PROTECTED COASTAL AREA (PCA): WHY? HOW?

Nada Malnar, B. Sc. Eng., Ivan Landek, B. Sc. Eng., Ivan Grubić, B. Sc. Eng.

DGU, State Geodetic Administration, Gruška 20, Zagreb, Croatia - (nada.malnar, ivan.landek, ivan.grubic)@dgu.hr

ABSTRACT:

The Adriatic Sea, its islands and coast are one of the biggest ecological and economical riches of Croatian Republic (RoC). Unfortunately, because of general carelessness in past, bad regulations, contempt of regulations as well as absence of continuous supervision and protection of coast and islands, we are witnessing daily devastation of the coastal area by illegal and unplanned building of catering establishment and apartment colonies. Biodiversity of Adriatic Sea is every day more in danger. Growing number of people and expansion of city areas, industry development, non-care of waste water, intensively fishery and tourism as well as contempt of regulations leaves permanently consequences on whole lively and non-lively world of Adriatic Sea and its coastal. Consequently, by Law for Phisical Planning and Construction, layed down on July 2007. y., it is prescribed that protected coastal area, protected nature values and pertaining to the history of culture entirety are areas of special interest for RoC.

1. INTRODUCTION

In coastal area of RoC live about 1750000 people.

Figure 1. The coast and the islands
(http://www.hr/hrvatska/geografija/jadran/obala-i-otoci)

Fishery reserves are decreased. Pollution and destroying of habitats has endangered existence of many kinds of plants and animals. Biogeographical emplacement, calcite as a mostly geological groundwork, pronounced karstic relief as well as coast indentedness and a fact that this area was asylum for plants and animals in ice age, are reason of biodiversity both continental and aquatic eco-systems. According to incomplete

data, around and in Adriatic Sea inhabit 6000 to 7000 plants and animals category. All those categories are connected by food chain. Eco-system is endanger by destruction one of those categories.

2. AIMS OF THE PCA

2.1 Definition of Protected Coastal Area (PCA)

PCA has been defined for the purposes of protection, sustainable, workable and economically effective exploitation and it includes all the islands, and the area that spreads 1000 m from the coastline inland and 300 m in to the sea. In PCA it is, by enforcement of area planning, required:

- to preserve and regenerate threatened areas of natural, pertaining to the history of culture and traditional values of coastal and behind-coastal region and encourage natural renewal of forests and autochthonous cultivar
- to define protection measures of environment ashore and in see and especially protection of resources of drinking water
- to provide free access to the coast, passage way close to coast and public interest in usage, especially maritime property
- to preserve unsettled islands and islets prior for agricultural production, recreation, organised attendance, research and free of building areas
- to cause development especially public infrastructure by protection and preservation of landscape value
- to restrict both expansion of construction area and connection between themselves, with reference to plan a new construction area out of area of forests
- to improve conditions of both evacuated exploitation field of mineral source materials and production areas prior by landscape planting or by gastronomy- tourist and sport-recreation purpose.

2.2 Definition of Maritime Property

The concept of Maritime property is defined inside of PCA. Maritime property is universally property of special interest for RoC, it has its especially protection and it is in use providing and according to Low about Maritime Property and Seaports.

Inner sea and territorial sea, sea bottom and subsoil, and part of land witch purpose is general use or is it proclaimed such, as well as everything that is permanently attach to land on its surface or bellow it, make maritime property.

As part of land it is considered: sea cost, harbors, banks, shelves, cliffs, ridges, beaches, deltas of rivers that pour into the sea, channels connected to the sea and live and non-live nature's riches in the sea and sea subsoil.

Sea coast spreads from the line of middle higher high sea water and includes part of land bounded with line that biggest waves reach during the storm along with part of land that is by its nature or purpose intended for sea exploitation, and is wide at least 6 meters from the line horizontally apart from the line of middle higher high waters.

Sea coast includes part of land made by filling up in the section that is used for sea exploitation.

For the purpose of identification both of protected coastal area borders and maritime property, photogrammetric shooting of entire coast and islands of the territory of RoC was taken in period from year 2004 to 2006. From those photos it was planned production of digital ortho photo in scale 1:2000 (DOP2) and import of vector data both PCA and maritime property on that background, what was done so far for a few pilot-area inside of inshore districts.

3. BIODIVERSITY

3.1 Inhabitants of Adriatic

Aside from the rich cultural heritage, diverse natural resources and attractions characterize the Adriatic. Nature is specially protected according to the Constitution of the Republic of Croatia. The state body with the special task of preserving nature is the Government Board for the preservation of nature.

The coastal region holds a special place, and therefore, there is a systematic policy of the preservation of nature through urban planning and managing of the sustainable development.

The institutes for research of the sea in Rovinj, Split and Dubrovnik carry out continuos biological, ecological and chemical research of the Adriatic.

Various animals and plants live in the Adriatic. We can distinguish two types of habitats: the plegic area or the area of the open sea where two big groups of organisms live plankton, that is to say, all organisms floating in the sea, and nektons or real swimmers, all organisms which can actively move around. The group of benthos, or life at the bottom of the sea, includes all organisms, which are constantly or occasionally connected to the sea bottom. In the water mass between the mentioned areas we can distinguish different belts or steps with different characteristics.

Supralythoral, which is the part, exposed to the spraying of the sea, Mediolythoral which is the area of the high and the low tide. Then comes infralitoral or the area of photophilic algae and, which in the Adriatic expands from the border of the low tide to 30-50 meters, Abyssal which reaches 50 to 200 meters, Hadal or the deep sea area, which extends more than 200 meters in depth.

Abyssal exists only in the southern part of the Adriatic, and in the area of the Jabuka basin, and hadal does not exist in our sea Crabs inhabit the supralythoral area of the Adriatic. Endemic algae, the Adriatic bladder wrack and sea anemone inhabit the mediolythoral area. In the infralythoral area, which is the largest one, many species of algae, corals, and different sorts of fish like sheepshead bream, the predatory yellow fish, ugly frog-fish, gilthead, goby, bamboofish and many others.

The quality of the water in the Adriatic is very well preserved. The results reached through the constant measuring of the quality of water on more than 800 beaches are in accordance with the strictest criteria. The only coastal area in danger is area close to big harbour-cities and a part of a cities with a improper sewerage. In such a case there are projects for improvement for that area.

3.2 Rare and endangered Species

Except for the cleanliness of the sea, another important quality of the coastal area is its biological and geographical particular quality, which can be seen in the number of species of plants and animals, and in the high number of endemic species (for example human fish).

Figure 2. Endangered species of animals

Figure 3. Endangered sea snails and bivalves

Endangered species of animals in Adriatic are: dolphin (Tursiops truncatus), sea turtle (Caretta caretta), sea horse (Hippocampus hippocampus and H. ramulosus), and both sea snails and bivalves like Tritons trumpet (Charonia tritonis seguenza), striped mussel (Mitra zonata), snail (Tonna galea) i date-shell (Litophaga litophaga).

Figure 4. Endangered species of plants

Endangered species of plants in Adriatic are: gorgonia (sort Eunicella and sort Paramuricea), red corals (Corallium rubrum) and sea blooming grass (Posidonia oceanica).

All these species are endangered by human action both of fishing and outlet of ballast-water, that caussed derangement of balance of eco-system.

4. PROTECTED ECOLOGICAL-FISHERY ZONE

It is interest of the RoC to maintain traditional fishery as one of main precondition of tourism development and to keep local population on islands. Concerning paragraph 55 of UN Convention of sea law, Croatian State Assembly proclaimed contents of entirely economy zone that regard on rights of exploitation and research, conservation and management of live nature riches outside of outer territorial sea boundary as well as jurisdiction over scientific sea research and protection and conservation of sea environment which resulted with establishment of protected ecological-fishery zone of the RoC.
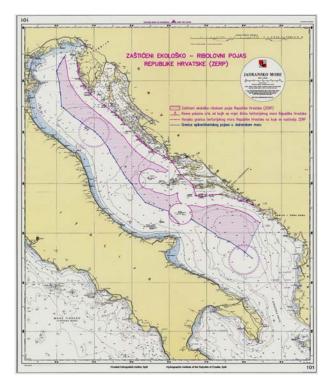

Figure 5. Protected ecological-fishery zone of the RoC
(http://www.mmtpr.hr)

Exclusive economic zone is the area which is continued to territorial waters maximum to 200 miles. In that aera both law and jurisdictions are regulated by UN Convection on the Law of the Sea.

Protection and exploatation of fishery riches, what is one of the basic motives for announcement of Exclusive economic zone (EEZ), UN Convention regulates with a special attention. The coastal State shall determine its capacity to harvest the living resources of the exclusive economic zone.

Where the coastal State does not have the capacity to harvest the entire allowable catch, it shall, through agreements or other arrangements and pursuant to the terms, conditions, laws and regulations, give other States access to the surplus of the allowable catch, especially in relation to the developing States mentioned therein.

In giving access to other States to its exclusive economic zone the coastal State shall take into account all relevant factors, including, inter alia, the significance of the living resources of the area to the economy of the coastal State concerned and its other national interests, the requirements of developing States in the subregion or region in harvesting part of the surplus and the need to minimize economic dislocation in States whose nationals have habitually fished in the zone or which have made substantial efforts in research and identification of stocks.

5. DEVELOPMENT OF SOFTWARE APLICATION FOR PCA

After adopting Act of amendments for Physical Planing two different ways of solving the task of inscribing of area boundary on corresponding cartographic backgrounds have been considered. One way is digital cartographic process with the final product – a map with inscribed boundary line – in analog form, i.e. "on the paper". The other way suggests that the result of digital cartographic process will be digital review PCA. SGA has decided to use the second way.

5.1 Sources

5.1.1 Cartographic background ： Cartographic background for laying PCA border is Croatian Base Map in scale 1: 5000. Sheets of that map cover the whole coastal area and almost the entire island area except a few islands (Silba, Olib, Premuda, Lastovo, Mljet and a part of Vis), data contents mostly corresponding to the state in 1970s and 1980s.

In the context of its activities SGA has over several past years conducted scans and georeferences of sheets of CBM (Croatian Base Map). Only the sheets that cover the subject area have already been scanned and georeferenced, but as works were done repeatedly and by different performers, the final results were not equal and consistent. Adjustment and data processing of large number of raster files requested increased the engagement of human and computer resources. The results of that processing were 1624 sheets of CBM in digital raster (TIF) format, in colour, with georeferencing data (TFW).

5.1.2 Coastal line ：Protected coastal area is defined by the distance from the coast line. As this line has never been determined from terrestrial sensing, which would request long term measurements, the same is taken in the shape of the coastal line mapped from photogrammetric shooting in scale 1: 20 000 in the process of producing a new topographic map in scale 1: 25 000 (TM 25). Coast line data in digital vector form have been detached from digital data of TM25. According to TM25 specifications, positional accuracy of this data is 1 m for well defined and built objects (in this case: concrete or stone coast, pier, breakwater, pier etc.) and 3 m for less defined, natural objects (natural coasts and beaches).

As new TM25 still does not exist for the whole coast and island area, for about 30% of the area, the coast line which was vectorized from scanned TM25 published in 1970s in earlier projects was taken.

5.1.3 Administrative boundaries：For the needs of spatial browsing and positioning, state and administrative boundaries data in Croatia taken from Official register of spatial entities of SGA in digital vector form were included in the application (see Figure 6.).
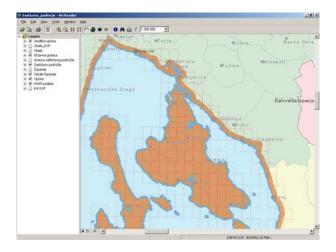

Figure 6. Data View window with administrative boundaries and PCA boundary line

5.1.4 Digital ortho photo：The Act regulates PCA charting on CBM completed with ortho photo display. Introducing DOP in the application is solved on the level of several patterns, i.e. area covered with two sheets of CBM i.e. DOP 1:5000 in colour of the area of island of Krk (see Figure 7.).
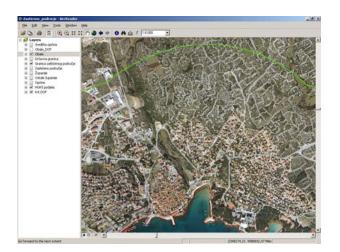

Figure 7. Data View window with Digital Ortho photo map in background

5.2 Making the application

Application conception was complex and demanding. It was obvious that application would be made in GIS surround and with usage of existing GIS program platforms. The production of a new application that would not lean on existing commercial programs would demand much more time. Also, the chosen platform had to have the ability of viewing and searching data by using simple and free software.

After reviewing the abilities of different program packages, it was decided that products of American company ESRI will be used. GIS and data cartographic processing were done using program packages ArcGIS and ArcPublisher, and free software ArcReader of the same house was used as data reviewer. Performed operations included:

- coast line data processing and PCA production,
- processing and loading cartographic background,
- processing data of administrative division and settlements,
- making application introduction part,
- making data reviewer,
- making short instructions for using data and application,
- Preparation for data delivery.

5.3 Description of application for PCA

For using PCA application a computer with Windows operating system and USB 2.0 port is required. Application and data are on a disk size 200 GB for whole Croatia or 40 GB for each county. The disk is built in a portable case with its own power supply, which is connected to computer trough USB 2.0 port. Application is automatically started after connecting the disk or choosing adequate command.

As mentioned earlier, the application consists of introduction part and data reviewer. By opening the application, you open the first page (slide) of introduction part on which is the name of application, state institute that had ordered and made application, legal fundament and the name of the company that had made technical preparations. Clicking a mouse opens the following page with annotation about basic information of the content and the way to use the application. The next page gives a warning with the purpose of protecting the data from illegal usage or distribution, and the following page gives information about basic software and hardware configuration for using the application. The last page of the introduction part enables the user to install and/or start free reviewer (ArcReader) and data review. In the application version with data for the whole Croatia at this point can be selected the state-county to be viewed.

By opening data reviewer the picture with vector boundaries of state-counties is presented. Further enlarging of the picture or changing scale of presented picture we can see how the content of review is changing; in other words, a larger scale is giving a more detailed review. By a huger scale (1:10 000 and more) is presented cartographic background - Croatian Base Map with PCA boundary line. Data reviewer enables easier searching and positioning through local autonomy entities (city/municipality) or through populated cities bigger than 1000 inhabitants, as well as the distance measuring, printing and other easier actions.

6. USING APPLICATIION FOR PCA AND FUTURE DEVELOPMENT

6.1 Working with application

After starting the application, we can see the preliminary pages (a fore described introduction part of application) of all kind of information about how the data was produced, as well as the Government act and other regulations, which were used in creating these pages. With one click on the mouse we can open

the application in ArcReader where the display is divided into two windows, with the table of contents lists data views (layer legends) on the left and display area (where the map features draw) on the right side (see Picture number 3).

In our case in data view window we can see vector data (boundaries) and raster data (cropped and georeferenced Croatian Base Maps), also in table of contents lists organized data frame as container for the same vector datasets (feature layers) and raster datasets (raster layers) on the map. Data separated in layers are displayed in data view window in different scale ranges (for example from M 1: 10 000 000 to M 1:300 000). The ranges are determined in accordance with the size of displayed territory and are presented per importance. A check box next to a layer indicates whether it is currently visible on the map. The active layer appears in bold font in the table of contents (Bockenhauer Mark; Clark Kristin, 2002.).
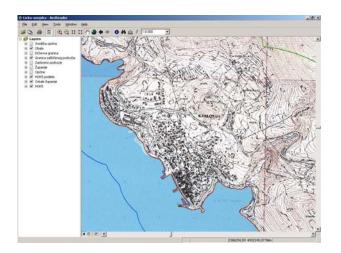

Figure 8. Final look of application for PCA

Identify features tool allows you to display the attributes for any feature you click on with your pointer. If you want to search for attributes you can search in all layers in your map or just in a specific layer. You can also choose to search all the fields (coast, state-county, city/municipality and CBM etc.), specific fields, or each layer's primary field for the appearance of the string you typed earlier. After the search is over, the window expands to reveal the findings. You will work in Data View, if you want to display, explore and analyse the data. When you choose to create a hard copy map, you need to move to the Layout View for printing the area of interest in the wanted scale.

6.2 Distribution application and vector data of PCA

Distribution vector data for PCA or produced application for local autonomy entities (city/municipality) and for all potential users for the purpose of making physical plans has been undertaken by State Geodetic Administration. Through Regulations for setting the costs for using the data of State geodetic measurements and real estate Cadastre (Republic of Croatia, 2003.) the price for publishing this product has been determined. Application for PCA for areas of a city or municipality in protected coastal area is identical to the developed application for area of state-county described before, with the diference that for preparing data for PCA, CD or DVD

ROM is used depending on the number of raster location maps of the requested area.

6.3 Enlargement and improvement of application

Short term of delivery did not allow the possibility of making tests and optimizing all the data and application. Hence the first version of application needs large memory capacities (disks), because of large number of raster data, which results in decelerating work with application. Optimizing data can decrease the large quantity of data so that the data for one state-county are reduced and thus can be saved on DVD ROM, and work with application is speeded up. This is visible by the distribution of application for PCA for areas of city or municipality, where the data are separated along specific smaller entireties and they are distributed on CD ROM, which has sped up work with application.

With this digital vector border protected coastal area shown on Croatian Base Map, SGA has made possible the further work scheduled by the Government decision, which is to make physical plans for areas of city or municipality. Because of relatively out-dated CBM raster data, the next step will be to load Digital Ortho photo maps in scale 1:5000 with latest information on buildings and other objects, into application. Further work may start by loading Cadastre plans into application, so that the position of every single parcel in respect to the PCA border can be determined. Besides further work on cartographic background data inside of PCA application, we are considering distribution of those data through Intranet or Internet.

7. CONCLUSIONS

Croatian Government has decided to protect its coastal area from illegal building, which has resulted in protected coast including all the islands and area that spreads 1000 m from the coastline inland and 300 m in to the sea. This project was conducted through cooperation of State Geodetic Administration (SGA), Ministry of Environmental Protection, Physical Planning and Construction, and finally a company, which has realized this whole idea. Hence, the GIS application using ArcGis software was created, as well as vector coastline with Croatian base maps at scale 1:5000 in background.

The final product is an independent application appropriate for installation from hard disk, DVD ROM or CD ROM, dependent on the size of requested area, which will allow reviewing PCA boundary line with corresponding cartographic background and the possibility exploring geographical or administrative names (coast, state-county, city/municipality and CBM etc.) in a simple way.

The described application possesses good layout qualities of articulate and functional view, easier searching and positioning, distance measuring, printing the area of interest in the wanted scale, and it is also independent from commercial (sales) software.

We predict this application will be expanded with loading Digital Ortho photo maps in scale 1:5000 (test area of island of Krk) into application, and larger scale maps - Cadastre plans in scale 1:2000 and Digital Ortho photo maps in scale 1:2000, also new coastal line mapped from photogrammetric shooting of all the protected coastal area in the Republic of Croatia.

REFERENCES

References from books:

Bockenhauer Mark; Clark Kristin (2002): Tutorial: Using ArcReader and ArcGIS Publisher, ESRI, New York, USA.

References from Official Gazette:

Republic of Croatia (2000.): Agreement on establishing the line between maritime delimitations and land waters. Official Gazette number 104/00, pages 3770-3772.

Republic of Croatia (2003.): Regulations for setting the costs for using the data of State geodetic measurements and real estate Cadastre. Official Gazette number 19/03, pages 998-1004.

Republic of Croatia (2004.): Law of amendments for Physical Planning. Official Gazette number 100/04, pages 3365-3368.

Republic of Croatia (2004.): The Government decision about land restructuring and coastal area protection. Official Gazette number 128/04, pages 5546-5549.

References from websites:

http://www.hr/hrvatska/geografija/jadran/obala-i-otoci

http://www.nn.hr/clanci/medjunarodni/2000/084.htm

http://www.mmtpr.hr/UserDocsImages/ZERP-karta.JPG

http://nautika.croatia.hr/AdriaticSea/Default.aspx?idLanguage=2&idCategory=796&idDocument=2565

http://nautika.croatia.hr/AdriaticSea/Default.aspx?idLanguage=2&idCategory=796&idDocument=2566

http://ufoparanormal.proboards40.com/index.cgi?board=Najvee blagoHrvatske&action=display&thread=146