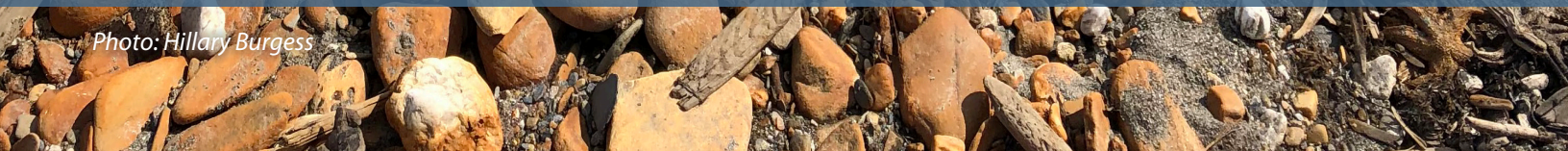




# Bering Strait Marine Debris Event Report

November 2021

Photo: Hillary Burgess



# Bering Strait Marine Debris Event Report

November 2021

## Acknowledgements

This report was developed through expert input from organizations and individuals who responded to, or had a relevant mission and/or mandate for, the Bering Strait Debris Event of 2020. The purpose of the report is to document the occurrence, impacts, observations, and lessons learned from a debris event that directly impacted local residents and shorelines across the Bering Strait region of Alaska. Coastal community members were the direct responders to the event and worked to provide reports, images, and descriptions that created awareness of the event. They also executed cleanups to remove the debris from their shorelines. Their time and effort in responding to and recording the debris event formed the basis for the documentation, analysis, observations, and recommendations contained in this report.

The overall report development and assembly was facilitated by the National Oceanic and Atmospheric Administration (NOAA) Marine Debris Program and the contributors listed below.

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## For citation purposes, please use:

National Oceanic and Atmospheric Administration Marine Debris Program (2021). Bering Strait Marine Debris Report. Silver Spring, MD: National Oceanic and Atmospheric Administration Marine Debris Program.

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Multiple recommendations in this document include potential actions that would rely on international engagement. It is understood that any such actions would be carried out through appropriate international and/or inter-governmental structures or channels.

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# Table of Contents

<b>Document Purpose and Description</b> .....	<b>5</b>
<b>Introduction</b> .....	<b>6</b>
<b>Initial Debris Arrival</b> .....	<b>6</b>
<b>Debris Sighting Analysis – Type, Condition, Labelling</b> .....	<b>8</b>
<b>Debris Type</b> .....	<b>8</b>
<b>Debris Condition</b> .....	<b>10</b>
<b>Debris Language</b> .....	<b>10</b>
<b>Possible Sources of Debris</b> .....	<b>11</b>
<b>Debris Event Impacts and Context</b> .....	<b>12</b>
<b>Response Coordination</b> .....	<b>13</b>
<b>Response Actions</b> .....	<b>14</b>
<b>Hindcast Modeling</b> .....	<b>14</b>
<b>Sighting Reporting and Tracking</b> .....	<b>15</b>
<b>Support Assessment</b> .....	<b>16</b>
<b>International Engagement</b> .....	<b>17</b>
<b>Response Observations / Context</b> .....	<b>18</b>
<b>Expansion of Vessel Traffic in the Region</b> .....	<b>18</b>
<b>Criticality of Regional and Local Response and Observations</b> .....	<b>18</b>
<b>Historical Debris Patterns in the Region</b> .....	<b>19</b>
<b>Lessons Learned - Gaps and Opportunities</b> .....	<b>19</b>
<b>Gaps and Challenges</b> .....	<b>19</b>
<b>Opportunities</b> .....	<b>20</b>
<b>Conclusion</b> .....	<b>21</b>
<b>References</b> .....	<b>24</b>
<b>Appendix A: Ad-hoc Response Group Participants</b> .....	<b>26</b>

# Table of Contents

<b>Appendix B: Sightings Reports Received</b> .....	<b>28</b>
<b>Appendix C: Media and Presentations Debris</b> .....	<b>35</b>
<b>Appendix D: Debris Reporting Flyer / Poster (UAF Alaska Sea Grant)</b> .....	<b>36</b>
<b>Appendix E: Hindcast Modeling Approach</b> .....	<b>37</b>

# Document Purpose and Description

The purpose of this document is to capture the events, actions, observations, and opportunities that were part of the response to an acute debris event which began in the late summer of 2020 in the Bering Strait region of Alaska. An acute debris event is an incident that results in the release of large amounts of marine debris. This may include natural incidents, such as severe storms, or anthropogenic incidents, such as maritime disasters. The overall goal of this document is to share experiences and help improve responses to future acute debris events.

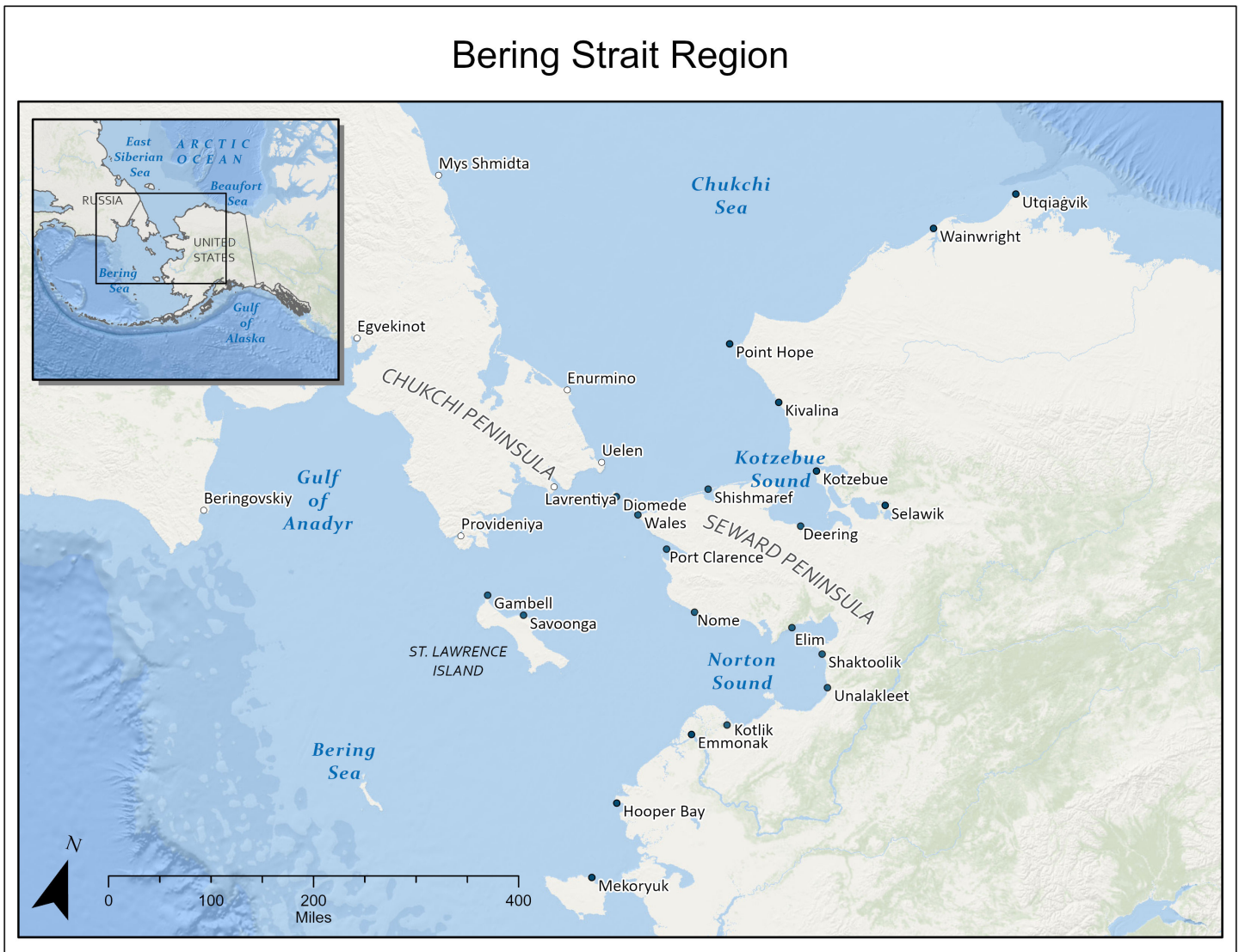


Figure 1: Bering Strait region orientation map, showing relevant land and sea locations, as well as populated places.

# Introduction

The Bering Strait is a unique and ecologically rich transboundary region, with coastal communities on both sides of the Strait, in the United States and Russia, dependent on marine resources that are harvested for both subsistence and economic purposes. It is also a region that is experiencing notable change, with evolving environmental conditions bringing corresponding changes to ecological conditions and human activity in the region. Beginning in late July 2020, local coastal community members and responders in the Bering Strait region began reporting notably increased amounts of marine debris coming ashore, with quantities and types of debris well outside the “normal” baseline typically observed in the region. These sightings began with reports from Saint Lawrence Island on July 27, with additional reports from Nome on July 30. From there, reports quickly expanded with sightings from Norton Sound, the Bering Strait, and northwards into the Chukchi Sea in the days and weeks that followed. The debris reported were predominantly international in manufacture, with Russian language labels evident on the majority of the items reported where language could be identified. Community members, acting from concern both for the environment and their food security, responded directly by removing debris that arrived and documenting sightings with photographs and descriptive reports. These reports were communicated through regional communication networks to staff at Kawerak, Inc. (Kawerak) and University of Alaska Fairbanks (UAF) Alaska Sea Grant faculty in the regional hub community of Nome. Kawerak and UAF Alaska Sea Grant staff notified state and federal responders with missions, jurisdiction, and interests relevant to marine debris. Based on the nature and timing of these reports and the “new” or un-weathered debris observed, the initial assessment was that the debris patterns appeared consistent with a point source debris release, such as accidental loss or intentional dumping from a vessel. This debris event added to existing concerns regarding impacts resulting from new and/or increased maritime activities in the region, including maritime transport, fishing, research, and military. As the debris event unfolded, community members expressed deep concern for the immediate and long term impacts and the potential for future events that could result from increased maritime activity. Starting in early August, the National Oceanic and Atmospheric Administration (NOAA) Marine Debris Program worked with state and federal responders, Kawerak, and UAF Alaska Sea Grant to form an ad-hoc group to share information and build common situational awareness in order to identify potential response actions. Those actions included:

- Tracking sightings received from regional communities through Kawerak and UAF Alaska Sea Grant.
- Conducting retrospective “hindcast” modeling to identify potential pathways and source locations.
- Identifying priority needs for direct support.
- Pursuing international communication and engagement with the Russian Federation.

Throughout the event, Kawerak and UAF Alaska Sea Grant continued to collect and catalog reports, images, and debris. UAF Alaska Sea Grant created and distributed informational debris event posters within the Bering Strait region that included points of contact for reporting debris sightings. Details on this debris event, including the debris types; arrival timeline; response efforts; and observations on gaps, challenges, and lessons learned, are outlined in this report.

## Initial Debris Arrival

Initial sightings of unusual debris were reported on the north shore of Saint Lawrence Island on July 27 and included plastic bags, general debris, and food items ashore near the community of Savoonga across multiple miles of shoreline. Subsequently, debris reports were received on July 30 from Gambell, Alaska, that included plastic bags and significant amounts of mixed debris ashore. Concurrently, a total of 124 items, including varied plastic containers (beverage bottles, cleaners, chemicals, etc.), were reported ashore west

of Nome on July 30. These were followed by additional reports of similar debris items (beverage bottles, hygiene product containers, boots, etc.), ranging from eastern Norton Sound North into the Bering Strait (Figure 2). In the following days and weeks, reports of debris continued to expand northward from Alaskan coastal communities on the southern Chukchi Sea. Reports of debris washing ashore continued into early November 2020, though in diminishing concentrations, with generally fewer items being reported per area. In some cases, these later reports included relatively fresh debris, which could have been from recirculation of the initial debris or a further debris loss/introduction event.

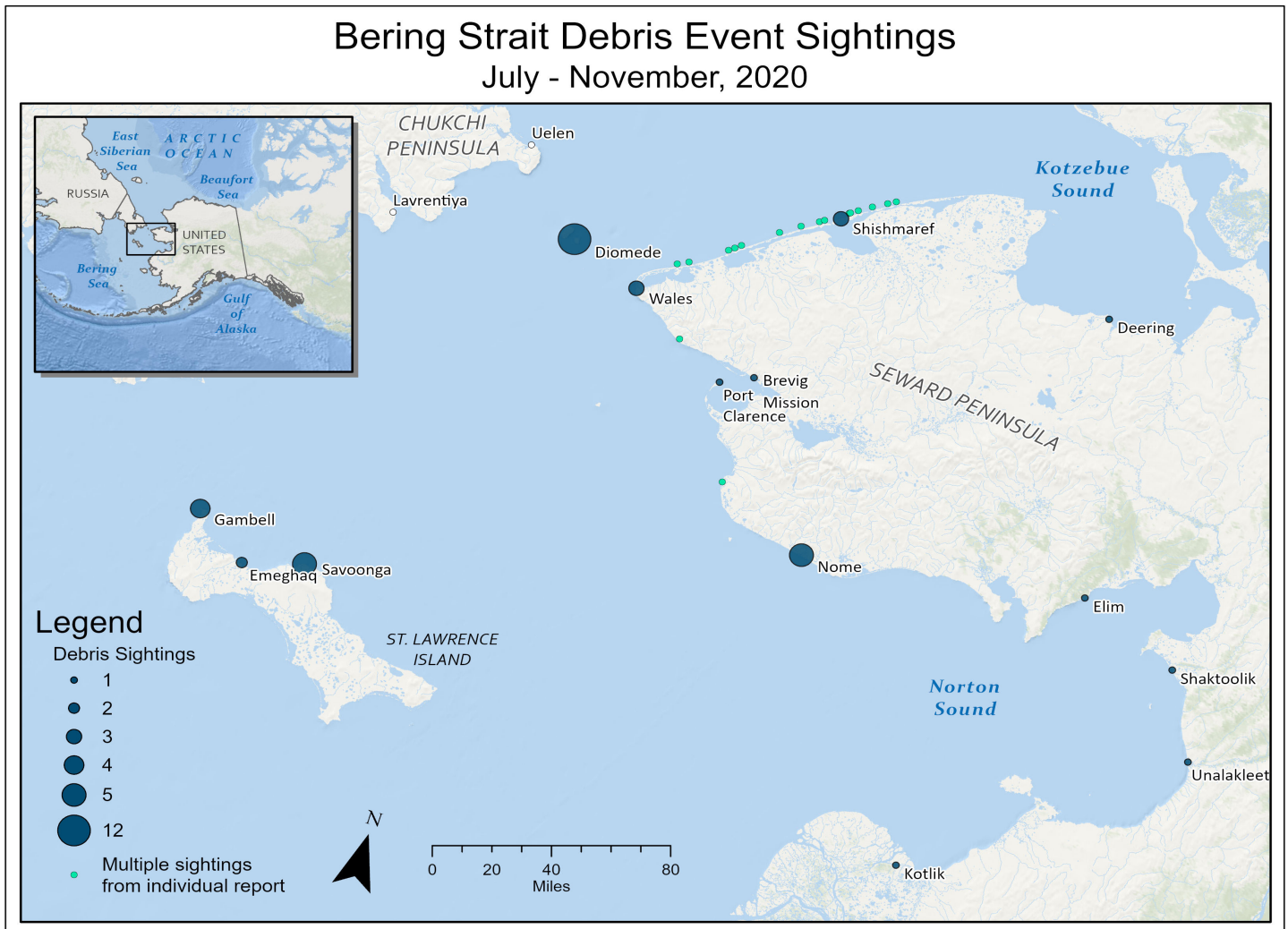


Figure 2: Debris sightings by location. Circles are colored, labeled, and sized to indicate the total number of sightings from the vicinity of a given community during the period sightings were reported, from July to November 2020. Individual reports represented variable amounts of debris, from individual items to hundreds of items. Sightings shown in teal were reported as part of otherwise scheduled marine mammal surveys conducted from U.S. Coast Guard helicopters, and as such are placed to represent specific debris locations, though they were part of a single sighting report.

Reports throughout the event came from community residents who initially encountered debris during their typical activities on shorelines, and then in some cases initiated more targeted efforts to survey shorelines for debris. Additionally, these local survey and reporting efforts were augmented by previously scheduled UAF Alaska Sea Grant marine mammal carcass beach surveys using U. S. Coast Guard helicopter support, as well as all-terrain vehicle (ATV) beach surveys in multiple locations. Over the course of the event, reports were received from residents in 11 different communities, including Shishmaref, Diomedede, Wales, Brevig Mission, Nome, Gambell, Savoonga, Deering, Elim, Kotlik, and Unalakleet. Individuals from these communities documented, reported, and conducted cleanup activities on a voluntary basis utilizing local resources and capacity.

# Debris Sighting Analysis – Type, Condition, Labelling

## *Debris Type*

---

Debris types reported during the event varied by location and were diverse, but certain item types were prevalent and notably unusual for the Bering Strait region by both type and by quantity. Sighting reports also varied in scope and scale, as some initial reports indicated many hundreds of individual items in a concentrated area, while other later reports indicated 1-10 total items identified or observed.

Over the course of the event, from July to November 2020, a total of 49 individual sighting reports were received from community members in the Bering Strait region. Of these 49 reports, 45 included digital photo documentation. In many cases, these images were collated into standardized formats by the UAF Alaska Sea Grant Marine Advisory Program Agent in Nome, which included the numbering of debris items for tracking purposes. This was done for debris directly reported by UAF Alaska Sea Grant, as well as debris that was shipped to Nome from other locations. Combining the narrative description of the debris items with the photo documentation, NOAA Marine Debris Program staff examined the reports and categorized the debris data and images received using a combination of the general categories commonly used in shoreline monitoring and assessment surveys (e.g., aerosol cans), as well as more customized categories to quantify specific items of concern or interest (e.g., rubber deck boots and military clothing). This analysis is presented here for type, with analysis and observations on debris condition and labeling to follow.

In terms of type, the results of this analysis showed a diversity of debris, with a predominance of beverage bottles and containers (Figure 3). Plastic bags, food containers, and other consumer debris items were also prevalent. However, some of the reported plastic bags may also have been used in commercial fishing activities, based on their design, size, and composition. Black and orange rubber deck boots were also a notably prevalent item, comprising 8.7% of the total objects that were reported and included photo documentation.



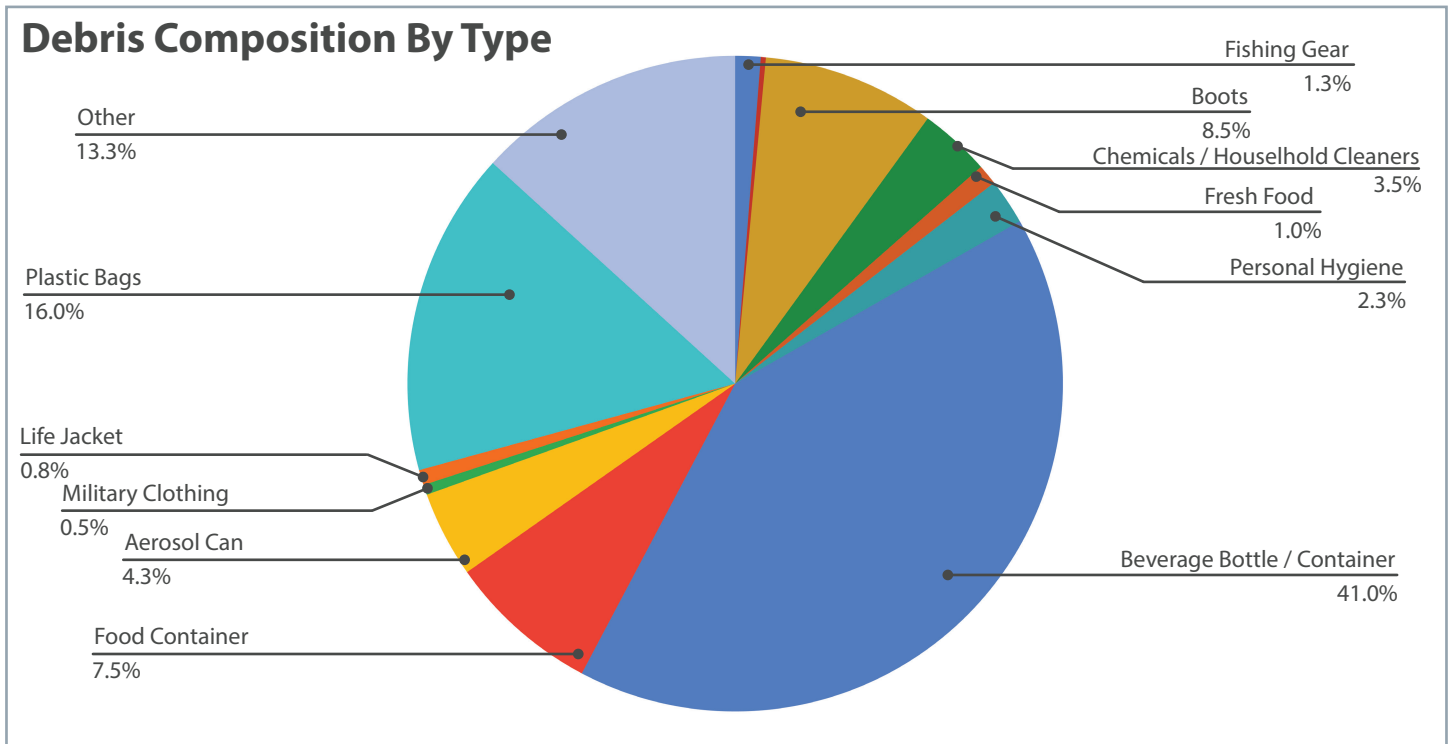


Figure 3: Composition of debris reported as percent of total count, based on analysis of narrative descriptions and photo documentation submitted by local community members.

At a general level, the debris reported were categorized into four primary groups or types:

- 1) **Consumer Debris** - Beverage bottles, food containers, personal hygiene products and containers, and cooking oils.
- 2) **Chemicals and Cleaners** - Household aerosol cans and cleaners. Several reports included identified or suspected hazardous material such as lubricating oils, insecticides, and hazardous chemical cleaning products.
- 3) **Commercial Fishing Gear and Equipment** – Black and orange rubber deck boots, blue bags that resembled bucket liners used in fishing fleets, packing bands, and longline equipment with labeling from a Russian fishing firm with offices in Vladivostok, Russia.
- 4) **Fresh Food** – In a few cases, including the original sightings reports from Saint Lawrence Island and Nome, identifiable fresh fruit and vegetables were observed within the debris.

Of note, there were individual items that appeared to be of Russian military origin, including a military cap that was reported from Savoonga on September 17, 2020, and a patent leather shoe reported ashore at Emeghaq (between Gambell and Savoonga) on September 22, 2020. Both of these items are categorized as “Military Clothing” in Figure 3. It is possible that these items may have been associated with the large military exercise in the Bering Sea during late August 2020, though the debris origin have not been confirmed (Isachenkov, 2020).

## Debris Condition

The majority of reported debris appeared to have recently entered the ocean. Many labels were still affixed and clear, the plastic was not degraded, and some items showed dates of manufacture or expiry in 2019 or 2020 (Figure 4). Items reported later in the event included objects that were notably more weathered, indicating these items were potentially not from the same source location or event.

## Debris Language

NOAA Marine Debris Program staff reviewed the images submitted with debris reports to categorize the debris based on language present in the labeling or marking of the objects. A total of 294 debris items were submitted with photographs – some items were submitted without photographs while others had multiple photographs per debris item. Language analysis was done using a dichotomous key previously developed for debris item language recognition/differentiation by University of Washington linguistics graduate students and faculty (Kessler, 2015). Items where no labeling was visible were categorized as “not present.” Items where the specific language could not be determined with reasonable certainty using the key were categorized as “indistinguishable / inconclusive.” In some cases, an individual debris item did not have sufficient labeling for language identification but could still be categorized by language based on other debris items with the same logo and complete labels. The results of this analysis indicated that Russian was the most common language represented (37.4%), followed by Korean (9.2%) and English (3.6%) (Figure 5). However, debris where labeling/marketing was either indistinguishable or not present made up nearly half (48.6%) of all objects.



Figure 4: Debris item showing date of manufacture or expiration of "28/11/2019" (Credit: J. Erickson).

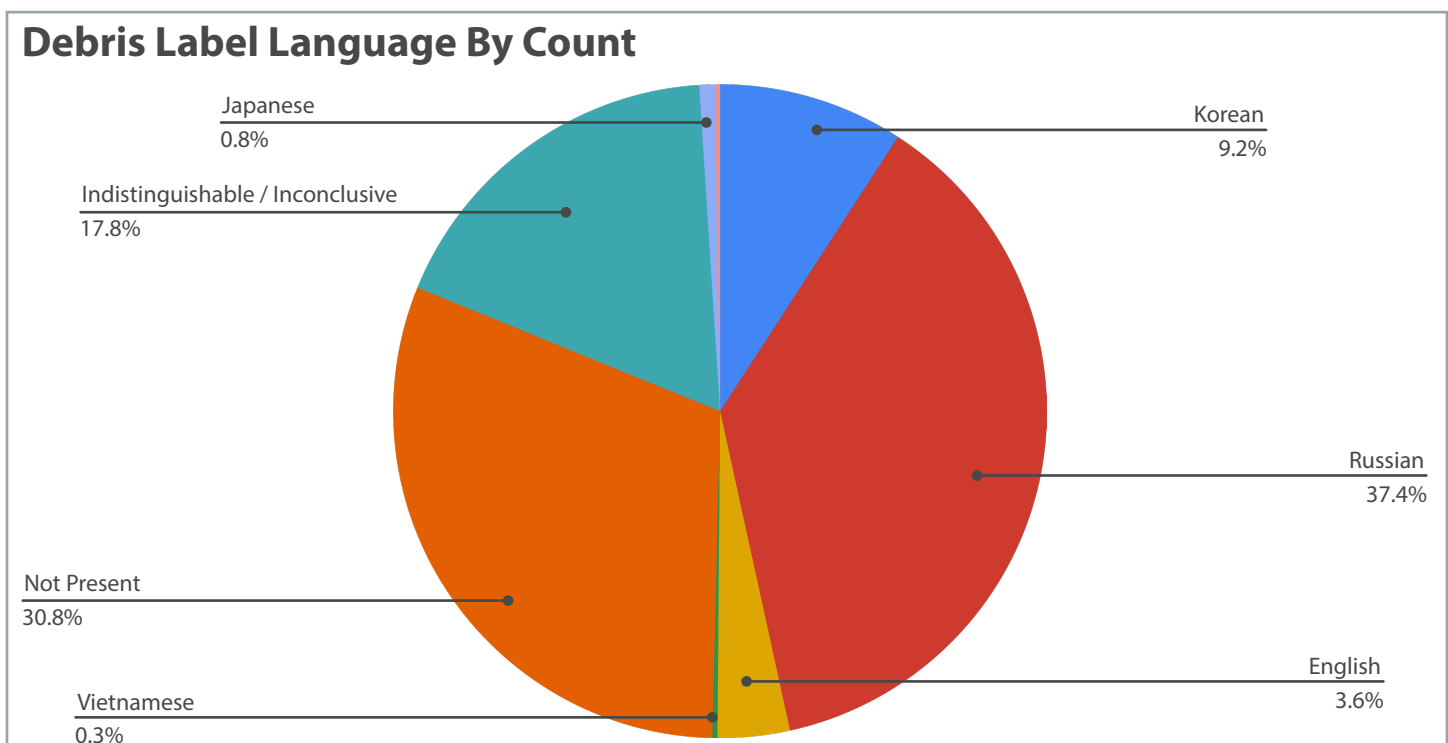


Figure 5: Language present on debris labels or markings expressed as percent of total count.

# Possible Sources of Debris

The initial assessment by staff from the NOAA Office of Response and Restoration Marine Debris Program and Emergency Response Division was that the debris patterns appeared consistent with a point source debris release, such as accidental loss or intentional dumping from a vessel. This assessment was supported by multiple factors including:

- 1) A roughly consistent composition and age across debris sightings and reports, including several consistent items across a wide area.
- 2) Debris appeared in an unusual amount in a compressed period of time.
- 3) The presence of clearly “new” items, including un-weathered plastics, other products, and fresh foods, such as fruit and vegetables.
- 4) Temporal and spatial diminishing of debris concentration from initial sightings.

The debris reported was also noted to be significantly different from the baseline of debris that is typically observed in the Northern Bering Sea and Bering Strait region, as identified by the community-based local responders. While direct comparisons were challenging, historical categorized debris removal data has generally included comparatively more fishery equipment/gear-related debris (net, line, floats, banding, etc.). This is based on historical removal efforts, much of which were conducted or coordinated by the Norton Sound Economic Development Corporation (NSEDC), and an analysis by the Alaska Marine Stewardship Foundation (Gaudet, 2014), which shows a total of 17.6% of items being fishing equipment/gear or fishing industry related items (Figure 6).

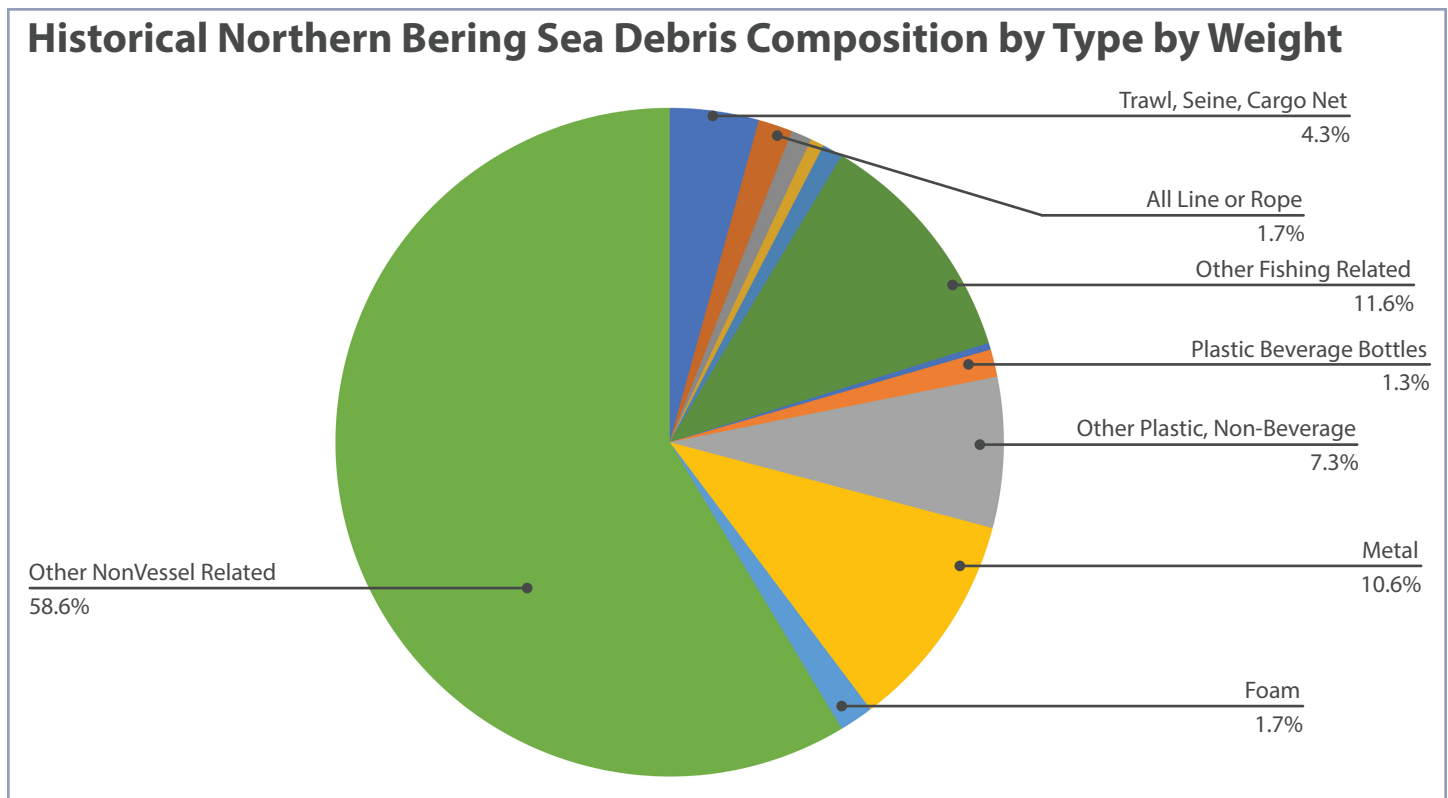


Figure 6: Marine debris removal data from the Norton Sound, St. Lawrence Island, and Northern Bering regions categorized by weight using Alaska Marine Stewardship Foundation / Marine Conservation Alliance Foundation protocol, synthesized in 2014 from historical cleanups in the region (Gaudet, 2014).

Fishing gear and fishing related items were reported as part of the 2020 debris event, but as a smaller component of the overall debris influx, making up 1.5% of total items by count (as indicated in Figure 2). However, there are limitations in comparison between the historical removal data and the sightings reports from the 2020 debris event. The historical removal data was categorized by weight rather than by count, which in turn skewed the data towards items that are heavier on a per-unit basis, including fishing nets and other fishing equipment/gear. Additionally, the historical removal data includes southern Norton Sound where a number of cleanups were performed at Stebbins and Saint Michael, which is outside the area where debris was reported as part of this debris event.

Likewise, foreign language consumer items are a historical component of debris in the Bering Strait region from the earliest recorded data, and have included items with Russian and East Asian language labeling (Figures 7, 8). However, they are atypical on most Alaskan shorelines in the northern Bering Sea / Bering Strait region, whereas a notable proportion was observed and reported during this event.



Figure 7: Image from 2014 debris removal report labeled "common foreign debris" (Credit: NSEDC).



Figure 8: Debris item from Savoonga cleanup, 2012 (Credit: NSEDC).

## Debris Event Impacts and Context

The diversity of the debris types observed during the event created the potential for varied impacts to marine and terrestrial wildlife resources and habitat, adding to existing concerns in the region. These potential impacts included entanglement of marine wildlife in line or fishing gear, and ingestion of plastics, both initially and as items degraded into smaller pieces over time. In addition to concern for these physical impacts, there were concerns over potential impacts from hazardous materials, such as the contents of insecticide, lubricating oil, and cleaning product containers that were also observed. While none of these impacts were directly observed or reported during the event, the potential was especially concerning in the region, because marine wildlife are essential subsistence, cultural, and economic resources for communities throughout the Bering Strait region. Northern Bering Sea resources have historically developed with limited impact from pollution based on the remoteness of the region. Local residents expressed to NOAA a deep concern that these resources and habitat will no longer remain pristine and safe unless debris and pollution are curtailed and prevented. Community members also reinforced that impacts to marine wildlife from debris is not only a conservation concern but a tribal sovereignty and food security concern for community members within the region. This concern extends not only to the availability of marine wildlife but the health of that wildlife as it relates to safe consumption, which can be a concern for many community members after a pollution event.

This event added to existing concern around food security and wildlife health in the Bering Strait region, as well as concerns for overall immediate and long term impacts on essential marine resources from increased maritime activity in the region. It also highlighted the need for local community residents to have awareness of both U.S. and international maritime activities that are occurring in the region. Situational awareness is needed because of the potential impact to direct human health and safety caused by use conflicts between the maritime activities of local community members and those of non-local parties. Community members have observed and reported the increased presence and proximity of new commercial fishing and processing activities (e.g., Pacific cod longline processors), and increasing vessel traffic of multiple types both in domestic (U.S.) and international waters. For example, overall vessel transits through the Bering Strait more than doubled from 2010 to 2019 as per data from Marine Exchange of Alaska (World Wildlife Fund U.S. Arctic Program, 2020). Increased activities can directly impact local maritime, shoreline subsistence, and commercial resources and activities. The potential impacts from increased industrial vessel traffic to marine wildlife in the Bering Strait region are diverse and wide-ranging, including debris entanglements with wildlife (Sheffield, 2010; Sheffield and Savoonga Whaling Captains Association, 2015; George et al., 2017), vessel strikes, debris ingestion, and oil-fouling both biogenic (Smith, 2020) and petroleum-based (Stimmelmayer et al., 2018). Without a directly identifiable source or responsible party and with notable increases of debris, debris events such as this one in the Bering Strait region add to these collective concerns, which also extend beyond marine debris to other pollution events.

Other non-debris pollution types and events can have significant impacts on marine wildlife and habitat, which have been observed and experienced directly by community members. A specific example occurred shortly before the debris event in June 2020 when a biogenic (non-petroleum-based) oily substance washed up on the shores of Saint Lawrence Island along with a number of dead birds. Collectively, these pollution and debris events reinforce concern for impacts to sensitive and critical environments and resources of the Bering Strait region, where a confined marine migratory corridor contains shared marine resources that are essential to the well-being of coastal communities.

## Response Coordination

In order to better understand and respond to the event, organizations collaborated to establish an ad-hoc working group focused on response to the debris event. This group included a range of organizations and agencies who had a mission, mandate, or direct interest in the debris event impacts, efforts, and outcomes. The organizations who participated in this group included:

**Local and Regional Responders** – Kawerak Inc., UAF Alaska Sea Grant, Norton Sound Economic Development Corporation

**State of Alaska Agencies** – Department of Fish and Game, Department of Environmental Conservation, Department of Natural Resources, Department of Commerce, Community, and Economic Development

**Federal Agencies** – National Oceanic and Atmospheric Administration (Office of Response and Restoration Emergency Response Division and Marine Debris Program), U.S. Fish and Wildlife Service, U.S. Coast Guard

A full listing of group participants and their affiliations is available in Appendix A.

The overall goals of this group were to share information, build common situational awareness, and identify needs and opportunities for direct actions to address the debris event that could be taken by different organizations within their mandate, authority, or jurisdiction. The group met via conference call, with multiple calls held in August 2020. As the understanding of debris types, quantities, and geographic scope became clearer and debris sighting tracking mechanisms were established, these conference calls shifted to being held roughly once per month during September and October, with group emails to supplement communications, and individual calls between group members on specific topics or questions. This improved situational awareness also aided in internal communications with state and federal agency leadership around the extraordinary nature of the event and the needs it highlighted.

In addition to communications within the ad-hoc response group, additional interested individuals or organizations also requested or initiated calls over the course of the event in order to share further information and identify additional opportunities for actions. These included calls with the U.S. Environmental Protection Agency (EPA) Indian Environmental General Assistance Program staff to evaluate connections or collaboration with their pre-existing programs and efforts, and conversations with both EPA and Inuit Circumpolar Council representatives regarding potential connections with ongoing Arctic Council efforts on general marine debris issues or topics under multiple working groups. These more general Arctic Council efforts include those under the Arctic Contaminants Action Program (ACAP) and the Conservation of Arctic Flora and Fauna (CAFF). In addition, there have been recent efforts on regional marine debris (or marine litter) action planning within the Protecting the Arctic Marine Environment (PAME) working group, and on monitoring guidelines through the Arctic Monitoring and Assessment Programme (AMAP). The State of Alaska Department of Environmental Conservation (ADEC) also included the topic of this debris event as part of regularly scheduled calls with community leaders and governments to assess impacts and the potential to utilize existing programs and activities, such as Backhaul Alaska, to remove collected debris.

## Response Actions

Based on group discussions, several key actions were taken to better assess the scope and scale of the debris event and investigate what could be determined regarding source identification. Highlighted actions are described in more detail below:

### *Hindcast Modeling*

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In partnership with the U.S. Coast Guard, NOAA worked to apply Office of Response and Restoration Emergency Response Division oceanographic modeling tools to evaluate the ability to “hindcast” or retrospectively model the pathways of the debris to help identify the most likely location and timing for when it was introduced into the ocean. NOAA Office of Response and Restoration Emergency Response Division oceanographers typically use these tools for modeling the path and fate of oil spills or other pollution events, but have a history of adapting them for other uses when requested, including search and rescue, animal recovery, and marine debris events. Most relevantly, NOAA Office of Response and Restoration Emergency Response Division oceanographers utilized the General NOAA Operational Modeling Environment, or GNOME, to assess the pathways, timeline, and fate of debris caused by the tsunami that struck Japan in 2011, which caused a significant increase in debris deposition in Alaska starting in 2012. The GNOME model, when applied to marine debris, functions by releasing thousands of simulated debris particles whose movements are then influenced by measured or modeled winds and ocean currents. Typically the model is run forward to estimate the future path and fate of objects, but in this case the model was run retrospectively to better understand the potential areas of origin that were most likely. Initial results of the GNOME model indicated that, based on wind and current patterns in late July, the most likely debris pathway would have been to come from the west and south of Saint Lawrence Island towards the Gulf of

Anadyr (Figure 9) though the area of probability, as defined by the spread of the simulated debris items, increased significantly with time based on the variability of both debris behavior and conditions. While this broad area meant that linking the debris to any one vessel or responsible party was not possible based on the modeling product, it did indicate general source pathways and timelines. Further information on the technical approach to the modeling effort can be found in Appendix E.

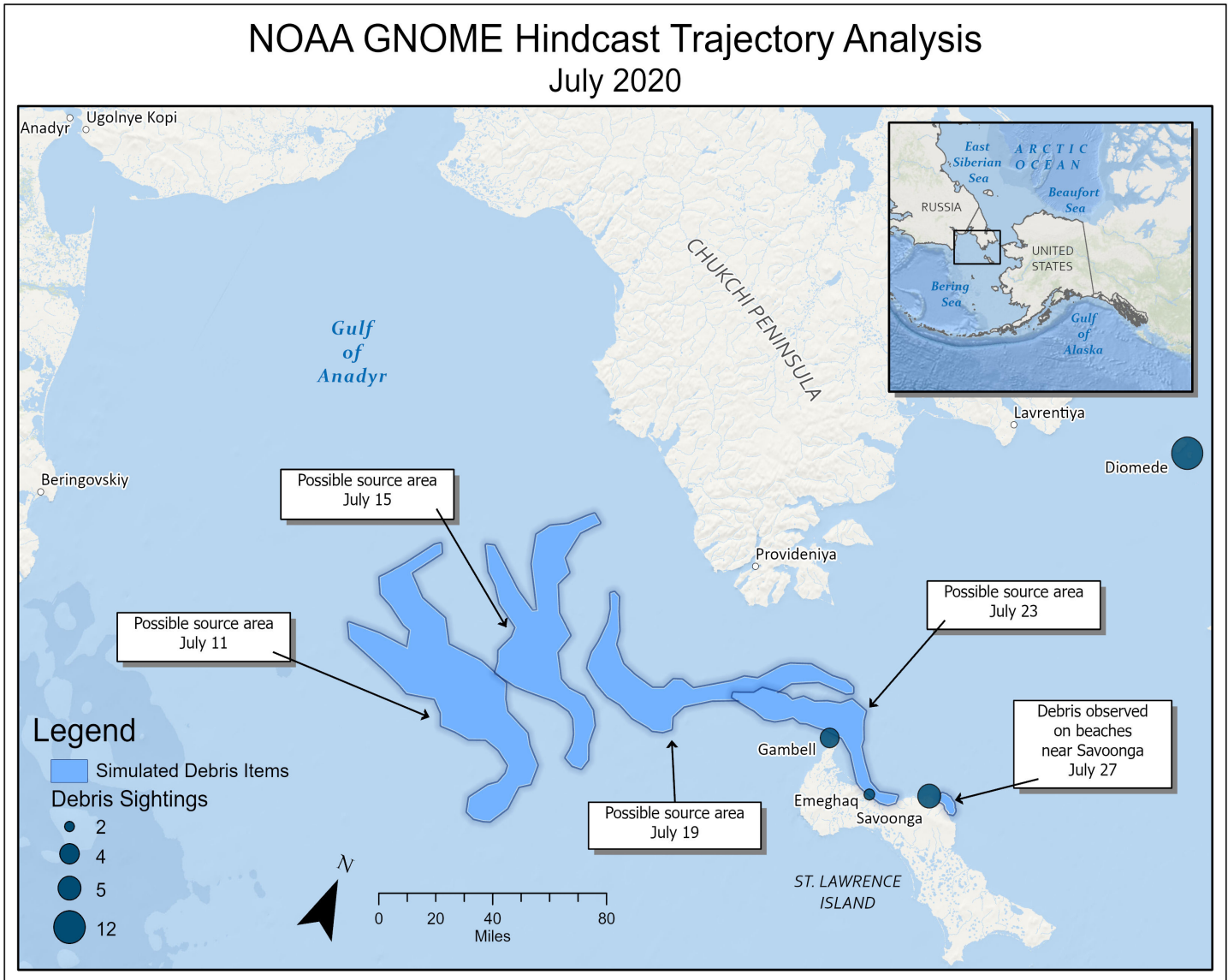


Figure 9: NOAA GNOME hindcast trajectory running from July 27 to July 11, 2020. This map displays simulated debris items which were all "released" at the initial observation point and then modeled retrospectively from July 27 to July 11, 2020. Polygons represent the extent of the modeled debris particles for each labeled date, indicating the potential area of introduction as of that time.

## Sighting Reporting and Tracking

The working group collaborated via email and conference calls to share information on sightings as they were received from community members, working to provide as many avenues as possible for people to report debris, and built a synthesized tracking spreadsheet to capture and record all the reports that were received. This included sharing guidance on where to submit sighting reports, as well as what information to include in reports. UAF Alaska Sea Grant produced an informational flyer with guidance on reporting debris sightings and distributed it to coastal communities in the Bering Strait region (Figure

10). NOAA also activated a dedicated email-based reporting account ([incident.debris@noaa.gov](mailto:incident.debris@noaa.gov)) in order to provide an additional option for reporting. The vast majority of sightings, all of which came from regional residents, were received through regional communication networks, having been submitted to UAF Alaska Sea Grant (Gay Sheffield, UAF Alaska Sea Grant Marine Advisory Agent - Nome) and Kawerak, Inc. (Austin Ahmasuk, Marine Advocate) in Nome. Both Sheffield and Ahmasuk also provided direct reports and photo documentation, and removed debris they encountered during their own observations and beach surveys throughout the debris event. Reports of debris ashore in the Bering Strait region continued through the established regional communication networks throughout the event. Over the course of the event, a total of 49 individual reports were received and tracked. A full list is available in Appendix B. It is important to note that these reports represent thousands of individual debris items. As an example, one report indicated the removal of “19 40-gallon size bags weighing about 50 pounds each” from 3 miles of shoreline near Gambell on August 3 (report from E. Apatiki). Additional sightings were also indicated on social media and other venues, and in some cases relayed for tracking.

## Support Assessment

Cleanup actions were executed by local community members, often soon after debris arrival. The volume of debris was notable, as evidenced by the previously mentioned removal efforts from Gambell, and other reports of cleanup efforts from Saint Lawrence Island, Nome, and other communities. These immediate cleanup efforts were conducted voluntarily by community members without any outside funding as there remains no funding vehicle or structure that exists to provide immediate funding specifically for response to debris events.

Recognizing the value and importance of the work by community members and the need for support to enable further activity, NOAA worked internally and with the response working group to identify, evaluate, and activate structures to deploy support to communities where targeted direct funding could be most helpful. By September 2020, NOAA was able to offer small grants to the communities most immediately and notably impacted by the event (Gambell, Savoonga, and Nome, west to east) in the amount of \$5,000 - \$10,000 per community. These funds were intended to support removal and disposal, as well as ongoing data collection to aid in identifying and understanding this and future debris events. UAF Alaska Sea Grant facilitated teleconferences with tribal councils in Savoonga and Gambell on the overall response and the funding opportunity. Following these calls, a short description of the funding opportunity was shared with representatives in Gambell, Savoonga, and Nome via email. Due to the combination of the event occurring late in the field season and the travel and logistical complications due to COVID-19 safety measures, no funded field work was possible in these communities in 2020. At the time of writing, NOAA has reached out and communicated with these same communities on potential actions and funding with the goal of supporting removal and data collection, and while Savoonga and Nome indicated interest, no operations have been possible in the 2021 field season.

### - FOREIGN TRASH ASHORE- SEE IT, REPORT IT

Since late July, trash with Russian and Korean writing has been washing ashore in the Bering Strait region and it is traveling with the wind and currents. Coastal communities should remain watchful and report any unusual marine debris that washes up on our beaches.



### PLEASE REPORT MARINE DEBRIS!

If you see unusual debris in the Bering Strait region, report it to NOAA at [incident.debris@noaa.gov](mailto:incident.debris@noaa.gov) or contact:

- Austin Ahmasuk (Kawerak – Nome) (907) 434-0962
- Gay Sheffield (Alaska Sea Grant – Nome): (907) 434-1149
- NOAA Marine Debris Program (Seattle): (206) 526-4661



#### HOW YOU CAN HELP



Take photos using your cell phone or camera and call in what you saw!

For more information on marine debris: <https://marinedebris.noaa.gov/>

Figure 10: Debris reporting protocols, assembled and distributed by Alaska Sea Grant. A full-size image can be found in Appendix D.



## ***International Engagement***

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Given the prevalence of foreign language labeling, specifically Russian, as well as hindcast modeling indicating debris pathways beginning from the Gulf of Anadyr, active commercial Pollock and Pacific cod fishing/processing activities in the Gulf of Anadyr, and the transboundary nature of the Bering Strait region, connections with federal agencies in the Russian Federation were pursued to better understand the status of marine debris on Russian shorelines and/or any insights on potential sources in the Bering Strait region.

Lacking pre-existing marine debris operational relationships with Russian Federation federal or local agencies, the first goal was to use appropriate government-to-government channels to identify the best agency to contact. This effort proceeded through multiple avenues:

- 1) The U.S. Coast Guard worked through staff posted at the U.S. Embassy in Moscow to identify the best points of contact and routes for communication regarding the status of this event and its potential origin. The Russian Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet) was identified as the suggested primary agency for marine debris issues, though no specific point of contact was identified and no contact was immediately possible.
- 2) The NOAA Marine Debris Program coordinated with the NOAA Office of International Affairs to engage with the U.S. Department of State, who suggested the Russian Ministry of Environment (Minprirody) as an additional agency that would potentially have additional or better relevant jurisdiction or knowledge. However, no specific point of contact was available or apparent. The topic of the Bering Strait Debris Event was added to an existing meeting request by the U.S. Department of State for the Russian Ministry of Environment. Unfortunately, this meeting was indefinitely delayed, and as a result, no direct contact with Minprirody was made.
- 3) In parallel to the other efforts, a meeting between U.S. Department of State staff and the U.S. Embassy in Moscow was scheduled with the Russian Federal Agency for Fishery (Rosrybolovstvo), whose portfolio also overlaps with elements of marine debris. The topic of the Bering Strait Debris Event was included in the meeting agenda, with questions and background materials drawn from working group discussions provided to the U.S. Department of State through the NOAA Office of International Affairs. The results of that meeting are pending as of this writing.

In the future, having an identified Russian Federation primary point of contact for the topic of marine debris will be important for information sharing and coordinating response to any future debris events or questions.

# Response Observations / Context

Over the course of the response, multiple key contextual realities were highlighted as critical for the overall understanding of the event. These are explained in more detail below:

## ***Expansion of Vessel Traffic in the Region***

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This debris event occurred in the context of notable increase in maritime activity for transport, commercial fishing, multi-national research, military activities, and eco-tourism in the northern Bering Sea and Bering Strait region. Maritime activities are also forecasted to increase in the future, are concurrent with reduced sea ice extent, quality, and duration, and have the potential to affect marine wildlife (Reeves et al., 2012). Projections from the U.S. Committee on the Marine Transportation System estimate that the number of vessels operating in the U.S. Arctic by 2030 could more than triple the number of vessels in 2008 (USMTS, 2019). Additionally, while further commercial fishing activity in U.S. federal marine waters north of Diomedes Island is not currently allowed based on the 2009 Arctic Fishery Management Plan by the North Pacific Fishery Management Council, fishing activity in the Exclusive Economic Zone of the Russian Federation was expanded into the Chukchi Sea with an initial Pollock fishery opening in 2020 (Rosen, 2020). Commercial fishing on the U.S. side of the Northern Bering Sea has also increased in recent years, with fishing efforts shifting northward in concert with the northward movement of commercially viable fish species (NOAA National Marine Fisheries Service, 2020). Beyond maritime transport (i.e., freight, fuel, etc.) and increased commercial fishing, there was also increased multi-national maritime military activity in the region during 2020, with the Russian Federation conducting training exercises (Isachenkov, 2020) and other nations deploying vessels for testing and training (Hofstaedter, 2020).

Taken together, these observed and projected increases in activity have furthered concerns from local communities for additional pollution events and impacts.

## ***Criticality of Regional and Local Response and Observations***

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As indicated previously, local observers and responders were the first to become aware of the event, and provided all sighting reports, observations, and photo documentation throughout the event. Without these coastal community members acting on their food security and public health concerns, and using existing regional communication networks, state and federal agencies would not have learned of the event as soon as they did, if at all. In addition to providing awareness of the debris event through reporting and photo documentation, the local community members voluntarily conducted debris removal without funding support or assistance. UAF Alaska Sea Grant staff in Nome also worked to raise awareness of the event by producing and distributing an informational flyer with points of contact, collecting and cataloguing debris, and submitting reports with additional detail and imagery documenting debris types and condition.

It is also important to note the local knowledge of debris patterns in composition and quantity that these reports reflect. Having a deep and nuanced knowledge of shoreline conditions, and the background amount and composition of debris allows community members to immediately identify changes that signal a shift in debris patterns or an acute debris event. This type of knowledge, also known as traditional ecological knowledge, is important in all places, but even more critical in areas where there is no long-term monitoring data or time series that could otherwise signal these events (though even in those situations monitoring data would signal with a longer lag time). It is essential that state and federal agencies maintain connections with regional communication networks for situational awareness of and throughout any future debris event.

## *Historical Debris Patterns in the Region*

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Historical debris data available in the Bering Strait and Norton Sound region are generally from removal efforts where the debris collected is divided and counted across predefined categories or types. This provides a quantitative understanding of the composition of debris across those categories. The Norton Sound Economic Development Corporation has facilitated community-led cleanups that have removed over one million pounds of debris from the region across a number of removal projects, including multiple projects on Saint Lawrence Island. These cleanups were executed by the Norton Sound Economic Development Corporation through multiple mechanisms, and in many cases as part of cleanup projects funded through the Marine Conservation Alliance Foundation (MCAF), a nongovernmental organization that was very active in marine debris removal in Alaska prior to ceasing operations in 2015, and was later known as the Alaska Marine Stewardship Foundation. The MCAF used a standardized debris categorization protocol that divides debris into categories by weight rather than count. An unpublished 2014 report by MCAF compiled and reviewed cleanup data across the state and grouped it into regions. These data, when averaged across the relevant regions per the report definitions, shows that by weight, debris has been historically highly diverse, including consumer debris, fishing industry activity, and unidentifiable debris. It should be noted that because of the method of measuring by weight, heavier items inherently are overrepresented in comparison to lighter items, such as empty bottles or other containers (as displayed in Figures 7, 8).

For future responses, having additional data on typical debris composition and quantity would be beneficial for quantifying and contextualizing the scope of the debris event and comparing it quantitatively with baseline debris depositions.

## **Lessons Learned - Gaps and Opportunities**

Looking toward potential future events and responses, there were several observations on gaps or challenges that are persistent difficulties in responding to acute debris events which are important to note or take into account. Conversely, there were also opportunities identified for actions that could be taken to improve future responses.

### *Gaps and Challenges*

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**Source Identification** – Tracing any one debris item back to a definitive source remains challenging and typically requires a unique identifier that can be traced to a specific location, individual, or organization. Acute debris events, such as the response to debris created by the 2011 tsunami that struck Japan, have demonstrated that only a very small number of items are able to be definitively traced back to a specific source location or time of introduction. Most traceable items from the tsunami were typically those with either government issued identification (vessels, home parts) or personal identifiers (name, location, contact information labeling). When marine debris is, or is suspected to be, from an international or foreign source, collaboration with international government agencies or other entities who can help trace debris identifiers is also critical. In a direct example from the 2020 Bering Strait Debris Event, a piece of longline fishing gear was reported ashore which included the name of a Russian commercial fishing company that operates within the Russian Economic Exclusive Zone in the Bering Sea. However, it is possible the item could have been lost in a separate incident from what caused the overall Bering Strait Debris Event.

**Dumping Enforcement** – While intentional dumping of plastic waste in the global ocean is banned under MARPOL Annex V, this provision remains difficult to track, detect, or enforce due to both to the difficulty of source identification (as discussed above), as well as the sheer vastness of open ocean areas as compared to the available surveillance/enforcement resources. This challenge is even more complicated with potential transboundary debris when the agency responsible for enforcement in the location where the debris is discovered does not have jurisdiction in the areas where the debris is most likely to have entered the environment.

**Lack of Debris Incident Reporting / Awareness** – Based on jurisdictions and existing agreements, there are no requirements or established communication pathways for general notification of vessel loss (sinking) or debris loss incidents along the Bering and Chukchi Sea maritime border between the United States and the Russian Federation. When responding to a vessel sinking in U.S. waters, the U.S. Coast Guard would activate for search and rescue and any HAZMAT response, but may not notify the Russian Border Patrol (BOKHR) unless direct assistance was requested. This protocol is also understood to be the same for Russian Border Patrol operations. As a result, source identification typically remains exclusively dependent on item identification and tracing, which remains challenging and rarely definitive.

**Impact on Local Communities** – Coastal community members throughout the Bering Strait region experienced this event directly, and were also the on-the-ground responders who identified the unusual nature and quantity of debris, reported on it, documented it, and removed it. All field work, whether data collection or removal, was performed by residents of impacted coastal communities where debris arrived. No dedicated fund or funding framework exists that is focused on response to acute debris events. As a result, communities, both in Alaska (and nationwide), typically must rely on local and existing capabilities to address and investigate marine debris and its impacts. This places added stress on limited resources, capabilities, and community members' time. This is especially true in the remote Bering Strait region, where infrastructure is limited and communities depend on harvesting marine resources for food and livelihood.

**Limited Baseline Data** – During the 2020 Bering Strait Debris Event, regional and local knowledge was key to the rapid identification of the atypical marine debris, both by composition and by quantity. Additionally, existing regional communication networks allowed rapid information sharing of this event to federal and state agencies. In locations where there are long-term time series of debris deposition data, quantifying the difference in debris by amount or composition can be done systematically and numerically. However, baseline debris data are limited throughout Alaska, and are especially limited in the remote Bering Strait region. The local knowledge of regional residents allows rapid identification of unusual debris events based on the direct and nuanced understanding gained from long-term observation. During the 2020 Bering Strait Debris Event, this knowledge was key to the rapid identification of the atypical marine debris, both by composition and by quantity. In locations where this knowledge does not exist, deposition data (either gathered by shoreline monitoring, categorized removal, aerial survey, or other means) can be crucial to identifying and understanding the occurrence and scope of an unusual or acute debris event.

## ***Opportunities***

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**Increased Collaboration with Russian Federation Agencies** - As highlighted in this report, there are multiple elements of the event response that would have benefited from established points of contact within Russian federal or regional government agencies in order to share and compare information, build common situational awareness, and identify or rule out potential debris sources. Working with Russian nongovernmental organizations or other Russian groups could also be helpful, but would need to be consistent with best practices for international communications, which often require formal government-to-government communications. These “pre-need” relationships are frequently highlighted in response

planning as essential to optimize response decisions, actions, and outcomes in the future. While the international nature of the region and communications poses additional complexity, it would be beneficial to establish those connections immediately to improve future responses.

**Integration / Collection of Baseline Debris Data** – While baseline data on debris quantity and composition are limited and unevenly distributed within the Bering Strait region (and Alaska generally), there are opportunities to expand future data collection. These opportunities include standardized shoreline monitoring through protocols such as the NOAA Marine Debris Monitoring and Assessment Project, but also the integration of debris categorization and quantification during removal operations. Over time, working to align or harmonize protocols would improve cross-comparability as well as improve the baseline understanding of debris patterns and signals within those patterns.

**Improved Connections with Existing Reporting and Data Gathering Frameworks** – Dedicated debris monitoring offers the most in-depth data in numerical format, yet it is also more labor intensive and less feasible in many cases given the equipment and time required for survey and data entry. Coastal communities in remote locations are typically the first to notice anomalous conditions in the marine and coastal environment. Strengthening communications between local, state, and federal response authorities, resource managers, and emergency responders is key to a regionally integrated and comprehensive response and common situational awareness. There are also existing reporting frameworks that some community members may already use to submit other environmental observations (e.g., weather, wildlife occurrence or behavior, etc.), such as the Local Environmental Observer network. Additional examples could include communities of practice focused on specific wildlife, such as seabirds or marine mammals. While these networks have their own purposes and focus areas, in a debris event response it can be beneficial for responding organizations or individuals to reach out to these pre-existing networks to request any relevant information that may have been received and integrate that data into the overall response tracking and understanding.

As highlighted earlier in this report, reporting through existing relationships and frameworks is frequently the most successful method. Building structures that integrate reports that are received through pre-existing networks, without creating confusion or disrupting those pre-existing communication pathways, is an important element that can improve situational awareness for responders as well as stakeholders when handled correctly. As noted previously, maintaining these networks and the communication pathways for local observers to report sightings is critical for situational awareness of any future debris event.

## Conclusion

The 2020 Bering Strait Debris Event was notable for many reasons. While marine debris is observed in the region regularly, the types and volume of debris were outside what had normally been observed by community members in multiple respects:

- Significant amounts of similar debris arriving in short time periods.
- Consistent types of debris appearing across the region within a relatively limited time period (e.g., deck boots, water bottles of similar type and age).
- Debris included primarily foreign language labeling, whereas historically observed debris has included foreign language labeled debris but at lower levels or frequency. Pursuing international communication and engagement with the Russian Federation.
- Much of the debris appeared to be relatively “new” and absent of the characteristic degradation or weathering that debris that has been in the ocean for a considerable time displays.

These elements together are consistent with a single or multiple point source release(s) – defined as a significant amount of debris entering the ocean at specific place and time, typically as a result of an accidental loss or improper disposal.

Community members took time to locate, document, and report debris items, conduct cleanup operations, and collect samples of debris items. They submitted a total of 49 individual reports that represent a much larger number, likely thousands, of individual debris items. The ability of local community members to note and respond to this influx and deposition of unusual debris reinforces the critical importance of local direct knowledge of environmental conditions and debris deposition patterns in their region. Such information is critical to inform awareness of, and response to, acute debris events. The experience of the group also reinforces the critical importance of existing regional communication and collaboration networks, such as those that already exist within the communities affected by the 2020 Bering Strait Debris Event. The relationships between local coastal community members and existing regional organizations Kawerak, Inc. and UAF Alaska Sea Grant were critical to gathering and distributing information on debris sightings and making connections between local sightings and state and federal response agencies. These connections improved awareness of the event across agencies and improved access to support in the form of scientific/technical support (modeling and sightings tracking), as well as funding support (through small grants offered to impacted communities).

The members of the ad-hoc response working group applied their respective experience to share information, identify needs, and pursue actions to address those needs within the capabilities available. Subsequent actions included conducting outreach through media, public presentations, and a poster created and distributed by UAF Alaska Sea Grant to raise awareness and make additional community members aware of methods to report sightings of any debris associated with the event. Sightings data were entered into a common tracker in order to better understand debris scope, geographic distribution, and trends in both movement and composition. Additionally, the group worked with the NOAA Office of Response and Restoration Emergency Response Division to leverage modeling tools to retrospectively analyze potential debris pathways and most likely areas of origin. The results of this modeling effort indicated the area South and West of Saint Lawrence Island, towards the Gulf of Anadyr, as the most likely area of origin. These results aligned with the observations of Russian language labeling on much of the debris where labels or markings were evident, as well as the observation of one item of fishing gear from a Russian commercial fishing firm.

This event reinforced known challenges in response to acute debris events. Debris items are often very difficult to trace back to a specific point or source of origin based on the generic nature of many items and their wide distribution. There is no mandatory reporting structure for debris loss events that would facilitate greater understanding of potential sources of debris when unusual items begin washing ashore. Funding is also a consistent challenge, as there are no specific funding vehicles available to rapidly deploy funds or assets for acute debris events. The funding opportunities that do exist are typically national grant application processes that have long lead times that make them unsuitable for immediate response activities. Lack of funding infrastructure meant that the direct field response - in terms of data collection, reporting, and removal – was entirely executed by local community members on a voluntary basis, which they conducted in addition to their existing day-to-day responsibilities.

This event highlighted the absence of established relationships and communications channels with Russian Federation agencies and organizations on marine debris (or marine litter) topics, events, and impacts. The transboundary nature of the Bering Strait region in general, and of this debris event in particular, reinforces the challenge and need of establishing these international relationships with Russian Federation contacts to share information and be able to respond to, and prevent future events.

There are multiple actions that could be taken in the immediate future to improve responses to future events:

- 1) Expand baseline data collection for debris quantities, composition, and trends in order to better quantify debris events in the Bering Strait region.
- 2) Explore collaboration and connection with other efforts in the region on, or related to, marine debris. That could include work under Arctic Council working groups, the EPA Indian Environmental General Assistance Program and its projects, as well as building connections to receive event related information from other existing observation networks.
- 3) Establish pre-need relationships with the appropriate Russian Federation agencies and organizations involved or interested in the issue of marine debris in order to share information that can assist in debris event response as well as prevention.
- 4) Investigate and capture information on funding options to support coastal communities with immediate response activities so that this information can be shared directly with communities in the event of a future debris event.
- 5) Maintain the networks and the communication pathways utilized or established during this event. This will enable local observers to report sightings and for those sightings to reach federal and state agencies as quickly as possible, which is critical for situational awareness of any future debris event, especially in remote regions.

While there are ongoing challenges in marine debris response, including for marine debris response in the Bering Strait region specifically, the lessons learned from the 2020 Bering Strait Debris Event present an opportunity to improve responses to future debris events. The findings summarized in this report can hopefully aid in responding to and preventing similar debris events in the future.

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# Appendix A: Ad-hoc Response Group Participants

The list below indicates individuals who participated in the ad-hoc response group through conference calls, email inputs, and direct calls. Additional organizations and individuals were consulted to share further information, including Environmental Protection Agency (EPA), EPA IGAP (Indian General Assistance Program), and other groups. Participants are listed in alphabetical order based on organization name.

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# Appendix B: Sightings Reports Received

Reported sightings are listed below, including dates, location information, description, and whether pictures were submitted with the report. Item descriptions in quotes are from the original reporting party, while "Ingest Description" indicates observations by NOAA staff in the initial review of reports. Names have been removed for privacy. The majority of sightings were reported to and collated by UAF Alaska Sea Grant or Kawerak and shared with NOAA and other agencies.

Sighting Date	Email/ Report Date	Location Description	Location (Lat/Long) or Nearby Landmark	Report / Item Description	Photos? (Y/N)
7/27/2020	7/27/2020	Savoonga (5 miles outside)		"lots of trash for miles along the shoreline", bags, debris, floating vegetables	N
7/30/2020		Nome to Sinuk River		"74 of 124 items noted between Nome and Sinuk River on 30 July"  08/17 Update - Objects show recent dates printed on objects, including July 2020 dates."	Y
7/30/2020		Gambell	ESE of Sivuqaq mountain	30-July: "...these are some kind of plastic bags, lots of trash all the way down the coast. .... bottles are also washed up in large numbers on this coast, its not just the plastic bags"	Y
7/31/2020	9/14/2020	Nome		31-July: "It was the first time I recall ever finding anything with Russian writing on it."	Y
8/1/2020	8/1/2020	Nome to Sinuk River		Aggregated image showing all debris collected 07/30/20?	Y
8/3/2020	8/4/2020	"Savoonga (Approximately same location as biogenic oil-fouling event, East of Savoonga, 16-18 miles)"		"footage taken yesterday (Native Village of Savoonga) that shows more trash ashore - as well as many dead murrens and fulmars scattered throughout."	Y
8/3/2020		Gambell		"My mom and I covered about 3 miles of shore today [3-Aug-2020]. Starting from the Ikuyek river to the Nengiighaq camp site. We picked (19) 40-gallon size bags weighing around 50 lbs each."  "the photo is not the only area littered, theres more down the coast. I'm thinking 5-10 miles of litter back there. Plastic bags/ bottles/straps, aerosol cans, rubber boots, etc. has washed up on the beach. Also pieces of rope and fishing net."	Y

Sighting Date	Email/ Report Date	Location Description	Location (Lat/Long) or Nearby Landmark	Report / Item Description	Photos? (Y/N)
8/3/2020	8/2-3/2020	Unalakleet		"Slavda beverage bottle (date indicates 28/11/19, potentially a best buy or mfg date of November 28, 2019"  "(lately we are seeing)...lots of Russian plastic jugs. I've been seeing several of these [see photo]...must be the popular cheap drink over there"	Y
8/8/2020	8/12/2020	Wales		Nivea Men bottle with cyrillic writing (appears to be body wash)	Y
8/9/2020	8/12/2020	Shishmaref		Aerosol bottle with cyrillic writing. "This is one of a few me and Amy found tonight on the beach. There were water jugs that were a gallon size also smaller, will take more pictures when I see them again."	Y
8/10/2020	8/12/2020	Port Clarence	65.06.0 N, 166.82.1 W	Orange foam boot, missing liner (one) with BJJK and "Kim Gu C__ LTD" badging. Looks like something what would be worn on deck. Waterproof men's boot, would associate with fishing industry.	Y
8/14/2020	8/16/2020	Diomede		Brown plastic bottle with what appears to be DV cyrillic characters on cap ( <a href="https://www.carlsberggroup.com/products/dv/dv-extra/">https://www.carlsberggroup.com/products/dv/dv-extra/</a> )	Y
	8/14/2020	Nome		Asian writing - english "Clear the pipeline"	
8/24/2020	9/2/2020	Nome		"trash seen when travelling by ATV along the water's edge from Nome to the Penny River on Aug-24, 2020"	Y
8/31/2020	9/1/2020	Shishmaref		These marine debris items were found on their beach Monday (Aug 31) and Tuesday (Sep 1)	Y
9/2/2020	9/2/2020	Shishmaref		Ingest Description (NOAA): Primarily consumer items, including aerosol and beverage bottles, primarily Korean (?) language. Debris generally more weathered.	Y
9/3/2020	9/6/2020	Shishmaref		Ingest Description (NOAA): Life jacket, what appear to be glass food jars, dark bottle. Debris generally more weathered.	Y

Sighting Date	Email/ Report Date	Location Description	Location (Lat/Long) or Nearby Landmark	Report / Item Description	Photos? (Y/N)
9/3/2020	9/8/2020	Wales to Shishmaref (flight)	"N 65'46.792; W167'43.445 N 65'48.368; W167'36.008 N 65'55.462; W167'12.357 N 65'56.673; W167'08.769 N 65'57.988; W167'04.748 N 66'05.162; W166'42.117 N 66'08.947; W166'29.122 N 66'11.851; W166'17.520 N 66'12.603; W166'14.394 N 66'16.845; W165'59.108 N 66'17.044; W165'58.378 N 66'18.348; W165'53.623 N 66'20.605; W165'44.604 N 66'22.867; W165'34.948 N 66'24.031; W165'29.476"	"- 15 total boots with lat/long, plus 2-3 prior to logging began - "Additional debris included (not photographed): plastic pallets, wooden crates, hard plastic net floats, asst. plastic bottles bottles bottles, plastic bags(?), a very large (industrial-sized) black ship fender, etc."	Y
09/04 - 09/05/20	9/6/2020	Diomedes		Ingest Description (NOAA): Plastic fragment of food container (legible, but weathered). Aerosol can of what appears to be wasp spray with what appears to be Korean labeling.	Y
9/9/2020	9/9/2020	Shishmaref		16' pole with 8 hooks recovered off the beach near Shishmaref earlier this evening. Best guess is this comes from the foreign fishing fleet operating S of the Strait.	Y
9/11/2020	9/12/2020	Diomedes		Ingest Description (NOAA): - Unweathered (new) plastic water bottle (russian labeling) - Weathered (older) metal aerosol can (russian labeling)	Y
	9/15/2020	Shaktoolik	"Found this by cape denbeigh (spell check) just outside of shaktoolik"		Y
	9/15/2020	Deering		"Hello. This was seen/found by Deering, Alaska 99736 second weekend in Sept. 2020. If you are making a pamphlet of all was found. I would like one. Very interesting. Hope this picture is good enough. Thanks"	Y
	9/16/2020	Elim		"This washed up near Elim Alaska"  Ingest Description (NOAA) - relatively recent/new beverage bottle with Korean labeling	Y

Sighting Date	Email/ Report Date	Location Description	Location (Lat/Long) or Nearby Landmark	Report / Item Description	Photos? (Y/N)
9/17/2020	9/17/2020	Savoonga		Ingest Description (NOAA): - Naval cap, reported as Russian. Passed on to USCG for awareness by reporting party	Y
9/17/2020	9/22/2020	Between Wales & Shishmaref	66°01.932 N, 166°52.208 W	Ingest Description (NOAA): - Life jacket, orange. No clear identification markers.	Y
9/20/2020	9/21/2020	Between Brivig Mission, near Lost River		"Between Brevig Mission and near Lost River yesterday, there was quite a bit of debris reported of different varieties. Attached is a photo of one of the bottles. There was also a green boot."	Y
9/20/2020	9/21/2020	Nome	Mile 18-21, West Beach	Ingest Description (NOAA): - Black foam boot with "Sardonix" label - Metal container of potentially cooking oil with both Russian and Asian (Japanese?) labeling - Beverage bottles, relatively new but crushed and no labels.	Y
9/21/2020	9/22/2020	Wales		"There were a number of plastic bottles, handful of milk cartons, a can of aerosol foam, a couple of hair style cans, and dozen or more of beer/alcohol bottle. This was from our inlet mouth to 4 miles down south of Singuuraq with pieces every 0.2 of a mile while every other item foreign."  Ingest Description (NOAA): - Mixture of weathered and non-weathered items - Many of newer items appear to be food containers of different kinds (ice cream, creamer), personal care products - Older items include bottles, fishing gear, and household aerosols	Y
	9/22/2020	Emeghaq (halfway between Gambell & Savoonga)		"And this is just a portion of what all washes up (from this summer)...this isn't everything...(there is) lots more I didn't take a pic of."  Ingest Description (NOAA): - Mixture of consumer debris (beverage bottles, personal hygiene, etc.) and fishing-activity associated debris (boot, fishing net, packing bands, buoy) - Ages of debris appear mixed - some items highly weathered while others show little weathering.	Y

Sighting Date	Email/ Report Date	Location Description	Location (Lat/Long) or Nearby Landmark	Report / Item Description	Photos? (Y/N)
9/23/2020	9/24/2020	Diomedede		Ingest Description (NOAA): - Russian beverage bottle	Y
9/28/2020	9/29/2020	Diomedede		Ingest Description (NOAA): - Russian beverage bottle, appears to be water bottle based on shape/size	Y
9/28/2020	9/29/2020	Gambell	~10 miles from Gambell	"Boots washed up on north side of island ten or so miles from Gambell"  Ingest Description (NOAA): - individual boots, 7 in total (6 in one image). 4 black, 3 orange (one of these somewhat more yellow orange)	Y
10/1/2020	10/2/2020	Wales		"Four more Russian water bottles, three more plastic milk bottles. And these three [photographed] items..."  Ingest Description (NOAA): - Newer orange deck boot, elephant logo - Newer cleaning product bottle (shape consistent with bathroom cleaner) - Older crushed beverage bottle	Y
9/29/2020	10/4/2020	Diomedede		Ingest Description (NOAA): - Russian beverage bottle, red cap with soft plastic label on white plastic bottle (appearance similar to creamer bottle)	Y
	10/04/20	----		There were 3 orange boots distantly scattered and washed ashore, but the swells washed them out again. Here is a green boot with a writing on it. Another hunter brought this to my yard. From July, August, September. The 3rd photo is snapped from a Gambell hunter's observer posted on facebook (10 miles south of Gambell)  Ingest Description (NOAA): - Three individual boots in three photos - Requested additional information on location and timing of objects - Images of orange boots are screenshot of Facebook report by Merlin K (line 34) - Single green boot - South/Southwest of St. Lawrence Island.	Y



Sighting Date	Email/ Report Date	Location Description	Location (Lat/Long) or Nearby Landmark	Report / Item Description	Photos? (Y/N)
	10/04/20	Outside of Elim		Ingest Description (NOAA): - Two images of beverage bottle, partially degraded/weathered, with potential Korean labeling - One image of weathered green beverage bottle	Y
10/13/2020	10/13/2020	"Emeghaq camp (halfway between Gambell & Savoonga)"		13-October: "Was a bit too windy from the north, didn't have much of a beach but this is what I found near the mouth at camp. ...it was a washed up food weekend."	Y
~10/07/20	10/14/2020	Kotlik		"14-October: "Last week my wife found a Russian light bulb. Then my daughter found two plastic bottles and a light bulb. The bottles had Korean writing. These were found near Point Romanof."  Ingest Description (NOAA): - Light bulb (LED design, appears) with cyrillic writing at base - Bottle caps with asian character labels (blue)	Y
10/18/2020	10/21/2020	East of Nome	64' 44.885 N 166' 28.185 W and 65' 24.279 N 167' 25.148 W	"Orange deck boot at each of the two lat/long locations. These boots had washed in with the recent weather event. Additionally, we flew Nome-Wales and noted 9 tires between Nome and the S outer "arm" of Port Clarence that had recently washed ashore. We continued to see bits of plastics, small colored containers, etc. along the entire route - as well as to the "beach" along the S face of the York mountains."	N
10/23/2020	10/24/2020	Savoonga		"There was also rubber boots but my phone died. One rubber boot was white and blue, child size 3 or 4. Writing was Chinese or something. Couldn't see [the writing] good as it was worn down".  Ingest Description (NOAA): Appears to be single cosmetic bottle with legible but weathered labeling in Russian. Denting suggests mechanical/physical degradation potentially from rocky shoreline.	Y
	10/24/2020	Savoonga			Y
11/4/2020	11/4/2020	Diomedede			Y

Sighting Date	Email/ Report Date	Location Description	Location (Lat/Long) or Nearby Landmark	Report / Item Description	Photos? (Y/N)
11/9/2020	11/9/2020	Diomedede		"Found on the North beach"  Ingest Description (NOAA): Two plastic beverage bottles, both with russian writing. First bottle has partially attached/remaining lable on side, otherwise somewhat weathered. Second has no label remaining, and appears to have sand or organic material inside.	Y
11/10/2020	11/10/2020	Diomedede		"Foreign electrical cord made in China...6ft China 3-pin Plug to C13 Power Cord"  Ingest Description (NOAA): Power cord looks to be standard 3 prong irregular hexagon shape power transmitting side (as for computers or other electronics. Cord was wrapped neatly with twist tie, potentially indicating limited time in water (or very strong twist tie)?	Y
11/10/2020	11/12/2020	Diomedede		"Good Year Tire washed in"	Y
11/11/2020	11/12/2020	Diomedede		"Made in the USA Columbia brand"	Y
11/15/2020	11/16/2020	Gambell		"There was a couple [two] that washed up on the west side of our beach."	Y
11/16/2020	11/17/2020	Diomedede		"More marine trash from China and elsewhere found on our Diomedede beach today"	Y

# Appendix C: Media and Presentations

Note: The event was also mentioned parenthetically as part of presentations on Alaska marine debris in general, but was not a focus of those presentations.

MEDIA INTERVIEWS + STORIES ON BERING STRAIT DEBRIS EVENT:			
Outlet	Date	Interviewed	Story Link
KNOM	08/19/20	Gay Sheffield, Peter Murphy, Robb Kaler, Erika Apatiki,	<a href="https://www.knom.org/wp/blog/2020/08/20/pulse-of-marine-debris-in-region-likely-coming-from-russian-side-of-bering-strait/">https://www.knom.org/wp/blog/2020/08/20/pulse-of-marine-debris-in-region-likely-coming-from-russian-side-of-bering-strait/</a>
Nome Nugget	08/24/20	Gay Sheffield, Ben Pungowiyi, Wes Jones, Peter Murphy,	<a href="http://www.nomenugget.com/news/foreign-plastic-continues-wash-region%E2%80%99s-beaches">http://www.nomenugget.com/news/foreign-plastic-continues-wash-region%E2%80%99s-beaches</a>
Washington Times	09/09/20	Austin Ahmasuk, Peter Murphy	<a href="https://www.washingtontimes.com/news/2020/sep/20/rising-red-tide-russia-accused-trashing-bering-str/">https://www.washingtontimes.com/news/2020/sep/20/rising-red-tide-russia-accused-trashing-bering-str/</a>
ADN	09/17/20	Austin Ahmasuk, Peter Murphy	<a href="https://www.adn.com/alaska-news/rural-alaska/2020/09/25/deck-boots-water-bottles-fruit-an-unusual-marine-debris-event-is-coating-bering-strait-beaches-in-trash-from-abroad/">https://www.adn.com/alaska-news/rural-alaska/2020/09/25/deck-boots-water-bottles-fruit-an-unusual-marine-debris-event-is-coating-bering-strait-beaches-in-trash-from-abroad/</a>
Seafood News	09/29/20	Austin Ahmasuk, Peter Murphy	<a href="http://seafood.com/Story/1181712/Mystery-Foreign-Marine-Debris-on-Bering-Strait-Beaches-Focus-of-NOAAs-ORR">http://seafood.com/Story/1181712/Mystery-Foreign-Marine-Debris-on-Bering-Strait-Beaches-Focus-of-NOAAs-ORR</a>
Nome Nugget	10/09/20	Gay Sheffield, Ken Stenek, Peter Murphy	<a href="http://www.nomenugget.com/news/foreign-trash-continues-wash-regional-shores">http://www.nomenugget.com/news/foreign-trash-continues-wash-regional-shores</a>
KNOM	10/13/20	Austin Ahmasuk, Gay Sheffield, Peter Murphy	<a href="https://www.knom.org/wp/blog/2020/10/17/bering-strait-region-sees-more-debris-from-russian-side-but-source-still-unknown/">https://www.knom.org/wp/blog/2020/10/17/bering-strait-region-sees-more-debris-from-russian-side-but-source-still-unknown/</a>
PRESENTATIONS ON BERING STRAIT DEBRIS EVENT:			
Event	Date	Presenter	Description
Strait Science	09/24/20	Gay Sheffield, Peter Murphy	Invited by Gay Sheffield to provide presentation to ongoing Strait Science remote presentation series. Presentation on event, response, and observations.
NMFS Brown Bag	11/24/20	Gay Sheffield, Peter Murphy	Presentation to NOAA NMFS team as part of Brown Bag series organized by Kate Savage (NMFS Juneau). Gay Sheffield presented first on sightings, response and context, with Peter Murphy following with presentation on ad-hoc group, modeling, and next steps.
Alaska Marine Science Symposium	01/27/21	Peter Murphy	Recorded presentation as part of AMSS, based on abstract drafted by Gay Sheffield and Peter Murphy that had been submitted in fall 2020. Presentation was available as part of AMSS Bering Sea Day on January 27, 2021.

# Appendix D: Debris Reporting Flyer / Poster (UAF Alaska Sea Grant)

## - FOREIGN TRASH ASHORE- SEE IT, REPORT IT

Since late July, trash with Russian and Korean writing has been washing ashore in the Bering Strait region and it is traveling with the wind and currents. Coastal communities should remain watchful and report any unusual marine debris that washes up on our beaches.



## **PLEASE REPORT MARINE DEBRIS!**

If you see unusual debris in the Bering Strait region, report it to NOAA at [incident.debris@noaa.gov](mailto:incident.debris@noaa.gov) or contact:

- Austin Ahmasuk (Kawerak – Nome) **(907) 434-0962**
- Gay Sheffield (Alaska Sea Grant – Nome): **(907) 434-1149**
- NOAA Marine Debris Program (Seattle): **(206) 526-4661**



**HOW YOU CAN HELP**



**Take photos using your cell phone or camera and call in what you saw!**

For more information on marine debris: <https://marinedebris.noaa.gov/>

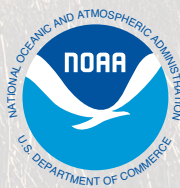
# Appendix E: Hindcast Modeling Approach

This information was provided by the NOAA Office of Response and Restoration Emergency Response Division oceanographer, Dylan Righi, who led the modeling effort for the debris event and is intended as a technical resource for any future modeling efforts.

In order to predict the likely source area for the observed debris, the General NOAA Operational Modeling Environment (GNOME) was used in a hindcast mode to generate possible debris trajectories. GNOME is a Lagrangian particle tracking model that ingests wind and ocean current data from numerous sources in order to predict ocean trajectories. Typically the model is used in spill response to predict where oil (or other chemical releases) will go in order to prevent and limit harm to the environment. GNOME can also be run in a “backwards” mode where the goal is reversed, the origin of an observed pollutant can be tracked back to its likely source.

To provide a useful result, GNOME needs quality data sources for winds and ocean currents, which are the main forces that move something along the ocean surface. For the debris hindcast model run here, winds from the NOAA North American Mesoscale Forecast System (NAM) and ocean currents from Naval Oceanographic Office Hybrid Coordinate Ocean Model (HYCOM) were used. The NAM wind model is developed and run operationally by the National Weather Service and provides wind direction and magnitude on a three kilometer grid every three hours. The resolution of the HYCOM model is 1/12 of a degree, which at the latitude of this study is approximately 4 kilometers. HYCOM provides surface ocean velocities at three hour intervals. The last mover used by GNOME is a horizontal diffusion used to represent wind and current energy at scales smaller than that resolved by the forcing models. In GNOME this is implemented as a random walk diffusion approach, with a scaling of  $105\text{cm}^2\text{sec}^{-1}$ .

One of the important parameters that must be defined for a GNOME trajectory model is the windage (sometimes called “leeway”) used for the particles being transported. Windage controls how much a particle floating on the ocean’s surface is affected by the wind pushing on it. A particle with a higher windage will be moved more by the wind. To understand this, consider a floating chunk of polystyrene: since it is light it will float high in the water and be moved more by the wind. A heavier object will float lower in the water and its movement will be less influenced by the wind. For the trajectory results presented here the types of debris observed were varied, so a windage value of 3% was chosen as a median value. GNOME model runs with higher and lower windages (2-5%) were also undertaken. Results for these trajectories were slightly different, but still showed possible source locations to the west and south of Saint Lawrence Island towards the Gulf of Anadyr.



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