Pinna rapanui n. sp. (Bivalvia: Pinnidae): The Largest Bivalve Species from Easter Island, South Pacific Ocean, Chile

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Pinna rapanui n. sp. (Bivalvia: Pinnidae): The Largest Bivalve Species from Easter Island, South Pacific Ocean, Chile[1]

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Abstract: A new bivalve species of the genus *Pinna* Linnaeus, 1758, is described from shallow water off the coast of Easter Island, southeastern Pacific Ocean. *Pinna rapanui* sp. n. has a small, broad, slightly angulated shell with a sculpture of commarginal growth lines and prominent radial ribs decorated by almost tubular, perpendicularly erect spines. This species is the 249th marine molluscan species found in Easter Island waters, and it is, by far, the largest bivalve species living around the island. A Polynesian origin of this species is suggested; however, its definite affinities with Indo-Pacific or South American fauna are still unknown.

Easter Island, or Rapa Nui in its native language, is the easternmost island in Polynesia and one of the most geographically isolated islands in the world, distant at least 2,200 km from its nearest neighbors, Ducie and Henderson Islands in the Pitcairn group, and about 3,800 km from Caldera, on the Chilean coast of South America. The marine fauna of Rapa Nui has definite biotic affinities with the fauna of the Indo-West Pacific; however, a high degree of endemism is evident in certain groups of invertebrates including bryozoans, corals, isopods, mollusks, and poriferans among others (Rehder 1980, Moyano 1991, Kensley 2003, Glynn et al. 2007, Fernández et al. 2014). Easter Island has been relatively well-studied in regard to its native mollusks; many published works have dealt with the abundance, species composition, records, and descriptions of the gastropods (Rehder 1980; Senders and Martin 1987; Osorio and Cantuarias 1989; Osorio 1991; Lorenz and Raines 2001; Raines 2002*a*, *b*, *c*, 2004, 2007; Geiger 2003; Brown and Raines 2004; Raines and Pizzini 2005; Gosliner 2011, among others), bivalves (Osorio 1995, Trego 1997, Dijkstra and Raines 1999, Dijkstra 2012, Raines and Huber 2012), chitons (Osorio et al. 2000, Dell'Angelo et al. 2004), and the terrestrial molluscan species of the island (Odhner 1922, Naranjo-García and Appleton 1998, Boyko and Cordeiro 2001, Kirch et al. 2009).

Of the bivalve species found in Easter Island, all comprise species of small shell size, often with a relatively low local abundance. These mollusks are characteristic of the Indo-Pacific and the South Pacific (Polynesian) fauna, with only a minor proportion of South American species (Rehder 1980, Raines and Huber 2012). The finding of a pinnid bivalve is surprising, and it may hint to the presence of other undescribed or unrecorded invertebrate species in this isolated small island in the South Pacific.

Members of the bivalve family Pinnidae Leach, 1819, have a worldwide distribution in temperate and tropical seas. They live partially buried in soft substrates, protruding slightly above the ocean floor and camouflaging against their surroundings (Keen 1971). This family is currently represented by 60 species, assigned to only two extant genera: *Atrina* Gray, 1842, and *Pinna* Linnaeus, 1758 (Gofas 2015). Half of these taxa correspond to species in the genus *Pinna*, most of them living

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in tropical or subtropical waters in the Caribbean and Southwest Pacific. Twelve of these species are found in Polynesia and a single species, *Pinna rugosa* Sowerby I, 1835, is found in American waters from Baja California (28.2° N) to Piura, Peru (5.6° S), including also Clipperton and the Galápagos Islands (Coan and Valentich-Scott 2012).

Pinnidae taxa have large or very large shells, only surpassed in size by those in the similarly infaunal genera *Hippopus* Lamarck, 1799, or *Tridacna* Bruguière, 1797. However, pinnid shells are very light, thin, and very fragile, with sharp posterior edges prone to damage (Rosewater 1961). Some species of the Pinnidae, for instance *Pinna rugosa* Sowerby I, 1835, and *Atrina maura* (Sowerby I, 1835) are commercially exploited in the Pacific (Ahumada-Sempoal et al. 2002), and *Pinna nobilis* Linnaeus, 1758, the largest species in the genus, has traditionally been exploited in the Mediterranean Sea for their shells, meat, and for their byssus, and it is currently a species under protection (Garcia-March et al. 2007).

MATERIALS AND METHODS

The species description is based on the holotype deposited under accession number MNHNCL 100364 in the Malacology collection of the Museo Nacional de Historia Natural de Chile (MNHNCL), at Santiago, Chile, while a paratype remains alive in a secluded location offshore Easter Island (see Wakeham-Dawson et al. [2002] regarding the nomination of living type species). The holotype was collected on 20 August 2012 from an offshore sandy and rocky bottom, partially covered by algal communities at a depth of about 10 m. Measurements were made with Vernier calipers reading to two decimal places. For the morphometric analysis, the work of Bengtson et al. (2014) was followed.

RESULTS

Systematics

Class BIVALVIA Linnaeus, 1758
Subclass PTERIOMORPIA Beurlen, 1944
Order PTEROIDEA Newell, 1965
Superfamily PINNOIDEA Leach, 1819
Family PINNIDAE Leach, 1819
Genus *Pinna* Linnaeus, 1758

Type species: *Pinna rudis* Linnaeus, 1758, subsequent designation by Children, 1823.

Pinna rapanui n. sp. Figures 1A–1D, 2A–2D.

DESCRIPTION OF HOLOTYPE: Shell reaching 109 mm in length and 76 mm in maximum width; fan-shaped, the posterior margin is truncate and slightly rounded near the ventral margin, with a moderately strong longitudinal keel on the anterior half of the shell. The ventral and dorsal margins form a top angle of about 38°. Valves thin and translucent, light-yellowish in color; colored mostly in the central area of the valves. Surface sculptured with moderately raised and very sparsely spaced radial ribs. Smaller ribs intercalate the primary ribs and are more evident at the posterior edge of the shell. There are about 12 primary ribs and 17 secondary ribs near the middle of its length and up to 28 primary ribs near the posterior margin; ribs on posterior margin being the most well marked. Ribs bear short, almost tubular, and somewhat closely spaced, erect spines that are almost perpendicular to the shell surface. Spines are larger and stronger near posterior margin. Commarginal sculpture consists of fine growth lines more noticeable on the dorsal and ventral sides. Dorsal and ventral margins are nearly straight to slightly concave. Interior of valves whitish, smooth, and lustrous. Nacreous layer is iridescent, occupying slightly more than the anterior half of the interior of shell, and divided along the posterior 4/5 of its length by a sharp, well-defined, brownish longitudinal sulcus. The dorsal lobe of the nacreous layer is extended a bit more to the posterior edge than the ventral lobe is. Dorsal lobe obliquely truncates posteriorly. Ventral lobe sloping rapidly and obliquely ventrally, more separated from the dorsal lobe at its posterior side. Both lobes diverge from the sulcus in about the last third of its height. Posterior adductor muscle scar is a small, slightly defined dorsal nacreous lobe, not extending onto ventral lobe or to the interlobal

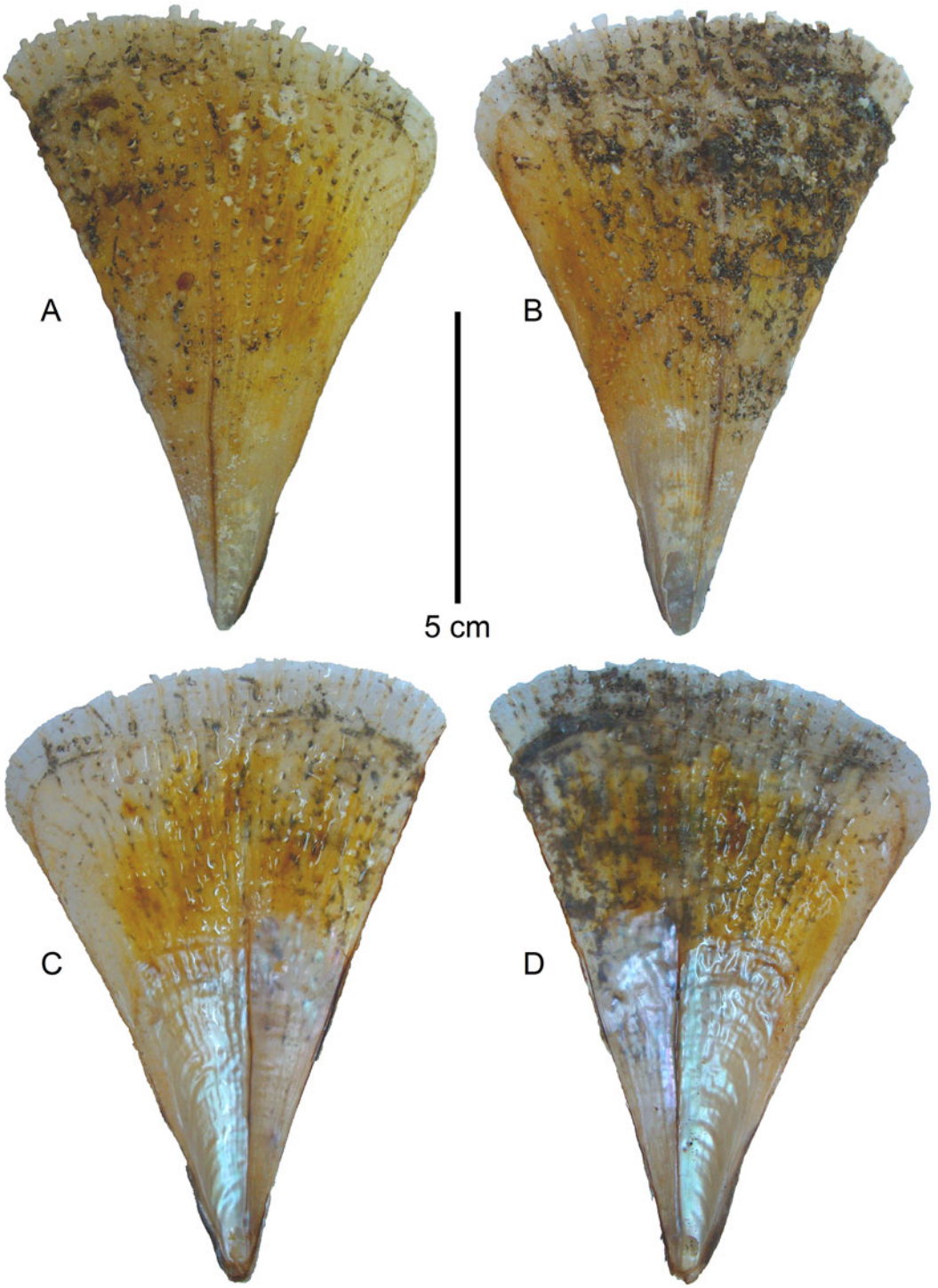

FIGURE 1. *Pinna rapanui* sp. n.: (*A*) left valve, exterior view; (*B*) right valve, exterior view; (*C*) left valve, interior view; and (*D*) right valve, interior view.

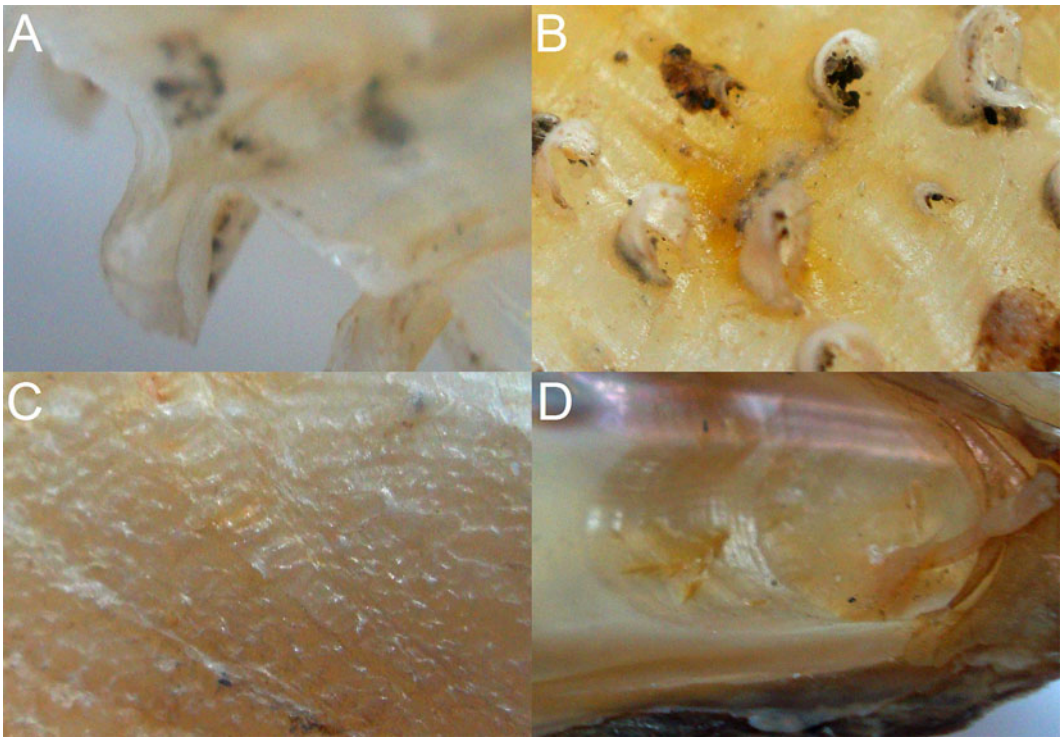

FIGURE 2. *Pinna rapanui* sp. n., details of shell morphology: (*A*) border of right shell, continuous with spines; (*B*) details of spines on middle of left valve; (*C*) detail of commarginal sculpture near anterior side of right valve; and (*D*) detail of posterior adductor muscle scar, right valve.

space. Anterior adductor scar is small, oval-shaped, and well-marked. Primary hinge ligament is thin, black, extending from anterior end of shell to posterior border of nacreous layer along dorsal margin. Secondary hinge ligament is a pale brownish color. Border of the posterior margin of both valves is simple and continuous with the spines. Apical external surface of valves is slightly eroded. Byssus is short and fine.

TYPE LOCALITY: Only known from Easter Island (27° 07′ S; 109° 22′ W), southeastern Pacific Ocean, Chile.

ETYMOLOGY: The species has been named after the type location; Rapa Nui Island, in the native Rapa Nui language (= Easter Island).

COMPARISONS: From the 30 species of *Pinna* distributed around the world (Gofas 2015), 17 are found in the Indo-Pacific, including the Hawaiian Islands, Polynesia, Australia, and Western America (Schultz and Huber 2013). Most of them differ from *Pinna rapanui* sp. n. in rough shell sculpture characteristics, including general shell proportions and the absence of spines, with the exception of the following species: *Pinna angustana* Lamarck, 1819; *Pinna cellophana* Matsukuma & Okutani, 1986; *Pinna dolabrata* Lamarck, 1819; *Pinna electrina* Reeve, 1858; *Pinna menkei* Reeve, 1858; *Pinna muricata* Linnaeus, 1758; and *Pinna rugosa* Sowerby I, 1835. This last species lives in shallow water (intertidal to 100 m depth) and is distributed from Piura, Bahía de Sechura, Peru (5.6° S) to San Felipe, Gulf of California, Baja California, Mexico (31.4° N), including Clipperton and the Galápagos Islands (Coan and Valentich-Scott 2012). This species differs from *Pinna rapanui* sp. n. in having a larger, much darker, and stouter shell, with a coarser sculpture of few radial ribs and stronger spines.

The new species differs from *Pinna angustana*—a species distributed from the Red Sea

to the Maluku Islands in Indonesia—mostly in its paler coloration (light yellowish in *P. rapanui* vs. red-brown to blackish gray in *P. angustana*), in having a broader profile with a much higher apical angle, and in having a shell surface sculptured with more ribs with more crowded spines. *Pinna cellophana*, an uncommon deep sea species distributed from Japan to the Philippines, differs from the new species in having a much smaller ventral nacreous layer and in the general morphology of the shell, which is broader and shorter and has a curved posterior to ventral margin. They have also a much less crowded sculpture, of 13 to 16 irregularly spaced longitudinal, low rounded ribs, with medium-sized spines (Schultz and Huber 2013).

Pinna dolabrata, a native to southern Australia (Hedley 1924), has a much more solid and elongated shell, with a sculpture of mostly commarginal frills, very different from the crowded, almost tubular spines found in *Pinna rapanui* sp. n.

Pinna electrina and *Pinna menkei* differ from the new species in the darker color of their shells (light horn to dark purple brown), in the white and widely spaced strong spines (*P. electrina*) and in their characteristic outline, with a strongly concave dorsal margin (*P. menkei*). Both of these species have a distribution restricted to eastern Australia.

Pinna muricata, the most common and most widespread Indo-Pacific species, found from the Red Sea to Polynesia (Schultz and Huber 2013), is the species most similar to *Pinna rapanui* sp. n.; however, it differs from the new species in having a lighter, more elongated shell, with a lower apical angle, a concave dorsal margin and with a sculpture of fewer (8–10) and stronger tubular spines, which are much more crowded and conspicuous in the new species.

DISCUSSION

This new bivalve species is another example of endemic Pacific Basin peripheral taxa, being a member of the Rapanuian faunal district (Newman and Foster 1983). A Polynesian origin of this new species via interisland dispersal is thus expected, as has been accounted for other rapanuian molluscan species (Rehder 1980). The existence of cryptic species in some of the most widely distributed Pinnidae taxa (for example in *P. muricata* and *P.* [*Streptopinna*] *saccata* [Linnaeus, 1758]) has also been recently acknowledged on the basis of molecular studies (Lemer et al. 2014), and it may also explain the presence of this species at Easter Island. Low-density populations of this species can also account for the rarity and only recent discovery of this bivalve, in the same manner as it has been explained for other invertebrate taxa in Easter Island, some of them with cryptic habitats (Boyko 2001, Kensley 2003).

Pinnid species are important elements of shallow water marine ecosystems, and they harbor a wide variety of symbiotic and parasitic fauna (Rosewater 1961, Ramos and von Prahl 1989); an in-depth study of the epibiont assemblages and associated invertebrate fauna living together with the communities of *Pinna rapanui* sp. n. around Easter Island is thus imperative. Studies of the Mediterranean *Pinna nobilis*, for example, have revealed that they act as "biodiversity islands" in a local spatial scale, increasing the spatial heterogeneity in the surrounding soft-bottom communities (Cosentino and Giacobbe 2008, Rabaoui et al. 2009). They may also reveal new clues regarding the origin of this taxon and its relationship with similar species in the South Pacific or South American coasts.

In conclusion, a new species of *Pinna* is described for Easter Island, being the 249th molluscan (and the 69th bivalve) species found in the location (C. Osorio, unpubl. data) and the largest bivalve species found in the island waters. We propose this species to be listed in a protected status, due to the scarcity of its occurrence in the island and the susceptibility of these species to mechanical damage due to habitat modifications and human intervention.

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Literature Cited

Ahumada-Sempoal, M. A., S. J. Serrano-Guzmán, and N. Ruiz-García. 2002. Abundancia, estructura poblacional y crecimiento de *Atrina maura* (Bivalvia: Pinnidae) en una laguna costera tropical del Pacífico mexicano. Rev. Biol. Trop. 50 (3–4): 1091–1100.

Bengtson, P., W. S. Ayoub-Hannaa, F. T. Fürsich, and M. Heinze. 2014. Taxonomy and palaeoecology of *Pinna* (*P.*) *cretacea* (Schlotheim, 1813) from the upper Cretaceous of the Sergipe Basin, Brazil. Rev. Bras. Paleontolog. 17 (3): 289–306.

Boyko, C. B. 2001. First record of *Baseodiscus hemprichii* (Nemertea: Baseodiscidae) on Easter Island (Rapa Nui) and a new eastern distribution boundary for the species. Pac. Sci. 55 (1): 41–42.

Boyko, C. B., and Cordeiro, R. 2001. The terrestrial mollusca of Easter Island (Gastropoda, Pulmonata). Basteria 65:17–25.

Brown, L., and Raines, B. 2004. Two new records of Epitoniidae from Easter Island, Chile. Zootaxa 402:1–7.

Coan, E. V., and P. Valentich-Scott. 2012. Bivalve seashells of tropical West America: Marine bivalve mollusks from Baja California to northern Peru. Santa Barbara Monographs. Santa Barbara Museum of Natural History, Santa Barbara, California.

Cosentino, A., and S. Giacobbe. 2008. Aspects of epizoobiontic mollusc assemblages on *Pinna* shells. II. Does the Mediterranean *P. nobilis* represent an isle of biodiversity? Cah. Biol. Mar. 49 (2): 161–173.

Dell'Angelo, B., B. Raines, and A. Bonfitto. 2004. The Polyplacophora of Easter Island. Veliger 47:130–140.

Dijkstra, H. H. 2012. A new recent species of *Parvamussium* (Bivalvia, Propeamussiidae) from Easter Island (Pacific, Chile). Basteria 76 (4–6): 133–138.

Dijkstra, H. H., and B. K. Raines. 1999. *Pascahinnites* n. gen. for "*Pecten* (*Chalmys*)" [*sic*] *pasca* Dall, 1908, a cemented Easter Island scallop (Bivalvia: Pectinidae). Basteria 63:199–203.

Fernández, M., P. Pappalardo, M. C. Rodríguez-Ruiz, and J. C. Castilla. 2014. Synthesis of the state of knowledge about species richness of macroalgae, macroinvertebrates and fishes in coastal and oceanic waters of Easter and Salas y Gómez islands. Lat. Am. J. Aquat. Res. 42 (4): 760–802.

García-March, J. R., A. M. García-Carrascosa, A. P. Cantero, and Y. G. Wang. 2007. Population structure, mortality and growth of *Pinna nobilis* Linnaeus, 1758 (Mollusca, Bivalvia) at different depths in Moraira bay (Alicante, Western Mediterranean). Mar. Biol. 150 (5): 861–871.

Geiger, D. L. 2003. Phylogenetic assessment of characters proposed for the generic classification of Recent Scissurellidae (Gastropoda: Vetigastropoda) with a description of one new genus and six new species from Easter Island and Australia. Molluscan Res. 23:21–83.

Glynn, P. W., G. M. Wellington, B. Riegl, D. B. Olson, E. Borneman, and E. A. Wieters. 2007. Diversity and biogeography of the scleractinian coral fauna of Easter Island (Rapa Nui). Pac. Sci. 61 (1): 67–90.

Gofas, S. 2015. Pinnidae Leach, 1819. World Register of Marine Species. Accessed 26 March 2015. http://www.marinespecies.org/aphia.php?p = taxdetails&id = 1776.

Gosliner, T. M. 2011. Six new species of aglajid opisthobranch mollusks from the tropical Indo-Pacific. Zootaxa. 2751:1–24.

Hedley, C. 1924. A revision of the Australian Pinnidae. Rec. Aust. Mus. 14 (3): 141–153.

Keen, A. M. 1971. Sea shells of tropical West America: Marine mollusks from Baja Cal-

ifornia to Peru. Stanford University Press, Stanford, California.
Kensley, B. F. 2003. Marine isopod crustaceans from Easter Island. Pac. Sci. 57 (3): 287–317.
Kirch, P., C. Christensen, and D. Steadman. 2009. Subfossil land snails from Easter Island, including *Hotumatua anakenana*, new genus and species (Pulmonata: Achatinellidae). Pac. Sci. 63 (1): 105–122.
Lamarck, J.-B. de. 1819. Histoire naturelle des animaux sans vertèbres. Librairie Verdière, Paris. 343 pp.
Lemer, S., B. Buge, A. Bemis, and G. Giribet. 2014. First molecular phylogeny of the circumtropical bivalve family Pinnidae (Mollusca, Bivalvia): Evidence for high levels of cryptic species diversity. Mol. Phylogenet. Evol. 75: 11–23.
Linnaeus, C. 1758. Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Editio decima reformata. 1. Holmiae, Salvius; ii +824 pp.
Lorenz, F., and B. K. Raines. 2001. A new species of *Cribrarula* (Gastropoda: Cypraeidae) from Easter Island. La Conchiglia 299:27–29.
Matsukuma, A., and T. Okutani. 1986. Studies on the Kawamura collection (Mollusca) in the National Science Museum, Tokyo-II. Catalogue of type specimens, with description of *Pinna cellophana* n. sp. (Bivalvia). Venus 45 (1): 1–10.
Moyano, G. H. I. 1991. Bryozoa marinos chilenos VIII: Una síntesis zoogeográfica con consideraciones sistemáticas y la descripción de diez especies y dos géneros nuevos. Gayana Zool. 55 (4): 305–389.
Naranjo-Garcia, E., and C. C. Appleton. 1998. Dos nuevos registros de moluscos terrestres introducidos en la Isla de Pascua, Chile. Biociencias 6:119–124.
Newman, W. A., and B. A. Foster. 1983. The Rapanuian faunal district (Easter and Sala y Gómez): In search of ancient archipelagos. B. Mar. Sci. 33 (3): 633–644.
Odhner, N. H. J. 1922. Mollusca from Juan Fernandez and Easter Island. Pages 219–254, plates 8–9 *in* C. Skottsberg, ed. The natural history of Juan Fernandez and Easter Island. Vol. 3. Almqvist and Wiksells Boktryckeri, Uppsala, Sweden.
Osorio, C. 1991. *Charonia tritonis* (Linne 1758) en la Isla de Pascua (Mollusca: Gastropoda: Cymatiidae). Rev. Biol. Mar. Oceanog. 26:75–80.
———. 1995. Dos nuevos registros de Isognomiidae (Mollusca, Bivalvia) para Isla de Pascua. Rev. Biol. Mar. Oceanog. 30 (2): 199–205.
Osorio, C., and V. Cantuarias. 1989. Vertical distribution of mollusks on the rocky intertidal of Easter Island. Pac. Sci. 43 (4): 302–315.
Osorio, C., M. E. Ramírez, A. M. Mora, and M. V. Vega. 2000. *Plaxiphora mercatoris* Leloup, 1936 (Polyplacophora: Mopaliidae) de Isla de Pascua, Chile. Iberus 18 (2): 41–50.
Rabaoui, L., S. Tlig-Zouari, A. Cosentino, and O. K. Ben Hassine. 2009. Associated fauna of the fan shell *Pinna nobilis* (Mollusca: Bivalvia) in the northern and eastern Tunisian coasts. Sci. Mar. 73 (1): 129–141.
Raines, B. K. 2002*a*. Collecting shells from the navel of the world. Am. Conchol. 30 (2): 8–9.
———. 2002*b*. Contributions to the knowledge of Easter Island Mollusca. La Conchiglia 304:11–40.
———. 2002*c*. Contributions to the Knowledge of Easter Island Mollusca, Part II. La Conchiglia. 305:41–50.
———. 2004. Studying Easter Island's molluscan fauna. Rapa Nui J. 18 (2): 108–111.
———. 2007. New molluscan records from Easter Island, with the description of a new *Ethminolia*. Visaya 2 (1): 70–88.
Raines, B. K., and M. Huber. 2012. Biodiversity quadrupled—Revision of Easter Island and Salas y Gómez Bivalves. Zootaxa. 3217:1–106.
Raines, B., and M. Pizzini. 2005. Contribution to the knowledge of the Family Caecidae: 16. Revision of the Caecidae of Easter Island (Caenogastropoda: Rissooidea Gray J. E., 1847). Iberus 23 (1): 49–65.
Ramos, G. E., and H. von Prahl. 1989. *Alpheus utriensis*, new species (Caridea: Alpheidae), from Utria Sound, Pacific Coast of Colombia. J. Crustac. Biol. 9 (3): 477–481.

Reeve, L. A. 1858. Monograph of the genus *Pinna*. Conchol. Iconica 11:plates 2–32.

Rehder, H. 1980. The marine mollusks of Easter Island (Isla de Pascua) and Sala y Gomez. Smithson. Contrib. Zool. 289. 167 pp.

Rosewater, J. 1961. The family Pinnidae in the Indo-Pacific. Indo-Pac. Mollusca 1 (4): 175–226.

Schultz, P. W. W., and M. Huber. 2013. Revision of the worldwide Recent Pinnidae and some remarks on fossil European Pinnidae. Acta Conchyl. 13:1–164.

Senders, J., and P. Martin. 1987. Description d'une nouvelle sous–espece de Cypraeidae en provenance de l'Ile de Pasques. Apex 2:13–22.

Sowerby, G. B. 1835. Characters of new species of Mollusca and Conchifera collected by Mr. Cuming. Proc. Zool. Soc. Lond. 1835:84–85.

Trego, K. D. 1997. Note on new bivalve records for Easter Island. Pac. Sci. 51 (2): 199.

Wakeham-Dawson, A., S. Morris, P. K. Tubbs, M. L. Dalebout, and C. S. Baker. 2002. Nomenclatural notes-type specimens: Dead or alive? Bull. Zool. Nomencl. 59 (4): 282–286.