

## Investigation of an outbreak of cercarial dermatitis

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### SUMMARY

We present the investigation of an outbreak of cercarial dermatitis that occurred in a recreational-tourist lake in the Québec City region (Canada) in the summer of 1999. A case-reporting form was sent to 450 families likely to have activities that would bring them in contact with the lake's water. The snails were characterized and the prevalence of their infestation by schistosomes was investigated. In total, 63 episodes consistent with cercarial dermatitis were reported. Sixty-nine percent of the cases occurred from swimming at the same beach. This location was the one where the only population of snails in the lake was identified. Shoreline residents were informed that they should not feed waterfowl, and a clean-up of the snail population was done at the start of the following summer. There were no cases of cercarial dermatitis at this site the following summer.

### INTRODUCTION

Cercarial dermatitis (swimmer's itch) is caused by skin penetration by the cercariae of a nonhuman species of schistosome [1]. The life cycle of this schistosome involves aquatic mollusc shellfish as intermediate hosts, and a bird or mammal as definitive host (see Fig. 1).

The cercariae enter the skin and the parasite cycle is interrupted. A hypersensitivity response supervenes with repeated exposure [2]. It can be summarized as a pruritic maculopapular eruption occurring 10–15 h after penetration by the cercariae. This reaction resolves in a week [3]. Although rare, systemic symptoms (fever, chills, adenopathy) have been reported [1, 4–6].

Cercarial dermatitis has been detected in several Canadian provinces [7] including Québec [8, 9]. Here we report the investigation of an outbreak of dermatitis that occurred in a recreational-tourist lake in the region of Québec City (Canada). This investigation clearly identified the problem so that steps to attenuate it could be taken the following summer.

### METHODS

#### Reporting the outbreak

Lac Beauport (Fig. 2) is a 833 m<sup>2</sup> lake approximately 20 km from the centre of Québec City. On its shoreline are 3 hotels, 4 public beaches and a few private beaches for lakeside residents.

On 5 August 1999, the Direction de santé publique de Québec (DSP, Québec City public health branch) was contacted about two different episodes of skin rashes after bathing in Lac Beauport. In one episode,

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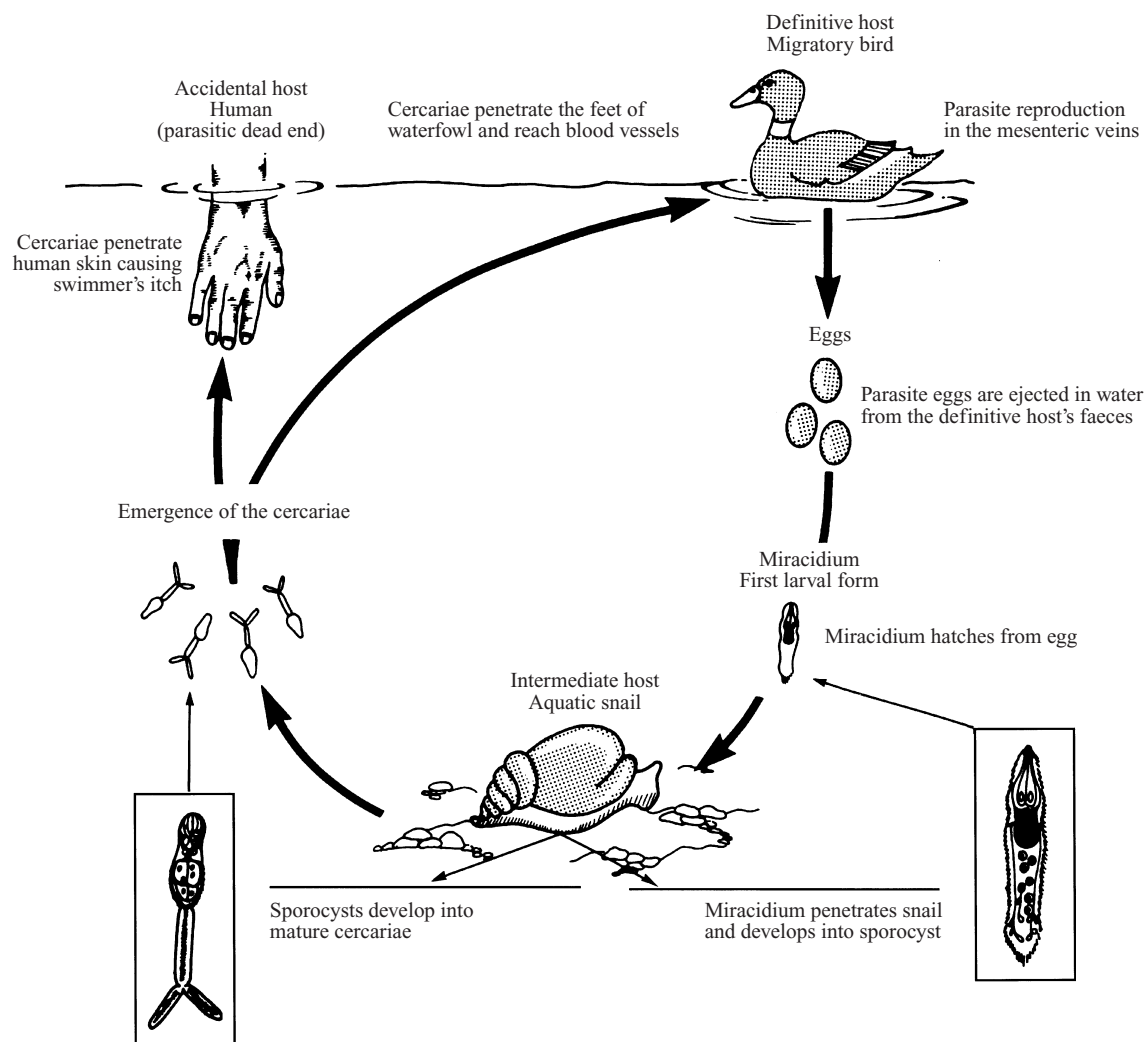


Fig. 1. Life cycle of parasite which causes cercarial dermatitis.

a man 38 years of age, his 10-year-old son, and two friends of the same age swam for 1–2 h on the afternoon of 31 July at beach A (a semi-private beach used by the residents of 32 homes on Lac Beauport) (Fig. 2). When they left the water, they felt severe itching without any lesions. Approximately 12 h later, the itching increased in intensity and papules appeared. These signs and symptoms disappeared in 1 week without any use of antibiotics. No gastrointestinal or other type of symptoms occurred. In the other episode, a 12-year-old girl and a friend reported essentially the same signs and symptoms after swimming at the same beach A at the end of May. The medical clinics serving the lake region were contacted and no case had been noted since the beginning of the summer season.

From the environmental standpoint, the Québec Ministry of Environment regularly visits the province's public beaches to check the faecal coliform

concentrations using a pre-established protocol in which samples are collected every 20 m at depths of 0.3 m and 1.2 m [10] and are analysed by a membrane filter technique [11]. On 5 August 1999, 2 of the 3 public beaches at Lac Beauport taking part in the programme had been visited 3 times, and the other 4 times. The geometric means of the samples from the beginning of the summer were 29, 32 and 21 colony forming units (CFU)/100 ml respectively for beaches B, C and D (Fig. 2).

Following this short investigation, a presumptive diagnosis of cercarial dermatitis (swimmer's itch) was made. The health professionals and citizens were informed about the possibility of a problem with cercarial dermatitis in Lac Beauport. A surveillance system was implemented in order to determine the time-space distribution of the cases to document the extent of the problem. Finally, an environmental investigation was carried out to support the diagnosis.

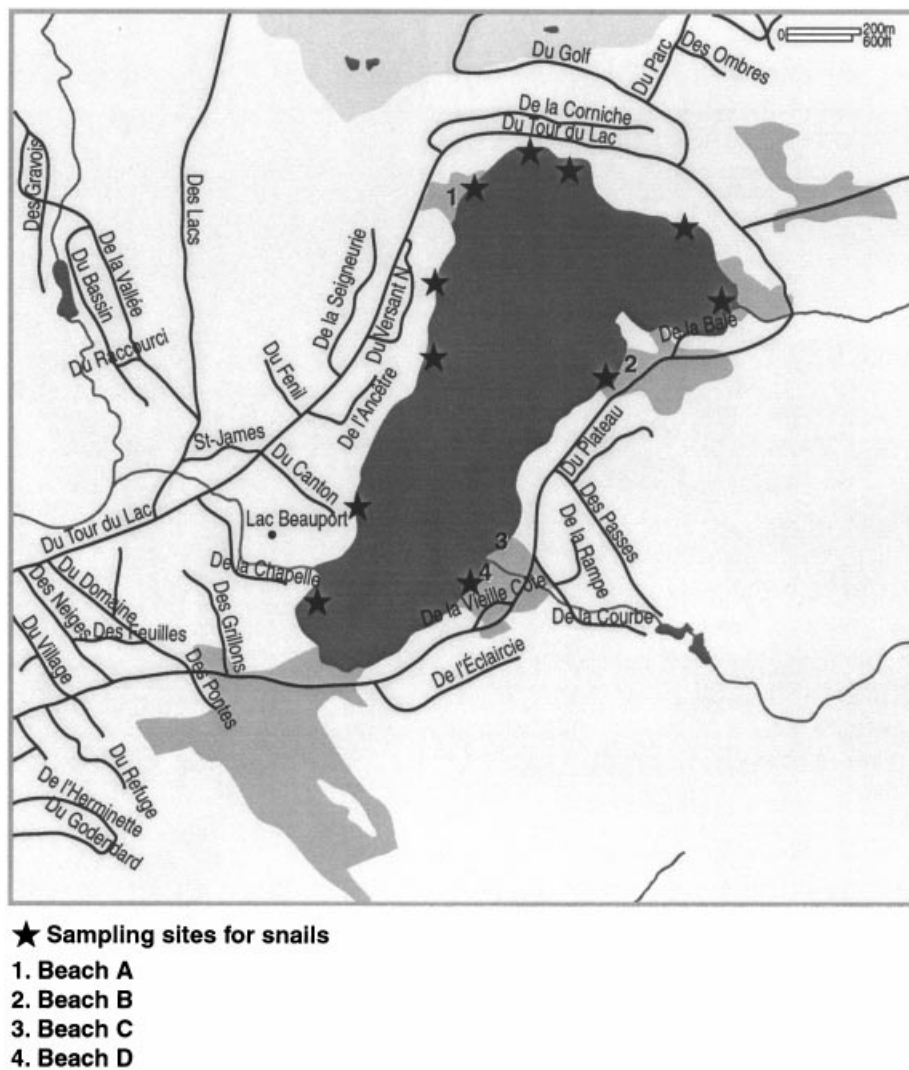


Fig. 2. Map of Lac Beauport.

### Epidemiological surveillance system

Epidemiological surveillance forms including a case definition, photo and case reporting forms were sent by the municipality to approximately 450 families likely to use Lac Beauport for their leisure activities.

The definition was as follows (translated from the French):

Small red plaques accompanied by itching. They appear suddenly after swimming and all at the same time, contrary to insect bites. They affect all uncovered parts of the body. After several hours, papules appear. They are the size of a dime and produce even more intense itching.

The forms asked the citizens to report all the cases that they saw during the summer season that were compatible with the given definition. These forms collected information on the number and sites of the

lesions, the swimming/bathing date and location, the type of swimming/bathing and the wearing of protective equipment. All the reported cases had to be reported on appropriately filled out forms. Uncertain cases (forms poorly completed) were contacted by telephone by a DSP research officer in order to ensure the validity of the data and the compatibility of the symptoms with the case definition.

### Environmental investigation

Due to the difficulty of isolating the parasite for cercarial dermatitis in the definitive host during investigations of outbreaks of cercarial dermatitis, an attempt is generally made to identify it from the intermediate host (water mollusc) [12–15]. An inventory of the Lac Beauport snail populations was drawn up and their state of parasite contamination

was verified. This inventory was done single blind, (i.e. the biologist that performed it did not know where the cases, already documented, had been swimming). Sampling was done at 11 locations around the lake away from the shore that were considered appropriate (Fig. 2) at a depth varying from 0.5–3 metres at dawn and in full daylight. The collected snails were then identified by species using an identification key [16]. They were then incubated individually in a Petri dish for a period of 24 h under an incandescent light. The emerging cercariae were photographed and classified according to their anatomical characteristics and their swimming behaviour [17].

Furthermore, following the epidemiological surveillance during the summer, sampling was carried out on 2 September at two locations where most of the cases occurred, in order to verify the presence of faecal coliforms, faecal streptococci, *Staphylococcus aureus* and *Pseudomonas aeruginosa*. A total of four samples were collected at each of the beaches and analysed by membrane filtration techniques [11].

## RESULTS

### Epidemiological surveillance system

The public health authorities received the reporting forms at the beginning of September. At that time, the forms were verified and all uncertain cases were contacted by telephone. In total, 28 people were called by a DSP research officer.

A total of 53 people reported episodes of symptoms compatible with cercarial dermatitis, 33 males (62.3%) and 20 females (37.7%). Of these, 28 (52.8%) were under 10 years of age, 4 (7.5%) were between 10 and 19 years of age, 10 (18.9%) were between 20 and 39 years of age, and 11 (20.7%) were 40 years of age or older. The range was from 2–67 years of age.

Of the 53 people, 45 had had only 1 episode, 7 reported 2 episodes, and 1 individual reported having had symptoms on 4 occasions. In total, 63 case-episodes were identified. Of these, 10 occurred in 19 young boys attending day camps at the end of July and beginning of August. The parents of the 19 young people were called on the telephone. Unfortunately, 3 could not be reached. A total of 10 episodes of symptoms compatible with cercarial dermatitis occurred in 10 children who had been in contact with Lac Beauport water. Of the 6 young people who had had no symptoms, 3 had been swimming and 3 had not.

Table 1. Characteristics of the lesions and bathing/swimming

	Number (No.)	Percentage (%)
Number of lesions		
< 5	6	9.5
Between 5 and 20	14	22.2
> 20	43	68.3
Site of lesions		
Face	1	1.6
Trunk	48	76.2
Upper limbs	41	65.1
Lower limbs	58	92.1
Type of bathing/swimming		
Wading	7	11.1
Swimming in shallow water	47	74.6
Swimming in deep water	23	36.5
Other (without wet suit)*	3	4.8

\* Wind surfing, water ski, jet ski or canoeing.

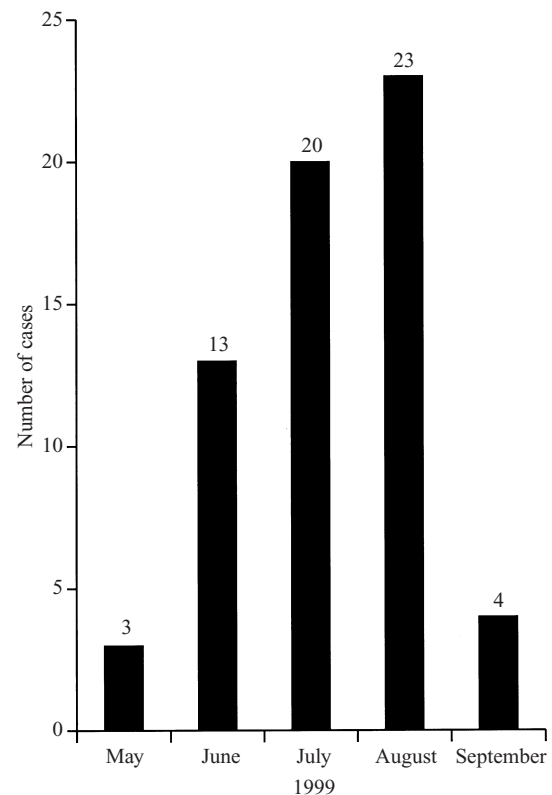


Fig. 3. Temporal distribution of cases by month.

Table 1 describes the characteristics of the lesions and the swimming or bathing in the reported episodes. Generally, the lesions occurred in significant numbers (more than 20) mainly on the lower limbs and trunk following bathing along the beach.

Figure 3 illustrates the temporal distribution of

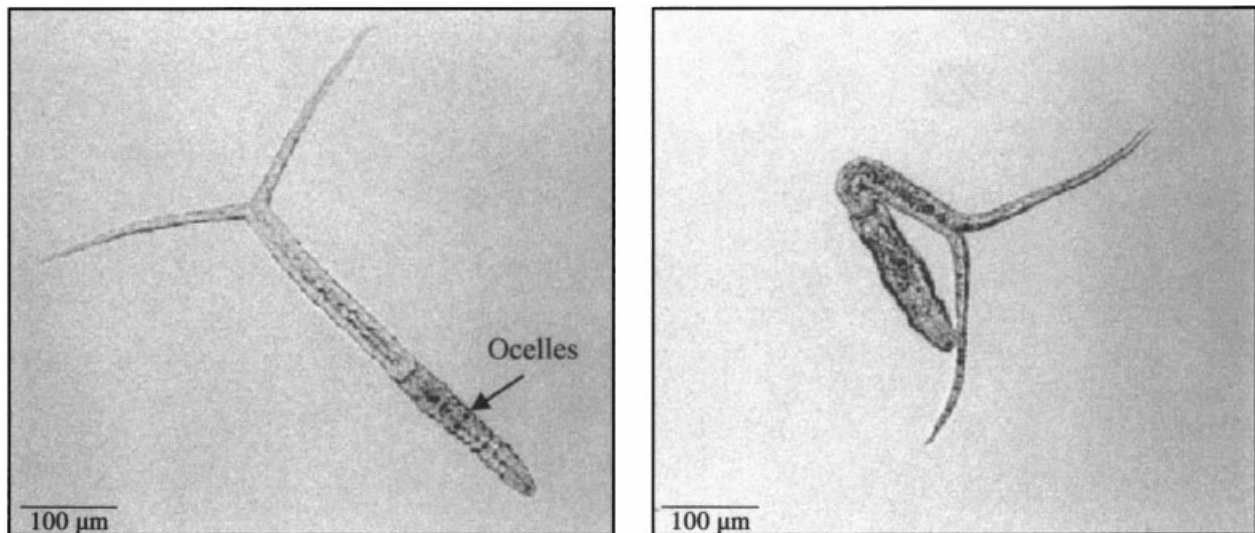


Fig. 4. One ocellate cercaria (left) and one non-ocellate isolated from the snails of Lac Beauport.

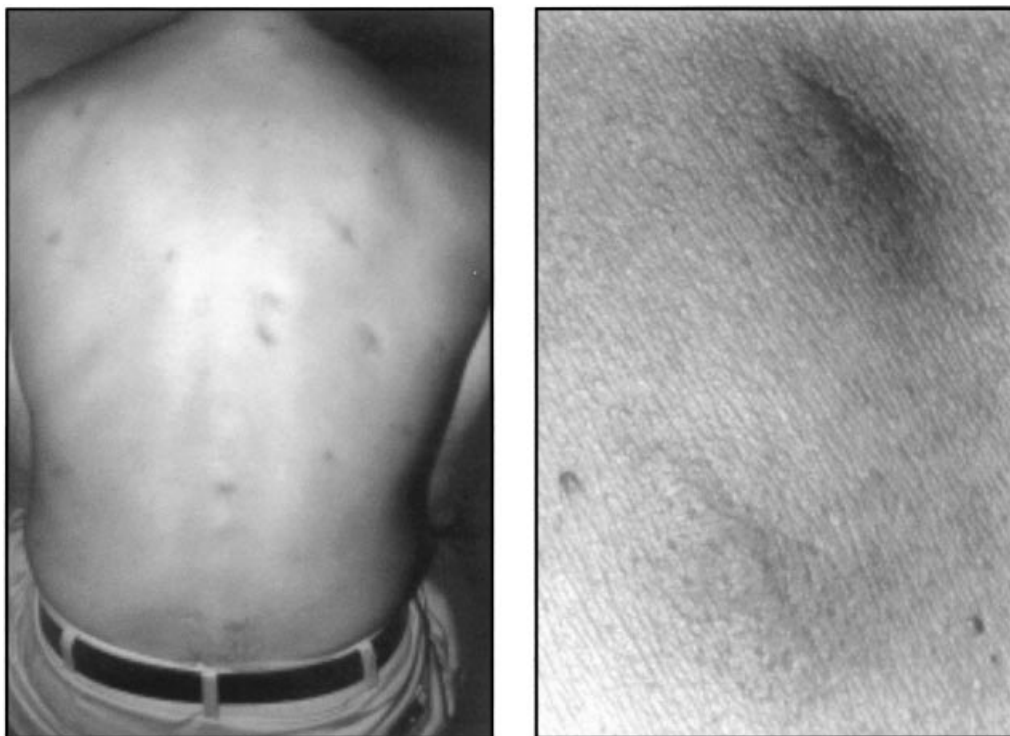


Fig. 5. Case of cercarial dermatitis contracted in Lac Beauport in summer 1999.

Table 2. Results of the water analyses carried out at beaches A and B on 2 September 1999

Beach	Faecal coliform GM* (CFU/100 ml)†	Faecal streptococcus GM (CFU/100 ml)	<i>P. aeruginosa</i> ‡ GM (CFU/100 ml)	Staphylococci GM (CFU/100 ml)
A: (n = 4)	9	< 1	0	21
B: (n = 4)	2	1	0	37

\* Geometric mean.

† Colony forming units per 100 millilitres.

‡ *Pseudomonas aeruginosa*.

cases by month. Due to the retrospective nature of the study, the precise date was entered for only 43 episodes. However, the month was invariably indicated by the respondents ( $n = 63$ ). Reported symptoms were mainly in July and August, but episodes occurred in May, June and September, indicating that they can occur throughout the entire swimming season.

From a geographical standpoint (Fig. 2), 42 episodes (69%) occurred following bathing at beach A or nearby, 6 (10%) were reported in the beach B section, 8 (13%) affected the members of a long-distance swimming club that swam around the lake, and 5 (8%) were isolated cases that appeared in people who bathed elsewhere in the lake. Two respondents did not indicate the bathing location and could not be reached to specify it.

### Environmental investigation

The environmental investigation aimed to identify the intermediate hosts (water snails) and subsequently the parasites themselves from a sample of the mollusc populations. Following an investigation of the entire shore, the biologist in charge of this aspect identified only one population of small snails from the *Physella gyrina* species. These molluscs were located near beach A.

A total of 142 snails were then collected for parasite investigation. Two forms of furcocercaria-type cercariae were identified, namely one non-ocellate cercaria and one ocellate cercaria (Fig. 4) respectively in 1.4 and 2.8% of the gastropods. The latter had already been identified during a previous investigation of dermatitis at Lac Nairn, a resort lake located some 100 kilometres from Québec City. At that time, the biologist in charge of the study, who was also in charge of investigating molluscs in the current study, had placed these parasites with a pipette on his forearm. A few minutes later, he felt itchy; this was followed 1 h later by the appearance of macula, and in the next 12 h by itchy papules that disappeared in 1 week [18]. The same biologist, during snail collection at beach A, contracted a significant case of dermatitis shortly after swimming (Fig. 5).

The results of the samples collected on 2 September in the sectors where most of the episodes of symptoms of dermatitis were reported (beach B and particularly beach A) are described in Table 2. At that time, the concentrations of indicators of faecal pollution (faecal coliforms and faecal streptococci) were very low in the

water of both beaches investigated, clearly below the reference limit recommended by Health and Welfare Canada [19], of 200 and 35 microorganisms/100 ml respectively. No *Pseudomonas aeruginosa* were detected. Finally, the concentrations of *Staphylococcus aureus* (beach A: 37/100 ml, beach B: 21/100 ml) are similar to those that are found in good quality surface water in Canada [20–21].

### DISCUSSION

The use of a case-reporting form distributed to the shoreline residents was chosen for several reasons. First, swimmer's itch is basically a benign pathology [9] in which a high proportion of the victims do not consult a physician. In addition, its diagnosis is essentially based on the clinical history, backed up by a chronological link to swimming [22]. In fact, trying to find parasites in skin biopsies is futile because the patients who consult a physician generally do so 24 h after exposure, when the micro-organism has already been destroyed by the immune process that it has initiated [22].

A total of 63 episodes of symptoms consistent with cercarial dermatitis were reported. Given the late date of the surveillance (mid-August), the proactive participation required of the citizens in filling out the forms and sending them, and finally, the benign nature of the pathology, the number of cases was probably higher.

The symptoms mainly affected children under 10 years of age. Of the cases reported, most said that they had more than 20 lesions. This may obviously be due to the fact that the people that had more significant dermatitis were more likely to report it.

The lesions affected the regions most likely to be in contact with swimming water, mainly the lower limbs (92.1%), the trunk (76.2%) and the upper limbs (65.1%). The people most affected were those who bathed along the shore (74.6%). This is very compatible with cercarial dermatitis, which occurs mainly in bathers in shallow water near areas of vegetation that are the habitat for aquatic molluscs [2]. This is why children are more at risk [2].

Figure 3 indicates that the symptoms can occur throughout the summer season. It is difficult to interpret the higher number of reported cases in July and August. These are in part due to the increased in swimmers during the summer season.

However, the geographical distribution is very revealing. In fact, of the 61 cases in which the bathing

location was noted, 42 (69%) occurred in beach A sector, and 8 (13%) in swimmers who swam around the lake who could also have contracted the disease in this same region. Interestingly, the beach A sector is the only location where a population of gastropods was identified.

This is strongly suggestive of a cercarial aetiology. It is all the more so if the results of the snail parasite investigation are included, which revealed the presence of an ocellate cercaria (Fig. 4) whose capacity to transmit the disease has been demonstrated experimentally. In addition, the same cercariae were also identified in molluscs from another nearby lake (Nairn) where an outbreak of dermatitis had occurred the previous year [18]. Finally, this cercaria has all the microscopic and behavioural characteristics of *Cercaria ocellata*, a cercaria associated with cercarial dermatitis [23] whose primary host is the duck [24]. Mallard ducks, a potential primary host [2, 25] that several shoreline residents of Lac Beauport were in the habit of feeding, were present in high numbers on the lake during the 1999 summer season. All these elements and the dermatitis that affected the biologist in charge of snail sampling in the context of mollusc collection (Fig. 5) help to confirm that the skin lesions at Lac Beauport in 1999 were cases of cercarial dermatitis.

On 2 September the concentrations of faecal coliforms and faecal streptococci at beaches A and B were low. The same was true for the two other indicators investigated, *Pseudomonas aeruginosa* and *Staphylococcus aureus*. This is very characteristic of the epidemiology of cercarial dermatitis, which often occurs in good quality recreational waters, as evaluated by the usual water safety indicators.

The epidemiological surveillance allowed the diagnosis to be confirmed at low expense and the extent of the problem to be defined from a control perspective. For a swimmer, the best means of protection against the cercarial dermatitis is to avoid infested water; otherwise, short swims of less than 10 min while wearing protective clothing [13] preferably in deep water [2], may possibly help in preventing this disease. Nevertheless, control of cercarial dermatitis is linked to the parasite's life cycle, which includes the presence of a definitive host (generally waterfowl), and an intermediate host (aquatic mollusc). Measures can therefore be implemented related to these two steps in the cycle.

It was consequently agreed to inform the local population about not attracting potential primary

hosts, particularly by avoiding feeding waterfowl. Furthermore, given that the snail population is limited to one sector (beach A), steps were taken to attempt to control this population. Some authors suggest the use of molluscicides such as copper sulphate or niclosamide [2, 22], but these products can have harmful effects on aquatic life. Also, the manual collection of snails and cleanup of vegetation zones in the sector in question may be considered [26, 27]. Taking into account the presence of a well delimited snail population at beach site A, it was suggested that action should be taken on the snails' habitat, which consisted mainly of organic waste. This was removed with a device used for cleaning septic tanks, a suction pump equipped with a 7.5-cm diameter hose connected to a tank. A team of divers did the work, which was completed in 8 h. This seems to have been effective because no case of dermatitis occurred at this location during the summer season in 2000.

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