

The Phylogenetic Position of *Branchamphinome* (Annelida, Amphinomidae) with a Description of a New Species from the North Pacific Ocean

Naoto Jimi^{1,2*}, Natsumi Hookabe³, Kenichiro Tani⁴, Ryuta Yoshida⁵, and Satoshi Imura^{1,6}

¹*National Institute of Polar Research, 10-3 Midori-cho, Tachikawa, Tokyo 190-8518, Japan*

²*Sugashima Marine Biological Laboratory, Graduate School of Science, Nagoya University, 429-63 Sugashima, Toba, Mie 517-0004, Japan*

³*Department of Biological Sciences, Graduate School of Science, The University of Tokyo, 7-3-1 Hongo, Bunkyo, Tokyo 113-0033, Japan*

⁴*Department of Geology and Paleontology, National Museum of Nature and Science, Tsukuba, Ibaraki 305-0005, Japan*

⁵*Tateyama Marine Laboratory, Marine and Coastal Research Center, Ochanomizu University, Kou-yatsu, Tateyama, Chiba 294-0301, Japan*

⁶*The Graduate University for Advanced Studies, SOKENDAI, 10-3 Midori-cho, Tachikawa, Tokyo 190-8518, Japan*

* Corresponding author. Email: beniimo7010@gmail.com

<http://zoobank.org/6DB1CBAF-E456-41CD-85E0-D30C1D3BDC0D>

Running head: A new species of *Branchamphinome*

Abstract

A new species of amphinomid polychaete, *Branchamphinome kohtsukai* sp. nov., is described from Japanese waters, 29–211 m in depth. The species is distinguishable from other congeners by the following features: *i*) branchiae with four–six filaments in midbody segments; *ii*) two pairs of eyes not coalescent; *iii*) the ventral side of the first four chaetigers broadly pigmented. This is the first record of *Branchamphinome* from the North Pacific Ocean. We provide a phylogenetic tree based on the sequences of four genes (COI, 16S, 18S, 28S) and discuss amphinomids' relationships.

Key words: Amphinomida, deep sea, Japan, Polychaeta, polychaetes, taxonomy

INTRODUCTION

Amphinomids are commonly known as fireworms to aquarists and divers because they have defensive dorsal calcareous chaetae and a complex mixture of toxins for defense against predators (Verdes et al., 2018). The family consists of approximately 180 nominal species in 22 genera (Borda et al., 2012; Barroso et al., 2017; Sun and Li, 2017), most of which are found under rocks or coral rubbles in shallow and tropical waters (Barroso et al., 2017).

The genus *Branchamphinome* Hartman, 1967 is a rare and enigmatic group of amphinomids. They have small bodies (about 1 cm long), orange body pigmentation, and branchiae from chaetiger 1. Currently, three *Branchamphinome* species are known from the shallow to bathyal area of the South Pacific, Atlantic, and Southern Oceans (*Branchamphinome antarctica* Hartman, 1967; *Branchamphinome islandica*, Detinova, 1986; *Branchamphinome tropicalis* Barroso, Ranauro, & Kudenov, 2017). Although several amphinomid species have been reported from the deep sea in Japan (e.g., Imajima, 2001, 2005, 2006, 2011; Jimi et al., 2018), there is no record of *Branchamphinome*.

Because of the presence of branchiae on all chaetigers and similar-shaped caruncles, *Branchamphinome* has been expected to be closely related to *Hermodice* Kinberg, 1857 or *Pherecardia* Horst, 1866 (Barroso et al., 2017, 2021). Molecular phylogenetic relationships among Amphinomida have been investigated in several previous studies (Wiklund et al., 2008; Borda et al., 2012, 2015), but a phylogenetic

position of *Branchamphinome* had not been clarified due to the lack of molecular data.

Eight specimens of *Branchamphinome* were collected from several sites during a survey of polychaetes in Japan. We describe the specimens as a new species and provide a phylogenetic tree based on four molecular sequences (*COI*, *16S*, *18S*, *28S*). This is the first report of *Branchamphinome* from the North Pacific Ocean.

MATERIALS AND METHODS

Fresh specimens were collected by dredging from two areas: *i*) off Noto Peninsula (37°17.212'N to 37°16.989'N, 137°13.829'E to 137°13.737'E), 70–91 m in depth; *ii*) off Jyogashima (st. 1, 35°08.567'N to 35°08.651'N, 139°33.142'E to 139°32.783'E; st. 2, 35°08.329'N to 35°08.402'N, 139°32.857'E to 139°32.504'E), 105–211 m in depth; *iii*) off Okinoshima, Boso Peninsula (34°59.778'N to 34°59.441'N, 139°48.736'E to 139°48.650'E), 29 m in depth. ROV *Box Fish* collected another specimen from Omurodashi (34°32.814'N, 139°26.572'E), 196 m in depth. The live specimens were photographed with a Nikon D5200 digital camera. They were fixed in 70% ethanol. After preservation, these specimens were observed with a Nikon SMZ1500 dissecting microscope and an OLYMPUS BX51 compound microscope. All of the material has been deposited in the National Museum of Nature and Science, Tsukuba (NSMT). We followed the morphological terminology of Barroso et al. (2017) in the taxonomic description below.

DNA extraction, sequencing, alignment, and removing ambiguous positions for specimens were carried out following the method detailed in Jimi et al. (2019). The length of amplicons was ~670 bp (*COI*), ~550 bp (*16S*), ~1800 bp (*18S*), ~1300 bp (*28S*). The newly obtained sequences *COI* (682 bp), *16S* (550 bp), *18S* (1704 bp), *28S* (888 bp) were deposited in GenBank (Table 1). A total of 67 sequences (18 species) were used for molecular analyses. The trimmed sequences of the four genes, *COI* (665 bp), *16S* (308 bp), *18S* (1736 bp), and *28S* (879 bp), were concatenated using the Kakusan program (Tanabe, 2007), which recommended a GTR+G evolutionary model for each of the genes. A phylogenetic tree was constructed using the maximum likelihood (ML) method in the RAxML-VI-HPC program (Stamatakis, 2006). The robustness of the ML tree was evaluated by 1000 bootstrap pseudo-replicates (F option). Bayesian Inference (BI) analysis was conducted using MrBayes 3.2.2 (Ronquist et al., 2012), with Markov chains of 10 million generations. The model choice for each

partition was also based on the Kakusan results. Run convergence was analyzed using Tracer v1.6 (Rambaut et al., 2018); the first one million generations were discarded as burn-in. The OTUs used in this study belong to Amphinomidae, while *Euphrosine foliosa* and *Euphrosine* sp. belongs to Euphrosinidae, so *E. foliosa* and *Euphrosine* sp. were used as a reference group according to Borda et al. (2015).

RESULTS

Systematics

Family **Amphinomidae** Lamarck, 1818

[Japanese name: umikemushi-ka]

Genus ***Branchamphinome*** Hartman, 1967

[New Japanese name: era-umikemushi-zoku]

Branchamphinome kohtsukai Jimi, sp. nov.

[New Japanese name: Kohtsuka-era-umikemushi]

(Figs. 1, 2, 3)

Material examined. Holotype: NSMT-Pol H-838, 5 mm long, 1 mm wide (without chaetae, in widest chaetiger), 22 chaetigers, off Jyogashima (st. 1, 35°08.567'N to 35°08.651'N, 139°33.142'E to 139°32.783'E; st. 2, 35°08.329'N to 35°08.402'N, 139°32.857'E to 139°32.504'E), 105–211 m in depth, 30 July 2020, collected by NH. Paratypes: NSMT-Pol P-839, six specimens, 3–7 mm long, 0.5–1 mm wide (without chaetae, in widest chaetiger), 22–30 chaetigers, collection data is the same as that of the holotype. NSMT-Pol P-840, only anterior end (posterior part was used for DNA extraction), one specimen, 2 mm long, 1 mm wide (without chaetae, in widest chaetiger), off Noto Peninsula (37°17.212'N to 37°16.989'N, 137°13.829'E to 137°13.737'E), 70–91 m in depth, 19 November 2019, collected by NJ. NSMT-Pol P-841, one specimen, 7 mm long, 1 mm wide (without chaetae, in widest chaetiger), 30 chaetigers, Omurodashi (34°32.814'N, 139°26.572'E), 196 m in depth, 23 March 2021, collected by NJ. NSMT-Pol P-842, one specimen, 6 mm long, 1 mm wide (without chaetae, in widest chaetiger), 28 chaetigers, off Okinoshima, Boso Peninsula (34°59.778'N to 34°59.441'N, 139°48.736'E to 139°48.650'E), 29 m in depth, 26 April 2021, collected by NJ.

Description. Body depressed, elongated, whitish in life and after fixation,

longitudinal midventral groove absent. Orange pigmentation present (Figs. 1, 2): three irregular rectangular patches on dorsal side of each chaetiger (Figs. 1A, C, E; 2A); rectangular interparapodial patches on ventral side of notopodia (Fig. 2A, C); large rectangular patches on ventral side of neuropodia on chaetigers 1–4 (Fig. 2B); small rounded spots on ventral side of neuropodia on chaetiger 4 and following chaetigers (Fig. 2B).

Prostomium oval, slightly longer than wide (Figs. 2A, D; 3A). Eyes present, two pairs, reddish, anterior pair eyes twice larger than posterior ones (Figs. 2A, D; 3A). Pairs of lateral antennae and palps present, blunt conical, smooth (Fig. 3A); palps as long as lateral antennae. A median antenna present, digitate, twice longer than lateral antennae (Fig. 3A). Caruncle chevron-shaped (Fig. 3A), consists of median keel and four lateral lobes, median keel extends to chaetigers 2–3 (depending on fixation), unattached in posterior part. Mouth opening between chaetigers 2 and 3. Pharynx eversible.

Parapodia biramous, notopodia and neuropodia well separated (Fig. 2C). Dorsal and ventral cirri occur singly on notopodium and neuropodium, conical, pale, arising from body wall, present in all chaetigers. Branchiae dichotomously branching tufts from chaetiger 1, present in all chaetigers, filaments digitiform, four–six filaments per branchia in middle body chaetigers (Fig. 3B).

Notochaetae contain three types: *i*) long, thick harpoon chaetae, with serration limited to one side (Fig. 3C); *ii*) long, serrated capillaries (Fig. 3D); *iii*) notoaciculae, stout, abruptly tapered spines, numbering four–five per parapodium (Fig. 3E). Notopodial hooks absent in all specimens. Neurochaetae comprise three types: *i*) bifurcate chaetae, longer tine seven times longer than shorter one, serrated along its inner side (Fig. 3F); *ii*) long serrated capillaries (Fig. 3G); *iii*) neuroaciculae, numbering two–three per parapodia (Fig. 3H).

Anus opening dorsally on terminal chaetiger; pygidium with a median grooved unpaired papilla.

Etymology. The species is named after Mr. Hisanori Kohtsuka. He has been engaged in marine biology for 30 years in Japan and revealed brilliant biodiversity of Japanese coastal waters. The specific name is a noun in the genitive case.

Confirmed distribution. Shallow to deep-sea waters of Japan, 29–211 m in depth.

Phylogenetic analysis

The topologies (Fig. 4) recovered by ML and BI analyses were identical. *Branchamphinome kohtsukai* sp. nov. and *Pareurythoe borealis* formed a clade with 97% bootstrap support in ML and 1.00 posterior probability in BI. *Pherecardia* cf. *striata* is sister to the *Branchamphinome–Pareurythoe* clade, with a high support value (95% BS, 1.00 PP).

DISCUSSION

The new species has a small body, branchiae in all chaetigers, and a chevron-shaped caruncle. These morphological characters are identified with the diagnosis of *Branchamphinome* in Barroso et al. (2017). The new species can be discriminated from other congeners by having four–five branchial filaments in the midbody segment, two separated pairs of eyes, and pigmentation of the first four chaetigers (see Key to species). The members of *Branchamphinome* have been reported from the shallow to deep-sea waters of the Southern, Atlantic, and South Pacific Oceans. This is the first record of *Branchamphinome* from the Northwestern Pacific Ocean.

The phylogenetic position of *Branchamphinome* has been discussed in Borda et al. (2015) and Barroso et al. (2017). Borda et al. (2015) provisionally classified *Branchamphinome* into Amphinominae. Barroso et al. (2017) inferred that *Branchamphinome* is closely related to *Pherecardia* based on the caruncles' shape. The caruncles are similar to each other in arrangements, although *Branchamphinome* lacks the intricate array of lateral lobes (Barroso et al., 2017). Our phylogenetic tree indicated that *Branchamphinome* belongs to Amphinominae, and *Pareurythoe* is closer than *Pherecardia* to *Branchamphinome* (Fig. 4). This result indicates two patterns of caruncle evolution: *i*) common ancestor species of the *Pherecardia–Branchamphinome–Pareurythoe* clade has a caruncle with lateral lobes, like *Pherecardia*, and lateral developed lobes were secondarily reduced in the *Branchamphinome–Pareurythoe* clade; *ii*) common ancestor species of the *P-B-P* clade has a caruncle without or with poorly developed lateral lobes, and lateral developed lobes were secondarily gained in the *Pherecardia* clade. For understanding the evolution of caruncle ornamentation, most parsimonious reconstructions of morphological characters based on a more robust

phylogenetic tree are needed.

Notopodial hooks are absent in *B. kohtsukai* sp. nov., although they are present in the two species *B. antarctica* and *B. tropicalis*. Barroso et al. (2017) mentioned that the presence of this character is size-dependent. Our phylogenetic tree indicated that this character is not synapomorphy of *Branchamphinome* and *Paramphinome* since the new species formed a clade with *Pareurythoe* (Fig. 4). We agree with the speculation of Barroso et al. (2017) that the presence of notopodial hooks in chaetiger 1 might be a size-related feature, which is ultimately lost during the later ontogenetic stage.

The reduction of body size might be a synapomorphy of the *Branchamphinome–Pareurythoe* clade in Amphinominae. Members of the clade have a small body (approximately 1 cm in length) (e.g., Silva, 1965; Hartman, 1967), while others have a large one (approximately 5–10 cm in length) (e.g., Çinar, 2008; Yáñez-Rivera and Salazar-Vallejo, 2011). We suppose that this miniaturization is likely to be related with adaptation to their habitat preference. Most species of Amphinominae are found under rocks or on the seafloor, while the members of the *Branchamphinome–Pareurythoe* clade inhabit sediments (based on NJ's observations in sampling and speculation). Evolutionary history of the lifestyle and body size reduction will be revealed based on broader OTUs sampling with habitat information in future studies.

Key to species of *Branchamphinome* Hartman, 1967 (emended from Barroso et al. [2017])

1. Branchiae with 15 to 18–20 filaments in midbody segment
..... *B. antarctica* Hartman, 1967
– Branchiae with four–eight filaments in midbody segment
.....2
2. Two pairs of eyes nearly coalescent, forming a figure ‘8’; body not characteristically pigmented..... *B. islandica* Detinova, 1968
– Two pairs of eyes, not coalescent and not forming a figure ‘8’; body characteristically pigmented.....3
3. Ventral side of first four chaetigers broadly pigmented, unlike following chaetigers
..... *B. kohtsukai* sp. nov.
– Ventral patches are equally pigmented in all chaetigers
.....*B. tropicalis* Barroso et al., 2017

ACKNOWLEDGMENTS

We thank Mr. Shozo Ogiso and the members of Noto Marine Laboratory Institute of Nature and Environmental Technology, Kanazawa University, Mr. Hisanori Kohtsuka and the members of Misaki Marine Biological Station, Dr. Yuka Masaki, Mr. Hideki Sezoko and the members of NSMT, the members of Shimoda Marine Research Center, University of Tsukuba, the members of Marine and Coastal Research Center, Ochanomizu University, and the research members of the 22nd JAMBIO Coastal Organism Joint Survey for generous help in sampling. We are also grateful to Mr. Kenichi Watanabe (NIPR) for helping with molecular analysis. This study was partly supported by JSPS KAKENHI JP19J00160 and Environment Research and Technology Development Fund (Grant Number: JPMEERF20204R01) of the Environmental Restoration and Conservation Agency of Japan to NJ.

COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS

NJ, NH, KT, and RY collected the samples, NJ carried out morphological observation, NJ conducted molecular analyses, SI helped with the observation and analyses, NJ wrote the text, and all authors approved the manuscript.

REFERENCES

- Barroso R, Ranauro N, Kudenov JD (2017) A new species of *Branchamphinome* (Annelida: Amphinomidae) from the South-western Atlantic, with an emendation of the genus. *J Mar Biol Assoc UK* 97: 835–842
- Barroso R, Kudenov JD, Halanych KM, Saeedi H, Sumida PYG, Bernardino AF (2018) A new species of xylophilic fireworm (Annelida: Amphinomidae: *Cryptonome*) from deep-sea wood falls in the SW Atlantic. *Deep Sea Res Part I* 137: 66–75

- Barroso R, Kudenov JD, Shimabukuro M, Carrerette O, Sumida PY, Paiva PC, et al. (2021) Morphological, molecular and phylogenetic characterization of a new *Chloeia* (Annelida: Amphinomidae) from a pockmark field. *Deep Sea Res Part I* 171: 103499
- Borda E, Kudenov JD, Bienhold C, Rouse GW (2012) Towards a revised Amphinomidae (Annelida, Amphinomorpha): description and affinities of a new genus and species from the Nile Deep-sea Fan, Mediterranean Sea. *Zool Scr* 41: 307–325
- Borda E, Yáñez-Rivera B, Ochoa GM, Kudenov JD, Sanchez-Ortiz C, Schulze A, et al. (2015) Revamping Amphinomidae (Annelida: Amphinomorpha), with the inclusion of *Notopygos*. *Zool Scr* 44: 324–333
- Çinar ME (2008) Description of a new fireworm, *Eurythoe turcica* sp. nov. (Polychaeta: Amphinomidae), from the Levantine coast of Turkey (eastern Mediterranean), with re-descriptions of *Eurythoe parvecarunculata* Horst and *Amphinome djiboutiensis* Gravier based on type material. *J Nat Hist* 42: 1975–1990
- Detinova NN (1986) Polychaetous annelids of Rekjanes Ridge (North Atlantic). *Tr Inst okeanol im P P Shirshova Akad Nauk SSSR* 120: 96–136
- Hartman O (1967) Polychaetous Annelids collected by the USNS Eltanin and Staten Island cruises, chiefly from Antarctic Seas. *Allan Hancock Monogr Mar Biol* 2: 1–387
- Horst R (1886) Contributions towards the knowledge of the Annelida polychaeta. Pt. 1. Amphinomidae. *Not Leyden Mus* 8: 157–174
- Imajima M (2001) Deep-sea benthic polychaetous annelids of Tosa Bay, southwestern Japan. *Nat Sci Mus Monogr* 20: 31–100
- Imajima M (2005) Deep-sea benthic polychaetous annelids from around Nansei Islands. *Nat Sci Mus Monogr* 29: 37–99
- Imajima M (2006) Polychaetous annelids from Sagami Bay and the Sagami Sea, Central Japan. *Mem Nat Mus Nat Sci* 40: 317–408
- Imajima M (2011) Polychaetous annelids collected from Sagami Bay toward the Ogasawara islands, Japan. *Mem Nat Mus Nat Sci* 47: 145–218
- Jimi N, Kimura T, Ogawa A, Kajihara H (2018) A new species of the rare, deep-sea polychaete genus *Benthoscolex* from the Sea of Kumano, Japan (Annelida, Amphinomidae). *ZooKeys* 738: 81–88

- Jimi N, Moritaki T, Kajihara H (2019) Polychaete meets octopus: symbiotic relationship between *Spathochaeta octopodis* gen. et sp. nov. (Annelida: Chrysopetalidae) and *Octopus* sp. (Mollusca: Octopodidae). *Syst Biodivers* 17: 80–85
- Kinberg JGH (1857) Nya släkten och arter af Annelider. Öfvers Kongl Vetensk-Akad Förh 14: 11–14
- Lamarck JB (1818) Histoire naturelle des Animaux sans Vertèbres, présentant les caractères généraux et particuliers de ces animaux, leur distribution, leurs classes, leurs familles, leurs genres, et la citation des principales espèces qui s’y rapportent; precedes d’une Introduction offrant la détermination des caractères essentiels de l’Animal, sa distinction du végétal et des autres corps naturels, enfin, l’Exposition des Principes fondamentaux de la Zoologie. Tome 5, Deterville, Paris
- Rambaut A, Drummond AJ, Xie D, Baele G, Suchard MA (2018) Posterior summarization in Bayesian phylogenetics using Tracer 1.7. *Syst Biol* 67: 901–904
- Ronquist F, Teslenko M, van der Mark P, Ayres DL, Darling A, Höhna S, et al. (2012) MRBAYES 3.2: Efficient Bayesian phylogenetic inference and model selection across a large model space. *Syst Biol* 61: 539–542
- Rousset V, Pleijel F, Rouse GW, Erséus C, Siddall ME (2007) A molecular phylogeny of annelids. *Cladistics* 23: 41–63
- Silva PHDH (1965) New species and record of Polychaeta from Ceylon. *Proc Zool Soc Lond* 144: 537–563
- Stamatakis A (2006) RAxML-VI-HPC: maximum likelihood-based phylogenetic analyses with thousands of taxa and mixed models. *Bioinformatics* 22: 2688–2690
- Struck TH, Purschke G, Halanych M (2006) Phylogeny of Eunicida (Annelida) and exploring data congruence using a Partition Addition Bootstrap Alteration (PABA) approach. *Syst Biol* 55: 1–20
- Sun Y, Li X (2017) A new genus and species of bristle worm from Beibu Gulf, South China Sea (Annelida, Polychaeta, Amphinomidae). *ZooKeys* 708: 1–10
- Tanabe AS (2007) kakusan: a computer program to automate the selection of a nucleotide substitution model and the configuration of a mixed model on multilocus data. *Mol Ecol Notes* 7: 962–964
- Verdes A, Simpson D, Holford M (2018) Are fireworms venomous? Evidence for the convergent evolution of toxin homologs in three species of fireworms (Annelida, Amphinomidae). *Genome Biol Evol* 10: 249–268

- Wiklund H, Nygren A, Pleijel F, Sundberg P (2008) The phylogenetic relationships between Amphinomidae, Archinomidae and Euphrosinidae (Amphinomida: Aciculata: Polychaeta), inferred from molecular data. *J Mar Biol Assoc UK* 88: 509–513
- Yáñez-Rivera B, Salazar-Vallejo SI (2011) Revision of *Hermodice* Kinberg, 1857 (Polychaeta: Amphinomidae). *Sci Mar* 75: 251–262

FIGURE LEGENDS AND TABLE CAPTION

Fig. 1. *Branchamphinome kohtsukai* sp. nov. Holotype (NSMT-Pol H-838). **(A)** whole body, dorsal view, **(B)** whole body, ventral view. Paratypes (NSMT-Pol P-839): **(C)** whole body, dorsal view, **(D)** whole body, ventral view, **(E)** whole body, dorsal view, **(F)** whole body, ventral view. Scale bars: 2 mm.

Fig. 2. *Branchamphinome kohtsukai* sp. nov. Holotype (NSMT-Pol H-838). **(A)** anterior end, dorsal view, **(B)** anterior end, ventral view. Paratype (NSMT-Pol P-839): **(C)** anterior end, lateral view, **(D)** anterior end, frontal view. Scale bars: 1 mm.

Fig. 3. *Branchamphinome kohtsukai* sp. nov. Holotype (NSMT-Pol H-838). **(A)** anterior end, dorsal view, **(B)** branchia, chaetiger 10, **(C)** tip of long thick harpoon notochaeta, chaetiger 10, **(D)** tip of serrated capillary notochaeta, chaetiger 10, **(E)** tip of notoacacula, chaetiger 10, **(F)** tip of bifurcate neurochaeta, chaetiger 10, **(G)** tip of serrated capillary neurochaeta, chaetiger 10, **(H)** tip of neuroacacula, chaetiger 10. Scale bar: **(A)** 250 μm , **(B)** 100 μm , **(C–H)** 50 μm .

Fig. 4. Maximum-likelihood (ML) phylogenetic tree of Amphinomidae based on COI, 16S, 18S, and 28S sequences. *Euphrosine foliosa* and *Euphrosine* sp. were used as ‘outgroups’ for the rest of the amphinomids. Nodal support values (bootstrap support [BS] value) higher than 50% are indicated on each branch. Posterior probability of each branch is also shown behind the bootstrap value.

Table 1. List of amphinomids and outgroup species included in the phylogenetic analysis, together with accession numbers in GenBank.

Table 1. List of amphinomids and outgroup species included in the phylogenetic analysis, together with accession numbers in GenBank.

Species	18S	28S	COI	16S	References
<i>Archinome storchi</i>	JN086533	JN086523	JN086543	JN086552	Borda et al. (2012)
<i>Archinome rosacea</i>	EF076777	EF076778	JX028111	JX028046	Wiklund et al. (2008); Borda et al. (2015)
<i>Archinome jasoni</i>	JX028118	LC466627	JX028112	KM979540	Borda et al. (2015)
<i>Archinome tethyana</i>	KM055049	JX028140	JX028113	JX028053	Borda et al. (2015)
<i>Archinome levinae</i>	KM055048	JX028134	KY684724	JX028037	Borda et al. (2015)
<i>Amphinome rostrata</i>	JN086534	JN086524	JN086544	JN086560	Borda et al. (2012)
<i>Branchamphinome kohtsukai</i> sp. nov.	MZ568461	MZ568459	MZ568411	MZ568464	This study
<i>Chloeia flava</i>	JN086536	JN086526	–	JN086554	Borda et al. (2012)
<i>Chloeia viridis</i>	JN086537	JN086527	JN086546	JN086555	Borda et al. (2012)
<i>Cryptonome barbada</i>	–	–	NC_037947	NC_037947	Barroso et al. (2018)
<i>Cryptonome conclava</i>	JN086535	JN086525	JN086545	JN086553	Borda et al. (2012)
<i>Eurythoe complanata</i>	JN086539	JN086529	JN086548	JN086557	Borda et al. (2012)
<i>Hermodice carunculata</i>	JN086540	JN086530	JN086549	JN086558	Borda et al. (2012)
<i>Hipponoa gaudichaudi</i>	JN086542	JN086532	JN086551	JN086561	Borda et al. (2012)
<i>Paramphinome jeffreysii</i>	AY838856	AY838865	AY838875	AY838840	Struck et al. (2006)
<i>Pareurythoe borealis</i>	JN086541	JN086531	JN086550	JN086559	Borda et al. (2012)
<i>Pherecardia</i> cf. <i>striata</i>	MZ568462	MZ568460	MZ568412	MZ568463	This study
Outgroup					
<i>Euphrosine foliosa</i>	JN086538	JN086528	JN086547	JN086556	Borda et al. (2012)
<i>Euphrosine</i> sp.	DQ779649	DQ779687	–	DQ779613	Rousset et al. (2007)