

Below the radar: foreign earthworms infiltrate Alaskan forests



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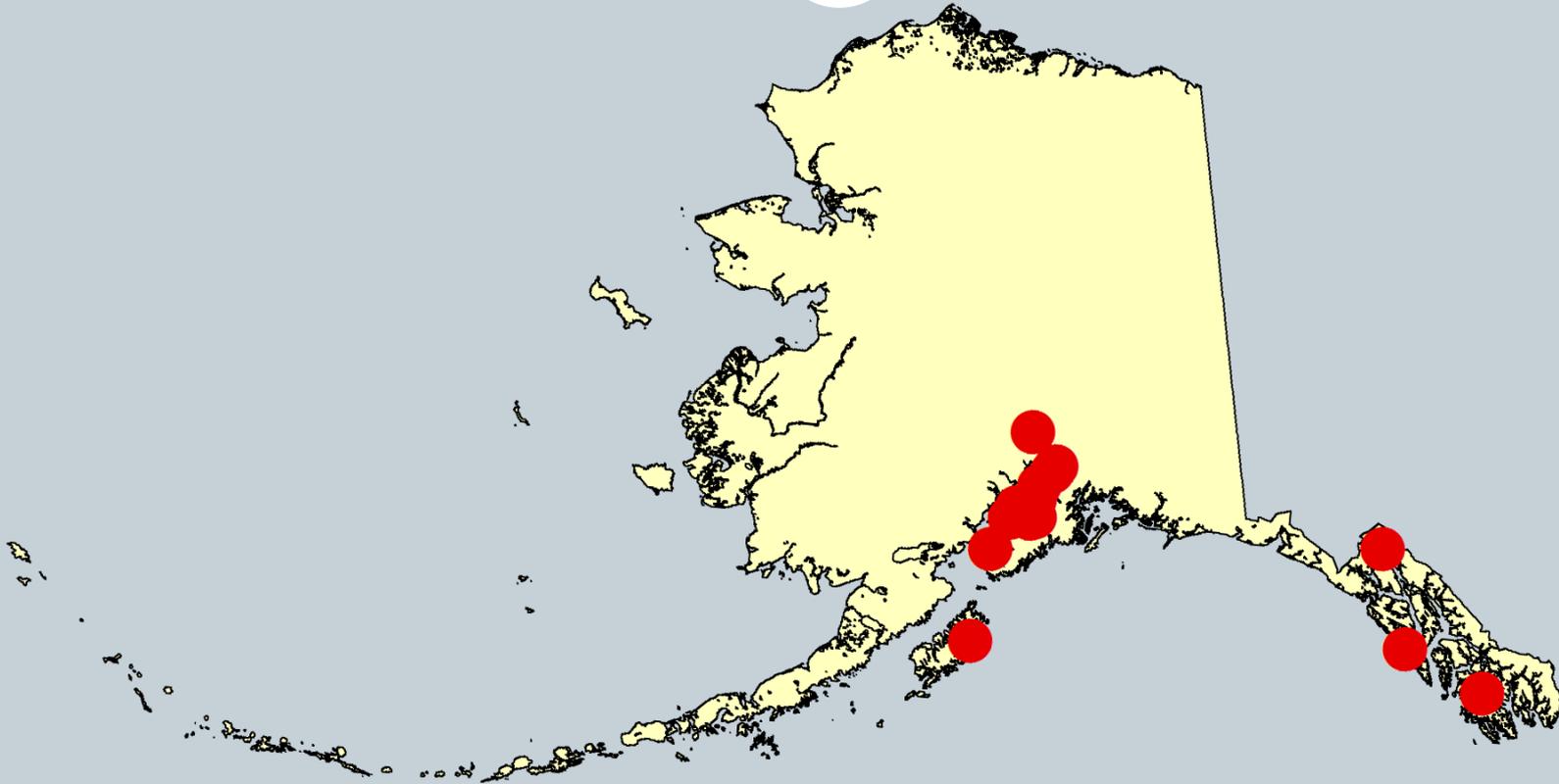
Outline

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- Diversity and distribution in Alaska
- Dispersal
- Ramifications of earthworm infestations
 - Direct effects
 - Effects on other species
- Highlighted species
- Earthworms on the Kenai National Wildlife Refuge
- Recommendations

Earthworm distribution in Alaska

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Alaskan earthworm specimen and literature records as of October 2010

Alaska earthworm diversity

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Native (?)	1
Feral exotic	15
Synanthropic exotic	1
Total	16

Family Megascolecidae

Arctiostrotus sp.

Family Lumbricidae

Allolobophora chlorotica (Savigny, 1826)
Allolobophoridella eiseni (Levinsen, 1884)
Aporrectodea rosea (Savigny, 1826)
Aporrectodea trapezoides (Dugès, 1828)
Aporrectodea tuberculata (Eisen, 1874)
Aporrectodea turgida (Eisen, 1873)
Dendrobaena attemsi (Michaelsen, 1902)
Dendrobaena octaedra Savigny, 1826
Dendrodrilus rubidus (Savigny, 1826)
Eisenia foetida (Savigny, 1826)
Eiseniella tetraedra (Savigny, 1826)
Lumbricus castaneus (Savigny, 1826)
Lumbricus rubellus Hoffmeister, 1843
Lumbricus terrestris Linnaeus, 1758
Octolasion cyaneum (Savigny, 1826)
Octolasion tyrtaeum (Savigny, 1826)

Earthworm Dispersal

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- Slow natural rates of dispersal (5-10 m/yr)
- Almost all long-range dispersal is human-caused:
 - Eggs and cocoons can be spread in tire treads
 - Transport of soil (e.g., potted plants)
 - Transport of wood and other material stored on the ground
 - Bait abandonment



Ramifications of earthworm infestations: direct effects

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- *Can completely remove litter and duff layers (up to 10 cm/yr!)*
 - Reduction or loss of organic layers
 - Formation of well-developed A horizon
- ↑ aeration
- ↑ water infiltration
- Generally accelerates nutrient cycling



Before

After



Ramifications of earthworm infestations: indirect effects

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- ↓ species dependent on a thick organic layer, mycorrhizal symbionts



- ↑ species adapted to soils worked by earthworms (Old World exotics?); non-mycorrhizal species



Invasional meltdown

— where exotic species interact positively. In this case, earthworms alter soil properties in a way that is likely to favor exotic plants.



Before



After





Octagonal-Tail Worm *Dendrobaena octaedra*

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- Probably the most widespread earthworm in Alaska; often spread by vehicles
- Parthenogenic
- Extremely cold-hardy and tolerant of acidic soils
- Small worms
- Restricted to organic soil layers, causing comparatively limited changes to soil





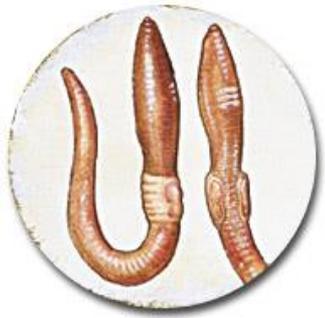
Nightcrawler

Lumbricus terrestris



- Commonly sold as live bait; spread by bait abandonment, gardening
- Apparently limited distribution in Alaska at present
- Very large worms
- Deep burrowers, bringing C from leaf litter into mineral soil





Red Marsh Worm

Lumbricus rubellus

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- Apparently limited distribution in Alaska at present; spread by gardening and bait abandonment
- Large worms
- Quickly consume organic material, incorporating it into mineral soil

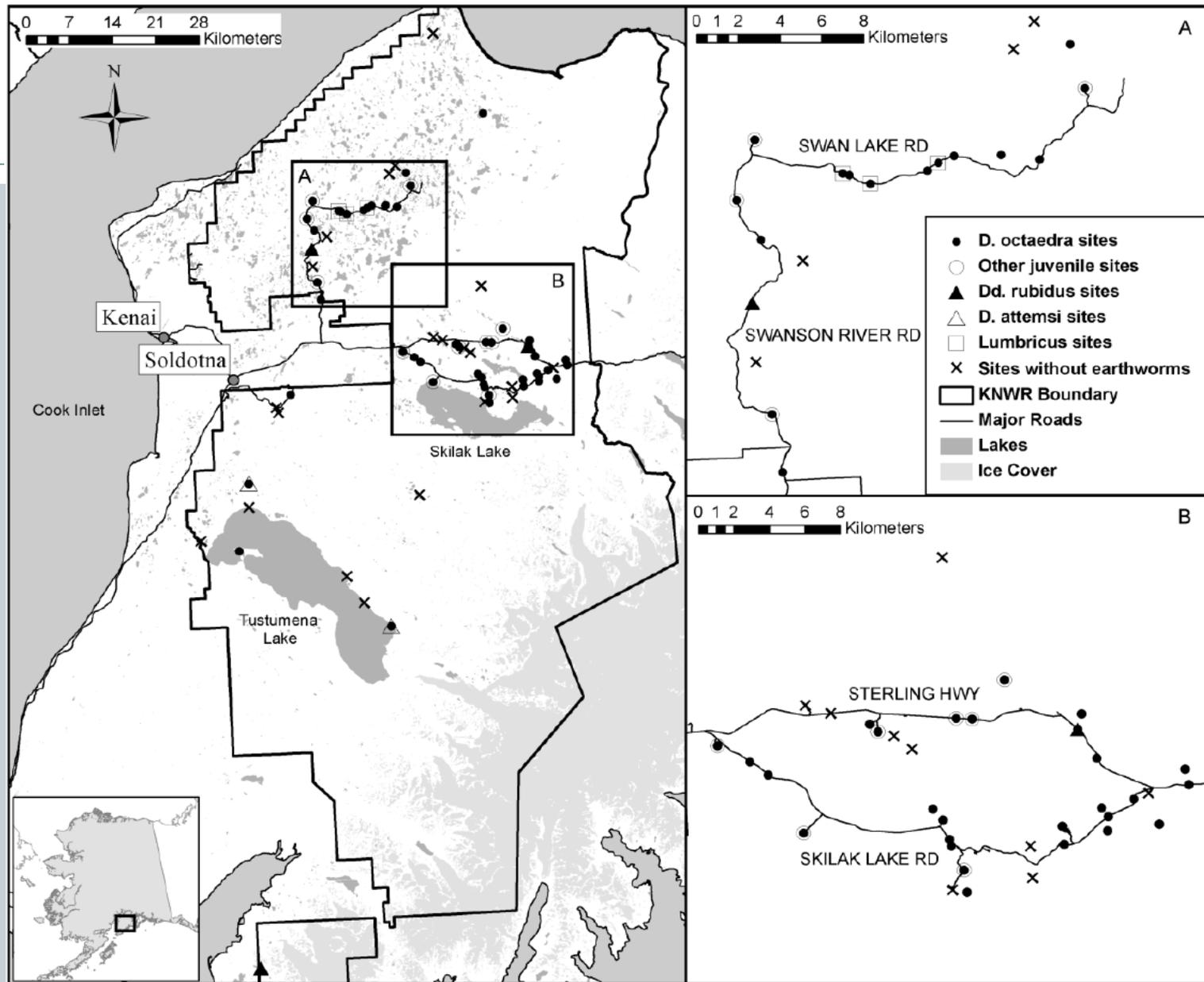


Earthworm distribution on the Kenai National Wildlife Refuge

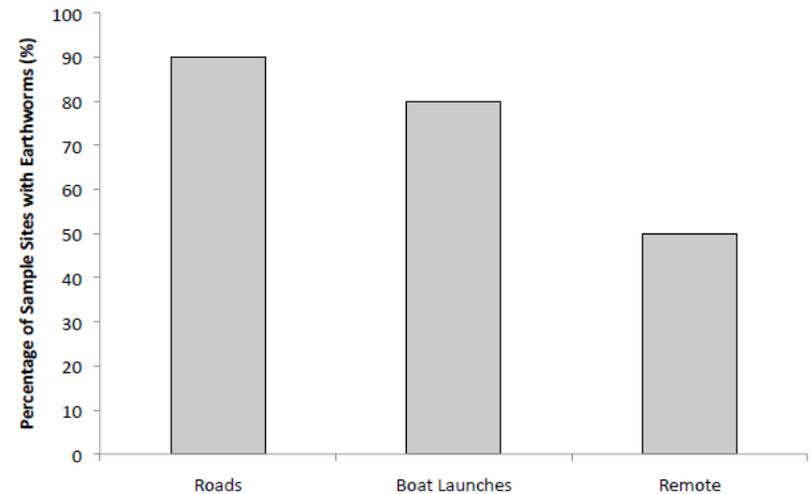
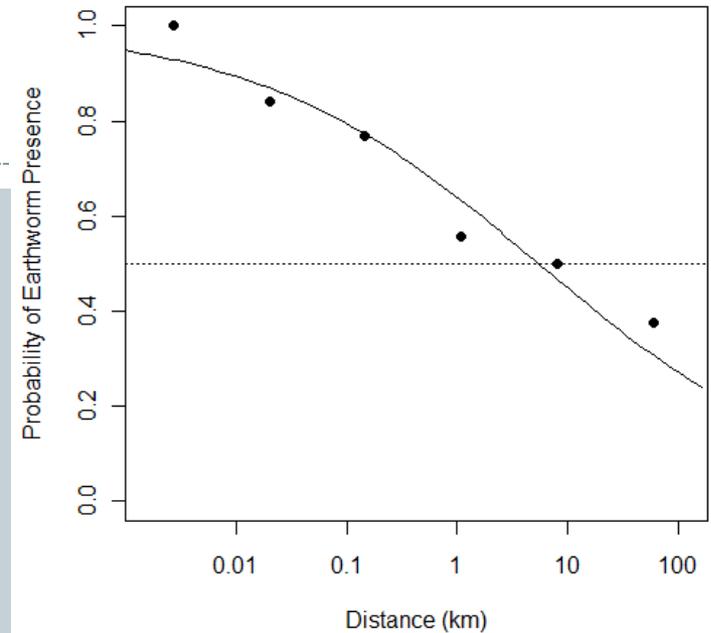
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- Deanna Saltmarsh M.S. thesis, 2011-2012
- 70 sites sampled over Kenai NWR
 - Roads
 - Boat launches
 - Remote sites



- Earthworms found at 70% of sites.
- Octagonal-Tail Worm at 50% of sites.
- Nightcrawlers present only in small areas at three nearby boat launches.
- 90% of road sites were infested.
- 50% of remote sites were worm free.
- Distance from roads was the best predictor of earthworm presence.



Recommendations

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- Fishing regulations should explicitly and clearly disallow the use of live earthworms as bait.
- Infested soil, compost, worm castings, and plantings should not be transported to worm-free areas.
- Tires of forestry equipment, trucks, and ATV's should be cleaned to prevent the spread of eggs and cocoons trapped in soil between tire treads.



Image Credits

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- Before and after photos courtesy Great Lakes Worm Watch (<http://www.nrri.umn.edu/worms/default.htm>).
- *Botrychium mormo* photo from <http://wisplants.uwsp.edu>.
- Earthworm paintings courtesy Nature Canada (<http://www.naturewatch.ca/english/wormwatch/>).
- How to help animation from Alberta Worm Invasion Project (<http://worms.biology.ualberta.ca>).
- Photo of tub of earthworms from ScienceNews for Kids (<http://www.sciencenewsforkids.org>).