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Short Communication

Jellyfish (*Chrysaora lactea*, Cnidaria, Semaestomeae) aggregations in southern Brazil and consequences of stings in humans

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ABSTRACT. The frequency of jellyfish blooms is generating a world-wide discussion about medusae population explosions, mainly those associated with stings. We report over 20,000 envenomations caused by *Chrysaora lactea* (Scyphozoa) in the State of Paraná (southern Brazil) during the austral summer of 2011-2012. Envenomations were considered mild, but almost 600 cases were treated in emergency services, with either toxic and allergic reactions, some with systemic manifestations. We proposed non-exclusive hypotheses to explain this large number of cases.

Keywords: *Chrysaora lactea*, Scyphozoa, jellyfish, envenomation, public health, stings, Paraná, Brazil.

Agregaciones de medusas (*Chrysaora lactea*, Cnidaria, Semaestomeae) en el sur de Brasil y consecuencias de picaduras en humanos

RESUMEN. La frecuencia de 'blooms' de medusas está generando debate a nivel mundial sobre los incrementos de poblaciones de medusas, sobre todo lo relacionado con picaduras. Se reportan más de 20.000 envenenamientos ocasionados por *Chrysaora lactea* (Scyphozoa) en el Estado de Paraná (sur del Brasil) durante el verano austral 2011-2012. Los envenenamientos fueron considerados leves, pero cerca de 600 casos fueron tratados en los servicios de emergencia, ya sea con reacciones tóxicas o alérgicas, algunas de ellas con manifestaciones sistémicas. Se proponen hipótesis no excluyentes para explicar este gran número de casos.

Palabras clave: *Chrysaora lactea*, Scyphozoa, medusas, picaduras, salud pública, Paraná, Brasil.

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Jellyfish are planktonic, free-swimming, sexually reproducing stages of some cnidarians (animals with unique microscopic intracellular structures called cnidae), collectively named Medusozoa (Marques & Collins, 2004; Collins *et al.*, 2006; Van Iten *et al.*, 2006). Ecological understanding of jellyfish populations is still in its early stages in Brazil (Migotto & Marques, 2006; Haddad & Marques, 2009). Around 100 species (polyps and medusae) are reported from the state of Paraná, of which 89 are hydrozoans (including hydromedusae, solitary and colonial hydroids), nine are scyphozoans (typical jellyfish) and two are cubozoans

(box jellyfish) (Marques *et al.*, 2003; Oliveira *et al.*, *in press*).

Medusae populations may suddenly grow rapidly (blooms) and do so frequently among the planktonic cnidarians, but why this happens is poorly understood. A "true" 'bloom' is an abnormal increase in seasonal populations and might have several causes (Graham *et al.*, 2001; Purcell, 2012). However, the term 'bloom' has become vernacular and has changed from its original biological meaning (Miranda *et al.*, 2012). In the vernacular, the bloom concept is usually applied to events that include problems for humans that may be

health (stings), economic (fisheries, energy, tourism) or environmentally (becoming a huge biomass) related. However, this convenient terminology is scientifically incorrect and not biologically based (Miranda *et al.*, 2012). Recently, the frequency of blooming is generating a world-wide discussion about medusae population explosions in all oceans (Brotz *et al.*, 2012; Schroepe, 2012; Condon *et al.*, 2013). Yet, in many cases these bloom events are incorrectly classified, because they are consequences of oceanographic factors that may concentrate a population, thereby giving the false impression of an abnormal population increase (Graham *et al.*, 2001; Miranda *et al.*, 2012). Thus, the relationship between blooms and stings is difficult to decipher.

Envenomations with cnidarians occur in all oceans. In Brazil, hydrozoans (Freitas *et al.*, 1995; Marques *et al.*, 2002; Haddad Jr., 2008), scyphozoans (Haddad Jr. *et al.*, 2002) and cubozoans Haddad Jr. *et al.*, 2010) have all been documented as culprits in stings with humans.

During the hotter months in 2011-2012 (December to February) many stings involving swimmers and jellyfish were reported from in the state of Paraná (southern Brazil). Here, we identify the causal agents and describe the cases and offer explanations for why this year had more stings than previous years.

Stings were surveyed by the 8th Firemen Brigade of the State of Paraná and personnel from the State Secretary of Health in Paraná. They worked at 101 coastal locations from 12 December 2011 to 26 February 2012. The survey was carried out when swimmers who were stung looked for first aid from the lifeguards and were then asked to fill out a questionnaire after being treated.

On 28 January 2012 we visited two beaches (Matinhos, 25°48'35"S, 48°31'50"W, and Caiobá 25°50'51"S, 48°32'18"W) to interview local people and fishermen as well as to collect specimens. Animals were collected while they were swimming in near shore waters or alive and stranded on the beach. Samples for molecular studies were preserved in ethanol 90% and for morphological analyses in 4% formaldehyde solution in seawater. Morphological examination and identification of the specimens followed the recent literature (Morandini & Marques, 2010).

Specimens collected and observed in the area of the stings were identified as the scyphomedusa *Chrysaora lactea* Eschscholtz, 1829 (Scyphozoa, Discomedusae, Pelagiidae) (Fig. 1). Between 17 December 2011 and 26 February 2012, a conservative estimate of the number of stings in this area was 20,471 incidents reported by the Firemen. The Paraná branch of the National Information System for Diseases and Accidents



Figure 1. A medusa of *Chrysaora lactea* Eschscholtz, 1829. This animal was collected *in situ*, where accidents had been reported. Umbrella diameter ~7 cm.

(SINAN is the Brazilian acronym) reported 21,343 accidents. These records are the greatest number of stings involving jellyfish, and also they are nearly 40 times greater than the number of stings ever reported (309 accidents in 2007-2008, 300 in 2008-2009, 241 in 2009-2010 and 541 in 2010-2011). The largest number of stings of the 2011-2012 season occurred between 19 January and 7 February, then again during Carnival, when many Brazilians are vacationing on the beach (19-23 February, Fig. 2). Stings did not seem to be concentrated in any particular area and were reported from the entire coast of Paraná, including the counties of Antonina (23 and 13 cases reported by the Firemen and the SINAN, respectively), Guaraqueçaba (63, SINAN only), Guaratuba (6,746 and 6,970), Matinhos (9,817 and 13,431), Paranaguá (3,885 and 866) (Fig. 3).

Jellyfish stings were considered mild, with instantaneously mild to moderate local pain and a burning sensation, with erythema and edema, occasionally forming lesions. Skin lesions varied in shape (rounded, ovoid, irregular, elongated) and some patients had dotted linear lesions up to 20 cm in length, caused by 1-3 tentacles. Most minor cutaneous markings disappeared 30-120 min after contact. A total of 592 cases were treated in emergency services, with

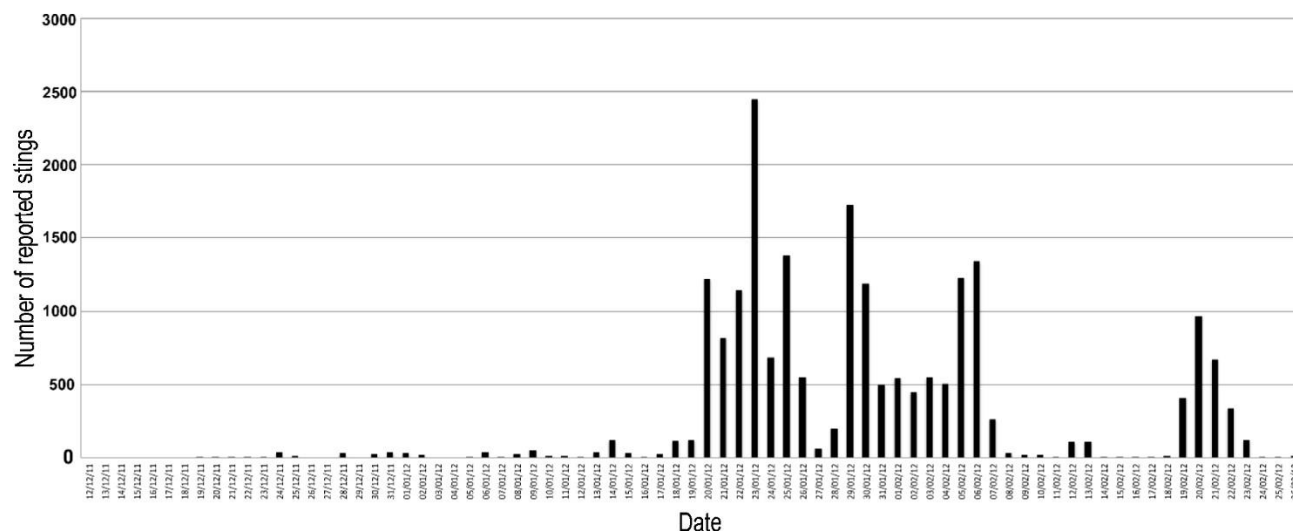


Figure 2. Daily number of stings due to the medusa *Chrysaora lactea* (from 12 December to 26 February 2012). Data from the firemen's records. Note the increasing numbers beginning on 19 January 2012.

either toxic and allergic reactions. About 36% of these cases had systemic manifestations.

Males were stung more often (55%), as well as younger people and children, who spend more time in recreational activities in the water. A single lesion was the only consequence of accidents in 77% of the patients, while other patients had four or more lesions in more than one area of the body. Lesions on the legs (36%) and arms (36%) were most common, followed by chest and abdomen (21%), face (5%) and neck (2%).

In spite of several co-occurring species, including *Olindias sambaquiensis*, *Physalia physalis*, *Stomolophus meleagris*, *Lychnorhiza lucerna*, *Chiropsalmus quadrumanus*, the jellyfish *Chrysaora lactea* was the only clear cause of the stings during the summer of 2011-2012 in Paraná. The reasons for this assumption are: *C. lactea* was observed in enormous numbers; the majority of the stings was mild and not presenting a clear pattern like for other species (see Haddad Jr. *et al.*, 2002). The only two cases of stings with *C. lactea* in the scientific literature were by researchers themselves who intentionally handled the animals. Those were mild and symptoms disappeared within an hour or so (Mianzan & Cornelius, 1999; Nogueira Jr. & Haddad, 2006) and similar to most reported here (also see Haddad Jr. *et al.*, 2010). However, the more serious stings may, in part, have been due to other species that are also in the area (Nogueira Jr. & Haddad, 2006) or due to allergic reactions (Haddad Jr. *et al.*, 2010).

Chrysaora lactea is one of the most common jellyfish along the entire Brazilian coast and adjacent countries (Mianzan & Cornelius, 1999; Morandini &

Marques, 2010). It is not a strong swimmer and usually passively travels with the current, but can move up and down in the water column while foraging (Morandini, *pers. obs.*). The *C. lactea* cnidome (the set of nematocysts of a species) is well-known (Morandini & Marques, 2010) although there are no toxicological studies for this species. Some other members of the same family (Pelagiidae), which have similar cnidomes, have strong toxins [*e.g.*, *Pelagia noctiluca* (Mariottini & Pane, 2010); *Chrysaora plocamia* (Vera *et al.*, 2005); *Chrysaora quinquecirrha* (Šuput, 2009)].

Several non-exclusive hypotheses for the large number of cases in 2011-2012 are possible. First, perhaps that year was the most efficient year to date for data collecting by the firemen and the health department. If so, then the true number may have not been reported in previous years. Next, more attention about stings may have appeared in the media that year and so people were more inclined to look for help when stung. Third, the season is the peak of summer vacation in Brazil, including Carnival, and the consequently increasing of bathers is expected. Finally, there is the possibility that this was a jellyfish bloom or an accumulation of jellyfish due to environmental causes (wind, tides, etc.).

There are many environmental factors that can explain the greater concentration of jellyfish near the beach (see mainly Graham *et al.*, 2001); but in the case reported here it may be explained by environmental factors such as winds and currents -like described for scyphomedusae in Uruguay by Olagüe *et al.* (1990), pushing more oceanic waters shoreward, causing the aggregation. Also, the number of the very common *C.*

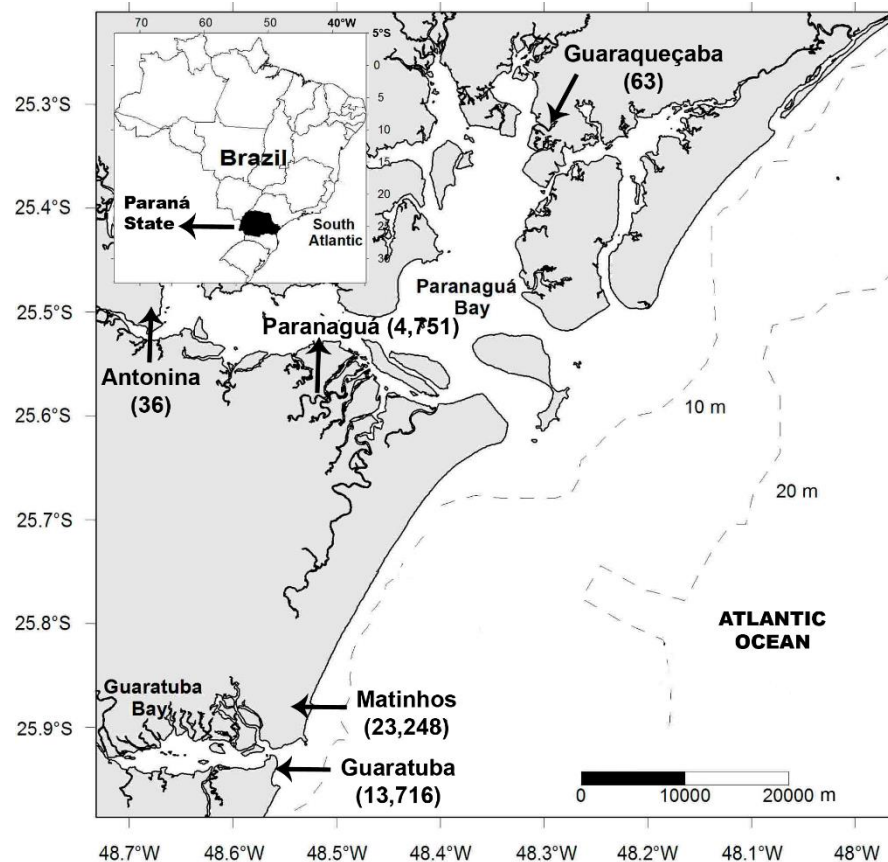


Figure 3. Map of the coast of Paraná State showing municipalities where stings were reported (arrows point to the county seats) followed by the number of recorded stings. Note that the number of stings decreased in the counties inside the Paranaguá Bay (see text for details).

lactea in Paraná is naturally larger than those of the other species (Nogueira Jr. & Haddad, 2006) and is more numerous than the same species in other regions, including the conterminous state of São Paulo (Morandini, *pers. obs.*). We suggest that, in fact, there is no evidence of a bloom, or an otherwise abnormal abundance in the shallow waters during the time period in question. Fishermen reported that the species was common farther from shore, although large numbers are less frequent near shore. In a qualitative survey of the fishermen, we found a unanimous opinion that, just prior to and at the time of the stings, winds were from the east. Navy wave data from January 2012 (350 km south of the area) also showed, at this time, long sequences of days with onshore waves. If similar wave movement was occurring in Paraná, we suggest that the jellyfish would have been pushed towards shore and thus concentrated at the time of the envenomations. This natural phenomenon is an apparent bloom caused by the environment (Graham *et al.*, 2001; Miranda *et al.*, 2012), in which a normal population is redistributed

and concentrated, rather than a true bloom, which is due to rapid population growth.

Also, it is important to note that the number of cases of stings were associated with a larger number of tourists in an area with environmental concentration of jellyfish. The daily reduction in the number of cases (Fig. 2) is probably more likely to be due to weather and a reduced number of tourists (and even fewer entering the water) rather than dispersal of the jellyfish.

A large incidence of stings may occur again in the future if environmental conditions coincide with the vacations for many people. To prevent similar numbers of envenomations, a program that monitors jellyfish abundance should be developed, along with a system for monitoring oceanic conditions that may cause aggregations of jellyfish, and together, they can establish an early alert system so that vacationers can be informed of sting risk. Better forecasting of jellyfish aggregations in tourist regions is probably the simplest, most cost-effective way to reduce the number of stings, especially when compared with the probably im-

sible option of biological control of jellyfish populations.

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