VOUCHER SHEET

Species name: *Notopoma* sp A SCAMIT 2012 **Date Examined:** 24 Mar 2012

Group: Amphipoda Family Ischyroceridae **Voucher By:** D. B. Cadien

Voucher Specimen(s): City of San Diego ITP (all Van Veen grab): I-2/2, 34m 24Jan2000, 1♂ 1♀; I-6/2, 26m 15Jan1998, 1♂ 4♀; I-7/2, 52m 24Jan2000, 1♂ 4♀; I-10/1, 20m 7Jul1998, 1♀; I-12/1, 28m 12Jan1998, 1 subadult ♂ 2♀; I-15/2, 31m 2Jun1999, 1♀; I-16/1, 27m 20Jan2000, 2♀; I-20/2, 42m 7Jan1999, 1♀; I-21/1, 41m 7Jan1999, 2♀; I-21/2, 40m 19Jan2000, 1♂ 2♀; I-23/l, 22m 12Jan1998, 3♀; I-23/2, 22m 12Jan1998, 2♂ 1♀; I-29/2, 37m 4Jan2001, 1♀: **City of San Diego Regional** (Van Veen Grab); 2147, 196m 7Jul1997, 1 juv ♀; 2687, 43m 3Aug1999, 1♂ 1♀: **MBC TOES** (Auriga Net) T12, 58m 16Jul1987, 1♂; **SONGS** (diver box core) F3 III, 19Sep1977, 1♀; **OCSD** (Shipek grab) K-1, Apr1971, 5♀; **HBGS** (diver box core) 1D IV, 8m 4Aug1993, 1♀; 1E III, 8m 8Aug1985, 1♀; 1F IV, 8m 4Aug1993, 1♀; **LBGS** (Shipek grab), B3J, 18m 8Jul1993, 1 juv ♀; **GOLETA** (diver box core) B-1 I, 28m 6Apr1993, 2♀; B-5 III, 28m 3Oct1988, 1♂; **LACSD** (Shipek grab) I-0D2, 23m Jan1976, 1♀; **REGIONAL MONITORING, SCBPP** (Van Veen grab) PLABE 11230, 1994, 2♀; **B'98** (Van Veen grab) Sta 2317, Aug1998, 1♀; Sta 2386, Aug1998, 1♂; Sta 2389, Aug1998, 2♀; Sta 2415, 14m 16Aug1998, 3♀; Sta 2467, 18m 22Jul1998, 2♀; Sta 2482, Aug1998, 1♀

SYNONYMY: Cerapus tubularis of J. L. Barnard 1962 not Say 1817
Cerapus "tubularis" of SCAMIT Ed. 2
Cerapus tubularis Cmplx of SCAMIT Ed. 6

LITERATURE:

Barnard, J. Laurens. 1962. Benthic marine Amphipoda of Southern California: families Aoridae, Photidae, Ischyroceridae, Corophiidae, Podoceridae. *Pacific Naturalist* 3:1-72.

---------, Kurt Sandved, and James Darwin Thomas. 1991. Tube-building behavior in *Grandidierella*, and two species of *Cerapus*. *Hydrobiologia* 223: 239-254.

Berge, Jørgen, Wim Vader, and Susanne Lockhart. 2004. A survey of amphipod associates of sea urchins, with description of new species in the genera *Lepidepecreella* (Lysianassoidea: lepidepecreelid group) and *Notopoma* (Photoidea: Ischyroceridae) from Antarctic cidarids. *Deep-Sea Research* II 51:1717-1731.

Just, Jean. 1984. Siphonoecetinae (Crustacea, Amphipoda, Corophiidae) 2: *Caribboecetes* Just, 1983, with description of six new species. *Steenstrupia* 10(2):37-64.

Lowry, James K. 1981. The amphipod genus *Cerapus* in New Zealand and subantarctic waters (Corophioidea, Ischyroceridae). *Journal of Natural History* 15:183-211.

--------- and Penny B. Berents. 1989. A redescription of *Cerapus tubularis* Say, 1817, based on material of the first reviewer, S. I. Smith, 1880, (Crustacea: Amphipoda: Corophioidea). *Journal of Natural History* 23:1341-1352.

---------. and ---------. 1996. The *Ericthonius* Group, a new perspective on an old problem (Crustacea: Amphipoda: Corophioidea). *Records of the Australian Museum* 48:75-109.

---------, and James Darwin Thomas. 1991. A new species of *Cerapus* from Cudjoe Channel, Lower Florida Keys, USA, with notes on male behavior (Crustacea: Amphipoda: Corophioidea). *Journal of Natural History* 25:1461-1467.

DIAGNOSTIC CHARACTERS:

1. Mesial margin of first peduncular article of antenna 1 modified into a flattened semicircular plate in both ♂ and ♀, forming an operculum to the tube when the animal withdraws. The plate extends distodorsally over article two.

2. Telson bearing arrays of recurved hooks arranged in 2 equal rows, with an extra unpaired hook near the telsonic margin; deeply cleft, reaching 75% of length.

3. Rostrum robust, acute, reaching beyond the lateral head lobe, joined ventrally by a ridge to a subrostral spine. Eyes with black corneas, less than 1/3 head diameter.

4. Male G2 carpochelate, lacking tooth on the posterior carpal margin. Supermales have two teeth on the posterior margin of the propod – a small one near the base of the dactyl, and a larger one at about 30% of propod length. There is no trace of these teeth in reproductive molt males, and neither adult or superadult males have posterior teeth on the carpus

5. Tube short, slightly longer than animal, thick-walled but flexible, those from shallow water black, often with lighter thin banding (some bands may be reddish); open at both ends; either loose on bottom or attached by amphipod silk threads to bottom structure, often an onuphid polychaete tube. Tubes from further offshore tend to be lighter, banded almost equally with light and dark bands, but of an overall grayish appearance.

6. A recurved cusp is present ventro-distally on the peduncle of the first uropod, as seen in *Cerapus cudjoe* (Lowry and Thomas 1991), although it is small compared to the cusp in that species..

RELATED SPECIES AND CHARACTER DIFFERENCES:

1. *Notopoma* sp A differs from all members of *Cerapus* in the expanded oval shape of the first peduncular article of antenna 1 which characterizes members of *Notopoma* and *Bathypoma*. Additional specific character differences between *N.* sp A and *Cerapus tubularis* are listed by Lowry and Berents (1989, pg 1350)

2. *Notopoma* sp A differs from members of *Bathypoma* by having the male G2 carpochelate rather than subchelate

3. *Notopoma* sp A differs from *N. cidaridis* in having eyes and lacking a uniarticulate antennal flagellum, and in the arrangement of the telsonic hooks.

4. *Notopoma* sp A differs from *N. argentina* in having two rows, rather than four, of recurved hooks on the telson, each containing the same number of hooks.

5. *Notopoma* sp A differs from *N. fluminense*, *N. fallohidea*. *N. harfoota*, *N. stoora*, *N. oppositus*, and *N. sismithi* in having two rather than a single row of recurved hooks on the telson.

6. *Notopoma* sp A differs from *N. africana*, *N. moorea*, and *N. stoddartae* in having both rows of telsonic hooks of equal length and containing the same number of hooks. The three mentioned species have the distal row with few hooks, and only about 25% the length of the proximal row.

7. *Notopoma* sp A differs from *N. crassicornis* and *N. lukini* in lacking a tooth midway along the posterior margin of the carpus of the male G2.

8. *Notopoma* sp A differs from another undescribed cerapid (probably also a *Notopoma*) taken intertidally among surfgrass roots in San Diego in tube configuration. Specimens are not currently available to provide morphological characters, but the tubes of this second species are longer than the animal, narrower and lighter in color than those of N. sp A (which in shallow populations is black with/or without scattered banding of lighter color). In N. sp A the animal is nearly as long as the tube, while in the other form it is only about 80% of the tube length and can fully withdraw from both ends. Tubes matching this intertidal form have not been observed offshore, and it is suspected this species is restricted to very shallow water, perhaps to only the

intertidal. Additional collections in appropriate habitat are required to provide more material for examination and comparison. The two tube types have not yet been obtained in the same collection, and are presumed not to co-occur

DEPTH RANGE: 5-196 m, although the majority of records are from less than 50 m

DISTRIBUTION: at least from Goleta to Tijuana on the mainland, and on the Northern Channel Islands shelf, probably throughout the SCB

Table 1. Described species placed in *Notopoma*

Species	Authorship	Described from	Z
Notopoma africana	Lowry and Berents 1996	off SE South Africa	680m
Notopoma argentina	Alonso de Pina 2005	Southern Argentina	2-10m?
Notopoma cidaridis	Berge, Vader & Lockhart, 2004	Elephant Island, Subantarctic islands	308-399m
Notopoma crassicornis	(Bate 1857)	Norway to British Isles, North Atlantic	75-94m
Notopoma fallohidea	(Lowry 1981)	New Zealand	2-12m
Notopoma fluminense	Valerio-Berardo, et al 2008	Campos Basin, southern Brazil	730-815
Notopoma harfoota	(Lowry 1981)	New Zealand	5-6m
Notopoma lukini	(Tzvetkova 1992)	Samishir Island, Kurile Islands, USSR	2-30m
Notopoma moorea	Lowry and Berents 1996	Society Islands, Polynesia	1-2m
Notopoma oppositus	(K. H. Barnard 1932)	South Georgia & subantarctic New Zealand	0-124m
Notopoma sismithi	(Stebbing 1888)	Kergulen and Macquarie Islands	112-216m
Notopoma stoddartae	Lowry and Berents 1996	Tasman Sea	12m
Notopoma stoora	(Lowry 1981)	New Zealand	3-14m

COMMENT: The genus *Notopoma* currently contains 13 described species (Table 1), all of which differ from the present provisional, usually in numerous characters. Berge et al 2004 provide a key including all except *N. argentina* and *N. fluminense*, both from the Western South Atlantic. While tempting, their key cannot be used to separate the species as its first couplet relies on the number of articles in the flagellum of antenna 1. The present provisional shows variation in this parameter between left and right antennae 1 on a single animal which bridge the gap (2-3 vs 4-5) used by Berge et al.

The only species known from the North Pacific is *N. lukini* Tzvetkova 1992. No members of this genus have previously been described from the North Eastern Pacific, or the South Eastern Pacific. They are predominantly an austral clade extending into subantarctic waters, although N. crassicornis is from the North East Atlantic.

The telsonic hook formula within the genus appears to fall into four basic categories, although details are unclear for several species. Most species have a single row of hooks. Next most frequent is two rows of variable length, the distal shorter. A single species is known for each of the other configurations; 2 equal rows (*N.* sp A), and four rows (*N. argentina*). There appear to be no secondary sexual differences in this character, and although increase in hook number with growth is expected, the basic four pattern classes should not be affected by ontogenic variability.

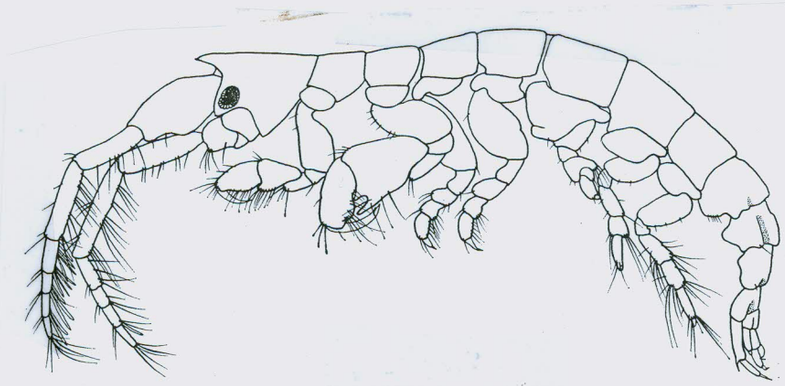
The commensal relationship noted by Berge et al for their new species has not been noted in other forms. *N. cidaridis* was found with its tubes loosely attached to the spines of the cidarid urchin *Rhynchocidaris triplopora*. Local diver observations of *Notopoma* sp A have found them to be frequent on shallow sandy open-coastal bottoms, usually in semi-protected wave climates. They are often found aggregating around the upright tubes of large onuphid polychaete worms such as *Diopatra*. There is some evidence that a "byssal" thread attachment can be maintained with the host tube, although it is also easily cut by the animal. During periods of heavy swell or strong bottom current flow such attachments may help the animal maintain position. During active foraging, or when moving to a new location, the attachment is severed to allow tube movement. The animals are antennapedic, that is the first antenna is strong, muscular, and can be used to drag the entire animal and its tube forward. This is described for other ischyrocerids, who have more strongly developed antennapedism; the siphonoectines. Their walking is described briefly by Just (1984), who points out that the main locomotor appendage is antenna two, which is more strongly developed in this group than is antenna one. I have watched

Caribboecetes buried in shell debris dig themselves out, emerging from the bottom antennae-first and dragging their domicile up out of the coarse sediments behind them (in siphonoecetines shells and other shelter may be used as domiciles, although often modified with amphipod thread extensions).

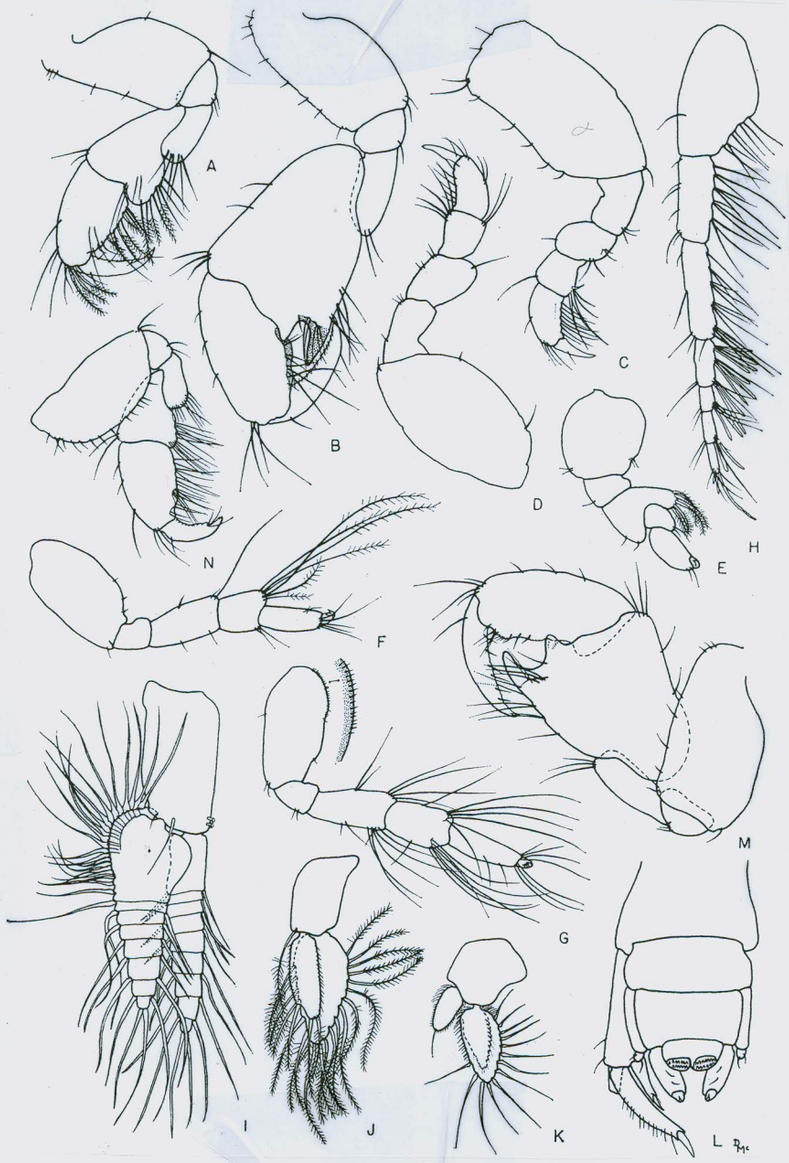
In this *Notopoma,* locomotion is affected primarily with the first antennae. Barnard et al (1991) also describe locomotion in one of their provisional species of *Cerapus*. In this account males were observed to swim while still in the tube, stroking powerfully through the water with contractions of their antennae. All this heavy lifting requires strong muscular development in the antennae themselves (seen in the relatively thick antennal peduncular articles), and strengthening of the antennal attachment to support the action of the antennal muscles. As a result the head of *Notopoma* has been modified in several ways to reduce cuticle flexibility and provide more rigid points for strong basal muscle attachments. The modifications involve a network of anastomosing ridges surrounding the insertions of the first antennae, which are connected to a sub-rostral spine at their nexus. A ridge runs up to the underside of the rostrum from this spine. The spine also serves as a "lock" for the antennal bases when the animal draws the antennae within the tube and rotates them so that their expanded first articles form an operculum to close the tube. The other genus of the cerapid clade with expanded basal antennal articles, *Bathypoma*, can also form an operculum (Lowry and Berents 1996).

Differences between mature males and female are primarily in the structure of G2, although the coxa of P5 is quite enlarged in adult females relative to males. Differences between mature males and supermales are of interest as well. In the second gnathopods, the changes in the structure of the propod posterior margin are very conspicuous. While no such differences were noted for three other species in the genus by Lowry (1981), in *Notopoma* sp A supermales add characters not seen in adult males. The additional teeth on the propod in supermales of this species differ markedly from other mature specimens of either sex.

ILLUSTRATION:



Notopoma sp A male 2.8mm, AHF Station 5975, lateral view (from J. L. Barnard 1962)



Notopoma sp A male 2.75mm, AHF Station 5975: A,B, gnathopods 1, 2; C, D, E, F, G, pereopods 3, 4, 5, 6, 7; H, antenna 1; I, J, K, pleopods 1, 2, 3: L, dorsal view of urosome. Male 3.0mm: M, gnathopod 2. Female 3.2mm: N, gnathopod 2 (from J. L. Barnard 1962)