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Jaspidiconus: what are the options?

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ABSTRACT The number of species of *Jaspidiconus* recognized in three recently published works are compared. These references varied in the number of species recognized as valid ranged from 6 to 36 taxa. Using a metric, Percentage synonyms, the degree to which taxa are lumped was measured. The Percentage synonyms varied from 0 in the base document to 69% and 56% in the other documents. Such variation among publications by different authors suggests that morphological species concepts are too subjective to allow direct comparisons among publications or identification of valid species. In contrast, use of molecular methods may avoid the problems of the subjective morphological species concepts. However, molecular methods are only valid when they are applied to geographically coded samples to arrive at clades in the phylogram. Use of molecular methods for samples that have previously been identified to taxon by morphological methods is biased by the need to identify samples to species first to obtain a phylogram.

KEYWORDS Morphological species concepts, *Jaspidiconus*, metric comparisons, western Atlantic.

INTRODUCTION

I enjoyed David Berschauer's Iconography of the *Jaspidiconus* and the comparison of the Cape Verde *Africonus* 'species flock' in the eastern Atlantic and the large number of potentially valid species of *Jaspidiconus* in the western Atlantic (Berschauer, 2015). He noted that the two were similar in that they have paucispiral protoconchs suggesting that they do not have extended dispersive larval stages. Normally this situation is taken as evidence that snails with this sort of protoconch do not have as good dispersal abilities when compared to snails with multispiral protoconch and supposed longer free floating larval stages (see Berschauer's discussion). The length of the larval periods associated with various protoconch morphologies is for the most part unknown so any assumptions made are hypotheses but seem to be reasonable ones. I would like to have seen comparisons between *Jaspidiconus* and other genera (*e.g.*, *Kohniconus* and *Dalliconus*) of Conilithidae (see Tucker & Tenorio, 2009 and 2013) most of which have multispiral protoconchs and with others such as *Perplexiconus* and *Coltroconus*, two conilithid genera along with *Artemidiconus* of the Conorbidae all of which have paucispiral protoconchs, but are not considered here. These last three genera all have relatively few species even if suggested synonyms are listed as valid. The last two also have relatively restricted ranges (*i.e.*, mostly in Brazil) compared to *Jaspidiconus*. What this means, I think, is that dispersal ability is not the only determinant of the number of species that any particular genus will produce. However, biogeographic influence on systematics is not the purpose of this paper. Rather, it is to show exactly how little we actually know about all of these species of *Jaspidiconus*. I intend to do this by using Berschauer's (2015) most recent account and comparing it to accounts by other authors from the 21st century. Given the assumption that we know what we are talking about, these species lists should more or less agree with each other. After all, we are all looking at the same shells.

MATERIALS

I am using Berschauer's (2015) Iconography as a guide to possibly valid species based on the biogeographic provinces of Petuch (2013). I am also listing the species as either valid species or synonyms from Tucker & Tenorio (2013) and from Kohn (2014). Geographically, Tucker & Tenorio (2013) cover all of the provinces and subprovinces listed by Berschauer (2015). Kohn (2014) excluded the Brazilian provinces recognized by Petuch (2013). I have selected this comparative material because it is easily available to collectors of cone shells. This list is admittedly somewhat biased because I was the coauthor of one of the three references that I surveyed. Other available references were not used because they cover smaller geographic areas (*e.g.*, Tucker, 2012). Others (*e.g.*, Abbott, 1974) are too old and do not include many of the newly described species of this last decade of systematic research on cone shells (*see* Table 1).

Because Kohn (2014) did not cover the entire western Atlantic region and did not have access to descriptions of many new species of *Jaspidiconus*, I have prepared a metric in Table 1 allowing Kohn's book to be compared to Tucker & Tenorio (2013). It uses 'Percentage synonyms' in order to judge degree of lumping (or splitting) (Table 1). A higher value indicates a greater degree of 'lumping' than does a lower value, which would indicate a greater degree of 'splitting'. The value for Percentage synonyms is 0% for the species included by Berschauer (2015). Berschauer (2015) did not list synonyms and all illustrated species were considered valid species.

DISCUSSION

Based on Percentage synonyms the book by Kohn (2014) most strongly lumps the various *Jaspidiconus* species together and at roughly twice the rate compared to Berschauer's listing. Kohn (2014) only discusses six species of *Jaspidiconus*. In contrast, Tucker and Tenorio (2013) took more of a splitters' approach to the species of *Jaspidiconus*. They listed 22 *Jaspidiconus* taxa. Kohn's 69% Percentage synonyms is about a third higher than is the 56% for Tucker & Tenorio (2013). The two percentage synonyms of 69% versus 56% for what are essentially the same species of *Jaspidiconus* indicates the general lack of congruence in the systematics of *Jaspidiconus*. It is further demonstrated by the relatively few taxa (6) used by Kohn (2014) compared to Tucker & Tenorio's (2013) 22 taxa and Berschauer's (2015) 36 taxa. Moreover for both Kohn and Tucker & Tenorio all of the Net changes are negative. In other words neither list species as valid that are not also listed as valid by Berschauer.

Such discrepancies may indicate that shell morphology cannot reliably be used to distinguish the species of *Jaspidiconus*. Apparently competent or expert students of cone shells can differ by as much as 50% in the number of valid species of *Jaspidiconus* that they recognize. There is no objective way to evaluate these classification schemes. Obviously, use of shell morphology as a basis for identifying species of *Jaspidiconus* will require precise identification and definition of shell morphological traits.

One possible method that may help clear up the systematics of the *Jaspidiconus* is use of DNA or RNA from mitochondrial genes. A preliminary tree (subtree A. Kohn, 2014, p. 420) included four taxa of the *Jaspidiconus* including

J. stearnsii, *J. mindanus*, *J. jaspideus*, and *J. pealii* (species nomenclature follows Kohn, 2014). This tree is not of much use because it includes only four of the 36 taxa that Berschauer (2015) listed as potentially valid species. A better approach may be to completely ignore the possible taxation as an identifier but instead use as many individuals from the many provinces and subprovinces without using taxon as an identifier. If there is more than one taxon, then these should show up in the trees as separate clades. The clades can be judged on this basis and on the possible relatedness of the various geographically defined taxa. Once sufficient individuals are processed, the known clades can be matched to the morphological species. Molecular genetics cannot work so long as all the factors including geographic origin are not included in the analysis. It is not possible to construct trees from animals already identified to species prior to producing the tree without introducing collector bias. Puillandre *et al.* (2014) demonstrates the value of approaching a species level problem using many individuals identified where they came from rather than being identified by subjective shell morphological traits.

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Table 1. Comparisons of the systematics of *Jaspidiconus* in publications by Berschauer (2015), Kohn (2014) and Tucker & Tenorio (2013).

Berschauer species	Subprovince	Endemic to	Kohn	Net change	T & T [5]	Net change
pfluegeri	Georgian	Not endemic	*J. pealii*	-1	*J. jaspideus ssp*	-1
fluviamaris	Floridian	Not endemic	Not included		*J. fluviamaris*	
pealii	Floridian	Florida Keys	*J. pealii*		*J. jaspideus ssp*	-1
vanhyningi	Floridian	Not endemic	*J. jaspideus*[1]	-1	*J. vanhyningi*	
mindanus	Floridian etc	Not endemic	*J. mindanus*[4]		*J. mindanus*	
stearnsii	Suwannean	Suwannean Subprov.	*J. stearnsii*[2]		*J. jaspideus ssp*	-1
mindanus bermudensis	Bermudan	Bermuda	*J. mindanus*	-1	*J. mindanus ssp*	
branhamae	Bahamian	Abacos	*J. pealii*	-1	*J. j. pealii*	-1
exumaensis	Bahamian	Exuma Sound	Not included		*J. j. pealii**	-1
herndli	Bahamian	Great Bahama Bank	Not included		*J. herndli**	
nodiferus	Bahamian	Not endemic	*J. jaspideus*	-1	*J. j. pealii*	-1
oleiniki	Bahamian	Bimini Chain	Not included		*J. j. pealii*	-1
verrucosus	Bahamian	Not endemic	*J. jaspideus*	-1	*J. j. pealii*	-1
agassizii	Antillean	St. Croix	Not included		*J. m. mindanus*	-1
anaglypticus	Antillean	Puerto Rico	*J. pusio*	-1	*J. anaglypticus*	
berschaueri	Antillean	St. Maartin	Not included		*J. berschaueri**	
duvali	Multiple	Guadeloupe	*J. pusio*	-1	*J. pusio*	-1
mackintoshi	Antillean	Virgin Islands	Not included		*J. m. mindanus*	-1
alexandremonteiroi	Nicaraguan	Cayos Miskitos	Not included		*T. ceruttii**	-1
allamandi	Nicaraguan	Roatan Island	Not included		*J. allamandi*	
roatanensis	Nicaraguan	Roatan Island	Not included		*J. roatanensis*	

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sargenti	Nicaraguan	Roatan Island	Not included		*J. j. jaspideus*	-1
acutimarginatus	Venezuelan	Not endemic	*J. jaspideus*	-1	*J. j. jaspideus*	-1
jaspideus	Multiple	Not endemic	*J. jaspideus*		*J. j. jaspideus*	
arawak	Grenadian	Grenadine Islands	Not included		*J. arawak**	
Subtotal		**0/36**		**-9/13**		**-14/25**
Percent synonyms		**0%**		**69%**		**56%**
pusio	Multiple	Not endemic	*J. pusio*[3]		*J. pusio*	
damasoi	Cearaian	Ceara coast	Not included		*J. damasoi*	
damasomonteiroi	Cearaian	Not endemic	Not included		*J. damasomonteiroi**	
ericmonnieri	Bahian	Bahian Subprovince	Not included		*J. ericmonnieri**	
henckesi	Bahian	Todos os Santo Bay	Not included		*J. henckesi*	
marinae	Bahian	Porto Itaparica Is.	Not included		*J. marinae**	
ogum	Bahian	Aratuba, Itaparica Is.	Not included		*J. ogum**	
pomponeti	Bahian	Todos os Santo Bay	Not included		*J. pomponeti**	
poremskii	Bahian	Bahia State	Not included		*J. poremskii**	
pusillus	Multiple	Brazilian Province	*J. pusio*	-1	*J. pusio*	-1
simonei	Paulian	Not endemic	Not included		*J. simonei**	
Number of taxa		36		6		22
Deviation				-10		-15

* indicates species that are discussed on the *Illustrated Catalog of Living Cone Shells* web site (www.conecatalogupdate.com/taxa-described-in-2014) . Most of them are accepted as tentatively valid species pending further study. However, they were not included in the printed version of Tucker & Tenorio (2013).

1. Kohn included *sulcatus* Mühlfeld, 1816; *corrugatus* Sowerby II, 1870, *verrcosus piraticus* Clench, 1942; *pseudojaspideus* Nowell-Usticke, 1968 as synonyms of *J. jaspideus*.

2. Kohn included *stictus* A. Adams, 1854, as an unused senior synonym for *J. stearnsii*.

3. Kohn included *minutus* Reeve, 1844; *crebrisulcatus* Sowerby II, 1857, and *boubeae* Sowerby III, 1903 as synonyms of *J. pusio*.

4. Kohn included *elventinus* Duclos, 1833, *rosaceus* Sowerby I, 1834, *cretaceus* Kiener, 1847, *lymani* Clench, 1942, and *karinae* Nowell-Usticke 1968 as synonyms of *J.* m*indanus*.

5. "T & T" is Tucker and Tenorio, 2013.

Comparison plate: *Jaspidiconus vantwoudti* new species herein by Petuch, Berschauer and Poremski, 2015. Additional specimens from the André Poremski collection. Top row: 11.8 mm and 12.1 mm; middle specimen 13.4 mm; bottom row: 12.5 mm and 12.9 mm. Specimens collected at Arashi Beach, Aruba, in coarse rubble at 6 to 8 feet of water in a high wave action environment. Photos by André Poremski.