THE INTERTIDAL ACORN BARNACLE TETRACLITA VITIATA DARWIN AT HERON ISLAND pdf

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, English, Book, Illustrated edition: The intertidal acorn barnacle Tetraclita vitiata Darwin at Heron Island / by W. Stephenson. Stephenson, W. (William), Get this edition.

Jell a , Julian C. The microbialites consist predominantly of felted aragonite, but blocky Mg-calcite and fringes of acicular aragonite also occur. A variety of microbial bodies and filaments occur within, and on the surface of, the microbialites. Although most Heron beachrock is cemented by isopachous fringes of acicular aragonite, irregular micritic cement is common adjacent to the microbialites. The micritic cement consists predominantly of felted aragonite and contains microbial filaments and organic matter similar to those in the microbialites. Both the microbialite and the micritic cement are interpreted to be biologically induced. Although physico-chemical models, including CO2 degassing and evaporation, are commonly held to be sufficient to promote the formation of beachrock, the similarity of Heron cryptic beachrock microbialite with micritic beachrock cements supports the contention that some beachrock cements are biologically induced. Introduction clude both physico-chemical and biological models. Physico-chemical models involve cement precipi- The origin of beachrock has been considered tation resulting from evaporation e. C61 73 ; models have been proposed for the stabilization and E-mail: The wide variety and irregular distribution of beachrock ce- 2. Setting ment morphologies and mineralogies suggest that a variety of different mechanisms have operated in Heron Island is a roughly elliptical carbonate sand the same, and in different, settings see reviews by cay measuring m by m that occurs on the Bricker, ; Krumbein, ; Scoffin and Stod- western leeward end of Heron Reef, a lagoonal dart, However, physico-chemical models, and platform reef located in the southernmost part of the particularly those relating to CO2 degassing, have Great Barrier Reef, immediately south of the Tropic dominated the recent literature e. Heron Reef is 10 km in length with a maximum Krumbein , p. Bernier and Dalongeville, We interpret the carbonate crusts as a second mode in May to June. Recent drilling in- microbialites and they are hereafter referred to as dicates that there is no permanent freshwater lens such. Heron beachrock microbialite crusts are sim- beneath the cay, but after significant rainfall a fresh ilar in gross morphology to cryptic microbialites to brackish lens may develop. Such a lens is quickly that occur in the subtidal reef frameworks of Heron dissipated by tidal pumping beneath the cay. Prevail- Reef Webb and Jell, ; Webb et al. Swells from the southeast to east- microcrystalline i. Both the microbialite and mi- waves often exceed 3 m in open water. Much of critic cement contain abundant filamentous microbes the wave energy is dissipated at the reef crest, but, i. Aragonite and Mg- at high tide, significant wave sets may reform across calcite micritic cements have been described from the reef-flat and break on the cay shore. Average tidal several other beachrock occurrences e. Although at its disturbed northwestern tip where coarse rub- the study of Heron Island beachrock and micro- ble dredged during enlargement of the boat harbor bialites is incomplete, preliminary observations sug- was dumped. Beachrock occurs intertidally along the gest that microbial communities are capable of in- southern and northern shores with small projections ducing carbonates, including cements, in intertidal also occurring from beneath the beach sands on the G. Locality map of Heron Reef and Heron Island. B Heron Island is a sand cay on the western end of Heron Reef. C Beachrock crops out predominantly on the northern and southern shores of the cay. Specimens described in this paper were collected from the southern beachrock exposure. Heron Island southern beachrock exposure, view toward the west. White scar above notebook represents exposed crypt where a specimen containing microbialites was removed. Note book is 12 cm across. Many bedding planes and joints are solution- edge of the cay Fig. Relict beachrock was enlarged and provide a variety of cavities crypts , identified in a core from beneath the cay. The south- especially in the upper one-third of the exposure ern outcrop is the most extensive and continuous. Along the length of the outcrop, covered by a variety of algae, cyanobacteria, and orthogonal jointing is prominent with one set parallel fungi e. Three strike-parallel zones to shore, another set perpendicular to strike, and a have been distinguished on the basis of surface texthird set parallel to bedding. In places, joints appear ture and algal cover Maxwell, ; Cribb, , to have been recemented. Toward the eastern end of and Davies and Kinsey documented the water the southern beachrock exposure, eroded, detached chemistry within the alga-lined pools over the tidal blocks of beachrock have been recemented into the cycle. Heron beachrock consists of cemented carbonate grains similar in texture, composition, and size to 3. Methods proximal sands and gravels of the modern beach. The sand is primarily composed of algal, coral, mol- Specimens of Heron beachrock from the southern luscan, and foraminiferal grains. Bedding is well de- exposure Figs. In several places, tions, and scanning electron microscopy SEM on one set of beachrock unconformably overlies older freshly broken and polishedâ€"etched surfaces. The exposed crypt from Fig. Back of crypt, below scale, is the vertical wall of a solution-enlarged joint covered by microcolumnar microbialite. The crypt was completely sealed over the top with outside access only along the lower peripheral edge. Scale is marked with centimeters. Observations were not made in the lower with SEM. Stable isotopic ratios of O and C were intertidal range owing to the lack of accessible crypts determined in the Department of Earth Sciences, in the lower seaward part of the beachrock. Micro- University of Queensland using a MME mass bialites occur most commonly on the ceilings of spectrometer. Insoluble residue obtained by etching crypts Fig. They do not occur in all avail- aid identification of organic matter. Microbialites were not observed on surfaces covered by unconsolidated sediment, but were observed in 4. Observations crypts that also contained partially indurated fine sediments that were burrowed by marine worms. Microbialites However, in those cases, microbialites occurred on elevated surfaces away from the fine sediment. Small Heron beachrock microbialites occur in cavities, calcareous worm tubes occur on the same surfaces which mostly represent solution-enlarged bedding as the microbialites and, in some cases, are incorpo- planes, vertical fissures of orthogonal joint sets, rated within the microbialites Fig. Microbialites were observed only in the up- thin crusts and microcolumns that are isolated or co- G. Surface view of cryptic microbialites. A Vertical surface from slab directly opposite vertical surface shown in Fig. Beachrock sand grains are not visible beneath the irregular microcolumnar microbialite. Scale bar is 1 cm. B Ceiling of different crypt covered by microbialite crust of anastomosing microcolumns. Crusts Petrographically, fresh microbialites are light to are hard, but typically are less well indurated than medium brown in thin section and are composed of co-occurring skeletal grains. Some crusts break into microcrystalline to cryptocrystalline carbonate i. Microstructure may be massive Fig. Laterally contin- irregular Fig. Fine skeletal debris is thickness, but individual microcolumns have lengths incorporated into massive and irregular fabrics, but typically between 0. Most individual crusts and microcolumns mm in length, but are rare. Microcolumns are equant are massive, but zonation is recognized on the basis to irregular in outline Fig. In many cases, microcolumns Finely laminated regions are less common. Microcolumns are oriented more or elongate, lath-like or sheath-like crystals lengths be- less perpendicular to the surfaces that they encrust. Where microcolumns which radiate irregularly from well defined surfaces project downward from ceilings, they do not occur or from obvious organic material e. Radiating aragonite fringes and microstalactites e. Stable isotope ratios are C2. Both aragonite and Mg- G. Thin section photographs of cryptic microbialites. A Encrusting calcareous worm tube nestled between sand grains on crypt surface, covered by microbialite. Apparent septum is scratch in glass. B Microbialite encrusting calcareous worm tube on red algal grain bottom. Note fine laminae in distal part of microbialite and incorporated angular sediment. Light-colored material above microbialite crust is poorly cemented and non-cemented debris and organic matter. C Longitudinal section through microbialite microcolumn. Note irregular lamination and massive interior. D Longitudinal section through microbialite microcolumn. Note subtle lamination and irregular dark zone on surface. E Tangential section of crypt surface showing transverse sections of microbialite microcolumns. F Transverse section through microbialite microcolumn. Note irregular lamination and zonation. SEM photographs of etched cryptic microbialites. A Felted aragonite microstructure of microbialite. Note irregular size and orientation of crystals and round filament molds. B Enlargement of A. Note irregular size and shape of crystals. C Aragonite fringes in microbialite representing needles radiating from tubular filament molds. D Aragonite needle fringes radiating from, and encapsulating, filament molds. Filaments are or relative abundance is discernible.

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2: Full text of "Transactions of the San Diego Society of Natural History"

*The intertidal acorn barnacle Tetraclita vitiata Darwin at Heron Island, (University of Queensland Papers, Great Barrier Reef Committee. Heron Island Research Station, v. 1, no. 3) [William Stephenson] on www.enganchecubano.com *FREE* shipping on qualifying offers.*

Elminius plicatus Gray and E. Epopella, containing the most primitive tetraclitids, is inferred to have evolved during the early Paleogene, and it is from this group that Tesseropora and later tesseroporans are derived. Elminius plicatus Gray y E. Epopella, conteniendo las tetraclitids mas primilivas se infiera que ha evolucionada durante del Paleogena, y es de este groupo que Tesseropora y tesseroporans mas tarde eslan derivado. Knowledge of the tetraclitid fauna of Australia, Tasmania, New Zealand, and the islands comprising the Antipodean Province is limited. Aside from the taxon Broch Tesseropora rosea Darwin, Tetraclita purpurascens forma breviscutum was collected by the Th. This species has neither been reported nor found in collections from any other locality and appears to be endemic to the Auckland Islands. Unfortunately, there is little known about the ecology of this tetraclitid. Flowever, he failed to indicate the affinities of this form to other tetraclitid groups. In re-examining the type specimens I noted several salient wall structures that readily characterize this taxon at the generic and specific level and suggest that its affinities are to the tesseroporan rather than to the tetraclitellan lineage Ross, The familial diagnosis presented earlier Ross, Parietal tubes uniformly distributed in one row 2 1. Parietal tubes uniformly distributed in more than two rows, or lacking Parietal tubes bearing transverse septa; scutum lacking depressor muscle crests 1 sp. Parietal tubes lacking transverse septa; scutum bearing depressor muscle crests 5 spp. Inner lamina present; longitudinal septa continuous; sheath adpressed, basal margin not depending 19 spp. Pliocene to Recent Tetraclita 3. Inner lamina absent; longitudinal septa discontinuous; sheath free with basal margin depending 3 spp. Shell large, conic; compartments may or may not be discrete; parietes effectively solid, permeated with cuticular chitin, and commonly discontinuous plates or longitudinal lamina depend from inner surface; radii non-tubiferous, narrow or obsolete; basis membranous; scutum triangular, higher than wide, bearing crests for depressor muscles; tergum narrow, spur not well separated from basi-scutal angle, truncate basally; mandible with 4 teeth, basal comb, and spine4ike inferior angle; maxilla I with spines comprising medial cluster of cutting edge. Pope, the Australian Museum, in recognition of her many contributions to the Cirripedia of the Australian region. Epopella breviscutnm Broch Tetraclita Tetraclita purpurascens forma breviscutum Broch, Tetraclita Telraclitella purpurascens forma breviscutum: Rose Island, Auckland Islands; intertidal; J. Shell low, conic; grayish-white; parietes deeply eroded; growth ridges discernible along basal margin only; orifice pentagonal with peritreme eroded; radii extremely narrow or obsolete, with articular surfaces weakly crenate; compartments weakly articulated when not secondarily fused; no inner lamina; longitudinal septa discontinuous basally, not fused, forming separate, smooth, depending plates Fig. F, G are presented in Table 1. External surface of opercular plates deeply eroded Fig. Shell and opercular plates of Epopella breviscutum. Mandible with 5 teeth including inferior angle Fig. Maxilla 1 deeply notched subapically Fig. Maxilla II taller than broad Fig. Rami of cirrus I grossly unequal in length Fig. Rami of cirrus 11 either essentially equal in length or inner ramus slightly shorter; intermediate articles of both rami squat, slightly protuberant; setae on both rami coarsely bipinnate, not comb-like. Rami of cirrus III antenniform Fig. Cirri IV-VI essentially equal in length with equal rami; short, slender setae at each articulation along greater curvature of intermediate articles; a single row of ctenae occurs along lateral face immediately below articulation; commonly 4 pairs of setae on cirri IV-V, and 3 on cirrus VI Fig. Cirral counts for the specimens in the type lot are summarized in Figure 5. Trophi of Epopella breviscutum. Thoracic appendages of Epopella breviscutum. Lectotype XID , b, c. Graph of range vertical line and mean values dotted line for cirral counts of anterior ramus left and posterior ramus right of Epopella breviscutum. Embryos in mantle cavity average 0. Stage I nauplii in mantle cavity average 0. Broch illustrated the opercular plates and trophi of breviscutum, but failed to select a holotype.

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Because the specimen or specimens he figured are no longer available, the specimens here figured opercular plates, figs. The space between the inner and outer lamina in Tetraclita is filled with a network of continuous longitudinal septa, which in effect create longitudinal tubes. These are more or less uniform in section, and occur in rows with the smallest and shortest tubes parallel to the outer lamina. In Tesseropora and Tesseroplax there is basically but one row of these tubes. Epopella breviscutum lacks an inner lamina, and thus is effectively solid walled. In the tesseroporan lineage, 1 interpret the evolutionary trend then as having been from a solid walled form with diametric growth Ross, Tesseroplax, also with a single row of tubes, is an early derivative of Tesseropora. Much confusion exists over the systematic position of Elminius, largely because certain of the included species are morphologically similar to the Balanidae on one hand and to the Tetraclitidae on the other Darwin, Those similar to the Balanidae have a deeply notched or incised labrum Moore. Those similar to the Tetraclitidae have a shallow or slightly notched labrum Broch, Additional morpholog- ical characters, especially in the shell, as noted below, strengthen the inference that at least two species of Eliminius, namely E. The criteria for forming this group are supported by the distribution of the species involved, all three occurring within the southeastern Australia- New Zealand region. The parietal plates in E. These undoubtedly impart rigidity and strength to the wall and provide a broad base of attachment and vertical support, much as in Emersonius and Chelonobia Ross and Newman, The internal structure of the parietes in E. Similar surficial depressions occur in E. The functional significance of these tubules and depressions remains unknown. Secondary calcification of the parietal tubes in tesseroporans aids in maintaining the shell in environments where it is subjected to abrasion or corrosion. The shell in Tesseroplax is strengthened by apical filling of the parietal tubes, much as in Tesseropora and Tetraclita, and by the formation of transverse septa in the basal portion. In Epopella, deposition of a layer of calcium carbonate between the youngest series of longitudinal septa serves the same function. In the Balanomorpha there has been selection both for structural reinforcement of the shell Darwin, and for the development in deep water forms of a protective mechanism against boring organisms Newman and Ross, in press. However, Epopella and other tesseroporans in general differ from these deep water forms in having a relatively much thicker and more complex wall. There is a considerable interval between the earliest known occurrence Recent of the evolutionary more primitive Epopella and of the more complex Tesseropora Oligocene. Thus the Epopella lineage must be significantly older than the fossil evidence indicates, a conclusion that is also suggested by the morphologically complex shell of E. Therefore, it seems probable that the origin of the tetraclitids should be sought in rocks dating from the Eocene if not the Paleocene or Cretaceous. Elizabeth Pope of the Australian Museum kindly searched the collections in her charge on numerous occasions for specimens, which she has made available to me. Thanks are also due Dr. Newman, Scripps Institution of Oceanography, for many invaluable discussions relating to various aspects of this and earlier studies on the Tetraclitidae. For comparative material and other courtesies I thank Dr. University College of North Wales. Studies on Pacific cirripeds. A monograph on the sub-class Cirripedia, with figures of all the species. The Balanidae or sessile cirripedes: London, Ray Society, , pis. A guide to the littoral balanomorph barnacles of New Zealand. Tuatara 1 5 2: The early stages of some New Zealand shore barnacles. Some littoral barnacles from the Tuamotu, Marshall, and Caroline Islands. Studies on the Cirripedian fauna of Japan. Cirripeds of Formosa Taiwan , with some geographical and ecological remarks on the littoral forms. The balanomorph bamaclesof the Kermadec Islands. Some intertidal barnacles of New Zealand. New Zealand 73 4: A critique on recent concepts of grow th in Balanomorpha Cirripedia: Thoracic cirripedes collected in Function of labial spines, composition of diet, and size of certain marine gastropods. The sessile barnacles contained in the collection of the U. A simplified key to the sessile barnacles found on the rocks, boats, wharf piles and other installations in Port Jackson and adjacent waters. Studies on the Tetraclitidae Cirripedia: The intertidal acorn barnacle Tetracliia vitiata Darwin at Heron Island. Seasonal abundance of first stage nauplii in 10 species of barnacles at Sydney. Box , San Diego, California 92 J

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Vineyard Sound Thalassiosira fluviatilis Phaeodactylum tricornutum Chlorella sp. Columbian coast South of Tasmania 8. Pacific gyre Skeletonema costatum 1â€”6 7. Marine phytoplankton, however, have been credited with assimilation numbers two or three times this value see Table II. Such high assimilation numbers could be the consequence of either 1 errors in the estimate of either photosynthetic CO2 fixation rate or chlorophyll content, or 2 a photosynthetic biochemistry that has the capacity for a several-fold greater rate of CO2 fixation than that in the leaves of land plants. These possibilities are discussed in this review. In coastal and highlatitude regions of the oceans, physical mixing and advection, as well as regeneration, become, however, major processes for supplying nutrients, contributing to greater and seasonally more variable primary productivity in these regions Lorenzen, ; Kirk, , p. Photosynthesis is allowed to proceed for several hours, after which the sample is filtered, washed to remove unfixed , and the remaining radioactivity is measured. Assimilation numbers are calculated from this measurement and an estimate of chlorophyll. In general, the procedure has yielded acceptably high assimilation numbers for Pmax Table II. Nevertheless, there is a widely held suspicion that it gives greatly under-estimated values Round, , p. It is, however, unlikely that the underestimates would be large given that the assimilation numbers obtained are of the same order of magnitude as the accepted Pmax of land plants. Instead, the likelihood of over-estimation needs to be considered. This could result from either erroneously high values of 14C incorporation or erroneously low values for chlorophyll chlorophyll is discussed below. Admittedly it is, at present, difficult to see how either of these possibilities could arise frequently. In what is known of the carbon metabolism of photosynthetic cells, there is, however, no major pathway whereby a separate pool of carbohydrate reserves are respired during photosynthesis. PEP carboxylation may, however, occur temporarily at high rates, using PEP generated from carbohydrate reserves accumulated during active photosynthesis at some other time or place. In attempts to correct for PEP carboxylations, researchers usually include control incubations in the dark. This dark fixation may, however, not all continue in the light; for example, the phytoplankton may carboxylate more PEP in the dark than in the light. This possibility will not be exhaustively discussed here, but four points may be mentioned. First, chlorophyll in small picoplanktonic algae may have escaped detection in the past because the pores of filters were too large to retain these cells. Secondly, acetone does not extract any chlorophyll from intact cells of some algae e. Finally, some microalgae are reported to have chloroplasts so fragile that enzymic degradation of chlorophyll a occurs during preparation of the sample for estimation. The chlorophyllide a would, however, be estimated as chlorophyll a in spectrophotometric and fluorimetric procedures but not using HPLC , so prob ably did not contribute to under-estimates in the past. This would result in high assimilation numbers i. CO2 fixed per unit of chlorophyll a. Most available information argues, however, against this explanation. First, the limiting step that determines photosynthetic capacity at light-saturation is believed to be a reaction of photosynthetic electron transport or of CO2 fixation rather than light-harvesting see p. Thus, the contents of accessory pigments would be irrelevant to the light-saturated rate of photosynthesis. Secondly, even under light-limited conditions where the photosynthetic rate is determined by lightharvesting, high values for carbon fixed per unit of chlorophyll a are unlikely to result from low chlorophyll a contents, because reported values for the latter are similar to those of the leaves of terrestrial plants. Similarly, values of 0. Nevertheless, some scattered information does suggest that certain microalgae may contain relatively little chlorophyll a. Cells that are nutrient-depleted, and thus growing slowly, have low chlorophyll a contents, as evidenced by carbon: Nevertheless, due to their slow growth these cells would not be expected to have high assimilation numbers. The low chlorophyll contents may represent a physiological response of the cells to avoid harvesting more light energy than can be used for growth, thus avoiding photoinhibition see p. But this is not necessarily so: Thus, it is difficult to propose that marine cyanobacteria have notably less chlorophyll a than do eukaryotic photosynthetic cells. This implies that the mean turnover time of the phytoplankton carbon pool in surface water is days, from which it can be inferred that the growth rate of cells varies between low values growth effectively ceased to values typical of rapidly growing cells e. Do such values represent the upper limits for Pmax? It would seem so: Other data are consistent with doubling times being considerably greater than 3 h. This maximum corresponds to a doubling time of 5. Geider concludes from theoretical considerations that a growth rate of 2. Langdon found that the photosynthetic efficiencies of several species were very similar, at about 0. This value predicts that a potential assimilation number of 6. The reader is referred to Eppley for an account of the effect of temperature on phytoplankton production, including observations of temperature coefficient Q10 values close to 2. This parameter Tmin specifies a lower temperature where growth or, in this case, photosynthesis theoretically becomes zero due exclusively to the lowering of temperature. In practice, other factors such as freezing may stop growth before Tmin is reached. Tmin values between Optimum temperatures varied from Leaves of plants grown under high light intensities are capable of higher rates of light-saturated photosynthesis measured with air-levels of CO2 than are leaves of plants grown under low light intensities; this applies whether the rates are expressed on a chlorophyll basis or a leaf area basis, since chlorophyll per unit leaf area varies little between the two groups of plants. A comparable study of a marine microalga Dunaliella tertiolecta , grown at five irradiances between 80 and has been reported recently by Sukenik et al. The response of the microalga to low or high light was, however, rather different to that of plant leaves: The cytochrome fcontent of Dunaliella cells also increased fourfold in response to low light rather than decreasing, as happens in plant leaves. Another electron transport component, plastoquinone which is implicated in the rate-limiting reaction of photosynthetic electron transport: The responses of Dunaliella also differed from those reported for diatoms. Some diatoms but not all contain similar amounts of chlorophyll a, whether grown at low or high light intensities see Kirk, , p. As the efficiency of light absorption is not expected to influence photosynthetic capacity, the variations in chlorophyll a content that are normally observed should not directly influence this parameter. These changes in chlorophyll a level will, however, influence Pmax, because Pmax is an expression of photosynthetic capacity per unit of chlorophyll a. The independence of photosynthetic capacityâ€”and the dependence on Pmaxâ€”on chlorophyll a level needs to be kept in mind when chlorophyll a levels vary considerably. Variation appears to be more common in phytoplankton than in leaves of terrestrial plants, but the tendency in phytoplankton appears to be in the direction of high chlorophyll levels in low-light adapted cells. There is no strong indication that the opposite trend low chlorophyll levels in highlight adapted cells extends to the point where chlorophyll levels are markedly lower and thus Pmax values are markedly higher than for the leaves of sun plants on land. Thus, the complete transit of the four electrons requires eight photons. The total of eight accumulated protons subsequently moves out through a coupling factor that uses the energy in this proton gradient to synthesise 2. As mentioned above, the processes are balanced so that, during carbohydrate synthesis, one CO2 is fixed for each O2 evolved and each eight photons captured: These authors describe how plastoquinone and probably over shorter distances plastocyanin, may diffuse along thylakoid membranes, moving reducing equivalents between three intrinsic supermolecular complexes: KELLY associated light-harvesting pigment-proteins and proteins involved in water-splitting, 2 cytochromes b6 and f and iron-sulphur protein, and 3 photosystem I with associated light-harvesting pigment-proteins and proteins involved in ferredoxin reduction. In contrast, studies of the function of chloroplast membranes from these algae are few, and the highest measured rates of O2 evolution are equivalent to an assimilation number of only 1. If Pmax is indeed limited by the rate of photosynthetic electron transport specifically, by the rate of re-oxidation of reduced plastoquinone: Harris ; Richardson et al. Higher values were obtained for cells grown under low light intensities, which suggests the calculated capacity of would be realistic for field populations of phytoplankton. Because 69 g carbon is 5. Both this calculation and the earlier one, however, represent theoretical extremes. This raises the light requirement to Furthermore, to compensate for dark respiratory losses, and to accommodate the extra photochemical energy needed to assimilate nitrogen including the substantial energy investment of 16 photons to reduce , produce lipids, and power energy-dependent membrane transporters, a value of say would be more realistic. Thus, the cells under the average m2 of ocean actually use about one-seventh of the light energy they are capable of using This relatively low value presumably reflects imperfect light capture because of such factors as uneven packaging of chlorophyll within cells, reaction centres being temporarily closed when photons arrive, optical properties of cell walls and, of course, the cells sometimes being at depths where available irradiance is low. If these estimates are correct, the capacity of algae to convert light energy into biomass restricts ocean photosynthesis to a ceiling of not more than seven times the assimilation number of 0. The assimilation number would then increase to 3. Thus, it must be concluded that if ocean photosynthesis is greater than estimated at present, it must be a consequence of one or more of the following: This value is obtained from the following. The eneregy content of a Thus, the energy in 46 Einsteins of light The energy released by burning an amount of glucose containing 69 g carbon i. When light of shorter wavelengthsâ€”and therefore consisting of higher-energy photonsâ€”is harvested as is common in the marine environment where accessory pigments such as fucoxanthin and peridinin collect blue-green light , the theoretical maximum efficiency of conversion is lower, because the extra energy content of the blue-green photons, as compared with nm photons, is lost as radiation-less thermal deexcitation before any conversion of light energy to chemical energy begins Walker, In addition, the conversion efficiency is further reduced if the more realistic quantum yield of 1 CO2 fixed per. In practice, actual energy conversion is well below the theoretical maximum because only a fraction of the available photons are captured and used see Kirk, , p. On a global scale, only about 0. Lieth gives an even lower estimate of 0. These values appear small. This concentration is little influenced by either pH or salinity. From this equation, it is clear that the concentration of HCO3 will vary with pH. In salt water, H2CO3 is half-dissociated at pH 5. Consequently, the ocean, which is at a slightly alkaline pH of 8. The species of inorganic carbon used for photosynthesis is CO2, which is the substrate for RuBP carboxylase. A low level of CO2 in the environment can limit photosynthesis the growth of wellilluminated C3 plants on land is CO2-limited. In water, the problem becomes greater, because the rate of diffusion of CO2 in water is less by a factor of than that in air Raven Experiments with Dunaliella, Synechococcus, and Ulva indicate that the uptake is not via simple diffusion into the cell, but rather that a carrier presumably a protein actively pumps into the cell, using energy probably ATP generated during photosynthesis. If the pH of the cytoplasm of phytoplankton cells is close to that of leaf cells about 7. This would have a profound influence on the likelihood of photorespiration occurring in marine phytoplankton see p. This enzyme is RuBP carboxylase and the sequence of reactions popularly termed the Calvin cycle permits plant growth because it is able to reduce CO2 to carbohydrate while at the same time regenerating the original amount of the CO2-acceptor RuBP. For example, in Figure 3 the net reduction of three CO2 to one triose-sugar occurs concomitantly with the re-synthesis of the three RuBP ready, as it were, to fix three more CO2. The activity of RuBP carboxylase in phytoplankton must therefore be comparable with observed photosynthesis rates, i.

4: Darwin And The Barnacle | Download eBook PDF/EPUB

Description: Darwin and the Barnacle by Rebecca Stott, lavishly illustrated and superbly told, is the fascinating story of how genius sometimes proceeds through indirection - and how one small item of curiosity contributed to history's most spectacular scientific breakthrough.

He is an international authority on the stomatopod and decapod crustaceans. Research interests include crustacean phylogeny and systematics invasive species and biosecurity, and deepwater faunas. BOCK Philip Bock became fascinated by bryozoans while geological mapping in south-west Victoria, where the sediments are often packed with their skeletons. He took up study of the living bryozoans of southern Australia in order to gain an understanding of their environmental variation. During that period, he taught a wide range of subjects, researched and supervised honours and graduate students in plankton, invertebrates especially Crustacea and Neurophysiology. He is currently Adjunct Associate Professor and regularly tutors in laboratory classes in plankton and crustaceans and gives guest lectures in these subjects and introductory neurophysiology. Zoology University of Wales , M. Plankton University of Southampton , Ph. She received her ix Author Biographies G. Her research on life history evolution uses Australian echinoderms with divergent life histories to investigate the role of evolution of development in generating larval diversity and speciation in the sea. She has published over refereed articles and book chapters. Guillermo Diaz-Pulido grew up in Colombia. He completed his B. Hons in Marine Biology in Colombia in and his Ph. He has done pioneering work on the ecology and diversity of reef algae from the Caribbean Sea and the Great Barrier Reef. His current research focuses on the dynamics of algae after coral disturbances, coral-algal interactions, and impacts of climate change on macroalgae. His fondest memories are more than days spent at sea on the RV Lady Basten working the back deck from midnight to midday. The goal of this research is to understand how these basic features of scleractinian corals respond to the environmental change inclusive of anomalous atmospheric CO2 concentrations. Jon was responsible for commencing and co-ordinating the Representative Areas Program, the major rezoning program undertaken for the Marine Park, between â€” As Principal Research Fellow he currently leads an active research and teaching group on marine tidal wetlands at the University of Queensland Centre for Marine Studies. With his detailed knowledge and understanding of tidal wetland processes he regularly advises on effective management and mitigation of disturbed and damaged ecosystems. His main research interests are sea snakes, island ecology, ants and tardigrades. He also produces videos for educational purposes. He holds a D. The last dealt with vegetation dynamics on the small cays of the Great Barrier Reef. She has worked on coral reefs around the world since Her main research interest is to better understand the roles of environmental conditions and disturbances, including changing water quality, for the biodiversity of nearshore coral reefs. Katharina was awarded a Ph. Her research interests are primarily on taxonomy, systematics, biogeography, and biodiversity, with recent work on the prediction of the presence of marine stingers and prevention and treatment of their stings. She has worked on medusae and ctenophores around the world since , with particular focus on Australian species since While working in Australia she has collected many thousands of specimens, with at least species new to science, including 14 new genera and four new families. After completing his B. Hons Ove travelled to the United States to complete his Ph. After postdoctoral work and lectureship Ove returned to Sydney in In addition, she has been studying the process of bioerosion not only on the GBR but also in French Polynesia, collaborating with French researchers. As well as publishing extensively she has been actively involved in the Australian Coral Reef Society ACRS for many years and commenting on management and zoning plans for Australian coral reefs. KELLEY Russell Kelley is a science communication consultant specialising in invisible or time dependent processes through animation and multimedia techniques. His printed work includes a series of popular publications visualising the biological and physical connections between the Great Barrier Reef and its catchments. He held a personal chair in marine science and has a 43 year association with the University. He worked on coral reef evolution, and changing sea levels, especially on the Great Barrier Reef. The School is a recognised world leader in tropical marine studies. His projects have encompassed a range of latitudes and include a well respected book on temperate marine environments. In addition to research and leadership, he teaches undergraduate and postgraduate students and supervises many postgraduate students. He has received numerous prizes and awards, and was elected to the Australian Academy of Sciences in , for his contribution to reef science. He provides frequent advice to gov- xii P. She has published on the history and roles of museums, taxonomy, conservation, and the Great Barrier Reef and is an internationally recognised authority on the taxonomy of the Ascidiacea. Her research interests include marine mammalian population ecology with an emphasis on life history, reproductive ecology, population dynamics, diet, distribution, abundance and movements of dugongs. She has also supervised several PhD students working on coastal cetaceans. His early interests were in the way plants absorb nutrients. This led to a lifelong interest in the physiology and ecology of algae and seagrasses. He has edited two books on the biology of seagrasses. He is also currently working on the potential effects of global climate change. David completed his undergraduate education at the University of Otago, New Zealand before moving to Melbourne, where he completed an M. His research integrates palaeoecological, ecological, historical, and climate data to provide critical insights into how marine communities are assembled and structured in the face of environmental variability and human impacts over extended periods of time. She obtained her B. She has also worked on a variety of projects in molecular biology and marine mammal ecology. His research over 25 years on seabed habitats and biota, including distribution and abundance mapping, effects of prawn trawling, recovery and dynamics, population modelling and assessments, provides an objective foundation to assist management in achieving sustainability of the seabed environment. Her current research focus is on taxonomy, biogeography, fossil history, evolution and post-bleaching recruitment of family Acroporidae. She is also reviewing the sea anemone fauna of Australia, with Dr Daphne Fautin and others. Formerly he was on the staff of the Zoology Department at the University of Queensland in Brisbane, from where he studied the molluscs of the Great Barrier Reef. During that time he visited research stations on the reef, studying opisthobranchs and bivalves. He is an authority on invasive marine molluscs in Australia. His current research examines the role of different spatial and temporal scales of habitat variability in structuring communities. In addition to research, he has also advised extensively on marine resource management and evaluation of marine reserves in California. He teaches postgraduate sampling and experimental design and statistics, and supervises postgraduate students in a range of different marine projects. He has more than publications. She has researched coral xiv 1. Introduction to the Great Barrier Reef P. The sheer size of the GBR Marine Park over km2 as well its beauty and biodiversity draw people from all over the world. For Australians, the reef is a source of much pride and enjoyment. What is perhaps a surprise is how much more we still need to know about coral reefs like the GBR. The underlying concept behind this book is to describe the patterns, processes, human interactions and organisms that underpin large reef ecosystems like the GBR. Although much of the content of this book is focused on the GBR, we consider it highly relevant to coral reefs in other parts of Australia and the rest of the world. There has been no other comprehensive introduction to the biology, environment, and management of the GBR, especially with regard to the major processes that underpin it or how issues such as deteriorating coastal water quality and climate change affect it. Extending our knowledge and understanding of these processes is vital if we are to sustainably manage the Reef, especially during the coming century of climate change. This book is aimed at undergraduate and postgraduate students and the informed public, as well as researchers and managers who would like to familiarise themselves with the complexity of coral reefs like the GBR. The project arose out of an advanced undergraduate course that has been held on the GBR over the past decade and extensive discussions on the need for a book like this at the ACRS. Through this society and the course, we were able invite the appropriate international experts to contribute to this book. A mosaic of reefs can be seen parallel to the mainland and extending hundreds of kilometres across the GBR. Quasi-true colour image showing the Great Barrier Reef along the continental shelf of north-eastern Australia. Insert shows a closer cross-shelf view of the reefs out from Hitchinbrook, near Townsville. The book is divided into three sections. The various habitats of the GBR are discussed, not only from the point of view of coral dominated ecosystems, but also includes the important associated inter-reefal areas. These components of the GBR, along with catchments and offshore deeper waters, are highly interconnected Fig. Designed and written by science communicator Russell Kelley and published by the ACRS, the Blue Highway poster portrays the reefs of the Great Barrier Reef as part of a larger supporting system that includes the coastal catchments. The poster illustrates how natural nutrient loads from runoff and ocean upwelling fuel a connected mosaic of ecosystems and the role inter-reef habitats play in supporting migrating species as they move from inshore nursery grounds to the outer reefs. Juveniles move from recruitment habitat to reefs and inter-reefal habitats, before they mature. The third and last section of this book, which is perhaps the most important, deals with the diversity of organisms that live in and around coral reefs Fig. In this section, the reader is introduced to the basic taxonomy of the major groups, as well as their biology and ecology. This is a fascinating journey through the unique and wonderful creatures of coral reefs. By weaving the basic taxonomy of these groups together with fascinating details of their lives, it is hoped that the interest of the reader will be inspired to explore this incredible diversity. Throughout this book we come back to the major challenges that reefs face in our changing world. For this reason, our book is unique is in that it reviews the past, current, and future trajectories and management of 3 The Great Barrier Reef Figure 1. Reefs of the world are at risk and knowledgebased management is critical. The GBR is at the forefront of this. It is our hope that this book will help develop a better understanding of coral reefs and to assist in maintaining their ecological resilience in order to allow them to survive the challenges of the future. As editors, we would like to thank the generous contributions from the many authors that have contributed to this book, the production of which would have not been possible otherwise. Individual corals appear to adapt to their ambient environmental conditions, generally also through the tolerance of their zooxanthellae. Temperature excursions, either higher or lower from the normal range, even if withstood by the same species elsewhere, may locally result in expulsion of the zooxanthellae, coral bleaching and possible mortality.

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The species composition and general ecology of intertidal organisms present at Heron Island, a coral cay in the Capricorn Group, are recorded in this paper.

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