

A new species of *Trapania* (Nudibranchia: Goniodorididae) from Western Australia with comparisons to other Indo-West Pacific *Trapania*

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Abstract

A new species of *Trapania* Pruvot-Fol, 1931 is described from near Rottnest Island, Western Australia. The new species *Trapania safracornia* shares several characteristics with other species of Indo-West Pacific *Trapania*. Those characters include a soft elongate body, no distinct mantle edge, two sets of curved dorsal lateral processes, non-retractile gill and rhinophores with no pockets, a radular formula of N x 1.0.1, a long tubular prostate and both a bursa copulatrix and a receptaculum seminis on the exogenous sperm duct. Characters that distinguish this as a new species include external red-brown coloration without any white spots, symmetrical white patches overlaid with yellow pigment, a yellow-tipped tail and lateral processes and a translucent red rhinophore club. *Trapania safracornia* also differs from the most externally similar species *T. brunnea* Rudman, 1987 in the radular morphology. *Trapania safracornia* has 10-14 main denticles per lateral tooth and up to eight additional small denticles between these. There is one small triangular denticle on the outside of the largest cusp at the base. The jaw rodlets of this new species are straight and pointed. A comparison between *Trapania safracornia* and other Indo-Pacific species of *Trapania* is presented.

Key words: *Trapania*, Goniodorididae, Phanerobranchia, Western Australia, Indo-West Pacific

Introduction

Goniodorididae H. & A. Adams, 1854 remains a poorly understood family of dorid nudibranchs. (Gosliner, 2004). Recent studies have added to the knowledge of some genera (Gosliner 2004; Wägele & Cervera 2001; Cervera *et al.* 2000; Millen & Bertsch 2000;

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Valdés & Ortea 1995; Rudman 1987). Presently there are twenty-three described species of *Trapania* Pruvot-Fol, 1931. Rudman (1987) described seven new species of *Trapania* from the Indo-West Pacific and redescribed an eighth species from Hong Kong. He compared these eight species to the Atlantic and Mediterranean species. Cervera and García-Gómez (1989b) described two new Atlantic-Mediterranean species. Cervera *et al.* (2000) compared the eleven described Atlantic and Mediterranean species of *Trapania* and also described a new species. Their paper presented a table comparing all twelve Atlantic and Mediterranean species. Three species, *T. velox* (Cockerell, 1901), *T. goslineri* Millen & Bertsch, 2000 and *T. inbiotica* Camacho-García & Ortea, 2000, have been described from the Pacific coast of North America. *Trapania rudmani* Miller, 1981 has been described from New Zealand. *Trapania japonica* (Baba, 1935) is described from Japan. Two species remain undescribed (Gosliner 1987).

The present paper describes a new species of *Trapania* collected from near Rottneest Island, Western Australia and compares it to the Indo-West Pacific species. A summary table is presented using the same characters examined by Cervera *et al.* (2000) for the Atlantic and Mediterranean species. Comparisons are also made between *Trapania safracornia* sp. nov. and externally similar Atlantic and Mediterranean species. The specimens studied are deposited at the California Academy of Sciences (CASIZ) in San Francisco, California.

Species Descriptions

Goniodorididae H. & A. Adams, 1854

Trapania Pruvot-Fol, 1931. Type species: *Trapania fusca* (Lafont, 1874), type species by monotypy—*Drepania fusca* Lafont, 1874: 369-370.

Trapania safracornia sp. nov.

(Figures 1–4)

Type material. Holotype: CASIZ156067. North side, Rottneest Island, Western Australia, Australia, 32.00S, 115.30E, collected by G. Gunness, 12 April 2001, 28 m.

Paratype: CASIZ162641. From type locality.

Additional specimens not collected: Two specimens, from type locality, photographed by G. Gunness, February 2004.

Distribution. This species is known only from the type locality.

Etymology. The specific name *safracornia* is taken from the Arabic *safr* meaning yellow and the Latin *cornus* meaning horn. The name refers to the yellow processes on this new species.

External Morphology. Living animals 7 and 8 mm in length. Body shape soft, elongate; plump midsection (Figs 1A, B). No distinct mantle edge. Elongate processes next to each rhinophore and on each side of the gill, curving upwards, towards posterior of animal. Gill and rhinophores not retractile, no rhinophore or gill pockets. Gill composed of three bi- or tripinnate branchial leaves. Anus situated within circle formed by gill branches. Long rhinophores with 9–10 lamellae on posterior side. Two long tapered oral tentacles, anterior edge of foot extends to elongate tapered corners and curved leading edge (Fig 1C). Genital aperture located on right side of body in anterior third.

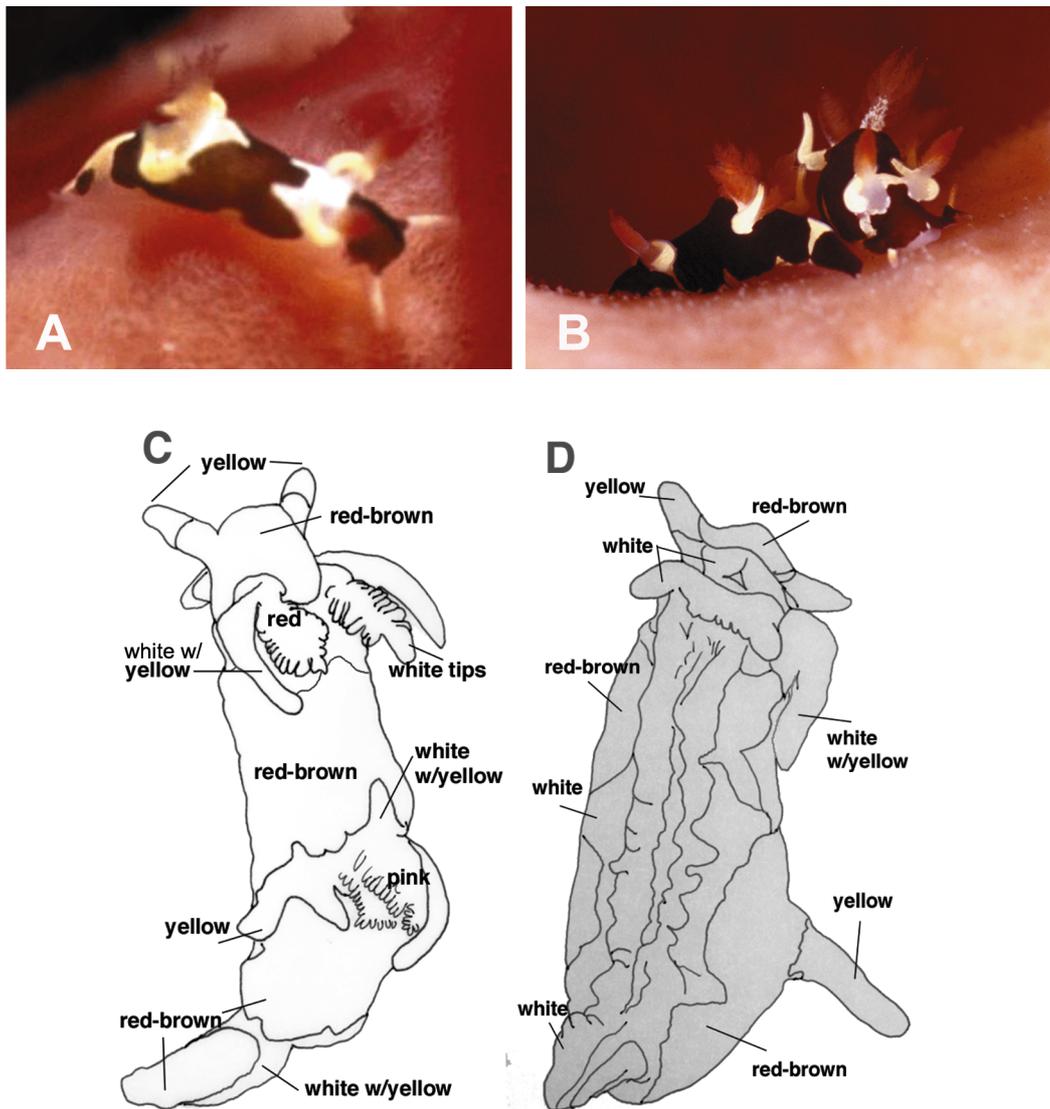


FIGURE 1. *Trapania safracornia*: Dorsal views of living animal; photos taken by Graeme Gunn. A, CASIZ156067, Holotype; B, Two uncollected specimens. C, D, Camera lucida drawings of living animal showing the color pattern (C, paratype; D, holotype). Approximate size in life: 7 mm.

Brown background color of living animal with symmetrical white patches between rhinophores, at gill, tail tip and posterior third of dorsum (Fig 1C). White patch at gill saddle-shaped and patch at rhinophores extends only posteriorly in two points. No white spots in addition to large white patches on dorsum. Irregularly shaped overlay of yellow pigment on white patch at posterior third of dorsum and on tail tip. Yellow pigment covers white ground color of elongate processes next to gill and rhinophores. White ring around rhinophoral apertures. Translucent rhinophore stalks with red club and white tips. Translucent gill branches with pinkish-tan apex. No distinguishing color on axes. Ventral side with long white patch extending length of animal, three symmetrical extensions of white color up body sides (Fig 1D). White oral tentacles, foot corner extensions. Red-brown anterior of foot.

Internal Anatomy. Oval buccal bulb (Fig 2A), small buccal pump and not as prominent as compared to other *Trapania* species (Rudman 1987). Tiny seed-shaped oral glands around the mouth. Radular formula 21 x 1.0.1 in both specimens (CASIZ156067, 162641). Teeth increase in size from oldest to newest (Fig 3A). Rachidian teeth absent. One long cusp on outer edge of each tooth with multiple large denticles (10–14) that vary in size, smallest located near inner edge (Fig 3B). Largest of main denticles always second or third from main cusp. In between largest denticles 1–2 minute denticles, up to eight per tooth. Largest cusp at outer edge of tooth with one small broadly triangular denticle at base of outer edge (Fig 3C). Jaw, a thickened plate with two rows of pointed rodlets around open edge (Fig 3D).

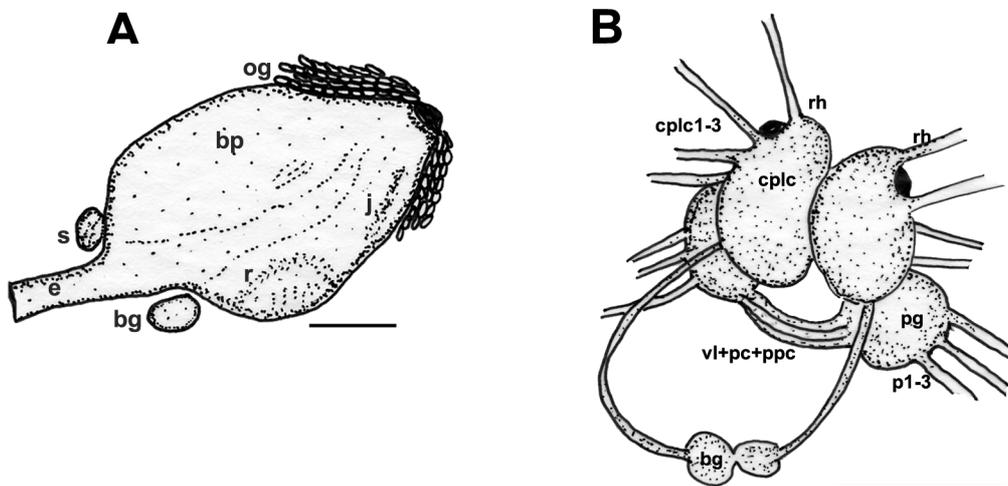


FIGURE 2. *Trapania safracornia* (CASIZ 156067), A, Camera lucida drawing of buccal bulb. Scale = 5.8 mm. B, Camera lucida drawing of Central Nervous System. Scale = 0.13 mm. Abbreviations: bg, buccal ganglia; bp, buccal pump; cplc, cerebral pleural complex; e, esophagus; j, jaw; og, oral glands; pc, pedal commissure; p1-3, pedal nerves; pg, pedal ganglia; cplc1-3, cerebral pleural complex nerves; ppc, parapedal commissure; r, radula; rh, rhinophoral nerve; s, salivary glands; vl, visceral loop.

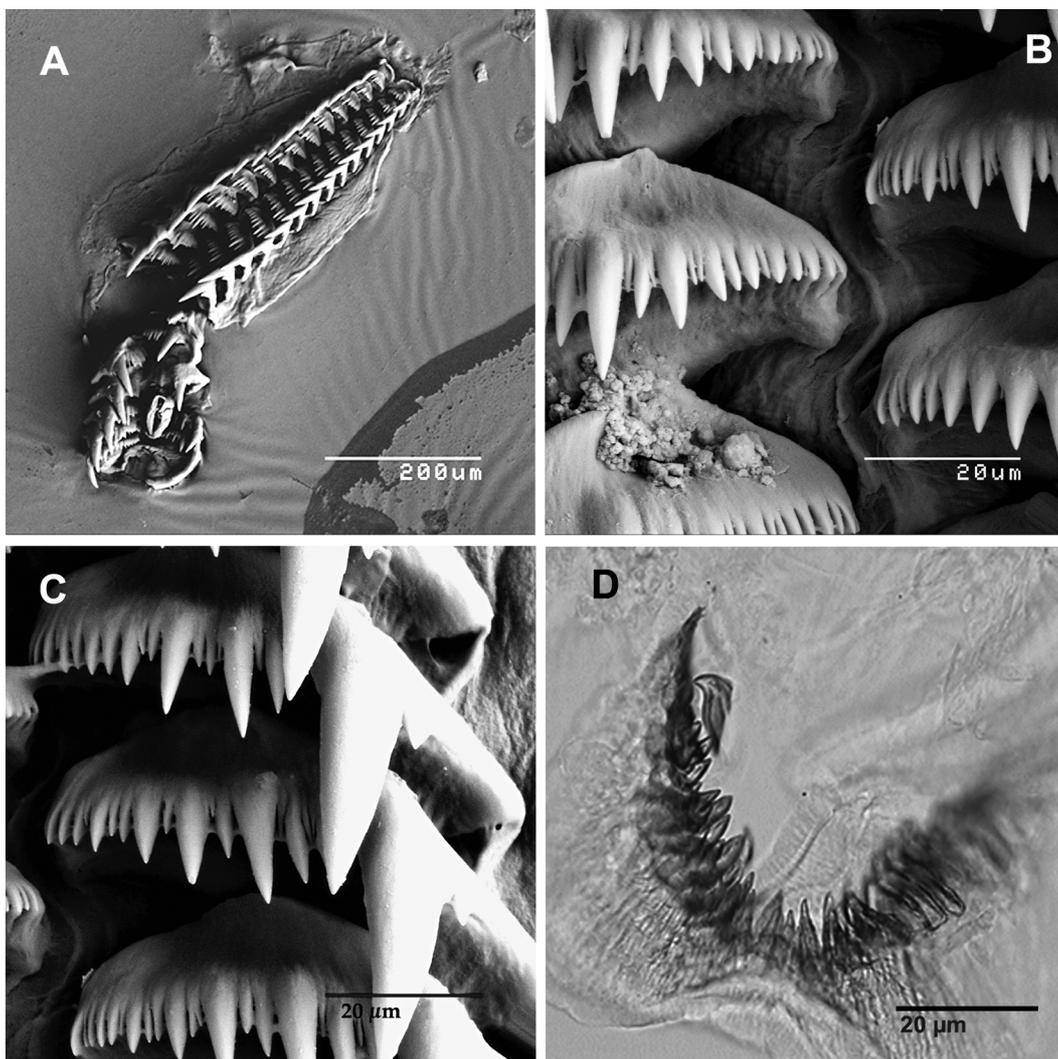


FIGURE 3. *Trapania safracornia* (CASIZ 156067), A-C. Radular morphology, scanning electron micrographs. A, Whole radula. B, Inner denticles, rows 10-12. C, Outer denticles, rows 12-14. D, Jaw rodlets, digital image from compound microscope.

Ampulla large, nearly round (Fig 4), branches into oviduct and prostate. Hermaphroditic duct enters ampulla terminally. Thin oviduct enters large female gland mass. Thick tubular prostate folds once after exiting ampulla, narrows into short, muscular deferent duct. Deferent duct widens into elongate penis. Sparse, small spines in distal portion of penis. Vaginal duct twice as long as deferent duct, lacks spines. Vaginal duct enters large, round bursa copulatrix at proximal end. Distal end of vaginal duct widens into bulbous vagina, which has longitudinal folds. From bursa copulatrix, separate oviduct connects to large, round receptaculum seminis. Bursa copulatrix approximately two times as large as

receptaculum seminis. Short uterine duct from receptaculum seminis to female gland mass.

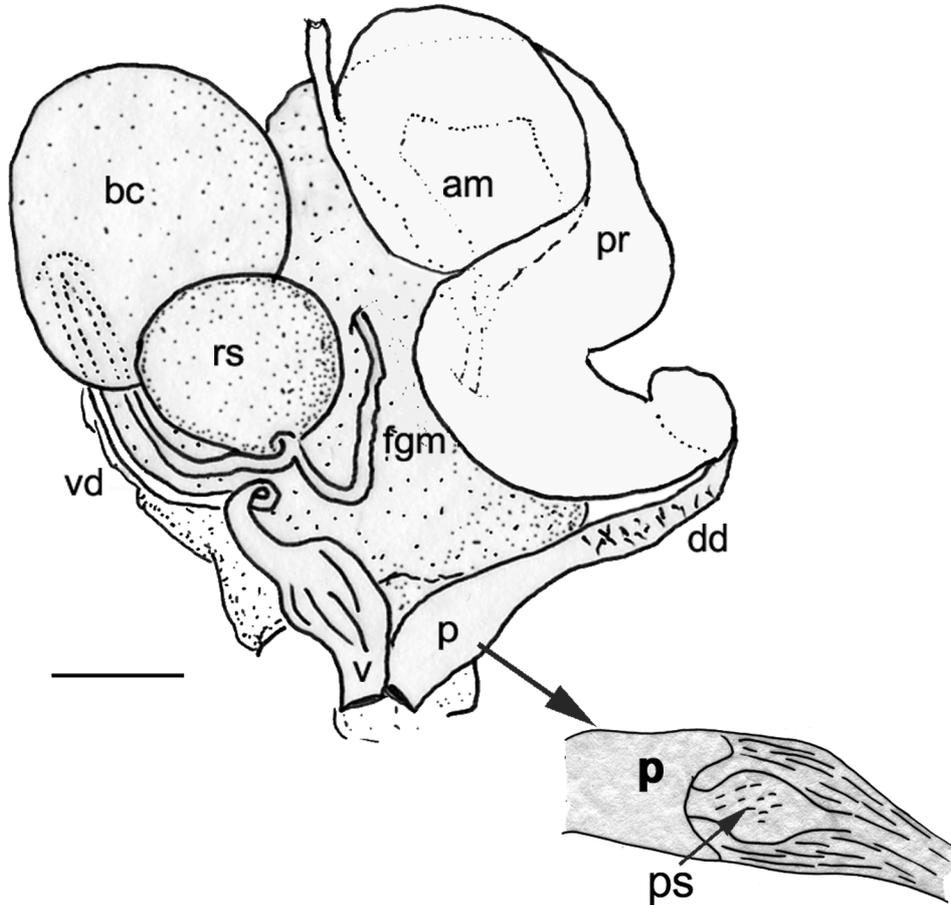


FIGURE 4. *Trapania safracornia* (CASIZ 156067), Reproductive organs. Abbreviations: am, ampulla; bc, bursa copulatrix; dd, deferent duct; fgm, female gland mass; p, penis; pr, prostate; ps, penial spines; rs, receptaculum seminis; v, vagina; vd, vaginal duct. Scale bar = 0.25 mm.

Central nervous system with fused cerebral and pleural ganglia (Fig. 2B). Eyes sessile on cerebral ganglia. Two equal sized pedal ganglia behind and slightly below cerebro-pleural complex, joined by short commissure. Three prominent nerves leading from pedal ganglia and four nerves including the rhinophoral nerve, originate from cerebro-pleural ganglia. Two buccal ganglia positioned ventral to esophagus.

Discussion

The general anatomy and reproductive systems of *Trapania* species show very little variation (Cervera *et al.* 2000; Cervera & García-Gómez 1989a; Cervera & García-Gómez

1989b; Rudman 1987; Miller 1981). Rudman (1987) noted that there are two sets of characters, external color and radular teeth and jaw morphologies that are most useful to distinguish *Trapania* species. Therefore, the external color of *T. safracornia* will first be compared to other externally similar species.

Externally, *T. safracornia* is most similar to *T. brunnea* Rudman, 1987 found along the east and south coasts of Australia, Tasmania and Lord Howe Island (Rudman, 1987). However, *T. brunnea* has sparsely scattered small white spots or iridescent specks on the dorsum, which *T. safracornia* lacks. Additionally, *T. brunnea* has a white streak or patch on the head and a white patch between the rhinophores that is H-shaped. The white patch between the rhinophores of *T. safracornia* is a thickened upside-down U-shape and the head is red brown, with no white patch. Other external differences include the color of the dorsal processes. *Trapania safracornia* has yellow processes, while *T. brunnea* has white processes with a brown band. The gill and rhinophore color differs between these two species as well. The gill of *T. safracornia* is translucent white with pink overtones and the rhinophores are translucent with red clubs, which have a white tip. In contrast, the gill of *T. brunnea* is white with a translucent brown axis that has reddish brown speckling. The rhinophores of *T. brunnea* have a translucent brown club with a white tip.

Another southeastern Australian species *T. benni* Rudman, 1987 also has a reddish brown body, however that species has a dense covering of slightly raised yellow or white spots (Rudman 1987). The gill and rhinophore color also differs between the two species. *Trapania safracornia* has a translucent gill with pinkish-tan tips, whereas *T. benni* has a translucent gill with white speckles and brown patches on the axis of each gill leaf. Further, the rhinophore color of *T. safracornia* is translucent with a red club and white tips, while *T. benni* has translucent rhinophores with white specking and patches of brown and yellow.

Trapania reticulata Rudman, 1987 from the Great Barrier Reef, Australia has a translucent brown dorsum but in that species there is an overlay of fine reticulate dark brown lines that *T. safracornia* does not have.

None of the other described Indo-West Pacific, Atlantic or Mediterranean *Trapania* species has a similar color pattern to *T. safracornia*. However, some species of *Trapania* have brown pigment on the dorsum such as the eastern Australian species *T. japonica* and *T. fusca*. But in those species the brown pigment is confined to spots. Additionally, the oral tentacles, gills and rhinophores of *T. fusca* are yellow while the oral tentacles of *T. safracornia* are white with translucent white gills and rhinophores. The ground color of *T. fusca* differs in that it is white while *T. safracornia* has a reddish brown background color.

The Mediterranean *T. lineata* Haefelfinger, 1960 has a reddish or clear brown ground color, but it also has random opaque white lines crossing over the body which *T. safracornia* does not have. *Trapania dalva* Marcus, 1972 from the northwest Atlantic has a cream ground color with brownish blotches on the body, but there is no yellow coloration on the processes and the gill is brown with white spots.

Two *Trapania* species have yellow or orange dorsal processes, similar to *T. safracornia*. The eastern Pacific *T. goslineri* has golden orange-tipped processes and a golden orange tail, but this species has black streaks on the processes and dark oval spots and streaks on the dorsum. The dorsal processes and tail of *T. safracornia* do not have dark streaks or spots. *Trapania hispalensis* Cervera, García-Gómez & Megina, 2000 has lemon yellow colored processes, gill and rhinophores, whereas only the dorsal processes are yellow in *T. safracornia*. The ground color of *T. goslineri* is white. Millen and Bertsch (2000) presented a table comparing *Trapania* species that share a white ground color and have dark or yellow markings.

In addition to the unique external color characters of *T. safracornia*, there is a particular combination of internal anatomical features, which sets this new species apart from other described *Trapania* species. With regard to reproductive characters, Miller (1981), Rudman (1987), Cervera & García-Gómez (1989a, b) and Cervera *et al.* (2000) observed that there are no significant differences between species of *Trapania*. Indeed, examination of the literature and accompanying drawings of other *Trapania* along with the dissection of the type specimens of *T. safracornia* revealed few differences between species. However, three differences were noted when comparing *T. safracornia* with *T. brunnea*, the most externally similar species. Although only two specimens of *T. safracornia* have been examined for the present study, the following variations should be examined for consistency if additional specimens are found. These include the length of the vaginal duct, which appears to be much longer and coiled in *T. safracornia* than in *T. brunnea*. The second difference noted is the size of the ampulla. In *T. safracornia* the ampulla is very large and round, in fact as large as the bursa copulatrix. In *T. brunnea* the ampulla is long and sausage-shaped and much smaller than the bursa. The third difference is the length and shape of the prostate. *Trapania safracornia* has a much shorter, thicker prostate than illustrated for *T. brunnea*. However, the prostate of both species has a marked narrowing into a longer deferent duct. These differences may be due to character plasticity although the three characters were consistent between the holotype and the paratype.

As for the jaw and radular morphology, Rudman (1987) noted that these characters were the most useful in differentiating species along with the external color. *Trapania safracornia* has similar radular and jaw morphology to *T. brunnea*. That is, both species have a large cusp closest to the center on the single radular tooth. But *T. brunnea* has two or three denticles on that large cusp, whereas *T. safracornia* has only one. In addition to the large outermost cusp, *T. safracornia* has 10–14 primary denticles per tooth, with one secondary, smaller denticle between these larger denticles. There are up to 8 of these smaller denticles on each tooth. *Trapania brunnea* also has up to fifteen large denticles but with only the occasional minute denticle between these larger primary denticles (Rudman 1987). The jaw of these two species differs in that *T. brunnea* has two bands of jaw rodlets that are recurved with pointed tips. This is in contrast to *T. safracornia*, which has a jaw with two rows of straight pointed rodlets.

TABLE 1. Comparison of the Indo-West Pacific *Trapania*. Abbreviations: NSW = New South Wales, Australia; QLD, Queensland, Australia; SA, South Australia; SE, Southeast Australia; WA, Western Australia.

	<i>T. safracornia</i> sp. nov.	<i>T. brunnea</i> Rudman, 1987	<i>T. benni</i> Rudman, 1987	<i>T. japonica</i> (Baba, 1935)	<i>T. reticulata</i> Rudman, 1987
Background color	Reddish-brown	Dark brown	Reddish-brown	White	Translucent brown
Other body colors	Symmetrical white patches, yellow pigment overlaid on posterior white patch and tail	Symmetrical white patches, scattered small white spots or iridescent specks	Symmetrical white patches, with dense white speckles, larger bright yellow marks, dense cover of raised small yellow or white spots	Randomly scattered, dark brown spots	Fine reticulate pattern of fine dark brown lines. Large yellow spots
Head color	Red-brown with yellow extensions	White midline streak or triangular patch	Large white patch	Same as background	Same as background
Foot color	White	White posterior tip and anterior corners, irregular white border	Irregular translucent white border	Brown spot on posterior	Same as background
Oral tentacle color	White	White upper third	Translucent white/white specks, yellow spot	Brown	No distinguishing colors
Rhinophore color	Translucent white stalk, translucent red club with white tip	Translucent white stalk w/white spots, translucent brown club with white tip	Translucent white stalk w/white specks, anterior patches of brown, yellow on posterior of club tip?	White stalk, brown club Tip? Lamellar edge	Brown stalk with small yellow spots, translucent brown club with white tip , dark brown lamellae edge
Lateral processes color	Opaque yellow	White with median dark brown band	White with red-brown marks	Bright yellow	Reticulate pattern same as on dorsum
Gill color	White base, translucent pink-red apex, no distinguishing axis color	White base, no distinguishing color on apex, brown axis with red-brown specks	Translucent white base with white speckles, no distinguishing apex color, brown patches on axis	Translucent white base, brown pigment on apex brown pigment on axis	Translucent white base and apex, edged in brown with yellow spots, no distinguishing axis color
Teeth rows	21 rows	30(+1) rows	24 rows	23(+1) rows	40(+1) rows
Tooth shape	1 large outer cusp with small outer denticle at base, 10 main inner denticles, one minute denticle between each	1 large outer cusp with 2-3 outer denticles at base, up to 15 inner denticles, some minute denticles in between	1 large central cusp with 2 denticles on outside, 3-4 inside	1 large central cusp with 12-24 denticles on inside, up to 9 on outside	1 broad, triangular outer cusp, with up to 16 denticles inside, 2 small basal denticles outside
Jaw	Jaw rodlets with pointed tips, in 2 rows	Jaw rodlets with recurved pointed tips, in 2 bands	Jaw rodlets tiny, long, pointed tips, in 1 ring	Jaw rodlets blunt or rounded, in 2 circular pads	Jaw rodlets with recurved pointed tips, in 2 bands
Buccal pump	Not prominent, more ovoid than round	Prominent, very muscular, rounded	Prominent, cone-shaped	Not prominent, rounded	Not prominent, rounded
Geographic range	Australia: Rottnest Island, WA	Australia: NSW, Tasmania, Victoria, SA, Lord Howe Is	Australia: NSW, Victoria	Australia: NSW, QLD Hong Kong	Australia: Great Barrier Reef, QLD
References	Present study	Rudman (1987) Willan (1989)	Rudman (1987)	Rudman (1987) Baba (1935)	Rudman (1987)

TABLE 1 (continued).

	<i>T. aureopunctata</i> Rudman, 1987	<i>T. toddi</i> Rudman, 1987	<i>T. aurata</i> Rudman, 1987	<i>T. darvelli</i> Rudman, 1987	<i>T. rudmani</i> Miller, 1981
Background color	Opaque white	Translucent white	Opaque white	Opaque white	Translucent white
Other body colors	Few irregular yellow spots	Symmetrical brown reticulate patches	Yellow-orange marks	No distinguishing colors	No distinguishing colors
Head color	Same as background	Same as background	Yellow-orange band on anterior edge	Same as background	Same as background
Foot color	Same as background	Yellow posterior	Yellow-orange posterior and edge	Same as background	Same as background
Oral tentacle color	No distinguishing colors	White with yellow band	Yellow-orange, white tip	Brown	No distinguishing colors
Rhinophore color	Opaque white stalk, club	Translucent white stalk, brown lower half of club with white specks, top half yellow with white tip	White stalk, yellow-orange club	Translucent white stalk, club lamellae edged with dark brown, dark brown band below white tip	White stalks, club, edges of lamellae speckled with opaque white
Lateral processes color	Opaque white with 1 large golden yellow spot	White with yellow band below tip. Brown spot midpoint	Broad band of yellow-orange	Upper two-thirds dark brown	Opaque white speckles, yellow line on upper surface
Gill color	Opaque white base and apex, no distinguishing axis color	Translucent white base w/ brown band, yellow apex, no distinguishing axis color	Opaque white base and apex, no distinguishing axis color	Translucent white base and apex with brown edges, no distinguishing axis color	Transparent base and apex, opaque white speckled axis
Teeth rows	24(+1) rows	42(+1) rows	28(+1) rows	31(+1) rows	31 rows
Tooth shape	1 large pointed cusp with 3 outer denticles, 3-4 inside denticles	1 very large elongate pointed cusp with 1 basal denticle outside, inside up to 14 secondary denticles	1 large pointed cusp with 1 prominent denticle on outside, up to 14 inside denticles	Heavily chitonized. 1 large cusp with 1 small, basal outer denticle, 10 triangular flattened inner denticles	1 large cusp with up to 3 outer denticles, up to 7 inner denticles
Jaw	Jaw rodlets with recurved pointed cusp, in 1 band	Jaw rodlets with recurved pointed tips, in 2 elongate pads	Jaw rodlets blade-like with blunt pointed tip, in 1 elongate pad, some short with many denticles on tip	Jaw rodlets straight with blunt pointed tips, in 2 elongate regions	Jaw rodlets pick-like in 2 plates on either side of jaw
Buccal pump	Prominent, muscular, rounded	Not prominent	Well-developed, muscular	Not greatly developed, rounded	Not described or illustrated
Geographic range	Australia: NSW	Hong Kong Red Sea	Hong Kong	Hong Kong	New Zealand
References	Rudman, 1987	Rudman (1987)	Rudman (1987)	Rudman (1987)	Miller (1981)

The radular formula differs between these two species. *Trapania safracornia* has 21 rows of teeth in mature specimens 6–7 mm in length. *Trapania brunnea* has 30(+1) rows in a mature 12 mm specimen.

The particular combination of characters that are found in *T. safracornia* distinguishes it as a new species. Table 1 compares some characteristics of all the described Indo-West Pacific *Trapania* species. See Cervera *et al.* (2000) for a table comparing the same characteristics for Atlantic and Mediterranean species.

Acknowledgements

This project was funded by NSF PEET grant DEB #9978155 (Phylogenetic systematics of dorid nudibranchs) to Terrence M. Gosliner. Graeme Gunness is the captain of the vessel that graciously provides the author research trips in southwest Western Australia. He found and photographed the specimens for this study. Ross Gudgeon kindly scanned the photos of the uncollected specimens. He and Ann Gunness expedited their delivery to the California Academy of Sciences. Fred Wells and the staff at the Western Australian Museum organized the collecting permits in Western Australia. John Hooper and the helpful people in the Marine Lab at the Queensland Museum generously provided the resources and good company during the completion of this study. Terry Gosliner assisted with the dissection of the male reproductive organs of the newly described species. Two anonymous reviewers provided very constructive comments that improved the draft manuscript.

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