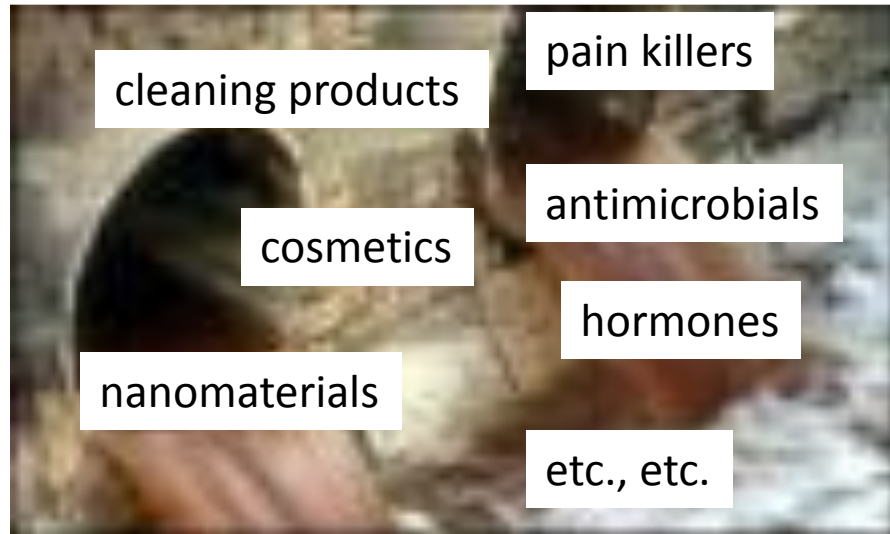


Substances of emerging concern – evaluating effects

Karen Kidd, University of New Brunswick, Saint John, NB



- Municipal wastewaters complex mixture of chemicals
- Natural and synthetic estrogens linked to feminization of male fishes

Feminized male fish have:

- Smaller gonads
- Vitellogenin
- Intersex

Implications for sustainability of fishes?
(#1 - whole ecosystem experiment)

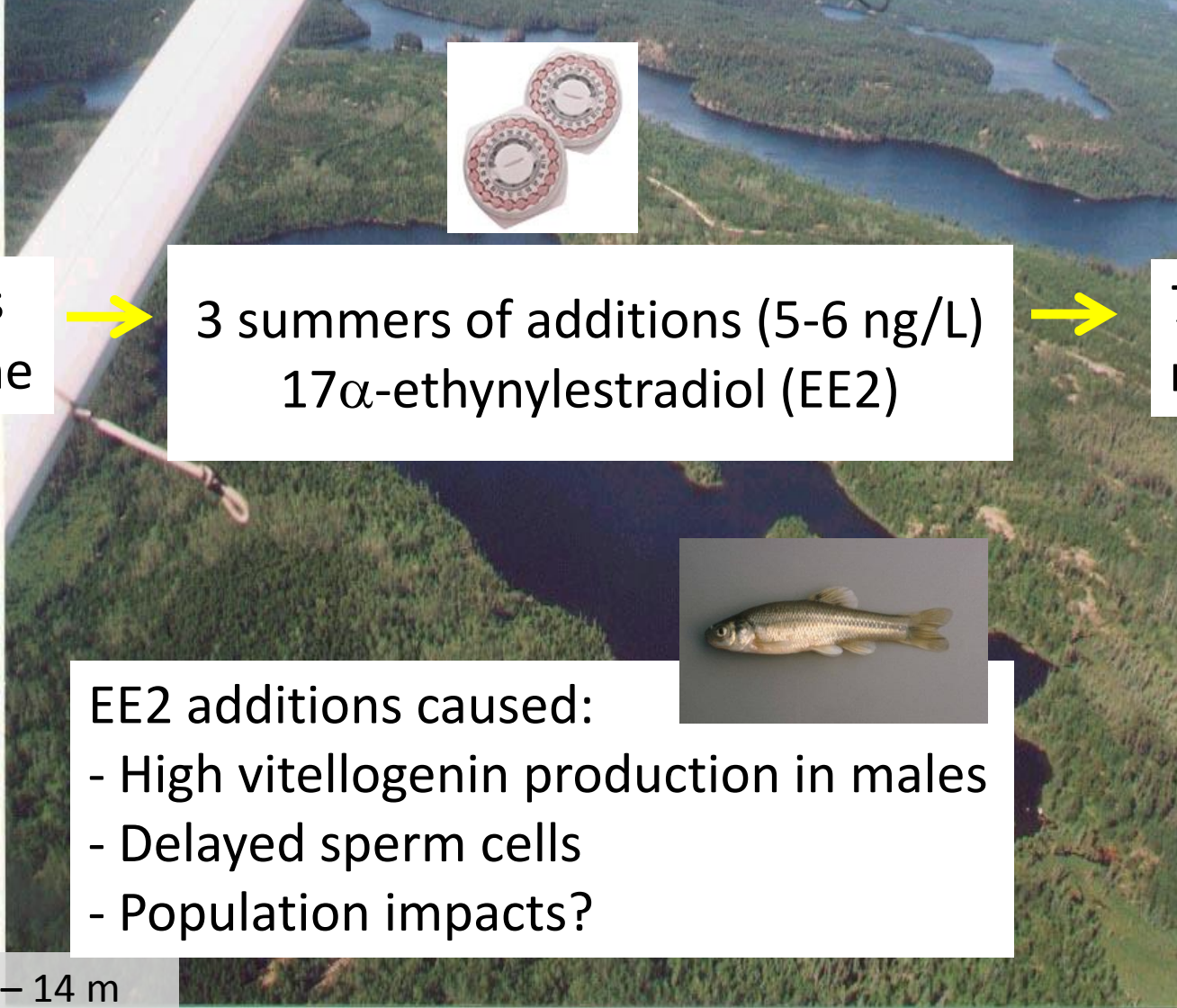


Darter, Grand River, ON
Bahamonde, Servos

Implications for fish populations and aquatic food webs?

Experimental Lakes Area (IISD-ELA)

Lake 260 - Estrogen Addition Lake



2 years
baseline



3 summers of additions (5-6 ng/L)
 17α -ethynylestradiol (EE2)



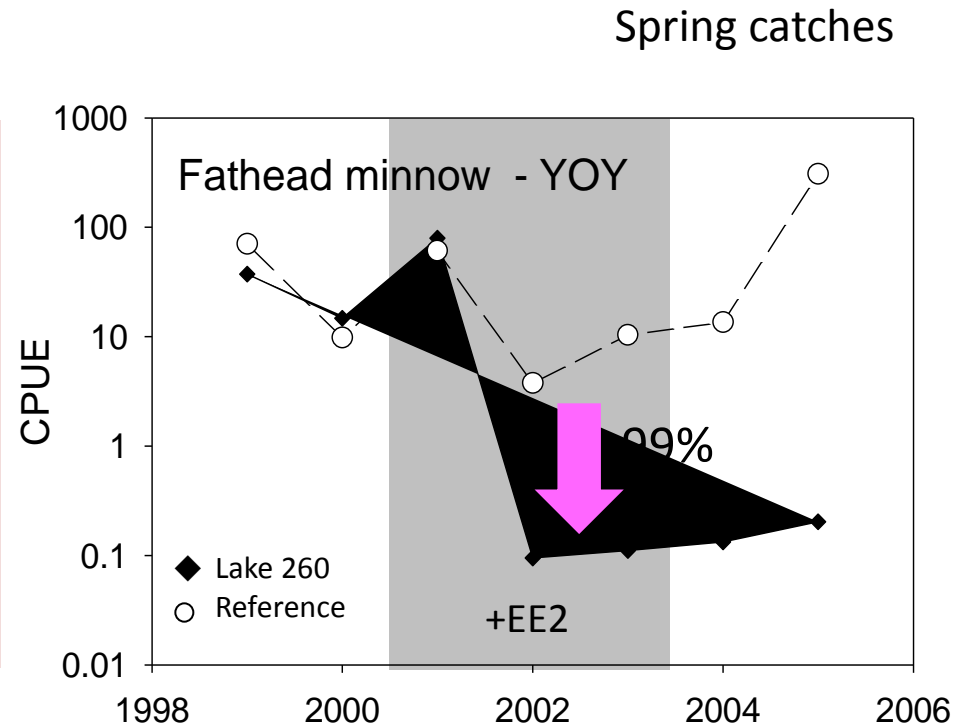
7 years
recovery

EE2 additions caused:

- High vitellogenin production in males
- Delayed sperm cells
- Population impacts?

Max depth – 14 m
Surface area – 36 ha

EE2 additions led to near extinction of fathead minnow population



Collapse of fathead minnow – Kidd et al. 2007 PNAS

Recovery of fathead minnow – Blanchfield et al. 2015 Environ. Sci. Technol.

Food web implications – Kidd et al. 2014 Phil. Trans. Royal Soc. B

Funding: CWN, NSERC, Fisheries and Oceans, ACC, Bayer Schering Pharma AG



What did we learn from this study?

4. Whole lake experiments invaluable

3. Indirect effects on fish prey

89%

78%

41%

Crustacean zooplankton

Rotifers

2. Indirect effects on fish predators

Lake trout

25%

no change

Pearl dace

58%

Algae and bacteria

no change

White sucker

Fathead minnow

99%

1. Direct effects on fish populations

Slimy sculpin

75%

70%

Littoral macroinvertebrates

EE2

What tools best identify impacts of substances of emerging concern?

A national CWN study

- Municipal wastewater treatment plants unique personalities, treatments, receiving environments
- How do we assess impacts? Expert workshop held
- #2 - CWN project (2013) to develop toolbox to identify sites of higher and lower concern (ending spring 2015)

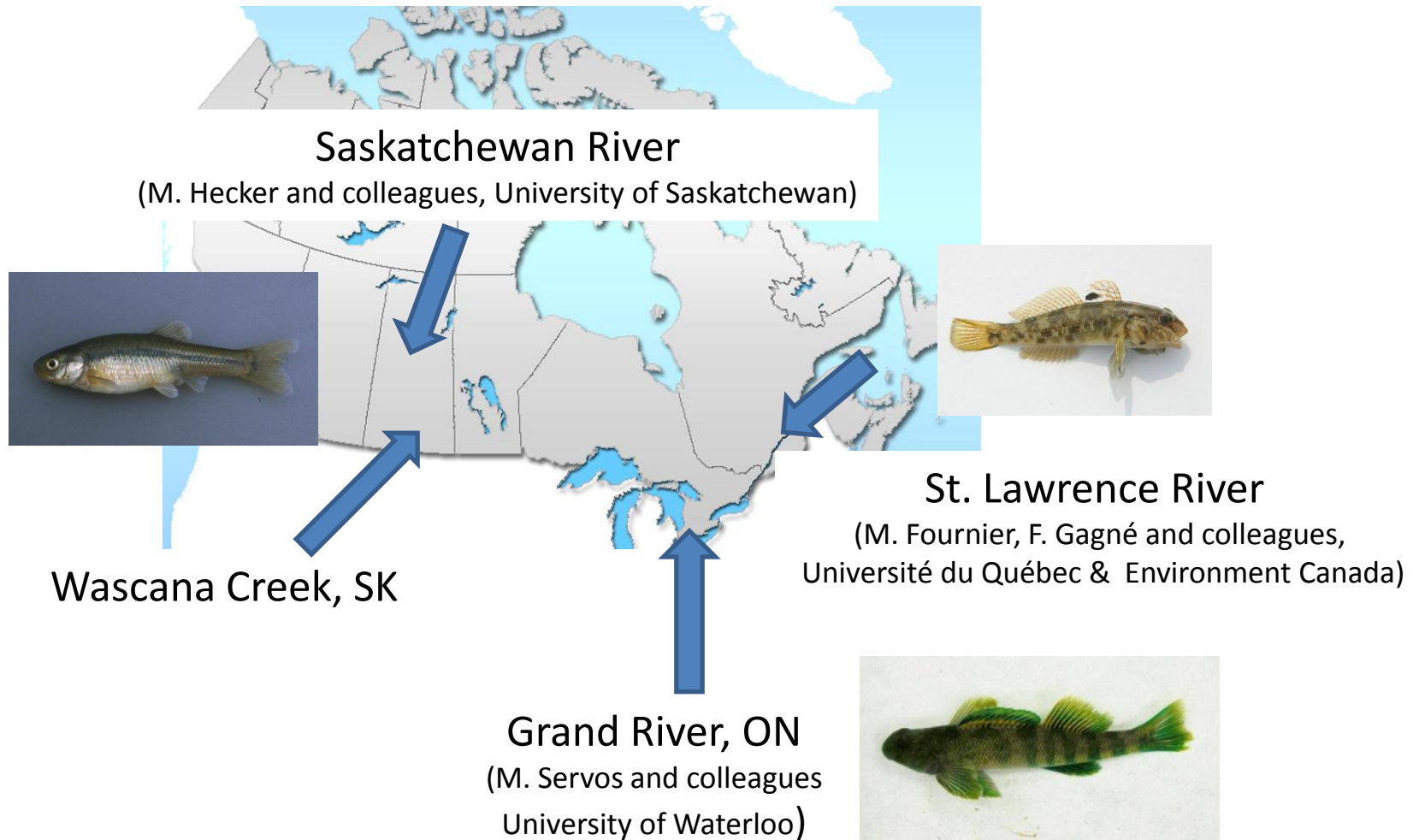


Small river receiving wastewaters after advanced treatment?



Large river receiving wastewaters after secondary treatment?

What measures best assess effects on fish?



- Multidisciplinary, collaborative approach
- Comparisons across diverse sites and diverse species

What is being evaluated?

Influents and effluents



Measures

- 1) Chemistry
- 2) In vitro bioassays
- 3) In vivo bioassays

Wild fish



Measures

- 1) Whole organism
- 2) Tissue
- 3) Physiological
- 4) Exposure

Which tools are most effective?

Links across levels of biological organization

Summary and value of toolbox approach – opportunities and value

- Results being contrasted across sites
- Identifying endpoints that distinguish sites of high and low concern
- Engaged in similar WERF Phase 2 project in US
- Near future - Develop guide for managers/operators, validate toolbox at other sites
- Common approach to assess:
 - whether there is a concern, where it is greatest
 - effectiveness of changes in treatment
- Informs decisions, focuses resources