Moving Horseshoe Crabs

Routes of animals and knowledge

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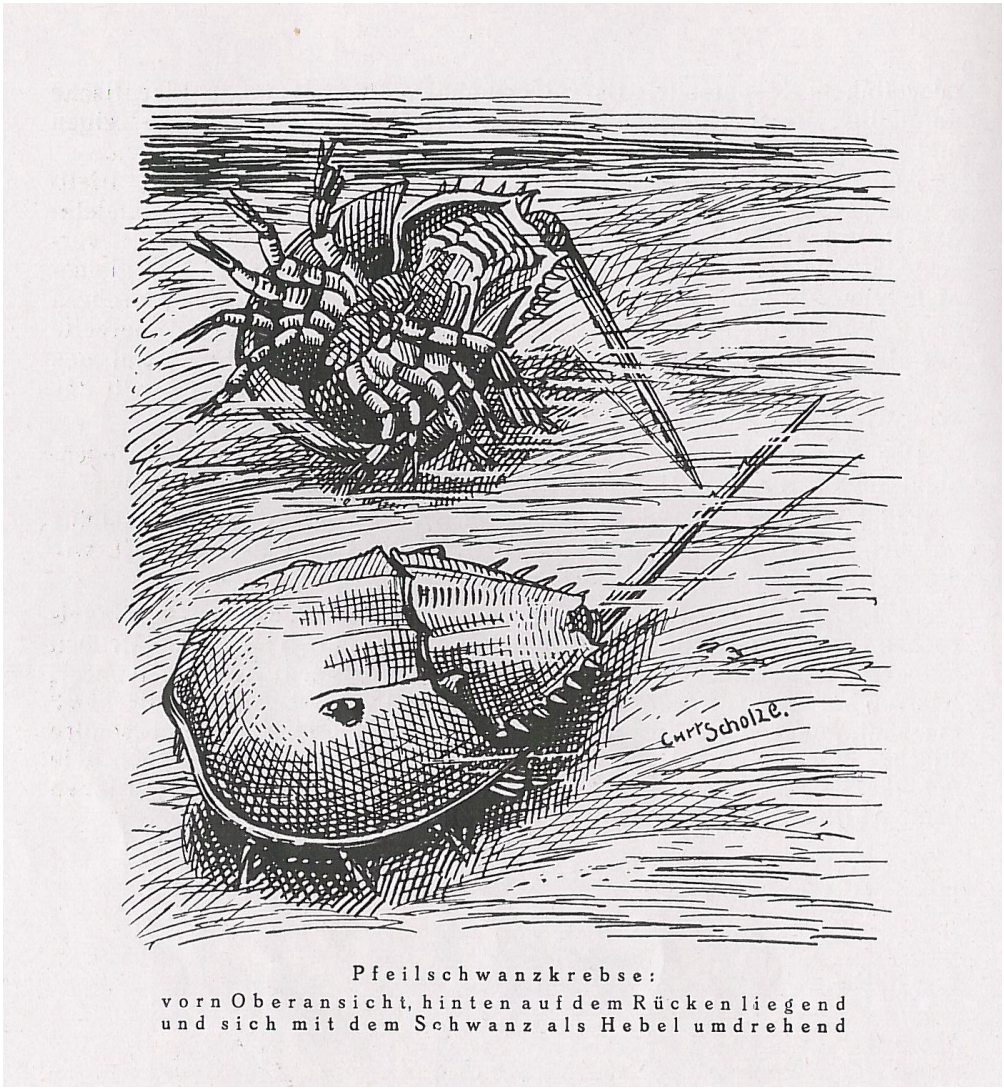

This 1914 drawing connects various places: it shows horseshoe crabs at the beach but is from Oskar Heinroth's Führer durch das Aquarium nebst Terrarium und Insektarium im Zoologischen Garten zu Berlin *(Guide to the Aquarium as well as the Terrarium and Insectarium at the Zoological Garden in Berlin).*

In August 1866, fishermen caught a number of horseshoe crabs off the Dutch coast. What was unusual about this by-catch was that the species, Limulus polyphemus (Linnaeus 1758), had mainly been found in the North Atlantic up until that point, but never in European waters.[1] How had the animals made their way to the North Sea, and why do we still know about them today? Or, in other words: How was knowledge about their distribution produced, and how was it disseminated?

Abandoned in the Ocean: From Aquarium Exhibits to Surplus Animals

Live horseshoe crabs came to Europe, among other things, on the back of the aquarium trade, which began picking up speed in the mid-19th century. At that time, successfully shipping live water creatures was still a sensational feat. There had already been imports of live animals for 18th-century menageries and the zoological gardens of the early 19th century. By contrast, the transport of aquatic animals had until that point been mainly limited to preserved specimens that arrived by trade or passenger ship in harbours, from where they made their way into natural history collections or the hands of private collectors. While seamen in harbour towns like Hamburg had long been supplying natural history museums, private collectors, and the natural history trade with sea creatures, it was only in the mid-19th century that the transport of live animals experienced a noticeable boom when the aquarium trade, which had begun in England, spread to Europe and beyond.[2]

The question of which species would prevail as aquarium animals and therefore objects of trade, and what value would be ascribed to them, depended on demand but also on practical factors such as their transportability and ability to survive. For, at that time, nowhere near all animals survived the long voyages on board ships, which often took months. In 1900, aquarists still believed it was a "recognised fact that it is much easier to import live elephants than a finger-long fish".[3] The particular challenge presented by attempting to transport live water creatures was that most of them required a rudimental environment to be created for them. This did not just take a lot of effort and money, but also required specific knowledge of a given species' habitat and the ability to manipulate physicochemical variables.

Unlike many other sea creatures, horseshoe crabs were extremely resilient animals. When William Lloyd, who was in charge of procuring animals for the recently opened Hamburg Aquarium, was ordering horseshoe crabs from the New York coast for the newly erected seawater tanks at the Hamburg zoological garden from animal trader Carl Hagenbeck in 1865, he noted:

> "We apply the term 'hardy' to such crabs as Limulus […] and by 'hard' we undefinedly mean that these animals are constructed to live for long periods when they are not actually immersed in water."[4]

These animals could be transported in tubs or crates with wet sand that only had to be moistened sporadically. They were therefore particularly well suited to being imported from overseas as the shipping costs were much lower than they were for transport tanks filled with water.[5] In the 1870s, horseshoe crabs were already being put on display in aquariums in Hamburg, Hanover, and Berlin.

In the case of the horseshoe crabs that Lloyd purchased for the Hamburg Aquarium, the animals' resilience became a real problem: "[T]he success with which they were brought over led to my getting many more than the Hamburg Aquarium could accommodate."[6] After he had sold and given away some of the surplus specimens, he handed off the rest of the animals – in secret, as he

admits – to the next steamship sailing from Hamburg to London with instructions to throw them overboard off Helgoland.[7] The horseshoe crabs' resilience thus led to the surplus animals being abandoned in the ocean. Seafaring and the aquarium trade were therefore two of the vectors that were – and still are – responsible for the global distribution of species, not just within but also outside of aquariums.

Fished out of the Sea: From By-Catch to an Object of Knowledge

When Lloyd found out that horseshoe crabs had been caught off the Dutch coast one year later, he had no doubt that they were the specimens from his secret release operation (or their descendants).[8] The fishermen sent their finds to naturalists and thus became part of a network of natural history observation and collecting. In this way, the horseshoe crabs changed their space and simultaneously their status once more: in the fishermen's nets, they went from being a surplus product of trade to becoming an object of knowledge. Scientific and popular natural history journals reported on the discoveries and sightings of horseshoe crabs in the sea. Lloyd, too, had found out about the animals found near Helgoland in a report. Around the same time, the natural history expert Thomas Southwell gave an account of horseshoe crabs that fishing boats had caught near Yarmouth on the Canadian coast and in North Wales[9] in the journal *The Zoologist*, as did a note in *Land and Water*.[10] In Germany, in turn, a certain Dr C. Lohmeyer reported in the *Emdener Zeitung* newspaper on a specimen that prawn fishers near Norderney had fished out of the sea. His news was shared again in the *Mittheilungen des Naturwissenschaftlichen Vereins* (Communications of the Scientific Association) in Frankfurt.[11] As the animals spread throughout the world's oceans, biogeographical knowledge about their movements was being spread in scientific and popular science texts. The horseshoe crabs migrated from the ocean through the aquarium and into science.

Historical knowledge from the 19th century about species distribution now forms an important resource for collecting data on and analysing the changes currently taking place in biodiversity. This applies to 'neozoa' – animals and subsidiary taxa that have established themselves in a region where they had not been native before due to (either deliberate or unintentional) human influence. This information can be found in reports on the "Bestandsaufnahme und Bewertung von Neozoen in Deutschland" (Inventory and Evaluation of Neozoa in Germany) commissioned by the German Federal Environmental Agency and by individual states.[12] The information provided by the fishermen and reports like Lloyd's from the 19th century are important for conducting work like this today. They are helping us to reconstruct the journeys taken by animals through space and time, and how they were distributed. The animals abandoned by Lloyd, for example, are listed in these reports as the first evidence of horseshoe crabs living in the North Sea. His report has become a historical source for reconstructing the distribution history of *Limulus polyphemus*, which is above all a history of the aquarium trade and maritime transport. This is because Lloyd's horseshoe crab example clearly illustrates the central role played by anthropogenic factors – such as the expansion of transport and trade infrastructures – in the distribution of animals and species, both inside and outside of aquariums. Over the course of the 20th century, there were further sightings of

horseshoe crabs off the German coast. In the 1960s, for example, there were accounts of sporadic discoveries in the North Sea and Baltic Sea, where a total of 18 specimens were documented between 1968 and 1976.[13] Today it is believed that all these finds can be attributed to ships in transit, probably fishing trawlers off the North American Atlantic coast that later released the animals into the ocean.[14] The presence of horseshoe crabs in the sea thus was a direct consequence of trade and seafaring.

So far, however, there has been no indication that horseshoe crabs have become established in German or Dutch coastal waters.[15] Neither the aquarium trade nor seafaring that have facilitated their spread across the earth have led to the permanent establishment of the species. In contrast, in many other cases, animals that, for example, were transported unnoticed in ships' ballast water or abandoned by aquarists have been able to establish new populations in new locations, like the Chinese mitten crab (*Eriocheir sinensis*), which was first spotted in the Aller and Elbe rivers in the 1910s and is now widespread in Germany. Horseshoe crabs and mitten crabs – in both cases, humans played the most important role in their (proliferation). And this does not just apply to distribution *vectors* like seafaring but also to the environmental and living conditions created by humans at the site in question, which have laid the foundations for both the introduction and endangerment of various species. For instance, the Atlantic horseshoe crab is now classed as an ('endangered species'), which has to do with the animals being commercially fished for the aquarium trade, fisheries (where horseshoe crabs are used as bait), and (biomedicine). This is compounded by the loss of spawning grounds[16] and changes being brought about by both coastal infrastructure on the East Coast of the US and anthropogenic climate change.[17] In turn, similar factors are playing a role in the question of how species establish themselves in new locations. In order to understand these spatial and temporal changes to biodiversity, we need to take a (long-term perspective). And it is precisely historical sources that are important in this regard as they provide information about the distribution of animals and changes to their environments that have been brought about by humans. Collection data and specimens, as well as reports from fishermen, can help us to understand the distribution routes of animals and knowledge. The same goes for natural history collections like the (Lamont-Doherty Collection), which is migrated today into (digital infrastructures). Such examples can help to analyse medium- and long-term changes, allowing us to gauge future dimensions and to act on current dynamics.

Footnotes

1. The range of the horseshoe crab *Limulus polyphemus* (which is not a real crab and is now zoologically considered to be an arachnid is considered to be mainly the North American Atlantic coast, ranging from southern Canada to Maine in the northern US, down to the Yucatan.↩
2. Shortly afterwards, it was possible to purchase aquarium animals through a broadly ramified and increasingly institutionalised aquaristic network, which encompassed traders and importers, fishermen and private enthusiasts, zoological gardens and research stations, public aquariums and breeders. Cf. Mareike Vennen. *Das Aquarium: Praktiken, Techniken und Medien der Wissensproduktion (1840-1910)*. Göttingen: Wallstein, 2018; Christian Reiß. *Der Axolotl: Ein Labortier im Heimaquarium*. Göttingen: Wallstein, 2019.↩
3. Paul Nitsche. *Der Import von lebenden Fischen: Rathschläge und Winke für die Einführung von Reptilien, Amphibien, Seewasserthieren und Wasserpflanzen für Aquarien- und Terrarienzwecke*. Berlin: self-published, 1901: 112.↩
4. William Alford Lloyd. "On the Occurrence of Limulus Polyphemus off the Coast of Holland, and on the Transmission of Aquarium Animals". *The Zoologist* 9 (1874): 3845-3855, 3850.↩
5. Cf. Lloyd, 1874; Alfred Brehm. *Führer durch das Berliner Aquarium: Eine kurze Beschreibung der in ihre zur Schaugestellten Thiere*. Berlin: Verlag des Berliner Aquariums, 1870: 83-84.↩
6. Lloyd, 1874: 3845.↩
7. Ibid.: 3846.↩
8. In summer 1873, fishermen caught four or five live specimens eleven kilometres off the Dutch island of Terschelling, which, according to Wolff (1977), were probably attributable to the Helgoland 'population', which is what Lloyd also believed at the time. Cf. Lloyd, 3846-47; T. Wolff. "The Horseshoe Crab *Limulus polyphemus* in North European Waters". *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening* 140 (1977): 39-52.↩

9. Thomas Southwell. “King Crab off the Dutch Coast”. *The Zoologist: A Monthly Journal of Natural History* 8 (1873): 3740.↩
10. *Land and Water*, 26.04.1873.↩
11. Quoted in Ernst Huth. “Der Pfeilschwanz (*Limulus Polyphemus*) in der Nordsee”. *Monatliche Mittheilungen des Naturwissenschaftlichen Vereins des Regierungsbezirks Frankfurt* 4, no. 19 (1886/87): 20.↩
12. See, e.g., Olaf Geiter, Susanne Homma, and Ragnar Kinzelbach. *Bestandsaufnahme und Bewertung von Neozoen in Deutschland: Untersuchung der Wirkung von Biologie und Genetik ausgewählter Neozoen auf Ökosysteme und Vergleich mit den potenziellen Effekten gentechnisch veränderter Organismen*. Berlin/Rostock: German Environment Agency, 2001.↩
13. An animal that a fisherman caught live near the East Frisian island of Spiekeroog in July 1972 was even kept for four years in the Wilhelmshaven Aquarium until it died in October 1972. Wolff, 1977. See, moreover, Stephan Gollasch. “A Horseshoe Crab *Limulus polyphemus* Found on Sylt Germany in 1970: Een degenkrab Limulus polyphemus gevonden op Sylt Duitsland in 1970”. *Zeepaard* 67 (2007): 79-81; Stephan Gollasch. “An Additional Record of the Horseshoe Crab *Limulus polyphemus* in the North Sea: Aliens”. *Journal of the Invasive Species Specialist Group of the IUCN Species Survival Commission* 22 (2005): 11.↩
14. Cf. Stephan Gollasch and Stefan Nehring. “National Checklist for Aquatic Alien Species in Germany”. *Aquatic Invasions* 1, no. 4 (2006): 245-269; Stefan Nehring and Heiko Leuchs. “Neozoa (Makrozoobenthos) an der deutschen Nordseeküste: Eine Übersicht”. *Bericht Bundesanstalt für Gewässerkunde Koblenz*. BfG-1200 1999: 1-131.↩
15. Cf. Gollasch and Stefan, 2006; Landesamt für Landwirtschaft, Umwelt und ländliche Räume des Landes Schleswig-Holstein (LLUR) (ed.). *Neobiota in deutschen Küstengewässern: Eingeschleppte und kryptogene Tier- und Pflanzenarten an der deutschen Nord- und Ostseeküste*. Flintbeck: Alfred-Wegener-Institut, Helmholtz Zentrum für Polar- und Meeresforschung, 2014: 108.↩
16. Nancy L. Jackson, David R. Smith, and Karl F. Nordstrom. “Physical and Chemical Changes in the Foreshore of an Estuarine Beach: Implications for Viability and Development of Horseshoe Crab (Limulus polyphemus) Eggs”. *Marine Ecology Progress Series* 355 (2008): 209-218. https://doi.org/10.3354/meps07211.↩
17. Robert E. Loveland and Mark Botton. “Sea Level Rise in Delaware Bay, USA: Adaptations of Spawning Horseshoe Crabs (Limulus polyphemus) to the Glacial Past, and the Rapidly Changing Shoreline of the Bay”. In *Changing Global Perspectives on Horseshoe Crab Biology, Conservation and Management*. Ruth H. Carmichael et al. (eds.). New York: Springer, 2015: 41-64.↩