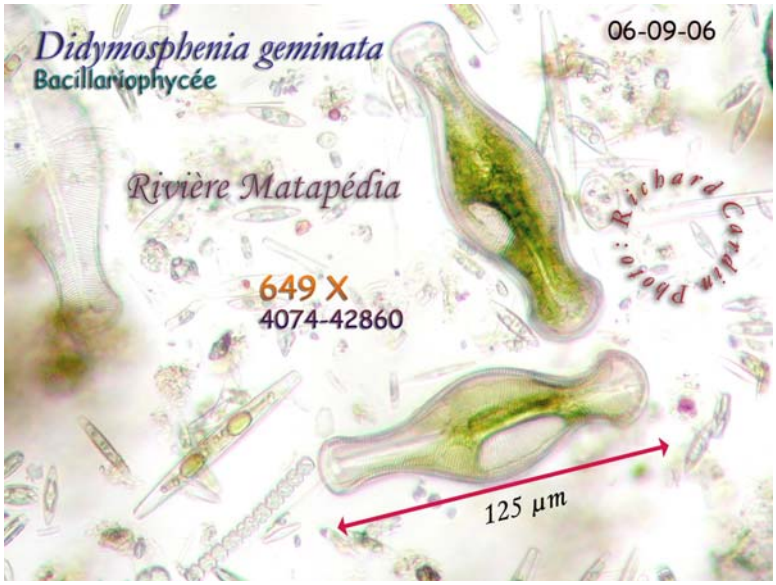
What Is Didymo and
How Can We Prevent It From Spreading In Our Rivers?



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Québec
Ministère du Développement durable,
de l'Environnement et des Parcs
Ministère des Ressources naturelles
et de la Faune

Photograph of cells of *Didymosphenia geminata*.
Source: Centre d'expertise en analyse environnementale du Québec, September 2006.

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1. Background

The first *Didymosphenia geminata* bloom in Québec occurred in the summer of 2006 in the Matapedia River in the Lower St. Lawrence region. The alga, commonly known as didymo, is a relatively rare species and is native to rivers and lakes in boreal and montane regions of the Northern Hemisphere. Since the mid-1980s, didymo has been reported in a number of countries. In Canada, didymo blooms have been observed in British Columbia, particularly in several central Vancouver Island rivers, in the Bulkley, South Thompson, Kettle, Columbia and Kootenay rivers, and east of the Rockies in the Bow, Red Deer and Old Man river basins in Alberta. A number of western U.S. states, including Montana, Dakota, Colorado and Utah, have also reported didymo blooms. In Europe, blooms have been confirmed in Finland, Hungary, Ireland, Iceland, Norway, Poland and Romania. The rivers of the South Island of New Zealand have also been seriously affected by didymo blooms, where it has been officially declared an unwanted organism.

The excessive algal blooms reported in certain rivers of New Zealand are an isolated occurrence and, at this time, there is no reason to believe that the algae will spread to the same extent in Québec salmon rivers. Québec's climate is very different from that of either the Southern Hemisphere or the west coast of Canada. In addition, the situation in certain rivers on Vancouver Island, which have been invaded by didymo in recent years, has improved considerably. The decline in didymo populations could be tied to the rivers' natural control mechanisms, which have not yet been identified. However, didymo blooms are still occurring in other Vancouver Island rivers.

2. Description

Didymosphenia geminata is a single-celled, microscopic, freshwater diatom, measuring approximately 100 – 130 micrometers length x 30 – 50 micrometers width. Its external cell wall, called a frustule, is composed of silica. Didymo produces a mucilaginous stalk by which the live cells attach to rocks and vegetation. During blooms, the stalks form mats that cover the stream bed. Only the cells of didymo are living; the stalks are formed of non-photosynthetic mucopolysaccharides and range in colour from **brownish yellow to white**. The algae can also be observed along the edges of lakes with rocky substrates exposed to wave action. To the touch, the algae **feel like wet cotton wool**.

Didymo occurs in shallow waters. When the river level falls, mats of dried algae on rocks can be mistaken for strands of toilet paper or parchment paper, causing concerns about possible sewage discharges. In contrast to cyanobacteria (blue-green algae) in southern Québec, didymo blooms are not caused by pollution or excessive phosphorus in streams. To the contrary, didymo thrives in oligotrophic, or low-nutrient, waters.

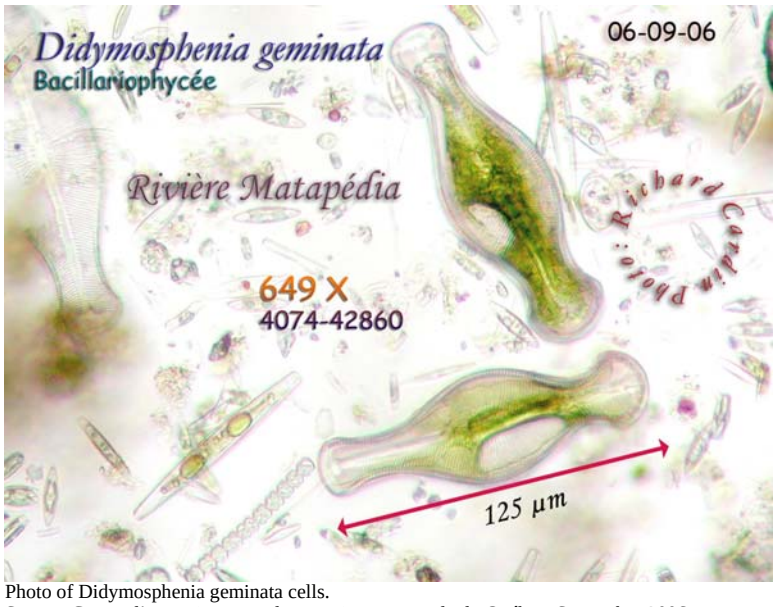


Photo of Didymosphenia geminata cells.
Source: Centre d'expertise en analyse environnementale du Québec, September 2006.

3. Characteristics of rivers affected by *Didymosphenia geminata*

The common characteristics of rivers affected by didymo blooms are:

- stable rocky substrate and river flow;
- high light exposure;
- clear, low-nutrient waters;
- significant fishing pressure;
- easy access.

4. Human health impacts

According to the available data, didymo does not render water unfit for consumption and it is not toxic. However, people swimming in waters downstream from areas containing high concentrations of didymo have complained of eye irritations, which may be caused by the silica of the frustules.

5. Potential impacts on habitat

In extreme cases, didymo blooms are believed to impact stream food webs by reducing algal diversity and altering the species composition of invertebrate communities. There are reportedly more snails, midges, tubifex worms and caddisflies but fewer mayflies. Furthermore, the proportional increase in caddisflies was not as great as the proportional increase in midges and tubifex worms.

If extensive, recurrent growths of didymo were to occur in Québec rivers, there is reason to believe that the alteration of the physical habitat and benthic invertebrate communities composition could potentially affect fish diet. Large mats of algae covering river beds could also cause changes in streamflow.

It has been suggested that the most important potential impact of didymo that has been studied may be the impact to pH during midday, at biomass levels as high as those observed in New Zealand. Cumulative effects of elevated pH levels could impact organisms sensitive to this change.

Mats of Didymosphenia geminata on a stone collected in the Matapédia River, in Portes de l'Enfer. Source: Matapédia River Watershed Council (CBVRM), October 2006.

6. Potential impacts on salmon and other salmonids

In early September 2006, the ministère des Ressources naturelles et de la Faune (MRNF) carried out an electric fishing survey at sites in the Matapédia River where a significant quantity of didymo had been observed and at other sites where a small quantity of the algae had been

reported. The results of the study did not show that the algae had a measurable impact on the abundance of juvenile salmons (parr).

MRNF also contacted several European government agencies, through the North Atlantic Salmon Conservation Organization. Fisheries experts and managers from France, Iceland, Ireland, Scotland, Finland and Norway described the situation in their respective countries and provided relevant information on the alga and its impacts on salmon.

Although the presence and spatial coverage of this alga have increased in recent years in some European countries, particularly Iceland, all authorities contacted agreed that no impacts had been observed or even suspected to date on Atlantic salmon, either adults or juveniles, or other salmonid species. Furthermore, results of studies on salmonids conducted in British Columbia and Norway indicated no significant negative effect attributable to didymo.

None of the government agencies contacted by MRNF has implemented any special decontamination procedure for didymo. Despite the fact that it is spreading in some areas, its presence does not appear to have an impact on the fishery or the maintenance of Atlantic salmon populations in the countries in which the agencies are located. However, Iceland requires mandatory cleaning of fishing equipment at its international airport and at ports of entry. This measure is designed to eliminate a parasite, *Gyrodactylus salaris*, which can result in mortality in juvenile Atlantic salmon.

7. Potential impacts on infrastructure and recreational activities

Growing mats of *Didymosphenia* or algal material from sloughing mats drifting in the current can sometimes clog water intakes. The equipment of fishers, kayakers, canoeists or other recreational users of rivers can also be made foul with didymo mats. The mats can affect the aesthetic quality of rivers, making them look as though they were polluted.

8. Vectors for the spread of didymo

The most likely explanation for the appearance of didymo algae in the Matapédia River is human transfer by users of the river. In British Columbia, it has been shown that the appearance of didymo coincided with the introduction of felt-soled waders on the market. Because didymo cells can survive for up to 30 days in wet felt soles, they can be transported from river to river. Migratory birds, pets and wildlife can also be vectors for the introduction and spread of the alga, as well as boats, diving equipment and any other equipment used in lakes and rivers.

9. Vulnerable rivers

So far, didymo has only been reported for some salmon rivers in the Bas-Saint-Laurent and Gaspésie regions. It has not been detected in the Côte-Nord region despite the fact that it has many salmon rivers. At this point, it is hypothesized that the physical and chemical

characteristics of water in the Côte-Nord rivers are not as favourable for didymo as those of the Bas-Saint-Laurent and Gaspésie rivers.

Table 1 lists the mean values of some physical and chemical characteristics of water for 17 rivers in the Côte-Nord region and for 15 rivers in the Bas-Saint-Laurent and Gaspésie regions. Since most of these rivers are not currently monitored, calculations were based on historical data collected between 1979 and 1985.

As results show, rivers from the Côte-Nord differ markedly from those of the Bas-Saint-Laurent and Gaspésie regions with respect to their low pH, alkalinity, and calcium values as well as their high dissolved organic carbon and true color measurements. The particular water quality characteristics of the Côte-Nord rivers do not seem to favour the establishment of didymo, which thrives in pristine, crystal clear and well-buffered waters. However, one should nevertheless consider these rivers at risk because they are heavily used by fishermen and other recreational users. For this reason, users of these rivers should also adopt the same precautionary measures to prevent the accidental introduction of didymo or any other invasive aquatic species.

Table 1. Mean values of some physical and chemical variables of rivers from the Côte-Nord and Bas-Saint-Laurent–Gaspésie regions.

Water Quality Variables	Côte-Nord (N=17)	Bas-Saint-Laurent–Gaspésie (N=15)
Calcium (mg/l)	2.0	27.0
Alkalinity (mg/l)	4.0	77.4
pH (pH units)	6.5	8.0
Dissolved Organic Carbon	4.9	2.5
True Colour (UCV)	27.6	8.1
Total P (mg/l)	0.019	0.020

Source: Banque de données sur les milieux aquatiques (BQMA), ministère du Développement durable, de l'Environnement et des Parcs (MDDEP)

10. Local and governmental action

The Centre de contrôle environnemental du Québec (CCEQ) of the ministère du Développement durable, de l'Environnement et des Parcs (MDDEP), in the Lower St. Lawrence, was informed of an algal bloom in the Matapédia River in late July 2006 by fishermen and the Corporation de Gestion des Rivières Matapédia et Patapédia (CGRMP). The CCEQ and MRNF conducted monitoring and sampling in the Matapédia River watershed in August and September 2006. The Matapédia River Watershed Council (CBVRM), local stakeholder subsidized by the MDDEP,

was also contacted by CGRMP to find out about the origin of the algal bloom. CBVRM investigations allowed to discover that the mats consisted of *Didymosphenia geminata*. This identification was later confirmed in late August 2006 by Dr. Max Bothwell, an Environment Canada researcher from British Columbia and a didymo expert.

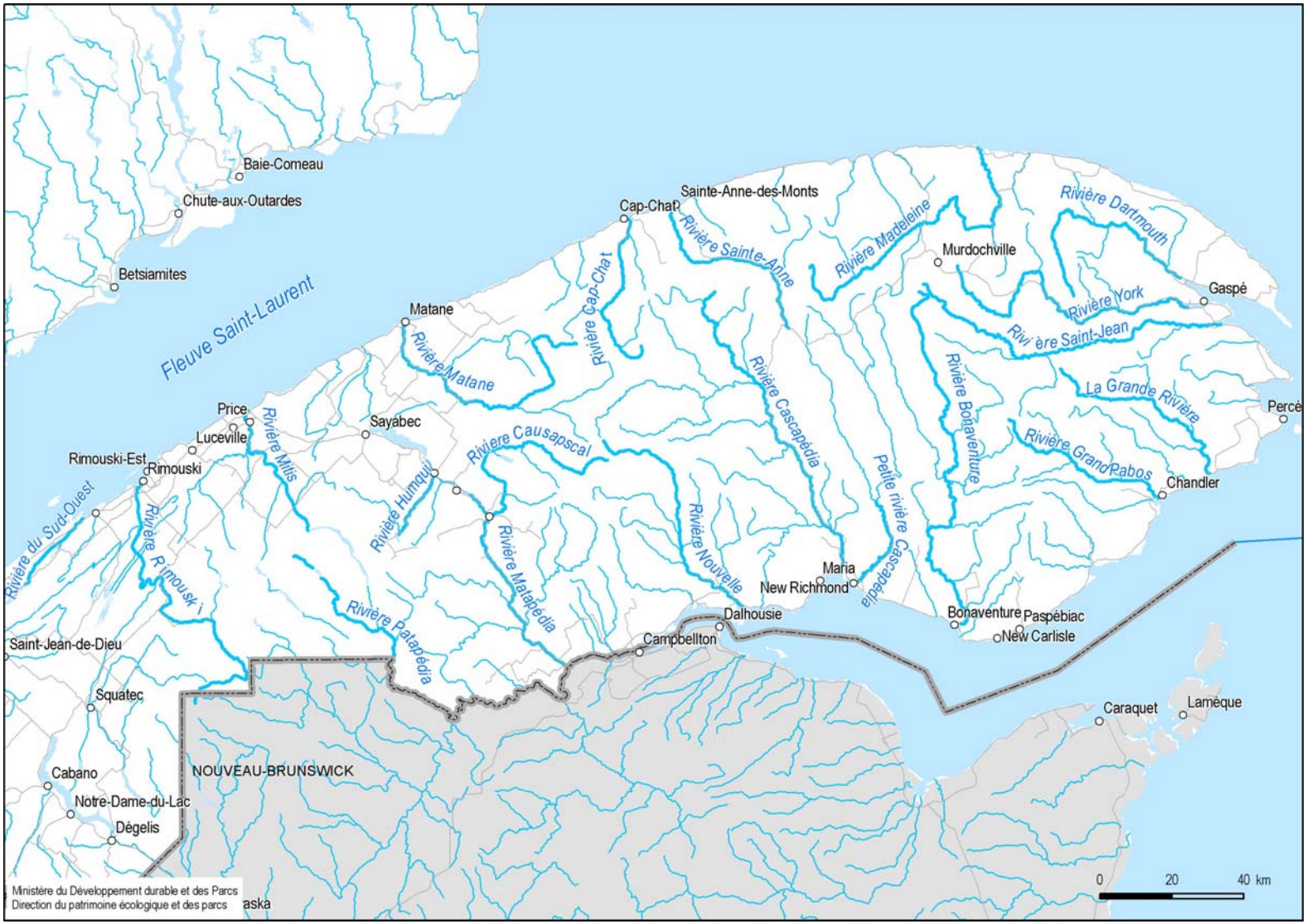
In early September 2006, an ad hoc working group was formed, composed of representatives of MDDEP, MRNF, CGRMP and CBVRM.

From November 7 to 17, 2006, the regional office of MDDEP carried out sampling in three rivers in the Lower St. Lawrence (Rimouski, Mitis and Matane rivers) and eight rivers in the Gaspé Peninsula (Nouvelle, Grande Cascapédia, Petite Cascapédia, Bonaventure, Saint-Jean, York, Dartmouth and Sainte-Anne rivers) aimed at detecting the presence of didymo (see map and table). These salmon rivers were selected because they may have been visited by the same users as those who frequented the Matapédia River in the summer of 2006.

Sampling results confirmed the presence of didymo cells in the Petite Cascapédia, Cascapédia, Nouvelle, Sainte-Anne and Bonaventure rivers in the Gaspé Peninsula. In the Lower St. Lawrence, the results revealed that the Matane River, in addition to the Matapédia River, was affected. However, the presence of didymo does not mean that blooms similar to those observed in the Matapédia River will necessarily occur in these rivers.

In 2007, didymo blooms reappeared in the Matapédia River and were observed for the first time in the Patapédia, Humqui, Nouvelle, Cascapédia, and Petite Cascapédia Rivers. Even though the blooms observed in the Matapédia River covered a longer distance in 2007 than in 2006, their extent was less severe. The blooms that affected the other rivers were light and occurred later at the end of summer or by early fall. Moreover, didymo cells were detected in the La Grande Rivière but they did not translate into blooms. These rivers will receive special attention in the years to come.

A steering committee and a scientific committee composed of representatives of MDDEP and MRNF are currently working, in collaboration with the main regional partners, to implement an action plan that aims at preventing the spread of didymo to other rivers or streams and limiting its expansion in affected watercourses.



Locations of the Bas-Saint-Laurent and Gaspésie watercourses affected by didymo in 2006 and 2007.

Table 2. Extent of Didymo presence reported for the Bas-Saint-Laurent and Gaspésie watercourses in 2006 and 2007.

Name of watercourse	Results of the 2006 Sampling Survey	Blooms reported in 2006 / Approximate extent measured from river mouth (km)	Results of the 2007 Sampling Survey	Blooms reported in 2007 / Approximate extent measured from river mouth (km)[1]
Causapscal	Absence	-	Absence	-
Patapédia		-	**Presence**	**7**
Matapédia	**Presence**	**39**	**Presence**	**56**
Nouvelle	**Presence**	-	**Presence**	**32**
Cascapédia	**Presence**	-	**Presence**	**13**
Petite Cascapédia	**Presence**	-	Absence	**32**
Bonaventure	**Presence**	-	Absence	-
Grand Pabos Nord		-	Absence	-
La Grande Rivière		-	**Presence**	-
Saint-Jean		-	Absence	-
York	Absence	-	Absence	-
Dartmouth	Absence	-		-
Madeleine		-	Absence	-
Sainte-Anne	**Presence**	-	Absence	-
Cap-Chat		-	Absence	-
Matane	**Presence**	-	Absence	-
Mitis	Absence	-	Absence	-
Rimouski	Absence	-	Absence	-
Sud-Ouest		-	Absence	-
Humqui		-		**2**

[1]: Didymo mats did not cover completely the river bed over the reported distance. Occurrences were sporadic.

Source : Ministère du Développement durable, de l'Environnement et des Parcs,
Direction régionale de l'analyse et de l'expertise du Bas-Saint-Laurent et de la Gaspésie–Îles-de-la-Madeleine

11. Prevention strategy

To prevent the introduction or spread of *Didymosphenia geminata* or any other aquatic invasive species, it is generally recommended to restrict the use of equipment, boats, clothing and other items to a single waterway wherever possible.

If you have to move from one waterway to another, equipment, boats, clothing and other items should be cleaned in accordance with certain guidelines, in order to prevent the spread of didymo. The following methods, developed and tested by New Zealand authorities (Biosecurity New Zealand), have proven effective in controlling the spread of didymo.

- **Check:** Before leaving the river, check your boat and equipment carefully and remove all obvious clumps of algae, taking care to look for hidden clumps. Leave clumps at the affected site. After leaving the affected area, if you find any clumps, do not wash them down the drain, but rather throw them in a garbage can. Treat your equipment as described below.

- **Clean:** all items that were in contact with water.

  - **Non-absorbent items:**

  Soak and scrub all items for **at least one minute** in one of the following solutions:

  – Very hot water kept above 60 °C (hotter than most tap water), or for at least 20 minutes in hot water kept above 45 °C (uncomfortable to touch).
  – A 2% solution of bleach (200 ml and water added to make 10 litres);
  – A 5% solution of salt (500 ml or 2 cups and water added to make 10 litres);
  – A 5% solution of antiseptic hand cleaner (500 ml or 2 cups and water added to make 10 litres);
  – A 5% solution of dishwashing liquid (500 ml or 2 cups and water added to make 10 litres).

  - **Absorbent items:**

  Absorbent items like felt-soled waders require longer soaking times to allow thorough saturation. Leave your absorbent material to soak:

  - At least **40 minutes** in **hot water** kept above 45 °C;
  - At least **30 minutes** in **hot water** kept above 45 °C containing a 5% dishwashing detergent solution.

- **Dry** completely your equipment if you cannot clean it adequately and then allow it to dry for an additional 48 hours before using it in another lake or river. Drying will eliminate didymo cells, but slightly moist didymo cells can survive for months. Items must be completely dry to the touch, inside and outside, to ensure that cells are eliminated**.**

- **Freezing of material:**

  Freezing any item until solid will also eliminate didymo cells.

When applying these decontamination methods, it is recommended that you:

- use biodegradable products and phosphate-free detergents;
- do not dispose of cleaning wastes in lakes or rivers;
- use a cleaning solution recommended above that will not alter your equipment;
- follow the product manufacturers' safety recommendations.

Additional precautions must be taken for the following items.

- **Motor boats**: Clean boats, both inside and outside, as well as mechanical parts (including propellers), various compartments and trailers with one of the above cleaning solutions.

- **Kayaks, canoes and dinghies**: Scrub the exterior of the craft vigorously with one of the recommended cleaning solutions for at least one minute, then fill the interior of the craft with the same solution and place all equipment, gear and clothing used in the boating activity into the boat. Immerse the equipment completely and stir the solution for at least one minute, then rinse with tap water.

- **ATVs**: Carefully examine vehicles to remove all clumps of algae that may be attached. Thoroughly clean the underside of vehicles, tires and parts that come into contact with the water with the cleaning solution. Leave the solution on for at least one minute. Commercial car washes with an underside spray are suitable for this purpose.

- **Fishing equipment**: Clean all rods, reels, fishing lines, flies, tackle boxes and waders and rinse with tap water. If it is not feasible to clean fishing equipment using the suggested method, fishers can choose to restrict the use of their equipment to a single lake or river.

- **Pets**: Wash pets for at least one minute with an animal shampoo or disinfectant. If they cannot be washed, they should be held in an area away from waterways for at least 48 hours.

- **Users and their clothing**: Wash yourself with soap or shampoo and dry yourself completely before entering another lake or river. Potentially contaminated clothing must be washed with laundry detergent and dried thoroughly before being reused. Shoes must be scrubbed or sprayed with one of the suggested cleaning solutions for at least one minute.

To report a didymo bloom, contact the nearest MDDEP regional office (see link below).
http://www.mddep.gouv.qc.ca/ministere/rejoindr/adr_reg.htm

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