1.2 Beach litter monitoring survey using stationary cameras

Section 1.2 of this Annex assumes that a variety of groups will conduct monitoring or surveys (hereinafter in this Annex referred to as "surveys") using a stationary camera for a variety of survey purposes to target litter in the environment, especially litter on the beach (and dunes), based on the common items listed in the main body of the guidelines.
The results of the demonstration test conducted using a survey methodology based on this Annex are presented in Appendix 2 Result of demonstration test for beach litter survey using stationary cameras (beach).

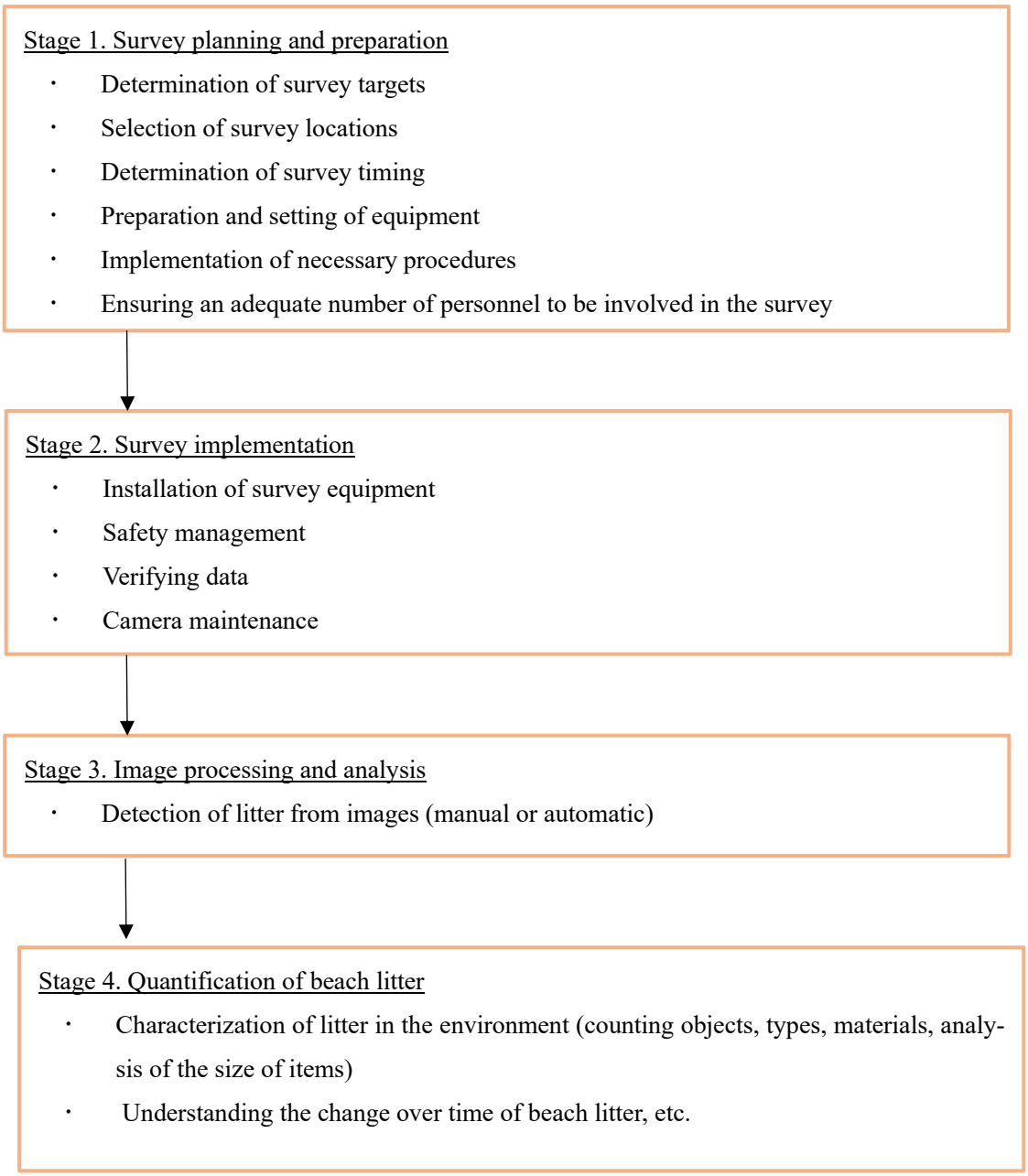
1.2.1 Survey planning and preparation

(1) Survey purpose

- It is important to clearly identify the survey purpose at the beginning since the survey plan depends on the survey purpose.
- See the main guidelines "Chapter II Purpose of monitoring and how to select the survey methods" for examples of survey objectives, methods for selecting survey (monitoring) methods, and monitoring methods to address various policy issues.
- Stationary cameras can be installed on the beach for a fixed period of time to enable regular and continuous monitoring. For this reason, they are considered to be particularly useful for understanding the current situation of beach litter in real time and for understanding the time series variations in the amount and type of litter.
- In understanding the trends in the increase and decrease of litter, it is not always necessary to understand the quantitative aspects, and it can also be a research objective to understand the periods when there is a lot of litter.

(2) Survey procedures

- A rough flow from the planning of the investigation to the image analysis is shown below. Stages 1 and 2 correspond to Section I of these guidelines Annex, and Stages 3 and 4 correspond to Section II.



(3) Survey target

(A) Target size

- If the purpose of the survey includes quantifying the amount of litter, decide in advance what size of litter will be targeted.
- In surveys using stationary cameras, the size of litter that can be measured will vary depending on the distance between the camera and the litter, and even within a single image, the size of litter that can be measured will differ between litter that is close to the camera and that is further away. For this reason, it is difficult to determine a general lower limit. In order to improve accuracy, it is necessary to increase the resolution of the subject or reduce the evaluation area so that the size of the litter to be detected is displayed as 100 pix or more. Hidaka et al. (2022) suggest increasing the resolution by adjusting the camera angle or increasing the number of pixels in the images.
- In several existing guidelines for beach litter surveys, such as the EU (European commission 2013), GESAMP (GESAMP 2019), NOAA (Burgess et al. 2021), and Japan (Ministry of the Environment, Government of Japan, 2023), the survey targets are litter of 2.5 cm or larger, which generally corresponds to macro litter. Therefore, it is recommended that litter of 2.5 cm or larger be targeted for comparability with existing surveys.

(B) Type of litter

- In surveys of beach litter, not only man-made litter, but also natural objects may be surveyed.
- For example, in Japan, driftwood affects ship operations and coastal landscapes, and is therefore a target item for litter composition surveys.
- In the demonstration test shown in Appendix 2, driftwood and other natural objects were also targeted. See Appendix 2 for details.

(C) Classification

- If identification of the type of man-made litter is included in the survey purpose, it is recommended to plan in advance the type of litter that you would like to classify.
- Table 1.1.3 shows the basic categories of litter used in these guidelines and Annex, and their correspondence to the EU (European commission 2013), OSPAR (OSPAR commission 2010), UNEP (Cheshire et al. 2009), NOAA (Burgess et al. 2021), and Japanese (Ministry of the Environment, Government of Japan, 2023) guidelines for each category.
- The items in Table 1.1.3 are classified as litter in the above-mentioned guidelines for beach litter surveys, and since they are frequently found in the world, it is recommended to conduct surveys from the viewpoint of comparison with other surveys.
- Some of the litter types, such as plastic caps, lids, food packaging, lighters, and cigarettes, are difficult to identify at this stage due to their small size or other reasons. Among these, plastic caps and cigarettes are major types of beach litter, so efforts should be made to monitor them as much as possible. However, these items are not mandatory for classification. Also, if there are other items that cannot be classified due to image resolution, only classifiable items should be included in a survey.
- In addition, when conducting surveys using stationary cameras on the beach, the size of the litter that can be measured will vary depending on the distance from the camera to the litter. There is a risk that litter types that can be identified from a short distance from the camera may be difficult to identify from a long distance. Therefore, it is possible to consider only including litter types that can be recognized even from a distance from the camera, or only including litter that is a short distance from the camera as the target of the survey, from the perspective of comparability with other surveys.
- In addition to the above, the final litter classification is determined based on the litter considered to be a problem in the survey area and the comparability to other surveys conducted in the same area.

Table 1.1.3. Classification Item Proposal and Correspondence with Other Guidelines

Classification Item		Correspondence with Other Guidelines				
Level1	Level2	EU (Item Code and Name)	OSPAR (Item Code and Name)	UNEP (Item Code and Name)	NOAA (Item Name)	Japan (Item Name)
Plastic	Caps/lids	G21-G24 (Plastic caps/lids drinks, Plastic caps/lids chemicals, detergents (non-food) , Plastic caps/lids unidentified, Plastic rings from bottle caps/lids)	15 (Caps/lids)	PL01 (Bottle caps & lids)	Bottle or container caps	Bottle cap, lid
	Beverage bottles	G7-G8 (Drink bottles <=0.5L, Drink bottles >0.5L)	4 (Drinks (bottles, containers and drums))	PL02 (Bottles < 2 L)	Beverage bottles	Plastic bottles for beverage (pet bottle) <1L, Plastic bottles for beverage (pet bottle)≧1L
	Plastic bags	G3 (Shopping Bags incl. pieces)	2 (Bags (e.g. shopping))	PL07 (Plastic bags (opaque & clear))	Bags	Plastic shopping bag
	Floats, buoys	G62, G63 (Floats for fishing nets, Buoys)	37 (Floats/Buoys)	PL14 (Plastic buoys)	Buoys and floats	Buoy (fishing implements) (plastics), Float/buoy made of foamed polystyrene
	Fishing nets, ropes, and twine (including ropes and twine other than fishing tools)	G49, G50, G52-G54, G56 (Rope (diameter more than 1cm), String and cord (diameter less than 1cm) , Nets and pieces of net, Nets and pieces of net < 50 cm, Nets and pieces of net > 50 cm, Tangled nets/cord)	31, 32, 33, 115, 116 (Rope (diameter more than 1 cm), String and cord (diameter less than 1 cm), Tangled nets/cord/rope and string, Nets and pieces of net < 50 cm, Nets and pieces of net > 50 cm)	PL19, PL20 (Rope, Fishing net)	Rope and nets	Rope/string (fishing implements), Fishing nets (fishing implements)
	Food packaging*	G3 (Crisps packets/sweets wrappers)	—	—	Food wrappers	Container and package for food
	Lighters*	G26 (Cigarette lighters)	16 (Cigarette lighters)	PL10 (Cigarette lighters)	Disposable lighters	Lighter
	Cigarettes*	G27 (Cigarette butts and filters)	64 (Cigarette butts)	PL11 (Cigarettes, butts & filters)	Cigarettes	Cigarette butt (filter)
Rubber	—	—	—	—	—	—
Cloth/textile	—	—	—	—	—	—
Paper/cardboard	—	—	—	—	—	—
Processed/worked wood	—	—	—	—	—	—
Metal	—	—	—	—	—	—
Glass/ceramics	—	—	—	—	—	—

*Food packaging, lighters, and cigarettes are not items that must be classified because their small size makes them difficult to distinguish at this time. However, future technological development may make it possible to identify them.

(4) Survey location

(A) Survey region

- In selecting the study area, the following points should be confirmed.
  - Whether the equipment can be brought to the site or procured.
  - Whether there is a suitable environment for a network. (In locations where a network is available, webcams can be used where captured images are automatically shared to the cloud. However, it is possible to use cameras that store images on the camera's hard disk even in the absence of a network.)

(B) Survey beach

- Select the survey beach after confirming the following points (i) to (v).
- The method of prior confirmation may include obtaining information from satellite images, interviewing nearby residents, or conducting a preliminary survey.
  - (i) **Whether the location of the beach litter survey is consistent with the survey purpose**: For example, if litter entering directly from a river is to be determined, the beach litter survey should be conducted near the mouth of the river. On the other hand, when you study the impact of ocean currents, it is desirable to be away from large estuaries.
  - (ii) **Whether the type of litter is appropriate for the survey purpose**: The type of beach litter that tends to drift and the season when it tends to drift differ depending on the orientation and slope of the beach.
  - (iii) **Permission to install cameras**: It is necessary to confirm whether permission to install cameras can be obtained from the beach administrator or local government. Particular attention should be paid when the beach has high nature values and is designated as a conservation area, or beaches with high tourism values and it is expected that many people will be entering the area.
  - (iv) **Accessibility**: Because it is necessary to enter the beach to install the stationary camera, it is necessary that the beach be one that can be accessed safely.
  - (v) **Whether the terrain is suitable for installing a camera**: There are various ways to install a stationary camera, such as drilling a hole in the concrete of an existing embankment and fixing it in place with metal fittings or to a railing, or constructing a tower to install it. When installing a tower, you will need a space of at least 1.5 m x 1 m, so please check in advance whether it is possible to install the tower in a place that will not be flooded even by high tides or waves. In addition, it is desirable to survey beaches with as little vegetation as possible, as it can be difficult to identify litter when there is a lot of vegetation, so it is preferable to choose a beach or location with as little vegetation as possible. It is also a good idea to consider whether it is possible to install a camera with a view that allows the camera to capture the area you want to survey.
- In addition, the following (i) to (iii) are points to keep in mind when conducting highly accurate estimations and releasing image data.
  - (i) **Beach substrate:** It is possible to survey any type of beach substrate. However it may necessary to avoid gravel beaches when the target size is small, as it is sometimes difficult to distinguish between litter and gravel of the same size or smaller in image analysis. Also, even on sandy beaches, if there is a lot of litter covering the beach, it can sometimes be difficult to distinguish between the background and the litter, which may reduce detection accuracy.
  - (ii) **The shore where cleaning is done:** When investigating changes in litter over time, it can be difficult to accurately grasp changes if cleaning activities are conducted during the period of the survey. It is a good idea to check in advance whether or not cleaning activities are conducted, how often and when they are conducted.
  - (iii) **Extent of use of the beach:** If people are captured in the photographs, there is a concern that personal information issues may arise if the image is automatically published on a website, etc. Also, when image analysis is conducted on images that include people, the amount of litter may not be accurately calculated, and so the data is often treated

as missing data (even if images that include people are included in the data, there is no need to manually remove the data before analysis, and in many cases it is possible to remove it afterwards, as the analysis results will be outliers (extremely large or extremely small values compared to the other data)). In addition, beaches with a lot of users are often cleaned frequently. Based on the above, it is desirable to choose a beach with as few users as possible and where people are unlikely to be in the picture.

(C) Survey area

(a) Selection of survey areas

- Due to the characteristic that stationary cameras can only take fixed-point photographs, the survey area is limited to a specific range, so the situation of the litter may differ greatly depending on the survey area selected. Therefore, the appropriate survey area for the survey purpose should be selected in advance by visual inspection, etc. For example, if you want to know when there is a lot of litter on a certain beach, you need to select a point that represents the variation in the amount of litter that washes up on the beach, and you may want to select a place where litter tends to accumulate.
- It is desirable to avoid places where the amount of beach litter is not considered representative of changes of the entire beach, as follows:
  - There is a lot of large litter washed up on the beach compared to other places.
  - There is a lot of litter from rainwater pipes etc.
  - The litter is localized in areas such as hollows where litter tends to accumulate.
- If the coastline is curved or there are structures such as jetties extending out from the beach, there may be places where litter tends to accumulate due to the effects of wind and waves. The survey area should be decided after checking the coastline shape and places where litter tends to accumulate visually in advance.
- In addition, if the purpose is to monitor illegal dumping, etc., it can be installed in a location where illegal dumping is likely to occur.
- The location for setting up the equipment should be decided by taking the following points into consideration.
  - Stationary cameras can be installed by fixing them to embankments or railings, or by constructing scaffolding, etc.
  - The direction and angle vary depending on what is being monitored (e.g. when monitoring plastic litter influenced by tidal fluctuations, the foreshore is suitable, while the backshore is more appropriate for monitoring fluctuations caused by waves).
  - It is preferable to avoid capturing people in the image as much as possible.
  - There is little vegetation during the survey period, so the litter can be seen.
  - There is a lot of litter to be surveyed.

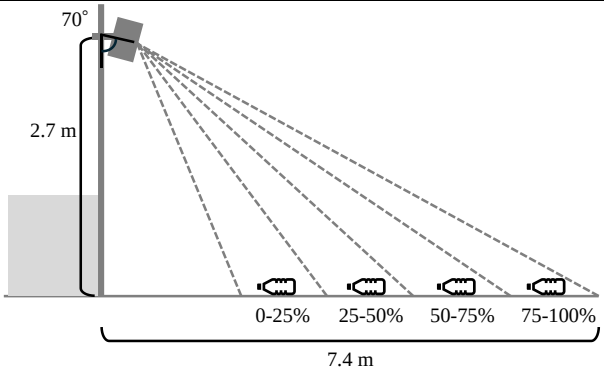
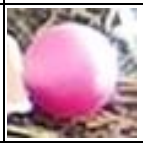
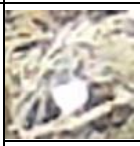
(b) Determining the range of the survey

- Since stationary cameras can only take pictures from a fixed point, the area surveyed is limited to a specific area of around 100 m^2. However, the area that can be surveyed and the resolution of the images depend on the height at which the stationary camera is installed and the angle of the camera. In addition, the stationary cameras need to be positioned close enough to the shore to recognize the litter.
- If the purpose of the survey does not include quantifying litter, and the purpose is to monitor the qualitative changes in litter volume, etc., it is possible to survey a wider area by installing the camera at a higher position or setting the camera angle to enable it to take pictures from a greater distance. However, if the height is raised, it becomes more difficult to install and maintain, so it is necessary to install the camera at a height that allows for installation and regular maintenance.
- If the purpose of the survey includes quantifying the amount of litter, the minimum value of the litter to be targeted will limit the height at which the camera is installed and the angle of the camera, and therefore the survey area will also be limited. Considering ease of

installation and maintenance, as well as image resolution, the height at which to install a stationary camera should be around 2.5 m.

- In the demonstration test for these guidelines, the images of the litter taken from the front to the back at the positions of 0-25%, 25-50%, 50-75%, and 75-100% and the camera installation conditions at the time are shown in Table 1.2.1. The camera installation conditions were set at an altitude of 2.7 m and an angle of 70° in consideration of the resolution of the litter and the survey range visible in the camera.
- The closer the litter is to the stationary camera in terms of linear distance (litter that is closer to the camera), the higher the resolution, and the closer the angle is to directly above, the easier it is to identify the shape of the litter.

Table 1.2.1. Camera installation conditions and how litter appears

	How Litter Appears				
Camera installation conditions	 Camera pixel count: 12 million pix				
Types of litter	Beverage can	Plastic bottle (without label)	Food tray (brown)	Food tray (transparent)	Rubber ball
					
0-25%					
	GSD : 1.0 mm				
25-50%					
	GSD : 1.2 mm				
50-75%					
	GSD : 1.9 mm				
75-100%					
	GSD : 2.3 mm				

- Depending on the terrain, it may be possible to install the camera at a higher position, for example if there are cliffs or high embankments in the surrounding area. The higher the camera is installed, the wider the area that can be photographed from directly above, but the ground resolution will also increase relatively, making it more difficult to detect small pieces of litter. Therefore, the installation height should be selected based on the size of the litter to be surveyed and the survey area you want to observe.

(5) Survey timing

(A) Survey season

- Stationary cameras can be used in any season, but please note that there are times of year when litter cannot be seen due to factors such as the growth of plants, snowfall, and changes in the shoreline position.
- For safety reasons, it is preferable to avoid bad weather and rough seas when installing stationary cameras.

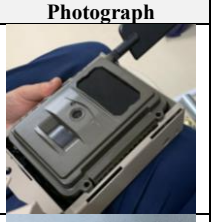
(B) Survey period

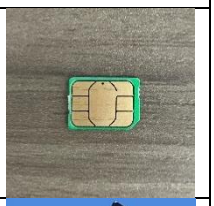
- The survey period is determined according to the survey objective.
- Since stationary cameras can be used to measure at high frequencies, they are suitable for understanding the time series changes in litter in the environment.
- The survey period should be decided according to the purpose of the survey, and the survey should be continued for a period longer than the period for which you want to understand.
- For example, if the objective is to assess the timing when beaches should be cleaned , the system can be installed for a period of one year or longer to identify trends when litter tends to accumulate, which can then be used to plan future cleaning activities.
- Additionally, it is believed that keeping the system installed for several years will allow for verification of the effectiveness of mitigation measures.
- However, the period during which it is possible to install the equipment is also related to the installation permission of the beach administrator or local government, so it is advisable to consult about the period during which it is possible to install the equipment before applying for installation permission.

(6) Survey equipment, Installation image

- The equipment required for image capture is as shown in Table 1.2.2 and Table 1.2.3. The main specifications for an example of a camera are shown in Table 1.2.4.
- The camera must have an interval shooting function (a function that repeatedly takes pictures at regular intervals). In addition, using a webcam with a function that automatically uploads captured images to the cloud enables unmanned, automated, and long-term observations, facilitating the monitoring of temporal variations.
- It is desirable to have a camera with at least 12 million pix, and it is desirable to use it within the range of the optical zoom (if it is difficult to obtain other methods include setting up a tower or installing equipment on top of a cliff).
- A large number of pieces of equipment are used to set up the equipment. In the case of beaches with many users, special care must be taken when managing equipment during installation, as leftover bolts or other materials after work may pose a risk of injury to beach users.

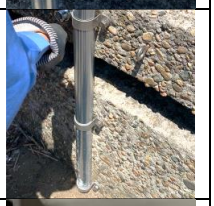
Table 1.2.2. Examples of equipment used for survey

Equipment	Uses	Consideration	Photograph
Interval camera	This is a device that can remotely view and save image data. A device that can connect to the Internet is recommended.	In many cases, a DC power supply that can be connected to a direct current battery is used (e.g. 6V DC). If an AC power supply is used, an AC conversion device (power supply converter) is required, and because the power consumption of the conversion device is high, it is not suitable for long-term operation.	
SD card	Install directly on the camera and save images. Even with cameras that can automatically save images to the cloud, there are times when the camera is disconnected from the network due to problems, so it is advisable	The larger the storage capacity, the more images can be stored, so choose a storage capacity according to the number of pixels in the photographs and the number of photographs you expect to take. Also, check in advance whether the SD card is compatible with the camera you will be using. In the demonstration experiment for these guidelines, the number of pixels in the photographs	

	to use an SD card in conjunction.	was set to 12 million pix, and the storage capacity of a single file was about 2.2 MB.	
SIM card	This is required when connecting a camera to the Internet. Please prepare a camera that is compatible with SIM cards in advance.	Use a SIM card that can connect to the Internet in the survey area.	
Camera case	To prevent theft of the camera, it is placed in a case with a padlock.	Use a camera case that is sturdy and can be locked with a padlock, etc.	
Solar panel	If you want to take continuous photographs without connecting to a power source, install a solar panel.	Choose a panel according to the required battery capacity, such as 80W_17.5V, 100W_22.5V, etc. Select a charge controller that matches the panel's open circuit voltage (V). *	
Battery	The power generated by the solar panels is stored.	Choose a battery that is suitable for solar power generation, such as a lead-acid battery for ships. General car batteries are not suitable for use in the field because they are prone to performance degradation due to voltage drops. Connect the above charge controller to prevent overcharging and overdischarging of the battery. Take safety measures such as storing the battery in a waterproof case to prevent electric shock accidents and fires caused by short circuits. *	
Controls	A controller that contains a system that links each facility together, with an internet device built in.	This is not necessary if the interval camera has a built-in communication function. If it does not have a built-in function, attach an external communication control device to control it.	 (Ministry of the Environment, 2020)
Signboard	Sign to indicate that an investigation is in progress	Clearly state that the survey is in progress, who is conducting the survey, and the contact details for emergencies, etc.	
Tool kit	Tools for setting up the camera (electric screwdriver, electric drill, wrench, etc.)	An electric drill is required to fix a single-tube pipe by making a hole in the concrete wall of a dike, etc.	

*Some interval cameras (hike cameras) are sold as a set with a solar panel and battery.

Table 1.2.3. Examples of equipment used for survey (installation fixtures)

Equipment	Uses	Consideration	Photograph
Anti-theft chain and padlock	Used to prevent theft of cameras and solar panels	The chain is fixed to the concrete of the embankment with screws, or fixed to the railing, and attached to the camera case and the mounting hardware for the solar panel.	
Single pipe	Used as equipment to install cameras in high locations	Adjust the length and number of poles according to the installation location. Two 2-meter pipes are required for installation on embankments or railings.	
Bracket for camera and solar panel installation	Used to fix a camera and solar panel to single pipes and adjust angle	The size of the camera case and solar panel must be suitable.	
Saddle band	Used to fix a single pipe to walls or embarkments by drilling a hole	The size of the single pipe must be suitable.	
Clamp	Used to connect single pipes and to install cameras and solar panels	It is desirable to protect the clamp with a plastic cover.	
Zip tie	Used to bind single pipes	-	
Clincher	Used to secure clamps and fittings	The size and length should be appropriate for each application.	
Hose and seal putty for pipe protection	Used to install hoses for pipe protection and fill the joints with waterproof seal putty	-	

Rust inhibitor, lubricant	Used to prevent metal corrosion and rusting	Products for use at sea, such as marine vessels, are preferable.	
Step ladder	Required when installing a camera at a high location	-	

Table 1.2.4. Example of interval camera specifications

Function	Specifications
Resolution	12 million pix
Power output	DC12V、Max 60 mA
Operating environment	Temperature: -20℃～50℃ Humidity: 5~ 90% (Non-condensing)
Protection class	Waterproof, dustproof IP65

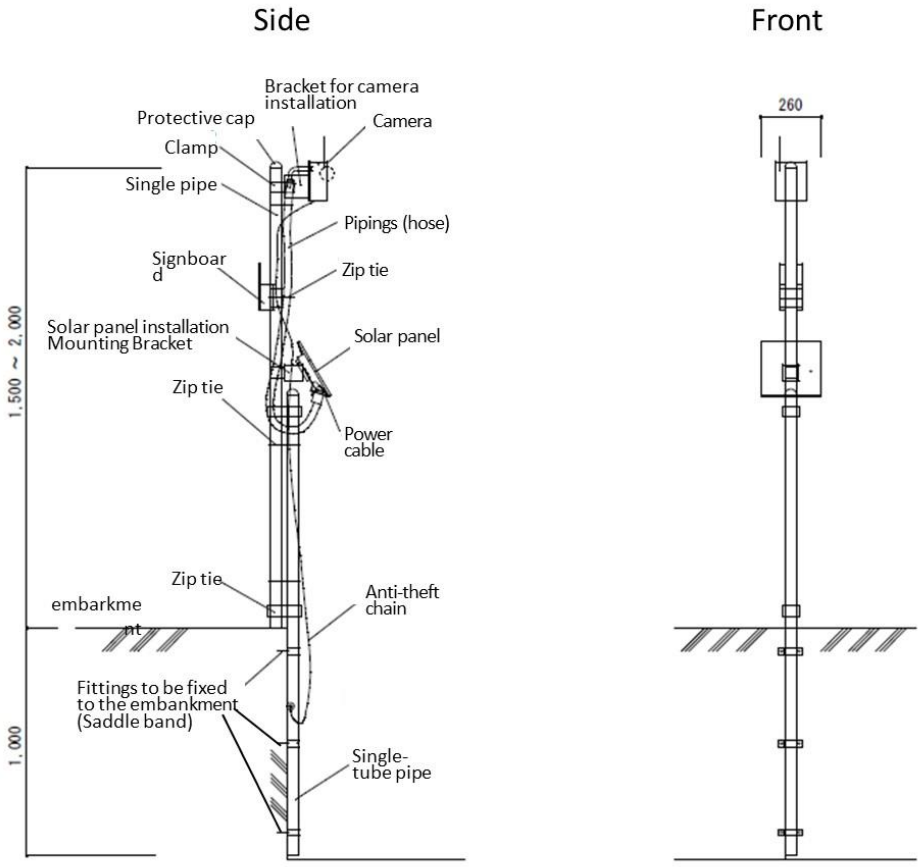
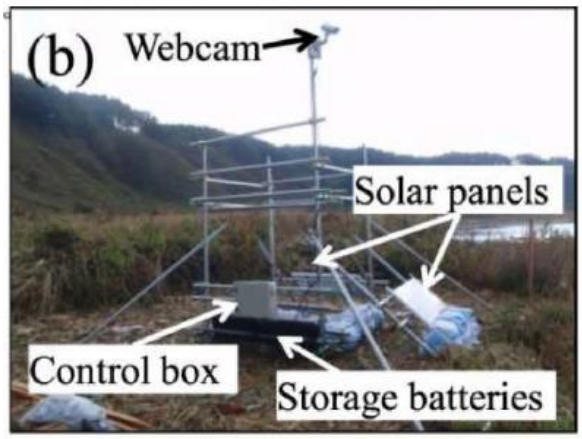


Figure 1.2.1. Details of stationary camera installation (example of installation on embankment)

(Example of fixing to a bank)

（Example of being fixed to a handrail）



Example of installation using a yagura
（Kataoka et al. （2012））

Figure 1.2.2. Example of equipment installation

(7) Legal considerations and requirements

- Apply for permits for installation of stationary cameras. Information such as location, method, duration of installation, frequency of data collection, need for constant monitoring/patrol network, and date and time of installation/removal work, should be organized in advance as it may be required. Since there are different laws and regulations by national and local governments, etc., and the applications required differ depending on the installation location, the necessary applications should be made after confirming in advance, and surveys should be conducted in accordance with the laws and regulations.
- If you are going to modify the existing structures of beach, such as by drilling holes in the concrete of the embankment, it is necessary to confirm with the beach administrator or local government about how to restore it at the end of the survey.
- Since it may take several months to obtain a permit, it is recommended that applications be submitted well in advance.

(8) Researcher

- It is advisable to have at least two people working together to install the equipment for safety reasons.
- As a large number of tools are used to install the equipment, it is advisable to have workers who are familiar with handling tools.
- Depending on the method of installing the equipment, it may be necessary to drill holes in the existing embankment or to partially process metal parts such as sheet metal for installing solar panels (cutting, drilling, bending, etc.) (see 1.2.2 Survey implementation). If it is difficult to conduct the work directly, design and installation can be outsourced to a construction company.

(9) Setting of equipment

(A) Shooting time and frequency

- Set the camera's shooting time to the time when there is sunlight and it is possible to take photographs (e.g. 5:00 AM-7:00 PM). Also it should be noted that the hours of sunlight vary depending on the season.
- There is no specific frequency for taking photographs, but if you want to know the timing of when litter drifts ashore based on changes in the tide, it is recommended to take photographs every hour.

(B) Other

- Depending on the specifications of the camera, you can register the phone number of a smartphone or other device and send setting changes and shooting instructions remotely via SMS from the smartphone app. This is convenient for taking photographs at any time or setting up the camera for later review.

(10) Preparation of survey equipment

- To ensure smooth installation of equipment at the survey site, preparations for equipment installation should be made in advance.
- When installing the camera in a high position, it is recommended to insert the SIM card and SD card and setting the camera beforehand.
- When installing solar panels on stationary cameras, it may be necessary to make or process parts in advance depending on the installation conditions, such as when adjusting the angle of the solar panels or connecting the wiring to the camera (see Figure 1.2.3 and Appendix 2). It is also possible to use batteries instead of solar panels, but in that case the batteries will need to be replaced periodically.
- The table below shows examples of parts processing when solar panels are installed, based on the results of the demonstration tests for these guidelines (see Appendix 2).

Figure 1.2.3. An example of a solar panel installed as a power source for a stationary camera and the steel plate component (processed) that serves as its base

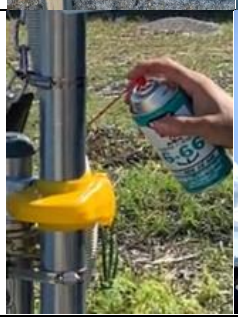
1.2.2 Survey implementation

(1) Setting up survey equipment

- Install survey equipment, including a stationary camera, at the survey site.
- There are various ways of installing cameras, such as drilling holes in the embankment and fixing them in place, fixing them to the railings, and building scaffolding. Table 1.2.5 shows an example of a camera fixed to an embankment in the demonstration test for these guidelines (see Appendix 2).
- Since it is expected to take half a day to one day to set up the survey equipment, it is recommended to schedule the survey well in advance.

Table 1.2.5. Example of a stationary camera (fixed to a embarkment)

No.	Procedure	Photo
1	- The single-tube pipes for installing the camera are fixed to the embankment.	
2	- The camera and solar panel are fixed to the single-tube pipe. The angle of the camera is adjusted while checking the images taken, taking into account the survey area and how the litter is visible. The angle of the solar panel is adjusted so that it faces south.	
3	- Wrap a hose around the wiring for protection, and secure the chain and piping to the single pipe with zip ties.	
4	- To prevent beach users from touching the survey equipment, signs will be placed stating that the area is being surveyed, that people should not touch the equipment, and providing the contact details of the person in charge.	

5	− To prevent theft of the camera, the round-head screws are fixed to the concrete embankment, etc., and a theft prevention chain and padlock is attached.	 
6	− When metal deteriorates due to sea breezes, it becomes difficult to open the case or remove the equipment. Therefore, rust inhibitor is sprayed on, and covers are placed over the metal joints.	 

(2) Data required for quantification of beach litter

For the assessment of time series data, it is preferable to obtain the following information during on-site operations such as equipment installation and during data analysis. The data to be collected may vary depending on the target beach and the timing of the survey, so considerations should be made accordingly.

Data required for quantification of beach litter is shown in Table 1.2.6 and Table 1.2.7. The characters listed in the "Category" column are as follows.

- F: Fundamental minimum requirements to identify the abundance of litter, sampling time, and location.
- E: Essential minimum requirements to make the survey results comparable.
- No letter: Optional data items obtained optionally (specific purpose or instrument availability).

Table 1.2.6. Static Information

Static Information (e.g., Camera Installation Details)			
Category	Data	Purpose of the Data	Remarks
F	Survey location	For result interpretation	
F	Survey date and time		
F	Camera resolution	For data accuracy verification	Record the higher value between the camera and AI
F	Camera installation height		
F	Camera installation angle		
F	Camera shooting settings		e.g., interval settings
E	Model of camera		
E	Distance from river mouth	For result interpretation	
E	Survey target		e.g., artificial objects, natural objects, plastics, etc.
	Beach substrate	For data accuracy verification	

	Beach orientation	For result interpretation	
	Beach slope		
	Cross-shore distance		
	Long-shore distance		
	Watershed area of the nearby rivers		
	Population density around the survey site and upstream areas		
	Land use patterns around the survey site and upstream areas		Industrial zone, urban area, rural area, etc. should be specified.
	Utilization status of the survey area		e.g., whether the area is used as navigation, port, etc.
	Nearby hydraulic infrastructure		e.g., dams, canals, levees, irrigation facilities, ports, water treatment plants, etc.
	Photographs and videos of site conditions	For data accuracy verification	Photographs and videos considered useful for analysis should include camera observation areas, scattered litter distribution, types, density, and work conditions.

Table 1.2.7. Time Series Information

Time Series Information (e.g., Meteorological Data)			
Category	Data	Purpose of the Data	Remarks
	Preceding number of dry days around the survey site	For result interpretation	Referring to the number of consecutive days during which the daily precipitation falls below a certain threshold (e.g., less than 10mm per day). The threshold may vary depending on the region.
	Cleaning history of the beach survey area		
	Temporary large-scale activities around the beach survey area (e.g., events)		
	Tide times		For stationary river cameras, applicable only for surveys conducted in the tidal reach of the river.
	Wave direction, height, and cycle		
	Weather (sunny, rainy, cloudy, etc.)		
	Wind speed and direction		

(3) Safety management

- For safety reasons, it is preferable that the installation work be conducted by two or more people.
- When installing equipment, it is recommended that the following equipment be worn for safety.
  - Gloves with non-slip features
  - Work clothes, safety shoes
- When installing solar panels, it may be necessary to process metal parts and wiring. In such cases, wear protective equipment such as protective gloves, protective goggles, and face shields that are cut-resistant and heat-resistant, which are necessary for metal processing.
- When setting up a camera at a high location, such as on top of a embarkment or using a stepladder, be careful of your footing and watch out for equipment falling. It is also advisable to wear a safety belt and helmet when working at heights.

(4) Confirmation of measurement data

- It is recommended that data be checked on a regular basis so that any camera malfunctions can be detected immediately.
- The following items should be checked:
  - State of power supply
  - Remaining battery capacity
  - Whether the image is shot successfully at the set interval and time.
  - Whether there is a deviation in the angle of view or water droplets or litter on the lens
  - SD card storage capacity

(5) Maintenance

- For webcams powered by solar panels, maintenance is not required as long as there are no abnormalities. However, after 1 - 2 years of installation, the equipment may deteriorate, in which case the equipment should be replaced.
- In the case of a battery-powered camera, the batteries need to be replaced regularly. In addition, if images are stored on the camera's SD card or other media, images need to be extracted from the SD card on a regular basis based on the capacity of the SD card and the size of the images stored.
- When the camera lens is fogged up due to humidity, or when clear images cannot be acquired due to dust or water droplets, or when images are not transmitted properly due to some abnormality, it is necessary to check the camera to resolve these problems.