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15 Sea Turtle Epibiosis

Michael G. Frick and Joseph B. Pfaller

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15.1 INTRODUCTION

In the marine environment, any exposed, undefended surface will eventually be colonized by marine propagules (Wahl, 1989). Colonization of inanimate structures (e.g., dock pilings and boat hulls) is called *fouling*, while colonization of other marine organisms is called *epibiosis*. Epibiosis results in spatially close associations between two or more living organisms (Harder, 2009), in which a single host (or *basibiont*) supports one or more typically opportunistic colonizers (or *epibionts*) (Wahl and Mark, 1999). Epibiosis is the most common form of symbiosis in the marine environment and may be classified into several types of associations (e.g., mutualism, commensalism, parasitism) depending on the interactions between a host and its epibionts (Leung and Poulin, 2008).

Sea turtles often act as hosts to a wide variety of epibionts, most of which are unspecialized organisms normally found associated with inanimate structures in the surrounding marine environment (i.e., "free living"). These types of epibiotic associations are known as *facultative commensalisms* (Wahl and Mark, 1999). That is, the host receives no direct benefit from the epibiont and the epibiont demonstrates little to no substrate specificity. For these associations to occur, the various settlement cues that facultative commensal epibionts utilize when selecting substrata must also be present on sea turtles (Zardus and Hadfield, 2004). Alternatively, there are several epibionts that are found almost exclusively on sea turtles (Frick et al., 2011a). These associations are known as *obligate commensalisms*, whereby the epibiont is dependent on the host turtle for survival, but the welfare of the host turtle is not dependent on the presence or behavior of the epibiont. While some obligate commensal epibionts are known to perform activities that might be considered beneficial to the host turtle, there are no examples of *obligate mutualisms*, in which both the host turtle and the epibiont depend on each other for survival. Future studies, however, may identify such obligate mutualisms. Most obligate (and facultative) commensal epibionts do not derive nutrients from the tissue of the host turtle and are not parasitic; instead the host turtle simply provides a foraging platform (Frick et al., 2002a). On the contrary, several sea turtle epibionts are known to derive nutrients from the tissue of the host turtle and, therefore, represent associations known as *parasitism* (Leung and Poulin, 2008). Parasitic epibionts of sea turtles are rare, but these associations may have important consequences for the health of host turtles (Greenblatt et al., 2004).

Following a rich history of anecdotal reports dating back to Darwin (1851, 1854), the study of epibiosis in sea turtles has received considerable attention in recent years. The vast majority of studies describe the diversity of epibiota, and speculate on the possible causes and effects of these associations. From these descriptive studies, we have learned a great deal with respect to the wonderful diversity of epibiotic forms found associated with sea turtles (Appendix A). Fewer studies, however, approach sea turtle epibiosis from the community perspective. These studies not only describe diversity of epibiota but also consider the structuring of epibiotic communities and the complex suite of interactions occurring on the turtle across space and time. Finally, even fewer studies attempt to quantify and understand the ecological interactions between turtles and their epibiota. These studies have allowed researchers to better understand the ecological and evolutionary implications of epibiosis, and to decipher the valuable information that can be gleaned from studying sea turtle epibionts.

Despite the antiquity of some sea turtle epibiont observations, the study of sea turtle epibiosis remains in a prolonged state of infancy when compared to the breadth of information that has recently and quickly accrued on sea turtle migrations and home ranges (largely through the deployment of satellite tags). Likewise, our understanding of sea turtle genetics and molecular phylogeny exceeds that of basic facets of sea turtle ecology—including diet, foraging behavior, and epibiotic associations. Given the documented declines of turtle populations in some areas, it has become imperative for scientists to understand how sea turtles interact with the constituents of the habitats they occupy, be it while foraging or through epibiosis. Such information allows scientists to view sea turtles within the context of a complex and ecologically rich marine environment, and it aids in modeling the potential impacts that certain natural and anthropogenic-driven events may have upon sea turtles and the habitats they utilize.

In this chapter, we begin by introducing many of the common forms of epibionts known to be associated with sea turtles. Second, we describe several common epibiotic community types, and discuss the spatial and temporal factors by which epibiotic communities are structured. Third, we propose a number of costs and benefits that may affect sea turtle–epibiont interactions and discuss the ecological inferences and implications of sea turtle epibiosis. Lastly, we outline a conceptual model of epibiosis with which researchers may apply to better understand the factors that affect their particular epibiotic systems and more easily decipher the important biological information that can be gleaned from studying epibiotic interactions.

15.2 COMMON FORMS

The diversity of epibionts known from sea turtles is exceptional. For example, loggerhead (*Caretta caretta*) and hawksbill turtles (*Eretmochelys imbricata*) are known to host 200+ and 150+ epibiont taxa, respectively. For this reason, we have not included an itemized list of epibionts from each turtle species. Instead, we have included a list of references that include records of epibionts from sea turtles separated by geographic region (Appendix A) and encourage investigators to examine the studies cited in this chapter.

15.2.1 Sessile Forms

Sessile forms attach directly to a substrate and do not move around freely. These forms are the most common and conspicuous epibionts of sea turtles. Most sessile forms have motile, planktonic larvae that recruit to suitable substrata, where they attach and transform into adults. For these organisms, the carapace and skin of sea turtles must possess certain settlement cues that larvae recognize, including water flow characteristics, chemical signals, and surface rugosity. Of the sessile forms documented from sea turtles, the most noticeable are barnacles (Cirripedia). Barnacles attached to the carapace of sea turtles are considered "pioneer" species that facilitate the colonization of subsequent epibiota (see Section 15.3.5; Frick et al., 2002b). Some coronuloid barnacles embed themselves in the skin and soft tissues of sea turtles (e.g., *Chelolepas cheloniae*). Through chemical mediation, these barnacles become encased in connective tissue, which aids in strengthening the shell of the barnacle while protecting the host tissue from further injury (Frick et al., 2011a). Other sessile forms include algae, foraminiferans, poriferans, cnidarians (Hydrozoa and Anthozoa), mollusks (Bivalvia), bryozoans, and tunicates. Many of these sessile forms are colonial and can reproduce asexually. As a result, some colonies are known to grow quite large and overtake much of the carapace of the host turtle. In such situations, aggregations of sessile forms provide additional surface area for the recruitment of other sessile epibiota, and create numerous crevices and spaces for the colonization of various motile epibionts (see later).

15.2.2 Sedentary Forms

Sedentary forms live a semi-sessile existence, in which motile individuals construct refugia or tubes attached to a substrate. Sea turtles host a variety of sedentary forms, including polychaete worms, amphipods, and tanaids (Frick et al., 1998, 2004b). Some sedentary forms create only small (1–2 mm long) tubes to dwell in, while others, particularly sabellariid worms and *Corophium* amphipods, will aggregate into dense communities—creating reef-like structures consisting of hundreds of individual tubes bonded together. These "worm reefs" can become quite large (up to 10 cm high) and cover the entire carapace of the host turtle (Frick et al., 2004b). These complex structures also provide suitable habitat for the colonization of small motile epibionts.

15.2.3 Motile Forms

Motile forms do not directly attach to a substrate and are capable of free movement throughout their lives. These organisms may colonize sea turtles directly from the plankton (similar to sessile forms) or secondarily colonize turtles after initially recruiting to their primary habitat. In the latter case, colonization may occur when resting turtles contact pelagic or benthic substrata. Motile forms reported as sea turtle epibionts include protozoans, sipunculid worms, platyhelminth worms, annelid worms (hirudineans and polychaetes), mollusks (Polyplacophora and Gastropoda), dipterans (flightless marine midges), decapods (Brachyura, Anomura, Caridea), copepods, ostracods, peracarids (amphipods, isopods, and tanaids), echinoderms (Ophiuroidea and Echinoidea), and fish

(Genera *Echeneis* and *Remora*; "shark suckers"). Most motile forms are small and cryptic, and live within the gaps and sinuses provided by aggregations of sessile and sedentary epibionts. Moreover, the deposition of sediment between sessile aggregations provides habitat for small infaunal animals that live in the trapped mud layer (e.g., polychaete worms, amphipods, and clams). For these reasons, the presence of most motile forms is often dependent on the preceding colonization of other sessile and sedentary epibiota. Two exceptions are *Caprella* amphipods, which cling tightly to the host carapace via limbs with hooked dactyls, and *Planes* crabs, which hide in the inguinal notch between the carapace and tail (Chace, 1951). Not surprisingly, these are two of the more common motile epibionts of sea turtles around the world.

15.3 COMMUNITIES AND COMMUNITY DYNAMICS

15.3.1 Pelagic/Oceanic Communities

All extant sea turtles, except the flatback turtle (*Natator depressus*), utilize pelagic and oceanic habitats during juvenile life stages (Bolten, 2003) and some continue to use these habitats throughout adulthood (e.g., *Dermochelys coriacea* and eastern Pacific *Lepidochelys olivacea*). Adult and subadult loggerhead turtles (*C. caretta*) are considered mostly neritic, but some individuals make occasional forays into the pelagic/oceanic environment (Frick et al., 2009; Reich et al., 2010). During pelagic/oceanic life stages, sea turtles may host communities of pelagic organisms that are typically found associated with drifting flotsam (e.g., *Sargassum*) and jetsam. These organisms primarily include pedunculate barnacles of the genera *Lepas* and *Conchoderma*, and grapsid crabs of the genus *Planes*. *Lepas* spp. and *Conchoderma* spp. are ubiquitous throughout the world's oceanic environment and are known to colonize a variety of other nektonic hosts (e.g., Reisinger and Bester, 2010; Pfaller et al., 2012). Studies on *Planes* crabs from oceanic-stage sea turtles represent the most detailed information on sea turtle–epibiont symbiosis to date (Davenport, 1994; Dellinger et al., 1997; Frick et al., 2000a, 2003b, 2004a, 2006, 2011b; Pons et al., 2011). Other less frequent epibionts of the pelagic/oceanic community may include pelagic sea slugs (*Fiona pinnata*), sea spiders (*Endeis spinosa*), pelagic tunicates (*Diplosoma gelatinosum*), and crabs of the genera *Portunus* and *Plagusia* (Frick et al., 2003a, 2011b; Loza and López-Juardo, 2004). The presence of pelagic/oceanic epibionts on sea turtles outside these areas strongly suggests that these turtles have recently migrated from the pelagic/oceanic environment, providing valuable insights into cryptic migratory behaviors and habitat preferences of sea turtles.

15.3.2 Benthic/Neritic Communities

After early life stages in pelagic/oceanic areas, most cheloniid sea turtles transition to more coastal and benthic habitats—presumably in search of food, and later for mates (Bjorndal, 1997). In benthic/neritic habitats, sea turtles become exposed to intense colonization pressure by marine propagules (larvae and spores) seeking to colonize submerged substrata and begin their benthic existence. The skin and especially the carapace of sea turtles provide suitable substrata for a variety of benthic/neritic organisms (Frick et al., 1998, 2000a; Schärer, 2001). As previously mentioned, the recruitment of sessile and sedentary forms (e.g., barnacles, tubicolous worms, and tunicates) facilitates the colonization of smaller motile forms (e.g., crabs, amphipods, mollusks, etc.), which inhabit the gaps and crevices between sessile aggregations. After prolonged exposure to settlement by local plants and animals in a given area, the epibiotic communities of sea turtles begin to resemble the adjacent benthic environment. For this reason, the species composition of benthic/neritic communities is largely dependent on the geographic region or habitat in which the host turtle occupies (Frick et al., 1998; Schärer, 2001). Complex benthic/neritic communities are most evident on nesting female turtles, which tend to remain relatively sedentary and localized during the nesting period (Frick et al., 2000b).

15.3.3 Obligate Communities

Obligate communities are composed almost entirely of organisms that are known exclusively as epibionts of sea turtles and other motile marine organisms. That is, these communities are largely independent of the habitat in which the turtle occupies (i.e., pelagic/oceanic vs. benthic/neritic). The predominant epibiont of obligate communities is the coronuloid barnacle *Chelonibia testudinaria*. This ubiquitous species is the most frequently reported epibiont of sea turtles and is also known to colonize crabs, sirenians, and crocodilians (Newman and Ross, 1976; Zardus and Hadfield, 2004; Cupul-Magaña et al., 2011; Nifong and Frick, 2011). *Chelonibia testudinaria* occurs in great numbers on some turtles and appears to function as a "pioneer" for the development of more extensive and diverse epibiotic communities (Frick et al., 2002b; Rawson et al., 2003). Aggregations of *C. testudinaria* provide refugia for other obligate epibionts, such as the ruby-eyed amphipod (*Podocerus chelonophilus*) and the robust tanaid (*Hexapleomera robusta*). However, both species will also cling directly to the skin and carapace of host turtles, and *P. chelonophilus* will also aggregate around epidermal lesions and eat necrotic tissue from the wounds of host turtles (Moore, 1995). Other obligate epibionts of sea turtles include marine red alga (*Polysiphonia carettia*), which is known only from cheloniid sea turtles (Senties et al., 1999), and several other species of coronuloid barnacles that are wholly chelonophilic (Ross and Frick, 2011). While some individual turtles are known to host strictly obligate communities (Frick et al., 2010a), most communities composed primarily of obligate epibionts also contain some facultative forms.

15.3.4 Community Distribution

The spatial distribution of epibiont communities on host turtles may be influenced by a complex suite of factors, including recruitment dynamics, water flow patterns, differential disturbance among body regions, and inter- and intraspecific interactions (Pfaller et al., 2006). In general, studies that examine or anecdotally report on the distribution of sea turtle epibionts have found that epibiont communities tend to aggregate on the carapace, as opposed to the skin or plastron (Gramentz, 1988; Fuller et al., 2010). Extra-carapacial epibionts mostly include barnacles, parasitic leeches, and *Planes* crabs (Chace, 1951; Gramentz, 1988; Frick et al., 1998; Hayashi and Tsuji, 2008). Some barnacles occur only along the plastral sutures (e.g., *Stomatolepas transversa*) (Young, 1991), while others mostly occur along the leading edges of the front flippers (e.g., *Stephanolepas muricata*) (Frick et al., 2011a). Limb movements, unfavorable water flow patterns, and the sloughing of skin by the host turtle probably restrict the recruitment and development of extra-carapacial epibionts. Nevertheless, information on the distributions of extra-carapacial epibionts is still lacking (Frick et al., 2011a).

Most studies that examine the spatial distribution of epibiont communities on sea turtles have focused on the carapace, where the densest and most diverse communities are found (Frick et al., 1998). These studies indicate that epibiotic communities tend to be distributed in nonrandom patterns. Most studies report a tendency for epibiont communities to cluster along the vertebral scutes and across the posterior third of the carapace (Caine, 1986; Matsuura and Nakamura, 1993; Frick et al., 1998; Pfaller et al., 2006). Such nonrandom distributions are thought to reflect the preference of filter-feeding epibionts (e.g., barnacles) for elevated flow rates along the vertebral scutes and the favorable settlement conditions for other epibiota along the posterior of the carapace where flow rates are reduced (Pfaller et al., 2006). Recruitment of "pioneer" species in these areas (e.g., *Chelonibia* barnacles and *Polysiphonia* alga) will then facilitate the accumulation of more diverse epibiotic communities (Gramentz, 1988; Frick et al., 2000b; Fuller et al., 2010). Additionally, the colonization and persistence of epibionts on the anterior costal scutes may be reduced by contact from the front flippers (Caine, 1986; Dodd, 1988) and/or removal during "self-grooming" (Schofield et al., 2006; Frick and McFall, 2007). Other studies show mostly random distributions among barnacle species with some spatial structuring among different size classes of barnacles (Fuller et al., 2010).

Recently, Moriarty et al. (2008) confirmed that the obligate commensal barnacle, *Chelonibia testudinaria*, is capable of substantial (but slow) post-settlement locomotion. Individual *C. testudinaria* were shown to move across multiple scutes from areas of low water flow to areas with better filter-feeding conditions. Such movements may be triggered by differential flow rates over the carapace or/and the presence of conspecifics that disrupt flow patterns. As previously mentioned, *Chelonibia* spp. are important "pioneer" species for epibiotic communities (Frick et al., 2000) and post-settlement locomotion will certainly affect the spatial distribution of epibiotic communities. However, as the density of *C. testudinaria* and other epibiota increases, post-settlement locomotion and survival will be reduced, and the overall distribution may become more reflective of differences in recruitment patterns (Pfaller et al., 2006).

Debilitated turtles will host epibionts, especially barnacles, over their entire external surface area—including portions of the mouth regularly exposed to the outside environment. These "barnacle bill" turtles will often suffer severe deformations as a result of barnacle colonization. Current information indicates that such turtles are immunosuppressed or lethargic prior to barnacle colonization and that limited mobility by the host likely facilitates rapid and prolific colonization of barnacles (Deem et al., 2009). Nevertheless, because healthy turtles may also support massive aggregations of epibionts over much of their bodies, it is difficult to judge the health of a turtle simply by examining epibiont loads and percentage coverage (*see* Deem et al., 2009).

15.3.5 Community Succession

Prior to the colonization of macroorganisms, all structures exposed to seawater initially undergo a similar sequence of events (Wahl, 1989): (1) biochemical conditioning, whereby surfaces absorb dissolved macromolecules; (2) bacterial colonization; and (3) unicellular eukaryote (e.g., yeasts, protozoa, and diatoms) colonization. To our knowledge, these critical stages in the process of epibiosis in sea turtles have never been explored.

The temporal succession of "macro"-epibiont communities on host turtles remains poorly understood, as well. To date, there is one study that examines temporal succession of epibiont communities from individual turtles over an extended period of time (Frick et al., 2002b). Using, flipper-tagging data, photography, and in situ assessments, epibiont data were collected from the carapaces of nesting loggerhead turtles (*C. caretta*) in Georgia, United States, over the course of 3 months. General observations of community succession were similar to those reported for neritic, epibenthic communities (Dean, 1981). Community succession is typically initiated when hard, sessile forms like barnacles (*C. testudinaria* in Frick et al., 2002b) colonize a relatively bare carapace. These "pioneers" facilitate the subsequent colonization of other epibiota by increasing the surface area for colonization and changing water flow patterns (Pfaller et al., 2006). Secondary colonizers include other sessile forms (e.g., hydrozoans and bryozoans) and sedentary forms, which take refuge within the interstices of the barnacles (e.g., tanaids). The accumulation of sediments among primary and secondary sessile forms then facilitates the colonization of sessile tunicates and many small, motile forms. Tunicates and other secondary sessile forms tend to overgrow and kill the barnacles beneath them. Tunicates (*Molgula manhattensis*) appear to be the climax species of the carapace epibiont community on nesting loggerheads in Georgia, United States. Aggregations of *M. manhattensis* occasionally cover the entire carapace at the end of the season, providing innumerable gaps and crevices for a diverse array of motile epibionts.

At or before reaching terminal succession, epibiont communities may be partially or catastrophically disturbed by various biotic and abiotic factors. Turtles that accumulate benthic/neritic communities may immigrate to different, less favorable habitats, causing the less tolerant epibionts to die and slough off. In some cases, this may completely clear the carapace of epibiota. Moreover, community succession may be disrupted when host turtles "groom" themselves by actively rubbing against submerged structures to remove epibiota (Heithaus et al., 2002;

Schofield et al., 2006; Frick and McFall, 2007). Evidence of such behaviors is often present in the form of longitudinal scratch marks on the carapace (Caine, 1986; Frick and McFall, 2007). Lastly, predatory epibionts (e.g., *Planes* crabs and several gastropods) and fish may systematically clean/remove certain epibionts (Davenport, 1994; Losey et al., 1994; Frick et al., 2000a, 2011b; Pfaller et al., 2008; Sazima et al., 2010). These factors may lead to partial or complete turnover of the epibiotic communities of sea turtles.

15.4 ECOLOGICAL INTERACTIONS

15.4.1 Effects on Epibionts

Epibionts may benefit from epibiosis through reduced competition and predation. These are major factors affecting the ability of marine propagules to successfully colonize a substratum (Enderlein and Wahl, 2004). Thus, when risk of predation is high or when settlement area is limited—whether by high population densities (e.g., on benthic structures) or by low substrata availability (e.g., on pelagic flotsam)—epibiosis of sea turtles may be beneficial for the survival of marine propagules (Wahl, 1989; Pfaller et al., 2012). Some "burrowing" barnacles may avoid predation by encasing themselves within the tissue of host turtles via chemical mediation (Frick et al., 2011b). Epibionts may also benefit from improved energetic positioning. Filter-feeding epibionts, such as barnacles, may benefit from favorable feeding currents on host turtles (Pfaller et al., 2006), while photosynthetic epibionts, such as algae, may benefit from increased oxygen and light availability (Shine et al., 2010). Furthermore, epibionts may benefit though range expansion and increased genetic mixing by hitchhiking on migratory turtles (termed *phoresis*). Researchers have hypothesized that sea turtles may act as long-distance dispersal vectors for benthic marine invertebrates (Schärer and Epler, 2007; Harding et al., 2011).

Epibiosis may be costly to epibionts when turtle behaviors cause physical disturbance and unfavorable fluctuations in physiological conditions (Wahl, 1989). Contact between turtles during mating, or between turtles and submerged structures (e.g., rock or coral ledges), may physically damage epibionts, especially those with fragile, erect body forms (e.g., leafy bryozoans and soft corals). As previously mentioned, sea turtles are also known to actively remove epibionts by scraping against submerged structures (Heithaus et al., 2002; Schofield et al., 2006; Frick and McFall, 2007). Moreover, epibionts that are sensitive to desiccation may die when turtles emerge to nest or bask at the surface (Caine, 1986; Bjorndal, 2003). Similarly, epibionts that are sensitive to fluctuations in temperature, salinity, or pressure may not survive when turtles migrate and/or dive. Another cost for certain epibionts might be reduced access to food resources and mates, which would ultimately cause reduced longevity and reproductive capacity. These costs might favor epibionts capable of asexual reproduction and dietary versatility.

15.4.2 Effects on Host Turtles

Epibiosis may be costly to host turtles when epibionts cause increased weight and drag. In extreme cases, epibiotic loads have been reported that effectively double the mass and volume of juvenile sea turtles (Bolten unpubl. data *in* Bjorndal, 2003). Epibionts attached to the carapace may increase drag by disrupting the laminar flow over the carapace (Logan and Morreale, 1994) and those embedded in the leading edge of the front flippers may increase drag while swimming (Wyneken, 1997; Frick et al., 2011a). The energetic costs of hosting epibionts are likely greatest when turtles undertake long-distance migrations and least when turtles remain relatively sedentary (e.g., females during internesting periods). Because otherwise healthy turtles will often support massive epibiont aggregations (Deem et al., 2009), turtles are apparently capable of overcoming the costs associated with "epibiotic drag" and should not be judged as healthy or unhealthy simply by examining epibiotic loads (see Deem et al., 2009). Furthermore, the aforementioned "barnacle bill" turtles tend to accumulate their prolific barnacle loads after (not before) becoming lethargic at the surface.

Epibiosis may also be costly to host turtles when certain epibionts detrimentally affect the health of host turtles. A number of common epibionts of sea turtles (e.g., platyhelminth worms, annelid worms and barnacles) are thought to be the cause of or related to infections of sea turtles (George, 1997; Alfaro, 2008). Tissue damage caused by burrowing epibionts may increase the vulnerability of host turtles to pathogens (George, 1997). Some coronuloid barnacles (e.g., *C. cheloniae*, *S. muricata*, and *Cylindrolepas darwiniana*) become embedded within hard and soft tissues of host turtles causing deep-tissue wounds that can sometimes leave impressions on the underlying bone (Hendrickson, 1958; Green, 1998; Frick and Zardus, 2010; Frick et al., 2010a). *Platylepas decorata* have also been found imbedded in the beaks of host turtles causing severe beak deformation, which may lead to reduced foraging capacity and death of the host turtle (see Green, 1998; Frick and Zardus, 2010). Other non-barnacle forms may act as disease vectors of pathogens. Parasitic marine turtle leeches (*Ozobranchus* sp.) not only consume host tissue but also are believed to act as disease vectors for the dispersal of the fibropapilloma-associated herpes virus found in latent tumors that often cover, deform, and debilitate host turtles (Greenblatt et al., 2004). Commensal gastropods of sea turtles may act as intermediate hosts for spirorchiid blood flukes (Frazier et al., 1985), which can have devastating effects on host turtles (George, 1997).

Host turtles may benefit from epibiosis through improved optical, chemical, or electrical camouflage. Predators may not recognize hosts as potential prey items if epibiotic communities visually or chemically resemble the surrounding benthic communities (Rathbun, 1925; Fishlyn and Phillips, 1980; Feifarek, 1987; Frazier et al., 1991). Moreover, dense epibiotic communities may disrupt electric fields produced by hosts, allowing hosts to avoid predation by predators that utilize electrolocation when searching for prey (e.g., sharks) (Ruxton, 2009). Hosts may also benefit from epibiosis through associational defense and cleaning. Epibionts with chemical or structural defenses (e.g., toxins, sharp projections, or hard outer coverings) may deter predation on host turtles (Wahl and Mark, 1999; Bjorndal, 2003). Predatory epibionts may provide a cleaning benefit by consuming other epibionts—some of which may be harmful—from the surface of host turtles (Davenport, 1994; Sazima et al., 2010).

15.4.3 Ecological Inferences

Studies of epibiosis have helped elucidate cryptic life history attributes of sea turtles and informed the implementation of conservation measures. While such studies will not and should not supplant the use of tag-return data, satellite telemetry, stable-isotope analyses, or population genetics, studying epibiosis can provide a time- and cost-effective alternative to elucidate the geographic ranges, habitat preferences, and migratory corridors of sea turtles. Using primarily examples from the well-studied epibiont community of loggerhead turtles in the northwestern Atlantic Ocean, we illustrate the types of ecological inferences that can be gained by studying the epibionts of sea turtles.

Epibiont data have been used to elucidate the foraging locations of loggerhead turtles nesting along the Atlantic coast of Florida, United States. These turtles occasionally host epibionts that are geographically restricted to far southern Florida, the Bahamas, and the Caribbean (Caine, 1986; Pfaller et al., 2008). Such associations suggest that these nesting turtles had recently migrated from more southerly areas where their range overlapped with free-living populations of the epibionts. Data from flipper-tag returns, satellite telemetry, and stable-isotope analyses have confirmed that turtles nesting in Florida frequently utilize these more southerly, tropical waters during nonbreeding seasons (Meylan, 1983; Foley et al., 2008; Pajuelo et al., 2012). Caine (1986) further extrapolated these epibiont data to suggest the presence of two discrete nesting assemblages along the southeastern United States, one to the north and one to the south of Daytona Beach, Florida (approximately 29° N latitude). Several years later this hypothesis was rather precisely confirmed by molecular data (Bowen et al., 1993; Encalada et al., 1998) and now these two nesting assemblages receive markedly different conservation status (Turtle Expert Working Group, 2009).

In another example from nesting loggerhead turtles in Florida, United States, Reich et al. (2010) supplemented stable-isotope data with epibiont community data to suggest a bimodal foraging strategy by female loggerheads prior to their arrival at breeding grounds. Because isotopic signatures (depleted vs. enriched $\delta^{13}C$) can vary along multiple environmental continua, the incorporation of epibiont data in this study provided additional support for an oceanic versus neritic dichotomy, as opposed to dietary or latitudinal gradients. These results have important implications for role of adult loggerhead turtles in the oceanic environment and the management policies that serve to protect them.

Epibiont data have also been used to assess the foraging migrations of juvenile and subadult loggerhead turtles. Killingley and Lutcavage (1983) used duel isotopic profiles ($\delta^{18}O$ and $\delta^{13}C$) from the shells of *C. testudinaria* to reconstruct the movements of subadult loggerheads between oceanic habitats in the northwest Atlantic and estuarine habitats in the Chesapeake Bay (Maryland and Virginia). Moreover, Limpus and Limpus (2003) used the presence of particular epibionts (*Planes* sp. and *S. muricata*) and morphological features to identify which juvenile turtles caught in neritic habitats in the southwest Pacific Ocean had recently recruited from the open ocean. In both studies, epibiont data provided valuable insights in to cryptic host movements that otherwise would have been very difficult to obtain.

Lastly, in another interesting application of epibiont data, Eckert and Eckert (1988) measured the size distribution of epibiotic barnacles (Conchoderma virgatum) on nesting leatherback turtles to extrapolate the time of arrival to the tropical nesting region. Because reproduction in these barnacles is typically restricted to tropical regions, their colonization of turtles is limited to the period when turtles also occupy tropical waters. Based on reproductive periodicity and established growth rates of barnacles (Eckert and Eckert, 1987), the authors determined that turtles do not arrive from temperate latitudes until just prior to nesting and orient directly toward their preferred nesting beach (Eckert and Eckert, 1988). These data have provided important information on the cryptic migratory behavior of leatherback turtles and have better informed the implementation of conservation measures.

15.4.4 Ecological Implications

The ecological implications of sea turtle epibiosis remain one of the most poorly understood aspects of this nascent field. Aside from many of the direct effects of epibiosis on host turtles and epibionts discussed earlier (Sections 15.4.1 and 15.4.2), sea turtle epibiosis may have other less obvious, indirect effects on the marine communities and habitats that sea turtles inhabit.

Several authors have discussed the potential role of sea turtles as dispersal vectors for a diverse array of marine invertebrates over broad geographic regions (Bjorndal and Jackson, 2003; Schärer and Epler, 2007; Harding et al., 2011; Lezama et al., 2012). Hitchhiking on highly mobile hosts may facilitate genetic mixing and/or range expansion for epibionts capable of reproducing on turtles or after arriving in distant locations (Rawson et al., 2003). These factors may be particularly important for invertebrate taxa with limited dispersal capacities (Schärer and Epler, 2007). Turtle-mediated genetic mixing may aid in maintaining the genetic diversity and homogeneity of marine invertebrate populations (Rawson et al., 2003), but may also inhibit biological diversification by impeding local adaptation or random divergence. Moreover, turtle-mediated range expansion may promote biological diversification if newly established populations subsequently remain isolated from their source populations, or disrupt ecosystem functioning when invaders compete with or consume resident species.

A recent study has drawn attention to the potential for turtle-mediated introductions of nonindigenous and potentially invasive species. Harding et al. (2011) report the first records of the nonindigenous veined rapa whelk (*Rapana venosa*) as an epibiont of loggerhead turtles in Virginia and Georgia. *R. venosa* is a generalist shellfish predator native to Asia that has recently been introduced in to the Chesapeake Bay (Harding and Mann, 1999). However, the size and stage of the epibiotic individuals on turtles in Georgia indicate the presence of an extra-Chesapeake breeding population of this invasive species. The authors suggest that turtle-mediated dispersal is currently the only compelling explanation for the occurrence of *R. venosa* on turtles in Georgia. These findings have important implications for the future management of invasive marine invertebrates.

Sea turtles are known to modify the physical structure of their habitat in a number of ways (Bjorndal and Jackson, 2003). Thus, another unexplored ecological implication of sea turtle epibiosis might be the extent to which turtles modify hard-bottom habitats when actively removing epibiota. This behavior involves turtles pushing their carapace against the underside of rock ledges and vigorously scrapping against the rock to remove epibiota, particularly barnacles (Frick and McFall, 2007). The rock ledges often erode during such behaviors, leaving behind scours or arched ledges, which turtles may return to for subsequent “self-grooming.” The extent to which these habitat modifications affect the surrounding reef or hard-bottom communities remains unknown.

15.5 CONCEPTUAL MODEL OF EPIBIOSIS

As we accumulate studies of epibiotic diversity in sea turtles, we have begun to formulate a conceptual framework to better understand and learn from these epibiotic interactions. While there have been several broad reviews on epibiosis (see Wahl, 1989; Wahl and Mark, 1999; Harder, 2009; Wahl, 2009), there has been no attempt to construct a conceptual framework to explain such associations. The conceptual model of epibiosis depicted in Figure 15.1 outlines three hierarchical factors inherent to epibiotic interactions: (1) geographic overlap (Figure 15.1A), (2) ecological overlap (Figure 15.1B), and (3) the balance of costs and benefits to hosts and epibionts that dictate the likelihood of epibiosis once in close proximity (Figure 15.1C). Because the factors that affect epibiotic interactions—as displayed in this conceptual model—are inherent to the biology of the species involved, we can learn about the ecology and evolution of these species by studying epibiosis. Such a conceptual framework will hopefully allow researchers to better understand the factors that affect their particular epibiotic systems and more easily decipher the important biological information that can be gleaned from studying epibiosis in sea turtles.

15.5.1 Geographic Overlap

A necessary prerequisite for epibiosis is geographic overlap between the range of the host turtle and the range of the epibiont (Figure 15.1A). Logically, without geographic overlap, epibiosis between a host turtle and any potential epibiont would never occur. This is an obvious criterion for epibiosis. However, because the host turtles are highly mobile, the occurrence of particular epibiont taxa with more limited distributions can reveal information about cryptic host movements. Studies of sea turtle epibionts have provided important information on the migratory behavior of loggerhead and leatherback turtles (Caine, 1986; Eckert and Eckert, 1988), and subsequently informed the implementation of conservation measures.

15.5.2 Ecological Overlap

Where geographic ranges overlap, epibiosis will then depend on the spatial and temporal overlap in ecology of the host turtles and potential epibionts (Figure 15.1B). Local geographic areas are typically heterogeneous mosaics of different habitats, each characterized by different ecological communities of plants and animals (e.g., saltmarshes, coral reefs, pelagic areas). The species composition of local communities may also vary through time, especially for seasonal differences

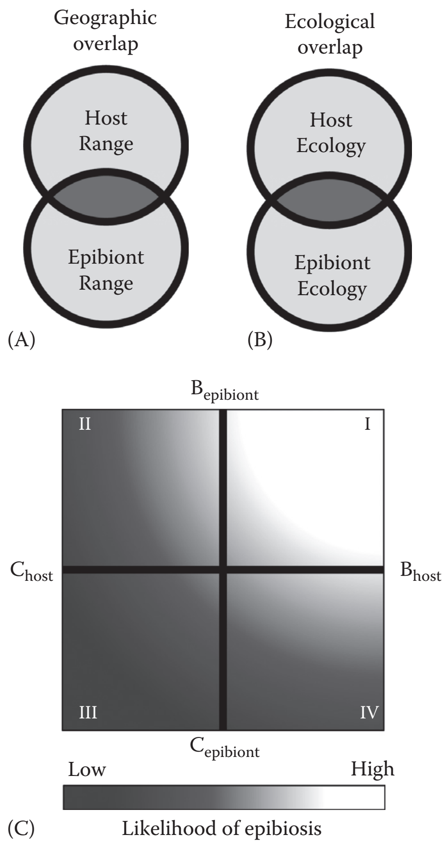

FIGURE 15.1 Conceptual model of epibiosis. (A,B) Venn diagrams showing the geographic and ecological overlap between hosts and epibionts, respectively. (C) Graph showing the likelihood of epibiosis based on the balance of cost and benefits to hosts and epibionts ($B_{epibiont}$, benefit to the epibiont; B_{host}, benefit to the host; C_{host}, cost to the host; $C_{epibiont}$, cost to the epibiont).

in recruitment of larval propagules. Host turtles may utilize many different habitats or may show preferences for certain habitats during different behaviors (e.g., foraging, resting, and mating) or life stages, or at different times of the year. In order for epibiosis to occur, the host turtles must occupy the same habitat at the same time as free-living populations of potential epibionts. Thus, the epibionts associated with a given host turtle should reflect the assemblage of plants and animals that occupy the habitats where the hosts spend time. For example, sea turtles that tend to inhabit benthic/neritic habitats tend to host different epibionts than turtles that tend to inhabit pelagic/oceanic habitats (Limpus and Limpus, 2003; Reich et al., 2010). Such information can be used to assess interspecific and intraspecific differences in habitat use, which is critical for the implementation of effective conservation strategies.

15.5.3 Balance of Costs and Benefits

Once in close proximity, there is a complex balance of costs and benefits for host turtles and potential epibionts that ultimately determine the likelihood of epibiosis. Figure 15.1 displays a 2D likelihood surface in which each axis represents a continuum from high benefit to high cost. The various positions of different hosts and epibionts along these cost-benefit axes depend on the net cost or benefit experienced during epibiosis. Because the relative costs and benefits are different for different turtle–epibiont pairs, some associations are more likely and therefore more frequent than others. Epibiotic interactions in which both species experience a net benefit would have a high likelihood of occurring and therefore would be more frequent (quadrant I). Such mutually beneficial associations would favor mechanisms for active attraction and may develop into obligate associations over evolutionary time. On the other end of the continua, interactions in which both species suffer high costs would have a low likelihood and would effectively never occur (quadrant III). Interactions in which one species incurs a high cost while the other receives minimal benefit would also have a low likelihood (bottom left of quadrants II and IV), as the former species would actively avoid such interactions and the latter would gain very little by exploiting the former. Conversely, if one species receives a high benefit at a high cost to the other species (top left of quadrant II and bottom right of quadrant IV), then such associations might exhibit patterns similar to that of parasitic interactions (top left of quadrant II only). Lastly, interactions in which one species receives a high benefit while the other incurs little or no cost would have a higher likelihood and would be relatively frequent (top left of quadrants II and IV). This last scenario characterizes many of the interactions between sea turtles and their epibiota, and is typically referred to as commensalism (Leung and Poulin, 2008).

As previously mentioned, epibionts may benefit from epibiosis through reduced spatial competition and predation (Wahl, 1989; Enderlein and Wahl, 2004; Pfaller et al., 2012), improved energetic positioning (Pfaller et al., 2006; Shine et al., 2010), and range expansion (Schärer and Epler, 2007; Harding et al., 2011), while coping with costs associated with physical disturbance (Wahl, 1989; Schofield et al., 2006; Frick and McFall, 2007), transport to unfavorable physiological environments (Caine, 1986; Bjorndal, 2003), and reduced access to food resources and mates. Host turtles may benefit from epibionts through optical, chemical, or electrical camouflage (Rathbun, 1925; Fishlyn and Phillips, 1980; Feifarek, 1987; Frazier et al., 1991; Ruxton, 2009) and associational defense and cleaning (Davenport, 1994; Wahl and Mark, 1999; Bjorndal, 2003), while coping with costs associated with increased weight and drag (Logan and Morreale, 1994; Bjorndal, 2003), and tissue damage and associated susceptibility to pathogens (George, 1997; Greenblatt et al., 2004). The balance of costs and benefits to host turtles and epibionts will ultimately determine the likelihood—and therefore the frequency—of epibiosis for most turtle–epibiont associations.

15.6 CONSIDERATIONS

Studies that seek to elucidate the relationships that exist between sea turtles and other marine organisms require investigators to adopt an interdisciplinary approach to data collections and analyses. Knowledge of the standard measurements and preservation methods employed by taxon specialists is important to properly report and archive marine algae and invertebrate specimens (Lazo-Wasem et al., 2011). A familiarity with the life histories and general biology of the marine organisms that utilize the habitats occupied by sea turtles is essential for identifying situations that bring sea turtles into contact with the marine organisms they consume and those that attach to them. An understanding of the major systematic characters that define the major family-groups of local marine flora and fauna is helpful for identification, and to adequately ascertain evolutionary relationships between sea turtles and other marine organisms.

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15.A APPENDIX A: ANNOTATED BIBLIOGRAPHY OF SELECTED SEA TURTLE EPIBIONT STUDIES AND REPORTS LISTED BY GEOGRAPHIC REGION

15.A.1 Caribbean–Western Atlantic

Bacon, 1976 (Trinidad); Bugoni et al., 2001 (Rio Grande do Sul: Brazil); Cardenas-Palomo and Maldonado-Gasca, 2005 (Yucatan: Mexico); Caine, 1986 (South Carolina, Florida); Farrapeira-Assunção, 1991 (Brazil); Frazier et al., 1985 (Georgia, Florida); Frazier et al., 1991 (Georgia); Frazier et al., 1992 (Georgia; Rio Grande do Sul: Brazil); Frick et al., 1998 (Georgia); Frick and Slay, 2000 (Georgia); Frick and Zardus, 2010 (Panama, Georgia, and Florida); Frick et al., 2000a, 2000b (Georgia); Frick et al., 2002a,b (Georgia); Frick et al., 2003a (Jumby Bay: Antigua); Frick et al., 2004b (Georgia); Frick et al., 2006 (Florida); Frick et al., 2010a (Nova Scotia, Georgia); Frick et al., 2010b (Georgia and Florida); Gruvel, 1905 (Antilles Sea); Henry, 1954 (Florida, Texas); Hunt, 1995 (Florida); Ives, 1891 (Yucatan: Mexico); Killingley and Lutcavage, 1983 (Virginia); Lutcavage and Musick, 1985 (Virginia); Nilsson-Cantell, 1921 (Florida); Nilsson-Cantell, 1939 (Bay of Chacopata: Venezuela); Pereira et al, 2006 (Almofala: Brazil); Pilsbry, 1916 (Cape Frio: Brazil; Delaware, Florida, New Jersey; Point Patuca: Honduras; West Indies); Plotkin, 1996 (Texas); Richards, 1930 (New Jersey); Rudloe et al., 1991 (Florida); Schwartz, 1960 (Maryland); Walker, 1978 (North Carolina); Wass, 1963 (Virginia); Wells, 1966 (Florida); Weltner, 1897 (Florida; Cuba; Bahia: Brazil); Young, 1991 (Brazil); Zavodnik, 1997 (Rovinj: Croatia); Zullo and Bleakney, 1966 (Massachusetts; Nova Scotia: Canada); Zullo and Lang, 1978 (South Carolina).

15.A.2 Mediterranean–Eastern Atlantic

Badillo-Amador, 2007 (Mediterranean Sea); Barnard, 1924 (Table Bay: South Africa); Broch, 1924 (Baie du Levrier: Mauretania; Gambia); Broch, 1927 (Rabat: Morocco); Carriol and Vader, 2002 (Finmark: Norway); Caziot, 1921 (Nice: France); Chevereaux and de Guerne, 1893 (between Algeria and Balaeres); Darwin, 1854 (Africa; Mediterranean Sea); Davenport, 1994 (Madeira); Frazier et al., 1985 (Peloponnesus, Zakynthos Island: Greece); Frick et al., 2010a (Gabon: Africa); Gauld, 1957 (Accra: Ghana); Geldiay et al., 1995 (Koycegiz-Dalyankoy: Turkey); Gramentz, 1988 (Malta, Zacharo, Zakynthos: Greece; Lampedusa: Italy); Gruvel, 1903 (Palermo: Italy; Alexandria: Egypt); Gruvel, 1931 (Gulf of Alexandrette); Haelters and Kerckhof, 1999 (DeHaan: Belgium); Haelters and Kerckhof, 2001 (Oostende: Belgium); Holothuis, 1952 (Ouddorp: the Netherlands); Holothuis, 1969 (Ameland Island: the Netherlands); Kitsos et al., 2005 (Aegean Sea); Kolosvary, 1939 (Rovigno, d'Istria: Croatia); Kolosvary, 1943 (Alexandria: Egypt; Palermo, Sicily: Italy); Kolosvary, 1951 (Mediterranean Sea); Koukouras and Matsa, 1998 (Aegean Sea; Levantine Basin); Lanfranco, 1979 (St. Julian's: Malta); Lucas, 1968 (Mediterranean Sea); Margaritoulis, 1985 (Zakynthos: Greece); Nilsson-Cantell, 1921 (Bibundi: Cameroon); Nilsson-Cantell, 1931 (Mediterranean Sea); O'Riordan, 1979 (Dingle: Ireland); O'Riordan and Holmes, 1978 (Ventry Harbor: Ireland); Pilsbry, 1916 (Taranto: Italy; Cape of Good Hope: South Africa); Quigley and Flannery, 1993 (Dingle Bay: Ireland); Relini, 1968 (Gulf of Trieste: Italy); Relini, 1969 (Adriatic Sea); Relini, 1980 (Adriatic Sea); Sezgin et al., 2009 (Turkey); Smaldon and Lyster, 1976 (Skarvoy: Norway; Crail, Kirkcudbrightshire: Scotland; Cornwall: England); Stubbings, 1965 (Hann, Saloum River: Senegal); Stubbings, 1967 (Goree, Hann: Senegal); Utinomi, 1959 (Banyuls-sur-Mer: France); Zakhama-Sraieb et al., 2010 (Gulf of Gabès: Mediterranean Sea).

15.A.3 Indo–West Pacific

Annandale, 1906 (Rameswaram Island: India; Gulf of Manaar); Balazs, 1978 (Hawaii); Balazs, 1980 (Hawaii); Balazs et al., 1987 (Hawaii); Borradaile, 1903 (Minikoi Island: India); Broch, 1916 (Broome: Australia); Broch, 1931 (Gulf of Thailand; Nagasaki: Japan); Broch, 1947 (Ream: Cambodia; Indochina); Bustard, 1976 (Great Barrier Reef: Australia); Daniel, 1956 (Tuticorin, Drusadai Islands, Royapuram Coast, Madras Coast: India); Daniel, 1962 (Little Andaman

Island: India); Darwin, 1854 (Low Archipelago: French Polynesia; Australia); Dawydoff, 1952 (Pulo Condore: Vietnam; Ream: Cambodia); Deraniyagala, 1939 (Bentota: Ceylon); Dobbs and Landry, 2004 (Great Barrier Reef: Australia); Fernando, 1978 (Porto Novo: India); Glazebrook and Campbell, 1990 (Torres Strait: Australia); Fischer, 1886 (Pulo Condor: Vietnam); Foster, 1978 (North Island: New Zealand); Frazier, 1971 (Aldabra Atoll); Frazier et al., 1985 (Orissa: India; Tanzania: Africa); Frazier, 1989 (Dwarka Island: India); Frazier et al., 1992 (Orissa, Gujarat: India; Karachi, Pakistan); Gordon, 1970 (Hawaii); Gruvel, 1903 (Seychelles; Mallicolo: Vanuatu; Djibouti; Sandwich Island; Cochinchina: Vietnam); Gruvel, 1907 (Andaman Islands: India); Gruvel, 1912 (Tuamotu Archipelago: French Polynesia); Hayashi and Tsuji, 2008 (Okinawa: Japan); Hendrickson, 1958 (Johor, Sarawak: Malaysia); Hiro, 1936 (Wakayama Prefecture, Aichi Prefecture: Japan); Hiro, 1937a (Baberudaobu Island: Palau); Hiro, 1939 (Toyama Bay: Japan); Jones, 1990 (Australia); Jones et al., 1990 (Tasmania; Australia); Jones et al., 2000 (summary of distribution); Kruger, 1911b (Sagami Bay: Japan); Kruger, 1912 (Timor Sea); Lanchester, 1902 (Kota Bharu: Malaysia); Limpus et al., 1983a (Campbell Island: Australia); Limpus et al., 1983b (Crab Island: Australia); Limpus et al., 2005 (Raine Island: Australia); Loop et al., 1995 (Milman Island: Australia); Losey et al., 1994 (Hawaii); Matsuura and Nakamura, 1993 (Kagoshima Prefecture: Japan); McCann, 1969 (North Island: New Zealand); Monroe and Limpus, 1979 (Queensland: Australia); Mustaquim and Javed, 1993 (Sandspit Beach: Pakistan); Newman et al., 1969 (Hawaii); Newman and Abbott, 1980 (California); Nilsson-Cantell, 1921 (Western Australia: Australia); Nilsson-Cantell, 1930a (Enoe Island: Malaysia); Nilsson-Cantell, 1932 (Bentota: Sri Lanka); Nilsson-Cantell, 1937 (Singapore); Nilsson-Cantell, 1938 (Maldives; Kilakarai, Andaman Islands, River Hooghly, mouth of Ganges: India); Pillai, 1958 (Quilon: India); Pilsbry, 1916 (Hawaii; Caroline Islands; Ana: Japan; Saigon: Vietnam); Pilsbry, 1927 (Hawaii); Ren, 1980 (Xisha Islands); Ren, 1987 (China); Ross, 1981 (Oman); Smaldon and Lyster, 1976 (Kuala Lumpur: Malaysia); Tachikawa, 1995 (Japan); Utinomi, 1949 (Hakata Bay: Japan); Utinomi, 1958 (Sagami Bay: Japan); Utinomi, 1966 (Amakusa: Japan); Utinomi, 1969 (Kharg: Iran); Utinomi, 1950 (Tanabe Bay: Japan); Utinomi, 1970 (Hakui, Cape Kyoga-misaki, Kamo, Nezugaseki, Sado Island: Japan); Wagh and Bal, 1974 (Bombay: India); Weltner, 1897 (Massaua: New Guinea; Torres Strait); Weltner, 1910 (Ile Europa); Zann and Harker, 1978 (Queensland: Australia); Zardus and Balazs, 2007 (Hawaii).

15.A.4 Eastern Pacific

Angulo-Lozano et al., 2007 (Sinaloa: Mexico); Beaumont et al., 2007 (Galapagos Islands: Ecuador); Brown and Brown, 1995 (Peru); Darwin, 1854 (Mexico; Galapagos Islands: Ecuador); Frazier et al., 1985 (Galapagos Islands: Ecuador); Frazier et al., 1992 (Santa Rosa: Ecuador); Frick et al., 2011a,b (Baja California: Mexico; Eastern Tropical Pacific; Galapagos: Ecuador); Green, 1998 (Galapagos Islands: Ecuador); Henry, 1941 (La Paz: Mexico); Henry, 1960 (Gulf of California, Guaymas: Mexico); Hernandez-Vasquez and Valadez-Gonzalez, 1998 (Jalisco: Mexico); Hubbs, 1977 (California); Kolosvary, 1943 (San Jose: Guatemala); Lazo-Wasem et al., 2011 (Jalisco: Mexico); MacDonald, 1929 (Cocos Island: Costa Rica); Newman et al., 1969 (Baja California: Mexico; Eastern Pacific); Pilsbry, 1916 (Baja California: Mexico; Galapagos Islands: Ecuador); Ross and Newman, 1967 (Baja California: Mexico); Stinson, 1984 (California); Vivaldo et al., 2006 (Michoacan, Oaxaca: Mexico); Weltner, 1897 (western Mexico; California; Valparaiso: Chile); Young and Ross, 2000 (Sonora: Mexico); Zullo, 1986 (Galapagos Islands: Ecuador); Zullo, 1991 (Galapagos Islands: Ecuador).

REFERENCES

Alfaro, A. 2008. Synopsis of infections in sea turtles caused by virus, bacteria and parasites: An ecological review. In A.F. Rees, M.G. Frick, A. Panagoloulou and K. Williams, compilers. *Proceedings of the 27th Annual Symposium on Sea Turtle Biology and Conservation*. NOAA Technical Memorandum NMFS-SEFC-569, Miami, FL, p. 5.

Annandale, N. 1906. Report on the Cirripedia collected by Professor Herdman, at Ceylon, in 1902. *Ceylon Pearl Oyster Fisheries, Supplemental Report* 31: 137–150.

Bacon, P. 1976. Cirripedia of Trinidad. *Studies on the Fauna of Curacao and Other Caribbean Islands* 50: 3–55.

Badillo-Amador, F.J. 2007. Epizoítos y parásitos de la tortuga boba (*Caretta caretta*) en el Mediterráneo Occidental. PhD thesis, Facultat de Ciencies Biologiques, Univesitat de Valencia, Valencia, Spain, 262pp.

Balazs, G.H. 1978. A hawksbill turtle in Kaneohe Bay, Oahu. *Elepaio* 38: 128–129.

Balazs, G.H. 1980. Synopsis of the biological data on the green turtle in the Hawaiian Islands. NOAA Technical Memorandum NMFS-7, pp. 1–141.

Balazs, G.H., R.G. Forsyth, and A.K.H. Kam. 1987. Preliminary assessment of habitat utilization by Hawaiian green turtles in their resident foraging pastures. NOAA Technical Memorandum NMFSC-SWFC-71, pp. 1–107.

Barnard, K.H. 1924. Contributions to the crustacean fauna of South Africa. *Annotates of the South African Museum* 20: 1–103.

Beaumont, E.S., P. Zárate, J.D. Zardus, P.H. Dutton, and J.H. Seminoff. 2007. Epibiont occurrence in Galapagos green turtles (*Chelonia mydas*) at nesting and feeding grounds. In A.F. Rees, M.G. Frick, A. Panagoloulou, and K. Williams, compilers. *Proceedings of the 27th Annual Symposium on Sea Turtle Biology and Conservation*. NOAA Technical Memorandum NMFS-SEFC-569, Miami, FL, p. 8.

Bjorndal, K.A. 1997. Foraging ecology and nutrition of sea turtles. In P.L. Lutz and J.A. Musick, eds. *The Biology of Sea Turtles*. CRC Press, Boca Raton, FL, pp. 199–231.

Bjorndal, K.A. 2003. Roles of loggerheads in marine ecosystems. In A.B. Bolten and B.E. Witherington, eds. *Biology and Conservation of the Loggerhead Sea Turtle*. Smithsonian Institution Press, Washington, DC, pp. 235–254.

Bjorndal, K.A. and J.B.C. Jackson. 2003. Roles of sea turtles in marine ecosystems: Reconstructing the past. In P.L. Lutz, J.A. Musick, and J. Wyneken, eds. *The Biology of the Sea Turtles*, Vol. II. CRC Press, Boca Raton, FL, pp. 259–274.

Bolten, A.B. 2003. Variation in sea turtle life history patterns: Neritic vs. oceanic developmental stages. In P.L. Lutz, J.A. Musick, and J. Wyneken, eds. *The Biology of the Sea Turtles*, Vol. II. CRC Press, Boca Raton, FL, pp. 243–257.

Borradaile, L.A. 1903. VII. The Barnacles (Cirripedia). In S. Gardner, ed. *The Fauna and Geography of the Maldive and Laccadive Archipelagoes, Being the Account of the Work Carried on and of the Collections Made by and Expedition during the Years 1899 and 1900*, Vol. I. University Press, Cambridge, MA, pp. 440–443.

Bowen, B.W., J.C. Avise, J.I. Richardson, A.B. Meylan, D. Margaritoulis, and S.R. Hopkins-Murphy. 1993. Population structure of loggerhead turtles (*Caretta caretta*) in the northwestern Atlantic Ocean and Mediterranean Sea. *Conservation Biology* 7: 834–844.

Broch, H. 1916. Cirripedien. Results of Dr. E. Moberg's Swedish scientific expeditions to Australia 1910–13. *Kungliga Svenska Vetenskaps Akademiens Handlingar* 52: 1–16.

Broch, H. 1924. Cirripedia. Parasitologia Mauritanica, Materiaux pour la Faune Parasitologique en Mauritanie. Arthropoda (2e Partie). *Bulletin Comite d'Etudes Hist. Sci. l'Afrique Occidentale Francaise* (October–December, 1924): 1–21.

Broch, H. 1927. Studies on Moroccan cirripeds (Atlantic Coast). *Bulletin de la Societe des Sciences Naturelles, Maroc* 6–7: 11–38.

Broch, H. 1931. Indomalayan Cirripedia. Papers from Dr. Th. Mortensen's Pacific Expedition 1914–1916. *Videnskabelige Meddelelser Dansk Naturhistorisk Forening* 91: 1–146.

Broch, H. 1947. Cirripedes from Indochinese shallow-waters. *Avhandlinger Norske Videnskaps-akademi Oslo I* 7: 1–32.

Brown, C.A. and W.M. Brown. 1995. Status of sea turtles in the southeastern Pacific: Emphasis on Peru. In K.A. Bjorndal, ed. *Biology and Conservation of Sea Turtles*, Revised edition. Smithsonian Institution Press, Washington, DC, pp. 235–240.

Bugoni, L., L. Krause, A.O. de Almeida, and A.A. De Pádua Bueno. 2001. Commensal barnacles of sea turtles in Brazil. *Marine Turtle Newsletter* 94: 7–9.

Bustard, H.R. 1976. Turtles of coral reefs and coral islands. In O.A. Jones and R. Endean, eds. *Biology and Geology of Coral Reefs*, Vol. III (Biology 2). Academy Press, NY, pp. 343–368.

Caine, E.A. 1986. Carapace epibionts of nesting loggerhead turtles: Atlantic coast of U.S.A. *Journal of Experimental Marine Biology and Ecology* 95: 15–26.

Cardenas-Palomo, N. and A. Maldonado-Gasca. 2005. Epibiontes de tortugas de carey juveniles *Eretmochelys imbricata* en el Santuario de Tortugas Marinas de Rio Lagartos, Yucatan, Mexico. *CICIMAR Oceanides* 20: 29–35.

Carriol, R.P. and W. Vader. 2002. Occurrence of *Stomatolepas elegans* (Cirripedia: Balanomorpha) on a leatherback turtle from Finnmark, northern Norway. *Journal of the Marine Biological Association of the United Kingdom* 82: 1033–1034.

Caziot, E. 1921. Les Cirripedes de la mer de Nice. *Bulletin Society Zoology, France* 46: 51–54.

Chace, F.A. 1951. The oceanic crabs of the genera *Planes* and *Pachygrapsus. Proceedings of the United States National Museum* 101: 65–103.

Chevereaux, E. and J. de Guerne. 1893. Crustaces et Cirripeds commensaux des Tortues marines de la Mediterranee. *Comptes Rendus des Seances de l'Academie des Sciences* 116: 443–445.

Cupul-Magaña, F.G., A. Rubio-Delgado, A.H. Escobedo-Galván, and C. Reyes-Nuñez. 2011. First report of marine barnacles *Lepas anatifera* and *Chelonibia testudinaria* as epibionts on American crocodile (*Crocodylus acutus*). *Herpetology Notes* 4: 213–214.

Daniel, A. 1956. The Cirripedia of the Madras Coast. *Bulletin of the Madras Government Museum* 6: 1–40.

Daniel, A. 1962. A new species of platylepadid barnacle (Cirripedia: Crustacea) from the green turtle from Little Andaman Island. *Annals and Magazine of Natural History (Series 13)* 5: 641–645.

Darwin, C. 1851. *A Monograph on the Subclass Cirripedia, with Figures of All Species. The Lepadidae, or, Pedunculated Cirripedes*. Ray Society, London, U.K. 400pp.

Darwin, C. 1854. *A Monograph on the Subclass Cirripedia, with Figures of All the Species. The Balanidae, the Verrucidae, etc*. Ray Society, London, U.K. 684pp.

Davenport, J. 1994. A cleaning association between the oceanic crab *Planes minutus* and the loggerhead sea turtle *Caretta caretta. Journal of the Marine Biological Society of the United Kingdom* 74: 735–737.

Dawydoff, C. 1952. Contribution a l'etude des invertebrates de la faune marine benthique de l'Indochine. *Bulletin biologique de la France et de la Belgique* 37(Suppl): 127–131.

Dean, T.A. 1981. Structural aspects of sessile invertebrates as organizing forces in an Estuarine fouling community. *Journal of Experimental Marine Biology and Ecology* 53: 163–180.

Deem, S.L., T.M. Norton, M. Mitchell, A. Segars, A.R. Alleman, C. Cray, R.H. Poppenga, M. Dodd, and W.B. Karesh. 2009. Comparison of blood values in foraging, nesting, and stranded loggerhead turtles (*Caretta caretta*) along the coast of Georgia, USA. *Journal of Wildlife Diseases* 45: 41–56.

Dellinger, T., J. Davenport, and P. Witz. 1997. Comparisons of social structure of Columbus crabs living on loggerhead sea turtles and inanimate flotsam. *Journal of the Marine Biological Association of the United Kingdom* 77: 185–194.

Deraniyagala, P.E.P. 1939. The tetrapod reptiles of Ceylon. *Ceylon Journal of Science, Colombo Museum, Natural History Series* 1: 1–412.

Dobbs, K.A. and A.M. Landry, Jr. 2004. Commensals on nesting hawksbill turtles (*Eretmochelys imbricata*), Milman Island, northern Great Barrier Reef, Australia. *Memoirs of the Queensland Museum* 49: 674.

Dodd, C.K. Jr. 1988. Synopsis of the biological data on the loggerhead sea turtle *Caretta caretta* (Linnaeus 1758). *U.S. Fish and Wildlife Service Biological Report* 88: 1–110.

Eckert, K.L. and S.A. Eckert. 1988. Pre-reproductive movements of leatherback sea turtles (*Dermochelys coriacea*) nesting in the Caribbean. *Copeia* 1988: 400–406.

Encalada, S.E., K.A. Bjorndal, A.B. Bolten, J.C. Zurita, B. Schoeder, E. Possardt, C.J. Sears, and B.W. Bown. 1998. Population structure of loggerhead turtle (*Caretta caretta*) nesting colonies in the Atlantic and Mediterranean as inferred from mitochondrial DNA control region sequences. *Marine Biology* 130: 567–575.

Enderlein, P. and M. Wahl. 2004. Dominance of blue mussels versus consumer-mediated enhancement of benthic diversity. *Journal of Sea Research* 51: 145–55.

Farrapeira-Assunção, C.M. 1991. Revisão do gênero *Chelonibia* Leach, 1817 na costa Brasileira (Crustacea, Cirripedia). *Abstracts of XVIII Congresso Brasileiro de Zoologia*, Salvador, Brazil, 133pp.

Feifarek, B.P. 1987. Spines and epibionts as antipredator defenses in the thorny oyster *Spondylus americanus* Hermann. *Journal of Experimental Marine Biology and Ecology* 105: 39–56.

Fernando, S.A. 1978. Studies on the biology of barnacles (Crustacea: Cirripedia) of Porto Novo region, South India. PhD dissertation, Center of Advanced Study in Marine Biology, Annamalai University, Tamil Nadu, India, 213pp.

Fischer, P. 1886. Description d'un nouveau genre de Cirripedes (*Stephanolepas*) parisite des tortues marines. *Actes de la Société Linnéenne de Bordeaux* 40: 193–196.

Fishlyn, D.B. and D.W. Phillips. 1980. Chemical camouflaging and behavioural defenses against predatory seastar by three species of gastropods from the surfgrass Phyllospadix community. *Biological Bulletin* 158: 34–48.

Foley, A.M., B.A. Schroeder, and S.L. MacPherson. 2008. Post-nesting migrations and resident areas of Florida loggerheads. In H. Kalb, A. Rohde, K. Gayheart, and K. Shanker, compilers. *Proceedings of the 25th Annual Symposium on Sea Turtle Biology and Conservation*. NOAA Technical Memorandum NMFS-SEFSC-582, Miami, FL, pp. 75–76.

Foster, B.A. 1978. The marine fauna of New Zealand: Barnacles (Cirripedia: Thoracica). *New Zealand Oceanographic Institute Memorandum* 69: 1–160.

Frazier, J. 1971. Observations on sea turtles at Aldabra Atoll. *Philosophical Transactions of the Royal Society of London, Series B* 260: 373–410.

Frazier, J. 1989. Observations on stranded green turtles, *Chelonia mydas*, in the Gulf of Kutch. *Journal of the Bombay Natural History Society* 86: 250–252.

Frazier, J.G., I. Goodbody, and C.A. Ruckdeschel. 1991. Epizoan communities on marine turtles. II. Tunicates. *Bulletin of Marine Science* 48: 763–765.

Frazier, J.G., D. Margaritoulis, K. Muldoon, C.W. Potter, J. Rosewater, C. Ruckdeschel, and S. Salas. 1985. Epizoan communities on marine turtles. I. Bivalve and gastropod mollusks. *Marine Ecology* 6: 127–140.

Frazier, J.G., J.E. Winston, and C.A. Ruckdeschel. 1992. Epizoan communities on marine turtles. III. Bryozoa. *Bulletin of Marine Science* 51: 1–8.

Frick, M.G., K. Kopitsky, A.B. Bolten, K.A. Bjorndal, and H.R. Martins. 2011a. Sympatry in grapsoid crabs (genera *Planes* and *Plagusia*) from olive ridley sea turtles (*Lepidochelys olivacea*), with descriptions of crab diets and masticatory structures. *Marine Biology* 158: 1699–1708.

Frick, M.G., P.A. Mason, K.L. Williams, K. Andrews, and H. Gerstung. 2003a Epibionts of hawksbill turtles in a Caribbean nesting ground: A potentially unique association with snapping shrimp (Crustacea: Alpheidae). *Marine Turtle Newsletter* 99: 8–11.

Frick, M.G. and G. McFall. 2007. Self-grooming by loggerhead turtles in Georgia, USA. *Marine Turtle Newsletter* 118: 15.

Frick, M.G., A. Ross, K.L. Williams, A.B. Bolten, K.A. Bjorndal, and H.R. Martins. 2003b. Epibiotic associates of oceanic-stage loggerhead turtles from the southeastern North Atlantic. *Marine Turtle Newsletter* 101: 18–20.

Frick, M.G. and C.K. Slay. 2000. *Caretta caretta* (loggerhead sea turtle) epizoans. *Herpetological Review* 31: 102–103.

Frick, M.G., K.L. Williams, A.B. Bolten, K.A. Bjorndal, and H.R. Martins. 2004a. Diet and fecundity of Columbus crabs, *Planes minutus*, associated with oceanic-stage loggerhead sea turtles, *Caretta caretta*, and inanimate flotsam. *Journal of Crustacean Biology* 24: 350–355.

Frick, M.G., K.L. Williams, A.B. Bolten, K.A. Bjorndal, and H.R. Martins. 2009. Foraging ecology of oceanic-stage loggerhead turtles *Caretta caretta. Endangered Species Research* 9: 91–97.

Frick, M.G., K.L. Williams, M. Bresette, D.A. Singewald, and R.M. Herren. 2006. On the occurrence of Columbus crabs (*Planes minutus*) from loggerhead turtles in Florida, USA. *Marine Turtle Newsletter* 114: 12–14.

Frick, M.G., K.L. Williams, E.J. Markestyn, J.B. Pfaller, and R.E. Frick. 2004b. New records and observations of epibionts from loggerhead sea turtles. *Southeastern Naturalist* 3: 613–620.

Frick, M.G., K.L. Williams, and M. Robinson. 1998. Epibionts associated with nesting loggerhead sea turtles (*Caretta caretta*) in Georgia. *Herpetological Review* 29: 211–214.

Frick, M.G., K.L. Williams, and D. Veljacic. 2000a. Additional evidence supporting a cleaning association between epibiotic crabs and sea turtles: How will the harvest of *Sargassum* weed impact this relationship? *Marine Turtle Newsletter* 90: 11–13.

Frick, M.G., K.L. Williams, and D.C. Veljacic. 2002a. New records of epibionts from loggerhead sea turtles *Caretta caretta* (L.) *Bulletin of Marine Science* 70: 953–956.

Frick, M.G., K.L. Williams, D. Veljacic, J.A. Jackson, and S.E. Knight. 2002b. Epibiont community succession on nesting loggerhead sea turtles, *Caretta caretta*, from Georgia, USA. In A. Mosier, A. Foley and B. Brost, compilers. *Proceedings of the 20th Annual Symposium on Sea Turtle Biology and Conservation*. NOAA Technical Memorandum, NMFS-SEFSC-447, Miami, FL, pp. 280–282.

Frick, M.G., K.L. Williams, D. Veljacic, L. Pierrard, J.A. Jackson, and S.E. Knight. 2000b. Newly documented epibiont species from nesting loggerhead sea turtles (*Caretta caretta*) in Georgia. *Marine Turtle Newsletter* 88: 103–108.

Frick, M.G. and J.D. Zardus. 2010. First authentic report of the turtle barnacle *Cylindrolepas darwiniana* since its description in 1916. *Journal of Crustacean Biology* 30: 292–295.

Frick, M.G., J.D. Zardus, and E.A. Lazo-Wasem. 2010a. A new *Stomatolepas* barnacle species (Cirripedia: Balanomorpha: Coronuloidea) from leatherback sea turtles. *Bulletin of the Peabody Museum of Natural History* 51: 123–136.

Frick, M.G., J.D. Zardus, and E.A. Lazo-Wasem. 2010b. A new coronuloid barnacle subfamily, genus and species from cheloniid sea turtles. *Bulletin of the Peabody Museum of Natural History* 51: 169–177.

Frick, M.G., J.D. Zardus, A. Ross, J. Senko, D. Montano-Valdez, M. Bucio-Pacheco, and I. Sosa-Cornejo. 2011b. Novel records of the barnacle *Stephanolepas muricata* (Cirripedia: Balanomorpha: Coronuloidea); including a case for chemical mediation in turtle and whale barnacles. *Journal of Natural History* 45: 629–640.

Fuller, W.J., A.C. Broderick, R. Enever, P. Thorne, and B.J. Godley. 2010. Motile homes: A comparison of the spatial distribution of epibiont communities on Mediterranean sea turtles. *Journal of Natural History* 44:1743–1753.

Gauld, D.T. 1957. An annotated check-list of the Crustacea of the Gold Coast. I. Cirripedia. *Journal of the West African Science Association* 3: 10–11.

Geldiay, R., T. Koray, and S. Balik. 1995. Status of sea turtle populations (*Caretta caretta caretta* and *Chelonia mydas*) in the northern Mediterranean Sea, Turkey. In K.A. Bjorndal, ed. *Biology and Conservation of Sea Turtles*, Revised edition. Smithsonian Institution Press, Washington, DC, pp. 425–437.

George, R.H. 1997. Health problems and disease of sea turtles. In P.L. Lutz and J.A. Musick, eds. *The Biology of the Sea Turtles*. CRC Press, Boca Raton, FL, pp. 363–385.

Glazebrook, R.S. and R.S.F. Campbell. 1990. A survey of the diseases of marine turtles in northern Australia. 2. Oceanarium-reared and wild turtles. *Diseases of Aquatic Organisms* 9: 97–104.

Gordon, J.A. 1970. An annotated checklist of Hawaiian barnacles (Class Crustacea: Subclass Cirripedia) with notes on their nomenclature, habitats and Hawaiian localities. *Hawaii Institute of Marine Biology Technical Report* 19: 1–130.

Gramentz, D. 1988. Prevalent epibiont sites on *Caretta caretta* in the Mediterranean Sea. *Naturalista Siciliano* 12: 33–46.

Green, D. 1998. Epizoites of Galapagos green turtles. In R. Byles and Y. Fernandez, compilers. *Proceedings of the 16th Annual Symposium on Sea Turtle Biology and Conservation*. NOAA-Technical Memorandum NMFS-SEFSC–412, Miami, FL, p. 63.

Greenblatt, R.J., T.M. Work, G.H. Balazs, C.A. Sutton, R.N. Casey, and J.W. Casey. 2004. The Ozobranchus leech is a candidate mechanical vector for the fibropapilloma-associated turtle herpesvirus found latently infecting skin tumors on Hawaiian green turtles (*Chelonia mydas*). *Virology* 1: 101–110.

Gruvel, A. 1903. Revision des Cirrhipedes appartenant a la collection du Museum d'Histoire Naturelle. *Nouvelles Archives du Museum D'Histoire Naturelle de Paris* (*Series 4*), 5: 95–170.

Gruvel, A. 1905. *Monographie des Cirrhipedes ou Theocostraces*. Masson et Cie, Editeurs, Paris, 472pp.

Gruvel, A. 1907. Cirrhipedes opercules de le l'Indian Museum de Calcutta. *Memories of the Asiatic Society of Bengal* 2: 1–10.

Gruvel, A. 1912. Mission Gruvel sur la cote occidentale d'Afriques (1909–1910) et collection du Museum d'Histoire Naturelle, Les Cirrhipedes. *Bulletin du Museum D'Histoire Naturelle, Series* 1: 344–350.

Gruvel, A. 1931. *Crustaces de Syrie*. Les etat de Syrie, Paris, France, pp. 397–435.

Haelters, J. and F. Kerckhof. 1999. Een waarneming van de lederschildpad *Dermochelys coriacea* (Linnaeus, 1758), en de eerste waarneming van *Stomatolepas dermochelys* Monroe and Limpus, 1979 aan de Belgische kust. *De Strandvlo* 19: 30–39.

Haelters, J. and F. Kerckhof. 2001. Opnieuw een klapmuts *Cystophora cristata* Erxleben, 1777 en een lederschildpad *Dermochelys coriacea* (Linnaeus 1758) aan onze kust. *De Strandvlo* 21: 81–83.

Harder T. 2009. Marine epibiosis: Concepts, ecological consequences and host defence. *Marine and Industrial Biofouling* 4: 219–31.

Harding, J.M. and R. Mann. 1999. Observations on the biology of the veined rapa whelk, *Rapana venosa* (Valenciennes, 1846) in the Chesapeake Bay, USA. *Journal of Shellfish Research* 24: 9–18.

Harding, J.M., W.J. Walton, C.M. Trapani, M.G. Frick, and R. Mann. 2011. Sea turtles as potential dispersal vectors for non-indigenous species: The veined rapa whelk as an epibiont of loggerhead sea turtles. *Southeastern Naturalist* 10: 233–244.

Hayashi, R. and K. Tsuji. 2008. Spatial distribution of turtle barnacles on the green sea turtle, *Chelonia mydas. Ecological Research* 2007 (*On-line Journal of the Ecological Society of Japan*), 5pp.

Heithaus, M.R., J.J. McLash, A. Frid, L.M. Dill, and G.J. Marshall. 2002. Novel insights into green turtle behaviour using animal-borne video cameras. *Journal of the Marine Biological Association of the United Kingdom* 82: 1049–1050.

Hendrickson, J.R. 1958. The green sea turtle, *Chelonia mydas* (Linn.), in Malaya and Sarawak. *Proceedings of the Zoological Society of London* 130: 455–535.

Henry, D.P. 1941. Notes on some sessile barnacles from Lower California and the west coast of Mexico. *Proceedings of the New England Zoological Club* 18: 99–107.

Henry, D.P. 1954. The barnacles of the Gulf of Mexico. Gulf of Mexico, its origin, waters and marine life. U.S. Fish and Wildlife Service, 55, *Fishery Bulletin* 89: 443–446.

Henry, D.P. 1960. Thoracic Cirripedia of the Gulf of California. *University of Washington Publication Oceanography* 4: 135–158.

Hernandez-Vasquez, S. and C. Valadez-Gonzalez. 1998. Observations on the epizoa found on the turtle *Lepidochelys olivacea* at La Gloria, Jalisco, Mexico. *Ciencias Marina* 24: 119–125.

Hiro, F. 1936. Occurrence of the cirriped *Stomatolepas elegans* on a loggerhead turtle found at Seto. *Annotationes Zoologicae Japonenses* 15: 312–320.

Hiro, F. 1937a. Cirripeds of the Palao Islands. *Palao Tropical Biological Station Studies* 1: 37–72.

Hiro, F. 1939. Studies on the cirripedien fauna of Japan. V. Cirripeds of the northern part of Honshyu. *Science Reports of the Tohoku Imperial University (Series 4)* 14: 201–218.

Holothuis, L.B. 1952. Enige interessante, met drijvende voorwerpen op de Nedelandse kust aangespoelde zeepissebedden en zeepokken. *De Levende Natuur* 55: 72–77.

Holothuis, L.B. 1969. Enkele interessante Nederlandse Crustacea. *Zoologische Bijdragen* 2: 34–48.

Hubbs, C.L. 1977. First record of mating ridley turtles in California, with notes on commensals, characters, and systematics. *California Fish and Game* 63: 263–267.

Hunt, T.L. 1995. Preliminary survey of commensals associated with *Caretta caretta*. In J.I. Richardson and T.H. Richardson, compilers. *Proceedings of the 12th Annual Workshop on Sea Turtle Biology and Conservation*. NOAA-Technical Memorandum NMFS-SEFSC-361, Miami, FL, pp. 204–207.

Ives, J.E. 1891. Crustacea from the northern coast of Yucatan, the harbor of Vera Cruz, the west coast of Florida and the Bermuda Islands. *Proceedings of the Academy of Natural Sciences of Philadelphia* 43: 176–207.

Jones, D.S. 1990. The shallow-water barnacles (Cirripedia: Lepadomorpha, Balanomorpha) of southern Western Australia. In F.E. Wells, D.I. Walker, H. Kirkman and R. Lethbridge, compilers. *Proceedings of the Third International Marine Biological Workshop: The Marine Flora and Fauna of Albany, Western Australia*. Western Australia Museum, Perth, Australia, pp. 333–437.

Jones, D.S., J.T. Anderson and D.T. Anderson. 1990. Checklist of the Australian Cirripedia. *Technical Report of the Australian Museum* 3: 1–38.

Jones, D.S., M.A. Hewitt, and A. Sampey. 2000. A checklist of the cirripedia of the South China Sea. *Raffles Bulletin of Zoology* 8(Suppl): 233–307.

Killingley, J.S. and M. Lutcavage. 1983. Loggerhead turtle movements reconstructed from 18O and 13C profiles from commensal barnacle shells. *Estuarine Coastal Shelf Science* 16: 345–349.

Kitsos, M., M. Christodoulou, C. Arvanitidis, M. Mavidis, I. Kirmitzoglou, and A. Koukouras. 2005. Composition of the organismic assemblage associated with *Caretta caretta. Journal of the Marine Biological Association of the United Kingdom* 2005: 257–261.

Kolosvary, G. 1939. Ueber Fundortsangaben adriatischer Balanen. *Bollettino dei Musei di Zoologia ed Anatomia Comparata della R. Università di Torino (Series III)* 47: 37–41.

Kolosvary, G. 1943. Cirripedi thoracica in der Sammlung des ungarischen National-Museums. *Annales Historico-Naturales Musei Nationalis Hungarici* 36: 67–120.

Kolosvary, G. 1951. Les balanids de la Mediterranee. *Acta Biologica* 2: 411–413.

Koukouras, A. and A. Matsa. 1998. The thoracican cirriped fauna of the Aegean Sea: New information, checklist of the Mediterranean species, faunal comparisons. *Senckenbergiana Maritima* 28: 133–142.

Kruger, P. 1911b. Zur Cirripedien fauna Ostasiens. *Zoologischer Anzeiger, Leipzig* 38: 459–464.

Kruger, P. 1912. Uber ostrasiatische Rhizocephalen. Anhang: Uber eninige intersante Vertreter der Cirripedia thoracica. *Abhandlungen der Mathematisch-Physikalische Klasse der Königlich Bayerischen Akademie der Wissenschaften, II Supplement Band* 8: 1–16.

Lanchester, W.F. 1902. On the Crustacea collected during the "Skeat Expedition" to the Malay Peninsula. *Proceedings of the Zoological Society of London* 2: 363–381.

Lazo-Wasem, E.A., T. Pinou, A. Peña de Niz, and A. Feuerstein. 2011. Epibionts associated with the nesting marine turtles *Lepidochelys olivacea* and *Chelonia mydas* in Jalisco, Mexico: A review and field guide. *Bulletin of the Peabody Museum of Natural History* 52(2): 221–240.

Lanfranco, G. 1979. *Stomatolepas elegans* Costa (Crustacea, Cirripedia) on *Dermochelys coriacea* Linn., taken in Maltese waters. *Central Mediterranean Naturalist* 1: 24.

Leung T.L.F. and Poulin R. 2008. Parasitism, commensalism, and mutualism: Exploring the many shades of symbioses. *Vie Milieu* 58: 107−115.

Lezama, C., A. Carranza, A. Fallabrino, A. Estrades, and M. López-Mendilaharsu. 2012. Unintended backpackers: Bio-fouling of the invasive gastropod *Rapana venosa* on the green turtle *Chelonia mydas* in the Río de la Plata Estuary, Uruguay. *Biological Invasions* doi:10.10007/s10530-012-0307-9.

Limpus, C.J. and D.J. Limpus. 2003. Biology of the loggerhead turtle in western south Pacific Ocean foraging areas, In A.B. Bolten and B.E. Witherington, eds. *Biology and Conservation of the Loggerhead Sea Turtle*. Smithsonian Institution Press, Washington, DC, pp. 93–113.

Limpus, C.J., D.J. Limpus, M. Munchow, and P. Barnes. 2005. Queensland turtle conservation project: Raine Island turtle study, 2004–2005. Queensland Government Conservation Technical and Data Report, pp. 1–37.

Limpus, C.J., J.D. Miller, V. Baker, and E. Mclachlan. 1983a. The hawksbill turtle, *Eretmochelys imbricata* (L.), in north-eastern Australia: The Campbell Island rookery. *Australian Wildlife Research* 10: 185–197.

Limpus, C.J., C.J. Parmenter, V. Baker, and A. Fleay. 1983b. The Crab Island sea turtle rookery in the north-eastern Gulf of Carpentaria. *Australian Wildlife Research* 10: 173–184.

Linnaeus, C. 1758. *Systema Naturae*. Holmiae, Editio Decima, Reformata, Vol. 1, 824pp.

Logan, P and S.J. Morreale. 1994. Hydrodynamic drag characteristics of juvenile *L. kempi*, *C. mydas*, and *C. caretta*. In B.A. Schroeder and B.E. Witherington, compilers. *Proceedings of the 13th Annual Symposium on Sea Turtle Biology and Conservation*. NOAA-Technical Memorandum NMFS-SEFSC-341, Miami, FL, pp. 248–252.

Loop, K.A., J.D. Miller, and C.J. Limpus. 1995. Nesting by the hawksbill turtle (*Eretmochelys imbricata*) on Milman Island, Great Barrier Reef, Australia. *Wildlife Research* 22: 241–252.

Losey, G., G.H. Balazs, and L.A. Privitera. 1994. Cleaning symbiosis between the wrasse, *Thalassoma duperry*, and the green turtle, *Chelonia mydas*. *Copeia* 1994: 684–690.

Loza, A.L. and L.F. Lopez-Juardo. 2004. Comparative study of the epibionts on the pelagic and mature female loggerhead turtles on the Canary and Cape Verde Islands. In R.B. Mast, B.J. Hutchinson, and A.H. Hutchinson, compliers. *Proceedings of the 24th Annual Symposium on Sea Turtle Biology and Conservation*. NOAA Technical Memorandum NMFS-SEFSC-567, Miami, FL, p. 100.

Lucas, M. 1968. Les cirrhipedes l'Europe. *Les Naturalistes Belges* 49: 105–160.

MacDonald, R. 1929. A report of some cirripeds collected by the S.S. "Albatross" in the eastern Pacific during 1891 and 1904. *Bulletin of the Museum of Comparative Zoology* 69: 527–538.

Margaritoulis, D. 1985. Preliminary observations on the breeding behaviour and ecology of *Caretta caretta* in Zakynthos, Greece. *2e Congrès international sur la zoogéographie et l'écologie de la Grèce et des régions adjacentes*, Athens, Greece, September 1981, 10, pp. 323–332.

Matsuura, I. and K. Nakamura. 1993. Attachment pattern of the turtle barnacle *Chelonibia testudinaria* on the carapace of nesting loggerhead turtles *Caretta caretta*. *Bulletin of the Japanese Society for the Science of Fish (Nippon Suisan Gakkaishi)* 59: 1803.

McCann, C. 1969. First southern hemisphere record of the platylepadine barnacle *Stomatolepas elegans* (Costa) and notes on the host *Dermochelys coriacea* (Linne). *New Zealand Journal of Marine and Freshwater Research* 3: 152–158.

Meylan, A.B. 1983. Marine turtles of the Leeward Islands, Lesser Antilles. *Smithsonian Institution Atoll Research Bulletin* 278: 1–43.

Moore, P.G. 1995. *Podocerus chelonophilus* (Amphipoda: Podoceridae) associated with epidermal lesions of the loggerhead turtle, *Caretta caretta* (Chelonia). *Journal of the Marine Biological Association of the United Kingdom* 75: 253–255.

Monroe, R. and C.J. Limpus. 1979. Barnacles on turtles in Queensland waters with descriptions of three new species. *Memoirs of the Queensland Museum* 19: 197–223.

Moriarty, J.E., J.A. Sachs, and K. Jones. 2008. Directional locomotion in a turtle barnacle, *Chelonibia testudinaria*, on green turtles, *Chelonia mydas*. *Marine Turtle Newsletter* 119: 1–4.

Mustaquim, J. and M. Javed. 1993. Occurrence of *Chelonibia testudinaria* (Linnaeus) (Crustacea: Cirripedia) in coastal waters of Pakistan. *Pakistan Journal of Marine Science* 2: 73–75.

Newman, W.A. and D.P. Abbott. 1980. Cirripedia: The barnacles. In R.H Morris, D.P. Abbott and E.C. Haderlie, eds. *Intertidal Invertebrates of California*. Stanford University Press, Stanford, CA, pp. 504–535.

Newman, W.A., V.A. Zullo, and T.H. Withers. 1969. Cirripedia. *Treatise on Invertebrate Paleontology, Part R, Arthropoda* 4: R206–R295.

Nifong, J.C. and M.G. Frick. 2011. First record of the American alligator (*Alligator mississippiensis*) as a host to the sea turtle barnacle (*Chelonibia testudinaria*). *Southeastern Naturalist* 10: 557–560.

Nilsson-Cantell, C.A. 1921. Cirripedian-Studien. Zur kenntnis der Biologie, Anatomie und Systematik dieser Gruppe. *Zoologiska Bidrag från Uppsala* 7: 75–395.

Nilsson-Cantell, C.A. 1930a. Diagnoses of some new cirripeds from the Netherlands Indies collected by the expedition of His Royal Highness the Prince Leopold of Belgium in 1929. *Bulletin de Musee Royal d'Histoire Naturelle de Belgique* 6: 1–2.

Nilsson-Cantell, C.A. 1931. Revision der Sammulung recenter Cirripedien des Naturhistorichen Museums in Bael. *Verhandlungen der Naturforschenden Gesellschaft in Basel* 42: 103–137.

Nilsson-Cantell, C.A. 1932. The barnacles *Stephanolepas* and *Chelonibia* from the turtle *Eretmochelys imbricata*. *Ceylon Journal of Science, Section B (Spolia Zeylanica)* 16: 257–264.

Nilsson-Cantell, C.A. 1937. On a second collection of Indo-Malayan cirripeds from the Raffles Museum. *Bulletin of the Raffles Museum* 13: 93–96.

Nilsson-Cantell, C.A. 1938. Cirripeds from the Indian Ocean in the collection of the Indian Museum, Calcutta. *Memoirs of the Indian Museum* 13: 1–81.

Nilsson-Cantell, C.A. 1939. Recent and fossil balanids from the north coast of South America. *Capita Zoologica* 8: 1–7.

O'Riordan, C.E. 1979. Marine fauna notes from the National Museum of Ireland 6. *Irish Naturalists Journal* 19: 356–358.

O'Riordan, C.E. and J.M.C. Holmes. 1978. Marine fauna notes from the National Museum of Ireland. 5. Passengers on the North Atlantic currents. *Irish Naturalists Journal* 19: 152–153.

Pajuelo, M., K.A. Bjorndal, K.J. Reich, M.D. Arendt, and A.B. Bolten. 2012. Distribution of foraging habitats of male loggerhead turtles (*Caretta caretta*) as revealed by stable isotopes and satellite telemetry. *Marine Biology* 159: 1255–1267.

Pereira, S., E.H.S.M. Lima, L. Ernesto, H. Matthews, and A. Ventura. 2006. Epibionts associated with *Chelonia mydas* from Northern Brazil. *Marine Turtle Newsletter* 111: 17–18.

Pfaller, J.B., K.A. Bjorndal, K.J. Reich, K.L. Williams, and M.G. Frick. 2006. Distribution patterns of epibionts on the carapace of loggerhead turtles, *Caretta caretta. Journal of the Marine Biological Association of the United Kingdom Marine Biodiversity Records* 1: e36.

Pfaller, J.B., M.G. Frick, F. Brischoux, C.M. Sheey III, and H.B. Lillywhite. 2012. Marine snake epibiosis: A review and first report of decapods associated with *Pelamis platurus. Integrative and Comparative Biology* 52: 296–310.

Pfaller, J.B., M.G. Frick, K.J. Reich, K.L. Williams, and K.A. Bjorndal. 2008. Carapace epibionts of loggerhead turtles (*Caretta caretta*) nesting at Canaveral National Seashore, Florida. *Journal of Natural History*. 42: 1095–1102.

Pillai, N.K. 1958. Development of *Balanus amphitrite*, with a note on the early larvae of *Chelonibia testudinaria. Bulletin of the Central Research Institute of Kerala, University of Kerala, Series C* 6: 117–130.

Pilsbry, H.A. 1916. The sessile barnacles (Cirripedia) contained in the collections of the U.S. National Museum; including a monograph of the American species. *U.S. National Museum Bulletin* 93: 1–366.

Pilsbry, H.A. 1927. Littoral barnacles of the Hawaiian Islands and Japan. *Proceedings of the Academy of Natural Sciences of Philadelphia* 79: 305–317.

Plotkin, P.T. 1996. Occurrence and diet of juvenile loggerhead sea turtles, *Caretta caretta*, in the northwestern Gulf of Mexico. *Chelonian Conservation and Biology* 2: 78–80.

Pons, M., A. Verdi, and A. Domingo. 2011. The pelagic crab *Planes cyaneus* (Dana, 1851) (Decapoda, Brachyura, Grapsidae) in the southwestern Atlantic Ocean in association with loggerhead sea turtles buoys. *Crustaceana* 84: 425–434.

Quigley, D.T. and K. Flannery. 1993. Southern marine fauna and flora from S.W. Ireland. *Porcupine Newsletter* 5: 152–155.

Rainbow, P.S. and G. Walker. 1977. The functional morphology of the alimentary tract of barnacles (Cirripedia: Thoracica). *Journal of Experimental Marine Biology and Ecology*. 28: 183–206.

Ranzani, C. 1817–1818. Osservazioni su i Balanidi. Bologna, opuscoli Scientifici I (1817): 195–202; II (1817): 269–276; III (1818): 63–93.

Rathbun, M.J. 1925. The spider crabs of America. *Bulletin— United States National Museum* 129: 1–598.

Rawson, P.D., R. Macnamee, M.G. Frick, and K.L. Williams. 2003. Phylogeography of the coronulid barnacle, *Chelonibia testudinaria*, from loggerhead sea turtles, *Caretta caretta. Molecular Ecology* 12: 2697–2706.

Reich, K.J., K.A. Bjorndal, M.G. Frick, B.E. Witherington, C. Johnson, and A.B. Bolten. 2010. Polymodal foraging in adult female loggerheads (*Caretta caretta*). *Marine Biology* 157: 651–663.

Reisinger, R.R. and M.N. Bester. 2010. Goose barnalces on seals and a penguin at Gough Island. *African Zoology* 45: 129–132.

Relini, G. 1968. Segnalazione di du cirripedi nuovi per l'Adriatico. *Bolletin de Societie du Adriatica Sciencia Trieste* 56: 218–225.

Relini, G. 1969. La distribuzione dei Cirripedi Toracice nei mari Italiani. *Archaeologie Botanica Biogreoria Italia 4*, 45: 169–186.

Relini, G. 1980. Cirripedi toracici. *Guide per il Riconoscimento delle Specie Animali delle Acque Lagunari e Costiere Italiane* 2: 1–122.

Ren, X. 1980. Turtle barnacles of the Xisha Islands, Guangdong Province, China. *Studia Marina Sinica* 17: 187–197.

Ren, X. 1987. Studies on Chinese Cirripedia (Crustacea) VIII. Supplementary Report. *Studia Marina Sinica* 28: 175–187.

Richards, H.G. 1930. Notes on the barnacles from Cape May County, New Jersey. *Proceedings of the Academy of Natural Sciences of the Philadelphia* 83: 143–144.

Ross, J. 1981. Hawksbill turtle Eretmochelys imbricata in the Sultanate of Oman. *Biological Conservation* 19: 99–106.

Ross, A. and M.G. Frick. 2011. Nomenclatural emendations of the family-group names Cylindrolepadinae, Stomatolepadinae, Chelolepadinae, Cryptolepadinae, and Tubicinellinae of Ross & Frick, 2007—Including current definitions of family-groups within the Coronuloidea (Cirripedia: Balanomorpha). *Zootaxa* 3106: 60–66.

Ross, A. and W.A. Newman. 1967. Eocene Balanidae of Florida, including a new genus and species with a unique plan of "turtle-barnacle" organization. *American Museum Novitates* 2288: 1–21.

Rudloe, J., A. Rudloe and L. Ogren. 1991. Occurrence of immature Kemp's ridley turtles, *Lepidochelys kempi*, in coastal waters of northwest Florida. *Northwest Gulf Science* 12: 49–53.

Ruxton, G.D. 2009. Non-visual crypsis: A review of the empirical evidence for camouflage to sense other than vision. *Philosophical Transactions of the Royal Society B*364: 540–557.

Sazima, C., A. Grossman, and I. Sazima. 2010. Turtle cleaners: Reef fishes foraging on epibionts of sea turtles in the tropical southwestern Atlantic, with a summary of this association type. *Neotropical Ichthyology* 8: 187–192.

Schärer, M.T. 2001. A survey of the epibiota of *Eretmochelys imbricata* (Testudines: Cheloniidae) of Mona Island, Puerto Rico. *Revista de Biologia Tropical* 51: 87–89.

Schärer, M.T. and J.H. Epler. 2007. Long-range dispersal possibilities via sea turtle—A case study for *Clunio* and *Pontomyia* (Diptera: Chironomidae) in Puerto Rico. *Entomological News* 118: 273–277.

Schofield, G., K.A. Katselidis, P. Dimopoulos, J.D. Pantis, and G.C. Hays. 2006. Behaviour analysis of the loggerhead sea turtle *Caretta caretta* from direct in-water observation. *Endangered Species Research* 2: 71–79.

Schwartz, F.J. 1960. The barnacle, *Platylepas hexastylos*, encrusting a green turtle, *Chelonia mydas mydas*, from Chincoteague Bay, Maryland. *Chesapeake Science* 1: 116–117.

Senties, G.A., J. Espinoza-Avalos, and J.C. Zurita. 1999. Epizoic algae of nesting sea turtles *Caretta caretta* (L.) and *Chelonia mydas* (L.) from the Mexican Caribbean. *Bulletin of Marine Science* 64: 185–188.

Sezgin, M., A.S. Ateş, T. Katağan, K. Bakir, and Ş. Yalçin Özkilek. 2009. Notes on amphipods *Caprella andreae* Mayer, 1890 and *Podocerus chelonophilus* (Chevreux and Guerne, 1888) collected from the loggerhead sea turtle, *Caretta caretta*, off the Mediterranean and the Aegean coasts of Turkey. *Turkish Journal of Zoology* 33: 433–437.

Shine, R., F. Brischoux, and A.J. Pile. 2010. A seasnake's colour affects its susceptibility to algal fouling. *Proceedings of the Royal Society B* 277: 2459–64.

Smaldon, G. and I.H.J. Lyster. 1976. *Stomatolepas elegans* (Costa, 1840) (Cirripedia): New records and notes. *Crustaceana* 30: 317–318.

Stinson, M.L. 1984. Biology of sea turtles in San Diego Bay, California, and in the northeastern Pacific. Master thesis, San Diego State University, San Diego, CA, 578pp.

Stubbings, H.G. 1965. West African Cirripedia in the collections of the Institut Francais d'Afrique Noire, Dakar, Senegal. *Bulletin de l'Institut Français d'Afrique Noire, Series A* 27: 876–907.

Stubbings, H.G. 1967. The cirriped fauna of tropical West Africa. *Bulletin of the British Museum (Natural History) Zoology* 15: 229–319.

Tachikawa, H. 1995. Notes on three species of stalked barnacles found from a turtle barnacle on the carapace of a green turtle, *Chelonia mydas. Nanki Seibutu* 37: 67–68.

Turtle Expert Working Group. 2009. An assessment of the loggerhead turtle population in the western northern Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-575.

Utinomi, H. 1949. Studies on the cirripedian fauna of Japan. VI. Cirripeds from Kyusyu and Ryukuyu Islands. *Publications of the Seto Marine Biological Laboratory* 1: 19–37.

Utinomi, H. 1950. Cirripeds commonly taken by dredging near Tanabe Bay (Record of collections dredged from off Minabe Prov. Kii, IV). *Nanki Seibutu* 2: 60–65.

Utinomi, H. 1958. Studies on the cirripedian fauna of Japan. VII. Cirripeds from Sagami Bay. *Publications of the Seto Marine Biological Laboratory* 4: 281–311.

Utinomi, H. 1959. Thoracic cirripeds from the environs of Banyuls. *Vie et Milieu* 10: 379–399.

Utinomi, H. 1966. Fauna and flora of the sea around the Amakusa Marine Biological Laboratory. Part VI., Cirriped Crustacea. *Amakusa Marine Biological Laboratory*, July 1966, pp. 1–11.

Utinomi, H. 1969. Cirripedia of the Iranian Gulf. *Videnskabelige Meddelelser Dansk Naturhistorisk Forening* 132: 79–94.

Utinomi, H. 1970. Studies on the cirripedian fauna of Japan. IX. Distributional survey of thoracic cirripeds in the southeastern part of the Japan Sea. *Publications of the Seto Marine Biological Laboratory* 17: 339–372.

Vivaldo, S.G., D.O. Sarabia, C.P. Salazar, A.G. Hernandez, and J.R. Lezama. 2006. Identification of parasites and epibionts in the olive ridley turtle (*Lepidochelys olivacea*) that arrived to the beaches of Michoacan and Oaxaca, Mexico. *Veterinaria Mexico* 37: 431–440.

Wagh, A.B. and D.V. Bal. 1974. Observations on the systematics of sessile barnacles from the west coast of India-1. *Journal of Bombay Natural History Society* 71: 109–123.

Wahl, M. 1989. Marine epibiosis. I. Fouling and antifouling: Some basic aspects. *Marine Ecology Progress Series* 58: 175–89.

Wahl, M. 2009. Epibiosis: Ecology, effects and defences. In M. Wahl, ed. *Marine Hardbottom Communities. Ecological Studies Series*, Vol. 206. Springer, Berlin, Germany, pp. 61–72.

Wahl, M., O. Mark. 1999. The predominately facultative nature of epibiosis: Experimental and observational evidence. *Marine Ecology Progress Series* 187: 59–66.

Walker, G. 1978. A cytological study of the cement apparatus of the barnacle, *Chelonibia testudinaria* Linnaeus, an epizoite on turtles. *Bulletin of Marine Science* 28: 205–209.

Wass, M.L. 1963. Check list of the marine invertebrates of Virginia. Virginia Institute of Marine Science Gloucester Point, Virginia, Spec. Sci. Rept. No. 24 (revised): 1–56.

Wells, H.W. 1966. Barnacles of the northeastern Gulf of Mexico. *Quarterly Journal of the Florida Academy of Science* 29: 81–95.

Weltner, W. 1897. Verzeichnis der bisher beschriebenen recenten Cirripedienarten. Mit Angabe der im berliner Museum vorhandenen Species und ihrer Fundorte. *Archiv für Naturgeschicthe* 1: 227–280.

Weltner, W. 1910. Cirripedien von Ostafrika. In: *Reise in Ostafrika*. V.A. Voeltzkow, Stuttgart, Germany, 2: 525–528.

Wyneken, J. 1997. Sea turtle locomotion: Mechanisms, behavior, and energetics. In P.L. Lutz and J.A. Musick, editors. *The Biology of Sea Turtles*. CRC Press, Boca Raton, FL, pp. 165–198.

Young, P.S. 1999. Subclasse Cirripedia. In: L. Buckup and G. Bond-Buckup, eds. *Os Crustáceos do Rio Grande do Sul*. Porto Alegre, Ed. Universidade/UFRGS, pp. 24–53.

Young, P.S. and A. Ross. 2000. Cirripedia. In: J.E.L. Bosquets, E.G. Soriano and N. Papavero, eds. *Bioversidad, Taxonomia y Biogeographia de Arthropodos de Mexico: Hacia una Sintesis de su Conocimiento*. Vol. II. Universidad Nacional Autonomia de Mexico, Mexico, pp. 213–237.

Zakhama-Sraieb, R., S. Karaa, M.N. Bradai, I. Jribi, and F. Charfi-Cheikhrouha. 2010. Amphipod epibionts of the sea turtles *Caretta caretta* and *Chelonia mydas* from the Gulf of Gabès (central Mediterranean). *Journal of the Marine Biological Association of the United Kingdom Marine Biodiversity Records* 3: e38.

Zann, L.P. and B.M. Harker. 1978. Egg production of the barnacles *Platylepas ophiophilus* Lanchester, *Platylepas hexastylos* (O. Fabricius), *Octolasmis warwickii* Gray and *Lepas anatifera* Linnaeus. *Crustaceana* 35: 206–214.

Zardus, J.D. and G.H. Balazs. 2007. Two previously unreported barnacles commensal with the green sea turtle, *Chelonia mydas* (Linnaeus, 1758), in Hawaii and a comparison of their attachment modes. *Crustaceana* 80: 1303–1315.

Zardus, J.D. and M.G. Hadfield. 2004. Larval development and complemental males in *Chelonibia testudinaria*, a barnacle commensal with sea turtles. *Journal of Crustacean Biology* 24: 409–421.

Zavodnik, D. 1997. *Chthamalus montagui* and *Platylepas hexastylos* two cirriped crustaceans new to the eastern Adriatic Sea. *Natura Croatica* (Croatian Nat. Hist. Mus.) 6: 113–118.

Zullo, V.A. 1986. Quaternary barnacles from the Galapagos Islands. *Proceedings of the California Academy of Sciences* 44: 55–66.

Zullo, V.A. 1991. Zoogeography of the shallow water cirriped fauna of the Galapagos Islands and adjacent regions in the tropical Eastern Pacific. In M.J. Jones, ed. *Galapagos Marine Invertebrates. Taxonomy, Biogeography and Evolution in Darwin's Islands*. Plenum Publishing Company, New York.

Zullo, V.A. and J.S. Bleakney. 1966. The cirriped *Stomatolepas elegans* (Costa) on leatherback turtles from Nova Scotian waters. *Canadian Field-Naturalist* 80: 163–165.

Zullo, V.A. and W.H. Lang. 1978. Order Cirripedia. In: R.G. Zingmark, ed. *Annotated Checklist of the Biota of the Coastal Zone of South Carolina*. University of South Carolina, Columbia, SC, pp. 158–160.

BIBLIOGRAPHY

Allee, W.C., A.E. Emerson, O. Park, T. Park, and K.P. Schmidt. 1949. *Principles of Animal Ecology*. W.B. Saunders Co., Pennsylvania, PA.

Allen, E.R. and W.T. Neill. 1952. Know your reptiles: The diamondback terrapin. *Florida Wildlife* 6: 42.

Angulo-Lozano, L., P.E. Nava-Duran, and M.G. Frick. 2007. Epibionts of olive ridley turtles (*Lepidochelys olivacea*) nesting at Playa Ceuta, Sinaloa, Mexico. *Marine Turtle Newsletter* 118: 13–14.

Aradas, A. 1869. Desrizione di una nuova specie del genere *Coronula. Atti della Accademia Gioenia di Scienze Naturali in Catania* 43: 215–224.

Arndt, R.G. 1975. The occurrence of barnacles and algae on the red-bellied turtle, *Chrysemys r. rubiventris* (LeConte). *Journal of Herpetology* 9: 357–359.

Aurivillius, C.W.S. 1894. Studien uber cirripedien. *Kongliga Svenska Vetenskaps-Akademien* 26: 1–107.

Ayling, A.M. 1976. The strategy of orientation in the barnacle *Balanus trigonus. Marine Biology* 36: 335–342.

Aznar, F.J., J.A. Balbuena, and J.A. Raga. 1994. Are epizoites indicators of a western Mediterranean striped dolphin die-off? *Diseases of Aquatic Organisms* 18: 159–163.

Baer, J.G. 1951. *Ecology of Animal Parasites*. University of Illinois Press, Urbana, IL.

Barnes, M. 1989. Egg production in cirripedes. *Oceanography and Marine Biology Annotated Review* 27: 91–166.

Bleakney, J.S. 1967. Food items in two loggerhead sea turtles, *Caretta caretta caretta* (L.) from Nova Scotia. *Canadian Field-Naturalist* 81: 169–272.

Booth, J. and J.A. Peters. 1972. Behavioral studies on the green turtle (*Chelonia mydas*) in the sea. *Animal Behaviour* 20: 808–812.

Bourget, E. 1977. Shell structure in sessile barnacles. *Naturaliste Canadien* 104: 281–323.

Briggs, K.T. and G.V. Morejohn. 1972. Barnacle orientation and water flow characteristics in California grey whales. *Journal of Zoology* 167: 287–292.

Cake, E.W., Jr. 1983. Symbiotic associations involving the southern oyster drill *Thais haemastoma floridana* (Conrad) and macrocrustaceans in Mississippi waters. *Journal of Shellfish Research* 3: 117–128.

Carr, A. 1952. *Handbook of Turtles*. Cornell University Press, New York.

Carr, A. 1964. Transoceanic migrations of the green turtle. *Bioscience* 14: 49–52.

Carr, A. 1965. The navigation of the green turtle. *Scientific American*. 12: 79–86.

Chen, Y. 1989. Cirripedia. In C. Wei and Y. Chen, eds. *Fauna of Zhejiang: Crustacea*. Zhejiang Science and Technology Publishing House, Hangzhou, Zhejiang Province, China, pp. 38–73.

Crisp, D.J. 1960. Mobility of barnacles. *Nature* 188: 1208–1209.

Crisp, D.J. 1974. Factors influencing the settlement of marine invertebrate larvae. In P.T. Grant and A.M. Mackie, eds. *Chemoreception in Marine Organisms*. Academic Press, Inc., NY, pp. 177–265.

Crisp, D.J. 1983. *Chelonibia patula* (Ranzani), a pointer to the evolution of the complemental male. *Marine Biology Letters* 4: 281–294.

Crisp, D.J. and J.D. Costlow, Jr. 1963. The tolerance of developing cirripede embryos to salinity and temperature. *Oikos* 14: 22–34.

Crisp, D.J. and H.G. Stubbings. 1957. The orientation of barnacles to water currents. *Journal of Animal Ecology* 26: 179–196.

Dall, W.H. 1872. On the parasites of the cetaceans of the N.W. coast of America, with descriptions of new forms. *Proceedings of the California Academy of Sciences* 4: 299–301.

deAlessandri, G. 1895. Contribuzione allo studio dei Cirripedi fossili d'Italia. *Bollettino della Società Geologica Italian* 13: 234–314.

deAlessandri, G. 1906. Studi monografici sui cirripedi fossili d'Italia. *Palaeon Italica* 12: 207–324.

Eckert, K.L. and S.A. Eckert. 1987. Growth rate and reproductive condition of the barnacle *Conchoderma virgatum* on gravid leatherback sea turtles in Caribbean waters. *Journal of Crustacean Biology* 7: 682–690.

Fabricius, O. 1790. Beschribung zweiter neuer Gattung Meereichein (Lepades) nebst der Islandischen Kammuschel (Ostrea islandica) mit abbildungen. *Schriften der Berlinischen Gesellschaft Naturforschender Freunde* 1: 101–111.

Fabricius, O. 1798. Tillaeg-til Conchylie-Slaegterne *Lepas*, *Pholas*, *Mya*, *Solen. Skrivter av Naturhiftorie Selskabet Kiobenhavn* 4: 34–51.

Felix, F., B. Bearson, and J. Falconi. 2006. Epizoic barnacles removed from the skin of a humpback whale after a period of intense surface activity. *Marine Mammal Science* 22: 979–984.

Fischer, P. 1884. Cirrhipedes de l'archipel de la Nouvelle-Caladonie. *Bulletin de la Société Zoologique de France* 9: 355–360.

Frazier, J. 1986. Epizoic barnacles on pleurodiran turtles: Is the relationship rare? *Proceedings of the Biological Society Washington* 99: 472–477.

Frazier, J.G. and D. Margaritoulis. 1990. The occurrence of the barnacle, *Chelonibia patula* (Ranzani, 1818) on an inanimate substratum (Cirripedia, Thoracica). *Crustaceana* 59: 213–218.

Frick, M.G. and A. Ross. 2002. Happenstance or design: An unusual association between a turtle, and octocoral and a barnacle. *Marine Turtle Newsletter* 97: 10–11.

Gamez Vivaldo, S., D. Osorio Sarabia, C. Peneflores Salazar, A. Garcia Hernandez, and J. Ramirez Lezama. 2006. Identificacion de parasitos y epibiontes de la tortuga golfina (*Lepidochelys olivacea*) que arribo a playas de Michoacan y Oaxaca, Mexico. *Veterinaria Mexico* 37: 431–440.

Geraci, J.R. and D.J. St. Aubin. 1987. Effects of parasites on marine mammals. *International Journal of Parasitology* 17: 407–414.

Gittings, S.R., G.D. Denis, and H.W. Harry. 1986. Annotated guide to the barnacles of the northern Gulf of Mexico. *Texas A&M University Sea Grant College Program* 86–402: 1–36.

Grant, C. 1956. Aberrant lamination in two hawksbill turtles. *Herpetologica* 12: 302.

Gray, J.E. 1825. A synopsis on the genera of Cirripedes arranged in natural families, with a description of some new species. *Annals of Philosophy* 10: 97–107.

Greef, S.R. 1885. Ueber die Fauna der Guinea-Inseln S. Thome und Rolas. *Sitzungsberichte der Gesellschaft zur Beforderung der gesammten Naturwissenschaften zu Marburg* 41–80.

Guess, R.C. 1982. Occurrence of a Pacific loggerhead turtle, *Caretta caretta gigas* Deraniyagala, in the waters off Santa Cruz Island, California. *California Fish and Game* 68: 122–123.

Gutmann, W.F. 1960. Funktionelle morphologie van Balanus balanoides. *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft* 500: 1–43.

Healy, J.M. and D.T. Anderson. 1990. Sperm ultrastructure in the Cirripedia and its phylogenetic significance. *Records of the Australian Museum* 42: 1–26.

Hiro, F. 1937b. Studies on the cirripedien fauna of Japan. II. Cirripeds found in the vicinity of the Seto Marine Biological Laboratory. *Memoirs of the College of Science, University of Kyoto (Series B)* 12: 385–478.

Jackson, C.G., Jr. and A. Ross. 1971. The occurrence of barnacles on the alligator snapping turtle, *Macroclemys temmincki* (Troost). *Journal of Herpetology* 5: 188–189.

Jackson, C.G., Jr. and A. Ross. 1972. Balanomorph barnacles on *Chrysemys alabamensis. Quarterly Journal of the Florida Academy of Science* 35: 173–176.

Jackson, C.G., Jr. and A. Ross. 1975. Epizoic occurrence of a bryozoan, *Electra crustulenta*, on the turtle *Chrysemys alabamensis. Transactions of the American Microscopy Society* 94: 135–136.

Jackson, C.G., Jr., A. Ross, and G.L. Kennedy. 1973. Epifaunal invertebrates of the ornate diamondback terrapin, *Malaclemys terrapin macrospilota. American Midland Naturalist* 89: 495–497.

Johnson, T.W., Jr. and R.R. Bonner. 1960. *Lagenidium callinectes* Couch in barnacle ova. *Journal of the Elisha Mitchell Society* 76: 147–149.

Kadovich, J. 1961. Relationship of some marine organisms of the northeast Pacific to water temperatures, particularly during 1957 through 1959. *California Fish and Game, Fisheries Bulletin* 112: 1–62.

Karuppiah, S., A. Subramanian, and J.P. Obbard. 2004. The barnacle, *Xenobalanus globicipitis* (Cirripedia, Coronulidae), attached to the bottle-nosed dolphin, *Tursiops truncatus* (Mammalia, Cetacea) on the southeastern coast of India. *Crustaceana* 77: 879–882.

Kasuya, T. and D.W. Rice. 1970. Notes on the baleen plates and arrangement of parasitic barnacles of the gray whale. *Scientific Reports of the Whales Research Institute* 22: 39–43.

Kato, M., K. Hayasaka, and T. Matsuda. 1960. Ecological studies on the morphological variation of a sessile barnacle, *Chthamalus challengeri*. III. Variation of the shell shape and of the inner anatomical features introduced by the population density. *Bulletin of the Marine Biological Station of Asamushi, Tohoku University* 10: 19–25.

Key, M.M., Jr., J.W. Volpe, W.B. Jeffries, and H.K. Voris. 1997. Barnacle fouling of the blue crab *Callinectes sapidus* at Beaufort, North Carolina. *Journal of Crustacean Biology* 17: 424–439.

Kim, I.H. and H.S. Kim. 1980. Systematic studies on the cirripeds (Crustacea) from Korea. 1. Balanomorph barnacles (Cirripedia, Thoracica, Balanomorpha). *Korean Journal of Zoology* 23: 161–194.

Kitsos, M., M. Christodoulou, S. Kalpakis, M. Noidou, and A. Koukouras. 2003. Cirripedia Thoracica associated with *Caretta caretta* (Linnaeus, 1758) in the northern Aegean Sea. *Crustaceana* 76: 403–409.

Klepal, W. 1987. A review of the comparative anatomy of the males in cirripedes. *Oceanography and Marine Biology: Annual Review* 25: 285–351.

Kolosvary, G. 1942. Studien an Cirripedien. *Zoologischer Anzeige* 137, pp. 138–150.

Kolosvary, G. 1947. Der balaniden der Adria. *Annales Historico-Naturales Musei Nationalis Hungarici* 39: 1–88.

Kruger, P. 1911a. Beitrage zur Cirripedien fauna Ostasiens. *Abhandlungen der Mathematisch-Physikalische Klasse der Königlich Bayerischen Akademie der Wissenschaften,* II Supplement-Band 6: 1–72.
Lamarck, J.B.A. de M. de. 1802. Mémoire sur la Tubicinelle. *Annales du Museum National d'Histoire Naturelle* 1: 461–464.
Lang, W.H. 1979. Larval development of shallow water barnacles of the Carolinas (Cirripedia: Thoracica) with keys to naupliar stages. NOAA-Technical Report-NMFS Circular-421, pp. 1–39.
Leach, W.E. 1817. Distribution systematique de la class Cirripèdes. *Journal de Physique de Chimie et d'Histoire Naturelle* 85: 67–69.
Leach, W.E. 1818. Cirripedes. In: Supplement to the fourth and fifth editions of the *Encyclopedia Britannica* 3: 168–171.
Lezama, C., M. Lopez-Mendilaharsu, F. Scarabino, A. Estrades, and A. Fallabrino. 2006. Interaction between the green sea turtle (*Chelonia mydas*) and an alien gastropod (*Rapana venosa*) in Uruguay. In M.G. Frick, A. Panagopoulou, A.F. Rees and K. Williams, compilers. *Proceedings of the 26th Annual Symposium on Sea Turtle Biology and Conservation*, Miami, FL, pp. 64–65. ISBN: 960-87926-1-4.
Linnaeus, C. 1767. Systema naturae per regna tria naturae—Edito duodecima, reformata. *Holmiae* 1: 533–1327.
Lutcavage, M.E. and J.A. Musick. 1985. Aspects of the biology of sea turtles in Virginia. *Copeia* 1985: 449–456.
Meischner, D. 2001. Seepocken auf einer Meeres-Schildkröte, ein ökologisches Idyll. *Nature und Museum* 131: 1–7.
Mignucci-Giannoni, A.A., C.A. Beck, R.A. Montoya-Ospina and E.H. Williams Jr. 1999. Parasites and commensals of the West Indian manatee from Puerto Rico. *Journal of the Helminthological Society of Washington* 66: 67–69.
Miranda, L. and R.A. Moreno. 2002. Epibionts from *Lepidochelys olivacea* (Eschscholtz, 1829) (Reptilia: Testudinata: Cheloniidae) in the central south region of Chile. *Revista de Biologia Marina y Oceanografia* 37: 145–146.
Mokaday, O., Y. Loya, Y. Achituv, E. Geffen, D. Graur, S. Rozenblatt and I. Bricker. 1999. Speciation versus phenotypic plasticity in coral inhabiting barnacles: Darwin's observation in an ecological context. *Journal of Molecular Evolution* 49: 367–375.
Monroe, R. 1981. Studies on the Coronulidae (Cirripedia): Shell morphology, growth, and function, and their bearing on subfamily classification. *Memoirs of the Queensland Museum* 20: 237–251.
Mörch, O.A.L. 1852. Cephalophora Catalogus Conchyliorum (Cirripedia) 1: 65–68.
Newman, W.A. 1996. Sous-classe des Cirripèdes (Cirripedia Burmeister, 1834), Super-ordres des Thoraciques et des Acrothoraciques (Thoracica Darwin, 1854—Acrothoracica Gruvel, 1905). *Traité de Zoologie* 7: 453–540.
Newman, W.A. and A. Ross. 1971. Antarctic Cirripedia. *American Geophysical Union, Antarctic Research Series* 14: 1–257.
Newman, W.A. and A. Ross. 1976. Revision of the balanomorph barnacles; including a catalog of the species. *San Diego Society of Natural History* 9: 1–108.
Newman, W.A. and A. Ross. 1977. A living *Tesseropora* (Cirripedia: Balanomorpha) from Bermuda and the Azores: First records from the Atlantic since the Oligocene. *Transactions of the San Diego Society of Natural History* 18: 207–216.
Newman, W.A. and A. Ross. 2001. Prospectus on larval cirriped setation formulae, revisited. *Journal of Crustacean Biology* 21: 56–77.
Nilsson-Cantell, C.A. 1930b. Cirripedes. In: Resultates Scientifiques du Voyage aux Indes Orientales Neerlandaises de LL. AA. RR. le Prince et la Princesse Leopold de Belgique. *Mémoires du Musee Royal d'Histoire Naturelle de Belgique* 3: 1–24.
Nilsson-Cantell, C.A. 1957. Thoracic cirripeds from Chile. *Lunds Universitets Arsskrift N.F. (Series 2)*, 53: 1–25.
Nogata, Y. and K. Matsumura. 2006. Larval development and settlement of a whale barnacle. *Biology Letters* 2: 92–93.
Orams, M.B. and C. Schuetze. 1998. Seasonal and age/size-related occurrence of a barnacle (*Xenobalanus globicipitis*) on bottlenose dolphins (*Tursiops truncatus*). *Marine Mammal Science* 14: 186–189.
Ortiz, M., R. Lalana, and C. Varela. 2004. Caso extremo de epibiosis de escaramujos (Cirripedia: Balanomorpha), sobre una esquilla (Hoplocarida: Stomatopoda), en Cuba. *Revista de Investigaciones Marinas* 25: 75–76.
Pasternak, Z, A. Abelson, and Y. Achituv. 2002. Orientation of *Chelonibia patula* (Crustacea: Cirripedia) on the carapace of its crab host as determined by the feeding mechanism of the adult barnacles. *Journal of the Marine Biological Association of the United Kingdom* 82: 583–588.
Peterson, M.N.A. 1966. Calcite: Rates of dissolution in a vertical profile in the central Pacific. *Science* 154: 1542–1544.

Pilsbry, H.A. 1910. *Stomatolepas*, a commensal barnacle in the throat of the loggerhead turtle. *American Naturalist* 44: 304–306.

Pitombo, F.B. 2004. Phylogenetic analysis of the Balanidae (Cirripedia: Balanomorpha). *Zoologica Scripta* 33: 261–276.

Rees, E.I.S. and G. Walker. 1977. A record of the turtle barnacle *Chelonobia* [sic] *testudinaria* (L.) in the Irish Sea. *Porcupine Newsletter* 5: 189.

Rice, D.W. and A.A. Wolman. 1971. The life history and ecology of the gray whale (*Eschrichtius robustus*). *American Society of Mammalogists, Special Publication* 3: 1–142.

Ridgway, S.H., E. Linder, K.A. Mahoney, and W.A. Newman. 1997. Grey whale barnacles *Cryptolepas rhachinecti* infest white whales, *Delphinapterus leucas*, housed in San Diego Bay. *Bulletin of Marine Science* 61: 377–385.

Riedl, R. 1963. Fauna und Flora der Adria. Cirripedia only, pp. 10–15, pls. 1–2, pp. 18–19, 252–258, Figs. 83–84, 2 maps. Paul Parey Verlag. Hamburg.

Ross, A. 1963a. A new Pleistocene *Platylepas* from Florida. *Quarterly Journal of the Florida Academy of Science* 26: 150–158.

Ross, A. 1963b. *Chelonibia* in the Neogene of Florida. *Quarterly Journal of the Florida Academy of Science* 26: 221–233.

Ross, A. 1964. Type locality of *Platylepas wilsoni* Ross. *Quarterly Journal of the Florida Academy of Science* 27: 278.

Ross, A. and W.K. Emerson. 1974. *Wonders of Barnacles*. Dodd, Mead and Co., New York.

Ross, A. and M.G. Frick. 2007. From Hendrickson (1958) to Monroe and Limpus (1979) and beyond: An evaluation of the turtle barnacle *Tubicinella cheloniae. Marine Turtle Newsletter* 118: 2–5.

Ross, A. and W.A. Newman. 1995. A coral-eating barnacle, revisited (Cirripedia, Pyrgomatidae). *Contributions to Zoology* 65: 129–175.

Ross, A. and W.A. Newman. 2000. *Pyrgoma kuri* Hoek, 1913: a case study in morphology and systematics of a symbiotic coral barnacle (Cirripedia: Balanamorpha). *Contributions to Zoology* 68: 245–260.

Ryder, J.A. 1879. Strange habitat of a barnacle on a gar pike. *American Naturalist* 8: 453.

Samaras, W.F. and F.E. Durham. 1985. Feeding relationship of two species of epizoic amphipods and the gray whale, *Eschrichtius robustus. Bulletin of the Southern California Academy of Sciences* 84: 113–126.

Scaravelli, D. 1998. Segnalazioni faunistiche. 29. *Stomatolepas elegans* (O.G. Costa 1838) (Crustacea Thoracica Balanidae). *Quaderno di Studi e Notizie di Storia Naturale Della Romagna* 10: 78.

Scarff, J.E. 1986. Occurrence of the barnacles, *Coronula diadema*, *C. reginae* and *Cetopirus complanatus* (Cirripedia) on right whales. *Scientific Reports of the Whales Research Institute* 37: 129–153.

Schmitt, W.L. 1965. *Crustaceans*. University of Michigan Press. Ann Arbor, MI.

Seigel, R.A. 1983. Occurrence and effects of barnacle infestation on diamondback terrapins (*Malaclemys terrapin*). *American Midland Naturalist* 109: 34–39.

Shields, J.D. 1992. Parasites and symbionts of the crab *Portunus pelagicus* from Moreton Bay, eastern Australia. *Journal of Crustacean Biology* 12: 94–100.

Southward, A.J. 1986. Class Cirripedia (barnacles). In W. Sterrer, ed. *Marine Fauna and Flora of Bermuda. A Systematic Guide to the Identification of Marine organisms*. John Wiley & Sons, New York, pp. 299–305.

Southward, A.J., ed. 1987. *Barnacle Biology*. A.A. Balkema, Rotterdam, the Netherlands, i–xxii + 443pp.

Southward, A.J. 1998. New observations on barnacles (Crustacea: Cirripedia) of the Azores region. Arquipelago. *Life and Marine Sciences* 16: 11–27.

Spears, T.L., L.G. Abele, and M.A. Applegate. 1994. A phylogenetic study of cirripeds and their relatives (Crustacea: Thecostraca). *Journal of Crustacean Biology* 14: 641–656.

Steenstrup, J.J.S. 1851. Videnskabelige Meddelelser fra den Naturhist. Forening i Kjöbenhavn, for Aaret, 1851. Table 3, Fig. 11–15.

Stunkard, H.W. 1955. Freedom, bondage and the welfare state. *Science* 121: 811–816.

Walker, L.W. 1949. Nursery of the gray whales. *Natural History* 58: 248–256.

Weltner, W. 1895. Die Cirripedien von Patagonien, Chile and Juan Fernandez. *Archiv für Naturgeschicthe* 61: 288–292.

Williams, K.L. and M.G. Frick. 2008. Tag returns from loggerhead turtles from Wassaw Island, GA. *Southeastern Naturalist* 7: 165–172.

Williams, A.B. and H.J. Porter. 1964. An unusually large turtle barnacle (*Chelonibia patula*) on a blue crab from Delaware Bay. *Chesapeake Science* 5: 150–153.

Withers, T.H. 1928. The cirriped *Chelonibia caretta* Spengler, in the Miocene of Zanzibar Protectorate. *Annals and Magazine of Natural History, Series* 10, 2: 390–392.

Withers, T.H. 1929. The cirriped *Chelonibia* in the Miocene of Gironde, France and Vienna, Austria. *Annals and Magazine of Natural History, Series* 10, 4: 566–572.

Withers, T.H. 1953. *Catalogue of Fossil Cirripedia in the Department of Geology*, Vol. 3, Tertiary. British Museum (Natural History), 396 pp.

Yasuyuki, N. and K. Matsumura. 2006. Larval development and settlement of a whale barnacle. *Biology Letters* 2: 92–93.

Young, P.S. 1991. The superfamily Coronuloidea Leach (Cirripedia, Balanomorpha) from the Brazilian coast, with redescription of *Stomatolepas* species. *Crustaceana* 61: 190–212.

Zangerl, R. 1948. The vertebrate fauna of the Selma Formation of Alabama. Part I. *Fieldiana: Geology Memoirs* 3: 116.

Zann, L.P. 1975. *Biology of a Barnacle (Platylepas ophiophilus Lanchester) Symbiotic with Sea Snakes*. University Park Press, Baltimore, MA, pp. 267–286.

Zullo, V.A. 1963. A preliminary report on systematic and distribution of barnacles (Cirripedia) of the Cape Cod region. Marine Biology Laboratory, Woods Hole, MA. Systematics Ecology Program, 33pp.

Zullo, V.A. 1969. Thoracic Cirripedia of the San Diego formation, San Diego County, California. *Contributions in Science Las Angeles County Museum* 159: 1–25.

Zullo, V.A. 1979. Marine flora and fauna of the northeastern United States, Arthropoda: Cirripedia. *NOAA Technical Report NMFS Circular* 425: 1–29.

Zullo, V.A. 1982. A new species of the turtle barnacle *Chelonibia* Leach, 1817, (Cirripedia, Thoracica) from the Oligocene Mint Spring and Byram Formations of Mississippi. *Mississippi Geology* 2: 1–6.

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