de *Protallagma titicacae* (Calvert). *Neotropica*, 18 (57): 129–135.

CALVERT (P.P.), 1909. Contribution to the knowledge of the Odonata of the Neotropical region. *Ann. Carn. Mus.*, 6: 73–364.

CARMOUZE (J.P.), ARZE (C.), QUINTANILLA (J.), 1977. La régulation hydrique des lacs Titicaca et Poopo. *Cah. ORSTOM, sér. Hydrobiol.*, 11 (4): 269–283.

CARMOUZE (J.P.), ARZE (C.), QUINTANILLA (J.), 1981. Régulation hydrochimique du lac Titicaca et l'hydrochimie de ses tributaires. *Rev. Hydrobiol. trop.*, 14 (4): 329–348.

CARMOUZE (J.P.), DEJOUX (C.), DURAND (J.R.), GRAS (R.), ILTIS (A.), LAUZANNE (L.), LEMOALLE (J.), LEVEQUE (C.), LOUBENS (G.), SAINT-JEAN (L.), 1972. Grandes zones écologiques du lac Tchad. *Cah. ORSTOM, sér. Hydrobiol.*, 6 (2): 103–169.

CERNOSVITOV (L.), 1939. 6. Oligochaeta. *In* : The Percy Sladen Trust Expedition to Lake Titicaca in 1937. *Trans. Linn. Soc. London*, ser. 3 (1): 81–116.

CHEVREUX (E.), 1904. Mission de Créqui-Montfort et Sénéchal de la Grange; note préliminaire sur les Amphipodes recueillis par M. le Dr. Neveu-Lemaire dans le lac Titicaca (juillet 1903). *Bull. Soc. Zool. de Fr.*, 29 (11): 131–134.

DEJOUX (C.), 1988. Panorama de la fauna béntica del Altiplano boliviano. Congreso Iberoamericano y del Caribe sobre la pesca y la acuicultura, Isla Margarita, Venezuela, 8–14 Mayo 1988: 13 p., multigr.

DEJOUX (C.), 1991. Les macro-invertébrés associés à la végétation aquatique dans la partie bolivienne du lac Titicaca. *Rev. Hydrobiol. trop.* 24 (2): 91–104.

DEJOUX (C.), MOURGUIART (P.), 1991. *Ecpomastrum mirum* (Mollusque Hydrobiidae) du lac Titicaca: un problème de taxinomie. *Bull. Mus. Nat. Hist. Nat.* (in press).

DEJOUX (C.), WASSON (J.G.), 1991. La faune benthique de quelques lacs d'altitude des Andes boliviennes. *Spixiana* (in press).

DELACHAUX (T.), 1928. Faune invertébrée d'eau douce des hauts plateaux du Pérou (région de Huancavelica, département de Junin). (Calanides, Ostracodes, Rotateurs nouveaux). Trav. Lab. Zool. Univ. Neuchâtel: 45–99.

D'ORBIGNY (A.), 1835. *Synopsis terrestrium et fluviatilium Molluscorum in suo per Amirican meridionalem itinere collectarum. Mag. Zool.*, 5 (61): 44 p.

D'ORBIGNY (A.), 1835–47. Mollusques. *In*: Voyage dans l'Amérique méridionale. A. D'Orbigny. Pitois-Levrault et Cie., Paris, vol. 5.

D'ORCHYMONT (A.), 1941. Palpicornia (Coleoptera). Notes diverses et espèces nouvelles. *Bull. Mus. Roy. Hist. Nat. Belg.*, 17 (1): 1–23.

DOS SANTOS (N.D.), 1966. Notas sobre *Aeschna* (*Hesperaeschna*) *peralta* Ris, 1918 e sua ninfa. *Actas Soc. Biol. Rio de J.*, 10 (5): 123–124.

FAXON (W.), 1876. Exploration of Lake Titicaca by Alexander Agassiz and S.W. Garman. 4. Crustacea. *Bull. Mus. Comp. Zool. Cambridge*, 3 (16): 361–375.

FLINT (O.S.), 1982. Studies of neotropical caddisflies, 30: larvae of the genera of South American Limnephilidae (Trichoptera). *Smith. contrib. to zool.*, 355: 30 p.

FRASER (F.C.), 1957. A revision of the Odonata of Chile. *An. Acad. Chil. Cienc. Nat.*, 21 (2): 153–166.

GAVRILOV (K.), 1981. Oligochaeta. *In*: Aquatic biota of Tropical South America, Part 2: Anarthropoda, Hurlbert, Rodríguez & Santos eds., San Diego State University, San Diego, California: 170–190.

GERMAR (E.F.), 1824. *Insectorum species novae aut minus cognitae, descriptionibus illustratae. Halae*, 624 p.

GILSON (H.C.), 1937. 1. Description of the expedition. *In*: The Percy Sladen Trust Expedition to Lake Titicaca in 1937. *Trans. Linn. Soc. London*, ser. 3, 1: 1–20.

GILSON (H.C.), 1964. Lake Titicaca. *Verh. Internat. Verein. Limnol.*, 15: 112–127.

GUIGNOT (F.), 1957. Beiträge zur Kenntnis der Insektenfauna Boliviens. *Opusc. Zool.*, 6: 1–10.

HAAS (F.), 1955. 17. Mollusca: Gastropoda. *In*: The Percy Sladen Trust Expedition to Lake Titicaca in 1937. *Trans. Linn. Soc. London*, ser. 3, 1 (3): 275–308.

HAAS (F.), 1957. Eine neue endemishe Schnecke aus dem Titicacasee. *Arch. Moll.*, 86 (4/6): 137–139.

HARMAN (W.J.), BRINKHURST (R.O.), MARCHESE (M.), 1988. A contribution to the taxonomy of the aquatic oligochaeta (Naididae) of South America. *Can. J. Zool.*, 66: 2233–2242.

HINTON (H.E.), 1940. 7. The Peruvian and Bolivian species of *Macrelmis Motsh.* (Coleoptera: Elmidae). *In* : The Percy Sladen Trust Expedition to Lake Titicaca in 1937. *Trans. Linn. Soc. London*, ser. 3, 1 (1): 117–147.

HUNGERFORD (H.B.), 1948. The Corixidae of the western hemisphere (Hemiptera). *Univ. Kansas Sci. Bull.*, 32: 4–827.

HYMAN (L.H.), 1939. New species of flat worms from North, Central and South America. *Proc. U.S. Nat. Mus.*, 86: 419–439.

KENNEL (J.), 1888. Untersuchungen an neuen Turbellarien. *Zool. Jb. (Syst.)*, 3: p. 444.

KUIPER (J.G.), HINZ (W.), 1983. Zur Fauna der Kleinmuscheln in den Anden (Bivalvia: Sphaeriidae). *Arch. Moll.*, 114 (4/6): 137–156.

LAVENU (A.), 1981. Origine et évolution néotectonique du lac Titicaca. *Rev. Hydrobiol. trop.*, 14 (4): 289–297.

LAZZARO (X.), 1985. Poblaciones, biomasas y producciones fitoplanctónicas del lago Titicaca. *Rev. Inst. Ecol.*, La Paz, 7: 23–64.

LERNER-SEGEEV (R.), 1971. *Limnocythere titicaca* new species (Ostracoda, Cytheridae) from Lake Titicaca, Bolivia. *Crustaceana*, 25 (1), 88–94.

LUNDBLAD (O.), 1924. Über einige Hydracarinen aus den peruanischen Anden. *Göteborg. VetenskSamh. Handl.* (S 4), 27 (10): 1–25.
LUNDBLAD (O.), 1930. Südamerikanische Hydracarinen. *Zool. Bidr. Upsala*, 13: 1–86.
LUNDBLAD (O.), 1944. Einige neue und venid bekannte Hydracarinen aus Südamerica. *Ent. Tidskr.*, 65: 135–162.
MARCUS (E.), 1942. Sobre Bryozoa do Brasil. II. Bol. Fac. Fil. Ci. Letr. Univ. Sao Paulo. Zool., 6 (1–5): 57–106.
MARCUS (E.), 1953. Bryozoa from Lake Titicaca. Bol. Fac. Fil. Ci. Letr. Univ. Sao Paulo, Zool., 18: 45–49.
MARTINEZ-ANSEMIL (E.), GIANI (N.), 1986. Algunos oligoquetos acuáticos de Bolivia. *Oecol. aquat.*, 8: 107–115.
MEDINA (C.), 1982. Determination of zoobenthos in Puno Bay of Lake Titicaca (Ojerani). *In*: Physical, chemical and biological conditions relating to water quality in Puno Bay, Lake Titicaca; Seminar abstracts, 32 p., multigr.
MEDINA (C.), 1983a. Determinación de la fauna bentónica en Ojerani. Tesis UNTA, Puno: 116 p.
MEDINA (C.), 1983b. Fauna bentónica en la bahía de Puno-Ojerani. UNDAP, Puno: 4 p., multigr.
MILBRINK (G.), 1983. An improved environmental index based on the relative abundance of Oligochaete species. *Hydrobiologia*, 102: 89–97.
MONIEZ (R.), 1889. Sur quelques Cladocères et sur un Ostracode nouveaux du lac Titicaca. *Rev. Biol. Nord France*, 1: 419–429.
MORALES (P.), CORNEJO (E.), LEVY (D.A.), CHALLCO (D.), MEDINA (A.C.), NORTHCOTE (T.G.), 1989. Effects of eutrofication on zoobenthos. *In*: Pollution in Lake Titicaca, Peru. Northcote, Morales, Levy, Greaven eds., Westwater Research Centre, Univ. Brit. Columbia, Vancouver: 101–113.
MOUCHAMPS (R.), 1963. Beiträge zur Kenntnis Insektenfauna Boliviens. 18. Coleoptera, 14. Sur quelques Berosini (Coleoptera-Hydrophilidae) de l'Amérique du Sud. *Mitt. Münchner Ent. Gesell.*, 53: 118–149.
MOURGUIART (P.), 1987. Les Ostracodes lacustres de l'Altiplano bolivien. Le polymorphisme, son intérêt dans les reconstitutions paléohydrologiques et paléoclimatiques de l'Holocène. Thèse Univ. Bordeaux 1, 263 p.
NORTHCOTE (T.G.), MORALES (P.S.), LEVY (D.A.), GREAVEN (M.S.), 1989. Pollution in Lake Titicaca, Peru: training, research and management. Westwater Research Centre, Univ. Brit. Columbia, Vancouver, 262 p.
PHILIPPI (R.A.), 1889. *Diagnoses molluscorum terrestrium et fluviatilium peruanorum. Malak. Bl.*, 16: 32–49.
PILSBRY (H.A.), 1924. South American land and freshwater mollusks. Notes and descriptions. I. Mollusks of Lake Titicaca. *Proc. Acad. Nat. Sci. Philad.*, 76: 49–51.
PILSBRY (H.A.), 1925. Lake Titicaca mollusks. *Nautilus*, 38: 103–104.
PILSBRY (H.A.), VANATTA (E.G.), 1896. New species of freshwater mollusks from South America. *Proc. Acad. Nat. Sci. Philad.*: 561–565.
RIBAGA (A.), 1902. *Acari sudamericani. Zool. Anz.*, 25: 502–508.
RINGUELET (R.A.), 1960. Una colección de hirudíneos del Perú. I. Sanguijuelas del lago Titicaca. *Physis*, 21 (61): 231–239.
RINGUELET (R.A.), 1978. Nuevos géneros y especies de Glossiphoniidae sudamericanos basados en caracteres ecto y endosomáticos (Hirudinea Glossiphoniiformes). *Limnobios*, 1 (7): 269–276.
RINGUELET (R.A.), 1981. Hirudinea. *In*: Aquatic biota of tropical South America. Part 2. Anarthropoda. Hurlbert, Rodríguez and Dos Santos, eds: 191–196.
ROBACK (S.S.), BERNER (L.), FLINT (O.S.), NIESER (N.), SPRANGLER (P.J.), 1980. Results of the Catherwood Bolivian-Peruvian Altiplano Expedition. Part 1. Aquatic insects except Diptera. *Proc. Acad. Nat. Sci. Philadelphia*, 132: 176–217.
ROBACK (S.S.), COFFMAN (W.P.), 1983. Results of the Catherwood Bolivian-Peruvian

Altiplano Expedition. Part 2. Aquatic Diptera including montane Diamesinae and Orthocladiinae (Chironomidae) from Venezuela. *Proc. Acad. Nat. Sci. Philadelphia*, 135: 9–79.

ROGICK (M.D.), 1945. Studies on freshwater Bryozoa. 16. *Fredericella australiensis* var. *browni*, n. var. *Biol. Bull.*, Woods Hole, 89 (3): 215–228.

RÜTZLER, (K.), 1978. Sponges in coral reefs. *In*: Coral Reefs: Research Methods. Monographs on Oceanographic Methodology, D. R. Stoddart and R. E. Johannes (eds.), UNESCO, 5 (21), pp. 299–313.

SCHINDLER (O.), 1955. Limnologische Studien im Titicacasee. *Arch. Hydrobiol.*, 51 (1): 42–53.

SCHLENZ (E.), 1981. Coelenterata. *In*: Aquatic biota of tropical South America. Part 2. Anarthropoda. Hurlbert, Rodríguez and Dos Santos, eds., San Diego State Univ., San Diego: 96–97.

SCHMIDT (F.), 1957. Contribution à l'étude des Trichoptères néotropicaux, II (Trichoptera). *Beitr. zur Ent.*, 7 (3–4): 379–398.

SMITH (J.), 1874. *Hyalella inermis*. Rep. U.S. Comm. for 1872 and 1873, p. 609.

SOLÉ-CAVA, (A.M.), KLAUTAU, (M.), BOURY-ESNAULT, (N.), BOROJEVIC (R.), and THORPE, (J.P.), 1991. Genetic evidence for cryptic specification in allopatric populations of two cosmopolitan species of the calcareous sponge genus *Clathrina*. *Marine Biology*, 111: 381–386.

TIMM (T.), 1970. On the fauna of the Estonian Oligochaeta. *Pedobiologia*, 10: 52–78.

TIMM (T.), 1990. Aquatic Oligochaeta from the farthest South-East of the USSR. *Proc. Estonian Acad. Sci. Biol.*, 39 (1): 55–67.

VARGAS (C.), 1982. La sédimentation lacustre subactuelle d'un bassin intramontagneux: le lac Titicaca (partie lac Huiñaimarca-Bolivie). Thèse Univ. Bordeaux 1: 91 p.

VIETS (K.), 1953. Neue Wassermilben aus Peru. *Veroff. Ubersee-Mus.* Bremen, (A), 2: 129–134.

VIETS (K.), 1955. 16. Hydrachnellae. *In* : The Percy Sladen Trust Expedition to Lake Titicaca in 1937. *Trans. Linn. Soc., London*, ser. 3, 1 (3): 249–274.

WALTER (C.), 1919. Hydracarinen aus der peruanischen Anden und aus Brasilien. *Rev. Suisse Zool.*, 27 (2): 19–59.

WECKEL (A.L.), 1907. *Hyalella knickerbrockeri*. *Proc. U.S. Nat. Mus.*, 32, p. 54.

WECKEL (A.L.), 1909. Freshwater amphipods from Peru. *Proc. U.S. Nat. Mus.*, 38: 623–624.

WOODWORTH (W.), 1897. On some Turbellaria from Illinois. *Bull. Mus. Comp. Zool. Harv.*, 31: 3–16.

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