NOBANIS - Invasive Alien Species Fact Sheet

Craspedacusta sowerbii

Authors of this fact sheet: Viktoras Didžiulis[1] and Żurek Roman[2]
[1]Coastal Research and Planning Institute, Klaipeda University, Lithuania, H. Manto - 84, LT-91210, Klaipėda, phone: +370 46 380905, viktoras@ekoinf.net, http://ekoinf.net
[2]Institute of Nature Conservation. Polish Academy of Sciences, Al. A, Mickiewicza 33, 310129 Krakow, Poland, E-mail: zurek@iop.krakow.pl

Bibliographical reference – how to cite this fact sheet:
Didžiulis, V. and Żurek, R. (2013): NOBANIS – Invasive Alien Species Fact Sheet – ***Craspedacusta sowerbii***. – From: Online Database of the European Network on Invasive Alien Species – NOBANIS www.nobanis.org, Date of access x/x/201x.

Species description

Scientific name: *Craspedacusta sowerbii* Lankester, 1880, Olindiidae.

Synonyms: *Microhydra ryderi* (Potts, 1885), *Microhydra germanica (*Roch 1924), *Limnocodium victoria (*Allman 1880), *Limnocodium sowerbii* (Lankester 1983), *Limnocodium kawaii* (Oka1907) *Limnocodium sowerbii var. kawaii* (Oka, 1907), *Craspedacusta ryderi* (Payne 1924), *Craspedacusta germanica* (acc. Dejdar, 1934), *C. kuoi* (Shieh & Wang, 1959), *C. xinyangensis* (He 1980, acc. to Li Q. Hang et al.. 2009), *Craspedacusta kiatingi* Gaw & Kung, 1939 (acc. Fritz et al. 2009)
C. vovasi Naumov & Stepanjants, 1971 was moved to other genera by Naumov & Stepanjants 1971; Xu and Wang (2009) consider *C. xinyangensis* as sub-species, *C. sowerbii xinyangensis.*
Craspedacusta marginata (Modeer 1762) later identifyied as M*aeotias marginata* (Modeer, 1791), history of this mistake is described by Mills and Rees 2000.

Common names: fresh water jellyfish (GB), Süßwassermeduse (AT), medúzka sladkovodní (CZ), Süßwasserqualle (DE), Lammikokmeduusa (FI), gėlavandenė medūza (LT), słodkowodna meduzka and paralelly Naumov & Stepanjants, 1971 kraspedakusta or hederyka Rydera (PL), Sötvattensmanet (SE), Zoetwaterkwal (NL)

Fig 1. Medusa of *C. sowerbii*, photo by Dawid Sawicki, Poland.

Species identification
Although 18 species within *Craspedacusta* have been described, only three species are recently considered to be valid (Jankowski 2001).
The valid species acc. to Jankowski (2001) are: *sowerbii, sinensis* and *iseanum,* but according to Fritz et al. (2009) the valid species are *sowerbii, sinensis* and *kiatingi* with the possibility of *C. ziguiensis* as a fourth species and several quite different sub-species or variations of *C. sowerbii.* In the Yangtze River system, there exist three genetically separate groups of *Craspedacusta,* Fritz et al. (2009) as listed above.

Individuals of this hydromedusa species usually appear in warm shallow pools as swarms of small jellyfish 5 to 25 mm in diameter. The hydromedusa is translucent with a whitish or greenish tinge (Peard 2005, Pennak 1989). It possesses four radial and one circular canal that form the gastrovascular cavity. The diameter of the circular canal is 5 to 22 mm. The tentacles are solid and vary in length. They are arranged in sets of three to seven short tentacles in between longer ones (Pennak 1989, Slobodkin and Bossert 1991). Shorter tentacles, with nematocysts, aid in capturing food and serve as a type of protection against predation, while the longer ones provide some stability when swimming. At the base of their tentacles, jellyfish have eyespots. Freshwater jellyfish has 4 very long tentacles, each parallel to a radial canal at the edge of the velum. The total number of tentacles varies from 50 to 500 (Pennak 1989) or from 218 (Pérez-Bote et al., 2006) to 497 (Boothroyd et al., 2002). In addition to the hydromedusa, *Craspedacusta sowerbii* appears in other microscopic forms such as podocyst, frustule, planula, and polyp (Acker and Muscat 1976). Two to four individual polyps can assemble in a colony 5 to 8 mm long (Pennak 1989), see fig. 3.

Native range
All *Craspedacusta* species inhabit freshwater bodies of Eastern Asia. However, one species *Craspedacusta sowerbii* Lankester, 1880, has expanded its range and currently has a worldwide distribution. This species has been detected in all continents except Antarctica (Dumont 1994). *C. sowerbii* is probably indigenous to the Yangtze River valley in China. Lately, *C, sowerbii* is considered as ponto-caspian species, Jankowski et al. (2008). The hydromedusae appear frequently in shallow pools along the river and in isolated impoundment like gravel-pits, sand-pits or quarries. Sometimes they are found in slowly running rivers also. In the upper river stretch of Yangtze River, a second *Craspedacusta* species named *C. sinensis* coexists with *C. sowerbii* (Slobodkin and Bossert, 1991).

Alien distribution

History of introduction and geographical spread
The first records of introductions were from water-lily tanks at Regents Park, London in 1880. Accounts of the Regents Park *Craspedacusta sowerbii* population were published simultaneously by Lankester (Lankester 1880) and by Allman (1880) who named the specimens *Craspedacusta sowerbii* and *Limnocodium victoria,* respectively. Also in 1880, a polyp was discovered in the same tanks and was correctly assumed to be a form of *C. sowerbii* (Payne 1924). Payne (1924) associated polyps of *Microhydra ryderi* as developmental stage of *Craspedacusta.* Later, Payne **(**1926**)** described some early cleavage stages; ciliated blastula, endoderm formation, elongation and the formation of the gastrovascular cavity – this stadium can be consider as young planula. These early stages were later also studied by Xu and Wang 2009. Similar polyps were found in Philadelphia **(**in 1885 i.e. twelve years before the medusae were detected in August, 1897) and were described as a separate species,

Microhydra ryderi. Also Boulenger and Flower (1928) clarified that *M. ryderi* was the polyp form of *C. sowerbii.*

The first observation in mainland Europe was in 1901 in France (Sowerby 1941). In 1905 the fresh water jellyfish appeared in Germany at Munich (Dejdar 1394, Geiter *et al.* 2002). The first record in Sweden is from 1969 (Jernelöv et al. 1970, Lundberg & Svensson 2003). It was first observed in Lithuania in August 2002 (Arbaciauskas and Lesutiene 2005) in an old gravel pit near the River Nemunas. The northernmost documented occurrence of *C. sowerbii* is from Finland (Väinölä 2002, Lundberg & Svensson 2003). The freshwater medusa is frequently observed in Western Europe and has been found also in Poland both in nature and aquaria – 26 sites (Wiktor & Witkowski 1999, Żurek 2010), Russia (Kanaev 1949, Dumont 1994, Nikolaeva 2006), Austria (Essl & Rabitsch 2002), and all remaining European countries excluding Albany, Greece, and some small countries of former Yugoslavia.

Pathways of introduction

There are four hypotheses of invasion paths:
Hypothesis 1: The natural distribution area of *Craspedacusta* is Eurasie and from there it was brought to England and later onwards to continental Europe.
Hypothesis 2: The natural distribution area of *Craspedacusta* is China, especially Yangtze River system.The freshwater jellyfish was most likely transported with ornamental aquatic plants from its native region in China (Slobodkin and Bossert 1991). Usually dispersal of polyps coincides with translocation of stocked fish and aquatic plants or movement of waterfowl (Angradi 1998).
Hypothesis 3: Dispersion of the species was natural and has happened since the existence of Gondwana (Zienkiewicz 1940).
Hypothesis 4: *Craspedacusta* is a ponto-caspian species, Jankowski 2001.

Not confirmed but possible is propagation by birds. Resting bodies termed podocysts and polyps may accidentally traverse to new habitats on bird's feet or amidst released fish. Under favourable conditions polyps are formed from podocysts (Peard 2005).

Alien status in region

It is very likely that due to the sporadic nature and specific conditions required for the occurrence of *C. sowerbii* medusa, this species already existed in many countries long before the “official” dates of first observations. As an example the species is believed to occur in Estonia in the polyp stage, but not as medusae (Arno Põllumäe, pers.comm.). The number of sites seems to depend on the number of monitored lakes and the activity of scientists. Actual sites in Europe are shown on Figure 2.

Country	Not found	Not established	Rare	Local	Common	Very common	Not known
Austria				X			
Belarus							X
Belgium			X				
Czech Republic				X			
Denmark			X				
Estonia							X
European part of Russia				X			
Finland			X				
Faroe Islands	X						
Germany					X		
Greenland	X						
Iceland	X						
Latvia	X						
Lithuania				X			
Netherlands			X				
Norway				X			
Poland			X				
Slovakia				X			
Sweden				X			

Table 1. The frequency and establishment of *Craspedacusta sowerbii*, please refer also to the information provided for this species at www.nobanis.org/search.asp. Legend for this table: **Not found** –The species is not found in the country; **Not established** - The species has not formed self-reproducing populations (but is found as a casual or incidental species); **Rare** - Few sites where it is found in the country; **Local** - Locally abundant, many individuals in some areas of the country; **Common** - Many sites in the country; **Very common** - Many sites and many individuals; **Not known** – No information was available.

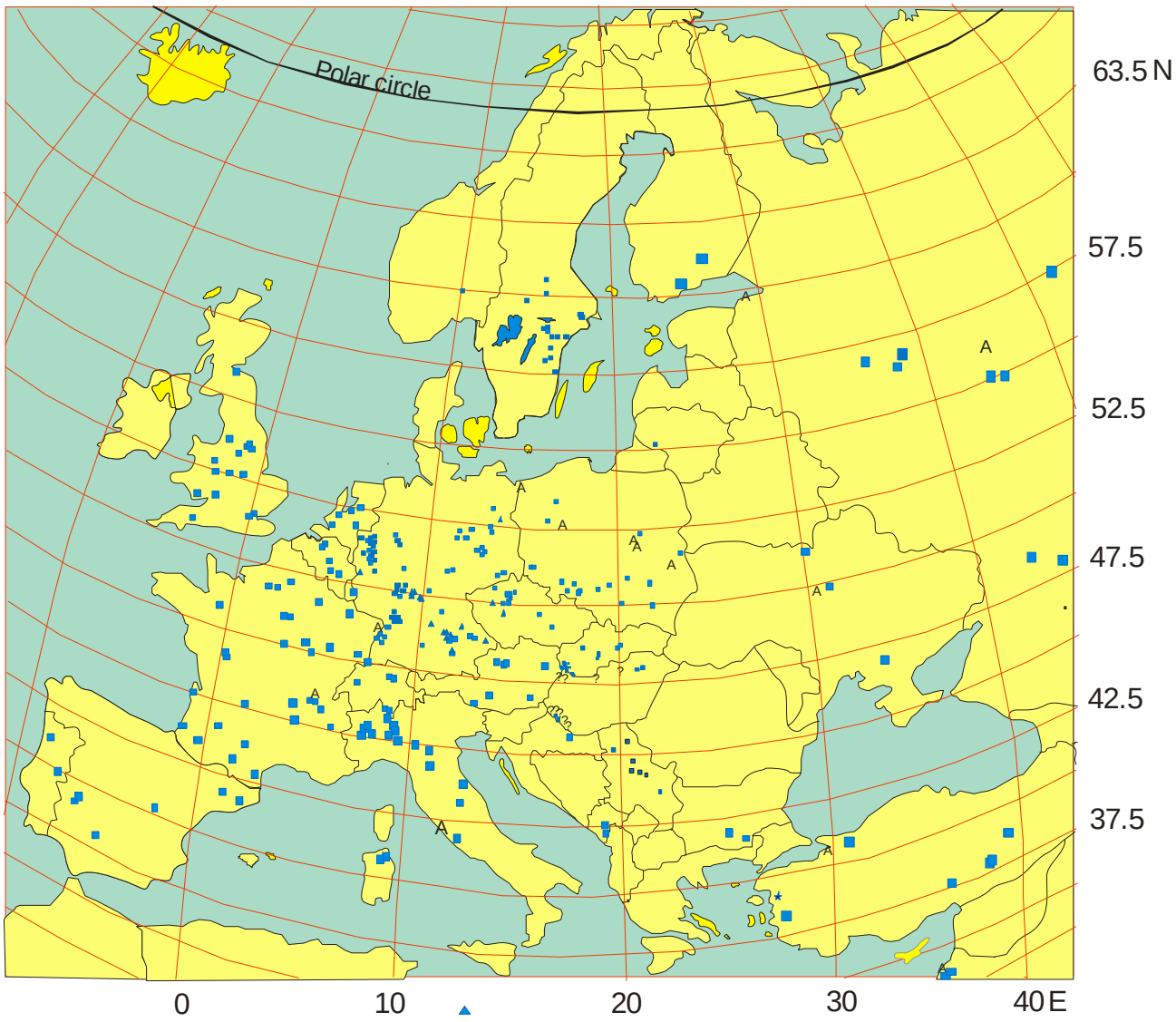

Fig. 2. Sites of *Craspedacusta sowerbii* in Europe. Data updated September 2012, Żurek 2010.

Ecology

Habitat description

Craspedacusta sowerbii is a fresh-water cnidarian and has been found in a variety of water environments: freshwater lakes, reservoirs, man-made impoundments, water-filled gravel pits, rock quarries, algae-filled ponds, and rivers. However, despite its ecological diversity, it seems to favour calm water to the rough water characteristic of most rivers (Pennak 1989, Peard 2005). It is a typical eurybiontic species. They have occurred in large river systems, natural lakes, aquaria, and ornamental ponds (Beckett and Turanchik 1980, Kanaev 1949, DeVries 1992, Tittizer et al. 2000, Peard 2005). Hydromedusae blooms are most common in summer and fall, from July to October in still or slow moving fresh water bodies, when water temperature rises to at least 25° C. The polyp form is believed

to have a much wider distribution than the hydromedusa form, because it exhibits a wider tolerance for cold temperatures (Kato and Hirabayashi 1991, Angradi 1998). Lately, Stanković & Ternjej 2010 found polyps of *Craspedacusta* and brown hydras (*Pelmatohydra oligactis*) together on live bivalve shells for the first time. They suggest that it marks the first record of commensalism of this kind. The water content in the body of *C. sowerbii* amounts to 96.7 – 99.87 %. The biomass varied from 0.06 to 331.86 mg/ individual, and the dry mass usually 0,01 to 2,50 mg (Jankowski 2000).

Reproduction and life cycle

C. sowerbii usually occur as single sexed populations, thus sexual reproduction is infrequent (Pennak 1989). Through asexual reproduction, a polyp may bud hydromedusae, frustules (non-ciliated larvae), and/or polyps. Hydromedusa and frustule buds grow and eventually separate from the polyp, while offspring polyps sometimes remain attached to the parent polyp forming a colony. Hydromedusae eventually reach sexual maturity and the cycle continues if environmental conditions are favourable (Pennak 1989, Slobodkin and Bossert 1991). Male and female hydromedusae reproduce sexually by releasing eggs and sperm to the water column. Fertilized eggs grow into small, crawling planulae (ciliated larvae). The worm-shaped planula metamorphoses into a polyp.
The life span is reported to be 34–51 days (Gang et al. 2006). Adults are resistant on hypoxia – in a study they died at O_2 concentration < 0,26 mg/dm^3 (Wang et al. 2006).

Dispersal and spread

Local occurrence of the medusae highly depends on environmental conditions such as temperature. Therefore explosions of populations may occur and be noticed at irregular intervals of time in different locations. Each subpopulation blooms and disappears in a number of weeks to months, not appearing again at that location for years. In some quarries in Poland (quarry Piast-50°39′39″N, 17°57′30″E, or Srebrne Lake, 50°45′27″N, 18°04′30″E) *Craspedacusta* is observed by frogmen every year.
Polyps are tiny and therefore knowledge about their distribution is very scarce (see Fig. 3). Protasov (1978) found double and triple polyps in the peryphyton of a channel to the run-of-river power plant on the Kanievski reservoir at temperature 28°C. Colony density usually attain 70 individuals /dm^2, and 3000 individuals/dm^2 on artificial substrate in summer and temperature 28°C. The optimal temperature for polyps is lower; they die at 30 ^{o}C, (Acker, Muscat 1976).

The distribution of the polyps of the species is likely to extend further than the recorded sightings of medusae, especially into colder climates because *Craspedacusta sowerbii* do not advance from polyp to the more readily identifiable hydromedusa stage in absence of warm temperatures (Pennak 1989, Kato and Hirabayashi 1991, Angradi 1998).

Fig. 3. Colony of *C. sowerbii* polyps, photo by Borys Wasiuk, Poland.

Impact

Affected habitats and indigenous organisms
The role of freshwater jellyfish in food webs as well as their impact on local aquatic communities still remains insufficiently studied. All cnidarians are opportunistic predators and fish egg and larvae might constitute a substantial part of their diet. However, zooplankton or benthic invertebrates could also be significant as a food source (Dodson and Cooper 1983, DeVries1992, Dumont 1994, Jankowski and Ratte 2001). Dumont (1994) speculated that *C. sowerbii* consumes fish eggs, even though it is generally not considered an important predator of eggs or small fish (Spadinger and Maier, 1999). Polyps are able to consume hatched young fry of *Morone saxatilis*, alga, nematods, oligochaeta, crustacea, water mites, insects and arachnida (Bushnell and Porter 1967).
Fish probably do not consume this jellyfish, but crayfish of the genus *Orconectes* were reported to prey actively on *Craspedacusta* under laboratory conditions (Dodson and Cooper 1983). Therefore crayfish are considered the only important predator of the hydromedusa phase (Pennak 1989, Slobodkin and Bossert 1991). The impact of freshwater medusae on the plankton community depends on density. It is considered to be insignificant, but the impact may dramatically increase with high medusae densities of up to 30 ind./ m^3 (Dumont 1994). A single medusa eats 190 planktonic animals daily. The digestion time is 4 -5 hours. At a density of 1 individual medusae per m^3 , the exploitation rate was 0.2 prey dm^{-3} d^{-1} (Spadinger, Maier 1999). In the Lake Kainui (New Zealand), the daily exploitation was < 0.5 % of the pray population (Boothroyd et al. 2002) Exploitation of some species like *Ceriodaphnia* is greater with 3.4 % efficiency. Thus, the presence of this medusa constitutes a significant cause of zooplankton mortality (Smith i Alexander 2008).

Genetic effects
None.

Human health effects
The freshwater medusae are not dangerous to people, but scald is possible.

Economic and societal effects (positive/negative)
The freshwater medusae sometimes occur in fresh water aquaria so it may be considered ornamental. In China, a technology of *Craspedacusta* culture has been patented since 2007. The main cause was "satisfying the demands of fish-culturists on decorative medusae".

One could speculate that in some rare medusae-bloom cases individuals over-consume oxygen and so decreases the quality of the environment fish live in. However, no real-world economic effects like decrease of freshwater fish catches were observed so far.

Management approaches

Prevention methods
It appears that individuals of the medusae occur in mass quantities only sporadically when water temperature exceeds 25 C degrees. Since population explosions are only noticed at irregular intervals of time in different locations and cause no major harm, no control measures are necessary.

Eradication, control and monitoring efforts
In the region, none of the countries have reported coordinated monitoring programmes to document the spread and impact of the fresh water jellyfish. However, since 2005 German skin divers are called on to report findings of this (and other) alien species to a registration office which is part of a new national project named “Neobiota in diving waterbodies”. Within five months this project has lead to that *C. sowerbii* was observed at more than 40 different locations in German waters (Fritz et al. 2007). It is very likely that this inconspicuous species is common in German waters and occur throughout the area (Nehring 2005).

Information and awareness
Today the occurrence of the fresh water jellyfish in Germany and a few other countries is generally accepted by various institutions and experts and is not the subject of public attention. However, a purposeful information platform has not yet been installed. Education and awareness-raising is needed. A first interesting step is the start of a new national project named “Neobiota in diving waterbodies” in 2005. German skin divers are call on to report findings of this (and other) alien species to the project registration office (VDST and BfN 2005).

Knowledge and research
Although biology of the *Craspedacusta* is well known, due to very sporadic and unpredictable distribution data, occurrences of this species may be underestimated and therefore this requires more studies.

Recommendations or comments from experts and local communities
Registering species occurrence by simply asking people to inform local authorities in case they see the medusae somewhere might provide better understanding of how widely this species is spread. An Internet survey as applied in Germany and Poland might be recommended.

References and other resources

Contact persons
Wolfgang Rabitsch (AT), Environment Agency Austria, Spittelauer Lände 5, A-1090 Wien, Austria; Phone: +43 1 31304 3340; E-mail: wolfgang.rabitsch@umweltbundesamt.at

Adam Petrusek (CZ), Department of Ecology, Charles University in Prague, Vinicna 7, CZ-12844 Prague 2, Czech Republic, e-mail: petrusek@cesnet.cz

Stefan Nehring (DE), AeT umweltplanung, Bismarckstrasse 19, D-56068 Koblenz, Germany; Phone: +49 261 1330398; E-mail: nehring@aet-umweltplanung.de

Arno Põllumäe (EE) Estonian Marine Institute, University of Tartu, Mäealuse Str. 10a, EE-, 12618 Tallinn, Estonia, Phone: +3726718974, E-mail: arno@sea.ee

Risto Vainola (FI) Zoological Museum, POB 17, FI-00014 University of Helsinki, Finland. E-mail: risto.vainola@helsinki.fi

Gísli Már Gíslason (IS) Institute of Biology,University of Iceland, Askja-Natural Science Building, IS-101 Reykjavik, Iceland, E-mail: gmg@hi.is

Zurek Roman (PL) Institute of Nature Conservation. Polish Academy of Sciences, Al. A, Mickiewicz 33, 310129 Krakow, Poland, E-mail: zurek@iop.krakow.pl

Melanie Josefsson (SE), Swedish Environmental Protection Agency, SE106 48 Stockholm, Phone: +46 18 673148, E-mail: Melanie.Josefsson@snv.slu.se

Links

Microscopy pictures of jellyfish in many life-stages: Microscopy UK
Indiana University of Pennsylvania – Freshwater Jelly fish pages
Aquatic alien species in German inland and coastal waters (database)
Alien species in Poland: http://www.iop.krakow.pl/ias/default.aspx
Craspedacusta in US: http://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=1068

References

Acker, T. S. and A. M. Muscat 1976. The ecology of *Craspedacusta sowerbii* Lankester, a freshwater hydrozoan. The American Midland Naturalist 95:323-236.

Allman, G. J. 1880. "The Freshwater Medusa." Nature 22: 218.

Angradi, T. R. 1998 Observations of Freshwater Jellyfish, *Craspedacusta sowerbyi* Lankester (Trachylina: Petasidae), in a West Virginia Reservoir. Brimleyana: The Journal of the North Carolina State Museum of Natural Sciences 25:35-42.

Arbaciauskas K. and J. Lesutiene, 2005. The freshwater jellyfish (*Craspedacusta sowerbii*) in Lithuanian waters. Acta Zoologica Lituanica, 2005, Volumen 15, Numerus 1. ISSN 1392-1657. pp: 54-57.

Beckett, D.C. and Turanchik, E. J. 1980. Occurrence of the freshwater jellyfish *Craspedacusta sowerbyi* Lankester in the Ohio River. Ohio J. Sci. 32:323-324.

Belk, D. and Hotaling D. 1971. Guam record of the freshwater medusa Craspedacusta sowerbyi. Micronesia 7:229-230.

Boothroyd I.,. Etheredge K., Green J. 2002. Alien predator: freshwater jellyfish in New Zealand. NIWA, Water Atmos. 10.

Boothroyd I.K.G., Etheredge M.K., Green J.D. 2002. Spatial distribution, size structure, and prey of *Craspedacusta sowerbyi* Lankester in a shallow New Zealand lake. Hydrobiol. 468: 23–32.

Boulenger, C. L. and Flower, W.U. 1928. The Regents Park Medusa *Craspedacusta sowerbyi* and its identity with *C. (Microhydra)* ryderi. Proceedings of the Zoological Society of London 66:1005-1015.

Dejdar E. 1934. Die Susswassermeduse Craspedacusta sowerbyi Lankaster in monographischer Darstellung. Z. Morph. u. Okol. d. Tiere 28: 595-691.

DeVries, D. R. 1992. The freshwater jellyfish *Craspedacusta sowerbyi*: a summary of its life history, ecology and distribution. J. Freshwater Ecol. 7:7-16.

Dodson, S. I. and S. D. Cooper, 1983. Trophic relationships of the freshwater jellyfish Craspedacusta sowerbyi Lankester 1880. Limnology and Oceanography 28(2): 345-351.

Dumont, H.J. 1994. The distribution and ecology of the fresh- and brakish- water medusae of the world. Hydrobiologia 272: 1-12.
Essl, F. and Rabitsch, W. 2002. Neobiota in Österreich. Umweltbundesamt, Wien, 432 pp.
Fritz G.B., Pfannkuchen M., Reuner A., Schill R.O. Brümmer F. 2009. *Craspedacusta sowerbii*, Lankester 1880 – population dispersal analysis using COI and ITS sequences. J. Limnol. 68 (1): 46–52
Fritz G.B., Schill R.O., Pfannkuchen M., Brümmer F. 2007. The freshwater jellyfish *Craspedacusta sowerbii* Lankester, 1880 (Limnomedusa: Olindiidae) in Germany, with a brief note on its nomenclature J. Limnol. 66 (1): 54–59
Gang W., Xie S., Xiao-Ming X. 2006. Research of period of survival in lab and feature of decease of *Craspedacusta sinensis*. Sihuan J. Zool. 26: 3.
Geiter, O., S. Homma, R. Kinzelbach, 2002. Bestandsaufnahme und Bewertung von Neozoen in Deutschland. Texte des Umweltbundesamtes 2002 (25).
Jankowski, T. 2001. The freshwater medusae of the world - a taxonomic and systematic literature study with some remarks on other inland water jellyfish. Hydrobiologia 462: 91-113.
Jankowski T. 2000. Chemical composition and biomass parameters of a population of *Craspedacusta sowerbii* Lank1880 (Cnidaria: Limnomedusa). J. Plankton Res. 22, 7, 1329–1340
Jankowski T., Collins A.G., Campbell R. 2008. Global diversity of inland water cnidarians. Hydrobiol. 598: 35–40
Jankowski, T. and Ratte, H.-T., 2001. On the influence of the freshwater jellyfish *Craspedacusta sowerbii* on the zooplankton community. Verhandlungen Internationale. Vereinigung für Theoretische und Angewandte Limnologie 27: 3287-3290.
Jernelöv, A., Löwén, I.-L., and Stake, E. 1970. Sötvattenmaneten *Craspedacusta sowerbii* funnen i Sverge. Fauna & flora 65:42.44.
Kanaev, I. I., 1949. Coelenterates (Coelenterata). In: V.I. Zhadin (ed.) Life in Freshwaters of USSR, pp. 220-228. Moscow-Leningrad.
Kato, K. I. and S. Hirabayashi, 1991. Temperature condition initiating medusa bud formation and the mode of appearance in a freshwater hydroid, Craspedacusta sowerbyi. Zoological science, Tokyo 8(6):1107.
Lankester. E. R. 1880. On *Limnocodium* (*Craspedacusta*) *sowerbii*, a new Trachomedusa inhabiting freshwater. Quarterly Journal of Microscope Science 20: 351-371
Lundberg, S. & Svensson, J-E. 2003. Medusainvasion i varma sjöar. Fauna & flora 98: 18-28. web version.
Mills C.E., Rees J.T. 2000. New observations and corrections concerning the trio of invasive hydromedusae *Maeotias marginata* (=*M. inexpectata*), *Blackforfia virginica*, and *Moerisia* sp. In the San Francisco Estuary. Sci. Mar. 64 (Suppl. 1) 151-155.
Nehring, S., 2005. International shipping - A risk for aquatic biodiversity in Germany. - In: Nentwig, W., Bacher, S., Cock, M.J.W., Dietz, H., Gigon, A. and Wittenberg, R. (Eds.), Biological Invasions - From Ecology to Control. Neobiota 6, pp. 125-143.
Nikolaeva, N. E. 2006. Случай обнаружения популяции пресноводной гидроидной медузы *Craspedacusta sowerbii* в реке Инга Тверской области. [Discovery of a population of freshwater hydroid jellyfish *Craspedacusta sowerbii* in the river Inga of Tver region]. - Vest. TeGU, ser. Biol. and Ekol. 2: 92─93.
Payne, F. 1924. A study of the freshwater medusae, *Craspedacusta ryderi*. Journal of Morphology 38:397-430.
Payne, F. 1926. Further studies on the life history of *Craspedacusta ryderi*, a freshwater hydromedusan. Biol Bull. 6, 433-443
Peard, T., 2005. Freshwater Jellyfish! Indiana University of Pennsylvania, Indiana, PA 25 URL: http://nsm1.nsm.iup.edu/tpeard/jellyfish.html
Pennak, R. W., 1989. Coelenterata. Fresh-water Invertebrates of the United States: Protozoa to Mollusca, 3rd edition. John Wiley and Sons, Inc., New York, pp. 110-127.
Pérez-Bote J.L., Muñoz A., Morán R., Roso R., Romero A.J. 2006. First record of *Craspedacusta sowerbyi* Lankester, 1880 (Cnidaria: Limnomedusae: Olindiidae) in the Proserpina Reservoir (Extremadura, SW Spain) with notes on their feeding habits. Belg. J. Zool. 136: 163–166.
Protasov A.A. 1978. Polyp of *Craspedacusta sowerbii* (Lankester) in the Dnieper River. Gidrobiol. Zh. 14: 42–43.
Slobodkin, L. B. and P. E. Bossert., 1991. The Freshwater Cnidaria or Coelenterates in Ecology and Classification of North American Freshwater Invetebrates, J.H. Thorp and A.P. Covich (editors). Academic Press, Inc. San Diego. pp. 135-136.
Smith A.S., Alexander J.E., Jr. 2008. Potential effects of the freshwater jellyfish *Craspedacusta sowerbii* on zooplankton community abundance J. Plankton Res. 30 (12): 1323–1327.
Sowerby, A.C., 1941. The romance of the Chinese fresh-water jellyfish. The Hongkong Naturalist Feb. 1941: 186-189.
Spadinger, R. and G. Maier, 1999. Prey selection and feeding of the freshwater jellyfish, Craspedacusta sowerbyi.

Freshwater Biology 41:567-573.
Stanković I. & Ternjej I. 2010. New ecological insight on two invasive species: *Craspedacusta sowerbii* (Coelenterata: Limnomedusae) and *Dreissenia polymorpha* (Bivalvia: Dreissenidae). J. Nat. Hist. 44, 45-46, 2707-2713
Tittizer, T., F. Schöll, M. Banning, A. Haybach and M. Schleuter, 2000. Aquatische Neozoen im Makrozoobenthos der Binnenwasserstraßen Deutschlands. Lauterbornia 39: 1-72.
Väinölä, R. 2002. The freshwater jellyfish *Craspedacusta sowerbii* in Finland. Memoranda Societatis pro Fauna et Flora Fennica 78: 13-15.
VDST and BfN, 2005. Zwischenbericht der Aktion Neobiota, Stand: 15. November 2005. - Unpublished report by Verband Deutscher Sporttaucher e.V. and Bundesamt für Naturschutz: 1-32. Project URL: http://www.neobiota.info
Wang D.L., Xu S.L., Jiang H.L., Yang H. 2006. Tolerance of *Craspedacusta sowerbyi xinyangensis* to the stresses of some ecological factors. J. Appl. Ecol. 17: 6.
Wiktor A., Witkowski A. 1999. Mass occurence of a jelly-fish, *Craspedecusta sowerbiy* (Lankester, 1880) (Cnidaria: Hyrozoa). Przeglad Zoologiczny XLIII, 89-93.
Xu S., Wang D. 2009. Life cycle of *Craspedacusta sowerbyi xinyangensis.* Current Zool. 55 (3),
Zienkiewicz L.A. 1940. Rasprostranenie presnovodnykh i slonovatovodnykh kishechnopolostnykh [The Distribution of Fresh- and Brackish-water Coelenterata]. Zool. Zh. 19: 580–602
Żurek R. 2010. *Craspedacusta sowerbii* – słodkowodna medusa. Cz. I. Historia odkrycia , rozmieszczenie i systematyka. [*Craspedacusta sowerbii – freshwater jellyfish, Part. I. Discovery, distribution and taxonomy. ChrońmyPrzyr. Ojcz. 66 (4), 283-294.*

Date of creation/modification of this fact sheet: 22-01-2008/ 10-06-2013