NOBANIS - Marine invasive species in Nordic waters - Fact Sheet

Ensis americanus

Author of this species fact sheet: Kathe R. Jensen, Zoological Museum, Natural History Museum of Denmark, Universiteteparken 15, 2100 København Ø, Denmark. Phone: +45 353-21083, E-mail: krjensen@snm.ku.dk

Bibliographical reference – how to cite this fact sheet:
Jensen, Kathe R. (2010): NOBANIS – Invasive Alien Species Fact Sheet – *Ensis americanus* – From: Identification key to marine invasive species in Nordic waters – NOBANIS www.nobanis.org, Date of access x/x/201x.

Species description

Species name
Ensis americanus, Gould in Binney & Gould, 1870

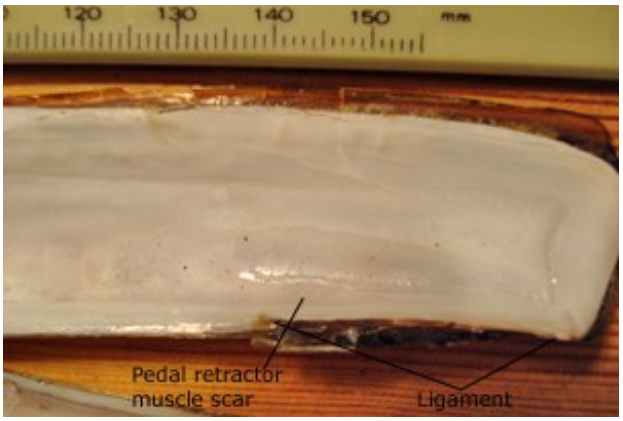
Synonyms
Solen ensis var. *Americanus* Gould in Binney & Gould, 1870; *Ensis directus* auctt., non *Solen directus* Conrad, 1843

Common names
American razor clam (UK); Atlantic Jackknife clam (USA); Amerikansk knivmusling (DK); Amerikansk knivmussla (SE); Amerikansk knivskjell (NO); Amerikanische Schwertmuschel (GE); Amerikaanse zwaardschede (NL); Couteau américain (FR).

Family
Pharidae H. & A. Adams, 1858 (see WORMS (World Register of Marine Species)). Only the genus *Solen* belongs in the family Solenidae Lamarck, 1809.

Identification
The American razor clam is characterized by an elongate (razor-shaped), brownish shell. The two valves are attached by a hinge in the anterior end. The hinge is composed of a few very small "teeth" and an elastic ligament. The shell is slightly curved or almost straight. In Nordic waters it rarely exceeds 20 cm in length.

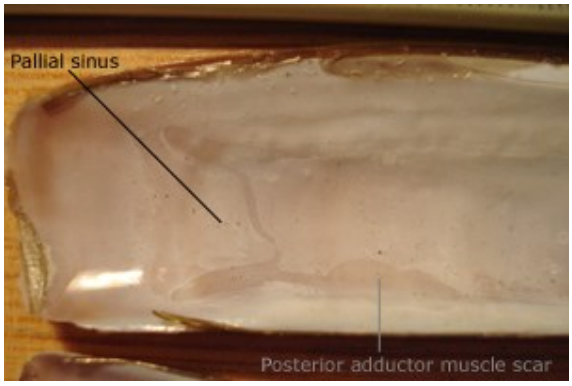
Ensis americanus - external shell



Ensis americanus - interior

Internally the shell is marked by adductor muscle scars anteriorly and posteriorly, and at the posterior end the pallial sinus is outlined; this indicated where the siphons can be withdrawn.

The American razor clam can be distinguished from other razor clams found in Nordic waters by the size, shape and location of the various scars and marks on the inside of the shell. In young, thin-shelled specimens marks may be indistinct and therefore difficult to see, and furthermore, irregularities caused by physical damage or other external impacts may occur.

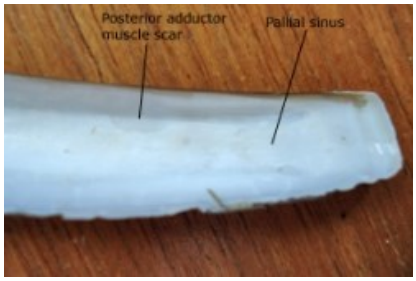


Ensis americanus - interior

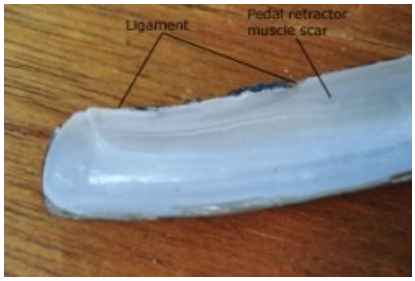
In *Ensis americanus* the pallial sinus has straight, narrow edges and the bottom is oblique; the shell is curved and wider than that of *E. ensis*.

Ensis ensis (Linnaeus, 1758), has a narrow, strongly curved shell; the posterior adductor muscle scar is located far from the pallial sinus. Further information here (pdf) (in Swedish)

Ensis ensis - external shell



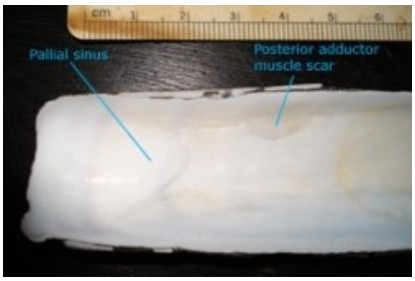
Ensis ensis – interior



Ensis ensis - interior

Ensis siliqua (Linnaeus, 1758), has a long, straight and relatively wide shell; it is the largest species in Nordic waters, often growing to more than 20 cm in length; the posterior adductor muscle scar is located close to the pallial sinus, which is slightly conical. Further information at The Conchological Society of Great Britain & Ireland.

Ensis siliqua - external shell

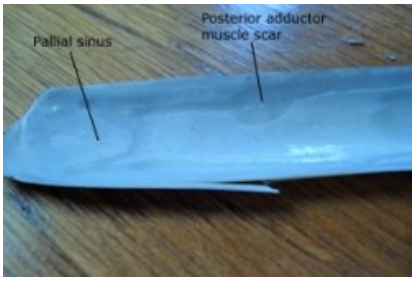


Ensis siliqua - interior

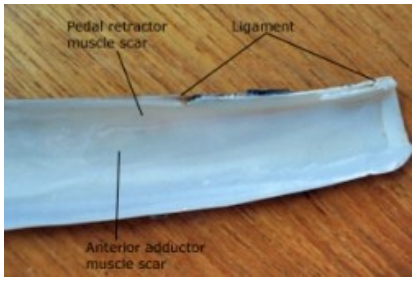
Ensis siliqua - interior

Ensis arcuatus (Jeffreys, 1865) has a slightly curved shell with straight, truncated ends; the distance between the bottom of the pallial sinus and the posterior adductor muscle scar is larger than the length of the scar. Further information see Tjärnö marinbiologiska laboratorium (in Swedish).

Ensis arcuatus - external shell



Ensis arcuatus - interior



Ensis arcuatus - interior

Ensis minor (Chenu, 1843) (Not = *E. minor* Dall) is a southern species occurring in the Mediterranean and the Atlantic coasts of Europe till the southern and western North Sea; it is likely that it will spread to the remaining North Sea with increasing temperatures. It is sometimes considered a variety of *E. siliqua* (see The Conchological Society of Great Britain & Ireland)

Phaxas pellucidus (Pennant, 1777) (=*Cultellus pellucidus*) has very thin and almost transparent shells, and muscle scars as well as pallial sinus are difficult to distinguish. Hence it can be difficult to distinguish young specimens of other razor clam species from this species. Hinge teeth are different.

Taxonomic problems

The American razor clam is known as *Ensis directus* (Conrad, 1843) in its native area, and this is also what is was called when it was first introduced to Europe (von Cosel *et al*., 1982). However, further studies showed that this name was based on a fossil and presumably extinct species (van Urk, 1972, 1987). Hence the name *Ensis americanus*, being second-oldest, has been applied by some scientists. However, not all taxonomists agree that the fossil species is different from the extant one, and both names are in current use. For example NOBANIS and DAISIE use *Ensis americanus*, Främmande Arter uses *E. directus*, as do most of the large international databases, *e.g.* WORMS, MARBEF Data System and ITIS, and the national checklists from different countries, *e.g.* Eno *et al*., 1997, Hopkins, 2001, Gollasch & Nehring (2006), Kerckhof *et al*. (2007), also use different names. To professional taxonomists this is just a minor nuisance; as long as the author name and year are included these scientists will know which species it is. For others it is very

confusing, and for database managers it is almost impossible to handle. The global databases seem to have agreed on using *E. directus*, but they do not give the reason(s) for this.

Distribution

Native distribution
The American razor clam occurs along the east coast of North America from Labrador to South Carolina.

History of introduction to Europe
Ensis americanus was first discovered at the German Wadden Sea coast in 1979 (Cosel *et al*., 1982), and in 1981 the first specimens were found in the Danish section of the Wadden Sea (Knudsen, 1989). The first record from Sweden was in 1982 (Främmande Arter, 2006). In the following years it dispersed northwards to Skagerrak, Kattegat and the Limfjord (Rasmussen, 1996; Knudsen, 1997), and southwards to the Netherlands, Belgium and northern France (Essink, 1985; Luczak *et al*., 1993). Later on it dispersed to the UK and to Norway, where it was first recorded in 1989 (Palmer, 2004; Brattegard & Holthe, 1997).

Ecology

Razor clams are famous for being able to burrow very fast and very deep into the sediment, making them difficult to capture live (Drew, 1907). The burrowing mechanism has been described in detail (Trueman, 1967). Their short siphons indicate that their usual position in the sediment is close to the surface. Often they are found with the posterior end protruding from the sediment, especially when they are exposed at low tide (Swennen *et al*., 1985). *Ensis americanus* lives in sandy or muddy sand substrate in fairly shallow water (intertidal to 12 m depth). It is a suspension feeder. In the Wadden Sea it grows to about 6 cm in one year; after 2 years they are about 12 cm long. After this growth slows down, and after 4 years they are about 14 cm long (Beukema & Dekker, 1995). Maximum biomass has been recorded in the German Wadden Sea, 1.4 kg AFDW (ash free dry weight) m^{-2}(Armonies & Reise, 1999). Compared to other species of *Ensis, E. americanus* can tolerate lower salinity and it is not as selective concerning sediment. *E. arcuatus* prefers coarse sand; *E. ensis* is found in the Venus-community, *i.e.* sand without wave action; *E. siliqua* prefers sandy bottom with heavy wave action and is most common in the Skagerrak. *E. americanus* is also rather tolerant of hypoxia (Schiedek & Zebe, 1987).

Reproduction
Ensis americanus have separate sexes and are broadcast spawners, *i.e.* eggs and sperm are released into the water and fertilization is external. Larval development takes about 2-3 weeks at 18° C (Kenchington *et al*., 1998). In the Wadden Sea spawning takes place in March – April. Settling density in the Wadden Sea has been reported as about 150 individuals m^{-2} (Beukema & Dekker, 1995), 440 individuals m^{-2} ((Mühlenhardt-Siegel *et al*., 1983) and more than 3000 individuals m^{-2} (Dauwe *et al*., 1998). Recruitment may be very low or absent following cold winters (Armonies *et al*., 2001).

Predators
In the Wadden Sea the American razor clam is eaten by oyster-catchers (Swennen *et al*., 1985). In places without tides, or where the razor clam lives at greater depths, especially diving ducks are capable of catching and eating these clams. In particular common scoters feed exclusively on American razor clams near the off-shore windmill farm at Horns Rev in the Danish part of the North Sea (Skov *et al*., 2008), but also eiders will feed on razor clams (Leopold *et al*., 2001). Moonsnails that usually drill circular holes in the shells of their prey may capture and ingest a razor clam by drilling in the muscular foot. This means that there will not be the tell-tale hole in the shell (Schneider, 1982). The razor clam usually escapes moonsnail predation by digging out of the sediment and somersaulting across the surface. Being out of the sediment, however, it is an easy prey for birds. In its native area *E. americanus* is also eaten by a species of nemertines and by seastars (McDermott, 1976).

Parasites
Although no parasites were introduced with *E. americanus*, they are now hosts for several native parasites, which may affect the natural life cycles of these parasites, but also relieve parasite pressure of native hosts (Krakau *et al*., 2006).

Impacts

Ecological and biological
Although the American razor clam is one of the most abundant bivalve species in many places, no direct impacts on native species or communities have been attributable to this species. This may be due to lack of quantitative data from before the introduction of the American razor clam. It could also be because it primarily competes with large species as *Mya arenaria*, which lives for many years and does not need to reproduce every year. *E. americanus* does not form permanent burrows, and will retract deeply into the sediment on disturbance. This, combined with its abundance, will be important for bioturbation.

Economic impacts
Several attempts have been made to exploit the American razor clam commercially (Palmer, 2004). Also, the possibility of culturing the species in aquaculture has been investigated (Freudenthal & Nielsen, 2005). Neither possibility has been deemed profitable so far. However, the dredging for razor clams (and other clams) has significant adverse effects on the ecosystem (Hall *et al*., 1990; Gaspar *et al*., 1994, 1998; Robinson & Richardson, 1998; Tuck *et al*., 2000; Chicharo *et al*., 2002; Fahy & Carroll, 2007; Hauton *et al*., 2007).

Other impacts
The sharp edges of the shells washed up on the beach and in shallow water may cause injuries to people walking bare-foot on the beach.

References

Amara, R., Laffargue, P., Dewarumez, J.M., Maryniak, C., Lagardère, F. and Luczac, C. 2001. Feeding ecology and growth of O-group flatfish (sole, dab and plaice) on a nursery ground (Southern Bight of the North Sea). Journal of Fish Biology 58: 788-803.

Armonies, W. 1996. Changes in distribution patterns of 0-group bivalves in the Wadden Sea: Byssus-drifting releases juveniles from the constraints of hydrography. Journal of Sea Research 35(4): 323-334.

Armonies, W. 2001. What an introduced species can tell us about the spatial extension of benthic populations. Marine Ecology Progress Series 209: 289-294.

Armonies, W. and Reise, K. 1999. On the population development of the introduced razor clam *Ensis americanus* near the island of Sylt (North Sea). Helgoländer Meeresuntersuchungen 52: 291-300.

Armonies, W., Herre, E. and Sturm, M. 2001. Effects of the severe winter 1995/96 on the benthic macrofauna of the Wadden Sea and the coastal North Sea near the island of Sylt. Helgoland Marine Research 55: 170-175.

Beukema, J.J. and Dekker, R. 1995. Dynamics and growth of a recent invader into European coastal waters: The American razor clam, *Ensis directus*. Journal of the Marine Biological Association of the United Kingdom 75: 351-362.

Cadée, G.C. 2007. Balanuliths: Free-living clusters of the barnacle *Balanus crenatus*. Palaios 22: 680-681.

Chícharo, L., Regala, J., Gaspar, M., Alves, F. and Chícharo, A. 2002. Macrofauna spatial differences within clam dredge-tracks and their implications for short-term fishing effect studies. Fisheries Research 54: 349-353.

Compaan, D.M. and Ellington, W.R. 2003. Functional consequences of a gene duplication and fusion event in an arginine kinase. Journal of Experimental Biology 206: 1545-1556.

Cosel, R. von 1990. An introduction to the razor shells (Bivalvia: Solenacea). In: The Bivalvia – Proceedings of a Memorial Symposium in Honour of Sir Charles Maurice Yonge, Edinburgh 1986 (ed. B. Morton), pp. 283-311. Hong Kong University Press, Hong Kong.

Cosel, R. von 1993. The razor shells of the eastern Atlantic. Part 1: Solenidae and Pharidae I. Archiv für Molluskenkunde 122: 207-321.

Cosel, R.von, Dörjes, J. and Mühlenhardt-Siegel, U. 1982. Die amerikanische Schwertmuschel *Ensis directus* (Conrad) in der Deutschen Bucht. I. Zoogeographie und Taxonomie im Vergleich mit den einheimischen Schwertmuschel-Arten. Senckenbergiana Maritima 14(3/4): 147-173.

Darriba, S., Fuencisla, S.J. and Guerra, A. 2004. Reproductive cycle of the razor clam *Ensis arcuatus* (Jeffreys, 1865) in northwest Spain and its relation to environmental conditions. Journal of Experimental Marine Biology and Ecology 311: 101-115.

Darriba, S., Fuencisla, S.J. and Guerra, A. 2005. Gametogenic cycle of *Ensis siliqua* (Linnaeus, 1758) in the Ría de Corcubión, northwestern Spain. Journal of Molluscan Studies 71: 47-51.

Dauwe, B., Herman, P.M.J. and Heip, C.H.R. 1998. Community structure and bioturbation potential of macrofauna at four North Sea stations with contrasting food supply. Marine Ecology Progress Series 173: 67-83.

Dörjes, J. 1992. Die amerikanische Schwertmuschel *Ensis directus* (Conrad) in der Deutschen Bucht. III. Langzeitentwicklung nach 10 Jahren. Senckenbergiana Maritima 22(1/2): 29-35.

Drew, G.A. 1907. The habits and movements of the razor-shell clam, *Ensis directus*, Con. Biological Bulletin 12(3): 127-140, plate II.

Eno, N.C., Clark, R.A. and Sanderson, W.G. 1997. Non-native marine species in British waters: a review and directory. Joint Nature Conservation Committee, Peterborough, UK, 136pp.

Essink, K. 1985. On the occurrence of the American jack-knife clam *Ensis directus* (Conrad, 1843) (Bivalvia, Cultellidae) in the Dutch Wadden Sea. Basteria 49: 73-80.

Essink, K. 1986. Note on the distribution of the American jack-knife clam *Ensis directus* (Conrad, 1843) in N.W. Europe (Bivalvia, Cultellidae).

Fahy, E. and Carroll, J. 2007. Consequences of hydraulic dredging for a razor clam *Ensis siliqua* (L.) bed in the North-West Irish Sea. Biology and Environment: Proceedings of the Royak Irish Academy 107B(3): 115-128.

Fernández-Tajes, J., Martinez-Lage, A., Freire, R., Guerra, A., Méndez, J. and González-Tizon, A.M. 2008. Genome sizes and karyotypes in the razor clams *Ensis arcuatus* (Jeffreys, 1865) and *E. siliqua* (Linnaeus, 1758). Cahiers Biologie Marine 49: 79-85.

Freudendahl, A.S. and Nielsen, M.M. 2004. Amerikansk knivmusling. Geirfuglen 2004 nr. 1: 23-25.

Freudendahl, A.S. and Nielsen, M.M. 2005. Dyrkning af amerikansk knivmusling. Screening af potentialet for kommerciel kultivering. Aarhus Universitet og Dansk Skaldyr Center, 104pp.

Gaspar, M.B. and Monteiro, C.C. 1998. Reproductive cycles of the razor clam *Ensis siliqua* and the clam *Venus striatula* off Vilamoura, southern Portugal. Journal of the Marine Biological Association of the U.K. 78: 1247-1258.

Gaspar, M., Castro, M. and Monteiro, C.C. 1998. Influence of tow duration and tooth length on the number of damaged razor clams *Ensis siliqua*. Marine Ecology Progress Series 169: 303-305.

Gaspar, M.B., Richardson, C.A. and Monteiro, C.C. 1994. The effects of dredging on shell formation in the razor clam *Ensis siliqua* from Barrinha, southern Portugal. Journal of the Marine Biological Association of the U.K. 74: 927-938.

Gollasch, S. and Nehring, S. 2006. National checklist for aquatic alien species in Germany. Aquatic Invasions 1(4): 245-269.

Graham, A. 1931. On the morphology, feeding mechanisms, and digestion of *Ensis siliqua* (Schumacher). Transactions of the Royal Society, Edinburgh 56(3): 725-751 + plate (unnumbered).

Hall, S.J., Basford, D.J. and Robertson, M.R. 1990. The impact of hydraulic dredging for razor clams *Ensis* sp. on an infaunal community. Netherlands Journal of Sea Research 27(1): 119-125.

Hansson, H.G. 2003. Artfaktablad *Ensis ensis* (Linnaeus, 1758) (Rakknivmussla). ArtDatabanken, SE. Available here (pdf)

Hansson, H.G. 2003. Artfaktablad *Ensis arcuatus* (Jeffreys, 1865). ArtDatabanken, SE Available here (pdf)

Hauton, C., Howell, T.R.W., Atkinson, R.J.A. and Moore, P.G. 2007. Measures of hydraulic dredge efficiency and razor clam production, two aspects governing sustainability within the Scottish commercial fishery. Journal of the Marine Biological Association of the United Kingdom 87: 869-877.

Henderson, S.M. and Richardson, C.A. 1994. A comparison of the age, growth rate and burrowing behaviour of the razor clams, *Ensis siliqua* and *E. ensis*. Journal of the Marine Biological Association of the United Kingdom 74: 939-954.

Holme, N.A. 1951. The identification of British species of the genus *Ensis* Schumacher (Lamellibranchiata). Journal of the Marine Biological Association of the United Kingdom 29: 639-647.

Holme, N.A. 1954. The ecology of British species of *Ensis*. Journal of the Marine Biological Association of the United Kingdom 33: 145-172.

Hopkins, C.C.E. 2001. Actual and potential effects of introduced marine organisms in Norwegian waters, including Svalbard. Directorate for Nature Management, Norway, 54pp.

Kenchington, E., Duggan, R. and Riddell, T. 1998. Early life history characteristics of the razor clam (*Ensis directus*) and the moonsnails (*Euspira* spp.) with applications to fisheries and aquaculture. Canada Technical Report on Fisheries and Aquaculture Science 2223: vii + 32pp.

Kerckhof, F., Haelters, J. and Golasch, S. 2007. Alien species in the marine and brackisch ecosystem: the situation in Belgian waters. Aquatic Invasions 2(3): 243-257.

Knudsen, J. 1989. Den amerikanske knivmusling, *Ensis americanus* Gould, 1870, en nyindvandret art i de danske farvande. Flora og Fauna 95(1): 17-18.

Knudsen, J. 1997. Ny dansk knivmusling fra Amerika. Dyr i Natur og Museum 1997, Nr. 1: 28-31.

Krakau, M., Thieltges, D.W. and Reise, K. 2006. Native parasites adopt introduced bivalves of the North Sea. Biological Invasions 8: 919-925.

Leopold, M.F., Kats, R.K.H. and Ens, B.J. 2001. Diet (preferences) of common eiders *Somateria mollissima*. Wadden Sea Newslwtter 2001-1: 25-31.

Luczak, C., Dewarumez, J.-M. and Essink, K. 1993. First record of the American jack knife clam *Ensis directus* on the French coast of the North Sea. Journal of the Marine Biological Association of the United Kingdom 73: 233-235.

McDermott, J.J. 1976. Predation of the razor clam *Ensis directus* by the nemertean worm *Cerebratulus lacteus*. Chesapeake Science 17(4): 299-301.

Mühlenhardt-Siegel, U., Dörjes, J. and von Cosel, R. 1983. Die amerikanische Schwertmuschel *Ensis directus* (Conrad) in der Deutschen Bucht. II. Populationsdynamik. Senckenbergiana Maritima 15(4/6): 93-110.

Ovcharenko, I., Olenin, S. and Gollasch, S. 2007. *Ensis americanus*. DAISIE factsheet. Available here (pdf) (Accessed 8 October 2008).

Palmer, D. 2003. The introduced razor fish *Ensis directus* in the Wash and North Norfolk. Shellfish News 16: 13-15.

Palmer, D.W. 2004. Growth of the razor clam *Ensis directus*, an alien species in the Wash on the east coast of England. Journal of the Marine Biological Association of the United Kingdom 84: 1075-1076.

Rasmussen, E. 1996. Nyt om den amerikanske knivmusling, *Ensis americanus* Gould 1870 (=*E. directus* Conrad) i danske farvande. Flora og Fauna 101(2): 53-60.

Robinson, R.F. and Richardson, C.A. 1998. The direct and indirect effects of suction dredging on a razor clam (*Ensis arcuatus*) population. ICES Journal of Marine Science 55: 970-977.

Schiedek, D. and Zebe, E. 1987. Functional and environmental anaerobiosis in the razor-clam *Ensis directus* (Mollusca: Bivalvia). Marine Biology 94: 31-37.

Schneider, D. 1982. Escape response of an infaunal clam *Ensis directus* Conrad 1843, to a predatory snail, *Polinices duplicatus* Say 1822. Veliger 24(4): 371-372.

Shanks, A.L. and Brink, L. 2005. Upwelling, downwelling, and cross-shelf transport of bivalve larvae: test of a hypothesis. Marine Ecology Progress Series 302: 1-12.

Skov, H., Durinck, J., Erichsen, A., Kloster, R.M., Møhlenberg, F. and Leonhard, S.B. 2008. Horns Rev II offshore wind farm food basis for common scoter. Baseline Studies 2007-08. DONG Energy, DHI Water – Environment – Health, Orbicon, Marine Observers, 47pp. Available here (pdf) (accessed 28 July 2009).

Strasser, M. and Günther, C.-P. 2001. Larval supply of predator and prey: temporal mismatch between crabs and bivalves after a severe winter in the Wadden Sea. Journal of Sea Research 46: 57-67.

Swennen, C., Leopold, M.F. and Stock, M. 1985. Notes on growth and behaviour of the American razor clam *Ensis directus* in the Wadden Sea and the predation on it by birds. Helgoländer Meeresuntersuchungen 39: 255-261.

Trueman, E.R. 1967. The dynamics of burrowing in *Ensis* (Bivalvia). Proceedings of the Royal Society B 166: 459-476.

Tuck, I.D., Bailey, N., Harding, M., Sangster, G., Howell, T., Graham, N. and Breen, M. 2000. The impact of water jet dredging for razor clams, *Ensis* spp., in a shallow sandy subtidal environment. Journal of Sea Research 43: 65-81.

Urk, R.M. van 1964. The genus *Ensis* in Europe. Basteria 28(1-2): 13-44.

Urk, R.M. van 1972. Notes on American fossil *Ensis* species. Basteria 36(2-5): 131-142.

Urk, R.M. van 1980. Probleme in der Systematik am Beispiel der Gattung *Ensis* (Mollusca, Bivalvia). Soosiana 8: 91-95.

Urk, R.M. 1987. *Ensis americanus* (Binney) (Syn. *E. directus* auct. non Conrad) a recent introduction from Atlantic North-America. Journal of Conchology 32: 329-333.

Voigt, M. 1999. *Ensis directus* (Conrad, 1843). In : Exotics across the ocean. Case histories on introduced species (eds. S. Gollasch, D. Minchin, H. Rosenthal and M. Voigt), pp. 31-35. Logos Verlag, Berlin.