Keeping the Okanagan Zebra & Quagga Mussel Free

Once invasive freshwater mussels become established in a water body, they are impossible to eradicate with any technology currently available.

- Download the full report at **www.obwb.ca/mussel**

Okanagan Lakes Ideal for Mussels

Okanagan lakes have low acidity and abundant dissolved calcium to grow mussel shells. Most lakes in the Southern Interior are at high risk of an infestation.

- **Zebra mussels** (*Dreissena polymorpha*) and **quagga mussels** (*Dreissena rostriformis bugensis*) are two species of prolific, invasive freshwater mussels.
- **Suitable environments for *Dreissena* growth:** pH between 7.4 and 9.4, 12°C to 24°C for optimal reproduction, within 2 – 70 m depth, with moderate to high plankton production and with a minimum calcium ion concentration of 12 -20 mg/L.
- **Adult invasive mussels colonize all types of living and non-living surfaces** including boats, water intake pipes, buoys, docks, piers, plants, and slow moving animals.

Risks to the Okanagan Ecosystem

It only takes a few mussels to infest an entire waterway and destroy its ecosystem. A zebra mussel invasion will have a huge impact on the Okanagan lake ecosystem. By displacing zooplankton, a mussel invasion shuts down the food chain that supplies fish. Infestations can also foul beaches with sharp shells, encrust boats, ruin sport fisheries, and affect water quality.

- **Quagga mussels are as prolific as zebra mussels:** a single mature female mussel can produce more than 1 million eggs in a spawning season.
- **Most at risk are fisheries, tourism, real estate values and water infrastructure,** including public and private water intakes.

Measure That Mussel:
Zebra - up to 15mm, Quagga - up to 20mm

Risks to Okanagan Water Supplies

Invasive mussels pose a significant threat to the Okanagan economy. Mussel colonies can block water intakes, interfere with municipal water supplies, damage pumps, and clog water distribution systems.

- **A cost of $43 million per year** is estimated to manage an infestation of Okanagan waters.

How Invasive Mussels Are Spread

Found as far west today as Lake Mead Nevada and the Red River south of Manitoba, invasive mussels are headed towards us on boats and fishing gear. Simple steps such as draining live wells, not dumping bait into lakes or rivers, removing attached mussels from hulls and cleaning vegetation off boat trailers can prevent the spread of invasive mussels into non-infested waters.

- **Trailered boats and boating equipment** are the most common vectors for mussel movement between water bodies.

Why Invasive Mussels Love Intakes and Outfalls

Intake structures provide excellent habitat for zebra mussel colonies. Water flowing through pipes delivers a continuous source of food and oxygen and carries away wastes, while intake structures themselves protect mussels from predation and environmental conditions such as storm wave activity and scouring by ice.

Infested intake pipe

- **Zebra mussels can attach to intake pipes at water flow velocities of up to 2 m/second.**

Zebra mussels enter water intakes as veligers (larvae) carried by the water flow, as juveniles when they crawl in using their clam-like foot, and as adults when they break loose from colonies and travel on lake or river currents (O'Neil, 1993).

Decontamination Procedures

Adult zebra mussels can live outside of the water for up to 5 days, or longer if left in a cool, moist environment.

For Boaters & Anglers: 'Clean, Drain, Dry'

- CLEAN off any visible debris from all equipment that enters the water
- DRAIN all water from bilge, ballast, live well and bait buckets onto dry land
- DRY all equipment for 5 days in the sun

For Water Suppliers:
Best currently available control for intakes, and most commonly used, is pre-chlorination.

Continuous chlorine concentrations of 1-3 mg/L at the end of the intake are effective at preventing mussels from attaching and growing on and in the intake (Rajagopal et al., 2002).

If used to control both zebra and quagga mussels, the amount of chlorine needed may reach hazardous levels (Grime, 1995). Primary concerns are chlorine's toxicity to non-target organisms and production of trihalomethanes from dissolved organics.

- **Continuous vs Intermittent Chlorination**
  Research has shown that mussels shut their valves as soon as they detect chlorine and open only after chlorine dosing is stopped. Under continuous chlorination mussels are constrained to keep shell valves shut and thereby starve. Intermittent chlorination has little to no effect on mussel mortality.

- **Mortality Varies with Water Temperature**
  Using 0.5mg/L residual chlorine, 95% D. polymorpha mortality was reached in 19 days at $25^{o}C$, compared to 43 days at $10^{o}C$ (Rajagopal et al., 2002).

Other Potential Control Methods:

- **Drawdown and Exposure** – for infestations within an impoundment suited to water level control.
- **Physical Removal** – for small-scale infestations only.
- **Suffocation** – deliberately inducing anaerobic conditions is usually confined to industrial applications.
- **Thermal Treatment** – can be used to keep intakes clear, best used to decontaminate boats.
- **Electricity** – an electric dispersal barrier for rivers to address floating veligers.
- **Biological Control** – using biological predator-prey interactions to manage mussel populations.

There are no known chemical controls suitable for use against invasive mussels in an open environment.

- **Copper algaecide** – may be effective on an early life stages but not adults.
- **Potassium** - Potassium chlorate ($KClO_3$) or potassium chloride (KCl) can be used to selectively kill invasive mussels, however the magnitude of application to a large infested water body may preclude its use.
- Other potential chemical control methods include radiation, filtration, removable substrates, ozone, antifouling coatings, etc.
- **A straining and ultraviolet (UV) light system** was installed at Hoover Dam. The strainer removes large mussels followed by treatment with UV light to kill or disable veligers from settling (Willett, 2011).

Download the full report at **www.obwb.ca/mussel**