

## JAVANELLA SANFORDAE, A NEW CYTHERIDAE (CRUSTACEA: OSTRACODA) SPECIES WITH A DISCUSSION ON THE VALIDITY OF THE GENUS JAVANELLA KINGMA

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**ABSTRACT** – *Javanella sanfordae*, a new Cytheridae (Crustacea, Ostracoda) species, is herein described and illustrated. Among the rare fossil and recent records of *Javanella*, this is the first outside the southeastern Asia and Australia regions. This may indicate a migration of this genus to the Atlantic before the elevation of the Isthmus of Panama during the middle Pliocene (4 to 3 Ma) or through the Drake Passage, and its subsequent dispersion in deeper waters along the Brazilian margin. The validity of the genus *Javanella* as well as its zoogeographical and stratigraphical distributions are discussed.

**Key words:** *Javanella*, Ostracoda, systematics, zoogeography, Brazilian margin.

**RESUMO** – *Javanella sanfordae*, uma nova espécie de ostracode da família Cytheridae (Crustacea, Ostracoda), é aqui descrita e ilustrada. Entre os poucos registros fósseis e recentes de *Javanella* este é o primeiro fora da região do Sudeste Asiático e Austrália. Isso pode indicar que a migração desse gênero para o Atlântico ocorreu antes da elevação do Istmo do Panamá, no Mesoplioceno (4 a 3 Ma), ou através da Passagem de Drake, e que, posteriormente, dispersou-se para as águas profundas da margem continental brasileira. A validade do gênero *Javanella* bem como suas distribuições estratigráfica e zoogeográfica são discutidas.

**Palavras-chave:** *Javanella*, Ostracoda, sistemática, zoogeografia, margem brasileira.

### INTRODUCTION

Marine podocopid ostracodes are one of the most diversified crustacean groups especially in the Cenozoic. Every year, new genera and species are proposed based either on new discoveries or on the splitting of previously described taxa during systematic reviews. The geologic history of oceanic basins clearly indicates that the South Pacific is an important centre of origin and migration for ostracodes being corroborated by high levels of diversity because the earliest stratigraphic records of some extant taxa are from that area (Whatley & Ayress, 1988).

The dispersal mechanisms of marine benthic species especially, are a recurrent research focus in ostracodology. Because podocopid ostracodes lack planktic larvae, many hypotheses have been proposed to explain how and when different taxa overcome potential zoogeographical barriers, in both shallow water and oceanic basins. It is traditionally assumed that the shallow water faunas present a high degree

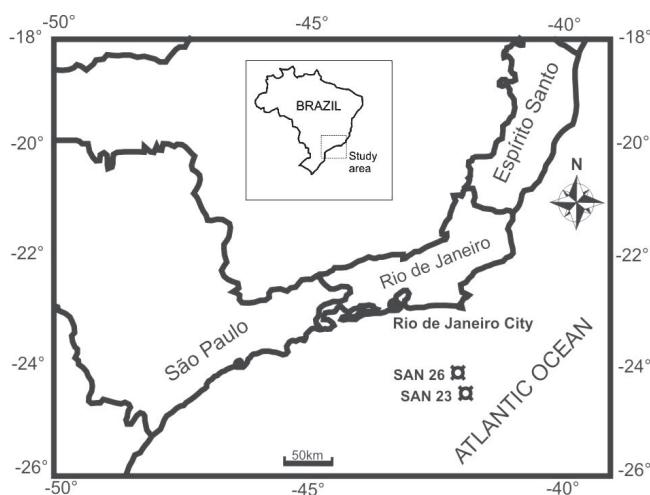
of endemism, while the deep sea taxa are predominantly pandemic. Although these general principles remain valid, recent studies have presented evidence that indicate this, in part, must be reevaluated. At the core of that discussion is the problem of taxonomic misinterpretation which may, for instance, increase the zoogeographical range of a species while in fact those records might combine distribution data of two or more taxa (Jellinek *et al.*, 2006; Schornikov, 2005). It is important to point out, however, the existence of species for which broad geographical range is appropriate. A faunal similarity between the South Pacific and Southeast Atlantic, for instance, has been noticed by Bergue *et al.* (2006) who recorded species such as *Cytheropteron lobatum* Ayress *et al.* 1996 and *Phyloneptunus provocator* Jellinek & Swanson, 2003 in deep waters off the SW Brazilian continental margin. Those occurrences show that migration routes have been established between those two regions some time during the Quaternary.

Studies on deep sea faunas by Carmo & Sanguinetti (1995,

1999), Drozinski *et al.* (2003), Bergue *et al.* (2006) and Bergue *et al.* (2007) have contributed to a more precise knowledge of Brazilian marine bathyal ostracodes. The first occurrence of some taxa in Brazilian waters such as *Cluthia* Neale, 1973, *Poseidonamicus* Benson, 1972, *Rimacytheropteron* Whatley & Coles, 1987 and *Clinocythereis* Ayress & Swanson, 1991, improved both the taxonomy and paleozoogeographical understanding of South Atlantic ostracode faunas. As a further contribution to that data base, this article describes *Javanella sanfordae* sp. nov. and discusses the validity of this genus based on occurrences recorded in the literature and examination of type material and the resultant implications for some aspects of the zoogeographical and stratigraphical distributions of *Javanella*.

## MATERIAL AND METHODS

The samples studied were taken from two piston cores from the upper slope of Brazilian southeast continental margin: SAN 26 (384 m water depth, lat. 23°42' S, long. 42°21.1' W) and SAN 23 (630 m water depth, lat. 23°49.5' S, long. 42°17.8' W) (Figure 1). Each of these samples of approximately 20 grams was prepared using conventional micropaleontological techniques with extracted specimens being imaged using both SEM and traditional optical microscopy. More detailed information relating to core length recovery, sedimentology and samples can be found in Bergue *et al.* (2006). The type material of *Pellucistoma kendengensis* Bold, 1950, housed in the Museum of Natural Science of Louisiana State University under the acronym HVH 4029, was analyzed by the first author in optical microscopy. The type material of *Javanella sanfordae* sp. nov. is housed at the Ostracoda Section of Museu de Paleontologia of the Universidade Federal do Rio Grande do Sul (MP-O), under the curatorial numbers MP-O-1794, 1795, 1796 and 1870. **Abbreviations:** C, carapace; V, valve; LV, left valve; RV, right valve; l, length; h, height; w, width.



**Figure 1.** Map of the eastern region of Brazil, showing the location of the study cores.

## SYSTEMATIC DESCRIPTIONS

Order Podocopida Müller, 1894

Suborder Podocopina Sars, 1866

Superfamily Cytheracea Baird, 1850

Family Cytheridae Baird, 1850

*Javanella* Kingma, 1948

**Type species.** *Javanella kendengensis* Kingma, 1948.

**Emended diagnosis.** Carapace subrectangular to fusiform, moderately inflated, predominantly smooth, caudal process somewhat below the middle height. Postero-median region marked with two prominent normal pore canals. Anterior elements of LV hinge composed of a shallow socket below a lobate tooth, median nearly smooth bar, and posterior small tooth followed by small socket. Marginal area moderately wide with deep anterior and shallow postero-ventral vestibulae, marginal pore canals more or less evenly spaced, simple and branching. Central muscle scars in a row of four adductors and a single frontal one; two mandibular scars not much visible.

**Species included.** *Javanella kendengensis* Kingma, 1948 and *Javanella sanfordae* sp. nov.

**Species excluded.** *Pellucistoma kendengensis* (Kingma, 1948) Bold, 1950; *Javanella caudata* (Hartmann, 1978) Howe & McKenzie, 1989; *Javanella arenicola* (Hartmann, 1978) Howe & McKenzie, 1989. For more details see Discussion and Conclusions and Table 1.

*Javanella sanfordae* sp. nov.

(Figures 2A-K)

**Derivation of name.** In honor to Ms Carlita Sanford, museum specialist at National Museum of Natural History, Smithsonian Institution, Washington D.C., who has been working on the Smithsonian microfossil collections for many years.

**Material.** 1 adult C, 4 adult V, 1 juvenile V.

**Holotype.** MP-O-1794, C, l: 0.42 mm; h: 0.19 mm; w: 0.15 mm.

**Paratypes.** MP-O-1795, LV, l: 0.40 mm; h: 0.19 mm; MP-O-1796, LV, l: 0.44 mm; h: 0.20; MP-O-1870, RV, l: 0.40 mm; h: 0.20 mm.

**Type locality.** SAN 23 sample 3.

**Age.** Late Pleistocene.

**Diagnosis.** Carapace subrectangular in lateral view, tumid in the centre and peripherally compressed posteriorly and anteriorly. Dorsal margin almost straight; ventral margin sinuate. Anterior margin broadly and somewhat obliquely rounded; posterior margin with conspicuous truncate caudal process just below the middle height. Surface predominantly smooth with delicate marginal rim and a conspicuous dorsal ridge. A "false" ventro-lateral oblique ridge appears in the SEM due to the valve inflation.

**Description.** Carapace delicate and subrectangular in lateral view. Both valves tumid in the centre and peripherally compressed posteriorly and anteriorly. RV slightly higher in the anterior portion. Dorsal margin almost straight; ventral

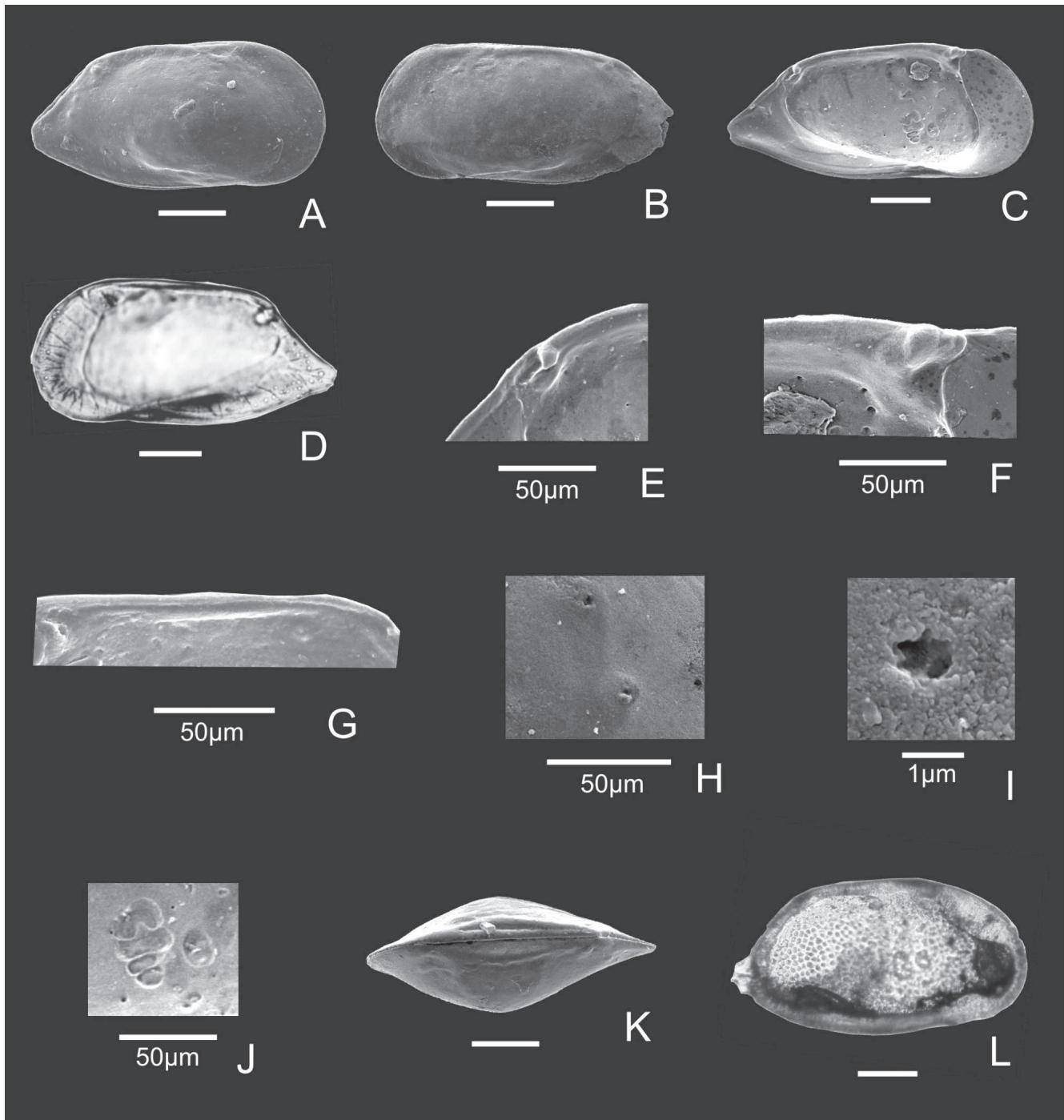


Figure 2. *Javanella sanfordae* sp. nov. **A**, carapace right lateral view, holotype, MP-O-1794; **B**, left valve external view, MP-O-1795 (broken); **C**, left valve internal view, MP-O-1796; **D**, right valve internal view in optical microscopy, MP-O-1870 (lost); **E**, hinge posterior part of left valve, MP-O-1796; **F**, Hinge anterior part of left valve, MP-O-1796; **G**, right valve hinge in detail, MP-O-1870 (lost); **H**, detail of the posterior normal pore canal pair, MP-O-1795; **I**, detail of a normal pore canal, MP-O-1794; **J**, Detail of central muscle scars, MP-O-1796; **K**, Carapace dorsal view, MP-O-1794; **L**, *Pellucistoma kendengensis* Bold, 1950, internal view in optic microscopy, HVH 4029. Scale bar = 100 µm, unless otherwise stated.

margin sinuate, slightly concave in the oral region. Anterior margin broadly and somewhat obliquely rounded; posterior margin with well developed truncate caudal process just below the middle height. Surface predominantly smooth with delicate marginal rim and a conspicuous dorsal ridge. A “false” ventro-lateral oblique ridge appears in the SEM due to the

valve inflation. Postero-median region marked with two prominent normal pore canals. Internal view: anterior elements of LV hinge composed of a shallow socket below a trilobate tooth, long smooth bar, small posterior tooth and bipartite shallow socket. RV with complementary elements, being made up by an obliquely positioned tooth below a trilobate socket,

narrow smooth groove and small socket and tooth. Anterior vestibulum more developed medially; postero-ventral vestibulum elongate and slightly projected into the caudal process. Marginal pore canals predominantly simple, mostly concentrated in the antero-ventral region, three ones running inside the caudal process. Central muscle scars in a row of four adductors and one frontal somewhat kidney shaped. Mandibular scars small and inconspicuous. Sexual dimorphism not observed.

**Discussion.** *Javanella sanfordae* sp. nov. differs from *J. kendengensis* Kingma, 1948 and *Pellucistoma kendengensis* (Kingma, 1948) Bold, 1950 by the outline, especially for the more broadly and symmetrically rounded anterior margin, by mandibular scars less developed, and the number of radial pore canals. The valve surface of *P. kendengensis*, moreover, is also thoroughly punctate. A comparison with the SEM photographs presented by Gou & Chen (1988) revealed minor differences in the structure of the hinge (more details see in Discussion and Conclusions).

**Occurrence.** SAN 26 sample 19; SAN 23 samples 3, 4.

**Distribution.** Late Pleistocene, Santos Basin (Brazil).

## DISCUSSION AND CONCLUSIONS

The genus *Javanella* was proposed by Kingma (1948) based only on two valves of late Pliocene samples from Java in the Indonesian Archipelago. Despite the scarcity of material, Kingma mentioned that the morphologic characteristics of the type species, *Javanella kendengensis*, were significantly different from any other genus previously described.

Unfortunately, in Kingma's paper the two valves are illustrated using poorly detailed pen and ink drawings,

hindering a more accurate determination of morphologic features of the type material. The muscle scar pattern was not described, probably as a result of the poor preservational state of his specimens and there is not detailed information on the hinge structure. Additionally, the holotype and the type locality are not indicated.

Keij (1979), in a short paper, presented a brief review of some taxa studied by Kingma (1948), including the new genus *Javanella*. In that scientific note he showed SEM photographs of the two valves of *J. kendengensis* Kingma, 1948 and presented both a lectotype and a diagnosis for this genus. However, in his concluding remarks he pointed out the necessity of a more complete review of this genus, which in his opinion was a distinct Indomalayan taxon.

Perhaps for the above reasons, the validity of *Javanella* has been questioned by some ostracodologists. Both the classical Treatise on Invertebrate Paleontology-Part Q (Benson *et al.*, 1961) and Bold (1950, 1958), refer it as a junior synonym of *Pellucistoma* Coryell & Fields, 1937, which explains why this genus is classified by some authors (e.g. Warne *et al.*, 2006) as a Paradoxostomatidae. Although the paradoxostomatids have a variable range of carapace morphologic features, the taxonomy of this family is also strongly based on soft part anatomy (McKenzie, 1969). For that reason the present authors have the opinion that the maintenance of *Javanella* in the family Cytheridae, as firstly assigned by Kingma (1948), is more sensible, as far as carapace studies are considered.

There are only a few records of *Javanella* in the literature (Figure 3), and according to Kempf's Index and Bibliography on Marine Ostracoda (Kempf, 1986, 1995) there are only three species formally described. Besides the type species there

**Table 1.** Comparative table showing the main morphological characteristics of *Javanella* species, or species ascribed to that genus. All species names and characteristics according to the original descriptions. 1, *Javanella kendengensis* Kingma, 1948; 2, *Pellucistoma kendengensis* (Kingma, 1948) Bold, 1950; 3, *J. kendengensis* [in Gou & Chen (1988)]; 4, *Paracytheroma caudata* Hartmann, 1978; 5, *Paracytheroma arenicola* Hartmann, 1978. Abbreviations: MS, muscle scars; RPC, radial pore canals; NPC, normal pore canals; AV, anterior vestibulum; PV, posterior vestibulum; P, present; A, absent. The dashes refer to not mentioned data.

Species	Outline	Hinge	Central MS	RPC	NPC	AV	PV
1	Subovate	Amphidont	-	Moderate Moderate, short and straight. Some false	-	P	A
2	Elongate	-	-	-	P	P	
3	Elongate	Gongylodont	4A; 1F	Moderate, simple or branched	Sieved	P	P
4	Subrectangular	-	4A; 1F	Moderate, simple or branched	-	P	P
5	Subovate	-	4A (two of them subdivided); 1F (subdivided into three)	Moderate, some branched	-	P	P

are two other species proposed by Hartmann (1978), *Paracytheroma caudata* and *P. arenicola*, which were reassigned by Howe & Mckenzie (1989) approximately a decade later into *Javanella*. Those authors argue that the well developed terminal hinge elements and more elongate carapace are more related to *Javanella* than *Paracytheroma*.

A worthy contribution to the *Javanella* issue was given by Gou & Chen (1988) who studied the distribution of *Saida* Hornbrook, 1952 and *Javanella* from the Pliocene of Leizhou Peninsula, China, presenting a redescription of *J. kendengensis* based both on SEM and optic microscopy photographs. In that article the figures show clearly most of the morphologic features omitted in the Kingma's drawings, such as the central muscle scars, vestibulae and marginal pore canals. There is also an improvement in the hinge description, for Kingma's description does not mention the presence of teeth, which are clearly visible not only in Gou & Chen (1988) but also in the Brazilian specimens.

As a result of our consideration of the published data (Table 1) and the results of the study of the Brazilian material, we now consider *Javanella* as a valid taxon because, as a whole, it possesses a number of morphological features which distinguish it from any other described genus, in particular the hinge pattern. The present authors, however, disagree with Howe & McKenzie's taxonomic reassignment, and consider the Australian species proposed by Hartmann (1978) as *Paracytheroma* species due to the general outline, the number of marginal pore canals and the central muscle scars. In this sense, the *Javanella* occurrence registered by Warne *et al.* (2006), in Shoal Bay, Australia is probably *Paracytheroma caudata* Hartmann, 1978.

As stated before, few published studies mention the occurrence of *Javanella* and all of them in the SE Asia/Australia region, the only exception being Bold's (1950) record of *Pellucistoma kendengensis* (*sic*) in the Miocene of Venezuela. Surprisingly, there are other Caribbean faunal elements present in southeast Brazilian bathyal depths such as *Heinia* sp. and *Nunana vandenboldi* Aiello & Szczecchura, 2001 (Bergue *et al.*, 2006), and similarities between Neogene Caribbean and Brazilian tropical shallow water ostracode species have been reported by Coimbra *et al.* (1999). Bold's type material of *Pellucistoma kendengensis* (*sic*), has been examined by the senior author who concluded that it is not co-specific with the Kingma's species (Figure 2L). Unfortunately, this material could not be coated for SEM analysis and some morphological details were not properly examined. The optical microscopy analysis showed that the Bold's species is quite different from both *Javanella kendengensis* and *J. sanfordae* sp. nov. and possibly belongs to another genus.

The data available are not sufficient to elucidate if the migration route of this genus from the Pacific Ocean was through the Drake Passage, in the south, or earlier than the elevation of the Isthmus of Panama, in the middle Pliocene (4 to 3 Ma). That tectonic and vicariant event has been identified to coincide with morphological changes in large populations of ostracodes occurring on both sides of the isthmus as well

Author	Age	Occurrence			
		Java (Indonesia)	Tonga Archipelago	Leizhou Peninsula (China)	Jason Bay (Malaysia)
Kingma (1948)	Pli	■			
Mckenzie (1981)	Rec		■		
Gou & Chen (1988)	Pli			■	
Zhao & Whatley (1989)	Rec				■
Reeves <i>et al.</i> (2005)	Rec				■

Figure 3. The published records of *Javanella kendengensis*, their ages and occurrences.

as the differentiation of species of the genus *Orionina* Puri, 1953 with small and isolated populations (Cronin, 1988; Cronin & Schmidt, 1988). In fact, Allison & Holden (1971) discussed the distribution of some marine species from Clipperton Island (eastern tropical Pacific) whose oldest stratigraphical record were in the Caribbean, as shown by Coimbra *et al.* (2004).

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