

# Rock Snot (Didymo/Cymbella) Risk Analysis for Arizona



Colorado River below Davis Dam July 9, 2009

## Name

Rock Snot

*Didymosphenia geminata* (6 species currently accepted taxonomically)

*Cymbella* sp. (220 species currently accepted taxonomically)

## Description

Rock Snot (a.k.a Didymo or Cymbella species) is a small microscopic diatom that can aggressively bloom and form massive colonies in a thick brown layer that completely covers the substrate. These colonies consist primarily of an extracellular stalk predominantly composed of polysaccharides and protein that hold the cell to the substrate. When the diatom cell divides the stalk also divides eventually forming a dense mat. The extracellular stalks remain even when the cell is no longer present. These stalks are resistant to degradation and can persist for several months. Various observers have described these mats as tissue paper, brown shag carpet or sheep skin covering the stream bed. Didymo feels like wet felt, wool, or cotton balls. It is hard to pull apart, and hard to remove from the substrate it has attached to. In contrast, most other algae species feel slimy and will slip through your fingers.

## Life History

Rock Snot species can thrive in clear, cool oligotrophic streams with stable flows and secure substrate. Since the mid 1980s, Didymo and Cymbella have begun to take on the characteristics

of an invasive species in both its native range and recently introduced waters in massive blooms. Didymo blooms affect benthic macroinvertebrate communities through habitat alterations and food web interactions and also make recreational activities unpleasant. There is speculation that the newly invasive populations of Didymo are the result of a new strain that has broader environmental tolerances. It has also been suggested that changes in the environment such as increased ultraviolet radiation may favor Didymo growth by either reducing the grazer population or limiting populations of other algal species that might out compete or repress Didymo growth. Most nuisance Didymo blooms reported occur in regulated rivers below dams.

The life cycle of a didymo colony occurs in phases. The first phase is when the free floating diatom cells attach to a rocky substrate and begin to produce stalks. These colonies are small circular clumps that range in size from 2 to 10 mm. As these colonies grow they merge together and may completely cover the substrate. Stalk production increases and colonies become one to two centimeters thick. Under favorable conditions stalk production proliferates, the diatoms produce excessive amounts of stalk material many times the length of the microscopic cell and can trail in the current to almost a meter in length. Senescent colonies can continue to affect streams and stream-based recreation. After the diatom cells themselves have died, the stalks persist on the stream substrate. These stalks may endure for several months and change color as they trap fine sediments. The stalks are slowly dislodged from the substrate and float down stream, collecting on sand bars, along the shoreline and wrapping around fishing lines.

### **Reproductive Strategy**

The reproductive strategy of diatoms includes both vegetative and sexual reproduction (Edlund and Stoermer, 1997), although the sexual stage has not been documented in *D. geminata* (Skabichevsky, 1983). When the cell divides through vegetative reproduction the stalk also divides, eventually forming a dense mass of branching stalks with the cell attached to the terminal end. It is not the individual Rock Snot cells that create the nuisance, but the massive production of extracellular stalk.

### **Environmental Tolerances and Restrictions**

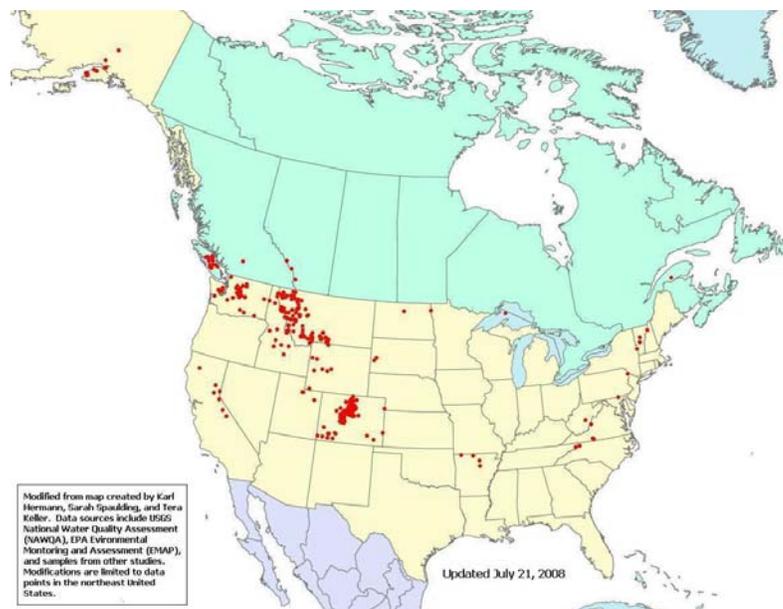
Didymo prefers cool (10 to 20°C), oligotrophic, flowing waters with low conductivity (< 500 but does best between 100 to 200 umhos/cm), pH between 7 and 9 with a water depth of < 2 meters and a secure substrate.

### **Preferred Habitat**

In North America and Europe, high density nuisance blooms are frequent in rivers directly below impoundments (Skulberg 1982, Dufford et al. 1987, Kawecka & Sanecki 2003). Didymo requires a stable substrate.

## Distribution

- **Native Range:** Cool temperate regions of the Northern Hemisphere, including the rivers of northern forests and alpine regions of Europe, Asia and parts of the western United States (not Arizona).
- **Expanded Range:** Didymo has also successfully invaded the Southern Hemisphere and has become established in New Zealand, Chile and Argentina.
- **Expanded Range in the United States:** Scattered populations throughout the United States, including New England, the Mid-Atlantic Region and the western U.S.



- **Current Status in Arizona:** Confusing. Although Didymo has long been suspected of being in Arizona it was not documented until recently. In early 2007, - Ms. Holly Wellard, a graduate student working with Dr. Emma Rosi-Marshall at Loyola University Chicago - found the diatom in the gut of a black fly larva collected in the Colorado River below Lees Ferry. Also, in response to reports of Didymo at Lees Ferry, an algae sample was collected in early 2009 by the Arizona Game and Fish Department (AGFD). The suspected sample was primarily composed of *Mougeotia* and *Cladophora*. However, a single Didymo cell was found associated with this sample.



*Didymosphenia geminata*  
Lees Ferry January 2009

In July 2009, the AGFD received complaints of “toilet paper” fouling the lines of anglers below Davis Dam on the Colorado River. In response to these complaints, a joint investigation was conducted by the AGFD and the Arizona Department of Environmental Quality. The investigation revealed that a bloom of suspected Didymo had occurred immediately downstream of Davis Dam. Due to the depth of the water and the swift current, a sample could not be collected from the substrate, and algal samples were only collected from the water column. However, stalks that were floating in the water column were collected for microscopic examination. The examination did not detect Didymo cells present, but other diatoms species such as *Cymbella sp.* were mixed in with the stalks. The drifting stalks, “toilet paper” were reported by anglers downstream as far as Needles Bridge, a distance of 32 river miles below Davis Dam.



*Cymbella sp.*  
Davis Dam July 2009

Both *Didymosphenia geminata* and *Cymbella sp.* belong to a guild of stalked colonial benthic diatoms that have been responsible for aquatic habitat degradation and complaints of nuisance algae in the western United States. *Cymbella* has been documented in other waters in Arizona, particularly the Salt River lakes, but has not exhibited nuisance characteristics in these waters. Both of these diatoms are characteristic spring dominants and the sloughing of the stalks below Davis Dam may indicate that the colony was in

senescence. Although only *Cymbella* frustules were identified, the stalks had the unique characteristics of *Didymo* (wet cotton balls and resistance when pulled apart).

The nuisance bloom of *Didymosphenia* sp. and/or *Cymbella* sp. has not returned to the Colorado River. Until another bloom occurs and a positive identification can be made this bloom will be considered to have been caused by *Didymosphenia geminata*.

- **Potential Expansion in Arizona**

The environmental tolerances suggest that conductivity and temperature may be the primary limiting factors for nuisance blooms of *Didymo* in Arizona. The most at-risk waters are those streams in the higher elevations with low conductivity primarily on top of the Mogollon Rim and the White Mountains.

### **Pathways**

This alga is so small it can go unobserved when it is a single algal cell on the bottom or in the water column. Additionally, the alga can remain viable for several weeks if kept moist. Because of this, spread of the alga is easy. Felt soled waders are often implicated in the accidental transport of the alga. The alga becomes attached to the felt, and if not properly cleaned or thoroughly dried before use, the diatom can spread to another waterbody. Any recreational equipment, including bait buckets, neoprene diving gear, water shoes/sandals, canoes, kayaks, and life jackets, that has come into contact with the water can also transport this diatom.

### **Potential Impacts**

#### **Wildlife/Habitat**

Abundance and diversity of benthic macroinvertebrates communities are likely to be affected by *D. geminata* through direct trophic interactions and habitat interactions (Larned et al. 2006). These mats will also reduce fish spawning habitat and make recreational activities unpleasant.

#### **Infrastructure**

Extensive mats may cause a modification or river hydraulics and biofouling of municipal, industrial, agricultural water intakes.

#### **Economic**

Loss of local recreational values as anglers, boaters and swimmers may avoid heavily infested areas.

#### **Human Health**

*Didymo* is not considered a human health risk.

#### **Benefits**

None

#### **Treatments**

- Remove all visible clumps of algae and plant material and mud from fishing gear, waders, clothing, water shoes and sandals, canoes and kayaks, and anything else that has been in the water.

- Soak and scrub all items for at least 10 minutes in *very hot water* with lots of soap. Felt-soled waders need 30 minutes.
- Dry all equipment

### Recommendation

Through Arizona Game and Fish Department Directors Order {A.R.S. §17-255.01(B)}, list Didymo; a.k.a. Rock Snot (*Didymosphenia geminata*) as an aquatic invasive species in Arizona, with subsequent affected waters listing and mandatory conditions for movement.



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### References

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