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Rafting seahorses: the presence of juvenile *Hippocampus patagonicus* in floating debris

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A total of 477 juvenile *Hippocampus patagonicus* recorded in 80 sampling events were detected rafting on the surface during high tide at San Antonio Bay, northern Patagonia, Argentina. If rafting juveniles drift long distances beyond their original populations, they have the potential to form new populations, which may explain the wide distribution of *H. patagonicus*.

Key words: dispersal; drift; north Patagonia; San Antonio Bay; species range; Syngnathidae.

Long-distance migration is not a well-understood phenomenon for seahorses *Hippocampus* spp. For other low mobile and sessile organisms, rafting has been described as a mechanism of dispersal (Hobday, 2000). Rafting is a passive movement by which an organism, attached to floating substrata, is dispersed by the currents. The hypothesis that *Hippocampus* could disperse by rafting (Teske *et al.*, 2005, 2007) is supported by records of individuals in the stomach contents of epipelagic predators whose habitats do not overlap with those of the *Hippocampus* ingested (Kleiber *et al.*, 2011), the association of *Hippocampus* with floating algae (Kingsford & Choat, 1985) and the presence of juvenile *Hippocampus* in the ichthyoplankton (Powell, 2000; Kanou & Kohno, 2001; Vandendriessche *et al.*, 2005).

This contribution describes the presence of juvenile Patagonian seahorse *Hippocampus patagonicus* (Piacentino & Luzzatto, 2004) attached to floating debris and swimming freely in San Antonio Bay. *Hippocampus patagonicus* has a wide geographic distribution in the south-west Atlantic Ocean (Luzzatto *et al.*, 2012). Two stable populations and several isolated records of *H. patagonicus* have been documented along the coast of the Argentine Sea. In addition, its presence along the

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Brazilian coast is highly suspected (Rosa *et al.*, 2011; Luzzatto *et al.*, 2012). Results are discussed in terms of their dispersal capacity and the threats that might affect this stage of the species.

San Antonio Bay (Fig. 1) is formed by a group of tidal channels located at the north-west extreme of San Matías Gulf, northern Patagonia, Argentina. It has a semi-diurnal tidal regime with a mean amplitude of 6·6 m (Hydrographic Navy Service of Argentina; www.hidro.gov.ar). The bay has two main channels: La Marea in the west and Escondido Channel in the east. Two other minor channels on the west and east sides are the Indio Channel and Caleta Falsa, respectively. During low tide, these two minor channels remain almost dry. San Antonio Bay is the type locality of *H. patagonicus* and it is one of the two locations in the Argentine Sea where stable populations are present (Piacentino & Luzzatto, 2004; Luzzatto *et al.*, 2012).

Juvenile *H. patagonicus* were counted by surveying shallow water habitats after high tide in the two minor channels of San Antonio Bay. Surveys were conducted in the Indio Channel during January and February (summer) of 2008, 2009, 2011 and 2012. In Caleta Falsa, surveys were conducted only in 2011 and 2012 (Fig. 1 and Table I). Surveys started after the predicted high tide for each sampling day because pilot work suggested that this was when juvenile *H. patagonicus* became most visible at the surface. Each survey consisted of one person counting juvenile *H.*

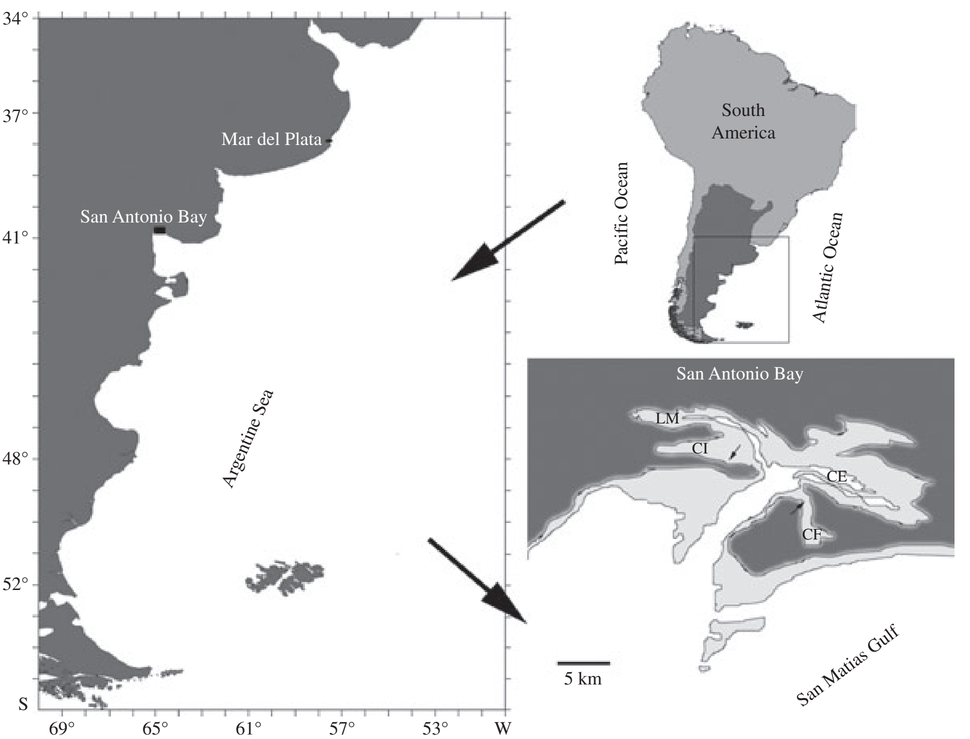

FIG. 1. Map showing the known localities of *Hippocampus patagonicus* in the south-west Atlantic Ocean. Bottom right: enlargement of the tidal channels that form San Antonio Bay, the sampling site. LM, La Marea; CI, Indio Channel; CE, Escondido Channel; CF, Caleta Falsa.

TABLE I. Number of sampling events, number of null events, mean, maximum and total number of rafting juveniles of *Hippocampus patagonicus* counted by site and year

	Indio Channel, 40° 45′ 22·61″ S; 64° 54′ 24·15″ W				Caleta Falsa, 40° 47′ 03·87″ S; 64° 50′ 30·37″ W	
Year	2008	2009	2011	2012	2011	2012
Sampling events (n)	18	25	17	7	5	8
Mean ± S.D., number per survey	11·3 ± 6·6	9·3 ± 6·1	1·9 ± 3·6	0	6·8 ± 4·3	4·3 ± 3
Null events (%)	0	0	35	100	20	12·5
Maximum number per sampling event	24	24	18	0	12	8
Total (n)	204	167	42	0	34	30

patagonicus at the surface for 45 min, while walking slowly at 1 m depth. Surveyors recorded the total number of juveniles and whether they were attached to floating debris or swimming freely.

A subset of the juvenile *H. patagonicus* found during surveys was measured to estimate their size distribution. During the first year of sampling, 72 juvenile *H. patagonicus* were randomly captured. Their heights were measured in mm with small callipers (coronet to tip of the tail) and they were returned to their natural environment. Juveniles ranged from 14 to 31 mm (mean ± S.D. = 22 ± 4 mm; $n = 72$). The rest of the individuals found were only counted, thus avoiding disturbance.

More juvenile *H. patagonicus* were found attached to floating debris than swimming freely at the water surface. Thirty-seven per cent of the *H. patagonicus* recorded were swimming freely at the surface, drifting passively on ocean currents. The other 63% were observed attached to floating debris (*e.g.* dried algae, seaweed and crab carapaces) by their prehensile tails. On two occasions juveniles were recorded coupled, linked together by their tails. The recording of this developmental stage in San Antonio Bay is possible owing to the presence of a stable *H. patagonicus* population in the area, the geomorphology of the bay and the tidal cycle of the site, which contributes to a recirculation of the water mass (Luzzatto *et al.*, 2012; M. Giaccardi & L.M. Reyes, unpubl. data).

Evidence from other studies suggests that *H. patagonicus* is not the only *Hippocampus* species with a potentially dispersive early life stage. In Tokyo Bay, juveniles of Japanese seahorse *Hippocampus mohnikei* Bleeker 1853 were recorded as part of the ichthyoplankton (Kanou & Kohno, 2001). In addition, under experimental conditions, juveniles of spotted seahorse *Hippocampus kuda* Bleeker 1852 preferred floating substrata (Mi *et al.*, 1998). Juveniles of long-snouted seahorse *Hippocampus guttulatus* Cuvier 1829 were found in epipelagic nets (Vandendriessche *et al.*, 2005) and juveniles of big-belly seahorse *Hippocampus abdominalis* Lesson 1827 were found drifting passively among macroalgae (Kingsford & Choat, 1985).

If rafting juvenile *Hippocampus* could drift long distances beyond their original populations, they may have the potential to settle in other areas, explaining the wide distributional range found in *H. patagonicus* and other species, with little genetic variation in their population structure, such as in European short-snouted seahorse *Hippocampus hippocampus* (L. 1758) (Woodall *et al.*, 2011).

In San Antonio Bay, the planktonic behaviour of rafting juveniles of *H. patagonicus* could be cause for conservation concern, as they could be facing threats. Seines are frequently used by fishermen and tourists for catching juvenile blenniids and atherinids (M. Giaccardi & L.M. Reyes, unpubl. data). These nets usually contain trapped juvenile *H. patagonicus* among the masses of debris that are discarded between fishing events (D.C. Luzzatto, pers. obs.).

The method used for this work could be used with some modifications to estimate abundances and population trends of juvenile *H. patagonicus*. To estimate abundances of rafting *H. patagonicus* a current meter could be used, as the area (or volume) covered by the sample design depends on the speed of the flow. The methodology suggested by this study is low cost, requires basic equipment and could be performed by local people after minimal training.

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References

Hobday, A. J. (2000). Persistence and transport of fauna on drifting kelp (*Macrocystis pyrifera* (L.) C. Agardh) rafts in the Southern California Bight. *Journal of Experimental Marine Biology and Ecology* **253,** 75–96.

Kanou, K. & Kohno, H. (2001). Early life history of a seahorse, *Hippocampus mohnikei*, in Tokyo Bay, Japan. *Ichthyological Research* **48,** 361–368.

Kingsford, M. J. & Choat, J. H. (1985). The fauna associated with drift algae captured with a plankton-mesh purse seine net. *Limnology and Oceanography* **30,** 618–630.

Kleiber, D., Blight, L. K., Caldwell, I. R. & Vincent, A. C. J. (2011). The importance of seahorses and pipefishes in the diet of marine animals. *Reviews in Fish Biology and Fisheries* **21,** 205–223.

Luzzatto, D. C., Sieira, R., Pujol, M. G. & Díaz de Astarloa, J. M. (2012). The presence of the seahorse *Hippocampus patagonicus* in the Argentine Sea based on the Cytochrome b sequence of mitochondrial DNA. *Cybium* **36,** 329–333.

Mi, P. T., Kornienko, E. S. & Drozdov, A. L. (1998). Embryonic and larval development of the seahorse *Hippocampus kuda*. *Russian Journal of Marine Biology* **24,** 325–329.

Piacentino, G. L. M. & Luzzatto, D. C. (2004). *Hippocampus patagonicus* sp. nov., nuevo caballito de mar para la Argentina (Pisces, Syngnathiformes). *Revista del Museo Argentino de Ciencias Naturales n.s.* **6,** 339–349.

Powell, A. B. (2000). Larval and pelagic juvenile fishes collected with three types of gear in Gulf Stream and shelf waters in Onslow Bay, North Carolina, and comments on ichthyoplankton distribution and hydrography. *Fishery Bulletin* **98,** 427–438.

Rosa, I. L., Oliveira, T. P. R., Osório, F. M., Moraes, L. E., Castro, A. L. C., Barros, G. L. M. & Alves, R. R. N. (2011). Fisheries and trade of seahorses in Brazil: historical perspective, current trends, and future directions. *Biodiversity and Conservation* **20,** 1951–1971.

Teske, P. R., Hamilton, H., Palsbøll, P. J., Choo, C. K., Gabr, H., Lourie, S. A., Santos, M., Sreepada, A., Cherry, M. I. & Matthe, C. E. (2005). Molecular evidence for long-distance colonization in an Indo-Pacific seahorse lineage. *Marine Ecology Progress Series* **286,** 249–260.

Teske, P. R., Hamilton, H., Matthe, C. A. & Baker, N. P. (2007). Signatures of seaway closures and founder dispersal in the phylogeny of a circumglobally distributed seahorse lineage. *BMC Evolutionary Biology* **7,** 1–19.

Vandendriessche, S., Messiaen, M., Vincx, M. & Degraer, S. (2005). Juvenile *Hippocampus guttulatus* from a neuston tow at the French–Belgian border. *Belgian Journal of Zoology* **135,** 101–102.

Woodall, L. C., Koldewey, H. J. & Shaw, P. W. (2011). Historical and contemporary population genetic connectivity of the European short-snouted seahorse *Hippocampus hippocampus* and implications for management. *Journal of Fish Biology* **78,** 1738–1756.