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DEBRIS DATA COLLECTION AND MONITORING SYSTEM DESIGN AND IMPLEMENTATION

(REPORT)

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INTRODUCTION

Project "Towards Model Cities for Regional Waste Management coastal areas in the north of Vietnam "-" Green Bay "(GreenBays) is located inThe Urban Waste Recycling Program (MWRP) is funded by United States Agency International Development (USAID) through Development Innovations Group (DIG). The project is implemented by the Centre for Supporting Green Development (GreenHub) with partners. The main goal of the project is reduce plastic trash pollution, especially marine litter and support food waste reduction in the project areas. During the project, to collect information, contribute to data on coastal waste in the project area, GreenHub has worked with others stakeholders conduct surveys and monitor coastal waste in Ha Long Bay and Cat Ba Islands. We have chosen the direction Ocean Conservancy (Ocean Conservancy) and locality coastal plastic waste monitoring method from the United Environment Program (UNEP) and National Oceanic and Atmospheric Administration US (NOAA) to match the Vietnamese conditions. Realizing that it is necessary to widely share knowledge about garbage survey and monitoring coastal waste as well as post-implementation results operating in the Ha Long Bay area, GreenHub decided to export the version of the "Survey and Monitoring of Waste in Coastal Vietnam".

I/ MARINE DEBRIS DATA COLLECTION AND MONITORING SYSTEM DESIGN AND IMPLEMENTATION – REPORT

Funded by the U.S Agency for International Development (USAID), the GreenBay project is aimed at reducing marine plastic pollution and setting the groundwork for a waste management campaign towards model cities in the project sites (in Ha Long and Cat Ba).

Some of the project activities include:

Conducting 03 marine debris surveys under the Marine Debris Monitoring Program in project sites, focusing on identifying sources and types of land- and sea-based plastic waste and proposing solutions.

Designing and implementing a public awareness-raising campaign to educate a larger community about the importance of marine debris, promote reuse/recycling habits, and recruit youth and volunteers for coastal clean-up events.

GreenHub conducted some waste surveys and assessments in Ha Long, Cat Ba, and Bai Tu Long.

1. Period 2016-2018

From 2016 to 2018, in collaboration with the International Union for Conservation of Nature (IUCN), Ha Long Bay Management Department, and other non-governmental organizations, GreenHub organized four "Action for A Green Ha Long" campaigns in Ang Du and Vung Ha area, Ha Long Bay.

The campaign put a strong emphasis on the importance of data collection in clean-up events and monitoring visits of wastes and pollution sources to timely inform the decision making process. We also noticed the increasing interest and attention of donors, NGOs, and other stakeholders in the issue of marine debris. In order to have a common understanding of the problems and be able to come up with proper solutions, it is necessary to have a standard methodology for monitoring and reporting to track changes in terms of marine debris sources, abundance, distribution, movement, and impacts on regional and national scales.

METHODOLOGY

Monitoring and Citizen Science

'Citizen science that empowers citizens in exploring, measuring, and experimenting with the world around them can play a valuable role. Citizens have a major role to play in addressing the challenges to a sustainable future. It is by 'doing science together' that we combine our resources and expertise to raise awareness, build capacity, and innovative lasting solutions grounded in society.'

Volunteering participation has been instrumental in shoreline debris sampling in many parts of the world (Hidalgo-Ruz and Thiel 2015, Zettler et al. 2017). Given the easy accessibility and attractive characteristics to people, most citizen science studies have been conducted on sandy beaches. Many of the common sampling protocols for sandy beaches are contributed by motivated and well-trained citizen scientists. Depending on the complexity of sampling programs, volunteers may autonomously conduct surveys, or they can support professional scientists during the sampling process. However, quality control and assurance are important for comparability between observers. Interested volunteers should participate in existing programs within their regions or extend the use of existing protocols (Table 4.2) to their local beaches. Given the complex habitats and inherent difficulties with marine debris sampling in other shoreline habitats, volunteers should survey these under the supervision of professional scientists.

Organisation	Scientific goals	Website
International Pellet Watch	Collection of pellets for chemical analysis	http://www.pellet-watch.org/
Korea Marine Litter Institute OSEAN (Our Sea of East Asia Network)	Macro-litter abundance and composition	http://koreamarinelitter.blogspot.com/
Ocean Conservancy: International Coastal Cleanup	Macro-litter abundance and composition	https://ocean-conservancy.org/trash-free-seas/international-coastal-cleanup/
Ocean Conservancy: Clean Swell	App for data collection	https://ocean-conservancy.org/trash-free-seas/international-coastal-cleanup/clean-swell/
National Oceanic and atmospheric (NOAA)	Macro-litter abundance and composition	https://www.noaa.gov/
COASST	Impact on biota	https://coasst.org/
Marine Debris Tracker	Marine litter composition	https://marinedebris.engr.uga.edu/

Organisation	Scientific goals	Website
Cientificos de la Basura	Macro-litter abundance and composition	http://www.cientificosdelabasura.cl/es/
Following the Pathways of Plastic Litter	Macro-litter abundance and composition	https://www.save-ocean.org/
Marine Litter Watch	Macro-litter abundance and composition	https://www.eea.europa.eu/themes/water/europes-seas-and-coasts/assessments/marine-litterwatch
Plastic Tide	Macro-litter abundance and composition using drone technology and AI	https://www.theNhựatide.com/
Global Ghost Gear Initiative	Distribution of ALDFG	https://www.ghostgear.org/

To promote the application of citizen science, we have chosen the Ocean Conservancy's method to apply for Action for a Green Ha Long campaign with the aim of raising public awareness and cleaning up the coastal areas. From 2018 to 2020, we have developed a more scientific method of coastal plastic waste monitoring, which is consulted from the guideline of the United Nations Environment Program (UNEP) and National Oceanic and Atmospheric Administration (NOAA) and adapted to Viet-

nam's conditions.

OCEAN CONSERVANCY:

Scientific goals: Macro-debris abundance and composition:

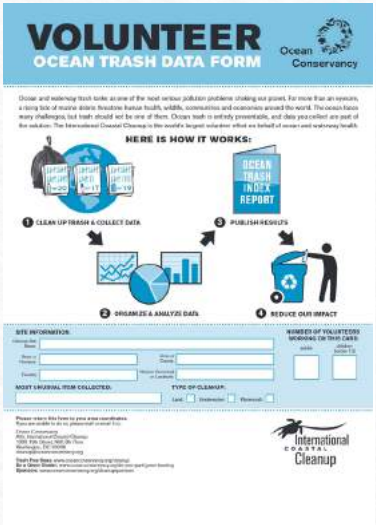
For over three decades, volunteers from Ocean Conservancy's International Coastal Cleanup have picked up waste along the world's shorelines: cigarette butts, food wrappers, abandoned fishing gear, and even automobiles and kitchen appliances.

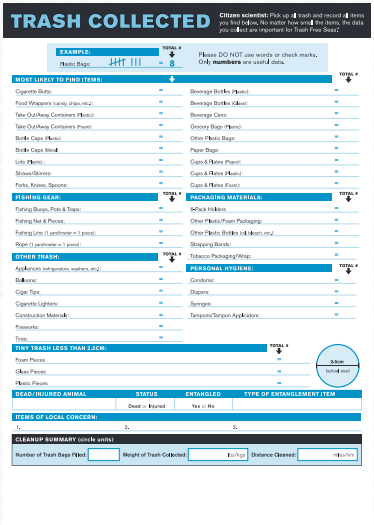
During the Cleanup: Emphasize the importance of data collection. Clean Swell application is used to keep track of the items being collected. This valuable information will then be used to create a quick view of the global marine debris problem and make an impact on long-term solutions. Provide volunteers with a group name to be entered on each user's collection screen—this makes it easy to look up your group totals later. With both data cards and Clean Swell, make data collection easier by suggesting that volunteers work in small teams that can share one data card. Designating a data recorder for each group is recommended. It is easier to collect data as items are picked up, rather than sorted after cleaning. Instruct volunteers on what to do if they encounter any hazardous items, such as sharp objects or dead, entangled, or injured animals. Remind them of any local safety hazards, such as power lines or poison ivy.

Establish a point-person to stay at the check-in station in case of health emergencies or any late arrivals.

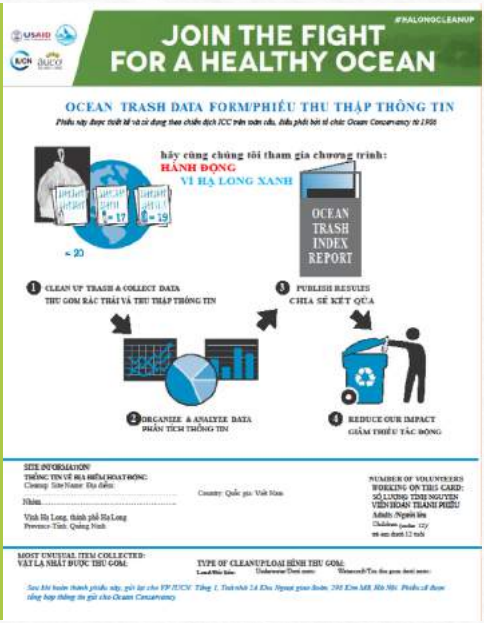
Tell volunteers what to do with the filled bags of trash and set a meeting time for the end of the cleanup so that everyone returns at the same time. Kids should always have adult supervision.

Datasheet at a global level:





Customized data-sheet for Vietnam



2/ PROCESS

CLEAN UP TRASH & COLLECT DATA → ORGANIZE & ANALYZE DATA → PUBLISH RESULTS → REDUCE OUR IM-PACT

3/ SITE AND CAMPAIGN INFORMATION

Name of campaign	Action for a green Ha Long
Campaign time	2016 – 2018
Cleanup Sites	Ang Du, Ha Long Bay Province: Quang Ninh Country: VietNam
Type of cleanup	Beach/ island clean up

Ang Du area includes 2 beaches: Ang Du 1 and Ang Du 2. The area has a total length of 200m, belonging to the World Natural Heritage Complex of Ha Long Bay. These are small, quiet beaches and extremely beautiful scenery. Not many tourists come to Ang Du beach, but this is one of the places to suffer from rubbish drifting from the bay.

4/ DATA ANALYSIS FROM COLLECTED DATA

7.26 km

652 volunteers

+12000 people engaged

Number of items: **+ 60,000 items**
Weight of collected garbage: **6,311 kg**

Percentage of Non-recyclable > **83%** and recyclable items **2%-17%**

TOP 2 TYPES OF WASTE WERE FOUND THE MOST

No	Counted by items	Number of items			
		10/01/2017	29/08/2017	14/06/2016	Total
1	Polystyrene	6,560	10,746	10,090	**27,396**
2	Hard Plastic Beverage Bottle	1,332	4,19	1,586	**3,337**

TOP 5 TYPES OF WASTE WERE FOUND THE MOST

No	June 2016		January 2017		August 2017		June 2018	
	Items	%	Items	%	Items	%	Items	%
1	**Polystyrene**	**44%**	**Polystyrene**	**66%**	**Polystyrene**	**80%**	**Polystyrene**	**70%**
2	Hard plastic piece	3%	Hard Plastic Beverage Bottle	12%	Unknown Hard Plastic	5%	Hard Plastic Beverage Bottle	11%
3	Hard Plastic Beverage Bottle	5%	Rubber sandals/ Flip-flops, Leather shoes	5%	Hard Plastic Beverage Bottle	3%	Hard Plastic Bottle Cap/Lid	7%

No	June 2016		January 2017		August 2019		June 2018	
	Items	%	Items	%	Items	%	Items	%
4	Grocery bags (plastic)	3%	Grocery Bags (Plastic)	4%	Grocery Bags (Plastic)	3%	Grocery Bags (Plastic)	7%
5	Rope	5%	Bottle Caps (Plastic)	2%	Bottle Caps (Plastic)	3%	Bottle Caps (Plastic)	2%

Pictures:

Mr. Tran Quang Dau from Vietnam Sea and Islands Administration (VASI), Ministry of Natural Resources and Environment takes part in waste collection

Waste collected by volunteers at Ang Du

Volunteers and waste collected in Ang Du 2

Mr. Michael Greene – USAID manager in Viet Nam takes part in waste collection with his wife and volunteer

Discussion, recommendations from results and upcoming actions

There is a change in the order and composition of the 5 most common types of waste found through 4 beach cleanup campaigns. However, polystyrene is still the most commonly found one in Ha Long Bay after four campaigns. Participants discussed different ideas to collect and treat polystyrene, for examples. Changes in people's awareness and behavior towards plastic uses. "Too much trash" was the common impression of the volunteers and 90% of them said that they would apply and share with their colleagues and families the information about trash

separation and trash auditing at work.

60% of the volunteers said that the program met 70 – 80% of their expectation while 35% had a higher satisfaction level at 90-100% of expectation. Feedbacks from different evaluation forms suggested that the organizers should take better control of the time by spending more time training trash auditing and separation as well trash collecting at beaches and should promote wider communication so that more people, especially local communities could know and take part in the campaign.

"This is a very meaningful program with clear messages to call for society's engagement in marine protection", said Mr. Tran Quang Dau from the Vietnam Sea and Islands Administration (VASI), Ministry of Natural Resources and Environment.

Regarding the plan to collect waste data in the Ang Du area in 2019, we have been working with Ha Long Bay Management Board to ask for continued collaboration. It was really good that Ha Long Bay Management Board introduced GreenHub to a waste collection company that has a contract to collect waste in Ha Long Bay, and GreenHub will provide training for this company's staff for the implementation of the 5th data collection on 10th, November 2019.

II/ IN 2019

Experiences from four "Action for A Green Ha Long" for the period 2016 - 2018 have shown that these programs should be upscaled, replicated, and if possible, adopted to be a protocol for Vietnam. The network of volunteers interested in data gathering and environment protection such as Ocean Saver should be promoted and expanded for scientific application in marine debris survey and monitoring and standardized methodology and reporting application.

In addition, plastic waste in the ocean is one of the most serious environmental problems. Although marine plastic pollution was recorded in the 70s of the last century, its quantitative analysis and sources of waste have been incomplete.

Vietnam is one of the countries that have the highest amount of plastic waste discharged into the sea in the world. Among the 20 countries studied, the amount of plastic waste from Vietnam to the sea ranged from 0.28 to 0.73 million tons/year, equivalent to 6% of the total plastic waste to the sea and ranked the 4th

in these top 20 countries. According to a report of the Viet Nam Plastic Association, in 2015, about 5 million tons of plastic were produced and consumed in Vietnam, in which about 80% of imported used materials came from scrap plastic.

Many coastal provinces and cities have also integrated the issue of marine plastic waste pollution and treatment into their local socio-economic development plans. However, in reality, Vietnam has not had any data identifying plastic sources, quantitative research, or statistics on the amount of plastic waste in coastal areas.

Recognizing the need for Vietnam's marine debris database, we applied a more scientific method:

1/ INTRODUCTION OF MARINE DEBRIS MONITORING PROGRAM DEVELOPED BASED ON NOAA AND UNEP METHODS:

Marine debris monitoring programs are necessary to compare debris sources, amounts, locations, movement, and impacts. However, Vietnam has not had monitoring data of waste sources and amounts to evaluate the effectiveness of policies to mitigate debris and provide insight into priority targets for prevention. Thus, the GreenHub has developed standardized marine debris shoreline survey protocols to facilitate regional and site-specific comparisons based on NOAA methods. This document provides a standard data sheet and two different methods for shoreline monitoring and assessment. To obtain marine debris data in Cat Ba, Bai Tu Long, the marine debris shoreline survey method has been conducted. GreenHub in collaboration with IUCN Vietnam have developed standardized marine debris shoreline survey protocols in Vietnam. Based on the Marine Debris Toolkits guidelines from the United States Oceanic Atmospheric Administration (NOAA) and the United Nations Environment Program (UNEP), GreenHub and IUCN have made appropriate adjustments to the natural and economic conditions of Vietnam to easily apply this standardized method at the local level.

Monitoring data can be used to set the baseline and evaluate the effectiveness of policies to mitigate debris and provide insight into priority targets for prevention. The monitoring results will be analyzed, shared, and recommended for general application to collect national data-

sets for marine waste monitoring in Vietnam.

The shorelines must meet the following requirements:

- Sandy beach or pebble shoreline
- Clear, direct, year-round accessible
- No breakwaters or jetties
- At least 100 m in length parallel to the water
- No regular cleanup activities within 3 months

The procedure of the method:

The order of conducting a plastic waste survey and monitoring includes the following steps: (1) preparation work; (2) conducting survey and monitoring; (3) data analysis and writing current situation reports; (4) data sharing with stakeholders and local authorities.

1.1. Preparation work

1.1.1 Select survey location

The number of survey sites in each selected area depends on the number and size of sandbars distributed in the area. Each area chooses from 3 to 6 sites, each of them has a sandbar length of 100m with the following criteria:

a. Required criteria

- Being sandy beach, cobblestone beach or dead coral debris
- Easy to access, not divided by seasons
- No dykes, breakwaters or wharves
- Having a coastal length of at least 100m
- There is no regular rubbish clean up activity, or the beach has rubbish cleanup activities taking place at least 3 months away from the time of the survey (noted in the beach data collection table);

b. Priority criteria

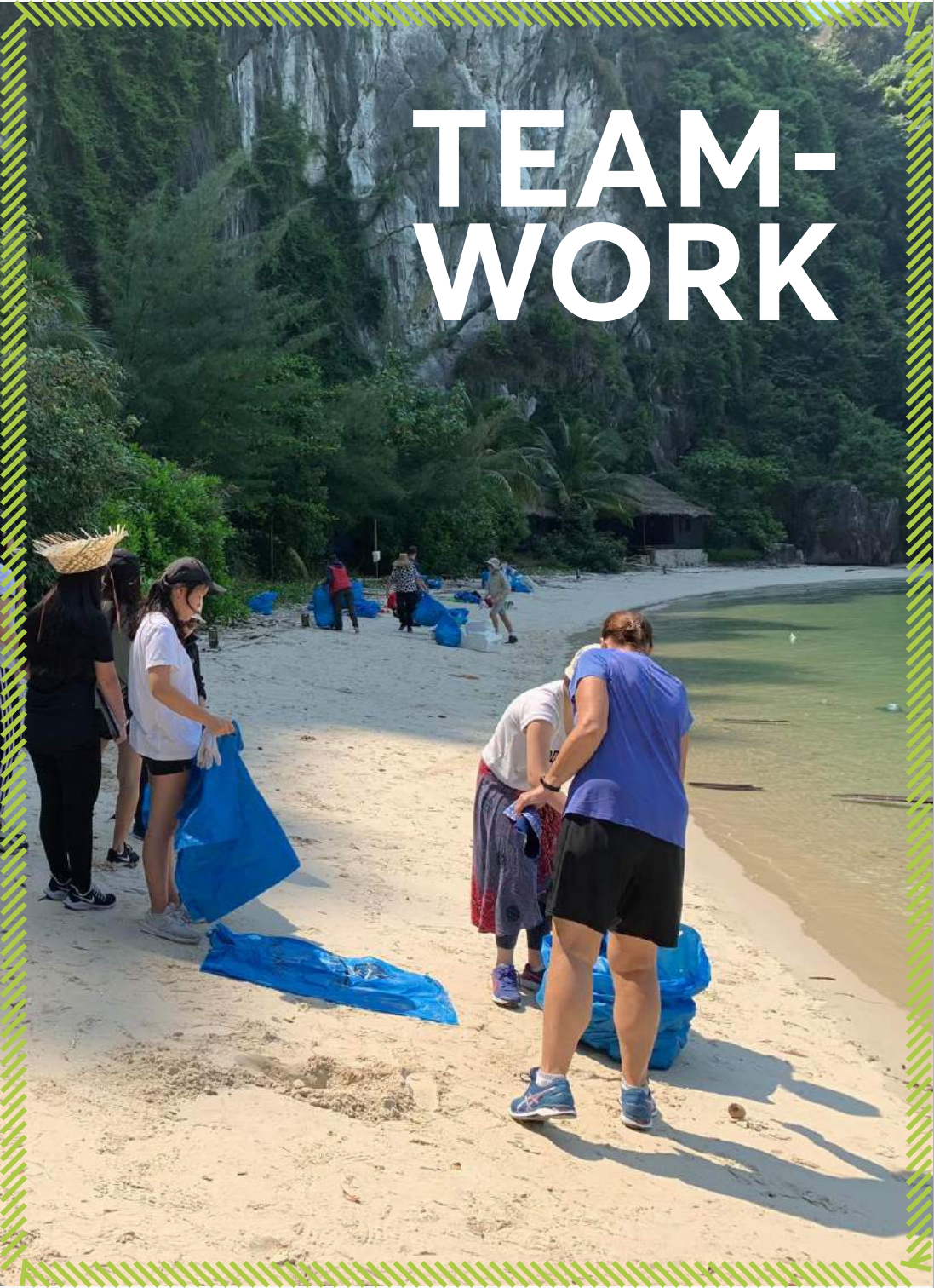
- Being an area of residence, foraging or breeding of one or many valuable and rare species.
- A feeding area or holiday ground for one or more migratory water birds. Plastic waste survey sites must be considered, selected, and conducted an overview survey (once a year if there is no sudden change due to natural or human factors). The selection criteria may change (reduce, supplement) depending on the actual situation in the locality.In addition, collecting relevant information, data and figures (scale, area, topography, physical, chemical characteristics, climate, oceanography, water quality, and biodiversity); issues related to the management, protection, and use of beaches in each locality; socio-economic status of communities and population clusters living in the area.

1.1.2 Randomly identify monitoring transects

After selecting the monitoring sites and overall evaluation, each beach (survey site) will be divided into 20 equal parts, each 5m wide and perpendicular to the shore, numbered from 1 up to 20 along the length of the beach (on topographic maps or Google Earth satellite images). Randomly select any 04 numbers to eliminate subjective factors from the review. These four numbers correspond to four transects, each with a width of 5 m will be collected plastic waste samples, corresponding to 20% of the total area of 100 m of beach selected as the study site. Monitoring time: 4 times per year (each quarter), minimum of 2 waves (northeast monsoon and southwest monsoon, depending on local practical conditions). The time to conduct monitoring is about 3 hours when the tide is lowest in the month. The location of the four selected sections remained unchanged during all monitoring visits.

1.1.3. Establishment of a working group

The plastic waste survey and monitoring working group consists of 3 to 6 members from the parts of the management board of the Marine Protected Area (MPA), National Park or local participation (depending on the source and timing of those MPAs, national parks or localities) and mobilize members from the community or conservation


TEAM-
WORK

volunteer groups to participate. The team is headed by a responsible staff member of the MPA, the National Park, or local responsible staff and members of the group. The team leader is responsible for the overall administration of the group's expertise and activities.

1.1.4. Method training for monitoring group

The hosting agency (MPA Management Board, National Park, Local) will organize training on methods of monitoring plastic waste at the beach before conducting field surveys and monitoring for participants. For repeated monitoring or trained staff members, it is not necessary to organize the training but the method must be re-disseminated by other non-focused forms such as sending printed documents or emails to the field monitoring participants, which can be done on the site.

1.1.5. Prepare survey tools and equipment

Tools and equipment used for the plastic waste survey include:

Survey location equipment: Handheld GPS devices, smartphones with GPS function, tape measure 50m or 100m.

- Camera or phone with photo function
- Table or hand-held scales (type 2kg or 5kg, the accuracy of at least 1 gram)
- Ropes, measuring tape with stakes (1m, 2m, 5m, and 50m)
- Buckets of water (or pails, bags) (type 2l, 5l, and 10l),
- Tarpaulin (3 - 6m2)
- Garbage bags after sorting;
- Non-erasable pens/pencils/ markers for writing on samples,
- Gloves, first aid kit ...
- Tables, charts ... record tally figures
-Notebook;

1.2. Conduct field surveys

1.2.1. Conducting an overview survey of the site and identifying the transects

Stretching the tape horizontally across the sand to identify the 100m area, marking the location of the transects to be surveyed which were randomly selected. Recording the information on the survey site and sections according to the form of "Site Information"

On this datasheet, it is noted that:

- GPS coordinates according to the WGS 84 coordinate system at the four corners of the study point;
- Survey time
- Weather conditions at the time of the survey. If the survey takes place immediately after the oc-

currence of extreme weather events (such as storms, cyclones, floods, etc.) in the survey area, make a note on the form.

- Characteristics of the beach: the width of the beach is from the upper landmark to the edge of the water (the landmark on the shore is the boundary separating sandy beaches with terrain, other substrates can be rocky mountains, soil, large trees ...), type of substrate, the current status of use (if applicable).

1.2.2. Counting and collecting waste samples

After identifying the location of 04 transects, detailed surveys will be conducted at those transects. Depending on the number of members, the survey team can be divided into 2 or 3 small groups of 2-3 people, each group is in charge of a transect. A transect is divided into sections with a length of 50 m, equivalent to a tape length of 50m. Plastic waste counting is conducted larger than 2.5cm, in turn, from the bank to the water's edge. The surveyor stands upright, looking ahead, without bending unless he needs to take the piece of trash to check. Photos of transects at the beginning and the endpoint and some common or special types of garbage, with large sizes (> 1m), are taken. There are two ways to count waste in the survey transect including horizontal and vertical movement described below:

How to move horizontally:

At each transect, use two 50m rolls of tape spread parallel and 5m apart. The two members move perpendicular to the cross-transect wire at 1m and 2m respectively. After moving all 5m of the transect, return to continue counting at 3m and 4m. Each member will count his/her own 1 meter of garbage and read to the third member to record the information on the Waste Density Sheet. To avoid counting overlaps between the two members, use a 5m rope to divide the boundary between the two members.

How to move vertically:

At each transect, use two 50m rolls of tape stretched in parallel and spaced 2.5m apart. The two members move parallel to each other along the cross-transect wire. Each member will count the amount of waste within his or her 1.25m and the third member will record the information on the Waste Density Sheet. To avoid counting duplicates, use a 5 m rope to divide the boundary between the two members. After moving all the transect wires,

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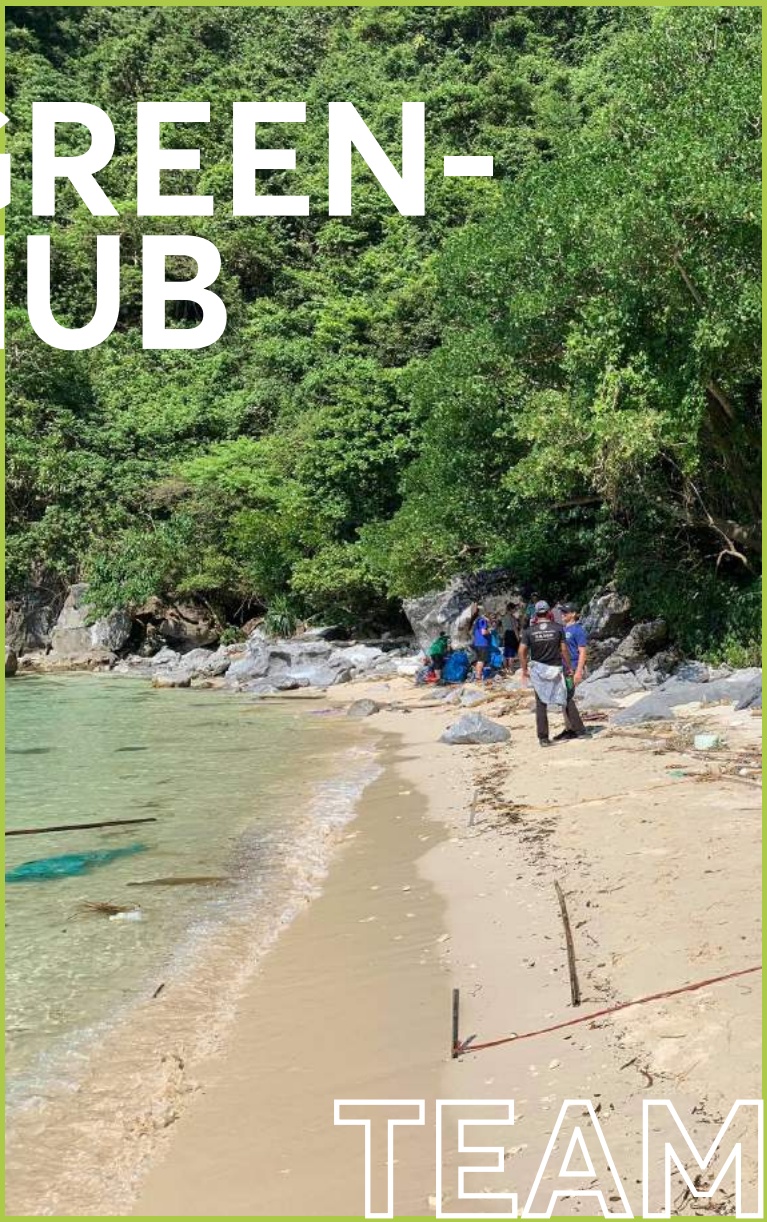
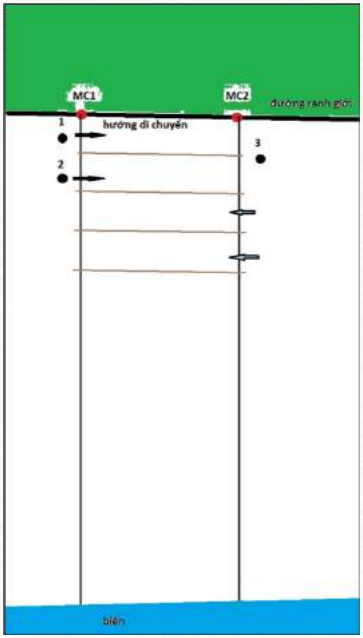
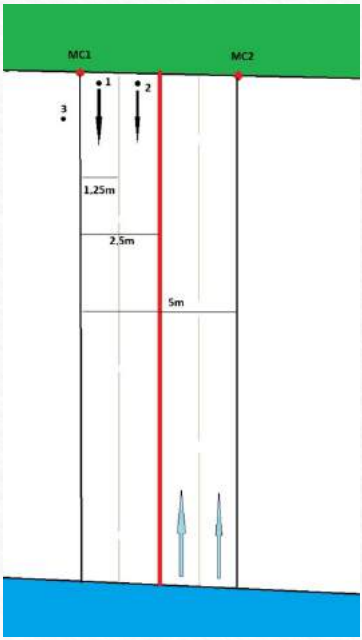


TEAM

move the first tape to the opposite position, 2.5m from the second rope, and make the same counting as above.





Describe two ways to move the waste sample count

1.2.3. Sorting and weighing waste

After counting, proceed to collect plastic waste to classify and weigh.

- Waste samples with large size and weight (for example trunk): only count, measure the largest size, and take pictures.
- Small size waste samples: the samples collected at each transect are collected and marked with etiket tag labels (clearly stating the number of transects, time, place of the survey). For example, the sample collected at the first 50 m of transect 1 will be marked as MC 1.I, the second will be MC 1.II ... and so on until the end of the beach. If the transect is less than 50m in length, the

actual length of the segment will be noted.

Waste after being collected at sections will be sorted and weighed according to the Waste Survey Form.

Based on materials and emission sources, waste is divided into the following categories (Details of classification of waste samples are presented in the Appendix):

- Inorganic waste: (1): Plastic; (2): Rubber; (3): Glass; (4): Metal; (5): Construction waste (except wood); (6) Other waste: includes inorganic waste whose materials have not been identified yet.
- Organic waste: (1) from nature (tree trunks, plants, and animals); (2) from humans: processed wood, leftovers ...

Weigh the total weight of each type of waste found after being sorted and calculate the volume of waste with a 10-liter bucket with a scale of 1 to 10 liters.

1.3. Data analysis and writing evaluation report

- Data will be synthesized on excel file and statistically analyzed to identify components, origins, weight, and trends of fluctuations overtime for local management.
- The analytical information will be built into the report of each survey and summarized in the annual summary report.

1.4. Share results with stakeholders, local authorities

Minimizing marine waste and plastic pollution is an integral part of the local solid waste management program. Therefore, the survey and monitoring results of land-based waste, aquaculture and fishing activities and tourism activities will help local management agencies to identify the current situation, to provide solutions for solid waste management and to reduce plastic waste, especially single-use plastic. The beneficiaries of the survey include People's Committees at all levels, Department of Natural Resources and Environment; Department of Construction; Department of Agriculture, local tourism companies.

2/ RESULTS

In 2019, GreenHub conducted 02 marine debris shoreline surveys in Cat Ba in May 2019 and September 2019.

2.1 1st survey in Cat Ba, May 2019

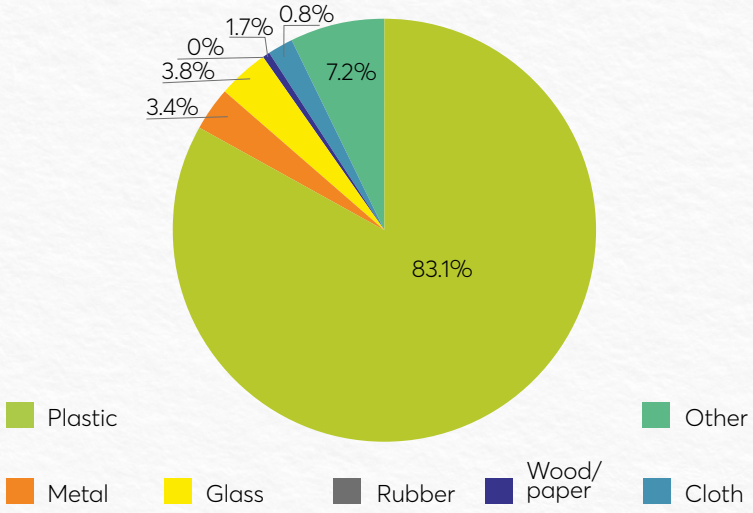
Site and survey information

Number of survey sites	3
Name Sites	Duong Danh, Cat Dua, Va Rong – Cua Dong Town: Cat Ba Country: VietNam
Duong Gianh characteristics	The area has mud mixed with sand, the width of the beach is about 300m at low tide. Easy to access, less waste. The beach is long. Farmers raise clams near the shoreline
Cat Dua characteristics	The area has sand mixed with gravel, the width of the beach is about 40m at low tide. The area near the coral, and have a lot of waste.
Va Rong – Cua Dong characteristics	The area has sand, coral crumbs, near Cat Dua area, the width of the beach is about 20 – 30 m at low tide, and has a lot of waste.

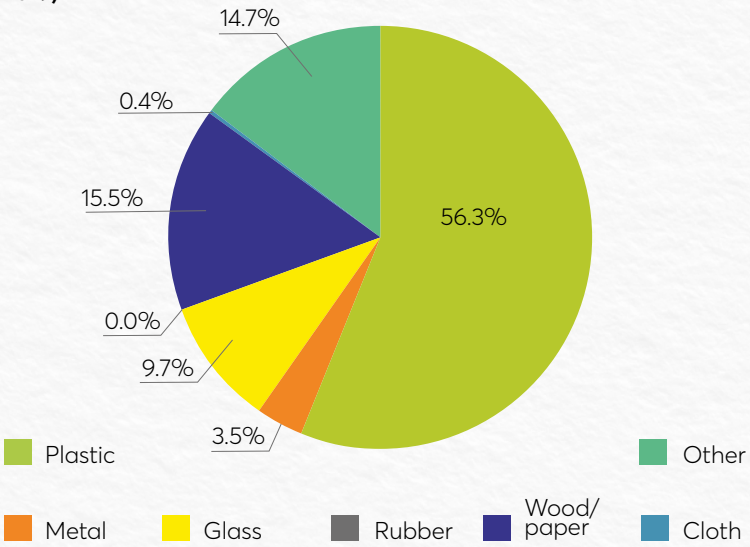
Data analysis from collected trash
Summary table of survey data on 7 main types of trash in Duong Gianh

The main types of trash	Plastic	Metal	Glass	Rub-ber	Wood/ Paper	Cloth	Other	Total
Amount	196	8	9	0	2	4	17	236
% the number of types of trash	83%	3%	4%	0%	1%	2%	7%	100%
Weight	2909	180	500	0	800	20	760	5169
% weight of trash	56%	3%	10%	0%	15%	0%	15%	100%

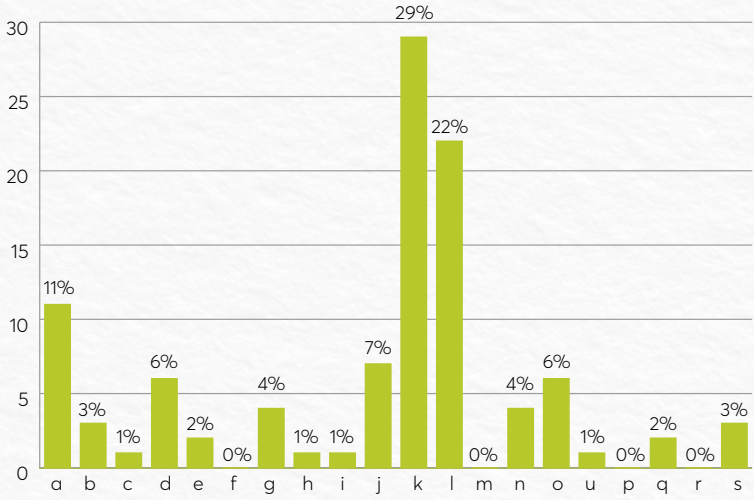
% the number of 7 main types of waste at Duong Gianh - Cat Ba (May 2019)



% the weight of 7 main types of waste at Duong Gianh - Cat Ba (May 2019)



% the amount of plastic waste at Duong Danh, Cat Ba (May 2019)

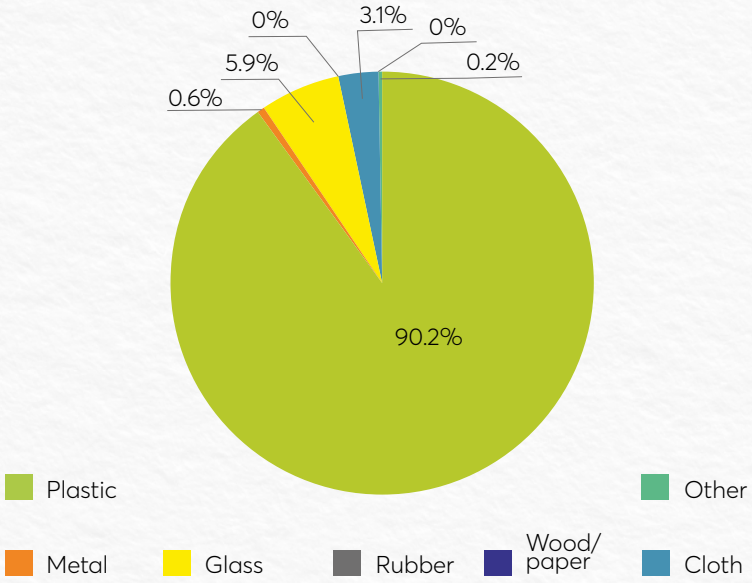


a) Hard plastic fragments
b) Foamed plastic fragments
c) Film plastic fragments
d) Food wrappers
e) Beverage bottles
f) Other jugs or containers
g) Bottles or container caps
h) Cigarettes
i) Dispoable cigarette lighters
j) Plastic bag
k) Plastic rope/ small net pieces
l) Buoys
m) Fishing lures and line
n) Cups (including polyster, foamed,...)
o) Plastic utensils
u) Straw
p) Balloons
q) Personal care products
r) Hard plastic float
s) Other

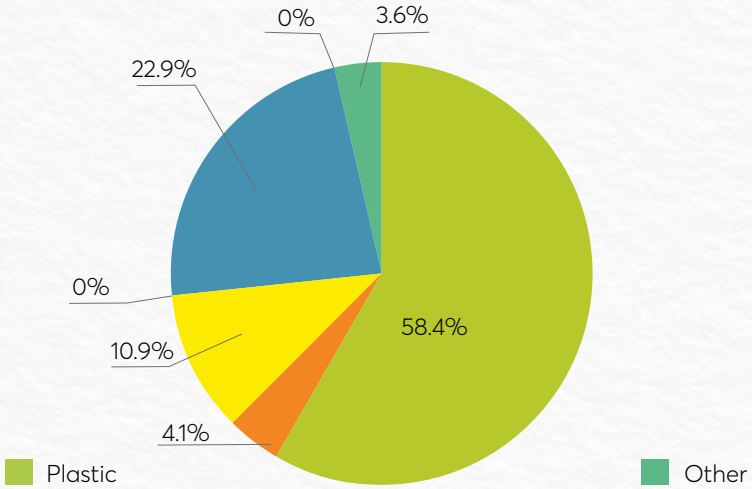
Summary table of survey data on 7 main types of trash in Cat Dua

The main types of trash	Plastic	Metal	Glass	Rub-ber	Wood/ Paper	Cloth	Other	Total
Amount	809	5	53	0	28	0	2	897
% the number of types of trash	90%	1%	6%	0%	3%	0%	0%	100%
Weight	3234,34	226,5	605,2	0	1268	200	760	5534,04
% weight of trash	58%	4%	11%	0%	23%	0%	4%	100%

% the number of 7 main types of waste at Cat Dua - Cat Ba (May 2019)

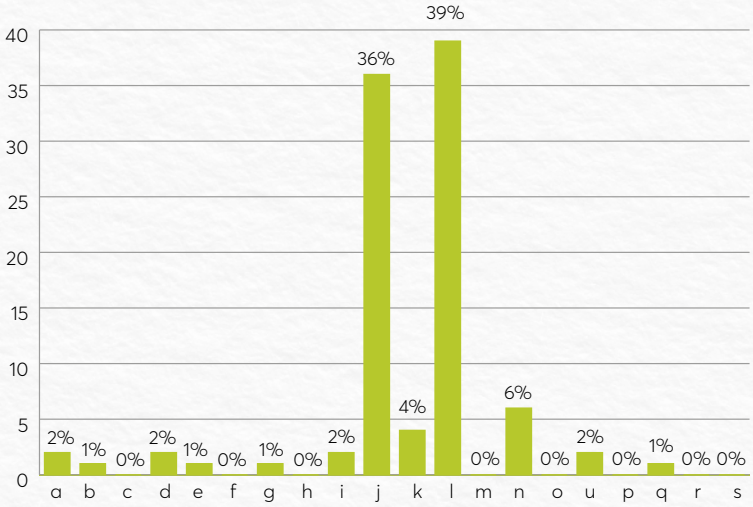


% the weight of 7 main types of waste at Cat Dua - Cat Ba (May 2019)

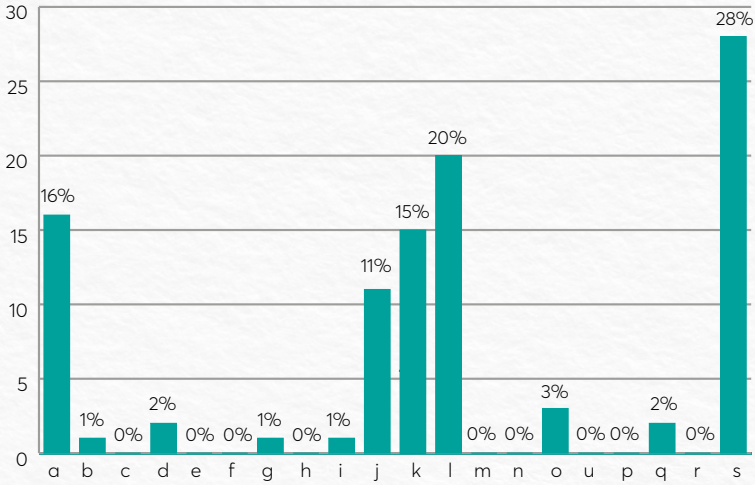


Metal Glass Rubber Wood/ paper Cloth

% the amount of plastic waste at Cat Dua, Cat Ba (May 2019)



% the weight of plastic waste at Cat Dua, Cat Ba (May 2019)

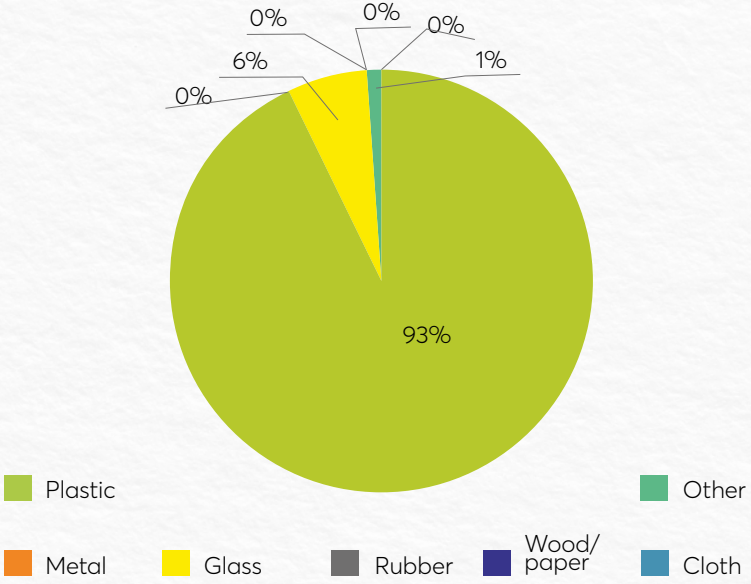


a) Hard plastic fragments
b) Foamed plastic fragments
c) Film plastic fragments
d) Food wrappers
e) Beverage bottles
f) Other jugs or containers
g) Bottles or container caps
h) Cigarettes
i) Dispoable cigarette lighters
j) Plastic bag
k) Plastic rope/ small net pieces
l) Buoys
m) Fishing lures and line
n) Cups (including polyster, foamed,...)
o) Plastic utensils
u) Straw
p) Balloons
q) Personal care products
r) Hard plastic float
s) Other

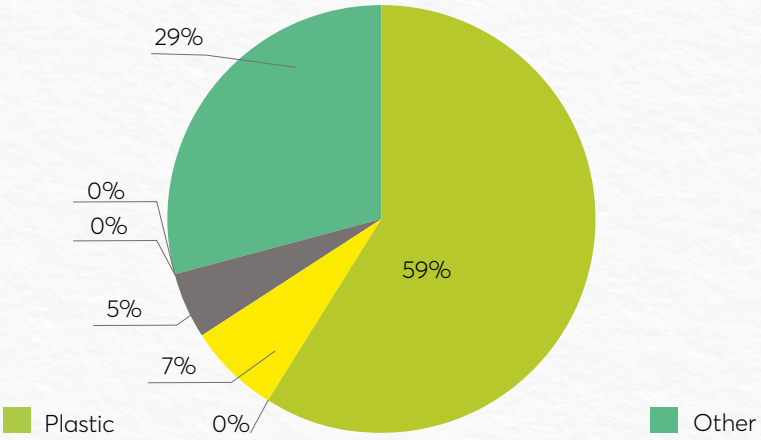
Summary table of survey data on 7 main types of trash in Va Rong - Cua Dong

The main types of trash	Plastic	Metal	Glass	Rub-ber	Wood/ Paper	Cloth	Other	Total
Amount	1151	2	78	1	4	0	8	1244
% the number of types of trash	93%	0%	6%	0%	0%	0%	1%	100%
Weight	2870	10	330	240	10	0	1431	4891
% weight of trash	59%	0%	7%	5%	0%	0%	29%	100%

% the number of 7 main types of waste at Va Rong - Cat Ba (May 2019)

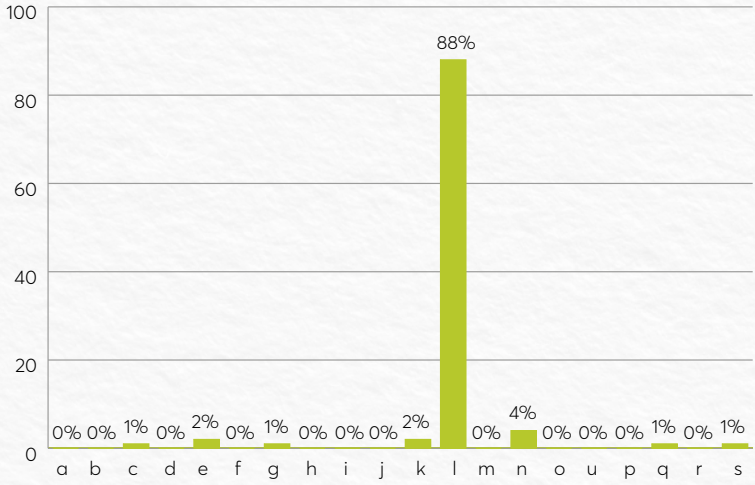


% the weight of 7 main types of waste at Va Rong - Cat Ba (May 2019)

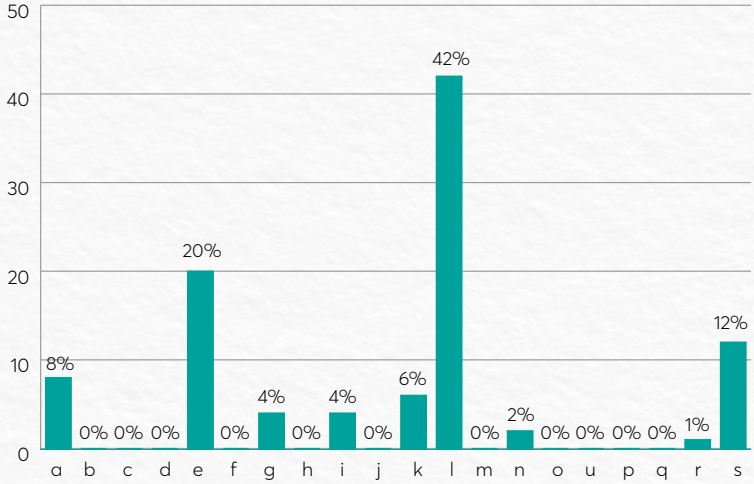


Metal Glass Rubber Wood/ paper Cloth

% the number of plastic waste at Va Rong - Cat Ba (May 2019)



% the weight of plastic waste at Va Rong - Cat Ba (May 2019)



a) Hard plastic fragments
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c) Film plastic fragments
d) Food wrappers
e) Beverage bottles
f) Other jugs or containers
g) Bottles or container caps
h) Cigarettes
i) Dispoable cigarette lighters
j) Plastic bag
k) Plastic rope/ small net pieces
l) Buoys
m) Fishing lures and line
n) Cups (including polyster, foamed,...)
o) Plastic utensils
u) Straw
p) Balloons
q) Personal care products
r) Hard plastic float
s) Other

Results:
We have collected a total of 2,377 items of marine debris on selected transects in three shorelines, including 236 items on Duong Danh, 897 items on Cat Dua, and 1,244 items on Va Rong. In terms of weight, a total of 15,594g of marine debris was collected, including 5,169g in Duong Danh, 5,534.04g in Cat Dua, and 4,891g in Va Rong. The 3 areas are suffering from artificial waste almost the same.
Overall, plastic is the main polluter on all three monitored shorelines; which accounts for 83.1% of marine debris found in Duong Gianh, 90.2% in Cat Dua, and 92.5% in Va Rong.
Most of the plastic waste is contributed by Styrofoam/buoys which is responsible for up to 88% of plastic waste in Va Rong and 39% in Cat Dua, while in Duong Danh, the highest proportion in plastic waste is taken up by plastic rope/small net pieces, at 29%.

2.6. 2nd survey in Cat Ba, September 2019
Conducted by Cat Ba National Park, local volunteers and volunteers from an international school.

Site and survey information:

Number of survey sites	3

Name Sites	Cat Dua, Va Rong – Cua Dong, Ba Cat Bang Town: Cat Ba Country: VietNam

The marine debris shoreline survey was conducted at Cat Dua, Va Rong and Ba Cat Bang of Cat Ba area, from 9:00 am to 10:00 am on 24th, 25th, and 26th of September respectively.

The survey team included GreenHub officers, Cat Ba National Park officers, Cat Hai ranger officers, and volunteers from the Learning Project and UNIS who had been trained by GreenHub prior to conducting the data collection.

After the survey, the team collected all waste on the beach in order not to disturb the next survey data and protect species living on the islands from human waste.

Collected waste was delivered to the treatment facility on the mainland.

The area is situated in the tropical monsoon region where there are two seasons, the hot rainy and the dry cool season. The rainy wet season is from April to October with the frequent typhoons and tropical storms. Therefore, to have precise data, the survey must be conducted twice, once in each season.

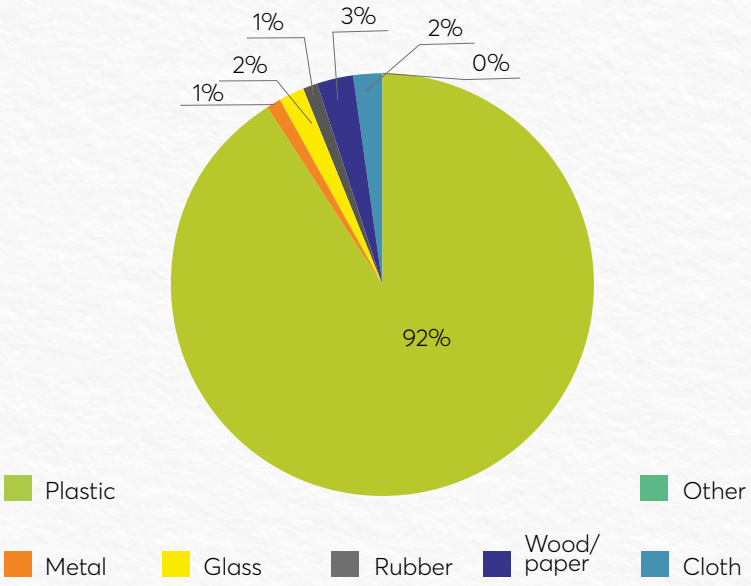
Data analysis from collected trash

Summary table of survey data on 7 main types of trash in Cat Dua

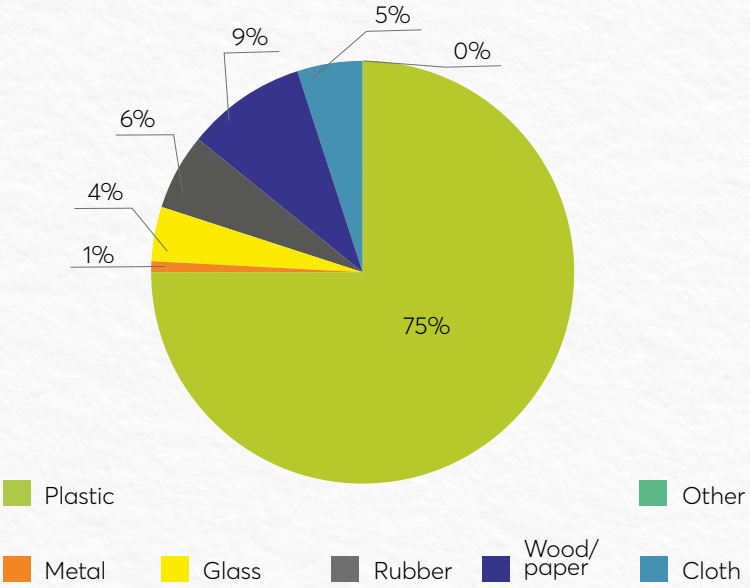
The main types of trash	Plastic	Metal	Glass	Rubber	Wood/ Paper	Cloth	Other	Total
Amount	811	5	18	6	22	16	0	878

The main types of trash	Plastic	Metal	Glass	Rub-ber	Wood/ Paper	Cloth	Other	Total
% the number of types of trash	92%	1%	2%	1%	3%	2%	0%	100%
Weight	10490	190	580	790	1225	730	0	14005
% weight of trash	75%	1%	4%	6%	9%	5%	0%	100%

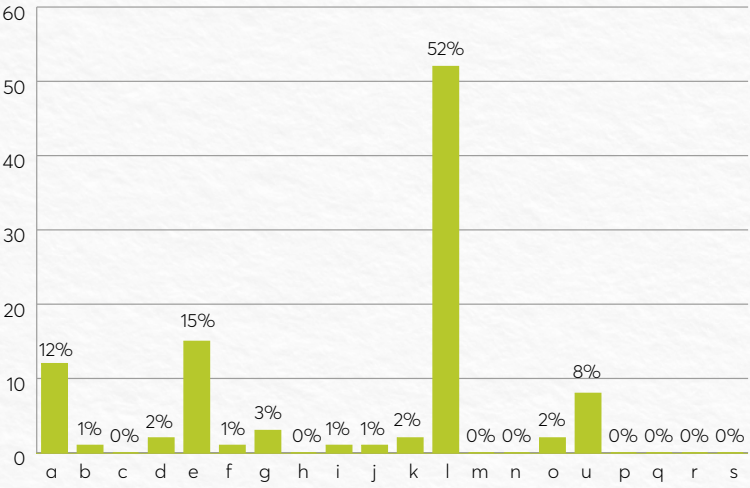
% the number of 7 main types of waste at Cat Dua - Cat Ba (Sep 2019)



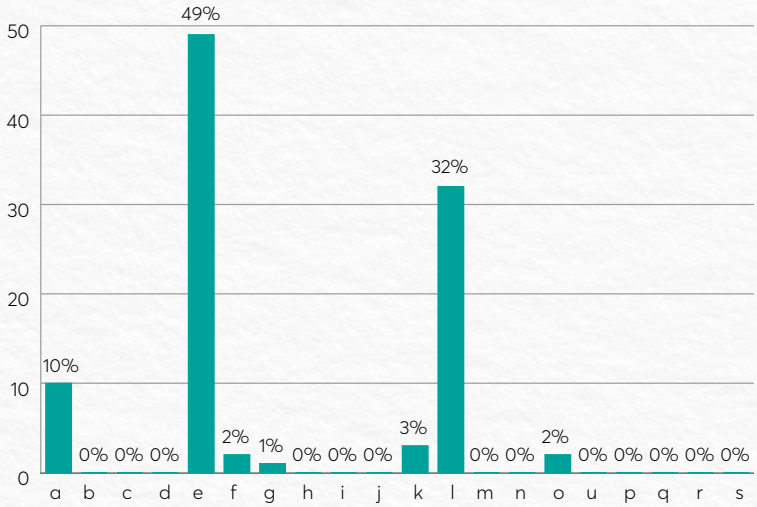
% the weight of 7 main types of waste at Cat Dua - Cat Ba (Sep 2019)



% the number of plastic waste at Cat Dua - Cat Ba (Sep 2019)



% the weight of plastic waste at Cat Dua - Cat Ba (Sep 2019)

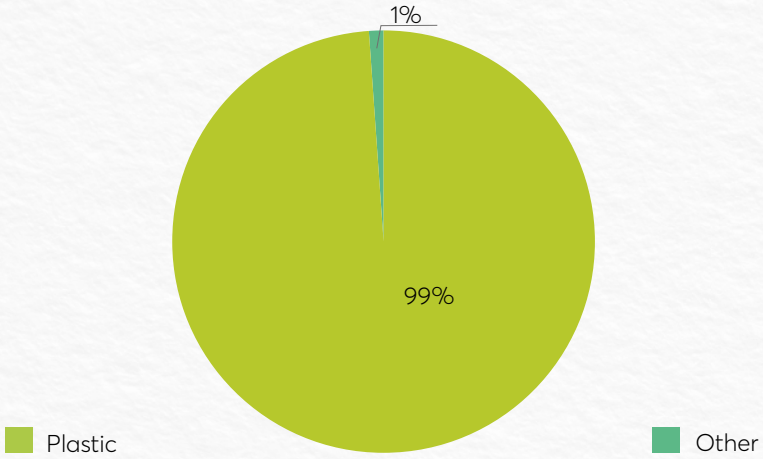


a) Hard plastic fragments
b) Foamed plastic fragments
c) Film plastic fragments
d) Food wrappers
e) Beverage bottles
f) Other jugs or containers
g) Bottles or container caps
h) Cigarettes
i) Dispoable cigarette lighters
j) Plastic bag
k) Plastic rope/ small net pieces
l) Buoys
m) Fishing lures and line
n) Cups (including polyster, foamed,...)
o) Plastic utensils
u) Straw
p) Balloons
q) Personal care products
r) Hard plastic float
s) Other

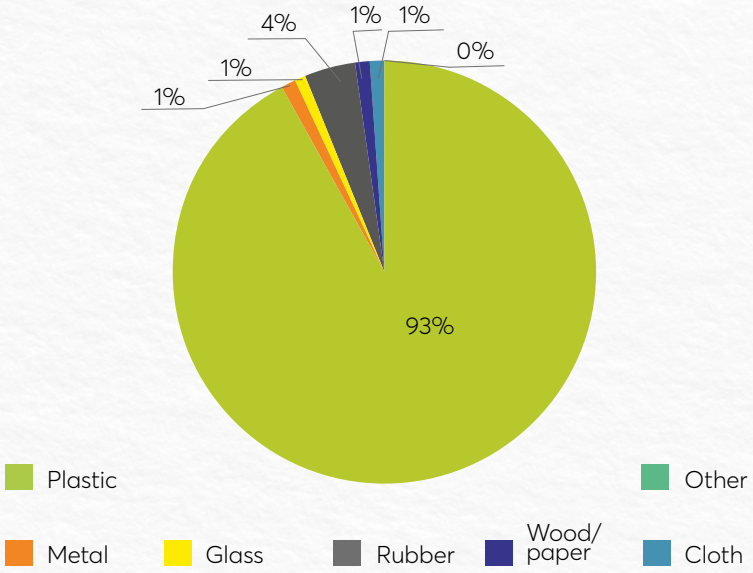
Summary table of survey data on 7 main types of trash in Va Rong - Cua Dong

The main types of trash	Plastic	Metal	Glass	Rub-ber	Wood/ Paper	Cloth	Other	Total
Amount	4042	5	17	17	18	2	0	4101
% the number of types of trash	99%	0%	0%	0%	0%	0%	0%	100%
Weight	36190	370	360	1600	340	200	0	39060
% weight of trash	93%	1%	1%	4%	1%	1%	0%	100%

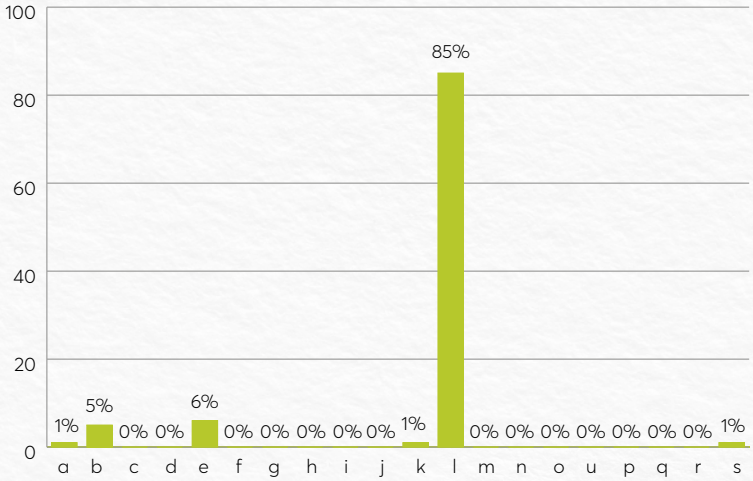
% the number of 7 main types of waste at Va Rong - Cat Ba (Sep 2019)



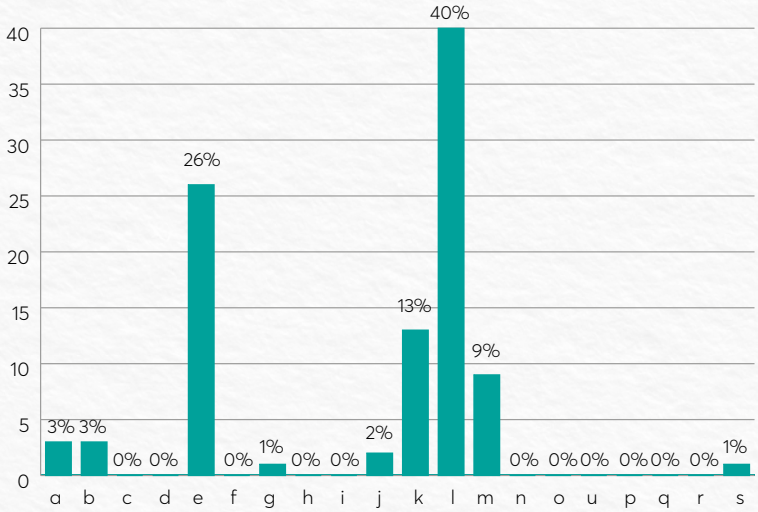
% the weight of 7 main types of waste at Va Rong - Cat Ba (Sep 2019)



% the number of plastic waste at Va Rong - Cat Ba (Sep 2019)



% the weight of plastic waste at Va Rong - Cat Ba (Sep 2019)



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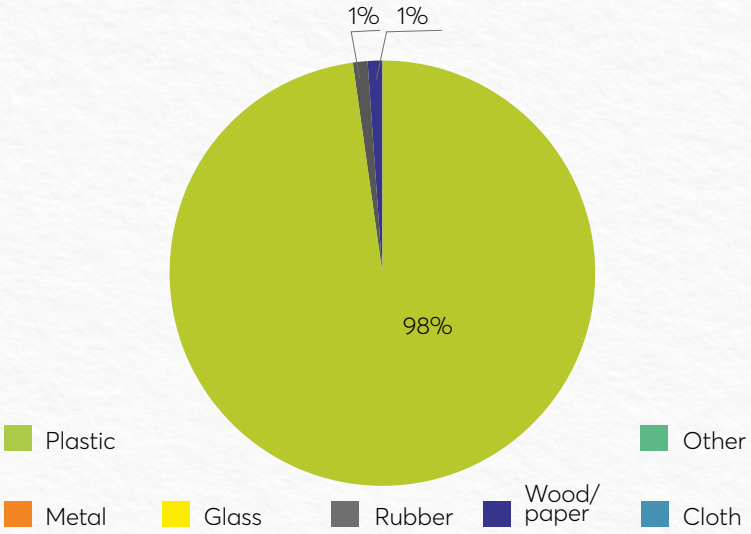
l) Buoys
m) Fishing lures and line
n) Cups (including polyster, foamed,...)
o) Plastic utensils
u) Straw
p) Balloons
q) Personal care products
r) Hard plastic float
s) Other

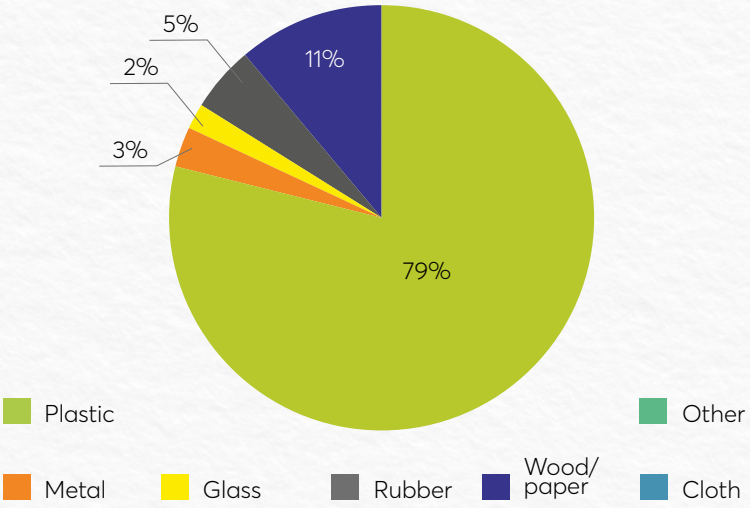
Summary table of survey data on 7 main types of trash in Cat Bang

The main types of trash	Plastic	Metal	Glass	Rub-ber	Wood/ Paper	Cloth	Other	Total
Amount	1963	3	2	11	11	1	0	1991
% the number of types of trash	99%	0%	0%	1%	1%	0%	0%	100%
Weight	13756	480	310	950	2000	0	0	17496
% weight of trash	79%	3%	2%	5%	11%	0%	0%	100%

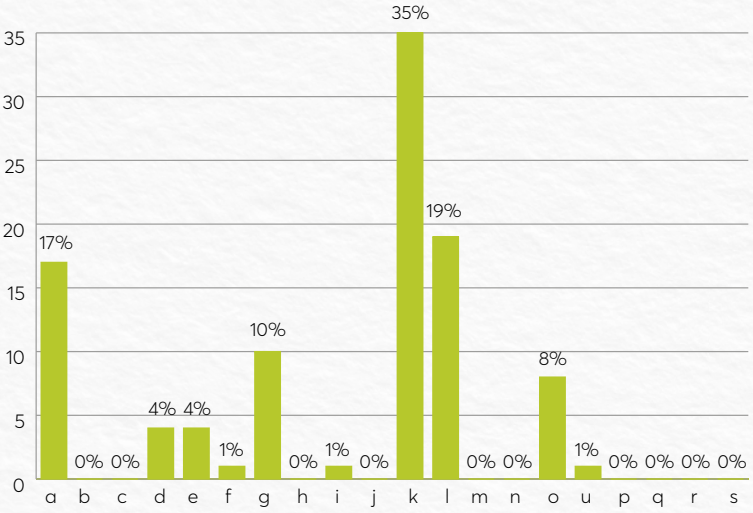
% the number of 7 main types of waste at Cat Bang - Cat Ba (Sep 2019)



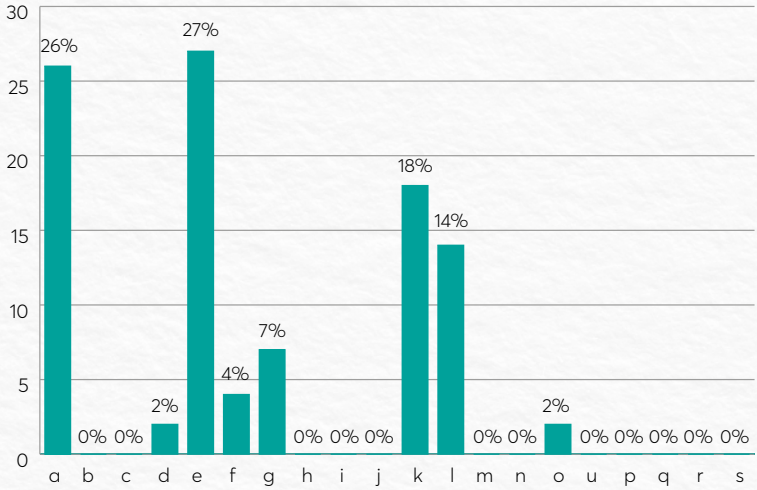
% the weight of 7 main types of waste at Cat Bang - Cat Ba (Sep 2019)



% the number of plastic waste at Cat Bang - Cat Ba (Sep 2019)



% the weight of plastic waste at Cat Bang - Cat Ba (Sep 2019)



a) Hard plastic fragments
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g) Bottles or container caps
h) Cigarettes
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j) Plastic bag
k) Plastic rope/ small net pieces
l) Buoys
m) Fishing lures and line
n) Cups (including polyster, foamed,...)
o) Plastic utensils
u) Straw
p) Balloons
q) Personal care products
r) Hard plastic float
s) Other

Results:

We have collected a total of 6,970 items of marine debris on selected transects in three shorelines, including 878 items on Cat Dua, 4,101 items on Va Rong, and 1,991 items on Ba Cat Bang. In terms of weight, a total of 70,561g of marine debris was collected, including 14,005g in Cat Dua, 39,060g in Va Rong, and 17,496g in Ba Cat Bang. Noticeably, out of the three shorelines, Va Rong is suffering the most from man-made waste.

Overall, plastic is the main polluter on all three monitored shorelines, which accounts for 92% of marine debris found in Cat Dua and 99% in both Va Rong and Ba Cat Bang shorelines. Styrofoam/buoys are responsible for up to 85% (3,424 items) of plastic waste in Va Rong and 52% in Cat Dua, while in Ba Cat Bang, the highest proportion of plastic waste is from fishing ropes/net, at 35% (690 items).

In Cat Dua, 119 beverage bottles were recorded, taking 49% (5,160g) of plastic waste, by weight. 100 hard plastic fragments were also found in this area, taking up to 1,040g.

In Va Rong, a significant number of 225 beverage bottles, the largest number of beverage bottles in surveyed areas, were collected, which was responsible for 9,520g.

In Ba Cat Bang, 26% of the weight of plastic waste was hard plastic fragments while 76 beverage bottles account for 27% of the plastic waste weight.

The remaining marine debris categories, including metal, glass, rubber, processed lumber, and other, only account for a minor quantity of waste. In Cat Dua, only 5 metal items, 18 glass objects, 6 rubber fragments, 22 processed lumber products, and 16 textile pieces were found. The situation in Va Rong was the same since it only had 5 metal items, 17 glass objects, 17 rubber fragments, 18 processed lumber products, and 2 textile pieces. This trend continued in Ba Cat Bang with only 3 items of metal, 2 of glass, 11 of rubber, 11 of processed lumber, and 1 of textile found.

Discussion:

It is evident that Va Rong is suffering the most from marine debris with 39,060g of waste compared to just 14,005g in Cat Dua and 17,496g in Ba Cat Bang. A number of reasons can explain this significantly high amount of waste in Va Rong. Firstly, Va Rong is the nearest shoreline in three surveyed areas. It is only

2.6km from Ben Beo port while Cat Dua and Ba Cat Bang are further, 2.8km and 3km respectively. Secondly, Va Rong shoreline faces directly to the floating village where local fishermen build fish-farms requiring a huge amount of fishing nets and Styrofoam. Therefore, Va Rong had to suffer from a huge number of 3,424 Styrofoam/buoy items.

Beverage plastic bottle is also a big concern to the area. A frustrating number of 225 bottles were found in Va Rong while in Cat Dua, 119 bottles were collected. It should be noticed that this number is only recorded for selected segments. Plastic bottles are still widely used by tourists, not only on the island but also on cruise ships.

2.3 Bai Tu Long

In 2019, GreenHub conducted the marine debris shoreline survey in Bai Tu Long in May 2019. The survey team included GreenHub officers and Bai Tu Long National Park officers who had been trained by GreenHub prior to conducting the data collection.

Site and survey information

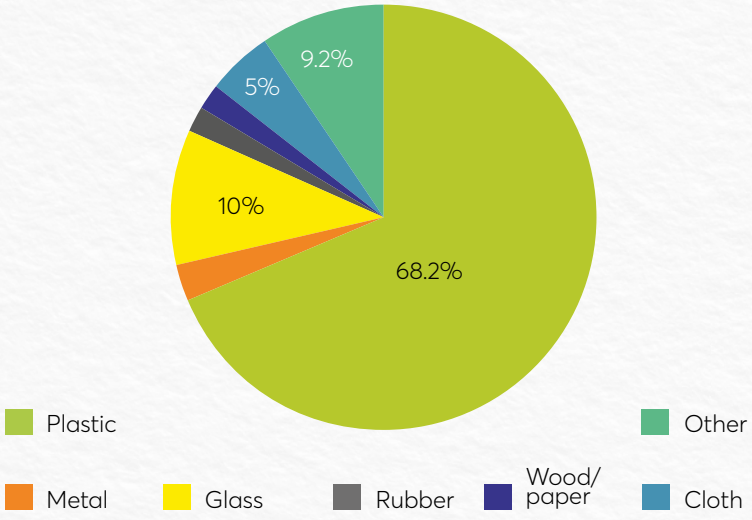
Number of survey sites	3
Name Sites	Con Trui, Bai Rua, Minh Chau Bay: Bai Tu Long, Van Don District Country: VietNam
Con Trui characteristics	The area has mud mixed with sand, the width of the beach is about 200m at low tide. Easy to access. The beach is long. The area near the coral, and have a lot of waste.
Bai Rua characteristics	The area has sand, the width of the beach is about 50-100m at low tide. Easy to access, and have a lot of waste. The area is a place where turtles spawn.
Minh Chau characteristics	The area has sand, the width of the beach is about 70 – 100 m at low tide, easy to access.

Data analysis from collected trash
Summary table of survey data on 7 main types of trash in Con Trui

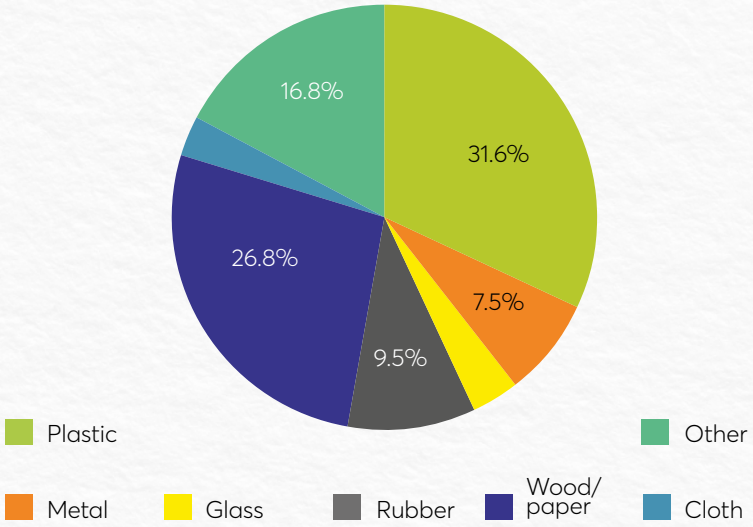
The main types of trash	**Plastic**	**Metal**	**Glass**	**Rubber**	**Wood/ Paper**	**Cloth**	**Other**	**Total**
Amount	163	6	24	5	7	12	22	239

The main types of trash	Plastic	Metal	Glass	Rub-ber	Wood/ Paper	Cloth	Other	Total
% the number of types of trash	68%	3%	10%	2%	3%	5%	9%	100%
Weight	3657	865	500	1100	3100	420	1940	11582
% weight of trash	32%	7%	4%	9%	27%	4%	17%	100%

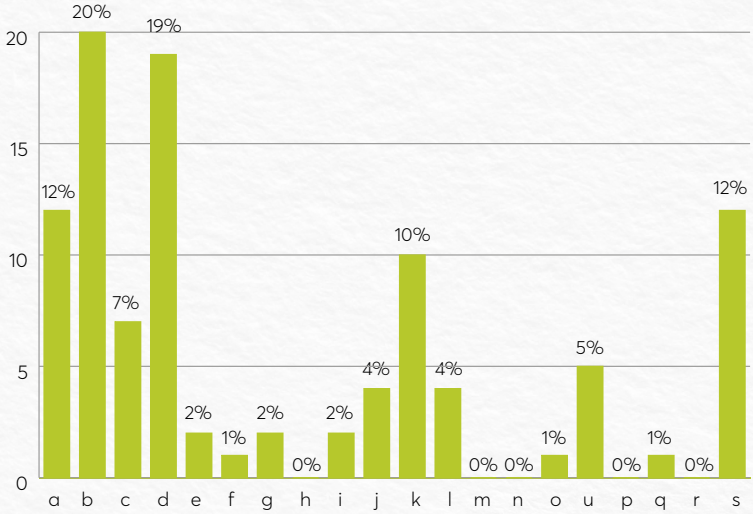
Summary table of survey data on 7 main types of trash in Con Trui - Bai Tu Long



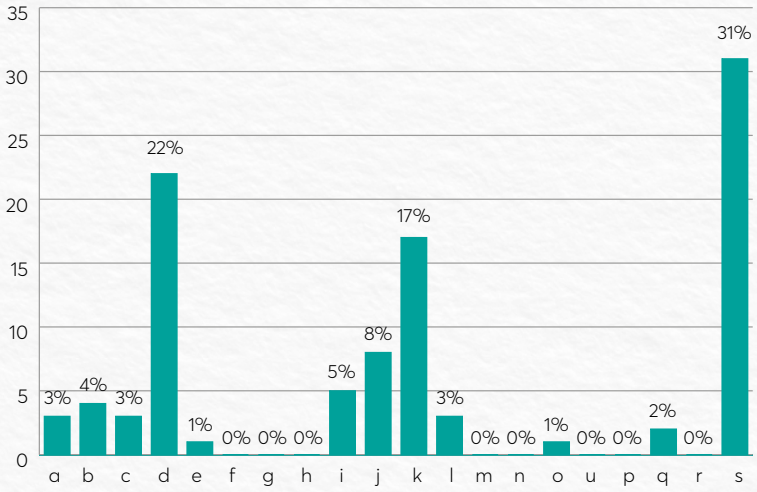
% the weight of 7 main types of waste at Con Trui - Bai Tu Long



% the number of plastic waste at Con Trui - Bai Tu Long



% the weight of plastic waste at Con Trui - Bai Tu Long



a) Hard plastic fragments
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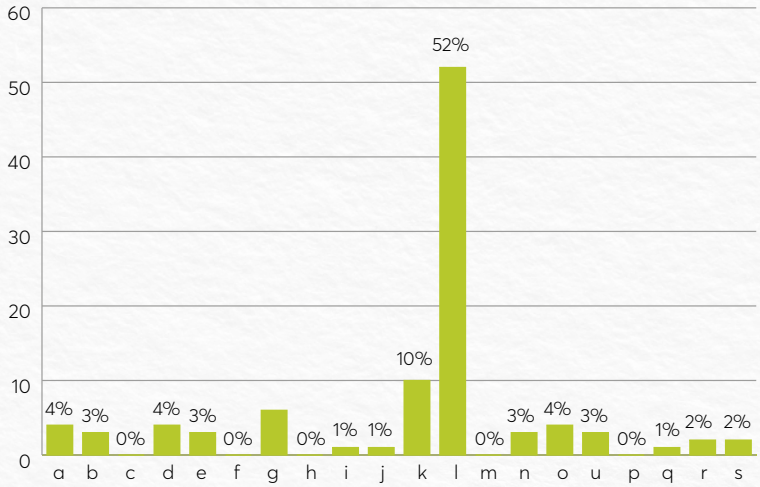
d) Food wrappers
e) Beverage bottles
f) Other jugs or containers
g) Bottles or container caps
h) Cigarettes
i) Dispoable cigarette lighters
j) Plastic bag
k) Plastic rope/ small net pieces
l) Buoys
m) Fishing lures and line
n) Cups (including polyster, foamed,...)
o) Plastic utensils
u) Straw
p) Balloons
q) Personal care products
r) Hard plastic float
s) Other

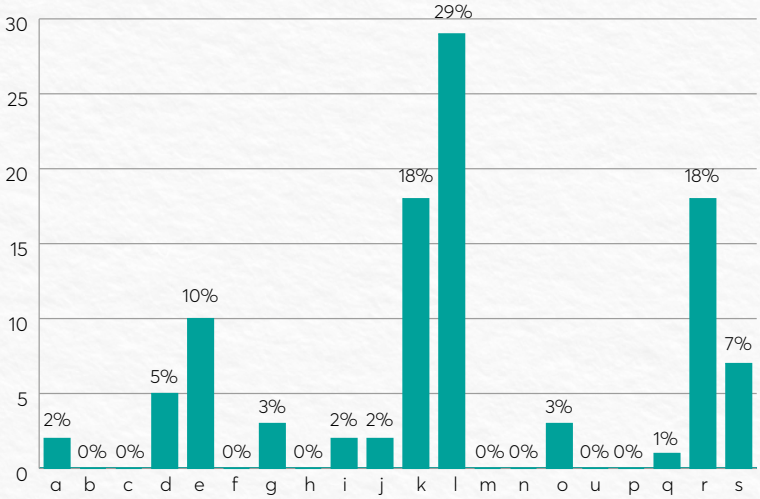
Summary table of survey data on 7 main types of trash in Bai Rua

The main types of trash	Plastic	Metal	Glass	Rub-ber	Wood/ Paper	Cloth	Other	Total
Amount	1632	13	26	16	30	3	2	1722
% the number of types of trash	95%	1%	2%	1%	2%	0%	0%	100%
Weight	14479	300	2855	1540	8615	310	10	28109
% weight of trash	52%	1%	10%	5%	31%	1%	0%	100%

% the number of plastic waste at Bai Rua - Bai Tu Long



% the weight of plastic waste at Bai Rua - Bai Tu Long



a) Hard plastic fragments
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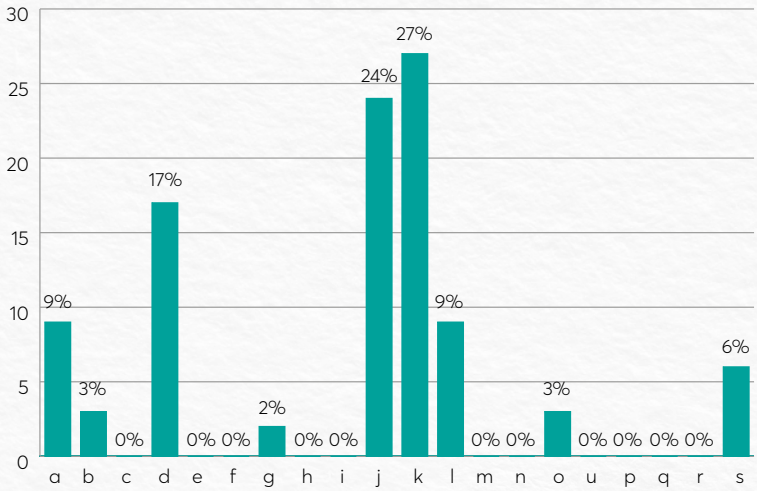
m) Fishing lures and line
n) Cups (including polyster, foamed,...)
o) Plastic utensils
u) Straw
p) Balloons
q) Personal care products
r) Hard plastic float
s) Other

Summary table of survey data on 7 main types of trash in Minh Chau

The main types of trash	Plastic	Metal	Glass	Rub-ber	Wood/ Paper	Cloth	Other	Total
Amount	26857	790	730	1815	6225	528	155	37100
% the number of types of trash	2286	108	10	21	32	11	3	2471
Weight	93%	4%	0%	1%	1%	0%	0%	100%
% weight of trash	72%	2%	2%	5%	17%	1%	0%	100%

% the weight of plastic waste at Minh Chau - Bai Tu Long



Results:

We have collected a total of 4,432 items of marine debris on selected transects in three shorelines, including 239 items on Con Trui, 1722 items on Bai Rua, and 2,471 items on Minh Chau. In terms of weight, 76,791g of marine debris was collected, including 11,582g in Con Trui, 28,109g in Bai Rua, and 37,100g in Minh Chau. Noticeably, in the three shorelines, Minh Chau is suffering the most from man-made waste.

Overall, plastic is the main polluter on all three monitored shorelines; which accounts for 68% of marine debris found in Con Trui, 95% in Bai Rua, and 72% in Minh Chau.

Most of the plastic waste is contributed by Styrofoam/buoys which is responsible for up to 52% of plastic waste in Bai Rua, while in Minh Chau, the highest proportion in plastic waste is taken up by plastic rope/small net pieces, at 42%, and in Con Trui, the highest proportion in plastic waste is taken up by foamed plastic fragment at 20%, food wrappers at 19%.

III/ CONCLUSION

From 2016 to 2018, in collaboration with the International Union for Conservation of Nature (IUCN), Ha Long Bay Management Department, and other non-governmental organizations, GreenHub organized four "Action for A Green HaLong" /coastal clean-up campaigns in Ang Du area, Ha Long Bay.

In 2019, GreenHub organized 2 surveys in Cat Ba and 1 survey in Bai Tu Long.

The results showed that plastic is the main polluter on all monitored shorelines. And most of the plastic waste is contributed by Styrofoam/buoys and plastic rope/small net pieces. Collected waste was delivered to the treatment facility on the mainland. GreenHub has researched the solutions for handling Styrofoam/buoys after collection. However, these solutions are costly and unreasonable, therefore, after collection, all Styrofoam/buoys waste was brought to the mainland and transported to the general waste treatment area.

Fishing activities in the area are developing to meet the increased demand of tourists every year. Hence, local fishermen have built fish-farm by Styrofoam and they have also used foam boxes to carry fish to the mainland to sell. These foam products are easily broken up by physical impacts, wave for example. So its fragments are carried by the stream

to the shoreline quickly. The fishery activities are also responsible for other waste such as fishing nets and ropes which can be easily observed in the surveyed shorelines.

Beverage plastic bottle is also a big concern to the area. A frustrating number of bottles should be noticed that this number is only recorded for selected segments. Plastic bottles are still widely used by tourists, not only on the island but also on cruise ships.

In Ha Long - Cat Ba area (project area):

- GreenHub has piloted the model of using styrofoam buoys coated with Line-X paint for some floating aquaculture households in Ha Long Bay and Bai Tu Long bay. Currently, the solution has been receiving positive feedbacks from the fishing farms. The solution for this floating material is expected to be a useful solution in protecting the marine environment from polystyrene waste and contributing to the sustainable development of the region.
- Organize training sessions, awareness-raising for local people, including fishing farms.
- Work with local authorities to make recommendations. Up to now, Ha Long Bay Management Board has decided to ban the use of disposable plastic products (plastic bottles) on cruise ships; The management board of bays in Cat Ba archipelago is also drafting this decision and may issue in the near future.
- GreenHub will provide training for Ha Long bay waste collection company's staff and carry out the 5th data collection on 10th, November 2019.

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