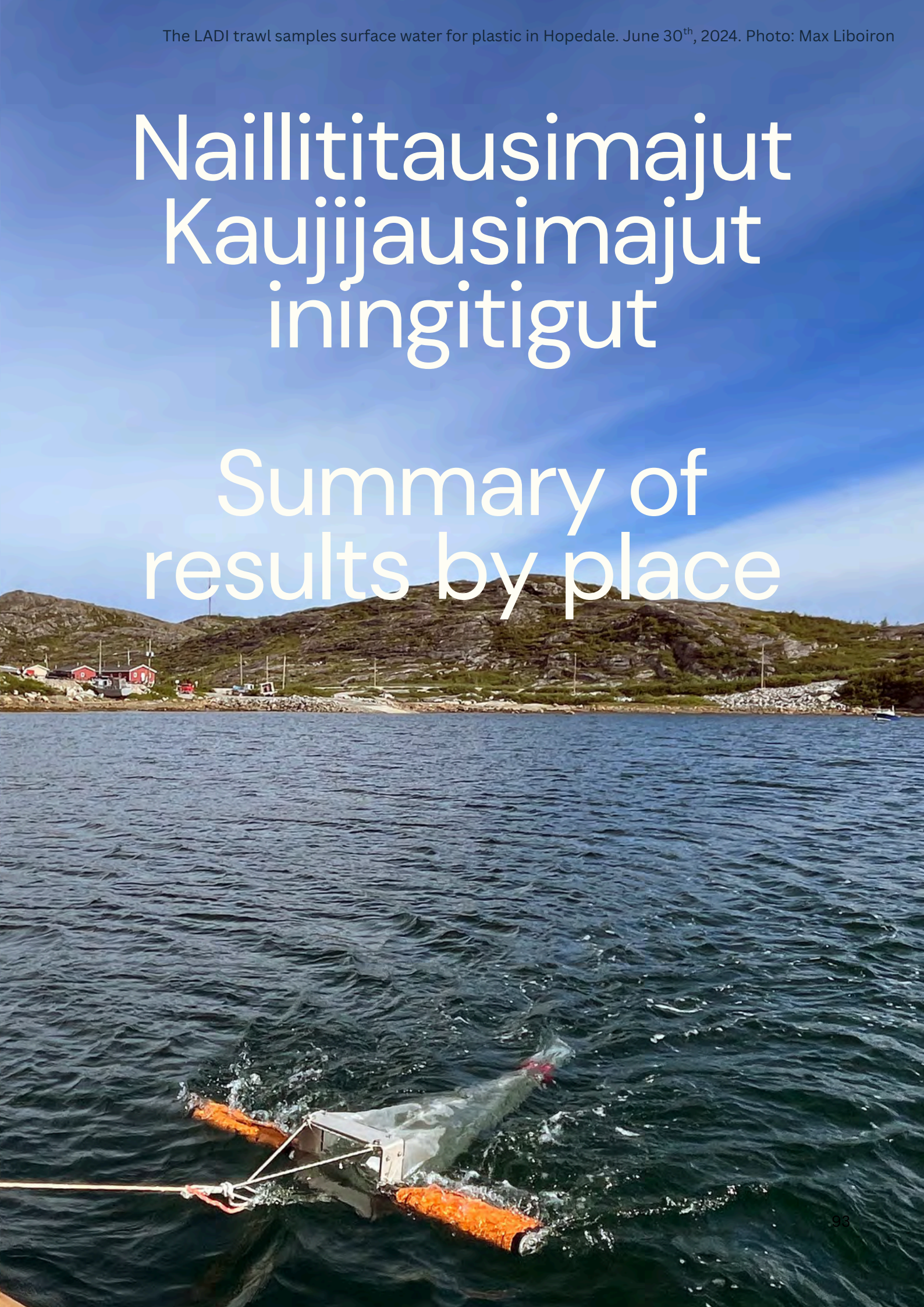


The LADI trawl samples surface water for plastic in Hopedale. June 30th, 2024. Photo: Max Liboiron

Naillititausimajut Kaujijausimajut iningitigut

Summary of results by place

Place matters to analysis. Not only are there different land uses, currents, wind patterns, and historical events in different places, but where and how we do research within a place influences the study. It's why are are careful with averages and presenting disaggregated data.

The influence of place on research findings is clear in the visualization on the next page (Fig. 10). In Rigolet, the unusual number of metal items are over 2,000 nails we picked up from one spot by Jacqueline Winter's house, where someone used to build and take apart boats. If we had stopped sonner, or not worked with Jacqueline, the results would be different. Likewise, the high number of paper and lumber items in Rigolet are from us using the boardwalk to count waste items– the cut ends of the boardwalk were left along the walk, and we counted them since they are technically waste items.

Below, photographs show different types of plastics found in surface water in different areas. You can see they are similar within a place, and different between them, indicating that the source of plastics in that area and at the time of sampling is different.

We always note when there are issues with regional trends or averages because of important differences between places.

Left to right: images of microplastics from Hebron, Saglek, Makkovik, and Nain Bay under a microscope with a dime for reference. Photos: Riley Cotter and Max Liboiron.

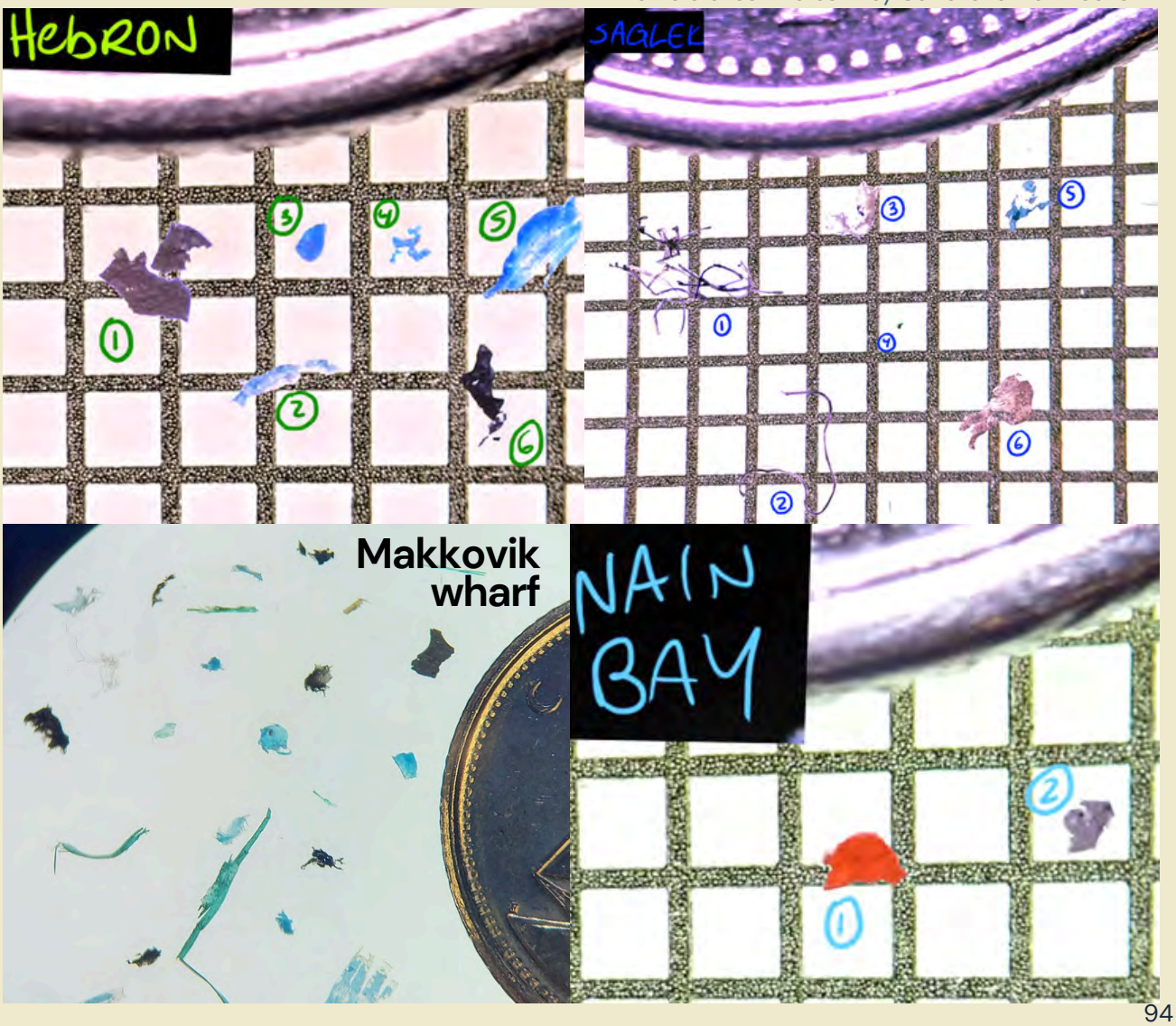
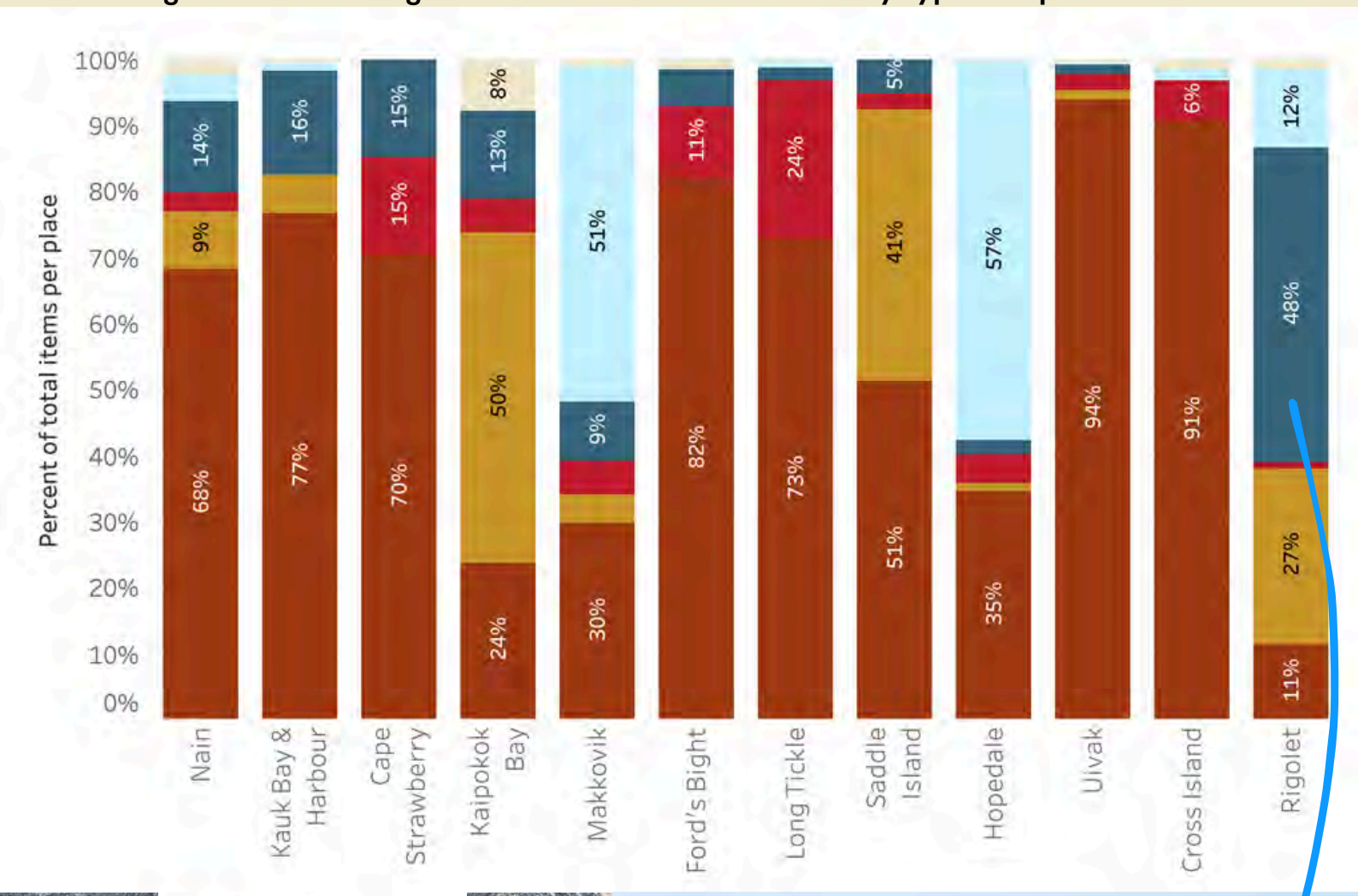
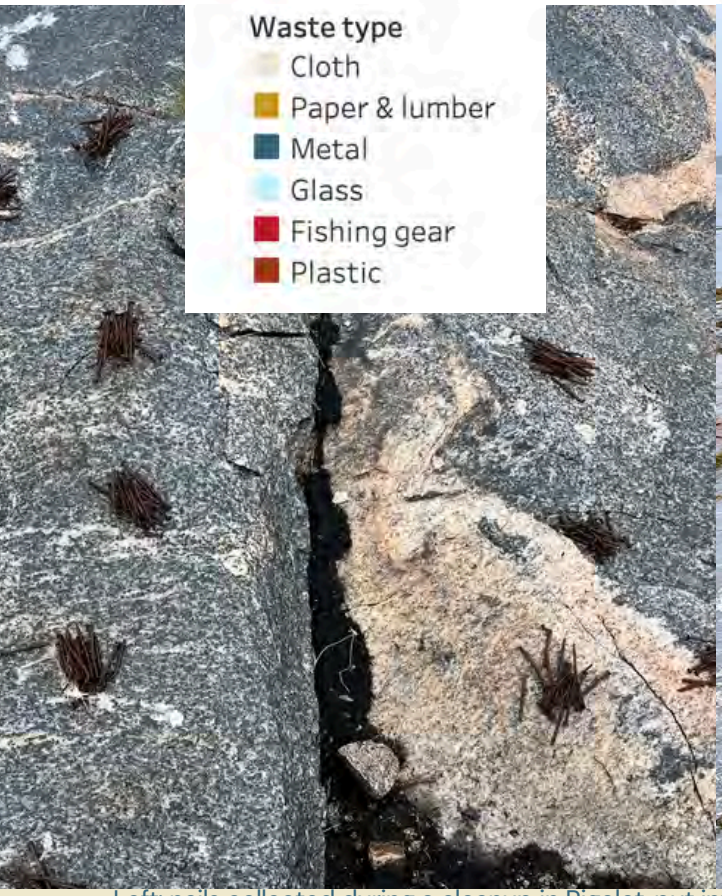


Figure 12: Percentage of waste items on shorelines by type and place



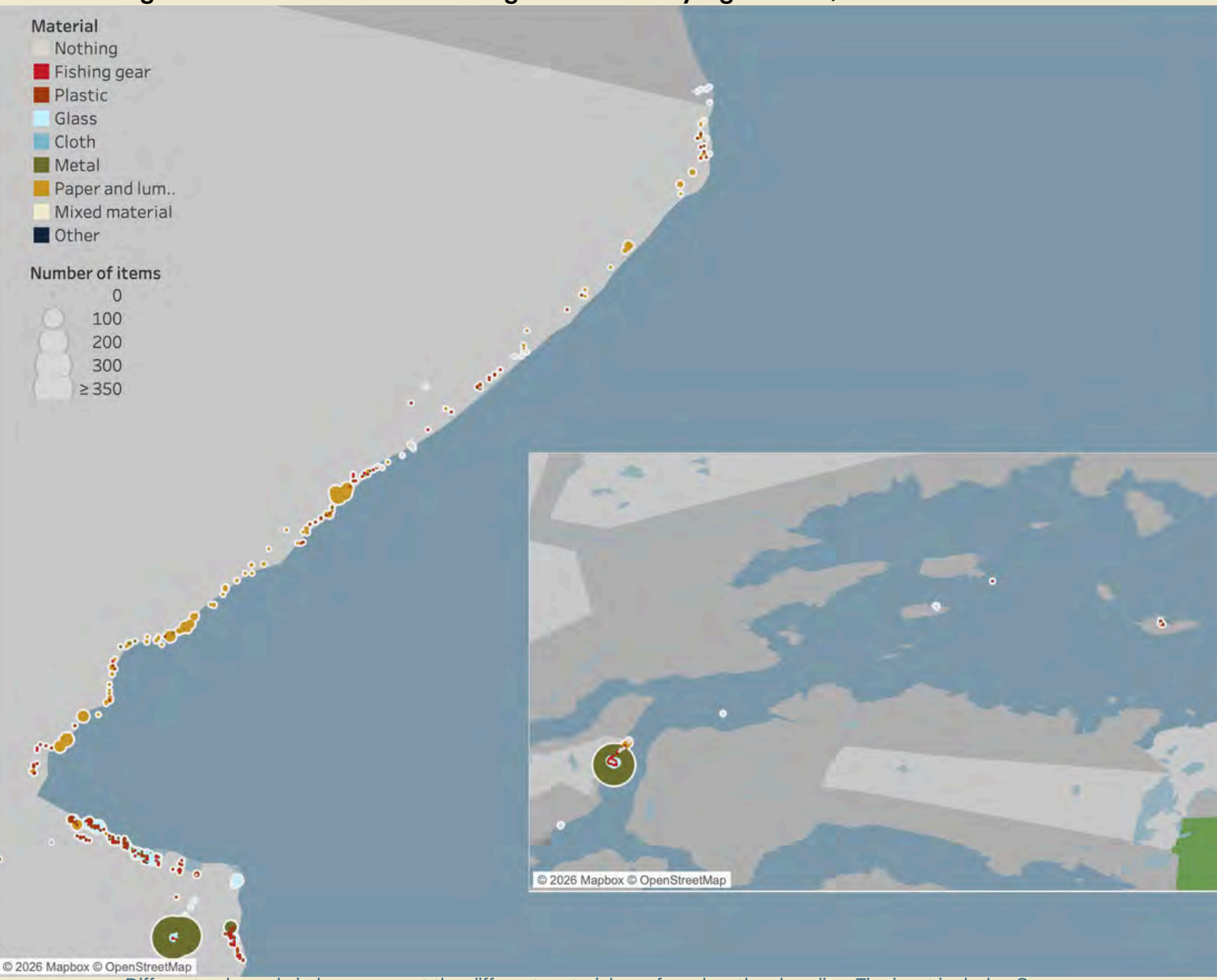


Left: nails collected during a cleanup in Rigolet, put into piles of 100. Right: Mylo, Liz Pijogge, and Jacqueline Winters collect nails in Rigolet, 2024. Photos: Max Liboiron.

Kikiak/Rigolet

There is a clear relationship between debris and land use around Rigolet (Fig. 11) Both plastic and glass are most concentrated near the community and decrease with distance, which is expected and reflects that waste shows up where people live. The high proportion of shoreline metal in town compared to other places in Nunatsiavut is because we cleaned the shore near Jacqueline Winter's house, where boats had been built and burned, leaving behind thousands of nails. Higher amounts of lumber are because we counted all human-made items along the boardwalk, where we found scraps from the boardwalk's construction.

Figure 13: Shoreline waste in Rigolet and outlying islands, 2024

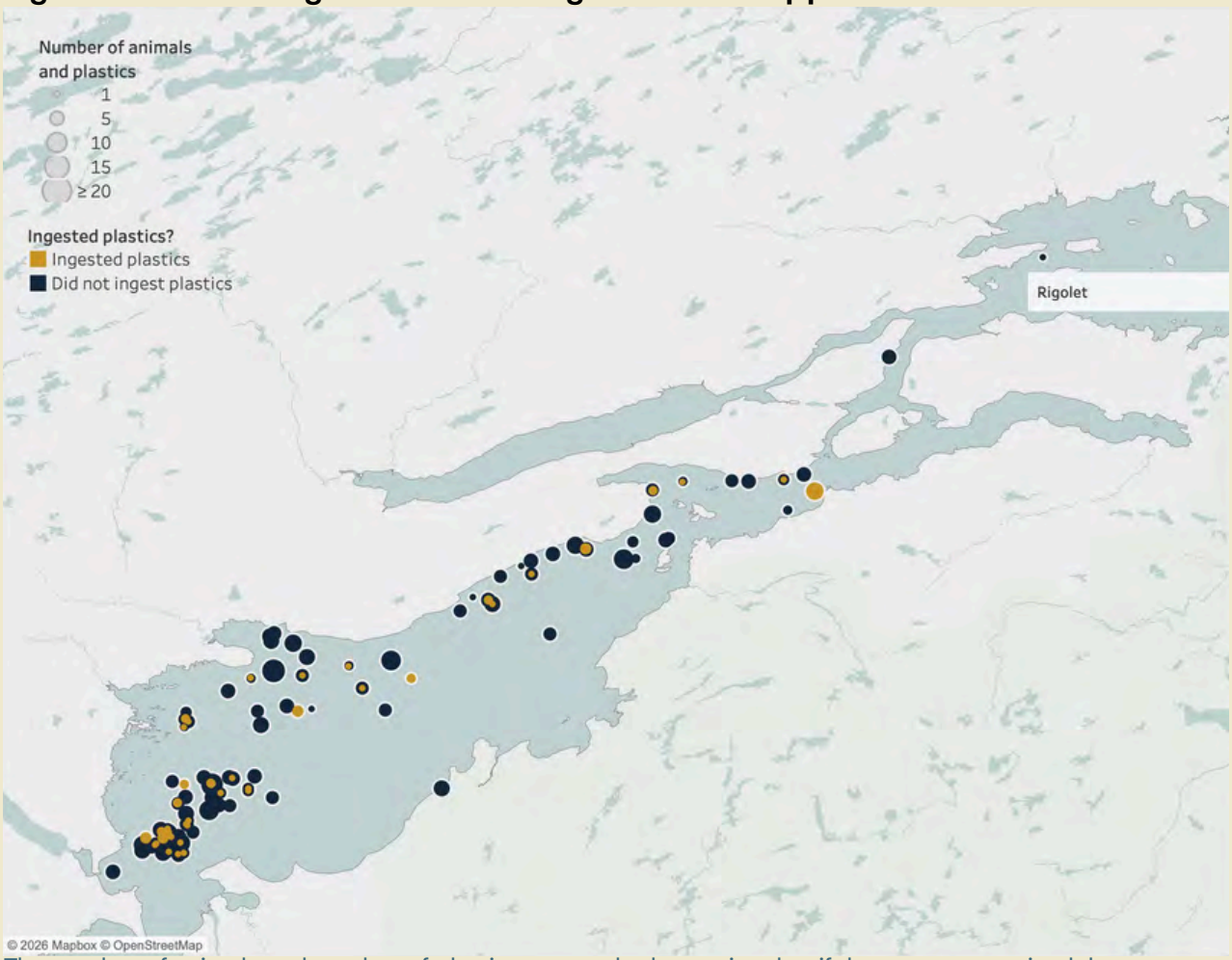


Different coloured circles represent the different materials we found on the shoreline. The inset includes Cross and Saddle islands, which had fewer plastics than around Rigolet, as expected.

Tessiartosoak/ Upper Lake Melville

More than half the Ringed seals from this study are from Upper Lake Melville. Most contained no plastics (62%). And even though the Ringed seal with the highest plastic count, in the study (7 pieces), was caught at Peter's Lewis Island near the mouth of the inlet, all plastics were microfibres the size of a piece of dust. More notably, threads from fishing gear were only found in seals caught closer to Goose Bay than to Rigolet. The seals caught by David Wolfrey from around Rigolet were comparable to the seals from caught in other parts of Nunatsiavut: around 35% of them had eaten plastic, most of which were dust-sized microfibres. The higher proportion of microfibres in Upper Lake Melville (52% compared to 39% farther north) suggests that wastewater is a key source of microplastics.

Figure 14: Plastic ingestion from Ringed seals in Upper Lake Melville



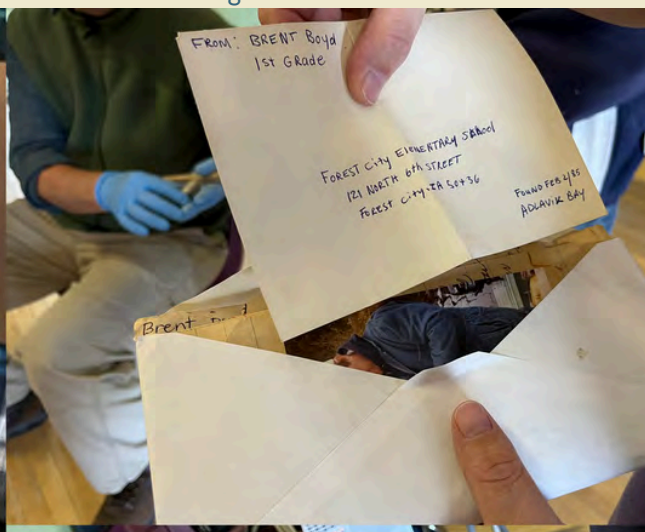
The number of animals and number of plastics are stacked, meaning that if there was one animal that ate one plastic, the yellow point would completely cover the black point, and if one animal ate two plastics, the yellow point would be twice as big as the black one. The yellow dots are the total number of plastics ingested, so even if only one of the animals ate several plastics, all the plastics would be represented.

Maggovik/Makkovik

There were two notable findings from around Makkovik:

First, as many community members told us, farther out from the community around places like Long Tickle, large amounts of come-from-away plastics wash up on shore. We did not see similar patterns in other places we looked, like Rigolet, though we may not have gone out far enough. People like Tony Andersen, Holly Andersen, and Errol Andersen showed us the items they'd found that came long distances, like a buoy from Kuujjuak, Nunavik (Errol), wooden toy boats (Holly), and drift cards (Tony). Tony even found a balloon that had been set adrift as part of a school project by a child in Iowa (see below)! We also found items from Greenland, Russia, and even Italy, on the shorelines around Long Tickle (opposite page).

Balloon from Iowa that drifted to Makkovik, found by Tony Andersen on skidoo trip. He wrote to the school boy who released the baloon. August 2023. Photo: Max Liboiron.



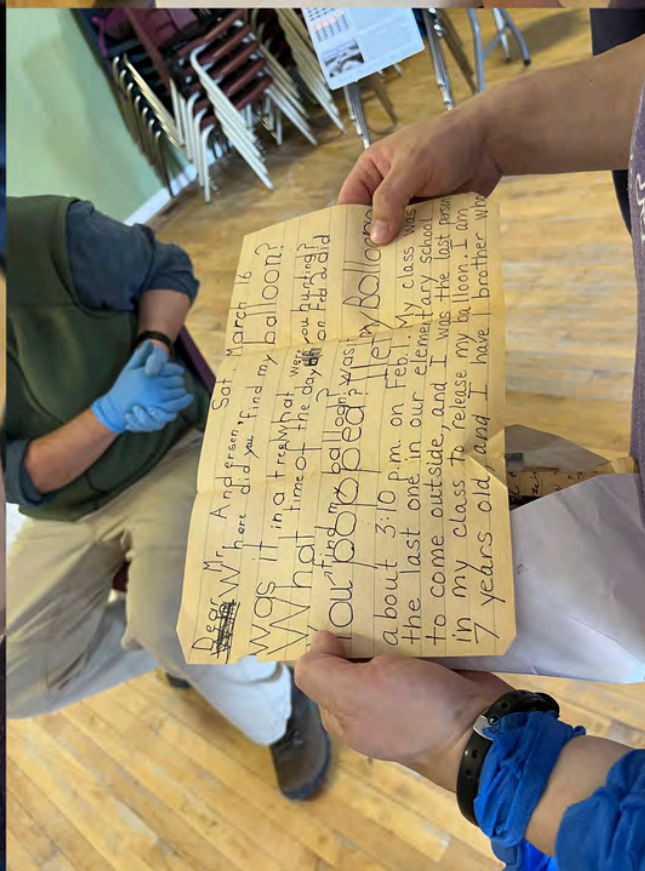
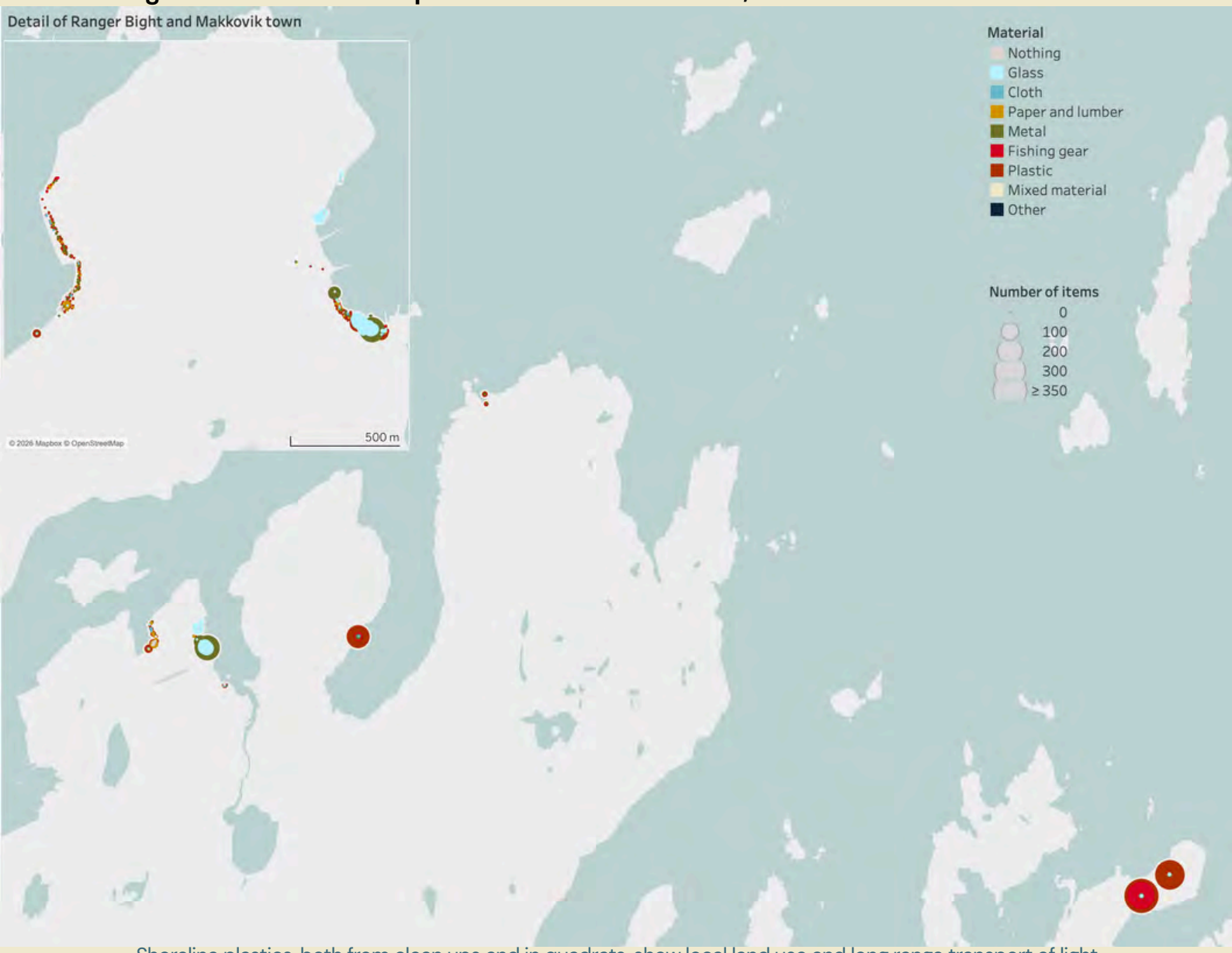


Figure 15: All shoreline plastics around Makkovik, 2021-2023



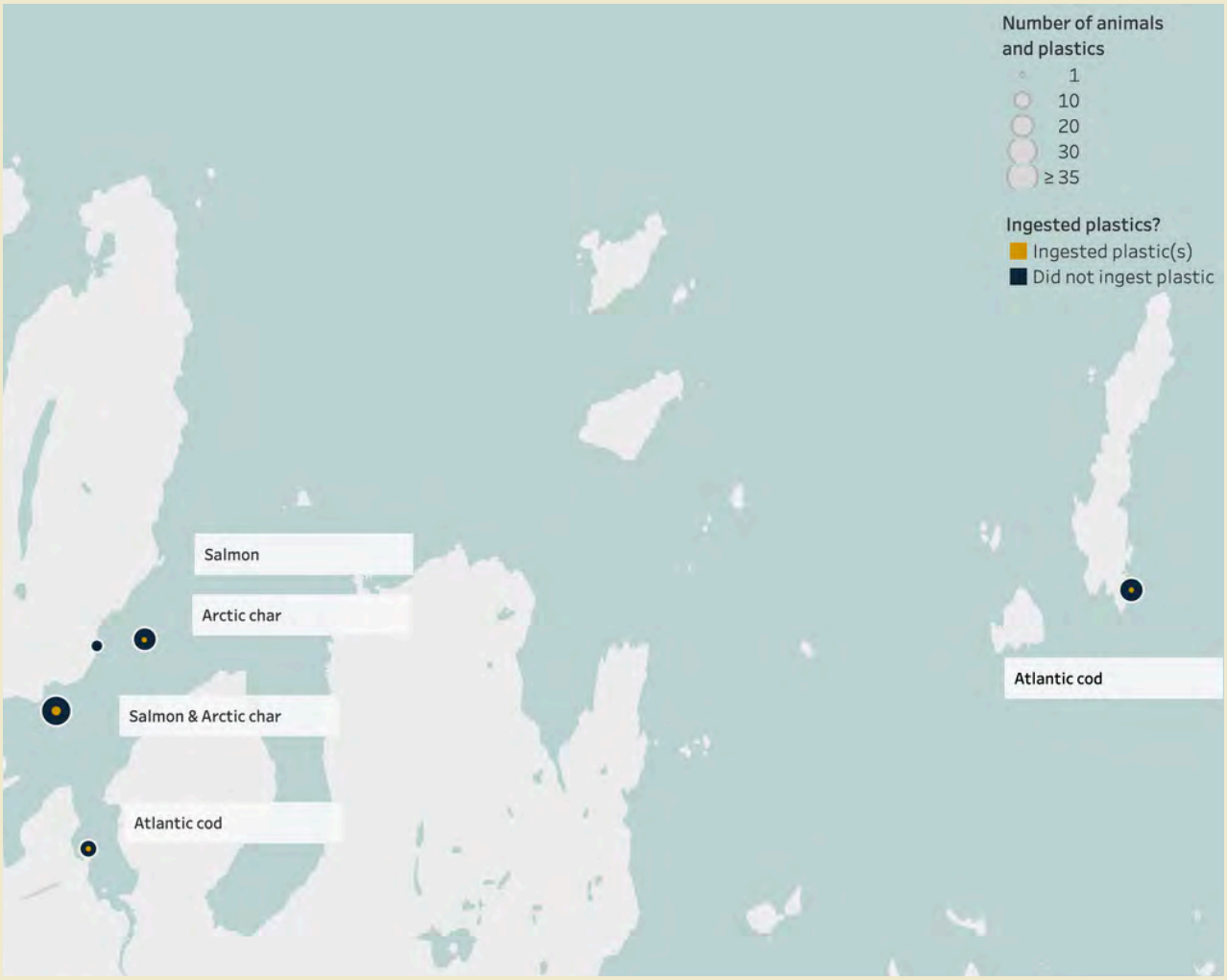
Shoreline plastics, both from clean ups and in quadrats, show local land use and long range transport of light and long-lived items influence on shorelines. In town, there is a lot of glass and metal, showing long-term human activity related to building and food preparation. While Makkovik and Ranger Bight had similar proportions of plastic, Ranger Bight had almost no glass, indicating a different history of sustained human habitation. Ranger Bight also showed a higher proportion of metal, largely from tin cans. Long Tickle, an outlying and north facing island, there is a build up of long-lived plastics (including items from the 1960s!).

Left: Buoy found by Errol Andersen, which he tracked to a beluga hunter in Nunavik. Makkovik, 2023. Right: Liz Pijogge shows a lid from "Faxe Kondt" a type of soda pop that is only sold in Denmark and Nordic countries, including Greenland. 2023. Photos: Max Liboiron.

the second interesting finding is that the wharf is a site of plastics entering the bay (Fig. 14). Many studies find that wharves are a source of plastics the water (Morrise et al, 2016; Han et al., 2019). In Makkovik, we found a high presence of fragment plastics near the wharf (79%) compared to only 51% in all surface waters. We also noticed that a high proportion of plastics near the wharf were melted (50% compared to 12% in all the rest of Nunatsiavut's surface waters outside of Makkovik), meaning burning plastic might be a particular contributor in the Makkovik area.

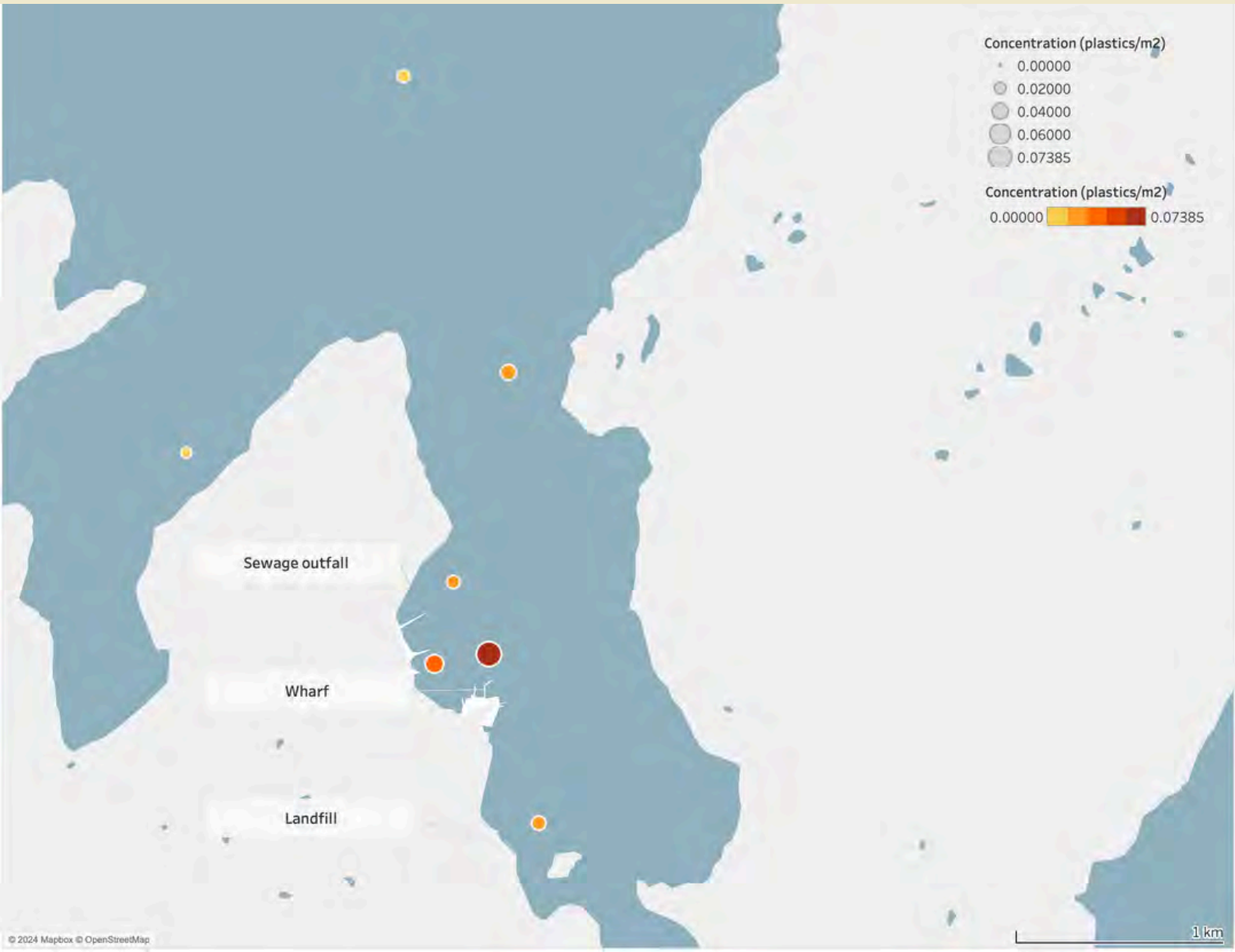
These environmental patterns do not directly relate to fish ingesting plastic. Most animals near Makkovik (salmon, Artic char, Atlantic cod, and rock cod) ingested no plastic (Fig. 14). We don't have a large enough sample size to draw species specific conclusions in the area. Thank you to Luke Lucy-Broomfield and family for catching most of the fish we got from the Makkovik region!

Figure 16: Number of animals sampled (black) and number of ingested plastics (yellow) around Makkovik

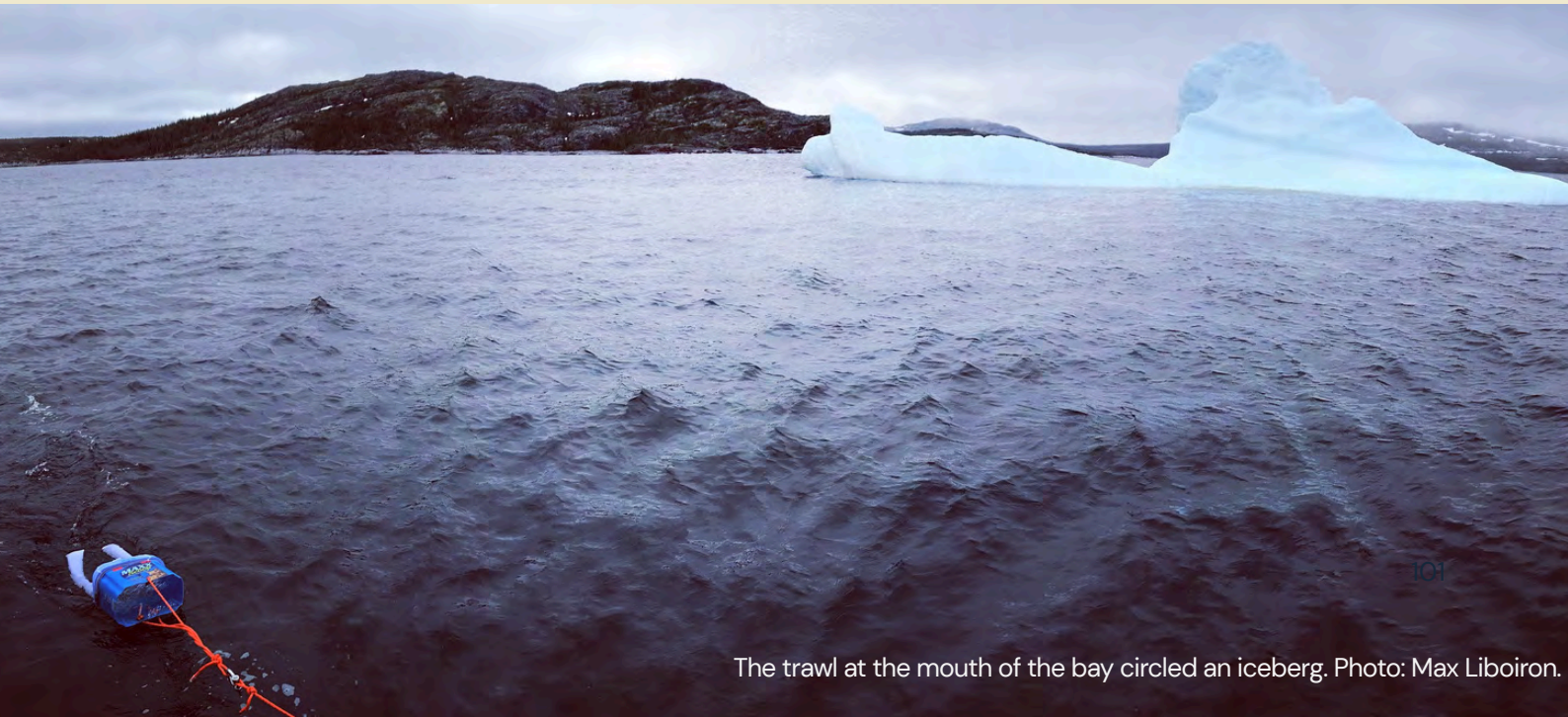


The number of animals and number of plastics are stacked, meaning that if there was one animal that ate one plastic, the yellow point would completely cover the black point. The yellow dots are the total number of plastics ingested. Most of the fish caught around Makkovik did not ingest plastics. Rock cod were caught in the area, but are not mapped because we do not have map coordinates for those particular fish.

Figure 17: Surface plastics around Makkovik, 2019



The surface water plastics around Makkovik show a clear pattern, were plastics near the wharf are the highest, followed by plastics in the bay. As we moved farther out into open water, plastics decreased on concentration.



The trawl at the mouth of the bay circled an iceberg. Photo: Max Liboiron.

Agvitok/Hopedale

In Hopedale, shoreline we looked at waste patterns in town and outside of town. Since Hopedale has been inhabited for a long time, glass was most concentrated near town, particularly along the northeastern end of Water street. Moving West toward the airport, plastic became more common. Most of the quadrats on Top Pond found no plastics (see Fig. 17 grey dots). The items that were found near Top Pond were mostly plastic.

Figure 18: Shoreline plastics around Hopedale (clean up and quadrats), 2024

Elizabeth Tuglavina collected samples around Hopedale because community members wanted to know whether there were plastics in freshwater. As she predicted, there were more plastics in the pond that was a US dump site, and the less plastics in Top and Bottom Ponds. In Shetniq, Bottom Pond, and Third Pond most samples included anthropogenic cellulose fibres, such as cotton microfibres from clothing, but there were very few overall. We didn't notice any direct link between Top Pond's shoreline and what we found in the water, although we'd still expect plastics from the shoreline to get into the water.

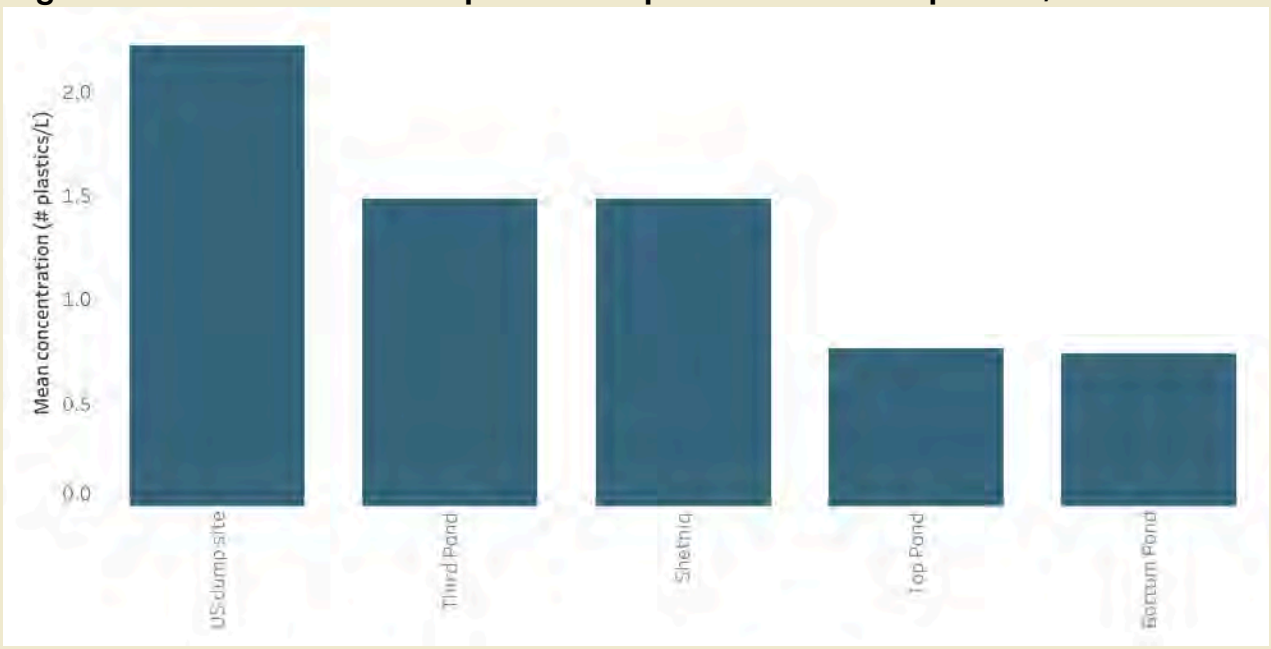
The plastics at the dump site were similar morphologies and polymers suggesting that dumping activity is not especially impactful on the plastics found in the pond and may just have more run off or activities there. The method we used to isolate plastics could account for any plastic larger than 0.45 microns (0.00045 mm).

Table 14: Baseline of plastics in pond water in Hopedale, 2024

Location	Sample size	% samples with no plastic	Total # of plastics	Minimum # of plastics	Median # of plastics	Maximum # of plastics	IQR of # of plastics	Median concentration (# plastics/L)	Mean concentration (# plastics/L)	SD of the mean concentration	Smallest size of waste material (mm)[a]	Total # of non-plastic waste materials
Top Pond	6	67%	2	0	0	1	0.75	0.0	**0.76**	1.18	0.03	1
Third Pond	3	67%	2	0	0	2	0.75	0.0	**1.48**	1.48	0.01	1
Bottom Pond	6	67%	2	0	0	1	1	0.0	**0.74**	0.74	0.01	4
Shetniq	3	67%	2	0	0	2	1	0.0	**1.48**	1.48		1
US dump site	3	67%	3	0	0	3	1.5	0.0	**2.22**	2.22	0.01	4
Total	**21**	**67%**	**11**	**0**	**0**	**3**	**1**	**0.0**	**1.17**	**1.94**	**0.01**	**11**

[a] The smallest dimension of the smallest human-made material that would determine the filter size required to capture the particle.

Figure 19: Concentration of plastics in pond water in Hopedale, 2024



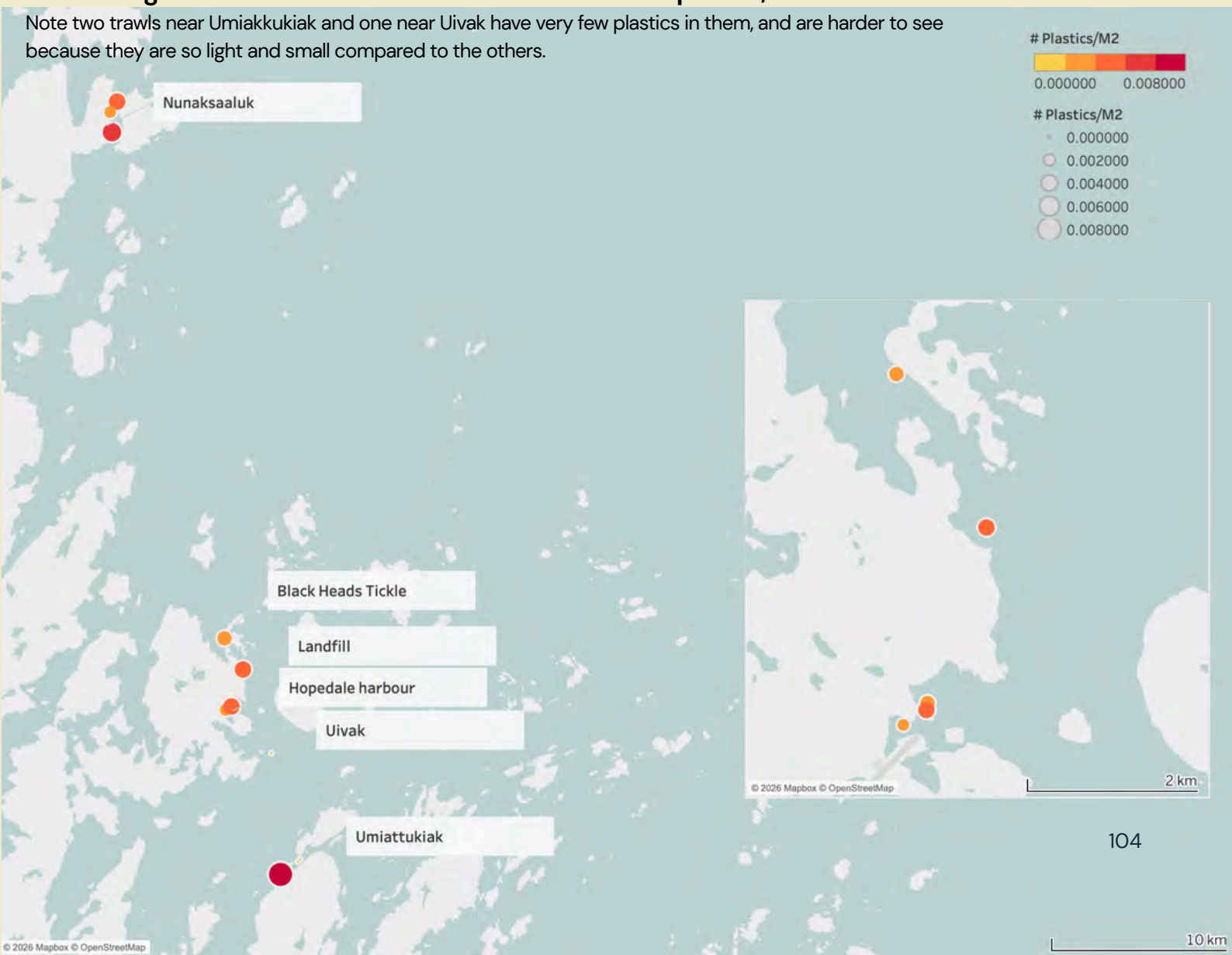
In June 2024, we did a two-day On-The-Land workshop in Uivak, near Hopedale. During the workshop we conducted two shoreline cleanups, one in North Uivak and one in South Uivak, and quadrats in South Uivak. We found a variety of items here, but plastics (bottles, wrappers, buckets, etc.) were the most common material. Of the object we picked up 93% were made of plastic. Thank you to everyone who did clean ups and quadrats there!

Following Makkovik, we did one set of trawls in the bay close to town, and another set in the water near the landfill. Ian Winters designed a comparison of two places known for fishing in opposite directions of Hopedale. Surface water near Nunaksaaluk showed plastic concentrations similar to those found close to town, which is unexpected given that levels typically decrease with distance from communities. Notably, a high proportion of polypropylene was identified there, although the particles varied in morphology and colour. Surface waters near Umiattiguiak contained almost no plastic. The debris distribution can change over relatively short distances, depending on currents or sources. Providing place based analysis, even within one region, helps us show these differences.

The low concentration of plastics in the water near town surprised us. For reference, the average concentration of plastics in Hopedale was about 87% less than in Makkovik (5 plastics per NHL hockey rink on average compared to about 38 on average in Makkovik). This suggests that less plastic enters the open waters of the harbour from activities in Hopedale, and/or that they are swept to sea faster.

Figure 20: Plastics in surface water around Hopedale, 2024

Note two trawls near Umiakkukiak and one near Uivak have very few plastics in them, and are harder to see because they are so light and small compared to the others.



KipukKak/Postville

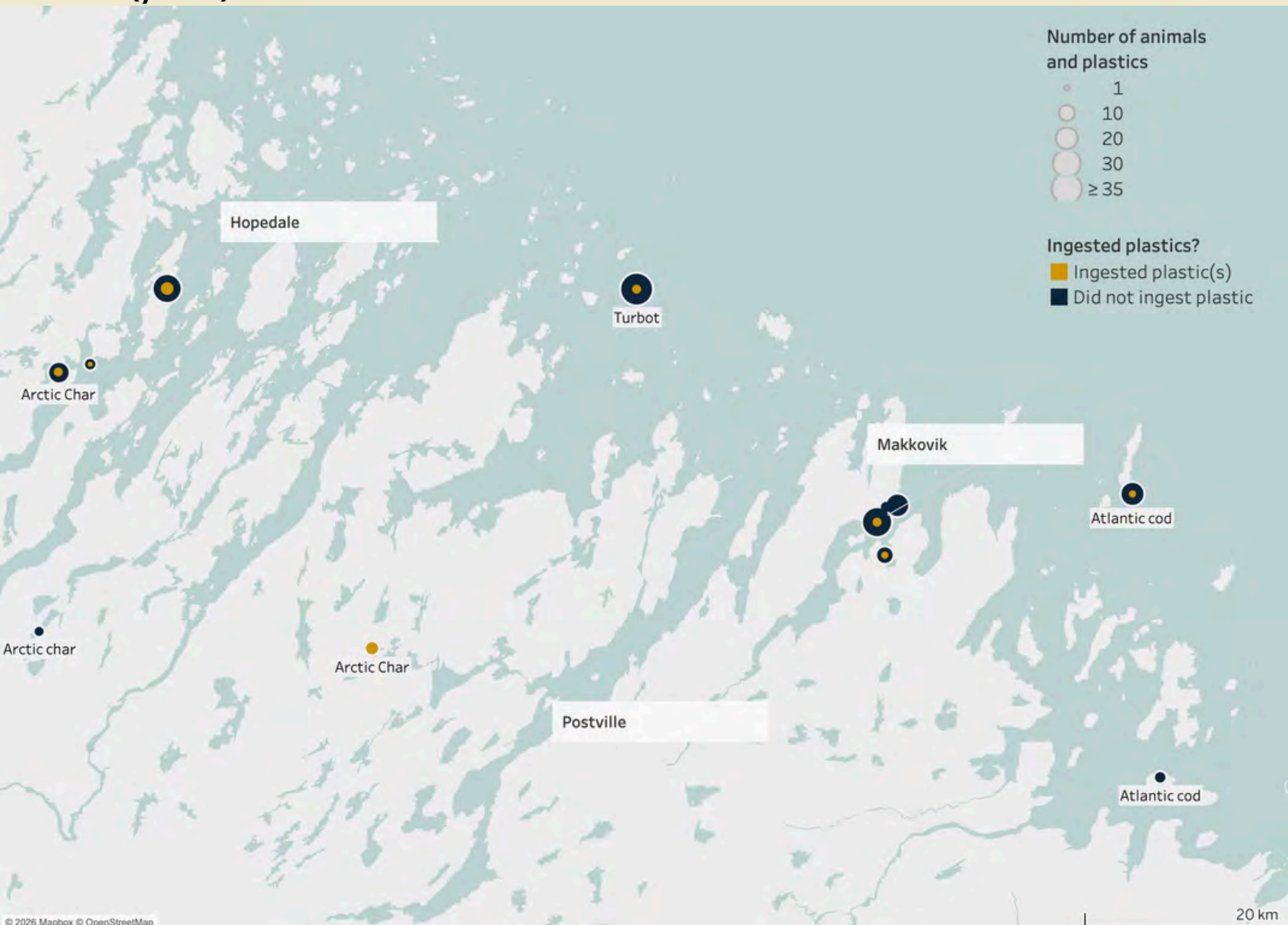
We recommend that sampling efforts focus on Postville next because our project ended before we could do significant sampling in the area. However, we do have sampling from the broader area.

In Kaipokok Bay, only a few items were recovered on the shoreline: a mix of materials, including plastic, lumber, and ceramic. There is no clear patterns or dominant trends.

Reuben Flowers provided samples of Arctic char and trout from Kittaujâluk in 2024. One of the char that ingested plastic had four fragments. This is relatively high given our other findings for char in Nunatsiavut. Three of these fragments were yellow acrylic, likely all from the same unknown source, and one was grey alkyd, which originates from paint. Another char ingested a brown thermoplastic urethane fragment which can also originate from many different things, from power tools to sporting goods. In this study, it is strange to find these kinds and numbers of plastics in freshwaters. Due tgo the oddity of these findings we recommend further studies in Postville.

Malcolm Wolfrey provided 33 turbot from the commercial fishery around Striped Island in 2019, and only 3 of them (9%) ate any plastic, and none of them ate more than one. There was a paint chip, a polypropylene fragment, and a microfibre.

Figure 16: Number of animals sampled (black) and number of ingested plastics (yellow) around Postville



Nunainguk/ Nain

More than 40% of all the animals we have for this study are from around Nain, most of which ingested no plastic. However, we found two particular birds that had unusual contaminants near Nain: a Hound duck from Whale Island that ate a toxic cigarette butt (Fig. 20), and a partridge from Itillak with a high concentration of lead in its system, almost certainly from eating a lead shotgun pellet since there is no other ways for the bird at that stage of life to have those kinds of levels. These are very unusual birds—only two out of hundreds. For both of these instances, we are sure that the source of the contaminant was local.

In Nain, microfibres were the most commonly ingested material for most species, regardless of location. These are as small as a piece of dust and easy for animals to poop.

Figure 21: Plastic ingestion by animals around Nain, 2017-2025

The black circles are the number of animals and the yellow are the number that didn't eat plastic. They are stacked, so whenever the black circle is larger, more animals did *not* eat plastics.

There are two places where plastics from fishing line stand out:

1. a thick-billed murre ingested multiple long, green polyethylene threads;
2. and Paul Island had an unusually high number clear polypropylene threads in surface water.

The further we moved from town the less platics we found on the shoreline. The concentration of shoreline plastics around the Illusuak Cultural Centre was 18.8 microplastics per square meter, one of the highest in this study, while in Kauk Harbour it was an average of less than one plastic (0.35) per square meter, and in Kauk Bay there were no plastics found in eight quadrats. At the base of Mount Sophie, we noticed an increase of mixed debris, including glass, plastic, and metal, likely due to materials blowing or floating and getting stuck. Below the dump, there were a high number of paper and film plastics that blew out (from 2017-18, before the nets were put in).

Cigarette butt retrieved from a Hound duck photographed under the microscope. It was about 2 cm long, around the length of a paper clip, which, compared to the other plastics found in this study, is pretty big! caught in 2023 and processed in 2024. Photo: Riley Cotter

Figure 22: Shoreline waste around Nain, 2017-2025

This data includes both clean up items and quadrats. Quadrats can produce zero plastics, and those are marked in grey in Kauk Harbour and Bay. You can tell which way the wind blows in Nain from the higher number of plastics against the shore under Mount Sophie near town, and on the south side of Kauk Harbour. The further from town, the fewer plastics found.
You can see the lower concentrations of plastics in Kauk Harbour and Bay compared to near town.
Special thank you to Frédéric Dwyer-Samuel, who took Max on an extremely long walk to do quadrats around Kauk Bay and Habour with Max.

Tongait/ Torngat Mountains

As expected, the Torngat Mountains showed the lowest overall levels of plastics in Nunatsiavut. On shorelines, it had the highest proportion of quadrats with no plastic (96% compared to 87% in the overall study), the lowest average concentration of plastic per quadrat (0.19 plastics/m^2 compared to 0.8 plastics/m^2 across all of Nunatsiavut; about 20 times less!). Nearly all sampled Arctic char contained no ingested plastic (out of 38 char, only 3 ingested plastic, about 8% compared to 26% in the overall study).

However, plastics were found, in Eclipse Harbour, the most northern place studied. We identified a hotspot in surface waters near Eclipse, where a trawl sample contained a high concentration of fishing line. This was somewhat unexpected given that there is less fishing activity in that area compared to somewhere like Nain Bay where we found no fishing line. It is possible that plastics might float to Eclipse and accumulate there, but Liz also says that fishing boats might stop in the area on the way to Iqaluit.

With such low overall levels, areas with more plastic became very noticeable. For example, both shoreline and surface water samples contained higher concentrations of plastic near Saglek than in other areas in the Torngats. This supports the conclusion that more plastic accumulates near places humans live. However, over four years of sampling, the plastic levels were similar indicating that plastic was not likely accumulating over time in the Saglek area. And despite the presence of plastics in Saglek, only 2 of 24 fish from there (8%) ingested plastic, a black fragment smaller than 1 mm and a microfibre. In Nachvak, the only other place where we have char from the Torngats, 1/11 (9%) of char had eaten plastic, and it was a green fragment, also less than 1 mm.

Liz Pijogge having her coffee while trawling surface water in the Torngats, 2020. Photo: Paul McCarney.

Figure 23: Map of plastics ingested by species in and around the Torngats

The yellow dots are animals that ate plastic and the black dots are animals that did not ingest plastic.

Figure 24: Map of surface water plastics in the Torngats

Statistics determined that there was not a trend in plastic concentrations closer to basecamp in Saglek, though there are some higher concentrations there. The highest concentration of plastics in the Torngats is from one trawl in Eclipse Harbour. Some of these plastics are shown in a miscroscope view inset.