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Introduction

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Abstract

Facts on political status, population, economy, human colonization, climate, geography, landscapes, vegetation, and nature conservation of New Caledonia are provided. Peculiarities of the New Caledonian biogeography are discussed. The history of the exploration and the actual composition of the water beetle fauna of New Caledonia are outlined briefly. Data on rare and endangered species are summarized. Almost 100 localities, which were sampled in the course of field surveys by M. Balke & G. Wewalka, 2001, and by M.A. Jäch, 2009, are listed.

Key words: New Caledonia, water beetles, biogeography, diversification, endemism, history of exploration of aquatic Coleoptera, locality descriptions, Haliplidae, Heteroceridae, Hydraenidae, Dytiscidae, Gyrinidae, Hydrochidae, Hydrophilidae, Limnichidae, Noteridae, Scirtidae, Spercheidae.

Introduction

Grande Terre, the main island of New Caledonia, is a rather large and old Pacific island of continental origin, characterized by enormous diversification and endemism. Entomologically it remains comparably little studied despite steadily intensifying efforts. Climate, vegetation zones and geology are unusually diverse on Grande Terre, varying often within only a few kilometers distance.

Though geographically well isolated today, a more or less continuous land connection with New Zealand very probably existed more than five million years ago. Today, Grande Terre forms the southern tip of the "Inner Melanesian Arc" stretching from the Moluccas via New Guinea, to the Solomon Islands, southward to Vanuatu, and New Caledonia.

Among New Caledonian aquatic invertebrates there are several groups with an outstanding degree of diversification and endemism: 1) crenobiontic gastropods with more than 50 species in five genera (HAASE & BOUCHET 1998), 2) Ephemeroptera with about 50 species in at least 20 genera (PETERS 2001), 3) Trichoptera with 190 species described (or in press) and about 200 undescribed ones awaiting description (ESPELAND et al. 2008), and 4) water beetles (with about 200 species (including undescribed museum specimens), and with at least two remarkably diverse genera: *Exocelina* BROUN and *Hydraena* KUGELANN). In contrast, certain insect orders, as for instance Plecoptera, are totally absent from New Caledonia.

Two thorough field surveys focussed on New Caledonian water beetles in the last decade. These were carried out by Günther Wewalka & Michael Balke in 2001, and by Manfred A. Jäch in 2009. More than 3,000 specimens were collected during these surveys. Though these field trips, even in aggregation with samples from a number of fellow scientists (e.g. S. Bilý, T. Blaik, J. Brinon, C. Burwell, S. Cazères, J. Damgaard, M. Degallier, R. Dobosz, A. Gervais, J. Gómez-Zurita, I. Ieniş, J.-P. Kataoui, G. Kuschel, S. Lamond, R.A.B. Leschen, I. Löbl, C. Mille, G.B. Monteith, S. & J. Peck, J.G. Peters, C. Pöllabauer, M. Schöller, H. Smit, T. Théry, M. Wanat, J. Wiesner, K. Will, I. Worm) and enriched with literature records and older museum collections (e.g. Naturhistorisches Museum Wien; The Natural History Museum, London; Institut Royal des

Sciences Naturelles de Belgique, Bruxelles), certainly do not represent a complete coverage of the island's species diversity, it seems most useful to summarize the current state of affairs.

Political status, population and economy

The "Territory of New Caledonia (or Nouvelle-Calédonie) and Dependencies" is part of France since the annexion by Napoleon III in 1853. Originally, it used to be a French penal colony, then a colony until 1946 and finally an overseas territory (territoire d'outre-mer, TOM) until 1999, but it has its own special status meanwhile. New Caledonia consists of three provinces: 1) North Province, 2) South Province and 3) Loyalty Islands (Îles Loyauté). Nouméa is the capital city.

New Caledonia enjoys significant legislative autonomy. Its currency, the Pacific Franc (XPF), is shared with Wallis & Futuna and French Polynesia. The indigenous people of New Caledonia are mostly Melanesians collectively known as Kanaks, a word derived by early European explorers from the Hawaiian "kanaka maoli", meaning human being. Independence from France to establish a sovereign Melanesian country named Kanaky is still an issue and might be settled in a referendum after 2013.

Population estimate for 2009 (www.isee.nc/recenspop/rp2009.html) was around 230,000, of which the indigenous Melanesians form the majority with about 44 %. Europeans now make up 34 % of New Caledonia's population, Polynesians 12 %, SE Asians about 4 %, and other minor groups the remainder.

The gross domestic product (GDP) estimate for 2008 was 6.1 billion €, the per capita 24,700 € (www.isee.nc). Grande Terre has the world's largest known nickel deposits estimated to contain no less than 30 % of our planet's reserves. Nickel is a highly demanded metal used to produce stainless steel. Cobalt, iron, chrome and manganese, as well as copper, zinc and lead also occur on Grande Terre. Thus, mining is a big industry and a great environmental threat. Tourism comes second to mining and related industries, with a good deal of interest focused on diving and exotic wedding locations mainly for Asian customers.

History of human colonization

Man settled in New Caledonia at least 4,000 years ago as evidenced by pottery ascribed to the so-called Lapita culture, but petroglyphs on Grande Terre suggest a much earlier arrival. The first European was Captain James Cook and his crew on September 4th, 1774 sailing the HMS Resolution. The sight of the mountainous interior of his anchoring site so much reminded him of Scotland, or Caledonia, home of his father, that he named his discovery accordingly. The next to follow was the French Admiral Joseph Bruny d'Entrecasteaux onboard the frigate La Recherche, accompagnied by Captain Huon de Kermadec on the Espérance. They set foot on Grande Terre on April 17th, 1793. Proper charting of the New Caledonian Archipelago only began in 1827 through the French naval officer and explorer Jules Sébastien César Dumont d'Urville sailing on L'Astrolabe. Eventually, whalers and especially Sandalwood collectors, and then missionaries arrived to comparably rapidly change the islands nature and its indigenous inhabitants.

Geography

Grande Terre lies in the South Pacific between 19° and 23° southern latitude and about 1,200 km east of Australia, approximately halfway between New Zealand and New Guinea. The total landmass of New Caledonia is 18,575 km^2 (for comparison: Fiji 18,274; Vanuatu 12,189; Solomon Islands 28,896; New Zealand 270,534), and has a coastline of 2,254 km.

New Caledonia consists of the main island Grande Terre (16,372 km^2), one of the largest Pacific islands, as well as numerous smaller islands such as Île des Pins, Loyalty Islands, Belep Islands, etc.

Often, Grande Terre, or "Le Caillou" ("The Pebble") and "New Caledonia" are used synonymously. To avoid confusion, the term New Caledonia is herein used only for the entire territory, whereas the main island is referred to as Grande Terre throughout this book.

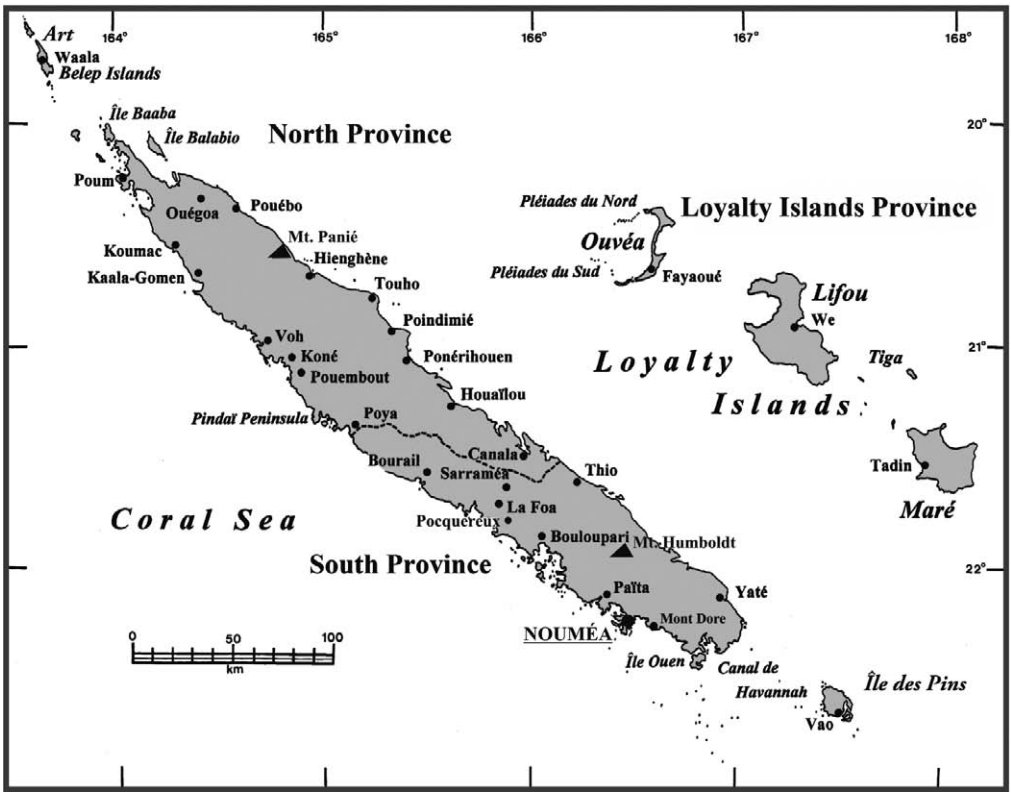


Fig. 1: Map of New Caledonia showing major islands, settlements and provinces (after BAUER & SADLIER 2000, modified).

The elongated Grande Terre is about 390 km long and 50 km wide. Its interior has a central mountain range stretching along the longer axis roughly from NW to SE. The highest peaks being Mt. Panié (1,628 m) in the north, and Mt. Humboldt (1,618 m) in the south (Fig. 1). The most frequently visited mountain of New Caledonia is Mt. Koghi[1] near the capital Nouméa.

The Belep Islands are found about 40 km north of Grande Terre; the main islands being Art and Pott; their highest elevation reaching 283 m. Île des Pins (152 km^2, 262 m high) lies roughly 50 km SE of Grande Terre. The Loyalty Islands (1,981 km^2; highest elevation 138 m) lie 100 km to the east. Six of the Loyalty Islands, Lifou, Maré, Tiga, Ouvéa, Mouli and Faiava, are inhabited. Finally, there are several large reef systems that also belong to the territory of New Caledonia (e.g. Chesterfield Reefs, d'Entrecasteaux Reefs). These reefs include a large number of tiny

[1] Also known as "Monts Koghis". In this book it is generally spelled as "Koghi", except when quoting label data.

emergent islands reaching only a few meters elevation. To our knowledge, no water beetles have ever been collected from these reefs.

Climate

Situated just north of the Tropic of Capricorn, the climate is temperate oceanic. September to March is the warmer season with average temperatures between 25–28°C, the rest of the year, April to August, being slightly cooler with an average temperature of 20–23°C along the coast. The average annual precipitation (Fig. 2) is around 1,500 mm, peaking in March (ca. 150 mm) and being lowest in October (ca. 50 mm). However, local differences are striking and induced by the central mountain range of Grande Terre: the windward, much greener east coast receives an average of 2,500–4,000 mm per year (e.g. Yaté 2,900 mm, Ponérihouen 2,400 mm), compared to only 1,000 mm in the lower, rather dry west coast. Also, the moister east has a more pronounced wet season, where during January to March precipitation may reach 500 mm, or even 750 mm during December, with a steep drop towards the mid of the year when certain streams may run dry. Tropical cyclones occasionally occur between December and March, and usually move south to south-east.

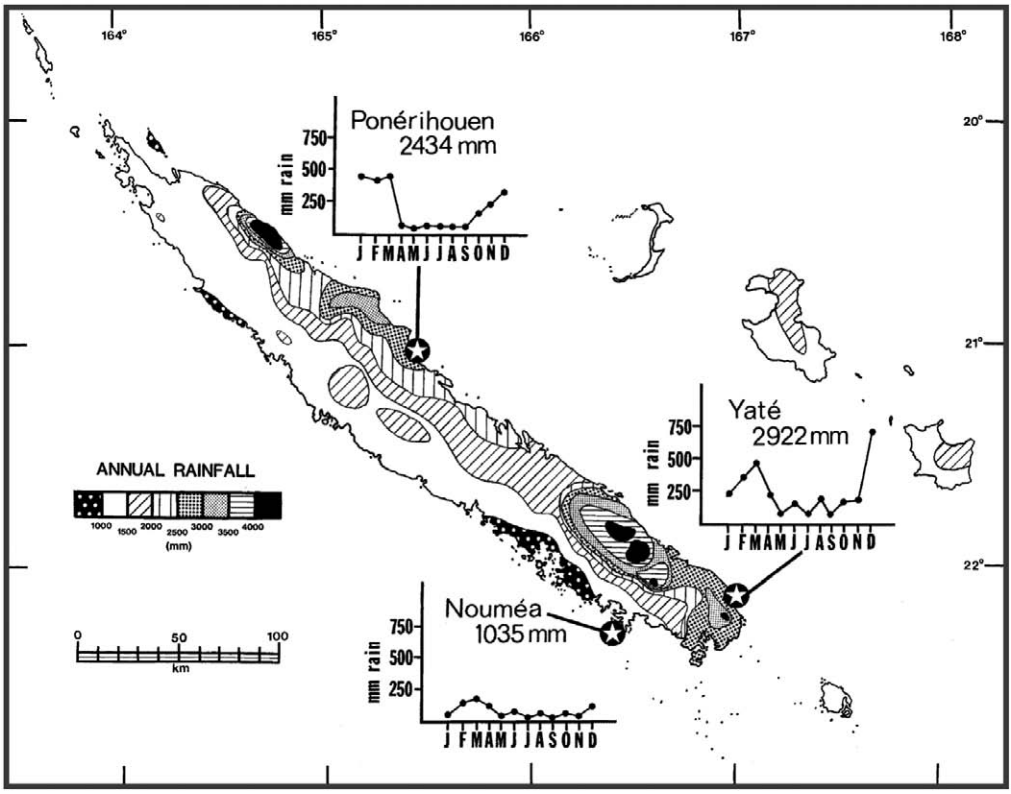


Fig. 2: Annual rainfall in New Caledonia, with mean monthly precipitation profiles for Nouméa, Yaté and Ponérihouen (after BAUER & SADLIER 2000).

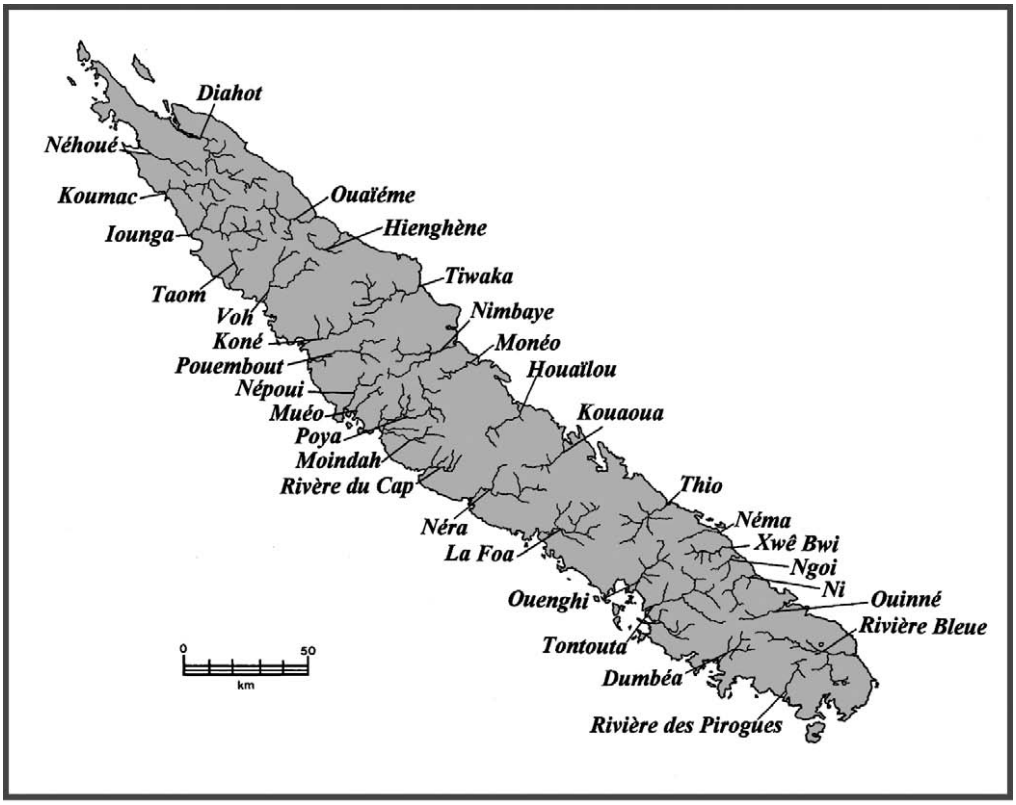


Fig. 3: Rivers of New Caledonia (after BAUER & SADLIER 2000).

Landscapes, vegetation and environmental threats

New Caledonia is very mountainous and rich in streams and rivers (Fig. 3) but none is navigable. There are few swampy areas, especially along the west coast (e.g. near Dumbéa), and the very south features a number of larger lakes and deep pools (dolines).

Local differences in precipitation are strongly reflected in the vegetation. The wet northeast coast and central ranges mainly support evergreen humid forest, which is believed to have covered up to 70 % of the island in the past. The much drier west coast was once dominated by sclerophyll forest (Fig. 4). Poor, ultramafic soils with high metal content feature the so-called maquis shrubland formations which range from dwarf sclerophyllous to high canopied wet forest. As depicted in Fig. 4, most of the original vegetation was destroyed and only about 1–2 % of the sclerophyll forests remain intact. Lowland maquis is strongly expanding in post human colonization times due to destruction of the original lowland forest. More than 6,000 km^2 of the original lowland vegetation have been replaced by savannah and the invasive *Melaleuca* Eucalypt. This highly disturbed anthropogenic vegetation type is maintained by cattle and introduced deer.

New Caledonia is a biodiversity hotspot (http://www.biodiversityhotspots.org): "To qualify as a hotspot, a region must meet two strict criteria: it must contain at least 1,500 species of vascular plants (> 0.5 % of the world's total) as endemics, and it has to have lost at least 70 % of its

original habitat" (Conservation International). New Caledonia qualifies well, as its fauna and flora are severely threatened by mining (Nickel is mined in open pits devastating entire mountain ranges), farming, logging, fires, hunting and, last but not least, by the introduction of alien plants and animals (see GRANDCOLAS et al. 2008).

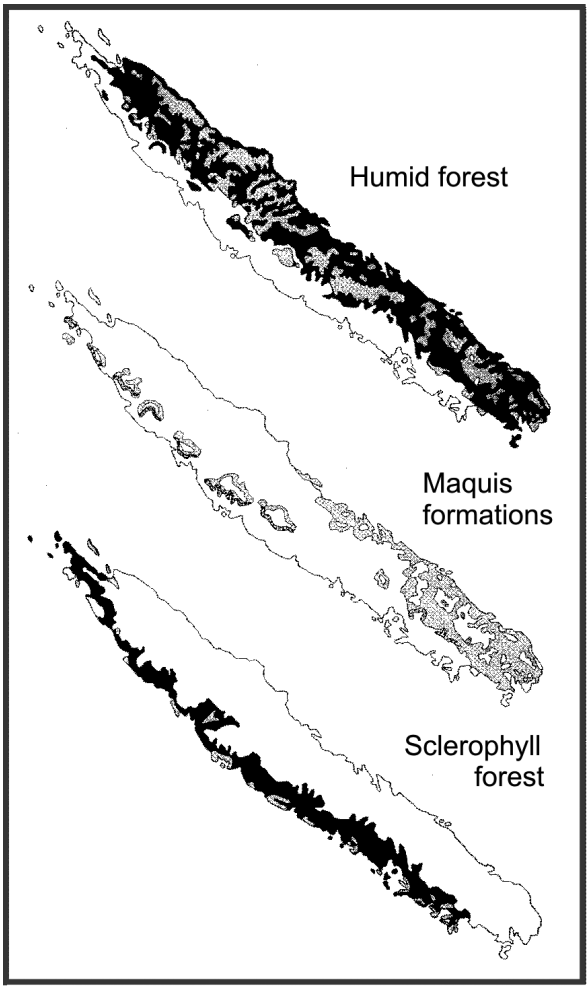


Fig. 4: Main vegetation types of New Caledonia. Light stipled are areas still occupied by each vegetation type, black areas are those where each type is now lost (after JAFFRÉ et al. 1998 and BAUER & SADLIER 2000).

The most powerful threat for water beetles is – besides habitat destruction – probably posed by introduced fish species, for instance *Poecilia reticulata* PETERS, and *Xiphophorus hellerii* HECKEL, both of which were found in abundance in pools in the Dumbéa Plain (north of Nouméa) by the first author.

Biogeography

Grande Terre is outstanding among the Pacific islands as it is rather large, with fairly high peaks along a long mountain range, and especially because of its old age and continental origin, whereas most other Pacific islands (incl. the Loyalty Islands, the Hawaiian Islands and the Galapagos Archipelago) are of more recent volcanic origin.

Grande Terre is a continental fragment of eastern Gondwana that split off 80 million years ago. This led to the view that New Caledonia's remarkable species diversity and endemism (see HOLLOWAY 1979, CHAZEAU 1993, MURIENNE et al. 2005, JOLIVET & VERMA 2008, KIER et al. 2009) results from a long local diversification process, rather than from a more rapid speciation after recent colonization events (GRANDCOLAS et al. 2008, SHARMA & GIRIBET 2009). However, it is now widely accepted that Grande Terre was totally submerged until about 37 million years ago. GRANDCOLAS et al. (2008) suggest that Grande Terre is a "Darwinian Island", because it lacks the biota characteristic of an old continental island, thus biogeographically representing "an oceanic island with a composite biota dominated by neo-endemism and disharmonic colonization".

At the time of its emergence (37 million years ago) Grande Terre formed part of the northeastern rim of a continental block known as Tasmantis (= Tasmantia, or Zealandia) (MCLOUGHLIN 2001, SANMARTÍN 2002, SMITH et al. 2007, TREWICK et al. 2007), most of which was probably submerged. However, an uplift of the Norfolk Ridge could have permitted at least an intermittent land connection with New Zealand during the Miocene (23–5 million years ago), which would explain the close ties between the fauna and flora of Grande Terre and New Zealand (see CHAZEAU 1993, NEUBERT et al. 2009). The Loyalty Islands are of volcanic origin. They have emerged about two million years ago (PARIS 1981).

SHARMA & GIRIBET (2009) suggest that the New Caledonian harvestman family Troglosironidae may have originated more than 100 million years ago, and the extant species began to diversify about 50 million years ago. Such potentially old groups with representatives in New Caledonia have thus the potential to uncover new facts about the geological past of Tasmantis.

Among aquatic Adephaga there seem to be few Tasmantian elements. The species of the genus *Exocelina* BROUN (Dytiscidae) in New Caledonia have diversified recently, but are also represented by a relatively older lineage (see BALKE et al. 2007b, WEWALKA et al. 2010); the species of *Rhantus* DEJEAN (Dytiscidae) are represented by the wide-spread *R. suturalis* which certainly arrived only recently, but this genus is represented in New Caledonia also by a group of four endemic and significantly older species (BALKE et al. 2007a, 2010). The unusually diverse Scirtidae of Grande Terre might indicate an ancient faunistic relationship with New Zealand, which has yet to be examined. One of the dryopid genera of New Caledonia (*Drylichus* HELLER) is possibly a very old element being very closely related with *Protoparnus* BROUN from New Zealand (KODADA et al. 2009).

The question of how old the New Caledonian biota really is, and more importantly when and where it came from, can probably only be settled to some degree once extensive molecular phylogenies become available (GRANDCOLAS et al. 2008). Extensive here means covering not only New Caledonian clades but ideally all relatives from the Australian/Pacific Region to put data into a wider context. Likewise, careful examination of geological evidence will be inevitable, especially to possibly explain patterns of endemism within New Caledonia (HEADS 2008a, b).

The major challenge for such DNA sequence data based age estimations is the wide-spread lack of specific and sufficiently precise calibration points. However, based on studies covering a wide geographical taxon sampling, relative age estimations will reveal diversification rates and tree topology will reveal colonization patterns, colonization frequency, and the relative age of colonization events. Thus, with the appropriate technology already in hand, the future task is to

obtain the samples needed to reveal the genetic background of the New Caledonian species diversification, in short their evolution in space and time.

The role of ultramafic substrate in speciation events

Grande Terre is known for its ultramafic rocks and soils (Fig. 5). Such substrates are nutrient poor, but rich in heavy metals (Mg, Fe, Cr, Co and Ni) and are ultrabasic. They formed during submersion when the ocean floor was pushed over the island's basement rocks caused by collision of the Indo-Australian and Pacific Plates (ESPELAND et al. 2008). After millions of years of surface erosion, ultramafic soils still cover one third of Grande Terre and parts of Île des Pins. Ultramafic soils are in fact naturally contaminated habitats requiring special adaptations. Several authors have suggested that these substrates have played an important role in the diversification of New Caledonia's flora (see HOLLOWAY 1979, LOWRY 1998). The flora on ultramafic substrates mainly in the moist evergreen forests and maquis is very diverse.

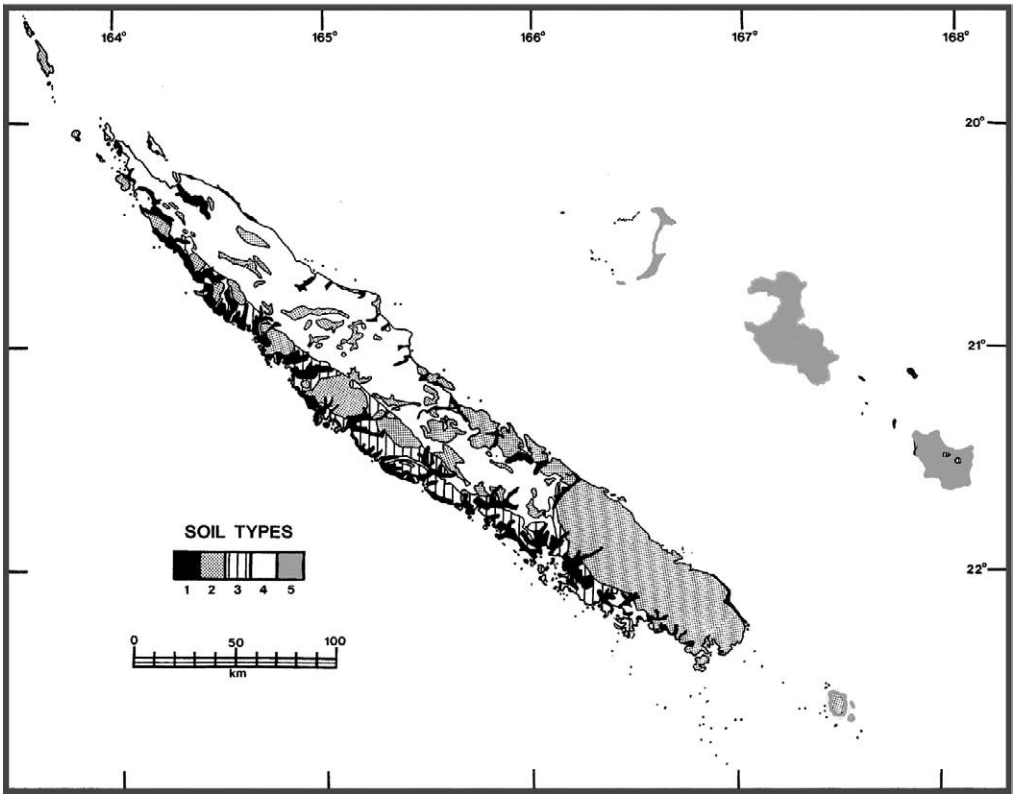


Fig. 5: Soil types of New Caledonia; (1) alluvial soils, (2) feralitic soils on ultramafic rocks, (3) brown soils over basic rocks, (4) other non-carbonated soils, (5) carbonated soils (after BAUER & SADLIER 2000).

Of the more than 1,800 plant species, around 90 % are New Caledonian endemics. Interestingly, very few of the more wide-spread species are found on ultramafic substrates: of 740 native species also occurring outside New Caledonia, only 173 (23.4 %) occur on ultramafic soil, while 587 are found on other substrates, and only 20 of these occur on both ultramafic and non-

ultramafic substrate (MORAT 1993, LOWRY 1998). HOLLOWAY (1979) observed that plants adapted to challenging ultramafic substrates might also have been successfully evolving special defense mechanisms against defoliation by insect larvae, while defense mechanisms of plants on other substrates are different. Notably, the diverse flora on ultramafic soil does not support a similarly diverse Lepidoptera fauna. ESPELAND et al. (2008) studied caddisflies which are extremely diverse in New Caledonia (see above). They conclude that: "(1) the ancestor of all species of *Xanthochorema* KIMMINS (Trichoptera) was present on ultrabasic substrate, (2) early speciation events were restricted to ultrabasic substrate, (3) younger ancestral species dispersed into non-ultrabasic substrates, and (4) late speciation events were restricted to non-ultrabasic substrate". Moreover, ESPELAND et al. (2008) suggest that their "... results correspond to the hypothesis that New Caledonia once was more extensively covered by ultrabasic rocks than at present" (ESPELAND et al. 2008). ESPELAND & JOHANSON (2010) used a more extensive coverage of New Caledonian caddisflies of the family Hydropsychidae and molecular phylogenetics in conjunction with lineage through time plots and environmental data to reveal possible motors of diversification. They suggest that ancestral New Caledonian Hydropsychidae diversified strongly on ultramafic substrates during the mid Tertiary, when ultramafic soils were much more widespread on Grande Terre than at present. Fragmentation of once continuous ultramafic substrate areas might have promoted speciation into new, non-ultramafic habitats.

The role of ultramafic substrates unfortunately remains little studied in context with faunal diversification in New Caledonia.

History of the exploration of the New Caledonian water beetle fauna

The first naturalist to arrive in New Caledonia was the Prussian Johann Reinhold Forster (1729–1798), sailing with James Cook in 1774, followed by the botanist Jacques-Julien H. de Labillardière (1755–1834), sailing with d'Entrecasteaux in 1793. Forster's entomological interests centered on Lepidoptera. We are not aware of any water beetles collected by him.

The middle of the 19th century saw long-term exploration by the Marist missionary Javier X.H. Montrouzier (1820–1897) [also known as Montrousier], who spent decades in Melanesia and finally died in Nouméa. His collections lay the foundations for our knowledge of the New Caledonian insect fauna. MONTROUZIER (1860) recorded the first water beetles from New Caledonia, e.g. *Exocelina aubei* (MONTROUZIER). Additional species descriptions, based on his collections, followed a few years later: PERROUD & MONTROUSIER[1] (1864), FAUVEL (1883). Other early collections include those of the naval surgeon Emile Deplanche (1824–1875), who collected mainly around Port-de-France (= Nouméa) between 1858 and 1860. The holotype of *Macrogyrus caledonicus* FAUVEL, the neotype of *Exocelina novaecaledoniae* (BALFOUR-BROWNE), and the types of several Scirtidae described by BOURGEOIS (1884) were for instance collected by him. In 1883, F.E. Pipitz (1815–1899) caught a couple of water beetles (e.g. some Hydrophilidae and Gyrinidae), which are now deposited in various Central European museums. Between 25.II.1911 and 5.VI.1912 two Swiss zoologists, Jean Roux (1876–1939) and Fritz Sarasin (1859–1942), carried out a thorough field survey of major importance (see SARASIN 1917, SARASIN & ROUX 1913–1929). Their beetles were published by HELLER (1916). Sarasin & Roux collected for instance the types of *Exocelina commatifera* (HELLER). In 1914, zoological and botanical collections, financed by the Royal Society, the Percy Sladen Trust Fund and the Worts Fund of the University of Cambridge, were made by P.D. Montague. From his material, some Dytiscidae (e.g. *Exocelina atripennis* BALFOUR-BROWNE) and some Hydrophilidae (e.g. *Dactylosternum montaguei* BALFOUR-BROWNE) were described. Lucy Evelyn Cheesman (1881–

[1] Throughout that article the name of the second author is spelled as "Montrousier".

1969) was an intrepid British entomologist, who spent many years in the Pacific Region including New Caledonia, where she collected for instance *Exocelina aubei* in 1949. *Limbodessus cheesmanae* (BALFOUR-BROWNE) was named after her in 1939. In 1949, Everett J. Ford Jr. collected the only specimen of Hydrochidae recorded from New Caledonia so far. During the Osaka Museum Scientific Expedition to New Caledonia in 1958, Y. Shibata and Y. Tsutsui collected specimens of an interesting endemic water beetle taxon, described as *Yateberosus* SATÔ in 1965. In 1958, Boris Malkin, a Polish coleopterist, rediscovered *Laccophilus seminiger* FAUVEL, which was already thought to be extinct in New Caledonia. In the 1960s, several coleopterists associated with the Bishop Museum, Honolulu (e.g. J.L. Gressitt), collected terrestrial beetles, including forest floor hydrophilids. The "Austrian New Caledonia Expedition", carried out by members of the University of Vienna and the Natural History Museum Vienna in 1965, was aimed mainly at running water ecology. Water beetles collected during that expedition were published by STARMÜHLNER (1968), OCHS (1968), and BERTRAND (1968, 1972). In August/September 1970, Herbert Franz (1908–2002), an Austrian geologist and coleopterist collected a number of Scirtidae, Hydrophilidae, as well as terrestrial Hydraenidae. In 1978, G. Kuschel, an entomologist from New Zealand, who had already been in New Caledonia in 1963, visited this archipelago again, together with his colleague J.C. Watt (1936–2006), collecting some terrestrial hydrophilids.

Besides the few articles listed above, very little has been published on New Caledonian water beetles in the 20th century. ORCHYMONT (1937: 154) compiled a checklist of the "Palpicornia" (Hydraenidae, Spercheidae, Hydrophilidae) of New Caledonia, which included 21 species (10 endemic). By 1945, only 57 species/subspecies (28 endemic) of water beetles were known from New Caledonia (BALFOUR-BROWNE 1945). STARMÜHLNER (1986) provided a "Checklist of the fauna of the mountain streams of the Pacific Continental Islands of New Caledonia". However, this list was most incomplete. Only two outdated specific names were included: "*Stethoxus australis*" [= *Hydrophilus australis* MONTROUZIER], and "*Hydaticus goryi*" [= *Hydaticus bihamatus goryi* AUBÉ]. The genus *Macrogyrus* RÉGIMBART (Gyrinidae) was erroneously regarded as "endemic", and the inclusion of the family Dryopidae was obviously based on misidentification (see below).

Collecting activities in New Caledonia intensified strongly toward the very end of the 20th century and during the first decade of the 21st century, providing the base of a much better knowledge of the water beetle fauna, which is presented below.

Water beetle composition of New Caledonia

As a Darwinian Island, Grande Terre is characterized by a very high degree of diversification and by the absence of certain groups that occur on the neighbouring continent (i.e. Australia).

The enormous diversification of certain water beetle genera may at least partly be explained by the highly diverse climate conditions (see above) in combination with an unusual wealth of geological substrates (Fig. 5). STARMÜHLNER (1968) was the first author trying to correlate the distribution of aquatic invertebrates with geological substrates.

Four families of aquatic Coleoptera are quite well represented in New Caledonia: Dytiscidae (54 spp.), Hydraenidae (> 30 spp.), Hydrophilidae (44 spp.), and Scirtidae (> 50 spp.).

Two genera are remarkably speciose: *Exocelina* BROUN (Dytiscidae) and *Hydraena* KUGELANN (Hydraenidae). *Exocelina* includes at present 36 New Caledonian species, while *Hydraena* has not yet been thoroughly studied, but it can be estimated to be as diverse as *Exocelina*.

New Caledonian Scirtidae are characterized by a rather high generic diversity, which has not yet been resolved completely. The phylogenetic relationships of these genera will provide important

data on the colonization of New Caledonia. The genus *Scirtes* ILLIGER includes 13 New Caledonian members, and there are probably several additional ones awaiting discovery.

Several families with world-wide distribution do not occur in New Caledonia: Hydroscaphidae, Sphaeriusidae, Elmidae, and Psephenidae. All these families are known from Australia.

Dryopidae are represented by two strictly terrestrial genera only (KODADA et al. 2009). Aquatic dryopids reported from New Caledonia by STARMÜHLNER (1968, 1986) are probably misidentified Limnichidae (*Byrrhinus* MOTSCHULSKY). Ptilodactylidae are well represented on Grande Terre (e.g. *Ptilodactyla australis* BOURGEOIS), however, it has not been established whether any of these species are aquatic.

Parasitic Water Beetles and Phytophagous Water Beetles (sensu JÄCH 1998, JÄCH & BALKE 2008) are so far also unknown from New Caledonia. The wide-spread Rice Water Weevil, *Lissorhoptrus oryzophilus* KUSCHEL (Erirhinidae), has for instance not been recorded from New Caledonia (see WILLIAMS 1944).

In part 1 of the "Water beetles of New Caledonia", the following families are treated: Dytiscidae, Gyrinidae, Haliplidae, Heteroceridae, Hydrochidae, Hydrophilidae, Limnichidae, Noteridae, Spercheidae, Scirtidae (partly). It should be mentioned that Dytiscidae and Hydrophilidae include also purely terrestrial members, which are treated here for completeness.

The contributions on Noteridae, Heteroceridae and some Hydrophilidae are based on a wider geographical scale because this seemed beneficial for a better geographical and/or taxonomic understanding.

The Hydraenidae, the remaining parts of the Scirtidae, faunistic/taxonomic updates on some of the other families, additional keys, a complete checklist of all New Caledonian water beetles as well as some contributions on larvae will be published in the "Water Beetles of New Caledonia (part 2)".

Further morphological and ecological information on the families treated herein can be obtained from the Handbook of Zoology (BEUTEL & LESCHEN 2005).

No thorough ecological investigations have been carried out on Carabidae and Staphylinidae, which probably include a number of Facultative Water Beetles and/or Shore Beetles. The marine shores of New Caledonia are very probably inhabited by a number of littoral beetles, which have not been studied.

In total 58 new species (Dytiscidae: 28, Hydrophilidae: 17, Scirtidae: 12, Limnichidae: 1) are described from New Caledonia in this book. In addition, three species and one subspecies of Noteridae and three species of Hydrophilidae are described from other Indo-Pacific Islands (Bacan, Ceram, Fiji, New Guinea, Wallis & Futuna).

Five dytiscid species, *Hydroglyphus daemeli* (SHARP), *H. godeffroyi* (SHARP), *H. trifasciatus* (WATTS), *Hydrovatus opacus* SHARP, and *Limbodessus cheesmanae* (BALFOUR-BROWNE), as well as four genera and two species of Hydrophilidae, *Aculomicrus* SMETANA, *Chaetarthria* STEPHENS, *Limnoxenus* MOTSCHULSKY, *Psalitrus* ORCHYMONT, *Cercyon nigriceps* (MARSHAM) and *Limnoxenus zealandicus* (BROUN), are newly recorded from New Caledonia in this volume.

Rare, extinct and threatened water beetles

The following non-endemic water beetles species are very rare or maybe even extinct in New Caledonia. They should be placed on the Red List of New Caledonian animals:

Haliplus oberthuri FAUVEL (Haliplidae) and *Canthydrus serialis* FAUVEL (Noteridae) have not been found in New Caledonia for about 150 years. According to FAUVEL (1883), they were

collected in a marshy area near Vata Bay, now part of Nouméa City. The marshy area does not exist any more. These two species have not been collected in any of the marshy areas sampled in the vicinity of Nouméa and therefore they could be regarded as extinct in New Caledonia.

Three species of Dytiscidae, *Allodessus bistrigatus* (CLARK), *Laccophilus seminiger* FAUVEL, and *Sternhydrus atratus* (FABRICIUS), have been recorded from New Caledonia in the 19th century. While *Laccophilus seminiger* was rediscovered in 1958 and not collected since then, some specimens of the two remaining species were rediscovered in New Caledonia very recently. The Australian dytiscid *Hydroglyphus daemeli* (SHARP) was collected in New Caledonia in 1965, but never found again. Thus all these four species are to be regarded at least as endangered or critically endangered (according to the IUCN Red List categories) in New Caledonia. *Hydroglyphus daemeli* and *Laccophilus seminiger* might even be considered locally extinct as they have not been collected for several decades.

Hydrophilus brevispina FAIRMAIRE (Hydrophilidae), one of the largest species of New Caledonian water beetles was not recorded from New Caledonia since RÉGIMBART (1901) and it may therefore be extinct in that Archipelago. The Australian *Berosus australiae* MULSANT & REY was also recorded from New Caledonia by FAUVEL (1883) and not found again, but this identification is rather doubtful.

Even more interesting from a global point of view are the endemic water beetle species of New Caledonia, several of which are very rare or possibly even extinct:

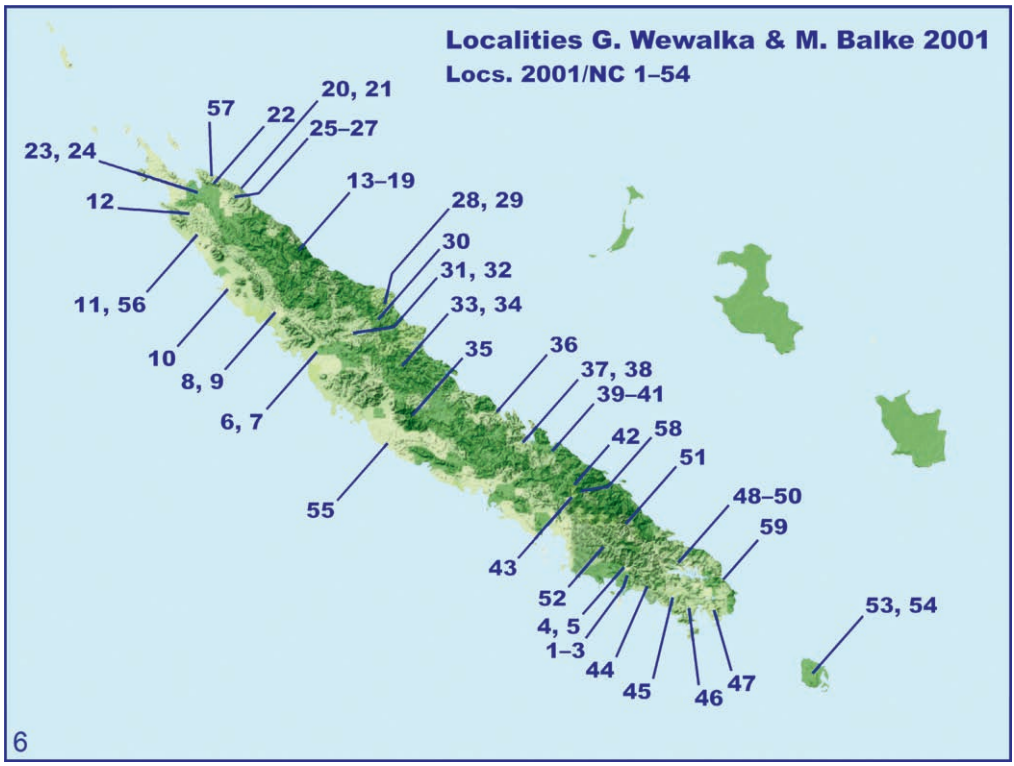
Aulonogyrus antipodum FAUVEL (Gyrinidae) was described in 1903 and only a single female has been collected since then (in 2008). Definitely, this species has to be considered as critically endangered. Eighteen species of *Exocelina* (Dytiscidae) have so far been recorded from only one square grid (25 × 25 km), and several of these species, e.g. *E. charlottae* WEWALKA et al., *E. creuxorum* WEWALKA et al., *E. ouin* WEWALKA et al., are known from only a single locality so far. *Exocelina inexspectata* WEWALKA et al. is known only from a single specimen, which was collected at light, its habitat therefore being still unknown. One endemic hydrophilid, *Berosus distigma* FAUVEL, has not been collected for more than a hundred years. Five species of *Scirtes* ILLIGER (Scirtidae) are known only from a single specimen. In the genus *Hydraena* (Hydraenidae) and in some other genera of Scirtidae there are probably also several SORD (species of restricted distribution), but these will be published in the "Water Beetles of New Caledonia (part 2)".

Checklist of water beetle families of New Caledonia

Dytiscidae	54 spp. (44 endemic, 81 %)
Gyrinidae	5 spp. (3 endemic, 60 %)
Haliplidae	1 sp. (possibly extinct in New Caledonia)
Heteroceridae	1 sp.
Hydraenidae	> 30 spp. (most of them probably endemic)
Hydrochidae	1 sp. (endemic?)
Hydrophilidae	44 spp. (31 endemic, 70 %)
Limnichidae	2 spp. (both probably endemic)
Noteridae	3 spp. (1 endemic, 33 %)
Scirtidae	> 50 spp. (most of them probably endemic)
Spercheidae	1 sp.

Collecting localities – M. Balke & G. Wewalka, 2001 (Grande Terre, Île des Pins)

(Figs. 6, 8–25)



SOUTH PROVINCE:

Loc. 2001/NC 1a: Mt. Koghi [also known as Monts Koghis], 500 m a.s.l., 2.XI.2001. Stream bed, rocky and gravelly ground, few sandy spots, almost dry when visited, on steep forested slope. Sampled by G. Wewalka only.

Loc. 2001/NC 1: Dumbéa, 50 m a.s.l., near road to Mt. Koghi [Monts Koghis], 3.XI.2001. Slowly flowing stream (max. 2 m wide), shaded, forming larger pools (max. 70 cm deep), edge with leaf packs and roots, ground sandy and gravelly with few larger stones.

Loc. 2001/NC 2: Dumbéa, 150 m a.s.l., road to Mt. Koghi [Monts Koghis], Rue de Forêt, 3.XI.2001. Stream in deep gorge, slightly flowing, edges sandy/gravelly.

Loc. 2001/NC 3: Dumbéa, 50 m a.s.l., near road to Mt. Koghi [Monts Koghis], 3.XI.2001. Slowly flowing stream (max. 2 m wide and 40 cm deep), partly shaded, egde with leaf packs and roots, ground sandy and gravelly.

Loc. 2001/NC 4, **4a** (Fig. 8): Dumbéa, 50 m a.s.l., swamp at road to upper course of River Dumbéa, 4.XI.2001 (NC 4) and 21.XI.2001 (NC 4a). Swampy area and inundated forest, larger shaded pools on red clay, with thick leaf layers, some reeds.

Loc. 2001/NC 5 (Fig. 9): Dumbéa, 150 m a.s.l., upper course of River Dumbéa, 4.XI.2001. Large river, 10–20 m wide and max. 3–4 m deep, slowly flowing, sun exposed, beetles taken from water holes on gravel banks and a ditch on dirt road close to the river.

NORTH PROVINCE:

Loc. 2001/NC 6: 5 km east of Pouembout, 20 m a.s.l., 6.XI.2001. Lowlands, dirt road inland to Forêt Plate, partly shaded pool (2 m², max. 50 cm deep) in otherwise dry stream bed on red clay, edges of pool with some leaves, grass and roots; water eutrophicated by cattle; surrounding area dry shrubland.

Loc. 2001/NC 7 (Fig. 11): 10 km east of Pouembout, 50 m a.s.l., 6.XI.2001. Lowlands, dirt road 10 km inland to Forêt Plate, small stream, slowly flowing, more or less shaded, collected from small backflows and bays at the edge, with leaves and pine needles; and larger, slowly flowing shallow stream nearby.

Loc. 2001/NC 8: Light trap (neon lamp) at edge of river (see Loc. 2001/NC 9), 50 m a.s.l., 6.XI.2001.

Loc. 2001/NC 9 (Fig. 10): 15 km NE Voh, 50 m a.s.l., 6.XI.2001. Almost stagnant river, 10–15 m wide and max. 1 m deep, gravelly, partly shaded, edge with dense mats of submerged vegetation; backflows with leaf packs.

Loc. 2001/NC 10: 1 km SW Camp Minier, 20 m a.s.l., 7.XI.2001. Coastal lowland, with low shrubs and eucalypts, small stream (in ca. 50 cm deep gully), rocky/gravelly, fully sun exposed, slowly flowing and partly interrupted, max. 2 m wide.

Loc. 2001/NC 11: 5 km east of Koumac, 50 m a.s.l., 7.XI.2001. River Koumac, between Koumac and the Grottes Koumac, ca. 20 m wide but almost completely dry when visited, river bed with gravel, mostly sun exposed; some residual pools with thick green algal mats, water temperature > 35° C, slightly shaded residual pool at river edge, under some larger trees, in leaf packs.

Loc. 2001/NC 12 (Fig. 12): 13 km north of Koumac, 50 m a.s.l., 7.XI.2001. Between Koumac and Ouégoa, ca. 13 km from Koumac, stream on coral gravel besides road, partly shaded, slowly flowing, richly vegetated, on one side of bridge forming larger pool max. 1 m deep.

Loc. 2001/NC 13: Mt. Panié, 550 m a.s.l., 8.XI.2001. Small stream, underneath of stones, in forest.

Loc. 2001/NC 14: Mt. Panié, 1200 m a.s.l., 8.XI.2001. Water hole on path, 20 × 20 × 20 cm, on red clay, in forest.

Loc. 2001/NC 15: Mt. Panié, 1200 m a.s.l., 8.XI.2001. Small stream, underneath of stones, in forest.

Loc. 2001/NC 16 (Figs. 13, 14, 17): Mt. Panié, 1350 m a.s.l., 8.–9.XI.2001. Slowly flowing stream close to alpinist hut, stream pools as well as dry but moist stream bed feeding into the pools, underneath of stones, in forest.

Loc. 2001/NC 17: Mt. Panié, 1550 m a.s.l., 9.XI.2001. Stream bed on level area below summit, in forest.

Loc. 2001/NC 18: Mt. Panié, 750 m a.s.l., 9.XI.2001. Water hole in otherwise dry stream bed, in forest.

Loc. 2001/NC 18a: Mt. Panié, 1100 m a.s.l., 9.XI.2001. Water hole in otherwise dry stream bed, in forest.

Loc. 2001/NC 19: Mt. Panié, 1400 m a.s.l., 9.XI.2001. Water hole in otherwise dry stream bed, in forest.

Loc. 2001/NC 19a: Mt. Panié, 900 m a.s.l., 9.XI.2001. Small stream, in forest.

Loc. 2001/NC 20 (Fig. 18): 3 km north Pouébo, 10 m a.s.l., 10.XI.2001. Swampy meadow at roadside, large ditch with fouling water, grassy edges, bottom muddy, sun exposed.

Loc. 2001/NC 21 (Fig. 15): 10 km north Pouébo, 10 m a.s.l., 10.XI.2001. Small stream, water stagnant, sun exposed, max. 1 m deep.

Loc. 2001/NC 22: Col d'Amoss, 350–120 m a.s.l., 11.XI.2001. Small stream.

Loc. 2001/NC 23: 9 km SSW Ouégoa, near road to Bondé, 50 m a.s.l., 11.XI.2001. Stream, partly shaded.

Loc. 2001/NC 24: west of Cols de Crève-Coeur, 100 m a.s.l., 11.XI.2001. Stream, water almost stagnant, max. 3 m wide, shaded, edge with leaf packs, in front of Cols de Crève-Coeur.

Loc. 2001/NC 25 (Fig. 19): 8 km south of Ouégoa, road to Mandjélia, 50 m a.s.l., 11.XI.2001. Water hole, sun exposed, open area, but two sides of hole partly shaded, water turbid, ground clay, max. 1 m deep, water at bottom cool.

Loc. 2001/NC 25a: 8 km south of Ouégoa, 2 km on the road to Mandjélia, 50 m a.s.l., 11.XI.2001. Stream pool in cultivated land.

Loc. 2001/NC 26: 10 km SE Ouégoa, road to Mandjélia, 560 m a.s.l., 11.XI.2001. Small stream in gully, water nearly stagnant, montane forest, shaded.

Loc. 2001/NC 27: 9 km SSE Ouégoa, road to Mandjélia, 100 m a.s.l., 12.XI.2001. Small stream in cultivated area.

Loc. 2001/NC 28: Pombeï, 50 m a.s.l., 13.XI.2001. Small stream, flowing over rather smooth rock, shaded, with leaf packs and roots.

Loc. 2001/NC 29: 20–30 km west of Poindimié, ca. 350 m a.s.l., 13.XI.2001. Small stream, water almost stagnant, turbid, max. 1 m deep, ground slightly muddy, edges sandy, with clay and with thick mats of vegetation.

Loc. 2001/NC 30: Bopope, 17 km west of Pombeï, 150 m a.s.l., 13.XI.2001. Small stream, shaded, water almost stagnant, in narrow swampy valley, abundance of leaves in water, numerous pools alongside stream bed; in the midst of cultivated, sun exposed area.

Loc. 2001/NC 31: ca. 25 km west of Pombeï, near Bobeito, 350 m a.s.l., 13.XI.2001. Sun exposed quarry, large pool, 5 × 15 m, about 1 m deep, ground very soft (sand/mud/clay).

Loc. 2001/NC 32: ca. 25 km west of Pombeï, near Bobeito, 300 m a.s.l., 13.XI.2001. Old mining road, area very dry and with disturbed forest and pine plantations. Small stream, almost dry, shaded, water eutrophicated and in part black, fouling.

Loc. 2001/NC 33: Aoupinié, 15 km SW Ponérihouen, 500–700 m a.s.l., 14.XI.2001. Stream bed in montane forest, slope very steep and rocky; water almost stagnant but clear, small residual pools with leaves and root mats.

Loc. 2001/NC 34 (Fig. 16): Aoupinié, 25 km SW Ponérihouen, 700 m a.s.l., 14.XI.2001. Western slopes of the range, stream bed, almost dry, only two small puddles left, bottom with leaves, sandy/rocky; shaded.

Loc. 2001/NC 35: Me Maoya Area, 4 km south of Nérin, 600 m a.s.l., 14.XI.2001. Wide, hardly shaded stream bed, sandy/gravelly/rocky, with some large boulders; with stream pools ca. 2 × 3 m wide, max. 1 m deep.

Loc. 2001/NC 36: 5–10 km south of Kouaoua, Creek des Orangers, 180 m a.s.l., 15.XI.2001. Stream (max. 2–4 m wide), in deep creek besides road, partly shaded, with pools (max. 1.5 m deep), ground rocky/gravelly, with slow flowing sections, banks sandy/gravelly, in part with leaves.

Loc. 2001/NC 37: Mt. Canala, 15–20 km south of Canala, 600 m a.s.l., 15.XI.2001. Puddle in otherwise dry stream bed, montane forest, shaded, stream bed comparably level but with some cascades up to 2 m high.

SOUTH PROVINCE:

Loc. 2001/NC 38 (Fig. 25): road Canala – Koindé – La Foa, southern slope of pass near Koindé, 620 m a.s.l., 16.XI.2001. Small shaded stream, slowly flowing, puddles with leaves. (Note: this locality is in the border region North / South Province, and most likely situated in the South Province).

NORTH PROVINCE:

Loc. 2001/NC 39: 20 km east of Canala, 100 m a.s.l., 15.XI.2001. River (max. 10 m wide, 1 m deep), water clean and cool, with large pools, hardly shaded, edge with leaf packs and gravel.

SOUTH PROVINCE:

Loc. 2001/NC 40: 16 km west of Thio, 350 m a.s.l., 16.–17.XI.2001. Pool (2 × 1 m wide and more than 50 cm deep) in stream bed formed by concrete ford; unshaded, bottom sandy, with clay, grassy edge, water slightly turbid.

Loc. 2001/NC 41 (Fig. 23): 10 km west of Thio, 50 m a.s.l., 17.XI.2001. Stream on black rock, water clear but only slowly flowing, edge with some leaves.

Loc. 2001/NC 42 (Fig. 20): 6 km south of Thio, 50 m a.s.l., 17.XI.2001. Swampy area around a fishpond, close to agricultural school, edge with grass and emergent plants.

Loc. 2001/NC 43: 18 km north of Bouloupari, 100 m a.s.l., 17.XI.2001. Stream in open land.

Loc. 2001/NC 44 (Fig. 22): Mt. Koghi [Monts Koghis], 500 m a.s.l., 19.XI.2001. Stream bed in montane forest, steep slope, almost dry, bed rocky, some gravel and sand in the more level parts of slope. Beetles in rock pools (max. 30 × 30 cm) on large boulders/bedrock, water full of fouling leaves. Upper part of stream with some flowing water, beetles collected from small water holes at edge, or minute backflows.

Loc. 2001/NC 45: 6 km east of Plum, 100 m a.s.l., 19.XI.2001. Rivière des Pirogues, near La Forestière. Small river, slightly flowing, unshaded, bottom red soil with rocks; open, rather flat country with gentle hills.

Loc. 2001/NC 46: 18 km east of Plum, 150 m a.s.l., 19.XI.2001. Path to La Capture, water hole on rocks.

Loc. 2001/NC 47 (Fig. 21): 2 km west of Prony, Goro Nickel Plant, 180 m a.s.l., 19.XI.2001. Water filled doline (towards the middle > 5 m deep), water crystal clear, edge with red soil, reeds and macrophytes.

Loc. 2001/NC 48: Rivière Bleue Provincial Park, 3 km from entrance, 150 m a.s.l., 20.XI.2001. Rainwater puddle on road, red soil, lowland forest.

Locs. 2001/NC 49/50 (Fig. 24): Rivière Bleue Provincial Park, 500–600 m a.s.l., 20.XI.2001. Hiking trail 7c. NC 49 = rainwater holes in red soil on trail, steep slope, montane forest. NC 50 = small stream, bed deeply cut into ground, shaded, beetles collected from water holes in bedrock at stream edge; water with leaves, in part fouling.

Loc. 2001/NC 51: Mt. Humboldt, 800–900 m a.s.l., 22.XI.2001. Trail starting in mining area, rainwater holes on trail, sun exposed, red soil.

Loc. 2001/NC 52: Mt. Mou, near Sanatorium, 400 m a.s.l., 23.XI.2001. Small stream, shaded, backflows with leaf packs and ditch at road, created by backflow, ground sandy/gravelly, shaded.

Loc. 2001/NC 53: Île des Pins, Grotte Reine Hortense, entrance, 50 m a.s.l., 24.XI.2001. Stream flowing from cave, shaded, in moist, cool valley with flat bottom, ground peaty, red soil. Backflows with leaf packs.

Loc. 2001/NC 54: Île des Pins, Kwanyi, 50 m a.s.l., 24.XI.2001. Secondary forest, dry stream bed, 1 m wide, cut into ground (ca. 50 cm), rest water puddle, 1.5 m long and max. 15 cm deep, ground with leaves; partly shaded.

SOUTH PROVINCE:

Loc. 2001/NC 55: Near Bourail, 1 m a.s.l., 6.XI.2001. Hand collecting at beach. Sampled by G. Wewalka only.

NORTH PROVINCE:

Loc. 2001/NC 56: 12 km E Koumac, Grotte de Koumac, ca. 100 m from entrance, 50 m, 6.XI. 2001. Hand collecting in cave. Sampled by G. Wewalka only.

Loc. 2001/NC 57: 8 km N Ouégoa, camping ground, 1 m a.s.l., 10.XI.2001. At beach, at light. Sampled by G. Wewalka only.

SOUTH PROVINCE:

Loc. 2001/NC 58: Mt. Ningua 20 km S Thio, 1100 m a.s.l., 17.XI.2001. Beating and hand collecting in mountain forest. Sampled by G. Wewalka only.

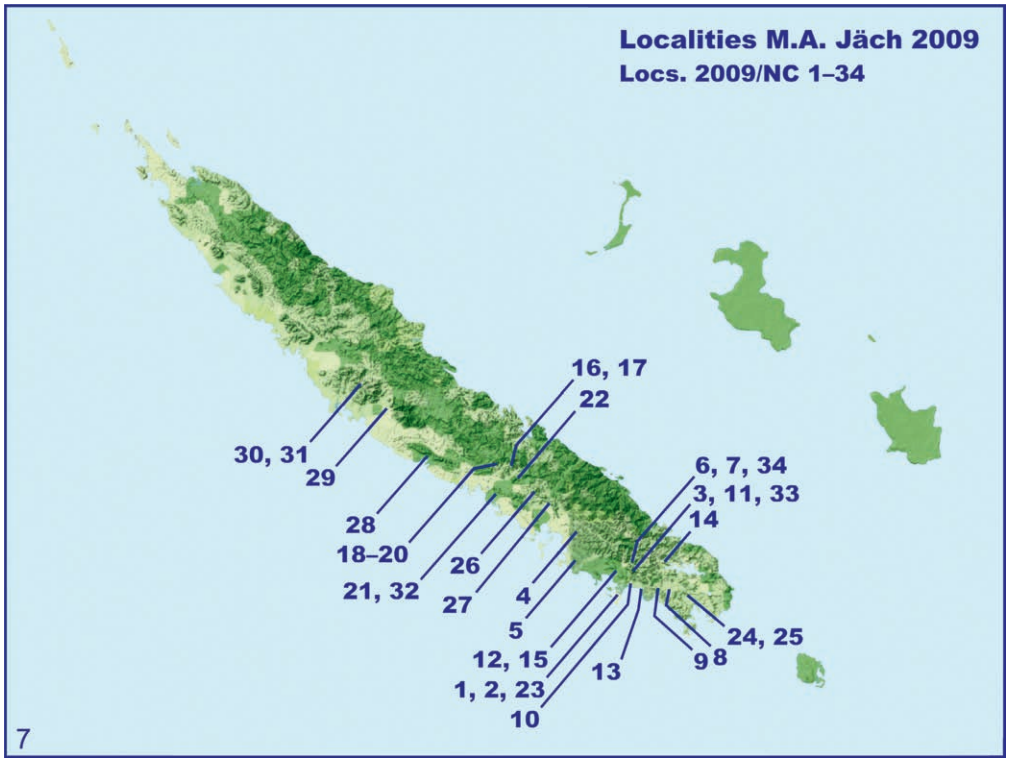
Loc. 2001/NC 59: Touaourou, ca. 10 km SE Yaté, 5 m, 19.XI.2001. At light. Sampled by G. Wewalka only.

Collecting localities – M.A. Jäch, 2009 (Grande Terre)

(Figs. 7, 26–51)

All distances in straight-line. Coordinates and elevations were taken with GPS ("Garmin eTrex Summit personal navigator"), and later partly adjusted with Google Earth Programme.

No water beetles were collected at Locs. 2009/NC 2, 13, 23.



SOUTH PROVINCE:

Loc. 2009/NC 1 (Fig. 26): northern Nouméa, Rivière Salée, 5 m a.s.l., 22°14'03.7"S/166°27'60"E, 22.XI.2009. Freshwater swamp near mangroves.

[**Loc. 2009/NC 2**: Nouméa, Baie de l'Orphelinat (sea port), 0 m a.s.l., 22°17'24.2"S/166°26'14.1"E, 22.XI.2009. Sea surface.]

Loc. 2009/NC 3 (Fig. 29): Mt. Koghi [Monts Koghis], ca. 5 km N Nouméa, 135 m a.s.l., 22°10'51.4"S/166°29'32.0"E, 22.XI.2009. Stream, ca. 3 m wide, flowing through disturbed forest.

Loc. 2009/NC 4 (Fig. 27): ca. 11 km NE Tontouta, ca. 40 m a.s.l., 21°56'14"S/166°17'21"E, 23.XI.2009. River Tontouta, restwater pools, hardly flowing shallow branch at margin of wide gravel bank, partly shaded by trees and bushes.

Loc. 2009/NC 5 (Fig. 28): Mt. Mou, ca. 13 km SE Tontouta, ca. 380 m a.s.l., 22°04'23.2"S/166°19'47.6"E, 23.XI.2009. Small stream, ca. 1–2 m wide, flowing through dense rainforest. Collection includes forest floor sifting by R. Schuh.

Loc. 2009/NC 6 (Fig. 31): ca. 10 km NNE Nouméa, ca. 70 m a.s.l., 22°08'02"S/166°30'47"E, 23.XI.2009. River Dumbéa (south branch), ca. 30 m wide, flowing through wide unshaded gravel bed; restwater pools; sandy margins; seepages.

Loc. 2009/NC 7: ca. 10 km NNE Nouméa, ca. 80 m a.s.l., 22°07'55.5"S/166°30'43.5"E, 23.XI.2009. Small stream (right tributary of River Dumbéa), ca. 1 m wide, flowing between bushes in gully (ca. 2 m deep).

Loc. 2009/NC 8 (Fig. 32): road Nouméa – Yaté, ca. 30 km NE Nouméa, ca. 100 m a.s.l., 22°11'15"S/166°43'21"E, 24.XI.2009. River (Rivière des Pirogues), ca. 8–10 m wide, flowing through open shrubland.

Loc. 2009/NC 9 (Fig. 33): road Nouméa – Yaté, ca. 20 km NE Nouméa, ca. 220 m a.s.l., 22°12'24"S/166°40'45.6"E, 24.XI.2009. Two small streams, ca. 1–2 m wide, flowing through isolated patch of rainforest.

Loc. 2009/NC 10 (Fig. 30): St. Louis, NE Nouméa, ca. 3 m a.s.l., 22°13'45.5"S/166°32'07.7"E, 24.XI.2009. Canal, ca. 1–5 m wide, flowing through open land.

Loc. 2009/NC 11 (Fig. 34): Mt. Koghi [Monts Koghis], ca. 5 km N Nouméa, ca. 500–550 m a.s.l., 22°10'33.4"S/166°30'22.7"E, 25.XI.2009. Small streams (1–3 m wide), flowing through forest. Collection includes forest floor sifting.

Loc. 2009/NC 12: ca. 10 km NW Nouméa, ca. 2 m a.s.l., 22°09'50.4"S/166°25'33.8"E, 25.XI.2009. Swamp in River Dumbéa flood plain.

[**Loc. 2009/NC 13**: ca. 10 km ENE Nouméa, E St. Louis, ca. 4 m a.s.l., 22°14'08.7"S/166°34'51.7"E, 26.XI.2009. River Coulée, potamal, ca. 20 m wide.]

Loc. 2009/NC 14 (Fig. 36): Rivière Bleue Provincial Park, between Pont Germain and Refuge Tristaniopsis, ca. 30 km NE Nouméa, ca. 160–180 m a.s.l., 22°06'03.7"S/166°39'27.8"E, 26.–27.XI.2009. River (Rivière Bleue), ca. 10 m wide, and several left tributaries, ca. 2–5 m wide, all flowing through forest. Collection includes light trap material.

Loc. 2009/NC 15 (Fig. 39): ca. 8 km NNW Nouméa, ca. 10 m a.s.l., 22°09'20.7"S/166°27'23.7"E, 28.XI.2009. Pools and backwaters of River Dumbéa flood plain.

Loc. 2009/NC 16 (Fig. 35): Col d'Amieu, ca. 10 km NNW La Foa, ca. 490 m a.s.l., 21°36'39"S/165°48'38"E and ca. 430 m a.s.l., 21°36'52"S/165°48'49.6"E, 28.XI.2009. Small streams (1–3 m wide), flowing through forest.

Loc. 2009/NC 17: ca. 1 km W Sarraméa, ca. 45 m a.s.l., 21°39'06.2"S/165°49'42.2"E, 28.XI.2009. River, ca. 10 m wide, slowly flowing, with gravel banks, partly shaded by trees.

Loc. 2009/NC 18 (Fig. 37): ca. 2 km NNE Farino, Refuge de Farino – Petite Cascade, ca. 270–340 m a.s.l., 21°38'55"S/165°46'53"E (coordinates taken at Refuge de Farino), 29.XI.2009. Rock pools and residual pools of two very small, almost dry streams (right tributaries of River Farino), flowing through degraded forest.

Loc. 2009/NC 18a: Refuge de Farino, at light (29.–30.XI.2009, 3.XII.2009).

Loc. 2009/NC 19 (Fig. 40): ca. 3 km N Farino, near Petite Cascade, ca. 340 m a.s.l., 21°38'09"S/165°46'33"E, 29.XI.2009. River Farino, ca. 5–10 m wide, flowing through forest.

Loc. 2009/NC 20: Parc des Grandes Fougères, ca. 5 km NNW Farino, ca. 340 m a.s.l., 21°37'08"S/165°45'37"E, 29.XI.2009. Small river (Me Peou), ca. 5–10 m wide, flowing through primary forest.

Loc. 2009/NC 21 (Fig. 38): ca. 7 km SE La Foa, ca. 20 m a.s.l., 21°44'04"S/165°53'23"E, 30.XI.2009. River Pocquereux, epipotamal, ca. 5–10 m wide, flowing through forest.

Loc. 2009/NC 22 (Fig. 41): ca. 2 km NE Sarraméa, near La Cuve, ca. 160 m a.s.l., 21°38'13"S/165°51'53"E, 30.XI.2009. Stream, 5–7 m wide, with large boulders, slowly flowing through forest.

Loc. 2009/NC 22a: cow dung on pasture.

[**Loc. 2009/NC 23**: Nouméa, Anse Vata, 1 m a.s.l., 22°18'14"S/166°26'04"E, 1.XIII.2009. Beach rocks.]

Loc. 2009/NC 24 (Figs. 42, 45): ca. 2 km NW Prony, ca. 140 m a.s.l., 22°18'36"S/166°48'33"E and ca. 125 m a.s.l., 22°18'24"S/166°48'21"E, 2.XII.2009. Two large pools, unshaded, > 100 m², 1.5 m deep. Some specimens collected by M. Madl.

Loc. 2009/NC 25 (Fig. 43): ca. 3 km NW Prony, ca. 120 m a.s.l., 22°18'16"S/166°48'15"E, 2.XII.2009. River, ca. 5–10 m wide, forming large blue colored pools, slowly flowing through shrubland and forest. Collection includes sweep net samples taken by M. Madl.

Loc. 2009/NC 26 (Fig. 50): Mt. Do, ca. 20 km ESE La Foa, near summit (ca. 1,000 m a.s.l., 21°45'14"S/166°48'00"E) and further below (ca. 820 m a.s.l., 21°45'38"S/165°59'59"E), 3.XII.2009. Forest floor sifting, together with R. Schuh.

Loc. 2009/NC 27 (Fig. 46): ca. 8 km NNE Bouloupari, ca. 120 m a.s.l., 21°48'08"S/166°04'12"E, 3.XII.2009. Stream (La Wamuttu), hardly flowing, mostly over bare rock and between big boulders, with numerous rock pools, through degraded forest.

Loc. 2009/NC 28 (Fig. 44): ca. 1 km S Bourail, ca. 5 m a.s.l., 21°34'56"S/165°29'43"E, 4.XII.2009. Swamp in meadow near River Néra.

NORTH PROVINCE:

Loc. 2009/NC 29 (Fig. 47): ca. 12 km NE Poya, ca. 120 m a.s.l., 21°16'21"S/165°14'46"E, 4.XII.2009. Small stream, ca. 1–2 m wide, flowing through degraded forest and pastures.

Loc. 2009/NC 30 (Fig. 51): ca. 4 km SW Népoui, ca. 140 m a.s.l., 21°12'48"S/165°06'06"E, 4.XII.2009. Small stream (left tributary of River Népoui), ca. 1–2 m wide, pools and waterfalls, flowing through degraded forest.

Loc. 2009/NC 31 (Fig. 48): ca. 17 km NE Népoui, ca. 110 m a.s.l., 21°13'30"S/165°05'30"E (and about 2 km upstream), 4.XII.2009. River Népoui, ca. 10–20 m wide, flowing through degraded forest and cultivated land.

SOUTH PROVINCE:

Loc. 2009/NC 32: La Foa, ca. 20 m a.s.l., 21°42'40"S/165°49'48"E, 4.XII.2009. Hotel Banu, at light.

Loc. 2009/NC 33: Mt. Koghi [Monts Koghis]; between Loc. 2009/NC 3 and Loc. 2009/NC 11, ca. 5 km N Nouméa, 325 m a.s.l., 22°10'30"S/166°30'05"E, 5.XII.2009. Stream, ca. 2–10 m wide, cascades and pools in deep gorge, flowing through forest.

Loc. 2009/NC 34 (Fig. 49): ca. 10 km NNE Nouméa, ca. 45 m a.s.l., 22°08'10"S/166°29'58"E and ca. 65 m a.s.l., 22°08'18"S/166°30'07"E, 5.XII.2009. River Dumbéa (south branch), ca. 30 m wide, flowing through wide unshaded gravel bed.

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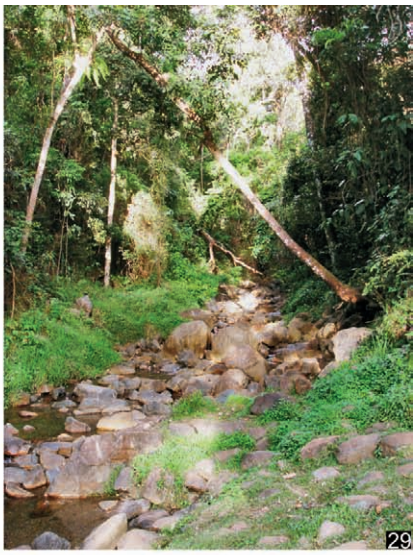
Figs. 8–12: Collecting localities of G. Wewalka and M. Balke, 2001: **8**) Loc. 2001/NC 4; **9**) Loc. 2001/NC 5; **10**) Loc. 2001/NC 9; **11**) Loc. 2001/NC 7; **12**) Loc. 2001/NC 12. Arrows point at actual collecting sites.

Figs. 13–20: Collecting localities of G. Wewalka and M. Balke, 2001: **13**) Loc. 2001/NC 16 (G. Wewalka: standing, C. Burwell and T. Moulds: sitting); **14**) Loc. 2001/NC 16; **15**) Loc. 2001/NC 21 (G. Wewalka); **16**) Loc. 2001/NC 34; **17**) Loc. 2001/NC 16; **18**) Loc. 2001/NC 20; **19**) Loc. 2001/NC 25; **20**) Loc. 2001/NC 42.

Figs. 21–25: Collecting localities of G. Wewalka and M. Balke, 2001: **21**) Loc. 2001/NC 47; **22**) Loc. 2001/NC 44; **23**) Loc. 2001/NC 41; **24**) Loc. 2001/NC 49/50; **25**) Loc. 2001/NC 38. Arrows point at actual collecting sites.



Figs. 26–30: Collecting localities of M.A. Jäch, 2009: **26**) Loc. 2009/NC 1; **27**) Loc. 2009/NC 4 (R. Schuh); **28**) Loc. 2009/NC 5; **29**) Loc. 2009/NC 3; **30**) Loc. 2009/NC 10.

Figs. 31–35: Collecting localities of M.A. Jäch, 2009: **31**) Loc. 2009/NC 6 (R. Schuh); **32**) Loc. 2009/NC 8; **33**) Loc. 2009/NC 9; **34**) Loc. 2009/NC 11 (weekend visitors); **35**) Loc. 2009/NC 16.

Figs. 36–41: Collecting localities of M.A. Jäch, 2009: **36**) Loc. 2009/NC 14; **37**) Loc. 2009/NC 18; **38**) Loc. 2009/NC 21 (R. Schuh); **39**) Loc. 2009/NC 15 (R. Schuh); **40**) Loc. 2009/NC 19; **41**) Loc. 2009/NC 22.

Figs. 42–47: Collecting localities of M.A. Jäch, 2009: **42**) Loc. 2009/NC 24; **43**) Loc. 2009/NC 25 (M.A. Jäch, R. Schuh); **44**) Loc. 2009/NC 28; **45**) Loc. 2009/NC 24 (M.A. Jäch); **46**) Loc. 2009/NC 27 (C. Mille); **47**) Loc. 2009/NC 29.

Figs. 48–51: Collecting localities of M.A. Jäch, 2009: **48**) Loc. 2009/NC 31 (M.A. Jäch); **49**) Loc. 2009/NC 34; **50**) Loc. 2009/NC 26; **51**) Loc. 2009/NC 30. Arrows point at actual collecting site.

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