

## CARIDEAN AND SERGESTID SHRIMP FROM THE KICK'EM JENNY SUBMARINE VOLCANO, SOUTHEASTERN CARIBBEAN SEA

BY

JOEL W. MARTIN<sup>1,3</sup>), KAREN WISHNER<sup>2</sup>) and JASON R. GRAFF<sup>2</sup>)

<sup>1</sup>) Natural History Museum of Los Angeles County, 900 Expedition Boulevard, Los Angeles,  
California 90007, U.S.A.

<sup>2</sup>) University of Rhode Island, Graduate School of Oceanography, URI Bay Campus, South Ferry  
Road, Narragansett, Rhode Island 02882-1197, U.S.A.

### ABSTRACT

“Kick'em Jenny” is a submerged active volcano located in the southeastern Caribbean off the island of Grenada. It is the southernmost active volcano, and the only active submerged volcano, in the Lesser Antilles volcanic arc. In 2003, an expedition to the volcano returned several specimens of caridean and penaeoidean shrimp collected at depths of approximately 260 m. The specimens represented three species, two oplophorids (*Janicella spinicauda* and *Oplophorus gracilirostris*) and one sergestid (*Sergia* sp., close to *S. robusta*). The latter is the first penaeoid shrimp recorded from the vicinity of any hydrothermal vent system. Interestingly, many of the shrimp were found immobile, lying on their side on the floor of the submerged volcano's caldera. All three species are known members of the mesopelagic community, raising the possibility (explored in a separate paper by Wishner et al., submitted) that they were killed or entrapped by the toxic volcanic gases in the water column. All three species are thus considered vagrants (sensu Martin & Haney, submitted) rather than vent endemics, as there are no obvious indications that any of the three species is modified for life at underwater hydrothermal regions.

### RÉSUMÉ

“Kick'em Jenny” est un volcan actif submergé situé dans les Caraïbes sud-est, au large de l'île de Grenade. C'est le volcan actif le plus méridional, et le seul volcan submergé actif, dans l'arc volcanique des Petites Antilles. En 2003, une expédition sur le site du volcan a rapporté plusieurs spécimens de crevettes carides et pénéides, récoltés à des profondeurs d'environ 260 m. Les spécimens représentent trois espèces, deux Oplophoridae (*Janicella spinicauda* et *Oplophorus gracilirostris*) et un Sergestidae (*Sergia* sp., proche de *S. robusta*). Cette dernière espèce est la première crevette pénéide signalée au voisinage d'un système de cheminées hydrothermales. Curieusement, beaucoup de crevettes ont été trouvées immobiles, reposant sur le côté sur le sol de la caldera du volcan submergé. Les trois espèces sont des membres connus de la communauté mésopélagique, suggérant la possibilité (explorée dans un article de Wishner et al., soumis) qu'elles

---

<sup>3</sup>) e-mail: [jmartin@nhm.org](mailto:jmartin@nhm.org)

ont été tuées ou piégées dans la colonne d'eau par les gaz volcaniques toxiques. Toutes les trois sont ainsi considérées comme vagabondes (sensu Martin & Haney, soumis) plutôt qu'endémiques des cheminées, car il n'y a pas d'indications claires qu'aucune de ces espèces ne soit modifiée pour la vie dans les régions sous-marines hydrothermales.

#### INTRODUCTION

The islands of the Lesser Antilles in the eastern Caribbean Sea represent a large volcanic arc extending from Puerto Rico and the Virgin Islands in the north to Grenada in the south. The "Kick'em Jenny" Volcano (KEJ) is an active submerged volcano located approximately 10 km off the northwest coast of Granada (12.3°N 61.6°W) (Sigurdsson & Sparks, 1979; see also Simkin & Siebert, 1994, for locations of Lesser Antilles volcanoes). It is the southernmost active volcano in the Lesser Antilles volcanic arc and the only active submarine volcano in the arc (Sigurdsson & Shepherd, 1974). As with other volcanoes in the arc, KEJ is associated with the subduction zone formed when the Caribbean Plate rides up and over the Atlantic Plate as the latter moves westward from the Mid-Atlantic Ridge. The volcano has a basal diameter of approximately 5 km and rises some 1,300 m above the sea floor; the top of the submerged volcano is at a depth of approximately 160 m. KEJ has erupted 10 times since 1939, with the most recent eruption occurring in 2001 (Fiske, 1984; Wishner et al., 2003; Wishner et al., submitted). A bibliography related to the volcano itself is maintained by the University of the West Indies' Seismic Research Unit and can be found on the web at: [http://www.uwiseismic.com/SRU\\_Site01/KeJ/kejbib.html](http://www.uwiseismic.com/SRU_Site01/KeJ/kejbib.html).

Recent oceanographic surveys of KEJ have revealed a shallow crater at the apex of the volcano at an average depth of approximately 250 m and an associated low-diversity biological community (Wishner et al., 2003, submitted). In 2003, collections made by ROV (Remotely Operated Vehicle) included specimens of caridean and penaeoid shrimp, and these collections form the basis of this paper.

#### MATERIALS AND METHODS

The Kick'em Jenny Volcano was explored and surveyed during cruise RB-03-03 of the NOAA ship "Ronald H. Brown" from 10 to 21 March, 2003, as part of the NOAA Ocean Exploration Program (chief scientist H. Sigurdsson). The Eastern Oceanics Remotely Operated Vehicle (ROV), under the direction of D. Lovalvo, was used for sampling and photography of the seafloor and benthic fauna. Photography included color video (monitored in the shipboard lab), frame grabs from the video, and still photographs. A suction sampler with a single sample container was used to collect larger fauna, especially shrimp. Water and animals

were vacuumed into the sampler via a tube and nozzle held by the remote arm of the ROV and positioned near the seafloor. The ROV was deployed most days for approximately 8 hrs and retrieved 1 suction sample per dive. Three of the suction samples, taken in the volcanic crater near vents, contained shrimp. Shrimp were sorted by hand from the suction sample, rinsed with seawater on a 153  $\mu\text{m}$  mesh sieve, and preserved in 4% buffered formalin.

Samples of all three species (2 specimens of *Janicella*, 1 of *Oplophorus*, and 1 of *Sergia* sp.) were sent to J. W. Martin in November of 2003. All four specimens initially were fixed in 4% buffered formalin but were transferred to sea water for shipping; upon arrival in Los Angeles the specimens were placed in 70% ethyl alcohol and examined with a Wild M5APO dissecting stereoscope. The four specimens have been deposited in the Crustacea collections of the Natural History Museum of Los Angeles County (LACM). The classification follows Martin & Davis (2001). The abbreviation CL = carapace length (measured from the posterior margin of the orbit to the posterior midline of the carapace); CL + R = carapace length plus the length of the rostrum (measured from the tip of the rostrum to the posterior midline of the carapace).

#### TAXONOMY

##### Infraorder CARIDEA

##### Family OPLOPHORIDAE Dana, 1852

##### Genus *Janicella* Chace, 1986

##### ***Janicella spinicauda*** (A. Milne-Edwards, 1883)

Material. — LACM CR 2003-010.1, Kick'em Jenny Volcano, 16 March 2003, Dive 3, 12°18.076'N 61°88.25'W, 261 m, "Caridea Type 1" on label, coll. J. Graff, K. Wishner. Two individuals, one of which is ovigerous; ovigerous specimen CL = 10.4 mm, CL + R = 20.5 mm; for non-ovigerous specimen CL = 10.4 mm, CL + R = 20.7 mm. Eggs large (one egg removed from beneath the abdomen measured 2.7 mm  $\times$  1.6 mm), oval, and orange.

Known range. — Chace (1986) referred to this species as "widespread mesopelagically in the tropical seas of the world, except in the eastern Pacific off the Americas."

Remarks. — *Janicella* is currently a monotypic genus, with *J. spinicauda* the only currently recognized species (the species was transferred from the genus *Oplophorus* by Chace, 1986). Both specimens from KEJ agree with the descriptions of this species given by Chace (1940, 1986), the former of which is repeated (figure only) by Holthuis (1993). The enormous eggs are one of the characters used in distinguishing this genus from others in the family (Chace, 1986).

Genus *Oplophorus* A. Milne-Edwards, 1881**Oplophorus gracilirostris** A. Milne-Edwards, 1881

Material. — LACM CR 2003-010.2, same collecting information as for *Janicella spinicauda* (above), but with “Caridean Type 3” on label: one individual, CL = 10.1 mm; CL + R = 24.5 mm.

Known range. — Chace (1986) reported the range of the species as “Off southeastern Africa, Indian Ocean, Indonesia, Philippines, southern Japan, Fiji Islands, Hawaii, Gulf of Mexico, Bahamas, Caribbean Sea; mesopelagic.”

Remarks. — There are four species in the genus *Oplophorus*, and the KEJ specimen agrees closely with previous descriptions of *O. gracilirostris* by Chace (1986). The very long rostrum, the tip of which exceeds the distal extremity of the antennal scales, is unique to this species among known species of *Oplophorus*.

## Infraorder PENAEOIDEA

## Family SERGESTIDAE Dana, 1852

Genus *Sergia* Stimpson, 1860**Sergia cf. robusta** (Smith, 1882)

Material. — LACM CR 2003-010.3, same collecting information as for both above species. One male, CL = 11.1 mm (excluding rostrum, which is extremely short in this group).

Known range. — See below under Remarks.

Remarks. — Identification of the single specimen, which was slightly damaged, is tentative. As noted by Vereshchaka (1994), “species of the genus *Sergia* resemble each other and seem to lack reliable morphological differences.” Photophores, used by both Vereshchaka (1994) and Perez Farfante & Kensley (1997) to determine species in the genus (and indeed to separate the genera *Sergia* and *Sergestes*), were either non-existent or had faded in the KEJ specimen; none were noted. According to Perez Farfante & Kensley (1997), there are 28 currently recognized species of *Sergia* (another was described later by Frogliani & Gramitto, 2000), of which eight (*S. grandis* (Sund, 1920), *S. hansjacobi* Vereshchaka, 1994, *S. japonica* (Bate, 1881), *S. robusta* (Smith, 1882), *S. splendens* (Sund, 1920), *S. talismani* (Barnard, 1947), *S. tenuiremis* (Krøyer, 1855), and *S. wolfii* Vereshchaka, 1994) have been reported from the western North Atlantic. This list differs slightly from that presented by Vereshchaka (1994), who included additionally the species *S. regalis* (Gordon, 1939), *S. laminata* (Burkenroad, 1940), and *S. extenuata* (Burkenroad, 1940). Using the key provided by Perez Farfante & Kensley (1997), our specimens agree mostly with the description of *Sergia robusta*. *Sergia robusta* was referred to as a “species group” by Vereshchaka (1994), who included in the

group the following 6 species from the North Atlantic and Caribbean: *S. robusta*, *S. grandis*, *S. regalis*, *S. extenuata*, *S. splendens*, and *S. wolfii*. The species *S. manningorum* Froglija & Gramitto, 2000, described from the eastern Atlantic was also formerly part of *S. robusta* sensu lato. If the species from KEJ is indeed *Sergia robusta*, it would be well within the known range of that species, which was reported by Perez Farfante & Kensley (1997: 200) as "Gulf of Mexico, Caribbean Sea, Surinam, North Sea, Faroe Islands, off Bermuda, Mediterranean, Cape Verde Islands to Congo and Angola." However, Froglija & Gramitto (2000) estimated the southern range of *S. robusta* to be further to the north within the western Atlantic (Froglija & Gramitto, 2000, fig. 3). Vereshchaka's (1994: 82) distributional map also differs, with *S. regalis* replacing *S. robusta* as the dominant species of *Sergia* in the Caribbean. Thus, according to Vereshchaka's (1994) data, *S. robusta* as reported here would be out of its normal distributional range.

#### DISCUSSION

The KEJ vent system and shrimp aggregations were located in the central volcanic crater at ~ 250-260 m depth (Wishner et al., 2003; submitted). No venting or shrimp assemblages were seen on the volcanic flanks or in secondary craters outside the main crater. In addition to the shrimp, other vent-associated organisms included white bacterial mats and a new species of spionid polychaete that lived in abundance in the mats (J. R. Graff and J. A. Blake, pers. comm.). Hydrothermal water emanated from fissures in the basaltic seafloor and through fine- and coarse-grained sediments. Gas bubbled from some, but not all, of the vents. The water temperature was hot subsurface in the sediment (at least 270°C, causing a plastic tubecore to melt), but in proximity to animals, water temperatures were only 1-3 degrees above ambient (14°C). Shrimp were aggregated near fissures (with and without bubbles) and were also lying on their sides on sediment and in rock crevices. In video records, some shrimp were actively swimming but many others lay immobile and did not respond to contact. It was unclear whether all were alive. However, most specimens brought on deck in the suction sampler were intact (not decomposed) and appeared transparent initially before turning opaque, indicating that they were living when captured. We have suggested that the shrimp were trapped in the volcanic crater during their diel vertical migration (from midwater source populations offshore) and that they then either succumbed to the toxic conditions or else resided opportunistically near the vents, potentially with a dual midwater-vent lifestyle (Wishner et al., submitted).

Although several species of oplophorid shrimps have been reported from the vicinity of hydrothermal vent systems (e.g., see Martin, 2003), our report of a

species of *Sergia* at KEJ is the first record of any penaeoid found in the vicinity of a hydrothermal system. To date, shrimp reported from hydrothermal vents or cold (hydrocarbon or brine) seeps represent 8 families, only one of which (the Alvinocarididae) contains vent endemic species. Species in the other families are assumed to be vagrants rather than endemics (sensu Martin & Haney, submitted), and this is certainly true of the three KEJ species. Because all three KEJ shrimp species are typically found in the mesopelagic realm, the possibility exists that the immobile shrimp encountered on the floor of the volcanic crater were trapped at some point during their diel migration and possibly killed or rendered comatose by toxic gases issuing from the vents (Wishner et al., submitted).

#### ACKNOWLEDGEMENTS

We thank all those who helped at sea and in the lab, especially D. Lovalvo and the ROV crew (M. Bowen, D. Coleman, K. Wallace), investigators K. Brown, J. B. Shepherd, D. C. Smith, and W. D. Wilson; graduate students S. Lundin and A. Staroscik; undergraduates L. Critchley, N. Koch, C. Mosher, and L. Mounce; and the captain and crew of the "R. H. Brown." This work was supported in part by a grant from the U.S. National Science Foundation (DEB 9978193, a PEET grant from the Systematic Biology Program awarded to J. W. Martin and D. K. Jacobs) and in part by NOAA grant NA030AR46000009 to H. Sigurdsson and S. Carey and by the University of Rhode Island. We thank J. Childress, P. Herring, B. Seibel, T. Shank, and C. Van Dover for helpful comments on the shrimp. Special thanks to Sam Hobel for assistance in locating additional information about the Kick'em Jenny Volcano and about the shrimp genera during a summer 2004 internship at the Natural History Museum of Los Angeles County.

#### REFERENCES

- CHACE, F. A., JR., 1940. Plankton of the Bermuda Oceanographic Expeditions, IX: The bathypelagic caridean Crustacea. *Zoologica*, New York, **25**: 117-209.
- —, 1986. The caridean shrimps (Crustacea: Decapoda) of the Albatross Philippine Expedition, 1907-1910, part 4: families Ophrophoridae and Nematocarcinidae. *Smithsonian Contributions to Zoology*, **432**: 1-82.
- FISKE, R. S., 1984. Volcanologists, journalists, and the concerned public: a tale of two crises in the eastern Caribbean. In: F. R. BOYD (ed.), *Explosive volcanism: inception, evolution, and hazards*: 170-176. (National Academy Press, Washington, D.C.).
- FROGLIA, C. & E. GRAMITTO, 2000. A new pelagic shrimp of the genus *Sergia* (Decapoda, Sergestidae) from the Atlantic Ocean. *Journal of Crustacean Biology*, **20** (spec. no. 2): 71-77.
- HOLTHUIS, L. B., 1993. The Recent genera of the caridean and stenopodidean shrimps: 1-328. (Nationaal Natuurhistorisch Museum, Leiden).

- MARTIN, J. W., 2003. Oplophorid shrimp (Decapoda, Caridea) from an Arctic hydrothermal vent. *Crustaceana*, **76** (7): 871-878.
- MARTIN, J. W. & G. E. DAVIS, 2001. An updated classification of the Recent Crustacea. *Natural History Museum of Los Angeles County, Science Series*, **39**: 1-124.
- MARTIN, J. W. & T. A. HANEY, submitted. Decapod crustaceans from hydrothermal vents and cold seeps: an update through 2004. *Zoological Journal of the Linnean Society*.
- PEREZ-FARFANTE, I. & B. KENSLEY, 1997. Penaeoid and sergestoid shrimps and prawns of the world: keys and diagnoses for the families and genera. *Mémoires du Museum National d'Histoire Naturelle, Paris*, **175**: 1-233.
- SIGURDSSON, H. & J. B. SHEPHERD, 1974. Amphibole-bearing basalts from the submarine volcano Kick'em Jenny in the Lesser Antilles Island Arc. *Bulletin of Volcanology*, **38**: 891-910.
- SIGURDSSON, H. & R. S. J. SPARKS, 1979. An active submarine volcano (Kick'em Jenny). *Natural History*, **88**: 38-43.
- SIMKIN, T. & L. SIEBERT, 1994. *Volcanoes of the world: 1-349*. (Geoscience Press, Tucson, Arizona).
- VERESHCHAKA, A. L., 1994. North Atlantic and Caribbean species of *Sergia* (Crustacea, Decapoda, Sergestidae) and their horizontal and vertical distribution. *Steenstrupia*, **20** (3): 73-95.
- WISHNER, K.F., H. SIGURDSSON, S. CAREY, D. C. SMITH, A. STAROSCIK, J. B. SHEPHERD, W. D. WILSON & S. LUNDIN, 2003. Biology of hydrothermal vents on Kick'em Jenny Volcano in the Caribbean. (Poster presentation at 10th Deep-Sea Biology Symposium, Coos Bay, Oregon, August 2003).
- WISHNER, K. F., J. R. GRAFF, J. W. MARTIN, S. CAREY, H. SIGURDSSON & B. A. SEIBEL, submitted. Are midwater shrimp trapped in the craters of submarine volcanoes by hydrothermal venting? *Deep-Sea Research*.