

cysts usually in pairs at base of primary tentacles.

Hydroid: Only known in *Olindias phosphorica* see below.

***Olindias phosphorica* (Delle Chiaje, 1841)**
(Figs. 120B-E)

Medusa: umbrella 40-60 mm wide, almost hemispherical, mesoglea fairly thick; 11-19 centripetal canals per quadrant; 30-60 primary tentacles; usually two statocysts at base of each primary tentacle; 100-120 secondary tentacles; 100-170 marginal clubs.

Hydroid: the polyps have not been yet found in field. Weill (1936) described from laboratory observations a small solitary hydranth without tentacles enclosed in a cylindrical or irregularly curved hydrothecae covering more than half its length, and much longer than the polyp itself; mouth distal surrounded by large cnidocysts.

Records from Mediterranean: western Mediterranean, Adriatic.

Known seasonality: 6-11.

Distribution: Atlantic; Mediterranean.

References: Kramp (1961); Goy (1973b); Castella i Tortella (1986); Gili (1986); Brinckmann-Voss (1987); Boero and Bouillon (1993); Avian *et al.* (1995); Medel and López-González, 1996; Goy (1997).

Genus *Scolionema* Kishinouye, 1910

Hydroid: solitary, small, and discoid; with not well defined hypostomial region, with up to 5 tentacles; presenting varied and intensive lateral asexual budding; medusa buds, frustules, cysts.

Medusa: Olindiidae without or with slight peduncle; with 4 simple radial canals; without centripetal canals; with folded gonads on 1/2 to 1/3 of distal part of radial canals only; with evenly distributed marginal tentacles all of one kind, with rudimentary organs of adhesion; with never more than 16 statocysts enclosed in mesoglea.

***Scolionema suvaensis* (Agassiz and Mayer, 1899)**
(Figs. 120F-H)

Hydroid: solitary, small, short, flat, discoid, with not well defined hypostomial region, with up to 3-5 tentacles; hydranths embedded in diatoms and detritus, presenting intensive lateral asexual budding of frustules or of resting stages (cysts) depending on environmental condition and more seldom medusa buds, after

medusa bud formation the hydranth is reduced to a kind of frustule without mouth and tentacles.

Medusa: umbrella 9 mm wide, about 6 mm high, mesoglea thick; gastric peduncle indicated; manubrium cruciform, about half as long as umbrella cavity; mouth with four small lips; gonads extending along distal 1/2 - 1/3 of radial canals, ribbon-shaped, much folded; 40 to 70 marginal tentacles of different lengths, with globular marginal bulbs, cnidocysts rings along whole length of tentacles, distal end sharply bent; adhesive pads rudimentary except in old tentacles; 16 statocysts; medusa budding on radial canals.

Reference: Goy (1973a).

***Limnomedusae* incertae sedis**

Genus *Calpasoma* Furmann, 1939

Hydroid: living in freshwater, of small size (100-600 µm); solitary but sometimes bi- or tripolar; 2 irregular whorls of tentacles at oral end, each tentacle consisting of a process of a single ectodermal cell (tentaculocyte) scattered with a few cnidocysts; hydranth reproducing only asexually, forming new polyps of their own type or frustules, never producing medusae; sometimes considered as a tentaculate form of *Craspedacusta* but no inter-conversion has been observed between the two forms. Following the authors they are considered or as two distinct species or as two stable forms of the same species.

***Calpasoma dactyloptera* Fuhrmann, 1939**
(Fig. 121A)

With the characters of the family.

Records from Mediterranean: fresh water aquariums in Israel.

Known seasonality: all the year ?

Distribution: Brazil; Hawaii; Hungary; Israel; Switzerland; USA (Indiana).

References: Furmann (1939); Rahat and Campbell (1974); Jankowski (2001).

Subclass SIPHONOPHORAE Eschscholtz, 1829
(Figs. 14, 15, 19)

Pelagic, pleustonic or epibenthic Hydrozoa, forming highly polymorphic modular colonies of polypoid and medusoid zooids attached to a stem or stolon supported by a floating and/or swimming system.

Polypoid zooids of several sorts: pneumatophore, gastrozooids, dactylozooids, and bracts. All of them usually associated with the gonophores in repetitive groups, or cormidia, along the stolon. All polypoid structures without oral tentacles. The part of the stem below the floating system, bearing the cormidia, is the siphosome, usually representing most of animal's length. Floating system composed by pneumatophores and/or nectophores (swimming bells) together forming the nectosome. The complete and fully developed animal is referred as the polygastric stage. Histologically, the polypoid and medusoid zooids resemble the corresponding types of Hydroidomedusae.

Three orders of Siphonophorae may be distinguished on the basis of the presence or absence of either an apical pneumatophore or of nectophores grouped in a nectosome: the Cystonectae possessing only a pneumatophore; the Physonectae possessing both a pneumatophore and a nectosome; the Calycophorae with only a nectosome.

Cnidome. The Siphonophorae have a cnidome of 9 cnidocyst types depending on the suborders: acrophores, anacrophores, desmonemes, stenoteles, homotrichous anisorhizae, atrichous isorhizae, microbasic mastigophores and birhopaloids, 4 of them being exclusive to the group but not common to all species: acrophores, anacrophores (doubtfully recorded for *Tiaricodon coeruleus* by Wenqiao and Xu, 1990), homotrichous isorhizae and birhopaloids. The cystonects seem to possess only isorhizae and stenoteles; the physonects have a general cnidome formed by acrophores, desmonemes, homotrichous anisorhizae, atrichous isorhizae, microbasic mastigophores, stenoteles and birhopaloids, the latest being exclusively found in the apolemiids *Apolemia uvaria* and *Tottonia contorta*; the calycophorans have anacrophores, desmonemes, stenoteles, homotrichous anisorhizae, microbasic mastigophores. The singlet microtubules of the cnidocyst cilium are very numerous, varying from 300 to 400, whereas in the other Hydrozoa the number varies between 8 and 22.

Remarks: the Siphonophorae can be considered as colonies of cormidia, formed by polypoid structures that are so specialised to be assimilated to the organs of an individual (the colony). They are sometimes considered as an enlarged larval nurse carrier or paedophore not becoming sexually mature but budding off sexual medusoids which may be released along with other stem constituents (Totton 1965). The cnidome suggests affinity with

the Anthomedusae since desmonemes, typical of this subclass, are present in some groups; also stenoteles are typical of Anthomedusae but are shared also with some Automedusae. Recent molecular analysis of siphonophore species also support their relationship with Anthomedusae (Collins, 2000, 2002). There is no alternation of benthic and pelagic life; the colonies remain pelagic along all their life-cycle (except the benthic-pelagic Rhodaliidae). Each gonophore has a limited number of eggs (1 in the Physonects, 2 to 30 in the Calycophores, see above), but a cormidium can form successive gonophores increasing the number of eggs, and the modular colonies, furthermore, are formed by numerous cormidia. Compared to most Antho- and Leptomedusae, whose benthic colonies are long-lived, can undergo a resting phase and to produce higher numbers of eggs or medusae, the Siphonophorae apparently have a much lower reproductive rate but little is known on this part of its biology.

References: Mackie and Boag (1963); Purcell (1984); Pagès and Gili (1992); Mackie *et al.* (1987); Kirkpatrick and Pugh (1984); Purcell and Mills (1988); Pugh (1999).

Order CYSTONECTAE Haeckel, 1887

Siphonophores with a relatively large pneumatophore and without nectosome; pneumatophore with apical pore; cormidia with gastrozooid, tentacle and gonodendron, without bracts; gonodendron with gonopalpons, gonophores and asexual swimming bells.

Key to the families

1. Pleustonic, pneumatophore horizontal Physaliidae
- Epi- and mesopelagic, pneumatophore oval to rounded Rhizophysidae

Family PHYSALIIDAE Brandt, 1835

This family is monotypic for *Physalia physalis*, the Portuguese Man O'War.

Reference: Totton, (1960), Carré and Carré (1995).

Genus *Physalia* Lamarck, 1801

Physalids with huge, asymmetric pneumatophore, purplish blue in colour, up to 30 cm in

length; top of the pneumatophore formed by an erectile "sail" running diagonally; cormidia attached to one side of the float, tentacles can stretch down many meters.

References: Totton (1960); Pagès and Gili (1992).

Physalia physalis (Linné, 1758)
(Figs. 121B-D)

The only pleustonic siphonophore. Colonies consisting of a large, purplish blue pneumatophore that floats on the sea surface, reaching about 30 cm in length in the largest specimens. The pneumatophore carries the polyps, which form cormidia at the oral end; its top an erectile sail, the all drifting at the mercy of the winds. Pneumatophore enantiomorphic, two forms, each the mirror image of the other. Each cormidium consisting of a gastrozoid associated with a tentacle and a gonodendron; however, unlike other siphonophores, tentacle separating from the basigaster during the later stages of development. The tentacles may attain several metres in length. Continuous formation of new cormidia. As the cormidia mature, new gastrozooids gradually lose their tentacles and becoming palpons. Small medusoid gonophores developing at the bases of the terminal palpons. Functional gonophores of a given colony are of a single sex only.

Records from Mediterranean: eastern and western Mediterranean, Adriatic.

Known seasonality: 3-6.

Distribution: widely distributed in tropical and subtropical regions in the three great oceans and sporadically found in the Mediterranean.

References: Totton (1965); Daniel (1974); Kirkpatrick and Pugh (1984); Gili (1986), Pagès and Gili (1992); Avian *et al.* (1995); Pugh (1999).

Family RHIZOPHYSIDAE Brandt, 1835

Oval-rounded pneumatophore with hypocystic villi at its base.

References: Carré and Carré (1995); Pugh (1999).

Genus ***Rhizophysa*** Péron and Lesueur, 1807
= *Epibulia* Haeckel, 1888

Rhizophysids with no wing-like processes (ptera) in young gastrozooids.

Reference: Purcell (1981a).

Rhizophysa filiformis (Forskål, 1775)
(Figs. 121E-F)

Pneumatophore oval, 4.9 mm high by 4.0 mm wide. Apical pore surrounded by a dark red circular spot. Pneumacodon, or outerwall, separated from pneumatosaccus, or inner wall, by a large cavity. Pneumatosaccus occupying the upper half of the pneumatophore. Hypocystic villi well developed occupying the lower half. Polyps developing at the base of the pneumatophore. Gastrozooids with three types of tentilla: tricornuate, the most common; palmate, or dendritic; and in the shape of a bird's beak. Gonotheca shaped like clusters of grapes located halfway between each pair of gastrozooids.

Records from Mediterranean: western Mediterranean.

Known seasonality: 2-9.

Distribution: Uncommon but widely distributed in the three great oceans and the Mediterranean.

References: Biegelow and Sear (1937); Pagès and Gili (1992); Mills *et al.* (1996); Pugh (1999).

Order PHYSONECTAE Haeckel, 1888

Siphonophorae with an apical pneumatophore and, beneath it, a series of nectophores, except the Athorybiidae which lack nectophores or with a reduced nectophore. Nectophores arranged in two opposite rows or circular chains forming the nectosomal region around the stem. Most of Physonectae present two budding zones, one under the pneumatophore giving nectophores and the other at the basal end of the nectosome, giving the cormidia that form the siphosome. Cormidia with bracts, with dactylozooids. Without asexual medusoids on the siphosome. When known with siphonula larvae.

Key to families (mostly after Pugh, 1999)

- 1. Nectophores present 2
 - Nectophores absent 7
- 2. Nectophores deeply hollowed axially and with tentacles between them; small delicate bracts.....
..... Apolemiidae
- Nectophores not hollowed axially, nectosomal tentacles absent..... 3
- 3. Nectosome and siphosome elongate, with a narrow stem 4
 - Nectosome and/or siphosome contracted or reduced 7
- 4. Nectophores bilaterally symmetrical, arranged

- biserially 5
- Nectophores dorso-ventrally flattened, usually asymmetric in shape, arranged in spiral..... Forskaliidae
- 5. Nectophores with straight dorsal radial canal.. 6
- Nectophores with sinuous dorsal radial canal..... Pyrostephidae*
- 6. Tentilla uncoiled; cnidoband hypertrophied; no cnidocyst on terminal process..... Erennidae*
- Tentilla coiled; cnidoband normal . Agalmatidae
- 7. Nectosome reduced or absent; siphosome reduced to solid body or corm Athorybiidae
- Nectosome normal..... 8
- 8. Nectosome elongated; siphosome shortened into laterally expanded spiral sac bearing enlarged palpons; bracts absent..... Physophoridae
- Nectosome and siphosome contracted to form a solid corm; with a pneumatophore and an aurophore Rhodaliidae*

*not present in Mediterranean Sea.

Family AGALMATIDAE Brandt, 1835

Physonect siphonophores with a biserial arrangement of nectophores in the nectosome and a long usually contractile siphosome. This is rather a catch all family. For many agalmatids four types of cnidocysts are present in the tentillum: homotrichous anisorhizas; either microbasic mastigophores or stenoteles; desmonemes and acrophores.

Remark: this is rather a catch all family.

References: Carré and Carré (1995); Pugh (1999).

Genus *Agalma* Eschscholtz, 1825

Agalmatids with tricornuate tentilla consisting of a central swelling and two contractile lateral filaments.

References: Pagès and Gili (1992); Mills *et al.* (1996).

Agalma clausi Bedot, 1888

(Figs. 122A-C)

Siphosomal stem rigid. Leaf-like bracts with deep red pigment spots on the surface, particularly the younger ones. Tricornuate tentilla that can be completely enclosed inside the involucre.

Records from Mediterranean: Strait of Messina, Alborán Sea.

Known seasonality: 4.

Distribution: Mediterranean and tropical Atlantic (Mills *et al.* 1996).

References: Bedot (1888); Mills *et al.* (1996).

Agalma elegans (Sars, 1846) Fewkes, 1880 (Figs. 122D-F)

Pneumatophore elongate, small, 1.1 mm high, apex red. Two rows of alternating nectophores attached to the stem. Nectophores V-shaped, with two prominent lateral wings. An apico-lateral ridge running from the apex of the lateral wing to the mid-point of the nectophore, an infero-lateral ridge running along the outer margin, and a latero-ventral ridge located on the central portion of the nectophore. Nectosac T-shaped. Pedicular canal short. Siphosomal stem contractile. Bracts triangular, elongate, foliaceous in appearance, dorsal surface convex, 9 mm long, with a central bracteal canal, extending to about four-fifths the length of the bract, occasionally continuing as a very fine canal to the distal end. Tentilla tricornuate.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: 12, 2 to 6.

Distribution: widely distributed in tropical and subtropical regions in the three great oceans and the Mediterranean (Alvariño, 1971).

References: Totton (1956, 1965); Palma (1973); Kirkpatrick and Pugh (1984); Pagès and Gili (1992); Lakkis and Zeidane (1995); Pugh (1999).

Agalma okeni Eschscholtz, 1825

(Figs. 122G-I)

Pneumatophore elongate, 7.0 mm high, apex pigmented. Nectophores similar to those of *A. elegans*, but nectosac Y-shaped. Bracts firm, up to 5.0 mm long, prismatic, triangular, gradually thickening towards the distal portion, which has three vertical ridges delimiting four distal facets. Bracteal canal filiform, central, not reaching the distal facets.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: 5 and 6.

Distribution: widely distributed in tropical and subtropical regions in all seas and in the Mediterranean (Alvariño, 1971).

References: Totton (1965); Gili (1986); Pagès and Gili (1992); Lakkis and Zeidane (1995); Pugh (1999).

Genus *Cordagalma* Totton, 1932

Agalmatids with unicornuate tentilla; with heart-

shaped nectophores devoid of lateral or vertical lateral ridges.

References: Pagès and Gili (1992); Margulis (1993); Carré and Carré (1995); Mills *et al.* (1996); Pugh (1999).

Cordagalma ordinata (Haeckel, 1888)
= *Cordalgama cordiforme* Totton, 1932
(Figs. 123A-B)

Colonies extremely fragile, reaching up to 30 cm in length. Nectosome occupying a third of colony length. Pneumatophore fusiform, apex lightly pigmented. Two opposing rows of alternating nectophores. Adult colonies having up to 40 heart-shaped nectophores with two rounded latero-anterior lobes and an acute centro-inferior lobe, 2.0 mm high by 1.4 mm wide. Lateral radial canals, ascending from the ostial canal, join the dorsal canal at the apex without describing a sigmoidal curve. Bracts shaped like a truncated pyramid, with four lateral facets. Very distinctive tentilla with a larval structure and simplified cnidome.

Records from Mediterranean: western Mediterranean.

Known seasonality: 4, 5.

Distribution: uncommon but widely distributed in warm waters throughout the world (Carré C., 1968b; Carré D., 1973; Gili, 1986), Great Barrier Reef (Totton, 1932), Chile (Palma, 1977). Epipelagic species also present at depths down to 726 m depth in the Alborán Sea (Mills *et al.*, 1996).

References: Totton (1932, 1965); Carré C. (1968b); Carré D. (1973); Palma (1973, 1977); Pagès and Gili (1992); Mills *et al.* (1996); Pugh (1999).

Genus ***Halistemma*** Huxley, 1859

Agalmatids whose tentilla have a single terminal filament (unicornuate) and only a vestigial involucrem. Characteristic sigmoidal courses for radial canals on the nectosac of the nectophore that begins with a downward sweep.

References: Pugh and Youngbluth (1988); Pagès and Gili (1992); Pugh (1999).

Halistemma rubrum (Vogt, 1852)
(Figs. 123C-G)

Pneumatophore oval, 5.0 mm high by 5.3 mm wide. Up to 46 nectophores per colony in two rows. Nectophore shape variable but squarish in

appearance, up to 5.2 mm in height, 6.6 mm in width, and 4.0 mm in dorso-ventral length. Two prominent lateral wings and extensive central thrust block containing the pedicular canal, more conspicuous in older nectophores. Nectosac large, T-shaped. Characteristic pattern of lateral radial canals describing three curves along the lateral surface of the nectosac; middle curve widest. Apico-lateral ridges not always reaching the level of the ostium. Bracts thin and leaf-shaped, variable in shape but usually with two lateral processes and a larger central one.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: 2-6, 10, 12.

Distribution: widely distributed in the three great oceans and in the Mediterranean (Alvariño, 1971).

References: Totton (1965); Alvariño (1971) as *Stephanomia rubra*; Carré D. (1971); Kirkpatrick and Pugh (1984); Avian *et al.* (1995); Lakkis and Zeidane (1995); Pugh (1999).

Genus ***Lychnagalma*** Haeckel 1888

Agalmatids with nectophores arranged biserially; apico-lateral ridges prominent and divided close to the base; lateral ridges extending out towards the top of the nectophore before reaching the apico-lateral ridges. Characteristic large tentilla consisted of a stalk, a tightly coiled cnidoband heavily armed with cnidocysts, and a terminal vesicle from which arise eight regularly spaced filaments (Pugh and Harbison, 1986).

Lychnagalma utricularia (Claus, 1879)
(Figs. 123, 124A-D)

Diagnosis: like the genus

Records from Mediterranean: Strait of Messina, Alborán Sea.

Known seasonality: 4.

Distribution: Mediterranean and Atlantic (Bahamas)

References: Pugh and Harbison (1986); Mills *et al.* (1996).

Genus ***Marrus*** Totton, 1954

Agalmatids with nectophores truncated apically, nectosacs with straight, unlooped radial canals; with unicornuate tentilla.

Reference: Andersen (1981).

Marrus orthocanna Totton, 1954
(Figs. 124E-G)

Nectophores longer than broad, up to 15 mm in length, with no distinct lateral ridges. The apical ridges divide close to the ostium and delimit two narrow, triangular distal facets. Thrust block well-developed and longer than the rounded lateral processes. Nectosac triangular. Bract roughly triangular with a flimsy, tacky appearance.

Records from Mediterranean: western Mediterranean.

Known seasonality: 6,12.

Distribution: North Atlantic and Mediterranean.

References: Totton (1965); Andersen (1981); Kirkpatrick and Pugh (1984); Gili (1986).

Genus ***Nanomia*** A. Agassiz, 1865

Agalmatids whose unicornuate tentillum has a basal involucre. Characteristic arrangement of the gonodendra in that male and female ones, attached at the base of palpons, alternate on either side.

Reference: Pagès and Gili (1992).

Nanomia bijuga (delle Chiaje, 1841)
(Figs. 125A-D)

Pneumatophore elongate, very small, 1.8 mm high, apex pigmented. Nectophores quadrangular, flattened in the abaxial-adaxial plane, L-shaped in lateral view, up to 2.3 mm high. Lateral wings twisting towards the adaxial or ventral surface of the colony. Nectophore with a well-developed ostial mouth, ostial velum broad. Looped lateral radial canals on extensive nectosac. Pedicular canal long. Bracts leaf-like, variable in morphology, often with 3 processes at the distal end, occasionally with a cross ridge.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: 4-11.

Distribution: widely distributed in warm and temperate regions of the three great oceans, and the Mediterranean (Alvariño, 1971).

References: Totton (1965); Carré D. (1969b); Alvariño (1971) as *Stephanomia bijuga*; Rottini (1971); Palma (1986); Gili (1986); Pagès and Gili (1992); Avian *et al.* (1995); Lakkis and Zeidane (1995); Pugh (1999).

Family APOLEMIIDAE Huxley, 1859

Uniquely, amongst the physonects, there is a ten-

tacle or clump of tentacles between each pair of nectophores. Nectophore deeply hollowed axially, forming a pair of large axial wings. Nectosac extensive, lateral radial canals follow an S-shape course of varying complexity. Bracts small and flimsy. This family requires a through review.

References: Carré and Carré (1995); Pugh (1999).

Genus ***Apolemia*** Eschscholtz, 1829

Apolemiids with 1-6 tentacles between each pair of nectophores.

Reference: Carré and Carré (1995).

Apolemia uvaria (Lesueur, ? 1811)
(Figs. 126A-D)

Colonies reaching several metres in length. Pneumatophore bulb-shaped, widening near the apex. Nectosome with up to twelve nectophores arranged in two parallel rows along the stem. Largest nectophore 3.7 mm high, 3.4 mm wide and 4.2 mm deep. Nectophore consisting of two wings looking like those of a butterfly, with a deep ventral thrust block. Nectosac large. Lateral radial canals S-shaped with short branches on the upper loop. Groups of five to six nectosomal tentacles issuing from the base of the nectophores near the pedicular canal, at the base of muscular lamellae. Siphosome up to several metres in length, composed of several cormidia. Each cormidium consists of a gastrozoid and about fifty palpons, both with thin filiform tentacles of a single type issuing from their bases. Palpons long and delicate. Bracts, like the nectophores, covered by opaque spots bearing cnidocysts on the outer surface.

Records from Mediterranean: western Mediterranean.

Known seasonality: 8-4.

Distribution: Seldom caught epiplanktonic species. Cited in the Mediterranean, in the vicinity of Naples, Messina, Monaco, and Villefranche-sur-Mer (Alvariño, 1971). In the Atlantic Ocean cited off the British Isles (Kirkpatrick and Pugh, 1984) and Norwegian fjords (Båmstedt *et al.*, 1998).

References: Totton (1965); Carré and Carré (1973, 1995), Alvariño (1971); Kirkpatrick and Pugh (1984); Pagès and Gili (1992); Båmstedt *et al.* (1998).

Family ATHORYBIIDAE Huxley, 1859

Physonects with relatively large pneumatophore. Nectosome greatly reduced or absent. Siphosome

reduced to a dense corm on which the cormidia are arranged in a spiral.

References: Biggs and Harbison (1978); Carré and Carré (1995).

Genus ***Athorybia*** Eschscholtz, 1829

Athorybiids without nectosome; pneumatophore large; bracts flimsy with inconspicuous rows of cnidocysts.

References: Totton (1954); Pagès (2002).

Athorybia rosacea (Forskål, 1775)
(Figs. 126E-F)

Pneumatophore large, red pigmented, with cormidia arranged in spiral around it. No nectosome. Elongate, flimsy bracts with 7 inconspicuous rows of cnidocysts running down the convex dorsal side.

Records from Mediterranean: western Mediterranean.

Known seasonality: 9-4.

Distribution: Atlantic and Mediterranean.

References: Pugh (1999); Pagès (2002).

Family FORSKALIIDAE Haeckel, 1888

Physonects with cylindrical or cone-shape nectosome, whose numerous nectophores have a multiserial, spiral arrangement. Nectophores flattened dorso-ventrally, often asymmetrical in shape. Nectosac restricted to basal half, with straight radial canals. Siphosome also coiled, with gastrozooids borne on long stalks. Gastrozooids borne on long peduncles that are covered in bracts. Bracts usually gelatinous and of variable shape of four types: stem, bolster and two kinds of knee-shape. Several gonopodons, with palpules, present on gonodendra, which bear both male and female gonophores.

References: Carré and Carré (1995); Pugh (1999), Pugh (2003).

Genus ***Forskalia*** K  lliker, 1853

With the characters of the family.

Reference: Pag  s and Gili (1992); Pugh (1999); Pugh (2003)

Forskalia asymmetrica Pugh 2003
(Figs. 126G-H)

Large nectophores, with small rounded left axial wing, and a small central apical incision. No lateral

incisions or pockets. No *rete mirabile*. Adult bracts of four types. Gonodendra bearing long gonopodons, with palpules; with female gonophores attached close to their bases. Male gonophores attached at end of a stalk.

Records from Mediterranean: off Villefranche-sur-Mer, off Messina (Sicily) and in the Albor  n Sea.

Known seasonality: 4.

Distribution: Mediterranean and Atlantic (the Bahamas; off Woods Hole, USA).

Reference: Pugh (2003).

Forskalia contorta (Milne Edwards 1841)
= *F. leuckarti* Bedot 1893
(Fig. 127A-F)

Large nectophores with large left axial wing, without central apical incision. Longitudinal flap on upper side in apical half. Lateral basal pockets extend in flaps onto the lower surface. Nectosac with pronounced lateral wings, with dorsal and ventral canals usually not arising from pedicular canal. No pigment spots on ostium. *Rete mirabile* present or absent in pedicular canal. Three types of adult bract; with only one knee-shaped type, whose bracteal canal bends through a right-angle and has a short side branch. Female gonophores, in two bunches, borne on long stalk, extending beyond male ones.

Records from Mediterranean: western Mediterranean, Adriatic.

Known seasonality: 9-6.

Distribution: rare, to date only caught in the Mediterranean (Totton, 1965) and observed from submersibles at depths between 150 and 600 m in the Bahamas (Youngbluth, 1984).

References: Totton (1965); Youngbluth (1984); Pag  s and Gili (1992); Avian *et al.* (1995); Pugh (1999), Pugh (2003).

Forskalia edwardsi K  lliker, 1853
(Figs. 127G-H)

Nectophores with small left axial wing, and no central apical incision; with apical thickened mesoglea. Small yellow pigment spot on ostium where dorsal radial canal joins ring canal. No *rete mirabile*. Four types of adult bract: knee-shape ones without side branch to bracteal canal. Gonodendra with female gonophores not having elongated base. Palpule of gonopodon has appearance of a string of beads.

Records from Mediterranean: off Villefranche-sur-Mer.

Known seasonality: in winter.

Distribution: western Mediterranean, Red Sea, Atlantic and Pacific.

References: Totton (1965); Youngbluth (1984); Pagès and Gili (1992); Pugh (1999), Pugh (2003).

Forskalia formosa Keferstein and Ehlers 1861
(Figs. 127I-K)

Nectophores with large, pointed left axial wing, and shallow but broad and rounded right wing. Small apical incision between them. Small lateral, but no baso-lateral pockets. No *rete mirabile*. Four types of adult bract; knee-shaped ones without side branch to canal. Gonodendra with female gonophores, in two bunches, attached close to bases of gonopalpons; male gonophores borne on long stalk.

Records from Mediterranean: off Villefranche-sur-Mer, off Messina (Sicily) and Alborán Sea.

Known seasonality: in winter.

Distribution: Mediterranean and Atlantic (The Bahamas).

References: Avian *et al.* (1995); Mills *et al.* (1996), Pugh (2003).

Family PHYSOPHORIDAE Eschscholtz, 1829

Physonects with a flimsy, apparently ridgeless nectophores each with an extensive nectosac, which has characteristic, looped lateral radial canals. Both dorsal and ventral canals are sinuous. Siphosome compact sac on which the simple, bractless cormidia are borne in spiral. Each cormidium has a single, greatly enlarged palpon. Monotypic family for the species *Physophora hydrostatica*.

Reference: Carré and Carré (1995).

Genus ***Physophora*** Forskål, 1775

With the characters of the family.

Reference: Pagès and Gili (1992).

Physophora hydrostatica Forskål, 1775
(Figs. 128A-C)

Pneumatophore elongate, 4.5 mm high, 1.1 mm wide, with a pore in the apical reddish region. Nectosome consisting of up to 12 nectophores in two alternate rows. Nectophore flimsy, devoid of conspicuous ridges and up to 20 mm high. Nectosac Y-

shaped. Upper half of radial canals describes a highly characteristic sigmoidal curve. Pedicular canal prominent. Palpons characteristic by their large size and banana-shape, with long and fine palpacles. Palpons covering and protecting the rest of the elements making up the bag-like siphosome and bearing clusters of cnidocysts on their distal ends.

Records from Mediterranean: western Mediterranean

Known seasonality: 9-4.

Distribution: widely distributed in tropical and subtropical regions in the three great oceans and in the Mediterranean (Alvariño, 1971).¹

References: Totton (1965); Alvariño (1971); Kirkpatrick and Pugh (1984); Gili (1986); Pagès and Gili (1992); Pugh (1999).

Order CALYCOPHORAE Leuckart, 1854

Highly polymorphic Siphonophorae without pneumatophore, with a reduced nectosome typically formed by one or two but sometimes more nectophores. Usually with a single bract per cormidia (except the Hippopodiidae without bracts), without dactylozooids (except in *Stephanophyes*), in some cases with asexual medusoid structures on siphosome. Generally the cormidial units are detached successively from the stem and become eudoxid or sexual stage. Usually a calyconula larvae.

Key to the families (after Pugh, 1999)

1. Nectophores dorso-ventrally flattened 2
 - Nectophores not dorso-ventrally flattened, bracts present 3
2.Up to 15+ similar, closely applied, dorso-ventrally flattened nectophores bearing protuberances or spines; large but shallow nectosac; bracts absent Hippopodiidae
 - Small, flattened nectophores, with vestigial nectosac and reduced somatocyst..... Prayidae, subfamily Amphicaryoninae
3. Nectophores and bracts rounded, smooth-walled, with thick mesoglea..... 4
 - Nectophores and bracts pointed, toothed or of irregular shape 6
4. Usually 2 nectophores 5
 - Single, fragile, larval nectophore, with a simple somatocyst and narrow hydroecium; small, fragile bract with a single canal Sphaeronectidae
5. Two nectophores of approximately equal size, forming an apposed pair; somatocyst simple or

- branched; bracts with 5 or 6 branches to the canal system..... Prayidae, subfamily Prayinae
- Two nectophores of unequal size, with reduced somatocysts; nectosac of smaller nectophore usually reduced or obsolete; bracts with two branches to canal system..... Prayidae, subfamily Amphicaryoninae*
 - 6. Two morphologically different nectophores; one (anterior) superimposed over the other (posterior) 8
 - With usually a single nectophore 7
 - 7. Single, usually large nectophore bearing simple or toothed ridges; somatocyst usually branched; large bract without neck shield and extensively branched canal system..... Prayidae, subfamily Nectopyramidinae*
 - Single, usually small, apically pointed nectophore, with simple caecal somatocyst; bract conical or angular 9
 - 8. Posterior nectophore with a somatocyst; anterior nectophore with extensive opening of hydroecium onto ventral surface; small bract with phyllocyst and 2 canals extending into neck shield..... Clausophyidae
 - Posterior nectophore without somatocyst; hydroecium of anterior nectophore usually opens basally; bracts conical or angular, with phyllocyst and, at most, one canal 9
 - 9. Conical stream-lined anterior nectophore, usually with shallow hydroecium; posterior nectophore, when present, usually apically truncated and of similar size or smaller than anterior one; conical bracts..... Diphyidae
 - Anterior nectophore angular, with inflated somatocyst and deep hydroecium; posterior nectophore, when present, larger than anterior one; rigid angular bracts Abylidae

*not present in the Mediterranean Sea.

Family ABYLIDAE Agassiz, 1862

Calycophorans with rigid, angular nectophores, the posterior one, without a somatocyst, usually being much larger, and bearing serrated ridges and teeth. In all but one species the somatocyst of the anterior nectophore has curved over to occupy a ventral position. The hydroecium of the anterior nectophore is an enclosed tube opening basally. During development a temporary larval bract is formed before the larval nectophore. The latter is retained in the polygastric stage as the anterior nectophore.

References: Sears (1953); Carré and Carré (1995); Pugh (1999).

Genus *Abyla* Quoy and Gaimard, 1827

Abylid with 10 or 11 facets in anterior nectophores. The apical facet is divided by a transverse ridge, and many ridges are serrated, particularly basally. Dorsal nectosac and median hydroecium are long tubes extending almost to apex of nectophore. The large oval somatocyst lies ventrally. Posterior nectophore with long, tapering apical apophysis, has only 4 ridges. The ventral ridges define the hydroecial wings and are heavily serrated basally. The left hydroecial wing bears a toothed comb or flap. Five, usually serrated, ostial teeth. Prismatic bracts with 6 facets, the dorsal one being rectangular. Very large phyllocysts, with 2 canals running down toward the ventro-lateral corners of the apical facet. The bracts cannot, at present, be identified specifically.

Reference: Pugh (1999).

Abyla haeckeli Lens and van Riemsdijk, 1908 (Figs. 128D-F)

Anterior nectophore as wide as long, without wing-like processes. Transverse ridge separates ventral facet from apico-ventral one. Posterior nectophore with up to 5 teeth on comb. Lateral ostial teeth closer to dorsal tooth than ventral ones.

Reference: Pugh (1999).

Genus *Abylopsis* Chun, 1888

Abylid whose anterior nectophore has a pentagonal dorsal facet without a median ridge. Seven-facet anterior nectophore, but without an apical facet, and pentagonal dorsal and ventral facets. The somatocyst has an apical diverticulum. Posterior nectophore has prominent basal teeth and with 5 ridges and a short curved apical apophysis. The left lateral ridge bifurcates close to the apex. Flaps on both wings of hydroecium. Bracts with 7 facets. Phyllocyst with swollen apico-lateral branches and apical diverticulum, while distally is a narrow tube.

References: Pagès and Gili (1992); Pugh (1999).

Abylopsis eschscholtzi (Huxley, 1859) (Figs. 128G-K)

Dorsal and ventral facets of anterior nectophore almost pentagonal, of nearly equal size, with strong-

ly serrated ridges. Lateral radial canals forming a right angle from the pedicular canal and directed towards the ostial canal, without ascending loop. Posterior nectophore less than twice as long as wide, with relatively large apical apophysis. Each hydroecial wing bearing a secondary wing whose inner margins is fused. Between four and eight teeth on the curve on the left wing, three or four on the right wing. Bracts cuboidal, their dorsal facet forms a regular pentagon, their apico-lateral facets rectangular.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: 4 to 7.

Distribution: common and abundant in the warm and temperate regions in the three great oceans, less common in the Mediterranean (Alvariño, 1971). Epipelagic distribution (Pugh, 1974).

References: Totton (1965); Alvariño (1971); Rot-tini (1971); Daniel (1974); Pugh (1974, 1999); Gili (1986); Pagès and Gili (1992); Avian *et al.* (1995); Lakkis and Zeidane (1995).

***Abylopsis tetragona* (Otto, 1823)**
(Figs. 129A-E)

Polygastric stage: anterior nectophore polyhedral with seven faces. Ventral and dorsal surfaces pentagonal, the latter higher, up to 10 mm in height. Ridges weakly serrated. Hydroecium deep, reaching nearly the midpoint of the nectophore. Radial canals of nectosac originating at the junction with the pedicular canal and rising towards the upper end, forming an ascending loop, and then descending to the circular canal. Somatocyst globular, with an apical diverticulum at the level of the nectosac. Posterior nectophore up to 40 mm in length, rectangular, three times as long as wide, with a prominent apophysis. Four radial canals in the upper half, five in the lower one because the left ventral canal has a blind termination halfway up and a little above the origin of a new canal forming a right angle and directed towards the ostial canal. A "rete" at the base of the right ventral canal, from which a short, blind ventral canal issues towards the left. Upper half of the right wing of hydroecium bearing a comb-like structure with about nine teeth. Lower portion bearing five basal teeth varying in size, right ventral tooth largest. Bract up to 7.0 mm high, elongated, pentagon with apico-lateral facets trapezoidal. Upper half of phyllocyst bearing two thick, lateral processes above the hydroecium and extending towards the apical surface in the form of a narrow diverticulum.

Gonophore in the shape of a rectangular prism 4.6 mm high with four distinct ridges ending in four acute basal cusps, the ventral cusps somewhat larger than the dorsal ones.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: present all the year.

Distribution: quite common in the temperate regions of the three main oceans, and in the Mediterranean (Alvariño, 1971). Epipelagic (Pugh, 1974), but also present in the mesopelagic zone (Gili *et al.*, 1987a).

References: Totton (1965); Carré C. (1967b); Alvariño (1971); Palma (1973); Pugh (1974, 1999); Bone and Trueman (1982); Gili (1986); Gili *et al.* (1987a); Pagès and Gili (1992); Avian *et al.* (1995); Lakkis and Zeidane (1995); Buecher (1999); Gamulin and Krisnic (2000).

Genus ***Bassia*** Agassiz, 1862

Abylines whose anterior nectophore has not an apical diverticulum to the somatocyst, and with the hydroecium not extending below the basal facet. Somatocyst large and globular. Posterior nectophore with 4 ridges ending in short basal teeth. Bract with median apical ridge has a quadrilateral dorsal facet. Phyllocyst is a long tube, swollen apically, without apico-lateral branches. Gonophore with four longitudinal ridges which end basally in minute teeth.

***Bassia bassensis* (Quoy and Gaimard, (1833)**
1834) (Figs. 129F-I)

Polygastric stage: ridges on specimens fixed in formalin taking on a bluish-white hue (same applies to eudoxids). Anterior nectophore a seven-sided polyhedral with pentagonal dorsal and ventral surfaces. Two quadrangular apico-lateral surfaces joined by a central apical ridge. Two large baso-lateral surfaces separated from the apico-lateral surfaces by a horizontal ridge. Hydroecium deep, reaching the midpoint of the nectophore, with a large quadrangular opening. Nectosac relatively small, with lateral radial canals running from the ostial canal to the junction with the pedicular canal, with only a slight curve instead of an arc. Apices of hydroecium and nectosac more or less at the same level. Somatocyst large, globular, devoid of diverticulum or apical projection. Posterior nectophore higher than the anterior nectophore, up to 15.0 mm high, consisting of four ridges, not as thin as in the anterior nectophore. Bases of ventral ridges compris-

ing two prominent teeth, right tooth larger than left tooth. Eudoxid: bract in the form of a seven-sided polyhedral with well-developed ridges. Dorsal surface rhomboidal, ventral surface in the shape of a five-pointed star. Apico-lateral surfaces quadrangular. Baso-ventral margins of lateral surfaces describing a curve ending in a medial tooth. Hydroecium large, deep, hook-shaped, reaching to the midpoint of the bract. Phyllocyst is a long tube long, without lateral processes. Gonophore with four lateral ridges that end basally in minute teeth.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: 3, 12.

Distribution: Present in the temperate regions of the three great oceans and in the Mediterranean (Alvariño, 1971).

References: Totton (1965); Palma (1973); Daniel (1974); Kirkpatrick and Pugh (1984); Gili (1986); Pagès and Gili (1992); Carré and Carré (1995); Lakkis and Zeidane (1995); Pagès *et al.* (2001).

Genus *Ceratocymba* Chun, 1888

Abylid with characteristically shaped bract, called a *cymba*. Anterior nectophore with 7 facets. Apical facet not divided by a transverse ridge. Posterior nectophore long and narrow, without wing-like expansions. Short dorsal ridge ends on the dorsal tooth. Bracts with a median dorsal ridge. Left lateral facet divided by another ridge. Bracts roughly triangular with a concave apical facet and prominent lateral horns. Phyllocyst with 2 thin ventro-lateral branches. Its distal end bends dorsally to form a blind sac.

References: Pagès and Gili (1992); Pugh (1999).

Ceratocymba sagittata (Quoy and Gaimard, 1827) (Figs. 130A-C)

Polygastric stage: anterior nectophore pyramidal, elongate, up to 40.0 mm high. Large, tapered apical process called a pyramidal process. Four ridges converging at the apex. Characteristic apical surface of the family Abylinae no longer present. Hydroecium bell-shaped, with a large opening, in the centre of the base of the nectophore. Nectosac narrow, high, reaching almost to the apex of the nectophore. Lateral radial canals ascending over a short segment of the nectosac from the pedicular canal, describing a very tight arc and then descending towards the ostial canal. Somatocyst oval, positioned between the dorsal surface of the nectophore and the dorsal surface

of the hydroecium; not extending past the apex of the hydroecium. Posterior nectophore elongated, oblong, up to 50.0 mm high, pointed apically. Left ventral wing ending in a characteristic prominent, elongate, serrated basal tooth. Comb on right ventral wing bearing six teeth; inferior margins of both wings dentate. Eudoxid: bract roughly triangular, with two supra-lateral horns and a dorsal ridge ending in a point basally. Up to 20.0 mm high. Apical surface triangular, concave. Characterized by a right lateral ridge, originating at the lower margin, stopping before it reaches the apico-dorsal ridge. Phyllocyst cylindrical, with two filiform lateral projections and a basal tip recurved upwards. Gonophore with basal teeth varying in size. A relatively short, inconspicuous hook issuing from one of the ventral ridges, curving towards the base of the hydroecium. Teeth located above the hook on the ventral margin of the opposite wing. A small dorsal tooth. Lateral ridge near the bract wall deeper than the opposing ridge at the apex.

Records from Mediterranean: Strait of Gibraltar.

Seasonality: ?

Distribution: widely distributed in the Atlantic Ocean, where its range is very broad. Also present in temperate regions in other seas and in the Mediterranean (Alvariño, 1971).

References: Bigelow and Sears (1937); Totton (1965); Casanova (1980); Alvariño (1981); Kirkpatrick and Pugh (1984); Pagès and Gili (1992); Pugh (1999).

Genus *Enneagonum* Quoy and Gaimard, 1827

Abylids where the large, pyramidal anterior nectophore is the only developed. The conical somatocyst is situated above the hydroecium, and extends to a greater height than the nectosac. The bract is cuboidal, with slightly concave facets. Swollen somatocyst with 2 lateral and apical processes.

Reference: Pagès and Gili (1992).

Enneagonum hyalinum Quoy and Gaimard, 1827 (Figs. 130D-F)

Polygastric stage developing only a single nectophore. Nectophore pyramidal, up to 15.0 mm wide. All surfaces homologous to those in other Abylopsinae, except that in *E. hyalinum*, there is a median ridge subdividing what is equivalent to the dorsal surface in other Abylopsinae. The two dorsal surfaces and the two apico-lateral surfaces visible when viewed from

the apex. A triangular basal surface beneath the dorsal surfaces, the two baso-lateral surfaces, and the ventral surface all visible when viewed basally. Ridges and basal margins slightly dentate. Somatocyst carrot-shaped, consisting of two thickened lateral processes and an apical diverticulum, lacking a descending dorsal segment, differentiating it from the somatocysts of the rest of the members of the family Abylidae. Arc followed by the lateral radial canal including a blind diverticulum. Eudoxid: bract cuboidal, 4.0 mm high. Five surfaces: apical, dorsal, ventral, and two laterals. No baso-lateral surfaces, the entire space being occupied by the large hydroecial opening. Swollen phyllocyst with 2 lateral and apical processes. Gonophore with a well-developed apophysis occupying nearly a third of the gonophore.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: 3.

Distribution: common in warm and temperate regions in the three great oceans, and in the Mediterranean (Alvarino, 1971). Epipelagic but also abundant in the mesopelagic zone down to a depth of 1000 m (Pugh (1974).

References: Bigelow and Sears (1937); Totton (1965); Daniel (1974); Pugh (1974, 1999); Kirkpatrick and Pugh (1984); Gili (1986); Pagès and Gili (1992); Lakkis and Zeidane (1995).

Family CLAUSOPHYIDAE Totton, 1965

Both anterior and posterior nectophores possess a somatocyst. The phyllocyst of the eudoxid bract when known has two fine branch canals that run down into the neck shield.

Genus *Clausophyes* Lens and Riemsdijk, 1908

Nectophores rounded, smooth, unridged, laterally flattened. Anterior nectophore usually smaller than posterior one, with deep hydroecium in basal half and with a long, thin somatocyst which has an elongated swelling towards its apex. Lateral canal of both nectophores are looped.

References: Pugh (1995, 1999).

Clausophyes ovata (Keferstein and Ehlers 1860) (Figs. 130G-I)

Polygastric stage: anterior nectophore up to 20 mm in height, roughly triangular but rounded at its

base. The deep hydroecium reaches to about the height of the nectophore and is open at the ostial level. Posterior nectophore up to 30 mm in height, with a large notched mouth. The hydroecium extends the length of the nectophore and is bounded by large lateral wings. The somatocyst is long and narrow.

Eudoxid: bract conical, up to 8 mm in height, with a rounded apex and an extensive neck-shield. The phyllocyst, slightly swollen basally reaches the apex. The gonophore is undescribed.

Records from Mediterranean: off Messina (Sicily), Adriatic, western Mediterranean.

Known seasonality: present all the year.

Distribution: Atlantic, Pacific, Mediterranean

References: Keferstein and Ehlers (1861, as *Diphyes ovata*), Kirkpatrick and Pugh (1984); Patri ti (1969) as *Clausophyes massiliana*, Gamulin and Krisnic (2000).

Family DIPHYIDAE Quoy and Gaimard, 1827

Calycophorae with polygastric stage with one or two dissimilar streamlined definitive nectophores arranged serially. Anterior nectophore with somatocyst, posterior not; hydroecium generally reduced in anterior nectophore; the nectosac occupies most of the nectophore.

References: Carré and Carré (1995), Pugh (1999).

Genus *Chelophyes* Totton, 1932

Diphyids with rigid nectophores; anterior one with 5 ridges, dorsal one extends only a short distance up from the ostium. Claw-shaped hydroecium. Posterior nectophore apically pointed, mouth-Fig. divided with two strong asymmetric teeth. Bracts with conical eudoxids, small rounded neck-shield, hydroecium cylindrical and long that almost stretches the apex.

References: Pagès and Gili (1992); Pugh (1999).

Chelophyes appendiculata (Eschscholtz, 1829) (Figs. 130J-K, 131A-C)

Polygastric stage: Anterior nectophore of firm consistency. Up to 12.0 mm in height by 3.6 mm in dorso-ventral width. Only three ridges, the two ventral ridges and the right lateral ridge (*sensu* Bigelow) converging at the apex. Left lateral ridge not reaching the apex and only a short section of the dorsal

ridge visible above the ostium. Hydroecium horn-shaped, directed towards the ventral surface and extending to approximately one sixth of the nectophoral height. Basal lamella divided into two square wings with sharp outer ends; basal lamella margin convex. Fusiform, long somatocyst that arises at the apex of the hydroecium, reaching two-thirds to three-quarters of nectosac height. Posterior nectophore 8.2 mm in height by 2.0 mm in dorso-ventral width, apex pointed, same consistency as that of the anterior nectophore slightly asymmetrical. Four ridges each ending basally in a conspicuous tooth, left tooth longer than right one. Ventral ridges bearing a tooth at the level of the ostium. Basal lamella entire, concave. Hydroecial canal long.

Eudoxid: bract roughly conical, hood-shaped, with a short, rounded neck-shield. Hydroecium deep. Phyllocyst cylindrical elongated reaching nearly to the apex. Gonophore composed of four longitudinal ridges. Peduncle long, penetrating into the bracteal cavity, rigidly attached to the bracteal margin.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: 1-12.

Distribution: widely distributed in warm and temperate regions in the three great oceans and the Mediterranean (Alvariño, 1971); one of the most common and abundant siphonophores in all seas. Epipelagic species also dwelling in the mesopelagic zone (Pugh, 1974; Gili *et al.*, 1987).

References: Totton (1965); Pugh (1974, 1999); Bone and Trueman (1982); Mackie and Carré (1983); Kirkpatrick and Pugh (1984); Gili (1986), Gili *et al.* (1987); Pagès and Gili (1992), Carré and Carré (1995); Lakkis and Zeidane (1995); Buecher (1999); Gamulin and Krisnic (2000).

Chelophyes contorta

(Lens and Van Riemsdijk, 1908)

(Figs. 131D-F)

Polygastric stage: anterior nectophore consistency firm, up to 4.6 mm in height by 1.7 mm in dorso-ventral width. Similar to that of *C. appendiculata*, the main difference is that the ventral facet is strongly twisted to the right. Five serrate ridges, (three to the apex) only a short section of the dorsal ridge visible above the ostium, right lateral ridge not reaching the apex. Ventral surface and somatocyst twisted to the right. Hydroecium

cornuate, directed towards the ventral surface, not as deep as in *C. appendiculata*, edge blunt. Basal lamella divided into two quadrangular wings, with a small tooth on the baso-central end of each. Posterior nectophore with five serrate ridges, ventral ridges longer on upper half of nectophore, shorter on the lower half, ending in sharp point longer on the left ventral ridge. Upper ventral Fig. fingernail-shaped issuing from the right ridge and directed towards the left ridge.

Eudoxid: very similar to that of *C. appendiculata* (Totton, 1965).

Records from Mediterranean: ?Alborán Sea.

Seasonality: ?

Distribution: widely distributed in warm and temperate regions in the Pacific and Indian oceans. Occasionally present in the Atlantic, where it has been recorded off Honduras, Venezuela, Bermuda, and Cape Verde. Cited in the Alborán Sea in the Mediterranean, near the Strait of Gibraltar (Alvariño, 1971). Nevertheless, the Atlantic records are doubtful because it seems that this species shows mainly an Indo-Pacific distribution.

References: Alvariño (1971); Pagès and Gili (1992); Pugh (1999).

Genus *Dimophyes* (Chun, 1897)

Diphyids with anterior nectophore without ridges, mouth Fig. undivided, hydroecium largely opened on its ventral side, carrot-shape somatocyst reaching to about two thirds the height of the nectophore. Posterior nectophore reduced, with the opening of the nectosac lying dorso-basally. Conical bract with extensive neck-shield that is run by a median canal from the phyllocyst; the latter with apical and lateral horns. Monotypic genus.

References: Pagès and Gili (1989, 1992d); Pugh (1999).

Dimophyes arctica (Chun, 1897)

(Figs. 131G-I)

Polygastric stage: anterior nectophore devoid of ridges, apex arched, 15.0 mm in height. Hydroecium deep, bell-shaped, with ventral opening, and summit above the ostium. Basal lamella high, entire, without wings. Somatocyst carrot-shaped, reaching to three-quarters of nectophore height. Posterior nectophore seldom found and much reduced. The deep hydroecium is bounded by two broad wings. The nectosac opens on to the baso-dorsal surface.

Eudoxid: up to 10 mm in height. The bract is conical with an extensive, thin neck shield. The phyllocyst has apical and lateral horns and a fine basal process, which passes down the neck shield. The gonophore has a very small mouth and any traces of a hydroecium.

Records from Mediterranean: western Mediterranean.

Known seasonality: present all the year.

Distribution: cosmopolitan species, inhabiting the three great oceans as well as the Antarctic, Arctic, and Mediterranean (Alvariño, 1971). Mesopelagic distribution in tropical latitudes, more epipelagic distribution in boreal and austral latitudes (Pugh, 1984; Pagès and Schnack-Schiel, 1996), though it may be found throughout the upper 1.000 metres of the water column (Pugh, 1974).

References: Totton (1965); Pugh (1974, 1984, 1999); Kirkpatrick and Pugh (1984); Pagès and Gili (1992).

Genus *Diphyes* Cuvier, 1817

Diphyids with 5 complete longitudinal ridges in the anterior nectophores and 3 prominent dorsal teeth in general. Deep hydroecium. Posterior nectophores, when developed, also with 3 ostial teeth in general and a long apical process (apophysis). Bracts generally helmet-shaped.

References: Pagès and Gili (1992); Pugh (1999).

Diphyes bojani (Eschscholtz, 1829) (Figs. 131J-K)

Polygastric stage: anterior nectophore elongated bearing five long, variably serrated ridges converging at the apex to form a pyramid, pentagonal in cross-section, 10.0 mm in height by 3.0 mm in dorso-ventral width. Three basal teeth all of the same size. Nectosac cylindrical, reaching nearly to the apex of the nectophore, upper third tapering. Hydroecium deep, extending to about one-third the height of nectophore, narrower than in *D. dispar*. Somatocyst fusiform, tip reaching nearly to the apex of the nectosac. Basal lamella entire, bearing a thin median crest. Posterior nectophore with five serrated ridges, upper third tapering, forming a prominent apophysis. Up to 6.6 mm in height by 2.2 mm in dorso-ventral width.

Eudoxid: bract shield-shape that covers the upper ventral half of the gonophore, different from that from all other diphyids.

Records from Mediterranean: western Mediterranean.

Known seasonality: present all the year.

Distribution: widely distributed in tropical and subtropical regions in the three great oceans and in the Mediterranean (Alvariño, 1971).

References: Totton (1965); Alvariño (1981); Pagès and Gili (1992); Pugh (1999).

Diphyes dispar Chamisso and Eysenhardt, 1821 (Figs. 132A-C)

Polygastric stage: anterior nectophore large, up to 36.0 mm in height by 18.0 mm in dorso-ventral width. Five ridges; dorsal ridge slightly dentate, dorso-basal tooth larger than the two baso-lateral teeth. Nectosac cylindrical, the upper portion tapering to a narrow caecal extension ending close to the apex of the nectophore. Hydroecial opening large, square, very deep, reaching to half of nectophore height or more. Somatocyst cylindrical, of variable length, but not exceeding the filiform apex of the nectosac, curving dorsally towards the nectosac until it touches. Basal lamella entire, margin concave. The dorsal ostial tooth is considerably larger than the lateral one. Mouth Fig. not divided. Posterior nectophore bearing five ridges, height 27.0 mm, dorso-ventral width 13.0 mm. Prominent apical apophysis fitting into the hydroecium of the anterior nectophore. Hydroecial groove large, bounded ventrally by a flat hook-shaped plate directed towards one of the lateral walls. Tooth at basal end of dorsal ridge dentiform, slightly larger than the lateral teeth.

Eudoxid: Bract conical, hood-shaped, with a large, rounded base. Hydroecium shallow, phyllocyst cylindrical, narrow, tapering near the tip, not reaching the apex of the bract. Gonophore with four denticulate ridges. Bases of the two dorsal ridges sharp, each of the two ventral ridges terminating in a small tooth and joined by an entire basal lamella.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: 9-12.

Distribution: widely distributed in temperate and warm regions of the three great oceans, and the Mediterranean (Alvariño, 1971). Species epipelagic, occasionally present at greater depths (Pugh, 1974).

References: Cervigón (1958); Totton (1965); van Soest (1973); Pugh (1974, 1999); Pagès and Gili (1992); Lakkis and Zeidane (1995); Gamulin and Krisnic (2000).

Genus *Eudoxoides* Huxley, 1859

Diphyids with small, rigid anterior nectophores, spirally twisted or not, with 5 serrated ridges, the dorsal one being complete. Mouth Fig. divided; no conspicuous ostial teeth. Posterior nectophore, when developed, with curved furrow between apex and pedicel.

Reference: Pagès and Gili (1989, 1992); Pugh (1999).

Eudoxoides spiralis (Bigelow, 1911)
(Figs. 132D-H)

Polygastric stage: only one nectophore developed, spiralled, up to 12 mm in height, consistency firm. Five twisted serrated ridges, but only four at apex as left ventral ridge joins the right ventral ridge just below the apex. Bases of ventral ridges dissimilar, in that the right ridge starts from the ventral notch in the hydroecium, while the left ridge starts at the level of the ostium. Hydroecium deep, carrot-shaped, with a rounded apex. Bases of the lateral walls of the hydroecium asymmetrical, with sharp ends. Basal lamella divided into two lanceolate wings, right wing larger than left one somatocyst, carrot-shaped, arising from a tiny peduncle and reaching around the midpoint of the nectosac.

Eudoxid: bract hood-shaped about 4.0 mm height, with two serrated ridges and a large, deep neck-shield. Phyllocyst thick and straight, reaching nearly the apex. Gonophore twisted, with four slightly dentate ridges, truncated at the summit.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: 3-6, 9, 10.

Distribution: widely distributed in the temperate regions of the three great oceans and the Mediterranean (Alvariño, 1971; Pugh, 1974).

References: Cervigón (1958), Totton (1965); Pugh (1974, 1999); Kirkpatrick and Pugh (1984); Gili (1986); Pagès and Gili (1992); Avian *et al.* (1995); Lakkis and Zeidane (1995).

Genus *Lensia* Totton, 1932

Diphyids with pyramidal anterior nectophores, generally ridged, number and disposition of the ridges being variable, from 5 to many. Small, divided mouth, with shallow hydroecium, rarely extending above ostial level. No ostial teeth. Posterior nectophore, when developed, truncated apically with a

rounded mouth. Bracts helmet-shaped. Shape of phyllocyst generally resembling that of somatocyst of anterior nectophore; (need of review).

References: Pagès and Gili (1992); Pugh (1999).

Lensia campanella (Moser, 1925)
(Fig. 133A-B)

Polygastric stage: anterior nectophore up to 6.3 mm in height by 3.0 mm in dorso-ventral width laterally compressed. Often twisted due to preservation. Walls smooth, rounded, bearing five very fine, barely discernible ridges, one dorsal, two laterals, and two ventral. Basal lamella slanted upwards towards the ventral surface. Hydroecium very flat. Basal lamella short, divided into two halves with rounded margins. Nectosac large, occupying nearly the entire nectophore. Somatocyst ovoid, slanted towards the basal lamella, with a short, thin peduncle. Pedicular canal moving to the base of the somatocyst. Posterior nectophore not been described.

Eudoxid: bract conical with rounded apex, with minute hydroecium. Club-shaped phyllocyst.

Records from Mediterranean: eastern and Western Mediterranean.

Known seasonality: present all the year.

Distribution: epipelagic (Pugh, 1974) common in tropical regions of the three great oceans and in the Mediterranean (Alvariño, 1971).

References: Totton (1965); Carré D. (1967); Carré C. (1968a); Pugh (1974, 1999); Pagès and Gili (1992); Avian *et al.* (1995); Lakkis and Zeidane (1995); Gamulin and Kršinić (2000).

Lensia conoidea (Keferstein and Ehlers, 1860)
(Figs. 133C-E)

Polygastric stage: anterior nectophore up to 20 mm high, consistency firm, with five complete ridges converging at an acute apex; basal end of dorsal ridge forming a tooth extending to below the level of the ostium. Basal lamella short, wide, cleft, extending underneath the nectosac. Hydroecium basal and minute. Somatocyst fusiform and vacuolated, reaching the midpoint of the nectosac. Base of basal lamella slanted upwards towards the ventral surface. Posterior nectophore rectangular but bearing five ridges, up to 20 mm high. Mesogloea thick, occupying nearly the entire ventral half of the nectophore. Basal lamella asymmetrical, with a central notch; left lappet somewhat higher than right lappet.

Eudoxid: bract conical, approximately 4 mm in height, with a long, swollen phyllocyst.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: present all the year.

Distribution: common and abundant in all seas, and in the Mediterranean (Bigelow and Sears, 1937; Alvariño, 1971), spanning a broad depth distribution from the surface down to the bathypelagic zone.

References: Bigelow and Sears (1937); Totton (1965); Carré D. (1967); Rottini (1971); Palma (1973); Pugh (1984,1999); Kirkpatrick and Pugh (1984); Gili (1986); Pagès and Gili (1992); Lakkis and Zeidane (1995); Gamulin and Krisnic (2000).

Lensia fowleri (Bigelow, 1911)
(Figs. 133F-H)

Polygastric stage: anterior nectophore high, up to 20.0 mm in height. Five complete ridges converging at the apex. Lateral ridges curving slightly towards the ventral surface at the base. Basal lamella large. Hydroecium extremely flat. Somatocyst ovoid or spherical, resting on the extensive basal lamella, entirely below the level of the ostium. Basal lamella divided into two wings. Posterior nectophore smaller and delicate. Hydroecium delimited, by two triangular-shaped wings, the small mouthFig. is undivided. Eudoxid: the bract is elongated, up to 4.5 mm in height, and rounded apically, with a wide neck shield which bears a marginal notch. The phyllocyst is small and globular.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: present all the year.

Distribution: more frequent and abundant in the Atlantic Ocean but extending into temperate regions of the Pacific and Indian oceans and the Mediterranean (Bigelow and Sears, 1937; Alvariño, 1971). Reported at depths down to 800 m (Leloup and Hentschel, 1935) but mainly dwelling in the upper 250 m (Pugh, 1974).

References: Totton (1965); Gamulin (1966); Rottini (1971); Pugh (1974, 1999); Casanova (1980); Kirkpatrick and Pugh (1984); Pagès and Gili (1992); Avian *et al.* (1995); Lakkis and Zeidane (1995).

Lensia hotspur Totton, 1941
(Fig. 133I)

Polygastric stage: anterior nectophore with five complete ridges, lateral ridges closer to dorsal ridge than to ventral ridges. Small, less than 10.0 mm in

height. Hydroecium minute, very flat, located below the level of the ostium. Somatocyst, short, angled obliquely, exhibiting great morphological variability, ovate or sausage-shaped, ventrally slanted, with a short peduncle. Basal lamella divided into two rounded, dorsally slanted wings. Posterior nectophore difficult to distinguish from that of the other *Lensia* species but has a rounded notch on the mouth-Fig.. Eudoxid: not yet discovered.

Records from Mediterranean: western Mediterranean, Alborán Sea.

Known seasonality: in winter.

Distribution: widely distributed in tropical regions of the Atlantic Ocean, but distribution range extending from latitude 59° N (Fraser, 1967) to 40° S. Isolated presence in the Indian and Pacific oceans (Alvariño, 1971). Recently cited in the Alborán Sea, near the Strait of Gibraltar (Dallot *et al.*, 1988).

References: Pagès and Gili (1992); Pugh (1999).

Lensia meteori (Leloup, 1934)
(Fig. 134A)

Polygastric stage: anterior nectophore very small and delicate, apex rounded, apparently without ridges, up to 7.0 mm high. Hydroecium narrow, high, slanting ventrally upwards, basal lamella indistinguishable from ventral surface of hydroecium, divided into two quadrangular wings. Upper edge of hydroecium above the level of the ostium. Somatocyst small, pyriform or globe-shaped, with a short pedicel. Posterior nectophore and eudoxid have not been described.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: present all the year.

Distribution: inhabiting temperate regions in the three great oceans (Alvariño, 1971), and in the Mediterranean (Leloup, 1934; Gili, 1986). Broad vertical distribution extending down to 800 m in depth (Pugh, 1974).

References: Totton (1965); Rottini (1971); Daniel (1974); Pugh (1974, 1999); Kirkpatrick and Pugh (1984); Gili (1986); Pagès and Gili (1992); Avian *et al.* (1995); Carré and Carré (1995); Lakkis and Zeidane (1995); Gamulin and Kršinić (2000).

Lensia multicristata (Moser, 1925)
(Figs. 134B-D)

Polygastric stage: anterior nectophore elongate, up to 15 mm in height, with seven longitudinal

ridges, latero-ventral ridges reaching neither the apex nor the ostial margin of the nectophore, lateral ridges ending slightly above the level of the ostium. Hydroecium small, as a shallow groove located below the level of the ostium. Basal lamella wide, divided into two wings whose inner margins are formed by a rounded tooth directed towards the hydroecium. Somatocyst filiform, with an extremely thin peduncle, reaching nearly the midpoint of the nectosac. Posterior nectophore with five ridges, lateral ridges not reaching the ostium. Basal lamella low and broad. Eudoxid not yet discovered, although Kirkpatrick and Pugh (1984) suggested that it might be *Eudoxia tenuis* (Patrity, 1965).

Records from Mediterranean: Adriatic, eastern (Crete and Ionian Seas) and western Mediterranean.

Known seasonality: present all the year.

Distribution: mesopelagic species (Pugh, 1984) distributed in the temperate regions of the three great oceans, and the Mediterranean (Bigelow and Sears, 1937; Alvarino, 1971).

References: Bigelow and Sears (1937); Totton (1965); Rottini (1971); Pugh (1974, 1999); Kirkpatrick and Pugh (1984); Pugh (1984); Gili (1986); Pagès and Gili (1992); Lakkis and Zeidane (1995); Gamulin and Kršinić (2000).

Lensia subtilis (Chun, 1886)
(Figs. 134E-G)

Polygastric stage: anterior nectophore conical, fragile, laterally compressed, apex rounded, apparently devoid of ridges but with folds. Up to 10 mm in height. Hydroecium wide, short, slanting upwards towards the ventral surface, upper edge above the level of the ostium. Somatocyst composed of a long, straight peduncle reaching to the midpoint of the nectophore, ending in a globe. Basal lamella small, divided into two wings. Posterior nectophore approximately the same size as the anterior nectophore, with five ridges, truncate apex, and rounded small basal lamella.

Eudoxid: bract small and rounded with a short phyllocyst. The gonophore has hydroecial folds only on the proximal part.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: 1-12.

Distribution: temperate regions of the three great oceans and the Mediterranean (Alvarino, 1971). Epiplanktonic, though it may extend down to depths of 500-1000 m (Pugh, 1974; Gili *et al.*, 1987a).

References: Cervigón (1958); Totton (1965); Pugh (1974, 1999); Ianora and Scotto di Carlo (1981); Kirkpatrick and Pugh (1984); Gili (1986); Pagès and Gili (1992); Avian *et al.* (1995); Carré and Carré (1995); Lakkis and Zeidane (1995); Gamulin and Kršinić (2000).

Lensia subtiloides (Lens and Van Riemsdijk, 1908)
(Figs. 135A-B)

Polygastric stage: anterior nectophore 3.7 mm high by 1.4 mm wide, consistency firm with five ridges converging at the apex. Hydroecium very shallow, summit at the same level as the ostium. Basal lamella slanting upwards towards the ventral surface. Mouth wide, with two short wings with rounded borders slightly overlapping. Somatocyst club-shaped, one-third/one-fifth of nectophore height. Posterior nectophore 3 mm in height with a slight apical promontory and a small tooth on the right side of the apex.

Eudoxid: bract rounded with club-shaped phyllocyst.

Records from Mediterranean: western Mediterranean.

Known seasonality: 12.

Distribution: present, though uncommon, in temperate coastal waters of the three great oceans and the Mediterranean (Alvarino, 1971). Frequently collected together with *Diphyes chamissonis*, to which appear to be associated in the Indo-Pacific region (Totton, 1954; Pagès *et al.*, 1989).

References: Bigelow and Sears (1937); Totton (1965); Daniel (1974); Gili (1986); Pagès and Gili (1992); Lakkis and Zeidane (1995); Pugh (1999).

Genus *Muggiaea* Bush, 1851

Diphyids with posterior nectophore not developed. Pyramidal anterior nectophore with 5 ridges. Deep hydroecium, not open ventrally, oblique, divided mouth. Somatocyst lies very close to nectosac wall.

References: Pagès and Gili (1989, 1992); Pugh (1999).

Muggiaea atlantica Cunningham, 1892
(Figs. 135C-D)

Polygastric stage: Nectophore small, up to 7 mm in height, with five complete relatively straight ridges converging at the apex. No basal teeth.

Hydroecium bell-shaped, relatively deep, up to one-third of nectophore height, the lower half situated below the level of the ostium. Somatocyst long, filiform, running closely along the ventral surface of the nectosac, ending in a small thickening at the level of the apex of the nectosac. Basal lamella wide, divided into two wings whose medial margins overlap.

Eudoxid: bract small, conical, dorsal surface longer than ventral surface. Sutural surface broad, flattened, suture prominent. Phyllocyst club-shaped. Hydroecial cavity shallow. Gonophore slightly twisted, with four ridges running from the base to the apex. Basal lamella short, curved.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: 1-12.

Distribution: neritic species inhabiting warm and temperate regions of the three great oceans and the Mediterranean (Bigelow and Sears, 1937; Alvariño 1971).

References: Russell (1938); Totton (1965); Daniel (1974); Purcell (1982); Kirkpatrick and Pugh (1984); Gili (1986); Gili *et al.* (1987a), Gili *et al.* (1987b); Gili *et al.* (1988); Pagès and Gili (1992); Lakkis and Zeidane (1995); Pugh (1999); Gamulin and Kršinić (2000).

***Muggiaea kochi* (Will, 1844)**
(Figs. 135E-F)

Polygastric stage: nectophore similar to that of *M. atlantica*, with five ridges converging at the apex. Up to 7 mm in height. Lateral ridges describing a characteristic sigmoidal curve. Hydroecium conical, less deep than in *M. atlantica*, reaching one-quarter of nectosac height. Basal lamella divided into two equal rectangular wings. Somatocyst filiform, cylindrical, reaching the midpoint of the nectosac.

Eudoxid: the bract is roughly conical, with a flattened facet, an asymmetrical basal process, and a very shallow hydroecial depression. The phyllocyst is club-shaped. The gonophores have four longitudinal ridges. There is a short, curved mouth.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: 1-12.

Distribution: Atlantic species abundant in neritic waters of temperate regions (Alvariño, 1971). In the southern hemisphere collected to latitude 23° S off

Brazil (Leloup and Hentschel, 1935). In the Pacific reported in the vicinity of the Galapagos Islands (Alvariño and Leira, 1986) and near the Panama Canal after entering from the Atlantic (Alvariño, 1974), Mediterranean.

References: Totton (1965); Alvariño (1971, 1974); Rottini (1971); Kirkpatrick and Pugh (1984); Gili (1986); Pagès and Gili (1992); Lakkis and Zeidane (1995); Pugh (1999); Gamulin and Kršinić (2000).

Genus *Sulculeolaria* Blainville, 1834

Diphyids with anterior nectophore with rounded apex, and without ridges; posterior nectophore of similar size with extensively looped lateral radial canals. Replacement nectophores of both types frequently with different characters. Small leaf-like bracts with direct release of gonophores, without eudoxid stage. Bracts of various species are not distinguishable.

References: Carré C. (1979); Pagès and Gili (1992); Pugh (1999).

***Sulculeolaria biloba* (M. Sars, 1846)**
(Figs. 135G-I)

Polygastric stage: anterior nectophore conical, without ridges, apex rounded. Firm consistency. Up to 20 mm high. Ostial margin devoid of teeth. Radial canals with transverse commissures connected to the ventral canal nearly at the level of the ostium. Somatocyst ovoid or filiform, sloping ventrally, one-sixth of nectophore height. Basal lamella divided into two large, rounded lappets, without protuberances. Posterior nectophore rectangular, up to 24.6 mm in height. No ostial teeth. Basal lamella consisting of two lateral lappets and a central mouth, with furrows reaching to half of lamella height; protuberances absent.

Records from Mediterranean: eastern and western Mediterranean, Adriatic.

Known seasonality: 4.

Distribution: warm, and temperate waters of the three great oceans (Alvariño, 1971), and in the Mediterranean (Gili, 1986). The numerous synonyms used for this species in the past make it difficult to confirm some of the early records, as discussed previously by Totton (1954).

References: Carré C. (1979); Kirkpatrick and Pugh (1984); Pagès and Gili (1992); Avian *et al.* (1995); Lakkis and Zeidane (1995); Pugh (1999).

Sulculeolaria chuni
(Lens and van Riemsdijk, 1908)
(Figs. 136A-B)

Polygastric stage: anterior nectophore conical, without ridges, apex rounded, consistency more delicate than other species of the genus. Up to 8 mm high. Ostial margin without teeth. Radial canals without transverse commissures in the first anterior nectophore, but commissures present in the replacement nectophore. Somatocyst quite straight, filiform or fusiform, up to two-fifths to three-fifths of nectophore height. Basal lamella short, divided into two lappets, without protuberances. Posterior nectophore cylindrical, up to 8.6 mm in height. No teeth on the ostial margin. Basal lamella divided into two rounded lappets separated by a shallow medial notch. Secondary posterior nectophore similar.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: present all the year, mainly 4-12.

Distribution: common species in equatorial and tropical regions in the three great oceans (Alvariño, 1971) and the Mediterranean (Bigelow and Sears, 1937; Carré C., 1979).

References: Cervigón (1958); Totton (1965); Rottini (1971); Palma (1973); Carré C. (1979); Ianoira and Scotto di Carlo (1981); Gili (1986); Pagès and Gili (1992); Avian *et al.* (1995); Lakkis and Zeidane (1995); Pugh (1999); Gamulin and Kršinić (2000).

Sulculeolaria quadrivalvis Blainville, 1834
(Figs. 136C-D)

Polygastric stage: anterior nectophore conical, apex rounded, without ridges firm consistency. Large, up to 20 mm in height. Ostial margin bearing two lateral and two dorsal teeth, well-developed, decreasing in size in the replacement anterior nectophores. Radial canals with transverse commissures linking the canals to the ventral canal at the level of the lower third of the nectosac. Transverse commissure tending to be smaller in replacement nectophores and sometimes not reaching the dorsal canal in the second following nectophore. Somatocyst elongate, sinuous, ventrally slanted, one-fifth to two-fifths of nectophore height in size, tending to be straighter in following nectophores. Two prominent, rounded basal lappets, each with a small protuberance on the dorsal margin, decreasing in size and

disappearing in replacement nectophores. Posterior nectophore up to 26.6 mm high. Nectosac with an oblique annular constriction affecting the upper dorsal and lower ventral halves. Ostial margin with two dorsal and two lateral teeth. Basal lamella divided into two large, rounded lobes with a central furrow occupying three-fourths of basal lamella length. Each lappet bearing an acute protuberance on the upper dorsal portion.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: present all the year.

Distribution: widely distributed in tropical and subtropical regions in the three great oceans and in the Mediterranean (Bigelow and Sears, 1937; Alvariño, 1971).

References: Totton (1965); Alvariño (1981); Palma (1973); Carré (1979); Kirkpatrick and Pugh (1984); Gili (1986); Pagès and Gili (1992); Avian *et al.* (1995); Lakkis and Zeidane (1995); Pugh (1999); Gamulin and Kršinić (2000).

Sulculeolaria turgida (Gegenbaur, 1853)
(Figs. 136E-F)

Polygastric stage: anterior nectophore conical, apex rounded, firm consistency, reaching 15 mm in height. Ostial margin devoid of teeth. Somatocyst small, ovoid or filiform, one-twentieth of nectophore height. Radial canals without transverse commissures in the first nectophore (NA1), but transverse commissures are present in the replacement nectophore (NA2), attached to the ventral canal above the level of the pedicular canal. Basal lamella divided into two lappets by a deep furrow reaching to the ostial margin, shorter in NA2. Tooth-like protuberances absent. Posterior nectophore cylindrical, tapering towards the ostial margin. Up to 10.0 mm high. No teeth on the ostial margin. Basal lamella entire, large, rounded, devoid of protuberances.

Records from Mediterranean: mainly Adriatic, eastern and western Mediterranean.

Known seasonality: 12-9.

Distribution: uncommon but distributed in temperate regions in the three great oceans, and in the Mediterranean (Bigelow and Sears, 1937; Alvariño, 1971). Epipelagic distribution.

References: Totton (1965); Carré (1979); Kirkpatrick and Pugh (1984); Gili (1986); Pagès and Gili (1992); Avian *et al.* (1995); Pugh (1999); Gamulin and Kršinić (2000).

Family HIPPOPODIIDAE Kölliker, 1853

Calycophorae with biserial arrangement of up to 16 or more flattened definitive nectophores in varying stages of development, the youngest being apical, nectophores fitting tightly together around a thin stem which can be retracted between them; without bracts, somatocyst curving smoothly over mid-dorsal surface of hydroecium and is without central organ.

Reference: Carré and Carré (1995).

Genus **Hippopodius** Quoy and Gaimard, 1827

Hippopodiid whose larval nectophore nectosac has only two radial canals.

References: Pagès and Gili (1992); Pugh (1999).

Hippopodius hippopus (Forskål, 1776)
(Figs. 137A-D)

Colonies formed by up to 16 nectophores arranged in two series opposite each other joined by a thin central stem. Upper nectophores younger, lower nectophores dropped from the colony as new nectophores form at the apex. Definitive nectophore hard and tough, horseshoe-shaped, up to 20.6 mm high and 16.0 mm wide. It may become opaque during fixation. Four rounded dorsal protuberances variable in size forming an arc above the ostium; the two central protuberances smaller. The nectosac is relatively large and a *rete mirabile* is located on the ventral radial canal, larger in juveniles.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: present all the year.

Distribution: widely distributed in tropical and subtropical regions in the three great oceans, and in the Mediterranean (Bigelow and Sears, 1937; Alvarinho, 1971; Pugh 1974).

References: (Bigelow and Sears, 1937); Totton (1965); Carré D. (1968a); Rottini (1971); Pugh (1974, 1999), Kirkpatrick and Pugh (1984, 1999); Gili (1986); Pagès and Gili (1992); Avian *et al.* (1995); Lakkis and Zeidane (1995); Gamulin and Kršinić (2000).

Genus **Vogtia** Kölliker, 1853

Hippopodiid of which the nectosac of larval nectophore has 4 radial canals.

References: Pagès and Gili (1992); Pugh (1999).

Vogtia glabra Bigelow, 1918
(Figs. 137E-F)

Colonies composed of two parallel rows of nectophores attached obliquely to a central stem. Oldest nectophores placed at the base of the colony. Youngest nectophores elongate, up to 7.3 mm high by 4.6 mm wide, with a triangular apical process consisting of three rounded protuberances, a larger central protuberance and two smaller lateral protuberances, halfway along the height of the nectophore. *Rete mirabile* present. Deep hydroecial groove from the base of the apex on the ventral surface of the nectophore, protected by lateral wings. Adult nectophore more rounded, up to 30.0 mm in diameter, horseshoe-shaped. Characterized by two rounded dorso-lateral processes and an additional apical process. Hydroecial groove shallower; hydroecium large and flattened.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: 5.

Distribution: widely distributed in the Atlantic Ocean from Ireland to Tristan da Cunha (Leloup, 1955). Sporadically present in the Pacific and Indian oceans and the Mediterranean (Alvarinho, 1971).

References: Pugh (1974, 1984, 1999); Kirkpatrick and Pugh (1984); Gili (1986); Pagès and Gili (1992); Lakkis and Zeidane (1995).

Vogtia pentacantha Kölliker, 1853
(Fig. 137G)

Colonies organized like the rest of the hippopodiids. Nectophore five pointed, up to 15 mm with small gelatinous teeth on the ridges, but with smooth facets except for occasional protuberances near the central ridge. Nectosac relatively small. Polygastric stage fragile and seldom found intact in net collections.

Records from Mediterranean: southern Adriatic, eastern and western Mediterranean

Seasonality: ?

Distribution: Atlantic, Mediterranean.

References: Bigelow and Sears (1937); Tré-gouboff (1957); Rottini (1971); Gamulin and Kršinić (2000).

Vogtia serrata (Moser, 1925)
(Fig. 137H)

Nectophore roughly triangular, up to 40 mm in diameter, with two small flaps at the centre of base.

Neither the distinctive ridges nor the facets bear spines or protuberances, and a small, deep hollow exist beneath each lateral process.

Records from Mediterranean: western Mediterranean.

Seasonality: ?.

Distribution: infrequent but inhabiting tropical and subtropical regions in the three great oceans, and the Mediterranean (Alvariño, 1971).

References: Bigelow and Sears (1937); Kirkpatrick and Pugh (1984); Pugh (1999).

***Vogtia spinosa* Keferstein and Ehlers, 1861**
(Fig. 138A)

Colonies composed of two parallel rows of nectophores attached obliquely to a central stem. Up to 19 nectophores, pentagonal in shape, up to 20 mm in length. Spine-like gelatinous tubercles closely spaced on the upper surface of the nectophore. Ventral surface a deep concavity devoid of spines. Nectosac large, flattened, with four radial canals and a *rete mirabile* on the ventral surface.

Records from Mediterranean: western Mediterranean.

Seasonality: ?

Distribution: infrequent but inhabiting tropical and subtropical regions in the three great oceans, and in the Mediterranean (Alvariño, 1971).

References: Bigelow and Sears (1937); Totton (1965); Pugh (1974, 1999); Kirkpatrick and Pugh (1984); Pugh, 1984; Pagès and Gili (1992).

Family PRAYIDAE Kölliker, 1853

Nectophores relatively large and usually rounded, mesoglea abundant; larval nectophore sometimes retained during polygastric stage or replaced by one to four definitive nectophores, whose somatocysts are often complexly branched; the eudoxid bracts are rounded and unridged.

References: Carré and Carré (1995); Pugh (1999).

Subfamily AMPHICARYONINAE Chun, 1888

Two nectophores differing in size. The larger, rounded one is believed to be the retained larval nectophore. The first definitive one smaller or vestigial. The bracteal canals are reduced to 2 long hydroecials. Bracts undistinguishable at present.

References: Carré and Carré (1995); Pugh (1999).

Genus *Amphicaryon* Chun, 1888

Prayid with two dissimilar nectophores; the larger, which is possibly the retained larval nectophore, partly encloses the reduced or vestigial definitive nectophore. The nectosac of the latter does not have an external opening. The eudoxid bract has a pair of lateral hydroecial canals.

References: Pagès and Gili (1992); Pugh (1999).

***Amphicaryon acaule* Chun, 1888**
(Figs. 138B-C)

Polygastric stage: colonies globe-shaped, composed of two nectophores. Larval nectophore large, ovoid, up to 10.7 mm in height, higher than wide, partially surrounding the vestigial nectophore. Larger nectophore has a nectosac somewhat higher than half nectophore height with four radial canals, the dorsal canal longer than the ventral canal. Upper portion of lateral canal forming a right angle. Vestigial nectophore is a disc within the ventral cavity of the larger nectophore. Nectosac with four simple radial canals, not open to the outside.

Eudoxid: small and thin, with two straight canals. It is folded to form a shield to the bell-shaped gonophores.

Records from Mediterranean: western Mediterranean.

Known seasonality: 9-4.

Distribution: present in tropical and subtropical regions of the three great oceans, and of the Mediterranean (Alvariño, 1971; Pugh, 1974). Epipelagic species that has been caught in the mesopelagic zone (Pugh, 1974).

References: Bigelow and Sears (1937); Totton (1965); Palma (1973); Daniel (1974); Pugh (1974, 1999); Kirkpatrick and Pugh (1984); Pagès and Gili (1992).

Subfamily PRAYINAE Chun, 1897

Prayid with two, occasionally up to 4, rounded, smooth-walled nectophores of similar size. Bracts with 6 canals, occasionally reduced to 5.

References: Carré and Carré (1995); Pugh (1999).

Genus *Desmophyes* Haeckel, 1888

Prayid with usually two avoid flimsy, cylindrical nectophores but there can be up to 6 biserially arranged nectophores. Nectosac occupying less than

half the height of the nectophores; with an ascending but no descending branch to the somatocyst; with four straight radial canals. Somatocyst unbranched and with a distinctive whitish swelling at the apex. Bracts small, compact and kidney-shaped, characterized by the presence of a large white spherical or ovoid central organ, giving rise to the thin bracteal canal. Gonophores fragile and reduced.

References: Pugh and Harrison (1987); Pugh (1992).

***Desmophyes annectens* Haeckel, 1888**
(Figs. 138D-F)

Polygastric stage: large swelling at the distal end of the ascending branch of the somatocyst. Nectosac occupying one-quarter the nectosac height.

Eudoxid: bracteal dorsal canal arises centrally from an inflated vesicle. Gonophore with two symmetrically arranged mantle canals and without lateral flaps toward their apices.

Records from Mediterranean: Villefranche-sur-mer.

Known seasonality: ?

Distribution: Atlantic; Mediterranean.

References: Pugh and Harbison (1987); Pugh (1992).

***Desmophyes villafrancae* (Carré, 1969)**
(Figs. 139A-C)

Polygastric stage: nectosac occupying two-third/two-fifth the nectophore height

Eudoxid: bracteal dorsal canal arises from the right hydroecial canal. Gonophore with a single mantle canal.

Records from Mediterranean: Villefranche-sur-mer (western Mediterranean).

Known seasonality: 5.

Distribution: endemic of Mediterranean Sea.

References: Carré C. (1969a); Pugh and Harbison (1987); Pugh (1992).

Genus *Lilyopsis* Chun, 1885

Prayid whose polygastric stage has two, possibly more very delicate and opposite conoid nectophores up to 10 mm in height; large nectosacs. Definitive nectophore has a bifurcated somatocyst and sinuous lateral canals on the nectosac. Larval nectophore has a simple somatocyst, slightly swollen at its tip, and straight radial canals on the nectosac.

Eudoxid: bract like a cushion, with central origin of dorsal canal. Gonophore with a single mantle canal.

References: Carré and Carré (1995); Pugh (1999).

***Lilyopsis rosea* Chun, 1885**
(Figs. 139D-F)

Diagnosis: like for the genus

Records from Mediterranean: western Mediterranean.

Known seasonality: ?

Distribution: Atlantic; Mediterranean.

References: Carré C. (1969b); Carré and Carré (1995), Pugh and Harbison (1987), Pugh (1999).

Genus *Prayola* Carré, 1969

Prayid with an apposed pair of conoid nectophores, whose extensive nectosacs (>half the height of the nectophore) open dorso-basally. The radial canals on the nectosac are slightly curved, suggesting an open S. The very short somatocyst possesses neither an ascending nor a descending branch. The bracts have only five bracteal canals, there being no dorsal canal. The gonophores possess a hydroecial gutter and two mantle canals of equal length. No special, asexual nectophores are present.

Reference: Pugh and Harbison (1987).

***Prayola tottoni* Carré 1969**
(Figs. 140A-D)

Polygastric stage: both nectophores conoidal, of same size, up to 5 mm in height and 4.5 mm in diameter. Pedicular canal almost horizontal. Nectosac more than half of nectophore height. Radial canals unequal, the ventral short straight the other slightly curved. Simple and very short superficial somatocyst, in both nectophores.

Eudoxid: bracts elliptical, cushion-like, with five short branched bracteal canals, no dorsal canal. Gonophore subspherical; pedicular canal vertical giving rise to two symmetrical mantle canals.

Records from Mediterranean: off Villefranche-sur-Mer (western Mediterranean).

Known seasonality: 4.

Distribution: endemic of the Mediterranean Sea.

References: Carré C. (1969c); Pugh and Harbison (1987).

Genus *Rosacea* sensu Bigelow, 1911

Prayid with two medium, rounded nectophores with simple somatocyst without side branches. Sinuous lateral radial canals on nectosac. Bracts kidney-

shaped, but with characteristic arrangement of canals.

References: Pugh and Harbison (1987); Pagès and Gili (1992); Pugh (1999).

Rosacea cymbiformis (Delle Chiaje 1822)
(Figs. 140E-F, 141A)

Polygastric stage: definitive nectophore less rounded, more flattened and elongate than in *R. plicata*, up to 17.5 mm high. The two definitive nectophores are attached ventrally, one partially surrounding the other. Hydroecium shallow, comprising a ventral canal with two faint lateral projections extending, dorso-basally, from near the apex to the ostium of the nectosac. Nectosac displaced dorsally, small, less than two-fifths of nectophore height, lateral radial canals curving three times, forming a W from the pedicular canal to the ostial ring canal. Somatocyst with descending branch as in *R. plicata*. Eudoxid: bract less compact than that of *R. plicata*, with the dorsal bracteal canal arising proximal to the spur on the left hydroecial canal.

Records from Mediterranean: Adriatic and western Mediterranean.

Known seasonality: 9-5.

Distribution: relatively common species, more abundant in the Atlantic, taken off the British Isles (Kirkpatrick and Pugh (1984), in the Bay of Biscay and off the Azores (Leloup, 1955), also taken in the Mediterranean (Bigelow and Sears, 1937). The depth distribution appears to be more epipelagic than that of *R. plicata*.

References: Totton (1965); Daniel (1974); Purcell (1981); Kirkpatrick and Pugh (1984); Pagès and Gili (1992); Avian *et al.* (1995); Pugh (1999); Gamulin and Kršinić (2000).

Rosacea plicata sensu Bigelow 1911
(Figs. 141B-C)

Polygastric stage: two types of nectophore, a temporary larval and a definitive one. Larval nectophore small, globe-shaped, 4.7 mm in size. Similar to that of the Hippopodidae, except that the pallial canal makes a sharp turn around the central organ. This nectophore is replaced by two larger definitive nectophores up to 18.0 mm in height. Mesoglea thick but not rigid, and consequently specimens when preserved and easily deformed, hindering identification and creating confusion with *R. cymbiformis*. Nectophores without ridges, globe-shaped or cylindrical. Nectosac dome-shaped, located

at the base of the nectophore, reaching to one the quarter nectophore height. Radial canals curving twice to form a horizontal S. Hydroecium ventral, deep, occupying a large part of the central portion of the nectophore without reaching either the apex or the base. Somatocyst simple with descending branch.

Eudoxid: bract kidney-shaped and compact. The longitudinal bracteal canals are reduced to spurs, and the dorsal canals raise distal to the spur on the left hydroecial canal. The gonophores are simple and bell-shaped.

Remark: the nectophores of the two *Rosacea* species can be difficult to tell apart. Generally *R. cymbiformis* lives in shallower depth than *R. plicata*.

Records from Mediterranean: western Mediterranean.

Known seasonality: 9.

Distribution: mesopelagic species (Pugh, 1984) widely distributed in the three great oceans and in the Mediterranean (Alvariño, 1971).

References: Totton (1965); Kirkpatrick and Pugh (1984); Pugh (1984, 1999); Gili (1986); Pugh and Harbison (1987); Pagès and Gili (1992).

Family SPHAERONECTIDAE Huxley, 1859

Calycophorae that retain the larval nectophore as the only one in the polygastric stage.

References: Carré and Carré (1995); Pugh (1999).

Genus *Sphaeronectes* Huxley, 1859

With the characters of the family.

References: Pagès and Gili (1992); Pugh (1999).

Sphaeronectes bougisi Carré D, 1968
(Figs. 141D-E)

Polygastric stage: nectophore small, 1.0 mm in height; spheroidal, slightly conical apically. Nectosac sub spherical, occupying the quasi totality of nectophore volume. Velum large, ventral. Pedicular canal virtual, very short, giving rise sagittally to two radial canals, the ventral short in almost immediate contact with the marginal canal, the dorsal longer and running up to the apex of the nectosac, the two lateral canals are straight, issued from two different points of the nectosac apex, the right one being located more ventrally than the left one, both connected to the marginal canal. Hydroecium conical,

symmetrical to the sagittal plan, triangular, small, located at the base of the ventral face. Somatocyst without peduncle, vertical, fusiform, at the ventral side of the nectosac. Siphosome with 3 to 4 cormidial buds.

Eudoxid: only just detached cormidia known, bract hemispherical with a globulous phyllocyst, gastrozoid with a short peduncle.

Records from Mediterranean: western Mediterranean.

Known seasonality: 7.

Distribution: endemic of the Mediterranean Sea.

References: Carré D. (1968 b), Carré C. (1968 d); Gili (1986).

***Sphaeronectes fragilis* Carré C. 1968**
(Figs. 141F-G)

Polygastric stage: nectophore spheroidal, slightly cylindrical, with thin walls, fragile, up to 5mm in height. Pedicular canal virtual. Nectosac large up to 4.5mm, subspherical. Radial canals looped with a secondary loop on the descending branch, their intersection with dorsal canal in ventral position on the nectosac. Hydroecium conical, symmetrical, in the sagittal plan, not very deep, 2/5 of nectosac height. Somatocyst vertical on ventral side of nectosac with a subspherical thickening and a long peduncle.

Eudoxid: not known.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: present all the year.

Distribution: endemic of Mediterranean Sea.

References: Carré C. (1968e); Avian *et al.* (1995); Gamulin and Kršinić (2000).

***Sphaeronectes gamulini* Carré C. 1966**
(Figs. 142A-D)

Polygastric stage: nectophore spheroidal, slightly conical up to 1.5 mm in height and diameter. Nectosac subspherical, 3/4 of the nectophore height. Pedicular canal short but visible. Right lateral canal inserted slightly above left radial canal. Radial canals looped, their intersection with dorsal canal in the ventral position on the nectosac. Hydroecium conical relatively deep, laterally flattened, 1/2 nectosac height, on the left of the sagittal plan. Somatocyst horizontal, on the right lateral ventral side of the nectosac, with a terminal ovoid thickening and a distinct stalk of the same size

Eudoxid: bract hemispherical, flat, hydroecium indistinct. Phyllocyst fungi form, globular with a peduncle of about the same size than body.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: present all the year.

Distribution: endemic of the Mediterranean Sea.

References: Carré (1968e); Ianora and Scotto Di Carlo (1981); Avian *et al.* (1995); Gamulin and Kršinić (2000).

***Sphaeronectes gracilis* (Claus, 1873, 1874)**
(Figs. 142E-F)

Polygastric stage: nectophore spheroidal, quite fragile, up to 8.0 mm in height. Nectosac small, reaching to half of nectophore height. Four straight radial canals arising from the same point at the apex of the nectosac over which bends the long, narrow, tubular, hydroecium which runs from the external opening to the pedicular canal at the apex of the nectosac. Velum broad. Pedicular canal long, readily distinguishable. Somatocyst horizontal, short, fusiform, and curved with a distal swelling, directed towards the dorsum above the apex of the nectosac. *Eudoxid*: (called diplophysa) bract small and spherical, with clear basal wings. The phyllocyst is long, obliquely angled and club-shaped. The gonophore is a simple bell, thickened towards its apex.

Records from Mediterranean: Adriatic, eastern and western Mediterranean.

Known seasonality: present all the year.

Distribution: common in Mediterranean (Trègoubouff, 1957; Patrì, 1964; Rottini, 1971; Ianora and Scotto Di Carlo, 1981); in the Atlantic collected off the Canary Islands (Chun, 1892) and the British Isles (Kirkpatrick and Pugh, 1984). In the Pacific collected off California (Purcell and Kremer, 1983); Chile (Palma, 1977) and Japan.

References: Totton (1965); Carré C. (1968e); Carré D. (1969a); Rottini (1971); Palma (1973); Ianora and Scotto Di Carlo (1981); Purcell and Kremer (1983); Kirkpatrick and Pugh (1984); Pagès and Gili (1992); Avian *et al.* (1995); Lakkis and Zeidane (1995); Pugh (1999); Gamulin and Kršinić (2000).

***Sphaeronectes irregularis* (Claus, 1873)**
(Fig. 142G)

Polygastric stage: nectophore spheroidal slightly conical, up to 7.1 mm in height and 5.7 mm in diameter. The radial canals are looped, their intersection

in the ventral part of the nectosac. Nectosac the 2/3 of nectophore height. Pedicular canal virtual. Hydroecium conical laterally flattened, not very deep, 1/3 of nectophore height. Somatocyst pyriform not pedunculate, vertical on the ventral side of the nectosac.

Eudoxid: hemispherical, slightly conical. Phyllocyst ovoid to piriform with a very short peduncle, length less than 1/2 of the bract height. Hydroecium not well developed, basal wing not very distinct.

Records from Mediterranean: eastern and western Mediterranean.

Known seasonality: present all the year.

Distribution: Mediterranean, Pacific.

References: Trégouboff (1957); Avian *et al.* (1995); Lakkis and Zeidane (1995); Gamulin and Kršinić (2000).

Class AUTOMEDUSA Lameere, 1920
emend. (see Bouillon and Boero 2000).
(Actinulidae, Narcomedusae, Trachymedusae)

Subclass ACTINULIDAE
Swedmark and Teissier, 1959

Free living, solitary, minute (up to 1.5-2 mm) members of the interstitial fauna of marine sand, resembling "actinuloid" larvae (e.g. *Solmundella* larvae); umbrella present or reduced; manubrium, or gastric tube, elongated, terminating into a simple mouth-opening; without canal system; with or without a cone-shaped aboral adhesive organ formed by incurved ectoderm; with one or two amphicoronate rings of solid tentacles, either aboral or marginal; with or without brood chamber (= remains of subumbrellar cavity); sexual cells in the endoderm of the manubrium wall; free ecto-endodermal statocysts similar to those of the Trachy- and Narcomedusae, inserted between adjacent tentacles; body covered by flagella; direct development and no classical planula-like stage, embryonic development giving rise to halhydrula larvae; no asexual reproduction; cnidome containing either stenoteles or microbasic mastigophores and, among others, atrichous anisorhizas and two particular cnidocysts: spirotele and aspirotele spironemes.

Distinctive Automedusa features: statocyst structure, embryonic development, formation of the brood chamber (subumbrellar cavity) by means of a circular invagination around the manubrium.

References: Swedmark and Teissier (1966); Laccasagne (1968a).

1. With conical aboral adhesive organ; a nerve ring; two aboral amphicoronate rings of tentacles; gonochoric; without brood pouch (i.e. subumbrellar cavity)..... Halammohydridae
- No aboral adhesive organ; no nerve ring; one marginal ring of tentacles of two kinds, adhesive and armed ones; with or without a brood pouch (i.e. subumbrellar cavity); hermaphroditic, viviparous Otohhydridae

Family HALAMMOHYDRIDAE Remane 1927

Body as a long gastric tube (manubrium) with a terminal mouth, with a small aboral cone, separated from manubrium by a neck, bearing an adhesive organ; aboral nerve ring; one aboral whorl of amphicoronate solid tentacles, alternating with ecto-endodermic statocysts; gonochoric; without brood pouch.

References: Thiel (1988); Bouillon and Boero (2000).

Genus *Halammohydra* Remane, 1927

With the characters of the family.

References: Swedmark (1956, 1957); Clausen (1967, 1971); Swedmark and Teissier (1958 a and b); Laccasagne (1968b).

1. 14 tentacles and 7 statocysts *H. octopodides*
- up to 28 tentacles and 12 statocysts
..... *H. schulzei*

Halammohydra octopodides Remane, 1927
(Fig. 143A)

Hallammohydra usually with up to 14 amphicoronate tentacles and 7 statocysts, tentacles without large basal thickening; one unique gonad; body 0.3 to 0.4 mm high.

Records from Mediterranean: Adriatic.

Seasonality: ?

Distribution: Cosmopolitan.

References: Salvini-Plauwen (1966); Thiel (1988); Avian *et al.* (1995).

Halammohydra schulzei Remane, 1927
(Figs. 143B-D)

Halammohydra with usually 28 amphicoronate tentacles (sometimes up to 32) and 12 statocysts; tentacles with a large basal thickening; generally two opposite gonads; body 0.7 to 0.8 mm high.

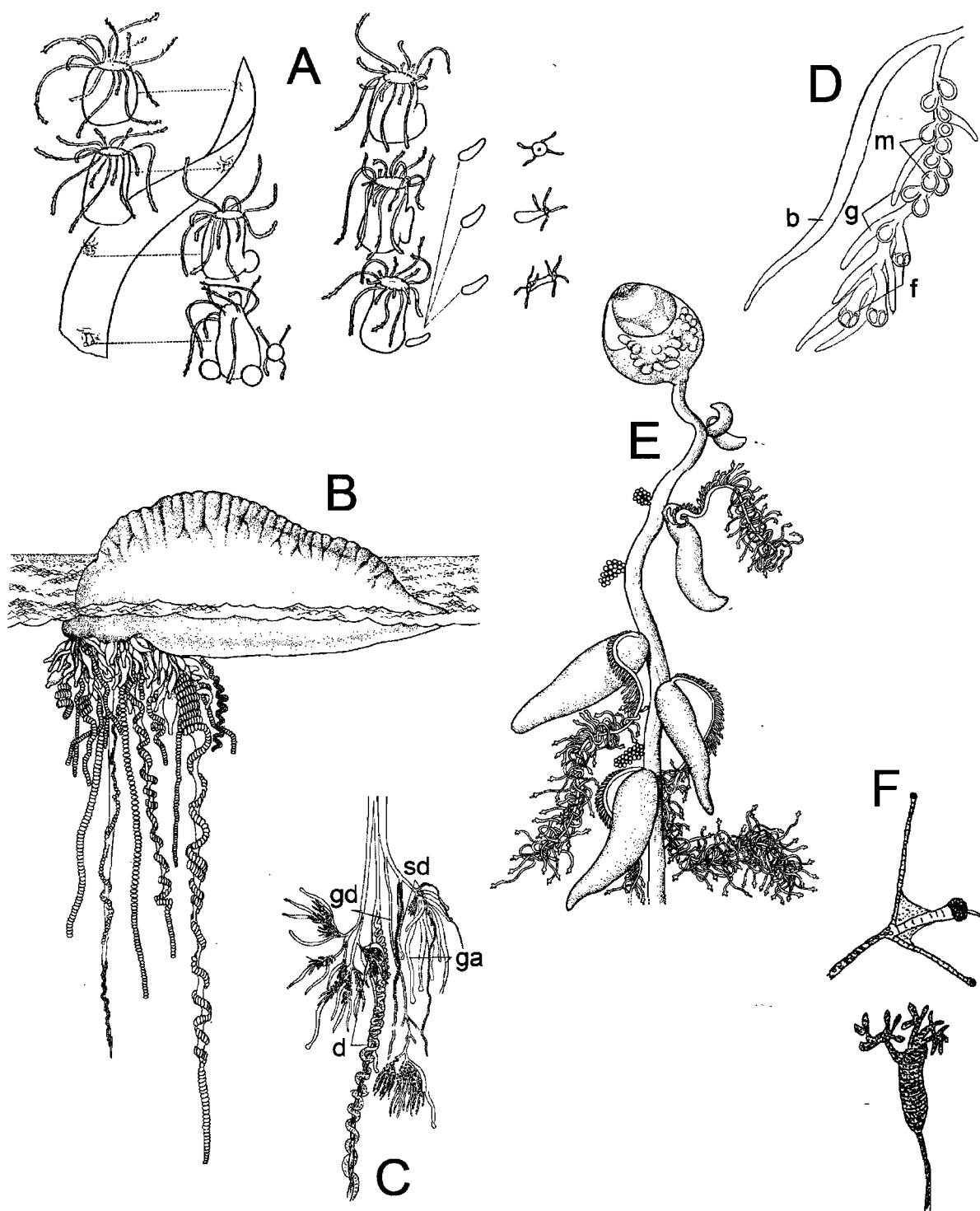


FIG. 121. – **Limnomedusae. Olindiidae.** A: *Calpasoma dactyloptera*: hydranths showing different stages of reproduction. **Siphonophorae. Physaliidae.** B to D: *Physalia physalis*: B: colony; C: cluster of persons from sexually mature colony; D: small part of a gonodendron. **Rhysophysidae.** E and F: *Rhizophyla filiformis*: E: colony; F: tentilla (A after Matthews, 1966; B and E after Pagès and Gili, 1992; C and D after Hyman, 1940; F after Pugh, 1999).

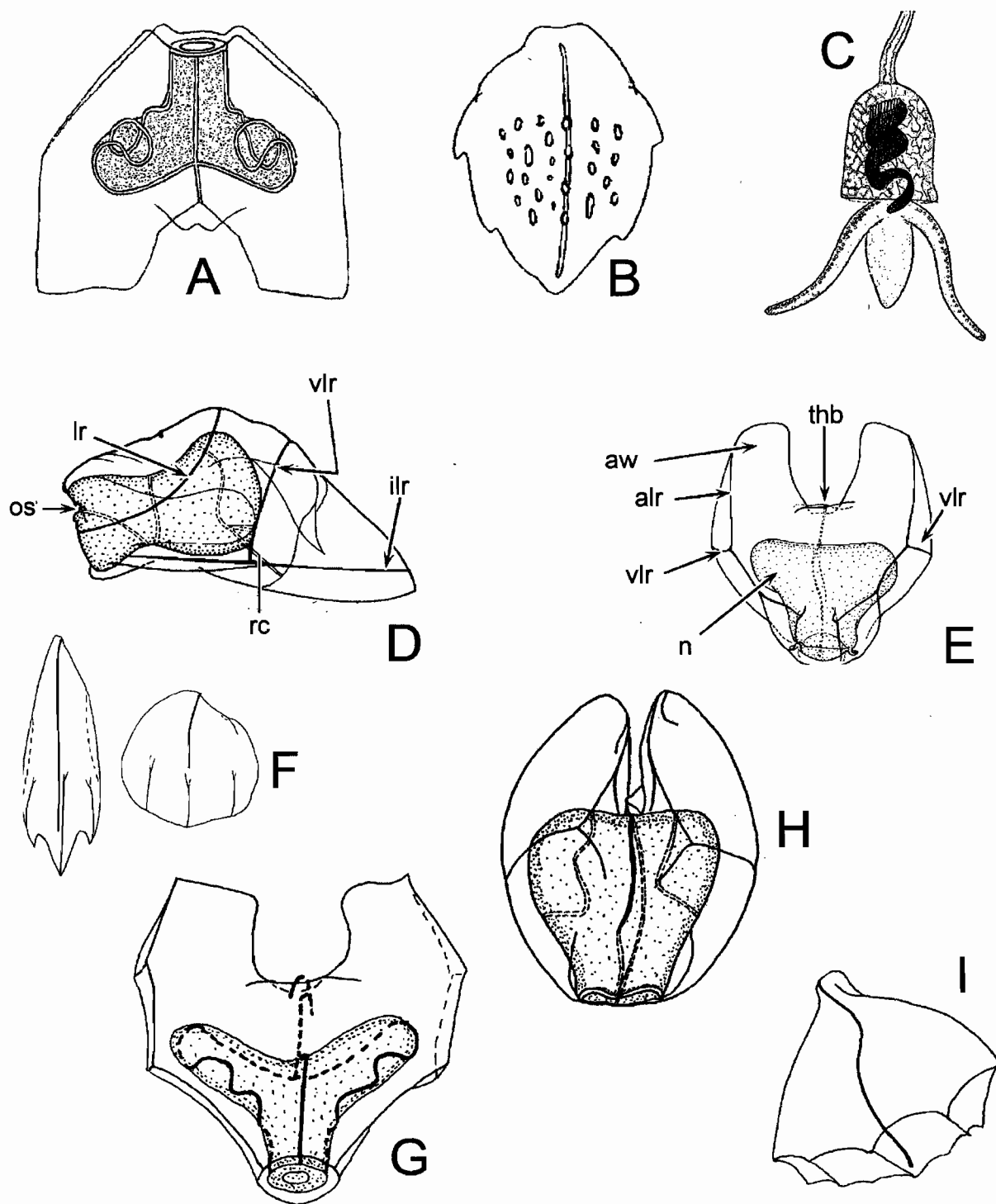


FIG. 122. – Siphonophorae, Agalmatidae. A to I: *Agalma*: A to C: *Agalma clausi*: A: nectophore; B: bract; C: tentilla. D to F: *Agalma elegans*: D: detail of a lateral view of a nectophore; E: detail of an upper view of a nectophore; F: bracts. G to I: *Agalma okeni*: G and H: upper and lateral view of nectophore; I: bract (A to C after Bedot, 1888; D to E after Totton, 1965; G and I after Pugh, 1999; H after Gili, 1986). alr: apico-lateral ridge; aw: apical wings; ilr: infra-lateral ridge; lr: lateral ridge; n: nectophore; os: ostium; rc: radial canal; thb: thrust block; vlr: vertical lateral ridge.

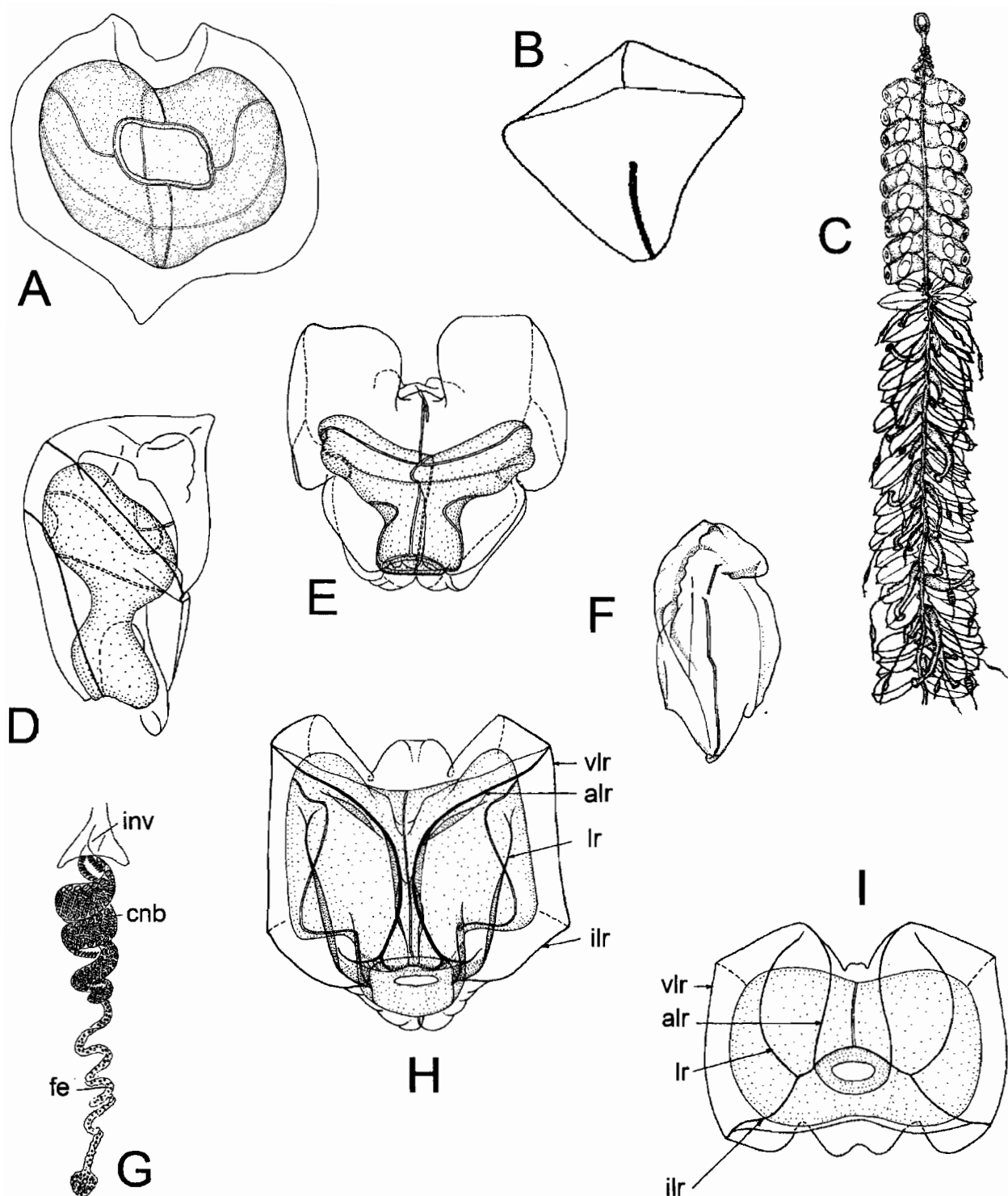


FIG. 123. – Siphonophorae. Agalmatidae. A to B: *Cordalgama cordiformis*: A: nectophore (ostial view); B: bract. C to G: *Halistemma rubrum*: C: polygstric stage; D: nectophore (lateral view); E: nectophore (from below); F: bract; G: tentillum. H and I: *Lychnagalma utricularia*: H: nectophore (upper dorsal view); I: nectophore (ostial view) (A after Pagès and Gili, 1992; C after Trégouboff, 1957; B, D to F after Pugh, 1999; G after Hyman, 1940, H and I after Pugh and Harbison, 1986). alr: apico-lateral ridge; cnb: cnidoband; fe: end of the tentillum filament; ilr: infr-lateral ridge; inv: involucre; lr: lateral ridge; vlr: vertical lateral ridge.

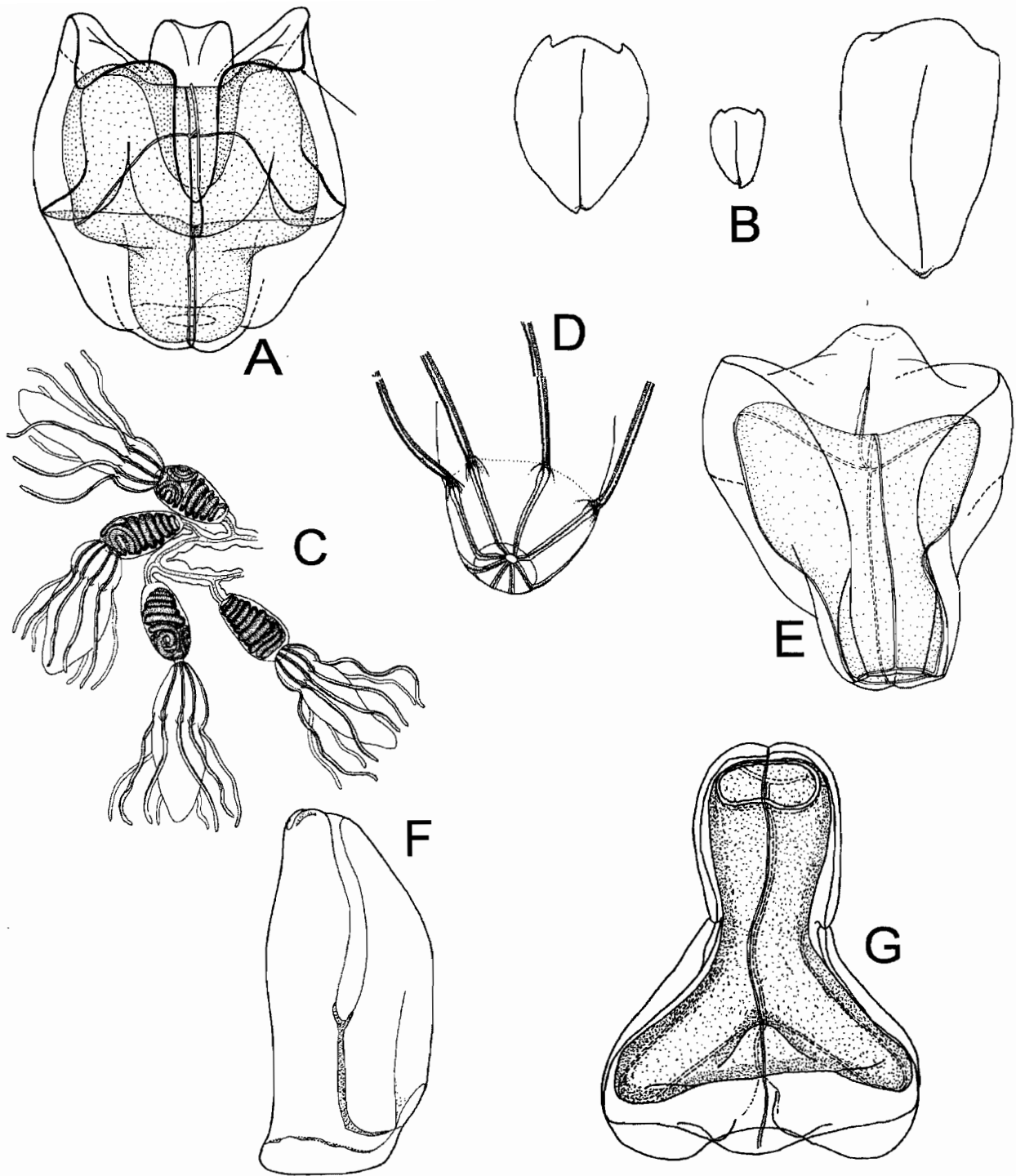


FIG. 124. – Siphonophorae. Agalmatidae. A to D: *Lychnagalma utricularia*. A: nectophore (lower ventral view), B: bracts (*Lychnalgama* spp.), C: general view of four tentilla, note the coiled cnidoband enclosed within the involucre and the terminal vesicle, D: detail of base of a detached terminal vesicle showing the octoradial filaments. E to F: *Marrus orthocanna*: E: upper view of nectophore, F: lateral view of nectophore, G: bract (A to D after Pugh and Harbison, 1986; E and F after Pugh, 1999; G after Gili, 1986).

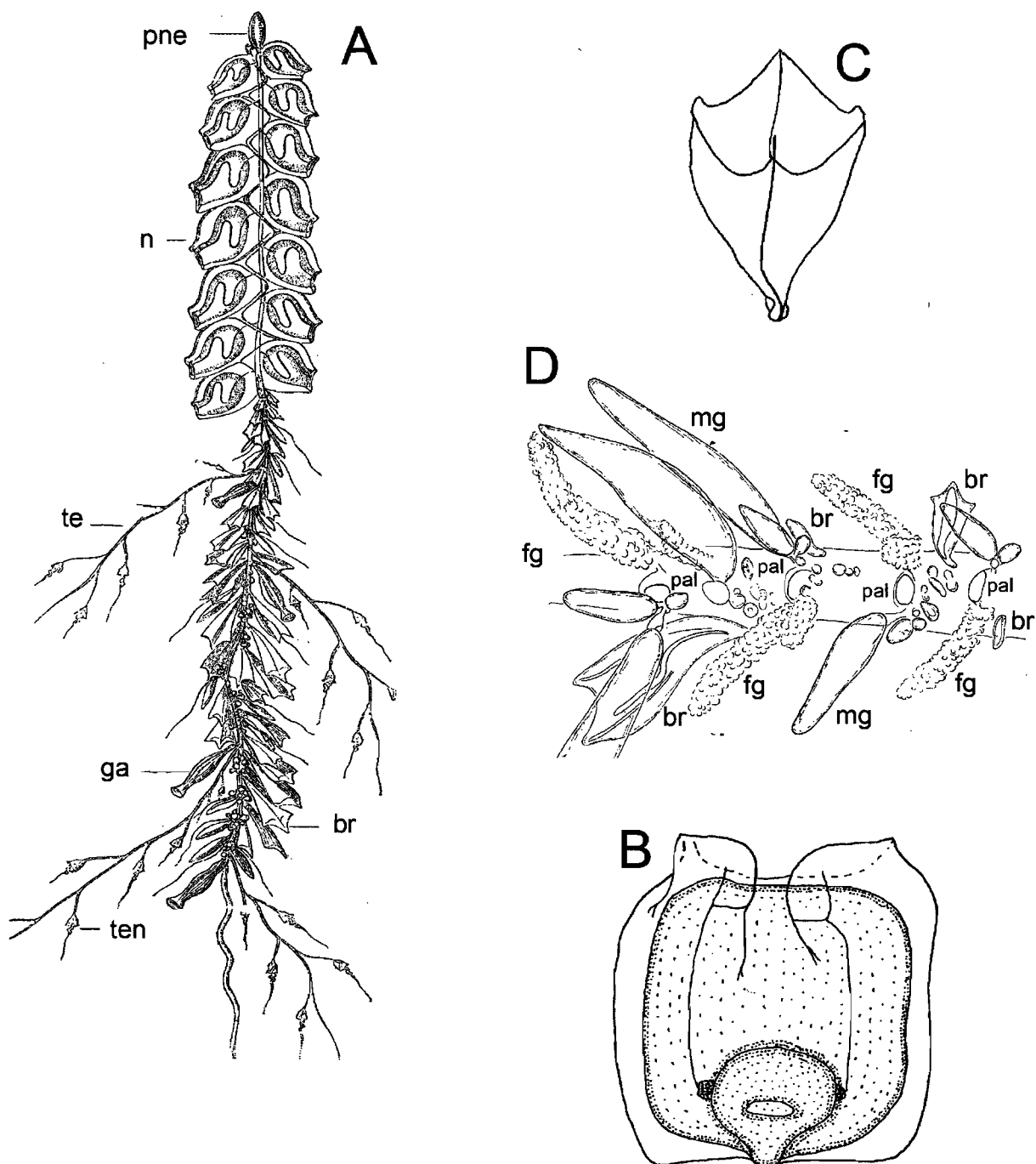


FIG. 125. – Siphonophorae. Agalmatidae. A to D: *Nanomia bijuga*: A: polygastric stage; B: upper view of nectophore; C: bract; D: part of an internode of the stem showing alternating male and female gonodendra arising from the base of a series of palpons. (A and D after Totton, 1965; B and C after Pugh, 1999); br: bract; fg: female gonophore; ga: gastrozooid; mg: male gonophore; n: nectophore; pal: palpon; pne: pneumatophore; te: tentacle; ten: tentilla.

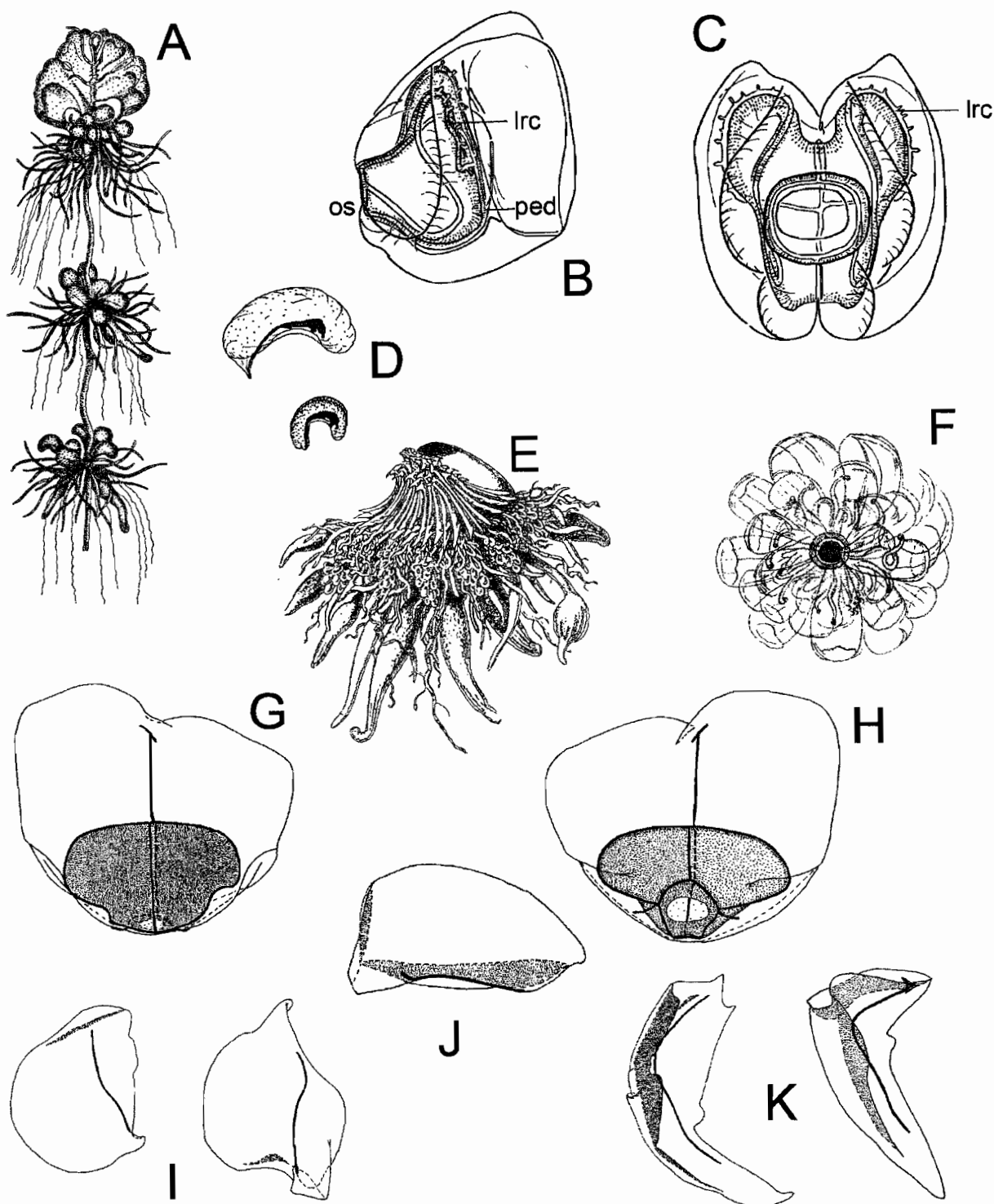
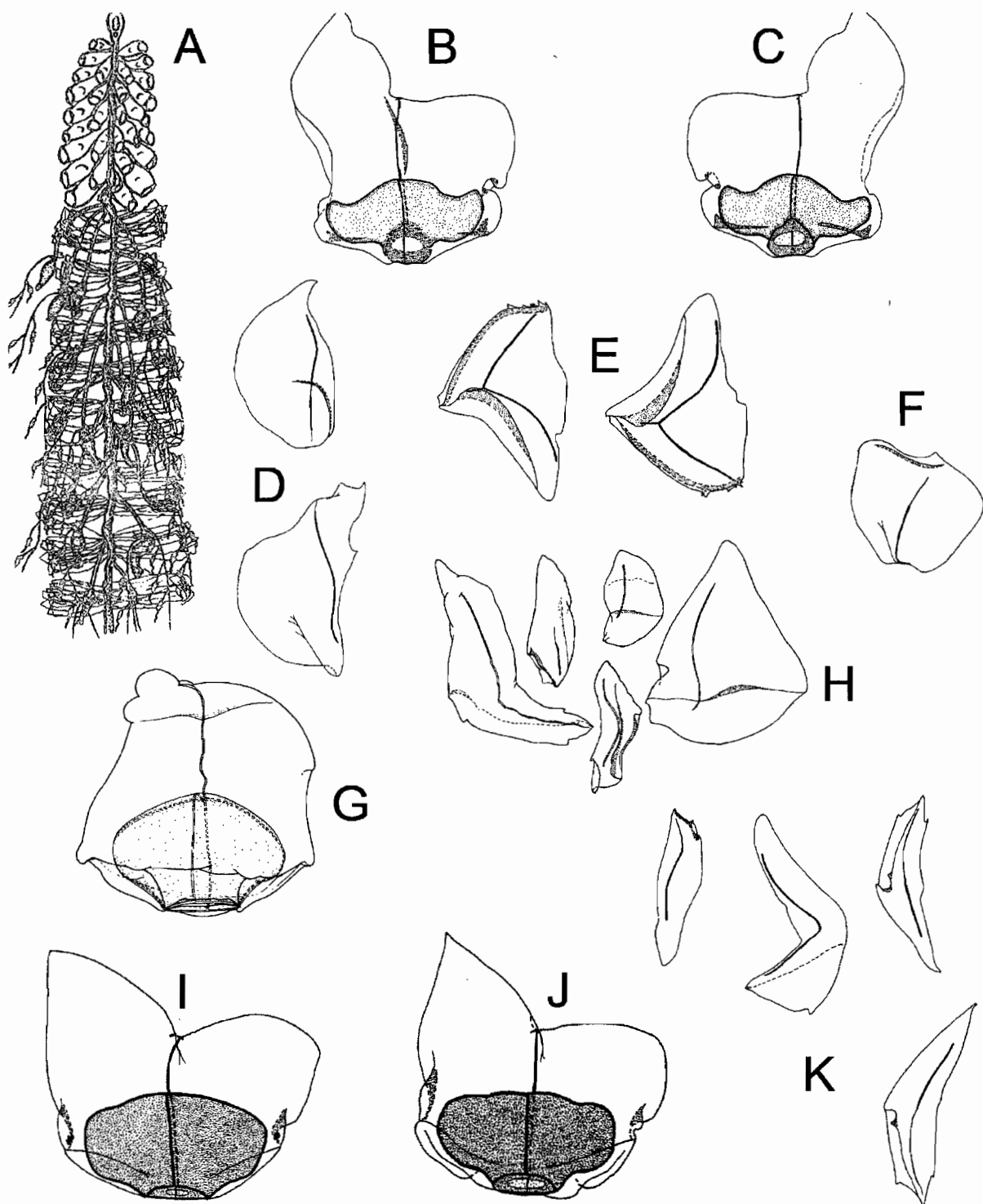


FIG. 126. – **Siphonophorae. Apolemiidae.** A to D: *Apolemia uvaria*: A: polygastric stage; B: nectophore (lateral view); C: nectophore (ostial view); D: bracts. **Athorybiidae.** E and F: *Athorybia rosacea*: E: polygastric stage (lateral view); F: dorsal view of a polygastric stage. **Forskaliidae.** G to K: *Forskalia asymmetrica*: G and H: inner and outer view of nectophores; I: inner and outer view of stem bracts; J: inner view of bolster bract; K: inner view of knee-shaped bracts (A to D after Totton, 1965; E after Pugh, 1999; F after Trégouboff, 1957; G to K after Pugh, 2003). lrc: lateral radial canal; os: ostium; ped: peduncle.



127. – Siphonophorae. Forskaliidae. A to K: *Forskalia*. A to F: *Forskalia contorta*: A: polygastric stage, B: nectophore (upper view), C: nectophore (inner view), D: stem bracts, E: knee bracts, F: third type of bract; G and H: *Forskalia edwardsi*: G: nectophore (upper view), H: various types of bracts; I to K: *Forskalia formosa*: I: nectophore (upper view), J: nectophore (lower view), K: various types of bracts (A after Trøgouboff, 1957, B to F, I to K after Pugh, 2003; G and H after Kirkpatrick and Pugh, 1984).

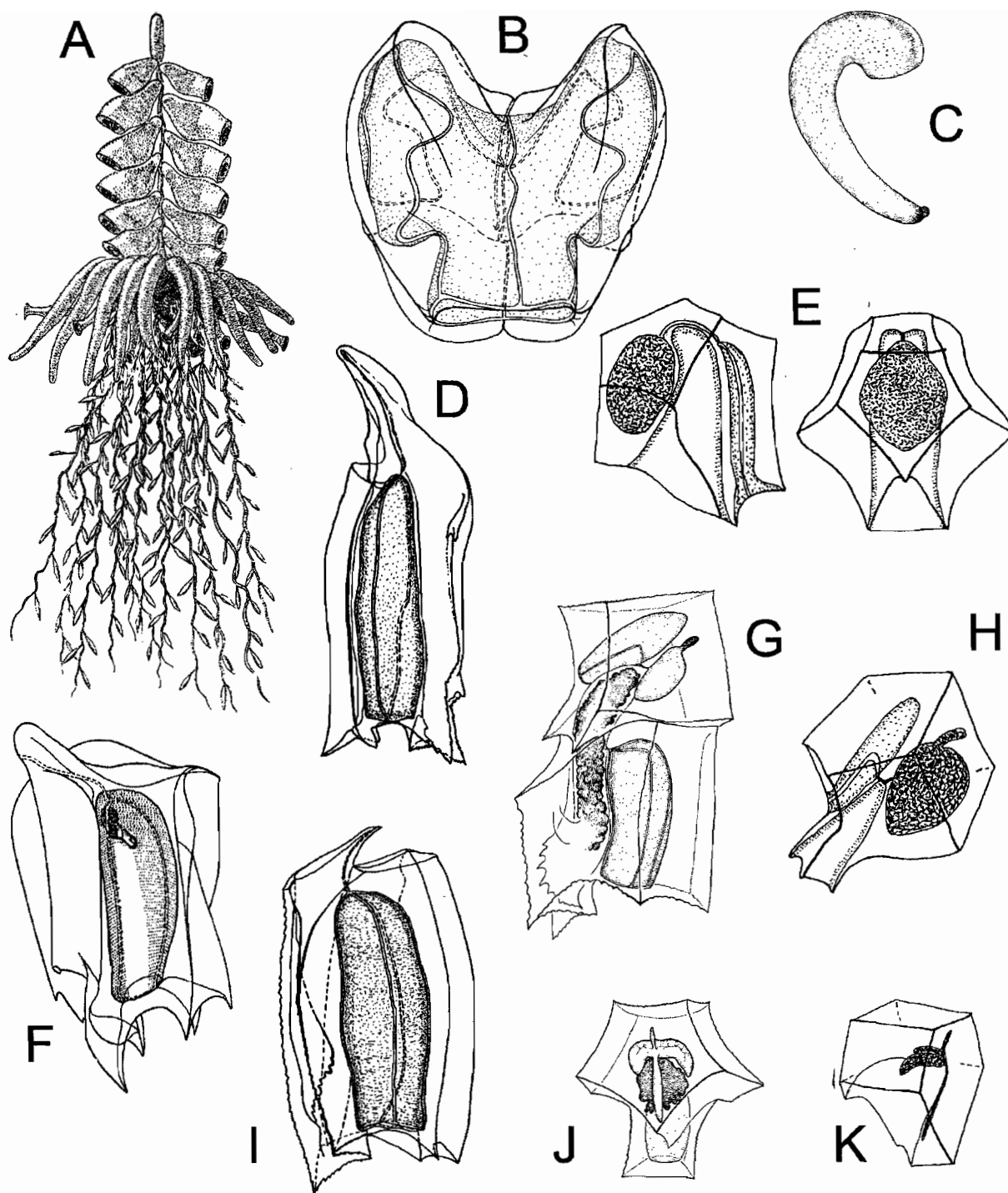


FIG. 128. – **Siphonophorae. Physophoridae.** A to C: *Physophora hydrostatica*: A: polygastric stage, B: nectophore (upper view), C: palpon **Abylidae**. D to F: *Abyla haeckeli*: D: posterior nectophore, E: ventral and lateral views of anterior nectophore, F: eudoxid; G to K: *Abylopsis eschscholtzi*: G: polygastric stage (lateral view), H: anterior nectophore, I: posterior nectophore, J: eudoxid, K: bract. (A to C after Kirkpatrick and Pugh, 1984; D and I after Gili, 1986; E, H and K after Pugh, 1999; F after Totton, 1965; G and J after Pagès and Gili, 1992).

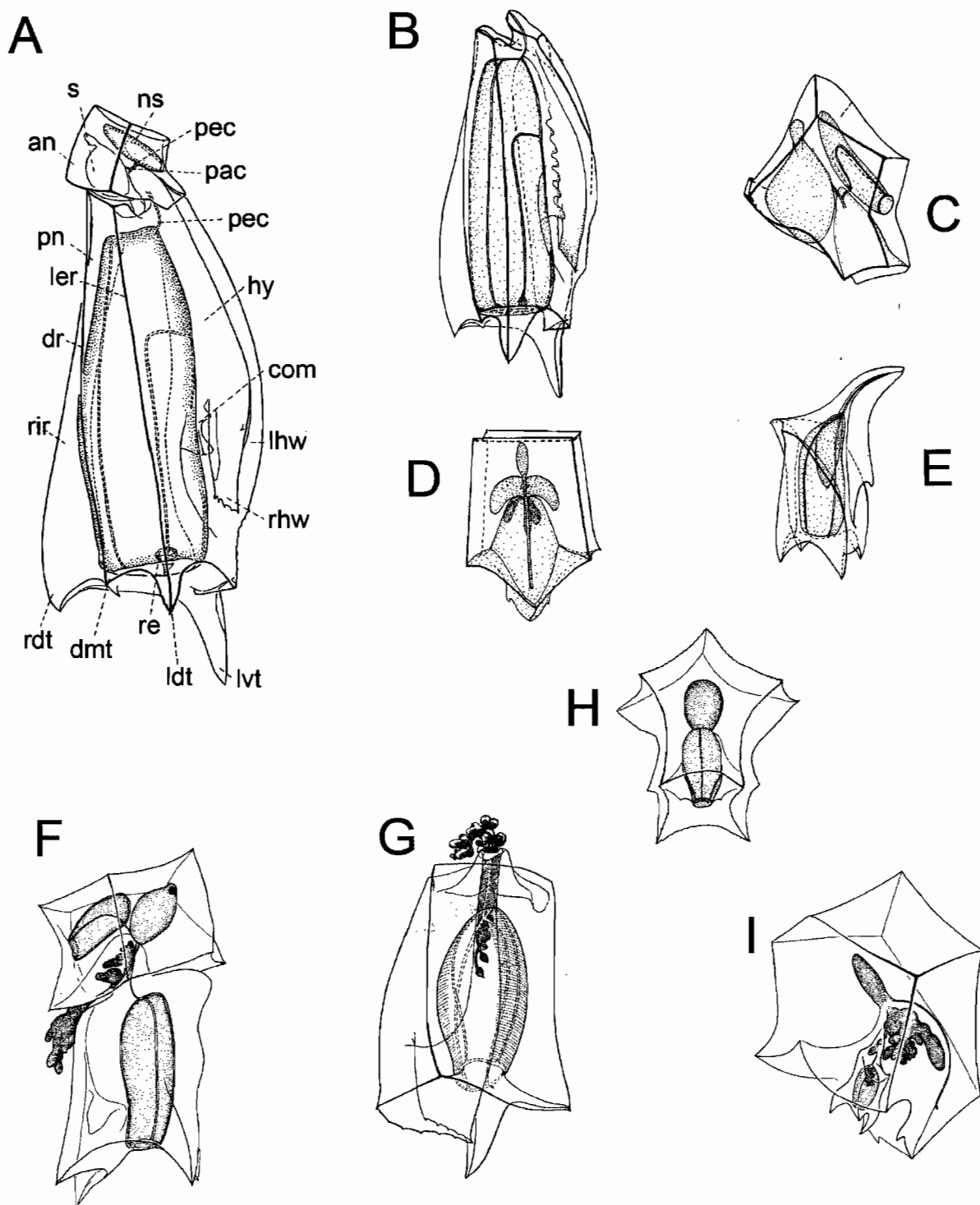


FIG. 129. – **Siphonophorae. Abylidae.** A to E: *Abylopsis tetragona*: A: polygastric stage; B: posterior nectophore; C: anterior nectophore; D: eudoxid bract; E: gonophore. F to I: *Bassia bassensis*: F: polygastric stage (lateral view); G: polygastric stage (dorsal view); H: anterior nectophore (dorsal view); I: eudoxid (latero-ventral view) (A and G after Totton, 1965; B to E after after Kirckpatrick and Pugh, 1984; F, H and I after Pagès and Gili, 1992). an: anterior nectophore; com: comb; dmt: dorso median tooth; dr: dorsal ridge; hy: hydroecium; ldt: left dorsal tooth; ler: left ridge; lhw: left hydroecial wing; lvt: left ventral tooth; ns: nectosac; pac: pallial canal; pec: pedicular canal; pn: posterior nectophore; rdt: right dorsal tooth; re: rete; rhw: right hydroecial wing; rir: right ridge; s: somatocyst.

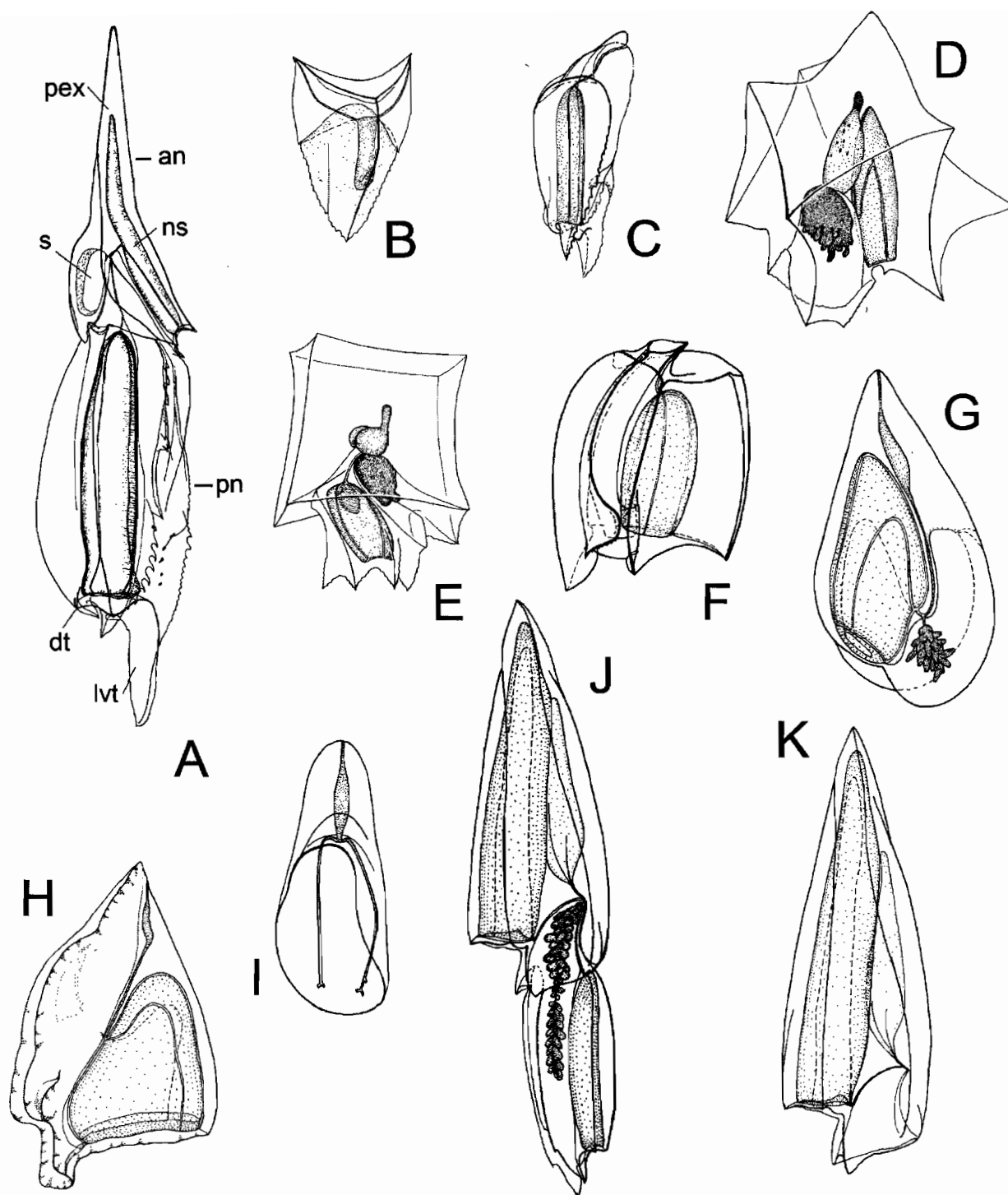


FIG. 130. — Siphonophorae. Abylidae. A to C: *Ceratocymba sagittata*: A: polygastric stage; B: eudoxid bract; C: gonophore. D to F: *Enneagonum hyalinum*: D: polygastric stage (lateral view); E: eudoxid bract (lateral view), F: gonophore. **Clausophyidae**. G to I: *Clausophyes ovata*: G: anterior nectophore; H: posterior nectophore; I: eudoxid bract. **Diphyidae**. J and K: *Chelophyes appendiculata*: J: polygastric stage; K: anterior nectophore (A after Totton, 1965; B, C, F to K after Kirkpatrick and Pugh, 1984; E, D, after Pagès and Gili, 1992). an: anterior nectophore; dt: dorsal tooth; lvt: left ventral tooth; ns: nectosac; pex: pyramidal extension; pn: posterior nectophore; s: somatocyst.

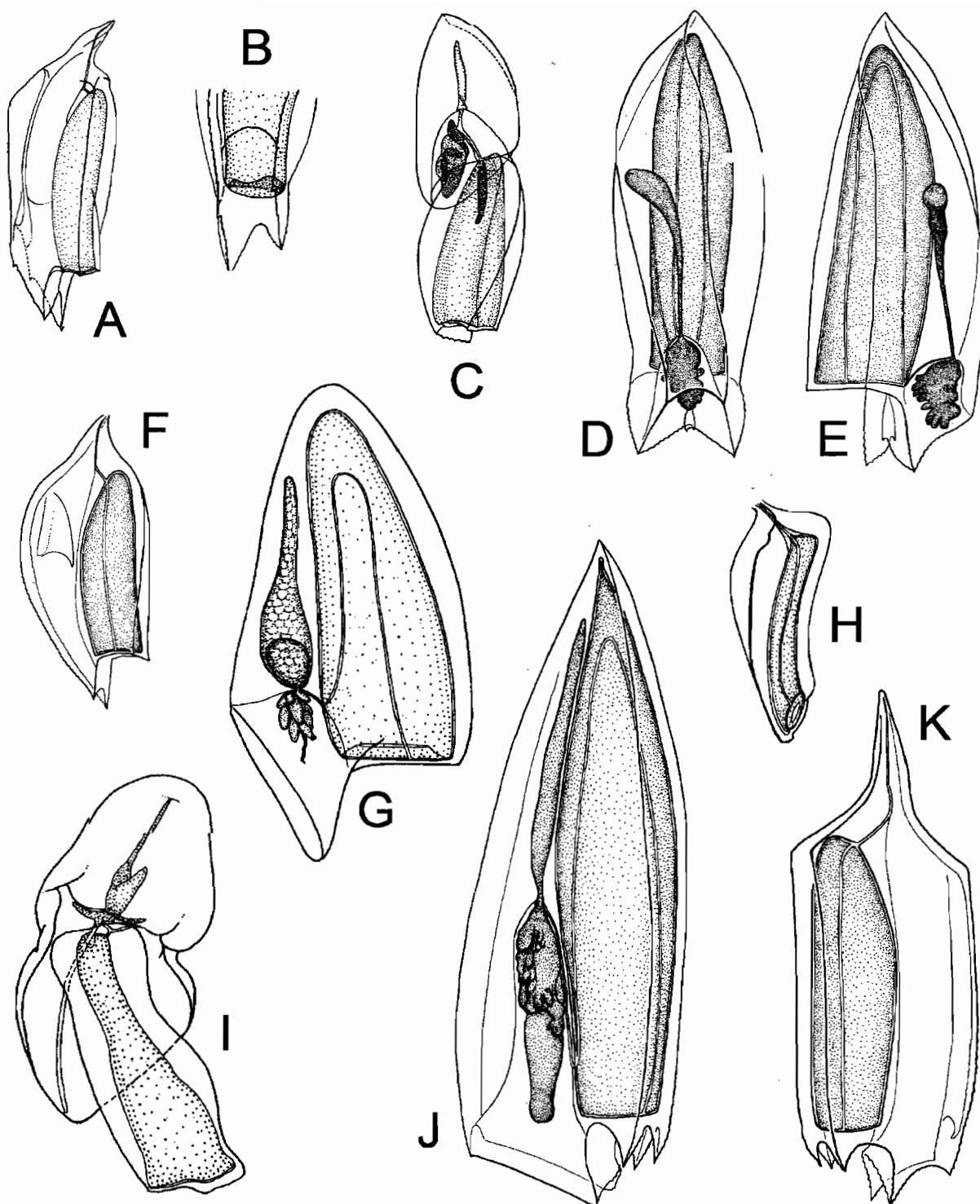


FIG. 131. – Siphonophorae. Diphyidae. A to C: *Chelophyes appendiculata*: A: posterior nectophore, B: detail of mouth-plate of posterior nectophore (dorsal view), C: eudoxid stage (dorsal view); D to F: *Chelophyes contorta*: D: anterior nectophore (ventral view), E: anterior nectophore (lateral view), F: posterior nectophore; G to I: *Dimophyes arcica*: G: anterior nectophore, H: posterior nectophore, I eudoxid stage; J and K: *Diphyes bojani*: J: anterior nectophore (lateral view), K: posterior nectophore (lateral view). (A, B, C, G to I after Kirkpatrick and Pugh, 1984; D to F, J and K after Pagès and Gili, 1992).

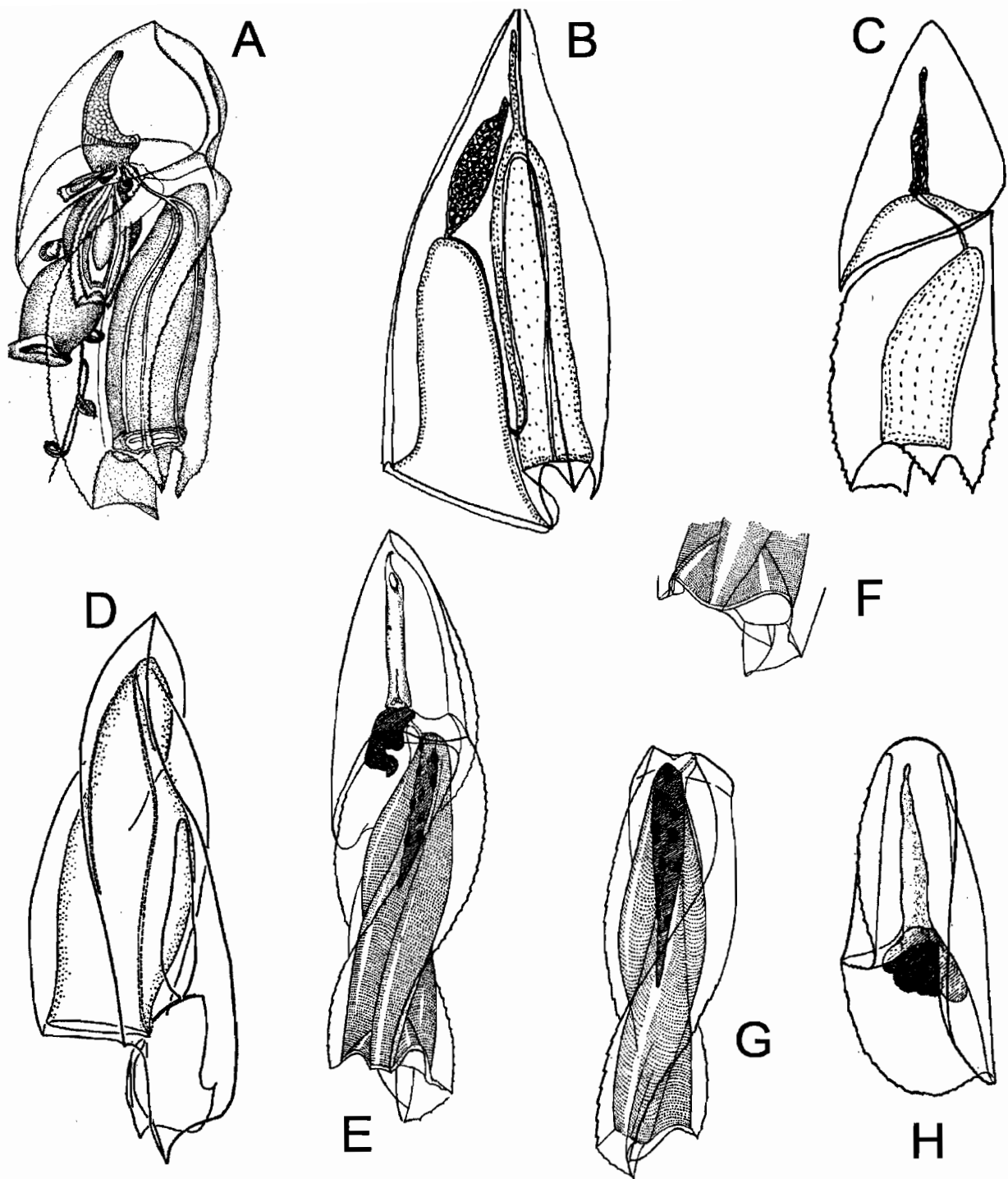


FIG. 132. – Siphonophorae. Diphyidae. A to C: *Diphyes dispar*: A: polygastric phase, B: anterior nectophore (lateral view), C: bract with gonophore; D to H: *Eudoxoides spiralis*: D: polygastric stage, E: lateral view of a whole animal, F: enlarged view of the base of figure E, G: lateral view of a detached female gonophore, H: ventral view of the bract (A after Trégouboff, 1957; B and C after Pugh, 1999; D to H after Totton, 1965).

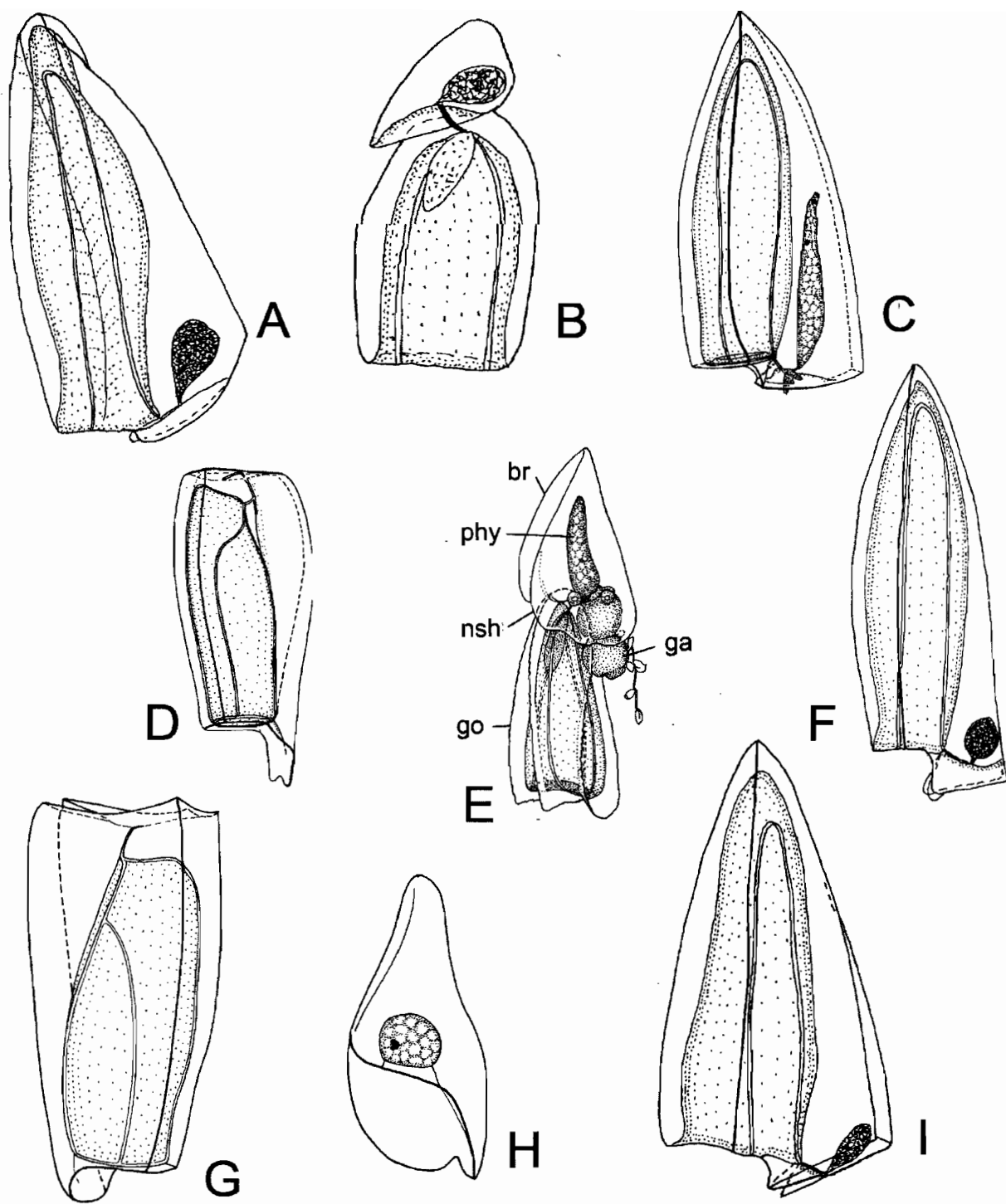


FIG. 133. – **Siphonophorae. Diphyidae.** A to I: *Lensia*: A and B: *Lensia campanella*: A: anterior nectophore (lateral view); B: bract with gonophore. C to E: *Lensia conoidea*: C: anterior nectophore; D: posterior nectophore; E: eudoxid stage (lateral view). F to H: *Lensia fowleri*: F: anterior nectophore; G: posterior nectophore; H: eudoxid bract (lateral view). I: *Lensia hotspur*: anterior nectophore (lateral view) (A, B and I after Pugh, 1999; C to H after Kirkpatrick and Pugh, 1984). br: bract; ga: gastrozoid; go: gonophore; nsh: neck-shield; phy: phyllocyst.

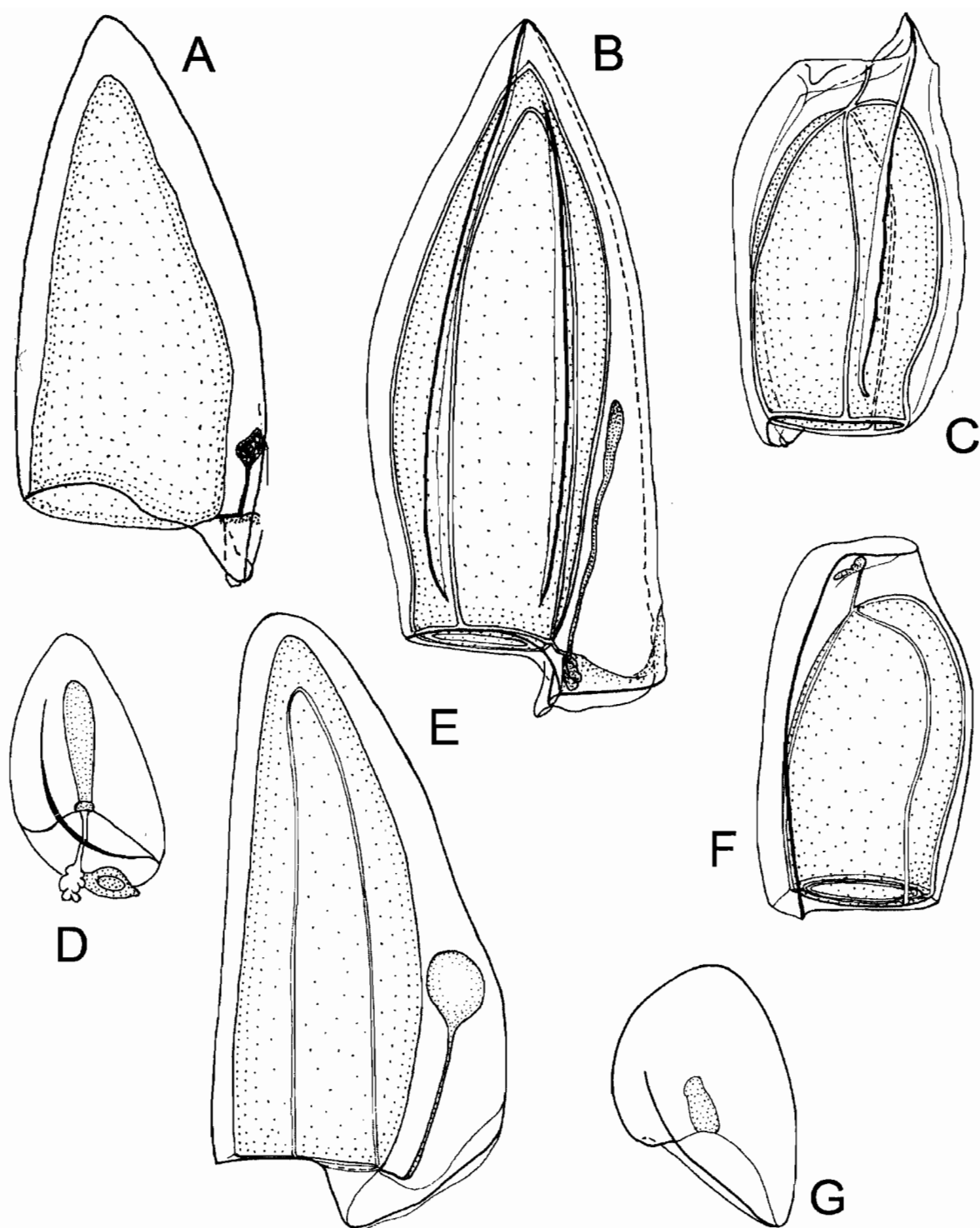


FIG. 134. – **Siphonophorae. Diphyidae.** A to F: *Lensia*: A: *Lensia meteori*: anterior nectophore (lateral view); B to D: *Lensia multicristata*: B: anterior nectophore, C: posterior nectophore, D: eudoxid bract (all lateral view). E to G: *Lensia subtilis*: E: anterior nectophore, F: posterior nectophore, G: eudoxid bract (all lateral view) (all after Kirkpatrick and Pugh, 1984).

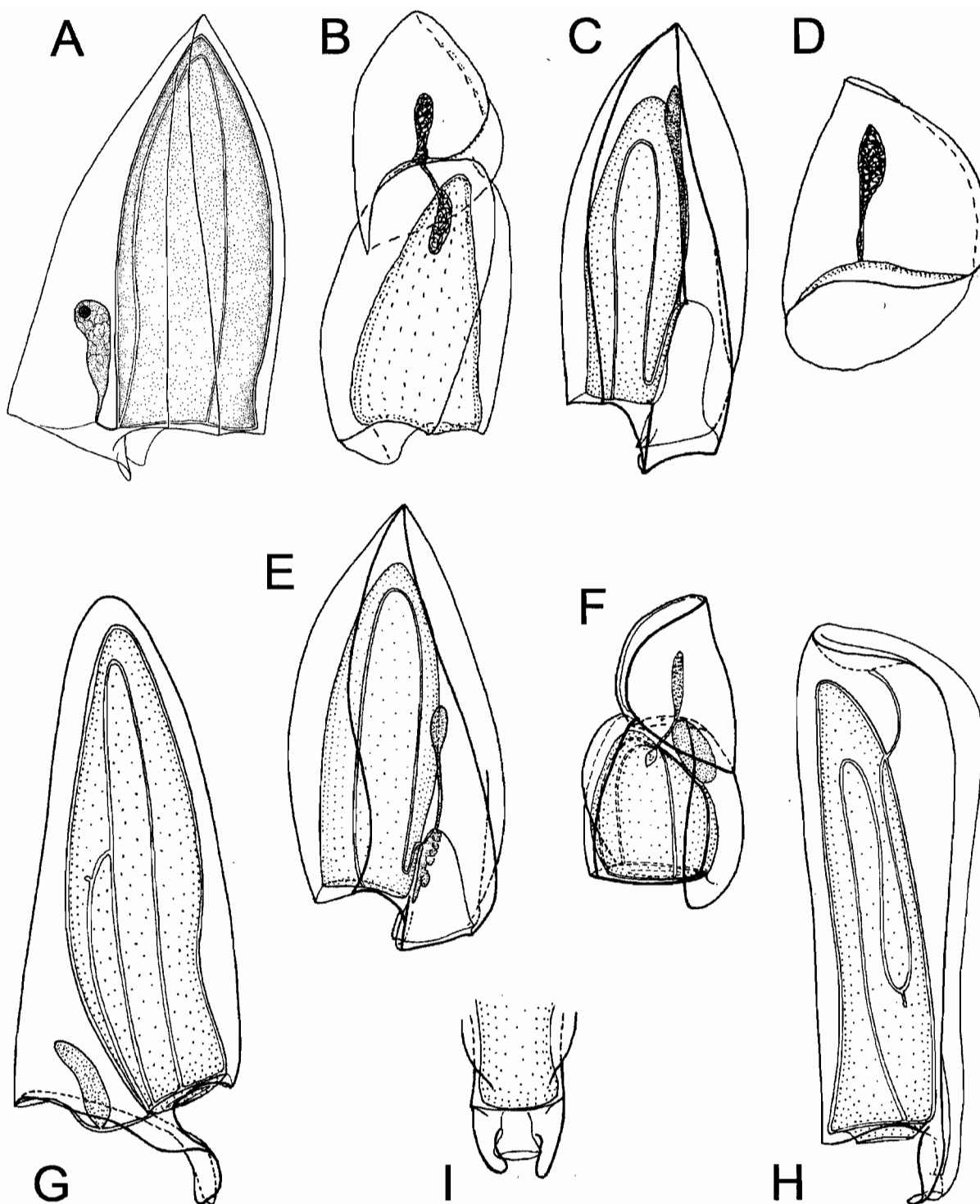


FIG. 135. – Siphonophorae. Diphyidae. A and B: *Lensia subtiloides*: A: anterior nectophore (lateral view), B: bract with gonophore; C to F: *Muggiaea*: C and D: *Muggiaea atlantica*: C: anterior nectophore (lateral view), D: bract; E: *Muggiaea kochi*: E: anterior nectophore, F: *Muggiaea* sp.: eudoxid stage (all lateral view); G to I: *Sulculeolaria biloba*: G: anterior nectophore (lateral view), H: posterior nectophore (lateral view), I: mouth-plate, detail of H (dorsal view) (A after Pagès and Gili, 1992; B and D after Pugh, 1999; C, E, F to I after Kirkpatrick and Pugh, 1984).

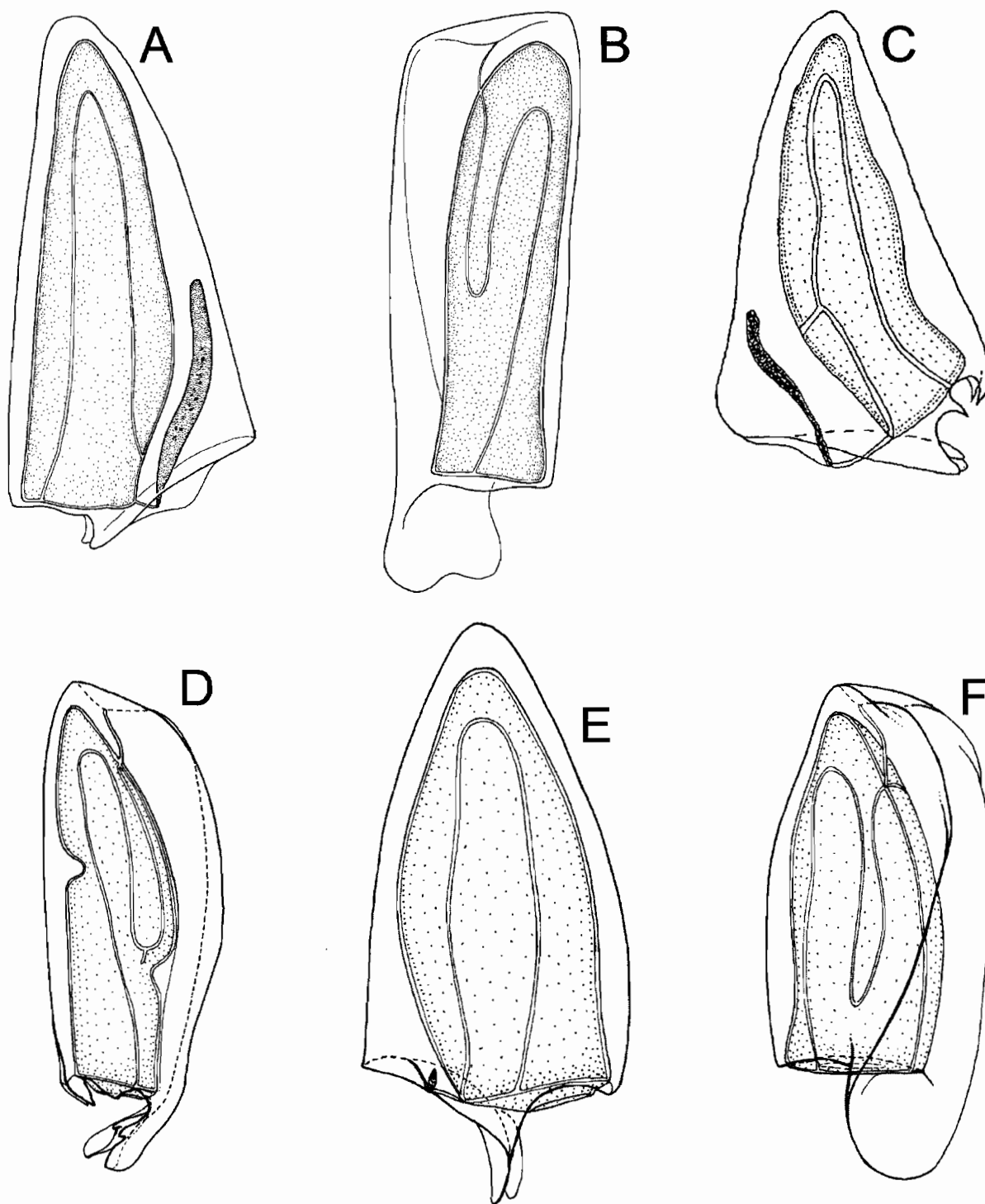


FIG. 136. – **Siphonophorae. Diphyidae.** A to F: *Sulculeolaria*. A and B: *Sulculeolaria chuni*: A: anterior nectophore, B: posterior nectophore (lateral views); C and D: *Sulculeolaria quadrivalvis*: C: anterior nectophore, D: posterior nectophore (lateral views); E and F: *Sulculeolaria turrida*: E: anterior nectophore, F: posterior nectophore (lateral views) (A and B after Pagès and Gili, 1992; C to F after Kirkpatrick and Pugh, 1984).

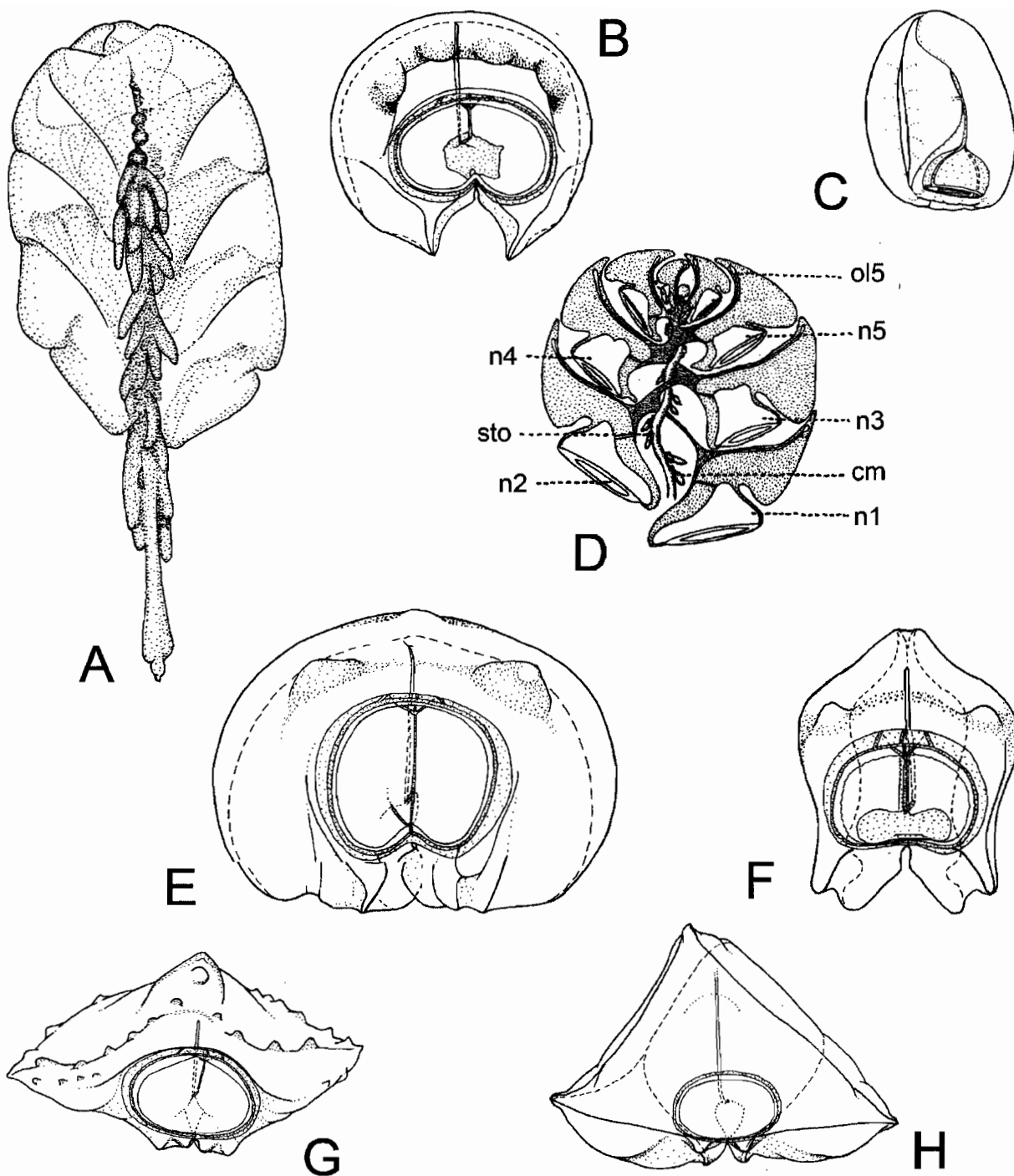


FIG. 137. – Siphonophorae. Hippopodiidae. A to D: *Hippopodius hippopus*: A: polygastric stage; B: definitive nectophore; C: larval nectophore; D: schema of the disposition of the nectophores in a colony. E to H: *Vogtia*: E and F: *Vogtia glabra*: E: definitive nectophore (dorsal view); F: young stage; G: *Vogtia pentacantha*: definitive nectophore (dorsal view); H: *Vogtia serrata*: definitive nectophore (dorsal view) (A to C, E to H after Kirkpatrick and Pugh, 1984; D after Trègouboff, 1957). cm: cormidia; n1, n2, n3, n4, n5: nectophores; ol5: oleocyte of nectophore; sto: stolon.

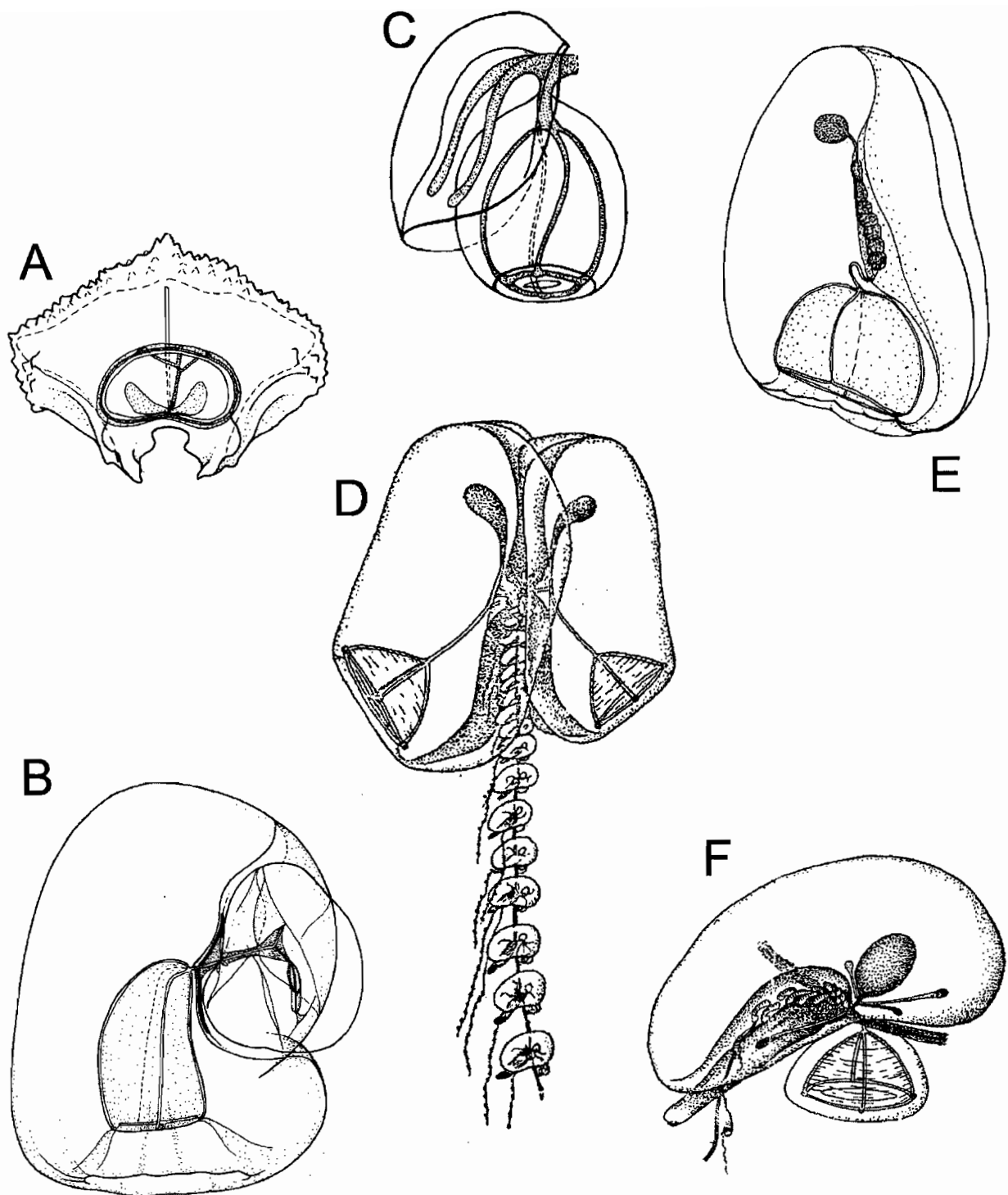


FIG. 138. – Siphonophorae. Hippopodiidae. A: *Vogtia spinosa*, definitive nectophore, (dorsal view). Prayidae. B and C: *Amphicaryon acaule*: B: nectophores of polygastric stage, C: eudoxid stage; D to F: *Desmophyes annectens*: D: polygastric stage, E: nectophore (lateral view), F: eudoxid bract with gonophore. (A to C, E after Kirkpatrick and Pugh, 1984; D and F after Kawamura, 1915).

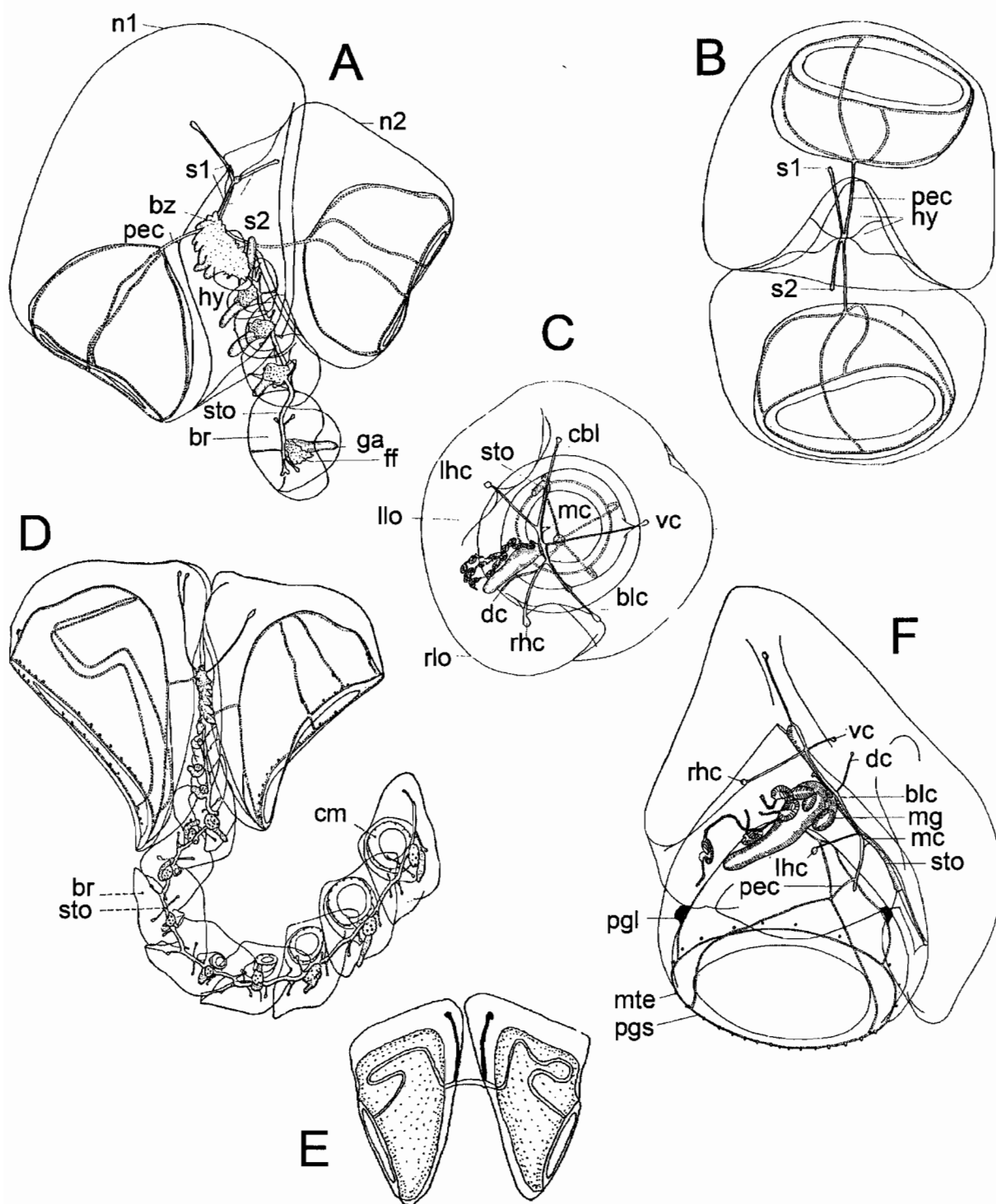


FIG. 139. – **Siphonophorae. Prayidae.** A to C: *Desmophyes villafranca*: A: polygastric stage; B: nectophores (apical view); C: cormidia (apical view). D to F: *Lilyopsis rosea*: D: polygastric stage, E: nectophore (lateral view); F: male cormidia detached of the stolon (A to c after Carré, C 1969a; D to F after Carré and Carré D, 1995). bz: budding zone; br: bract; pec: pedicular canal; blc: bract longitudinal canal; dc: dorsal canal; rhc: right hydroecial canal; lhc: left hydroecial canal; cm: cormidia; vc: ventral canal; ff: fishing filament; ga: gastrozooid; mg: male gonophore; mc: mantle canal; vc: ventral canal; hy: hydroecium; llo: left lobe; rlo: right lobe; n1 and n2: nectophores 1 and 2; pgl: pigmentary lamella; mte: marginal tentacle; s1: somatocyst of nectophore 1; s2: somatocyst of nectophore 2; pgs: pigmentary spot; sto: stolon.

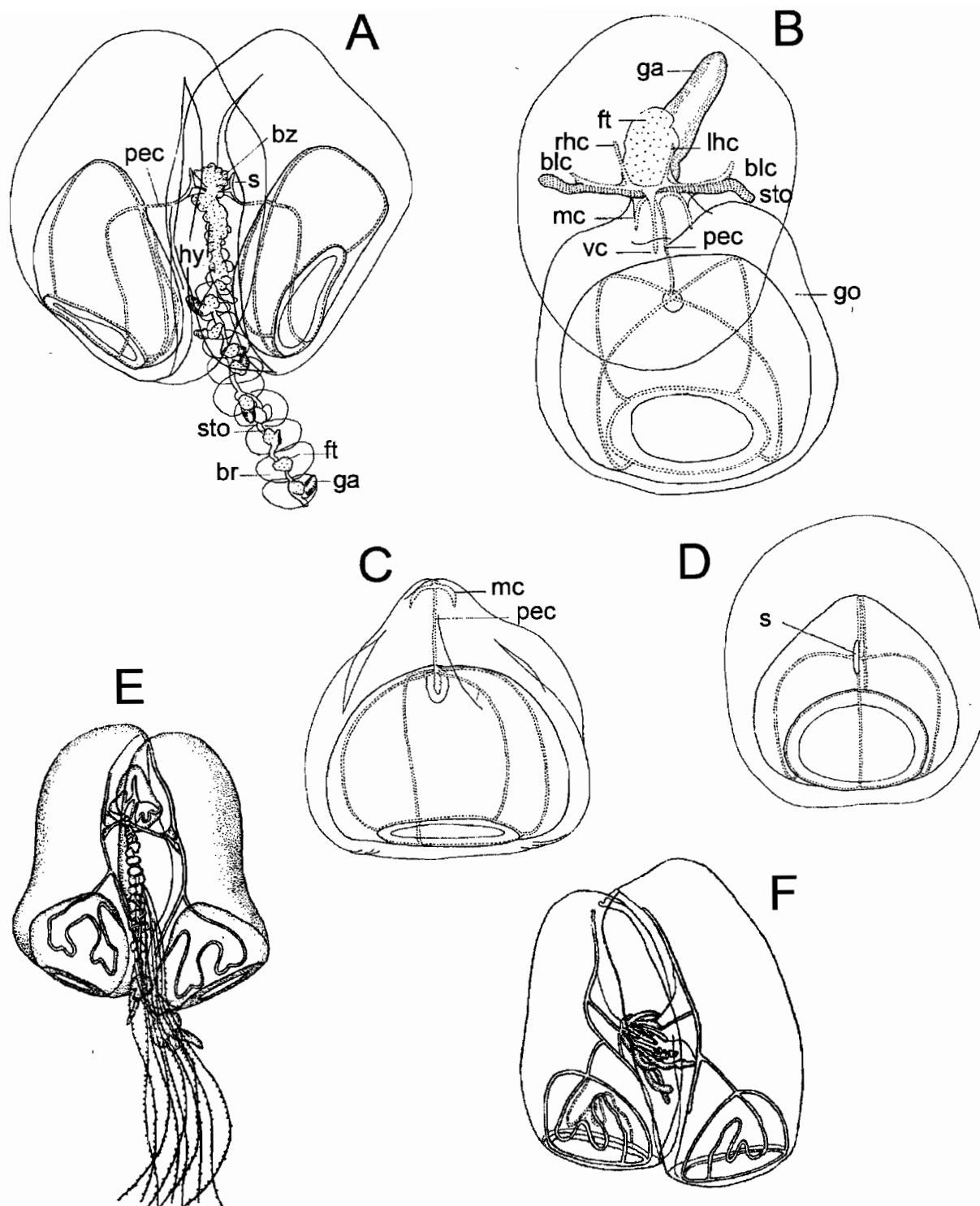


FIG. 140. – **Siphonophorae. Prayidae.** A to D: *Prayola tottoni*: A: polygastric stage; B: cormidia from below; C: gonophore (ventral view); D: nectophore (ventral view). E and F: *Rosacea cymbiformis*: E: young polygastric stage; F: two definitive nectophores (A to D after Carré C, 1969c; E and F after Trégouboff, 1957). blc: bracteal longitudinal canal; br: bract; bz: budding zone; ft: fishing tentacle; ga: gastrozoid; go: gonophore; hy: hydroecium; lhc: left hydroecial canal; mc: mantel canal; pec: pedicular canal; rhc: right hydroecial canal; s: somatocyst; sto: stolon; vc: ventral canal.

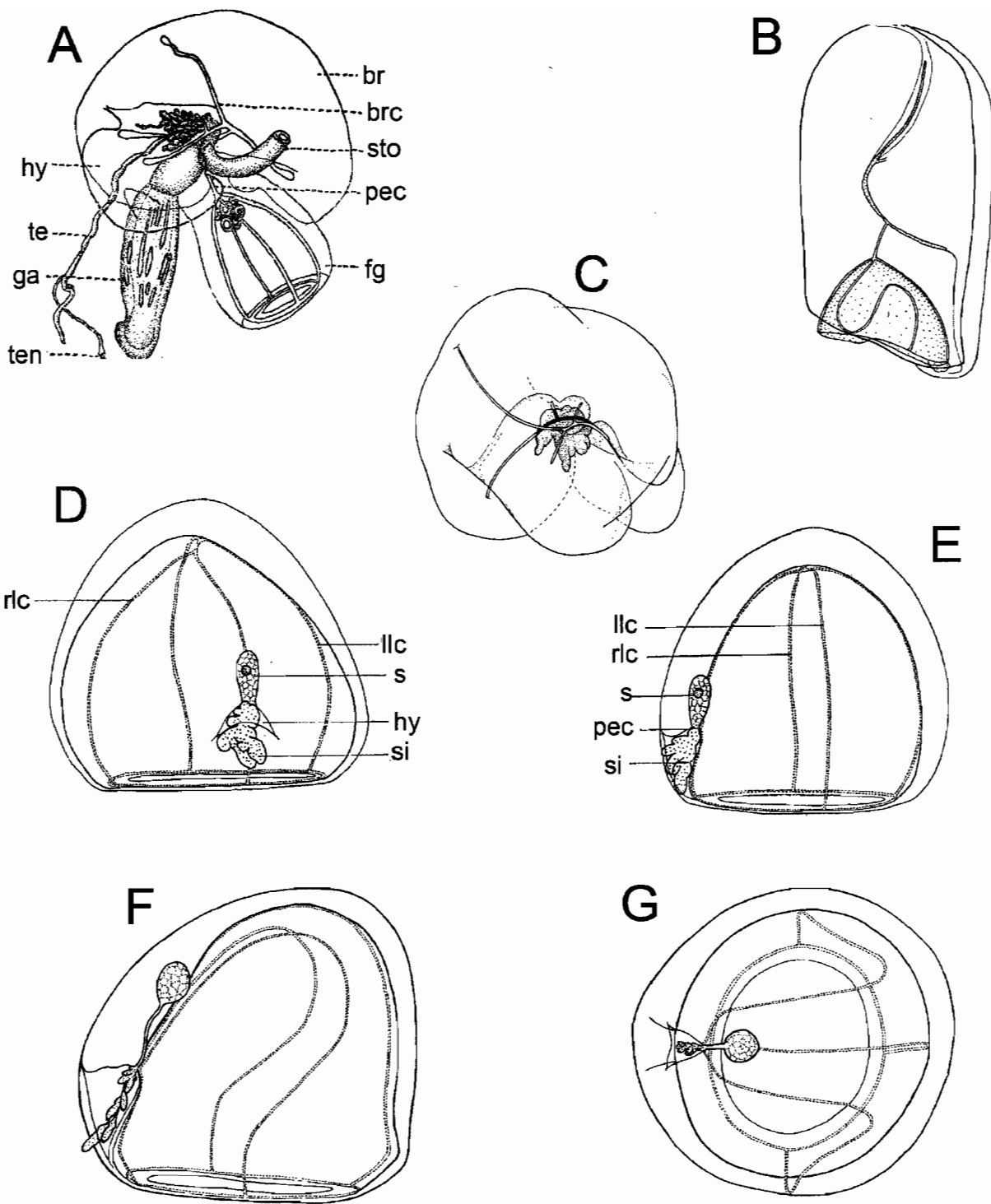


FIG. 141. – **Siphonophorae. Prayidae.** A to C: *Rosacea*: A: *Rosacea cymbiformis*: adult cormidia; B and C: *Rosacea plicata*: B: nectophore (lateral view); C: eudoxid bract (dorso-lateral view). **Sphaeronectidae**: D to G: *Sphaeronectes*: D and E: *Sphaeronectes bougisi*: nectophores; D: lateral view; E: ventral view. F and G: *Sphaeronectes fragilis*: nectophores: F: lateral view; G: apical view (A after Trégouboff, 1957; B and C after Kirkpatrick and Pugh, 1984; D and E after Carré, 1968d; F and G after Carré, 1968c). br: bracteal canal; br: bract; fg: female gonophore; ga: gastrozoid; hy: hydroecium; llc: left lateral canal; pec: pedicular canal; rlc: right lateral canal; s: somatocyst; si: siphonosome; sto: stolon; te: tentacle; ten: tentillum.

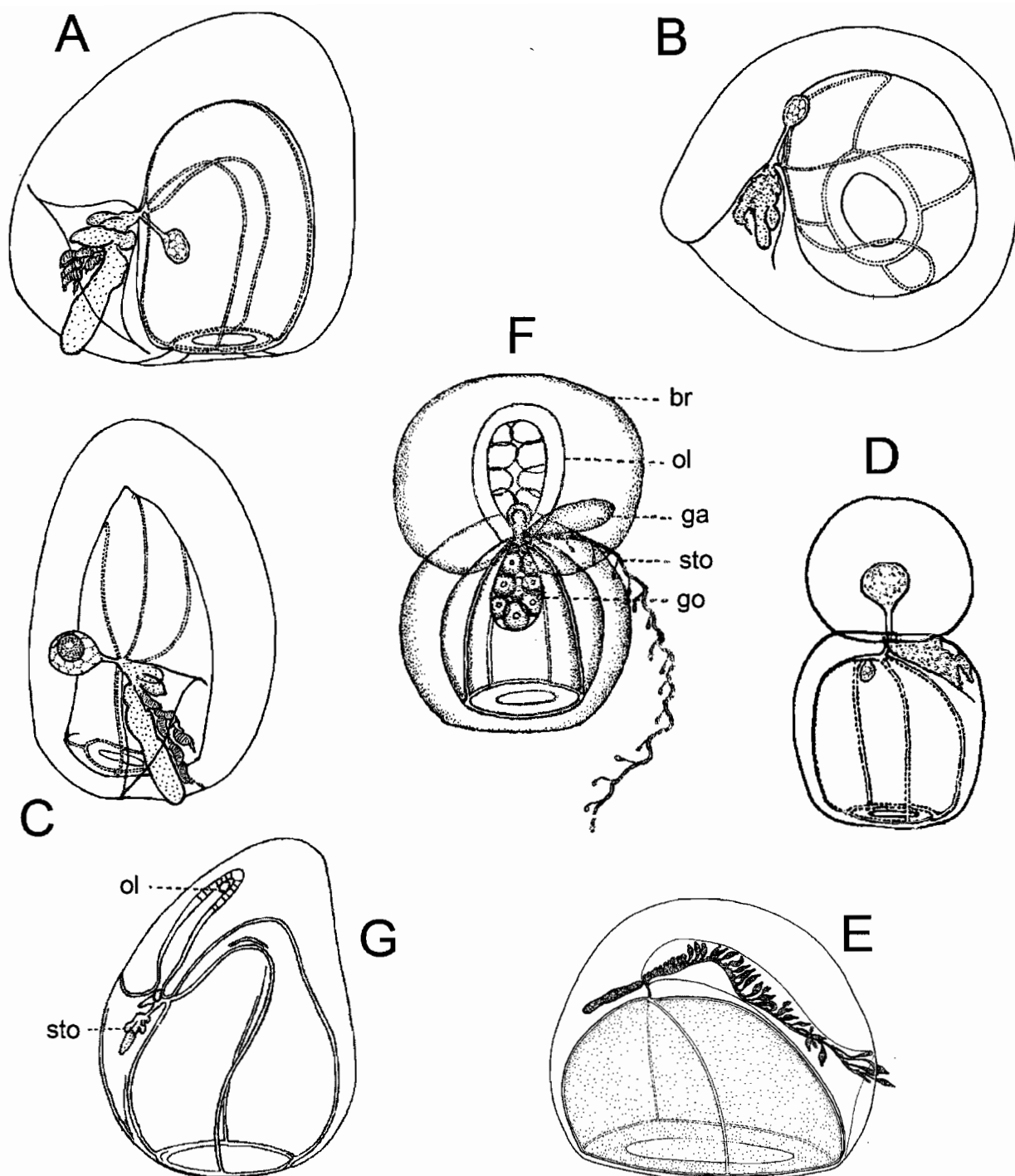


FIG. 142. – **Siphonophorae. Sphaeronectidae.** A to G: *Sphaeronectes*: A to D: *Sphaeronectes gamulini*: A to C: nectophores: A: lateral view; B: apical view; C: ventral view. D: eudoxia. E and F: *Sphaeronectes gracilis*: E: polygastric stage; F: eudoxid stage. G: *Sphaeronectes irregularis*: nectophore (A to D after Carré, 1966, E after Pagès and Gili, 1992; F and G after Trégouboff, 1957). br: bract; ga: gastrozoid; go: gonophore; ol: oleocyte; sto: stolon.