



Salinity and temperature tolerances of *Neomysis americana* (Crustacea: Mysida) sub adults: Perspectives on vulnerability, and distribution in South America

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ABSTRACT

Mysid *Neomysis americana* links the benthic and pelagic food webs of numerous estuaries of the Western Atlantic. Aim was to understand the vulnerability of one of their recruitment stages i.e. sub adults to realistic ranges of salinity and temperature. Such may help to understand their present and predict future latitudinal distribution. Sub adults of *N. americana* were collected from Laguna de Rocha estuary, Uruguay and exposed to salinities 5, 10, 15, 20, 25, and 30 at each of four experimental temperatures: 10 °C, 20 °C, 25 °C and 30 °C, for 72 h. Irrespective of temperature, survival was lowest in salinity 5. Survival was overall high in salinity 15 but in higher salinities such as 25, 30 mysids struggled to survive. Survival was particularly low in 10 °C, highest in 20 °C; and did not improve significantly in 25 °C and 30 °C. Results indicate that the recruits of *N. americana* can only withstand intermediate salinities and temperatures. Their vulnerability during seasonal anomalies, floods and droughts cannot be ruled out. Narrow range of temperature tolerance of the recruits may be a reason of absence of *N. americana* in cold temperate and warm tropical Atlantic coasts of South America. In the context of climatic warming, *N. americana* may extend its distribution along the southern coasts of Argentina but not towards northern Brazil.

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1. Introduction

Spatial distribution of any coastal species depends on its ability to tolerate wide ranges of salinity and temperatures (Segal and Burbank, 1963; Somero, 2005; Galván et al., 2016). In estuaries salinity and temperature fluctuate at different time scales with every filling and ebbing tide, breach of mouth, seasonal changes in freshwater supply, floods, droughts (Elliott and McLusky, 2002). Amplitudes of salinity and temperature variability in estuaries are further escalated by ongoing climatic changes which is an additional stress for the estuarine inhabitants such as zooplankton (David et al., 2005; Reguero et al., 2013; Barros et al., 2015). Changes in salinity and temperature are known to influence survival, population structure and distribution of estuarine zooplankton (David et al., 2005; Kordas et al., 2015; Rice et al., 2015). Experiments on salinity and temperature tolerances have been used widely for providing explanations behind the presence/absence, and the distribution of numerous estuarine hyperbenthos including mysids (Roddie et al., 1984; Webb et al., 1997; Paul et al., 2013).

A significant portion of the estuarine hyperbenthos is crustacean mysid shrimps (Mauchline, 1980; Murano, 1999). Benthic and the

pelagic food webs of numerous estuaries are coupled by mysids because numerous macro-invertebrates (e.g. Crabs) and fishes (some of them commercially harvested) prey on them (Mauchline, 1980; Sardiña and Lopez Cazorla, 2005). Eco-physiology of mysid genera such as *Neomysis* and *Mesopodopsis* have been explored in detail for understanding the vulnerability of their population structure and distribution but mostly in the Northern Hemisphere (DeLisle and Roberts, 1986; McKenney and Celestial, 1995). Survival, distribution of many mysid species are limited by their tolerance to wide range of salinities and temperatures (DeLisle and Roberts, 1986; McKenney and Celestial, 1995; Paul et al., 2013). In South America, experimental evidences show that salinity limits the survival of mysids in the estuaries of Brazil (Miyashita and Calliari, 2016) but such studies have not been performed on *Neomysis* which is one of the most abundant and ecologically important estuarine mysid in the region.

Mysids of *Neomysis* spp. are prevalent in the subtropical to warm temperate coasts of East Atlantic and the West Pacific Oceans (Pezzack and Corey, 1979; Mauchline, 1980; Mees et al., 1994; Murano, 1999; Yamada et al., 2007). Mysid *Neomysis americana* is mostly distributed in the estuaries along the Atlantic coasts of the Americas (North and South together) (Fig. 1) (Pezzack and Corey, 1979, 1982; Hoffmeyer, 1990; Calliari et al., 2007), except for a very recent report from the northern coasts of the Netherlands (Wittmann et al., 2012). In the

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Americas, it has been reported from latitude of 25°N to 50°N (i.e. from southern Newfoundland in Canada to the coasts of Florida, USA) and 30°S to 40°S (i.e. from southern Brazil to Bahia Blanca estuary in Argentina) (Fig.1) (Pezzack and Corey, 1982; Hoffmeyer, 1990; Viñas et al., 2005). The species may have a distributional disjunction; so far it has not been reported from the tropical coastlines of the Western Atlantic (Fig.1) (Hoffmeyer, 1990; Murano, 1999). Experiments show that the recruits (e.g. new born, juveniles) of the northern populations of *N. americana* had suffered from high mortality within 12 to 48 h, when they were subjected to temperature over 22 °C or below 10 °C under varying salinity, which may indicate the inability of the species to withstand broad ranges of salinity and temperature fluctuations (Pezzack and Corey, 1982). A similar study on the southern population may provide insights of their absence from the tropics and cold temperate regions and future distribution in context of climatic warming in South West Atlantic (Reguero et al., 2013; Barros et al., 2015; Nagy et al., 2015).

Southern populations of *Neomysis americana* has been studied, especially those from the Rio de la Plata estuary and its sub-estuaries (salinity 0.5 to 33, temperature 10 °C to 25 °C) where densities can be as high as 2520 individuals per cubic meter. These mysids are particularly abundant near brackish zones and have a marked habit of vertical migration (Calliari et al., 2001, 2007; Schiriati et al., 2006). Their breeding has been reported throughout the year, but their densities are highest in early spring to summer (austral) (Viñas et al., 2005). Sub adults of *N. americana* approximate 4 mm but adults could be between 7 and 14 mm depending on sex, reproductive stage, seasons and latitude (Hoffmeyer, 1990; Viñas et al., 2005). The species is known colonize intermittently open/closed lagoons along the Uruguayan coasts; e.g. it is highly abundant in Laguna de Rocha estuary (Rodríguez-Graña et al., 2008). It feeds on detritus, macrophytes, copepods and in turn is predated by fishes such as white croaker (*Micropogonias furnieri*), silverside (*Odontesthes* sp.) and flatfishes (e.g. *Paralichthys orbignianus*) thereby a stable population structure of this species is important for



Fig. 1. Distribution of mysid *Neomysis americana* along the Atlantic coasts of the Americas. The grey arrow indicates approximate location of Laguna de Rocha. In Laguna de Rocha map (inset) the grey shaded area indicates the collection site within the estuary (modified after Rodríguez-Graña et al., 2008).

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