IS "ROCKSNOT" (*DIDYMOSPHENIA GEMINATA*) IN GRAND TETON NATIONAL PARK?

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ABSTRACT

Didymosphenia geminata is a microscopic single-celled freshwater diatom. The invasive behavior of *D. geminata* is greatly altering physical and biological conditions in streams and rivers; the stalk material byproduct that *D. geminata* produces has the potential to cover up to 100% of stream substrate with a thickness of 20 cm. Even though *D. geminata* is native to the United States, it is acting like an invasive species. Once only identified in nutrient poor waters, *D. geminata* has been expanding its native range and is occurring more frequently in nutrient-rich streams and rivers. We conducted a survey of *D. geminata* in Grand Teton National Park Wyoming and to our knowledge, this is one of the first surveys examining *D. geminata* in this area. We found and confirmed *D. geminata* in approximately 7 streams including; Phelps Lake Outlet $1.5x10^8$ cells/m^2, Taggert Lake Outlet $2.4x10^7$ cells/m^2, Phelps Lake Inlet $2.1x10^6$ cells/m^2, Jenny Lake Outlet $8.4x10^5$ cells/m^2, Flat Creek $2.9x10^7$ cells/m^2, Leigh Lake Outlet $1.3x10^4$ cells/m^2, and Fish Creek $9.2x10^5$ cells/m^2. Potential commonalities in the sites where *D. geminata* was found and confirmed in Grand Teton National Park include lake outlet streams and high traffic areas.

INTRODUCTION

Rock snot, or *Didymosphenia geminata*, commonly known as '*Didymo*', is a microscopic single-celled freshwater diatom (Figure 1). Diatoms are algal protists that are important primary producers in aquatic systems (Prescott et al. 2005). The cell walls (frustules) of diatoms are made of silica (SiO_2) and vary greatly in shape and size. *D. geminata* is one of the largest diatoms at approximately 130 µm in length and can be identified by its unique shape. In valve view *D. geminata* has an hour glass/figure-eight conformation, and in its girdle view it is wedge-shaped. One main problem with *D. geminata* is that it is acting as an invasive species and greatly altering physical and biological conditions in streams and rivers.

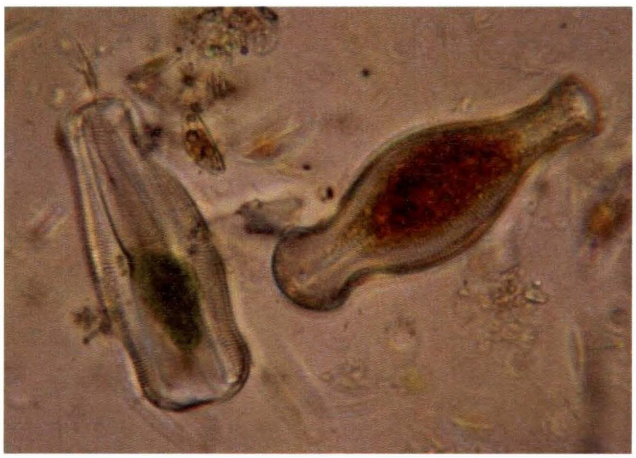

Figure 1. Picture taken by Lisa Kunza: *D. geminata* shown at x400 magnification in valve view (right image) and girdle view (left image), sample from Taggert Lake Outlet.

D. geminata itself, however, is not the primary problem, but rather, the stalk material it produces; when the cell dies, this stalk material remains on the stream bottom in a wool-like mat. Mats can cover up to 100% of stream substrate with a thickness of 20cm (Spaulding and Elwell 2007). Such coverage poses a risk of substantial changes in ecological processes such as ecosystem metabolism, nutrient cycling, and animal behaviors, as well as ecological properties such as species diversity, population size, and nutrient pools (Kilroy 2006). For instance, *D. geminata* mats alter the

ability of invertebrates with appendages to move, decreasing biodiversity in and around the stream. Therefore, *D. geminata* mats can impact fish populations.

D. geminata is documented in areas of North America (Canada & U.S.), Asia (China), Europe (Scotland, Sweden, and Finland), and has been recently documented in New Zealand (Kilroy 2004). Even though *D. geminata* is present in the United States, information about its native range is limited. In fact, the main diatom identification manual (Patrick and Reimer 1966) only describes *D. geminata* as being present in Virginia. Even though *D. geminata* is native to North America, it has been acting like an invasive species. *D. geminata* has been expanding its range. Until recently, *D. geminata* was limited to nutrient-poor waters, but is now occurring more frequently in nutrient-rich streams and rivers (Spaulding and Elwell 2007).

Early detection is key in preventing and/or slowing the spread of *D. geminata*. Early detection increases the potential for successful mitigation of impacts and also enables more efficient targeting of containment, control, and public awareness measures (Schmidt 2007). We are performing a presence/absence survey of *D. geminata* in Grand Teton National Park, Wyoming. To our knowledge this is one of the first surveys examining *D. geminata* in this area.

✦ METHODS

Study Area

Our *D. geminata* research project was divided into two primary portions; field sampling and laboratory work. Field sampling took place in streams located in Grand Teton National Park, Wyoming; some streams located just outside the park were sampled as well to provide a better estimation of *D. geminata*'s presence (Figure 2).

We sampled approximately 25 streams including; the streams along the Teton Range, the Snake River and tributaries east of the Snake River such as Pilgrim Creek, Pacific Creek, Arizona Creek, Lizard Creek, Polecat Creek, Spread Creek, and Ditch Creek. A complete list of all streams is in Appendix A. All laboratory work was conducted at the University of Wyoming/National Park Service Research Station and the laboratories located at the University of Wyoming.

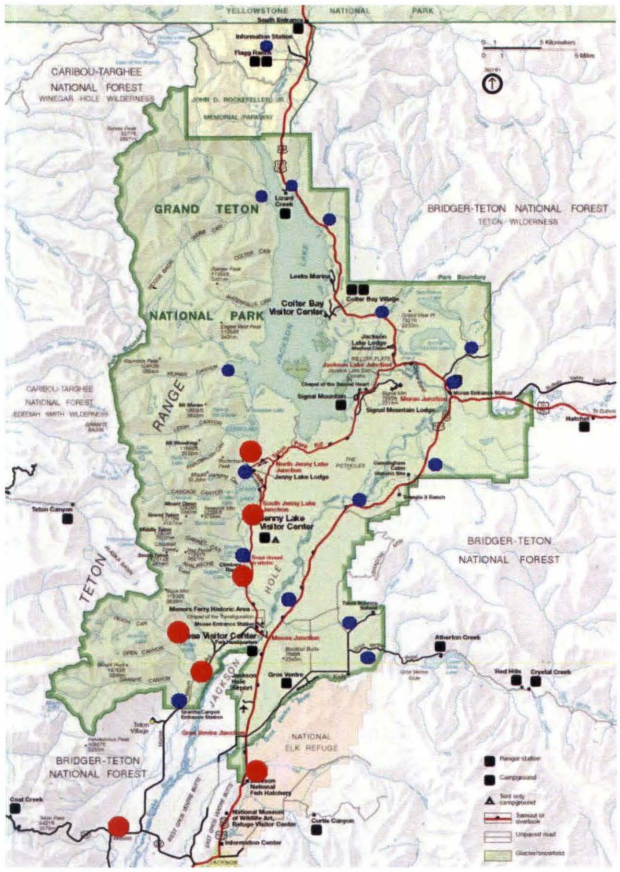

Figure 2.Picture adapted from <http://www.colonialvoyage.com>. Red dots symbolize areas where *D. geminata* was found and confirmed and blue dots symbolize areas where *D. geminata* was not found: Snake River at South Park Bridge is not shown on the map, however it would be represented with a blue dot as no *D. geminata* was found.

Streamside Procedures

We searched for *D. geminata* mats at each field location and sampled the mats directly, if present. To do this, we collected five rocks and measurements of *D. geminata* on the rocks were taken. We measured the thickness of *D. geminata* in centimeters and coverage of *D. geminata* on a 10cm² area of the rock. We placed mats in Whirl-paks for future reference. We then scrubbed the rocks and the homogenized liquid was placed into two separate 20mL scint vials per rock.

We sampled no fewer than 5 cobbles (over 100-200 meters reach) in each stream. Each rock was thoroughly scrubbed into a tray and the homogenized liquid was sub-sampled. We measured the surface area of each rock containing the sample in order to normalize cell counts per unit area; this was done by tracing each rock on Rite-in-the-Rain paper to estimate surface area.

In order to prevent us from spreading *D. geminata*, we immediately submerged all brushes, graduated cylinders, trays, and shoes worn at the site in 10% antibacterial detergent solution for more than 30 minutes after being exposed to the stream. It is recommended to use a 5% solution of bleach or detergent (Spaulding and Elwell 2007); however, we took further precautions by treating our gear with a much higher concentration. We then made a report for each individual stream stating details such as the number of people present at the stream, visual and physical aspects of the stream (GPS coordinates and elevation measurements).

Laboratory Procedures

We created wet mounts to seek out *D. geminata* at a microscopic level (5 slides per rock were observed or 25 slides per stream). Wet mounts were created by placing one drop of homogenized liquid on a microscope slide using a plastic pipette and covering it with a cover glass slip. We looked over the entire area of the cover glass for *D. geminata* cells and stalk material using a microscope at 100x magnification. If other diatoms or stalk material were present, we made a note of it. If *D. geminata* was present in the slide, each individual cell was counted and documented. To avoid contamination, we used a different microscope slide, cover slip, and plastic pipette for each stream. We then used these values to calculate the concentration of *D. geminata* in the stream (detection limit: 620 cells/m^2). We stored the second 20mL scintillation vial of the remaining sample in 2% gluteraldehyde to preserve for future reference.

✦ RESULTS

We found and confirmed *D. geminata* in approximately 7 streams, mostly lake outlets. *D. geminata* mats were present in Taggert Lake Outlet where few mats were present and Phelps Lake Outlet where mats were very dense. We found a trend of *D. geminata* presence in lake outlet streams and high traffic areas; areas where people had direct access to the stream or highly traveled areas (bridges, roads, trails, etc.).

✦ DISCUSSION

We found *Didymosphenia geminata* inside and outside of Grand Teton National Park, Wyoming. The information gathered from the various streams and rivers where *D. geminata* was not found will provide a valuable reference to prior conditions if this potentially destructive diatom does appear in these areas in the future. Our findings have improved the knowledge about the presence and absence of *D. geminata* in Grand Teton National Park's streams and rivers as well as streams and rivers just outside of the park. Research needs to continue in these areas to better understand not only the presence and absence of D. geminata, but its spread and reasons behind dispersal. Potential commonalities in the sites where *D. geminata* was found and confirmed in Grand Teton National Park include lake outlet streams and high traffic areas; four of the seven streams where *D. geminata* was found are lake outlet streams and all streams were noted as high traffic areas (no less than 10 people present at the stream).

Sample Locations	D.geminata Abundance (cells/m^2)
Phelps Lake Outlet	$1.5*10^8$
Taggert Lake Outlet	$2.4*10^7$
Phelps Lake Inlet	$2.1*10^6$
Jenny Lake Outlet	$8.4*10^5$
Flat Creek	$2.9*10^7$
Leigh Lake Outfall	$1.3*10^4$
Fish Creek	$9.2*10^5$
Blacktail Spring Creek	0
Kelly Warm Springs	0
Triangle X Creek	0
Two Oceans Creek	0
Bradley Lake Outlet	0
String Lake Outlet	0
Lizard Creek	0
Arizona Creek	0
Polecat Creek	0
Granite Creek	0
Berry Creek	0
Moran Creek	0
Pilgrim Creek	0
Pacific Creek	0
Ditch Creek	0
Spread Creek	0
Snake River @ South Park Bridge	0

Table 1: Illustrates the abundance of *D. geminata* in sample locations. Note the evident trend of *D. geminata* abundance in lake outlet streams.

✦ LITERATURE CITED

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Prescott, L.M., J.P. Harley and D.A. Klein. 2005. Microbiology Sixth Edition. The McGraw Hill Companies, Inc. 560, G-8.

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Appendix A

Streams Researched	GPS Coordinates Top of Reach	Concentrations (*D. geminata* cells/m²)	Lake Outlet (Y/N)	People Present? (Y/N)
Phelps Lake Outlet	N 43° 37.565' W 110° 47.025'	$1.5*10^8$	Y	Y
Taggert Lake Outlet	N 43° 41.806' W 110° 44.162'	$2.4*10^7$	Y	Y
Phelps Lake Inlet	N 43° 39.139' W 110° 48.365'	$2.1*10^6$	N	Y
Jenny Lake Outlet	N 43° 44.748' W 110° 43.624'	$8.4*10^5$	Y	Y
Flat Creek	N 43° 29.671' W 110° 45.401'	$2.9*10^7$	N	N
Leigh Lake Outfall	N 43° 47.846' W 110° 43.715'	$1.3*10^4$	Y	Y
Fish Creek	N 43° 29.880' W 110° 52.344'	$9.2*10^5$	N	Y
Blacktail Spring Creek	N 43° 40.521' W 110° 41.726'	0	N	Y
Kelly Warm Springs	N 43° 38.410' W 110° 37.099'	0	N	Y
Triangle X Creek	N 43° 45.570' W 110° 34.990'	0	N	N
Two Oceans Creek	N 43° 52.522' W 110° 29.309'	0	N	N
Bradley Lake Outlet	N 43° 42.742' W 110° 43.938'	0	Y	Y
String Lake Outlet	N 43° 47.041' W 110° 43.678'	0	Y	Y
Lizard Creek	N 44° 00.411' W 110° 40.848'	0	N	N
Arizona Creek	N 43° 58.474' W 110° 38.623'	0	N	N
Polecat Creek	N 44° 06.624' W 110° 41.575'	0	N	Y
Granite Creek	N 43° 36.386' W 110° 48.317'	0	N	Y
Berry Creek	N 43° 59.837' W 110° 42.678'	0	N	N
Moran Creek	N 43° 51.707' W 110° 45.256'	0	N	N
Pilgrim Creek	N 43° 54.468' W 110° 34.885'	0	N	N
Pacific Creek	N 43° 51.209' W 110° 30.747'	0	N	N
Ditch Creek	N 43° 39.809' W 110° 37.728'	0	N	N
Spread Creek	N 43° 47.404' W 110° 32.233'	0	N	N
Snake River @South Park Bridge	N 43° 23.095' W 110° 44.779'	0	Y	Y