
3 Spatial sampling: Capturing fish distribution and habitat usage data at multiple scales

Sampling Plan, Remark Group of Islands, Recherche Archipelago for March-April 2006

This segment describes a method for improving sampling of fish distributions and habitat usage. This segment describes a plan for secondary sampling, based on:

1. Analysis of data from a preliminary field sampling dataset
2. The capture of sites across a range of depths and habitats
3. The concentration of sites to test for spatial dependence in fish distributions.

Purpose of the resurvey:

In order to further investigate the species environment relationship, underwater video sampling of fish distribution and habitat usage using baited underwater video systems (BUVs) will be conducted across the depth gradient present at the Remark group of islands in the Recherche Archipelago. The major considerations for planning are to ensure the best possible dataset for fish distribution across all representative habitats and depths, while accommodating field logistical issues (e.g. number of drops, location and ease of access due to weather conditions). All available georeferenced datasets were used to optimize the design in terms of (1) characterizing the full extent of the study area, (2) capturing the range of habitats and depth combinations present, and (3) ensuring adequate sampling across different spatial scales to allow investigation of spatial patterns of fish distributions in the region.

Available datasets used for design:

- *Fish surveys*
 - o *transects (Oct. 200) &*
 - o *baited video surveys(June 2002)*
- *Video surveys*
 - o *Drop video (April-May 2002)*
 - o *Towed video (Oct. 2002, May & Oct. 2003)*
- *Broad spatial scale benthic habitat map (collated June 2004)*
- *Side scan tracks and mosaics (Oct. 2002, May & Oct. 2003)*
 - o *Esperance Bay region,*
 - o *Duke of Orleans Bay region &*
 - o *Cape Arid region*
- *Bathymetry grid (100 m)*
- *Wave modeling (from 2002)*
 - o *Significant wave height grid*
 - o *Benthic shear stress grid*

Design:

A fish sampling program carried out as part of the Fisheries Research and Development Corporation funded project, "Characterising the fish habitats of the Recherche Archipelago", investigated the spatial distribution of demersal fish in the temperate coastal waters of the Recherche Archipelago at regional scales of 50 to 100 km separation. However, as a fixed number of samples were spread out over a larger spatial extent, there was no measure of heterogeneity of substrate across the region nor was there any indication of the spatial pattern of the assemblages within any one location. By concentrating on a smaller geographic extent with more sampling within a location, a clearer picture of the spatial patterns of fish assemblages may have been seen. A more concentrated sampling effort would have also provided a measure of any spatial autocorrelation that is present in the system, and this should be considered in any further studies.

The next sampling effort planned for March/April 2006 will concentrate on Esperance Bay, and specifically the Remark Island Group. The reasons to focus on this area include the availability of additional environmental information (including wave height and shear stress) and the strong bathymetric gradient that exists, extending to the south-west (see Figure 12).

The sidescan sonar data allows the distinction between boundaries in substrate type (Figure 13) and will be used to assist in determining the location of the BUVs to ensure greater sampling coverage of heterogeneous substrate areas with less coverage of homogeneous areas. The existing broad scale benthic habitat map will also assist in choosing locations for the BUVs to allow for good representation across all known habitats.

Analysis of the initial data using predictive modelling has provided a new insight into the environmental variables that drive the observed patterns of distribution and have identified the need to collect data from across the entire known depth range of the species of interest. Consequently, it is desirable that more sampling be carried out to the south-west of the Remark Group in order to collect data from a greater depth range and allow analysis of the distribution of species not investigated to date because of the lack of data.

The basic principles behind the sample layout will be to get fairly regular, unbiased coverage of the study area, to gather habitat usage information over a variety of spatial scales in multiple directions, particularly those with the most frequent (spatial) changes in habitat, and to collect footage in areas of interest identified from the sidescan mosaic maps (e.g. boundaries and unique features).

Addressing Sampling Design Objectives

(1) Characterizing the full extent of the study area

The main factor limiting the extent of the sampling protocol will be the number of BUVs drops that can be carried out. Considering the cost of boat time, video tapes for the stereo

units and the available weather window for the area, it has been planned that allowing a schedule of 2 to 3 weeks should provide a total of 10-12 days actual boat time. Based on previous sampling efforts, 30 camera drops a day is practical and thus it is aimed to collect 300 samples for this new study.

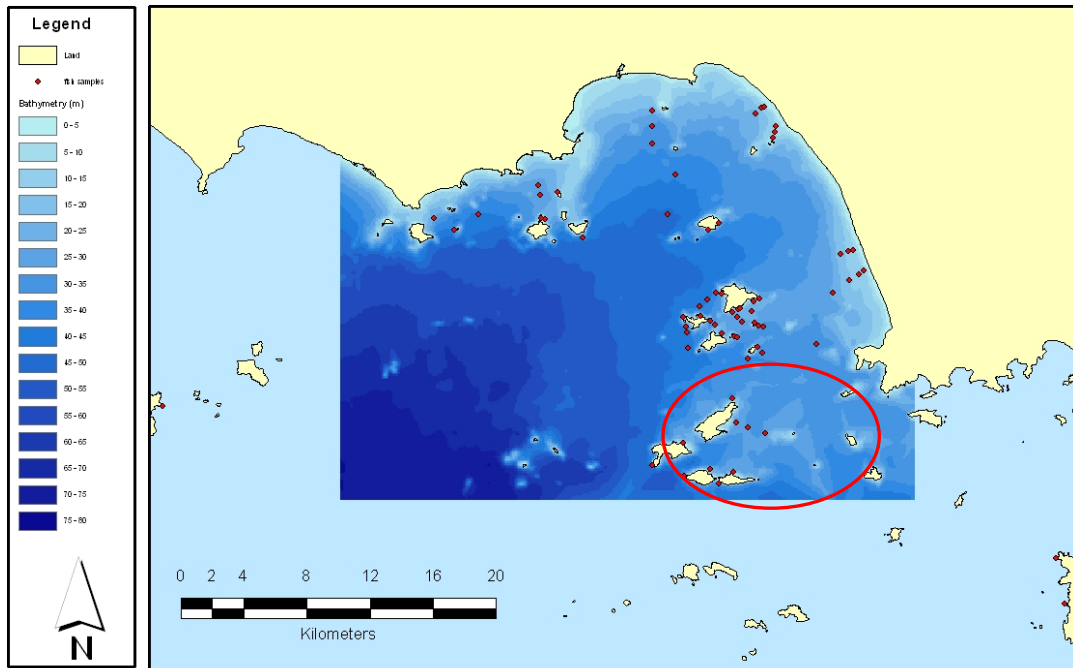
The shape of the study area (Figure 14) is based on following the bathymetry gradient and the sidescan sonar coverage. The irregular shape has been adopted to ensure that all sampling is conducted within the extent of the data sets for wave height and shear stress so that these variables can be included in all analysis for the collected data. This covers an area of approximately 45 km² which must be sampled.

(2) Capturing the range of habitats present

The large change in bathymetry extending south-west from the coast is considered the major environmental factor likely to influence seafloor habitat characteristics and, to a large degree will also be controlling the distribution of fish. As a result, the sampling area is laid out to cover this depth gradient and the sampling points will be distributed through this area at varying distances apart (the actual spread of sampling points will be determined following further analysis of the sidescan mosaics). Ideally, the sidescan mosaics and benthic habitat maps would be used to ensure sampling effort is proportionately allocated to provide information about all substrate and depth classes. However, the current maps for the area can only be used as a base from which to start and cannot be relied upon solely to divide up the sampling effort across the study area.

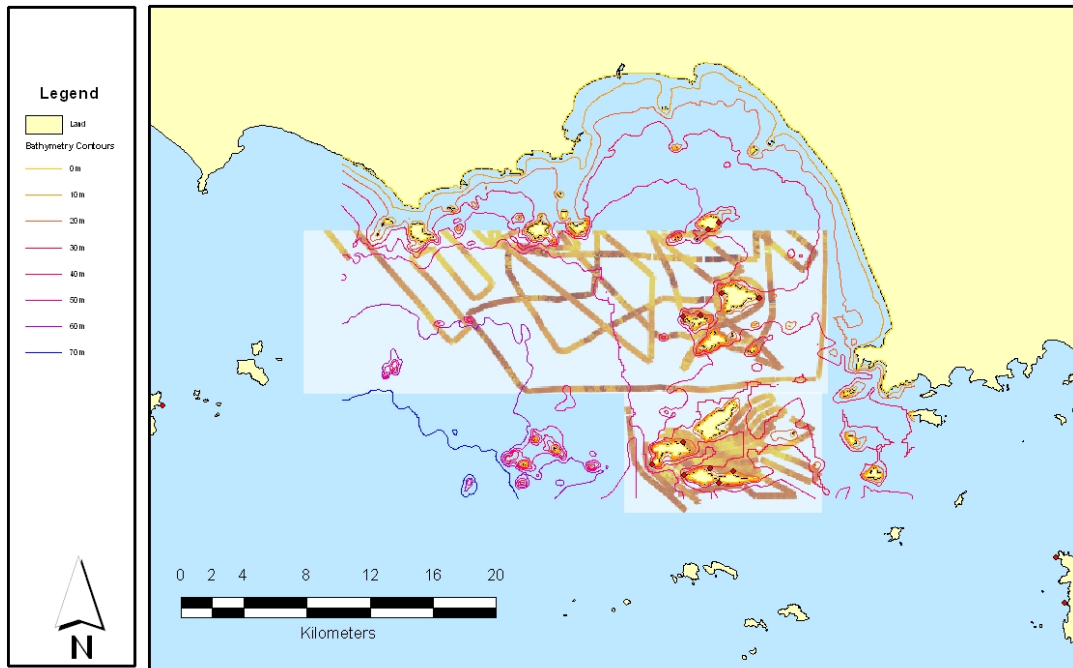
(3) Minimizing the effort required for data collection

While it is aimed to have 300 data points across the study area, all sampling points will be prioritized to ensure coverage of the study area is still achieved in the event of weather or equipment problems. The main priority is to collect data across the entire sampling area and then at increasingly finer spatial scales as time and weather permits. The exact position of the sampling points will be determined following final examination of the sidescan mosaics and after completion of the first stage of data analysis.



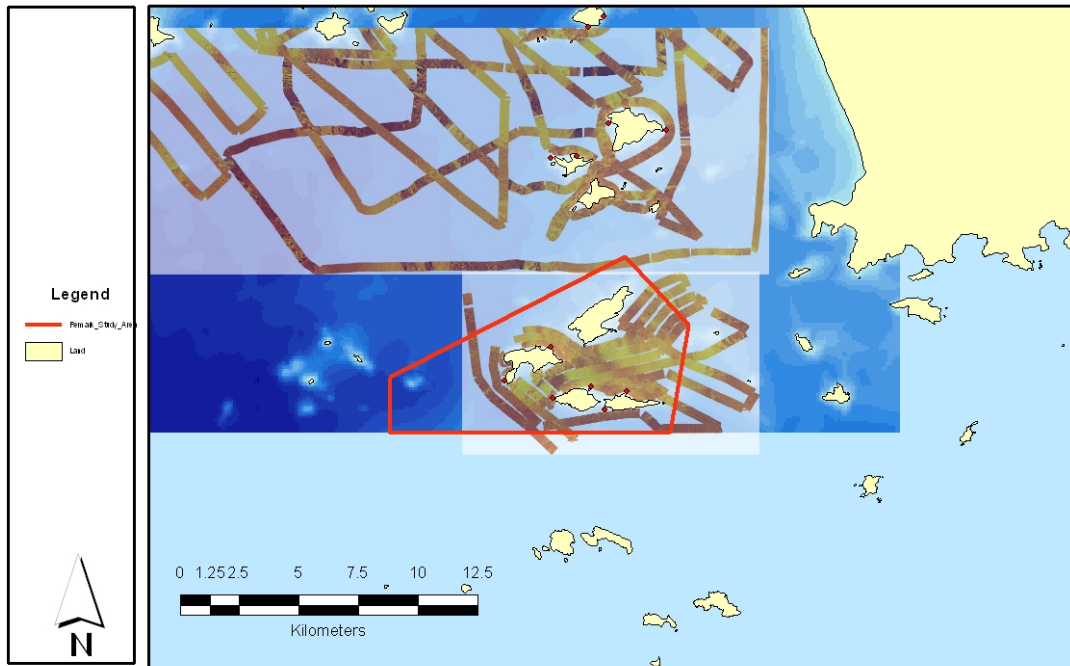
Map showing the bathymetry gradient for Esperance Bay and the locations where fish distributions have already been sampled

Figure 3-1 Map of Esperance Bay showing the Remark island group (circled in red), the strong bathymetry gradient extending to the south-west and the locations of sampling points from previous surveys.



Map showing the existing sidescan coverage for Esperance Bay and the bathymetry contours over the area

Figure 3-2 Map of Esperance Bay showing the existing coverage of sidescan sonar for the Remark Group of islands and also the bathymetry contours for the area



Map showing the proposed study area (red boundary) for sampling the distribution and habitat use of fish in the Remark Group of islands in Esperance Bay

Figure 3-3. Map of the proposed study area (in red) for the Remark Group of islands in Esperance Bay following the bathymetry gradient and sidescan sonar coverage.