

The influx of marine debris from the 2011 Great Japan Tsunami to North American shorelines

Cathryn Clarke Murray, Sherry Lippiatt, Kate Le Souef, and Nikolai Maximenko

November 8, 2016



Five million tons entered the ocean



© U.S. Navy



© U.S. Navy



4.8 to 12.7 million tons debris entering the ocean annually



Photo credit: Lightspeed Digital



Photo credit: NOAA



Photo credit: Hideoaki Maki

(Jambeck et al 2015 Science)

4.8 to 12.7 million tons debris entering the ocean annually



Research Questions

- Can we detect the debris influx from tsunami?
- How does it compare to background levels of marine debris?
- What is the cumulative influx of debris?

Shoreline Data Sources

1. NOAA Shoreline Monitoring
2. Great Canadian Shoreline Cleanup surveys
3. NOAA disaster debris reports

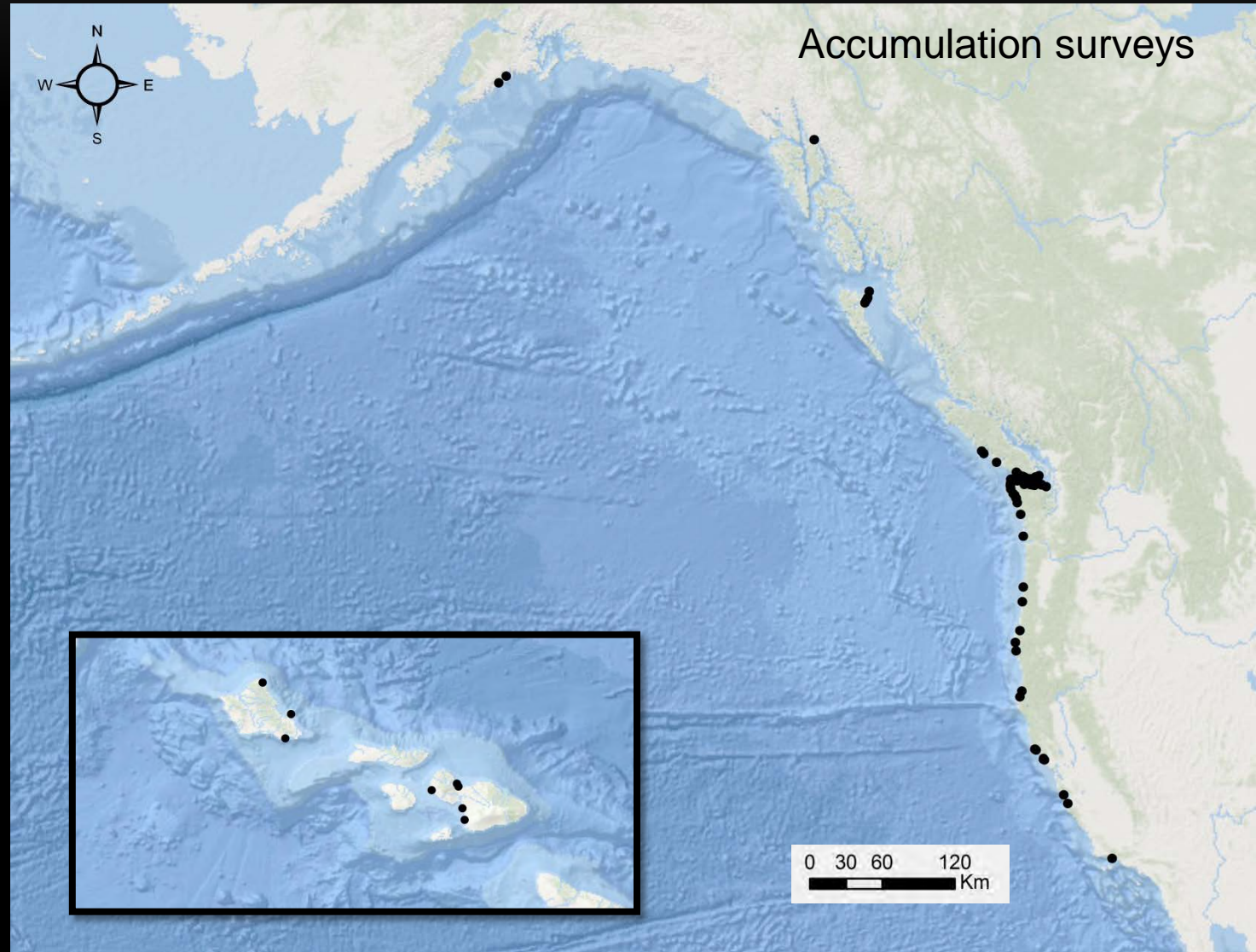


Photo credit: Lightspeed Digital

NOAA Marine Debris Monitoring and Assessment Project

Debris monitoring

- Accumulation surveys
- Standing stock surveys
- Over 800 surveys
- More than 120 sites
- 2011 - present



Olympic Coast National Marine Sanctuary (OCNMS) Shoreline Surveys

- National Marine Debris Monitoring Program
- Washington State
- 2001- early 2011
- 47 beaches
- 11 sites match post-2011 survey
- Indicator items only



Marine Debris - Indicator Items

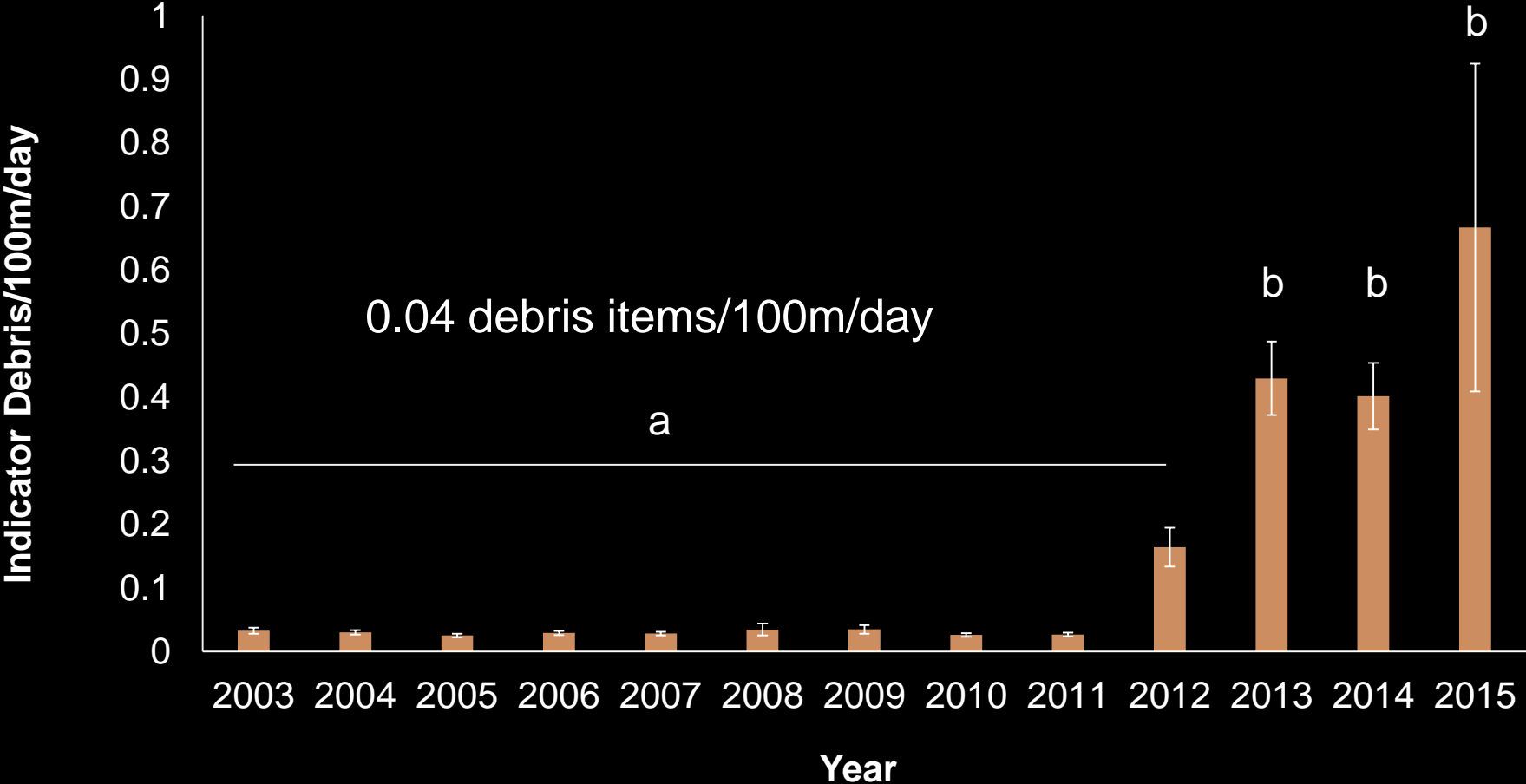
- Balloon
- Plastic bag
- Plastic bottle
- Straw
- Fishing line
- Buoy
- Trap



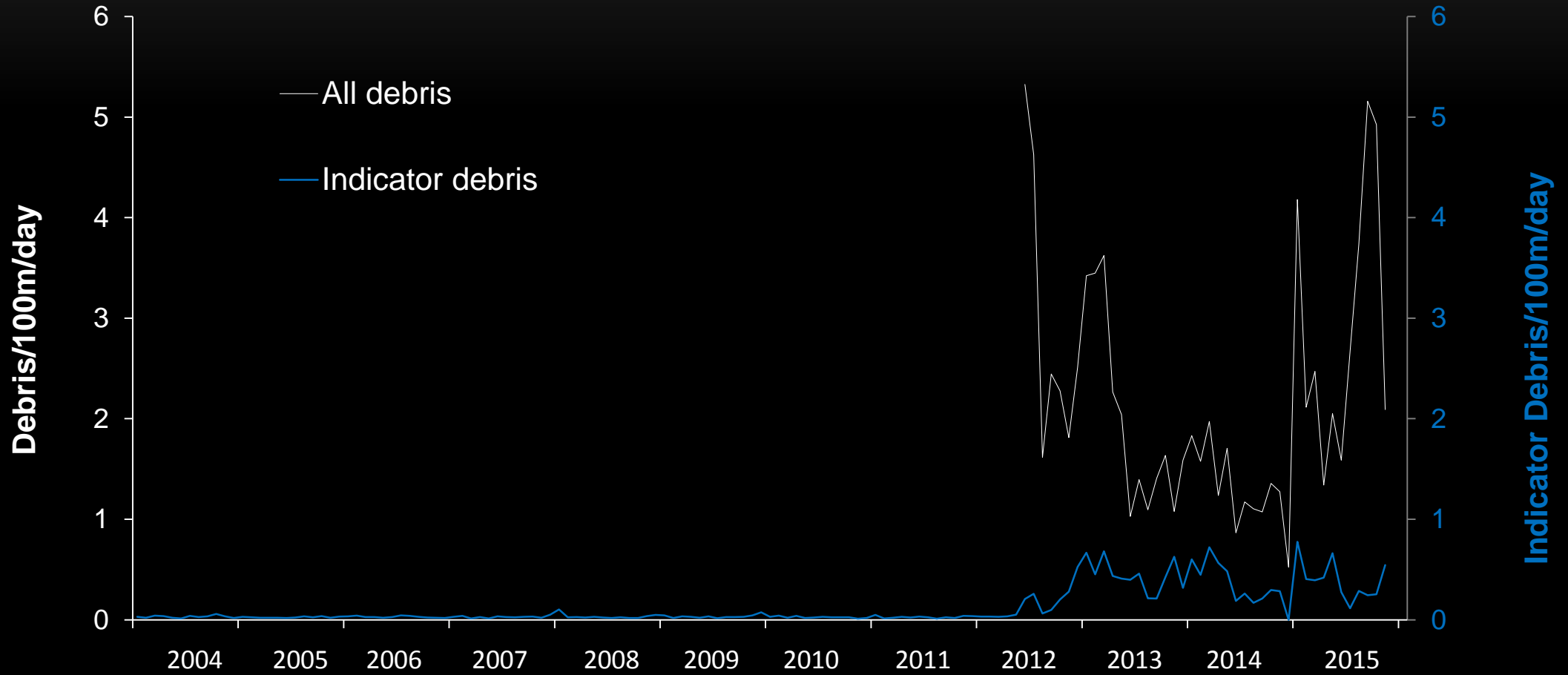


Debris increased 10-times over baseline

0.5 debris items/100m/day

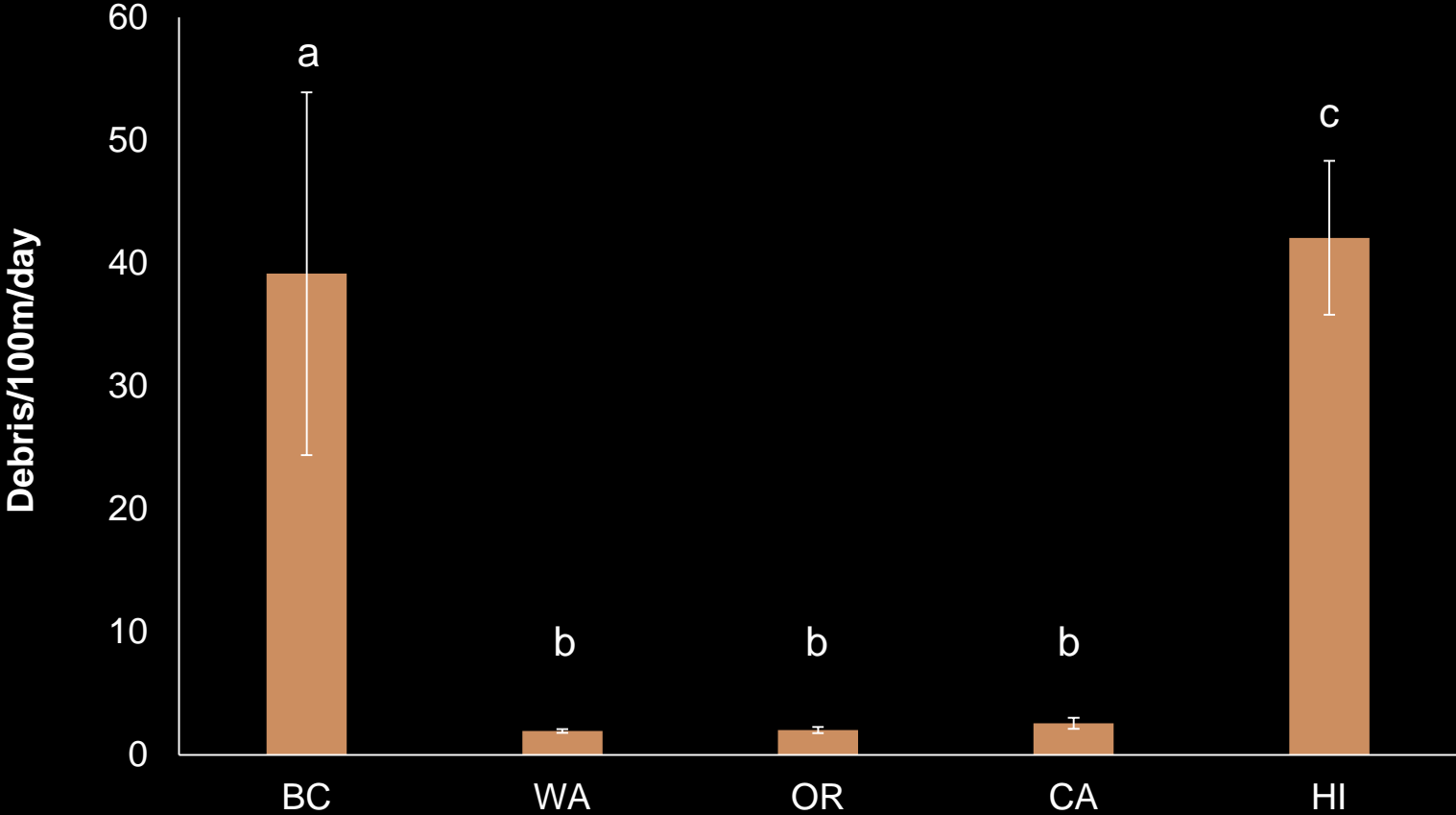


Total debris arrivals





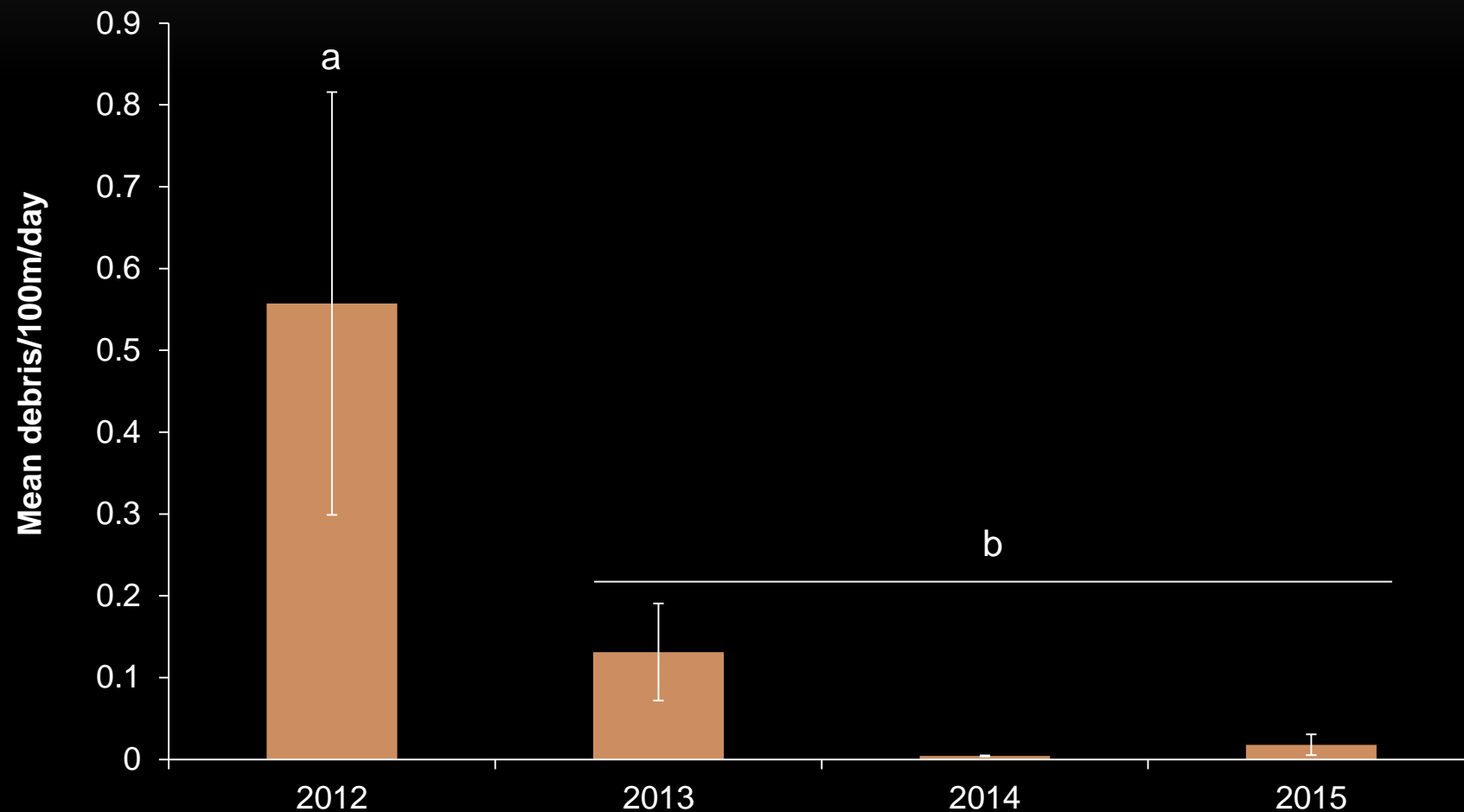
Debris arrival highest in BC and Hawaii, Alaska*



AK – few accumulation surveys
BC – driven by a few high surveys
HI – most debris of all states



Alaska – debris arrived early



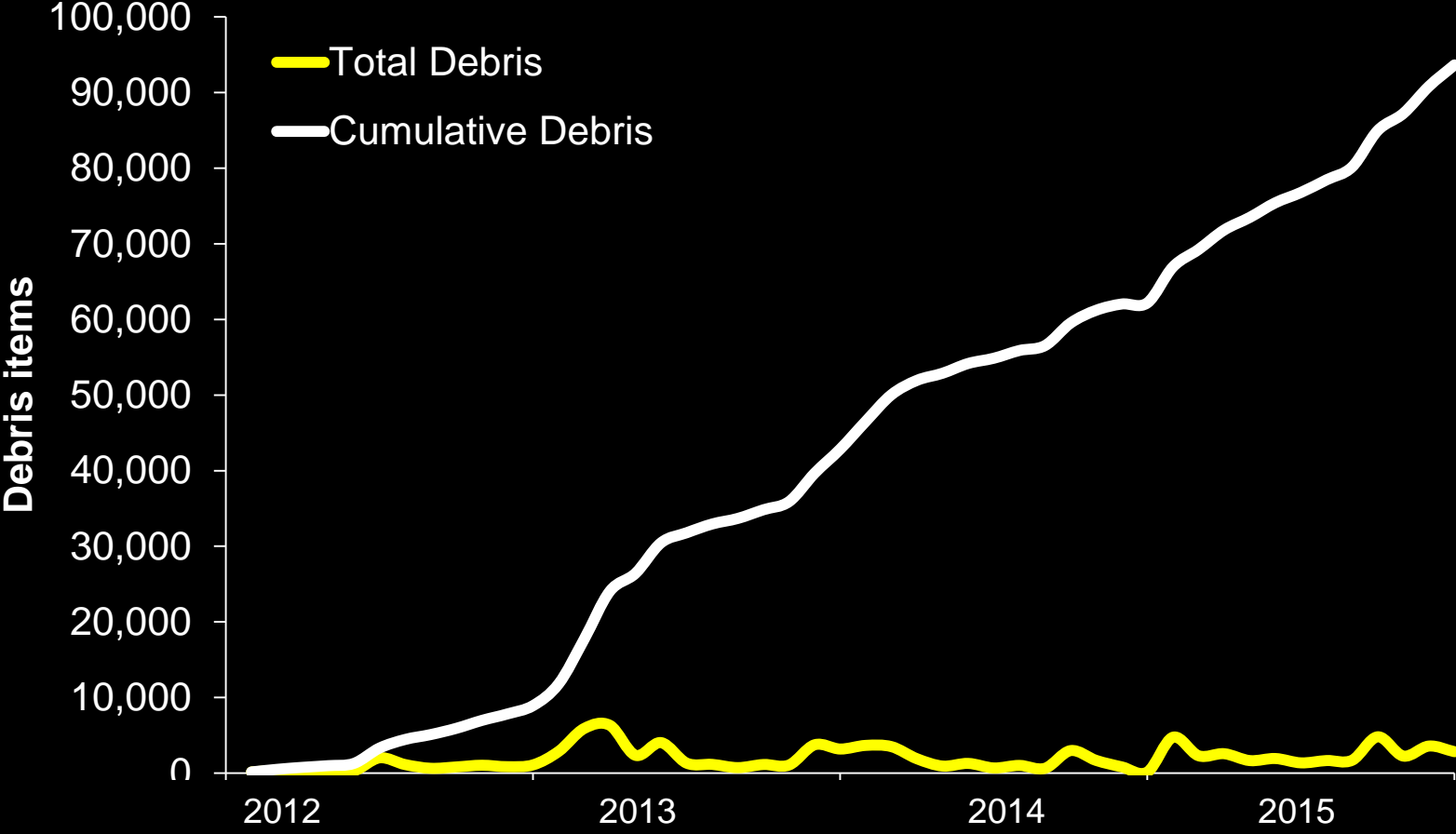


Barge removed almost 3,400 tonnes of debris from Alaska



Photo credit: NOAA

Total Debris Accumulation

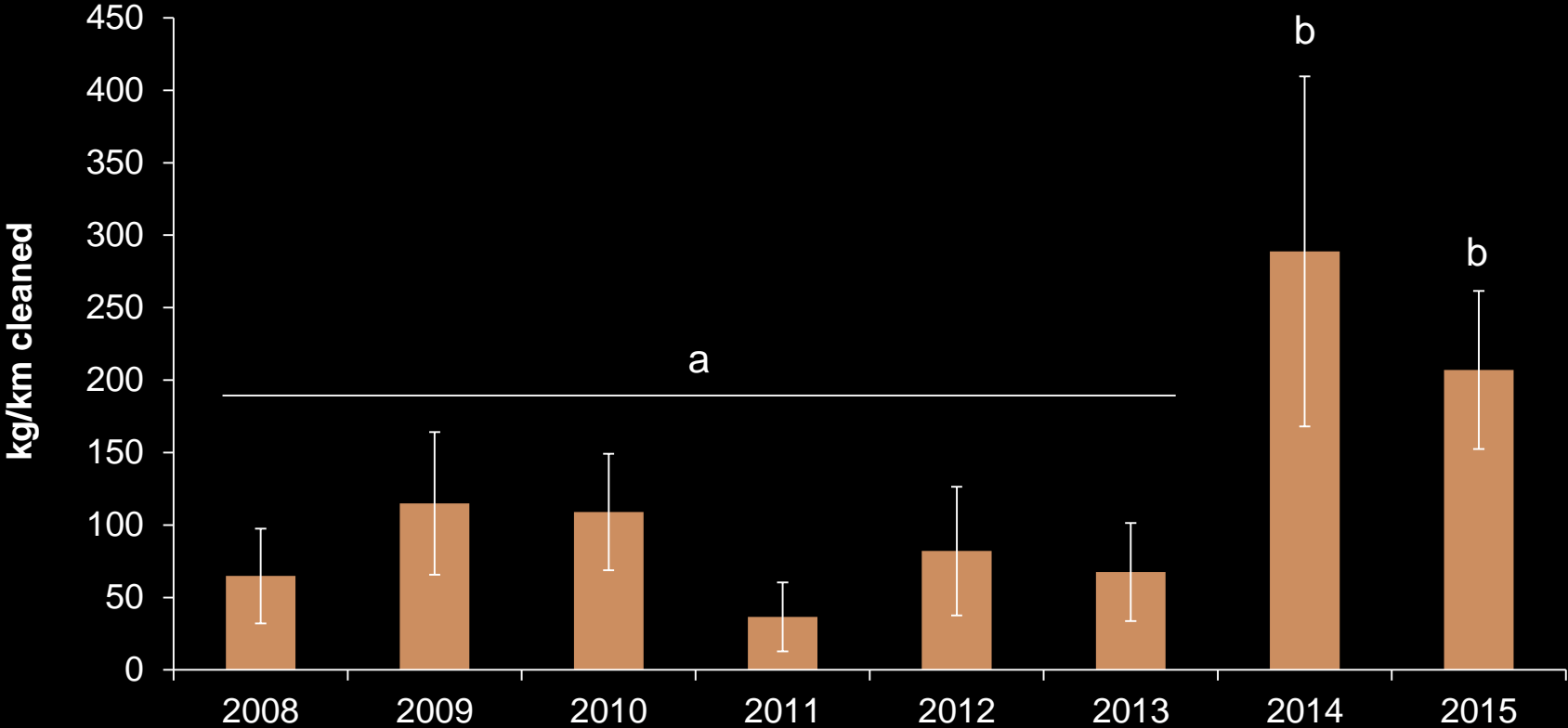


Shoreline Cleanup data

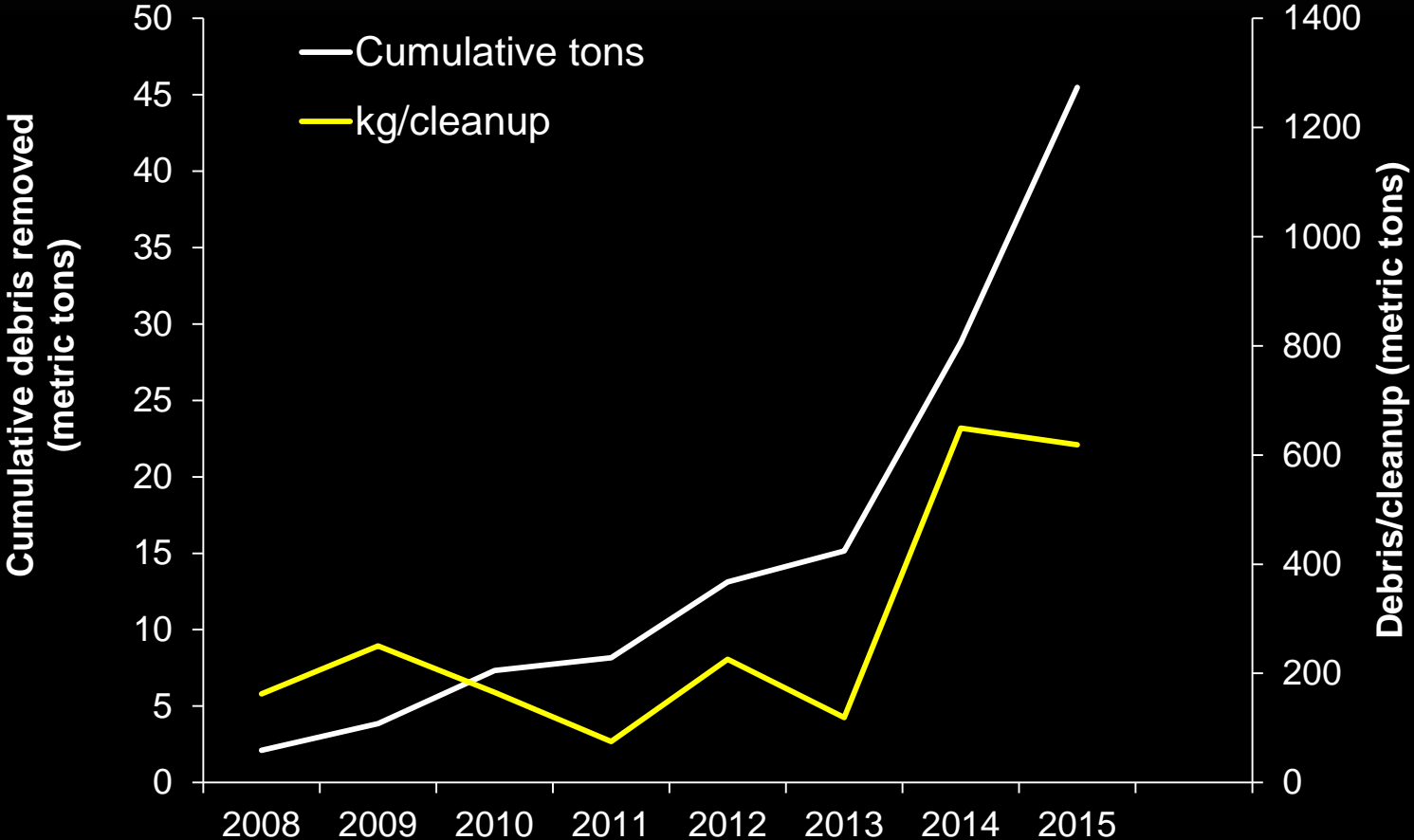
- British Columbia
- 81 sites
- 2008 - present
- Debris weight (kg)



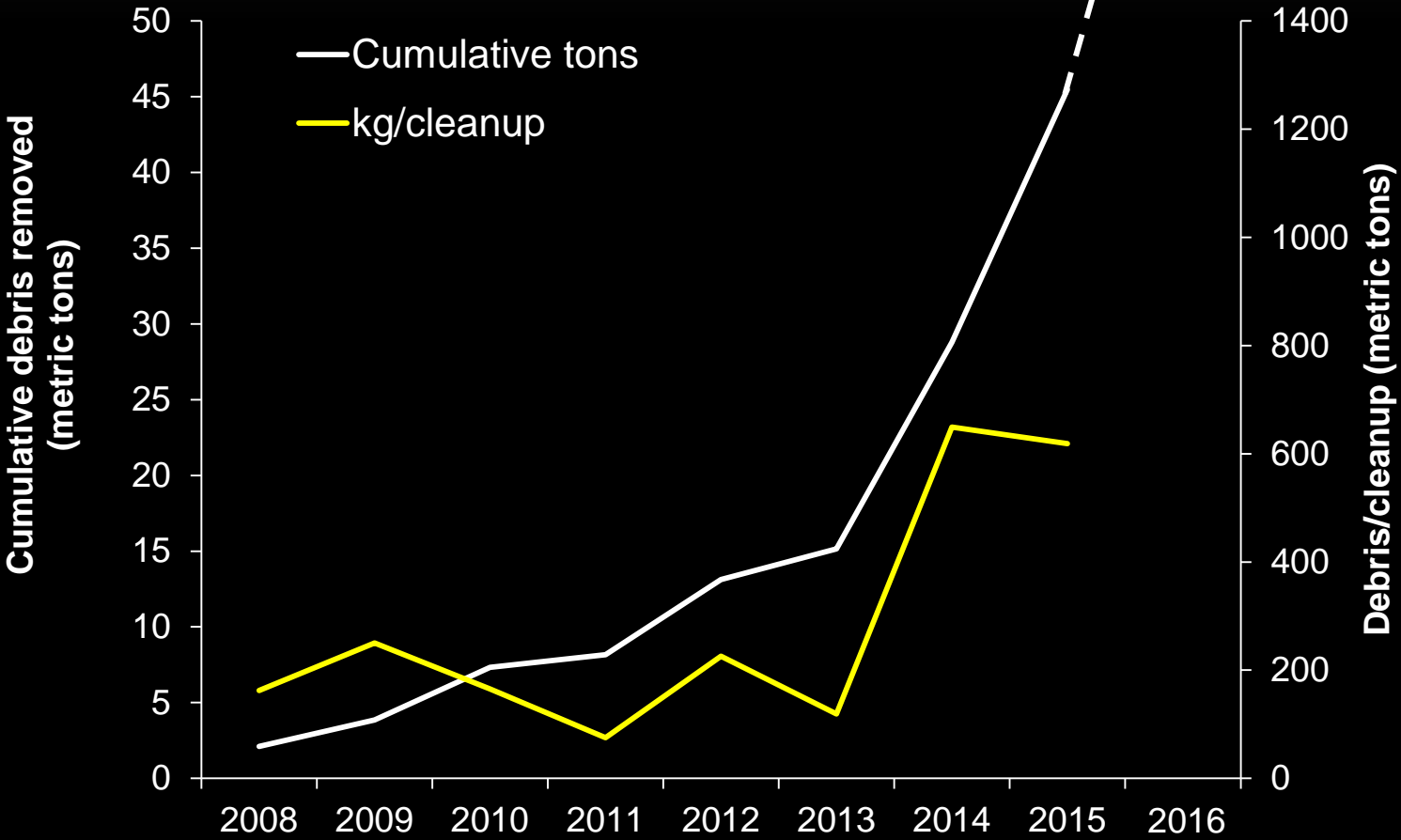
British Columbia – 5 time increase in debris



Significant debris loads removed in BC



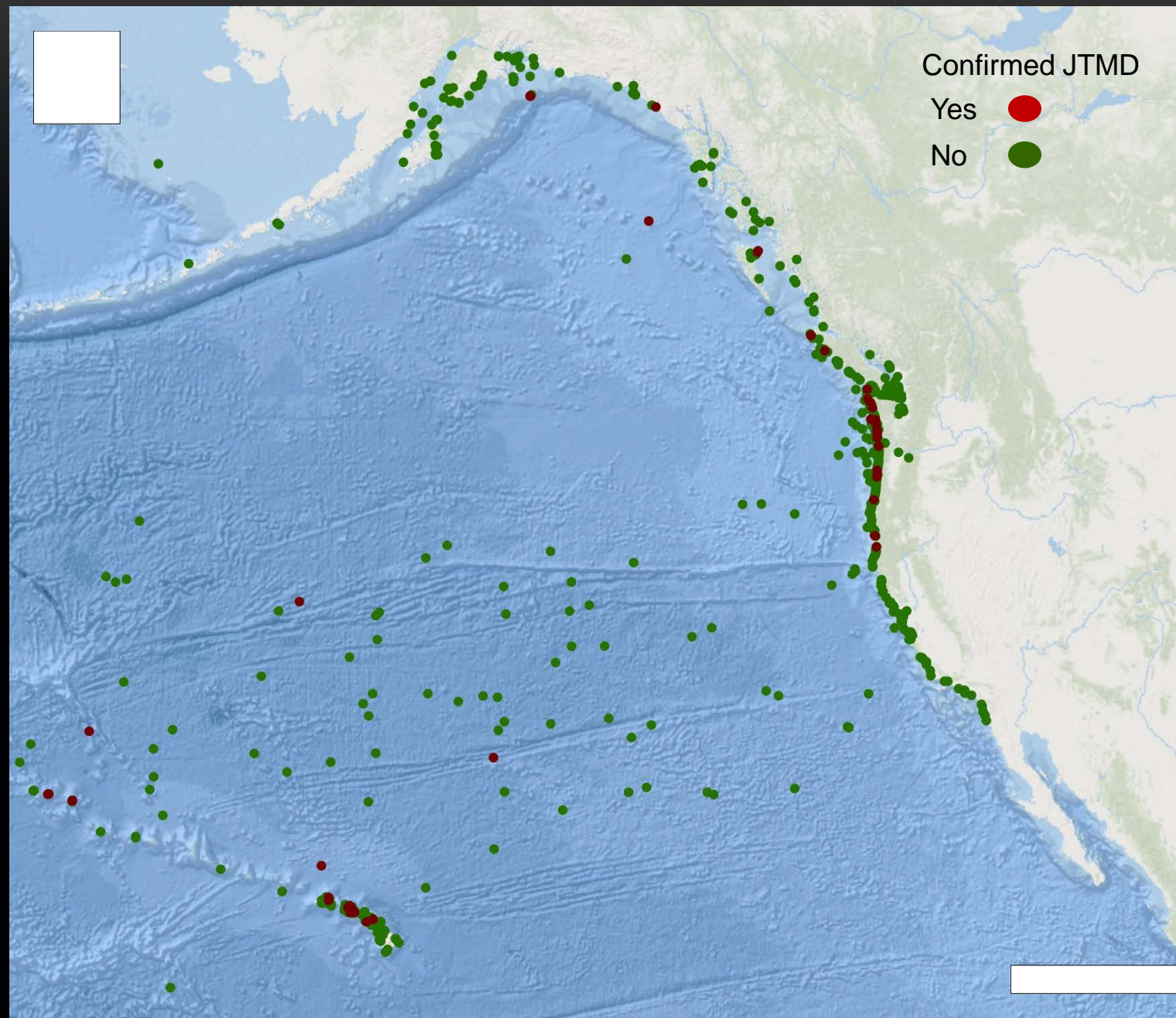
Significant debris loads removed in BC



September 2016 – more than 120 tons removed by two barges

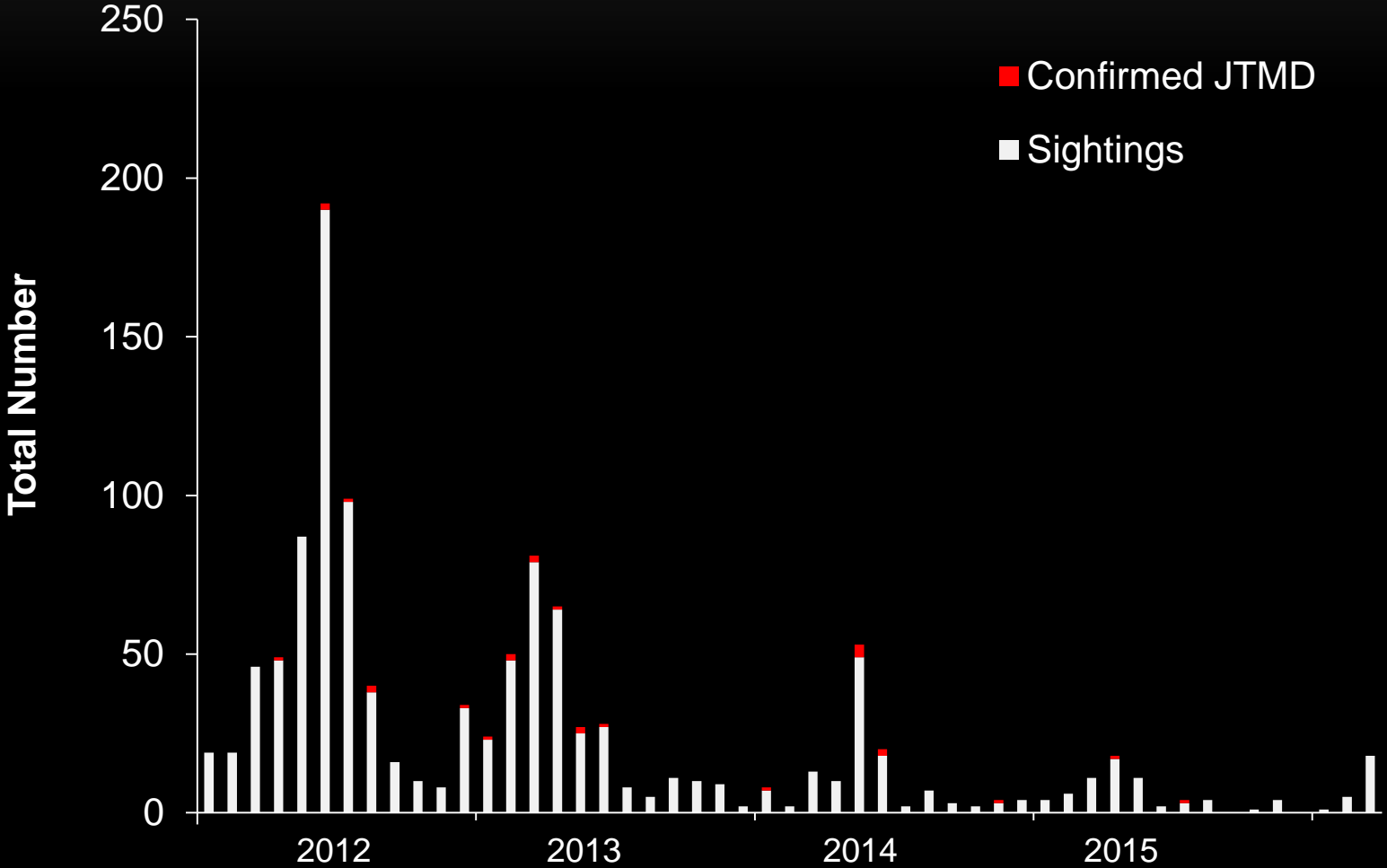


Disaster debris reports

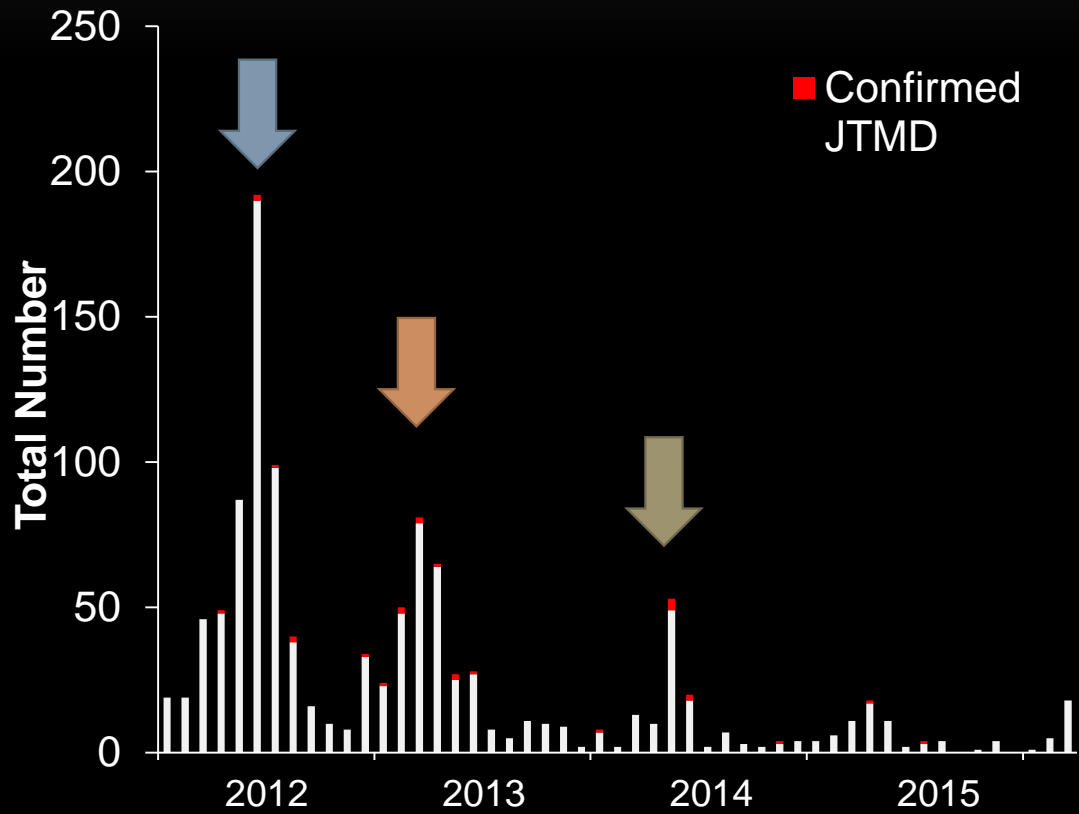




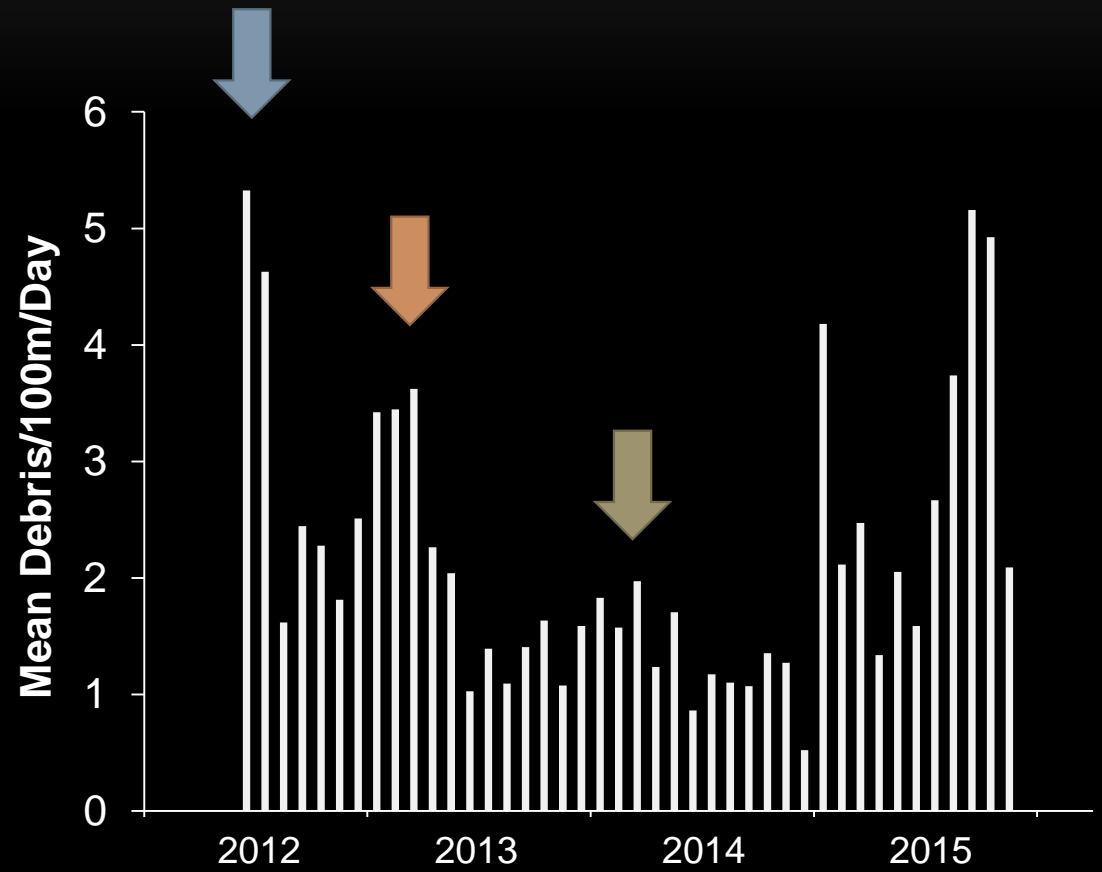
Disaster debris sightings varied over time



Correlations in peaks of debris



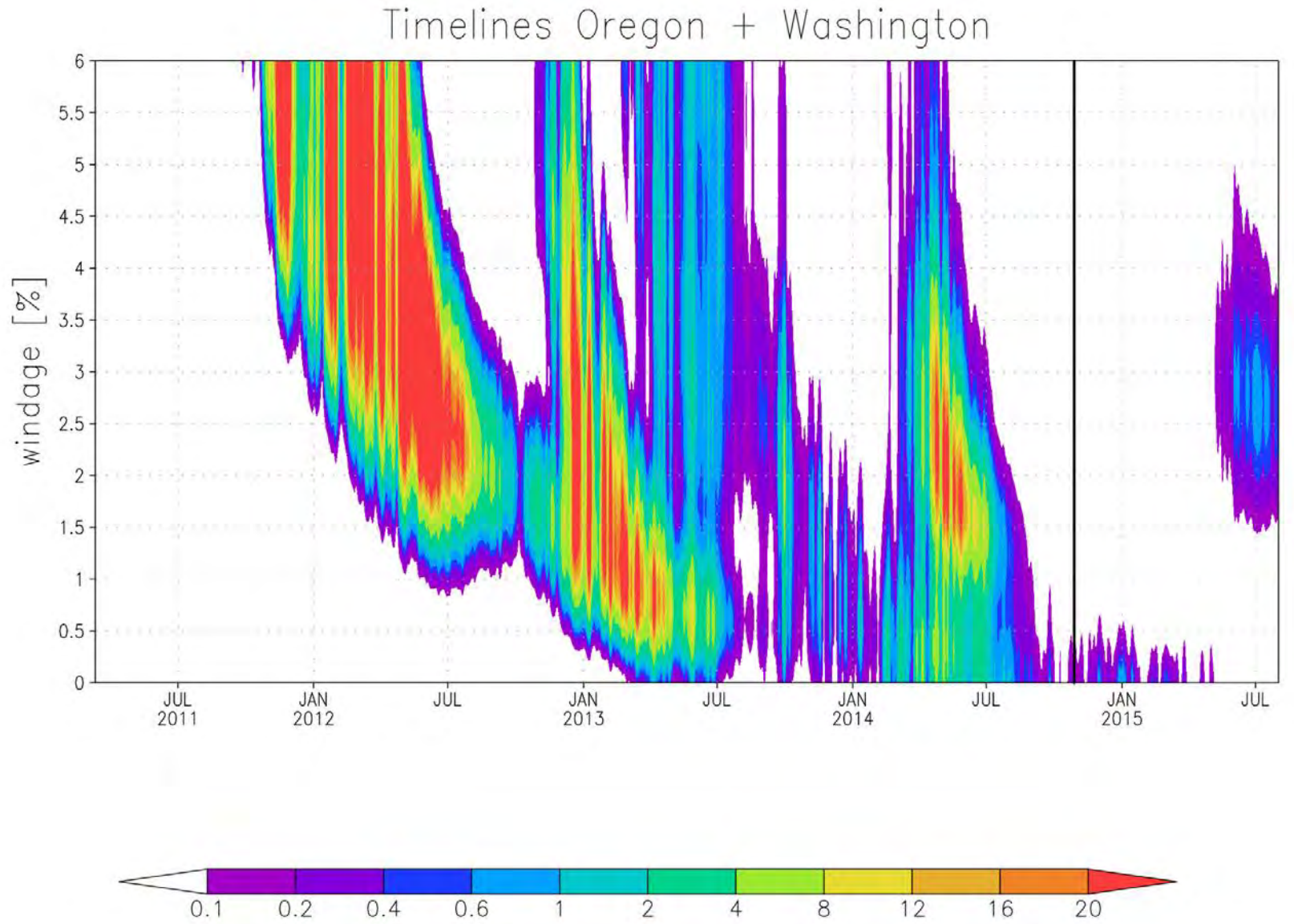
Disaster debris sightings – North American landfall



Beach debris accumulation – WA, OR, CA



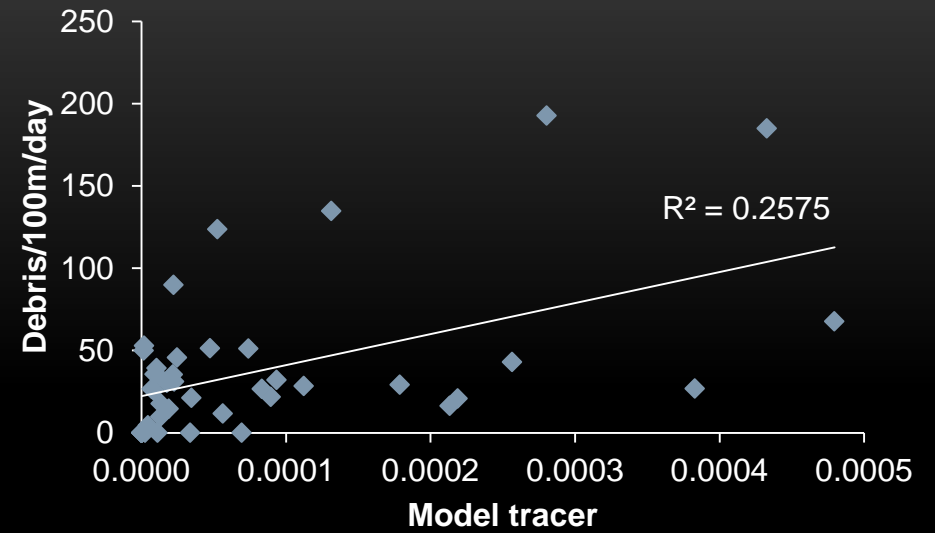
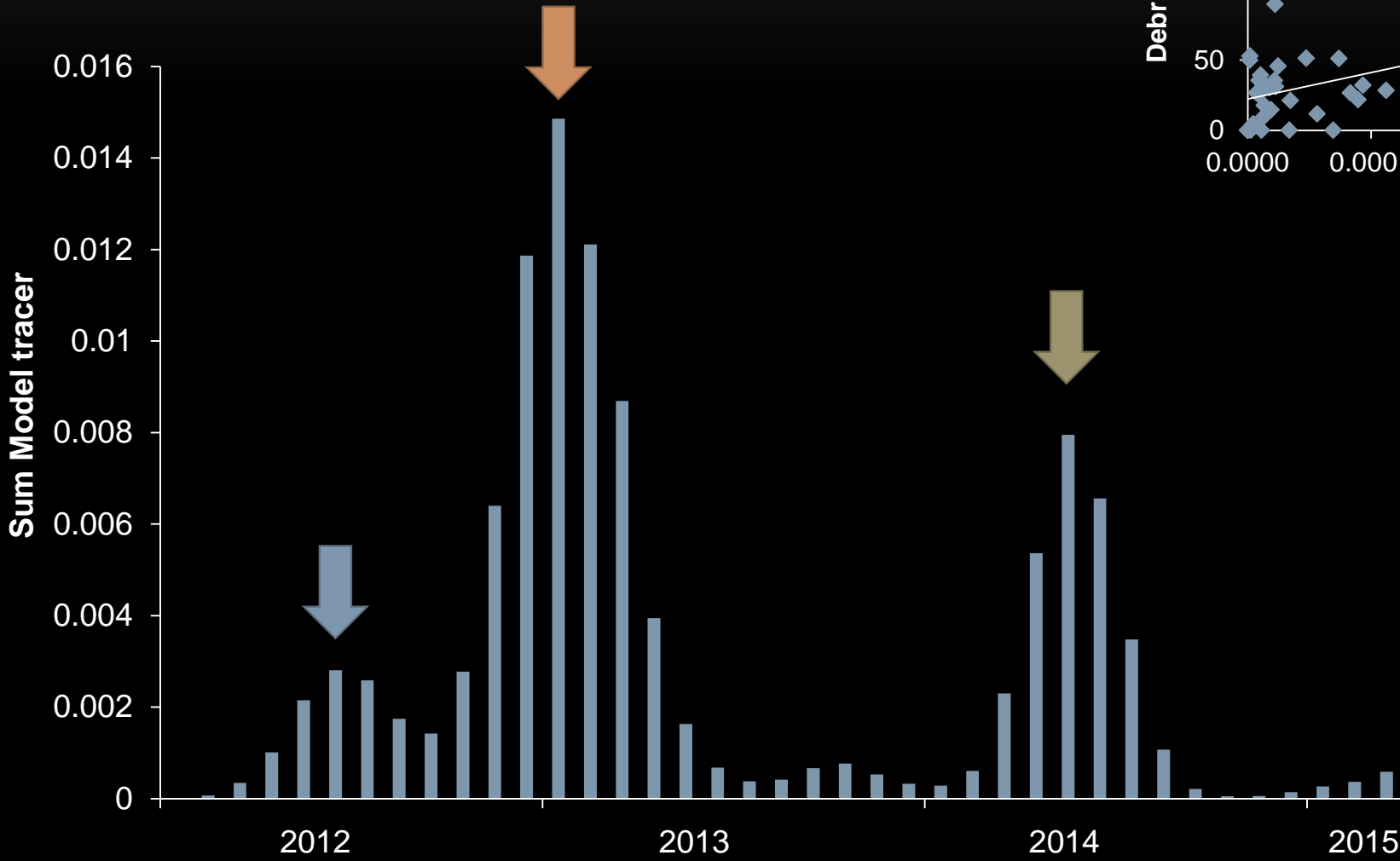
Model predictions



Source: Nikolai Maximenko, UH



Model tracer correlated with monthly debris landings



Conclusions

- Substantial, significant increase in marine debris landfall attributed to the tsunami

Photo credit: Lightspeed Digital



Conclusions

- Substantial, significant increase in marine debris landfall attributed to the tsunami
- Debris landfall consistent with modeling predictions

Photo credit: Lightspeed Digital



Conclusions

- Substantial, significant increase in marine debris landfall attributed to the tsunami
- Debris landfall consistent with modeling predictions
- Significant debris load to coastal ecosystems

Photo credit: Lightspeed Digital



Conclusions

- Substantial, significant increase in marine debris landfall attributed to the tsunami
- Debris landfall consistent with modeling predictions
- Significant debris load to coastal ecosystems
- Affected regions need continued cleanup and monitoring for impacts of debris and possible introductions of invasive species

Photo credit: Lightspeed Digital



Acknowledgements

This research is funded by the Ministry of the Environment of Japan through the North Pacific Marine Science Organization (PICES)

Debris cleanup funding was provided by the Government of Japan through NOAA and the BC Provincial Government

Shoreline litter data was supplied by the Great Canadian Shoreline Cleanup, a joint conservation initiative of the Vancouver Aquarium Marine Science Centre and WWF-Canada (www.shorelinecleanup.ca)

Assistance and advice were provided by Nancy Wallace, Peter Murphy, Nir Barnea, and Liam Antrim

