

PAEWG-01-13

First Meeting of the Protected Areas and Ecosystems Working Group (PAEWG1)

18-19 March 2019

A proposal of methodological approach to complement the SIOFA's
Benthic Protected Areas Designation Protocol

Relates to agenda item: 6.1 Protected Areas and Ecosystems Working Group

(PAEWG 3.4 Protected area protocols)

Working paper Info paper

Delegations of France (Territoires) and Australia

Abstract

This document is a draft to be discussed and amended within the PAEWG, and finalized during the PAEWG 2019 physical meeting. This concept note describes a method that may complement the existing BPA designation protocol. The method consists in analyzing, over a standardized grid, physical and biological parameters of the whole study area. BPA proposals may be evaluated measuring the matching between the network of proposals and the parameters which can be considered separately as conservation issues

Recommendations *(working papers only)*

This document is to be discussed within the PAEWG-01 and during the PAEWG-01 physical meeting.

Introduction

This document describes a method to design a network of Benthic Protected Areas in the SIOFA perimeter. This approach needs to be discussed further and as an addition to the existing designation protocol (REF).

The SIOFA Scientific Committee adopted a BPA designation protocol in 2018 (REF). This [designation protocol] was used by the Scientific Committee to evaluate the Benthic Protected Areas proposals presented in 2018 (REF). This protocol is based on the evaluation of the matching between each proposal of area to be protected and a list of conservation issues and criteria XX. These criteria include XX. According to this protocol, proposals are evaluated separately.

The method presented here constitutes an addition to the existing designation protocol and is based on the concept of network of sites. This method will help evaluate each BPA (1) within the global context of the Southern Indian Ocean and (2) within the context of the existing protected areas.

The proposed method consists in analyzing, over a standardized grid, physical and biological parameters of the whole study area. A series of statistics is derived for each cell in the grid. Cells are then clusterised according to their underlying statistics, and sub-regions are identified. BPA may be projected onto the grid and evaluated by (1) measuring the representation of the sub-regions within the network of proposed and existing BPAs and by (2) measuring the matching between the network of proposals and the parameters which can be considered separately as conservation issues (e.g. connectivity of seamounts, representativity of upperslope bathomes...).

In the following section, we present this method and provide elements to be discussed during the meeting.

2. Schematic description of the method

2.1 Defining the statistical space for the analysis

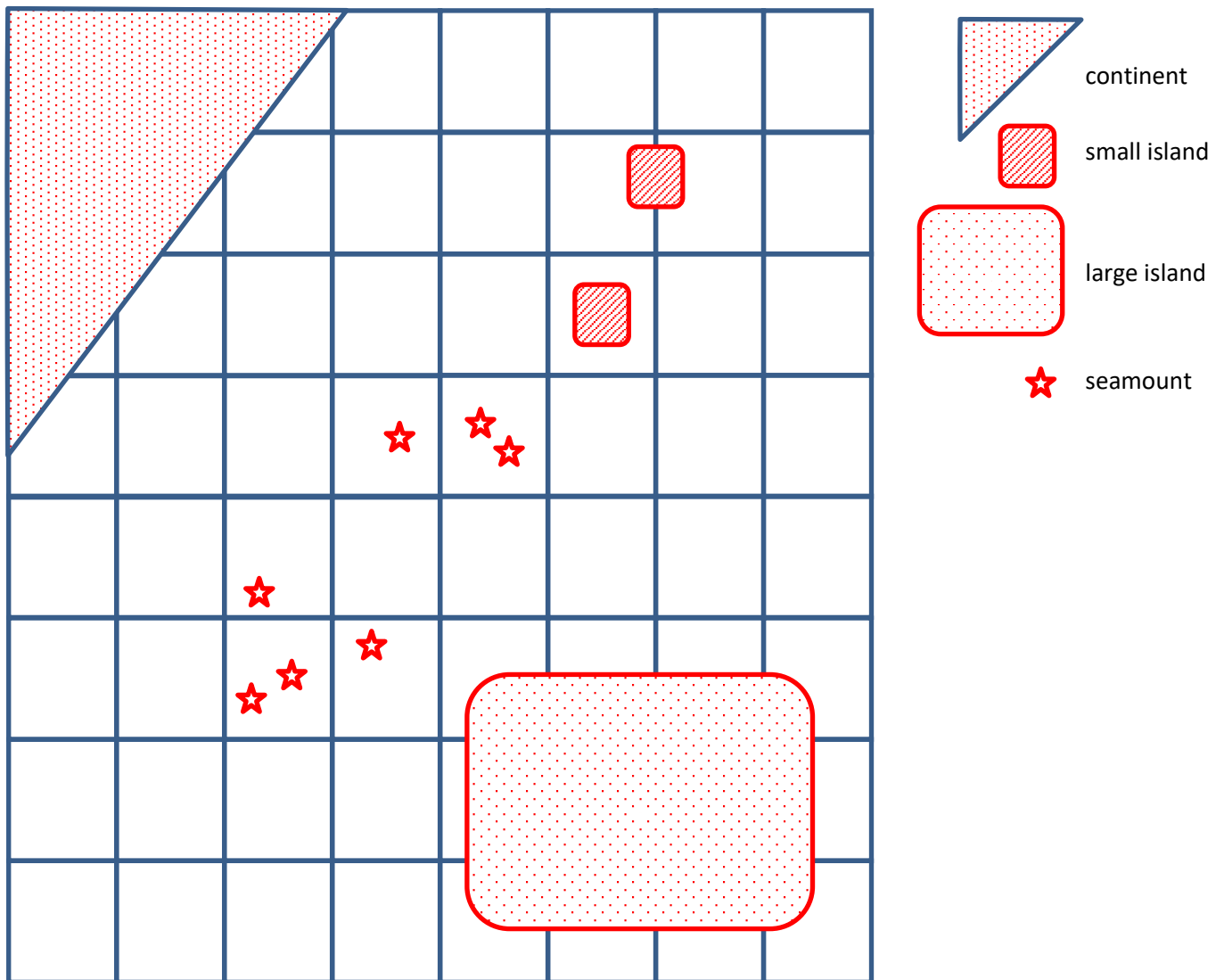


Figure 1: The first step is to define the geographical scale of the layers used to perform the analysis. Statistical grid can be defined for example into a series of squares of one degree. Spatial elements, such as continental coasts, islands and seamounts, can be mapped. GIS software, such as the free and open QGIS environment, can be used:

<https://www.qgis.org/>

2.2 Physico-chemical factors: the example of chlorophyll

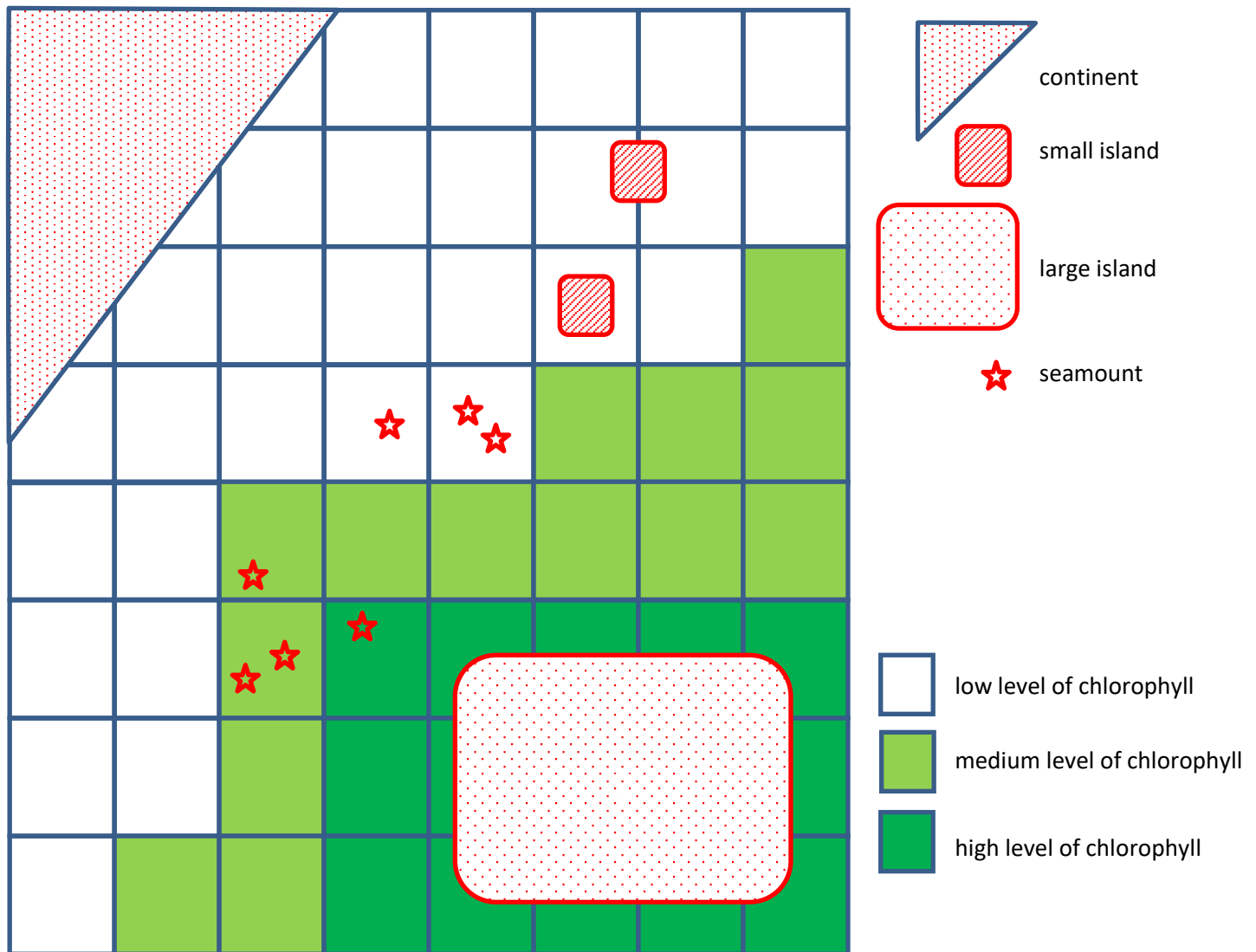


Figure 2: The second step is to build the environmental layers. Some layers are publicly available and can be downloaded from various international portals, such as the Bio-ORACLE project: <http://www.bio-oracle.org/>.

Here, chlorophyll concentration derived from satellite imagery can be considered as a proxy of the benthic ecosystems productivity. In our theoretical example, contrasts in chlorophyll concentration suggest the presence of three regions of low, medium and high level of productivity. Only one seamount is located within an area with high level of productivity.

2.3 Physico-chemical factors: the example of temperature

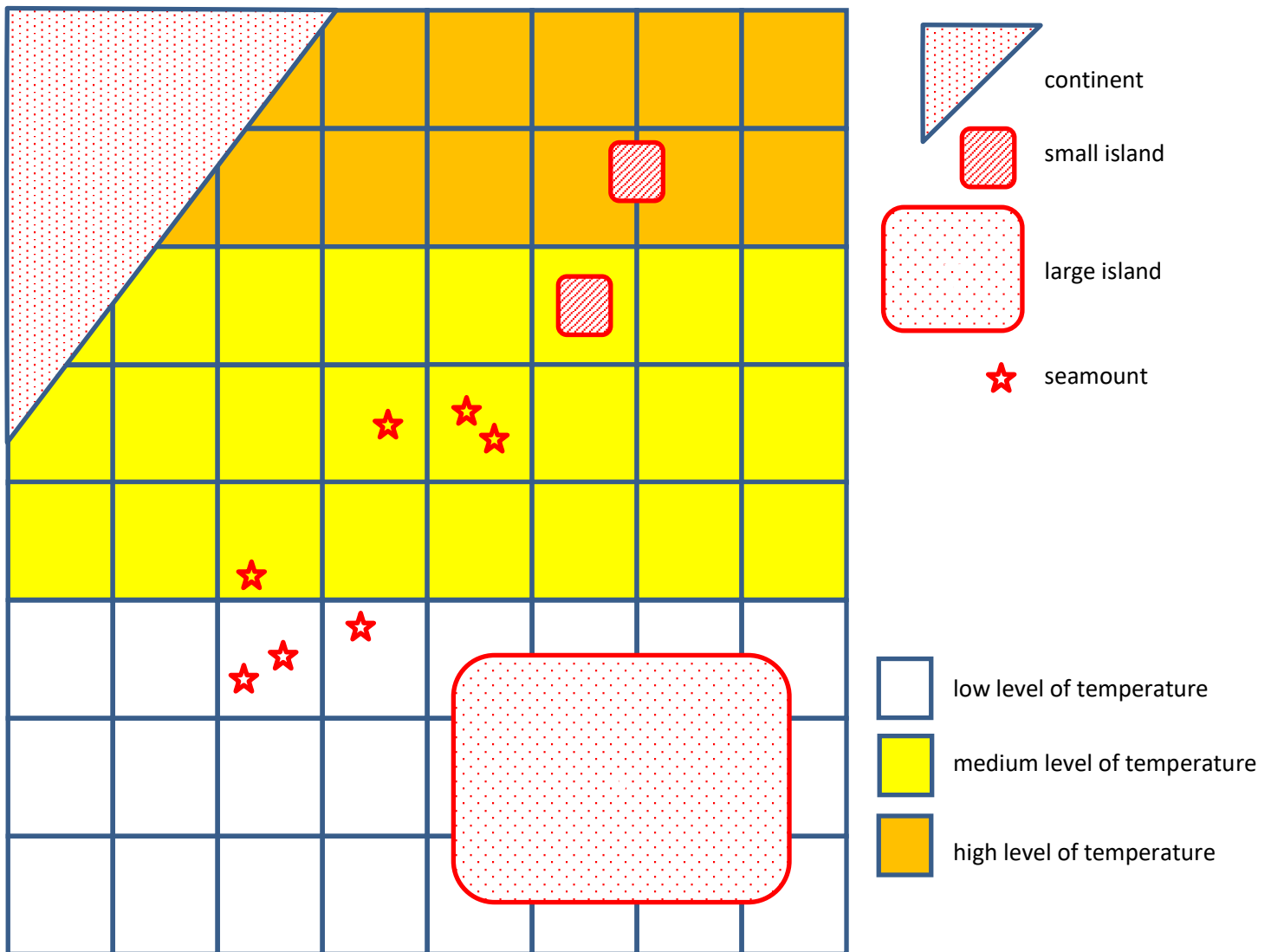


Figure 3: Here, sea surface temperature (SST) can be considered both as a proxy of climate and as an environmental factor influencing the benthic ecosystems functioning. Three regions with a latitudinal gradient of SST are highlighted. Any seamount is located in the warmer region.

2.4 Level of knowledge and anthropic data: the example of biological sampling

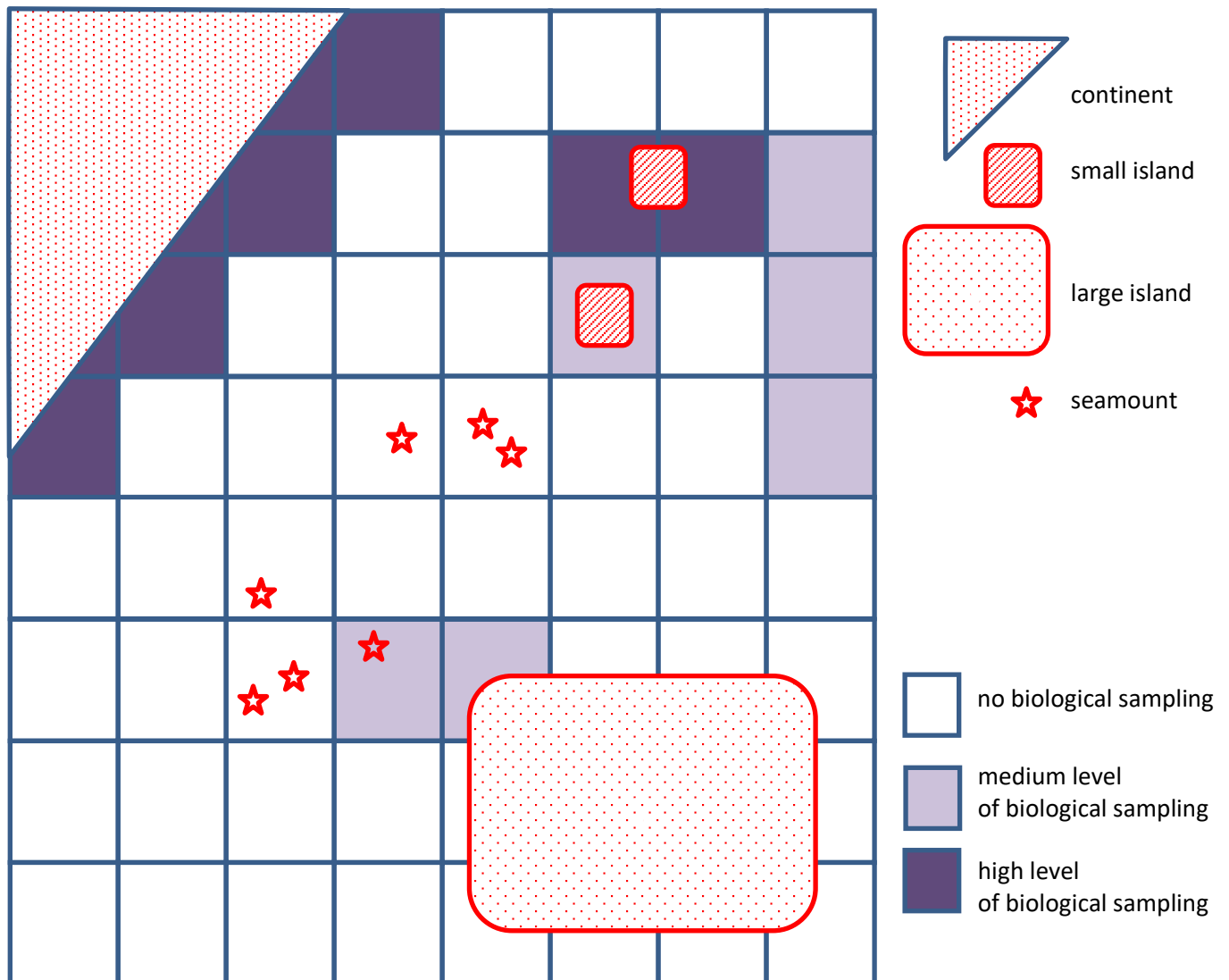


Figure 4: Level of knowledge and anthropic data can be summarized in each cell of the grid. Fishing activity can be included in these layers. Here, we present the level of biological sampling as a proxy of the knowledge level about the benthic biodiversity. This data can be obtained from the scientific survey reports or open biodiversity databases such as the GBIF project: <https://www.gbif.org/>.

In our theoretical example, biological sampling is important along continental coasts and around a lone small island located at the north of the study area. The seamounts are data-poor areas, with only one seamount including biological sampling.

2.5 Spatial data: the example of distance matrices

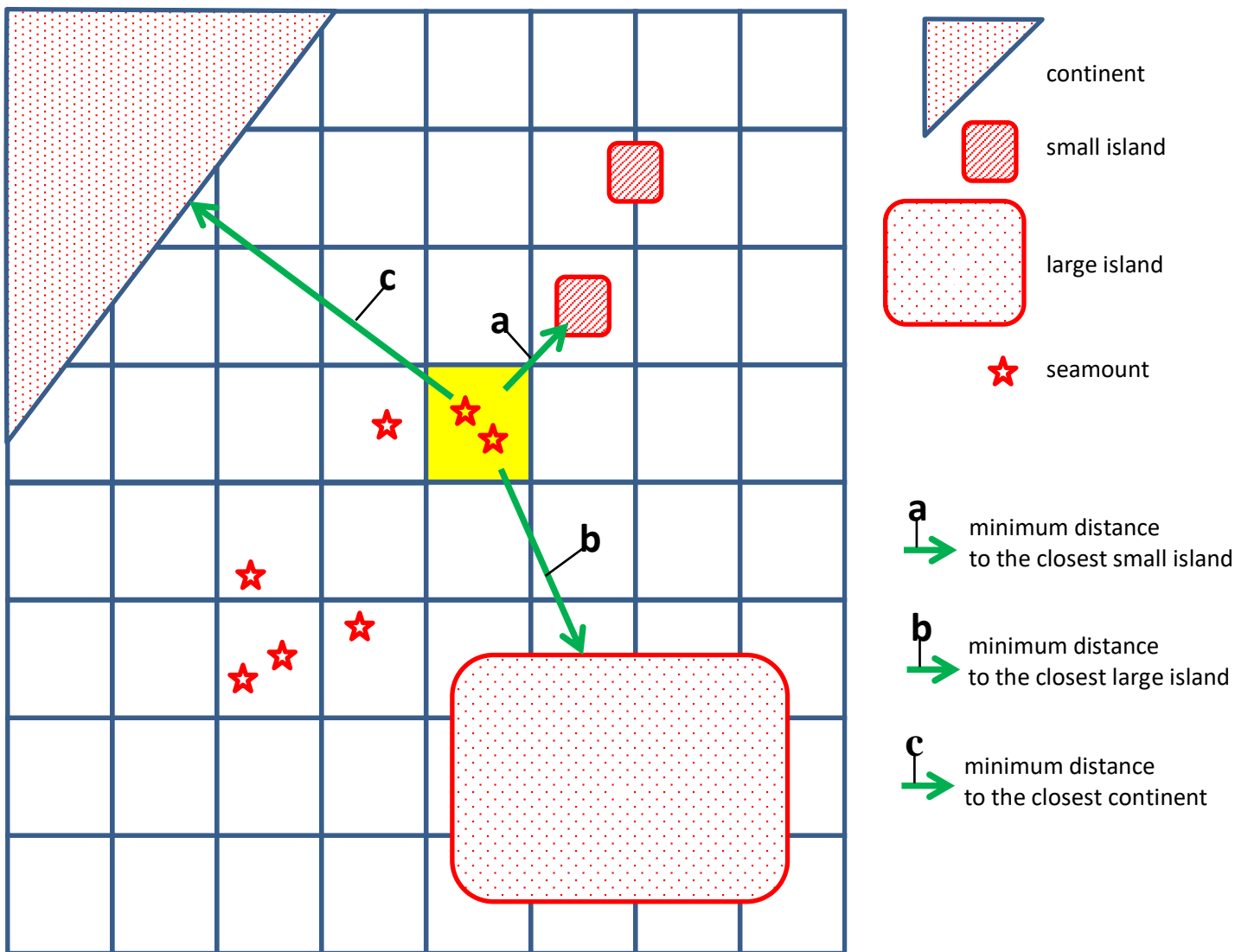


Figure 5: The next step is to summarize spatial data into statistics. Here, we compute distance matrices to obtain three statistics for each of the grid cells. The minimum distance to the closest small island, large island and continent can be considered as a proxy of connectivity with the coasts and coastlines.

2.6 Spatial data: the example of seamounts connectivity

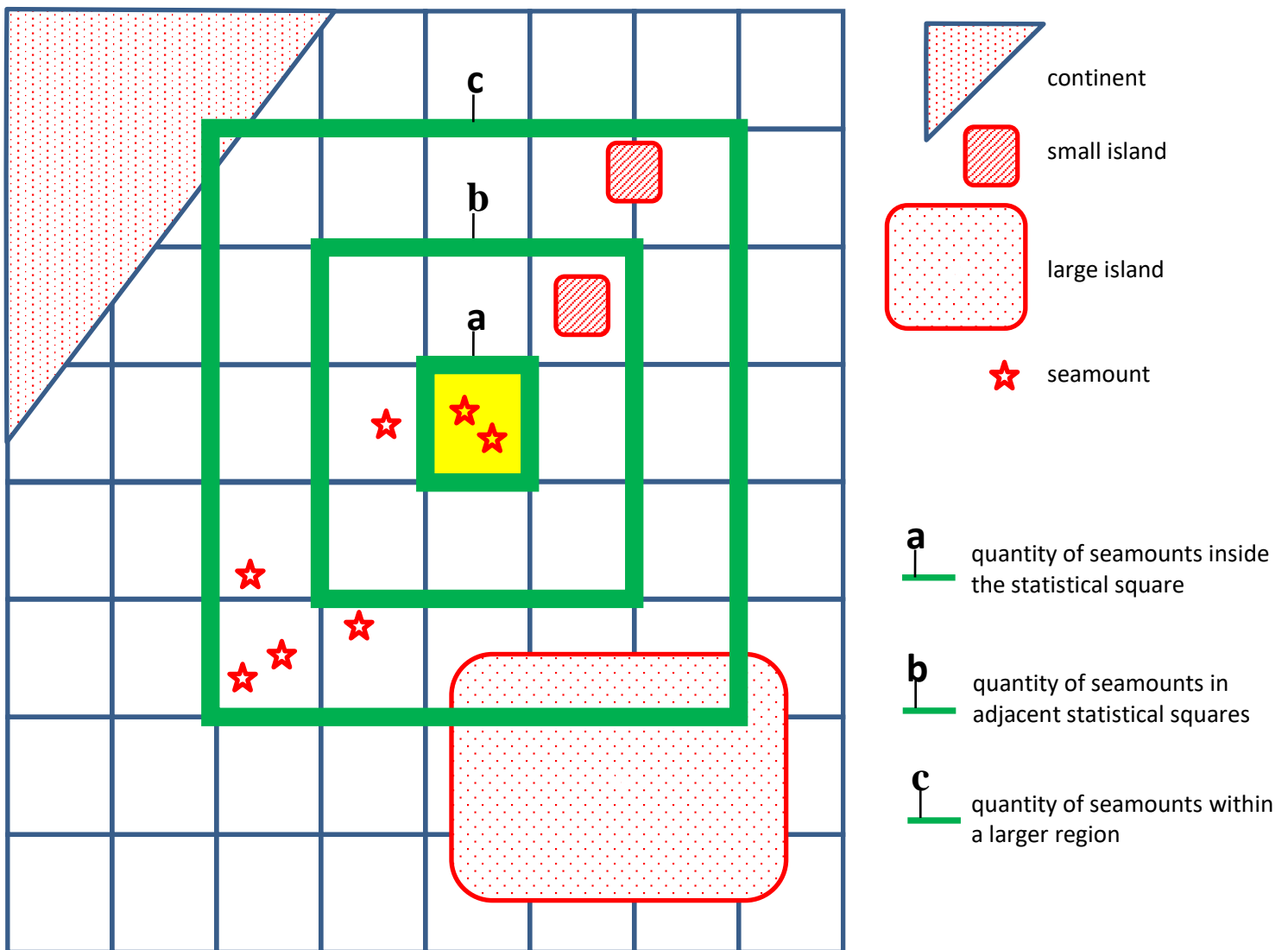


Figure 6: Here, we consider the connectivity network of the seamounts. For each grid cell, we compute the number of seamounts located within each given cell, and within adjacent regions at various geographical scales. This highlights the contribution of each cell to the connectivity of seamounts, at local and regional scales.

2.7 Spatial data: the example of bathymetry

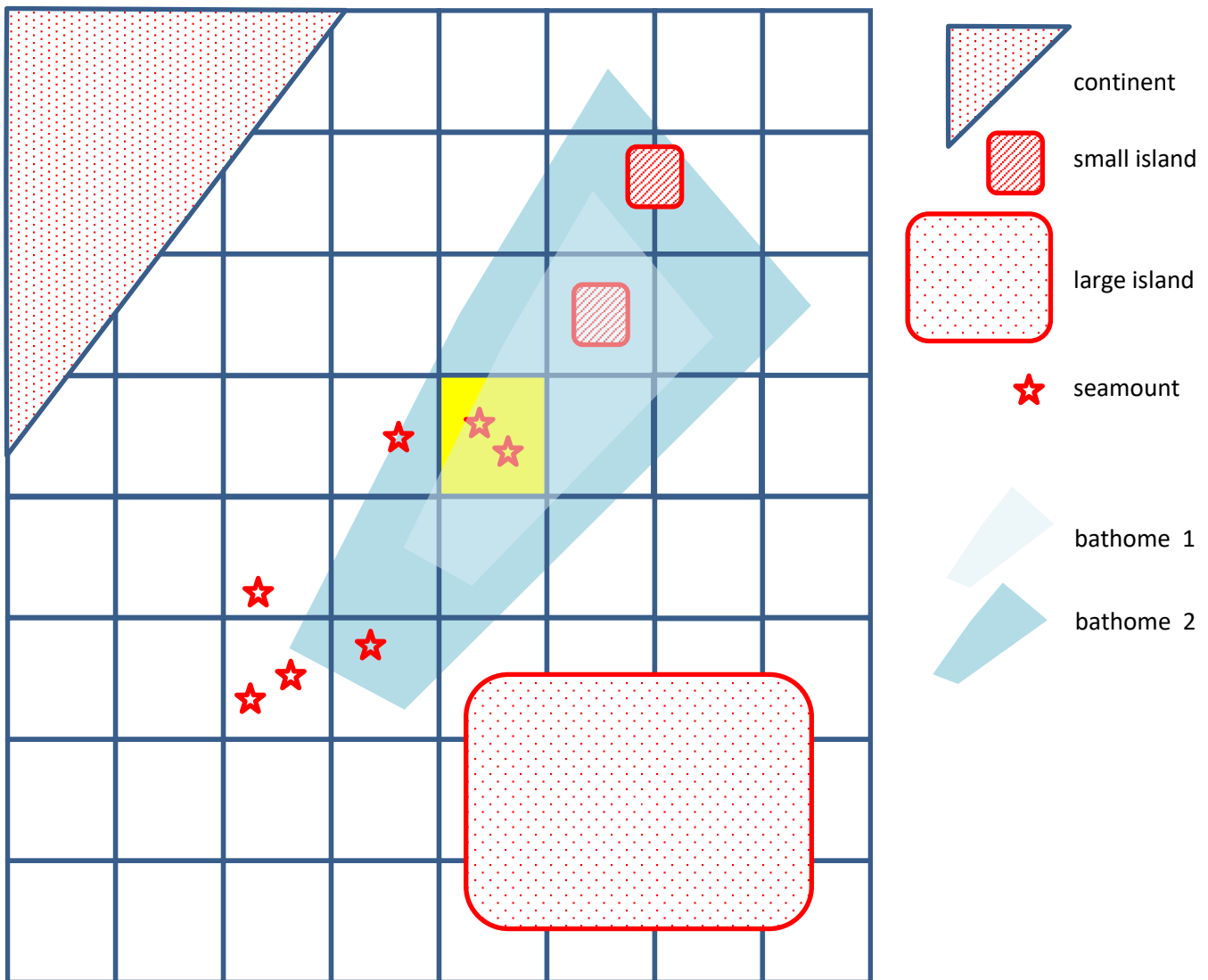


Figure 7: Here, we consider the representativity of the bathomes. Bathymetry of the study area is summarized into statistical squares. For each square, we can compute the percentage of each bathome, as it has been processed by the Scientific Delegations of the parties in 2018 for the Benthic Fishing Impact Assessment. Conservation issues such as the representativity of upperslope bathomes can be considered with this method.

The free and open General Bathymetric Chart of the Oceans can be used to build the appropriate layers:
<https://www.gebco.net/>

2.8 Clustering the data: the example of ecological regions

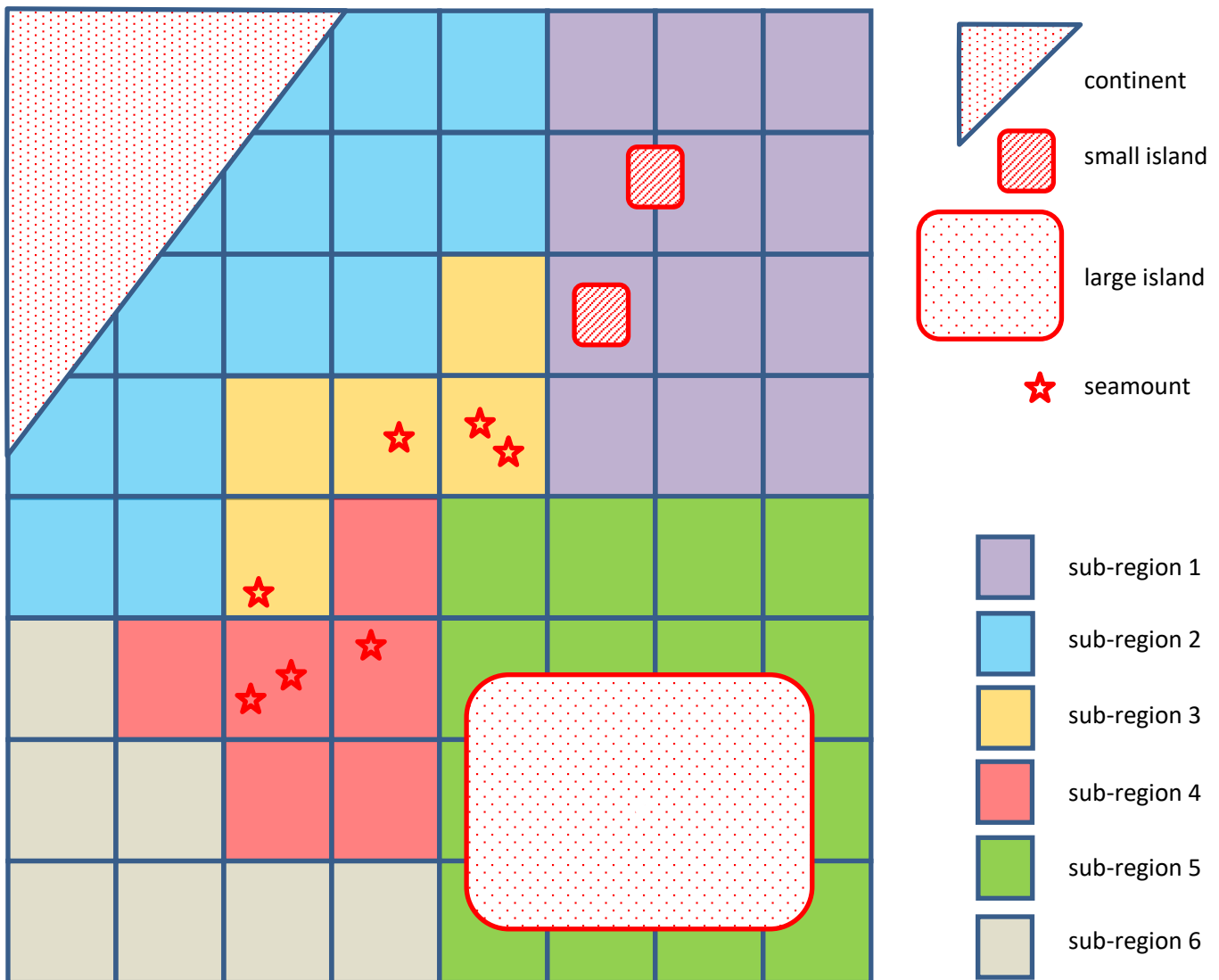


Figure 8: The next step of the analysis is to highlight sub-regions using clustering methods. Clustering is applied to the selected statistical layers. Clustering allows to group the statistical squares. Clustering is computed to obtain groups which:

- minimize the variation of the selected statistics between the squares of each group,
- maximize the differences of the selected statistics between the groups.

Groups can be considered as a proxy of real ecological sub-regions. In our theoretical example, we obtained six sub-regions. These sub-regions are based on the layers we have selected. They reflect the similarity of the statistical squares according to the chlorophyll concentration, the temperature, the level of biological sampling, the connectivity with coast and coastlines, the connectivity of seamounts and the representativity of bathomes.

The free and open R Project for Statistical Computing can be used to perform this step of the framework: <https://www.r-project.org/>

2.9 Evaluation of proposals of Benthic Protected Areas

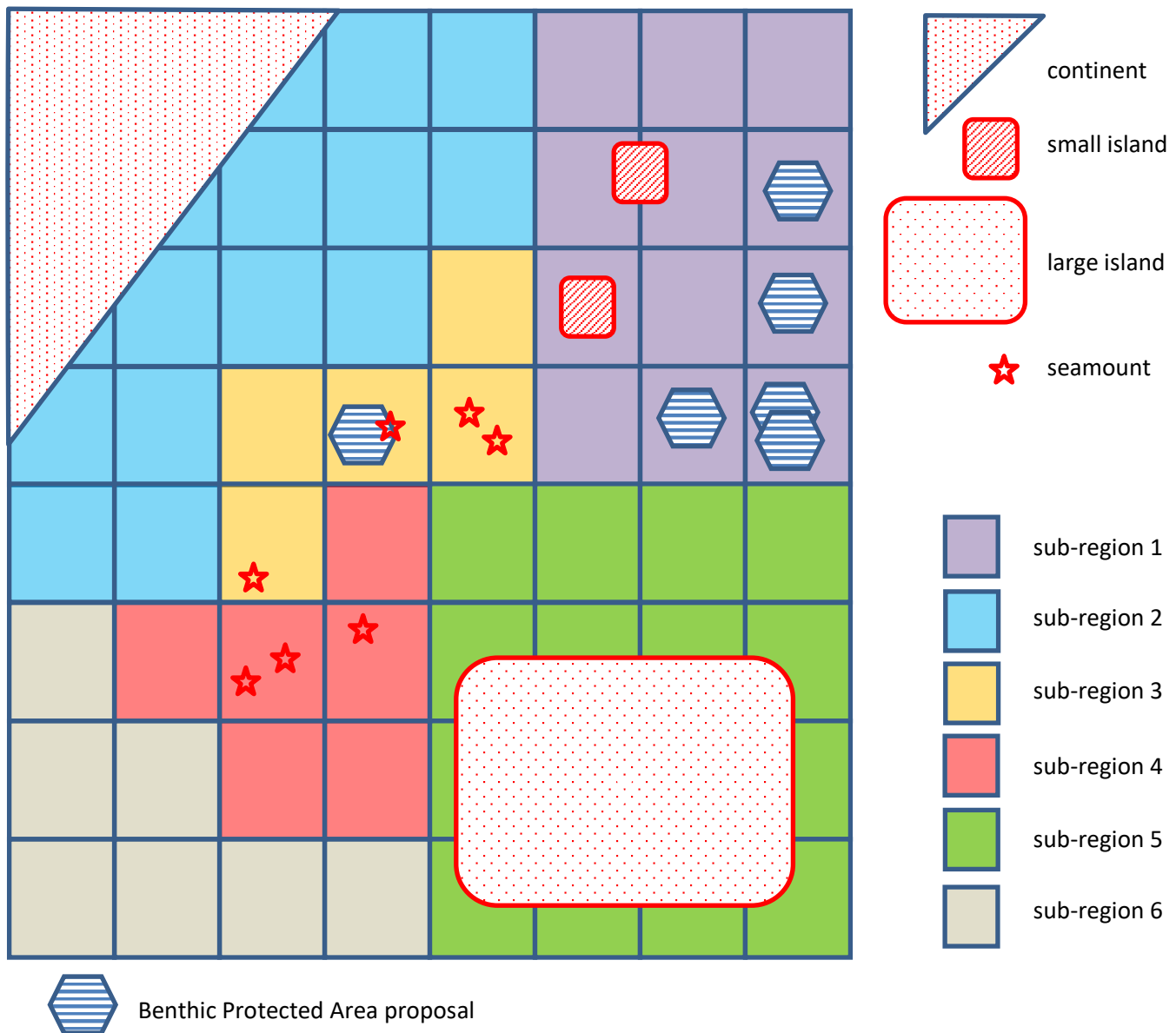


Figure 9: The next step is to cross the geographical distribution of the Benthic Protected Area proposals with the selected statistical layers and the grid of the sub-regions. This allows to evaluate:

- how the proposals meet the statistical parameters which can be considered separately as relevant criteria and conservation issues (e.g. connectivity of seamounts, representativity of upperslope bathomes...),
- how the sub-regions are represented by the proposals, considered as a network.

In our theoretical example, only one sub-region is well represented by the Benthic Protected Area proposals. Furthermore, the proposals don't match with the criteria of connectivity of the seamounts.

Discussion

The concept of workflow described here would allow a significant improvement both for the scientific design of the proposals of Benthic Protected Areas and for their evaluation by the Scientific Committee of the SIOFA.

Beyond the integration of the network concept, this approach would enhance the scientific robustness of the evaluations, which could be based on:

- the use of environmental statistics to describe areas where no scientific biological sampling have been processed,
- the possibility of performing a scientific analysis of the proposals while including data-poor areas, according to the concept of “best available science”,
- the use of common tools, with the share of statistical grids and datasets, clustering methods and software,
- the possibility to implement thresholds for the criteria which could justify a Benthic Protected Area.

The discussion of the Scientific Committee could be based on:

- the choice of the statistical layers,
- the choice of the scale of the layers,
- the choice of the clusterization method to obtain relevant sub-regions,
- the choice of the software to be used,
- the thresholds and criteria to be considered.