

GEOGRAPHIC AND DEPTH DISTRIBUTION OF *BATHYBEMBIX* (*BATHYBEMBIX*) *BAIRDII* (DALL, 1889) (MOLLUSCA, GASTROPODA, TROCHIDAE) IN THE EAST PACIFIC

Michel E. Hendrickx^{1, 3} & Jorge López²

¹ Laboratorio de Invertebrados Bentónicos, Unidad Académica Mazatlán, ICML, UNAM, P.O. Box 811, Mazatlán, Sinaloa, C.P. 82000, México. ² CCCNPESCA, San Salvador, El Salvador. ³ Corresponding author (669)985-2845 a 49, Fax (669)982-6133; e-mail: michel@ola.icmyl.unam.mx

ABSTRACT. *Bathybembix* (*B.*) *bairdii* (Dall, 1889), a deepwater mollusc of the Family Trochidae, was collected in the Southeast Gulf of California, Mexico and off the coast of El Salvador during exploratory cruises depths of 778 m - 2140 m and was very abundant in El Salvador. Information on *B. (B.) bairdii* distribution pattern from the Gulf of California indicate that this species is well adapted to severe hypoxic (< 2.0 ml O₂/l) to almost anoxic (0.07-0.15 ml O₂/l) environment. Abundances of up to 769 kg per trawl were detected off the coast of El Salvador, with average population density close to 25 kg/ha. This species is considered as a potential economical significant by-catch species of the deep water pandalids shrimp fishery.

Keywords: *Bathybembix* (*B.*) *bairdii*, distribution, East Pacific.

Distribución geográfica y batimétrica de *Bathybembix* (*Bathybembix*) *bairdii* (Dall, 1889) (Mollusca, Gastropoda, Trochidae) en el Pacífico este

RESUMEN. *Bathybembix* (*B.*) *bairdii* (Dall, 1889), un molusco de la Familia Trochidae de aguas profundas, fue recolectado en el sureste del golfo de California, México y frente a la costa de la República de El Salvador durante cruceros exploratorios. Esta especie fue recolectada en profundidades de 778 m - 2140 m y fue muy abundante en El Salvador. Los datos del golfo de California indican que esta especie está adaptada a condiciones hipóxicas severas (< 2.0 ml O₂/l) hasta condiciones casi anóxicas (0.15-0.07 mlO₂/l). Abundancias de hasta 769 kg por arrastre fueron detectadas frente a la costa de El Salvador, con una densidad media cercana a 25 kg/ha. Esta especie es considerada un recurso potencial de la fauna de acompañamiento de la pesca de camarones pandálidos.

Palabras clave: *Bathybembix* (*B.*) *bairdii*, distribución, Pacífico este.

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INTRODUCTION

The genus *Bathybembix* Crosse, 1893 includes three species of deepwater molluscs of the family Trochidae in the East Pacific: *Bathybembix* (*Bathybembix*) *bairdii* (Dall, 1889), *B. (B.) macdonaldi* (Dall, 1890), and *B. (B.) humboldti* Rehder, 1971. These are relatively large species (43 mm, 55 mm and 75 mm maximum known height, respectively) that have been recorded throughout large areas of the East Pacific. *Bathybembix* (*B.*) *bairdii* distribution ranges from the Bering Sea, Alaska, to the Gulf of Tehuantepec, Mexico, in depths of 350 m - 1400 m. *B. (B.) macdonaldi* has been recor-

ded from Panama to Chile, depths of 200 m - 1200 m; and *B. (B.) humboldti* from Peru to Chile, depths of 200 m - 1480 m, and off Guatemala at 1500 m. Three other deep-water species (1460 m to 2490 m) from the East Pacific that were previously included in *Bathybembix* have been transferred to the genus *Calliotropis* Seguenzia, 1903: *C. ceratophora* (Dall, 1896) has been recorded from off San Diego, California, to El Salvador; *C. equatorialis* (Dall, 1896) from off San Diego to Panama; and *C. galapagana* (Dall, 1908), known from a single specimen collected off the Galapagos Islands (Keen, 1971; Rehder, 1971; McLean &

Andrade, 1986; McLean & Gosliner, 1996; Skoglund, 2002).

As in virtually all species of deepwater invertebrates distributing mostly between the tropics, there is little information available on the abundance and local distribution for species of the genus *Bathybembix*. They have been scarcely reported in literature, although some species might represented a fishery potential as by-catch of other species of mollusks or species of deepwater shrimps and fishes (McCrae, 1994; Veliz & Vásquez, 2000).

In recent years, there has been an increasing interest for exploring deepwater habitats in some countries bordering the Eastern Tropical Pacific (ETP) either by using net trawls, benthic sledges or baited traps (see Kameya *et al.*, 1997; Ramírez-Rodríguez *et al.*, 2003; Hendrickx, 2005). Preliminary surveys have been organized with a view to detect new or little known fishery resources that might be used in order to compensate for the dramatic decrease of fishing stocks (mostly of penaeid shrimps) along the continental shelf. One of the target taxa of these surveys is the deepwater caridean shrimp *Heterocarpus* (Pandalidae), represented in the ETP by three species (*Heterocarpus affinis* Faxon, 1893; *Heterocarpus hostilis* Faxon, 1893; *Heterocarpus vicarius* Faxon, 1893) (Hendrickx, 1995). By-catch species have sometimes been considered as an important secondary resource that could considerably increase the interest to develop a large scale fishery if target species has enough fast population duplicates rates and this species has a significant economical value. The presence of large quantities of *B. (B.) bairdii* in exploratory trawls from off the coast of El Salvador and records for this species from deepwater samples in the Southeast Gulf of California, prompted us to consider this species as a potential fishery resource in the ETP and to report recent data related to the distribution and abundance of this species.

MATERIAL AND METHODS

Samples from the Southeast Gulf of California, Mexico, were obtained during a series of four exploratory cruises of the deep-sea

benthos (TALUD cruises) aboard the R/V El Puma of the Universidad Nacional Autónoma de México. Five transects, roughly perpendicular to the coast, were visited in 2000-2001 (Fig. 1A) and a total of 57 stations were sampled with a 2.35 m wide, 0.90 m high benthic sledge operated at a depth range of 550 m - 2250 m. Epibenthic dissolved oxygen concentrations were measured from water samples obtained near bottom (opening-closing bottles) with the Winkler method (duplicate samples) (see Hendrickx, 2001 for details).

Samples from El Salvador were obtained in November and December 2000, when the fishery company ARKA S. A. de C. V. (ISMARSA group) set up exploratory surveys of benthic fauna between 360 m and 1080 m (200 - 600 fathoms). Samples were obtained with a 21 m wide, ca. 5 cm stretch-mesh, fishing trawl (12 m - 14 m opening when trawling), operated from the fishing vessel FAMAR II (ca. 20 m overall length). Fishing area off El Salvador was defined as the area extending from 88° 00' W to 90° 00' W (Fig. 1B), transects were delimited by depth range (360 m - 1080 m) and distance measured perpendicularly from the coast (120 km - 130 km). A total of 16 trawls of about one hour each were performed. Fresh weight of major groups of organisms (*i.e.*, crustaceans, molluscs, fish and echinoderms) obtained in each trawl was estimated using standard commercial spring scales.

RESULTS

Gulf of California, México. In general, samples where *B. (B.) bairdii* (Fig. 2) was collected were dominated by crustaceans, echinoderms, and fishes. Because sample weight and species composition were relatively small and the sampling device used during the survey was qualitative, no proportion of the catch by major groups is available.

A total of only 26 specimens were collected in nine samples, from 778 m to 2140 m. Most samples (8 out of 9) were collected at <1240 m depth. Epibenthic dissolved oxygen concentration varied from almost anoxic (0.15 ml/l - 0.07 ml/l) to hypoxic (<2.0 ml/l), thus indi-

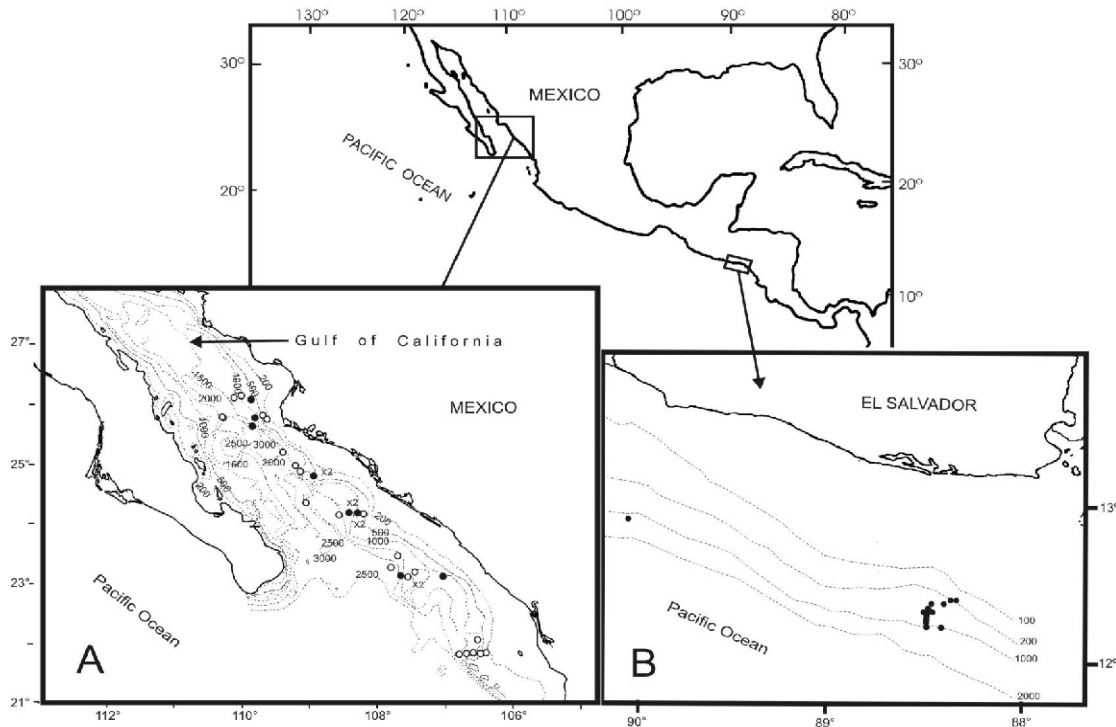


Figure 1. Map of Mexico (A) with sampling localities in the Southeast Gulf of California and of the coast of El Salvador (B). Solid circles indicate sampling stations where material of *B. (B.) bairdii* was collected; open circles correspond to sampling stations with no specimens of *B. (B.) bairdii*. Double samples indicated by X 2. Depth shown in meters.

Figura 1. Mapa de México (A) con las localidades de muestreo en el sureste del golfo de California y de las costas de El Salvador (B). Los círculos sólidos indican las estaciones de muestreo en donde se recolectó material de *B. (B.) bairdii*; los círculos abiertos corresponden a estaciones de muestreo sin especímenes de *B. (B.) bairdii*. Doble muestreo indicado con X 2. Profundidad en metros.

cating a relatively strong tolerance to low oxygen conditions for this species. Most specimens were relatively small considering the maximum known size of this species (55 mm height) but in two stations they were close to their maximum height (Table 1).

El Salvador. Samples taken off the coast of El Salvador contained five major groups of marine species. Considering all captures, shrimps (39.0%) and snails (33.0%) largely dominated composition of the catch by weight. Other numerically dominant groups included fishes (16.0%), lithodid crabs (3.5%), and cephalopods (0.5%). The rest (8.0%) mostly included echinoderms. *Bathybembix* (*B.*) *bairdii* was collected in 14 out of 16 samples, thus suggesting relatively broad distribution in the area of study. The catches were relatively abundant, but for technical reasons no attempts were made to count the specimens

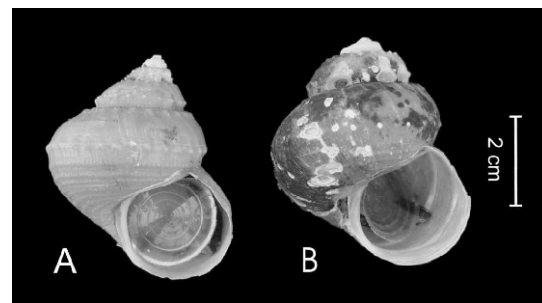


Figure 2. *Bathybembix* (*B.*) *bairdii* (Dall, 1889), Gulf of California, Mexico, *Regional Collection of Invertebrates*, ICML, UNAM, Mazatlán. A. Specimen with shell intact. B. Specimen with worn shell (catalogue EMU-7043).

Figura 2. *Bathybembix* (*B.*) *bairdii* (Dall, 1889), Golfo de California, México, *Colección Regional de Invertebrados*, ICML, UNAM, Mazatlán. A. Ejemplar con concha intacta. B. Ejemplar con concha gastada (catálogo EMU-7043).

captured in the trawl. Fresh biomass varied from 14 kg/trawl/h to 769 kg/trawl/h (Table 2),

Table 1. Records of *Bathybembix* (*B.*) *bairdii* and selected epibenthic environmental variables during the TALUD cruises in the Southeast Gulf of California, Mexico. St. = sampling station; NS = number of specimens collected per trawl.

Tabla 1. Registros de *Bathybembix* (*B.*) *bairdii* y de variables ambientales epibentónicas obtenidas durante las campañas TALUD en el sureste del Golfo de California, México. St. = estación de muestreo; NS = número de especímenes recolectados por arrastre.

Cruise	Date	St.	Lat. N - Long. W	Depth (m)	Dissolved O ₂ (ml/l)	NS	Height (mm)
TALUD IV	26-VIII-2000	25	24° 53.2 - 108° 59.4	778-800	0.29	7	Ago-24
	27-VIII-2000	33	25° 45.9 - 109° 48.1	1060-1090	0.51	3	51 - 54
TALUD V	14-XII-2000	11	23° 14.0 - 107° 00.0	850-870	0.07	5	23 - 26
	14-XII-2000	14	23° 16.32 - 107° 40.7	2080-2140	1.98	1	10
	15-XII-2000	18	24° 15.21 - 108° 17.15	940-990	0.15	3	33 - 38
TALUD VI	15-III-2001	18	24° 14.91 - 108° 16.28	890-950	0.29	2	32 - 34
	16-III-2001	25	24° 51.68 - 108° 57.87	830-850	0.21	1	33
	17-III-2001	34	25° 43.83 - 109° 53.97	1240-1220	0.86	1	52
TALUD VII	9-VI-2001	32B	26° 3.0 - 109° 55.4	780	0.1	3	30 - 31

Table 2. Records of *Bathybembix* (*B.*) *bairdii* from the FAMAR II cruises off the coast of El Salvador. ND = no data.

Tabla 2. Registros de *Bathybembix* (*B.*) *bairdii* de las campañas FAMAR II frente a las costas de El Salvador. ND = sin datos.

Sampling	Date	Lat. N - Long. W	Depth (m)	Catch (kg)
1	10/XII/00	12° 23' - 88° 30'	900	198
2	10/XII/00	12° 21.826' - 88° 30.384'	851	769
3	10/XII/00	12° 21' - 88° 30'	921	67
4	10/XII/00	12° 26' - 88° 29'	896	118
5	11/XII/00	12° 21' - 88° 30'	913	107
6	11/XII/00	ND	890	0
7	11/XII/00	12° 23.664 - 88° 30.070'	912	45
8	11/XII/00	12° 27.885' - 88° 27.117'	920	136
9	11/XII/00	12° 27.408' - 88° 24.850'	907	14
10	13/XII/00	ND	898	0
11	14/XII/00	12° 24.711' - 88° 30.073'	824	64
12	14/XII/00	12° 25.950' - 88° 28.800'	900	34
13	14/XII/00	12° 24.831' - 88° 30.007'	857	67
14	15/XII/00	12° 20.930' - 88° 26.160'	900	28
15	15/XII/00	12° 24.707' - 88° 30.052'	852	15
16	15/XII/00	12° 28.160' - 88° 22.030'	900	103

recording an average of about 110 kg/haul/h. A rough estimation of average density using a trawling speed of 2.0 knots, provides ca 25 kg/ha (sweeping method). This preliminary information indicates that *B. (B.) bairdii* is relatively abundant in the sampling area within the depth range between 800 m - 925 m. Considering the size range of collected specimens (32 mm - 44 mm height) and the maximum known size of this species, specimens were of average size.

DISCUSSION

Although there is one record for *B. (B.) bairdii* from off Isla San Pedro (Guaymas; 27° 39' N, 111° 21' W) (one sample collected in 1968 by the R/V "T. Roosevelt"; Scripps Institution of Oceanography Mollusca Catalog BI68-16), it has apparently never been reported from the Gulf of California. It is not included in the Mollusca species reported by Parker (1964) for the Gulf of California. Hendrickx & Brusca (2005) omitted it from their checklist of mollusks from this area, thus overlooking the Scripps catalog record. The data reported here indicate that this species is likely distributed throughout the southern Gulf of California (23° 14' N to 26° 3' N) and most probably feature a continuous distribution to the central Gulf (at least north to off Guaymas), but apparently with less frequency of positive station as recorded at El Salvador. The presence of the species in deepwater off Guatemala is not surprising considering its presence in the Gulf of Tehuantepec, only 850 km north (Keen, 1971). It should be emphasized that, contrary to what Aviles & Pacheco (1998) reported in their publication, the only specimen of *Bathybembix* (*B.*) *bairdii* they collected in 1995 is from an off-shore locality off Nicaragua (12° 06' N, 87° 05' W), and not from off the coast of El Salvador.

The discovery of relatively abundant populations of *B. (B.) bairdii* off the coast of El Salvador at depths accessible to commercial trawl is perhaps of interest for fishery purposes as the species presents an attractive and marketable aspect, its relatively large size, and taste of cooked specimens is adequate for marketing, as demonstrated by tests made with El Salvador specimens by the local re-

search team (unp. data). Trochidae have not been considered of commercial importance in FAO fishery area of the central eastern Pacific. Only one intertidal species, *Tegula pellisserpentis* (Wood, 1828), reaching up to 50 mm of maximum height and distributed from Guatemala to Colombia, was included in a recent review of mollusks important for fisheries (Pou-tiers, 1995). However, *B. (B.) bairdii* (locally known as Baird's top snail) has been reported as one of the marine snails occurring off the coast of Oregon, USA, of interest for development of commercial fishery (McCrae, 1994). According to McCrae's web page, this species is distributed between 90 m - 540 m (50 and 300 fathoms), which is considerably shallower than records available in printed literature, including the distribution depth recorded in the present study.

Catches obtained from off the coast of El Salvador indicate that *B. (B.) bairdii* could be considered a potential by-catch species of deep water Pandalids shrimp fishery if a well managed trawling fishery is to be developed in the area. Before any effort of commercial fishery in Central America, however, the resource should be thoroughly studied, stocks, duplication rates and longevity adequately estimated, and a sustainable fishing policy proposed. As for the Gulf of California, additional information is required to establish if abundance of *B. (B.) bairdii* is actually higher than what is reported herein, and this might be achieved by using more adequate sampling devices for large gastropods as used in El Salvador.

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