



**CLEAN
DRAIN
DRY**

Prevent the Spread of Aquatic
Invasive Species

Quagga Mussel (*Dreissena rostriformis bugensis*) Zebra Mussel (*Dreissena polymorpha*)

ZEBRA AND QUAGGA MUSSELS

These freshwater bivalves are native to the Black Sea region of Eurasia. They were first introduced to the Great Lakes in the late 1980s, by trans-Atlantic ships discharging ballast water that contained adult or larval mussels. They spread widely and as of 2019, can be found in Ontario, Quebec and Manitoba. They are now established in at least 24 American states. Quagga and zebra mussels have not yet been detected in BC, Saskatchewan, Alberta or the north.

IDENTIFICATION

Zebra and quagga mussels—or dreissenid mussels—look very similar, but quagga mussels are slightly larger, rounder, and wider than zebra mussels. Both species range in colour from black, cream, or white with varying amounts of banding. Both mussels also possess byssal threads, strong fibers that allow the mussel to attach itself to hard surfaces—these are lacking in native freshwater mussels.

There are other bivalve species found within BC waters to be distinguished from zebra and quagga mussels (*see table on reverse*).

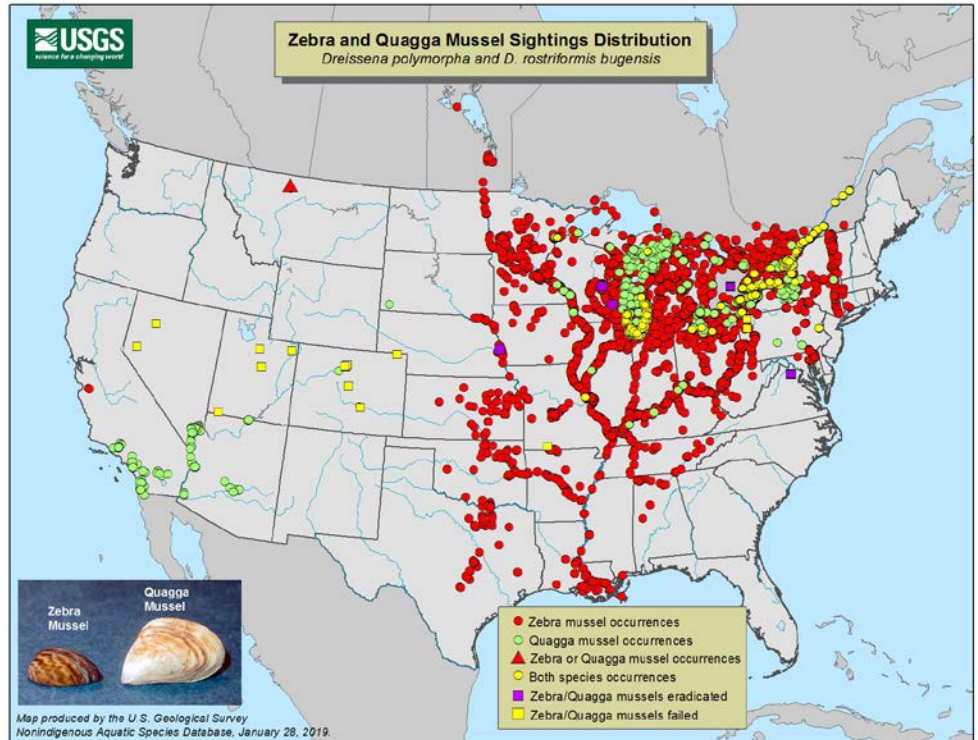
ECOLOGICAL CHARACTERISTICS

Habitat: Zebra mussels can be found in the near shore area out to a depth of 110 metres, while quagga mussels may be as deep as 130 metres. Zebra and quagga mussels prefer depths of 2-12 metres and 10-30 metres respectively, in freshwater lakes, rivers, reservoirs, ponds and quarries, but have been reported in brackish waters as well.

Reproduction: Females can produce up to one million eggs each year. Fertilized eggs hatch into free-floating veligers (larvae) within 2-3 weeks, produce a calcium-based shell and then settle to a hard surface.

Dispersal: Dreissenid mussels may disperse naturally as a free-swimming larvae with water currents or as adults attached to other organisms, aquatic infrastructure or boats.

Human-mediated dispersal includes commercial shipping, recreational boating, water in live wells, bait bucket or bilges and equipment such as work barges and dredges. The primary transport vector within North America is recreational boating. Depending on the temperature and humidity, dreissenids can survive up to **30 days** out of water.



IMPACTS

Ecological: Zebra and quagga mussels pose a serious threat to the biodiversity of aquatic ecosystems, competing for resources with native species like phytoplankton and zooplankton, which form the basis of aquatic food webs.

Removal of large masses of phytoplankton can alter the water clarity, forcing light-sensitive organisms deeper into the water body and also encourages the growth of unwanted aquatic vegetation. Dreissenid mussels selectively avoid toxic algae when feeding, which may facilitate toxic blooms.

Economic: Dreissenid mussels create massive colonies that can block water intakes and interfere with municipal water supplies, agricultural irrigation and power plant operations. This often results in millions of dollars per year being allocated to removal and management. The impact of invasive mussels to BC if introduced is projected to be at least **\$43 million** annually.

Social: Dreissenid mussel colonies can take over beaches, leaving the shoreline covered in razor sharp shells that render it unusable for recreational purposes, and in turn affect property values and tourism. They can also affect boaters as they colonize exposed boat surfaces and often damage boat engines by clogging water intakes.

Once established, invasive dreissenids are nearly impossible to fully eradicate from a water body. Currently, there are very limited tools available to attempt to control or eradicate dreissenid mussels from natural systems without causing harm to other wildlife, including salmonids. Prevention is the most effective solution to protecting waters from invasive mussels.

PREVENTION

CLEAN off all plant parts, animals, and mud from boat and equipment (e.g. boots, waders, fishing gear).

DRAIN onto land all items that can hold water (e.g. buckets, wells, bilge, and ballast). Ensure to always pull all the plugs!

DRY all items completely before launching into another body of water.

Remember, this goes for all types of watercraft and gear—canoes, kayaks, paddle boards, paddles/oars, life jackets, etc.—not just motorized boats!

Rule of thumb: if it touches water it needs to be cleaned.

Learn more at CleanDrainDry.ca

	SPECIES	PHOTO & LENGTH*	SHELL CHARACTERISTICS	DISTINGUISHING FEATURES
FRESHWATER HABITAT	Zebra Mussel <i>Dreissena polymorpha</i> I NP	 ≤3.5 cm	D-shaped, variable dark and light banding	Bysall threads, straight mid ventral line, bilaterally symmetrical
	Quagga Mussel <i>D. rostriformis bugensis</i> I NP	 ≤4 cm	D-shaped, may have banding ranging from black, cream to white	Bysall threads, asymmetrical with without a straight mid ventral line
	Rocky Mountain Ridged Mussel <i>Gonidea angulata</i> N P	 ≤12 cm	Trapezoidal, bluish-green shell with defined growth rings	No bysall threads, only found in the Okanagan Basin
	Asian Clam <i>Corbicula fluminea</i> I P	 ≤6.5 cm	Ovate, yellow/green to brown shell with concentric rings	No bysall threads, inside of shell is purple
	Floater Mussels <i>Anodonta</i> spp. N P	<i>A. kennerlyi</i>  ≤12.5 cm	Elliptical, yellow to brown, smooth & shiny	No bysall threads
		<i>A. oregonensis</i>  ≤12.5 cm	Elliptical, light to dark brown, smooth and shiny	
		<i>A. nuttalliana</i>  ≤18 cm	Ovate, olive, yellow, red-brown or black	
	Western Pearlshell <i>Margaritifera falcata</i> N P	 ≤12.5 cm	Elongated, light brown to dark brown or black	Much thicker shell than dreissenid species, no bysall threads, bottom shell edge is concave

MARINE HABITAT	Blue Mussels <i>Mytilus</i> spp. P	<i>M. californianus</i> N  ≤25 cm	Wedge-shaped, bluish black to brown, ridged	Bysall threads
		<i>M. trossulus</i> N  ≤10 cm		
		<i>M. edulis</i> I  ≤10 cm		
		<i>M. galloprovincialis</i> I  ≤10 cm		

*Images shown at 1/4 of actual size except *A. nuttalliana* and *M. californianus* which are shown at 1/2 of actual size.
 †A. Benson, Bugwood.org; ‡A. Smith; §F. Maretzsohn, Bugwood.org; ¶I. Gardiner; *L. Gelling; **B. Davies; ††L. Schroeder

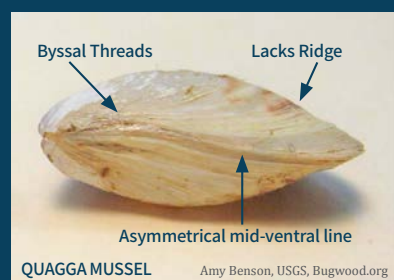
N Native species I Invasive species
 NP Not present in BC P Present in BC



Fisheries and Oceans Canada

Pêches et Océans Canada

ISC Invasive Species Council of BC



LEGAL STATUS IN BC

Under provincial regulations, zebra and quagga mussels (dead or alive) are **Prohibited Species** and are illegal to possess, breed, transport or release.

REPORTING IN BC

For watercraft that have been operated outside of BC, AB, WA, ID, OR, or WY please contact the BC Conservation Officer Service R.A.P.P. Hotline 1-877-952-7277 prior to entering BC waters. Additionally, all watercraft must stop at open designated watercraft inspection stations in BC. It's the LAW. Sightings of zebra or quagga mussels must be reported to the R.A.P.P. hotline.

For more information on Clean Drain Dry and local partners go to bcinvasives.ca.

REFERENCES/LINKS

Ministry of Environment. Mussel Defense Program. <https://www2.gov.bc.ca/gov/content/invasive-mussels/invasive-mussel-defence-program>. Accessed 2018, August, 28.
 Theriault et al. 2012. Risk Assessment for Three Dreissenid Mussels (*Dreissena polymorpha*, *Dreissena rostriformis bugensis*, and *Mytilopsis leucophaea*) in Canadian Freshwater Ecosystems <http://www.dfo-mpo.gc.ca/library/348700.pdf>
 Western, Oregon and Winged Floaters *Anodonta* spp. https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/best-management-practices/okanagan/anodonta_spp.pdf
 Western Pearlshell https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/best-management-practices/okanagan/margaritifera_falcata.pdf
 Mytilus trossulus E-FAUNA BC: ELECTRONIC ATLAS OF THE WILDLIFE OF BRITISH COLUMBIA <http://linnet.geog.ubc.ca/ef fauna/Atlas/Atlas.aspx?sciname=Mytilus%20trossulus>



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