

**ELECTRONIC ATLAS OF THE CASPIAN SEA
FOR MARINE RESOURCES AND COASTAL ZONE MANAGEMENT, FISHERIES,
ENVIRONMENTAL PLANNING, IMPACT ASSESSMENT**

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ABSTRACT: Management of fisheries must be integrated with management of the ecosystem. To accelerate this process the *Electronic Atlas of the Caspian Sea* is being created by S.O. Services Information Joint Stock Company. Computer maps are based on the use of high resolution images taken from space showing temporal changes in topography, infrastructure, coastlines, vegetation, currents, sediments, water colour, etc., results of "know-how" imagery interpretation, expert analysis and GIS technology. The Electronic Atlas of the Northern Part of the Caspian Sea with Delta of Volga River has already been created.

It is believed that the two biggest threats to the successful management of our aquatic resources are: the lack of information and understanding about fish stocks and their interaction with the broader ecosystem; and the failure of management generally to implement adjustment measures to remove the excess capacity from commercial fisheries where available data clearly demonstrate that stocks are under severe pressure.

The Electronic Atlas is going to be a part of the Geographic Information System of the Caspian basin and the coastal zone to undertake a comprehensive evaluation of government relationships to indigenous coastal communities, with regard to fisheries management issues and arrangements, laws, obligations, local needs and customs, and traditional environmental knowledge. It includes the following:

Digital bathymetric database.

The bathymetric database was created by vectorizing bottom contour charts at the scale of 1:200 000; coastlines, canals, microrelief and other features were updated with the use of recent black and white and multispectral band remote-sensing images, black and white and multispectral-band photos. Bottom contour charts provide a picture of the seafloor topography with the geographic coordinate reference system, vertical datum, mean sea level, content-projection coordinates, bathymetric contours and shoreline features. Application: designed use is for the cartographic base for the Atlas of Fisheries, expert analysis, marine resources study and monitoring of fishing.

Planning charts and colour display charts with half-tone photomosaic can be made. They are intended for displaying boats suspected of breaching fisheries legislation, plans or projects and can be used for official reports, wall mounting, plotting and briefing. They can be fitted together by the user to provide coverage of specific areas. They can be used for the collection of fisheries statistic data (like plotting diagrams), monitoring of fishing, general voyage planning, etc.

Digital photomosaics database. Digital image data are intended for:

1. Thematic mapping and coastal engineering.

Spectrozonial digital images have been computer processed to enhance sandbanks and bars, channels and water, in order to update charts in this area of constantly shifting sands and changing depths. Colour high resolution images give an accurate representation of the physical environment (geomorphology, geology, slopes, surface water, etc.), population and urbanization (population densities, networks, infrastructure), agricultural land use/landcover, woodlands, natural heritage, wilderness areas.

Computer simulation against a backdrop of remote-sensing images enables planners to visualise the project, specific areas, structures, to optimize their design and to blend in with the surrounding.

2. Possible application in *offshore petroleum exploration*. It will help to define coastal and seafloor major structures and tectonic-element boundaries and show how its minerals and petroleum systems fit into this framework.

3. Ecological impact assessment, environmental protection and coastal zone planning.

- fisheries resources;
- biological information;
- aquaculture (the potential of native alternative species for cultivation, alternative food sources, environmental issues related to site suitability, water quality, diseases, etc.);
- international and major subdivision boundaries (exclusive economic zones, administrative areas of territorial waters, state/territory fisheries zones, zones of total ban on fishing, etc.);
- geographical names, fish inspection stations, fish monitoring stations, fish breeding plants.

Complex thematic mapping and expert analysis

1. Complex (comprehensive) thematic mapping could be made at scale:

- regional - 1:200 000-1:50 000;
- local - 1:50 000-10 000
- urban (cadastral) - 1:5 000

Expert analysis consists of the following processes: description by maps, modeling and cartographic study.

2. Water/marine resources study (fresh, salt, silt load, ground waters, inventory of lakes, delineation of melioration fields, etc.).

3. Coastal zones study (shorelines, land forms, tide-influence areas, vegetation, wetland, sand dunes, etc.). Monitoring of seasonal variation in the mouths of the Volga River. By studying images acquired on different dates, experts are trying to determine the main cycles governing these variations. Monitoring of continuing changes along a coastline or the state of mangrove swamps. A study of advancing sand dunes along the coast is trying to find protection measures.

4. Shelf and shallow waters (microrelief, sediments, vegetation, algae, sea currents and watercourses, watershed, regeneration flow, overflow, etc.).

5. Land management, agriculture and aquaculture (cadastre and land-use mapping, recreational, parks). Aquaculture research should be more aligned with the agricultural sector, due to its similarities with farming activities.

6. Urban and rural planning study begins with making an imagemap of population distribution (population densities) then goes on to assess needs and identify development options.

7. Floods. Flood control of the entire river and sea area begins with the accurate mapping of the main beds of all water courses and of local land use/landcover. These maps can be used to site and plan control works, simulate flood impact, prepare contingency plans, and if disaster strikes, to assess damage and draw up reconstruction strategies.

8. Ecological impact assessment.

- Ecological audit maps, showing the real ecological condition of the territory at the moment of granting a license to own land or before undertaking a development project on any scale:
 - land-use, vegetation, forestry, soil, waters, etc.
 - sources of pollution, anthropogenic changes (deforestation, desertification, soil degradation, aridity, etc.)
 - areas with dangerous and catastrophic phenomena.
- Maps of ecological stability, showing:
 - Ability of nature to be stable in the face of anthropogenic changes;
 - Stabilizing measures for natural components and genesis preserving of flora and fauna;
 - Site analysis for regional planning related to economic development, damsite location, route selection of highways or pipelines, etc.

- Ecological prognostic maps, showing dynamic, prognostic, recommendation aspects and measures:
 - Emergency measures for disaster areas with dangerous and catastrophic phenomena (flood, earthquake, mud flowing, land subsidence, etc.); for setting up policies to combat desertification and diminishing water resources (the example of the Aral Sea shows how one can trace the long-term effects, in fragile areas, of development decisions taken without thought for the environment);
 - Forecasting measures for regional planning (power station constructions, industrial waste sites, industrial complexes construction, mining industry, oil and gas industry, transportation);
 - Preventive measures for environment protection (land, forest, waters, vegetation), showing soil erosion and siltation, pollution, outfalls, oil spills, coastal erosion, changes in natural drainage, fluctuations of ground waters, etc.

These maps are necessary for estimation and forecasting of ecological situations and their changes as well as for giving recommendations which could normalize the situation. Synthetic maps allow one to single out territories featuring a certain intensity of the anthropogenic changes.

GIS and expert systems development. Creation of:

- Cartographic data banks
- Knowledge bases for expert systems
- Digital terrain models and orthophotos

Perspective views.

3-D perspective views are possible. They are ideal for simultaneously viewing both raster data and vector data. They give experts greater overview and a better understanding of the geometry of the different structures and features; they are also useful for testing the geometric consistency of different plots.

Software and hardware.

Microstation "Intergraph" software package and PC-Pentium computer with the highest speed and memory were selected as a basis of GIS application.

Conclusion.

Basic principles of complex thematic mapping for marine resources and coastal zone management, fisheries, environmental planning, impact assessment are presented. The role of

high resolution (5-8 m) space imagery, “know-how” image interpretation and GIS technology is stressed.

Excellent resolution of images enables us to identify all known and sometimes unknown features and formations and to plot their boundaries accurately. The accuracy (level of detail) of interpreted features in most cases is much higher than it should be for the original scale (1:200 000). So larger scale maps could be made. The low density vegetation and shallow waters covering the surface make it easier to achieve such good results.

The methods of image interpretation and expert analysis which are used here are applicable to most of the world's major sedimentary basins. A detailed report on the methods and results of the study will be available to users in the form of 40 pictures (samples) and a brochure. These pictures and their formalized description in digital form could form a knowledge base for future expert or intelligent systems. Training, education and consulting services based on the GIS technology specific to marine resources projects can possibly reduce the gap between those who produce and those who use information, between those who decide and those who implement.