

BUCHAREST CONVENTION
on Protection of the Black Sea Against Pollution
BIODIVERSITY and LANDSCAPE CONSERVATION

BLACK SEA ENVIRONMENT PROGRAMME



**Identifying Key Black Sea Coastal Habitats:
Coastal Habitat Red Book for Georgia**

PILOT STUDY FINAL REPORT

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**TECHNICAL ASSISTANCE TO THE BLACK SEA
ENVIRONMENTAL PROGRAMME**

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Preface

The Black Sea Regional Activity Centre for Conservation of the Biological Diversity in Batumi, Georgia with assistance from the EuropeAid Black Sea Environmental Programme project (implemented by ARCADIS Euroconsult) is working on the development of a common methodology for the preparation of a Black Sea Habitats Red Data Book. Georgia is the pilot for the rest of the Black Sea range states, so that problems can be identified and a methodology can be described.

The ultimate goal of the Habitat Red Book is to be able to better protect important habitats and species, by exactly knowing their location and condition and at the same time having a baseline to monitor them. In this way conservation efforts can be more focussed.

The wider objective of the present work is to fulfil part of a requirement of The Black Sea Biodiversity and Landscape Conservation Protocol, that was signed in June 2002 by the Environmental Ministers of Black Sea countries, in Sofia, Bulgaria.

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Abbreviations

ACCOBAMS	Agreement on Conservation of the Cetaceans of the Black Sea, The Mediterranean Sea and the Contiguous Atlantic Ocean
AG	Advisory Group
AG CBD	Advisory Group on Conservation of Biological Diversity
BLMPIF	Biodiversity and Landscape Monitoring Programme and Indicator Framework
BS	Black Sea
BSBLCP	Black Sea Biodiversity and Landscape Conservation Protocol
BSBLCP-SAP	Strategic Action Plan for the Black Sea Biodiversity and Landscape Conservation Protocol
BSC	Black Sea Commission
BSEP	Black Sea Environmental Programme
BSIMAP	Black Sea Integrated Monitoring and Assessment Programme
CBD	Conservation of Biological Diversity
DPSIR	Framework based on Driving force, Pressure, State, Impact and Response indicators
ECNC	European Centre for Nature Conservation
EEA	European Environmental Agency
EEC	European Economic Community
ESRI	Environmental Systems Research Institute
EU	European Union
EUNIS	European Nature Information System
GEF	Global Environmental Facility
HRB	Habitat Red Data Book
ICZM	Integrated Coastal Zone Management
MEFRI	Marine Ecology and Fisheries Research Institute (Batumi)
PEBLDS	Pan-European Biological and Landscape Diversity Strategy
PEEN	Pan-European Ecological Network
PS	Permanent Secretariat of the Black Sea Commission (Istanbul)
PMA	Pollution Monitoring and Assessment
RAC	Regional Activity Centre

1 Introduction

1.1 Background

In June 2002, the Parties of the Bucharest Convention on the Protection of the Black Sea Against Pollution took a major initiative for promoting sustainable management of the Black Sea ecosystem by adopting a Protocol on Black Sea Biodiversity and Landscape Conservation (see <http://www.blacksea-commission.org/OfficialDocuments>).

Article 4, para 4 of the Protocol stipulates that:

The Contracting Parties shall adopt a list of landscapes and habitats of Black Sea importance that may be destroyed, or important by their nature, culture or historical value.

Although the Protocol itself has not yet been fully ratified and is therefore not in force, work has proceeded on adapting the institutions and work programmes of the Black Sea Commission to meet its requirements. In particular, the AG-CBD has led the preparation of a Strategic Action Plan for the Black Sea Biodiversity and Landscape Conservation Protocol (BSBLCP-SAP).

The August 2004 version of the BSBLCP-SAP includes the following provisions:

5.2.1(2) by the year 2008 to make inventory, classification and mapping of habitats and communities (biocoenoses) in BSBLCP area according to commonly agreed criteria (e.g. EUNIS) and methodology and based on shared Geographic Information System (GIS);
5.2.1(5) develop criteria for identification of habitats and communities of the Black Sea importance and prepare a List of Habitats of Black Sea Importance that shall form the second part of Black Sea Species and Habitats Red Data Book;
5.2.1(6) publish the Black Sea Red Data Book of Species and Habitats and establishing a regional mechanism for its regular update.

Moreover, the draft BSBLCP-SAP suggests in 5.2.2(4) that BS Range States should:

integrate the system of protected landscapes, Biosphere Reserves, National Parks and other types of protected areas with existing international initiatives aiming at establishing a Pan-European Ecological Network under the auspices of the Pan-European Biological and Landscape Diversity Strategy (PEBLDS) and complement existing national initiatives on ecological networks.

1.2 Black Sea Integrated Monitoring and Assessment Programme

The Black Sea Integrated Monitoring and Assessment Programme (BSIMAP) was initiated by the Black Sea Commission in June 2002. This programme seeks to establish a harmonised system for biological, chemical and physical monitoring, quality assurance and control, data collection and storage, and analysis of trends.

Within BSIMAP, a biodiversity and landscape monitoring programme, as required by Article 4 of the Protocol, is also under development. The main objectives of this programme are to collect and analyse data and report on how the six Black Sea states:

- protect, preserve, improve and manage in a sustainable and environmentally sound way areas of particular biological or landscape value, notably by the establishment of protected areas according to the procedure in Annex 1 of the Protocol;
- ensure that species occurring in the area to which the Protocol applies are maintained at favourable conservation status and habitats close to undisturbed;

- ensure that species of economic importance, especially living marine resources, are used sustainably;
- restore and rehabilitate damaged areas of previously high biodiversity and landscape value;
- restore and maintain in good condition the landscapes of high nature, historical, cultural and aesthetic value.

Thus, the Habitat Red Data Book (HRB) will supplement marine assessment requirements through addressing a range of environmental indicators in relation to the marine and coastal zones and biodiversity. It will also be combined with elements of related activities that are also required by Protocol. These include monitoring of biodiversity, delineation of the coastal zone, mapping of habitats and important species and development of a habitats and species Geographical Information System. The advantage of using GIS is that all these different aspects can be easily combined in a query and reports can be generated.

1.4 Biodiversity and Landscape Monitoring Indicators

BSIMAP has adopted the use of indicators as a basis for communicating information about the state of a selected environmental topic. With regard to the state of biodiversity and landscapes in the Black Sea region, about 90 of the 420 or so core environmental indicators identified by the European Environment Agency (EEA) are relevant. Not all of these indicators can be used given the current level of resources available to the Black Sea Commission: a selection has to be made, and their application tested.

However, the production of a Habitat Red Data Book would address over 30 of the EEA core indicators (see Table 1) and is therefore a very efficient tool for biodiversity and landscape monitoring.

1.5 Habitat Pilot Study in Georgia

From December 2003 to September 2004, the RAC CBD at Batumi in Georgia undertook a pilot study on the development of a common methodology for the preparation of a Black Sea Habitats Red Data Book. It was carried out with assistance from the EuropeAid Black Sea Environmental Programme project (implemented by ARCADIS Euroconsult) and is intended to provide a basis for discussion with other Black Sea range states in the development and adoption of a common methodology, based on GIS technology, as required by the BSBLCP-SAP.

The ultimate goal of the Habitat Red Book is to afford better protection and management for important habitats and their associated species, by knowing their exact location and condition and at the same time having a baseline to monitor them. In this way conservation efforts can be more focused.

Table 1: EEA Core Set of Indicators Addressed by a Habitat Red Data Book

EEA Code	Indicator
AGRI04	High Nature Value farming areas
BDIV01	Habitats and biodiversity
BDIV01a	State of 10 main EUNIS habitats types per biogeographic region and per country
BDIV01b	Change of 10 main EUNIS habitats types per biogeographic region and per country (including agro-ecosystems)
BDIV01c	Percentage and trends in wilderness areas by country, biogeographic region, Europe
BDIV01d	Naturalness of forests
BDIV02	Species diversity
BDIV02a	Species richness in proportion to surface area of the countries
BDIV02b	Species richness in proportion to surface area of biogeographic regions
BDIV02c	Species richness by main 10 main EUNIS habitats types
BDIV02d	Tree species composition in forests
BDIV02e	Changes in species composition
BDIV02f	Endemic Species richness in proportion to surface area of biogeographic regions
BDIV02g	Trends of species groups (carnivores, raptors, geese,... species of economic interest...)
BDIV02h	Trends of representative selection of species associated with different ecosystems (including agro-ecosystems)
BDIV03	Threatened species
BDIV03a	Number of threatened taxa occurring at different geographical levels
BDIV03b	Number of globally threatened species endemic to Europe
BDIV03c	Percentage of globally threatened species per biogeographic region
BDIV03d	Percentage of European threatened species per biogeographic region
BDIV05	Threats to ecosystems
BDIV05a	Threats in and around wetland sites
BDIV06	Landscape changes
BDIV06a	Landscape-level spatial pattern of forest cover
BDIV12	Habitat diversity in designated areas
BDIV12a	Percentage (in surface area) of Annex I habitat-type included in potential Sites of Community Interest (pSCIs)
BDIV12b	Change (in surface area) of Annex I habitat-type included in pSCIs
BDIV12c	Range of Habitats of European Interest present in designated areas
TELC01	Land cover changes in surroundings of designated areas
TELC01a	Proximity of transport infrastructure to designated areas
TELC02	Fragmentation of ecosystems and habitats by transport infrastructure
TELC04	Agriculture land cover changes
TELC05	Landscape diversity

As a result of the pilot study in Georgia, it is now possible to generate answers to a wide range of management-related queries, in the form of lists or maps in digital and hard copy format, such as:

- What habitats types (terrestrial and marine) are present?
- Where does a specific habitat type occur and what is its extent in hectares?
- Which habitat types that are considered endemic, and where are they situated?
- What habitat types have high conservation importance, and where are they located?
- Which habitat types support populations of plant and/or animal species that are considered as important for maintaining the biodiversity of Georgia, and where are these located?
- What infrastructure (main roads, residential areas, industrial areas) impacts habitats in the area?
- What is the distribution of threatened species listed in Annex II of the Protocol in general, and trends over 10-year periods?

This information can be used by the wide range of stakeholders including Black Sea Commission; BS Permanent Secretariat; BS Advisory Groups; National Focal Points; scientists and national and local government officials, employees from wildlife services, NGO's, and ICZM spatial planners.

2 Methodology

Aspects of biodiversity of the marine and littoral zones of each of the six Black Sea countries have been described in National Reports, produced under BSEP between 1997-1998. A series of *Environmental Profiles* have also been produced which include some biodiversity information. The Commission recently published a report on the *State of the Environment of the Black Sea, Pressures and Trends, 1996 - 2000*, that provides a rather cursory overview about biodiversity, important habitats and protected areas (Black Sea Commission 2002). Thus, no systematic approach to classifying, mapping and assessing habitats and their associated species in the Black Sea region has been undertaken to date.

To a large extent, the concept of a Black Sea Habitat Red Data Book builds on the work of the sister Helsinki Commission for the Protection of the environment of the Baltic Sea that published a red list of marine and coastal biotopes in 1998 (Helcom 1998; see www.helcom.fi/a/proceedings/bsep75.pdf). This in turn built on an earlier assessment of biotopes in the Waddensea region. However, whereas the Helcom red list provides a useful analysis of the biotopes and biotope complexes found in the Baltic Sea region, and analyses their status, it does not provide maps of where the most important biotopes occur, nor does it take account of particular sites for supporting threatened species.

In order to produce the results presented in this report, the following aspects were addressed, which together form the overall methodology employed (see Figure 1).

2.1 Area of Coverage

Article 3 of the Protocol defines the area to which it applies as the Black Sea and Azov Sea, “including the coastal zone designated by each Contracting Party, including wetlands”. Unfortunately, none of the Parties has yet designated a coastal zone area for monitoring purposes.

For the purposes of the Georgian pilot study, therefore, the 12-nautical mile (22 km) boundary was taken as the seaward boundary, and the administrative boundaries of the coastal raions were taken as the inland boundary for mapping coastal habitats (and by extension, landscapes) in the country (Figure 2). The use of raion boundaries also has the advantage of facilitating the correlation of environmental indicators with socio-economic indicators, especially population trends, agriculture and forestry development, and tourism for which data is collected on an administrative unit, not biogeographic, basis.

2.2 Classification and Identification of Coastal Habitats

It may have been noticed that the Helcom Red List deals with “biotopes”, whereas the Protocol speaks of “habitats”. According to the EEA, these and related terms may be defined as follows (see <http://glossary.eea.eu.int/EEAGlossary>):

- Biotope – well-defined geographical area, characterised by specific ecological conditions (soil, climate, etc.), which physically supports the organisms that live there (biocoenosis);
- Biocoenosis – association of living organisms, animals and plants, which occupy the same geographical area (biotope);

Figure 1: Schematic Design of Habitat Red Data Book Pilot Study

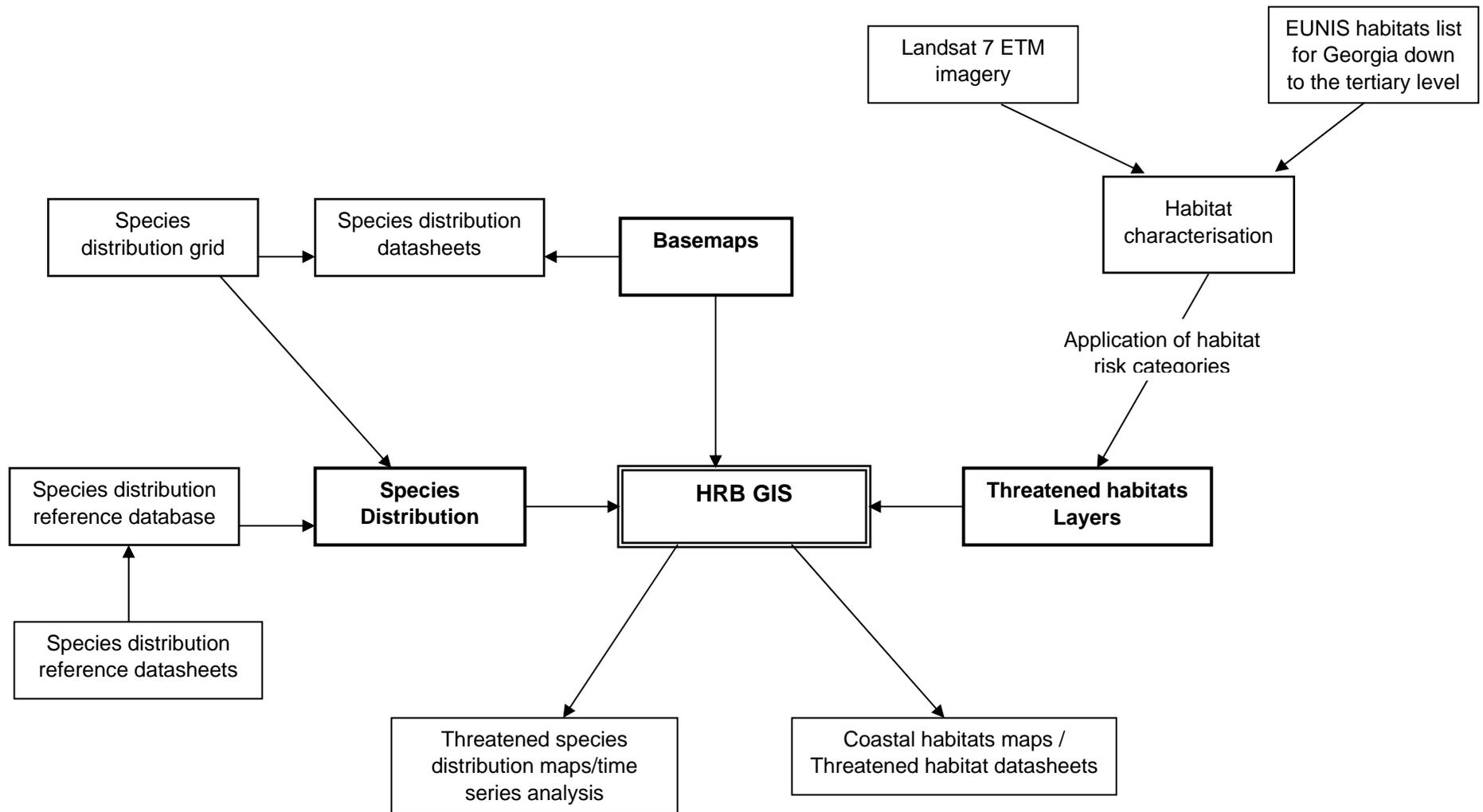
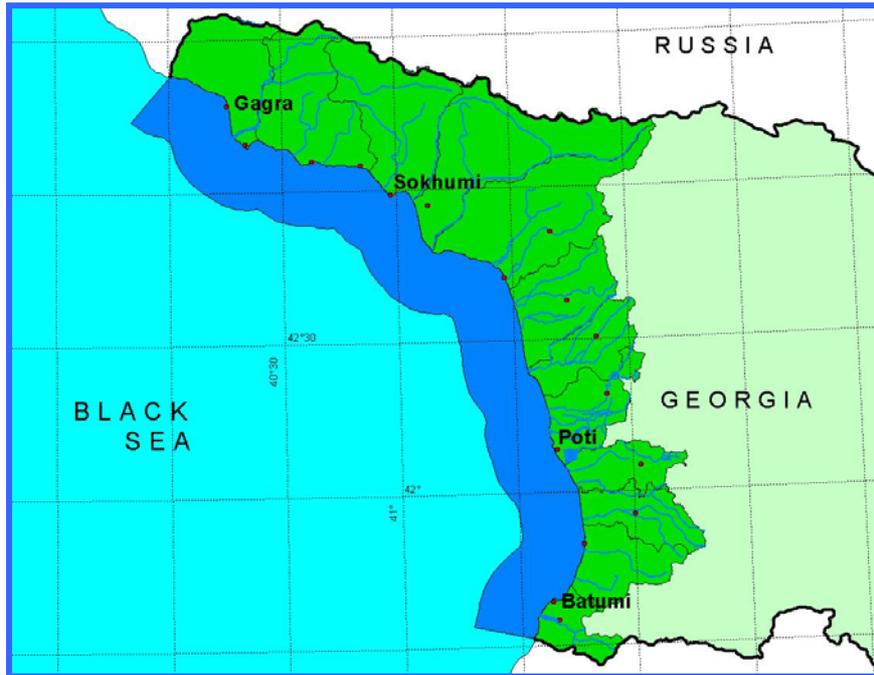


Figure 2: Map of HRB study area including coastal districts and 12 nautical miles zone

- Habitat – (1) the place or type of site where an organism or population naturally occurs; (2) terrestrial or aquatic areas distinguished by geographic, abiotic and biotic features, whether entirely natural or semi-natural;
- Habitat type – plant and animal communities as the characterising elements of the biotic environment, together with abiotic factors (soil, climate, water availability and quality, and others), operating together at a particular scale.

Thus, a biotope refers more to particular place (e.g. the Kobuleti mire system), while a habitat constitutes a more general set of environmental conditions that includes the biotic characteristics (e.g. ombrogenous mires) and is not necessarily tied to a particular location. But for most practical purposes, the two terms are more or less synonymous.

Given that the HRB will eventually cover the whole Black Sea region, and the need to ensure compatibility with pan-European initiatives (such as PEEN), it was decided to use the EUNIS habitat classification system (see <http://eunis.eea.eu.int/habitats.jsp>). This system is anyway already used by several Black Sea range states.

Accordingly, a team of habitat experts at the RAC analysed the EUNIS habitat list, down to the tertiary level, to determine which habitats and habitat complexes occurred in the coastal area defined in 2.1 above.

Some habitat types which were present in Georgia but not yet included in the EUNIS list were described and forwarded to the European Topic Centre for Nature Protection and Biodiversity for future reference.

Having determined the range of habitat types present, the distribution of terrestrial types (as polygons) in the study area was determined by carrying out a structured classification of four Landsat 7 Extended Thematic Mapper scenes, acquired between 10 July 2000 and 6 September 2001 at a resolution of 30 m (see Appendix C). For marine substrate habitat types, a provisional distribution map was prepared based on sampling studies (e.g. for oil

exploration) and the personal experience of the experts concerned over the last 30 years.

2.3 Identification of and Data Collation for Threatened Species

For the purposes of the pilot study, the threatened species to be considered along with the habitats were taken to be those listed in Annex II of the Protocol (Provisional List of Species of Black Sea Importance). This Annex includes 126 species as follows:

Group	No. species
Algae	6
Flowering plants	4
Sponges	2
Polychaete worms	5
Crustaceans	28
Insects	3
Halacarids	1
Molluscs	9
Echinoderms	2
Acrania	1
Fish	38
Birds	22
Mammals	5

Species experts from the RAC selected those species from Annex II that occurred in Georgia (including migrants). Using published information and their own field data, the experts then prepared distribution maps for each species, as far as possible divided in to the following six decennial time periods (for trend analysis):

1946 – 1955; 1956 – 1965; 1966 – 1975; 1976 – 1985; 1986 – 1995; 1996 – 2005

For terrestrial or pelagic organisms, mapping was carried out by indicating the recorded presence of the species in a 10 x 10 km grid that was interpolated with the pan-European biodiversity mapping grid of 50 x 50 km, adopted by the EEA as well as the European Bird Census Council, Planta Europaea, Worldmap (British Natural History Museum) and others (see <http://dataservice.eea.eu.int/dataservice/metadetails.asp?id=625>). The use of such an equal-area grid allows the calculation and comparison of biodiversity indices and location of centres of biodiversity (or “hotspots”).

Where the 10 km grid did not align perfectly with the longitudinal boundary of the 50 km grid (because of the Earth’s curvature), the grid squares were divided using the same algorithm as for the 50 km grid so that all distribution data remained compatible with the larger pan-European grid.

For benthic species, distribution data were available only from the sampling stations employed by MEFRI for monitoring purposes. These data were therefore plotted according to the point locations of these sampling sites.

In addition to species distribution, information was also provided on literature sources and their inclusion in other nature protection conventions.

The data base created is provided in the CD-ROM accompanying this report, and selected

species maps are given in Appendix B.

2.4 GIS Design and Biodiversity Mapping

The technical specifications for the GIS established for the HRB is given in Appendix C. The species data base was assembled in Microsoft Access, and incorporated in the GIS using ESRI ArcView software, where it could be combined with habitat polygon information.

The GIS was then used to carry out some initial time series analysis of species distributions (see Section 3), and to develop and map a preliminary red list of coastal habitats based on the criteria set out in Section 4.

2.5 Field Verification

The final stage of the methodology was to carry out field verification of the habitat type distributions determined from the satellite image classification. This “ground truth” exercise would allow the image to be more precisely classified and thus the habitats more accurately mapped and demarcated. Unfortunately, the pilot study resources were insufficient to allow field verification, and this remains to be done.

3 Results

3.1 Habitat Types Identified

The EUNIS habitat list was examined down to the tertiary level to determine which habitats and habitat complexes occurred in the coastal area of Georgia. In total 174 types of habitats and 21 habitats complexes were identified (see Table 1).

In addition, three habitats that are found in Georgia and not included in the original EUNIS list were identified. Their description and recommended coding is given in Table 2.

3.2 Threatened Species and their Distributions

Out of 126 species of Black Sea importance included in the Annex II of the protocol, the local species experts identified 74 that occur in Georgia (see Table 3).

Based on published information and their own field data, the experts then prepared distribution maps for each species, divided into the six decennial time periods (for trend analysis), and also allowing for seasonal patterns of occurrence (breeding, migration, wintering). The distribution information was mapped using the ESRI ArcView software.

As an example, the distribution of the sevryuga sturgeon (*Acipenser nudiventris*) along the Georgian Black Sea coast and rivers over the six decennial time intervals starting from 1946 is given in Figure 2. Its area of distribution has varied from 800 km² (during 1946-55) to 2200 km² (1956-65) with average of 2000 km² during other decennial intervals. As for the geographical coverage, it steadily occurs in the central part of the Georgian Black Sea coast: between River Rioni and River Inguri and in Ochamchire shelf area. Since 1965 it is also found in the Batumi area, at the mouth of River Chorokhi.

The data base on the CD-ROM accompanying this report provides similar maps for all Annex II species in Georgia; selected species maps are given in Appendix B.

Table 1: List of habitats and habitats complexes characteristic for the Georgian coastal area

CODE	DESCRIPTION
A	Marine habitats
A1	Littoral rock and other hard substrata
A1.1	Littoral rock very exposed to wave action
A1.2	Littoral rock moderately exposed to wave action
A2	Littoral sediments
A2.1	Littoral gravels and coarse sands
A2.2	Littoral sands and muddy sands
A2.4	Littoral combination sediments
A3	Sublittoral rock and other hard substrata
A3.2	Infralittoral rock moderately exposed to wave action and/or currents and tidal streams
A3.6	Circalittoral rock moderately exposed to wave action or currents and tidal streams
A3.8	Deep circalittoral rock habitats exposed to strong currents
A3.9	Deep circalittoral rock habitats exposed to moderately strong currents
A3.C	Vents and seeps in sublittoral rock
A4	Sublittoral sediments
A4.1	Sublittoral mobile cobbles, gravels and coarse sands
A4.2	Sublittoral sands and muddy sands
A4.3	Sublittoral muds
A4.4	Sublittoral combination sediments
A4.5	Shallow sublittoral sediments dominated by angiosperms
A4.7	Deep shelf sediment habitats
A5	Deep-sea bed
A5.3	Deep-sea sand substrates
A5.4	Deep-sea muddy sand substrates
A5.5	Deep-sea muds
A5.7	Canyons, channels, slope failures and slumps on the continental slope
A5.8	Deep-sea trenches
A5.A	Deep-sea bed influenced by hypoxic water column
A7	Pelagic water column
A7.1	Neuston
A7.2	Completely mixed water column with reduced salinity
A7.3	Completely mixed water column with full salinity
A7.4	Partially mixed water column with reduced salinity and medium or long residence time
A7.5	Unstratified water column with reduced salinity
A7.6	Vertically stratified water column with reduced salinity
A7.7	Fronts in reduced salinity water column
A7.8	Unstratified water column with full salinity
A7.9	Vertically stratified water column with full salinity
A7.A	Fronts in full salinity water column
B	Coastal habitats
B1	Coastal dune and sand habitats

B1.1	Angiosperm communities of sand beach driftlines
B1.2	Sand beaches above the driftline
B1.3	Shifting coastal dunes
B1.4	Coastal stable dune grassland (grey dunes)
B2	Coastal shingle habitats
B2.3	Upper shingle beaches with open vegetation
B2.4	Fixed shingle beaches, with herbaceous vegetation
B2.5	Shingle and gravel beaches with scrub vegetation
B3	Rock cliffs, ledges and shores, including the supralittoral
B3.1	Supralittoral rock (lichen or splash zone)
B3.2	Unvegetated rock cliffs, ledges, shores and islets
B3.3	Rock cliffs, ledges and shores, with halophytic angiosperms
FB	Shrub plantations
C	Inland surface water habitats
C1	Surface standing waters
C1.1	Permanent oligotrophic lakes, ponds and pools
C1.2	Permanent mesotrophic lakes, ponds and pools
C1.3	Permanent eutrophic lakes, ponds and pools
C2	Surface running waters
C2.1	Springs, spring brooks and geysers
C2.3	Permanent non-tidal, slow, smooth-flowing watercourses
C2.4	Tidal rivers, upstream from the estuary
C2.6	Films of water flowing over rocky watercourse margins
C3	Littoral zone of inland surface waterbodies
C3.2	Water-fringing reedbeds and tall helophytes other than canes
C3.3	Water-fringing beds of tall canes
C3.5	Pioneer and ephemeral vegetation of periodically inundated shores
C3.6	Unvegetated or sparsely vegetated shores with soft or mobile sediments
D	Mire, bog and fen habitats
D1	Raised and blanket bogs
D1.1	Raised bogs
D2	Valley mires, poor fens and transition mires
D2.1	Valley mires
D2.2	Poor fens
D2.3	Transition mires and quaking bogs
D4	Base-rich fens
D4.1	Rich fens, including eutrophic tall-herb fens and calcareous flushes and soaks
D5	Sedge and reedbeds, normally without free-standing water
D5.1	Reedbeds normally without free-standing water
D5.3	Swamps and marshes dominated by [<i>Juncus effusus</i>] or other large [<i>Juncus</i>] spp.

E	Grassland and tall forb habitats
E2	Mesic grasslands
E2.1	Permanent mesotrophic pastures and aftermath-grazed meadows
E2.2	Low and medium altitude hay meadows

E2.3	Mountain hay meadows
E2.4	Iberian summer pastures (vallicares)
E2.6	Agriculturally-improved, re-seeded and heavily fertilized grassland, including sports fields and grass lawns
E3	Seasonally wet and wet grasslands
E3.1	Mediterranean tall humid grassland
E5.5	Subalpine moist or wet tall-herb and fern habitats
E5.6	Anthropogenic forb-rich habitats
F	Heathland, scrub and tundra habitats
F2	Arctic, alpine and subalpine scrub habitats
F2.2	Evergreen alpine and subalpine heath and scrub
FA	Hedgerows
FA.1	Hedgerows of exotic species
FA.2	Highly-managed hedgerows of native species
FA.4	Species-poor hedgerows of native species
FB	Shrub plantations
FB.1	Shrub plantations for whole-plant harvesting
FB.2	Shrub plantations for leaf or branch harvest
FB.3	Shrub plantations for ornamental purposes or for fruit, other than vineyards
FB.4	Vineyards
G	Woodland and forest habitats and other wooded land
G1	Broadleaved deciduous woodland
G1.1	Riparian [<i>Salix</i>], [<i>Alnus</i>] and [<i>Betula</i>] woodland
G1.2	Fluvial [<i>Fraxinus</i>] - [<i>Alnus</i>] and [<i>Quercus</i>] - [<i>Ulmus</i>] - [<i>Fraxinus</i>] woodland
G1.3	Mediterranean [<i>Populus</i>], [<i>Fraxinus</i>], [<i>Ulmus</i>] and related riparian woodland
G1.4	Broadleaved swamp woodland not on acid peat
G1.5	Broadleaved swamp woodland on acid peat
G1.6	[<i>Fagus</i>] woodland
G1.7	Thermophilous deciduous woodland
G1.8	Acidophilous [<i>Quercus</i>]-dominated woodland
G1.9	Non-riverine woodland with [<i>Betula</i>], [<i>Populus tremula</i>], [<i>Sorbus aucuparia</i>] or [<i>Corylus avellana</i>]
G1.A	Meso- and eutrophic [<i>Quercus</i>], [<i>Carpinus</i>], [<i>Fraxinus</i>], [<i>Acer</i>], [<i>Tilia</i>], [<i>Ulmus</i>] and related woodland
G1.B	Non-riverine [<i>Alnus</i>] woodland
G1.C	Highly artificial broadleaved deciduous forestry plantations
G1.D	Fruit and nut tree orchards
G2	Broadleaved evergreen woodland
G2.9	Evergreen orchards and groves
G3	Coniferous woodland
G3.1	[<i>Abies</i>] and [<i>Picea</i>] woodland
G3.2	Alpine [<i>Larix</i>] - [<i>Pinus cembra</i>] woodland
G3.3	[<i>Pinus uncinata</i>] woodland
G3.5	[<i>Pinus nigra</i>] woodland
G3.6	Subalpine mediterranean [<i>Pinus</i>] woodland
G3.7	Lowland to montane mediterranean [<i>Pinus</i>] woodland (excluding [<i>Pinus nigra</i>])
G4	Mixed deciduous and coniferous woodland
G4.1	Mixed swamp woodland

G4.2	Mixed taiga woodland with [Betula]
G4.6	Mixed [Abies] - [Picea] - [Fagus] woodland
G4.8	Mixed non-riverine deciduous and coniferous woodland
G4.F	Mixed forestry plantations
G5	Lines of trees, small anthropogenic woodlands, recently felled woodland, early-stage woodland and coppice
G5.1	Lines of trees
G5.2	Small broadleaved deciduous anthropogenic woodlands
G5.5	Small mixed broadleaved and coniferous anthropogenic woodlands
G5.8	Recently felled areas
H	Inland unvegetated or sparsely vegetated habitats
H2	Screes
H2.1	Cold siliceous screes
H2.2	Cold limestone screes
H2.3	Temperate-montane acid siliceous screes
H2.4	Temperate-montane calcareous and ultra-basic screes
H2.5	Acid siliceous screes of warm exposures
H2.6	Calcareous and ultra-basic screes of warm exposures
H3	Inland cliffs, rock pavements and outcrops
H3.1	Acid siliceous inland cliffs
H3.2	Basic and ultra-basic inland cliffs
H3.4	Wet inland cliffs
H3.5	Almost bare rock pavements, including limestone pavements
H3.6	Weathered rock and outcrop habitats
H4	Snow or ice-dominated habitats
H4.1	Snow packs
H4.2	True glaciers
H4.3	Rock glaciers and unvegetated ice-dominated moraines
H5	Miscellaneous inland habitats with very sparse or no vegetation
H5.2	Glacial moraines with very sparse or no vegetation
H5.3	Sparsely- or un-vegetated habitats on mineral substrates not resulting from recent ice activity
H5.6	Trampled areas
I	Regularly or recently cultivated agricultural, horticultural and domestic habitats
I1	Arable land and market gardens
I1.1	Intensive unmixed crops
I1.2	Mixed crops of market gardens and horticulture
I1.3	Arable land with unmixed crops grown by low-intensity agricultural methods
I1.4	Inundated or inundatable croplands, including rice fields
I1.5	Bare tilled, fallow or recently abandoned arable land
I2	Cultivated areas of gardens and parks
I2.1	Large-scale ornamental garden areas
I2.2	Small-scale ornamental and domestic garden areas
I2.3	Weed communities of recently abandoned garden areas
J	Constructed, industrial and other artificial habitats
J1	Buildings of cities, towns and villages
J1.1	Residential buildings of city and town centres
J1.2	Residential buildings of villages and urban peripheries

J1.3	Urban and suburban public buildings
J1.4	Urban and suburban industrial and commercial sites still in active use
J1.5	Disused constructions of cities, towns and villages
J1.6	Urban and suburban construction and demolition sites
J1.7	High density temporary residential units
J2	Low density buildings
J2.1	Scattered residential buildings
J2.2	Rural public buildings
J2.3	Rural industrial and commercial sites still in active use
J2.4	Agricultural constructions
J2.5	Constructed boundaries
J2.6	Disused rural constructions
J2.7	Rural construction and demolition sites
J4	Transport networks and other constructed hard-surfaced areas
J4.1	Weed communities of transport networks and other constructed hard surfaced areas
J4.2	Road networks
J4.3	Rail networks
J4.4	Airport runways and aprons
J4.5	Hard-surfaced areas of ports
J4.6	Pavements and recreation areas
J4.7	Constructed parts of cemeteries
J5	Highly artificial man-made waters and associated structures
J5.3	Highly artificial non-saline standing waters
J5.4	Highly artificial non-saline running waters
J5.5	Highly artificial non-saline fountains and cascades
J6	Waste deposits
J6.1	Weed communities of waste deposits
J6.2	Household waste and landfill sites
J6.3	Non-agricultural organic waste
J6.4	Agricultural and horticultural waste
J6.5	Industrial waste
J6.6	Waste resulting from building construction or demolition
Habitat complexes	
X01	Estuaries
X03	Brackish coastal lagoons
X04	Raised bog complexes
X05	Snow patch habitats
X06	Crops shaded by trees
X07	Intensively-farmed crops interspersed with strips of spontaneous vegetation
X08	Rural mosaics, consisting of woods, hedges, pastures and crops
X09	Pasture woods (with a tree layer overlying pasture)
X10	Mixed landscapes with a woodland element (bocages)
X11	Large parks
X13	Land sparsely wooded with broadleaved deciduous trees
X14	Land sparsely wooded with broadleaved evergreen trees
X15	Land sparsely wooded with coniferous trees
X16	Land sparsely wooded with mixed broadleaved and coniferous trees

X20	Treeline ecotones
X21	Archaeological sites
X22	Small city centre non-domestic gardens
X23	Large non-domestic gardens
X24	Domestic gardens of city and town centres
X25	Domestic gardens of villages and urban peripheries
X28	Blanket bog complexes

Table 2: Georgian coastal habitats proposed for addition to EUNIS

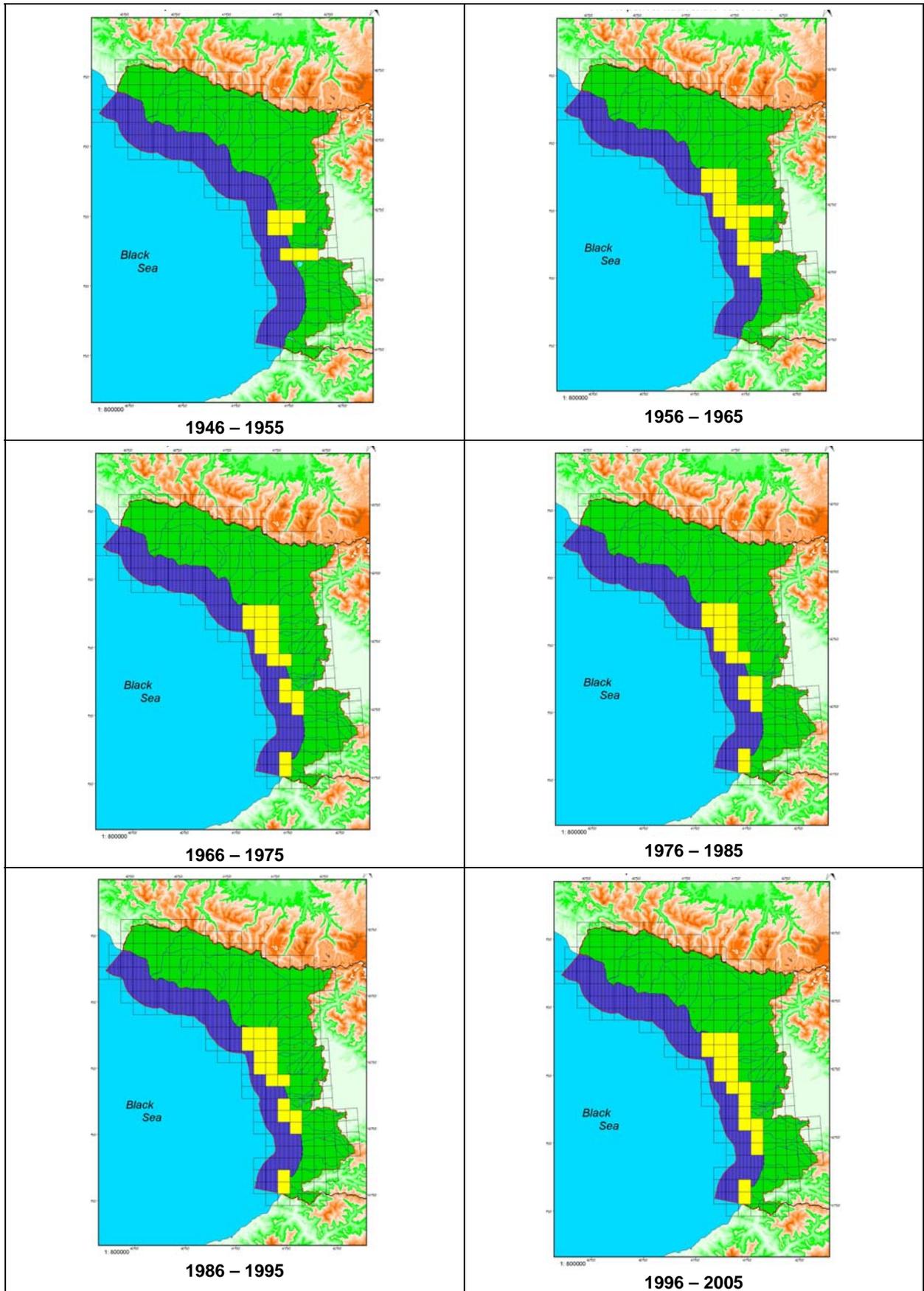
Code/name	G1.76 Relict Kolkhic Forests
Description	Description: Relict Broad-leafed deciduous forest. The following endemic species dominate here: <i>Quercus hartwissiana</i> , <i>Quercus imeretina</i> , <i>Pterocarpa pterocarpa</i> , <i>Buxus Colchica</i> and lianas like <i>Rubus hirtus</i> , <i>Humulus lupulus</i> , <i>Smilax excelsa</i> . This lowland habitat type occurs usually on the border of bogs on peat soils.
Code/name	F2.226 'Shqeriani'
Description	Mountainous scrub formation. Adjara and Laz endemic species are represented here: <i>Rhododendron ungerii</i> , <i>Rhododendron smirnowii</i> , <i>Epigea gaultherioides</i> . The substrate is Acid granite.
Code/name	E. Secondary meadows [coenocis]
Description	Occurs in places where the forest was cut a 100 years ago (or more). After this, secondary cenosis has been established. It is dominated by invasive species such as <i>Polygonum thunbergii</i> , <i>Sporoborus fertilis</i> . Today they represent low quality pastures. Substrate is alkaline.

**Table 3: Species of Black Sea importance occurring in Georgia
(Annex II of BSBLCP)**

Number in Annex	Group in Annex	Species
1	Algae	<i>Cystoseira barbata</i>
3	Algae	<i>Dictyota dichotoma</i>
7	Plants	<i>Salvinia natans</i>
8	Plants	<i>Trapa natans</i>
9	Plants	<i>Zostera Marina</i>
11	Spongia	<i>Lissodendoryx variisclera</i>
13	Polychaeta	<i>Eteone siphonodonta</i>
15	Polychaeta	<i>Nainereis laevigata</i>
16	Polychaeta	<i>Ophelia bicornis</i>
17	Polychaeta	<i>Phyllodoce nana</i>
19	Crustacea	<i>Apseudopsis ostroumovi</i>
24	Crustacea	<i>Callianassa pontica</i>
25	Crustacea	<i>Callianassa truncata</i>
26	Crustacea	<i>Caprella acanthifera</i>
27	Crustacea	<i>Carcinus mediterraneus</i>
36	Crustacea	<i>Labidocera brunescens</i>
37	Crustacea	<i>Macropipus arcuatus</i>
38	Crustacea	<i>Pilumnus hirtellus</i>
39	Crustacea	<i>Pontella mediterranea</i>
44	Crustacea	<i>Upogebia pusilla</i>
45	Crustacea	<i>Xantho poressa</i>
49	Halacaridae	<i>Halacarellus procerus</i>
50	Mollusca	<i>Bela nebula</i>
51	Mollusca	<i>Cyclope donovani</i>
52	Mollusca	<i>Donacilla cornea</i>
56	Mollusca	<i>Pachygrapsus marmoratus</i>
57	Mollusca	<i>Patella tarentina</i>
62	Pisces	<i>Acipenser guldenstaedti</i>
63	Pisces	<i>Acipenser guldenstaedti colchicus V. Marti</i>
64	Pisces	<i>Acipenser nudiventris</i>
66	Pisces	<i>Acipenser stellatus</i>
67	Pisces	<i>Acipenser sturio</i>
68	Pisces	<i>Aidablennius sphinx</i>
69	Pisces	<i>Aphia minuta</i>
71	Pisces	<i>Belone belone euxini</i>
72	Pisces	<i>Callionymus belenus</i>
73	Pisces	<i>Dicentrarchus labrax</i>
74	Pisces	<i>Diplodus annularis</i>
75	Pisces	<i>Hippocampus quittulatus microstephanus</i>
77	Pisces	<i>Huso huso</i>
78	Pisces	<i>Knipowitschia longicaudata</i>
79	Pisces	<i>Lipophrys pavo</i>
82	Pisces	<i>Mesogobius batrachocephalus</i>
83	Pisces	<i>Mullus barbatus ponticus</i>
84	Pisces	<i>Nerophis ophidion</i>
85	Pisces	<i>Pomatomus saltator</i>
86	Pisces	<i>Pomatoschistus caucasicus</i>
87	Pisces	<i>Salmo trutta labrax</i>
88	Pisces	<i>Sarda sarda</i>
89	Pisces	<i>Scomber scombrus</i>
90	Pisces	<i>Scorpena porcus</i>
92	Pisces	<i>Serranus scriba</i>
94	Pisces	<i>Spicara smarís</i>

Number in Annex	Group in Annex	Species
95	Pisces	<i>Syngnathus tenuirostris</i>
96	Pisces	<i>Syngnathus typhle</i>
98	Pisces	<i>Trigla lucerna</i>
100	Aves	<i>Asio flammeus</i>
102	Aves	<i>Ciconia nigra</i>
103	Aves	<i>Gelochelidon nilotica</i>
104	Aves	<i>Haliaeetus albicilla</i>
105	Aves	<i>Himantopus himantopus</i>
107	Aves	<i>Pandion haliaetus</i>
109	Aves	<i>Pelecanus crispus</i>
110	Aves	<i>Pelecanus onocrotalus</i>
114	Aves	<i>Platalea leucorodia</i>
115	Aves	<i>Plegadis falcinellus</i>
116	Aves	<i>Puffinus puffinus yelkouan</i>
117	Aves	<i>Recurvirostra avosetta</i>
120	Aves	<i>Sturnus roseus</i>
121	Aves	<i>Tadorna ferruginea</i>
122	Mammalia	<i>Delphinus delphis</i>
123	Mammalia	<i>Lutra lutra</i>
125	Mammalia	<i>Phocoena phocoena</i>
126	Mammalia	<i>Tursiops truncatus</i>

Figure 3. Distribution of *Acipenser nudiiventris* by 10 km grid over six decennial time periods



4 Coastal Habitat Assessment

4.1 Risk Assessment

The Helcom (1998) red list highlights the importance of designing a coherent and robust system of criteria that will communicate as precisely as possible the degree of threat posed to a certain habitat type. This essentially entails undertaking a risk assessment for each habitat type, an exercise which, compared with the development of criteria and categories for species red lists, is a relatively new field (for a recent example, see the EnRisk project of ECNC at www.ecnc.nl/doc/projects/enrisk.html).

The typical procedure for a risk assessment would address the following questions:

- What impacts to the habitat do or may occur?
- How harmful are these impacts to the habitat type?
- How likely is it that these impacts will occur?
- How frequently and where will these impacts occur?
- How much confidence can be placed in the results of the risk assessment?
- What are the critical data gaps and can these gaps be filled?
- Are further iterations to the risk assessment needed?

First, with regard to the kinds of impacts that marine and coastal habitats may suffer, the Helsinki red list provides a codified list that can be conveniently adopted for the Black Sea HRB:

Code	Impact
Group C: LOSS OR CHANGE (irreversible or reversible)	
CA	Agriculture (intensive, changing, land reclamation, cessation of traditional farming)
CB	Construction, dredging, dumping of dredged material
CD	Coastal defence e.g. dyking, sand stabilisation
CE	Eutrophication (fertilization, sewage, combustion)
CF	Overfishing, bottom trawling
CFm	Mariculture or fish farming
CG	Mechanical damage (traffic, tourism)
CH	Building activities for recreation purposes (chalets, marinas)
CM	Mineral extraction (prospecting, mining, dredging)
CP	Pollution (non-eutrophication) of air, earth and water (pesticides, waste disposal, sewage, combustion, oil)
CT	Forestry (deforestation, plantations, changes)
CW	Water regulation (drainage, rerouting, extraction/desiccation, land reclamation)
CY	Military activities (firing and bombing ranges, etc)
Group D: HABITAT DISTURBANCE (temporary)	
DA	Agriculture, forestry
DB	Construction, dredging, dumping of dredged material, mineral extraction
DF	Fishing, hunting
DR	Recreational activities
DY	Military activities

Second, it will be evident that impacts may affect different habitat types in different ways and with different consequences related to the extent, distribution, intactness and biophysical

properties of the habitat type concerned. Accordingly, it is important to consider the *vulnerability* of a particular habitat type to a certain impact (the likely harm this is being or might be done).

The third factor to take into account is the *in situ ecological quality* of the habitat type in terms of how complete and representative is its associated biological communities of plants and animals: creeping degradation of a habitat means the loss of certain physical structures, species communities and characteristic animals and plants living in that habitat (and perhaps eventual conversion to a different habitat type).

A fourth attribute of habitat types, related to quality, is *importance* for supporting threatened species, whether for breeding, feeding or resting on migration (or a combination of all of these).

4.2 Habitat Type Risk Assessment Criteria

The Helsinki red list suggests that criteria for habitat risk assessment should be suitable to describe qualitative (subjective) and quantitative (objective) trends in the conditions of a particular habitat type. Furthermore, trends should be assessed over a sufficient period of time (10 to 20 years, ideally 100 to 150 years) to avoid misinterpreting natural fluctuations.

However, in recent years there has been a general acceptance that risk assessment criteria should be as quantitative as possible, based on the best available ecological science. The reason for this is evident in the Helsinki red list itself, in that only qualitative criteria (i.e. the subjective best judgement of the expert group) were used to determine the status of the biotopes in the Baltic Sea; there is a high likelihood that a different expert group might reach different conclusions, especially as time passes.

Given the increasing availability of powerful computers and improvements in remote sensing and GIS technologies, as well as pan-European harmonisation of the basic categorisation of habitat types, a move to more quantitative or objective criteria seems justified, and has been adopted in this pilot study for the Black Sea HRB. It is not claimed that these criteria are yet definitive, but they provide a basis for further discussion and testing.

4.2.1 *Habitat vulnerability criteria*

The starting point was to adapt the criteria published in 2000 by IUCN-The World Conservation Union (see <http://www.iucn.org/themes/ssc/redlists/categor.htm>) for assessing the status of species for the international red list insofar as these could be used for habitat risk assessment in terms of vulnerability to impacts. These criteria are:

Code	Criterion
V1	Overall extent
V2	Occurrence
V3	Quantitative analysis

V1: Overall extent

This criterion measures the absolute coverage of the habitat type in hectares, as deduced from classification of satellite imagery.

V2: Occurrence

This criterion is calculated as the percentage of 10 km grid cells in which the habitat type occurs as a proportion of the total number of grid cells in the Black Sea coastal region. It aims to provide a measure of whether the distribution, as opposed to extent, changes over time. More sophisticated statistical techniques might be applied, such as nearest-neighbour analysis, to assess fragmentation.

V2: Quantitative analysis

This criterion concerns any form of analysis which estimates the extinction probability of a habitat type based on known impacts, vulnerability, and any specified management options. Quantitative analyses (e.g. climate change / sea-level rise models) should make full use of all relevant available data to provide an estimate of the impact of stochastic events on the habitat type. In presenting the results of quantitative analyses, the assumptions (which must be appropriate and defensible), the data used and the uncertainty in the data or quantitative model must be documented.

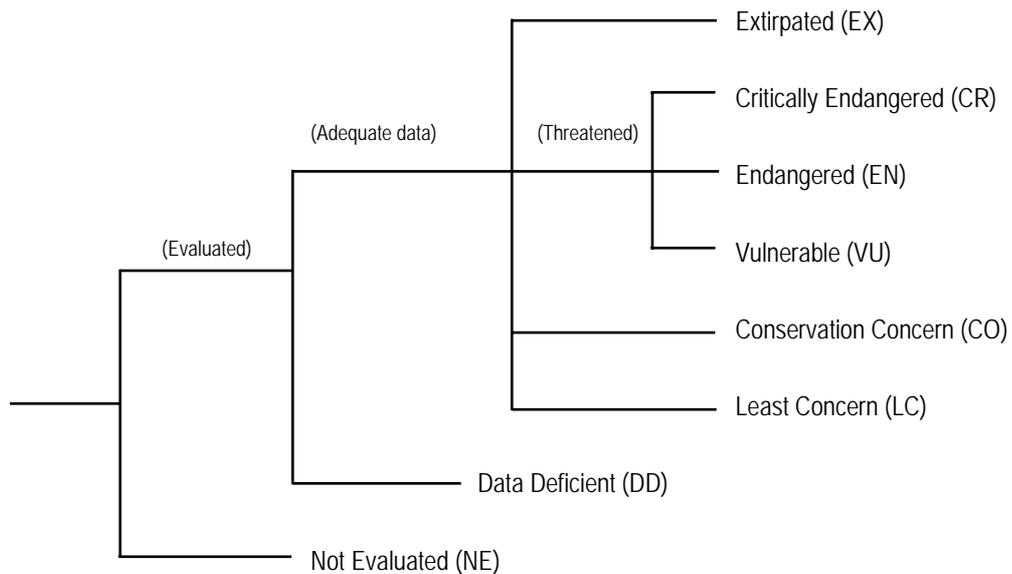
4.2.2 *Habitat quality / importance criteria*

To capture the ecological quality and importance of a habitat type, the following criteria (derived from those contained in the Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat, the Bern Convention on the Conservation of European Wildlife and Natural Habitats and EC Habitats Directive) were established:

Code	Criterion
Q1	The habitat type is endemic to, i.e. found only or predominantly in, the Black Sea region
Q2	The habitat supports an important population (1% or more) at any stage in its life cycle of any species listed for protection in any annex of the Bern Convention, Bonn Convention, EC Birds Directive or EC Habitats Directive, or important species listed in Annexes of the Protocol
Q3	The habitat is highly representative of the Black Sea region (covers 5% or more of the area) and is in a natural or near-natural condition
Q4	The habitat contains populations of plant and/or animal species important for maintaining the biological diversity of the Black Sea region

4.3 Habitat Risk Categories

A scheme of habitat risk categories is provided in Figure 2, again based on those developed by IUCN-The World Conservation Union for the international species red list. The differences are that “Extirpated” is used instead of “Extinct” as this seems a more appropriate term for habitats; “Extinct in the Wild” has been dropped; and “Near Threatened” substituted by “Conservation Concern”.

Figure 4: Scheme of Habitat Risk Categories (after IUCN, 2000)

4.3.1 Extirpated (EX)

A habitat type is extirpated when all trace of it has disappeared and there is no reasonable prospect for its natural recovery or restoration.

4.3.2 Critically endangered (CR)

A habitat type is Critically Endangered when the best available evidence indicates that it meets any of the following criteria, and it is therefore considered to be facing an extremely high risk of extirpation:

- V1a Reduction in extent observed, estimated, inferred or suspected of 90% or more over the last 10 years, where the causes of the reduction are clearly reversible and understood and ceased.
- V1b Reduction in extent observed, estimated, inferred or suspected of 80% or more over the last 10 years, where the causes of the reduction may not be reversible or may not be understood or may not have ceased.
- V2 Occurrence estimated to be less than 1,000 ha and is severely fragmented (occurs in 5 or more 10 km grid cells) or known to exist at only a single location.
- V3 Quantitative analysis showing the probability of extirpation is at least 50% within 10 years.
- Q2 Reduction of 90% or more in the population of any important species observed, estimated, inferred or suspected over the last 10 years, where the causes of the reduction are clearly reversible and understood.
- Q4 Reduction of 50% or more of species composition important for maintaining Black Sea biodiversity in the last 10 years.

4.3.3 Endangered (EN)

A habitat type is Endangered when the best available evidence indicates that it meets any of the following criteria, and it is therefore considered to be facing a very high risk of extirpation:

- V1a Reduction in extent observed, estimated, inferred or suspected of 70% or more over the last 10 years, where the causes of the reduction are clearly reversible and understood and ceased.
- V1b Reduction in extent observed, estimated, inferred or suspected of 50% or more over the last 10 years, where the causes of the reduction may not be reversible or may not be understood or may not have ceased.
- V2 Extent of occurrence estimated to be less than 10,000 ha and is highly fragmented (occurs in 20 or more 10 km grid cells) or known to exist at only a single location.
- V3 Quantitative analysis showing the probability of extirpation is at least 20% within 20 years.
- Q2 Reduction of 50% or more in the population of any important species observed, estimated, inferred or suspected over the last 10 years, where the causes of the reduction are clearly reversible and understood.
- Q4 Reduction of 20% of more of species composition important for maintaining Black Sea biodiversity in the last 10 years.

4.3.4 *Vulnerable (VU)*

A habitat type is Vulnerable when the best available evidence indicates that it meets any of the following criteria, and it is therefore considered to be facing a high risk of extirpation:

- V1a Reduction in extent observed, estimated, inferred or suspected of 50% or more over the last 10 years, where the causes of the reduction are clearly reversible and understood and ceased.
- V1b Reduction in extent observed, estimated, inferred or suspected of 30% or more over the last 10 years, where the causes of the reduction may not be reversible or may not be understood or may not have ceased.
- V2 Extent of occurrence estimated to be less than 50,000 ha and is significantly fragmented (occurs in 50 or more 10 km grid cells) or known to exist at only a single location.
- V3 Quantitative analysis showing the probability of extirpation is at least 10% within 50 years.
- Q2 Reduction of 20% or more in the population of any important species observed, estimated, inferred or suspected over the last 10 years, where the causes of the reduction are clearly reversible and understood.
- Q4 Reduction of 10% of more of species composition important for maintaining Black Sea biodiversity in the last 10 years.

4.3.5 *Conservation Concern (CO)*

A habitat type is of Conservation Concern when the best available evidence indicates that it meets any of the following criteria, and it is therefore considered to be a high priority for monitoring and conservation management:

- V1a Reduction in extent observed, estimated, inferred or suspected of 20% or more over the last 10 years, where the causes of the reduction are clearly reversible and understood and ceased.
- V1b Reduction in extent observed, estimated, inferred or suspected of 10% or more over the last 10 years, where the causes of the reduction may not be reversible or may not be understood or may not have ceased.
- V2 Extent of occurrence estimated to be less than 100,000 ha and is significantly fragmented (occurs in 100 or more 10 km grid cells) or known to exist at only a single location.

- V3 Quantitative analysis showing the probability of extirpation is at least 10% within 50 years.
- Q1 The habitat type is endemic to, i.e. found only or predominantly in, the Black Sea region.
- Q2 The habitat supports an important population (1% or more) at any stage in its life cycle of any species listed for protection in any annex of the Bern Convention, Bonn Convention, EC Birds Directive or EC Habitats Directive, or important species listed in Annexes of the Protocol.
- Q3 The habitat is highly representative of the Black Sea region (covers 5% or more of the area) and is in a natural or near-natural condition.
- Q4 The habitat contains populations of plant and/or animal species important for maintaining the biological diversity of the Black Sea region.

4.3.6 *Least Concern (LC)*

A habitat type is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Conservation Concern. Widespread and manmade habitat types are typically included in this category.

4.3.7 *Data Deficient (DD)*

A habitat type is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extirpation. Data Deficient is therefore not a category of threat. Listing of a habitat type in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate.

4.3.8 *Not Evaluated (NE)*

A habitat type is Not Evaluated when it has not yet been evaluated against the criteria.

5 Red Data Habitats in Georgia

Based on the habitat risk assessment criteria described in the previous section, and information currently available, ten threatened habitat types were identified, as listed below. All types fell in to the risk category “endangered” because of their small geographic area and rather fragmented distribution.

#	Category	Code	EUNIS habitat type
1	EN	D1.1	Raised bogs
2	EN	B1.3	Shifting coastal dunes
3	EN	G1.5	Broadleaved swamp woodland on acid peat
4	EN	A4.2	Sub-littoral sands and muddy sands
5	EN	A4.1	Sublittoral mobile cobbles, gravels and coarse sands
6	EN	C1.5	Permanent inland saline and brackish lakes, ponds and pools
7	EN	A1.1	Littoral rock very exposed to wave action
8	EN	A2.2	Littoral sands and muddy sands
9	EN	A4.3	Sublittoral muds
10	EN	X01	Estuaries

Maps of the location and spatial extent of these habitats were produced using ERDAS imagine and ESRI Arcview software. It should be noted that the habitats location/extent information is entirely derived from the satellite imagery and/or topographic maps and personal experience of habitats experts. Unfortunately, no ground-truthing could be conducted at this stage.

For each of the threatened habitats data sheets were prepared including the following information:

- Modifications: Black Sea region = Georgia coastal / marine area, and species only from Annex II of the BSBLCP
- Habitat Risk Category
- Habitat type - description (EUNIS)
- Map (including stats like %cover of area)
- Criteria met for importance
- Key species supported
- Status
- Conservation impacts
- Conservation measures required

The data sheets with all the above associated information are given in Appendix A to this report.

6 Conclusions

This pilot study on red data habitats in Georgia achieved a number of positive conclusions, including:

- demonstrating the feasibility of using the EUNIS habitat classification system as a standard for delimiting different habitat types in the coastal zone and its immediate hinterland;
- the application of remote sensing and GIS techniques for locating, mapping and assessing the habitat types identified;
- assembling species information and creating a data base capable of displaying distribution maps using a 10 km grid and over six decennial periods in order to assess trends;
- devising a quantitative set of criteria for habitat risk assessment independent of the habitat types themselves so that baseline conditions can be determined and changes in status more easily monitored.

Unfortunately, the robustness of the habitat mapping could not be tested in the field owing to the lack of resources for ground surveys. Even so, the ten habitat types classified as “endangered” appear to be accurate, and further investigation would be likely to reveal further habitats in other risk categories.

There appear to be no major scientific obstacles (funds and capacity for coordination permitting) in extending the approach developed in this study across the Black Sea coastal region as a whole. The main refinement required would be a thorough testing of the habitat risk assessment criteria in order to achieve an ecologically more meaningful system over such a large area.

In the meantime, due attention to the ten Georgian endangered habitats should be paid in ongoing ICZM plans.

7 Reference Sources

The following internet-based resources were used in the preparation of this report.

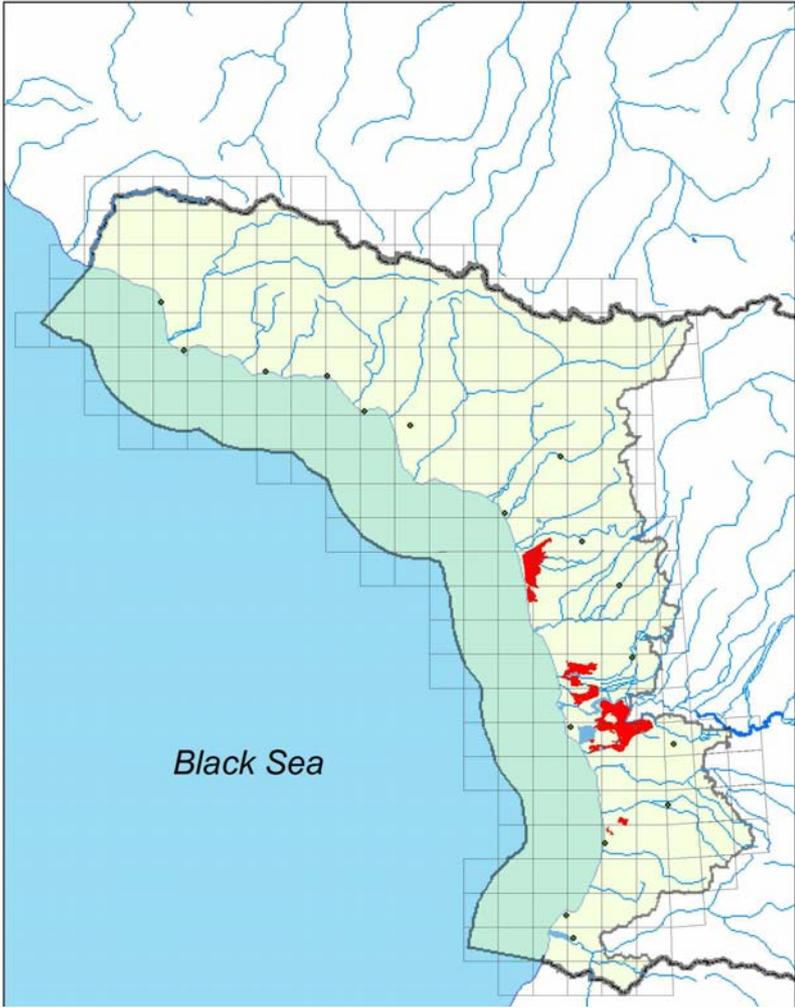
Owner	Topic	Address
Black Sea Commission	Protocol on Black Sea Biodiversity and Landscape Conservation	http://www.blacksea-commission.org/OfficialDocuments/BLDCProtocol_main.htm
European Centre for Nature Conservation	Environmental Risk Assessment for European Agriculture	www.ecnc.nl/doc/projects/enrisk.html
European Environment Agency	Glossary of environmental terms	http://glossary.eea.eu.int/EEAGlossary
European Environment Agency	European Biodiversity Mapping Grid	http://dataservice.eea.eu.int/dataservice/metadetails.asp?id=625
European Environment Agency	European Habitat Classification (EUNIS)	http://eunis.eea.eu.int/habitats.jsp
Helsinki Commission: Baltic Marine Environment Protection Commission	Red List of Marine and Coastal Biotopes and Biotope Complexes of the Baltic Sea, Belt Sea and Kattegat	www.helcom.fi/a/proceedings/bsep75.pdf
World Conservation Union (IUCN)	Species Red List Categories	http://www.iucn.org/themes/ssc/redlists/categor.htm

APPENDIX A

Threatened Coastal Habitats in Georgia

EUNIS Habitat type: D1.1 – Raised bogs
Category: EN
Total area 9,190 ha
EUNIS Description: "Highly oligotrophic, strongly acidic communities composed mainly of sphagnum growing on, and forming, peat and deriving moisture and nutrients only from rainfall (ombrotrophic). They form only in cool climates with heavy rainfall. They are most widespread in the boreal zone and in the mountains and hills of the nemoral zone; they occur locally in the lowlands of the nemoral zone and rarely in the middle Eurasian steppe zone. Their independence from ground water is the result either of upward growth or of changes in the water table. Bogs harbour, in addition to various sphagnum species, which are abundant, dominant and the major component of their formation, a small number of acidophilous plants such as [<i>Eriophorum vaginatum</i>], [<i>Scirpus cespitosus</i>] ([<i>Trichophorum cespitosum</i>]), [<i>Carex pauciflora</i>], [<i>Carex pauperula</i>], [<i>Ledum palustre</i>], [<i>Vaccinium oxycoccos</i>], [<i>Andromeda polifolia</i>], [<i>Drosera rotundifolia</i>] and lichens. Animal species are not numerous but those that are adapted to bogs are highly specialised. (Source: Devillers, P., Devillers-Terschuren, J. and Vander Linden, C. (2001))
Criteria met for importance V2
Key species supported: <i>Recurvirostra avocetta</i> , <i>Himantopus himantopus</i> , <i>Gelochelidon nilotica</i> , <i>Asio flammeus</i> , <i>Pelecanus onocrotalus</i> , <i>Pelecanus crispus</i> , <i>Haliaeetus albicilla</i> , <i>Ciconia nigra</i> , <i>Pandion haliaetus</i> , <i>Plegadis falcinellus</i> , <i>Platalea leucorodia</i>
Status: Kolkheti mires are included in the Kolkheti National park. Kobuleti mires are within the strict nature zone of the Kobuleti Nature Reserve.
Conservation impacts: Agriculture, construction, pollution, water regulation
Conservation measures required: Protection, restoration
Habitat location/distribution map

EUNIS Habitat type: B1.3 – Shifting coastal dunes
Category: EN
Total area 450 ha
EUNIS Description: Mobile sands of the coasts of the boreal, nemoral, steppe, Mediterranean and warm-temperate humid zones, unvegetated or occupied by open grasslands; they may form tall dune ridges or, particularly along the Mediterranean and the Black Sea, be limited to a fairly flat upper beach, still subject in part to inundation. (Source: Devillers, P., Devillers-Terschuren, J. and Vander Linden, C. (2001))
Criteria met for importance V2
Key species supported: <i>Recurvirostra avocetta</i> , <i>Himantopus himantopus</i> , <i>Gelochelidon nilotica</i> , <i>Asio flammeus</i> , <i>Pelecanus onocrotalus</i> , <i>Pelecanus crispus</i> , <i>Plegadis falcinellus</i> , <i>Platalea leucorodia</i>
Status: Part of the sand-dunes fall within Kolkheti National Park
Conservation impacts: Construction, pollution
Conservation measures required: Protection
Habitat location/distribution map

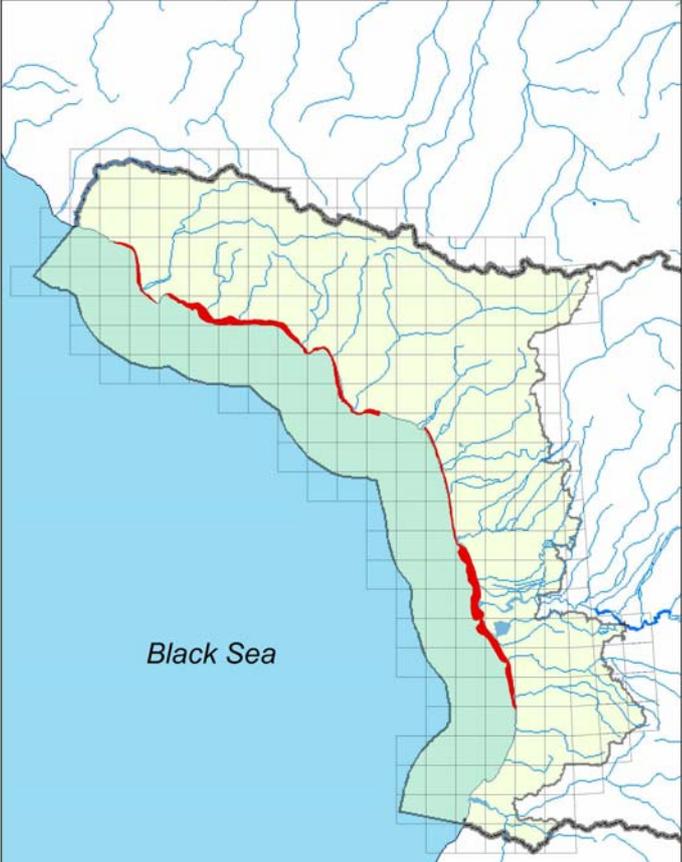

EUNIS Habitat type: G1.5 – Broadleaved swamp woodland on acid peat
Category: EN
Total area 19,770 ha
EUNIS Description:
Criteria met for importance V2
Key species supported: <i>Asio flammeus</i> , <i>Haliaeetus albicilla</i> , <i>Ciconia nigra</i> , <i>Pandion haliaetus</i>
Status: The central part of the woodland falls within Kolkheti National Park
Conservation impacts: Agriculture, forestry
Conservation measures required: Protection, enforcement
Habitat location/distribution map


EUNIS Habitat type: A4.2 – Sub-littoral sands and muddy sands
Category: EN
Total area 11,453 ha
EUNIS Description:
Criteria met for importance V2
Key species supported: <i>Cystoseira barbata</i> , <i>Dictyota dichotoma</i> , <i>Nainereis laevigata</i> , <i>Ophelia bicornis</i> , <i>Phyllodoce nana</i> , <i>Apseudopsis ostroumovi</i> , <i>Callianassa pontica</i> , <i>Caprella acanthifera</i> , <i>Carcinus mediterraneus</i> , <i>Macropipus arcuatus</i> , <i>Pilumnus hirtellus</i> , <i>Upogebia pusilla</i> , <i>Bela nebula</i> , <i>Cyclope donovani</i> , <i>Donacilla cornea</i> , <i>Acipenser guldenstaedti colchicus</i> , <i>Acipenser nudiventris</i> , <i>Acipenser stellatus</i> , <i>Huso huso</i> , <i>Mesogobius batrachocephalus</i> , <i>Mullus barbatus ponticus</i> , <i>Nerophis ophidion</i> , <i>Syngnatus tenuirostris</i> , <i>Syrignatus typhle</i> , <i>Trigla lucerna</i>
Status: No conservation status
Conservation impacts: Overfishing, bottom trawling
Conservation measures required: Protection, enforcement
Habitat location/distribution map
 <p>The map displays the coastline of Georgia, with the Black Sea to the west. The land area is shaded in light green, and the sea is light blue. A red line indicates the distribution of the habitat, which follows the coast from the western part of Georgia down to the southern part. The text 'Black Sea' is written in the sea area.</p>

EUNIS Habitat type: A4.1 – Sublittoral mobile cobbles, gravels and coarse sands
Category: EN
Total area 2,527 ha
EUNIS Description:
Criteria met for importance V2
Key species supported: <i>Cystoseira barbata</i> , <i>Dictyota dichotoma</i> , <i>Nainereis laevigata</i> , <i>Ophelia bicornis</i> , <i>Phyllodoce nana</i> , <i>Carcinus mediterraneus</i> , <i>Pilumnus hirtellus</i> , <i>Upogebia pusilla</i> , <i>Bela nebula</i> , <i>Cyclope donovani</i> , <i>Donacilla cornea</i> , <i>Callionyrnus belenus</i> , <i>Diplodus annularis</i> , <i>Hippocampus guttulatus microstephanus</i> , <i>Mesogobius batrachocephalus</i> , <i>Mullus barbatus ponticus</i> , <i>Scorpena porcus</i> , <i>Trigla lucerna</i>
Status: No conservation status
Conservation impacts: Pollution
Conservation measures required: Protection, enforcement
Habitat location/distribution map
 <p>The map displays the Black Sea coastline and inland river networks. A yellow-shaded area covers a large portion of the coastal and inland regions. A green-shaded area is located along the coast, and a red line highlights the specific habitat distribution within this green area. The text 'Black Sea' is printed in the blue water area.</p>

EUNIS Habitat type: C1.5 – Permanent inland saline and brackish lakes, ponds and pools
Category: EN
Total area 2,390 ha
EUNIS Description: Athalassic brackish, saline or hypersaline lakes, ponds or pools and their pelagic animal, green algal or lower algal communities, including marine mammal, bird and pelagic fish communities of the large inland seas of central Eurasia and of the big brackish lakes of the boreal zone. (Source: Devillers, P., Devillers-Terschuren, J. and Vander Linden, C. (2001))
Criteria met for importance V2
Key species supported: <i>Acipenser stellatus</i> , <i>Asio flammeus</i> , <i>Ciconia nigra</i> , <i>Gelochelidon nilotica</i> , <i>Haliaeetus albicilla</i> , <i>Himantopus himantopus</i> , <i>Pandion haliaetus</i> , <i>Pelecanus crispus</i> , <i>Pelecanus onocrotalus</i> , <i>Platalea leucorodia</i> , <i>Tadorna ferruginea</i> , <i>Lutra lutra</i>
Status: Lake Paliastomi is designated as a Ramsar site and included in Kolkheti National Park
Conservation impacts: Pollution, agriculture, eutrophication, military activities, fishing, hunting
Conservation measures required: Protection, enforcement
Habitat location/distribution map


EUNIS Habitat type: A1.1 – Littoral rock very exposed to wave action
Category: EN
Total area 14 ha (does not include Abkhazian coast)
EUNIS Description: Extremely exposed to exposed bedrock and boulder shores. Mussels and barnacles dominate these shores, occasionally with robust fucoids in extremely exposed conditions or turfs of red seaweed. (Source: Connor, D.W., Brazier, D.P., Hill, T.O., & Northen, K.O. (1997))
Criteria met for importance V2
Key species supported: <i>Cystoseira barbata</i> , <i>Dictyota dichotoma</i> , <i>Puffinus puffinus yelkouan</i> , <i>Halacarellus procerus</i> , <i>Pontella mediterranea</i> , <i>Labidocera brunescens</i> , <i>Patella tarentina</i> , <i>Pachygrapsus marmoratus</i>
Status: None
Conservation impacts: Coastal defence, pollution (non-eutrophic) of air, earth and water
Conservation measures required: Designation
Habitat location/distribution map


EUNIS Habitat type: A2.2 – Littoral sands and muddy sands
Category: EN
Total area 27,760 ha (does not include Abkhazian coast)
EUNIS Description: Shores of muddy sand, typically consisting of particles less than 4 mm in diameter, where the mud fraction (less than 0.063 mm diameter particles) makes up between 10% and 30% of the sediment. Typically, the sand fraction is medium (particle diameter 0.25-1 mm) or fine (particle diameter 0.063-0.25 mm) sand. Muddy sand usually forms gently sloping flats that remain water-saturated throughout the tidal cycle. They support communities predominantly of polychaetes and bivalves, including the lugworm [<i>Arenicola marina</i>], the cockle [<i>Cerastoderma edule</i>] and the Baltic tellin [<i>Macoma balthica</i>], but may also have seagrass [<i>Zostera noltii</i>] beds (LMS.Znol). (Source: Connor, D.W., Brazier, D.P., Hill, T.O., & Northen, K.O. (1997))
Criteria met for importance V2
Key species supported: <i>Cystoseira barbata</i> , <i>Dictyota dichotoma</i> , <i>Naineris laevigata</i> , <i>Ophelia bicornis</i> , <i>Phyllodoce nana</i> , <i>Apseudopsis ostroumovi</i> , <i>Callianassa pontica</i> , <i>Caprella acanthifera</i> , <i>Carcinus mediterraneus</i> , <i>Macropipus arcuatus</i> , <i>Pilumnus hirtellus</i> , <i>Upogebia pusilla</i> , <i>Bela nebula</i> , <i>Cyclope donovani</i> , <i>Donacilla cornea</i> , <i>Acipenser guldenstaedti colchicus</i> , <i>Acipenser nudiventris</i> , <i>Acipenser stellatus</i> , <i>Huso huso</i> , <i>Mesogobius batrachocephalus</i> , <i>Mullus barbatus ponticus</i> , <i>Nerophis ophidion</i> , <i>Syngnatus tenuirostris</i> , <i>Syngnatus typhle</i> , <i>Trigla lucerna</i> .
Status: Partly protected under the Kolkheti National Park
Conservation impacts: Overfishing, bottom trawling
Conservation measures required: Enforcement of fisheries regulations
Habitat location/distribution map


EUNIS Habitat type: A4.3 - Sublittoral muds
Category: EN
Total area 36,450 ha (does not include Abkhazian coast)
EUNIS Description:
Criteria met for importance V2
Key species supported: Eteone siphonodonta, Phyllodoce nana, Apseudopsis ostroumovi, Callianassa truncata, Caprella acanthifera, Carcinus mediterraneus, Pilumnus hirtellus, Bela nebula, Cyclope donovani, Acipenser guldenstaedti colchicus, Acipenser nudiventris, Acipenser stellatus, Acipenser sturio, Huso huso, Mesogobius batrachocephalus, Mullus barbatus ponticus, Nerophis ophidion, Syngnathus tenuirostris, Syngnathus typhle, Trigla lucerna
Status: None
Conservation impacts: Overfishing, bottom trawling
Conservation measures required: Enforcement of fishing regulations
Habitat location/distribution map


EUNIS Habitat type: X01 - Estuaries
Category: EN
Total area 870 ha
EUNIS Description: Broadening of rivers entering the sea. Detailed habitats can be coded by combining subdivisions of prefix 11 with the relevant physiographic subdivisions of unit 13.2. (Source: Devillers, P., Devillers-Terschuren, J. and Vander Linden, C. (2001))
Criteria met for importance V2
Key species supported: <i>Salvinia natans</i> , <i>Trapa natans</i> , <i>Zostera Marina</i> , <i>Acipenser guldenstaedti</i> , <i>Acipenser guldenstaedti colchicus</i> V. Marti, <i>Acipenser nudiventris</i> , <i>Acipenser stellatus</i> , <i>Acipenser sturio</i> , <i>Huso huso</i> , <i>Mesogobius batrachocephalus</i> , <i>Mullus barbatus ponticus</i> , <i>Salmo trutta labrax</i> , <i>Dicentrarchus labrax</i> , <i>Diplodus annularis</i> , <i>Nerophis ophidion</i> , <i>Pomatoschistus caucasicus</i> , <i>Spicara smaris</i> , <i>Syngnathus tenuirostris</i> , <i>Syngnathus typhle</i> , <i>Knipowitschia longicaudata</i> , <i>Ciconia nigra</i> , <i>Gelochelidon nilotica</i> , <i>Haliaeetus albicilla</i> , <i>Himantopus himantopus</i> , <i>Pandion haliaetus</i> , <i>Pelecanus crispus</i> , <i>Pelecanus onocrotalus</i> , <i>Platalea leucorodia</i> , <i>Plegadis falcinellus</i> , <i>Puffinus puffinus</i> , <i>yelkouan</i> , <i>Recurvirostra avosetta</i> , <i>Tadorna ferruginea</i>
Status: None
Conservation impacts: Agriculture, construction, coastal defence, building activities for recreation purposes, mineral extraction, pollution (non-eutrophic) of air, earth and water, water regulation, military activities, fishing, hunting
Conservation measures required: Designation, protection, enforcement
Habitat location/distribution map

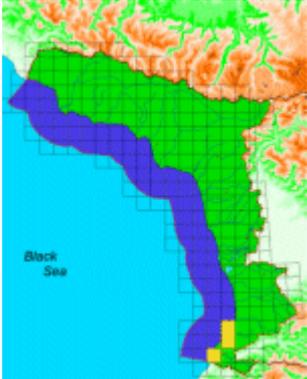
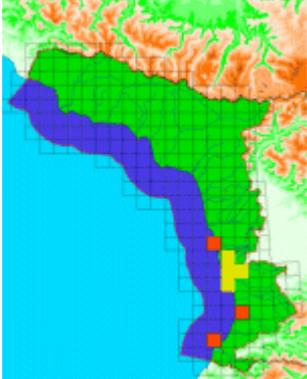

APPENDIX B

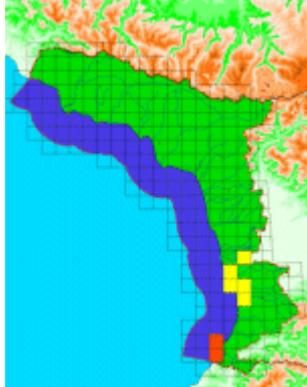
**Recent distribution (1996 – 2004) of Selected Species of
Black Sea Importance in Georgia**

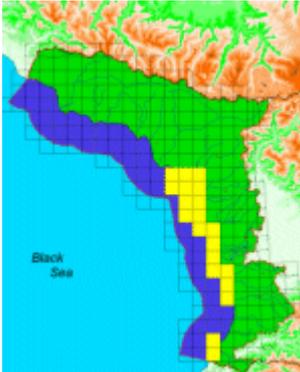
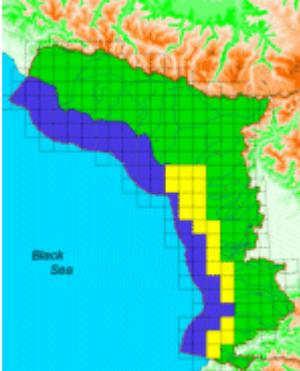
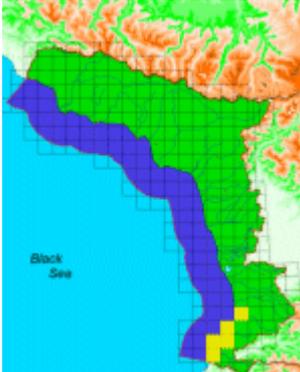
(from Black Sea Biodiversity and Landscape Conservation Protocol, Annex II)

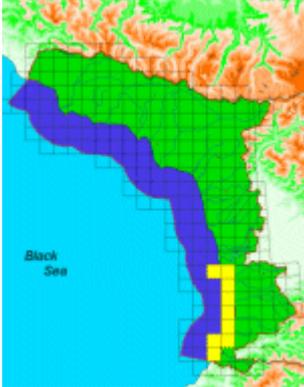
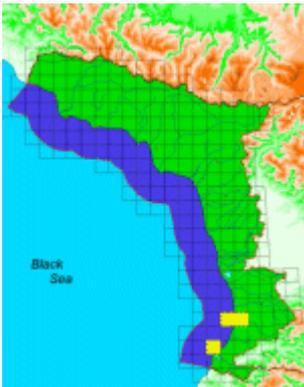
Key

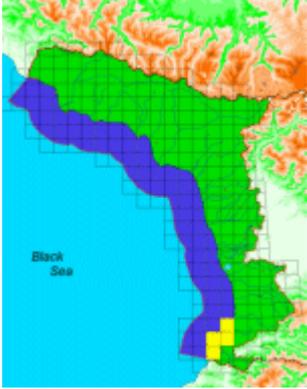
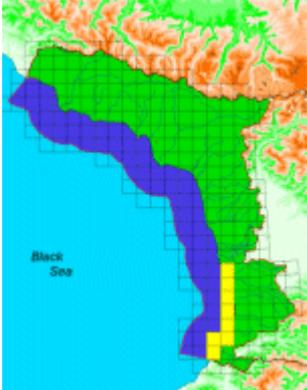
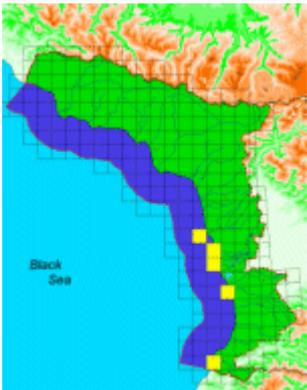
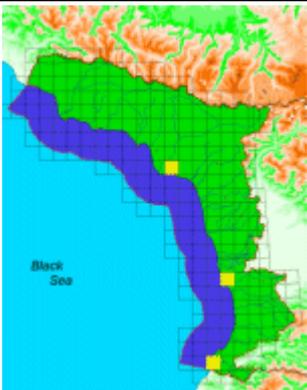
- Yellow square = recorded
- Red square = surveyed but not found
- Red triangle = recorded
- Green triangle = surveyed but not found

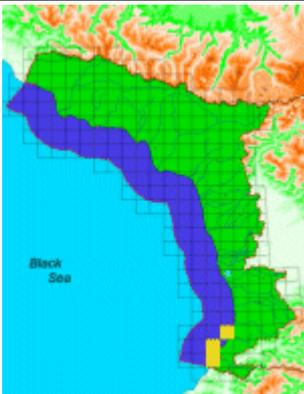
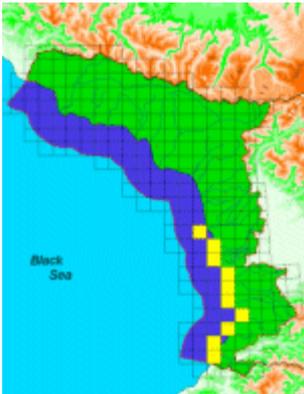
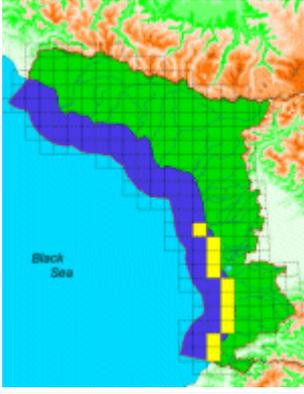
Group	Species	
Algae	Cystoseira barbata	
	Dictyota dichotoma	
Water ferns	Salvinia natans	

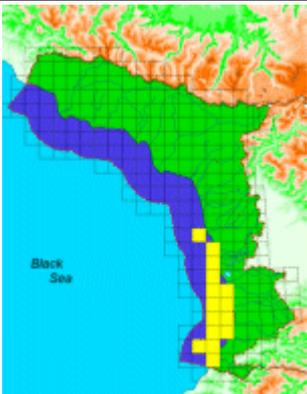
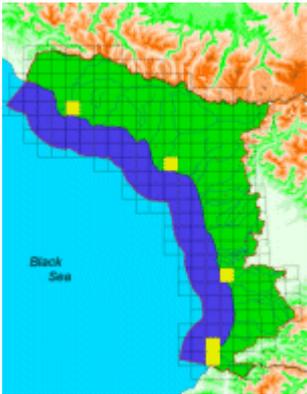
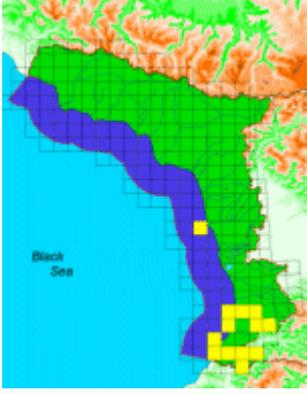
<p>Higher plants</p>	<p><i>Trapa natans</i></p>	
<p>Polychaete worms</p>	<p><i>Ophelia bicornis</i></p>	
	<p><i>Eteone siphonodonta</i></p>	
<p>Crustaceans</p>	<p><i>Pontella mediterranea</i></p>	

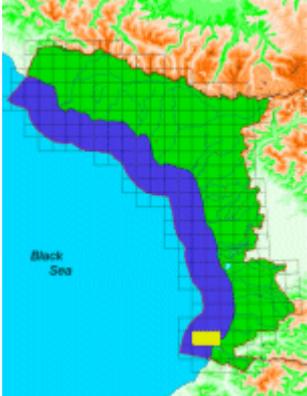
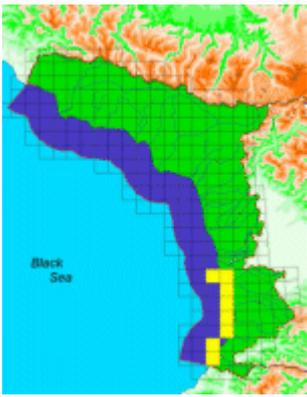
Halacarids	Halacarellus procerus	
Fish	Acipenser nudiventris	
	Acipenser stellatus	
	Aidablennius sphinx	

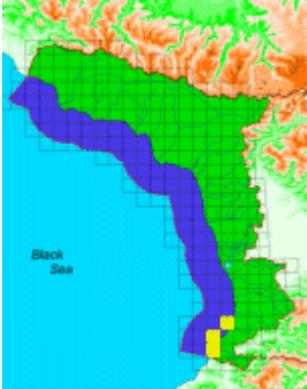
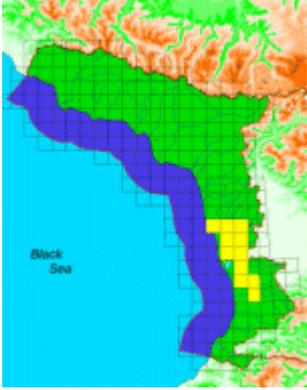
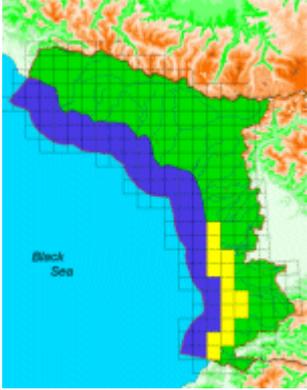
	<p><i>Aphia minuta</i></p>	
	<p><i>Belone belone euxini</i></p>	
	<p><i>Callionymus belenus</i></p>	
	<p><i>Dicentrarchus labrax</i></p>	

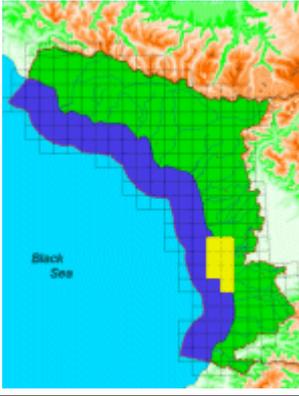
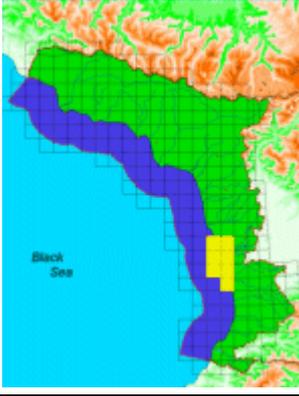
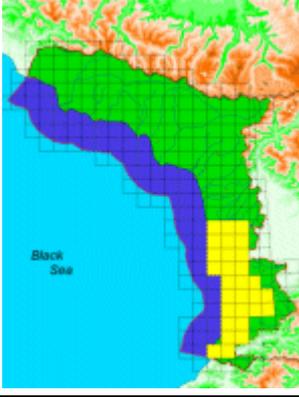
	<p><i>Diplodus annularis</i></p>	
	<p><i>Hippocampus guttulatus microstephanus</i></p>	
	<p><i>Huso huso</i></p>	
	<p><i>Knipowitschia longicaudata</i></p>	

	<p>Lipophrys pavo</p>	
	<p>Mesogobius batrachocephalus</p>	
	<p>Mullus barbatus ponticus</p>	
	<p>Nerophis ophidion</p>	

	<p>Pomatomus saltator</p>	
	<p>Pomatoschistus caucasicus</p>	
	<p>Salmo trutta labrax</p>	
	<p>Sarda sarda</p>	

	<p><i>Scomber scombrus</i></p>	
	<p><i>Scorpena porcus</i></p>	
	<p><i>Serranus scriba</i></p>	
	<p><i>Spicara smaris</i></p>	

	<p><i>Syngnathus tenuirostris</i></p>	
	<p><i>Trigla lucerna</i></p>	
<p>Birds</p>	<p><i>Ciconia nigra</i> (breeding)</p>	
	<p><i>Puffinus puffinus yelkouan</i> (wintering)</p>	

	<p><i>Pelecanus onocrotalus</i> (wintering)</p>	
	<p><i>Pelecanus crispus</i> (breeding)</p>	
	<p><i>Pelecanus crispus</i> (wintering)</p>	
	<p><i>Gelochelidon nilotica</i> (wintering)</p>	

APPENDIX C

GIS Specifications and Landsat Scene Classification

The Georgian Black Sea Red Data habitat maps were created from the Landsat ETM scenes and stored as an ArcView shapefiles. The following 4 Landsat ETM+ Level 1G scenes were acquired:

1. Scene 171/031 dated 05 September 2000
2. Scene 172/031 dated 10 July 2000
3. Scene 173/030 dated 06 September 2001
4. Scene 172/030 dated 10 July 2000

The parameters for these images are:

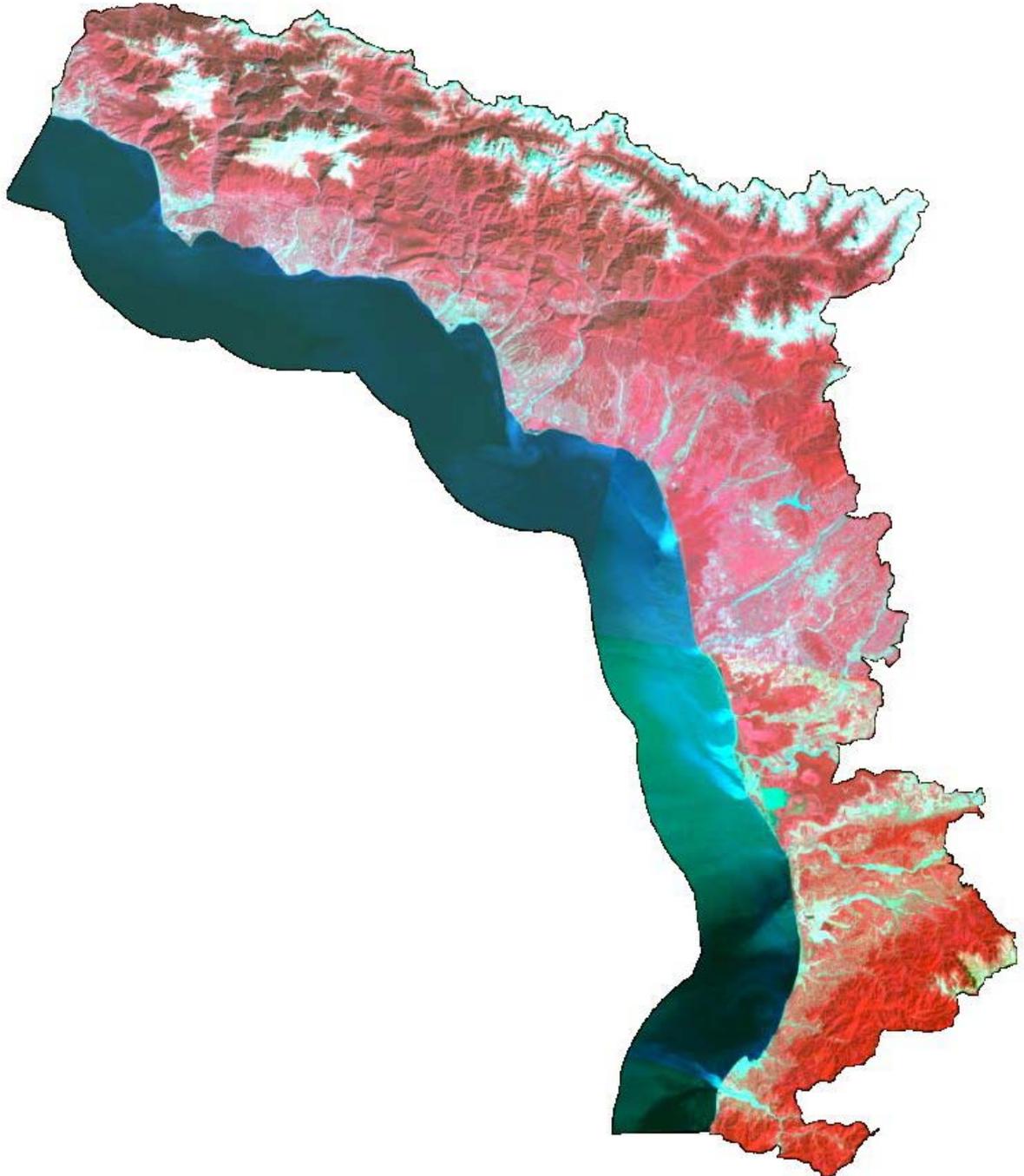
Format: GeoTIFF
Radiometric Correction Method: CPF
Number of Bands: 8
Media: CD-Rom (ftp'd first)
Image Orientation: NUP
Resampling Method: Nearest neighbor
Cell Size for Pan Band: 15m (default)
Cell Size for Reflective Bands: 30m (default)
Cell Size for Thermal Bands: 60m (default)
Map Projection: 37

Erdas Imagine Professional 8.7 was obtained for preparation and classification of imagery. IMAGINE Professional provides a comprehensive set of tools for advanced geographic imaging, remote sensing and GIS professionals, including:

- Working with files in geospatially linked viewers
- Digitize Arc Coverage and Shapefiles on top of images
- Display and analyze ESRI Geodatabases
- Perform image georeferencing
- Mosaic images
- Interpolate surfaces from points
- Orthorectify images
- Advanced spatial, radiometric and spectral enhancement
- Analyze information in radar images
- Perform advanced image classification
- Perform graphical spatial modeling
- Extract information from hyperspectral imagery

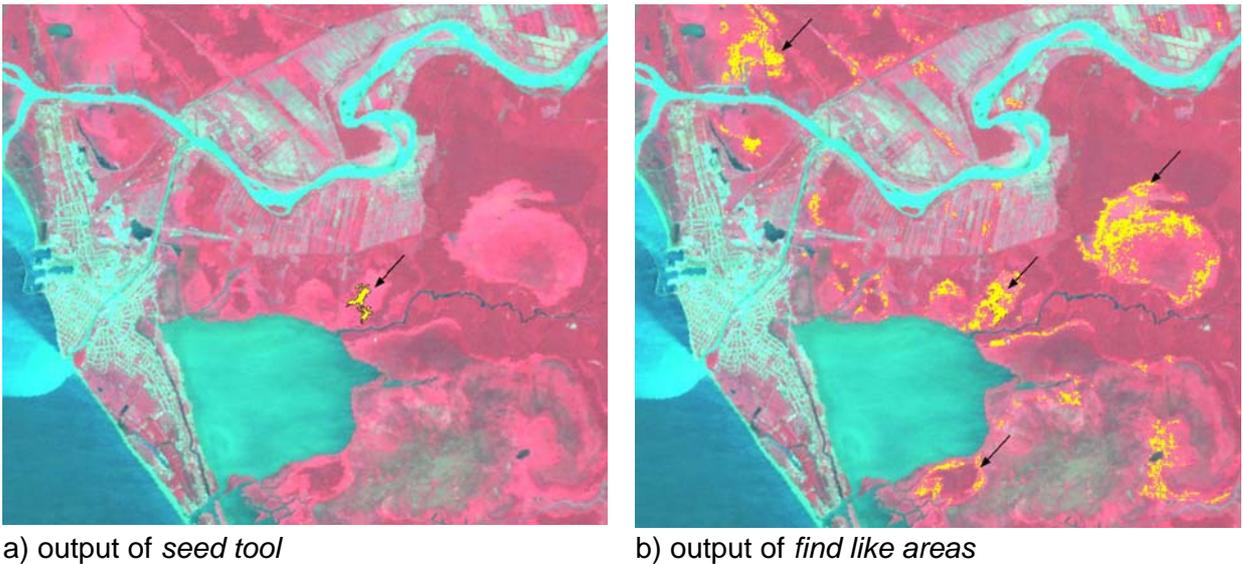
The application of ERDAS Imagine in the pilot study resulted in an extraction of separate habitats types and delineation of habitats polygons. Initially the mosaic of the four scenes was prepared and clipped to a coastal zone boundary coverage using the coastal zone shapefile as a mask for the spatial subset (Figure 2).

Figure 5: Mosaic of Landsat Scenes for the Georgian Coast



In order to identify and map specific habitats types, the feature extraction procedure was conducted using the *seed tool* feature in conjunction with *Find like* areas. In order to facilitate identification of the habitat features and enhance the display characteristics of the image, the histogram stretch (gamma) was applied. The seed tool was then used to delineate and map the habitats patterns observed in a color composite of bands 4,5 and 3. The results from the *seed tool* property were used by the *Find like area* feature to locate additional areas throughout the image with the same spectral characteristics, not necessarily contiguous to the original area selected with the seed tool (Figure 3).

Figure 6: Application of seed tool function in conjunction with find like areas



In some cases, namely for delineation of small-in-extent habitats, there was a need to limit analysis to certain areas of the image, for time and resources efficiency. In such situations analysis masks of the appropriate size were used.

To check the extent and location of identified habitat types, the 50 K topographic maps and aerial imagery was used as a reference. Topographic maps were available for the whole study area, while the aerial imagery was available for Ajara and the part of Georgian coastline, excluding Abkhazia.

The extracted habitat polygons were converted into a shape file and mapped using the ESRI ArcView 3.2 software. Attribute information (area and perimeter) was calculated using the x-tools extension.