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**Organization:** Fisheries and Oceans Canada

**Problem Statement:**

Aquatic invasive species present a major ecological and economic threat throughout the world. In North America, a group of four large and voracious fish species collectively known as the Asian carps are currently threatening to invade the Great Lakes. The Great Lakes are the world's largest freshwater system and are home to more than 100 species of native fishes and a multi-billion dollar fishing industry. Canada and the United States are working together to prevent Asian carps (Bighead Carp, Silver Carp, Grass Carp and Black Carp) from entering the Great Lakes. Prevention is more effective and much less costly than trying to control an invasive species after it arrives. Asian carps have already caused great ecological and economic damage in the Mississippi River basin where they have already invaded. A 2011 'Binational Ecological Risk Assessment for Bigheaded Carps in the Great Lakes' showed that the Great Lakes are at high risk of invasion by Asian carps and that ecological consequences could be high. In this risk assessment, high risk tributaries were identified by computer modelling and many of these tributaries have been sampled for Asian carps between 2013 and 2015 as part of Fisheries and Oceans Canada's early detection surveillance program. No Bighead Carp, Silver Carp or Black Carp have been observed. In 2013, two triploid sterile Grass Carp were caught in Grand River, a tributary of Lake Erie. In 2014, one triploid Grass Carp was caught in the Grand River. In 2015, six diploid (reproductive) Grass Carp were caught in Lake Ontario and an adjacent pond, and three other triploid or undeterminable ploidy were caught Lake Ontario, Lake Erie and the lower Niagara River. Given the discovery of diploid, or potentially reproductive, Grass Carp in Lake Ontario in 2015, managers need to expand surveillance to include early life stages (fish eggs and larvae). The issue is to determine the specific time of year to target surveillance efforts for spawning adults and early life stages in high risk tributaries of the Great Lakes so that we can best prevent spawning and control populations. This time window may change from year to year and tributary to tributary. A real-time tool to help field staff determine when to visit high risk areas would be helpful.

**Solution:**

Given the vast scale of the Great Lakes and limited on-the-ground resources, we need a program/application using online real-time temperature and flow data determine the most high risk areas to sample and the times of years during which these areas should be sampled. Specifically, we would like an application or tool that could be used by field staff and managers to determine when Asian carps would be entering individual streams to spawn each summer. Water temperatures and flows vary inter-annually and it is difficult to predict when field crews should be searching for staging individuals. It is thought that Asian carps require a certain water flow and minimum water temperature or accumulated growing degree days to move towards and aggregate in spawning streams. These aggregations of Asian carp individuals provide both an elevated risk of reproduction and an opportunity to control and remove large portions of an invading population. This real-time tool could be made flexible enough to predict spawning times of different fish species that spawn in streams (e.g., Asian carps, salmonids).

**Supporting Data/Information:**

A graduate student at the University of Toronto Scarborough is working on models to predict when and where Asian carps would spawn in the Great Lakes using information on their behaviours in their native and invaded ranges, as well as local environmental conditions in the Great Lakes. The proposed application would tie in closely with this student's work.

Background information on Asian carps and links to risk assessments: http://www.dfo-mpo.gc.ca/science/coe-cde/ceara/AIS-EAE/asian\_carp-carpe\_asiatique-eng.htm

**Do you agree to follow up with the relevant organization/team after the 2016 Fishackathon?**  
 Yes

**Required Steps and Data Sources**

1. Using online, real-time water temperature data, provide real-time growing-degree days (base 15) using following equation: ∑(Mean Daily water temperature -15 if >0) starting January 1.

When sum = 650 then onset of Asian Carp is expected

When sum = 900 then mass spawning of Asian Carp is expected

Online data sources provided at end of problem statement.

2. Using the temperature and flow, predict and graph daily the length of stream required for Asian Carp spawning using this equation: D=3.6\*V\*I

V=stream velocity (m/s)

I=estimated incubation time (h)

I is based on any one of these equations:



Here are example graphs.



3. Compare the required river length to the actual river length to the first barrier. Measure distance of river between the Great lakes and the first dam or waterfall using GoogleEarth.

4. Use this decision tree to determine the likelihood of Asian Carp spawning on any given day.

GDD15 >650

Not Suitable

Water temp

>17oC

Unimpounded Length

> Predicted

Flow Spike

>0.7m/s

GDD15

>900

Minimally

Suitable

Highly

Suitable

Flow Spike

>0.7m/s

Very

Suitable

Suitable

USGS Gauging Stations in the Great Lakes Basin with Stream Temperature and Velocity Data

Michigan

<http://waterdata.usgs.gov/mi/nwis/uv/?site_no=04119400&agency_cd=USGS&amp>;

<http://waterdata.usgs.gov/mi/nwis/uv/?site_no=04157005&agency_cd=USGS&amp>;

<http://waterdata.usgs.gov/mi/nwis/uv/?site_no=04165500&agency_cd=USGS&amp>;

New York

<http://waterdata.usgs.gov/ny/nwis/uv/?site_no=04231600&agency_cd=USGS&amp>;

Indiana

http://waterdata.usgs.gov/nwis/uv/?site\_no=04092750&agency\_cd=USGS&amp;

USGS 04092750 INDIANA HARBOR CANAL AT EAST CHICAGO, IN

<http://waterdata.usgs.gov/nwis/uv/?site_no=04095090&agency_cd=USGS&amp>;

USGS 04095090 PORTAGE-BURNS WATERWAY AT PORTAGE, IN

<http://waterdata.usgs.gov/nwis/uv/?site_no=04182755&agency_cd=USGS&amp>;

USGS 04182755 JUNK DITCH AT FORT WAYNE, IN

Illinois

<http://waterdata.usgs.gov/nwis/uv/?site_no=05536890&agency_cd=USGS&amp>;

USGS 05536890 CHICAGO SANITARY AND SHIP CANAL NR LEMONT, IL

Wisconsin

<http://waterdata.usgs.gov/nwis/uv/?site_no=04087170&agency_cd=USGS&amp>;

USGS 04087170 MILWAUKEE RIVER AT MOUTH AT MILWAUKEE, WI

<http://waterdata.usgs.gov/nwis/uv/?site_no=04087142&agency_cd=USGS&amp>;

USGS 04087142 MENOMONEE RIVER AT 16TH STREET AT MILWAUKEE, WI

<http://waterdata.usgs.gov/nwis/uv/?site_no=040851385&agency_cd=USGS&amp>;

USGS 040851385 FOX RIVER AT OIL TANK DEPOT AT GREEN BAY, WI

<http://waterdata.usgs.gov/nwis/uv/?site_no=04073466&agency_cd=USGS&amp>;

USGS 04073466 SILVER CREEK AT SPAULDING ROAD NEAR GREEN LAKE, WI

<http://waterdata.usgs.gov/nwis/uv/?site_no=04084445&agency_cd=USGS&amp>;

USGS 04084445 FOX RIVER AT APPLETON, WI