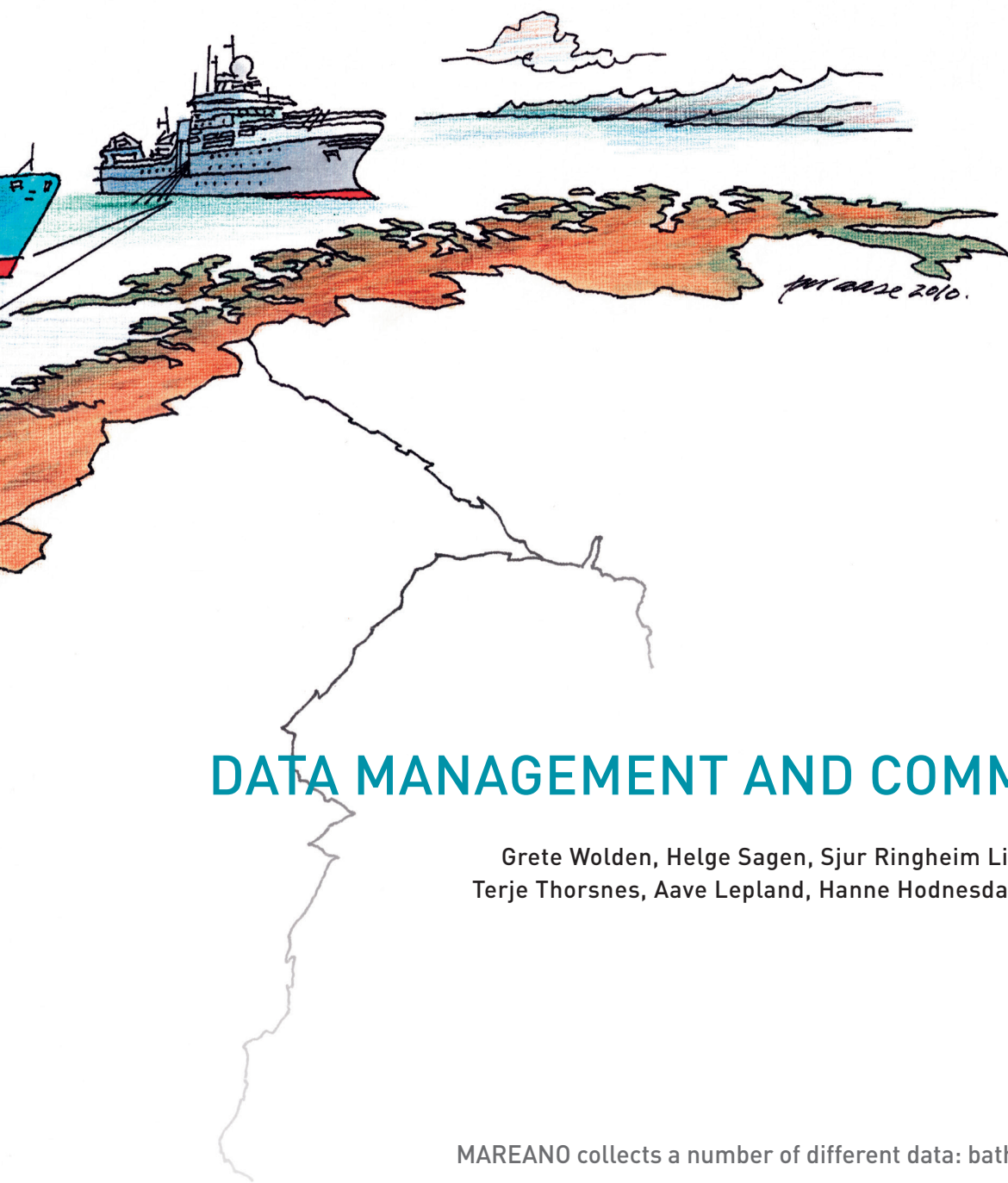




**Data flow in MAREANO:** The MAREANO mapping starts by depth measurements from surface vessels equipped with multi beam echo sounders. The data are sent to the NHS in Stavanger for quality control and data-management. Based on the depth data, terrain models are produced for IMR and NGU to select which areas are to be mapped biologically and geologically. These surveys are carried out from the IMR research vessels. Biological samples and data are managed by IMR, whose headquarters are in Bergen, while geological samples and data are managed by NGU in Trondheim. Handling, analyses and management are carried out by the agency appointed national experts within each field. Results are made available to decision-making authorities, scientists and the general public.



## DATA MANAGEMENT AND COMMUNICATION

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MAREANO collects a number of different data: bathymetry, biological samples, chemical samples, sediment data and video. The data are processed by the collecting agency before being communicated to the end users. The primary users are politicians deciding on the management of the Norwegian seas.

## 12.1. NEW KNOWLEDGE

Norway governs vast marine areas and, despite our extensive knowledge of the water masses in these areas, the seabed is relatively unexplored and new knowledge is required. One main objective for MAREANO is to provide new knowledge for the Management Plans for the Norwegian seas, which are being continuously updated. However, this new knowledge can also be useful for other purposes, thus it is important that data and results are managed and communicated in a way that makes them available to all potential users. They must also be secured for the future.

When discussing Norwegian marine areas, the topics most commonly addressed are oil and energy activities, fisheries and transportation. Today, MAREANO results are used to shed light on all these areas. In the future, however, we may need to look at our marine areas from other perspectives. We

may consider aquaculture and sea ranching in deeper areas with new species. We may discuss sub-sea mineral extraction or hydropower plants, or maybe seabed tourism. And what if we discover deep-sea species that have a positive health and environmental function? In such cases, data on the seabed's physical, biological and chemical environment collected by MAREANO may provide a useful knowledge basis for our decision makers.

Data collection and handling is expensive and time consuming. Bathymetry mapping is carried out by vessels moving at 6 knots while mapping depths in a "band" across the seabed. The shallower the waters, the narrower the band. At 200 m depth, it is about 500 m wide, which means that about 100 km<sup>2</sup> can be mapped per day in good weather conditions. Consequently, covering all Norwegian marine areas will take a very long time. For the biological, chemical and geological mapping, sampling stations are selected both randomly

and based on previously accumulated knowledge. For the biological, geological and chemical sampling it is the deeper areas that are most time consuming, and it may take up to 24 hours to complete a physical sample in deep water. Since there are two physical stations and 10 videostations per 1000 km<sup>2</sup>, the biological, geological and chemical sampling is less time consuming than bathymetry mapping.

Another mapping of Norwegian marine areas of this scale will most likely not happen for many years. The terrain in our marine areas is stable, thus bathymetry data will be valid for a long time. The biology may change more rapidly, so a current status of the biology will be useful for scientists who in the future wish to study changes in the seabed life. We need an appropriate system for managing and communicating MAREANO results now and in the future

### MARBUNN – A Database for Biological, Chemical and Geological Survey Data

The database Marbunn has been developed by IMR as part of MAREANO to manage information on all sampling stations, as well as quality-controlled measurement data from biological, geological and chemical samples.

Metadata on stations are automatically collected from the research ship's log system. This guarantees good quality of position and weather data. Other relevant information, such as details on the biological sampling, is recorded manually and

controlled after each survey. Additionally, results of the biological sampling are entered after the samples have been processed on land. These data are linked to the location data and can be retrieved along with the processed results.

The Marbunn database has been designed for storing the various kinds of data collected during surveys. The automatically logged location data can be linked to data from seabed videos, results of chemical sediment sampling (i.e. multi-core

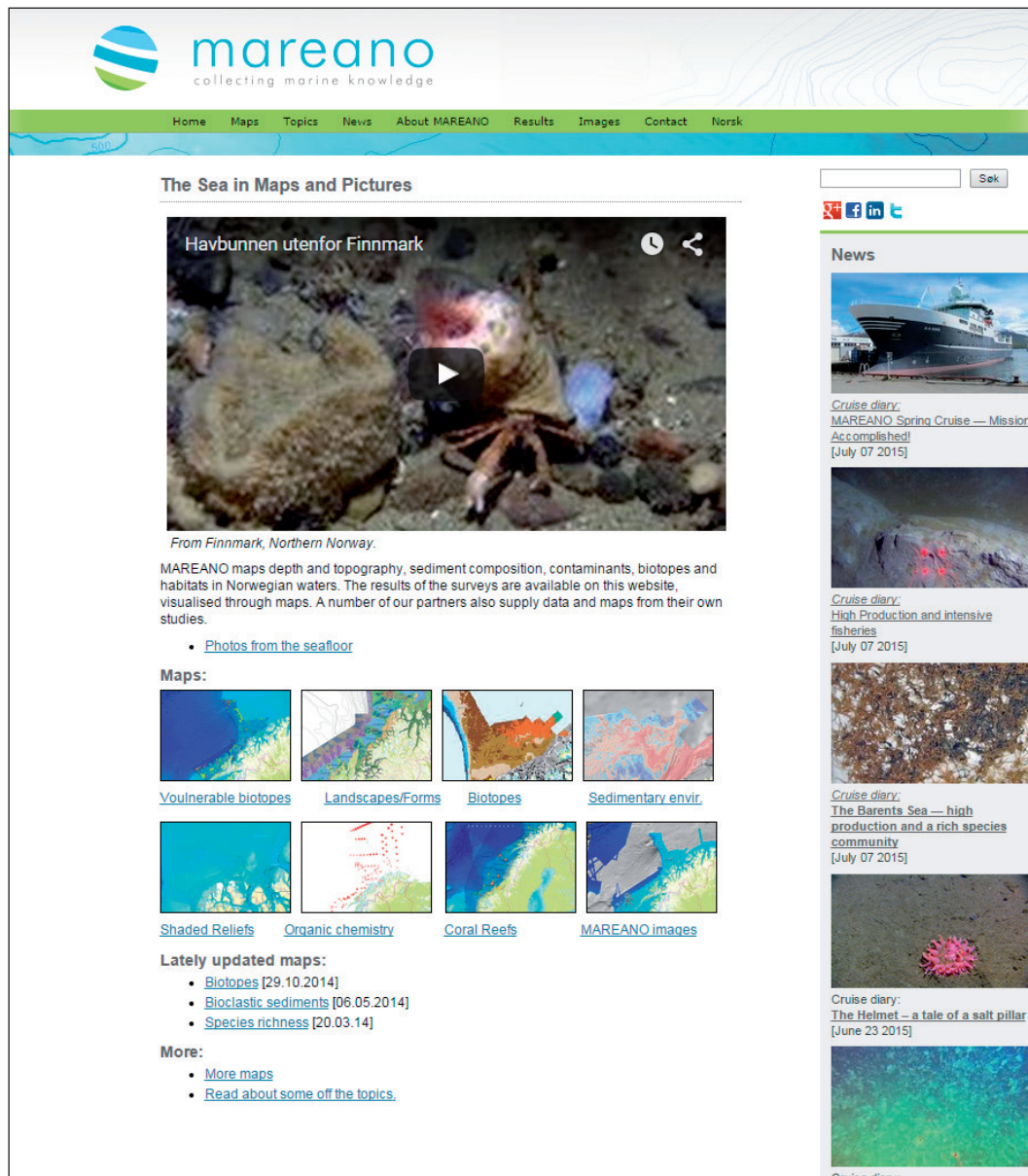
stations) and other data sets.

Marbunn has been used during MAREANO surveys since the beginning of the project. As the vessels do not always have connection to the Internet, a local copy of the database is used in the field. At the end of each survey, the field data are synchronised with the database on land, and the new data are quality-controlled. The lab crew record the results of their analyses in the quality-controlled database.



A box corer (left) samples sediment data and the RP sledge (center) collects data on benthic fauna. Cleaning of samples for benthic analysis (right).

Figure 1. [www.mareano.no](http://www.mareano.no) is the MAREANO website where news and results are communicated regularly.



## 12.2. DATA MANAGEMENT

“Data management” means to secure the collected data and make them available for use.

The data collection in MAREANO takes place on board ships at sea. When the information has been collected, it is sent to the agency responsible for its management. The NHS has the national management responsibility for depth data, IMR is responsible for biological and chemical samples and video, and NGU is responsible for geological and chemical samples. This responsibility includes processed

results and products, such as terrain models, and sediment and habitat maps.

A project specific approach to data management has not been developed for MAREANO. Instead, the data are included in the established handling processes of each agency. In other words, there is no MAREANO database containing all the data. The data are stored in various databases already used by the agencies, one example being Marbunn (see Basic Facts 1). This means that updated data sets are always stored at the agency responsible for their management.

Metadata are also stored in the agencies’ databases. This is information about the data life history: data source, sampling methods, sampling equipment, date, processing, quality, weather conditions during the sampling and other circumstances which may influence the data use. Metadata increases the value of the data, as it gives the user the opportunity to assess whether the available information is appropriate for its intended use.

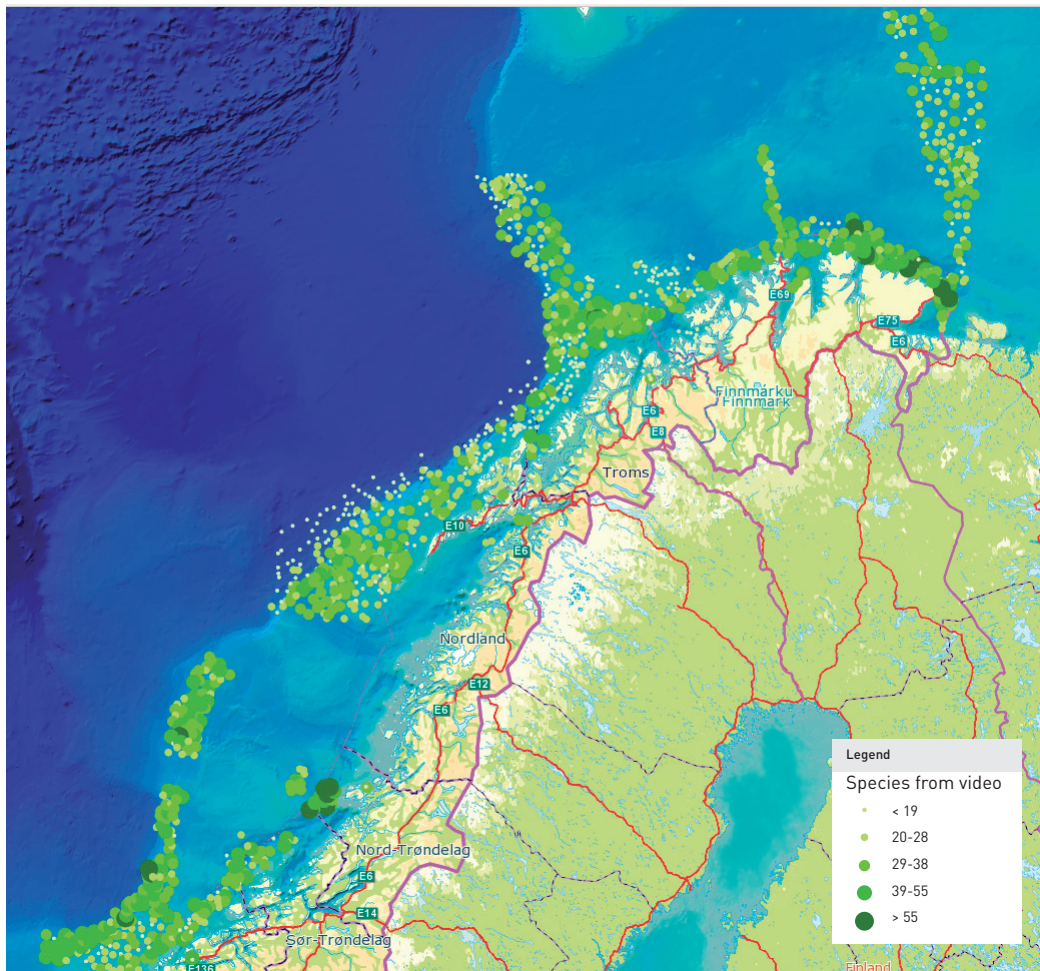


Figure 2. The map service on mareano.no has been used to make a map of large parts of the surveyed area. The map shows number of species observed by video, and in the background there is a blue coarse shaded relief of the seabed

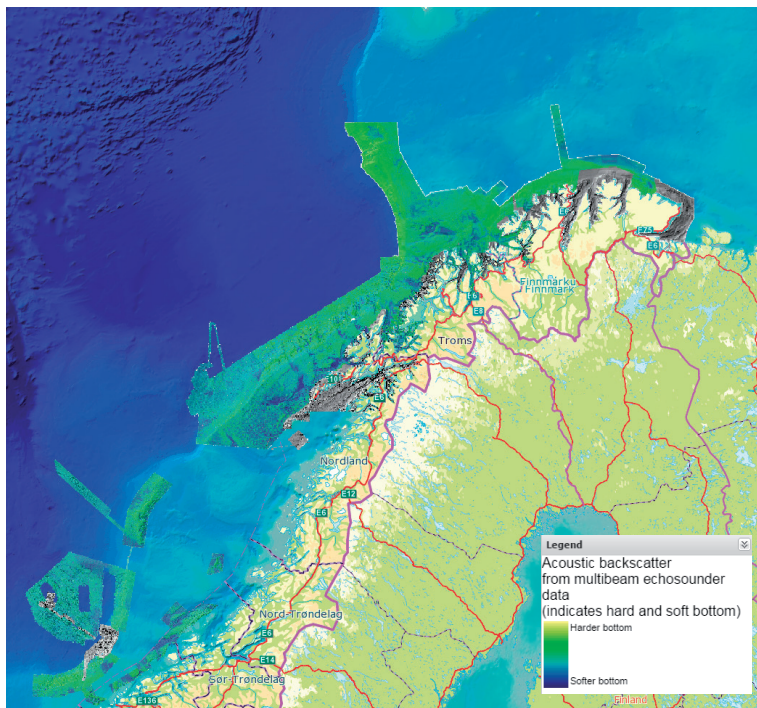


Figure 3. The map shows processed backscatter data from multibeam echosounder. The strength of the backscatter indicates the seabed hardness. In the background there is a blue coarse shaded relief of the seabed, and a grey more detailed shaded relief.

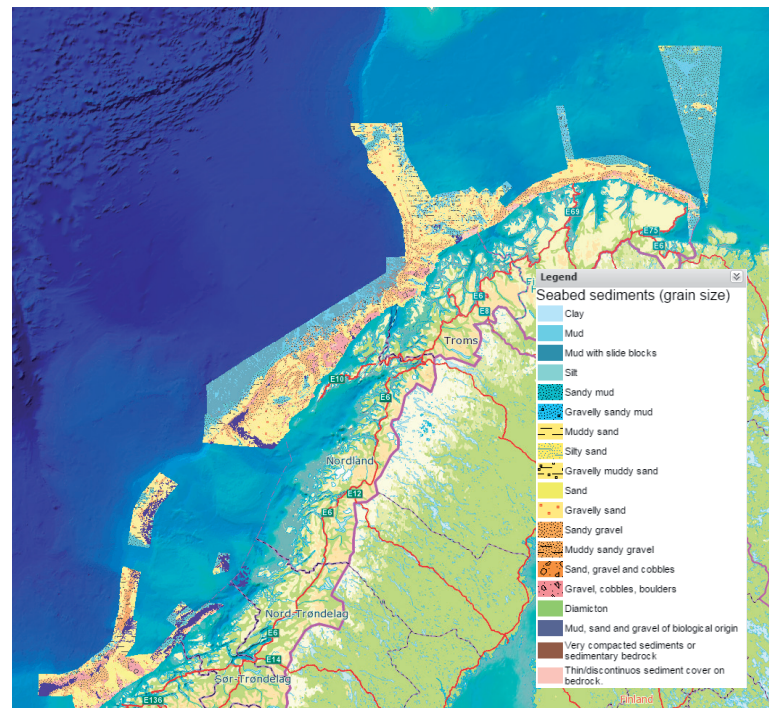


Figure 4. The map shows the distribution of sediments, classified after grain size. In the background there is a blue coarse shaded relief of the seabed.

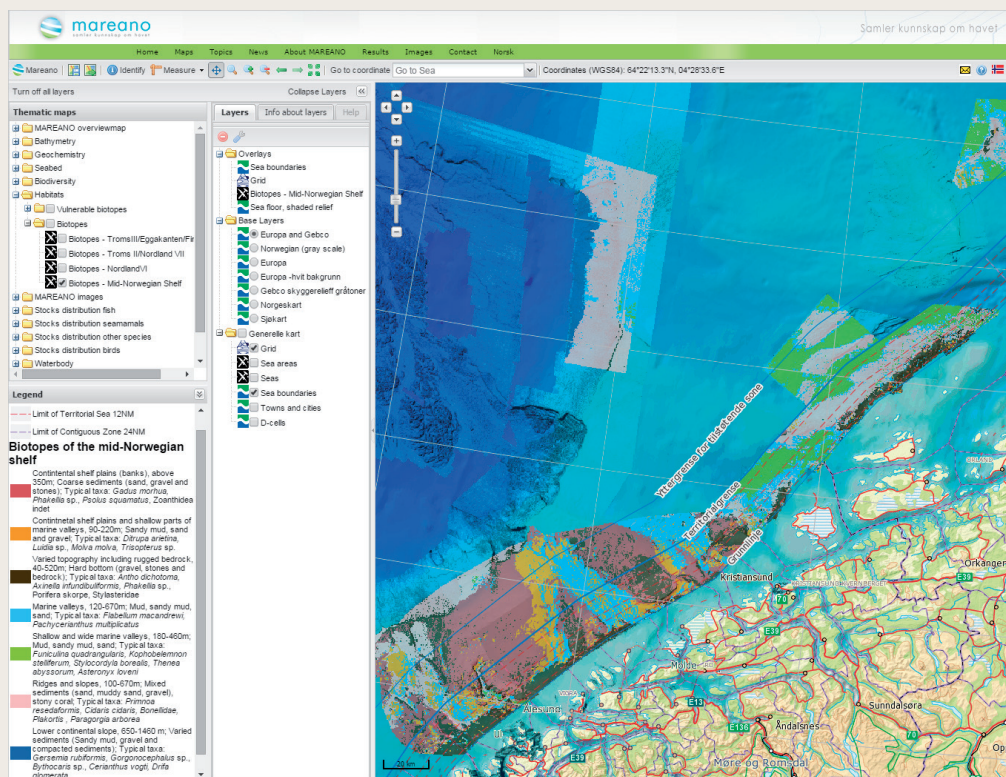
## Map service on mareano.no

Results from MAREANO are communicated through a map service on mareano.no where contributions from all MAREANO partners can be put together in interesting and informative maps.

The maps show anything from concentration of chemical substances and distribution of seabed sediments and benthic fauna, to overviews of the areas mapped by MAREANO. Additional data external to MAREANO have also been added, providing the opportunity to include map layers exceeding the MAREANO topics.

The example map to the right shows modeled biotopes of the mid-Norwegian shelf. The Norwegian maritime Boundaries as Baseline and Outer limit of Territorial Waters are plotted. In the background, there is a detailed land map and shaded relief of the seabed. The menus of the map service is on the top, and the different map layers and the legend is to the left of the map.

The map service has been developed and is managed by the Norwegian Marine Data Centre at IMR, based on existing software for map viewing online. The maps can be printed or downloaded as an image. All map layers are also available as Web Map Services (WMS), and the maps can be shown in different geographic information systems (GIS).



## Basic Facts 2

### 12.3. COMMUNICATION

New knowledge gained through MAREANO will only be of public benefit if it is used. Thus, the main principle of the MAREANO communication is to make knowledge available as soon as possible, after quality-control of the raw data, for use by the agencies' own researchers, colleagues nationally and internationally, the authorities and society at large.

The results of the MAREANO mapping are published regularly on the programme's website, mareano.no, where images, videos, thematic introductions, reports and news are made available to the decision-making authority, scientists and the general public. This is also where data from the MAREANO participants can be downloaded; and an online map service allows users to compose tailored maps (see Basic Facts 2). The users decide which map layers to include and which should be shown on top. The end result may be a map showing bathymetry (seabed topography), bottom hardness and number of species observed on video (see Figure 2).

The MAREANO mapping results are also distributed through a collaboration called Norway Digital and the web portal georange.no (see Basic Facts 3). In Norway Digital, a variety of government and private agencies have joined forces to provide access to updated

geographical information. Through this collaboration, MAREANO has gained access to data collected by other institutes for other purposes, and all these agencies have access to MAREANO data.

### Norway Digital – A National Geographical Infrastructure

- Norway Digital is a collaboration between more than 600 establishments that are either collecting and managing map data and other place-specific geographical information or are users of such information.
- This collaboration is a national infrastructure for geographical information, with the intention of providing access to a wide range of data and information for all end-users. The collaboration is coordinated by the Norwegian Mapping Authority.
- Georange.no is the national website for map data and other geographical, place-specific information in Norway. The website is the map service of Norway Digital, and includes a chart catalogue.
- The Norway Digital collaboration is based on Report no. 30 to the Storting (2002–2003), "Norway Digital – a Common Foundation for Added Value" and is part of the national IT strategy as described in the documents, "eNorway 2009" and Report no. 17 to the Storting (2006–2007), "An Information Society for All".

