JOINT NATURE CONSERVATION COMMITTEE

Marine Monitoring Handbook
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Edited by Jon Davies (senior editor), John Baxter, Martin Bradley, David Connor, Janet Khan, Eleanor Murray, William Sanderson, Caroline Turnbull and Malcolm Vincent

UK Marine SACs Project

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Procedural Guideline No. 2-2
Sediment profile imagery

Brendan O'Connor[1]

Background

Sediment Profile Imagery, or SPI, is an innovative and cost-efficient method of surveying and/or monitoring marine aquatic environments with a view to establishing the environmental status of these habitats or as part of a site inventory study. The traditional method of sediment sample collection and subsequent laboratory analysis is time-consuming and expensive and the time taken to return the data is slow.

SPI is based on single lens reflex (SLR) camera photography and computer-based image analysis which greatly accelerates the data acquisition. The camera system consists of a wedge-shaped prism with a plexiglas face plate; light is provided by an internal strobe (Figure 1). The back of the prism has a mirror mounted at a 45 degree angle to reflect the profile of the sediment-water interface up to the camera, which is mounted horizontally on the top of the prism. The prism is filled with distilled water, and because the object to be photographed is directly against the face plate, turbidity of the ambient seawater is never a limiting factor.

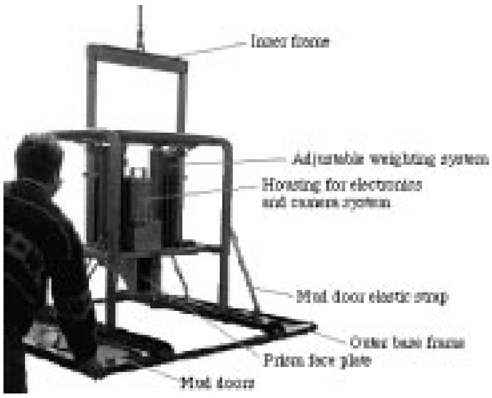

Figure 1 A remote operated SPI system

The camera prism is mounted on an assembly that can be moved up and down by producing tension or slack on the winch wire. As the camera is lowered, tension on the winch wire keeps the prism in the 'up' position until the support frame hits the bottom. At this point the tension on the winch wire is reduced causing the inner frame to move to the 'down' position, penetrating the undisturbed sediment water interface. The upper 25cm of the seafloor, as seen in profile, is then photographed in high resolution with a film camera. To this basic system, it is possible to add an additional camera which also photographs the sediment surface before the prism penetrates the sediment.

After each image is taken, the camera is raised two or three metres off the bottom and redeployed for taking another image ('sample'). Typically, a number of replicate images are taken at each station within a period of about five minutes. An array of other measurement devices may also be attached to the frame to efficiently obtain information about water column properties (e.g. salinity, temperature, oxygen).

Purpose

- to identify different seabed types and redox status (in relation to organic enrichment gradients)
- to identify sediment type and bed forms
- to identify habitat quality (in relation to physical disturbance and deoxygention)

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1 Aqua-Fact International Services Limited, 12 Kilkerrin Park, Liosbaun Road, Galway, Ireland.

Advantages

- rapid deployment whether by diver or boat
- permanent images of the sea bed profile
- no physical sample analysis required
- turn-around to report very rapid

Disadvantages

- only works on mud or muddy sand sediments without subsurface obstructions
- samples not available for identification of fauna or sediment particle size (ground truthing or quantitative analysis)
- sediment may smear on faceplate and make interpretation difficult
- equipment may flood

Logistics

Equipment required

Sediment profile camera: This can be diver held or remotely operated on a frame lowered from a boat. Ideally, the surface of the sediment should also be photographed using a separate camera (by the diver) or a camera mounted on the remotely-operated frame before it touches the seabed.
Survey vessel: A vessel with lifting equipment is required, preferably an A-frame at the stern, with suitable winch gear.

Personnel

- full diving team if diver operated
- appropriate boat and crew

Method

Survey brief

Deploy the SPI camera to penetrate the sediment, ideally to a minimum of two-thirds the height of the face plate but not above the top of the face plate (Figure 2). Take three separate (replicate) images at the required stations (stations along a transect, locations in an area). If over- or under-penetration is noted from the first deployment, the weights should be adjusted accordingly.

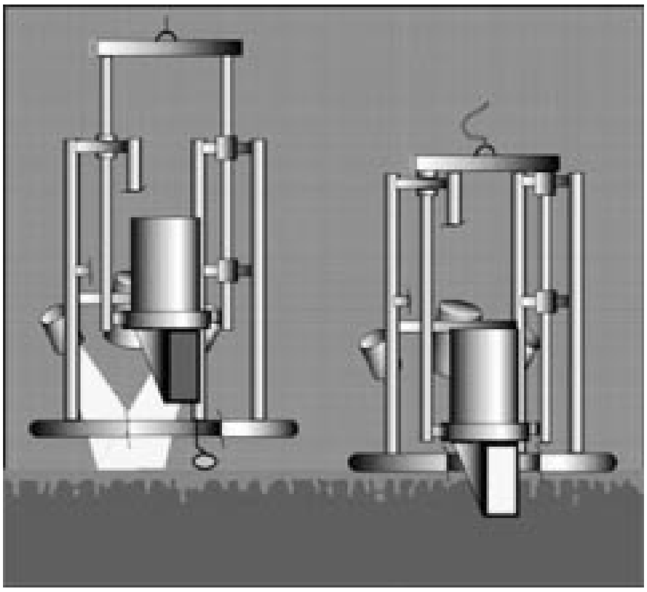

Figure 2 Drawing of SPI. *Left*: a lead first hits the bottom and triggers a camera which takes a photo of the undisturbed sediment surface. *Right*: the prism penetrates the sediment and a profile image of the sediment is being taken.[2]

Field

Usually three penetrations are used per sample station to obtain a mean depth for the redox discontinuity layer. This also makes it possible to obtain information on heterogeneity so that simple statistics can be performed (mean and standard deviation for depth of penetration, number of gas vesicles present, mean redox discontinuity depth).

Laboratory

SPI technology can readily quantify over 20 physical, chemical and biological parameters, including: sediment grain size; prism penetration; surface pelletal layer; sediment surface relief; mud clasts; redox area; redox contrast; current apparent redox boundary; relict redox boundaries; methane gas vesicles; apparent faunal dominants; voids; burrows; surface features (e.g. worm tubes, epifauna, shell); dredged material; microbial aggregations; and successional stage.

2 Image and caption taken from **http://www.marecol.gu.se/projengl/hansnilssonpen.html** – Hans Nilsson, Gothenburg University.

Data analysis

Figure 3 In this image there is a high abundance of burrowing marine worms, most likely Capitellid Polychaetes like *Capitella capitata or Malacoceros fuliginosus*. These opportunistic worms thrive in high organic loading conditions and their burrowing action can often reintroduce oxygen into depleted sediments.

Photographs are analysed to extract the depth of penetration, redox discontinuity level and voids (number and size of vesicles, presence and absences). Improved interpretation of photographs can be obtained by using computerised image analysis (digitisation and enhancement). The exact analyses will depend on the type of information required. More detailed descriptions are presented at **http://www.aquafact.ie/SPI2.html** and **http://www.courses.vcu.edu/ENG-esh/diaz/diaz_services.htm**.

Accuracy

Depends on number of replicates, qualitative assessment to phi value possible. Species identification, however, is very limited.

Time required

Field

About 30 stations a day from a boat. A diver could sample 10 stations with 3 images at each, along a transect.

Laboratory

Each enhanced image takes approximately 5 minutes to analyse.

Health and safety

All appropriate requirements for diving or boat-based remote sampling. No additional safety requirements are necessary.

References/further reading

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Address for further information

Aqua-Fact International Services Limited, 12 Kilkerrin Park, Liosbaun Road, Galway, Ireland. Tel: +353 91 756812/756813; Fax: +353 91 756888; e-mail: **aquafact@iol.ie**

For a description of the equipment and its deployment, see **http://www.courses.vcu.edu/ENG-esh/diaz/diaz_services.htm**