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Cephalopod identification keys to Histioteuthidae, Cranchiidae and Octopodiformes of the Azores, with an updated check-list

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This work is a combination of unpublished cephalopod identification keys compiled by Malcolm R. Clarke for the Azores region (Central North Atlantic) and a review of the Octopoda of the Azores by João Gonçalves (MSc Thesis 1993, originally written in Portuguese), updated with recent literature. A regional list of cephalopod species of the Azores is provided totaling 83 species, with identification keys for: *i*) Histioteuthidae, including five species; *ii*) Cranchiidae, including eleven species; and *iii*) Octopodiformes, including *Vampyroteuthis infernalis* Chun, 1903 (Order Vampyromorpha), three cirrate and fourteen incirrate octopuses. Separate keys are given for Octopodiformes species. The revisions are discussed and a more detailed description of Octopoda species is included.

Key words: Atlantic, Azores, cephalopods, identification key, check-list

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INTRODUCTION

The occurrence of cephalopods in the Azores has been known since the colonization of the archipelago in the 15th century, when the population started to use the common coastal species (common octopus and squid). However, scientific study was only initiated in the middle of the 19th century. In fact, Drouët (1858) was the first to report cephalopods of this region with a list of six species. Since then, the number of species has steadily increased, most of which are oceanic squids.

Oceanic cephalopods are a particularly complicated study object due to the difficulty of collecting specimens (Clarke 1996). In the Azores region (here defined as the Azorean EEZ, 36-40º N, 25-32ºW), as in other areas surrounded by a vast expanse ocean, knowledge of these mollusks has come from a diversity of sources. Samples collected during scientific research cruises are probably most important. However, fishermen, nautical tourism operators and even curious people often collect opportunistic specimens that are very valuable for improving our knowledge on the subject.

Malcom R. Clarke was a scientist who contributed massively to improving scientific knowledge of cephalopods of the Azores (e.g. Clarke 2006); see Gomes-Pereira et al. 2014; Rodhouse et al. 2014). He had huge expertise in the identification and ecology of oceanic cephalopods, which he shared enthusiastically with young scientists. He compiled an identification key for the Azores region for use in workshops (e.g., Xavier et al. 2007), in which he included 78 species for the region, a work that unfortunately never was published (Clarke 2000, unpublished). Thus, we share this important and poorly known work with updated information.

METHODS

The following cephalopod identification keys use simple diagnostic features, and were developed by Malcolm Clarke (MC) in the early 1990s, when he coordinated several dietary studies in the region (Clarke 2000, unpublished). The information on Octopoda of the Azores originates in the unpublished M.Sc. thesis of J. Gonçalves (Gonçalves 1993). Following these works, keys to the Histioteuthidae, Cranchiidae, Octopodiformes, and Octopodidae are provided, and keys for other families will be developed in future works.

The manuscript of MC is revised for a) synonymy, b) new regional records c) and species descriptions. It is also updated in order to avoid trichotomous branching of identification keys that occurred in the some cases in the original version. The taxonomy is adopted from Jereb et al. (2014). Invalid old names have been replaced and new species added, following revisions on cephalopod species of the Azores (Gonçalves 1991; Cardigos & Porteiro 1998) and some more recent records have been included. The species lists presented before each identification key in the original MC document, have been moved to Annex 1, in order to facilitate comprehension of the identification keys. Two species of *Opistoteuthis* are included following the descriptions of Villanueva et al. (2002). The key to the Octopodidae of the Azores is extended, based on the work of Gonçalves (1993), as well as Roper et al. (1984), Jereb et al. (2014) and Strugnell et al. (2014). The key was kept as originally developed, designed to identify only females of argonautoid octopods (*Tremoctopus* sp., *Haliphron atlanticus*, *A. argo* and *Ocythoe tuberculata*), with some notes given on sexual dimorphism. The rationale for changes concerning species additions and synonymies is covered under Discussion.

RESULTS

Identification keys for the cephalopods of the Azores are by taxon: Histioteuthidae, Cranchiidae, Octopodiformes, and Octopodidae, as originally arranged in the MC keys. The updated checklist of species occurring in the Azores Exclusive Economic Zone (EEZ) is presented at the end of the paper (Annex 1).

HISTIOTEUTHIDAE

1. Web between arms forms an umbrella, with a deep inner web. Terminal elongated, black photophores on arm tip.

Histioteuthis bonnellii (Ferrussac, 1835)

- Web between arms absent or does not extend more than 20% of arm length. No elongated, black photophores on arm tips. 2

2. More than 5 series of photophores on the bases of the fourth arms. Cartilaginous ridges bearing a row of pointed cusps along the length of arms I, II and III, and along the dorsal midline.

H. meleagroteuthis (Chun, 1910)

- Fewer than 4 series of photophores on the bases of the fourth arms. No cartilaginous ridges bearing pointed cusps on arms or dorsal midline 3

3. Rings of arm suckers with teeth. Central suckers of club 3-4 times the diameter of peripheral suckers. Dorsal part of funnel organ has longitudinal ridge or flap on each limb 4

- Rings of large arm suckers smooth. Largest central suckers no more than 3 times the diameter of marginal suckers. Limbs of dorsal part of funnel organ smooth 5

4. Arms 2-2.5 times ML (in adults). Shallow outer web between arms up to 14% of longest arm. All photophores on ventral mantle similar in size. 17 photophores around right eye. Limbs of dorsal part of funnel organ with triangular flap. Head length 50-75 % ML. Skin often has small fleshy papillae. Male reproductive organs double

Stigmatoteuthis arcturi (Robson, 1948)

- Arms 1-1.5 times ML, (in adults). Shallow outer

web between arms absent. Large photophores on ventral mantle alternating with small. 17 large and one small photophores around right eye. Limbs of dorsal part of funnel organ with ridge but no flap. Head length in mature males 33-50 % ML. Head length in mature females markedly shorter than length of greatly elongated mantle. Skin smooth. Male reproductive organs single
H. reversa (Verrill, 1881)

5. Central suckers of club not more than l.5 times diameter of marginal suckers. Arm tip photophores (dorsal series) are separated from proximal photophores by a free space. Mantle elongate with cylindrical anterior part. Rings of marginal ventral row of suckers on club not widened
H. celetaria celetaria (G.Voss, 1960)

- Central suckers of club 2-3 times the diameter of marginal suckers. Dorsal series of arm tip photophores run to tips without interruption. Mantle conical or goblet-like. Rings of marginal ventral row of suckers widened on club.
H. corona (N. Voss & G. Voss, 1962)

CRANCHIIDAE

1. Cartilaginous tubercles (cristae) on mantle-funnel and nuchal fusions 2

- No cartilaginous tubercles on mantle-funnel and nuchal fusions 4

2. Cartilaginous tubercles all over body, body almost globular in small specimens, with larger individuals somewhat elongate
Cranchia scabra Leach, 1817
- Cartilaginous tubercles restricted to parts of the body, which is not globular 3

3. Cartilaginous tubercles in single row
Leachia spp. Lesueur, 1821

- Cartilaginous tubercles in inverted V-shape
Liocranchia rheinhardtii (Steenstrup, 1856)

4. Body sac-like, fins subterminal and paddle-shaped
Bathothauma lyromma Chun, 1906

-Body pointed, fins terminal 5

5. Fins short and paddle-like, attached to the gladius on dorsal projection, large funnel, arms short 6

-Fins elongated 7

6. Large chromatophores
Helicocranchia pfefferi Massy, 1907

-Body and head covered with small black photophores *H. joubini* (G. Voss, 1962)

7. Hook-like teeth on tentacle sucker rings, elongated body 8

-Teeth on tentacle sucker rings not hook-like, broader elongated body 9

8. Single hooks on tentacles, pointed body, slim, long lanceolate narrow fin with insertion on shell sac *Galiteuthis armata* Joubin 1898

- Two large teeth make double hooks on tentacle, long lanceolate narrow fin with anterior insertion on gladius *Taonius pavo* (Lesueur, 1821)

9. Digestive gland with six distinct photophores on its rounded ventral side *Megalocranchia* spp.

- No well defined photophores under digestive gland, no photophores on any arm tips 10

10. Four series of suckers on tentacle stalks
Teuthowenia megalops (Prosch, 1847)

-Two series of suckers on tentacle stalks
Egea inermis Joubin, 1933

OCTOPODIFORMES

1. Broad fins, tissue gelatinous, arms joined by web and cirri 2

- No fins 5

2. Black skin, two white filaments between bases of arms I and II
Vampyroteuthis infernalis Chun, 1903

- Pale or reddish-brown skin, no filaments 3

3 Animal normally elongated on longitudinal axis. No secondary web, dorsal side of web attached to aboral side of arms as far as tips of arms. Ventral side attached only as far as middle of arm. Round or oval hollow inflation with firm walls where web is attached to lateral side of arms. *Grimpoteuthis umbellata* (Fischer, 1883)

- Animal flattened in anterior-posterior plane 4

4. Arm sucker count in adults 73 to 80. Suckers 29–31 usually largest and sucker enlargement in distal field approximately equal on all arms. First cirrus usually occurs between suckers 2 and 3.
Opisthoteuthis grimaldii (Joubin, 1903)

- Mantle length longer than 50 mm. TL up to 350 mm. Arm sucker count in adults 82–106. Distal sucker enlargement absent on arms I, slight on arms II, greatest on arms III and IV with suckers 40 or 41 usually largest. First cirrus typically occurs between suckers 3 and 4 or 4 and 5.
Opisthoteuthis massyae (Grimpe, 1920)

5. Body gelatinous (translucent /transparent) 6

- Body muscular (opaque) with few exceptions 10

6. Arms shorter or equal to mantle. Presence of ring light organ (yellowish) around the mouth in mature females (fresh animals). Digestive gland oval shaped. Suckers in one series on arms. 7

- Arms longer than mantle 8

7. Brain optic stalks shorter or equal to the eye diameter (optic gland against brain). Eyes normal (> 18% of ML) and close (little space between them). Red-toned skin. Suckers very close (space between continuous ones smaller than sucker diameter). *Japetella diaphana* Hoyle, 1885

- Optic stalks several times longer than eye diameter. Small eyes (9-12% of ML), more widely spaced. Suckers more widely spaced (space between continuous ones larger than its diameter). Mature males have modified III arms: right arm III has 1-3 enlarged suckers; left arm III is hectocotylised with elongated ligula.
Bolitaena pygmaea (Verrill, 1884)

8. Body very transparent, vitreous, suckers in a single series, enlarging outside web. Mantle with a wide opening. Long pointed digestive gland perpendicular to the mantle axis. Small rectangular eyes (9-17% of ML), large space between them (optic gland distant from brain).
Vitrelledonella richardi Joubin, 1918

- Non transparent skin 9

9. Very gelatinous, fragile, with few chromatophores and is almost transparent (Voss, 1967). Female mantle length to at least 328 mm. Male mantle length to at least 10 mm.
Tremoctopus gelatus Thomas, 1977

- Smooth dark reddish skin with a chromatic mottled pattern in fresh animals. Mantle with wide opening. Funnel embedded in the head, but with a free tip. Deep web extending along the arms. Suckers in two series on parts of the arms (parallel or not), at least in arms section without web. Females can reach large sizes. Males much smaller than females with hectocotylus inside a sac underneath right eye giving appearance of having only seven arms.
Haliphron atlanticus Steenstrup, 1861

10. Presence of cephalic water pores or "external shell", pelagic animals 11

- Absence of cephalic water pores or "external shell", bottom living animals Octopodidae (see key for Octopodidae)

11. Large flaps of skin on dorsal arms in females, dwarf males 12

- Female has no large flaps of skin on arms, reticulated pattern on ventral mantle, with numerous tubercles. Dorsal surface greyish and ventral yellowish-orange, iridescent in the mantle of fresh animals. Arms II and IV longest. A single pair of cephalic water pores on ventral surface of head. Dwarf males (can reach 69 mm TL), have right III arm hectocotylised.

Ocythoe tuberculata Rafinesque, 1814

12. Animals without a thin external calcareous shell 13

- Flap of skin only attached to arm I in females which secrete a calcareous shell to brood eggs. Presence of a narrow, thin and wavy external calcified chamber (<30 cm diam.), surrounded by a thin skin membrane. Females live inside chamber. Dwarf males (TL <15 mm), left III hectocotylised, which can be longer than body and be retracted within a sack above the eye. Males might live inside pelagic salps.

Argonauta argo Linnaeus, 1758

13. Muscular body. Females large (< 2000 mm TL) with very thin flap of skin (veil) between the longest arms (I and II) (as large or longer than arms), with 2-6 large ocular spots. Two pairs of cephalic water pores in the head: one above dorsal side, another in the ventral side. Dwarf male (mantle length can reach 15 mm) has right III arm hectocotylised,

Tremoctopus violaceus Delle Chiaje, 1830 *in* 1823-1831.

OCTOPODIDAE

1. Adults of small to medium size (<500 g). Presence of cirri above the eyes (the prominence of these depends on the state of contraction of the body or the type of conservation liquid). Males with left arm III hectocotylised. 2

- Adults of medium or large size (usually > 500 g). No cirri above the eyes or very little prominent. Males with right third arm hectocotylised 3

2. Body soft, flabby (slightly gelatinous), skin smooth or with few solitary warts, colouration uniformly orange in live animals, two cirri well visible above each eye. Head equal or slightly larger than the rest of the body. Web 30-40% of longest arm L, funnel organ VV or W shaped, ligula and calamus are short (3-7% arm L). Gills with 9/10 external lamellae. No skin fold along sides of body.

Pteroctopus tetracirrhus (Delle Chiaje, 1839-1841)

- Body firm, skin covered in flat-topped papillae, one cirrus above each eye (sometimes multilobbed), webs 20-30% (<40%) of length of longest arm, funnel organ W-shaped (rarely VV), ligula and calamus long (8-10% arm L). Skin folds along sides of body, forming an almost continuous line, slightly salient, separating ventral area. Ventral colouration lighter than dorsal. Gills with 11/14 external branchial lamellae.

Scaergus unicirrhus (Delle Chiaje, 1839-1841)

3. Dorsal arms (I) shorter than lateral arms (II and III) 4

- Dorsal arms (I) longest and thickest (or coequally stoutest with arms II). Right arm III of males hectocotylized by modification of tip to a large stout, tubular ligula (up to 14% of hect. arm). Animals of average size (normally 300-500 g, but exceptionally 2 kg). Colouration of live animal generally reddish/orange with white spots over the mantle, in two series above the dorsal surface of arms, in the periphery of the web and

between the arms and at the base of the suckers. Spots sometimes still visible in fixed animals (although in this case not whitish, but slightly lighter than the rest). Gills with 9/13 external lamellae. *Callistoctopus macropus* (Risso, 1826)

4. Adult animals large (normally 1-3 kg, up to 15 kg). Arms moderately long, dorsal arms (I) shorter than the others. Skin slightly rugged (in fresh animals) or covered by small vesicles (fixed animals), and small cirri or papillae can occur in the mantle (especially if the animal is contracted and in fixed animals). Colouration very variable but generally heterogeneous, reddish-brown, greyish, with a reticulated pattern. May have two white patches in front and below both eyes (in live animals). Gills with 7-11, generally 8 external lamellae. Shortened right arm III of males, hectocotylized by modification of tip into a very small, spoon-shaped small ligula (<2.5% of hect. arm) *Octopus vulgaris* (Cuvier, 1797)

- Animals of medium size (normally < 500 g, can exceptionally reach 2 kg). Arms very long, typically >5 times ML, Smooth skin. Membrane between arms well developed, extending almost to arm tips, being much wider on ventral side of arms. Gills with 9/10 external lamellae. Small cirri on top of each eye. Colour of fresh animal white or cream, with small spots of more clear tone (hyaline) throughout the body, especially in the web between the arms (seen at transparency). Males with long ligula (~15% hect. arm).
Octopus salutii Verany, 1839

DISCUSSION

The updated checklist of cephalopod species known from the Azores EEZ consists at present of 83 species (Annex 1). Some species that were not in the MC list, but reported by Cardigos & Porteiro (1998), have also been added. This is the case for the Sepiolidae *Rossia macrosoma*, reported by Joubin (1895) based on a stomach content record collected south of Flores Island. The same applies to the squid *Octopoteuthis sicula*, reported by Joubin (1920), who collected a young specimen with a net at the surface SW of São Miguel Island (station 2172: 36º 50' N, 26º 50'W) on 23/08/1905.

On the other hand, some species reported by Cardigos & Porteiro (1998), have not been included in the final list, as they are species collected outside the actual Azorean EEZ. This is the case for *Mastigoteuthis agassizii* Verrill, 1881 reported by Lu & Clarke (1975) based on two specimens caught on 06/10/1970 in a RMT net at 1000-1250 m depth NE of S. Miguel island (40ºN; 20ºW), and *Echinoteuthis danae* Joubin, 1933, reported by Kristensen & Knudsen (1983) based on a specimen caught in a net at 800 m depth during a "Dana" campaign SW of Flores Island (34º 40'N, 33º16'W- Station 1368). The presence of *Hyaloteuthis pelagica* (Bosc, 1802) also reported from the Azores by Cardigos & Porteiro (1998), based on Roper et al. (1984) could not be confirmed and was therefore excluded.

An intriguing circumstance relates to the occurrence of the cuttlefish *Sepia officinalis* Linnaeus, 1758, in his first report of the cephalopods of the Azores, Drouët (1858, 1861) mentioned the regular presence of this species in the archipelago (coasts of Pico and São Miguel islands). Later Dautzenberg (1889) and Girard (1892) also referred to Drouët. Boletzky (1983), in a review of the species, reported *S. officinalis* in the Azores based on a distribution map only, without reference, but presumably pertaining to the records of the previous authors. However, Drouët (1858, 1861) seems to be the only author who observed first hand its presence in the Azores, and *Sepia officinalis* has not been considered in subsequent checklists. However, curiously, in May 2007 a cuttlefish was photographed near the shore of Santa Maria Island by the biologist João Monteiro (pers. comm.) during a diving expedition (Luso Expedition – S/Y CREOULA). Despite being a single record it was decided to include this species in the final list (Annex 1).

Histioteuthidae

Most of the Histioteuthidae species were reported from the Azores by Clarke et al. (1993), from fresh specimens found in sperm whales *Physeter macrocephalus* stomach contents. Five species of

this family are known in the region (Annex 1). *Histioteuthis dofleini* (Pfeffer, 1912) reported by Cardigos & Porteiro (1998) is nowadays considered a synonym of *Stigmatoteuthis arcturi* and *H. elongata* (Voss & Voss, 1962) is considered synonymous with *H. reversa* (Roper & Jereb, 2010). Sexual dimorphism of *H. reversa* was included following Voss et al. (1998). *Histioteuthis meleagroteuthis* was added to the list and identification key based on species identified from beaks taken from sperm whales caught off Pico (Clarke et al. 1993).

Cranchiidae

The eight species of Cranchiidae reported for the Azores by Cardigos & Porteiro (1998) were increased to 12 species after adding the species from the MC original list. *Megalocranchia* sp. mentioned in the original list represents in fact more than one unidentified species of this genus, as stated by Clarke et al. (1993).

Octopodiformes

The Octopoda of the Azores have been reported since the earliest molluscan studies in the region by Drouet (1858) and Prince Albert of Monaco I campaigns (e.g., Dautzenberg 1889; Joubin 1920, 1924). More recently, Gonçalves (1991, 1993) reviewed the Octopoda records for the Azores, clarified old misspellings and synonymies and added two species, making a total of 14 species. Porteiro & Cardigos (1998) added two more, *Bolitaena microcotyla* Hoyle, 1904 and *Eledonella pygmaea* A.A. Verrill, 1884 that nowadays are considered synonyms of *B. pygmaea* (Norman & Finn 2014). *Eledonella pygmaea* Hoyle, 1886, present in the MC list (not in the identification key), corresponds nowadays to *B. pygmaea*. Recently, Vecchione et al. (2010) reported the capture of *B. pygmaea* inside the Azorean EZZ in 2004 (42,9ºN; 29,1-6ºW), close to the NW limit.

The occurrence of *Japetella diaphana* Hoyle, 1885, in the Azores, reported by Gonçalves (1991, 1993), was based on Joubin (1920, 1924), however, it had been recorded earlier as *Bolitanea diaphana* Hoyle, 1885, by Murray et al. (1912), from a specimen caught in 1910 (Station 54) during the *Michael Sars* Expedition. This species was later caught inside the Azores EEZ as reported by Joubin (1937; Station 1370 – 13-6-1922: 4 individuals) and more recently caught during the *G.O. Sars* Expedition (2004) as reported by Vecchione et al. (2010; 2 specimens). Other occurrences of this species close to the Azorean EEZ have also been reported (e.g. Lu & Clarke, 1975).

Opisthoteuthidae

Grimpoteuthis grimaldii Joubin, 1903 was present in the original MC list but is now known as *Opisthoteuthis grimaldii* (Joubin, 1903). It was described from the Azores by Joubin (1903) as *Cirroteuthis grimaldii* Joubin, 1903 (junior synonym); there are no further records in the region. According to Villanueva et al. (2002), *Opisthoteuthis grimaldii* and *O. massyae* Grimpe, 1920 have both been reported in the Azores but not *O. agassizii* Verrill, 1883 which is restricted mostly to the Gulf of Mexico and the Caribbean Sea. The latter species was, however, reported for the Azores by Porteiro and Cardigos (1995), apparently erroneously citing Joubin (1900). In the MC original identification key only *Opisthoteuthis depressa* Ijima & Ikeda, 1895, was mentioned, a species only known from waters off Japan, and thus removed from the final list. Therefore, only *O. grimaldii* and *O. massyae* are included, and diagnostic information on *Opistoteuthis* has been added following Villanueva et al. (2002). *Grimpoteuthis umbellata* (Fischer, 1883) is present in the MC identification key and has been added to the species list (Annex 1). The systematics of cirrate octopods should be considered with caution. Systematic instability in this group reflects a scarcity of records and the loss or degradation of several type specimens. Recent descriptions of several new species, some of them from the North Atlantic (e.g. Villanueva et al. 2002; Collins 2003) may help clarify this issue.

The families Amphitretidae Hoyle, 1886 and ldioctopodidae Taki, 1962 were mentioned in the MC original list without genera or species, and were absent from the key. There are no such records for the Azores, and these families have therefore not been included in the final list.

Benthoctopus ergasticus (Fischer & Fischer, 1892), included in the original MC list, has been reclassified as *Bathypolypus ergasticus* by Muus (2002). *Bathypolypus sponsalis* (Fischer & Fischer, 1892) was also in the MC list, but as far as we know there are no records of this species within

the Azorean EEZ. Both species inhabit deep waters in the NE Atlantic, from south Ireland to Cape Verde islands (Muus 2002). *Bathypolypus sponsalis* is found at depths between 170 and 1835 m (Quetglas et al. 2001; Muus 2002) and *B. ergasticus* between 510 to 1370 m (Muus 2002). Despite a highly reasonable expectation that both species might be found in the Azorean EEZ, they have not, so far, been recorded, and for this reason they are excluded from the identification key and the final list (Annex 1).

The presence of *Bentoctopus* in the Azores is still problematic (Gonçalves 1991, 1993). A female individual with 178 mm (total length) was caught in 1896 at 1600 m depth, at south of Flores island (Station. 719) by Joubin (1900) and classified as *Octopus levis* Hoyle, 1885 with affinities to *Octopus januarii* Steenstrup. Later, Robson (1932) considered this species as *Benthoctopus* (?) *pseudonymus* with affinities to *Benthoctopus piscatorium.* The type specimen of the latter corresponds to *Bathypolypus arcticus* (Muus 2002). Looking into the original description of Joubin (1900) and the additional observations of Robson (1932) for this species, the absence of ink sac, the smooth skin without ocular cirri, the biserial suckers, are in agreement with the definition of *Benthoctopus* made by Voss (1988a, b). However, other features of this specimen (arm formula 1>2>3>4; arm index (arm length/total length) = 69% (Joubin 1900), or 77% (Robson 1932); small gills with 5½ filaments in each demibranch; small suckers (6,4 % of DML) of similar size, in two series, and widely spaced; short and sub-equal web (33%); funnel organ VV shaped (Robson 1932); do not correspond to known species of this genus, such as *Benthoctopus oregonae* Toll, 1981, *B. januarii* Toll, 1981, *B. normani* Allcock et al., 2006 and *B. johnsonianus* Allcock et al., 2006, reported for the NE Atlantic (Jereb et al. 2014). The shape of the funnel organ and the number or branchial lamellae also does not agree with the features of *Muusoctopus* described by Gleadall (2004; W shaped funnel organ and 7-10 gill lamellae). It should be noted that the genus *Benthoctopus* was attributed to several deep-water octopuses with two rows of suckers and no ink-sack and is currently in need of revision (Muus 2002; Strugnell et al. 2009). Thus, it is advisable to keep the Azorean record as *B. pseudonymus* (Grimpe, 1922) until new information is available. Additionally, *Benthoctopus pseudonymus* was considered a valid species by Norman & Hochberg (2005) and reported from the Azores by Norman et al. (2014).

Some benthic octopus species reported from the Azores by Gonçalves (1991,1993) were also added to the final list namely *Octopus salutii* and *Callistoctopus macropus* (Risso, 1826), previously known as *O. macropus*, genus name changed by Norman & Hochbert (2005). Finally, a recent occurrence of the rare species *Tremoctopus gelatus* in 2015 in Faial Island, was also added to the list (see Gonçalves et al. in this issue).

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ANNEX 1 – UPDATED LIST OF CEPHALOPODS OF THE AZORES EEZ

Notes on ecology are included for some species, *facsimile* of the original unpublished document by Malcolm Clarke.

Class CEPHALOPODA Cuvier, 1798
Subclasse COLEOIDEA Bather, 1888

Order SEPIIDA Naef, 1916
Family **Spirulidae** Owen, 1836
Spirula spirula – Oceanic, midwater

Order SEPIOLIDA Clark,
Family **Sepiidae** Keferstein, 1866
Sepia officinalis

Family **Sepiolidae** Leach, 1817
Heteroteuthis dispar – Seamounts
Rossia macrossoma

Order TEUTHOIDEA Naef, 1916
Suborder **MYOPSIDA** Orbigny, 1845
Family **Loliginidae** Steenstrup, 1861
Loligo forbesi - Shelf, midwater

Suborder **OEGOPSIDA** Orbigny, 1845
Family **Lycoteuthidae** Pfeffer, 1908
Lycotheuthis diadema - Oceanic

Family **Enoploteuthidae** Pfeffer, 1900
Abraliopsis pfefferi - Oceanic, mesopelagic
Abraliopsis morisi - Oceanic
Abralia veranyi - Oceanic
Enoploteuthis leptura - Oceanic, mesopelagic

Family **Ancistrocheiridae** Clarke, 1988
Ancistrocheirus lesueuri - Oceanic, slope, bottom

Family **Pyroteuthidae** Clarke, 1988
Pyroteuthis margaritifera aurentiaca
Pteryrgioteuthis giardi
Pteryrgioteuthis gemmata

Family **Octopoteuthidae** Berry, 1912
Octopoteuthis spp. Oceanic, mesopelagic
Octopoteuthis "gigas" Oceanic
Octopoteuthis rugosa Oceanic
Octopoteuthis sicula
Taningia danae - Slope, bottom

Family **Onychoteuthidae** Gray, 1849
Onychoteuthis banksii - Oceanic, mesopelagic.
Onychoteuthis borealis-japonicus - Oceanic, mesopelagic.
Onychia carribaea - Oceanic, mesopelagic
Ancistroteuthis lichtensteinii - Oceanic, mesopelagic
Moroteuthis sp.

Family **Cycloteuthidae** Naef, 1923
Discoteuthis laciniosa -Oceanic, mesopelagic
Discoteuthis discus

Family **Gonatidae** Hoyle, 1886
Gonatus steenstrupi - Oceanic, N. Atlantic
Gonatus fabricii - Oceanic, Arctic

Family **Lepidoteuthidae** Naef, 1912
Lepidoteuthis grimaldii

Family **Pholidoteuthidae** Voss, 1956
Pholidoteuthis boschmai - Oceanic, slope, ?near bottom

Family **Architeuthidae** Pfeffer, 1900
Architeuthis dux - Slope, seamounts, ?near bottom

Family **Histioteuthidae** Verrill, 1881
Histioteuthis bonnellii bonnellii - Above slopes
Histioteuthis reversa - Oceanic midwater
Histioteuthis corona corona - Oceanic, mesopelagic
Histioteuthis celetaria - Oceanic, mesopelagic
Histioteuthis meleagroteuthis Oceanic, mesopelagic?

Family **Stigmatoteuthidae**
Stigmatoteuthis arcturi - Oceanic, midwater

Family **Neoteuthidae** Naef, 1921
Neoteuthis thielei - Oceanic, mesopelagic

Family **Bathyteuthidae** Pfeffer, 1900
Bathyteuthis abissicola - Oceanic, mesop.

Family **Chtenopterygidae** Grimpe, 1922
Chtenopterus sicula - Oceanic, mesopelagic

Family **Brachioteuthidae** Pfeffer, 1908
Brachioteuthis reesi

Family **Ommastrephidae** Steenstrup, 1857
Ommastrephes bartrami - Oceanic, midwater
Sthenoteuthis pteropus - Oceanic, mesopelagic
Todarodes sagittatus

Family **Thysanoteuthidae** Keferstein, 1866
Thysanoteuthis rhombus - Oceanic, midwater

Family **Chiroteuthidae** Gray, 1849
Chiroteuthis veranyi
Chiroteuthis joubini
Valbyteuthis sp.

Family **Mastigoteuthidae** Verrill, 1881
Mastigoteuthis hjorti
Mastigoteuthis magna
Mastigoteuthis glaucopis
Mastigoteuthis grimaldii

Family **Grimalditeuthidae** Pfeffer, 1900
Grimalditeuthis bonplandi

Family **Joubiniteuthidae** Naef, 1922
Joubiniteuthis portieri

Family **Cranchiidae** Prosch, 1849
Cranchia scabra
Liocranchia reinhardti
Helicocranchia pfefferi
Helicocranchia joubini
Teuthowenia megalops
Taonius pavo
Galiteuthis armata
Megalocranchia spp.
Bathothauma lyromma
Leachia spp.
Egea inermis

OCTOPODIFORMES (AZORES)
Order VAMPYROMORPHA Pickford, 1939
Family **Vampytoteuthidae** Thiele, 1915
Vampyroteuthis infernalis

Order OCTOPODA Leach, 1818
Suborder **CIRRATA** Grimpe, 1916
Family **Opisthoteuthidae** Verrill, 1896
Opishtoteuthis grimaldii
Opisthoteuthis massyae
Grimpoteuthis umbellata

Suborder **INCIRRATA** Grimpe, 1916
Family **Bolitaenidae** Chun, 1911
Japetella diaphana
Bolitaena pygmaea

Family **Vitreledonellidae** Robson, 1932
Vitreledonella richardi

Family **Octopodidae** Orbigny, 1845
Octopus vulgaris
Octopus salutii
Callistopus macropus
Benthoctopus pseudonymus
Scaergus unicirrhus
Pteroctopus tetracirrhus

Family **Tremoctopodidae** Brock, 1882
Tremoctopus violaceus
Tremoctopus gelatus

Family **Ocythoidae** Gray, 1849
Ocythoe tuberculata

Family **Argonautidae** Naef, 1912
Argonauta argo

Family **Alloposidae** Verrill, 1882
Haliphron atlanticus