

Raising names from the dead: a time-calibrated phylogeny of frog shells (Bursidae, Tonnoidea, Gastropoda) using mitogenomic data

Malcolm Sanders, Didier Merle, Michel Laurin, Céline Bonillo, Nicolas Puillandre

▶ **To cite this version:**

Malcolm Sanders, Didier Merle, Michel Laurin, Céline Bonillo, Nicolas Puillandre. Raising names from the dead: a time-calibrated phylogeny of frog shells (Bursidae, Tonnoidea, Gastropoda) using mitogenomic data. Molecular Phylogenetics and Evolution, 2021, 156, pp.107040. 10.1016/j.ympev.2020.107040 . hal-03101324

HAL Id: hal-03101324
https://hal.science/hal-03101324

Submitted on 7 Jan 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Raising names from the dead: a time-calibrated phylogeny of frog shells (Bursidae, Tonnoidea, Gastropoda) using mitogenomic data.

Malcolm T. Sanders[a,b], Didier Merle[a], Michel Laurin[a], Céline Bonillo[c] & Nicolas Puillandre[b]

[a] Centre de Recherche en Paléontologie - Paris CR2P – UMR 7207 – CNRS, Muséum national d'Histoire naturelle, Sorbonne Université, 8 rue Buffon, CP 38, 75005 Paris, France;

[b] Institut de Systématique, Évolution, Biodiversité ISYEB – Muséum national d'Histoire naturelle, CNRS, Sorbonne Université, EPHE, Université des Antilles, 57 rue Cuvier, CP26, F-75005 Paris, France;

[c] Service de systématique moléculaire SSM – UMS 2700 – MNHN, CNRS, Muséum national d'Histoire naturelle, Sorbonne Université. 57 rue Cuvier, CP26, 75005 Paris, France

Abstract

With 59 Recent species, Bursidae, known as « frog shells », are a small but widely distributed group of tropical and subtropical gastropods that are most diverse in the Indo-West Pacific. The present study is aimed at reconstructing phylogenetic relationships of bursid gastropods based on extensive and representative taxon sampling. Five genetic markers (cytochrome c oxidase subunit I (*cox1*), 16s and 12s rRNA mitochondrial genes, 28s rRNA and Histone H3 nuclear gene) were sequenced for over 30 species in every known genus but *Crossata*. Furthermore, we sequenced the complete mt-genome of 9 species (10 specimens) (*Aspa marginata, Marsupina bufo, Korrigania quirihorai, Korrigania fijiensis, Tutufa rubeta, Bursa lamarckii, Lampasopsis rhodostoma (twice), Bufonaria perelegans* and *Bursa* aff. *tuberosissima)*. Our analysis recovered Bursidae as a monophyletic group, whereas the genus *Bursa* was found to be polyphyletic. The genera *Talisman* and *Dulcerana* are resurrected and the genera *Alanbeuella* gen. nov. and *Korrigania* gen. nov. are described. Dating analysis using 21 extinct taxa for node and simplified tip calibrations was performed, showing a diversification of the group in two phases. Diversification seems to be linked to tectonic events leading to biodiversity relocation from the western Tethys toward the Indo-Pacific.

Key words: Bursidae, *Bursa*, marine molluscs, time-tree, fossil calibration, phylogeny

1. Introduction

Bursidae Thiele, 1925 (frog shells) are a moderately diverse tonnoidean family with 59 currently recognized extant species (WoRMS, 2020). Twenty extinct species were previously recognized but this number was downsized recently to eleven (Sanders *et al*., 2019). Recent bursids have a tropical and subtropical distribution with the southernmost records in eastern South Africa (Sanders *et al*., 2017), Northern New Zealand (Spencer *et al*., 2016) and the Walters shoal (https://expeditions.mnhn.fr/campaign/waltersshoal). The northernmost records (*Bursa scrobilator* (Linnaeus, 1758)) are from Nice, southern France and Savona, northwestern Italy [we consider the specimen from northern Finistère, Britany, France attributed by Delongueville & Scaillet (2000) to *Bufonaria rana* (Linnaeus, 1758) to be dubious]. They are intertidal to subtidal organisms most often associated with hard substrates such as rocks, coral or sponges, where they can be abundant. Very little is known about bursid diet; Houbrick & Fretter (1969) described it for three species (*Lampasopsis cruentata* (G. B. Sowerby II, 1835), *Lampasopsis rhodostoma* (G. B. Sowerby II, 1835) & *Bursa granularis* (Röding, 1798)); all of them prey on annelids by removing them from their tubes or crevices and swallowing them. Kohn (1983) figured a specimen of *Bursa bufonia* (Gmelin, 1791) using its muscular foot and its radula to grip a starfish and saw through its armored skin, much in the same fashion as species belonging to the genus *Charonia* Gistel, 1848 (Bose *et al*., 2017).

In Southeast Asia, frog shells are consumed as food, resulting in a human health issue since they host bacteria producing tetrodotoxin (Noguchi *et al*., 1984; Magarlamov *et al*., 2017). Shells of *Bufonaria rana* (Linnaeus, 1758) are used in traditional Chinese medicine to cure ulcers and furuncle carbuncles (Ahmad *et al*., 2018). Bursids also have had cultural importance to mankind since at least the Middle Palaeolithic (300,000 to 50,000 BP); Peresani *et al*. (2013) showed that Neanderthals used a fossil shell belonging to the genus *Aspa* H.

Adams & A. Adams, 1853 as a pendant. The most culturally significant use of Bursidae is reported from western Fiji where shells from *Tutufa* Jousseaume, 1881 (called *davuisogasoga*) are considered sacred and are used as ceremony trumpets (Gatty, 2009) or worn as earlobe stretcher during battle (*Sau mocemoce*, Fiji Museum, 2017). In the last few centuries, trumpets made of *Tutufa* shells have been sold throughout the Pacific instead of the more traditional and much rarer (and pricy) Triton (*Charonia tritonis* (Linnaeus, 1758)).

Bursidae are readily recognizable by their shell showing a well-defined posterior exhalant siphon (anal notch) at the top of the outer lip and by their thick, coarsely sculptured ornamentation displaying knobs, warts, tubercles and nodules, hence their vernacular name: frog shells. Very variable in size, the smallest species, *Lampasopsis lucaensis* (Parth, 1991), never exceeds 23 mm in height whereas *Tutufa bardeyi* (Jousseaume, 1881), with a height up to 450 mm and a width up to 300 mm, is one of the largest and most capacious of all gastropod shells (Beu, 1998). Most bursids range between 40 and 50 mm in height. The radula is characterized by a basal interlocking process on the central tooth (Beu, 1998), and by a flap on the outer posterior edge of each lateral tooth that overlaps the tooth in the preceding row (Barkalova *et al*., 2016).

As inferred from their protoconch, similar to all other tonnoideans, they are supposed to have a long to extremely long larval stage granting for some of them trans-oceanic dispersal capabilities. However, Sanders *et al*. (2017) showed that such capabilities were greatly overestimated for one of the most widespread species of Bursidae: *Bursa granularis*. Once considered to be a single species with a worldwide distribution, it in fact includes at least four species restricted to the Indian, the Pacific and the western Atlantic Oceans, respectively, plus one restricted to southernmost Western Australia, as confirmed by an integrative taxonomy approach combining molecular and morphological characters. This result thus suggests that the species diversity of the family may be underestimated.

Further morphological characteristics are a spiral ornamentation of the convex part of the whorl composed of six to eight primary cords (*sensu* Merle, 2005 and Sanders *et al*., 2017) that can be lost during the ontogeny. Secondary and tertiary ones can appear later on and sometimes grow to such importance that they can be confused with primary cords (e.g., *Dulcerana granularis* (Röding, 1798)). Such characters, sometimes difficult to observe for shallow water species, whose shells are often colonized and strongly encrusted by coralline algae (especially in the genera *Bursa* Röding, 1798, *Lampasopsis* Jousseaume, 1881 and *Tutufa*), can be also difficult to interpret. Consequently, the systematics of the Bursidae, largely based on the morphological work carried out by Beu (1981, 1987, 1998) and Cossignani (1994), remains confusing.

Until recently, the most widely accepted classification of Bursidae recognized seven genera: *Aspa* Adams & A. Adams, 1853, *Bufonaria* Schumacher, 1817, *Bursa* Röding, 1798, *Bursina* Oyama, 1964, *Crossata* Jousseaume, 1881, *Marsupina* Dall, 1904 and *Tutufa* Jousseaume, 1881. As happened for many other gastropod taxa in the last decade, molecular phylogenies challenged this shell-based classification. Although based on a limited number of species, Castelin *et al*. (2012) and Strong *et al*. (2018) demonstrated that the genera *Bursa* and *Bursina* are polyphyletic. Hence, Strong *et al*. (2018) resurrected two previously synonymized genera, *Lampasopsis* and *Tritonoranella* Oyama, 1964. This suggests that an extended dataset may reveal other discrepancies and calls for a new classification for the group.

The main goal of this study is to propose a phylogeny of the Bursidae using several genetic markers, including full mitogenomic coding regions (plus non-coding 12s and 16s) and nuclear genes for better resolution than previous studies. We added several species compared to the works of Castelin *et al*. (2012) and Strong *et al*. (2018) (from 17 and 21, respectively, to 33), focusing on the type species of the available genus names, in order to convert the molecular phylogeny into a new genus-level classification of the frog shells. Furthermore, the

fossil record of the Bursidae is rather good. A recent review (Sanders *et al*., 2019) showed that, in addition to the 11 extinct species, 26 extant ones have an exceptionally long fossil record (reaching the Miocene for some), making the Bursidae a good empirical model for testing two calibration strategies (node dating and simplified tip dating).

2. Material and methods

2.1 Sampling

The material for this study was collected from various localities during a series of shallow-water and deep-sea expeditions, mainly organized by the MNHN (Muséum national d'Histoire naturelle, Paris), in Vanuatu (SANTO 2006), the Philippines (PANGLAO 2004, PANGLAO 2005), French Guiana (GUYANE 2014), Guadeloupe (KARUBENTHOS 2012, KARUBENTHOS 2015), Marquesas Islands (PAKAIHI I TE MOANA), Western Australia (WESTERN AUSTRALIA 2011), New Caledonia (CONCALIS, EBISCO, EXBODI, NORFOLK 1, NORFOLK 2, TERRASSES), French Polynesia (Tuhaa Pae 2013), Mozambique (INHACA 2011, MAINBAZA), Madagascar (ATIMO VATAE, MIRIKY), Salomon Islands (SALOMON 2), Papua New Guinea (PAPUA NUIGINI), Taiwan (Zhong Sha 2015), Viet Nam (NT-2014), Mauritania (MIWA), Azores, Panama and California. MNHN specimens collected before 2012 were anaesthetized with an isotonic solution of MgCl2 and fixed in 96% ethanol. Specimens collected after 2012 were processed with a microwave oven (Galindo *et al*., 2014); the living molluscs in small volumes of sea water were exposed to microwaves for c. 30 s. Bodies were immediately removed from shells and dropped into 96% ethanol. Non-MNHN material was preserved in 90% ethanol; we do not know how they were originally fixed. The analyzed material included 432 specimens; 385 deposited in the MNHN, one in the Natural History Museum of Santa Barbara (SBMNH), four in the Zoology department of the University of Bergen (ZMB), 38 in the Florida natural

History Museum (UF) and four in the Severtsov Institute of Ecology and Evolution, Moscow. Furthermore, sequences from five species (*Bufonaria nana* (Broderip, & Sowerby, 1829), *Galeodea echinophora* (Linnaeus, 1758), *Cymatium parthenopeum* (Salis Marschlins, 1793), *Cymatium cingulatum* (Lamarck, 1822) and *Tonna galea* (Linnaeus, 1758)) were mined from GenBank. Sequences from four of these taxa (*G. echinophora, C. parthenopeum C. cingulatum* and *T. galea*) were used as outgroups. The specimens and their corresponding sequences were registered in the Barcode of Life Data System and GenBank (Supp. Tab. 1). Sampling was selected to be as taxonomically extensive as possible, covering all the currently recognized genera. Particular effort was put into adding type species in order to provide a sound systematic revision of the group. All specimens with sequences obtained by either Sanger sequencing (single gene fragments) or Ion Torrent sequencing (mt-genomes) are listed in Supp. Tab. 1.

2.2 DNA extraction, PCR amplification and Sanger sequencing

DNA was extracted using the Epmotion 5075 robot (Eppendorf), following the manufacturers' recommendations. Fragments of five genes were analyzed: (i) the cytochrome c oxidase subunit I (*cox1*) using primers LCO1490/HCO2198 (Folmer *et al*., 1994), (ii) mitochondrially encoded 12s rRNA (12s) using primers 12sA/12sB (Palumbi, 1996), (iii) mitochondrially encoded 16s rRNA (16s) using primers 16SH/16LC (Palumbi, 1996), (iv) the nuclear 28S rRNA gene using primers C1 and D2 (Jovelin & Justine 2001) and the nuclear Histone H3 gene using primers H3F/H3R (Colgan *et al*., 2000). PCR reactions were performed in volumes of 20 µl, containing 3 ng DNA, 1× reaction buffer, 2.5mM MgCl2, 0.26 mM dNTP, 0.3 mM of each primer, 5% DMSO and 1.5 units of Qbiogene Q-Bio Taq. The amplification consisted of an initial denaturation step at 94°C for 5 min (3 min for H3), followed by 40 cycles of denaturation at 94°C for 35 s (20 s for H3), annealing at 47°C for

158 *cox1*, 62°C for 12s, 54°C for 16s, 52°C for 28s and 58°C for H3 during 35 s (20 s for H3)
159 followed by extension at 72°C for 1 min (30 s for H3). The final extension was at 72°C for 5
160 min. PCR products were purified and Sanger sequenced in both directions by the Eurofins
161 sequencing facility.
162
163 2.3 *Primer design for long range PCR*
164 The Myseq shotgun sequencing of a specimen of *Lampasopsis rhodostoma* (G.B. Sowerby II,
165 1835) (MNHN-IM-2013-11042) was subcontracted to Genome Quebec, using the Illumina
166 Genomic DNA Sample Preparation protocol for libraries preparation. The mitogenome of this
167 specimen was assembled over the closest tonnoidean mitogenome available in the literature:
168 *Galeodea echinophora* (Linnaeus, 1758) (GenBank accession number: NC_028003.1, Osca *et*
169 *al*., 2015) using the Map-to-reference tool of Geneious 9.1.7 (http://www.geneious.com,
170 Kearse *et al*., 2012) set on medium sensitivity (allowing 15% of gaps per read and 30% of
171 mismatches). These two mitogenomes were then aligned using MAFFT (Katoh *et al*., 2002)
172 with the only other tonnoidean mitogenome available in the literature at the time of the study,
173 *Cymatium parthenopeum* (Salis Marschlins, 1793) (GenBank accession number: NC_013247,
174 Cunha *et al*., 2009). Conserved regions (identified by eye) were analyzed using the primer
175 design option of Geneious for melting temperature calculation (Breslauer *et al*., 1986).
176 Following the recommendations of Hinsinger *et al*. (2015), we selected primers with little or
177 no self- or heterodimer, and closely matching annealing temperatures with primer melting
178 temperatures selected between 50 and 65°C. We also used universal *cox1* primers. Primers are
179 provided in Supplementary Table 2. Only 10 over the 13 primers where used to amplify the
180 complete mitogenomes; they were chosen in order to minimize the number of fragments
181 needed for reconstructing a mitogenome. When two primers were neighboring, they were
182 pooled in the mix to minimize the number of PCRs and maximize the probability of

amplification in case of mutation within the primers (they are noted “bis” in the first column of Supp. Table 2).

2.4 Long range PCRs for complete mitogenome amplification and sequencing.

In order to complete the mitogenome amplification, we amplified four overlapping fragments (Fig. 1). Long range PCR were used because it allows the amplification of much longer fragments than Sanger PCR. We followed a modified protocol of Hinsinger *et al*. (2015): PCR reactions were performed in 18 µl volume including 5X LongAmp Taq Reaction Buffer, 0.4 ng/µl Bovine Serum Albumin (BSA), 3.5% DMSO, 300 nM of each primer, 300 µM of dNTPs, and 1 unit of LongAmp Taq polymerase. After an initial denaturation of 30 s at 94°C, the DNA was amplified through 60 cycles of 20 s at 94°C, 30 s at 55°C, and 15 min at 65°C, with a terminal elongation for 15 min at 65°C.

The PCRs were visualized on ethidium bromide stained agarose gel, and the amounts for pooling were estimated from the intensity of the bands (Timmermans *et al*., 2010), taking into account PCR size and using one of our own PCRs as intensity standard across gels. Libraries for genome sequencing approach were generated using NEBNext© Fast DNA Fragmentation & Library Prep Set for Ion TorrentTM (E6285L, New England Biolabs), loaded onto Ion 316V2 chips. The sequencing was performed at the *Service de Systématique Moléculaire* (UMS 2700, 2AD, MNHN, Paris).

2.5 Genome assembly

Short-read DNA sequences from Ion Torrent were assembled into a single sequence corresponding to a complete mt genome using the Map to reference tool of Geneious (using the *Lampasopsis rhodostoma* MNHN-IM-2013-11042 reconstructed mt genome as reference)

set on custom sensitivity (Min map quality: 30, allowing 10% gap per read and 20% mismatch per read). The 13 mt protein-coding genes were annotated by identifying their open reading frames and by comparing them with other reported tonnoidean mt genomes. The transfer RNA (tRNA) and the ribosomal RNA (rRNA) were annotated by comparing them with other reported tonnoidean mt genomes and assumed to extend to the boundaries of adjacent genes (Boore *et al*., 2005).

2.6 Sequence alignment

Sequences were aligned for each gene independently using MAFFT (Katoh *et al*., 2002). The accuracy of automatic alignments was controlled using Gblocks 0.91b for poor quality positions (Castresana 2002) on the LIRM online server (http://phylogeny.lirmm.fr/phylo_cgi/). No indels were detected in the protein-coding genes.

2.7 Data sets

The first dataset corresponds to all available *cox1* sequences. The second dataset includes the *cox1*, 12s, 16s, H3 and 28S concatenated sequences of one specimen of each of the 33 species previously recognized morphologically and confirmed as clades with the *cox1* dataset. In order to minimize the number of missing data, in several cases, sequences from conspecific specimens were concatenated (Supp. Table 3), but only if their *cox1* sequences had a pairwise uncorrected p distances less than 2% (thus suggesting conspecificity). For the same reason, outgroup sequences downloaded from GenBank were concatenated when they belonged to the same family (Strong *et al*., 2018) (the correspondence is shown in Supp. Table 1). The third dataset includes the concatenated analysis of the 13 protein-coding genes and the two rRNAs from the mitochondria, using nucleotide sequences. The fourth dataset is a concatenation of the second and third datasets (partial *cox1*, 12s and 16s, where replaced by complete genes in

the taxa for which we sequenced the mt-genome), resulting in a dataset with a similar set of genes compared to the dataset 3 (only the two nuclear genes from dataset 2 were added), but with a higher number of samples.

2.8 Phylogenetic analyses

Maximum likelihood (ML) trees were estimated using IQ-TREE V 1.6.12 (Trifinopoulos *et al*., 2016) from 1,000 independent searches, each starting from distinct random trees. Robustness of the nodes was assessed using the thorough bootstrapping algorithm (Felsenstein, 1985) with 1,000 iterations and using the ultrafast bootstrap approximation (Hoang *et al*., 2017). IQ-TREE analyses were performed on the IQ-TREE web server (http://iqtree.cibiv.univie.ac.at/). Bayesian inferences (BI) were performed by running two parallel analyses in MrBayes 3.2.2 (Ronquist *et al*., 2012). For *cox1* analyses, each run consisted of 8 Markov chains and 10,000,000 generations, three swaps at each generation, a sampling frequency of one tree each 1,000 generations, and the chain temperature set at 0.02; for datasets 2 to 4 the number of generations was increased (30,000,000 for dataset 2 and 3, and 70,000,000 for dataset 4). Convergence of each analysis was evaluated using TRACER 1.4.1 (Rambaut *et al*., 2014) to check that all effective sample size values exceeded 200. Consensus trees were calculated after omitting the first 25% of the trees as burn-in. Analyses were performed on the Cipres Science Gateway, using MrBayes 3.2.2 on XSEDE. In all analyses (ML and BI), genes were separated into unlinked partitions; additionally, all protein-coding genes were separated into three partitions, one for each codon position. The substitution model was set to GTR + I + G for both ML and BI analyses following Abadi *et al*. (2019).

2.9 Calibration strategy and molecular dating

Dating was performed by running two parallel analyses in MrBayes 3.2.2 (Ronquist *et al*., 2012), with prior probability distribution on branch lengths set on a birth-death model, with an independent gamma rate (igr) relaxed clock model (variance distribution of the prior set on exponential 10). Each run consisted of eight Markov chains and 100,000,000 generations, three swaps at each generation, a sampling frequency of one tree each 1,000 generations and the chain temperature set at 0.02. Two dating analyses were conducted; one solely using node dating and one combining tip and node dating.

Most node calibrations were done using a truncated log normal distribution as it places the highest probability on ages somewhat older than the fossil, diversification being necessarily older than the observed fossil record. We used a uniform distribution to calibrate the node Bursidae. Boundaries of the distribution were determined using the occurrence of the oldest Bursidae of the extinct genus *Olssonia* Sanders, Merle & Puillandre, 2019 for the lower boundary and the oldest fossil of the genus *Aquitanobursa* M. T. Sanders, Merle & Puillandre, 2019 for the upper boundary, as Sanders *et al*. (2019) suggested that crown Bursidae may be bracketed by these two fossils.

Bursidae, *Bursa*, *Bufonaria*, *Lampasopsis*, *Tritonoranella*, *Marsupina*, *Dulcerana*, *Korrigania* gen. nov. and *Bursina* were the only clades constrained.

For the simplified tip dating analysis we considered the sequence of extant specimens to be of the same age as those of fossil specimens belonging to the same species (Tab. 1). Normally, tip dating requires integrating morphological data into the analysis (for both extinct and recent species) in addition to the molecular data. However, in such analyses, the fossil record typically concerns extinct taxa for which no molecular sequences are available (e.g., Pyron 2011, Vinther *et al.*, 2017). In the present case, we have an abundant fossil record of extant taxa that appears to belong to the same branches (tips or species) as the sequenced taxa. Furthermore, for our dataset that includes closely related taxa (five genera are represented by

four to five species each), shell characters are generally too poorly informative to fully resolve the phylogeny. We have thus tested this new, simplified tip dating method to see if it gives results coherent with those of node dating.

All tip calibrations were set to follow a uniform distribution of the prior as it is the only distribution that allows the implementation of a wide stratigraphic range. Information regarding the fossils used in calibration, the parameters of the calibration prior distribution and references for fossil identifications and stratigraphic attributions are reported in Tab. 1.

2.10 Transforming a phylogeny into a genus-level classification.

Following the guidelines of Puillandre *et al*. (2014), genus names were given only to well-supported clades. Then, genus names were applied based on the position of their type species in the tree. If the type species of a nominal genus had not been sequenced, application of the name was determined by reference to the morphologically most similar species included in the molecular analysis. If more than one name was applicable for a clade, the valid name was determined by the rule of priority.

Providing an extended classification of the Bursidae including the attribution of all currently accepted species to the new genera based on a reevaluation of the shell morphology goes far beyond the scope of this paper and will be treated in an upcoming article.

3. Results

3.1 Mitochondrial genome organization

The complete mt genomes of *Tutufa rubeta*, *Marsupina bufo, Lampasopsis rhodostoma* (two specimens), and the partial mt genome of *Bufonaria perelegans, Aspa marginata*, *Bursa* cf.

tuberosissima, Korrigania quirihorai and *Korrigania fijiensis* were sequenced and assembled (see Table 2 for genome length and sequencing coverage). Like most animal mt genomes (Boore & Brown, 1994), they encode for 13 protein-coding genes, 22 tRNA, and two rRNA genes (Fig. 1) The gene order of the newly sequenced mt genomes is identical to the gene arrangement of other reported tonnoidean mt genomes (Osca *et al*., 2015).

3.2 Phylogenetic analyses

Dataset 1 yielded poorly resolved phylogenies that did not present any evidence of conflict with the other datasets in the topologies (minor conflicts are always unsupported). This dataset will not be discussed further but the ML tree is accessible in Supplementary Fig. 1. Datasets 2, 3 and 4 produced compatible topologies, the only difference being that the clade *Aspa* + *Alanbeuella* gen. nov. of dataset 2 (Supp. Fig. 2) does not branch as sister to most of the other Bursidae but with the clade C, containing *Bursina*, *Bufonaria*, *Korrigania* gen. nov. and *Tritonoranella*, with very low support (Fig. 2; Supp. Figs. 2 and 3). Of all the datasets, dataset 4 (mitogenomes + 28S + H3) produced the phylogeny with the highest support and is the one further discussed below.

As shown by Castelin *et al*. (2012) and Strong *et al*. (2018), the monophyly of the Bursidae is well supported (posterior probabilities PP = 1, ultrafast bootstrap UFBP=100, bootstrap BS = 100) (Fig. 2).

The ML and BI analyses showed some minor differences within *Tutufa* and regarding the relationship between *Aspa* and *Alanbeuella corrugata*; these differences are shown in Fig. 2.

In the BI analysis the first dichotomy divides two poorly supported clades, an Atlantic clade (not found in ML) containing *Aspa marginata* and *Alanbeuella corrugata*, and a second clade that contains the rest of the Bursidae. The early branching of *Aspa* and *Alanbeuella* gen. nov.

is consistent with the fact that they are the only extant genera with, for each of them, a Late Paleogene record (Sanders *et al*., 2019). Nine supported major clades can be recognized within the main bursid group (highlighted in Fig. 2). These clades, in addition with three other single species lineages, are each attributed to a distinct genus (see classification for name attribution). Relationships between genera have various levels of support, ranging from highly supported for clade A (PP = 0.99, UFBS= 99.7 BS = 86), containing *Tutufa*, *Marsupina* and *Lampasopsis* and Clade C minus *Tritonoranella* (PP = 1, UFBS= 98.5 BS = 96), to moderately supported for clade B containing *Bursa*, *Talisman* and *Dulcerana* (Fig. 2).

Compared with earlier works (Castelin *et al*., 2012 and Strong *et al*., 2018), the main difference lies in the phylogenetic position of *Tutufa*; in both previous works, it branches as a sister group of all the other bursids, but with the increased sampling, in particular in the *Lampasopsis* clade, and with the addition of *Marsupina*, *Aspa* and *Alanbeuella corrugata*, and more genes sequenced, it is well embedded within the Bursidae with good support (PP = 1, UFBS= 97.4 BS = 88), as sister group to *Marsupina*. The deep sea (200 to 1000 m deep) genus *Tritonoranella* was closely related to *Lampasopsis* (with low support) in previous studies; it is now sister group to the clade containing *Korrigania* gen. nov., *Bufonaria* and *Bursina* (still with low support, PP = 0.82, UFBS= 84.2 BS = 86). All the species belonging to these clades are commonly found in deep water (to the exception of some species of *Bufonaria*), unlike *Lampasopsis* that never occurs below 100 m deep. The species *Lampasopsis thomae* (d'Orbigny, 1847) and *L. rhodostoma* were still recently accepted as synonyms; Strong *et al*. (2018) suggested the resurrection of the name *L. thomae*, and our work supports their suggestion; furthermore, they are not even sister species.

3.3 Dating analyses

The two dating datasets recover rather similar divergence times (Supp. Fig. 4) except for the clade *Aspa* + *Alanbeuella* gen. nov., which is four million years older (34.07 My, Fig. 3A) in the tip+node dating dataset. However, this difference is not statistically significant because the credibility intervals overlap broadly.

All the nodes but those used for calibration had credibility intervals broader than 2 Ma. The Bursidae found their origin during the Late Campanian (72.4 Ma, Late Cretaceous). Frog shell genera appeared between 25 and 30 Mya with a diversification starting between 12 and 21 Mya for non-monospecific genera.

4. classification

4.1 Name attribution

Clades containing type species are readily nameable: *Aspa* (type species: *Ranella laevigata* Lamarck, 1822 = *Buccinum marginatum* Gmelin, 1791), *Tritonoranella* (type species: *Triton ranelloides* Reeve, 1844), *Lampasopsis* (type species: *Ranella rhodostoma* G. B. Sowerby II, 1835), *Marsupina* (type species: *Buffo spadiceus* Montfort, 1810 = *Murex bufo* Bruguière, 1792), *Tutufa* (type species: *Murex rana bubo* Linnaeus, 1758), *Dulcerana* (type species: *Tritonium granulare* Röding, 1798) and *Bursa* (type species: *Bursa monitata* Röding, 1798 = *Murex bufonius* Gmelin, 1791).

We retain the original spelling *Lampasopsis* instead of *Lampadopsis* used by Strong *et al*. (2019). *Lampadopsis* was an unjustified emendation of *Lampasopsis* made by Fischer (1884) and is not of prevailing usage (P. Bouchet pers. com.), therefore the ICZN Article 33.3.1 does not apply.

The type species of *Bufonaria* and *Bursina*, respectively *Bufonaria spinosa* Schumacher, 1817 (a junior synonym of *Bufonaria echinata* (Link, 1807)) and *Ranella nobilis* Reeve, 1844, were not included in this study. *Bufonaria perelegans* Beu, 1987 is morphologically extremely

similar to *Bufonaria echinata*; the only noticeable difference is that *Bufonaria echinata* has much longer spines on its sutural, first and third primary cords. *Bursina nobilis* and *B. ignobilis* (Beu, 1987) can only be differentiated by their size when they are adult, *Bursina nobilis* being slightly larger and taller. Consequently, the well supported clades containing *Bufonaria perelegans* and *Bursina nobilis* are attributed to the genera *Bufonaria* and *Bursina*, respectively.

We still consider *Crossata* (not included in the sampling) to be a valid genus under the current delimitation (Powell & Berschauer, 2017). *"Bursa" verrucosa* (G. B. Sowerby I, 1825) and "*Bursa*" *condita* (Gmelin, 1791) are two morphologically distinct species that we were unable to obtain for this phylogenetic study, and they are not readily attributable solely based on their morphology to any newly delimited genus; fortunately, they are type species of *Annaperenna* and *Colubrellina* respectively. These two monospecific genera are provisionally considered valid, pending their inclusion in a molecular phylogeny.

The only two remaining species in our phylogeny that must be attributed to a new genus are the Atlantic and Pacific species *"Bursa" corrugata* and the Mediterranean Sea and Eastern Atlantic Ocean *"Bursa" scrobilator*. A possible genus name for *A. corrugata* may be *Talisman*, a name based on the type species *Talisman parfaiti* Folin, 1884. Warén & Bouchet (1990) considered this genus to be a *nomen dubium* based on a juvenile of either *"Bursa" scrobilator, Aspa marginata* or *"Bursa" corrugata;* they restricted the possible attribution of *Ta. parfaiti* to these three species because they are the only ones occurring in the Atlantic. *Ta. parfaiti* is known by a single juvenile specimen (held in the MNHN) composed of a bursid-like protoconch and a single shell whorl. Crocetta *et al*., (2020) reanalyzed the type specimen and concluded that based on the strongly reticulate sculpture of protoconch II, *Talisman parfaiti* was likely based on a larval shell of "*Bursa" scrobilator*. *Bufonariella* Thiele, 1929 (type species *Murex scrobilator* Linnaeus, 1758) is another available name for "*Bursa"*

scrobilator but *Talisman* has priority over it. To our knowledge there is no other available name for *"B". corrugata,* and a new genus name is given for this genus: *Alanbeuella* gen. nov.

The only other clade that we consider to be of generic level without a previously published name is the well supported one containing *"Bursa" awatii*, *"Bursina" fijiensis*, *"Bursa" fosteri,* and *"Bursa"quirihorai*; we erect a new name for it: *Korrigania* gen. nov.

4.2 Systematics

Phylum Mollusca Cuvier, 1795

Class Gastropoda Cuvier, 1795

Order Neogastropoda (following the opinion of Osca *et al*., 2015)

Superfamily Tonnoidea Suter, 1913 (1825)

Family Bursidae Thiele, 1925

Genus *Alanbeuella* Sanders, Merle, Laurin, Bonillo & Puillandre gen. nov.

Zoobank: zoobank.org:act:99B4D509-7B27-40FA-A53D-BEB3ADA14E7E

Type species. *Biplex corrugata* Perry, 1811

Included species. *Alanbeuella corrugata* (Perry, 1811) n. comb., Recent; *Alanbeuella victrix* (Dall, 1916) n. comb., Late Oligocene, Georgia, USA.

Etymology. Dedicated to the malacologist and paleontologist Alan G. Beu for his remarkable contribution to the taxonomy of the Bursidae.

Diagnosis. Relatively lightly built shell, varices aligned (can be slightly displaced in the last whorl), six primary cords (P) on the convex part of the whorl, P2 and P4 totally atrophied in varical and intervarical position, P6 reduced in intervarical and atrophied in varical only, large

nodules on varical P1 and P3, disappearing entirely on the last whorl of large specimens. Varical P1 is split into two cords, first whorl lost in nearly every specimen, strong projection of the outer lip, and second row of denticles (ID, D1-D6) on the outer lip. Ovate operculum, subanterior nucleus.

Genus *Korrigania*, Sanders, Merle, Laurin, Bonillo & Puillandre gen. nov.

Zoobank: zoobank.org:act:73224CBE-CD87-4EC0-A6B8-612966A5608D

Type species. *Ranella fijiensis* Watson, 1881

Included species. (only extant taxa), *Korrigania awatii* (Ray, 1949) n. comb., *Korrigania fijiensis* (Watson, 1881) n. comb., *Korrigania fosteri* (Beu, 1987) n. comb., *Korrigania quirihorai* (Beu, 1987) n. comb.

Etymology. Based on the Brittany (France) elusive dwarf-like spirit Korrigan.

Diagnosis: Fusiform, very light built shell (extremely light in *K. awatii*), seven primary cords (P1-P7) on the convex part of the whorl, P2 and P4 atrophied, P6 and P7 reduced, varices displaced but less than in *Tutufa* or *Tritonoranella.* Ovate operculum, subanterior nucleus.

Comparison: resembles *Tritonoranella* but lacks black stripes on the columella.

5. Discussion

5.1. Using molecular trees to reinterpret shell characters

While morphological data played a pioneering role in malacology, in recent times it was supplanted by molecular data due to decreasing cost of generating molecular data and because morphology-based phylogenies of molluscs are often poorly resolved, in particular when considering shell characters alone. Yet morphological data remain tremendously important (Giribet, 2015) and mollusc taxonomy remains largely dependent on shell characters, in particular for non-academics (Bouchet *et al.*, 2016) that have no access to sequencing

457 facilities. Hence, re-interpreting morphological characters in the light of molecular
458 phylogenies is crucial in order to provide operational classifications.

459 A detailed review of bursid morphology would be beyond the scope of this paper and we
460 focus here on the recently resurrected and newly described genera. Until recently nearly half
461 of the bursid species belonged to the genus *Bursa*; they are now allocated to seven genera
462 (plus two extinct genera discussed in Sanders *et al*., 2019).

463 Species belonging to *Bursa sensu stricto* are now relatively easy to identify, with a white,
464 thick, plump and a nodulous shell with a strongly curved anterior siphonal canal, similar to
465 *Lampasopsis* but with a very long and tubular posterior siphonal canal. Species of *Dulcerana*
466 and *Talisman* are also rather similar with their brownish fusiform shells but can be easily
467 distinguished by their varices that are aligned in *Dulcerana* (one varix every 180° of the
468 whorl) and unaligned in *Talisman* (one varix every 200° or so of the whorl). Specimens of
469 *Allanbeuella* are also similar to *Dulcerana* and *Talisman* in shape, size and color but they
470 have two rows of denticles on the outer lip while there is only one in other Bursidae. Species
471 of *Tritonoranella* and *Korrigania* gen. nov. are more difficult to distinguish, as they both have
472 white and elongated thin shells, but the black stripes on the columella are characteristics of
473 *Tritonoranella* species. *Annaperenna* specimens also have black stripes but large black warts
474 on their otherwise white shell make them easily recognizable.

475

476 *5.2 Drawbacks of the Node+tip calibration approach, and potential alternatives*

477 The trees obtained with the two calibration approaches are rather similar, but the "node+tip"
478 tree presents two major drawbacks: First, our method assumes that the molecular sequences
479 have not changed significantly since the time represented by the fossil used to date each tip.
480 However, these ages represent a very small proportion of tree depth, so the impact of this
481 problem should be minor. Second, even though every species represented in the tree are

extant species, the resulting tree is not ultrametric. This is due to the fact that, even if the fossils were considered to belong to an extant species, during the analysis they are considered as possibly extinct because Mr Bayes 3.2 cannot accommodate stratigraphic ranges, per se, as prior. However, the fact that the set of nodal ages yielded by our simplified tip dating analysis overlap broadly those of the node-dated analyses (Supp. Fig. 4) suggests that this method performs well, at least on this dataset.

Another option to use an even greater proportion of the data on the bursid fossil record would be to estimate diversification rates and divergence times under the Fossilized Birth–Death Process (Heath *et al.*, 2016; Stadler *et al.*, 2018; Didier & Laurin, 2020; Luo *et al.*, 2020). In any case, the main caveat for the use of all those methods is our ability to reconstruct a sound morpho-anatomical phylogeny of our group.

5.3 Origin of the Bursidae

The very early diversification of the Bursidae remains obscure due to the fact that no undisputable bursid fossil has ever been found in strata older than those in which specimens of the Eocene Peruvian genus *Olssonia* were found (Beu, 1988; Sanders *et al.*, 2019).

Our dataset gives us a late Cretaceous to early Paleogene origin of the Bursidae. Even though *Alanbeuella* gen. nov. and *Aspa* are among the geologically oldest genera known in Bursidae with fossils as old as the Aquitanian (Early Miocene) (Sanders *et al.*, 2019), time trees show an earlier origin of both genera during the Early Oligocene. Three hypotheses can be proposed to explain why *Alanbeuella* gen. nov. and *Aspa* fossil are not found in Oligocene deposits. (1) Considering the low support of clade A + B + C (Fig. 2), our topology may be wrong; (2) Early Oligocene *Aspa* and *Alanbeuella* gen. nov. occur in the Aquitaine Basin where deposits of that period are poorly preserved. This may prevent the discovery of early forms of those genera. (3) The evolutionary rates of this part of the tree is apparently different from the rest

507 the Bursidae tree (*Aspa* shows quite a longer branch compared to its sister group - Fig. 2). It is
508 then possible that the clock model used in the analysis artificially gave an older diversification
509 time. Such artefacts have been consistently shown in other groups (Schwartz & Maresca,
510 2006). Pending new fossil discoveries, this problem could be addressed by increasing the
511 number of molecular characters for *Alanbeuella corrugata*, the only extant species of its
512 genus, or by using a Fossilized Birth–Death Process, which does not necessarily require to
513 estimate molecular rates of evolution (e.g., Didier and Laurin, 2020).
514 Molecular dating suggests that the crown Bursidae diversifies during the Bartonian (Middle
515 Eocene) (Fig. 3); this is consistent with the fact that the Thanetian (Late Paleocene) extinct
516 species *"Bursa" saundersi* Adegoke, 1977 from West Africa (Nigeria) bears numerous
517 characters resembling those of bursids (the varices closely spaced and nearly aligned up the
518 whorls, the sculpture of coarse nodes and the short spire place it in the Bursidae rather than in
519 the Ranellidae or the Cymatiidae). However, it lacks the distinctive anal notch of the family.
520 Even though it was removed from crown Bursidae by Sanders *et al*. (2019), it may very well
521 be an early, stem-bursid that pre-dates the acquisition of the posterior siphonal canal. The
522 surprising Paleocene/Eocene biogeographic connection between West Africa and Peru is
523 rather easy to understand because there were fewer biogeogeographic constraints (there was
524 no Panama isthmus at this time) and because the geologic record in these regions is poor.
525
526 *5.4 Speciation in the Bursidae*
527 The speciation event (cladogenesis) that gave birth to the clades A+B and C was probably
528 caused by bathymetric isolation. Clade C is composed of species commonly found more than
529 300 m deep, and up to 1000 m for some species of *Korrigania* gen. nov. and *Tritonoranella*.
530 On the contrary, species within A+B are rarely collected alive below 100 m deep (*Tutufa*
531 *tenuisgranosa* is the sole species to be found under 100 m but never over 220 m). *Aspa* and

Alanbeuella corrugata being shallow water species as well, deep sea colonization by the clade C is then considered as an apomorphy of the clade. Speciation induced by bathymetry has already been hypothesized for gastropods in the Bursidae by Castelin *et al*. (2012) and in the Abyssochrysoidea by Osca *et al*. (2014).

Among the sampled species, two are geographically restricted to Western Atlantic and the Caribbean: *Lampasopsis thomae* and *Marsupina bufo*. Separation with their sister groups, respectively *Lampasopsis cruentata* from the East Indo-Pacific and *Marsupina nana* from eastern Pacific, are both estimated to have occurred around 15 Mya, which corresponds to the initial closure of the Panama isthmus (Montes *et al*., 2015).

5.5 Diversification of the Bursidae

Global climatic events have been recognized to be possible biodiversity drivers (Erwin, 2009). According to our results, the first diversification event of Bursidae (Bartonian) is synchronous with such an event: the last supra-regionally recognized Eocene thermal event, the MECO (Mid Eocene Climatic Optimum; Vandenberghe *et al*., 2012; Fig. 3B). However, this does not imply that there is a causal link, and no other pattern could be linked between observed time diversification and later climatic events such as the “grande coupure” (Eocene–Oligocene glaciation) or the middle Miocene disruption, casting doubt on the link between the two events.

Most Bursidae are dependent of coral, for both hunting and nesting, and some genera (*Lampasopsis* and *Bursa*) even developed camouflage strategies to look like bits of coral. Those that do not rely on coral (*Aspa, Talisman, Korrigania* gen. nov. and *Alanbeuella* gen. nov.) live on rocky shores or sponges, especially in the case of deep-sea organisms (*Korrigania* gen. nov.). Coral reef geographical location and extension has changed drastically during the Cenozoic (Renema *et al*., 2008, Pellissier *et al*., 2014), probably driven

by the tectonic activity (Leprieur *et al*., 2016). It is quite possible that bursid diversification follows this pattern. Leprieur *et al*. (2016) showed that the location of the major marine biodiversity hotspot (modeled using coral diversity data) has moved across the globe during the last 50 million years, transitioning from the western Tethys during the Eocene (55–33 Ma) to the Arabian Peninsula and Western Indian Ocean during the Late Eocene and Oligocene (37–15 Ma), and finally to the Indo-Australian Archipelago in the Miocene (15–5 Ma) (Fig. 3C). This movement was primarily driven by successive closure of the Tethys followed by the collision of the Arabian and Indian plates with Eurasia. Bursid diversity through time seems to follow the same pattern. Genera branching early in the timetree, namely *Aspa* and *Alanbeuella* gen. nov., originated between the Bartonian (Middle Eocene, 41-38 Ma) and the Chattian (Late Oligocene, 28-23 Ma); both genera occur in western Tethys during the Early Miocene and are still living in the Atlantic. As suggested by the fossil record, the maximal diversity occurred between the Early and Middle Miocene in the Eastern Atlantic, Western Tethys and Paratethys (Sanders *et al*., 2019), with the appearance of genera like *Talisman* and *Tritonoranella* (a genus that only occurs in the Indo-Pacific now). The second phase of diversification started during the Langhian (Middle Miocene, 16-13 Ma). Then, most bursid genera diversified outside the Mediterranean Sea (ancient Western Tethys), mainly in the Indo-Pacific region (*Bufonaria, Bursina, Korigania, Lampasopsis, Bursa* and *Dulcerana*) and some in the Western Atlantic and Caribbean (*Marsupina, Crossata). Lampasopsis* may have originally diversified in Western Atlantic, even though most of its recent diversity is in the Indo-Pacific today, because the oldest fossil representatives of the group are found in the Caribbean (Beu, 2010; Sanders *et al*., 2019). The Mediterranean Sea was drained completely during the Messinian (Late Miocene, 7-5 Ma), forcing out or trapping in every species of Bursidae. *Talisman scrobilator* was the only one to come back.

6 Conclusion

With 56% of the currently-recognized extant species represented in the dataset, this work constitutes the first large-scale revision of the Bursidae. A new classification of the frog shells is proposed, including a tentative solution to the decade-long debate regarding the delimitation of the family type genus, *Bursa*, leading to the resurrection of all previously synonymized genus names (though two are not phylogenetically tested). The integrative approach using mitogenomic data and the extensive fossil record allow us to infer the chain of events leading to the extant diversity of the Bursidae. However, further work needs to be done in order to provide a complete phylogeny of the Bursidae. First, shifting to the mitogenomic scale has been proven to significantly improve the resolution of the trees, but to this day, we have no full mitogenomic data for *Dulcerana*, *Alanbeuella* gen. nov. and *Tritonoranella.* Second, taxonomic sampling should be increased, including in particular the species *Crossata ventricosa* (Broderip, 1833), *Annaperenna verrucosa*, *Colubrellina condita* and *Bufonaria foliata* (Broderip, 1826), respectively type species of *Crossata* Jousseaume, 1881, *Annaperenna* Iredale, 1936, *Colubrellina* Fischer, 1884 and *Chasmotheca* Dall, 1904. Furthermore, *Bufonaria* is among the most diverse bursid genera (nine recognized species), but it is greatly under-sampled in this study. To thoroughly test the monophyly of this group, several species need to be added to the tree.

This phylogeny of Bursidae is only a first step toward a more integrative study of the group. Indeed, the complex ornamentation of the shell may allow us to reconstruct a phylogeny of the group using morphological characters for both extant and extinct species. Using this matrix in combination with the molecular one and a fossil occurrence database, diversification analyses could be conducted using the fossilized birth death process (Didier *et al*., 2017), and paleontological dating of this clade could be performed (Didier and Laurin, 2020).

606 Finally, if generating genomic-scale molecular data is becoming easier, achieving a
607 representative sampling for molecular systematics is becoming increasingly difficult,
608 considering the multiplicity of permits required to sample the whole distribution area of the
609 targeted taxa, spanning numerous countries. The future will tell whether the Article 8a of the
610 Nagoya Protocol for the Convention of Biological Diversity (encouraging the Parties to apply
611 the protocol to "create conditions to promote and encourage research […] through simplified
612 measures on access for non-commercial research purposes") will reverse the trend (Bouchet *et*
613 *al*., 2016). For the time being, compliance with regulations on 'Access and Benefit Sharing'
614 and 'Prior Informed Consent' is an obstacle that hampers study of biodiversity to such an
615 extent that it may hinder conservation efforts which is contrary to the main purpose of the
616 Nagoya protocol. For instance, by unduly delaying research, entire species might vanish
617 before they are detected or recognized. The recent finding by Sanders *et al*. (2017) that *Bursa*
618 *granularis* actually includes four species illustrates this danger.
619
620 **Acknowledgments.**
621 A large part of the molecular material in this paper originates from various shore-based
622 expeditions conducted by MNHN, Pro-Natura International (PNI) and Institut de Recherche
623 pour le Développement (IRD) as part of the Our Planet Reviewed program (SANTO 2006,
624 MAINBAZA, INHACA 2011, PAPUA NIUGINI 2014); by MNHN and IRD as part of the
625 Tropical Deep-Sea Benthos program (TERRASSES); by MNHN and AAMP (Pakaihi i Te
626 Moana); and by MNHN (PANGLAO 2004, Western Australia 2011, KARUBENTHOS
627 2012). Domestic and foreign partners include the University of San Carlos, Cebu City;
628 Maritime College, Luganville; Universidade Eduardo Mondlane, Maputo; University of
629 Papua New Guinea, Port Moresby, and National Fisheries College, Kavieng; the Western
630 Australian Museum, Perth. Funders and sponsors include the Total Foundation, Prince Albert

II of Monaco Foundation, Stavros Niarchos Foundation, Richard Lounsbery Foundation, Vinci Entrepose Contracting, Fondation EDF, the Philippines Bureau of Fisheries and Aquatic Resources (BFAR), and the French Fonds Pacifique. We thank Jon Anders Kongsrud (ZMB) and Daniel Geiger (SBMNH) for the loan of material from their respective institutions. All expeditions operated under the regulations then in force in the countries in question and satisfy the conditions set by the Nagoya Protocol for access to genetic resources. We thank Barbara Buge, Julien Brisset and Gilberto Marani (MNHN) for their role in specimen processing during the expeditions and their help in curating the specimens. We gratefully acknowledge Philippe Bouchet for his continuing insight during this project and Agnès Dettaï for technical guidance during mt-genome amplification and sequencing. Finally, we express our gratitude to the two anonymous reviewers of this paper, for their insightful comments and suggestions. This project was jointly supported by the Service de Systématique Moléculaire (UMS 2700 CNRS-MNHN), by the LABEX BCDiv (SU, MNHN, UPMC, CNRS, IRD, ANR, EPHE, Investissements d'avenir, Paris Diderot) ant the ATM Emergence (MNHN).

References

ABADI, S., AZOURI, D., PUPKO, T., & MAYROSE, I. (2019). Model selection may not be a mandatory step for phylogeny reconstruction. *Nature communications*, **10(1),** 934. https://doi.org/10.1038/s41467-019-08822-w

AHMAD, T. B., LIU, L., KOTIW, M., & BENKENDORFF, K. (2018). Review of anti-inflammatory, immune-modulatory and wound healing properties of molluscs. *Journal of Ethnopharmacology*. **210**, 156-178. https://doi.org/10.1016/j.jep.2017.08.008

BALUK W. (1995). Middle Miocene (Badenian) gastropods from Korytnica, Poland. Part II. *Acta Geologica Polonica*, **45 (3-4)**, 1-255.

BARKALOVA, V. O., FEDOSOV, A. E., & KANTOR, Y. I. (2016). Morphology of the anterior digestive system of tonnoideans (Gastropoda: Caenogastropoda) with an emphasis on the foregut glands. *Molluscan Research*, **36(1),** 54-73. https://doi.org/10.1080/13235818.2015.1082954

BEU A. G. (1981). Australian gastropods of the family Bursidae. Part 1. The families of Tonnacea, the genera of Bursidae, and revision of species previously assigned to *Tutufa* Jousseaume, 1881. *Records of the Australian Museum* **33,** 248-324. https://doi.org/10.3853/j.0067-1975.33.1980.200

BEU A. G. (1987). Taxonomy of gastropods of the families Ranellidae (= Cymatiidae) and Bursidae. Part 2. Descriptions of 14 new modern Indo-West Pacific species and subspecies, with revisions of related taxa. *New Zealand Journal of Zoology* **13,** 273-355. https://doi.org/10.1080/03014223.1986.10422668

BEU A. G. (1998). *Résultats des Campagnes MUSORSTOM volume 19. Indo-West Pacific Ranellidae, Bursidae and Personidae (Mollusca: Gastropoda), a monograph of the New Caledonian fauna and revisions of related taxa*. Muséum national d'Histoire naturelle, Paris (Mémoires du Muséum national d'Histoire naturelle; 178).

BEU, A. G. 2005. Neogene fossil tonnoidean gastropods of Indonesia. *Scripta Geologica*, **130**, 1-186.

BEU, A. G. 2010. Neogene tonnoidean gastropods of tropical and South America; a contribution to the Dominican Republic and Panama Paleontology projects and uplift of the Central American Isthmus. *Bulletins of American Paleontology*, **377–378**, 1–550.

BOORE, J. L., & BROWN, W. M. (1994). Complete DNA sequence of the mitochondrial genome of the black chiton, *Katharina tunicata*. *Genetics*, **138(2)**, 423-443.

BOORE, J. L., MACEY, J. R., & MEDINA, M. (2005). Sequencing and comparing whole mitochondrial genomes of animals. *Methods in enzymology*, **395**, 311-348. https://doi.org/10.1016/S0076-6879(05)95019-2

BOSE, U., WANG, T., ZHAO, M., MOTTI, C. A., HALL, M. R., & CUMMINS, S. F. (2017). Multiomics analysis of the giant triton snail salivary gland, a crown-of-thorns starfish predator. *Scientific reports*, **7(1)**, 6000. https://doi.org/10.1038/s41598-017-05974-x

BOUCHET, P., BARY, S., HEROS, V. & MARIANI, G. (2016). How many species of molluscs are there in the world's oceans, and who is going to describe them? Tropical Deep-Sea Benthos. Vol. 29. *Mémoires du Muséum National d'Histoire Naturelle*, **208, 9-25**

BRESLAUER, K. J., FRANK, R., BLÖCKER, H., & MARKY, L. A. (1986). Predicting DNA duplex stability from the base sequence. *Proceedings of the National Academy of Sciences*, **83(11)**, 3746-3750. https://doi.org/10.1073/pnas.83.11.3746

CASTELIN, M., LORION, J., BRISSET, J., CRUAUD, C., MAESTRATI, P., UTGE, J., & SAMADI, S. (2012). Speciation patterns in gastropods with long-lived larvae from deep-sea seamounts. *Molecular Ecology*, **21(19)**, 4828-4853. https://doi.org/10.1111/j.1365-294X.2012.05743.x

CASTRESANA, J. (2002). *GBLOCKS: selection of conserved blocks from multiple alignments for their use in phylogenetic analysis. Version 0.91 b*. J. Castresana, EMBL

COLGAN, D.J., PONDER, W.F., EGGLER, P.E., (2000). Gastropod evolutionary rates and phylogenetic relationships assessed using partial 28S rDNA and histone H3 sequences. *Zoologica. Scripta*. **29,** 29-63. https://doi.org/10.1046/j.1463-6409.2000.00021.x

COSSIGNANI, T. (1994). *Bursidae of the World*. Mostra Mondiale Malacologia; L'Informatore Piceno.

CRAMER, B. S., TOGGWEILER, J. R., WRIGHT, J. D., KATZ, M. E., & MILLER, K. G. (2009). Ocean overturning since the Late Cretaceous: Inferences from a new benthic foraminiferal isotope compilation. *Paleoceanography*, **24(4)**, 1-14. https://doi.org/10.1029/2008PA001683

CROCETTA, F., CAPUTI, L., PAZ-SEDANO, S., TANDUO, V., VAZZANA, A., & OLIVERIO, M. (2020). High genetic connectivity in a gastropod with long-lived planktonic larvae. *Journal of Molluscan Studies*, **86(1)**, 42-55, https://doi.org/10.1093/mollus/eyz032.

CUNHA, R., GRANDE, C., ZARDOYA, R. (2009). Neogastropod phylogenetic relationships based on entire mitochondrial genomes. *BMC Evolutionary. Biology*. **9**, 210, https://doi.org/10.1186/1471-2148-9-210

DELONGUEVILLE, C., & SCAILLET, R. (2000). Découvertes malacologiques en Bretagne. *Novapex*, **1(3-4)**, 87-89.

DIDIER, G., LAURIN, M., (2020). Exact distribution of divergence times from fossil ages and tree topologies, *Systematic Biology* https://doi.org/10.1093/sysbio/syaa021

DIDIER, G., M. FAU, AND M. LAURIN. (2017). Likelihood of tree topologies with fossils and diversification rate estimation. *Systematic Biology*, **66**,964–987, https://doi.org/10.1093/sysbio/syx045

ERWIN, D. H. (2009). Climate as a driver of evolutionary change. *Current Biology*, **19(14)**, R575-R583, https://doi.org/10.1016/j.cub.2009.05.047.

HOANG, D., T., CHERNOMOR, O., VON HAESELER, A., MINH, B., Q., & VINH, L., S., (2018) UFBoot2: Improving the Ultrafast Bootstrap Approximation, *Molecular Biology and Evolution*, **35(2),** 518–522, https://doi.org/10.1093/molbev/msx281

FELSENSTEIN, J. 1985. Confidence limits on phylogenies: an approach using the bootstrap. *Evolution*, **39(4)**, 783-791, https://doi.org/10.1111/j.1558-5646.1985.tb00420.x

FIJI MUSEUM (2017). Sau mocemoce ni valu, *Fiji Virtual Museum,* http://virtual.fijimuseum.org.fj/template.php?id=82-238&next=1596&cat=20, last consulted: 20/09/2017

FISCHER P. (1884). Manuel de Conchyliologie et de Paléontologie Conchyliologique,. **7**,. 609-688.

FOLMER, O., BLACK, M., HOEH, W.,LUTZ, R. &VRIJENHOEK, R. (1994). DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. *Molecular Marine Biology and Biotechnology,* **3**, 294–299.

GALINDO, L. A., PUILLANDRE, N., STRONG, E. E., & BOUCHET, P. (2014). Using microwaves to prepare gastropods for DNA barcoding. *Molecular Ecology Resources*, **14(4)**, 700-705, https://doi.org/10.1111/1755-0998.12231.

GATTY, R. (2009). *Fijian-English Dictionary: with notes on Fijian culture and natural history*. Gatty, Suva, Fiji.

GIRIBET, G. (2015). Morphology should not be forgotten in the era of genomics–a phylogenetic perspective. *Zoologischer Anzeiger-A Journal of Comparative Zoology,* **256**, 96-103, https://doi.org/10.1016/j.jcz.2015.01.003.

HINSINGER, D. D., DEBRUYNE, R., THOMAS, M., DENYS, G. P., MENNESSON, M., UTAGE, J., & DETTAI, A. (2015). Fishing for barcodes in the Torrent: from COI to

complete mitogenomes on NGS platforms. *DNA Barcodes*, **3(1)**, 170-186. https://doi.org/10.1515/dna-2015-0019

JOVELIN R, JUSTINE J-L. (2001). Phylogenetic relationships within the Polyopisthocotylean monogeneans (Plathyhelminthes) inferred from partial 28S rDNA sequences. *International Journal for Parasitology*, **31**, 393–401. https://doi.org/10.1016/S0020-7519(01)00114-X

KATOH, K., MISAWA, K., KUMA, K.I., MIYATA, T., (2002). MAFFT: a novel method for rapid multiple sequence alignment based on fast Fourier transform. *Nucleic Acids Research*. **30**, 3059–3066. https://doi.org/10.1093/nar/gkf436

KEARSE, M., MOIR, R., WILSON, A., STONES-HAVAS, S., CHEUNG, M., STURROCK, S., & THIERER, T. (2012). Geneious Basic: an integrated and extendable desktop software platform for the organization and analysis of sequence data. *Bioinformatics*, **28(12)**, 1647-1649. https://doi.org/10.1093/bioinformatics/bts199

KOHN, AJ (1983) Feeding biology of gastropods. In: SALEUDDIN ASM, WILBUR KM (eds) *The Mollusca, Vol 3. Physiology,Part 2.* Academic Press, New York,.

LEPRIEUR, F., DESCOMBES, P., GABORIAU, T., COWMAN, P. F., PARRAVICINI, V., KULBICKI, M., ... & BELLWOOD, D. R. (2016). Plate tectonics drive tropical reef biodiversity dynamics. *Nature Communications*, 7, 11461. https://doi.org/10.1038/ncomms11461

LANDAU, B., BEU, A., & MARQUET, R. (2004). The Early Pliocene Gastropoda (Mollusca) of Estepona, Southern Spain: Tonnoidea, Ficoidea. *Palaeontos*, **5**, 35-102

LANDAU B., HARZHAUSER M. & BEU A. G. (2009). A Revision of the Tonnoidea (Caenogastropoda, Gastropoda) from the Miocene Paratethys and their palaeobiogeographic implications. *Jahrbuch Der Geologischen Bundesanstalt*, **149**, 61-109.

LOZOUET P. (1998). Nouvelles espèces de gastéropodes (Mollusca: Gastropoda) de l'Oligocène et du Miocène inférieur de l'Aquitaine (Sud-Ouest de la France). *Cossmanniana*, **5 (3-4)**, 61-102.

LUO, A., DUCHÊNE, D. A., ZHANG, C., ZHU, C. D., & HO, S. Y. (2020). A Simulation-Based Evaluation of Tip-Dating Under the Fossilized Birth–Death Process. *Systematic Biology*, **69(2)**, 325-344, https://doi.org/10.1093/sysbio/syz038

MAGARLAMOV, T. Y., MELNIKOVA, D. I., & CHERNYSHEV, A. V. (2017). Tetrodotoxin-producing bacteria: Detection, distribution and migration of the toxin in aquatic systems. *Toxins*, **9(5)**, 166, https://doi.org/10.3390/toxins9050166

MERLE D. (2005). The spiral cords of the Muricidae (Gastropoda, Neogastropoda): importance of ontogenetic and topological correspondences for delineating structural homologies. *Lethaia* **38(4)**, 367-379. https://doi.org/10.1080/00241160500355129

MONTES, C., CARDONA, A., JARAMILLO, C., PARDO, A., SILVA, J. C., VALENCIA, V., ... & NIÑO, H. (2015). Middle Miocene closure of the Central American seaway. *Science*, **348(6231)**, 226-229. https://doi.org/10.1126/science.aaa2815

NOGUCHI, T., MARUYAMA, J., NARITA, H., & KANEHISA, H. (1984). Occurrence of tetrodotoxin in the gastropod mollusk *Tutufa lissostoma* (frog shell). *Toxicon*, **22(2)**, 219-226.

OSCA, D., TEMPLADO, J., & ZARDOYA, R. (2014). The mitochondrial genome of *Ifremeria nautilei* and the phylogenetic position of the enigmatic deep-sea Abyssochrysoidea (Mollusca: Gastropoda). *Gene*, **547(2)**, 257-266, https://doi.org/10.1016/j.gene.2014.06.040.

OSCA, D., TEMPLADO, J. & ZARDOYA, R. (2015). Caenogastropod mitogenomics. *Molecular Phylogenetics and Evolution*, **93**, 118–128. https://doi.org/10.1016/j.ympev.2015.07.011

OLSSON, A. A. (1930). Contributions to the Tertiary paleontology of northern Peru: Part 3, Eocene Mollusca. *Bulletins of American Paleontology*, **17(62)**, 1-96.

PALUMBI S. (1996). Nucleic acids II: the polymerase chain re- action. In: HILLIS D, MORITZ C, MABLE BK, eds. *Molecular systematics*. Sunderland, MA: Sinauer Associates, 205–247.

PELLISSIER, L., LEPRIEUR, F., PARRAVICINI, V., COWMAN, P. F., KULBICKI, M., LITSIOS, G., ... & MOUILLOT, D. (2014). Quaternary coral reef refugia preserved fish diversity. *Science*, **344(6187)**, 1016-1019. https://doi.org/10.1126/science.1249853

PERESANI, M., VANHAEREN, M., QUAGGIOTTO, E., QUEFFELEC, A., & D'ERRICO, F. (2013). An ochered fossil marine shell from the Mousterian of Fumane Cave, Italy. *PLoS One*, **8(7)**, e68572. https://doi.org/10.1371/journal.pone.0068572

POWELL II C.L. & BERSCHAUER D.P. (2017). *Crossata* (Gastropoda: Bursidae) in the eastern Pacific: A morphologic and paleontologic perspective. *The Festivus*. **49(3**, 179-198.

PUILLANDRE, N., DUDA, T. F., MEYER, C., OLIVERA, B. M., & BOUCHET, P. (2014). One, four or 100 genera? A new classification of the cone snails. *Journal of Molluscan Studies*, **81(1)**, 1-23. https://doi.org/10.1093/mollus/eyu055

PYRON, R.A., (2011). Divergence-time estimation using fossils as terminal taxa and the origins of Lissamphibia. *Systematic Biology* **60**, 466–481, https://doi.org/10.1093/sysbio/syr047.

RAMBAUT, A., SUCHARD, M.A., XIE, D. & DRUMMOND, A.J. 2014. Tracer v1.4. http://beast.bio.ed.ac.uk/Tracer.

RENEMA, W., BELLWOOD, D. R., BRAGA, J. C., BROMFIELD, K., HALL, R., JOHNSON, K. G., & O'DEA, A. (2008). Hopping hotspots: global shifts in marine biodiversity. *Science*, **321(5889)**, 654-657. https://doi.org/10.1126/science.1155674

ROBBA E. (1996) The Rembangian (Middle Miocene) mollusk-fauna of Java, Indonesia. I. Archaeogastropoda. *Rivista Italiana di Paleontologia e Stratigrafia*, **102 (2)**, 267-292.

RONQUIST, F., TESLENKO, M., VAN DER MARK, P., AYRES, D. L., DARLING, A., HÖHNA, S., ... & HUELSENBECK, J. P. (2012). MrBayes 3.2: efficient Bayesian phylogenetic inference and model choice across a large model space. *Systematic Biology*, **61(3)**, 539-542. https://doi.org/10.1093/sysbio/sys029

SANDERS M.T., MERLE D., BOUCHET P., CASTELIN M., BEU A.G., SAMADI S. & PUILLANDRE N. (2017). One for each ocean: revision of the *Bursa granularis* (Röding, 1798) species complex (Gastropoda: Tonnoidea: Bursidae). *Journal of Molluscan Studies*, **83(4)**, 384-398. https://doi:10.1093/mollus/eyx029.

SANDERS, M. T., MERLE, D., & PUILLANDRE, N. (2019). A review of fossil Bursidae and their use for phylogeny calibration. *Geodiversitas*, **41(1)**, 247-265. https://doi.org/10.5252/geodiversitas2019v41a5

SCHWARTZ, J. H., & MARESCA, B. (2006). Do molecular clocks run at all? A critique of molecular systematics. *Biological Theory*, **1(4)**, 357-371 https://doi.org/10.1162/biot.2006.1.4.357

STADLER, T., GAVRYUSHKINA, A., WARNOCK, R. C., DRUMMOND, A. J., & HEATH, T. A. (2018). The fossilized birth-death model for the analysis of stratigraphic range data under different speciation modes. *Journal of Theoretical Biology*, **447**, 41-55, https://doi.org/10.1016/j.jtbi.2018.03.005.

STRONG, E. E., PUILLANDRE, N., BEU, A. G., CASTELIN, M., & BOUCHET, P. (2019). Frogs and tuns and tritons–A molecular phylogeny and revised family classification of the predatory gastropod superfamily Tonnoidea (Caenogastropoda). *Molecular Phylogenetics and Evolution*, **130**, 18-34. https://doi.org/10.1016/j.ympev.2018.09.016

TIMMERMANS, M. J. T. N., DODSWORTH, S., CULVERWELL, C. L., BOCAK, L., AHRENS, D., LITTLEWOOD, D. T. J., ... & VOGLER, A. P. 2010. Why barcode? High-

throughput multiplex sequencing of mitochondrial genomes for molecular systematics. *Nucleic Acids Research*, **38(21)**, e197-e197. https://doi.org/10.1093/nar/gkq807

TOMIDA, S., KADOTA, M. & HOSODA, E. (2013). A fossil tropical giant gastropod *Tutufa* (Gastropoda: Bursidae) from the Miocene Yugashima Group of Izu Peninsula, central Japan. *Bulletin of the Mizunami Fossil Museum*, **39**, 65–68.

TRIFINOPOULOS, J., NGUYEN, L. T., VON HAESELER, A., & MINH, B. Q. (2016). W-IQ-TREE: a fast online phylogenetic tool for maximum likelihood analysis. *Nucleic Acids Research*, **44(W1)**, W232-W235, https://doi.org/10.1093/nar/gkw256.

VANDENBERGHE, N., HILGEN, F.J., SPEIJER, R.P., OGG, J.G.,GRADSTEIN, F.M., HAMMER, O., HOLLIS, C.J., ANDHOOKER, J.J. (2012). The Paleogene Period, p. 855-921. In GRADSTEIN, F.M., OGG, J.G., SCHMITZ, M., ANDOGG, G. (eds.), *The Geologic Time Scale* 2012. Elsevier, Amsterdam.

VINTHER, J., PARRY, L., BRIGGS, D. E., & VAN ROY, P. (2017). Ancestral morphology of crown-group molluscs revealed by a new Ordovician stem aculiferan. *Nature*, **542(7642)**, 471-474, https://doi.org/10.1038/nature21055.

WARÉN, A. & BOUCHET, P. (1990). Laubierinidae and Pisanianurinae (Ranellidae), two new deep-sea taxa of the Tonnoidea (Gastropoda: Prosobranchia). *The Veliger*, **33**(1), 56-102.

Table 1. Fossil calibration prior information, Mr bayes parameter for prior distribution are given in <min_age>,<max_age> for uniform distribution and in <min_age>,<mean_age>,<st.dev.> for offset lognormal distribution, ages are given in millions of years

calibrated taxon	calibration prior distribution	Mr Bayes parameters	fossil used	Period	Origin / Formation	Ref for systematic attribution	Ref for stratigraphy
Bursidae	uniform	(27.82,41.2) ;	Olssonia yasila & Aquitanobursa tuberosa	Bartonian (Middle Eocene) & Chatian / Aquitanian (Oligocene/Miocene)	Yasila formation Peru & Aquitaine Basin France	Sanders et al., 2019	Olsson, 1930 & Lozouet 1998
Bursa	offsetlognormal	(9, 12, 1);	Bursa cf. rosa	Late Miocene	Citalahab, West Java	Sanders et al., 2019	Beu 2005
Dulcerana		(9, 12, 1);	"Bursa" cf. granularis	Late Miocene	Citalahab, West Java	Sanders et al., 2019	Beu 2005
Lampasopsis		(20, 22, 1);	B. (Marsupina) albofasciata boussingaulti (=Lampasopsis cf. rugosa)	Aquitanian/ Burdigalian (Early Miocene)	Punta Gavilán formation, northern Venezuela	Sanders et al., 2019	Beu 2010
Marsupina		(14, 16, 1);	Marsupina cf. bufo	Middle Miocene	Shoal River formation Florida, USA	Sanders et al., 2019	Beu 2010
Tritonoranella		(14, 16, 1);	Tritonoranella cf. ranelloides	Middle Miocene	Trinity Hill Sandstone member of Moruga Formation, Trinidad	Sanders et al., 2019	Beu 2010
Tutufa		(13.5,18.5,1);	Tutufa sp.	Middle Miocene	Ena Limestone Japan	Tomida et al. 2013	Tomida et al. 2013
Aspa Marginata	uniform	(0,18);	Aspa Marginata	Middle Miocene	Po valley Italy & Paratethys	Landau et al., 2004	Landau et al., 2004

Bufonaria perelegans	(0,11);	Bufonaria perelegans	Middle Miocene (early Preangerian)	Cijarian, western Java	Sanders et al., 2019	Beu 2005
Talisman scrobilator	(0,14);	Talisman scrobilator	Langhian/ Seravalian (Middle Miocene)	Paratethys Austria and Poland	Landau et al., 2004	Baluk 1995
Bursina margaritula	(0,3.5);	Bursina margaritula	Pliocene	Tjikeusik, Java	Beu 2005	Beu, 2005
Dulcerana cubaniana	(0,2);	Dulcerana cubaniana	Pleistocene	Various formation from Panama, Cuba, Dominican republic and Barbados	Sanders et al., 2017	Beu 2010
Lampasopsis thomae	(0,12);	Lampasopsis thomae	Burdigalian (Early Miocene)	Chipola Formation, Florida, USA	this study	Beu 2010
Marsupina bufo	(0,7);	Marsupina bufo	Tortonian/Messinian (Late Miocene)	Gurabo Formation in Dominican Republic	Sanders et al., 2019	Beu 2010
Marsupina nana	(0,5);	Marsupina nana	Early Zanclean (Early Pliocene)	Charco Azul Group, Penita Formation , Quebrada La Penita, Pacific coast of Costa Rica	Beu 2010	Beu 2010
Alanbeuella corrugata	(0,20);	Alanbeuella corrugata	Burdigalian (Early Miocene)	Aquitaine basin	Landau et al., 2009	Landau et al., 2009
Tritonoranella latitudo	(0,2.5);	Tritonoranella latitudo	late Pliocene	Kendeng beds, Java	Beu 2005	Beu 2005
Tritonoranella ranelloides	(0,2.5);	Tritonoranella ranelloides	Pliocene	Cayo Agua Formation Panama	Beu 2010	Beu 2010
Tutufa bubo	(0,5);	Tutufa bubo	Late Miocene	Pendopo Oilfield, east of Talang Akar,	Beu 2005	Robba, 1996

				Sumatra		
Tutufa rubeta	(0,7);	Tutufa rubeta	Late Miocene	Citalahab, West Java	Beu 2005	Beu 2005

Table 2. Complete and partial mt genomes sequenced and reconstructed in this study

Species	Specimen ID	Proportion assembled	Mitogenome size	Number of read assembled	Coverage			
					Min	Max	Mean	Standard dev.
Tutufa rubeta	IM-2013-10139	100	15397	7421	12	438	122	101
Bufonaria perelegans	IM-2007-43034	52		2574	0	273	46	63
Aspa marginata	ZMB-92447	56		3568	0	522	66	100
Marsupina bufo	IM-2013-56144	100	15403	3736	9	200	51	32
Bursa aff *tuberosissima*	IM-2007-43041	69		507	0	22	7	6
Lampasopsis rhodostoma	IM-2013-11043	100	15392	6604	14	284	86	46
Korrigania quirihorai	IM-2013-52981	93		955	0	75	12	9
Bursa lamarkii	IM-2013-13449	100	15407	4760	10	218	62	38
Korigania fijiensis	IM-2009-5459	86		765	0	42	10	9
Lampasopsis rhodostoma	IM-2013-11042	100	15392	22176	138	536	217	42

Supp. Tab. 1. Voucher and GenBank registration numbers and locality information for sequenced specimens

Institution number	Used in dataset(s)	*Genus*	*Species*	Campaign	Station	Latitude	Longitude	Depth (m)	BOLD ID	GB *cox1*
Mined from GenBank	1,2,4	*Cabestana*	*spengleri*							
Mined from GenBank	1,2,4	*Cymatium*	*cingulatum*							
Mined from GenBank	1,2,4	*Bufonaria*	*rana*							MN389085
Mined from GenBank	2,3,4	*Cymatium*	*parthenopeum*							NC-013247
Mined from GenBank	2,3,4	*Galeodea*	*echinophora*							NC-028003
MNHN-IM-2007-33056	1	*Dulcerana*	*affinis*	SANTO 2006	NR08	15°35,7'S	167°07,4'E	11	TONO140-17	MF124239
MNHN-IM-2007-33097	1	*Dulcerana*	*granularis*	SANTO 2006	VM61	15°28,5'S	167°15,5'E	0-1	TONO123-17	MF124192
MNHN-IM-2007-33115	1	*Dulcerana*	*granularis*	PANGLAO 2004	M7	09°36,1'N	123°45,2'E	0-3	TONO141-17	MF124186
MNHN-IM-2007-33147	1	*Korrigania*	*fijiensis*	EXBODI	DW2576	20°20'S	158°43'E	390-394	TONO283-20	MT519986
MNHN-IM-2007-40255	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM001-08	JX241227
MNHN-IM-2007-40256	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM002-08	JX241228
MNHN-IM-2007-40257	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM003-08	JX241229
MNHN-IM-2007-40258	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM004-08	JX241230
MNHN-IM-2007-40259	1	*Korrigania*	*quirihorai*	EXBODI	DW2528	22°49'S	159°23'E	320-345	MSM005-08	JX241231
MNHN-IM-2007-40260	1	*Korrigania*	*quirihorai*	EXBODI	DW2528	22°49'S	159°23'E	320-345	MSM006-08	JX241232
MNHN-IM-2007-40261	1	*Korrigania*	*quirihorai*	EXBODI	DW2526	22°46'S	159°23'E	330-340	MSM007-08	JX241233
MNHN-IM-2007-40262	1	*Korrigania*	*quirihorai*	NORFOLK 2	DW2040	23°41'S	168°01'E	285	MSM008-08	JX241234
MNHN-IM-2007-40263	1	*Korrigania*	*quirihorai*	NORFOLK 2	DW2093	24°44'S	168°09'E	230	MSM009-08	JX241235
MNHN-IM-2007-40264	1	*Korrigania*	*quirihorai*	NORFOLK 2	CP2140	23°00'S	168°22'E	270-350	MSM010-08	JX241236
MNHN-IM-2007-40265	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM011-08	JX241237
MNHN-IM-2007-40266	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM012-08	JX241238
MNHN-IM-2007-40267	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM013-08	JX241239
MNHN-IM-2007-40268	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM014-08	JX241240
MNHN-IM-2007-40269	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM015-08	JX241241

MNHN-IM-2007-40270	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM016-08	JX241242
MNHN-IM-2007-40271	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM017-08	JX241243
MNHN-IM-2007-40272	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM018-08	JX241244
MNHN-IM-2007-40273	1	*Tritonoranella*	*latitudo*	NORFOLK 1	no data				MSM019-08	JX241245
MNHN-IM-2007-40274	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM020-08	JX241246
MNHN-IM-2007-40275	1	*Korrigania*	*quirihorai*	NORFOLK 1	no data				MSM021-08	JX241247
MNHN-IM-2007-40276	1	*Korrigania*	*quirihorai*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM022-08	JX241248
MNHN-IM-2007-40277	1	*Korrigania*	*quirihorai*	NORFOLK 1	no data				MSM023-08	JX241249
MNHN-IM-2007-40278	1	*Korrigania*	*quirihorai*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM024-08	JX241250
MNHN-IM-2007-40279	1	*Korrigania*	*fijiensis*	NORFOLK 2	CP2139	23°01'S	168°23'E	372-393	MSM025-08	JX241251
MNHN-IM-2007-40280	1	*Korrigania*	*fijiensis*	NORFOLK 2	CP2139	23°01'S	168°23'E	372-393	MSM026-08	JX241252
MNHN-IM-2007-40281	1	*Korrigania*	*fijiensis*	NORFOLK 2	CP2139	23°01'S	168°23'E	372-393	MSM027-08	JX241253
MNHN-IM-2007-40282	1	*Korrigania*	*fijiensis*	NORFOLK 2	CP2139	23°01'S	168°23'E	372-393	MSM028-08	JX241254
MNHN-IM-2007-40283	1	*Korrigania*	*fijiensis*	NORFOLK 2	CP2139	23°01'S	168°23'E	372-393	MSM029-08	JX241255
MNHN-IM-2007-40284	1	*Korrigania*	*fijiensis*	NORFOLK 2	CP2139	23°01'S	168°23'E	372-393	MSM030-08	JX241256
MNHN-IM-2007-40285	1	*Korrigania*	*fijiensis*	NORFOLK 2	CP2139	23°01'S	168°23'E	372-393	MSM031-08	JX241257
MNHN-IM-2007-40286	1	*Korrigania*	*fijiensis*	NORFOLK 2	CP2139	23°01'S	168°23'E	372-393	MSM032-08	JX241258
MNHN-IM-2007-40287	1	*Tritonoranella*	*latitudo*	NORFOLK 2	DW2135	23°02'S	168°21'E	295-330	MSM033-08	JX241259
MNHN-IM-2007-40288	1	*Tritonoranella*	*latitudo*	NORFOLK 2	DW2093	24°44'S	168°09'E	230	MSM034-08	JX241260
MNHN-IM-2007-40289	1	*Tritonoranella*	*latitudo*	NORFOLK 2	DW2093	24°44'S	168°09'E	230	MSM035-08	JX241261
MNHN-IM-2007-40290	1	*Tritonoranella*	*latitudo*	NORFOLK 2	DW2126	23°16'S	168°14'E	398-550	MSM036-08	JX241262
MNHN-IM-2007-40291	1	*Tritonoranella*	*latitudo*	NORFOLK 2	DW2040	23°41'S	168°01'E	285	MSM037-08	JX241263
MNHN-IM-2007-40292	1	*Tritonoranella*	*latitudo*	NORFOLK 2	DW2040	23°41'S	168°01'E	285	MSM038-08	JX241264
MNHN-IM-2007-40293	1	*Tritonoranella*	*latitudo*	NORFOLK 2	DW2040	23°41'S	168°01'E	285	MSM039-08	JX241265
MNHN-IM-2007-40294	1	*Tritonoranella*	*latitudo*	NORFOLK 2	DW2040	23°41'S	168°01'E	285	MSM040-08	JX241266
MNHN-IM-2007-40295	1	*Tritonoranella*	*latitudo*	NORFOLK 2	CP2095	24°46'S	168°10'E	283-310	MSM041-08	JX241267
MNHN-IM-2007-40296	1	*Tritonoranella*	*latitudo*	NORFOLK 2	CP2095	24°46'S	168°10'E	283-310	MSM042-08	JX241268
MNHN-IM-2007-40297	1	*Tritonoranella*	*latitudo*	NORFOLK 2	DW2151	22°43'S	167°14'E	353-368	MSM043-08	JX241269
MNHN-IM-2007-40298	1	*Korrigania*	*quirihorai*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM044-08	JX241270

MNHN-IM-2007-40299	1	*Korrigania*	*quirihorai*	NORFOLK 1	DW1675	24°44'S	168°09'E	231-233	MSM045-08	JX241271
MNHN-IM-2007-40300	1	*Korrigania*	*quirihorai*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM046-08	JX241272
MNHN-IM-2007-40301	1	*Korrigania*	*quirihorai*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM047-08	JX241273
MNHN-IM-2007-40302	1	*Korrigania*	*quirihorai*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM048-08	JX241274
MNHN-IM-2007-40303	1	*Korrigania*	*quirihorai*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM049-08	JX241275
MNHN-IM-2007-40304	1	*Korrigania*	*quirihorai*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM050-08	JX241276
MNHN-IM-2007-40305	1	*Korrigania*	*quirihorai*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM051-08	JX241277
MNHN-IM-2007-40306	1	*Korrigania*	*quirihorai*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM052-08	JX241278
MNHN-IM-2007-40307	1	*Korrigania*	*quirihorai*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM053-08	JX241279
MNHN-IM-2007-40308	1	*Korrigania*	*quirihorai*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM054-08	JX241280
MNHN-IM-2007-40309	1	*Korrigania*	*quirihorai*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM055-08	JX241281
MNHN-IM-2007-40310	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM056-08	JX241282
MNHN-IM-2007-40311	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM057-08	JX241283
MNHN-IM-2007-40312	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM058-08	JX241284
MNHN-IM-2007-40313	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM059-08	JX241285
MNHN-IM-2007-40314	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM060-08	JX241286
MNHN-IM-2007-40315	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM061-08	JX241287
MNHN-IM-2007-40316	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM062-08	JX241288
MNHN-IM-2007-40317	1	*Tritonoranella*	*latitudo*	NORFOLK 1	DW1659	23°38'S	167°42'E	449-467	MSM063-08	JX241289
MNHN-IM-2007-40318	1	*Korrigania*	*fijiensis*	EXBODI	DW2576	20°20'S	158°43'E	390-394	MSM064-08	JX241290
MNHN-IM-2007-40319	1	*Korrigania*	*fijiensis*	EXBODI	DW2576	20°20'S	158°43'E	390-394	MSM065-08	JX241291
MNHN-IM-2007-40320	1	*Korrigania*	*fijiensis*	EXBODI	DW2576	20°20'S	158°43'E	390-394	MSM066-08	JX241292
MNHN-IM-2007-40321	1	*Korrigania*	*fijiensis*	EXBODI	DW2612	19°35'S	158°41'E	392	MSM067-08	JX241293
MNHN-IM-2007-40322	1	*Korrigania*	*fijiensis*	EXBODI	DW2612	19°35'S	158°41'E	392	MSM068-08	JX241294
MNHN-IM-2007-40323	1	*Korrigania*	*fijiensis*	EXBODI	DW2612	19°35'S	158°41'E	392	MSM069-08	JX241295
MNHN-IM-2007-40324	1	*Korrigania*	*fijiensis*	EXBODI	DW2607	19°33'S	158°40'E	400-413	MSM070-08	JX241296
MNHN-IM-2007-40325	1	*Korrigania*	*fijiensis*	EXBODI	DW2607	19°33'S	158°40'E	400-413	MSM071-08	JX241297
MNHN-IM-2007-40326	1	*Korrigania*	*fijiensis*	EXBODI	DW2607	19°33'S	158°40'E	400-413	MSM072-08	JX241298
MNHN-IM-2007-40327	1	*Korrigania*	*fijiensis*	EXBODI	DW2607	19°33'S	158°40'E	400-413	MSM073-08	JX241299

MNHN-IM-2007-40328	1	*Korrigania*	*fijiensis*	EXBODI	DW2607	19°33'S	158°40'E	400-413	MSM074-08	JX241300
MNHN-IM-2007-40329	1	*Korrigania*	*fijiensis*	EXBODI	DW2607	19°33'S	158°40'E	400-413	MSM075-08	JX241301
MNHN-IM-2007-40330	1	*Korrigania*	*fijiensis*	EXBODI	DW2608	19°33'S	158°40'E	393-396	MSM076-08	JX241302
MNHN-IM-2007-40331	1	*Korrigania*	*quirihorai*	EXBODI	DW2564	20°25'S	158°41'E	333-386	MSM077-08	JX241303
MNHN-IM-2007-40332	1	*Korrigania*	*quirihorai*	EXBODI	DW2564	20°25'S	158°41'E	333-386	MSM078-08	JX241304
MNHN-IM-2007-40333	1	*Tritonoranella*	*latitudo*	EXBODI	DW2576	20°20'S	158°43'E	390-394	MSM079-08	JX241305
MNHN-IM-2007-40334	1	*Korrigania*	*quirihorai*	EXBODI	DW2576	20°20'S	158°43'E	390-394	MSM080-08	JX241306
MNHN-IM-2007-40335	1	*Korrigania*	*quirihorai*	EXBODI	DW2576	20°20'S	158°43'E	390-394	MSM081-08	JX241307
MNHN-IM-2007-40336	1	*Korrigania*	*fijiensis*	EXBODI	DW2576	20°20'S	158°43'E	390-394	MSM082-08	JX241308
MNHN-IM-2007-40337	1	*Korrigania*	*quirihorai*	EXBODI	DW2576	20°20'S	158°43'E	390-394	MSM083-08	JX241309
MNHN-IM-2007-40338	1	*Tritonoranella*	*latitudo*	EXBODI	DW2526	22°46'S	159°23'E	330-340	MSM084-08	JX241310
MNHN-IM-2007-40339	1	*Tritonoranella*	*latitudo*	EXBODI	DW2526	22°46'S	159°23'E	330-340	MSM085-08	JX241311
MNHN-IM-2007-40340	1	*Tritonoranella*	*latitudo*	EXBODI	DW2526	22°46'S	159°23'E	330-340	MSM086-08	JX241312
MNHN-IM-2007-40341	1	*Korrigania*	*fijiensis*	EXBODI	DW2526	22°46'S	159°23'E	330-340	MSM087-08	JX241313
MNHN-IM-2007-40342	1	*Tritonoranella*	*latitudo*	EXBODI	DW2530	22°48'S	159°23'E	338-343	MSM088-08	JX241314
MNHN-IM-2007-40343	1	*Korrigania*	*fijiensis*	EXBODI	DW2525	22°48'S	159°23'E	408-410	MSM089-08	JX241315
MNHN-IM-2007-40344	1	*Tritonoranella*	*latitudo*	EXBODI	DW2525	22°48'S	159°23'E	408-410	MSM090-08	JX241316
MNHN-IM-2007-40345	1	*Tritonoranella*	*latitudo*	EXBODI	DW2634	21°05'S	160°46'E	342-347	MSM091-08	JX241317
MNHN-IM-2007-40346	1	*Tritonoranella*	*latitudo*	EXBODI	DW2504	24°48'S	159°46'E	390-600	MSM092-08	JX241318
MNHN-IM-2007-40347	1	*Korrigania*	*fijiensis*	EXBODI	DW2577	20°20'S	158°39'E	399-602	MSM093-08	JX241319
MNHN-IM-2007-40348	1	*Korrigania*	*fijiensis*	EXBODI	DW2577	20°20'S	158°39'E	399-602	MSM094-08	JX241320
MNHN-IM-2007-40349	1	*Korrigania*	*fijiensis*	EXBODI	DW2577	20°20'S	158°39'E	399-602	MSM095-08	JX241321
MNHN-IM-2007-40350	1	*Korrigania*	*quirihorai*	EXBODI	DW2577	20°20'S	158°39'E	399-602	MSM096-08	JX241322
MNHN-IM-2007-40351	1	*Korrigania*	*fijiensis*	EXBODI	DW2576	20°20'S	158°43'E	390-394	MSM097-08	JX241323
MNHN-IM-2007-40352	1	*Korrigania*	*fijiensis*	EXBODI	DW2576	20°20'S	158°43'E	390-394	MSM098-08	JX241324
MNHN-IM-2007-40353	1	*Korrigania*	*quirihorai*	NORFOLK 1	DW1727	23°19'S	168°15'E	190-212	MSM099-08	JX241325
MNHN-IM-2007-40354	1	*Korrigania*	*quirihorai*	NORFOLK 2	DW2040	23°41'S	168°01'E	285	MSM100-08	JX241326
MNHN-IM-2007-40355	1	*Korrigania*	*quirihorai*	NORFOLK 2	DW2040	23°41'S	168°01'E	285	MSM101-08	JX241327
MNHN-IM-2007-40356	1	*Korrigania*	*quirihorai*	NORFOLK 2	DW2040	23°41'S	168°01'E	285	MSM102-08	JX241328

MNHN-IM-2007-40357	1	*Korrigania*	*quirihorai*	NORFOLK 2	DW2040	23°41'S	168°01'E	285	MSM103-08	JX241329
MNHN-IM-2007-40358	1	*Korrigania*	*fijiensis*	EXBODI	DW2577	20°20'S	158°39'E	399-602	MSM104-08	JX241330
MNHN-IM-2007-40359	1	*Korrigania*	*fijiensis*	EXBODI	DW2606	19°37'S	158°42'E	442-443	MSM105-08	JX241331
MNHN-IM-2007-40360	1	*Korrigania*	*fijiensis*	EXBODI	DW2606	19°37'S	158°42'E	442-443	MSM106-08	JX241332
MNHN-IM-2007-40361	1	*Korrigania*	*fijiensis*	EXBODI	DW2606	19°37'S	158°42'E	442-443	MSM107-08	JX241333
MNHN-IM-2007-40567	1	*Korrigania*	*quirihorai*	EXBODI	DW2564	20°25'S	158°41'E	333-386	TONO287-20	MT520016
MNHN-IM-2007-42267	1	*Korrigania*	*quirihorai*	NORFOLK 1	no data			-	TONO041-12	MT519991
MNHN-IM-2007-42671	1	*Korrigania*	*fijiensis*	CONCALIS	DW2996	18°01'S	163°01'E	487-500	TONO338-20	MT520034
MNHN-IM-2007-42721	1	*Bursina*	*ignobilis*	CONCALIS	DW3000	18°31'S	163°07'E	210-212	TONO190-18	MH581306
MNHN-IM-2007-42722	1	*Bursina*	*ignobilis*	CONCALIS	DW3000	18°31'S	163°07'E	210-212	TONO032-12	JX241335
MNHN-IM-2007-42723	1	*Bursina*	*ignobilis*	CONCALIS	DW3000	18°31'S	163°07'E	210-212	TONO004-12	JX241336
MNHN-IM-2007-42724	1	*Korrigania*	*fijiensis*	CONCALIS	CP2959	19°00'S	163°14'E	394-407	TONO105-12	JX241337
MNHN-IM-2007-42725	1	*Korrigania*	*fijiensis*	CONCALIS	CP2959	19°00'S	163°14'E	394-407	TONO072-12	JX241338
MNHN-IM-2007-42738	1	*Korrigania*	*quirihorai*	CONCALIS	DW2951	18°58'S	163°25'E	300	TONO079-12	JX241339
MNHN-IM-2007-42739	1	*Korrigania*	*quirihorai*	CONCALIS	DW2951	18°58'S	163°25'E	300	TONO029-12	JX241340
MNHN-IM-2007-43030	1	*Korrigania*	*awatii*	SALOMON 2	DW2302	09°07'S	158°22'E	254-341	TONO066-12	JX241341
MNHN-IM-2007-43031	1	*Korrigania*	*awatii*	PANGLAO 2005	CA2337	09°32'N	123°42'E	362	TONO030-12	JX241342
MNHN-IM-2007-43032	1	*Korrigania*	*awatii*	PANGLAO 2005	CA2337	09°32'N	123°42'E	362	TONO093-12	JX241343
MNHN-IM-2007-43033	1	*Korrigania*	*awatii*	PANGLAO 2005	CA2337	09°32'N	123°42'E	362	TONO056-12	JX241344
MNHN-IM-2007-43034	1,3	*Bufonaria*	*perelegans*	SANTO 2006	EP04	15°33'S	167°12,7?12,8'E	89-109	TONO117-12	JX241345
MNHN-IM-2007-43036	1,2,4	*Tutufa*	*bufo*	PANGLAO 2004	P3	09°31,1'N	123°41,5'E	100	TONO094-12	JX241346
MNHN-IM-2007-43037	1	*Dulcerana*	*affinis*	SANTO 2006	DR84	15°43,4'S	167°15'E	6	TONO069-12	JX241347
MNHN-IM-2007-43039	1	*Dulcerana*	*affinis*	PANGLAO 2004	R24	09°37,5'N	123°46,8'E	0-2	TONO080-12	JX241349
MNHN-IM-2007-43041	1,2,3,4	*Bursa*	*cf.tuberosissima*	PANGLAO 2004	M5	09°35,5'N	123°43,3?44,3'E	0-2	TONO108-12	JX241350
MNHN-IM-2007-43042	1	*Dulcerana*	*affinis*	SANTO 2006	DR03	15°31,1'S	167°15,8'E	2-30	TONO058-12	JX241351
MNHN-IM-2007-43043	1	*Bufonaria*	*perelegans*	SANTO 2006	EP04	15°33'S	167°12,7?12,8'E	89-109	TONO118-12	JX241352
MNHN-IM-2007-43044	1,2,4	*Tutufa*	*tenuigranosa*	SALOMON 2	DW2236	06°51'S	156°23'E	208-230	TONO067-12	JX241353
MNHN-IM-2007-43045	1,2,4	*Bursa*	*rosa*	SANTO 2006	DB20	15°36,5'S	167°01,4'E	22-25	TONO099-12	JX241354
MNHN-IM-2007-43046	1	*Bursa*	*lamarckii*	PANGLAO 2004	R73	09°30,9'N	123°40,8'E	2-30	TONO112-12	JX241355

MNHN-IM-2007-43048	1	*Korrigania*	*fosteri*	PANGLAO 2004	P1	09°36'N	123°45'E	90-200	TONO096-12	JX241356	
MNHN-IM-2007-43049	1	*Dulcerana*	*granularis*	SANTO 2006	VM61	15°28,5'S	167°15,5'E	1	TONO007-12	JX241357	
MNHN-IM-2007-43050	1	*Tutufa*	*rubeta*	PANGLAO 2004	B40	09°34,6'N	123°49,9'E	22	TONO095-12	JX241358	
MNHN-IM-2007-43052	1,2,4	*Bursina*	*ignobilis*	SANTO 2006	EP22	15°37,3?37,4'S	167°05,8?6,0'E	78-91	TONO081-12	JX241360	
MNHN-IM-2007-43054	1,2,4	*Bursa*	*lamarckii*	SANTO 2006	DR87	15°38,5'S	167°15,1'E	13	TONO008-12	JX241361	
MNHN-IM-2007-43056	1	*Dulcerana*	*affinis*	SANTO 2006	VM02	15°34,9'S	167°02,4'E	0-1	TONO059-12	JX241363	
MNHN-IM-2007-43057	1,2,4	*Bufonaria*	*perelegans*	SANTO 2006	AT54	15°32,1'S	167°14,1'E	68-79	TONO034-12	JX241364	
MNHN-IM-2007-43058	1	*Korrigania*	*awatii*	PANGLAO 2005	CP2372	08°39'N	123°16'E	255-301	TONO044-12	JX241365	
MNHN-IM-2007-43059	1	*Dulcerana*	*affinis*	SANTO 2006	FR09	15°32,4'S	167°11,8'E	1-42	TONO018-12	JX241366	
MNHN-IM-2007-43060	1	*Dulcerana*	*affinis*	SANTO 2006	VM02	15°34,9'S	167°02,4'E	0-1	TONO098-12	JX241367	
MNHN-IM-2007-43061	1	*Tutufa*	*tenuigranosa*	PANGLAO 2004	P3	09°31,1'N	123°41,5'E	100	TONO031-12	JX241368	
MNHN-IM-2007-43062	1	*Bursa*	*lamarckii*	PANGLAO 2004	R43	09°41,3'N	123°49,5'E	3-41	TONO109-12	JX241369	
MNHN-IM-2007-43063	1	*Tutufa*	*rubeta*	SANTO 2006	FR65	15°35,4'S	166°59,2'E	-	TONO010-12	JX241370	
MNHN-IM-2007-43064	1	*Dulcerana*	*granularis*	PANGLAO 2004	M5	09°35,5'N	123°43,3?44,3'E	0-2	TONO285-20	MT520030	
MNHN-IM-2007-43066	1,2,4	*Bursa*	*tuberosissima*	PANGLAO 2004	R24	09°37,5'N	123°46,8'E	0-2	TONO113-12	JX241371	
MNHN-IM-2007-43067	1	*Lampasopsis*	*rhodostoma*	SANTO 2006	DB53	15°28,8'S	167°15,2'E	5	TONO009-12	JX241372	
MNHN-IM-2007-43068	1,2,4	*Lampasopsis*	*rhodostoma*	PANGLAO 2004	R50	09°35,7'N	123°44,4'E	3-7	TONO110-12	JX241373	
MNHN-IM-2007-43069	1	*Dulcerana*	*affinis*	SANTO 2006	VM46	15°34,5'S	167°12,3'E	-	TONO006-12	JX241374	
MNHN-IM-2007-43070	1	*Dulcerana*	*granularis*	SANTO 2006	DB83	15°43,4'S	167°15'E	6	TONO017-12	JX241375	
MNHN-IM-2007-43071	1	*Dulcerana*	*granularis*	SANTO 2006	VM62	15°28,8'S	167°15,3'E	0-1	TONO019-12	JX241376	
MNHN-IM-2007-43408	1	*Korrigania*	*quirihorai*	TERRASSES	DW3101	22°59'S	168°21'E	320-390	TONO061-12	JX241377	
MNHN-IM-2007-43409	1	*Korrigania*	*quirihorai*	TERRASSES	DW3101	22°59'S	168°21'E	320-390	TONO075-12	JX241378	
MNHN-IM-2007-43410	1	*Korrigania*	*quirihorai*	TERRASSES	DW3056	23°42'S	168°01'E	250-330	TONO090-12	JX241379	
MNHN-IM-2007-43411	1	*Korrigania*	*quirihorai*	TERRASSES	DW3056	23°42'S	168°01'E	250-330	TONO054-12	JX241380	
MNHN-IM-2007-43413	1	*Korrigania*	*quirihorai*	TERRASSES	DW3090	22°16'S	167°08'E	260	TONO106-12	JX241381	
MNHN-IM-2007-43414	1	*Korrigania*	*quirihorai*	TERRASSES	DW3102	22°59'S	168°23'E	410-430	TONO076-12	JX241382	
MNHN-IM-2007-43416	1	*Korrigania*	*fijiensis*	TERRASSES	CP3089	22°17'S	167°12'E	390-410	TONO024-12	JX241383	
MNHN-IM-2007-43419	1	*Tritonoranella*	*latitudo*	TERRASSES	DW3069	23°18'S	168°05'E	300-320	TONO051-12	JX241384	
MNHN-IM-2007-43420	1	*Korrigania*	*fijiensis*	TERRASSES	DW3114	22°44'S	167°14'E	350-380	TONO077-12	JX241385	

MNHN-IM-2007-43421	1	*Korrigania*	*fijiensis*	TERRASSES	DW3077	23°15'S	168°14'E	420-540	TONO035-12	JX241386
MNHN-IM-2007-43422	1	*Korrigania*	*quirihorai*	TERRASSES	CP3055	23°42'S	168°01'E	250-320	TONO107-12	JX241387
MNHN-IM-2007-43423	1	*Korrigania*	*fijiensis*	TERRASSES	DW3102	22°59'S	168°23'E	410-430	TONO084-12	JX241388
MNHN-IM-2007-43430	1	*Korrigania*	*fijiensis*	TERRASSES	CP3049	23°42'S	168°16'E	380-410	TONO013-12	JX241389
MNHN-IM-2007-43431	1	*Korrigania*	*fijiensis*	TERRASSES	DW3105	22°59'S	168°22'E	420	TONO021-12	JX241390
MNHN-IM-2007-43432	1	*Korrigania*	*quirihorai*	TERRASSES	DW3110	23°02'S	168°16'E	270-310	TONO062-12	JX241391
MNHN-IM-2007-43433	1	*Korrigania*	*quirihorai*	TERRASSES	DW3056	23°42'S	168°01'E	250-330	TONO025-12	JX241392
MNHN-IM-2007-43435	1	*Korrigania*	*fijiensis*	TERRASSES	DW3105	22°59'S	168°22'E	420	TONO036-12	JX241393
MNHN-IM-2007-43436	1	*Korrigania*	*fijiensis*	TERRASSES	DW3105	22°59'S	168°22'E	420	TONO022-12	JX241394
MNHN-IM-2007-43437	1	*Korrigania*	*fijiensis*	TERRASSES	DW3077	23°15'S	168°14'E	420-540	TONO101-12	JX241395
MNHN-IM-2007-43439	1	*Korrigania*	*quirihorai*	TERRASSES	DW3056	23°42'S	168°01'E	250-330	TONO092-12	JX241396
MNHN-IM-2007-43548	1	*Korrigania*	*fijiensis*	TERRASSES	DW3102	22°59'S	168°23'E	410-430	TONO039-12	JX241397
MNHN-IM-2007-43550	1	*Korrigania*	*fijiensis*	TERRASSES	DW3127	23°00'S	167°16'E	400-420	TONO086-12	JX241398
MNHN-IM-2007-43552	1	*Korrigania*	*fijiensis*	TERRASSES	DW3121	22°45'S	167°13'E	380-400	TONO103-12	JX241399
MNHN-IM-2007-43553	1	*Korrigania*	*fijiensis*	TERRASSES	DW3127	23°00'S	167°16'E	400-420	TONO023-12	JX241400
MNHN-IM-2007-43554	1	*Korrigania*	*quirihorai*	TERRASSES	DW3069	23°18'S	168°05'E	300-320	TONO043-12	JX241401
MNHN-IM-2007-43555	1	*Korrigania*	*quirihorai*	TERRASSES	DW3102	22°59'S	168°23'E	410-430	TONO063-12	JX241402
MNHN-IM-2007-43562	1	*Korrigania*	*fijiensis*	TERRASSES	DW3127	23°00'S	167°16'E	400-420	TONO037-12	JX241403
MNHN-IM-2007-43563	1	*Korrigania*	*quirihorai*	TERRASSES	DW3090	22°16'S	167°08'E	260	TONO078-12	JX241404
MNHN-IM-2007-43564	1	*Korrigania*	*quirihorai*	TERRASSES	DW3102	22°59'S	168°23'E	410-430	TONO026-12	JX241405
MNHN-IM-2007-43566	1	*Korrigania*	*quirihorai*	TERRASSES	CP3054	23°42'S	168°01'E	240-260	TONO014-12	JX241406
MNHN-IM-2007-43567	1	*Korrigania*	*quirihorai*	TERRASSES	DW3069	23°18'S	168°05'E	300-320	TONO001-12	JX241407
MNHN-IM-2007-43569	1	*Korrigania*	*quirihorai*	TERRASSES	DW3102	22°59'S	168°23'E	410-430	TONO027-12	JX241408
MNHN-IM-2007-43570	1	*Korrigania*	*quirihorai*	TERRASSES	DW3102	22°59'S	168°23'E	410-430	TONO064-12	JX241409
MNHN-IM-2007-43571	1	*Korrigania*	*fijiensis*	TERRASSES	DW3127	23°00'S	167°16'E	400-420	TONO102-12	JX241410
MNHN-IM-2007-43572	1	*Korrigania*	*fijiensis*	TERRASSES	DW3102	22°59'S	168°23'E	410-430	TONO104-12	JX241411
MNHN-IM-2007-43587	1	*Korrigania*	*quirihorai*	TERRASSES	DW3102	22°59'S	168°23'E	410-430	TONO002-12	JX241413
MNHN-IM-2007-43589	1,2,4	*Tritonoranella*	*latitudo*	TERRASSES	DW3102	22°59'S	168°23'E	410-430	TONO100-12	JX241414
MNHN-IM-2007-43590	1	*Korrigania*	*quirihorai*	TERRASSES	DW3102	22°59'S	168°23'E	410-430	TONO028-12	JX241415

MNHN-IM-2007-43593	1	*Korrigania*	*quirihorai*	TERRASSES	DW3102	22°59'S	168°23'E	410-430	TONO015-12	JX241416
MNHN-IM-2007-43596	1	*Korrigania*	*fijiensis*	TERRASSES	DW3127	23°00'S	167°16'E	400-420	TONO085-12	JX241417
MNHN-IM-2007-43597	1	*Korrigania*	*fijiensis*	TERRASSES	DW3102	22°59'S	168°23'E	410-430	TONO053-12	JX241418
MNHN-IM-2007-43598	1	*Korrigania*	*fijiensis*	TERRASSES	DW3102	22°59'S	168°23'E	410-430	TONO071-12	JX241419
MNHN-IM-2007-43599	1	*Korrigania*	*fijiensis*	TERRASSES	DW3127	23°00'S	167°16'E	400-420	TONO038-12	JX241420
MNHN-IM-2007-43602	1	*Korrigania*	*fijiensis*	TERRASSES	DW3121	22°45'S	167°13'E	380-400	TONO087-12	JX241421
MNHN-IM-2007-43604	1	*Tritonoranella*	*latitudo*	TERRASSES	DW3056	23°42'S	168°01'E	250-330	TONO011-12	JX241422
MNHN-IM-2009-5459	3,4	*Korrigania*	*fijiensis*	CONCALIS	DW2995	18°00'S	163°04'E	450-495	TONO074-12	JX241433
MNHN-IM-2009-15888	1	*Dulcerana*	*granularis*	ATIMO VATAE	TR13	25°08.1'S	46°47.7'E	16-20	TONO294-20	MT519947
MNHN-IM-2009-15907	1	*Lampasopsis*	*cruentata*	ATIMO VATAE	TA52	25°02.4'S	46°59.6'E	8-14	TONO290-20	MT519978
MNHN-IM-2009-15916	1	*Lampasopsis*	*lucaensis*	ATIMO VATAE	TA52	25°02.4'S	46°59.6'E	8-14	TONO291-20	MT519994
MNHN-IM-2009-15917	1	*Lampasopsis*	*lucaensis*	ATIMO VATAE	TS04	25°02.3'S	47°00.3'E	22-24	TONO293-20	MT519992
MNHN-IM-2009-15927	1	*Bursa*	*rosa*	ATIMO VATAE	TV13	25°04.4'S	46°57.1'E	4-5	TONO292-20	MT519965
MNHN-IM-2009-15944	1	*Bursina*	*ignobilis*	ATIMO VATAE	CP3623	25°41.4'S	45°59.2'E	74-80	TONO288-20	MT519968
MNHN-IM-2009-15950	1	*Dulcerana*	*granularis*	ATIMO VATAE	TM16	25°06.7'S	46°49.9'E	0-1	TONO289-20	MT520074
MNHN-IM-2009-15969	1	*Tutufa*	*tenuigranosa*	ATIMO VATAE	CP3589	25°03'S	44°00'E	132-153	TONO295-20	MT520027
MNHN-IM-2009-22029	1	*Bursina*	*ignobilis*	TERRASSES	DW3106	23°02'S	168°21'E	180-220	TONO298-20	MT519940
MNHN-IM-2009-22032	1	*Korrigania*	*fosteri*	CONCALIS	DW2932	19°05'S	163°30'E	215-225	TONO020-12	JX241423
MNHN-IM-2009-22055	1	*Tritonoranella*	*latitudo*	CONCALIS	DW2963	18°22'S	162°59'E	220-240	TONO114-12	JX241424
MNHN-IM-2009-22175	1	*Tritonoranella*	*latitudo*	CONCALIS	DW2932	19°05'S	163°30'E	215-225	TONO299-20	JX241425
MNHN-IM-2009-22265	1	*Bursa*	*rosa*	INHACA 2011	MM18	26°03.5'S	32°52.9'E	0-1	TONO301-20	MT520053
MNHN-IM-2009-22268	1	*Bursa*	*rosa*	INHACA 2011	MR27	26°06.3'S	32°58.0'E	17	TONO302-20	MT519937
MNHN-IM-2009-23292	1	*Dulcerana*	*granularis*	INHACA 2011	MM2	26°02.5'S	32°53.5'E	0-1	TONO124-17	MF124212
MNHN-IM-2009-23302	1	*Dulcerana*	*granularis*	INHACA 2011	MR4	26°06.3'S	32°58.0'E	17-19	TONO125-17	MF124240
MNHN-IM-2009-23312	1	*Dulcerana*	*elisabettae*	WESTERN AUSTRALIA 2011	WA20	35°04,54'S	117°58,35'E	4-12	TONO143-17	MF124238
MNHN-IM-2009-23319	1	*Dulcerana*	*elisabettae*	WESTERN AUSTRALIA 2011	WA17	35°06,46'S	118°01,28'E	20	TONO144-17	MF124184
MNHN-IM-2009-23322	1	*Dulcerana*	*elisabettae*	WESTERN AUSTRALIA 2011	WA20	35°04,54'S	117°58,35'E	4-12	TONO126-17	MF124233
MNHN-IM-2009-24728	1	*Dulcerana*	*granularis*	INHACA 2011	MM4	26°03.7'S	32°54.8'E	0-1	TONO300-20	MT519983
MNHN-IM-2009-28423	1	*Korrigania*	*quirihorai*	EXBODI	DW3855	22°19'S	168°41'E	340-345	TONO303-20	MT520024

MNHN-IM-2009-28425	1	*Korrigania*	*quirihorai*	EXBODI	DW3896	22°19'S	168°41'E	340-343	TONO304-20	MT519964
MNHN-IM-2009-28426	1	*Korrigania*	*quirihorai*	EXBODI	DW3855	22°19'S	168°41'E	340-345	TONO305-20	MT519976
MNHN-IM-2009-28427	1	*Tritonoranella*	*latitudo*	EXBODI	DW3857	22°18'S	168°42'E	342	TONO306-20	MT520039
MNHN-IM-2009-28428	1	*Korrigania*	*quirihorai*	EXBODI	DW3896	22°19'S	168°41'E	340-343	TONO307-20	MT520048
MNHN-IM-2009-28431	1	*Korrigania*	*quirihorai*	EXBODI	CP3788	22°13'S	167°07'E	264-273	TONO308-20	MT520047
MNHN-IM-2009-28432	1	*Korrigania*	*quirihorai*	EXBODI	CP3898	22°18'S	168°42'E	340-346	TONO309-20	MT520077
MNHN-IM-2009-28434	1	*Korrigania*	*quirihorai*	EXBODI	DW3896	22°19'S	168°41'E	340-343	TONO310-20	MT519996
MNHN-IM-2009-28435	1	*Korrigania*	*quirihorai*	EXBODI	DW3896	22°19'S	168°41'E	340-343	TONO311-20	MT519998
MNHN-IM-2009-28439	1	*Korrigania*	*quirihorai*	EXBODI	DW3896	22°19'S	168°41'E	340-343	TONO312-20	MT520066
MNHN-IM-2009-28440	1	*Korrigania*	*quirihorai*	EXBODI	CP3898	22°18'S	168°42'E	340-346	TONO313-20	MT520068
MNHN-IM-2009-28441	1	*Korrigania*	*quirihorai*	EXBODI	DW3896	22°19'S	168°41'E	340-343	TONO314-20	MT520031
MNHN-IM-2009-28442	1	*Korrigania*	*quirihorai*	EXBODI	CP3788	22°13'S	167°07'E	264-273	TONO315-20	MT520042
MNHN-IM-2009-28443	1	*Korrigania*	*quirihorai*	EXBODI	DW3784	22°13'S	167°09'E	353-365	TONO316-20	MT519929
MNHN-IM-2009-28444	1	*Korrigania*	*quirihorai*	EXBODI	DW3855	22°19'S	168°41'E	340-345	TONO317-20	MT519957
MNHN-IM-2009-28447	1	*Korrigania*	*quirihorai*	EXBODI	CP3898	22°18'S	168°42'E	340-346	TONO318-20	MT520055
MNHN-IM-2009-28448	1	*Korrigania*	*quirihorai*	EXBODI	DW3855	22°19'S	168°41'E	340-345	TONO319-20	MT519948
MNHN-IM-2009-28449	1	*Korrigania*	*quirihorai*	EXBODI	DW3784	22°13'S	167°09'E	353-365	TONO320-20	MT519939
MNHN-IM-2009-28450	1	*Korrigania*	*quirihorai*	EXBODI	DW3900	22°17'S	168°41'E	355-357	TONO321-20	MT520049
MNHN-IM-2009-28451	1	*Korrigania*	*quirihorai*	EXBODI	DW3900	22°17'S	168°41'E	355-357	TONO322-20	MT520073
MNHN-IM-2009-28455	1	*Korrigania*	*quirihorai*	EXBODI	CP3789	22°11'S	167°07'E	335-350	TONO323-20	MT520019
MNHN-IM-2009-28456	1	*Korrigania*	*quirihorai*	EXBODI	DW3928	18°38'S	164°20'E	362-402	TONO324-20	MT519981
MNHN-IM-2009-28457	1	*Korrigania*	*quirihorai*	EXBODI	DW3900	22°17'S	168°41'E	355-357	TONO325-20	MT520025
MNHN-IM-2009-28459	1	*Korrigania*	*quirihorai*	EXBODI	DW3896	22°19'S	168°41'E	340-343	TONO326-20	MT520032
MNHN-IM-2009-28463	1	*Tritonoranella*	*latitudo*	EXBODI	DW3855	22°19'S	168°41'E	340-345	TONO327-20	MT519977
MNHN-IM-2009-28464	1	*Tritonoranella*	*latitudo*	EXBODI	DW3855	22°19'S	168°41'E	340-345	TONO328-20	MT520038
MNHN-IM-2009-28465	1	*Tritonoranella*	*latitudo*	EXBODI	DW3896	22°19'S	168°41'E	340-343	TONO329-20	MT519975
MNHN-IM-2009-28466	1	*Tritonoranella*	*latitudo*	EXBODI	DW3855	22°19'S	168°41'E	340-345	TONO330-20	MT520001
MNHN-IM-2009-28467	1	*Tritonoranella*	*latitudo*	EXBODI	DW3855	22°19'S	168°41'E	340-345	TONO331-20	MT519970
MNHN-IM-2009-28468	1	*Korrigania*	*fijiensis*	EXBODI	DW3785	22°15'S	167°10'E	386-387	TONO332-20	MT520008

MNHN-IM-2009-28471	1	*Korrigania*	*fijiensis*	EXBODI	DW3785	22°15'S	167°10'E	386-387	TONO333-20	MT520029
MNHN-IM-2009-28472	1	*Korrigania*	*fijiensis*	EXBODI	DW3930	18°37'S	164°26'E	448-464	TONO334-20	MT519969
MNHN-IM-2009-28473	1	*Talisman*	*corrugata*			01°39.0' N	07°17.7' E	4-8	TONO335-20	MT520078
MNHN-IM-2009-28475	1	*Korrigania*	*quirihorai*	EXBODI	DW3855	22°19'S	168°41'E	340-345	TONO336-20	MT519946
MNHN-IM-2009-28476	1	*Korrigania*	*quirihorai*	EXBODI	DW3855	22°19'S	168°41'E	340-345	TONO337-20	MT519944
MNHN-IM-2009-5146	1,2,4	*Lampasopsis*	*lucaensis*	MAINBAZA	DW3168	26°12'S	35°03'E	87-90	TONO284-20	MT520064
MNHN-IM-2009-5147	1	*Lampasopsis*	*lucaensis*	MAINBAZA	DW3168	26°12'S	35°03'E	87-90	TONO050-12	JX241426
MNHN-IM-2009-5148	1	*Dulcerana*	*granularis*	MAINBAZA	DW3168	26°12'S	35°03'E	87-90	TONO057-12	JX241427
MNHN-IM-2009-5149	1,2,4	*Tritonoranella*	*ranelloides*	MAINBAZA	CP3144	23°33'S	35°41'E	171-180	TONO082-12	JX241428
MNHN-IM-2009-5149	1	*Tritonoranella*	*ranelloides*	MAINBAZA	CP3144	23°33'S	35°41'E	171-180	TONO082-12	JX241428
MNHN-IM-2009-5454	1	*Korrigania*	*quirihorai*	CONCALIS	DW2973	18°14'S	163°06'E	275-288	TONO003-12	JX241430
MNHN-IM-2009-5455	1	*Korrigania*	*quirihorai*	CONCALIS	DW2973	18°14'S	163°06'E	275-288	TONO055-12	JX241431
MNHN-IM-2009-5457	1	*Tritonoranella*	*latitudo*	CONCALIS	DW2932	19°05'S	163°30'E	215-225	TONO073-12	MT520043
MNHN-IM-2009-5458	1	*Korrigania*	*fijiensis*	CONCALIS	DW2995	18°00'S	163°04'E	450-495	TONO088-12	JX241432
MNHN-IM-2009-5459	1,2,3,4	*Korrigania*	*fijiensis*	CONCALIS	DW2995	18°00'S	163°04'E	450-495	TONO074-12	JX241433
MNHN-IM-2009-5460	1	*Korrigania*	*fijiensis*	CONCALIS	DW2995	18°00'S	163°04'E	450-495	TONO089-12	JX241434
MNHN-IM-2009-5461	1	*Korrigania*	*fosteri*	CONCALIS	DW2932	19°05'S	163°30'E	215-225	TONO040-12	JX241435
MNHN-IM-2009-5463	1	*Tritonoranella*	*latitudo*	CONCALIS	DW2949	19°00'S	163°28'E	261-272	TONO012-12	JX241436
MNHN-IM-2009-5466	1	*Korrigania*	*quirihorai*	CONCALIS	CC2929	19°56.5'S	163°50.1'E	28-30	TONO046-12	JX241437
MNHN-IM-2009-7246	1	*Bursina*	*ignobilis*	MIRIKY	DW3244	14° 54,67' S	46° 55,54' E	58-87	TONO296-20	MT520018
MNHN-IM-2009-7249	2,4	*Bursina*	*margaritula*	MIRIKY	CP3288	14° 31,9' S	47° 26,54' E	46-54	TONO286-20	
MNHN-IM-2009-7250	1,2,4	*Bursina*	*ignobilis*	MIRIKY	DW3244	14° 54,67' S	46° 55,54' E	58-87	TONO297-20	MT520014
MNHN-IM-2009-7251	1	*Bursina*	*gnorima*	MIRIKY	CP3260	15°35'S	45°45'E	179-193	TONO378-20	MT519933
MNHN-IM-2009-7252	1	*Bursina*	*gnorima*	MIRIKY	CP3241	14°30'S	47°27'E	274-325	TONO221-18	MH581305
MNHN-IM-2009-7260	2,4	*Bursina*	*gnorima*	MIRIKY	CP3208	12°41'S	48°17'E	231-237	TONO047-12	
MNHN-IM-2013-10059	1	*Bursa*	*tuberosissima*	PAPUA NIUGINI	PR214			1-8	TONO344-20	MT520058
MNHN-IM-2013-10139	3,4	*Tutufa*	*rubeta*	PAPUA NIUGINI	PR02	05°12,1'S	145°49,3'E	15-17		
MNHN-IM-2013-10178	1,2,4	*Tutufa*	*rubeta*	PAPUA NIUGINI	PR04	05°10,1'S	145°50,5'E	30	TONO345-20	MT519945
MNHN-IM-2013-10179	1	*Tutufa*	*rubeta*	PAPUA NIUGINI	PR04	05°10,1'S	145°50,5'E	30	TONO346-20	MT520040

MNHN-IM-2013-10236	1,2,4	*Bursa*	*tuberosissima*	PAPUA NIUGINI	PR04	05°10,1'S	145°50,5'E	30	TONO339-20	MT520033
MNHN-IM-2013-10488	1	*Tutufa*	*rubeta*	PAPUA NIUGINI	PR01	05°11,3'S	145°49,4'E	22	TONO340-20	MT520067
MNHN-IM-2013-10813	1	*Tutufa*	*rubeta*	PAPUA NIUGINI	PR04	05°10,1'S	145°50,5'E	30	TONO341-20	MT520026
MNHN-IM-2013-10855	1	*Tutufa*	*rubeta*	PAPUA NIUGINI	PR05	05°11,3'S	145°49,6'E	-	TONO342-20	MT520062
MNHN-IM-2013-11041	1	*Dulcerana*	*affinis*	PAPUA NIUGINI	PR08	05°09,9'S	145°50,4'E	22	TONO128-17	MF124209
MNHN-IM-2013-11042	used only for reference	*Lamapsopsis*	*rhodostoma*	PAPUA NIUGINI	PR08	05°09,9'S	145°50,4'E	22		
MNHN-IM-2013-11043	2,3,4	*Lamapsopsis*	*rhodostoma*	PAPUA NIUGINI	PR08	05°09,9'S	145°50,4'E	22	TONO343-20	
MNHN-IM-2013-11468	1	*Dulcerana*	*affinis*	PAPUA NIUGINI	PFM01	05°11'S	145°48,1'E	2	TONO139-17	MF124191
MNHN-IM-2013-11544	1	*Bursa*	*tuberosissima*	PAPUA NIUGINI	PR13	05°12,3'S	145°48,8'E	8-10	TONO350-20	MT520061
MNHN-IM-2013-11598	1	*Dulcerana*	*affinis*	PAPUA NIUGINI	PM12	05°00,2'S	145°47,6'E	0-1	TONO133-17	MF124217
MNHN-IM-2013-11738	1	*Tutufa*	*rubeta*	PAPUA NIUGINI	PB11	05°12,5'S	145°49,1'E	13	TONO351-20	MT519962
MNHN-IM-2013-11859	1	*Bursa*	*tuberosissima*	PAPUA NIUGINI	PR15	05°17,9'S	145°46,7'E	21	TONO352-20	MT520023
MNHN-IM-2013-12023	1	*Bursa*	*tuberosissima*	PAPUA NIUGINI	PR16	05°12,5'S	145°49,1'E	13	TONO353-20	MT520069
MNHN-IM-2013-12072	1	*Bursa*	*tuberosissima*	PAPUA NIUGINI	PR18	05°10,9'S	145°48'E	0-2	TONO354-20	MT520044
MNHN-IM-2013-12098	1	*Bursa*	*tuberosissima*	PAPUA NIUGINI	PB12	05°11,8'S	145°48,8'E	7-15	TONO355-20	MT520036
MNHN-IM-2013-12297	1	*Bursa*	*tuberosissima*	PAPUA NIUGINI	PM12	05°00,2'S	145°47,6'E	0-1	TONO356-20	MT520052
MNHN-IM-2013-12462	1,2,4	*Lampasopsis*	*cruentata*	PAPUA NIUGINI	PR20	05°17,8'S	145°46,9'E	22	TONO357-20	MT520059
MNHN-IM-2013-12519	1	*Tutufa*	*rubeta*	PAPUA NIUGINI	PB14	05°13,8'S	145°48'E	15	TONO358-20	MT519985
MNHN-IM-2013-12827	1	*Dulcerana*	*affinis*	PAPUA NIUGINI	PR27	05°04,7'S	145°48,8'E	7	TONO134-17	MF124248
MNHN-IM-2013-12981	1	*Dulcerana*	*affinis*	PAPUA NIUGINI	PR29	05°05,6'S	145°49,4'E	-	TONO135-17	MF124228
MNHN-IM-2013-12992	1	*Lampasopsis*	*cruentata*	PAPUA NIUGINI	PR29	05°05,6'S	145°49,4'E	-	TONO359-20	MT520045
MNHN-IM-2013-13150	1	*Bursa*	*tuberosissima*	PAPUA NIUGINI	PR35	05°06,3'S	145°49,3'E	-	TONO360-20	MT519941
MNHN-IM-2013-13449	3,4	*Bursa*	*lamarckii*	PAPUA NIUGINI	PM25	05°01,1'S	145°47,9'E		TONO361-20	
MNHN-IM-2013-13452	1	*Bursa*	*lamarckii*	PAPUA NIUGINI	PM25	05°01,1'S	145°47,9'E	-	TONO362-20	MT519999
MNHN-IM-2013-13756	1	*Bursa*	*tuberosissima*	PAPUA NIUGINI	PM25	05°01,1'S	145°47,9'E	-	TONO363-20	MT520010
MNHN-IM-2013-14088	1	*Bursa*	*tuberosissima*	PAPUA NIUGINI	PR62	05°02,2'S	145°48,4'E	-	TONO364-20	MT519960
MNHN-IM-2013-14386	1,2,4	*Tutufa*	*bubo*	PAPUA NIUGINI	PR67	05°01,6'S	145°48,1'E	-	TONO365-20	MT519980
MNHN-IM-2013-14727	1	*Bursa*	*tuberosissima*	PAPUA NIUGINI	PM12	05°00,2'S	145°47,6'E	0-1	TONO366-20	MT519953

MNHN-IM-2013-14733	1	*Dulcerana*	*affinis*	PAPUA NIUGINI	PM12	05°00,2'S	145°47,6'E	0-1	TONO136-17	MF124213
MNHN-IM-2013-14749	1	*Bursa*	*tuberosissima*	PAPUA NIUGINI	PM12	05°00,2'S	145°47,6'E	0-1	TONO367-20	MT519997
MNHN-IM-2013-14779	1	*Tutufa*	*rubeta*	PAPUA NIUGINI	PB26	04°59,1'S	145°47,7'E	22	TONO368-20	MT519971
MNHN-IM-2013-14970	1	*Bursa*	*tuberosissima*	PAPUA NIUGINI	PB27	05°03,9'S	145°48,8'E	12	TONO369-20	MT520009
MNHN-IM-2013-15499	1	*Lampasopsis*	*rhodostoma*	PAPUA NIUGINI	PR107	05°10,2'S	145°50,4'E	17	TONO370-20	MT520050
MNHN-IM-2013-15805	1	*Bursa*	*lamarckii*	PAPUA NIUGINI	PR115	05°18'S	145°46,1'E	17	TONO371-20	MT519942
MNHN-IM-2013-16045	1	*Tutufa*	*rubeta*	PAPUA NIUGINI	PB34	05°07,1'S	145°49,4'E	15	TONO372-20	MT520002
MNHN-IM-2013-16520	1	*Bursa*	*lamarckii*	PAPUA NIUGINI	PR128	05°18'S	145°46,7'E	0-30	TONO373-20	MT519934
MNHN-IM-2013-17422	1	*Bursa*	*tuberosissima*	PAPUA NIUGINI	PD66	05°15,5'S	145°47,3'E	26	TONO374-20	MT519935
MNHN-IM-2013-18014	1	*Bursa*	*tuberosissima*	PAPUA NIUGINI	PR203	05°10,3'S	145°48,5'E	1-19	TONO375-20	MT519974
MNHN-IM-2013-18064	1	*Bursa*	*tuberosissima*	PAPUA NIUGINI	PR211	05°15,5'S	145°47,3'E	-	TONO376-20	MT520003
MNHN-IM-2013-18273	1	*Lampasopsis*	*cruentata*	PAPUA NIUGINI	PB47	05°11,3'S	145°49,6'E	5	TONO377-20	MT520005
MNHN-IM-2013-18934	1	*Bursa*	*gnorima*	PAPUA NIUGINI	CP4053	03°03'S	142°19'E	300-308	TONO406-20	MT519956
MNHN-IM-2013-18935	1	*Bursa*	*gnorima*	PAPUA NIUGINI	CP4053	03°03'S	142°19'E	300-308	TONO408-20	MT520056
MNHN-IM-2013-18936	1	*Bursa*	*gnorima*	PAPUA NIUGINI	CP4053	03°03'S	142°19'E	300-308	TONO405-20	MT520037
MNHN-IM-2013-18937	1	*Bursa*	*gnorima*	PAPUA NIUGINI	CP4053	03°03'S	142°19'E	300-308	TONO404-20	MT519958
MNHN-IM-2013-18938	1,2,4	*Bursa*	*gnorima*	PAPUA NIUGINI	CP4053	03°03'S	142°19'E	300-308	TONO407-20	MT519979
MNHN-IM-2013-19029	1	*Bursa*	*gnorima*	PAPUA NIUGINI	CP4054	03°03'S	142°20'E	380-384	TONO409-20	MT520020
MNHN-IM-2013-19062	1	*Bursa*	*gnorima*	PAPUA NIUGINI	CP4053	03°03'S	142°19'E	300-308	TONO410-20	MT519989
MNHN-IM-2013-19491	1	*Dulcerana*	*cubaniana*	KARUBENTHOS 2012	GR37	16°30,04'N	61°28,79'W	16	TONO142-17	MF124250
MNHN-IM-2013-19496	1	*Dulcerana*	*cubaniana*	KARUBENTHOS 2012	GR33	16°22,88'N	61°31,43'W	9	TONO138-17	MF124199
MNHN-IM-2013-19596	1	*Dulcerana*	*cubaniana*	KARUBENTHOS 2012	GM09	16°05,44'N	61°46,02'W	1	TONO131-17	MF124201
MNHN-IM-2013-20121	1	*Dulcerana*	*cubaniana*	KARUBENTHOS 2012	GM07	16°10,45'N	61°46,78'W	1	TONO129-17	MF124185
MNHN-IM-2013-20184	1	*Dulcerana*	*cubaniana*	KARUBENTHOS 2012	GM09	16°05,44'N	61°46,02'W	1	TONO137-17	MF124190
MNHN-IM-2013-20247	1	*Dulcerana*	*cubaniana*	KARUBENTHOS 2012	GR13	16°07,61'N	61°46,53'W	11	TONO130-17	MF124204
MNHN-IM-2013-20452	1	*Lampasopsis*	*thomae*	KARUBENTHOS 2012	GB02	16°21,97'N	61°37,98'W	11	TONO266-18	MH581304
MNHN-IM-2013-52966	1	*Lampasopsis*	*cruentata*	TUHAA PAE 2013	ARU02	22°26,5'S	151°20,5'W	19	TONO411-20	MT519995
MNHN-IM-2013-52974	1	*Bursa*	*bufonia*	PAKAIHI I TE MOANA	MQ16 M	10°27,84'S	138°39,97'W	0-1	TONO412-20	MT520054
MNHN-IM-2013-52977	1,2,4	*Bursa*	*bufonia*	PAKAIHI I TE MOANA	MQ16 M	10°27,84'S	138°39,97'W	0-1	TONO413-20	MT520057

MNHN-IM-2013-52978	1	*Bursa*	*bufonia*	PAKAIHI I TE MOANA	MQ16 M	10°27,84'S	138°39,97'W	0-1	TONO414-20	MT519943
MNHN-IM-2013-52979	1,2,4	*Bursa*	*bufonia*	PAKAIHI I TE MOANA	MQ16 M	10°27,84'S	138°39,97'W	0-1	TONO415-20	MT519972
MNHN-IM-2013-52980	1	*Bursa*	*bufonia*	PAKAIHI I TE MOANA	MQ16 M	10°27,84'S	138°39,97'W	0-1	TONO416-20	MT519931
MNHN-IM-2013-52981	1,2,3,4	*Korrigania*	*quirihorai*	EXBODI	CP3898	22°18'S	168°42'E	340-346	TONO417-20	MT519951
MNHN-IM-2013-52982	1,2,4	*Tritonoranella*	*latitudo*	EXBODI	DW3855	22°19'S	168°41'E	340-345	TONO418-20	MT520060
MNHN-IM-2013-52984	1	*Korrigania*	*quirihorai*	EXBODI	CP3856	22°19'S	168°41'E	338	TONO419-20	MT520063
MNHN-IM-2013-52985	1	*Korrigania*	*quirihorai*	EXBODI	CP3898	22°18'S	168°42'E	340-346	TONO420-20	MT519966
MNHN-IM-2013-52986	1	*Tritonoranella*	*latitudo*	EXBODI	DW3867	22°52'S	169°26'E	146-610	TONO421-20	MT519961
MNHN-IM-2013-52987	1,2,4	*Tritonoranella*	*latitudo*	EXBODI	DW3855	22°19'S	168°41'E	340-345	TONO422-20	MT519930
MNHN-IM-2013-52988	1	*Tritonoranella*	*latitudo*	EXBODI	DW3855	22°19'S	168°41'E	340-345	TONO423-20	MT519938
MNHN-IM-2013-52990	1	*Korrigania*	*quirihorai*	EXBODI	DW3896	22°19'S	168°41'E	340-343	TONO424-20	MT520011
MNHN-IM-2013-52996	1	*Bursa*	*rosa*	PAKAIHI I TE MOANA	MQ11 II 01	08°55,8'S	140°13,6'W	38	TONO425-20	MT519959
MNHN-IM-2013-52997	1	*Dulcerana*	*affinis*	PAKAIHI I TE MOANA	MQ11 II 01	08°55,8'S	140°13,6'W	38	TONO145-17	MF124220
MNHN-IM-2013-52998	1	*Dulcerana*	*affinis*	PAKAIHI I TE MOANA	MQ11 II 01	08°55,8'S	140°13,6'W	38	TONO146-17	MF124183
MNHN-IM-2013-52999	1	*Lampasopsis*	*cruentata*	PAKAIHI I TE MOANA	MQ1 GR	08°56,21'S	140°05,45'W	8-10	TONO426-20	MT520076
MNHN-IM-2013-53005	1	*Lampasopsis*	*cruentata*	PAKAIHI I TE MOANA	MQ2 GR	08°56,23'S	140°07,24'W	20-23	TONO427-20	MT519993
MNHN-IM-2013-53006	1	*Lampasopsis*	*cruentata*	PAKAIHI I TE MOANA	MQ11 II 09	07°54,3'S	140°34,1'W	28	TONO428-20	MT519987
MNHN-IM-2013-53008	1	*Lampasopsis*	*cruentata*	PAKAIHI I TE MOANA	MQ24 R	09°23,71'S	140°07,76'W	6-12	TONO429-20	MT520013
MNHN-IM-2013-53009	1	*Lampasopsis*	*cruentata*	PAKAIHI I TE MOANA	MQ11 II 04	08°48,2'S	140°03,1'W	28	TONO430-20	MT519973
MNHN-IM-2013-53010	1	*Gen.*	*sp.*	PAKAIHI I TE MOANA	MQ11 II 01	08°55,8'S	140°13,6'W	38	TONO431-20	MT519949
MNHN-IM-2013-53012	1	*Lampasopsis*	*cruentata*	PAKAIHI I TE MOANA	MQ11 II 13	08°55,4'S	140°01,2'W	36	TONO432-20	MT519950
MNHN-IM-2013-53013	1,2,4	*Lampasopsis*	*cruentata*	PAKAIHI I TE MOANA	MQ11 II 13	08°55,4'S	140°01,2'W	36	TONO433-20	MT520007
MNHN-IM-2013-53041	1	*Dulcerana*	*granularis*	INHACA 2011	MB6	25°59.5'S	32°54.3'E	2-10	TONO147-17	MF124226
MNHN-IM-2013-56022	1	*Talisman*	*corrugata*	GUYANE 2014	CP4357	06°33,8'N	53°07,8'W	60-61	TONO434-20	MT519988
MNHN-IM-2013-56124	1	*Marsupina*	*bufo*	GUYANE 2014	CP4344	05°08,7'N	51°58,7'W	47	TONO382-20	MT520046
MNHN-IM-2013-56144	1,2,4	*Marsupina*	*bufo*	GUYANE 2014	CP4344	05°08,7'N	51°58,7'W	47	TONO383-20	MT520051
MNHN-IM-2013-57181	3,4	*Marsupina*	*bufo*	ILES DU SALUT	SC09	05°17,5'N	52°35,2'W	7		
MNHN-IM-2013-60314	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4538	16°38'N	61°31'W	320-338	TONO395-20	MT520022
MNHN-IM-2013-60315	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4538	16°38'N	61°31'W	320-338	TONO392-20	MT519955

MNHN-IM-2013-60316	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4538	16°38'N	61°31'W	320-338	TONO389-20	MT520000
MNHN-IM-2013-60317	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4538	16°38'N	61°31'W	320-338	TONO394-20	MT519963
MNHN-IM-2013-60503	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4554	16°21'N	60°56'W	300-370	TONO391-20	MT520012
MNHN-IM-2013-60523	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4555	16°24'N	60°51'W	100-258	TONO388-20	MT520041
MNHN-IM-2013-60560	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4556	16°24'N	60°49'W	367-428	TONO390-20	MT519936
MNHN-IM-2013-60561	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4556	16°24'N	60°49'W	367-428	TONO386-20	MT520006
MNHN-IM-2013-60671	1,2,4	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4566	16°21'N	60°51'W	165-260	TONO385-20	MT520028
MNHN-IM-2013-60752	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4573	16°20'N	60°55'W	389-413	TONO393-20	MT520015
MNHN-IM-2013-60753	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4573	16°20'N	60°55'W	389-413	TONO387-20	MT520035
MNHN-IM-2013-61153	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4612	16°20'N	60°51'W	250-290	TONO402-20	MT519952
MNHN-IM-2013-61187	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4615	16°23'N	60°50'W	226-270	TONO396-20	MT519990
MNHN-IM-2013-61199	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4615	16°23'N	60°50'W	226-270	TONO398-20	MT519932
MNHN-IM-2013-61200	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4615	16°23'N	60°50'W	226-270	TONO384-20	MT520070
MNHN-IM-2013-61365	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4634	15°48'N	61°26'W	304-310	TONO401-20	MT520004
MNHN-IM-2013-61366	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4634	15°48'N	61°26'W	304-310	TONO399-20	MT519982
MNHN-IM-2013-61367	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4634	15°48'N	61°26'W	304-310	TONO400-20	MT520075
MNHN-IM-2013-61368	1	*Tritonoranella*	*ranelloides*	KARUBENTHOS 2015	DW4634	15°48'N	61°26'W	304-310	TONO397-20	MT520065
MNHN-IM-2013-61403	1	*Tritonoranella*	*latitudo*	KARUBENTHOS 2015	CP4636	15°51'N	61°26'W	262	TONO403-20	MT519967
MNHN-IM-2013-61690	1	*Tutufa*	*tenuigranosa*	ZHONG SHA 2015	CP4135	19°59'N	114°38'E	211-218	TONO381-20	MT520021
MNHN-IM-2013-8179	1	*Lampasopsis*	*thomae*	KARUBENTHOS 2012	GM08	16°07,57'N	61°46,45'W	1	TONO347-20	MT520072
MNHN-IM-2013-8181	1	*Lampasopsis*	*thomae*	KARUBENTHOS 2012	GR13	16°07,61'N	61°46,53'W	11	TONO379-20	MT519954
MNHN-IM-2013-8184	1	*Lampasopsis*	*thomae*	KARUBENTHOS 2012	GR13	16°07,61'N	61°46,53'W	11	TONO380-20	MT520017
MNHN-IM-2013-8185	1	*Lampasopsis*	*thomae*	KARUBENTHOS 2012	GR13	16°07,61'N	61°46,53'W	11	TONO349-20	MT520071
MNHN-IM-2013-8684	1	*Dulcerana*	*cubaniana*	KARUBENTHOS 2012	GR49	16°09,71'N	61°07,73'W	15	TONO132-17	MF124224
MNHN-IM-2013-8776	1,2,4	*Lampasopsis*	*thomae*	KARUBENTHOS 2012	GB08	16°02,38'N	61°45,71'W	17	TONO348-20	MT519984
SBMNH-460303	1,2,4	*Marsupina*	*nana*							MT679995
ZMB-86382-A	2,4	*Talisman*	*scrobilator*	Porto da horta Azores						MT679997
ZMB-86382-B	1,2,4	*Talisman*	*scrobilator*	Porto da horta Azores						MT679996
ZMB-92447	1,2,3,4	*Aspa*	*Marginata*	Mauritania						MT679998

Supp. Tab. 2. Primers for the long range PCRs, including primers designed for the Bursidae. F: forward, R: Reverse. TM: temperature of melting.

Fragment in Fig. 1	Primer name	5'-3' sequence	F/R	TM (°C)	Publication
Frag. 1 F	Folmer_F/L	GGTCAACAAATCATAAAGATATTGG	F	51.1	Folmer et al.,1994
Frag. 4 R	Folmer_R/H	TAAACTTCAGGGTGACCAAAAAATCA	R	51	
Frag. 2 F	MS_12SF4669	GTGCCAGCATCCGCGGTTA	F	61	This study
	MS_16SF6214	CGGTACTCTGACCGTGCAAAGG	F	64	
	MS_16SR6691	AGATAGAAACTGACCTGGCTCACG	R	62,7	
Frag. 1 R	MS_R7937	TATTTACCTAATYTTTAGCTTCCAATGCT	R	58.9	
Frag. 3 F	MS_F9734	ACCTTTGGCTTACAAGACCAATGCT	F	61.3	
Frag. 3 F bis	MS_F9649	TTCCTGGGGACAATTTGTCTTGAAAAC	F	61.9	
Frag. 2 R	MS_R11502	ATTTTATCTTCAACTCCACAGATTGATGT	R	59.6	
	MS_R13295	CCTTAGCATCTTCAGTGCTATGCTC	R	63	
Frag. 4 F	MS_F14405	AGCGAGAAATTTGCATTCGGTTTC	F	59.3	
Frag. 4 F bis	MS_F14480	AATAGAGGCGCCTAGCTGTTAATTAG	F	61.6	
Frag. 3 R	MS_R15004	AGTTAGCAGCCCTGTTTTACTCCAAG	R	63.2	

Supp. Tab. 3. Specimens for which the sequence was used in the various datasets. GB: sequence mined from GenBank, in bold specimen different than the one used for *cox1*.

Genus	*species*	cox-1	16S	12S	28S	H3	Mitogenome
Aspa	*Aspa marginata*	ZMB-92447	-	ZMB-92447	-	ZMB-92447	ZMB-92447
Bufonaria	*Bufonaria perelegans*	IM-2007-43034	**IM-2007-43057**	**IM-2007-43057**	**IM-2007-43057**	**IM-2007-43057**	IM-2007-43034
	Bufonaria rana	GB:LSGB-22701	GB:HQ833983	GB:HQ833861	-	GB:HQ834134	-
Talisman	*Talisman scrobilator*	ZMB-86382-B	-	ZMB-86382-B	-	**ZMB-86382-A**	-
Bursa	*Bursa bufonia*	IM-2013-52979	IM-2013-52979	IM-2013-52979	-	**IM-2013-52977**	-
	Bursa cf. *tuberosissima*	IM-2007-43041	IM-2007-43041	IM-2007-43041	-	IM-2007-43041	IM-2007-43041
	Bursa lamarckii	IM-2013-13449	IM-2013-13449	-	**IM-2007-43054**	-	IM-2013-13449
	Bursa rosa	IM-2009-22265	**IM-2007-43045**	IM-2009-22265	**IM-2007-43045**	-	-
	Bursa tuberosissima	IM-2007-43066	IM-2007-43066	IM-2007-43066	IM-2007-43066	**IM-2013-10236**	-
Bursina	*Bursina gnorima*	IM-2013-18938	**IM-2009-7260**	IM-2013-18938	-	IM-2013-18938	-
	Bursina ignobilis	IM-2009-7246	**IM-2007-43052**	IM-2009-7246	**IM-2007-43052**	-	-
	Bursina margaritula	-	-	IM-2009-7249	-	IM-2009-7249	-
Dulcerana	*Dulcerana affinis*	IM-2007-43060	**IM-2007-43042**	IM-2007-43060	IM-2007-43060	IM-2007-43060	-
	Dulcerana cubaniana	IM-2009-23406	**IM-2013-19596**	IM-2009-23406	-	IM-2009-23406	-
	Dulcerana elisabetae	IM-2009-23312	**IM-2009-28474**	-	-	-	-
	Dulcerana granularis	IM-2007-43049	IM-2007-43049	**IM-2007-43070**	IM-2007-43049	IM-2007-43049	-
Korrigania	*Korrigania awatii*	IM-2007-43030	IM-2007-43030	IM-2007-43030	**IM-2007-**	IM-2007-43030	-

					43032		
	Korrigania fijiensis	IM-2009-5459	IM-2009-5459	IM-2009-5459	**IM-2007-43430**	**IM-2009-5458**	IM-2009-5459
	Korrigania fosteri	IM-2007-43048	IM-2007-43048	IM-2007-43048	IM-2007-43048	**IM-2009-22032**	-
	Korrigania quirihorai	IM-2013-52981	IM-2013-52981	IM-2013-52981	**IM-2007-43587**	-	IM-2013-52981
Lampasopsis	*Lampasopsis lucaensis*	IM-2009-5146	**IM-2009-5147**	IM-2009-5146	-	IM-2009-5146	-
	Lampasopsis cruentata	IM-2013-53013	IM-2013-53013	**IM-2013-12462**	-	IM-2013-53013	-
	Lampasopsis rhodostoma	IM-2013-11043	IM-2013-11043	IM-2013-11043	**IM-2007-43068**	**IM-2007-43068**	IM-2013-11043
	Lampasopsis thomae	IM-2013-8776	IM-2013-8776	IM-2013-8776	-	IM-2013-8776	-
Marsupina	*Marsupina bufo*	IM-2013-56144	IM-2013-56144	IM-2013-56144	-	IM-2013-56144	IM-2013-56144
	Marsupina nana	SBMNH-460303		SBMNH-460303	-	-	-
Alanbeuella	*Alanbeuella corrugata*	IM-2009-28473	IM-2009-28473	IM-2009-28473	-	-	-
Tritonoranella	*Tritonoranella latitudo*	IM-2007-43589	IM-2007-43589	**IM-2013-52987**	-	**IM-2013-52982**	-
	Tritonoranella raneloides	IM-2009-5149	IM-2009-5149	**IM-2013-60671**	-	-	-
Tutufa	*Tutufa bubo*	IM-2013-14386	IM-2013-14386	IM-2013-14386	-	IM-2013-14386	-
	Tutufa bufo	IM-2007-43036	IM-2007-43036	IM-2007-43036	IM-2007-43036	-	-
	Tutufa rubeta	IM-2013-10139	IM-2013-10139	IM-2013-10139	-	-	IM-2013-10139
	Tutufa tenuigranosa	IM-2007-43044	IM-2007-43044	IM-2007-43044	-	IM-2007-43044	-
Outgroups	*Galeodea echinophora*	GB:NC-028003.1	GB:NC-028003.1	GB:NC-028003.1	**GB:DQ916482**	**GB:AF033686.1**	GB:NC-028003.1
	Cymatium parthenopeum	GB:NC-013247	GB:NC-013247	GB:NC-013247	-	**GB:HQ834133.1**	GB:NC-013247

Figure Legends

Fig. 1. Position of the primers on the mitogenome of *Lampasopsis rhodostoma*. Blue lines represent the fragments of mtDNA amplified by the long range PCRs. Black lines represent the overlapping sections of the amplified fragments, green lines represent coding genes, red lines represent rRNA genes, clockwise green arrows represent forward primers, counterclockwise green arrows represent revers primers, pink arrows represents tRNA.

Fig. 2. Bayesian phylogram based on a concatenated mitochondrial and nuclear gene dataset (dataset 4) analyzed in Maximum likelihood (ML) with Bayesian analysis (BA) support plotted on the ML topology. Support for nodes is given as Posterior probabilities (PP)/ ultrafast bootstraps (UFBS)/ bootstraps (BS). Figured specimens are sequenced vouchers. Black cartouche show clade found in BI but not in ML with PP written in white. Outgroup branches are not to scale. Scale bar indicates substitution/site.

Fig. 3. Bursid biodiversity evolution through time and relevant paleoenvironmental context. A. Maximum clade credibility chronogram obtained from the Bayesian analyses performed on dataset 4 with *Galeodea echinophora* and *Cymatium parthenopeum* as outgroup (*C. parthenopeum* not shown). Node values are posterior mean ages (Ma), with node bars representing their 95% highest probability density (HPD) intervals. Black * indicates calibrated nodes. Figured fossils are those used for node calibration (see Tab. 2). B. Thermal variations during the Cenozoic. The blue curve represents the benthic foraminiferal oxygen isotopic (d18O) trends through time (reproduced from Cramer *et al*., 2009) d18O is a proxy of the temperature. Geological time scale in million years with abbreviations: Lut, Lutetian, Bar, Bartonian, Pri, Priabonian, Rup, Rupelian, Cha, Chattian, Aqui, Aquitanian, Lan, Langhian, Ser, Serravallian, Tor, Tortonian, Mes, Messinian, Zan, Zanclean, Pia, Piazencian, Pleisto,

Pleistocene. C. Hopping hotspot observed from coral simulated model for three time periods, Eocene, Miocene and Quaternary/current. Diversity values were rescaled between 0 (minimum, pink) and 1 (maximum, green). Reproduced after Leprieur *et al*. (2016).

Supp. Fig. 1: Maximum likelihood phylogram based on partial *cox1* sequences (dataset 1). Bootstrap values are indicated at the nodes. Voucher registration numbers are indicated for each terminal. See Tab. 1 for sources. Scale bar indicates number of nucleotide substitutions per site.

Supp. Fig. 2: Maximum likelihood phylogram based on a concatenated mitochondrial (*cox1*, 12s, 16s) and nuclear gene (28S, H3) dataset (dataset 2), bootstrap frequencies are indicated at the nodes. Scale bar indicates number of nucleotide substitutions per site.

Supp. Fig. 3: Maximum likelihood phylogram based on a concatenated analysis of the 13 protein-coding genes in the mitochondria (dataset 3), ultrafast bootstrap and conventional bootstrap frequencies are indicated at the nodes. Scale bar indicates number of nucleotide substitutions per site.

Supp. Fig. 4: Maximum clade credibility chronograms obtained from Bayesian analysis of the concatenated dataset, calibrated with fossils at the nodes and tips (A), and with node only (B). Time indicated in millions of years. 95% confidence intervals indicated in blue bars.

Graphical abstract

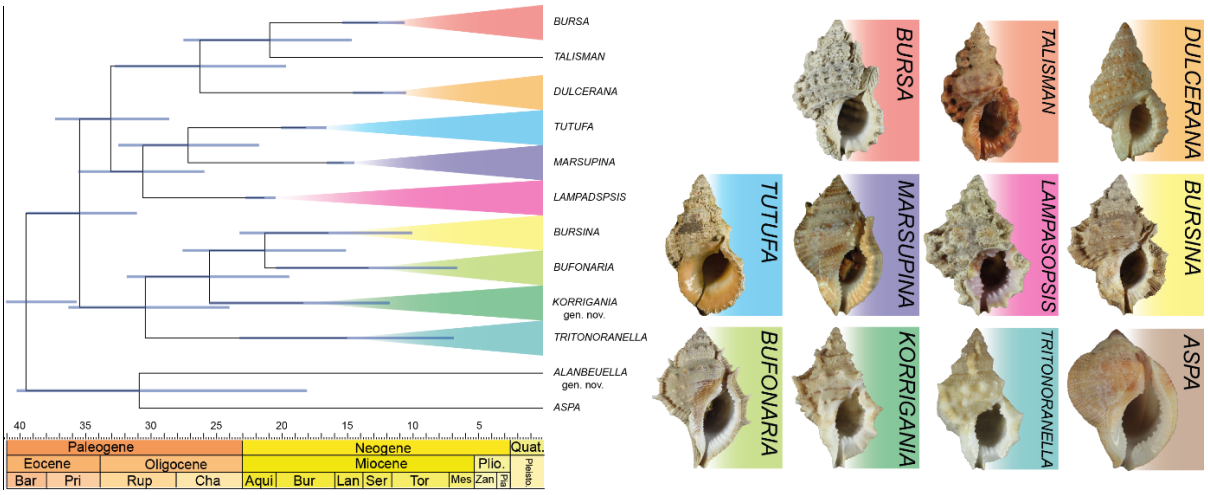


Fig. 1

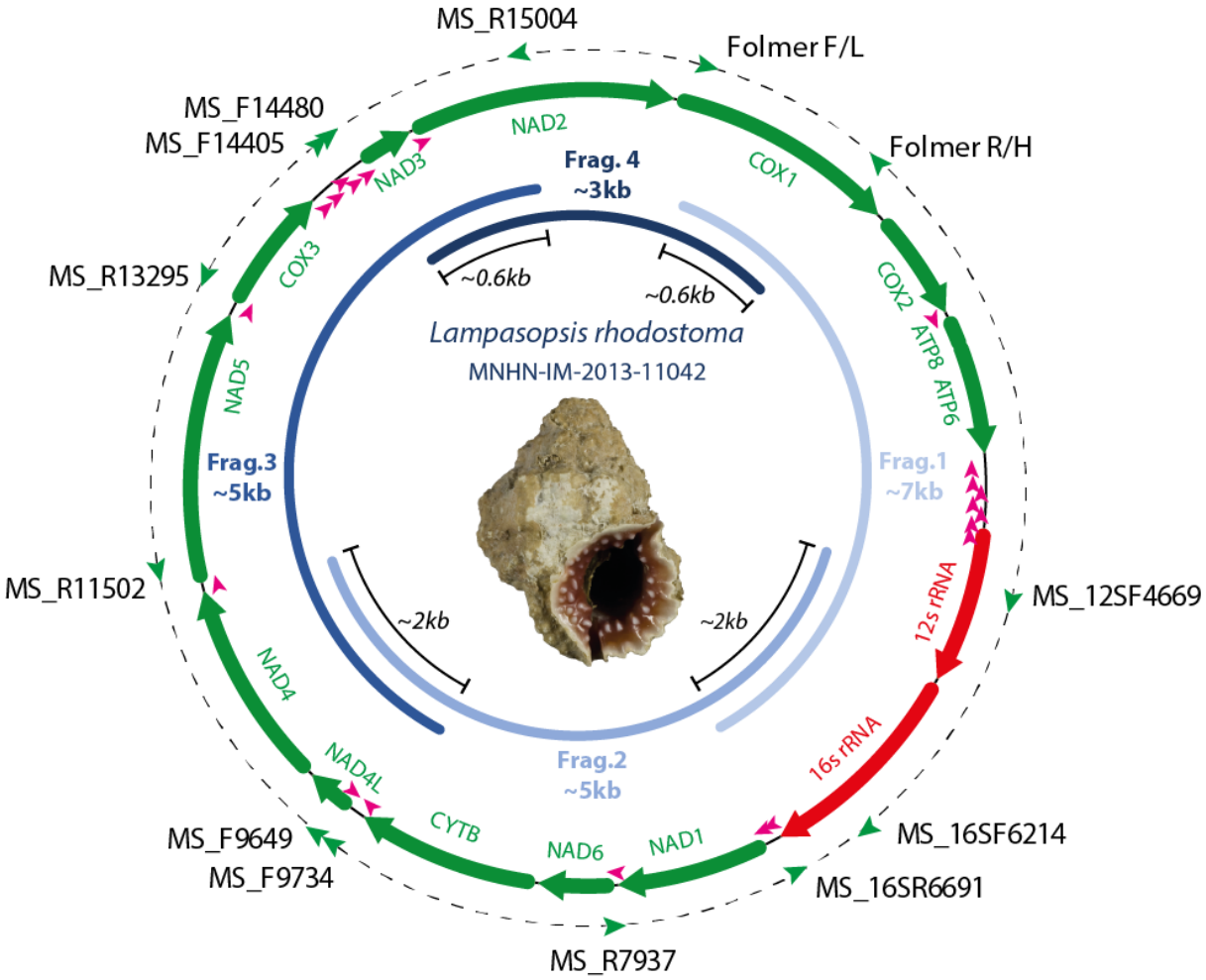

MS_R15004
Folmer F/L
Folmer R/H
MS_12SF4669
MS_16SF6214
MS_16SR6691
MS_R7937
MS_F9649
MS_F9734
MS_R11502
MS_R13295
MS_F14480
MS_F14405
NAD2
COX1
COX2
ATP8
ATP6
12s rRNA
16s rRNA
NAD1
NAD6
CYTB
NAD4L
NAD4
NAD5
COX3
NAD3
Frag. 4
~3kb
Frag.1
~7kb
Frag.2
~5kb
Frag.3
~5kb
~0.6kb
~0.6kb
~2kb
~2kb
Lampasopsis rhodostoma
MNHN-IM-2013-11042

Fig. 2

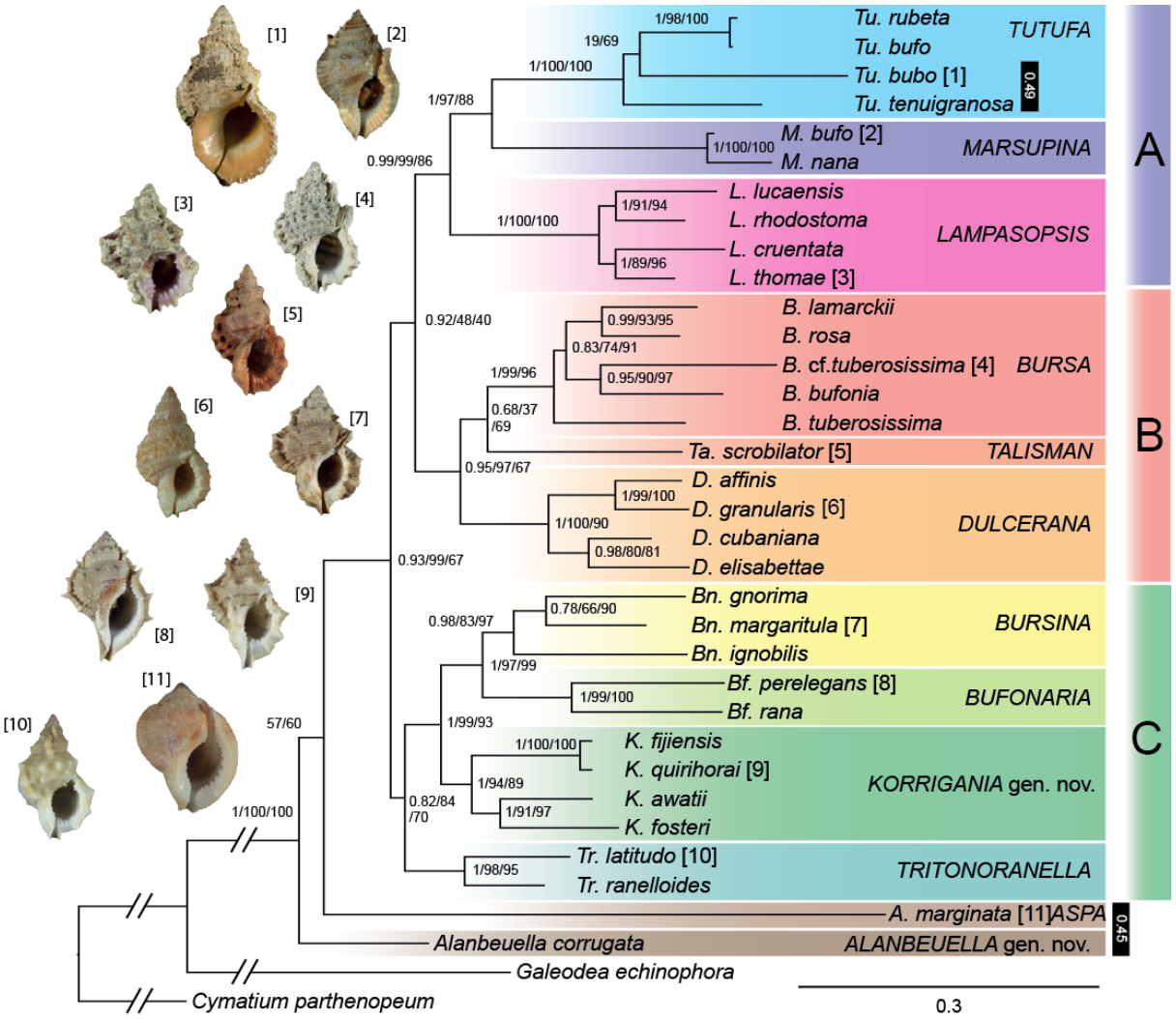
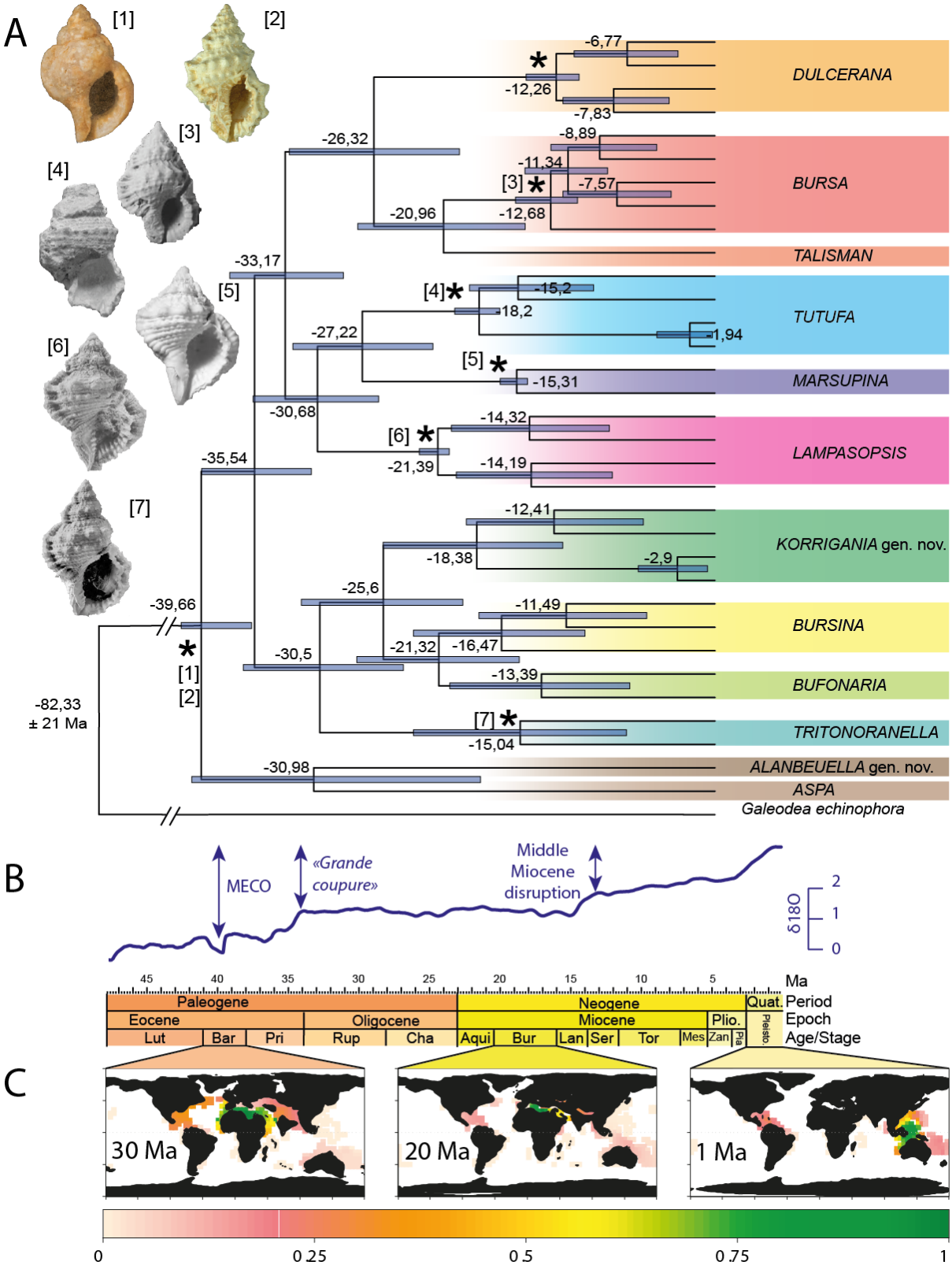
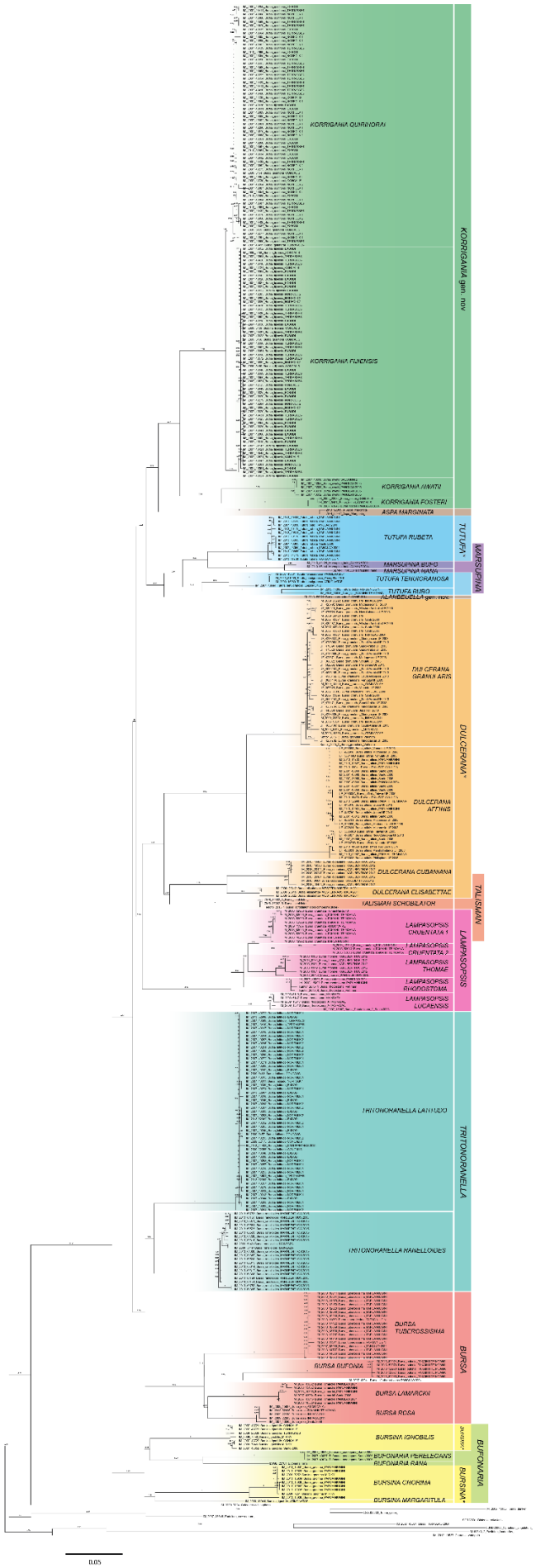

[1]
[2]
[3]
[4]
[5]
[6]
[7]
[8]
[9]
[10]
[11]
1/98/100
19/69
1/100/100
1/97/88
Tu. rubeta
Tu. bufo
Tu. bubo [1]
Tu. tenuigranosa
TUTUFA
0.49
1/100/100
M. bufo [2]
M. nana
MARSUPINA
A
0.99/99/86
1/91/94
1/100/100
L. lucaensis
L. rhodostoma
L. cruentata
L. thomae [3]
LAMPASOPSIS
1/89/96
0.92/48/40
0.99/93/95
0.83/74/91
1/99/96
0.95/90/97
B. lamarckii
B. rosa
B. cf.tuberosissima [4]
B. bufonia
B. tuberosissima
BURSA
0.68/37
/69
Ta. scrobilator [5]
TALISMAN
B
0.95/97/67
1/99/100
1/100/90
0.98/80/81
D. affinis
D. granularis [6]
D. cubaniana
D. elisabettae
DULCERANA
0.93/99/67
0.78/66/90
0.98/83/97
Bn. gnorima
Bn. margaritula [7]
Bn. ignobilis
BURSINA
1/97/99
1/99/100
Bf. perelegans [8]
Bf. rana
BUFONARIA
C
57/60
1/99/93
1/100/100
1/94/89
1/91/97
0.82/84
/70
K. fijiensis
K. quirihorai [9]
K. awatii
K. fosteri
KORRIGANIA gen. nov.
1/100/100
1/98/95
Tr. latitudo [10]
Tr. ranelloides
TRITONORANELLA
A. marginata [11]
ASPA
0.45
Alanbeuella corrugata
ALANBEUELLA gen. nov.
Galeodea echinophora
Cymatium parthenopeum
0.3

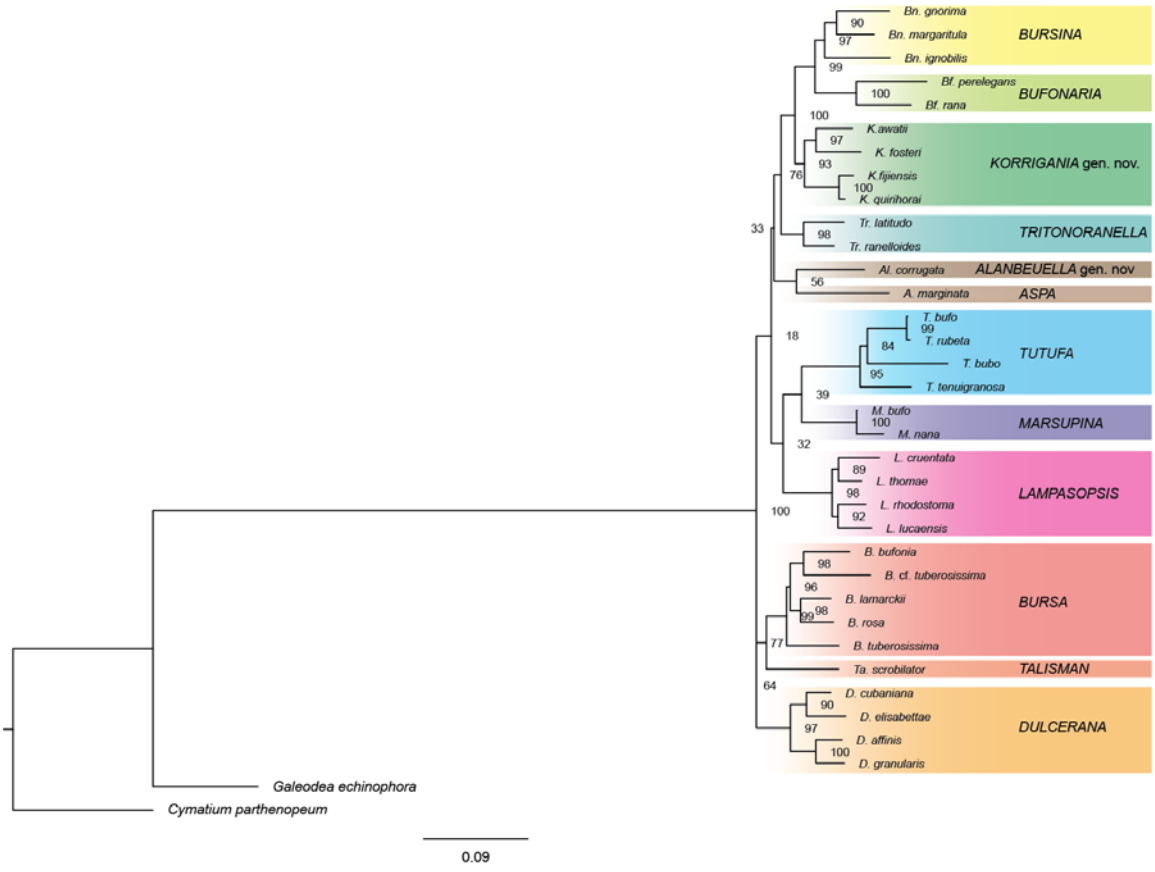
Fig. 3


A
[1]
[2]
[3]
[4]
[5]
[6]
[7]
-6,77
-12,26
-7,83
-8,89
-11,34
-7,57
-12,68
-26,32
-20,96
-33,17
-15,2
-18,2
-1,94
-27,22
-15,31
-30,68
-14,32
-14,19
-21,39
-35,54
-12,41
-18,38
-2,9
-25,6
-39,66
-11,49
-21,32
-16,47
-30,5
-13,39
-15,04
-30,98
-82,33
± 21 Ma
DULCERANA
BURSA
TALISMAN
TUTUFA
MARSUPINA
LAMPASOPSIS
KORRIGANIA gen. nov.
BURSINA
BUFONARIA
TRITONORANELLA
ALANBEUELLA gen. nov.
ASPA
Galeodea echinophora
B
MECO
«Grande coupure»
Middle Miocene disruption
δ18O
2
1
0
45
40
35
30
25
20
15
10
5
Ma
Paleogene
Neogene
Quat.
Period
Eocene
Oligocene
Miocene
Plio.
Epoch
Lut
Bar
Pri
Rup
Cha
Aqui
Bur
Lan
Ser
Tor
Mes
Zan
Pia
Pleisto
Age/Stage
C
30 Ma
20 Ma
1 Ma
0
0.25
0.5
0.75
1

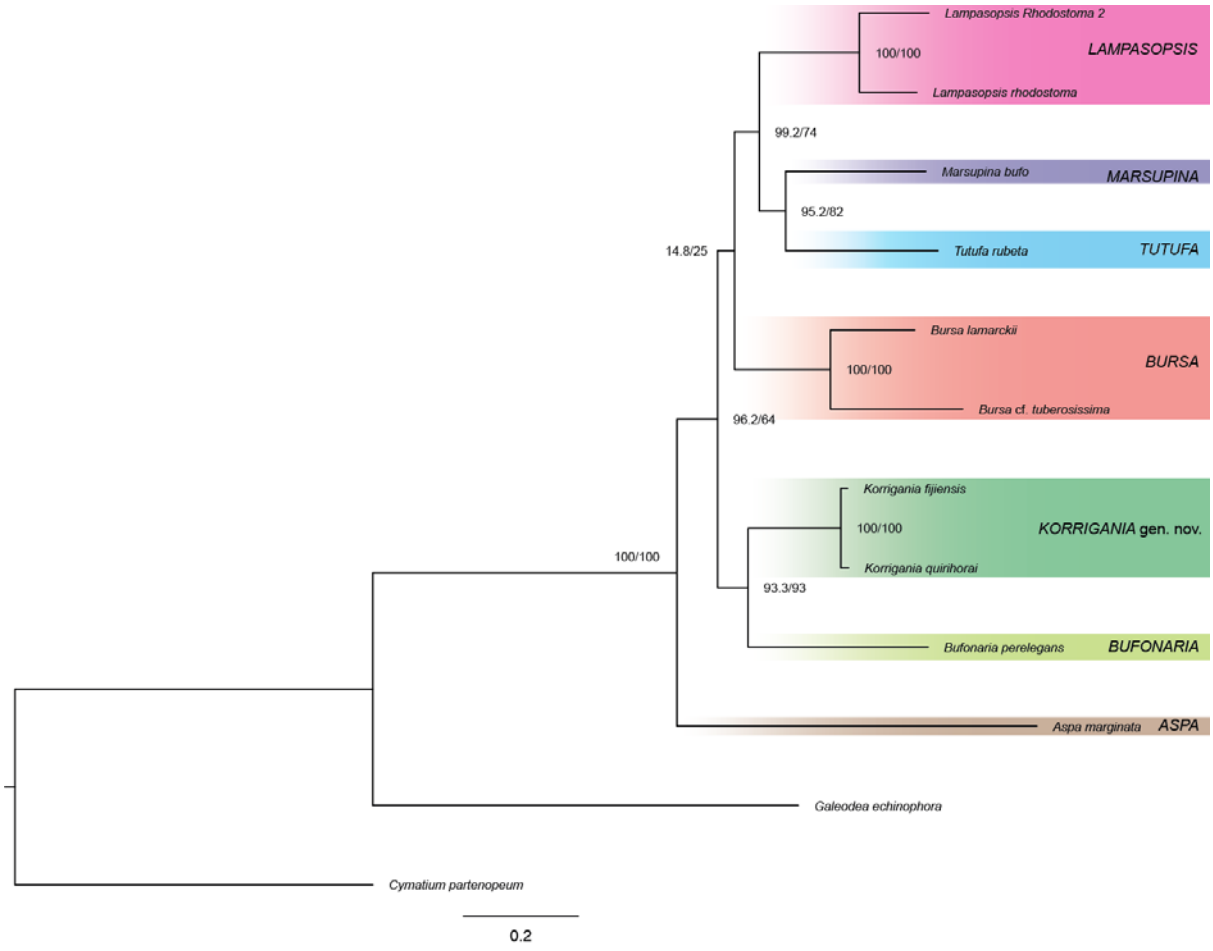
Supp. fig. 1


KORRIGANIA QUIRINORAI
KORRIGANIA FUEGENSIS
KORRIGANIA AWATI
KORRIGANIA FOSTERI
KORRIGANIA gen. nov.
ASPA MARSINATA
TUTUFA RUBETA
TUTUFA*
MARSUPINA RUBRO
MARSUPINA NANA
TUTUFA TENUIGRANOSA
TUTUFA BURO
MARSUPINA
ALAMBEVELLA gen. nov.
DULCERANA GRANULARIS
DULCERANA ORIENTATA 1
DULCERANA ORIENTATA 2
DULCERANA ATTINIS
DULCERANA*
DULCERANA CUBANIANA
DULCERANA CLISAGETTAE
TALISMAN SCHOBLAIOH
TALISMAN
LAMPASOPSIS ORIENTATA 1
LAMPASOPSIS ORIENTATA 2
LAMPASOPSIS THOMAE
LAMPASOPSIS RHODOSTOMA
LAMPASOPSIS LUCANENSIS
LAMPASOPSIS
TRITONORANELLA LATITUDO
TRITONORANELLA NANELLOIDES
TRITONORANELLA
BURSA TUBEROSSISIMA
BURSA BUFONIA
BURSA LAMARCKII
BURSA ROSA
BURSA
BURSINA IGNOBILIS
BUFONARIA HERELEGANS
BUFONARIA RANA
BUFONARIA
BURSINA CINORMA
BURSINA MARGARITULA
BURSINA*
0.05

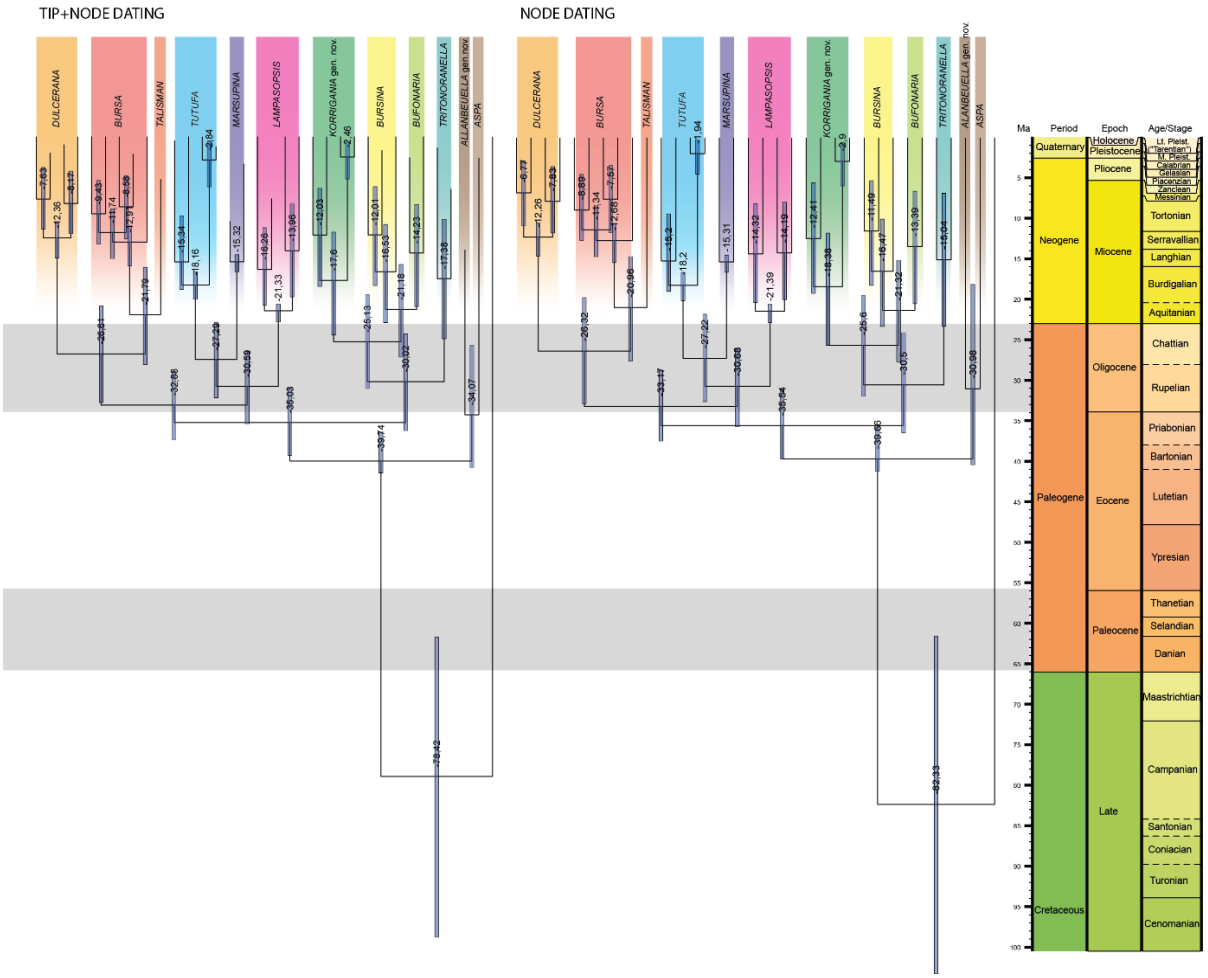
Supp. fig. 2


Bn. gnorima
Bn. margaritula
Bn. ignobilis
BURSINA
Bf. perelegans
Bf. rana
BUFONARIA
K.awatii
K. fosteri
K.fijiensis
K. quirihorai
KORRIGANIA gen. nov.
Tr. latitudo
Tr. ranelloides
TRITONORANELLA
Al. corrugata
ALANBEUELLA gen. nov
A. marginata
ASPA
T. bufo
T. rubeta
T. bubo
T. tenuigranosa
TUTUFA
M. bufo
M. nana
MARSUPINA
L. cruentata
L. thomae
L. rhodostoma
L. lucaensis
LAMPASOPSIS
B. bufonia
B. cf. tuberosissima
B. lamarckii
B. rosa
B. tuberosissima
BURSA
Ta. scrobilator
TALISMAN
D. cubaniana
D. elisabettae
D. affinis
D. granularis
DULCERANA
Galeodea echinophora
Cymatium parthenopeum
0.09

Supp. fig. 3


Lampasopsis Rhodostoma 2
100/100
LAMPASOPSIS
Lampasopsis rhodostoma
99.2/74
Marsupina bufo
MARSUPINA
95.2/82
14.8/25
Tutufa rubeta
TUTUFA
Bursa lamarckii
BURSA
100/100
Bursa cf. tuberosissima
96.2/64
Korrigania fijiensis
100/100
KORRIGANIA gen. nov.
100/100
Korrigania quirihorai
93.3/93
Bufonaria perelegans
BUFONARIA
Aspa marginata
ASPA
Galeodea echinophora
Cymatium parthenopeum
0.2

Supp. fig. 4


TIP+NODE DATING
NODE DATING
DULCERANA
BURSA
TAUSMAN
TUTUFA
MARSUPINA
LAMPASOPSIS
KORRIGANIA gen. nov.
BURSINA
BUFONARIA
TRITONORANELLA
ALLANBEUELLA gen. nov.
ASPA
Ma
Period
Epoch
Age/Stage
Quaternary
Holocene / Pleistocene
Lt. Pleist. (Tarentian)
M. Pleist.
Calabrian
Gelasian
Pliocene
Piacenzian
Zanclean
Messinian
Neogene
Miocene
Tortonian
Serravallian
Langhian
Burdigalian
Aquitanian
Paleogene
Oligocene
Chattian
Rupelian
Eocene
Priabonian
Bartonian
Lutetian
Ypresian
Paleocene
Thanetian
Selandian
Danian
Cretaceous
Late
Maastrichtian
Campanian
Santonian
Coniacian
Turonian
Cenomanian