The chiton fauna (Mollusca: Polyplacophora) of South Africa

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‘I know the meaning of plagiarism and declare that all of the work in the dissertation, save for that which is properly acknowledged, is my own.

Signed: Signed by candidate

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Abstract:

Chitons are a diverse class of molluscs inhabiting marine waters and constitute a significant, yet relatively underexplored group of invertebrates in South Africa. Over the past three decades, taxonomic research has resulted in a pronounced increase in the description of regional chiton species, with the result that the most recent (1985-2006) series of global monographs on chitons by Kaas and Van Belle now cover only 22 of the 50 chiton species currently recognised from the region, highlighting the need for a new synthesis of the fauna. This dissertation documents all the known chiton species inhabiting South African waters and adds new records of species that were previously undocumented. The study identifies an additional eight species new to the region from South African museum collections. A remarkable endemism is found in this group, with 46% of chiton species in South Africa found nowhere else. Of these endemics, 34% can be found only on the South Coast. The dissertation also includes a complete species list of the region and a user-friendly field guide that highlights key taxonomic features of the region's chiton species, with an accompanying binomial key for identification of species. It includes photographs and illustrations to aid in species identification, as well as a distribution map for each species. Chitonida is the largest order found in the region, with Acanthochitonidae, Chaetopleuridae, Chitonidae and Ischnochitonidae as four of the largest families in the region. *Leptochiton* is the most diverse genus in the region, also indicating a relatively high species richness in deeper waters. Chiton species of the region exhibit a greater species richness to the east and a higher endemicity to the South, with 56% of the species found on the South Coast endemic, though there seem to be a low intensity of collection on the Eastern coast. Although this dissertation adds significantly to the regional chiton fauna, further sampling and research is needed to comprehensively resolve and describe all the species and to assess their conservation status, given the anthropogenic threats these species face, including habitat destruction and possible unethical and unregulated collections.

Chapter 1: Introduction and overview

Polyplacophora, commonly referred to as chitons, coat-of-mail shells, or s uck-rocks, represent a fascinating class of molluscs, boasting more than 1000 extant species and constituting the third-largest taxon among the Mollusca. Members of this group display an oval or elongated, bilaterally-symmetric, dorsoventrally-flattened body plan. They possess a calcareous shell consisting of eight plates, known as valves, surrounded by a soft girdle adorned with various protective elements, such as bristles, spines, or scales.

Polyplacophora can be divided into three orders: Callochitonida (52 species), Chitonida (843 species), and Lepidopleurida (202 species) (data from WoRMS, accessed 18 Oct. 2023). However, the group continues to remain relatively understudied, as evidenced by the frequent discovery of new species whenever chiton habitats are explored. For instance, Reyes-Gomez *et al.* (2017) recently identified nine new species within a singular reef system in Mexico. Moreover, the multitude of synonyms, arguments for reinstatements, and developments in chiton systematics by Sirenko (2006) and others highlight ongoing uncertainty regarding the most reliable methods for identifying chiton species.

The need for chiton research is particularly pressing in South Africa and there are no current taxonomists in South Africa working on this group. Understanding the local chiton fauna is not only ecologically significant, but also holds economic importance. Chitons are used as bait for fishing in local regions, as food resource in traditional communities, and even considered a delicacy in various countries like Mexico (Avila-Poveda, 2020). While the precise reasons and extent of their use in traditional medicine are not fully comprehended, it is noteworthy that chitons are among the most traded invertebrate animals for traditional medicine in KwaZulu-Natal (Herbert *et al*., 2003). This raises concerns about potential overexploitation, particularly if the extraction of these species is not properly controlled, especially as global food sources decline. The ethical considerations surrounding the sale of live chitons are also intricate, often intertwined with the social dynamics and traditional beliefs of local communities. Overexploitation of inshore marine invertebrates is a known issue on the East coast , due to high human population densities (Griffiths *et*

al., 2010). Avila-Poveda (2020) published a paper on the emergence of coastal organism fisheries, with a specific focus on the economic importance of protecting such species through fishery regulations. Works of this nature become increasingly crucial for safeguarding species, but it is the foundational taxonomic research that sets the stage for the practical applications and protection of these valuable organisms.

This dissertation attempts to collate existing information on the chiton fauna within mainland South Africa's Exclusive Economic Zone (EEZ). It is important to note that island territories outside these borders, such as the Prince Edward Islands, are excluded. The South African EEZ is an area of remarkable oceanographic and faunal diversity. It is flanked by the Indian Ocean to the East and the Atlantic Ocean to the West, so the coastal environment varies from subtropical to temperate. This region encompasses a total of nine distinct marine bioregions, namely the Namaqua, South-Western Cape, Atlantic offshore, Agulhas, Indo-Pacific offshore, West Indian Offshore, Natal, Delagoa, and South West Indian offshore. Notably, five of these bioregions are coastal regions (Griffiths *et al.* 2010).

The South African EEZ supports a rich biodiversity, comprising more than 13,000 described marine species, of which approximately 33% are endemic (Griffiths *et al*. 2010). Although there are numerous Marine Protected Areas (MPA's) established along the coastline, covering approximately 23% of the coastal zone, it is a matter of concern that only about 9% of these areas are considered to have received adequate protection (Griffiths *et al.,* 2010). Furthermore, this protection is not uniformly distributed across the region, with a noticeable spatial imbalance favouring the East Coast in terms of coverage and enforcement, with few reserve areas along the West coast.

This dissertation aims to update and revise the species list and provide a descriptive account of the chitons of South Africa. To accomplish this, an exhaustive compilation and review of all pertinent literature pertaining to South African Polyplacophora was undertaken to extract crucial taxonomic data. The World Register of Marine Species (WoRMS) website played a pivotal role as a valuable resource for cross-referencing and updating the taxonomic status of the species documented. Additionally, field visits

were conducted to two major museums in South Africa that house significant collections of chitons: the Natal Museum of South Africa (NMSA) and the Iziko South African Museum (IZIKO). During these visits, specimens of all chiton species from South Africa, housed within these museums, were examined. This led to the identification of several species that were already in the collections, but had not previously been reported in the scientific literature as present in the South African region.

This dissertation is structured into four chapters:

Chapter 1: This initial section serves as a preamble to the entire work. It encompasses a historical overview of the taxonomy of South African chitons. Additionally, it offers a summary of the anatomical characteristics utilized for distinguishing chiton species. The introduction also elaborates on the methods employed in gathering and utilizing information for this project. Furthermore, it includes a glossary of terms to facilitate understanding for readers.

Chapter 2: This chapter provides a detailed account of newly identified chiton species that have been incorporated into the regional fauna as a result of re-examination of existing museum collections. These additions comprise species previously documented primarily from countries in the Western Indian Ocean North of South Africa, but not previously described in South Africa itself.

Chapter 3: This section provides a comprehensive field guide to the South African chiton fauna. It encompasses a practical key designed to aid in the identification of known chiton species from the region. This is followed by species account of each species which include a concise diagnostic description, distribution map and standardized photographs or illustrations.

Chapter 4: This comprises a brief discussion which reviews taxon and diversity distribution in the South African region, delves into the implications of these patterns and ponders potential future priorities and challenges in regional chiton research.

History of Polyplacophora taxonomy in South Africa:

The inception of South African chiton taxonomy can be traced back to a follow-up on Linnaeus' "Systema Naturae" by Gmelin in 1791. In this seminal taxonomic publication, Gmelin documented the largest chiton species in South Africa, *Dinoplax gigas*, alongside species from around the world.

Subsequently, in 1797, Spengler made a significant contribution by describing three new chiton species from the region. Building upon this foundation, Blainville's comprehensive work in 1825 encompassed species descriptions from diverse regions worldwide and an additional two descriptions for South Africa. Just three years later, in 1828, Gray added to the growing body of knowledge by describing one more chiton species from South Africa.

Reeve's groundbreaking work in 1847 marked the publication of the very first monograph on chitons which included South African chitons. Within this pioneering monograph, Reeve described six distinct chiton species from South Africa, all originating from the Cape of Good Hope. Among these, two have since been synonymized, though it is worth noting that only one of the six species represented a new description at that time.

Subsequently, in 1848, Krauss emerged as the first author to concentrate solely on the South African region. His comprehensive study encompassed molluscs from all orders and he documented 17 chiton species indigenous to the region. Among these, five were eventually synonymized into two presently recognized species, while three constituted new descriptions of South African chitons. Additionally, three species were documented, but not accepted as distinct species from the region. This ultimately accounted for all 11 species known at that point in South Africa.

Following this, Pilsbry (1898-1894) described two new species from South Africa and included a valuable key for identifying chitons on a global scale. Sykes (1899) contributed to South African chiton fauna by introducing a new species of *Dinoplax*,

with another new description of a novel South African chiton. He also introduced another in his publication in 1901, which specifically focused on South African species. Further additions to the chiton taxonomy came through global revisions, including the work of G. B. Sowerby III in 1903 and Thiele in 1906 and 1909. Nierstrasz described one more species in 1906 in a publication dedicated to South African chitons. This work not only introduced a new species, but also documented another 11 known species from the region.

After a period of relative inactivity in the study of South African chitons, Ashby emerged as a prominent figure in 1931, publishing a monograph on the group. Prior to this, in 1928, Ashby had introduced a new chiton species in his work, but it was his monograph in 1931 encompassing descriptions of 29 chiton species from the South African region that had the most significant contribution, although only 19 of these species are currently recognized. Within this comprehensive work, one new species was described, 10 were identified as synonyms of previously described species, and eight were provided with the correct, presently accepted species names. In 1934, Ashby contributed yet another species to the South African chiton fauna through a publication that delved into the diversity of *Dinoplax* species in the region. Hereafter, a singular species description was undertaken by Koch in 1951, preceding Barnard's noteworthy work in 1963. In this publication, dedicated to the molluscs of South Africa, Barnard described a total of three new chiton species. The publication provided detailed insights into 24 chiton species from South Africa, all of which are currently recognized, though 11 names have since been updated. In addition, Bullock described a new chiton species in a publication centred on chitons from the western Indian Ocean in 1972.

Following this period, Kaas emerged as a significant contributor to South African chiton taxonomy, making substantial contributions to the field. In 1985, his work led to the description of three new chiton species. Furthermore, the monumental "Monograph of Living Chitons," authored by Kaas and van Belle in 1985-1990, introduced two additional new chiton species from South Africa. Strack, who worked extensively on chitons globally, contributed to the sixth volume of this monograph. In 1996 he also described a new chiton species originating from South Africa.

Over the subsequent years, seven additional new chiton species have been described. Notably, Sirenko played a dominant role in documenting and describing species from the South African region over the past 23 years. In 2014, Muratov made a valuable contribution by photographing all type specimens in the Natal Museum of South Africa (NMSA). Furthermore, the taxonomic clarification of *Craspedochiton* was achieved through the collaborative efforts of Schwabe and Els in 2019.

An accumulation curve showing the increase in numbers of chiton species known from South Africa over time is shown in Figure 1.1. This shows a steady increase of species descriptions over time, although with considerable gaps (1800-1820,1850-1890, 1940-1950), where no papers were published. Certainly there is no indication of a slowing down in the discovery rate, suggesting that many species still remain to be added to the fauna.

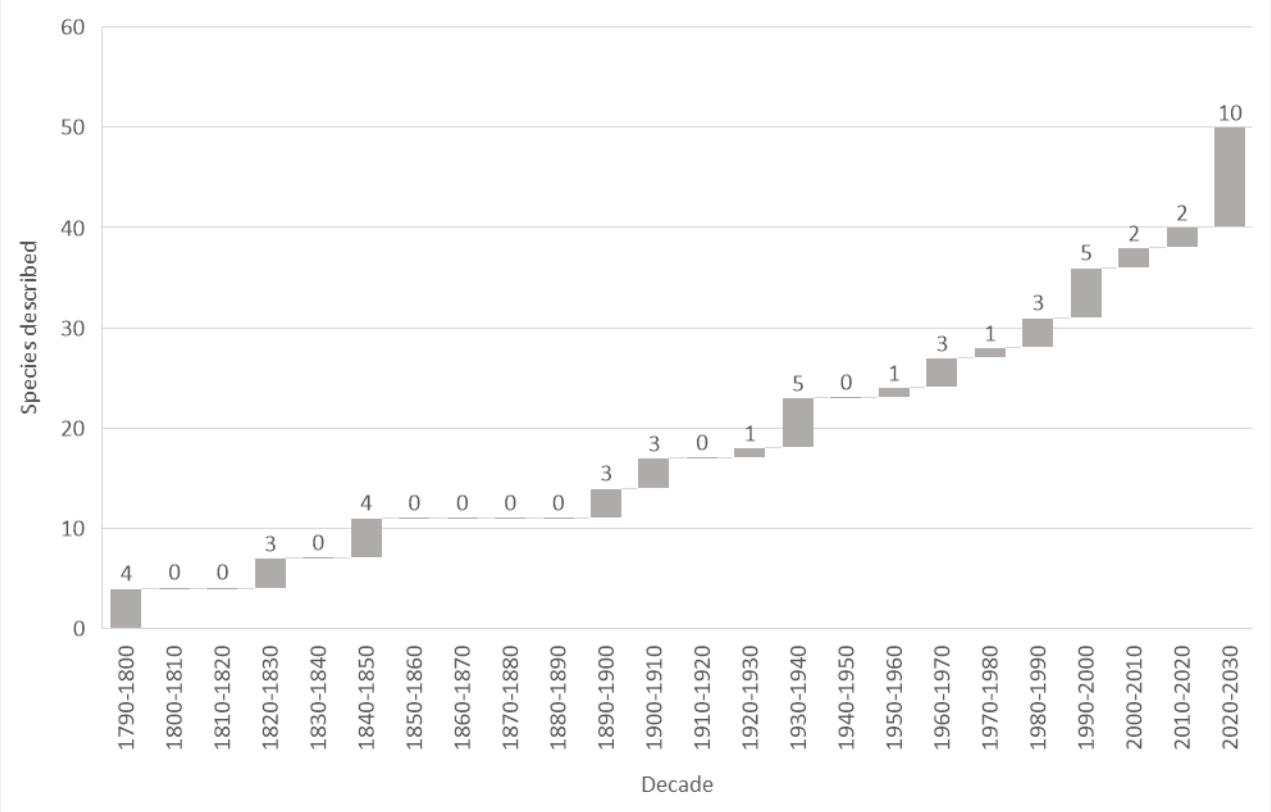

Figure 1. 1: Rate of accumulation of the known chiton faun of South Africa 1790 to present, including species recorded herein for the first time.

Despite the considerable efforts dedicated to chiton taxonomy in South Africa, several challenges also persist within the fauna as currently described. In particular understanding of the genera *Craspedochiton* and *Dinoplax* remains confused. These

challenges are exacerbated by a history of literature that has at times synonymized and altered species ranks, only to be revised once more by subsequent researchers (Schwabe and Els, 2019). For many chiton species in this region, the landscape is characterized by numerous synonyms and confusing generic classifications. Furthermore, a lack of comprehensive illustrations and descriptive features in species descriptions compounds the limited knowledge of chitons in South Africa (Schwabe and Els, 2019). While efforts have been made by authors like Schwabe and Els (2019), Kaas, Van Belle and Strack (1984-2006), and more recently Sirenko (2023) to clarify the taxonomy of certain genera in the region, it is important to acknowledge that taxonomic work is an evolving process.

In light of these challenges, phylogenetic studies employing genetic material have emerged as a valuable tool for understanding various taxa. This approach will be explored further in subsequent discussion, as it offers a promising avenue for addressing the complexities of chiton taxonomy. However, this dissertation focus more on taxonomy than systematics.

Identifying chitons:

The dearth of published authors from South Africa focusing on chitons in the region and the scarcity of common names for chiton species imply a lack of knowledge about this group, not only among scientists, but also among the public. This seems surprising, considering that these animals are easily accessible. Chitons are mostly found in the intertidal to subtidal zone, with only a small portion of genera inhabiting deep waters. They can be found firmly clinging to mostly smooth substrata using their foot and girdle.

Various publications focusing on classification methods for chitons have been considered and discussed. Some systems have been developed to delineate families from each other, while other have discussed taxonomy of species identification characteristics In early research, the focus was solely on the shell of the animals. Sirenko, however, proposed a classification system that incorporated other characteristics, such as the girdle, aesthete canals of the shell, gills, radula, and

more (Sirenko, 2006). Though this was a system of classification, some important diagnostic features were explained that could also prove useful in identification of species within a clade. Van Belle (1983) thoroughly discussed previous classification systems, but as these often focused on singular or few characteristics, Sirenko (2006) consequently called them "artificial." These characteristics seem to have been more important for taxonomical identification than for systematics. Bergenhayn (1955) omitted girdle characteristics, which could be helpful to a certain point, as the shell is more easily preserved than the girdle parts. This was used by most authors for taxonomic diagnostic feature descriptions, explaining the large range of synonyms and misplacement of genera on many species recognized today. Shells may be similar, but other characteristics could delineate one species from another— especially in heavily-eroded specimens. Ashby (1929, 1931) used many more characteristics for his system of classification, forming the basis for recent systems. The point made by Sirenko (2006) was certainly a compelling argument in support of his idea to base systems on as many characteristics as possible, which holds great significance when studying phylogenies and the evolution of chitons. However, adapting some of these features to taxonomy, one must exercise caution, as this approach could result in variations within a single species being identified as different species, which is a current challenge faced with many South African Polyplacophora taxa, such as *Craspedochiton* and *Dinoplax*. Therefore, only the basic features currently used to taxonomic descriptions are added to the diagnostic species features in this dissertation. Finer details may be added to the “remarks” sections of each entry. The diagnostic characteristics are explained in the methodology to follow, which is based off Schwabe (2010) and is the standard used in modern chiton taxonomy. Certain characteristics, now considered important, were missing from original and even previous re-descriptions. Although efforts have been made to fill as many of these gaps as possible, a few remain undefined.

Apart from the abovementioned, genetic analysis is a relatively new method of systematics, aiming to define groups in a more objective manner. However, this approach sometimes proves confusing, as certain phylogenies extracted from DNA analysis do not align with the morphological features identified and used to divide groups by experts like Sirenko (2006). This discrepancy does not imply that genes "lie," but rather suggests that the interpretation or reading of these genes might not

yet be at the level required to link genetic material to morphological characteristics effectively, resulting in a coherent system for taxonomists. Nonetheless, this branch of research on Polyplacophora is advancing and has facilitated a better understanding of phylogenies of different groups, as demonstrated by studies conducted by Sigwart *et al*. (2011). Incorporating these genetic studies in coherent of morphological based systems, such as this one, discrepancies between literature might be resolved in future and genetic research could also extend to taxonomic identification in the future, not just systematics.

Anatomical features used in identification:

Chitons are strictly marine, although a few species tolerate salinity fluctuations. Their life history starts with pelagic trochophores with a short lifecycle, quickly transforming into baby chitons that inhabit various marine substrata. Chitons lack sensory cephalic organs, such as eyes and tentacles, but some taxa, like *Lucilina* and *Callochiton*, have light-sensitive spots called shell eyes and eye spots, respectively, on their valves (Varney *et al.,* 2024). These eyes or spots enables the animal to perceive light and seek refuge during the day. Thus, with some exceptions, most species tend be found under rocks or in crevices during the day, and are more active in the open at night.

All of the anatomical features that follow are adapted from Schwabe (2010).

The head valve (HV, or valve i) of a chiton, sometimes called the anterior valve, is followed by six intermediate valves (IV or valves ii-vii), followed by the tail valve (TV or valve viii), sometimes called the posterior valve (Fig. 1.2a (I)). The HV and TV can also be called the terminal valves, collectively. The TV is extremely important for species identification, as it holds information on all the sculpture present on the valves, with the addition of the mucro features. These animals can curl up for protection when disturbed using muscles and tendons between their articulating valves. This characteristic makes studies on preserved specimens challenging, as the specimens are often curled up and too brittle to be flattened for study. The size of chitons varies from about 2 to almost 200mm among some specimens of the giant chitons (*Dinoplax*) in South African waters.

The valves consist of three layers (from top to bottom): the properiostracum, the tegmentum, and the hypostracum (articulamentum and myostracum), while some species also contain a mesostracum – a layer between the tegmentum and articulamentum. Only the tegmentum and articulamentum is crucial for species identification (Figure 1.2b (II)). The tegmentum of the IV zonate into a central area and two lateral areas (Figure 1.2b (I)). In most species, the articulamentum projects on the sides of the tegmentum, forming insertion plates and eaves, which are tegmental edges overhanging the attachment points to the articulamentum (Figure 1.2b (II)).

Insertion teeth, created as bridges between extended slits in the articulamentum, embed the insertion plates into the soft girdle tissue. Additionally, the articulamentum projects anteriorly in the intermediate valves and tail valve, creating projections known as apophyses (sutural laminae), as seen in Figure 1.2b(I). These apophyses enable the animal to roll up and protect itself by articulating with the anterior valve before. The apophyses are divided by a jugal sinus, sometimes with a jugal lamina (connection between the apophyses), which corresponds with the jugal area on the dorsal side of the valve, which is a triangular swelling or lifted area along the middle of the valve. The top of the tail valve is often indicated by a swelling called a mucro (Figure 1.2b(I)). This divides the tail valve into two areas: an antemucronal area (sculptured like the central area) at the anterior side and a postmucronal area (sculptured like the head valve and the lateral areas) on the posterior side.

The shell is surrounded by a girdle, sometimes called the mantle, consisting of a perinotum (dorsal part) and hyponotum (ventral part), which ventrally surrounds the foot (Figure 1.2a (II)). The perinotum carries girdle armature, such as spicules or scales, and sensory organs that serves as receptors, while the hyponotum most often carries scales. These elements are very important in identification of a species. At the anterior end of the foot there is a mouth visible from the head, as seen in Figure 1.2a (II). Sometimes mouth lappets extending anteriorly are also visible. *Lepidopleurida* shows a pigmented stripe exterior to the mouth lappets. On the posterior end of the foot is the anus on a tiny papilla

Between the girdle and the foot lies a pallial groove, sometimes called the mantle cavity, containing the gills (Kaas & van Belle, 1989:9). Between this groove and the

hyponotum, there is a pallial- or mantle fold. This fold can extend laterally to form a mantle lappet at the posterior end. The mantle fold also assist carnivorous chitons to catch prey by the building of precephalic tentacles. Chitons also possess a radula of 17 teeth per transverse row, similar to other molluscs, but more simple and conserved, used for scraping food off the substrata. However, there has been reports that the radula can vary between individuals of the same species, or be similar between different species, making it less reliable for taxonomic identification. This, however, could be mutations. Therefore, minor differences in the radula can hold taxonomic value, and therefore radula descriptions are included in species descriptions in this project where possible, specifically for the head of the major lateral tooth, which can show distinct points (cusps or denticles) (Schwabe, 2010; Kaas & van Belle, Vol 1; Smith, 1960). It is essential to note that with some exceptions, chitons cannot reliably be identified by their colour, due to significant colour variations within species.

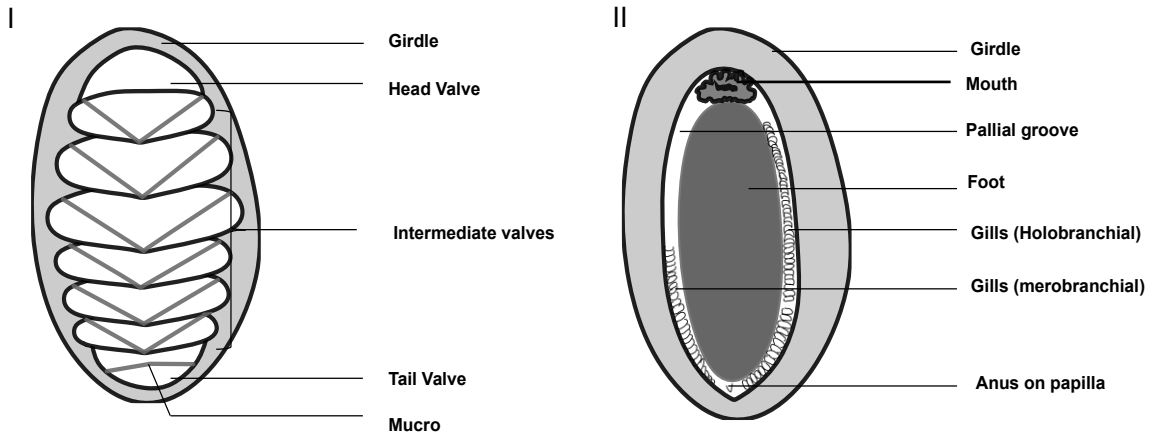

Figure 1.2a: I: Dorsal view of a chiton; II: Ventral view of a chiton.

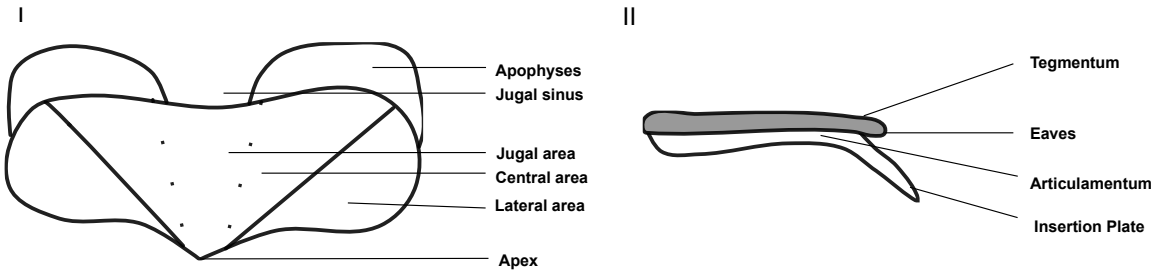

Figure 1.2b: I) Dorsal view of a chiton valve; II) Lateral view of a chiton valve.

Methods:

To standardise the method for describing the various characteristics of chiton, form, size and elevation was described by using the values from Table 1, with form classified by length to width ratios (Middendorff, 1947), size classified by length (Iredale & Hull, 1924) and elevation classified by height to width ratios of the fourth valve (Kaas and van Belle, 1981).

Table 1.1: Criteria for form, sized and elevation classifications.

Form		**Size**		**Elevation**	
Broad oval	>0 – ≤1.5	Small	≤15mm	Low	≤0.25
Oval	>1.5 - 3.5	Medium	>15-30mm	Moderate	>0.25-0.45
Elongate oval	>3.5	Large	>30mm	High	>0.45

Valve descriptions follow that of Schwabe (2010), where the HV have a diagnostic posterior margin (straight with a possible apex or widely v-shaped with a possible deep semicircular notch). The posterior valve margin is formed by the lateral areas of the intermediate valves, which can be straight, concave or convex. This margin can sometimes form an apex. Areas on intermediate valve are described as mentioned earlier and displayed in Figure 1.2. The mucro of the tail valve can move anterior or posterior from the centre of the valve, and this is also use for species identification. Furthermore, the postmucronal area, when viewed from the side, shows a profile of either straight, convex or concave. See Schwabe (2010) for more details on the valve areas and forms.

The slit formulas for intermediate valve slits are given using the number of slits on head valve/ number of slits on one side of the intermediate valve/ number of slits on tail valve. Additionally, the number of gills on species changes with age, and hence this information is not provided. However, the placement of gills remains constant and can be either merobranchial (placed in the posterior half of the pallial fold) or holobranchial, extending from anterior to posterior in the pallial fold. Furthermore, the gills can be abanal (with only one gill behind the nephriodophore – the excretory pore of the kidney) or adanal (Schwabe, 2010).

Whenever possible, live images are provided, but many species have not been

photographed alive and here, museum specimens were photographed, or, in the worst cases, drawings were made when specimens were not available for photography. Scale bars of 1mm are provided, unless otherwise stated.

Girdle armature and tegmental sculpture are among the most important field identification characteristics of chitons. Consequently, detailed drawings of each species' girdle elements are included, as not all photographs can clearly display the details of these parts. All these drawings are original. The valve sculpture may vary throughout the organism's ontogeny and may, therefore, look different from the photographs in some instances and under different environmental conditions. Additionally, maps are included to show the known distribution of species as based on museum records and websites such as GBIF, OBIS and WoRMS.

The taxonomic key and diagnoses in this guide primarily focus on taxonomic differences that can be used to differentiate between local species, with field identification features added where possible. However, with the lack of research and collection on this group, field identification features, such as colour and distribution, are tentative. For more detailed information on taxonomic features and for global distinctions, Kaas and van Belle (1985-2006) can be of help, as their monograph provides measurements of girdle features and other specific characteristics needed for distinction from other non-endemic species.

Glossary of technical terms used:

Abanal: The gill arrangement where only one ctenidium is posterior to the nephridiopore.

Adanal: A gill arrangement where more than one ctenidia is posterior to the nephridiopore.

Aesthete canals: The innervated canal system in chitons that comprises a complex of cavities filled with sensory tissue, featuring dorsal surface openings referred to as sensory pores on the tegmental surface.

Articulamentum: The visible ventral layer of a chiton valve which extends into insertion plates and apophyses, used for taxonomy identification.

Biscupid: A cusp of a major lateral radula tooth divided into two lobes.

Carination: This describes a valve's form: if it takes on a keel-like shape with a rounded margin on one side and a beaked margin on the other, resulting from the pronounced development of the jugal area, it is carinated, otherwise the valve is described as "round-backed".

Corpuscles: Particles on a girdle of a chiton, mostly calcareous, which are too small to identify as a spicule or scale.

Gills: A series of feathered gills, suspended from the roof of the pallial groove.

Cusp: The head of the major lateral tooth of a chiton radula.

Diagonal: The interior edge of the lateral areas on an intermediate valve of a chiton.

Eaves: A part of the tegmentum extending over the connection point between the tegmentum and the articulamentum. Can be described as "spongy" if many nerve channels creates a porous effect.

Eyespots: Clusters of photoreceptors that can be identified by pigmentation which are attached to aesthetes.

Girdle: The soft, thick tissue surrounding the shell of a chiton, sometimes called the **mantle.**

Granule: Raised, rounded sculpture in various patterns on the tegmental surface.

Holobranchial: A gill arrangement that exhibits unrestricted extension of the gills from the anterior to the posterior of the pallial groove.

Hyponotum: The ventral part of the girdle.

Imbricating: Overlapping one another.

Insertion plate: Lateral extensions of the articulamentum beyond the margins of the tegmentum, embedding the valve into the soft girdle tissue.

Jugal area/jugum: The triangular middle area of the central area distinctly wider anteriorly and reduced towards the apex. This is separated from the pleural area.

Marginal fringe: Spicules around the edge of the girdle, demarcating the hyponotum from the perinotum

Merobranchial: A gill arrangement where the gills are restricted to the posterior half of the pallial groove.

Mouth lappets: Anterior extensions of the head that aids in feeding.

Mucro: A small central point or apex on the tail valve from where growth of the valve starts.

Nephridiopore: The external pore of the excretory organ.

Pectinated: Identifiable by a series of closely-spaced narrow projections or divisions.

Perinotum: The dorsal part of the girdle.

Pleural area: The area between the jugal area and the lateral areas on an intermediate valve.

Pustule: Large, globe-like granules.

Quincunx: In groups of five.

Shell eyes: Lens-bearing eyes made of shell material that can form images which intersperses the aesthetes of some groups, *Lucilina* in particular from the regional species.

Side slopes: The lateral areas in profile, which can be straight, convex or concave.

Sutural tufts: Sensory organs positioned along the sutures or junctions between the chiton's valves, comprising an array of specialized spines adorned with sensory setae, enabling the chiton to detect and respond to its surrounding environment.

Sinuate: A series of alternating curves or convex and concave segments along its outer edge, creating a distinctive and characteristic pattern.

Tegmental sculpture: The surface or shell ornamentation of a chiton valve. This texture is a distinctive taxonomic feature.

Tegmentum: The exposed portion of a chiton shell exhibiting a diverse array of sculptures and colours.

Tricuspid: A cusp of a lateral radula tooth divided into three lobes.

Uniscupid: A cusp of a lateral radula tooth not divided.

Abbreviations:

IZIKO: Iziko Museum of South Africa in Cape Town.

GBIF: Global Biodiversity information Facility.

WoRMS: World Register of Marine Species.

NMSA: Natal Museum of South Africa

OBIS: Ocean biodiversity information system.

SAMS: South African Museum Specimen from IZIKO museum

ZISP: Zoological Institute of the Natural History museum in Russia (Russian Academy of Science)

Chapter 2: Additions to the chiton fauna of South Africa

This section deals with the additions to the regional chiton fauna discovered by examining the collections of the Natal Museum. Many of these specimens have been identified or collected many years ago, but no reports on their presence in the region could be found, so these ae documented below.. Specimen data is given with date of collection as priority. All scale bars are 1mm, unless otherwise specified.

Systematic Part

Class Polyplacophora Gray, 1821

Subclass Neoloricata Bergenhayn, 1955

Order Chitonida Thiele, 1909

Suborder Chitonina Thiele, 1909

Superfamily Chitonoidea Rafinesque, 1815

Family Ischnochitonidae Dall, 1889

Genus *Ischnochiton* J. E. Gray, 1847

Type species: *Ischnochiton textilis* (Gray, 1828)

Genus distribution: Cosmopolitan

***Ischnochiton indianus* Leloup, 1981**

Figure 2.1

Ischnochiton (Radsiella) indianus Leloup, 1981:2, fig 1, Pl I. figs. 1-4.
Ischnochiton (Ischnochiton) indianus; Kaas, 1985:327; Kaas and van Belle, 1985(4):134-136, fig. 58.
Ischnochiton indianus; Kaas, 1996:370; Dell'Angelo *et al.,* 2011:26.

Material: Seven specimens, six from Kosi Bay and one from Sodwana in northern

KwaZulu-Natal from 9-45m depth. Stored in the NMSA: D7710 – Dredged off Kosi Bay (-26.8983˚, 32.8967 ˚) from the *R. V. Meiring Naude* in 1987 in between sand at 30m; D9331 and E1647 – Dived, Main Reef Kosi Bay (-23.9016 ˚, 32.8668 ˚) in 1987 at 9m and 17m depth; E1650 – Dived, Two-Mile Reef (-27.5329 ˚, 326787) in 1986 at 10m on stones; S1098 and S1955 - Dived, Main Reef Kosi Bay (-23.9016 ˚, 32.8668 ˚) in 1990 at 17m and 21m respectively in shallow furrows and gullies filled with sand; S5742 - Dredged off Kosi Bay (-26.905 ˚, 32.925 ˚) from the *R. V. Sardinops* in 1990 amongst sand, stones and algae at 45m.

Remarks: *Ischnochiton indianus* seems to be limited to the south-western area of the Indian Ocean around Madagascar and the East coast of Southern Africa. It was reported by Dell'Angelo *et al.* (2011:26) as occurring in Madagascar, Mozambique and KwaZulu-Natal, but I have been unable to locate any specific formal reports of this species being sampled in South Africa, so the locality records listed above are the first properly documented records from the region. The species has a smooth tegmentum with some longitudinal ribs at the front margin along the lateropleural areas and clear growth lines. It is quite different from other *Ischnochiton* species from the southern parts of South Africa in terms of sculpturing. It can be distinguished from *I. oniscus* (Figs 48 A-C) by its higher elevation and its sculpture, where *I. oniscus* has little bumps covering the whole valves instead of ribs only on the laterpleural areas. Furthermore, *I. oniscus* is often freckled with green markings, while *I. indianus* seem to commonly show shadings of cream with brown blotches. *Ischnochiton oniscus* is also slightly more elongated than *I. indianus*. Furthermore, *I. indianus* can be found only in the subtidal zone, while *I. oniscus* are more common in the intertidal, although also occasionally in the subtidal. Although these are the only two *Ischnochiton* species found along the Northern KwaZulu-Natal region, *I. indianus* also differs from other South African species in its valve sculpture, where *I. bergoti* (Western Cape, Figs 47 A-C) has minutely granulated tegmentum with forwardly converging rows of granules along lateropleural areas, leading to a fine quincuncial pattern towards the jugum, *I. elizabethensis* (South coast of South Africa, Figs 49 A-C) has randomly dispersed to wavey patterns of circular granules and *I. textilis* (Saldanha Bay to Durban, Figs 45 A-C) has ribs on lateral areas and punctate central areas.

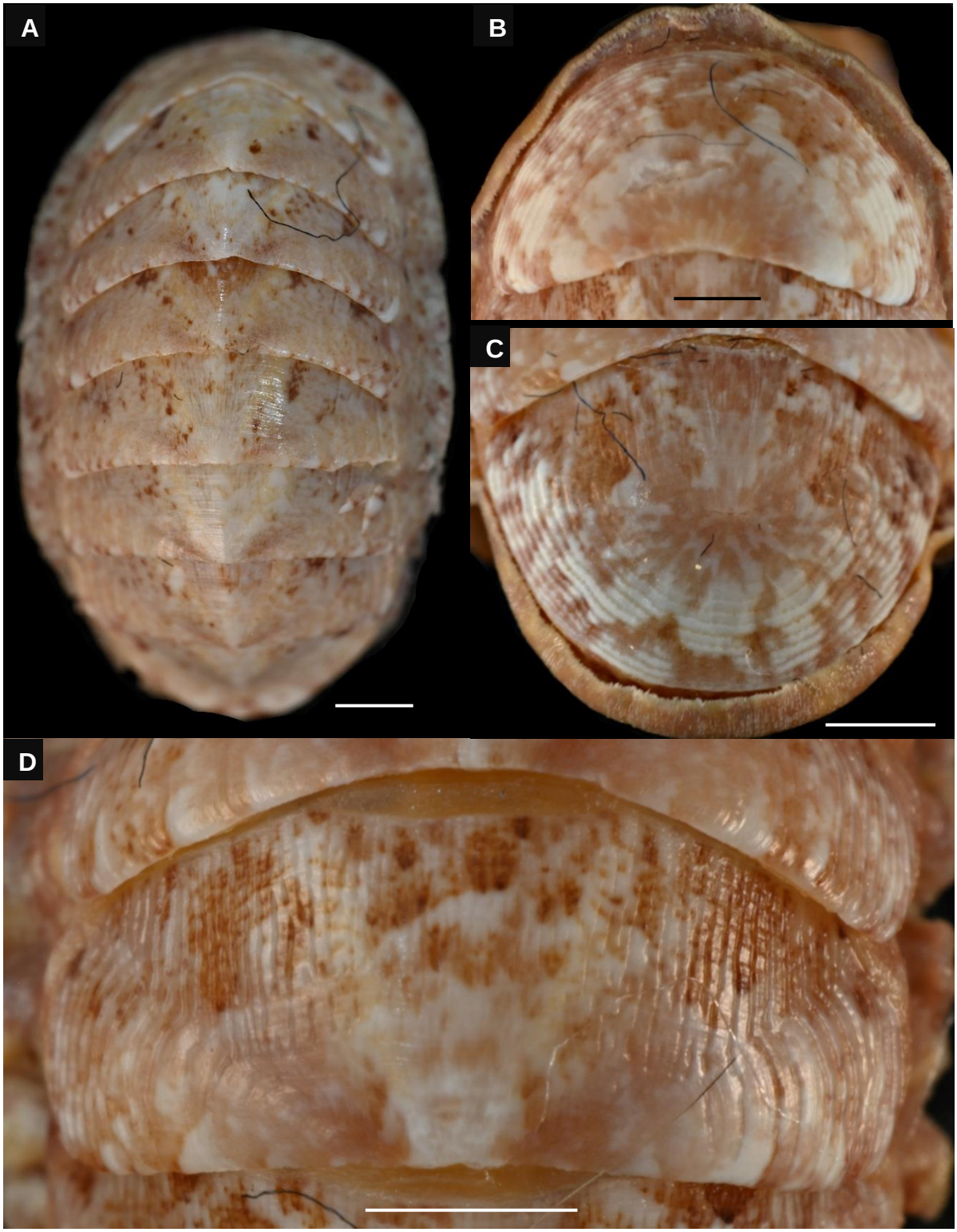

Figure 2.1: *Ischnochiton indianus* (Specimen S1955, NMSA): A - Dorsal view of whole specimen; B - Dorsal view of head valve; C - Dorsal view of tail valve; D - Dorsal view of intermediate valve.

Family Chitonidae Rafinesque, 1815

Genus *Tegulaplax* Iredale & Hull, 1926

Type species: *Tegulaplax hululensis* (E. A. Smith, 1903)

Genus distribution: Indian Ocean

***Tegulaplax hululensis* E. A. Smith, 1903**

Figure 2.2

Ischnochiton hululensis E. A. Smith, 1903:619, pl. 36, figs, 3-6.
Ischnochiton ravanae Sykes, 1903:178, pl. 1, fig. 4.
Chiton imbricatus Nierstrasz, 1905:79, pl. 2, fig. 37, pl. 7, fig. 188-194. *Chiton platei* Thiele, 1909:92, pl. 9; fig. 46-48; Leloup, 1981a:17, 37.
Chiton howensis Hedley & Hull, 1912:278, pl. 13, fig. 7.
Tegulaplax matthewsi Iredale & Hull, 1926:172, pl. 18, figs. 26, 27.
Tegulaplax howensis; Iredale & Hull, 1926:171; 1932:139, pl. 8, figs 17-24.
Chiton hululensis; Leloup, 1952:23, 56, fig.10, pl.3: fig.5. – Slieker, 2000:48, pl.12: fig.17
Chiton (Tegulaplax) hululensis; Kaas, 1979:866, pl.2, figs 11- 19. – Kaas, 1986:17, figs 44-45. – Strack, 1993:12, pl.3: fig.9; pl.7: figs 8-9. – Dell'Angelo & Smriglio, 1999:184, pls.62-63: fig.112; Dell'Angelo *et al.,* 2004:54, pl. 4 figs 12-14; Kaas and van Belle, 1985-2006(6):240-242, fig. 97.
Chiton (Chiton) hululensis; Van Belle & Wranik, 1991:370, fig.15.
Tegulaplax hululensis; Saito, 2006:121, fig. 5E.

Material: Two specimens at the NMSA: D8948 and E1361 – Dredged off Kosi Bay (-26.92 ˚, 32.9067 ˚) from the *R. V. Meiring Naude* in 1987 in between fine sand at 40m.

Remarks: Reports of *T. hululensis* are fairly common from the Indian Ocean and thus it is no surprise to find this species off South Africa, as it is also known from Mozambique and Madagascar. However, only two specimens were found in 1987 and no others have been reported since. This is the only species of this genus reported from South Africa thus far. *Tegulaplax hululensis* is the type species of the genus, but it was originally placed in *Ischnochiton* by Smith (1903) and then, in 1926, Iredale and Hull described the genus *Tegulaplax,* differentiating this species from *Ischnochiton.* Thereafter, *T. pulchra* Kaas 1991 and *T. boucheti* (Kaas, 1989) were described almost nine decades later, *T. boucheti* occurs in south-east Asian islands such as the Philippines and Izu islands, while *T. pulchra* only occurs in New Caledonia. Ribbed dorsal scales in viewed specimen of *T. hululensis* and documented for *T. bouchetti* differentiates both these species from *T. pulchra,* which has smooth dorsal scales. Major lateral tooth of group as follows: Unicuspid in *T. boucheti,* bicuspid in *T. hululensis* and tricuspid in *T. pulchra*

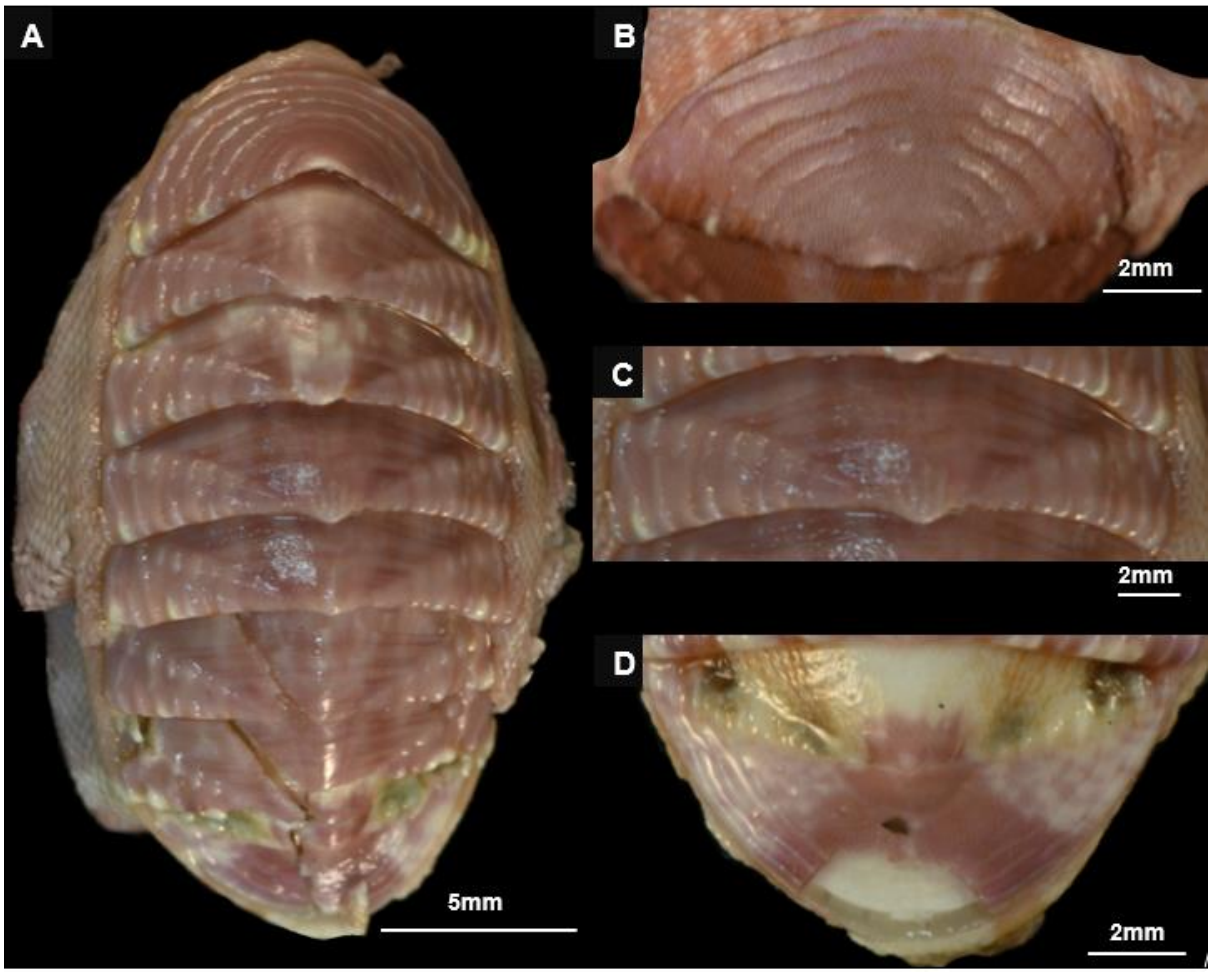

Figure 2.2: *Tegulaplax hululensis* (Specimen E1361, NMSA): A - Dorsal view of whole specimen; B - Anterior view of head valve; C - Dorsal view of intermediate valve; D - Dorsal view of tail valve.

Genus *Chiton* Linnaeus, 1758

Type species: *Chiton tuberculatus* Linnaeus, 1758

Genus distribution: World-wide

***Chiton laterorugosus* Kaas, 1986**

Figure 2.3

Chiton (Chiton) laterorugosus Kaas, 1986:16-17, figs 36-43; Kaas, van Belle & Schwabe, 2006(6):105, fig. 33.

Material: Two specimens from Kosi Bay at NMSA: S4011 – Dredged off Kosi Bay (-26.9 ˚, 32.925 ˚) from the *R. V. Sardinops* in 1990 on coral slabs at 50m depth; W9707 – Dredged off Kosi Bay (-26.9817˚, 32.9267 ˚) from the *R. V. Sardinops* in 1990 amongst sand, stones and algae at 51m.

Remarks: *Chiton laterorugosus* has only previously been reported from Madagascar. Two specimens were, however, found in 1990 in the subtidal zone off Kosi Bay. Again, this is the only species from this genus reported to date for South Africa. The radiating rows of warts on the intermediate valve's lateral areas are the main diagnostic feature of this species. Species originally seen as close relatives of this species, such as *Rhyssoplax barnardi* Ashby, 1931 and *Callistochiton kaasi* Leloup, 1981 have both been subsequently placed in other genera from *Chiton.* This might indicate uncertainty about the genus placement.

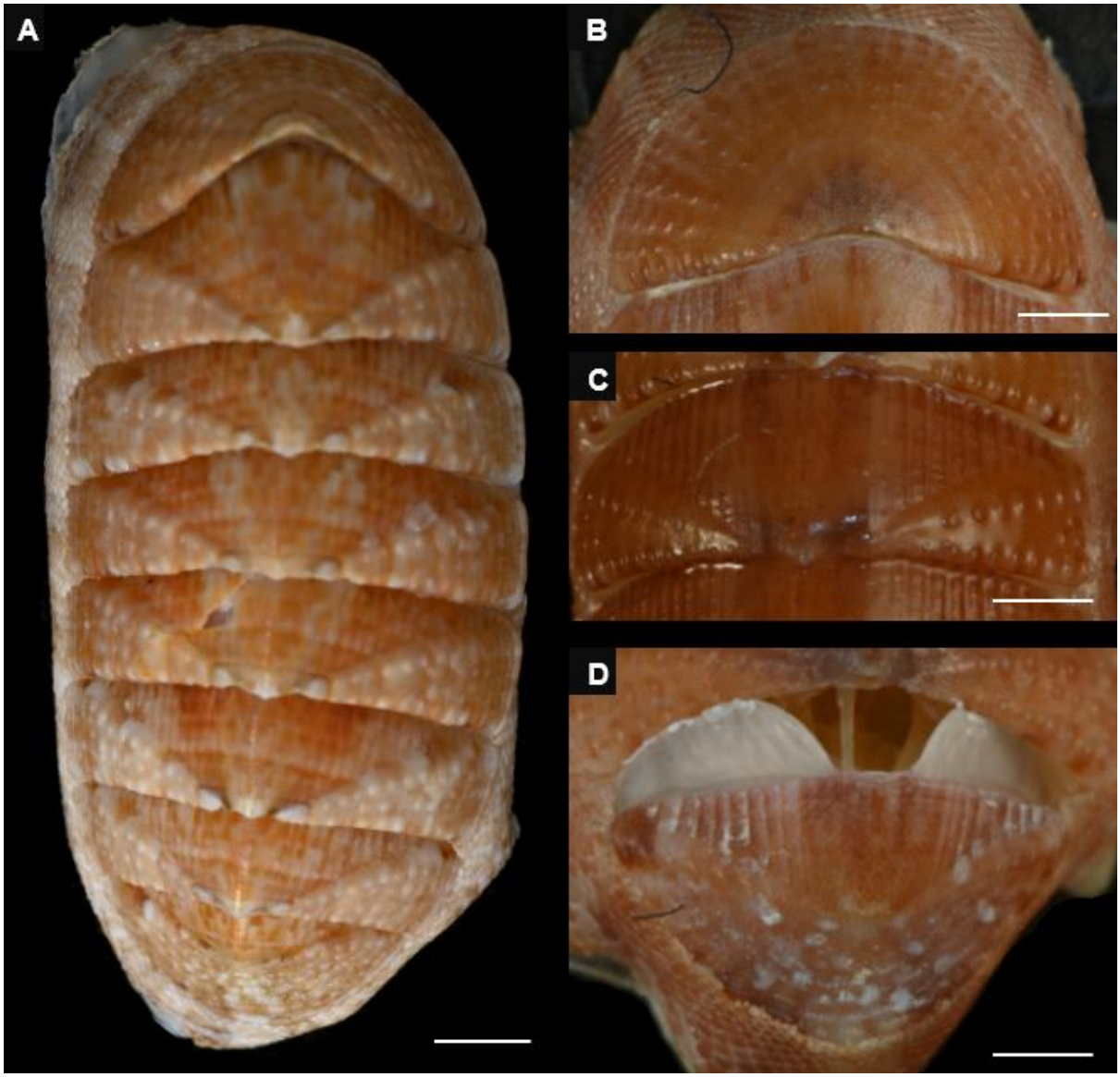

Figure 2.3: *Chiton laterorugosus :* A - Dorsal view of whole specimen (Specimen W9707, NMSA); B - Dorsal view of head valve (Specimen W9707, NMSA); C - Dorsal view of intermediate valve(Specimen S4011, NMSA):; D -Dorsal view of tail valve(Specimen W9707, NMSA).

Genus *Lucilina* Dall, 1882

Type species*: Lucilina lamellosa* (Quoy & Gaimard, 1835)

Genus distribution: Indian Ocean, Western Pacific and Red Sea.

Lucilina carnosa Kaas 1979

Figure 2.4

Tonicia (Lucilina) carnosa Kaas, 1979:869, pl. 3: figs 101; Kaas & van Belle, 1985-2006(6):323-325, fig. 133.
Tonicia indica Leloup, 1981:40, pl. II, fig 7; pl. III: fig.1.
Lucilina carnosa; Kaas 1996:372; Sirenko, 2012:83-85, figs 23-24

Material: One specimen at NMSA: S4007 - Dredged off Kosi Bay (-26.9 ˚, 32.925 ˚) from the *R. V. Sardinops* in 1990 in between coral slabs and rocks at 50m.

Remarks: *Lucilina carnosa* was previously known from Mozambique, Madagascar, Seychelles and South Vietnam. It is thus unsurprising to find that this species extends southwards into the tropical waters of northern KwaZulu-Natal in South Africa. It is currently the only species from this genus known from South Africa. This is a beautiful and unique species and fits the holotype description without a doubt, especially with the eight rows of straight shell eyes splitting into two or three rows as it expands from the apex. Extremely like *Lucilina suezensis* (Reeve, 1847), but differs in more prominent tegmental sculpture and the girdle where *L. carnosa* has ribbed scales in between shafted spicules, while *L. suezensis* has both ribbed and smooth scales in between shafted spicules, as well as ventral scales slightly grooved in *L. carnosa,* but not in *L. suezensis,* although the girdle in both species seems smooth to the naked eye.

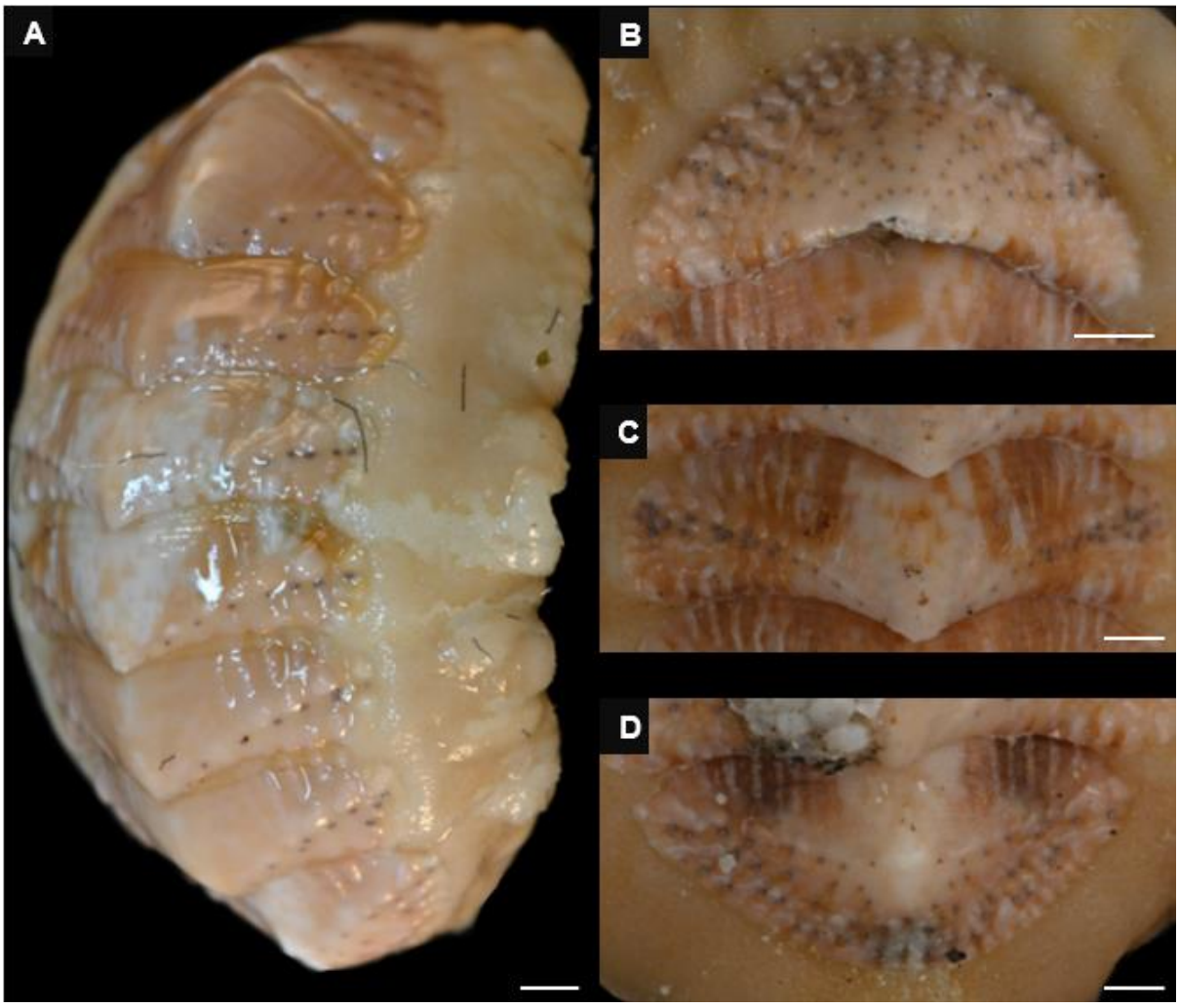

Figure 2.4*: Lucilina camosa* (Specimens S4007 (A) and D4843(C-D), NMSA): A - Side view of whole specimen; B - Dorsal view of head valve; C - Dorsal view of intermediate valve; D - Dorsal view of tail valve.

Family Chaetopleuridae Plate, 1899

Genus *Dinoplax* P. P. Carpenter [in Dall], 1882

Type species: *Dinoplax gigas* (Gmelin, 1791)

Genus distribution: Restricted to south and east coasts of Africa.

***Dinoplax chelazziana* (A. J. Ferreira, 1983)**

Figure 2.5 & 2.6

Dinoplax fossus non Sykes; Kaas, 1979:861.
Chaetopleura chelazziana Ferreira, 1983:254, figs 3-10; Dell'Angelo *et. al.,* 2011:30, fig. 4H.

Chaetopleura (Chaetopleura) chelazziana; Kaas and van Belle, 1987:93-95, fig. 40. *Dinoplax chelazziana*; WoRMS, AphiaID: 386178

Material: Three specimens from Northern KwaZulu-Natal at NMSA: D9648 – Dived between Bhanga Nek and Kosi Bay on an algal reef 0.5km south of marker 13 (-26.9016 ˚, 32.8668 ˚) at 9m in 1987; S1469 - Dived between Bhanga Nek and Kosi Bay on an algal reef 0.5km south of marker 13 (-26.9016 ˚, 32.8668 ˚) at 5m in 1990; W9771 – Collected from the Umvoti River Mouth (-29.1592 ˚, 30.6249 ˚) in 1971.

Remarks: The specimens examined match the holotype description from Kenya by Ferreira (1983) and Kaas and van Belle (1987). *Dinoplax chelazziana* was only recently described from Madagascar by Dell Ángelo *et al.* (2011). It is unclear who moved this species from its original genus, *Chaetopleura*, to *Dinoplax.* The combination was created by Schwabe in 2009 on WoRMS, but no basis of record was given. Nonetheless, the thick, heavy, ribbed valves and delicate spinelets on the girdle support this decision. A pustulose girdle, and clear ribs on both the central and lateral areas, although more striking on the lateral areas, distinguish the shell of this species from all three other species in this genus, also explaining the first genus placement of *Chaetopleura*. Although only *D. gigas* has been found in the same region (distinguished by a smoother shell and spicules in bunches instead of all over girdle), both *D. fossus* and *D. validifossus* can be distinguished from *D. chelazziana* by the less-prominent tegmental sculpture in both *D. fossus* and *D. validifossus,* as well as the girdle elements, where *D. validifossus* has longer spicules and *D. fossus* has thicker spicules, as seen in Fig 2.6.

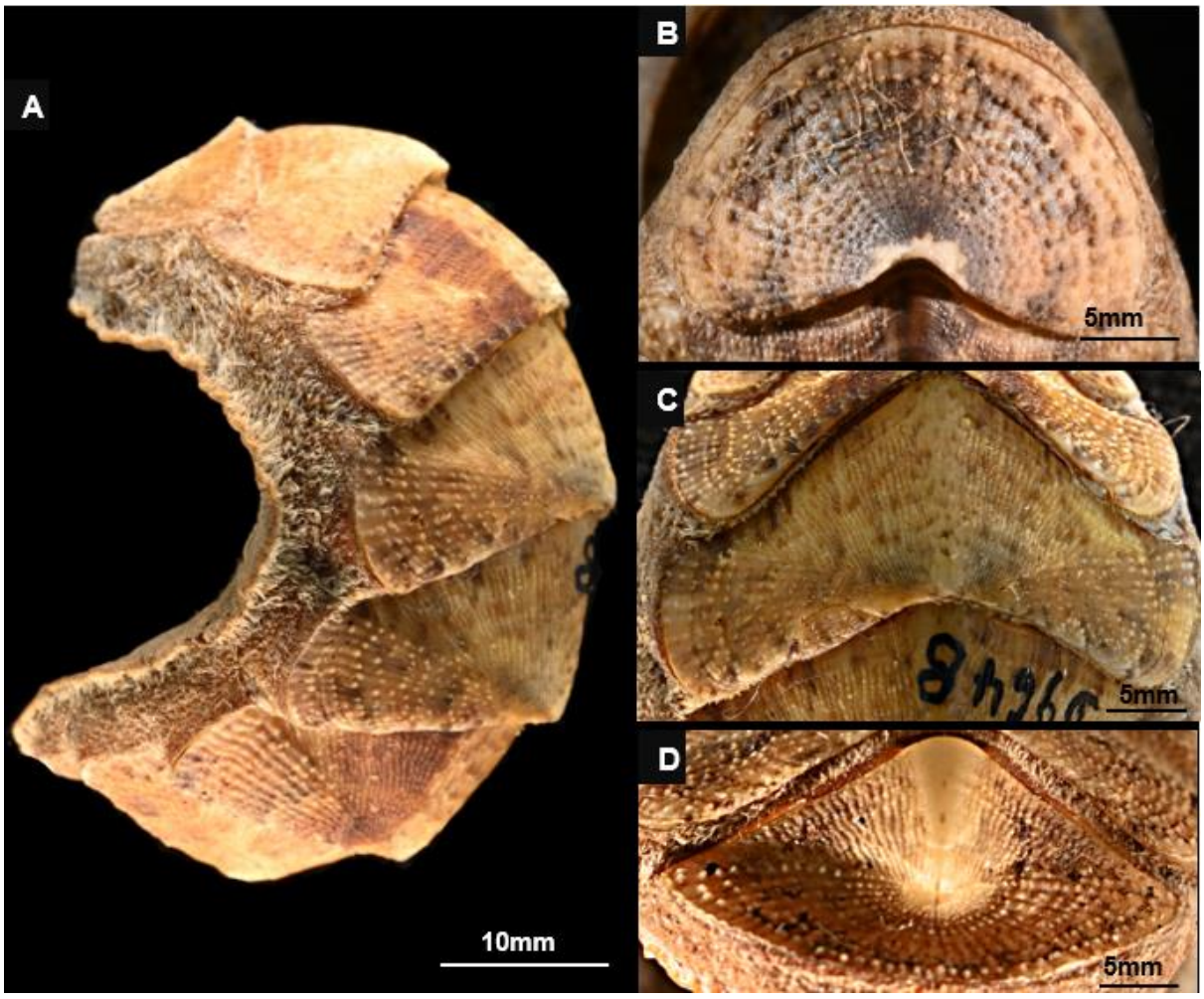

Figure 2.5: *Dinoplax chelazziana* (Specimen - D9648, NMSA): A - Lateral view of whole specimen; B - Dorsal view of head valve; C - Dorsal view of Intermediate valve; D - Posterior view of tail valve.

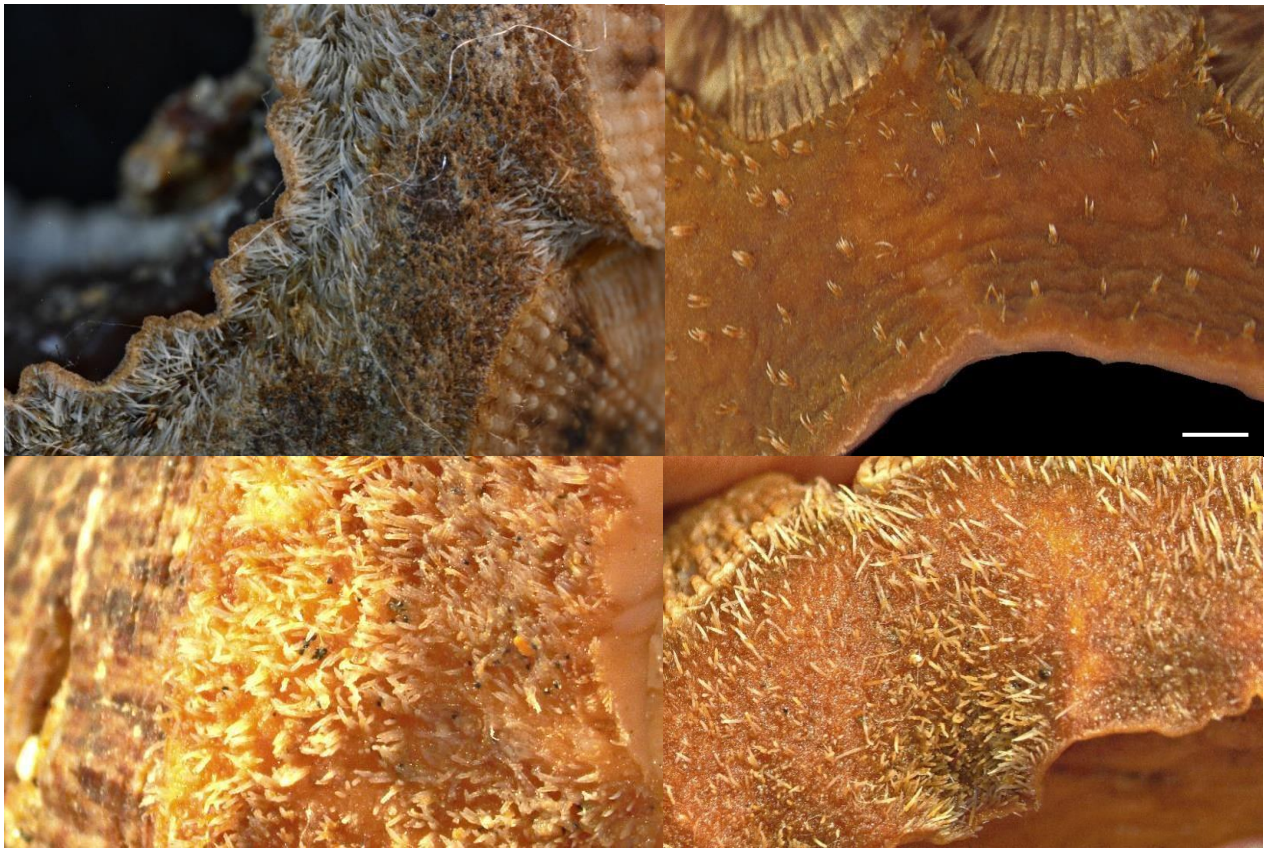

Figure 2.6: Girdle armature of *D. chelazziana* with delicate, very long spinelets, *D. gigas* with bunched, short spicules, *D. fossus* with dense, thick spicules and *D. validifossus* with longer and scattered spicules.

Suborder Acanthochitonina Bergenhayn, 1930

Superfamily Mopalioidea Dall, 1889

Family Mopaliidae Dall, 1889

Subfamily Mopaliinae Dall, 1889

Genus *Plaxiphora* Gray, 1847

Type species: *Plaxiphora aurata* (Spalowsky, 1795)

Genus distribution: Australia, Southern South America, Southern Africa, New Zealand and Sri Lanka.

Plaxiphora tulearensis Leloup, 1981

Figure 2.7

Plaxiphora tulearensis Leloup, 1981:38, fig. 21, pl. 1: fig.5, pl. 4: fig.1; Kaas, 1986:14; Saito & Okutani, 1991:191; Kaas and van Belle, 1994:276, fig. 112

Material: Four specimens at NMSA: W9768 – collected from a low sandstone reef platform at Mapelane Beach (-28.1115 ˚, 32.5658 ˚) in 1983; D2413 – collected from the intertidal zone at the Qolora River mouth (-32.6292 ˚, 28.4319 ˚) in 1986; D5935 – collected from the littoral zone of Mission Rocks in the St. Lucia area (-28.2784 ˚, 32.4865 ˚) in 1987; W8506 – collected from intertidal zone at Black Rock (-27.1304 ˚, 32.831 ˚) in 2011.

Remarks: *Plaxiphora tulearensis* was previously only known from Madagascar, so it is no surprise to find it extends along the tropical North-Eastern Coast and East South Coast of South Africa. This is the first record for the genus *Plaxiphora* in South Africa. The specimens match the description from Kaas and van Belle (1985-2006). This is a very striking species with beautiful shells with folds almost like in *Callistochiton*, but much less defined and with ribs rippling towards the outside margin on the top fold, and interesting girdle bunches: with long, ribbed, yellowish spines on shafts, scattered in between ribbed scales.

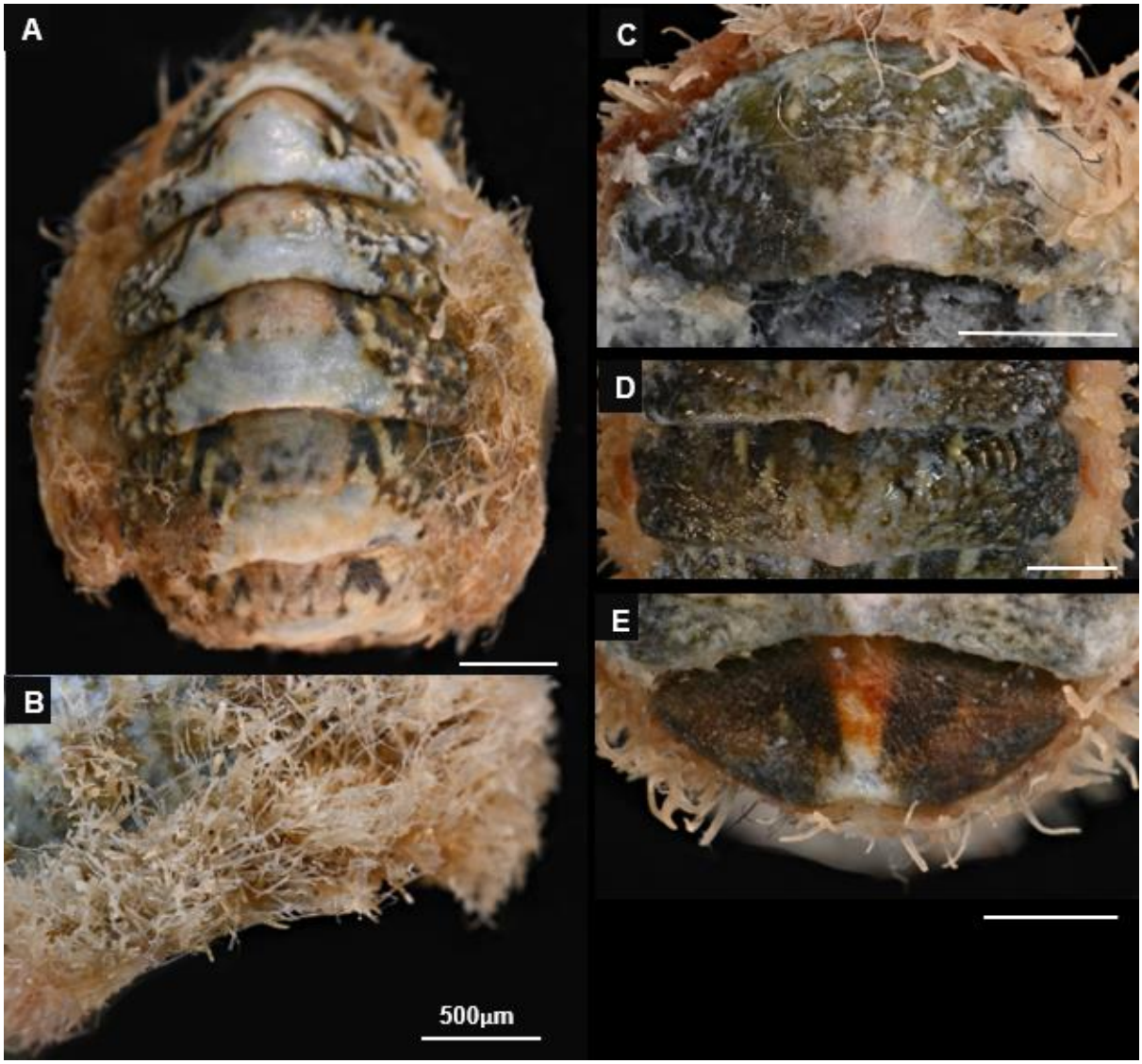

Figure 2.7: *Plaxiphora tulearensis*: A - Dorsal view of whole specimen (Specimen W9768, NMSA): B – Girdle(Specimen W9768, NMSA):, C - Dorsal view of head valve (Specimen W8506, NMSA); D - Dorsal view of Intermediate valve(Specimen W8506, NMSA); E - Dorsal view of tail valve (Specimen W8506, NMSA).

Superfamily Cryptoplacoidea H. Adams & A. Adams, 1858

Family Acanthochitonidae Pilsbry, 1893

Subfamily Acanthochitoninae Pilsbry, 1893

Genus *Acanthochitona* Gray, 1821

Type species: *Acanthochitona fascicularis* (Linnaeus, 1767)

Genus distribution: Cosmopolitan – occurring on shores of every continent, except Antarctic waters.

***Acanthochitona jugotenuis* Kaas, 1979**

Figure 2.8

Acanthochitona jugotenius Kaas, 1979:873, pl. 4: figs 1-13; Muratov, 2014:381, 403, fig. 39

Material: One specimen at NMSA: S1099 – collected off Kosi Bay (-26.9016˚, 32.86683˚) at 17m depth in 1990.

Remarks: This species, which was mentioned by Schwabe and Els (2019) in an informal note on the differences between the *Acanthochitona* species in the region as occurring in South Africa, but appears not to have been included in any previous species lists of the region. Also no formal report on locations at which specimens were found, by who they were identified or where they are deposited appears to have been published. The specimen from the Natal Museum matches the description by Kaas (1979) in both girdle and shell characteristics. The shell has granules more closely set and a wider jugal area than seen in *A. garnoti,* which occurs from Saldanha Bay to Port St. Johns. This specimen, aligning with the description of *A. jugotenuis*, has a much wider girdle and much less prominent jugal area ribbing than seen in *A. variegata,* which occurs in False Bay, East London and Bhanga Nek. The tegmentum also differs from both these regional species, with the granules being much rounder. With regards to the girdle, the spines of this species are curved, whereas both *A. garnoti* and *A. variegata* have straight spines.

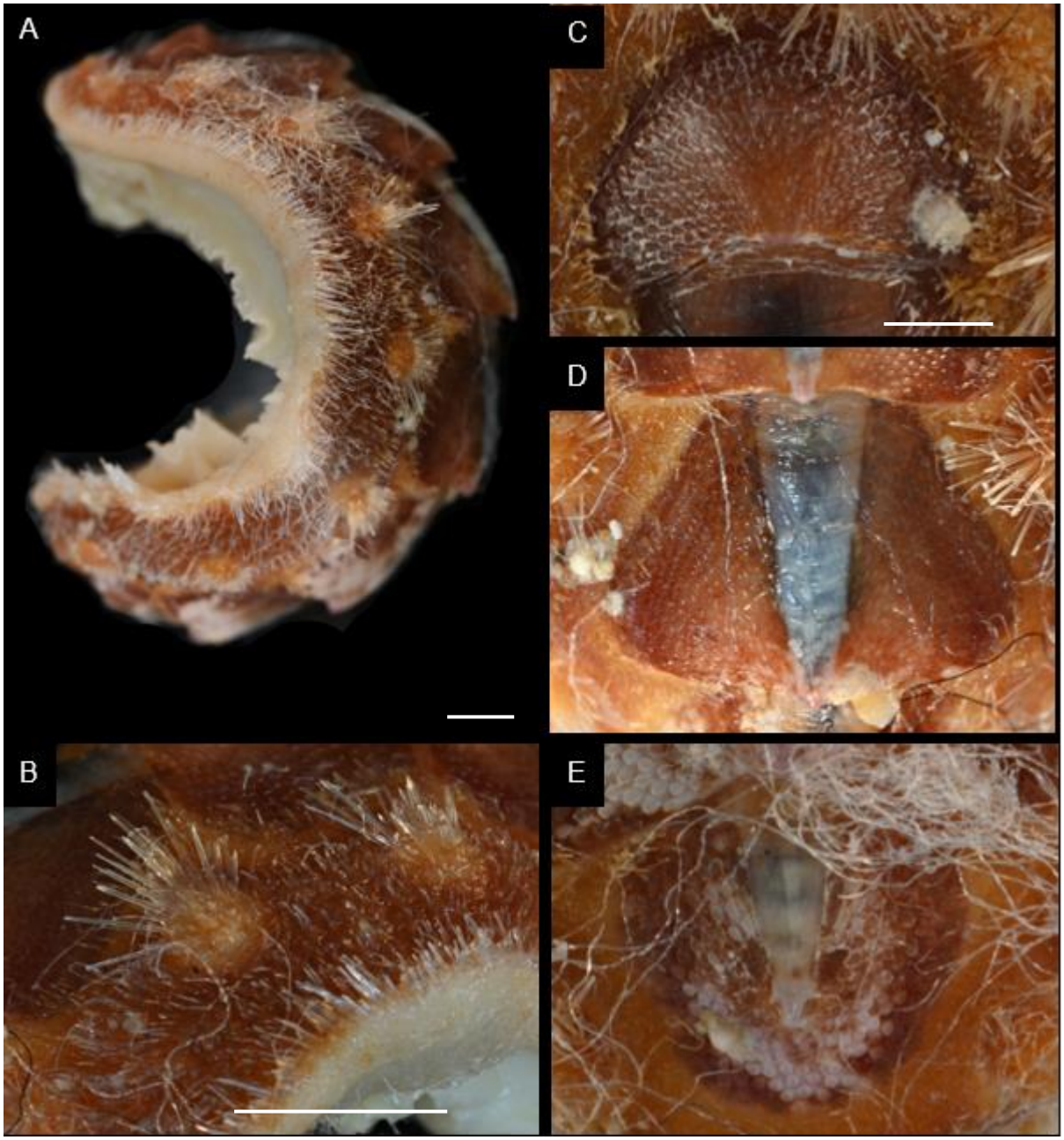

Figure 2.8: *Acanthochitona jugotenuis*: A - Lateral view of whole specimen (Specimen S1099, NMSA):; B – Satural tuff on dorsal side of girdle; C - Dorsal view of head valve; D - Dorsal view of intermediate valve; E - Dorsal view of tail valve.

Order Lepidopleurida Thiele, 1909

Suborder Lepidopleurina

Family Leptochitonidae Dall, 1889

Genus *Leptochiton* Gray, 1847

Type species: *Leptochiton asellus* (Gmelin, 1791)

Genus distribution: Cosmopolitan except for the North Indian Ocean and Western Africa.

Leptochiton nierstraszi (Leloup, 1981)

Figure 2.9

Lepidopleurus (Pilsbryella) nierstraszi Leloup, 1981:27, textfig. 13, pl. 2: fig. 1. *Leptochiton (Leptochiton) nierstraszi;* Kaas & van Belle 1985:130, fig. 58.*Lepidopleurus (Leptochiton) nierstraszi,* Dell'Angelo *et al*., 2004:49, pl. 1: figs 1-9.
Leptochiton nierstraszi; Strack, 1993:3-4; Dell'Angelo *et al*., 2020:404, fig. 20

Material: One small specimen at NMSA: W9720 – collected from the intertidal zone at Boteler Point, KwaZulu-Natal (-27.0124 ˚, 32.867 ˚) in 1990.

Remarks: Although this species was previously only known from Madagascar and the Red Sea, the genus is already well represented in South African waters. The highly elevated granules of this species clearly distinguish it from its relatives known from South Africa. The valves carry extremely elevated, mushroom shaped, big, round granules arranged in quincunx, concentrated on the jugal areas of the valves, whereas all other relatives in the region (*Leptochiton sykesi* – Western Cape - with microscopic granules, *L. hodgsoni* – Simon's Town, Western Cape to Shelly Beach, KwaZulu-Natal - with large, spaced out but flat granules, *L. chariessa* - East London to Cape St. Blaize - with spaced out, small granules in longitudinal rows, *L. meiringae* – East London to Plettenberg Bay - with more closely set longitudinal ribs of small granules, *L. permodestus* – from Bhanga Nek to Plettenberg Bay - with small granules radially arranged, *L. dispersus* – Eastern Cape - with wavey longitudinal lines of small granules, unevenly dispersed and *L. smirnovi* – False Bay - with medium granules closely beset in almost perfect longitudinal lines) all have less elevated granules as tegmental sculpture.

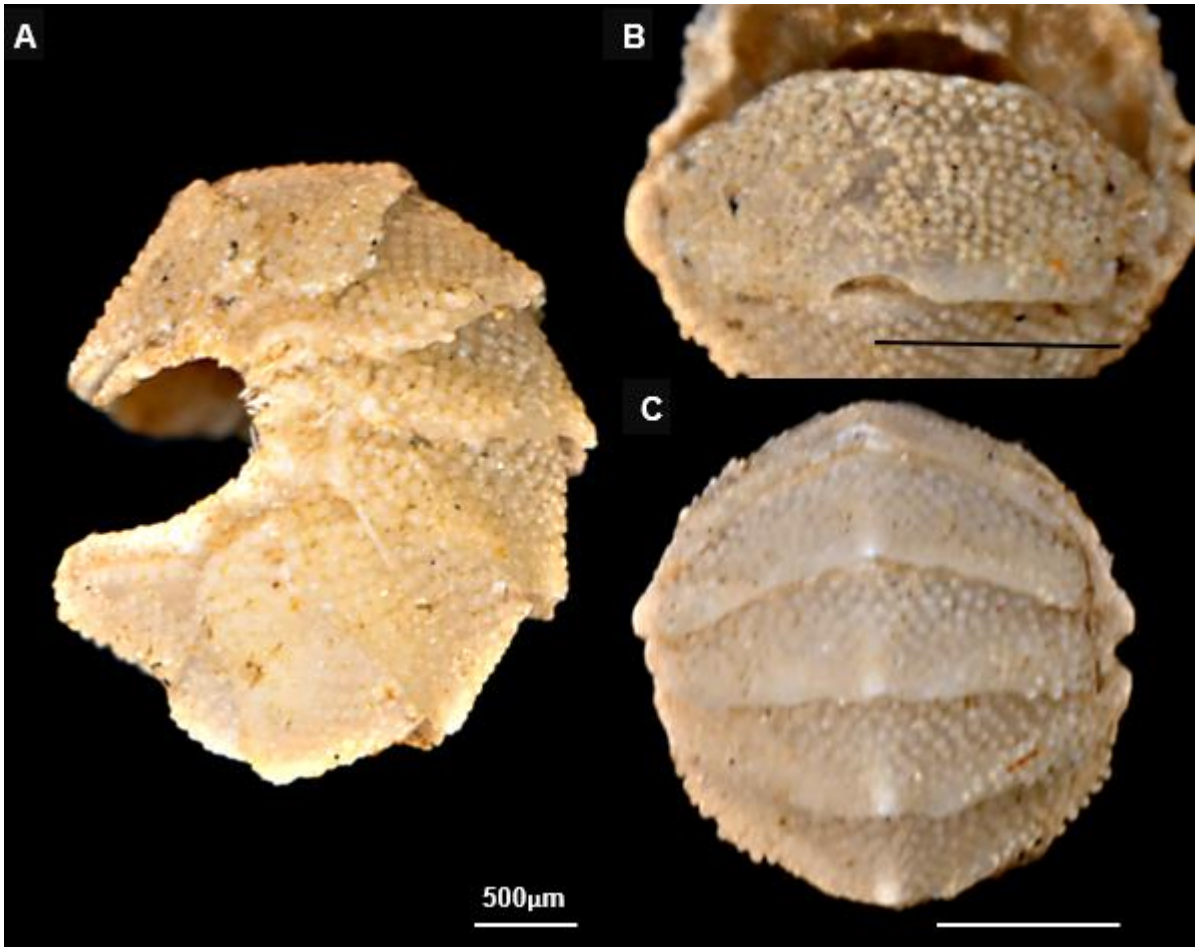

Figure 2.9*: Leptochiton nierstraszi* (Specimen W9720, NMSA): A - Lateral view of whole specimen; B - Dorsal view of head valve; C - Dorsal view of intermediate valve.

Discussion

A striking feature of this account is that all the additions reported originate from Northern KwaZulu-Natal. There are several reasons for this. Firstly, the numbers of marine researchers and hence number of samples collected along the South African coast has historically been biased towards the Cape (Griffiths *et al.,* 2010), with much fewer samples collected in KwaZulu-Natal. Also, northern KwaZulu-Natal harbours the only true tropical habitats along the South African coastline and hence shares much of its marine fauna with the tropical Western Indian Ocean. The shared border with Mozambique and proximity to Madagascar, also explains why most of the new records were previously reported from one of both of these regions. For further discussion of the implication of this study and proposed directions for further research, see the discussion chapter of this dissertation.

Chapter 3: Field guide to South African chitons

This chapter aims to provide a relatively simple guide to the identification of all known regional chiton species in South Africa, suitable for use by students and other non-specialists. A dichotomous key is provided to assist in the identification of specimens without needing detailed knowledge of chiton terminology. Additionally, a standardized account is provided for each known species, each with an accompanying photograph, and drawings where necessary. A distribution map showing known records is also included for each entry.

When identifying a specimen, it is suggested to first use the key to identify the species, but to follow this by reading the diagnosis of the species and checking that the specimen conforms to all the diagnostic characteristics.

Key to South African chitons

1A No insertion plates 2

1B Insertion plates present.....3

2A Subtidal, extremely large tail valve, fine sculpture ..... *Parachiton indecorus*

2B Elongated tail valve with almost evenly sized granules on tegmentum.....4

3A Very elongated, from KwaZulu-Natal, 5 or less slits on head valve 11

3B Oval to elongate oval, tegmentum clearly exposed. 12

4A Marginal fringe present, intertidal to subtidal zone, tegmental sculpture highly elevated with mushroom-shaped granules. ..... *Leptochiton nierstraszi*

4B Moderately elevated to flat granules on tegmental sculpture 5

5A Tegmental sculpture with longitudinally dispersing lines of pustules in an inconsistent, wave-like pattern, scattered across central area, slight growthlines, no marginal fringe, occurs deeper than the intertidal zone ..... *Leptochiton dispersus*

5B Neat tegmental sculpture 6

6A Collected from the intertidal to subtidal zone 7

6B Collected from deeper than 50 meters.....8

7A Lateral areas not raised, marginal fringe present, intertidal to subtidal zone, granules spaced out and slightly raised ..... *Leptochiton hodgsoni*

7B Lateral areas not raised, marginal fringe present and intertidal to subtidal zone, granules tight and flat..... *Leptochiton smirnovi*

8A Growth lines distinctive, tegmental sculpture very fine and collected from deeper than the subtidal zone. ..... *Leptochiton sykesi*

8B Growthlines weak or absent, defined sculpture 9

9A Deeper than 200m, radial sculpture in central area with drop to oval-shaped granules ..... *Leptochiton permodestus*

9B Longitudinal sculpture in central area with more rounded granules 10

10A Faint growth lines with some rows of pustules, no marginal fringe and deeper than subtidal zone..... *Leptochiton chariessa*

10B Granules arranged in lines, deeper than 200m; no growthlines,..... ..... *Leptochiton meiringae*

11A Valves with striated jugal are? What is this and small granules on lateropleural area .....

..... *Cryptoplax dupuisi*

11B Valves with large ribs from posterior to anterior margin *..Cryptoplax sykesi*

12A Head valve with no more than 5 slits 13

12B Head valve with more than 5 slits 18

13A Girdle width average, with tufts of spicules 14

13B Girdle extremely wide, often extended anteriorly, subtidal 16

14A Intertidal zone, North KwaZulu-Natal. sculpture very fine .....
..... *Acanthochitona jugotenuis*

14B Head valve half elliptical to almost semicircular in shape, sculpture moderate to strong (unless weathered) 15

The 2 halves of a couplet should have matching content so give shape of head valve in A and distribution in B (or stick to just sculpture),

15A Oval form, narrow valves, usually darker in colour, often on open exposed rocks, short tufts of spines, gills holobranchial..... *Acanthochitona garnoti*

15B Elongate oval form, wider valves, usually light coloured, never exposed, long tufts of spines, gills merobranchial..... *Acanthochitona variegata*

16A KwaZulu-Natal, apophyses rounded, projecting anteriorly, medium girdle tufts..... *Craspedochiton isipingoensis*

16B Apophyses wing-shaped or calloused, projecting laterally and anteriorly, small girdle tufts.....17

17A Flat granules on tegmentum, naked girdle appearance, sculptured jugal area .....*Craspedochiton productus*

17B Extremely convex, tail valve with mucro lifting posteriorly, followed by a convex postmucronal slope with roundish tegmental granules, velvet girdle appearance and smooth jugal area, Eastern Cape.....
..... *Craspedochiton umgazianus*

18A Prominent sculpture with two highly elevated pleural folds that show growth ridges..... *Callistochiton ashbyi*

18B No pleural folds 19

19A Apophyses connected and eyespots present, slits many.....20

19B Apophyses not connected.....22

20A Northern KwaZulu-Natal, subtidal, lateral areas not raised, eyespots in anterior third of lateral areas..... *Callochiton herberti*

20B Lateral areas raised, eyespots abundant on lateral areas and end valves ...

.....21

21A Intertidal, chestnut colour, semicircular head valve, small tail valve, 4 slits on IV, mucro antemedian..... *Callochiton dentatus*

21B Subtidal, 2-3 slits on IV, reddish, head valve less than semi-circular, mucro central..... *Callochiton jeareyae*

22A Sinus on tail valve.....35

22B No sinus on tail valve.....23

23A Valves subcarinated or carinated, longitudinal riblets, rugose teeth, pustulose/foveolate tegmentum..... 24

23B Smoother insertion teeth, valves not heavily sculptured, apophyses separated, tegmental sculpture not pustulose 32

24A Tegmental sculpture pustulose, mucro subcentral, eaves solid, girdle with spicules, spinelets or bristles.....25

24B Large, tegmentum foveolate or ribbed, girdle thick and leathery, insertion teeth directed forward.....29

25A Brown, tegmentum almost smooth, dark, long and thick dark spinelets spread across girdle, under rocks in low tide pool .....*Chaetopleura papilio*

25B Tegmental sculpture prominent, fine bristles or spines as girdle armature. 26

26A Western Cape, highly elevated, tegmentum with widely spread pustules, chitinous hair on girdle, usually pale in colour..... *Chaetopleura pomarium*

26B Pustules scarcely scattered on tegmentum, beaded riblets present, often colourful 27

27A KwaZulu-Natal, subtidal zone with very long bristles on girdle, riblets on lateropleural areas and widely dispersed pustules on lateral areas..... .....*Chaetopleura pustulata*

27B No individual prominent pustules but rather beaded riblets. 28

28A Subtidal zone, bunches of small spicules with hyaline hairs, very fine tegmental sculpture in central areas but lifted beads on lateral area ribs, no slitrays ..... *Chaetopleura dubruini*

28B Almost even riblets on tegmentum, spicules rising from chitinous cups and corneous hairs scattered in bunches, slitrays present .... *Chaetopleura pertusa*

29A Scattered tufts of striated spines, microscopically punctated/foveolate

tegmental sculpture ..... *Dinoplax gigas*

29B Tegmental sculpture clear, girdle completely covered in spicules 30

30A Longitudinal riblets from the lateropleural areas. 31

30B Riblets radiating from apex; long and thin spicules densely spread across girdle ..... *Dinoplax validifossus*

31A KwaZulu-Natal, shallow intertidal zone, long, glassy, thin spicules on girdle, tegmentum with tubercles and riblets, valves beaked, apophyses separated ..... *Dinoplax chelazziana*

31B Short, thick spicules on girdle, mucro submedian,valves not beaked, apophyses connected with lamina ..... *Dinoplax fossus*

32A Tegmentum smooth, spongy eaves, teeth obtuse 33

32B Solid eaves and well-developed valves 36

33A No girdle tufts ..... *Lepidochitona turtoni*

33B Girdle with tufts of spicules or needles, mucro antemedian, tegmental sculpture almost smooth.....35

34A Elongate oval, mucro anterior, grains all over valves.....*Plaxiphora parva*

34B Oval, mucro posterior, sculpture with two weak furrows on IV and lobed lateral areas with grains over the rest of the valve ... *Plaxiphora tulearensis*

35A Eastern Cape, subtidal, smooth ventral scales, tegmentum smooth to finely granulose, straight posterior slope..... *Lepidochitona dicksae*

35B Ribbed ventral scales, concave posterior slope, prominent apex. ....*Lepidochitona africana*

36A Insertion plates not pectintaed. 37

36B Insertion plates pectinated.....43

37A Perinotum scales conical l38

37B Perinotum scales not conical, but ribbed. 39

38A Deeper than 200m, Western Cape , tegmentum smooth with microperforation and growth lines only, smooth lamina between apophyses .....*Stenosemus simplicissimus*

38B Eastern Cape, from continental shelf, tegmentum with longitudinal grooves on central areas and radial grooves elsewhere, pectinated lamina between apophyses ..... *Stenosemus merweae*

39A Tegmental sculpture with radial granulose riblets on lateral areas and a punctated central area.....*Ischnochiton textillis*

39B Tegmentum without central punctation. 40

40A Western Cape, under stones in littoral zone, most often white to light brown, dorsal scales clearly ribbed with 5 deep ribs..... *Ischnochiton bergoti*

40B Scales smooth to the naked eye..... 41

41A KwaZulu-Natal, subtidal zone, clear ridges on lateropleural area and growth lines on lateral areas, mucro antemedian ..... *Ischnochiton indianus*

41B Mucro submedian with bumps spread across tegmentum. 42

42A Array of colour spots, scales striated, longitudinal sculpture on lateral areas with extended antemucronal area..... *Ischnochiton oniscus*

42B Scales smooth, wavey sculpture and extended postmucronal area ....*Ischnochiton elizabethensis*

43A Shell strongly furrowed, apophyses large, intermediate valves short but wide 44

43B Shell not furrowed. 46

44A KwaZulu-Natal, brown with banded girdle of darker stripes, tegmentum with prominent grooves on lateral areas and less prominent grooves on lateropleural areas. .....*Rhyssoplax salihafui*

44B Tegmentum without prominent grooves on lateral areas 45

45A Bright colour with lighter blotches, tegmentum with clearly grooved lateropleural areas but smooth lateral areas.....*Rhyssoplax crawfordi*

45B Tegmentum mostly smooth with some faint grooves on lateral areas and dotted growth lines .....*Rhyssoplax.polita*

46A On rocks exposed to wave action, weathered valves, thick and eroded, shell eyes present, callus on tail valve, terminal mucro.....*Onithochiton.literatus*

46B No callus on tail valve 47

47A KwaZulu-Natal, shell eyes present in anterior third of lateral area .....*Lucilina.carnosa*

47B No shell eyes present. 48

48A KwaZulu-Natal, concentric, wavy ridges on tegmentum but smooth central area ..... *Tegulaplax hululensis*

48B No wavy ridges, pustules or warts on lateral areas 49

49A Brown with small bumps on lateral areas and found on the south-western coast of South Africa ..... .*Radsia nigrovirescens*

49B KwaZulu-Natal in deep subtidal, large, flat warts on lateral areas and found

on the North Eastern Coast of South Africa..... *Chiton laterorugosus*

In a key the two halves of the couplet should have matching content, at least for opening ‘main’ phrase. It is permissible to add another clue eg re distribution after this but better to put this in brackets, especially if you can only apply it to the one half of the couplet

Systematic Part

LEPTOCHITONIDAE

No insertion plates

Parachiton Thiele, 1909

Parachiton; Van Belle, 1988:47; Sirenko, 2000:93.
(Parachiton); Vaught *et al*., 1989:2; Kaas & Van Belle, 1985:163.
(Parachiton) Thiele, 1909:14; Dell'Angelo *et. al*., 2004:49. *Leptochiton*

Tail valve enlarged and elongated, with the mucro shifted towards the posterior. Fine tegmental sculpture. Girdle adorned with small scales, cylindrical spicules on the fringe, and longer structures along the shell edges. Robust radula teeth, featuring a tridentate cusp, broad and rounded cusps on the major lateral tooth.

Distribution: Tropical and Subtropical regions, ranging from the Mediterranean Sea to KwaZulu-Natal (South Africa), and extending across the Bay of Bengal and Asia to Tasmania. Found in rocky intertidal zones to depths of 150m.

Remarks: Most prevalent in Australia and New Zealand, this genus holds the distinction of being the most widespread and possibly the oldest among living chitons. South Africa currently hosts only one known species from a single record on the border of South Africa and Mozambique.

Parachiton indecorus (Kaas & van Belle, 1990)

Figure 3.1

Leptochiton (Parachiton) indecorus Kaas & Van Belle, 1990:14, fig. 4; Muratov, 2014:381, fig. 34- 38.
Parachiton indecorus; Muratov, 2014:381.

Colour: Ivory, live and preserved**.**

Form: Elongate oval, small (up to 7mm), elevation moderate, carination absent, valves rounded.

Valves: Head valve semicircular, posterior margin widely V-shaped. Intermediate valve rectangular, anterior margin straight to slightly concave, posterior margin straight, side margins rounded, apex not prominent, lateral areas not raised. Tail valve very large and very long, front margin sinuous, with mucro not prominent and posteriorly moved, post mucronal slope steep and straight. Tegmentum with sculpture microgranulose, head valve radially grooved, lateral areas with minute granules in quincunx and fine, longitudinal riblets or minute pustules on central areas, less prominent to the center and growth lines present. Articulamentum weak, white. Apophyses small and trapezoidal, jugal sinus wide.

Girdle: Narrow. Dorsal spicules dense, sharp, and grooved, with longer spicules, some straight and grooved and other bent and smooth, around shell margins. Ventral scales elongated, smooth, beaked, and bluntly pointed. Marginal fringe absent.

Radula: Central tooth cornet-shaped. First lateral tooth wing-shaped with a projection at the base. Major lateral tooth cusp tricuspid, large and blunt with the central one being the longest and the inner one being the shortest.

Gills: Not documented in descriptions and not visible in paratype due to heavy curling.

Habitat: Subtidal.

Type locality: Boteler Point, KwaZulu-Natal.

Global distribution: Endemic to South Africa.

Regional distribution: Known only from northern KwaZulu-Natal. Type locality off Boteler Point, and a paratype near Bhanga Nek.

Remarks: This species is poorly collected and reported. According to Kaas and Van Belle (1990: 16), the closest relative, *P. eugenei* from Madagascar, differs in head valve sculpture, central area sculpture and girdle armature, but this relative has not been found in South Arica. This species likely occurs in Mozambique, as it is recorded close to that border.

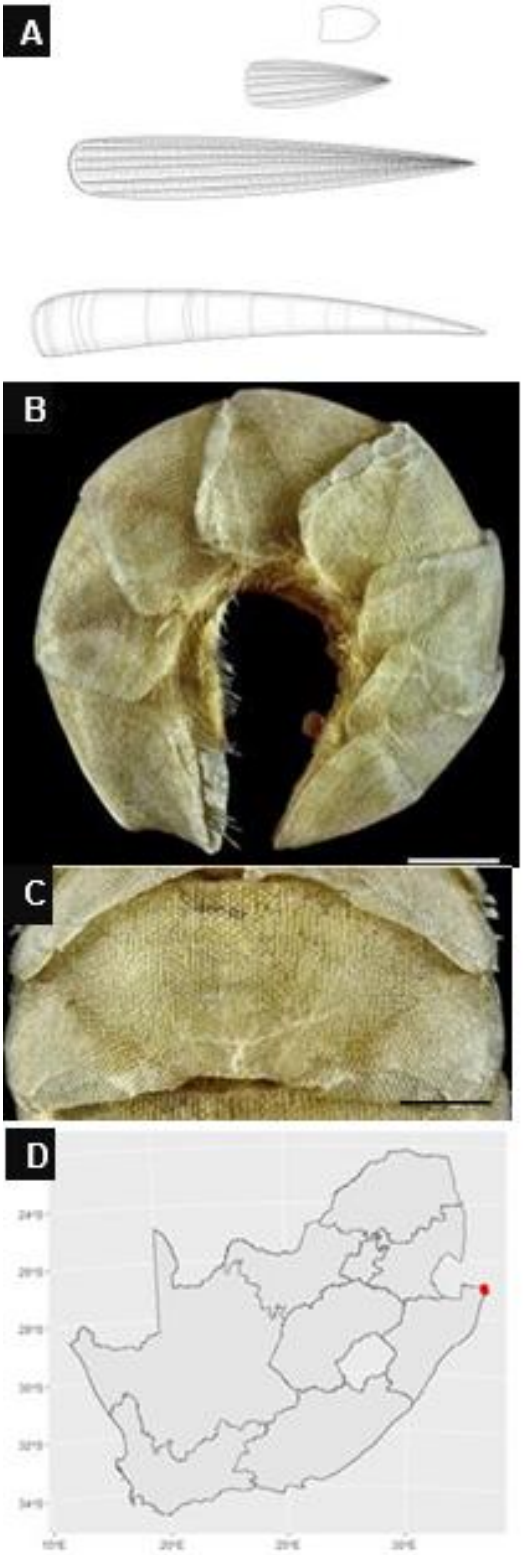

Figure 3.1) *Parahiton indecorus* (holotype NMSA D7408/T14 – Boteler Point, KwaZulu-Natal): A – Girdle armour; B - Whole specimen; C - Intermediate valve (all photos supplied by Igor Muratov from the Natal museum); D – Distribution in South Africa(endemic).

Leptochiton Gray, 1847
Chiton (Leptochiton) Gray, 1847: 127.
Lepidopleurus (Leptochiton) Gray, 1847:168.
Leptochiton (Trachyradsia) Dall, 1878:283.
Lepidopleurus (Pilsbryella) Nierstrasz, 1905:11.
Leptochiton (Pilsbryella) (Nierstrasz, 1905:13).
Lepidopleurus (Xiphiozona) Berry, 1919:44-47.
Leptochiton (Leptochiton) Kaas and van Belle, 1985:36; Eernisse, 1998.
Leptochiton; Sirenko, 2015:152-153:; Sigwart & Sirenko, 2012:5, 9.

Small to medium-sized chitons with rounded and thin valves. Tegmentum adorned with almost evenly sized granules. Elongated tail valve smaller than *Parachiton*. Girdle covered in small granular scales, occasionally interspersed with spicules or entirely spiculose.

Distribution: Widely distributed, mainly in Australasia, Japan, and North Atlantic. Several species present along the South African coast.
Remarks: This is the most diverse genus of chitons in South African waters, boasting eight species, all of which are endemic, except for *L. nierstraszi* (Leloup, 1981). While most deep-water chitons belong to this genus, but three South African species are intertidal, the remaining four inhabiting depths from 70 - 433m (Sirenko, 2016:145)

Leptochiton nierstraszi (Leloup, 1981)

Figure 3.2

Lepidopleurus (Pilsbryella) nierstraszi Leloup, 1981:27, textfig. 13, pl. 2: fig. 1.
Leptochiton (Leptochiton) nierstraszi; Kaas & van Belle 1985:130, fig. 58.
Lepidopleurus (Leptochiton) nierstraszi, Dell'Angelo *et al*., 2004:49, pl. 1: figs 1-9.
Leptochiton nierstraszi; Strack, 1993:3-4; Dell'Angelo *et al*., 2020:404, fig. 2.

Colour: Ivory, live and preserved**.**
Form: Oval, medium (up to 28mm), elevation moderate, valves rounded, subcarinated.
Valves: Head valve semi-circular, posterior margin slightly V-shaped. Intermediate valve rectangular, anterior margin slightly convex in valve II and concave in valves III-VII, posterior margin straight, side margins rounded, apex indicated, notched and lateral areas slightly raised. Tail valve with mucro prominent at anterior third, anterior margin convex, posterior slope concave. Tegmentum with extremely elevated, mushroom shaped, big, round granules arranged in quincunx, concentrated on jugum, growth lines not visible. Articulamentum thin, white. Apophysis small and triangular shaped, jugal sinus wide and shallow.
Girdle: Narrow. Dorsal scales imbricating, rounded, small, ribbed with a few cylindrical spines. Marginal fringe with some smooth and some ribbed medium spines.
Radula: Major lateral tooth cusp uniscupid and curved.
Gills: Not documented or visible in viewed specimen.
Habitat: On the bottom or under intertidal rocks.
Type locality: Boteler Point, KwaZulu Natal.
Global distribution: Madagascar, Red Sea and South Africa.
Regional distribution: Known only from Boteler Point, Northern KwaZulu-Natal.
Remarks: Only found twice in South African waters – one juvenile and one adult. The specimen depicted is extremely small (about 2mm) and appears to be a juvenile. It is brittle, curled up and so difficult to view details without damaging the specimen (E765). More specimens are needed to confirm further anatomical details.

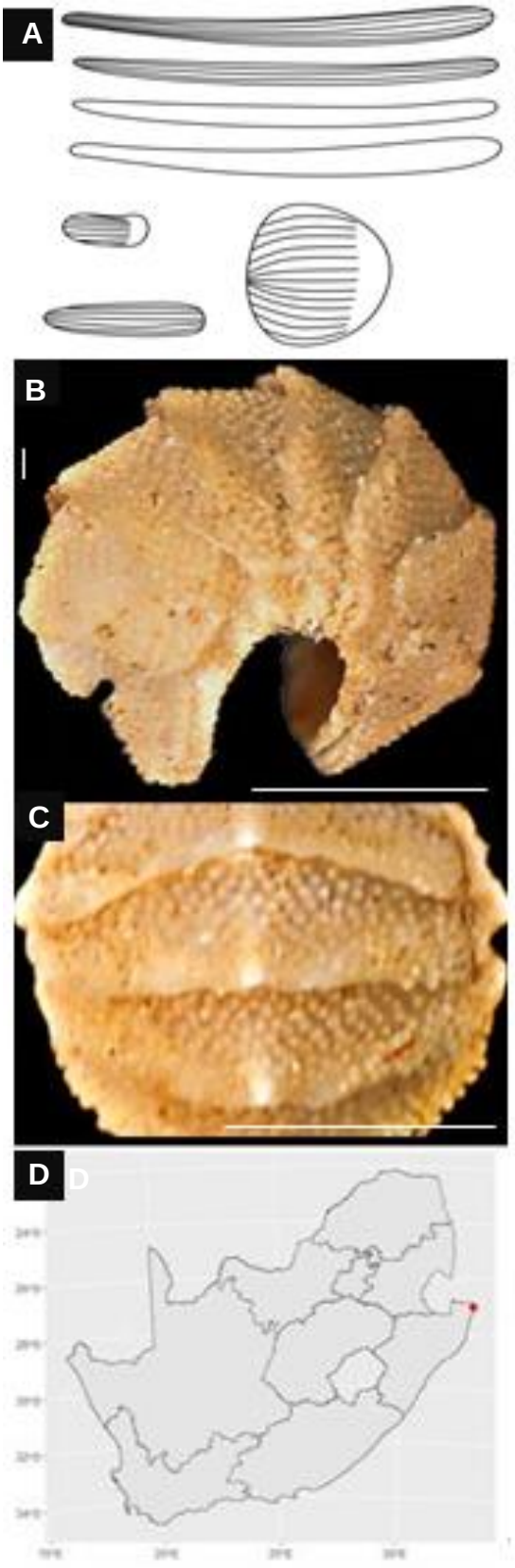

Figure 3.2) *Leptochiton nierstraszi* (Specimen NMSA E765 – Boteler Point, KwaZulu-Natal): A – Girdle armour; B - Whole specimen; C - Intermediate valve D - Distribution in South Africa.

Leptochiton smirnovi Sirenko, 2016

Figure 3.3

Leptochiton smirnovi Sirenko, 2016:145-151.

Colour: Ivory, live and preserved.
Form: Elongate oval, small (up to 7mm), elevation moderate, valves rounded, carination absent.
Valves: Head valve semicircular, posterior margin concave. Intermediate valves rectangular shape, anterior margin straight, posterior margin straight, apex weak and lateral areas not raised. Tail valve wider than head valve, mucro sub-central and not prominent, posterior slope concave. Tegmentum with oval shaped flat granules, dense on central areas, in longitudinal rows on antemucronal area and in rows of five elsewhere. Articulamentum moderately developed, apophysis wide, short and subtriangular.
Girdle: Narrow. Dorsal scales wide, ribbed, dorsally rounded; ventral scales elongated, pointy, dorsally ribbed. Marginal fringe with long spicules.
Radula: Central tooth narrow. First lateral tooth elongated. Major lateral tooth cusp tricuspid.
Gills: Merobranchial.

Habitat: Intertidal zone under stones.

Type locality: Sunny Cove, False Bay.

Global distribution: Endemic to South Africa.
Regional distribution: Known only from Sunny Cove, False Bay.
Remarks: Not examinined due to absence of specimens in South African museums, as the original author deposited the specimens in Academy of the Zoological Institute of the Russian Sciences, St. Petersburg. No other specimens have been reported since.

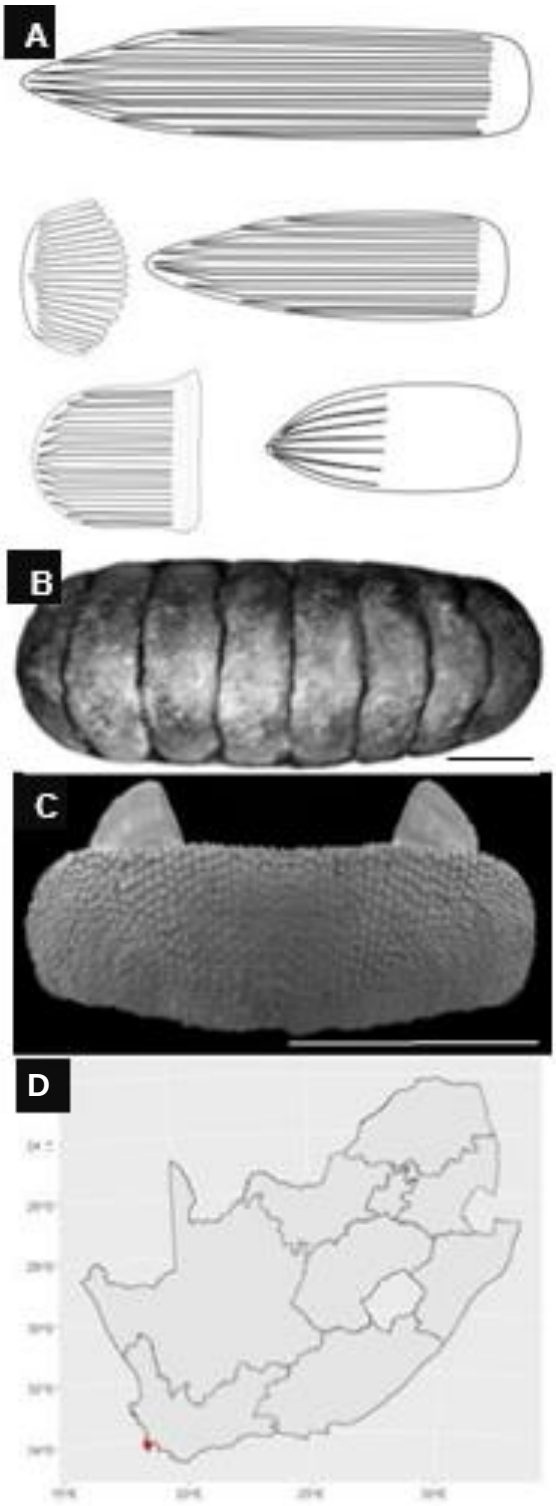

Figure 3.3) *Leptochiton smirnovi* (holotype ZISP 2260 – Sunny Cove, False Bay): A – Girdle armour; B - Whole specimen; C – Intermediate valve. All Figures from Sirenko (2016); D – Distribution in South Africa (endemic)..

Leptochiton dispersus Kaas, 1985

Figure 3.4

Leptochiton (Leptochiton) dispersus Kaas, 1985: 300, figs 1-13; Kaas and van Belle, 194:377-401, figs 13-21.
Leptochiton dispersus; Sirenko, 2016:145, 149.

Colour: Light brown to transparent, live and preserved.
Form: Elongate oval, small (up to 10mm), elevation moderate, carination absent, valves rounded.
Valves: Head valve semicircular, anterior slope straight, posterior margin almost straight but notched. Intermediate valves with anterior margin straight, posterior margin concave, apex weak, lateral areas not raised. Tail valve with mucro slightly posterior and pointed, posterior slope concave. Tegmentum with irregular longitudinal lines of pustules, partly covering the central areas, antemucronal area sculptured with chalky interstices with less prominent pustules elsewhere, growth marks very slight on some valves. Articulamentum white with apophysis small, triangular shaped.
Girdle: Wide. Dorsal side with spicules white among narrow calcareous, elongated, bluntly pointed, flattened, slightly bent, and imbricating scales; Ventral side with larger scales, imbricating with fine longitudinal striae. Marginal fringe absent.
Radula: Major lateral tooth cusp uniscupid, sharp, long and slender. Central tooth with evenly rounded narrow blade. First lateral tooth wing-shaped and small.
Gills: Merobranchial. Adanal.
Habitat: 90-100m depth on marine debris.
Type locality: Qolora River, Eastern Cape.
Global distribution: Endemic to South Africa.
Regional distribution: Known only from Qolora River in the Eastern Cape.
Remarks: This species is quite different from other South African *Leptochiton* species according to the original author, and closer to an Indonesian species, *L. lineatus* (Nierstrasz, 1905). Only found once in South Africa and unfortunately the type specimen is not intact. More material required.

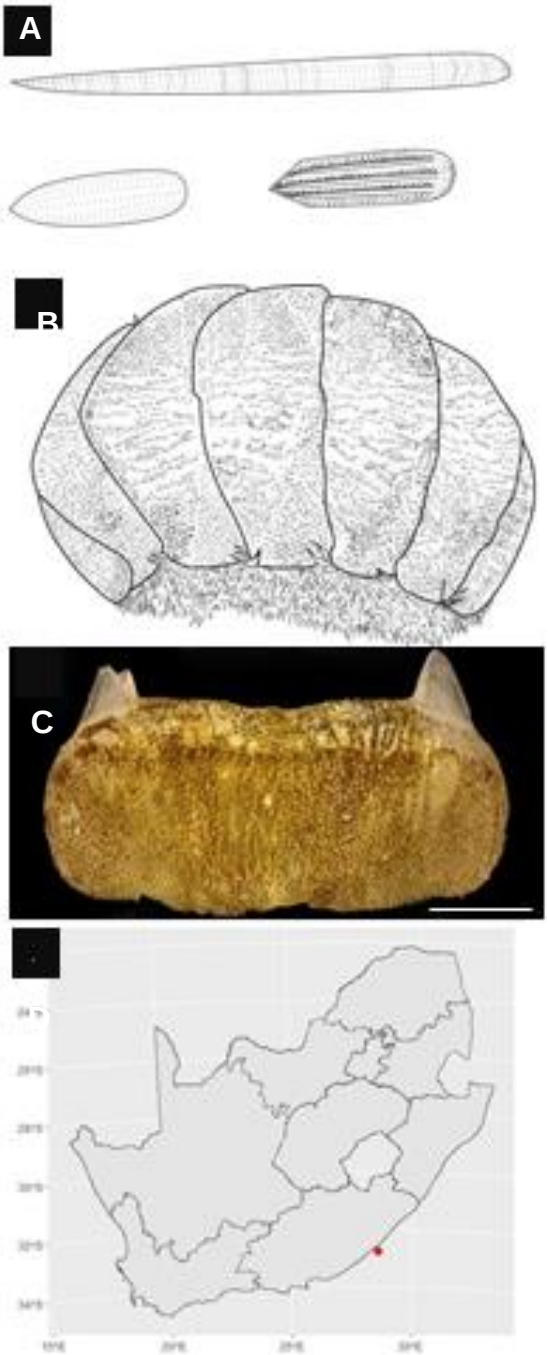

Figure 3.4) *Leptochiton dispersus* **(**holotype NMSA C4658/T3047 – Qolora River, Eastern Cape): A – Girdle armour; B - Drawing of whole specimen; C – Intermediate valve (Figure supplied by Igor Muratov from the Natal Museum); D – Distribution in South Africa(endemic)..

Leptochiton permodestus Kaas, 1985

Figure 3.5

Leptochiton (Leptochiton) permodestus Kaas, 1985: 303, figs 14-25; Kaas and van Belle, 1987:16; Muratov, 2014:382-383, fig. 55.

Leptochiton permodestus; Sirenko, 2016:150.

Colour: White to brown, live and preserved.

Form: Broadly oval, small (up to 7mm), elevation moderate, valves rounded but thin and brittle, carination absent.

Valves: Head valve semi-circular, front slope straight, posterior margin almost straight, slightly V-shaped. Intermediate valves rectangular, anterior margin concave, posterior margin straight, apex weak and lateral areas not raised. Tail valve a third of a circle, front margin straight, mucro posterior, swollen, posterior slope concave. Tegmentum with subtle raised, spaced-out, oval/drop-shaped granules on head valve and central areas, without growth lines. Articulamentum white, poorly developed with apophysis trapezoid.

Girdle: Dorsal scales oval, ribbed, pointed and spicules ribbed, ventral scales finely striated in radiating rows. Marginal fringe absent.

Radula: Major lateral tooth with long and slender cusps. Central tooth with narrow and rounded blade. First lateral tooth triangular with two wing-like processions.

Gills: Merobranchial. Adanal.

Habitat: 390-400m depth in muddy sand.

Type locality: Betty's Bay, Overberg Coast, South Africa.

Global distribution: Endemic to South Africa.

Regional distribution: Betty's Bay on SW Cape to northern KwaZulu-Natal

Remarks: The word "*permodestus*" means "very modest" and refers to the fine sculpture. According to Kaas (1977), this species' closest relatives seem to be *Belknapchiton alveolus* (Loven, 1846) occurring in Spain, France, Norway and the Northwestern Atlantic waters, and *B. belknapi* (Dall, 1878) from the South Western parts of South America, as well as the North Pacific Ocean. Both these species were in the genus *Leptochiton,* but have now moved to a new genus, *Belknapchiton* (Sirenko *et a*l., 2022). These differ in radula characteristics and body size and shape. Some museum specimens have localities described from Hermanus and Betty's Bay in the Western Cape, but the coordinates of the specimens are off East London.

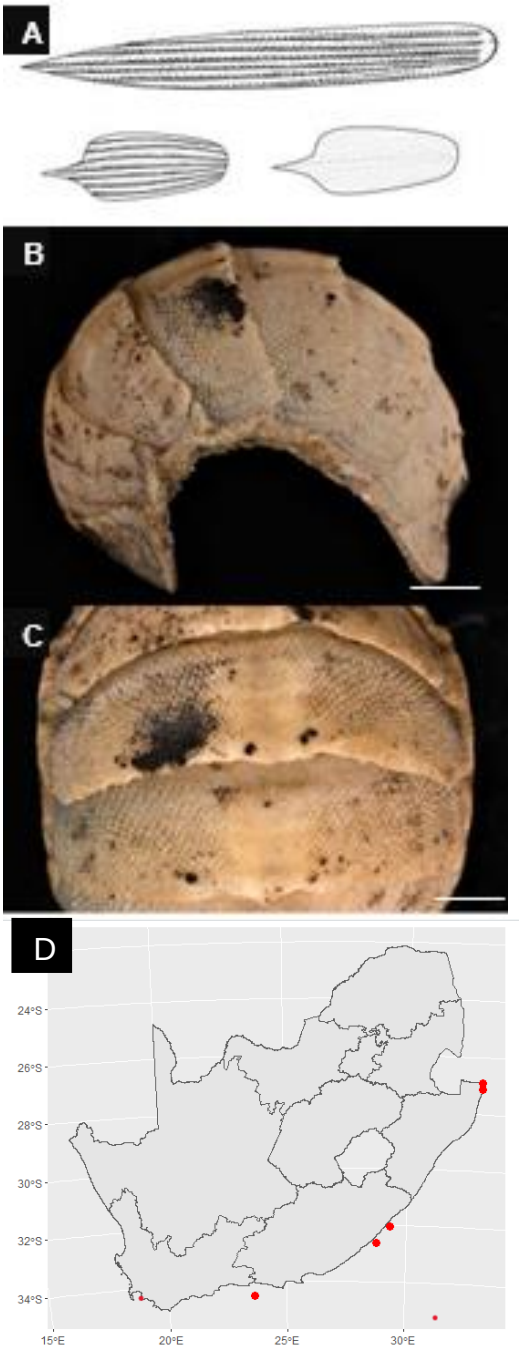

Figure 3.5) *Leptochiton permodestus* (Specimen NMSA V1270 – Plettenberg Bay): A – Girdle armour; B - Whole specimen; C – Intermediate valve; D – Distribution in South Africa(endemic)..

Leptochiton meiringae Kaas, 1985

Figure 3.6

Leptochiton (Leptochiton) meiringae Kaas, 1985: 305, figs 26-30; Kaas & van Bell, 1987:18; Muratov, 2014:382, figs 44-50.
Leptochiton meiringae; Sirenko, 2016:150.

Colour: Yellowish live and pale preserved.
Form: Broadly oval, small (up to 5mm), elevation moderate, valves rounded but thin and brittle, carination slight.
Valves: Head valve semicircular, anterior slope straight, posterior margin widely V-shaped. Intermediate valve rectangular, anterior margin concave, posterior margin straight, apex weak and lateral areas not raised. Tail valve large, front margin straight, mucro posterior, slightly swollen, posterior slope concave. Tegmentum with subtle, raised, spaced out granules in lines, growth lines absent. Articulamentum white, thinly developed, apophysis trapezoid.
Girdle: Dorsal scales oval, pointed with riblets, and dorsal spicules ribbed; ventral scales finely striated in radiating rows. Marginal fringe absent.
Radula: Major lateral tooth cusp uniscupid, long and pointed. Central tooth with rounded, narrow blade. First lateral tooth triangular with two wing-like processes.
Gills: Merobranchial. Adanal.
Habitat: 80-100m depth on marine debris or in muddy sand.
Type locality: East London, Eastern Cape.
Global distribution: Endemic to South Africa.
Regional distribution: Knysna to East London
Remarks: As with most species from Kaas (1985), the original description is of high quality and just lacked the radula description, which was later added by Kaas and van Belle (1985).

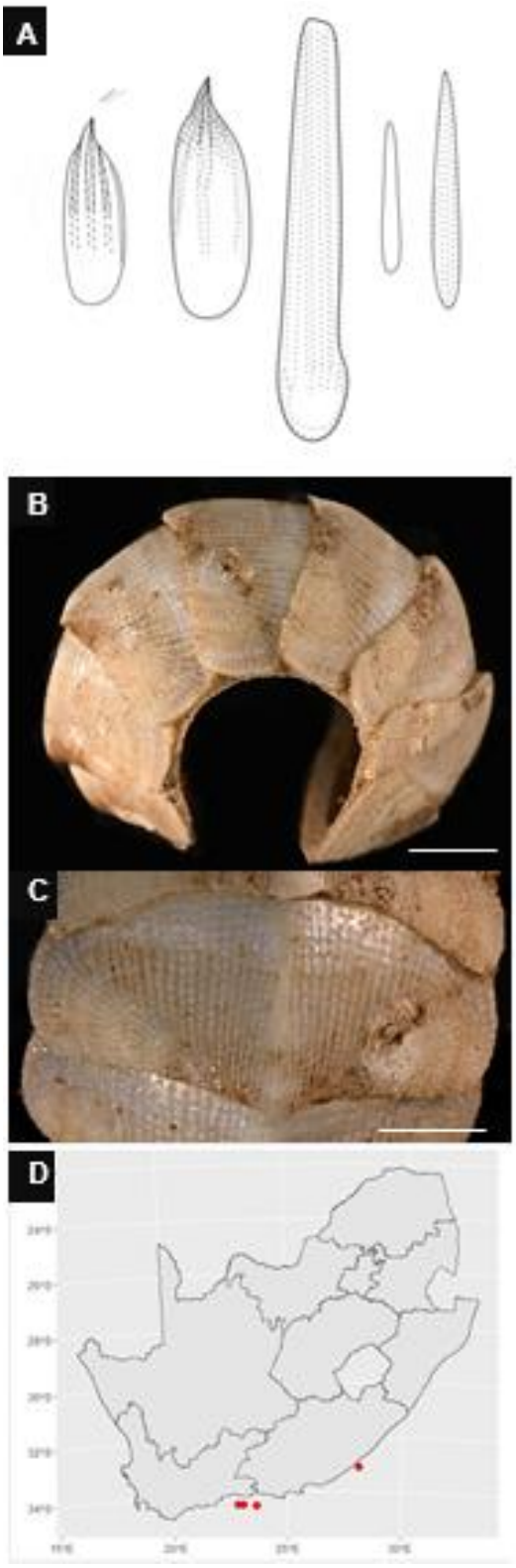

Figure 3.6) *Leptochiton meiringae* (Specimen NMSA V1269 – Plettenberg Bay): A – Girdle armour; B - Whole specimen; C – Intermediate valve; D - Distribution in South Africa(endemic).

Leptochiton chariessa (Barnard, 1963)

Figure 3.7

Lepidopleurus chariessa Barnard, 1963:332, fig. 29h.
Leptochiton (Leptochiton) chariessa; Kaas and van Belle, 1985:76, fig. 33; Kaas, 1985:300.
Leptochiton chariessa; Sirenko, 2016:145, 149.

Colour: Brown live and pale brown preserved.
Form: Elongate oval, small (up to 15mm), elevation slight, carination slight, valves rounded.
Valves: Head valve semicircular, posterior margin straight to concave. Intermediate valve rectangular to trapezoid, anterior margin sinuate and rounded, posterior margin slightly concave, side margins rounded, apex small, lateral areas not raised. Tail valve with front margin convex, mucro bluntly pointed, subcentral, posterior slope depressed. Tegmentum with head valve displaying fine radiating rows of granules and concentric growth marks on head valve; intermediate valve with pustules arranged in longitudinal rows on central area, faint growth lines in lateral areas and radiating rows of pustules elsewhere, antemucronal area with rows of granules, converging posteriorly towards the sides; postmucronal area with radial rows of granules and faint growth marks. Articulamentum white, apophysis triangular.
Girdle: Narrow. Dorsal scales oval, ribbed, pointed; dorsal spicules fine and ribbed; ventral scales finely striated and in radiating rows. Marginal fringe absent.
Radula: Not documented.
Gills: Not documented, and gills of preserved specimens not present.
Habitat: Amongst marine growth and calcareous debris, 70-80m depth**.**
Type locality: Cape St. Blaize, Mossel Bay.
Global distribution: Endemic to South Africa.
Regional distribution: Cape St. Blaize to East London.
Remarks: This species differs from *L. sykesi* by being less ridged, but is not as fine and delicate as *L. sykesi*.

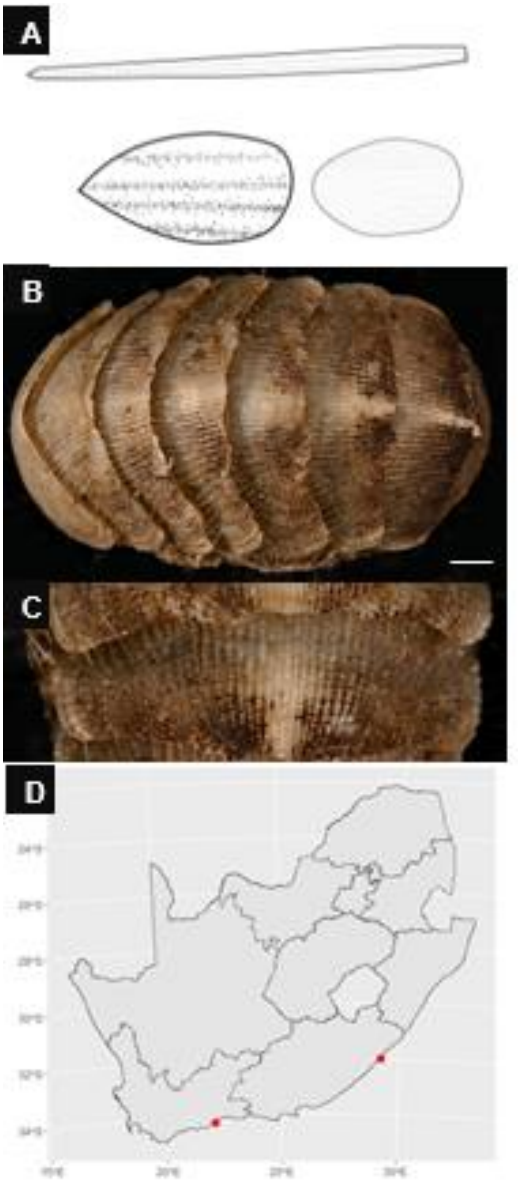

Figure 3.7) *Leptochiton chariessa* (Specimen NMSA C5891 - Mgwetyana River mouth): A – Girdle armour; B - Whole specimen; C – Intermediate valve; D – Distribution in South Africa(endemic)..

*Leptochiton sykesi (*G. B. Sowerby III, 1903)

Figure 3.8

Chiton (Hanleya) sykesi Sowerby III, 1903:225, pl. 5: fig.13.
Lepidopleurus sykesi; Thiele, 1906:328, pl. 29: figs 6-8; Ashby, 1931:15, pl. 2: figs 16-19; Ba .
Leptochiton (Leptochiton) sykesi; Kaas and van Belle, 1985:75, fig. 32.
Leptochiton sykesi; Sirenko, 2016:150; Herbert *et al*., 2018:320.

Colour: White to brown shell with yellower girdle when live
and pale orange to brown when preserved.
Form: Elongate oval, medium (up to 25mm), elevation moderate, carination present, valves heavy and rounded.
Valves: Head valve semicircular with posterior margin widely V-shaped. Intermediate valves with apex small and pointed, lateral areas raised. Tail valve with mucro pointed and posterior, posterior slope deeply concave. Tegmentum with tiny knobs in longitudinal rows on central areas and antemucronal area, not quite radial on the head valve, lateral areas and post mucronal area, growth lines present and distinctive. Articulamentum calloused, white, well developed, apophysis small and triangular, jugal sinus straight.
Girdle: Narrow. Dorsal scales elongated, bluntly pointed, with around 8 longitudinal grooves, some spicules, ventral scales in radiating rows, imbricating, thin, flat with three faint grooves.
Radula: Major lateral tooth cusp strong, bidentate, (inner denticle long, bent and pointed; outer cusp small and blunt). Central tooth rounded and widened at base.
Gills: Merobranchial.
Habitat: 70-110m depth.
Type locality: Off Cape Point.
Global distribution: Endemic to South Africa.
Regional distribution: Restricted to Atlantic coast of Western Cape.
Remarks: The type specimen is in too poor condition to inspect undescribed features, but Kaas and van Belle (1985:75) described most features absent from the original description. Some records indicate a possible presence in the Antarctic Peninsula (Schwabe & Sellanes, 2010; Sirenko, 2006b; Sirenko & Gallardo, 2005).

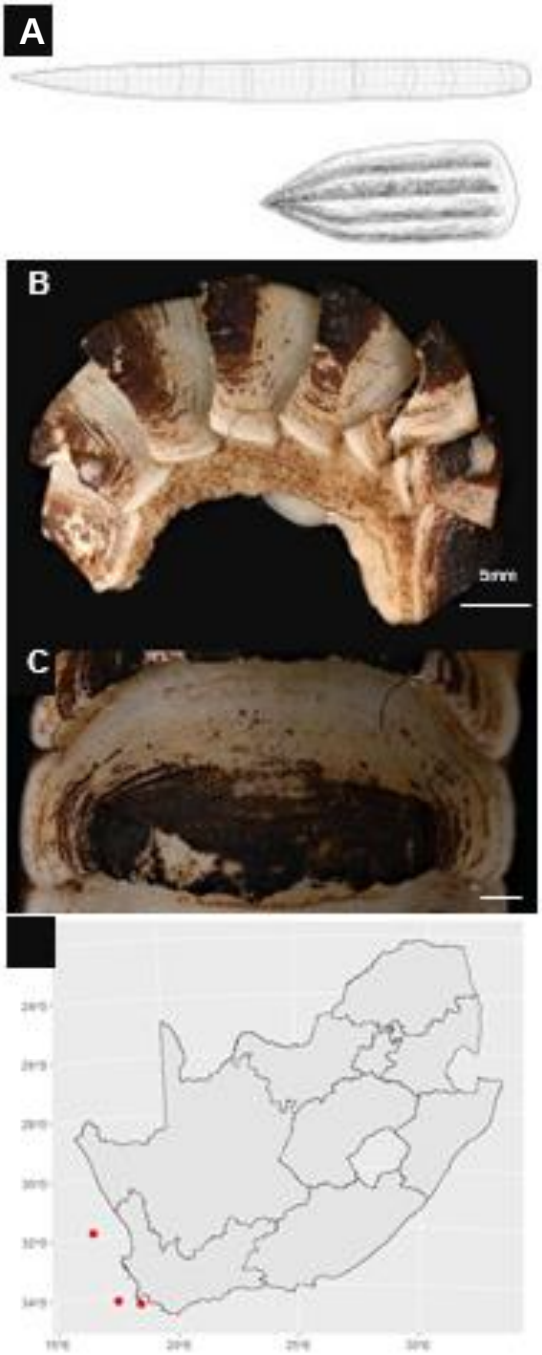

Figure 3.8) *Leptochiton sykesi* (Specimen SAMC V468):A – Girdle armour; B - Whole specimen; C – Intermediate valve; D – Distribution in South Africa(endemic)..

Leptochiton hodgsoni (Sirenko, 2000)

Figure 3.9

Parachiton hodgsoni Sirenko, 2000:93, figs 1-5.
Leptochiton hodgsoni; Sirenko, 2015:24-31; Sirenko, 2016:145, 150.

Colour: White, red and/or orange live and white to pale live colours preserved.
Form: Small (up to 10mm), elongate oval, elevation moderate, subcarinated, valves rounded.
Valves: Head valve semicircular. Intermediate valves rectangular, anterior margin slightly rounded, posterior margin straight, side margins rounded, lateral areas not raised. Tail valve long, small, mucro slightly prominent, positioned posteriorly, posterior slope straight. Tegmentum with longitudinal grooves on the head valve, intermediate valves with widely spaced longitudinal rows of granules on the central area and lateral areas carry radially arranged pustules. Articulamentum white to transparent, developed weakly, apophyses triangular to trapezoid.
Girdle: Very narrow. Clothed with needles, smooth, striated, in chitinous cusps, dorsal scales broad, curved and sculptured, ventral scales elongated and bluntly pointed distally. Marginal fringe with needles.
Radula: Major lateral tooth small with narrow, pointed tridentate cusp. Central tooth small, long, narrow and cornet-shaped. First lateral tooth small.
Habitat: Intertidal to subtidal zone.
Type locality: Glencairn, False Bay.
Global distribution: Endemic to South Africa.
Regional distribution: Simon's Town, Western Cape to Shelly Beach, KwaZulu-Natal.
Remarks: This species broods juveniles in its pallial groove. There is only one specimen, disarticulated, small and without girdle, currently available from the Iziko Museum in South Africa, with the locality of De Kelders in the Western Cape. All the type specimens are at the Zoological institute of St. Petersburg. One specimen was later found by Renee Els in 2022 in Port Elizabeth.

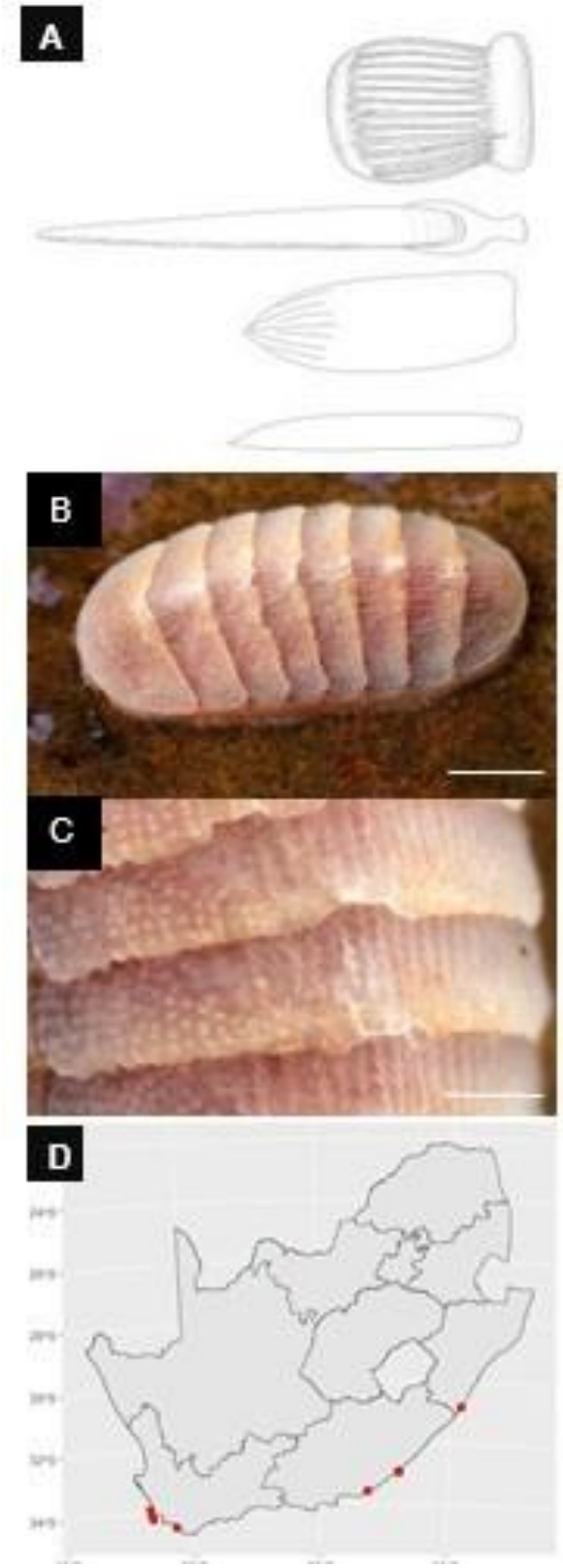

Figure 3.9) *Leptochiton hodgsoni* (Live photo from Port Elizabeth, intertidal): A – Girdle armour; B - Whole specimen; C- Intermediate valve (photos supplied by Reneè Els and edited); D -Distribution in South Africa(endemic)

MOPALIIDAE

No shell eyes or eye spots, sinus on tail valve, one slit on intermediate valves, teeth mostly long and sharp and not pectinated, never with scales.

Plaxiphora Gray, 1847

Chiton (Plaxiphora) Gray, 1847:65, 68.
Plaxiphora (Euplaxiphora) Shuttleworth, 1853:193.
Plaxiphora (Frembleya) H. Adams, 1867:445.
Streptochiton Dall, 1879:298.
Plaxiphora (Guildingia) Carpenter[in Dall], 1882:284, 288.
Plaxiphora (Poneroplax) Iredale, 1914:32.
Plaxiphora (Diaphoroplax) Iredale, 1914:424.
Plaxiphora (Maorichiton) Iredale, 1914:424.
Kopionella Ashby, 1919:66-73, pl. 11.
Mopalia (Semimopalia) Dall, 1919:514.
Aerilamma Hull, 1924:113.
Vaferichiton Iredale & Hull, 1932:131.
Plaxiphora (Mercatora) Leloup, 1942:43.
Hachijomopalia Taki, 1954:No page number available.
Plaxiphora (Plaxiphora); Kaas and van Belle, 1994:265.
Plaxiphora; Liu, 2008:458.

Oval shape with narrow valves. Tail valve features a discreet posterior sinus. Distinguished by a terminal/posterior mucro and an elegantly elongated apex. Immaculately smooth insertion plates, exhibiting a rounded and uninterrupted contour. Girdle adorned with lengthy bristles, akin to setae.

Distribution: Along the coastlines of Australia, South America, Tristan da Cunha, New Zealand, the South China Sea, Polynesia, Madagascar, Mozambique, and South Africa.
Remarks: Despite the description of over 20 species within this genus, their distributions are not specified on WoRMS, underscoring the prevailing uncertainty surrounding the geographic ranges of most species in this group.

Plaxiphora tulearensis Leloup 1981

Figure 3.10

Plaxiphora tulearensis Leloup, 1981:38, fig. 21, pl. 1: fig.5, pl. 4: fig.1; Kaas, 1986:14; Saito & Okutani, 1991:191; Kaas and van Belle, 1994:276, fig. 112.

Colour: Light orange with white and brown marble, live and preserved.
Form: Oval, small (up to 8mm), elevation moderate, carination absent, valves beaked.
Valves: Head valve semicircular, front slope convex, posterior margin widely V-shaped with a shallow notch. Intermediate valve rectangular, anterior margin convex, posterior margin widely V-shaped, jugum produced, and lateral areas raised. Tail valve small, mucro posterior and prominent. Tegmentum has two weak furrows on the intermediate valves, large grains over the central area, punctated pleural areas with large, flattened grains unevenly arranged, lobed lateral areas, head valve has fusing, large, rounded grains weakly ridged.
Articulamentum white, development strong, apophysis triangular and sharp in intermediate valves, but rounded to rectangular in tail valve; jugal sinus wide, semi-circular. Slit formula: 8-10/1/0.
Girdle: Scales and yellowish spines ribbed.
Radula: Major lateral tooth cusp tricuspid, pointed. Central tooth not documented. First lateral tooth widened at the base.
Gills: Not documented.
Habitat: In littoral zone on low sandstone reef platforms.
Type locality: Toliara, Madagascar.
Global distribution: Madagascar and South Africa.
Regional distribution: KwaZulu-Natal to Eastern Cape.
Remarks: Addition to the South African fauna as on p.28.

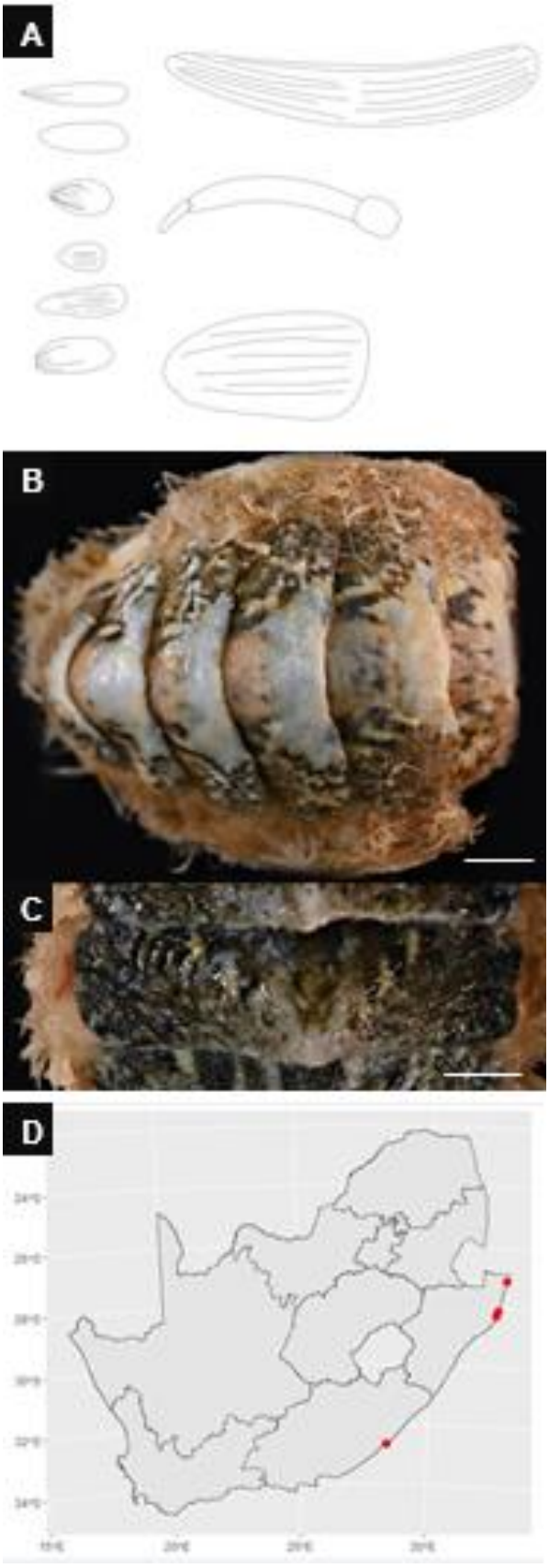

Figure 3.10) *Plaxiphora tulearensis*: A – Girdle armour; B - Whole specimen NMSA W9768 – Mapelane Beach, St. Lucia; C - Intermediate valve of specimen NMSA W8506 - Black Rock, Kosi Bay; C – Distribution in South Africa.

Plaxiphora parva Nierstrasz, 1906

Figure 3.11

Plaxiphora (Plaxiphora) parva Nierstrasz, 1906:501, figs 38-43; Kaas, 1985:862.
Plaxiphora parva; Thiele, 1909:23; Leloup, 1942:31; Leloup, 1952:5.
Aerilamma parva; Hull, 1924:113; Iredale & Hull, 1926:168.
Plaxiphora dardennei Leloup, 1981: 36, fig. 19, pl. 2, fig 3.
Plaxiphora granulata Leloup, 1981: 37, fig. 20, pl. 2, fig. 5.

Colour: Faint pink and black.
Form: Elongate oval, small (up to 5mm), elevation slight, valves beaked.
Valves: Head valve semicircular, front slope straight, posterior margin widely V-shaped. Intermediate valve rectangular, anterior margin convex, posterior margin almost straight, jugum produced, and lateral areas raised. Tail valve small, mucro anterior and prominent, concave posterior slope. Tegmentum with small cusps, round in shape, sculptures the head valve and tail valve, with larger humps on intermediate valves. Lateral areas with a clear diagonal line covered in elongated, curved cusps with granules in quincunx no growth lines visible. Articulamentum white, development intermediate, apophysis short and small and sinus poorly developed. Slit formula: 8-10/1/0.
Girdle: Girdle wide and covered with numerous long, brown, chitinous hair-like structures bunched together.
Radula: Major lateral tooth cusp tricuspid, pointed. Central tooth not documented. First lateral tooth widened at the base.
Gills: Holobranchial and abanal.
Habitat: Intertidal zone.
Type locality: Mozambique
Global distribution: Madagascar and surrounding islands, Mozambique and South Africa.
Regional distribution: Restricted to KwaZulu-Natal.
Remarks: Though this species was not formally described from South Africa before, Sirenko and Dell'Angelo (2024) reported the differences of this species to another, using specimens from South Africa. Images here are also taken from Sirenko and Dell'Angelo(2024).

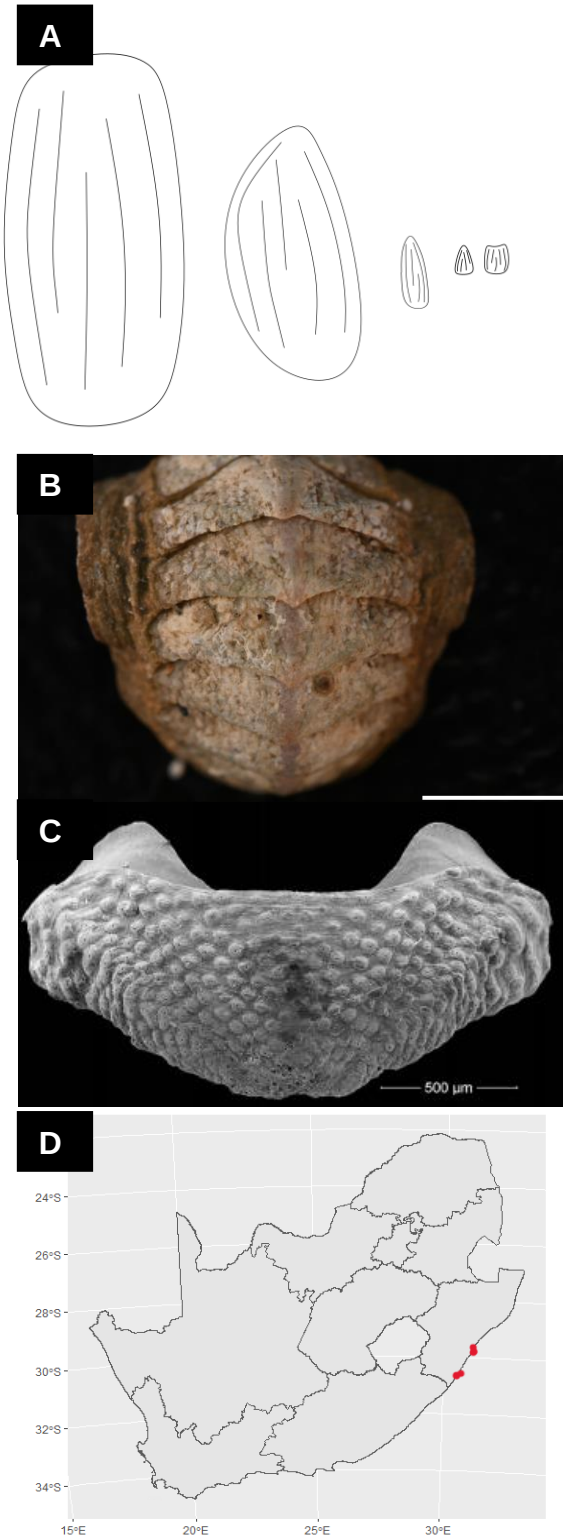

Figure 3.11) *Plaxiphora parva*: A – Girdle armour; B – Intermediate valve of preserved specimen with surrounding girdle on curved body; C - Intermediate valve of specimen from Sirenko and Dell'Angelo (2024) - Mpenjati; C – Distribution in South Africa.

CRYPTOPLACIDAE

Tegmentum reduced or absent with 5 or less slits on head valve.

Cryptoplax Blainville, 1818

Chiton (Cryptoplax) Blainville, 1818:124.
Chitonellus Lamarck, 1819:316.
Chiton (Ametrogephyrus) Middendorff, 1847:97 (offprint:33).
Chiton (Dichachiton) Middendorff, 1847:97 (offprint:33).
Chiton (Phaenochiton) Middendorff, 1847:96 (offprint:32).

Highly elongated or vermiform in shape, featuring minute mid-line valves on the dorsal side, while the ventral side displays a shallow furrow and an elongated foot; posterior mucro, several detached valves; anterior valve possessing three slits; gills merobranchial.

Distribution: South Africa, Madagascar, Red Sea, Southern China Sea, Australia.

Remarks: Can be confused with worms due to their elongated shapes.

Cryptoplax dupuisi Ashby, 1931

Figure 3.12

Cryptoplax dupuisi Ashby, 1931:13, pl. 2: figs 14-15; Kaas, 1979:876; Ferreira, 1983:249-297; Dell'Angello *et al*., 2011:30.

Colour: Variable both live and preserved.
Form: Extremely elongated, large (up to 80mm), elevation moderate (higher at head valve), carination present, valves beaked.
Valves: Head valve semi-elliptical, posterior margin straight. Intermediate valve rhomboid to elliptical, jugal area narrow. Tail valve with mucro posterior and posterior slope steep and straight. Tegmentum granulose in juveniles, while ribbed in adults, growth lines present. Articulamentum white, strongly developed, apophysis triangular. Slit formula unknown, slitrays absent.
Girdle: Wide. Spiculesconical and straight with 8-9 striae dorsally, but absent on the first four valves in most specimens; ventral spicules short, straight, dorsally ribbed. Marginal fringe with smooth spicules.
Radula: Major lateral tooth with large head. Central tooth short with blade. First lateral tooth wing-shaped.
Gills: Not documented.
Habitat: In crevices and burrows up to 38m depth.
Type locality: Madagascar.
Global distribution: Madagascar, Mozambique, South Africa.
Regional distribution: Only in KwaZulu-Natal.
Remarks: This species exhibits a narrower form compared to *C. sykesi*, and its sculpturing lacks pronounced regularity. Notably, juveniles of this species display considerable divergence from adults, a characteristic commonly observed in various *Cryptoplax* species. The first record in South Africa was by Kaas, 1979.

Figure 3.12) *Cryptoplax dupuisi* (Specimen NMSA S8963 – Kosi Bay*)*: A – Girdle armour; B - Whole specimen; C – Intermediate valve.; D – Distribution in South Africa.

Cryptoplax sykesi Thiele, 1909

Figure 3.13

Cryptoplax sykesi Thiele, 1909: 53, pl. 6: figs 83-86; Ashby, 1931:12; Ferreira, 1983:287, fig.3; Barnard, 1963:331; Strack, 1993:1-40; Dell"Angelo *et al*., 2004:60.
Cryptoplax erythraeus Selli, 1974:260, pl. 11 figs 8-9.
Cryptoplax enigmaticus Leloup, 1980:7, pl. 1 figs 1–2, pl. 2: fig.1

Colour: Ivory, pinkish or brown with markings live, brown to orange preserved.

Form: Extremely elongated, but relatively wedge-shaped or wider than most species in the genus, large (up to 31mm), carination present, elevation and beak not documented.

Valves: Head valve not documented. Intermediate valve oval to diamond shaped, with jugum narrow, raised. Tail valve with mucro posterior (prominence not documented) and posterior slope convex. All valves strongly convex. Tegmentum with 4-7 longitudinal rows of granules forming some riblets on each side of the smooth jugum on the central area (granules absent in juveniles). Slit formula: 3/0/0. Articulamentum brownish white with apophyses elongated and sinus deep.

Girdle: Wide. Dorsal spicules straight, interspersed with curved, large spicules and ventral spicules pointed.

Radula: Major lateral tooth cusp tricuspid. Rest of radula not documented.

Gills: Not documented.

Habitat: On dead coral or under stones up to 25m depth.

Type locality: Red Sea.

Global distribution: Red Sea, Madagascar, Reunion, Mauritius, Amirante Islands, Mozambique, South Africa.

Regional distribution: Only one found in Umkomaas, KwaZulu-Natal.

Remarks: Some authors see *Cryptoplax striata* from Madagascar as the same species, but currently they arer ecognised as different species, based on Thiele's (1909) description of the differences between the two specimens. The first record of presence in South Africa was by Ashby (1931).

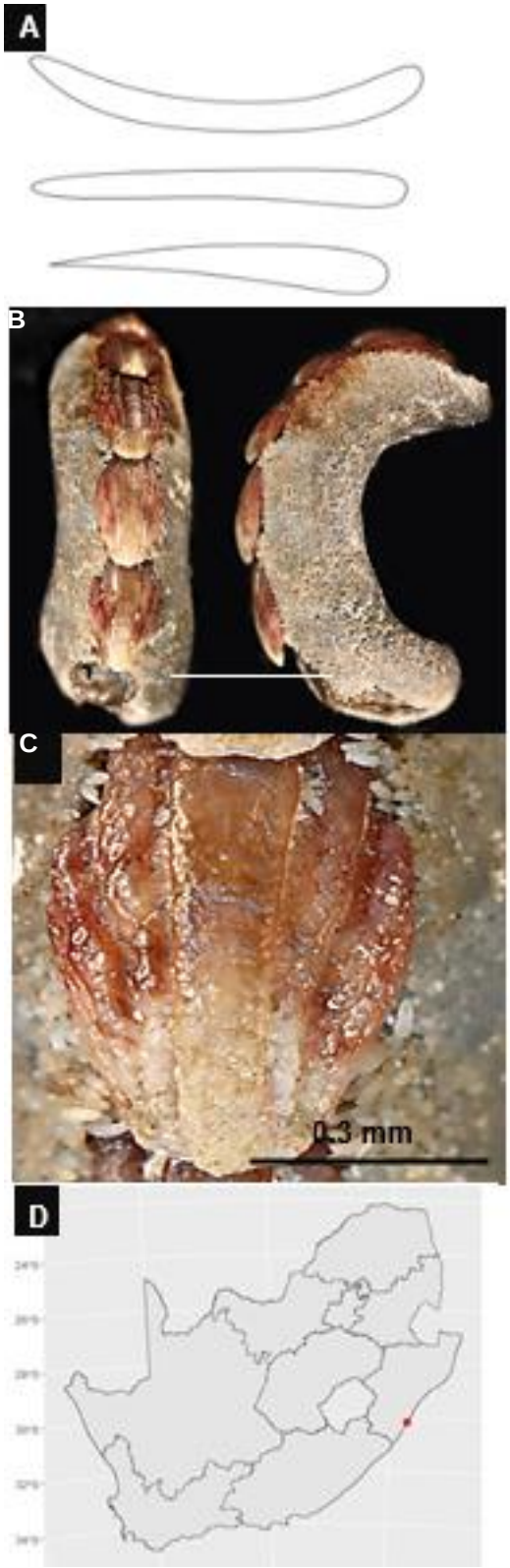

Figure 3.13) *Cryptoplax sykesi* (Specimen NMSA 1355 - Umkomaas): A – Girdle armour; B - Whole specimen; B – Intermediate valve. C – Distribution in South Africa.

ACANTHOCHITONIDAE

Shell plates not sunken into the girdle, but rather loose. Head valve with no more than 5 slits.

Acanthochitona Gray, 1821

Acanthochiton Gray, 1821:234; Sirenko & Saito, 2017:473.
Chiton (Acanthochaetes) Risso, 1826:page number not available.
Chiton (Acanthochites) Risso, 1826:page number not available.
Chiton (Acanthochiton) Hermannsen, 1846:2.
Chiton (Hamachiton) Middendorff, 1847:97 (offprint:33).
Chiton (Platysemus) Middendorff, 1847:98 (offprint:34).
Anisochiton P. Fischer, 1885:881-882.
Acanthochites (Meturoplax) Pilsbry, 1894:119-120.

Tufts of long spicules on girdle. Elongated valves partly covered by a wide, oval girdle. No insertion plates in the end valves, but partial evidence of insertion plates project from the intermediate valves. Valves do not display a lateral and central area, but are rather divided into a jugal area and lateropleural area.

Distribution: Cosmopolitan – occurring on shores of every continent except Antarctica.

Remarks: Species from this genus cannot be identified from their valve sculpturing and shapes only, and the central tooth of the radula are not consistent within a species from this genus.

Acanthochitona garnoti (Blainville, 1825)

Figure 3.14

Chiton garnoti Blainville, 1825:552; Krauss, 1848:42.
Acanthochites garnoti Nierstrasz, 1906:498.
Acanthochiton garnoti Ashby, 1928:78, pl. 7: fig. 15; Ashby, 1931:7.
Acanthochitona garnoti Kilburn and Rippey, 1982:137; Strack, 1996:132; Branch, *et al*., 2016:163.

Colour: Dark grey to brown and green with white stripes beside jugal area live, brown preserved.
Form: Oval girdle with elongate shell, large (up to45mm), carination absent, valves flatly beaked.
Valves: Head valve semi-elliptical, front slope rounded; posterior margin V-shaped(concave). Intermediate valve variable but mostly subtriangular to rhomboid, convex margin anterior, posterior margin widely V-shaped(convex), apex indicated, jugum raised. Tail valve small, front margin convex, mucro, posterior, not prominent, posterior slope convex. Tegmentum with small, widely separated, oval granules on head valve and lateropleural areas with fine striae on jugal area. Articulamentum development moderate, blue to green or light brown, apophysis large. Slit formula: 4-5/0-2/2.
Girdle: Wide. Small spicules and greenish bristles interspaced with larger ones, each side of shell carries nine tufts of long, glassy spines.
Radula: Major lateral tooth with tricuspid cusp. Central tooth not documented. First lateral tooth wing-shaped.
Gills: Holobranchial.
Habitat On exposed rocks and crevices from the inter- to mid tidal zone.
Type locality: Cape of Good Hope.
Global distribution: Mauritius, Reunion and South Africa. Some suggestions from WoRMS and other articles from Fiji and Venezuela, but this cannot be confirmed.
Regional distribution: Saldanha Bay to Southern KwaZulu-Natal.
Remarks: Granules on tegmentum slightly more lifted and denser than in *A. variegata.* Granules also more prominent on younger individuals, while valves can be heavily eroded in some adults. One of most common species and one of few found exposed on open rock. No reports from Namibia or the Northern Cape were found, although Branch et al.(2022) do display an occurrence in the area.

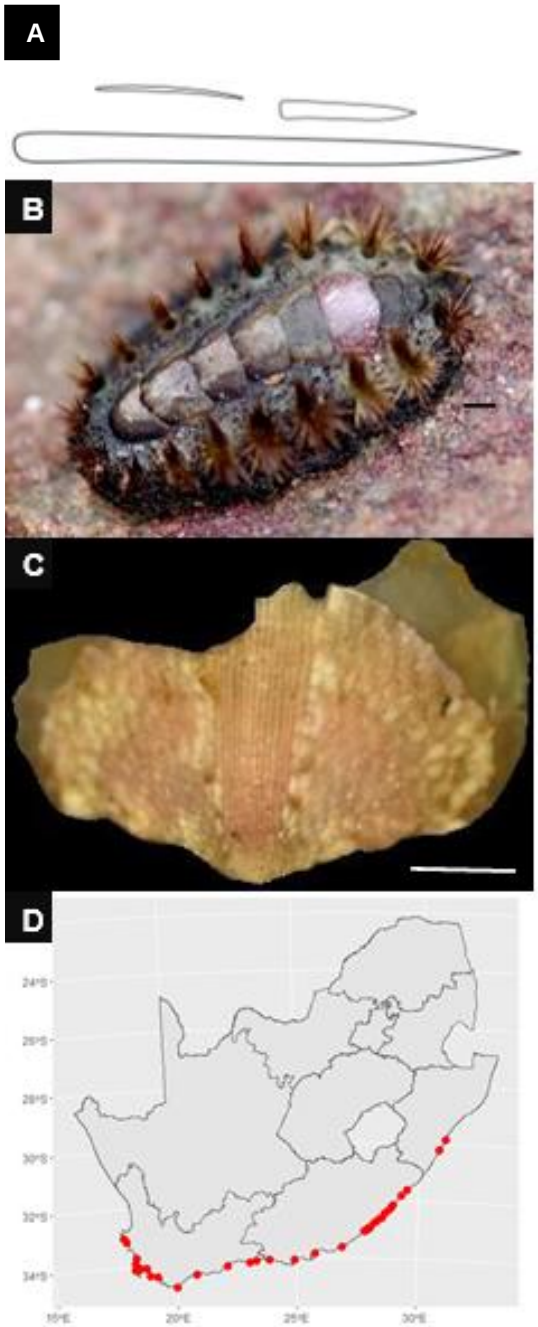

Figure 3.14) *Acanthochitona garnoti*: A – Girdle armour; B - Whole specimen (Live photo supplied by Charles Griffiths, Cape Town); C - Intermediate valve from SAMC type specimen, Cape of Good Hope); D – Distribution in South Africa.

*Acanthochitona variegata (*Nierstrasz, 1906)

Figure 3.15

Acanthochites variegatus Nierstrasz, 1906:500, figs 31-37.
Acanthochiton turtoni Ashby, 1928:79, pl. 6: figs 1-4.
Acanthochiton turtoni var. tenuigranosus Ashby, 1931: 10, pl. 2: fig. 13.
Acanthochitona tortoni Strack, 1996:133

Colour: Variety of colours, but mostly light beige live, pale preserved.
Form: Small (up to 10mm), Elongate oval with shell elongate, elevation high, subcarinated, valves beaked.
Valves: Head valve almost semicircular, front slope straight, posterior margin concave. Intermediate valve with jugum lifted and apex indicated. Tail valve as long as wide but mostly smaller than head valve, mucro slightly posterior, prominent, posterior slope concave. Tegmentum with irregularly arranged, flattened, almost granulose granules on pleural area, radial ribs of round pore-like granules on lateral areas, jugum with fine diverging ova forming radial ribs, head valve with fine diverging ova and tail valve with strong radial sculpturing with nodules. Growth lines absent. Articulamentum white or pink to translucent, development weak with weak jugal sinus.
Girdle: Wide with calcareous dorsal spines, brown and uncoloured, straight; tufts with spines much longer than *A. garnoti.* Ventral spines small and pressed together. Marginal fringe present.
Radula: Not documented.
Gills: Merobranchial.
Habitat: Intertidal zone, discrete and camouflaged, never exposed.
Type locality: Isipingo, KwaZulu-Natal.
Global distribution: Endemic to South Africa.
Regional distribution: False Bay to Bhanga Nek in northern KwaZulu-Natal.
Remarks: A common species often confused with *A. garnoti*. This species is also quite mobile and does not attach as strongly on substrate as other chitons. The record from Bhanga Nek suggests presence in Mozambique as this site is almost on the border of the countries.

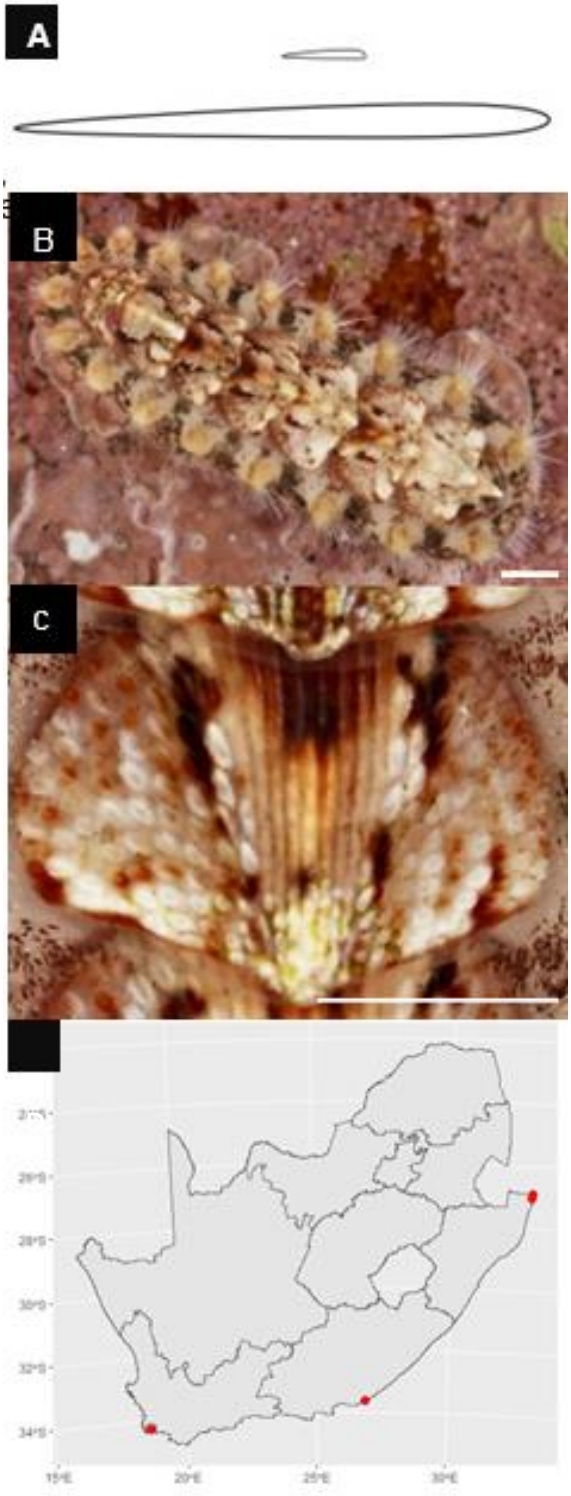

Figure3.15) *Acanthochitona variegata:*A –Girdle armour; B - Whole specimen; C - Intermediate valve (Photos supplied by Reneè Els- East London); D – Distribution in South Africa(endemic)

Acanthochitona jugotenuis Kaas, 1979

Figure 3.16

Acanthochitona jugotenius Kaas, 1979:873, pl. 4: figs 1-13; Muratov, 2014:381, 403, fig. 39.

Colour: Brown to yellow live and preserved.
Form: Elongate oval, medium (up to 30mm), elevation slight, carination present, valves rounded.
Valves: Head valve semicircular, posterior margin widely v-shaped and front slope rounded. Intermediate valve trapezoid, jugum linear and enlarged on first valve, anterior margin straight to convex, posterior margin straight, apex unclear. Tail valve hexagonal, mucro slightly posterior, non-prominent, posterior slope convex. Tegmentum with lightened, rounded, concave pustules enlarging towards outer margins on head valve, crowded and randomly arranged, jugum longitudinally ribbed, pleural area densely beset with rounded pustules forming pear shapes towards jugum, rounded again on tail valve. Articulamentum white to blue, apophysis wide, large, wing-shaped, jugal sinus wide, rounded. Slit formula: unknown/1/2. Teeth finely striated.
Girdle: Wide. Dense, needle-like spicules slightly curved and smooth. Marginal fringe spicules ribbed.
Radula: Not documented.
Gills: Not documented.
Habitat: Intertidal zone.
Type locality: Nacala Bay, Mozambique.
Global distribution: Mozambique and South Africa.
Regional distribution: Reported only from Bhanga Nek in Northern KwaZulu-Natal.

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Remarks: Curved spicules are a diagnostic feature separating this species from *A. garnoti* and *A. variegata*. This species is more known from Mozambique, but has additionally been found once in South Africa (Chapter 2: Additions to the chiton fauna of South Africa).

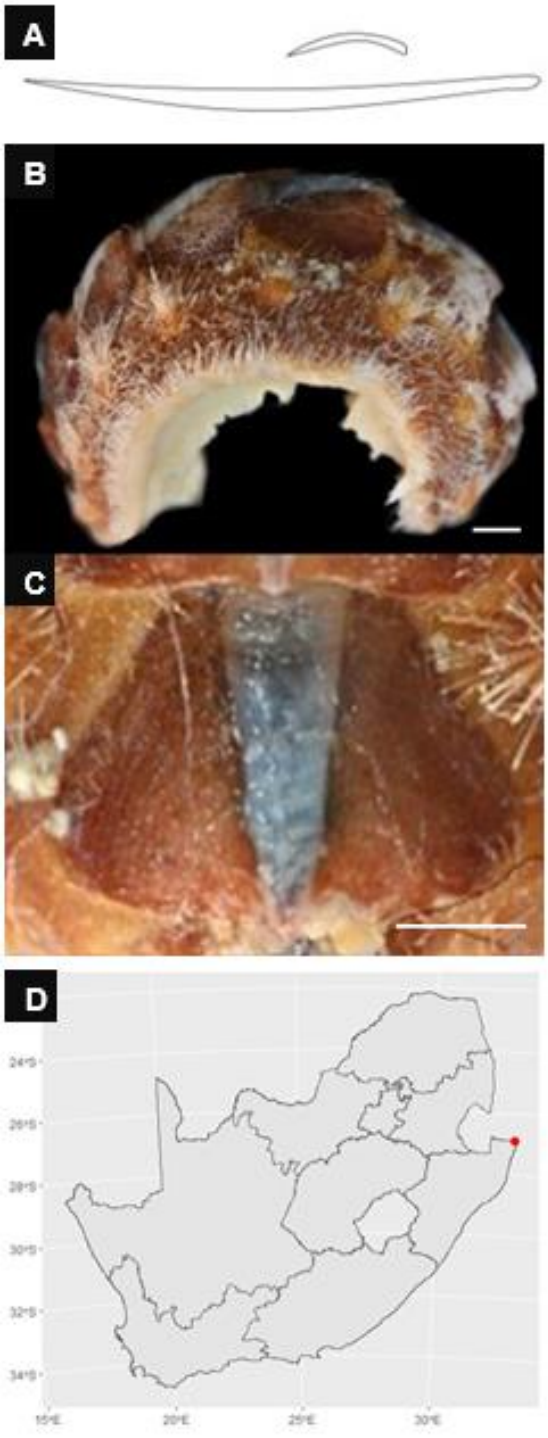

Figure 3.16) *Acanthochitona jugotenuis* (Specimen NMSA S1099 – Kosi Bay)*:* A – Girdle armour; B - Whole specimen; C -Intermediate valve; D – Distribution in South Africa

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Craspedochiton Shuttlewortth 1853

Chiton (Craspedochiton) Shuttleworth, 1853:191.
Angasia Carpenter [in Dall], 1882:283.
Craspedochiton (Spongiochiton) Dall, 1882:286.
Phacellozona Pilsbry, 1894:139.
Craspedochiton (Thaumastochiton) Thiele, 1909:34.
Craspedochiton; Schwabe & Els, 2019:73-78.

Uncommon among chitons, these broad chitons exhibit a modified foot adapted for carnivorous behaviour. Characterized by enlarged anterior girdles that are raised to ensnare prey. The prey is then engulfed as the girdle is drawn down. Distinctive sculptured tegmentum, spicule-covered girdles, and dorsal tufts adorn them. They possess merobranchial, abanal gills, solid articulamentum, solid apophyses, and backward-directed pectinated insertion plates. Notably, a sizable rectangular central radula tooth is present.

Distribution: Southern Asia, South Africa, Australia, New Zealand.
Remarks: These unusual carnivorous chitons have evolved a diverse palate, preying on a range of small crustaceans, barnacles, worms, and assorted invertebrates. They share this predatory lifestyle with other genera such as *Placiphorella*, *Notoplax*, and *Loricella*, but these genera are absent from the South Africa.

Craspedochiton productus (Carpenter in Pilsbry, 1892)

Figure 3.17

Spongiochiton productus Carpenter in Pilsbry, 1892-1893:26.
Acanthochites (Notoplax) carpenteri Pilsbry, 1893-1895:35, pl. 1: figs 14-22.
Acanthochites (Notoplax) involutus Pilsbry, 1893-1895:35, pl.1: figs 27-35.
Craspedochiton liberiensis Thiele, 1909:33.
Notoplax producta Ashby, 1931:10.
Craspedochiton producta Strack, 1996:132.

Colour: Light brown to pinkish orange live, pale preserved.
Form: Oval species, large (up to 41 mm), not carinated, elevation low, valves rounded.
Valves: Head valve almost semicircular, straight front slope, concave posterior margin. Intermediate valve with straight to convex anterior margin, straight posterior margin, subtriangular shape, rounded side margins, prominent apex, lateral areas slightly raised. Tail valve with rounded front margin, small with non-prominent, submedian mucro and straight to convex posterior slope. Tegmentum with convex, raised grains and slight growth lines. Jugal area indicated with lighter stripes on the side. Articulamentum weakly developed, widely separated apophysis, deep jugal sinus. Slit formula: 5/1/6-7; long, even, teeth distinctive. Eaves narrow.
Girdle: Porous, widened anteriorly with hairs, scales and minute tufts under magnification but appears naked.
Radula: Not documented.
Gills: Merobranchial, abanal.
Habitat: Subtidal zone.
Type locality: New Zealand.
Global distribution: New Zealand, possibly New Caledonia (unconfirmed), Philippines, South Africa and Central West Africa.
Regional distribution: This variant definitely occurs between Hout Bay to East London, with other variants (or possible other species such as *C. carpenteri*, *C. moebiusi* and *C. umgazianus*), further to the KwaZulu- Natal coast (Schwabe and Els, 2019).
Remarks: Historically, this species was deemed conspecific with *C. isipingoensis*, yet it's now firmly acknowledged as heterospecific. Ongoing taxonomic deliberations still shroud the genus in uncertainty, making it plausible that the geographical distribution may encompass not just a single species, but rather a cluster of closely-related ones. Given this taxonomic flux, the reliability of distribution data drawn from museum specimens becomes questionable. Consequently, the distribution of *C. productus* is expected to be more narrow than suggested by available data. First record of South African presence is from Ashby (1931).

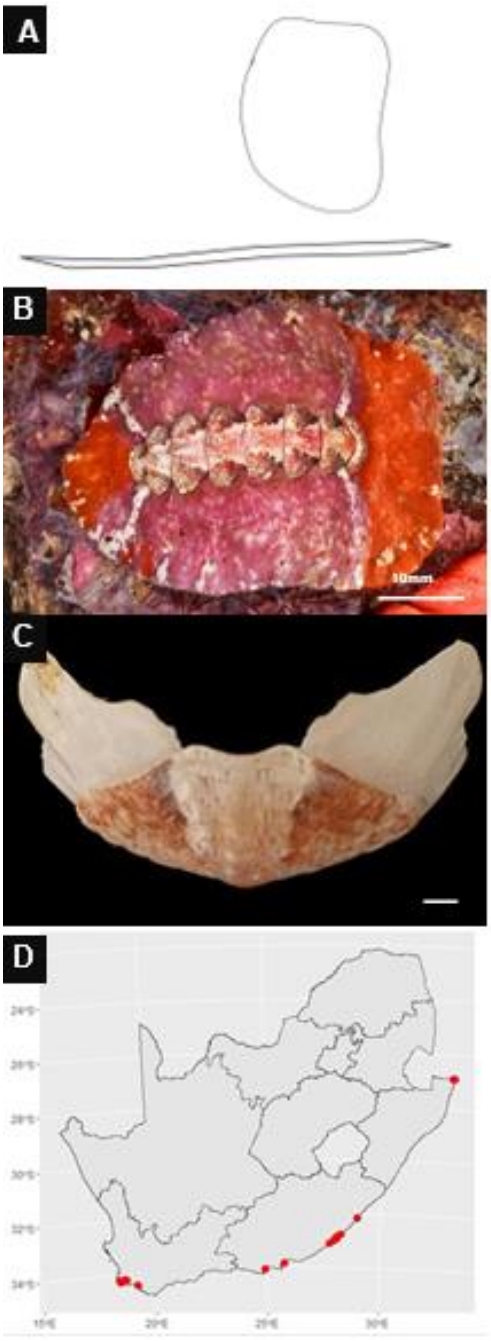

Figure 3.17) *Craspedochiton productus*: A – Girdle armour; B - Whole specimen (Photo by Renee Els MG8840); C-Intermediate valve (Specimen SAMS B2675 - Jeffrey's Bay);D– Distribution in South Africa.

Craspedochiton isipingoensis (Sykes, 1901)

Figure 3.18

Onithochiton isipingoensis Sykes, 1901:259, Nierstrasz, 1906:34.
Thaumastochiton isipingoensis; Barnard, 1974:663-781.
Craspedochiton (Spongiochiton) isipingoensis; Kaas, 1979:872.
*Craspedochiton isipingoensis;*Leloup, 1981:1-46; Schwabe and Els, 2019:75.

Colour: Ivory with dark green/brown markings on shell, yellow/purple/brown body live, faded preserved.
Form: Oval, small (up to 10mm), moderate elevation, slight carination, valves slightly beaked.
Valves: Head valve semicircular, straight posterior margin. Intermediate valve with rounded anterior margin, rectangular shape with rounded side margins, prominent apex, pronounced jugal area, lateral areas raised. Tail valve round with terminal prominent mucro, straight or concave posterior slope. Tegmentum with polymorphic granules on most areas, postmucronal area with irregular slightly raised granules in concentric rows. Granules more pronounced following slits. White or pink articulamentum well developed, apophysis round or trapezoid shape.
Slit formula: 5-6/1/9, sharp teeth with grooves on the dorsal side.
Girdle: Wide and widened anteriorly with microscopic spicules and 18 tufts, blunt spicules on posterior marginal fringe, scales of various shapes, most striated, elongated and pointed distally, ovoid corpuscules distally and scattered, long, cylindrical spines in between, marginal fringe with cylindrical, elongated, rounded at two ends, finely striated longitudinally spines.
Radula: Not documented.
Gills: Merobranchial.
Type locality: Isipingo, KwaZulu-Natal.
Habitat: On encrusting coralline algae, medium sand, shells, and dead coral rubble up to 50m depth.
Global distribution: Madagascar, East and South Africa, possibly also New Zealand.
Regional distribution: Restricted to KwaZulu-Natal.
Remarks: Another variant is found in Mauritius, called *Craspedochiton moebiusi*, but it is classified as a separate species by Schwabe and Els (2019).

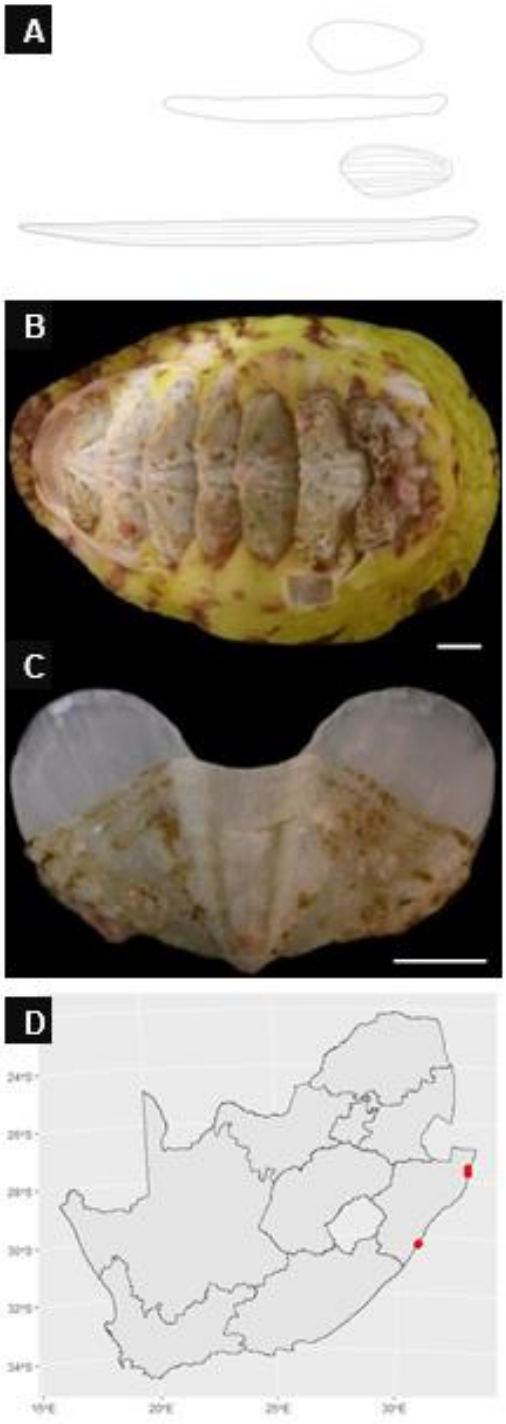

Figure 3.18) *Craspedochtion isipingoensis* (NMSA D5019): A – Girdle armour; B - Whole specimen; C -Intermediate valve; D – Distribution in South Africa.

Craspedochiton umgazianus (Koch, 1951)

Figure 3.19

Notoplax umgaziana Koch, 1951:211, pl. 23; Schwabe and Els, 2019:83.

Colour: Can vary from brown to red with some peculiar examples with green girdles live, faded preserved.
Form: Oval, large (up to 48mm), moderate elevation, not carinated.
Valves: Head valve not as notched as *C. isipingoensis,* but more notched than the Mauritian variant known as *C. moebiusi,* also not as ribbed as *C. moebiusi.* Jugal area smooth. Intermediate valves (especially second valve) trapezoidal. Oval tail valve. Articulamentum with smooth insertion plates and distinct grooves on the dorsal side, straight jugal sinus, apophyses extended.
Girdle: Velvet appearance due to large, solid, club-shaped spicules, posterior marginal fringe indistinctive.
Radula: Tricuspid cusp on major lateral tooth.
Gills: Not documented.
Habitat: Subtidal zone.
Type locality: Near Umgaziana River, South Africa.
Global distribution: Endemic to South Africa.
Regional distribution: Known only from Eastern Cape Province
Remarks: The material pertaining to the type is presently missing. This species has been reestablished as an independent species quite recently, by Schwabe and Els (2019). Previously, it had been regarded as synonymous with *C. isipingoensis*. The discourse surrounding the taxonomic distinction between these two species predominantly revolves around ontogeny variations within the species. Schwabe and Els (2019) supported their argument for reinstatement by drawing from three distinct life stages of *C. umgazianus*, all of which exhibit notable differences from *C. isipingoensis*.

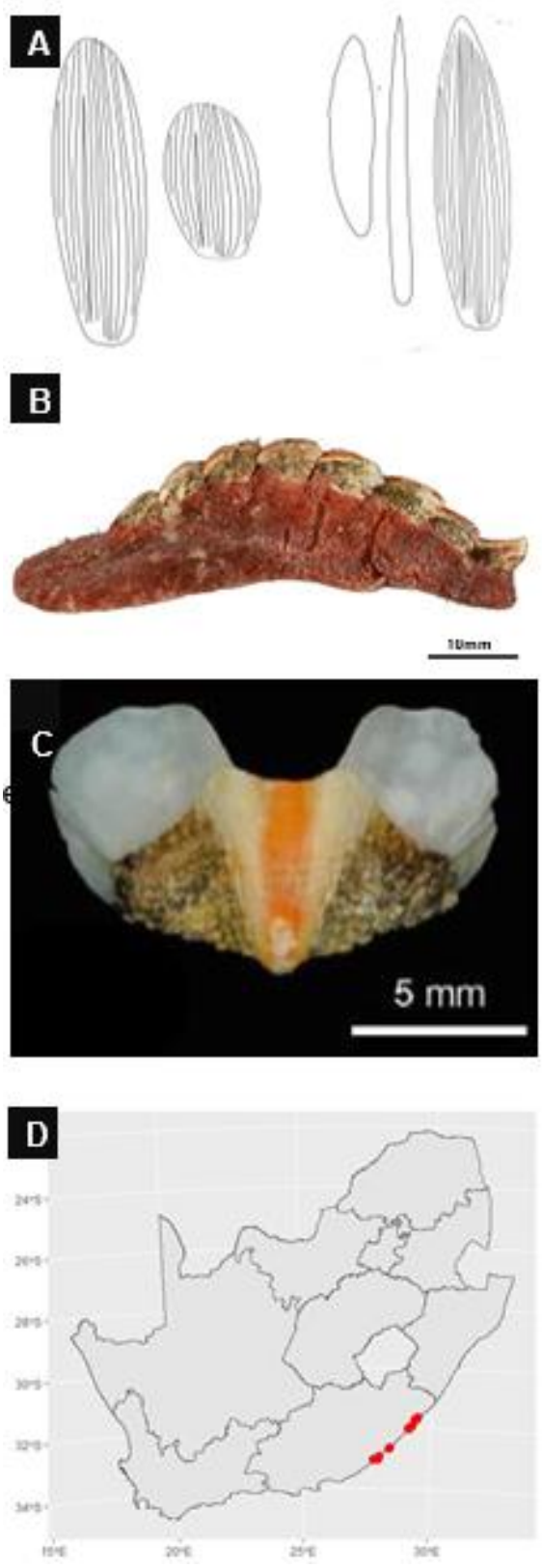

Figure 3.19) *Craspedochiton umgazianus*: A – Girdle armour; B - Whole specimen (Photo by Renee Els); C - Intermediate valve (Photo from Schwabe & Els (2019)); D - Distribution in South Africa(endemic).

TONICELLIDAE

Apophyses lack connection. Presence of merobranchial gills. Absence of pigmentary eyes. Girdle scales may be small or absent. Phytophilous behaviour.

Lepidochitona Gray, 1821

Lepidochitona (Lepidochitona) Gray, 1821:234.
Ischnochiton (Trachydermon) Carpenter, 1864:649.
Trachydermon (Craspedochilus) G. O. Sars, 1878:115.
Trachydermon (Trachyradsia) Carpenter in [Dall], 1878:68.
Beanella Dall, 1882:284.
Lepidochitona (Middendorffia) Carpenter in Dall, 1882:287.
Lepidochitona (Spongioradsia) Pilsbry, 1894:65.

Oval to elongate-oval, moderate-sized, featuring a single slit on each side of the intermediate valves. Girdle lacks corneous branching. The granulose tegmentum showcases a slit formula primarily consisting of many/mostly 1/many. These species inhabit the interspaces of crustose coralline algae. Juvenile nurturing takes place within the pallial groove.

Distribution: North Pacific from the Arctic Circle to Alaska, Gulf of Mexico, Norwegian Sea to Mediterranean, Brazil, Senegal and South Africa.

Remarks: Within South Africa, this genus stands as the solitary representative of its family. While it may occasionally be mistaken for *Callochiton*, it can be readily differentiated by its lack of pigmentary eyes and distinctive girdle traits.

Lepidochitona turtoni (Ashby, 1928)

Figure 3.20

Trachydermon (Craspedochilus) turtoni Ashby, 1928:80, pl. 6: figs 5-8.
Lepidochitona (Lepidochitona) turtoni Kaas and van Belle, 1994:108.
Lepidochitona tortoni Sirenko and Hayes, 1999:81-86.

Colour: Ivory with red or brown markings or bands on the girdle, live and preserved.
Form: Oval to elongate oval, small (up to 5mm), elevated, valves beaked, carination blunt.
Valves: Head valve semicircular, convex front slope, intermediate valves with straight anterior margin and straight to concave with apex posterior margin, rectangular shaped, rounded side margins, indicated apex, lateral areas slightly raised. Tail valve small, straight front margin, submedian, prominent mucro, straight posterior slope. Tegmentum with radiating rows of even granules on head valve so small it is barely visible to the naked eye, though aesthetes are more visible, longitudinal rows converging on the sides of lateral areas and postmucronal area, with growth lines sometimes visible. White articulamentum weakly developed, short jugal sinus, slitrays present. Eaves porous.
Girdle: Narrow with very tiny spicules dorsally, ribbed and sharp scales with minute grains ventrally and spicules on marginal fringe.
Radula: Major lateral tooth with tricuspid cusp. Central tooth rectangular.
Gills: Merobranchial.
Habitat: Subtidal to intertidal zone.
Type locality: Port Alfred.
Global distribution: Endemic to South Africa.
Regional distribution: Elands Bay to Port Alfred.
Remarks: Specimens from Port Alfred and Kommetjie are quite different and might possibly be two distinct species. More research on these is needed. The radula was missing from the type specimen described by Thiele. Specimens collected from Mouille Point during this study are much redder in appearance, more elongated than oval, occur solely on crustose coralline algae and have shallower growth lines, with the central tooth less square-shaped than previous descriptions, and the valves more beaked. This seems to comply with Sirenko (2023) describing intraspecific variability. However, the species in this genus are separated by very minor differentiations.

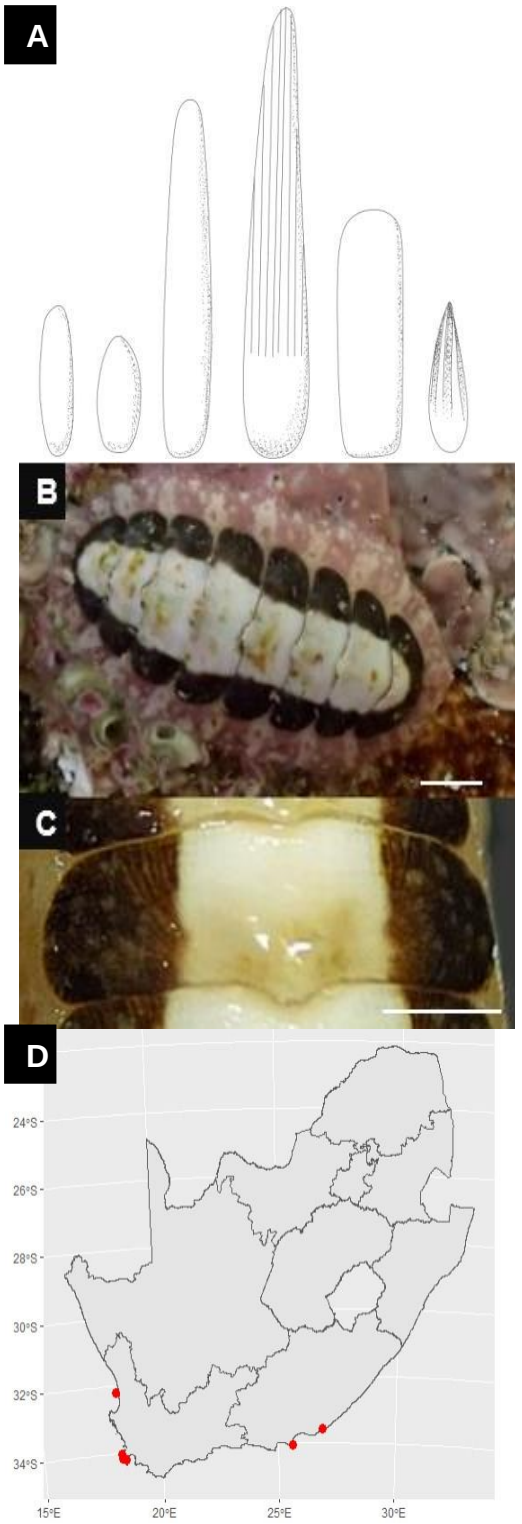

Figure 3.20) *Lepidochitona turtoni*: A - Whole specimen (Photo by Charles Griffiths, Mouille Point); B - Intermediate valve; C – Distribution in South Africa (endemic).

Lepidochitona dicksae **Sirenko and Hayes, 1999**

Figure 3.21

Lepidochitona dicksae Sirenko and Hayes, 1999:81: figs 1-4; Muratov, 2014:377-400: figs 5-8.

Colour: Various shades of brown/yellow to red with some white blotches live, faded preserved.
Form: Oval to elongate oval, small (up to 5mm), very elevated, not carinated, valves beaked**.**
Valves: Head valve semicircular with straight to V-shaped posterior margin. Intermediate valve broadly rectangular, anterior margin almost straight, posterior margin slightly concave at the sides, rounded side margins, indicated apex, lateral areas raised. Tail valve slimmer than head valve, with antemedian, prominent mucro, anterior margin not documented or viewed, straight posterior slope. Tegmentum smooth to finely granulose with weak growth lines. Articulamentum weakly developed, sharp teeth with slitrays, rounded apophyses, slit formula: 9/1/11. Eaves narrow and porous.
Girdle: Smooth with small spicules, Sutural tufts with 2-4 long spines and some long, straight spicules in between small scales; marginal fringe with straight, flattened spicules and ventral surface with smooth scales.
Radula: Major lateral tooth with tricuspid, rounded cusp, central tooth short with thin blade, tulip-formed; first lateral tooth wing-shaped.
Gills: Merobranchial, abanal.
Habitat: Subtidal along coralline algae.
Type locality: Noordhoek, Algoa Bay.
Global distribution: Endemic to South Africa.
Regional distribution: Known only from the type locality in Noordhoek (Algoa Bay).
Remarks: Sutural tufts, tegmental sculpture and tail valve slits differ this species from *L. turtoni*.

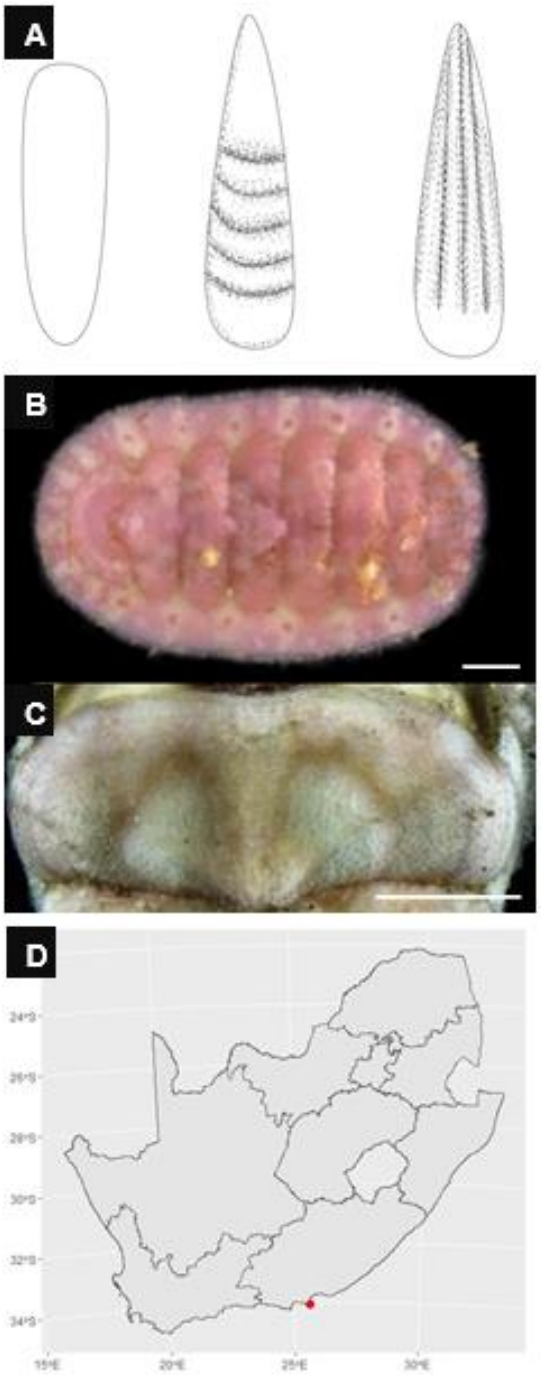

Figure 3.21) *Lepidochitona dicksae* A – Girdle armour; B - Whole specimen (Photo by Renee Els - Algoa Bay); C Intermediate valve (Photo by Igor Muratov of Holotype NMSA V6152/T1539 – Noordhoek) D – Distribution in South Africa(endemic).

Lepidochitona africana Sirenko, 2023

Figure 3.22

Lepidochitona africana Sirenko, 2023:299: figs 9-18.

Colour: Very variable ranging from monocolour brown to white or with white, blue or dark brown spots live, faded preserved.
Form: Elongate oval, small (up to 14mm), carinated and beaked. Elevation slight.
Valves: Head valve semicircular, posterior margin widely V-shaped and notched. Intermediate valves broadly rectangular, anterior margin almost concave, posterior margin concave at both sides of a prominent apex, side margins rounded, lateral areas slightly raised. Tail valve smaller than head valve, anterior margin concave, antemedian mucro, concave post mucronal slope. Tegmentum smooth to the naked eye with aesthete pores radial on head valve, pleural to lateral areas and post mucronal area, longitudinally otherwise. Growth lines faint. Articulamentum not weak, white, thin apophyses rounded to trapezoidal, short insertion plates.
Slit formula 9/1-1/8-11. Slits narrow with slit rays present. Eaves narrow and porous.
Girdle: Clothed with spicules (small, flattened slightly, pointed and lightly ribbed with 2-3 ribs on the upper half), many (20+) tufts of long needles curved between valves and around end valves with another row of tufts near margin. Marginal fringe with needles (smooth and ribbed). Ventral scales ribbed on upper half, and pointed.
Radula: Major lateral cusp tridentate.
Gills: Merobranchial.
Habitat: Intertidal on or under rocks or boulders to 1.5m depth.
Type locality: Port Alfred.
Global distribution: Endemic to South Africa.
Regional distribution: Glencairn (False Bay) to Mpenjati (KwaZulu-Natal).
Remarks: Although specimens were collected from 1996-2000, this species was only described by Sirenko (2023). No material is deposited in South Africa. Differs from other SA species by sutural tufts.

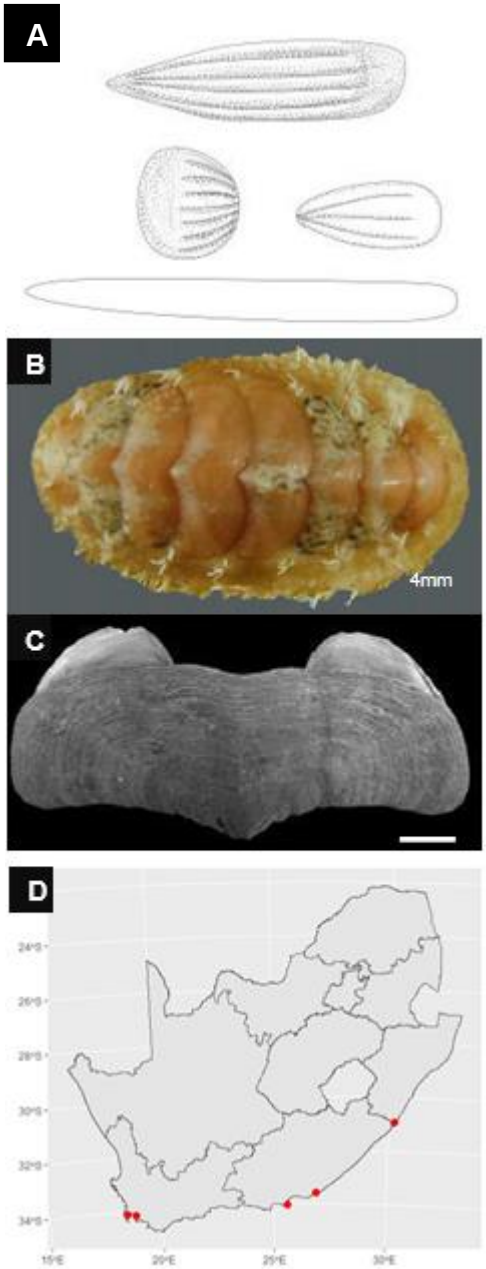

Figure 3.22) *Lepidochitona africana*: A – Girdle armour; B - Whole specimen (Photo from Sirenko, 2023:300, Fig. 9F); C - Intermediate valve (Photo from Sirenko, 2023:300, Fig. 10C); D – Distribution in South Africa (endemic)..

CHAETOPLEURIDAE

Valves carinated, tegmental sculpture usually with pustules, teeth formula many/1/many, no shell eyes or eye spots, eaves solid, girdle with spicules or spinelets.

Chaetopleura Shuttleworth, 1853

Chiton (Chaetopleura) Shuttleworth, 1853:190.
Chaetopleura (Pallochiton) Dall, 1879:297.
Variolepis Plate, 1899:201.
Typhlochiton Dall, 1921:4-5.
Chaetopleura, Day, 1963:4; Kilburn & Rippey, 1982:137; Ferreira, 1983:205; Kaas and van Belle, 1987:42.

Valves subcarinated at the least. Pustulose tegmentum mostly with beaded longitudinal riblets. Short, rugose insertion teeth. Mucro subcentral. Eaves solid. Girdle with spicules or spinelets, sometimes bristles. Nephridiophore between gills 3 and 4.

Distribution: Cosmopolitan, with a bigger percentage coverage over the subtropical to tropical regions of Africa, as well as south and Central America (Schwabe, 2006:23).

Remarks: This group is one of the best known in South Africa, with many reports and recognition in all recent taxonomical work from South Africa, as well as field guides.

Chaetopleura pertusa (Reeve, 1847)

Figure 3.23

Chiton pertusus Reeve, 1847:88.
Chaetopleura pertusa Ashby 1931:23; Kilburn and Rippey, 1982:138, pl. 33: fig. 4; Strack, 1996:128; Branch et al., 2002:160; Schwabe, 2006:24, fig. 1.
Chaetopleura (Chaetopleura) pertusa Kaas and van Belle, 1985:85.

Colour: Pinkish orange to red with blotches live, brown to orange preserved.
Form: Oval to elongate oval, medium (up to 20mm), moderately elevated, subcarinated, valves rounded. **Valves**: Head valve more than semicircular, straight-slightly concave front slope, V-shaped posterior margin with notch. Intermediate valve with forwardly produced jugum, convex anterior margin, straight posterior margin, rectangular with rounded side margins. Apex not prominent. Lateral areas raised. Tail valve with straight front margin, smaller than head valve, antemedian, prominent mucro, concave posterior slope. Tegmentum with radially arranged pustules on head valve, lateral areas, and post mucronal area; longitudinal riblets and pits on central area and antemucronal area. Growth lines obsolete. White to pink articulamentum strongly developed, wide apophysis triangular to subtriangular with wide sinus. Slit formula: 9/1/many. Deep teeth. Slitrays present. Eaves solid and narrow.
Girdle: Wide with spicules rising from chitinous cusps and corneous hairs scattered in bunches, some bearing a terminal spicule; rectangular scales on dorsal side: round topped and concave base.
Radula: Major lateral tooth with bicuspid cusp, pointed. Central tooth broadens into a blade. First lateral tooth short and broadens toward blade.
Gills: Holobranchial, abanal.
Habitat: Under rocks in the low-tidal and subtidal zone.
Type locality: Simon's Town, False Bay.
Global distribution: South Africa, and one report from Gough Island (Iziko Museum - SAMS-A055472).
Regional distribution: Vredenburg (Western Cape) to Durban.
Remarks: The radial numerous fine riblets on the lateral areas and longitudinal fine riblets on the central and antemucronal areas separate *C. pertusa* from *C.pustulata* (p. 75). The granule sizes are small and prominent, while bigger in *C. pustulata* and less prominent *in C. papilio.*

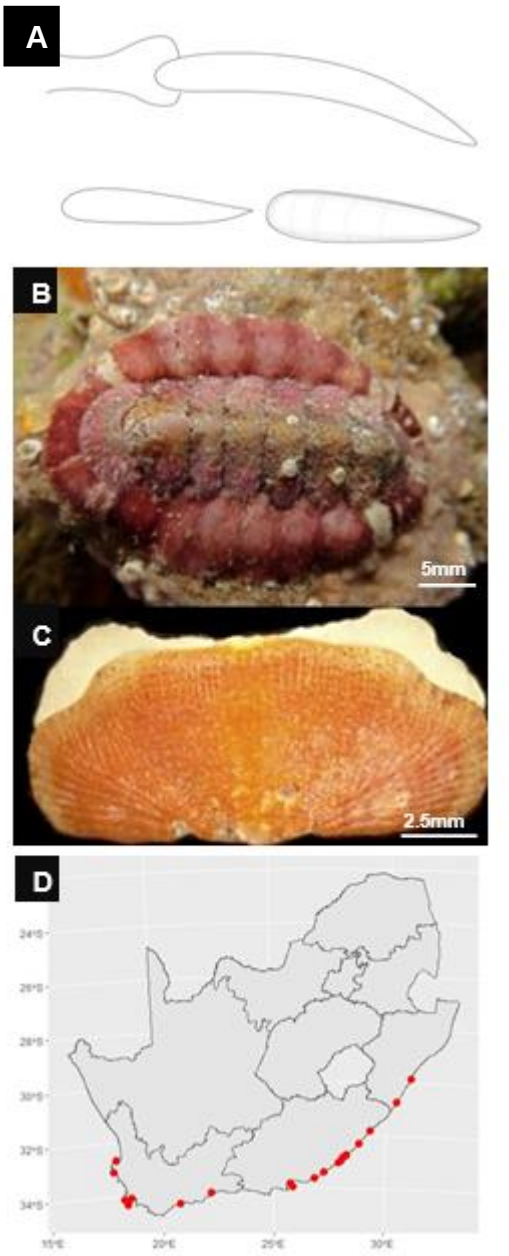

Figure 3.23) *Chaetopleura pertusa*: A – Girdle armour; B - Whole specimen (Photo by Charles Griffiths, False Bay); C - Intermediate valve (Specimen MB-A055466 – Cape Infanta); D – Distribution in South Africa.

Chaetopleura papilio (Spengler, 1797)

Figure 3.24

Chiton papilio Spengler, 1797:86-87, fig. 15; Kaas & Knudsen, 1992:70-71.
Chiton castaneus Qouy and Gaimard, 1835:387, pl. 74 fig. 33-34.
Chiton watsoni Sowerby II, 1840:288; Pilsbry, 1894:72.
Chaetopleura destituta Sykes, 1902:195; Ashby, 1931:26.
Chiton (Callochiton) gaimardi Clessin, 1903:65, pl. 23 fig. 7.
Chaetopleura papilio; Nierstrasz, 1906:512-514; Ashby, 1931:22; Kilburn and Rippey, 1982:138, pl. 33: fig. 3; Branch, 2002:160; Schwabe, 2006:138, pl. 33: fig. 3.
Chaetopleura (Chaetopleura) papilio; Kaas and van Belle, 1985:83.

Colour: Brown, live and preserved.
Form: Oval species, large (up to 90mm), moderate elevation, carinated and valves rounded.
Valves: Head valve semicircular, slightly rounded to straight front slope, widely V-shaped posterior margin notched. Intermediate valve with forwardly produced jugum, straight anterior margin, straight posterior margin, rectangular shape with rounded side margins, unclear apex, lateral areas raised. Tail valve with convex front margin, as wide as the head valve, submedian, swollen mucro, straight posterior slope. Tegmentum maroon to brown with light brown stripes or black stripes on a paler jugum, sometimes with blue or white spots, tiny pustules radially arranged on mostly smooth to lightly grooved head valve, few tiny pustules on lateral areas, central areas grooves converging posteriorly, tail valve smooth with some radial grooves, growth lines visible on most valves. White articulamentum with small brown spot under apices, strongly developed, wide apophysis triangular to subrectangular with wide, semi-circular jugal sinus. Slit formula: 9/1/9-13. Smooth, deep, irregular teeth. Slitrays present. Eaves solid.
Girdle: Girdle wide and brown, spicules and unbranched bristles, rectangular scales with triangular protuberance from a concave base.
Radula: Major lateral tooth cusp bicuspid obtusely pointed. Central tooth rectangular. First lateral tooth wing shaped.
Gills: Holobranchial. Adanal.
Habitat: Under rocks in intertidal pools.
Type locality: South Africa.
Global distribution: Namibia, South Africa and Mozambique.
Regional distribution: Vredenburg on west coast to East London.
Remarks: This species is one of the most easily identified in the region. Given its presence in both Namibia and Mozambique, the species is likely to also occur in KwaZulu-Natal and the Northern Cape, but no such records were found. A blue specimen was found during the study. There is also a report from 280m depth, but as this seems suspect it is not included.

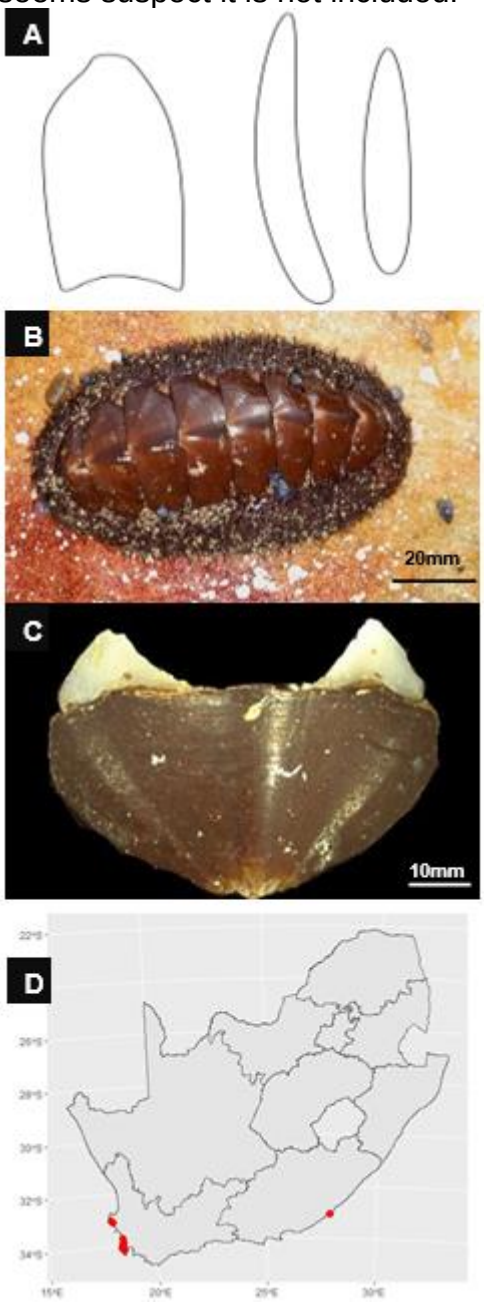

Figure 3.24) *Chaetopleura papilio*: A – Girdle armour; B - Whole specimen (Photo by Charles Griffiths); C - Intermediate valve; D – Distribution in South Africa.

Chaetopleura pomarium Barnard, 1963

Figure 3.25

Chaetopleura (Chaetopleura) pomarium Barnard, 1963:335, fig. 29.
Chaetopleura pomarium Kilburn, and Rippey, 1982:138; Kaas and Van Belle, 1985:91; Branch, 2002:160.

Colour: Brown-pale, live and preserved.
Form: Oval, medium (up to 20mm), moderate elevation, carinated and valves rounded.
Valves: Head valve semicircular, straight front slope, widely V-shaped, notched posterior margin. Intermediate valve with forwardly produced jugum, straight anterior margin, straight posterior margin, rectangular shape, straight side margins. Apex unclear, lateral areas not raised but defined. Tail valve with angular front margin, same size as head valve, antemedian, prominent mucro, straight-concave posterior slope. Tegmentum light brown with lighter apical areas and pustules, radial large pustules on head valve, tail valve and lateral areas, smaller pustules longitudinal but converging posteriorly on central areas, no growth lines. White articulamentum weakly developed, small apophysis subrectangular with a wide jugal sinus. Slit formula 10/1/? and smooth teeth with slitrays present. Eaves solid.
Girdle: Narrow with scale-like spicules (coarsely ribbed on distal half) and chitinous hairs bearing needles, supramarginal spicules embedded in chitinous cups, ventral scales elongate and smooth with a convex protuberance at the distal side with a concave base.
Radula: Major lateral tooth with bicuspid cusp, pointed. Central tooth square with thin blade. First lateral tooth irregular aliform.
Gills: Holobranchial. Abanal.
Habitat: Intertidal- to subtidal zone.
Type locality: Lüderitz Bay, Namibia.
Global distribution: Namibia and South Africa.
Regional distribution: Known only from Atlantic seaboard of Western Cape.
Remarks: The small size, long hairs and pale colour, as well as the prominent granules in radial and longitudinal lines, are characteristic of this species. The species possibly occurs in the Northern Cape as well, since it has been reported in Namibia.

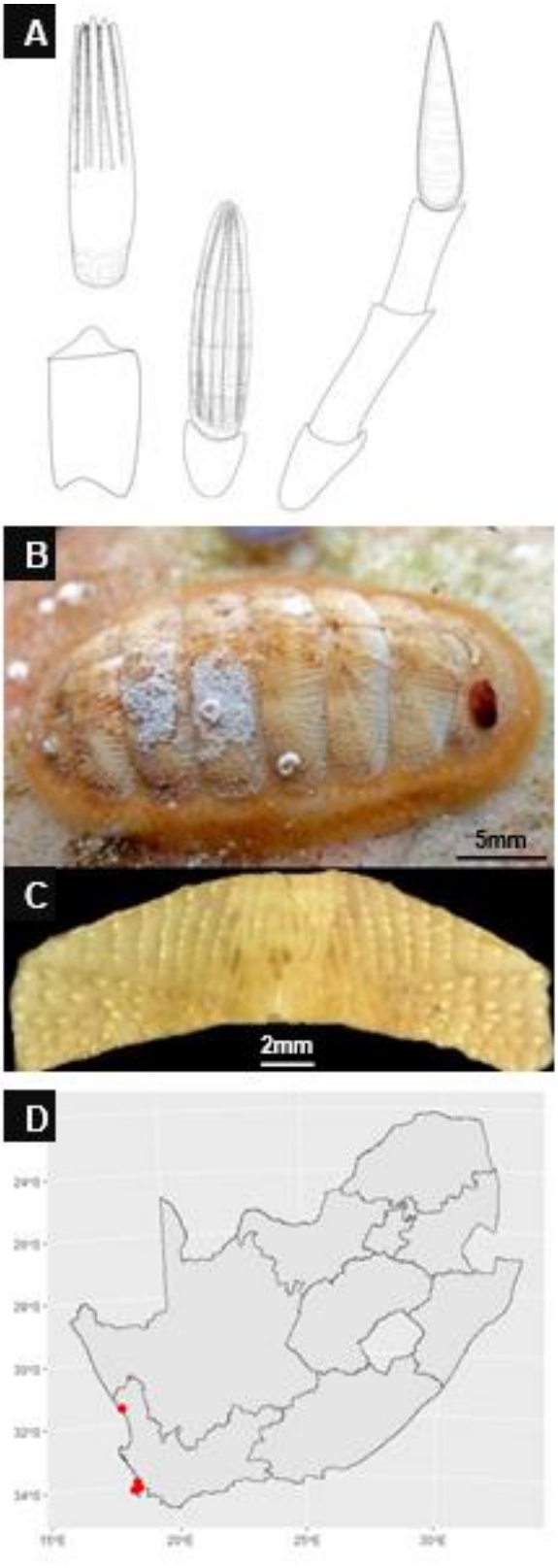

Figure 3.25) *Chaetopleura pomarium*: A – Girdle armour; B - Whole specimen (Photo by Charles Griffiths); C - Intermediate valve (SAMC MB-A055432 - Kommetjie); D – Distribution in South Africa.

Chaetopleura pustulata (Krauss, 1848)

Figure 3.26

Chiton pustulatus Krauss, 1848:42, fig. 7.
Chaetopleura pustulata Nierstrasz, 1906:488; Schwabe, 2006:25, fig. 2; Muratov, 2014:382.
Chaetopleura natalensis Kaas and Van Belle, 1990:31-33, fig. 12.

Colour: Grey or brown with blotches, live and preserved.
Form: Oval, medium (up to 25mm), moderate elevation, carinated, valves beaked.
Valves: Head valve semicircular, straight front slope, widely V-shaped posterior margin. Intermediate valve with forwardly produced jugum, obliquely truncated shape at the front corners of valve. Lateral areas slightly raised. Tail valve narrower than the head valve, central, non- prominent mucro. Tegmentum grey or light brown with cream, green and brown blotches, radiating rows of pits interspaced with pustules on head valve, intermediate valves with longitudinal, posteriorly converging rows of pits interspaced with pustules and postmucronal area with random cylindrical pustules enlarging away from the mucro, but no pits, no growth lines. Lateral areas with big protruding pustules. Whitish articulamentum with two red-brown streaks radiating from the apices, long, large apophysis semi-oval shape. Slit between deep teeth. Eaves solid.
Girdle: Covered with tiny spicules and bristles.
Radula: Major lateral tooth with bicuspid cusp, pointed. Central tooth rectangular shape but narrows towards base.
Gills: Holobranchial. Adanal. **Habitat**: Subtidal zone.
Type locality: Natal, South Africa.
Global distribution: Endemic to South Africa.
Regional distribution: Tongaat (KwaZulu-Natal) and East London (Eastern Cape).
Remarks: This species was synonymized with *C. pertusa* by Ashby (1931: 24), but Kaas and van Belle (1990) reinstated it as a distinct species, which they called *C. natalensis,* but this is now synonymized as *C. pustulata* (Schwabe,2006: 26). Extreme prominence of lateral pustules and beaked valves help to distinguish this species from *C. pertusa* (p. 72).

The extra red inland dot on top of map is an error

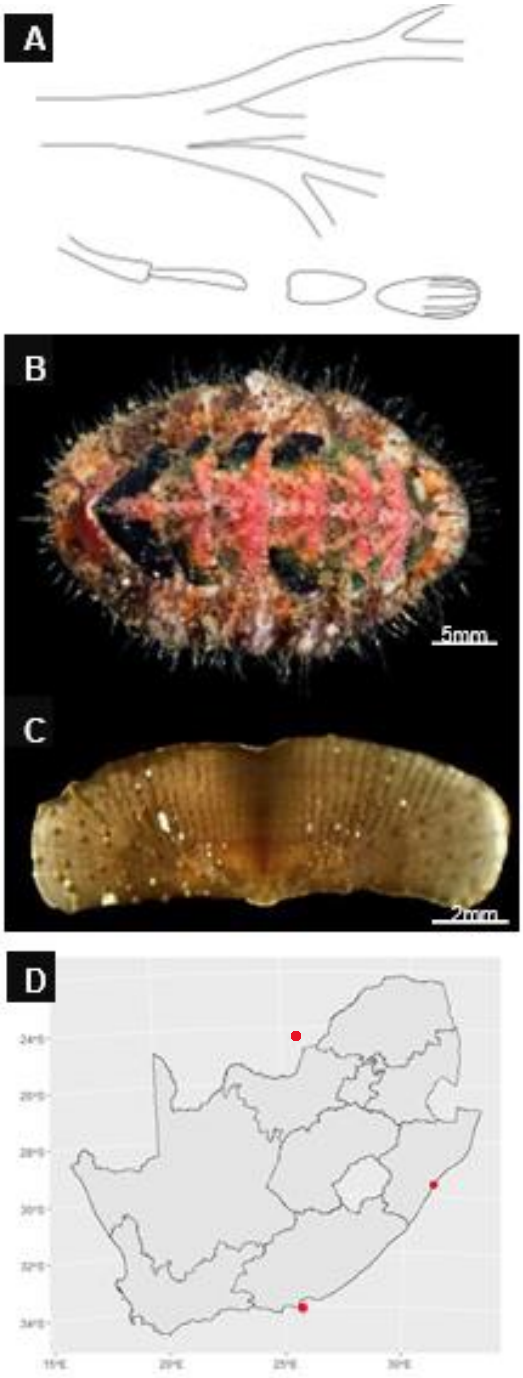

Figure 3.26) *Chaetopleura pustulata*: A – Girdle; B - Whole specimen (Photo by Renee Els MG1687 – East London); C -Intermediate valve (Specimen NMSA-Mol 0W0258 – Red sands, Eastern Cape); D – Distribution in South Africa (endemic).

Chaetopleura debruini (Strack, 1996)

Figure 3.27

Lepidozona debruini Strack, 1996:128, fig. 1-9.
Chaetopleura debruini; Schwabe, 2006:28, fig. 5.

Colour: Red-brown live, pale preserved.
Form: Oval to elongate oval, medium (up to 30mm), moderate elevation, carinated and valves rounded.
Valves: Head valve semicircular, straight front slope, notched, widely V-shaped posterior margin. Intermediate valve with forwardly produced jugum, convex anterior margin, straight to slightly concave posterior margin, narrow rectangular shape, slightly rounded side margins. Apex indicated. Lateral areas raised. Tail valve with straight or slightly convex anterior margin, narrower than head valve, antemedian prominent mucro, concave posterior slope. Tegmentum ivory or light brown with red or brown streaks and spots, with radiating riblets on head valve, lateral areas and postmucronal area, while riblets are longitudinally arranged on central area and antemucronal area, growth lines present. White articulamentum weakly developed, wide apophysis subrectangular shape. No slitrays present.
Girdle: Wide. Similar colour to tegmentum with small, ribbed scales and bunches of small spicules with hyaline hairs on perinotum spicule.
Radula: Central tooth rectangular and stocky. Major lateral tooth with sharp cusps.
Gills: Holobranchial. Abanal.
Habitat: Under rocks embedded in sand in the subtidal zone only.
Type locality: East London, South Africa.
Global distribution: Endemic to South Africa.
Regional distribution: False Bay, Hermanus and East London.
Remarks: Originally placed under *Lepidozona* Pilsbry, 1892 by Strack (1996), but Kaas *et al.* (2006) moved it to *Chaetopleura* and Schwabe (2006) supports this reclassification due to girdle and radula characteristics.

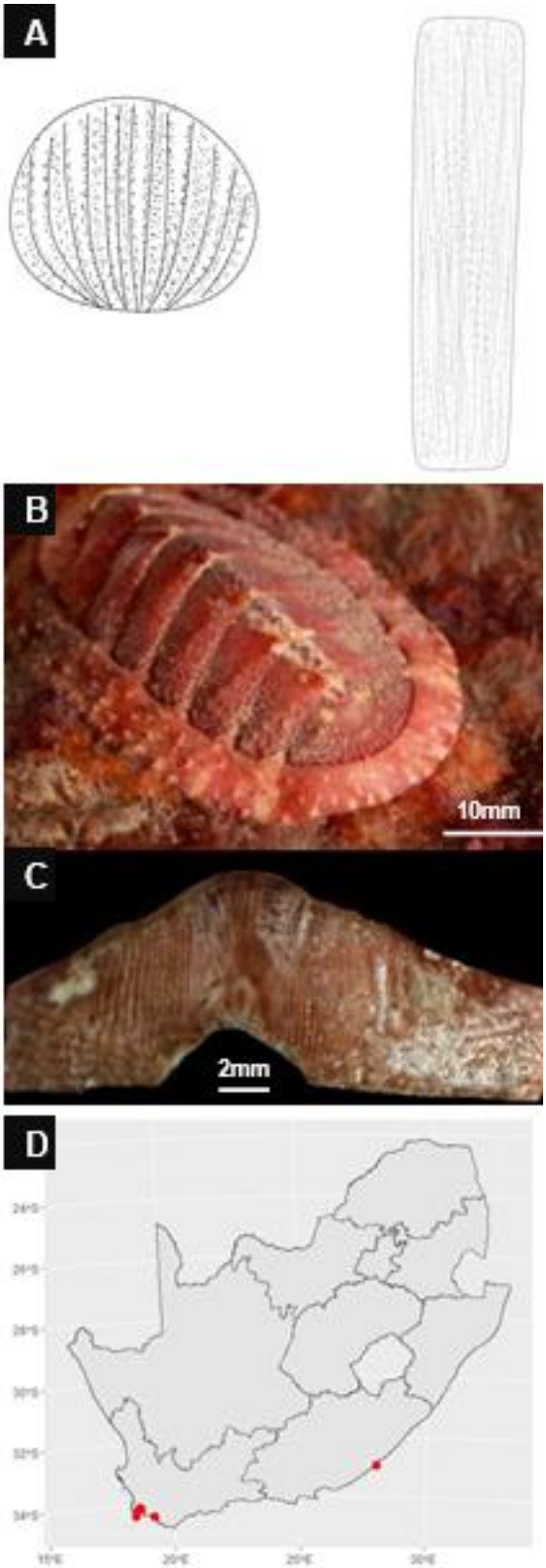

Figure 3.27) *Chaetopleura debruini*: A – Girdle armour; B - Whole specimen (photo by Renee Els), C - Intermediate valve (SAMS S8166 – False Bay); D – Distribution in South Africa(endemic).

Dinoplax Carpenter [in Dall], 1882

Size large, substantial valves, tegmentum ranging from smooth to delicately sculptured. Insertion teeth prominently oriented forward on the tail valve, while the girdle, though thick and leather-like, features intricate spinelets. Foot often enlarged, covering the mouth on the ventral side.

Distribution: Endemic to Africa.
Remarks: All four species within this genus are indigenous to South Africa. While a measure of confusion persists regarding the precise boundaries distinguishing *D. giga*s, *D. validifossus,* and *D. fossus,* the present taxonomic division has ample support, showing these species to be distinct entities, rather than mere variants of one another. However, to definitively confirm their status, genetic research remains a priority.

Dinoplax gigas (Gmelin, 1791)

Figure 3.28

Chiton albus sensu Barbut, 1788:438.
Chiton gigas Gmelin, 1791:3206.
Chiton subgigas Blainville, 1825:519-555.
Dinoplax gigas; Nierstrasz, 1906:489; Ashby, 1928:82, pl. 8: figs 22-24; Ashby, 1931:27; Kilburn and Rippey, 1982:138, pl. 33: fig. 5; Kaas and Van Belle, 1985:110; Branch et al., 2002:162.
Dinoplax gigas alfredensis Bartsch, 1915:179, pl. 39: figs 1 & 2.

Colour: Grey with cream/brown shell, live and preserved.
Form: Oval to elongate oval, large (up to 170mm), elevated, carinated, valves rounded**.**
Valves: Head valve small, straight or convex front slope, sinuous posterior margin. Intermediate valve with forwardly produced jugum, sunk pleural areas, straight to concave anterior margin, straight or convex posterior margin, rectangular shape, rounded side margins, apex unclear, lateral areas raised. Tail valve with concave anterior margin, narrower than head valve, posterior prominent mucro, convex posterior slope. Tegmentum grey, speckled with dark brown and buff, sculpture mostly eroded, No ribs on pleural areas, fine punctation or foveation on central area, with growth lines. White articulamentum has brown markings, strongly developed, wide apophysis rounded, with shallow jugal sinus. Slit formula: 9/1/10, serrated teeth, without slitrays. Eaves solid**.**
Girdle: Leathery, narrow, grey speckled with brown and buff, fine spinelets elongated, smooth and straight, cupped spicules and prominent little scattered tufts of striated spines on the perinotum, spines concave at base, distally rounded and ribbed towards the inner margin interspersing spinelets on the rest of the perinotum.
Radula: Major lateral tooth tricuspid cusp. Central tooth hexagonal with no blade. First lateral tooth narrow based, broadening towards bladeless anterior margin with sharp protuberance at inner corner.
Gills: Holobranchial.
Habitat: Under rocks and boulders in sand in intertidal zone, or on flat rocky reefs in sand in subtidal zone.
Type locality: Unknown.
Global distribution: South Africa and Mozambique.
Regional distribution: Saldanha Bay (Western Cape) to Jeffrey's Bay and once found in North KwaZulu-Natal.
Remarks: Large, common and one of best known of regional chitons. Differences between related species include punctation: microscopically punctated in *D. gigas,* finely punctated in *D. fossus* with much more distinct riblets and most distinctive riblets in *D. validifossus*. Girdle armature differs in *D. gigas* having bunches of spines and some single spines while *D. fossus* and *D. validifossus* are fully, densely covered in spines that may form groups.

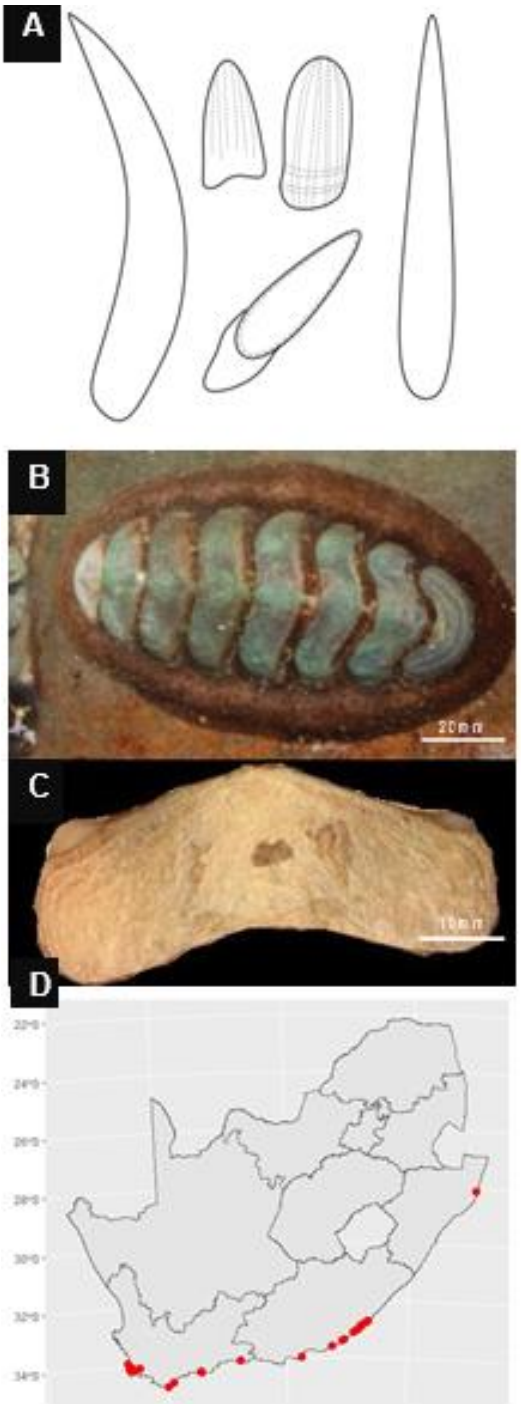

Figure 3.28) *Dinoplax gigas*: A – Girdle armour; B - Whole specimen (Photo by Charles Griffiths); C - Intermediate valve; D – Distribution in South Africa.

Dinoplax fossus Sykes, 1899

Figure 3.29

Chiton gigas non Gmelin, 1791; Krauss, 1848: 30, pl. 3, fig. 3.
Dinoplax fossus Sykes, 1899:277, fig. 1; Ashby, 1931: 292; Turton, 1932: 210; Barnard, 1963: 338; Kilburn & Rippey, 1982:138; Kaas and Van Belle, 1985:113.
Dinoplax gigas non (Gmelin, 1791); Ashby, 1928:82, pl. 8, figs. 22-24; 1931:27, pl. 4, figs. 40-42; 1934:77, pl. 9, figs. 1-2.

Colour: Grey to brown with creamy shell and various brown markings, live and preserved.
Form: Oval to elongate oval, large (up to 80mm), moderate elevation, carinated, valves rounded.
Valves: Head valve semicircular, convex front slope, straight to concave posterior margin. Intermediate valve with forwardly produced jugum, concave or straight anterior margin, convex posterior margin, broadly oval shape, rounded side margins, apex unclear, lateral areas slightly raised. Tail valve convex front margin, narrower than head valve, slightly posterior prominent mucro, straight or convex posterior slope. Tegmentum creamy white with variable markings, head valve always eroded with age, numerous radiating flat ribs on lateral areas, foveolate central area with longitudinal markings that can produce rib-like patterns, numerous radiating flat ribs on tail valve, with growth lines. White to brown and green articulamentum strongly developed, wide apophysis rounded shape, connected by lamina, very shallow jugal sinus. Slit formula: 7-11/1/7-11, serrated teeth in line with sculpture of ribs on tegmentum, without slitrays. Eaves solid.
Girdle: Narrow, grey to brown, various spicules mostly yellow or brown, densely packed.
Radula: Major lateral tooth with pointed, tricuspid cusp
Gills: Holobranchial, abanal.
Habitat: Under rocks and boulders, often embedded in sand.
Type locality: eMkhomazi, KwaZulu-Natal.
Global distribution: Endemic to South Africa.
Regional distribution: Eastern Cape and KwaZulu-Natal.
Remarks: Riblets from lateropleural area are longitudinal, while *D. validifossus* has riblets radiating from the apex. Girdle spines shorter, thicker, and more bunched than in *D. validifossus.*

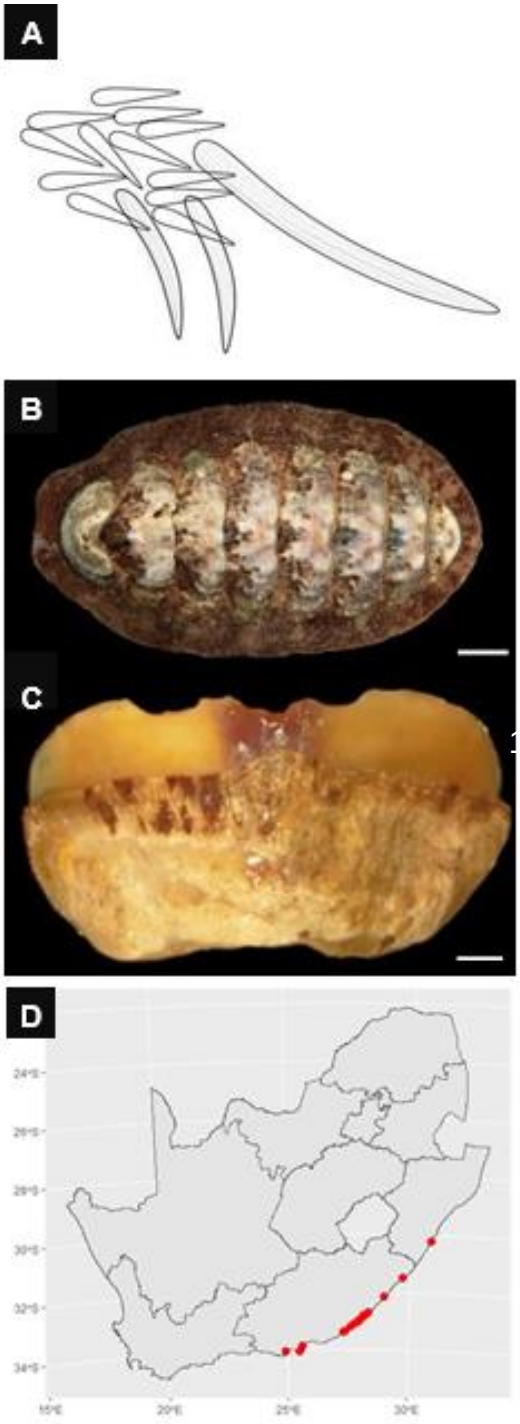

Figure 3.29) *Dinoplax fossus*: A – Girdle armour; B - Whole specimen (Photo by Renee Els); C - Intermediate valve; D – Distribution in South Africa(endemic).

Dinoplax validifossus Ashby, 1934

Figure 3.30

Dinoplax gigas validifossus Ashby, 1934:77-79, Pl. 9, fig. 3.
Dinoplax gigas non (Gmelin, 1791); Nardini, 1934: 250, fig. 1.
Dinoplax validifossus; Barnard 1963:338; Kilburn and Rippey, 1982:138, pl. 33; Kaas and van Belle, 1985:114; Branch et al., 2002:160.

Colour: Shades of brown and grey, live and preserved.
Form: Oval to elongate oval, large (up to 60mm), moderate elevation, carinated, valves rounded.
Valves: Head valve semicircular, slightly convex front slope, concave posterior margin, rounded at the sides. Intermediate valve with pointed jugal area, straight anterior margin, convex posterior margin rectangular to triangular shape, rounded side margins, apex unclear, lateral areas slightly raised. Tail valve with straight or rounded front margin, narrower than head valve, posterior prominent mucro, convex posterior slope. Tegmentum buff with red and brown markings, clear radial ribs on the head valve, lateral areas and tail valve, intermediate valves have ribs on central to pleural area, with growth lines. Articulamentum white, marked with spots, strongly developed with wide apophysis rounded, shallow jugal sinus. Slit formula: 10-12/1/8-10, slightly ribbed teeth without slitrays. Eaves solid.
Girdle: Wide and grey, small spicules, although larger than *D. fossus* and lightly striated.
Radula: Major lateral tooth with tricuspid cusp. Central tooth hexagonal without blade, formed like a tulip. First lateral tooth narrow based with sharp protuberance at inner corner, end rounded.
Gills: Holobranchial, abanal.
Habitat: Under rocks and boulders in sand of intertidal zone.
Type locality: Unknown.
Global distribution: South Africa and Mozambique.
Regional distribution: Eastern Cape and southern KwaZulu-Natal.
Remarks: A solitary specimen from Mozambique has been documented, suggesting that the actual distribution extends the length of KwaZulu-Natal. Alternatively this specimen might have been introduced to Mozambique, or specimen data might have confused, as the record lacks coordinates (SAMS MB-A032639)**.** Radial ribs in pleural areas and long, not bunched together, slender spicules across girdle separate it from both *D. gigas* and *D. fossus.*

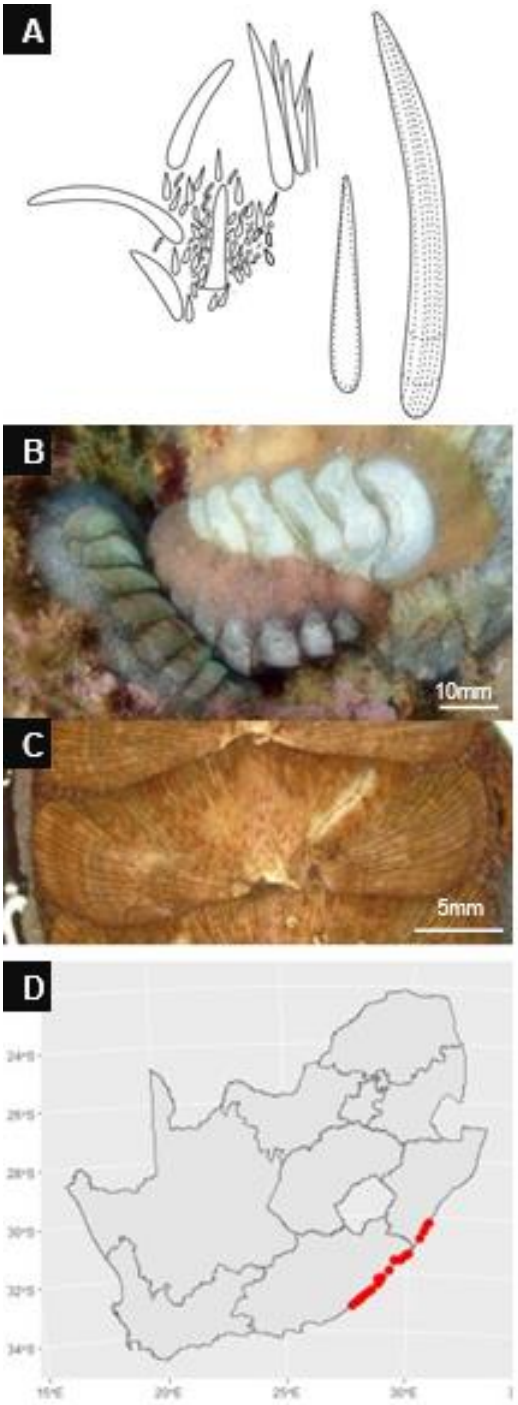

Figure 3.30) *Dinoplax validifossus*: A – Girdle armour; B - Whole specimens (Photo by Charles Griffiths); C - Intermediate valve (SAMS MB-A055428, Qolora); D – Distribution in South Africa**.**

Dinoplax chelazziana (Ferreira, 1983)

Figure 3.31

Dinoplax fossus non Sykes; Kaas, 1979:861.
Chaetopleura chelazziana Ferreira, 1983:254, figs 3-10; Dell'Angelo *et. al.,* 2011:30, fig. 4H. *Chaetopleura (Chaetopleura) chelazziana;* Kaas and van Belle, 1987:93-95, fig. 40.
Dinoplax chelazziana; WoRMS, AphiaID: 386178.

Colour: Light brown, live and preserved.
Form: Elongate oval, elevation moderate, large (up to 70mm), carinated, slightly beaked.
Valves: Head valve more than semicircular, front slope straight or concave, posterior margin deeply V-shaped. Intermediate valves almost rectangular, but with some bulges at the anterior and posterior margin, anterior margin convex, posterior margin concave, side margins rounded. Tail valve with prominent, central mucro and concave postmucronal slope. Tegmentum light brown with flat, radial riblets bearing small, round tubercles on head valve, lateral areas and postmucronal area, longitudinal riblets diverge forward on central areas with almost smooth jugal area. Eaves solid. White articulamentum, rounded apophyses, narrow, deep sinus. Slit formula 7/1/9.
Girdle: Light brown, abundant long, glassy, thin spicules dorsally and rectangular, transparent scales ventrally. Woolly appearance.
Radula: Central tooth pentagonal. First lateral tooth rectangular. Major lateral tooth tricuspid cusp.
Gills: Holobranchial, abanal.
Habitat: Shallow intertidal zone.
Type locality: Gezira, Somalia.
Global distribution: Madagascar, Somalia to South Africa.
Regional distribution: Known only from KwaZulu-Natal.
Remarks: This species was initially placed under *Chaetopleura* by Ferreira (1983), but then later recognized as *Dinoplax*. This particular species stands out notably from the other three within this genus due to its discernible characteristics. Notable distinguishing features with tubercles on riblets, distinct apophyses, distinct valve shape, and relatively smaller yet intricately dispersed spicules across the girdle. Importantly, it is worth noting that this species remains less explored compared to its counterparts, leaving room for the possibility of intermediate variations between it and the other species. This is the first record of this species in South Africa (See Chapter 2).

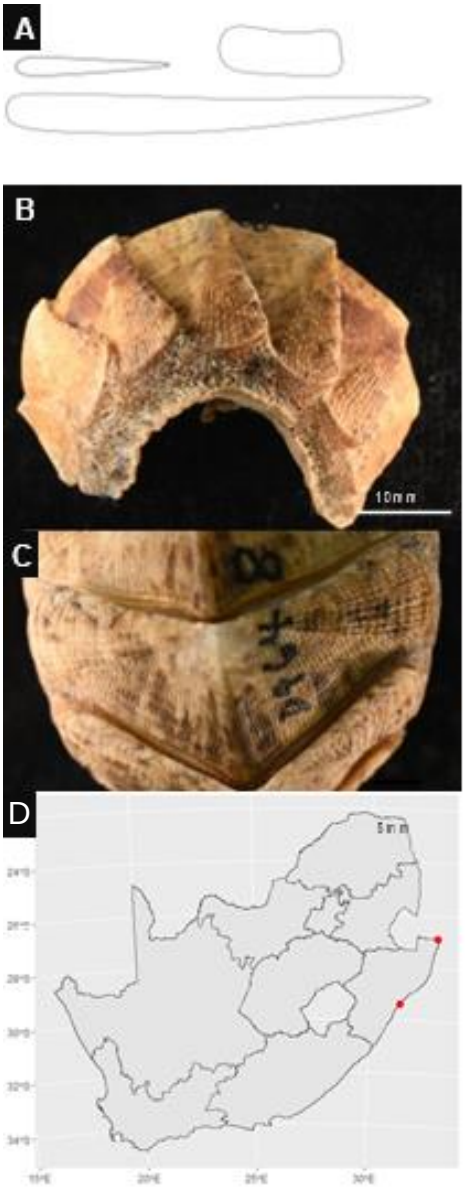

Figure 3.31) *Dinoplax chelazziana* (NMSA D9648 – Bhanga Nek): A – Girdle armour; B - Whole specimen; C -Intermediate valve; D - Distribution in South Africa.

CHITONIDAE

Smooth to highly sculptured, insertion plates strong and coarse, very variable in both size and shape, as well as girdle elements.

Radsia Gray, 1847

Chiton (Radsia) Gray, 1847:126.

Regular, smooth, imbricating scales on girdle. Apophyses notched and insertion plates serrated.

Distribution: Santiago Island, Ecuador, Namibia and South Africa.

Remarks: There are only three species in this genus world-wide, with only one species in Southern Africa and the other two in Ecuador.

Radsia nigrovirescens (Blainville, 1825)

Figure 3.32

Chiton (Chiton) nigrovirescens Blainville, 1825:538.
Chiton capensis Gray, 1828:5.
Chiton (Sypharochiton) nigrovirens Ashby, 1931:47, pl VII: figs 78-81.

Colour: Brown to black valves with banded girdle, live and preserved.
Form: Oval, medium (up to 25mm), elevation low, carination present, valves beaked.
Valves: Head valve semi-circular, front slope straight to slightly rounded, posterior margin straight. Intermediate valves rectangular, anterior margin concave and posterior margin widely V-shaped, side margins rounded. Apex indicated posterior of a lifter jugum; lateral areas raised. Tail valve same size as head valve, mucro slightly prominent, antemedian, anterior margin straight, posterior slope straight. Tegmentum with radial riblets on head valve, lateral areas and post mucronal area with central areas smooth or finely threaded. Growth lines present. Articulamentum moderately developed. Apophyses medium, rounded and notched. Insertion teeth short, slits shallow with slit rays. Slit formula: many/1/many. Eaves appear to be solid.
Girdle: Almost wide, striped with brown and black and clothed with smooth scales.
Radula: Major lateral tooth with pointed unicuspid head.
Gills: Holobranchial, abanal.
Habitat: Under rocks and damp crevices in the mid-intertidal zone.
Type locality: Cape of Good Hope, South Africa.
Global distribution: West Coast of South Africa up to Namibia.
Regional distribution: Namibia to Cape Agulhas.
Remarks: This species broods juveniles within the pallial groove. The dark appearance is very characteristic, and specimens are usually clustered together, mostly under rocks. Although no records are available further up the West Coast of South Africa, the distribution may well extend over that region, as multiple records exists from Namibia.

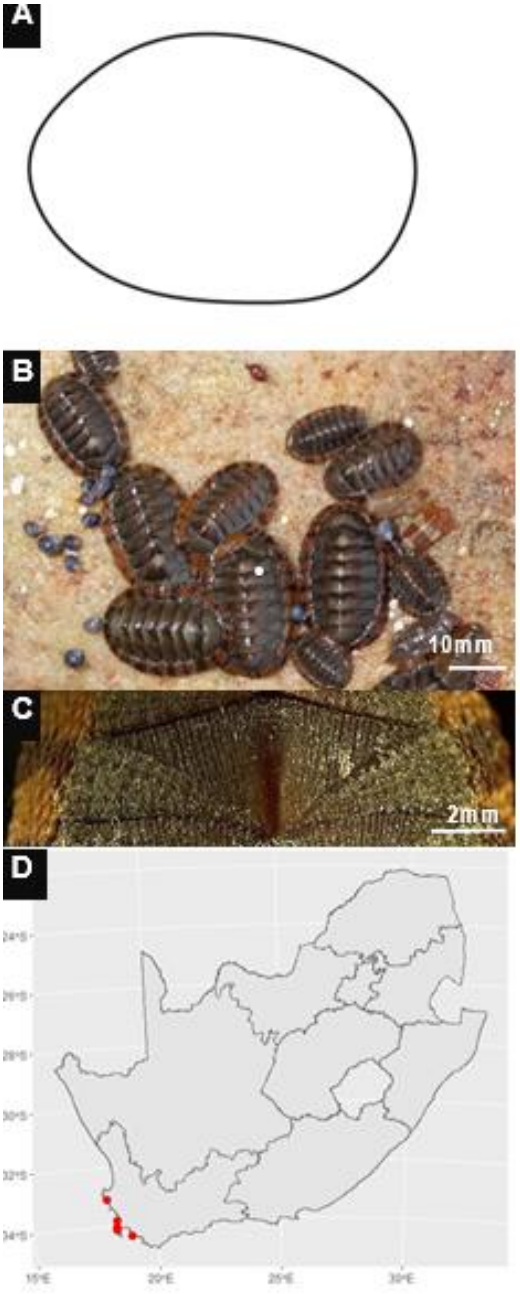

Figure 3.32) *Radsia nigrovirescens*: A– Girdle armour; B - Whole specimen (Photo by Charles Griffiths); C – Intermediate valve; D – Distribution in South Africa.

Rhyssoplax Thiele, 1893
Chiton (Clathropleura) Tiberi, 1877:136, 143.
Rhyssoplax; Bullock, 1988:150; The Bulletin of Zoological nomenclature Opinion 951:18-19.
Chiton (Anthochiton) Thiele, 1893:377.
Chiton (Rhyssoplax) Thiele, 1893:368.

Shell strongly furrowed and sculptured. Apophyses large. Intermediate valve narrow lengthwise but wide.

Distribution: Mediterranean Sea, Red Sea, Africa, Madagascar, Thailand, India, Australia and New Zealand, Pacific Islands, Gulf of Mexico, and Prince Edward Island.
Remarks: Widely distributed genus incorporating over 50 species. It has only been given genus status since 1988, before which it was considered a subgenus of *Chiton*.

Rhyssoplax polita (Spengler, 1797)

Figure 3.33

Chiton politus Spengler, 1797:89; Kaas & Knudsen, 1992:73.
Chiton tulipa Quoy & Gaimard, 1835:389, pl 74 figs 35-36; Krauss, 1848:37; Pilsbry, 1893:104-105.
Chiton tulipa alfredensis Ashby, 1928:87, pl 8 figs 19-21.
Chiton (Rhyssoplax) tulipa; Strack, 1996:131.

Colour: Various beautiful colours with abstract patterns such as seen in fig. 33B live, faded preserved.
Form: Elongate oval, large (up to 55mm), elevation slight, carination slight, valves beaked.
Valves: Head valve semi-circular, front slope straight to slightly rounded, posterior margin widely V-shaped. Intermediate valve rectangular, anterior margin straight, side margins rounded, posterior margin straight, apex indicated, jugal area marked with colour shading, lateral areas raised. Tail valve smaller than head valve, mucro prominent and antemedian, anterior margin straight and posterior slope concave. Tegmentum mostly smooth with some grooves on lateral areas as well as dotted growth lines. Articulamentum bluish-white to yellow, development strong. Apophyses short, rounded to subtriangular, narrow, notched and separated with a wide and serrated jugal sinus. Slit formula: many/1/many, no slitrays. Eaves solid.
Girdle: Thick and wide. Usually banded. Scales convex with no ribbing.
Radula: Central tooth short, first lateral tooth long and flat. Major lateral cusp unicuspid.
Gills: Holobranchial, adanal.
Habitat: Intertidal and subtidal zones on boulders or reef platforms.
Type locality: Cape of Good Hope.
Global distribution: Endemic to South Africa.
Regional distribution: Langebaan (Western Cape) to Xhora River mouth (Eastern Cape).
Remarks: A common and striking species frequently found on the shore or by recreational divers. The common name is the tulip chiton.

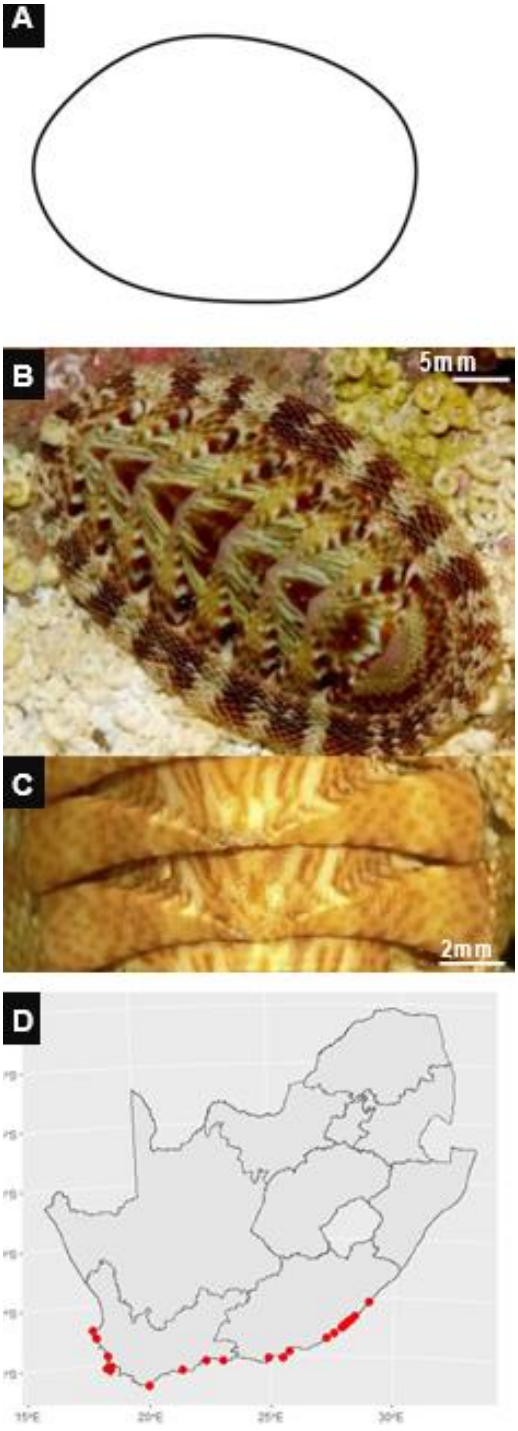

Figure 3.33) *Rhyssoplax polita*: A Girdle elements; B- Whole specimen (Photo by Charles Griffiths); C - Girdle; D – Distribution ‘’in South Africa (.endemic)

Rhyssoplax salihafui (Bullock, 1972)

Figure 3.34

Chiton salihafui Bullock, 1972:240, pl 44: figs 3-5
Chiton (Chiton) salihafui; Kaas, 1979:863, pl 2 figs 5-10; Ferreira, 1983: 267, 290, fig. 21; Kaas & Van Belle, 1988: 129; Bullock, 1988: 167 & 169; Van Belle & Wranik, 1991: 371; Kaas e*t. al.*, 2006:97.
Rhyssoplax salihafui; Dell'Angelo *et al.*, 2020:372, figs 7-12.

Colour: Dull green to grey with some speckles of cream, white, dark green or brown, live and preserved.
Form: Large (up to 50mm), juveniles carinated but less so as adults.
Valves: Head valve, lateral areas and postmucronal area with broad, flat radial ribs. Central area and antemucronal area with inconspicuous flat longitudinal ribs with smooth jugal area. Lateral areas raised. Mucro anterior with postmucronal slope straight to slightly concave. Articulamentum blue or green with some brown discolourations. Apophyses subtriangular to semi-oval with pectinated lamina. Insertion plates pectinated. Slit formula: 8/11-1-12/13. Eaves solid.
Girdle: Scales smooth, surfaced, opaque – thick and large on dorsal surface, rectangular and transparent on ventral surface.
Radula: Central tooth rectangular. First lateral tooth large.
Gills: Not recorded.
Habitat: Middle to high intertidal zone.
Type locality: Tanzania.
Global distribution: Madagascar, Somalia, Tanzania and South Africa.
Regional distribution: Found only in northern KwaZulu-Natla
Remarks: First recorded from South Africa by Kaas (1979). Quite scarce and could therefore be a conservation concern. Subsistence shellfish harvesting in Northern KwaZulu-Natal might have led to the decline of this species (Herbert *et al*., 2003:13; Kyle *et al*., 1997).

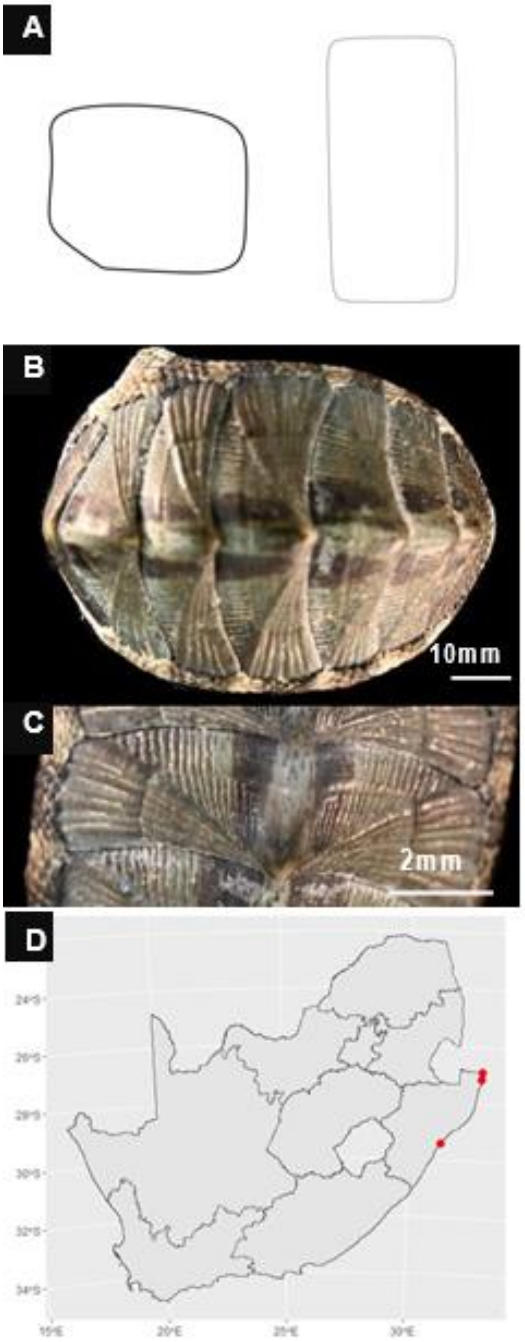

Figure 3.34) *Rhyssoplax salihafui* (NMSA W8492 – Black Rock, KwaZulu-Natal):A – Girdle armour; B - Whole specimen; C – Intermediate valve; D – Distribution in South Africa.

Rhyssoplax crawfordi (Sykes, 1899)

Figure 3.35

Chiton crawfordi Sykes, 1899:279; Ashby, 1931:44; Kilburn & Rippey, 1982:139; Barnard, 1963:343.
Chiton (Rhyssoplax) crawfordi; Strack, 1996:131-132.

Colour: Orange/olive/brown, sometimes with lighter blotches, such as in Figure 35B, live and preserved.
Form: Elongate oval, medium (up to 30mm), elevation high, carination clear, valves beaked.
Valves: Head valve semi-circular, front slope very slightly rounded, posterior margin widely V-shaped. Intermediate valves rectangular, anterior margin slightly rounded, side margins rounded, posterior margin straight, apex prominent, jugal area convex and lifted, lateral areas clearly raised. Tail valve same size as head valve, mucro prominent and central, anterior margin slightly convex, but rounded, posterior slope concave. Tegmentum clearly ribbed on lateropleural areas, as well as antemucronal area, while smooth with microscopic punctation on lateral areas, head valve, jugal area and post mucronal area. Growth lines present but slight. Articulamentum white and development strong. Apophyses not notched, wide and rounded, jugal sinus narrow, rounded with serrated lamina. Slit formula 8/1/14(Based on a single specimen, may vary). Slitrays present, eaves not solid.
Girdle: Wide with dorsal scales large and ribbed, ventral scales more spicule-like. Marginal fringe present.
Radula: Major lateral tooth bicuspid.
Gills: Holobranchial, adanal.
Habitat: Subtidal (more common) to intertidal zone on sand or rocks or marine debris.
Type locality: Algoa Bay.
Global distribution: Endemic to South Africa.
Regional distribution: False Bay to Durban.
Remarks: Tegmental sculpture is very distinctive feature.

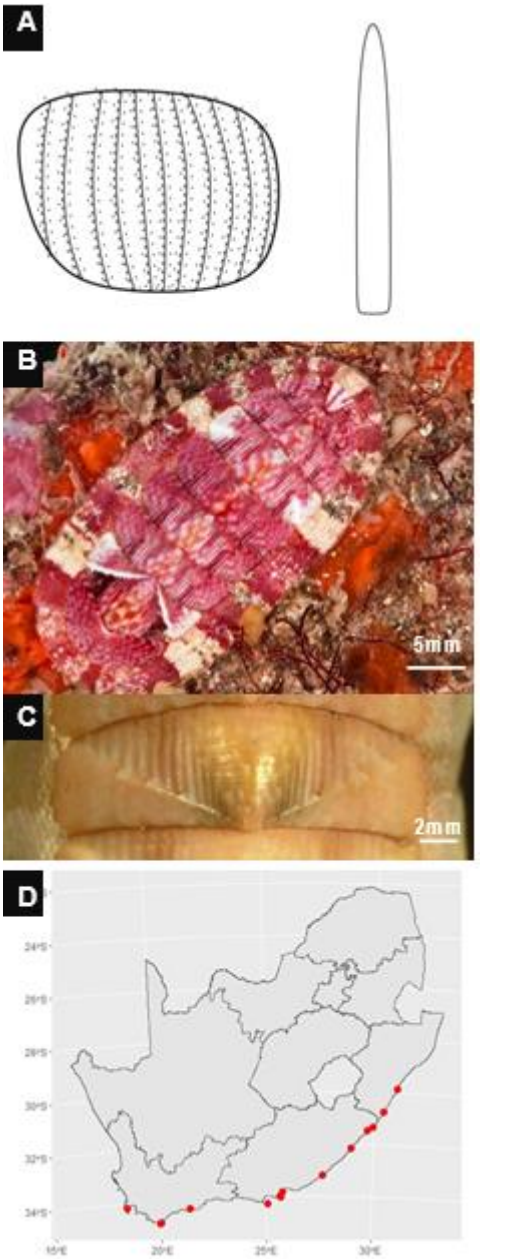

Figure 3.35) *Rhyssoplax carwfordi*: A – Girdle armour; B - Whole specimen (Photo by Renee Els); C – Intermediate valve; D – Distribution in South Africa(endemic).

Onithochiton Gray, 1847

Chiton (Onithochiton) Gray, 1847:65, 68.
Pristochiton Clessin, 1904:104.
Tonicia (Onithoplax) Thiele, 1909:3, 115, 117.
Onithella Mackay, 1933:345.
Nodiplax Beu, 1967:479.

Valves thick but become very eroded. Spongy girdle with spines, bristles or scales. Posterior valve with callus only, no teeth or slits. Shell eyes present. Terminal prominent mucro.

Distribution: Canada, Red Sea, Arabian Sea, East China Sea, Australia, New Zealand and South Africa.

Remarks: The callus in the tail valve is the most prominent distinguishing feature from other similar genera, such as *Plaxiphora* (p. 51).

Onithochiton literatus (Krauss, 1848)

Figure 3.36

Chiton literatus Krauss, 1848:36, pl. 3 fig. 6.
Chiton wahlbergi Krauss, 1848:36, pl. 3 fig. 1.
Plaxiphora wahlbergi; Pilsbry 1892-1893:322, pl 55 figs 17, 18.
Onitochiton literatus; Ashby, 1931:50; Nierstrasz, 1906:505; Kaas, 1979:871; Ferreira, 1983:274; Kilburn & Rippey, 1982:140; Branch *et al*., 2002:162.

Colour: Cream to brown with various cream and green markings, live and preserved.
Form: Elongate oval, large (up to 50mm), elevation moderate to high, only valve II carinated, valves beaked.
Valves: Head valve V-Shaped, front slope convex to rounded, posterior margin inwardly rounded. Intermediate valve rectangular, anterior margin straight to convex or outwardly rounded, side margins rounded, posterior margin M-shaped, jugum lifted on valve II, apex prominent and lateral areas raised slightly. Tail valve large, mucro not prominent and submedian, anterior margin straight and post mucronal slope flat. Tegmentum with radial ribs splitting into nodules on the head valve, lateral areas and tailvalve, with fine longitudinal diverging ridges, growth lines present with shell eyes on lateral area edges. Articulamentum strong. Apophyses triangular, medium and notched. Slit formula: 8/1/8. Teeth and jugal sinus serrated, slitrays present. Eaves porous.
Girdle: Wide with densely packed microscopic spicules.
Radula: Major lateral tooth with bulbous, uniscupid cusp and central tooth long and slender, but blunt.
Gills: Holobranchial, adanal.
Habitat: On rocks exposed to severe wave action.
Type locality: Natal, South Africa.
Global distribution: Western side of Indian Ocean from the Red Sea to South Africa.
Regional distribution: East London to Kosi Bay.
Remarks: The only chiton species found inhabiting rocks openly exposed to wave action. Shell eyes visible only in uneroded specimens.

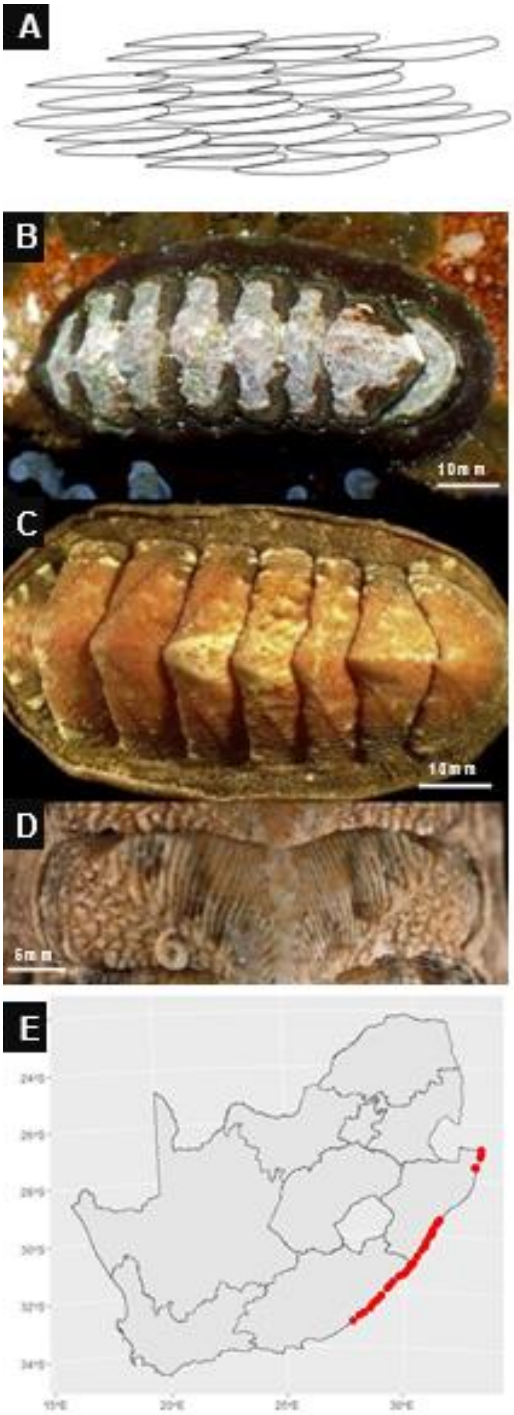

Figure .3.36) *Onithochiton literatus*: A – Girdle armour; B - Whole specimen eroded (Photo by Charles Griffiths); C – Whole specimen uneroded, D–Intermediatevalve (NMSA B2723 – Port Shepstone); E-Distribution in South Africa.

Lucilina Dall, 1882

Tonicia (Lucilina) Kaas, 1979:869. *Acanthopleura (Lucilina)* Dall, 1882: 284. *Toniciopsis* Thiele, 1893:371.
Lucilina, WoRMS, AphiaID: 206921.

Pustulose tegmentum with beaded longitudinal riblets. Numerous tail valve slits, one slit per intermediate valve. Mucro subcentral. Eaves solid. Gills not holobranchial.

Distribution: Red Sea, Arabian Sea, Sri Lanka, Madagascar and surrounding islands, Australia, Pacific Islands.

Remarks: Seen as a subgenus by earlier literature (e. g. Kaas, 1979:869), but more recently treated as a full genus (Kaas, 1996).

Lucilina carnosa (Kaas, 1979)

Figure 3.37

Tonicia (Lucilina) carnosa Kaas, 1979:869, pl. 3: figs 1010.
Tonicia indica Leloup, 1981:40, pl. II, fig 7; pl. III: fig.1
Lucilina carnosa; Kaas 1996:372; Sirenko, 2012:83-85, figs 23-24.

Colour: Pale to light brown or a tinge of orange to pink live and preserved.
Form: Elongate oval, medium (up to 20mm), valves slightly beaked, carination absent.
Valves: Apex strong. Latero-pleural areas ribbed with almost smooth jugal area. Lateral areas raised and radially ribbed with V-shaped pustules as on head valve, and separated from central area with a granulose rib, which also occur on the posterior margin. Shell eyes: 8 rows of straight shell eyes splitting into 2-3 rows towards margins on head valve, with shell eyes on lateral area furrow splitting into more rows towards the margin. Growth lines present. Tail valve with central to submedian mucro. Articulamentum well developed, white. Very long insertion plates, pectinated with formula 8/1/8-10. Apophyses rounded and well developed, with pectinated lamina.
Girdle: Wide. Smooth to the naked eye, but dorsally beset with tiny, elongate, ribbed, pointed scales not imbricating. Slender, small spicules on chitinous shafts scattered between the ribbed scales. Ventral scales square with rounded tops and longitudinal sulci.
Radula: Not documented.
Gills: Not documented or visible in specimens viewed, but expected to be merobranchial.
Habitat: On coral slabs around 50m depth.
Type locality: Conducia Bay, Mozambique.
Global distribution: Mozambique, South Africa, Madagascar and surrounding islands.
Regional distribution: Kosi Bay and Bhanga Nek.
Remarks: Very similar to *Lucilina sueziensis* (Reeve, 1847) from the Red and Arabian Seas, but differs in intensity of scale ribbing and lateral area sculpture, as well as head valve ornamentation and tail valve form (Kaas, 1979:871). This is the first record of this species in South Africa (see Chapter 2).

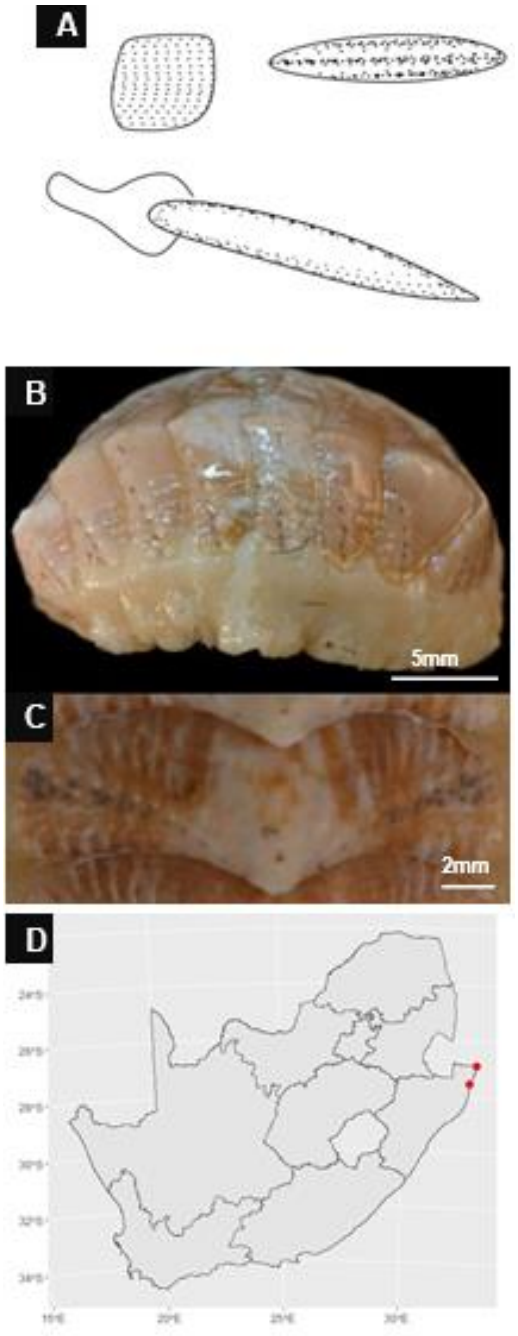

Figure 3.37) *Lucilina carnosa* (NMSA 0S4007 – Kosi Bay): A– Girdle armour; B - Whole specimen; C – Intermediate valve; D – Distribution in South Africa.

Chiton Linnaeus, 1758

Chiton Linnaeus, 1758:667; Ibanez *et al.,* 2021:700.
Chiton (Lophyrus) Poli, 1791:nom. null.
Oscabrion Herrmannsen, 1847:291.
Sclerochiton Dall, 1882:284, 287.
Amaurochiton Thiele, 1893:283.

Large, oval, pectinated insertion plates, blunt cusps more than 90˚ from the major lateral tooth's axis.

Distribution: Occurs in all oceans except the Red Sea, but especially common in Peru and Chile.
Remarks: This was the first genus named in the Polyplacophora, giving the group its common name of "chitons".

Chiton laterorugosus Kaas, 1986

Figure 3.38

Chiton (Chiton) laterorugosus Kaas, 1986:16-17, figs 36-43.

Colour: Uniformly roseate with some lighter spots or light beige and maroon marble with colour banded girdle live, with a yellow tone preserved.
Form: Small (up to 9mm), elongate oval, elevated, carinated, valves slightly beaked.
Valves: Head valve semicircular with small pustules, concentric in radiating rows, posterior margin widely V-shaped. Intermediate valves almost rectangular, central areas with sulci smoothing to the jugal area. Lateral areas raised with radiating rows of little warts. Tail valve with submedian mucro, concave posterior slope.
Articulamentum thin, greyish white. Insertion teeth finely pectinated. Apophyses broad and rounded with a wide jugal sinus with pectinated lamina. Slitrays visible. Slit formula: 8/1/10.
Girdle: Dorsal girdle beset with imbricating scales (curved, ribbed, rounded and diamond shaped). Ventral girdle beset with rectangular scales. No marginal fringe.
Radula: Central tooth small and narrow. First lateral tooth slender. Major lateral tooth with blunt, unicuspid head.
Gills: Holobranchial, abanal.
Habitat: Dredged amongst coral slabs, algae, sand and stones from around 50m depth.
Type locality: Madagascar.
Global distribution: Southern Madagascar and South Africa.
Regional distribution: Known only from Kosi Bay.
Remarks: Previously only known from Tuléar, Madagascar, this is the first record in South Africa. The lateral parts and end valves are the most striking features differentiating this species from close relatives such as *Rhyssoplax barnardi* Ashby, 1931 and *Callistochiton kaasi* Leloup, 1981, of which neither occur in South Africa, but in Madagascar.

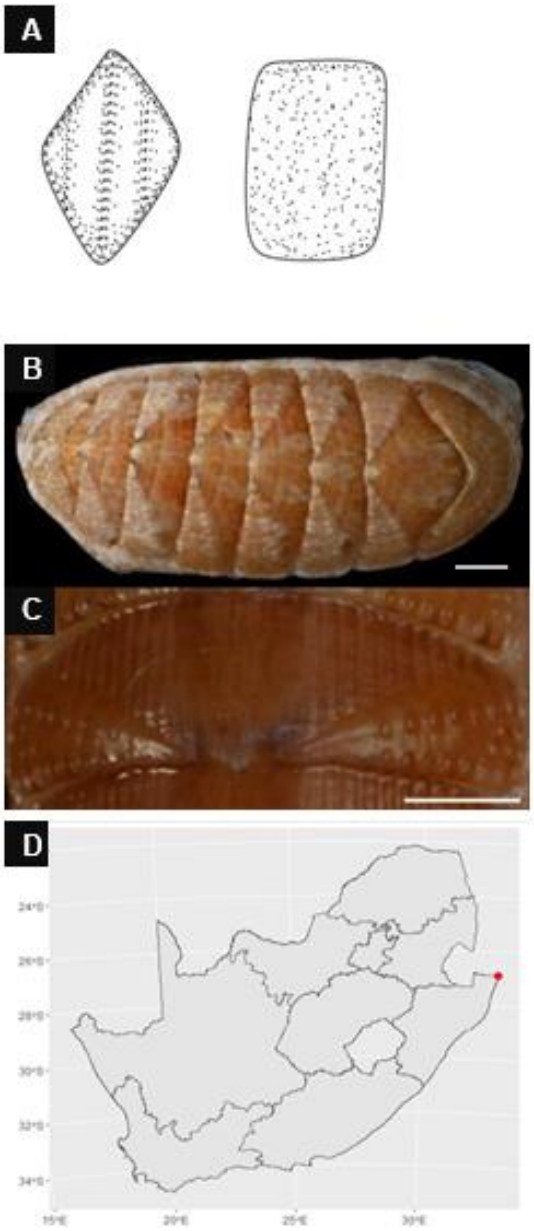

Figure 3.38) *Chiton laterorugosus* (NMSA W9707 – Kosi Bay): A – Girdle armour; B - Whole specimen; C - Intermediate valve; D – Distribution In South Africa.

Tegulaplax Iredale & Hull, 1926

Chiton (Tegulaplax) Iredale & Hull, 1926:170-171.

Elongate oval, wide girdle, pectinated insertion plates well developed, slit formula 8-10/1/10-13. Concentric, wavy ridges on tegmentum with smooth central areas and concentric growth lines. Marginal fringe with spicules, dividing dorsal imbricating, transparent, ribbed scales from ventral small corpuscules.

Distribution: Tropical and subtropical waters of the Indo-Pacific, also in the Mediterranean Sea.

Remarks: Tegulaplax was raised to genus from subgenus by Sirenko (2006: 45). Iredale and Hull (1926:171) were the first to recognize this genus, but no adequate description was provided by these authors. Kaas (1979:866) provided a description for the genus based on the type species.

Tegulaplax hululensis (E. A. Smith, 1926)

Figure 3.39

Ischnochiton hululensis E. A. Smith, 1903:619, pl. 36, figs, 3-6.
Ischnochiton ravanae Sykes, 1903:178, pl. 1, fig. 4.
Chiton imbricatus Nierstrasz, 1905:79, pl. 2, fig. 37, pl. 7, fig. 188-194.
Chiton platei Thiele, 1909:92, pl. 9; fig. 46-48; Leloup, 1981a:17, 37.
Chiton howensis Hedley & Hull, 1912:278, pl. 13, fig. 7.
Tegulaplax matthewsi Iredale & Hull, 1926:172, pl. 18, figs. 26, 27.
Tegulaplax howensis; Iredale & Hull, 1926:171; 1932:139, pl. 8, figs 17-24.
Chiton hululensis; Leloup, 1952:23, 56, fig.10, pl.3: fig.5. – Slieker, 2000:48, pl.12: fig.17.
Chiton (Tegulaplax) hululensis; Kaas, 1979:866, pl.2, figs 11- 19. – Kaas, 1986:17, figs 44-45. – Strack, 1993:12, pl.3: fig.9; pl.7: figs 8-9. – Dell'Angelo & Smriglio, 1999:184, pls.62-63: fig.112; Dell'Angelo et al., 2004:54, pl. 4 figs 12-14.
Chiton (Chiton) hululensis; Van Belle & Wranik, 1991:370, fig.15.*Chiton imbricatus* Nierstrasz, 1905.
Tegulaplax hululensis; Saito, 2006:121, fig. 5E.

Colour: Pink to violet, sometimes with white, green, or brown marks when live, pale roseate preserved.
Form: Oval, medium (up to 26.5mm), elevation moderate.
Valves: Irregular, wavy, concentric riblets on head valve, lateral areas and postmucronal areas with smooth central areas and antemucronal areas. Growth lines present.
Girdle: Dorsal scales ribbed, marginal closely set with spicules in long stalked chitinous shafts – smaller ribbed ones as well as longer striated ones, but not quite reaching the marginal fringe position. Supramarginal corpuscules like *Lepidochitona* species. Slit formula 9/1/11.
Radula: Central tooth very narrow and slender. Major lateral tooth bicuspid head.
Gills: Not documented.
Habitat: Intertidal zone up to 40m depth.
Type locality: Maldives.
Global distribution: Mediterranean, Madagascar, South Africa, Mozambique, Australia, Red Sea and Japan.
Regional distribution: Known only from Kosi Bay.
Remarks: Only known Polyplacophora Lessepsian (Red Sea to Mediterranean) migrant. This species is unusually widespread, but there is little doubt that all these records refer to the same species. This is the type species for the genus *Tegulaplax.* This species was also previously only known from the intertidal zone, but the one specimen from Kosi Bay was collected from a 40m depth dredge, and is is the first report for South Africa (see Chapter 2).

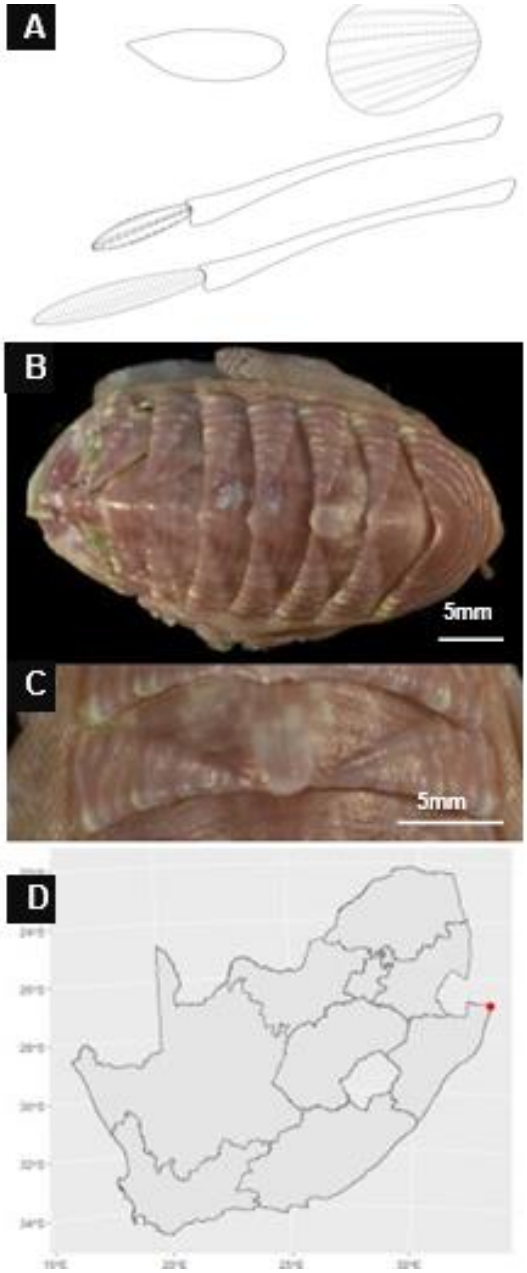

Figure 3.39) *Tegulaplax hululensis* (NMSA E1361 – Kosi Bay): A – Girdle armour; B - Whole specimen; C - Intermediate valve; D – Distribution in South Africa.

ISCHNOCHITONIDAE

~Insertion plates multi-fissured at end valves, teeth not pectinated.

Stenosemus Shuttleworth, 1853

Chiton (Stenosemus) Middendorff, 1847:98.
Lophyrus G. O. Sars, 1878:113.
Ischnochiton (Chondropleura) Thiele, 1906:335, pl. 29, figs. 21-25.
Lepidopleuroides Thiele, 1928:564.
Lophyrochiton Yakovleva, 1952:102.
Ischnochiton (Stenosemus) Kaas and van Bell, 1994(5):43.

Deep, cold-water chitons. Wide girdle with juxtaposed corpuscles. Small marginal fringe present.

Distribution: Arctic to Antarctic and deep tropical waters. Prefer temperatures under 14˚C and depths beyond 100m.

Remarks: This widespread genus was was initially regarded as a subgenus of *Ischnochiton* (p. 65) but Sirenko (2006) gave *Stenosemus* full generic rank.

Stenosemus merveae Sirenko, 2016

Figure 3.40

Stenosemus merveae Sirenko, 2016:9, figs 4-7.

Colour: Brown with creamy blotches and banded girdle, live and preserved.
Form: Small (up to 19mm), oval, carination present, elevation high.
Valves: broadly
Head valve semicircular. Intermediate valves rectangular, front margin convex, posterior
margin straight, rounded side margins. Lateral areas raised. Tail valve narrower than head valve. Antemedian mucro. Concave postmucronal slope. Tegmentum sculptured with longitudinal grooves on central area, radial grooves on lateral areas and head valve. Growth lines present. Blueish articulamentum. Rounded apophyses connected with pectinated, notched lamina. Weak slit rays and short insertion plates. Teeth not pectinated. Solid eaves. Slit formula: 13/1/12.
Girdle: Narrow for the genus. Dorsally beset with spicules (large, bent, striated) with smaller dorsal spicules in between with long chitinous hairs carrying a small spicule at the tip. Marginal fringe with sharp spicules. Ventrally beset with thin, flat, rectangular scales shrinking and turning to triangular shapes near the outer margin.
Radula: First lateral tooth wing-shaped. Major lateral tooth with uniscupid cusp.
Gills: Merobranchial, adanal.
Habitat: Known only from deeper waters off the continental shelf.
Type locality: Knysna, South Africa.
Global distribution: Endemic to South Africa.
Regional distribution: Knysna and Cape Recife.
Remarks: Only known from two records, In the description the location is given as “near Cape Town”, but recorded coordinates in that publication show the location to be off Knysna, from *RV Africana* bottom trawl and again at 110 m off Cape Recife. This is one of only three species from the genus, and the only one present in South African waters, that is multicoloured.

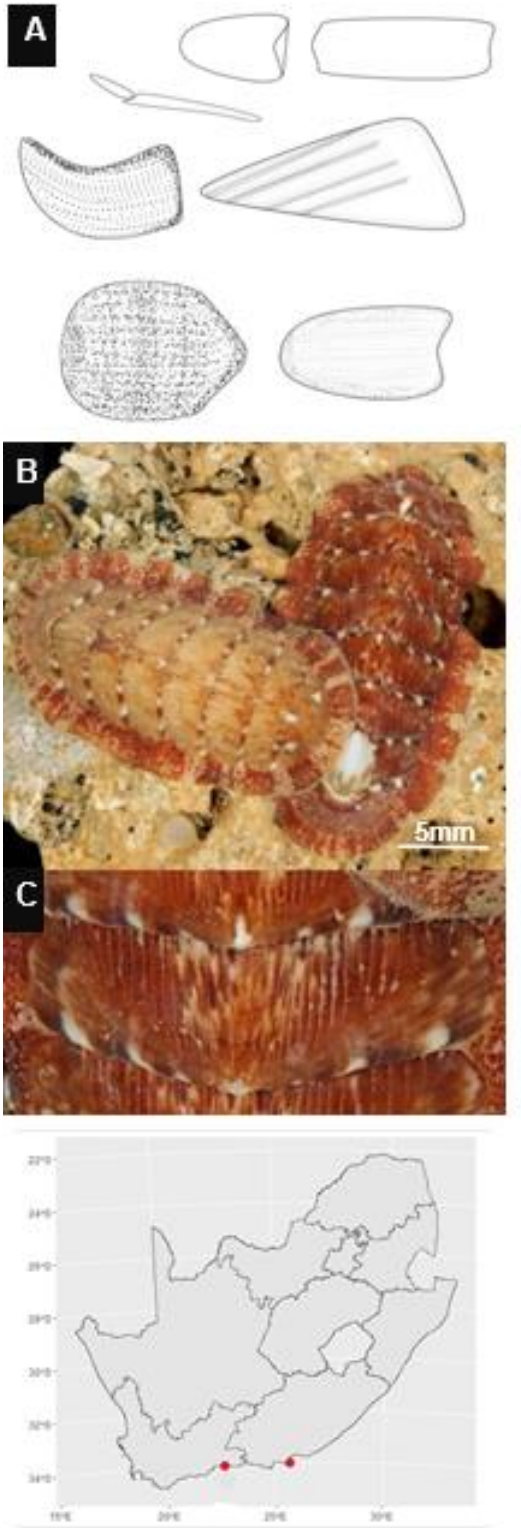

Figure 3.40) *Stenosemus merveae*: A – Girdle armour; B - Whole specimen (Photo by Renee Els); C – Intermediate valve (Photo by Renee Els, cropped); D – Distribution in South Africa (endemic).

Stenosemus simplicissimus (Thiele, 1906)

Figure 3.41

Ischnochiton (Chondropleura) simplicissimus Thiele, 1906:325-326, pl. 29; Kilias, 1995:169.
Ischnochiton (Stenosemus) simplicissimus; Kaas, 1985:139; Kaas & van Belle, 1990:67, fig. 27; 1998:171.
Stenosemus simplicissimus; Sirenko, 1994:164; 2005:36; Gutt *et al.,* 2000:4; Linse *et al.,* 2006:155; Schwabe, 2008:72-24, fig 1-4.

Colour: Uniform dull white, live and preserved.
Form: Medium (up to 16mm), elongate oval, carinated, elevation moderate.
Valves: Head valve posterior margin widely V-shaped with clear notch. Intermediate valves trapezoid to rectangular with rounded side margins and anterior margin convex with posterior margin concave. Lateral areas clearly raised. Tail valve semicircular, antemedian prominent mucro present with steep, straight postmucronal slope. Tegmentum smooth with micro perforation, although radial striation sometimes visible on juveniles. Growth lines present. Articulamentum thin and white. Apophyses short and wide, triangular to rectangular in tail valve, with smooth jugal lamina. Slit formula 14-16/1-2/10-13. Slitrays present. Eaves spongy.
Girdle: Calcareous scales bent, weakly striated, blunt and inwardly directed on dorsal surface, shrinking towards the margin with some sharp spicules on shafts in between scales. Ventral surface covered with rectangular scales.
Radula: Central tooth rectangular. First lateral tooth wing shaped.
Gills: Merobranchial.
Habitat: 284-1064m depth.
Type locality: Cape of Good Hope, South Africa.
Global distribution: Southern Ocean from South Georgia Island to the Eastern Weddell Sea, as well as South Africa.
Regional distribution: Off Cape of Good Hope.
Remarks: Only known in this region from the type specimen, with additional material from other localities later found (Schwabe, 2008). No specimens are stored in South Africa. The type specimen can be found in the Natural History Museum Berlin, Germany. Consequently, this species could not be studied, nor photographed in the scope of this project.

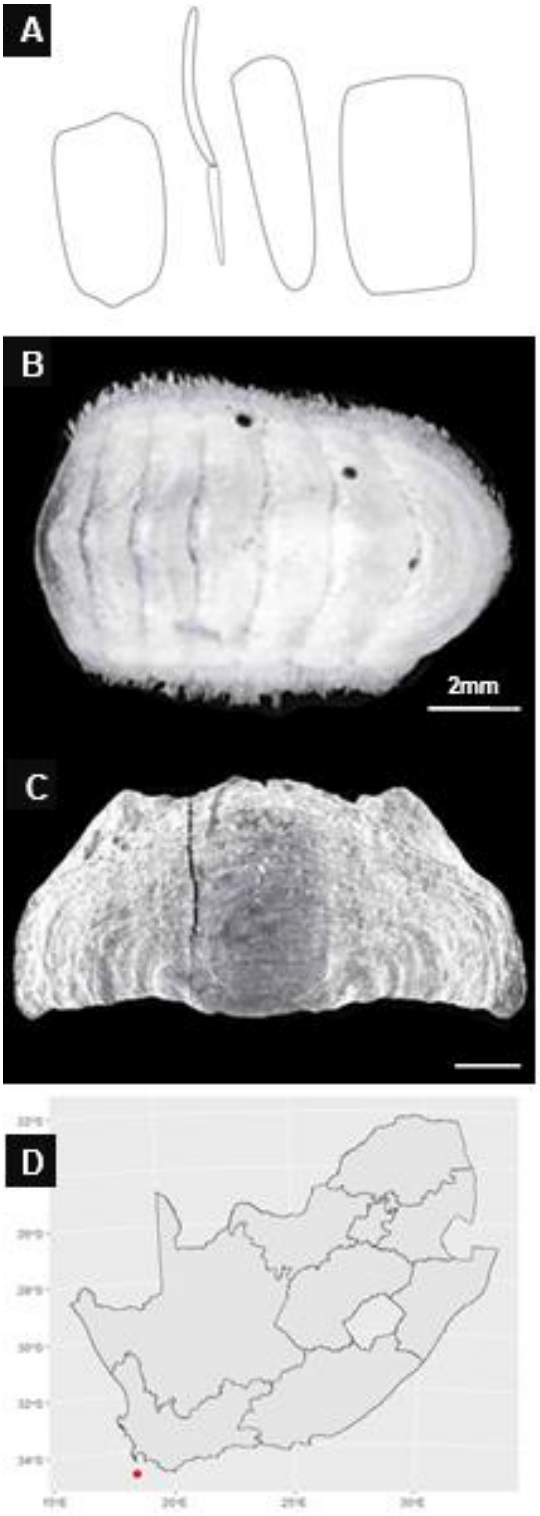

Figure 3.41) *Stenosemus simplicissimus*: A – Girdle armour; B - Whole specimen (Photo from Schwabe, 2008:73); C – Intermediate valve (Photo from Schwabe, 2008:73); D – Distribution in South Africa.

Ischnochiton Shuttleworth, 1853

*Ischnochiton*Gray, 1847:126, 168.
Chiton (Ischnoradsia) Shuttleworth, 1853:189.
Ischnochiton (Heterozona) P. P. Carpenter [in Dall], 1879:82.
Lepidoradsia P. P. Carpenter, 1879:283.
***Ischnochiton (Radsiella)* Pilsbry, 1892:54; 86, 139.**
Lophyropsis Thiele, 1893:387.
Ischnochiton (Haploplax) Pilsbry, 1894;71; Ashby, 1927:91; Kaas & van Belle, 1985:62.
Ischnochiton (Anisoradsia) Iredale & May, 1916:108.
Autochiton Iredale & Hull, 1924: 227, 282.
Haploplax (Chartoplax) Iredale & Hull, 1925:295.
*Ischnochiton (Simplischnochiton)*Van Belle, 1974:11, 54-60.
Ischnochiton (Ischnochiton); Kaas & van Belle, 1985(4):78.
Haploplax;Ashby & Hull, 1992:290-291.

Valves and insertion plates thin, insertion plates smooth, single notch on intermediate valves, imbricate scales small on margin. Eaves solid, sharp, smooth slits.

Distribution: Worldwide except in the Northern Atlantic and Arctic Ocean.

Remarks: With *Leptochiton* and *Chaetopleura,* this is one of the three most speciose genera in the South African region, boasting five local species. These species are very common, and most are well known. Except for *I. textilis* where ribbed sculpture is the most prominent feature, scales seem to be the best characteristic to differentiate between *Ischnochiton* species. Slit formulas are very variable and consequently not a good character to identify species.

Ischnochiton textilis (Gray 1828)

Figure 3.42

Chiton solea Sowerby, 1840:61.
Chiton textilis Gray, 1828:5, pl6: fig. 20; Krauss, 1848:38.
Chiton textilis var. punctulata Krauss, 1848:39.
Chiton tigrinus Krauss, 1848:38, pl. 3: fig. 5.
Chiton ludwigi Krauss, 1848:36.
Chiton indicus Sowerby, 1892:51.
Ischnochiton tigrinus var. unicolor Pilsbry 1893:144.
Ischnochtion reticulatus; Turton, 1932:211 (non Chiton reticulatus Reeve, 1847).
Ischnochiton (Radsiella) textilis; Ashby 1931:36.
Lepidopleurus fodiatus Rochebrune, 1881b:119.
Ischnochiton (Ischnochiton) textilis; Kaas and van Belle, 1985(4):117-119, fig. 50.
Ischnochiton textilis; Barnard, 1963:388, fig.29j; Leloup, 1968a:25, fig. 9, pl. 2: figs C-D; Fischer, 1978:42; Kilburn & Rippey, 1982:138, fig. 83, pl. 33, fig. 7; Strack, 1996:131; Fernandez *et al.,* 2006:60, fig. 5.

Colour: Variable, often with one solid colour or zebra patterns such as in Figure 3.42: B live, faded when preserved.
Form: Elongate oval, large (up to 40mm), elevation moderate, carination absent or slight, valves rounded.
Valves: Head valve semicircular, posterior margin concave with rounded sides. Intermediate valve rectangular, anterior margin straight/roundly convex, posterior margin straight/concave, side margins rounded. Apex not prominent. Lateral areas raised. Tail valve large, anterior margin straight or convex, submedian mucro not prominent, posterior slope concave. Tegmentum with radial granulose riblets on lateral areas, punctated with diamond-shaped pits anteriorly converging and radiating riblets on central area. Growth lines present. White articulamentum weak/intermediate. Apophysis wide, short and notched, triangular to subtriangular with sinus shallow and wide. Slit formula: 14-18/2-6/11-20 Teeth deep and sharp. Slitrays present. Eaves solid.
Girdle: Wide. Clothed with scales (small, convex, thin, imbricating and grooved) with 12-24 transverse ridges, ventral scales elongate.
Radula: Major lateral tooth with bicuspid cusp, pointed. Central tooth bulbous and angular. First lateral tooth sharp and slender.
Gills: Holobranchial, abanal.
Habitat: Under boulders in the low intertidal to subtidal zone.
Type locality: Cape of Good Hope, South Africa.
Global distribution: Endemic to South Africa.
Regional distribution: Saldanha Bay to Umsikaba, southern KwaZulu-Natal.
Remarks: One record from OBIS is from Namibia. If the occurrence in Namibia is true, it is likely that this species would be present in the Northern Cape as well. Probably the most common South African chiton and easily distinguishable by the tegmental sculpture. Cape Town specimens have smoother sculpture, while specimens from KwaZulu-Natal have coarser sculpture.

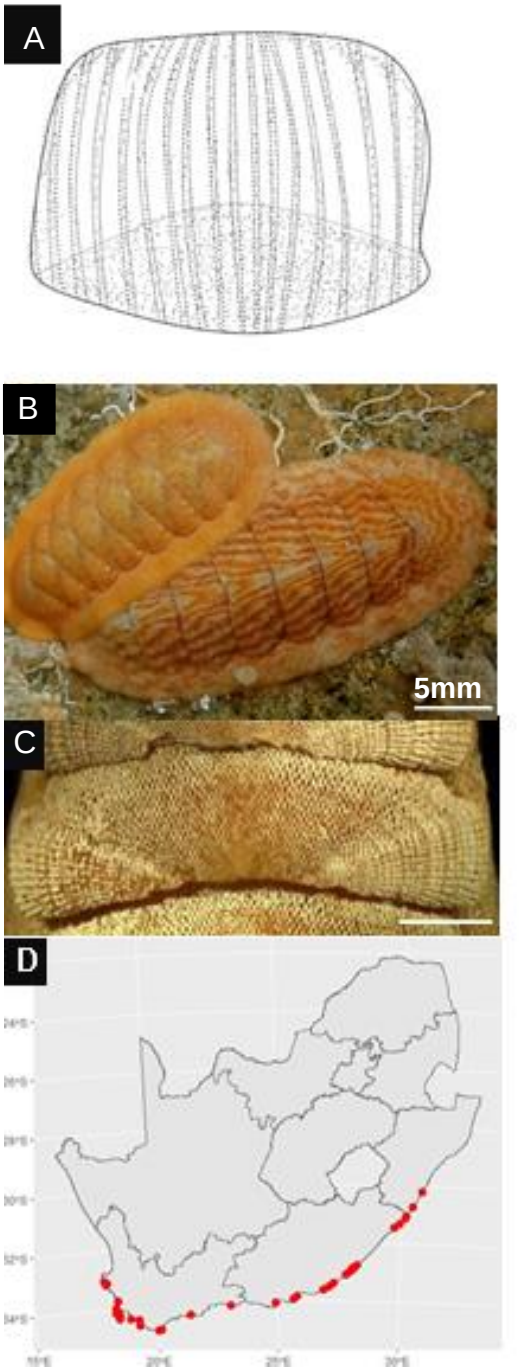

Figure 3.42) *Ischnochiton textilis*: A– Girdle armour; B - Whole specimen (Photo by Charles Griffiths); C – Intermediate valve; D – Distribution in South Africa (endemic).

Ischnochiton indianus Leloup, 1981

Figure 3.43

Ischnochiton (Radsiella) indianus Leloup, 1981:2, fig 1, Pl I. figs. 1-4.
Ischnochiton (Ischnochiton) indianus; Kaas, 1985:327; Kaas and van Belle, 1985(4):134-136, fig. 58.
Ischnochiton indianus; Kaas, 1996:370; Dell'Angelo *et al.,* 2011:26.

Colour: Cream with various brown blotching live and preserved.
Form: Elongate oval, small (up to 8mm), elevated.
Valves: Head valve semicircular. Intermediate valves rectangular with side margins rounded. Tail valve semi-oval, mucro antemedian and not very prominent, post mucronal area weakly concave. Jugum narrowed and raised. Tegmentum is mainly smooth with light ribbing on lateropleural areas and growth lines clear on lateral areas. Apophyses short, rounded. Slit formula: 15/2/12.
Girdle: Narrow. Dorsal scales striated, round-topped and ventral scales small and rectangular. Marginal fringe with cylindrical spicules longitudinally striated.
Radula: Not documented.
Gills: Not documented.
Habitat: Subtidal to 45m depth.
Type locality: Mozambique.
Global distribution: Madagascar, Mozambique and East coast of South Africa.
Regional distribution: Sodwana Bay and Kosi Bay in northern KwaZulu-Natal.
Remarks: This is not a very well-known chiton, but tegmental sculpture and valve formation, as well as marginal fringe, easily distinguishes it from other *Ischnochitons* in the region. As a first record of the species in South Africa (see Chapter 2), this is also the only *Ischnochiton* recorded in Northern KwaZulu-Natal.

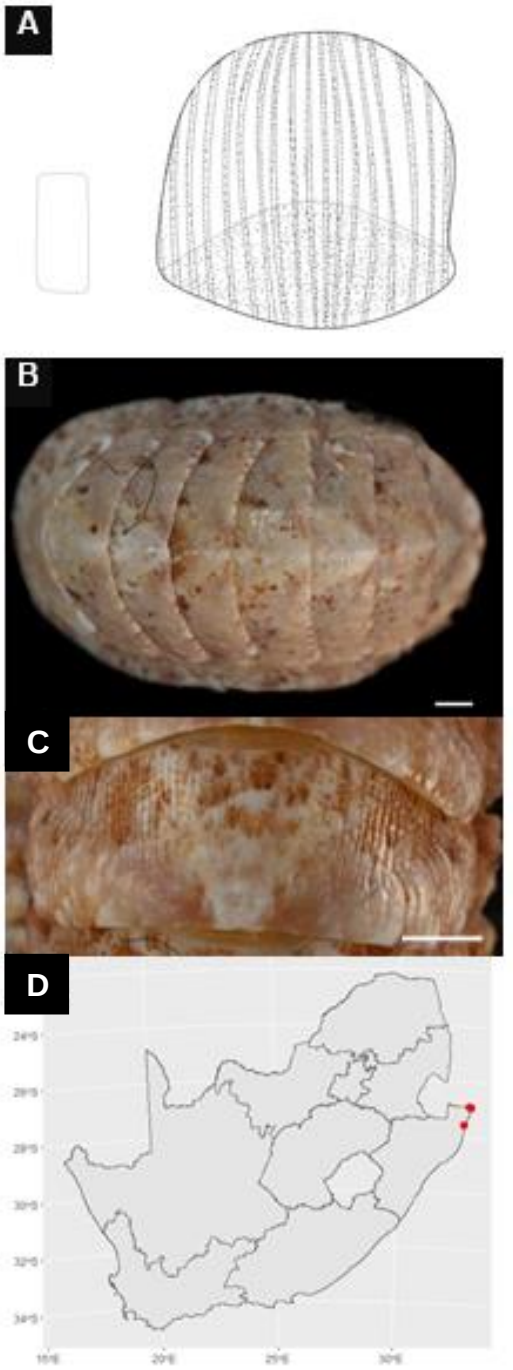

Figure 3.43) *Ischnochiton indianus* (NMSA S1955: A – Girdle armour; B - Whole specimen; C – Intermediate valve; D – Distribution in South Africa.

Ischnochiton bergoti (Vélain, 1877)

Figure 3.44

Chiton bergoti Vélain, 1877:123, pl. 4, figs. 19-20.
Chiton constanti Vélain, 1877:124, pl. 4, figs. 21-22.
Ischnochiton macgillivrayi Pilsbry, 1892:101.
Ischnochiton hewitti Ashby, 1931:33, pl. 5, figs. 50-53.
Ischnochiton (Ischnochiton) bergoti, Kaas & van Belle, 1990(4):122-123.

Colour: White to brown live and preserved.
Form: Elongate oval, small (up to 15mm), elevation high, carination absent, valves rounded.
Valves: Head valve semi-circular, front slope straight to slightly rounded, posterior margin roundly concave. Intermediate valve rectangular, anterior margin straight, posterior margin straight, side margins rounded. Apex not indicated but jugal area indicated, although not raised. Lateral areas not raised. Tail valve same size as head valve, mucro not prominent, antemedian, anterior margin almost concave, posterior slope straight. Tegmentum minutely granulated, forwardly converging rows of granules along lateropleural areas, leading to a fine quincuncial pattern towards jugum and central area minutely granulated. Growth lines present. Articulamentum white to blue, development weak to intermediate. Apophyses round, wide, not notched, sinus straight. Slight slitrays visible. Teeth sharp. Slit formula 11-13/1/11-14. Eaves solid.
Girdle: Narrow. Scales with beautiful, large, clear ribs (about 3-6).
Radula: Major lateral tooth with tricuspid, pointed cusp. Central tooth elongated.
Gills: Holobranchial, adanal.
Habitat: Under stones in the littoral zone.
Type locality: Saint Paul Island, Alaska.
Global distribution: Islands of the Atlantic Ocean, Islands of the Southern Indian Ocean, as well as South Africa up to South Angola.
Regional distribution: Saldanha Bay to False Bay.
Remarks: A brooding species, as with *Radsia nigrovirescens* (p. 83) and *Rhyssoplax crawfordi* (p. 87), as well as *Lepidochitona* species. Ashby (1931 was the first to record this species, although not recognized as *Ischnochiton bergoti* by him and named as *I. hewitti*. Kaas and van Belle (1990) synonymized Ashby's record with *I. bergoti.*

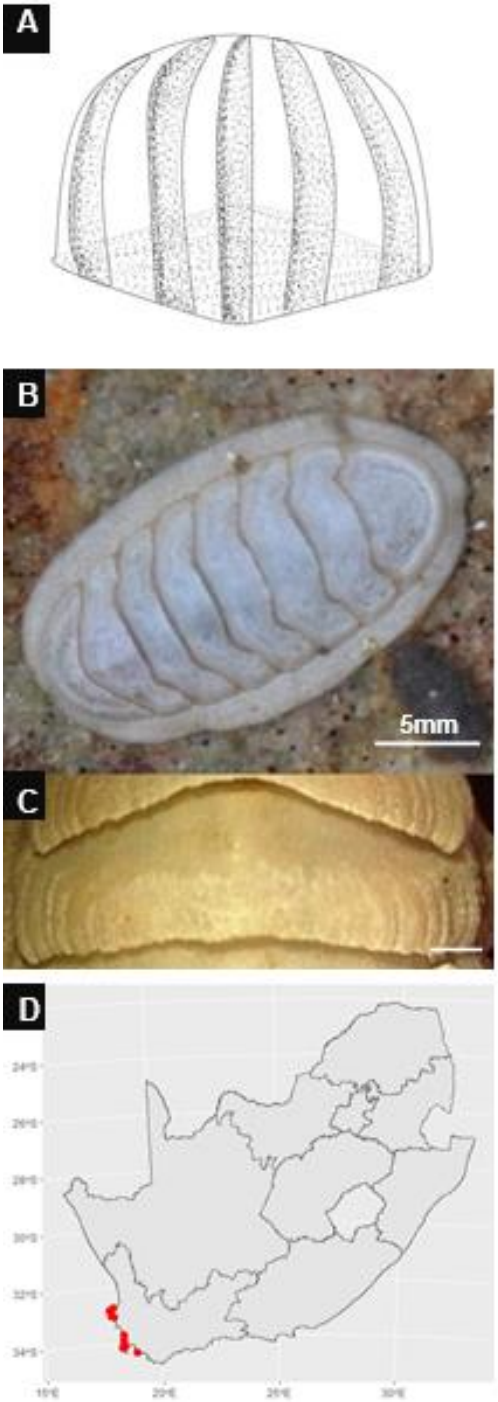

Figure 3.44) *Ischnochiton bergoti*: A– Girdle armour; B - Whole specimen (Photo by Charles Griffiths); C – Intermediate valves; D – Distribution in South Africa.

Ischnochiton oniscus (Krauss, 1848)

Figure 3.45

Chiton oniscus Krauss, 1848:39, pl. 3, fig. 4.
Ischnochitononiscus; Nierstrasz, 1897:512; Sykes, 1898:41-42;Ashby,1927:84-85;Strack, 1996:131; Muratov, 2014:378-379, figs. 1-3.
Ischnochiton oniscus alfredensis Ashby, 1931:31, pl. 5: fig. 54.
Ischnochiton eucosmia W. H. Turton, 1932:211, pl. 54.
Ischnochiton oniscus var. albocarinatus W. H. Turton, 1932:210, pl. 54.
Ischnochiton oniscus var. aurantius W. H. Turton, 1932:210.
Ischnochiton oniscus var. pyramidalis W. H. Turton, 1932:210.
Ischnochiton (Ischnochiton) oniscus var. pyramidalis Kaas & van Belle, 1990:119-122, fig. 51.

Colour: Variable and often mottled live, faded preserved.
Form: Elongate oval, medium (up to 20mm), elevated, carination absent and valves rounded.
Valves: Head valve semi-circular, front slope rounded, posterior margin concave. Intermediate valves rectangular, anterior margin convex to crescent, side margins rounded, posterior margin straight. Apex indicated. Lateral areas raised; central areas convex. Tail valve with mucro submedian and slightly prominent, anterior margins straight and posterior slope straight to slightly concave. Tegmentum with irregular to rounded bumps almost radial on head valve, more longitudinal to wavey on some areas. Growth lines abundant. Articulamentum colour depending on tegmentum colour. Apophyses notched, rounded, short, medium, sinus shallow and wide. No slitrays. 9-12/1/9-12. Eaves solid.
Girdle: Narrow. Spicules on marginal fringe, dorsa scale small, opaque, brown with white edges, minutely striated with about 16 striae extending to the apex, thin and short, not imbricating but closely set and erect; ventral scales elongate and rectangular.
Radula: Major lateral tooth cusp tricuspid, pointed. Central tooth with bulbous base. Lateral tooth narrow and sharp.
Gills: Holobranchial, adanal with interspace.
Habitat: Grouped under smooth rocks in sandy pools in the intertidal-subtidal zone.
Type locality: Natal, South Africa.
Global distribution: South Africa and Mozambique.
Regional distribution: Hout Bay to Zululand.
Remarks: Differs from *I. textilis* by smoother sculpture, Similar to an onyx stone, jugal and apex clear. Differs from *I. elizabethensis* by having striated scales and longitudinal sculpture on lateral areas and across pleural area, where more wavey in the case of *I. elizabethensis*. *I. oniscus* also has a longer antemucronal area than *I. elizabethensis,* which has a longer postmucronal area.

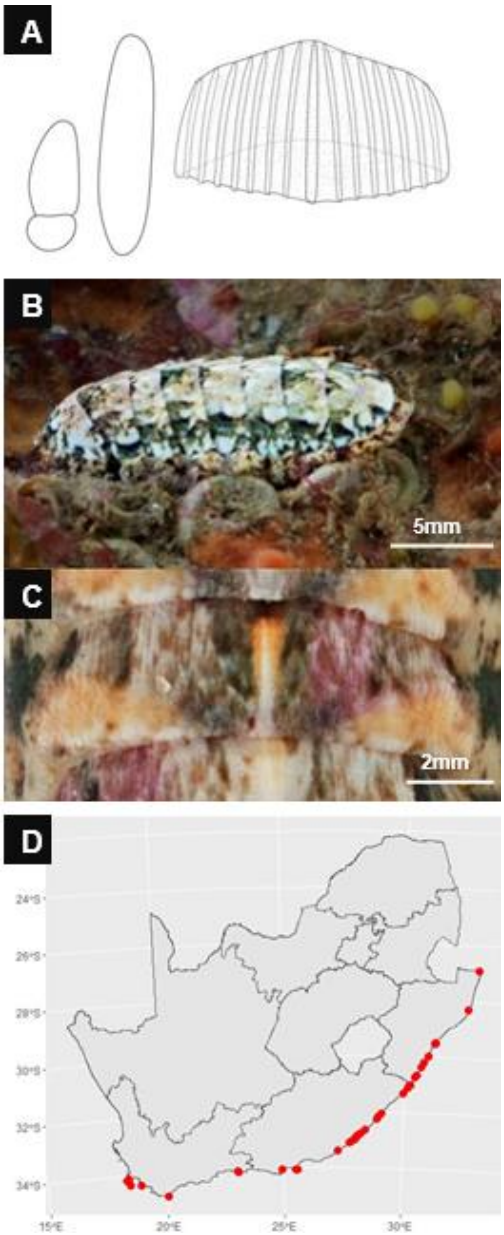

Figure 3.45) *Ischnochiton oniscus*: A – Girdle armour; B - Whole specimen (Photo by Renee Els); C – Intermediate valve (Photo by Renee Els, cropped); D – Distribution in South Africa.

Ischnochiton elizabethensis Pilsbry, 1894

Figure 3.46

Ischnochiton (Ischnochiton) elizabethensis Pilsbry, 1894: 8-9.
Ischnochiton elizabethensis; Sykes, 1898:41-42;Ashby, 1928:85, pl. 6, figs. 9-11;Ashby, 1931:32; Sirenko & Schwabe, 2002:193-197.
Ischnochiton elizabethensis var. piperatus W. H. Turton, 1932:211, pl. 54.

Colour: White to buff or olive live, faded preserved. **Form**: Elongate oval, small (up to 10mm), elevated, carinated, valves rounded.
Valves: Head valve semicircular, front slope straight or slightly rounded, posterior margin concave. Intermediate valves rectangular, anterior margin straight or rounded, side margins rounded, posterior margin straight, apex indicated but not prominent, jugum flat and central area not elevated, lateral areas hardly raised. Tail valve same size as head valve with mucro prominent, submedian, anterior margin straight and posterior slope concave. Tegmentum with randomly dispersed to wavey patterns of circular granules. Growth lines boldly present. Articulamentum white with brown and/or grey markings, development weak to intermediate with apophyses not notched, but medium, round, and short, jugal sinus straight and smooth. Teeth smooth and sharp. Slit formula 10-13/1-2/10-11. Eaves narrow, solid.
Girdle: Narrow. Scales with smooth, polished anterior, but fine striated posterior under high magnification, thin, broad, translucent, flattened but when loose, bent over for complete imbrication, or turned over.
Radula: Major lateral tooth with uniscupid cusp.
Gills: Holobranchial, adanal.
Habitat: Grouped under smooth rocks in sandy pools in the intertidal-subtidal zone.
Type locality: Port Elizabeth, South Africa.
Global distribution: Endemic to South Africa.
Regional distribution: Western Cape to Eastern Cape.
Remarks: Differs from *I. oniscus* by larger, polished, broader scales and overall, randomly arranged, coarser sculpture, granules more circular, central area also much less elevated than in *I. oniscus*. My own observations: *I. elizbethensis* is much flatter, with even and wider valves than *I oniscus,* scales much denser. Synonymized by Kaas and van Belle (1985-1994) to *I. oniscus,* but separate species according to Sirenko and Schwabe (2002).

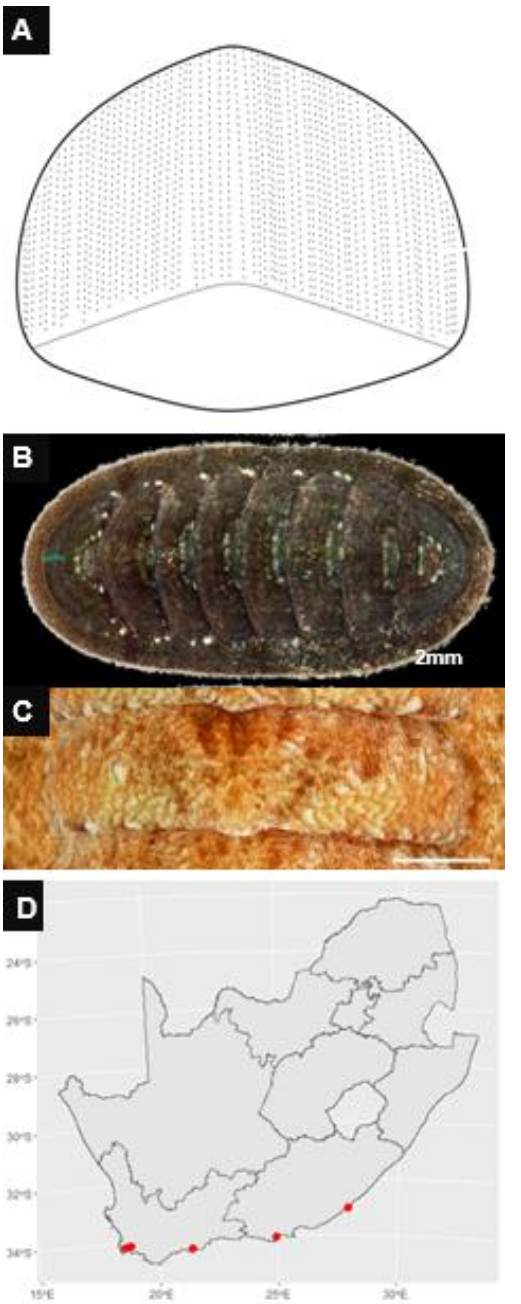

Figure 3.46) *Ischnochiton elizabethensis*: A– Girdle armour; B - Whole specimen; C – Intermediate valve; D – Distribution In South Africa(endemic).

CALLISTOPLACIDAE

Not large, tegmentum strongly sculptured with ribs and insertion plate slits corresponding to ribs, sharp teeth.

Callistochiton Shuttleworth, 1853

Chiton (Callistochiton) P. P. Carpenter [in Dall], 1879:269.
Callistochiton P. P. Carpenter [in Dall], 1893:87; Kaas & van Belle, 1994:123.
Lophochiton Ashby, 1923:233.
Callistassecla Iredale & Hull, 1925:351.
Callistochiton (Allerychiton) Dell'Angelo & Oliverio, 1998:186.

Valves strongly sculptured with two heavily-sculptured ribs on lateral areas. Scales imbricating and grooved basally, but smooth dorsally. Insertion plates short and smooth, curving outwards. Median or submedian mucro.

Distribution: Tropical and subtropical waters only.

Remarks: This is the smallest family in South Africa with only this one genus and single species in the regional fauna.

Callistochiton ashbyi (Barnard, 1963)

Figure 3.47

Chiton ashbyi Barnard, 1963**:**343, fig. 29m.
Callistochiton ashbyi Dell'Angelo, *et al.,* 2011:26.

Colour: Pinkish orange to red with blotches live, with brown tone preserved.
Form: Oval to elongate oval, medium (up to 20mm), moderately elevated, subcarinated, valves rounded.
Valves: Head valve more than semicircular, straight-slightly concave front slope, V-shaped, notched posterior margin. Intermediate valve with forwardly produced jugum, convex anterior margin, straight posterior margin, rectangular with rounded side margins. Apex not prominent. Lateral areas raised. Tail valve with straight front margin, smaller than head valve, antemedian, prominent mucro, concave posterior slope. Tegmentum with radially arranged pustules on lateral areas; longitudinal riblets and pits on central area. Growth lines obsolete. White to pink articulamentum strongly developed, wide apophysis triangular to subtriangular with wide sinus. Slit formula: 9/1/many. Deep teeth. Slitrays present. Eaves solid and narrow.
Girdle: Wide with spicules rising from chitinous cusps and corneous hairs scattered in bunches, some bearing a terminal spicule; rectangular scales on dorsal side: round top and concave base.
Radula: Major lateral tooth with sharp, bicuspid head. Central tooth broadens into a blade. First lateral tooth short and broadens toward blade.
Gills: Holobranchial, abanal.
Habitat: Under rocks in the low-tidal and subtidal zone.
Type locality: Cape infanta, South Africa (type specimen consisting of one intermediate valve only).
Global distribution: South Africa and Madagascar.
Regional distribution: Cape Infanta.
Remarks: Kaas and van Belle (1985) considered *C. ashbyi* as a junior synonymof *C. crosslandi*, which occurs only in Madagascar, but the two are now regarded as separate species. *D*iffers from *C. crosslandi* in that the head valve does not have bifid ribs, more longitudinal ribs on intermediate valves and less radial ribs on the tail valve. Further local material urgently required to confirm other features

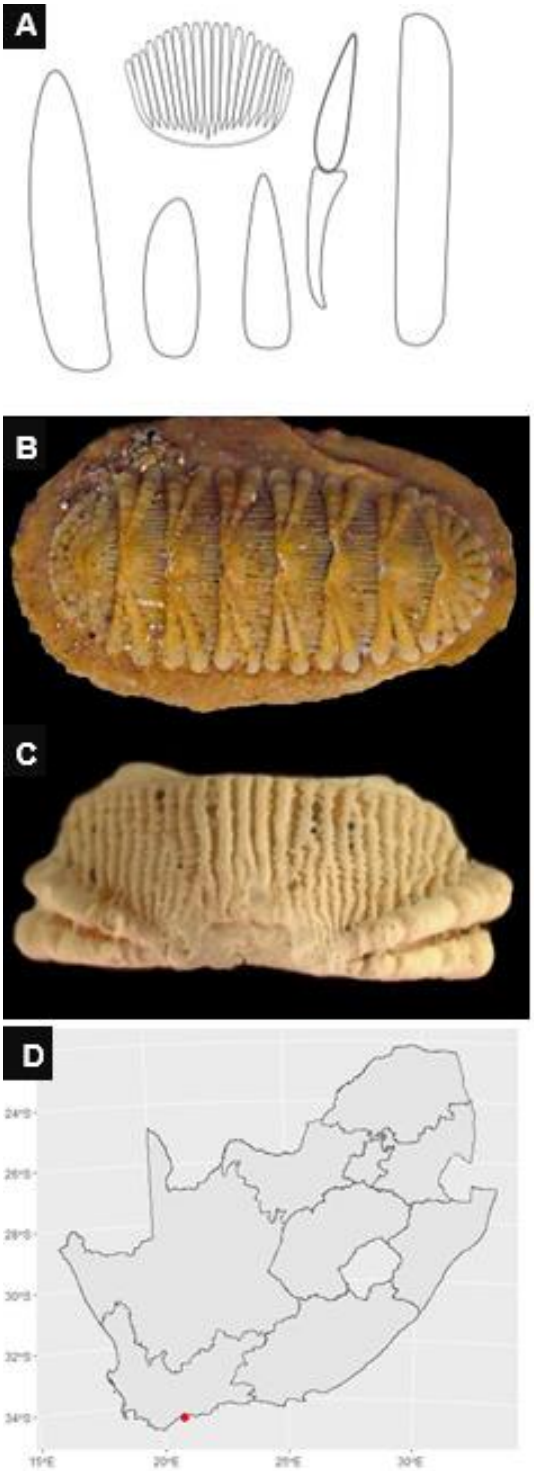

Figure 3.47: *Callistochiton ashbyi* A – Girdle armour; B - Whole specimen (Madagascar specimen, photo supplied by Bruno Dell'Angelo); C – Intermediate valve (Type specimen SAMS MB-A009337, Cape infanta); D - Distribution in South Africa.

CALLOCHITONIDAE

Slits more numerous than any other group, apophyses wide and connected with lamina, eye spots always present, eaves spongy, girdle with spicules or chitinous productions.

Callochiton Gray, 1847

Callochiton Gray, 1847:126.
Ischnochiton (Trachyradsia) Carpenter, 1878:286.
Callochiton (Stereochiton) Carpenter [in Dall], 1882:283, 286.
Callochiton (Icoplax) Thiele, 1893:392.
Acutoplax Cotton & Weeding, 1939: 189.
Paricoplax Iredale & Hull, 1929:87.

Not large. Valves subcarinated at the least. Short, rugose insertion teeth. Sculpture finely granulose. Girdle wide and covered with spicules that are directed inwards and always imbricating. First uncinal tooth reduced and radula rows asymmetric.

Distribution: Common in the NE Atlantic, Mediterranean, Indian Ocean, Western Pacific Ocean, Australasian seas and South African waters.

Remarks: Many insertion teeth in intermediate valves are the key diagnostic feature for this group in South Africa.

Callochiton dentatus (Spengler, 1797)

Figure 3.48

Chiton cerasinus Gmelin, 1791:3204; Pilsbry, 1894:116.
Chiton bicolor (non Gmelin 1791:3204); Spengler, 1797:90, pl 6 fig.18; Pilsbry, 1894:68.
Chiton dentatus Spengler, 1797:88, pl. 6 fig. 16; Pilsbry, 1894:68.
Chiton planatus Spengler, 1797:91; Pilsbry, 1894:68.
Chiton castaneus W. Wood, 1815:13, pl. 2 figs 2-3.
Chiton fulgetrum Reeve, 1847:Plate XIII; Sykes, 1894a:132.
Ischnochiton (Trachyradsia) fulgetrum; Pilsbry, 1892:83, pl 8 figs 80-82.
Callochiton dentatus; E.A. Smith, 1910:210; Kaas & van Belle, 1985:15-17, fig. 3.
Callochiton planatus; E.A. Smith, 1910:210.
Callochiton (Trachyradsia) castaneus; Ashby, 1931:18 pl.2 fig. 24, pl 3 figs 25-27; Leloup, 1970:1 figs 1-3.

Colour: Yellow-chestnut, live and preserved.
Form: Oval, large (up to 55mm), elevation moderate, subcarinated, valves rounded.
Valves: Head valve semicircular, front slope straight, posterior margin almost straight. Intermediate valve rectangular, anterior and posterior margin straight, side margins rounded and apex prominent with a diagonal furrow over pleural area and lateral areas raised. Tail valve small, mucro pointed and antemedian, anterior margin convex and posterior slope almost straight, but more concave due to a more prominent mucro in younger specimens. Sculpture granulose in radiating riblets – these granules seem like pits from the naked eye but under a microscope, elongated granules form, lateral areas containing rows of many eye spots with growth lines present. Tegmentum white/pink and strong. Apophyses short, triangular, wide relative to size and not notched, jugal sinus very wide and shallow. Slit formula many/4/many, teeth irregular, slitrays present. Eaves porous.
Girdle: Wide with spicules minute and needle like, as well as scales smooth and pointed
Radula: Major lateral tooth cusp tricuspid. Central tooth short, strong and narrowing towards base.
Gills: Holobranchial, adanal.
Habitat: Solitary under rocks in the intertidal zone (usually low-tide pool).
Type locality: Cape of Good Hope.
Global distribution: Endemic to South Africa
Regional distribution: Port Nolloth to Durban.
Remarks: Better known as *C. castaneus,* but identified by Kaas and van Belle (1982: 138) to be *C. dentatus.* This distribution is peculiar and quite wide for a single species, but it seems to be a pattern in many of the South African species. Perhaps this is evidence of the lack of research in chitons and indicates that much more research on the taxonomy of these chitons is necessary. There is only a single occurrence recorded from KwaZulu-Natal.

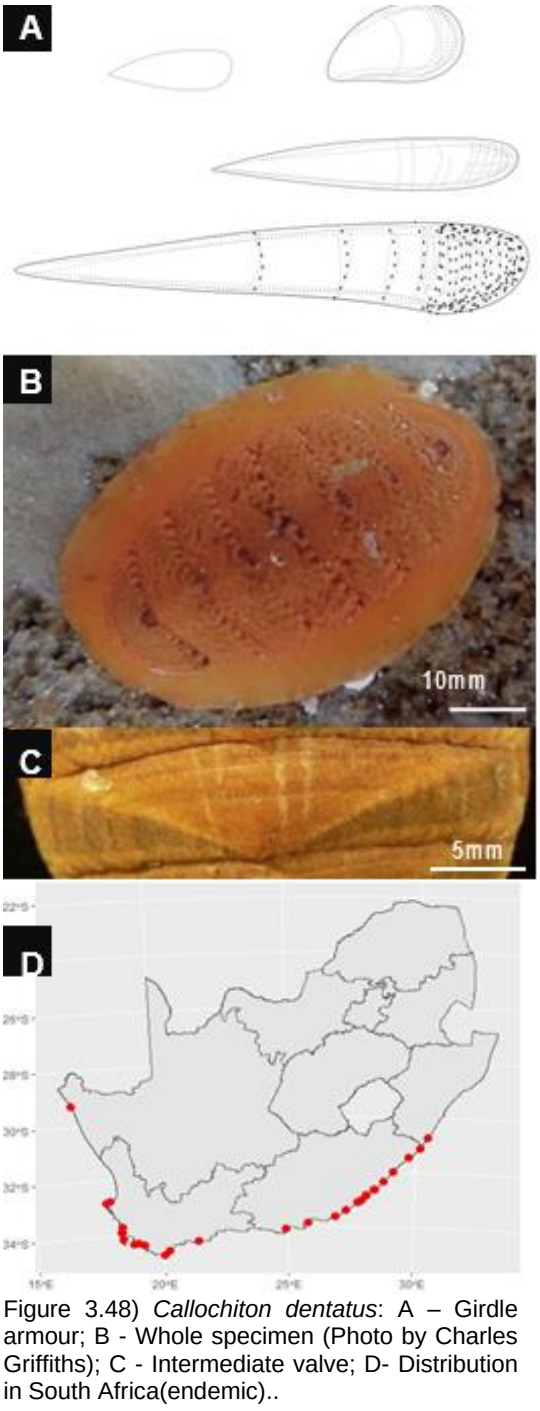

Figure 3.48) *Callochiton dentatus*: A – Girdle armour; B - Whole specimen (Photo by Charles Griffiths); C - Intermediate valve; D- Distribution in South Africa(endemic)..

Callochiton herberti Kaas & van Belle, 1990

Figure 3.49

Callochiton herberti Kaas and van Belle, 1990:24, fig.9.

Colour: Red brown, live and preserved.
Form: Small (up to 5mm), elevation low, subcarinated, Valves beaked.
Valves: Head valve almost semicircular, front slope convex, posterior margin widely V-shaped. Intermediate valves side margins rounded. Apex prominent. Lateral areas not raised. Tail valve with mucro anterior, anterior margin bluntly angular. Radiating striae on head valve, lateral areas, and post mucronal areas, with longitudinal minute granules on central areas and antemucronal area. Eye spots on anterior third of lateral areas and tail valve. Articulamentum transparent and weak. Apophyses short. Eaves porous.
Girdle: Wide with fine spicules and oviform scales distally pointed on dorsal surface.
Radula: Tricuspid, blunt cusp on major lateral tooth.
Gills: Not documented.
Habitat: Subtidal.
Type locality: Natal, South Africa.
Global distribution: Reported only from KwaZulu-Natal but expected to occur in Mozambique as the existing record is on the border.
Regional distribution: Sodwana Bay to Kosi Bay.
Remarks: Has only been reported by Kaas and Van Belle (1990) and the only specimens available in the Natal Museum are the holotype and paratypes they described. Also recorded from Madagascar according to GBIF, but no formal reports could be found confirming this. This species could most likely occur in Mozambique as well, due to the proximily of the border to the reported sites in KwaZulu-Natal.

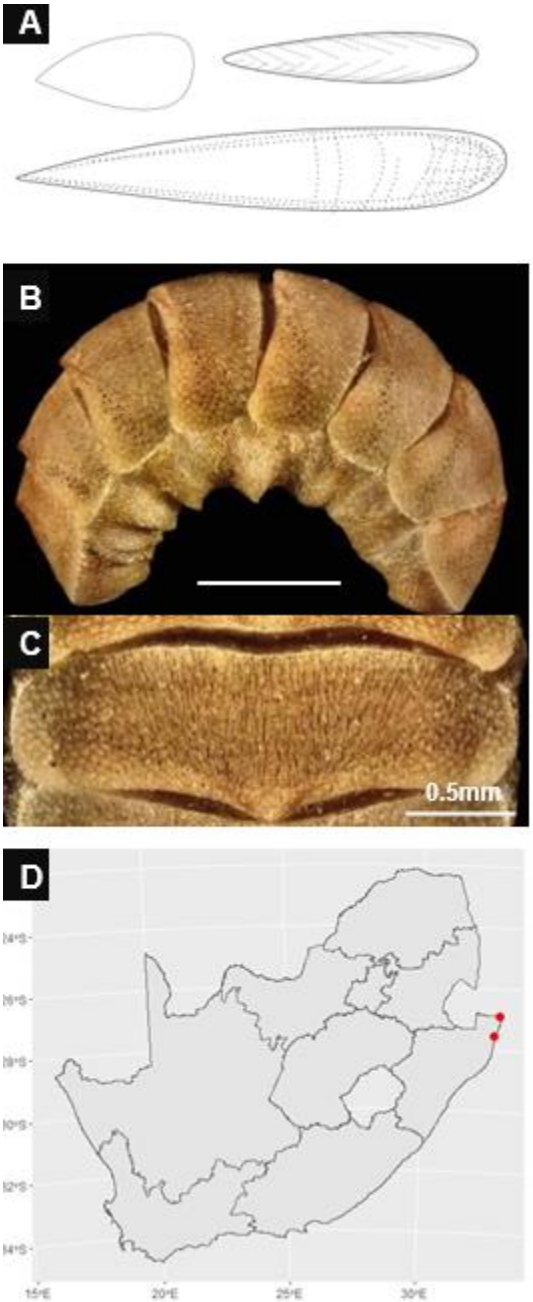

Figure 3.49) *Callochiton herberti*: A – Girdle armour; B - Whole specimen (Photo by Igor Muratov NMSA); C - Intermediate valve (Photo by Igor Muratov NMSA, cropped); D – Distribution in South Africa(tentative endemic).

Callochiton jeareyae Dell'Angelo & Mifsud, 1998

Figure 3.50

Callochiton jeareyae Dell'Angelo & Mifsud, 1998:25 figs 1-15.

Colour: Red, sometimes with white or cream blotches live, faded preserved.
Form: Oval, medium (up to 16mm), subcarinated, elevation moderate. Valves rounded.
Valves: Head valve less than semi-circular, posterior margin almost straight. Intermediate valves broadly rectangular, anterior margin slightly convex, posterior margin convex at both sides of apex, side margins rounded, lateral areas raised. Tail valve with mucro hardly raised - but central. Tegmentum minutely granulose with 6-7 longitudinal grooves on either side of the central area, eyespots closely set on head valve, lateral areas and post mucronal area. Articulamentum same colour as tegmentum, apophyses very wide and short and connected by lamina, insertion plates short with irregular teeth. Eaves porous. Slit formula: 21/2-3/16.
Girdle: Wide with spicules (fine, elliptical, rough), as well as some long, smooth spines close to the margin. Marginal spicules smooth at base with some oblique grooves. Smooth, oviform, imbricating scales covers ventral area.
Radula: Central tooth tulip shaped. Major lateral tooth with bifurrowed head and tridentate cusp, inner much larger than outer.
Gills: Not documented.
Habitat: Subtidal.
Type locality: Algoa Bay.
Global distribution: Endemic to South Africa.
Regional distribution: From False Bay to Algoa Bay.
Remarks: There are no additional museum specimens deposited since the author's initial publication (NMSA-T1443), but there have been reports from East London by colleagues.

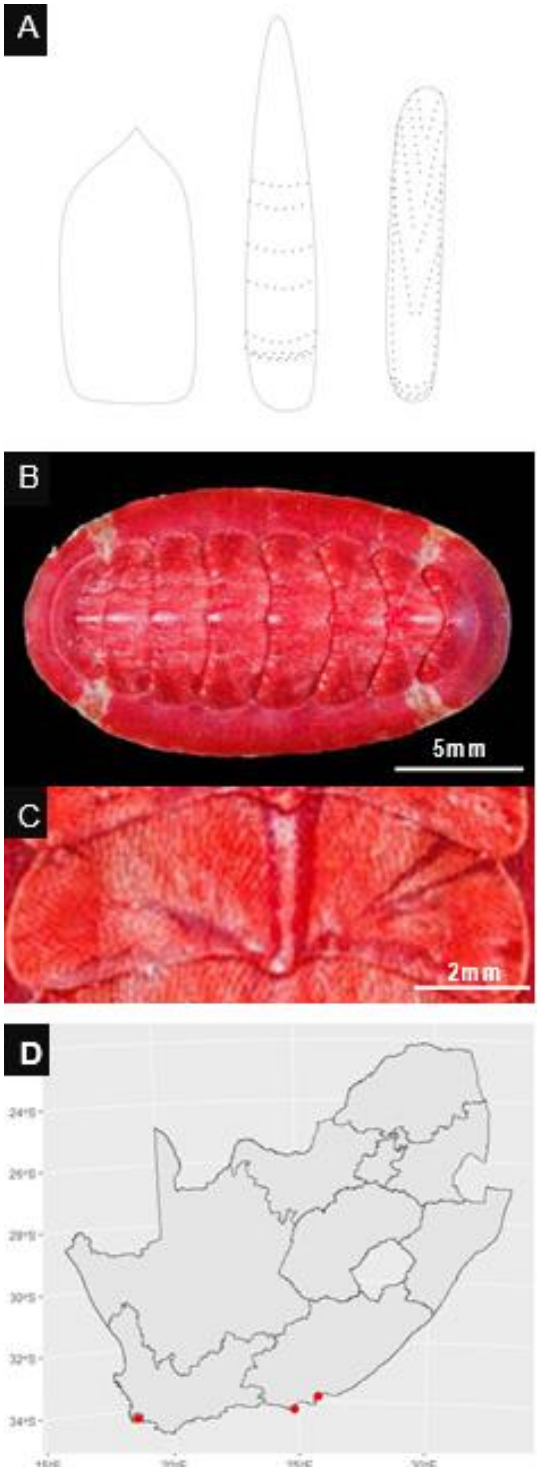

Figure 3.50) *Callochiton jeareyae*: A – Girdle armour; B - Whole specimen (Photo by Renee Els, retouched); C – Intermediate valve (Photo by Renee Els, cropped); D – Distribution in South Africa(endemic).

Chapter 4: Discussion

Though the last monograph of world chitons (Kaas and van Belle, 1985-2006) did not include all families, it is the most recent comparable publication and described a mere 22 species from South Africa, whereas this dissertation has increased the species list to 50 – an increase of 127%. This, however, includes all the families in the EEZ of South Africa. The species described here include some species described for the region prior to the publication of Kaas and van Belle, but not included therein. Also included are species described from the region by other authors subsequent to the monograph's publication. Eight additional species are added in the course of this study based on examination of museum collections.

Many of the regional species, such as *Acanthochitona garnoti, Callochiton dentatus* and *Chaetopleura pertusa,* have a very wide distribution record, while others, from the same genera, have single or extremely limited records, such as *Acanthochitona jugotenuis, Callochiton herberti* and *Chaetopleura pustulata*. In terms of biogeographic distribution, the West Coast exhibits lower species richness. The species here are predominantly concentrated in the Western Cape, while the coast of the Northern Cape Province has been very poorly sampled due to poor access to this remote region. Consequently, in the analysis of Table 4.1., species occurring in the Western Cape and Namibia are expected to also occur in the Northern Cape province. However, this is tentative, as there is no data or certainty of the occurrence, as several weel known species have been found in Namibia and the Western Cape, and are absent in the Northern Cape, such as the brown mussel(*Perna perna*) and the pacific oyster (*Magallana gigas*) (Branch *et al.*, 2016).

The South coast hosts 33 chiton species and stands out as the region with the highest rate of endemism, boasting most of South African endemic species, with 54.5% of the species found on this coast being endemic under current formal species occurrence reports. The slight majority of these South Coast endemics are found in the Eastern Cape, while the Western Cape boasts a notable number of species endemic to just that province (Table 4.1), indicating a localized distribution. Moreover, 34% of South African *endemic* species can *only* be found along the South Coast. These trends

underscore the notion that molluscs tend to exhibit greater species richness as one moves eastward, while the South Coast emerges as a stronghold for endemicity, a concept well-supported by Griffiths *et al*. (2010). His trend is expected since that region is the most distant from political borders.

Despite expectations of higher species diversity on the East Coast, there appears to be a gap in shore sampling in this region, as most records of chitons are from the South Coast, as can be seen in the distribution maps. Singular reports of many species on the East Coast, such as most of the additions, as well as *Chaetopleura pustulata*, suggest potential underrepresentation. Nevertheless, KwaZulu-Natal stands out with the highest overall species richness (32 species - Table 4.1), with exclusive coastal presence reaching almost 50% in the East Coast, although most of these are shared with Mozambique and/or Madagascar, resulting in low endemicity.

The current endemicity percentage for South African chitons, based on formal occurrence reports, stands at 46%, signifying a considerable proportion of species unique to this region. In addition to this, a further 22% of chiton species are endemic to the wider Southern African region, encompassing Mozambique, Namibia, and South Africa. This leaves only 32% of South African chiton species with distributions extending beyond broader Southern African waters. This high level of endemism among chitons can be attributed to their slow-moving nature and a relatively brief pelagic stage during their early development. Consequently, only a limited number of chiton species are cosmopolitan in distribution. Species from KwaZulu-Natal, however, share the same climate of the Tropical Indian Ocean and Madagascar and Mozambique, leading to most species on the Eastern Coast not being endemic but sharing biological attributes to those of these bordering countries, as is commonly seen when moving towards political boundaries, while the South Coast (Western Cape and Eastern Cape) do not share boundaries with other countries, are in their own unique temperate climate of the Southern Ocean and consequently have a high rate of endemicity. The Western and Eastern Cape, which both are in the temperate climate region and house more than 43% of endemic species from South Africa not present in KwaZulu-Natal. Both provinces have more than 50% of the present species endemic, with Eastern Cape having 20 of its present 29 species endemic and the Western Cape having 15 of its 28 species being endemic. By contrast KwaZulu-Natal

has only have 10 of its 32 present species being endemic, t with many of these most probably in fact being present in Mozambique as well, though not yet reported there.

Table 4.1: The presence and endemism of South African chitons by province.

Province	Total number of species	% endemics
NC*	6	33
WC	28	57
EC	29	69
KZN	31	35

Table 1:*Occurrence based on likelihood of occurrence, please see species entries for clarification. NC=Northern Cape; WC=Western Cape; EC=Eastern Cape; KZN= KwaZulu=Natal.

In terms of its taxonomic composition the chiton fauna is dominated by members of the order Chitonida. This is expected, as Chitonida is the largest global order, making up 76.8% of chitons world-wide (data from WoRMS). The local order contribution can be attributed to the remarkable diversity within four of the five largest families within South Africa that fall under the Chitonida. These four families are - Acanthochitonidae, Chaetopleuridae, Chitonidae, and Ischnochitonidae -boast a high species richness (Fig. 4.1). However, in contrast to the other major order, Lepidopleurida, represented by Leptochitonidae, these families currently exhibit relatively lower levels of endemism. Notably, *Dinoplax* as a genus of Acanthochitonidae, however, is the only genus exclusive to Africa, with 50% of its species being endemic to South Africa. The fifth largest family (Tonicellidae), however, falls under Chitonida as well, but has a 100% endemic rate.

Leptochitonidae, however, contains the largest genus in the region, *Leptochiton,* containing eight species. Most of these species are currently only reported from South African waters, but two of these are in question: *L.* hodgsoni, with a possible occurrence in the Gulf of Venice, according to a single (questionable) record on OBIS, as well as *L. sykesi*, thought to also occur in Antarctic waters. As Lepidopleurida is the oldest order, this might be due to a longer divergence timeframe for specializing and adaptation in the group, bearing more distinctive features between species, or just a lack of sampling as most of the species in this group is deep-water inhabitants.

Furthermore, Callochitonidae is the only family in the order Callochitonida, making it the smallest order, yet concurrently the one with

the highest endemism rate, with one family (Callochitonidae) matched only by the family Tonicellidae (Order: Chitonida) at 100% endemism (Fig 4.1). However, two of the three species under Callochitonidae are currently have an uncertain distribution, as Two Oceans (Branch *et al.,* 2016) extends the presence of *C. dentatus* to Namibia and GBIF have a recorded occurrence of *C. herberti* in Madagascar, but no formal reports could be found to confirm these extensions.

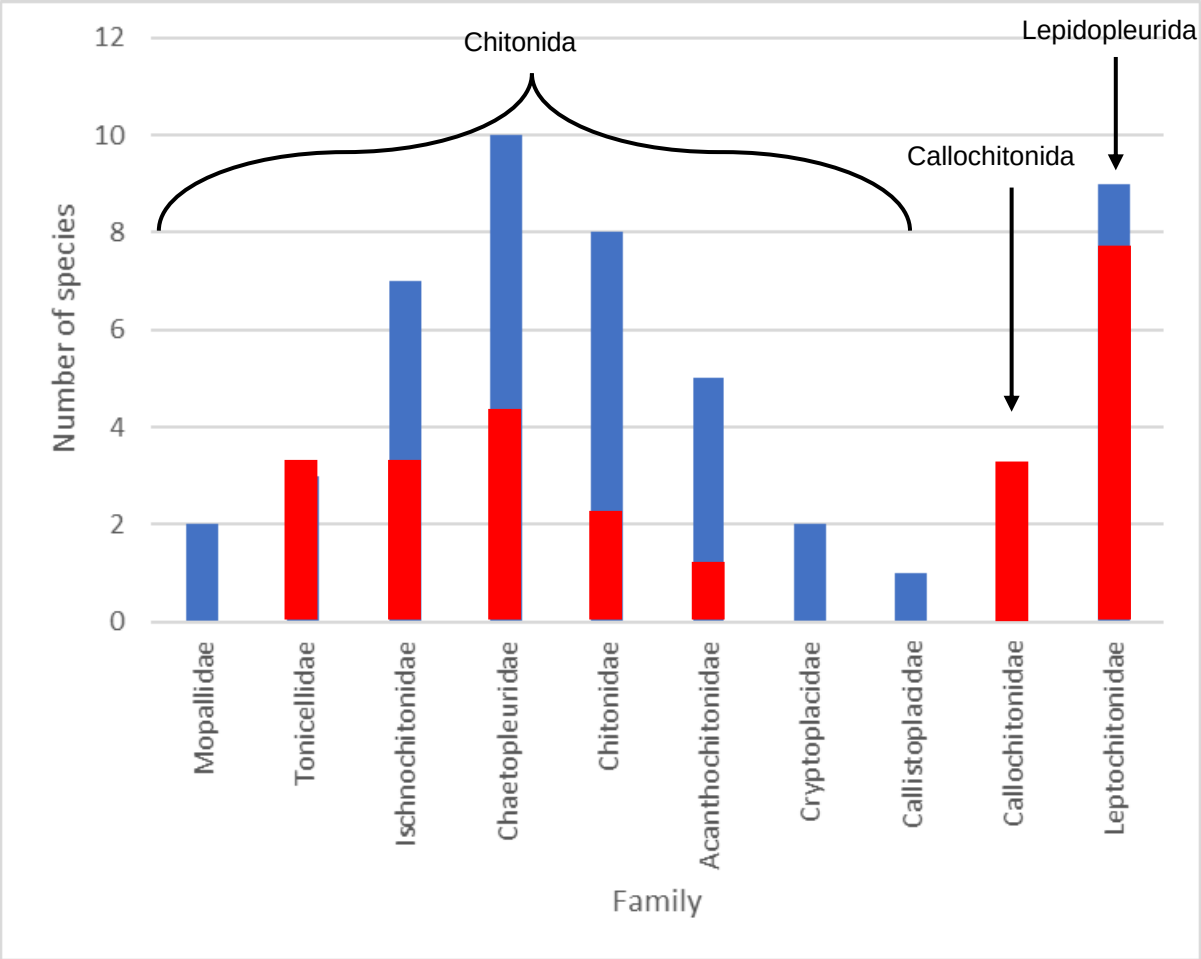

Figure 4.1 Species richness and endemism of chiton species from South Africa by family and order; endemic species shown in red (based on formal reports).

Analysing the fauna with respect to generic composition, the prominent genera within the South African chiton community include *Leptochiton* (eight species), *Ischnochiton* (five), and *Chaetopleura* (five). Following closely are *Dinoplax* with four species, while *Lepidochitona*, *Acanthochitona*, *Craspedochiton*, *Callochiton*, and *Rhyssoplax* encompass three species each. In contrast, *Cryptoplax, Plaxiphora* and *Stenosemus*, both considered uncommon, are represented by only two described local species.

As chitons are better known as intertidal invertebrates, it is expected to see a decline in records in increasing depth. This is evident considering the number of records per species of deepwater chitons, such as seen in *Stenosemus* and *Leptochiton.* Nevertheless, a surprising 14% of the known chiton fauna in South Africa can be found at depths exceeding 30 m. Most of these are in the deepwater genus *Leptochiton*, where *L. chariessa*, *L. dispersus* and *L. meiringae* all only occur between 70-100m, while *L. sykesi* has been found at 110m and *L. permodestus* in far deeper waters between 390-400m. The genus *Stenosemus* accompanies *Leptochiton* here at depths of 100-110m where *S. merveae* occur, while *S. simplicissimus* can occur up to a depth of 1064m. These genera are known to be deep water chitons. There is, however, an odd record of the genus *Chaetopleura*, from 280m, although this species is known from the intertidal to subtidal zone. This report is suspect and could be a mistaken locality of specimen collection. Nonetheless, a relatively high species richness in the deeper waters of South Africa is suggested, although records are scarce, which might rather be due to a lack of collection and accessibility instead of a lack of presence, as diverse deep sea chiton communities have been described (Schwabe, 2008).

The newly added fauna in this study are all reported from within the intertidal and/or subtidal zones. Sampling challenges persist at greater depths, largely due to elevated costs and inaccessibility without specialized equipment. However, the discovery of numerous endemic species in deeper South African waters underscores the potential for extensive findings within the deep-water chiton fauna in the years to come, as more samples are collected. Together with a basic guide providing identification of shore samples, a likelihood of an upsurge in chiton species descriptions in the foreseeable future persists, provided efforts be coordinated to explore these regions and secure funding for sample collections by both governmental entities, as well as curious amateur shore explorers or taxonomists.

Efforts by organizations like the NMSA and IZIKO museums to increase collection field trips are encouraging, and as these samples are systematically sorted, it is anticipated that new chiton species will be uncovered. There is, however, a noticeable gap in the knowledge of chiton fauna on the West Coast. Whether this gap results from a genuine absence of species, or a deficiency in sample collections due to inaccessibility of the

coast, further investigation is warranted to elucidate the reasons behind the scarcity of chiton data. This may suggest a comparatively low diversity of Polyplacophorans on the West coast, potentially aligning with the expectation that these animals prefer warmer tropical waters (Griffiths *et al*., 2010).

In terms of conservation chitons are little exploited although some spcies in KwaZulu-Naltal are collected for use in traditional medicine. Anthropogenic influences, notably climate change and rising sea levels, probably pose more significant challenges. These changes can lead to habitat alterations and disruptions, potentially displacing or disturbing species, both through recreational and constructive activities. In many cases, there is a capacity gap for law enforcement within coastal Marine Protected Areas (MPAs), especially in a developing country like South Africa. As a result, the onus for protection and exploration often falls on the shoulders of the local citizens. Science communication is therefore of the utmost importance.

Jonathan Wojcik's quote encapsulates these unique creatures: Chitons are akin to …”armoured slugs from the dawn of time, with stones for eyes and magnets for teeth. We're lucky they're so slow, small and harmless - I'm pretty sure they only exist as a stern warning to us all of what mother nature is capable of”.

In conclusion, South Africa’s chiton fauna, currently comprises 50 described species, showcases an intriguing blend of documented records, museum discoveries, and newfound species. This expanded knowledge reveals a considerably higher diversity than previously reported. It opens a promising avenue for further research on this fascinating taxon within the region, offering substantial opportunities for exploration and study, leaving one to wonder how many groups are still in need of discovery.

Bibliography

Adams, H. and Adams, A. (1853-1858). *The genera of Recent Mollusca; arranged according to their organization*. London, van Voorst. Vol. 1: xl + 484 pp.; vol. 2: 661 pp.; vol. 3: 138 pls. [Published in parts: Vol. 1: i-xl (1858), 1-256 (1853), 257-484 (1854). Vol. 2: 1-92 (1854), 93-284 (1855), 285-412 (1856), 413-540 (1857), 541-661 (1858). Vol. 3: pl. 1-32 (1853), 33-72 (1954), 73-96 (1855), 97-112 (1856), 113-128 (1857), 129-138 (1858)].

Adams, H. (1867). Descriptions of six new species of shells, and note on *Opisthostoma de-Crespignii*. *Proceedings of the Zoological Society of London*, 1866: 445–447.

Ashby, E. (1919). Notes on Australian Polyplacophora, including descriptions of two new genera, a new variety, and the description and proposed recognition of Mr Bednall's *Stenochiton pilsbryanus*. *Transactions and Proceedings of the Royal Society of South Australia*, 43: 66-73, pl. 11.

Ashby, E. (1928). South African chitons, being a description of the Polyplacophora represented in the Turton collection. *Proceedings of the Malacological Society of London*, 18(2): 76-92.

Ashby, E. (1931). Monograph of the South African Polyplacophora (chitons). *Annals of the South African Museum*, 30: 1–59.

Barbut, J. (1788). *The genera vermium of Linnæus part 2d. Exemplified by several of the rarest and most elegant subjects in the orders of the Testacea, Lithophyta, and Zoophyta Animalia, accurately drawn from nature. With explanations in English and French.* London. (White). pp. i-xxvii; 1-76, Tab. I-XIV.

Barnard, K.H. (1963). Contributions to the knowledge of South African marine Mollusca. Part IV. Gastropoda: Prosobranchiata: Rhipidoglossa, Docoglossa, Tectibranchiata, Polyplacophora, Solenogastres, Scaphopoda. *Annals of the South African Museum*, 47: 201–360.

Bartsch, P. (1915). Report on the Turton Collection of South African marine mollusks, with additional notes on other South African shells contained in the United States National Museum. *Bulletin, United States National Museum,* 91: xii + 305 pp., 54 plates.

Bergenhayn, J. R. M. (1930). Die Loricated von Dr. Sixten Bocks Pazifik-Expedition 1917-1918, mit spezieller berucksichtigung der perinotumbildungen und der schalenstruktur. *Goteborgs Kungliga Vetenskaps*, 1(12), 1-46.

Bergenhayn, J. R. M. (1955). Die fossilen schwedischen Loricaten nebst einer vorläufigen revision des systems der ganzen klasse Loricata. *Lunds Universitets Årsskrift, Neue Folge Adv. 2*, 51(8): 1-41.

Berry, S. S. (1919). Notes on West American chitons - II. *Proceedings of the California Academy of Sciences ser. 4*, 9(1): 1-36, pls 1-8.

Beu, A. G. (1967). Notes on New Zealand chitons (Mollusca, Amphineura). *New Zealand Journal of Marine and Freshwater Research,* 1: 475-481.

Blainville, H. M. D. de (1825). *Dictionnaire des Sciences Naturelles (*F. Cuvier*, ed.),* vol. 36. Levrault, Strasbourg & Paris, & Le Normant, Paris. Pp 519-555.

Bouchet, P., Decock, W., Lonneville, B., Vanhoorne, B., and Vandepitte, L. (2023). Marine biodiversity discovery: the metrics of new species descriptions. *Frontiers in Marine Science*, 10: 929-989.

Branch G., Griffiths C., Branch M. and Beckley L. (2016). *Two Oceans*, ed. 4. Cape Town: Struik Nature. 464 pp.

Bullock, R.C. (1972). Notes on the genus *Chiton* in the western Indian Ocean (Mollusca: Polyplacophora). *Occasional Papers on Mollusks*, 3(44), 237-251.

Bullock R.C. (1988). The genus *Chiton* in the New World (Polyplacophora: Chitonidae). *The Veliger,* 31:141–191.

Carpenter, P. P. (1864). Supplementary report on the present state of our knowledge with regard to the Mollusca of the West Coast of North America. *Reports of the British Association for the Advancement of Science,* 33: 517-686.

Clessin, S. (1843-1904). Die familie Chitonidae. *Systematisches Conchylien-Cabinet von Martini und Chemnitz,* 6 (4): 1-135.

Cotton, B. C. and Weeding, B. J. (1939). Flindersian Loricates. *Transactions of the Royal Society of South Australia,* 63(2): 180-199.

Dall, W. H. (1882). On the genera of chitons. *Proceedings of the United States National Museum*, 4: 279-291.

Dall, W. H. (1889). A preliminary catalogue of the shell−bearing marine mollusks and brachiopods of the southeastern coast of the United States, with illustrations of many of the species. *Bulletin of the U. S. Natural Museum,* 37: 1−221.

Dall, W. H. (1919). Descriptions of new species of chitons from the Pacific Coast of America. *Proceedings of the United States National Museum*, 55(2283): 499-516.

Dall, W. H. (1878). Descriptions of new forms of molluscs from Alaska contained in the collections of the National Museum. *Proceedings of the United Stated National Museum,* 1(1): 1-3.

Dall, W. H. (1879). Report on the limpets and chitons of the Alaskan and Arctic

regions, with descriptions of genera and species believed to be new. *Proceedings of the United States National Museum*, 1: 281-344.

Dall, W. H. (1882). On the genera of chitons. *Proceedings of the United States National Museum*, 4: 279-291.

Dell'Angelo, B., Bonfitto, A., Taviani, M. and Sabelli, B. (2004). Chitons (Mollusca, Polyplacophora) from bioclastic sands of the Ifaty-Tuléar back reefs (Madagascar, Western Indian Ocean). *Società Italiana di Malacologia Bollettino Malacologico*, Suppl. 5, 45–62.

Dell'Angelo, B. and Misfud, C. (1998). *Callochiton jearyae*, a new species from South Africa (Mollusca, Polyplacophora). *Bollettino Malacologico,* 33: 25–28.

Dell'Angelo, B; and Oliverio, M. (1998). A new polyplacophoran subgenus for the Northeast Atlantic (Ischnochitonidae: Callistoplacinae). *Bollettino Malacologico,* 32: 145–150.

Dell'Angelo, B., Prelle, G., Sosso, M. and Bonfitto, A. (2011). Intertidal chitons (Mollusca: Polyplacophora) from southern Madagascar. *African Invertebrates*, *52*(1): 21-37.

Dell'Angelo, B. and Smriglio, C. (1999). *Chitoni viventi del Mediterraneo*. Evolver.

Dell'Angelo, B., Landau, B.M., Sosso, M., and Taviani, M. (2020). Late Pleistocene Red Sea Mollusca:1. Polyplacophora. *Zootaxa*, 4772(3), 401-449.

Eernisse D.J. (1998). Class Polyplacophora. In: *Taxonomic atlas of the benthic fauna of the Santa Maria basin and western Santa Barbara channel. The Mollusca Part 1 – The Aplacophora, Polyplacophora, Scaphopoda, Bivalvia and Cephalopoda*. Santa Barbara Museum of Natural History, 8: 49-73.

Fernandez, C.Z., Vendrasco, M.J. and Runnegar, B., 2007. Aesthete canal morphology in twelve species of chiton (Polyplacophora). *The Veliger*, *49*(2): 51-69.

Ferreira, A. J. (1983). Researches on the coast of Somalia. The chiton fauna (Mollusca Polyplacophora). *Monitore Zoologico Italiano*, 9: 249–297.

Fischer, P. (1880-1887). *Manuel de conchyliologie et de paléontologie conchyliologique, ou histoire naturelle des mollusques vivants et fossiles suivi d'un Appendice sur les Brachiopodes* (Oehlert, D. P. and Woodward, S. P. *ed*). Paris: F. Savy. 1-11: xxiv + 1369 pp., 23 pls.

Gmelin, J. F. (1791). Vermes. In: *Linnaeus Caroli a Linnaei Systema Naturae per Regna Tria Naturae, Tome 1(6).* (Beer, G. E. *ed.*). Lipsiae [Leipzig]. 3021-3910 pp.

Gray, J. E. (1821). A natural arrangement of Mollusca, according to their internal structure. *London Medical Repository*, 15(87): 229–239.

Gray, J. E. (1828-1830). *Spicilegia zoologica; or, original figures and short systematic descriptions of new and unfigured animals*. Treüttel, Würtz & Co. & Wood. Parts I & II: part I, 1–8, pls. 1–6 (1 July 1828); part II, 9–12, pls. 7–11 (August 1830).

Gray, J. E. (1847). A list of the genera of recent Mollusca, their synonyms and types. *Proceedings of the Zoological Society of London,* 15: 129-219.

Griffiths, C. L., Robinson, T. B., Lange, L. and Mead, A. (2010). Marine biodiversity in South Africa: An evaluation of current states of knowledge. *Plos One*, 5(8): 1-13.

Gutt, J., Sirenko, B. and Arntz, W. (2000). Biodiversity of the Weddell Sea: macrozoobenthic species (demersal fish included) sampled during the expedition ANT XIII/3 (EASIZ I) with *RV Polarstern*. *Berichte zur Polarforschung (Reports on Polar Research)*, 372:1-103.

Hedley, C. and Hull, A. F. B. (1912). The Polyplacophora of Lord Howe and Norfolk Islands. *Proceedings of the Linnean Society of New South Wales*, 37: 271-281, pls 11-13.

Herbert, D.G., Hamer, M.L., Mander, M., Mkhize, N. and Prins, F., 2003. Invertebrate animals as a component of the traditional medicine trade in KwaZulu-Natal, South Africa. *African Invertebrates*, *44*(2), pp.1-18.

Herbert, D.G., Jones, G.J., and Atkinson, L.J. (2018). Phylum Mollusca. In: Atkinson, L.J. and Sink, K.J. (eds) *Field Guide to the Offshore Marine Invertebrates of South Africa*. Malachite Marketing and Media: Pretoria. Pp. 249–320.

Herrmannsen, A. N. (1846-1852). *Indicis Generum Malacozoorum primordia*. Fischer, Cassel. Vol. 1: i-xxviii, 1-637 pp.; Vol. 2: 1-717, xxix-xlii pp.; Supplementa et corrigenda: i-v, 1-140 pp.

Ibáñez, C. M.; Pardo-Gandarillas, M. C.; Méndez, M. A.; Sellanes, J.; Sigwart, J. D. and Sirenko, B. (2021). Phylogenetic position and morphological descriptions of Chiton species from the south-eastern Pacific. *Zoological Journal of the Linnean Society.* 191(3): 695-719.

Iredale, T. (1914). The chiton fauna of the Kermadec Islands. *Proceedings of the Malacological Society of London*, 11(1), 25-51.

Iredale, T. and May, W. L. (1916). Misnamed Tasmanian chitons. *Proceedings of the Malacological Society of London,* 12: 94-117, pls 4-5.

Iredale, T. and Hull, A. F. B. (1923-1927). A monograph of the Australian loricates. I-IX. *Australian Zoologist,* 3(5): 186-194.

Kaas, P. (1979). The Chitons (Mollusca: Polyplacophora) of Mozambique. *Annals of the Natal Museum*, 23: 855-879.

Kaas, P. and van Belle, R. A. (1985-2006). *Monograph of living chitons (Mollusca: Polyplacophora)*. Volume 1-6: Brill, Netherlands.

Vol. 1. Order Neoloricata: Lepidopleurina (1985).

Vol. 2. Suborder Ischnochitonina. Ischnochitonidae: Schizoplacinae, Callochitoninae & Lepidochitoninae (1985).

Vol. 3. Suborder Ischnochitonina. Ischnochitonidae: Chaetopleurinae & Ischnochitoninae (pars) (1985). Additions to Vols 1 & 2 (1987).

Vol. 4. Suborder Ischnochitonina. Ischnochitonidae: Ischnochitoninae (continued). Additions to Additions to Vols 1, 2, and 3. 1996. Pp. 298.

Vol. 5. Suborder Ischnochitonina:Ischnochitonidae:Ischnochitoninae (concluded), Callistoplacinae, Mopaliidae. 2006. Additions to Vols 1, 2, 3, and 4.

Vol. 6. Kaas P., Van Belle R.A. & Strack H. 2006. Suborder Ischnochitonina (concluded); Schizochitonidae & Chitonidae, additions to volumes 1-5. 464 pp.

Kaas, P. (1985). Notes on Loricata, 11-14. *Zoologische Mededelingen, Leiden*, 59(25): 299-320.

11. New species of *Leptochiton* Gray, 1847 dredged off East London and Transkei, South Africa.

12. *Ischnochiton obtusus* Carpenter in Pilsbry, 1895, rediscovered.

13. On some little known chitons from the Tropical West Pacific Ocean.

14. *Ischnochiton (Stenosemus) vanbellei spec. nov*., a new Mediterranean chiton.

Kaas, P. (1986). Revision of the chitons (Mollusca: Polyplacophora) from the coral-reefs of Tulear, SW Madagascar, and of the Mascarene Islands. *Mesogee*, 46, 9-23.

Kaas, P. and Knudsen, J. (1992). Lorentz Spengler's descriptions of chitons (Mollusca Polyplacophora). *Zoologische mededelingen,* 66(3): 49-90.

Kaas P. (1996). Chitons (Mollusca: Polyplacophora) from the Seychelles with description of a new species. *Zoologische Mededelingen*, 70(25): 367-375.

Kilburn, R.N. and Rippey, E. (1982). *Sea shells of Southern Africa*. Macmillan South Africa, Johannesburg.

Koch, H. (1951). A new chiton from South Africa. *Journal of Molluscan Studies*, 28(6): 211-212.

Krauss, F. (1848). *Die südafrikanischen Mollusken: ein beitrag zur kenntniss der Mollusken des Kap-und Natallandes und zur geographischen verbreitung derselben, mit beschreibung und abbildung der neuen Arten*. Ebner & Seubert.

Kyle, R., Pearson, B., Fielding, P.J., Robertson, W.D. and Birnie, S.L., 1997. Subsistence shellfish harvesting in the Maputaland marine reserve in northern KwaZulu-Natal, South Africa: rocky shore organisms. *Biological Conservation*, *82*(2), pp.183-192.

Lamarck, J.-B. M. de. (1819). *Histoire naturelle des animaux sans vertèbres*. Tome 6(1): vi + 343 pp. Paris: published by the author.

Leloup, E. 1942. Contributions a` la connaissance des polyplacophores. 1. Famille Mopaliidae Pilsbry, 1892. *Me ´moirs du Muse ´e Royal d'Histoire Naturelle de Belgique*, (2)25:1–64, pls. 1–6.

Leloup, E. (1952). Polyplacophores de l'Océan Indien et des côtes de l'Indochine Française. *Mémoires de l'Institut Royal des Sciences Naturelles de Belgique, deuxième série*, (2)47: 1-69.

Leloup, E. (1965). Description d'une espèce nouvelle de chiton recueillie par la Calypso dans le Golfe de Guinée, *Notoplax foresti* sp. nov. *Bulletin du Muséum national d'Histoire naturelle,* 2(37): 155–161.

Leloup, E. (1980). Chitons de la Mer Rouge, du golfe de Suez et de la Méditerranée. *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique*, 52(1): 1–14.

Leloup, E. (1981). Chitons de Tuléar, Réunion, Maurice et Tahiti. *Bulletin de l'Institut royal des Sciences naturelles de Belgique: Biologie*, 53(3), 1-46.

Linnaeus, E. (1758). Systema Naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. *Editio decima, reformata*, 10(1): 824 pp. Laurentius Salvius: Holmiae.

Linnaeus, C. (1767). *Systema naturae per regna tria naturae: secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis*. Ed. 12. 1., Regnum Animale. 1 & 2. Holmiae [Stockholm], Laurentii Salvii. pp. 1-532 [1766] pp. 533-1327.

Linse, K.; Barnes, D. K. A. and Enderlein, P. (2006). Body size and growth of benthic invertebrates along an Antarctic latitudinal gradient. *Deep-Sea Research II,* 53: 921-931.

Liu, J.Y. [Ruiyu] (ed.). (2008). *Checklist of marine biota of China seas*. China Science Press. 1267 pp.

Mackay, J. S. (1933). A new loricate from north Queensland. *Australian Zoologist,* 7: 345-348.

Middendorff, T.A. (1847). Beiträge zu einer Malakozoologia Rossica. *Mémoires de l'Académie Impériale des Sciences de Saint Pétersbourg. Sciences Mathématiques, Physiques et Naturelles. 2e Partie, Sciences Naturelles*, 6(1): 67-200 [offprint 1-151], pls 1-14.

Muratov, I. V. (2014). Primary types in the collection of molluscs in the KwaZulu-Natal Museum: Polyplacophora. *African Invertebrates*, 55(2), 377-412.

Nardini, S. (1934). Molluschi delle spiagge emerse del Mar Rosso e dell'Oceano Indiano. *Palaeontographia Italica,* 34: 171-267, pls 14-18.

Nierstrasz, H. F. (1906). Beiträge zur Kenntnis der fauna von Süd-Afrika. VI. Chitonen aus der Kapkolonie [sic] und Natal. *Zoologische Jahrbücher, Abteilung für Systematik, Geographie und Biologie der Tiere*, 23: 487–520.

Opinion 951. (1971). *Rhyssoplax* Thiele, 1893 (Amphineura): Designation of a type-species under the Plenary Powers. *Bulletin of Zoological Nomenclature*, 28(1), 18-19.

Pilsbry, H. A. (1892-1893). *Manual of conchology, structural and systematic, with illustrations of the species. Ser. 1. Vol. 14: Polyplacophora (Chitons). Lepidopleuridae, Ischnochitonidae, Chitonidae, Mopaliidae*. pp i-xxxiv, 1-350, pls 1-40. Conchological Section, Academy of Natural Sciences, Philadelphia.

Pilsbry, H. A. (1894). Notices of new chitons, II. *The Nautilus*, 7(10).

Plate, L. H. (1898-1901). Die anatomie und phylogenie der chitonen. Fauna Cjilensis. *Zoologische Jahrbücher*, 2: 15-216.

Poli J.X. (1791). *Testacea utriusque Siciliae eorumque historia et anatome tabulis aeneis illustrata.* Ex Regio Typographeio, Parmae. Vol. 1: pp. i-lxxiii, [1-6], i-x, 1-90, 1-50, [1], 1-74, pls 1-18.

Quoy, J. R. C. and Gaimard, J. P. (1832-1835). *Voyage de la corvette l'Astrolabe: exécuté par ordre du roi, pendant les années 1826-1829, sous le commandement de M. J. Dumont d'Urville. Zoologie.* Paris, J. Tastu, Éditeur-Imprimeur.

Rafinesque, C. S. (1815). *Analyse de Nature, ou Tableau de l'Univers et des Corps Organisés*. Palermo: Jean Barravecchia.

Reeve, L. A. (1847). *Monograph of the genus Chiton*. In:*Conchologia Iconica; or, illustrations of the shells of molluscous animals*, vol. 4, pls 1-33 and unpaginated text. L. Reeve & Co., London.

Reyes-Gómez, A., Ortigosa, D. and Simões, N. (2017). Chitons (Mollusca, Polyplacophora) from Alacranes Reef, Yucatan, Mexico.

ZooKeys, 665: 1-36.

Risso, A. (1826-1827). *Histoire naturelle des principales productions de l'Europe Méridionale et particulièrement de celles des environs de Nice et des Alpes Maritimes*. Paris, F.G. Levrault. 3(XVI): 1-480, 14 pls.

Rochebrune A.T. de. (1881). Diagnoses d'espèces nouvelles de la famille des Chitonidae. *Bulletin de la Société Philomatique de Paris,* (7) 5: 115–121.

Saito, H. and Okutani, T. (1991). Taxonomy of Japanese species of the genera *Mopalia* and *Plaxiphora* (Polyplacophora: Mopaliidae). *The Veliger*, 34(2), 172-194.

Saito, H. (2006). Shallow water chitons (Mollusca: Polyplacophora) from Puerto Galera, Mindoro Island, the Philippines. *Memoirs of the National Science Museum*, 44, 119-133.

Sars, G. O. (1878). *Bidrag til Kundskaben om Norges arktiske Fauna. I. Mollusca Regionis Arcticae Norvegiae. Oversigt over de i Norges arktiske Region Forekommende Bløddyr.* Brøgger: Christiania, xiii + 466 pp., pls 1-34 & I-XVIII.

Schwabe, E. (2006). Taxonomic notes on chitons. On some species of *Chaetopleura* from South Africa (Mollusca: Polyplacophora: Ischnochitonidae). *African Invertebrates*, 47(1), 23-30.

Schwabe, E. (2008). Discovery of the South African polyplacophoran *Stenosemus simplicissimus* (Thiele, 1906) (Mollusca, Polyplacophora, Ischnochitonidae) in the Southern Ocean. *American Malacological Bulletin*, 24(1), 71-77.

Schwabe, E. (2010). Illustrated summary of chiton terminology. *Spixiana*, 33(2), 171-194.

Schwabe, E. and Sellanes, J. (2010). Revision of Chilean bathyal chitons (Mollusca: Polyplacophora) associated with cold-seeps, including description of a new species of Leptochiton (Leptochitonidae). *Organisms Diversity & Evolution*, 10:31-55.

Schwabe, E. and Els, R. (2019). The genus *Craspedochiton* (Mollusca: Polyplacophora: Acanthochitonidae) in South African waters: what do we really know about it? *Archiv für Molluskenkunde*, 148(1), 73-92.

Selli, R. (1974 ["1973"]). Molluschi quaternari di Massaua e di Gibuti. In: *Missione geologica dell'Azienda Generale Italiana Petroli (A.G.I.P.) nella Dancalia meridionale e sugli altipiani hararini (1936-1938)*. Documentazione Paleontologica, Academia Nazionale dei Lincei, 4(2), 151-444.

Shuttleworth, R. J. (1853). Über den Bau der Chitoniden, mit Aufzählung der die Antillen und die Canarischen Inseln bewohnenden Arten. *Mittheilungen der Naturforschenden Gesellschaft Bern,* 1: 169-207.

Sigwart J.D. and Sirenko B.I. (2012). Deep-sea chitons from sunken wood in the West Pacific (Mollusca: Polyplacophora: Lepidopleurida): taxonomy, distribution, and seven new species. *Zootaxa* 3195: 1-38.

Sigwart, J.D., Schwabe, E., Saito, H., Samadi, S. and Giribet, G. (2011). Evolution in the deep sea: a combined analysis of the earliest diverging living chitons (Mollusca: Polyplacophora: Lepidopleurida). *Invertebrate Systematics*, 24(6), 560-572.

Simroth, H. (1892-1894). *Dr. H.G. Bronn's Klassen und Ordnungen des Thier-Reichs, wissenschaftlich dargestellt in Wort und Bild*. Bd. 3, Mollusca, Abt. 1: Amphineura und Scaphopoda. Leipzig: Winter. 467 pp., pls 1-22.

Sirenko, B. and Hayes, B., 1999. A n. sp. of *Lepidochitona* (Mollusca, Polyplacophora) from South Africa. *Ruthenica*, *9*:81-86.

Sirenko, B. (2000). A new and unusual species of *Parachiton* (Mollusca: Polyplacophora) from South Africa. *African Zoology*, 35(1): 93–98.

Sirenko, B. and Schwabe, E. (2002). Taxonomic notes on chitons. 2. Taxonomic status of chitons of the *Ischnochiton oniscus* group (Mollusca, Polyplacophora, Ischnochitonidae). *Spixiana*, *25*(3): 193-198.

Sirenko, B.I. and Gallardo, C. (2005). Chitons (Polyplacophora) of Chile. In *Poster Abstracts of the IVth International Congress of the European Malacological Societies*: 5-8.

Sirenko, B. (2006)a. New outlook on the system of Chitons (Mollusca: Polyplacophora). *Venus*, 65(1-2), 27-49.

Sirenko, B. (2006)b. Report on the present state of our knowledge with regard to the chitons (Mollusca: Polyplacophora) of the Magellan Strait and Falkland Islands. *Venus*, 65, 81–89.

Sirenko, B. I. (2012). Chapter 2: Chitons (Mollusca, Polyplacophora) of Nhatrang Bay, South Vietnam. pp. 56–122 [In] *Britayev, T. A. & Pavlov, D. S. Benthic fauna of the Bay of Nhatrang, Southern Vietnam.* Moscow : KMK Scientific Press Ltd. Vol.2 491 pp.

Sirenko, B. (2015). Shallow and deep-sea chitons of the genus *Leptochiton* Gray, 1847 (Mollusca: Polyplacophora: Lepidopleurida) from Peruvian and Chilean waters. *Zootaxa*, 4033(2), 151-202.

Sirenko, B. (2016). A new South African *Leptochiton* (Mollusca: Polyplacophora: Lepidopleurida). *Ruthenica*, 26(3-4), 145-151.

Sirenko, B.I., and Saito, H. (2017). New species of chitons of the superfamily Cryptoplacoidea (Mollusca: Polyplacophora) from Vietnamese waters. *Zootaxa*, 4299(4), 451-506.

Sirenko, B. (2023). Chitons of the genus *Lepidochitona* (Mollusca: Polyplacophora) in the Indian Ocean and ordering of species compositions of some genera of the subfamily Tonicellinae. *Zootaxa,* 5228(3): 292-316.

Sirenko, B and Dell'Angelo, B.. 2024. First species of the genus *Plaxiphora* Gray, 1847 (Mollusca: Polyplacophora) from the Paleocene of Europe. *Proceedings of the Zoological Institute RAS*, *328*(3):379-383.

Slieker, F.J.A. (2000). *Chitons of the world. An illustrated synopsis of recent Polyplacophora*. Mostra Mondiale Malacologia: Cupra Marittima, Italy. Pp. i–vi, 1–154.

Smith, E. A. (1903). A list of species of Mollusca from South Africa, forming an appendix to G. B. Sowerby's "Marine shells of South Africa." *Proceedings of the Malacological Society of London*, 5(6), 354-402.

Smith, E. A. (1910). On South African marine Mollusca with descriptions of new species. *Annals of the Natal Museum,* 2: 175-220, pls 7-8.

Sowerby, G. B. 1832. *The Conchological Illustrations or, Coloured Figures of All the Hitherto Unfigured Recent Shells*. London: [s.n.].

Sowerby, G. B. III. (1892). *Marine shells of South Africa. A catalogue of all the known species with references to figures in various works, descriptions of new species, and figures of such as are new, little known, or hitherto unfigured*, London: G. B. Sowerby. 89 pp., 5 pls.

Sowerby, G. B. III. (1903). Mollusca of South Africa. *Marine Investigations in South Africa.* 2(3): 213-232, pls 3-5.

Spalowsky, A. 1795. *Prodromus in Systema Historicum Testaceorum*. Vienna: Ignaz Alberti's Widow. 1-13, i-iv, 1-88, i-xii pp., 13 pls.

Spengler, L. (1797). Udforlig beskrivelse over det mangeskallede konkylie-slaegt, af Linneus kaldet Chiton; med endeel nye arter og varieteter. *Skrivt, naturh. Selsk.*, 4: 62-106, pl. 6.

Strack, H.L. (1993). The Polyplacophora of the Red Sea. *Journal of the Malacological Society of Australia*, 14: 1-40.

Strack, H. L. (1996). Report on a collection of South African chitons, including the description of a new *Lepidozona* species. *Basteria*, 59, 127-133.

Sykes, E. R. (1898). Note on *Ischnochiton oniscus* Krauss and *I. elizabethensis* Pilsbry. *The Nautilus,* 12(4): 41-42.

Sykes E. R. (1899). On *Dinoplax fossus*, n. sp., and *Chiton crawfordi*, n. sp., from South Africa. *Proceedings of the Malacological Society of London.* 3(5): 277-279.

Sykes, E. R. (1901). Description of *Onithochiton (?) isipingoensis*, n.sp., from South Africa. *Proceedings of the Malacological Society of London.* 4(6): 259.

Sykes, E. R. (1902). Description of *Chaetopleura destituta,* n. sp., from South Africa. *Proceedings of the Malacological Society of London,* 5: 195.

Sykes, E.R. (1907). Reports on the marine biology of the Sudanese Red Sea. 5. On the Polyplacophora or chitons. *Zoological Journal of the Linnean Society London,* 31:31-34.

Taki, I. (1954). A peculiar chiton from Hachijo-jima with special reference to its distribution in the Pacific. *Records of the Oceanographic Works, Japan,* 1: 60-65.

Thiele, J. (1891-1893). [continuation of F.H. Toschel] *Das Gebiss der Schnecken zur Begründung einer natürlichen Classification*, 2: 249-334 [1891]; 337-409, i-ix [1893].

Thiele, J. (1906). Ueber die Chitonen der deutschen Tiefsee- expedition. *Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer "Valdivia" 1898-1899.* 9(2): 325-336, pl. 29.

Thiele, J. (1909). Revision des systems der Chitonen. *Zoologica [Stuttgart]*, 22, 1-70.

Thiele, J. (1928). Arktische Loricaten, Gastropoden, Scaphopoden und Bivalven. *Fauna Arctica,* 5: 561-632.

Tiberi, N. (1877). Fam. Chitonidi. Specie viventi Mediterranee e fossili Terziarie Italiene. *Bullettino della Societa Malacologica Italiana,* 3: 136-159.

Turton, W. H. (1932). *The marine shells of Port Alfred S. Africa*. Humphrey Milford, London. pp. i-xvi, 1-331, pls 1-70.

Van Belle, R. A. (1983). The systematic classification of the chitons (Mollusca: Polyplacophora). *Informations de la Societe Belge de Malacologie*, 11: 1-178.

Van Belle, R.A. (1988). De Europese keverslakken (Polyplacophora). *Vita Marina*, 1: 9-132.

Van Belle, R.A. and Wranik, W. (1991). Chitons (Mollusca: Polyplacophora) from the coasts of Yemen and Socotra Island. *Fauna of Saudi Arabia*, 1:366-381.

Varney, R.M., Speiser, D.I., Cannon, J.T., Aguilar, M.A., Eernisse, D.J. and Oakley, T.H. (2024). A morphological basis for path-dependent evolution of visual systems. *Science*, *383*(6686):983-987.

Vaught, K.C.; Abbott, R.T. and Boss, K.J. (1989). *A classification of the living Mollusca*. American Malacologists: Melbourne. ISBN 0-915826-22-4. XII, 195 pp.

Vélain C. (1877). Observations générales sur la faune des deux iles [Saint-Paul et Amsterdam] suivies d´une description des mollusques. *Archives de Zoologie Expérimentale et Générale,* 6: 1-144, pls 1-5.

Wood, W. (1815). *General conchology or a description of shells, arranged according to the Linnean system*. London, John Booth. Vol. 1, lxi + 7 + 246 pp., 60 pl.

World Register of Marine Species. (Date of access: 18 Oct. 2023). [Online Resource]. Available at: https://www.marinespecies.org/index.php

Yakovleva, A. M. (1952). [in Russian] *Shell-bearing Mollusks (Loricata) of the seas of the USSR. Fauna USSR no. 45:* 107 pp, 53 figs., 11 pls. Zoological Institute, Academy of Sciences of the USSR, Moscow.