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NOTES

Suction Dredge Removal of an Invasive Macrophyte From a Spring-fed River in Central Texas, USA

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INTRODUCTION

In 1996, Beckett's water trumpet (*Cryptocoryne beckettii*) was found growing in the upper San Marcos River (SMR), located in Hays County, Texas, USA (Rosen 2000). The SMR is spring-fed and is home to numerous endangered and threatened species, including Texas wild rice (*Zizania texana*), Texas blind salamander (*Eurycea rathbuni*), San Marcos salamander (*Eurycea nana*), fountain darter (*Etheostoma fonticola*), Comal Springs riffle beetle (*Heterelmis comalensis*) and the San Marcos gambusia (*Gambusia georgei*) now thought to be extinct. Any changes to these species' habitats may prove detrimental to their existence.

Beckett's water trumpet is in the Araceae family native to Sri Lanka (Jacobsen 1977). This plant produces basal, ovate leaves with an upper surface that is green to dark green to brown and a lower surface that is red to brown. Its inflorescence is a spadix enclosed by a spathe that resembles a trumpet. Species in the *Cryptocoryne* genus are highly sought after decorative plants for aquariums (de Graaf and Arends 1986, Jacobsen 1987).

Beckett's water trumpet reproduces easily by rhizome fragmentation. Fragments as small as 2 mm can easily break off from the parent plant and grow into a separate plant (Reumer 1984). Beckett's water trumpet also can reproduce sexually, but this has not yet been seen in the SMR (M. L. Alexander, pers. observ.).

Most likely introduced into the SMR via unwanted aquarium disposal, Beckett's water trumpet began to cover much of the riverbed in the lower 2.9 km of the upper SMR (the portion from the headwaters down to the confluence with the Blanco River) only a few years after its initial discovery. Between 1998 and 2000, the exotic Beckett's water trumpet's average rate of aerial expansion was 80% per year, increasing from 171 to 646 m^2 (Doyle 2001). An April 2005 survey documented Beckett's water trumpet covering 1951 m^2 in the lower 2.9 km of the upper SMR. The majority of colonies mapped in 2005 was found at shallow depths (between 30 and 120 cm) and in areas of rapidly flowing water (Michael Robertson, BIO-WEST, Inc., pers. comm.). This preference for shallow, rapidly flowing areas of the river makes Beckett's water trumpet a potentially serious threat to the endangered Texas wild rice in the SMR (Power 1996, Poole and Bowles 1999). While the introduction of any aggressive, non-native species is a concern, Beckett's water trumpet provides an extra threat because it grows in the same habitat conditions as the endangered Texas wild rice and has invaded a portion of Texas wild rice's critical habitat. Fortunately, the growth of the exotic species was downstream of Texas wild rice current distribution. However, these species were separated by less than 100 m in 2002.

In response to this threat, the San Marcos National Fish Hatchery and Technology Center, U.S. Fish and Wildlife Service (USFWS) initiated an effort to remove Beckett's water trumpet from the upstream end of its range in the SMR to create a larger buffer between Beckett's water trumpet and Texas wild rice. Here, we present the methods and success rate of these efforts.

MATERIALS AND METHODS

In August 2002, researchers from USFWS and Baylor University began to examine the use of a hand-operated suction dredge to remove the invasive Beckett's water trumpet from the river. The 10.2-cm diameter dredge was powered by a 23-horsepower Briggs and Stratton engine and connected to a 2.4 by 1.5 m mesh basket, all mounted on two 1.2-m long pontoons. The total price for the equipment was $6,250.00. A SCUBA diver operated the suction end of the dredge. Plant material and substrate were sucked into the dredge via venturi suction and deposited into the floating basket. A dredge operator was positioned on the floating dredge and basket and ensured maximum drainage through the mesh of the basket by shoveling dredged material into the corners. There also was a spotter on land or within the water, depending on environmental conditions, to facilitate communication between the diver and pump operator. We removed the collected material from the basket and deposited it on shore behind silt fencing.

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Between August 2002 and March 2004, USFWS and Baylor University field assistants and volunteers from 14 organizations and agencies (the team) operated the dredge. The team attempted to remove all Beckett's water trumpet growing within a 610-m long segment of the lower 2.9 km of the upper SMR section (beginning 3,505 m upstream of the confluence with the Blanco River).

After completion of the dredging operation in this zone, we began a monitoring program to ensure that regrowth was quickly removed. Between June 2004 and January 2008, we surveyed the 610-m segment of the river for regrowth 11 times. When regrowth was found, we recorded the amount observed and then removed the growth using the suction dredge. Each day before using the dredge, the site to be dredged was swept using a 45 by 30 cm dip net in an attempt to remove macroinvertebrates and fish from the area, including the endangered fountain darter.

RESULTS AND DISCUSSION

Between August 2002 and March 2004, via the suction dredge, we removed 537 m^2 aerial cover of Beckett's water trumpet growing in the 610-m segment of the SMR. The dredge was used for 47 days (846 person hours).

In June 2004, we found 18 patches of regrowth in this segment of the river. A patch was defined as an individual plant or group of individual plants that overlap. The average aerial cover of a patch was 0.3 m^2. By June 2005, we found only six patches of regrowth, and one year later, we found no regrowth (Figure 1). The 11 monitoring events that occurred between June 2004 and January 2008 took a total of 264 person hours.

Although more time is needed to conclusively determine if this removal method is successful, the data support the use of a suction dredge as a management tool to remove the invasive Beckett's water trumpet from the SMR, at the very least, if not a tool for eradication of this nuisance exotic species. As seen from the amount of person hours it took to remove just over 500 m^2 aerial cover of Beckett's water trumpet, this is a labor intensive process. Employing a larger diameter dredge and a permanent work crew devoted solely to the dredging process could possibly eradicate Beckett's water trumpet along the entire infested stretch of the river. If this method had been employed within the first two years of Beckett's water trumpet discovery in the SMR, eradication might already have been accomplished.

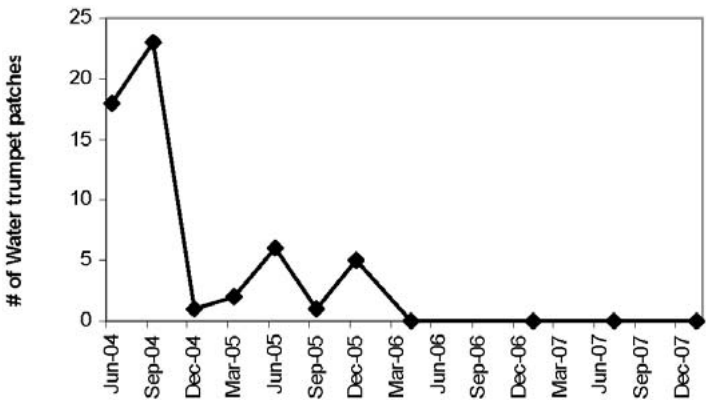

Figure 1. Number of Beckett's water trumpet (*Cryptocoryne beckettii*) patches found and removed during monitoring events between June 2004 and January 2008.

Using a suction dredge to remove an entire plant, including all root tissue, removes the surrounding substrate as well, which may have negative impacts on communities of invertebrates, surrounding native plants, algae and fish (Haynes and Madarewicz 1982, Lubke et al. 1984, Nichols 1984, Maier and Buchholz 1996, Akpan 1998). Managers must decide if the benefits of suction dredging to eradicate an invasive aquatic plant outweigh the possible negative effects before using this method to remove an exotic plant from an aquatic environment.

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LITERATURE CITED

Akpan, E. R. 1998. Possible environmental impact of channelization and dredging on the ecology of the Cross River estuary system, Nigeria. Trop. Freshw. Biol. 7:53-61.

de Graaf, A. and J. C. Arends. 1986. The occurrence of *Cryptocoryne* and *Lagenandra* (Araceae) on Sri Lanka. Nord. J. Bot. 6:757-764.

Doyle, R. D. 2001. Expansion of the exotic aquatic plant *Cryptocoryne beckettii* (Araceae) in the San Marcos River, Texas. Sida 19:1027-1038.

Haynes, J. M. and J. C. Makarewicz. 1982. Comparison of benthic communities in dredged and undredged areas of the St. Lawrence River, Cape Vincent, NY. Ohio J. Sci. 82:165-170.

Jacobsen, N. 1977. Chromosome numbers and taxonomy in *Cryptocoryne* (Araceae). Bot. Notes 130:71-87.

Jacobsen, N. 1987. *Cryptocoryne*, pp. xx-xx. *In:* M. D. Dassanayake (ed.), A revised handbook to the flora of Ceylon. Amerind Publishing Co. Pvt. Ltd., New Delhi.

Lubke, R. A., P. E. Reavell and P. J. Dye. 1984. The effects of dredging on the macrophytic vegetation of the Boro River, Okavango Delta, Botswana. Biol. Conserv. 30:211-236.

Maier, G. and R. Buchholz. 1996. Zooplankton communities of gravel pits in relation to trophy, dredging activity and macrophyte growth. Limnologica 26:353-360.

Nichols, S. A. 1984. Macrophyte community dynamics in a dredged Wisconsin lake. Water Resour. Bull. 20:573-576.

Poole, J. and D. E. Bowles. 1999. Habitat characterization of Texas wild-rice (*Zizania texana* Hitchcock), an endangered aquatic macrophyte from the San Marcos River, TX, USA. Aquat. Conserv. 9:291-302.

Power, P. 1996. Effects of current velocity and substrate composition on growth of Texas wildrice (*Zizania texana*). Aquat. Bot. 55:199-204.

Reumer, J. W. F. 1984. Cytotaxonomy and evolution in *Cryptocoryne* (Araceae). Genetica 65:149-158.

Rosen, D. J. 2000. *Cryptocoryne beckettii* (Araceae), a new aquatic plant in Texas. Sida 19:399-401.