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South Asia

Nurdle Pollution Along the Western And Southern Coastline Of Sri Lanka Following Recent Ship Accidents

(Photo Credit - The New Indian Express)

Nurdle Mapping Survey conducted on 07th - 09th October, 2025

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Acknowledgements:

This report would not have been possible without the great support, active participation, and contributions of Greenpeace Volunteers who helped in collecting data.

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Definitions

Plastic Nurdles:
Pre-production plastic pellets, commonly known as nurdles, are tiny plastic pellets (smaller than 5 mm or 0.20 in) that are universally used in the plastics industry for the manufacture of plastic products [1].

Transboundary Impacts:
Environmental effects caused by pollutants, waste, or debris crossing borders, demanding global cooperation for solutions [2].

Persistent Organic Pollutants (POPs):
Enduring toxic chemicals accumulating in organisms and ecosystems, posing global environmental and health risks [3].

Bioaccumulation:
A- process where pollutants or toxins increase in concentration as they move from one organism to the next through the food chain. This phenomenon has significant implications for sustainability, particularly concerning ecosystem health and human well-being, as higher trophic levels, including humans, can accumulate dangerous levels of contaminants from their diet [4].

Nurdle Pollution/Spill:
Environmental contamination by nurdles. These lentil-sized particles are inadvertently released into ecosystems during plastic production, transport, and processing, contributing significantly to microplastic accumulation in aquatic and terrestrial environments. Nurdles pose ecological threats through ingestion by wildlife and their capacity to absorb persistent organic pollutants [5].

Biomagnification:
Increasing concentration of persistent substances in organisms at successively higher levels in a food chain [6].

Executive Summary

This report highlights the growing concern of plastic nurdle pollution along the coastline of Sri Lanka, following two significant maritime incidents the 2021 MV X-Press Pearl disaster [7] and the recent 2025 MSC Elsa 3 ship sinking off the coast of Kerala, India [8]. These maritime disasters posed serious, long-term ecological and socioeconomic impacts by discharging billions of plastic pellets into the marine environment. Once entering the sea, nurdles can spread far and wide with currents and tides, making coastal communities living near major ports or busy shipping lanes at risk of being affected by this pollution.

From 07th to 09th October, a survey was carried out across 16 beaches from Negombo to Galle to assess the level of pollution and characteristics of nurdles accumulated along the coastline. The results revealed a varying concentration of nurdles across the sampling sites, while most of the observed nurdles were white and semi-translucent, suggesting they were likely related to the recent spill caused by the MSC Elsa 3 shipwreck on 25th May 2025. Another set of nurdles displayed weathering observations, suggesting they had been exposed to the environment for a much longer time.

Additionally, nurdles with a cylindrical shape started to appear along the shores following the recent MSC Elsa 3 ship accident and were observed accumulating among the other pellet forms. While direct source attribution requires further verification, these observations strongly suggest transboundary transport of nurdles from the Kerala spill to Sri Lankan shores, following monsoon weather and oceanographic currents.

The study points out the urgent requirement for regional coordination and long-term monitoring of microplastic pollution, as well as accountability of polluters and fair compensation for impacted communities. Given Sri Lanka’s dependence on coastal fisheries and the ecological sensitivity of ecosystems such as coral reefs, seagrass beds, and mangroves, unmanaged nurdle contamination significantly threatens marine biodiversity, food security, and coastal livelihoods.

1. Introduction

On 25th May 2025, just a couple of weeks before World Oceans Day and 4 years after the X-Press Pearl disaster [9],[7] in Sri Lanka, it was India's turn to witness one of its major ship accidents when the Liberian-flagged container ship MSC ELSA 3 sank off the coast of Kerala, South India. The vessel was traveling from Vizhinjam to Kochi when it developed a severe 26-degree starboard list caused by flooding in one of its compartments. Despite salvage attempts, the ship capsized and sank at 14.6 nautical miles and 50m deep southwest of Kochi. It carried 643 containers, including 13 classified as hazardous and 12 containing calcium carbide. The ship also had 84.44 metric tons of diesel and 367.1 metric tons of furnace oil, raising environmental concerns with oil and chemical leaks posing a serious threat to the regional marine ecosystems. Besides, the vessel held as many as 60 containers of plastic pellets, whose contents have since then been carried over by monsoon weather and currents to wash ashore on the Kerala, Tamil Nadu, and Sri Lankan coastlines.

Since this incident, massive quantities of microplastic pellets have been reported washing ashore along India's southwestern coastline, including Kovalam, Thiruvananthapuram, Kollam, Alappuzha, and Tamil Nadu, and drifting across the Palk Strait to the northern, western, and southern coasts of Sri Lanka. Initial observations from multiple sites in both countries show that nurdles have spread widely over several hundred kilometers, reaching sensitive ecological areas such as the new Dhanushkodi Greater Flamingo Sanctuary and the Gulf of Mannar Marine Biosphere Reserve.

Strong monsoon and severe weather have carried plastic nurdles spilled into Kerala seas to the Sri Lankan coast, raising serious concerns about the environmental consequences of the MSC ELSA 3 incident, which is believed to be the source of the spill. The first observations of plastic nurdles washing ashore in Sri Lanka were reported on the southern beaches of Mannar Island in the second week of June 2025, when larger quantities subsequently landed in high tide areas along the northern, western, and southern coasts.

Figure 01: Nurdle Spill Samples from Mannar on 13th June, 2025
(Photo Credit - Jeeva Nezhan)

Nurdle spills have highlighted the impact of these tragedies on vulnerable coastal communities, whose livelihoods depend on healthy oceans. The local fishing industry is especially at risk, as these microplastics can be mistaken by marine animals as food, fish eggs, and further lead to fish contamination and financial hardships, including due to fishing restrictions and consumer reluctance. Besides, the long-term devastating effects [10] on marine life, sensitive ecosystems and coastal communities could be catastrophic, urging calls for action to address this pollution as soon as possible.

Nurdles are small plastic pellets about the size of a lentil that are used to produce most plastic items. Billions of nurdles are processed each year, but tons of them also spill directly into the global environment. Nurdles can be easily released into the marine environment [11] from lost containers at sea during rough weather conditions or when a container ship eventually sinks with all its cargo. Their small size, buoyancy, and lightweight nature allow them to disperse widely across oceans and coastlines, posing serious concerns for ecological and human health.

Beyond their physical presence as pollution agents in ecosystems, nurdles also act as chemical carriers. Given the nature of manufacturing from fossil fuels, these nurdles contain a complex mixture of additives [12] and residual monomers, including phthalates, bisphenol A (BPA), organotins, heavy metals, flame retardants, and PFAS (per- and polyfluoroalkyl substances). Many of these chemicals are not tightly bound within the polymer matrix, allowing them to leach into surrounding environments over time, particularly under heat, UV exposure, or physical abrasion. Studies have shown that these chemical leachings can continue throughout the lifetime of a nurdle [13], posing chronic risks to ecosystems, marine organisms and public health. This situation is particularly concerning for island nations like Sri Lanka, which mostly depend upon fisheries to fulfill nutritional needs.

SFurthermore, and once released into the marine environment, nurdles can absorb and concentrate persistent organic pollutants [14] (POPs) such as polychlorinated biphenyls (PCBs), dichlorodiphenyldichloroethylene (DDE), and polycyclic aromatic hydrocarbons (PAHs). These often attain concentrations that are up to a million times higher than those of surrounding seawater. Long-lived and bioaccumulative, these pollutants have been linked to mutagenic, carcinogenic, and endocrine-disrupting effects in both humans and wildlife. Often mistaken for food/fish eggs or other natural prey, these nurdles are ingested by marine organisms, including seabirds, turtles, and fish, resulting in digestive blockage, starvation, and mortality. They also act as vectors of toxics along the food chain. Moreover, the accumulation of nurdles can cause alterations to beach characteristics such as sand temperature and permeability, which can affect the survival of hatchlings or the nesting behaviors of species like sea turtles that rely on specific beach conditions.

Accidents of cargo ships carrying diverse hazardous chemicals and these primary products of plastics can lead to complex spills of pollutants in marine ecosystems. One such incident that happened in Sri Lanka was the catastrophic fire on the container ship X-Press Pearl [15], [7], which sank 18 km off the western coast in May 2021. This disaster caused a massive spill of plastic pellets—with the vessel carrying 11,680 tons of nurdles at the time. The MSC Elsa 3 spill has now added to this legacy of plastic pollution from the X-Press Pearl, implying continuous impacts to Sri Lanka, given the persistence, chemical complexity, and mobility of these particles.

This survey focused on assessing the distribution, concentration and characteristics of the nurdle pollution along Sri Lanka's western, and southern coastlines, aiming to provide insight into the scale and implications of this growing environmental crisis.

Figure 02: A composite of feild photographs showing spilled nurdles washed ashore during the coastal survey, along the western and souther coasts of Sri Lanka
Image Credit - GPSA, 2025

2. Method of Surveying

1. Survey Area

This survey focused on **the Western and Southern Provinces from Negombo to Galle**—which were identified as the most impacted areas by the nurdle spills from the MSC Elsa 3 and X-Press Pearl ship accidents.

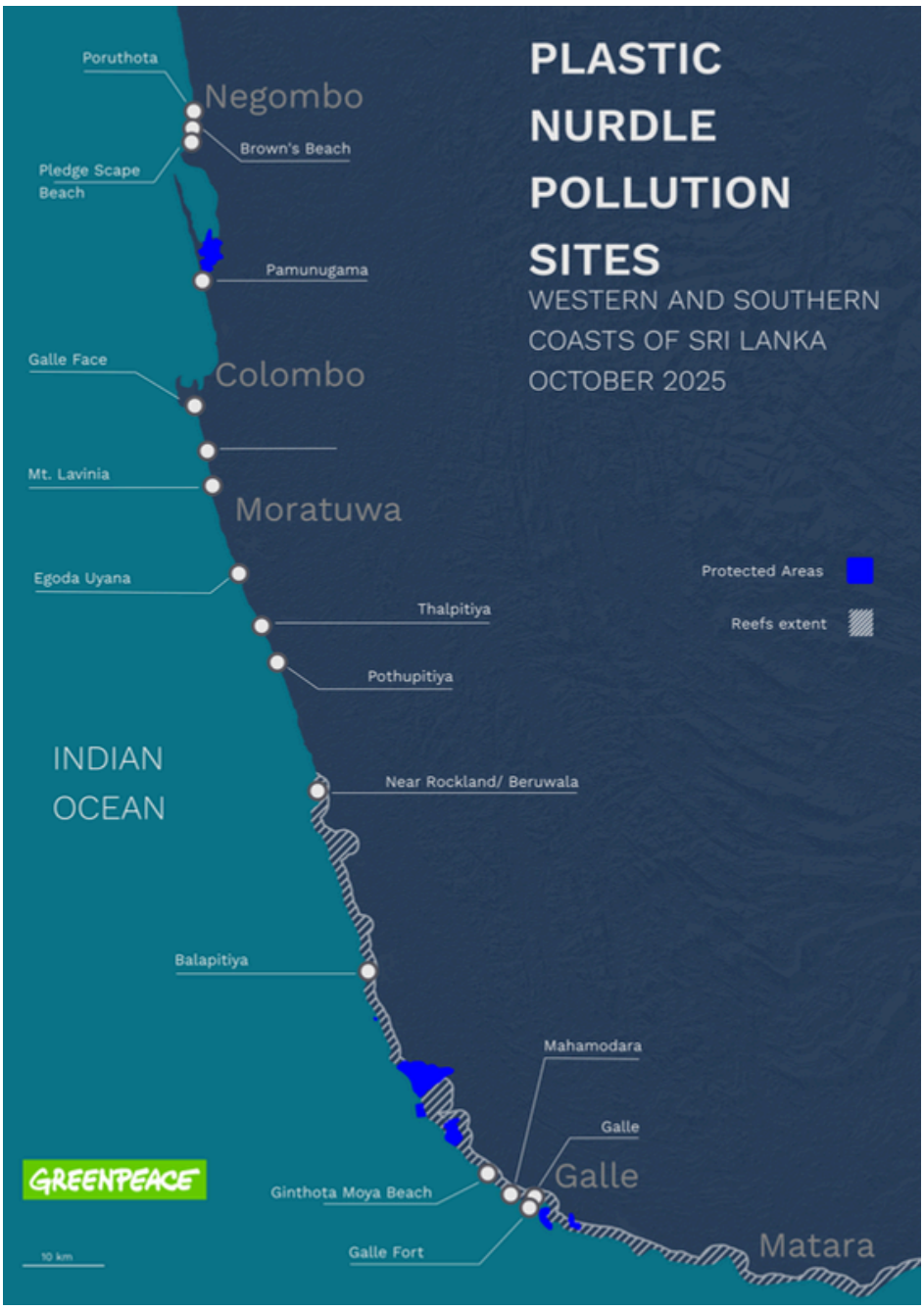

Figure 03: Map image of the survey area

3. Data Collection

A visual and quantitative assessment was conducted across 16 coastal sites to evaluate nurdle pollution levels. Data collection was done through a Google Forms application designed for form-centric data entry. Each sampling site included the count of nurdle density within a defined quadrat area (60 cm × 60 cm). High-resolution, geo-tagged photographs were captured after placing the quadrats on the sand, followed by manual counting of nurdles within each quadrat to estimate surface accumulation, together with observations on the shape variations and color changes of nurdles.

At each site, five quadrats were assessed within a 50-meters (approximately 164 ft) stretch of the beach. The 50-meters transect line laid along the high-tide mark was used as the sampling belt, extending 1 meter below (seaward) the tide line to define the sampling area. Each quadrat was placed randomly within each 10-meters segment of the transect, maintaining a minimum space of 3 meters between adjacent quadrats.

GPS coordinates for each site were recorded, with the use of Google Earth to support spatial analysis. For each quadrat, nurdles present on the upper surface layer were counted, and their morphological characteristics were observed based on color and shape to record their nature and compare them with 2021-2022 data from the X-Press Pearl accident.

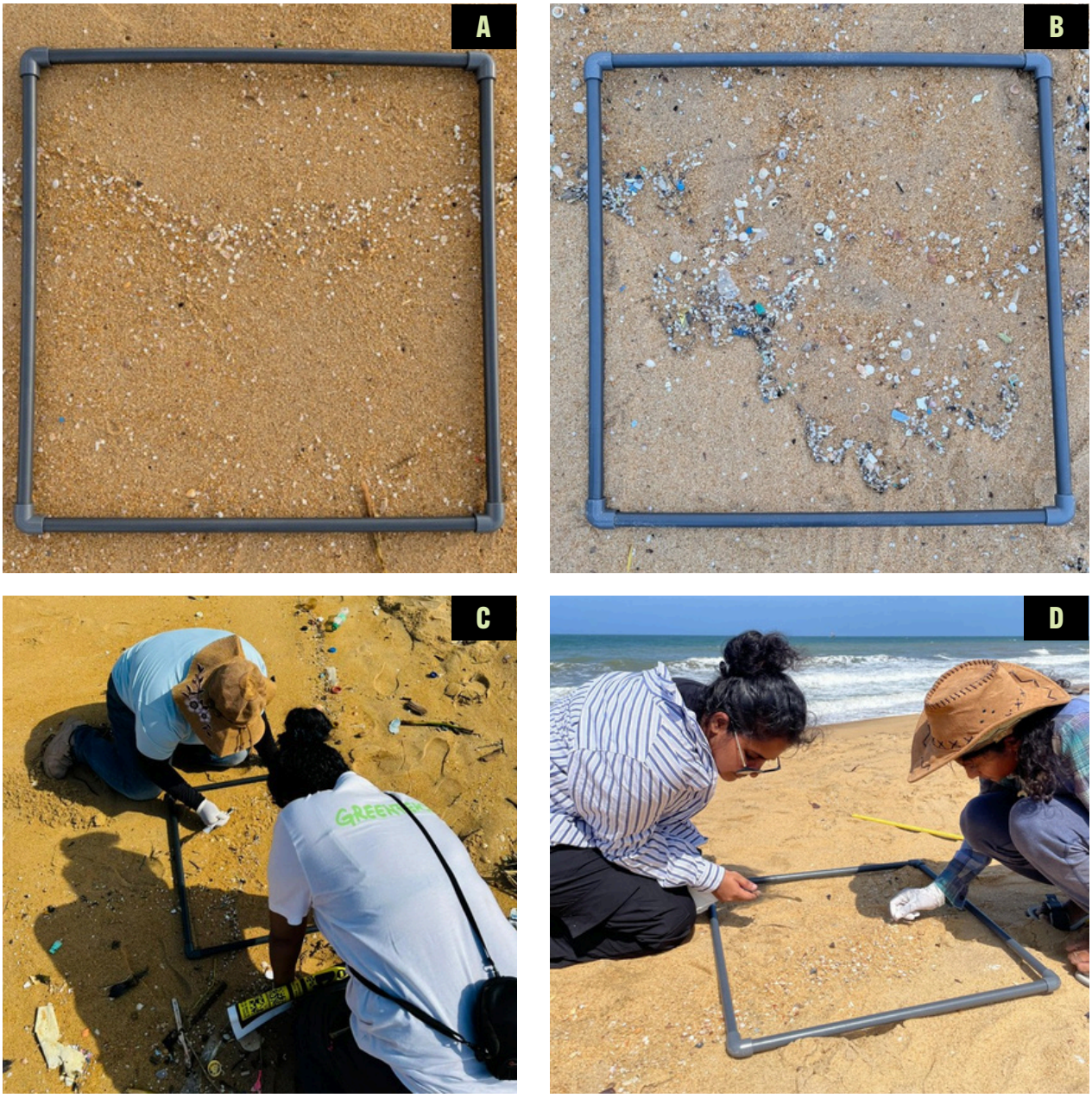

Figure 04: Feild observations from the coastal nurdle mapping survey; The panels show (A-B) the quadrat setup used for counting plastic nurdles on the beach and; (C-D) survey team conducting onsite quantification of nurdles along the shoreline
Image Credit - GPSA, 2025

Geo-tagged high-resolution images of the quadrats were taken, and for each, nurdles of the upper surface layer were counted. (The data included counts and classification of nurdles by color and shape for accurate comparison across different sites).

In documenting the morphological status of the nurdles, our survey considered the following parameters:

- Individual count of nurdles (manual counts were cross-checked with detailed examination of high-resolution images to ensure accuracy).
- Color categories, including white, opaque, and discolored (yellowed or darkened).
- Shape variations, including weathered/irregular pellet forms and cylinder-shaped forms.

Figure 05: Team members conducting the survey
Image Credit - GPSA, 2025

4. Findings

The survey revealed varying levels of nurdle accumulation along the western and southern coastlines of Sri Lanka, extending from Negombo to Galle. A total of sixteen sampling locations were covered using 60 x 60 cm quadrats placed along the most recent high tide line, and the mean nurdle count per square meter was calculated for each beach site.
Based on these mean values per m^2, sites were categorized into five pollution levels:

Low (<20), Medium (21-70), High (71-200), Very High (201-600), and Extreme (>600), reflecting the density of nurdle contamination observed per unit (1 m^2).

Among the 16 surveyed sites, only Galle Beach (6°02'12"N 80°13'33"E) showed a relatively low level of nurdle contamination. 3 sites — namely, Poruthota, Pothupitiya, and Galle Fort — were categorized under the medium-level nurdle pollution range (21-70/m^2), while four sites — Brown's Beach, Near Rockland/Beruwala, Balapitiya, and Ginthota Moya Beach — showed high levels (71-200/m^2) of pollution. Five sites — Galle Face, Mount Lavinia, Egoda Uyana/Moratuwa, Thalpitiya, and Mahamodara — exhibited very high levels (201-600/m^2) of contamination, marking them as critical hotspots of nurdle accumulation along the beach. Notably, Pledge Scape Beach recorded an extreme level of pollution (>600/m^2), with the highest mean count of nurdles per square meter (1441/m^2) among surveyed sites.

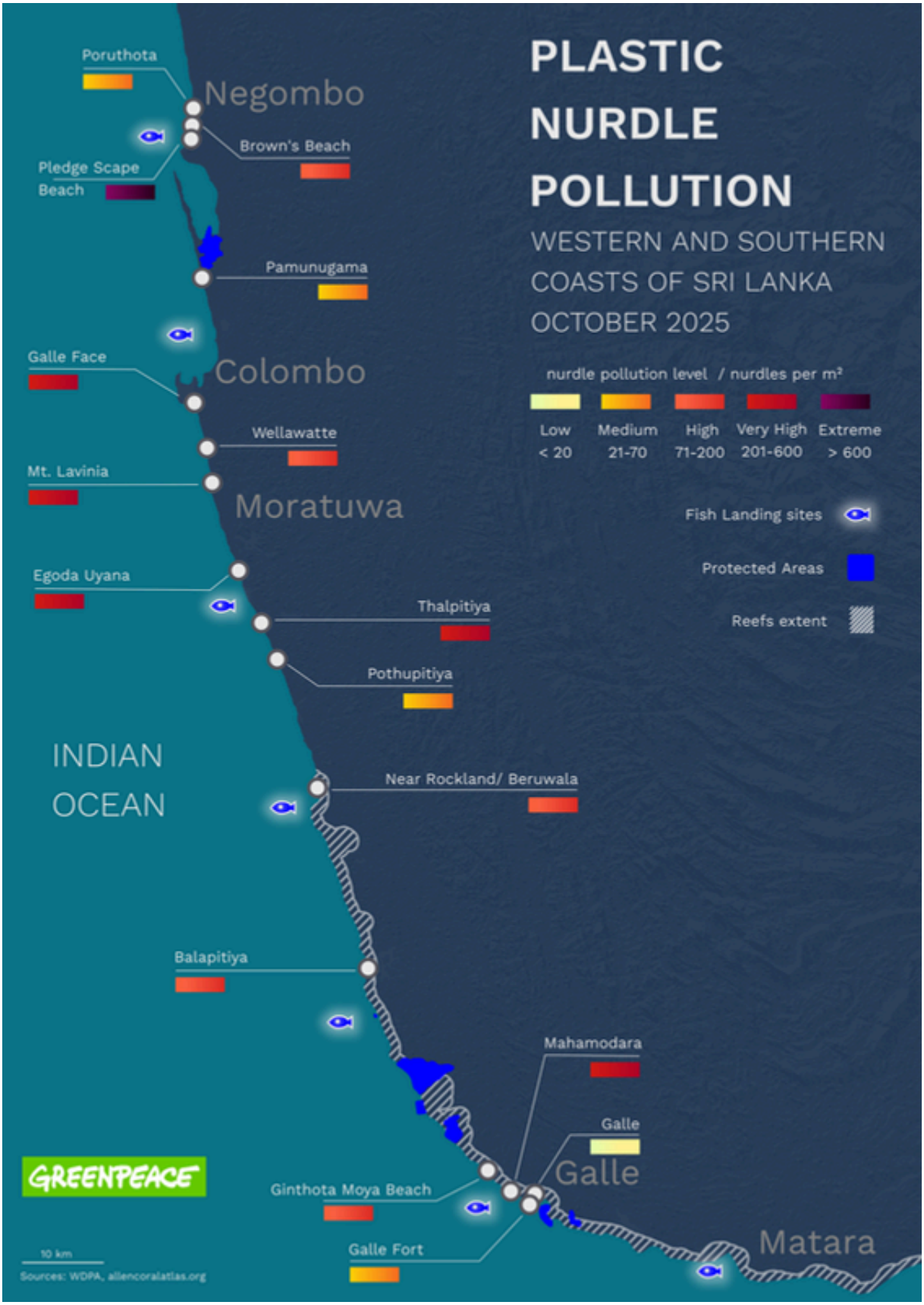

Figure 06: Nurdle distribution along the surveyed coastline

Based on these findings, the site categorization according to the pollution levels is as follows:

- Extreme Concentration: Pledge Scape Beach
- Very High Concentration: Galle Face, Mount Lavinia, Egoda Uyana/Moratuwa, Thalpitiya, and Mahamodara
- High Concentration: Brown's Beach, Near Rockland/Beruwala, Balapitiya, and Ginthota Moya Beach
- Medium Concentration: Poruthota, Pothupitiya, and Galle Fort
- Low Concentration: Galle Beach

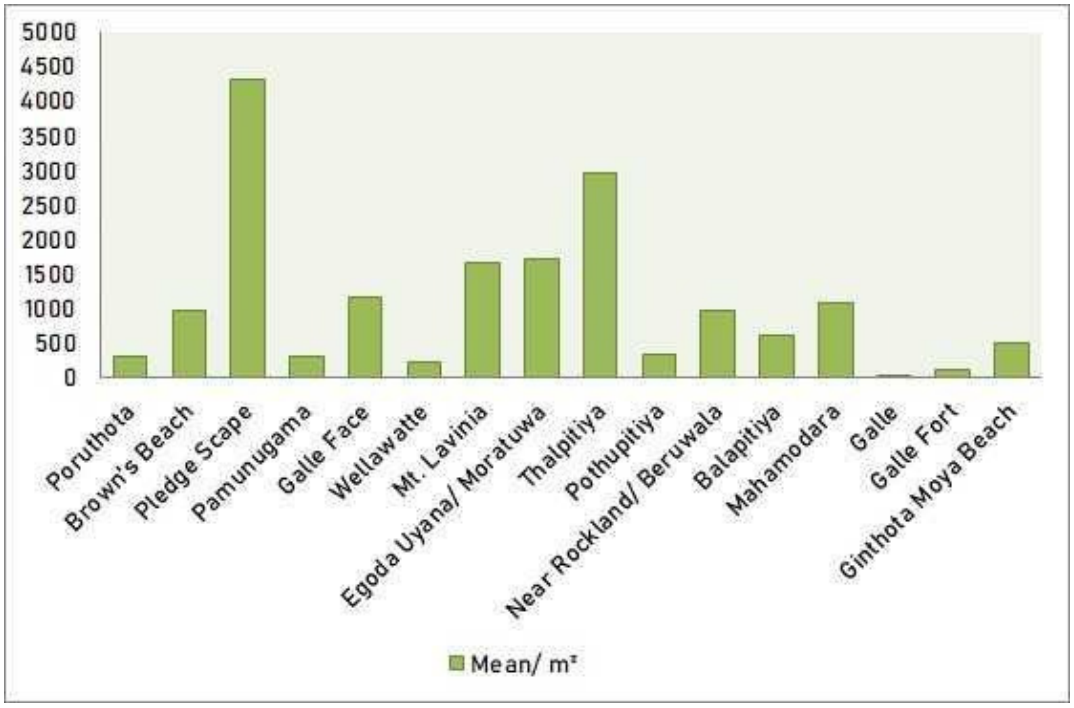

Figure 07: Mean Nurdle Count per m² by each Beach

Spatial analysis of the results indicates a clear gradient of nurdle accumulation along the western coastline, with the most polluted areas concentrated between Colombo and Galle. The results are shown on the above map, with each site color-coded based on its level of pollution (low, medium, high, very high, and extreme).

Beyond quantity documentation, qualitative observations of the nurdles revealed notable variations in color, shape, and surface condition. Across most sites, the majority of pellets were white or semi-translucent, with the typical characteristics of raw plastic resin pellets. However, several beaches, particularly those with higher accumulation, contained discolored (yellowed or darkened) nurdles that have been weathered, indicating prolonged exposure to sunlight and seawater. Also, at nearly every site, there were cylindrical-shaped, granule-like nurdles mixed in with other white/transparent, fresh-looking pellets. The cylindrical-shaped pellets matched some of the types of nurdles connected to the recent MSC ELSA-3 spill, which had not been seen along the Sri Lankan coastline before this incident.

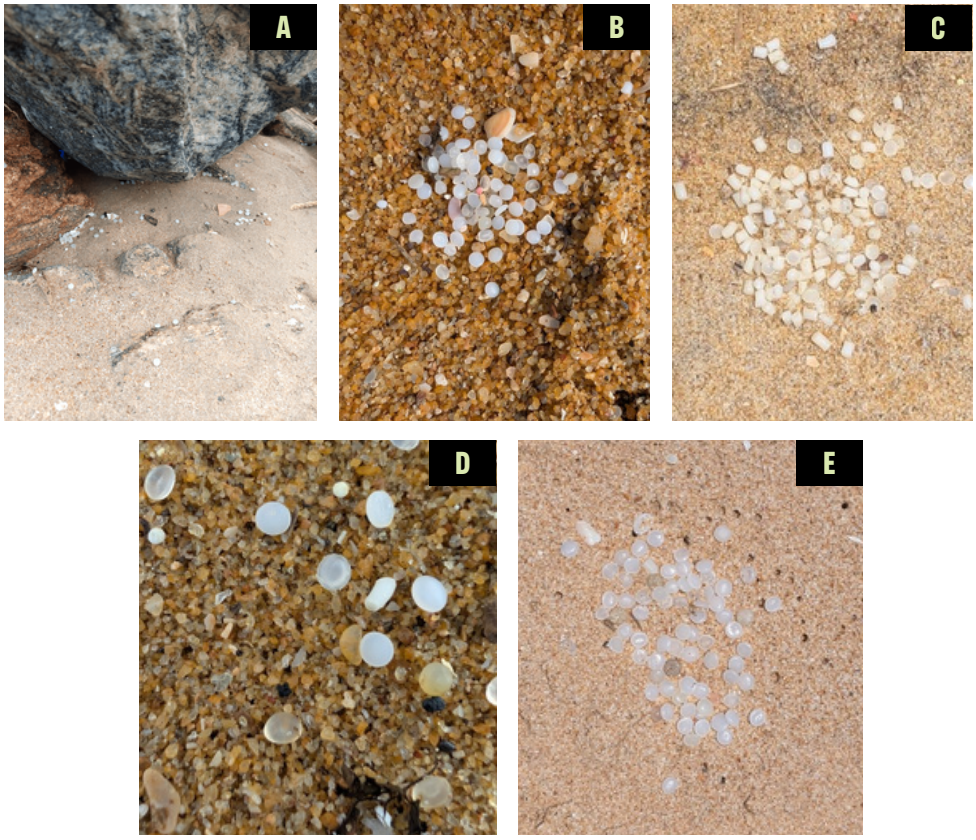

Figure 08: Field observations from coastal nurdle mapping survey; Panel (A),(B) and (E) show mixed nurdle accumulations dominated by white and white-transparent, fresh-looking pellets. Panel(C) presents cylindrical, granule-like nurdles observed among other white and semi-translucent forms. Panel (D) includes a combination of all major nurdle types documented during the survey

Image Credits - GPSA 2025

No animal carcasses were observed throughout the whole survey. Still, information received from local community members indicates a noticeable increase in the landing of nurdles since the MSC Elsa 3 shipwreck on 25th May 2025. During field observations, it was noted that groups of community women, appointed by a local government institution (Marine Environment Protection Authority—MEPA), carried out daily beach cleanup surveys from 9 AM to 2 PM. Despite other ongoing community-based cleanup efforts, these groups reported collecting large numbers of nurdles on the beach every day. This highlights the wide extent and long-term nature of the nurdle pollution along our coastline.

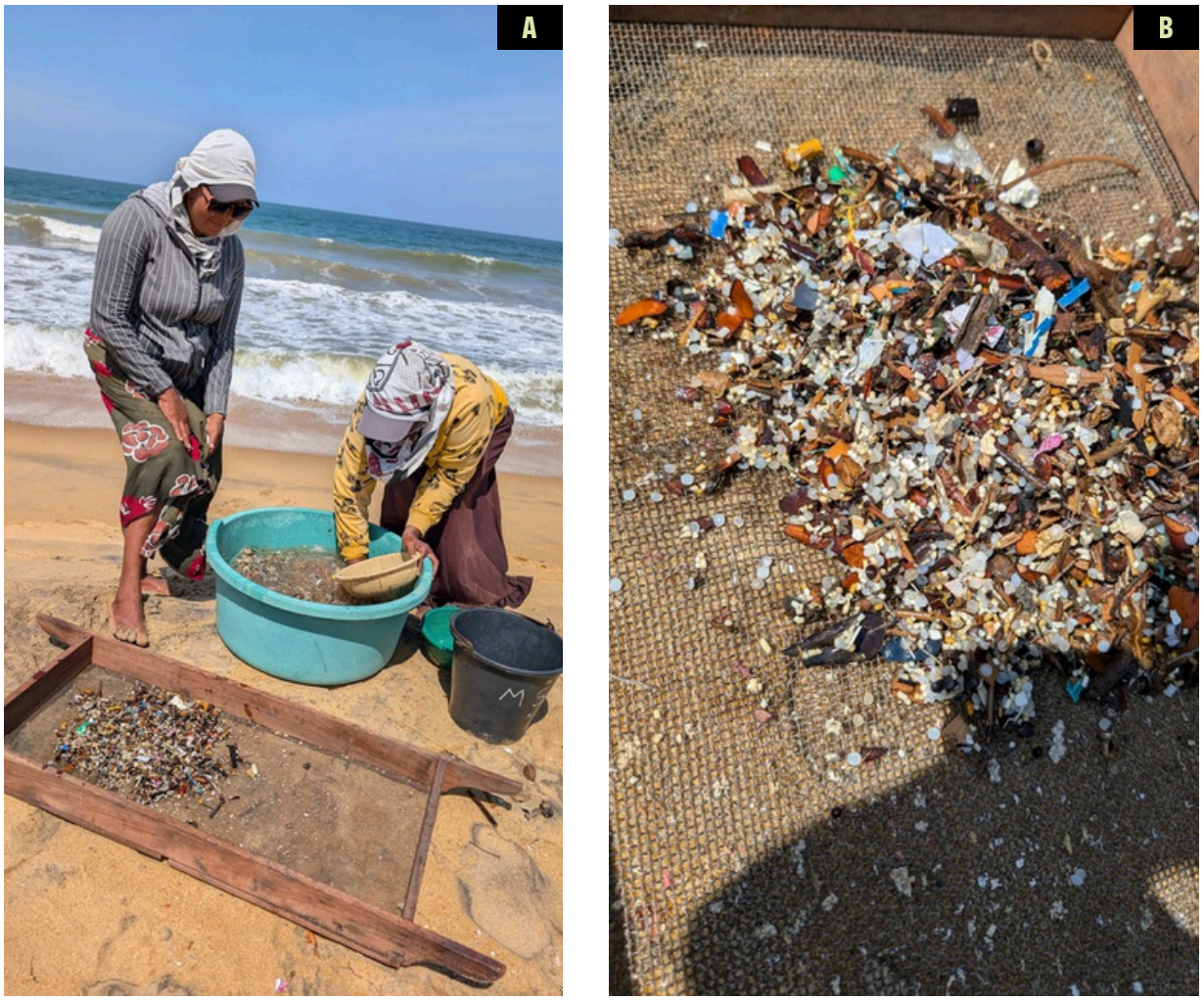

Figure 09: Field observations from coastal nurdle mapping survey; Panel (A) shows community women participating in field cleanup and survey operations along the shoreline, and panel (B) separated nurdles collected from beach sand
Image Credits - GPSA 2025

5. Discussion

The findings of the current survey reveal significant inconsistency in nurdle accumulation along the surveyed beaches, with the concentrations ranging from “low” to “extreme” across different sites. The majority of the observed nurdles were white/semi translucent, as those reported following the MSC Elsa 3 shipping disaster, indicating recent contamination. Additionally, the presence of cylindrical-shaped nurdles mixed with other more frequent convex or lentil-shaped pellet types, all of them of white and/or white-transparent color, indicates that ongoing deposition may be linked to the same spill event caused by the recent ship accident in Kerala. Some nurdle samples displayed weathering and discoloration characteristics, suggesting extended exposure and degradation in the environmental processes. These isolated samples are likely pollution remnants from the X-Press Pearl incident in May 2021.

The implications of these findings are not just about pollution distribution levels; they have more serious environmental, ecological, or even human health effects that extend widely [16]. Once deposited on beaches or in nearshore environments, nurdles undergo fragmentation, oxidation, and biofouling, causing gradual release of absorbed toxic compounds. At the same time, the surface of these plastic nurdles act as an ideal substrate for harmful microorganisms [17], allowing the formation of a biofilm harboring pathogenic bacteria such as Vibrio spp. and E. coli. Thereby, this increases potential disease risks to both marine life and human health.

Furthermore, as observed in studies conducted worldwide, chemical adsorption on nurdles significantly increases the pollution load. Persistent organic pollutants (POPs) —including PCBs, PAHs, and DDE, along with heavy metals and oil residues, readily stick to the surface of plastic nurdles, turning them to act as carriers of concentrated toxics across environmental systems. Studies from Japan [18] and the aftermath of the X-Press Pearl disaster [19] in Sri Lanka indicate that these chemicals can stick to nurdles at concentrations that are millions of times greater [20] than the levels present in surrounding seawater.

Once these pollutants are ingested by marine organisms [21], they can bioaccumulate and biomagnify throughout the food webs, ultimately reaching human plates through seafood consumption. In simple terms, plastic nurdles do not just pollute the ocean as physical debris, they also absorb and spread highly concentrated toxic chemicals [22], becoming chemically more toxic, posing serious impacts by injuring marine life [23], ecosystems, and potentially human health.

The ecological consequences are equally severe. According to scientific literature, many marine organisms — more than 220 marine species — have been found ingesting plastic nurdles, leading to blockage of their gastrointestinal tracts, reducing their ability to feed properly [24] (reduced feeding efficiency), and causing them to starve to death or to suffer internal organ injuries leading to pain, infection, and death eventually. For species such as seabirds and sea turtles, nurdle ingestion can also lead to defects in development over time [25]. Finally, nurdles may change the composition and natural properties of sediments, for instance, affecting their temperature and disrupting nesting turtle behaviors—since turtle eggs depend on specific sand temperatures for successful incubation. It can also affect small invertebrate populations that live and rely on these sediments.

In the context of the present survey, the observed distribution of nurdles along the coasts of Sri Lanka not only highlights the transboundary nature of such plastic pollution, but also the critical need for accountability within the global shipping and logistics sector. While the persistence and dispersal of these pellets make nurdle cleanup operations difficult, it is not fair and not effective to expect local communities or authorities to deal with long-term impactful consequences they are not responsible for. Instead, big shipping companies like MSC, owner of the MSC Elsa 3 container ship that sank off Kerala this year, should be held accountable for the damages caused to our invaluable regional ecosystems and wildlife, as well as for their dramatic socio-economic impacts such as the loss of livelihoods for fishing communities.

6. Conclusion

This survey highlights the urgency of addressing nurdle pollution along Sri Lanka's coastline. While the research remains limited in scope, the observations clearly display the widespread presence of plastic nurdles, most of which highly likely originated from the recent MSC ELSA 3 shipwreck. While definitive identification evidence requires laboratory-based polymer and additive fingerprinting, the spatial distribution patterns of nurdle presence and monsoon dynamics provide a strong indication of cross-border dispersion. The monsoon-driven reversal of current systems around Sri Lanka, particularly the Southwest Monsoon Currents within this period, must have boosted the chance of transboundary transport, facilitating the movement of nurdles across the region, showing the complex interaction between seasonal oceanography and nurdle pollution dynamics due to these circulation patterns in the northern Indian Ocean.

Recommendations:

- Improve national laws and enforcement systems to be aligned with, or ahead of international agreements and standards, to prevent nurdle pollution throughout the entire plastic pellet supply chain, by enforcing stricter protocols for plastic pellets handling and transport, and advance spill recovery technologies.

- Mandate the reporting of any loss or spillage of plastic pellets at every stage of the global supply chain to ensure transparency, accountability, and traceability of plastic nurdle handling procedures.

- Classify plastic nurdles as a distinct type of cargo, with specific safety measures introducing specialized requirements for packaging, labeling, and stowage of cargo to minimize the potential risks of spills during maritime operations.

- Establish well-defined procedures for rapid response and compensation systems ensuring financial and legal accountability, as per the "polluter pays" principle.

Annexes:

1.Summary of Nurdle Count Data by Site

Beach	Coordinates	Q1	Q2	Q3	Q4	Q5	Total	Mean/ m2
Poruthota	7°15'32"N 79°50'30"E	23	58	20	8	4	113	63
Brown's Beach	7°14'23"N 79°50'25"E	21	39	57	125	107	349	195
Pledge scape	7°13'27"N 79°50'21"E	274	738	532			1544	1441
Pamunugama	7°04'05"N 79°51'05"E	17	21	13	34	27	112	63
Galle Face	6°55'39"N 79°50'34"E	85	186	150			421	393
Wellawatte	6.876581"N,79.856967"E	37	17	22			76	71
Mt. Lavinia	6°50'15"N 79°51'46"E	97	162	45	162	126	592	332
Egoda Uyana/ Moratuwa	6°44'19"N 79°53'33"E	59	94	197	152	110	612	343
Thalpitiya	6°40'47"N 79°55'05"E	132	118	447	173	189	1059	593
Pothupitiya	6°38'19"N 79°56'09"E	33	7	27	40	10	117	66
Near Rockland/ Beruwala	6°29'38"N 79°58'52"E	0	109	35	124	80	348	195
Balapitiya	6°17'27"N 80°02'17"E	16	36	55	29	86	222	124
Mahamodara	6°02'23"N 80°11'55"E	165	23	42	90	71	391	219
Galle	6°02'12"N 80°13'33"E	3	2				5	7
Galle Fort	6°01'29"N 80°13'11"E	0	12	14	14		40	28
Ginthota Moya Beach	6°03'48"N 80°10'22"E	99	48	18	13		178	125

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Greenpeace South Asia is a newly established regional office of the Global Environmental Organization, Greenpeace. As an independent and globally active network, Greenpeace works to drive changes in attitudes and behaviours, aiming to protect and conserve the environment while promoting peace.

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