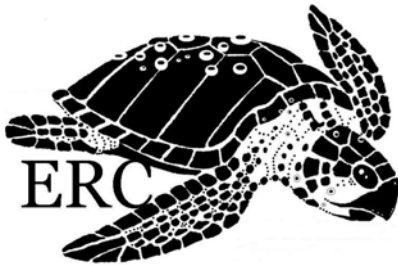


EPIBIONT RESEARCH COOPERATIVE SPECIAL PUBLICATION No. 1 (ERC-SP1)

**A SYNOPSIS OF THE LITERATURE ON
THE TURTLE BARNACLES
(CIRRIPIEDIA: BALANOMORPHA: CORONULOIDEA)
1758-2007**



COMPILED BY: THE EPIBIONT RESEARCH COOPERATIVE

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The **EPIBIONT RESEARCH COOPERATIVE** (ERC) is a collaborative working group dedicated the multidisciplinary examination of sea turtles and their epibionts. Our goal is to synthesize the available resources related to turtle epibionts – particularly those associated with turtle barnacles of the superfamily Coronuloidea – whereby researchers will have convenient access to important specimens and literature, many of which are antiquated and, unfortunately, no longer extant. Our efforts, therefore, are vital to preserve the rich scientific history of epibiont research pioneered by individuals like *Carolus Linnaeus* and *Charles Darwin* for future students of this interesting field of study.



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Cover photograph: An immature green sea turtle (*Chelonia mydas*) from Brazil. Numerous specimens of the turtle barnacle *Chelonibia testudinaria* are attached to the carapace. Photo by Bruno Amir.

INTRODUCTION

The barnacles of the superfamily Coronuloidea are specialized sessile crustaceans that live as obligate commensals of sea turtles, sirenians, whales, other crustaceans and sea snakes (Ross & Newman 1967). Their evolution is marked by the development of several unique reproductive and growth strategies that allow them to cling to the hard and soft tissues of their host; as a result, they have evolved wall shapes and structures that are unique among the sessile Cirripedia. Fossil evidence suggests that coronuloid barnacles have maintained their commensal relationship with chelonians, and perhaps other large nektonic organisms, since at least the Eocene (cf. Zangerl 1948; Ross and Newman 1967).

This review is an attempt to bring together the literature on the turtle-barnacle association and to summarize what coronuloids have been reported from what turtle species and where. It is our hope that this synopsis of information will provide a useful reference for workers in the field – allowing researchers a means by which to cross reference their findings to determine whether or not the species in question has been reported from a particular host turtle species or a particular region before. Additionally, workers will be able to cross reference if the barnacle species in question has ever been reported on a particular region of the host turtle before (i.e. head, skin, flippers, plastron, etc.). Unfortunately, in many cases the taxonomy of these barnacles is unsettled and therefore many workers have had to apply names to specimens simply as an expedient. Nonetheless, beyond some major adjustments, we have accepted the names of the barnacles as they appeared in the literature with the caveat that many are incorrect. In a field as vast as this, our ability to elucidate the nature of the relationships that exist between coronuloids and sea turtles is somewhat hindered by the scattered nature of the relevant literature. Thus, it is inevitable that some references will have been missed.

SECTION 1: BARNACLE/TURTLE SPECIES ASSOCIATION

The following list includes all barnacle records for which the host was cited in the original reference. The reliability of the early records for both the turtle and barnacle is often questionable and subject to reevaluation.

Chelonibia testudinaria

Caretta caretta (Atlantic loggerhead).- Bacon, 1976: 34; Bugoni et al., 2001: 7; Davenport, 1994: 735; Frick and Slay, 2000: 201; Frick et al., 1998: 213; Frick et al., 2000: 3; Geldiay et al., 1995: 428; Gramentz, 1988: 37; Gruvel, 1931: 404; Hunt, 1995: 205; Killingley and Lutcavage, 1983: 345; Koukouras and Matsa, 1998: 136; Lutcavage and Musik, 1985: 453; Margaritoulis, 1985: 328; Pereira et al., 2006: 17; Plotkin, 1996: 79; Richards, 1930: 143; Wells, 1966: 86; Young, 1991: 191; Zavodnik, 1997: 116.

Caretta caretta (Pacific loggerhead).- Frazier, 1971: 402; Guess, 1982: 122; Matsuura and Nakamura, 1993: 1803; Monroe and Limpus, 1979: 199; Stubbings, 1965: 893; Utinomi, 1970: 359; Weltner, 1897: 254.

Chelonia mydas (Atlantic green).- Bugoni et al., 2001: 7; Gauld, 1957: 10; Gittings et al., 1986: 30; Ives, 1891: 189; Pereira et al., 2006: 17; Stubbings, 1965: 893; Utinomi, 1969: 92; Young, 1991: 191.

Chelonia mydas (Pacific green).- Balazs, 1980: 20; Balazs, et al., 1987: 58; Beaumont et al., 2007; Borradaile, 1903: 443; Brown and Brown, 1995: 238; Daniel, 1956: 31; Dawydoff, 1952: 129; Edmonson, 1946: 231; Fernando, 1978: 114; Frazier, 1971: 394; Frazier, 1989: 250; Glazebrook and Campbell, 1990: 102; Green, 1998: 63; Hayashi & Tsuji, 2007: 2; Hendrickson, 1958: 523; Hiro, 1937a: 69; Limpus et al., 1994: 145; Mustaquim and Javed, 1993: 73; Pillai, 1958: 126; Stinson, 1984: ---; Tachikawa, 1995: 67.

Eretmochelys imbricata (Atlantic hawksbill).- Cardenas-Palomo & Maldonado-Gasca 2005: 32; Frick et al., 2003: 9; Kolosvary, 1939: 38.

Eretmochelys imbricata (Pacific hawksbill).- Annandale, 1906: 143; Balazs, 1978: 128; Daniel, 1956: 31; Deraniyagala, 1939: 204; Glazebrook and Campbell, 1990: 102; Hernandez-Vazquez and Valadez-Gonzalez, 1998: 121; Hiro, 1936: 69; Limpus et al., 1983: 192; Nilsson-Cantell, 1932: 258; 1937: 95; Ross, 1981: 102; Ross and Newman, 1967: fig. 5; Wagh and Bal, 1974: 121; Young and Ross, 2000: 224.

Lepidochelys olivacea (Olive ridley).- Angulo-Lozano et al., 2007; Hiro, 1936: 312; 1937b: 470; 1939: 214; Utinomi, 1949: 24; Vivaldo et al., 2006: 434.

Lepidochelys kempii (Kemp's ridley).- Gittings et al., 1986: 30; Rudloe et al., 1991: 50; Walker, 1978: 205.

Natator depressus (Flatback).- Limpus et al., 1983:180; Monroe and Limpus, 1979: 199.

Dermochelys coriacea (Leatherback).- Rees and Walker, 1993: 189.

Chelonibia caretta

Chelonia mydas (Atlantic green).- Broch, 1924: 16; Utinomi, 1969: 92.

Chelonia mydas (Pacific green).- Barnard, 1924: 93; Daniel, 1956: 32; Weltner, 1910: 528.

Eretmochelys imbricata (Pacific hawksbill).- Borradaile, 1903: 443; Dawydoff, 1952: 129; Dobbs and Landry, 2004: 674; Hiro, 1937a: 69; Limpus et al., 1983: 192; Loop et al., 1995: 246; Monroe and Limpus, 1979: 199.

Eretmochelys imbricata (Atlantic hawksbill).- Frick et al., 2003: 9.

Caretta caretta (Atlantic loggerhead).- Bacon, 1976: 34; Bugoni et al., 2001: 7; Gramentz, 1988: 37; Holthius, 1952: 77; Hunt, 1995: 205; Pilsbry, 1916: 267; Wells, 1966: 86; Zullo and Bleakney, 1966: 164; Young, 1991: 191.

Caretta caretta (Pacific loggerhead).- Monroe and Limpus, 1979: 199.

Chelonia sp.- Weltner, 1897: 254.

Chelonibia manati lobatibasis

Caretta caretta (Atlantic loggerhead).- Pilsbry, 1916: 266; Wells, 1966: 86.

Chelonibia manati crenatibasis

'Loggerhead' (presumably Caretta caretta).- Pilsbry, 1916: 266.

Chelonibia ramosa

Chelonia mydas (Atlantic green).- Korschelt, 1933: 2.

Chelonibia patula

Caretta caretta (Mediterranean Loggerhead). – Badillo, 2007: 66; Kitsos et al., 2005: 259.

Platylepas hexastylos

Caretta caretta (Atlantic loggerhead).- Bacon, 1976: 34; Broch, 1927: 30; Beaumont et al., 2007; Bugoni et al., 2001: 7; Chevreaux and de Guerne, 1893: 443; Gramentz, 1988: 37; Holthuis, 1952: 72; Koukouras and Matsa, 1998: 136; Lutcavage and Musik, 1985: 453; Pilsbry, 1916: 285; Stubbings, 1965: 899; Stubbings, 1967: 301; Utinomi, 1959: 384; Wells, 1966: 87; Zavodnik, 1997: 116; Zullo and Bleakney, 1966: 164.

Caretta caretta (Pacific loggerhead).- Monroe and Limpus, 1979: 205; Utinomi, 1970: 360.

Chelonia mydas (Atlantic green).- Broch, 1924: 18; Bugoni et al, 2001: 7; Richards, 1930: 143; Schwartz, 1960: 116; Stubbings, 1965: 899; Young, 1991: 195.

Chelonia mydas (Pacific green).- Balazs, 1980: 20; Balazs, 1985: 17; Daniel, 1956: 33; Frazier, 1971: 394; Frazier, 1989: 250; Losey et al., 1994: 686; Zann and Harker, 1978: 206.

Dermochelys coriacea (leatherback).- Bacon, 1976: 34; Utinomi, 1970: 360; Eckert and Eckert, 1987: 684; 1988: 401; O’Riordan, 1979: 356.

Eretmochelys imbricata (Pacific hawksbill).- Fischer, 1886: 195; Foster, 1978: 117; Glazebrook and Campbell, 1990: 102; Hiro, 1937a: 70; Kruger, 1912: 13; Limpus et al., 1983: 192; Monroe and Limpus, 1979: 205.

Lepidochelys kempii (Kemp’s ridley).- Lutcavage and Musik, 1985: 453.

Lepidochelys olivacea (Olive ridley).- Hernandez-Vazquez and Valadez-Gonzalez, 1998: 121; Hiro, 1936: 312; Vivaldo et al., 2006: 434 (misidentified as *Chelonibia testudinaria*).

Natator depressus (Flatback).- Monroe and Limpus, 1979: 205.

Platylepas hexastylos ichthyophila

Chelonia mydas (Atlantic green).- Young, 1991: 197.

Platylepas hexastylos var.

Caretta caretta (Atlantic loggerhead).- Wells, 1966: 37.

Platylepas coriacea

Caretta caretta (Atlantic loggerhead).- Grammentz, 1988: 37.

Dermochelys coriacea (leatherback).- Monroe and Limpus, 1979: 208.

Platylepas decorata

Caretta caretta (Pacific loggerhead).- Monroe and Limpus, 1979: 206.

Chelonia sp. (presumably Atlantic green: C. mydas).- Young, 1991: 194.

Chelonia mydas (Pacific green).- Darwin, 1854: 429; Green, 1998: 63; Limpus et al., 1994: 147; Monroe and Limpus, 1979: 206; Zullo, 1991: 188.

Eretmochelys imbricata (Pacific hawksbill).- Hiro, 1937a: 70; Limpus et al., 1983: 192; Monroe and Limpus, 1979: 206.

Platylepas multidecorata

Eretmochelys imbricata (Pacific hawksbill).- Daniel, 1962: 641.

Platylepas sp.

Caretta caretta (Atlantic loggerhead).- Bugoni et al., 2001: 7.

Dermochelys coriacea (leatherback).- Bacon, 1970: 64.

Eretmochelys imbricata (Atlantic hawksbill).- Cardenas-Palomo & Maldonado-Gasca 2005: 32.

Stephanolepas muricata

Caretta caretta (Pacific loggerhead).- Monroe and Limpus, 1979: 201.

Chelonia mydas (Pacific green).- Balazs, 1980: 20; Limpus et al., 1994: 147; Monroe and Limpus, 1979: 201; Zullo, 1991: 188.

Eretmochelys imbricata (Pacific hawksbill).- Balazs, 1978: 128; Bustard, 1976: 347; Deraniyagala, 1939: 204; Fischer, 1886: 193; Limpus et al., 1983: 192; Monroe and Limpus, 1979: 201; Nilsson-Cantell, 1932: 258.

Stomatolepas pulchra

Chelonia mydas (Pacific green).- Ren, 1980: 196.

Stomatolepas transversa

Chelonia mydas (Pacific green).- Hayashi & Tsuji, 2007: 2; Limpus et al., 1994: 147; Monroe and Limpus, 1976: 205; Nilsson-Cantell, 1930b: 20.

Chelonia mydas (Atlantic green).- Young, 1991: 201.

Stomatolepas praegustator

Caretta caretta (Atlantic loggerhead).- Pilsbry, 1910: 304; Wells, 1966: 87.

Caretta caretta (Pacific loggerhead).- Monroe and Limpus, 1979: 203.

Lepidochelys kempii (Kemp's ridley).- Lutcavage and Musik, 1985: 453.

Natator depressus (Flatback).- Limpus et al., 1983: 180.

Stomatolepas dermochelys

Dermochelys coriacea (leatherback).- Eckert and Eckert, 1987: 684; Eckert and Eckert, 1988: 401; Haelters and Kerckhof, 1999: ---; Haelters et al., 2001: 14; Monroe and Limpus, 1979: 203.

Stomatolepas elegans

Caretta caretta (Atlantic loggerhead).- Stubbings, 1967: 902; Stubbings, 1967: 300; Relini, 1968: 223.

Chelonia mydas (Atlantic green).- Young, 1991: 200.

Chelonia mydas (Pacific green).- Ren, 1987: 182.

Dermochelys coriacea (Leatherback).- Carriol & Vader, 2002: 1033; Foster, 1978: 117; Holthius, 1969: 44; Lanfranco, 1979: 24; McCann, 1969: 152; O'Riordan and Holmes, 1978: 152; Quigley and Flannery, 1993: 153; Smaldon and Lyster, 1976: 317; Utinomi, 1970: 363; Zullo and Bleakney, 1966: 162.

Lepidochelys olivacea (Olive ridley).- Foster, 1978: 117; Hiro, 1936: 312.

Stomatolepas sp.

Lepidochelys olivacea (Olive ridley).- Vivaldo et al., 2006: 434 (misidentified as *Chelonibia testudinaria*).

Cylindrolepas darwiniana

Family Cheloniidae (loggerhead or green).- Pilsbry, 1916: 288.

Chelonia mydas (Pacific green).- Green, 1998: 63; Zullo, 1991: 188.

Eretmochelys imbricata (Pacific hawksbill).- Zullo, 1991: 188.

Lepidochelys olivacea (Olive ridley).- Hubbs, 1977: 265.

Cylindrolepas sinica

Chelonia mydas (Pacific green).- Ren, 1980: 197.

Chelolepas (= Tubicinella) cheloniae

Caretta caretta (Pacific loggerhead).- Hendrickson, 1958: 524; Monroe and Limpus, 1979: 199.

Chelonia mydas (Pacific green).- Hendrickson, 1958: 524 (= *Stephanolepas muricata*); Limpus et al., 1994: 147, 2005: 10; Ross & Frick, 2007.

Eretmochelys imbricata (Pacific hawksbill).- Dobbs and Landry, 2004: 674; Loop et al., 1995: 246; Nilsson-Cantell, 1935: 258 (= *Stephanolepas muricata*).

Natator depressus (Flatback).- Limpus et al., 1983: 180.

SECTION 2: BARNACLE LOCATION ON HOST TURTLE

The following list gives the site of attachment of each species. Some authors only allude to “skin” and thus do not differentiate between the skin on the flippers or elsewhere on the body.

Chelonibia testudinaria

HEAD.- Balazs, 1980: 20; Cardenas-Palomo & Maldonado-Gasca, 2005: 32; Green, 1988: 63; Hendrickson, 1958: 523; Kitsos et al., 2005: 259; Limpus et al., 1983: 192; Margaritoulis, 1985: 328.

CARAPACE.- Angulo-Lozano et al., 2007; Annandale, 1906: 143; Bacon, 1976: 34; Badillo, 2007: 70; Balazs, 1978: 128; Balazs, 1980: 20; Balazs et al., 1987: 58; Borradaile, 1903: 443; Brown and Brown, 1995: 238; Cardenas-Palomo & Maldonado-Gasca, 2005: 29; Daniel, 1956: 31; Deraniyagala, 1939: 204; Edmonson, 1946: 231; Frazier, 1989: 250; Frick et al., 1998: 213; Frick et al., 2003: 9; Geldiay et al., 1995: 428; Glazebrook and Campbell, 1990: 102; Gramentz, 1988: 37; Green, 1998: 63; Gruvel, 1903: 115; Guess, 1982: 122; Hendrickson, 1958: 523; Hiro, 1936: 312; 1937a: 69; 1937b: 470; 1939: 214; Hernandez-Vazquez and Valadez-Gonzalez, 1998: 121; Hunt, 1995: 205; Kitsos et al., 2005: 259; Koukouras and Matsa, 1998: 136; Limpus et al., 1983: 192; Limpus et al., 1994: 145; Margaritoulis, 1985: 328; Matsuura and Nakamura, 1993: 1803 (medial, axial); Monroe and Limpus, 1979: 199; Mustaquim and Javed, 1993: 73; Nilsson-Cantell, 1932: 258; 1937: 95; 1939: 5; Pillai, 1958: 12; Relini, 1980: 80; Ross, 1981: 102; Rudloe et al., 1991: 50; Stinson, 1984: ---; Stubbings, 1967: 296; Tachikawa, 1995: 67; Utinomi, 1949: 24; 1970: 359; Walker, 1978: 205; Wells, 1966: 86; Young and Ross, 2000: 224; Zavodnik, 1997: 116.

PLASTRON.- Badillo, 2007: 70; Balazs, 1980: 20; Balazs et al., 1987: 58; Cardenas-Palomo & Maldonado-Gasca, 2005: 32; Davenport, 1994: 736; Glazebrook and Campbell, 1990: 102; Gramentz, 1988: 37; Green, 1998: 63; Gruvel, 1931: 404; Hayashi & Tsuji, 2007: 2; Kitsos et al., 2005: 259; Limpus et al., 1983a: 192; Limpus et al., 1983b: 180; Limpus et al., 1994: 145; Margaritoulis, 1985: 328; Young and Ross, 2000: 224.

FLIPPERS.- Cardenas-Palomo & Maldonado-Gasca, 2005: 32; Deraniyagala, 1939: 204; Green, 1998: 63; Kitsos et al., 2005: 259; Limpus et al., 1983: 180; Limpus et al., 1994: 145; Margaritoulis, 1985: 328; Rees and Walker, 1993: 189.

TOENAIL.- Darwin, 1854: 392.

SKIN.- Cardenas-Palomo & Maldonado-Gasca, 2005: 32; Kitsos et al., 2005: 259; Rees and Walker, 1993: 189.

Chelonibia caretta

CARAPACE.- Bacon, 1976: 34; Badillo, 2007: 65; Broch, 1924: 16; Daniel, 1956: 32; Dobbs and Landry, 2004: 674; Frick et al., 1998: 213; Frick et al., 2003: 9; Gramentz, 1988: 37; Hunt, 1995: 205; Limpus et al., 1983: 192; Pilsbry, 1916: 267; Wells, 1966: 86.

FLIPPERS.- Borradaile, 1903: 443.

SKIN.- Monroe and Limpus, 1979: 199.

HEAD.- Dobbs and Landry, 2004: 674.

PLASTRON.- Dobbs and Landry, 2004: 674.

Chelonibia ramosa

CARAPACE.- Korschelt, 1933: 2.

Chelonibia patula

CARAPACE.- Badillo, 2007: 67; Kitsos et al., 2005: 259

FLIPPERS. – Kitsos et al., 2005: 259.

SKIN. – Kitsos et al., 2005: 259.

Platylepas hexastylos

HEAD.- Badillo, 2007: 73; Richards, 1930: 143; Schwartz, 1960: 116.

CARAPACE.- Bacon, 1976: 34; Badillo, 2007: 73; Broch, 1924: 18; Chevreux and de Guerne 1893: 443; Gramentz, 1988: 39; Kitsos et al., 2005: 259; Schwartz, 1960: 116; Utinomi, 1970: 360; Young, 1991: 195; Zavodnik, 1997: 116.

PLASTRON.- Badillo, 2007: 73; Schwartz, 1960: 116.

FLIPPERS.- Bacon, 1976: 34; Gramentz, 1988: 39; Hernandez-Vazquez and Valadez-Gonzalez, 1998: 121; Limpus et al., 1983:192 (ventral surfaces of flippers); Schwartz, 1960: 116; Zann and Harker, 1978: 206.

SKIN.- Bacon, 1976: 34; Badillo, 2007: 73; Balazs, 1980: 20; Balazs et al., 1987: 58 (neck and pelvic area); Foster, 1978: 117; Eckert and Eckert, 1980: 401; Glazebrook and Campbell, 1990: 102 (neck, axillary, inguinal regions); Gramentz, 1988: 39; Hiro, 1936: 312; Koukouras and Matsa, 1998: 136; Losey et al., 1994: 686; O’Riordan, 1979: 356; Stubbings, 1965: 902; Wells, 1966: 87.

Platylepas hexastylos ichthyophila

SKIN.- Young, 1991: 197.

Platylepas decorata

HEAD.- Green, 1998: 63.

PLASTRON.- Green, 1998: 63; Limpus et al., 1983: 192.

SKIN.- Darwin, 1854: 427; Green, 1998: 63; Limpus et al., 1983: 192; Limpus et al., 1994: 147; Young, 1991: 194.

FLIPPERS.- Green, 1998: 63; Limpus et al., 1983: 192.

Stomatolepas dermochelys

FLIPPERS.- Eckert and Eckert, 1980: 401.

SKIN.- Eckert and Eckert, 1980: 401; Haelters et al., 2001: 14.

Stomatolepas elegans

CARAPACE.- Utinomi, 1970: 363.

FLIPPERS.- Badillo, 2007: 77-78; Holthius, 1969: 44; Lanfranco, 1979: 24; McCann, 1969: 152; Smaldon and Lyster, 1976: 317; Young, 1991: 200; Zullo and Bleakney, 1966: 162.

SKIN.- Badillo, 2007: 77-78; Carriol & Vader, 2002: 1003; Hiro, 1936: 312; Smaldon and Lyster, 1976: 317; Lanfranco, 1979: 24; O’Riordan and Holmes, 1978: 152; Quigley and Flannery, 1993: 153; Young, 1991: 200.

MOUTH CAVITY (GULLET). – Kitsos et al., 2005: 259.

Stomatolepas praegustator

MOUTH CAVITY (GULLET).- Limpus et al., 1983: 180; Pilsbry, 1910: 304; Wells, 1966: 87.

FLIPPERS.- Wells, 1966: 87; Monroe and Limpus, 1979: 203.

SKIN.- Monroe and Limpus, 1979: 203.

Stomatolepas transversa

PLASTRON.- Hayashi & Tsuji, 2007: 2; Limpus et al., 1994: 147; Monroe and Limpus, 1979: 205; Nilsson-Cantell, 1930: 20; Young, 1991: 201.

FLIPPERS.- Young, 1991: 201.

Cylindrolepas darwiniana

HEAD.- Green, 1998: 63; Hubbs, 1977: 265.

MOUTH.- Green, 1998: 63.

CARAPACE.- Green, 1998: 63.

PLASTRON.- Green, 1998: 63; Zullo, 1991: 188.

FLIPPERS.- Green, 1998: 63; Hubbs, 1977: 265.

SKIN.- Hubbs, 1977: 265.

Cylindrolepas sinica

SKIN.- Ren, 1980: 197.

Stephanolepas muricata*

CARAPACE.- Bustard, 1976: 347; Deraniyagala, 1939: 205; Hendrickson, 1958: 524; Nilsson-Cantell, 1932: 258.

PLASTRON. – Nilsson-Cantell, 1932: 258.

FLIPPERS.- Badillo, 2007: 75; Balazs, 1978: 128; Balazs, 1980: 20; Deraniyagala, 1939: 205; Limpus et al., 1983: 192; Limpus et al., 1994: 147; Monroe and Limpus, 1979: 201; Zullo, 1991: 188.

SKIN.- Fischer, 1886: 193; Nilsson-Cantell, 1932: 258.

*note: Locations for *S. muricata* given for sites other than the ‘skin’ or flippers are most likely the following species: *Chelolepas cheloniae*. Nilsson-Cantell misidentified *C. cheloniae* as *S. muricata* from collections made by Deraniyagala. Consequently, the same diagnosis was used by Hendrickson and Bustard. This confusion was outlined and settled by Ross & Frick (2007) and the appropriate changes have been made in the following species account.

Chelolepas (=Tubicinella) cheloniae

CARAPACE.- Dobbs and Landry, 2004: 674; Hendrickson, 1958: 524; Limpus et al., 1983: 180; Limpus et al., 1994: 147; Limpus et al., 2005: 10; Loop et al., 1995: 246; Monroe and Limpus, 1979: 199; Nilsson-Cantell, 1932: 260.

SECTION 3: BIOGEOGRAPHY

The list below includes all distribution records whether or not the turtle host was cited.

CARIBBEAN-WESTERN ATLANTIC

Chelonibia testudinaria.- Bacon, 1976: 34 (Toco Depot, Trinidad); Bugoni et al., 2001: 7 (Brazil); Cardenas-Palomo & Maldonado-Gasca, 2005: 32 (Yucatan, Mexico); Conrad, 1846: 398 (Tampa Bay, Florida); Farrapeira-Assuncao, 1991: 133 (Brazil); Frick et al., 1998: 213 (barrier islands, Georgia); Frick and Slay, 2000: 103 (Georgia); Frick et al., 2000: (barrier islands, Georgia); Frick et al., 2003: 9 (Jumby Bay, Antigua); Gruvel, 1905: 267 (Antilles Sea); Henry, 1954: 444 (Florida Keys; Texas); Hunt, 1995: 205 (Casey Key, Florida); Ives, 1891: 189 (Progreso, Yucatan); Killingley and Lutcavage, 1983: 345 (Chesapeake Bay, Virginia); Koukouras and Matsa, 1998: 136 (Aegean Sea and Levantine Basin); Lutcavage and Musik, 1985: 453 (Chesapeake Bay, Virginia); Nilsson-Cantell, 1921: 370 (Florida); 1939: 5 (Bay of Chacopata, Venezuela); Pereira et al., 2006: 17 (Almofala beaches, Brazil); Pilsbry, 1916: 264 (Key West, Florida; Point Patuca, Honduras; Cape Frio, Brazil); Plotkin, 1996: 78 (Mustang Island, North and South Padre Islands, Texas); Rees and Walker, 1993: 189 (Lleyn Peninsula, Gwynedd, North Wales); Richards, 1930: 143 (Wildwood, New Jersey); Rudloe et al., 1991: 50 (Walker, 1978: 205 (Beaufort, North Carolina); Wass, 1963: 36 (Virginia); Wells, 1966: 86 (St. Teresa, Florida; Bald Point, Florida); Weltner, 1897: 254 (Key West, Florida; Cuba; Bahia, Brazil); Young, 1991: 191 (Sao Sabastiao, Rio Grande, Ilha de Trinidad, Brazil); Zavodnik, 1997: 116 (Rovinj, Croatia); Zullo and Lang, 1978: 160 (South Carolina).

Chelonibia caretta.- Bacon, 1976: 34 (Toco Depot, Trinidad); Frick et al., 1998: 213 (barrier islands, Georgia); Frick et al., 2003: 9 (Antigua); Kolosvary, 1943: 99 (Mediterranean); Stubbings, 1967: 297 (Mauretania); Pilsbry, 1916: 267 (Delaware Bay, New Jersey; West Indies); Wells, 1966: 86 (St. Teresa, Florida); Young, 1991: 191 (Brazil); Zullo and Bleakney, 1966: 164 (Cape Cod, Massachusetts).

Chelonibia manati lobatibasis.- Pilsbry, 1916: 265 (Osprey, Florida); Wells, 1966: 86 (Bald Point, Florida).

Platylepas decorata.- Young, 1991: 194 (Abrolhos Archipelago, Brazil).

Platylepas hexastylus.- Bacon, 1976: 34 (Paria Bay, Matura Bay, Trinidad); Bugoni et al., 2001: 7 (Rio Grande do Sul, Brazil); Henry, 1954: 444 (Texas); Koukouras and Matsa, 1998: 136 (Aegean Sea and Levantine Basin); Lutcavage and Musik, 1985: 453 (Chesapeake Bay, Virginia); Pilsbry, 1916: 285 (Delaware Bay; Osprey, Florida); Richards, 1930: 143 (Cape May, New Jersey); Schwartz, 1960: 116 (Chincoteague Bay, Maryland); Wass, 1963: 36 (Virginia); Wells, 1966: 87 (Bald Point, Florida); Young,

1991: 195 (Joao Pessoa, Tramandai, Brazil); Zullo and Bleakney, 1966: 164 (Cape Cod, Massachusetts); Zullo and Lang, 1978: 160 (South Carolina).

Platylepas hexastylus ichtthyophila.- Young, 1991: 197 (Joao Pessoa, Brazil).

Platylepas hexastylus var.- Wells, 1966: 87 (Bald Point, Florida).

Platylepas sp.- Bacon, 1970: 64 (Trinidad); Bugoni et al., 2001: 7 (Rio Grande do Sul, Brazil); Cardenas-Palomo & Maldonado-Gasca, 2005: 32 (Yucatan, Mexico); Young, 1991: 197 (Iguape, Brazil).

Stomatolepas elegans.- Carriol & Vader, 2002: 1003 (Finmark, Norway); Zullo and Bleakney, 1966: 162 (Sambro, Nova Scotia; Seawall, Nova Scotia); Zullo and Lang, 1978: 160 (South Carolina).

Stomatolepas praegustator.- Lutcavage and Musick, 1985: 453 (Chesapeake Bay, Virginia); Pilsbry, 1910: 340 (Dry Tortugas, Florida); Wells, 1966: 87 (Bald Point, Florida); Young, 1991: 200 (Joao Pessoa, Brazil; Abrolhos Archipelago, Brazil).

Stomatolepas transversa.- Young, 1991: 201 (Joao Pessoa, Brazil).

Cylindrolepas darwiniana.- Pilsbry, 1916: 287 (West Indies ?).

MEDITERRANEAN-EASTERN ATLANTIC

Chelonibia testudinaria.- Badillo, 2007: 68 (Mediterranean); Barnard, 1924: 92 (Table Bay, South Africa); Broch, 1924: 202 (Equatorial Africa); Caziot, 1921: 51 (Nice, France); Darwin, 1854: 392 (west coast Africa, Mediterranean); Davenport, 1994: 736 (Madeira); Gauld, 1957: 10 (Accra, Ghana); Geldiay et al., 1995: 428 (Koycegiz-Dalyankoy, Turkey); Gramentz, 1988: 37 (Zacharo and Zakyntos, Greece; Lampedusa, Italy); Gruvel, 1903: 115 (Palermo, Italy; Alexandria, Egypt); 1931: 404 (Gulf of Alexandrette, Mediterranean); Kitsos et al., 2005: 259 (Aegean Sea, Greece); Kolosvary, 1939: 38 (Rovigno, d'Istria, Adriatic); Kolosvary, 1943: 99 (Alexandria, Egypt); Kolosvary, 1951: 412 (Mediterranean); Lucas, 1968: 136 (Mediterranean); Margaritoulis, 1985: 328 (Zakyntos, Greece); Nilsson-Cantell, 1921: 369 (Bibundi, Africa); 1931: 116 (Mediterranean); Relini, 1969: 169 (Adriatic); Relini, 1980: 88 (Adriatic); Stubbings, 1965: 893 (Hann, Saloum River, Senegal); Stubbings, 1967: 296 (Senegal).

Chelonibia caretta.- Badillo, 2007: 71 (Mediterranean); Barnard, 1924: 93 (Table Bay, South Africa); Broch, 1924: 16 (Baie du Levrier, Mauretania); Gramentz, 1988: 37 (Zakyntos, Greece; Lampedusa, Italy); Holthius, 1952: 77 (Ouddorp, Netherlands); Pilsbry, 1916: 267 (Cape of Good Hope).

Chelonibia patula. – Badillo, 2007: 71 (Mediterranean); Kitsos et al., 2005: 259 (Aegean Sea, Greece).

Platylepas coriacea.- Gramentz, 1988: 37 (Malta).

Platylepas hexastylus.- Badillo, 2007: 71 (Mediterranean); Broch, 1924: 203 (Gambia); Broch, 1927: 30 (Rabat, Morocco); Chevreux and de Guerne, 1893: 443 (between Algeria and Balaeres); Darwin, 1854: 428 (Mediterranean); Gramentz, 1988: 37 (Malta); Holthius, 1952: 77 (Ouddorp, Netherlands); Kolosvary, 1943: 101 (Palermo, Sicily); Lucas, 1968: 132 (Mediterranean); O’Riordan, 1979: 356 (Dingle, Ireland); Relini, 1980 (Italy); Stubbings, 1965: 899 (Goree, Senegal; Hann, Senegal); Utinomi, 1959: 384 (Banyuls-sur-Mer, France).

Stomatolepas elegans.- Badillo, 2007: 76 (Mediterranean); Holthius, 1969: 44 (Ameland Is., Netherlands); Kitsos et al., 2005: 259 (Aegean Sea, Greece); Lanfranco, 1979: 24 (Spinola Bay, St. Julians, Malta); Pilsbry, 1916: 289 (Taranto, Italy); O’Riordan and Holmes, 1978: 152 (Ventry Harbor, Ireland); Quigley and Flannery, 1993: 153 (Dingle Bay, S. W. Ireland); Relini, 1968: 223 (Gulf of Trieste, Italy); Smaldon and Lyster, 1976: 317 (Skarvoy, Norway; Crail and Kirkcudbrightshire, Scotland; Cornwall, England); Stubbings, 1965: 902 (Hann, Senegal).

Stomatolepas dermochelys.- Haelters and Kerckhof, 1999 (DeHaan, Belgium); Haelters et al., 2001: 14 (Oostende, Belgium).

Stephanolepas muricata. – Badillo, 2007: 74 (Mediterranean).

INDO-WEST PACIFIC

Chelonibia testudinaria.- Annandale, 1906: 143 (Rameswaram Is., Gulf of Manaar); Balazs, 1978: 128 (Kaneohe Bay, Oahu, Hawaii); Balazs, 1980: 20 (Hawaiian Islands); Balazs et al., 1987: 58 (Maui, Hawaiian Islands); Borradaile, 1903: 443 (Minikoi Is.); Broch, 1916: 14 (Broome, Australia); 1931: 122 (Koh Mak, Gulf of Siam; Nagasaki, Japan); 1947: 7 (Ream, Cambodia; mouth of Bassac River, Indochina); Daniel, 1956: 31 (Tuticorin, India; Drusadai Ids., India; Royapuram Coast, India); Darwin, 1854: 392 (Low Archipelago); Dawydoff, 1952: 129 (Poulo Condore, Viet Nam); Deraniyagala, 1939: 204 (Bentota, Ceylon); Edmonson, 1946: 231 (Hawaiian Islands); Fernando, 1978: 114 (Porto Novo, India); Glazebrook and Campbell, 1990: 102 (islands in Torres Strait, Australia); Frazier, 1971: 394 (Aldabra Atoll); Frazier, 1989: 250 (Bet Dwarka Island, Gulf of Kutch, India); Gordon, 1970: 94 (Honolulu, Oahu, Hawaii); Gruvel, 1903: 115 (Seychelles; Mallicolo, New Hebrides; Obok, French Somaliland; Sandwich Ids.); Gruvel, 1907: 8 (Andaman Islands); Hayashi & Tsuji 2007: 2 (Okinawa, Japan); Hendrickson, 1958: 523 (Talang Talang, Besar Is., Sarawak); Hiro, 1936: 312 (Wakayama-ken, Japan); 1937a: 69 (Palao; Kaisyaru off Baberudaobu Is.); 1939: 214

(Toyama Bay, Japan); Jones, 1990: -- (Western Australia); Jones et al., 1990: 11 (northeast coast, Great Barrier Reef, Gulf of Carpentaria, Australia); Jones et al., 2000: 260 (summary of distribution); Kruger, 1911: 57 (Sagami Bay, Japan); Lanchester, 1902: 371 (Kota Bharu, Malaysia); Limpus et al., 1983a: 192 (Campbell Island Rookery, Australia); Limpus et al., 1983b: 180 (Crab Island, Gulf of Carpentaria, Australia); Matuura and Nakaamur, 1993: 1803 (Fukiage Beach, Kagoshima Prefecture, southwest Japan); Monroe and Limpus, 1979: 199 (Heron Island, Mon Repos Island, Boydong Island, Queensland, Australia); Mustaquim and Javed, 1993: 73 (Sandspit Beach, Pakistan); Newman and Abbott, 1980: 516 (southern California); Nilsson-Cantell, 1930: 19 (Enoe Is. Aroe Archipelago); 1932: 258 (Bentota, Ceylon); 1937: 95 (Singapore); 1938: 77 (Kilakarai, India; Andamans; River Hooghly, mouth of Ganges, India); Pillai, 1958: 126 (Quilon, India); Pilsbry, 1916: 264 (Pearl Harbor, Oahu, Hawaiian Islands; Caroline Is.; Ana, Japan); 1927: 316 (Honolulu Harbor, Oahu); Ren, 1980: 187 (Xisha Island, South China Sea); Ross, 1981: 102 (Sultanate of Oman); Tachikawa, 1995: 67 (Japan); Utinomi, 1949: 24 (Hakata Bay, Japan); Utinomi, 1958: 309 (Sagami Bay, Japan); Utinomi, 1966: 8 (Amakusa, Japan); Utinomi, 1969: 92 (Kharg, Iran); Utinomi, 1970: 59 (Kamo and Nezugaseki, Japan; Tassya, Sado Is.); Wagh and Bal, 1974: 121 (Bombay, India); Weltner, 1899: 443 (Red Sea); 1910: 528 (Ile Europa, Mozambique Channel).

Chelonibia caretta.- Borradaile, 1903: 443 (Minikoi Is.); Daniel, 1956: 32 (off Madras Coast, India); Darwin, 1854: 394 (northern Australia); Dawydoff, 1952: 129 (Ream, Cambodia); Dobbs and Landry, 2004: 674 (Milman Island, Australia); Hiro, 1937a: 69 (Palao); Jones et al., 1990: 11 (north coast, northeast coast, Great Barrier Reef, northeast oceanic region, Australia); Jones et al., 2000: 260 (summary of distribution); Loop et al., 1995: 246 (Milman Island, Australia); Limpus et al., 1983: 192 (Campbell Island Rookery, Australia); Monroe and Limpus, 1979: 199 (North Reef, Heron I., Wistari Reef, Boydong, I., Queensland, Australia); Nilsson-Cantell, 1938: 14 (Maldives); Pilsbry, 1916: 267 (Saigon, Viet Nam); Utinomi, 1969: 92 (Kharg, Iran); Weltner, 1897: 254 (Massaua, New Guinea; Torres Strait); 1910: 528 (Ile Europa, Mozambique Channel).

Platylepas hexastylus.- Balazs, 1980: 20 (Hawaiian Islands); Balazs et al., 1987: 58 (Molokai, Maui and Oahu, Hawaiian Islands); Daniel, 1956: 33 (Royapuram Coast, India); Fischer, 1886: 195 (Poulo-Condor, Indochina); Foster, 1978: 117 (Piha Beach, Auckland, New Zealand); Frazier, 1971: 394 (Aldabra Atoll); Frazier, 1989: 250 (Bet Dwarka Island, Gulf of Kutch, India); Hiro, 1936: 312 (Wakayama-ken, Japan); 1937a: 70 (Palao); Jones et al., 1990: 12 (north and northwest coast, east coast, Australia); Jones et al., 2000: 260 (summary of distribution); Kruger, 1912: 13 (Timor Sea); Limpus et al., 1983: 192 (Campbell Island Rookery, Australia); Losey et al., 1994: 686 (Kaneohe Bay, Oahu, Hawaii); Monroe and Limpus, 1979: 279 (Queensland, Australia); Ren, 1980: 188 (Xisha Island, South China Sea); Utinomi, 1950: 62 (Tanabe Bay, Japan); Utinomi, 1970: 360 (Sado Is., Japan, Hakui, Japan; Cape Kyoga-misaki, Japan); Zann and Harker, 1978: 206 (Magnetic I., Queensland, Australia).

Platylepas coriacea.- Jones et al., 1990: 12 (Tasmania; central east coast, Australia); Monroe and Limpus, 1979: 208 (Wreck Rock near Bundaberg, Mon Repos I., Alexandra Headlands, southeast Queensland, Australia).

Platylepas decorata.- Darwin, 1854: 429 (Lord Hood Island, Low Archipelago); Gruvel, 1912: 350 (Tuamotu Archipelago); Hiro, 1936: 319 (Seto, Japan); Hiro, 1937a: 70 (Kaisyaru, Palao); Jones et al., 2000: 260 (summary of distribution); Jones et al., 1990: 12 (lower east coast, central east coast, Great Barrier Reef, Australia); Limpus et al., 1983: 192 (Campbell Island Rookery, Australia); Monroe and Limpus, 1979: 206 (Queensland, Australia); Nilsson-Cantell, 1921: 376 (west coast, Australia); Ren, 1980: 190 (Xisha Island, South China Sea).

Platylepas multidecorata.- Daniel, 1962: 641 (Little Andaman Is.).

Stomatolepas dermochelys.- Jones et al., 1990: 12 (central east coast, northeast coast, Australia); Monroe and Limpus, 1979: 203 (Wreck Rock near Bundaberg, southeast Queensland, Australia).

Stomatolepas elegans.- Foster, 1978: 117 (Flat Point and mouth of Whareana River, New Zealand); Hiro, 1936: 312 (Wakayama-ken, Japan); Jones et al., 2000: 261 (summary of distribution); Ren, 1987: 182 (China); McCann, 1969: 152 (mouth of Whareama River, North Island, New Zealand); Smaldon and Lyster, 1976: 318 (Kuala Lumpur, Malaysia); Utinomi, 1970: 363 (Tassya, Sado Is., Japan).

Stomatolepas praegustator.- Jones et al., 1990: 12 (central east coast, northeast coast, Great Barrier Reef, Australia); Monroe and Limpus, 1979: 203 (Heron I., Mon Repos I., Queensland, Australia).

Stomatolepas pulchra.- Ren, 1980: 191 (Jinyindao, Xisha Island, South China Sea).

Stomatolepas transversa.- Hayashi & Tsuji 2007: 2 (Okinawa, Japan); Jones et al., 1990: 12 (Great Barrier Reef, Australia); Monroe and Limpus, 1979: 205 (Wistari Reef and Heron I., Queensland, Australia); Nilsson-Cantell, 1930: 20 (Enoe I., Aroe Archipelago).

Cylindrolepas darwiniana.- Jones et al., 1990: 12 (central east coast, Australia).

Cylindrolepas sinica.- Ren, 1980: 194 (Jinyindao, Xisha Island, South China Sea); Jones et al., 2000: 261 (summary of distribution).

Cylindrolepas sp.- Newman et al., 1969: R289 (Hawaii).

Stephanolepas muricata.- Balazs, 1978: 128 (Kaneohe Bay, Oahu, Hawaii); Balazs et al., 1987: 58 (Maui, Hawaiian Islands); Bustard, 1976: 347 (Great Barrier Reef, Australia); Deraniyagala, 1939: 204 (Bentota, Ceylon); Fischer, 1886: 193 (Poulo-

Condor, Condor Islands); Gruvel, 1903: 151 (Cochin, China); Jones et al., 1990: 12 (central coast, northeast coast, Great Barrier Reef, Australia); Jones et al., 2000: 261 (summary of distribution); Limpus et al., 1983: 192 (Campbell Island Rookery, Australia); Monroe and Limpus, 1979: 201 (Mon Repos I., Heron I., Moreton Bay, Boydong I., Queensland, Australia); Nilsson-Cantell, 1932: 258 (Bentota, Ceylon).

Chelolepas (= Tubicinella) cheloniae.- Dobbs and Landry, 2004: 674 (Milman Island, Great Barrier Reef, Australia); Hendrickson, 1958: 524 (Talang Talang, Besar Ids., Sarawak); Jones et al., 1990: 12 (central east coast, northeast coast, Australia); Loop et al., 1995: 246 (Milman Island, Great Barrier Reef, Australia); Limpus et al., 1983: 180 (Crab Island, Gulf of Carpentaria, Australia); Limpus et al., 2005: 10 (Raine Island, Australia); Monroe and Limpus, 1979: 199 (Mon Repos I., southeast Queensland, Australia); Nilsson-Cantell, 1932: (Bentota, Ceylon, as Stephanolepas muricata).

EASTERN PACIFIC

Chelonibia testudinaria.- Angulo-Lozano et al., 2007; Beaumont et al., 2007 (Galapagos Islands); Brown and Brown, 1995: 238 (Peru); Darwin, 1854: 392 (west coast of Mexico, 23°N); Green, 1998: 63 (Galapagos Ids.); Henry, 1941: 105 (La Paz, Mexico); 1960: 143 (Gulf of California; Guaymas, Mexico); Kolosvary, 1943: 99 (San Jose, Guatemala); MacDonald, 1929: 537 (off Cocos Is.); Nilsson-Cantell, 1959: 7 (Valparaiso, Chile); Pilsbry, 1916: 264 (San Bartholome Bay, Baja California, Mexico; Cape San Lucas, Baja California, Mexico; Albemarle Is., Galapagos; San Luis Gonzaga Bay, Gulf of California; Magdalena Bay, Baja California); Ross and Newman, 1967: fig. 5 (Magdalena Bay, Baja California); Stinson, 1984: -- (San Diego Bay, California); Vivaldo et al., 2006: 434 (Michoacan and Oaxaca, Mexico); Weltner, 1897: 254 (western Mexico, California; Valparaiso, Chile); Zullo, 1986: 56 (Isla Santa Fe, Galapagos Islands); Young and Ross, 2000: 224 (Puerto Penasco, Sonora Mexico); Zullo, 1986: 56 (Isla Santa Fe, Galapagos, fossil).

Platylepas hexastylos.- Beaumont et al., 2007 (Galapagos Islands); Hernandez-Vazquez and Valadez-Gonzalez, 1998: 121 (La Gloria, Jalisco, Mexico); Newman et al., 1969: R289 (Baja California, Mexico); Vivaldo et al., 2006: 434 (misidentified as Chelonibia testudinaria; Michoacan and Oaxaca, Mexico).

Platylepas decorata.- Darwin, 1854: 429 (Galapagos Ids.); Green, 1998: 63 (Galapagos Ids.); Zullo, 1991: 188 (Isla Santa Cruz, Galapagos Islands).

Cylindrolepas darwiniana.- Green 1998: 63 (Galapagos Ids.); Hubbs, 1977: 265 (La Jolla, California); Zullo, 1991: 188 (Isla Santa Cruz, Galapagos Islands).

Cylindrolepas sp.- Newman et al., 1969: R289 (Eastern Pacific).

Stephanolepas muricata.- Balazs, 1980: 20 (Hawaiian I.); Zullo, 1991: 188 (Isla Santa Cruz, Galapagos Islands).

Stephanolepas sp.- Newman et al., 1969: R289 (California).

Stomatolepas sp.- Vivaldo et al., 2006: 434 (misidentified as *Chelonibia testudinaria*; Michoacan and Oaxaca, Mexico).

SECTION 5.1: SYSTEMATICS OF THE
CORONULOID BARNACLES

ARNOLD ROSS & MICHAEL G. FRICK

† = extinct

Superfamily Coronuloidea Leach, 1818

Family Chelonibiidae Pilsbry, 1916

Subfamily Chelonibiinae Pilsbry 1916

Chelonibia capellini de Alessandri, 1895†
Chelonibia caretta (Spengler, 1790)
Chelonibia depressa Seguenza, 1876†
Chelonibia hemisphaerica Rothpletz &
Simonelli, 1890†
Chelonibia manati Gruvel, 1903
Chelonibia manati crenatibasis Pilsbry, 1916
Chelonibia manati lobatibasis Pilsbry, 1916
Chelonibia patula (Ranzani, 1818)
Chelonibia patula dentata Henry, 1943
Chelonibia ramosa Korschelt, 1933
Chelonibia testudinaria (Linnaeus, 1758)
Chelonibia testudinaria solida Withers, 1929†

Subfamily Emersoniinae Ross, 1967†

Emersonius cybosyrinx Ross, 1967†

Family Platylepadidae Newman & Ross, 1976

**Subfamily Platylepadinae Newman & Ross,
1976**

Platylepas decorata Darwin, 1854
Platylepas coriacea Monroe & Limpus, 1979
Platylepas hexastylos (Fabricius, 1798)
Platylepas h. ichthyophila Pilsbry, 1916
Platylepas indicus Daniel, 1958
Platylepas krugeri Kruger, 1912
Platylepas multidecorata Daniel, 1962
Platylepas ophiophilus Lanchester, 1902
Platylepas wilsoni Ross, 1963†

Platylepas sp. (sensu Young, 1991)

Subfamily Cylindrolepadinae nov.

Cylindrolepas darwiniana Pilsbry, 1916

Subfamily Stomatolepadinae nov.

Stephanolepas muricata Fischer, 1886
Stomatolepas dermochelys Monroe & Limpus,
1979
Stomatolepas elegans (Costa, 1883)
Stomatolepas praegustator Pilsbry, 1910
Stomatolepas pulchra Ren, 1980
Stomatolepas transversa Nilsson-Cantell, 1930

Subfamily Chelolepadinae nov.

Chelolepas cheloniae (Monroe & Limpus,
1979)

Family Coronulidae Leach, 1817

Subfamily Coronulinae Leach, 1817

Coronula aotea Fleming, 1959†
Coronula barbara Darwin, 1854†
Coronula bifida Bronn, 1831†
Coronula diadema (Linnaeus 1767)
Coronula dormitor Pilsbry & Olson, 1951†
Coronula ficarazzensis Gregorio, 1895†
Coronula macsotayi Weisbord, 1971†
Cetopirus complanatus (Morch, 1852)
Cetolepas hertleini Zullo, 1969†

Subfamily Cryptolepadinae nov.

Cryptolepas rhachianecti Dall, 1872

Subfamily Xenobalaninae Gruvel, 1905

Xenobalanus globicipitis Steenstrup, 1851

Subfamily Tubicinellinae nov.

Tubicinella major Lamarck, 1802

SECTION 5.2: FAMILIAL & SUB-FAMILIAL DESCRIPTIONS OF THE
CORONULOIDEA: ARNOLD ROSS & MICHAEL G. FRICK

Superfamily Coronuloidea Leach, 1817
(nom. transl. Newman, 1996 [ex Coronulidae Leach, 1817:68])

Definition – Balanomorpha with operculum occupying substantially less than full area of orifice; scutum and tergum ranging from weakly developed and articulated to disarticulated, variously reduced or completely absent; wall either eight-plated (R-RL-CL¹-CL²-C) or six-plated (R-CL¹-CL²-C), parietes solid, with internal or external longitudinal canals; basis membranous.

Type genus – *Coronula* Lamarck, 1802:464; by original designation (Leach, 1817:68).

Remarks – The taxa included herein are the only ones known among the balanomorpha in which the opercular plates, when present, do not fully occlude the orifice. In many of the platylepadid taxa the apex of the wall and opercular plates are dehiscent. All of the species are symbionts that superficially or deeply invade the tissues of the host or entrain host tissue (see Korschelt 1933, fig. 15).

Family Chelonibiidae Pilsbry, 1916
(nom. transl. Newman 1996 [ex Chelonibiinae Pilsbry, 1916:262])

Definition – Wall either eight-plated (R-RL-CL¹-CL²-C) or six-plated (R-CL¹-CL²-C), bi- to multilamellar with longitudinal tubes internal, opercular plates normal, always present; apertural (formerly “opercular” or “oral”) hood absent.

Type genus – *Chelonibia* Leach, 1817:68 by original designation of Pilsbry (1916:262).

Subfamily Chelonibiinae Pilsbry, 1916:262

Definition – Wall eight-plated (R-RL-CL¹-CL²-C), bilamellar, with internal, longitudinal canals; parietal space between (primary, secondary and tertiary) laminae filled with longitudinal septa, the spaces between which may be partially to almost completely filled; without external T-shaped flanges and canals.

Remarks – In this subfamily sutures uniting the true rostrum and rostrilaterals (compound rostrum) are visible, at least internally. None of the species are known to have an apertural hood. Also, protandric and complementary males are only known to occur in this subfamily of coronuloid (Zardus & Hadfield 2004).

Subfamily †Emersoniinae Ross, 1967
Emersoniinae [sic] Ross, in Ross and Newman, 1967:7

Definition – Wall six-plated (R-CL¹-CL²-C); multilamellar (composed of box-like cells); rostrum compound.

Type genus – *Emersonius* Ross, in Ross & Newman, 1967; by original designation.

Remarks – Emersoniinae has much the same ground plan of longitudinal septa between the laminae of the parietes as do the chelonibiines, except the spaces between the septa are filled by box-like cells rather than solid material. The reconstruction of this extinct taxon suggests it only had six plates.

Family Platylepadidae Newman & Ross, 1976
(nom. transl. Newman & Ross, 1976
[ex Platylepadinae Newman & Ross, 1976])

Definition – Wall six-plated (R-CL¹-CL²-C); relatively thin; parietes each with midrib and/or tooth; longitudinal tubes when present external (internal in *Chelolepas*); apertural hood absent (except in *Chelolepas*); primary or internal lamina (including the sheath) solid, outer lamina (when present) formed by joining of longitudinal T-shaped flanges extending from inner wall, thus forming external longitudinal canals.

Type Genus – *Platylepas* Gray, 1825; by original designation (Newman & Ross, 1976).

Remarks – Monroe (1981) was confronted with an ambiguous definition of the platylepadids stemming from the work of Pilsbry (1916). Newman & Ross (1976) recognized the platylepadids at the familial level, but they did not provide a definition. Apparently for the want of an adequate definition to guide him, Monroe (1981) reassigned the platylepadids to the coronulids. Young (1991) also encountered the same problem with Pilsbry's definition of the platylepadid series and similarly questioned the validity of this taxon.

Subfamily Platylepadinae Newman & Ross 1976:44

Definition – Wall peltate, or low conical; mono- or bi-lamellar; parietes with a large internal midrib either with or without a corresponding external medial sulcus; midrib having several conspicuous alternating ridges incorporated into basal surface; external longitudinal sulci, when present, formed by T-shaped flanges; sutural elaborations absent; orifice worn by corrosion or abrasion, or dehiscent.

Remarks – This subfamily includes one genus: *Platylepas*, which is partially embedded within the host.

Subfamily *Cylindrolepadinae* nov.

Definition – Wall more or less cylindrical, as high or higher than wide, mono-lamellar; paries with median tooth weakly developed, apparently without basal teeth but secondarily filled with calcareous material, median sulcus if present closed; few relatively prominent, lateral teeth on each side of median tooth; lateral sulci likely present, few in number and bounded by rather wide denticles; orifice apparently worn away by corrosion rather dehiscent.

Type species – *Cylindrolepas darwiniana* Pilsbry, 1916:288, by original designation.

Remarks – It appears that the type specimen of *Cylindrolepas darwiniana* is lost or no longer extant. Moreover, the host and locality of origin for this specimen are unknown and presumed, by Pilsbry (1916), to be from the Carribean. However, surveys from this region by Schärer (2003) and Frick *et al.* (2003) have not yielded any specimens of this distinctly cylindrical platylepadid. Green (1998), however, found *C. darwiniana* to occur fortuitously on green turtles in the Galapagos and it is likely that Pilsbry's specimen came from this region. Nonetheless, it may be prudent to designate a neotype for this subfamily and redescribe to species from Galapagos specimens.

Subfamily *Stomatolepadinae* nov.

Definition – Wall shallow to deep, bowl- or boat-shaped; parietal midribs, sulci and teeth absent; sutural elaborations well-developed, simple or antler-like (bringing mantle tissue in contact with host tissue); longitudinal tubes absent (enlarged, longitudinal sutural channels circulatory rather than parietal canals).

Type genus – *Stomatolepas* Pilsbry, 1910:304.

Remarks – The two genera included herein develop complex, more or less elaborate sutural ornamentation bringing mantle tissue into contact with host tissue. Other than for the membranous basis, elaborations for bringing mantle tissue into contact with host tissue not obvious in the two related subfamilies.

Subfamily *Chelolepadinae* nov.

Definition – Wall cylindrical; parities without midribs and major basal teeth; with relatively large, outward-projecting, sutural eminencies each formed by a pair of abutting flanges; parities with small longitudinal tubes which develop between fine basal teeth rather than as the external tubes that develop between the T-shaped ribs in *Tubicinella*.

Type genus – *Chelolepas cheloniae* (Monroe & Limpus, 1979) (see Ross & Frick, 2007)

Family Coronulidae Leach, 1817
(non. transl. Newman & Ross, 1976 [ex Coronulidae Pilsbry, 1916:268
(synonymy) pro Coronulidea (sic) Leach, 1817:68])

Definition – Wall six-plated (R-CL¹-CL²-C), relatively thick, mono-lamellar, or bi-lamellar when T-shaped flanges and longitudinal canals present; parietes without mid-rib; opercular plates reduced, tergum vestigial or absent, or tergum and scutum absent; apertural hood present.

Type genus – *Coronula* Lamarck, 1802:464; by original designation (Leach, 1817:68).

Remarks – Leach (1817) included *Tubicinella*, *Coronula* and *Chelonibia* when he proposed this family, but did not specify the type genus. Since *Coronula* was the nominal genus upon which the family-group was based, it becomes, ipso facto, the type by original designation. *Chelonibia* has since been relegated to the Chelonibiidae. The Coronulidae is now recognized as including four subfamilies, the Coronulinae, Cryptolepadinae, Tubicinellinae & Xenobalaninae.

Subfamily Coronulinae Leach, 1817

Definition – Wall large, massive, hemispherical to barrel-shaped; external T-shaped longitudinal flanges well-developed; body chamber extending above the surface of the host.

Type genus – *Coronula* Lamarck, 1802:464.

Remarks – We have limited this subfamily to three genera (*Coronula*, *Cetopirus* & *Cetolepas*) which, while "perched" upon whales, these types draw host skin into the cavities of the shell in order to better hold on. They are readily distinguished from the Cryptolepadinae subfam. nov. which have simple rather than T-shaped external flanges and are completely imbedded in host tissue. Both these subfamilies are readily distinguishable from Tubicinellinae and Xenobalaninae to be taken up shortly.

Scarff (1986) reports members of this subfamily from Pacific right whales (*Eubalaena japonica*) and Félix *et al.* (2006) report that humpback whales (*Megaptera novaeangliae*) will breach in order to remove aggregations of *Coronula*. A study by Nogata & Matsumura (2006) describes the larval development and settlement of *Coronula diadema*.

Subfamily Cryptolepadinae nov.

Definition – Wall relatively light; termination of longitudinal flanges simple, not T-shaped; body chamber cup-shaped and situated below surface of host tissues.

Type genus – *Cryptolepas* Dall, 1872:300, by monotypy.

Remarks – The reductions and specializations of the shell of *Cryptolepas*, a form unknown to Darwin (1854), to some extent anticipated in *Cetolepas*, form a grade of organization intermediate between *Coronula* and *Xenobalanus*. While particularly fond of attaching to gray whales (*Eschrichtius robustus*), the barnacle *Cryptolepas rhachianecti* will also attach to captive or sick belugas (*Delphinapterus leucas*) and killer whales (*Orcinus orca*) (Ridgway *et al.*, 1997; Samaras, 1989). Samaras & Durham (1985) illustrate the cyprid stage of *C. rhachianecti*.

Subfamily Xenobalaninae Gruvel, 1905:280

Definition – Wall much reduced in sizes and structure, including loss of T-shaped flanges, serving as a shallow anchor for the extraparietal, membranous stalk, body chamber and apertural hood; opercular parts lost.

Type genus *Xenobalanus* Steenstrup, 1851:61, pl. 3, figs. 11-15, by original designation, Gruvel, 1905:280.

Remarks – *Xenobalanus globicipitis* is monotypic and is the most unusual of the whale if not balanomorph barnacles since, as Darwin (1852:156) noted it has "...the external appearance of a pedunculated cirripede...". While the wall has been reduced to an anchor, the arthrodiol membrane supporting the operculum has been lengthened into a slender stalk extending from it. Distally the stalk expands to a capitulum-like structure, but without plates since the terga and scuta have been lost. Together with the apertural hood, it houses the body of the barnacle. Part of the hood forms "fins" which may serve to stabilize the barnacle in the turbulent flow of water from the trailing end of the fins of certain cetaceans to which it attaches. It is found worldwide and has been reported as a commensal of porpoises, dolphins and pilot whales (Aznar *et al.*, 1994; Orams & Schuetze, 1998; Samaras, 1998; Karuppiah *et al.*, 2004).

Subfamily Tubicinellinae nov.

Definition – Wall thin, cylindrical, much higher than wide; with minute, external longitudinal canals formed by external septa with T-shaped flanges.

Type genus – *Tubicinella* Lamarck, 1802:461.

Type species – *Tubicinella major* Lamarck, 1802:463; by subsequent designation Pilsbry, 1916:281; Recent, South America, host unknown, but occurs as a commensal of southern right whales (*Eubalaena australis*).

Remarks – The numerous, small parietal tubes of each compartment in *Tubicinella*, which are remarkably uniformly rectangular, distinguish it from all other coronulids. It is distinguished from all coronulids by the development of conspicuous external, more or less widely spaced, circumferential ridges. In addition to these two features, it is easily distinguishable from the only other tubular coronuloid, *Chelolepas*, by the large sutural projections arranged in irregular whorls in the latter. It is known from the Pacific and South Atlantic Oceans.

SECTION 6: BARNACLE SPECIES DOCUMENTED FROM TURTLES (OBLIGATE AND NON-OBLIGATE FORMS)

Twenty-nine nominal species of “turtle barnacles” are presently recognized. These are unequally distributed between the balanomorph families Chelonibiidae and Platylepadidae. Not all occur on turtles however. Some are found only on mollusks, decapod crustaceans, stomatopods, xiphosurans, gars, sea snakes, crocodiles, dugongs and manatees or several related groups of these organisms (Darwin 1854; Pilsbry 1916; Ross and Newman 1967; Newman and Ross 1976; Monroe and Limpus 1979). The record of a whale barnacle by Caldwell (1963), *Coronula regina* Darwin, on a Pacific loggerhead from the Gulf of California, Mexico is likely a misidentification of *C. testudinaria* as contemporary analyses of barnacles from turtles in this region have never found *C. reginae*; however, this species is common from whales encountered here. The following are those known to occur only on turtles:

Chelolepas cheloniae (Monroe & Limpus, 1979)
Chelonibia caretta (Spengler, 1790)
Chelonibia manati lobatibasis Pilsbry, 1916
Chelonibia ramosa Korschelt, 1933
Chelonibia testudinaria (Linnaeus, 1758)
Cylindrolepas darwiniana Pilsbry, 1916
Cylindrolepas sinica Ren, 1980
Platylepas coriacea Monroe and Limpus, 1979
Platylepas decorata Darwin, 1854
Platylepas sp. (*sensu* Young 1991) (Figure 4 C,D)
Stomatolepas dermochelys Monroe and Limpus, 1979
Stomatolepas elegans (Costa, 1838)
Stomatolepas praegustator Pilsbry, 1910
Stomatolepas pulchra Ren, 1980
Stomatolepas transversa Nilsson-Cantell, 1930
Stephanolepas muricata Fischer, 1886

With the exception of *Chelonibia patula*, *Platylepas hexastylus hexastylus* and *Platylepas hexastylus ichthyophila*, the following occur on living organisms other than sea turtles. *Chelonibia patula* has also been found on inanimate floating objects (Relini 1980; Frazier and Margaritoulis 1990) as well as a human femur (Monroe 1981). This species, along with *P. hexastylus hexastylus* and *P. hexastylus ichthyophila*, are also found on turtles, but the latter subspecies has only been reported once from green turtles in Brazil (Young, 1991).

Chelonibia dentata Henry 1943 (decapod crustaceans)
Chelonibia manati Gruvel, 1903 (manatees)
Chelonibia patula Ranzani, 1820 (crabs, mollusks, stomatopods, etc.)
Platylepas hexastylus hexastylus (Fabricius, 1798) (dugongs)
Platylepas hexastylus ichthyophila Pilsbry, 1916 (fish)
Platylepas indicus (Daniel, 1958) (sea snakes)
Platylepas krugeri Pilsbry, 1916 (sea snakes)
Platylepas ophiophilus Lanchester, 1902 (sea snakes)

None of the presently known fossils have been found associated with the remains of turtles. In addition, we are unaware of any reports of fossil turtles having abnormalities that might be attributed to the former presence of barnacles – like bowl-shaped pits left in bone as seen in platylepadid colonization of extant chelonians (Figure 1). The following are those known only from their fossil record (see Withers 1928, 1953; Ross 1963b, 1964):

Emersonius cybosyrinx Ross, 1967; late Eocene, Florida

Chelonibia capellini (deAlessandri, 1895); middle Miocene-Pliocene, Italy

Chelonibia depressa (Seguenza, 1876); Pliocene, Sicily

Chelonibia hemispherica (Rothpletz and Simonelli, 1890); Pliocene, Canary Is.

Chelonibia melleni Zullo, 1982; Oligocene, Mississippi

Chelonibia testudinaria var. *solida* Withers, 1929; early Miocene, France

Platylepas wilsoni Ross, 1963; Pleistocene, Florida

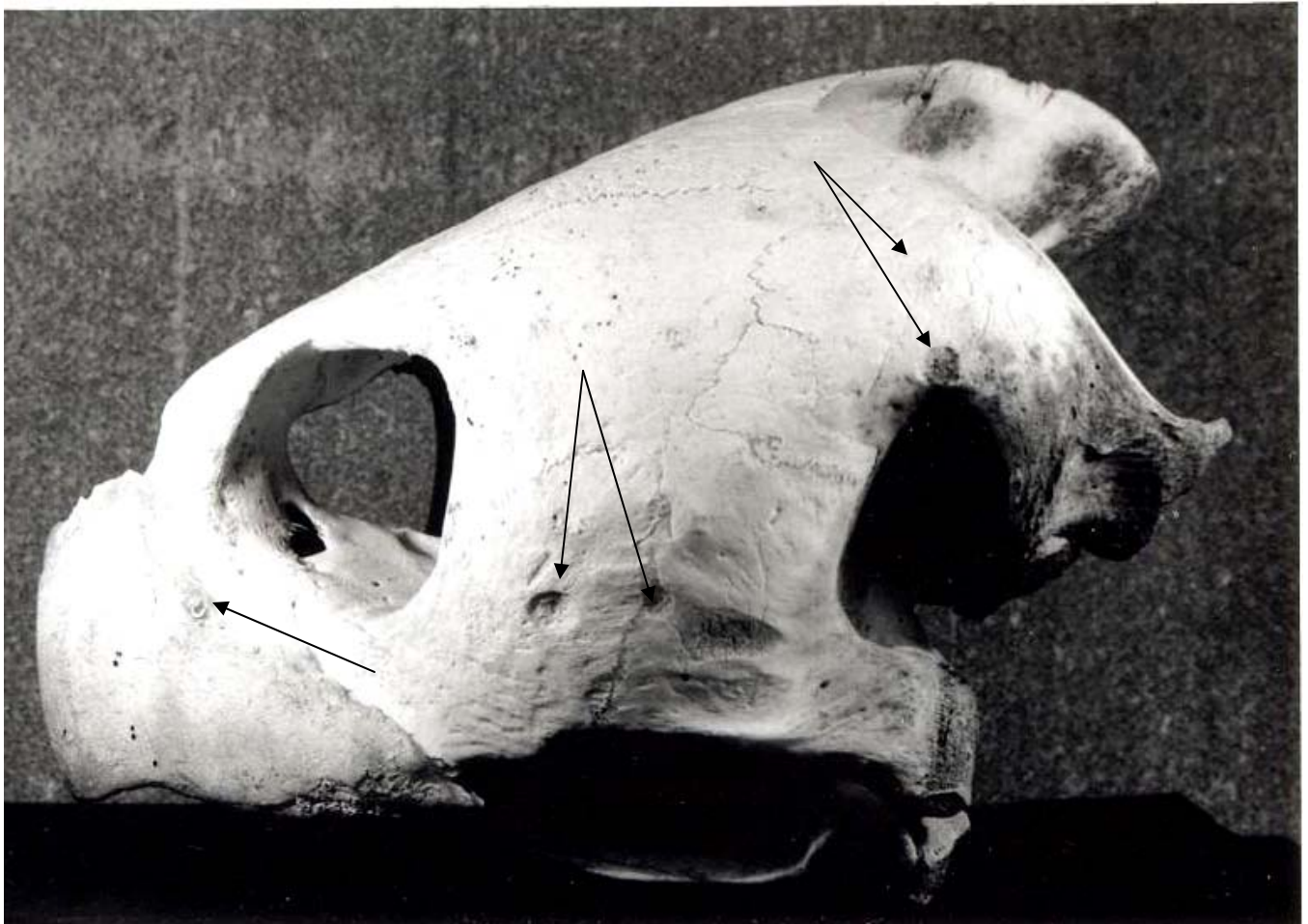


FIGURE 1. Views of skull and tomium of an Atlantic loggerhead stranded on the beach at Brunswick, Georgia. The attached barnacles growing in the skin on the skull caused osteolysis immediately internal to the attachment sites. The numerous scattered pits in the skull (indicated by arrows) vary in depth from barely perceptible to 3-4mm. The platylepadids are still embedded in the tomium.

The barnacles listed below occur fortuitously on sea turtles, and many are non-obligate commensals that can be found in a variety of epifaunal situations (see Zullo and Bleakney 1966; Bleakney 1967; Hubbs 1977; Monroe and Limpus 1979; Caine 1986; Eckert and Eckert 1987; Dodd 1988; Gramentz 1988; Tachikawa 1995; Frick et al. 1998, 2000; Green 1998; see also review in Lauckner 1985).

STALKED BARNACLES (PEDUNCULATES):

Lepas anatifera Linnaeus, 1767
Lepas anserifera Linnaeus, 1767
Lepas hillii Leach, 1818
Lepas pectinata Linnaeus, 1767
Lepas testudinata Aurivillius, 1894
Dosima fascicularis (Ellis and Solander, 1786)
Conchoderma auritum (Linnaeus, 1767)
Conchoderma virgatum (Spengler, 1790)
Conchoderma virgatum chelonophilum (Leach, 1818)

ACORN BARNACLES:

Amphibalanus amphitrite (Darwin, 1854)
Amphibalanus eburneus (Gould, 1841)
Amphibalanus improvisus (Darwin, 1854)
Amphibalanus variegatus (Darwin, 1854)
Amphibalanus venustus (Darwin, 1854)
Balanus calidus Pilsbry, 1916
Balanus laevis laevis (Brugiere, 1789)
Balanus poecilus Darwin, 1854
Balanus trigonus Darwin, 1854
Chthamalus fragilis Darwin, 1854
Chthamalus stellatus angustitergum Pilsbry, 1916
Conopea galeata (Pilsbry, 1907)
Elminius modestus Darwin, 1854
Megabalanus galapaganus Pilsbry, 1916
Megabalanus cocopoma Darwin, 1854
Megabalanus antilliensis (Pilsbry, 1916)
Pachylasma giganteum (Philippi, 1836)
Perforatus perforatus perforatus (Brugiere, 1789)
Verruca laevigata (Darwin, 1854)



FIGURE 2. A small specimen of the purple acorn barnacle *Megabalanus coccopoma* (left) attached to $\frac{1}{2}$ a turtle barnacle, *Chelonibia testudinaria*. A young striped acorn barnacle, *Balanus trigonus*, is growing in the suture of the turtle barnacle (center of the photograph).

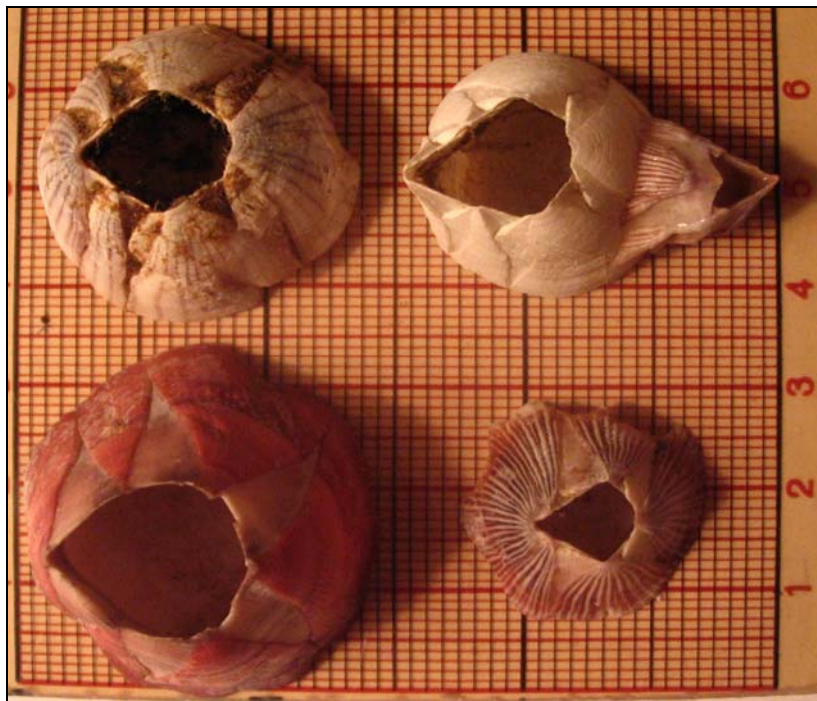


Figure 3. Non-obligate barnacles from turtles (clockwise): *Amphibalanus amphitrite*, *Amphibalanus eburneus* (with deformed *B. trigonus* attached), *Balanus trigonus*, *Megabalanus coccopoma*.

SECTION 6: REPRESENTATIVE ILLUSTRATIONS OF THE CORONULOIDEA

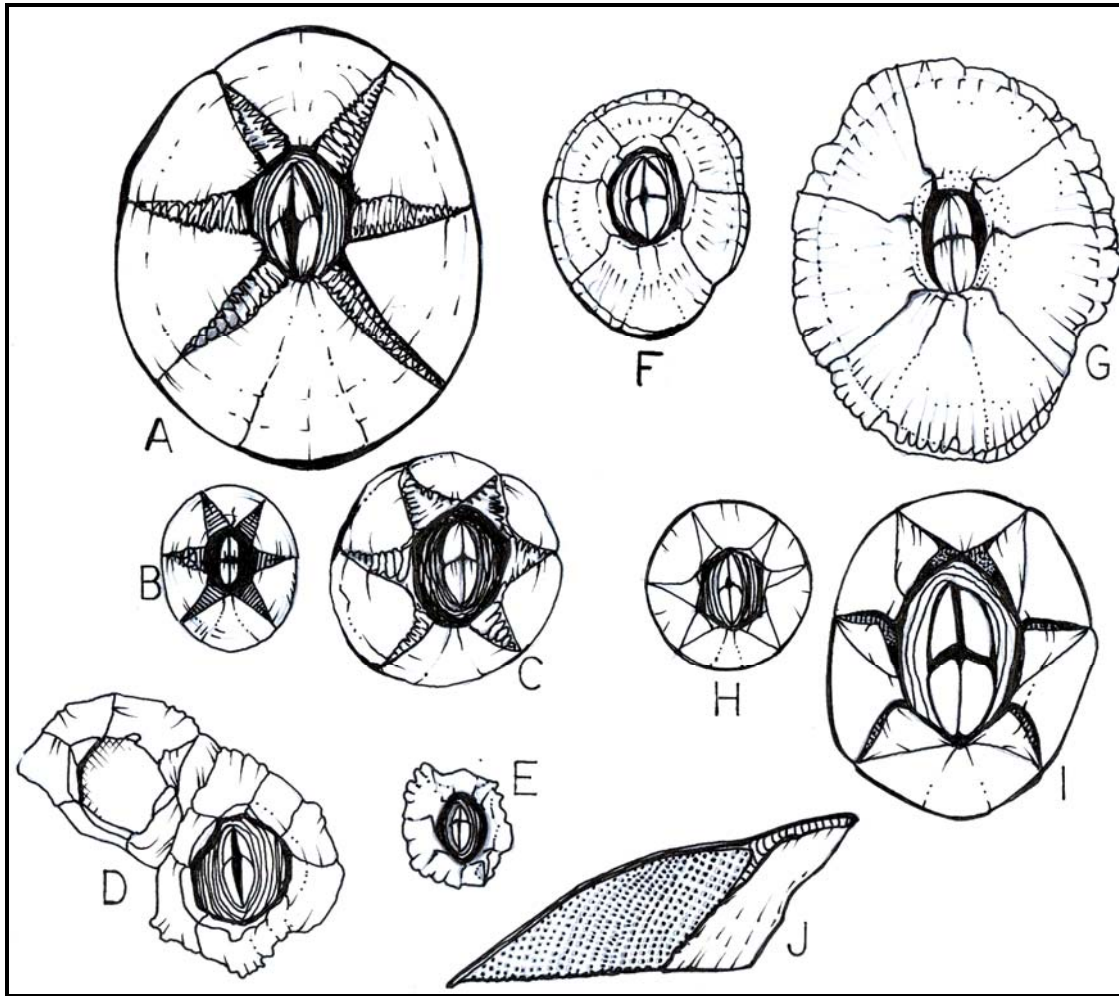


Figure 4. Representatives of the Family Chelonibiidae. **A.** *Chelonibia testudinaria*, **B.** *Chelonibia testudinaria*, **C.** *Chelonibia testudinaria*, **D.** *Chelonibia manati crenatibasis*, **E.** *Chelonibia manati lobatibasis*, **F.** *Chelonibia caretta*, **G.** *Chelonibia caretta*, **H.** *Chelonibia patula*, **I.** *Chelonibia patula*, **J.** *Emersonius cybosyrinx* (cross-section of rostrum). Composite figure adapted from Pilsbry (1916), Young (1991) and Ross & Newman (1967).

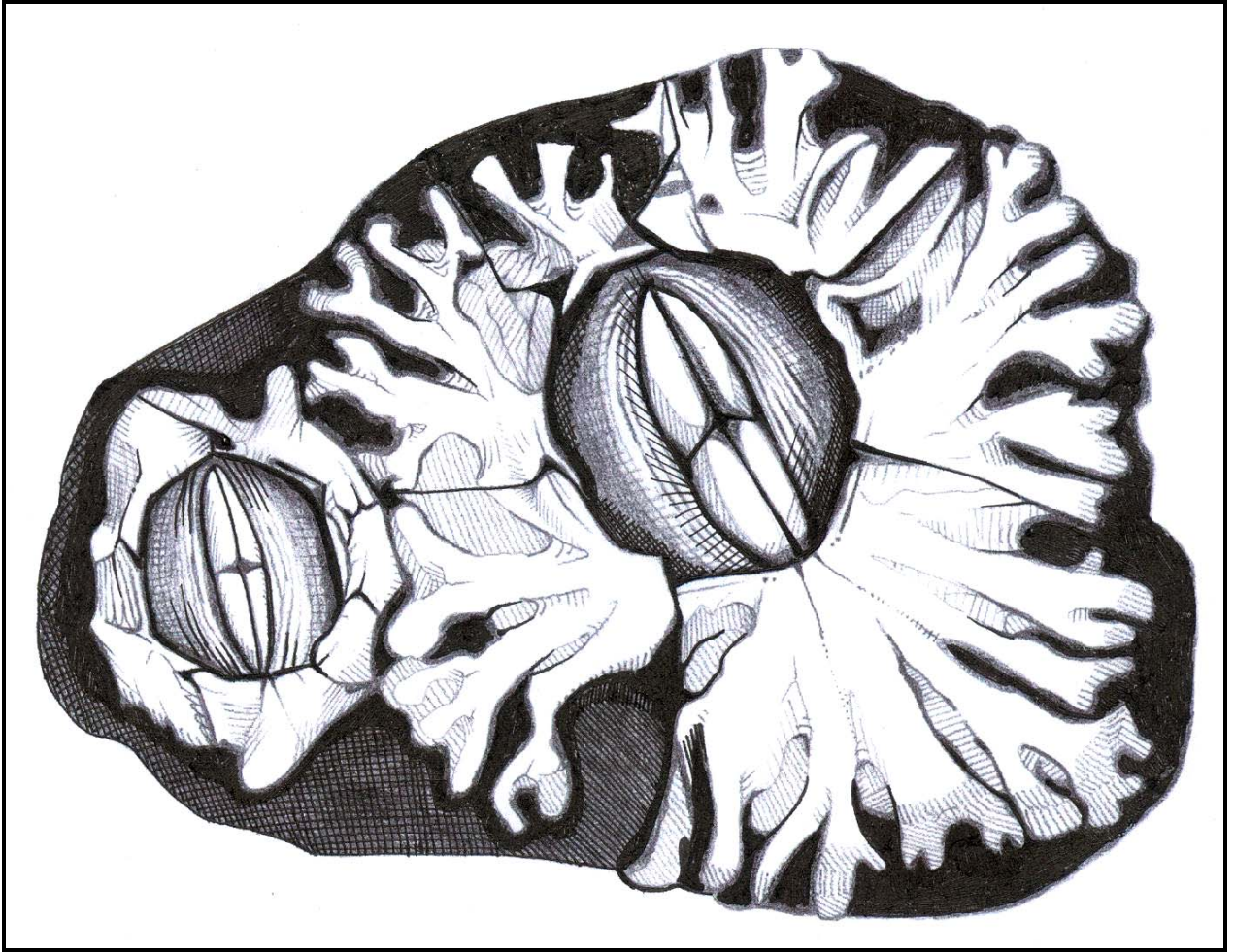


Figure 5. *Chelonibia manati* adapted from Gruvel (1903).

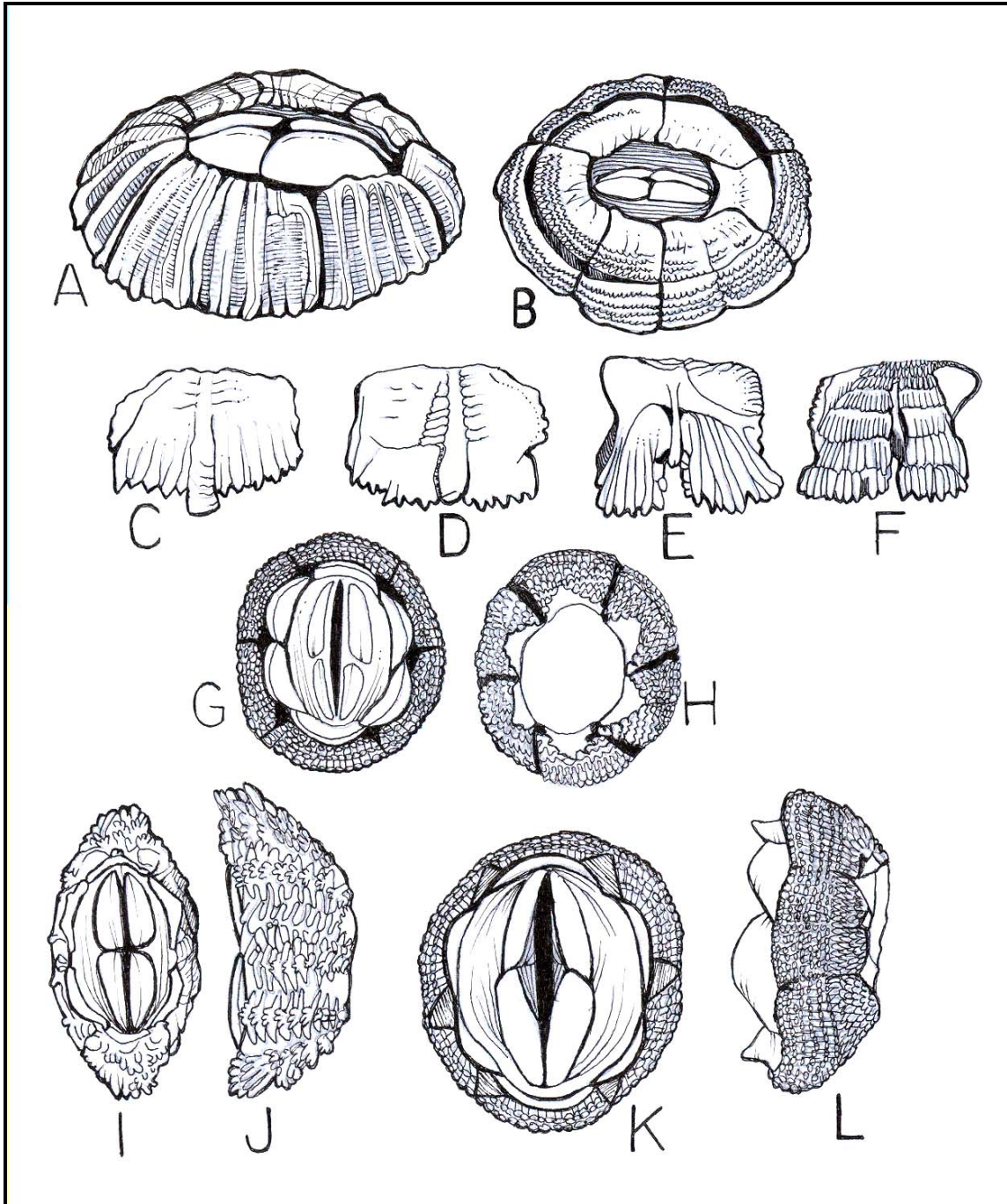


Figure 6. Representatives of the Platylepadidae. **A.** *Platylepas decorata*, **B.** *Platylepas hexastylos hexastylos*, **C.** *Platylepas* sp. (sensu Young 1991, lateral plate - exterior), **D.** *Platylepas* sp. (sensu Young 1991, lateral plate - interior), **E.** *Platylepas hexastylos ichthyophilia* (lateral plate - interior), **F.** *P. h. ichthyophilia* lateral plate (exterior), **G.** *Stomatolepas elegans* (top view), **H.** *S. elegans* (bottom view), **I.** *Stomatolepas transversa* (top), **J.** *S. transversa* (lateral view), **K.** *Stomatolepas praegustator* (top view), **L.** *S. praegustator* (lateral view). Composite figure adapted from Pilsbry (1916), Young (1991).

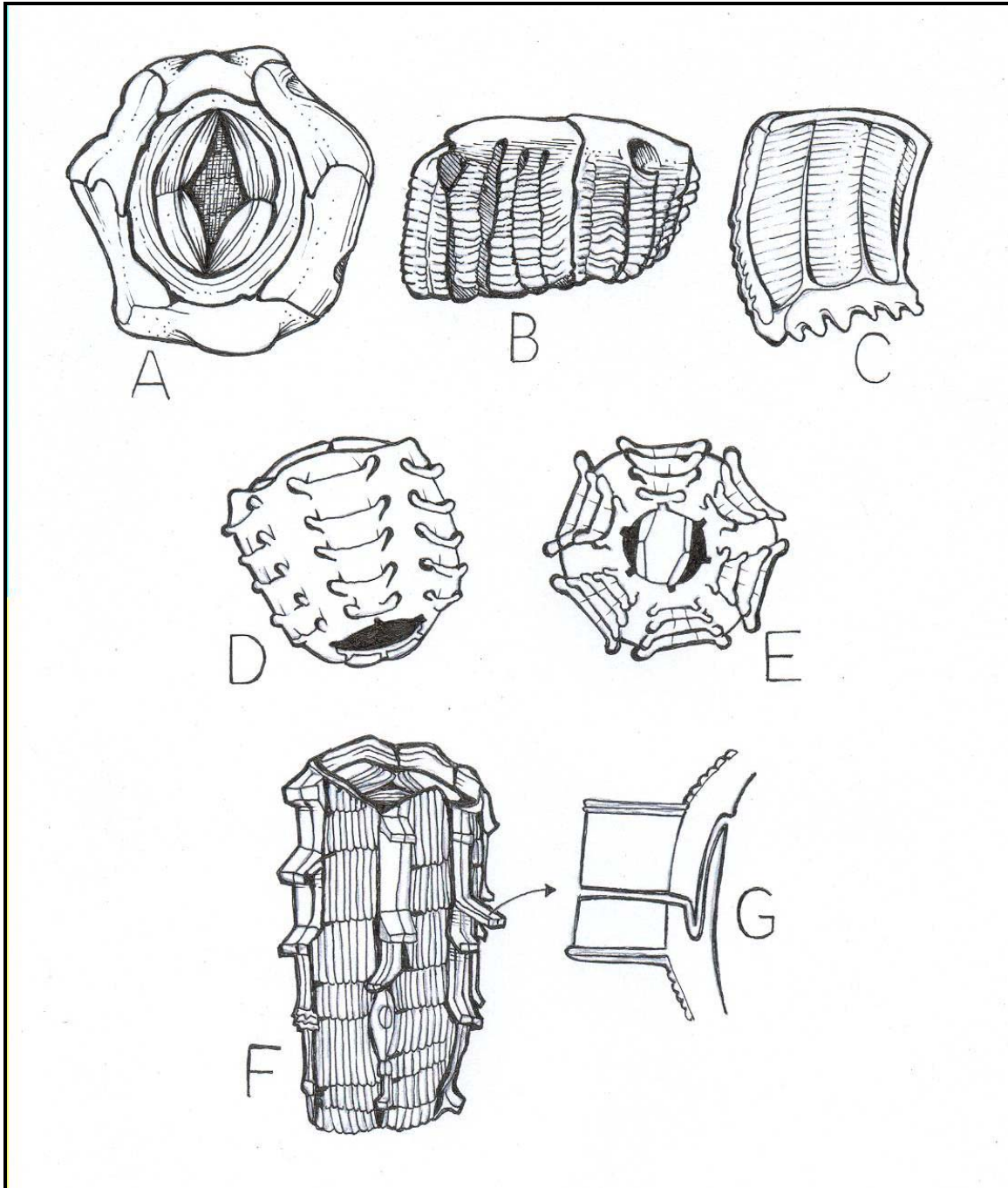


Figure 7. Representatives of the Platylepadidae (II) **A.** *Cylindrolepas darwiniana* (top), **B.** *C. darwiniana* (lateral view), **C.** *C. darwiniana* (internal view of rostrum), **D.** *Stephanolepas muricata* (lateral view), **E.** *S. muricata* (bottom), **F.** *Chelolepas cheloniae* (lateral view), **G.** *C. cheloniae* (view of bisected flange). Composite figure adapted from Fischer (1886), Pilsbry (1916) and Nilsson-Cantell (1932).

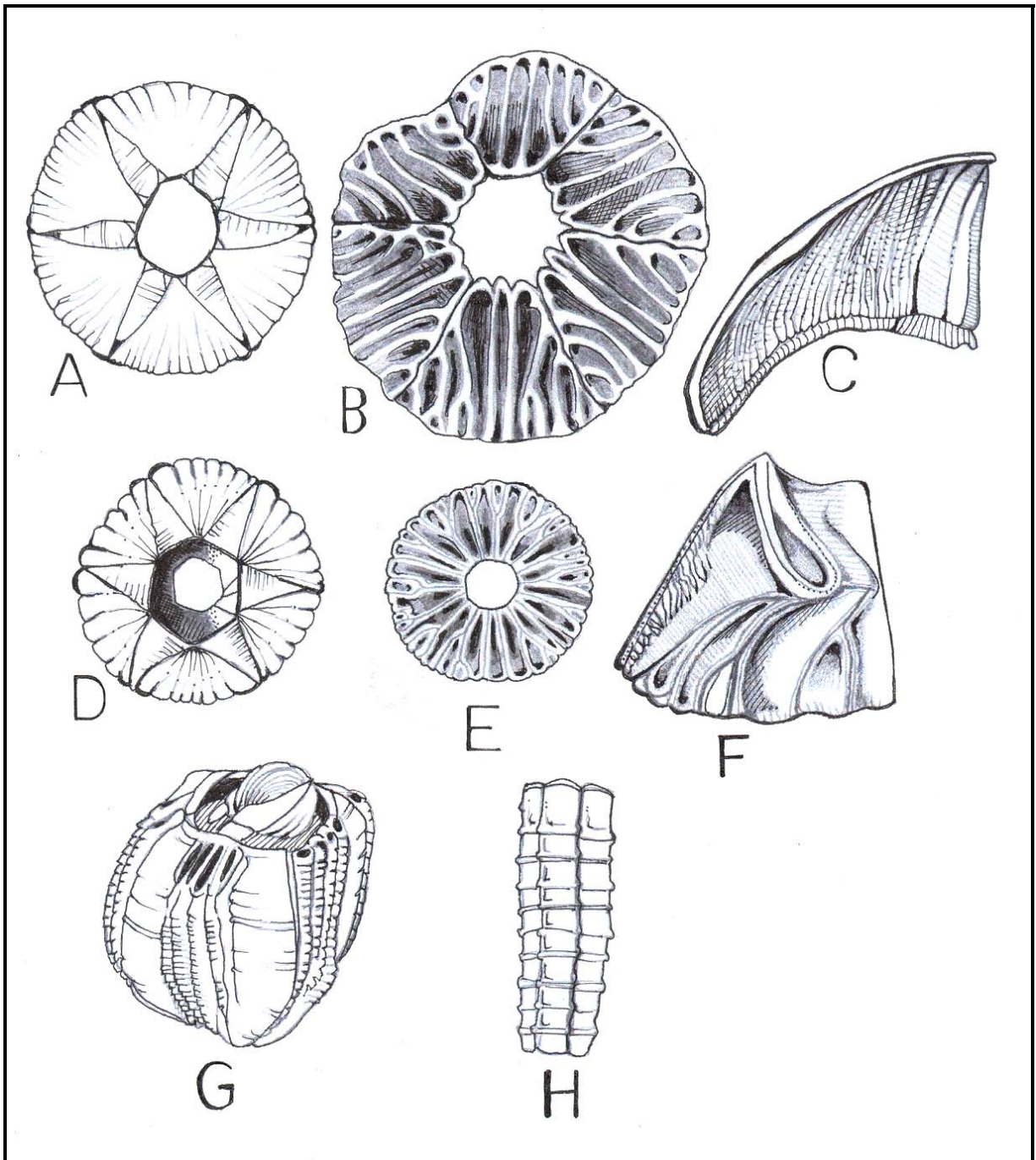


Figure 8. Coronulidae cont'd. **A.** *Cetopirus complanatus* (top), **B.** *C. complanatus* (bottom), **C.** *C. complanatus* (internal view), **D.** *Coronula reginae* (top), **E.** *C. reginae* (bottom), **F.** *C. reginae* (internal view), **G.** *Coronula diadema* (dorso-lateral view), **H.** *Tubicinella major* (lateral view). Composite figure adapted from Pilsbry (1916).



Figure 9. Coronulid barnacles *Coronula reginae* (dashed arrow) and *Coronula diadema* (solid arrow) on the lower jaw of a humpback whale (*Megaptera novaeangliae*). Photo courtesy of Oregon State University, Bruce Mate.



FIGURE 10. Coronulid barnacles *Cryptolepas rhachianecti* in the skin of a gray whale (*Eschrichtius robustus*). The spaces between barnacles are occupied by cyamids or 'whale lice' *Cyamus scammoni*. Photo courtesy of Oregon State University, Bruce Mate.

SECTION 7: LITERATURE CITED & A SYNOPSIS OF THE LITERATURE ON THE TURTLE BARNACLES (CIRRIPEDIA: BALANOMORPHA: CORONULOIDEA)

This section also includes several references that, although they do not concern coronuloid barnacles, are useful in ascertaining symbiotic relationships between barnacles and other organisms.

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