Ikajusimajuk: Nunalimmi-ilinganiKajut kititanikkut Atusimajut PiusiKatlutik

Supplement: Community-based Quantitative Methods

Arctic Char in a bin, n.d: Photo: Eldred Allen

The Nunalinni kamatsianik palastikkinik igitauKattatunik Nunatsiavummi plastic monitoring project recognized that many standard, Western methods of sampling, counting, and doing statistics did not adequately answer most community research questions and priorities.

This report supplement opens the black box of the analytical decisions and behind the scenes moments that informed changes in the quantitative methods we used. It is a companion document to the *Nunalinni kamatsianik palastikkinik igitauKattatunik Nunatsiavummi 2017-2026* report. We intend for this document to be useful to Indigenous communities, researchers, and funders—in all cases, readers who are already familiar with quantitative methods, even if they are not experts in them.

When we say "community-based quantitative methods" we mean methods, based in numeracy and numbers, that were carried out by Indigenous people in an explicit attempt to ensure research addressed community priorities, questions, and understanding. Both PIs are Indigenous, though the main person who carried out statistical analysis, Max Liboiron, is Michif and not Inuit. Liz Pijogge, the Inuit PI on this project, provided testing, questions, corrections, and approvals. The project also used participatory statistics, so multiple community members and Nunatsiavut Government staff, were also part of fine tuning quantitative methods and interpretations, even if their hands were not on keyboards.

A few notes about our overall approach to methods:

1. **Place-based versus generalization:** The methods we discuss here are designed for Nunatsiavut, and are specific to that place, people, and activities. However, the approach speaks to underlying principles of Indigenous quantitative research. In short, we don't expect our solutions to generalize to other places, but we do think the problems and questions that led to our solutions will.
2. **Ongoing development:** Many of the examples in these annotations are part of an iterative process. That means we tried something and it didn't work. And sometimes the next thing we tried didn't work, either. Some of these methods are still "good enough" rather than "good." We've flagged that whenever possible.
3. **Wild food priority:** We always talk about animals/wild food first and most often in all our analyses, and that type of sampling has the most attention in our methodological adjustments. This is because it was always, always framed as the most important focus of the study. Knowing that wild food is safe to eat was always our central message, and the methods followed this imperative.

Each section talks about how Western science traditionally analyses data and how our methods needed to shift to meet community priorities and center local knowledge. These shifts fundamentally changed the method to practice or create an Indigenous quantitative method, even when we retained some or all Western components. As Walters and Andersen state in their work *Indigenous Statistics*: "while the dissimilarity of the standpoints will necessarily result in divergence between Western and Indigenous quantitative methodologies, this difference should not be conflated with the reverse: to differ from Western quantitative methodology is not the same as opposing it. Nor, as is the practice in much of the current discussion of Indigenous methodologies, should difference from colonizer settler methodologies sit at the core of what makes Indigenous methodology Indigenous" (2013: 73). This statement follows to the discussion of Indigenous quantitative methods.

HOW WE CHOSE SAMPLE SIZES FOR ANIMALS

Most of our samples came from animals that hunters brought us or were shared in the community freezer (see Figure S1 opposite page). The animals we selected to study were chosen because they were brought to us. For example, we thought we might look at Long tailed ducks, but hunters didn't bring us any so we didnt study them. And we added Thick billed murre because these were commonly hunted and eaten.

Sample size–the number of animals from one species, or number of trawls in one area–is important because you need enough samples to be confident that the patterns you find are real, rather than the result of chance. If you flip a coin three times and it comes up heads each time, you may make an error and conclude that the coin has heads on both sides. The more variable the thing you are studying is, the more samples you need. For example, if some animals had zero plastics and some had 50 and there was no real average, we'd want to sample more to see what is happening. A common starting point is 30 samples, but that number may increase or decrease depending on how much variation is found.

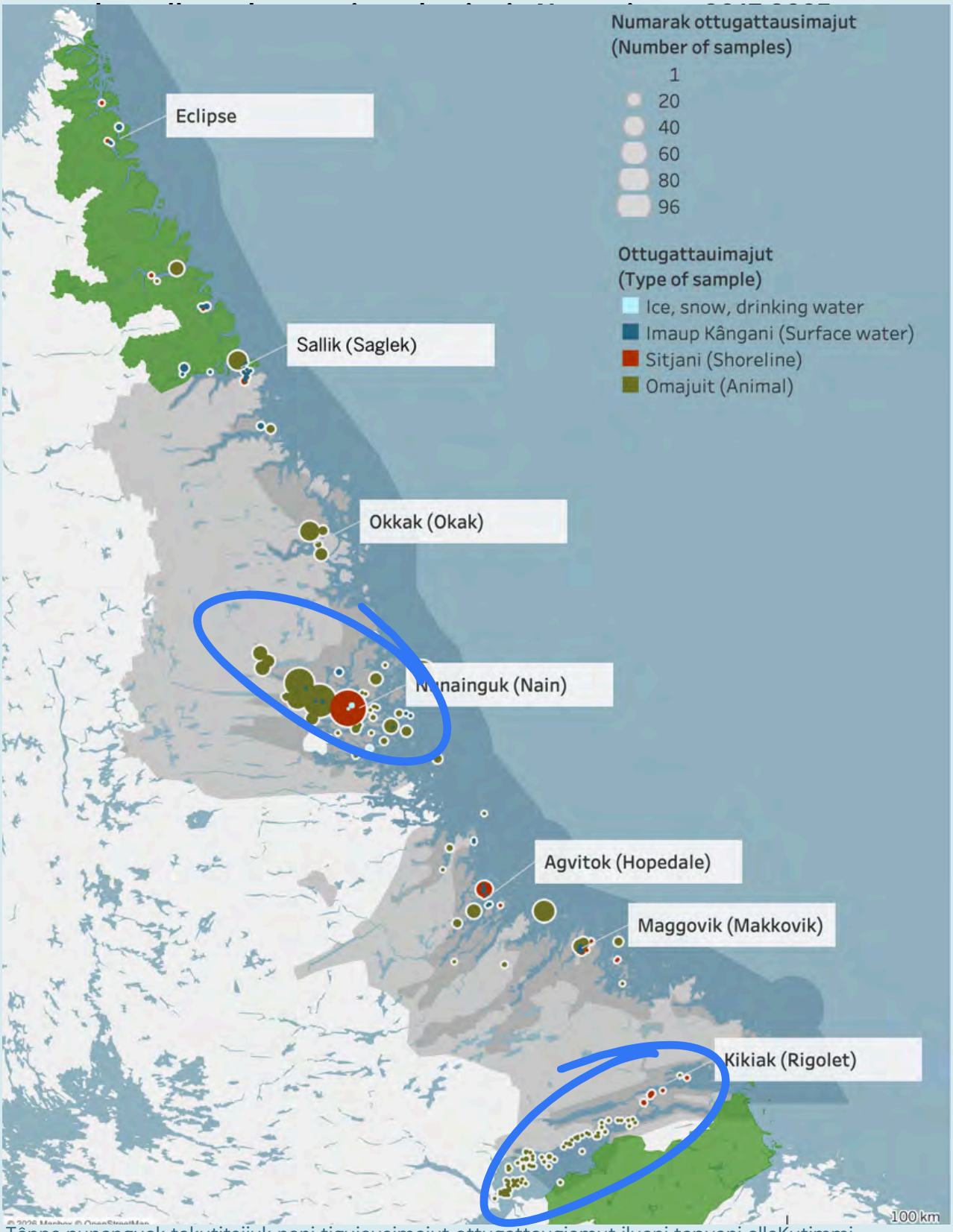
This is the logic we used to include or exclude findings from analysis– if sample sizes seemed too small to be sure of the results, we left them out of analysis, but still included them for context.

There are also some grey areas. For example, for Common eiders, we had a sample size of twenty-four (24). Three components led to the decision to include Common eider with a sample size of less than 30:

- Community Priority: The Eider Duck is a common source of food–common enough that we had 24 of them.
- Variance: Variance tells us about how much things differ from the average. Low variability means the numbers are pretty similar and we can be confident they are showing us a true trend. For Eider, the standard deviation (or how much the average Eider varies from the "average" Eider) is 0.88. This means that most eiders ingested less than one plastic compared to the average. That's low variance. So we include the data.
- Morphology: The morphology refers to the type of plastic consumed. Of the plastics consumed, 91% were microfibers. These are the tiniest, lowest weight, and most poopable of the plastics. They are the least likely plastic morphology to cause harm to the animal. Also, 91% is an unusually high percentage, which introduces low variance to the type of plastic, not just the number.

In combination, the high cultural importance, low-medium variance, and low risk due to plastic morphology, we chose to include the Common eider with a smaller sample size.

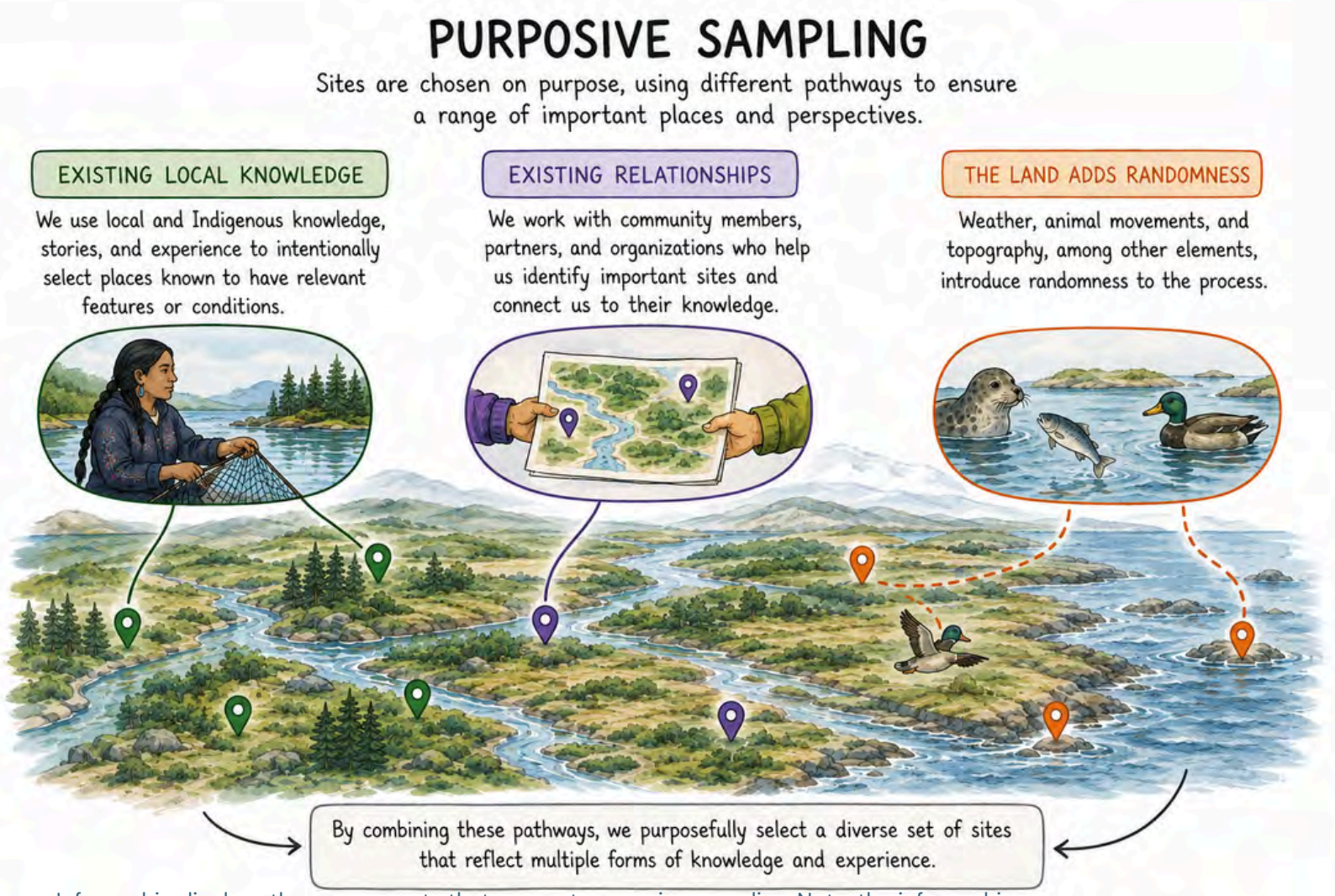
Figure S1: Nunanguak palâstikkinik kamagijaujut Nunatsiavummmi / All



Tânna nunanguak takutitsijuk nani tigujausimajut ottugattaugiamut iluani tapvani allaKutimmi katitsuvigijausimajunut. Angijummaget numarait ammalu Kanuittusuatuinnait tigujausimajut ottugattaugiamut Kanitangani Nainimi tamannauluasimajuk inigijaummat Liz-imut, suliaKapvinga, ammalu sangijumik ataKatiKajuk.

This map shows where samples in this report were collected. It is also a map of relationships. For instance, the large number and variety of samples around Nain are because this is where Liz lives, works, and has strong connections.

Figure S2: Purposive sampling infographic



Infographic displays the components that support purposive sampling. Note: the infographic was made using AI.

Ian Winters (right), with Katrina Anthony (center) and Max Liboiron (left) in Hopedale harbour before Ian decided the best places to go outside the harbour to sample (Nunaaksaluk and Umiattugiak). 2024. Photo: Laura Crick

HOW WE CHOSE SAMPLES FOR SURFACE WATER

Liz Pijogge chose the majority of the surface water locations, almost always because other research was happening in the area. After sampling near the wharf, Hayward Broomfield chose the locations in Makkovik, and Ian Winters chose the locations around Hopedale, both based on where they thought there would be interesting locations to compare to one another. For instance, Henry identified where the landfill blew waste into the water, and the location the fish plant dumped guts. Ian took us to places where people fished, one north of Hopedale and one south.

THE PROBLEM OF CONCENTRATION IN SURFACE WATER

The standard way to count plastics in water is concentration: the number of plastics per volume of water. We first determined whether the flowmeter reading (i.e. the amount of water that the flowmeter told us we sampled) made sense for the amount of time and distance that was trawled. For example, sometimes we had samples taken over 30 minutes, over several kilometres, yet the flowmeter said we sampled tiny amount of water (i.e. 4 m2 of water). This meant the flow meter was wrong. We could have used distance travelled, but on the ocean, distance in a boat doesn't always correlate to the amount of water you sample if you're moving with or against the tide or current. There was nothing wrong with the sample itself, but we had no way to calculate the concentration of plastic, so these instances were excluded from concentration calculations (e.g. Hebron). Instead, we talked about the types of plastics found in these samples.

THE PROBLEM OF AVERAGE IN SURFACE WATER

Statistically, the greatest problem for representing surface water was the average or mean. In Western science, providing the average concentration of surface water over a large area is the norm. But we found that there was large enough variation in one area that an average would be misleading.

We left the wharf in Makkovik out of the regional average concentration, though left it in the summary table (marked in gold in the next image). It's also why we have the standard deviation in that table. We have narrative break out sections talking about the Makkovik wharf and its uniqueness as well. In the summary of surface water sites in Table S3 we have "Makkovik wharf" broken out as its own site, with Makkovik harbour separate, even though the wharf is in the harbour.

Table S3: Summary of plastics in surface water in Nunatsiavut, 2017-2025

Place	# Samples[a]	Samples with no plastic (%)	Mean concentration	Standard deviation +/-	Average/NHL hockey rink[c]
Nain (average)	5	3 (60%)	0.0068	0.0088	11
Nain Bay	2[b]	2 (100%)	0.0000	0.0000	0
Webb's Bay	1	0	0.0083	n/a	13
Paul Island	2	1 (50%)	0.0128	0.0119	20
Hopedale (average)	12	2 (17%)	0.0029	0.0023	5
Hopedale	6	0	0.0033	0.0013	5
Nunaaksaluk	3	0	0.0035	0.0013	6
Umiattugiak	3	2 (67%)	0.0027	0.0046	4
Uivak Point	1	1 (100%)	0.0000	0.0000	0
Makkovik (average)	7	0	0.0278	0.0221	44
Makkovik wharf	1	0	0.0738	n/a	117
Makkovik Harbour	4	0	0.0242	0.0089	19
Outside Makkovik	2	0	0.0118	0.0036	38
Torngats (average)	26	11 (42%)	0.0049	0.0056	8
Eclipse	5	1 (20%)	0.0077	0.0100	12
Saglek	18	8 (44%)	0.0039	0.0041	6
Ramah	3	2 (67%)	0.0060	0.0062	9
Hebron	1	0	0.0052	n/a	8
Total	51	16 (31%)	0.0077	0.0056	12
Nunatsiavut average[d]	**44**	**10 (23%)**	**0.00326**		**4**

[a] We were unable to measure the concentration of plastics in some samples, so the number here indicates the number of samples with concentration data only.

[b] To be sure of our results, we usually only calculate concentrations for areas with three samples collected that accurately measured the volume of water sampled. Given that this is a community report, we summarize all data here, but generally 3 or more samples produce more reliable results.

[c] The number of plastics in a square meter are scientific standards, but the numbers do not make intuitive sense (what does 0.010 plastics in a meter look like?!) so we use the number of plastics in an area the size of an NHL hockey rink instead. It's much easier to think about 17 plastics in a hockey rink. See the section on surface water plastics for more details.

[d] This is the average without the wharf in Makkovik. You can see the difference between this number and the Total in the line above–the "total" is almost double because the wharf in Makkovik skews the data so much. This average without the wharf is a truer number for all of Nunatsiavut.

TO BASELINE OR NOT TO BASELINE?

A baseline is a benchmark. A baseline is a fixed number and how that number was made, that becomes the point of comparison for future monitoring to see if it is getting better or worse. They are created when there is a strong sample size and low variation between places or seasons, so we can be confident the number reflects the overall phenomenon it is supposed to measure.

Not every finding is a baseline. You cannot mix species, since every animal forages differently, in different environments, and each will have its own plastic ingestion baseline figures. Sometimes there are too few samples, too much variation, or not enough geographical coverage.

Sometimes there is a baseline, but it is very specific– such as when all our samples of scallops, Brasswing ducks, Hound ducks, and Dovekies (bully birds) all came from around Nain. In that case, we noted that these are ingestion baselines for animals around Nain, because we don't know if they generalize to other places (see yellow mark up on the baseline table on the next page, which is Table 4 in the main report). We also define what we mean by "around Nain" in the table notes so that future research understands our range. We did the same thing for the baseline of shoreline quadrat data, providing three different baselines: one for all of Nunatisavut, which we flagged as misleading, one for near communities, and one for outside of communities, which are truer baselines since there is always more waste near communities than away, and merging them gives a misleading figure.

We provide two measures of variance in our baseline tables (circled in green on the table on the next page) so that readers can see how the data is spread out, and can make judgments about the variance. If there is notable variance, we indicate that (this was rare).

However, even when there is not enough of a sample size or high variation, we still provide a *summary* (rather than a *baseline*!) of the data. the main reason we had to provide a summary instead of a baseline in this study was because of low sample sizes, so we include the sample size in our tables, and grey out the figures, explaining why they are not part of the baseline in the table caption (circled in blue in the table). After considerable discussion, we left these in because they can still be used for context and decision making by community members. That is, the summaries align with Indigenous data sovereignty, and the right for Indigenous Peoples to govern and make decisions based on their own data, rather than our exclusion of that data because it does not meet our parameters of a baseline.

Finally, in our baseline section of this report, there are a series of summaries of characteristics of plastics (morphologies, size classes, colours, polymer). These are not baselines in the sense of being a line you can measure against, since there are so few plastics– for example, even with 68 Atlantic cod, there are only 10 plastics, which makes it hard to generalize about the types of plastics found, since a single plastic accounts for 10% of the total! Yet we still provided these summaries in the baselines section because our findings and discussions with community members show that the type of plastic, which is aligned with its source, is central to governance and evaluation. While the number of plastics in an area might not change, if the type of plastics changes, that is still crucial information for understanding change.

Table S3: Baseline figures for plastic ingestion by animals near Nain,[a] 2019–2025

Animal	Sample size[b]	# of animals that ate plastic	% animals that ate plastic (%FO)[c]	% animals that did NOT eat plastic	Total number of plastics eaten	Minimum # of plastics eaten	Median # of plastics eaten[d]	Maximum # of plastics eaten	IQR of # plastics eaten[e]	Mean # of plastics eaten	Standard deviation of the mean[f]	Median size of plastics eaten (mm)[g]	total # of non-plastic waste materials eaten[h]
aKiggik (White partridge)	74	18	24.3%	75.7%	26	0	0	3	0.0	0.35	0.73	1.31	11
appak (Thick-billed murre)	40	5	12.5%	87.5%	10	0	0	6	0.0	0.25	1.00	10.26	4
pitsiulâk (Black guillemot)	32	12	37.5%	62.5%	19	0	0	4	1.0	0.59	0.98	0.53	5
Matsojak (Scallop)	32	3	9.4%	90.6%	4	0	0	2	0.0	0.13	0.40	1.37	2
Appaliatsuk (Dovekie)	8	3	37.5%	62.5%	3	0	0	1	1.0	0.38	0.52	1.17	2
angik (Hound duck)	3	1	33.3%	66.7%	1	0	0	1	0.5	0.33	0.58	21.33	1
Pitsuilâppak (Brasswing)	1	1	100.0%	0.0%	1	1	1	1	0.0	1.00	n/a	6.10	0
Nipisak (Lumpfish)	1	1	100.0%	0.0%	4	4	4	4	0.0	4.00	n/a	0.82	0

[a] Animals that were caught between Kamarsuk and Napattusuak, or that were collected from the Nain community freezer, are included as baselines for the Nain region.

[b] The greyed-out rows are for sample sizes that are too small to make a baseline. They should be understood as preliminary findings that show whether animals ingest plastics or not, but not the amount, frequency, or range.

[c] FO% stands for Frequency of Occurrence, the main Western scientific measure for plastic ingestion that measures the percent of animals in a sample that ingested plastic, no matter the size of plastic or how many plastics the animal ate.

[d] The median is an average that is the most central number in a dataset. If the median number of plastics is 0, it means most animals in the study ate no plastics.

[e] The Interquartile range (IQR) tells us about the spread of the middle 50% of data points. In this baseline, an IQR of 0 means that at least three quarters of the animals ate no plastics.

[f] The standard deviation (SD) tells us how far data points are from the mean. It measures variation. When the standard deviation is smaller than the mean, the data points are clustered relatively close to the average, suggesting consistent values. When the SD is larger than the mean, the data is highly spread out (more variation), which often indicates the presence of extreme outliers or that the average isn't a good representation of the "typical" value.

[g] Median length of the longest side.

[h] Like cotton or paper. Non-plastic waste materials are not included in the other summary statistics for plastics, meaning these counts are in addition to the ones in the rest of the table.

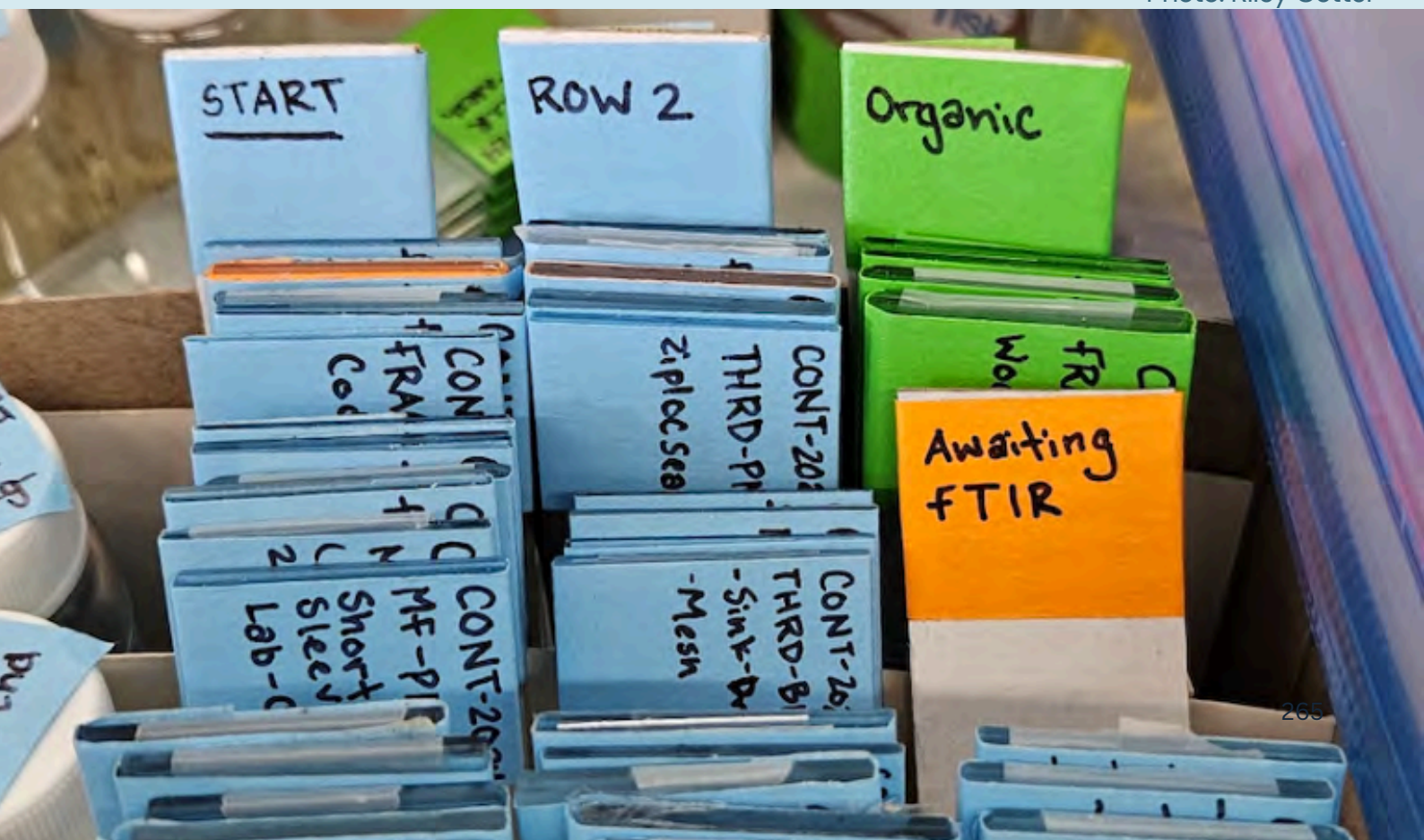
QUALITY ASSURANCE

Quality assurance (QA) refers to the checks and balances used to ensure the number of plastics that we report is representative of the plastics that were *actually* in the sample and not contamination. For example, microfibres that come off of our clothes, float in the air, or are on the end of your fishing hook from your mittens are all "contamination"–yes, you can contaminate a pollution sample! We work hard to identify and eliminate sample contamination.

Most plastics labs have quality assurance, but the practices change depending on the lab. For example, often labs will gather micrifibre plastics that are in the air in a petri dish, count them, and use a formula to remove the same number of microfibres from the sample. We don't do this, though. We still have a sample of the microfibres from the air in a petri dish, but because community members always ask where a plastic came from, and which exact plastic came from which exact fish, we cannot remove microfibers mathematically. Instead, we spend considerable time matching the type, colour, width, and other characteristic of each contaminant plastic to each one in the sample, and remove them by hand. This takes longer, but we can say exactly which plastic came from precisely which sample.

We keep a contamination library–a record of all main sources of contaminants, like those red life jackets NG bought in bulk, common fishing ropes, blue jeans, and ziplock bags–to help us identify common contaminants.

CLEAR's contamination library listing all the common sources of plastic contaminants.
Photo: Riley Cotter



POSITIVE QUALITY ASSURANCE

Positive Quality Assurance refers to the type of QA we do to identify false negatives (where we miss a plastic that was in the sample). Two of our main positive quality assurance protocols are:

1. **Spiking Samples:** We add known plastics to samples. We check to see whether the technician recovers the plastics and keep a record of recovered plastics. This helps us determine how successful we are at recovering plastics, and whether there are any influences, like emotions or time of day that impact a technicians recovery rate.
2. **Redos:** For every third sample processed, we run a redo. When a technician finishes processing a sample, they will place it in the fridge for a second technician to process. Sometimes we use redo's on tricky samples, too. For quadrats we primarily conduct re-dos in the field. Often two people would check a quadrat to ensure we picked up all the plastic. Then we would bag the plastic and send it back to the lab where it would be rechecked for morphology. The only exclusion to the field re-dos are the samples from the Torngats which Liz collected by herself.
3. **Removal of samples with low positive QA**: If a technician misses spiked plastics, and they are also not recovered in the redo, we usually remove the sample from the study because we cannot be sure that other plastics were not missed.

NEGATIVE QUALITY ASSURANCE

Negative Quality Assurance helps us make sure we are avoiding false positives—saying something is a plastic in a sample but either it isn't a plastic, or it's not from the sample. Most of these activities ensure that any detected plastic are not because of contamination from the environment, tools, or researchers. If we found a plastic, say from someone's mitten, but we counted it as part of the sample, that would be a false positive.

Blanks: Blanks are ways to identify plastics in the environment. On the land, you make a blank by doing all of the steps to collect a sample, but do not actually collect a sample. Basically, you pretend it's a real sample, and put your hands in the bag, scrunch the bag into the cooler, write on the bag, and all the other things we do to samples. We then process those blanks the same as a real sample to identify and eliminate any contaminants that might have been there from the collector and not the sample.

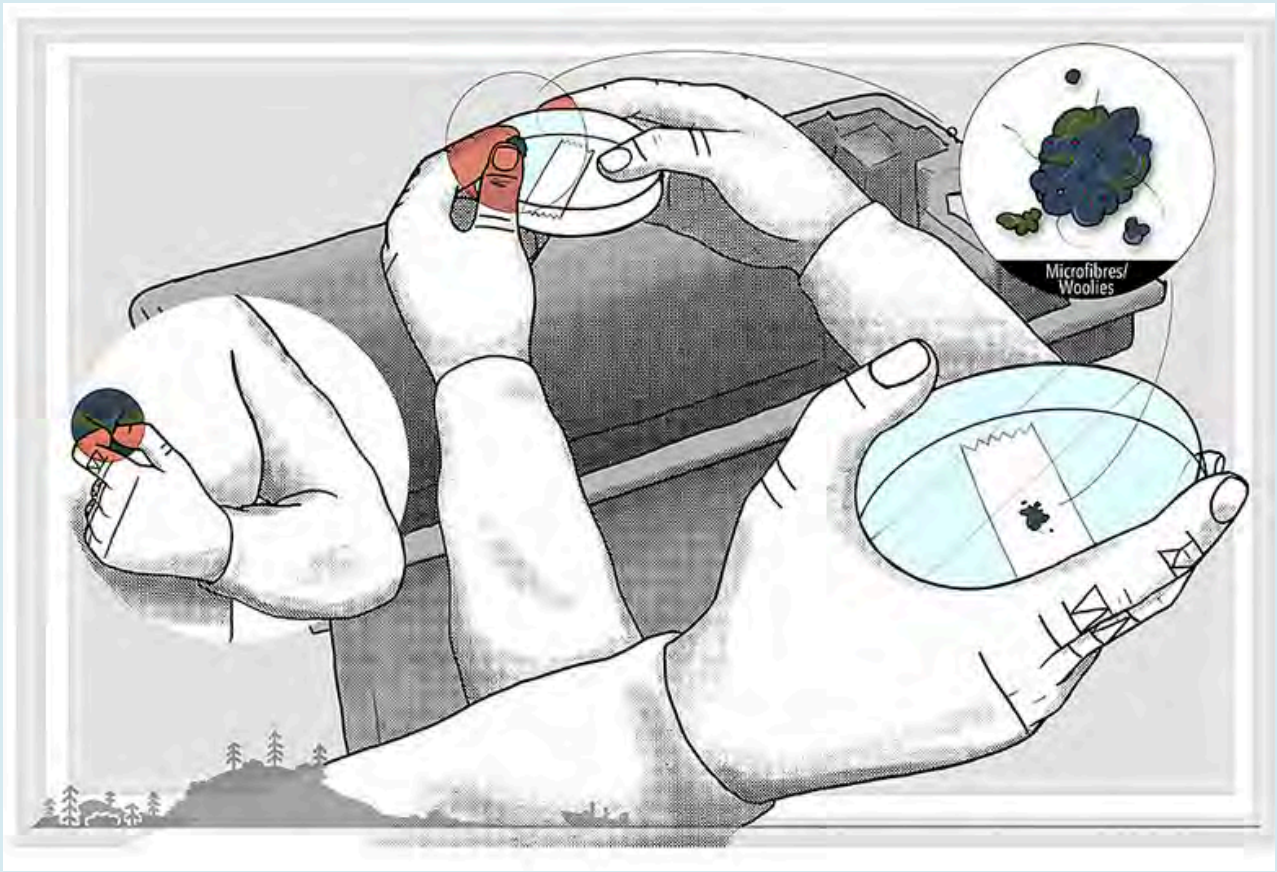
Lab blanks: These are petri dishes that we put a piece of double sided tape in when we process a sample in the lab. The air control catches any of the microfibres that might contaminate a sample from the air, but also our lab coats.

Contamination Libraries: We categorize and log anything in the lab that might be a contaminant. This "library" shows the history of contaminants in the lab and allows for us to check plastics against common sources we have found in the lab. Whether that is the microfibres from a technician's fuzzy socks in 2017 or a rope used in Rigolet in 2024, this library represents an ongoing history of the project's contaminants. In essence, its multigenerational and leaves clues for future technicians.

Pink Lab Coats: Most plastics labs use pink lab coats for QA. Like all clothing, our lab coats shed microfibers that sometimes end up in samples. Their unique pink colour makes them easy to spot and eliminate as contamination.

FTIR Spectroscopy: After we have done redos, and SPOT, we use infrared spectroscopy (a fancy laser!) to test whether something is plastic and determine what type polymer constitutes the plastic. A subsample, about 10-15%, go for FTIR analysis. Most often, we send everything we can to FTIR. To incorporate our margin of error we don't send everything that we think is plastic. And, if we retrieve multiple plastics that obviously have the same origin or are the same plastic that fragmented under the microscope, we only send one of them for FTIR

Illustration of how to make a contamination control from a hunter's clothing. This allowed lab techs to eliminate any similar particles in the sample. Illustration by James Jacque.



QUALITY ASSURANCE FOR ANIMALS

For each group of samples, we look at the QA numbers to see if we need to adjust the findings. That is, whether we need to provide caution when reporting findings, in case our sample processing missed plastics or not. In all cases, we've found that the QA numbers do not result in a change in reporting.

Table S5: Quality assurance for animals

Sample	Positive QA (%)	Negative QA (%)
iKaluk (Arctic char)	85%	90%
natsik (Ringed seal)	70%	87%
aKiggik (White partridge)	87%	100%
Ogatuinnak (Atlantic cod)	86%	100%
appak (Thick-billed murre)	91%	94%
Natânnavak (Turbot)	75%	100%
pitsiulâk (Black guillemot)	100%	87%
Ujagak Ogâtsuk (Rock cod)	92%	90%
Matsojak (Scallop)	94%	100%
mitik (Common eider)	80%	75%
Ânâtlik (Brook trout)	82%	100%
kavaisitik (Salmon)	75%	100%
Suglutuk (Surf scoter)	100%	91%
Appaliatsuk (Dovekie)	75%	80%
A-angik (Hound duck)		100%
kanajuk (Sculpin)	100%	100%
Ânâtlik (Lake trout)	100%	
Pitsuilâppak (Brasswing)		
niglik (Canada goose)		
Nipisak (Lump fish)		
Total	84%	94%

Here, positive quality assurance (QA) measures the recovery rate of spiked samples (% of samples whose planted plastics were recovered by the processor). Negative quality assurance (QA) uses independent re-analysis of a subset of samples by a second processor to determine if plastics were missed (expressed as % agreement, or % of samples with no additional plastics found by a second processor). In both cases, the higher the number, the better the quality assurance. These figures do not include samples that have been removed from the study if their QA showed there was a threat of false negatives–these are figures for the findings in this report. Brasswing (n=1), Goose (n=0.5), Lump fish (n=1) and Lake trout (n=2) were exploratory due to sample sizes listed in brackets. The only one that had negative QA protocols recorded was the lumpfish. 1 sample, plastics found in redo, so negative QA of 0%. The only one with positive QA protocols recorded was lake trout. Hound duck had a sample size of 4, one was spiked. The technician involved ended up having their batch of samples removed as compromised, so that QA datapoint was lost for hound duck.

THE PROBLEM WITH AVERAGES

In Western science, the average, or mean, is the most common way to report a central number for a dataset. You will see claims such as, "birds ingested an average of 2.3 plastics." While we do provide this number so our study is comparable to others, we use medians instead. That is because:

- **The zeros are hidden:** While most animals didn't eat any plastic at all, some animals eat a few plastics, which can skew the average. For birds in this study, for example, most birds ate no plastics, but the few instances of a bird eating several shifted the average to 0.62 plastics per bird.

- **The high points are hidden:** Even though most animals do not ingest plastics, we still want to represent the ones that eat a lot of plastic. For example, we had one Turr who ingested six pieces of plastic. Even though its only one bird, that bird matters because it is being eaten by a hunter. While, the samples ended up being small and pose no health risk in this case, it is still a meaningful number for evaluation.

- **Species matter**: Scientists no longer average plastic ingestion across species, but they used to. But this hid species that ingested few plastics, as well as those that ate a lot. For example, partridge frequently ingest more plastics than Turrs. Turrs are marine birds. Partridges forage on land. They eat different things in different environments. Unsurprisingly, they ingest plastics differently, too. That's why in plastic pollution research, it's common practice to analyze species separately, and why lumping them together can be misleading.

- **Wild food is safe to eat**: One of the impacts of hiding zeros is that it makes it seem as though most animals are ingesting plastics, since even one animal in a hundred ingesting a plastic is a 1% ingestion rate and 0.01 plastics/bird. It makes it harder to see the 99 animals that age no plastics. Since we are dedicated to communicating the safety of wild food, we foreground more representative numbers that show the strength of the zeros we find. For this dataset, that involves minimums (smallest numbers), medians (middle numbers), and interquartile ranges (the spread of numbers), and only then the mean.

Table S6: Cropped from Table 3 Baseline figures for plastic ingestion by animals near Nain,[a] 2019–2025

Animal	Sample size[b]	# of animals that ate plastic	% animals that ate plastic (%FO)[c]	% animals that did NOT eat plastic	Total number of plastics eaten	Minimum # of plastics eaten	Median # of plastics eaten[d]	Maximum # of plastics eaten	IQR of # plastics eaten[e]	Mean # of plastics eaten	Standard deviation of the mean[f]	Median size of plastics eaten (mm)[g]	total # of non-plastic waste materials eaten[h]
aKiggik (White partridge)	74	18	24.3%	75.7%	26	0	0	3	0.0	0.35	0.73	1.31	11

THE DIFFERENCE BETWEEN A BLANK AND A ZERO

There are different types of absences that show up in our dataset. Because zeros mean there is no contaminant, and means something different than a blank space where there is no data, an n/a where the measure isn't applicable, or something else, we take care to report each type differently and accurately.

Table S7: Details on the polymers found in surface water by place

Polymer type	Nain Bay	Webb's Bay	Paul Island	Nain area total	Saglek	Eclipse	Ramah	Hebron	Torngats total
Polypropylene		1 (25%)	10 (71%)	11 (52%)	1 (3%)	1 (6%)			2 (3%)
Polyethylene		2 (50%)		2 (10%)	4 (11%)				4 (6%)
PET	1 (33%)	1 (25%)		2 (10%)	5 (14%)	5 (31%)	1 (11%)	6 (60%)	17 (24%)
Nylon			1 (7%)	1 (5%)	13 (35%)	4 (25%)	6 (67%)		23 (32%)
Alkyd	2 (67%)			2 (10%)	7 (19%)	5 (31%)	2 (22%)	2 (20%)	16 (22%)
ABS			2 (14%)	2 (10%)	1 (3%)	1 (6%)			2 (3%)
Acrylic			1 (7%)	1 (5%)	2 (5%)				2 (3%)
PVC					2 (5%)			1 (10%)	3 (4%)
Cellulose acetate									
Crumb rubber									
Polyurethane									
Polystyrene								1 (10%)	1 (1%)
PAN					1 (3%)				1 (1%)
POM					1 (3%)				1 (1%)
Total plastics[a]	**3**	**4**	**14**	**21**	**37**	**16**	**9**	**10**	**72**

1-24%	25-49%	50-74%	75-100%

In this table, the blanks mean that the particular polymer didn't come back from FTIR. It does not mean they are not in the environment (which would be a zero), or we didn't specifically go looking for each polymer and not find it (also a zero), or that a specific polymer wasn't relevant to a sample (n/a).

FREQUENCY OF OCCURRENCE

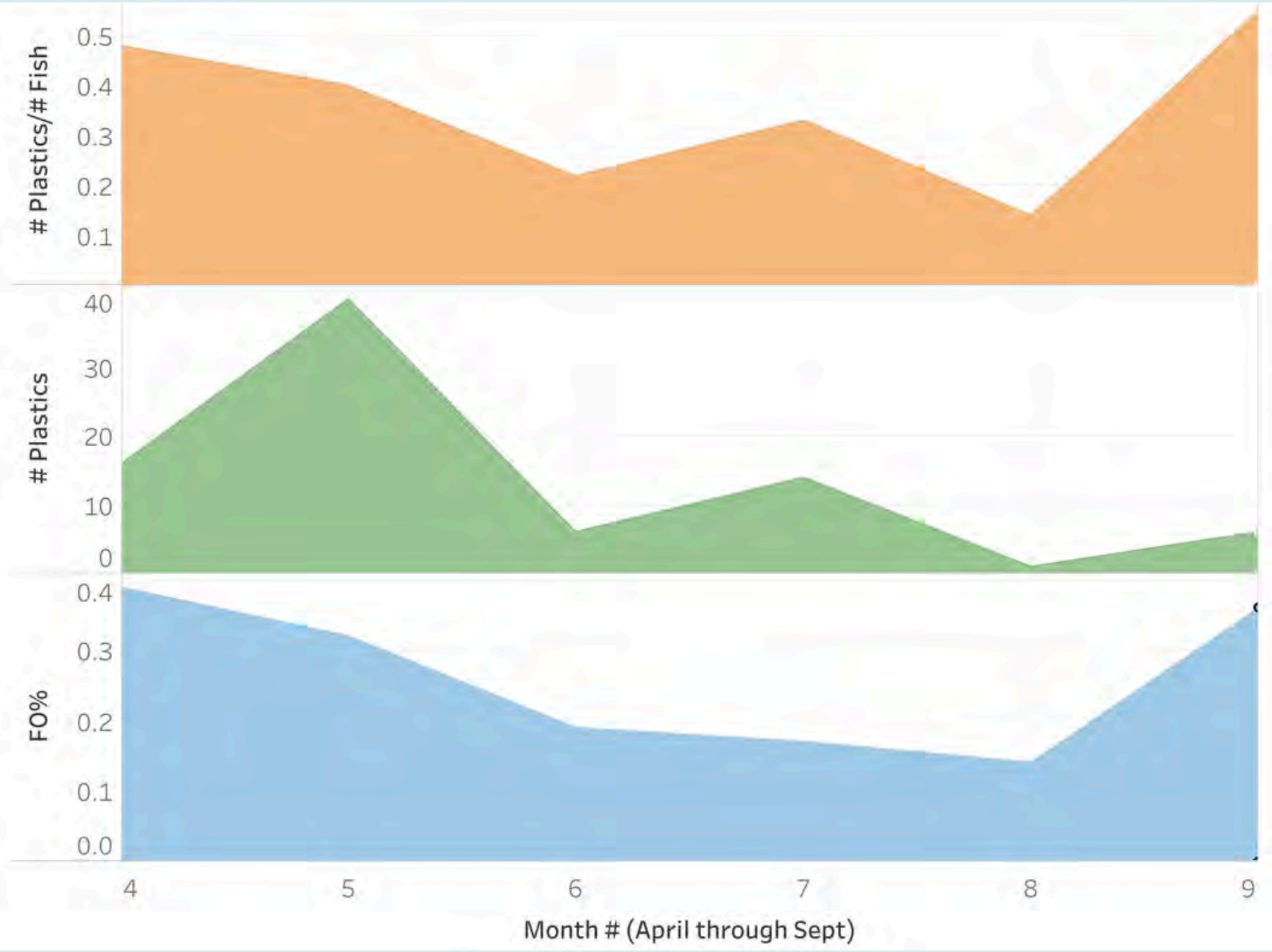
Frequency of Occurrence (FO%), is by far the main Western scientific measure for plastic ingestion. FO% measures the percent of animals in a sample that ingested plastic, no matter how much plastic they each ingested. If one fish in a hundred ate a plastic the size of dust, the FO% is 1%. The quantity, size, and morphology are not considered. If that fish ate 10 bottle caps or 10 microfibers the size of a piece of dust, the FO% is still 1%.

Frequency of Occurrence is primarily concerned with the health or characterization of a population, so smoothing out differences between individual animals is part of it's focus. It also "corrects" for the number of animals sampled–if you have more animals, you're more likely to have more plastics. Because the FO% is a ratio of all samples, it automatically accommodates the sample size. This allows FO% to be compared across different studies readily, regardless of different sampling sizes

However, when we spoke community members, the population was rarely of concern. People were more concerned with a particular fish or group of fish caught at a specific place by a named fisher. They cared about the health of the individual fish, including whether it had ingested a lot of plastics or large plastics. And the primary interest was the foodweb and the number and type of plastics entering it.

For this reason, while we still report FO% so our studies are comparable to other scientific studies, we privilege other measures as well, including the median (the middle number, for the most common number of plastics ingested, which is usually zero), the number of plastics per animal, which is an average that indicates the count of plastics but is corrected for the number of samples, and finally the total number of plastics to show the number of plastics entering the food web, period. The median and total count are both better aligned with Indigenous food soverignty, since they show both that wild food doesn't usually eat plastics, as well as the intensity of plastics entering Inuit foodwebs, including of when more animals are caught seasonally, from particular places, or from particular species.

Figure S8: Three ways to show seasonal changes in plastic ingestion by iKaluit (Arctic char) in Nunatsiavut, 2017-2022



The bottom (blue) graph shows Frequency of Occurrence, the percent of fish sampled that ate plastics, regardless of how many plastics they ate. The middle (green) graph shows the total number of plastics that fish ate, regardless of how many fish were caught that month. The top (orange) graph is the most sensitive, showing the number of plastics divided by the number of fish sampled. Note a low sample size (<30) in August and September (fall), makes that season less indicative of a trend.

DETERMINING INFLUENCE

Most community members were interested in what influenced animals to ingest plastics at all, or to ingest more plastics. Influence means that two things are effecting one another.

In statistics, this is often called correlation. Detecting influence depends on sample size and variability. It treats no detectable influence as no influence, and often puts influence into a binary decision (yes or no).

But, those are not the only things that influence means. It can also refer to meaningful patterns. Statistics can do this, but so can lay knowledge, looking at data within context that is not quantitative, and other ways to analyze numbers in ways that are grounded in real-world experience; that is, as a pattern that makes sense given what we know about the environment.

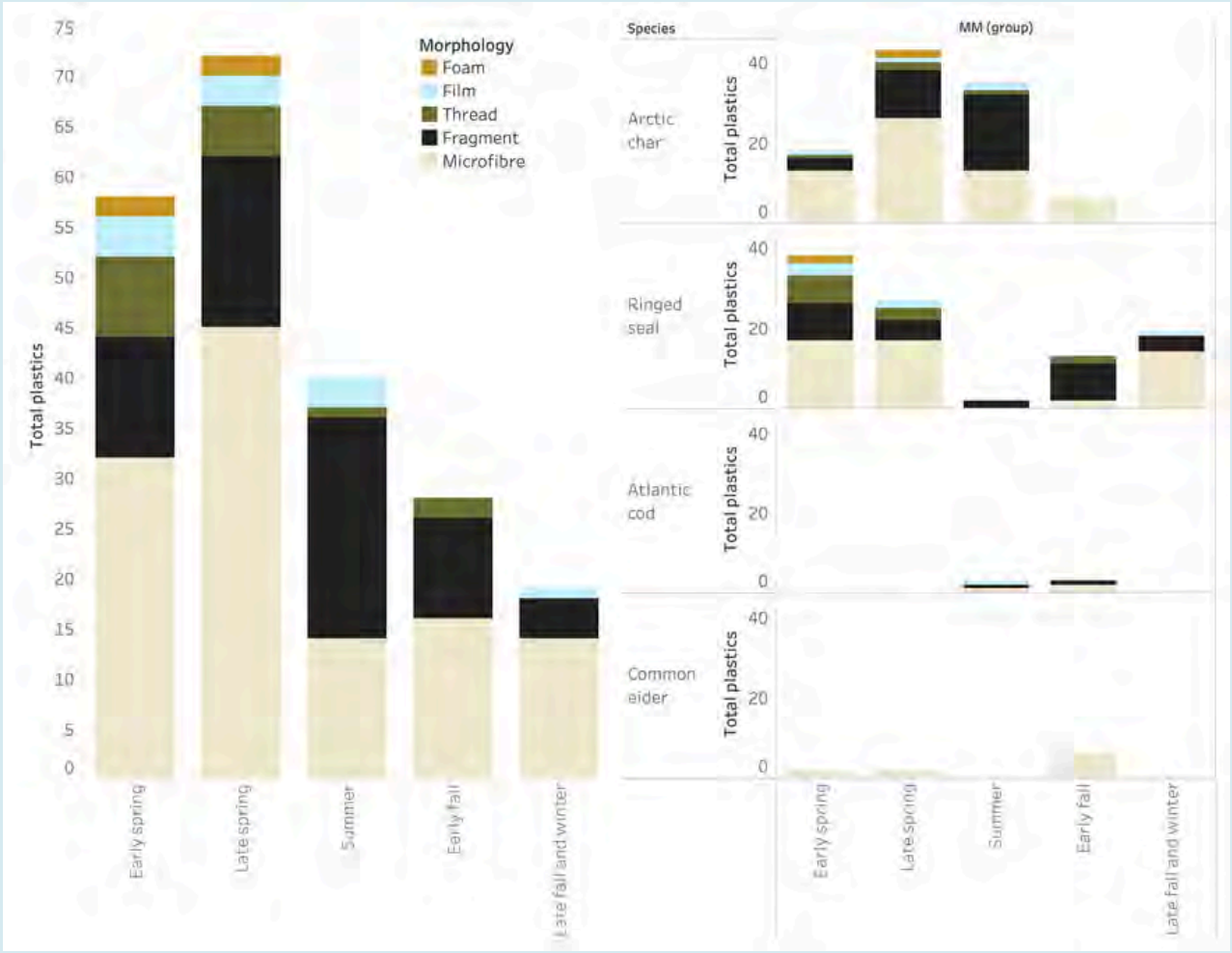
When creating the section on influence in this report (to see whether season, year, hunger, and other elements resulted in animals ingesting more or fewer plastics), we started by running a range of inferential statistics including: linear regressions, chi squares, t-tests and z-tests, ANOVA's (specifically around season). In all cases, we made sure that we were analyzing data from animals we had from multiple seasons. We ran our tests using number of plastics, frequency of occurrence (FO%), plastics per animal, plastic morphologies, and three ways to understand season: as different months of the year, in a four month calendar, and in the Inuit traditional six month calendar.

All of the inferential statistics said that there is no statistically significant relationship between animals eating plastic and season. The tests said: there is no influence! This did not seem true, either when we talked to community members or when you looked at the data itself. Liz and others talked about how dirty the water is in the spring, which is when the most plastics would be in it. It's also when animals, and especially fish like Char, are feeding intensively, and when most community members are out fishing.

Statistically speaking, when one of those tests say there is no relationship, it means is that there is not sufficient evidence to reject the null hypothesis (that season has no effect). It does not necessarily mean there is no effect, but that there is not enough data in the model to claim there is an effect.

So, we aimed to show the seasonal data as clearly as possible (figure S10, next page), so that community members and NG staff can make their own interpretations in addition to what the statistics reported, and to avoid over claiming on our part.

Figure S10: Morphologies of plastics ingested by animals according to season, including species-specific figures for species with sufficient plastic data in more than one season, 2017-2025



This graph displays a range of data for each season, privileging the raw number of plastics (the plastics entering the food web) to reflect more intensive fishing in certain seasons. We broke down the data to more clearly show morphologies of all plastics recovered from animals across different seasons.

Note that sample sizes across seasons differ considerably (i.e. more animals were sampled in the spring/summer months than in the fall/winter), so higher bars in one season should not be taken to mean that more animals ate plastics; there may just be more animals collected in that season. The graph on the left shows all plastics across all species. However, plastic ingestion is highly species-specific, so it is more informative to break out plastic characteristics per species, as seen on the right for species surveyed in more than one season. These graphs are for animals that had sampling in more than one season.

It shows that some animals, like Common eider, only ingest microplastics, and have fairly even ingestion habits. Other animals, like natset (Ringed seal) and iKaluit (Arctic char), have a lot more seasonal variation and more samples, and are some of the drivers behind the numbers of compiled animals.

PLACE-BASED ANALYSES

Typically, Western scientific plastic monitoring research aggregates the data across regions, making claims about "the Bering Sea" or even "the Arctic" (Cotter, 2026). Aggregate data, represented as singular figures, struggles to address community research questions about the source of plastics and inform decisions at a local level because it removes the small and meaningful differences between places in a region. Even a region the size of Nunatsiavut–which is quite large!– has meaningful differences between places in terms of seasons, landscapes, land use, and, of course, plastic sources and sinks.

We include a section on plastics in each place, and ran statistics and created data visualizations that showcased plastic data according to places (communities, collection sites, sub-regions–each time being clear about how we were delineating one place from another, since it isn't always obvious). We also often give place-based summaries alongside any for Nunatsiavut as a whole, such as the shoreline baseline for shorelines in towns versus on the land.

How did we determine what was "a place"? For animals, a "place" (like Nain or Hopedale) was determined by either: 1) what a hunter or fisher called a place, in which case it was a distinct place in the data, and/or 2) if it was a skidoo or boat ride from a place, meaning someone who lived there could have gotten the animal. We used the latter case when something came through a community freezer, when we didn't have an exact location from the hunter, or when we were compiling numbers for a regional average or analysis. Thus, places we sampled are a product of the relationships that guided the research.

Three examples of place based decisions:

1. Originally the final table for shoreline plastics in quadrats was laid out with main regions (Hopedale, Makkovik, Nain, Rigolet & Torngats), but this missed the importance of location even within a region. For example, the waste environment around the wharf is very different from the environment on the boardwalk or outside of town. We used a combination of collector's notes and coordinates to separate data into locally specific categories. This allowed for quadrats to be grouped close together and ensured that the waste environment matches the quadrats (i.e. town centre, wharf, boardwalk, airstrip, sewage outlet, each with slightly different environmental profiles).
2. Rigolet had two interesting points: a ton of lumber and a lot of metal. There was a lot of lumber because we walked along the board walk and collected all the ends that had been sawed off to make a smooth walkway. We counted a lot of metal because we went in front of Jacqueline's house where someone used to burn boats on the shoreline. We counted over 2000 nails! So even the places within Rigolet, nevermind the differences between Rigolet and Saglek, were important context for understanding and using the findings.
3. Near Nain, Paul's island is not grouped with other sites near Nain because the types of plastics we found there (mostly threads) are very different than other locations. After excluding Paul's island, we chose not to aggregate Nain Bay and Web's Bay together into a place called "Nain" because they are very far apart. Although they had almost identical types of plastics, an aggregate for Nain wouldn't be very truthful based on only two spots.

Figure S11: Example of a place-based analysis in-progress, 2026

This behind-the-scenes image shows how we were grouping samples in one of our ingestion analyses. We often had to visualise the locations to see if they might fall into one analyses or another depending on location. Here, we have Postville and Hopedale grouped together.

Table S12: Baseline of plastics from shoreline quadrats in Nunatsiavut

Region	Location	Sample size	% with plastic	Mean density (plastics/ m^2)	Standard deviation of mean	Median density (plastics/ m^2)	IQR
Hopedale	Near airstrip	71	13%	0.79	2.50	0	0
	Town	85	21%	1.41	3.31	0	0
	South Uivak	8	0%	0.00	0.00	0	0
	Top Pond	62	11%	0.97	3.29	0	0
	Total	**226**	**15%**	**1.04**	**3.01**	**0**	**0**
Makkovik	Near landfill	2	50%	1.00	1.41	1	1
	Ranger Bight	21	29%	0.62	1.24	0	1
	Sewage outfall	17	47%	0.88	1.50	0	1
	Wharf	11	91%	3.64	3.98	2	3.5
	Total	**51**	**49%**	**1.37**	**2.45**	**0**	**2**
Nain	Town (Illusuak Cultural Centre)	5	100%	8.40	6.50	9	6
	Kauk Bay	8	0%	0.00	0.00	0	0
	Kauk Harbour	23	13%	0.30	0.82	0	0
	Total	**36**	**22%**	**1.36**	**3.67**	**0**	**0**
Rigolet	Big Island	14	0%	0.00	0.00	0	0
	Boardwalk	35	14%	0.80	2.34	0	0
	Cabin	10	0%	0.00	0.00	0	0
	Cross Island	5	0%	0.00	0.00	0	0
	Saddle Island	15	13%	0.53	1.41	0	0
	Town	12	15%	8.33	15.95	0	5
	Total	**91**	**11%**	**1.49**	**6.38**	**0**	**0**
Torngats	Eclipse	16	0%	0.00	0.00	0	0
	EKortiarsuk Fjord	19	0%	0.00	0.00	0	0
	Nachvak	38	8%	0.08	0.27	0	0
	Ramah Bay	14	0%	0.00	0.00	0	0
	Saglek	184	5%	0.26	1.23	0	0
	Total	**271**	**4%**	**0.19**	**1.02**	**0**	**0**
Nunatsiavut[a]	**Total**	**675**	**13%**	**0.80**	**3.21**	**0**	**0**
Nunatsiavut in towns	**Total**	**212**	**27%**	**1.73**	**4.94**	**0**	**1**
Nunatsiavut going off	**Total**	**451**	**6%**	**0.34**	**1.64**	**0**	**0**

0%	1-24%	25-49%	50-74%	75-100%

This table does not include a series of daily quadrats that Kayla Wyatt, Geraldine Andersen, and Caroline Nochasak did from May to Oct 2024, to see if plastics were loading onto shore after ice break-up; checking every day will result in fewer plastics than checking once or twice a year.

[a] As you can see from the variation within each site (such as the area in Nain by the Cultural Centre compared to Big Island in Rigolet, for example), that the average for all of Nunatsiavut is somewhat misleading. We recommend using one average measure for in communities and another for outside of communmities. "Town" is our measurements is somewhere waste can blow out of a yard or truck.

ANATTAUSOT METRIC

One of the most common community questions was whether animals were being harmed by plastics. While we did not see any blockages, ulcers, perforations, or other visual indications of harm from the few and small plastics we found, and we assured people that the plastics were very small, we wanted to provide a more robust way of talking about plastics passing through animals. Since we also found larger, hard, and often sharp items in animal's gastrointestinal (GI)tracts such as squid beaks, shells, bones, and rocks, we wanted to additionally communicate how a GI tract routinely handles similar objects.

We developed the Anattausot metric to determine whether ingested plastic items are poopable. Katie Winters, our translator, translated "poopable: as anattausot.

Since measuring an animal's anus poses both logistical and ethical issues, we used a proxy measure. Our proxy: the widest dimension of ingested plastics compared to the widest dimension of naturally ingested items we find in the GI tract such as bones or stones. If the plastic is smaller, we've achieved anattausot!

We measured the longest diameter of items found in animal GI tracts, both plastics (blue lines on Table S13) and non-plastics (yellow lines), to the nearest 0.01 mm using digital calipers. The largest diameter is distinct from the longest dimension, as elongated items (e.g., untangled fishing line or oblong fragments) are assumed to traverse the gastrointestinal tract aligned with the direction of flow rather than perpendicular to it (ie, we assume no one pooped sideways).

Our measurements differed slightly in birds to account for physical differences in digestion compared to other animals. First, birds have gizzards capable of grinding large, hard items into smaller pieces. We measured items retrieved before and after the gizzard. Existing studies show that plastic-related internal injuries in birds typically occur in the upper and mid-GI tract (particularly in the proventriculus–gizzard and small intestine), we also noted any ulcers, scars, inflammation, and fibrotic tissue remodelling ("plasticosis") in samples (Charlton-Howard et al., 2023). Additionally, the birds have cloaca designed for the passage of large rigid objects, namely eggs. To contextualise and extend the Anattasout metric to eggs in addition to hard parts, we compiled species-specific average egg diameters. Including both egg and hard part dimensions provides a measure demonstrating that passage of large, hard items such as plastics through the cloaca is a normal aspect of avian anatomy.

Finally, we use both the maximum size and the median (middle) size to show potential discomfort versus normal egestion. Consistently, this metric determined that plastics are smaller than other hard items routinely ingested by all species.

In Table S13 on the next page, originally Table 16 in the original report, we note that there is one instance with a plastic whose maximum size is larger than the maximum bone ingested, but that the large plastic was a film– the most flexible type of plastic.

Table S13: Summary of anattausot metric compared to plastic sizes in animals studied in Nunatsiavut, 2023-2025

Animal	Common hard part	Largest diameter[a] of hard part eaten (mm)	Median diameter of hard part ingested (mm)	Largest diameter of plastic eaten (mm)	Median diameter of plastic eaten (mm)	Plastic smaller than hard part (Y/N)?[b]
iKaluk (Arctic char)	Thin fish bone	4.19	1.15	9.63	0.19	N[c]
Ânâtlik (Brook trout)	Beetle	6.35	2.96	0.01	0.01	Y
mitik (Common eider)[d]	Mussel shell	14.91/6.56	3.37/4.77	5.65/0.36	0.64/0.19	Y
natsik (Ringed seal)	Thin fish bone	9.51	1.21	7.24	0.22	Y
kavaisitik (Salmon)	Fish ear bone	11.24	1.04	0.30	0.16	Y
Matsojak (Scallop)	Calcified stone	3.46	1.31	0.75	0.17	Y

[a] The largest diameter is different from the longest dimension (length), as long, thin plastics (like untangled fishing line) are assumed to pass through the gut lengthwise, following the direction of flow.
[b] Whether the plastic with the largest diameter is smaller in all dimensions than the hard part with the largest diameter.
[c] The plastic with the largest diameter in char was a 9.63mm clear film made of polyethylene. The next widest plastic was a 4.21mm wide blue microfibre bundle, which is also flexible. (All other char plastics were smaller than hard parts).
[d] Common eider (like all birds) have gizzards that grind food after it leaves the proventriculus and before it enters the intestine. The tougher the food (like shells or seeds), the thicker and more muscular the gizzard is to aid in digestion. Because of this grinding process, the largest diameters of hard parts and plastics in eider ducks are reported before and after the gizzard.

Hard items found in the GI tracts of Ringed seals used for the annattausot metric. Photo: Max Liboiron

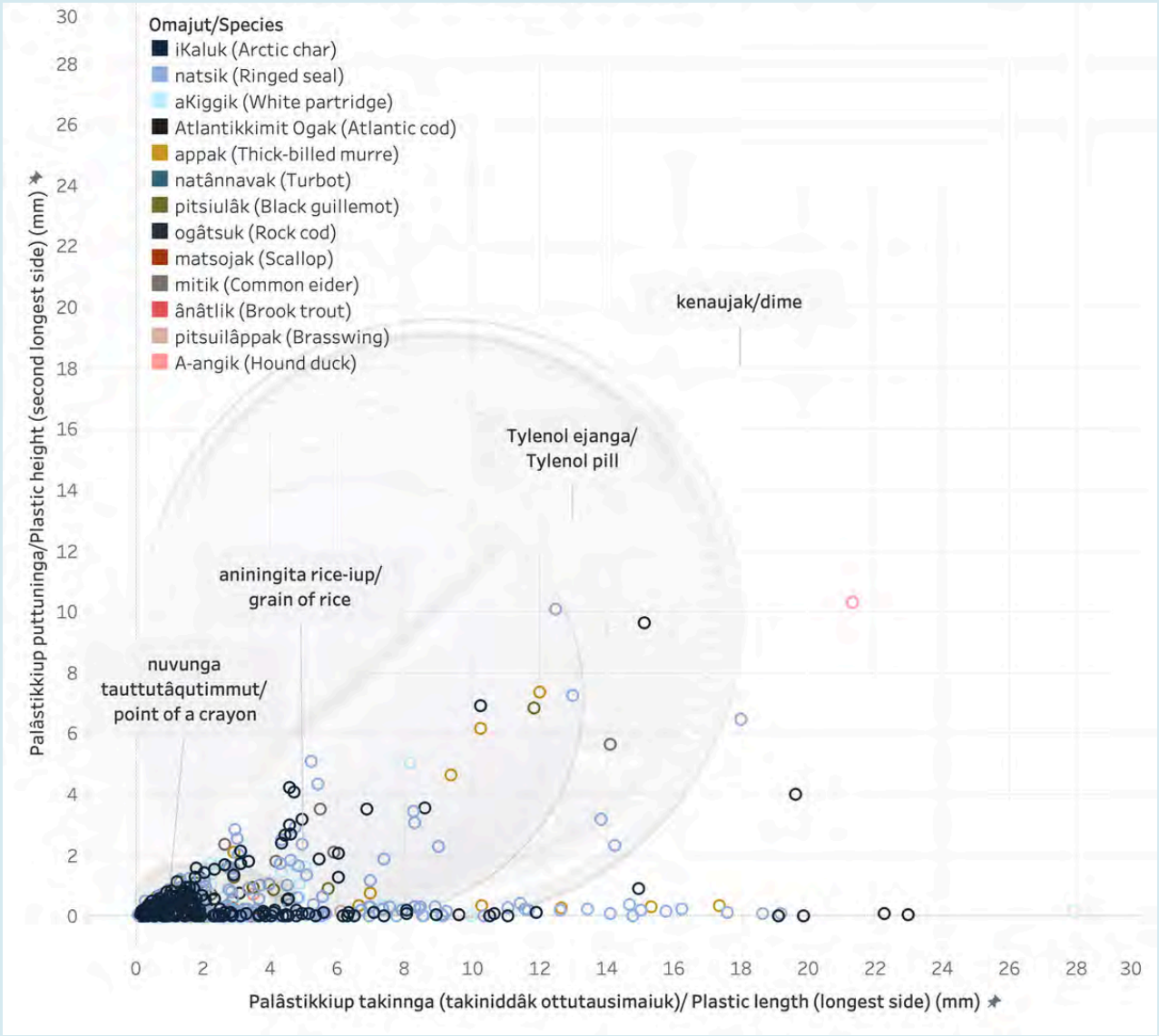
CHOOSING INTUITIVE MEASUREMENTS

Often the standards for comparing plastics are not very intuitive. For example, the number of plastics in a square kilometre of surface water are scientific standards for measuring plastics in surface water, but the numbers do not make intuitive sense (what does 0.010 plastics in a km look like?!).

We use a variety of different examples to create more accessible plastics comparisons throughout the report:

- For plastics ingested by animals, we compare to a grain of rice, tylenol, and coins (dimes and nickels, usually).
- For surface water, so we use the number of plastics in an area the size of an NHL hockey rink instead, rounded to a whole number. It's much easier to think about 17 plastics in a hockey rink!

Figure S14: The size of each plastic ingested by an animal, 2017-2025



HHUNTER REPORT BACK

While not included in this report, in the last three years of the project we gave hunters the raw data from their animals in the study. This included the number, type, size, polymer, colour, and morphology of any plastics present and whether there were any plastics at all (see below).

We added a summary at the bottom of the reports with some summary statistics and a comparison of those statistics to the overall study (usually the FO%, which does not skew because of sample size, as all hunters had smaller sample sizes than the entire study).

We also acknowledged any samples that the hunter supplied that were excluded from the overall study. These were removed due to quality control methods, after processing in the lab, indicated that the results were not reliable. For more on quality control see page 265.

If you are a hunter and would like more details about the animals you caught in the study, please reach out to Max Liboiron.

Figure S15: Example of a hunter report

Sample ID	Date Collected	Collected By	Location	Species	Food In Sample? Y/N	Total Number of Plastics	Morph: Film (bag)	Morph: Foam	Morph: Fragment	Morh: Microfibre (from wastewater)	Colour: Black	Colour: Blue	Colour: Clear	Colour: Green	Colour: Grey	Colour: Red	Colour: White	Size Class: Meso	Size Class: Micro	Polymer: Alkyd	Polymer: PAN	Polymer: PET	Polymer: Polyethylene	Polymer: Unknown
2022-Melville-001	2022-04-22	David Wolfrey	Charley Cove	Ringed seal		0																		
2022-Melville-002	2022-04-23	David Wolfrey	Green Island	Ringed seal	Y	0																		
2022-Melville-003	2022-04-24	David Wolfrey	St John's Island	Ringed seal		0																		
2022-Melville-005	2022-04-30	David Wolfrey	Charlies Point	Ringed seal	N	1	1						1						1				1	
2022-Melville-006	2022-04-30	David Wolfrey	Lake Melville	Ringed seal	Y	0																		
2022-Melville-007	2022-04-30	David Wolfrey	High Lands	Ringed seal		2		1	1						1		1		2					2
2022-Melville-008	2022-05-01	David Wolfrey	Lake Melville	Ringed seal	Y	3			2	1		1			1		1		3	2		1		
2022-Melville-009	2022-05-01	David Wolfrey	George Gear nap	Ringed seal		0																		
2022-Melville-010	2022-05-01	David Wolfrey	Big Pot Cove	Ringed seal		1				1	1								1					1
2022-Melville-011	2022-05-01	David Wolfrey	Little Pot Cove	Ringed seal		0																		
2022-Melville-012	2022-05-03	David Wolfrey	Upperside Green Island	Ringed seal		0																		
2022-Melville-013	2022-05-03	David Wolfrey	Valley Bight	Ringed seal		0																		
2022-Melville-015	2022-05-03	David Wolfrey	Peter Lewis Island	Ringed seal	N	7				7			1	4		2		2	5		1	2		4
TOTAL						14	1	1	3	9	1	1	2	4	2	2	2	2	12	2	1	3	1	7

This report is for David Wolfrey

Out of the 13 Ringed seals caught by David Wolfrey in 2022, 5 had ingested plastics (38%). This is lower than seal from Nunatsiavut overall (43%).

Of all the seals caught by David Wolfrey in 2022, the seal caught from Peter Lewis Island on May 3, 2022, ingested the most plastics (7), which were all microfibres (from clothing fibres in wastewater).

The limited samples sizes by location limit the reliability of comparative results between locations.

Samples removed from the study

2 seals caught by David Wolfrey in 2022 were removed from the study because quality control methods, after processing in the lab, indicated that the lab results were not reliable.

If you have any questions about this study, please contact Max Liboiron at Memorial mliboiron@mun.ca.

For a full report for All plastic monitoring in Nunatsiavut, see https://civiclaboratory.nl/plastic-pollution-monitoring-in-nunatsiavut/

DATA VISUALISATIONS

Data visualisations make data more accessible *to a particular interpretation*. They are never raw, and always overdetermine how the information can be understood.

Over the course of this partnership, we began with more traditional Western scientific visualisations, and gradually, in conversation with community members, adapted them to be more information-rich so there are more interpretations possible.

In the series below, we show this evolution of visualisations. All of them foreground that wild food is safe to eat, which has always been our core message, but they arrange the data in different ways.

Figure S16: Plastic ingestion for species caught in Nunatsiavut (orange) and baselines NL (blue); Our first data visualisation, 2021

This graph shows the percentage of sampled animals that had ingested plastics in Nunatsiavut (orange) compared to existing data in the wider province (blue). note that only iKaluit (arctic char), natset (Ringed seal), and turbot have large enough sample sizes that the data is a good reflection of populations.
Note: this visualization was specifically for an NG staff initial report back in 2021. It focused exclusively on frequency of occurring (FO%) (mainly to allow direct comparison to other studies, in blue), did not emphasis zeros (every bar is the ratio of plastics ingested, not their absence), and small sample sizes that were not reliable for baselines are indicated in the text, but they are shown indiscriminately in the graph itself.

Figure S17: Public data visualisation, April 2023

By 2023, we were able to share our results publicly with community following permission from the Nunatsiavut Government Secretariat. This is the visualisation we used for that first presentation in Nain, which highlights both the plastics and the lack of plastics in a ratio, and also shows the sample sizes for each species without erasing species. The added text contextualizes the plastics themselves, and the main finding that even though this is contaminant data, wild food is safe to eat.

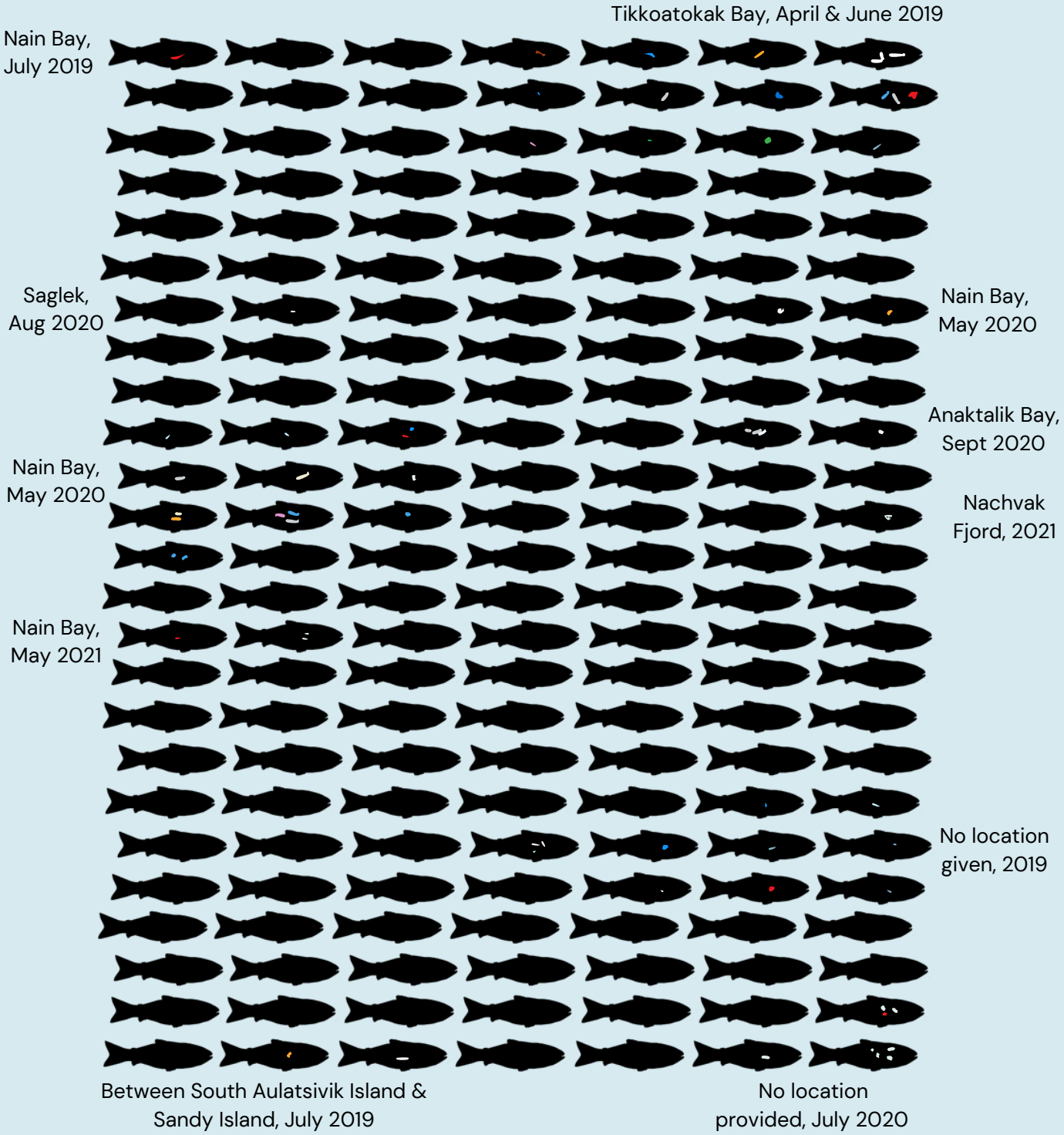
Figure S18: Public data visualisation, Summer 2023

A few months later, we produced a one-pager with all results for community visits. It had this infographic on it, which attempted to better highlight the ratio of animals that did not ingest plastics.

However, after showing the image to Kayla Wyatt, who worked with the project as a community-based researcher, she interpreted the visualization to mean that some iKaluit (Arctic char) and natset (Ringed seal) were full of plastic, others ingested no plastic, and that one animal was partly full of plastics. So, we went back to the drawing board!

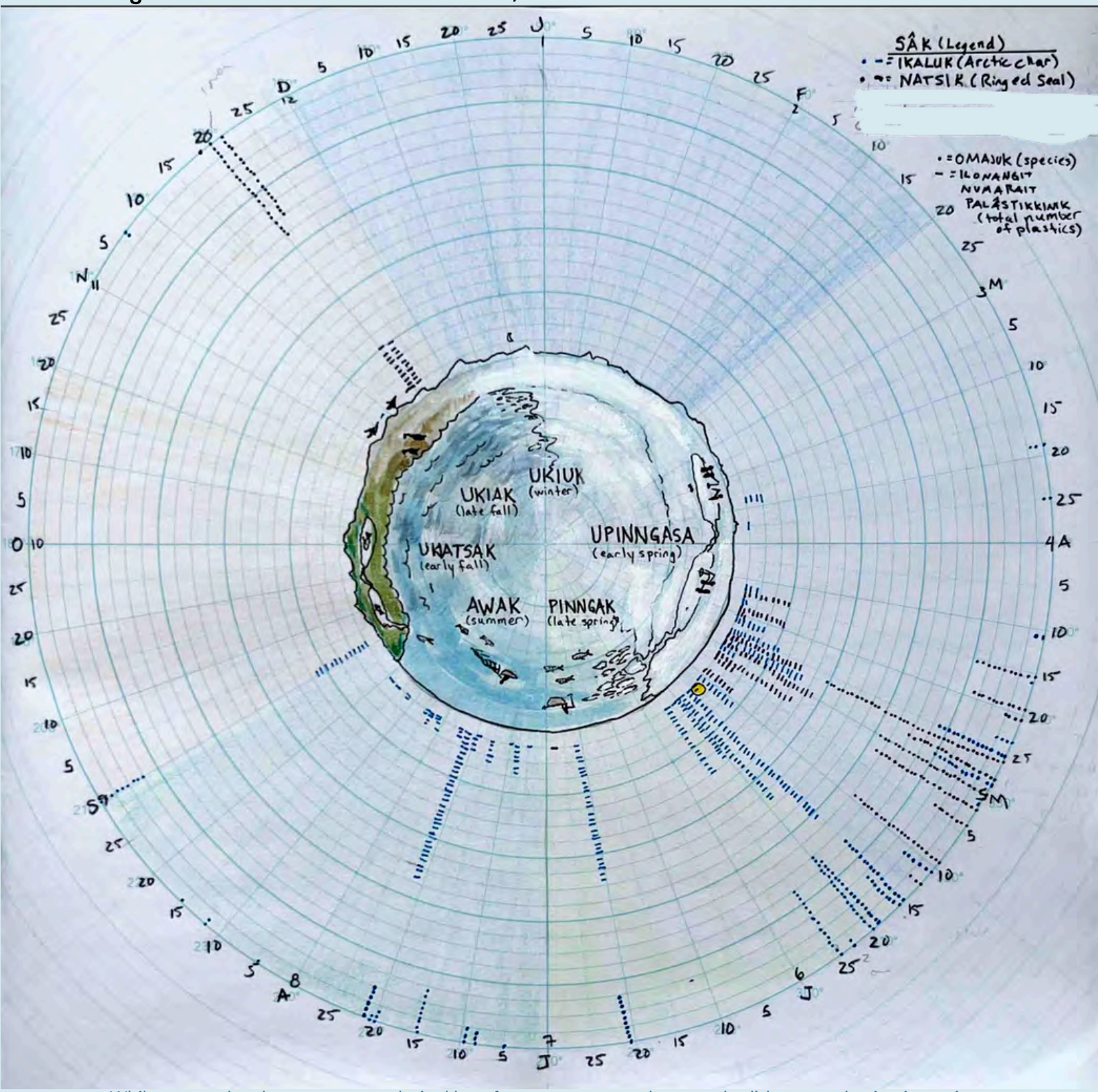
In 2024, the community one-pager had a table with ingestion rates, but the visualisation was just a map of samples.

Figure S19: Public data visualisation, 2025



Our most developed data visualisation of plastic ingestion is this information-rich infographic, which depicts a representative subsample of Arctic char (there is also one for Ringed seal). Instead of using a summary statistic (which is available in text and tables), it shows individual, specific animals in the study, identifies their location and year of collection, and visualises the number, shape, and colour of plastics ingested. The caption in the original visualisation, on page tktk of this report, notes that the size is not correct– all plasics are shown extra large so you can see them with your eyes instead of a microscope. This information-rich version allows viewers more agency to use the information for their own analysis and decisions.

Figure S20: Draft data visualisation, 2026



While season has been a core analytical lens for many years, only recently did we try plotting ingestion on a circular plot that showed the continuity of seasons and meaningful land changes. This draft was designed for the final report in 2025, and again now in 2026, but the labour-intensive process means that it has only ever reached this draft stage. The community did not explicitly ask for a circular statistic—nor did anyone ask for visualisations that provided more information, showed zeros more clearly, or were annotated for sample size. All evolution have been about greater fits with what we hear in conversations and from Nunatsiavut researchers. We show some older visualisations alongside these ones, and our philosophy is that showing the data in many ways with different interpretations, rather than One Right Way, serves Indigenous Data Sovereignty and the use of data for governance best.