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Marine debris in five national parks in Alaska

L. Polasek [a,b,*], J. Bering [a], H. Kim [c], P. Neitlich [d], B. Pister [c], M. Terwilliger [e], K. Nicolato [f], C. Turner [f], T. Jones [g]

[a] Alaska SeaLife Center, PO Box 1329, Seward, AK 99664, USA
[b] School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, USA
[c] Kenai Fjords National Park, PO Box 1221, Seward, AK 99664, USA
[d] Western Arctic National Parklands, 41A Wandling Road, Winthrop, WA 98862, USA
[e] Wrangell-St. Elias National Park and Preserve, PO Box 439, Copper Center, AK 99573, USA
[f] Katmai National Park and Preserve, PO Box 7, King Salmon, AK 99613, USA
[g] National Park Service, Alaska Regional Office, 240 W. 5th Ave, Anchorage, AK 99501, USA

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ABSTRACT

Marine debris is a management issue with ecological and recreational impacts for agencies, especially on remote beaches not accessible by road. This project was implemented to remove and document marine debris from five coastal National Park Service units in Alaska. Approximately 80 km of coastline were cleaned with over 10,000 kg of debris collected. Marine debris was found at all 28 beaches surveyed. Hard plastics were found on every beach and foam was found at every beach except one. Rope/netting was the next most commonly found category, present at 23 beaches. Overall, plastic contributed to 60% of the total weight of debris. Rope/netting (14.6%) was a greater proportion of the weight from all beaches than foam (13.3%). Non-ferrous metal contributed the smallest amount of debris by weight (1.7%). The work forms a reference condition dataset of debris surveyed in the Western Arctic and the Gulf of Alaska within one season.

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1. Introduction

The remote, relatively pristine coastline of Alaska has a surprisingly high accumulation of marine debris. Ocean currents and vessel activity result in large deposits of debris on Alaska's beaches (Howell et al., 2012). Currents bring in debris from other regions including Russia, Japan and China (Derraik, 2002; Coe and Rogers, 2011). Marine debris has continued to rise in recent years, and is likely to continue an upward trajectory with the increase in population, visitation and exploration in Alaska (Alaska Marine Stewardship Foundation, 2014).

There are numerous descriptive reports on marine debris in Alaska by agencies and foundations, but these are often challenging to locate and offer little discussion or conclusions (e.g., Cook, 1988; King, 2008; Marine Conservation Alliance Foundation, 2008; Carswell et al., 2011; Maselko and Johnson, 2011). Peer reviewed literature on marine debris in Alaska is limited and primarily focuses on plastics and fishing debris (e.g., Shaw, 1977; Pichel et al., 2012; Davis and Murphy, 2015). In spite of the shortage of data, efforts have been underway to clean the Alaskan coastline. Local and federal governmental agencies and non-profit organizations have been conducting targeted marine debris removal efforts in Alaska for several years. Additionally, a significant influx of debris resulting from the 2011 tsunami in Japan raised awareness and funding for debris removal in Alaska as debris from the tsunami event started washing up on the coast (Marine Conservation Alliance Foundation, 2012; Barnea et al., 2014).

In 2013, the National Oceanic and Atmospheric Administration (NOAA) sponsored a workshop in Anchorage, Alaska, to prioritize marine debris response efforts. The prioritization effort relied on a 2012 State of Alaska aerial imaging effort to map the density and distribution of marine debris across the Gulf of Alaska. The workshop identified high priority areas needing to be cleaned based on a combination of debris density, land access, feasibility of debris removal, natural and cultural resources threatened and economic impact. Several of the high priority areas were in Alaska's national parks.

The National Park Service (NPS) in Alaska, recognizing the high degree of visitor use and the wilderness designation of much of the NPS managed coastline, has been conducting marine debris surveys since 2009. Specifically, Kenai Fjords National Park (KEFJ) partnered with the Resurrection Bay Conservation Alliance to clean beaches with in KEFJ annually. Katmai National Park (KATM) and the Alaska Sealife Center (ASLC) partnered in 2013 to conduct an initial clean-up of the park's most visited coastal site. However, the NPS recognized that a larger coordinated effort, in conjunction with efforts already underway by NOAA, would be more effective at addressing an increased area of debris removal.

The main goal of this project was to remove as much marine debris as possible from five coastal National Park Service units in Alaska.

* Corresponding author at: 820 Harrison Rd, New Braunfels, TX 78132, USA.
E-mail address: lori.polasek1@gmail.com (L. Polasek).

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Documentation of debris collection was a secondary goal and beaches were not chosen randomly, but for management concern, logistics and access. Debris was documented in broad categories with debris weights collected per beach to enable categorization by composition and sources to ultimately strategize how to prevent debris entry into the system. The documentation facilitated assessment of differences in accumulation within the parks and between two regions: the Gulf of Alaska and the Western Arctic.

2. Methods

2.1. Sampling locations

Marine debris collection occurred within five National Park Service units between May 21 and July 22, 2015. The park units were Kenai Fjords National Park (KEFJ), Wrangell-St. Elias National Park and Preserve (WRST), Katmai National Park and Preserve (KATM), Bering Land Bridge National Preserve (BELA) and Cape Krusenstern National Monument (CAKR) (Fig.1). Beaches were not randomly selected, but were chosen by the project lead at the park (Table 1, Fig. 2). The combined coastline in National Park land in Alaska is 3640 miles with 2104 miles of coastline associated with the parks in this publication. Much of this land is extremely remote and therefore very difficult to access. It would not have been possible to access all sites of a random design were used for beach selection. Beaches therefore were chosen based on multiple factors. Some of those factors included debris accumulation zones, but other factors included feasibility of boat or plans access, cost of access and ability to safely move crew on and off sire and housing/camping options for cleanups that lasted more than one day. The park based project leads chose beaches based on known accumulation zones, management concerns, accessibility and cost of access.

For this study, a beach was defined as a continuous stretch of shoreline. A beach was continuous if it could be walked in its entirety at high tide and was separated from other sample areas by at least 1 km. Some beaches were too long to be sampled in one day, so they were sampled in segments. Segments within a beach were aggregated.

2.2. Debris collection

For each beach, surveyors walked the beach and collected all debris >10 mm long from the waterline inshore to the highest strandline on the upper shore. Partially buried or debris lodged in logs and rocks was excluded if it was unsafe or time prohibitive to remove, but in general, <5% of total debris remained on a cleaned beach. The surveyors walked in an organized pattern to ensure that the entire deposition area was surveyed and debris was removed. This pattern varied by park and beach width. Survey teams were comprised of two to 12 persons. The survey teams weighed the debris according to six categories: plastic, rubber, non-ferrous metal, rope/netting, foam and 'other' (Table 2). Glass, ferrous metals and processed lumber were not collected since their impacts are considered relatively innocuous.

To measure the length of the beach sampled, a track line was recorded using a Global Positioning System (GPS). The line measured depended on the geography of the beach: the berm line, wrack line, approximate vegetation line or beach centerline (Table 1). Beach length in kilometers (km) was used as a metric to standardize all sites; however, beach width varied widely within and between sites. While the additional measure of beach width would have provided area surveyed for

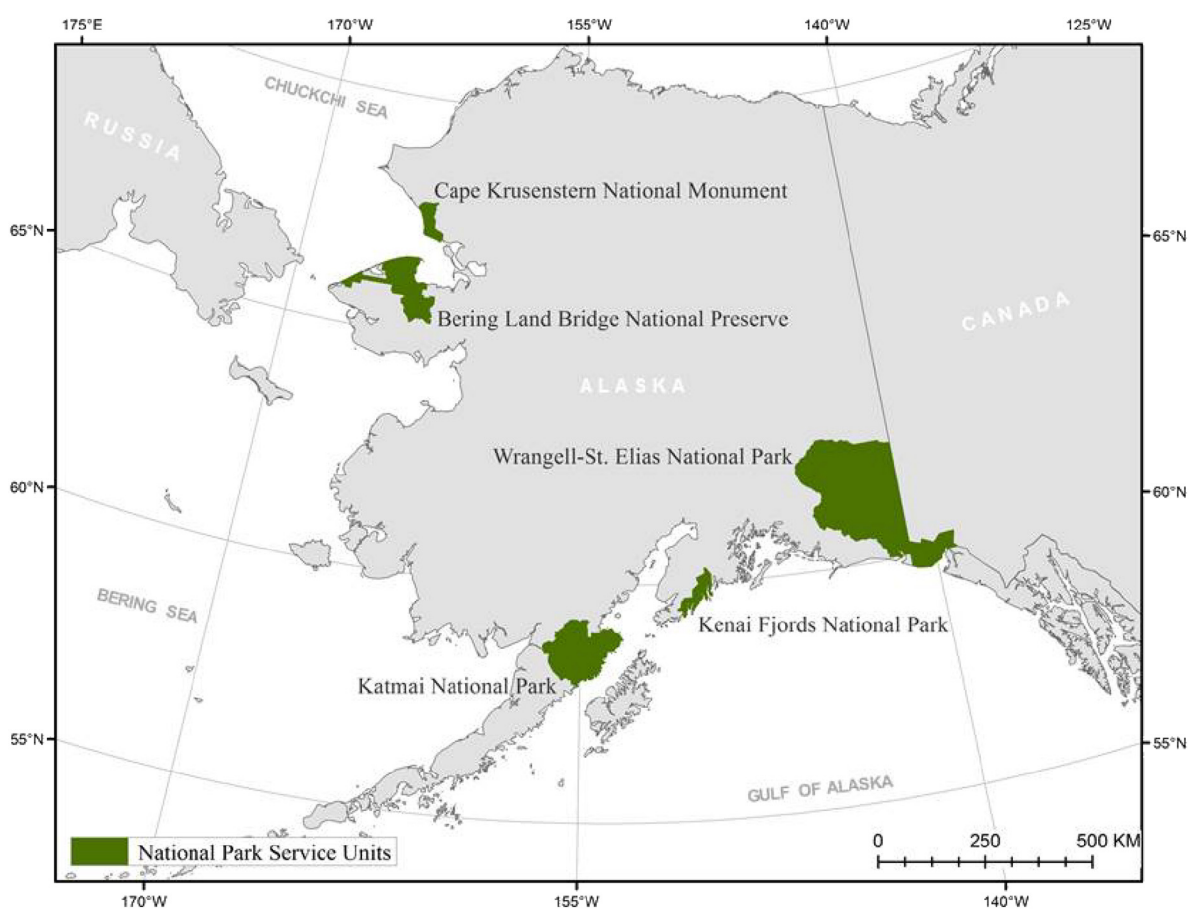

Fig. 1. Locations of five National Park Service units participating in marine debris collections.

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