ASTROPECTEN OF THE MEDITERRANEAN SEA

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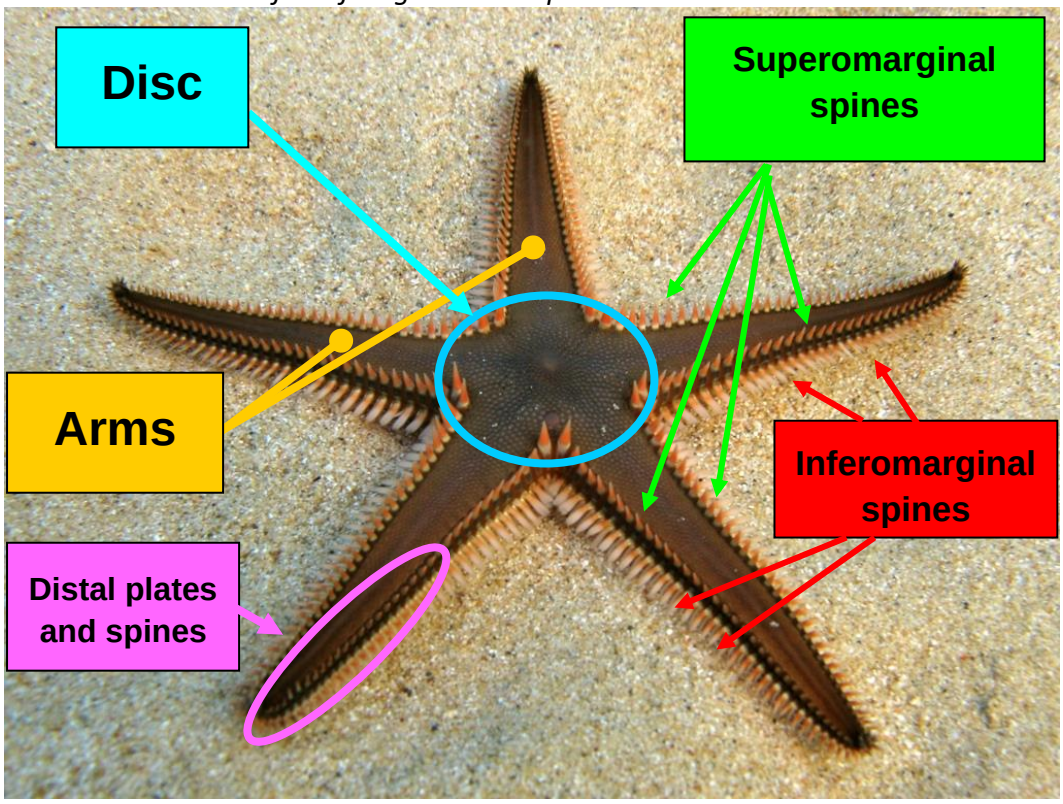
The starfishes of genus *Astropecten* live on mobile seabed (sandy, muddy or gravel seabed) and they remain usually buried under sediment during the day. In the late afternoon and the night them go out to hunt mainly bivalve molluscs, which are their favourite prey. In turn they are preyed on by large molluscs such *Charonia lampas*, *Charonia variegata* and probably *Tonna galea*.

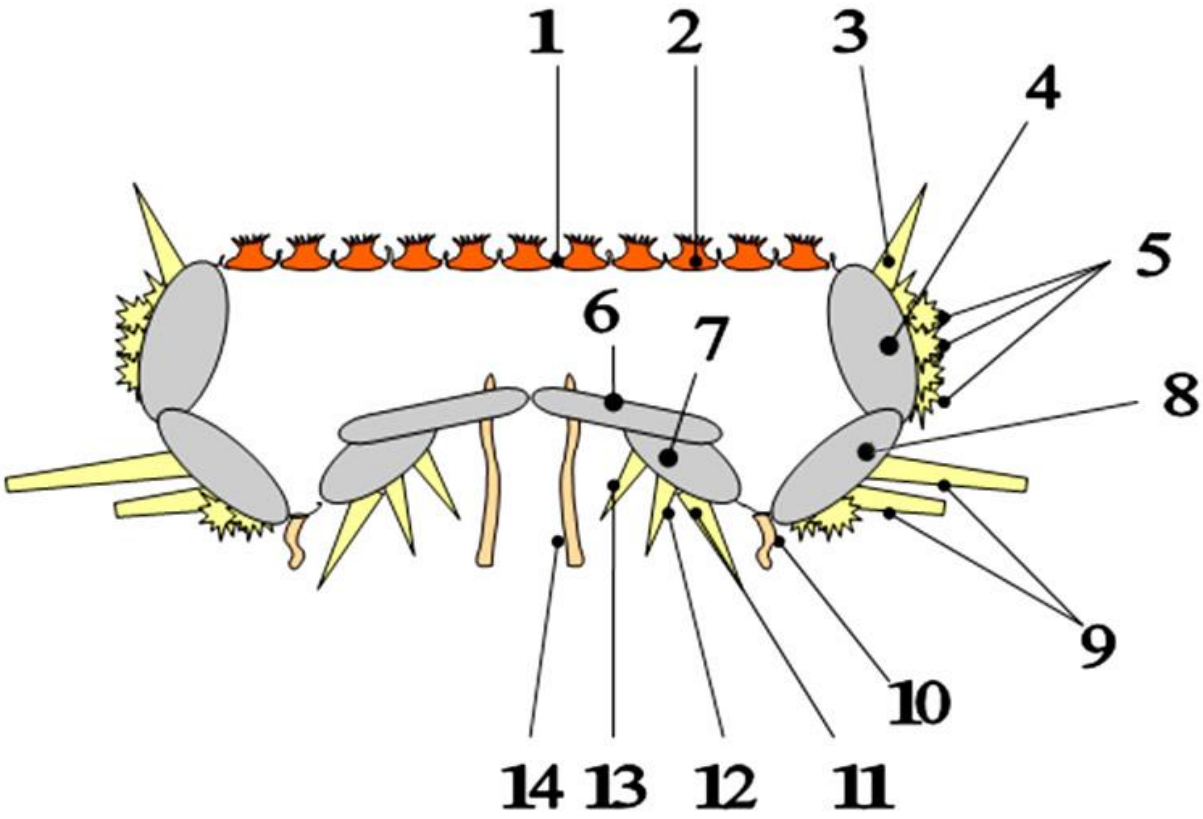
In Mediterranean Sea live six species of the genus Astropecten:
- *Astropecten aranciacus* (Linnaeus, 1758)
- *Astropecten jonstoni* (Delle Chiaje, 1827)
- *Astropecten irregularis* (Pennant, 1777)
- *Astropecten spinulosus* (Philippi, 1837)
- *Astropecten bispinosus* (Otto, 1823)
- *Astropecten platyacanthus* (Philippi, 1837)

These seastars may look similar in appearance but usually it is possible to determine the species by photo checking the features described by principal authors that have analyzed over the years many specimens in the laboratory. All of the following are described the main features found in thousands of specimens encountered and photographed in Mediterranean Sea (Italy: Trieste, Sardinia; France: Corse; Croatia: Istria, Rab, Cres, Krk, Pag, Murter, Hvar; Greece: Lefkada, Kefalonia, Gulf of Arta, Peloponnese, Karpathos, Milos, Kimolos, Naxos, Paros, Antiparos, Ano Koufonissi, Kato Koufonissi, Donoussa, Mykonos, Crete, Limnos, Schinoussa, Sithonia; Spain: Menorca, Formentera) and the features described by the authors Enrico Tortonese, Réné Koehler, Emil Von Edler Marenzellerin, Hubert Ludwig, Ludwig Heinrich Philipp Döderlein. For species *A. aranciacus*, *A. jonstoni*, *A. irregularis*, *A. spinulosus* usually determining the right species is quite easy, but for more complex species as *A. bispinosus* and especially *A. platyacanthus* it needs a more thorough analysis. The main features to determine the species by photo are: the appearance of the superomarginal plates and spines, the shape of disc and arms and the colour of aboral side. For good identifications is therefore useful a whole picture of the specimen and one of detail of the superomarginal plates: this can be done without turning over or disturbing the animal.

The main elements of starfish genus Astropecten:



Description of arm's section of starfish genus Astropecten:



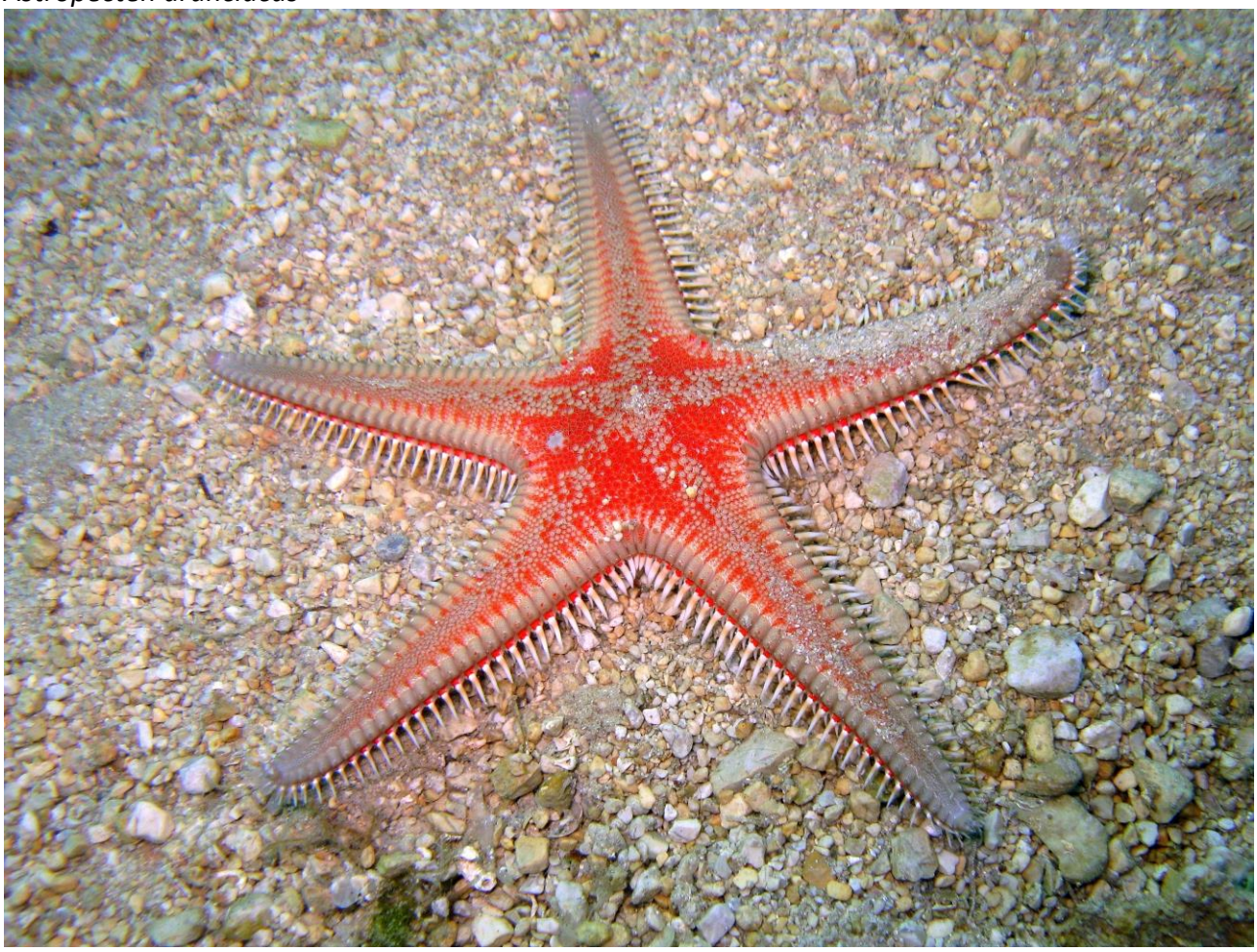
1- papulas: they are soft and retractable appendages with respiratory functions
2- paxilla
3- superomarginal spines
4- superomarginal plates
5- scales and small spines covering the vertical face of superomarginal plates
6- ambulacral plates
7- adambulacral plates
8- inferomarginal plates
9- inferomarginal spines
10- pedicellaria: special pedicels with prehensile termination necessary to grab bodies and detritus
11- external adambulacral spines
12- median adambulacral spines
13- internal adambulacral spines
14- ambulacral pedicellaria

The starfishes have two sides: an upper side called "aboral side" (which is normally visible), and a bottom side called "oral side" (which rests on the seabed).

Astropecten aranciacus

This starfish has superomarginal plates low and rounded equipped with 1 to 3 small spines and inferomarginal plates with long, pointed, strong, regularly arranged spines. The inferomarginal spines have orange- yellowish color at the base and white towards the tip. It is rugged with a normal size disc and pointed arms. The color of the aboral side is given by a succession of with upper extremity paxillae (from the top they look like round dots) red-orange in combinations with paxillae grey or beige. The superomarginal plates are usually grey or beige homogeneous. This is the largest species of Astropecten in Mediterranean Sea with a maximum diameter of 55 cm (usually it measures about 30 cm). *A. aranciacus* lives on sandy, muddy or gravel bottoms at depths between 2 and 100 m. This species is active and easy to find in the late afternoon and during the night. It's a starfish with a lot of features and can be distinguished easily from the other species by colors and size. Sometimes it is confused with *A. irregularis* but it is distinguished because *A. aranciacus* has a different color of the aboral side (red-orange usually with grey or beige dots instead of pink) and superomarginal spines (present even if small instead of absent in Mediterranean specimens).

Astropecten aranciacus



Astropecten aranciacus: emission of gametes

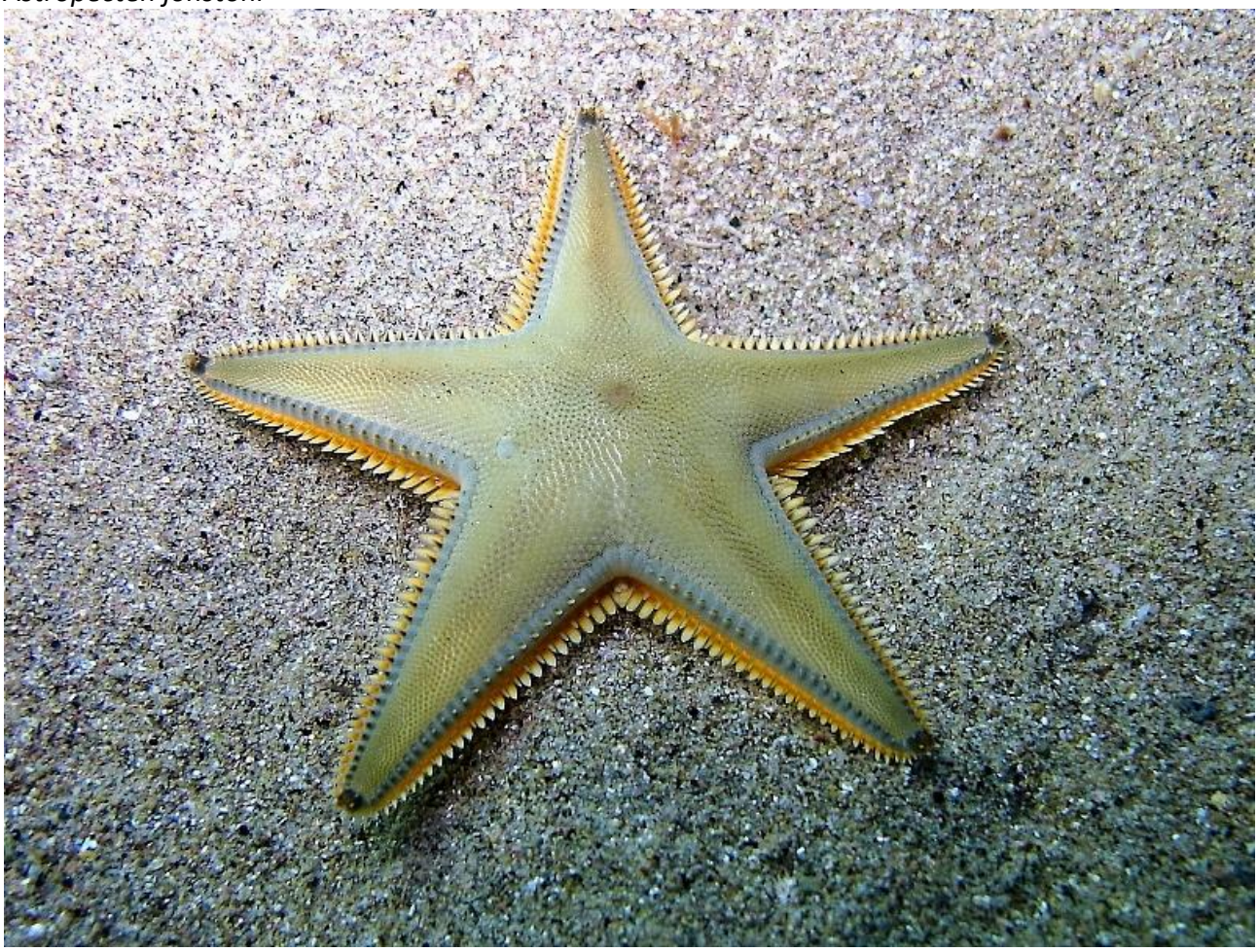
Detail of superomarginal plates and paxillae of Astropecten aranciacus

Astropecten jonstoni

This sea star has superomarginal plates low and rounded with very short spines, usually only in the distal plates (only in populations of western Adriatic many specimens have spines on all the dorsal marginal plates and relatively long). The inferomarginal plate has a short and pointed external spine, arranged with great regularity, kept parallel to one another and few mobile. The inferomarginal spines have dark orange color at the base and white-yellowish towards the tip on going to draw a sort of orange outline at the base of the sea star. The overall shape is peculiar with a disc bigger than other species and arms rather court, triangular and very pointed that accentuates the classic shape of star. The colors of the aboral side is clear with various nuances that can be tending towards beige, turquoise-green or grey-brown. It is the smallest species of Astropecten of Mediterranean Sea with a maximum diameter of about 7-8 cm. It prefers sandy seabed at low depths as between 1 and 12 m. Unlike other Astropecten, it is active and easy to find during the day, especially in early morning and late afternoon. This starfish usually can be distinguished easily by its overall shape, the size, the shot and rigid inferomarginal spines and colors of aboral size. It can to be confused with young specimens of *A. irregularis* but it is distinguished because *A. jonstoni* has shorter and more rigid inferomarginal spines and a different color of the aboral side (beige, turquoise-green or grey-brown instead of pink). Rarely it is confused also with very young specimens of *A. platyacanthus* which may have superomarginal plates without spines or with very small spines but *A. jonstoni* differs for to have shorter and more rigid inferomarginal spines and a different appearance of the superomarginal plates (low, rounded and totally covered with small scales instead of high, vertical with the top inside edge totally bare).

Astropecten jonstoni

Astropecten jonstoni



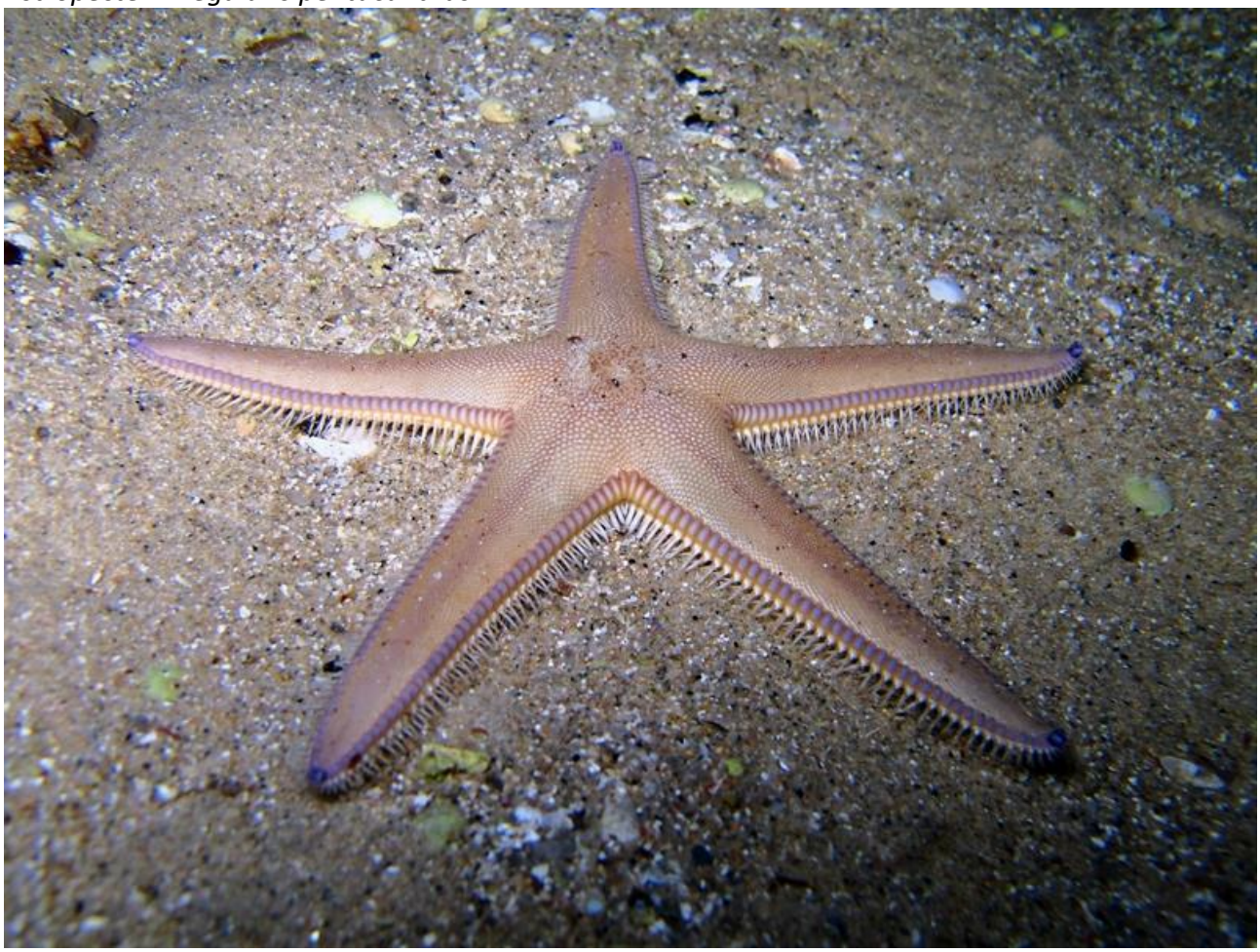
Detail of superomarginal plates and spines of Astropecten jonstoni

Astropecten irregularis

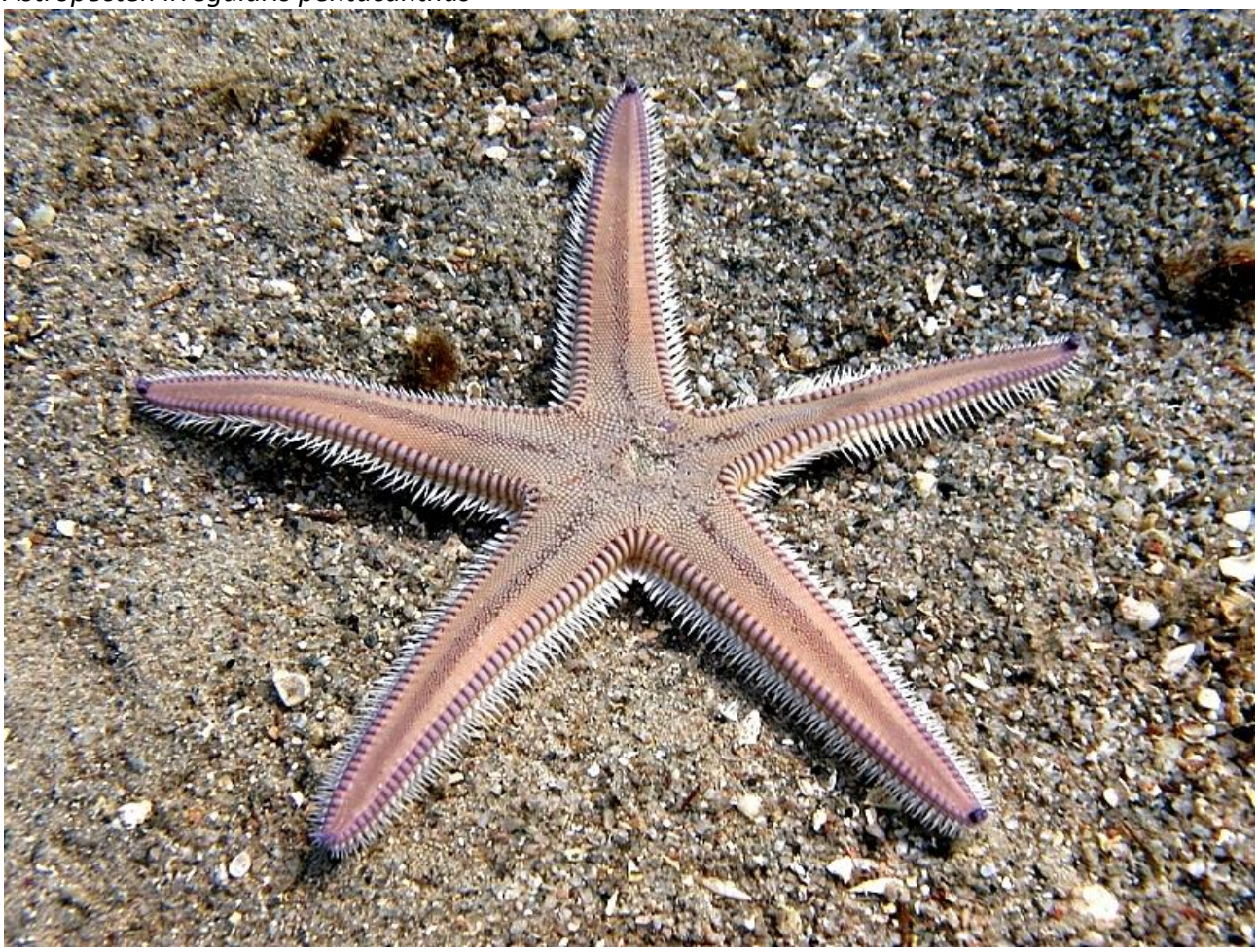
This species live in the Atlantic and Mediterranean, but the two populations show differences in superomarginal spines: the Mediterranean's specimens have superomarginal plates devoid of spines (considered by some author as the subspecies *Astropecten irregularis pentacanthus*), while the Atlantic populations are provided with one spine for each superomarginal plates (considered the subspecies *Astropecten irregularis irregularis*) or more spines (considered by some author the subspecies *A. irregularis serratus* and by some others as a variety of *A. irregularis irregularis*).

This starfish has well-defined, medium height superomarginal plates and the specimens from Mediterranean Sea are totally devoid of spines. The inferomarginal plates have thin, long, highly mobile spines, sometimes completely white, sometimes with yellowish base. The arms make up among them, at their base where they join the disc, a very clean corner. The typical color of the aboral side is pink or yellowish-pink homogeneous with the ends of the arms purple, sometimes with many small darker dots in the central disc. Occasionally, in some specimens of this species, can be observed a noticeable swelling in the center of the disc probably due to the ingestion of some clam or to the respiratory function: when the animal is hidden can use this bulge protrudes to keep the disc out of the sediments for respiratory functions (called by Enrico Tortonese the "aboral-cone"). Usually it has a diameter of about 10-12 cm with a maximum of 19 cm. It's a common species in all kinds of mobile seabed from 1 to about 1.000 m deep. This species is active during the night, rarely since the late afternoon. In Mediterranean Sea this starfish can be distinguished by the superomarginal plates devoid of spines and color of the aboral side. Sometimes it is confused with A. aranciacus but observing these features it is always easy to distinguish them. The very young specimen of A. irregularis can look a lot like to A. jonstoni for the shape having a large disc and pointed arms and for the absence of superomarginal spines and it need to check the inferomarginal spines (long and mobile in A. irregularis instead of short and rigid) and the color of the aboral side.

Astropecten irregularis pentacanthus



Astropecten irregularis pentacanthus



Astropecten irregularis pentacanthus

Detail of superomarginal plates devoid of spines (feature of Astropecten irregularis pentacanthus)

Detail of "aboral-cone" sometimes visible in Astropecten irregularis

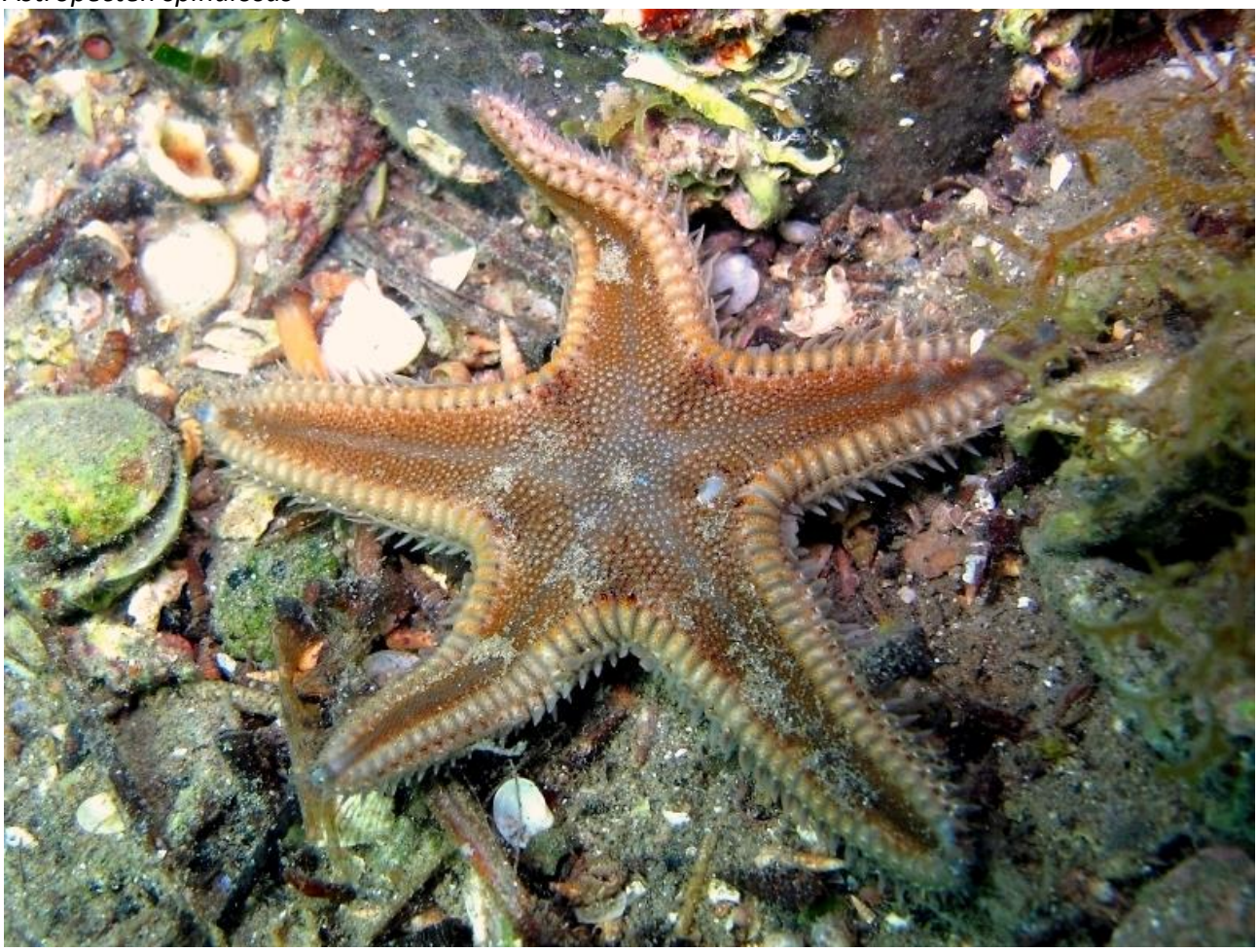
Astropecten spinulosus

It has very low superomarginal plates (the height of the vertical face is slightly big than the width), completely covered by scales and very small spines. Only from 1 to 3 small spines on the top of each plate can be considered a real spine (the other spines are too small). The color of these spines is the same of the superomarginal plates and it is brown or clear brown. The inferomarginal spines are long and pointed with a typical brownish-purple color. It looks like a slender starfish. The aboral side is dark brown, reddish-brown, rarely greenish, usually with clear radial lines well visible at the center of each arms. It prefers sandy seabed near meadows of *Posidonia oceanica, Cymodocea nodosa* or other mobile seabed in areas with algae from 1 to 50 m deep. It is the only *Astropecten* that often moves away from mobile seabed and it is possible to meet it on hard bottoms, in caves or climbing on *Posidonia oceanica*. This species is active and easy to find during the night, occasionally also in the late afternoon. It is a small starfish, usually 6-8 cm and maximum just under 10 cm in diameter. This sea star can be distinguished mainly by the low superomarginal plates, the small superomarginal spines, the colors of the aboral side and the colors of inferomarginal spines. This species can be confused for shape and color only with *A. platyacanthus* but the differences in the superomarginal plates and spines are considerable because *A. spinulosus* has low superomarginal plates with 1-3 small spines instead of narrow and high superomarginal plates equipped with 1 strong spine.

Koehler, R. (1921). Faune de France. Echinodermes; pag. 48-49:- "Astropecten spinulosus… …L'aire paxillaire est relativement large en raion de l'étroitesse des plaques marginales dorsales… …Les plaques marginales dorsales sont assez étroites et la hauteur de leur face vertical est un peu plus grande que la largeur de leur face dorsale."; "La coleur de la face dorsal du corps est brunâstre, brun-olivâtre ou vetr-rougeâtre, toujours assez foncée".

Astropecten spinulosus

Astropecten spinulosus



Astropecten spinulosus

Detail of very low superomarginal plates of Astropecten spinulosus

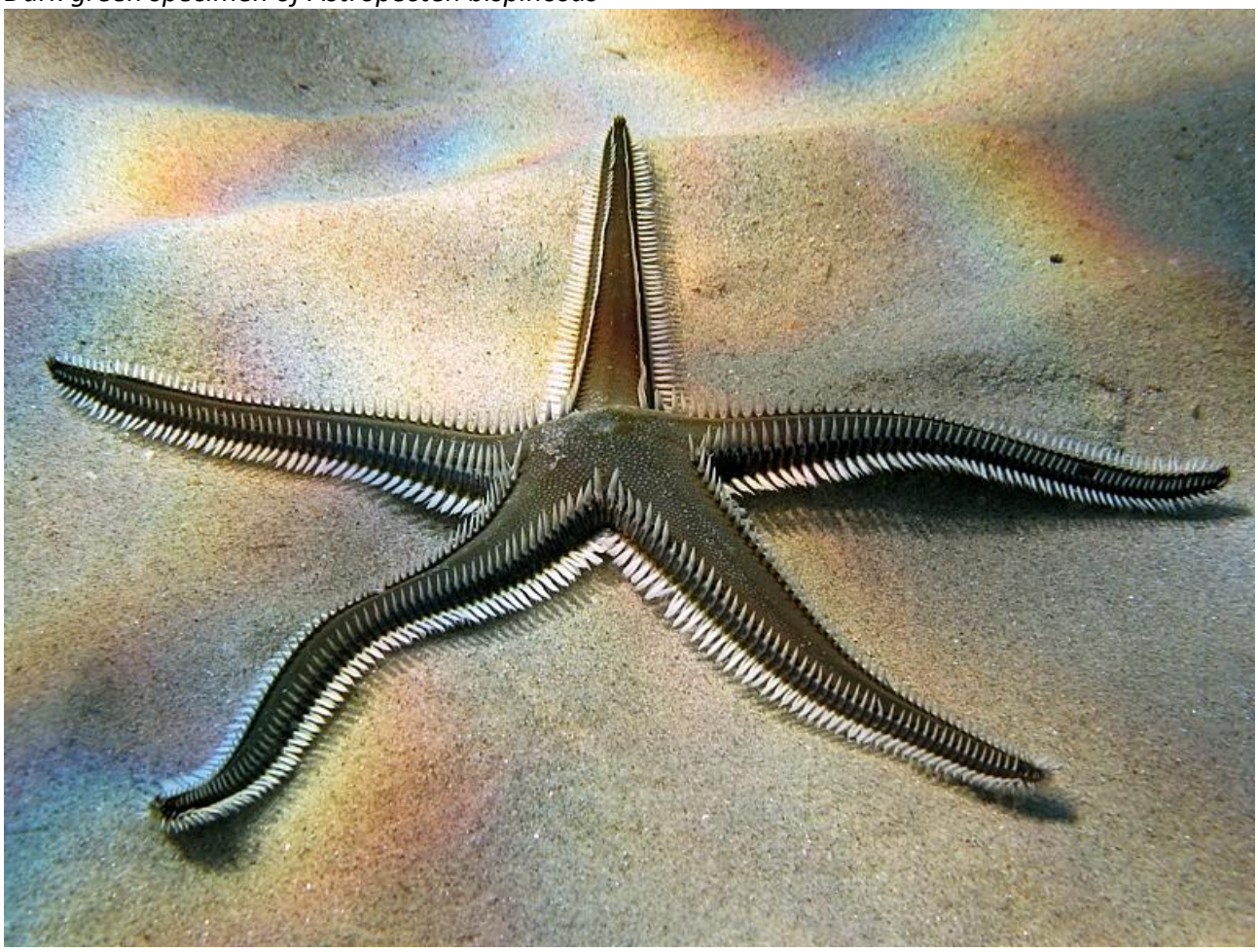
Detail of very low superomarginal plates of Astropecten spinulosus

Astropecten bispinosus

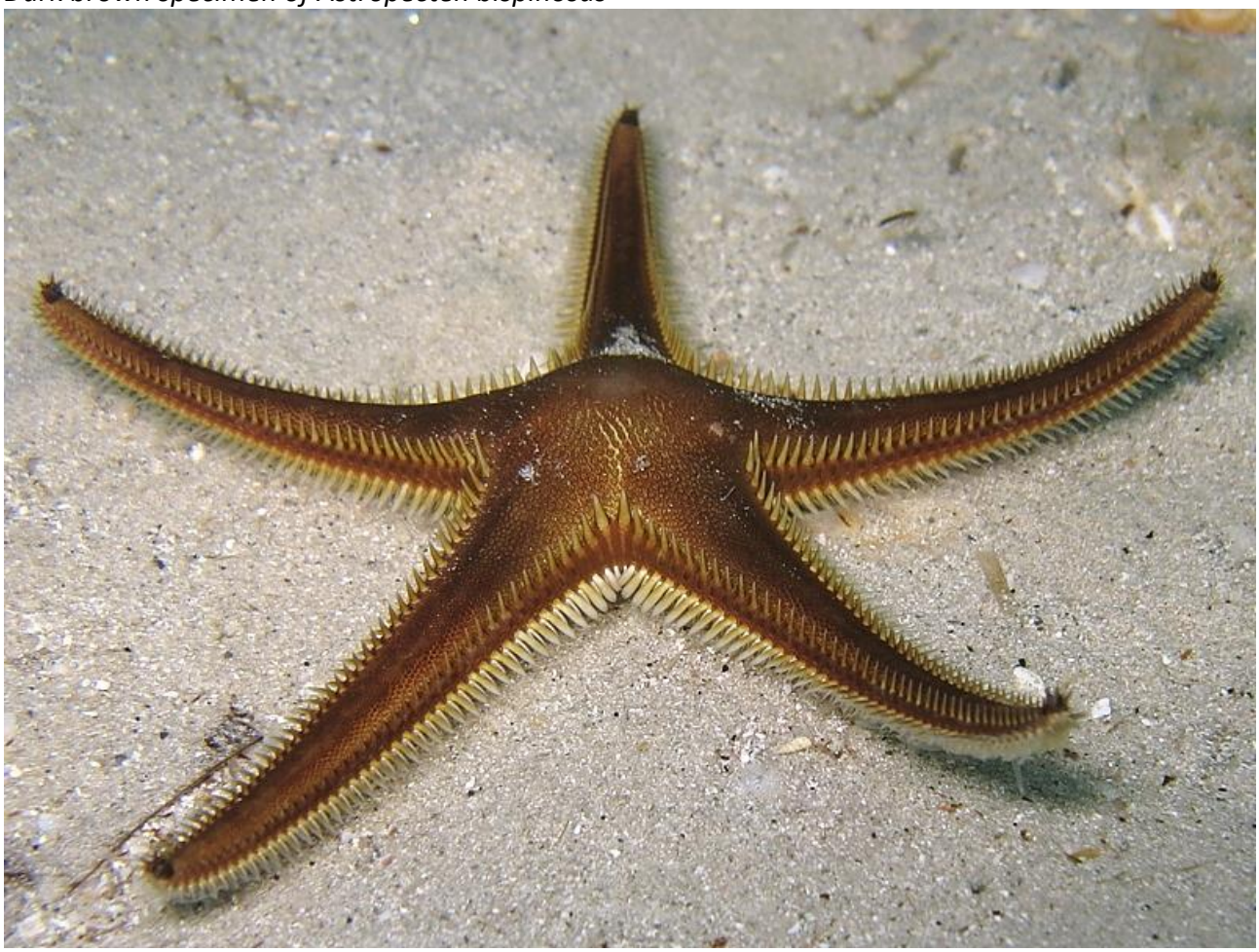
This sea star has very narrow and high superomarginal plates with a bare area on the vertical face of them (visible in the lateral side of arms between inferomarginal spines and superomarginal spines). Every superomarginal plate is equipped with 1 very long, sharp, clean conical spine usually with white color but sometimes yellow or orange. The superomarginal spine is always placed on the top internal edge of plates so there aren't any bare areas on top of superomarginal plates. The maximum number of superomarginal plates, observed on each arm, is 77; normally the number is between 40 and 60, depending on the size of the starfish. The pair of superomarginal spines between the arms is often longer than all the others spines. The inferomarginal spines can to have the same colors of the superomarginal spines and they are long, flat, few pointed, arranged with great regularity, kept parallel to one another and few mobile. This *Astropecten* has a typical shape with a small disc and very long and thin arms, even if this characteristic can be more or less accentuated. The aboral side has uniform color and can be dark green, dark brown or rarely light brown-pink. It has a large size and may reach about 21 cm in diameter. It prefers sandy seabed near meadows of *Cymodocea nodosa* at depths between 2 and 100 m. This species is active and easy to find especially in the late afternoon, but sometimes it is possible to find it during the day or during the night. Usually this starfish can be distinguished by its typical shape, the narrow and high superomarginal plates with a strong and conical spine. It may be confused only with *A. platyacanthus,* distinguishing them can be complex, to identify correctly *A. bispinosus* is necessary mainly to check the position of the spines on the top of superomarginal plates (placed on the top internal edge of plates instead of spaced from the inside edge with a small bare area on the top internal edge), the shape of superomarginal spines (quite conical instead of more irregularly shaped and slightly flattened laterally) and the bare area on the vertical face of superomarginal plates (instead of superomarginal plates laterally covered with scales and small spines features of A. platyacanthus).

Tortonese Enrico (1965). Fauna d'Italia. Echinodermata; pag. 140-143:- "Astropecten bispinosus… …Piastre margino-dorsali strette e alte, con un'ampia zona nuda laterale e un robusto aculeo inserito sull'orlo superiore e interno."; "Astropecten platyacanthus… …Queste (piastre margino-dorsali) sono quasi completamente rivestite di aculei e squame e portano un aculeo, più o meno scostato dall'orlo superiore e interno."; "Gli individui (di Astropecten platyacanthus) leptobrachiati (con braccia piccole), naturalmente, presentano una più spiccata rassomiglianza con Astropecten bispinosus ma il diverso aspetto delle piastre marginali facilita sempre la corretta identificazione." (pag. 143); "…Astropecten platyacanthus, fra l'altro, differisce da "Astropecten bispinosus per il minor numero di piastre margino-dorsali: nelle due specie i massimi valori noti sono rispettivamente 48 e 77.".

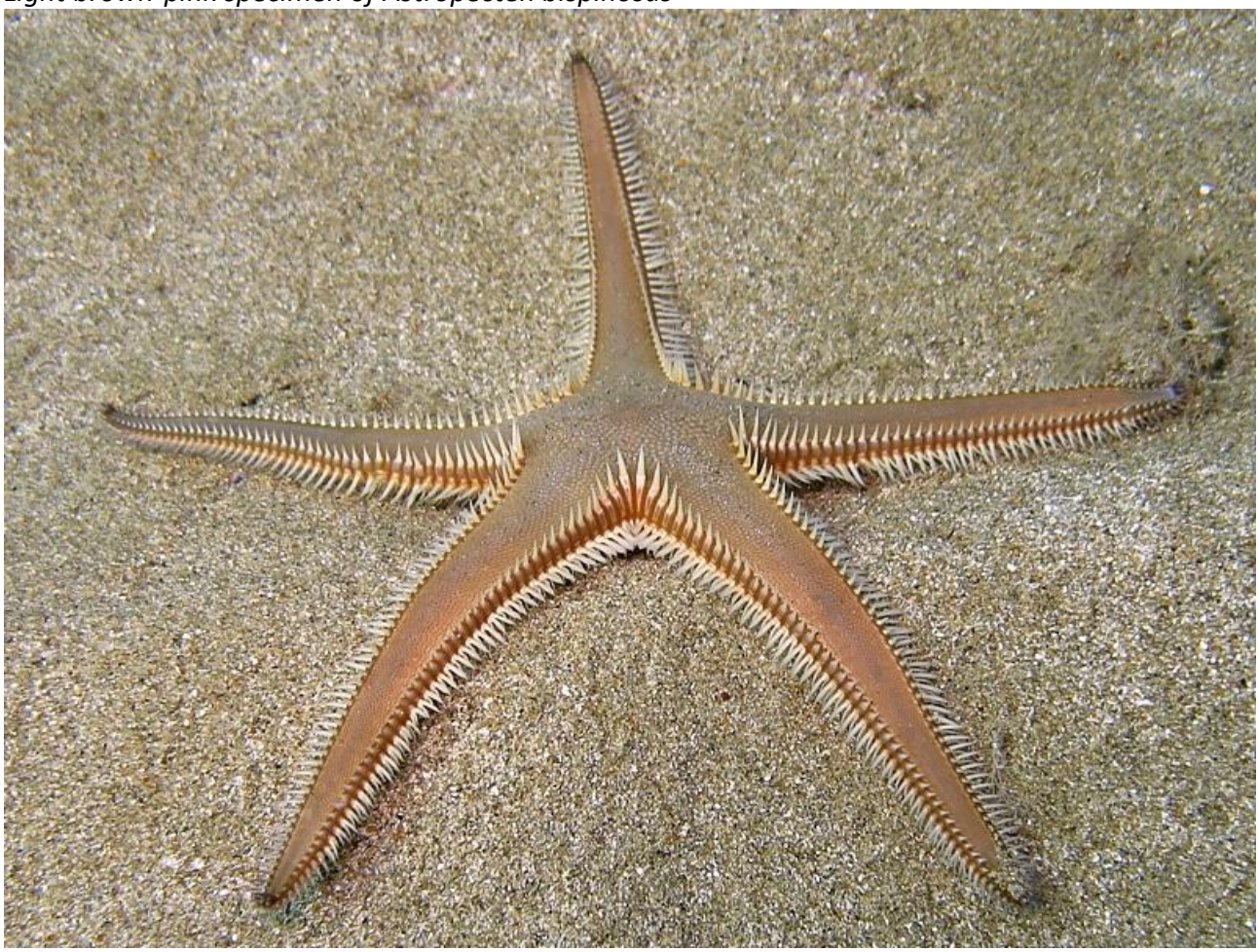
Dark green specimen of Astropecten bispinosus



Dark brown specimen of Astropecten bispinosus



Light brown-pink specimen of Astropecten bispinosus



Detail of the superomarginal spine always placed on the top internal edge of plates so there aren't any bare areas on top of superomarginal plates (feature of Astropecten bispinosus)

Detail of the bare area on the vertical face of superomarginal plates (Astropecten bispinosus)

Astropecten platyacanthus

It has narrow and high superomarginal plates, laterally (on the vertical face) covered with scales and small spines. Every superomarginal plates is equipped with 1 strong spine, usually sharp but irregularly shaped, slightly flattened laterally, usually yellowish but rarely white or orange. Occasionally, especially in young specimen, only the superomarginal plates between the arms are equipped with one strong spine while the distal plates are devoid of spines and very rarely it can to have all the superomarginal plates devoid. Only in the populations of certain areas of the Mediterranean (for example, the South of Corsica) this feature is quite frequent. The superomarginal spines are (more or less) spaced from the inside edge of plates and they leave on top (on the base of each spine) a small bare area that it is white if there is a strong spine in the plate (usually in the plates near the disc) or blue-violet if the plate has very small spine or no spine (usually in the distal plates towards the tip of arms). The maximum number of superomarginal plates, observed on each arm, is 48; normally the number is between 29 and 43, depending on the size of the starfish. The inferomarginal spines can to have the same colors of the superomarginal spines and they are long, flat and quite pointed. It is an *Astropecten* with very variable features and it can have wide or narrow arms. The aboral side has very variable colors and it can be more or less dark brown, olive green, pink-brown, bluish-grey, usually it is visible a dark radial lines at the center of arms. It lives on all mobile seabed at depths between 1 and 60 m, but it is more frequently in seabed of mixed coarse sand and mud at 1-4 m depth. This species is active and easy to find during the night but also during the day, especially in early morning and late afternoon. Usually it reaches a diameter of 9-12 cm and exceptionally it can measure up to 18 cm. It is the Mediterranean *Astropecten* hardest to identify both for the variability of features of the species, both for the resemblance to some other species.

Koehler, R. (1921). Faune de France. Echinodermes; pag. 47-48:- "Astropecten platyacanthus … …est caractérisée principalement par ses plaques marginales dorsales et ventrales munites de petits piques plus nombreux et plus forts que chez l' Astropecten bispinosus typique. Les faces latéral vertical des marginales dorsales, au lieu d'ĉtre neus en leur milieu, portent d'assez nombreux petits piques …"

Tortonese Enrico (1934). Annali del Museo civico di storia naturale Giacomo Doria (Volume 57); pag. 236:- "Secondo l'insigne echinologo tedesco (Ludwig Heinrich Philipp Döderlein), l'A. platyacanthus presenta i seguenti caratteri. ... Le (piastre) margino-dorsali non sono mai così alte e strette come nel bispinosus, ed il loro aculeo, invece di essere inserito sull'orlo interno, ne è più o meno scostato - in tutte le piastre o almeno in quelle distali - cosicché tra l'aculeo e l'orlo interno rimane una zona più o meno larga, occupata da un certo numero di granuli allungati e spesso squamiformi, più grossi degli aculei dei passilli. La parte mediana delle piastre marginali, sia dorsali come ventrali, non è nuda, ma porta granuli e squamule più o meno abbondanti. Inoltre le braccia sono di rado allungate e il numero di piastre margino-dorsali è proporzionalmente molto più alto nell'A. bispinosus che nel platyacanthus. Il Döderlein aggiunge infine che quest'ultimo è una specie molto variabile e a caratteri non ancora ben marcati, mentre il precedente ha ormai fissato ogni sua particolarità morfologica e varia poco."

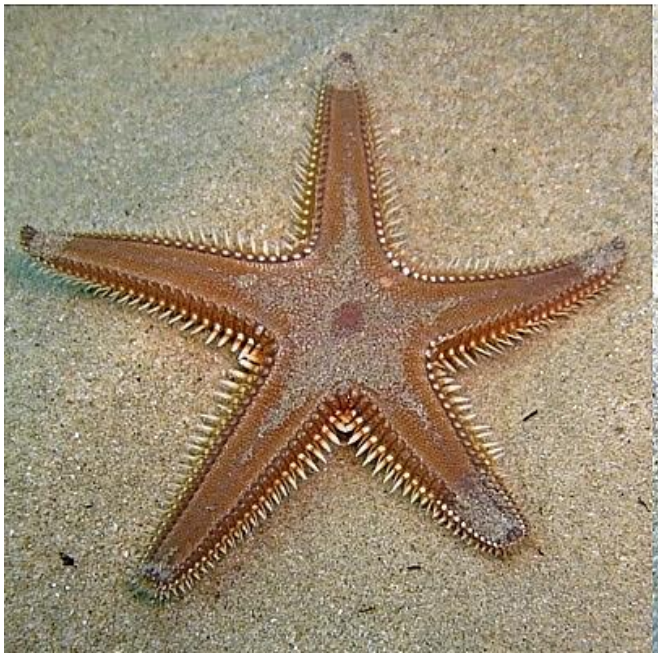
Astropecten platyacanthus

Astropecten platyacanthus

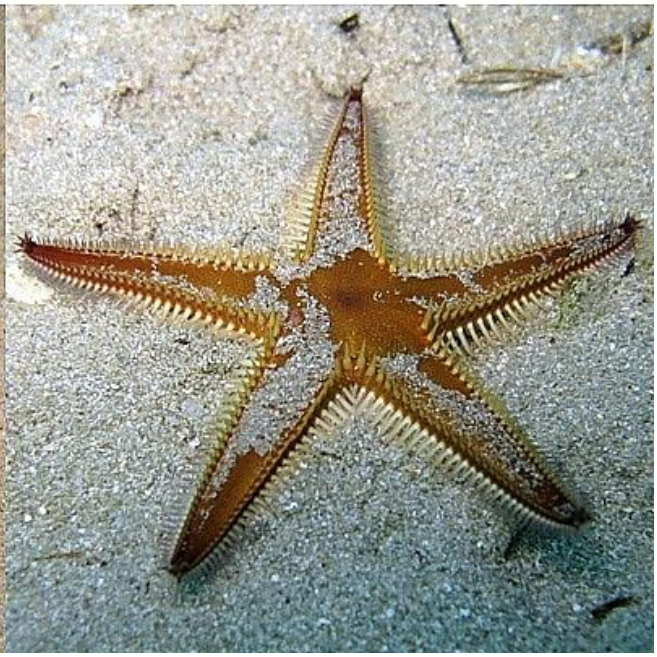
Range of colors for Astropecten platyacanthus

A. platyacanthus is distinguished from *A. bispinosus* mainly for the position of the spines spaced from the inside edge with a visible small bare area on the top internal edge of the plates instead of spines placed on the top internal edge of plates without small bare area on the top. Another important *A. platyacanthus*'s feature is that the superomarginal plates are laterally, on the vertical face, covered with scales and small spines rather than nude. Moreover, it is different because it has irregularly shaped, laterally flattened superomarginal spines (rather than clean conical spine) and because it has average less numerous and therefore less dense superomarginal plates on each arm. In addition, on average *A. platyacanthus* has a central disc larger, a color of aboral side a little different, a small red dot on the tip of arms is usually visible (usually not visible in *A. bispinosus*), it has a body and inferomarginal spines more mobile and usually inferomarginal spines less pointed.

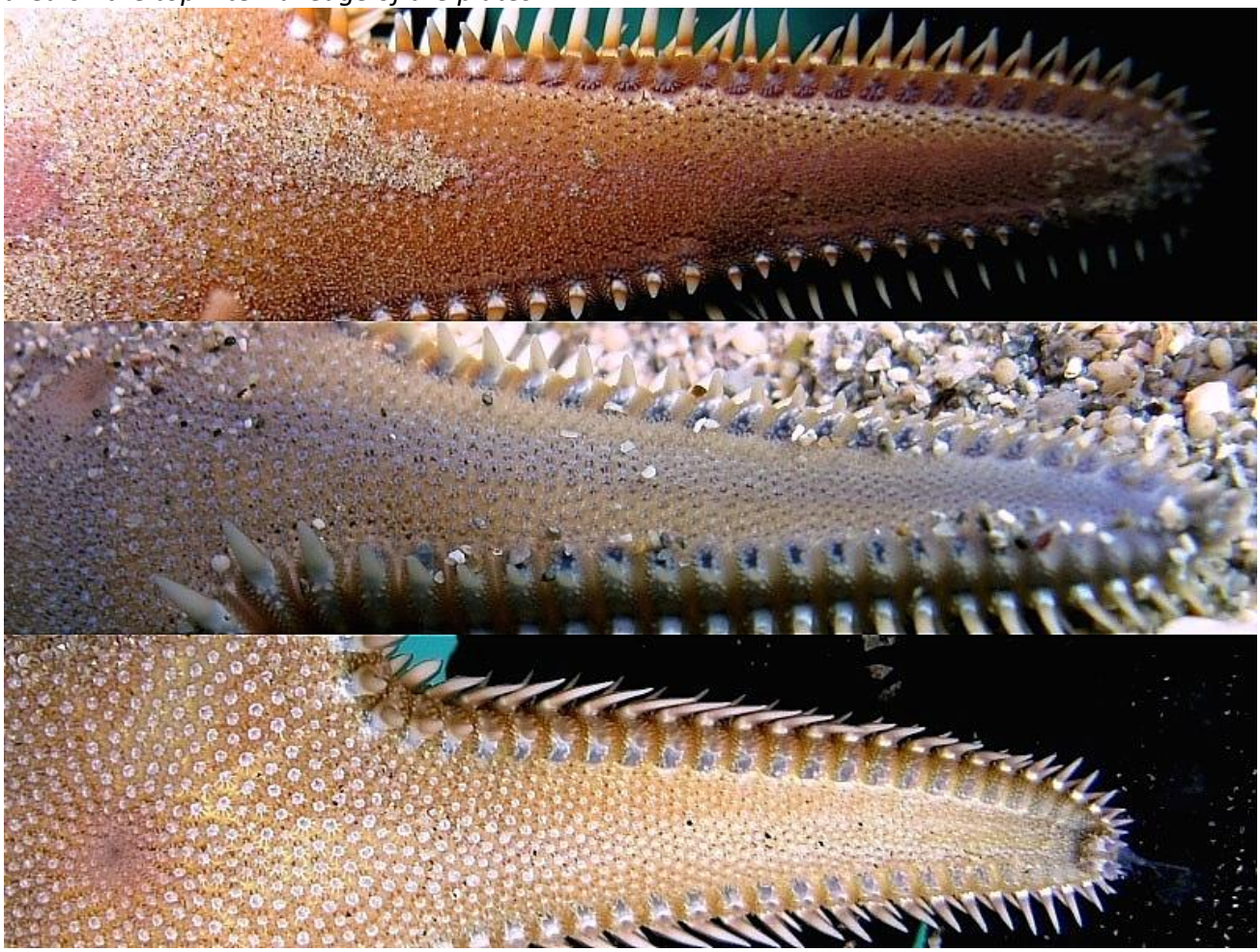
Astropecten platyacanthus



Astropecten bispinosus



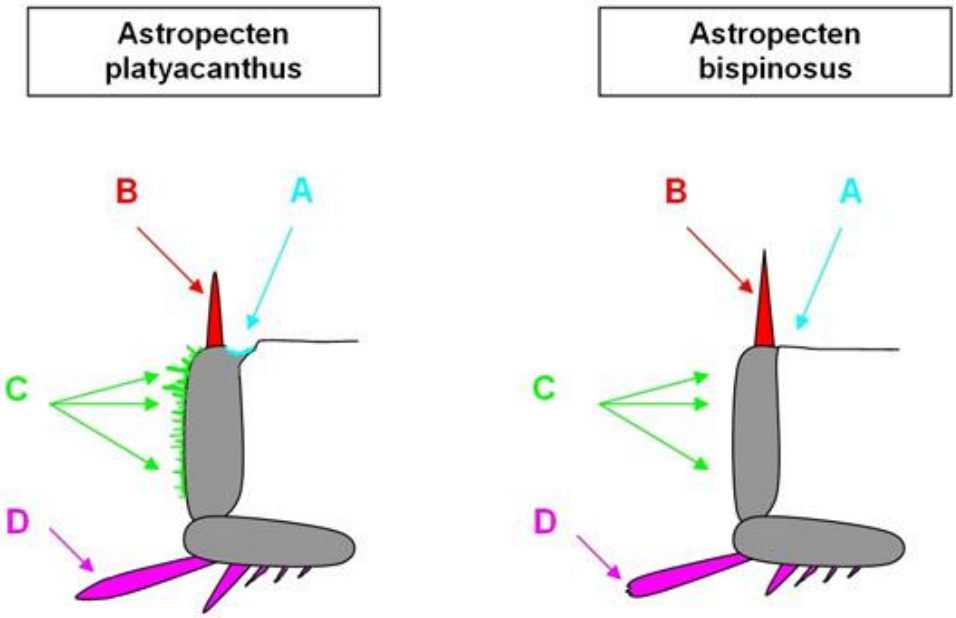
A. platyacanthus's superomarginal spines spaced from the inside edge with a visible small bare area on the top internal edge of the plates



A. platyacantus: detail of superomarginal plates, laterally covered with scales and small spines

Astropecten platyacanthus has a small red dot in the tip of arms

Design of the main differences between Astropecten platyacanthus and Astropecten bispinosus



A = A. platyacanthus is distinguished from A. bispinosus for the superomarginal spines spaced from the inside edge of plates. They leave on top, on the base of spines, a small bare area.
B = A. platyacanthus is a bit different from A. bispinosus for the superomarginal spines irregularly shaped, laterally flattened (rather than clean conical spine).
C = A. platyacanthus is distinguished from A. bispinosus for the vertical face of superomarginal plates laterally covered with scales and small spines rather that plates laterally nude
D = A. platyacanthus is a bit different from A. bispinosus for the inferomarginal spines, usually less pointed.

A. platyacanthus is distinguished from *A. spinulosus* by very different superomarginal plates: highest, defined and equipped with very big and strong superomarginal spines. The colors whitish or yellowish of inferomarginal spines are also different in these species because quite different to the typical color blue-purple of *A. spinulosus*. *A. platyanthus* can measure up to 18 cm, while *A. spinulosus* reaches at maximum just less 10 cm in diameter.

Astropecten platyacanthus

Astropecten spinulosus

The young specimens of *A. platyacanthus* sometimes can be confused with *A. jonstoni* for the shape and the color, but it is always easy to distinguish them by very different superomarginal plates (high with the top inside edge totally bare instead of low, rounded and totally covered with small scales) and longer inferomarginal spines.

Astropecten platyacanthus

Astropecten jonstoni

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