Report on Removing Marine Debris from Beaches near Yakutat, Alaska in 2012

Bill Lucey and Ted Koller

Japanese Volleyball found on Blacksand Spit
Translations:
Top: Kei Aoki from Ibaraki Prefecture – Nov 26, 1979
Middle: Yuko Hamada from Fukushima Prefecture – September 6, 1979
Bottom: Yuri Hikage from Tochigi Prefecture – March 11, 1980

For
Marine Conservation Alliance Foundation
431 N Franklin St Suite 305
Juneau, Alaska 99801
Abstract

Fourteen paid laborers worked a total of 770 hours to collect 10,590.35 pounds of marine debris from 25.8 linear miles of beach near Yakutat, Alaska by the Yakutat Department of Planning and Natural Resources (YDPNR). YDPNR crews collected thirty-one trawl net samples, and one High Seas Drift Net (HSDN) sample. Debris weight per linear mile was most comparable to 2010 for all beaches cleaned including the reference site at Ocean Cape. Debris totals for 2012 reversed the overall weight decrease since 2009. Weight calculations in 2009 were the highest, though this was skewed by a large mass of trawl web. Collections in 2011 were the lowest on record. Debris composition ratios were significantly different in 2012. Overall buoy and Styrofoam weight increased from previous years. Given the debris composition shift along with items identified from the tsunami hit region indicate the Fukushima area Tsunami as the source of this increase in wind driven debris types.

Introduction

The YDPNR was awarded its 6th annual Marine Conservation Alliance Foundation (MCAF) grant for cleaning Yakutat area beaches. MCAF funded the project with money from the United States Fish and Wildlife Service’s FY 12 Grant F12AF70202 and the Alaska Brewing Company’s Coastal Code. The amount of debris encountered this year was much greater than expected following the low volume collected in 2011. The project work hours and fuel exceeded the grant allotment. The borough used additional funding through the Parks and Recreation as well as the Planning Department.

Yakutat is located along an isolated coastline in the northern panhandle of Southeast Alaska. The Alaska Coastal Current flows northwest peeling off the North Pacific Gyre while the dominant weather pattern is from the southeast. Yakutat bay creates an eddy effect with debris accumulations along the point known as Ocean Cape though debris collects along the entire 1,057 miles of shoreline with the borough boundaries. This coastline is predominately-open sand beach exposed to the Gulf of Alaska with interspersed islands and rocky shores within Yakutat and Icy Bays. Cleanups on nearby beaches are accessible by road near town and by landing craft within the Situk Estuary system and Yakutat Bay islands. However the majority of the coastline is off the road system is dominated by shore break. Access is limited to running through breakers into river mouths with boats or to beach landings using airplanes or helicopters.
Methods

We used local knowledge based on past cleanups, fishermen observations and citizen reports to select areas that target higher accumulation of marine debris. We then organized groups of paid laborers, student interns and sometimes volunteers to perform the cleanup.

Crews typically collected debris in donated ALPAR plastic bags. The bags, along with larger debris items, where carried, dragged, or ferried in boats and All-Terrain Vehicles (ATVs).

Trash analysis of debris composition took place at the YDPNR office where an open space laboratory allows material to be weighed with a 200lb digital scale and sorted by MCAF designated categories. All debris was taken to the landfill, with the exception of floats which are typically reused by the fishing fleet. All nets recovered were sampled and placed in plastic bags, with GPS locations and shipped to MCAF to help identify the source of the nets.
The YDPNR has selected a section of beach as an index site around the geographic point known as Ocean Cape. The site is a known accumulation zone for debris and has been monitored since 2008 in order to track changes in quantity and composition of debris. For the reference site at Ocean Cape, a 20% sample of all debris was examined. This sample was sorted and weighed based on the criteria in Tables 1, 2, and 3. An approximate total weight was calculated based on this sample. A 15% sample of all debris was taken from all other sites.

Results

Cleanups began on June 15, 2012 and continued through June 29, 2012 (Table 1). Crews cleaned six beach segments, ranging from 4,402 to 22,048 linear yards (Table 1). Six beaches in the Yakutat area were cleaned, including the Ocean Cape reference site, Ankau Saltchucks, Blacksand Spit, Coast Guard Beach, Cannon Beach and Lost River Beach. Data from Coast Guard Beach to Lost River Beach are reported as one site so that numbers are more comparable to Blacksand Spit, the longest beach segment (Tables 1-3). For comparison of debris totals, 2010 data from Khantaak Island were removed, as these items were a large mass of trawl web and crab pots collected by dragging the ocean floor and are not comparable to other years.

Blacksand Spit Debris. The white Styrofoam cylinders are likely used in Japanese mariculture operations.
The cleanup effort employed 14 laborers who worked a total of 770 hours to collect 10,590.35 pounds of marine debris from 45,473 linear yards of beach. Crews collected thirty-one trawl net samples, and one High Seas Drift Net (HSDN) sample. The HSDN weighed approximately 800 pounds and took three ATV’s to extract and drag down the beach to the landing craft.

Table 1. Date Location, beach latitude, longitude, length and width of beach natural accumulation area, number of trawl net samples, number of HSDN samples, and marine mammal observations

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<th>Location</th>
<th>Beach</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Length of Beach (yds)</th>
<th>Width of Beach</th>
<th>Natural Accumulation Area</th>
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Table 2. Actual Weight by Category

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<th>All Line or Rope Net (lbs)</th>
<th>Domestic Gill Net (lbs)</th>
<th>HSDN (lbs)</th>
<th>Buoy s (lbs)</th>
<th>Other Fishing Related (lbs)</th>
<th>Banding (lbs)</th>
<th>Plastic Beverage Bottles (lbs)</th>
<th>Plastic Non-Beverage Containers (lbs)</th>
<th>Metal (lbs)</th>
<th>House Foam</th>
<th>Styrofoam Buoys (lbs)</th>
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Total Weight: 10,590.35
Table 3. Composition of debris (by % of total weight)

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<td>9.6</td>
<td>16.0</td>
<td>22.6</td>
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Figure 1. Map of beaches cleaned
Discussion

A. Changes in Reference Site Debris

The 2012 marine debris cleanup in the Yakutat area was completed over budget, due to the larger than expected amount of debris after the 2011 collection decline. The index site is a cape that
intercepts the Alaska coastal current as it enters Yakutat Bay accumulating debris on its southern face and trapping more debris in the north facing eddy. It collected a total of 589.65 pounds, 235.86 pounds per mile, of marine debris over a distance of 4,402 yards (Figure 2). Debris totals at Ocean Cape increased sharply in 2009 and declined through 2011. In 2012, however, this trend was reversed with the highest debris totals since 2009. 289.8 pounds, 115.9 pounds per mile, of this debris was comprised of Styrofoam building insulation and Styrofoam floats (Figure 3). These figures represent 49.1% of the total reference site weight. This figure is 110.7 pounds per square mile higher than 2011 totals.

Hard plastic buoys totaled 34.15 total pounds, 13.7 pounds per mile, at the index site (Figure 4). The increase in buoy weight is 8.5 pounds per mile higher than in 2011. Considering the 2.5 mile length of the reference site, this is a significant increase. Buoy weight data were unavailable for 2009. 2010 saw a slightly higher total buoy weight, however, considering that most buoys found in 2012 were between 2-4 pounds, this difference likely represents only 1-2 buoys. Furthermore, crews cleaned the reference site for three days in 2010, whereas only 1 day was spent at Ocean Cape in 2012 due to budget concerns. The large buoys used for mariculture found in 2012 have never been seen anywhere near these quantities. It is also known that local subsistence and commercial fisherman collected large numbers of buoys from Ocean Cape and Cannon Beach, due to its easy access from Yakutat. These numbers, however, are difficult to quantify though they likely skewed the final weight downward. An annual weight comparison of the index site since 2008 reveals the quantity of marine debris collected

Official estimates of total marine debris generated by the Tsunami vary. There appears to be consensus that the majority of debris has sunk, however, 1.5 million tons are predicted to reach North America with the vast majority beginning to hit the beaches in 2013.

Figure 2. Ocean Cape Reference Site Weight
The large black buoy is likely used for seaweed and oyster farming operations in Japan.
Japan Broadcasting Corporation NHK World filming tsunami debris and CBY cleanup efforts. This Buoy #10 translates as “The Glory” and is from a Japanese fishing boat bearing that name.

Another Buoy #10 from the same boat found in Haida Gwaii in British Columbia. The Japan Broadcasting Corporation (NHK) will be starting a program returning marine debris from North America to the original owners.

Potential impacts of the 2011 Japanese Tsunami

Figure 5 below shows changes in Styrofoam collected since 2010. Styrofoam poundage per mile has increased dramatically. These data were unavailable for 2007-2009 as these classes of debris were not separated out. Large chunks of housing insulation as well as white Styrofoam cylinders used for mariculture were found on all beaches (Tables 2 and 3) and along the outer coast of the Malaspina Forelands (see NPS Report appendix B). Though Styrofoam of various types has been found every year during cleanup efforts, totals such as this have been unprecedented. Furthermore, these specific types of Styrofoam have never been seen in the quantities found in 2012. Housing insulation and Styrofoam mariculture floats totaled 4094.24 pounds and 38.6% of the total weight. Though this percentage is lower than that of the reference site, the dramatic increase in Styrofoam found is the same trend seen at Ocean Cape. In our opinion this dramatic increase in Styrofoam is likely attributable to the Japanese tsunami. Overall debris poundage may increase in 2013, when the majority of the debris from the Japanese tsunami is predicted to make landfall on the North American Pacific Coast. However, the majority of wind-driven debris may have already reached local beaches and future debris characterization may change.
Figure 6 on the following page shows changes in the weight of buoys collected from 2010 – 2012 and in 2008. These data were not available for 2009. Existing data indicates that the overall decreasing trend in buoy totals has been reversed in 2012. Buoy weight was 78.8 pounds per mile and 18.9% of total debris. The size and type of the buoys collected was highly variable, however, the majority were round and between 2.0 – 4.0 pounds. Larger buoys allegedly used for seaweed and oyster farming were also collected and averaged seventeen pounds. Many of the buoys that have washed up on the coastline, however, have been collected by commercial and subsistence fishermen. Therefore, the actual total is likely higher than what was collected during our cleanup efforts. Many of these buoys, particularly the largest ones, were likely from the Japanese tsunami, as evidence by Japanese lettering on many of them. A visiting CNN cameraman took one as a souvenir because it bore the name Musashi. Not only is Musashi the name of the Japanese company that manufactures these buoys, but is also the name of his favorite Japanese cartoon character based on a Samurai from the 1500s. Similar buoys have been found in Sitka Sound and on Montague Island. The overall increase in buoy totals also indicates that many have come across the Pacific from Japan.

**Figure 5** Styrofoam weight compositions

![Styrofoam weight compositions](image)

*Loading debris from Blacksand Spit to be taken to the landfill*
Figure 6. Buoy weight distribution and changes by year

Note: Blacksand Spit buoy totals were 1,916.7 pounds total and 153.3 pounds per mile. Due to limited access, these buoys were likely not taken by local fishermen. Blacksand Spit has not been cleaned since 2008, and some of this increase is applicable to this. Similar to all other beaches, however, Blacksand Spit accumulated a large amount of large oyster and seaweed farming buoys.

Figure 7 on the following page indicates the overall changes in marine debris totals per year since 2007. Unofficial cleanup efforts have been ongoing for years; however, 2008 was the first year when debris was separated by the current categories. These calculations are based on the total debris collected per mile on each beach. The highest total for debris collected per mile since 2007 was 821.1 pounds in 2009. This was due to the removal of a very large mass of trawl gear and rope left over from the 1970’s.

In following years, debris totals declined sharply. This year however, with the increase in buoys and Styrofoam likely from the 2011 tsunami, debris totals rose sharply from 190.4 pounds/mile in 2011 to 415.3 pounds/mile in 2012. Furthermore, the low debris total in 2008, increase in 2009, decrease from 2010-2011, and sharp increase in 2012 is consistent with debris total trends from the Ocean Cape reference site. The debris in 2009 was predominantly fishing debris such as crab pots and netting. In 2012, however, this was not the case as the vast majority of the debris found appeared wind driven. Based on this year’s data of 415.3 pounds per mile, we estimate that approximately 103,825 pounds of debris have potentially landed along a linear coast line measurement of around 250 miles of outer beach in the borough. The total coastline of the Yakutat Borough is actually 1,057 miles including all bays and islands. When these bays and islands are included in the calculations, we estimate that up to 438,972.1 pounds of marine debris has potentially accumulated on the Yakutat Borough beaches, however, the amount is likely lower due to varying accumulation rates based on geography.
Trash to Energy: Options for disposing of marine debris and municipal waste

This year’s annual beach cleanup saw a reversal in the downward trend of marine debris collected from Yakutat Beaches. Total debris increased almost three-fold over the previous year. The possibility of increasing debris from the Tsunami is yet to be determined. This is due to the ocean circulation patterns that will bring the majority of the debris back out to sea after nearing the North American shoreline. However, it is possible that this wind driven debris we are seeing currently may be a harbinger for the next few years and we will be seeing large increases in volume.
The Yakutat Municipal Landfill is unable to accept any more beach cast debris as the foam and plastic is of high volume though the weight is low. Below is a compiled list of links for various trash-to-energy systems compiled by the U.S. Forest Service and the City and Borough of Yakutat. Systems such as these have been successfully implemented in Massachusetts, Rhode Island, New York, New Jersey, Oregon, and Hawaii. Due to the large amount of trawl nets found on the Yakutat Forelands beaches, a burner such as that used in Hawaii is a viable option. Other Pacific coastal communities are experiencing debris accumulation from the Japanese tsunami, however in other communities the scale of the problem is reduced due to their ability to dispose of it.

http://www.crra.org/pages/prof_faci_wte.htm
http://marinedebris.noaa.gov/projects/images/netstoenergy.jpg
http://news.cnet.com/8301-11128_3-20123706-54/waste-to-energy-green-or-greenwash/
http://proceedings.ndia.org/jsem2008/abstracts/8207.pdf
http://www.alternative-energy-news.info/technology/garbage-energy/
http://www.wastetoenergyplan.com/
http://www.chinookenergy.com/
http://www.aquacare.com/waste-to-energy-systems/
http://bulkhandlingsystems.com/solutions-for-the-waste-industry/waste-to-energy-systems/
http://www.recoveredenergy.com/d_wte.html

The borough currently has partial funding through a combination of Army Corps of Engineer Feasibility Study and State appropriations to initiate a small scale biomass/waste cogeneration effort at the City Landfill. Electrical generation would range from 60 kW to 125 kW. Plastic buoys, rope, netting, Styrofoam and household waste could be combined with hog fuel and wood chips from forestry activities to co-burn for electricity.

Another option is to apply for a General Permit from DEC and excavate a hole on borough property to bury the debris. The final option is to ship the material out of town at considerable cost.
Our landfill is competent at separating out electrical waste, batteries, hazardous waste and many recyclables. We feel that burning both beach cast and household plastics and paper in conjunction with wood is the best option for solving several problems concurrently; affordable electrical generation, the end of burying trash and eliminating marine debris.

We are currently looking for proven technology that we can immediately purchase and begin working out localized issues such as moisture, delivery rates and combustion efficiencies.

**Alternative Energy Working Committee**

Scott Newlun – Manager - Yakutat Power – (907)784-3264

Skip Ryman – Manager - City & Borough of Yakutat (907) 784-3323 ext. 103

Bert Adams Jr. – Manager - Yakutat Tlingit Tribe (907) 784-3238

Lee Benson – US Forest Service –Yakutat Station — District Ranger (907) 784-3359

Mike Thompson – US National Park Service – District Ranger (907) 784-3295

Bill Lucey – Planning & Natural Resources - City & Borough of Yakutat (907) 784-3329

**Appendices**

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**UNITED STATES DEPARTMENT OF THE INTERIOR**

**NATIONAL PARK SERVICE**

**CASE INCIDENT RECORD**

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Summary: On 07/06/2012 Michael Thompson Yakutat District Ranger (WRST) Wildlife Biologist Judy Patera and Wildlife Technician Brandie Radičan successfully attached and setup two wildlife observation still cameras to a large Sitka Spruce tree overlooking a Stellar Sealion hall-out rock off the Sitkagi Bluffs. Conducted an aerial/helicopter marine debris survey from the Grand Wash to Yana Stream along the Malaspina Forelands within Wrangell-St. Elias NP/P. Also conducted an aerial reconnaissance over a recently discovered landslide that occurred at an elevation of 3500 above the Hubbard Glacier and flowed into Disenchantment Bay sometime this past May. Observed the slide point release of origin at an elevation of 3500 above sea level.

Details of the incident: On 07/06/2012 at approximately 1030 AM I conducted an aerial Tsunami Marine Debris Survey flying from the Grand Wash to Yana Stream along the Malaspina Forelands within Wrangell- St. Elias NP/P. I observed numerous 55 gallon barrel-sized Styrofoam floats approximately every 200 to 400 yards and various other large black rubber buoys accumulating above the high tideline. GPS coordinates taken from the helicopter at Sitkagi Bluffs marking both Styrofoam and rubber floats/buoys were N 49 degrees 43.47 x W 140 degrees 45.64 (photo’s attached).

Marine debris was observed accumulating beyond the park boundary and could be seen for miles towards Pt. Riou at the mouth of Icy Bay.

Selected References on Effects of Marine Debris on Fish and Wildlife

Plastic ingestion by planktivorous fishes in the North Pacific Central Gyre

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Environmental implications of plastic debris in marine settings—entanglement, ingestion, smothering, hangers-on, hitch-hiking and alien invasions

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Abstract: Over the past five or six decades, contamination and pollution of the world’s enclosed seas, coastal waters and the wider open oceans by plastics and other synthetic, non-biodegradable materials (generally known as ‘marine debris’) has been an ever-increasing phenomenon. The sources of these polluting materials are both land- and marine-based, their origins may be local or distant, and the environmental consequences are many and varied. The more widely recognized problems are typically associated with entanglement, ingestion, suffocation and general debilitation, and are often related to stranding events and public perception. Among the less frequently recognized and recorded problems are global hazards to shipping, fisheries and other maritime activities. Today, there are rapidly developing research interests in the biota associated with entanglement, ingestion, suffocation and general debilitation, and are often related to stranding events and public perception. Among the less frequently recognized and recorded problems are global hazards to shipping, fisheries and other maritime activities. Today, there are rapidly developing research interests in the biota associated with entanglement, ingestion, suffocation and general debilitation, and are often related to stranding events and public perception.

INGESTION OF PLASTICS BY TELEOST FISHES

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Ingestion of plastic debris by many types of animals such as turtles and seabirds is well documented and considered to be a serious threat to their survival. Marine fishes also ingest plastic debris but the amount ingested and the effect of the ingested debris are not well documented. If large amounts of inert plastic debris were ingested, it might affect the fishes’ well-being by blocking the digestive tract and reducing the feeding drive. Also, certain types of debris could cause injury to the digestive tract and, depending on its chemical composition, might even have a toxic effect. In this paper, we review the literature to determine what is known about ingestion of plastics by marine fishes and report on our studies on ingestion of plastic particles by larvae and juveniles. There is at present no comprehensive list of fishes known to have ingested plastic. However, observations made incidental to other studies indicate that many species do at least occasionally ingest plastic. Plastics have been found in larvae, juveniles, and adults of both pelagic and demersal species. Currently, there is no clear evidence that juvenile and adult fish have been affected by ingesting plastic. Studies in the field on larval fish have suggested that swallowed plastic spheres could cause intestinal blockage and that poly- chlorinated biphenyls associated with the surface of the spheres could have toxic effects. Laboratory experiments to determine the effect of plastic ingestion on larval and juvenile fish have been equivocal. In some cases the fish were observed to take particles, but then reject them. We have found in our laboratory studies on larvae that five of six species tested—Atlantic menhaden, Brevoortia tyrannus, pinfish, Lagodon rhomboides, spot, Leiostomus xanthurus; striped mullet, Hugil cephalus, and two species of flounder, Paralichthys spp.—will feed on polystyrene microspheres. However, only spot and mullet were found to have particles in their gut. Particles passed from the gut after a period of time and larvae subsequently fed on brine shrimp larvae.


A fourteen-Year Survey of Plastic Ingestion by Western North Atlantic Seabirds

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Abstract: To evaluate the incidence of ocean-borne plastic particle ingestion by western North Atlantic seabirds, we analyzed the gut contents of 1033 birds collected off the coast of North Carolina from 1975-1989. Twenty-one of 38 seabird species (55%) contained plastic particles. Procellariiform birds contained the most plastic and the presence of plastic was clearly correlated with feeding mode and diet. Plastic ingestion by procellariiforms increased over the 14 year study period, probably as a result of increasing plastic particle availability. Some seabirds showed a tendency to select specific plastic shapes and colors, indicating that they may be mistaking plastics for potential prey items. We found no evidence that seabird health was affected by the presence of plastic, even in species containing the largest quantities: Northern Fulmars (Fulmarus glacialis), Red Phalaropes (Phalaropus fulicaria) and Greater Shearwaters (Puffinus gravis).

**Diet of the southern opah Lampris immaculatus on the Patagonian Shelf; the significance of the squid Moroteuthis ingens and anthropogenic plastic**

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ABSTRACT: The diet of the large pelagic fish, the southern opah Lampris immaculatus was examined along the Patagonian Shelf in the Falkland Islands region. Stomachs were available for 69 fish collected in 1993 and 1994. Surprisingly, this fish had a relatively narrow range of prey items. The single most frequent prey item was the onychoteuthid squid Moroteuthis ingens (predominantly juveniles) which was eaten by 93% of the fish. The other important prey were the loliginid squid Loligo gahi, the myctophid fish Gymnoscopelus nicholsi and the southern blue whiting Micromesistius australis. There was no evidence of larger individuals of L. immaculatus ingesting larger individuals of any of the 4 main prey species. An unexpected finding was the relatively high incidence of plastic ingestion (14% of fish). The plastic came from a variety of sources including food, napkin and cigarette wrappers and various pieces of plastic line and straps used in securing boxes. In several instances, there was evidence of feeding on fishing boat discards. The findings reveal a significant impact of plastic pollution in this region of the Southwest Atlantic.


**Density of Plastic Particles found in zooplankton trawls from Coastal Waters of California to the North Pacific Central Gyre**

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**Trypsin content in intestines of herringlarvae, Clupea harengus, ingesting inertpolystyrene spheres or livecrustacea prey**


**Ingestion of Plastic and Unusual Prey by a Juvenile Harbour Porpoise**

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References from Marine Debris in Alaska: Coordinating our efforts


Marine Debris in Alaska: Coordinating Our Efforts

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Includes bibliographical references.


Citation: Williams, M., and E. Ammann. 2009. Marine debris in Alaska: Coordinating our efforts. Alaska Sea Grant College Program, University of Alaska Fairbanks.