

## Using a geographic information system for coastal fisheries management

*Coastal fisheries management includes collecting data in the field to determine the status of marine resources and the environment (habitat). A geographic information system, or GIS, is useful for field survey planning to determine coordinates of sampling stations using satellite imagery, past survey data, and habitat maps. It is also handy after a survey to show the locations of sampling stations and associated data on a map. Finally, GIS is often used for delineating zones such as marine protected areas or survey sites, calculating corresponding areas, and plotting the location of resource-related attributes such as pearl oyster shell lines, fish traps, farms or dwellings.*

In most Pacific Island fisheries authorities, the need for and use of GIS is gradually increasing. Yet, because of cost and licensing issues, the availability of commercial GIS software (such as ArcGIS or MapInfo) is often limited to a few desktop positions, and the use of GIS is not widespread despite its usefulness.

To solve this issue, a free alternative to commercial software — capable of being used on all desktops — is needed. Several open-source applications are available although Quantum GIS (QGIS) is most appropriate for the Pacific because of its relative ease of use and features, as well as for the support of an active developer community that constantly improves and maintains the software. QGIS version 1.8 provides all of the features needed for most coastal fisheries applications. It is compatible with both ArcGIS and MapInfo, and SPC's Coastal Fisheries Programme (CFP) team uses it on a daily basis.

QGIS can usually be installed from the microservers that CFP has deployed in Pacific Island African, Caribbean and Pacific countries as part of the EU-funded SciCOFish project, and can be freely downloaded from <http://www.qgis.org>

### QGIS training: Lessons learned

In 2012, CFP conducted on-the-job QGIS trainings for marine resource assessment and management in several Pacific Island countries. Training sessions were customised to use existing country survey data and satellite imagery, highlighting the usefulness of GIS for survey planning and habitat mapping prior to field work, displaying survey data analysis, and calculating areas for stock estimation.

Various training activities were conducted, ranging from overlaying bubble maps and pie charts on top of satellite imagery, to more advanced activities such as delineating zones and using geoprocessing tools to manipulate polygons and calculate habitat areas.

During the training, several problems, which most trainees struggled to solve without the active help of the trainer, were identified. These problems would probably prevent fisheries officers from conducting similar tasks by themselves. To ensure that future QGIS users will not be discouraged and will quickly benefit from QGIS use in their daily tasks, special emphasis was given to addressing these issues during the training.

Some issues relate to the choice of the project projection and the simultaneous display of layers in different projections, and include:

- on-the-fly re-projection is not enabled and, therefore, some layers do not show up;
- QGIS sometimes crashes when enabling on-the-fly projection for a universal transverse mercator (UTM) raster that overlaps the date line; and
- for a longitude-latitude geographic coordinate system (GCS) layer, the unit is the degree for scale bar and square degree for areas; for UTM layers, the unit is the meter (Fig. 1).

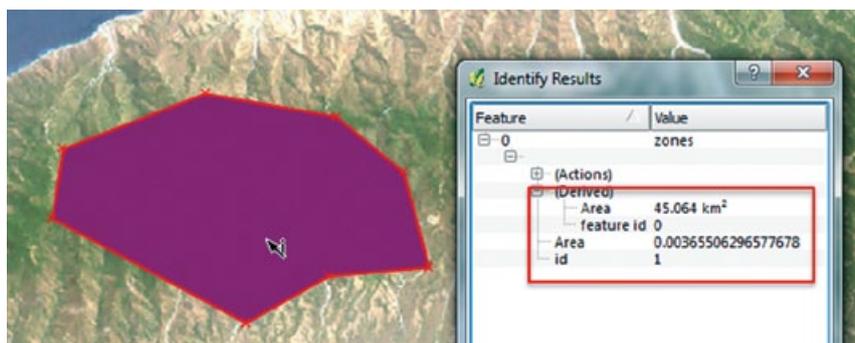


Figure 1. In this figure, the calculated area is expressed in square degrees while derived area is expressed in square kilometers.

These issues can be solved by changing the default settings, carefully choosing the project and layer projections (UTM or longitude–latitude) according to desired outputs, and using geometric columns in addition to area-calculated columns to determine polygon areas in square kilometers.

Trainers also found that due to differences of behaviour between QGIS and MapInfo (e.g. polygon closed with a right click in QGIS instead of a double click in MapInfo), former MapInfo users were likely to produce polygons with geometric errors (duplicate nodes and knots) when delineating zones (Fig. 2). Users must be trained to detect and correct geometric errors, and must be aware that geometric errors can possibly cause geoprocessing errors that are not always easy to interpret at later stages.

Finally, fisheries officers were shown how to produce bubble maps to display survey data. From layer properties, it is possible to make the size of the chosen symbol proportional to a field value. The problem is that for a round shape (disk), size corresponds to the radius of the disk, and thus its area increases proportionally to the square of the value, which provides the wrong visual clue. Users are more familiar with bubble representations where the disk area (not radius) increases linearly to the value (which means that the size must be proportional to the square root of the value) (Fig. 3).

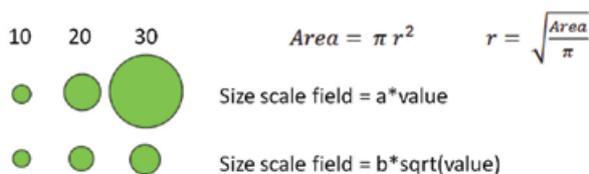


Figure 3. Disk size scaled by field value.

Calculating the square root of the field value must either be done before importation into QGIS or by adding a calculated field to the layer. The latter method is more flexible but some users faced difficulties due to shapefile limitation on field names (no more than 10 characters) and data type (decimal number for which the precision must be set).

Because most beginner GIS users will face these problems, training sessions should concentrate on providing solutions and tips to help new users explore the full potential of QGIS.

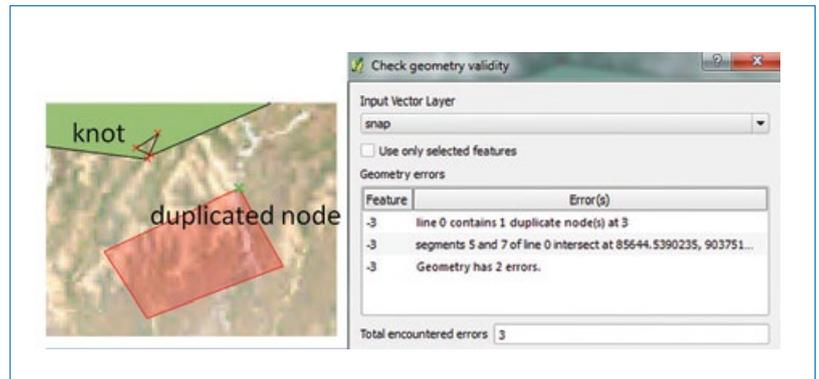


Figure 2. Common geometric errors.

### Extending QGIS for fisheries

QGIS is not just an open-source GIS program; it also has a mechanism that allows users to extend the basic application by developing additional plugins in Python to solve specific problems not covered by QGIS's standard features. Hundreds of plugins can be downloaded from official repositories, such as Points2One to generate a path from a list of waypoints; OpenLayers to download background images from Bing Maps, Google Maps and others; or Table Manager to edit the structure of shapefiles.

Special purpose plugins can also be developed for Pacific Island fisheries. For example, SPC is promoting the use of manta tows for resource assessments. Each tow has a start and end GPS position. Because there is no natural way to convert these pairs of points into lines, SPC created a plugin that creates transect lines from start and end positions.<sup>1</sup> More features can be added to facilitate the analysis and display of survey data, and SPC plans to develop additional plugins in 2013.

#### For more information:

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<sup>1</sup> Plugin available from <http://www.spc.int/CoastalFisheries/qgis/plugins.xml> repository