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Amphidromus jeffabbasorum, a new species (Gastropoda: Camaenidae)
from Indonesia
N. N. THACH

Revision of the *Dauciconus daucus* complex (Gastropoda: Conidae).
Description of two new species: *Dauciconus jacquescolombi* n.sp. from La Martinique
and *Dauciconus massemi* n.sp. from French Guyana.
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Amphidromus jeffabbasorum, a new species (Gastropoda: Camaenidae) from Indonesia

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Keywords:

Gastropoda, Helicoidea, Camaenidae, *Amphidromus*, Banten, Java Island, Indonesia, new taxon.

Abstract:

A new species of genus *Amphidromus* Albers, 1850 is described from Banten area, Java Island of Indonesia and compared to four other species of this genus: *Amphidromus webbi babiensis* Laidlaw, 1954, *Amphidromus banksi* Butot 1900, *Amphidromus perversus perversus* var. *borneensis* Pilsbry, 1900 and *Amphidromus enganoensis* Fulton, 1896. It is characterized by swollen body whorl, prominent spiral band and axial stripes that are coalescent, forming large blotches.

Introduction:

The genus *Amphidromus* Albers, 1850 belongs to the family Camaenidae and has many species collected in Indonesia. In April of 2016, a hitherto camaenid was found. It was not listed in the works by Laidlaw (1954), Laidlaw & Solem (1961), Springsteen & Leobrera (1986), Parkinson et al. (1987), Abbott (1989), Dharma (2005), Stanisic et al. (2010) and Schileyko (2011). It is here described as new to science.

Abbreviations:

ANSP	Academy of Natural Sciences of Drexel University, Philadelphia, USA
MNHM	Muséum National d'Histoire Naturelle, Paris, France
NNT	Collection Dr N.N.Thach
JA	Collection John Abbas
AH	Aperture height
BH	Body whorl height
SH	Shell height
SW	Shell width

Systematics:

Class Gastropoda Cuvier, 1797
Superfamily Helicoidea Rafinesque, 1815
Family Camaenidae Pilsbry, 1895
Genus *Amphidromus* Albers, 1850
Subgenus *Amphidromus* (*Amphidromus*) s.str.
Type species of genus: *Helix perversus* Linnaeus, 1758
(subsequent designation by von Martens, 1860)

Amphidromis (*Amphidromus*) *jeffabbasorum* n.sp.
Figures 1-10

Diagnosis:

A species of genus *Amphidromus* that differs from other species of this genus in having a well inflated body whorl, prominent spiral banding and axial stripes coalescent, forming large blotches and covering mostly the exterior surface.

Description:

Shell large for the genus (45-50 mm in average adult height, reaching 54.5 mm in large specimens), elongate-tapering in shape. Dextral specimens are less numerous than sinistral ones (4 of 12 collected specimens). Shell width 57.4% of shell height (see Table 1 with measurements of ten specimens). Spire moderately tall and occupying 28.2% shell height, sutures adpressed. Body whorl swollen, periphery rounded. Outer surface ornamented with broad spiral bands and axial stripes that are usually coalescent, forming large blotches. Sculpture consisting of many weak closely-spaced axial riblets extending from suture to suture. Aperture elongate, occupying 51% of shell height with external pattern visible within, outer lip broad, calloused and reflexed. Columella straight and heavily calloused, apex white. Color usually brown with yellowish spiral bands, white outer lip and columella.

Table 1. SW/SH, BH/SH, AH/SH of *Amphidromus jeffabbasorum* n.sp.

No	SH mm	SW mm	SW/SH	Mean SW/SH	BH mm	BH/SH	Mean BH/SH	AH mm	AH/SH	Mean AH/SH
1	49.4	30.0	0.61	0.574	35.0	0.71	0.718	25.5	0.52	0.510
2	52.7	27.8	0.53		35.6	0.68		24.0	0.46	
3	44.8	27.0	0.60		33.0	0.74		23.5	0.52	
4	48.5	28.2	0.58		34.6	0.71		24.3	0.50	
5	47.4	28.5	0.60		34.8	0.73		25.5	0.54	
6	47.8	28.1	0.59		35.0	0.73		24.7	0.52	
7	54.5	30.0	0.55		38.7	0.71		27.0	0.50	
8	48.0	27.0	0.56		35.3	0.74		24.8	0.52	
9	49.6	27.8	0.56		35.4	0.71		24.8	0.50	
10	47.7	26.6	0.56		34.4	0.72		25.0	0.52	

Type material:

Holotype 49.4 mm high in MNHN (Figs.1,2).

Paratypes: all from type locality,

Paratype 1: 52.7 mm high in ANSP (Fig.3a, 4, 5),

Paratype 2: 44.8 mm high in JA (Fig.3b, 7),

Paratype 3: 48.5 mm high in NNT;

Paratype 4: 47.4 mm high in JA;

Paratype 5 to 9 (not illustrated).

Type locality:

Banten, a huge area from west of Jakarta till the western most tip of Java island, Indonesia.

Habitat:

The type specimens were collected on leaves of assorted trees in Banten area, Java Island, Indonesia.

Etymology:

This new species is named in honor of Jeff Parsons of Australia and John Abbas of Hawaii for providing the type material that they collected in Indonesia.

Discussion:

- *Amphidromus (Amphidromus) jeffabbasorum* n.sp. is close to *Amphidromus webbi babiensis* Laidlaw, 1954 (Fig. 13, 14) in swollen body whorl and prominent spiral banding but not always sinistral and differing in not excavated columella, less constricted sutures, more elongate outer lip and wider spire whorls that gradually decrease in diameter (not abruptly decrease in diameter like in the latter).

- *Amphidromus banksi* Butot, 1955 (Fig. 15) differs mainly from *Amphidromus jeffabbasorum* by a more rounded aperture, more constricted sutures, lack of broad spiral band at body whorl and axial stripes not coalescent.

- *Amphidromus perversus perversus* var. *borneensis* Pilsbry, 1900 (Fig. 12) differs mainly from *Amphidromus jeffabbasorum* by lack of spiral bands and axial stripes are widely separated (not coalescent like in the latter).

- *Amphidromus enganoensis* Fulton, 1896 (Fig. 11) differs mainly from *Amphidromus jeffabbasorum* by more inflated whorls, more angulate outer lip and lack of spiral bands.

Acknowledgements:

I want to thank Museum of Natural History London, UK for the photos of *Amphidromus webbi babiensis* and *Amphidromus banksi*, Guido & Philippe Poppe for the photo of *Amphidromus enganoensis* and Bunjamin Dharma for the photo of *Amphidromus perversus perversus* var. *borneensis*. Thanks are also due to the reviewers for useful comments.

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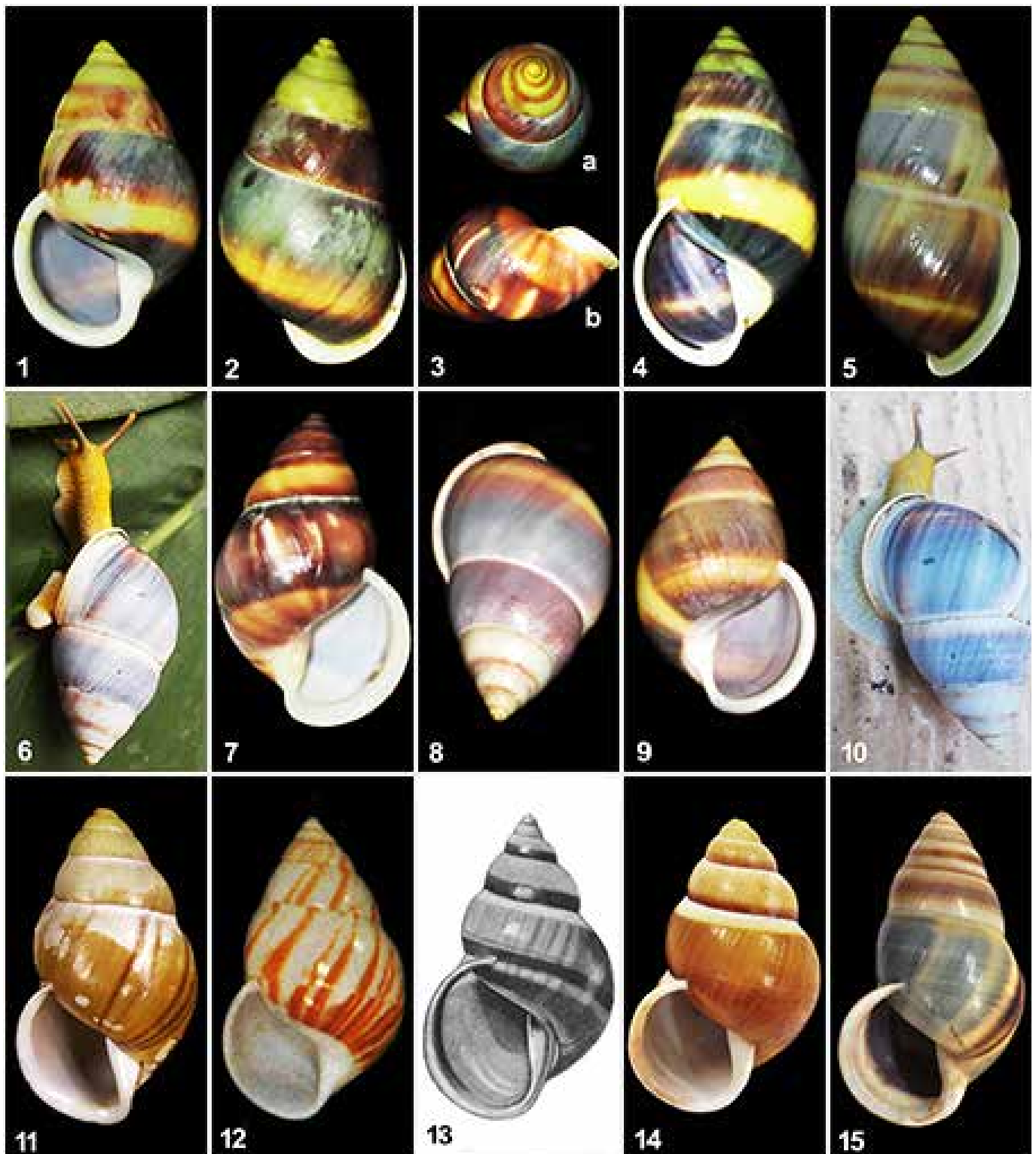
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WEBSITE of Philippe & Guido Poppe (Conchology Inc.).

Plate



1-10: *Amphidromus jeffabbasorum* n.sp., Banten, Indonesia

- 1,2: Holotype 49.4mm SH, MNHN

- 3a,4,5: Paratype 1: 52.7mm SH with apical, ventral and reversed outer lip views, ANSP

- 3b,7: Paratype 2, 44.8mm SH with anterior end view and ventral view

- 6, 10: Live molluscs, photo.J.Abbas

- 8: Paratype 3, 48.5mm SH with spire view

- 9: Paratype 4, 47.4mm SH

- 11: *Amphidromus enganoensis* Fulton, 1896, 39.5mm SH for comparison, photo G.& P. Poppe

- 12: *Amphidromus perversus perversus* var. *borneensis* for comparison, photo B.Dharma

- 13: *Amphidromus webbi babiensis* for comparison, figure Laidlaw

- 14: *Amphidromus webbi babiensis* for comparison, photo London Museum of Natural History.

- 15: *Amphidromus banksi* for comparison, photo London Museum of Natural History.

Revision of the *Dauciconus daucus* complex (Gastropoda: Conidae).
Description of two new species: *Dauciconus jacquescolombi* n.sp. from Martinique
and *Dauciconus massemi* n.sp. from French Guyana.

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Key Words: Taxonomy, new species, Conidae, complex, endemism, *Dauciconus*, *jacquescolombi*, *massemi*, *daucus*, *boui*, *norai*, *goajira*, *vikingorum*, *riosi*, *worki*, *orioi*, *amphiurgus*, *glicksteini*, Martinique, French Guyana.

Abstract: *Dauciconus jacquescolombi* and *Dauciconus massemi*, two previously unrecognized species belonging to the genus *Dauciconus* (Gastropoda, Conidae) are named. The two species live in rather deep water: the first one from Martinique Island, the second one from French Guyana. The new species are compared with 12 members of the *Dauciconus daucus* complex: *D. daucus* (Hwass in Bruguière, 1792); *D. boui* (da Motta, 1988); *D. norai* (da Motta & G. Raybaudi Massilia, 1992); *D. goajira* (Petuch, 1992); *D. vikingorum* (Petuch, 1993); *D. riosi* (Petuch, 1980); *D. worki* (Petuch, 1998); *D. orioi* Petuch 2013; *D. amphiurgus* (Dall, 1889); *D. aff. amphiurgus* (under study); *D. glicksteini* (Petuch, 1987).

Introduction

The genus *Dauciconus* is composed of species living in tropical waters of the Western Atlantic and Eastern Pacific. According to various authors it contains a variable number of species. It is also considered (Puillandre & al. 2014) as a subgenus of *Conus* Linnaeus, 1758. Its type species is *Conus daucus* Hwass in Bruguière, 1792. In this study we are revising a group representing only a small part of its biodiversity: the Tropical Western Atlantic species similar to the type species of the genus. We call it the “*Dauciconus daucus* complex”. In fact, DNA and the phylogeny of most of these species are unknown and the taxonomy of the members of the complex does not currently achieve consensus. According to various authors, the validity or synonymy of different taxa varies. The opinions of various authors and sources is given in the table below. In this paper, we consider all these taxa as valid species and we describe two more new species in the complex.

<i>D. daucus</i> group species / Authors	Petuch (2013)	Filmer (2001)	Tucker & Tenorio (2013)	Kersten (The Cone Collector Website as of 08/21/2016)	Daccarett & Bossio (2011)	Rios (1994)	Kohn (2014)
<i>D. daucus</i> (Hwass, 1792)	valid	valid	valid	valid	valid	valid	valid
<i>D. boui</i> (da Motta, 1988)	valid	valid	<i>daucus</i>	valid	<i>daucus</i>	-	<i>daucus</i>
<i>D. norai</i> (da Motta & Raybaudi, 1992)	valid	valid	<i>daucus riosi</i>	valid	<i>daucus</i>	-	<i>daucus</i>
<i>D. goajira</i> (Petuch, 1992)	valid	<i>daucus</i>	valid	<i>daucus</i>	<i>daucus</i>	-	<i>daucus</i>
<i>D. vikingorum</i> (Petuch, 1993)	valid	<i>daucus</i>	valid	<i>daucus</i>	<i>daucus</i>	-	<i>daucus</i>
<i>D. riosi</i> (Petuch, 1980)	valid	<i>daucus</i>	<i>daucus riosi</i>	<i>daucus</i>	-	valid	-
<i>D. worki</i> (Petuch, 1998)	valid	valid	<i>daucus riosi</i>	valid	<i>daucus</i>	valid	-
<i>D. orioi</i> Petuch, 2013	valid	-	<i>daucus riosi</i>	valid	-	-	-
<i>D. amphiurgus</i> (Dall, 1889)	valid	valid	valid	valid	valid	-	valid
<i>D. aff. amphiurgus</i> (under study)	<i>amphiurgus</i> (pers.com.)	-	-	-	-	-	<i>daucus</i>
<i>D. glicksteini</i> (Petuch, 1987)	valid	<i>amphiurgus</i>	valid	<i>amphiurgus</i>	-	-	<i>amphiurgus</i>

Table 1: Validity of different species of *Dauciconus daucus* group according to some authors

Résumé: *Dauciconus jacquescolombi* et *Dauciconus massemi*, deux espèces du genre *Dauciconus* (Gastropoda, Conidae) non reconnues à ce jour sont décrites. Ces deux espèces vivent dans des eaux relativement profondes : la première de La Martinique, la seconde de la Guyane Française.

Ces nouvelles espèces sont comparées aux 12 espèces du complexe *Dauciconus daucus* : *D. daucus* (Hwass in Bruguière, 1792); *D. boui* (da Motta, 1988); *D. norai* (da Motta & G. Raybaudi Massilia, 1992); *D. goajira* (Petuch, 1992); *D. vikingorum* (Petuch, 1993); *D. riosi* (Petuch, 1980); *D. worki* (Petuch, 1998); *D. orioi* Petuch 2013; *D. amphiurgus* (Dall, 1889); *D. aff. amphiurgus* (en cours d'étude); *D. glicksteini* (Petuch, 1987).

The tropical Western Atlantic region from North Carolina, USA, to North Argentina encompasses different marine faunal region. Petuch (2013) has divided this region into three provinces: Carolinian, Caribbean and Brazilian, which are divided in sixteen subprovinces, each of which has its own separate fauna. A summary map of these provinces and subprovinces is shown here (see Figure 0).

An explanation of abbreviations used in the text can be found in the end of this work.



Figure 0: Geographical distribution map of the 3 provinces and 16 subprovinces of the tropical Western Atlantic region (Petuch, 2013)

1- *Dauciconus jacquescolombi* new species - Plates 1-2



Figure 1: *Dauciconus jacquescolombi* n.sp.
Holotype MNHN IM 2000-27489

Type material

Holotype

The holotype of *Dauciconus jacquescolombi*, new species is deposited in the Muséum National d'Histoire Naturelle, Paris, France: MNHN IM 2000-27489.

Paratypes

The specimens numbered 1 to 25 are the paratypes of the new species.

Paratype 16 is stored in the Muséum d'Histoire Naturelle de La Rochelle, France: MHNLR 2007.8.1.3. Paratypes 18 to 20 are stored in the Staatliches Museum für Naturkunde, Stuttgart, Germany: SMNS 91361 - 91359 (collection da Motta). The other paratypes are in private collections.

Description

The adult shell is conical to broadly conical in overall shape and moderately small to medium-sized (35 to 57 mm) with an average length of 44.5 mm. The adult shell has about 13 stepped whorls.

The protoconch of this new species is eroded in all available specimens preventing us from counting the number of whorls. The spire is low with an average AH / L value of 0.90 (average relative spire height (RSH) value is 0.10), its profile is concave in the first whorls and become progressively straighter to flat and even subdepressed in gerontic specimens as in paratype 14. The profile of the spire whorls appears to be slightly

Studied specimens

Measurements: L, MD, HMD, AH are given in millimeters; RD, PMD, RSH are without dimension.

N°	L	MD	HMD	AH	RD	PMD	RSH	Deposition
0	39.00	21.42	32.62	33.63	0.64	0.97	0.14	Holotype Martinique MNHN IM-+2000-27489
1	50.59	29.50	43.42	45.85	0.64	0.95	0.09	Paratype 1 Martinique coll. JC
2	50.44	29.52	43.74	45.78	0.64	0.96	0.09	Paratype 2 Martinique coll. JC
3	43.92	25.73	39.30	40.10	0.64	0.98	0.09	Paratype 3 Martinique coll. JC
4	38.67	23.12	35.15	35.79	0.65	0.98	0.07	Paratype 4 Martinique coll. JC
5	38.11	21.20	33.41	34.04	0.62	0.98	0.11	Paratype 5 Martinique coll. JC
6 *	45.74	26.44	40.98	41.06	0.64	1.00	0.10	Paratype 6 Martinique coll. EM
7	42.93	23.31	36.10	37.10	0.63	0.97	0.14	Paratype 7 Martinique coll. JC
8 **	42.09	24.80	33.30	34.82	0.71	0.96	0.17	Paratype 8 Martinique coll. JC
9 **	38.83	23.17	32.60	34.04	0.68	0.96	0.12	Paratype 9 Martinique coll. JC
10 * #	30.60	17.60	26.23	26.77	0.66	0.98	0.13	Paratype 10 St Vincent coll. JC
11	41.00	23.00	35.19	35.84	0.64	0.98	0.13	Paratype 11 Martinique coll. JC
12 #	34.50	19.41	31.23	32.51	0.60	0.96	0.06	Paratype 12 Martinique coll. JC
13	51.31	29.93	45.44	46.63	0.64	0.97	0.09	Paratype 13 Martinique coll. CR
14	42.86	27.39 §	35.38 §	40.84 §	0.67	0.87	0.05	Paratype 14 Martinique coll. JPV
15	54.14	31.82 §	43.88	50.68	0.63	0.87	0.06	Paratype 15 Martinique coll. GL
16	41.30	24.91 §	35.24	38.55	0.65	0.91	0.07	Paratype 16 Martinique MHNLR 2007.8.1.3
17	52.12	29.80	43.92	45.69	0.65	0.96	0.12	Paratype 17 Martinique coll. TJ
18	3.00	25.01 §	36.55 §	40.40	0.62	0.90	0.06	Paratype 18 Sta Lucia coll. da Motta SMNS 91361
19	41.50	24.60 §	35.28 §	36.77	0.67	0.96	0.11	Paratype 19 Guadeloupe coll. da Motta SMNS 91360
20	45.70	25.26 §	38.08 §	41.09 §	0.61	0.93	0.10	Paratype 20 Martinique coll. da Motta SMNS 91359
21	45.30	25.80 §	37.00 §	40.48 §	0.64	0.91	0.11	Paratype 21 Martinique coll. GR
22	48.50	29.56 §	39.81 §	42.71 §	0.69	0.93	0.12	Paratype 22 Martinique coll. JC
23	47.51	27.92	41.06 §	43.54 §	0.64	0.94	0.08	Paratype 23 Martinique coll. GB
24	57.18	33.48	51.42	52.41	0.64	0.98	0.08	Paratype 24 Martinique coll. PC
25	35.6	19.7	31.5	32.6	0.60	0.97	0.08	Paratype 25 Martinique coll. AM
Averages	44.5	25.8	38.1	40.1	0.64	0.95	0.10	

Table 2: Morphometric data of *Dauciconus jacquescolombi* n.sp.

stepped in some specimens. The suture is linear and rather deeply incised. The sutural ramp is sculptured with five to six spiral grooves that most often become obsolete with growth. The last whorl is smooth with a broadly carinate shoulder. The outline is convex adapically in the first third of the last whorl and has nearly straight sides basally (between HMD and the base). The position of the maximum diameter is of 95 % of the aperture length of the shell. The relative diameter of the last whorl varies from 0.60 to 0.71 (average RD = 0.64). The HMD / L ratio varies from 0.79 to 0.91 on the 25 studied specimens (average: 0.86). The basal sculpture is weak. The aperture is long, straight and does not widen anteriorly. The origin of lip has a straight to slightly winged profile and the anal notch is V shaped. The siphonal lip outline is straight. The pattern of the last whorl is made up of three irregular spiral white bands bordered by chestnut brown blotches positioned at the periphery, at the middle and at the abapical quarter of the last whorl. These bands separate two wide zones of a mustard yellow to orange brown colour. In some specimens the chestnut blotches extend into zebra-striped axial streaks or flames connecting the white bands. The central white spiral band is

rather wide and always present while the two others may be almost absent. The color of the basal part of the columella varies between yellow, salmon to orange and is lighter than the rest of the shell. The spire is white with rather regularly spaced orange to brown radial markings. The protoconch and first teleoconch whorls are deep pink. The interior of the aperture is whitish.

Living animal

The paratype 22 (JC coll.) was photographed alive by Bruno Besse & Francis Hennequin. The animal appears to have a burgundy ("lie-de-vin") coloured foot that is different from *D. daucus* which is of orange colour. Moreover the periostracum seems smooth and transparent light tan (different from the tufted ones of *D. riosi*, *D. worki*, *D. daucus*, *D. boui* & *D. norai*).



Figure 2: *Dauciconus jacquescolombi* n.sp. Paratype 22. (F. Hennequin).

Derivatio nominis

The new species is dedicated to Jacques Colomb, a well known French collector who dived many of the specimens of the new species and kindly gave the holotype to the MNHN.

Type locality

Grande Anse, Martinique Island.

Species range

The new species has been collected some decades ago in the Western part of Martinique Island: Grande Anse, Pointe Ba-leine, le Prêcheur, La Perle Islet, Fort de France Bay (near "le Tuyau") and also in Le Diamant (S.W. Martinique).

Apart from Martinique, the new species has apparently also been found in other islands of the Lesser Antilles: two paratypes from the collection da Motta (SMNS) come from Saint Lucia (43.0 mm) and from La Gare, Guadeloupe (41.5 mm) and one from the coll. J. Colomb originates from Saint Vincent (30.6 mm).

Habitat

The new species was collected between the 70's and the 90's in 30 to 60 m depth, in the sand near small rocks, without grass or coral.

No information is available on its diet. It is probably vermivorous, like *Dauciconus daucus*.

Comparison

D. jacquescolombi n. sp. has been known under the name of *D. riosi* "from Martinique" for many years. The new species is known with certainty from Martinique Island and some nearby islands in the Antillean Arc while *D. riosi* is found off Brazil from Bahia to Espiritu Santo States. They are separated by several thousand kilometres and no shell having the characters of the two species is known from the seas between these localities. The patterns are similar but the early whorls of the new species are pink coloured compared to pale cream to tan in *D. riosi*. The silhouette of the last whorl is also distinct with *D. riosi* being more cylindro-conical and therefore having a lower Position of the Maximum Diameter (PMD: 0.92) and *D. jacquescolombi* being more conical with a PMD of 0.95.

D. worki has a plainer pattern of yellow or orange with only sparse brown elements most often grouped around the paler

central spiral band. It is therefore easily separated from both *D. riosi* and *D. jacquescolombi*. Its early whorls are cream to yellow not pink as in the new species.

D. jacquescolombi is also wider (RD: 0.64) than are both *D. riosi* and *D. worki* (RD: 0.61 and 0.60 respectively). Finally the new species is reported to have a smooth translucent periostracum without tufts while *D. riosi* and *D. worki* have well developed spiral rows of tufts on the last whorl.

D. jacquescolombi n.sp. is one of four sympatric species of the complex living in Martinique Island. *D. norai* has a yellow apex instead of a pink one in the new species. The ground color of *D. norai* is very variable while in *D. jacquescolombi* it is consistently yellow or orange and its pattern is more complicated and also more extensive with chestnut brown zones that are limited to dots and spots in most specimens of *D. norai*.

D. boui is a smaller species (average length 31.4 mm.) than *D. jacquescolombi* (44.5 mm). Its pattern is different with a yellow or orange background and many axial flames. Both species have flat spires but the apex of *D. boui* is yellowish to very pale pink while that of the new species is always vivid pink. The periostracum of *D. boui* is strongly tufted contrary to the smooth one of *D. jacquescolombi*.

The soft parts of the animal of *D. jacquescolombi* display a burgundy or red wine color that differs from all the other species of the complex living in Martinique.

D. daucus cannot be confused with the new species with its plainer pattern, different periostracum, ecology, depth, and animal colour. *D. amphurgus* and *D. aff. amphurgus* (under study) are absent from the Caribbean both being Carolinian species.

The two species from Colombian-Venezuelan coast differ strongly in pattern and are not likely to be confused with the new species. They do not have extended brown patches on the last whorl. Both species also have higher spire, are slender (RD: 0.60 (*D. vikingorum*) and 0.63 (*D. goajira*) against 0.64 for the new species) and have a lower position of the maximum diameter (PMD: 0.91 (*D. vikingorum*) and 0.89 (*D. goajira*) against 0.95 for *D. jacquescolombi*). *D. goajira* also differs in its turnip shape.

II *Dauciconus massemmini* new species - Plate 3

Figure 3: *Dauciconus massemmini* n. sp. Holotype MNHN IM 2013-56509 with operculum (the operculum is not at the same scale than the shell)

An important part of the type specimens of this species were obtained through the "Our Planet Reviewed" programme. The Muséum National d'Histoire Naturelle (MNHN) and Pro-Natura International (PNI) have conducted in 2014-2015 a biodiversity expedition to French Guyana. The marine component of the expedition (Principal investigator: Philippe Bouchet) took place during two periods: in July-August 2014, a 9-persons offshore survey on board B.O. Hermano Ginès

deployed a Warén dredge (DW) and a beam trawl (CP) at 68 stations between 20 and 650 meters; in September-October 2014, a 15-persons party based at Iles du Salut conducted a shore-based survey around the islands and at a few other locations along the coast of French Guyana, performing intertidal sampling, trapping and diving in 0-10 meters. Overall the expedition sampled some 800 species of molluscs, 260 species of decapod crustaceans, 115 species of echinoderms, and 60 species of algae, reflecting both the low regional species richness and the intensity of the 2014 survey. Among the Conidae collected during the expedition, specimens similar to members of the *D. daucus* complex proved to be a new one.

Type material

Studied specimens

Measurements: L, MD, HMD, AH are given in millimeters; RD, PMD, RSH are without dimension.

Description

The adult shell is conical in overall shape and medium-sized to moderately large (31 to 59 mm when adult) with an average length of 41.8 mm. The adult shell has about 12 whorls.

The protoconch present on paratype 8 is smooth and ivory coloured and has at least 2.5 whorls. The spire is of moderate height with an average AH / L value of 0.86 and the average relative spire height (RSH) value of 0.14. Its outline is concave with a raised apex. The profile of the spire whorls is slightly stepped with the 4 or 5 first early postnuclear whorls more stepped. The suture is linear and rather deeply incised. The sutural ramp is sculptured with about five fading to three spiral grooves and radial threads. The last whorl is smooth with a carinate shoulder. The basal area has about 12 to 15 spiral ribs. The outline, is slightly convex in the adapical third of the last whorl with nearly straight sides basally. The position of the maximum diameter is of 97 % of the aperture length of

N°	L	MD	HMD	AH	RD	PMD	RSH	Deposition
0 lv	35.75	16.92	29.36	30.80	0.55	0.95	0.14	Holotype MNHN IM-2013-56509
1 lv	34.59	17.60	30.00	30.57	0.58	0.98	0.12	Paratype 1 MNHN IM 2013-56508
2 lv	31.40	16.51	26.54	27.52	0.60	0.96	0.12	Paratype 2 MNHN IM-2013-56024
3 x lv	22.80	11.04	18.67	19.31	0.57	0.97	0.15	Paratype 3 MNHN IM-2013-55914
4	36.38	18.90	30.38	31.16	0.61	0.98	0.14	Paratype 4 MNHN IM-2000-27757
5	59.10	31.70 §	49.00 §	50.70 §	0.63	0.97	0.14	Paratype 5 coll. DM
6 #	44.80	24.14 §	38.18 §	39.72 §	0.61	0.96	0.11	Paratype 6 coll. DM
7	46.00	23.90 §	40.40 §	41.30 §	0.58	0.98	0.10	Paratype 7 coll. DM
8	12.00	5.79 §	9.30 §	9.57 §	0.60	0.97	0.20	Paratype 8 coll. DM
9	42.90	21.50 §	35.00 §	36.40 §	0.59	0.96	0.15	Paratype 9 coll. DM
10	37.50	20.40	31.90 §	33.20	0.61	0.96	0.11	Paratype 10 MHNLR 2007.8.1.1
11	40.40	21.50	34.00 §	34.80 §	0.62	0.98	0.14	Paratype 11 MHNLR 2007.8.1.2
12	51.50	26.09 §	42.53 §	44.48 §	0.59	0.96	0.14	Paratype 12 private coll.
Averages	41.8	21.7	35.2	36.4	0.60	0.97	0.14	

Table 3: Morphometric data of *Dauciconus massemi* n.sp.

Holotype

The holotype of *Dauciconus massemi*, n. sp. is stored in the Muséum National d'Histoire Naturelle, Paris, France: IM 2013-56509, Vessel Hermano Gines, CP 4380, off Iracoubo, 102-104 m, 06°31' N ; 52°27' W, lv.

Paratypes

The specimens numbered 1 to 12 are the paratypes of the new species.

Paratype 1: MNHN IM 2013-56508, Vessel Hermano Gines, CP 4380, off Iracoubo, 102-104 m, 06°31' N; 52°27' W, lv.

Paratype 2: MNHN IM 2013-56024, Vessel Hermano Gines, CP 4357, off Organabo, 60-61 m, 06°33.8' N; 53° 07.8' W, lv.

Paratype 3: MNHN IM 2013-55914, Vessel Hermano Gines, CP 4348, off Kourou, 115 m, 05°46' N; 51° 23' W, lv.

Paratype 4: MNHN IM 2000-27757

Paratypes 10 and 11: MHNLR 2007.8.1.1 and MHNLR 2007.8.1.2, respectively.

The other paratypes are in private collections.

the shell. The relative diameter of the last whorl varies from 0.55 to 0.63 (average RD = 0.60). The HMD / L ratio varies from 0.82 to 0.88 on the 11 studied adult specimens (average: 0.84). Juveniles seem to have a lower ratio: 0.77 for the paratype 8 (L= 12 mm). The aperture is long, straight and does not widen anteriorly. The origin of lip has a straight to slightly excavated profile and the anal notch is U shaped.

The ground colour of the shell is light purple, the last whorl is yellow ochre to orange brown coloured. There is a white spiral band at the middle of the last whorl which is generally overlaid by chestnut brown blotches. Blotches of the same colour are also present below the spiral band although they are less conspicuous. Moreover, one or two irregular interrupted white bands are situated under the shoulder. These are very variable in width and sometimes obsolete. The last whorl is covered by a variable number (4 to 33 in the examined specimens) of spiral rows of rather regularly spaced chestnut brown dots or streaks. The distribution of these spiral rows over the last whorl is very irregular in some specimens (e.g. paratypes 6, 9 & 10) and may include broad undotted zones. Some specimens (e.g. paratype 12) are covered by a pattern of brown irregular axial lines. The color of the basal part of the columella varies between whitish to orange yellow and is lighter than the rest of the shell. The spire is white with orange brown radial streaks and blotches running from the shoulder to the last 6 last whorls. The interior of the aperture

is tinged with lavender to violet. The juvenile paratype (#8) is almost plain white with a few widely separated spiral rows of pale brown dashes.

Living animal

Periostracum is smooth (without tufts), translucent, pale yellow.

Operculum of the holotype of the new species is elongated, the length is about one quarter of its aperture height.

Derivatio nominis

The new species is dedicated to David Massemin, first author of the book “*Seashells and snails from French Guiana*” and shell collector.

Type locality

Off Iracoubo, 102–104 m, 06°31' N; 52°27' W, French Guyana

Species range

Off French Guyana, Surinam (Van Mol, 1973) at the boundary with Guyana waters. The range is situated between the deltas of Orinoco and Amazon rivers.

Habitat

The new species was collected from 60 to 115 m. deep, between 6°34' North (off Organabo) and 5°46' North (off Kourou) in the Surinamian subprovince.

Comparison

D. massemini n. sp. is the only species belonging to the *D. daucus* complex found in its range in the Surinamian subprovince. It differs from *D. daucus* by its narrower shell, and more complex pattern with a light purple background colour and yellow ochre to orange brown markings. The periostracum of the new species is translucent and smooth while that *D. daucus* is thicker and shortly tufted.

The three Brazilian species of the complex (*D. riosi*, *D. worki*, *D. jorioi*) live several thousand kilometres away as shown in the map below (p. 22), leaving a long stretch of coast where members of the *D. daucus* complex have never been collected. They have different patterns and colours in the yellow, orange and brown range. No intergrading specimen is known.

The two Colombian-Venezuelan species are also allopatric and differ in shape, colour and pattern. *D. goajira* is broader and somewhat pyriform and has a pale violet to yellow ground colour with axial flames concentrated in the anterior half of the last whorl. *D. vikingorum* also has a different pattern and colour range. The spire of *D. massemini* n. sp. is distinctly higher (RSH: 0.14 against 0.11 and 0.12).

D. amphurgus is a Carolinian species living in a different biogeographic region. The new species differs in its smoother last whorl and straighter sides while *D. amphurgus* is more swollen with a lower position of the maximum diameter (PMD: 0.92 for *D. amphurgus* against 0.97 for *D. massemini* n. sp.). *D. amphurgus* has a variable periostracum (Kohn, 2014) that may be either thick and distinctly tufted or smooth, yellowish but opaque while the new species has a smooth, translucent yellowish one. The protoconch of *D. amphurgus* is reported to have three whorls (van Mol & Tursch, 1968) while the new species has 2.5 whorls.

D. aff. amphurgus (under study) from the northern Gulf of Mexico lives in a different biogeographic region (Carolinian). It has a whitish background of the last whorl and a pattern of axial orange to red-brown flames thus differing from the new species. *D. aff. amphurgus* may be similar in shape and smoothness to *D. massemini* n. sp. but has a different periostracum with tufts (Kohn, 2014).

Of the Martinique endemics *D. norai* is the most similar with

some specimens having a creamy pattern. However, *D. massemini* has a slender shape and is much less variable in colour. In *D. norai* the spiral threads on the sutural ramps are obsolete on the last whorls while they remain strong in the new species. The protoconch and early whorls of *D. norai* are cream yellow instead of whitish in *D. massemini*. *D. boui* and *D. jacquescolombi* have a pattern and a flat spire different from those seen in the new species.

III Review of the *Dauciconus daucus* (Hwass in Bruguière, 1792) complex

The two new species described above belong to a group of species that share a number of common traits. These species have often been united within the species *Dauciconus daucus* (Hwass in Bruguière, 1792). Within this complex, from North to South of the Western Tropical Atlantic region we consider the following species as valid:

D. amphurgus (Dall, 1889),
D. aff. amphurgus (Dall, 1889), from Gulf of Mexico,
D. glicksteini (Petuch, 1987),
D. daucus (Hwass in Bruguière, 1792),
D. boui (da Motta, 1988),
D. norai (da Motta & G. Raybaudi Massilia, 1992),
D. goajira (Petuch, 1992),
D. vikingorum (Petuch, 1993),
D. riosi (Petuch, 1980),
D. worki (Petuch, 1998),
D. jorioi Petuch 2013,
D. massemini n.sp.,
D. jacquescolombi n.sp.

In the last published revision of Western Atlantic Conidae (excluding Brazilian species), Alan J. Kohn only accepts two species as valid while we manage to identify seven described species from this region plus two new species described herein, and potentially one yet undescribed from the Gulf of Mexico. Three Brazilian species out of Alan Kohn's book scope are added in our study. It is therefore necessary to reassess the characteristics of the various species we recognize in this group. In assessing which members of the *Daucus* complex should be considered species or assigned as synonyms, we have used the concepts of species alignment within provinces proposed by Petuch 2013 and the genus structure proposed by Tucker & Tenorio. We have also used mathematical analysis techniques similar to those used by Kohn 2014. The results are reflected in the list of species above. Only two of the above species are considered to have junior synonyms proposed by other authors.

Synonymy of *Dauciconus daucus* (Hwass in Bruguière, 1792)

The species is introduced in the “Encyclopédie Méthodique – Histoire Naturelle des Vers” in 1792. The short French diagnose reads as following (translated in english): “Conical shell, red or yellow, maculated or banded with white, spire flat and obtuse, pink coloured apex”. In the detailed description (species n° 51, pp 651–652) four varieties are introduced identified by a letter, A, B, C and D, that differ in colour and pattern and refer to illustrations in previous works. The range is given as “... mers de l'Amérique, on en trouve à l'Isle S. Domingue, à la Guadeloupe et à la Martinique”.

The plates of the Cones were ordered by Hwass himself and engraved from the actual shells in his collection. They were published in 1798 in the “Tableau Encyclopédique et Méthodique des trois Règnes de la Nature”, but without captions and explanations as Bruguière was on an expedition trip at that time. Three figures correspond to varieties described by Hwass.

Lamarck is the first author who gives citations to the figures of the “Tableau” for his own varieties of the species *Conus daucus*. They are in plate 327 figs. 3, 4 and 9 (fig. 4).

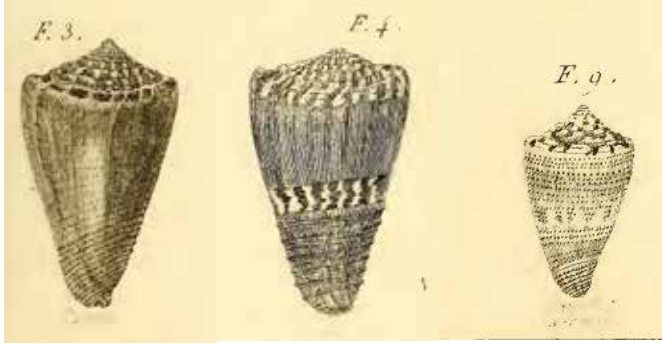


Figure 4: Figures of the varieties of *C. daucus* from the “Tableau Encyclopédique” engraved from Hwass’ shells (1798) (pl. 327, fig. 3, 4 & 9).

The shells were present in the Hwass collection but have been lost during the many transfers of the shells (Mermod, 1947) after Hwass death and are not present in the Muséum d’Histoire Naturelle de Genève.

From the description and figures of *Conus daucus* in the original work and from Lamarck’s revision it appears that a mixture of several species are involved. Clench (1942) designated the figure of Chemnitz in “Conchylien Cabinet” volume 10 (1788) in the plate 144A, fig. L (our fig. 5) as representative of the type. He also restricted the type locality to the island of Gaudeloupe among those cited by Hwass and Bruguière.

This figure is quite poor but shows a deep orange brown and conical shell. Only the white spots on the spire are not really characteristic of the species. Kohn (1992) confirmed that the designation made by Clench is valid and is representative of the lectotype of *Conus daucus* Hwass in Bruguière, 1792. The characters of the shells of the species are given in Table 5 of this work.

The synonymy of the species comprises the following names:

Cucullus cardinalis Röding, 1798. This is a junior homonym of *C. cardinalis* Hwass in Bruguière, 1792. It is also an objective synonym of *C. daucus* Hwass in Bruguière, 1792 as it is based on the same type figure in Chemnitz 1788.

Conus pastinaca Lamarck, 1810. The holotype (fig. 6) is present in MHNG. and appears to be a pale yellowish specimen of *D. daucus*. We agree with previous authors (eg. Old, 1965; Walls, 1979; Filmer, 2001; Tucker & Tenorio, 2013; Kohn, 2014) that it appears to be a pale yellowish specimen of *D. daucus*.



Figure 5: Lectotype of *C. daucus* from Chemnitz (1788, pl. 144A, fig. L)



Figure 6: Holotype of *C. pastinaca* Lamarck, 1810 MHNG (31 mm) (picture by Alan J. Kohn)

Conus mamillaris Green, 1830. The description and figures appear to refer to a faded specimen of *D. daucus* from Florida (fig. 7).

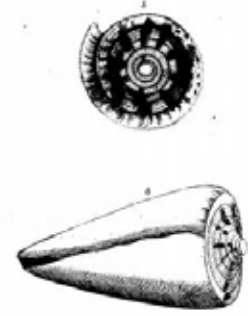


Figure 7: figure representative of the holotype of *C. mamillaris* Green, 1830

Conus croceus Sowerby I, 1833. The name has been placed in synonymy of *C. daucus* by Sowerby himself in 1841 in the Index to the plates of Conchological illustrations. All authors after him agreed. The shell on which the figure is based is lost. No type locality is given. The figure (fig. 8) shows an undulate shoulder and a complex pattern with three spiral rows of dark brown spots on a whitish background separating orange zones dotted with brown. The descriptive text in Latin is limited to a few words: “*C. Daucus*, Brug. var. “*lutea, fasciata et punctata*” (*croceus*, list.)”. There is no indication of locality. The figure and description do not fit our concept of *D. daucus* (Hwass in Bruguière, 1792). The only figure and the lack of information do not allow us to identify it with certainty to any other species of Conidae. Our conclusion is that *Conus croceus* Sowerby, 1833 is a nomen dubium.



Figure 8: Figure representative of the holotype of *C. croceus* Sowerby I, 1833 (Conchological Illustrations Part 29, fig. 27) (fig. size: 44 x 25 mm)

Conus arausiensis “Chemnitz” Reeve, 1843. Reeve cites this name as a synonym of *C. daucus*. It is also cited as a synonym by Clench (1942). Finally, Filmer (2001) states that this name is unavailable (nomen nudum). The figure of *C. daucus* (Pl. XX, species 114) given by Reeve conforms to our concept of the species.

Conus castus Reeve, 1844. The holotype is preserved in NHMUK. It is a severely worn shell with a broken aperture. The dorsum shows faint rows of minute dots. Its description does not give a locality. The opinion of previous authors (Walls, 1979; Coomans, Moolenbeek & Wils, 1983; Filmer, 2001; Tucker & Tenorio, 2013; Kohn, 2014) is followed by us.

Conus sanguinolentus Reeve, 1849. The type locality is not given by Reeve. From the figure (Conus Supplement pl. VIII, species 274), reproduced here (fig. 9) the shell falls within the variability of *D. daucus* although it shows unusual axial dark brown blotches separated by a paler spiral central band. Filmer (2001) correctly states that the name is unavailable being a junior homonym of *Conus sanguinolentus* Quoy & Gaimard, 1834, and is a synonym of *D. daucus*.

Conus comptus A. Adams, 1854. Walls (1979) erro-



Figure 9: Figure representative of the holotype of *C. sanguinolentus* Reeve, 1849 (Conchologia Iconica – Conus Supplement, pl. VIII, sp. 274)

neously placed this taxon within the synonymy of *D. daucus*. The holotype is a worn specimen of *Floraconus papilliferus* (Sowerby I & Sowerby II, 1834). Moreover, the name *comptus* is preoccupied by *Conus comptus* Gould, 1853 a synonym of *Chelyconus purpurascens* (Sowerby I & Sowerby II, 1833).

Conus connectens A. Adams, 1855. Examination of the holotype leaves little doubt on its synonymy with *D. daucus*. *C. connectens* represents a whitish form with sparse pale orange markings mostly concentrated near the base (fig. 10). The shell is somewhat faded and presents signs of gerontism (Röckel, 1988). The locality given in the original description is China and caused much confusion in the past. The name *C. connectens* has been applied until recently to *Strategoconus (Vituliconus) circumcinctus* (Iredale, 1929) (e.g. Walls, 1979; Estival & Von Cosel, 1986; Drivas & Jay, 1987). Röckel (1988) identified *C. connectens* with *D. daucus* and we agree with his conclusions.



Figure 10: Holotype of *C. connectens* A. Adams, 1855 NHMUK (54 mm) (picture by Mike Filmer)

Conus daucus v. luteus Krebs, 1864. The author introduces the name as a variety. He does not give any description and only states “together with the orange – coloured species”. The Latin word “luteus” means “yellow” so we can guess that the variety intended by Krebs is of that colour difference. Such shells are regularly found among typical *D. daucus*. *C. daucus v. luteus* is a junior homonym of *Conus luteus* Sowerby II, 1833, a Polynesian species.

Conus caribbaeus circumcinctatus Nowell-Usticke, 1968. The lectotype is a worn specimen of the whitish dotted form of *D. daucus*. This is the opinion of Coomans, Moolenbeek and Wils (1985) and Filmer, (2001)

Conus centurio cruzensis Nowell-Usticke, 1968. Vink (1984a) placed this taxon in the synonymy of *Conus daucus* Hwass in Bruguière, 1792. From examination of the picture of the lectotype (AMNH n° 195444) it appears to be a severely worn and partly broken shell of *Kohniconus centurio* (Born, 1778) as correctly stated by Coomans, Moolenbeek and Wils (1985) and Filmer (2001).

Kohn (2014) adopts a broad concept of the species and place *D. boui* and *D. norai* in the synonymy of *D. daucus*. He argues that the shell shapes of the three species are not distinguishable on the basis of an analysis of variance of shell morphology. *D. goajira* and *D. vikingorum* are also synonymized with *D. daucus* by Alan Kohn. We consider that these four taxa are valid species. We give below the information allowing to differentiate the species we recognize in the complex. We also performed a morphological discriminant analysis on our own sample (table 4) that is presented further in this work.

Synonymy of *Dauciconus amphiurgus* (Dall, 1889)

William Dall introduced in 1889 the name of this species in one long sentence but he does not illustrate it. He states that the species has “dark streaks... always followed by an equivalent pale area, a thickish epidermis, and the top of the whorls excavated and striated”. The type locality is Cabo Catoche, Yucatan, in the Gulf of Mexico. The holotype is preserved in

USNM (fig. 11).

Conus juliae Clench, 1942. Clench criticized the poor description of *D. amphiurgus* in his Monograph on Conidae from the Western Atlantic (1942) and could not access the holotype. However he described and illustrated his new species from a shell collected off Fort Walton in the Northern Gulf of Mexico (fig. 12). There is no doubt that both taxa represent the same species.

Walls (1979) placed *C. mayaguensis* Nowell-Usticke, 1968 in the synonymy of *D. amphiurgus*. The former originates from Puerto Rico, is smaller and smoother. The holotype shows axial hairlines displayed at the periphery – a character found in species of the *Purpuriconus* genus. We believe that it is not related to the more northerly *D. amphiurgus* in agreement with Kohn (2014).

Kohn (2014) adopts a broad concept of *Conus amphiurgus* Dall, 1889 and places several species in the synonymy of *D. amphiurgus*:

- *Conus penchaszadehi* Petuch, 1986 is in fact a valid species from the Colombian coast with a distinct paler pattern of yellow or orange without darker dots or streaks and a constant sculpture of spaced spiral ribs. No shell resembling it is known from the Gulf of Mexico or the Eastern Coast of the U.S.A.
- *Conus aureonimbosus* Petuch, 1987 is a rare valid species living in deep waters of the Northern Gulf of Mexico. Its shell is smaller, smoother, more slender and more straight sided and also has a different pattern than *D. amphiurgus*.
- *Conus binghamae* Petuch, 1987 is another rare species. It varies in colour from yellow to bluish purple and has a bright yellow protoconch. It seems to be more closely related to *Gladioconus patae* (Abbott, 1971) although subadult shells of *D. amphiurgus* from the Northern Gulf of Mexico may have similar patterns.
- *Conus colombianus* Petuch, 1987 is a poorly known species known from an island off Colombia where it is probably endemic. The holotype is somewhat faded but is stouter, smoother and has a different pattern of pale creamy yellow with midbody darker blotches. Specimens agreeing with that species have never been found in the Northern range of *D. amphiurgus*.
- *Conus hennequini* Petuch, 1993 is endemic to a small stretch of the Ocean side of Martinique Island. It has a smooth last whorl except spiral grooves towards the base and its pattern is pale cream with some darker stains around the middle of the body whorl. The remarks about *C. colombianus* and *C. penchaszadehi* also apply for this species.

In his book, Kohn also illustrates in the plate 62 several specimens from Jamaica (fig.1), Calivigny Island (fig. 2), that appear to be related to the *Purpuriconus* or *Magellaniconus* groups of species. Finally one specimen of *D. massemmini* n.sp. from



Figure 11: Holotype of *C. amphiurgus* Dall, 1889 USNM (40 mm) (picture by Mike Filmer)



Figure 12: Holotype of *C. juliae* Clench, 1942 FMNH (54 mm) (picture by Mike Filmer)

Guyana is pictured on the same plate (figs. 5 & 6). While other specimens of *D. massemmini* are presented on the plate 63 as *Conus sanderi* Wils & Moolenbeek, 1979. His concept of *D. amphiurgus* is therefore a mixture of species.

Splitting the *Dauciconus daucus* complex

Lozet and Pétron (1977) are the first authors to express the possibility that several species may hide behind *Dauciconus daucus*. In page 108 under the caption “(193) *Conus* sp.” they illustrate three specimens of *D. jacquescolombi* n.sp. and they write (translated from French): “These three beautiful cones originate from Martinique and have until now defied any attempt of identification.” In the same page and under the caption “(195) *Conus* sp.” they show five specimens of *D. norai* da Motta & Raybaudi, 1992. The text reads as follows (translated from French): “Here again are five very beautiful cones from Martinique whose identification causes problems. If the shapes are very similar to *C. daucus* on the other hand the colours are very distant”.

In the same book one specimen of *Dauciconus boui* da Motta, 1988 is illustrated in fig. 188a, page 107, as *Conus centurio* var. *cruzensis*.

At that time a team of scuba divers actively collected shells in Martinique and they were the source of this new material that was distributed among collectors.

In 1979, Vink studied additional material he could obtain from a French diver and information received from collectors and concluded that the two *Conus* sp. of Lozet and Pétron belonged to *C. daucus*. He argues that intergrades between the typical *C. daucus* and the *C. sp.* 193 and *C. sp.* 195 can be found and illustrates a series of shells as a demonstration. He also gives the data for two specimens of *C. sp.* 193 found by Codman Hislop in Saint Vincent and by David Hunt in Saint Lucia.

In 1984, in his series on “The Conidae of the Western Atlantic”, Vink (1984a) confirms his opinion and illustrates in colour other specimens. Our opinion is that: 1a, 1e and 1f are genuine *D. daucus*; 1c and 1d are *D. jacquescolombi* n. sp.; 1g is *D. boui* and 1b, 1h, 1i and 1j are *D. norai*.

Soon after, Petuch (1986) described *Conus riosi* from off Salvador, Bahia State, Brazil. The species is similar to *C. sp.* 193 of Lozet & Pétron. This was the first of a series of new taxa in the *D. daucus* complex. In 1988 da Motta described *Conus (Dauciconus) boui* from Martinique Island. The species corresponds to what Lozet & Pétron showed as *Conus centurio* v. *cruzensis*. Then the same author in association with Gabriella Raybaudi Massilia described *Conus (Dauciconus) norai* in 1992. It is the *Conus* sp. 195 of Lozet & Pétron. The text contains explanations about the differences in bathymetry and soft parts of the three species obtained together with the shells used for descriptions from Patrice Bou, a French diver and collector living in Martinique Island.

In this publication the authors also state that the *Conus* sp. 193 of Lozet & Pétron is *Conus riosi* Petuch, 1986. They are the first to propose this assimilation.

As the new species were received with reservation by the conchological community (Mailly, 1989), da Motta published during the same year a paper in which he refutes the objections. He shows photographs of live animals of the three species showing the different animals and two pictures of the radular teeth of *D. daucus* and *D. boui* that appear strikingly different. In the same year, Ed Petuch introduces *Conus goajira*, a pyriform shell from off Colombia. In 1993, *Conus vikingorum* is described from the same region but differs from the previous species in being taller, more straight sided and more colourful.

Later in 1998 the same author describes another species from Brazil: *Conus (Dauciconus) worki*. This species is yellowish orange in colour, slender and smaller than the sympatric *D. riosi*. The latest described species is *Dauciconus jorioi* Petuch, 2012. The only known specimen is the holotype and it was collected on the remote Trindade Island off the coast of Brazil. It looks like *D. riosi* but has a simpler pattern of dark brown with irregular white spiral bands at periphery and midbody. The base is salmon orange.

Distinction of the species in the *Dauciconus daucus* complex

Average measurements and ratio relative to the species of the *Dauciconus daucus* group have been calculated or estimated, they are showed in Table 4.

-1- *Dauciconus daucus* (Hwass in Bruguière, 1792) Plate 4

a. habitat

Dauciconus daucus is living in the coral reefs in clean coral sand near turtle grass beds (*Thalassia testudinum*) in shallow water areas between 1 and 20 m. depth (Petuch, pers. comm.). In Martinique da Motta reports depths from 4 to 35 m. Diaz reports depths of 5 – 50 m. on rocky and coralligenous bottoms in the surroundings of Santa Marta, Colombia.

b. range

It is the widest ranging species in the complex. It is found from the S.E. Florida (Palm Beach and Miami) and Florida Keys, the South of the Gulf of Mexico (Isla de Sacrificios, near Veracruz, Mexico and all the Yucatan Peninsula and Belize. Bahamas, Cuba, Jamaica, Virgin Islands, Haiti, Puerto Rico, Dominican Republic, the whole Antillean arc, Barbados, it is also present in the Bay Islands, and the San Blas Archipelago in Panama. Finally it is found in the islands off the northern coast of South America (Curacao, Aruba, Bonaire, Islas Rosarios...). Its range is limited to the North by cooler temperatures notably in winter, it is therefore absent from the coasts of Georgia and Carolina where *D. amphiurgus* may be found. In the Northern Gulf of Mexico *D. daucus* is not present further North than Dry Tortugas or Sanibel and is absent from Western Florida to Veracruz. The lack of suitable habitat and cool winter temperatures are probably the main reason of this situation. It is also absent from Bermuda. In the south, it does not live further west than Barbados. *D. daucus* is also absent along the continental coast of South America: Western, central and Eastern Venezuela, Los Roques, Goajira or Paraguana Peninsulas but it is present westwards from Santa Marta, Eastern Colombia (Diaz, 1990). It is absent from the Guyana shelf where it is replaced by *D. massemmini* n. sp. Further along the Brazilian coast, it remains absent. Related species as *D. riosi*, *D. worki* and *D. jorioi* live much further south leaving a long stretch of coast without known representative of the complex. The reason is the lack of suitable habitats for this species in these zones where muddy bottoms with strong terrigenous inputs from rivers, open sand beaches and muddy mangrove jungles predominate.



Fig. 13: living *Dauciconus daucus*
Martinique (DT)



Fig. 14: *Dauciconus daucus*
Aruba (CA)

Species / Averages values	Number of specimens studied	L	MD	HMD	AH	RD	PMD	RSH
<i>D. daucus</i>	12	28 – 60 41.8	22.6	33.5	36.9	0.61	0.91	0.12
<i>D. boui</i>	12	27 - 36 31.4	18.2	25.5	28.4	0.64	0.90	0.09
<i>D. norai</i>	13	27 - 51 37.2	21.4	30.8	33.9	0.63	0.91	0.09
<i>D. cf. norai</i>	2	37 - 47 42.1	23.3	34	37.8	0.62	0.90	0.10
<i>D. goajira</i>	9	35 - 44 38.3	21.4	30.3	34.1	0.63	0.89	0.11
<i>D. vikingorum</i>	6	33 - 50 41.8	22.1	33.4	36.8	0.60	0.91	0.12
<i>D. riosi</i>	9	42 - 61 50.1	28.9	42.6	46.3	0.61	0.92	0.08
<i>D. worki</i>	6	30 - 55 41.0	21.9	33.6	36.2	0.60	0.93	0.12
<i>D. jorioi</i>	1	53.0	29.0	43.1	46.9	0.67	0.92	0.12
<i>D. amphiurgus</i>	7	32 - 47 41.1	21.7	32.0	34.9	0.62	0.92	0.15
<i>D. glicksteini</i>	2	21 - 45 31.3	16.7	25.5	26.9	0.62	0.95	0.15
<i>D. aff. amphiurgus</i> (under study)	8	28 - 54 36.4	18.2	29.5	32.0	0.57	0.92	0.12
<i>D. jacquescolombi n.sp.</i>	24	35 - 57 44.5	25.8	38.1	40.1	0.64	0.95	0.10
<i>D. massemini n.sp.</i>	9	35 - 59 41.8	21.7	35.2	36.4	0.60	0.97	0.14

Table 4: Average measurements and ratios relative to the 121 specimens of *Dauciconus* studied

c. characterization of the species

- Shell
 - Colour pattern: the last whorl is mostly plain coloured with a paler central spiral band. There are white spots on the spire. The colour varies from white or pink to yellow, cream or orange. Orange specimens are most common. Some specimens have spiral rows of minute dark dots on the last whorl.
 - Protoconch: it is pink. It has three whorls.
 - Shape: the spire is slightly elevated, straight or slightly concave, with spiral threads rapidly becoming obsolete. The shell is conical, smooth.
- Periostracum: it is rather thick with five to seven wide rows of short tufts (fig. 14, pl. 4 fig. 11).
- Soft parts: the foot, head and siphon are plain orange (fig. 13).
- Radular tooth: it is illustrated by Warmke (1960) fig. 4. from a 45 mm. long specimen from Puerto Rico.

-2- *D. boui* (da Motta, 1988) Plate 6

a. habitat

The species lives in deep coral reefs. Da Motta (1992) stated that *D. boui* is found on reef areas in 20-30 m depths, but it may also be found in shallower water in 10 m. (Touitou, pers. comm.) or deeper down to 55 m. (Colomb, pers. comm.). According to da Motta the species has diurnal habits. It is found upon sand either in the center or on the sides of sand pockets (Touitou, pers. comm.). The habitat consists of scattered rocks with blue and red sponges and algae on a fine sand bed (da Motta, 1992). Pierre Clovel (pers. comm.) found yellow shells on sand bottoms among scattered algae in 25-40 m, a differ-

ent more reddish form in 40-50 m. in small sand pockets and a smaller form in coral sand between 40 and 50 m. in strong currents. Divers in Martinique (Clovel, pers. comm.) have observed that the species is found less often in the last ten years.

b. range

The species is found from La Pointe du Bout, Cap Salomon to Le Diamant in Martinique Island on the Caribbean side of the island. Localities from Aruba, La Dominique and Saint Lucia found in the literature have yet to be confirmed. Vink (1984b) illustrates a shell of the species from Barbados (fig. 1g). It is a Grenadian sub-province endemic.

c. characterization of the species

- Shell
 - Colour pattern: the last whorl has brown axial streaks and flames on a yellow to dark orange background. There is a spiral central band with white blotches. The spire is coloured with dark brown streaks.

Figure 15: *D. boui* live, yellow form Martinique. (DT)Figure 16: *D. boui* live reddish form Martinique (DT)

- Protoconch: it is eroded in all specimens seen.
- Shape: the spire is flat and even sometimes depressed, shallow spiral threads becoming obsolete on the last whorl. Shell wide and conical. The shell length is moderately small and varies very little (Touitou, pers. comm.).
- Periostracum: it has five to seven closely set rows of long tufts (pl. 6 fig. 11).
- Soft parts: da Motta (1992) illustrates the foot as red peppered with black on sides and the siphon as orange with a few black streaks. Touitou (2004) states that the colour of the soft parts varies with the colour of the shell: red-orange shells have animal of the same colour and yellow shells have yellow soft parts. He shows pictures of live animal (figs 16 & 17) that confirm this observation. Pierre Clovel (pers. comm.) has observed that the animal is often red but also sometimes yellowish orange.
- Radula: the radular tooth of *D. boui* is illustrated by da Motta (1992), fig. 4 right.

-3- *D. norai* (da Motta & G. Raybaudi Massilia, 1992)

Plates 5 - 6

a. habitat

The species lives in deep coral reefs in sand and rocks between 20 to 50 m. (da Motta, 1992; Touitou, pers. comm.) and on sandy bottoms with algae or at the base of rocks in sand between 10 to 40 m. (Clovel, pers. comm.). The animals are buried in sand pockets during the day and emerge at night to feed on small worms (da Motta, 1992; Clovel, pers. comm.). According to Pierre Clovel (pers. comm.) the species was observed in aquarium to feed on small worms in aquarium. Like *D. boui* it has almost disappeared from the localities where it was formerly found.

b. range

Martinique: Fort de France Bay (near "le Tuyau"), Cap Salomon and Grande Anse. One specimen was said to be dead taken in Guadeloupe Island but this locality needs confirmation with more specimens. Vink (1984b) shows a specimen from Curaçao with a compatible pattern (fig. 1h). It is a Grenadian subprovince endemic.

c. characterization of the species

- Shell
 - Colour pattern: colour is very variable from yellow to mauve, greenish and brown through shades of cream, pink, and deep orange. The last whorl has an intricate (often reduced) pattern of brown blotches, white streaks and a paler central band. There also are brown blotches on the sutural ramps.
 - A few shells (referred to in this work as *D. cf. norai*, Plate 6, n°1 & 2) with an extreme pattern of axial brown flames are almost morphologically identical with this species but need more specimens and more studies to be possibly separated from *D. norai*.
 - Protoconch: it is eroded in all specimens seen. The apex is cream to yellow.
 - Shape: the spire is concave, slightly elevated to almost flat. Spiral threads are present on the sutural ramp until the last whorl.
 - Periostracum: it has five to seven spiral rows of sparse tufts set in small patches of a few ones.
 - Soft parts: the animal is yellow with the sides of the foot peppered of black.
 - Radula: the radular tooth of *D. norai* is illustrated by da Motta (1992), fig. 4 left. The tooth differs from that of *D. boui* in having a more pronounced waist.

-4- *D. goajira* (Petuch, 1992) Plate 7

a. habitat

It lives in deep water, around 50-100 m and is found only in the strange deep water mud and sponge ecosystem in clear sand sea floors (Petuch, pers. comm.).

b. range

From the Goajira Peninsula and Los Monjes Archipelago in the Gulf of Venezuela to the mouth of Magdalena river near Barranquilla (Colombia). The species is restricted to the Venezuelan subprovince.

c. characterization of the species

- Shell
 - Colour pattern: the main colour varies: pink, mauve, yellow, beige, orange or brown with a paler central spiral band and sparse irregular brown spots or axial streaks. The spire is white with brown streaks.
 - Protoconch: it is eroded in all specimens seen. The apex is pale yellow to pink.
 - Shape: the spire is moderately elevated, concave and stepped. The sutural ramps have spiral threads crossed by growth lamellae becoming obsolete on the last whorl. The last whorl is obese and is more or less turnip shaped with rounded sides. *D. goajira* has a smaller and more truncated pyriform shell than *D. vikingorum*.
 - Periostracum: smooth, with large tufts and bristles along the shoulder carina
 - Soft parts: unknown
 - Radular tooth: illustrated by Tucker & Tenorio (2009), pl. V fig. 20.

-5- *D. vikingorum* (Petuch, 1993) Plate 8

a. habitat

It lives on a muddy sand substrate and sponges, in 10-50 m depths (Petuch, pers. comm.) or on a substrate of calcareous gravel and sponges at 40 m. depth (Diaz, 1990 as *C. amphurgus*).

b. range

The species ranges from Goajira Peninsula to Santa Marta near Cartagena and continue to the Golfo de Uraba, Colombia. It is the second Venezuelan subregion endemic species in the complex.

c. characterization of the species

- Shell
 - Colour pattern: colour varies from yellow, to vivid orange and bright pink. There are irregular sparse brown blotches sometimes forming axial flames or streaks mostly around the paler central band.
 - Protoconch: it is eroded in all specimens seen. The apex is pale yellow.
 - Shape: the spire is moderately elevated, concave. On the sutural ramps, the spiral threads become obsolete on the last whorl. The sides are parallel on the apical fifth of the last whorl and then become straight towards the anterior end. *D. vikingorum* is, on the average, larger in size with much straighter sides than *D. goajira*.
 - Periostracum: smooth, with large tufts on the carina (Petuch, pers. comm.).
 - Soft parts: unknown.
 - Radular tooth: unknown.

-6- *D. riosi* (Petuch, 1980) Plate 9

a. habitat

The species lives in 30-100 m depths on coralline algae sea floors far offshore (Petuch, pers. comm.).

b. range

Off the coasts of the Bahia and Espiritu Santo States, Brazil. It is restricted to the Bahian subprovince.

c. characterization of the species

- Shell
 - Colour pattern: it varies from yellow, pale mauve to chestnut brown with two bands of darker brown blotches and streaks with white connected blotches under periphery and in the center of the last whorl. The anterior extremity is paler with some dark brown axial streaks and white blotches.
 - Protoconch: it is eroded in all specimens seen. The apex is pale yellow.

- Shape: the spire is almost flat with the apex protruding. The last whorl is wide with parallel sides on the adapical fifth, then becoming straight.
- Periostracum: it is translucent, yellow with about 8 narrow rows of tufts that are widely spaced on the last whorl (pl. 9 fig. 8).
- Soft parts: A recent Brazilian study (Luiz Simone's team) showed that the color, the anatomy and the DNA of *D. riosi* and *D. worki* were different.
- Radular tooth: illustrated by Tucker & Tenorio (2009), pl. VI fig. 1.

-7- *D. worki* (Petuch, 1998) Plate 8

a. habitat

In 10–40 m depths on sand bottoms (Petuch, 1998).

b. range

Off the coasts of the Bahia and Espiritu Santo States, Brazil. Like the previous species it is a Bahian subprovince endemic.

c. characterization of the species

- Shell
 - Colour pattern: The last whorl displays a yellow to orange plain colour. A pale central band is ornate with dark brown spots mostly on the upper side. There may be spiral rows of dark brown dots on the body whorl. The anterior end is coloured the same way than the rest of the body whorl but without brown dots.
 - Protoconch: In a juvenile shell the protoconch has 2.5 whorls. The apex is pale yellow.
 - Shape: The spire is moderately elevated and concave. The last whorl is slightly swollen adapically with straight sides towards the base. Size of the shells is generally smaller than those of *D. riosi*.
- Periostracum: It is translucent with narrow and widely spaced 8–9 rows of tufts (from a picture by A. Jorio).
- Soft parts: A recent Brazilian study (Luiz Simone's team) showed that the color, the anatomy and the DNA of *D. riosi* and *D. worki* were different.
- Radular tooth: it is probably illustrated by Tucker & Tenorio (2009), pl. V fig. 19 as that of *Dauciconus daucus* from Salvador de Bahia, Brazil.

-8- *D. jorioi* Petuch 2013 Plate 9

a. habitat

The unique specimen was collected dead on an "open rock platform bottom", with hermit crab.

b. range

Trindade Island far offshore of Espiritu Santo State, Brazil. It is restricted to the northern limit of the Bahian subprovince.

c. characterization of the species

- Shell
 - Colour pattern: the ground colour is white covered by two wide bands of chocolate brown with irregular margins. The anterior tip is pale salmon pink.
 - Protoconch: it is eroded in the only known shell.
 - Shape: the spire is slightly elevated and mostly straight. The last whorl has parallel sides on the adapical fifth, then becomes conical and straight.
- Periostracum: unknown.
- Soft parts: unknown.
- Radular tooth: unknown.

-9- *D. amphiurgus* (Dall, 1889) Plate 10

a. habitat

The species lives in depths of 20–50 m. on the U.S.A. Atlantic Coast (Petuch, pers. comm.) and between 100–200 m. in South Florida and the Gulf of Mexico. Kohn (2014) gives depths from 2 m. to 216 m. for shells identified by us as this species. Its habitat is in calcareous environments (Tunnell & al. 2010), or in fine sand with seaweeds in shallow water or in sand in deeper sea (Kohn, 2014), or from offshore reefs and

"cayos" in Campeche banks (Vink, 1984b).

b. range

From Cape Lookout, North Carolina (Kohn, 2014) to the Florida Keys. Gulf of Mexico from Western Florida to Texas, Yucatan. It is a Carolinian species living in subtropical or temperate waters.

c. characterization of the species

- Shell
 - Colour pattern: the colour is variable: white, cream, yellow, deep orange or salmon. The last two colours being most common. The last whorl may have spiral rows of darker brown dots that sometimes connect to form axial flammules and a few blotches on either sides of the central paler band.
 - Protoconch: van Mol (1968) shows a protoconch of three whorls.
 - Shape: the spire is moderately elevated and mostly straight except the protruding protoconch. The last whorl has swollen sides and a rough low spiral sculpture.
 - Periostracum: it is smooth, yellowish and translucent on some shells like the holotype, or strongly tufted and opaque in other specimens (Kohn, 2014).
 - Soft parts: They appear to be as variable as the shell colour (Kohn, 2014). Bright orange red or tan siphon, light gray spotted with tan or red orange foot. In one specimen the sole of the foot is white with a yellow anterior tip.
 - Radular tooth: we could not find an illustration of the radular tooth of the species. However it is described by Kohn (2014). Warmke (1960) illustrated a tooth from a shell from Puerto Rico identified as *Conus juliae*, probably belonging to *D. mayaguensis* (Nowell-Usticke, 1968).

-10- *D. glicksteini* (Petuch, 1987) Plate 10

Very limited information is available about this species. It lives in deep water off Palm Beach. We have only seen pictures of a very limited number of specimens. From the small size, colour, pattern and smooth shell it seems to be different from *D. amphiurgus*. It live in deep water (50–200 m.) in southeastern Florida, from Stuart south to Dania Beach, most specimens being dredged off Palm Beach (Petuch, pers. comm.). However more informations and specimens are necessary to assess the characters of this rare species.

-11- *D. aff. amphiurgus* Plate 10

These shells are presently under study by J.K. Tucker.

a. habitat

66 m., coralline rubble.

b. range

Localities are taken from Kohn (2014): Northern Gulf of Mexico, East Flower Garden Bank, South East of Galveston, Texas; off Freeport, Texas; off Terrebonne Bay, Louisiana; South of Barataria Bay, Louisiana.

c. characterization of the species

- Shell
 - Colour pattern: it is rather constant. Irregular orange to brown blotches form axial flames or streaks. A white mid-body band is encircled with brown spots on both sides.
 - Protoconch: unknown.
 - Shape: The spire is moderately elevated and slightly concave. Spiral threads are present until the last whorl. The sides of the last whorl are straight. The outline is slender. The last whorl is smooth except in the anterior fourth.
 - Periostracum: it is translucent, yellow, tufted set in narrow ranks (pl. 10 fig. 9).
 - Soft parts: The siphon is orange, the foot is also orange and dotted with tan and gray (Kohn, 2014).
 - Radular tooth: unknown.

	<i>D. daucus</i>	<i>D. boui</i>	<i>D. norai</i>	<i>D. jacquescolombi</i> <i>n.sp.</i>	<i>D. goajira</i>
Max size	73.3	36.0	52.2	57.2	43.2
Avg size	41.8	31.4	37.2	44.5	38.3
Spire	straight to concave, moderately elevated	concave, slightly elevated to depressed	concave, slightly elevated	concave, straight pyramidal slightly elevated	concave, moderately elevated
Apex color	pink to yellow	whitish or pale yellow	yellow, white	pink	pale pink
Protoconch & early whorls	3 whorls then smooth	pointed	pointed	pointed	pointed
Periostracum	thick or translucent with short tuft	with six – seven wide rows of strong tufts	tufted with seven – eight narrow and distant rows of long white tufts	thin, smooth brown translucent	tufted
Animal color	uniformly orange	siphon orange or yellow with black streaks, foot red-orange or yellow peppered with black on the sides	yellow, foot peppered of black on sides	“lie-de-vin” wine red	
Pattern	white, yellow, pink, orange or red; solid with a central paler band; possibly spiral rows of small brown dots; spire same colour than shell with white spots	yellow with pale central band; axial streaks or dots orange to brown; spire white with orange to brown streaks	purplish ground colour with yellow, orange, pink, red or brown irregular blotches; paler central band encircled with darker spots; spire white with dark orange or brown flecks and streaks	3 white bands on the last whorl	pale pink with a paler central spiral band and sparse irregular axial brown streaks; spire white with brown streaks
Shape	conical	wide, conical	conical	conical to broadly conical	wide at periphery, constricted at middle of last whorl
Aperture color	like the pattern	white	variable according to the last whorl	whitish	variable, according to last whorl overall colour
Ground color	white or light pink	white	white	white	variable, according to last whorl overall colour
Anterior tip color	same as last whorl	pale orange to salmon	variable, linked to the last whorl	yellow to salmon.	variable, linked to the last whorl
Depth (m)	1 – 20 m	10 – 60 m but mostly 20-30	30 -60 m	30-60 m	35 -100 m
Substrate	clean coralline sand, in sea grass beds	deep coral reefs exposed in fine sand pockets with scattered rocks, sponges and algae on a fine sand bed.	deep coral reefs buried in fine sand pockets with scattered rocks, sponges and algae on a fine sand bed	sand near small rocks without grass or coral	mud and shell hash bottoms among sponges
Habitat Range	West Indies, Cuba South Florida, ABC Isl., Colombia, Honduras, Virgin Isl., Mexico, Belize, Bahamas, Puerto Rico, Haiti, Dominican Rep., Los Roques, Panama, San Blas Isl.	Martinique Barbados (da Motta, Vink), Aruba?	Martinique Guadeloupe? Curaçao? (Vink)	Martinique Guadeloupe St Lucia, St Vincent	from Barranquilla (Colombia) to Los Monjes Archipelago (Venezuela)
Subprovince	Florida Keys, Bahamian, Antillean, Grenadian, Nicaraguan	Grenadian	Grenadian	Grenadian	Venezuelan

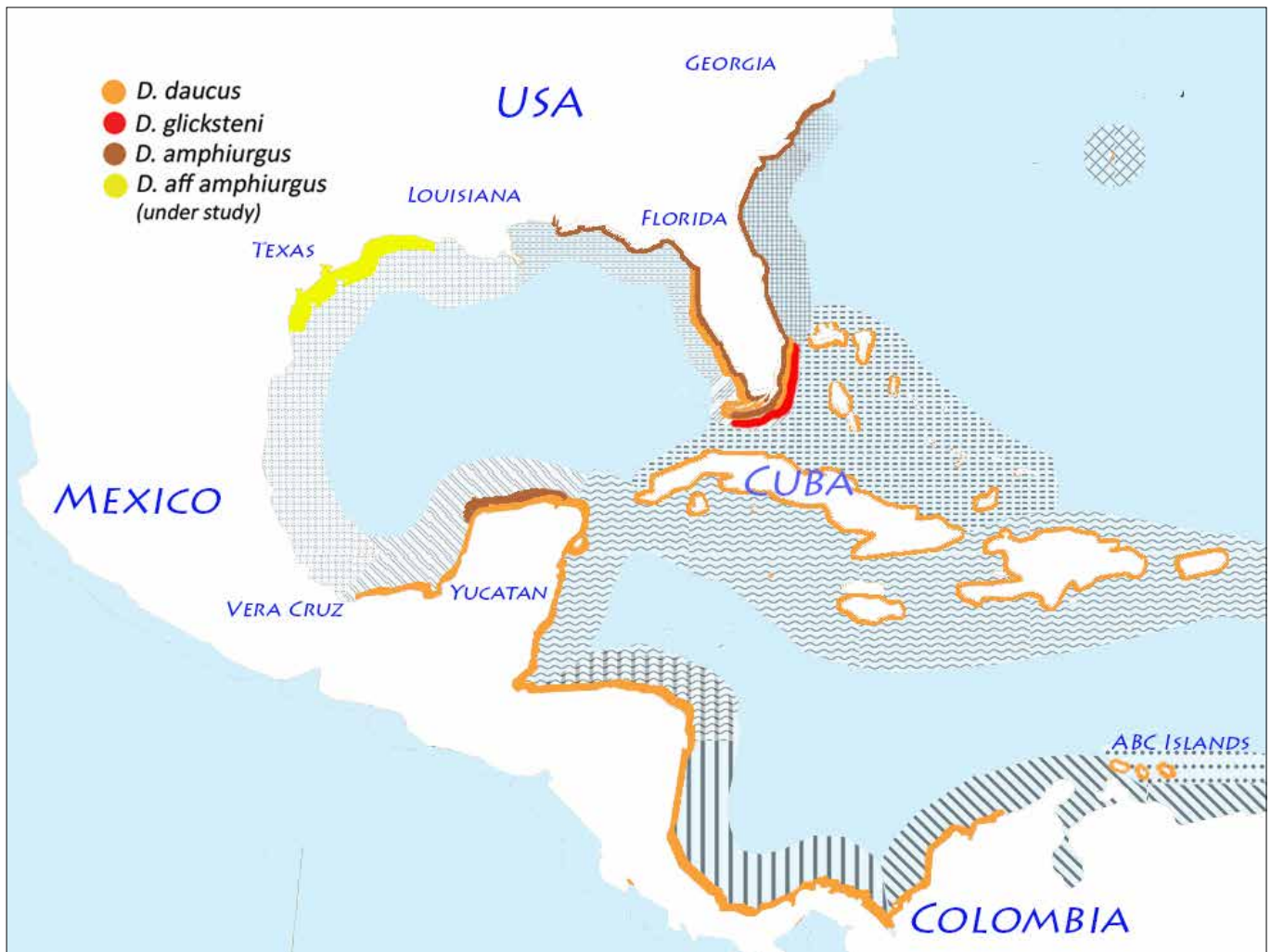
Table 5a: Comparison of the characteristics of the *D. daucus* complex species

	<i>D. vikingorum</i>	<i>D. massemini n.sp.</i>	<i>D. riosi</i>	<i>D. worki</i>
Max size	54.2	59	74.3	70.5
Avg size	41.8	41.8	50.1	41.0
Spire	concave, moderately elevated.	concave moderately elevated	flat, apex protruding	slightly concave to straight slightly stepped
Apex color	pale yellow.	whitish.	pale cream to tan	cream to yellow
Protoconch & early whorls	pointed	2 whorls pointed then 3 whorls slightly beaded	pointed	cream to yellow
Periostracum	smooth	smooth, translucent	translucent, yellow, narrow and widely spaced 6 – 7 rows of tufts	translucent, narrow and widely spaced 8 – 9 rows of tufts
Animal color				
Pattern	from white or yellow to orange red or deep pink; darker spots mostly around the paler central band	white spiral band at the middle of the last whorl overlaid by brown blotches. interrupted white bands under the shoulder; last whorl irregularly covered by spiral rows of brown dots or streaks	large axial chestnut brown flammules on yellow to or- ange background with paler central band	dark brown blotches around paler central band on a yel- low to orange background; may have dark brown dots or spots on the last whorl; never flammulated
Shape	cylindro-conical	conical	cylindro-conical	conical
Aperture color	pale orange, white	pink purple	white	white
Ground color	white	very light purple	white	yellow to orange
Anterior tip color	variable according to last whorl overall colour	white	whitish to orange yellow	same as last whorl
Depth (m)	20-50 m	60-115 m	30-100 m	10-40 m
Substrate	clean limestone sand.		coralline algae sea floors	coralline algae sea floors.
Habitat Range	from Gulf of Morosquillo to Guajira Peninsula (Colom- bia)	French Guyana- Suriname	Bahia and Espiritu Santo States Brazil	from Salvador (Bahia State) to Cabo Frio (Rio de Janeiro State) Brazil
Subprovince	Venezuelan	Surinamian	Bahian	Bahian

Table 5b: Comparison of the characteristics of the *D. daucus* complex species

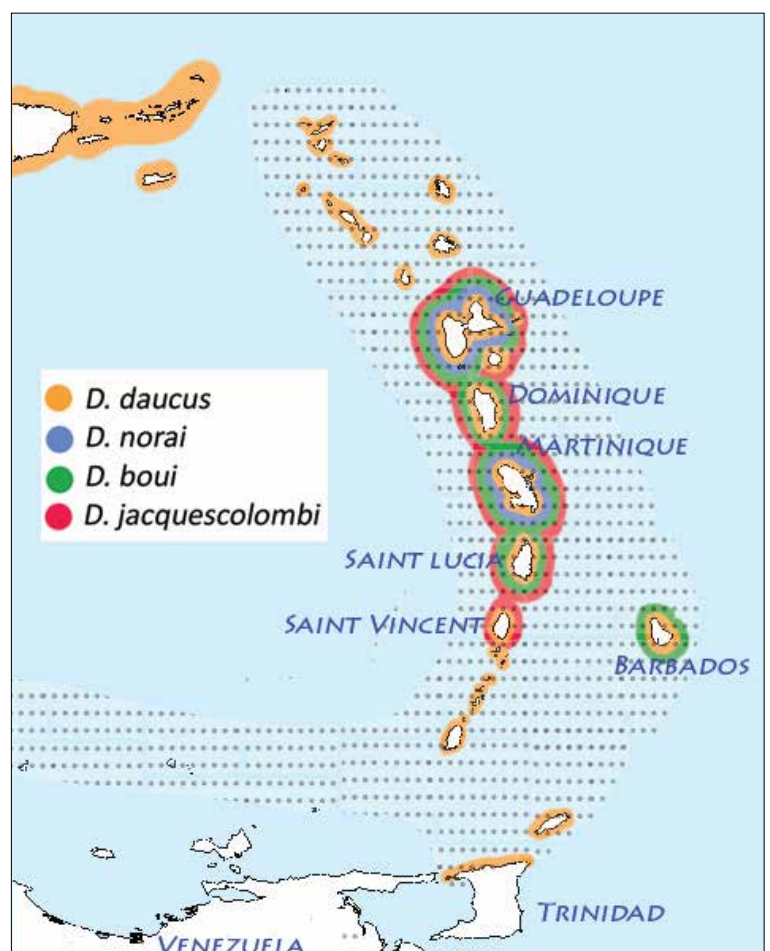
	<i>D. jorioi</i>	<i>D. amphiurgus</i>	<i>D. glicksteini</i>	<i>D. aff. amphiurgus</i>
Max size	53	74	28	54
Avg size	53	41.1	31.3	36.4
Spire	stepped	slightly concave	slightly concave and stepped, moderately elevated	slightly concave and stepped, moderately elevated
Apex color	white	white.	bright pink	pink
Protoconch & early whorls		3 whorls then 3 whorls with beads		
Periostracum		tufted in wide or narrow ranks. Holotype appears to have a smooth translucent periostracum	unknown	tufted, in narrow ranks
Animal color		bright orange red or tan siphon, light gray foot spotted with tan, sole white with yellow anterior tip	unknown	siphon orange foot orange dotted with tan and gray (Kohn, 2014)
Pattern	chocolate	red, orange, pink, cream, white or yellow; with or without brown flammules, spots or dots	plain salmon, pink or lavender with widely spaced spiral rows of small dots	irregular orange to brown blotches forming axial flames or streaks; white midbody band encircled with brown spots on both sides
Shape	stout cylindro-conical	swollen, stout or elongate	conical, slightly swollen	slender straight sides
Aperture color	pale salmon	white or pink	pink	white
Ground color	white	red, orange, pink, cream or yellow	salmon, pink, lavender	pale pink to white
Anterior tip color	pale salmon orange	white or pink	pink, paler than last whorl	pale salmon pink
Depth (m)	5 m. (dead)	2 -216 m	50-200 m	20 - 66 m
Substrate	on open rock platform bottom with hermit crab	sand		coralline rubble
Habitat Range	Trindade Isl.	Cabo Catoche, Yucatan, Mexico, Texas, Louisiana, Western Florida, Eastern Florida, South Carolina, North Carolina.	Palm Beach, Florida.	Louisiana, Texas, USA.
Subprovince	Bahian	Georgian, Palm Beach Provinciatone, Florida Keys, Suwannean, Texan, Yucata-nean	Palm Beach Provinciatone, Florida Keys ?	Suwannean, Texan

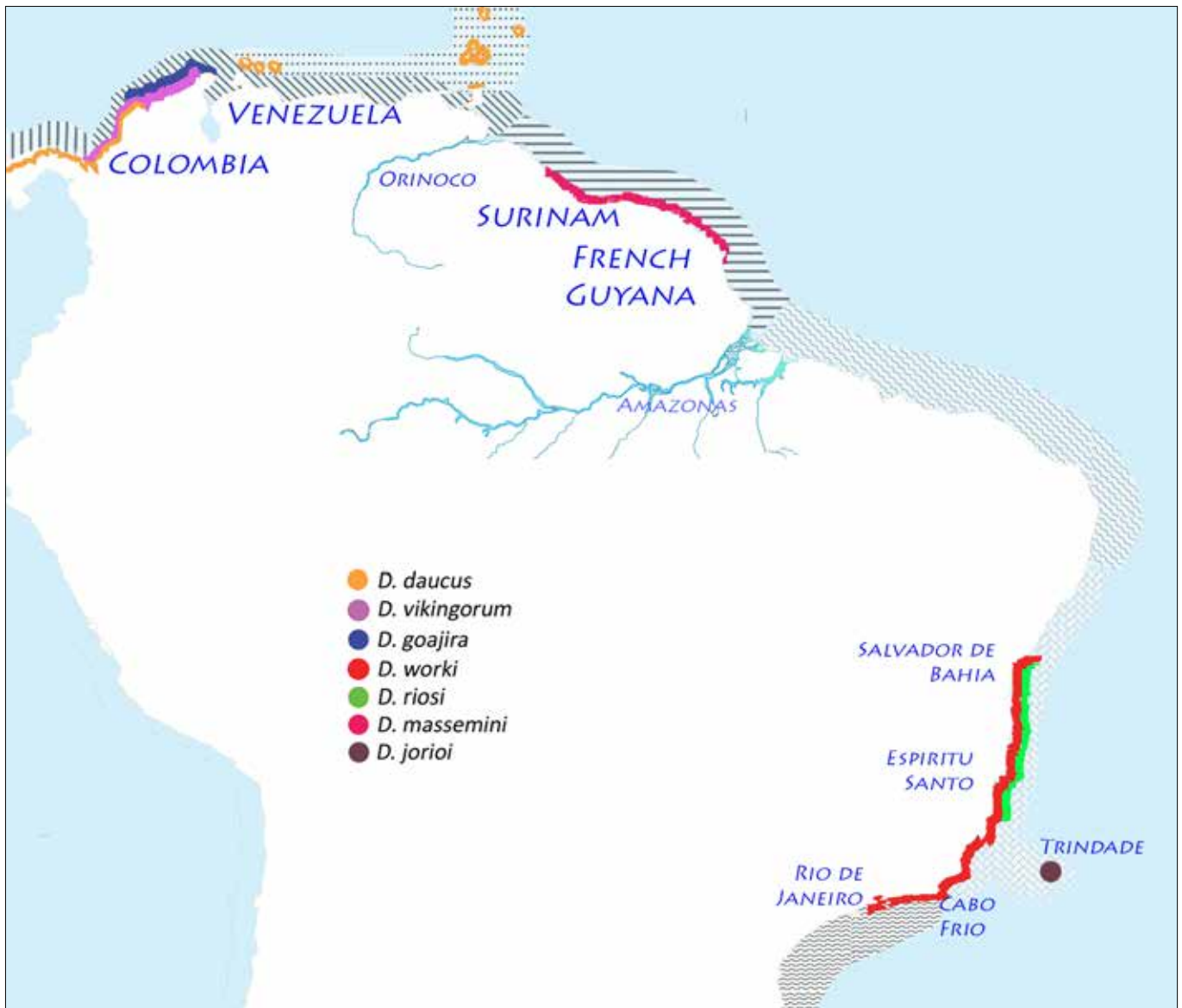
Table 5c: Comparison of the characteristics of the *D. daucus* complex species



Distribution maps of the species in the *Dauciconus daucus* complex

These maps show the distribution areas of all species of the *D. daucus* complex and match the morphological analysis groups, i.e. Gulf of Mexico & South East USA, Lesser Antilles and South America.





Morphological discriminant analysis of the *D. daucus* complex

A linear discriminant analysis (LDA) was first developed in 1936 by Robert Fisher for taxonomic classification. A quite similar method ("R" programming) is carried out with 121 specimens from 14 populations of *Dauciconus* identified on shape, pattern and locality:

D. jacquescolombi, *D. massemini*, *D. daucus*, *D. boui*, *D. norai*, *D. cf. norai*, *D. goajira*, *D. vikingorum*, *D. riosi*, *D. worki*, *D. jorioi*, *D. amphiurgus*, *D. aff. amphiurgus*, *D. glicksteini*.

Seven different morphometric shells parameters: L; MD; HMD; AH; RD; PMD; RSH are used as variables. The matrix (7 x 7) of variances and co-variances between the parameter group means is calculated. The analysis consists in determining the linear combinations which are maximizing the sum of the within species variances along these combinations.

All the 14 populations of the *D. daucus* group have rather similar shapes and morphological characteristics, nevertheless this analysis yields significant separation of almost of the clouds of points corresponding to the different species.

-A- Species from *D. daucus* group from all the Tropical Western Atlantic Regions:

D. jacquescolombi, *D. massemini*, *D. daucus*, *D. boui*, *D. norai*, *D. cf. norai*, *D. goajira*, *D. vikingorum*, *D. riosi*, *D. worki*, *D. jorioi*, *D. amphiurgus*, *D. aff. amphiurgus*, *D. glicksteini*.

Coefficients of linear discriminants:

LD1 (the first discriminant direction) & LD2 (the second one) are the linear combination of the 7 morphometric variables.

The results are given here.

LD1 = - 0.1422 L - 0.6018 MD + 1.0225 HMD - 0.4887 AH + 56.4001 RD - 51.1555 PMD - 26.9689 RS

LD2 = - 0.92906 L + 0.02278 MD - 0.83310 HMD + 1.86844

AH + 16.59000 RD

+ 62.63521 PMD + 24.65283 RSH

Proportion of trace:

The direction LD1 represents 43.92 % of the total variability (% variance) in the measurements.

LD2 represents 30.53 % of the total variability.

LD3 to LD7 have a smaller weight: between 10.61 and 0.47 %.

The two principal discriminant directions LD1 & LD2 are represented below (LD2 = f(LD1)) for each specimen of each species studied.

When all the studied species are represented together we can notice that the 2 new species: *D. massemini* and *D. jacquescolombi* are rather well separated from the other similar species.

Particularly, *D. massemini* n.sp. very well separated from *D. vikingorum* from Colombia a similar shell confused with it in the literature.

D. jacquescolombi n.sp. is well separated with *D. boui*, rather well separated with *D. norai*. Morphological separation between *D. jacquescolombi* n.sp. with the Brazilian *D. riosi* is far less evident by this kind of analysis. Similarly the points corresponding to *D. amphiurgus* and *D. aff. amphiurgus* are mixed.

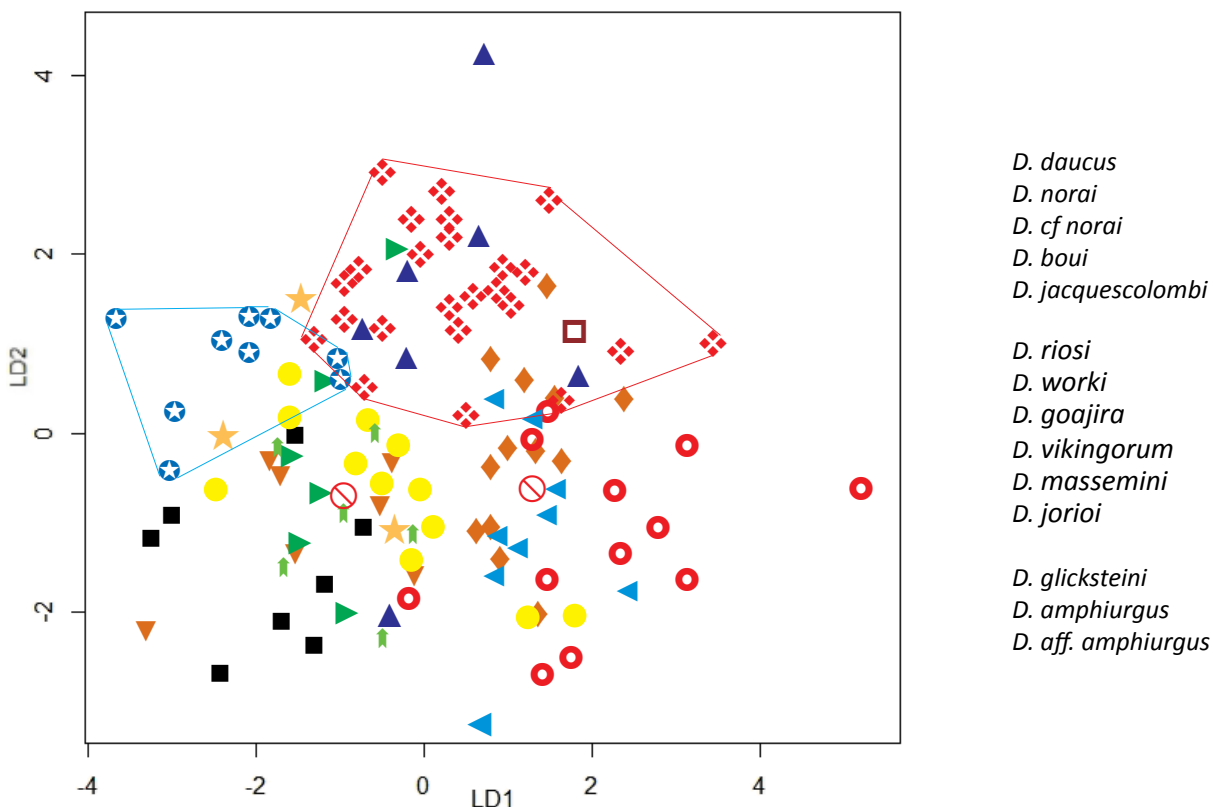


Figure 6: LD2 = f(LD1) for all Tropical Western Atlantic regions

B- Species of *D. daucus* group from Lesser Antilles Region:*D. jacquescolombi*, *D. daucus*, *D. boui*, *D. norai*, *D. cf. norai*.

Coefficients of linear discriminants:

LD1 = 2.2129 L - 1.0425 MD + 0.5716 HMD - 2.4576 AH + 19.2104 RD

- 57.4526 PMD - 89.6816 RSH

LD2 = - 0.2941 L - 0.4079 MD - 0.5830 HMD + 1.2214 AH - 15.9728 RD + 14.1757 PMD

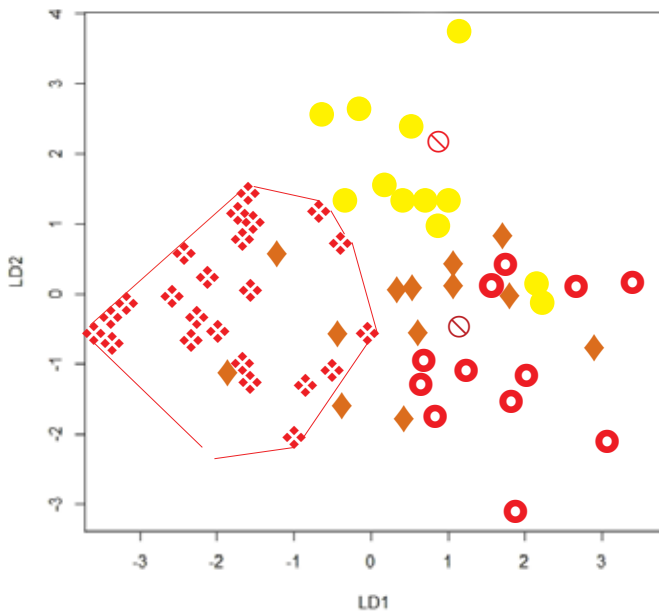
+ 52.4654 RSH

The direction LD1 represents 71.90 % of the total variability in the measurements.

LD2 represents 25.99 % of the total variability.

LD3 = 14.7 %; LD4 = 6.4 %

LD1 & LD2 are represented below (LD2 = f (LD1)) for each specimen of each species studied.



D. daucus (yellow circle)
D. norai (orange diamond)
D. cf. norai (red circle with slash)
D. boui (red circle)
D. jacquescolombi (red diamond)

Figure 7: LD2 = f (LD1) for Lesser Antilles region

In Lesser Antilles region, *D. jacquescolombi* n. sp. is very well separated from *D. daucus*, *D. boui* and *cf. D. norai* and rather well with *D. norai*.

D. norai and *D. boui* are rather well separated. *D. daucus* is also rather well separated with the other species.

D. cf. norai with only two specimens cannot be clearly separated by this analysis from *D. norai* (nor from *D. boui*).

C- Species of the *D. daucus* group from South America Region:*D. massemmini*, *D. goajira*, *D. vikingorum*, *D. riosi*, *D. worki*, *D. jorioi*, *D. daucus*.

Coefficients of linear discriminants:

LD1 = - 1.0828 L - 0.7728 MD + 1.0712 HMD + 0.7058 AH + 65.8901 RD

- 78.1842 PMD + 24.4430 RSH

LD2 = - 0.8269 L + 1.6808 MD + 1.2789 HMD - 1.2654 AH - 82.0491 RD - 54.7318 PMD

+ 25.4517 RSH

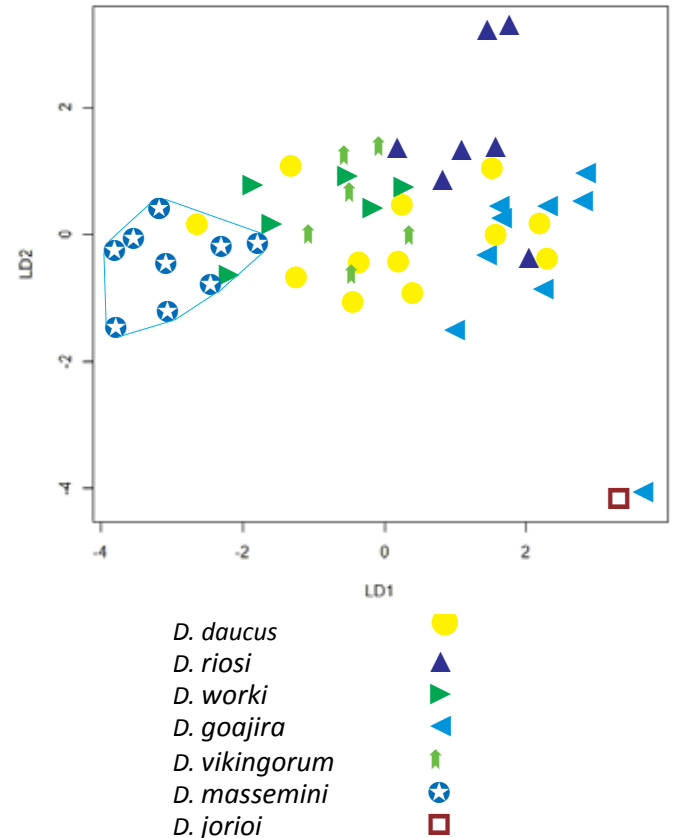
The direction LD1 represents 67.70 % of the total variability in

the measurements.

LD2 represents 17.35 % of the total variability.

LD3 to LD6: 12.73 to 0.06 %.

LD1 & LD2 are represented below (LD2 = f (LD1)) for each specimen of each species studied.



D. daucus (yellow circle)
D. riosi (blue triangle)
D. worki (green triangle)
D. goajira (blue triangle)
D. vikingorum (green triangle)
D. massemmini (blue star)
D. jorioi (red square)

Figure 8: LD2 = f (LD1) for South America region

D. massemmini n. sp. is well separated from all the other species: *D. daucus*, *D. vikingorum*, *D. goajira*, *D. riosi*, *D. worki* & *D. jorioi*.

D. vikingorum and *D. goajira* are well separated; *D. riosi* and *D. worki* are also well separated.

D. daucus cannot be separated, by this analysis, from *D. vikingorum* nor from *D. worki*.

D. jorioi with only one specimen (the holotype) is separated from the other species.

D- Species of the *D. daucus* group from Gulf of Mexico & South East USA Region:*D. daucus*, *D. amphirgus*, *D. aff. amphirgus*, *D. glicksteini*.

Coefficients of linear discriminants:

LD1 = + 1.0956 L + 0.5423 MD - 1.0779 HMD - 0.6447 AH - 72.3009 RD

+ 26.5066 PMD - 27.9141 RSH

LD2 = 1.0915 L - 0.6537 MD + 1.5622 HMD - 2.2380 AH + 18.9513 RD - 84.2489 PMD

- 49.2434 RSH

Proportion of trace: LD1 (0.5975); LD2 (0.2493)

The direction LD1 represents 59.75 % of the total variability in the measurements.

LD2 represents 24.93 % of the total variability.

LD3 = 15.32 %

LD1 & LD2 are represented below (LD2 = f (LD1)) for each specimen of each species studied.

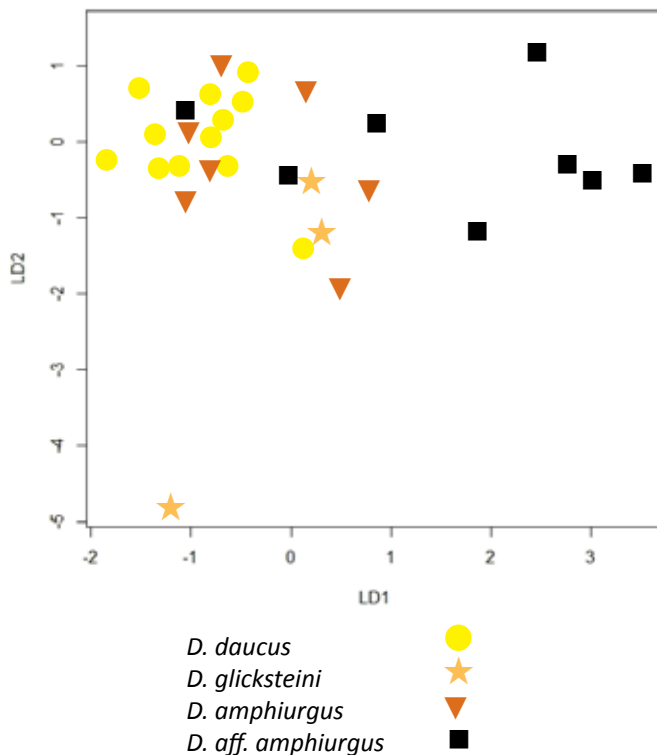


Figure 9: LD2 = f (LD1) for Gulf of Mexico & South-East USA region

D. aff. amphurgus is rather well separated from *D. amphurgus* and from *D. daucus*. We can observe also that *D. daucus* and *D. amphurgus* cannot be separated by this analysis. Finally, with few points, it is impossible to separate *D. glicksteini* from the other species.

Abbreviations

CMNH: Carnegie Museum of Natural History, Pittsburgh, U.S.A.
 FMNH: Florida State Museum of Natural History, Gainesville, Florida, U.S.A.
 MHNG: Muséum d'Histoire Naturelle, Geneve, Switzerland.
 MHNLR: Muséum d'Histoire Naturelle de La Rochelle, La Rochelle, France.
 MNHN: Muséum National d'Histoire Naturelle, Paris, France.
 MORG: Museu Oceanográfico do Rio Grande do Sul, Brazil.
 NHMUK: Natural History Museum, London, England.
 SMNS: Staatliches Museum für Naturkunde, Stuttgart, Germany.
 USNM: National Museum of Natural History (Smithsonian), Washington, D.C., U.S.A.

AM: António Monteiro
 CA: Carlos Afonso
 CR: Christophe Roux
 DM: David Massemmin
 DT: David Touitou
 EM: Eric Monnier
 GB: Guy Boltz
 GL: Georges Lhaumet
 GR: Georges Richard
 JC: Jacques Colomb
 JPV: Jean-Pierre Vezzaro
 LL: Loïc Limpalaër
 PC: Pierre Clovel
 PP: Philippe Potier
 TJ: Thierry Joly

L: Length
 MD: Maximum Diameter

HMD: Height of Maximum Diameter
 AH: Aperture Height
 RD = MD / AH: Relative Diameter of last whorl
 PMD = HMD / AH: Position of Maximum Diameter of the last whorl
 RSH = (L-AH) / L: Relative Spire Height
 *: broken lip
 **: broken base
 #: eroded spire
 ‡: subadult specimen
 (values not used for the averages of : L, MD, HMD & AH)
 §: estimated values
 lv: living specimen, DNA sequenced
 coll: collection
 pers. comm.: personal communication

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PLATE 1



- 1 *D. jacquescolombi* 50.59 mm Martinique Paratype 1 Coll. JC
 2 *D. jacquescolombi* 39.00 mm Martinique Holotype MNHN
 3 *D. jacquescolombi* 50.44 mm Martinique Paratype 2 Coll. JC
 4 *D. jacquescolombi* 38.70 mm Martinique Paratype 4 Coll. JC
 5 *D. jacquescolombi* 43.92 mm Martinique Paratype 3 Coll. JC

- 6 *D. jacquescolombi* 30.60 mm St Vincent Paratype 10 Coll. JC
 7 *D. jacquescolombi* 38.11 mm Martinique Paratype 5 Coll. JC
 8 *D. jacquescolombi* 45.74 mm Martinique Paratype 6 Coll. EM
 9 *D. jacquescolombi* 42.93 mm Martinique Paratype 7 Coll. JC
 10 *D. jacquescolombi* 41.00 mm Martinique Paratype 11 Coll. JC

PLATE 2



- 1 *D. jacquescolombi* 51.31 mm Martinique Paratype 13 Coll. CR
- 2 *D. jacquescolombi* 42.86 mm Fort de France, Martinique Paratype 14 Coll. JPV
- 3 *D. jacquescolombi* 52.12 mm Martinique Paratype 17 Coll. TJ
- 4 *D. jacquescolombi* 43.18 mm Sta Lucia Paratype 18 SMNS 91361 Coll. BdM
- 5 *D. jacquescolombi* 54.14 mm Martinique Paratype 15 Coll. GL

- 6 *D. jacquescolombi* 41.50 mm Guadeloupe Paratype 19 SMNS 91360 Coll. BdM
- 7 *D. jacquescolombi* 45.70 mm Martinique Paratype 20 SMNS Coll. BdM
- 8 *D. jacquescolombi* 45.30 mm Martinique Paratype 21 Coll. GR
- 9 *D. jacquescolombi* 48.50 mm Martinique Paratype 22 Coll. JC
- 10 *D. jacquescolombi* 57.18 mm Martinique Paratype 23 Coll. PC

PLATE 3



- 1 *D. massemini* 35.75 mm French Guyana Holotype
MNHN IM 2013-56509
- 2 *D. massemini* 34.59 mm French Guyana Paratype 1
MNHN IM 2013-56508
- 3 *D. massemini* 31.40 mm French Guyana Paratype 2
MNHN IM 2013-56024
- 4 *D. massemini* 22.80 mm French Guyana Paratype 3
MNHN IM 2013-55914
- 5 *D. massemini* 59.10 mm French Guyana Paratype 5 Coll. DM

- 6 *D. massemini* 36.38 mm French Guyana Paratype 4
MNHN IM 2000-27757
- 7 *D. massemini* 37.50 mm French Guyana Paratype 10
MHNLR 2007.8.1.1
- 8 *D. massemini* 44.80 mm French Guyana Paratype 6 Coll. DM
- 9 *D. massemini* 12.00 mm French Guyana Paratype 8 Coll. DM
- 10 *D. massemini* 42.90 mm French Guyana Paratype 9 Coll. DM
- 11 *D. massemini* 51.50 mm French Guyana Paratype 12
Private Collection

PLATE 4



- 1 *Dauciconus daucus* 39.82 mm Anse d'Arlet, Martinique Coll. EM
- 2 *Dauciconus daucus* 32.00 mm Martinique Coll. EM
- 3 *Dauciconus daucus* 54.40mm Devil's Cove, Grenadines Coll. MB
- 4 *Dauciconus daucus* 30.90 mm Cayos de San Andreas, Colombia Coll. JKT
- 5 *Dauciconus daucus* 40.68 mm Martinique Coll. EM
- 6 *Dauciconus daucus* 44.13 mm Curaçao Coll. EM
- 7 *Dauciconus daucus* 35.58 mm Trinidad, Cuba Coll. EM

- 8 *Dauciconus daucus* 55.83 mm Los Testigos, Venezuela Coll. EM
- 9 *Dauciconus daucus* 28.91 mm Les Saintes, Guadeloupe Coll. EM
- 10 *Dauciconus daucus* 35.00 mm West Indies Coll. EM
- 11 *Dauciconus daucus* 38.61 mm Martinique with periostracum Coll. JC
- 12 *Dauciconus daucus* 50.32 mm Martinique Coll. EM
- 13 *Dauciconus daucus* 49.33 mm Ste Lucie, Guadeloupe Coll. EM

PLATE 5



- 1 *Dauciconus norai* 37.40 mm Pointe de la Baleine, Martinique
Holotype MHNG 16150 Coll. BdM
2 *Dauciconus norai* 41.30 mm Pointe Burgos, Martinique Coll. EM
3 *Dauciconus norai* 36.73 mm Cap Salomon, Martinique Coll. EM
4 *Dauciconus norai* 31.93 mm Cap Salomon, Martinique Coll. EM
5 *Dauciconus norai* 44.40 mm Martinique Coll. EM
6 *Dauciconus norai* 26.80 mm Martinique Coll. EM
7 *Dauciconus norai* 50.89 mm Martinique Coll. EM

- 8 *Dauciconus norai* 28.64 mm Martinique Coll. EM
9 *Dauciconus norai* 44.00 mm Martinique Coll. JC
10 *Dauciconus norai* 37.16 mm Martinique Coll. EM
11 *Dauciconus norai* 35.11 mm Grande Anse, Martinique Coll. EM
12 *Dauciconus norai* 29.50 mm Martinique Coll. JC
13 *Dauciconus norai* 40.90 mm Martinique Coll. TJ
14 *Dauciconus norai* 43.50 mm Guadeloupe Private Collection

PLATE 6



- 1 *Dauciconus cf norai* 47.04 mm Martinique Coll. EM
- 2 *Dauciconus cf norai* 37.10 mm Martinique Coll. PP
- 3 *Dauciconus boui* 30.20 mm Pointe de la Baleine, Martinique
Holotype MHNG 988 105 Coll. BdM
- 4 *Dauciconus boui* 31.69 mm Anse d'Arlet, Martinique Coll. EM
- 5 *Dauciconus boui* 27.21 mm Martinique Coll. EM
- 6 *Dauciconus boui* 32.79 mm Fort de France, Martinique Coll. JPV

- 7 *Dauciconus boui* 32.00 mm Martinique Private Coll.
- 8 *Dauciconus boui* 28.80 mm Martinique Paratype Coll. GR
- 9 *Dauciconus boui* 32.00 mm Martinique Private Coll.
- 10 *Dauciconus boui* 28.90 mm Martinique Coll. JC
- 11 *Dauciconus boui* 30.50 mm Martinique Coll. JC
- 12 *Dauciconus boui* 32.57 mm Martinique Coll. EM

PLATE 7



- 1 *Dauciconus goajira* 35.00 mm Cabo de la Vela, Goajira, Colombia Holotype CMNH
- 2 *Dauciconus goajira* 39.50 mm Venezuela Coll. EM
- 3 *Dauciconus goajira* 41.13 mm Los Monges, Venezuela Coll. EM
- 4 *Dauciconus goajira* 35.60 mm Cartagena, Colombia Coll. LL
- 5 *Dauciconus goajira* 36.75 mm Los Monges, Venezuela Coll. EM

- 6 *Dauciconus goajira* 43.22 mm Cabo de la Vela, Goajira, Colombia Coll. EM
- 7 *Dauciconus goajira* 41.22 mm Cabo de la Vela, Goajira, Colombia Coll. EM
- 8 *Dauciconus goajira* 36.2 mm Coll. EM
- 9 *Dauciconus goajira* 36.67 mm Golfo de Triste, Venezuela Coll. EM
- 10 *Dauciconus goajira* 38.80 mm Cabo de la Vela, Goajira, Colombia Coll. CR

PLATE 8



- 1 *Dauciconus vikingorum* 46.62 mm Venezuela Coll. EM
- 2 *Dauciconus vikingorum* 37.00 mm Puerto Colombia, Colombia 35 m Holotype CMNH Photo A. Kohn
- 3 *Dauciconus vikingorum* 33.70 mm La Guajira, Colombia 45-55 m Coll. EM
- 4 *Dauciconus vikingorum* 42.60 mm La Guajira, Colombia 45-55 m Coll. EM
- 5 *Dauciconus vikingorum* 41.30 mm Coll. JKT
- 6 *Dauciconus vikingorum* 49.20 mm Los Monges, Venezuela 60 m Coll. TJ

- 7 *Dauciconus worki* 30.01 mm Salvador de Bahia, Brazil Coll. EM
- 8 *Dauciconus worki* 35.00 mm Vitoria, Espirito Santo, Brazil Holotype FLMNH
- 9 *Dauciconus worki* 34.38 mm Camocim, Ceara, Brazil Coll. EM
- 10 *Dauciconus worki* 43.49 mm Vitoria, Espirito Santo, Brazil Coll. EM
- 11 *Dauciconus worki* 48.50 mm Alcobaça, Brazil Coll. EM
- 12 *Dauciconus worki* 54.60 mm Guarapari, Espirito Santo, Brazil Coll. CR

PLATE 9



1 *Dauciconus riosi* 54.00 mm Salvador de Bahia, Brazil
Holotype MORG

2 *Dauciconus riosi* 61.20 mm Guarapari, Espirito Santo, Brazil Coll. TJ

3 *Dauciconus riosi* 41.92 mm Brazil Coll. EM

4 *Dauciconus riosi* 39.00 mm Brazil Private Coll.

5 *Dauciconus riosi* 50.52 mm Guarapari, Espirito Santo, Brazil
Coll. EM

6 *Dauciconus riosi* 41.92 mm Brazil Coll. EM

7 *Dauciconus riosi* 49.91 mm Guarapari, Espirito Santo, Brazil
Coll. EM

8 *Dauciconus riosi* 52.80 mm Brazil Coll. AJ

9 *Dauciconus jorioi* 53.00 mm Trindade Island, Brazil
Holotype FMNH 328432

PLATE 10



- 1 *Dauciconus amphiurgus* 40.0 mm Cabo Catoche, Yucatan, Mexico
Holotype USNM Photo A. Kohn
- 2 *Dauciconus amphiurgus* 44.68 mm Yucatan, Mexico Coll. EM
- 3 *Dauciconus amphiurgus* 31.80 mm Florida SMNS Coll. BdM
- 4 *Dauciconus amphiurgus* 36.20 mm Yucatan Coll. GR
- 5 *Dauciconus amphiurgus* 42.50 mm Cap Canaveral, Florida Coll. LL
- 6 *Dauciconus amphiurgus* 47.00 mm Florida SMNS Coll. BdM

- 7 *Dauciconus amphiurgus* 38.00 Ft Walton Beach, Florida Coll. EM
- 8 *Dauciconus aff. amphiurgus* 38.0 mm Louisiana 66 m
- 9 *Dauciconus aff. amphiurgus* 37.5 mm Barataria Bay, Louisiana
FLMNH
- 10 *Dauciconus glicksteini* 21.0 mm Palm Beach, Florida 120 m
Holotype USNM Photo M. Filmer
- 11 *Dauciconus glicksteini* 21.0 mm Florida Coll. EP
- 12 *Dauciconus glicksteini* 45.0 mm Key West, Florida Coll. TJ



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