

First record and rapid geographic expansion of spiny water-flea (*Bythotrephes longimanus*) in Manitoba, Canada, 2009-2014

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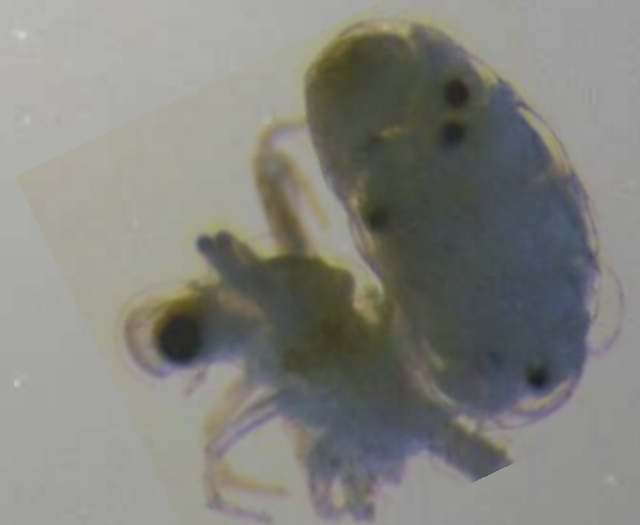
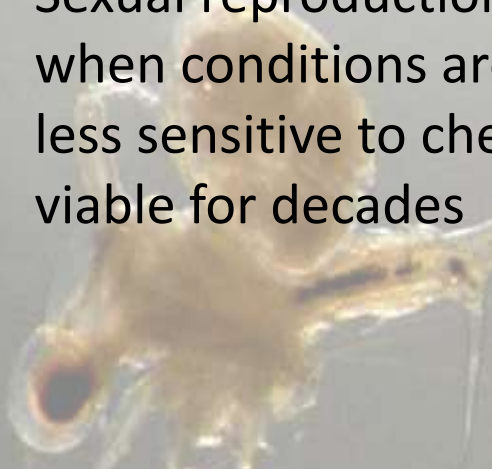
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SWF Biology

- Single polymorphic species *Bythotrephes longimanus*
- Cyclical parthenogenesis:
 - Asexual (parthenogenic) reproduction produces broods of eggs ($n=2-10$) that develop into female clones and are released into the water column
 - Sexual reproduction generates diapausing eggs ($n=2-5$) when conditions are unfavourable; less sensitive to chemicals, desiccation; viable for decades
- Mainly visual feeders
 - Resides in the epilimnion during the day
 - Consumes $\sim 75\%$ of its body weight in prey per day
 - Doubling of consumption rate at 26°C vs. 21°C (Kim 2012)



Drift traps for larval fish assessment

Pointe du Bois Generating Station Spillway Replacement Project

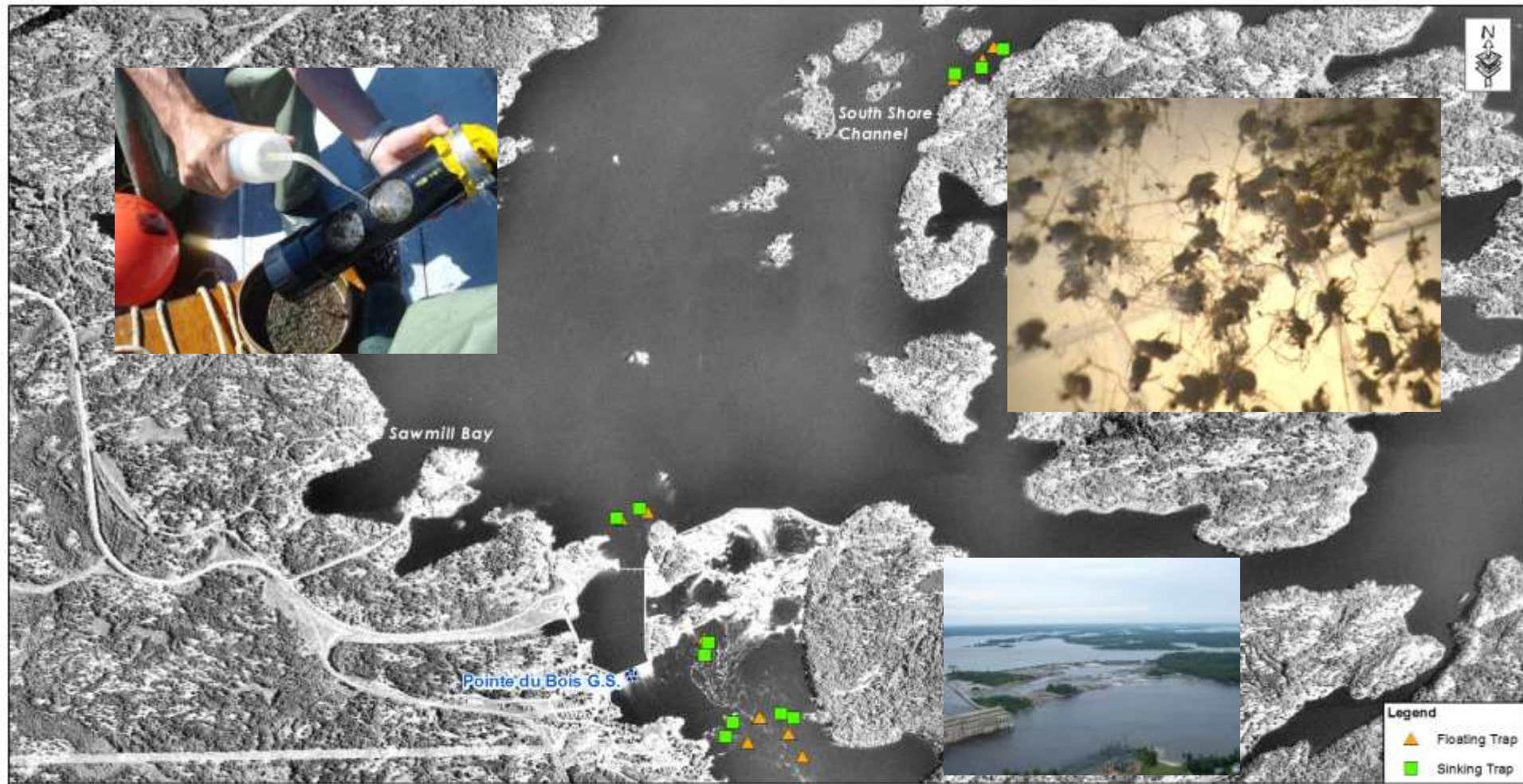


Kicknet and benthic grab samples taken at Pointe du Bois and Lac du Bonnet, 2011



Drift traps for larval fish assessment, 2010 and 2012

Pointe du Bois Generating Station Spillway Replacement Project

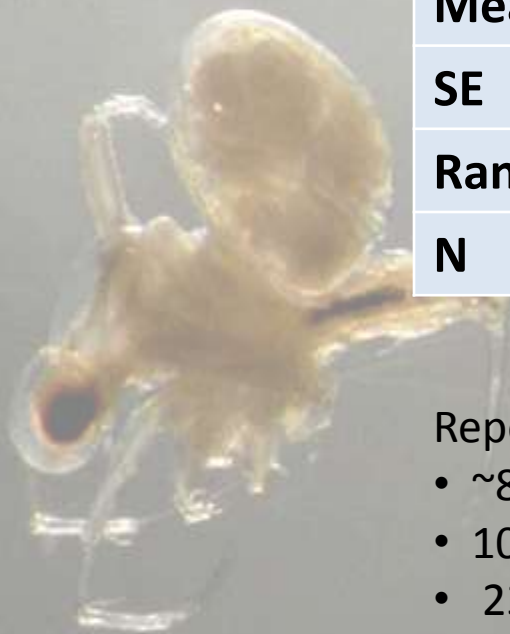


Drift density ($n \cdot m^{-3}$) of *Bythotrephes* in floating and sinking drift traps set in the Winnipeg River at Pointe du Bois in 2010 and 2012

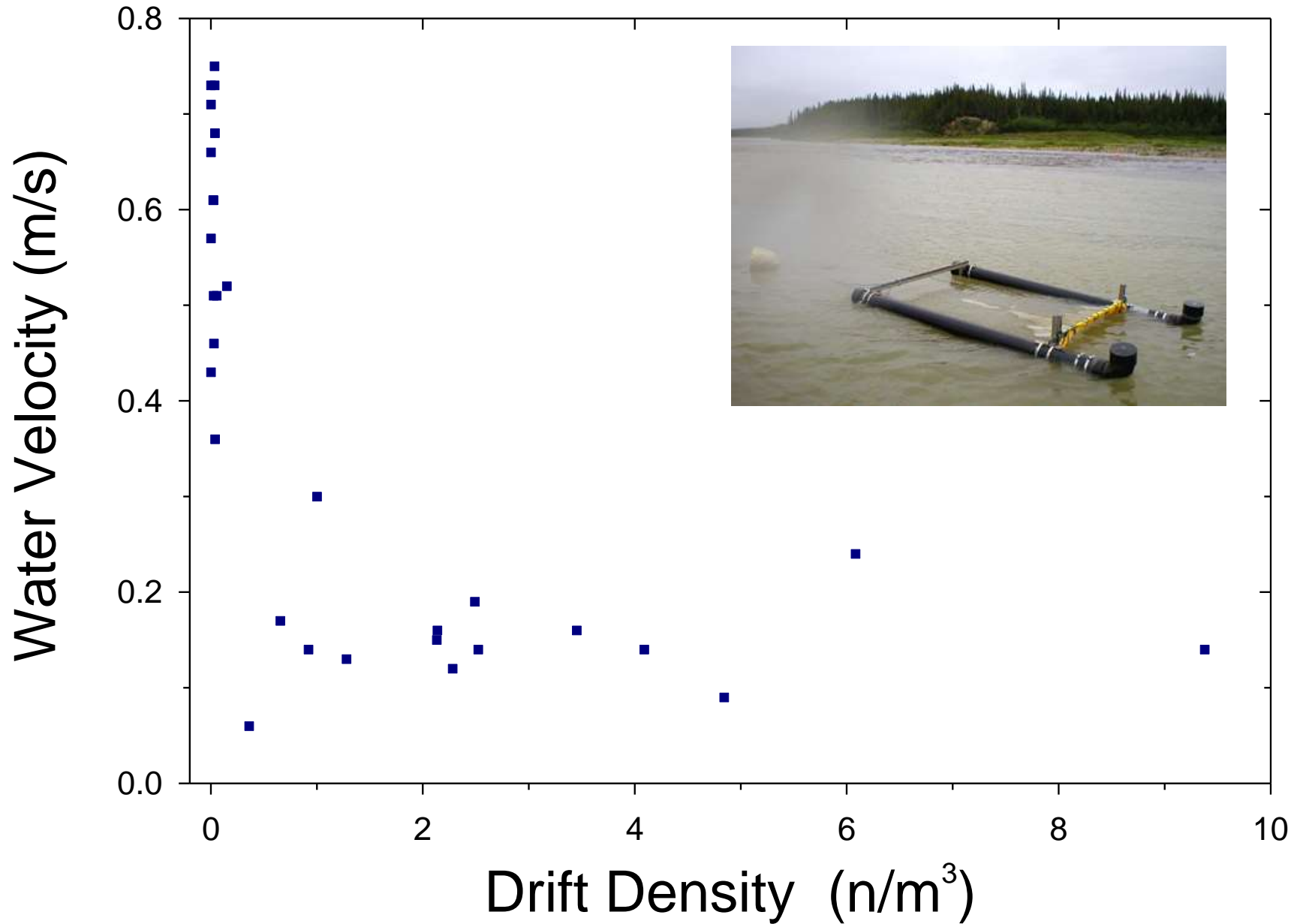
Statistic	2010		2012	
	Float	Sink	Float	Sink
Mean	8.1	0.17	1.5	0.03
SE	5.2	0.12	0.4	0.01
Range	1.0-22.3	0.01-0.65	0-9.4	0-0.25
N	4	5	30	30

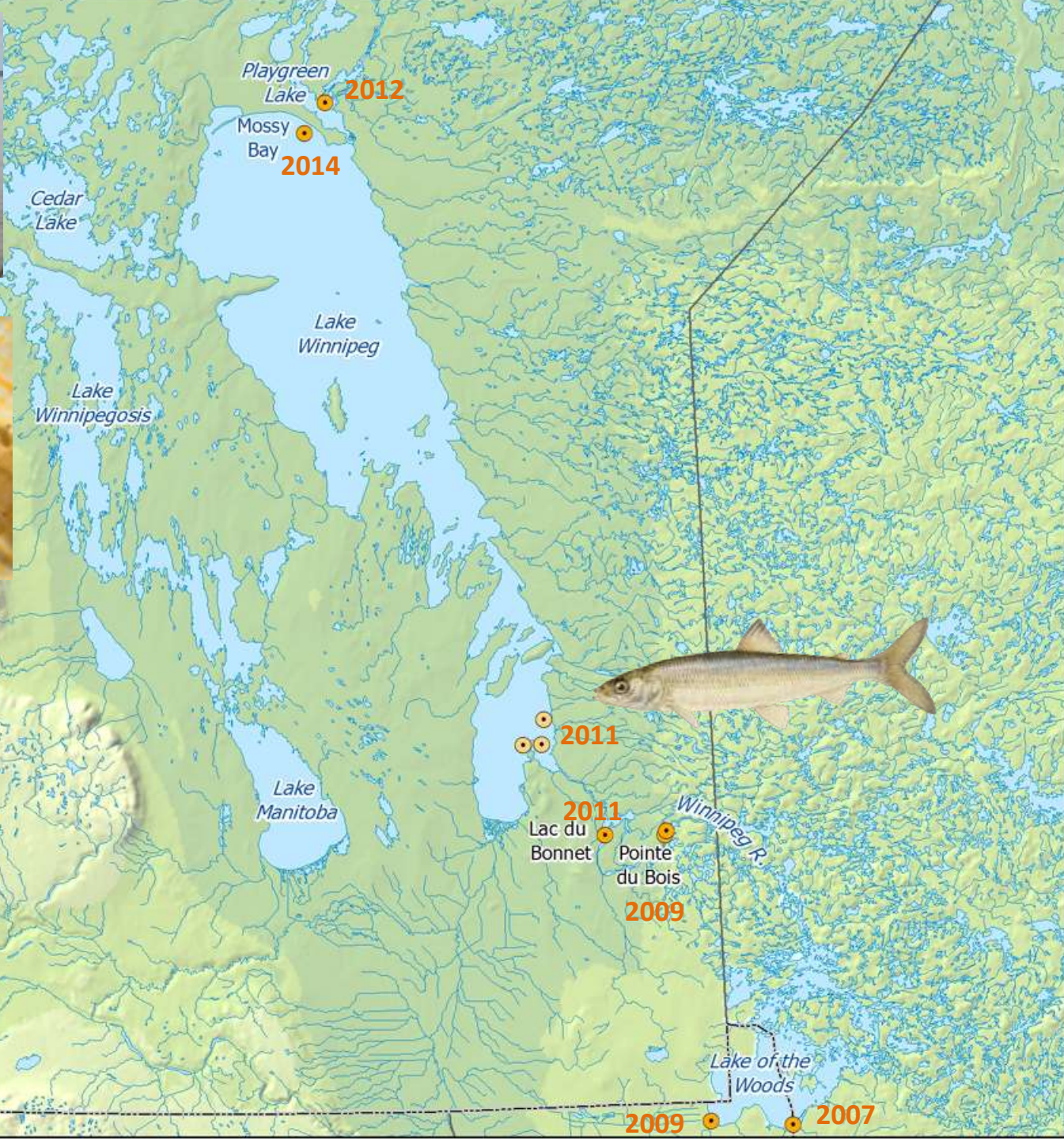
Reported *Bythotrephes* densities (mid-late summer):

- $\sim 85 \cdot m^{-3}$; Rybinsk reservoir (Grigorowich et al. 1998)
- $10-11 \cdot m^{-3}$ Lake Huron, Michigan (Barbiero & Tuchman 2004)
- $23 \cdot m^{-3}$ Lake Erie, Eastern basin (Barbiero & Tuchman 2004)
- $32 \cdot m^{-3}$ Lake Erie, Central basin (Barbiero & Tuchman 2004)
- $1-13 \cdot m^{-3}$ in 17 Canadian shield lakes (Boudreau & Yan 2003)



Winnipeg River at Pointe du Bois, 2012





- Established SWF Populations
- SWF in Fish Stomach
- International Boundary
- State/Provincial Boundary

0 25 50 75 100
Kilometres

Coordinate System: UTM NAD 83, Zone 14N

Some documented impacts of *Bythotrephes*

Effect	Comments	Reference
Zooplankton community		
Increased predation rates	300% higher in invaded lakes	Foster & Sprules 2009
Displacement of native taxa	e.g., <i>Leptodora kindtii</i> ; <i>Mesocyclops edax</i>	Yan et al 2001; Weiz & Yan 2010; Hessen et al. 2011; Hovius et al. 2007
Fewer species, lower abundance and biomass	<i>Bosmina</i> , <i>Chydorus</i> , several <i>Daphnia</i> species are most sensitive	Strecker 2011, Azan et al 2015; Boudreau and Yan 2003
Induces prey (<i>Bosmina</i> , <i>Daphnia</i>) vertical migration to deeper, cooler strata	Reduction in prey growth	Pangle et al. 2007; Strecker & Arnott 2008
Changed species composition and/or relative abundance	Increase in the relative abundance of copepods and <i>Holopedium sp. vs Cladocera</i>	Strecker et al. 2006; Azan et al 2015
Increase in the mean trophic position of the zooplankton community	Potential for mercury biomagnification; little evidence from field studies on mid-trophic invasive species	Rennie et al. 2011; Rennie et al. 2010; Johnston et al. 2003; Hogan et al. 2007
Increased rotifer abundance	competitive/predatory release	Hovius et al 2006, 2007; Strecker et al. 2011 ; Azan et al 2015
Ecosystem		
Altered composition/biomass of the phytoplankton community	Mixed results in the literature	Hovius et al 2006; Strecker et al. 2011; Azan et al. 2015
Lower epilimnetic productivity	Lower abundance and/or availability of SWF prey for fish	Pangle et al. 2007; Strecker & Arnott 2008; Foster & Sprules 2009
Lower abundance of other (native) invertebrate predators	<i>Chaoborus sp.</i> , <i>Mysis sp.</i>	Hovius et al. 2006, 2007
Reduced consumption and growth of fish species (e.g., Rainbow Smelt)	SWF spine retention	Feiner et al. 2015
Economics		
Fouling of fishing gear	Also acts as a vector for dispersal	MN Sea Grant

Factors to be considered when assessing potential long-term impacts of *Bythotrephes* on Lake Winnipeg and the Nelson River

- There have been several exceptions to the commonly observed impacts; in some invaded lakes zooplankton species richness or abundance has increased (site-specific impacts, Azan et al. 2015);
- Potential severe short-term impacts will likely not be permanent:
 - Some Norwegian lakes where *Bythotrephes* invaded many decades ago, now have greater zooplankton diversity than before: Competitive release; Behavioural adaptations to *Bythotrephes* predation by native species (Hessen et al. 2011)
 - Rescue effect from local or regional dispersers (Strecker and Arnot 2010)
- Although *Bythotrephes* has been shown to occur in many different waterbodies covering a wide range of environmental variables, it has been most successful in large, deep, nutrient poor lakes (MacIsaac et al. 2000);
- Distribution and abundance of *Bythotrephes* is related to lake trophic status
 - *Bythotrephes* has declined in or disappeared from lakes undergoing eutrophication (e.g., Lago Maggiore, Italy; Lake Ringsjön, Sweden)

Acknowledgements

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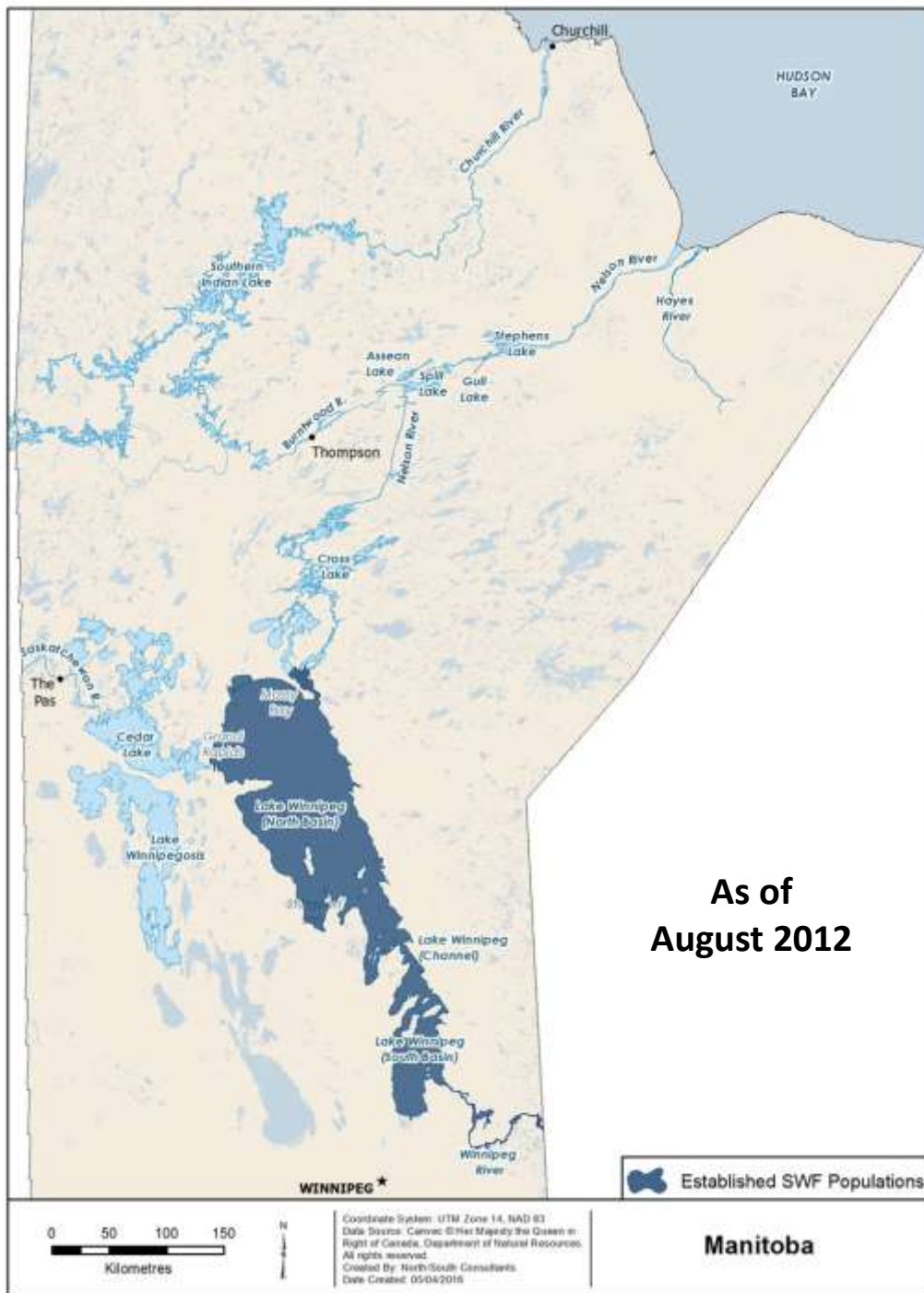
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Thank You





Bythotrephes was not found in kicknet or benthic grab samples from the Nelson River downstream of Playgreen Lake in 2014 and 2015

