

The freshwater jellyfish *Craspedacusta sowerbii* Lankester, 1880 (Limnomedusa: Olindiidae) in Germany, with a brief note on its nomenclature

Gisela B. FRITZ*, Ralph O. SCHILL, Martin PFANNKUCHEN and Franz BRÜMMER

Universität Stuttgart, Biologisches Institut, Abteilung Zoologie, Pfaffenwaldring 57, 70569 Stuttgart, Germany

*e-mail corresponding author: gisela.fritz@bio.uni-stuttgart.de

ABSTRACT

The freshwater jellyfish *Craspedacusta sowerbii* Lankester is distributed worldwide in temperate, freshwater habitats. However, such a successful, worldwide dispersion of the medusa and its minute, less obvious polyp is unique among the freshwater jellyfish species (Limnomedusae, Olindiidae). Although numerous reports were given shortly after its discovery, the interest did not cease over the years. In cooperation with the German Underwater Federation (Verband Deutscher Sporttaucher e. V.) additional data of freshwater jellyfish occurrences could be obtained. In combination with previously published discovery reports, these data provide an area-wide observation of the distribution of freshwater jellyfish within the Federal Republic of Germany, adding 21 to the previously known *C. sowerbii* locations. Indications are that there is a far more wide spread distribution of the medusa than thought and the potentially even wider distribution of the often times overlooked polyp.

Key words: Cnidaria, distribution, freshwater jellyfish, neobiota

1. NOMENCLATURE

The first descriptions of the freshwater jellyfish were published within a few months after its discovery in a water lily tank in Regent's Park, London, England in 1880 (Allman 1880, Lankester 1880a, Lankester 1880b). The first written report was presented by E. Ray Lankester naming the new medusa *Craspedacusta sowerbii* (Lankester 1880a). Within a week, J. Allman gave a presentation describing the same species naming it *Limnocodium victoria* (Allman 1880). A name dispute arose, which was not eased by the fact that Lankester "in respect to Allman" suggested the name *Limnocodium sowerbii* (Lankester 1880b). The International Commission on Zoological Nomenclature (ICZN) decided on *C. sowerbii*, Lankester (Allen 1910, Stiles 1910), as a presentation is not considered to be equivalent to a publication. It is noteworthy to mention that almost 40% of all viewed literature use "*sowerbyi*" instead of the correct, as given in the first publication by Lankester, "*sowerbii*" and about 80% of those were published after the 1970s.

2. DISTRIBUTION

Within a few decades of the discovery of *C. sowerbii* reports and observations from all continents on its distribution were published. Although the jellyfish was considered to be from South-America, it was shown in the 1950s that the species originated from the Yangtsekiang River system, China (Kramp 1950). Of the limited number of freshwater jellyfish species, *Craspedacusta* species occur almost worldwide (Acker & Muscat 1976, Pennak 1956), however, the genus *Limnocnida* seems to

dominate the waters of India (Ahmad *et al.* 1987) and Africa, with the exception of South-Africa (Rayner 1988). Although multiple species of the genus *Craspedacusta* have been described, so far five species have been recognized (Boulenger & Flower 1928) (Fig. 1). Although all of these freshwater jellyfish occupy similar habitats, only *C. sowerbii*, its minute polyps (Fig. 2a) and its medusa (2.5 cm) (Fig. 2b), shows a worldwide distribution (Acker & Muscat 1976; Payne 1924; Pennak 1956; Rayner 1988). Possible reasons might be the ability for several forms of vegetative reproduction, such as budding a polyp, which stays attached to form a colony and budding a motile frustule which attaches and builds a new polyp (Dejdar 1934; Reisinger 1957) and, in addition, the successful long-term survival and adaptation to new areas without or with limited sexual reproduction and its genetic advantages. Furthermore, the possible ability to survive adverse conditions by producing a durable, chitin covered resting body (Acker & Muscat 1976; Bouillon & Boero 2000a) might aid in the successful conquest of different freshwater habitats.

The immediate interest of the discovered Limnomedusa (Hydrozoa, Olindiidae) was great and did not cease over the years. Usually the medusa was discovered by chance or when looking for some other organism of interest. Interestingly enough, it was mainly observed in artificial bodies of water e.g. gravel pits, as gravel and clay pits, garden ponds, reservoirs, aquaria and even wastewater treatment facilities (Augustin *et al.* 1987; Davis 1955; Schmitt 1939; Tattersall 1933; Thomas 1951), however, there are some records from natural lakes (Deevey & Brooks 1943; Dexter *et al.* 1949; Fantham & Porter 1938) as well as backwaters or slow

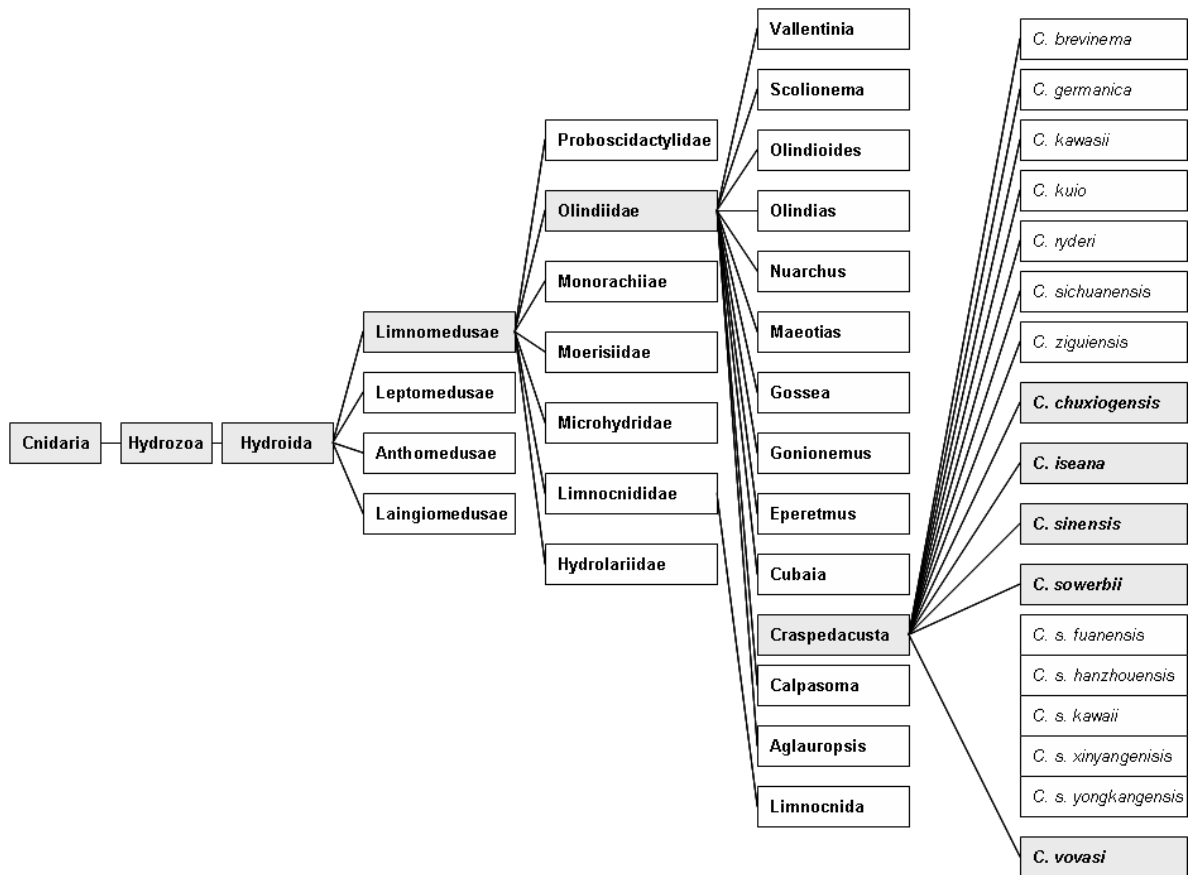


Fig. 1. Phylogeny and Nomenclature of *Craspedacusta sowerbii*.

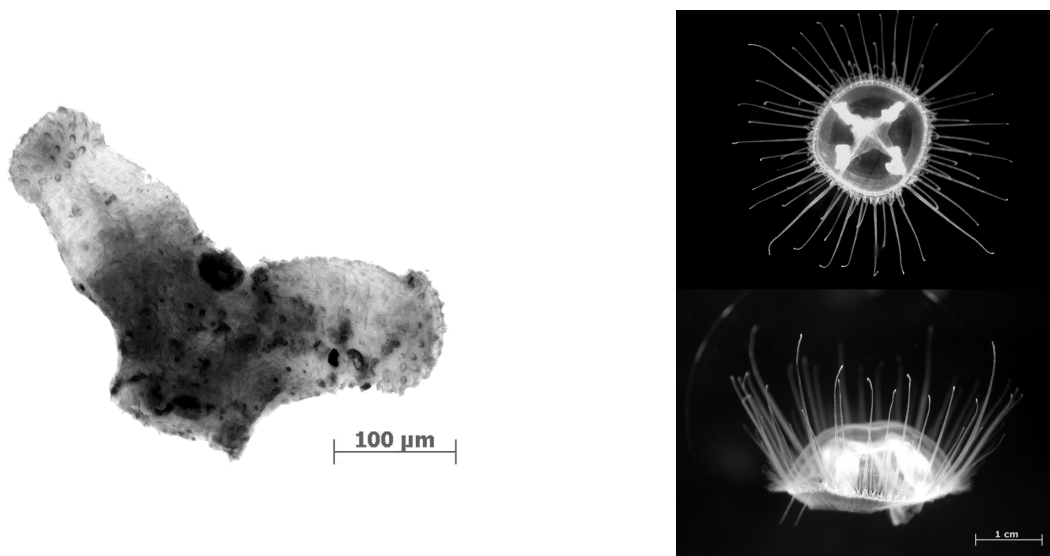


Fig. 2. *Craspedacusta sowerbii*. Left: a colony with two polyps. Right: two views of the medusa.

flowing portions of streams and rivers (Beckett & Turanchik 1980; Lundberg & Svensson 2003; Potts 1897; Rayner & Appleton 1992). There could be two reasons for that: 1) Non-indigenous plants and animals are more often introduced into artificial lakes than in natural ones and 2) these artificial bodies of water are

more closely watched, e.g. for water quality control, biological studies etc., hence chances are greater to observe the medusae (Thomas 1951).

Like in many other countries, several observations were made in Germany in the early 20th century (Fig. 3a). One of the first observations, that also included a

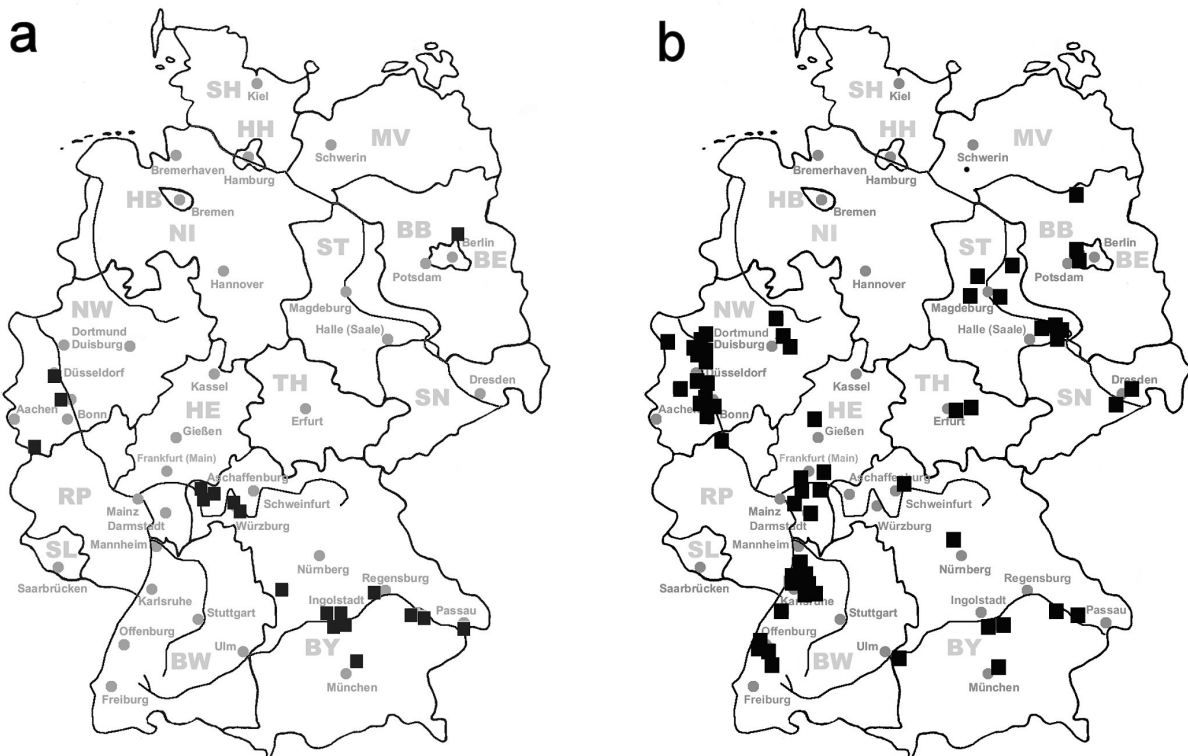


Fig. 3. Reports of *Craspedacusta sowerbii* in Germany. Reported locations of *Craspedacusta sowerbii* **a:** before 1990 and **b:** after 1990. Gray dots indicate selected cities within Germany. Capital letters are official abbreviations of the federal states (BW = Baden-Wuerttemberg, BY = Bavaria, BE = Berlin, BB = Brandenburg, HB = Bremen, HE = Hesse, HH = Hamburg, MV = Mecklenburg-Western Pomerania, NI = Lower Saxony, NW = North Rhine-Westphalia, RP = Rhineland-Palatinate, SL = Saarland, SN = Saxony, ST = Saxony-Anhalt, TH = Thuringia). Major river systems are shown.

detailed description, reported a medusa found near Berlin which showed several morphological differences to *C. sowerbii*. Hence, the medusa was published with the name *Microhydra germanica* (Moser 1930; Persch 1933; Roch 1924a; 1924b), however, later on, several publications showed the similarities of the polyps and the necessity to combine several species, including *M. germanica* and *C. ryderi*, to *C. sowerbii* (Bouillon & Boero 2000a, b; Boulenger & Flower 1928; Dejdar 1934).

Within the last two decades, an increasing number of reports were made on new *Craspedacusta* occurrences. This could be due to two main reasons: 1) increasing recreational, aquatic activities lead to an increase in observations and 2) the freshwater jellyfish is spreading. The present study worked in cooperation with the German Underwater Federation (VDST), especially to obtain broad-scale distribution data on the freshwater jellyfish. The data obtained so far (Verband Deutscher Sporttaucher 2006), added 21 additional locations to the previously published information (Tab. 1). The distribution of reports is slightly skewed towards the southwest of Germany (Fig. 3a, Fig. 3b), which is probably due to the availability of appropriate habitat within these areas, with Baden-Wuerttemberg and Bavaria having a lot of artificial bodies of water, whereas the number of

lakes in the northeast is lower. The obtained information indicates a far more wide spread distribution of the medusa than thought. Knowing that the minute polyp goes unnoticed in most cases and does not always produce medusae, the polyp probably has a far wider but unknown distribution.

With this ongoing project and further reports on the jellyfish, more research can be done on the distribution of this freshwater cnidarian. Although a lot has been published on *C. sowerbii*, methods of introduction and transportation, numbers of introduction events, as well as details on certain life cycle phases are still uncertain. As for most temperate species, warmer temperatures lead to an increase in production (Purcell 2005), it will be interesting to observe the distribution patterns of *C. sowerbii* in the light of a global warming event. The fact that most *Craspedacusta* populations are single-sexed (Petrušek *et al.* 2005), eliminating the evolutionary advantages of sexual reproduction, as well as the fact, that within most countries mainly one sex occurs (Petrušek *et al.* 2005), gives rise to the hypotheses that there were only a limited number of introduction events to single countries, but a very high mobility within regions to spread from habitat to habitat. Molecular analyses on population level might give more insight into jellyfish dynamics.

Tab. 1. Distribution of *Craspedacusta sowerbii* in Germany. Lakes marked with an * have been reported for the first time during this study. Most of the lakes below are artificial bodies of water such as quarry ponds, ponds or gravel pits.

Location	Nearest City	Year of first report	Source
Baden-Wuerttemberg (BW)			
Lake Heide	Karlsruhe	2002	(Marthä 2002, Tappenbeck 2002, Verband Deutscher Sporttaucher 2006)
Lake Sieben-Erlen	Karlsruhe	2002	(Marthä 2002, Tappenbeck 2002, Verband Deutscher Sporttaucher 2006)
Quarry pond Epple	Karlsruhe	2002	(unknown 2006)
St. Leoner Bathing Site	Karlsruhe	2002	(Tappenbeck 2002)
Lake Matschel	Mannheim	2002	(Marthä 2002, Tappenbeck 2002, Verband Deutscher Sporttaucher 2006)
Quarry pond Lahr	Offenburg	2002	(Tappenbeck 2002)
Lake Flückiger*	Offenburg	2002	(Tappenbeck 2002)
Quarry pond Spöck*	Freiburg	2005	(Verband Deutscher Sporttaucher 2006)
Lake Freyer*	Karlsruhe	2005	(Verband Deutscher Sporttaucher 2006)
Lake near Linkenheim*	Karlsruhe	2005	(Verband Deutscher Sporttaucher 2006)
Lake Streitköpfle*	Karlsruhe	2005	(Marthä 2002, Tappenbeck 2002, Verband Deutscher Sporttaucher 2006)
Lake Metzgerallmend*	Karlsruhe	2005	(Marthä 2002, Tappenbeck 2002, Verband Deutscher Sporttaucher 2006)
Lake Hohwiesen*	Karlsruhe	2005	(Verband Deutscher Sporttaucher 2006)
Lake Achern*	Mannheim	2005	(Verband Deutscher Sporttaucher 2006)
Lake Achern*	Offenburg	2005	(Verband Deutscher Sporttaucher 2006)
Bavaria (BY)			
Gravel pit Main near Lohr	Aschaffenburg	1923	(Kronfelder 1984)
Lake Freigericht West	Aschaffenburg	1947/1948	(Kronfelder 1984)
Quarry pond near castle Emmerichshafen	Aschaffenburg	1979	(Kronfelder 1984)
Quarry pond near Ingolstadt	Ingolstadt	1967	(Kronfelder 1984)
Lake Dreigroschen	Ingolstadt	1970er	(Beck & Krach 1984)
Feilenmoos (3 different ponds)	Ingolstadt	1982	(Beck & Krach 1984)
Pond Forsterweiher	Ingolstadt	1983	(Beck & Krach 1984)
Gravel pit near Hagau	Ingolstadt	1983	(Beck & Krach 1984)
Lake Auwald	Ingolstadt	1983	(Beck & Krach 1984)
Pond Einlaufweiher	Ingolstadt	2002	(Marthä 2002, Tappenbeck 2002, Verband Deutscher Sporttaucher 2006)
Lake Hofstätten	München	1974	(Kronfelder 1984)
Lake Haagen	Bayreuth	2002	(Tappenbeck 2002)
Quarry pond Oberachdorf/Wörth a. d. Donau	München	1982	(Heß & Kronfelder 1988, Kronfelder 1984)
Lake Marzlingen*	München	2005	(Verband Deutscher Sporttaucher 2006)
Lake Gerolfingen	Nürnberg	1983	(Beck & Krach 1984)
Pond Oberndorf	Nürnberg	2002	(Tappenbeck 2002)
Oxbow lake "Langer Sporn"/River Danube	Passau	1962	(Kronfelder 1984)
Lake Weicheringen	Passau	2002	(Marthä 2002, Tappenbeck 2002)
Pond Sarching	Regensburg	1967	(Kronfelder 1984, Marthä 2002)
Pond KFV near Landau/Isar	Regensburg	1975	(Kronfelder 1984)
Lake Friedenhaiensee	Regensburg	1979-1983	(Kronfelder 1984)
Backwater of the River Isar	Regensburg	1977	(Kronfelder 1984)
Pond Luberweiher	Regensburg	1979	(Kronfelder 1984)
Quarry pond near Unterharthof	Regensburg	1981	(Kronfelder 1984)
Unnamed fishpond	Regensburg	2002	(Marthä 2002)
Pond Attinger	Regensburg	2004	(Beck & Krach 1984)
Lake Schongauer Sandgraben	Schweinfurt	1939	(Kronfelder 1984)
Quarry pond Schleusenammer	Schweinfurt	1948	(Kronfelder 1984)
Quarry ponds near Schweinfurt	Schweinfurt	1940	(Kugler 1940)
Lake Gurren*	Ulm	2005	(Verband Deutscher Sporttaucher 2006)
Backwater of the River Main	Würzburg	1950	(Kronfelder 1984)
Quarry pond near Gambach	Würzburg	1982	(Kronfelder 1984)
Lake Gloeckle	Würzburg	2002	(Tappenbeck 2002)
Berlin (BE)			
Lake Niederneuendorf	Berlin	2001	(Marthä 2002, Tappenbeck 2002)
Lake Wannsee	Berlin	2006	(K. Reichert, pers. comm., 2006)
Brandenburg (BB)			
Finnow Canal	Berlin	1931	(Reisinger 1934)
Lake Dagow	Fürstenberg	2006	(P. Kasprzak, pers. comm., 2006)

(continued)

Tab. 1. Continuation.

Location	Nearest City	Year of first report	Source
Hesse (HE)			
Aje	Darmstadt	2002	(Marthä 2002, Tappenbeck 2002, Verband Deutscher Sporttaucher 2006)
Lake Westhafen, Frankfurt a. M.	Frankfurt a.M.	1932	(Reisinger 1934)
Lake Krotzenburg	Frankfurt a.M.	2002	(Tappenbeck 2002)
Lake Erlen	Frankfurt a.M.	2002	(Tappenbeck 2002)
Lake Vogel	Frankfurt a.M.	2005	(Verband Deutscher Sporttaucher 2006)
Lake Mönchswald*	Frankfurt a.M.	2005	(Marthä 2002, Verband Deutscher Sporttaucher 2006)
Quarry pond Winkel*	Gießen	2005	(Verband Deutscher Sporttaucher 2006)
North Rhine-Westphalia (NW)			
Pond Alsdorf	Aachen	1985	(Jankowski 2000)
Lake Rahmer	Duisburg	2001	(Verband Deutscher Sporttaucher 2006)
Lake Alte Schachtanlage	Duisburg	2002	(Tappenbeck 2002)
Lake Schleien	Duisburg	2002	(Tappenbeck 2002)
Lake Wambach	Duisburg	2003	(BSWR (Biologische Station Westliches Ruhrgebiet) 2003-2006)
Lake Töpfer/Tegge	Duisburg	2003	(BSWR (Biologische Station Westliches Ruhrgebiet) 2003-2006)
Rhein-Herne Canal	Duisburg	2003	(BSWR (Biologische Station Westliches Ruhrgebiet) 2003-2006)
Lake Haubach	Duisburg	2003	(BSWR (Biologische Station Westliches Ruhrgebiet) 2003-2006)
Landschaftspark Duisburg	Duisburg	2004	(BSWR (Biologische Station Westliches Ruhrgebiet) 2003-2006)
Lake Goch Ness*	Duisburg	2005	(Verband Deutscher Sporttaucher 2006)
Lake Loheide near the marina*	Duisburg	2005	(Verband Deutscher Sporttaucher 2006)
Lake Zacharias	Dortmund	2002	(Tappenbeck 2002)
Lake Möhne*	Dortmund	2005	(Verband Deutscher Sporttaucher 2006)
Quarry pond Dornhecke	Düsseldorf	1956	(Dennert 1959)
Lake Langenfeld	Düsseldorf	2002	(Marthä 2002, Tappenbeck 2002)
Green Lake	Düsseldorf	2003	(BSWR (Biologische Station Westliches Ruhrgebiet) 2003-2006, Verband Deutscher Sporttaucher 2006)
Lake Adolfo*	Düsseldorf	2005	(Tappenbeck 2002, Verband Deutscher Sporttaucher 2006)
Lake Am Blankenwasser*	Düsseldorf	2005	(Verband Deutscher Sporttaucher 2006)
Lake Elb*	Düsseldorf	2005	(Verband Deutscher Sporttaucher 2006)
Lake Volksgartenweiher	Köln	1931	(Reisinger 1934)
Lake Dornhecke	Köln	1995	(Verband Deutscher Sporttaucher 2006)
Lake Stockemer*	Köln	2002	(Verband Deutscher Sporttaucher 2006)
Lake Berggeist	Köln	2004	(Tappenbeck 2002, Verband Deutscher Sporttaucher 2006)
Lake Fühlingen*	Köln	2005	(Verband Deutscher Sporttaucher 2006)
Gravel pit Uckendorf*	Köln	2005	(Verband Deutscher Sporttaucher 2006)
Garden pond	Münster	2002	(Tappenbeck 2002)
Rhineland-Palatinate (RP)			
Lake Dungkopf	Köln	2003	(Tappenbeck 2002, Verband Deutscher Sporttaucher 2006)
Saxony (SN)			
Gravel pit Leuben	Dresden	2002	(Tappenbeck 2002)
Lake Vogelberg	Dresden	2002	(Marthä 2002, Tappenbeck 2002)
Saxony-Anhalt (ST)			
Quarry pond I, II und III, Löbejün	Halle (Saale)	2002	(Marthä 2002, Tappenbeck 2002, Verband Deutscher Sporttaucher 2006)
Lake Wehrstädter	Magdeburg	1994	(Tappenbeck 2002)□
Lake Belicker	Magdeburg	1997	(Marthä 2002, Tappenbeck 2002)
Lake Grüner Waldsee	Magdeburg	2002	(Marthä 2002, Tappenbeck 2002)
Lido	Magdeburg	2002	(Marthä 2002)
Lido Sandersdorf	Magdeburg	2002	(Marthä 2002, Tappenbeck 2002, Verband Deutscher Sporttaucher 2006)
Süplinger Canyon*	Magdeburg	2002, 2005	(Marthä 2002, Verband Deutscher Sporttaucher 2006)
Lake Förstergrube	Magdeburg	2004	(H. Preuss, pers. comm., 2006)
Thuringia (TH)			
Gravel pit	Erfurt	2002	(Marthä 2002)
Lake Niederweimar*	Erfurt	2003	(Verband Deutscher Sporttaucher 2006)

ACKNOWLEDGEMENTS

We want to thank all the NEOBIOTA-participants of the NEOBIOTA project initiated by the German Underwater Federation (VDST). In addition, all the observations given by personal communication: Kerstin Reichert, Heike Preuss and Peter Kasprzak. The authors also want to thank Andrew Polaszek, Executive Secretary of the International Commission on Zoological Nomenclature, for his information on the correct spell-

ing of *C. sowerbii*. This publication is dedicated to the late Mrs. Görtz, whose aquaristic interest provided us with the first polyps of *C. sowerbii*, which were then cultivated at the Department of Zoology, Universität Stuttgart, Germany.

REFERENCES

- Acker, T.S. & A.M. Muscat. 1976. Ecology of *Craspedacusta sowerbii* Lankester, a freshwater hydrozoan. *Am. Midl. Nat.*, 95: 323-336.

- Ahmad, F.M., N.S. Sen, K.P. Mishra & A.K. Bharti. 1987. A new species of *Limnocoidea* (Limnomedusae, Coelenterata) from freshwater aquarium in India. *Hydrobiologia*, 144: 33-36.
- Allen, J.A. 1910. Opinions rendered by the International Commission on Zoological Nomenclature. *Science*, 32: 380-382.
- Allman, G.J. 1880. The freshwater medusa. *Nature*, 22: 218.
- Augustin, H., W. Foissner & H. Adam. 1987. A sewage plant as a remarkable new habitat of the fresh-water polyp *Craspedacusta sowerbii* (Hydrozoa: Coelenterata). *Limnologica*, 18: 225-226.
- Beck, J. & E. Krach. 1984. Bemerkungen zum Auftreten der Süßwasserqualle *Craspedacusta sowerbii* Lank. im mittelbayerischen Raum. *Archaeopteryx*, 1984: 41-50.
- Beckett, D.C. & E.J. Turanchik. 1980. Occurrence of the freshwater jellyfish *Craspedacusta sowerbyi* Lankester in the Ohio River. *Ohio J. Sci.*, 32: 323-324.
- Bouillon, J. & F. Boero. 2000a. The hydrozoa: a new classification in the light of old knowledge. *Thal. Sal.*, 24: 3-45.
- Bouillon, J. & F. Boero. 2000b. Synopsis of the families and genera of the hydromedusae of the world, with a list of the worldwide species. *Thal. Sal.*, 24: 47-296.
- Boulenger, C. & L. Flower. 1928. The Regents Park medusa *Craspedacusta sowerbyi* and its identity with *C. (Microhydra) ryderi*. *Proc. Zool. Soc. Lond.*, 66: 1005-1015.
- BSWR (Biologische Station Westliches Ruhrgebiet). 2003-2006. Süßwassermedusen im westlichen Ruhrgebiet. <http://www.bswr.de/Fauna/suesswasserqualle.htm>. (Accessed: 14. Jun 2006).
- Davis, C.C. 1955. Notes on the food of *Craspedacusta sowerbii* in Crystal Lake, Ravenna, Ohio. *Ecology*, 36: 364-366.
- Deevey, E.S., Jr. & J.L. Brooks. 1943. *Craspedacusta* in open water, Lake Quassapaug, Connecticut. *Ecology*, 24: 266-267.
- Dejdar, E. 1934. Die Süßwassermeduse *Craspedacusta sowerbii* Lankester in monographischer Darstellung. *Z. Morphol. Ökol. Tiere*, 28: 595-691.
- Dennert, G. 1959. Ein interessantes Hohltier unserer heimischen Süßwasserfauna: *Craspedacusta sowerbii* Lank. *Mikrokosmos*, 48: 79-83.
- Dexter, R.W., T.C. Surrarrrer & C.W. Davis. 1949. Some recent records of the freshwater jellyfish *Craspedacusta sowerbyi* from Ohio and Pennsylvania. *Ohio J. Sci.*, 49: 235-241.
- Fantham, H.B. & A. Porter. 1938. Occurrence of the freshwater medusa *Craspedacusta sowerbii* in eastern Canada. *Nature*, 141: 515-516.
- Heß, W. & M. Kronfelder. 1988. Zur Nahrungsaufnahme der Süßwassermeduse *Craspedacusta sowerbii* Lankester. *Acta Albertina Ratisbonensia*, 45: 243-248.
- Jankowski, T. 2000. Chemical composition and biomass parameters of a population of *Craspedacusta sowerbii* Lank 1880 (Cnidaria:Limnomedusa). *J. Plankton Res.*, 22: 1329-1340.
- Kramp, P.L. 1950. Freshwater medusae in China. *Proc. Zool. Soc. Lond.*, 120: 165-184.
- Kronfelder, M. 1984. Notiz zum Vorkommen der Süßwassermeduse *Craspedacusta sowerbii* Lankester in Bayern. *Spixiana Muenchn*, 7: 1-3.
- Kugler, H. 1940. Neuer Fundort von *Craspedacusta sowerbii* Lankester. *Zool. Anz.*, 130: 250.
- Lankester, E.R. 1880a. On a new Jellyfish of the Order Trachomedusae, living in fresh water. *Science*, 1: 34.
- Lankester, E.R. 1880b. On *Limnocoidea* (*Craspedacusta sowerbii*), a new Trachomedusa inhabiting freshwater. *Q. J. Microsc. Sci.*, 20: 351-371.
- Lundberg, S. & J.-E. Svensson. 2003. Medusae invasions in Swedish lakes. *Fauna Och Flora*, 98: 18-28.
- Marthä, H. 2002. Süßwasserqualle (*Craspedacusta sowerbii*). http://www.taucher.net/redaktion/22/Suesswasserqualle-Craspedacusta_sowerbii_6.html. (Accessed: 14. June 2006).
- Moser, J. 1930. Microhydra E. Potts. *Sitzungsber. Ges. Naturf. Freunde.*, Berlin.
- Payne, F. 1924. A study of the fresh-water medusa, *Craspedacusta ryderi*. *J. Morph.*, 38: 387-430.
- Pennak, R.W. 1956. The fresh-water jellyfish *Craspedacusta* in Colorado with some remarks on its ecology and morphological degenerataion. *T. Am. Microsc. Soc.*, 75: 324-331.
- Persch, H. 1933. Untersuchungen über *Microhydra germanica* Roch. *Z. Wiss. Zool.*, 144: 163-210.
- Petrusek, A., J. Šedivý, S. Lundberg & J.-E. Svensson. 2005. Detecting multiple invasions of *Craspedacusta sowerbyi* by indentification of the sex of the medusae. INWAT: Biological invasions in inland waters, Firenze, May 5-7, 2005.
- Potts, E. 1897. A North American fresh water jelly fish. *Am. Nat.*, 31: 1032-1035.
- Purcell, J.E. 2005. Climate effects on formation of jellyfish and ctenophore blooms: a review. *J. Mar. Biol. Assoc. U.K.*, 85: 461-476.
- Rayner, N.A. 1988. First record of *Craspedacusta sowerbyi* Lankester (Cnidaria: Limnomedusae) from Africa. *Hydrobiologia*, 162: 73-77.
- Rayner, N.A. & C. C. Appleton. 1992. *Craspedacusta sowerbyi*, new record (Cnidaria: Limnomedusae) from southern Africa. *S. Afr. J. Zool.*, 27: 143-145.
- Reisinger, E. 1934. Die Süßwassermeduse *Craspedacusta sowerbyi* Lankester und ihr Vorkommen im Flußgebiet von Rhein und Maas. *Die Natur am Niederrhein*, 10: 33-43.
- Reisinger, E. 1957. Zur Entwicklungsgeschichte und Entwicklungsmechanik von *Craspedacusta* (Hydrozoa, Limnotrachelina). *Z. Morphol. Ökol. Tiere*, 45: 656-698.
- Roch, F. 1924a. *Microhydra germanica* - die deutsche Süßwassermeduse. *Bl. f. Aquar. Terr. Kde.*, 36: 205-208.
- Roch, F. 1924b. *Microhydra germanica*, eine neue Süßwassermeduse. *Zool. Anz.*, 58: 131-136.
- Schmitt, W.L. 1939. Freshwater jellyfish records since 1932. *Am. Nat.*, 73: 83-89.
- Stiles, C.W. 1910. Summaries of six opinions (9, 11, 13, 15, 17, 18) by the International Commission on Zoological Nomenclature. *Science*, 31: 150-151.
- Tappenbeck, L. 2002. Die Süßwasserqualle (*Craspedacusta sowerbyi*, Lankester 1880). <http://www.halophila.de/startseite/startseite.html>. (Accessed: 14. June 2006).
- Tattersall, W.M. 1933. Occurrence of *Craspedacusta sowerbyi* Lankester in Monmouthshire. *Nature*, 132: 570.
- Thomas, I.M. 1951. *Craspedacusta sowerbii* in south Australia, with some notes on its habits. *T. Roy. Soc. South Aust.*, 74: 59-65.
- Unknown. 2006. Tauchreviere. <http://www.staempfli.de/Tauchen/tauchen.html>. (Accessed: 19.Sept.2006).
- Verband Deutscher Sporttaucher, e.V. 2006. NEOBIOTA - neue Arten in Tauchgewässer. <http://www.neobiota.info>. (Accessed: 31. Aug. 2006).

Received: April 2007

Accepted: May 2007