Zebra Mussel Found in Cedar Lake, 2021

Zebra Mussel Rapid Response Assessment for Cedar Lake, Aitkin County, Minnesota, September 7, 2021

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September 2021

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Results of the Search: The first zebra mussel observation in Cedar Lake, Aitkin County, was reported by a lake resident on the week of July 11, 2021 on the north end of the lake between the peninsula and small island. On July 15, 2021, Tim Plude (MnDNR AIS specialist) and another MnDNR employee searched and found 3 more zebra mussels in the same area.

On September 7, 2021, volunteer searchers from the Cedar Lake Conservancy and 3 searchers from Blue Water Science conducted a rapid response assessment to look for additional zebra mussels in Cedar Lake. The searchers spent a total of 32 hours (1920 minutes) to search 13 areas of shoreline (Table 1). Twelve zebra mussels at 4 sites were found in Cedar Lake on September 7, 2021.

Table 1. Search results for the zebra mussel inspection sessions on September 7, 2021.

	Blue Water Science Staff					Cedar Lake Conservancy Volunteers	**Total for 9.7.21**
	Site A	**Site B**	**Site C**	**Site D**	**Site E**	**Areas 3, 4, 6, 9, 10, 11, 12, 13**	
Site description	Northern island close to peninsula	Outlet	Northern island around the point (3rd island)	Shoreline south of Site 6	Access	(Search areas are in Figure 1)	--
Duration of search at this site (minutes)	105	45	25	20	30	20 to 90 minutes	--
Number of searchers	3	3	3	3	3	--	--
Total search time (minutes)	315	135	75	60	90	22 hours	**32 hours**
Length of shoreline searched (ft)	600	300	300	200	200	200-800	--
Total number of zebra mussels found	7	3				2 (1 in Area 6 and 1 in Area 13)	**12**
Approximate size of zebra mussels (millimeters)	15-19 mm ZM strongly attached	13-19 mm ZM weakly and strongly attached				13 mm and 19 mm	**13-19 mm**
Search methodology	wading, snorkeling	wading, snorkeling	wading, snorkeling	wading, snorkeling	wading, snorkeling	wading	--

Locations of Zebra Mussels Found in Cedar Lake

One zebra mussel was found the week of July 11, 2021 by a Cedar Lake resident in Cedar Lake. On July 15, 2021, MnDNR searchers found 3 more zebra mussels. On September 7, 2021, a rapid response zebra mussel search by Cedar Lake volunteers and Blue Water Science personal found 12 additional zebra mussels (Figure 1). At the end of the September 7, 2021 search, a total of 16 zebra mussels had been found from 4 locations. Zebra mussels ranged in size from 13 to 19 mm in length.

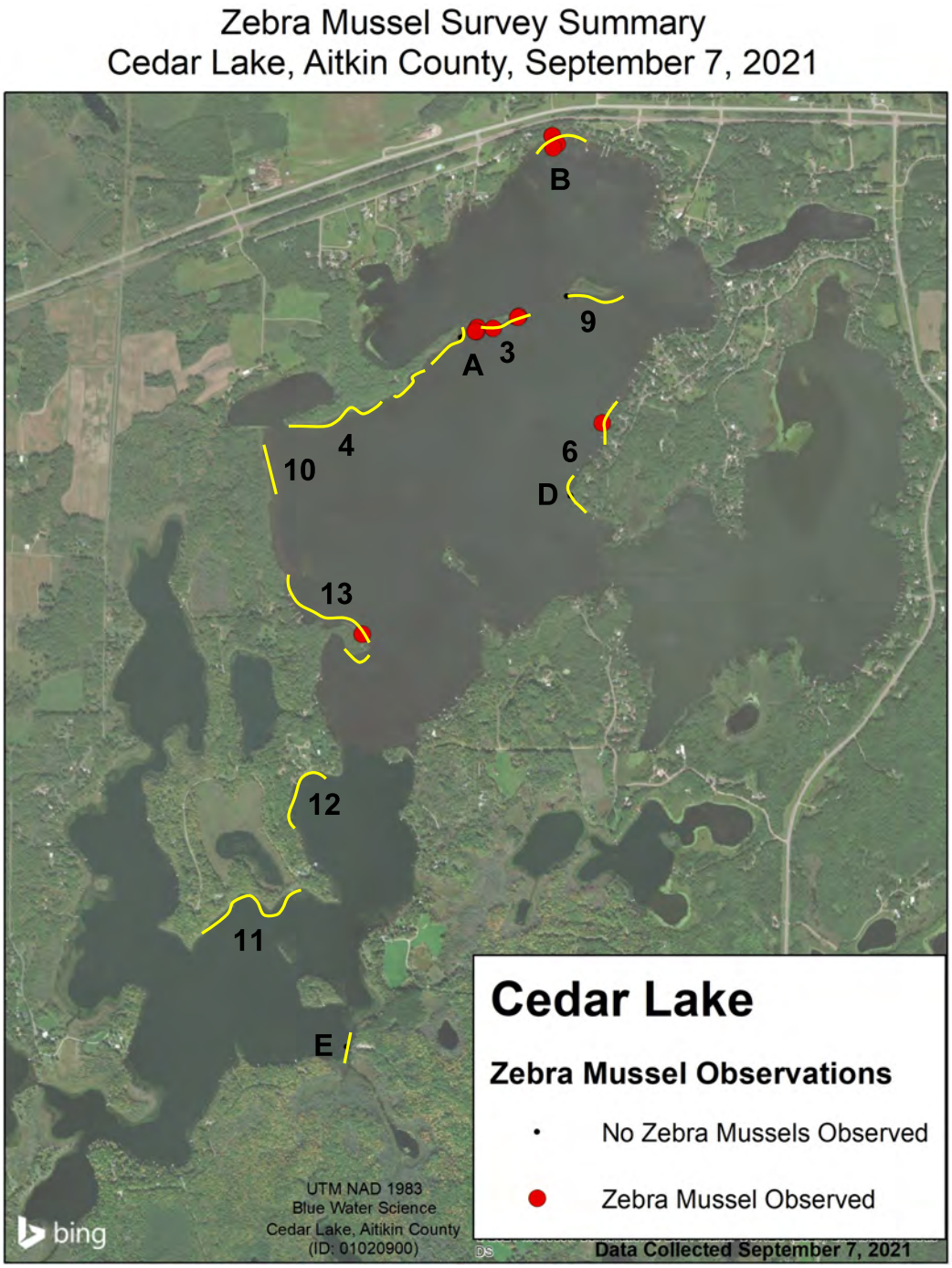

Figure 1. Twelve zebra mussels were found at 4 areas on September 7, 2021 (red dots) by Cedar Lake volunteers and Blue Water Science.

Cedar Lake Zebra Mussels

A total of 12 adult zebra mussels were found during the Cedar Lake zebra mussel search on September 7, 2021 (Figure 2). Sizes ranged from 16 mm to 19 mm. Zebra mussels were found as solitary individuals on rocks, branches, or attached to native mussels.

Figure 2. Zebra mussel sizes in Cedar Lake, collected on September 7, 2021. Zebra mussels on top of the ruler were found by Cedar Lake volunteers. Zebra mussels on the bottom of the ruler were found by Blue Water Science.

Zebra Mussel Eradication Index and a Recommended Action Plan

Ten criteria are considered when evaluating a potential success of conducting a zebra mussel eradication treatment. Points are assigned on a scale from 0 to 100 for each criterion. Points are added up and the higher the score, the higher the probability for a successful eradication.

Christmas Lake is used as a reference lake. Christmas Lake, Hennepin County, had an eradication treatment in April of 2015. However zebra mussels were observed later in Christmas Lake. The Zebra Mussel Eradication Index score for Christmas Lake was 810. When index scores are less than 800 the probability of a successful eradication attempt diminishes.

The Cedar Lake index score of 210 is low enough to indicate that an eradication attempt has a very low probability to succeed.

Based on available information an eradication attempt would have a low probability of success and is not recommended for Cedar Lake. Instead the recommended action is to continue lake monitoring and conduct small scale zebra mussel control projects in the future.

Cedar Lake Zebra Mussel Index Scores

Criteria	Scores for the Zebra Mussel Eradication Index		
	Poor 0 - 30	Fair 30 - 60	Excellent 60 - 100
1. Prior to a zebra mussel discovery, a minimum of 30 hours and 7,000 objects should be checked monthly for early detection. Plate or tube samplers should be deployed and checked monthly.	10		
2. Monthly early detection inspections indicate zebra mussels came into the lake within a month. Alternatively, there is specific knowledge of a recent introduction on an object (for example recent installation of a used boatlift with zebra mussels).	10		
3. Rapid response assessment involves up to 90 hours of additional searching and 20,000 objects should be checked.		**50** (32 hours on September 7, 2021 + estimated 10 hours for MnDNR = a minimum of 42 search hrs)	
4. Zebra mussels are found at 1 or 2 sites. If three sites or more are found the probability of eradication decreases.	**20** (4 sites)		
5. Zebra mussels should be immature. It has to be assumed immature zebra mussels were introduced on objects detached and reattached to new objects. Presence of mature zebra mussels indicates the probability of ongoing spawning.	**20** (all adults present)		
6. Individual mature zebra mussels should be separated by distance. If two or more mature zebra mussels are found in close proximity successful spawning is likely to have occurred and dispersal of veligers and juveniles may be widespread but undetected.	**20** (mature zebra mussels found close together at several sites)		
7. Wave action on containment barriers along open stretches of shoreline causes leakage of treatment water and dilution by lake water reducing the chemical concentration of the toxic agent within the containment area. It is best if the containment area is in a secluded location such as a bay or a cove.	**20** (open shorelines)		
8. Treatment area should be at least 3 times larger than known area of distribution at a site. A total area greater than 10 acres will be difficult to administer.	**20** (estimate of 30 acres of treatment)		
9. The probability of reintroduction should be low. Is the public access gated, are inspectors present from sunup to sundown, etc? Also do nearby lakes have zebra mussels?	**20** (Leech Lake has zebra mussels)		
10. The smaller the lake the better. The odds of a successful eradication for lakes greater than 300 acres in size is low.	20 (Cedar Lake is1,726 acres in area)		
Total Score	**210**		

What Will Zebra Mussels Do in Cedar Lake?

Zebra mussels are present in Cedar Lake. One of many questions is what kind of a population will they produce. Based on available data it appears conditions would support most sub-optimal growth out to 10 feet of water depth (Table 2). The chlorophyll levels indicate an optimal food source for zebra mussels. However, optimal substrate which includes hard surfaces such as rocks, branches, docks, and boat lifts is estimated to be less than 5% of the lake area in the growing zone. Zebra mussels will likely use aquatic plants which are sub-optimal for attachment. Zebra mussels will probably peak in 6 to 8 years and then densities will decrease due to a lack of food (algae). After that, they will still be present, but at low densities.

Table 2. Water column zebra mussel suitability criteria and Cedar Lake water column conditions.

		Little Potential for Adult Survival	Little Potential for Larval Development	Moderate (survivable, but will not flourish)	High (favorable for optimal growth)
Shell Formation Factors					
Calcium (mg/l)	**Cedar Lake**			25.4 (9.7.21)	
	Mackie and Claudi 2010*	*<8*	*8 - 15*	*15 - 30*	*>30*
pH	**Cedar Lake**				8.4 (9.7.21)
	Mackie and Claudi 2010	*<7.0 or >9.5*	*7.0 - 7.8 or 9.0 - 9.5*	*7.8 - 8.2 or 8.8 - 9.0*	*8.2 - 8.8*
Alkalinity* (as mg $CaCO_3$/l)	**Cedar Lake**			95 (9.7.21)	
	Mackie and Claudi 2010	*<30*	*30 - 55*	*55 - 100*	*100 - 280*
Conductivity* (umhos)	**Cedar Lake**				210 (9.7.21)
	Mackie and Claudi 2010	*<30*	*30 - 60*	*60 - 110*	*>110*
Food Factors					
Chlorophyll a (ug/l) (June-Sept)	**Cedar Lake**				3.7 (2020)
	Mackie and Claudi 2010	*<2.5 or >25*	*2.0 - 2.5 or 20 - 25*	*8 - 20*	*2.5 - 8*
Secchi depth (m) (June-Sept)	**Cedar Lake**				3.4 (2019 & 2020)
	Mackie and Claudi 2010	*<1 or >8*	*1 - 2 or 6 - 8*	*4 - 6*	*2 - 4*
Total phosphorus (ug/l) (June-Sept)	**Cedar Lake**			11 (10 year avg)	
	Mackie and Claudi 2010	*<5 or >50*	*5 - 10 or 35 - 50*	*10 - 25*	*25 - 35*
Substrate Factors (Dissolved oxygen and sediment composition)					
Dissolved oxygen (mg/l)	**Cedar Lake**			3-4 m (1981)	0-3 m (1981)
	Mackie and Claudi 2010	*<3 mg/l*	*3 - 7 mg/l*	*7 - 8 mg/l*	*>8 mg/l*
Bottom substrate in growing zone (0-20 feet)	**Cedar Lake**	35%		60%	5%
		soft muck with no hard objects		silt, sand, aquatic plants	rock or wood

*Mackie, G.L. and R. Claudi. 2010. Monitoring and control of macrofouling mollusks in fresh water systems. Second Edition. CRC Press, Boca Raton, FL.

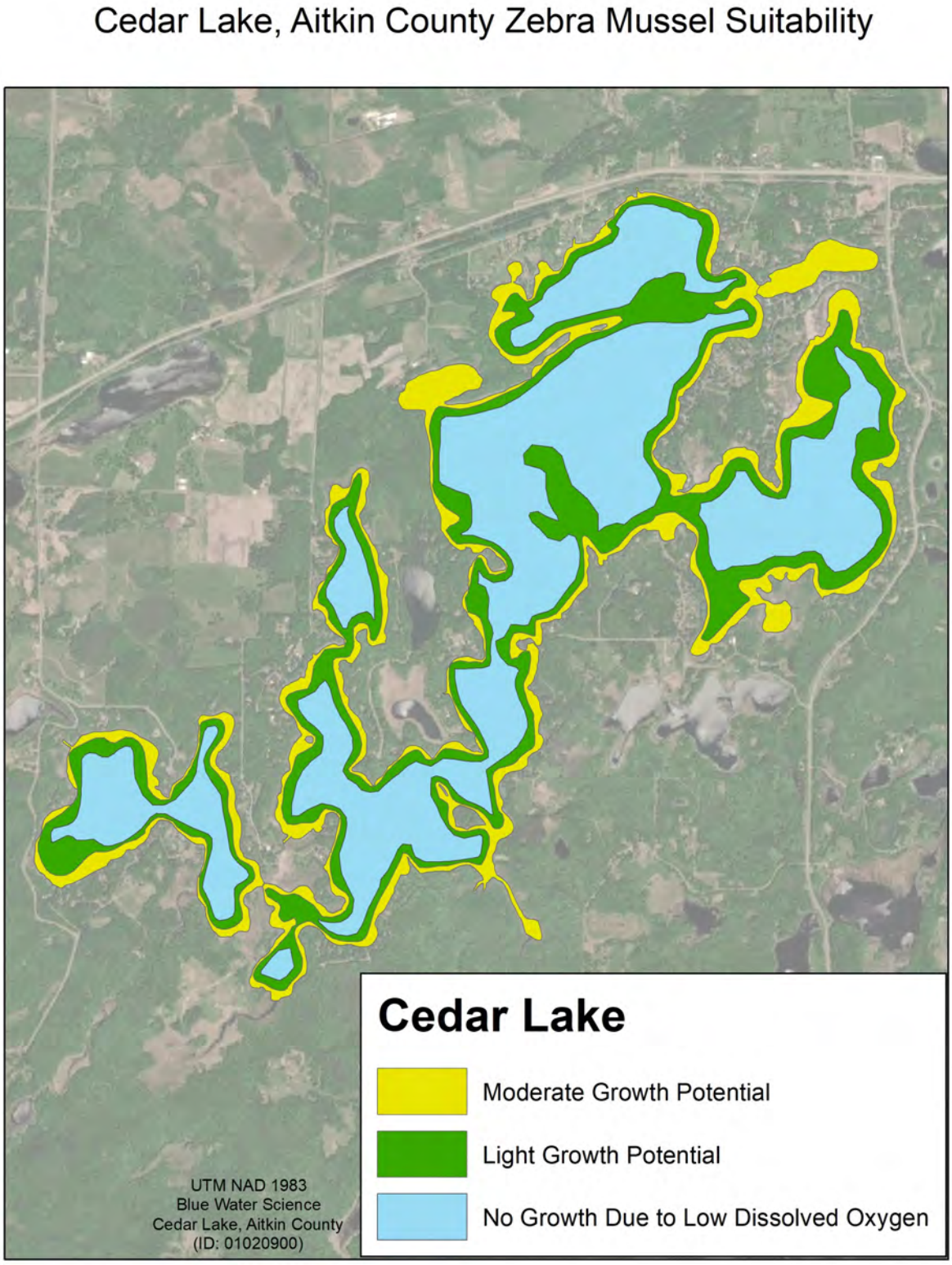

Figure 3. Zebra mussel growth would be limited to the nearshore areas of Cedar Lake (yellow and green shading). Although algal conditions representing their food source are optimal, calcium concentrations are in the moderate range and will slightly limit growth. Green shading indicates light zebra mussel growth due to limiting dissolved oxygen conditions. Blue shading indicates areas of low dissolved oxygen in Cedar Lake and would not support zebra mussel growth. Key: Green shading = light growth, yellow shading = moderate growth, and blue shading = no growth.

Cedar Lake Zebra Mussels Found on September 7, 2021

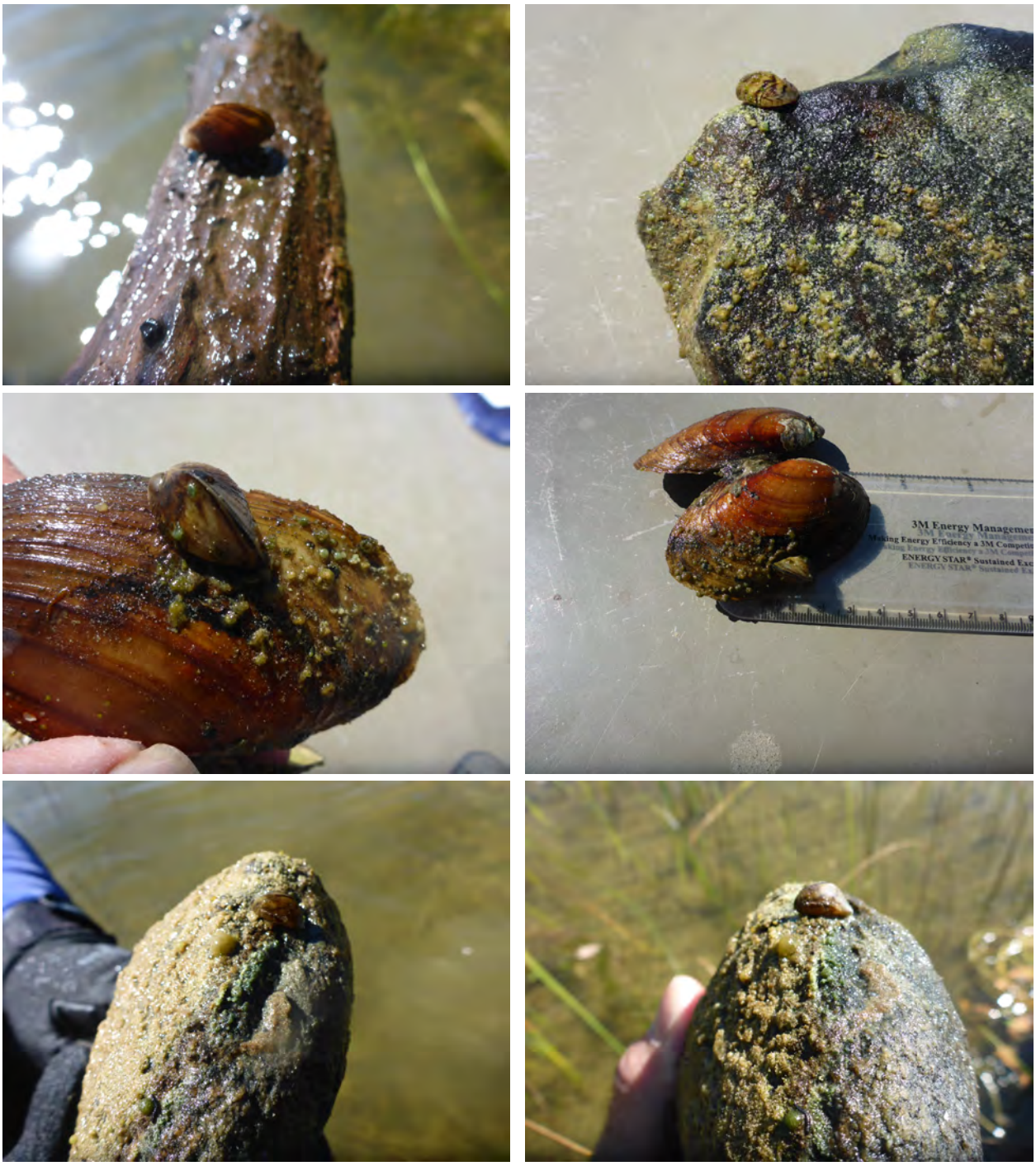

Figure 4. Some of the zebra mussels found on September 7, 2021.