INVASIVE AQUATIC SPECIES SAMPLING - KAHSHE LAKE - 2017

Carried out by the Kahshe Lake Ratepayers' Association (KLRA) - Funded by the Federation of Ontario Cottagers' Associations (FOCA) with technical support from the Ontario Federation of Anglers and Hunters (OFAH).

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Boat Operator: Russ Pearson

Photos by: Shane Pearson

ABSTRACT

This document presents the findings of an aquatic invasive species sampling program carried out in 2017 to determine the possible presence of spiny and fishhook waterfleas, zebra mussels and freshwater jellyfish that could pose a threat to the waters of Kahshe Lake. Although the sampling program failed to identify the presence of any of the above aquatic invasive species which could pose a long term threat to the health and survival of more beneficial native zooplankton species, continued vigilance is required to ensure that the lake maintains its current quality. This is underscored by the documented presence of three of the four species in other lakes in the Muskoka area.

1.0 Introduction

This project was conducted to determine if Kahshe Lake has been impacted by three important invasive aquatic species: *Spiny Waterflea, Fishhook Waterflea and Zebra mussels*. These species have been introduced into some Muskoka Lakes from the Great Lakes via marine vessel transfer and the failure of operators to properly clean fishing boats and their related fishing gear before launching in Muskoka lakes. Other possible vectors of invasive species introduction are boating enthusiasts who launch their boats without proper cleaning following pleasure use in the great lakes or the various connecting water/lock systems.

As Kahshe Lake is a popular fishing destination, it has historically been host to a number of fishing derbies attracting bass and other fishing boats from all over Ontario. While fishing derbies have declined in recent years, the lake is still widely known as a great sport fishing destination and there are several public launch ramps to facilitate entry.

The spiny and fishhook waterfleas are important zooplankton species, as an increase in their numbers can disrupt normal zooplankton growth and survival and ultimately, aquatic species higher up the food chain. The main reason for impacts higher up the food chain is because these types of zooplankton do not provide the nutritive value to fish and other higher food chain members, and this in turn ripples up the food chain to other aquatic and terrestrial species who in turn depend on fish as a dietary source.

Another invasive aquatic species that has become widespread in Ontario's great lakes and other inland lakes is the zebra mussel. It is a small (3-5cm long), freshwater clam with a brown and cream-coloured striped shell that was originally from Eurasia. It was first discovered in North America in Lake St. Clair in 1988. Scientists believe that zebra mussels arrived in the ballast water of a ship traveling from a European port. Zebra mussels spread quickly into all of the Great Lakes, the St. Lawrence River, and connected waterways, and many inland lakes in southern Ontario.

Although it was not listed as a species that would be evaluated in the sampling program, another invasive aquatic species of interest is the freshwater jellyfish, as Kahshe Lake has been recently identified in media reports as being impacted by this invasive species. Like the two waterfleas, this species thrives in water with lower calcium levels, as it does not need this nutrient to build a hard coating. As such, it has a lower mineral concentration and is less favourable as a dietary source to fish and other organisms. This in turn can lead to undesirable long term changes in zooplankton biodiversity which then impacts other species higher in the food chain.

In 2017, the Federation of Ontario Cottagers' Association (FOCA) notified lake associations that they were prepared to fund a number of pilot projects to begin a more comprehensive understanding of invasive species. The KLRA responded to this initiative with a proposed program for the sampling and determination of the presence of the above invasive species. In preparing the proposal, it was determined that the Ontario Federation of Anglers and Hunters (OFAH) was offering a no charge loan of dedicated sampling equipment and the analysis of water samples collected throughout Ontario for the two of the above referenced invasive species. Although the fishhook waterflea and freshwater jellyfish were not specifically addressed in the sampling program offered by the OFAH, the writer visually evaluated each of the samples collected for the presence of freshwater jellyfish. While this would not rule out smaller life stages such as eggs, frustule or planula larvae or polyps of this species, it would certainly identify the presence of adult jellyfish and likely mature polyps or polyp colonies. In the case of

the fishhook waterflea, the OFAH analysis of the water samples would have captured this species as well, as it is similar in size to the spiny waterflea.

With this as a basis, a proposal was prepared and was awarded funding by FOCA to cover a small number of related sampling costs and report printing. The terms of the FOCA award included the preparation of a final report and the completion of a FOCA project summary questionnaire with a minimum of five pictures documenting key pilot project activities and participating people by December 15, 2017. The questionnaire was completed on schedule and accepted by FOCA. This report constitutes the final component of the funded project.

2.0 Overview of Aquatic Invasive Species

The following information has been extracted from:

- *Field Guide to Aquatic Invasive Species*. 2010. Lui et al., Ontario Ministry of Natural Resources
- *Spiny and Fishhook Waterfleas. 2012.* Ontario Invading Species Centre.
- *Early Detection & Distribution Mapping System (EDDMaps)*. 2014. The University of Georgia Center for Invasive Species and Ecosystem Health; adopted by Ontario in April 2014.
- *Zebra Mussels Invade Ontario Waters.* 2006. Invading Species Awareness Program (OMNR and OFAH), August 2006.

In addition, images of these species can be found in Attachment 1.

Spiny Waterflea

- The spiny waterflea belongs to the class Crustacea, a group of animals such as crabs and shrimps that possess a hard exoskeleton (outer shell).
- They measure about 10mm in length, of which the tail spine comprises about 60%.
- Like all other Crustacea, its exoskeleton moults in order to grow. The spiny water flea is unique because it sheds only the exoskeleton that covers its body, retaining the exoskeleton that covers the tail spine.
- **T**ail spine is straight or slightly angled from the body, with 1-3 pairs of barbs, and a straight needle-like tip.
- The head has a single large, dark, compound eye; also present are a pair of jaws which are used to pierce and shred its prey.
- This animal has four pairs of legs; the first, longer pair is used for catching prey, whereas the other pairs of limbs are designed for grasping prey while they are being consumed.
- Spiny water flea is a voracious predator and can eat up to 20 organisms of zooplankton daily.
- They prefer large, deep, clear, oligotrophic lakes but will occur in slightly eutrophic waters like those of Kahshe Lake.
- They tolerate water temperatures from 5-28^{o}C and migrate vertically in the water column to deeper, cooler waters in the day and surface waters at night.

Pathway of Introduction and Spread:

- First reported in Lake Ontario in 1982, and found in all of the Great Lakes by 1987.
- They now occur in over 100 inland lakes in Ontario.

- Believed to have been introduced to the Great Lakes via ballast water discharge of commercial shipping vessels.
- Spiny waterflea primarily reproduce parthenogenically (a form of reproduction where an individual develops from an unfertilized egg); therefore, it has the capacity to colonize quickly with a single female.
- Sexual reproduction produces resting eggs which overwinter and can remain dormant for long periods of time.

Impacts:

Spiny waterflea consumes up to three times as much as native species of zooplankton such as *Daphnia*, which is an important food source for juvenile fish species. As a result the spiny water flea competes directly with these juvenile fish for food. When populations of this invader are high, consumption is significant, and the amount of food available to native species of predatory zooplankton, smaller forage fish, and juvenile fish is reduced.

Other zooplankton predators may be affected directly through competition for food or indirectly because of a shift in prey items available. Small fish have difficulty consuming spiny waterflea and larger fish that prey on the species may experience reduced growth rates because the waterflea spines are indigestible (accumulate in the stomach) and do not offer any nutritional value. Also, the species can attach to and foul fishing lines, downrigger cables, and other equipment used for fishing.

Planktivorous fish such as whitefish and lake herring feed on spiny waterflea. However, studies have indicated that juvenile fish smaller than 10cm in length are unable to use the spiny waterflea as a source of food due to the long tail spine, which prevents them from swallowing it.

Fishhook Waterflea

- Predatory cladoceran that collects in transparent cotton-like masses on fishing lines.
- Total length of 10 mm, with the tail spine comprising about 80% of total length.
- **T**ail spine is strongly angled (~90^{o}) from body, with 1-3 widely spaced pairs of barbs, and a unique loop or "hook" at the tip.
- Head has single, dark, compound eye and the dorsal egg pouch is elongated and pointed.
- Found in open deep waters, preferring the upper, warmer water layer but able to tolerate a wide range of water temperatures from approximately 8-30^{o}C.

Pathway of Introduction and Spread:

- First recorded in Lake Ontario in 1998, the St. Lawrence River by 1999 and Lake Erie by 2001. To date, not reported in inland lakes or elsewhere in Canada. In the United States, occurs in Lake Michigan, Lake Erie and the connected Detroit River, and several 'Finger Lakes' in New York State.
- Introduced probably via ballast water discharge of a commercial shipping vessel, with Great Lakes populations derived from the Baltic Sea.
- Fishhook waterfleas also reproduces parthenogenically and therefore, have the capacity to colonize quickly with a single female.

- Sexual reproduction produces resting eggs which overwinter and may be transported, along with adults, to inland lakes in bait buckets, live wells, mud, bilge water, or on fishing and other equipment.

Impacts:

Predation by fishhook waterflea on small native zooplankton has likely led to the declines observed in several zooplankton species in Lake Ontario. The fishhook waterflea may compete with native planktivorous fish or other zooplankton predators for food. Because of its barbed tail, the species attaches to fishing gear and clogs nets and trawls, fouling equipment used for recreational and commercial fishing.

Summary of Impacts of Both Waterfleas

- Researchers believe that spiny waterfleas are the greatest threat to the biodiversity and structure of native zooplankton communities on the Canadian Shield since acid rain.
- Because their main diet is zooplankton, they reduce food supplies for small fish and the young of sport fish such as bass, walleye and yellow perch.
- A few animals can quickly multiply into a large population.
- They are easily spread between waterbodies on angling equipment and bait buckets, and in live wells and bilge waters.
- Spiny waterflea introductions result in an average 30 to 40 per cent decline in native populations of zooplankton.

Zebra Mussels:

- The zebra mussel (*Dreissena polymorpha)* is a 3-5cm long freshwater clam with a brown and cream-coloured striped shell originally from Eurasia.
- A female zebra mussel can produce up to one million eggs each year, with reproduction beginning when water temperatures reach 12°C or higher. Upon hatching, free-floating microscopic larvae (called veligers), are dispersed by water currents, wind and wave action.
- Two to three weeks later, the zebra mussel larvae begin to develop their shell and become too heavy to float in the water. They then settle and secrete sticky fibres which they use to attach to any hard surface. They continue to grow and are soon large enough to be seen by humans.
- Depending on conditions, zebra mussels can live between two to five years, and grow up to five centimeters in length.

Pathway of Introduction and Spread:

- First discovered in North America in Lake St. Clair in 1988.
- Are believed to have arrived in the ballast water of a ship traveling from a European port.
- Zebra mussels have spread quickly into all of the Great Lakes, the St. Lawrence River, and connected waterways, and many inland lakes in southern Ontario.
- Zebra mussels are highly adaptable and can survive in lakes with a wide range of environmental conditions.
- In the future, zebra mussels, could spread throughout southern Ontario and regions of northern Ontario if prevention measures are not taken by recreational water users.

Impacts:

The introduction of the zebra mussel has caused enormous changes to the Great Lakes basin ecosystem, and has had major economic and social impacts. Mussels filter plankton out of the water, which depletes it as a food source for native species and also results in clearer water, thereby increasing sunlight penetration and promoting the presence of toxic algal growth and blooms. Large colonies can take over fish spawning areas and beaches, cutting the feet of potential swimmers. They also clog water intake lines because of their dense colonies.

Freshwater Jellyfish

- The freshwater jellyfish is a hydrozoan which is most easily identified when it takes the form of a small, bell-shaped jellyfish, known as a hydromedusa.
- The hydromedusa measures about 5–25 mm in diameter, and is translucent with a whitish or greenish tinge.
- Freshwater jellyfish exhibit four very long tentacles and many shorter tentacles.
- Like other invasive species, the freshwater jellyfish is an opportunistic predator, feeding on small organisms that come within its reach.
- Both polyp and hydromedusa forms use nematocysts (stingers) to capture prey. Polyps are able to camouflage themselves by secreting a sticky mucous that adheres particles to their body.
- Conspicuous swarms of hydromedusae appear sporadically, but are only one part of the animal's life cycle. The various forms are summarized below:
    - mature hydromedusae (the most commonly recognized bell-shaped form),
    - planulae larvae (from fertilized eggs produced sexually by the hydromedusae which then metamorphose into the polyp form),
    - polyps, which are capable of budding to produce hydromedusae as well as daughter polyps or,
    - frustulae larvae, which move to new locations before metamorphosing into new polyps.
- Polyps overwinter by contracting into resting bodies called podocysts, which are essentially dormant cellular balls surrounded by a protective chitin-like membrane that allows them to withstand more extreme conditions than the active forms. When conditions are favorable, the podocysts grow into polyps again.

Pathway of Introduction and Spread:

- Freshwater jellyfish is an invasive species thought to have originated in China's Yangtze River.
- They were discovered in the U.S. in the Huron River near Ann Arbor, MI, in 1933, and in Lake Erie shortly thereafter.
- It has since been recorded in Lake Huron and Lake St. Clair, as well as dozens of inland lakes and streams throughout the region.
- In Canada, freshwater jellyfish have been documented in Quebec since 1955 and in Ontario since 1980.

Impacts:

An evaluation of Kahshe Lake is important because recent media coverage has identified the lake as one of several lakes in Muskoka where freshwater jelly fish have been reported. The news report failed to mention that this was based on observations made back in 2005 and 2006, and not a recent finding.

The impact of this widespread jellyfish is unclear, but it is believed that it's preference for predatory zooplankton, such as the rotifer *Asplanchna*, could influence relative zooplankton species structure. Under laboratory conditions and in 4 mm of water, polyps ae reported to have killed and fed on striped bass larvae.

Freshwater jellyfish is not considered dangerous to humans. Although its stings can paralyze macroinvertebrates and small fish, its small nematocysts are not likely to penetrate human skin.

3.0 Sampling Methodology

As a participant in the OFAH's Invasive Species Watch Program, the sampling kit was shipped to the project lead in early August, 2017. The first step in the program was to disinfect the entire sampling apparatus by immersing in tap water heated to not less than 50^{o}C for at least 10 minutes.

Figure 1 below shows this being completed.

The next step was to select target sampling locations. As invasive species would most likely to have originated from the launch of marine vessels into the lake at established boat launch sites, these were the initial target locations. As such, Sites 1, 2 and 3 were located in the vicinity of known launch sites. Another three sites were added to provide greater geographical coverage of the lake and to ensure that some samples were from the areas with the greatest water depth.

Figure 1: Disinfecting the Sampling Equipment Prior to Use

Figure 2 below shows the locations of the sampling sites, while Table 1 provides additional information on the sampling methodology and characteristics of each of the six sites.

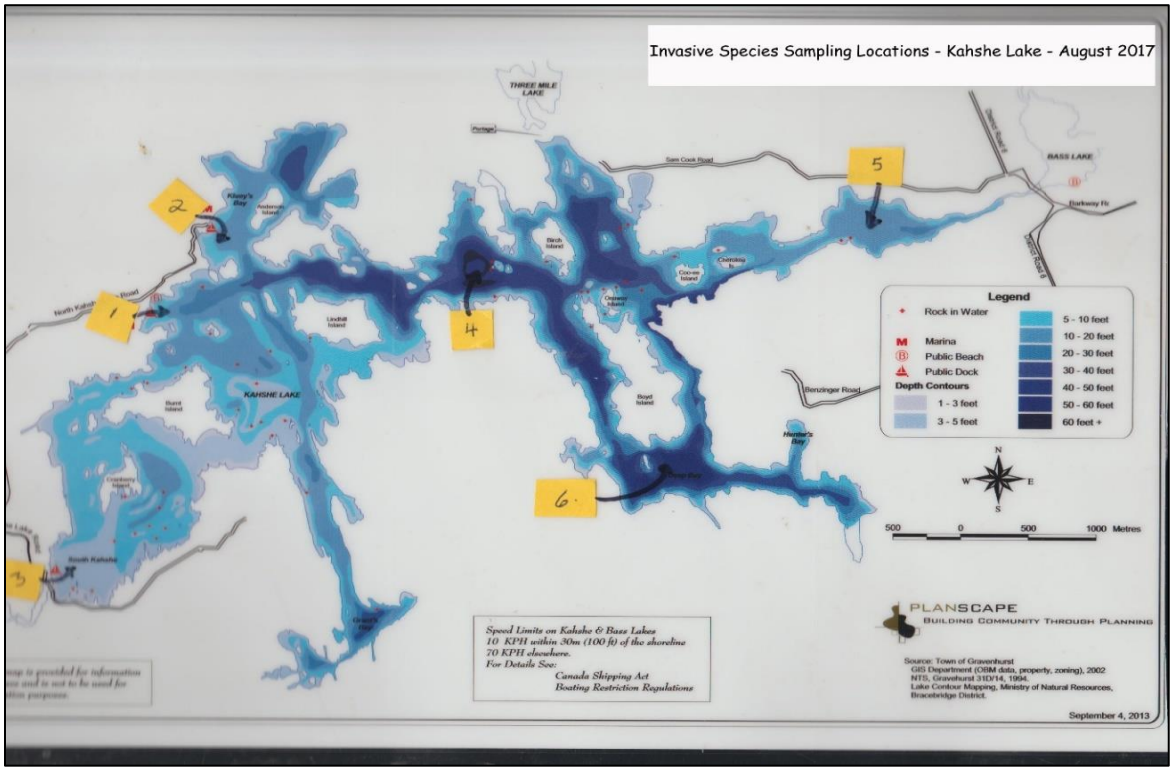


Figure 2: Location of Invasive Species Sampling Sites – Kahshe Lake, August 23, 2017

As noted in Table 1 and Figures 3 below, there were two recommended methods of collecting samples depending on water depth.

Table 1: Description of Invading Species Sampling Sites – August 23, 2017

Invading Species Watch: Sampling Data Sheet

Please print clearly and use a pencil. Fill out all information required on each sample bottle: Sample number/Site number etc. Use a **separate sample** bottle for each sampling site on the lake. Record Latitude/Longitude coordinates in **decimal degrees**. Example: Lat: 44.37218 Long: -78.21083

Lake Name: KAHSHE LAKE
County: MUSKOKA
Township: MORRISON
Volunteer Name: RON PEARSON
Address: 46-70 ROEHAMPTON AV, TORONTO M4P1R2
Date of sampling: (yyyy/mm/dd) 2017/08/23
Weather Conditions: SUNNY, MODERATE WIND
Wind Speed: ~20 KM/HR

ONTARIO'S INVADING SPECIES AWARENESS PROGRAM

Wind Speed Categories
No wind = flags barely moving 0-5km/h
Light Wind = flags fluttering 5-20 km/h
Strong Wind = Flags Whipping greater than 20 km/h

Sample #	Horizontal Haul or Vertical Haul	Water Depth (m)	Water Temperature (°C)	GPS Coordinates Lat/Long Decimal Degrees with 5 decimal places	Comments (Closest marina, boat-launch, island, beach, bay, other)
e.g. 1	Vertical	10 m	18	44.37218, -78.21083	Near boat launch
1	HORIZONTAL	4-1	22	44°51'41" N 79°17'41" W	Near Dennes Marina + Boat Launch
2	Horizontal	5-3	23	44°52'0" N 79°17'16" W	Near ROCKHAVEN INN & Boat Launch
3	Horizontal	2.6	23	44 52 5 N 79 13 34 W	SOUTH KAHSHE Near Boat Launch
4	Vertical	25	23	44 51 47 N 79 15 50 W	Deepest spot on Lake
5	Horizontal	6.2	22	44 52 5 N 79 13 34 W	Near Houseys Rapids
6	Vertical	10.5	22	44 51 47 N 79 15 50 W	Deep Bay

Figure 3: Determination of Haul Method

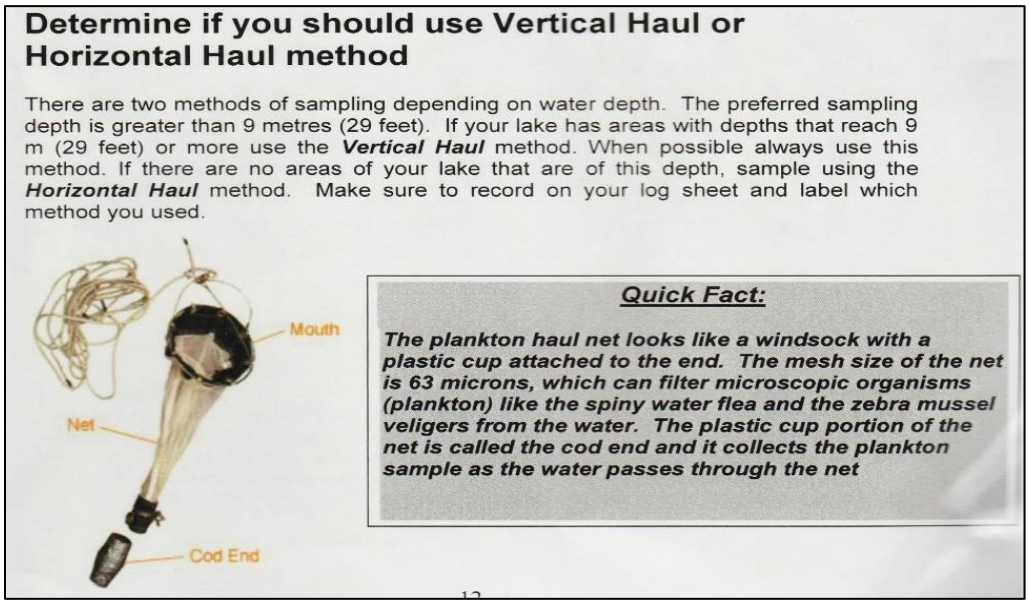
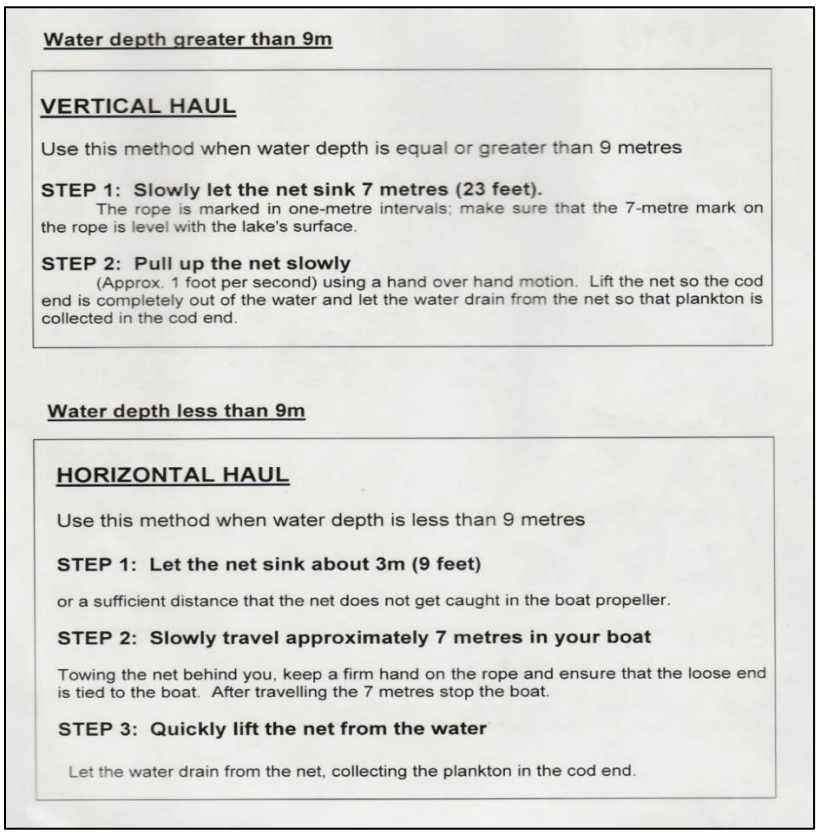
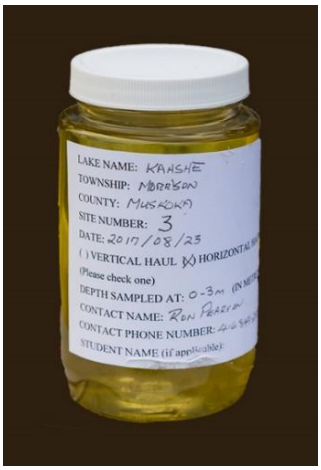


Figure 4 below outlines how each vertical or horizontal haul was conducted at each site.

Figure 4: Sampling Method for Vertical and Horizontal Haul Sampling – August 2017





Following collection of each sample, the lake water was placed in the provied sampling bottles and labelled as shown in Figure 5 below. Following the collection and bottling of the sample at each site, the next step was to preserve the sample and ship the entire package back to OFAH for identification. The preservation was accomplished by adding isopropyl alcholol in a ratio of approximately 1:1.

The samples were then refrigerated until pick up by the courier the following day.

Figure 5: Sample Bottle with Label

Figures 6 through 13 below show the sampling methodology as it was conducted at the six sites on Kahshe Lake on August 23, 2017.

Figure 6: Sampling Kit from OFAH

Figure 7: Boat Operator for Sampling Program

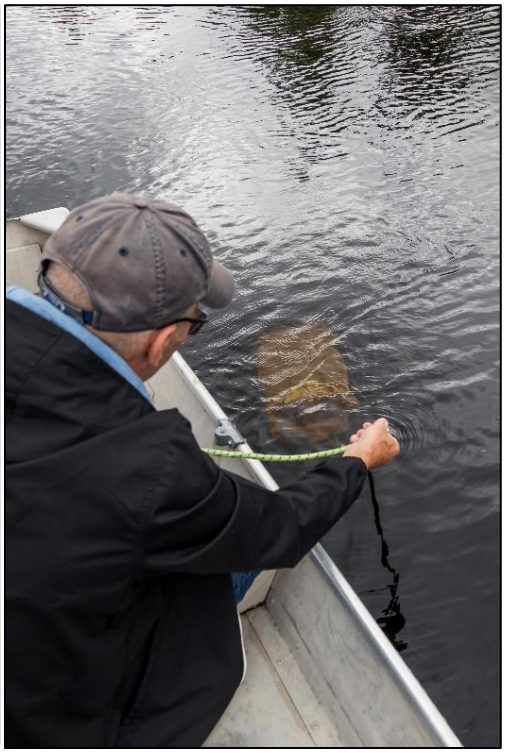


Figure 8: Sampling Net Being Lowered into Water

Figure 9: Raising the Net in a Vertical Haul

Figure 10: Filling the Screened Cod after Raising

Figure 11: Excess Water Draining from Cod **Figure 12: Water Sample in Cod Ready to Fill Bottle**

4.0 Sampling Results

Although the final report on the 2017 Invasive Species Sampling Program across all sampling sites in Ontario has not yet been released by the OFAH, the writer has received correspondence from the OFAH on the findings for Kahshe Lake, and these are summarized in Table 2 below.

Table 2: Invasive Species Water Analysis Results from the OFAH - 2017

Waterbody	Date Sampled	Sample Number	Sampling Method	Water Depth	Zebra Mussel Veligers Present?	Spiny Waterflea Present?
Kahshe Lake	August 23	1	Horizontal	4.1	No	No
Kahshe Lake	August 23	2	Horizontal	5.3	No	No
Kahshe Lake	August 23	3	Horizontal	2.6	No	No
Kahshe Lake	August 23	4	Vertical	25	No	No
Kahshe Lake	August 23	5	Horizontal	6.2	No	No
Kahshe Lake	August 23	6	Vertical	10.5	No	No

While the laboratory did not report on the presence or absence of the fishhook waterflea, it is unlikely to have been present, as it is similar in size to the spiny waterflea.

The OFAH also did not specifically search for freshwater jellyfish; however, given their larger size, at a minimum, the mature hydromedusae would have been captured via both the horizontal and vertical haul methods employed in the study. As none were detected in any of the sampling sites, this particular life stage of the freshwater jellyfish does not appear to be present in Kahshe Lake.

In an effort to give some perspective to these findings, the Early Detection and Distribution Mapping System Ontario (EDDMaps Ontario) was accessed to determine the occurrence of the four species included in the Kahshe Lake study throughout Ontario and more specifically in the Muskoka area.

The figures that follow present the findings from the 2017 EDDMaps Ontaro database. To begin, only the fishhook waterflea has remained in Lake Ontario following its first siting in 1998, and as such, an EDDMaps has not been shown for this species.

All three other species have spread to inland lakes as shown in Figures 13 through 18 below.

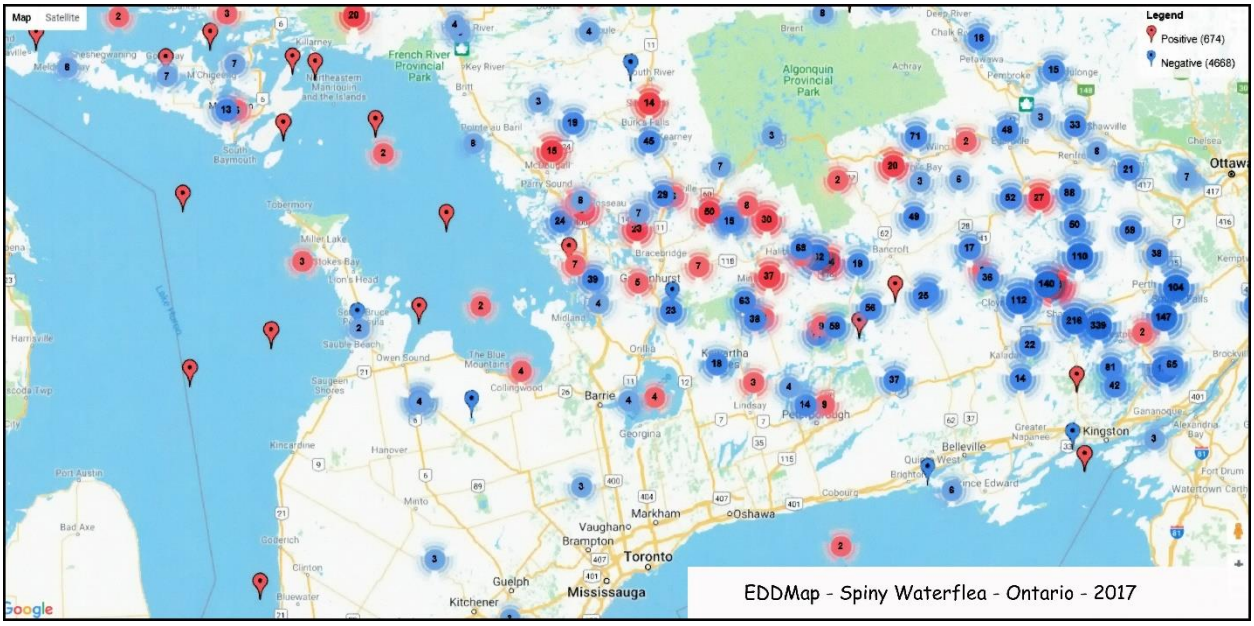


Figure 13: Detection of Spiny Waterflea in Ontario - 2017

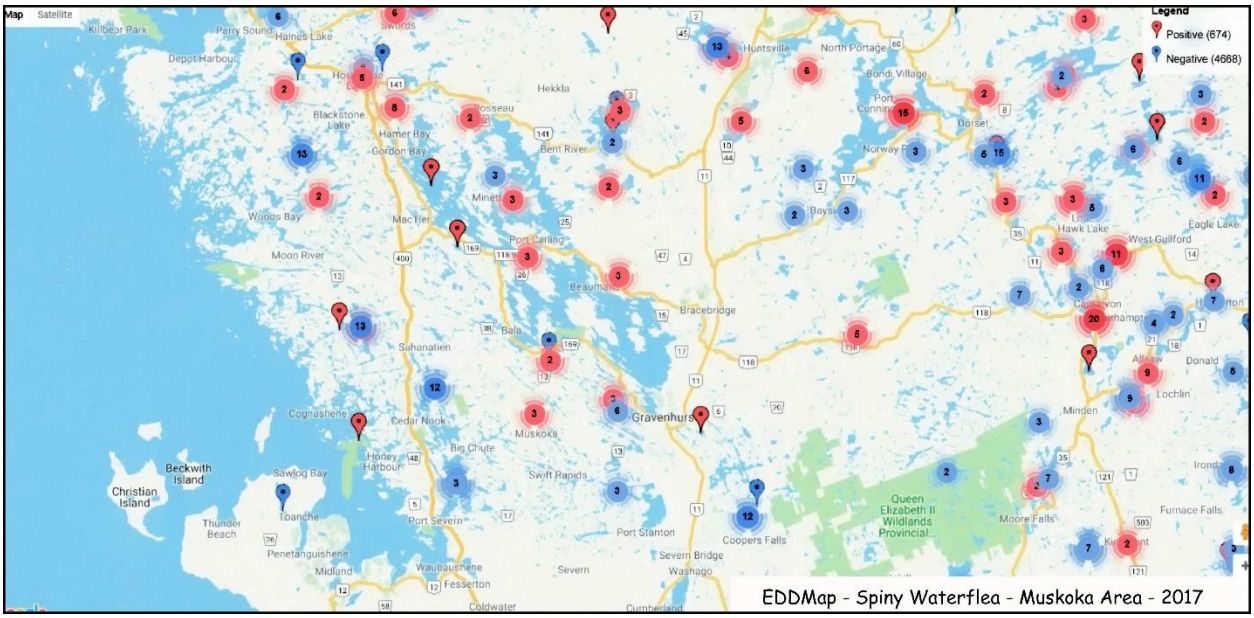


Figure 14: Detection of Spiny Waterflea in Muskoka Area – 2017

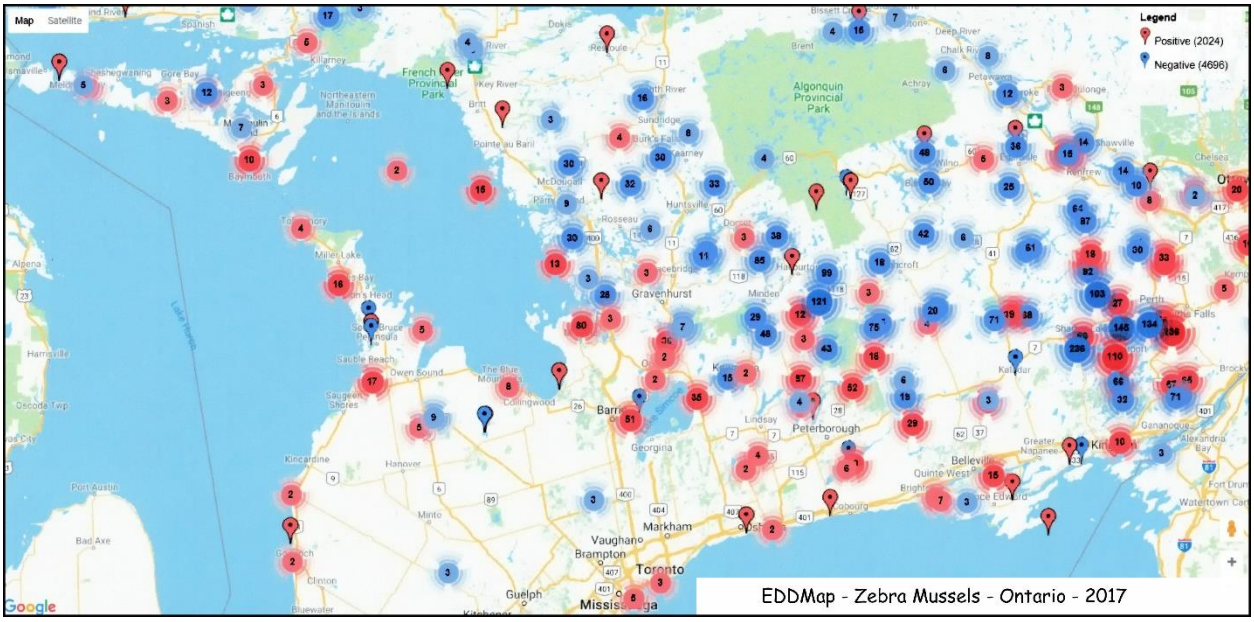


Figure 15: Detection of Zebra Mussels in Ontario – 2017

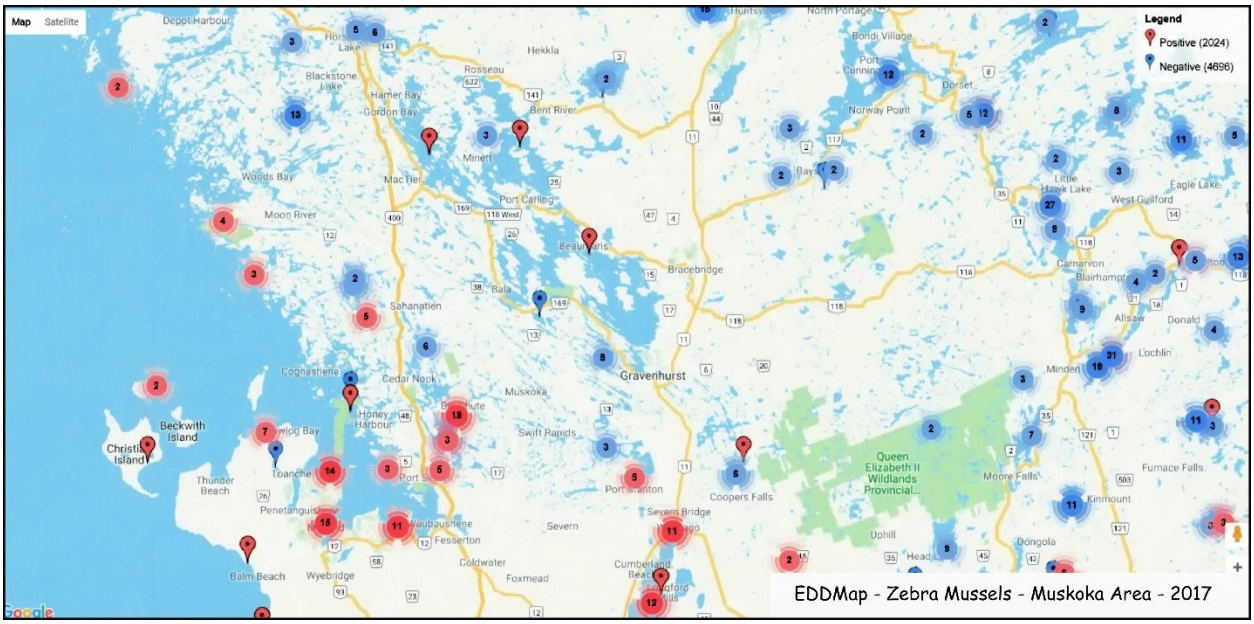


Figure 16: Detection of Zebra Mussels in Muskoka Area – 2017

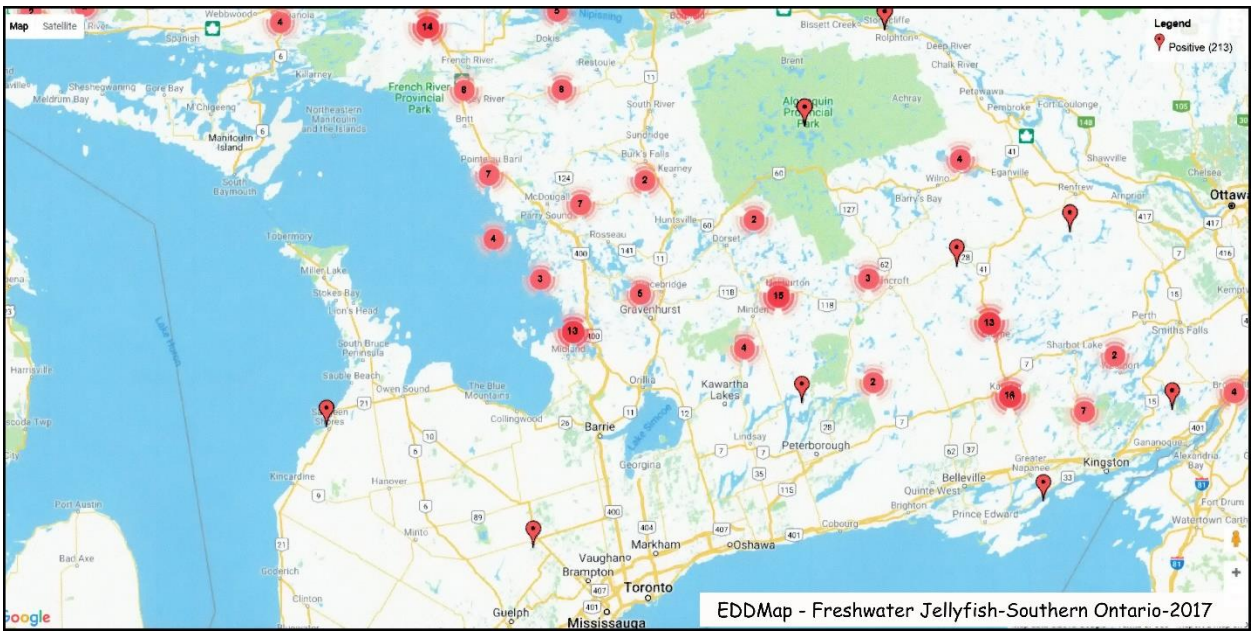


Figure 17: Detection of Freshwater Jellyfish in Ontario – 2017

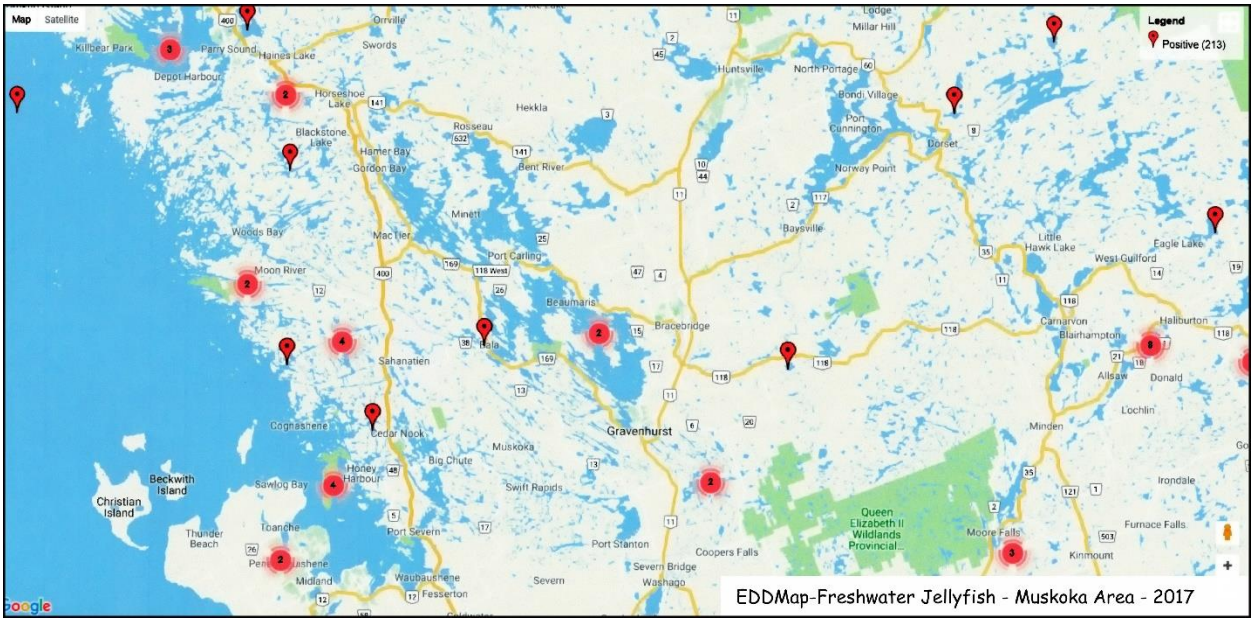


Figure 18: Detection of Freshwater Jellyfish in Muskoka Area – 2017

As noted by the red coloured positive indicators in each of the above figures, three of the four invading aquatic species evaluated in the 2017 Kahshe Lake study have been reported in inland lakes throughout Ontario and in particular, the Muskoka area.

In the case of the freshwater jellyfish (Figure 18), Kahshe Lake has been identified as being positive for this species. However, as this detection was based on an observation over 10 years ago, it should be qualified accordingly. The current study did not detect any evidence of this invasive species, although this also needs to be qualified, as it was based on a visual assessment for the larger life stage which would have been captured in the netting system used at the six sampling sites in 2017.

5.0 Conclusions and Recommendations

The results from this invasive species sampling program on Kahshe Lake in 2017 have failed to detect any of the invasive aquatic species that were identified as potential species of concern. This included the following species:

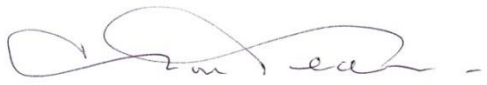
- Spiny waterflea
- Fishhook waterflea
- Zebra mussels
- Freshwater jellyfish

The obvious qualifier to a study like this is that "the absence of evidence cannot be considered as evidence of absence", as although the sampling program included six locations, other sampling locations may have yielded different findings. However, given that the lake was sampled at major boat lauching locations where invasive species would most likely to have been introduced as well as the fact that samples were collected from both deep and shallow waters and from representative areas of the lake, the evidence of absence presents a fairly robust case to conclude that Kahshe Lake has not yet been impacted by these four invasive species.

While these findings are certainly good news, the presence of three of these four species in other lakes in the Muskoka area is cause for concern and continued vigillance, as the likelihood of future impact cannot be ruled out.

What can we do to protect our lake?

- Learn how to identify these invaders (pictures included in this report).
- Inspect your boat, trailer and equipment after each use, and remove all plants, animals and mud before launching it after use in another waterbody.
- Drain water from your motor, live well, bilge and transom wells while on land.
- Rinse all boats and recreational equipment with high pressure (>250 psi) or hot (50°C / 122°F) water or let it dry in the sun for at least five days.
- If you've seen an invasive species in the lake, and you're sure of what it is, please contact the toll-free Ontario Invading Species Hotline at 1-800-563-7711, or visit **www.invadingspecies.com** to report a sighting.
- If you're unsure whether your observation is of an invading species, try to get a sample or picture and call or text me at (416) 843-2805 to discuss what you've found.

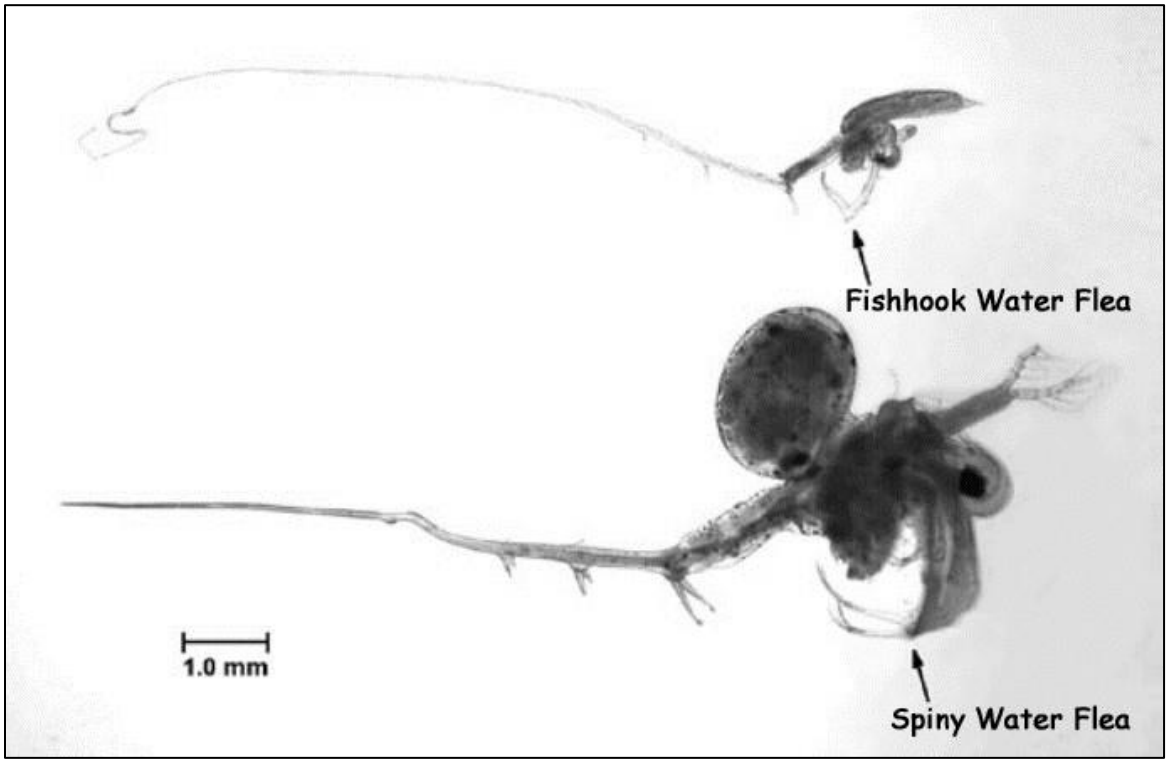


Ron Pearson

Kahshe Lake Steward

ATTACHMENT

Images of Spiny and Fishhook Waterflea (from: *Spiny and Fishhook Waterflea Fact Sheet. 2012. Invasive Species Centre.ca*)



Images of Zebra Mussels – from Zebra Mussels Invade Ontario Waters, August 2006 and Commonwealth of Massachusetts, 2018.

mages of Freshwater Jellyfish (from: Feshwaterjellyfish.org. 2017. Dr. T. Peard web-site)