PANAMJAS
Pan-American Journal of Aquatic Sciences

New record of the alien mollusc *Rapana venosa* (Valenciennes 1846) in the Uruguayan coastal zone of Río de la Plata.

ANDREA LANFRANCONI*, MARISA HUTTON, ERNESTO BRUGNOLI & PABLO MUNIZ

*Sección Oceanología, Facultad de Ciencias, Iguá 4225, Montevideo 11400, Uruguay. *E-mail: andrea.lanfranconi@gmail.com*

Abstract. *Rapana venosa*, an invasive gastropod reported for the Río de la Plata estuary since 1998, represents a serious risk to the shellfish fauna with economic value of the region. In this contribution new records in the Uruguayan coastal zone of the easternmost distribution limit are presented. Also are discussed potential impacts of the range expansion over the local biodiversity.

Key words: biological invasion, gastropods, biodiversity, estuary, South-western Atlantic.

Resumen. Nuevo registro del molusco *Rapana venosa* (Valenciennes 1846) en la zona costera Uruguaya del Río de la Plata. *Rapana venosa*, molusco invasor reportado para el Río de la Plata desde 1998, representa un riesgo para la malacofauna de importancia económica de la zona. Se presentan resultados sobre su límite este de distribución para la costa uruguaya y se discuten sus potenciales impactos en la biodiversidad autóctona.

Palabras clave: invasión biológica, gastrópodos, biodiversidad, estuario, Atlántico Sud Occidental.

As in other areas of the world, the south-western Atlantic enclose many exotic aquatic species (Schwindt 2001, Orenzans *et al*. 2002, Silva & Souza 2004) and Uruguayan ecosystems are not an exception of this scenario (Brugnoli *et al*. 2005, 2006, Muniz *et al*. 2005). *Rapana venosa* (Gastropoda, Muricidae) is a large carnivore whelk native from Asia (Tsi 1983, Chung *et al*. 1993). It has been recorded in the Río de la Plata estuary for the first time in 1998 by Scarabino *et al*. (1999) and Pastorino *et al*. (2000). This species is frequently found in surveys carried out in the middle and outer portions of the estuary (Giberto *et al*. 2006, Carranza & Rodríguez 2007, Carranza *et al*. 2007, Cortelezzi *et al*. 2007).

Rapa whelks show wide termohaline tolerance (Chung *et al*. 1993, ICES 2004), fast growth, high fertility (ICES 2004, Harding *et al*. 2007a), a planktonic phase ranging from 14 to 80 days (Mann & Harding 2000), tolerance to water pollution and hypoxia (Zolotarev 1996). All of these traits made this organism a successful invader. Furthermore, this voracious predator of molluscs (Savini *et al*. 2002) can be considered one of the most unwelcome invasive species impacting large native mollusc populations (Drapkin 1963, Zolotarev 1996, Giberto *et al*. 2006). Despite its importance as an invasive species little is known in South America about its distribution, population structure, and potential ecological impacts on the native benthic community and on the trophic web.

Having highlighted *Rapana venosa* ecological importance, the present contribution aims to report the expansion of its distribution range in the Uruguayan coastal zone, and also to analyze morphometric variables, sex-ratio and epibionts coverture of the collected organisms.

The Río de la Plata (34º-36º30’ S, 55º-58º30’ W) is a large extension (38,000 km^2) and shallow (5-25 m) coastal plain estuary that according to salinity can be divided in upper (< 0.4) and outer (0-33) (Framiñan *et al.* 1999) zones. This study was carried out in a coastal area localized in the outer zone (Fig. 1), characterized by rocky shores and sandy beaches.

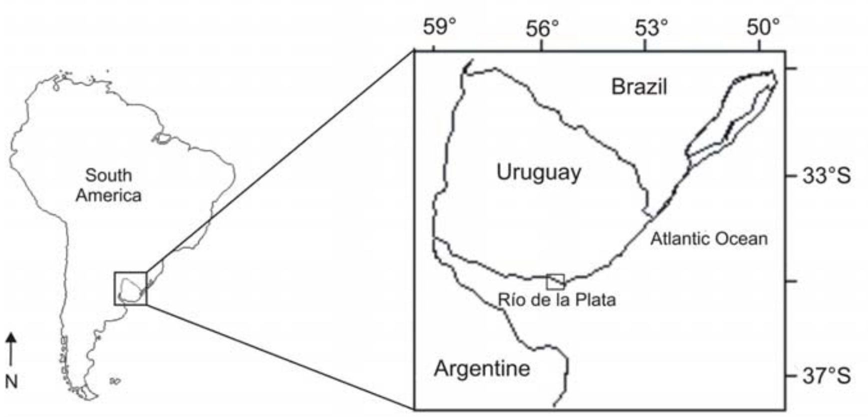

Figure 1. South America, and Uruguay with the sampling zone studied in the Uruguayan coastal zone (☐).

Data was obtained by scuba diving on April 15 of 2006, using an squared sampler (5x5 m) covering an area of 25 m^2 in Playa Hermosa (34°50´38´´S, 55°18´09´´W) at late afternoon. Depth, water temperature and salinity were measured *in situ* using a field conductimeter and an echo-sounder (Table I).

Collected specimens of *Rapana venosa* were immediately frozen and examined later in the laboratory. Total shell length (SL) and Total shell width (SW) were measured using a calliper (0.1 mm) (Fig. 2). Total animal wet weight (TW) was recorded using a digital scale balance (0.1 g). To analyze the relationship between SL and other two variables, regression test were performed using the four common models (i.e. lineal, logarithmic, exponential and geometric), verifying with the determination coefficient the best one. The sex was determined by the presence of penis and reddish-brown gonads (male) and absence of penis and the presence of gonopore and yellow gonads (female). Also we analyzed organisms for signs of imposex anomalies in the reproductive apparatus, the imposition of male sexual characters including a penis and vas deferens onto females under toxic effects of pollutants (Mann *et al*. 2006). Coverage type and percentage of epibionts were also determined.

Environmental variables measured in the sampling site are presented in Table I. The total number of snails recorded was 18 (0.72 individuals/m^2). Shell length ranged between 57.3 and 81.2 mm, width between 45.1 and 61.3 mm and total weight ranged from 41.1 to 91.1 g. The best fit for Log SL vs. Log SW and Log SL vs. Log TW relationship was obtained applying a lineal model (Y= ax+b), with R^2 of 0.68 and 0.73 respectively (Fig. 3). The ratio of males and females was 0.64, being 39% and 61% mean values of males and females respectively. The lack of imposex signs in females of the present study could be interpreted as a symptom of a healthy population or a signal that this population had not been exposed enough time to TBT to develop signs of imposex. In relation to the epibionts the following taxa were identified: Coelenterata (Anthozoa: *Anemone* sp.), Annelida (Polychaeta: *Polydora* sp.), Mollusca (Bivalvia: *Ostrea* sp.), Arthropoda (Crustacea: not identified barnacles) and Bryozoa (Cheilostomata: *Membranipora* sp.), being the last two the most abundant. The majority of the specimens (67%) presented low epibionts cover (0-25% of coverage).

Table I. Tolerance range of *Rapana venosa* to temperature, salinity, type of sediment and depth at native regions and other invaded regions, and the data obtained in this work (study area).

	Study Area	Native region	Other invaded regions
Depth (m)	1.5	ND	up to 40
Substratum (type)	sand-rock	hard sand	sand -rock
Temp. (°C)	18.5	4-35	7-24
Salinity	16.6	ND	25-32

ND = no data

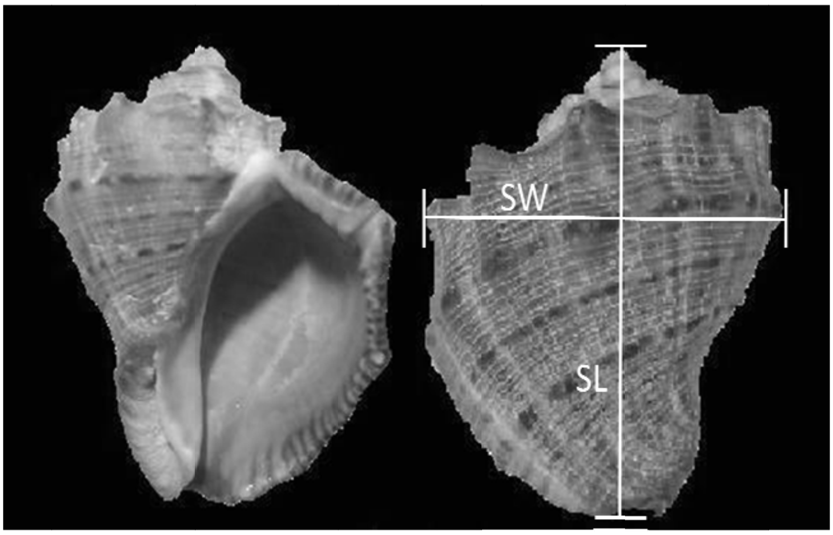

Figure 2. *Rapana venosa*: Ventral and dorsal view, with biometric variables measures in the present study. SW= total shell width, SL= total shell length.

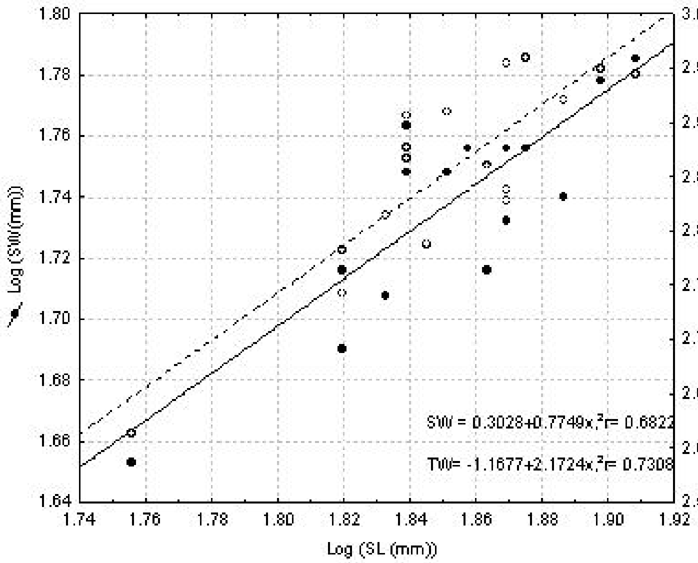

Figure 3. *Rapana venosa*: Relationships between SL vs SW and SL vs TW. Equation of the best model fitted and R^2 are also presented in the figure.

Even though the reduced number of organisms collected in this study, the results obtained could be useful as an approach to the potentially problem that this invasion could cause in the Uruguayan coastal zone. As far as we know the present data constituted the first approach to population feature in the eastern distribution limit of the species in Uruguay. Figure 4 shows the advance of rapa populations since 2005. The abundance of rapa individual here reported (0.72 individual/m^2) are higher than those reported by Savini *et al.* (2004) for the northern Adriatic Sea. The size range of organisms here recorded and the common presence of egg masses with living larvae, during the austral summer (personal observations of the authors) are both an indication that *R. venosa* populations are mature and established.

Considering all studies performed in this region of South America, the present distribution of *R. venosa* seems to be restricted exclusively to the Río de la Plata estuary (Figure 4). The lack of rapa individuals in the Atlantic Ocean coast could be attributed to the presence of the native gastropod *Stramonita haemastoma* (Linnaeus 1767, Muricidae), since the environmental characteristics of this zone are in the range established for *R. venosa*. *S. haemastoma* could be a possible competitor that occupies a similar ecological niche and is also a large active predator (Rios 1994) that seems to be highly salinity dependent and cannot enter the estuary, then, is restricted to the ocean waters. However, the question about if rapa whelk can outcompete *S. haemastona* is still open. Since molluscan invasions in estuaries and marine ecosystems have hardly altered communities (Carlton 1999), the need for specific research on this topic is highlighted as a warning to native biodiversity loss. The life history and reproductive strategies of *R. venosa*, combining characteristics of both r and K strategies, facilitates its development in niches that may be available or used in the new habitats and fruitfully compete with native species that share habitat requirements (Harding *et al.* 2007b).

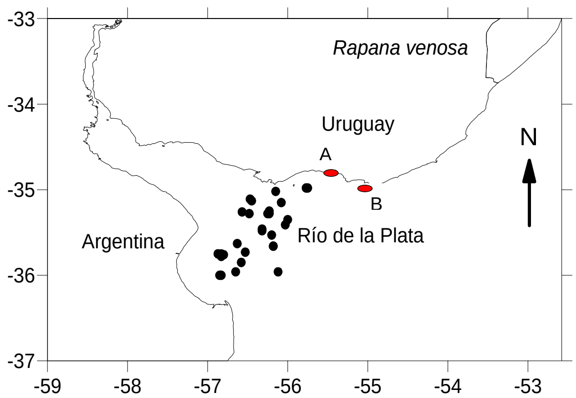

Figure 4. Distribution of *Rapana venosa,* modified of Brugnoli *et al*. 2007. Black dots: distribution at 2005; red dots, actual range of distribution: A: Playa Hermosa (this report), B: Punta del Este (unpublished data, collected in October 2008).

In the Río de la Plata estuary the coexistence of this predator (*R. venosa*) with populations of native bivalves (e.g. *Mactra isabelleana*, *Ostrea puelchana*) could be related to the predation pressure over this indigenous species (Giberto *et al*. 2006). The Uruguayan coastal zone, and particularly the outer Río de la Plata, has important mussel banks of the commercially exploitable blue mussel (*Mytilus edulis platensis*) which are the first mollusc resource of the country (Riestra & Defeo 1994). In this sense, the spread of *R. venosa* could be a threat for this natural resource, as stated before by Scarabino *et al.* (1999). Moreover, local fishermen reported that rapa whelks usually are found in the long lines eating over the baits (dead fish) near the rocky shores where also mussels are inhabiting (mean depth of 2 m).

Researches on the first stages of invasions are necessary in order to detect exotic species before they cause damage to local community and ecosystems. It is clear that once established in the new environment, the eradication of exotic species is not easy (de Poorter 1999). Therefore, only with a good knowledge of the distribution, ecology, life history and impacts of alien species it would be possible to improve management and control.

Acknowledgment

Special thanks to EC Incofish Project Contract 003739 (WP3) for partially supported the study. Thanks to M. Diaz, F. Scarabino, I. Pereyra, J.M. Clemente and M. Bessonart for collaboration in the field sampling. The manuscript was enhanced by the comments and suggestios of three anonymous reviewers.

References

Brugnoli, E., Clemente, J., Boccardi, L., Borthagaray, A. & Scarabino, F. 2005. Update and prediction of golden mussel (*Limnoperna fortunei*): distribution in the principal hydrographic basin of Uruguay. **Anais da Academia Brasileira de Ciências**, 77: 235-244.

Brugnoli, E., Clemente, J., Riestra, G., Boccardi, L. & Borthagaray, A. I. 2006. Especies acuáticas exóticas en Uruguay: situación, problemática y gestión. Pp. 351-361. In: Menafra, R., Rodríguez-Gallego, L., Scarabino, F. & Conde, D. (Eds.). **Bases para la conservación y manejo de la costa uruguaya**. Vida Silvestre, Montevideo, Uruguay, 668 p.

Brugnoli, E., Muniz ,P., Venturini, N. & Burone, L. 2007. Environmental Perturbation and Coastal Benthic Biodiversity in Uruguay. Pp. 75-126. In: Willis, I. C. (Ed.). **Progress in Environmental Research**. Nova Publishers, New York, 309 p.

Carranza, A. & Rodríguez, M. 2007. On the benthic mollusk of Banco Inglés (Río de la Plata). **Animal, Biodiversity and Conservation**, 30: 161-168.

Carranza, A., Scarabino, F. & Ortega, L. 2007. Distribution of Large Benthic Gastropods in the Uruguayan Continental Shelf and Río de la Plata Estuary. **Journal of Coast Research**, 24(1A): 161-168.

Carlton, J. 1999. Molluscan invasions in marine and estuarine communities. **Malacología**, 41: 439-454.

Chung, E. Y., Kim, S. Y. & Kim, Y. G. 1993. Reproductive ecology of the purple shell *Rapana venosa* (Gastropoda: Muricidae), with special reference to the reproductive cycle, depositions of egg capsules and hatchings of larvae. **Korean Journal of Malacology**, 9: 1-15.

Cortelezzi, A., Rodrígues-Capitulo, A., Boccardi, L. & Arocena, R. 2007. Benthic assemblages of a temperate estuarine system in South America: Transition from a freshwater to an estuarine zone. **Journal of Marine Systems**, 68: 569-580.

de Poorter, M. 1999 Borrador de Guías para la prevención de pérdidas de diversidad biológica ocasionadas por invasión biológica. Cuarta Reunión del Órgano Subsidiario de Asesoramiento Científico, Técnico y Tecnológico. Documento de Base. Unión Internacional para la Naturaleza. 15 p.

Drapkin, E. 1963. Effect of *Rapana bezoar* Linné (Mollusca, Muricade) on the Black Sea fauna. **Doklady Akademii Nauk SRR,** 151: 700-703.

Framiñan, M. B., Etala, M. P., Acha, E. M., Guerrero, R. A., Lasta, C. A. & Brown, O. B. 1999. Physical characteristics and processes of the Rio de la Plata estuary. Pp. 161-194. In: Perillo, G. M. E., Piccolo, M. C. & Pino-Quivira, M. (Eds.). **Estuaries of South America: their geomorphology and dynamics.** Springer, Berlin, 223 p.

Giberto, D. A., Bremec, C. S., Schejter, L., Schiariti A., Mianzan, H. & Acha E. 2006. The invasive Rapa Whelk *Rapana venosa* (Valenciennes, 1846): status and potentialecological impacts in the Río de la Plata estuary, Argentina-Uruguay. **Journal of Shellfish Research,** 25: 919-924.

Harding, H. M., Mann, R. & Kilduff, C. W. 2007a. The effects of female size on fecundity in a large marine gastropod *Rapana venosa* (Muricidae). **Journal of Shellfish Research**, 26: 33-42.

Harding, J. M., Kingsley-Smith, P., Savini, D. & Mann, R. 2007b. Comparison of predation signatures left by Atlantic oyster drills (*Urosalpinx cinerea* Say, Muricidae) and veined rapa whelks (*Rapana venosa* Valenciennes, Muricidae) in bivalve prey. **Journal of Experimental Marine Biology and Ecology**, 352: 1-11.

ICES (International Council for the Exploration of the Sea). 2004. Alien Species Alert: *Rapana venosa* (veined whelk). Mann, R., Occhipinti, A. & Harding, J. M. (Eds.). ICES Cooperative Research Report N° 264 , 14p.

Mann, R. & Harding, J. M. 2000. Invasion of the North American Atlantic coast by a large predatory Asian mollusc. **Biological Invasions**, 2: 7-22.

Mann, R., Harding, J. M. & Wesctcott, E. 2006. Occurrence of imposex and seasonal patterns of gametogenesis in the invading veined rapa whelk *Rapana venosa* from Chesapeake Bay, USA. **Marine Ecology Progress Series**, 310: 129-138.

Muniz, P., Clemente, J. & Brugnoli, E. 2005. Benthic invasive pests in Uruguay: a new problem or an old one recently perceived? **Marine Pollution Bulletin**, 50: 1014-1018.

Orensanz, J. M., Schwindt, E., Pastorino, G., Bortolus, A., Casas G., Darrigran, G., Elías, R., López Gappa J. J., Obenat, S., Pascual, M., Penchaszadeh, P., Piriz, M. L., Scarabino, F., Spivak, E. D. & Vallarino, E. A. 2002. No longer the pristine confines of the world ocean: a survey of exotic marine species in the southwestern Atlantic. **Biological Invasions**, 4: 115-143.

Pastorino, G., Penchaszadeh, P. E., Schejter, L. & Bremec, C. 2000. *Rapana venosa* (Valenciennes, 1846) (Mollusca: Muricidae): a new gastropod in south Atlantic waters. **Journal of Shellfish Research**, 19: 897-899.

Riestra, G. & Defeo, O. 1994. Aspectos de la dinámica poblacional y estructura de la comunidad del mejillón *Mytilus edulis platensis* en la Costa Atlántica Uruguaya. **Comunicaciones de la Sociedad Malacológica Uruguaya**, 7: 345-356.

Rios, E. 1994. Seashells of Brazil. Editora da FURG, Rio Grande, 368 p.

Savini, D., Harding, J. M., & Mann, R. 2002. Rapa whelk *Rapana venosa* (Valenciennes, 1846) predation rates on hard clams *Mercenaria mercenaria* (Linnaus, 1758). **Journal of Shellfish Research**, 21: 777-779.

Savini, D., Castellazi, M., Favruzzo, M. & Occhipinti-Ambrogi, A. 2004. The alien mollusc *Rapana venosa* (Valenciennes 1846; Gastropoda, Muricidae) in the northern Adriatic Sea: population structure and shell morphology. **Chemistry and Ecology** 20: 411-424.

Scarabino, F., Menafra, R. & Etchegaray, P. 1999. Presencia de *Rapana venosa* (Valenciennes, 1846) (Gastropoda: Muricidae) en el Río de la Plata. **Boletín de la Sociedad Zoológica de Uruguay (Segunda Época)**, 11: 40.

Schwindt, E. 2001. Impacto de un poliqueto exótico y formador de arrecifes. Pp. 109-113. In: Iribarne, O. (Ed.). **Reserva de la Biosfera Mar Chiquita: Características físicas y ecológicas**. Editorial Martín, Mar del Plata, 320 p.

Silva, J. S. & Souza, R. C. 2004. Água de lastro e bioinvasão. Pp. 1-10. In: Silva, J. S. &

Souza, R. C. (Eds.). Agua de lastro e bioinvasão, Interciencia, Río de Janeiro, 224p.

Tsi, C. Y., Ma, X. T., Lou, Z. K. & Zhang, F. S. 1983. Illustrations of the fauna of China (Mollusca). **Science Press**, **Beijing,** 2: 1-150.

Zolotarev, V. 1996. The Black Sea ecosystem changes related to the introduction of new mollusks species. **P.S.Z.N.I: Marine Ecology**, 17: 227-236.

Received January 2009
Accepted May 2009
Published online June 2009