URBAN ECO ISLANDS

HANDBOOK

for Developing Urban Eco-Islands with Smart Solutions

Interreg Central Baltic

EUROPEAN UNION
European Regional Development Fund

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Introduction

This handbook offers a guide for the integrated development planning of small islands close to urban areas. Proximity to cities creates a large potential for these islands to become smart and sustainable tourism destinations while taking the islands' natural and cultural assets into account – **Urban Eco-Islands.**

The handbook can be useful for local authorities, island communities and land owners, as well as other similar stakeholders who make decisions on how the island's values can be preserved, but also to use them for developing sustainable tourism attractions and products without harming the environment.

Based on the experience from mainly two Baltic Sea islands, Aegna (Tallinn) and Vasikkasaari (Helsinki) in the project "Urban Eco-Islands – Urban and Smart Island Tourism Destinations", the handbook offers support for replicating this type of development work in other locations of the Baltic Sea and beyond.

The handbook summarises the key steps on **how to develop a strategy for a small how to develop a strategy for a small sustainable island and use smart solutions – digital technology and citizen science approach** for collecting data from the environment and also from the visitors. It also gives examples of integrated destination development as illustrative cases for inspiration to other small urban islands.

Detailed guiding questions and templates for the strategic planning are provided in the Excel-based Urban Eco-Islands' strategy development tool.

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Photos: Tuomas Lahti, Teemu Saloriutta, Neeme Möll, Andrus Kahn

1. The Smart and Sustainable Island Development Model

The development of a sustainable island should be a **strategic process**. It has to take into account all sustainability dimensions, be based on a systematic assessment of the current situation as well as on stakeholder involvement, and also be a targeted action.

The smart and sustainable development model offers an approach to strategic planning in the context of small islands. The small islands are particular as they face various limitations due to the issues of scale and isolation[1].

The sustainability dimensions form a strategic framework for the island from the perspective of its **environmental, economic, social and cultural support systems.** These support systems should be the basis for integrated decision-making by linking the environment, resources, population, development and management. The core of the sustainable development strategy is to strengthen the island's capacity in all four sustainability dimensions (Figure 1).

Figure 1. Sustainability dimensions and elements for the development of a small island

[1] Kerr, S. A. 2005. What is small island sustainable development about? Ocean & Coastal Management 48: 503-524.

Each support system (sustainability dimension) incorporates key factors (elements) that impact the island's sustainability. Depending on the island's conditions (such as size), the most relevant factors may vary to some extent. The following framework can be employed to analyse small islands` environments which have a local community (year-round or summer residents) as well as some economic activities and cultural content.

Environmental sustainability aims at maintaining ecosystem and nature's services at a suitable level. Ecosystem services – both renewable and non-renewable resources and waste absorptive capacity – provide benefits to humans and improve their welfare.[2] The following aspects are important to consider for a small island:

Maintaining ecosystems integrity and nature values – there is sufficient capacity for nature protection (planning, enforcement, monitoring, cooperation, etc.) to sustain ecosystems' composition, structure, and function on the island. Comprehensive ecological databases for conservation evaluation are created, maintained and applied throughout the planning process.

There is regular monitoring of human impact on nature to guide the island's development, such as via visitor counters and investments in paths and signposts to manage the acceptable level of impact. The level of nature-related awareness and behaviour is high on the island (supported by information boards, timely communication via digital channels, participatory activities).

Efficient resource and waste management – the maintenance and use of local natural resources, e.g., forests, mineral resources (such as sand, gravel, clay as building materials), local fish stock, etc., are appropriate for the island.

The waste collection system, both for the islanders and visitors, as well as the transport of collected waste to the mainland meet the needs of the island. The system considers seasonality and types of waste (e.g., package, paper and cardboard, biowaste, bulky waste, hazardous waste, construction waste, waste electrical and electronic equipment). The visitors are informed and people's waste-related behaviour is good on the island. Wastewater disposal is safe.

Balanced spatial planning, land use and building decision-making – the planning, land use and building decisions take into account the information on nature monitoring (plant and habitat surveys, birds nesting, etc.), possible effects of climate change and other environmental risks.

Economic sustainability aims at efficiently using the available resources to assure profitability over time. Together with environmental sustainability conditions, it supports the viable development of a territory.[3] For the economic viability of the island, the following elements are relevant:

- **Logistic support and connectivity** – transport connectivity with the mainland meets the island's needs, both for islanders and transporting goods.
- **Sufficient and optimal infrastructure** – infrastructure and its maintenance meet the island's needs, e.g., communications network, energy infrastructure, water infrastructure, roads/trails, harbours/marinas, visitor infrastructure (such as signage, campfire sites, camping areas, toilets), etc.
- **Local small businesses** – the provision of services and products meets the island's needs, e.g., food services and products, accommodation services, guide services, mobility services (such as bike rental, water mobility options), etc. The conditions created support year-round economic activities. There is sufficient information about local services and products available (e.g., online, on-site).

[2] Moldan, B., Janoušková, S., Hák, T. 2012. How to understand and measure environmental sustainability: Indicators and targets. Ecological Indicators: 17: 4–13.
[3] Barile, S., Quattrociocchi, B., Calabrese, M., & Iandolo, F. 2018. Sustainability and the Viable Systems Approach: Opportunities and Issues for the Governance of the Territory. Sustainability 10.3 (2018): 790.

Social and managerial sustainability aims at achieving the local community's wellbeing and longevity. As the sustainability of community relates to the collective aspects of social life,[4] the following elements play a key role in a small island context:

- **Cohesive local community** – the islanders are willing to develop and act as a cohesive local community, engage community members and cooperate, plan and develop local life, and join into an organisation with an elected management body.
- **Engaging knowledge and awareness** – local people's knowledge is involved in making decisions that affect local life, and their understanding of sustainability is promoted. Therefore, information about the island and participation opportunities in decision-making processes must reach all the islanders.
- **Cooperation** – local community cooperates with stakeholders (relevant authorities, service providers, visitors, etc.). External organisations partner with local businesses and individuals (e.g., to carry out local tasks). The islanders have access to vital public services.

> In case no people live on the island yet, either permanently or temporarily, local authorities should explore potential visitors' views before developing the island. Do the general public support the island's development ideas, and would they be interested in visiting the island?

Cultural sustainability aims at ensuring the continuation of cultural heritage and values of the island. Sustainable management of cultural capital is the core of culturally sustainable development.[5] The key elements for a small island are:

- **Preservation of cultural heritage/objects** – the island's tangible and intangible cultural heritage is adequately protected and preserved.
- **Exhibition of cultural heritage/objects** – there is sufficient information on the cultural heritage available for visitors. The cultural heritage sites are safely accessible to visitors.
- **Building cultural identity and values** – the island's values are used to develop the island's cultural identity. Local educational and tourism programmes highlight the natural and cultural values of the island.

Smart solutions

In each sustainability dimension, smart solutions can help small islands achieve sustainability by using technologically advanced equipment, software or other innovative solutions. This handbook introduces the possibilities for **smart solutions** in planning the island's environmental monitoring and visitor management with the help of **digital solutions** and **citizen science** method (Chapter 6).

As the EU Smart Islands Initiative (2017) has indicated, islands have significant potential to function as laboratories for technological, social, environmental, economic and political innovation. Islands are living labs that can offer important lessons on multiple policy fronts, including energy, transport, circular economy, multi-level governance and ICT.

The small islands, in particular, have limited human and other resources and accessibility. Hence, smart digital solutions can help people to use resources more efficiently and reduce the transport need to the islands for monitoring, maintenance and data collection visits. Furthermore, smart solutions can raise people's environmental awareness and increase potential visitors' interest in the island.

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[4] Dempsey, N., Bramley, G., Power, S., & Brown, C. 2011. The social dimension of sustainable development: Defining urban social sustainability. Sustainable Development, 19(5), 289–300.
[5] Throsby, D. 2017. Culturally sustainable development: theoretical concept or practical policy instrument? International Journal of Cultural Policy, 23(2), 133–147.

2. Strategic Planning Process

Long-term and strategic development of an island requires a systemic approach. In the development of a tourism destination, three levels have an impact: destination capabilities at the level of individual actors, coordination at the destination level, and inter-destination bridge ties at the level of a larger region[6]. In the case of island development, the island should have an appropriate management system in place with agreed roles and responsibilities for planning, implementing, and monitoring the strategic framework (covering the whole management cycle of planning, doing, learning, and acting, see Figure 1). If the island is part of a bigger municipality, its management should be integrated into the local government's structure.

This handbook focuses on the strategic planning part of the integrated development process. The strategy planning aims to reach consensus with the stakeholders on the following questions:

Where do we want to be?

Where are we now?

How to get where we want to go?

How do we know we have arrived?

The planning process for a strategy of an island, including its tourism dimension, can be divided into three main stages (Figure 2):

I. The first stage is setting the shared long-term vision. For a vision, stakeholders usually agree on the **island's core values** and evaluate its **sustainable tourism potential,** in case the island aims to be a tourism destination (Chapter 3).

II. The second stage is to **assess the island's sustainability. Current gaps and future needs** from the viewpoint of the island's environmental, economic, social and cultural support systems will be identified and priorities established (Chapter 4).

III. In the third stage, stakeholders will agree on the **strategic goals** according to the island's values, vision, gaps and needs. Finally, stakeholders will compile an **action plan** and define **indicators** for measuring the island's success in achieving its vision (Chapter 5).

[6] Haugland, S.A., Ness, H., Grønseth, B.-O., Aarstad, J. 2011. Development of Tourism Destinations: An Integrated Multilevel Perspective. Annals of Tourism Research, Vol. 38, No. 1, pp. 268–290.

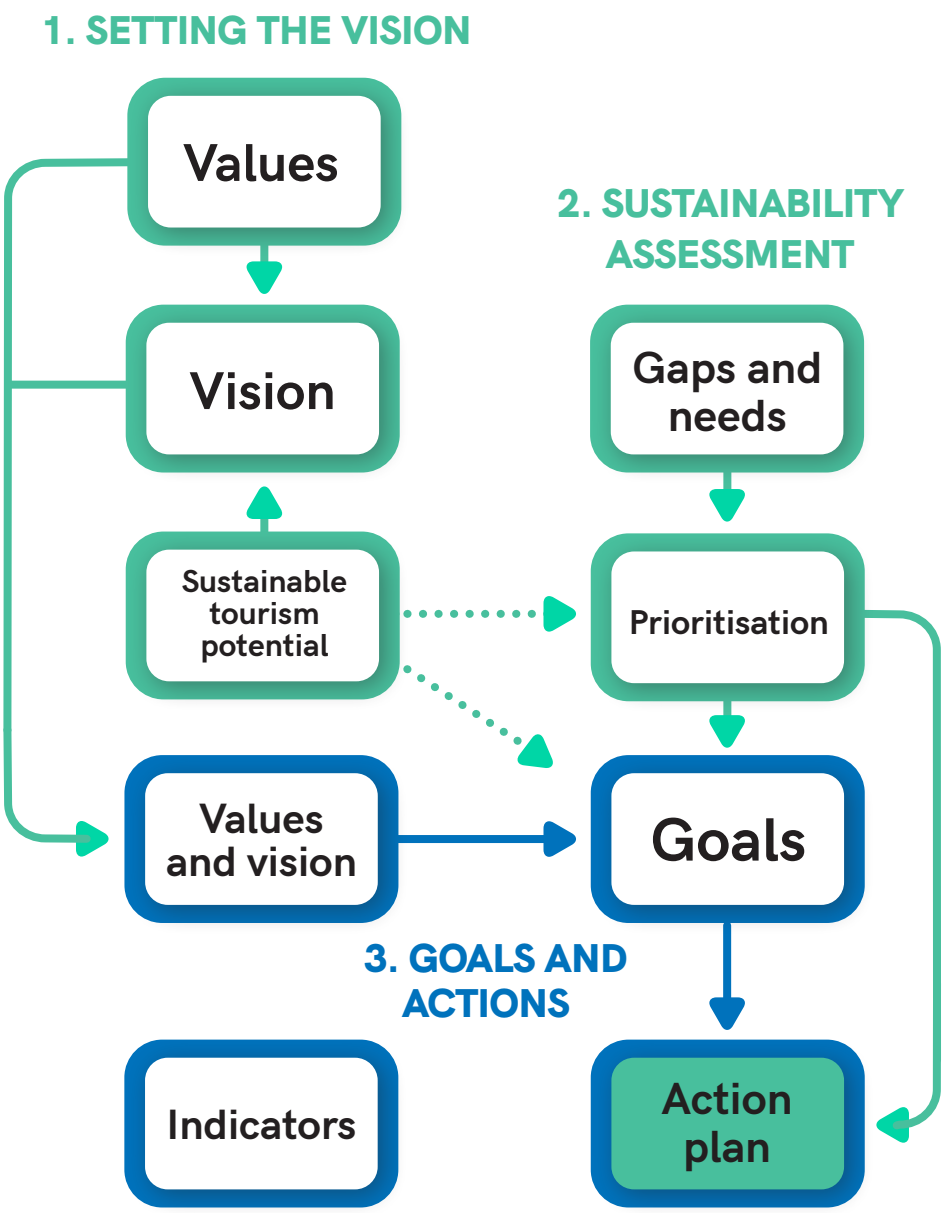


Figure 2. Stages and steps for developing the sustainability strategy

The best way to carry out these stages is to set up a joint **working group** of representatives of the island community, local government, relevant public authorities and other stakeholders. The stakeholder working group collects data and material to set the vision, conduct initial sustainability assessment, and compile the draft strategy. The output of each stage is discussed with a wide range of stakeholders to get their feedback and input to the next step.

The following three chapters provide more guidance for the planning stages.

3. Setting the Vision

Setting a vision is the collective creation of an image for the island's desired future. The vision aims to strengthen the island's values, guide actions and lay the basis for collaboration with the island community in a long-term perspective.

The vision is rooted in the island's **core values**, assets and future potential, as well as in the capabilities of its people. Thus, the visioning could start with agreeing on the core values of the island that guide its strategic planning. These values are positive existing or desired guiding principles, qualities, or behaviours important for the island. For example, the values can be related to the sense of community, protection of the natural and cultural environment, integrated development, etc.

If the aim is to develop tourism, **tourism potential for the island's sustainable development** should be assessed separately due to the vulnerability of island environments. The sustainable tourism activities consider the unique qualities of the island's nature and heritage and take advantage of the local values (such as nature values, cultural and historical values, community values, educational values, recreational values).

The World Tourism Organisation (UNWTO) defines sustainable tourism as "Tourism that takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities".

To assess the tourism potential of the island's natural, cultural and heritage assets and identify the island's capability in sustainable tourism, the stakeholders could consider the following components:

- Uniqueness – natural and cultural values and identity which differ from other islands
- Nature tourism – potential to offer ecological attractions and nature experiences to visitors
- Cultural tourism – potential to offer historical attractions and cultural experiences or events to visitors
- Economic feasibility – potential to offer recreational services and products which are economically feasible for developers and at a reasonable cost for visitors
- Community participation – willingness and capacity of the local community to participate in tourism development

If these components are valued highly, they are assets for the island.

For vision building with the community, it may be useful to apply the scenario planning method. The working group together with stakeholders creates alternative scenarios that outline the different combinations of possible trends, facts and assumptions for the island's future. The outcome of the scenario planning is a vision which shows the preferred future of the island. The vision statement usually takes the desired scenario together in one sentence.

The templates and guiding questions for identifying the core values, assessing the sustainable tourism potential and setting the vision are provided in the Urban Eco-Islands' strategy development tool.

4. Sustainability Assessment

Sustainability assessment aims at setting a sustainability baseline for the island by identifying gaps between current performance and potential.

In the working group meetings, stakeholders should assess each dimension of the island's sustainability (environmental, economic, social, and cultural) in order to identify the areas where improvement is needed, either immediately or in the future. The gaps and needs may be related to data, knowledge, implementation.

The assessment should start with the strategic and legal frame to establish whether all relevant national, regional and local regulations and strategic documents are in place for the island. For assessing the island's sustainability, the description of sustainability dimensions in Chapter 1 can be taken as a basis.

Photos: Piret Kuldna and Tiit Kallaste

Nature monitoring

As nature is commonly one of the main attractions on island destination, special attention should be paid to nature monitoring, protection and awareness when assessing its environmental sustainability. It is essential that conservation biology is incorporated in the planning and development process of the island in a timely manner.

It is vital to perform the nature monitoring system in the island development work prior to other economic, social and cultural development activities and repeat monitoring throughout the development process. Islands have unique and very fragile nature values, which often cannot be found in other locations. They are isolated ecosystems where the island's size and distance from other islands and the mainland have a significant effect on habitat resilience, species immigration rates and survival. The island's flora and fauna are typically sensitive to disturbance. This phenomenon makes island nature values very sensitive to human impact.

In addition to special characteristics of island ecosystems, it must not be forgotten that shores and underwater habitats also have an important role in island biodiversity conservation. The Baltic Sea is a unique marine environment that has special underwater natural and cultural values. Thus, it is noteworthy to follow the precautionary principle in the planning process because once nature values are lost, they are often irreplaceable no matter what reactive measures are taken.

Attention should be paid to at least the following questions to identify potential gaps and needs in nature monitoring and protection:

At what level is the biodiversity known on the island?

- Plant survey and vegetation types
- Bird/nesting survey
- Other key animal species surveys, e.g., butterflies or bats
- Underwater analysis

What is known about and expected from the visitor flow?

- Degradation risk
- Visitor counters and regular surveillance

What is known about and expected from nature awareness?

- Signposts in place and knowledge available online

How is nature monitoring implemented?

- Monitoring targets (coverage)
- Frequency (regular/irregular)

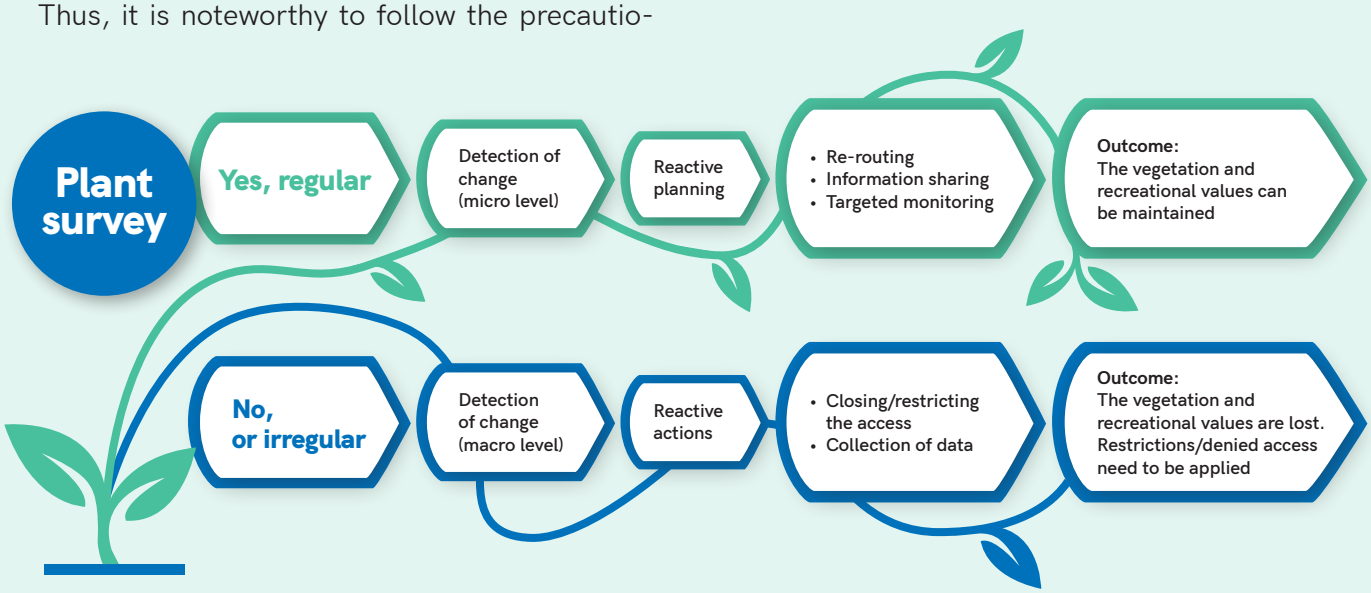


Figure 3. A chain of impact to demonstrate a case where crucial nature monitoring is not recognised and performed regularly.

Various sources of information can be useful for sustainability assessment:

- Previous studies on the island,
- Stakeholder workshops, roundtables and meetings,
- Interviews and expert assessments,
- Surveys of local population and visitors, etc.

Visitor surveys

Visitor surveys can provide valuable information for the island's sustainability assessment and strategy development. Understanding visitors' motivation, perception of the island's values, and visiting experience satisfaction are important for planning the destination and monitoring visitor flows and impacts.

Questioning the visitors on their exiting the island at harbours, piers and watercraft enables to collect immediate impressions and opinions from people of different ages and gender who visited the island for various purposes. Both self-completion and interviewer-administered questionnaire method can be applied where either the respondent fills in the questionnaire form or the interviewer notes down the respondent's answers. To gather data for planning and to monitor sustainable tourism on the island, the following survey topics can be considered:

Respondents' profile – socio-demographic attributes of visitors, such as age, gender, nationality and place of residence (domestic or international visitor);

Profile of visit and visitation patterns – means of transport to and from the island, length and frequency of visit, travel group composition and size, activities on the island;

Visit planning – pre-visit information sources, reasons for the visit and influencing factors;

Visitor perceptions and visitor experience outcomes – expectations and satisfaction, the most and least favourite places visited on the island, perceived values and tourism impacts of the island, and willingness to contribute to the island's development, such as paying for the services and participating in the environmental monitoring.

A sample questionnaire for the visitor survey is provided in Annex 1.

The data collection methods for sustainability assessment can include digital solutions and a citizen science approach, which are further described in Chapter 6.

When the gaps and needs are identified, they should be prioritised in order to rank their **importance for the island's sustainable development.**

Prioritisation can take place according to the agreed legal, strategic, economic, environmental, cultural, social and time criteria. For example, the stakeholder working group assesses each identified gap and need, whether it:

- is a legal obligation or a strategic goal, causes financial cost or lost revenue, causes harm to the environment, local community and/or culture, requires action within a year or later.

These criteria are commonly used in prioritisation to determine the important issues that should be followed up by concrete measures in the action plan. The more a gap meets the criteria, the more critical it is for the island to bridge this gap.

The templates and guiding questions for identifying gaps and needs as well as establishing priorities are provided in the Urban Eco-Islands' strategy development tool. The strategy developers can choose from the list of sustainability assessment questions that apply to their island conditions.

5. Goals and Actions

After prioritising the gaps and needs, stakeholders can agree on long-term development goals for the island and draw up an action plan that details the steps of achieving the goals.

Goals should be aligned with the island's vision, gaps and needs. The fulfilment of development goals will contribute to the realisation of the vision.

To reach the goals, stakeholders need to decide on the **action plan.** The description of actions or tasks under each goal should include actors and responsibilities, timeline, financial resources required and targets or expected results. The expected results are output indicators which measure the completion of the intended actions.

Thus, the plan for each action should answer at least four main questions:

Who will carry out the action?

By what time will the action be completed?

How will the action be financed?

What are the expected results?

In order to measure **the success (result or impact) of the island's strategy in achieving its vision,** also outcome indicators need to be selected. Defining indicators in each dimension of sustainability provide a basis from which to monitor change and progress over long term.

The island's strategy that is agreed with the stakeholders needs to be also adopted by the local government council.

The templates for establishing goals and action plan and a possible list of outcome indicators are provided in the Urban Eco-Islands' strategy development tool. The strategy developers can choose from the list of indicators those which apply to the conditions of their island.

The examples of the planning and implementation of the waste management system on Aegna and the visitor infrastructure on Vasikkasaari and Aegna are provided in Annex 4.

Photos: Helen Saarniit

6. Smart Solutions

Data collection – either by people or sensors – is the first step toward gaining information and ultimately, knowledge. Understanding the location is key to impactful actions. Technological advances have made data gathering easier and the analysis tools more accessible.

6.1. Digital solutions

The digital solutions in developing tourism and other activities on small islands can be classified into five categories:

- Environment monitoring
- Visitor monitoring
- Aerial image analysis
- Virtual experience
- Transportation

In the following, the five primary use areas are introduced. More detailed information about the digital solutions that have been tested on Vasikkasaari (Finland) and Aegna (Estonia) are provided in Annex 2.

Weather stations are the traditional sensors for **environmental monitoring.** They monitor factors such as temperature, humidity, wind speed and direction. Air quality sensors measure the number of nanoparticles in the air and can be very useful in assessing the area's conditions (Annex 2.1). In case there is no power in the location a solar panel setup can be installed. It is composed of the panels, a charge controller and batteries and it is relatively easy to set up.

Data is of no use unless visualised. There are plenty of solutions for this, like Grafana, which is relatively simple to use after understanding how queries work. Some services offer an all-in-one-platform for LoRa sensor management such as NoraNet.

The amount of visitor traffic in a certain area can be measured with infrared sensors (for example, on a pier in island locations) or cameras looking at a parking area. Another option is to track the number of Bluetooth-devices in a given area anonymously. In crowded urban areas, most people have a Bluetooth device on them, although the factor might change in non-urban areas. Nevertheless, this measurement gives an indication of how many people have been in an area along with the routes taken and the time stayed in various locations (Annex 2.2).

In selecting suitable visitor counting methods, the objectives of the calculation, the specific attributes of the area, and the resources (power and network) available should be considered. Infrared counters are good for point-specific visitation counts and complement on-site visitor surveys and can be powered with batteries. Bluetooth-tracking gives more information on how and where visitors move around but require grid power, network access and large numbers of visitors in order to provide useful results.

Infrared solutions are reliable, accurate and work in all weather conditions. Other ways to gather visitor information is through mobile operators and service providers such as sport tracking apps that collect data directly from mobile users.

Aerial images can be analysed for various purposes from counting people to analysing vegetation. Aerial images can be acquired from drones, planes or satellites. The resolution of the images depends on the altitude and cameras. For a more general vegetation analysis in a broader area, a lower resolution image can suffice (Annex 2.3). For species recognition, on the other hand, a better-quality image is often needed. The top-quality images that drones provide can also be used for remote bird nest counting, preserving the birds' habitat from unnecessary intrusion (Annex 2.4). Satellite data can be hard to come by with a limited budget, but, for example, the European Space Agency (ESA) provides very accessible data from public satellites.

Emerging technologies, such as **Virtual Reality (VR)** and **Augmented Reality (AR),** have influenced the tourism supply-side and tourists alike. VR can be used as a marketing tool for promotional and communication purposes during a pre-travel phase because it can digitally

transport potential customers to a travel destination or hotel. VR technology utilises images, sounds and physical sensations to make users feel physically present in a virtual environment. A virtual tour will help people to plan a visit or let them experience the destination even if they cannot visit it in person (Annex 2.5).

Live video is a medium that is gaining popularity, and live streaming is one of the significant marketing trends in the travel and tourism sector, with the most important platforms including Facebook, YouTube and Instagram. Urban Eco-Islands project set up a live camera stream of the Helsinki skyline[7] along with a chatbot that fetches maritime data from open application programming interfaces (API) and announces the passing boats in a YouTube video stream.

When considering remote locations, **transportation** of visitors and supplies becomes the key factor. Automotive chains of supply with drones and/or marine vessels have been a prominent theme in recent years and will increase in relevance in the upcoming years. Expanding access to islands by providing different transportation solutions to the ferry transportation services, for example, is a good way to boost activities in otherwise hard-to-access areas. These solutions often fall into the generic domain of MaaS (Mobility as a Service). In 2020, an electric ferry boat was tested for Vartiosaari[8], an island near Vasikkasaari in Helsinki. Some day the boats could be autonomous, but for now, the technology is not quite ready yet, and the law usually demands a captain on every vessel.

What to consider:

- Always test hardware, software and firmware before going to the location. A digital twin representation is an increasingly handy tool, allowing you first to test the functionality and suitability of the equipment, along with simulations on expected impact. Especially remote locations or otherwise hard-to-access sites benefit from this.
- Remote controllability tends to break down easily even with market solutions. Usually, in a couple of weeks, the data packages (e.g., via LoRa technology) tend to drop and eventually a hard reset is needed.
- Simpler is better. The more devices and/or software you have in the system, the more variables there are for breaking down.

Table 1 summarises the suitability of the main applications of digital solutions for small island conditions.

A Bluetooth station on Vasikkasaari. Photo: Noora Reittu

A visitor counter on Aegna. Photo: Merilin Laager

[7] www.youtube.com/channel/UCjxn80cfS7TDQMS-Y6CinVQ
[8] https://forumvirium.fi/en/callboats-operates-on-demand-between-the-vartiosaari-island-and-laajasalo-in-helsinki-during-the-summer-of-2020/

Table 1. Digital solutions tested in small island conditions

Digital solutions	**Applications**	**Suitability for small island conditions** (green=good, yellow=average)
Water temperature sensor	Water temperature monitoring on beaches	Allows accurate information automatically and throughout the year.
Infrared people counter	Counting the exact numbers of people entering or exiting	Provides daily counts. Can be powered with batteries.
Drone video footage	Replacing the traditional fieldwork survey in annual bird nesting counting or determining the amount of green vegetation	Can film nature areas that are difficult to access providing a non-intrusive way to monitor bird nesting.
Weather station	All-in-one weather data gathering	Allows a wide range of data output. It needs to be installed in some existing structure.
Noise sensor	Decibel monitoring	Gives an average decibel count. Not particularly useful for generally quiet areas.
Air quality sensor box	Measuring air temperature, humidity, air pressure, small particles and optionally volatile organic compound (VOC) gases	Not very precise but inexpensive and useful in monitoring air quality trends.
Bluetooth tracking	Tracking and giving information on the routes visitors use	Works better with an electrical grid than off-grid. Requires network access.
Satellite imagery analysis	Assessing the impact of visitors and monitoring vegetation decay, e.g., using Normalised Difference Vegetation Index (NDVI)	Helpful to visualise and identify the seasonal variation of vegetation. Needs special expertise in analysis.

6.2. Citizen science

Citizen science is a research and engagement method where citizens collect and analyse data, often in collaboration with scientists. In an island's strategic planning, citizen science can be used to support the decision-making in different stages, depending on the needs of the island.

For example, citizens – island residents and visitors – can gather data for the sustainability assessment and monitor the impact of the island's strategy in achieving its vision. This data may include a range of observations, e.g., **environmental or social impacts, peoples' experiences, or observations of plants or animals.**

Data collection with volunteers' help can have multiple co-benefits such as collecting more extensive data sets, awareness-raising, increasing scientific literacy among participants, etc. However, in order to gain these benefits, citizen science projects require careful planning, ideally with methods co-created together with potential citizen scientists.

Both the coordinating organisation and the citizen scientists should be motivated to collect the data. The motivation will help guarantee that sufficient data is collected. Thus, the method used to collect the data as well as the theme should be tested with the public or the target groups within the public. One process to maximise participation within citizen science activities is the following:

1. Identify the challenges that you want to collect data about (together with stakeholders, if possible)
2. Identify the possible actors who need to be involved (together with stakeholders, if possible)
3. Get commitment
4. Identify the target groups related to the citizen scientists and
5. Plan the activities together.

What to consider:

- Review and assess existing standard methodologies and tools which can support in producing robust and appropriate data for decision making and which are appropriate for the target group. If no method exists, co-create one with your stakeholders – including your citizens!
- Ensure that the data collection methodology, data sources and formats, and the methods of transferring the data are appropriate for the final data user.
- Create your communication and supporting materials for users (e.g. step-by-step guides).
- Test your methodology and materials with your target group of users, including citizen scientists.
- Ensure that privacy issues are considered.

Examples of two citizen science projects related to nature observation and marine litter are provided in Annex 3.

Photo: Heidi Tuhkanen

7. Doing, Learning and Acting

In this handbook, we focused on the planning phase of the island's development strategy. After the strategy is approved and adopted in the local government council, its implementation starts. The implementation must be regularly checked whether the expected results are achieved and the island is moving towards its vision. As learning from smart solutions is an important part of developing a small island, its management should be adaptive to respond to new information obtained through data collection and monitoring. If the monitoring results indicate that the strategy implementation should be adjusted or updated, corresponding actions need to be taken (Figure 4).

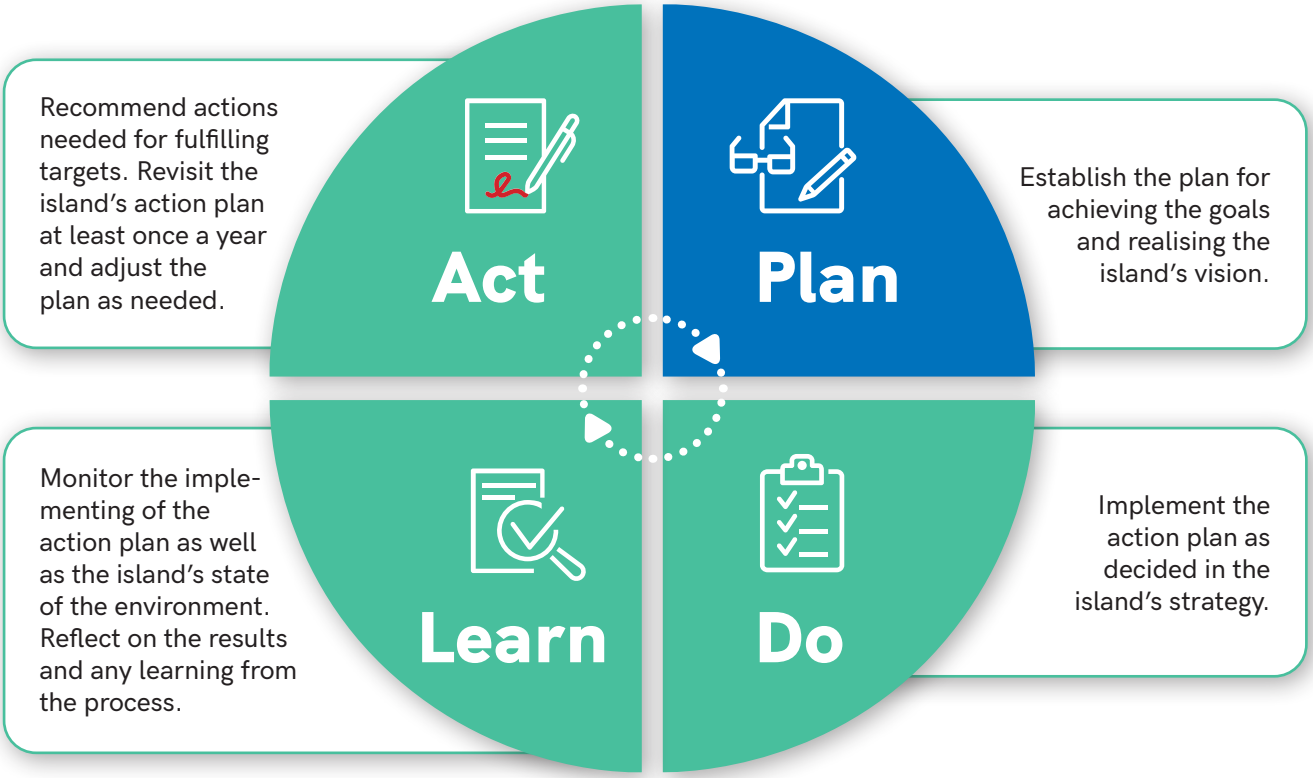


Figure 4. Plan-Do-Learn-Act cycle

8. Useful Resources

STRATEGIC PLANNING OF SMALL ISLANDS

Habitability: Planning the Future of Islands by Christian Pleijel. Report: Our Habitability. Sustainable Development of Kökar 2020–2030 (2050):
https://europeansmallislands.com/2020/11/22/habitability-planning-the-future-of-islands/

CRITERIA AND INDICATORS WHICH MATCH WITH THE VARIOUS COMPONENTS OF SUSTAINABILITY ASSESSMENT

EUROPARC Sustainable Tourism in Protected Areas 2019.
How to Become a Europarc Sustainable Destination – Technical Guidelines:
www.europarc.org/sustainable-tourism/become-a-sustainable-destination/

European Commission.
European Tourism Indicators System (ETIS) for sustainable destination management:
https://ec.europa.eu/growth/sectors/tourism/offer/sustainable/indicators/

Global Sustainable Tourism Council (GSTC) Destination Criteria:
www.gstcouncil.org/gstc-criteria/gstc-destination-criteria/

CITIZEN SCIENCE

European Citizen Science Association's website as a resource platform:
http://ecsa.citizen-science.net/documents/

Citizen science for all – a guide for citizen science practitioners.
Bürger Schaffen Wissen (GEWISS) publication.
Available online at www.buergerschaffenwissen.de/en

Annex 1. Interview Questionnaire Example

I YOUR CURRENT VISIT TO /ISLAND/

1. How did you come to /island/? The main transport means was: (Please tick one box)

a. ☐ Ferry b. ☐ Own speedboat / boat c. ☐ Kayak/canoe d. ☐ Speedboat service/sea taxi/ other

2. Which of the following best describes the purpose of your current visit? (Please tick one box)

a. ☐ Recreation b. ☐ Study c. ☐ Other:

3. Was it your first or repeat visit to /island/? (Please tick one box)

a. ☐ First visit b. ☐ Repeat visit c. ☐ I or my contact have a cottage/house on the island

4. How long was your visit?

a. ☐ Day trip No. of hours: b. ☐ Overnight trip No. of nights:

If it was an overnight trip, where did you stay?

a. ☐ Rented accommodation, incl. camping b. ☐ In a tent c. ☐ In a private house

5. How did you visit /island/, alone or in a group?

a. ☐ Alone b. ☐ With family members / relatives / friends c. ☐ With tourism group
d. ☐ With pupils / students / colleagues

6. What activities did you engage in? (Please tick all relevant boxes)

a. ☐ Guided tour b. ☐ Independent sightseeing c. ☐ Educational/training programme
d. ☐ Nature observation e. ☐ Sunbathing / sea bathing f. ☐ Landscape games (e.g. geocaching)
g. ☐ Sporting activity h. ☐ Visiting event i. ☐ Picking berries, herbs, mushrooms etc.
j. ☐ Other:

No. of people in the group including you: No. of children under age 16 in your group:

7. Which was your most favourite and least favourite place you visited?

Option A. Please mark the number of the place from the map:
The most favourite place: Why did you like this place the most?
The least favourite place: Why did you like it the least?

Option B. Please tick the box of your favourite place:
a. ☐ / name of place/ b. ☐ / name of place/ c. ☐ / name of place/, etc.
Why was it your favourite?
Which place did you find unpleasant, why?

II PLANNING YOUR CURRENT VISIT TO /ISLAND/

8. Option A. Did you use any of the following sources of information on /island/?
(Please tick all relevant boxes)

a. ☐ Website of /island/ b. ☐ Website of /city/ c. ☐ Internet search d. ☐ Social media
e. ☐ Print media / TV / radio f. ☐ Book / brochure g. ☐ Tourist Information Centre
h. ☐ Ferry/Boat company's advertisement i. ☐ Other person j. ☐ Other:

Option B. From where did you get to know about /island/? (Please tick all relevant boxes)

a. ☐ Internet search b. ☐ Website of /city/ c. ☐ Social media
d. ☐ Print media / TV / radio e. ☐ Book or brochure f. ☐ Tourist Information Centre
g. ☐ Ferry/Cruise company's advertisement h. ☐ Other person i. ☐ Other:

9. Please rate the level of importance of each factor to your visit of /island/:
5 = very important, 4 = rather important, 3 = neither important nor unimportant (neutral), 2 = rather unimportant, 1 = not important, 0 = can't say

a. Interest in the island:	Very important	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, not important	☐ 0
b. Interest in nature:	Very important	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, not important	☐ 0
c. Interest in history:	Very important	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, not important	☐ 0
d. Seafaring/sea:	Very important	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, not important	☐ 0
e. Event on the island:	Very important	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, not important	☐ 0
f. Particular activity on the island:	Very important	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, not important	☐ 0
g. Invitation by someone:	Very important	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, not important	☐ 0
h. Earlier visit to the island:	Very important	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, not important	☐ 0
i. Other, please specify and rate:							

III VALUES OF /ISLAND/ AND YOUR EXPECTATIONS

10. Please rate, how important the following values of /island/ are for you:
5 = very important, 4 = rather important, 3 = neither important nor unimportant (neutral), 2 = rather unimportant, 1 = not important, 0 = can't say

a. Nature protection value:	Very important	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, not important	☐ 0
b. Cultural value:	Very important	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, not important	☐ 0
c. Educational value:	Very important	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, not important	☐ 0
d. Recreational value:	Very important	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, not important	☐ 0
e. Value of /island/ as an island:	Very important	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, not important	☐ 0
f. Other, please specify and rate:							

11. Please rate to what extent the visitor management of /island/ met your expectations:

5 = fully met my expectation, 4 = rather met my expectation, 3 = neither met nor unmet, 2 = rather did not meet, 1 = didn't meet my expectation, 0 = can't say

a. Ferry service:	Fully met	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, didn't meet	☐ 0
b. Availability of information about paths:	Fully met	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, didn't meet	☐ 0
c. Availability of information about sightseeing:	Fully met	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, didn't meet	☐ 0
d. Waste management:	Fully met	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, didn't meet	☐ 0
e. Public facilities (e.g., toilets, campfire sites):	Fully met	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, didn't meet	☐ 0
f. Catering:	Fully met	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, didn't meet	☐ 0
g. Accommodation:	Fully met	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, didn't meet	☐ 0

If anything did not meet your expectation, please describe it here:

12. Should there be additional services or facilities available in /island/?

(Please tick one box in each row. If yes, please specify what kind of service/facility is needed)

a. For nature-based activities	☐ Yes:	☐ No	☐ Don't know
b. For educational purpose	☐ Yes:	☐ No	☐ Don't know
c. For catering	☐ Yes:	☐ No	☐ Don't know
d. For accommodation	☐ Yes:	☐ No	☐ Don't know
e. For water sports equipment	☐ Yes:	☐ No	☐ Don't know
f. For easier routes	☐ Yes:	☐ No	☐ Don't know
g. Resting areas/benches	☐ Yes:	☐ No	☐ Don't know
h. Grill/Campfire sites	☐ Yes:	☐ No	☐ Don't know
h1. Would you be willing to pay for the firewood?	☐ Yes:	☐ No	☐ Don't know

13. Did you notice any of the following human activities as a worrisome problem for /island/?

5 = yes, noticed a lot, 4 = noticed a little bit, 3 = noticed, but not as a worrisome problem (neutral), 2 = rather did not notice, 1 = didn't notice at all, 0 = can't say

a. Trampling outside paths:	Noticed a lot	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, didn't notice	☐ 0
b. Disturbance of birds, animals:	Noticed a lot	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, didn't notice	☐ 0
c. Damage to trees, bushes:	Noticed a lot	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, didn't notice	☐ 0
d. Littering:	Noticed a lot	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, didn't notice	☐ 0
e. Making loud noise:	Noticed a lot	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, didn't notice	☐ 0
f. Too many people visiting the island at the same time:	Noticed a lot	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, didn't notice	☐ 0
g. Other:	Noticed a lot	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1, didn't notice	☐ 0

14. Thinking of your experience in /island/ overall, to what extent do you agree or disagree with the following statements?

5 = agree, 4 = rather agree, 3 = neither agree nor disagree (neutral), 2 = rather disagree, 1 = disagree, 0 = can't say

a. I am satisfied with my visit to /island/:	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0
b. Behaving in an environmentally responsible way was made easy:	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0
c. I'm concerned about how tourism impacts the natural values of /island/:	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0
d. I would have liked to know more about the nature and history of /island/:	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0

15. In your mind, what would be the reasonable price for a ferry ticket to /island/?

a. ☐ Current price b. ☐ Same as public transportation in /city/ c. ☐ euros d. ☐ Don't know

15.1. Should /city/ have "archipelago-card" in use, which includes transport costs for all open island destinations (cf. museum card)?

☐ Yes ☐ No ☐ Don't know

How much would you be willing to pay for "archipelago -card"? euros/season

IV CONCLUDING QUESTIONS

16. Would you be interested in participating in any of the following data gathering activities?

a. Water quality monitoring:	☐ Yes	☐ No	☐ Don't know
b. Wildlife monitoring:	☐ Yes	☐ No	☐ Don't know
c. Waste monitoring:	☐ Yes	☐ No	☐ Don't know

17. Your age and month of birth:

18. Your gender: a. ☐ Female b. ☐ Male c. ☐ Other / Don't want to say

19. Your nationality:

20. Where do you normally live?

a. ☐ In /country/ In which city / city district / municipality?

b. ☐ Outside /country/ In which country?

If you have any other comments, please write them here:

If you want to be informed about the project, you can leave your e-mail here:

THANK YOU!

Filled in by the interviewer:

Date of the interview: End time of the interview: Group:

Annex 2. Examples of Digital Solutions

Annex 2.1. Sensor data collection

Objective

To gather environmental data from nature location.

Location: Vasikkasaari (Helsinki), Aegna (Tallinn)

Target groups: City officials, island visitors

Usefulness in island conditions

Environmental data gathering from sensors is an inexpensive way to collect data such as air temperature, water temperature, wind speed and direction, as well as air quality from a location. This data could be interesting for some visitors eager to know what to wear and when to go to a remote island. Depending on the quality of the sensor, the data can be useful for scientific purposes too.

Description of the activity

Vasikkasaari is an off-grid location, so a power infrastructure was built around 2x 300W solar panels. Aegna has access to grid power.

Sensors installed on both islands:

- Weather station (measures wind speed, wind direction, rain, air temperature, humidity) (on Vasikkasaari and Aegna)
- Water temperature sensors (one on Vasikkasaari, two on Aegna)
- Air quality sensor (PM10, PM2,5) (on Vasikkasaari)
- Noise sensor (dB) (on Vasikkasaari)

Most of the sensors were bought from commercial suppliers. Some (e.g., the air quality sensor) were built inhouse for testing purposes. Remote access was achieved with microprocessors (for example, ESP32) but caused some trouble and needed rebooting every ten days or so. Thus, the main problems were caused by the inability to access the sensors and systems on the island without physical presence.

On Aegna, the weather station is located at the port and the two water sensors at the two main beaches – North and South beach (20 m from the shore).

Key messages and lessons learned

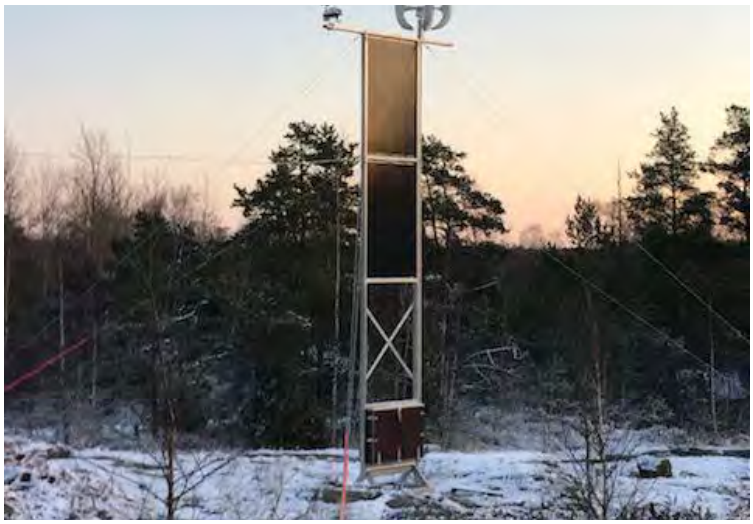
One of the target islands (Vasikkasaari) was an off-grid location with no access to power. The installed sensors are very low-energy sensors but require a steady stream of energy nevertheless. Making sure the power infrastructure works without major blackouts is crucial.

Many networks can be used in transferring the data to the servers. The LoRawan network has very low power consumption, a long range and is very suitable for an IoT network setup.

Data alone is next to no value if not combined and refined. Combining data to give instantaneous knowledge on what to wear, for example, could be one way to add value to the collected data. Data visualisation is another important aspect of data accessibility and usability.

Suitability of data collection with sensors in small island conditions on a 5-point scale: Good

Need for investment: Low



Air quality sensor and weather station on Vasikkasaari. Photos: Veli Airikkala

Annex 2.2. Monitoring visitor flows and directions: Bluetooth technology and visitor counters

Objective

To anonymously track the routes chosen by visitors and time spent at different locations.

Location: Vasikkasaari (Helsinki), Aegna (Tallinn)

Target groups: City officials, the general public

Usefulness in island conditions

While urbanisation is growing and urban areas are expanding and densifying, the social significance of recreational areas and green spaces is constantly growing, as they significantly impact citizens' well-being. Visitor information, especially from the sensitive natural areas of islands, is an important tool for planning the maintenance of islands, and information is also needed for the sustainable development of recreational and nature areas.

In newly opened islands with designated visitor areas and paths, it is useful to track where people go and where they spend their time during their visitation. Visitor information can be used to plan better the resources and the adequate level of maintenance services (such as waste management and outdoor toilet management). Overall, it is important to count visitor flows to capture daily, weekly and seasonal visitation trends, understand year-on-year growth, justify investments and support decision-making and data-driven active planning.

Description of the activity

In 2020, Forum Virium Helsinki implemented a digital solution pilot to find out whether visitors walk along trails on Vasikkasaari, what the most popular areas of the island among visitors are and how well visitors find new rest areas built during the summer.

Ten base stations detecting Bluetooth-signals were installed with Hypercell in strategic locations on Vasikkasaari (Figure 5). Since Vasikkasaari is an off-grid location, Hypercell developed a power-independent solution for this project, which can become part of its product portfolio in the future. Bluetooth technology was used to track the movement of visitors on the island from July to the end of September.

The City of Tallinn installed infrared visitor counters in 6 locations on Aegna Island to measure the number of visitors and monitor change. Results are coming continuously (30-minute interval).

Key messages and lessons learned

Based on the collected data, it was possible to show that most of the people visiting Vasikkasaari head to the Commandant's House and a resting area nearby. Some movement was also observed in the direction of the old oil tank. Stays at rest stops have not been long for visitors, suggesting visitors tended to walk more around the island in the sense of exploring. Visitors also stayed well on the trails built on the island and did not get lost on forest trails.

The places for infrared counters have to be well chosen to get maximum and adequate results. Based on the experience of the first summer season, one counter is planned to be moved to a different location because permanent island residents are passing this counter on a daily basis. It was learned from the experiment that infrared people counters are inexpensive and easy to install. This solution is easy to replicate if the LoRaWAN network is available.

Suitability of Bluetooth tracking in small island conditions on a 5-point scale: Average

Need for investment: Medium

Suitability of infrared counter in small island conditions on a 5-point scale: Very good

Need for investment: Low

Figure 5. The locations of the Bluetooth base stations (arrows), the total number of observations (large integer) and the percentage of total observations

Annex 2.3. Nature decay monitoring with satellite data

Objective

To assess the correlation between visitor amounts and nature decay.

Location

Vasikkasaari and Vallisaari (Helsinki), Aegna (Tallinn)

Target groups: Environmental experts, city officials

Usefulness in island conditions

Islands with regular visitor activity could be analysed with this method. The impacts visitors have on nature can be evaluated via paths widening, moss decay etc. The decay is monitored by analysing satellite images and the Normalised Difference Vegetation Index (NDVI) of the island locations. NDVI is a simple but effective index for quantifying green vegetation.

Description of the activity

The goal of the pilot with Zero Gravity (company specialised utilising satellite data) was to answer the question of how people visiting Vasikkasaari, Vallisaari and Aegna islands over a certain time period affect its vegetation and island ecosystem. Satellite imagery analysis was combined with drone video footage acquired in 2020. The data used for the analysis are from the European Space Agency (ESA) Sentinel2 satellite and range from 2015 to 2020. The data were cleaned from cloudy images and prepped to suit the methodology. To determine the amount of green vegetation on the islands the Normalised Difference Vegetation Index was calculated.

Project findings and other interesting datasets reflecting the vegetation were visualised in a user-friendly dashboard[9].

Key messages and lessons learned

While possibly obvious, it was good to validate the hypothesis with clearly specified methods to allow replicability. In a preliminary analysis, the findings have been promising. ESA is required by competition laws to reduce their satellite image resolutions. Nevertheless, the Sentinel2 images turned out to be good enough (and free).

An important factor was the inclusion of Vallisaari (Helsinki) among the monitored locations. The island is divided between a restricted army-zone and areas open to the public. This division provided distinctive areas for comparison.

The results showed some interesting trends in the NDVI-index over the years. In Vallisaari, it could be seen that in the summer of 2017, the green vegetation of the area closed to visitors increased permanently compared to the area open to visitors (Figure 6). Although more data for a longer comparison are needed, preliminary findings have set up the table for more research in the future.

Suitability of nature decay monitoring with satellite data in small island conditions on a 5-point scale: Average

Need for investment: Medium

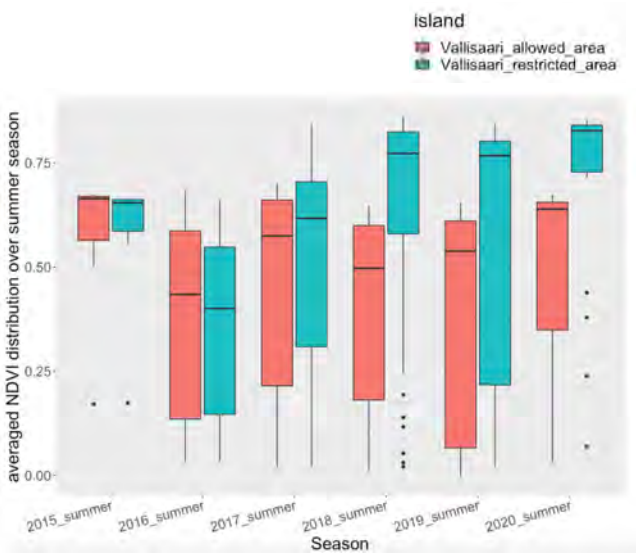


Figure 6. Comparison of summer month averaged NDVI from the tourist area and restricted area on Vallisaari. Treetops and green areas (grass, moss) correlate directly with the index. The change in NDVI vegetation index in the Vallisaari restricted area can be seen in the graph from 2017 onwards.

[9] https://uei.zerogravity.fi/webapp/

Annex 2.4. Nature monitoring with a drone: Bird nest counting

Objective

To test if a drone can help or replace traditional fieldwork survey in annual bird nest counting.

Location: Harakka Island (Helsinki)

Target groups: Environmental experts, nature surveyors

Usefulness in island conditions

Traditional fieldwork in nature monitoring is very time consuming and resource-intensive and sometimes done in dangerous conditions.

Drones can access nature areas which are otherwise very difficult to access. Very sensitive areas need not be ashored if a drone can do the surveillance. It can save time during fieldwork because it moves more easily in the air than humans on the ground.

Data are automatically received in GIS format for analysis.

Description of the activity

Barnacle goose was chosen as an example because it has already been monitored annually, the species is large enough to be easily detected from the air, and it is known to bear some human disturbance. It was important to make sure that the drone will cause no harm to surveyed species. It was ensured from previous surveys and map analyses that all necessary data information could be acquired with a drone compared to traditional fieldwork monitoring.

For the actual survey, suitable timing for monitoring was anticipated in the spring and spare days were reserved if, e.g., nesting was to be late or weather conditions would not allow drone flights. In addition to a drone, other equipment such as binoculars, appropriate clothing, pencil, paper, smartphones were needed.

A nature expert prepared the flight in the drone equipment settings before the fieldwork.

After implementation, technical work to prepare map images for analysis, analysing the results (number of bird nests), saving data and reporting were required.

Key messages and lessons learned

As a result, Harakka Island was mapped with the drone. Experts were able to count bird nests from the images except for those cases covered by the bushes. If not too disturbing to the monitored species, it would be advised to fly the drone at 30 to 50 meters above ground to ensure sufficient accuracy for bird nest identification from the images. In case a drone is used for the first time in monitoring, a manual survey on the ground should be carried out for comparison and validation of drone results.

It was useful to reserve several dates for monitoring because windy or very cloudy conditions may hinder data gathering with the drone. The survey requires know-how about drone equipment use, choosing suitable technical settings and nature expertise. It must also be confirmed that the drone does not cause any harm to surveyed species and that there might be restrictions where a drone can be used. It must also be accounted for that public authorities require registration for drone users.

Suitability of birds nest counting with a drone in small island conditions on a 5-point scale: Good

Need for investment: Low

View to Harakka Island from a drone. Photo: Tuomas Lahti

Annex 2.5. Information sharing to the public via digital format: Information boards and virtual tour

Objective

To improve the availability of information about islands' nature, history and other topics for the public on the spot and online.

Location: Vasikkasaari (Helsinki), Aegna (Tallinn)

Target groups: The general public, island visitors

Usefulness in island conditions

Information boards on islands are essential to share information about hiking paths and sightseeing as well as guide people's behaviour. In small island conditions, the information may be more simple to update in digital format than on paper.

In addition, the digital format allows visitors to be provided with rapidly changing data, such as weather data (on which the connection between the mainland and island depends), water temperature and other seasonal info (e.g., fire hazard warnings), accurate ferry times and emergency contacts.

Solutions for self-guided tours and offering information and visual content online make the island accessible for all, including those who cannot visit the island, e.g., due to limited physical ability.

Description of the activity

One digital information board was installed both on Aegna and on Vasikkasaari, which requires the following equipment: a stand for the digital screen, power distribution system, and web environment.

360° photo material was filmed with a hand camera for a virtual tour on Vasikkasaari[10] by Northman VR.

In addition, an eBooklet was published on both islands, and Vasikkasaari was added to the urban nature portal Citynature.eu.[11]

A nature expert prepared the flight in the drone equipment settings before the fieldwork.

After implementation, technical work to prepare map images for analysis, analysing the results (number of bird nests), saving data and reporting were required.

Key messages and lessons learned

A digital information display needs electricity and Internet connectivity, software to control it and a power line connection. The display cannot be installed faced to the sun, and it needs a weatherproof casing with ventilators. The display itself has to be designed to operate 24 hours a day, seven days a week.

Visual nature photos and accurate maps are important when sharing information on nature destination. Also, ensure the resources for updating the contents and for maintenance.

Suitability of digital information boards and creating a virtual tour in small island conditions on a 5-point scale: Very good

Need for investment: Low

A digital information board at Aegna harbour. Photo: Merilin Laager

[10] https://360.northmanvr.com/F18AibiTyP/14339531p&278.03h&57.86t
[11] https://citynature.eu/en/location/vasikkasaari/

Annex 3. Examples of Citizen Science Activities

Annex 3.1. Biodiversity-related citizen science activities with iNaturalist

Objective

- To collect biodiversity-related information from the islands around Helsinki.
- To spread awareness of urban biodiversity and encourage citizens to observe the surrounding nature.

Location

Harakka and Vasikkasaari Islands (Helsinki)

Target groups: Schoolchildren/youth, teachers, guides, island residents

Usefulness in island conditions

The activity can contribute to species monitoring and gathering baseline data about the species on an island which may be less known. It can also be used to identify issues, e.g., invasive or non-native species trends (nature monitoring). Local knowledge should be utilised to plan the activity. The activity can also be used to build local knowledge and support the understanding of and interest in nature and nature conservation (nature education). It is relatively low cost as free mobile applications are available. However, time of staff and guides should be allocated to creating the materials, and developing, promoting and implementing the activities.

Description of the activity

As the Vasikkasaari visitor survey indicated visitor interest in species monitoring, this was discussed with the main stakeholders (City of Helsinki Environment Services and the neighboring Harakka Island's Nature School to ensure commitment to the activity. iNaturalist mobile app was selected as a software tool for species data collection based on discussions with national organisations dealing with species-related data to ensure that the data would be robust enough for their use.

Potential pilot activity target groups included local i) nature enthusiasts, ii) nature school students, iii) guided tour participants and iv) Harakka Island visitors.

iNaturalist guidance materials were created and revised with nature school educators and other stakeholders (incl. slides guidance for teachers, slides for all users[12], a promotional video[13] for all users).

Training on iNaturalist app (requires tablets or mobiles with SIM cards) was held for Helsinki nature guides and Harakka nature school. A BioBlitz-event – observing nature to record all the living species within a designated area within a certain time – was organised for the general public in Helsinki.

Nature school educators and school teachers incorporated iNaturalist app activities into their existing curriculum.

Key messages and lessons learned

Activities and aims need to be user-driven (e.g. educator-driven) to ensure the ownership of activities. The level of integration of citizen science activities into curriculum depend on the educator and their needs.

Working on an real-life issue can motivate activity organisers, educators, as well as students in the implementation of citizen science activities.

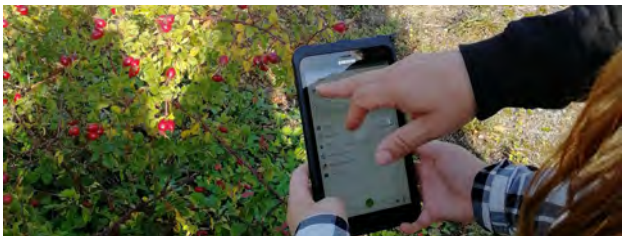
People may require a push and ongoing support, e.g. some type of context, campaign or external motivator to start and continue with citizen science activities.

Citizen science activities need to be age-appropriate. Younger students need continual engagement, while older students can collect data more independently.

Continual or annual monitoring can also contribute to time-series datasets.

Suitability of citizen science activities with iNaturalist in small island conditions on a 5-point scale: Very good

Need for resources: Low



Nature observation with the iNaturalist app on Harakka Island. Photo: Heidi Tuhkanen

[12] www.hel.fi/helsinki/fi/asuminen-ja-ymparisto/luonto-ja-viheralueet/luontoretket/tekemista-luonnossa/
[13] www.helsinkikanava.fi/fi/player/vod?assetId=60084625

Annex 3.2. Marine litter-related citizen science

Objective

To create a programme on the nature and origin of marine litter found on the beaches for teachers and schoolchildren.

Location: Aegna (Tallinn)

Target groups: Schoolchildren, teachers

Usefulness in island conditions

The research study programme helps to increase awareness of litter reaching the Baltic Sea. Litter can enter the sea as a result of human activities on both land and the sea. An island with a varied coastline allows to understand better the relationships between the beach type and the accumulation, composition, and possible origin of marine litter.

Description of the activity

The citizen science programme "The nature and origin of marine litter"[14], developed together with Aegna Nature House, consists of the following parts: guidance material for teachers, worksheets for students, photobank of marine litter, and public database for results.

The purpose of the programme is to determine the spatial distribution, composition and possible origin of marine litter on selected beaches.

During the Aegna day of study, the students studied litter found on the beach – litter washed ashore by the sea and left by people on the beach. Trash left on the beach can also be considered marine litter since it is likely to end up in the sea if it is not removed from the beach.

Equipment used: Work gloves for each participant. For a group of 4–6 students: One smaller and one larger garbage bag, possibly a basket or bucket for heavier litter; two boxes for small litter particles and for sediment sampling to identify micro-litter with a microscope; a writing pad and a pen; a phone to set coordinates and take pictures of the litter.

In addition, the smart application Litterati[15] was tested on Aegna to collect data on litter in a global database.

Key messages and lessons learned

The most suitable age group for the programme is 14–18-year-old pupils. They are able to analyse their findings and thus provide input to the research on marine litter from the citizen science perspective.

The best time to study marine litter on beaches is before and after the tourism season. During the tourism season, beaches can be cleaned regularly. Repeated surveys twice a year enable to analyse changes in marine litter over time.

Before going to the day of study on a beach, it is recommended for students to familiarise themselves with the topic and the types of litter at school.

Suitability of marine litter-related citizen science in small island conditions on a 5-point scale: Very good

Need for resources: Low

Coastal monitoring for the collection of marine litter data on Aegna. Photo: Piret Kuldna

[14] www.sei.org/projects-and-tools/projects/urban-eco-islands-eng/
[15] www.litterati.org/

Annex 4. Other Examples

Annex 4.1. New resting areas, nature trail and hiking routes

Objective

To improve the visitor experience on the island and ensure sustainable use of the island to bear the increasing visitor numbers.

Location: Vasikkasaari (Helsinki), Aegna (Tallinn)

Target groups: Island visitors

Usefulness in island conditions

Well-planned visitor infrastructure is the basis for developing sustainable tourism on the island.

Appropriate hiking routes, maps and information material let visitors know about the island's opportunities and values. Clear trails, resting areas and signposts are essential for guiding visitors to sustainable behaviour and preventing unnecessary trampling outside the paths.

Description of the activity

In order to protect the island's nature, the condition of existing routes and the needs of recreational structure improvements were mapped on both islands.

Based on the assessment, the design of resting areas and trails was planned together with the city experts and stakeholders. Altogether three resting areas were built, and one nature trail with signposts was built on Vasikkasaari.

On Aegna, the network of hiking trails together with visitor information was updated, marked on the map and in nature. In total, four large island maps and 24 information posts were installed on the island to guide the visitors.

In the most sensitive places, the hiking trails were covered with mulch made of local material – storm-broken branches. This way, the path sides were also cleaned to prevent the spread of potential forest fire.

Key messages and lessons learned

Analyse the existing network and condition of the trails – which routes people use, whether the paths meet the needs of nature protection and what is needed to make the route a memorable hike.

To identify the target visitors of the island and compose information texts accordingly. For example, as Aegna is also a destination for guided environmental education tours, this material can serve as a learning tool.

Engage local people in addition to authorities.

Choose a suitable design for visitor infrastructure, use environmentally-friendly and local construction materials, e.g., wood and mulch.

Plan the construction before high visitor flow.

Make sure that maintenance will take place regularly after the investment.

Suitability of the described solution for building visitor infrastructure in small island conditions on a 5-point scale: Very good

Need for investment for building new infrastructure: High

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A hut on Vasikkasaari. Photo: Annika Harlio

Visitor infrastructure on Aegna. Photos: Raul Rink

Annex 4.2. Where the waste goes on a small island: Waste management system on Aegna

Objective

To renew the waste management system and enable the appropriate storage of collected waste.

Location: Aegna (Tallinn)

Target groups: Island residents and visitors

Usefulness in island conditions

When developing small island tourism, a well-functioning waste management system is essential.

The system should consist of long- and short-term objectives and targets, suitable forms for waste collection, storage and transport to the mainland. Last but not least, sharing clear information to residents and especially visitors as well as raising their awareness are important parts of the waste management system.

In island conditions, the waste management system requires a different approach than on the mainland since waste treatment possibilities are limited. In general, two approaches for waste collection are possible on small islands: 1) Residents and visitors take their waste back to the mainland themselves, or 2) Waste is collected from residents and visitors on the island and transported periodically to the mainland. On Aegna, the second option is used.

Description of the activity

From 2021, the Tallinn Waste Centre is the official partner of Tallinn City for waste management on Aegna Island. Tallinn Waste Centre employs an operator on the island to collect waste, run the new waste management station and bring waste to the mainland, where it will be processed. The frequency of transport will depend on when the bins come full.

There are separate containers for collecting packaging waste, glass and mixed municipal waste in places which people visit the most on the island: public beaches, camping sites, attractions and harbour area. Local residents and businesses compost biowaste on site.

Built in 2020, the new waste management station (59,9 m2) operates as a central collection point on the island. The station is equipped with containers for different types of waste (packaging waste, glass, paper and cardboard, mixed municipal waste, hazardous waste) and a separate space for bulky waste.

Key messages and lessons learned

- If waste is collected on the island, then the funding of the system needs to be thought through and organised. On Aegna, the City of Tallinn finances the public network of the waste collection since it is considered that a well-functioning waste collection system helps avoid littering and damage to the environment.
- The planning of the waste management system should start from the waste analysis: what type of, how much, when and where waste is generated on the island. Based on the results, it can be decided how many public trash bins are needed, where temporary waste storage should be located and how large its capacity is as well as how often waste is shipped to the mainland.
- The information about waste collection requirements has to be clear and easily accessible, especially for island visitors.

Suitability of digital information boards and creating a virtual tour in small island conditions on a 5-point scale: Very good

Need for investmentand operational cost of waste collection: High

Waste management station on Aegna. Photo: Andrus Kahn.

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