Palâstikket nigijausimajut omajunut

Plastic ingestion by animals

Ânâtlik (trout) in an hole in the ice. Photo: Eldred Allen

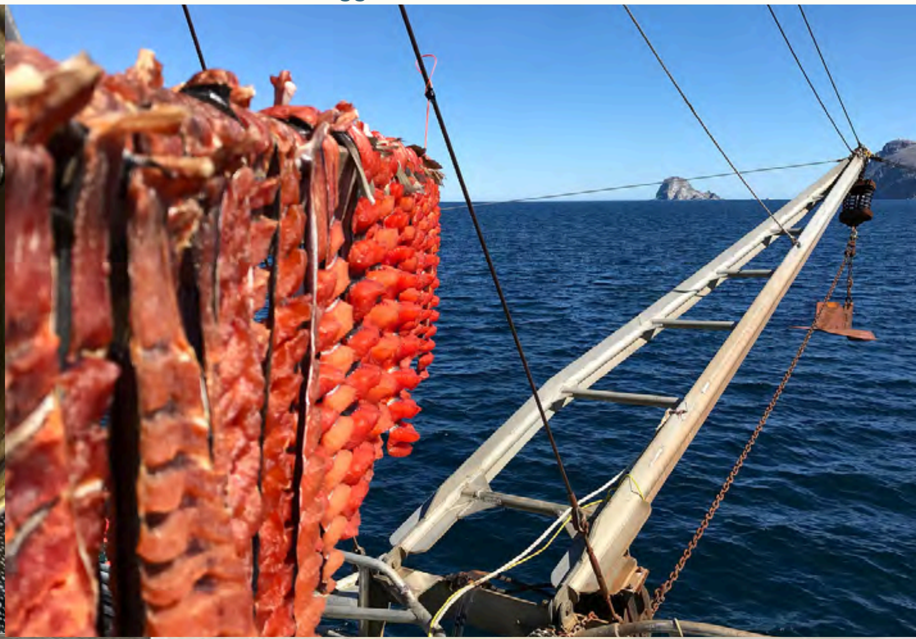
Tainna ikKanattonippâk napvâtausimajuk tapvani Kaujisannimi unavuk niKituKait Kanuingitut nigigiangit isumagillugit palâstikket.

The most important finding of this study is that wild food is safe to eat in terms of plastics.

Max, Liz ammalu asigiallait Kaujisattet tâpsuminga suliangujumut nigisimajut omajunik nigisimajut tâpsumangat Kaujisannimit.

Max, Liz and other researchers on this project eat animals from this study.

Top left: partridge soup, from partridge caught by Daryll Lyall, Nain 2025. Photo: Paul McCarney. Top right: Freshly caught arctic char. Photo: Eldred Allen. Bottom: Caribou stew, smoked iKaluk, and red berries with sugar made by Blanche Winters for the research team when we were in Maggovik (Makkovik), 2023. Photo: Max Liboiron.

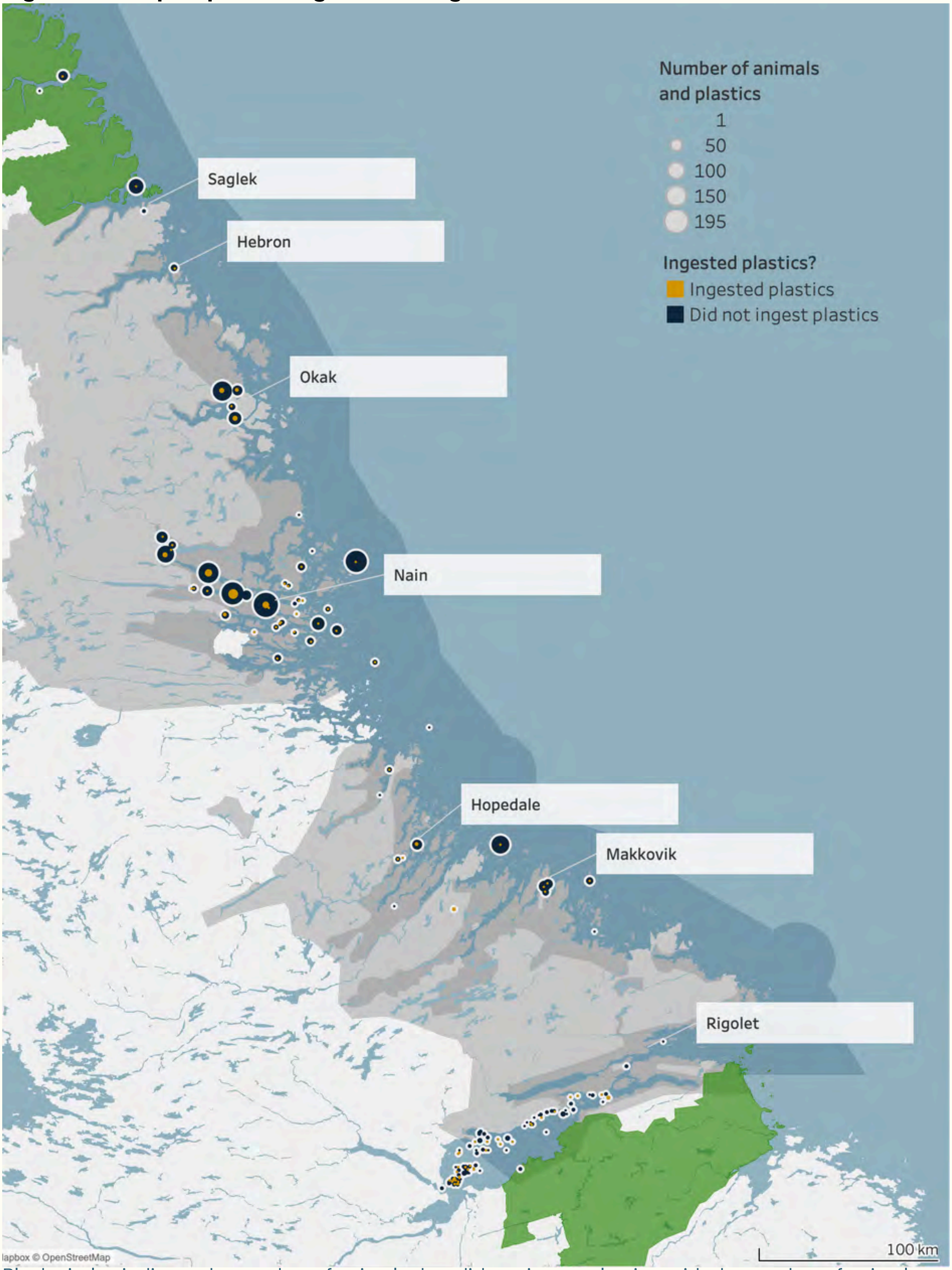


There are ten species of animals with a large enough sample size to use as a baseline in this study. Other animals are also discussed, but the small sample sizes mean they are preliminary findings.

- **iKaluk (Arctic char), 348 samples.** Caught by the Nachvak Basecamp team, Ed Flowers, Geraldine Andersen, Liz Pijogge, Michelle Saunders, Luke Lucy-Broomfield and family, Catharyn Andersen, Gary Ford, Freeman Dicker, Neus Campanyà i Llovet, Reuben Flowers, Nick Flowers, Shawn Rivoire, Simone Daniels, Taylor Shiwak.
- **natsik (Ringed seal), 152 samples.** Caught by David Wolfrey, Guido Rich, Joey Angnatok, Joseph Townley, Tyler Powell.
- **aKiggik (White partridge), 74 samples.** Caught by Chesley Ittulak, Darrel Lyall, Donovan Pijogge, Ed Flowers, Jerry Barbour, Liz Pijogge.
- **Ogatuinnak (Atlantic cod), 68 samples.** Caught by Ed Flowers, Liz Pijogge, Luke Lucy-Broomfield and family.
- **appak (Thick-billed murre), 40 samples.** Caught by Ed Flowers, Liz Pijogge, Paul McCarney and Kayla Wyatt (from the Nain community freezer).
- **natânnavak (Turbot/Greenland halibut/Reinhardtiushippoglossoides), 33 samples.** Caught by Malcolm Wolfrey.
- **pitsiulâk (Black guillemot), 32 samples.** Caught by Darrel Lyall, Ed Flowers, Liz Pijogge.
- **Ujagak Ogâtsuk (Rock cod), 32 samples.** Caught by Luke Lucy-Broomfield and family.
- **Matsojak (Scallop), 32 samples.** Caught by Snowden Pijogge, Donnovan Pijogge, Liz Pijogge.
- **mitik (Common eider duck), 24 samples.** Caught by Ed Flowers, Edward Sillitt, Liz Pijogge, Jerry Barbour, William Ikkusek.
- **naujaummijuk (Northern fulmar/Fulmarus glacialis), 70 samples**, based on a study by Avery Gomm et al (2018).

Freshly caught salmon being prepared. Photo: Eldred Allen

Figure 25: Map of plastic ingestion caught for food in Nunatsiavut, 2017-2025



Black circles indicate the number of animals that did not ingest plastics, with the number of animals that did ingest plastics in yellow over top. The number of each is represented by the size of the circles.

Table 15: Summary for plastic ingestion by all animals in Nunatsiavut, 2017–2025

Animal	Sample size	# animals that ate plastic	% animals that ate plastic (%FO)[a]	% animals that did NOT eat plastic	Total number of plastics eaten	Median # of plastics eaten per animal[b]	Mean # of plastics eaten per animal	SD in the mean[c]	Range of # plastics eaten per animal	IQR of plastics eaten[d]	Average size of plastics eaten (mm)[e]	Average plastic size similar to
iKaluk (Arctic char)	348	89	26%	74%	125	0	0.4	0.8	0–7	1.0	2.53	match head
natsik (Ringed seal)	152	66	43%	57%	109	0	0.7	1.1	0–7	1.0	3.06	Q-tip
aKiggik (White partridge)	74	18	24%	76%	26	0	0.4	0.7	0–3	0.0	0.79	mechanical pencil tip
Ogatuinnak (Atlantic cod)	68	9	13%	87%	10	0	0.2	0.4	0–2	0.0	6.10	pencil eraser
appak (Thick-billed murre)	40	5	13%	88%	10	0	0.3	1.0	0–6	0.0	2.93	Q-tip
Natânnavak (Turbot)	33	3	9%	91%	3	0	0.1	0.3	0–1	0.0		
pitsiulâk (Black guillemot)	32	12	38%	63%	19	0	0.6	1.0	0–4	1.0	2.83	Q-tip
Ujagak Ogâtsuk (Rock cod)	32	2	6%	94%	2	0	0.1	0.2	0–1	0.0	1.23	sewing pin
Matsojak (Scallop)	32	3	9%	91%	4	0	0.1	0.4	0–2	0.0	21.33	nickel
mitik (Common eider)	24	7	29%	71%	11	0	0.5	0.9	0–3	1.0	1.01	sharp pencil tip
Ânâtlik (Brook trout)	19	1	5%	95%	1	0	0.1	0.2	0–1	0.0	2.22	sesame seed
kavaisitik (Salmon)	17	2	12%	88%	2	0	0.1	0.3	0–1	0.0	2.89	Q-tip
Suglutuk (Surf scoter)	11	5	45%	55%	9	0	0.8	1.1	0–3	1.5	1.03	sharp pencil tip
Appaliatsuk (Dovekie)	8	3	38%	63%	3	0	0.4	0.5	0–1	1.0	1.03	sharp pencil tip
A-angik (Hound duck)	3	1	33%	67%	1	0	0.3	0.6	0–1	0.5	1.65	blunt pencil tip
kanajuk (Sculpin)	3	0	0%	100%	0	0	0.0	0.0	0	0.0		
Ânâtlik (Lake trout)	2	1	50%	50%	1	0.5	0.5	0.7	0–1	0.5	5.32	pencil eraser
Pitsuilâppak (Brasswing)	1	1	100%	0%	1	1	1.0		1	0.0	9.92	pinky fingernail
niglik (Canada goose)	1	0	0%	100%	0	0	0.0		0	0.0	1.07	sharp pencil tip
Nipisak (Lump fish)	1	1	100%	0%	4	4	4.0		4	0.0	2.36	pinhead
Naujaummijuk (Northern fulmar)[f]	80	19	24%	76%	928		11.6		0–135		5.98	pencil eraser

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

Legend (Table opposite)

This table includes data for animals where we had 24 samples or more. Sample sizes under 24 are understood to be preliminary and areas for further study.

[a] 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 how much plastic they ingested.

[b] 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 samples ate no plastics.

[c] The standard deviation (SD) tells us how spread out the data is around the mean. A smaller SD means data points are closer to the mean, while a larger SD means they are more spread out.

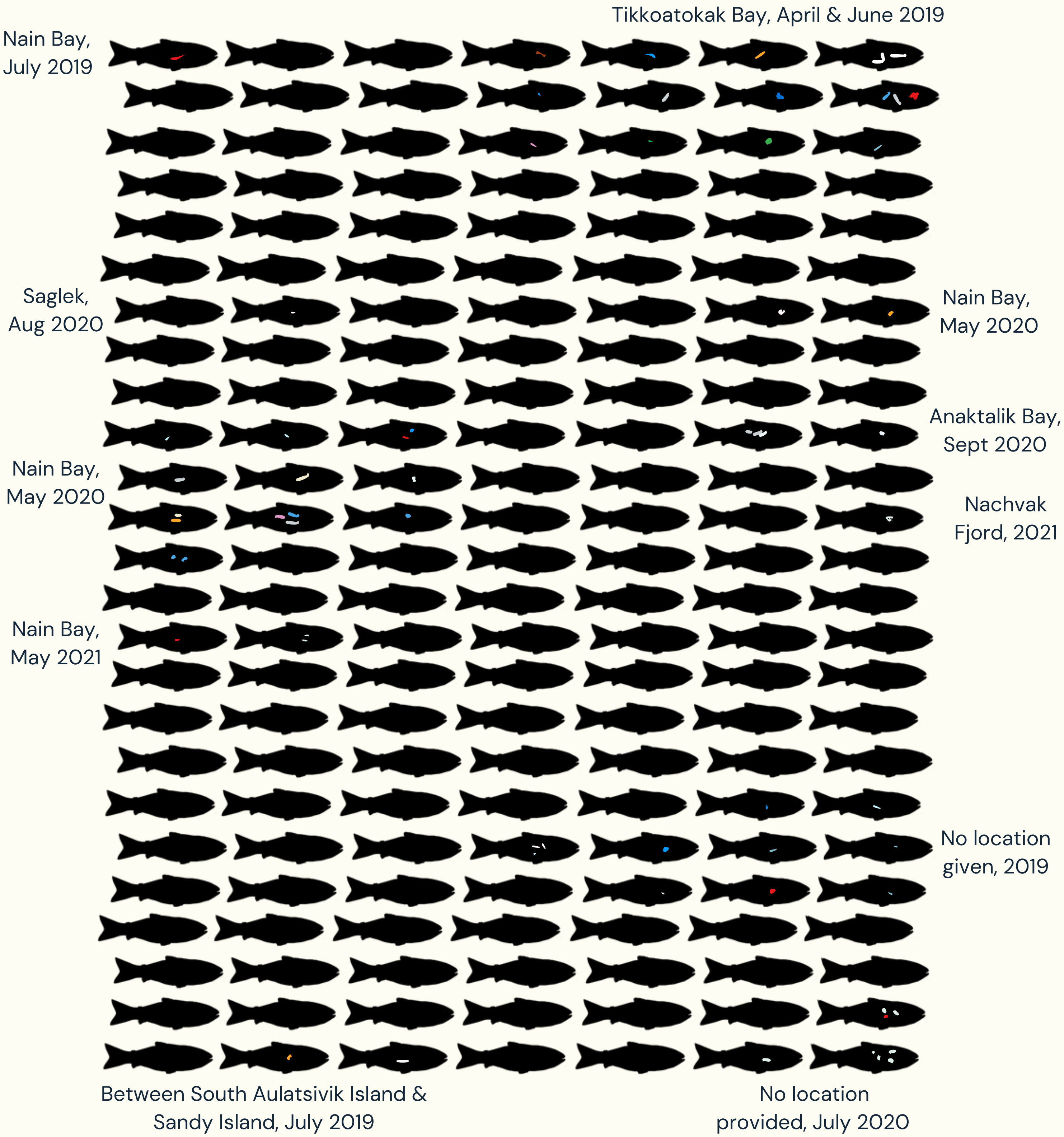
[d] The Interquartile range (IQR) tells us about the spread of the middle 50% of data points. An IQR of 0 means that most animals ate the same number of plastics.

[e] Mean length of the longest side.

[f] Data for naujaummijuk (Northern fulmar) are based on combining two published studies that were not created as part of this study: Avery Gomm et al., 2018 and Provencher et al., 2018.

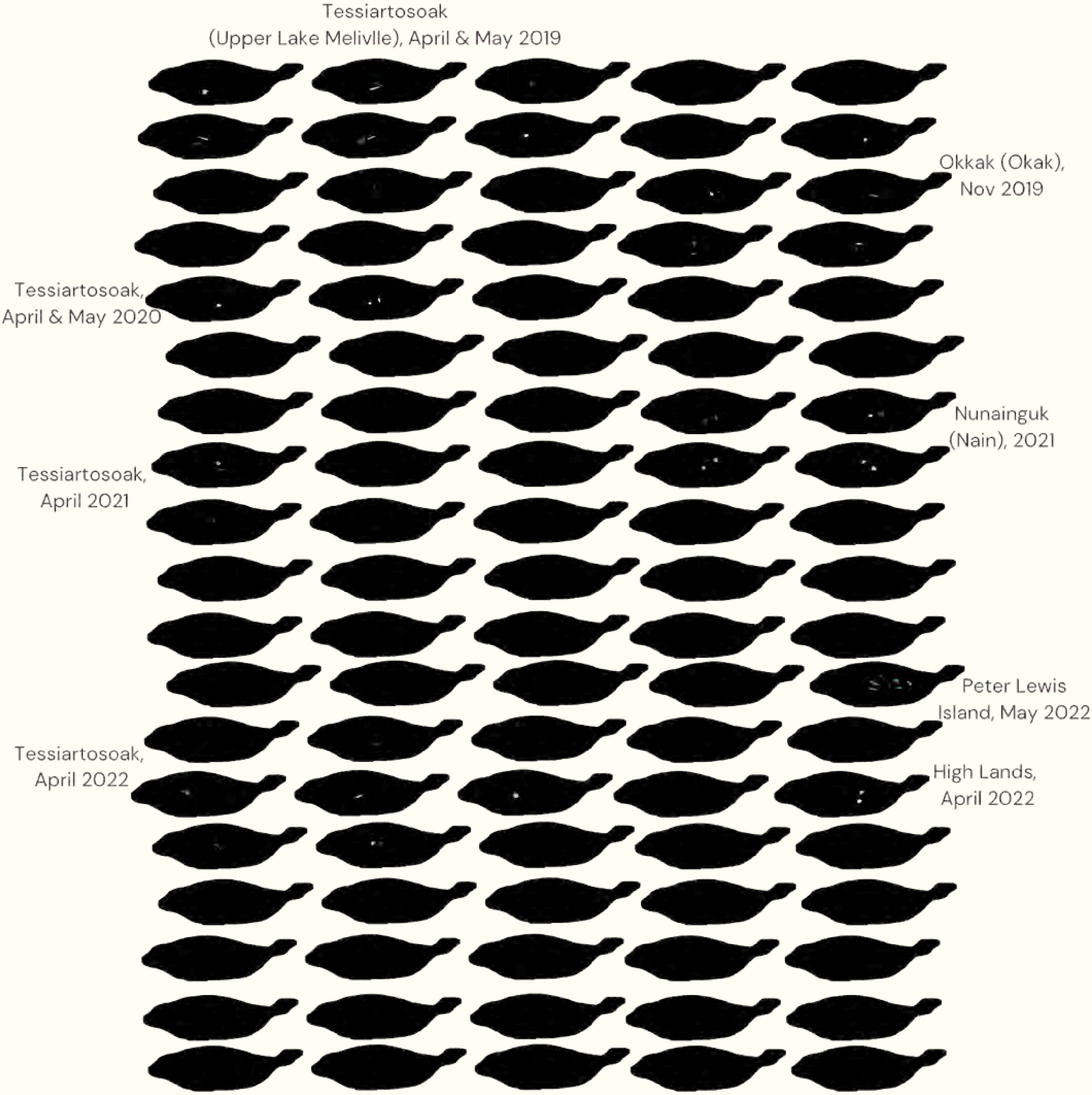
Unknown fisher cleaning a Ânâtlik (trout). Photo: Eldred Allen

Figure 26: Description of plastics ingested by iKaluit (Arctic char) in Nunatsiavut, 2017-2022



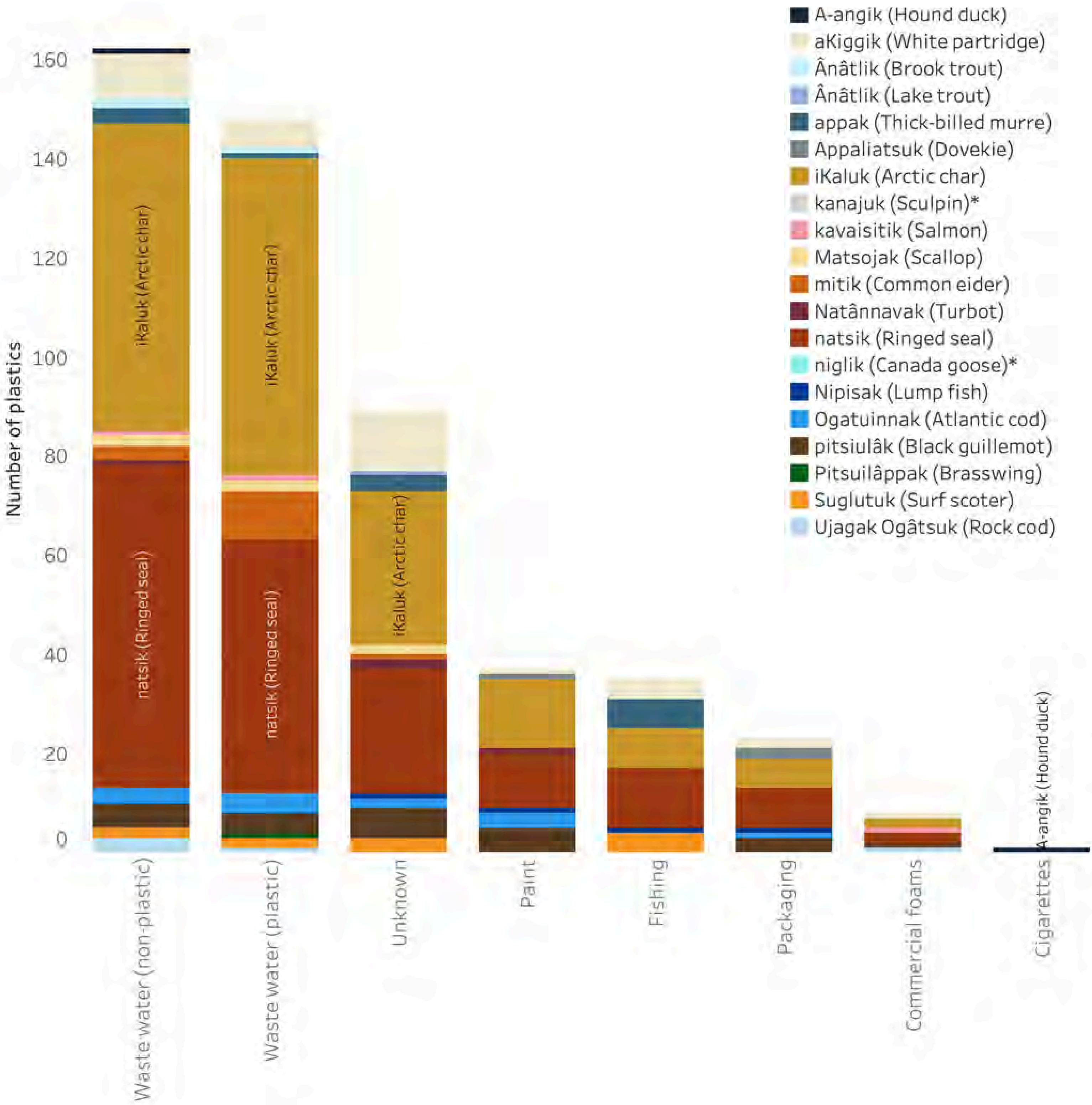
This infographic shows the number of fish that did not eat plastics, and for those that did, the number, shape, and colour of plastics are shown along with the location, month, and year the fish was caught. The plastics pictured are not to scale (in reality you can only see most of them with a microscope!). We processed 348 iKaluit between 2017-2025, but not all are pictured here.

Figure 27: Description of plastics ingested by natset (Ringed seal) in Nunatsiavut, 2017-2022



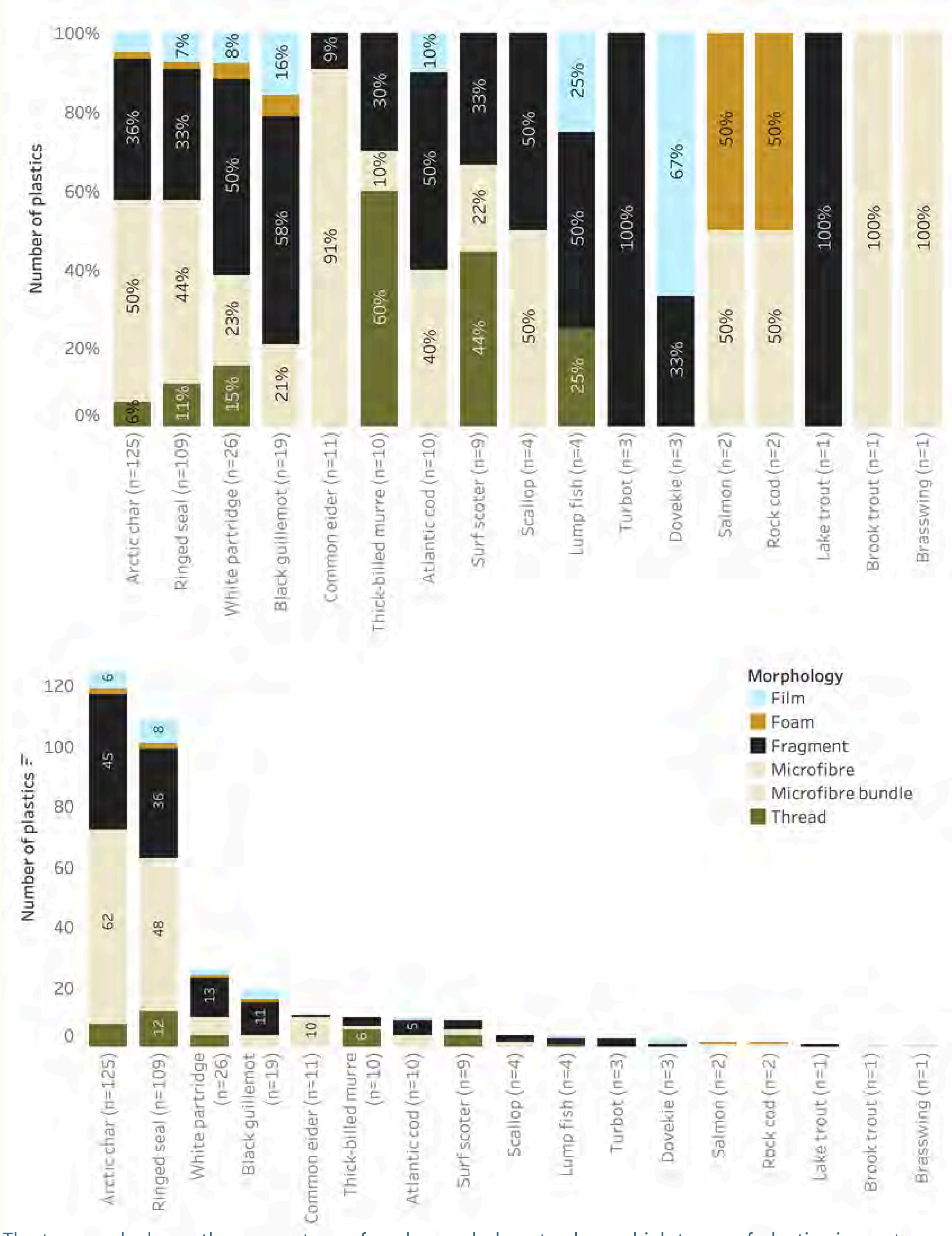
This infographic shows whether a natsik ingested plastics and for those that did, the number, shape, and colour of plastics are shown along with the location, month (if available), and year the fish was caught. The plastics pictured are not to scale (in reality you can only see most of them with a microscope!). We studied 152 natset between 2017-2025, but not all are pictured here.

Figure 28: Likely sources of plastics ingested by animals, 2017-2025



Natset (ringed seal) and iKaluit (Arctic char) are the largest blocks on most of the bars because we have the largest sample sizes for those animals. You can see that the proportions are pretty stable across all souces, with some minor changes here and there. We labeled the single A-angik (hound duck) because it is the only cigarette butt ingested by an animal in our whole study. This is still important though, because cigarette butts are by far the most toxic plastic we found ingested by any animal, and the only plastic from our study that can certainly have negative health impacts for an animal.

Figure 29: Morphologies of plastics ingested by animals, 2017-2025



The top graph shows the percentage of each morphology to show which types of plastics impact certain species. The bottom graph shows the raw number of plastics, which varies widely across species. The (n) after each animal refers to the number of plastics being described.
Morphology refers to the form of the plastic. Film plastics are from plastic sheeting or bags and are almost always local in origin. Foams are also usually local. Fragments are smaller pieces of larger plastics (birds often eat more fragments, worldwide). Microfibres are from clothing and are found in wastewater. Threads are usually from fishing gear.

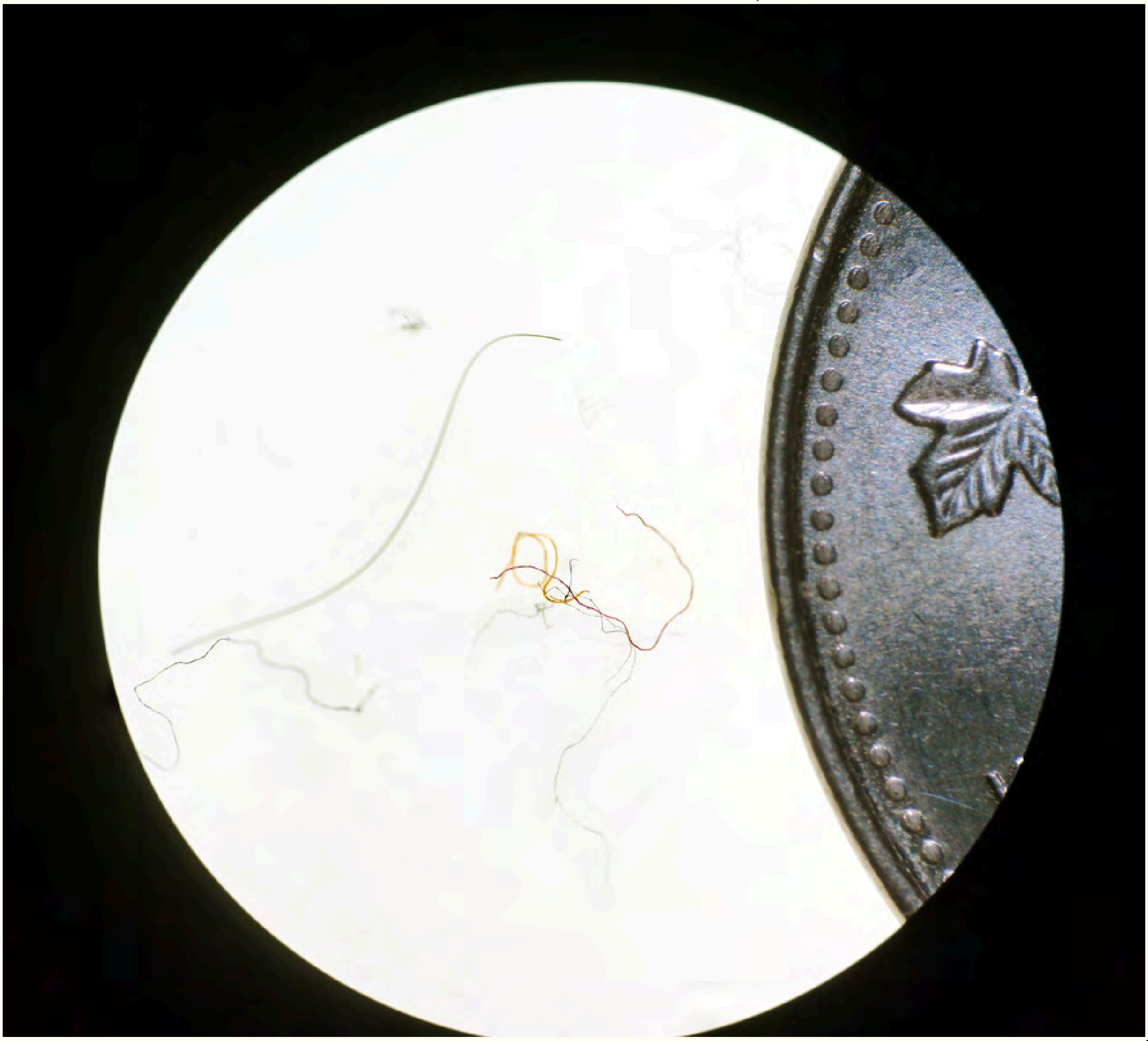
Almost half (43%) of the plastics ingested by animals used for wild food in this study were microfibres like those in house dust.

Naujaummijuit (Northern fulmars) are very different from the other animals. They eat more larger plastics more often (76% of the 80 birds sampled ate an average of 11.6 plastics each; the average size was nearly 6mm, which is the size of a pencil eraser). They also aren't wild food species, and only pass through Nunatsiavut to migrate. That means they arent eaten as often as other wild food.

Overall, each animal ingested a lower number of plastics than the number of plastic microfibers that would fall on your dinner plate from house dust.

A study in the United Kingdom calculated that about 114 plastic microfibers would land on an average-sized dinner plate (12.5cm radius) during a 20-minute meal (Catarino et al 2018).

Microfibers next to a nickel for scale taken under a microscope (St John's). Photo: Max Liboiron.



Melissa Morgan processes a trawl sample in the lab while CJ Hoegg-Phelps loosk on, 2024. Photo: Alex Stead.

TakugatsaKangilak upvalu ilimanattuKalungilak pisimajunit palâstikkinit

No evidence of physical or chemical harm from plastics

None of the animals in this study had plastics blocking their guts, puncture wounds or ulcers from plastics, or had guts full of plastics that would have made them feel full. That doesn't mean this doesn't happen, but that it isn't common in the species we studied.

Figure 30: The relative size of typical plastics we find in our study, compared to a sharpie and a quarter

We are not worried that ingestion of plastics means more chemicals in the food web.

Plastics are known to absorb chemicals such as PCBs and can carry some of their own chemicals in from their manufacture like phthalates or bisphenol A (BPA). Some scientists find that these chemicals move from plastics into the animals that eat them, and some find the chemicals do not move into the animals.

We tested feathers from over 50 Partridge, Turrs, and Eider ducks caught around Nain for mercury, lead, arsenic, and cadmium. All of these heavy metals are associated with plastics. Only one parridge had a high level of lead, which was likely from it eating a shotgun pellet. The level of lead *could not* have come from its diet, plastics, or the environment. No other birds had concerning levels of any heavy metal, and many birds had no detectable levels at all. This work was conducted in partnership with Dr. Alex Bond at the Natural History Museum (UK). Nakummek to everyone who participated in the analysis workshop in Rigolet to be part of this analysis!

A study of naujaummijuit (Northern fulmars) from the Labrador Sea focused on whether PCBs on plastics ingested by the birds transferred to their livers (Provencher et al., 2018). In this study, ten naujaummijuit (Northern fulmars) that had ingested various amounts of plastic were evaluated, including one bird with the highest number of ingested plastics in the study (31 plastics!). Even then, scientists "found no significant correlations between the PCB concentrations in the birds and the mass or number of retained ingested plastic pieces in the stomach, this held true when PCBs were considered by a number of different ways" (Provencher et al., 2018: 1). In short, even when animals are eating lots of large plastics, it doesn't mean the attached chemicals are transferring into the animals.

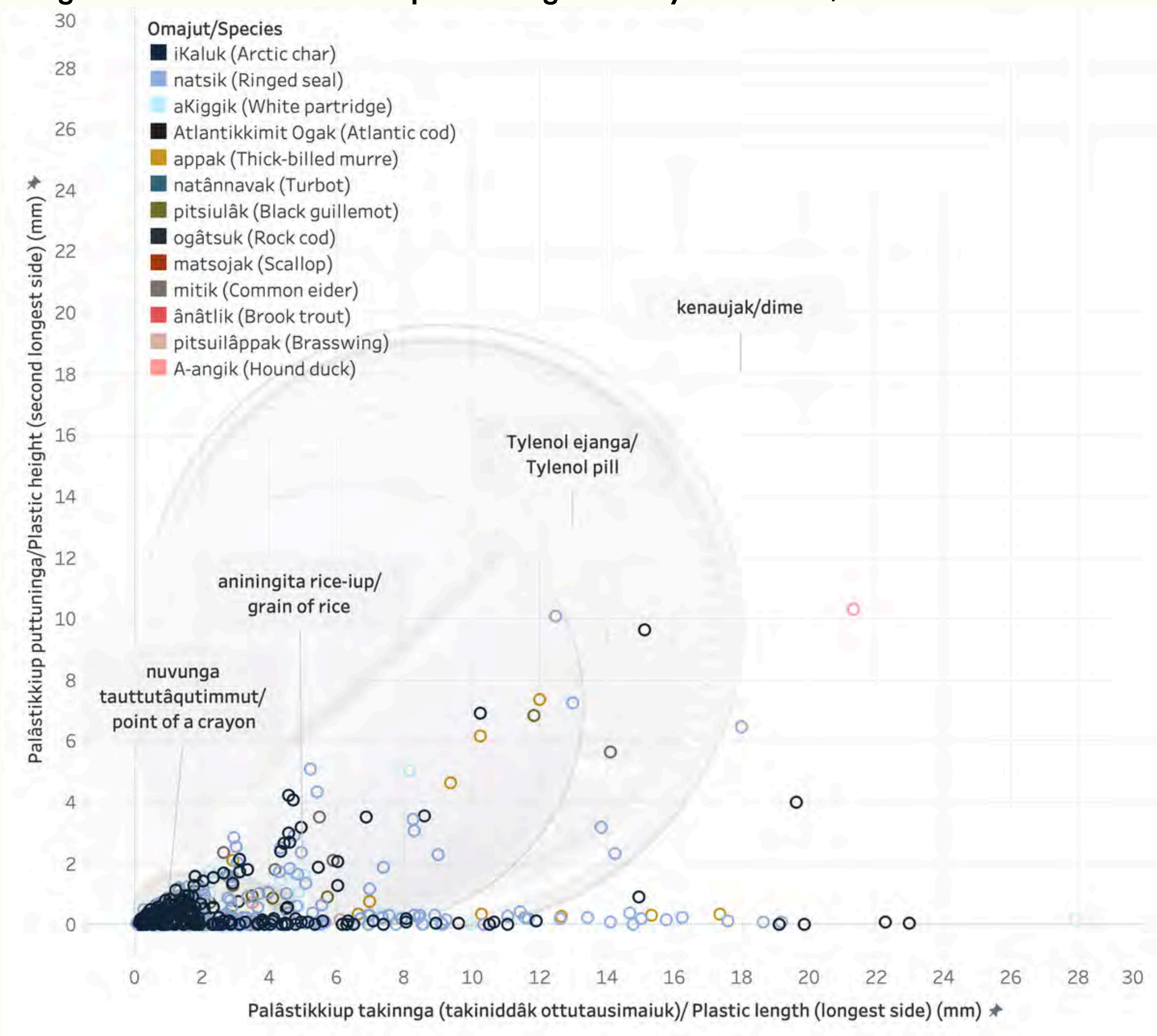
Alex Bond shows levels of heavy metals detected in birds caught around Nain during a community co-analysis workshop in Rigolet. All birds in this graph have low or no levels of heavy metals in their feathers, 2025. Photo: Paul McCarney.

The top group of plastics, which are larger and have more red and yellow fragments are characteristic of the sizes and number found in naujaummijuit (Northern fulmar). These came from sample AVI 1065 from the Labrador Sea near Okkak. At the bottom, circled in black, there are three tiny plastics: one green/blue fragment, one dark fragment, and a tiny microfibre. These are not from a single natsik (Ringed seal), but were selected from three natset to show the range of sizes that natset have eaten. The nickle is there for size reference.

Unuluat palâstikket nigijausimajut omajunut atuttauKattajunut niKituKannut mikijovuk

Most plastics ingested by animals used for wild food are tiny

Figure 31: The size of each plastic ingested by an animal, 2017-2025



This graph shows the size of each plastic by charting its longest side (bottom axis) against its second longest size (left axis) compared to common items. Most of the plastics are smaller than a grain of rice, of which more than half are smaller than the point of a crayon. A few are larger, with the largest being the size of a dime on one side (but these are flat and long). The largest item is the pink dot from the Hound duck—that is a cigarette butt.

Table 16: 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 (mm)	Median diameter of hard part (mm)	Largest diameter of plastic (mm)	Median diameter of plastic (mm)	Plastic < 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)	Mussel shell	14.91/6.56[d]	3.37/4.77[d]	5.65/0.36[d]	0.64/0.19[d]	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.

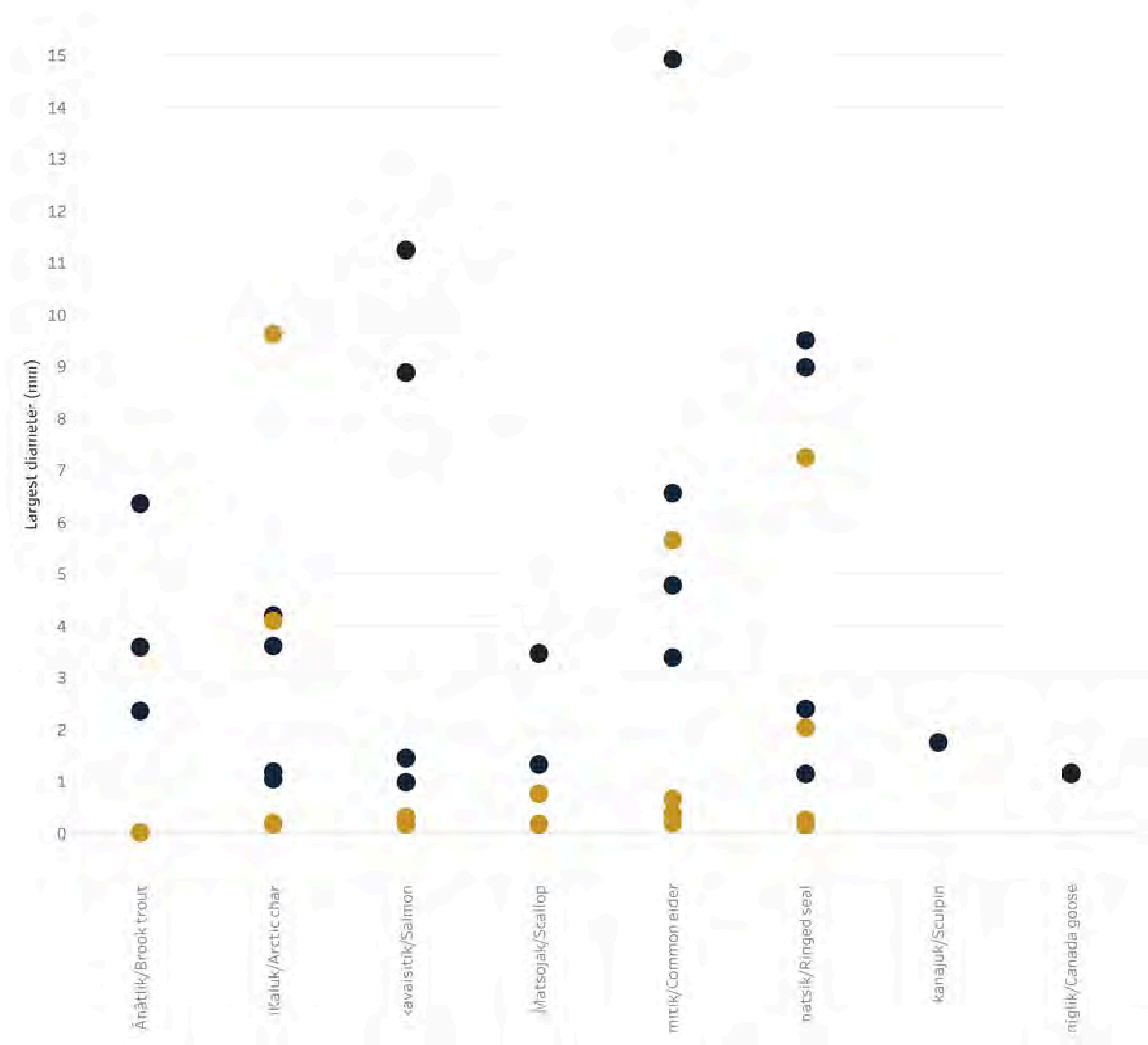
The Anattausot Metric

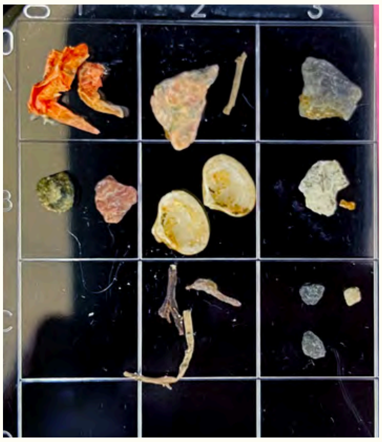
We developed the Anattausot metric to determine whether ingested plastic items are poopable. To assess poopability, we estimated the maximum size of hard, indigestible items that naturally pass through the GI tract. Since measuring an animals anus poses both logistical and ethical issues, we used a proxy measure. Our proxy: the size of a plastic compared to the width of an animal's anus. If the plastic is smaller, you've achieved anattausot!

Our measurements differed slightly in birds to account for physical differences in digestion. Specifically, birds have gizzards that can grind up hard parts, so we measured items retrieved before and after the gizzard. Additionally, birds have cloaca designed for the passage of large rigid objects, namely eggs. To contextualise and extend the Anattasout metric, we compiled species-specific average egg diameters and used a proxy for the functional maximum passage size of the distal intestine and cloaca, based on the assumption that recovered items easily passed all upstream anatomical constrictions, such as the gizzard and proventriuculus.

None of our samples had blockages of the GI tract or included plastics that were longer than the width of the animals anus. They were all poopable!

Figure 32: Largest diameter of plastic graphed with the anattausot metric for animals studied in Nunatsiavut, 2023-2025





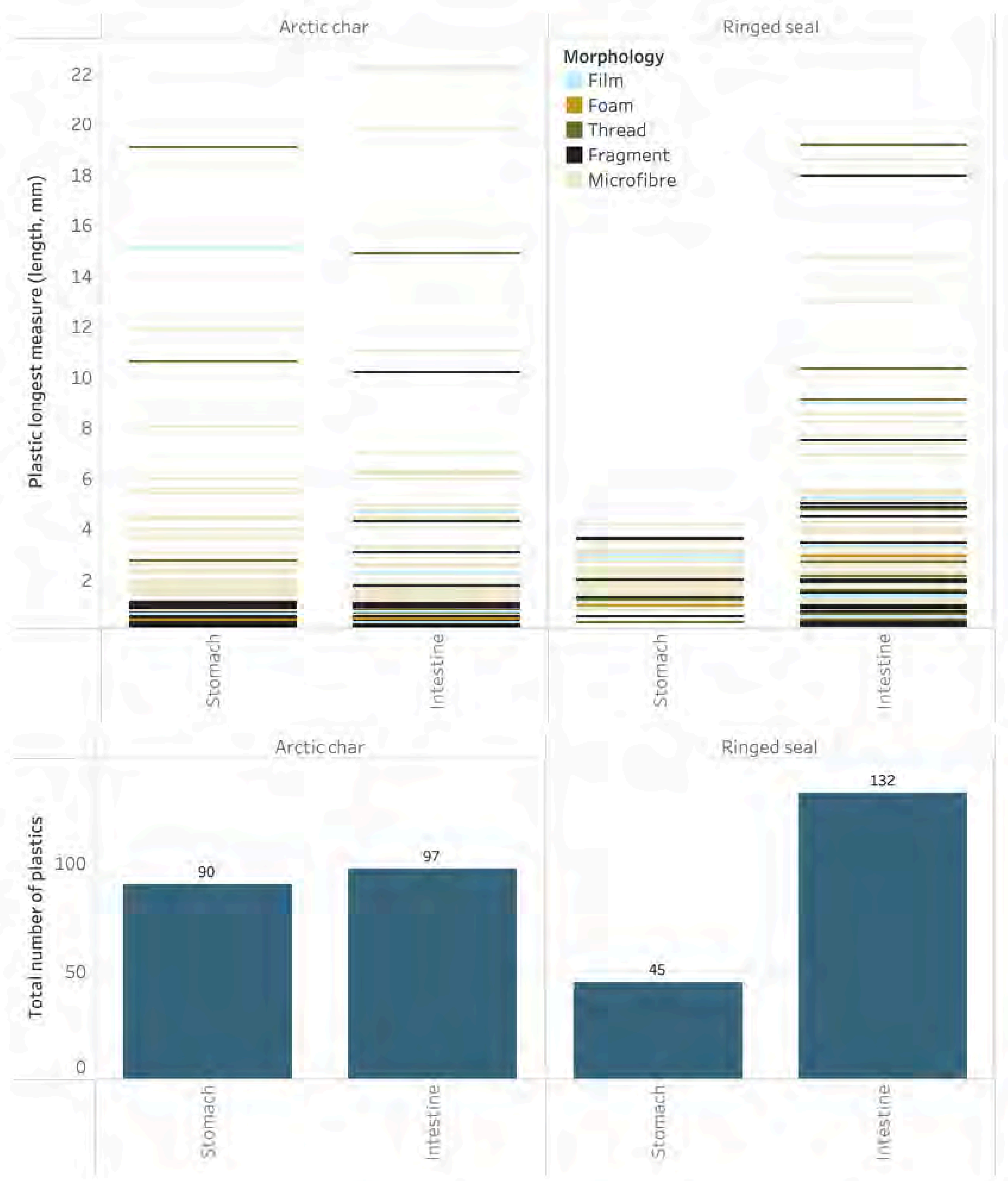
Hard parts collected from natset (Ringed seal) GIT. Photo: Max Liboiron.

Hard part measurements are in dark blue, and plastic measurements are in gold. Each point represents the maximum and median measurement of an item found before and after the intestine.

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. Whether the plastic with the largest diameter is smaller in all dimensions than the hard part with the largest diameter. The plastic with the largest diameter in char was a 9.63mm clear film made of polyethylene, which is flexible.

Though no plastics were recovered from Sculpin nor the Canada goose, their hard part measures are here for reference. Note: anattausot measurements began in 2023.

Figure 33: Location and size of plastics recovered from Arctic char and Ringed seal gastrointestinal tracts (stomach versus intestine)



The number and size of plastics in the stomach versus the intestines of different animals can vary greatly. Many plastic ingestion studies only look in the stomachs of animals, which may drastically under-represent the number, size, and even type of plastics recovered. It may also mean studies that only look at one part of the GI tract are not comparable to studies that look at the entire tract if the data can not be shifted to align. This is why we argue for harmonization, where all data is reported in a way that it can be re-aggregated for comparison, compared to standardization, where it is assumed that all methods are identical.

Table 17: Frequency of Occurrence for all animals in Nunatsiavut, 2017-2025

Animal	% of animals that ate plastic (FO%)
iKaluk (Arctic char)	26%
Natsik (Ringed seal)	43%
aKiggik (White partridge)	24%
Ogatuinnak (Atlantic cod)	13%
appak (Thick-billed murre)	13%
Natânnavak (Turbot)	9%
pitsiulâk (Black guillemot)	38%
Ujagak Ogâtsuk (Rock cod)	6%
Matsojak (Scallop)	9%
mitik (Common eider)	29%
Naujaummijuk (Northern fulmar)	76%

Some notes about how these numbers are made:
There is some science behind the way we present plastic ingestion here. First, the sample sizes must be at least 24 animals for us to report them. This is because if you have fewer animals, it's hard to tell how true the numbers are for the wider population. Maybe you just got animals that just happened to have plastic or not, like flipping a coin five times and getting heads each time.

Second, because different animals have different eating habits, we only compare species to themselves. We do not compare iKaluit (Arctic char) directly to natset (Ringed seals), for example, because they forage so differently: they aren't comparable.

Finally, the main way that Western scientists think about plastic ingestion numbers is a measure called Frequency of Occurrence (the abbreviation is "FO%"), which measures the percent of animals in the study that ingested plastics, no matter how many plastics they ate. For example, if you have one iKaluk out of ten that ate one plastic, that's a FO% of 10%. If you have one iKaluk out of ten that ate 50 plastics, that's still a FO% of 10%. Max believes that this measure is because the Western scientific traditions are mainly interested in the health of an animal population, not how an individual animal might be doing or what ingestion might mean for the people eating those animals. But when we spoke to Inuit researchers and community members, it was clear that individual animals and the number of plastics they ingested truly mattered. So did seasonality and other animal-environment links. For this reason, we will look at different ways to understand plastic ingestion by animals below.

Sunat attuiKattajon palâstikkisajannik nigijaummata?
What influences plastic ingestion?

Nalliuvik/Season likely matters to plastic ingestion by iKaluit	Visual patterns, local knowledge, and local observations show **more microfibres and more ingestion by Arctic char in the early spring**.
Jârik/Year matters to natset, iKaluit, ogatuinnait, and aKigget ingestion	The amount of plastics ingested did change year to year for the species with enough data, but not in any consistent direction: **it's not getting better or worse. Some years just had more.**
Kinijak/Foraging has potential influence on ingestion for some animals	How animals eat has a **potential influence** on the types of plastics ingested for some animals.
Inik/Place does not matter for plastic ingestion by animals	None of the species in this study showed a regional effect on how many plastics they ate. This doesn't mean there aren't local patterns, but there is **no regional pattern.**
Kâk/Hunger is not influencing whether animals in this study ingest plastics	Animals with full and empty stomachs had the same trends in plastic ingestion. **Animals are not eating plastics because they are hungry.**

How we understand "influence"
When we ask whether season, year, place, or hunger influences how much animals ingest of plastics, we are asking whether there is a **meaningful pattern in the variation** (between seasons, between years, between places, etc.).

There are many ways to answer this question. Inferential statistics, which tell us whether variation is due to chance or a meaningful pattern, is one way. So is local and Inuit knowledge, visual identification of patterns, and lived experience. In this dataset, 'influence' is not well captured by statistical significance alone, and we rely on all sources of knowledge to report the influence of factors on plastic ingestion.

In short, **when we say influence, we mean a consistent, plausible, and contextually supported pattern of variation,** even if it is not statistically detectable under current sampling conditions.

Nalliuvik /Season

likely matters to plastic ingestion by iKaluit

The animals for which we have the most consistent seasonal data is iKaluit (Arctic char). Spring is when iKaluit (Arctic char) are in freshwater and are caught by ice fishing. In late spring (June), they move from freshwater to marine water and eat intensively. Liz related the observation that when the ice melts in June and the char come down, the water is dirty and full of waste that's been frozen in the ice all winter, so iKaluit (Arctic char) would likely eat more plastics then.

In the summer, iKaluit (Arctic char) remain in marine areas to feed in June and July. Reuben Flowers told us about how iKaluit (Arctic char) go back to freshwater the last full moon in July, when the highest tide can get them to the lakes (if there is low rain and the river is low, they have to wait and this might extend the summer season, but only for iKaluit). In the fall, August and September, iKaluit (Arctic char) are back in freshwater, and fat from their summer eating.

Local knowledge and raw numbers: Liz and Reuben's knowledge aligns with the data, but only when we look at the total number of plastics, rather than the ratio of iKaluit (Arctic char) ingesting plastics FO% (Fig. 31). That is, a "usual" number of iKaluit (Arctic char) are ingesting plastics, but they are ingesting more. Since one of the things we care about most is the number of plastics entering Inuit foodways as well as the health of animals, the number of plastics is important.

The statistics: When we did statistics on iKaluit (Arctic char), but also other animals for which we have samples in two or more seasons—natset (Ringed seal), ogatuinnait (Atlantic cod), and aKigget (White partridge)—no statistical pattern was detected. That is, the statistics say that even though there are more or fewer plastics or animals ingesting plastics, the variation is not strong enough to say there is a meaningful trend. This included negative binomial models for the presence or absence of plastic (with or without the inclusion of region, $p = 0.34$). Inter-annual variation in seasonal plastic ingestion (variance = 0.35) could be contributing to the lack of statistically significant seasonal trends per species. A linear trend model that looked at the total count of plastics in iKaluit (Arctic char) *across* months did not find a statistically significant trend ($p = 0.34$).

These statistics specifically mean that there isn't strong *statistical* evidence that there is a seasonal influence—it does not prove there is no effect. Instead, it suggests high variability, and/or limited sample size, and/or a weak or inconsistent effect: things that make statistics less powerful.

Overall: Given the strong descriptive, local, and observational knowledge, we conclude that the data suggests an increased intensity of plastic ingestion in the spring, and a higher likelihood of ingesting microfibres (the smallest and most common type of marine plastic).

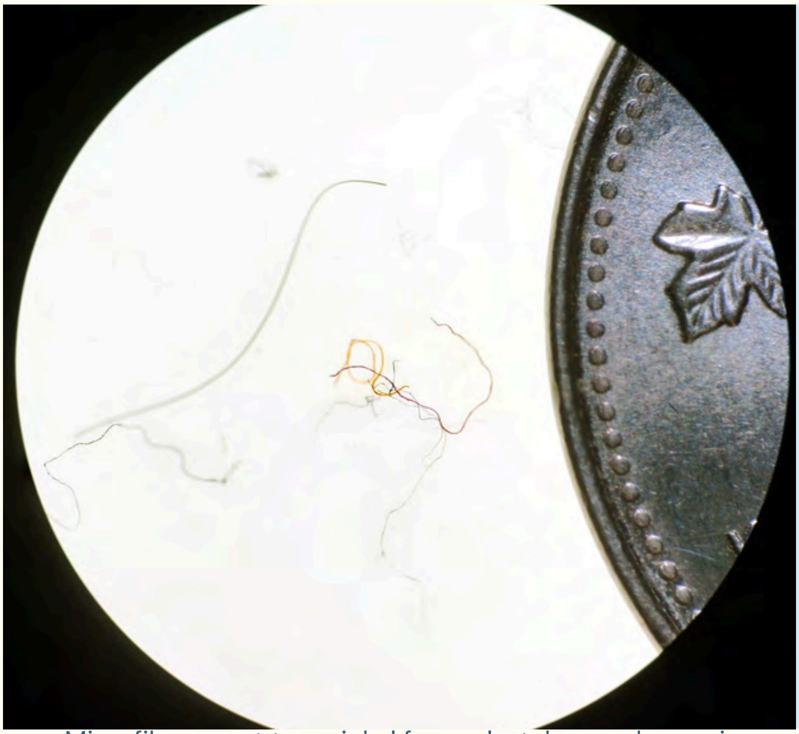
In the spring (during ice melt), most plastics are microfibres from laundry wastewater. In the summer, this shifts to fragments.

Through Pearson's Chi-squared tests, we did find a suggestive seasonal trend in the morphologies (shapes) ($p=0.08$) and colours ($p=0.07$) of plastics ingested by iKaluit (Arctic char). We don't have enough plastics from fall char (n=6) to understand if there is a shift there. There was not enough variation in the particles ingested by other seasonally sampled species (natset, ogatuinnait and aKigget) to complete these statistical tests for them.

Table 18: Morphologies (shapes) of plastics ingested by iKaluit (Arctic char) by season

Months	Season	Fragment	Microfibre	Thread	Film	Foam	Total plastics
Mar - mid May	Early Spring	13 (26%)	31 (62%)	3 (6%)	1 (2%)	2 (4%)	**50**
end May - Jun	Spring	2 (18%)	8 (73%)	0%	1 (11%)	0%	**11**
Jul - Aug	Summer	19 (54%)	13 (37%)	1 (3%)	2 (6%)	0%	**35**
Sept - mid Oct	early Fall	0%	6 (100%)	0%	0%	0%	**6**
All months	**Total**	**34 (33%)**	**58 (57%)**	**4 (4%)**	**4 (4%)**	**2 (2%)**	**102**

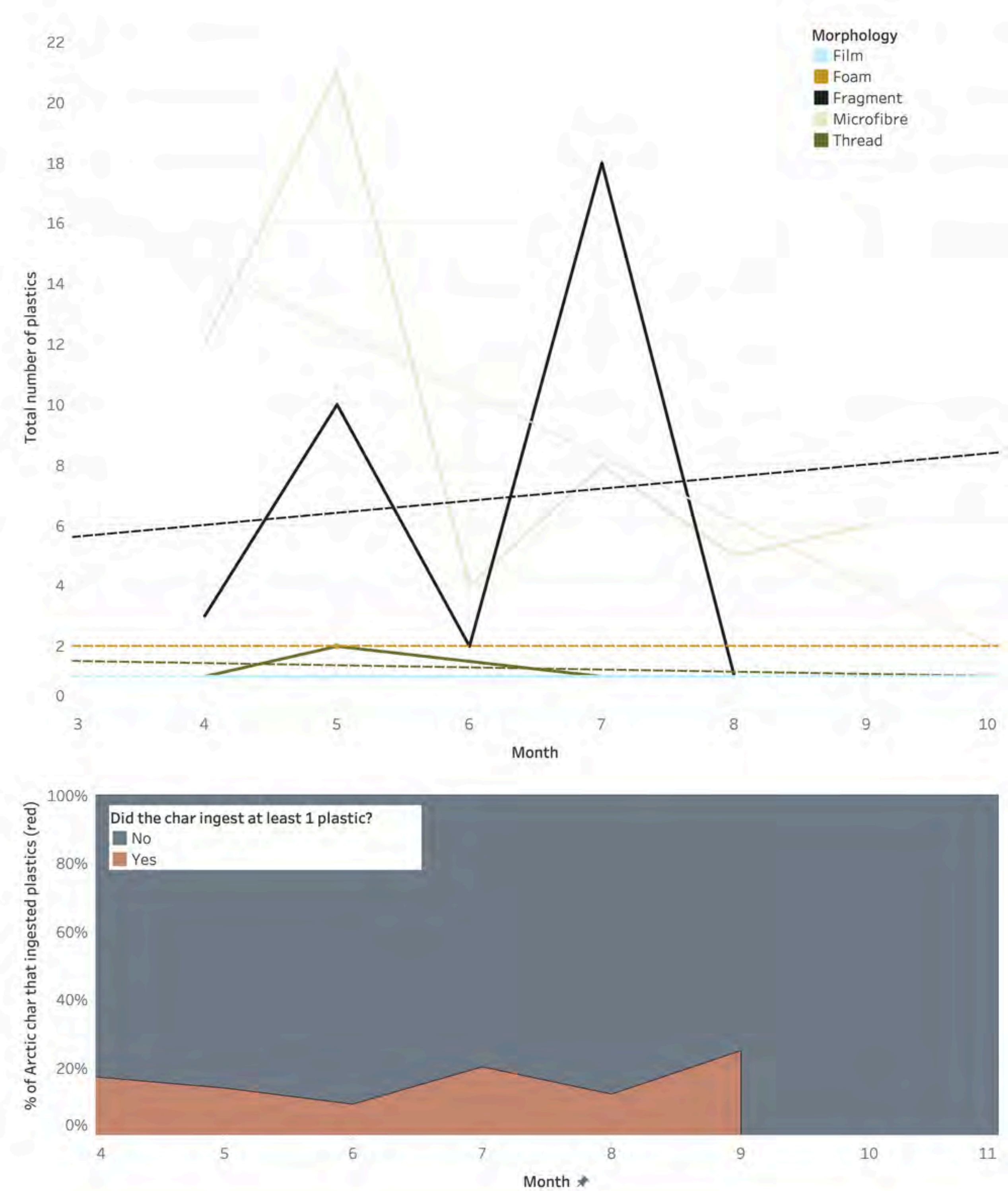
0%	1-24%	25-49%	50-74%	75-100%



One of the reasons we are not worried about plastic ingestion in iKaluit (Arctic char) is because **more than half (60%) of the plastics they eat are microfibres the size of dust** (literally lint from laundry wastewater, see photo to the left) and the share of microfibres is highest in the spring during runoff and ice melt when they eat more plastics (49%).

Microfibers next to a nickel for scale, taken under a microscope (St. John's), 2021. Photo: Max Liboiron

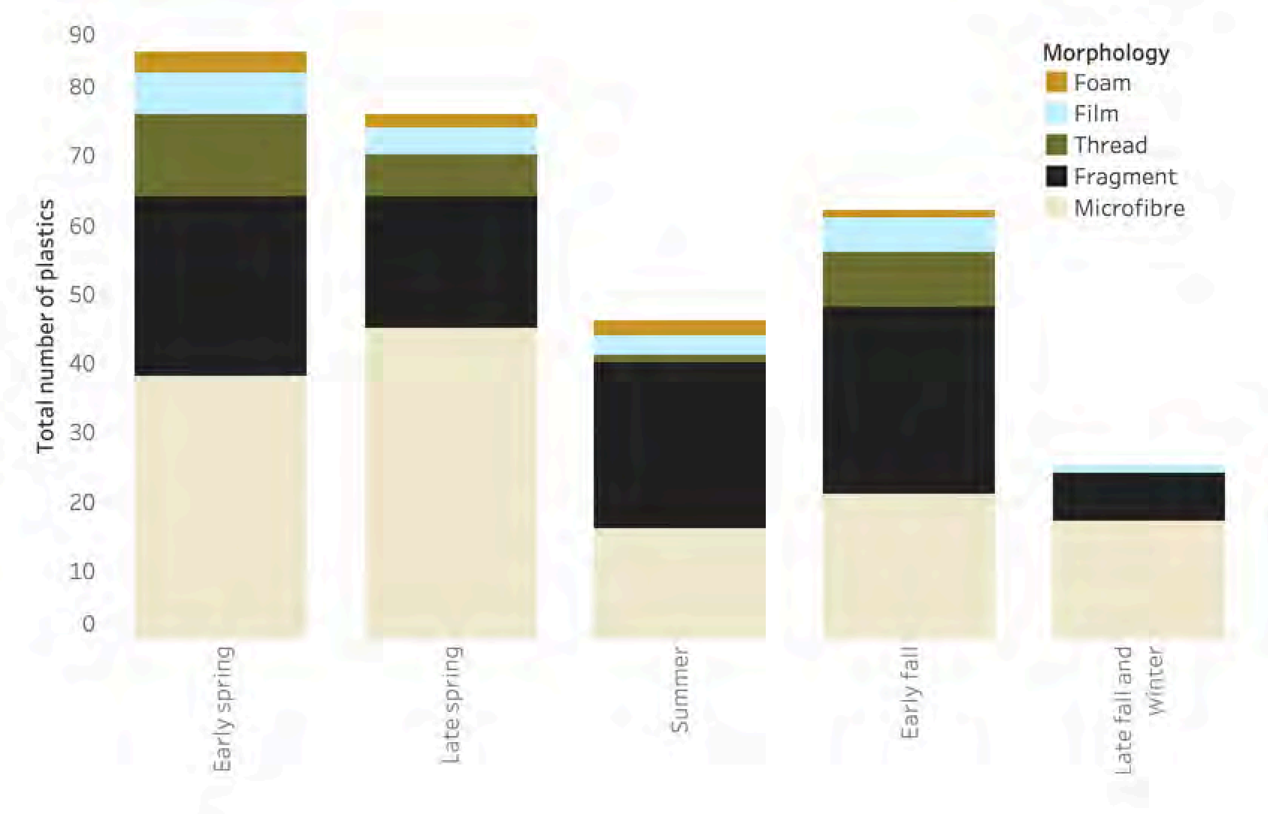
Figure 34: Plastics ingested by iKaluit (Arctic char) by season and month in Nunatsiavut, 2017-2026

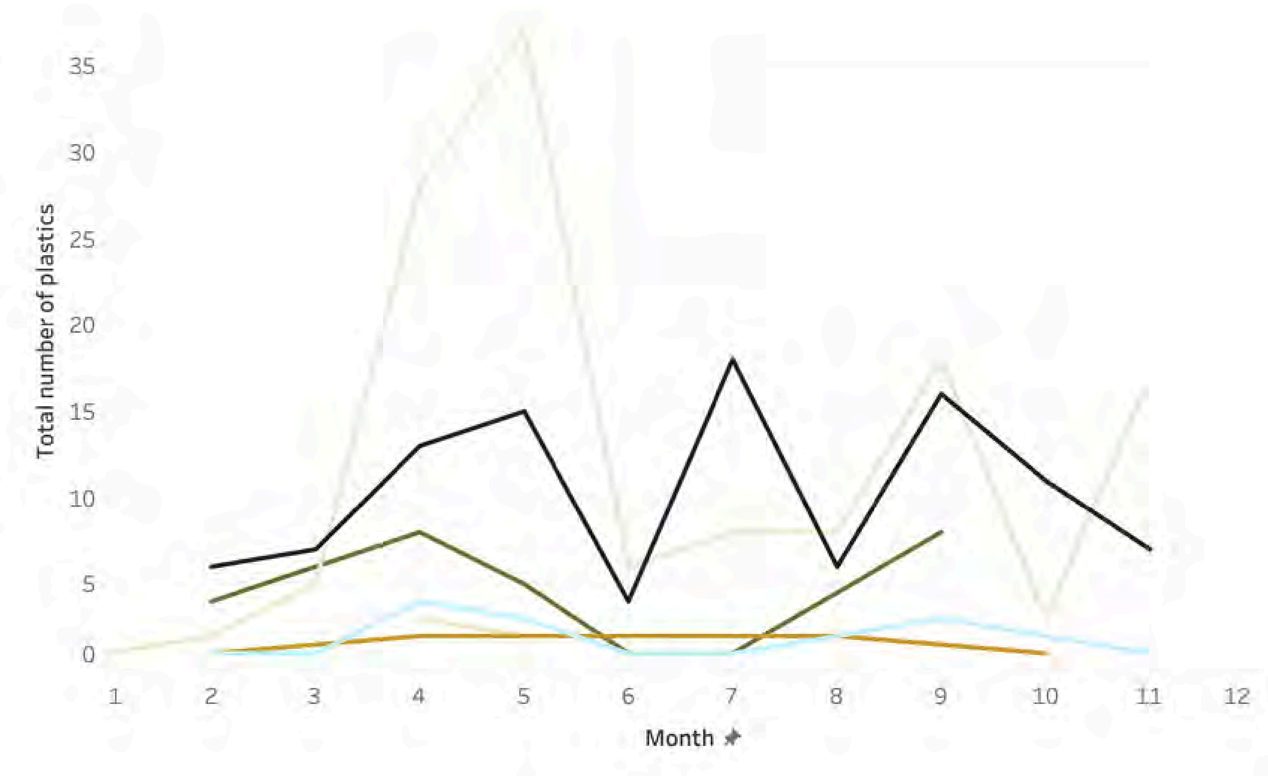


The top line chart shows the total number of plastics ingested by iKaluit (Arctic char), regardless of how many were caught, by morphology. The spike of microfibers in May (month 5) during ice break-up is when water is dirtiest. Though there is an obvious visual decrease in microfibers in later months, the trend line based on a linear regression has a p-value of 0.189 (not significant).

The bottom graph is of the frequency of occurrence (FO%) for the same time period. The percent of iKlauit (Arctic char) that ingested plastics, regardless of how many plastics they ingested. This does not show the spike in plastics during ice breakup. We have both here to show that the main scientific metric for animal ingestion, FO%, does not always serve the request questions of community members, nor is it well-suited to show the number of plastics entering foodways.

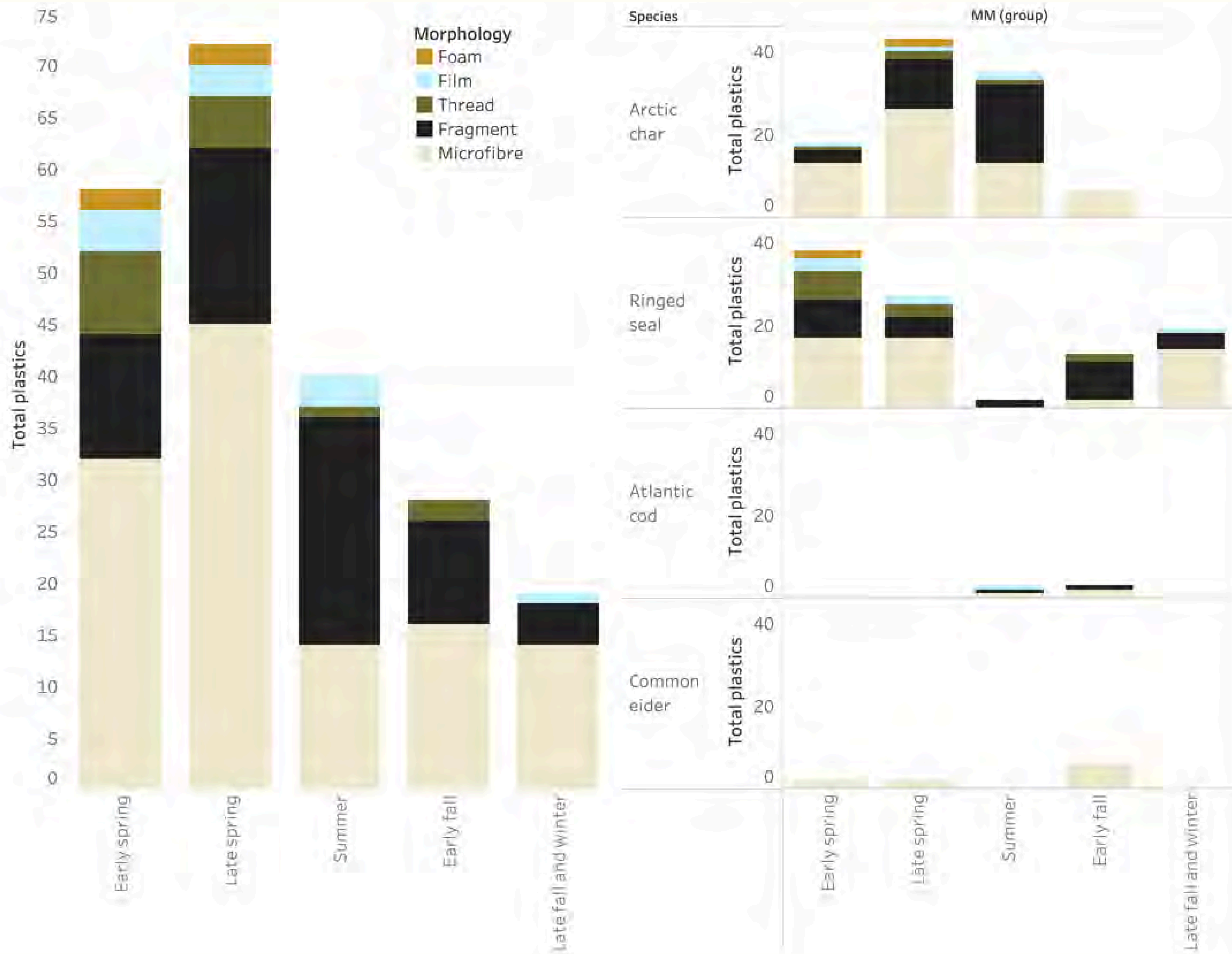
Figure 35: All plastics ingested by all animals by season and month in Nunatsiavut, 2017-2025





These graphs show all the plastics in Inuit foodways by season (top) and month (bottom). They include all animals, regardless of sample size and whether the animals were caught across seasons. The plastics are colour-coded to show the morphologies (types) of plastics. The spike in microfibers in the spring is driven, in part, by the high number of iKaluit (Arctic char) in the study.

Figure 36: 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



The graphs above break down the 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 data visualizations show the higher number of plastics of all kinds, but particularly microfibres, in the early and late spring, but also how this shifts by animal and sample size. They highlight why a combination of count and kind of plastics, as well as species and how we sample, are important to the story of seasonal plastic ingestion—there is some important variation. **But overall,** animals we have the most data for—iKaluit (Arctic char) and natset (Ringed seals)—ingest more plastics in the spring and there are more microfibres in the late spring for iKaluit (Arctic char).

Manasse Pijogge collects mussels in Inkanialuk, near Nunainguk (Nain) in the Spring, April 2024.
Photo: Max Liboiron

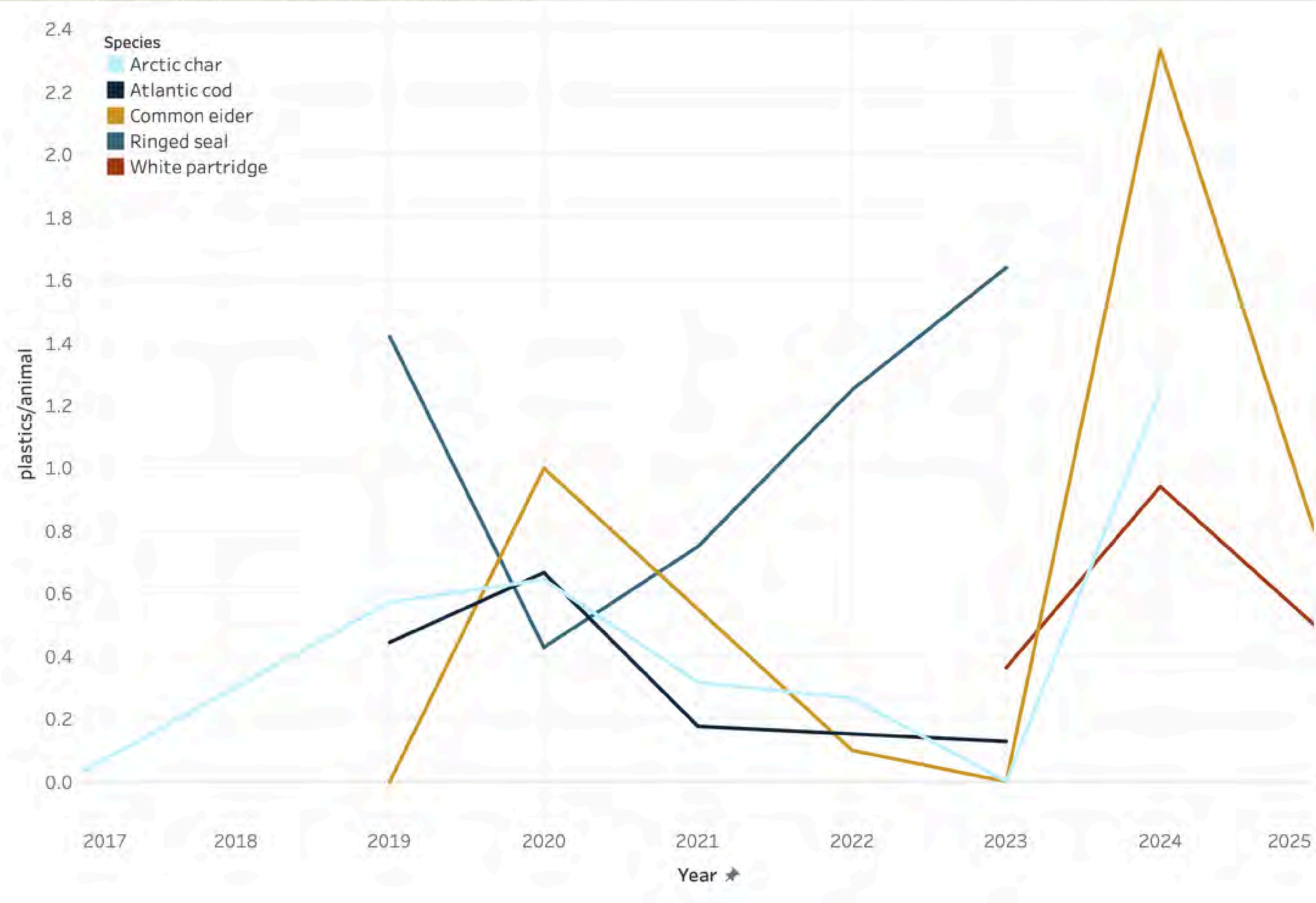
Jârik/Year

does matter to natset, iKaluit, ogatuinnait and aKigget plastic ingestion

For animals that we have samples from multiple years, **the year influenced the number of plastics ingested per animal.** This includes Kaluit (Arctic char), natset (Ringed seals), ogatuinnait (Atlantic cod) and aKigget (White partridge). Negative binomial models based on the number of plastics per animal showed variation in plastic ingestion trends from year to year (random effect variance = 0.35). For iKaluit (Arctic char), alone, we also ran frequency of occurrence (FO%), and the year of collection was a significant predictor of plastic ingestion when subject to a binomial generalized linear model (p=0.03).

There was not a consistent upward or downward trend in years. This means the problem is not getting noticeably worse over time, but is meaningfully different from year to year. iKaluit (Arctic char) caught in 2017 and 2021 had significantly lower plastic ingestion than those caught in 2024 (p=0.03, and 0.003, respectively), while those caught in 2020 had higher plastic ingestion than those caught in 2021 (p=0.03).

Figure 37: Plastics ingested per animal, by year



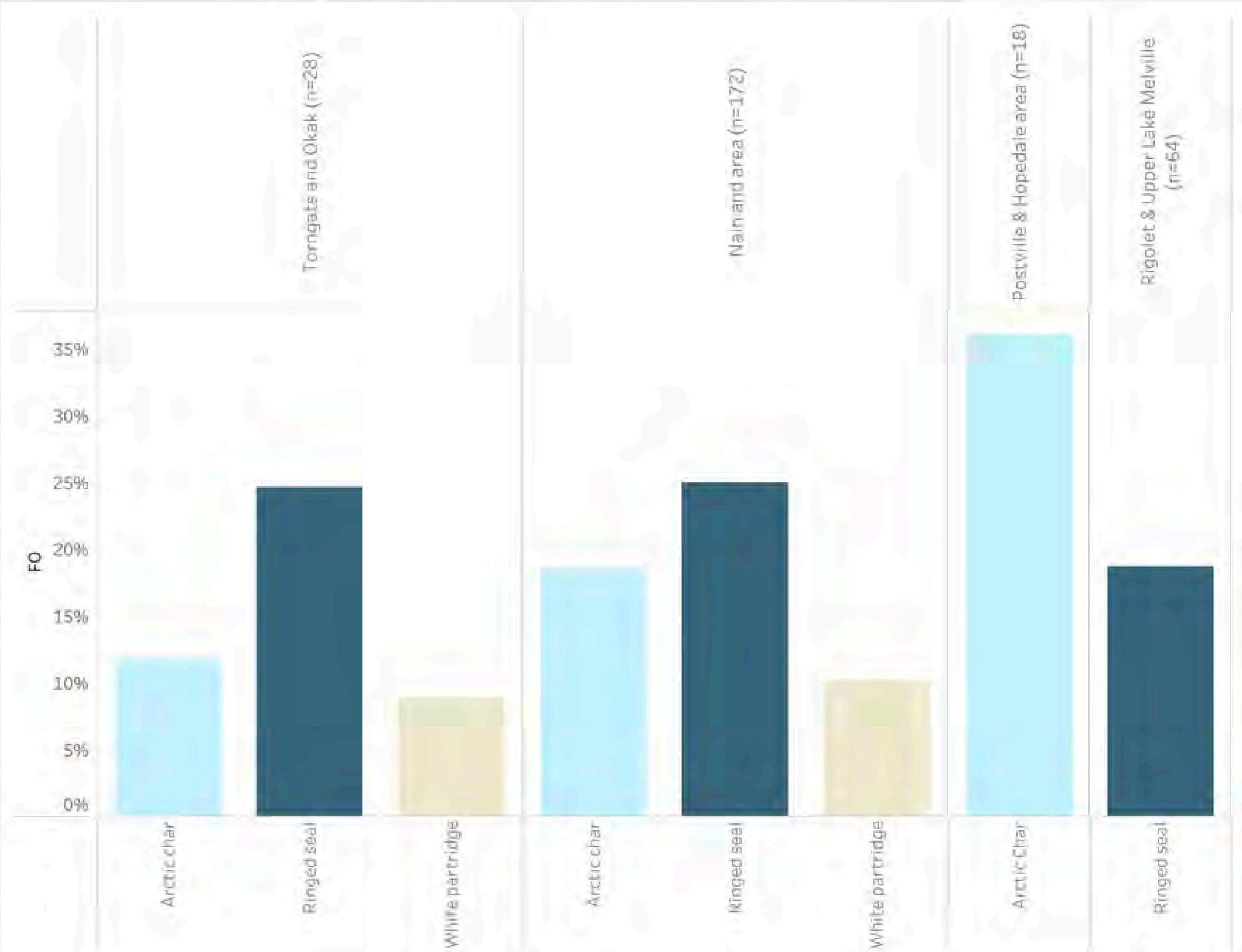
There is a meaningful variation in the number of plastics per animal within these five species, all of whom have three or more years of sample collection data. Visually, the trends look all over the place—and they are! There isn't a trend across years, meaning there isn't an overall increase or decrease over time. Instead, there are peaks and valleys in each year.

Inik/ Place

does **not** matter for plastic ingestion by iKaluit, natset, ogatuinnait or aKigget

A regional analysis on animals is difficult because most animals aren't eating plastics, and you cannot compare FO% across species, since different animals eat differently. Also, we have very different sample sizes of animals from different locations and many of them are too small for comparison (Fig. 35). However, we have some species with good or ok sample sizes from different regions: iKaluit (Arctic char), natset (Ringed seal), and aKigget (White partridge).

Figure 38: Frequency of occurrence for animals in different regions of Nunatsiavut, 2017-2025.



Animals have a sample size of twenty (20) or more in each location. This is fairly small, but there are few animals with enough samples in each region for analysis. For example, Makkovik had only ten iKaluit (Arctic char) and was excluded. The combined sample size for all animals in each region is noted by (n).

Statistically, a mixed model binomial generalized liner model (GLM) found place not to significantly contribute to plastic ingestion in iKaluit (Arctic char), natset (Ringed seal), ogatuinnait (Atlantic cod) or aKigget (White partridge) (random effect variance = 3.018×10^{9}). That means that while some of the numbers look different, the differences are likely due to chance, sample size, or other factors.

Kâk/Hunger
is **not** influencing whether animals ingest plastics

A binomial generalized linear model (GLM) and analysis of deviance (ANOVA) showed that when controlling for species, there is no significant link at this time between the presence/absence of food in the animal's gut and plastic ingestion ($p=0.5$). Animals do not seem to be eating plastic because they are hungry.

Kinijak/ Foraging
has potential influence on the types of plastics ingested

We wanted to see if animals were eating the same kind of plastics that were in the water, or if they were being selective, and eating certain types of plastic on purpose. We ran a statistical model (PERMANOVA) comparing the morphologies, colours and polymers of ingested plastics in species with 24 or more individuals. None of the species had ingested plastics that differed significantly from plastics in surface trawls. However, ogatuinnait (Atlantic cod) and pitsiulât (Black guillemot) did show a marginal trend towards ingesting polymers at proportions that did not match the proportions available in surface water ($p=0.05$ for both species).

Seal swimming in Nunatsiavut. Photo: Eldred Allen

Atjigengitonningit palâstikket nigijauKattajunut omajunut Nunatsiavummi atjigengitonninga asinginnut iniujunut

Comparison of plastics ingested by animals in Nunatsiavut compared to other places

↓ iKaluit: Lower than Cambridge Bay

iKaluit (Arctic char): There is one study on iKaluit (Arctic char) from Iqaluktuuttiaq (Cambridge Bay), Nunavut, but the sample size is small (22 fish) (Hamilton et al, 2024). Nonetheless, we include a comparison here because the results are very different from Nunatsiavut. They found that 95% of fish had ingested plastics with an average of 11 plastics each, and double that number if they included microfibres from non-plastic clothing like cotton. All numbers are considerably higher than the 24.5% of fish with an average of 0.36 plastics per fish reported in our study.We record but do not usually include non-plastic microfibres in our studies, but when we do, our iKaluit (Arctic char) have a FO% of 33% and ingest less than one particle (0.54/fish) on average.

Natset: not comparable

Natset (Ringed seal): There are two scientific studies (Bourdages et al, 2020 and Jardine et al, 2023) on natset (Ringed seals), but they use such different methods and quality assurance that they are not comparable to our study.

↑ Ogatuinnait: Higher than island of Newfoundland

Ogatuinnait (Atlantic cod): According to this study, a higher proportion (13.2%) of ogatuinnait (Atlantic cod) ingested plastic than those from comparable studies on the island of Newfoundland where the proportion of animals with ingested plastics ranged from 1.4-2.4% (Liboiron et al, 2019 & 2019; Saturno et al, 2020). Studies in the Northeast Atlantic have been consistent with this ingestion rate, reporting plastics in 1.2-3% of fish (Rummel et al, 2016; Bråte et al., 2016). However, most of these comparable studies only looked at larger microplastics (greater than 1mm in size). The median size of ingested plastic in ogatuinnait (Atlantic cod) was 0.84 mm, so half of all ingested plastics were less than 1mm in size.

↑ Pitsiulât: Higher than Nunavut

Pitsiulât (Black guillemot): A higher proportion of pitsiulât (Black guillemot) from Nunatsiavut had ingested plastic than those from Nunavut. However, the comparable study with a sample size greater than 24 (Baak et al, 2024) only looked at larger microplastics (greater than 1mm in size). The median size of ingested plastic in pitsiulât (Black guillemot) in our study was 0.53mm, meaning that most ingested plastics were less than 1mm in size.

≈ Mitet: Within range

Mitet (Common eider): Only 24 mitet (Common eider) were included in this study, so our results are preliminary. We found that 29% of mitet (Common eider) ingested plastic, falling within the middle of the range of what is reported by comparable studies. On the island of Newfoundland, studies report plastic ingestion ranging from 2.1% (English et al, 2015) to 2.5% (Holland et al, 2016) of birds. In the Wadden Sea on the other side of the North Atlantic, however, Bange et al. (2023) report plastics in 93% of birds.

≈ Appait: Similar to comparable studies

Appait (Thick-billed murre): In our study, 12.5% of appait (Thick-billed murre) ingested plastics. This is slightly higher than the 7% of birds with ingested plastics on the island of Newfoundland reported by Bond et al (2013). The study by Bond et al. only looked at larger microplastics (greater than 1 mm in size) while our study looked for plastics down to a cutoff size of 0.25mm, but our study found appait (Thick-billed murre) only ingested plastics larger than 1 mm. Three studies in Nunavut reported plastic ingestion in appait ranging from 0-13%, which aligns with our results.

aKigget, Natânnavait, Ujagak ogâtsuk, and matsojak: Not comparable

aKigget (white partridge), Natânnavait (Greenland halibut), Ujagak ogâtsuk (rock cod) and matsojak (scallop): There are currently no other published research on plastic ingestion for these species.

Background image: Mount Sophie, 2021: Photo: Max Liboiron

Table 19: Comparison of plastic ingestion by animals caught for wild food in Nunatsiavut (2017-2025) to studies in nearby or similar places

This study (Nunatsiavut)				Comparable Northern studies				
Species	**Sample size**	**%FO[a]**	**Cutoff[b] (mm)**	**Sample size**	**%FO[a]**	**Cutoff[b] (mm)**	**Location**	**Source**
iKaluit / Arctic char	347	**26%**	0.25	22	**95%**	?	Nunavut	Hamilton et al., 2024
ogatuinnait / Atlantic cod	68	**13%**	0.25	81	**1%**	0.50	Baltic/North Sea	Rummel et al, 2016
				205	**2%**	1.00	Avalon peninsula, NL	Liboiron et al., 2016
				1,010	**2%**	1.00	Avalon peninsula, NL	Liboiron et al., 2019
				302	**3%**	?	Norway	Bråte et al., 2016
				216	**1%**	1.00	Fogo Island, NL	Saturno et al., 2020
pitsiulât / Black guillemot	32	**38%**	0.25	3	**0%**	1.00	Nunavut	Poon et al, 2017[c]
				20	**0%**	1.00	Nunavut	Baak et al., 2020[c]
				51	**0%**	1.00	Nunavut	Baak et al., 2024[c]
kavaisitet / salmon	17	**12%**	0.25	69	**0%**	1.00	Campbellton, NL	Liboiron et al, 2019
mitet / Common eider	24	**29%**	0.25	42	**93%**	0.30	Wadden Sea	Bange et al., 2023[c]
				48	**2%**	1.00	NL	English et al., 2015[c]
				40	**3%**	0.50	Little Fogo Island, NL	Holland et al. 2016[c]
appait / Thick-billed murre	40	**13%**	0.25	30	**13%**	0.80	Nunavut	Bourdages et al, 2021[c]
				186	**11%**	?	Nunavut	Provencher et al., 2010[c]
				30	**0%**	0.80	Nunavut	Baak et al, 2020[c]
				32	**7%**	1.00	NL	Bond et al, 2013[c]
				10	**0%**	1.00	Nunavut	Poon et al, 2017[c]
appaliatsuk / Dovekie	8	**38%**	0.25	171	**30%**	1.00	Conception Bay, NL	Avery-Gomm et al, 2016[c]
kanajuit / Sculpin	3	**0%**	0.25	7	**43%**	0.02	Northwest Territories	Moore et al, 2022

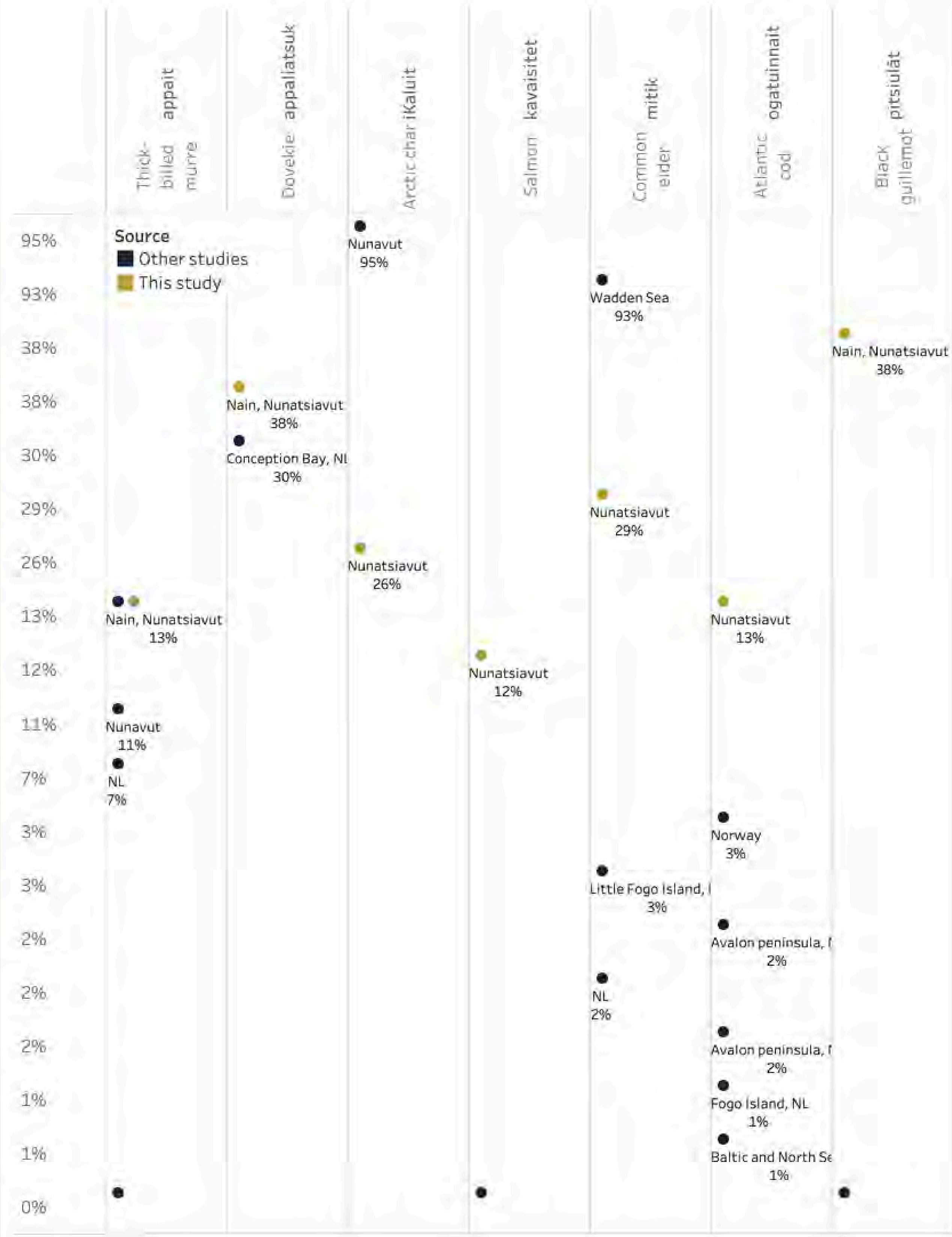
Better than other studies	**Similar to other studies**	**Higher figures than other studies**	**Sample size < 24 (preliminary results)**

[a] Frequency of occurrence (FO%) is the main Western scientific measure for plastic ingestion that measures the percentage of animals in the sample that have eaten at least one plastic. It does not indicate how large (size of a piece of dust or a frisbee) or how many (1 or 100) plastics an animal ate. We have not found that this number is of particular interest to community members, but it is the main metric used in Western science and would be the basis of comparison to other studies.

[b] "Cutoff" is the lower detection limit of the study, meaning the size of the smallest plastics that can be reliably captured by the methods. Studies with higher cutoffs can be expected to find fewer plastics, because they are not including plastics smaller than their cutoff size.

[c]Study did not describe the use of procedural blanks or controls in their research

Figure 39: Comparison of plastic ingestion (%FO) by animals from Nunatsiavut to studies in nearby places



Two of the Nunatsiavut studies have smaller sample sizes (appaliatsuk / Dovekie n=8, kavaisitet / Salmon study, n=17), but all others have 20 or more. Different studies have slightly different cut off sizes for plastics, or quality assurance, but we only included studies here that we determined were comparable methodologically. See Table 19 for more details.

Kanuittonngit palâstikket nigijauKattajunut omajunut Nunatsiavummi

What kind of plastics are ingested by animals in Nunatsiavut?

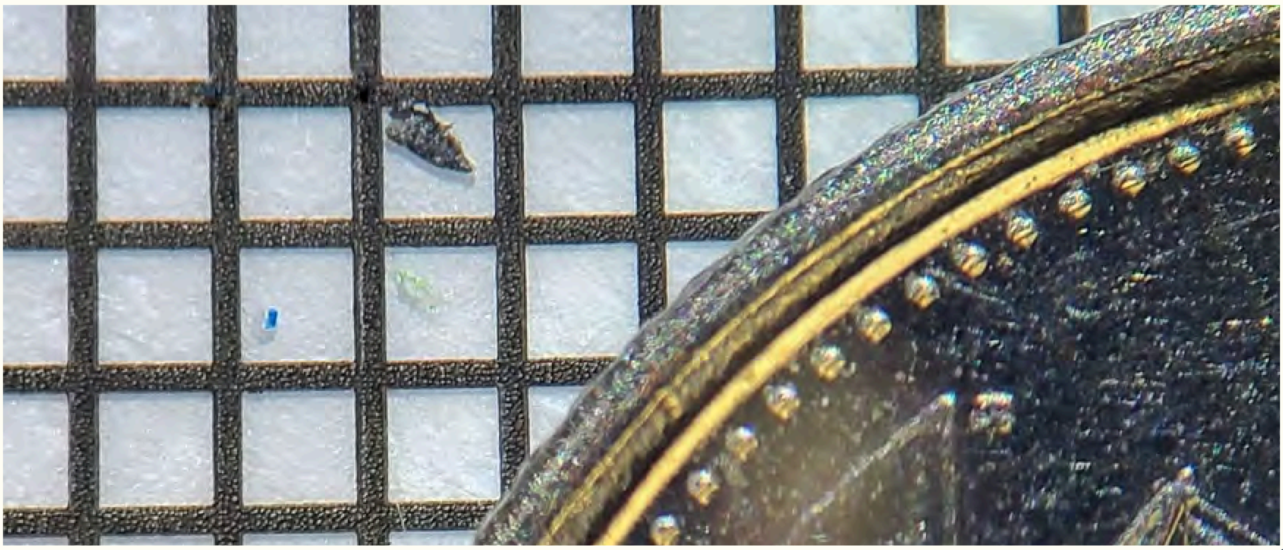
Size	Source	Colour	Polymer
Microplastics (smaller than a grain of rice)	Mainly microfibres from wastewater (microfibres)	Mainly dull colours (blue, black, grey, clear)	Mainly PET and acrylonitrile

Size: Naujaummijuit (Northern fulmars) eat much larger plastics than other animals in our study, so an average that aggregates all species and sizes together is misleading. Naujaummijuit (Northern fulmars) ingested plastics up to 42.4mm (i.e. the size of a lime), with an average of 6mm (i.e. the size of a pinky fingernail).

But for the iKaluit (Arctic char) and natset (Ringed seals), the longest plastic was 19.9 mm (the width of an Aspirin tablet), which was a clear clothing fibre that an iKaluk (Arctic char), caught by Reuben Flowers, ingested in Comma Island, south of Agvitok (Hopedale).

Table 1 in the introductory summary includes median sizes for each species, but overall, all animals mostly ingest microplastics under 5mm, smaller than a grain of rice.

Three microplastics ingested by an iKaluk from Nain in 2019. The grid is 1mm, and the coin on the right is a nickel for scale. Photo: Max Liboiron.



Likely sources: Figuring out the original source of a microplastic can be tricky or even impossible. This is why we say "likely" meaning that it's possible, but not guaranteed. We can use a combination of polymer type (the type of plastic, like PET or nylon), morphology (the shape of plastic), and sometimes colour to identify likely sources. Alkyd polymers, for example, are used in paints and varnishes, and we can visually confirm if these plastics are fragments ("chips" of paint), and that come in bright colours or have different colours on each side. If these three things align, it's very likely to be paint.

Identifying likely sources is important because it can help identify where interventions to reduce plastics can make the most impact.

Microfibres from laundry are the largest share of plastics in all animals (43%), and represent a fair share of plastics in surface water (22%, see the baselines section on likely sources). While there is no way to tell if these microplastics are local or whether they travel long distances, there are some ways to wash clothes that decrease microfibre release into wastewater locally, including:

- Buy clothes with natural fibres (cotton, wool, and fur rather than nylon, PET, fleece, polyester, etc.)
- Wash in cold water
- Front loading machines create fewer microfibres than top loading machines (Hartline et al. 2016)
- Line dry instead of tumble dry
- Consider using microfibre filters at home such as the Lint LUV-R, which removes 87% of microfibres from the wash (McIlwraith et al. 2018)
- At the community level, consider treatment and filtration that specifically address microfibres

Table 20: Summary of proportion of plastics likely originating from local sources in all animals from Nunatsiavut, 2017-2025

Locality	iKaluk (Arctic char)	natsik (Ringed seal)	aKiggik (White partridge)	pitsiulâk (Black guillemot)	mitik (Common eider)	Ogatuinnak (Atlantic cod)	appak (Thick-billed murre)	Suglutuk (Surf scoter)	Matsojak (Scallop)	Nipisak (Lump fish)	Natânnavak (Turbot)	Appaliatsuk (Dovekie)	Ujagak Ogâtsuk (Rock cod)	kavaisitik (Salmon)	Ânâtlik (Brook trout)	Pitsuilâppak (Brasswing)	A-angik (Hound duck)	Ânâtlik (Lake trout)	kanajuk (Sculpin)	niglik (Canada goose)
# local plastics	10	16	6	4	0	1	0	0	0	1	0	3	1	1	0	0	0	0	0	0
% local plastics	8%	15%	23%	21%	0%	10%	0%	0%	0%	25%	0%	100%	50%	50%	0%	0%	0%	0%	0%	0%
Total plastics	**125**	**109**	**26**	**19**	**11**	**10**	**10**	**9**	**4**	**4**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**0**	**0**

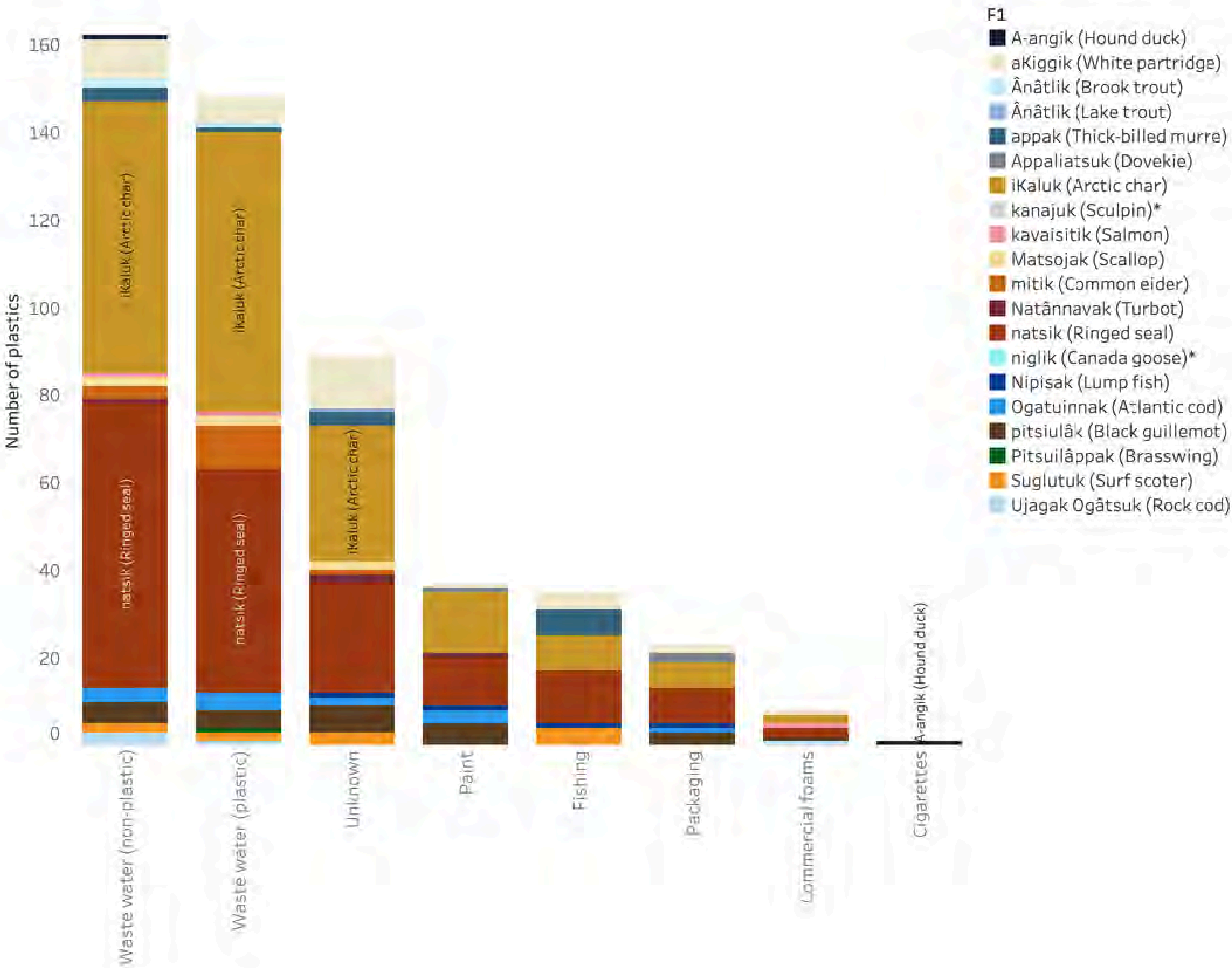
Table 21: Summary of likely sources of plastics ingested by all animals in Nunatsiavut, 2017-2025

Animal	Laundry Wastewater (microfibers)	Paint[a]	Fishing line[b]	Packaging[c]	Commercial foams[d]	Cigarette butts	Unknown[e]	Total plastics
iKaluk (Arctic char)	64 (51%)	14 (11%)	8 (6%)	6 (5%)	2 (2%)		31 (25%)	**125**
natsik (Ringed seal)	51 (47%)	11 (10%)	12 (11%)	8 (7%)	2 (2%)		25 (23%)	**109**
aKiggik (White partridge)	6 (23%)	1 (4%)	4 (15%)	2 (8%)	1 (4%)		12 (46%)	**26**
pitsiulâk (Black guillemot)	4 (21%)	5 (26%)		3 (16%)	1 (5%)		6 (32%)	**19**
mitik (Common eider)	10 (91%)						1 (9%)	**11**
Ogatuinnak (Atlantic cod)	4 (40%)	3 (30%)		1 (10%)			2 (20%)	**10**
appak (Thick-billed murre)	1 (10%)		6 (60%)				3 (30%)	**10**
Suglutuk (Surf scoter)	2 (22%)		4 (44%)				3 (33%)	**9**
Matsojak (Scallop)	2 (50%)						2 (50%)	**4**
Nipisak (Lump fish)		1 (25%)	1 (25%)	1 (25%)			1 (25%)	**4**
Natânnavak (Turbot)		1 (33%)					2 (67%)	**3**
Appaliatsuk (Dovekie)		1 (33%)		2 (67%)				**3**
Ujagak Ogâtsuk (Rock cod)	1 (50%)				1 (50%)			**2**
kavaisitik (Salmon)	1 (50%)				1 (50%)			**2**
Ânâtlik (Brook trout)	1 (100%)							**1**
Pitsuilâppak (Brasswing)	1 (100%)							**1**
A-angik (Hound duck)						1 (100%)		**1**
Ânâtlik (Lake trout)							1 (100%)	**1**
kanajuk (Sculpin)								**0**
niglik (Canada goose)								**0**
Total plastics	**148 (43%)**	**37 (11%)**	**35 (10%)**	**23 (7%)**	**8 (2%)**	**1 (1%)**	**89 (26%)**	**341**

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

[a] Mainly alkyd fragments. However acrylic, polystyrene and polyester paints were also found.
[b] Threads with neutrally buoyant polymers.
[c] Plastic bags or films usually made from polyethylene or polyproylene.
[d] Styrofoams, upholstery filling or housing insulation.
[e] Small, hard fragments of larger plastics that could not be identified further. For example, it is difficult to tell whether a blue fragment the size of a pencil lead tip came from a plastic bottle cap or a toy plane.
Blank cells mean there is nothing to record in that part of the table. They do not mean zero: a zero means that an observation was made and the thing being measured was absent.

Figure 40: Number of plastics from likely sources ingested by animals in Nunatsiavut, 2017-2025.

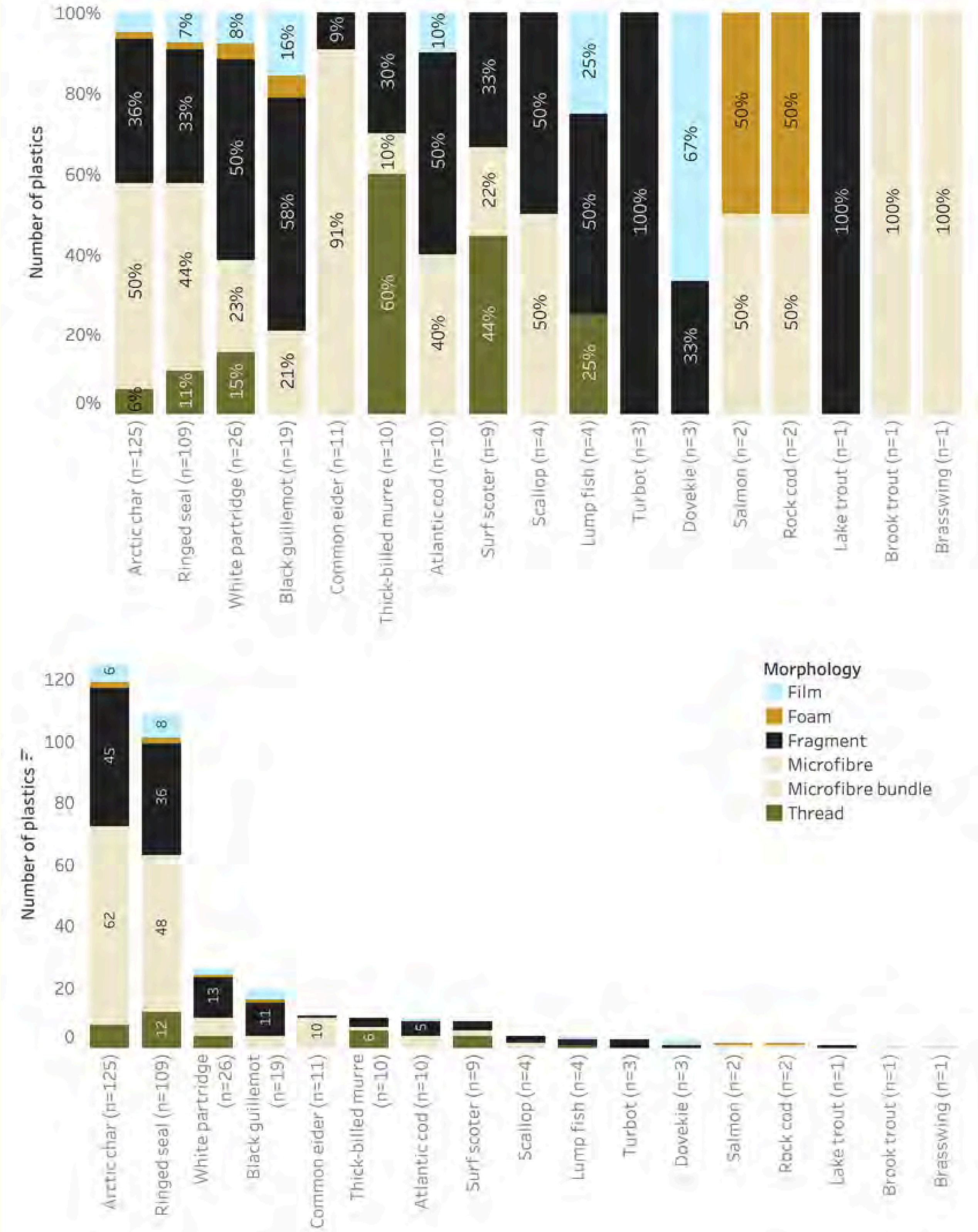


Each coloured segment within each bar is a different species (listed in the legend on the right). For species with large samples sizes, they are often ingesting plastics from multiple sources, though birds like appak (Thick-billed murre) are ingesting more fishing line compared to other species. Overall, waste water is the main source of both plastic and non-plastic industrially-made items in animals. Some microfibres are from non-plastic sources, like cotton shirts, and some are made of plastic, like in fleece. We've included them here because they are both waste items.

"Unknown" sources include plastics were we cannot identify a likley source. Many of these are fragments from larger items, but we don't know what kind of item.

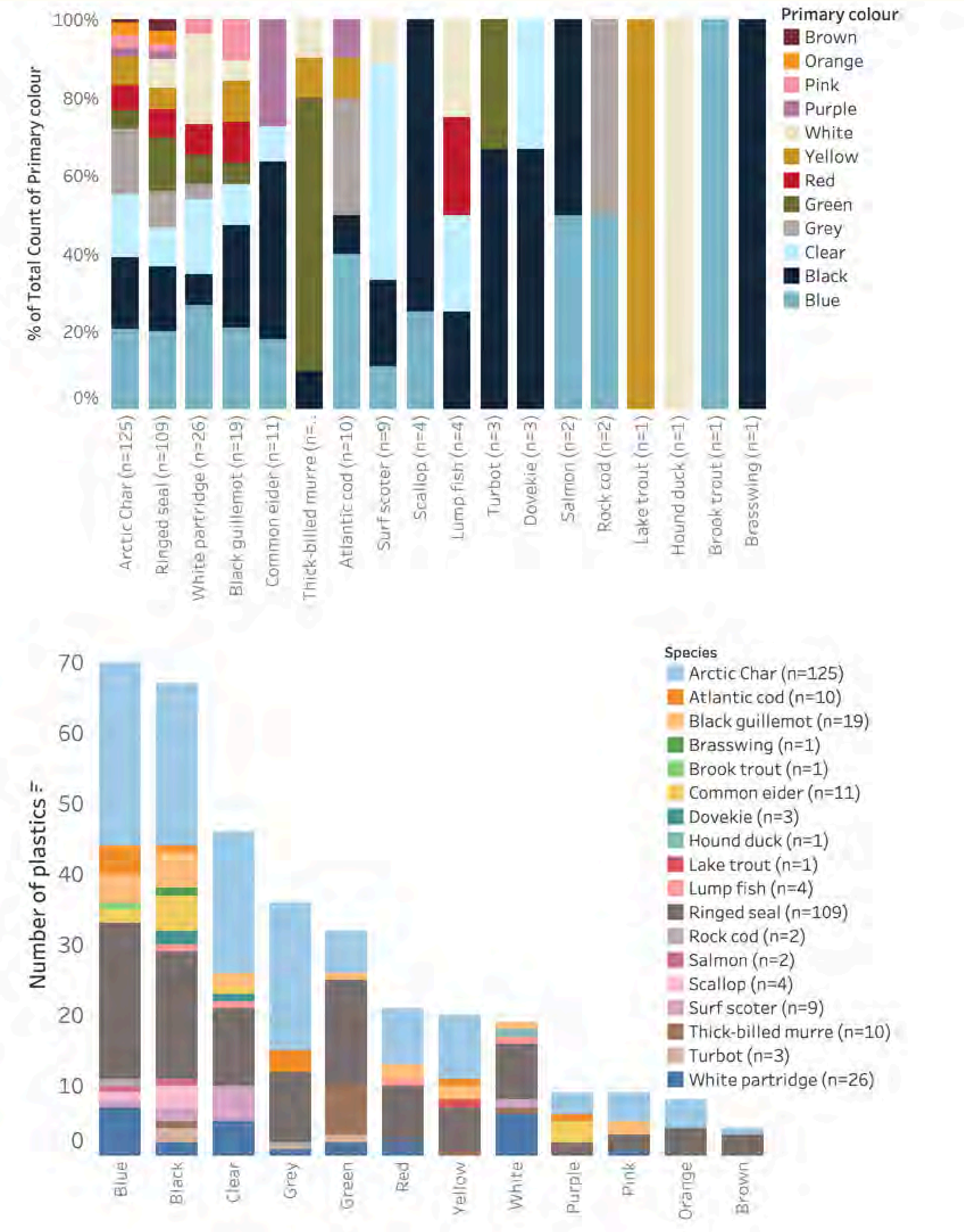
There is a single cigarette butt in the study, found in a a-angik (Hound duck), but we have included it here as it is a particularly toxic source of plastic (see page 106 for image).

Figure 41: Morphologies of plastics ingested by animals in Nunatsiavut, 2017–2025



The top graph shows the percentage of each morphology to better see which types of plastics impact certain species. The bottom graph shows the raw number of plastics, which varies widely across species. The (n) after each animal refers to the number of plastics being described.
Morphology refers to the form of the plastic. Film plastics are from plastic sheeting or bags and are almost always local in origin. Foams are also usually local. Fragments are smaller pieces of larger plastics (birds often eat more fragments, worldwide). Microfibres are from clothing and are found in wastewater. Threads are usually from fishing gear.

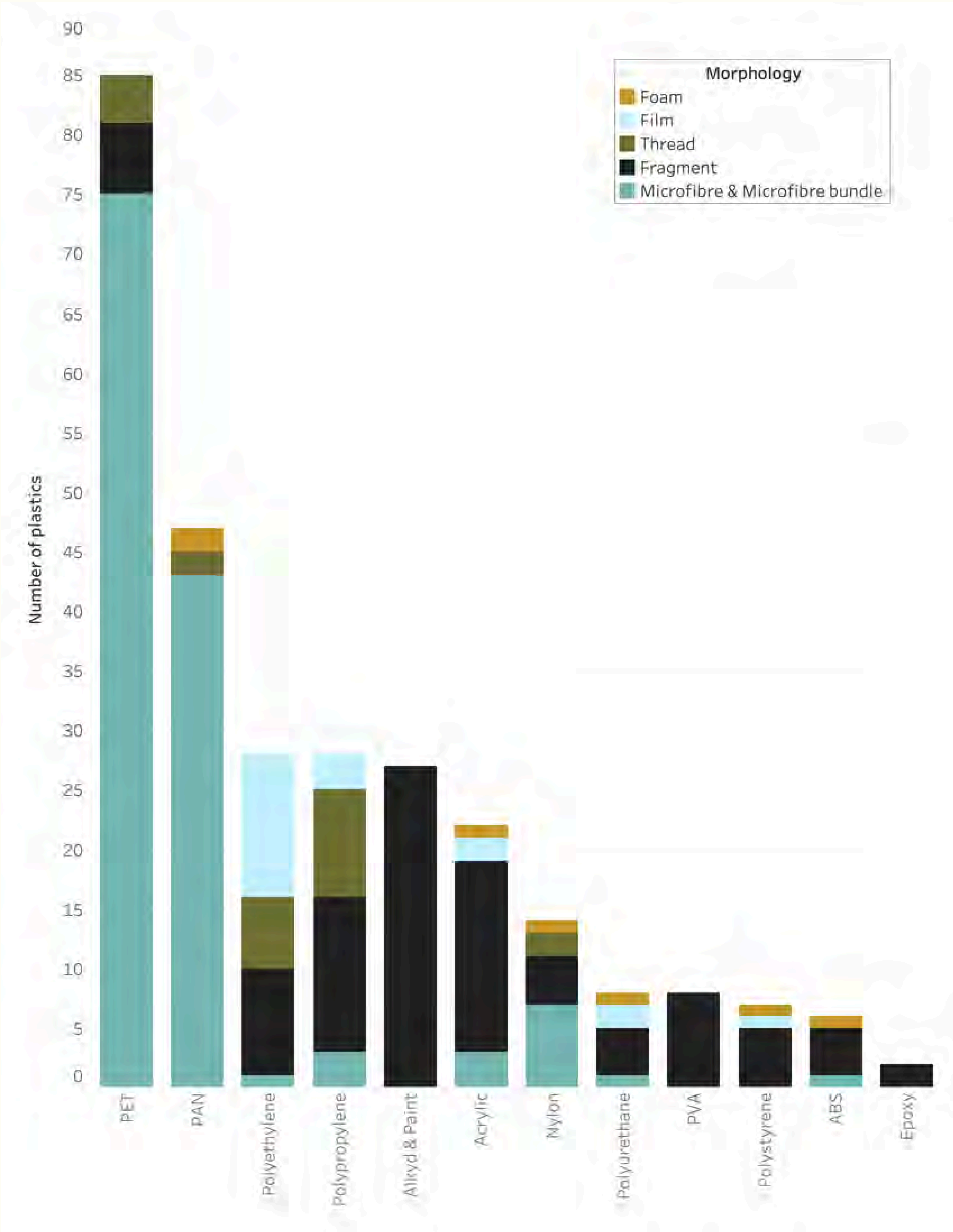
Figure 42: Colours of plastics ingested by animals in Nunatsiavut



The n after animal names in the top graph are the number of plastics each ingested, not sample size.

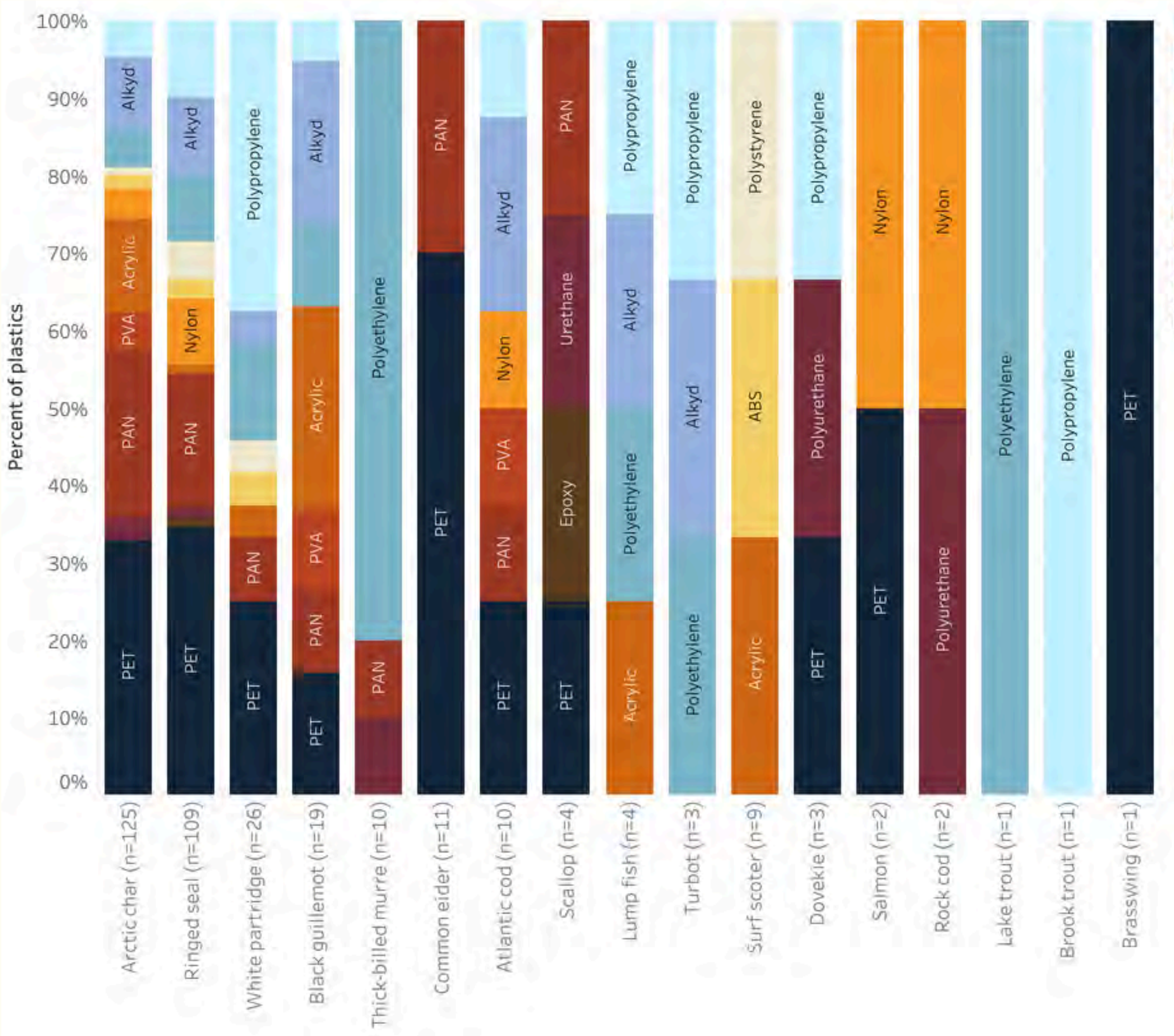
Colour: Blue and black plastics, often microfibres, are the most common colour of plastic in marine environments worldwide (Hanninen et al., 2021; Huntington et al., 2020; Ikenoue et al., 2023; Jiang et al., 2020; Liboiron et al., 2021; Lusher et al., 2015). It is not surprising they are also the most common colours ingested by animals. Green plastics are often fishing line. Overall, it does not appear that some species are ingesting plastics because they are seeking out specific colours of prey and mistaking plastics for food.

Figure 43: Number of plastics ingested by animals in Nunatsiavut by polymer



Polymer and morphology are related. Most plastics ingested were PET (polyethylene terephthalate) and PAN (polyacrylonitrile), both in the polyester family and both used in textiles. As you can see, most of the PET and PAN plastics were microfibres, which come from textiles like clothing.

Figure 44: Polymer of plastics ingested by animals in Nunatsiavut



The n after each animal is for the number of plastics that species ingested, not the sample size.

The colour of each polymer designates is density compared to sea water: the lighter the blue, the less dense the polymer. These are expected to float. The darker orange/brown, the more dense the polymer. These are expected to sink in seawater. Only polymers with 2 or more items are visualized here.

Polymer: Thirty percent (n=85) of all ingested plastics were PET. More than half of these (56%) were microfibres from clothing.

The fishing line in this study was mainly polypropylene (39%, n=9) and polyethylene (26%, n=6), both of which are common fishing net plastics because they float well or can be made neutrally buoyant with blends. There were two to four pieces of fishing gear made of nylon, PET, and PAN.

A quarter (25%, n=27) of fragments were paint or alkyd plastics.