A REVISION OF THE STARFISH GENUS *UNIOPHORA* (Asteroidea; Asteriidae)

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SUMMARY

The genus *Uniophora* which is widely distributed in temperate Australian seas is reviewed. *Uniophora globifera, U. fungifera, U. sinusoida, U. multispina, U. obesa, U. uniserialis* are placed in the synonymy of *U. granifera*, and *U. gymnonota* is considered to be a synonym of *U. nuda*. Population samples from Spencer and St. Vincent Gulfs, South Australia, are analysed and statistical differences noted. Specimens from New South Wales, Victoria and Tasmania are compared and observations are made upon the ecology and distribution of the South Australian forms.

INTRODUCTION

The genus *Uniophora* is a prominent and distinctive representative of the seastars of temperate Australian waters having a distribution around the coast of the southerly half of the continent from Collaroy Reef near Sydney on the east coast to Lancelin Island in Western Australia.

The members of the genus are extremely variable and have long been a source of perplexity to taxonomists. Lamarck (1816) described *Asterias granifera* from Tasmania and Gray (1841) created the genus *Uniophora* naming *U. globifera* from New South Wales. Perrier (1875) described *Asterias nuda* from Pt. Lincoln, South Australia, *Asterias fungifera* from "Nouvelle Hollande" and *Asterias sinusoida* from Hobart, Tasmania. The species of Lamarck and Perrier were all subsequently placed in the genus *Uniophora*. In 1923 Clark added *U. dyscrita* from Western Australia and in 1928 *U. gymnonota, U. multispina, U. obesa* and *U. uniserialis* all from Spencer or St. Vincent Gulfs, South Australia. Subsequent shore collecting (Cotton and Godfrey, 1942) showed that of the ten species, certainly eight and probably nine were to be found in the gulfs of South Australia.

This paper is largely the result of collecting by the author with SCUBA diving apparatus over a number of years. The examination of the considerable material so gathered shows that the supposed speciation of the genus in the South Australian gulfs does not exist, and it is believed that there are only two species in South Australian seas.

The collections of the Australian Museum, the National Museum of Victoria and the Western Australian Museum have been examined; the forms from Victoria, New South Wales and Tasmania are considered conspecific with *U. granifera* but the Western Australian form *U. dyscrita* is regarded as specifically distinct. Differences between the several forms are discussed and spine

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counts are used to determine statistical differences between population samples. This method is believed to be novel in the study of asteroids. Geographical and ecological notes are also given and a map showing the distributions of the various forms in the gulf regions is added.

In this paper the following abbreviations are used: A.M., Australian Museum; N.M.V., National Museum of Victoria; S.A.M., South Australian Museum. W.A.M., Western Australian Museum.

UNIOPHORA GRANIFERA Lamarck

Asterias granifera Lamarck, 1816, p. 560.
Uniophora globifera Gray, 1840, p. 288.
Asterias fungifera Perrier, 1875, p. 337.
Asterias sinusoida Perrier, 1875, p. 338.
Uniophora sinusoida Clark, 1928, p. 411.
Uniophora obesa Clark, 1928, p. 409.
Uniophora uniserialis Clark, 1928, p. 413.
Uniophora multispina Clark, 1928, p. 407.
Uniophora multispina multispina Stach, 1938, p. 332.
Uniophora multispina uniserialis Stach, 1938, p. 332.

Material Examined, "Granifera" group. S.A.M. (117 specimens) K174-6, K191, K597-8, K600, K629-K641. A.M. (16 specimens) from N.S.W. J.127-8, J.144, J.7444, J.6884, J.7008. From Tas. J.141, J.143, J.168-9, J.5410-5414. N.M.V., 5 specimens labelled Port Phillip Survey. "Multispina" group (98 specimens) S.A.M. K181-3, K185, K187-9, K190, K193, K520-1, K601-2, K605, K626, K635, K643-651.

In 1875 Perrier (1875, p. 342) noted the puzzling diversity of the specimens before him and considered them to comprise four distinct species. Later Fisher (1923, p. 597) referred Gray's *globifera* to the species *granifera*. It is now clear that there is only one species which shows considerable morphological variation both between and within its component populations. The differences in morphology relate principally to the frequency, size and regularity of arrangement of the dorsal spines. The populations examined fall into two groups each of which has its own preferred habitat and finds a distinctive phenotypic expression. One group is called "granifera" as specimens of it have predominantly the characteristics formerly ascribed to *U. granifera* and the other group is termed "multispina" to indicate a similar relationship with the former species *U. multispina*.

"*Granifera*" *Group*

This group is polymorphic and falls into three more or less conspicuous forms. Historically these forms have been treated as three species, namely, *Uniphora granifera*, *U. sinusoida* and *U. fungifera*. A given population of the group may contain representatives of all three forms but usually there is a preponderance of one form with a few representatives of one or both of the other forms. Where two of the forms are represented in a population there are usually numbers of specimens of intermediate form, and on occasions specimens of one form have been seen with a regenerated arm of another form.

The form first described as *U. globifera* is most commonly encountered and is characterised by swollen and capitate carinal spines. A typical specimen is figured by Clark (1928, p. 404). The carinal series of plates carries up to 25 enlarged capitate spines, frequently placed singly at the apex of each zigzag formed by the outline of the plates. Interspersed between these enlarged spines are a variable number of much smaller capitate spines either singly or in small groups. The dorso-lateral plates have numerous spines of varying size usually

about as large as the smaller spines of the carinal series and these are often irregularly placed. Here and there the spines of the supero-marginal plates are as large as those along the carinal lines.

Specimens from New South Wales which have this form are remarkable for the size of their enlarged capitate carinal spines which are larger than those seen in South Australian specimens. They also differ from the latter in possessing a larger number of smaller capitate spinelets dorsally and on the intermarginal plates. The actino-lateral spines are quite variable; sometimes they are typical but at others more like those in "multispina" group. The specimens were all taken apparently on rocky bottoms and are either from Long Reef, Collaroy, or Sydney Harbour.

A second form which was formerly designated *U. sinusoida* possesses a markedly zigzag carinal series of plates bearing spines which are capitate but not nearly as conspicuous as the globose spines of the previous form. In some specimens it is difficult to detect a carinal series of plates at all and dorsally the spines appear to form the margins of a series of discontinuous polygonal papular areas. The figures of Clark (1928, p. 412) and Stach (1938, p. 332) are quite typical of this kind of specimen.

A number of such specimens have been examined from Port Phillip Bay, Victoria and have less conspicuous dorsal spines than the South Australian specimens while several rather resemble those in "multispina" group. Specimens from the Australian Museum taken in Tasmania are placed in this group with some hesitation. The arrangement of the spines and the general appearance of these specimens are typically *sinusoida*-like but the dorsal spines of some specimens, particularly those taken in D'Entrecasteaux Channel, Tasmania, are fine and pointed as is sometimes the case in "multispina" group.

In some localities there commonly appears a third form which is remarkable for the proliferation of spines dorsally. Instead of enlarged capitate spines occurring singly or in groups of two or three along the carinal series, there are groups of 10 to 20 small and closely appressed, capitate spines, often with the central one much larger than the surrounding ones. These groups of spines are usually contiguous and together appear to form an almost flat dorsal surface. In other respects the specimens do not differ significantly from those previously mentioned. These specimens conform to such a striking degree with Perrier's description of *Asterias fungifera* (1875) that no doubt this form, or something very close to it, is that which is so described. It is to be noted also that Fisher (1926, p. 198) who compared the type specimens of *Asterias fungifera* and *Asterias sinusoida* thought the latter to be a "slenderer and stouter spined example of the same species".

I have only observed "granifera" populations on reefs and rocky bottom. Stach (1938) however, reports several specimens from *Posidonia* beds in the Sir Joseph Banks Group, Spencer Gulf, South Australia, but it is possible that these specimens came from a granitic reef nearby. Some of the specimens from Port Phillip Bay, Victoria, and also from D'Entrecasteaux Channel, Tasmania, also appear to occur on sandy bottom but as indicated previously these specimens are atypical. The form ranges from low water down to about 20 m in depth but is found in greatest abundance in depths between 5 and 10 m; in favourable conditions where the wave action is moderate but not severe two or three specimens may occur to the square metre.

The favourite diet is a small tunicate which abounds on shallow reefs. Very frequently the seastar is found with its rays encircling the tunicate and

protuding its everted stomach into the animal's oral aperture. How it achieves this is not known. Its tube feet clearly could not exert the same force on the tunicate as they could upon the shells of a bivalve. In the latter case the force exerted by each tube-foot on the shell would be cumulative; whereas in the former case, the aperture appears to be controlled by musculature immediately surrounding it and the seastar could bring very few of its tube feet to bear upon these muscles, and hence would exert little force on them. It is possible that the animal discharges a stomach enzyme or toxin which paralyses or narcotizes its prey so enabling it to gain entry. Certainly when the starfish is removed the tunicate is unusually sluggish in closing its aperture. To a lesser degree the seastar has been observed to feed on reef-dwelling univalves and bivalves and on various encrusting ascidians. Specimens taken from shallow water are usually brick-red in colour but occasional ones are seen in which the papular areas are a dark blue. Specimens from deeper water between 15 and 20 m are usually more brightly coloured, ranging from bright red to orange. Orally specimens are red to orange.

"Multispina" Group

Specimens from these populations are distinguishable from those of "granifera" populations by the comparatively regular arrangement of the carinal and dorso-lateral plates and the spines on them. The carinal series carries from 1 to 4 rather small capitate spines to each plate and the series forms a straight line medially on the dorsal surface with a tendency in some specimens to zigzag distally. On each side of this series and parallel with it are two regular dorso-lateral series carrying similar but smaller spines. In some populations the latter series bear spines only sporadically and the supero-marginal series bear them irregularly. The spines themselves vary considerably from being capitate or bluntly pointed to being fine and sharp. Where "multispina" and "granifera" populations intergrade, as is not uncommonly the case, the characteristic differences tend to become obscured.

The forms described by Clark as *U. obesa* and *U. uniserialis* are both well within the range of variability shown by "multispina" races and there can be no doubt as to their synonymy. The figures of Clark (1928, pp. 407, 410 and 412) indicate the remarkable diversity existing in the appearance of specimens.

"Multispina" populations are abundant on the angiosperm beds of *Cymodocia antarctica* Endlicher, *Posidonia australis* Hooker, and *Zostera muelleri* Irmisch characteristic of the coastal margins of the South Australian Gulfs particularly in the less exposed regions. Their principal diet is bivalves and univalves which are abundant in the sand among the fibrous angiosperm roots. Most specimens are dark red in colour but some are lighter, tending to become fawn. This form is commonly found down to 10 m but occasionally specimens have been taken from deeper water and there is an unusual record of 3 specimens from 30 m taken by Mr. R. C. Sprigg off Carickalinga Head in St. Vincent Gulf, South Australia.

UNIOPHORA NUDA Perrier

Asterias nuda Perrier, 1875, p. 335.

Uniophora gymnonota Clark, 1928, p. 405.

Material Examined. S.A.M. (80 specimens) K178-9, K522, K599, K636, K642, K652.

Perrier's type was stated to have come from "Port Lincoln, (detroit de Torres)". A series of specimens taken off Cape Donnington just outside Pt.

Lincoln Harbour, South Australia conforms exactly with Perrier's description and confirms Clark's view (1928, p. 417) of the place of origin of the species.

The species is distinguishable from the "multispina" group by the very small number and size of its spines, and many specimens, save for the adambulacrals, are quite denuded of spines. It is without exception, covered by a thick skin which tends to conceal the existing spines but does not obscure the prominent plates forming the carinal, dorso-lateral and marginal series.

Examination of Clark's type of *U. gymnonota* shows no significant differences between it and the specimens from Cape Donnington. Clark purported to distinguish *U. nuda* from *U. gymnonota* on the ground that the latter did not have any pedicellariae corresponding to those observed by Perrier in the ambulacral groove and which he described in these terms "droit, court, large, en forme de triangle". . . . However there are similar pedicellariae in Clark's type and in many other specimens from the north coast of Kangaroo Island and Spencer Gulf, South Australia and it is concluded that Clark's differentiation was in error.

This species has a greater depth range and diversity of habitat than *U. granifera*. The specimens from Cape Donnington were taken in 16 m from thick beds of the hammer oyster *Malleus meridianus* Cotton. Several specimens were observed feeding on the oyster and this no doubt constituted their principal diet. In Nepean Bay near Kingscote, South Australia in 5-8 m there are large colonies inhabiting the beds of the angiosperms *Zostera* sp. and *Halophila ovalis* (R. Brown) Hooker. There it feeds on bivalves and on small tunicates which find a ready attachment to debris and rocks scattered on the bottom. It also occurs in deeper water off the north coast of Kangaroo Island and in Backstairs Passage, South Australia, in 20 to 40 m on rocky or shellgrit bottoms. In colour the species varies from reddish brown to fawn, the specimens from deeper water being invariably the lighter in colour.

UNIOPHORA DYSCRITA Clark

Uniophora dyscrita Clark, 1923, p. 244.

A total of 15 specimens have been examined from the private collection of Dr. E. P. Hodgkin all of which are referred to this species. There are 5 juvenile specimens numbered U.D. 9-13 from deep water (120 to 200 m) and the remainder are from shallow water. The specimens show considerable diversity and one or two approach *U. granifera* (sinusoida form) in appearance; but in the main the species is quite distinctive.

In four specimens numbered U.D. 1-4 from Rockingham and Woodman's Point near Fremantle, Western Australia, the spines on the carinal series are stout at the base and conically pointed. These spines are often 2-3 mm long and 0·5-0·7 mm in diameter at their base, and number from 25-30 along the carinal line. There are also 20 or more much smaller spinelets along the same line. Elsewhere on the dorsal surface there are many fine spinelets up to 0·5 mm long on the plates. One of these (U.D. 1) is shown in Plate 1. These specimens conform to Clark's description except that the carinal series is more evident than appears to be so in the type. In four other specimens numbered U.D. 5-8 from Woodman's Point, Cockburn Sound and Carnac Island, Western Australia, the dorsal spines on the carinal series and elsewhere are predominantly capitate and globose. A few of the spines are rather bluntly pointed. Apparently there is considerable variation in colour in the species. The colour dorsally ranges from dark red to fawn and in some specimens the papular areas are a greenish-brown. Below the colour is orange. Most of the specimens were taken on rocky bottom but several are reported from muddy or sandy bottom.

Two specimens numbered U.D. 14 and 15 present some difficulty by reason of their extraordinary spinulation. One of these, U.D. 14 is shown in Plate 1. They were both taken at the Naval Base, Cockburn Sound, Western Australia. These specimens differ from those described earlier in having few stout spines but many more fine bluntly pointed spinelets often about 1 mm long and 0·5-0·6 mm in diameter, some of which are slightly flattened at their distal ends and somewhat chisel-like. The carinal plates are very sinuous and obscure and with the dorso-lateral plates enclose large polygonal areas devoid of spines. The spines on the carinal plates number from 80-100 on each arm. The marginal spines and actino-lateral spines are not as flattened or as chisel-like as the specimens described above. A few of the actino-lateral spines are divided into two or three short branches but this is not a distinctive feature of the species as Clark asserts (1928, p. 417). It is not considered that the differences in these two specimens are of sufficient magnitude to justify separation and in view of the diversity shown by the other specimen, they are believed to represent at most a variant form. They were reported to have been taken at 3 m depth on *Pinna* from which it may be inferred that their habitat is a sandy or muddy bottom.

The juvenile specimens, the largest of which has R/r = 22/4 mm were all dredged off Rottnest Island, Lancelin Island or Cape Naturaliste, Western Australia. It is noteworthy that in one specimen (U.D. 9) the innermost series of actinal plates nearest the adambulacral armature carries 3 spines on each plate. In the other 4 specimens there are only 2 to each such plate. Otherwise there are no notable differences other than those one would expect from juvenile specimens.

The absence of adult specimens from deep water off Western Australia as for South Australia lends credence to the view that this is a shallow water species and that the specimens from deep water are expatriates which having settled there as larvae, do not find favourable conditions for survival to maturity.

The adult specimens show considerable variation in the character of the spines but there is no doubt that they are conspecific. Having regard to their diversity which at one extreme approaches *U. granifera* "granifera" group there exists some doubt whether this form should be given specific status. Taken individually, none of the characters used by Clark (1923, p. 244 and p. 246) in creating the species are reliable and each of them is shown at least in some degree by one or other of the South Australian forms. On the other hand the overall appearance of the majority of specimens is unlike that of any seen from South Australia or elsewhere. The occurrence in some specimens of larger and relatively long pointed spines on the rays and disk is distinctive and the clusters of fine and pointed spinelets on the carinal and dorso-lateral plates in others are unique in the genus. On the whole the species is considered valid.

An endemic distribution in the temperate waters of the lower west coast of Western Australia is indicated from the present material. No specimens have been recorded from the Great Australian Bight. From the brief notes accompanying the specimens the species shows some variability in habitat and may occur on rock, sand, or muddy bottom in depths to 20 m.

Distribution in the South Australian Gulfs

Uniophora granifera is seldom found on exposed coastlines; it prefers protected waters and occurs predominantly along the coastal fringe of gulfs and bays down to about 15 m. Occasionally juveniles with R up to 10 mm have been taken in deeper water of 40-50 m but this environment is apparently unsuitable as larger specimens have never been taken at such depth despite extensive collecting and dredging.

Uniophora nuda is found in the protected parts of more open waters but so far has not been taken in St. Vincent Gulf.

Figure 1 indicates the distribution of the species in the Gulfs.

Populations of "granifera" group occur in abundance on the reefs of the eastern coastal margin of St. Vincent Gulf southwards from Glenelg. These reefs are not continuous and colonies of the seastar are geographically separated by

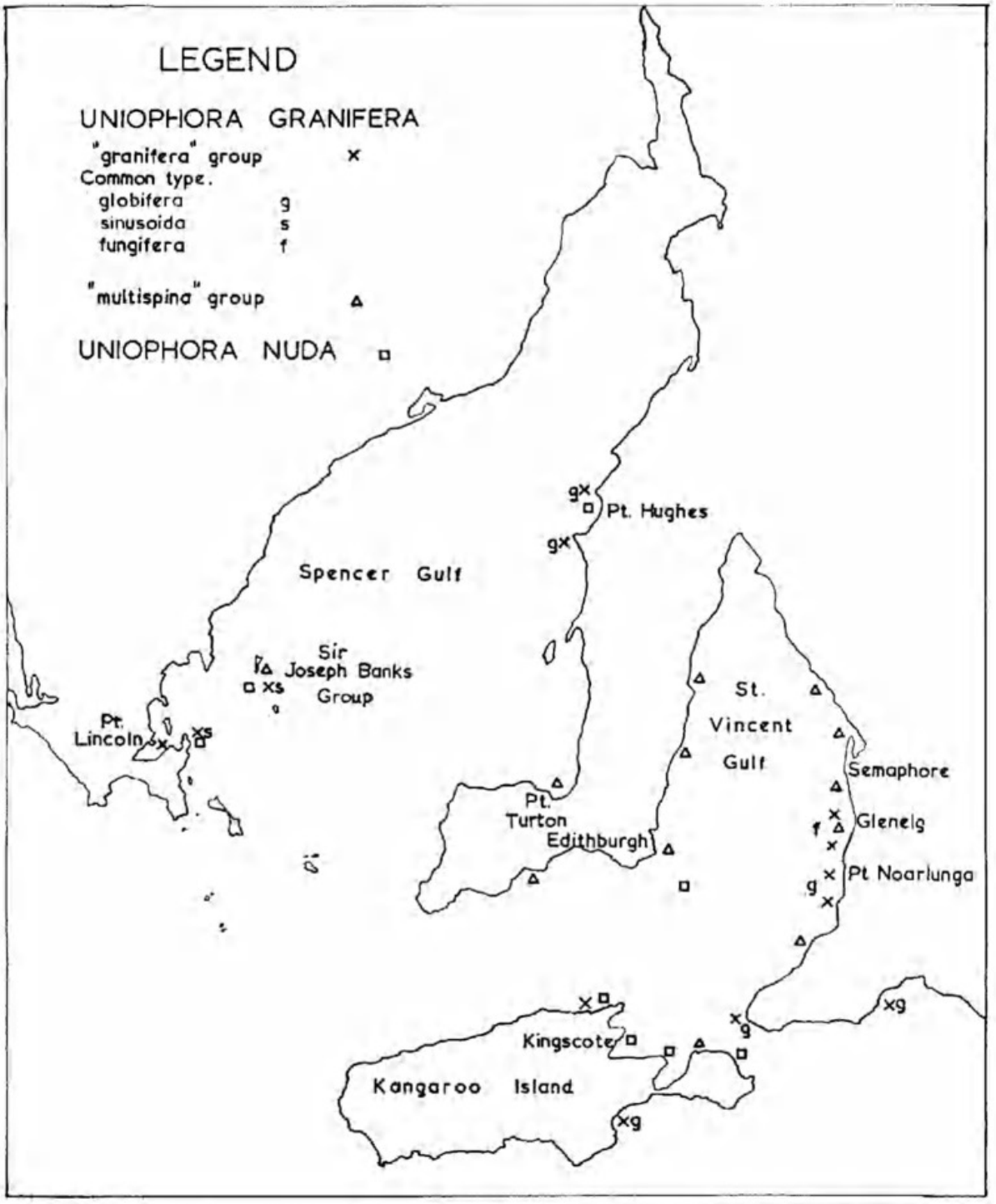

Fig. 1. The distribution of the species in Spencer and St. Vincent Gulfs showing the occurrence of the dominant forms.

stretches of sandy bottom. There are not many representatives of the "sinusoida" form here; the "fungifera" form is dominant at Glenelg, in Holdfast Bay and Halletts Cove but further south the "globifera" form is more common. The population samples are not sufficient to assess accurately the proportions in which the three forms occur. It is noted however that the specimens of the dominant form from any one locality are fairly homogeneous and that there are minor but recognizable morphological differences when a population sample from one place is compared with one from an adjacent colony. The inter-population differences do not appear to follow any pattern of variation and no clines have been detected. The distribution of populations of "multispina" group corresponds with the extent of the beds of *Posidonia* and *Cymodocia* on the coastal margins of St. Vincent Gulf. It is found along much of the western margin of the Gulf but on the eastern margin it is common only to the north of Holdfast Bay; specimens are seldom taken to the south.

Some intergradation between *U. nuda* and "multispina" forms of *U. granifera* has been observed on the north coast of Kangaroo Island near Cape Marsden and about Eastern Cove (Clark, 1928, p. 411) but its extent is not known. The evidence does not suggest that it is at all frequent or widespread. No intergradation has been observed anywhere between *U. nuda* and any forms of "granifera" group even where the two species are found in the same geographical area, although in different ecological niches.

The distribution in Spencer Gulf is still sketchily known. Despite extensive diving no specimens have been taken around the Gambier Islands, the Neptunes, or Thistle Island but they seem to be common enough in the quieter waters further north. In the Sir Joseph Banks Group it appears that *Uniophora granifera* occurs commonly both with the "granifera" and "multispina" kind of spinulation (Stach, 1938, p. 329), and *U. nuda* has also been dredged in deeper water off Spilsby Island.

No specimens of *U. granifera* have been taken west of Spencer Gulf but as little collecting has been done on the west coast of Eyre Peninsula its discovery in suitable localities along that coast would not be surprising. As yet only *U. granifera* "granifera" group has been taken off the coasts of New South Wales, Victoria and Tasmania.

Differences in Uniophora Colonies

The forms differ basically from each other in the number and nature of the spines, notably those dorsally on the rays. Spine counts therefore seem to offer the best method of presenting the differences statistically despite the irregularity of arrangement of the spines. The spines along the plates of the carinal series from the base of the ray to the tip were counted and the results are expressed in spines per cm to compensate for size variations.

Because of the unpredictable local occurrence of colonies there are not many collections which are sufficiently comprehensive to give reliable statistical definitions of the several populations. For the sake of completeness even small series are analysed so that the data in the following table and Figure 2 comprise the figures for all series of five or more specimens.

The purpose of the statistical record is firstly to show the close relationship between the several forms and secondly to determine the variability within a population and so complete the empirical description of the material. Analysis of the larger population samples shows that the spine-counts follow a normal distribution curve and a comparison of population samples indicates a gradual

TABLE 1

Geographical occurrence of Uniophora colonies sampled.

Form	Locality + Depth (in metres)	No. of specimens	Mean size of sample (R) in cm.
(1) *U. nuda*	Cape Donnington—15m.	5	8·3
(2) ,,	Sir Joseph Banks Group—30m.	6	4·3
(3) ,,	Kingscote—Nepean Bay—5m.	57	4·5
(4) ,,	Backstairs Passage—30m.	5	8·8
(5) *U. granifera* ("multispina" group)	Edithburgh—5m.	28	4·5
(6) ,,	Outer Harbour—5m.	10	4·7
(7) ,,	Semaphore—10m.	17	10·2
(8) ,,	Pt. Turton—7m.	14	6·8
(9) *U. granifera* ("granifera" group)	Glenelg Breakwater—5m.	17	7·5
(10) ,,	Halletts Cove—7m.	7	6·0
(11) ,,	Pt. Noarlunga—7m.	34	4·6
(12) ,,	Pt. Willunga—8m.	21	4·0
(13) ,,	Snapper Rock off Cape Donnington—5m.	6	6·4
(14) ,,	Pt. Hughes—5m.	6	4·6

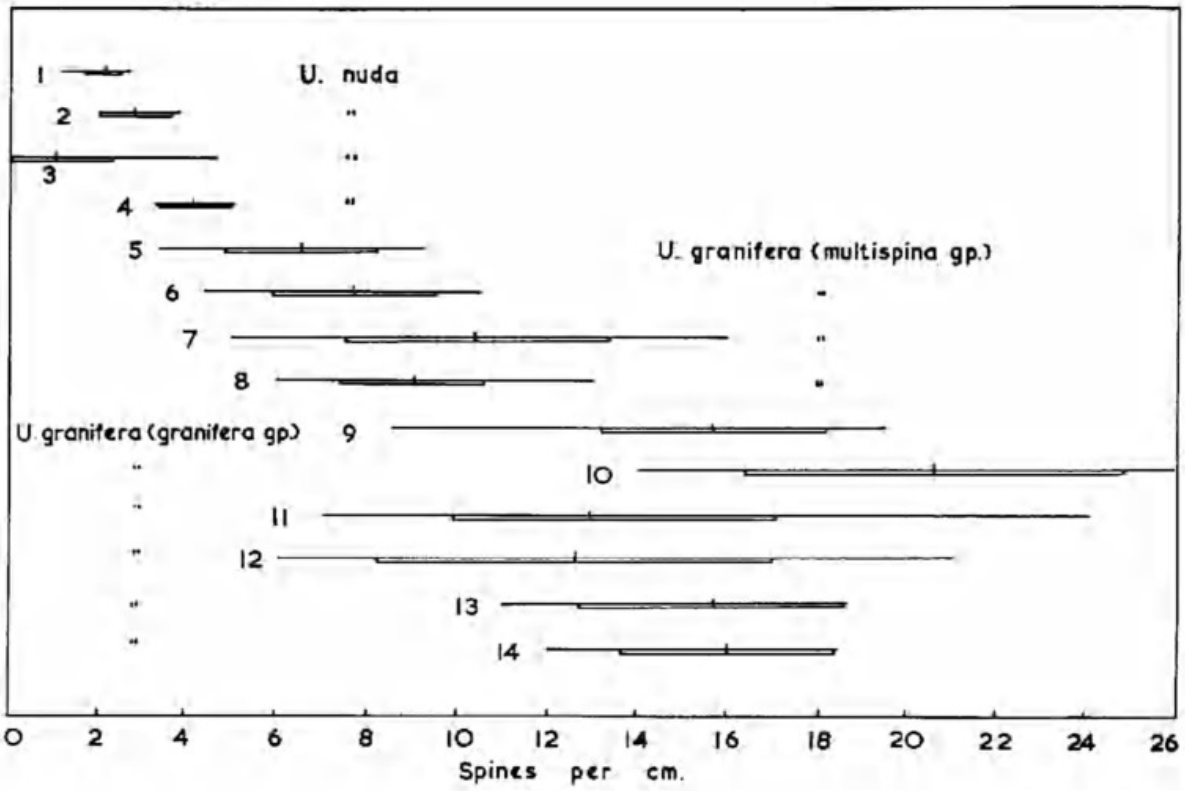

Fig. 2. The graph is a summary of Uniophora carinal spine-counts. In each case the single line represents the range, the rectangle in block one Standard Deviation on either side of the mean, and the vertical line the mean.

increase in spine counts from *U. nuda* to *U. granifera*. Despite the slight overlap between *U. nuda* and *U. granifera* it is considered that the combination of the differences between the two is sufficient to justify specific differentiation. Table 2 summarises the characters which are useful in discriminating between the forms. It is evident at once, that there are no diagnostic characters which can be relied upon as absolute determinants; the characters are all variable and can be used only in conjunction with others to distinguish the forms. Even then the degree of overlap may in some cases cause difficulty. Another problem is that Table 2 is based primarily on the South Australian material so that when the specimens from other States are examined it is found that the character combinations are not quite the same and intermediate degrees of relationship exist. Other characters are referred to in the literature which have been used from time to time as determinants, for example the presence of pedicellariae and pebbled areas in the intermarginal plates, but these are now ignored as they have not been found to be of any significance.

TABLE 2

Major differences between Uniphora species.

	U. dyscrita	*U. nuda*	*U. granifera*	
			"granifera" gp.	"multispina" gp.
Carinal series, i.e. central series of plates dorsally on rays	Zig-zag	Straight, sometimes zig-zag distally	Zig-zag sometimes irregular	Straight, sometimes zig-zag distally
Carinal spines Frequency (per cm.)	Capitate or bluntly pointed 9-15	Inconspicuous fine and pointed 0-5	Capitate, singly or in groups 8-25	Capitate sometimes bluntly pointed singly or in groups 4-13
Dorso-lateral spines	Irregularly arranged, often in groups. Smaller and finer than carinals	Absent	Irregularly arranged, or arranged to form polygonal papular areas	Form 1 or 2 regular series each side of carinals
Supero-marginal spines	Capitate or flattened terminally	Rare or absent	Capitate	Slightly capitate. Often in groups of 2-3
Actino-lateral spines	Present	Rare or absent	Present	Present

The considerable increase in spine numbers per cm along the carinal line in "granifera" group as shown in Figure 2 is due partly to the exaggerated development of the characteristic zigzag carinal plates and partly to the increase in spines on the plates. Of the series from St. Vincent Gulf it is noteworthy that the specimens from Port Noarlunga southwards are generally smaller and have fewer and more capitate spines than those further north. The series from Halletts Cove and Glenelg Breakwater shows some intergradation with "multispina" group.

Table 1 also shows the variation in the mean size of adult specimens from the populations sampled. The reason for the diversity in size is not known. It does not appear to be related directly to age as there is no difference in maximum size of specimens collected in one locality at different times of the year and in different years. The seastars are sedentary in habit and it is probable that the type and quantity of food available is an important factor. It is noted for example that the specimens of *U. nuda* from the rich hammer oyster beds off Cape Donnington are considerably larger than the specimens of the same species from the quiet waters of Nepean Bay, Kangaroo Island.

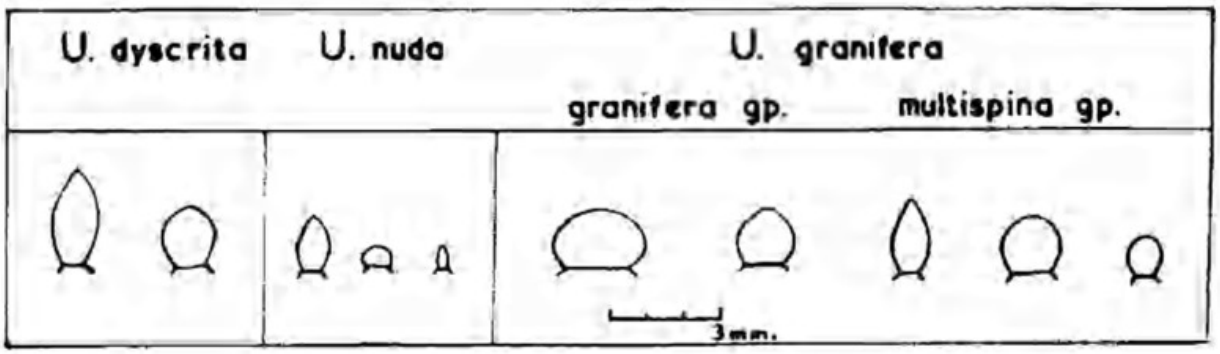

Fig. 3. Lateral view of prominent carinal spines on rays.

CONCLUSION

The greater amount of material now available reveals that in the South Australian Gulfs there are two species of *Uniophora*. One of these *U. granifera* contains two component groups of populations, each of which has some peculiarities of behaviour, distribution and morphology. The populations called "granifera" are found on rocky bottom along coasts of moderate wave action whereas "multispina" populations occur on sandy bottom and in calmer water. Specimens having characteristics of both "granifera" and "multispina" have been taken on bottoms of a mixed character. The interesting problem is raised whether the differences in morphology are genetically or ecologically determined, but this cannot be resolved without experimental work.

The existing evidence suggests that *U. nuda* is a distinct species but this view may require reconsideration should intermediate populations be discovered. Whatever the case is, the two species have succeeded in occupying a variety of habitats and so been able to flourish in the Gulf regions in an abundance, which is without rival among the asteroids. There is no evidence of the species achieving the same success elsewhere on the Australian coast.

Uniophora dyscrita must be retained as a valid species for the present. There is no record of the species from the Great Australian Bight. It is quite likely that the exposed coasts and long stretches of sandy shore of that region constitute a natural barrier sufficient to prevent gene flow between the South Australian and Western Australian species. (See Womersley and Edmonds, 1958, p. 221, and Jennings, 1963, p. 45.) In view of the known ecological requirements of the species much of this coast would not provide favourable conditions for survival. The differences already visible indicate genetic variation and hence the evolution of separate species.

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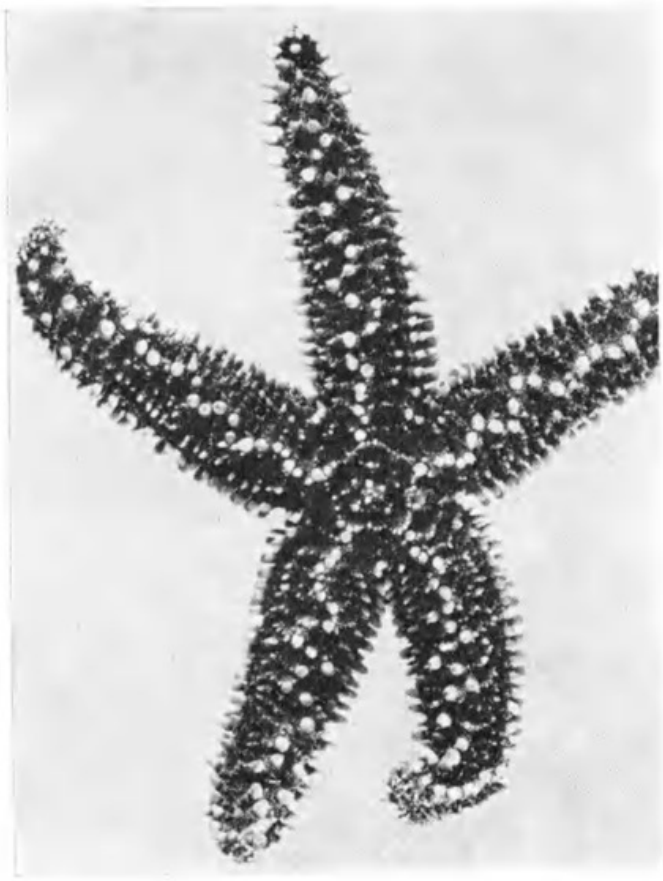

Plate 1

(1) Dorsal view of specimen of *Uniophora dyscrita* numbered U.D. 1 R = 54 mm. Collected R. Howlett on muddy, sandy bottom. Depth 25 ft. Palm Beach Jetty 3/3/60. Rockingham, W.A. (Photo E. P. Hodgkin.)

(2) Dorsal view of specimen of *Uniophora dyscrita* numbered U.D. 14 R = 55 mm.
Collected Stn. 61 Naval Base, Cockburn Sound, W.A., among Pinna 10 ft. deep by Marine Gp W.A. Naturalists 10/4/60. (Photo E. P. Hodgkin.)

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