Report on the execution of SØRKAPP MARINE LITTER CLEANUP project in 2021

forScience

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Contents

1. About forScience Foundation[1]

The forScience Foundation is a little non-governmental organization, whose statutory aims include diverse scientific, ecological and educational activity. For lack of external funding, our work was initially limited to co-organizing events and contributing to projects carried out by others.

Sørkapp Marine Litter Cleanup is our first fully independent endeavour. The funding necessary for its execution was granted in 2018 by Svalbard Environmental Protection Fund. A year later, on account of the 100th anniversary of establishing diplomatic relations between Poland and Norway, the project received the honorary patronage of the Embassy of the Republic of Poland in Oslo and the Royal Norwegian Embassy in Warsaw.

More information about the forScience Foundation can be found (in English) on www.forScience.pl, while content related to the work carried out in Svalbard as part of *Sørkapp Marine Litter Cleanup* is available on our Facebook page. It's worth noting that the page is public, so accessing the material does not require having a Facebook account.

[1] *Some of the descriptions included in the present document come from or are clearly based on passages published originally in Report on the execution of Sørkapp Marine Litter Cleanup project in 2019 [1], which is available on the Foundation's website. Nonetheless, in order to get the full picture of the undertaking we recommend reading both reports.*

2. Environmental context

The issue of marine litter may be approached in a number of ways. The widest recognition is usually given to initiatives focusing on prevention, such as raising the awareness of environmental consequences of excessive consumption, collective efforts to curb production or attempts to find more nature-friendly materials. There is also much talk about improving existing systems of waste management and disposal and imposing appropriate legal measures to force changes among the most avid enthusiasts of the plastic *status quo*. By targeting the sources of the problem, such solutions may eventually effectively reduce the amount of waste making its way into the oceans. We must, however, remember that implementing them on a wider scale is often complicated and time-consuming, because they interfere with the sphere of politics and business, where the well-being of the planet is seldom considered a priority. And the clock is ticking.

According to a report published recently by the United Nations Environmental Programme (UNEP), over 85% of all marine waste is broadly understood plastic. Every year, at least 9 million tonnes of it enter the world's seas and oceans, and it is not unreasonable to expect that the number will triple within the next two decades[2] [2]. The consequences will be devastating. But even if, hypothetically speaking, the amount of plastic waste in marine and coastal environments stayed precisely at its current level, the concentration of microplastic particles in the world's oceans could as much as double by mid-century [3]. This is because even the most radical mitigation measures taken today will not undo the damage that has already been done. That's why education and legislation are not enough.

Stranded marine litter must be removed from the environment while it is still possible.

To increase the efficiency of initiatives aimed at reducing plastic pollution, raising awareness and limiting production must go hand in hand with active removal of plastic waste from the environment, before inevitable processes of degradation and fragmentation turn it into unremovable microplastic[3]. As part of *Sørkapp Marine Litter Cleanup* project, the forScience team is doing exactly that.

[2] *It is the most conservative projection of those included in the report. Under a somewhat less optimistic scenario, by the year 2030 the amount of plastic waste entering aquatic ecosystems on an annual basis will have exceeded 53 million tonnes.*

[3] *Remarks on the necessity of this type of activity appear in numerous papers dealing with the issue of marine pollution, including the above-mentioned UNEP report [2] and the article „A global mass budget for positively buoyant macroplastic debris" [3].*

3. Project objectives

Sørkapp Marine Litter Cleanup is an initiative combining scientific goals with down-to-earth practical work for the sake of Svalbard's natural environment. As a result, the project's objectives fell into two distinct categories.

First of all, we aimed to achieve an immediate positive impact by eliminating the direct risk posed by stranded marine litter to local wildlife. In order to maximize our contribution to cleanup activities completed in the past and carried out simultaneously, we focused on a remote section of Svalbard's coast, whose location and natural features make beach cleaning a serious challenge[4]. The section covers the north-western coast of Sørkappland, located within Sør-Spitsbergen National Park, and constitutes the first potential accumulation zone for marine debris carried northwards by the West Spitsbergen Current and westwards by the East Spitsbergen Current.

One of the aims of the project was to eliminate the risk posed by beach litter to local wildlife.

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Apart from litter itself, the team collected litter data, including, for example, the place of manufacture.

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To increase the scientific value of the project, apart from the litter itself we also collected information on its type, amount, distribution and – as far as possible – origin. By repeating the procedure on the same stretch of the coast the following season, the Foundation expected to collect data that would make it possible to draw conclusions regarding the rate of litter accumulation in this part of Svalbard and the differences in litter concentration between individual working sections.

The original plan assumed that in 2019 the forScience team would remove all beach litter and collect the above-mentioned litter data from 23 km of the coast[5]. Due to prolonged periods of adverse

[4] *According to the information provided by the Governor's Office, no official cleanup activities had been performed in the area prior to the commencement of Sørkapp Marine Litter Cleanup project. We have found out, however, that an unofficial beach cleanup took place along this section of the coast in August 1985. The information was shared by Adam Krawczyk from the Jagiellonian University in Kraków, Poland, who was at the time in Palffyodden with a group of fellow scientists. In his journal Krawczyk described a meeting with four young Norwegians who conducted the cleanup. They started in Gåshamna, but it is hard to say where they stopped or how thorough they were. For lack of more specific information, we assumed that the litter found within the project's target area had been accumulating since at least 1985.*

[5] *Before the beginning of the fieldwork, the project's target area had been divided into 23 working sections, each of them 1000 m long and 100 m wide. Because the sections were mapped out on the basis of shapefiles showing a simplified coastline, the length of the sections on the map differed from their actual length. If we recalculate the total length of the target area according to the actual length of the coastline, it turns out to be over 30 km long. More information on the issue can be found in Chapter 5: Methodology and scope of project fieldwork.*

weather, however, the plan was implemented only partially. Litter and data collection tasks were completed along 15 sections of the coast, which affected the amount of obtained data, but not its quality, as the reduction in the target area had no impact on the adopted methodology.

Further complications occurred in 2020, when the COVID-19 pandemic forced us to postpone the second round of project fieldwork, which was to take place over the summer, until the following year. For this reason, conclusions regarding the rate of litter accumulation, which we present in Chapter 8: Results, are based on data acquired in 2019 and 2021, and not – as was initially assumed – in 2019 and 2020.

Nevertheless, the results of fieldwork carried out as part of *Sørkapp Marine Litter Cleanup* project shed new light on the rate in which marine litter accumulates along the north-western coast of Sørkappland. Bearing in mind how little has so far been known on this topic, they are bound to prove useful for environmental management and scientific research.

4. Project target area

Sørkappland is the southernmost tip of Spitsbergen, which is the largest island in the Svalbard Archipelago. The area stretches from Sørneset (in the south) to the southern coast of Hornsund Fiord (in the north) and lies entirely within Sør-Spitsbergen National Park.

The fragment of the coast selected for the project starts at Andvika Bay and finishes near Breineset. Its eastern limit is marked by a natural barrier in the form of the steep slopes of Wurmbrandegga ridge, while in the south the fragment reaches the coastal plain of Breinesflya, terminating between the branches of the Slaklielva river (Fig. 4.1)

In the east, the project's target area is limited by the steep slopes of Wurmbrandegga ridge.

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The southernmost working section terminates between the branches of Slaklielva river.

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One side of the project's target area is bordered by Hornsund Fiord, while the other faces the Greenland Sea. The beaches overlooking the open sea are under the influence of the warm West Spitsbergen Current and the cold East Spitsbergen Current, which flow along the western coast of the island, as well as wind waves generated by westerly winds and ocean swell generated at a considerable distance from the shore during storms. The part of the coast situated inside Hornsund Fiord is largely sheltered from phenomena occurring at sea. It is, however, affected by winds blowing

from the northerly and north-westerly direction as well as easterly and north-easterly winds (prevalent in this part of the Svalbard Archipelago), which have no impact on the western coast.

Fig. 4.1. Target area of *Sørkapp Marine Litter Cleanup* project (in red)

Map created by forScience Foundation
on the basis of a map available on TopoSvalbard © Norwegian Polar Institute

The area situated inside Hornsund Fiord is largely sheltered from phenomena occurring at sea.

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The beaches within the project's target area are mainly covered with coarse-grained gravel, stones and rocks of various sizes, while the shape of the shore is outlined by rocky outcrops. In the intertidal zone, the shoreline is highly varied, with numerous cliffs and crags. Sandy beaches are less common and the majority of them can be found in the part of the coast which faces westwards towards the open sea. They are flatter, with a thick layer of stones and gravel in the intertidal zone. Found along the entire length of the coast are numerous skerries, or underwater rocky reefs, which have a considerable impact on the direction and energy of the waves reaching the shore.

A typical beach of north-western Sørkappland.

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Sandy beaches are much less common.

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The highly diversified shoreline made it possible to arrive at preliminary conclusions regarding litter concentration within particular sections of the coast. At the same time, differences resulting from the target area's location (due to which some working sections border the open sea and some stretch along the edge of Hornsund Fiord) allowed us to gather information which will contribute to better understanding of the impact of winds, waves and swell, and ocean currents on the accumulation and distribution of beach litter in this part of Svalbard.

5. Methodology and scope of project fieldwork

There have been several projects carried out in Svalbard, whose aim was (and, in the case of ongoing projects, is) to remove stranded marine litter, estimate the scale of litter pollution or determine litter sources and human behaviour due to which litter items end up on local beaches. The methodology, however, differs significantly from one initiative to another. The main priority for most of them is collecting marine litter data and not the litter itself, while those in which scientific deliberations regarding the rising levels of litter pollution are less relevant than beach cleaning activity, often focus on random sections of the coast and seldom document the scope and effects of completed work[6].

Sørkapp Marine Litter Cleanup combined scientific goals (data collection) with practical ecological objectives (beach cleanup), and the methodology adopted by the Foundation constituted a well-thought-out fusion of strategies employed by other organizations. As a result, the forScience team not only removed beach litter from a relatively large area, but also collected quantitative and qualitative data, which led to conclusions about the rate of litter accumulation and differences in litter concentration along particular sections of the coast in north-western Sørkappland.

[6] *More details on these initiatives can be found in Report on the execution of Sørkapp Marine Litter Cleanup project in 2019.*

Due to the COVID-19 pandemic, fieldwork planned for the summer of 2020 was conducted a year later. As a result, conclusions regarding the rate of litter accumulation are based on data from 2019 and 2021, and not – as was initially expected – from 2019 and 2020. It should also be noted that the COVID-related slowdown in tourism and many other areas of activity means that the circumstances surrounding the execution of *Sørkapp Marine Litter Cleanup* were hardly typical. We have no way of telling how this has affected the condition of Svalbard's coast and the results of our analyses.

In the year 2021, project fieldwork was carried out within the same target area as in 2019 (more details in Chapter 4: Project target area) and was based on the same working sections #1–#23, each of which measured 1 km in length and 100 m in width. The sections were mapped out with the use of a map available through the Svalbardkartet application of the Norwegian Polar Institute [4], which shows the simplified coastline of the relevant area (Fig. 5.1.A). The total length of sections #1 to #23 did not, therefore, correspond with the actual length of the shoreline. Because such discrepancies are inevitable even when using the most accurate maps, the mapping out of the working sections was influenced mostly by practical factors, namely the ease with which their outer limits could be determined.

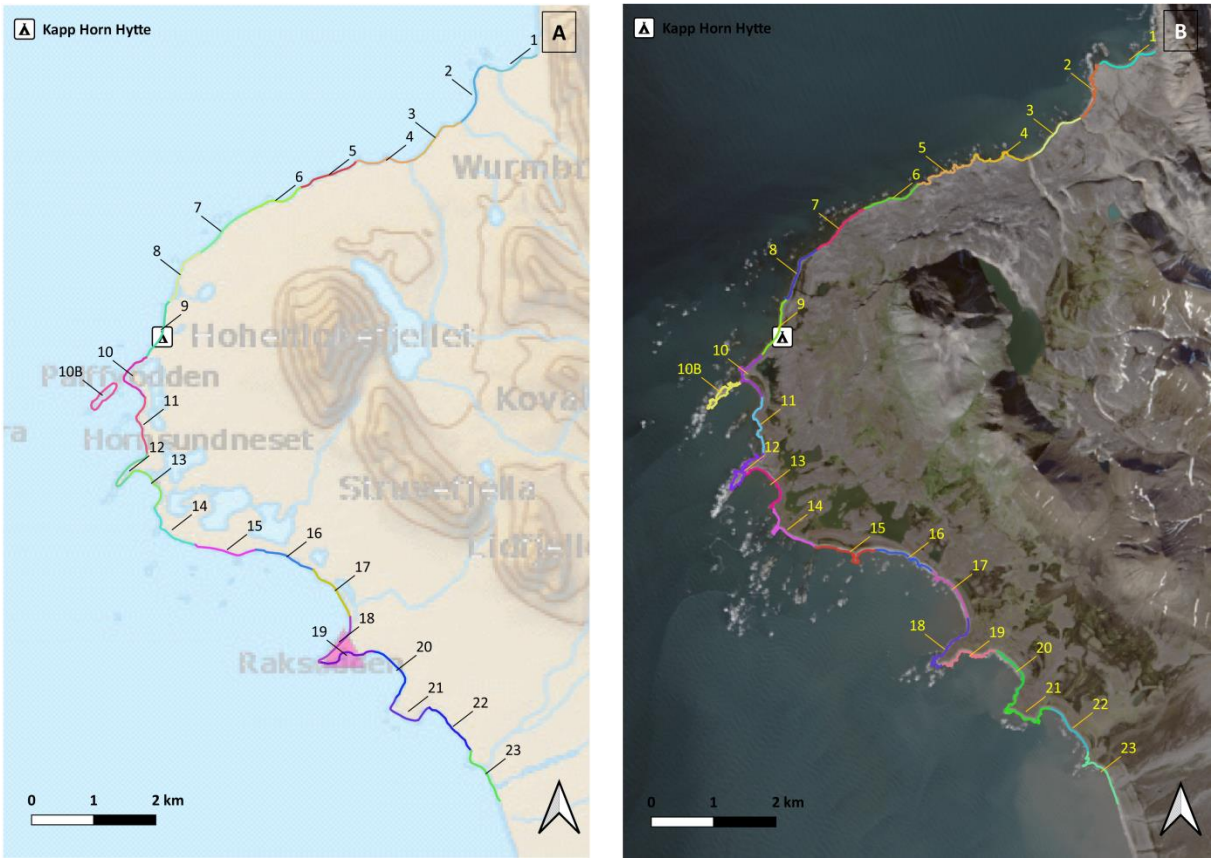

Fig. 5.1. The target area of the project divided into working sections:
A: mapped out based on the map of Spitsbergen available on Svalbardkartet © Norwegian Polar Institute;
B: mapped out based on digital Svalbard shoreline data available on Kartdata Svalbard 1:100 000 (S100 Kartdata) / Map Data Land I © Norwegian Polar Institute (2014)

Maps created by forScience Foundation
based on a map and satellite image published by the Norwegian Polar Institute / USGS Landsat

Thus mapped out working sections could not, however, serve as the basis for calculating the rate of litter accumulation, as the aim of these calculations was to determine the quantity of litter (in kilograms) which the waves deposit within a year on every kilometre of the coast (kg/km/a). For the aim to be achieved, it was necessary to make use of the most accurate available data on the course and length of the shoreline. This condition was met by a thematic layer containing a digitalized image of Spitsbergen's shoreline, made available by the Norwegian Polar Institute [5] (Fig. 5.1.B). And so, a closer inspection of Figure 5.1 makes it clear that the line in map A, showing the simplified working sections used in the field, is significantly less complicated than the line in map B, which is a more accurate reflection of the shoreline used for the purpose of subsequent analyses and calculations. Differences in the length of working sections in maps A and B are presented in Table 5.1.

Tab. 5.1. Differences in the length of working sections #1 to #23
A: according to the map of Spitsbergen available on Svalbardkartet © Norwegian Polar Institute;
B: according to the digital Svalbard shoreline data available on Kartdata Svalbard 1:100 000 (S100 Kartdata) / Map Data Land I © Norwegian Polar Institute (2014)

Information collated by forScience Foundation

Working section	Length [m]			Working section	Length [m]		
	A	B	difference		A	B	difference
#1	1000	1014	14	#12	1000	2069	1069
#2	1000	1391	391	#13	1000	1261	261
#3	1000	1043	43	#14	1000	1406	406
#4	1000	1428	428	#15	1000	1419	419
#5	1000	1645	645	#16	1000	1246	246
#6	1000	1035	35	#17	1000	1224	224
#7	1000	1068	68	#18	1000	1808	808
#8	1000	1062	62	#19	1000	1585	585
#9	1000	1028	28	#20	1000	1035	35
#10	1000	1369	369	#21	1000	1881	881
#10B	1735	2026	291	#22	1000	970	-30
#11	1000	1177	177	#23	1000	1346	346

All spatial analyses have been made with the use of geographic information system software QGIS 3.20, and the remaining calculations have been done in MS Excel (Microsoft Office Professional Plus 2019).

The #10B working section, visible in Figure 5.1 and Table 5.1, constitutes an additional section. It covers a group of near-shore rocks, known as Pomorsteinane, which does not fit the definition of the coast adopted in the project. The forScience team, however, took advantage of the opportunity (and very low water, which enabled easy access to the rocks) to remove the litter accumulated also in this area. The results presented in the current report are based on calculations which take into account the weight of litter collected within section #10B and the actual length of the section. Both values have been added to the values obtained for section #10.

In 2021, beach litter was collected by a group of 3–5 people, working in two subgroups. Each subgroup recorded the location, appearance and special features of selected litter items (which were generally unusual items and items with labels containing basic product information). For this purpose we used survey forms, cameras and GPS devices. Basic fieldwork equipment included also personal litter bags and a supply of big bags, which we used to set up temporary litter depots. In order to reduce the amount of unnecessary waste generated during the execution of the project, this year the forScience team used litter bags and big bags made specifically for the purpose out of used up fertilizer sacks (thoroughly cleaned of any remains of their original content) and discarded car seat belts. Through creative reuse of second-hand material, we eliminated the need to purchase new big bags and avoided their premature disposal (after a single use), which is otherwise inevitable due to complicated transport logistics in Svalbard. Such an approach let us reduce both the financial and environmental cost of the project.

Additionally, bearing in mind the risk of encountering a polar bear, the field group was always equipped with at least two firearms, a flare gun and a sufficient supply of appropriate ammunition. In order to enable communication between subgroups and – if need be – with the outside world, we also carried VHF radiotelephones, a satellite phone and an inReach device.

Our basic field equipment included, among others, communication devices and firearms.

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Nets and ropes trapped under rock debris were cut out with a hacksaw.

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The team collected all litter items visible to the naked eye[7], the only exception being fragments of fishing nets and ropes trapped under rock debris, whose removal was impossible or potentially dangerous (due to falling rocks). As far as possible, the trapped fishing nets and ropes were cut out from under the rocks with a hacksaw, which turned out to be the best tool for the purpose. Although the work was done on a strip of land about 100 metres wide, counting from the edge of the water, most litter lay no more than several meters inland.

Due to weather conditions, fieldwork was carried out at different times of day. As a result, water level was not always the same (as it depends on the tidal stage). Bearing in mind, however, that waves and swell prevent marine litter from accumulating in the intertidal zone, the approach does not introduce an error.

[7] *In line with the litter classification adopted by the Foundation, driftwood and items made of wood did not qualify as litter and were therefore left on the coast. The same was true of all manmade objects which – according to the provisions of Svalbard Environmental Protection Act – constitute the so-called movable historical objects (artefacts).*

Every few hundred metres, a temporary litter depot was set up, with all litter items collected within a given section placed in big bags and secured against the wind. The spots for litter depots were selected so that they could be safely accessed from the sea[8]. The bags were clearly labelled and their exact location recorded with a GPS device. Within a few days, with the help of an inflatable boat, all litter was transferred near Kapp Horn Hytte, which served as the Foundation's field base.

To create temporary litter depots, we used bags made for the purpose out of second-hand materials.

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Within a few days, litter depots were transferred to the base with the help of an inflatable boat.

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Litter from each working section was divided into the following categories:

- Plastic
- Nets and ropes
- Rubber
- Other (e.g. multi-material waste, polystyrene, synthetic foams)
- Metal
- Glass
- Hazardous waste (e.g. aerosols, lubricants, electronic waste, batteries)

What is important to realize is that *Plastic* is not the only category involving litter items made of synthetic materials. According to the litter classification adopted by the forScience Foundation for the purpose of the project, the *Plastic* category included mainly containers, packaging and other items which, before the age of plastic, were predominantly made of wood, metal and glass. Made of synthetic materials, however, were also litter items categorized as *Nets and ropes*[9], *Rubber* and *Other*, which included mainly multi-material waste, synthetic foams and polystyrene. The same was true of containers holding substances classified as *Hazardous waste* (such as industrial lubricants or fuel), although in this case the weight of the substance itself usually exceeded the weight of the container. All in all, if we wish to know the overall amount of synthetic materials as a proportion of all beach litter collected as part of the project from the north-western coast of Sørkappland, we must take into account the first four of the eight categories listed above.

[8] *It should be pointed out that the north-western coast of Sørkappland is lined with numerous skerries, which are not marked on the available navigational charts. What it means in practice is that navigating along the coast, even in a little inflatable boat with an outboard engine, requires considerable knowledge of the area, experience and favourable weather. It also means that the position of temporary litter depots must not be a matter chance.*

[9] *Nets and ropes made of natural fibres constituted no more than 5% of all litter in this category.*

Litter categorized as *Plastic*, *Other* and *Nets and ropes* was made of various types of synthetic material.

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Synthetic materials were a common component of hazardous litter items.

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Next, litter belonging to particular categories was carefully weighed. Contrary to many initiatives whose aim is to monitor the concentration of stranded marine litter[10], *Sørkapp Marine Litter Cleanup* project involved collecting weight data, and not number data, which is to say, counting individual litter items. Bearing in mind the character of the project's target area (predominance of rocky and stony beaches), enormous force with which the waves break against the shore during frequent storms, and increased brittleness of synthetic materials caused by weather conditions (especially high UV radiation levels), we assumed that marine litter accumulating on the beaches of Sørkappland would undergo a relatively rapid fragmentation. Observations made during project fieldwork confirmed this assumption. Over time, the process of fragmentation causes a large increase in the total number of litter items (as each fragment constitutes a separate item) without increasing their overall weight. As a result, the image of the coast based on number data may be very different from the image based on weight data.

Number of litter items: 1
Total weight: 0.01 kg

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Number of litter items: 1
Total weight: 66.30 kg

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Besides, a high incidence of large litter items meant that the number approach, which renders items weighing a few grams equal to those of several dozen kilograms, would distort the perception of the litter situation on Svalbard's coast. As a result, even though both methods of analysis – by number

[10] *The best example of such an initiative is beach monitoring conducted in keeping with the guidelines provided by Oslo/Paris Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR).*

and by weight – have their advantages, we are convinced that in the Arctic the weight approach is more appropriate[11].

Yet another argument in favour of the weight approach is the fact that all available statistics concerning waste production on a global and local scale as well as the effects of the existing waste management policies, including the quantity of waste entering the world's seas and oceans on an annual basis, are invariably based on weight data. This means that if environmental consequences of this aspect of human activity are to be better understood, marine litter accumulating on the shoreline should also be quantified in terms of weight.

The litter removed from Svalbard's coast was weighed with the use of the *AXIS* BD150S digital hanging scale (maximum weight: 150 kg; division: 50 g; accuracy: 10 g). The scale was calibrated by the producer for usage in Palffyodden (coordinates: 76°53.674'N 15°31.195'E). Additionally, the forScience team used two *Pesola* Macro Line spring scales (maximum weight: 2.5 kg and 5.0 kg; division: 20 and 50 g respectively; accuracy: 0.3%). Despite considerable accuracy of the used equipment, weight data presented further in the document are merely an approximation. The sheer amount of collected litter and conditions in which it was weighed made it virtually impossible to dry the items properly and remove contamination by sand, barnacles and algae (*biofouling*). The contamination was the most severe in case of large fragments of nets and ropes.

Due to the scope of the project, litter analysis carried out by the forScience team did not involve recording the size and identifying individual litter items. This type of data was gathered only for selected (mainly unusual) objects.

Once the litter had been weighed and the weight written down (separately for each category and each section), the litter was put back into big bags, this time according to its type rather than the section of the beach where it had been picked up. This was to facilitate the process of waste disposal, which the litter eventually underwent at the waste management facility in Longyearbyen. All big bags were carefully labelled and secured to prevent potential damage by wind or animals.

6. Impact of weather conditions on project fieldwork

The participants of the second round of project fieldwork arrived in Longyearbyen on June 16, after having completed a 10-day quarantine in Oslo. Two days later they set out for Hornsund. The work related to transporting expedition supplies and equipment to Palffyodden as well as tidying up and adapting Kapp Horn Hytte, which was to serve as the Foundation's field base, began on June 20. Thanks to relatively good weather, this stage of the expedition was promptly completed and the forScience team was ready to start with the fieldwork on June 22. In reality, however, it turned out to be impossible. Due to heavy snowfalls in winter and low temperatures in summer, much of the project's target area was still covered with a thick layer of snow and ice, whose melting was further slowed down by enormous quantities of seaweed (*Laminaria*) piled up on top of it by the waves.

[11] *These and other arguments in favour of using weight data in the analyses of beached marine litter concentrations are given by L. Smith and W. R. Turrell in the article „Monitoring Plastic Beach Litter by Number or by Weight: The Implications of Fragmentation" [6].*

Much of the project's target area was covered with a thick layer of snow and seaweed.

© Barbara Jóźwiak, forScience Foundation

In some sections of the coast, snow banks did not melt throughout July.

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As a result, at first the forScience team could only engage in general beach monitoring, with the key project tasks performed only on the rare sections of the coast which were free of snow and seaweed. Adopting a more systematic approach became feasible only when the snow cover had partially melted, which is to say, approximately 10 days after the team's arrival in Palffyodden. Still, bearing in mind our presence at the field base and readiness to go ahead with the plan, we consider June 22 to be the official start date of the second round of project fieldwork. The end date is July 22, when all the collected beach litter was picked up from Palffyodden by the crew of the Norwegian Coast Guard vessel KV Nordkapp. The meteorological data presented below covers approximately this period.

The data come from the Watchdog 2700 automatic weather station (Spectrum Technologies), set up in the vicinity of Kapp Horn Hytte on June 24. The station measured air temperature and humidity, wind speed and direction, and solar radiation. Information regarding the sensors can be found below, in Table 6.1. The station was placed 2 m above the ground, 100 m east of the cabin (exact location: 76°53.700'N 15°31.450'E) and recorded meteorological parameters once every half an hour. Used in the following description of weather conditions were also total daily precipitation data for June and July 2021 taken from Meteorological Bulletins published by the Polish Polar Station Hornsund [7–8] and available at the Station's official website.

Tab. 6.1. Description of sensors installed in the Watchdog 2700 automatic weather station, which recorded meteorological parameters in Palffyodden in the summer season of 2021

Source: Spectrum Technologies

	Sensor	Specification	Accuracy
1	Wind direction	every 1°	±3°
2	Wind speed	from 0.1 to 322 km/h	±3 km/h, ±5%
3	Air temperature	from -40°C to +125°C	±0.3°C for -40°C to +90°C
4	Air humidity	from 0% to 100%	±2% RH at 25°C
5	Solar radiation	from 0 to 1500 W/m^2	±5%

From June 25 to July 22, the average daily air temperature was +4.2°C. The maximum temperature of +9.5°C was recorded on July 15 at 13:00 UTC. It was the warmest day of the period with the highest average daily air temperature, which peaked at +7°C (Fig. 6.1). The minimum air temperature was +0.9°C, recorded in the small hours of July 7. Low temperatures were one of the factors behind the slow melting of the snow covering the shore, which caused delays to our fieldwork schedule. They were also largely responsible for the high frequency of low-visibility conditions, such as fog and mist, which we discuss in more detail at the end of this chapter.

As was the case in 2019, during the course of project fieldwork precipitation events were not particularly intense. Between June 25 and July 22, we recorded 12 days with rain, with the total amount of precipitation being 19.2 mm (which is 19.2 litres per m^2). Maximum precipitation occurred on June 30, when the total daily amount of rain reached 6.1 mm. This took place during a period of fierce winds, which – just as in 2019 – swept through the Hornsund area at the end of June and the beginning of July. Although relatively little precipitation may seem like a positive phenomenon, it is worth remembering that, with air temperatures above zero, heavy rain makes snow melt faster. Keeping in mind the delay to this year's project fieldwork caused by the prolonged presence of snow, more rainy weather, especially in June, would have definitely been more advantageous.

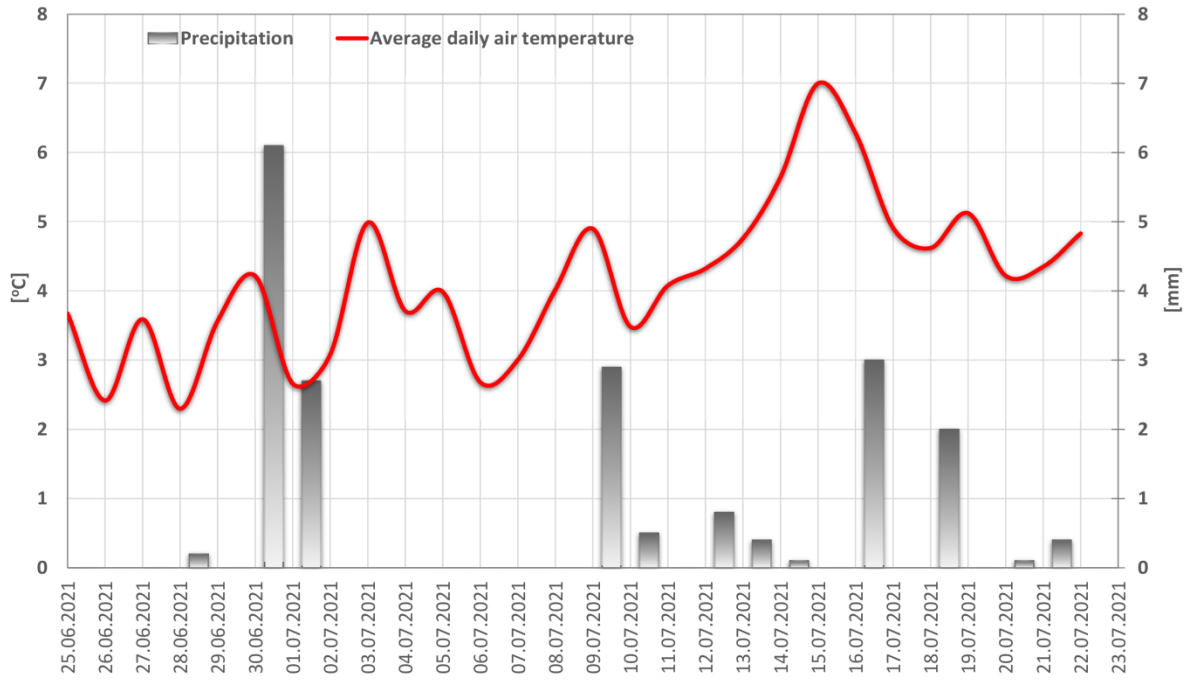

Fig. 6.1. Total daily precipitation and average daily air temperature over the course of project fieldwork

Chart created by forScience Foundation based on data from the Watchdog 2700 weather station and Meteorological Bulletins of the Polish Polar Station Hornsund [7–8]

The location of Palffyodden and Kapp Horn Hytte, which stands on an unsheltered patch of elevated ground, means that the Foundation's field base is exposed to high winds, regardless of their direction. The only exception are easterly winds (Fig. 6.2), or more specifically winds from ENE, E and ESE directions, which we are partially protected from by Hohenlohefjellet, a mountain rising from the surrounding plain approximately 2 km from the cabin. The rest of the project's target area is just as exposed. For this reason, an intrinsic element of project fieldwork was wind, with gusts reaching 20.6 m/s or 74 km/h (recorded on July 16). During the period which the forScience team spent in

Sørkappland, moderate or above moderate breeze (wind speed > 5.5 m/s, which is Beaufort force 4 and above) was recorded on 15 days, out of which 9 days were characterized by fresh or strong breeze (wind speed > 8 m/s with gusts > 10 m/s).

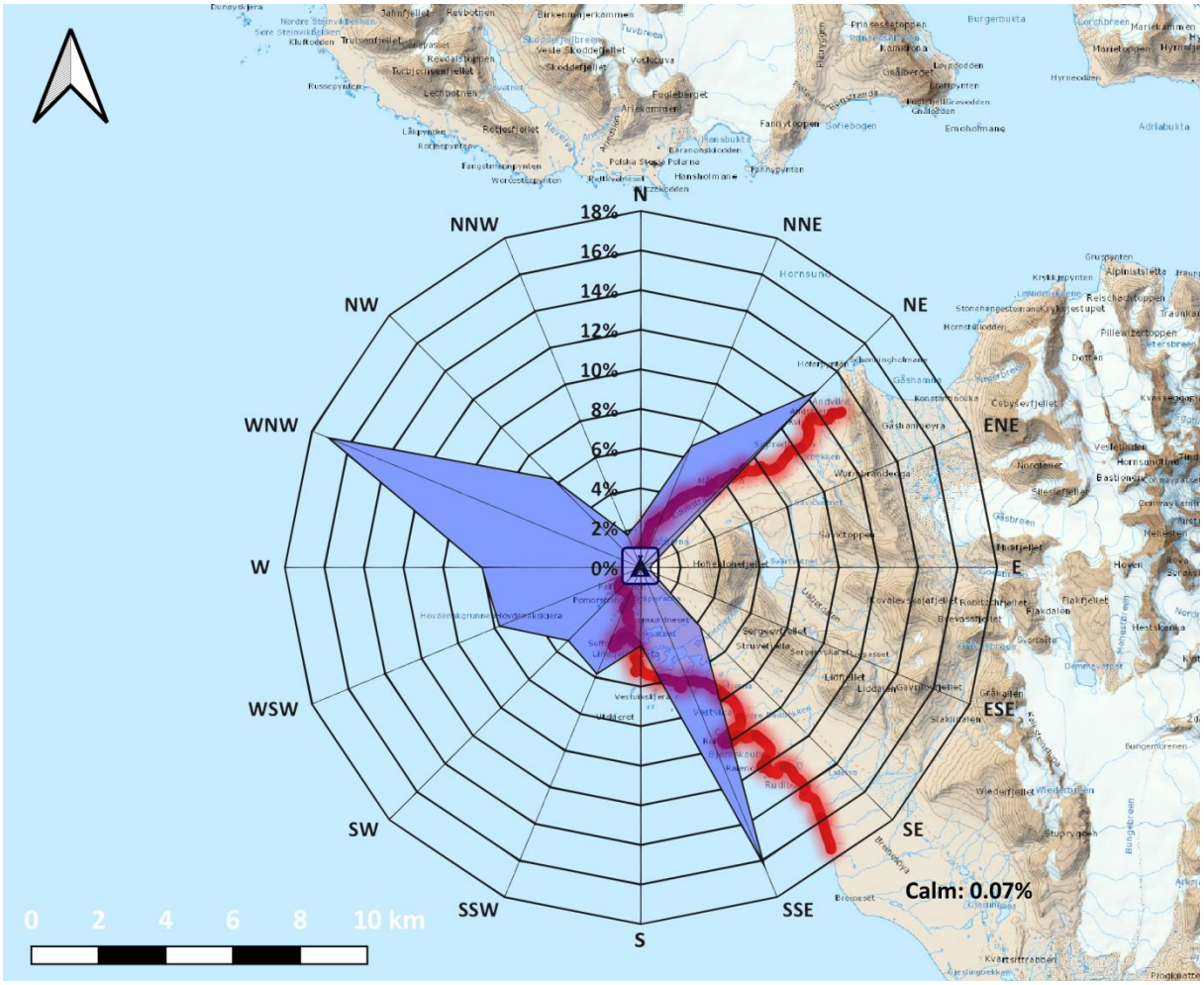

Fig. 6.2. Percentage frequency of wind from various directions recorded in Palffyodden between June 25 and July 22

Wind rose created by forScience Foundation based on data from the WatchDog 2700 weather station and the map of Spitsbergen available at Svalbardkartet © Norwegian Polar Institute

Meteorological data come from the Watchdog 2700 automatic weather station set up near the base.

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In this part of Hornsundneset plain the only protection from the wind is given by Hohenlohefjellet.

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The diagram showing the speed of wind and wind gusts in the relevant period of time (Fig. 6.3) clearly indicates that windless weather was a rarity. And although working on land was perfectly feasible even in very windy conditions, wind above 5.5 m/s made it difficult and sometimes impossible to use the inflatable boat. This hindered the process of collecting temporary litter depots and meant that the forScience team had to reach even the most distant working sections on foot, which was both time- and energy-consuming.

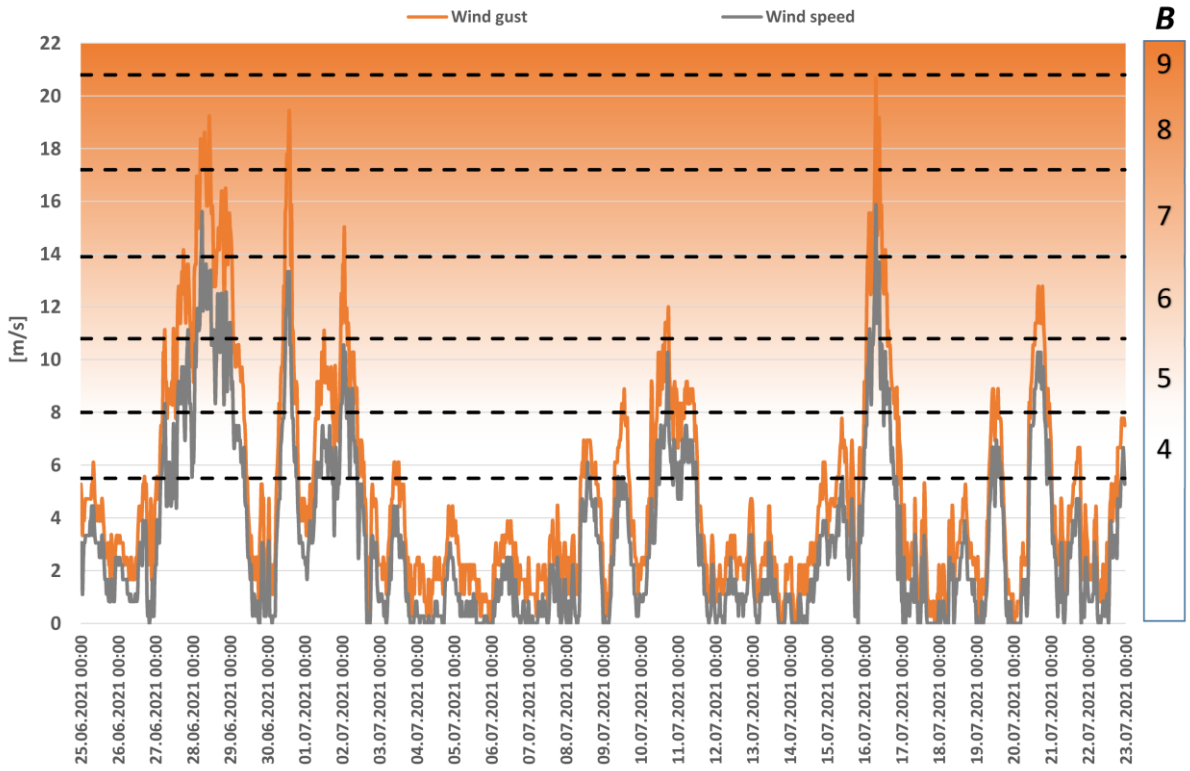

Fig. 6.3. Wind speed and wind gust speed over the course of project fieldwork
B – Beaufort scale, where 4 is moderate breeze, 5 – fresh breeze, 6 – strong breeze, 7 – near gale, 8 – gale

Diagram created by forScience Foundation based on data from the WatchDog 2700 weather station

Another difficulty was regular fog and mist, during which visibility was often reduced to several dozen metres. Because we did not record low-visibility days during our stay in Palffyodden, we counted their number after returning from Svalbard on the basis of meteorological data acquired on site. Using air temperature and air humidity data, we calculated the so-called dew point (which is the temperature at which the airborne water vapour starts to condense to form liquid water). We assumed that fog or mist could occur when the difference between air temperature and dew point did not exceed 2°C. This way we were able to determine the approximate number of days when fog or mist were very likely to occur (Fig. 6.4).

Additionally, Figure 6.4 shows the records from the solar radiation sensor, which measured the intensity of solar energy reaching the Earth's surface. The unit applied for this parameter is watt per square metre [W/m^2] and the recorded values are high only when the sky is not obscured by clouds or fog. Figure 6.4 makes it clear that such conditions occurred very rarely. The forScience team could enjoy sunny weather for as little as 23% of the time it spent in Palffyodden. And although sunshine or lack thereof affected no more than the team's morale, thick fog undoubtedly constituted another

factor hindering the execution of project fieldwork. Due to the already mentioned skerries and the lack of sufficiently detailed navigational charts, using an inflatable boat during low-visibility conditions involved major risks. Just as problematic was working on land, where a chance encounter with a polar bear, which is hard to notice in the fog, could have put all involved in serious danger.

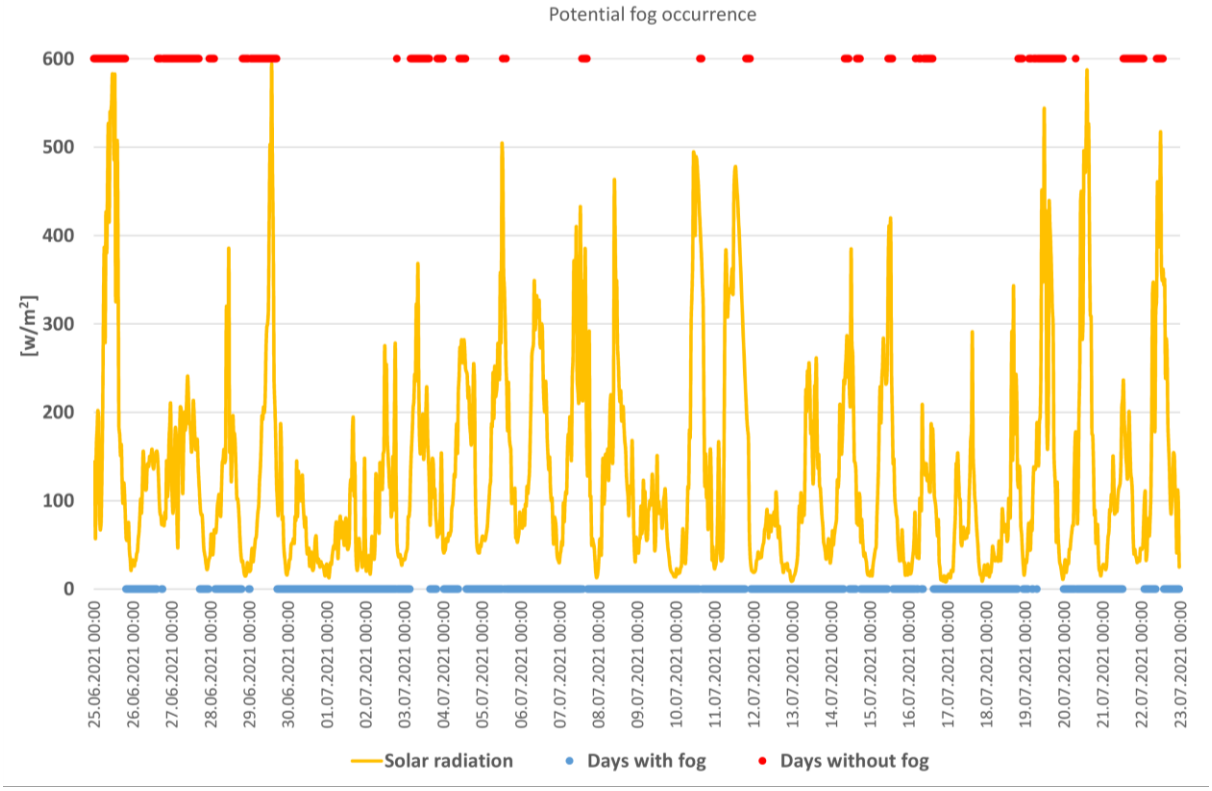

Fig. 6.4. Solar radiation, days with fog and days without fog over the course of project fieldwork

Diagram created by forScience Foundation based on data from the WatchDog 2700 weather station

Low visibility made it difficult and often impossible to use the inflatable boat.

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Due to the presence of polar bears, conducting fieldwork in the fog was very risky.

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With the weather being what it was, only 11 out of 30 days which the forScience team spent in Sørkappland could be devoted to project fieldwork. Despite adverse conditions, however, the dedication and perseverance of the team made it possible to successfully complete all project tasks planned for the season.

7. Logistics of litter disposal

After being carefully weighed, the litter was sorted again, this time in accordance with waste sorting guidelines applicable in Longyearbyen, which specify that all waste must be divided into plastic and other burnable material, nets and ropes, metal, glass, and hazardous waste. The guidelines had been confirmed with Longyearbyen Community Council (Longyearbyen Lokalstyre) and Longyearbyen Miljøstasjon waste management facility prior to the team's arrival in Sørkappland.

On July 22, all beach litter collected this season and 300 kg of aluminium fishing buoys, which remained in Palffyodden after the first round of project fieldwork, were picked up by the Norwegian Coast Guard vessel KV Nordkapp and transported to Longyearbyen. The litter was unloaded at the so-called coal quay (Kullkaia), at which point it was taken over by the employees of the local waste management facility.

The litter was sorted and bagged in line with the guidelines provided by Longyearbyen Miljøstasjon.

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The litter left Palffyodden with the help of the crew of the Norwegian Coast Guard vessel KV Nordkapp.

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Thanks to an agreement between Longyearbyen and Handelens Miljøfond, beach litter collected this season as part of *Sørkapp Marine Litter Cleanup* project (as well as other marine litter removed from Svalbard's shoreline during voluntary beach cleanups) was disposed of at the expense of Handelens Miljøfond.

8. Results

8.1. The year 2021 in numbers

Between June 22 and July 22, the forScience team conducted the second round of *Sørkapp Marine Litter Cleanup* project fieldwork. The aim of the fieldwork was to collect and describe marine litter stranded on 23 working sections of the coast, whose detailed description can be found in Chapter 5: Methodology and scope of project fieldwork. The litter collected within sections #1–#3 and #19–#23 had been accumulating in the area for at least 36 years (see: Footnote 4 in Chapter 3: Project objectives), while the litter removed from sections #4–#18 had been washed ashore after mid-July 2019 (when the forScience team completed the first round of project fieldwork).

Tab. 8.1.1. Litter collected within 23 working sections of the coast in the north-western part of Sørkappland. All values have been rounded to 1 kg.

	Category	Quantity collected [kg]	Fishing buoys [kg]
SYNTHETIC MATERIALS	PLASTIC	1054	484
	NETS AND ROPES	559	-
	RUBBER	53	-
	OTHER	150	-
	METAL	303	219
	GLASS	22	-
	HAZARDOUS	29	-
	Total	**2170**	

Within all working sections (#1–#23) we collected the total of 2170 kg of beach litter. The only manmade items left on the shore were items made of wood (neutral to the environment) and those which, pursuant to Svalbard Environmental Protection Act, constitute movable historical objects and are therefore protected elements of Svalbard's cultural heritage. The only other item intentionally left on the beach was a metal cylinder clearly marked as hazardous. According to the Norwegian Coast Guard, the item was most probably a dummy torpedo (used for military training purposes), which might have contained phosphorus or other highly flammable substances. For safety reasons, the item was not weighed. It was clearly marked with three plastic fishing buoys (which, unlike the torpedo itself, were included in the statistics from this working section) and reported to the Norwegian Coast Guard. It is supposed to be removed from the coast (along with the fishing buoys) as soon as possible.

Left within the project's target area were, among others, all movable historical objects.

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The litter item identified as a dummy torpedo shall be removed from the coast by the Norwegian military.

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Figure 8.1.1 shows the proportion of particular litter categories in the overall amount of litter removed from each of the twenty three working sections (#1–#23) cleaned this season. The size of each pie chart indicates the total weight of beach litter (in kilograms) collected within a given section, so the larger the pie chart is, the more polluted the section was.

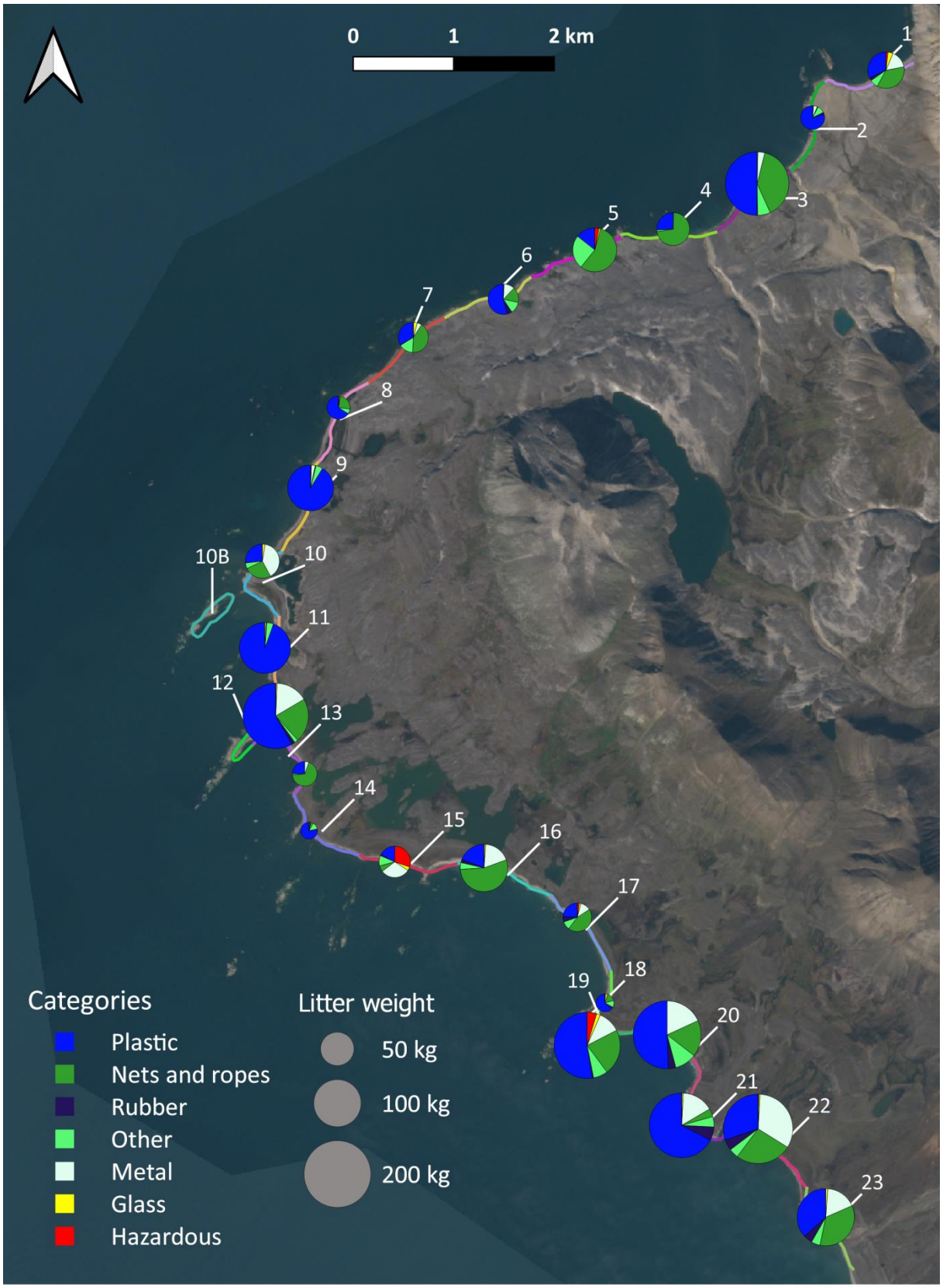

Fig. 8.1.1. Pie charts illustrating the proportion of different litter categories collected during the summer season of 2021 on the coast of north-western Sørkappland. The size of pie charts indicates the total weight of litter removed from a given working section.

Figure created by forScience Foundation

Used in the figure was a satellite image of the coast published by the Norwegian Polar Institute / USGS Landsat

At this stage it is worth reminding that working sections #4–#18 were cleaned by the forScience team two years before, in 2019, while sections #1–#3 and #19–#23 had not been cleaned for at least 36 years. As expected, the sections which had not been cleaned before were a lot more polluted. For sections #3, #19, #20, #21, #22 and #23, the overall weight of all litter categories collected within a single section ranged from 147.2 kg (#23) to 216.4 kg (#22). The only exceptions were sections #1 and #2, located inside Hornsund Fiord, where the overall amount of collected litter (59.8 and 26.5 kg respectively) was comparable to that removed from the sections which had been cleared of all litter items two years before.

When considering the collected litter in terms of its weight, the most polluted of the working sections cleaned for the second time was section #12, with the total of 193.1 kg of litter. It should be noted, however, that much of the total value was due to a single litter item (a piece of wire rope holding together fragments of fishing nets and several dozen plastic buoys) which weighed 115 kg.

One of the most polluted „new" sections was section #22.

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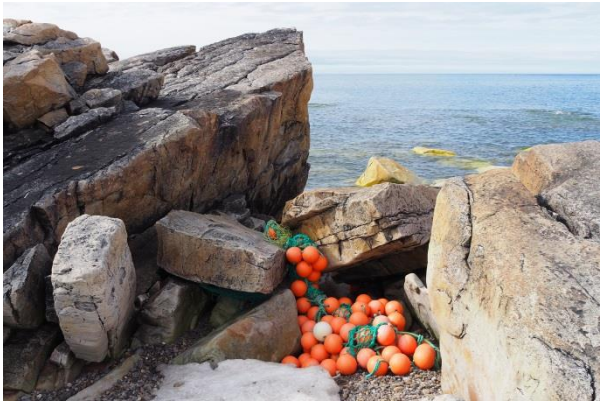

A single litter item found within section #12 weighed the total of 115 kg.

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The least polluted were sections #2, #8, #13, #14 and #18, where the overall weight of litter per section did not exceed 30 kg. This season, the minimum amount of beach litter in a single section was 12.8 kg (#14).

The most common litter category was plastic[12]. The highest concentration of plastic litter occurred in sections #11, #12 and #21, where the overall weight of plastic items was 111.3 kg, 112.5 kg and 128.0 kg respectively. In all working sections apart from section #1 the plastic fraction contained fishing buoys.

The second most common category of beach litter was nets and ropes, which we found within every working section. The smallest amount of nets and ropes was removed from sections #2, #9, #11 and #14, where the overall weight in this category was 0.3 kg, 0.6 kg, 0.4 kg and 0.6 kg. The maximum quantity of nets and ropes collected within a single section amounted to 71.4 kg (#3).

If we consider jointly all categories containing litter made of synthetic materials, the sections with the highest concentration of this type of litter were #3 (174.2 kg), #19 (164.6 kg) and #20 (170.8 kg).

[12] *More details about litter classification adopted for the purpose of the project can be found in Chapter 5: Methodology and scope of project fieldwork.*

The total weight of all synthetic materials collected within a single working section topped 100 kg in eight cases (sections #3, #11, #12 and #19–#23), and the percentage of synthetic materials in the total weight of beach litter collected this season was almost 84%[13].

The least common categories of beach litter were glass (22 kg total weight)[14], hazardous waste (29 kg) and rubber (53.4 kg). Section #13 was free of litter belonging to any of these categories. It was, at the same time, the section with the lowest concentration of plastic waste (6.9 kg) and one of the lowest concentrations of synthetic materials in general (26.2 kg).

8.2. Litter accumulation rate

In order to assess how lasting the effects of *Sørkapp Marine Litter Cleanup* were, we analysed the data from the fragment of the coast which had been cleaned twice (in 2019 and 2021). As mentioned before, the fragments comprised working sections #4–#18, which is why the following discussion refers only to this part of the project's target area. Analysing the acquired data allowed us to make preliminary estimates regarding the rate of litter accumulation, which is to say, the speed with which new litter items are stranded along the north-western coast of Sørkappland. No information about the litter accumulation rate has so far been available for any part of the Svalbard Archipelago.

In 2019, from sections #4–#18 we removed the total of 3745 kg of beach litter[15], which had been gathering in the area since at least 1985 (see: Footnote 4 in Chapter 3: Project objectives). After the completion of the first round of fieldwork, the area which was cleared of all litter items visible to the naked eye became our baseline. The original plan assumed that the forScience team would return to Sørkappland in 2020 to once again clean the area and weigh the collected litter. Due to the COVID-19 pandemic, however, the task was completed a year later. In 2021 from the previously cleaned working sections we removed the total of 942.3 kg of beach litter.

This means that the amount of litter washed ashore within the analysed fragment of the coast in just two years (2019–2021) constituted, on average, ¼ of the amount accumulated in the area prior to the launching of the project. If we assume that the litter collected in 2019 had been accumulating on the shore for at least 34 years (1985–2019), it is hard to escape the impression that the rate at which marine litter pollutes local beaches is a lot higher nowadays than a few decades ago.

It is worth noting that the average value of ¼, given in the previous paragraph, was in fact different for each litter category and each analysed working section. It was caused, among others, by the fact that the weight data used in the calculations comprised all litter items removed from the coast. The largest of them made the value for a given working section differ substantially from those for adjacent sections (even if the sections did not differ in terms of geomorphology). Examples of such large items include, among others, a sonar buoy found in 2019 with the estimated weight of 1000 kg (#16) and a plastic container from 2021, which weighed exactly 100 kg (#11).

[13] *The number corresponds roughly with the information given by UNEP. As stated in the report published in October 2021, on a global scale, synthetic materials account for at least 85% of all marine litter [2].*

[14] *The fact that litter items within this category often included random pieces of glass (which cannot have arrived at the target area in such a form), suggests that the watertight containers they belonged to were mechanically fragmented on land, with the missing elements gradually buried in the shoreline (see: Chapter 8.2: Litter accumulation rate).*

[15] *The total weight given in Report on the execution of Sørkapp Marine Litter Cleanup project in 2019 is 3631 kg. This value, however, does not include the litter removed from section #10B (114 kg).*

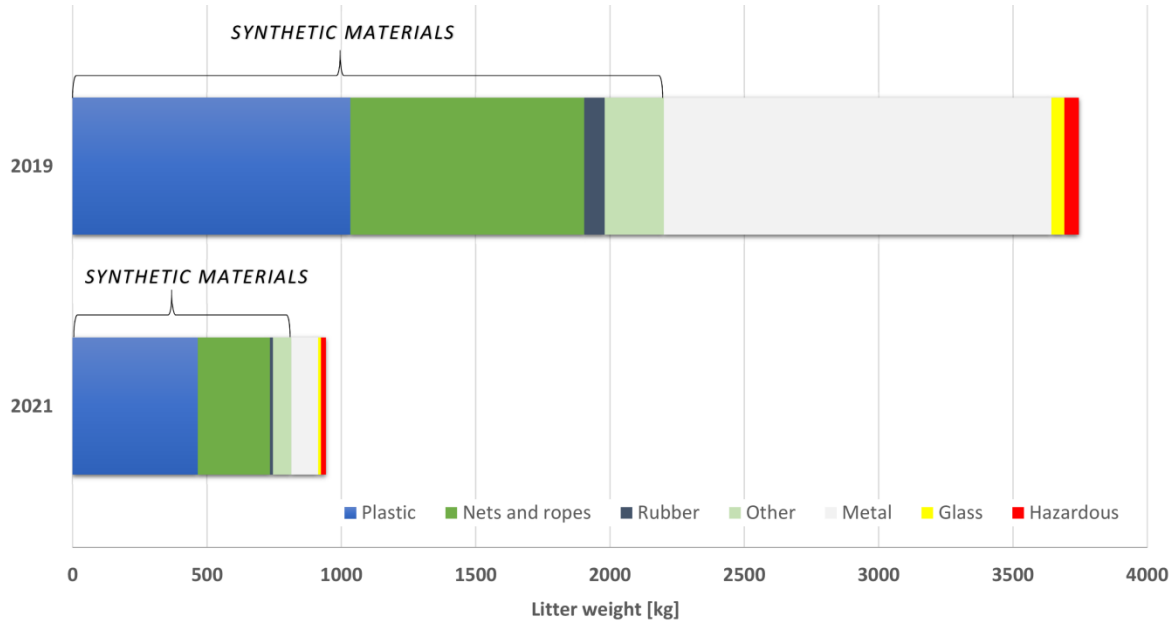

Fig. 8.2.1. Compared weight of litter collected in 2019 and 2021 within 15 working sections (#4–#18) of the coast in north-western Sørkappland, including a division into litter categories.

Chart created by forScience Foundation

The sonar buoy found in 2019 weighed c. 1000 kg and was removed from the beach by KV Nordkapp.

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The plastic container removed by the forScience team in 2021 weighed exactly 100 kg.

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To determine the rate of accumulation we used litter concentration data obtained from baseline sections #4–#18 in 2021. Because accumulation rate is given in kilograms per kilometre per year, data for working sections mapped out on the basis of the simplified rendition of the coast (Fig. 5.1.A and Tab. 5.1.B) had to be recalculated according to the actual length of the shoreline in the analysed area (Fig. 5.1.B and Tab. 5.1.B). The results of the analyses and calculations, which can be found in Chapter 5: Methodology and scope of project fieldwork, Table 5.1, show that the actual overall length of working sections #4–#18 (including section #10B) was 22 271 m.

Dividing the total weight of litter collected in 2021 within working sections #4–#18 (942.3 kg) by the total length of these sections (22.27 km) and then by two (because the weight data was obtained after two years), we received the average litter accumulation rate of 21.2 kg per every 1 km of the shoreline per year (21.2 kg/km/a). For individual working sections the accumulation rate ranged from a little over 4 kg/km/a (sections #14 and #18) to over 40 kg/km/a (sections #9, #11, #12 and #16).

The highest rate of litter accumulation was 50 kg/km/a (#11). The differences are likely to stem not only from the random distribution of large litter items, but also from the sections' location and geomorphological features (see: Chapter 8.3: Litter concentration and coast morphology).

What must be taken into account, however, is that especially during heavy storms which regularly occur in this part of Svalbard, the waves may not only strand new litter on the shore, but also:

- bury previously deposited litter items in the sand and rocks, and in case of extremely violent storms – cover them with rock debris from crumbling cliffs
- uncover previously buried litter items by washing away the coast
- wash back into the ocean some of the litter accumulated on the coast

and, as was already mentioned in Chapter 5: Methodology and scope of project fieldwork, accelerate the process of litter fragmentation, which reduces the efficiency of cleanup efforts (because small litter fragments are easier to miss) and makes it easier for even more litter to become buried in the shoreline or washed back into the ocean[16].

Marine litter that has been washed ashore becomes gradually buried in the shoreline.

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During particularly violent storms litter items may be covered with rock debris from crumbling cliffs.

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The data collected by the forScience Foundation do not make it possible to draw conclusions regarding the total weight of litter items buried in sand and covered with rocks and rock debris in the analysed area. As a result, the rate of litter accumulation calculated as part of *Sørkapp Marine Litter Cleanup* project is presumably underestimated.

8.3. Litter concentration and coast morphology

During both rounds of project fieldwork the concentration of marine litter stranded within individual working sections exhibited clear spatial variability. Bearing in mind the location of the project's target area and the diversity of beach types (see: Chapter 4: Project target area), it seems reasonable to assume that the rate of litter accumulation is affected, among others, by the location and morphology of the coast and the near-shore zone.

[16] *More information on how marine litter may get repeatedly stranded, buried, uncovered and washed back into the ocean can be found in the article „A global mass budget for positively buoyant macroplastic debris in the ocean" [3].*

Figure 8.3.1 shows the total weight of beach litter collected in 2019 and 2021 within particular working sections. Because in 2019, due to very harsh weather conditions, the forScience team managed to clean only sections #4–#18, the weight of litter that was probably present in sections #1–#3 and #19–#23 was estimated based on the premise that the amount of marine litter washed ashore between 2019 and 2021 constituted, on average, ¼ of the amount accumulated in a given section in the years 1985–2019. The average value comes from the analysis of weight data obtained this year for sections #4–#18 and should be considered as indicative rather than precise.

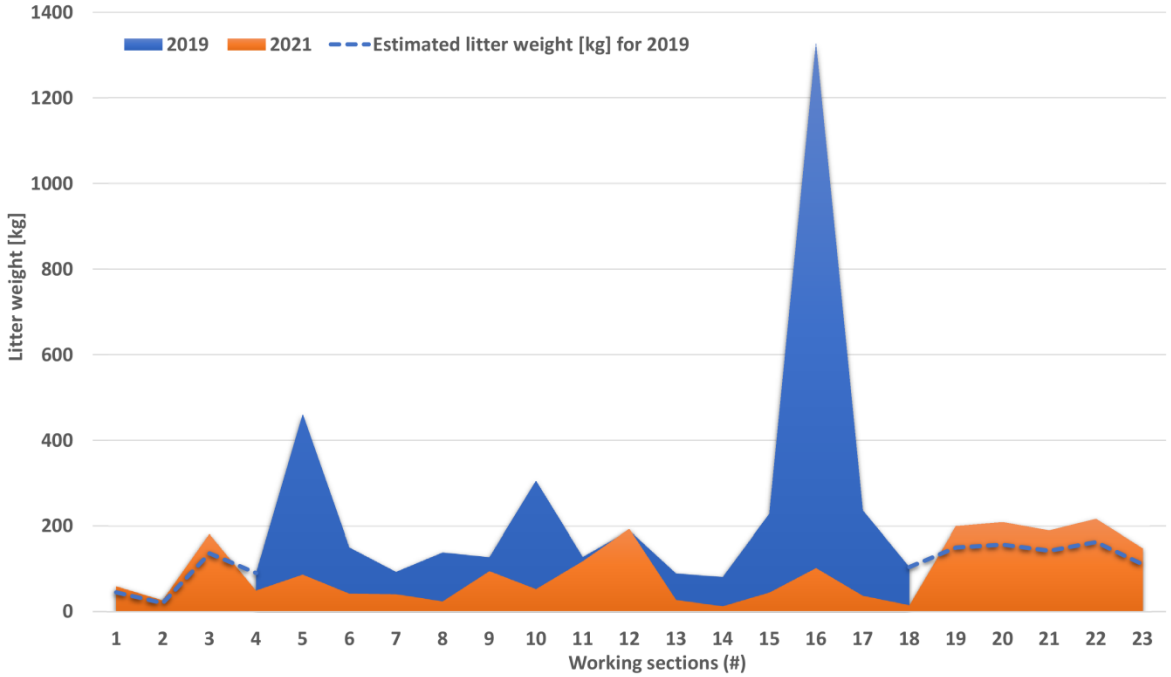


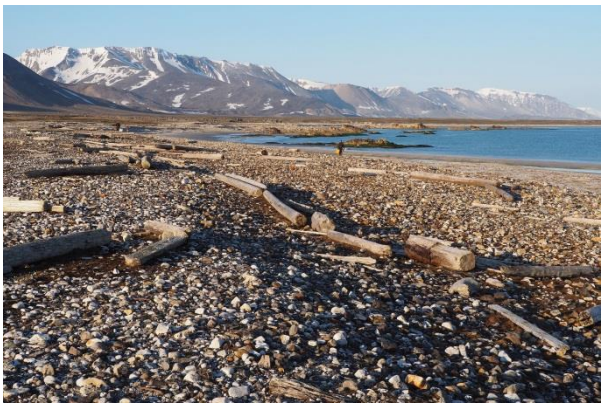
Fig. 8.3.1. The weight of beach litter collected in 2019 and 2021 within working sections #1–#23 of the project's target area in the north-western part of Sørkappland.
The dotted line shows the estimated weight of litter accumulated in sections #1–#3 and #19–#23 until 2019. The method of calculation has be described in the report.

Diagram created by forScience Foundation

Both in 2019 and 2020, the least littered section was #14 (Fig. 8.3.1), where we collected 81.1 kg (2019) and 12.8 (2021) kg of beach litter. Although the section faces the open sea, the near-shore area is dotted with numerous skerries and rocks (known as Vestvikskjera), which may have an impact on wave energy and direction, and thus on litter accumulation rate within the section.

In the year 2019, the section where the overall weight of collected litter was the largest was #16 (Fig. 8.3.1), stretching along the northern part of Vestvika Bay, whose sand-and-gravel shore faces westwards. Even though the number of skerries within the bay is limited, it does contain a large group of rocks jutting out of the water. The shores of the bay rise gently above water level. It is worth noting that the section would remain among the most polluted sections even if we disregarded the sonar boy, whose weight was estimated at 1000 kg[17]. In 2021, removed from section #16 was the total of 101.9 kg of litter, which made it the third most polluted section within the fragment of the coast that was first cleaned two years before.

[17] *After deducing the sonar buoy, the total weight of litter collected from section #16 in 2019 was 327 kg, which makes the section the second most polluted section of all (after #5, from which we then removed 460.6 kg of beach litter).*



One of the most polluted sections was #16, lining the northern part of Vestvika Bay.

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Section #5 stretches south of Sigfredbogen Bay, inside Hornsund Fiord.

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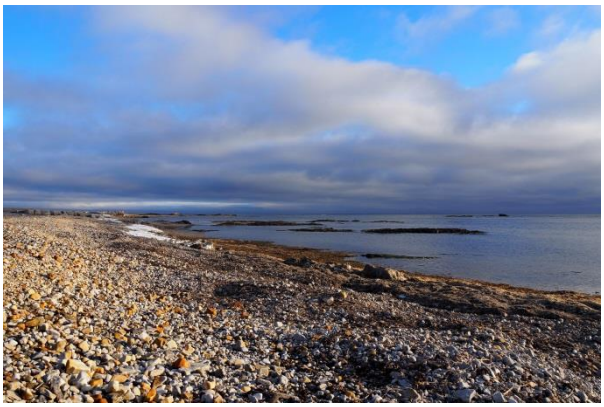
The second in terms of litter concentration in 2019 was section #5, which differs from section #16 both with regard to location and geomorphological features. Section #5 covers a stretch of the coast lying south of Sigfredbogen Bay, inside Hornsund Fiord, and its near-shore area is dotted with a large number of skerries and rocks, which often form steep cliffs a few metres in height. The numbers for this section were boosted by a single net fragment weighing 130 kg, but section #5 would remain the second most polluted section even if the item had not been taken into account. In 2021, the total amount of litter removed from section #5 was five times smaller than two years before (86.8 kg), but the section was nonetheless the second most polluted one within the previously cleaned area inside the fiord (sections #4–#9).

Sections #9 and #11, which in 2019 were only moderately polluted (with approximately 127 kg of beach litter removed from each of them), in 2021 counted among the most polluted sections within the previously cleaned area. In 2021, from section #9 we removed the total of 94.5 kg and from section #11 – 117.7 kg, which constituted 74% and 92% respectively of the amount found within the sections two years before.

Section #9, which is where Kapp Horn Hytte is located, is characterized by a largely homogenous shoreline covered with pebbles of various size, worn smooth by the waves. The beach is narrow with a relatively steep beach ridge whose height reaches up to two metres. Although during low tide the access to the shore is hindered by numerous rocks and skerries, most of them disappear under water during high tide and thus are not an obstacle for breaking waves. What is also worth noting is that the shore in this area is often covered with an enormous quantity of seaweed (*Laminaria*), which inevitably increases litter retention on land. Section #9 faces in the north-westerly direction (WNW, NW and NNW) towards the open sea. Bearing in mind that over the course of project fieldwork the WNW direction was among the three most prevalent wind directions recorded (Fig. 6.2), it may be assumed that the higher rate of litter accumulation in this area is due to the geography of the coast.

Contrary to section #9 described above, section #11 stretches along a little cove whose northern boundary is marked by a group of near-shore rocks known as Pomorsteinane, and southern – by Suffolkpynten headland. The shore in this place is mostly sand and stone, with the near-shore area full of rocks and skerries. Because of its location, section #11 is exposed to winds blowing from W and WSW directions.



Within section #9, access to the shore is hindered by numerous rocks and skerries.

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Section #12 was the only one where the amount of litter collected in 2021 was larger than in 2019.

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Section #12 was the only one where the total amount of beach litter collected during the second round of project fieldwork (193.1 kg) exceeded the amount removed in 2019 (189.3 kg). Section #12 covers much of Suffolkpynten – a narrow headland extending almost 600 m into the sea, which is the westernmost part of Sørkappland. In the south, where the headland borders with Lindqvistbukta Bay, the shore is steep and rocky, and the beach is covered with stones. Found in its northern part are rocky cliffs rising a few metres overhead and facing the open sea. Despite plenty of skerries, the headland is exposed to waves coming in from southerly, westerly and northerly directions.

Even though it might seem that the rate of litter accumulation in sections overlooking the open sea would be significantly higher than in sections lying inside the fiord, observations made over the course of project fieldwork do not confirm these predictions. The accumulation rate appears to be the highest within the sections situated at the mouth of the fiord, but the data acquired as part of the project do not make it possible to determine why this is the case. The forScience Foundation plans to continue investigating the effect of wave and wind activity, and the type of the coast on marine litter accumulation. The results of these investigations shall be published in the future.

8.4. Origin of litter items

The litter data collected by the forScience team during both rounds of project fieldwork included, among others, the information on the origin (producer and place of manufacture) of litter items removed from the environment. Collecting such data involved taking photographs of product labels and trademark symbols found on individual litter items, the idea behind it being that the information might help identify main sources of litter accumulating along the north-western coast of Sørkappland. Ultimately, however, the approach failed to bring satisfying results.

A great majority of litter items removed from the coast as part of the project had no markings whatsoever that would reveal their origin. As a result, the data we did manage to collect concerned only a fraction of all collected litter. Any conclusions based on these data would not therefore be reliable.

Besides, even if a given item still had a legible product label, the information it included (like, for example, the best before date) made it possible at best to estimate when the item was discarded (or

lost). It was not, however, a sufficient basis for decisive conclusions regarding the actual sources of these items (i.e. persons or entities responsible for their presence on Arctic beaches). Information about the producer and place of manufacture might prove useful if Svalbard introduced an Extended Producer Responsibility (EPR) scheme that would make it possible to take measures against companies, whose products pollute local beaches. As it is, the data seems to serve no practical purpose.

The majority of litter items had no labels that would state or indicate their place of origin.

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Knowing the place of manufacture is not enough to determine the sources of litter pollution in Svalbard.

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Despite difficulties with determining the origin of litter accumulated on the coast of Sørkappland, items such as fishing nets, buoys and floats or conveyor belt fragments undoubtedly come from fishing vessels operating in nearby fishing grounds. As a result, it seems more than justified to take steps to tighten regulations regarding the proper disposal of fishing gear, enforce these regulations more vigorously and make fishing companies accountable for the pollution they generate (by making them, for example, cover the cost of removing fishing-related litter items from the fragile Arctic environment).

9. Additional promotional and informational activity

The forScience Foundation used *Sørkapp Marine Litter Cleanup* project as a springboard for broad activity aimed at raising ecological awareness, especially in the context of northern polar regions. Since 2019, the activity included among others:

- a lecture entitled "Katastrofa nie tylko klimatyczna. Arktyka jako wyznacznik kondycji naszej planety", delivered during a conference „Klimat dla ludzi – ludzie dla klimatu", which took place on 13–15 December 2019 at Dolnośląski Ośrodek Doskonalenia Nauczycieli in Wrocław, Poland
- a series of interviews for the radio (Radio Kampus) and public television, including:
    - TVN24: Polacy sprzątali Arktykę ze śmieci
    - TVP Polonia: Halo Polonia
    - PolandIn (in English): Cleaning the Arctic as the way of spending holidays
    - Polsat Rodzina: Mamma Mia! Odcinek 177

- a series of magazine articles discussing various aspects of the project and the issue of marine litter, including:
    - Biologia w szkole: Arktyczne plaże toną w śmieciach
    - Biologia w szkole: Plastikowa Arktyka
    - Wyborcza.pl: Zebrali tony śmieci w Arktyce
    - Magazyn Zew Północy: Sørkapp Marine Litter Cleanup, czyli porządki na Svalbardzie, *Zew Północy,* Nr 35, s. 29–31
- a series of articles about the project, Svalbard and the issue of marine litter, which are available on the official website of the forScience Foundation in Polish and in English,
- educational classes for primary and secondary school children and teenagers from cities such as Warsaw (on site workshops and presentations) and Poznań (Arctic webinars).

This year, due to restrictions resulting from the COVID-19 pandemic, informational and educational activity has taken place mainly in the Foundation's social media, where new project-related material is published every few days. Our posts deal not only with the issue of marine litter on Arctic beaches, but also with Svalbard's history, natural environment and responsible tourism.

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11. Acknowledgements

We would like to express our warmest thanks to all those who went out of their way to ensure the successful completion of the second round of project fieldwork:

- **Kasia Filimonow**, **Krzysiek Pełka** and **Paweł Lewandowski** for taking up the challenge, significantly contributing to the success of project fieldwork and making it all so much fun,
- **Jan Marcin Węsławski**, **Leszek Kotwicki** and **Wojtek Moskal** from the Institute of Oceanology, Polish Academy of Sciences, for useful advice and key equipment,
- **the team of the Polish Polar Station Hornsund** and especially **Joanna Perchaluk** for the care and assistance without which completing the fieldwork would have definitely been much more of a challenge,
- **Norwegian Coast Guard**, especially **the command and crew of KV Nordkapp** for logistic support and readiness to offer further assistance during subsequent editions of the project,
- **Barbara Jóźwiak (Senior)** and **Rafał Rybakiewicz** for unflagging enthusiasm for *Sørkapp Marine Litter Cleanup* and help at many different levels,
- **BB Kite Buggy** for tailor-made expedition gear,
- **Stig Henningsen** from Henningsen Transport & Guiding for his trust in the forScience team,
- **Melissa Nacke** from the Association of Arctic Expedition Cruise Operators (AECO) for making sure no simultaneous cleanup activity interferes with our results,
- **Baltic House Poland** for their fondness for the Arctic and shabby wooden cabins

and the rest of you who followed our ups and downs all these months. We are delighted you kept us company on the epic journey that *Sørkapp Marine Litter Cleanup* project turned out to be.

Barbara Jóźwiak and Adam Nawrot

Report on the execution of **Sørkapp Marine Litter Cleanup** project in 2021

editing and proofreading	
graphic design	Barbara Jóźwiak
cover photographs	

digital edition

project funded by:

SVALBARD ENVIRONMENTAL PROTECTION FUND

publisher: forScience Foundation

Przy Skarpie 70/47, 87–100 Toruń, Poland

www.forScience.pl

Toruń 2021

ISBN 978-83-956002-3-4