

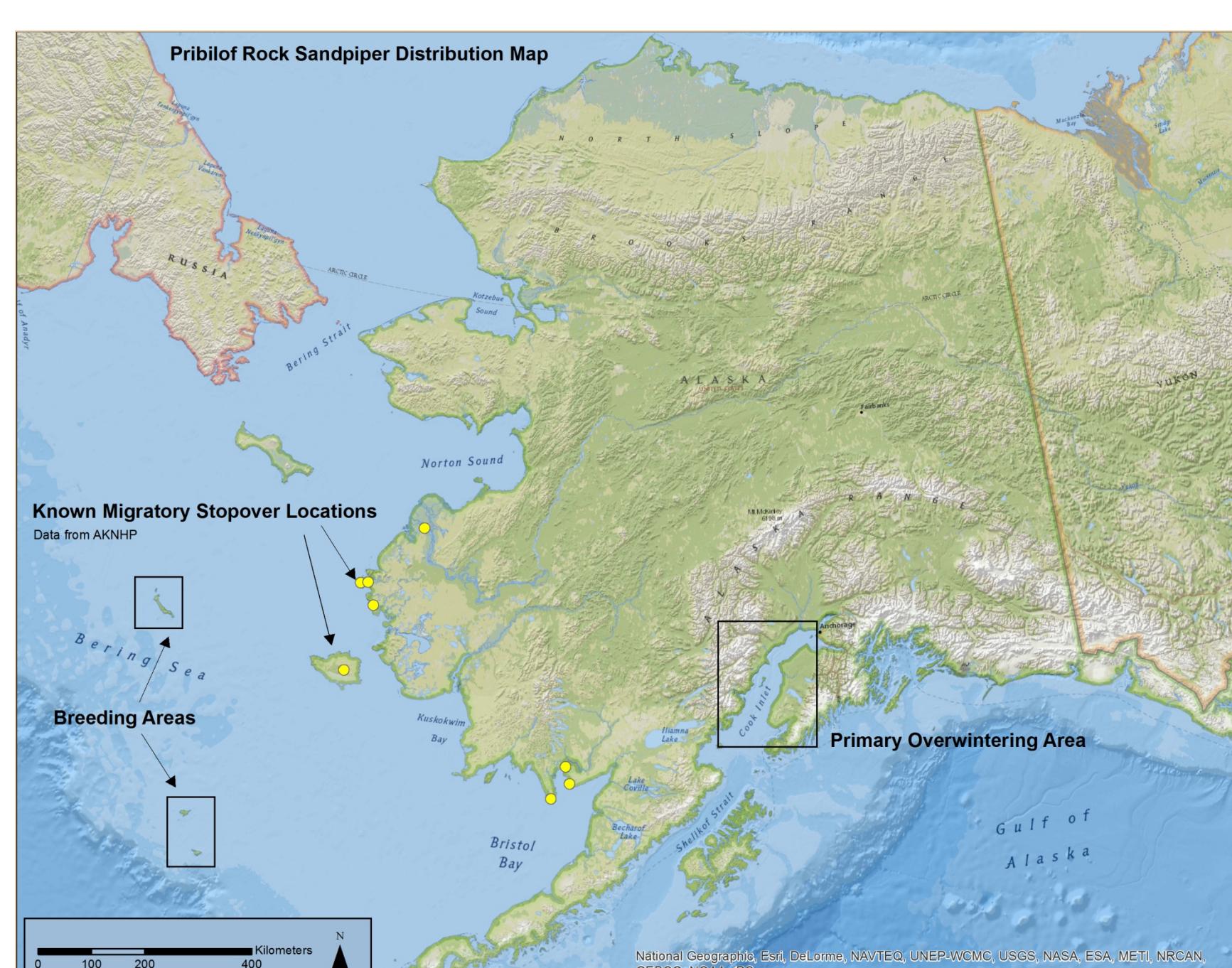
Assessment of Bioavailable Hydrocarbons in Pribilof Rock Sandpiper Fall Staging Areas and Overwintering Habitat

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Background

- The Pribilof Island rock sandpiper (*Calidris ptilocnemis ptilocnemis*), has one of the smallest annual distributions of any shorebird subspecies and primarily overwinters in Cook Inlet, Alaska.
- In fact, almost the entire world population of Pribilof Island rock sandpipers (approximately 20,000 individuals) overwinters along Cook Inlet's mud and sand flats, feeding on invertebrates exposed by shifting ice floes.
- Cook Inlet is an area with existing oil and gas development and high marine vessel activity which may result in inadvertent spills or discharge.
- A main fall migratory staging area on St. Paul Island is adjacent to St. Paul harbor and thus birds may be exposed to hydrocarbons from high levels of human activity before fall migration.



Objective

Determine baseline levels of polynuclear aromatic hydrocarbons (PAHs), in known Pribilof Island rock sandpiper overwintering locations of Cook Inlet and a known fall migratory staging area. PAHs are considered the primary toxic fraction of oil (Leighton 1993) and these data can be utilized as baseline information to effectively assess the impacts of potential future oil or gas spills.



Oil and Gas Development in Cook Inlet (left) and Human Development adjacent to St. Paul Island Staging Area (below)



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Methods

- Low-density polyethylene membrane sampling devices (PEMDs) were deployed in winter 2011 and spring/summer 2014 at three locations on the west side of Cook Inlet. Corresponding sediment samples were collected as well.
- Samples were also deployed at pre-migratory staging areas on St. Paul Island (fall 2011 and 2013).
- Samples were analyzed for polynuclear aromatic hydrocarbons (PAHs) using standard GC-MS methods. Total PAH (TPAH) concentrations were calculated by summing concentrations of 44 individual PAHs.
- Composition of PAH was modeled to characterize source attributes, which could range from pyrogenic (such as creosote) to petrogenic (such as crude oil).

Pribilof Island Rock Sandpipers in Cook Inlet (left) and Cook Inlet Overwinter Habitat (far left)



Results

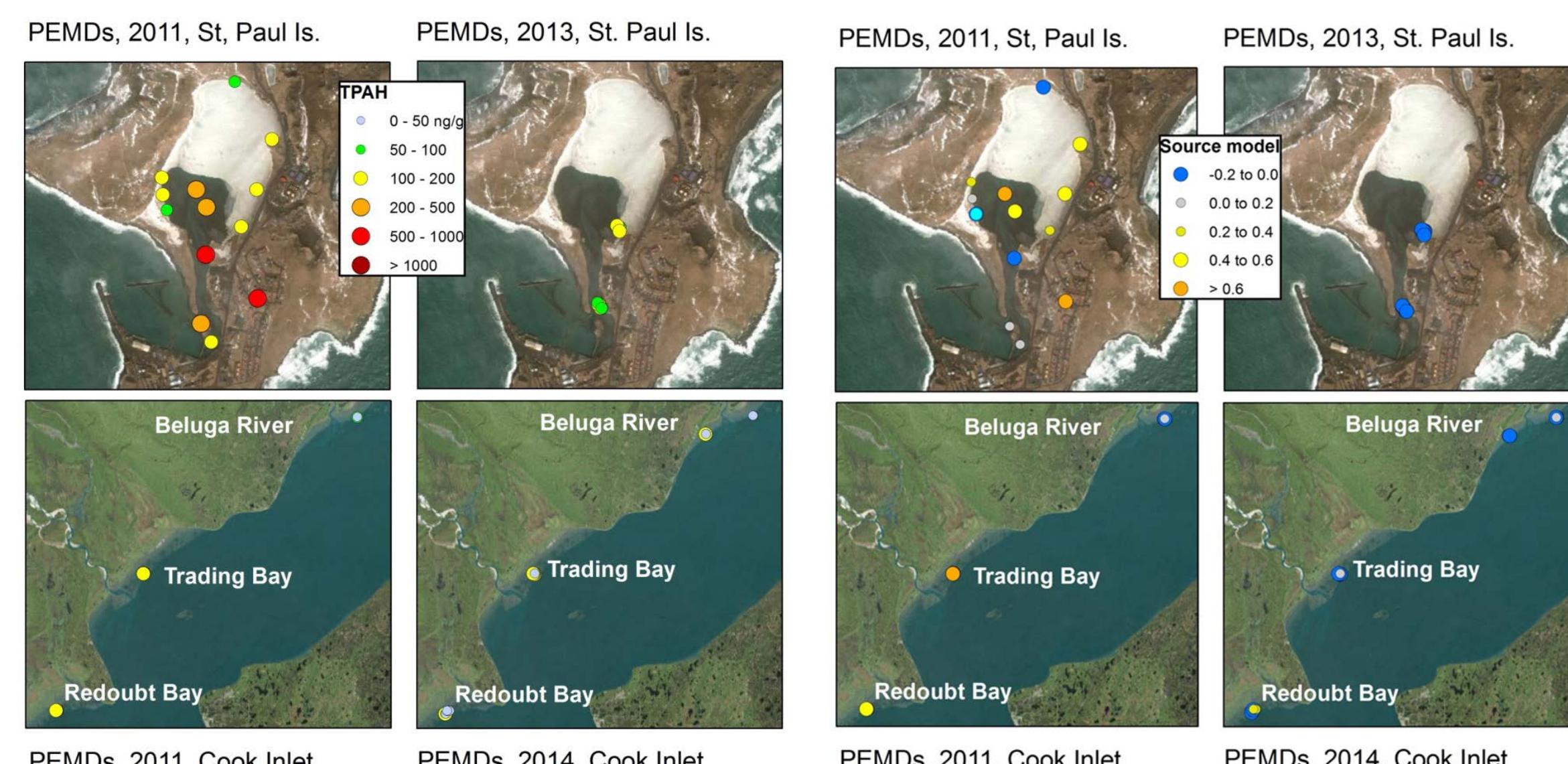


Fig. 1. TPAH concentration in PEMDs (ng/g device). Each point represents a single sample, replicate samples can overlap and may not always be visible.

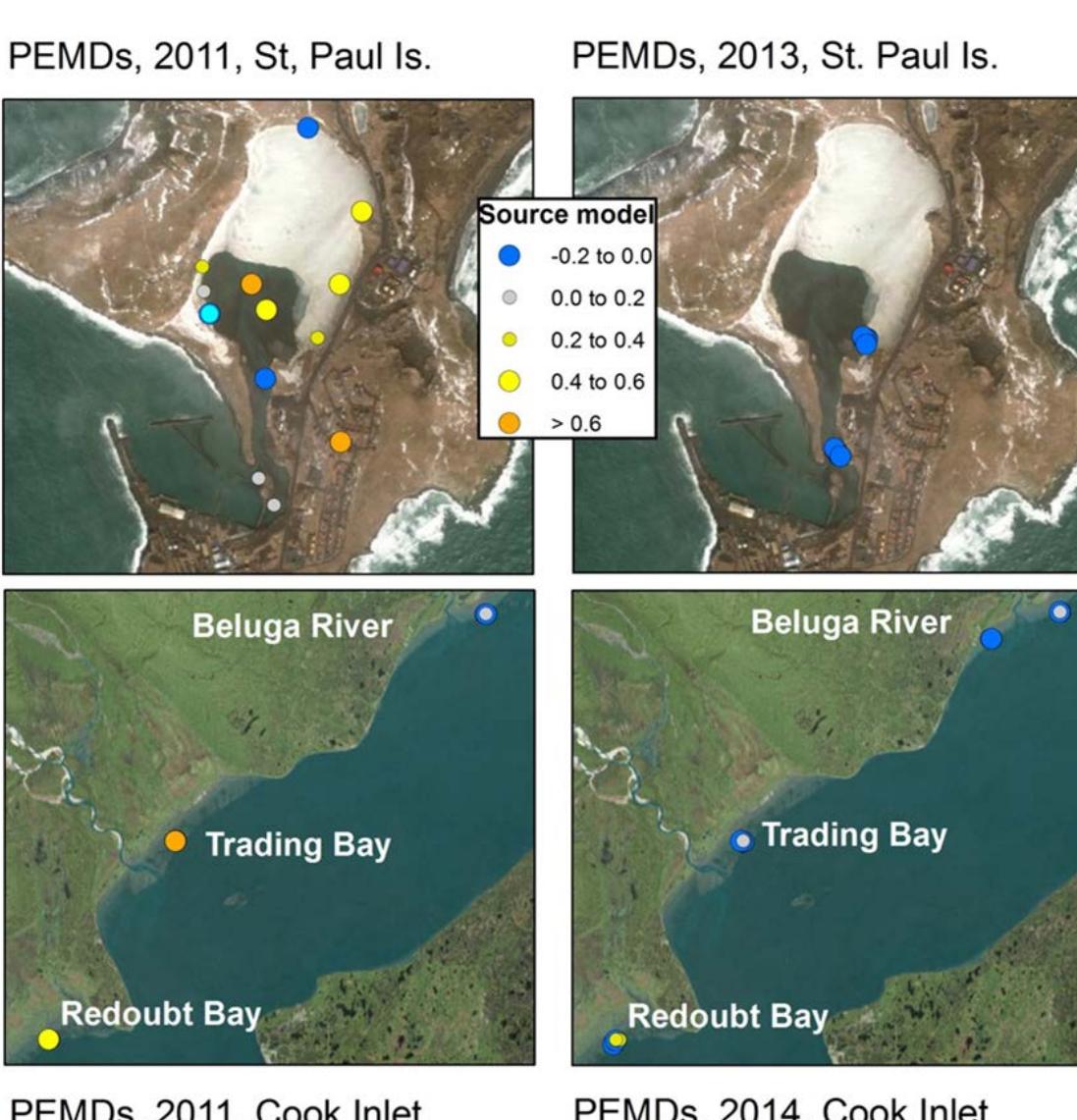


Fig. 2. PAH source model results for PEMDs. Negative values indicate pyrogenic composition, positive values are petrogenic, and values near zero are ambiguous.

PEMDs

PEMDs from Cook Inlet and St. Paul Island generally accumulated small quantities of hydrocarbons (Figure 1).

- Two- and three-ring PAH composition in PEMDs was consistent with oil in 13% of all field samples (12 of 90).
- St. Paul Island TPAH concentrations ranged from 16-819 ng/g device in all samples.
 - Total PAH concentrations were substantial (>500 ng/g device) in 2 of 28 samples and had petrogenic signatures (Figures 1 and 2).
- Cook Inlet TPAH concentrations ranged from 5-178 ng/g device in all samples (n=62).
 - Eight Cook Inlet samples had petrogenic signatures in 2011. However, TPAH concentrations in the petrogenic subset were not particularly high (140-178 ng/g device)
 - No elevated TPAH concentrations or strong petrogenic signatures were observed in Cook Inlet in 2014.

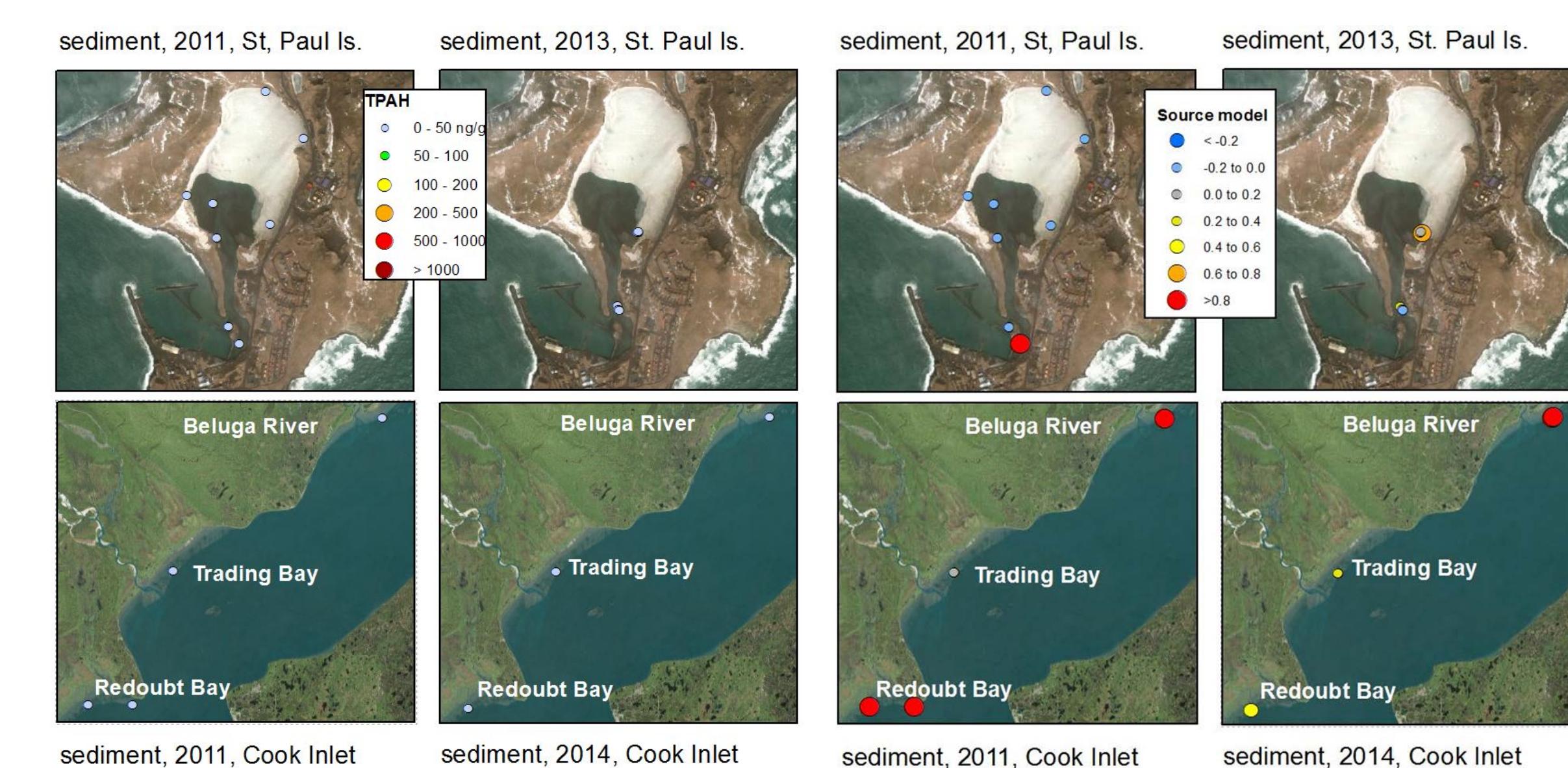


Fig. 3. TPAH concentration in sediment (ng/g dry weight). Each point represents a single sample, replicate samples can overlap and may not always be visible.

Fig. 4. PAH source model results for PEMDs. Negative values indicate pyrogenic composition, positive values are petrogenic, and values near zero are ambiguous.

Conclusions

There was limited evidence of rock sandpiper habitat contamination by anthropogenic hydrocarbons in St. Paul Island and Cook Inlet.

- PEMDs generally accumulated small quantities of hydrocarbons and were generally consistent with background levels.
 - However, total PAH concentrations were substantial in 13% of samples (2 of 15) on St. Paul Island in 2011.
- Oiled sediment was observed in St. Paul Island and Cook Inlet, but was consistent with typical background levels (<100 ng/g dry weight).
 - Likewise, the dominance of odd-chain n-alkanes is considered natural. (Clark and Blumer 1967; Zhao et al. 2003; Harji et al. 2008).
 - Perylene was frequently prominent or the dominant PAH in sediment. Perylene likely originates from contemporary processes in sediment (Venkatesan 1988).
- It is unlikely that the TPAH concentrations and distribution observed on St. Paul Island or Cook Inlet will cause adverse effects to the Pribilof Island rock sandpiper.



Pribilof Island Rock Sandpipers in St. Paul Island Staging Area

Management Implications

- The Pribilof Island rock sandpiper, with its limited annual range, small population size, and use of one primary overwintering area makes it vulnerable to threats from human disturbance.
- There was evidence of limited contamination by PAHs in St. Paul Island and Cook Inlet. However petrogenic sources were found in some samples.
- There are currently not TPAH concentrations great enough or widespread enough to cause adverse biological effects.
- However, these data provide a useful baseline in the event of future spills or discharges to develop appropriate mitigation measures for habitat restoration activities.



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