

A new genus of brackish-water ostracod, *Swansonella*, from the Avon-Heathcote Estuary, Christchurch, New Zealand

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Abstract

A new extant genus of brackish-water ostracod is described. The description of this leptocytherid genus, *Swansonella*, is based on the type species *S. newbrightonensis* collected from the sediments of the Avon-Heathcote Estuary, Christchurch, New Zealand. The taxonomy of another leptocytherid, brackish-water genus *Ishizakiella* is also reviewed, and *I. novaezelandica* (Hartmann 1982) reassigned to *Swansonella*.

Keywords : *Swansonella newbrightonensis* n.gen. n.sp. - ostracoda - brackish - extant - New Zealand - Avon-Heathcote Estuary.

Introduction

Considerable interest has been shown in the marine ostracods of New Zealand over the past fifty years. Early work was predominantly biostratigraphic (Hornibrook 1952, 1968). Over the last 30 years Kerry Swanson has been the main contributor in New Zealand to the field of ostracodology. During this time the focus of research on these microscopic crustaceans has moved away from biostratigraphic work to that of a palaeoenvironmental and palaeogeographical nature. The estuarine environment represents the interface between marine and terrestrial conditions, and an understanding of fossil ostracods that are diagnostic of this environment should provide a useful tool

for paleoenvironmental research. In particular, such work is likely to have application in neotectonic studies and investigations of the sedimentary record for evidence of sea-level fluctuations in New Zealand.

Extant species may provide an insight into the ecology of their fossil counterparts, and could also provide a relatively inexpensive way of monitoring estuarine environments and the impacts that human activities have on these systems.

There is a need for improved taxonomic precision with respect to the marginal marine ostracod fauna, and also for the collection of environmental data to define the physicochemical ranges of individual species. Swanson pioneered the use of Differential Interference Contrast

microscopy, which has proved to be a powerful tool for the resolution of ostracod anatomical detail to a level which was previously unattainable.

This paper describes a new genus of leptocytherid ostracod from the Avon-Heathcote Estuary, Christchurch, New Zealand, and discusses the generic placement of extant and fossil species currently placed in the genus *Ishizakiella*.

Abbreviations used in descriptive text; LV = left valve, RV = right valve.

Materials and Methods

Sampling in the Avon-Heathcote Estuary was carried out over a period of a year, at two to three week intervals. Small quantities of the top 2 - 3 cm of surface sediment were removed with a trowel when the site was aerially exposed. The samples were then washed, on site, through a 63 μm sieve to remove unwanted organics, fine silt and mud. The <63 μm fraction was stored in a ventilated plastic container with approximately 1 - 2 cm of water above the sediment surface.

In the lab, specimens were picked from the sample, narcotized then gradually introduced to a 90% solution of ethanol prior to dissection.

Soft parts were examined and photographed using both normal transmitted light and Differential Interference Contrast microscopy (DIC). Carapace examination was carried out by Scanning Electron Microscope (SEM) using back scatter or secondary electron imaging or a combination of both techniques.

Systematics

Family Leptocytheridae Hanai, 1957

Subfamily Leptocytherinae Hanai, 1957

Swansonella n.gen.

Diagnosis: Carapace with pronounced sexual dimorphism. Valves of both genders with anterior and posterior vestibules, and with ventral 'snap-knob' on right valve.

Included species: *Ishizakiella newbrightonensis*, *Ishizakiella novaezelandica* (Hartmann 1982) Bay of Islands, New Zealand.

Swansonella newbrightonensis n.gen., n.sp.

Type material: Holotype female carapace, UCF1417. Paratypes: male carapace, UCF1418; 'soft parts' of dissected female, UCF1419; 'soft parts' of dissected male, UCF1420.

Repository: Collection of Department of Geological Sciences, University of Canterbury, Christchurch, New Zealand.

Type locality: Pleasant Point, beneath the jetty, which is approximately 500m from the entry point of the Avon River into the Avon-Heathcote Estuary, Christchurch, New Zealand.

Description: Carapace (Plate 1, figures 1 - 3) outline elongate, highest point at approximately mid length, dorsal margin gently arched. Ventral margin inwardly curving, with 'snap-knob' located close to point of greatest curvature. Contact margin and hinge diverge from carapace outline postero-dorsally and mid-ventrally. Size small to medium. Weakly to moderately well calcified. Pinkish-orange coloration observed in many adult valves (more obvious in entire carapace than in an isolated valve), not seen in juveniles.

Anterior margin depressed, rounded in dorsal view in both sexes, in lateral view carapace tapers towards anterior. Sexual dimorphism pronounced. Female longer and higher than male (see Table 1), broadening towards posterior margin and truncated in posterior view. Male

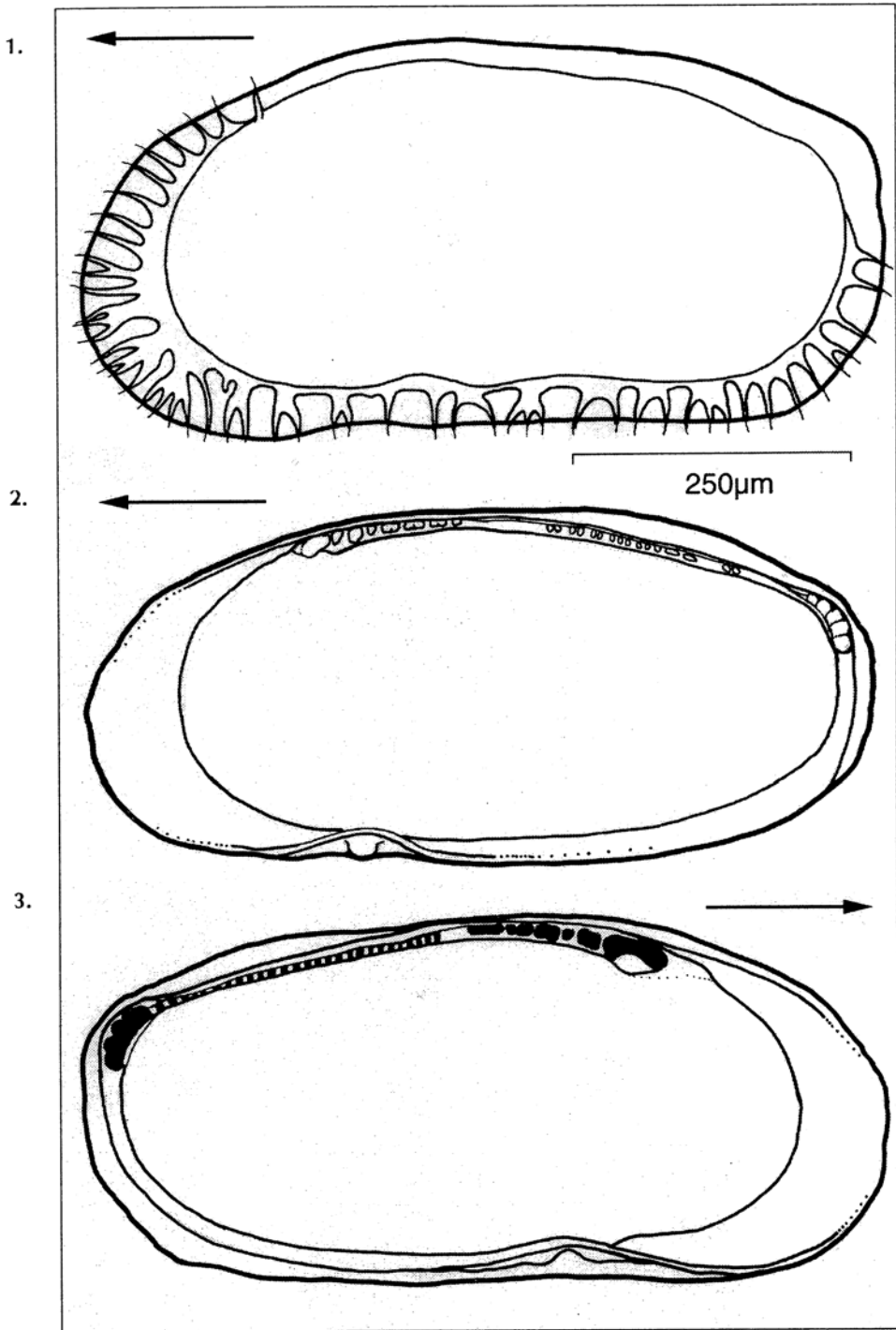


Plate 1. Fig.1. Internal view, marginal pores, female R.V.; Fig.2. Internal view marginal zone female, R.V.; Fig.3. Internal view marginal zone female, L.V.

	Female	Male
Left valve:	Length 644-722 μm	Length 585-644 μm
	Height 312-332 μm	Height 273-293 μm
Right valve:	Length 634-692 μm	Length 585-624 μm
	Height 312-332 μm	Height 273-293 μm
	Width 331-370 μm	Width 273-292 μm

Type specimen: Female width and height: LV 643 x 322 μm , RV 634 x 312 μm .

Table 1. Carapace dimensions (μm). Range of sizes resulting from measurements of left and right valves of six male and eight female specimens of *Swansonella newbrightonensis* (including type specimen).

posterior margin more rounded and tapered in posterior view. Internally, postero-ventral area of calcified inner margin appears narrower in females due to shape and depth of brood pouch. External sculpture (Pl.2, figs. 1, 2 & 5): Reticulations, weak, irregular in shape and size, enclosing 3 - 6 pits (each pit approximately 10 μm in diameter) on solum of each fossa. Strong bifurcated ridge on anterior margin, three strong ridges sub-parallel to ventral margin weakening mid-ventrally and one strong ridge on posterior margin. Note position of latter varies between sexes due to difference in carapace shape posteriorly. Weak dorsal sulcus slightly forward of carapace midpoint, may be related to muscle attachments. Male with shallow ventro-posterior depression.

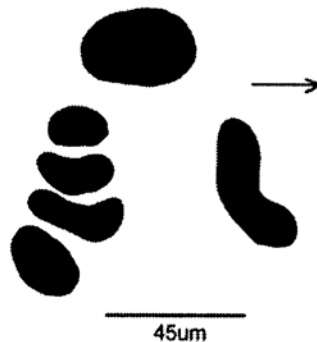
Hinge: Arcuate, anterior element of right valve (Pl.2, fig. 7) with 7 - 8 individual, sub-quadrate teeth with depression between first and second teeth. First to third teeth largest, remainder approximately half size of first three. Median element smooth at anterior end, then crenulate with five small, rounded individual toothlets at posterior. Posterior element (Pl.2, fig. 8) with 4-5 teeth which become larger posteriorly.

Left valve bearing corresponding

sockets with supporting 'platform' below socket of anterior element. Ventral 'snap-knob' (Pl.2, fig. 6) located to the anterior of mid-ventral.

Approximately fifty typically leptocytherid marginal pore canals of both branching and polyfurcate types. Normal pores scattered, but more numerous on anterior margin between anterior ridge and anterior rim; both simple and annulated setae observed.

Muscle scars: Subvertical row of 4 adductor scars with V-shaped frontal scar. Fulcral point large, ovoid, shallow depression (33 μm x 23 μm) situated directly above, and in close proximity to uppermost scar (Text fig. 4). Base of coxa, which is accommodated by fulcral point, measured 23 μm in desiccated state with covering tissue still attached.



Text figure 4

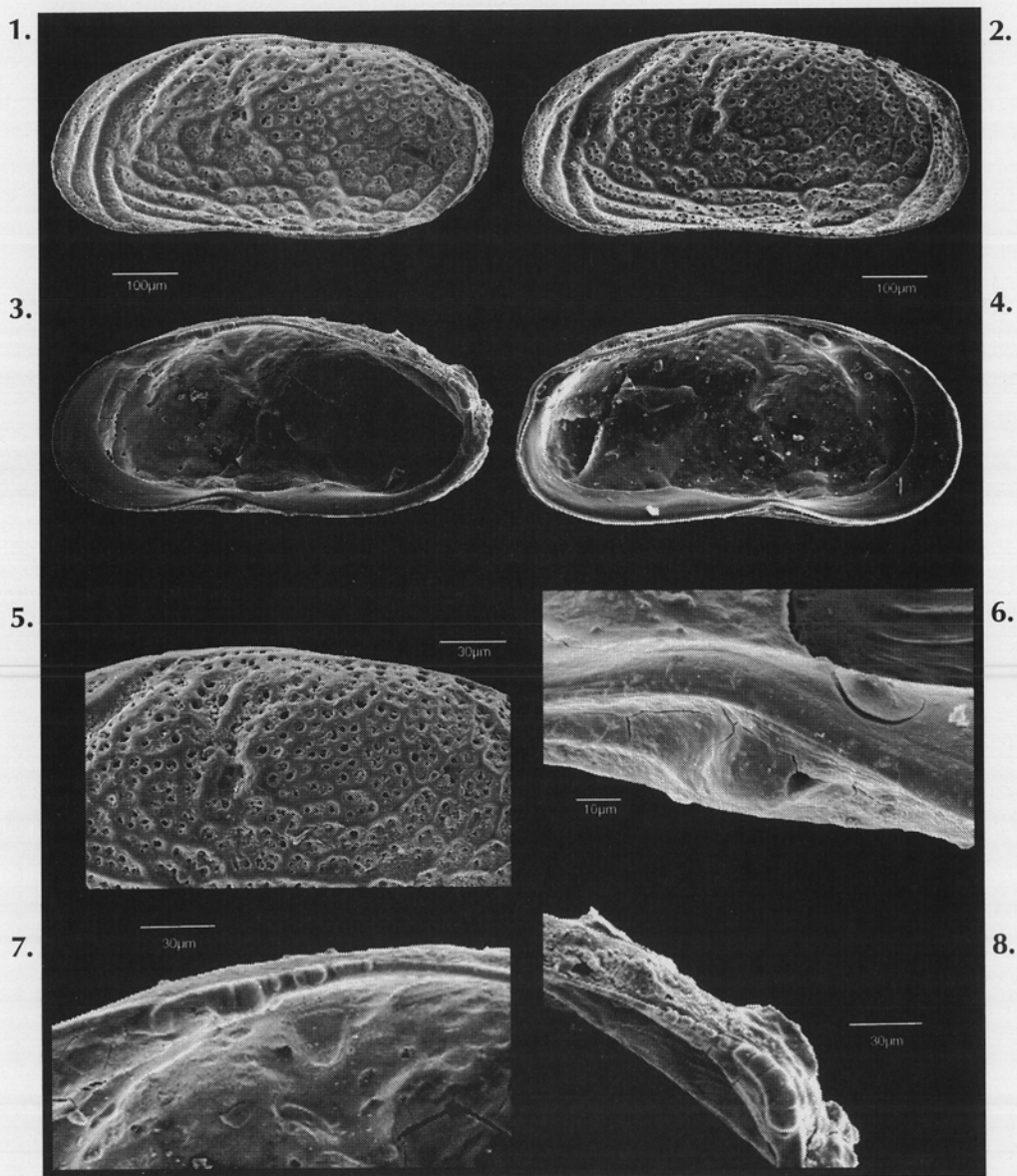


Plate 2. **Fig. 1.** External view L.V., female; **Fig. 2.** External view L.V., male; **Fig. 3.** Internal view R.V., female; **Fig. 4.** Internal view L.V., male; **Fig. 5.** External sculpture; **Fig. 6.** Ventral snap-knob R.V., female; **Fig. 7.** Anterior element of hinge, R.V., female; **Fig. 8.** Posterior element of hinge, R.V., female.

Appendages:

Examination of the soft anatomy revealed no obvious differences in morphology or dimensions of appendages between male and female, with the exception of copulatory organs (discussed in detail below). Descriptive terminology relating to appendage segments and setation is based, in part, on the descriptive model proposed by Broodbakker and Danielopol (1982). In accordance with this model, the appendages are described in a position such that they lie in "the same plane as the body axis and the carapace hinge" (Pl.3, fig. 1). The terms 'proximal' and 'distal' are used in relation to distance from the body, therefore, the proximal end of an appendage or segment is that end which is closest to the body. Dimensions of appendages are provided in Table 2.

Antennule (Pl.3, fig. 2)

Five segmented. Second segment with cilia dorso-distally. Third segment with long thin tapering simple seta and long claw-like seta postero-distally. Fourth segment bearing 2 long claw-like setae on posterior margin, first near the midpoint and second at distal end. Fourth segment also bears five fine, tapering simple setae; one short at base of first claw-like seta, pair (one short, one long) between this and second claw-like seta, one short at distal end of segment at base (proximal) of fifth segment, and one positioned centrally. Distal end of the fifth segment bears 2 setae, one long and claw-like and one long, thin and bifurcated. The division of this otherwise simple seta is located close to point of attachment. Setal elements created by this split are slightly unequal in length and may easily be mistaken for 2 separate setae. Claw-like

setae plumose/serrated(?), gently curving and tapered to a point.

Antenna (Pl.3, figs. 3 & 4)

Four segmented. First segment bearing large, strongly tapered, 2-jointed exopodite antero-distally. Second segment with long, tapered simple seta postero-distally. Third segment bearing 3 tapering plumose setae on posterior margin, two of equal length and similar appearance just beyond midpoint of segment and third positioned distally. Small spatulate aesthetasc situated dorso-posteriorly in close proximity to paired setae; cilia occur between third seta and proximal end of segment four. Fourth segment with cilia posteriorly and 2 large, gently curving claw-like setae distally.

Mandible (Pl.3, fig. 5)

Coxa generally heavily chitinised, with 'saddle-like' depression on dorsal shaft, to the rear of dental plate. Dental plates asymmetric, each bearing 6 - 7 teeth. Palp relatively short and stout, with long, thick simple seta ventro-proximally and a pair of simple setae (one short, one long) ventro-distally. Three long, thick simple setae dorso-distally. Fourth segment with 3 short thick setae distally.

Maxilla

Four endites with multiple setae distally. Dorsal-most processes 2-segmented with multiple setae distally on both segments. Respiratory plate with 13 - 14 long, plumose strahlen.

Thoracic legs (Pl.3, fig. 6)

Four segmented. All thoracic legs similar in shape but graduated in length, first thoracic leg being shortest and third leg longest.

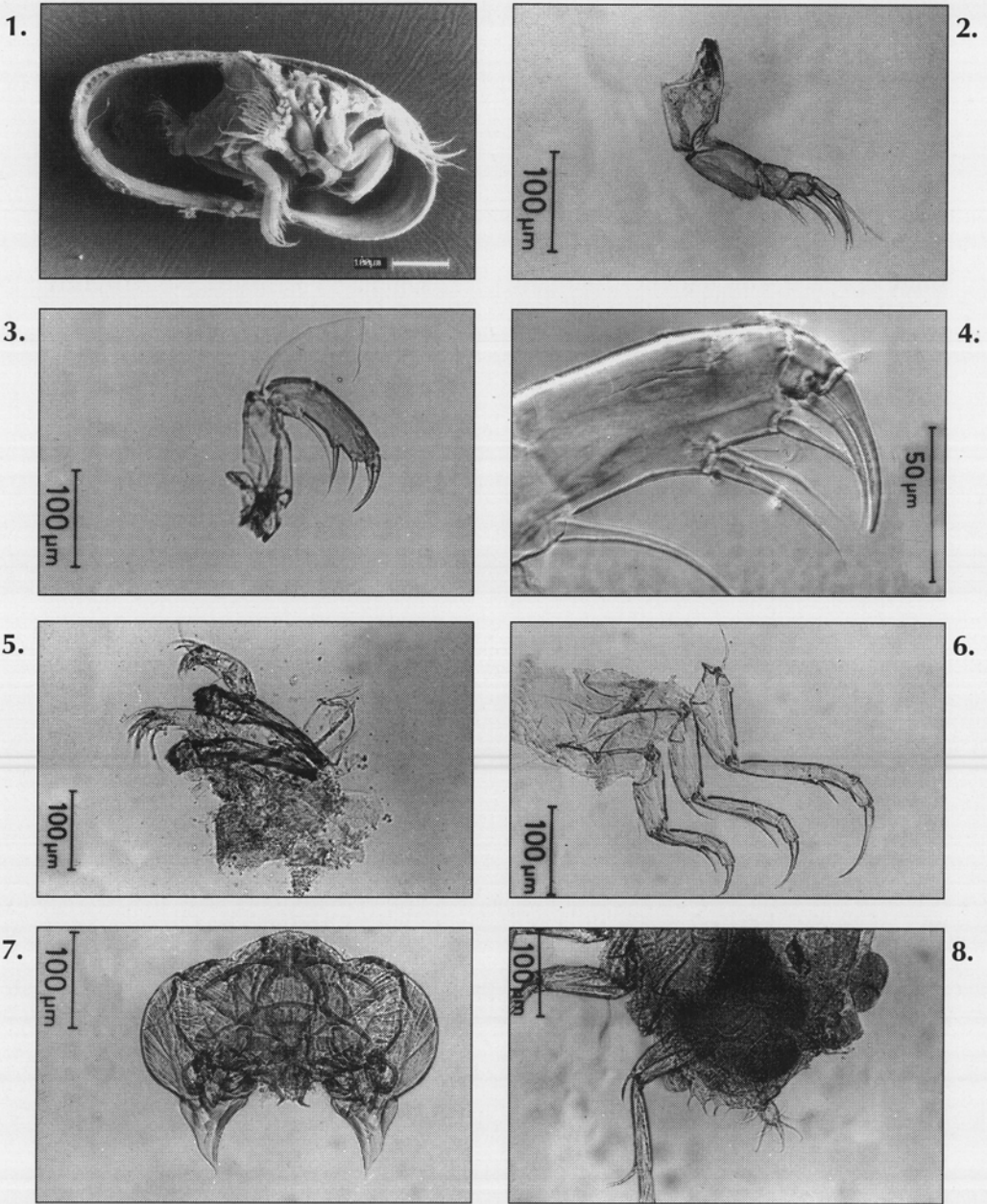


Plate 3. Fig. 1. Internal view L.V. (female); Fig. 2. Antennule; Fig. 3. Antenna; Fig. 4. Antenna; Fig. 5. Mandible with coxae and palps; Fig. 6. Thoracic legs; Fig. 7. Male hemipene; Fig. 8. Female copulatory parts.

Protopod of each leg with medium-length seta ventro-proximally, proximal third of which is simple and slightly tapering towards constriction. Beyond this, seta granulose/pappose(?) and tapered to a point. A short simple seta is present ventrally, just beyond midpoint of protopod. First leg with pair of short plumose setae dorso-distally. Second and third legs each with one short plumose seta dorso-distally. Second segment of all legs with plumose seta dorso-distally. Fourth segment with cilia dorso-distally and large, gently curving terminal claw. Terminal claw constricted at a third of its length then tapering to a point, plumose beyond midpoint. Claw on third leg approximately three times length of claw on first leg.

Genitalia (Pl.3, fig. 7 male; fig. 8 female)

Male: Hemipene moderately well chitinised, with heavily chitinised support framework, consisting of struts arranged to form pair of inverted triangles each bisected by another equally heavily chitinised strut. Peniferum rounded with tapering 'beak-like' frontal lobe. Distal end of frontal lobe relatively thin and prone to folding. Seminal duct can be traced down from the anterior edge of peniferum to the lower peniferum where

it coils, and terminates in a ramus. The external surface of the ramus with a tubercle just beyond the midpoint. Spatulate lobe situated at distal end of peniferum central to anterior edge of posterior lobe. In ventral view two pairs of very small simple setae located close to distal end of hemipenes, in close proximity to ramus.

Female: 'Two-pronged structure' (furca?), positioned in close proximity to each of the 2 genital lobes. Each 'prong' bearing short, curved, simple seta distally, the seta constricted proximally and tapering to a point. Dorso-distal to genital lobes (and associated structures) is single lobe, bearing one short, sharply tapered seta. Abdomen terminating dorso-distally in 'tail-like' structure which is divided into large upright process, bearing approximately 8 long simple setae distally, and smaller flaccid process bearing 3 long, simple setae distally.

In general, female caudal parts are considered simpler and less useful taxonomically than those of the male, and their microscopic examination can be difficult because of their small size and minimal chitinisation. Consequently, they have been ignored, or have received scant attention by most neontologists, traditionally. Examination of female

Table 2. Lengths of appendages (μm) for *Swansonella newbrightonensis*.

Segment:	I	II	III	IV	Term. Claw(s)
Antenna	100	40	81	15	103/101
Antennule	78	78	25	25	
Mandible coxa	205				
Mandible palp	83	18	10	12	
Thoracic leg 1	72	53	22	22	43
Thoracic leg 2	93	75	28	25	75
Thoracic leg 3	100	106	30	34	92

specimens of *Swansonella newbrightonensis*, using Differential Interference Contrast microscopy, reveals however, that, in fact, the female caudal parts present a number of characters which could prove of taxonomic importance in future work.

Remarks:

Swansonella newbrightonensis: The external appearance of the carapace could easily be confused with *Swansonella novaezelandica* (Hartmann 1982), but the former is significantly larger (*S. newbrightonensis* range of length of valves; male LV 585-644 µm, RV 585-624 µm, female LV 644-742 µm, RV 634-692 µm, *S. novaezelandica* male LV 520-560 µm, RV 520-570 µm; female LV 540-570 µm, RV 530-600 µm). In addition, they can be separated on the basis of hingement, antennal setation, and some aspects of the male copulatory organ.

In *S. novaezelandica* the median element of the hinge of the right valve is straight and crenulate through to the posterior element, whereas in *S. newbrightonensis*, the dorsal margin is arcuate and crenulation is discontinuous from the median to the posterior element. The postero-distal seta on the second segment of the antenna is considerably longer in *S. newbrightonensis* than *S. novaezelandica*. In the former it terminates beyond the midpoint of the first posteriorly positioned seta of the third segment, whereas in the latter, almost level with the origin of that seta. The hemipenes of both species are very similar in overall shape, however, *S. novaezelandica* is asymmetric. One side of the hemipene bears a blade-like structure, located close to the ramus on the lower peniferum. In addition, the shape and degree of angularity between

the chitinised struts of the support structure varies between the species.

Ecology: The type locality of *Swansonella newbrightonensis* is characterized by sandy sediment with very low mud content and was within about 0.5 m radius of an isolated patch of sea rush (*Juncus maritimus*). The site is submerged between mid and high tides. From mid to low tide, ephemeral ponding can occur at the base of the sea rush, and the sediment remains wet (though not saturated) during periods of aerial exposure.

The new species was not found in sediment with high mud content lower on the shore adjacent to the type locality.

Live specimens were collected from wet sediment all year round, and were most abundant during the summer months, when gravid females made up the highest percentage of the adult population. Two other leptocytherid ostracods, *Callistocythere neoplana*? Swanson (1979), one unidentified species, and an ostracod of undetermined affinity, often occurred in samples along with *Swansonella newbrightonensis*.

Discussion

From Tanella to Ishizakiella

The type specimens of both *Tanella* Kingma (1948) and *Ishizakiella* McKenzie & Sudijono (1981), were recovered from Indonesian fossil material: *Ishizakiella* from the Plio-Pleistocene of Sangiran, Java, and *Tanella* from the Pliocene of Atjeh, Sumatra.

Subsequent to detailed re-examination of Kingma's fossil type material by Van Morkhoven (1963) and Keij (1979) several extant species assigned to *Tanella* were reassigned to *Ishizakiella*. McKenzie (1982) discusses in detail, the sequence

of events leading to the reassignment of these species which included: *T. novaezealandica* Hartmann (1982) from New Zealand, *T. muirensis* Hanai (1957) from Japan, *T. supralittoralis* Schornikov (1974) from Russia, and *T. pacifica* (= *Cythere inflata* Brady 1890, non Muenster 1830) from Fiji. The present author agrees that these species do not belong in *Tanella*, but questions whether they should be included in *Ishizakiella*. This doubt is raised on the basis of three significant morphological differences between the type species and later additions to the genus; the absence or presence of a ventral snap-knob, contrast in hinge structure and the presence or absence of vestibules. Evidence presented below indicates that, based on carapace morphology those later reassignments to *Ishizakiella*: *I. muirensis*, *I. supralittoralis*, *I. pacifica* and *I. novaezealandica* were incorrect, as is the more recently assigned species *Ishizakiella ryukyuensis* Tsukagoshi (1994) described from the Ryukyu Islands of southern Japan.

Ventral 'snap-knob'

In their description of the type species of *Ishizakiella*, *I. foveoreticulata* McKenzie & Sudijono (1981) make no comment about the presence or absence of a ventral 'snap-knob.' However, in a later paper, Krstic and McKenzie (1991) state that '*Ishizakiella* s.str. lacks a ventral snap-knob'. Since *I. muirensis*, *I. pacifica*, *I. ryukyuensis*, *I. supralittoralis* and *I. novaezealandica* all have a ventral snap-knob they cannot be considered to be true species of *Ishizakiella*.

Hingement

The difference in hingement between the type species and all other species of *Ishizakiella*, including *I. novaezealandica*,

also provides compelling evidence for misclassification.

McKenzie's (1981) drawing of the internal view of the right valve of the type species shows, and his accompanying text states that the median element of the hinge is "...an elongate narrow crenulate median groove". In other species assigned to the genus the grooved, or negative, median element of the hinge is located on the left valve.

Anterior and posterior vestibules

An additional feature of the valves of *Ishizakiella*, and one that McKenzie (1981) includes in his diagnosis of the genus, is the lack of an anterior vestibule. All later assignments to *Ishizakiella*, with the exception of *I. supralittoralis*, clearly have both anterior and posterior vestibules. *Ishizakiella supralittoralis* presents a further taxonomic problem, as the adult carapace shows, not only a marked difference in hingement from other *Ishizakiella* species, but also a departure from the branching marginal pore system which is typical of leptocytherids. Tsukagoshi (1994) attributed these differences in *I. supralittoralis* to paedomorphic evolution, as the features in question occur in juvenile stages of other species assigned to *Ishizakiella*.

Phylogenetic relationships

The phylogenetic relationship between extant *Ishizakiella* species was examined in a recent paper by Yamaguchi (2000). The results of this paper were based on mitochondrial COI gene sequencing, and indicate that the genetic links between the New Zealand species (now *Swansonella novaezealandica*) and other extant species currently assigned to *Ishizakiella* are weak relative to the strength of other

interspecific genetic links within that group.

The new genus *Swansonella* is represented by the type species *S. newbrihtonensis* n.sp. It is proposed that *Ishizakiella novaezelandica* (Hartmann 1982), should also be assigned to the new genus. Hartmann collected *I. novaezelandica* from Russell, in the Bay of Islands, the Firth of Thames (both North Island), Okarito Lagoon (west coast of South Island) and Stewart Island. He reported two size ranges for that taxon (forma major and forma minor) which, despite exhibiting slight differences in carapace detail, could not be differentiated on the basis of soft anatomy. The holotype and several paratypes of this species were selected from specimens of the smaller form, which Hartmann found only at the Bay of Islands locality. Since 'forma major' is not represented in type material and was not recovered at the type locality, it has not been possible to re-examine the relationship between these forms. It is, therefore, possible that 'forma major' represents an additional species, which may be synonymous with *Swansonella newbrihtonensis*.

Unfortunately Hartmann did not provide exact site locations, thus attempts at recollection of the larger form have been unsuccessful.

For this project, several sediment samples were collected from Okarito Lagoon (approximately 130 km south of Hokitika), in March 2001, however no ostracods were recovered. The most likely explanation for this absence is the choice of sampling sites, but it is possible that ecological changes have occurred within the lagoonal system since Hartmann's collections were made. For example, in the week prior to sampling, unusually dry

weather conditions resulted in the formation of a sand bar which effectively cut the lagoon off from its tidal influence (a phenomenon which occurs approximately on a four yearly basis. Pers. comm. Kerry Gordon 2001). It is possible that the physical conditions and/or water chemistry prevailing at the lagoon at the time of sampling were altered sufficiently to render the environment unsuitable for the continued survival of its usual brackish-water floral and faunal assemblage. This theory is supported by the absence of live organisms from these samples.

In the view of the present author, the differences documented here are of sufficient importance to justify the removal of species exhibiting these characters from the genus *Ishizakiella*, and their placement in new, as yet unspecified leptocytherid genera, with the exception of *I. novaezelandica*, which is now reassigned to the new genus *Swansonella*.

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