Caspian Environment Programme

Transboundary Diagnostic Analysis Revisit

10 December, 2007

EXECUTIVE SUMMARY

The CEP TDA Revisit was completed in December 2007 following an intensive desk study of materials collected from the second phase of the Caspian Environment Programme. The intention of the CEP TDA Revisit is to provide a follow on review of the priority transboundary issues, to assess the efforts conducted during the CEP Phase II implementation, and to extrapolate where additional efforts are warranted. The SAP and NCAPs are reviewed followed by an analysis of the priority areas of concern as identified in the SAP. The issues addressed in the TDA are: decline in biodiversity; decline in environmental quality (pollution); decline in bioresources (fisheries); decline in coastal infrastructure and habitat; and impacts of the oil industry in the region. This is supplemented by an analysis of governance mechanisms, socio-economic conditions in the region, and stakeholder analysis and public involvement strategy.

The methodology employed by the CEP TDA Revisit team involved an intensive desk study of all reports produced for the CEP PCU from 2003 – 2007. Regional and international specialists were called upon to review the materials and assess the status of the major transboundary issues through the scope of the CEP work and related efforts in the region. The revisit directly, through its researchers, brought additional information to the fore in order to expand the understanding of the transboundary issues and new parallel studies were commissioned on climate change impacts and land-based sources and where managed by the Programme Coordination Unit.

SAP and NCAP review assessed the implementation of the SAP and the NCAPs in the Caspian littoral countries. It is based on the National SAP Implementation Assessment Reports, these being national studies carried out in each littoral country to assess the implementation of the SAP/NCAPs. The study has also benefited from information collected through SAP/NCAP Implementation Assessment Questionnaires developed by the CEP Programme Coordination Unit and completed by the SAP Implementation Coordinators in all the countries except Russia.

There are three essential points that may be gleaned from the SAP/NCAP review. First, the SAP and the associated NCAPs have been instrumental in directing increasing technical assistance and investment resources to address the regionally agreed-upon Caspian environmental issues. Second, a constructive, cooperative regional dialogue has been established on Caspian environmental concerns. There is a need to 'formalize' the SAP and the NCAPs, a move that would increase their effectiveness in both of the previous regards, as well as in achieving their other, more tangible stated objectives. This sets the stage for ongoing work within CEP at the national and the regional level focusing on coordination and collaborative efforts.

The priority transboundary issue of the decline in biodiversity showed that trends identified in the initial 2002 CEP TDA continue. There is a low level of information available, despite the existence of this information within some government sectors and the regional scientific community. The project has designed and constructed a state-of-the art biodiversity database and set of monitoring programmes for both terrestrial and marine ecosystems, but as yet the countries have not fully implemented

them. The main biodiversity datasets available to CEP are from the oil and gas industry or have been produced by the CEP itself. Several biodiversity projects have been undertaken in collaboration with the international oil companies in the region, including an inventory of Caspian Coastal Sites that are especially vulnerable, development of an Interactive Map Service (IMapS) through IPIECA and the development of Caspian Seal Conservation Action Plan.

Additionally, through GEF-IMO Globallast project joint studies have been undertaken to determine the scale of the problem of transfer of invasive species to and from the Caspian and how this traffic can be controlled most economically. Invasive species are one of the greatest threats not only to the Caspian's biodiversity but also the functioning of its ecosystem. The evidence is building that the ecosystem is in flux and the changes are caused by a series of introductions culminating in *Mmemiopsis Leidyi* (ML) and these changes may be not yet have run their course. The planktonic communities have been drastically altered by a series of invasive species, for example the copepod *Acartia tonsa* introduced in the 1970's has become highly dominant and in some locations may be the only species present where once there were 10-15 species. There are similar stories for the benthic community although the productivity does not seem to have diminished. Efforts are needed to stop further introductions of invasive species through the management of ballast waters either on board the vessels or at specific on-shore treatment facilities. There are potential biological control solutions for ML but these have yet to be agreed by the Caspian states.

The international oil companies have conducted significant studies on population of Caspian Seals and the threats to their survival, which include: Canine Distemper Virus (CDV); Persistent Toxic chemicals creating low fertility among females; increased hunting; malnutrition due to collapse of prey fish populations, such as the tulka, due to over fishing and disturbance by shipping during breeding. The population size of the Caspian Seal is still in dispute varying from 110,000 to 350,000 and a common surveying methodology is urgently sought.

As it stands now, it is difficult to conclude the status of marine biodiversity in the Caspian and a full monitoring programme needs to be activated linked to monitoring programmes for fisheries, pollution and oceanography. The trophic linkages between the planktonic and benthic communities and the top predators need to be better defined in order to improve our understanding of the system and management of its bioresources Knowledge regarding the terrestrial biodiversity is more complete although fragmented. Even in protected areas is not clear that regular monitoring is being undertaken and where it is some of the techniques used provide only qualitative data. Outside the protected areas little is known and a first order monitoring programme needs to be established using remote sensing to identify threats and trends.

The transboundary issue of decline in environmental quality remains a priority concern in the region. The efforts of CEP II have been focused a validatory assessment of the pollution status of the coastal zone and determination of pollution fluxes from the main Caspian basin rivers (Volga, Kura and Terek), including a second assessment of land-based sources.

Regarding the state of the environment of the Caspian Sea, the concentrations of some metals in the region are often elevated relative to other locations globally. Although the origin is mostly likely natural due to the metaliferrous nature of the drainage basin, some contributions can be expected from the extensive mining operations in the region. Mercury contamination is evident in the coastal zone of Azerbaijan. Little evidence exists of widespread contamination due to petroleum hydrocarbons. However, the Terek River certainly acts as a source of such pollution. Widespread contamination of chlorinated pesticides, notably DDT and HCHs (*e.g.*, lindane), continues to be seen in the Caspian Sea. Data for DDT and its breakdown products demonstrate that the pollution results from contemporary, rather than historical, sources. Because such ongoing inputs apparently result from illegal usage, a future priority in the region should be to reinvigorate or initiate enforcement of environmental legislation, such as the widespread ban of DDT.

There are many reasons to suppose that the flux of several pollutants entering the Caspian Sea has diminished since the early 1990s. Some possibilities include a decline in agricultural and/or industrial activities, improved environmental standards and legislation, possibly better enforcement of some regulations and the trapping of contaminants in the reservoirs, especially in the Volga and Kura River basins. Unfortunately, insufficient reliable data exist to validate possible claims as to improved water quality in the riverine systems discharging into the Caspian Sea. The sources of pollutants to the Caspian Sea remain poorly characterized. A robust estimate of current pollutant fluxes into the Caspian Sea remains an elusive goal for most rivers. Reliable historical data, for the most part, originate form the Soviet era. For instance, fluxes of organochlorinated pesticides have been reported for rivers in the Soviet Union. Some efforts have been made to estimate riverine fluxes from the Volga and Terek. Insufficient information is available for the Kura and Ural Rivers, as well as the Iranian rivers, to estimate their contributions. Inputs from diffuse sources, including the atmosphere, are even less understood. In this vein, the application of RAPS methodology seems to have failed, most notably because countries did not follow the same procedures. As a result, estimates of pollutant loads and fluxes cannot be readily compared throughout the region.

CEP study of land based sources of pollutants, through a rapid assessment strategy, was not applied in a standardized manner and it is difficult to draw meaningful conclusions from the acquired data. Sector base data suggests that there are challenges with land based oil pollution in Azerbaijan, Iran and Russia, agricultural and municipal wastes in Iran and Russia, and industrial pollution in Russia and Azerbaijan.

The catches of sturgeon and tulka have continued to decline. The total reported sturgeon catch in 2004 was approximately 900 tonnes compared to 25,000 tonnes in the early 1980s and the fishery has completely collapsed. The countries are now working with CITES, FAO and CEP to strengthen the fisheries management, but it is believed that problems of the fishery should be looked at from a new perspectives. The decline of the tulka fishery was blamed in the first TDA solely on the presence of ML, but from analysis of recent catch data that overfishing has played its part and may even have allowed the rapid colonization of ML. Management of the tulka

fisheries is weak and needs to be strengthened. The decline in tulka mirrors in time that of sturgeon fisheries, and has wide ranging implications on the ecosystem, including perhaps the health of the seal populations.

The underlying and root causes of unsustainable bioresource utilization identified during the 2002 CEP TDA were poor regional management, overfishing, illegal fishing and pollution remain valid but the productivity and integrity of the ecosystem is also now recognized as an underlying cause.

The EU project pursued efforts to improve fisheries management in collaboration with CEP. As a solution to the sturgeon fishery problem they proposed a dramatic increase in the number of fingerlings released to restore the populations, improve enforcement and increase public awareness. It was recognized that a better assessment of sustainable allowable catch; agreements on stock assessment methodologies; and improved hatchery techniques and certification were needed. The bioresources management efforts however continue to be bulked by a reluctance of countries to share fishing data despite pressures from CITES. It is hoped that there will be an increase in cooperation with the possible development of a fisheries protocol for the Tehran Convention.

With regards to fisheries management, there have been institutional challenges in producing national plans and a regional fisheries strategy for the Caspian. The Caspian Commission on Aquatic Bioresources (CAB) to which all Caspian countries are members, has been working with CITES to set quotas and combat illegal fishing for the sturgeon fishery. CEP has proposed the assist CAB with efforts in monitoring, assessment and evaluation in coordination with FAO, however there has been low coordination between international organizations to date and therefore efforts have been under realized.

The decline in coastal infrastructure and habitat was determined in the 2002 TDA as weakly transboundary, since impacts are mainly local and national although the causes are generally global.

The Caspian Sea level rose significantly in the 1980s reaching a high point in 1995 of - 26.7m (Baltic datum) causing significant flooding and economic losses. The water levels have subsequently fallen but remains relatively high and there are concerns that with climate changes levels could rise again, perhaps to as high – 25.0m in the medium term. The impacts of climate change on the Caspian environment and its water levels have been predicted by a number of teams working in the Caspian but knowledge of the system is not yet sufficient to give any assurance to these predictions. Each country has taken steps ranging from initial assessment of possibilities to actual construction of barriers against sea level rise based on an array of possible scenarios. Azerbaijan anticipates significant flooding of up to 136,190 hectares of coastal lands in the next 35 years with a 1.5m rise in sea level, including residential areas, agricultural land, industrial enterprises, oil facilities and ports. Iran is already experiencing significant flooding of its coasts, with combined problems of storm surges and erosion of coastal areas and planning difficulties are envisaged. Kazakhstan has already lost one million hectares to coastal flooding and is constructing dikes to protect settlements and vulnerable oil installations, as well as planning for new fresh water and power supplies. The coasts of Russia have

experienced less notable recent changes due the influence of Volga delta, but an additional water level rise will have impacts. On the Turkmenistan coast there are significant social and economic costs predicted due to flooding, impacting oil storage depots and loss of communication lines and pipelines and there is a recognition for good land use planning.

The 2002 CEP TDA suggested that an expert assessment be undertaken to determine a set of likely agreed scenarios for water levels taking into account existing patterns and climate change and in support a pilot project be conducted to develop an adaptive management plan for a particular sensitive coastal site (Anzali Lagoon in IR of Iran). .Anzali Lagoon was selected because it is importance as a conservation area, as Ramsar site, as well as an active port. A baseline assessment was conducted and a GIS database developed and concept model was constructed, upon which future sea level scenarios and impacts on the lagoon and port could be tested. The concept model was tested at a high level role playing workshop with the decision makers of the region and the process was observed. Full development of the adaptive management plan was found to be difficult because of the lack time and resources and lack of a comprehensive concept model to better understand of the ecosystem dynamics in the lagoon. A number of strategic options were however tested at the workshop including: the need for construction of an outer barrier for flood protection; possible need to relocate populations and industry away from the lagoon and the port; and, adapt to changing conditions with acceptance that some areas of the port may be inundated. The results and findings of this study need to be disseminated more widely in the region and used as a model for future pilots.

The marine litter project was developed with UNEP assistance towards the creation of a regional marine litter strategy. During CEP II implementation an assessment of regional marine litter in all 5 Caspian countries was conducted. This was to lead the preparation of a draft regional strategy and its integration of the strategy into the CEP SAP however the lack of data prevented progression; however it was recognized that marine litter is an emerging issue and that it is not yet addressed in a transboundary context. It is anticipated that this will impact coastal habitats, tourism and the fishing industries especially. It is recommended that a full assessment of the scale and scope of marine litter is conducted for the Caspian.

Decline in coastal infrastructure and habitats is closely linked with other transboundary issues such as decline in biodiversity and pollution through damage to coastal habitats secondary pollution caused by flooding of contaminated lands. Rising sea waters will have significant ramifications for the planning authorities and the oil industry, ports and transportation which may not have yet been fully considered by the countries. It is recommended that regional scenarios for water level fluctuation are agreed and economic evaluations of losses, including the environmental and social losses are undertaken at sensitive sites around the Caspian.

The transboundary issue of impacts of the new oil and gas industry on the Caspian Sea diverges from those above, in that it is one which has potential impact, but as yet not been observed. The 2002 CEP TDA did not find evidence of high levels of ubiquitous oil pollution from current activities despite perceptions that this would be the case. However, the concerns pertaining to impacts of accidental spills remain, especially as the industry continues to be increasingly active in the region. The rising

price of oil in the global market will continue to draw the oil companies to the Caspian and the growth in exploration and development is predicted to continue.

The development trends and challenges facing the petroleum industry have shifted since the initial 2002 CEP TDA. On one hand, the construction of the Baku-Tbilisi-Ceyhan and Caspian Petroleum Consortium pipelines has increased transportation options from the region to the main international markets; but on the other exploration of the Caspian has been disappointing and the estimates of available resources have been downgraded from a possible 144 billion barrels in 1996 to a possible 32.2 billion barrels in 2005. While there has been significant development of oil resources in Azerbaijan with the Shah Deniz and Azeri-Chirag-Guneschli fields, and in Kazakhstan with the Tengiz and Karachaganak fields, development of the Kazakh "super field" Kashaghan has been delayed and is not expected to come on line until 2010 at the earliest.

The delay of the Kashaghan field development impacts current geopolitical maneuvering around options for transportation of the oil through the BTC pipeline, and through Russian pipelines. There is also the possibility of the construction of a Trans-Caspian sub sea pipeline. At this time, the Russian and Iranian governments are objecting to this potential pipeline due to environmental concerns, and this has the potential to become a significant issue once Kashaghan comes on line.

The environmental impacts of the petroleum industry on the Caspian environment include on-going leakages from inundated historic wells and flooding of existing historic oil fields as well as accidental spillages. There are tensions with some NGOs regarding pollution impacts however the concerns raised have not been verified with reliable empirical data. In order to assist the countries to address the potential concerns, the countries have signed and ratified the Tehran Convention and have developed protocols on Pollution from Land-based Sources and, currently in negotiation, Concerning Regional Cooperation in Cases of Emergency. Some sections of the oil and gas industry sources have voiced concern about how the Convention will impact the legal status and their operations; however, overall, they have been supportive.

The governance and institutional analysis section summarizes the National Briefs on Legislative and Institutional Frameworks for the Protection and Sustainable Management of the Caspian Sea Environment prepared by National Legal Experts of the five Contracting Parties to the Convention for the Protection of the Marine Environment of the Caspian Sea (Tehran Convention). The analysis provides a review and an update on the status of the national legislative and institutional frameworks in light of their commitments under the new Tehran Convention, the draft protocols and the SAP. For each of the five SAP EQOs it undertakes an analytical review of the possible legislative and institutional opportunities, challenges, and bottlenecks focusing on compliance and enforcement. It develops recommendations for adjustments and modifications necessary to meet the obligations of the Tehran Convention and its draft protocols, identifying priority areas within national legislation in need of strengthening and suggesting measures to increase regional coherence.

Since the 2002 CEP TDA significant progress has been made in the region with regards to the establishment and support of legal and institutional mechanisms. Countries are bringing legislation into to line with the Tehran Convention and emergent protocols. The process is not expected to be quickly accomplished. As countries take steps to bring legislation into line it is advised that the countries work towards the standardization of their legal and regulatory instruments where possible and appropriate. Overall, there are two distinct prescriptions to be discerned from the analysis: (1) the need for increased standardization across the region as measures, methods, and legal standards must be harmonized across the region in order to increase the efficiency of governance institutions; and (2) the need to support increased public involvement mechanisms in the decision making process as public involvement may be satisfactorily permitted in that it is provided for legally, but the saliency of environmental issues must be addressed by raising public awareness if the public is to become actively engaged in the decision making process.

The Socio-economic section compares the socio-economic and development setting outlined in the 2002 CEP TDA to the current situation based on updated information. While the 2002 TDA section expertly outlined the situation and the importance of the specific variables used, this socio-economic review compares and contrasts new information to more fully describe the changing socio-economic conditions and trends and environmental pressures they may bring. Issues of demographic shifts are highlighted including an increasing population in the south and west of the region – especially in urban areas of Azerbaijan. Overall forecasts of population growth rates has been reduced from initial estimates and human health have not deteriorated as dramatically as expected, and in some cases there have been notable improvements in health care availability for populations, especially in Turkmenistan. There is a slight drop of infant mortality rates and no notable decline in life expectance across the region. In Iran and Russia there is an increase in the UN Human Development Index. Economic conditions have improved in terms of the Gross National Income, but inflation has also increased as consumer prices climb. The percentage of earnings from agriculture has declined while industry and services has increased, in part driven by the increase in oil and gas sector revenues. These trends over time should be followed and regularly updated in order to best understand how human socio-economic developments impact regional environmental conditions.

CEP worked to liaise with people at different regional, national and local levels. As a strategic approach towards project communication objectives, CEP formulated a Public Participation Strategy (PPS) for the Caspian Sea to help enhance its communications and public involvement objectives. The Caspian PPS was based on the ground-truthing surveys and Stakeholder Analysis Report and through a consultative and participatory process within the Caspian region. The stakeholder involvement and public participation strategy for CEP is a critical part of the effectiveness of the organization within national and regional institutions. Because the health of the Caspian waters touch so many different groups, from oil companies to fishermen, tourist to coastal residents, it is vital to have a link that will enable them to be involved in the project implementation and development where appropriate. The 2002 CEP TDA featured a very involved stakeholder analysis which provided insights into the concerns and priorities of stakeholder throughout the region. This was supplemented by the 2004 Caspian Regional Stakeholder Analysis Revisit (SAR),

summarized in the text with recommendations included for each of the specific priority issues.

The TDA revisit has identified a number of new directions and knowledge gaps which need to be followed and filled. There is a need to look at the management of bioresources in a more holistic manner and to embrace more convincingly the concept of the ecosystem based management approach to fisheries. The linkages between fishing and changes in the energy flow through the trophic network, provoked by invasive species, pollution and other human activity are becoming clearer. Stronger inter-sectoral coordination is required and robust monitoring and data management systems are needed to support both fisheries and conservation plans to achieve this aim. The concept of a sustainable sturgeon fishery, based on increased natural spawning should be pursued. Invasive species remain a real threat to the integrality of the Caspian ecosystem and the countries need to take action to manage the discharge of ships ballast waters, the main transfer agent for marine invasives, as urgent priority. The pollution picture for the Caspian has not changed perceptibly since the last TDA, although our knowledge of the pollution loading is still vague and implications of climate change causing perhaps higher run-off and flooding of contaminated lands needs to be better defined. Adaptation to climate change and specifically potential sea level rises should receive more attention particularly where sensitive conservation sites are under threat. The lesson learnt and the methodologies developed by the Anzali Lagoon pilot project should be expanded and disseminated. The countries have made significant environment investments in the past five as reported in the national SAP/NCAP implementation reviews and, with increased oil and gas revenue and public awareness as reported in the stakeholder analysis revisit, it is hoped that this trend will continue. Finally, it is with great satisfaction that the TDA revisit recognizes the strides the countries have made towards regional cooperation and management with the signing and ratification of the Tehran Convention and development of its attendant protocols; however, this success is tempered by weak national institutions which remain barriers to good governance.

DEDICATION

This Transboundary Diagnostic Analysis update is dedicated to Dr. Kerim Rajapov (----), the former National Focal Point from Turkmenistan and its member of the CEP Steering Committee. Dr. Rajapov's great wisdom, knowledge, environmental concern and dedication hugely benefited the Caspian Environment Programme and his demise was a grate loss to it.

Acknowledgements

This TDA update benefited from the dedicated work of numerous individuals, agencies, institutes, projects and corporations. These works have been mostly produced by the national experts of the Caspian countries and have been effectively led and substantially assisted by the National Focal Points (NFPs), the Strategic Action Programme Implementation Coordinators (SAPICs) and the Caspian Regional Advisory Groups (RAGs). The International Partners, namely the World Bank, UNEP, UNDP and the European Union contributions to the TDA update process and output have been considerable .The inputs by international consultants have been equally invaluable, in particular inputs by Tim Turner, who took a leading facilitating role in the process. The oil and gas industry, assisted the process through sharing of own data and information.

Production of the TDA update would have not been possible without the efficient project execution assistance of the United Nations Office for Projects Services (UNOPS). The overall conceptualization, design, production monitoring and editing of the TDA has been led by the Programme Coordination Unit (PCU) in Tehran, Islamic Republic of Iran.

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Acronyms

AAB	anomalous algal bloom
AR	Astrakhan Roads
AZ	Azerbaijan
BOD	biological oxygen demand
BP	British Petroleum
BS	Black Sea
BW	ballast waters
CAB	Commission on Aquatic Bioresources
CCSI	Caspian Coastal Sites Inventory
CDV	Canine Distemper Virus
CEP	Caspian Environmental Programme
CITES	Commission on International Trade in Endangered Species
CSCAP	Caspian Seal Conservation Action Plan
DDT	dichlorodiphenyltrichloroethane
EIA	Environmental Impact Assessment
EQO	Environmental Quality Objective
ESPOO	Convention on Environmental Impact Assessment in a Transboundary Context
FAO	Food and Agriculture Organization
FRAG	Fisheries Regional Advisory Group
GEF	Global Environment Facility
GIWA	Global International Waters Assessment
HCH	hexachlorocyclohexane
IAEA	International Atomic Energy Agency
IFRO	Iranian Fisheries Research Organization
IMapS	Caspian Interactive Map Service
IPIECA	International Petroleum Industry Environmental Conservation Association
IR	Islamic Republic of Iran
KZ	Kazakhstan
LV	Lower Volga
MCL	Maximum contaminant level
ML	*Mnemiopsis leidyi*
NATO	North Atlantic Treaty Organisation
NCAP	National Caspian Action Plan
NEAP	National Action Plan on Environmental Protection
NFP	National Focal Point
NGO	Non Governmental Organization
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PH	petroleum hydrocarbons
POPS	Persistent Organic Polluting Substances
QA/QC	Quality Assessment/Quality Control
RAPS	Rapid Assessment of Pollution Sources
REMP	Regional Environmental Monitoring Programme
RF	Russian Federation
RSFMP	Regional Strategic Fisheries Management Plan

SAP	Strategic Action Programme
SCM	Steering Committee Meeting
SMF	Sustainable Management of Fisheries
SoA	Sea of Azov
SOI	State Oceanographic Institute
TACs	Total Allowable Catch
TDA	Transboundary Diagnosis Analysis
TK	Turkmenistan
TPHs	total petroleum hydrocarbons
TSS	total suspended solids
UDWS	Unified Deep Water System
VBW	Volga-Baltic Waterway
VDW	Volga-Don waterway
UDWS	Unified Deep Water System
WCMC	UNEP's World Conservation Monitoring Centre
WTO	World Trade Organization

1. Introduction

The CEP TDA Revisit was completed in December 2007 following an intensive desk study of materials collected from the second phase of the Caspian Environment Programme. The intention of the CEP TDA Revisit is to provide a follow on review of the priority transboundary issues, to assess the efforts conducted during the CEP Phase II implementation, and to extrapolate where additional efforts are warranted. The SAP and NCAPs are reviewed followed by an analysis of the major transboundary issues. The issues addressed in the TDA are: decline in biodiversity; decline in environmental quality (pollution); decline in bioresources (fisheries); decline in coastal infrastructure and habitat; and impacts of the oil industry in the region. This is supplemented by an analysis of governance mechanisms, socio-economic conditions in the region, and stakeholder analysis and public involvement strategy.

The 2002 CEP I TDA was conducted towards the end of the first phase of CEP I and brought together the findings of the ten Caspian Regional Thematic Centres and the studies undertaken by the programme partners (EU, UNDP, UNEP and the World Bank). The TDA-SAP was conducted before GEF formalized the process and prepared best practice guidelines and there are some gaps in the original TDA, however it was innovative and it was the first TDA produced which incorporated a stakeholder analysis and identified emerging as well as perceived transboundary issues. The TDA provided the background information on the Caspian Sea's physical and biogeochemical characteristics, socio-economic and development setting and the legal and regulatory setting, as well as investigating eight transboundary issues, which were:

- Decline in Certain Fish Stocks, including Sturgeon
- Degradation of Coastal Landscapes and Damage to Coastal Habitats
- Threats to Biodiversity (including invasive species)
- Overall Decline in Environmental Quality
- Decline in Human Health
- Damage to Coastal Infrastructure and Amenities
- Invasive and Introduced Species
- Contamination from Offshore Oil and Gas Activities

The development of the TDA was a highly participatory process and numerous multi-disciplinary workshops were held to evaluate the scale of the issues and there linkages. This holistic approach ensured stakeholder buy-in to the TDA findings and its relevance in the formulation of the SAP and NCAPs. From the eight transboundary issues identified in the TDA, four areas of concern were selected for inclusion into the SAP under the following EQOs:

- Conservation and Sustainable Use of Bioresources
- Conservation of Biodiversity
- Improve the Water Quality of the Caspian
- Sustainable Development of Coastal Zones

During negotiation of the SAP a fifth EQO was added to Strengthen Stakeholder Participation in Environmental Stewardship.

The TDA and the SAP were guides the design of the UNDP-GEF and the EU's second phase support to the Caspian Environment Programme. The objectives of the UNDP-GEF CEP II project were to fill information gaps identified in the TDA and to initiate SAP implementation, focusing on the Conservation of Biodiversity and Improvement of Water Quality. The EU supported the implementation of Conservation and Sustainable Use of Bioresources and through a small grants programme Sustainable Development of Coastal Zones. A listing of the studies undertaken in CEP II is given in Appendix 5.

The 2007 CEP II TDA Revisit has been conducted in order to delineate where progress has been made since the initial TDA, as well as to more completely detail the priority areas of concern from the 2002 CEP I TDA. In compiling the TDA revisit the CEP II studies and activities have been tracked through a wide array of reports and analyses and brought together in order to get an enhanced picture of the status of the Caspian environment and the human impacts and their causes. The TDA revisit objectives were to:

- Verify that the priority areas of concern identified in CEP I were still valid and the ranking remained unchanged.
- Identify with more certainty the underlying and root causes of the priority areas of concern
- Identify further information gaps and scope out new interventions to fill those gaps.
- Inform the new Action Plan to be formulated under the Tehran Convention

The 2007 CEP II TDA Revisit provides a means to check the effectiveness of the SAP in reaching it's aims.

2. Methodology

As part of the TDA revisit additional work was undertaken to refine the causal chain analyses and a second stakeholder analysis was conducted, in order to gauge if there have been changes in opinions, understanding, and cause/effect relationships throughout the region. For each major priority area, a review of national and regional information was conducted, based on the available CEP II reports produced and supplemental studies carried out by affiliated organizations and institutions. The two emerging areas of concern identified in CEP I, the impact of the oil and gas activities and invasive species, were also analyzed. Specific national and regional studies were commissioned on land-based sources (executed by GPA); climate change impacts; governance and institutional analysis; and socio-economic status, The TDA revisit reviews the data available and findings reached in CEP I TDA, and compares them with those in the CEP II studies to determine whether any new knowledge had arisen or major shifts in understanding and perception had occurred.

The reviews of the data for the CEP II 2007 TDA Revisit were undertaken by regional and international experts familiar with the CEP II activities. The findings were

reviewed by the staff of the CEP Programme Coordination Unit and the final analysis was undertaken by the TDA revisit team. As part of the process two TDA workshops were held to confirm the areas of concern, review the causal chain analysis and agree the coverage and structure of the TDA revisit document. The meetings were attended by both regional and international experts from a fill range of disciplines to conserve the holistic approach achieved in CEP I.

All reports used in the TDA revisit were provided from the PCU and are listed in Appendix 1; most of these reports are available on the CEP web-site (www.caspianenvironment.org) Authors of the individual sections also provided references to additional studies used to further support the analysis. These references are included with each subchapter.

3. SAP and NCAPs Review

3.1. Introduction

Part of the process of achieving the CEP's stated goals regarding environmentally sustainable development in the Caspian region has been identifying the priority environmental issues and developing a regional Strategic Action Programme (SAP) and five National Caspian Action Plans (NCAPs), one for each of the littoral countries.

This section reviews and assesses the implementation of the SAP and the NCAPs in the Caspian littoral countries. It is based on the National SAP Implementation Assessment Reports, these being national studies carried out in each littoral country to assess the implementation of the SAP/NCAPs. The study has also benefited from information collected through SAP/NCAP Implementation Assessment Questionnaires developed by the CEP Coordination Unit and completed by the SAP Implementation Coordinators in all the countries except Russia.

The SAP and NCAPs, in most cases, are without direct legal status; however, there are numerous examples of legislation being created that aims to achieve the same environmental objectives as the SAP/NCAPs see section 5 on legislation.

3.2. Caspian Sea Regional Overview

The CEP Steering Committee approved the SAP in Nov 2003 in Tehran as "guidelines for the voluntary adherence of the countries." The SAP identifies the national and regional interventions needed to address the priority regional environmental concerns. The NCAP remains a tool for implementing a number of environmental interventions at the national level, many of which contribute to meeting SAP objectives.

Several of the National SAP Implementation Assessment Reports highlighted that new priorities have appeared and old objectives have become less relevant since the SAP and NCAP were first drawn up. In particular, it was argued that the capacity of the littoral states had improved through increased oil revenues due to high oil prices.

There is little evidence suggesting that at the national level the NCAPs or the SAP have been given legal recognition other than in Turkmenistan where the NCAP is integrated into the NEAP. However there is evidence that numerous legal requirements have been introduced or strengthened which may lead to SAP/NCAP objectives being achieved. Whether the introduction of these new laws was driven by the NCAPs or SAP is not explicit, although it is clear that SAP and NCAPs have been instrumental in initiating and /or facilitating the process.

A key development which may bear influence on the recognition and status afforded the SAP and NCAPs is the approval of the Framework Convention for the Protection of the Marine Environment of the Caspian Sea, known as the Tehran Convention. In August 2006 the Convention became enforceable. The Convention and its associated protocols target the same objectives as the SAP. The CEP Steering Committee Meeting held in December 2006 in Moscow offered its "institutional structures and policy documents" to the Convention Secretariat, an offer which was welcomed by the High Level Meeting of the Parties to the Convention that dovetailed the SCM. First

Conference of the Parties to the Convention, held in May 2007, acknowledged ' the need to align the Caspian Environment Programme and its instruments to the objectives of the Tehran Convention and its implementation' and welcomed 'the offer and recommendation of the Steering Committee of the Caspian Environment Programme to use, if it is considered necessary, the advisory and the technical services and assistance of the Caspian Environment Programme for the further development and implementation of the Tehran Convention' .

The SAP encourages all states to sign and ratify the Stockholm Convention, the Aarhus Convention, the Convention on Environmental Impact Assessment in a Transboundary Context (ESPOO), and the Convention to Combat Desertification. The Stockholm Convention has been signed but not ratified by Kazakhstan and Russia while Azerbaijan and Iran have ratified it. Kazakhstan and Turkmenistan have signed and ratified the Aarhus Convention. Russian Federation has signed the Espoo Convention which has been ratified by Azerbaijan and Kazakhstan. Azerbaijan, Iran, and Kazakhstan have signed and ratified the Convention to Combat Desertification. Russian Federation and Turkmenistan are members of the UN Convention to Combat Desertification.

3.3. Financing of SAP activities

The total SAP expenditure by country and Environmental Quality Objective can be found in Table 3.3.1. These figures are based on the best available 'estimates' of the SAP and NCAP 'interventions'. These figures are not exact and fully indicative of the reality on the ground given that the 'intervention' are not obligatory and as such not always included the approved official plans and furthermore noting that the estimates may at times not reflect the complex federal and administrative budgeting and accounting mechanisms.

Table 3.3.1. Known Expenses for SAP Implementation in USD (2004-6)

	AZ	IR	KZ	*RF	TK	**Total by EQO**
EQO 1: Conservation and Sustainable Use of Bioresources	-	22,576,000	575,000	In excess of 3,700,000	2,554,000	**In excess of 29, 405, 000**
EQO 2: Conservation of Biodiversity	25,000	10,931,000	850,000		585,000	**12,391,000**
EQO 3: Improve the Water Quality of the Caspian	6,220,000	11,738,000	15,668,000	In excess of 3 millions -	12,433,000	**In excess 49,059,000**
EQO 4: Sustainable Development of the Coastal Zones	-	20,000	23,000	2,600,000	225,000	**2,868,000**
EQO 5: Strengthen stakeholder participation in Caspian environmental stewardship	-	1,788,000	-	-	829,000	**2,617,000**
Total SAP Expenditure by Country	**6,245,000**	**47,053,000**	**17,116,000**	**In excess of 9,300,000**	**16,626,000**	**In excess of 96,340,000**

* Data for Russia refers to 2004/5 only

3.4 Environmental Interventions outside the SAP but Meeting SAP Objectives

There are numerous examples of legislation being created that aims to achieve the same environmental objectives as the SAP/NCAPs. Because these are not formally tied to the objectives, they are not included in Table 3.3.1; however, an examination of them is clearly germane.

All five countries have had interventions of this type, but Kazakhstan stands out when both the number of these and the breadth of their applicability is taken into account—it has undertaken projects that benefited four of the five EQOs (only EQO 4 remains unaddressed). Overall, EQO 3 received the most attention across the five countries, a fact that mirrors the findings regarding the formal implementation of SAP objectives in Table 3.3.1. This is presumably due to EQO 3's greater immediate appeal, as well as its compatibility with the littoral countries' economic and infrastructure development objectives. EQO 2 was a distant second, followed by EQO 5, and finally EQOs 1 and 4.

3.5. Findings from the Implementation Assessment Questionnaires

The CEP Coordination Unit collected information through its SAP/NCAP Implementation Assessment Questionnaires; these were developed by the CEP Coordination Unit and completed by the SAP Implementation Coordinators in all the countries except Russia.

Questionnaire 1 was completed by all the states except Russia and examined the rate of success in undertaking the SAP Intervention by giving a score of 'Highly Satisfactory' (the expected outcome appears to have been fully achieved, 'Satisfactory' (the expected outcome appears to have been achieved efficiently with only minor shortcomings), 'Moderately Satisfactory' (the expected outcome is likely to have been achieved efficiently with moderate shortcomings), 'Moderately Unsatisfactory' (the expected outcome has moderate shortcomings that limit its achievement, but resolution is likely), 'Unsatisfactory' (the expected outcome has significant shortcomings that limit its achievement, and resolution is uncertain) and 'Highly Unsatisfactory' (the expected outcome has major shortcomings that limit its achievement, and resolution is unlikely) to each indicator. In total, 105 indicators were given a rating.

Of those 105 indicators the following received the highest rating of satisfactory or better across the region (excluding Russia):

<u>EQO 1, Conservation and Sustainable Use of Bioresources</u>

1.4 b:	Legal instruments in place to mitigate illegal trade/strengthen mechanisms to reduce illegal trade
3.2 b:	Improved health and education status in coastal communities as measured by life expectancy and years at school

<u>EQO 2, Conservation of Biodiversity</u>

1.1 a:	Regionally endorsed Biodiversity Protocol.
1.5 a:	An informed and more active public and more environmentally conscious decision making bodies
1.6 a:	Increased reference to biodiversity as a key issue in coastal planning /land use decision making documents

4.2 a: Evidence of use of modern protected area management

EQO 3, Improve the Water Quality of the Caspian

2.1 a: Implemented regional monitoring programme to focus on certain contaminants and hotspots, with information exchange among relevant bodies, standardized monitoring protocols, including baseline contaminant levels

2.2 a: Implemented rapid assessment programme for contaminant levels throughout all Caspian waters, including synchronized assessment standards, and region-wide information sharing mechanisms

3.1 a: Developed and adopted protocol on land-based sources of pollution

EQO 5, Strengthen Stakeholder Participation in Caspian Environmental Stewardship

2.2 a: Mandatory application of EIA in development project decisions making process and increased number of public meetings

In contrast, the indicators across the region that received a rating of unsatisfactory or worse were:

EQO 1, Conservation and Sustainable Use of Bioresources

1.3 b: A continually updated review of the status of the Caspian biodiversity

EQO 2, Conservation of Biodiversity

6.1 a: A health map of the Caspian's marine habitats based on standardized assessment methodology

EQO 3, Improve the Water Quality of the Caspian

3.7 a: Adopted protocol on dumping at sea

5.3 a: Reduction in nutrient loading by 30% in critical areas

6.5 a: Risk assessment completed and made available to relevant bodies for consideration

EQO 4, Sustainable Development of the Coastal Zones

1.3 a: Functioning national and regional data centers and access to GIS database for use by coastal planning authorities

At the country level, Azerbaijan was rated to have met 30 out of the 105 indicators (29%) to a satisfactory or above level, Kazakhstan 40 out of 105 (38%), and Turkmenistan 46 out of 105 (46%). Iran scored 6 out of 105 (6%). All Iran's scores were lower than the other 3 states. This may reflect weaker implementation or a more critical appraisal of the programme. Likewise, Azerbaijan was rated to have met 7 out of 105 indicators (7%) at a level of unsatisfactory or worse, Kazakhstan had zero indicators rated at unsatisfactory or worse, Turkmenistan only 6 and Iran 45 out of 105 (43%).

Questionnaire 2 examined the root causes for the lack of success in achieving the 20 SAP targets. Of the five littoral Caspian states, only Azerbaijan and Iran completed this questionnaire.

In the case of Azerbaijan, the root cause most commonly cited was "insufficient national funding to implement the agreed interventions." "Insufficient national funding" was referred to as a root cause for 65% of the SAP targets and "insufficient international support and partnership" was the second most common cause cited as a reason in 35% of the SAP targets. Lack of political will to take needful actions, insufficient national monitoring and evaluation of the SAP and NCAP implementation, lack of accountability and transparency, organized crime and corruption, and lastly, perceived conflict between national and regional interests were not deemed a cause at all in achieving any of the targets.

The findings for the Iranian questionnaire were as follows: the most frequently cited root causes were "insufficient national monitoring and evaluation of the SAP & NCAP implementation" and "lack of and/or inadequate regional strategies, polices and management plans." These two root causes applied to 70% of the SAP targets. The least referred to causes were "perceived conflict between national and regional interests" (quoted in 2% of targets) and "lack of accountability and transparency, organized crime and corruption" (quoted in 4% of targets).

The root causes 'low value attached to environmental considerations' and 'insufficient national funding' rated highly in both questionnaires. In Iran 'insufficient national monitoring and evaluation' was one of the two most often cited causes, yet in Azerbaijan this was not considered to be an issue at all.

Obtaining completed questionnaires from Russia, Kazakhstan and Turkmenistan would lead to greater understanding of the root causes across the programme and region.

3.6. Impediments and Barriers to Full Implementation

The sources for the impediments and barriers to implementation are threefold: a) obstacles identified by each National Assessment Report, b) issues that have come to attention through examining all National Assessment Reports, and c) analysis of the SAP Implementation Assessment Questionnaires. In what follows we have listed the major impediments and barriers:

3.6.1. Roles and decision making processes are not defined

In a programme of such complexity and with so many actors it is vital that the decision making processes and the roles at all levels are defined; this includes the programme being endorsed from the highest (e.g. the Cabinet) to the lowest levels (e.g. individual farmers and fishermen).

In Iran it appears the NCAP and SAP never were endorsed by the government at a sufficiently high level—at most it was endorsed by the CEP host institution, the Department of the Environment. Environmental protection is rarely a government's highest priority and the Ministry or Department responsible for environmental protection usually has a lower status than the majority of other ministries. Achieving the highest level buy-in within the Cabinet, prior to competing demands developing and influencing decisions, may go some way towards mitigating the erosion of environmental policies. This issue of authority was further illustrated in Iran where the task of fund raising for the NCAP and SAP was assigned to the NFP, but it did not have the authority to perform this function and this fact greatly impaired its

effectiveness. Another example taken from Iran further demonstrates the importance of clearly defined roles and decision making processes; the representatives at the programme planning stages were specialists and not the decision makers for planning and policy development. This undermined the commitment of those managers when it came to implementation. A further risk is that decisions are made in isolation without consultation with other departments or ministries resulting in inefficiencies in the form of gaps or overlaps.

3.6.2. The NCAP and SAP Lack Legal Status

Without legal recognition, the programmes rely mostly on the interest and the good will of the authorities and there is no obligation to design any project in line with the NCAP or SAP. With legal recognition the NCAP and SAP would serve as a binding prioritization mechanism for any Caspian Sea related projects.

3.6.3. Achieving Competent Monitoring and Reporting across Sectoral Actors

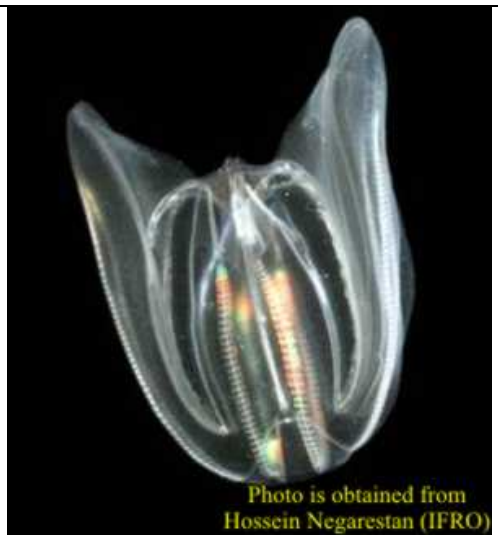
A further point of note is the high number of implementing partners and their varying status (i.e. national ministries, local governments, international organizations, NGOs and private sector actors). Monitoring and reporting at both the regional and national level becomes a challenge with such a broad spectrum of actors with varying levels of competency.

3.7 Conclusion

There are three essential points that may be gleaned from this section. First, the SAP and the associated NCAPs have been instrumental in directing increasing technical assistance and investment resources to address the regionally agreed-upon Caspian environmental issues (see Table 3.3.1, above). Second, a constructive, cooperative regional dialogue has been established on Caspian environmental concerns. Finally, the report highlights the need to 'formalize' the SAP and the NCAPs, a move that would increase their effectiveness in both of the previous regards, as well as in achieving their other, more tangible stated objectives.

4. Priority Transboundary Problems

4.1 Threats to Biodiversity



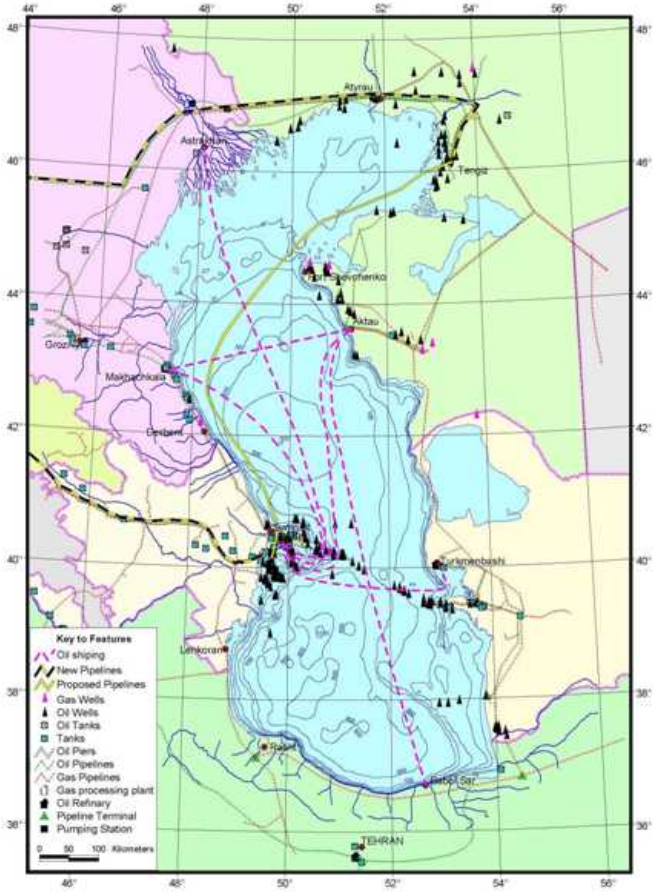
Picture from www.zooplankton-online.net/gallery.html

Caspian seals on the haul-out (Photo by Pavel Erokhin)

Mother pauses and turns round to look at pup
(photo by CISS team)

4.1.1 Studies and findings of CEP II Studies

There is a widespread perception that the Caspian is in a state of ecological decline, and that one aspect of this is a decline in biodiversity. This is of particular concern, due to the status of the Caspian as a unique water body inhabited by a large number of endemic species. There is also a widespread belief that the Caspian is very sensitive to the impacts of industrial activities and in particular to those associated with oil and gas production and transportation.



Decline in biodiversity can be defined in several ways:

- The reduction in abundance of rare, ecologically important or 'flagship' species
- A more general reduction in the overall number of species
- A reduction in the number of species in particular ecological or taxonomic groups
- A temporary loss and/or reduction in abundance of species which critically affect processes such as productivity

It is important to recognise that there is a difference between direct loss of genetic diversity (as would be the case with the loss of a sturgeon or seal species) and

functional loss (where the reduction of one or more species has an adverse effect on ecological function and therefore a 'knock-on' effect on wider biodiversity).

It was recognised in CEP I that a key issue was the lack of quantifiable data regarding biodiversity to support the general perception that the biodiversity in the Caspian was in decline. In response a number of studies were initiated under CEP II including;

- Development of biodiversity database and preliminary monitoring programme
- Caspian Coastal Sites Inventory
- Caspian Interactive Map Service
- *Mnemiopsis Leidyi* monitoring
- Caspian Sea Ballast Water Management Study
- Caspian Seal Census
- Caspian Seal Conservation Action Plan

These studies were designed to address key gaps in knowledge and identify where future efforts should be focused.

Biodiversity database and monitoring programme
The Caspian Sea has been the subject of vast amount of scientific research and monitoring since the early 18th century and substantial knowledge and information resides in the scientific institutions of the riparian states, particularly Azerbaijan and the Russian Federation. The first stage in the development of the biodiversity database was a develop a comprehensive meta database of all available biodiversity data both coastal and marine held by scientific institutions, Ministries and the private sector, principally the Oil and Gas sector, building upon what had been created in CEP I (see regional data report). Requests were made for the datasets to be shared with the CEP, but unfortunately only the oil and gas industry responded. Much of the biodiversity data obtained from the oil and gas companies relates to baselines prepared for EIA and relating to specific sites and developments. There is biodiversity data from the regional monitoring programmes conducted by BP and Agip-KCO but it is limited. Disappointingly, no national data sets from the academy of sciences or regulatory authorities in the five states countries were provided although CEP was assured that regular monitoring programmes were taking place. Regarding species reference collections, CEP was informed of the existence collections in the Institutes of Zoology and Botany of the Russian Federation in St Petersburg and in the Academy of Sciences in Azerbaijan; however, the only known verified collection being actively maintained is held by the laboratory ERT, based in Baku and working exclusively for the oil industry.

Following on from the data review, CEP, in conjunction with the Institute of the Southern Seas based in Sevastopol and IOC, developed a state-of-the-art, web-based integrated biodiversity database onto which the countries could up load all available monitoring data, in accordance with set QA/QC procedures. The database has been in operation for a number of months but again disappointingly none of the countries have deposited any data sets. A revised species master list has been prepared to accompany the database, which will need to be updated on a regular basis as knowledge of the Caspian communities and species grow.

Going forward, the project developed in consultation with leading regional practitioners, an initial biodiversity monitoring programme focusing on the marine environment to compliment the Regional Environmental Monitoring Programme (REMP) agreed and developed in CEP I. The REMP programme focuses on contaminant pollution in the coastal zones at selected sites. Key indicator species and habitats were identified and monitoring protocols developed in line with best practice and matching available resources. Although monitoring programmes are on-going in the region, it is clear that monitoring is under funded in the region and laboratories are under equipped. The new monitoring programme was agreed by the countries and the necessary sampling equipment provided by CEP, but as yet no monitoring results have been yet been submitted by the countries, after more than one year. The establishment of the biodiversity monitoring programme as well as the REMP is a key activity in achieving sustainable management of the Caspian ecosystem and its bioresources and should be seen as a priority by the countries.

It is hoped that this biodiversity database will form the nucleus of an integrated information system drawing together fisheries, oceanographic and contamination datasets and allowing simultaneous interrogation on a GIS platform. The creation and maintenance of such a system as a vital management tool will be a major challenge for the countries and CEP in the next five years.

Caspian Coastal Sites Inventory (CCSI)

In its first phase, CEP undertook a regional assessment of key coastal habitats as part of the biodiversity studies. The assessment was a desk-study and no field evaluations were undertaken and it was recognized that many areas, particularly marginal ones outside the protected areas, had not been surveyed for a number of years and therefore the baseline knowledge was fragmented. In order to address this gap CEP commissioned an inventory of coastal sites and seasonal monitoring of selected sensitive sites in each of the riparian states over a single year. The results of this work are presented in the Caspian Coastal Site Inventory report. The new marine monitoring protocols developed as part of the biodiversity monitoring programme where appropriate were tested and where necessary amended accordingly. The monitoring was envisaged as first step ground-truthing exercise leading to perhaps a more comprehensive coastal monitoring based on remote sensing techniques, similar to that used extensively in Kazakhstan promoted by the oil industry. Kazakhstan experts are already able from satellite imagery to identify the major biomes in the Northern Caspian from satellite imagery and track changes in their quality and coverage. However, further ground-truthing work needs to be undertaken on the coastal zones in the middle and south Caspian to be able to establish a full monitoring programme-based on satellite imagery.

The selection of the sensitive sites in a number of the countries was biased toward protected areas rather than marginal sites, which was CEP's primary interest. With the exception of monitoring in Turkmenistan and Kazakhstan the classification and survey of biomes suffered at the expense of the more obvious identification of rare and endangered higher animal species. The limitations of the project budget restricted the country teams in the main to terrestrial surveys and marine surveys were limited.

As stated above in most countries particular attention was given to rare and endangered species, including amphibians, reptilians, birds, and mammals. The seasonal dynamic of species composition and abundance of main species was analyzed for each sensitive site and for the region as a whole, enhancing the knowledge baseline for these sites. The presence of many rare species was confirmed. In Iran alone more than half a million of birds were counted and 220 species identified. Specimens of 37 rare and endangered species were found at the main Iranian sites during winter time including the Lesser Red-breasted Goose (*Branta ruficollis*) and Siberian crane (*Grus leucogeranus*). Similar figures were obtained for other countries: Azerbaijan – 300,000 specimens of birds, 216 species, 36 rare species; Turkmenistan – 380,000 specimens, 113 species, 15 rare species; Kazakhstan – 310 specimens, 122 species, 25 rare species; Russia – 220,000 specimens, 129 species, 26 rare species. Some rare species were not observed during this short term monitoring survey (5 days in each season), especially birds of prey, which appear in the region for a short time on their migration path. For some other species new locations were identified.

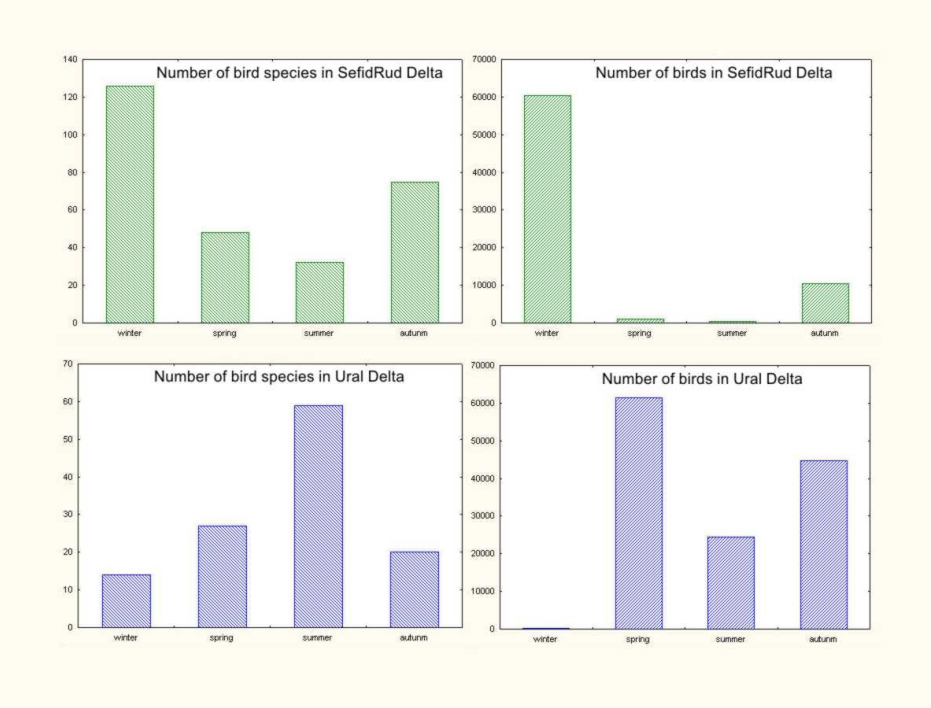


Figure 4.1.1 Data from one year monitoring (Caspian Coastal Site Inventory)

Table 4.1.1. Number of species identified during monitoring survey around 25 sensitive sites on the Caspian coast (listed in the Red Data Books and total number of species). (Regional report on Caspian Coastal Site Inventory)

	Amphibians	Reptilians	Birds	Mammals
Azerbaijan	5/9	5/26	36/216	10/49
I.R. Iran	1/6	3/12	37/222	5/18
Kazakhstan	0/2	2/16	25/122	2/30
Russia	no data	no data	26/129	no data
Turkmenistan	0/2	2/15	15/113	6/20
Total	5/10	6/43	53/320	16/76

The result of this work is presented in a set of country reports and a series of thematic maps contained in the final project report. However, because of the monitoring methodologies used most of the data cannot be incorporated into the Caspian biodiversity database. It is to be hoped that this monitoring will continue and be expanded and the monitoring techniques refined.

Caspian Interactive Map Service

The CEP in collaboration with the International Petroleum Industry Environmental Conservation Association (IPIECA), commissioned UNEP's World Conservation Monitoring Centre (WCMC), Cambridge UK to develop and host a Caspian Interactive Map Service (IMapS). IMapS was developed in response to the need of a tool to facilitate environmental planning and emergency response. Caspian Sea IMapS is an interactive mapping tool, accessible over the internet and delivering environmental information in the form that is usable by a variety of different people from field based environmental practitioners to high level policy makers. With IMapS end users can create customized maps online to meet their individual information requirements. Caspian IMapS is hosted by the WCMC server (direct link http://ipieca.unep-wcmc.org/imaps/ipieca/caspian).

Caspian IMapS contains about 30 GIS layers for following themes:

- Sensitive and Protected Areas
- Habitats
- Species
- Infrastructure
- Response Features
- Socio-economic Features
- Satellite Imagery

The data and information for IMapS were collected from a variety of sources such as World GIS resources, local and national governments, non-governmental and international organizations and projects. National consultants were hired in each of the Caspian states in order to provide diverse range of environmental subjects such as Environment Sensitivity Index for Caspian coasts, protected areas, and socio-economic resources.

It is intended that the Caspian IMapS will become an integral tool for environmental practitioners working in the Caspian region and will continue to develop with new and updated data and functionality over a number of years. In nearest plan is updating species distribution information with the new data obtained in framework of the CEP CCSI project.

Mnemiopsis leidyi monitoring

The first report of possible presence *Mnemiopsis leidyi* in the Caspian Sea appeared in 1995. A 'jelly-fish' was reported but without any clear description and therefore it is a matter of conjecture when *Mnemiopsis* arrived in the Caspian and the speed of its colonization. The first proven report occurred in 1999, specimens being found and identified in the shallow waters around Turkmenistan coasts by scientists from Astrakhan. In 2000, *Mnemiopsis leidyi* was observed in huge numbers all over South Caspian Sea, indicating that the initial invasion had occurred some time earlier. In the year 2000 with the support of CEP a regular monitoring programme was started, which tracked an explosive increase in the number and biomass of *Mnemiopsis leidyi* in the years 2000-2002. During CEP II monitoring has continued with the results showing a small decrease and stabilization in biomass in the period 2003-2006 (A.

Roohi, A.E. Kideys, G. Finenko, 2005. Impacts of Invasive Ctenophore *Mnemiopsis leidyi* on the Fisheries of the Black and Caspian Seas). However the stabilization process is not complete and in some areas huge blooms still occur, as recorded in the summer of 2005.

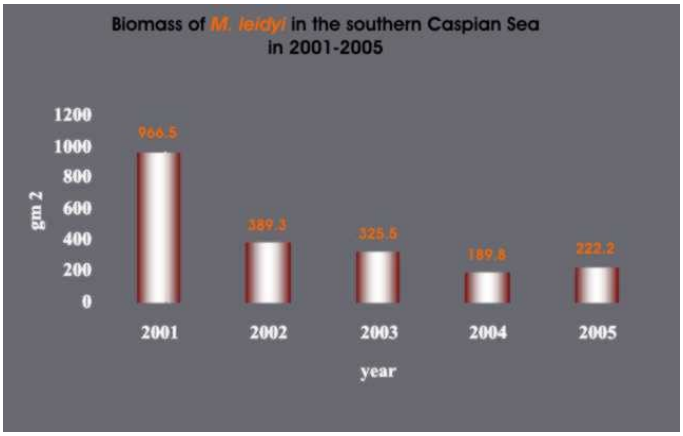


Figure 4.1.2 From A. Roohi, A.E. Kideys, G. Finenko, 2005. Impacts of Invasive Ctenophore Mnemiopsis leidyi on the Fisheries of the Black and Caspian Seas

It became evident, that the presence of *Mnemiopsis leidyi* is rather rare in the North Caspian, due to the cold winter and less saline waters. It appears only in summer period carried by water currents from the South. The South Caspian is the main wintering and spawning ground, recording the highest numbers of young animals, as well as the total numbers and biomass. Numbers and biomass increase from spring to summer with a peak in the August and declining in autumn and winter. In winter and early spring it almost disappears for the North Caspian Sea and is present in low numbers in the Middle and South Caspian. Maximum abundance of *Mnemiopsis* was observed in 2002 at 1700 specimens per m^3 in the South Caspian Sea.

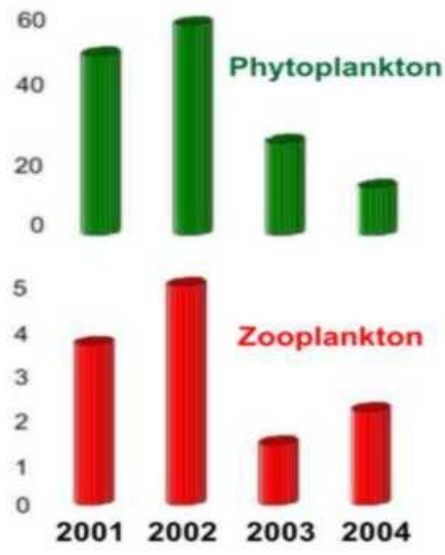


Figure 4.1.3 Biomass of phyto- and zooplankton around Iranian coast (From A. Roohi, A.E. Kideys, G. Finenko, 2005. Impacts of Invasive Ctenophore Mnemiopsis leidyi on the Fisheries of the Black and Caspian Seas)

The introduction of the ctenophore *Beroe Ovata* as a biological control agent has been discussed extensively in the region over the last seven years. The beneficial impact of BO on the Black Sea on ML populations, where it was introduced, as was ML, through ballast waters of ships, shows it to be an effective if not complete solution. Supported by CEP the countries have undertaken numerous in-vitro experiments on the impact of *Beroe* on ML populations and the planktonic and fish communities as well as producing a comprehensive EIA on its introduction shared with the countries. Currently there is no agreement on the purposeful introduction of BO, or another biological control measure, waiting perhaps for its accidental introduction with ballast waters as on the Black Sea.

The presence of huge amount of ML which feed on zooplankton can totally change the structure of the phyto- and zooplankton, and even benthic communities. The diversity and biomass of zooplankton may be reduced by 2-3 times and in some recent surveys instead of 10-17 species expected only one species (*Acartia tonsa*) was found, although this may not be solely due to the presence of ML (see below). Similar changes have been observed in the phytoplankton community during the 2000-2003. The biomass and diversity of benthic community increased two-fold in the same period suggesting a change in the energy pathway. Whatever the reason there has been a dramatic shift in the trophic network, which continues to have ramifications.

In the period 2000-2003 rapid decline of tulka stock and fishery occurred (The present state of the Russian fishery of the Caspian kilka and biological characteristics of commercial catches. Kosturin et al, 2005; Official report from IFRO (Shilat official); AzNirkh data (Official report Azerbaijan SAPIC). It is not clear whether this decline is due to over-fishing, since there is evidence of an earlier reduction in catches, or the appearance of the *Mnemiopsis leidyi* bloom or both. Two years after the ML bloom the biomass is although still high, at a significantly lower level; however, the changes in the structure of the zoo- and phytoplankton continue. Oddly in Iran there are reports of both zoo- and phytoplankton communities in the coastal zone becoming richer in species composition and smaller forms appearing in phytoplankton, and several species which have not been observed for a number of years have been reported. However, CEP has been unable to confirm these findings and scientists working for the oil and gas sector have not observed the same trends. In the open sea (deep waters of the South-West Caspian) *Acartia tonsa,* an invasive species, has been dominant in zooplankton in the last few years comprising 99%-100% of the total zooplankton biomass (see below).

It is clear that the invasion of *Mnemiopsis leidyi* has disrupted the whole Caspian ecosystem, however other earlier invasive species may also have played there part and it is unclear what its long-term impacts may be. .

Acartia tonsa Dana,1848

Picture from www.zooplankton-online.net/gallery.html

Acartia tonsa is a widespread copepod. It is common to coastal areas where sometimes it is found in huge abundance. Native population inhabits Indian Ocean, Atlantic and Pacific coast of North and South Americas. It was introduced to the Black Sea in the middle 1970s – the first record is for 1976. Surprisingly the same species was found in Mediterranean Sea only in 1985. In the Caspian Sea *Acartia tonsa* appeared in early 1980s. In the North Caspian Sea it was observed in 1982 and in the Middle Caspian in the 1983. Early publications for the Caspian Sea refer to *Acartia clausi* as a new copepod found in the Caspian Sea. Later on it was realized that a new species belongs to *Acartia tonsa,* and *Acartia clausi* for the Caspian Sea was a misidentification. Today this species is found everywhere in the Caspian. After the appearance of *Mnemiopsis leidyi Acartia tonsa* has become an absolute dominant in zooplankton community in the South and Middle Caspian. In 2003-2005 it formed up to 90% of zooplankton biomass with abundance up to 1000 specimens in cubic meter and biomass up to 20mg/m^3.

In its native distribution *Acartia tonsa* it overlaps with the distribution area of *Mnemiopsis leidyi* and it is possible that it is pre-adapted to the presence of ctenophore. There are few peculiarities in *Acartia tonsa* biology which explains it abundance in the Caspian Sea in the presence of huge numbers of *Mnemiopsis leidyi* where all other zooplankton have been reduced in number and biomass. Maximum abundance of both mature copepodits and nauplius larva is in the upper 10 meters, but the significant number of mature *Acartia tonsa* both males and females can be found at depths of 20-100 meter where *Mnemiopsis* is rare. Single specimens of *Acartia tonsa* can be found even at depths 200-600 meters. Females produce eggs not in one go, but regularly, every 5-6 days, with 20 eggs in each single spawning. Each female actively produces eggs for a period of 70-80 days in 13-15 events, producing a total of up to 250-300 eggs. The eggs are heavy and rapidly sink to the bottom or deeper water where they are safe and unavailable to *Mnemiopsis leidyi*. *Acartia tonsa* reproduce not only in summer, but throughout the year. This that also helps even a part of population to escape direct harvest by *Mnemiopsis leidyi* in the winter and early spring seasons. This reproduction strategy helps *Acartia tonsa* to escape pressure of planktivore species and maintaining abundance on sufficient level.

Data obtained from the Caspian Sea Biodiversity Database
<www.caspianenvironment.org/biodb/eng/zooplankton/**Acartia**%20**tonsa**/main.htm >
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Caspian Sea Ballast Water Management Study

During CEP I ships' ballast waters (BW) were recognized as the main transfer agent for invasive species into and out of the Caspian Sea, via the Volga-Don waterway (VDW), connecting the Caspian with the Black Sea and the Volga-Baltic Waterway (VBW), connecting the Caspian with the Baltic. The management of ballast waters on the vessels on these waterways was therefore recognized as priority intervention for the SAP. The CEP in collaboration with the IMO-GEF Globallast project agreed to undertake a study of the traffic of ship-borne invasive species. The objectives of the study were to make an assessment of extent of aquatic species transfer through ships' ballast water and sediments into and out of Caspian Sea, and to use the results and recommendations from this assessment to help develop a road map and action plan for Ballast Water Management.

The assessment of shipping traffic and BW movements in and out of the Caspian the noted that:

- The transit time along the Black Sea and Caspian Sea waterway is generally 4-5 days, but this varies according to the level of ship queuing due to wind surges in the Sea of Azov and Astrakhan.
- Most voyages made in ballast are from the Mediterranean, Black Sea or Sea of Azov ports, and include tankers returning to the Lower Volga and Caspian Sea and some cargo ships, such as those carrying scrap metal from Turkmenbashy/Krasnovodsk.
- Voyages made in ballast from the Caspian Sea are few, and typically occur following delivery of heavy equipment or construction modules to petroleum operations.

- The principal waste reception facilities appear to be located at Rostov-on-Don, Volgograd, Astrakhan and the new port being developed at Orlya, but are not designed or suitable for managing ballast water.
- Checks of ships' documents are regularly carried out in ports but these do not show violations of the BW regulations and appear to suggest that BW operations in the Lower Volga and Volga Don waterway are quite rare.
- Regular BW sampling for laboratory analysis is not carried out in the port from which vessels depart into the CS and SoA, or where they arrive from these seas.
- Private discussions with ships' captains indicated that BW is not exchanged in the specified areas before entering the ADSC or VCC, and that unlogged BW operations are made for navigational purposes along parts of the VDW and LV.

The BW movements identified by the assessment during April-September 2006 reporting exercise amounted to a total of 328,800 tonnes, 81.3% of which was eastbound along the VDW to the lower Volga and Caspian Sea, and 10.4% was westbound to the Sea of Azov and/or the Black Sea. The remaining small volume (48,200 tonnes; 8.3% of the total) was moved south and north along the Volgo-Baltic Waterway (VBW). The ships carrying this water represented a wide range of vessel types and ages, i.e. constructed from the 1960s to the present day. The majority were between 17 and 30 years old, while the most modern ships (>5 years old) were tankers.

An important point noted during the study was that the predominant west-to-east movement of BW matched the pattern of non-native aquatic species acclimation and invasions into the Black Sea then the Caspian Sea, with the latter being facilitated by the acclimation permitted by the decreasing salinity gradient from the eastern Mediterranean to the SoA and LD, and low salinities in the AR/northern CS.

It was concluded that existing areas designated for BW exchange (Sea of Azov and Astrakhan Roads) do not provide an effective measure for reducing the risk of aquatic invasions and minimizing the future BW-mediated transfer of non-native species is possible by:

.1 building land-based installations for BW treatment (including possible use of special BW collection barges at port roads and anchorages); and/or

.2 equipping ships with an effective on-board BW treatment system, if small enough to fit on the ship; and

.3 Implementing an effective monitoring/compliance system for checking the origin and treatment status of BW on board vessels.

It is recognized the role of the Russian Federation (RF) will be both pivotal in the implementation of a BW action plan and that this would not be easy, given that:

(a) the BS-CS waterway is an internal domestic waterway used by RF-flagged ships, and requires special permission for use by Foreign-

flagged ships. Establishment of any reception facility for treating BW therefore represents a domestic issue.

(b) changing the status of the waterway, for example as part of a WTO agreement, is unlikely to be an easy process, as it will need to address economic ramifications to the RF shipping companies.

(c) the BS-CS waterway is part of the RF's Unified Deep Water System (UDWS) that connects to the Baltic Sea, and therefore the RF will need to co-ordinate development of any BW management strategy with the Baltic countries as well as the Caspian countries.

There is a broad consensus that improving BW management can only be achieved by a unified and uniform regional approach – not only for the Caspian Sea region itself, but also in concert with the regional efforts that are now being made by countries that have formed regional groups around the Black Sea, the Baltic Sea and parts of the Mediterranean Sea.

Seals in the Caspian Sea

The Caspian seal is the only marine mammal in the Caspian Sea. It is endemic species for the Caspian Sea and is listed on the IUCN Red List of Threatened Animals as vulnerable. It feeds on tulka and other small fish throughout the Caspian and migrates in the winter to the North Caspian to breed, with the pups being born on the ice shelf.

It is still unclear how many seals remain in the Caspian Sea. From a population estimated at more than 1 million in the early 20th century, present population estimates vary from about 110,000 to 350,000 (CISS report, Khuraskin et al., 2003; 2004; 2005; 2006). For much of the 19th and 20th century, hunting was carried out (including pups) in the North Caspian area and in the early 20th century, almost 100,000 seals were killed each year. Although the hunting quotas still survive, set by the Caspian Commission for Bioresources, no organized hunting has taken place in the last decade, principally because of a lack of a market for seal products. However in 2006-2007 due to decline in fishing resources seals' hunting has become more active, especially in the North.

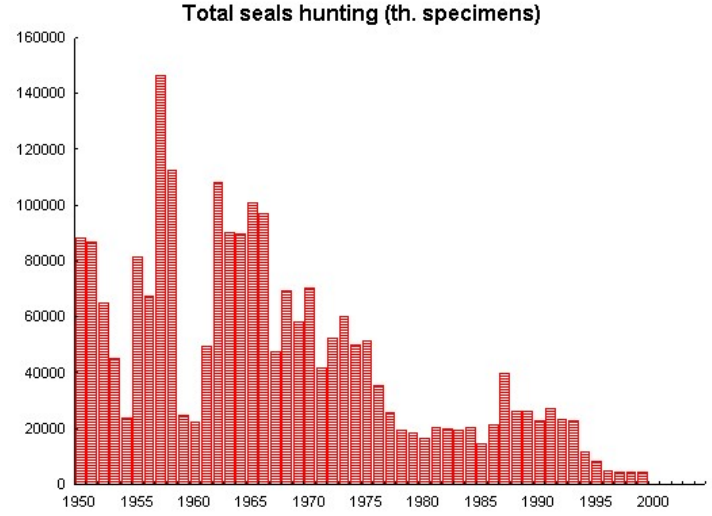

Figure 4.1.4 Data from official FAO statistic web-site - Fishsta+

The seal population has been subject to recent mass mortalities that have reduced the population significantly. In 2000, a mass mortality caused some tens of

thousands of deaths throughout the Caspian (Azerbaijan, Kazakhstan, Russia, and Turkmenistan). The 2000 mortality was particularly notable for the role played by canine distemper virus – CDV (Kuiken et al., 2006). Nearly all the seals examined in 2000 tested positive for this morbilivirus. The seal mortalities were repeated in 2006-2007 but at a lower scale, with about a thousand dead seals found around Aktau-Buzachi peninsula (Kazakhstan). Again, all the dead seals examined tested positive for CDV (Kazakhstan Institute of Microbiology Report, 2007). Earlier studies in other areas of the world have shown that contamination from persistent toxic substances may cause females to become barren as well as suppress their immunity system (De Swart R.L et al., 1996). High levels of PTS were found in seal tissues examined during the 2000 mortality and this corresponded to highs of pesticides found in certain areas of the Caspian (see original TDA). Up to 50%-70% of females are thought to be barren in the Caspian Sea, although the ratio of barren females changes from year to year. There is no estimation what is the natural ratio of barren females but even 50% would appear high.

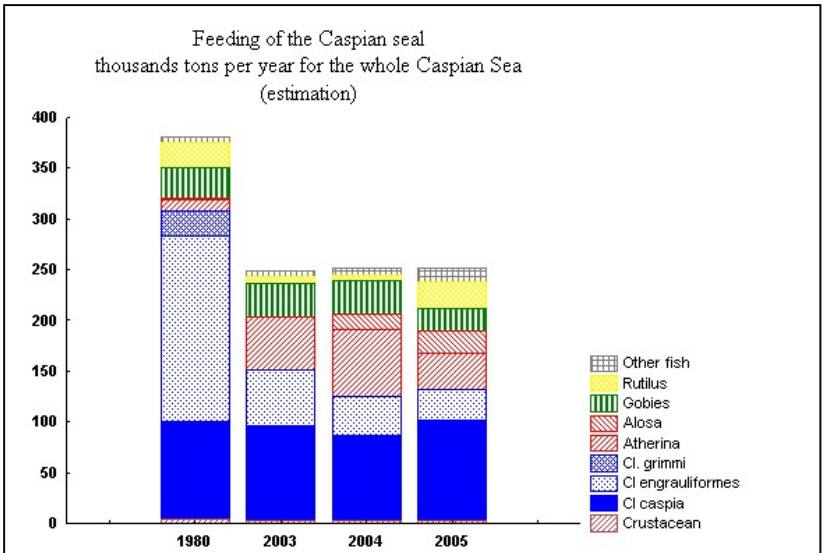

Figure 4.1.5 Data on the seals feeding from Khuraskin et al 2001, 2003, 2004, 2005, 2006

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Besides pollution and hunting, there are other stresses acting on the Caspian seal population. A major food source for the seals is the tulka, one of the small and abundant fish of the Caspian. For the past decades tulka stocks have reduced dramatically due to a number of reasons, including over fishing and the invasion of the ctenophore *Mnemiopsis leydyi.* Caspian seal diet consists almost 100% of fish preferring fish of small and middle size (see figure 4.1.5). Tulka is an important part of the seal diet throughout the Caspian – up to 30%-70% of the total (shown above in blue).

In the North Caspian with more or less stable stocks of tulka in recent years there would appear to be little change in the seals feeding, although some seasonal changes have been observed in correlation with availability of different prey species. Consumption of roach for example regularly increases from spring to autumn, with maximum up to 50% in August-September.

In the Middle and South Caspian a decrease in tulka consumption has been observed in the last years and it has been substituted by the sand-smelt (*Atherina boyeri*), and gobies (mainly *Neogobius sp*.) (Khuraskin et al 2001, 2003, 2004, 2005, 2006) The seal as an active predator and can easily shift from one fish species to another, whatever is the most abundant. It would be interesting to see if pressure on

the tulka stocks had increased predation on fingerling sturgeons in recent years. It is estimated that approximately each seal consumes up to 700-1000 kg of fish annually, and that depending on numbers of seals this could convert to 100-150 thousands tons per year of tulka per year. This amount is comparable with the total tulka catches (all three species) and in recent years would suggest that there has been significant competition, and, as a consequence, the overall health of seal population may be suffering. It is clear that the consumption of tulka by the seals (and other predators) needs to be accounted during calculation of the tulka TACs Total Allowable Catch.

Disturbance on the ice during pupping season and pups-mother separation is another threat to the seal population which has recently been recognize. In 2006 a study carried out with the support of the oil company Agip KCO was undertaken to determine the response of breeding seals to the passage of an icebreaker vessel. The behavior of 270 mother-pup pairs, 117 lone pups (without mothers visible from the ship) and 99 single adults was recorded as the ship progressed through the ice. There were more very small pups seen without their mother than statistically expected. Most of these small pups were seen along the edge of the shipping channel. Mother-pup pairs closer than 100m from the ship's channel almost always moved away from the ship as it passed and almost all pups followed their mothers as they moved away. More than 40% of lone pups moving away from the channel edge tried to follow another seal, most often another lone pup. It was concluded that icebreaker passage through the seal pupping grounds has a measurable negative impact on seal welfare and may compromise the survival of some pups. A new pattern may be establishing where seals use the shipping channels to penetrate the ice field and establish breeding habitat on channel edges. A potential mitigation measure is to switch icebreaker routes after seals have established breeding territories, since after this critical period seals are not likely to move to new areas. Icebreakers should not traverse high density seal pupping habitat and should not pass within 100m of a mother-pup pair. Selecting a track to avoid breeding seals would require study of the establishing colonies in late January.

(photo)

Mother pauses and turns round to look at pup (photo by CISS team)

Photo by Pavel Erokhin

AGIP-KCO has also funded studies of breeding populations in the northern Caspian. Aerial surveys were carried in February 2005 and 2006 to assess the annual pup production and the size of the breeding population of the species. Based on a survey of 11% of the ice field in Kazakh territory and a the total count of pups of 2,140 in 2005 and 1,860 in 2006 the project has estimated the total Caspian seal population size to be 110-115 thousands individuals, using a 'hind-casting' model.

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In 2005, and to a lesser extent 2006, much of the seal ice habitat was occupied by seals at relatively low densities (up to 3 adults or pups per km^2). In 2005 there were considerable areas of moderate adult and pup seal densities (3–6 adult or pups per km^2) surrounding a relatively few areas of seal 'hot spots' of up to a mean density of 22 adults or 12 pups per km^2. However, in 2006 the majority of seals were crowded into small areas of more dense hot spots. In both years the hot spots were concentrated in the South-West of the ice area. The total number of eagles (a potential predator) counted was 243 in both years, giving an estimate for the overall number of eagles on the ice of 2,209.

These studies have provided key information for the development of the Caspian Seal Conservation Action Plan (CSCAP) which has now been adopted by all the Caspian countries. On April 10, 2007 Dr. Makhtumkuli Akmuradov, in the capacity of SCM Chairperson, approved the CSCAP as 'guidelines for the voluntary adherence by the countries'. CSCAP is in line with EQO II of the SAP "Conservation of Biodiversity", particularly with Target 1 "Increased regional collaboration to achieve maximum regional benefits for biodiversity" and Target 2 "Ensure all key species are maintained or restored to viable levels". As a result of the Caspian Seal Conservation Plan seal conservation has become a separate Target 4 under EQO 1 in the Updated SAP.

Causes

The original biodiversity TDA reviewed the number of species (native, endemic, invasive and threatened) believed to be present in the Caspian, but recognised that

a) there was little consensus on the total number of species and
b) that there was a fundamental lack of good contemporary information even on the most 'high profile' species

The original TDA also stated that the damage to biodiversity was evident, but that there was a lack of quantitative data to support such a conclusion. It is important to clarify which aspects of biodiversity appear to be under threat:

- The reduction in abundance of rare, ecologically important or 'flagship' species
- A more general reduction in the overall number of species
- A reduction in the number of species in particular ecological or taxonomic groups
- A temporary loss and/or reduction in abundance of species which critically affect processes such as productivity

It is also useful to distinguish between the terrestrial and marine environments. In the former, loss of habitat may threaten individual or rare species on a local basis. In the marine environment, there is a greater risk that threats and pressures will be more immediately transboundary in effect. This is important, since a high proportion of the total number of species are marine, and since the health of the marine environment is crucial to the welfare of all the littoral states.

Much of the concern about biodiversity decline relates to the status of flagship or indicator species. In particular, the observed threats to seal and sturgeon populations are widely considered to be predictive of a more general deterioration in the status of the Caspian. Seals and sturgeon, as the top predators in the Caspian system, are generally considered to be excellent indicators of ecological health. This is true, to the extent that the welfare of seals and sturgeon depends on a healthy ecosystem. If the ecosystem is in decline, this will inevitably be reflected in a decline in seal and sturgeon populations. What is not true, however, is the converse – that a decline in seal and sturgeon populations is *necessarily* due to a decline in the underlying ecology. It is quite possible for species at the top of the food chain to be affected directly by specific factors without there being any corresponding change in the underlying ecosystem. At present, the only clear evidence available is of a decline in flagship species; the previous TDA identified a need for more information on the status of the underlying ecosystem, and this continues to be a pressing need.

Marine monitoring carried out by oil companies over the past 10 years has examined the composition of benthic invertebrate and planktonic communities in some detail. Over this period, there has been no evidence of a decline in benthic biodiversity in the South Caspian. While it is not possible to determine whether the structure of recent benthic communities is comparable to those of the more distant past, it is possible to state with some confidence that no adverse trends have been observed over the past decade, and that species diversity does not appear to be changing. This leads to two conclusions:

a) that there is not at present any widespread decline associated with transboundary pollution
b) that there is no obvious limitation of benthic food sources for demersal feeders such as sturgeon

One issue which needs to be highlighted is that there are practical difficulties in comparing the results of individual monitoring studies with species lists which have been compiled over many decades. This relates to the limitations of marine sampling methods; a species may occur infrequently in samples without being genuinely rare. Consequently, it may be necessary to sample for several years in order to be sure that all species present in an area have been observed and recorded. As a result, it is inevitable that individual surveys will always report fewer species than are present in any of the 'master species lists'. The only solution to this problem is to ensure a sustained and consistent monitoring effort over many decades; unless this is done (and coordinated at an international level) it will not be possible to collect sufficient data to fully and correctly understand the status of Caspian biodiversity.

What are the potential threats to ecological health and biodiversity?

From the preceding paragraphs, it is clear that there is not in fact a convincing case that pollution is a fundamental threat to the health of the Caspian at present. It is, of course, a local and perhaps regional problem, but there is no evidence that it is causing a widespread decline.

Clearly, hunting and fishing represent a specific threat to seals and sturgeon; and, as top predators, they will be more vulnerable to pollutants such as pesticides (since

pesticide impacts are chronic, these pollutants often have relatively little impact on short-lived invertebrate species).

Invasive species were identified as a potential threat in the original TDA, and it is worth giving further consideration to ways in which such threats could be expressed. Many invasive species, both accidental introductions (e.g. the copepod *Calanipeda aquae dulcis*) and deliberate introductions (e.g. *Nereis diversicolor* and *Abra ovata*) appear to have integrated well into the Caspian system (although *Nereis* and *Abra* often dominate near shore habitats). In recent years, there has been much concern about the introduction of the ctenophore *Mnemiopsis*; this is a species which has demonstrated the potential to significantly destabilise parts of the ecosystem, but it is important to recognise that it is not the only species which may have done so. The following examples will illustrate this point:

a) the diatom *Pseudosolenia calcar-avis* appeared in the Caspian in the mid-20th century, and rapidly became established to the point where it often represented 90% or more of the phytoplankton biomass. *Psedosolenia* is a very large diatom, and is almost certainly too large for the native zooplankton species to consume. Consequently, it is possible that since the establishment of *Pseudosolenia* up to 90% of primary production has not been available to native zooplankton populations. This may have contributed to a progressive decline in zooplankton production, with consequent effects on planktivorous fish species
b) the copepod *Acartia tonsa* also appeared in the late 20th century. (see above box) This species rapidly became the dominant zooplankton species. One reason for this may be that *Acartia* can feed more effectively on *Pseudosolenia* than can the native zooplankton species
c) the appearance of *Mnemiopsis* at the end of the 20th century appears to have been followed by a rapid decline in the diversity of native and endemic species, but not in the abundance of *Acartia*
d) a key difference between *Acartia* and native copepod species is the method of reproduction – native species all retain embryos in egg sacs, whereas *Acartia* releases fertilized eggs into the water column. The fact that native species carry their embryos until hatching means that predation pressure by *Mnemiopsis* on native species is considerably higher than on *Acartia*
e) the present situation in the South Caspian (reported by national ministries and by the oil industry) is that native species are almost completely absent, but that *Acartia* remains common and abundant.

The above points suggest that a major threat to the Caspian may have arisen through the impact of invasive species on zooplankton diversity. If zooplankton production is adversely affected, then a decline in fisheries would naturally follow. However, it is also possible that the impact of two alien species (*Pseudosolenia* and *Mnemiopsis*) may to some extent have been offset by the ability of another invasive species (*Acartia)* to resist these impacts. The consequence in the long term cannot yet be predicted, but one real possibility is of a simplified equilibrium community consisting primarily of invasive species which is capable of sustaining sufficient production to keep the rest of the ecosystem healthy. If this occurs, then there will have been a real loss of biodiversity within the zooplankton community, but this might not seriously affect biodiversity in the wider Caspian ecosystem.

How can we quantify and evaluate these threats?

The foregoing discussion clearly indicates that threats are not limited to direct human activity, and that ecological interactions initiated by species introductions may still be in a state of change. One key area to focus on is a study of primary and secondary production – the planktonic communities are a fundamental basis for the health of the entire marine system.

It is also essential to establish and implement a consistent, region-wide benthic and fisheries monitoring programme. Without a clear quantitative description of ecological and biodiversity status, it will be impossible to identify either causes or solutions. What must be avoided at all costs is misidentifying the problem – this must be done on the basis of reliable and quantitative data, not on the basis of opinion or belief. Resources must be directed at the real problems – the worst outcome would be to allocate precious resources to the wrong problems, since this would guarantee that no effective solutions would be implemented.

4.1.2 Linkages with other transboundary problems

The issue of threats to biodiversity is closely linked to the other transboundary problems in the Caspian region, including the decline in environmental quality from pollution impacting biodiversity in particular the higher trophic levels which in turn impacts negatively on bioresources.

The decline in environmental quality can cause problems for biodiversity by creating additional stresses on the health of specific species or populations within the Caspian. During the previous TDA the seal mortality events were tied to the increased levels of POPs in the environment accumulating in the seal tissues. Additional studies have shown that there are also specific contamination hotspots of persistent toxic substances which may impact the health of localized biodiversity, such as near industrial centers along the Caspian coasts.

Coastal development has a direct impact upon the coastal habitats, causing deteriorating and fragmentation of key biomes. The lack of integrated coastal zone management in the Caspian countries is a real concern. Protected coastal sensitive sites especially where constrained by peripheral development and threatened by water level fluctuations are of particular concern especially in the South Caspian where tourism development is accelerating.

Decline in biodiversity is linked to the decline in bioresources, as food chains are potentially disrupted and feeding patterns altered due to shifts in species composition. Because of the unique biodiversity of the region and high number of endemic species, a disturbance in food chains may impact species that are of high ecological and economic value such as sturgeon. With introduction of M*nemiopsis leidyi* as well as other species, the food web may undergo potentially significant disruptions. As discussed above, at present the productivity of benthic community has not been impacted and dermal feeding species such as the sturgeon may not be affected, although the threat remains.

Invasive species of flora and fauna would appear to be the most prominent threat to biodiversity on the Caspian at present. Although invisible they have the potential to the greatest lasting damage to the Caspian ecosystem and all effort to must be made to control the invasive transfer, in particular through ship ballast waters.

The most visible threat to biodiversity is the oil and gas industry although we do not believe that it is either the most serious or a direct threat. The perception is that this threat is most pervasive due to the high profile accidents within the petroleum industry. The threat of accidental discharges is significant but temporary and all the major many oil companies are taking steps to guard against them.

4.1.3 Climate change impacts

Climate change impacts on biodiversity in the Caspian Sea region are difficult to forecast, as clear models do not currently exist. If the conditions become hotter and drier in the region due to a decline in rainfall in the basins of tributaries, it can be expected that this will impact the Caspian by diminishing wetlands, reduction in inflows into the Caspian and increasing evaporation. This in turn would result in constriction of habitats and perhaps localized increases salinity and shifts in the food chain composition. In the event that conditions become wetter and cooler, there is a chance that increased pollutants from flooding of contaminant lands with sea level rise, combined with larger fluxes of pollutants from the tributary basins for similar reasons.

Some climate models forecast hotter and drier weather in the southern part of the Caspian and cooler and wetter in the Northern part and especially in the Volga drainage basin. Fluctuation in ice coverage in the north Caspian could have consequences for seal populations as pupping patterns may be disrupted. Throughout the Caspian fluctuation in water temperatures could have great influence on the phytoplankton productivity and changes in phytoplankton dominants. Climate changes along with other factors could lead to increasing of algal blooms. These changes will be reflected in all planktivore species, first of all zooplankton and then pelagic fish species such as the Tulka. Even small fluctuation of the sea level could lead to significant changes in the benthic communities in shallow waters and in the littoral zone. Reduction of benthic invertebrates in this zone will have negative impact on sandpipers and many other birds feeding in shallow shore zone.

4.1.4 Knowledge gaps

The foregoing discussion clearly indicates that threats are not limited to direct human activity, and that ecological systems, initiated by species introductions, may be in a state of flux. One key area to focus is the primary and secondary production and diversity in the phytoplankton-zooplankton-benthos communities as indicators of the health of the entire marine system.

- There is an absence of a clear quantitative description of ecological and biodiversity status (for taxonomic and ecological groups and for the region), which makes it difficult to identify either causes or solutions.
- There is no full Caspian catalogue of invasive species and their impacts.

- More knowledge is needed about the nature of CDV infestation of the Caspian seal population; quantitative data on pollution impact on immunity suppression, and the natural female fertility levels.
- There is no full Caspian catalogue of invasive species and their impacts.
- There is no agreement on rare and endangered species and species status differ in the five countries and this leads to situations where the same species can be subject to commercial fishing/hunting in one country and protected in another. Caspian seal and the Caspian whitefish – kutum are examples.
- There is a need for a list of sensitive and protected areas and special management recommendations for these areas, including and simple, cost effective monitoring programme to track trends.
- Further study of the potential impacts of climate change is required on terrestrial and marine biodiversity.

Besides knowledge gaps there are action gaps:
- All countries need to abide by their agreements to making available environmental data and information to CEP and the public on a regular basis – no information on concentration of contaminants, mortality events, primary and secondary productivity, and fish stock assessments, quotas and landings has been shared;
- A decision on the introduction of *Beroe ovata* as a control agent *Mnemiopsis leidyi*;
- Training and equipment in ML monitoring has been delivered in all five countries for *Mnemiopsis leidyi,* but no regular monitoring is performed by countries;
- Implementation of the Caspian Seal Conservation Action Plan;
- All countries need to abide by their agreements to making available environmental data and information to CEP and the public – no information on concentration of contaminants, mortality events, primary and secondary productivity, and fish stock assessments, quotas and landings are shared on the regular basis.

4.1.5 Recommendations

Based on the key knowledge gaps and actions, a number of key recommendations are proposed:

- Establish a regional integrated biodiversity monitoring programme based on a agreed M&E framework (with permanent consultation/training of experts within the region) to develop a baseline and identify trends including changes in community structure.
- Unification of monitoring protocols for marine and terrestrial habitats based on the results of biodiversity monitoring and CCSI projects and explore the potential for remote sensing.
- Develop a Ballast Waters Action Plan for the Caspian
- Following on from the CCSI study, identify areas of biodiversity distinction for focused attention, especially for marine habitats
- Creation of reference collection under CEP umbrella - there are some reference collections in existence but they are not available to many specialists in the region.
- Creation of Caspian Red Book of endangered and threatened species. The process of species evaluation is very important for understanding species status particularly for the region and elaboration proper managing actions.

- Further ecotoxological studies of seals and sturgeon to determine the impact of persistent toxic substances on the higher trophic levels, in particular the long-lived species.
- Evaluate the economic importance of protecting regional biodiversity and communicate the results to the general public and Government decision makers.

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4.2 Changes in Environmental Quality

4.2.1 Sources of Information since TDA 2002

The TDA prepared in 2002 provided a good overview of the environmental situation based on information available at that time. Unfortunately, there were several knowledge gaps. Since then, considerable effort has been made in trying to clarify many aspects of the environmental quality of the Caspian Sea. Several different international organizations, spearheaded by the Caspian Environment Programme, have undertaken relevant studies in the region, in particular focusing on improving knowledge of the state of the environment, estimating riverine fluxes of pollutants and identifying land-based sources of pollution. In many cases, these investigations have provided new information that was unavailable at the time of the 2002 TDA. Accordingly, this appraisal cannot be limited to considering changes in environmental quality, but rather the new results provide a basis for better understanding of the Caspian Sea environment.

Regarding firstly the state of the environment, CEP sponsored sediment surveys in 2005, which featured some marked differences to the 2000-2001 sampling campaign. Notably, sediments were collected throughout the coastal zone of Turkmenistan. Good sample coverage was obtained in the Volga Delta and Estuary. Sampling in Azerbaijan concentrated on the area near the mouth of the Kura River, but no materials were obtained from the known pollution hot spot of the Baku Bay region. Whereas the 2005 survey in the Islamic Republic of Iran essentially revisited sites from the previous investigation, many fewer samples were collected in Kazakhstan. Data reports from the various laboratories undertaking chemical analyses are available at the CEP web site (www.caspianenvironment.org). All data were interpreted to give an overall assessment of the environmental quality of the Caspian Sea (de Mora, 2006). Additionally, more information about Turkmenistan was provided in a study of Saymonov Bay (CEP, 2006b). An algal bloom that occurred in the South Caspian Sea in 2005 was investigated using remote sensing techniques (CEP, 2006a).

A major criticism that could be lodged at the 2002 TDA was the lack of information about fluxes of pollutants to the Caspian Sea. An attempt was made to counteract this deficiency during CEP Phase II through field investigations of the Volga and Kura, and desktop studies of the Terek and Sefidroud Rivers (reports available at www.caspianenvironment.org). As discussed below, these studies met with mixed, but generally limited, success. Moreover, no recent information has been obtained for the Ural River. The Kura-Aras catchment region has been the focus of considerable attention in recent years. Not only has there been an autonomous GEF Project, but there have been studies sponsored by NATO and Tacis that examine the state of the environment and pollutant fluxes. Also, the IAEA conducted a radiological survey of the Kura and Araks Rivers in Azerbaijan to measure ^{137}Cs, ^{238}U, ^{234}U, $^{239+240}Pu$, ^{238}Pu, ^{90}Sr and ^{241}Am activity in sediment samples and some aquatic plants (Sansone *et al.*, 2005).

CEP has assisted the riparian countries to conduct rapid assessments of pollution sources (RAPS). National reports are available at the CEP web site (www.caspianenvironment.org). Similarly, a Global International Waters Assessment of the Caspian Sea drainage basin was completed (UNEP, 2006). Habitat and community modification exerted the greatest impacts on the Caspian Sea region and was prioritized for causal chain analysis and policy option analysis.

4.2.2 State of the Environment

CEP Survey of Sediments in the Caspian Sea
A report (de Mora, 2006) interpreted sediment quality and assessed marine pollution in the coastal zone of the Caspian Sea based on 84 surface sediment samples that were collected during 2005 on oceanographic missions sponsored by the Caspian Environment Programme. Notably, the contaminant screening survey included Turkmenistan, the results of which are highlighted in the next section. Although uniformity was achieved with respect to sampling and sample handling procedures, chemical analyses were conducted in various laboratories. A differing suite of determinands (metals, chlorinated hydrocarbons and petroleum hydrocarbons) was measured with varying standards of quality, as exemplified by the marked disparities in the achievable detection limits. In the absence of sediment quality criteria for the Caspian Sea, pollution was assessed with cautious reference to national sediments quality guidelines from outside the region.

Little evidence of metal contamination was observed in these surveys, apart from a number of sites in Azerbaijan with elevated mercury levels. Although some elements (arsenic, chromium, copper, and nickel) exhibited concentrations sufficiently high to exceed sediment quality guidelines, such metals undoubtedly have a high natural background in this mineral-rich region (de Mora *et al*., 2004a). Nevertheless, anthropogenic activities, notably mining, may have further enhanced the metal content in some sediments of the Caspian Sea. This might explain apparent hot spots for copper in Azerbaijan. Several metals (cadmium, lead, silver, uranium, and zinc) had relatively low levels posing no environmental concerns.

Contamination with respect to DDT-related compounds was observed near the mouths of the Volga and Kura Rivers, as well as at numerous places in the coastal zone of Iran (Figure 4.1). The ratio of *p,p'*-DDT: *p,p'*-DDE provides a useful index to assess whether the □-DDTs at a given site are fresh or aged, with a value <0.33 considered to indicate an aged input (Stranberg *et al.*, 1998). On this basis (Figure 4.2), much of the DDT was fresh rather than aged, as previously observed in the region (de Mora *et al*., 2004b). Thus, DDT contamination remains an ongoing transboundary issue in the Caspian Sea.

Several other organochlorinated pesticides were investigated. Concentrations were invariably low in Kazakhstan and Turkmenistan. Hexachlorocyclohexanes (HCHs), notably lindane, was of concern in some parts of the marine environment of Azerbaijan. Sources strengths (*i.e.* local usage) of the other organochlorinated pesticides (*e.g.*, chlordane, heptachlor, aldrin, dieldrin, endrin, endosulfan) in the

different regions varied considerably, but concentrations were generally not of environmental concern.

The Σ-PCBs content was much higher in Azerbaijan than elsewhere, surpassing the sediment quality guideline value of 23 ng g^{-1} dry weight at two locations. PCB-chlorination distributions indicated that most sites had experienced multiple inputs of different commercial mixtures of PCBs, including Sovol and TCD of Soviet origin. The Goldberg Index reflected the relative magnitude of the principal sources of organochlorinated compounds, thereby highlighting the importance of agricultural DDT inputs in Iran and Russia compared to industrial PCB discharges in Azerbaijan.

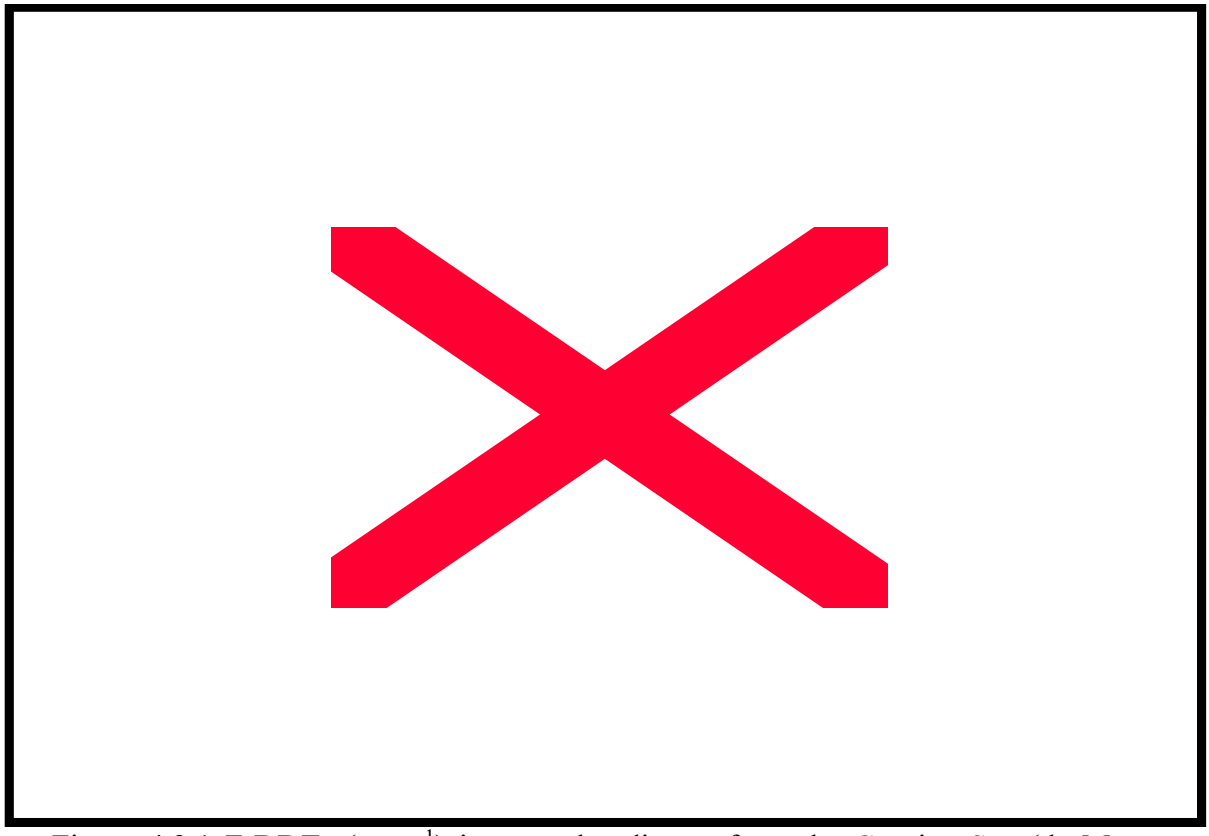

Figure 4.2.1 Σ-DDTs (pg g^{-1}) in coastal sediment from the Caspian Sea (de Mora, 2006)

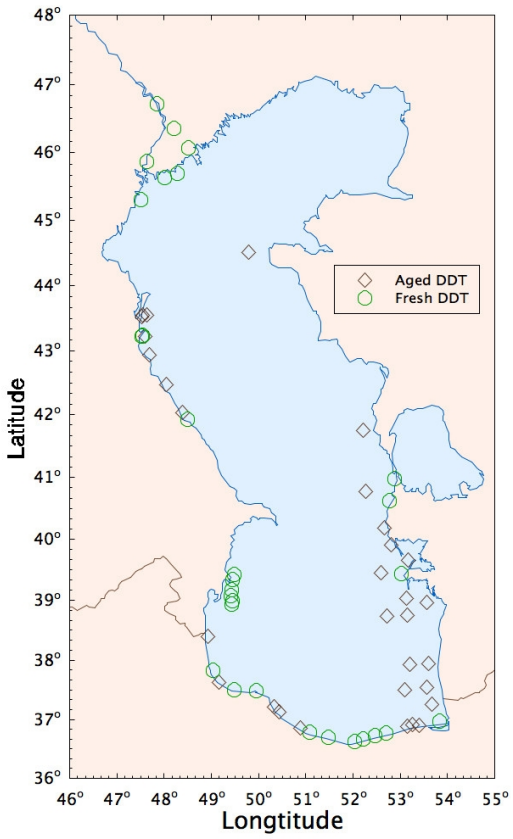

Figure 4.2.2 Sites in the Caspian Sea with fresh or aged DDT categorized by the ratio of *p,p'*-DDT: *p,p'*-DDE, for which values <0.33 denote fresh inputs (de Mora, 2006)

Petroleum hydrocarbon (Σ-PHs) concentrations were relatively low by global standards, with the caveat that some known pollution hot spots were not sampled in these surveys. The distribution of *n*-alkanes and the carbon preference index suggested a petrogenic origin for petroleum hydrocarbons at some sites in Azerbaijan, Kazakhstan and Russia. PHs in Iran and Turkmenistan, as well as some locations in Russia, derived predominantly from marine and terrestrial biogenic sources. Based on the weathering index, several sites in Azerbaijan and Turkmenistan exhibited a high degree of biodegradation and chronic contamination of degraded petrol. In contrast, relatively fresh inputs of hydrocarbons were apparent in Iran and southern Turkmenistan. The concentrations of polycyclic aromatic hydrocarbons (Σ-PAHs) never exceeded the sediment quality guideline value of 4022 ng g^{-1}. Based on various diagnostic ratios, the PAHs tended to be derived primarily from oil with some combustion products, especially in Azerbaijan. Minor contributions from diagenetic sources were detected, principally near the Volga Delta.

Environmental Quality in Turkmenistan

The sediment survey described above included data from 18 coastal sites in Turkmenistan. These results provide important new information given the paucity of data from Turkmenistan, and accordingly are considered here in more detail. The grain size of the sediments varied greatly, with fine-grained material comprising 2-87% of the total. The mineralogy was dominated by calcium carbonate, with comparatively less aluminum and iron than in other locations in the Caspian Sea. Consequently, relatively lower concentrations of most metals associated with natural terrigenous/terrestrial origins would be expected. This is indeed the case for many elements, such as chromium, copper, mercury, nickel, vanadium, and zinc. The distribution of copper in the Caspian Sea is shown in Figure 4.3. In contrast, the highest levels of barium, usually associated with drilling activities, and uranium, often were observed in Turkmenistan. Some elements, notably arsenic, copper and nickel, did exceed sediment quality guidelines (Long *et al.*, 1995) at a limited number of sites. Such behaviour has been recorded elsewhere in the Caspian Sea and attributed to natural origins (de Mora *et al*., 2004a).

Regarding chlorinated pesticides, concentrations in the sediments of Turkmenistan were invariably quite low, as exemplified for Σ-DDTs in Figure 4.1. This was also true for PCBs, with concentrations of Σ-PCBs in the range 0.043-1.31 pg g^{-1}. The PCB chlorination patterns typically were indicative of deriving from Sovol, a PCB mixture manufactured and utilized during the Soviet era. The situation was quite different when considering petroleum hydrocarbons. Concentrations of PHs at some sites in Turkmenistan were as high as the maximum values recorded in the other riparian states. The distribution of total aliphatic hydrocarbons in the Caspian Sea is shown in Figure 4.3.

Another study commissioned by CEP reviewed the history of pollution, biodiversity and remediation efforts in Saymonov Bay (CEP, 2006b). Located in the northwest part of Krasnovodsk (Turkmenbashi) Bay, Saymonov Bay is now a closed water body

with a surface area of about 14.4 km^2 and a maximum depth of only 1-2 m. The underlying layer of anoxic silt sediments may be up to 0.5 m thick. Significant pollution in the bay dates back to 1941 with the construction of the Turkmenbashi Oil Refinery, which discharged untreated wastewaters until 1961. The Krasnovodsk (Turkmenbashi) Power Station was put into operation in 1962. The waste ditch (canal) that was built as a consequence became a dam isolating Saymonov Bay from the larger Krasnovodsk (Turkmenbashi) Bay. During the early 1990s, the sewerage system of Turkmenbashi became obsolete, resulting in frequent leaks and significant volumes of fecal waters contaminated the bay. Today, the largest facilities impacting the local environment in and around the Saymonov Bay are the Turkmenbashi oil refinery; water provision, sewerage and transport infrastructure of Turkmenbashi town; and the Hotel Serdar, which discharges the brine from a desalination facility. The major pollutants entering the bay comprise oil products, phenols, nitrogenous nutrients and copper. An environmental survey of the bay was conducted during the period from 2002 to 2004. Water and sediment samples showed significant levels of hydrocarbon pollution. The President of Turkmenistan issued a decree relating to pollution mitigation and remediation of the bay. Environmental quality, especially with respect to oil pollution, has been observed to improve, largely as a result of the installation of new treatment facilities at the refinery, better maintenance programmes, and pumping oil products out of the ground waters.

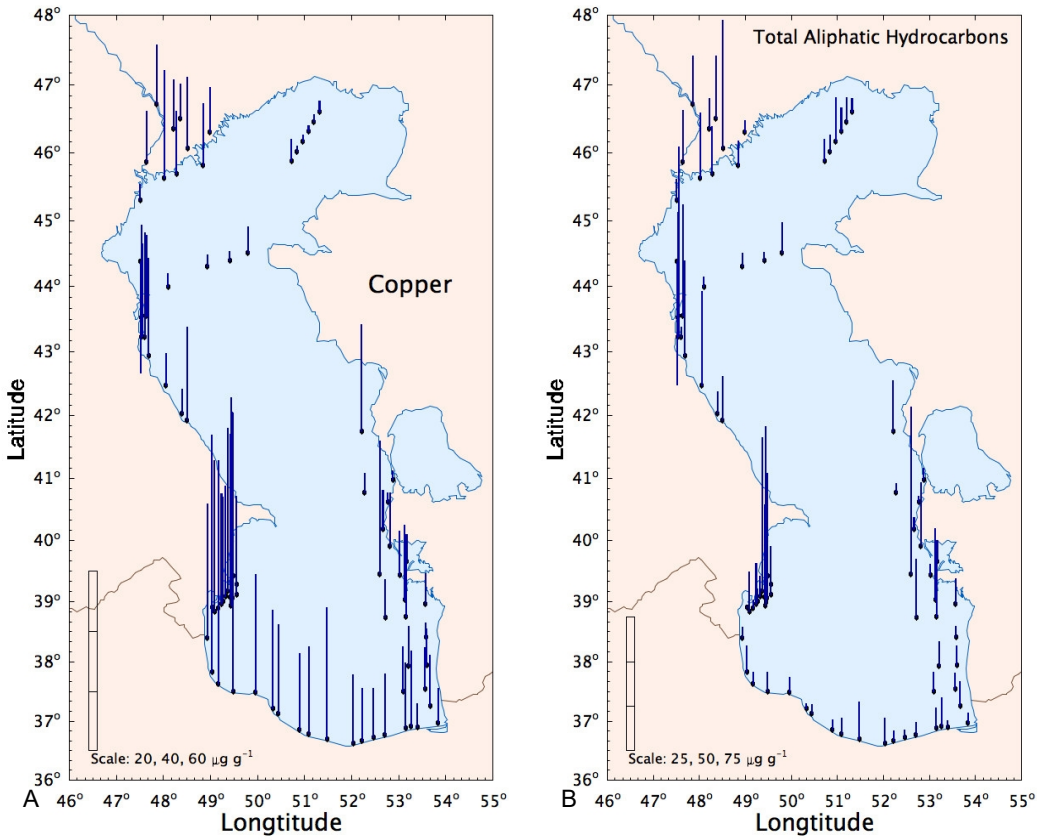

Figure 4.2.3 Distribution of copper (A) and total aliphatic hydrocarbons (B) in sediments of the Caspian Sea (de Mora, 2006)

Recapitulating, there is little evidence of marine pollution through most of the coastal zone of Turkmenistan. Although there is notable pollution, particularly with respect to

oil, in Saymonov Bay, this is essentially a closed water body with little exchange with the Caspian Sea. Moreover, remediation efforts currently underway seem to be improving the local environmental quality.

Sediment Studies in the Volga River Delta

As part of the CEP-sponsored sediment surveys, a set of 10 samples was collected in the Volga Estuary and Delta. Chemical analyses were undertaken at the Geochemical Laboratory of the P.P. Shirshov Institute of Oceanology of Russian Academy of Sciences (SIO RAS), in cooperation with Laboratories of ROSHYDROMET in Obninsk (Typhoon) and the State Oceanographic Institute (SOI) in Moscow (Lobkovsky & Rozanov, 2006). The data were interpreted as part of the overall pollution assessment of the Caspian Sea (de Mora, 2006). No new insights were gained with respect to metals and petroleum hydrocarbons, particularly as low levels were observed for most elements and substances.

The distribution of total aliphatic hydrocarbons in sediments of the Caspian Sea is shown in Figure 4.3. Concentrations in the vicinity of the Volga River are not especially remarkable. The generally low amounts of arsenic measured in the Volga River region, 2.70-5.70 $\mu g\ g^{-1}$, agreed well with previous observations of only 4.1 $\mu g\ g^{-1}$ for sediments in the Volga Delta (Winkels *et al.*, 1998). The chromium concentrations in the Volga Delta (16.8-211 $\mu g\ g^{-1}$) were comparable to a background level (average 96; range 22-159 $\mu g\ g^{-1}$) defined on the basis of 175 samples from the Astrakhanskiy biosphere reserve (Lychagin *et al*., 1995). Lower concentrations have been observed in the Volga Delta, 62 ± 14 $\mu g\ g^{-1}$ (Winkels *et al*., 1998) and further offshore in the Russian sector of the Caspian Sea, 32 ± 19 $\mu g\ g^{-1}$ (de Mora *et al*., 2004a). As evident in Figure 4.3, low copper levels, 10.0-31.6 $\mu g\ g^{-1}$, were also found in the Volga Delta, agreeing well with some previous measurements in the Volga Delta, 26 ± 8 $\mu g\ g^{-1}$ (Winkels *et al.*, 1998). The maximum nickel value in the Caspian Sea, 156 $\mu g\ g^{-1}$, was observed in the Volga Delta (de Mora, 2006). The Zn content of sediments in the Volga Delta, 41.0-97.0 $\mu g\ g^{-1}$, were in good agreement with other studies in the Volga: 65 ± 16 $\mu g\ g^{-1}$ (Winkels *et al.*, 1998) and 10-86 $\mu g\ g^{-1}$ (Lychagin *et al.*, 1995), but generally higher than had been measured at other locations in the Russian sector of the Caspian Sea, 2.8-52.9 $\mu g\ g^{-1}$, (de Mora *et al.*, 2004a).

Little can be said of the data for chlorinated hydrocarbons, because almost all results were noted as below the detection limit. This finding was somewhat surprising, particularly in the case of lindane (γ-HCH), which previously had been shown to be a major pollutant in the Russian sector of the Caspian Sea with concentrations up to 609 $pg\ g^{-1}$ (de Mora *et al*. 2004b). The widespread use of lindane in the Russian Federation has been well documented (Zhulidov *et al.*, 1998). The Volga River and the much smaller Terek River contributed comparable fluxes of γ-HCH to the Caspian Sea, the later owing to agricultural practices in the catchment region (Zhulidov *et al.*, 2000). Thus, the report (Lobkovsky & Rozanov, 2006) that lindane was below detection limits (<40 $pg\ g^{-1}$) in sediments from the Volga Delta is irreconcilable with previous survey results. In the same vein, the maximum concentrations of Σ-PCBs in the Caspian Sea had also previously been observed in the Russian sector (de Mora *et al*. 2004b).

A review of historical data for sediment quality in the Volga Estuary and Delta, commissioned by CEP, has provided some valuable insights into the Volga system (Korshenko *et al*., 2006). The sediments are extremely heterogeneous, with grain size distributions strongly influenced by the hydrodynamic regime. Thus, there are spatial gradients as the content of a given constituent can vary with distance from the riverbank and location (*i.e.* river branch) within the estuary and delta. Temporal variations are both seasonal and inter-annual in nature. The heterogeneity exacerbates the problem of seeking trends in data, as exemplified for some metals (Figure 4.2) and organic substances (Figure 4.5). The huge inter-annual differences in concentrations, especially marked for nickel, render it impossible to comment on environmental change, either for better or worse. Apart from Pb, the metal (Cu, Ni, and Cd) concentrations span those observed during the 2005 survey (de Mora, 2006). With regard to the organic substances, it is encouraging to note the measurable levels of α-HCH and γ-HCH. The average concentrations of the latter (0.586-6.533 ng g^{-1}) generally exceed those measured offshore (de Mora *et al*., 2004b) and signify that there has indeed been noteworthy lindane pollution in the delta. Similarly, the average concentrations of DDT (3.8-10.13 ng g^{-1}) generally exceed measurements (maximum of 1.8 ng g^{-1}) previously reported for the Russian sector of the Caspian Sea (de Mora *et al*., 2004b) and reinforce the conclusion that DDT and its breakdown products comprise a major ongoing pollution problem in the region. The average content of PHs (9.225-39.86 µg g^{-1}) concurs with other studies for the region (Tolosa *et al*., 2004), indicating that there is no petroleum hydrocarbon pollution in the Volga Delta.

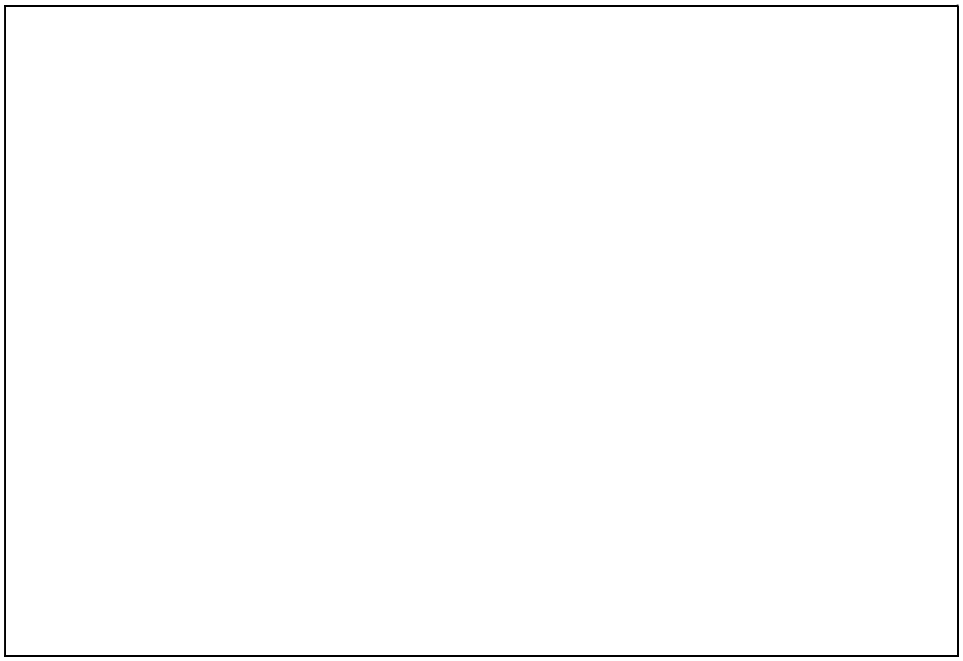

Figure 4.2.4 Inter-annual variations in average metal concentrations in sediments of the Volga Delta (data from Korshenko *et al*., 2006)

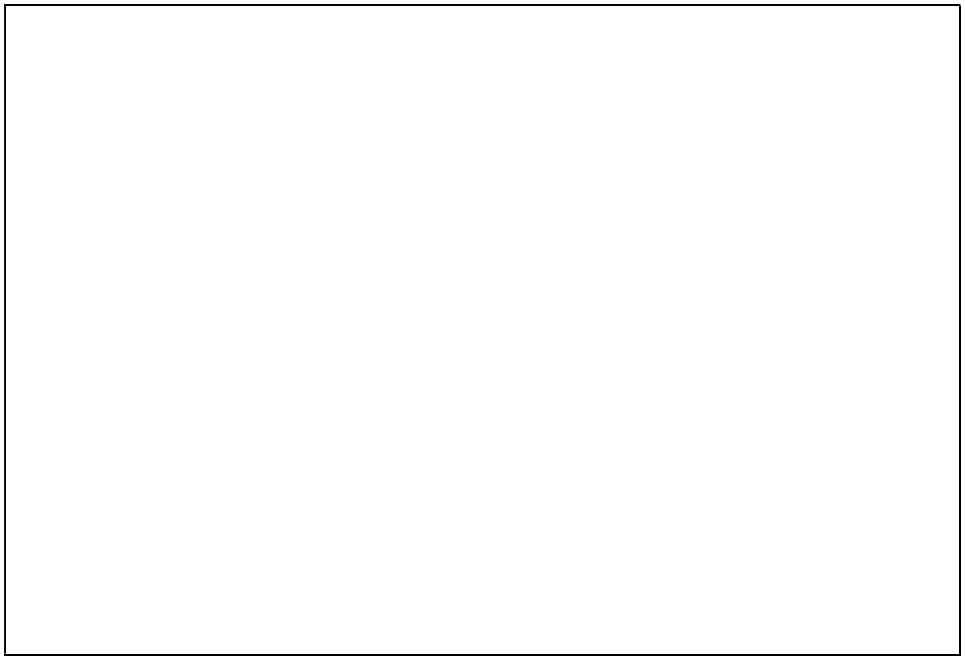

Figure 4.2.5 Inter-annual variations in average concentrations of organic contaminants in sediments of the Volga Delta (data from Korshenko *et al*., 2006)

Sediment Studies in the Kura River Delta

The 2005 CEP-sponsored sediment survey in Azerbaijan focused on the region near the mouth of the Kura River. Chemical analyses of the 16 samples were carried out by Azecolab (Suleymanov, 2006) and the data were interpreted as part of the overall pollution assessment of the Caspian Sea (de Mora, 2006). For the most part, the new study corroborated earlier work in that there is only limited metal pollution in the region, noting that the vicinity of Baku Bay was not surveyed in 2005. The relatively high levels of chromium and nickel are attributed to natural sources. Observations (Figure 4.3) confirmed previous findings (de Mora *et al.*, 2004a) that the Kura River acts as an important source of Cu. The origin of this contamination may be mining activities in the catchment area (Dumont, 1995). Hg levels were notably high at a number of sites in Azerbaijan, sometimes exceeding the sediment quality guideline value of 0.15 μg g^{-1} (Long *et al.*, 1995). The maximum concentration, 0.198 μg g^{-1}, in these sediments from Southern Azerbaijan was lower than the maximum, 0.45 μg g^{-1}, previously observed in contaminated sediments just south of Baku Bay (de Mora *et al.*, 2004a).

Total aliphatic hydrocarbon concentrations near the mouth of the Kura River are amongst the highest observed during the 2005 survey (see Figure 4.3), but fall short of the level, 500 μg g^{-1}, considered to be indicative of significant pollution (Volkman *et al.*, 1992). The levels of Σ-PHs in Azerbaijan (1-96 μg g^{-1}) were much lower than the concentrations of up to 1820 μg g^{-1} that had previously been recorded (Tolosa *et al.*, 2004). Similarly, the content of Σ-PAHs (2.3-103 ng g^{-1}) was markedly lower than the amounts (338-2988 ng g^{-1}) that had previously been observed (Tolosa *et al.*, 2004). However, both observations are readily explained in that the present survey focused on the vicinity near the mouth of the Kura River, whereas previous hot spots of Σ-PHs and Σ-PAHs had been situated just south of Baku Bay.

Several organochlorinated substances were examined. Concentrations of Σ-DDTs are shown for all sites in Figure 4.1. Noting that the sediment quality guideline value for Σ-DDTs is 1600 pg g^{-1} (Long *et al.*, 1995), clearly DDT-type compounds exceeded this quality standard at a number of locations in Azerbaijan. Although the maximum concentration found in Azerbaijan (6660 pg g^{-1}) was somewhat lower than that (13400 pg g^{-1}) previously recorded (de Mora *et al.*, 2004b), widespread pollution of Σ-DDTs near the mouth of the Kura River was confirmed. Moreover, ongoing usage of DDT in the catchment of the Kura River system remains an issue of environmental concern (see Figure 4.2). The highest concentrations of total hexachlorocyclohexanes (Σ-HCHs refers to the sum of all isomers measured) were observed in Azerbaijan, (630-19300 pg g^{-1}). The greatest value exceeded the maximum previously measured in Azerbaijan, 3.46 ng g^{-1} (de Mora *et al.*, 2004b), and was comparable to known polluted regions. With respect to Σ-PCBs, two sites had concentrations (30.0 and 28.7 ng g^{-1}) exceeding the sediment quality guideline value of 23 ng g^{-1} (Long *et al.*, 1995). As found for Σ-HCHs, these concentrations were greater than levels, 0.3-2.8 ng g^{-1}, recorded in the previous CEP survey (de Mora *et al.*, 2004b). In conclusion, the Kura River continues to be an important source of chlorinated hydrocarbons for the coastal zone of Azerbaijan.

Algal Bloom in the South Caspian Sea (2005)

A new impact first noticed in 2005 was the anomalous algal bloom (AAB) that occurred in the Southern Caspian and affected an area of 20,000 km^2. Analysis of the satellite images for the same time period in the previous five years did not reveal evidence that a bloom of such scale had occurred (CEP, 2006a). The unprecedented bloom of blue-green algae developed in mid-August and persisted until the end of September. The bloom development was very fast – the phenomenon was first registered in satellite imagery on August 12 and reached its reaching maximum extent by September 1, as shown in Figure 4.6. In mid-September 2005, the AAB reached the Iranian coastal area alarming local inhabitants and hampering fishing in the area. The Iranian Fisheries Research Organization (IFRO) identified the algal species responsible for the AAB as *Nodularia* based on its morphological characteristics. The thickness of the floating algal layer was estimated in tens centimetres; its biomass was huge. The threat of serious pollution of the shoreline and coastal waters with algal decay products was very high, but fortunately changes in the weather prevented propagation of the AAB further onshore and led to its subsequent destruction.

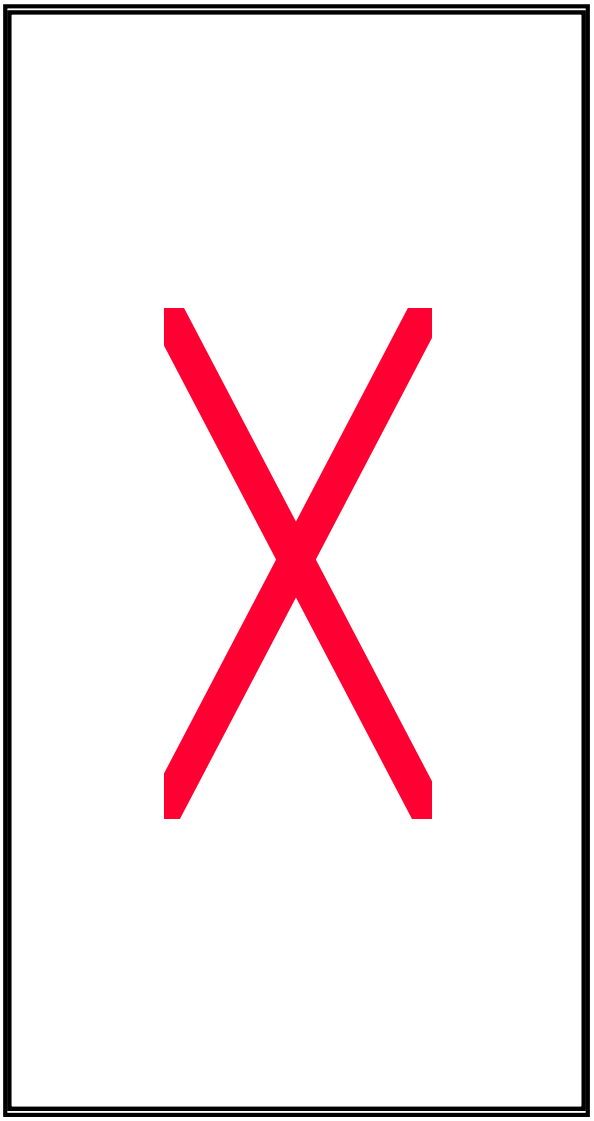

Figure 4.2.6 Chlorophyll-*a* concentrations in the surface waters of the Caspian Sea on September 1, 2005 (CEP, 2006a)

A survey to detect algal blooms in the South Caspian Sea using both remote sensing and field investigations was conducted in 2006. No algal bloom comparable to the 2005 event was observed during August and September in western part of Iranian coastal waters. Surprisingly a smaller bloom developed near Anzali Waters (Iran) on 8th October 2006 when the water temperature was significantly lower than during September. Field studies indicated that the red alga *Hetrocapsa* was responsible for this event, rather then *Nodularia* that had been responsible for the larger 2005 bloom.

A number of hypotheses regarding possible reasons for AAB have been proposed, including climatic changes effects. High sea surface temperatures and low wind conditions during the first two weeks of August have been interpreted as the main explanations for triggering the AAB occurrence in 2005 (CEP, 2006a). However, the lack of field measurements precludes definitive conclusions regarding the cause.

4.2.3 Riverine Fluxes of Pollutants into the Caspian Sea

The Caspian Sea comprises one of the most important endorheic basins in the world, and so given its landlocked nature, no flow-through system exists to help self-purification. Pollutants entering the water body have no means by which to be removed, and thus are retained. This situation reinforces the importance of understanding contaminant inputs in order to choose the best-informed and most cost-effective means to mitigate and remediate pollution. The key pathway to the Caspian Sea is the rivers, underlining the importance of quantifying riverine fluxes of pollutants. To this end, CEP has sponsored desktop and field studies of some of the key rivers in the region. A synopsis of the chief findings is provided here. Original reports are available on the CEP web site (www.caspianenvironment.org).

Volga River

A desktop study of the main persistent toxic substances (PTS) in water and bottom sediments in the Lower Volga at a distance of 200 km from the Caspian Sea was conducted (Korshenko *et al*., 2006). Published information and archived data originated from the State Monitoring Programme at Roshydromet network stations in the upper and central parts of the Volga Delta, together with scientific missions of the State Oceanographic Institute of Roshydromet and the Institute of Water Problems at the Russian Academy of Sciences. Key measurements comprised water and sediment discharges, aquatic pollutant concentrations, the distribution of water flow in the Volga Delta, and estimates of discharges of water, suspended solids and pollutants in different parts of the Volga Delta. Results obtained during the past 10 years were compiled as monthly, quarterly and annual averages in order to estimate the discharge of pollutants by the Volga River into the Caspian Sea. Generally, 40-50% of the flow occurs during the freshet in May or June.

The estimated annual fluxes at different parts of the delta for some key pollutants are summarized in Table 4.2.1. These averages are calculated for three zones in the delta, namely at the apex and the shoreline (DSL) at the western and eastern delta fronts. The fluxes of pollutants from the Volga River into the Caspian Sea vary within the range from tens of kilogrammes for pesticides to tens of thousands of tonnes for petroleum hydrocarbons. The western part usually receives 60-70% of flow, except for lindane (γ-HCH), which is more prevalent in the eastern discharge.

Comparison of data from the period 1995-2004 to those from 1977-1993 (as cited in Korshenko *et al*., 2006) illustrates some interesting differences. There have been marked declines in the fluxes of petroleum hydrocarbons and chlorinated pesticides (DDT, DDE, and γ-HCH). Whereas the annual discharge of some components (detergents, phenols and copper) has remained relatively unchanged, the flux of zinc has apparently doubled in recent years.

Table 4.2.1 Estimate of the annual flux of some pollutants from the Volga River into the Caspian Sea (data from Korshenko *et al*., 2006)

Pollutant	Unit	Delta Apex		DSL* 1995-2004		
		1977-1993	*1995-2004*	*Total*	*Western part*	*Eastern part*
PHs	1000 tonnes	71.65	54.80	57.10	37.2	19.9
Detergents	1000 tonnes	5.29	6.96	7.95	4.35	3.60
Phenols	1000 tonnes	0.70	0.98	1.07	0.68	0.39
Iron	1000 tonnes			51.05	31.55	19.50
Zinc	1000 tonnes	4.97	9.42	9.45	6.01	3.44
Copper	1000 tonnes	2.19	1.89	1.66	1.13	0.53
Nickel	1000 tonnes			1.49	0.94	0.55
Lead	tonnes			439	276	163
Cobalt	tonnes			311	195	115
Manganese	tonnes			273	172	101
Chrome	tonnes			186	117	69
Cadmium	tonnes			122	77	45
Mercury	tonnes			15.4	9.7	5.7
DDT	kg	3710	186	94	56	38
DDE	kg	1320	27	29.5	23.6	5.9
α-HCH	kg		nd	5	nd	5
γ-HCH	kg	1026#	115	87	27	60

* DSL = delta shoreline; # data for 1983-1986 rather than 1977-1993

Kura River

A pilot study was conducted in the Kura River, with a survey undertaken at seven sites from the Mingechaur Reservoir to the Kura River Delta (CEP 2005). Although the prime objective was to determine pollutant fluxes into the Caspian Sea, the design of the study rendered this aim too ambitious. Water sampling was conducted only in June and August of 2005. Reliable estimates of pollution transport depend upon having long-term data of reliable quality. Unfortunately, historical data sets are sparse. Moreover, even official data for water discharge rates in the Kura River remain limited. Nevertheless, some valuable data were reported. A wide range of elements (As, Cd, Cr, Cu, Hg, MO, Ni. Pb, and Zn) was determined in the river waters, with values always below the respective Maximum Contaminant Level (MCL), generally taken to be the amount permissible in drinking water. Measurable levels of PAHs, PCBs, and several chlorinated pesticides were often, but not always, detected.

The International Atomic Energy Agency conducted a radiological survey of the Kura and Araks River system in Azerbaijan (Sansone *et al*., 2005). The activity of several radioisotopes (^{137}Cs, ^{238}U, ^{234}U, $^{239+240}$Pu, ^{238}Pu, ^{90}Sr and ^{241}Am) was measured in sediment samples and some aquatic plants. The values obtained for the radionuclide levels in the freshwater sediments were relatively low, and in most cases below the detection limit. The ^{90}Sr values in all the sediment samples were below the detection limit. The ^{137}Cs activity measured in the sediment was mainly attributable to atmospheric fallout from nuclear weapons tests and in part to the Chernobyl-derived caesium. The ^{137}Cs activity in aquatic plants collected at two locations of the Kura-

Araks basin was low and ranged from detection limits to 3.5±0.6 Bq kg^{-1} dry weight. The vertical distribution of ^{238}U and ^{234}U activities in a sediment core and grab samples showed constant values. The $^{234}U/^{238}U$ activity ratio varied from 0.97 to 1.00 with a mean value of 0.99±0.01 and confirmed that ^{238}U and ^{234}U were of natural origin. The $^{238}Pu/^{239+240}Pu$ activity ratio observed was 0.03±0.02. The $^{239+240}Pu/^{137}Cs$ activity ratio in the surface layer of the sediment core of the Araks River was 0.031, which was consistent with the decay corrected ratio (0.032 in 2005) that would be expected based upon global integrated bomb fallout (0.012 in 1963). Overall, this IAEA report shows that radionuclides are natural and/or related to known atmospheric inputs (Chernobyl and weapons testing).

Terek River

A desktop study was conducted to estimate the recent annual flux of various pollutants from the Terek, Sulak and Samur Rivers to the Caspian Sea (Korshenko, 2007). Roshydromet data were compiled from the State Monitoring Programme in the central and lower parts of the Terek Delta (2002-2005) and scientific expeditions of State Oceanographic Institute (2002-2004). Roshydromet standard investigations were used to assess the concentration of pollutants, namely petroleum hydrocarbons, heavy metals, phenols, detergents, nutrients (nitrites, nitrates, ammonium and total nitrogen) and silicates, as well as the discharge of river water at two hydrological stations in the Terek Delta, namely Karagalinsky (21 km upriver) and Alikazgan (108 km upriver), noting that data from the later were available only for 2005.

The review does reveal some difficulties as regards data interpretation for these river systems. The monitoring programme has been inconsistent. Chlorinated pesticides and PCBs were not included in the monitoring programme of the rivers. No measurements of PHs in the Sulak and Samur Rivers have been conducted. Detailed information about the contaminants was not available, given that only averages and the ranges of concentrations were reported. Although the flux of contaminants from the Sulak and Samur Rivers cannot be quantified, limited assessment for certain contaminants can be made for the Terek River.

The chemical results from the two stations in the Terek River were presented as quarterly averages, noting that measurements seem to have been made only once or twice per quarter. These data collected over a 4-year period, together with the river discharge data, permit a crude estimate of the riverine flux of some substances of interest, notably copper, zinc, phenols and total petroleum hydrocarbons (Table 4.2.2).

Table 4.2.2 Estimates of the annual flux of some pollutants from the Terek River into the Caspian Sea (data from Korshenko, 2007)

Substance	Annual Flux (1000 Tonnes / year)					
	Karagalinsky					*Alikazgan*
	2002	*2003*	*2004*	*2005*	*Average*	*2005*
Copper	0.03	0.042	0.05	0.03	0.038	0.028
Zinc	0.06	0.057	0.07	0.03	0.054	0.07
Phenols	0.015	0.006	0.046	0.025	0.023	0.025
TPHs	0.84	0.62	3.63	1.29	1.595	2.42

The SOI expeditions (2002-2004) measured various constituents in both water and sediments of the Terek River, with some limited sites also having been investigated in the Sulak and Samur Rivers (Korshenko, 2007). Data from the expeditions corroborated the results of the State Monitoring Programme. Most notably, it was concluded that the Terek River was polluted by petroleum hydrocarbons, noting that many measurements exceeded sediment quality guideline values. The relatively elevated levels of copper, nickel and lead that were observed in the sediments of all three rivers were interpreted to be natural in origin, a reflection of the metaliferrous nature of the drainage basin.

Sefidroud River

A desktop study has been conducted by CEP of the general pollution in the Sefidroud River in 2007. The Sefidroud River is the largest Iranian river entering the Caspian Sea and constitutes a major route of sturgeon migration for spawning and reproduction. All available national data was garnered from scientific literature in the libraries of the International Sturgeon Research Institute, Gilan University, the Department of Environment, Inland Waters Aquaculture Research Centre, the Regional Water Board of Gilan, and the Agriculture and Natural Resources Research Centre. The review unfortunately highlighted that contaminant monitoring and pollution studies are extremely limited. The sporadic data and information does not allow even a preliminary quantitative assessment of riverine fluxes. This river seriously suffers from various major sources of pollution such as agrochemicals, sewage, and industrial effluents. Significant levels of suspended solids are caused by soil erosion, sand mining and resuspension of fine-grained material from the bed of the Sefidroud reservoir. Judging by the rapid growth of agriculture, urbanization, and industry, together with the lack of environmental management, the overall environmental quality of the Sefidroud River has probably been declining constantly during past few decades.

Ural River

There are no data available to estimate annual pollutant fluxes. Limited information from sediment surveys (de Mora *et al*., 2004a) suggests that mining activities have likely augmented the naturally high flux of some metals, notably chromium, from the metal-rich catchment region.

4.2.4 Identification of Land-Based Sources (LBS) of Pollution

One approach for assessing the environmental quality of Caspian Sea was based on estimating pollution loads in the near Caspian watershed. The Rapid Assessment of Pollution Sources (RAPS) was proposed as a simple method for approximating the quantity and type of contaminants arising from various land-based sources, both point and diffuse, in each littoral state. The estimation was based on knowledge of land use and activity within the area characterized as the near Caspian watershed. Point sources were categorized into the following major 10 sectors:

1. Food, beverages and tobacco
2. Textile wearing apparel, leather and footwear
3. Wool, cork and furniture
4. Paper, paper products and publishing
5. Chemicals, petrol, coal, rubber not plastic products
6. Non-metallic mineral products excluding coal and petrol
7. Basic metal industries
8. Fabricated metal products, machinery, transport and optical
9. Other manufacturing industries
10. Sewage

Diffuse sources were classified into 8 major sectors comprising:

1. Agriculture
2. Aquaculture
3. Manufacturing
4. Urban Runoff
5. Waste Treatment
6. Transport
7. Power Generation
8. Miscellaneous

National reports for all riparian countries are available on the Internet (www.caspianenvironment.org). Despite proposing a simple methodology, the littoral states did not follow the guidelines as stipulated, thereby making comparisons within the region difficult. They generally failed in that the pollution loads tended to be estimated using existing data for pollution sources for which the quality and adequacy of measurements may not always have been sufficient. Considering the five national reports, Table 4.3 presents the evaluation of data quality of the RAPs.

Table. 4.3 Evaluation of data quality in the RAPS of Caspian littoral states

Country	Comments
Azerbaijan	▪ GIWA methodology was applied only for limited point sources. ▪ No assessment report was provided. ▪ The pollution load for selected sites was reported on the basis of direct measurements, but the quality of data is poor. ▪ No data and information was provided on diffuse sources. ▪ A generalized pollution load of major rivers was provided. ▪ No assessment was made of agricultural uses, including pesticides
Islamic Republic of Iran	▪ Point and diffuse sources have been fully covered. ▪ A short assessment report applying GIWA methodology was

	presented. ▪ No assessment was made of agricultural uses, including pesticides.
Kazakhstan	▪ GIWA methodology has been applied both for point and diffuse sources, but the quality of data is not satisfactory. ▪ Some supplementary data was provided on the oil and gas sectors. ▪ No assessment was made of agricultural uses, including pesticides.
Russian Federation	▪ GIWA methodology was not used; the assessment was based on direct measurements of combined treatment plant both for sewage and industrial sectors. ▪ The same method was used for diffuse sources and limited to certain activities. ▪ Agriculture, aquaculture, and land use have not been considered in load calculations. ▪ Estimation is extremely conservative and low, incompatible with source types and magnitudes. ▪ No assessment was made of agricultural uses, including pesticides.
Turkmenistan	▪ The assessment report is poor and the applied method is unclear. ▪ A review report on the environment and pollution status of Saymonov Bay was included.

Important land based sources of pollution to the sea in **Azerbaijan** were found to be the oil and gas sector, urban waste water, industries, agriculture activities, and waste dumping sites. The sources are distributed in six major areas including Guba-Hachmaz, Sumgait industrial area, Baku, Neftechala, Lenkoran, and Astara. The pollution load calculations using GIWA methodology was limited to point sources associated with only certain sectors, namely food, beverages and tobacco; chemicals, petrol, coal, rubber not plastic products; basic metal industries; other manufacturing industries; and sewage. Sewage and oil refineries were recognized as the main sources of pollutants to the Caspian Sea in Azerbaijan.

Pollution loads in the **Islamic Republic of Iran** were calculated for all sectors for both point and diffuse sources, except for transportation and the agricultural application of pesticides. Sewage and agriculture activities, especially animal husbandry, are the major sources of pollution (*i.e.*, BOD, TSS, and nutrients) in the Islamic Republic of Iran. Urban runoff also contributes to the total suspended solids (TSS) pollution load. The nutrients (total nitrogen and total phosphorus) are derived from both point (sewage) and diffuse (crops and pastures) sources. Calculated source apportionment of pollution loads in the three Caspian provinces are 26.5% and 73.5% for point and diffuse origins, respectively. Compared to calculations completed during Phase I of the CEP, the total pollution load has increased considerably in Iran. However, several mitigating circumstance can explain this change. Firstly, the sources inventory is more complete, thereby providing more and better data. There was a better identification of point sources in this area and pollution loads from diffuse sources that were not considered during Phase I have been incorporated into the new calculations. Secondly, there has been an increase in the urban wastewater pollution load due to an increase in population.

Atyrau and Mangystau, the Caspian oblasts of **Kazakhstan**, are characterized by intensive economic development, in particular in the oil and gas sector. The history of

oil and gas production in the region dates back nearly 100 years. As a result of the sea level rise in the Caspian, oil pollution has been caused by flooded oil wells situated near the coastline. There are 19 oilfields with 1485 oil wells in the coastal zone, of which 148 are located in the flooded area. Only 24 flooded oil wells have been sealed during 2004-2006. Similarly with regard to air pollution, about 80-85% of the total atmospheric emissions (about 90,000 tones) from these two oblasts in 2006 came from oil and gas related industries. The largest sources of atmospheric pollution included TengizShevrOil, EmbaMunaiGaz», KazMunaiGaz, Atyrau Oil Refining Plant, TeploElectroTsentral, InterGaz Central Asia, KazTransOil.

The total volume of sewage was reported to be about 900,000 m^3 in 2006. Most of sewage waters (84% in volume) discharge to evaporation and filtration fields, rather than directly to the surface waters. There are 33 evaporation pans, many of which are sited very close to seashore, that are used to handle both municipal sewage and wastes from the oil and gas industry.

Radioactive pollution and tailings of uranium wastes are the most serious environmental problems in this area. The major tailings site of Koshkar-Ata is located only 7-8 km from the seashore. Within last 15 years, the negative impact of the tailings on the coastal environment has increased significantly due to a reduction in the efficiency of the plant, together with an increase in the volume of waste that is generated. Moreover, the water level in the tailings pond fell causing the pond to dry up and consequently triggering the wind dispersal of radioactive elements to the surrounding vicinity. The Pb-210 in the atmosphere exceeds background values by about 15 times. Atmospheric pollution has been observed with respect to fluoride, phosphate, chromium, copper, nickel, tungsten, and zinc. Also in Atyrau oblast, 22 enterprises use 179 sources of ionizing radiations. All these sources have been registered in Oblast Department of the State Sanitary-and-Epidemiologic Supervision. Additionally, there are 16 specialized storages in order to store ionizing radiations sources.

In the **Russian Federation**, the pollution sources from the industrial sector include ferrous and non-ferrous metallurgy, engineering and metal-working industries, ship repair and marine ports, chemical industry, woodworking and other light industry, food processing, fisheries, oil and gas related activities (extraction, pipelines and refining), and the extraction of construction materials, sulfur, and sodium chloride. Pollution from the agricultural sector comes from the production of fruits, vegetable, and grain (wheat, rye, millet, corn, and rice) and animal husbandry (cattle, sheep, and poultry).

The Astrakhan oblast is an important transport centre, where the Caspian marine and the Volga River ways intersect railways and highways. The main mineral resources in the oblast are hydrocarbons (oil, gas and gas condensate), sodium chloride (the Baskunchak deposit is one of the largest in the world with 98% content of sodium chloride of high quality supplying 80% of the total demand in Russia) and construction materials (gypsum, limestone and others). There are six principal cities and towns, of which the largest is Astrakhan city having over 50% of the population. The major discharge of sewage water comes from three towns: Astrakhan, Znamensk

and Akhtubinsk of which more than 93% comes from Astrakhan city. Pollution of water bodies and land in the Astrakhan oblast is mainly caused by overloading of the design capacities of wastewater treatment plants in towns and urban settlements, pollution from dumpsites for domestic and industrial wastes, and the emission of harmful substances into atmosphere. The main atmospheric emissions result from the extraction and transportation of natural gas, together with the production and distribution of power and water. "Astrkhangasprom" accounted for 84.6% of the total volume of atmospheric pollutant emissions in the Astrakhan oblast in 2005.

In Dagestan, major sources of polluted sewage entering directly into the Caspian Sea and surface water bodies originate from industrial facilities and sewage systems of towns and cities located within 5 km of the Caspian Sea coast. More than 70% of the pollutants were produced by seven major sources located directly on the Caspian coast. According to the 2004 pollution inventory, over 4.2 million tonnes of wastes of varying hazard categories had accumulated in storehouses, dumpsites, waste disposal ponds, and open grounds for waste storage and disposal. The wastes included about 4 million tonnes of solid domestic waste, 135.7 thousand tonnes of drilling waste, about 8 thousand tonnes of oily waste, over 400 kg of galvanic production wastes and about 32,000 mercury-containing lamps. In this vein, one of the most important problems in Dagestan is the lack of procedures for handling of pesticides in an ecologically safe manner. About 400 registered dumpsites exist and occupy over 100 hectares. Most of these waste dumpsites are located within 100 km distance of the Caspian Sea. Currently, 248 tonnes of worthless or forbidden pesticides, including 120 tonnes of unidentified pesticide mixtures and 100 kg of granosan, are stockpiled in the main storehouses of SUE "Dagagropormchemistry" and the Ministry of Agricultural. Considering atmospheric pollutants, more than 85.3% of the emissions originate from fuel and energy related industrial complexes.

The pollution load from the Republic of Kalmykia may be considered as insignificant in comparison with Astrakhan oblast and the Republic of Dagestan. Agricultural activities are the major source of pollution. The population is about 289,000, of which over half live in rural areas. The Republic of Kalmykia has rather diverse mineral resources comprising construction materials (sand, clay, shell rock), agrochemical resources (potassium and rock salts, dolomite), and bischofite. Also, there are important oil and gas reserves, both on land and in coastal waters. At present, nine operational oil and gas fields are located within 15-30 km of the Caspian Sea.

The major activities in the coastal province of Balkan Welayaty in **Turkmenistan** are oil and gas production, oil refining, power generation, food and light industry, fishing and cattle breeding. About 90% of the potential oil reserves are concentrated in the Caspian Sea Turkmen shelf. Agriculture is very limited due to lack of fresh water and the salinity of the soil, but there are significant numbers of sheep, cows and camels. Most of the coastal zone supports very low population levels and so pollution is limited to the region where oil and gas related activities occur. Thus, Saymonov Bay is the most polluted coastal area due to the discharge industrial effluents. Oil pollution is notable in the waters and sediments of the bay.

The Global International Waters Assessment of the Caspian Sea drainage basin was conducted by a multidisciplinary team of international and national experts (UNEP, 2006). The main environmental concerns, ranked in descending order of importance, comprised habitat and community modification; unsustainable exploitation of fish and other living resources; pollution; freshwater shortage; and global change. Thus, habitat and community modification were considered to exert the greatest impacts on the Caspian Sea region. The main causes were recognized as pollution from oil spills and agricultural discharges; introduction of invasive species, such as the comb-jellyfish *Mnemiopsis leidyi*; unsustainable harvesting fishery practices, including poaching; and the damming of rivers discharging into the Caspian Sea. Several root causes were identified, mostly relating to outdated practices. Inferior equipment was being used, especially in the oil industry, agriculture continued to rely on cheap but environmentally harmful pesticides, and there was an absence in the region of decontamination facilities for ships. Environmental management has been hampered by poor expert advice, inadequate environmental legislation and a lack of law enforcement.

4.2.5 Knowledge Gaps and Future Priorities

State of the Environment
Regarding the state of the environment of the Caspian Sea, the concentrations of some metals in the region are often elevated relative to other locations globally. Although the origin is mostly likely natural due to the metaliferrous nature of the drainage basin, some contributions can be expected from the extensive mining operations in the region. Mercury contamination is evident in the coastal zone of Azerbaijan. Little evidence exists of widespread contamination due to petroleum hydrocarbons. However, the Terek River certainly acts as a source of such pollution. Widespread contamination of chlorinated pesticides, notably DDT and HCHs (*e.g.*, lindane), continues to be seen in the Caspian Sea. Data for DDT and its breakdown products demonstrate that the pollution results from contemporary, rather than historical, sources. Because such ongoing inputs apparently result from illegal usage, a future priority in the region should be to reinvigorate or initiate enforcement of environmental legislation, such as the widespread ban of DDT.

Pollutant Inputs into the Caspian Sea
There are many reasons to suppose that the flux of several pollutants entering the Caspian Sea has diminished since the early 1990s. Some possibilities include a decline in agricultural and/or industrial activities, improved environmental standards and legislation, possibly better enforcement of some regulations and the trapping of contaminants in the reservoirs, especially in the Volga and Kura River basins. Unfortunately, insufficient reliable data exist to validate possible claims as to improved water quality in the riverine systems discharging into the Caspian Sea.

The sources of pollutants to the Caspian Sea remain poorly characterized. A robust estimate of current pollutant fluxes into the Caspian Sea remains an elusive goal for most rivers. Reliable historical data, for the most part, originate form the Soviet era. For instance, fluxes of organochlorinated pesticides have been reported for rivers in

the Soviet Union (Zhulidov *et al*., 1998; Zhulidov *et al*., 2000). Some efforts have been made to estimate riverine fluxes from the Volga and Terek. Insufficient information is available for the Kura and Ural Rivers, as well as the Iranian rivers, to estimate their contributions. Inputs from diffuse sources, including the atmosphere, are even less understood. In this vein, the application of RAPS methodology seems to have failed, most notably because countries did not follow the same procedures. As a result, estimates of pollutant loads and fluxes cannot be readily compared throughout the region.

Based on current knowledge gaps, a number of key recommendations can be offered:

1. To establish a regional monitoring programme for an agreed core set of pollutants using harmonized protocols and underpinned by credible QA/QC procedures.
2. To incorporate, into the regional aquatic pollution monitoring programme, measurements at the mouths of the major rivers in order to estimate pollutant fluxes into the Caspian Sea.
3. To reassess national inventories of land-based sources of pollution, especially for the core set of pollutants, using a harmonized procedure.
4. To investigate pollution profiles in the deltaic sediments of the major rivers in order to determine recent trends in contaminant inputs that can be used both to evaluate the efficacy of past environmental regulations and to serve as a benchmark against which to compare future change.
5. To conduct a desktop study to assess the relative importance of diffuse sources, including atmospheric inputs, of key pollutants.
6. To investigate the environmental mobility of pollutants currently retained in reservoirs behind damns in the major rivers, with a view to evaluating the environmental risk they pose for the Caspian Sea.

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4.3 Decline in Bioresources

4.3.1 Introduction

Sources of information since 2002 TDA
The 2002 CEP TDA covered extensively the decline in bioresources, specifically the sturgeon fisheries, which was initially believed to be due to over and illegal fishing in the post Soviet era, and oil and gas development in the region. This section revisits the status of the two main fisheries focusing on work done the EU supported project on Caspian Fisheries, Sustainable Management of Fisheries (SMF) and new data from the littoral countries, on the sturgeon and tulka catches. There is a review of fisheries management in the Caspian, specifically the challenges currently being faced to successful coordination efforts in the region and a review of the causes in the light of this information. Finally these issues are discussed in terms of linkages with other transboundary issues and information gaps.

4.3.2 Sturgeon Fisheries

The EU project reported further decline in the sturgeon fishery since the completion of the 2002 CEP TDA as shown below in figure 4.3.1 signaling a complete collapse of the fishery and was able to assess in more detail its historical decline.

Table 4.3.1. Sturgeons catch by species for entire Caspian Sea by species composition in 1990-2004 (in th. tons) (FAO data - Fishsta+ 2007; Official data from Azerbaijan Fishery Institute (2006); Official report from IFRO (Shilat official, 2006)

	Great sturgeon (Beluga)	Russian sturgeon (Ossetra)	Persian sturgeon	Stelatte sturgeon (Sevruga)	Bastard sturgeon (Ship)	Total
1990	1.40	7.73	1.4523	5.842	0.031	16.4553
1991	1.13	5.80	1.2211	5.1465	0.0344	13.3320
1992	1.05	5.03	1.1886	4.6749	0.0383	11.9818
1993	1.09	2.87	0.704	2.7641	0.0755	7.5036
1994	0.58	1.82	0.7389	2.5391	0.0433	5.7213
1995	0.66	1.808	0.6465	1.7772	0.0377	4.9294
1996	0.42	1.204	0.7443	1.4128	0.0426	3.8237
1997	0.44	1.386	0.6642	1.0628	0.0406	3.5936
1998	0.306	1.425	0.7163	1.011	0.0673	3.5256
1999	0.23	1.017	0.5579	0.7076	0.05	2.5625
2000	0.274	0.822	0.572	0.5238	0.058	2.2498
2001	0.198	0.648	0.698	0.4455	0.049	2.0385
2002	0.183	0.668	0.517	0.3668	0.045	1.7798
2003	0.155	0.498	0.405	0.3006	0.0215	1.3801
2004	0.119	0.304	0.275	0.2097	0.015	0.9227

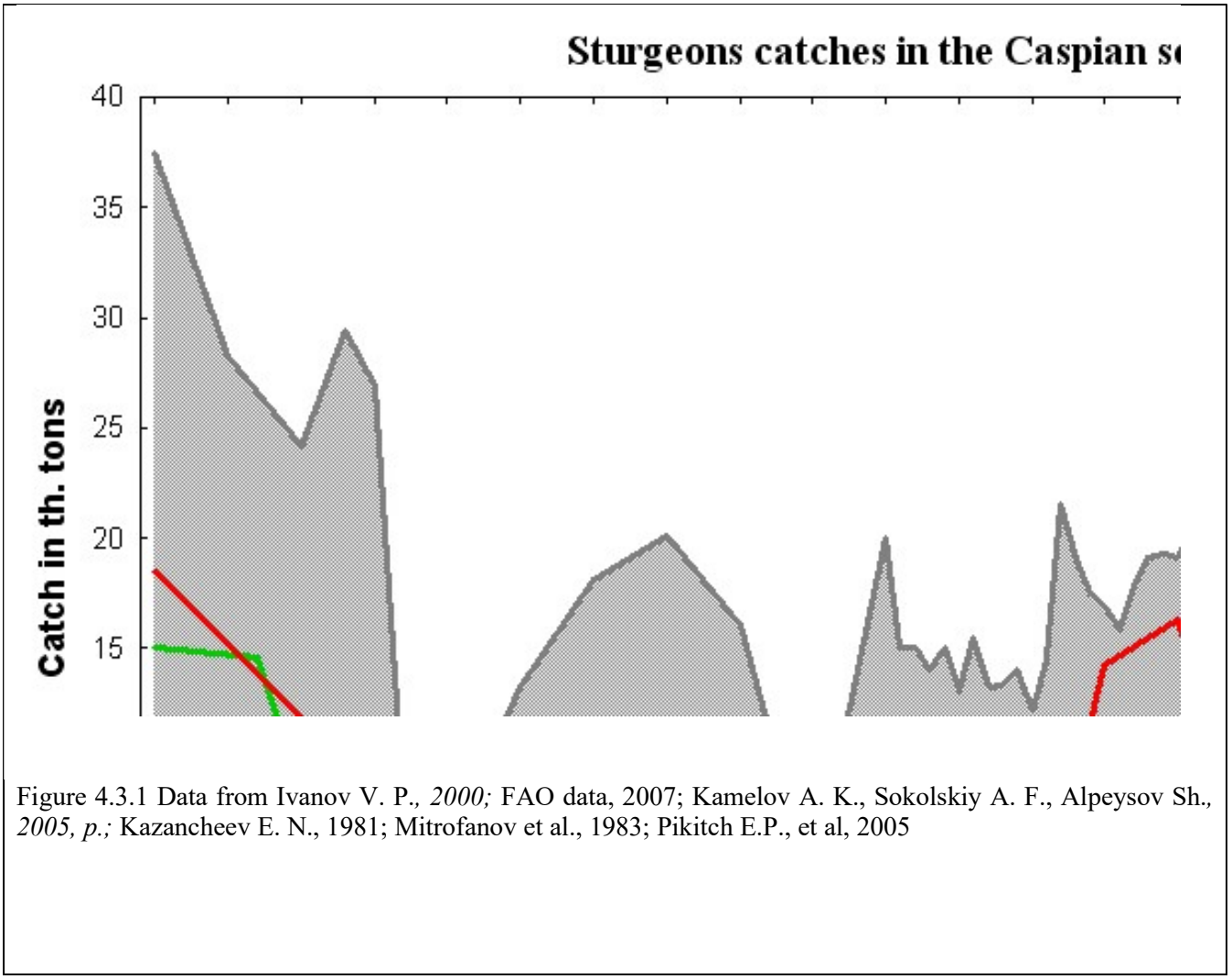

Figure 4.3.1 Data from Ivanov V. P.*, 2000;* FAO data, 2007; Kamelov A. K., Sokolskiy A. F., Alpeysov Sh.*, 2005, p.;* Kazancheev E. N., 1981; Mitrofanov et al., 1983; Pikitch E.P., et al, 2005

Official catch in the entire Caspian Sea in the two years 2003/4 is about one hundred tons only. Half of all belugas are now caught now in the Ural basin, whereas fifteen years back 50% has been caught in Volga basin, 25% - in Ural basin, 23% around South shoreline in Iran.

Catches of Russian sturgeon (*Acipenser gueldenstaedtii*i) reached a peak in the 1970s – up to 10-12 thousands tonnes but has been declining ever since. At beginning of 1990s catches were a credible 5-7 thousands tons and at the time Russian sturgeon was the main commercial sturgeon species forming almost 50% of the total sturgeon catch. The catch has now been reduced dramatically to 5% of the 1990 level; however, it still forms about 30% of total catch in 2004, showing the scale of the general decline. The catch of the Stellate sturgeon (*Acipenser stellatus*), another species of great economic importance, has been reduced from about 5

thousands tons in early 1990s (the peak catch in 1970s was 10-13 thousands tons) to a mere 200-300 tons in 2003-2004. Stellate sturgeon is smaller compared to the other Caspian diadromous sturgeons and therefore a one ton catch comprises many more individuals. Stellate sturgeon formed about 30% of the total Caspian catch in 1970s and 1990s, but in 2004 had dropped to 20%. In the Ural basin where Stellate sturgeon used to form up to 75% of the total catch in the 1990s the decline has been particularly severe.

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The Bastard or Ship sturgeon (*Acipenser nudiventris* Lovetsky, 1828) always has been found in the Caspian but in very small numbers. Total catches never exceed 100 tons and form 1% or less of the total catch. The records show that the catch levels of this species from the Ural River where they predominate have been more or less stable.

The Persian sturgeon (*Acipenser persicus* Borodin, 1897) for a long time was classified as a sub-species of the Russian sturgeon and included in the catch statistics for that species, but starting from 1990 separate catch data has been made available. During the twentieth century the catch of Persian sturgeon was significantly smaller than either the Russian or Stellate sturgeon and the total catch never exceeded 1.5 thousands tons. Due to the release of huge numbers of fingerlings by the Islamic Republic of Iran during the 1990s, the catch increased dramatically and was more or less stable for ten years with about 400-500 tons taken by in IR of Iran (1993-2001), where 70% of the Persian sturgeon is caught. However, in recent years catches have declined to 200 tonnes in Iran and 300 tonnes for the Caspian Sea as a whole despite a four fold increase in fingerling release.

As can be seen the structure of sturgeon catches has changed through the years with the Persian sturgeon playing a more important role, not due to increased landings but a drastic reduction in catches of other species. Landings in all species have been reduced in the last 15 years, some by 10-20 times, which would point to a common problem for all species of sturgeons in the Sea.

4.3.3 Tulka Fisheries

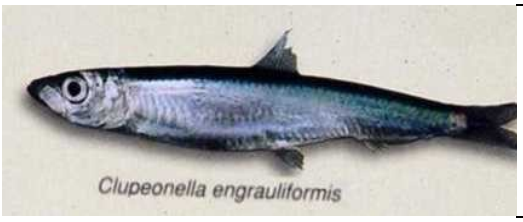
The EU fisheries project made available considerable data on the Kilka or Tulka fisheries which was not available during the first TDA. This shows that there has been a dramatic decline in catches. In addition analysis of the component species catch data has provided interesting insights into the dynamics of the fishery and impacts of *Mnemiopsis Leidyi* and other invasive species. There is some evidence, albeit circumstantial, that suggests that as well as over fishing, the decline in the fishery could be due to decline in productivity of the Caspian, which perhaps began before the invasion of ML and was precipitated by other invasive species.

Species nomeclature

It is normally sufficient to use the name “sprat” for the Caspian genus *Clupeonella*, and in many scientific articles this name is used, however at the same time the name “sprat” is also used for the genus *Sprattus.* Some confusion can also be found with the name “kilka”. Sometimes it is used for *Sprattus sprattus balticus* as ‘baltiyiskaya kilka’, especially in Russia and Russian language and moreover, the name ‘kilka’ is used in Russia as a commercial

name for many preserves prepared for human consumption from many species of small herrings including *Clupeonella*, *Sprattus* and even *Engraulis* (Anchovy). The best name for the Caspian and Black Sea genus *Clupeonella* is therefore "tulka" to distinguish it from all other genera. Now taxonomists (Kottelat, 1997) distinguish the following species in genus *Clupeonella*:

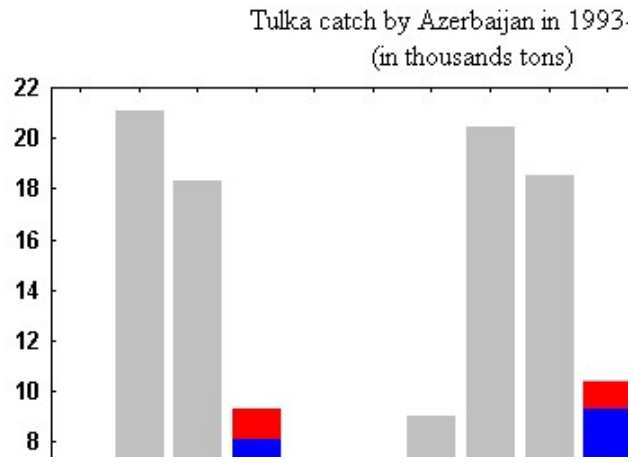
- *Clupeonella abrau* – Abrau sprat or **Abrau tulka** (Black Sea)
- *Clupeonella cultriventris* – Black Sea sprat or **Black sea tulka** or **common tulka** (Black Sea)
- *Clupeonella caspia* – Caspian sprat or **Caspian tulka**, (Caspian Sea). For a long time this species was described as a subspecies of common tulka from the Black Sea and sometimes fishery organizations continue name it as 'common kilka' in the Caspian Sea.
- *Clupeonella grimmi* – Southern Caspian sprat or **Southern Caspian tulka** or **Big-eye tulka** (Caspian Sea)
- *Clupeonella engrauliformis* – Anchovy sprat or **Anchovy tulka** (Caspian Sea)
- *Clupeonella tscharchalensis* – Charhal sprat or **Charhal tulka** (Charhal Lake in the Ural basin and some lakes in the middle Volga River). This species for a long time was known as a freshwater form of the Caspian tulka. It is now considered to be a separate species.



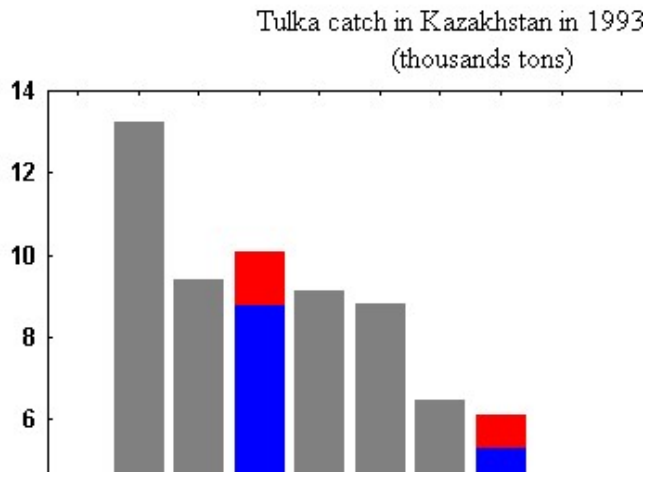
Tulka catches dramatically decreased over the period 1999-2003 in all countries, with the exception of Turkmenistan; the sharpest declines were recorded in the IR of Iran and Russia. The total Caspian tulka catch in 2003 was only 50 thousand tonnes compared to a peak catches in the 1970s of 350 thousand tonnes. In 2004-2005 the total catch increased slightly and reached 65 thousand tones. Contrary to the trend, in Turkmenistan catches increased from 6 thousands tons in 1998 to 14 thousands tons in 2003. As can be seen from figure 4.3.2 the decline in the Tulka fishery although dramatic in the past five years began in the 1980s and has been relentless every since; interestingly mirroring the decline in the sturgeon fishery (see figure 4.3.1) It is understood that the trophic linkage between the sturgeon and Tulka fisheries is relatively weak with sturgeon mainly being demersal feeders on benthic organisms, although perhaps more research is required. Certainly there is trophic linkage between the Tulka and the Caspian Seal which is discussed in a later section.

The full cause of the tulka decline is currently unclear, although over-fishing is undoubtedly a major component.

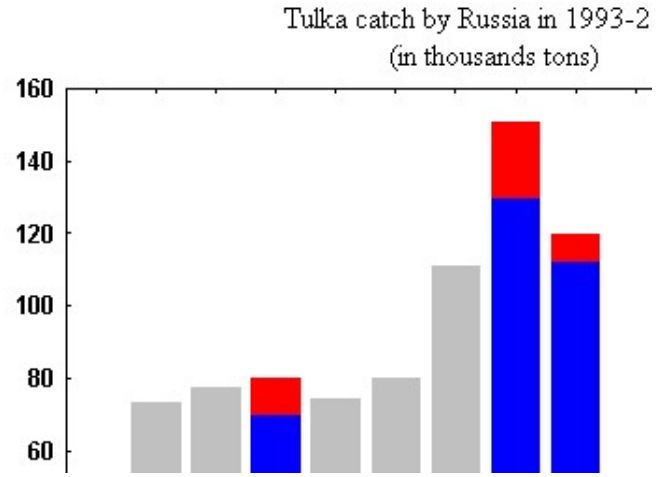
Figure 4.3.2



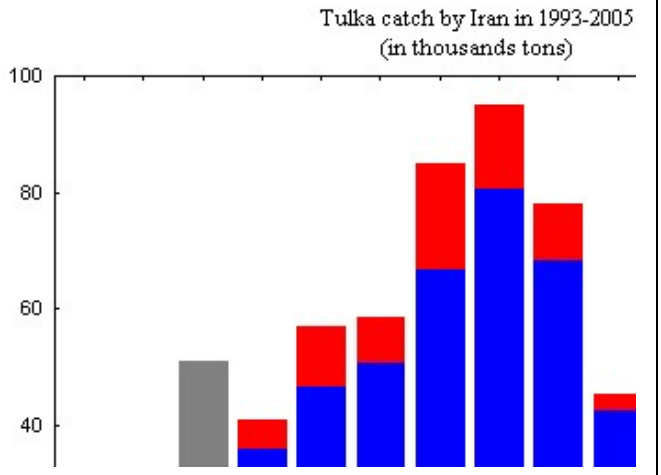
Data from Karpuk M.I., Mazhnik A. Yu., Vlasenko A.D. 2006. Methodological approach to determination of national quotas on aquatic bioresources in the Caspian Sea; and official AzNIRKh report



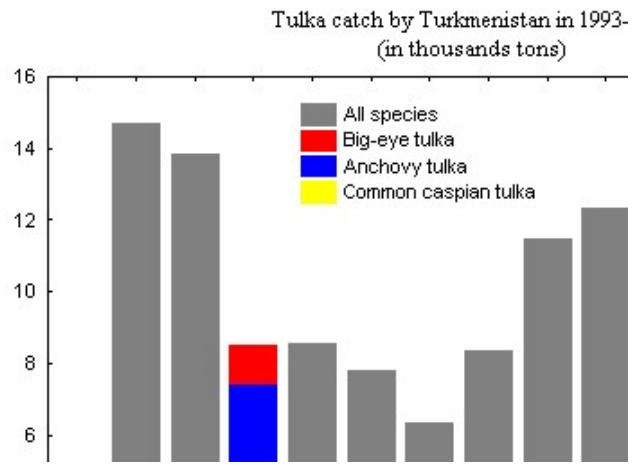
Data from Karpuk M.I., Mazhnik A. Yu., Vlasenko A.D. 2006. Methodological approach to determination of national quotas on aquatic bioresources in the Caspian Sea;



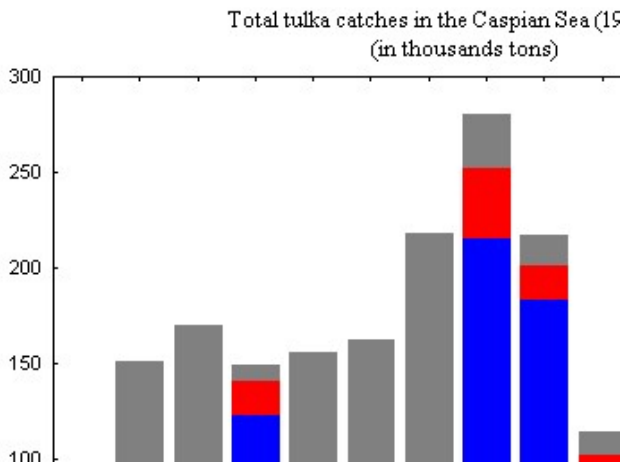
Data from Karpuk M.I., Mazhnik A. Yu., Vlasenko A.D. 2006. Methodological approach to determination of national quotas on aquatic bioresources in the Caspian Sea;



Data from Hasan Fazli, 2007. Population dynamics and stock assessment of kilka (genus: Clupeopnella) in Iranian waters of the Caspian Sea.



Data from Karpuk M.I., Mazhnik A. Yu., Vlasenko A.D. 2006. Methodological approach to determination of national quotas on aquatic bioresources in the Caspian Sea; and Official Balkanbalyk data



Combine data from sources mentioned above

In the 2002 CEP TDA much was made of the presence of the ctenophore – *Mnemiopsis leidyi* (ML) which appeared in the Caspian Sea around 2000;this species is a potential threat, direct and indirect, to the tulka, competing for food and predating on the eggs and larval fish stages. However, it should be noted that the decline of the fishery began before the ML appeared in the Caspian and before its numbers increased dramatically, suggesting that there were other factors including over-fishing that had an impact.

It should be noted that the presence of *M. leidyi* does not reduce the numbers of spawning fish or individual fecundity directly. The only possible impact of *M. leidyi* on the adult fish is through the food chain as it can be a major competitor of tulka for food in the form of zooplankton, but there are also some peculiarities between ML and the tulka. *Mnemiopsis* feeds on all available zooplankton organisms, mostly at depths between 1-25 metres .and feeds in day time and above the thermocline, although some bigger individuals may be found deeper. Differences in distribution, biological characteristics and spawning behavior of three tulka species can be crucial for understanding of the impacts of both *Mnemiopsis leidyi* and fishing pressure. There are three endemic species of Tulka recognized in the Caspian Sea, each species with its own peculiarities in distribution, food preference, spawning time and other biological and ecological characteristics. They also differ in their sensitivity to competition and predation from *Mnemiopsis leidyi*

Anchovy tulka (*Clupeonella engrauliformis* (Borodin, 1904)) is the most abundant species among all Caspian fishes. For a long time it was the main fishery, forming up to 70% of total tulka catch. This species inhabits Middle and South Caspian Sea, and appears in small numbers in the North Caspian. It is evident that there are several local stocks, but nothing is known about their specific migration patterns. Anchovy tulka spawns 8 months in a year from May till December. The numbers of spawning individuals increase from spring to autumn with 80% spawning in October-November. It becomes mature in the second year at a length of about 90-100 mm. Anchovy Tulka rarely appears at a depth less than 10 meters. In spring it is found at depths between 10-20 metres, in the summer it moves to deeper waters and in winter it is found at depths of 90-100 metres. Anchovy tulka have daily vertical migration, following the plankton to the upper water levels in the day time and descending to the deeper levels at night. The main food is Copepods, mainly *Eurytemora* and *Acartia*. This Tulka species feeds during daylight and has positive phototaxis and can be attracted by artificial lights when fishing at night, losing orientation and becoming easy to catch. The main fishing area and feeding grounds is the Southern Caspian and with only 12% being caught in the Middle Caspian. There is a significant overlap with *Mneniopsis leidyi* in timing, depth and prey and competition between the two could be crucial. As can be seen from the plots above the decline of catches in Iran and by the Russian fleet (shown in blue) commenced in 2000/2001 with the emergence of ML. There is also a partial overlap between ML distribution and the spawning and nursing grounds of the Anchovy Tulka.

Caspian tulka (*Clupeonella caspia* Svetovidov, 1943) is also an abundant species in the Caspian and has two distinct stocks: one in the North and another in the South Caspian. The North Caspian stock spawns in May, returning to the Middle Caspian for feeding and wintering. The South Caspian stock spawns in the southern Caspian in March and in autumn and winter concentrates in the middle and southern Caspian at a depth of 20-30 meters. In the spring and summer it mainly inhabits

depths of between 5-15 meters. The species is fast growing and in 3 months can reach 60 mm in length. Many fish become mature in the first year at a length of between 50-70 mm. It is also attracted by light, but never loses orientation, so it is more difficult to catch than the Anchovy Tulka. Usually this species inhabits the warmer waters above the thermocline. The main food is species of Cladocerans and Copepods. Caspian tulka is a daytime feeder. There is full overlap with *Mnemiopsis leidyi* in time, area and prey particularly for the South Caspian stock and feeding competition could be crucial. On the other hand, it may escape impact of *Mnemiopsis leidyi* during spawning and nursery period, since spawning either occurs in the northern Caspian or in March when the *Mnemiopsis leidyi* abundance is minimal. The catch levels (shown in yellow above) have remained relatively stable over the past 5 years and have not had the dramatic decline seen with the Anchovy Tulka.

Southern Caspian (or big-eye) tulka (*Clupeonella grimmi* (Kessler, 1877)) is a deep water species, inhabiting the deep waters under the thermocline. It never appears at depths less than 20 meters and is most commonly found at depths of 80-100 meters with fingerlings even deeper – up to 400 metres. The species becomes mature on the second and third year at a length of about 100 mm. Spawning occurs all the year round with maximum in January-March. Little is known about it seasonal migration and opposite to the other tulka species, the big-eye tulka is a night time feeder at depths of between 40-100 meters and has negative phototaxis. Its main food is mysids and *Limnocalanus*, which inhabit deep and cold waters (14º C and depth 40-100 meters). The main feeding grounds are in the South and Middle Caspian over depths of 100 meters or more and it migrates to the upper water levels at night and moves to downward during the day. There is no direct overlapping with *Mnemiopsis leidyi* either in time, area or prey. This species is rather rare near the shoreline and usually occurs in the open water. In the past it formed up to 10-18% of total catch tulka, but now it is less than 1%, suggesting that its decline is not related to the presence of ML.

In summary, it appears that only the Anchovy Tulka and south stock of Caspian Tulka are in competition and impacted by *Mnemiopsis leidyi*.

Average size of tulka in commercial catch varies from 80 mm up to 100 mm (Roohi, Kideys, Finenko, 2005). This would suggest that Caspian tulka which matures at 60 mm has better chance of successful spawning, perhaps even twice before capture, than the Anchovy tulka and Big-eye tulka, which become mature at a length 90-100 mm. The Anchovy and Big-eye are caught just at the time of maturation and a large of the commercial catches of these fish could be immature, significantly reducing their chances of successful spawning. Long-term monitoring of tulka stocks in the south Caspian shows a continued decline in size of fish and deterioration in condition starting from 1995 (E. Mamedov, 2005). There is a clear evidence of over-fishing on the Anchovy tulka stock in the South Caspian before the appearance of ML. It is however difficult to separate the effects of over-fishing and competition with ML on Anchovy tulka. They are the main zooplankton feeders in the southern Caspian Sea and their interaction is complex and maybe influenced by other external factors. There are reports of ML appearing as early as 1995, perhaps the large tulka populations prevented any significant ML bloom until 2000 and it was only after decline of tulka stock due to over fishing that ML became dominant and is now inhibiting tulka re-stocking.

One piece of good news is that the condition factor of all three species of tulka is at a normal level and in fact since 2000 has significantly increased, indicating they all have enough food (mainly *Acartia* in the recent years) and are not starving. The presence of ML and other alien species is a root cause for fisheries decline, but there are specific immediate and underling causes, such as overfishing and lack of fishery management which have compounded the problem.

4.3.4 Fisheries Management in the Caspian Sea

The officials of national fisheries agencies of the Caspian Sea range states are all members of the Commission on Aquatic Bioresources (CAB). Initially the representatives of only four Caspian states (Republic of Azerbaijan, Kazakhstan, Russian Federation and Turkmenistan) were members of the CAB and from 1996 the Islamic Republic of Iran participated as observer at the annual meetings. The Islamic Republic of Iran became an official member of CAB in 2002.

The CAB is an inter-agency body with representatives drawn from the responsible fisheries agencies and ministries in each country and has the following objectives:

- Coordination and cooperation between range states on conservation and exploitation of the Caspian bioresources;
- Scientific collaboration and data exchange including conducting joint research (stock assessment);
- Regulation fishing based on scientific data;
- Determination of Total Allowable Catch (TAC), and export quotas of shared stocks.

The chair and deputy chair of the Commission are elected for a 2 year period and are supported by a secretariat responsible for all necessary coordination and communication with CAB parties. Since 2002, the CAB has established several working groups on conservation and sustainable use of sturgeon, criteria for quota setting, combating on illegal sturgeon catch, invasive species and CAB status and bioresources agreements.

Regarding the sturgeon fishery, under a CAB agreement and in accordance with the requirements of the Commission on International Trade in Endangered Species (CITES) (resolution conference 12.7, CoP 13) the Caspian Sea countries have agreed to conduct winter and summer stock assessments through joint investigation, using similar design research methods, vessels and equipment. It has been agreed that a representative of each country, can, if so wish, attend on the board the research vessel of any other country, as an observer to record all the results at each sampling station. During these surveys hydro-biological, hydro-chemical and toxicological samples is collected. In the case of sturgeon, the abundance, relative and absolute frequency of the stocks are to be determined as well as the species distribution and physiological status. On the basis of the scientific data presented by each state and after consultation, the Commission sets the catch and export quota for each sturgeon species for the coming year. This procedure has already resulted in much improved

cooperation and consultation amongst the sturgeon range states and has provided a powerful incentive for future collaboration.

Despite such coordination activities, a number of issues regarding the sturgeon fishery have been identified by the CAB and CITES which need to be resolved:

- Is a trawl survey an appropriate method to estimate sturgeon abundance and biomass, considering the different depths in the North, Middle and South Caspian Sea? The EU survey work went part way to answering this question but further work is required.
- Should fixed or random survey stations be used?
- Should the catch data from fixed gill nets deployed in the shallow waters be included as part of the marine survey and what is the accuracy of these data?
- Should catch coefficients and escape ability coefficients be used for different species at various deeps of the Caspian Sea?
- What stochastic methodologies may be used in analyzing and processing the data and how should it be presented?
- The CAB needs to determine the Total Allowable Catch (TAC) and estimate the illegal catch which is used either domestically and/or enters into the international markets illegally.
- The CAB need to develop procedures for validation of numbers of sturgeon fingerling released from the hatcheries.

The Food and Agriculture Organization (FAO) in response have prepared a technical assistance project to help resolve some of these questions. The FAO project which has faced delay in implementation will need to be coordinated with the CEP initiatives dealing with Bioresources management. The World Bank will also be providing financial support through PROFISH project and sectoral review initiatives.

The Caspian Environment Programme has had limited success in influencing bioresources management issues, principally due to failure to engage the appropriate organizations at the regional level, and in certain cases at the national level. The CEP national focal points tend naturally to orient the activities towards their own organizational objectives and the intersectoral coordination and collaboration is often forgotten with key shareholders at times being excluded.

Under the Caspian Environment Programme, the EU supported project took the lead on bioresources, including regional coordination and management issues and was been able to gather important regional information and identify and highlight key problems. The EU project also supported the formation and functioning of the Fisheries Regional Advisory Group (FRAG) in lieu of the Fisheries Regional Thematic Centre that ceased to function at the close of CEP I. Despite these efforts and persistent endeavors CEP has been unable to establish appropriate links with the CAB The CEP has therefore reviewed and assessed bioresource issues independent of the CAB, sometimes reaching conclusions and recommendations which have not met with the formal agreement of members of the CAB and leading to some agreed CEP activities not being fully supported in all Caspian states.

At present the Commission on the Caspian Sea Aquatic Bioresources (CAB) is the only official regional organization conducting joint fishery related research and

making decisions on utilization, of shared stocks, including sturgeons, tulka and seals. The Commission is responsible for making rational and positive decisions based on sound scientific principles and the principles of sustainable fisheries and ecosystem based management approach. To this end, the Secretariat of the CAB needs to apply more effort in building up scientific and technical expertise and the establishment of a Scientific Committee which whould provide a solid platform for multilateral exchange of scientific information and experience with other countries and international organizations such as FAO, CITES, UNDP, UNEP. The CAB should not function in isolation but contribute to a common pool of knowledge and where appropriate seek technical and financial assistance from the international community.

Negotiations have begun, supported by the interim secretariat of the Tehran Convention on fisheries scoping paper which could lead to a fisheries protocol. It is hoped that this initiative will develop further under the next phase of the GEF support to the CEP and that CAB will be involved in the process.

4.3.5 Causes

The 2002 Caspian TDA analysed the underlying and root causes for the decline in the major fisheries of the Caspian, in particular the sturgeon fisheries, which at that time were in a critical state and threatened with closure. The following underlying and root causes were identified;

1) Reduced access to sturgeon spawning sites beginning in the 1930s with the construction of weirs, mostly for agricultural purposes, followed by the construction of large embankments on the Volga River in the 1960s and the Kura and Sefidroud rivers in the early 1970s.

2) Destruction of sturgeon spawning grounds due to exploitation of materials (e.g. gravel and sand mining), stabilization of river banks and installation of pumping stations for irrigation; and

3) Chemical and organic pollution from industrial activities and oil exploitation, as well as agricultural (pesticides and fertilizers) sources.

4) Adoption of inappropriate fishery regulations or slow adoption of protective measures. Prior to 1962 sturgeon catches were unlimited after this were regulations was initiated in the USSR to ban open-sea catch of sturgeon;

5) Absence of inter-governmental agreements on common fishery policy for shared stocks; and

6) Lack of integrated or ecosystem based approach to fisheries management (e.g. single taxon of commercial fisheries management that does not take into account the interconnection between fish stocks and their impact on the food chain).

7) Increase in poaching due to a rapid decline in socio-economic conditions in the CIS following the collapse of the Soviet Union. Coastal populations faced almost

complete unemployment because of the closure of state-owned agriculture farms ("kholkozes");

8) Reduction of State budgets which weakened fisheries and trade enforcement and increased corruption and decreased fisheries investment, particularly in restocking programs.

9) Insufficient knowledge of species adaptation to the changing Caspian situation and overall status of fish stocks.

While these underlying causes still are valid the weighting towards inadequate and mismanagement of the fisheries may have been exaggerated and perhaps fundamental alterations in the ecosystem could be also be a major underlying cause, in particular with the tulka fisheries. During CEP II, interventions in this area led by the EU SMF focused on the strengthening of fisheries management governance and improvement of fisheries catch data. The project objectives, which were only partially secured, were to:

- Strengthen regional capacity for regional fisheries research and management
- Help develop guidelines for recovery of sturgeon and other stocks
- Assist with developing regulatory systems for national and regional fisheries management.

The project was hampered by a lack of engagement by a number of Caspian states and a general reluctance to share fisheries data. Although draft 'Best Practice Stock Assessment and Management Manual' and 'Regional Strategic Fisheries Management Plan (RSFMP)' were produced by the team, as part of the CITES requirements for normalizing the Caspian sturgeon fishery, these documents were not adopted by the Caspian states. A principle objective of the RSFMP was to re-establish a sustainable sturgeon fishery in the Caspian, which, it was assumed, can be achieved through a three pronged approach:

- Dramatic increase in the production and release of healthy, optimum sized fingerlings – the EU team calculated that 700 million fingerlings would be needed, based on Iranian data, to re-establish the fishery. It is not clear how this figure was determined or if it is possible to achieve in a short time-frame or even it is economically viable.

- Improved enforcement of existing fisheries and export regulations and a comprehensive programme, including social and economic interventions to reduce illegal fishing

- An enhanced public awareness campaign to the plight of the sturgeon.

An ecological based management approach is referred to in the management plan but the details of how it may be introduced into the Caspian is lacking and there is little or no reference to the re-establishment of natural spawning grounds, although the lack genetic diversity is seen as a critical threat.

A weakness of the RSFMP is the lack of clarity regarding the sturgeon fishery's sustainable level and the criteria by which that sustainability is measured. The countries discussed the possibility to return to the days of sturgeon stock status in the 1970s but agreed that this could know whether this were possible after rigorous scientific analyses of the number of fingerlings needed to be released to achieve recovery have been carried out. It was also recognized that investment in stock enhancement is costly and the economic viability would need to be carefully considered. Further, the region needs urgently to evaluate the extent of, and underlying sociological and economic causes of illegal fishing, and to mitigate anthropogenic impacts such as pollution.

Any assessment of the level of sustainability must take into account:

- the primary and secondary productivity of the Caspian ecosystem, which may have, based on albeit circumstantial evidence, been altered significantly since the 1970s with a series of invasive species culminating with *Mnemiopsis Leydi*.
- Sustainable stocking levels for the individual sturgeon species
- Efficiency and effectiveness of past, present and future stocking programmes as a replacement for natural spawning. Are the hatcheries more effective than natural recruitment as is presumed?
- Catch levels including illegal catch.
- Existing stock levels

According to the 2002 CEP TDA, in 1980 to 2000 between 55-70 million fingerlings were released into the Volga river alone, and in the late 1990's Azerbaijan and Iran together claim to have released up to a further 45 million in any one year. This represents a significant increase on initial fingerling production when the hatcheries were first established; however, this additional effort does not halt the fishery's decline. In some quarters doubt has been expressed over the veracity of certain stocking figures, claiming that they might have been inflated in order to enhance country benefits under the Bioresource Commission quota system. There are also questions regarding the size and location of releases of fish, with fry rather than fingerlings being produced. Since there is no certification of system for the hatcheries it is impossible to confirm with any certainty the level of stocking during this turbulent period and evaluate the potential stocking deficit.

The TDA reports a 30% reduction in sturgeon spawning grounds in the Ural and Volga with approximately 1700 hectares still remaining, in the Volga a 90% reduction has occurred In the Ural there are estimated 1110 hectares of spawning grounds remaining representing the only major resource. Approximately 500 hectares of spawning grounds are claimed for the Terek, Sulak and Kura-Aras but there is little evidence it validate these figures. The status and usage of these grounds is not recorded and CEP has carried out no assessment of the status of the individual river fisheries. It would be interesting to discover if the fisheries in those rivers where substantial spawning grounds still exist are fairing better or worse than those supported by hatcheries alone. Also where there are no hatcheries, for example on the Terek and Sulak rivers, it is not clear whether the remaining spawning grounds are being fully utilized. This information would provide a better insight into the sustainable sturgeon catch level on the Caspian.

It is understood that a bi-lateral project between the Russian Federation and Kazakhstan has been commissioned with the objective of managing and protecting the spawning grounds in the Ural River. In conjunction, work has begun by Kazakh scientists on the development of sturgeon population dynamics on the Ural river (R.A. Karayev; ICES Journal of Marine Science, 63). Similar studies of the natural spawning grounds have been proposed for the Kura and Aras rivers, which should be pursued.

Further stock assessment work is therefore required before sustainable level can be defined. Work by the EU project during CEP II with the Iranian Fisheries Organization supported the effectiveness of the trawl methodology for sturgeon stock assessment. Cameras attached to the trawls showed that the sturgeon does not swim away and try to avoid the net as it approached which was one of the past criticisms of the technique and was thought to lead to underestimate of stock levels. There was unfortunately no opportunity to re-evaluate the ultra-sound monitoring techniques, which had proved to be of potential value in the stock assessment of both sturgeon and kilka in CEP I. Further stock assessment work is therefore required before sustainable level can be defined.

There is still some reluctance by the countries to share fisheries data particularly data on the sturgeon fishery and the EU project was unable to establish a common fishery database. This is an important task if we want to improve our knowledge regarding the fisheries.

During the project the Caspian countries came under increasing pressure from the international community, in particular through CITES and international NGOs, to strengthen the regional aspects of fisheries management. The countries have begun negotiations on a Fisheries Scoping Paper under the Tehran Convention hopefully leading to a Fisheries Protocol and improved sharing of fisheries data between countries and with the wider international community.

4.3.6 Linkages with other transboundary problems

The decline or change in biodiversity and decline in bioresources are closely linked, as food chains and feeding patterns are potentially disrupted due to trophic shifts. As mentioned above, a disturbance in the phytoplankton-zooplankton and benthic communities caused by invasive species for instance may impact species at higher trophic levels, which are of high economic value, such as sturgeon. With the invasion of ML as well as introductions of other species the naturally occurring food web may have undergone or be undergoing potentially significant disruptions particular when under concurrent stresses.

Fish stocks, such as sturgeon and tulka, already vulnerable due to over-fishing may be sensitive to a decline in water quality, although there is no evidence at present of this being the case in the Caspian. High levels of Persistent Toxic Substances can impact an individual's fecundity and health and, while there is no direct evidence that can lead to death, some severe cases of tumours and necrosis in liver and heart, can be lethal. During CEP I some analyses of sturgeon tissue was undertaken to determine pesticide and heavy metal levels however the research was limited and further work is

required before conclusions can be drawn. Some researches have shown that tulka may be the most sensitive species to any kind of pollution in the Caspian Sea, however it is not a long lived species.

The risks due to oil and gas also have a potential impact on bioresources. If large accidental spills occur, bioresources would be expected to suffer at least in the short-term. In addition, the introduction of invasive species through ballast waters of ships, associated with the oil and gas industry activities, has the potential to disrupt food chain dynamics.

4.3.7 Knowledge gaps

Up to 100 years of fisheries research in the Caspian has produced a large amount of information is accumulated in the region. Nevertheless there remains some key knowledge which is still missing:

- How reliable are data from present stock assessments and are the methodologies used appropriate for the Caspian Sea.
- What is the survival rate of sturgeon fingerlings from hatchery and natural spawning grounds and how can they be improved?
- What is the sustainable level of the sturgeon fishery and can it be achieved through an initial massive input of fingerlings, and if so what levels are required?
- What are the migration patterns of local tulka stocks and how are they impacted by ML and other invasives?
- How has the decline in the Tulka fishery impacted on top redators, such as the Caspian Seal, and how should their consumption be taken into account when calculating ToC?
- How do parasites, viruses and bacteria function in the Caspian ecosystem and affect on bioresources?
- What are the key trophic linkages and energy pathways and how do they impact on fishery productivity? This knowledge is needed in order to implement the Ecosystem Based Management approach and will help to predict the changes and impacts caused by new invasive species and changes in dominant species in the lower trophic levels.

4.3.8 Summary and recommendations

The most effective way of establishing sustainable fisheries in the Caspian Sea is to work with the national fishery organizations as well as local population (fishermen), NGO and community organizations rather than regional bodies. Coordinated and consistent action plans and technical protocols for the key elements need to be developed at the national level to manage the resources effectively. The plans need to have strong political and financial support and be bound by an over-arching regional strategy and supported by a basin-wide monitoring and evaluation framework. It is also important that such action plans and technical protocols be made available to the public to ensure transparency and allow for technical from other fishery stakeholders and build consensus on subsequent steps. In this regard the EU project has shown the way by assisting Kazakhstan developed a prioritized national fisheries plan which should be a model for the other Caspian states. Whilst CITES can

play an important role in ensuring that strong regional management is in place throughout the Caspian Sea, on a more day-to-day basis the CAB, Tehran Convention secretariat and CEP need to find ways to collaborate and attract international funding. A first step may be to allow the participation of CEP and other international organizations as observers in CAB SCM and other related meetings.

A number of practical activities could be recommended to mitigate the problem of bioresources reduction (for sustainable management of bioresources) for inclusion into national plans and regional strategy:

- To develop national fishery strategies and action plans under a single regional strategy;
- To rehabilitate eroding fisheries stocks, including sturgeon through development of an Ecosystem Based Management approach and an integrated information management system, incorporating fisheries, biological and oceanographic data and information;
- To protect and rehabilitate natural spawning grounds as well as fish river migratory routes including river de-siltation measures, fish ladders/lifts, public awareness campaigns, pilot Pollutants Reduction Management Plans;
- To improve the efficiency of hatcheries and restocking programs including pan-culturing techniques and commercialization programes;
- To establish tagging programmes to identify and track individuals and other programmes to identify separate fish stocks;
- To investigate new and evaluate old stock assessment methodologies on the Caspian and provide increased technical support;
- To reduce of fishery pressure by extension of aquaculture, sturgeon farming and tourism as well as community oriented poverty alleviation/sustainable livelihood initiatives;
- To investigate ways to reduce the impact of *Mnemiopsis leiydyi* on Tulka fisheries;
- To strengthen fisheries management to reduce over-fishing and minimize illegal fishing, including regional arrangements and capacity building measures for bioresources management e.g., improved legislation, enforcement and compliance.

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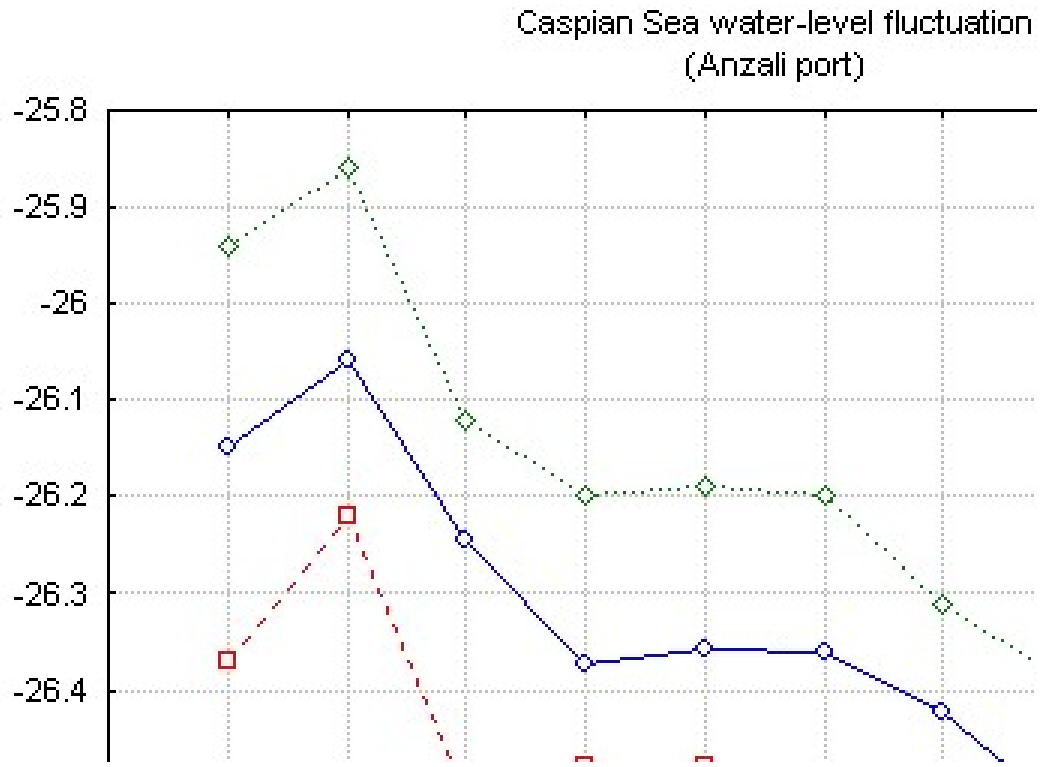
4.4 Damage to Coastal Habitat and Infrastructure

4.4.1 Introduction

Damage to coastal infrastructure and amenities linked to the fluctuation in the Caspian Sea water levels was recognized as a transboundary issue in the 2002 TDA, but was classified as weakly transboundary since the impacts are national rather than regional even though the causes may be global.

Predictions of long-term water fluctuations on the Caspian Sea are difficult and are made doubly so by the unknown effects of climate change on the run-off from the Caspian basin and rates of evaporation from the sea surface. Over the past 2000 years the range in water level fluctuation has been 7 m, with the lowest sea level being observed in the 6th–7th centuries. From the beginning of the 20th century up to 1929, the level of the Caspian Sea remained close to – 26.2 m (all the heights are with respect to the Baltic altitude system). During the 20th century, there was total fall of 3m and a decrease in the Sea area of approximately 40000 km^2, mostly due to the drying of the shallow-water North Caspian. After 1929 levels began to drop rapidly and, by 1956, had fallen by almost 2m (Fig. 4.4.1). This fall was caused by a severe drought in the Volga River basin, which resulted in a decrease in runoff. In the late 1950s, the humidity in the sea basin increased and a number of major reservoirs were constructed in the Volga River, later in the Kura-Aras, reducing temporarily, basin runoff. Therefore, in the 1950s–1960s, the level of the Caspian Sea stabilized rather than rose.

Figure 4.4.1



In the 1970s, the level fell caused by again a decrease in the Volga River runoff and also an increase in the evaporation from the sea surface and in 1977, the level fell down to a mark of – 29 m, the lowest over the past 400–500 years. Starting from 1978, the sea level began to rise rapidly in 1995, the level reached a mark of – 26.7m (see Fig. 2). As reported in the original TDA this sea level rise caused substantive losses of lands, displacement of people and damage to infrastructure around the Caspian coast, costing billions of dollars. In low lying areas such as Kalmikya it also increased the risk of flooding dramatically. The rise was explained by high run off from the Volga. By 2004 the sea had retreated and fallen by 30 cm down to a mark of – 27 m. The questions now arise whether the level will rise again perhaps driven by climate change or fall back to more historic levels and, if it does rise, how can we plan for such an eventuality.

The causes for the level oscillations in the Caspian Sea are a matter of intense debate within the scientific community. Work by the Russian scientists in the Federal Hydrometreological Service has confirmed that the sea level regime in the Caspian Sea in the past was governed by the ratio between the cyclonic and anticyclonic over the North Atlantic and the resulting regime of the atmospheric precipitation. However, human induced climate change which has become evident over the past twenty years and its impacts need to be assessed and oscillations in wider climatic systems taken into account. It should be appreciated also that there will be a so-called commitment to sea-level rise whereby even if the climate stabilizes, sea levels may continue to rise for centuries due to the long time scales of the oceans and ice sheets.

4.4.2 Findings of CEP II studies

In CEP I the Caspian Regional Thematic Centre for Water Level Fluctuation developed a basin-scale model for the prediction of water levels and linked it to the output from a series of global climate change models. The results were interesting but inconclusive with results, depending on which climate change model outputs used, predicting both level rises and falls. The conclusion drawn in the TDA was that instead of trying to predict precise water levels we should develop a series of plausible medium to long term scenarios based on expert opinion, against which adaptive management strategies and plans could be developed.

To address this issue the GEF funded:

- A series of national and regional studies of the impact of climate change on the Caspian environment

- A pilot project for the development of an Adaptive Management Plan for Anzali Lagoon, Islamic Republic of Iran

During CEP I considerable effort was expended to get the countries to embrace the concept of Integrated Coastal Zone Management, including the implementation of some limited pilot projects (see SAP). Although the countries have shown interest in the concept and some of them already have coastal planning legislation in place (see section 5) implementation at the regional level remains challenging. One issue which has emerged is that of marine litter and as part of CEP II a study of marine litter on

the Caspian was carried out in conjunction with UNEP and the GPA to assess the scale of the problem and possible solutions.

4.4.3 Impact of Climate Change on Caspian Coastal Environment

Many different approaches have been used to forecast long-term variations and trends in Caspian Sea water levels and water balance components. These studies used linear and nonlinear stochastic models with either discrete or continuous time, physical models of interaction between the inner dynamics and the outer medium noise, and other methods. However, a good forecast that explains long-term trends is still absent.

It is not agreed whether to what extent climate change could affect the sea level rise and recent predictions include the following:

- Kazakhstan Institute of Meteorology predicts that levels of Caspian Sea have return periods of 100 and 1000 year and concludes that till 2005 climate changes will be undetectable and until 2020, because of increased water consumption, will have no significant impact. In the short term the Institute predicts that the water level will be -26.2 m in the year 2010.

- Moscow Hydrological Institute claimed that studies reveal that without information about Caspian Sea evaporation regime, a precise analysis of future levels of water can not be undertaken.

- Researchers at the Caspian Center in Russia predicts future water consumption in the basin of 35-40 cubic kilometres and n these circumstances it is predicts that the current rising trend of water levels will continue until 2010 to -25.52 m which is 1.45 metres above the base year (1992) (Tajzeyehchi, M. 1375)

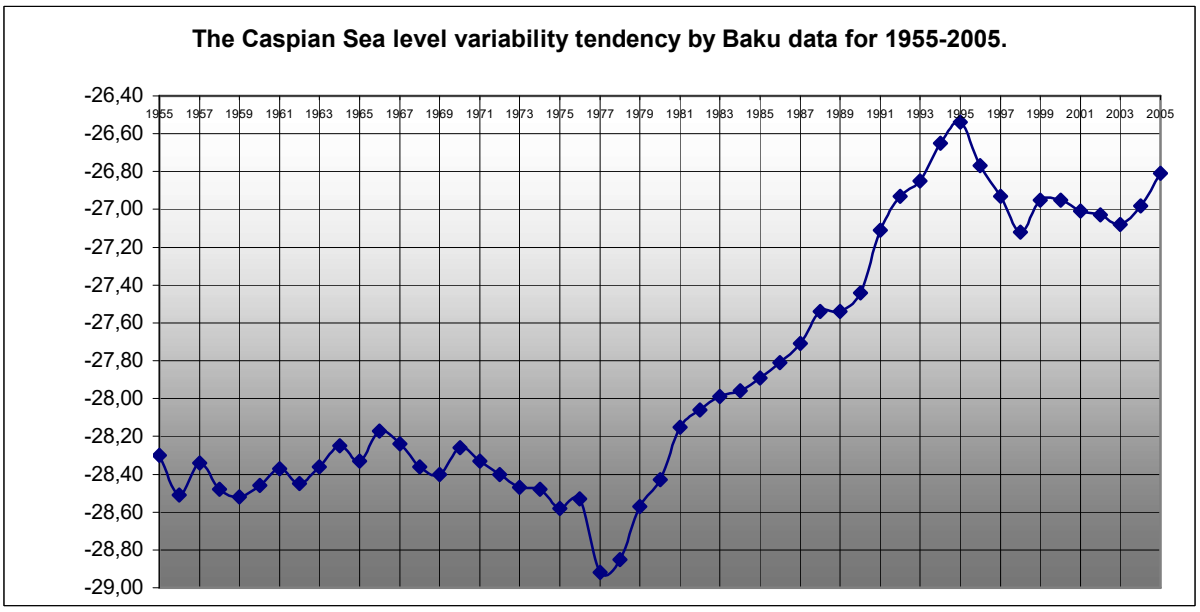
As can be seen there is as yet no regional consensus.

In the Caspian states various studies have been undertaken on the impact of water level fluctuation and climate change on the coastal zone however the scenarios used and the level detail available varies greatly. In some countries, for example in Kazakhstan, flood defense measures are already being designed - in conjunction with the oil development of the North-East shelf - while in others planning is only just beginning.

Azerbaijan

In the framework of "First National Communication on Climate Change" UNPCCC of Azerbaijan Republic, studies were undertaken by the Hydrometeorological Services and Institute of Geography Institute of the National Science Academy into the impact of climate change. In the 20th Century as a result of sea level rise 48450 ha of Azerbaijan's coastland was flooded with 10 thousand ha of irrigation lands impacted. The flooding caused critical situations on the Lenkoran-Astara coasts and the Absheron Peninsula which are particularly sensitive to flooding.

Figure 4.4.2 Caspian Sea level change over last 50 years, Baku, Republic of Azerbaijan.



Azerbaijan predicts that the Caspian Sea level could rise by 1.5m from its current level to -25.0m by 2030-2040 and this would put at flood risk an additional 87.7 thousand ha of coastal land. This is outlined in Table 4.4.2.

Table 4.4.2 Existing and predicted flooded areas on Azerbaijan coasts

Region	Flood area for 1995 year (-26,5м abs) (ha)	Predicted flood area for 2030-2040, level -25.0 m abs (ha)
Northern coastal zone (from Samur creek to Absheron Peninsula	4230	12400
Absheron Peninsula	3820	6010
Kura river delta and Gizilagach Bay	37230	111800
Lenkoran-Astara zone	3170	5980
Total on Azerbaijan	**48450**	**136190**

In the regions the expected impacts due to a sea level rise of 1.5m are;

- ***Northern coastal plain.*** The lands located on the Samur River creek and beach and Shollar coast will be exposed to increased scouring and abrasion, and to the south increased flooding. Flooding distance inland from the sea in this region will vary from 50 to 300m resulting in a loss of 8170ha. The impacted areas will include tourist resorts, 17 industrial enterprises and a 60km length of highway.
- ***Absheron Peninsula.*** This region has the most developed infrastructure and is where 40% of the population and 66% of the industrial development resides. Impact would be greatest in the urban areas of Baku, Sumgait, Sangachal, Gobustan, Primorskiy and Pirallahi. There are threats of flooding for highways

including 10 km between Sangachal and Primorsky, fixed oil platforms, the Oily Rocks and Bibi-Eybat oil fields, Baku harbor and a number of industrial enterprises located at the coast. The total flooded area in the region will be 6010ha.

- ***Kura river delta – Gizilagach bay.*** Part of Kura-Araz lowland, this region is a centre for wheat and melon production, and has important fisheries, petrochemical industry and transport infrastructure. South of the Kura river is the unique Gizilagach nature reserve. The Gizilagach bay is separated from the sea by a foreland which, due to previous flooding, has already been breached and the resulting intrusion has changed the hydrological regime and salinity change of the bay. A sea level rise of 1.5 m would further exacerbate the problem. The predicted sea level rise would impact 10 urban centres, 23 industrial enterprises and approximately 111800 ha of land would be lost.
- ***Lenkoran-Astara.*** The region is subtropical and is a centre for tea and rice production and the food processing and fishing industry. The region has a relatively high population density. Over the last fifty years the region's coast has been gradually exposed to the abrasion due to the rise and fall of the sea level and it is estimated that 300 thousand m^3 of material are eroded per year, and, as a result, the Baku-Astara railway has already had to be relocated further onshore. The sea level rise will lead to the loss of 5980 ha of land and will impact Lenkoran and Astara and 13 other urban centres.

If conversely there were to be an abrupt fall Caspian Sea level there would be a loss of wetlands and a decrease in the depth of shipping channels.

Iran

According to the I.R. Iran National Report on 'Climate Change and Vulnerability in the South Caspian Sea (2007)', the sea level rise in the past two decades has lead to increased risk for many social and economic activities and also change of environmental conditions of coastal regions. In Iranian coasts, in recent times about 77,800 ha of coastal lands had been flooded: Golestan province 27%, Mazandaran province 39% and Guilan province 34%. In Mazandaran and Golestan 1300 residential properties and 17212 ha of arable lands was lost. (Ghanghermeh, 1384). It is believed that the Caspian Sea level will continue to rise in the coming years and the provincial authorities need to be aware of the threat and plan for the worst eventualities. An example of the challenges to planning and coastal management is in the Neka region, where the coastline has been severely eroded by wave action and storm surges, in a relatively short time interval. The sea now threatens the local power station and stone bunds have had to be constructed as flood protection at considerable expense. The sea level rise has also increased the hydrostatic pressure on underground walls of the power station and there is real concern that a storm surge may eventually flood the power station itself. Other anticipated impacts include further erosion of sand coasts and river deltas and submergence western coast and advancement of the sea as the result of wind and storm surges.

Kazakhstan

The economic damage due to the rise of the Caspian Sea water level to the -27 m level during the last decade in Kazakhstan is estimated to have cost US $1.1 billion. One million ha of land has been inundated, including 357 thousand ha of agricultural land. Large land areas are now under the threat of storm surge flooding, including the city of Aktau, Bautino village, 23 settlements (20 in the Atyrau and 3 in the Mangistau region) and 28 oil and gas fields. A further sea level rise will result in flooding of new territories, settlements and industrial enterprises, most of them are located in the Atyrau region. The planning for sea level rise is quite advanced in Kazakstan linked to the development of the oil and gas deposits in the north-east shelf and shows what level of investment will be required throughout the Caspian.

The length of the existing sea defenses or dikes (330 km) is insufficient to give adequate flood protection to the territories exposed and many of the existing dykes are incomplete. Much of the threatened land has little economic value and therefore full flood protection is only appropriate for the more developed parts of the coast. Reconstruction of existing and the construction new protection structures is foreseen including frontal and ring type dykes. New defenses are recommended to be built on the coast along the - 26 m contour line. An important part of the planned adaptation measures is the provision of drainage systems to prevent surface and ground waters accumulating behind the dykes.

The city of Atyrau and its suburbs are to be defended by a small ring dyke at the -26 m contour, with stone armoring. The city will be connected to the hinterland by a raised embankment. The protection plan envisages construction of a reinforced concrete parapet along the top of the dyke in the case of a further sea level rise up to - 25 m. To prevent intrusion of the Ural River flood waters construction of two low-head dams has been recommended.

Most settlements of the Atyrau region subject to flooding will be protected by dykes. The protection system of the settlements in the Mangistau region will consist of a ring dyke to protect the city of Aktau, a frontal dyke to defend the settlement of Kuryk and earth dykes to protect Akshunkar, Kalamkas and Karazhanbas settlements. There are some settlements in the coastal zone for which provision of full protection is more expensive than relocation to other areas. This will affect 17 settlements in the Isataysky and Makhambetsky region, and 2 small settlements in the Kurmangazinsky region with a population of 8,700 people.

Oil fields will be protected by construction of both frontal and ring dykes. Protection is planned for Tengizskoe, Korolevskoe, Kara-Arna, Kalamkas, Karazhanbas, Severnoe Buzachi oil fields.

Local measures planned to protect transport infrastructure include:

- Construction of a ring drainage systems around the perimeter of airports (Atyrau city airport);
- Reinforcement of the Astrakhan-Atyrau, Astrakhan-Makat and Kulsary-Tengiz railway embankments;
- Relocation of a 40 km section of the Kulsary-Tengiz railway;

- Coastal protection reinforcement and reconstruction of port facilities (the Aktau and Bautino sea ports).

More complex measures include the construction of transport corridors on lands exposed to flooding in the form of strengthened dyke-roads, with sufficient width to carry oil and gas pipelines inside or on top. These dyke-roads will connect settlements and oil fields and will compensate for the loss of existing roads.

A stable fresh water supply to the population and to industrial facilities in the coastal zone is an important part of the planned measures for a further rise sea levels and will include:

- Relocation of the intake and water purification facilities from the zone threatened by flooding at the Kigach tributary of the Volga River delta and construction of a new water pipeline from the Volga River to the Kulsary settlement through areas not affected by the Caspian Sea;
- Construction of a new water pipeline from the Volga River to replaced the existing Kigach-Mangyshlak pipeline which is threaten by flooding;
- Relocation of water purification stations to areas not be affected by flooding;
- Construction of a new water purification station to supply the city of Atyrau from the Ural River;
- Relocation of a 230 km section of the Samara-Uzen water pipeline threatened by flooding to guarantee industrial supplies to the Ural region.

Power stations and heat, gas and electricity distribution networks will be also need to be relocated and protected with new power lines will be constructed in non-flooded areas or along dyke-roads.

Russia

During the sea level fall from 1929 up to the end of the 1950s, on the average, the seaward edge of the delta of the Volga River advanced by about 10–20 km. The end of the regression was characterized by stable delta outlines and the recent rise of the Caspian Sea level has not produce the expected changes. For the time being, it appears the influence of the sea level rise has been suppressed by the presence of the vast the shallow-water area off the river mouth. The last two decades of sea level rise has resulted only in an increase in the sea depths close to the Volga mouth and a re-construction of offshore islands (some of them disappeared). However, if the sea level will reach a mark of –26.5 m, the influence of the sea may noticeably grow. In particular, this may be manifested in a freer penetration of flood onsets into the delta and an enhancement of flooding during these periods.

In the Terek–Kuma plain, the influence of the recent sea level rise increases as the observer moves south from the Volga delta. In the southern part of the Kalmykian coast this influence is manifested in the landward shift of the narrow coastal band and in the flooding of its outer edge by the sea. The shoreline receded during this period at a rate of approximately 200m per year. In addition the sea level rise has caused erosion of coastal spits and formation of low abrasive escarpments.

In the coastal plain of Dagestan, the level rise has resulted in an enhancement of the coastal abrasion including the coastal terraces in the regions of Makhachkala, Kaspiisk, and Derbent and the area of the beach in the region has significantly decreased. For various anthropogenic reasons, the erosion of the marine edge off the delta of the Sulak River also increased.

On the whole, during the 20-year-long period erosion began to dominate the coastal processes, however accretion still occurs in the extreme north of the coast, especially within the Volga River delta.

Turkmenistan

In Turkmenistan the rise in the sea level and consequential flooding of large coastal areas has brought about significant economy and social costs. In 1995 the rapid rise threatened numerous settlements, industrial and cultural sites. The city Khazar and the suburban settlement Garakol suffered greatly and the electricity transmission station and gas networks were flooded. The highway Garakol-Alaja was flooded and the peninsula Cheleken was turned into an island flooding a petroleum storage depot which occupied the territory. Significant sections of the Jebel-Khazar road were washed away, and 12km of communication lines and 25 km of the water pipe were submerged. Within flooded areas there were numerous industrial enterprises and there was a critical situation at the oil-fields of Oval - Toval – Goturdepe and Eastern Cheleken.

The eastern and southeastern coasts of Uzynda gulf, across which the Goturdepe-Belek oil pipeline runs, were flooded. A number of residential and cultural sites in the city Turkmenbashy were flooded and destroyed and the oil/gas production facilities of “Guvylduz” and “Garabogazsulfat” were threatened.

Since the retreat of the sea in 1995 a number of resident areas have been relocated and part of the highway Jebel-Khazar and the Goturdepe-Belek pipeline re-routed. It is recognized that there is need for careful planning on all coasts subjected to flooding (Khazar, Garakol, Ekerem, Garabogas, Esenguly, Chekichler) especially where new industrial and oil-and-gas facilities are to be located.

In 1978 to prevent the sea level fall to reduce evaporation, the channel, connecting the sea with the Kara-Bagaz-Gol and the gulf, was dammed and, as a result, the gulf dried up. When the sea level instead began to rise first a channel first dug across the dam which allowed 66 m^3/s of water to be transferred to the gulf, creating an area of $3.5km^3$ and then, in 1992 the dam was removed and by 1996 the it returned to original condition.

Figure 4.4.3

The Caspian sea level forecasts for 2020 based on probabilities of 5 % (A) and 50 % (B)

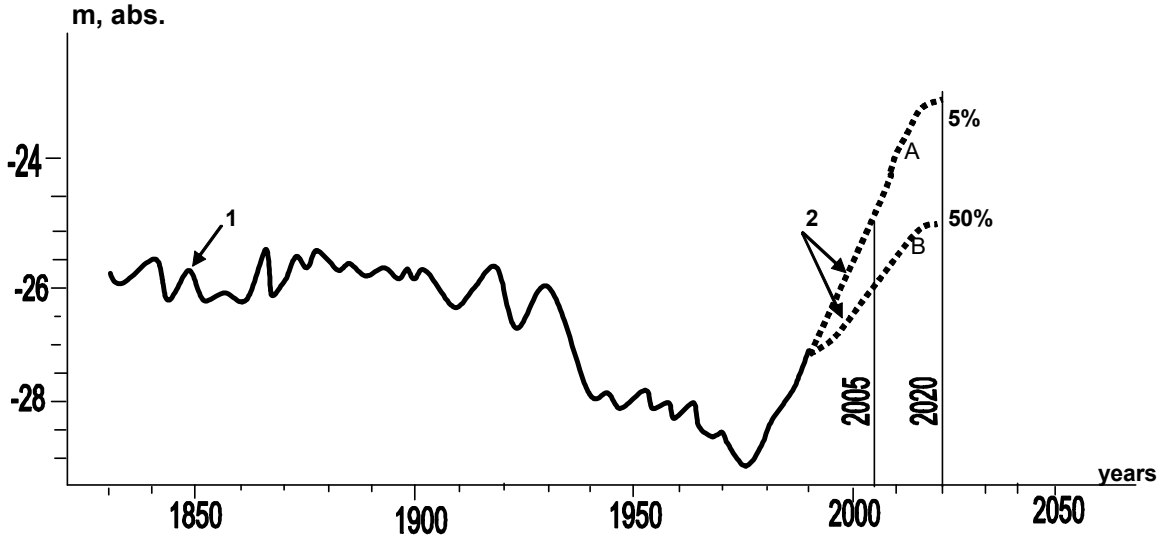


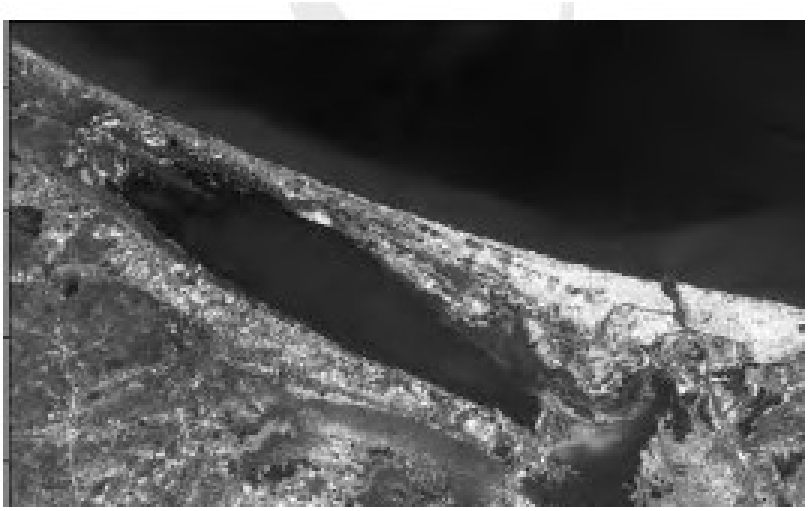
Figure 4.4.3 the sea levels predicted by Turkmen scientists with probabilities of 5% and 50%, which was prepared as part of the national communication on climate change. Further studies are required to identify precisely the vulnerable areas and rates of erosion and accretion these predicted rises will induce. A further rise in the Caspian Sea level will affect adversely not only residential areas, industry and infrastructure, but also the unique coastal biomes of Turkmenistan. Western Turkmenistan is "dry" subtropical, ideal for long term development of agricultural crops such as olives, figs, pomegranates and grapes and the invading sea will affect the potential for agrarian development and perhaps the microclimate itself.

4.4.4 Anzali Lagoon Adaptive Management Plan

The TDA identified the need for the countries to develop strategies to adapt to large scale water level fluctuations and to protect critical coastal areas. Anzali Lagoon, a Ramsar site on the south-west Caspian lowlands of the Islamic Republic of Iran, was chosen as pilot site for investigation, later expanded to include Anzali Port in order to look at the wider socio-economic implications of sea level rises.

Anzali Wetland complex is comprised of large, shallow, eutrophic freshwater lagoons, shallow impoundments, marshes and seasonally flooded grasslands. The main wetland covers about 11,000 ha, and with an open lagoon, 26km long and 2.0 – 3.5 km wide, surrounded by reed-beds, which extends its eastern limit a further 7 km. (fig 4.4.4). It is a good example of a natural and continuous wetland that supports an extremely diverse wetland flora and fauna. It supports huge numbers of wintering ducks, geese, swans and coots and is listed under the Ramsar Convention as a site of international importance.

Fig 4.4.4 The Anzali Lagoon Satellite Picture.



The CEP project was implemented in three phases:

- baseline assessment of the area and construction of a GIS database
- development of a concept model of future sea level rises and potential impacts on the lagoon and Anzali Port region
- development of an adaptive management strategy

The project team reviewed the scientific literature and decided because the sea level rise was such a poorly understood phenomena that the main scenario to be investigated should be kept simple; the importance being to understand the response to the scenario by the decision makers. Therefore, the analysis is based on a uniform 1.2-m rise over 10 years, starting in 2007. The primary source of the 1.2-m Caspian Sea rise is assumed to be collapse of the Siberian Ice Shelf, although this does not preclude other contributions to the rise over this 10 year period. The scenario has the following characteristics:

• A uniform rise of 1.2-m per 10 years from 2007 to 2017;
• A global-scale phenomena;
• The onset of the rapid rise is sudden and unexpected based on preceding observations;
• When the rise begins in 2007, there is considerable uncertainty about how long it will continue as the collapse process is poorly understood; and
• The end of the rapid rise is equally abrupt and the Caspian sea-level rise slows substantially in 2017.

Note that because of the extreme nature of this sea level scenario, all other climate factors are presumed to remain constant, which in relative terms is a reasonable assumption.

The immediate effect is the submergence and increased flooding of coastal land, and saltwater intrusion of surface waters, including Anzali Lagoon. There would also be longer-term lagged effects, including morphological change and saltwater intrusion into groundwater. Low-lying coastal areas, such as the margins of the Anzali Lagoon, are the most sensitive. However, before an area is inundated, it will first experience an

increase frequency of flooding and storm damage, and as the existing flood plain is flooded more frequently, and the flood plain will expand in size. Therefore, while most analyses distinguish inundation and increased flooding as distinct processes, they are in fact part of a continuum. Flooding in the Anzali Port city and Anzali Lagoon will be due to two main causes: surges on the open coast and high river flows and the sea level rise will increase the level and frequency of these extreme events and flooding will penetrate up the Anzali Lagoon beyond the 1.2-m elevation of the inundation.

The location of the coastal wetlands (freshwater, brackish and salt marsh systems) is intimately linked to the Caspian Sea water level. In response to sea-level rise, coastal wetland experience faster vertical accretion due to increased sediment and organic matter input. If vertical accretion equals sea-level rise, the coastal wetland will grow upwards in place. However, if accretion is less than sea-level rise, the coastal wetland steadily loses elevation relative to sea level. A 1.2 metre rise over ten years will however almost certainly overwhelm the accretion capacity of the wetlands in the Iranian Caspian coast and all existing wetlands are assumed to drown. Direct losses of coastal wetland due to submergence can be offset by inland wetland migration (coastal dryland conversion to wetland). The effectiveness of this process will depend on land elevations, sediment supply and the presence or absence of barriers to migration, including periphery roads, sea walls and dikes and residential development. The Caspian coast of Iran is densely populated and there are already concerns regarding improper land planning in the region.

The final project aim was to develop a preliminary adaptive management plan for Anzali Lagoon and its environs, taking into account sea level rises. This is was found to be a challenging task and the project was only able to fulfill it in broad terms by drafting the management objectives and targets and identifying elements of a planning process. An adaptive management plan establishes clear management goals and a structured decision making framework in which management decisions and actions are based on explicit conceptual models of system function. The adaptive management process acknowledges that uncertainties exist in our understanding of ecosystem functions and provides an operational framework for updating management plans based on improved understanding of ecosystem dynamics. As new insight on ecosystem functions emerges through periodic monitoring and analysis, this information is fed back into the planning and management process. A well designed monitoring programme of the key physical and ecological variables is a crucial to the mechanism of the plan and it is important to ensure that the information collected has a bearing on the management process. Implementation of the plan will consist of regular monitoring, analysis of the data, periodic revisions to the conceptual model, and implementation of pre-planned and appropriate intervention measures if agreed thresholds are exceeded. If target values are not exceeded, no action should be taken. If thresholds are exceeded, pre-planned interventions measures should be implemented and conceptual model re-adjusted and new thresholds set.

The project team established a set of general management principles and objectives and selected three planning options for testing which were:

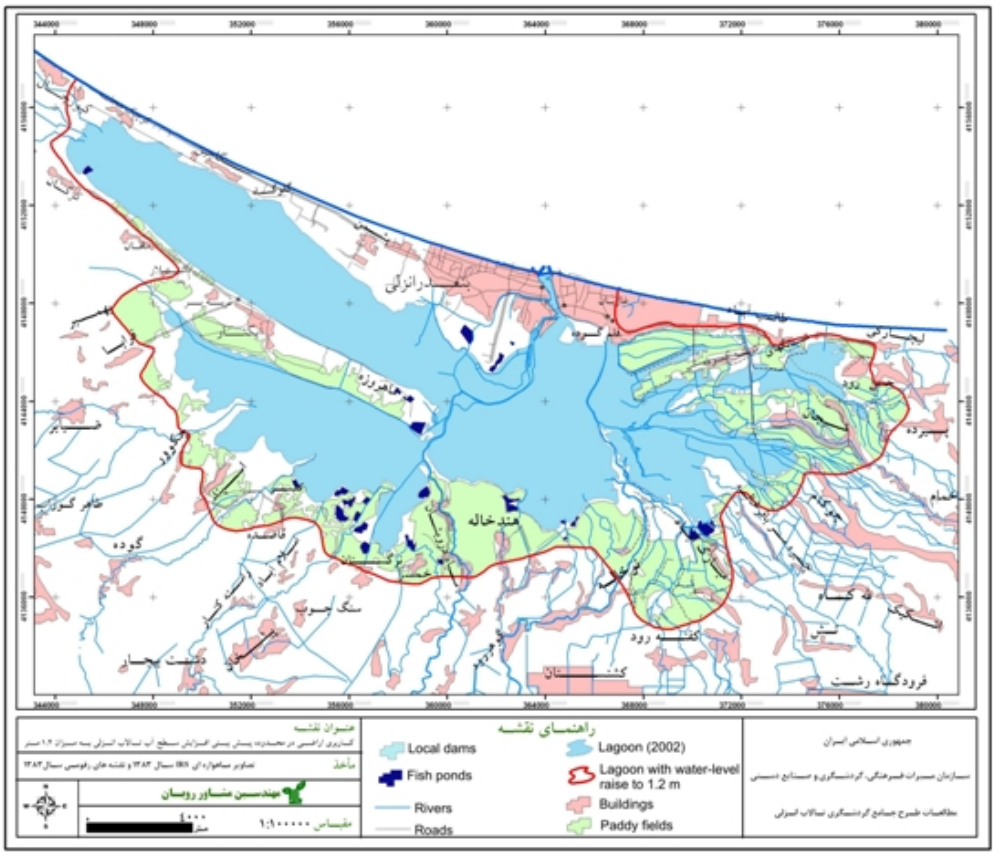
- Construct an outer barrier to provide flood protection for Anzali Port City and the Anzali Lagoon at existing levels;

- Relocate enterprises, infrastructure and people from Anzali Port and around the Anzali Lagoon.

- Adapt to the threat by reshaping the Anzali Port with some areas being inundated and others being protected;

The project team then conducted a one day role playing workshop with high ranking decision makers to observe and understand the decision process.

The project didn't advance as far as expected or hoped due perhaps to a development of only a first order conceptual model. More work on the detail impact of a series of scenarios needs to be undertaken including economic evaluation of those impacts, environmental and socio-economic, before realistic decision thresholds can be set and tested.



4.4.5 Marine Litter

Marine litter is a complex though solvable problem with significant implications for the marine and coastal environment and human activities all around the world. It originates from several sources, travels in many paths and finally sinks in different distances from its origin making its wide spectrum of negative environmental, economic, safety, health and cultural impacts highly considerable. Despite efforts made internationally, regionally and nationally, there are indications that the marine litter problem continues to worsen.

While note has been made of the marine litter in the areas around major ports and in some densely populated Caspian coastline, as well as in connection with waste disposal from vessels, no systematic attempt has been made to conceptualize the issues and to develop a regional strategy to address it. Towards this end, CEP in cooperation with UNEP, attempted to develop a Regional Marine Litter Strategy.

Development and implementation of a Regional Strategy was initially planned to pass through the following three phases:

Phase I - Assessment of the regional marine litter situation in the five littoral states of Azerbaijan, I.R.Iran,, Kazakhstan, Russia and Turkmenistan;

Phase II - Preparation of a draft Regional Strategy; including a regional meeting of experts and national authorities; and

Phase III - The integration of the Regional Strategy into the CEP SAP.

The expected outputs from the Phase I and Phase II were a Review Document and a Strategy and Action Plan Document. These documents, when produced would have formed the basis of the final output, i.e. a costed Programme of Work.

In practice the course of activities had to be somewhat revised since it became hampered by lack of specific information on marine litter and most of the countries could not separate the issue of marine litter from the boarder issue of waste management in coastal areas. The apparent lack of regional interest in the marine litter issues highlighted the need to be more proactive and sensitize the planners and the decision makers to the issue in the region it. It also led to insufficient information and analysis that would have been required to produce the Review and Action Plan Documents.

Marine litter is an emerging but largely ignored issue in the Caspian region. Based on estimations and observations, marine litter levels are already problematic and even growing in some parts of the Caspian Sea. Nevertheless no regional action has yet been taken towards solving this problem. National actions have also been not well targeted and appear to be insufficient. Main reasons are:

- Insufficient targeted laws and regulations on marine litter prevention, control or mitigation at regional, national or sub-ordinal level

- Absence of national organizations or institutions specifically tasked to deal with marine litter
- Lack of a Regional Coordinating Unit specifically tasked to manage the Caspian Sea marine litter issues
- Insufficient number of professional marine litter experts and researchers in the region
- Lack of specific policies on marine litter prevention, control or mitigation at regional, national or sub-ordinal level
- Lack of economic instruments to prevent the polluters to pollute
- Insufficient enforcement capacity and inadequate compliance measures at regional, national and coastal levels
- Lack of monitoring/assessment

Marine litter is considered to be a "growing transboundary" concern or "weakly transboundary" problem. However, there is still a need for regional agreements and activities to prevent and control the problem, especially for items with long term persistence such as plastics.

It is estimated that most of the marine litter is coming from land-based activities and that most of the litter in the marine and coastal environment consist of plastics which persists and moves in the water for a long time.

Unsustainable tourism in the Caspian coastal area is a major cause of marine litter problem in this part of the region. Inefficiency and inconsistency in waste management system and inappropriate disposal of waste can result in high volumes of litter in the marine and coastal environment.

Although there is no report on the exact impacts of marine litter on human or animal health or indeed on the whole ecosystems, it is suggested that marine litter can affect the region in a number of ways:

a) Environmental impacts: which consist of a variety of threats to the biodiversity including entanglement, and poisoning of species by litter; ruining the pristine habitats and beaches; transportation of invasive species and impacting the benthic communities.

b) Socio-economic impacts: Marine litter contaminates beaches, harbors and marinas, and coastal areas in general. This could affect human health in many ways including direct contact with debris such as broken glass or hazardous waste, e.g. hospital wastes like syringes. Agriculture and cattle grazing are also impacted by marine litter on coastal areas. Marine litter can also affect the fishery industry by damaging nets and fish stocks, fishing vessels and gears.

c) Other impacts include damage to recreational and leisure activities. Since tourism is a high source of income in the Caspian region, in particular in the Iranian coastal zone, marine litter can damage the aesthetic appeal of the marine/coastal environment causing "direct" and "hidden" cleaning-up costs for the authorities to sustain the aesthetic appeal of the region.

The general findings of the study were that:

1- Not much quantitative information is available on the volume, distribution, composition and other aspects of marine litter in the Caspian. Therefore, causes and effects are poorly defined.

2- Due to lack of research on this topic, it is difficult to assess the economic damages associated with the marine litter impacts on the ecosystem, human health, recreational & leisure, agriculture and animal husbandry, fishery industry or military navigation.

3- We do not have enough monitoring data to source the marine litter items accurately.

4- Long term effects of plastics, especially on biodiversity and human health, are not well known.

4.4.6 Linkages with other transboundary problems

Damage to coastal infrastructure and amenities was identified in the TDA as being weakly transboundary; however, once linked to the issue of sea level rises and climate change the shared/transboundary characteristics of the problem become more apparent. The obvious linkage and one that was demonstrated to a degree in the Anzali Lagoon pilot was the threat to biodiversity and the degradation of coastal habitats. The rise of the sea levels threatens wetlands throughout the Caspian, their natural ability to adapt to change being hampered by human development and poor land use planning; for example the inability of a wetland to retreat in face of the sea because of the constraints imposed peripheral development on the along the landward edges. Adaptation management plans should be developed for all major conservation sites along the Caspian coast to ensure their survival and should be integrated with wider land use coastal plans. Focus should be on agreeing regional management objectives for the wetlands and development of clear conceptual models.

The inundation of coastal lands can cause secondary pollution, particularly in industrialised areas were contaminated lands exist. A clear picture of the potential pollution is still not available and needs to be evaluated for the whole of the Caspian as part of a further study of land-based sources. Particular attention should be paid to the Absheron peninsula and its oil complexes and the highly developed coast of the Islamic Republic of Iran.

4.4.7 Recommendations

Under CEP II a start has been made to evaluate the potential losses due to a rapid rise sea level, due either to natural or man-induced climate change however there are still a lot of knowledge gaps. The Anzali Lagoon pilot was unable to develop a working adaptive management plan principally because it failed to clearly define the concept model for the lagoon and port and evaluate the impact of sea level rises in sufficient detail particularly in economic terms. The budget was limited and task challenging; however, perhaps too much time and resources were spent on establishing the baseline and not enough on the planning process. The pilot was to be a model for replication throughout the Caspian region but further more focused work is required before this can be achieved.

The following recommendations are made:

- Establish a set of agreed scenarios water level fluctuations over a 25 year planning period, taking into account international and regional expert opinion on the impact of climate change.
- Where required, undertake full economic assessments of potential loss for each of the scenarios, including environmental and amenity losses.
- Disseminate the results of the Anzali Lagoon and Port pilot project and, based on the techniques and methodologies developed, establish conceptual models and management adaptation plans for five sites around the Caspian coast (a mixture of sites: industrial, environmental and residential).
- Design M&E frameworks for special protected areas and wetlands threatened by sea level rise linked to agreed scenarios.
- Establish national programmes for monitoring marine litter and establish control programmes in each country.

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4.5 Ecological Impacts of Oil Activities in the Caspian

4.5.1 Introduction

The potential environmental impacts of the oil and gas industry in the Caspian Sea have drawn significant consternation since the fall of the Soviet Union. The 1995 article in the journal *Nature* "Ecocide in the Caspian" foretold of a sea awash in oil and destruction of functioning ecosystem processes (Dumont, 1995). Throughout the 2002 development of the CEP I TDA oil pollution was cited as a major concern among experts, though other stakeholders throughout the region were less concerned with oil pollution than other issues. Despite concerns that the pollution loads in the Caspian waters would be significant due to new, internationally based oil and gas development activities, some 15 years after the reserves became accessible this has not yet emerged as a significant issue. While the prospect of an accidental spill remains, oil development continues to increase, with higher standards than ever applied in the basin. Recently, apparent increased awareness of the Caspian environmental concerns has led governments in the region to apply stricter standards to the international operators, which may lead to further restrictions on development in the region. (Chazan, 2007)

This section will provide an overview of impact of the oil development sector in the Caspian environment and will provide a review of efforts made by CEP, particularly with regards to the development of the Framework Convention, and the petroleum industry in response. The advances in the development of the Caspian reserves, and challenges facing those will be summarized, with attention to the areas of exploration, development and transportation issues. The potential for environmental impacts of the activities of the petroleum sector development will be explored, in terms challenges of historic pollution, transportation options, and recent events pertaining to agreements regarding ongoing developments. This section will conclude with a discussion of future trends in development and the various factors which are likely to influence future development scenarios, especially pertaining to environmental conditions of the Caspian. Natural gas will not be specifically addressed because of the limited impacts natural gas has on the marine environment, while the impacts of oil are potentially far more significant.

The information in this section is drawn from a desk study of the Caspian petroleum industry development over the past fifteen years, as well as a review of social, economic, geopolitical and geological factors influencing the ongoing development of the Caspian reserves. The data presented here has been cross referenced and verified to the extent possible, in accordance with accepted academic research methodologies.

The 2002 CEP TDA determined that oil and gas development in the Caspian was a high priority emerging issue that was highly transboundary. This analysis suggested that as oil development in the region continued the need to manage it properly to ensure environmental conditions would be paramount and that with the initial estimates for development rates, it was believed that the chances for spills were especially high. The CEP I TDA drew special attention to the problems of "*potential sources of contamination include not only oil and gas extraction, but also transport, refining, downstream industries, and accidental releases. Flooding of former oil wells by rising water levels has been another documented source of contamination, and one that may get worse in the future. In particular, flooded wells in Azerbaijan,*

Kazakhstan, and Turkmenistan are known to have released hydrocarbon to the environment." (CEP I TDA V.2 p.126) Further, the initial TDA also suggested that "*the environmental impacts can be separated into two categories. Impacts from historically poor oil and gas industry practices have, and still are, adversely affecting the environment. Impacts from recent oil and gas activities involving multi-national corporations may be less severe due the strict international standards being applied in most Production Sharing Agreements (PSAs). Any improvement in environmental record of individual activities may be offset in part by the expected vast expansion of these activities in the next twenty years. Although the chronic impact may not be as intense, there is increased risk of a major spill, which must be addressed by emergency planning and preparedness."* (CEP I TDA V.2 p. 128) These initial assessments of the situation have come to fruition that development rates have increased and there is more transportation of oil on the sea; however, the dire consequences of the oil development from increased spills and drastically increased development due to significant new finds in the region have not yet emerged.

(CEP to insert map of oil fields and pipelines into text)

4.5.2 Development trends and challenges

As expected, the development of the petroleum sector in the Caspian has continued to increase activity since the previous TDA, yet at a slower rate than initially forecast. This activity has been tampered by reduced expectations of the quantity of available in the Caspian region. Nonetheless, earlier substantial finds and development scenarios continue to push the economic prioritization for oil sector development in the region as oil prices reach new highs and unprecedented global demand continues to drive markets. This development includes significant investment in transport infrastructure for petroleum products, including the completion of the Baku-Tbilisi-Ceyhan pipeline to the Mediterranean Sea, and enhancement of the Russian Caspian Pipeline Consortium lines to the Black Sea. These developments carry potentially significant environmental impacts for the Caspian waters.

Initial expectations for the amount of petroleum reserves were overestimated and have been reduced downwards significantly since the 2002 CEP TDA. As a result of downsized and delayed production schedules, less oil is being exploited in the Caspian than initially forecast in the 1990's, thus proportionally reducing the potential negative impacts on the environment. Despite the disappointing results in exploration, the increasing price of oil, combined with geopolitical developments and rising oil prices, the international oil companies have continued remain active in the Caspian waters with the belief that Caspian oil will remain profitable.

The major development continues to be in Azerbaijan and Kazakhstan sectors, and no new large in the other three countries. The US Energy Information Administration, which the widely accepted international standard for estimations, has significantly adjusted it's previous estimates of proved oil reserves. (Proved energy reserves are the estimated quantities of energy sources that analysis of geologic and engineering data demonstrates with reasonable certainty are recoverable under existing economic and operating conditions. The location, quantity, and grade of the energy source are usually considered to be well established in such reserves.

(http://www.eia.doe.gov/glossary/glossary_p.htm) Table 4.5.1 provides the overview for the Caspian region estimates for 1996 and 2005. The 1996 data is ranges of proved and possible billion barrels available for Azerbaijan, Kazakhstan, and Turkmenistan. The 2005 data shows low and high billion barrels, based on exploration trends throughout the region for all countries, with estimated Caspian reserves for Iranian and Russian added to the totals. It should be noted that the 2005 proved reserves fall very closely within the parameters of the 1996 proved reserves suggesting that only minimal new productive fields have been discovered. The proved reserves of the Caspian region are less than one third to one eight what was believed to be possible in 1996.

Table 4.5.1 Caspian littoral states: estimates of proved oil reserves

	1996 Estimates		2005 Proved reserves	
	Proved	Possible	Low	High
	Billion bbl	Billion bbl	Billion bbl	Billion bbl
Country				
Azerbaijan	3.6-11	27	7	12.5
Iran*	--	--	0.1	0.1
Kazakhstan	10-16	85	9	17.6
Russia*	--	--	0.3	0.3
Turkmenistan	1.4-1.5	32	0.546	1.7
Total	15 -28.5	144	16.946	32.2

*Includes only those reserves located in Caspian Sea basin. Source: US Energy Information Administration from Neff, 2005, and from Shenoy et. al 1999

In Azerbaijan, there have been initial disappointments from major anticipated reserves, however, the near term exploitation of proved reserves have resulted in an oil boom for the national economy. It should be noted that the State Oil Company of the Azerbaijani Republic (SOCAR) sets estimates based on measuring standards more broadly than those of other the industry sources. Current development, especially combined with natural gas extraction has moved forward consistently and is being exported through pipelines to Turkey. There have been some positive results from exploration for oil especially from the Shah Deniz field south of Baku, and from the Azeri-Chirag-Guneshli (ACG) field east of Baku. These fields face the challenging geological conditions, including presence of mud volcanoes, difficult weather, deep, high pressure reservoir, minimal pore pressure range, drill hole stability problems, unconsolidated sediments, and shallow-depth drilling hazards. According to petroleum industry news sources, international environmental standards are being followed to the extent possible, and as a result there has not been the significant level of ecological degradation anticipated by some.

In Kazakhstan, three main fields dominate the attention of oil development, Tengiz, Karachaganak, and Kashagan. By far the largest, the Kashagah field was hailed as one

of the largest finds of the century. It drew significant international attention and was initially expected to come on line in 2008, though it is facing significant challenges in terms exploration and development have set delays to late 2010.(----, August 9, 2006) Oil exploration is risky and the north Caspian's deep, high-pressure reservoirs are dangerous and technically difficult to tap. The environmental sensitivities of the northern Caspian are significant, and with more dry wells in the other major fields, the Kashagan Consortium headed by Italian oil company ENI with Exxon and Shell and other major international firms, is under additional pressure to start production as soon as possible to meet requirements of the PSAs. Yet, the development of Kazakhstan's Caspian resources is proving to be a serious challenge. In 2006, AKIOK Shell, the foreign group that discovered the Kashagan deposit in 2000, for the second time delayed start-up. The field lies in shallow, environmentally sensitive waters that freeze over in winter. Agip KCO is developing the field from artificial islands, surrounded by ice-protection barriers." (----, November 3, 2006, 1) Among these challenges are large volumes of hydrogen sulphide associated with the reserve, which make design of the production facilities to ensure health and safety of operatives particular expensive. There had been plans to re-inject gas into Kashagan's reservoirs, which drew strong negative attention from the environmental NGO community. (*ibid*, Bukharbayeva, July 5, 2004, and -----, July 1, 2004) These plans have since been altered due to the problems this would create is the gas were to escape.

The transportation of Caspian petroleum resources has seen significant advances, with major investments in pipelines from the Caspian to the major international markets. The main developments since the CEP I TDA are the completion of the Baku-Tbilisi-Ceyhan (BTC) pipeline and the increased capacity by the Caspian Pipeline Consortium (CPC) to carry oil from the northern Caspian to the Black Sea Coast at Novorossiisk. Both of these pipeline projects have faced significant challenges due to concerns about environmental impacts, though a significant majority of the concerns lie outside of the Caspian Basin.

There have been pressures to send Kazakh oil through the BTC pipeline, which could introduce challenges to the environment of the Caspian as it is would have to be either shipped from the ports of Atrau and Aktau to Baku or transferred via a new sub-sea pipeline. EU and US governments have provided incentives for Kazakhstan to agree to pump oil through the BTC pipeline, possibly including construction of the sub sea pipeline. This would diversify transportation options from the Kashagan field, as well support the BTC line after Azeri oil reserves have peaked. In June 2006, Kazakhstan, which has far bigger oil reserves than Azerbaijan, formally agreed to send oil through BTC, broadening the scope of the project to the eastern shores of the Caspian. (Gorst, 2006) In August 2007, SOCAR and Kazakh state oil company KazMunaiGaz signed an agreement on strategic cooperation in oil and gas and a memorandum on the joint implementation of the Trans-Caspian project in Astana. KazMunaiGaz head Uzakbai Karabalin said at a press conference that if up to 20 million tonnes of Kazakh oil will be transported in the system to Azerbaijan each year it will be loaded using tankers and if transport is increased an oil pipeline will be built. (-----, August 15, 2007) A fleet of shuttle tankers will also be required to move Kazakhstani crude across the Caspian Sea to enter BTC at Baku. Kazakhstan wants to control trans-Caspian shipments itself. KazMunaiGaz has taken delivery of three 20,000 dwt tankers. But many more will be required. (------, November 3, 2006, 2)

While the proposed sub sea oil pipeline has resulted in consternation from Iran and Russia, as Mahmoud Khagani, director general for Caspian affairs at Iran's petroleum ministry, told a conference of officials that Russia and Iran opposed construction of any trans-Caspian pipelines until the legal status of the Sea was resolved. (Roberts, et al. 2006) Additionally, both Russia and Iran have been eagerly courting Kazakhstan to increase transportation of increasing oil supplies. Existing transport from the Tengiz field via the CPC lines is expected to increase, with potential infrastructure improvements in Russian ports such as Makhachkala, which tie into the Russian Transneft system. At the same time, sources claim Iran is building larger tankers in the hope of attracting more Kazakhstani crude to its Caspian port of Neka, which is already linked by pipeline with refineries at Tehran and Tabriz. (------, November 3, 2006, 2) To date the pace of oil swaps, involving Iran purchasing oil from Kazakhstan and then selling equivalent Iranian oil in exchange, only slowly continues to increase. In 2005 Iranian oil swaps with Kazakhstan reached 1.4 million tons, rising in 2006 to 4.2 million tons. (Daly, 2007) Plans for additional pipelines between the Caspian and Asia are emerging with negotiations underway to pump Kazakh Caspian oil to energy hungry markets in western China.

4.5.3 Environmental Impacts/ Linkages to Other Transboundary Issues

Damage to the Caspian from recent activities has been difficult to document empirically, though there have been several incidents which has served as fodder for those who feel that development of petroleum resources should be severely curtailed. Concerns about impacts on human health and wildlife, especially seals and fish have been voiced by governments and NGOs alike, though at times it appears this may be a case of using a green screen veneer to increase attention to environmental issues, while also creating other beneficial externalities.

The 2002 CEP TDA cited CRTC reported estimates that nearly 60 percent of the annual oil input into the Caspian came from natural sources or sources outside the immediate basin: seepage and erosion (12.5%), rivers (46.9%) and atmosphere (0.6%). The rest can from oil industry activities (5%), municipalities (13.1%), and other industry (21.9%). Historic pollution from flooded, abandoned wells drilled during the Soviet era continues to be problematic as the leakages have been slow to be addressed. According to sources only one in five leaking oil wells have been successfully capped despite investments from governments to address this. (-----, October 23, 2004 and -----, September 21, 2006) The environmental impacts of the leaking wells are highlighted especially as challenges threaten human settlements. The pollution that comes from rivers is believed to be also significant, and as recent flooding events in the Caucasus have illustrated when sizable increase in surface oil was found off the coast north of Azerbaijan shortly after severe rainfalls inundated oil soaked lands in the region, likely from the Terek river. (-----, May 10, 2005) There has been some disagreement within the region regarding the causes of pollution which have drawn attention from international press, specifically the amount of hydro-carbon pollution from the major contributing basins to the Caspian. (-----, December 16, 2004) The reinjection of gas, mentioned earlier, has also drawn significant consternation from those concerned about the potential impacts on the populations in the region, especially in the Kazakh sections of the northern Caspian.(-----, July 30, 2004, Kim, 2004).

Despite claims pertaining to the impacts of the oil and gas industry activities, these have not borne up well under empirical scrutiny. The causality for decline in some fish stocks, seal die offs, and effects on human health are difficult to determine. When multibillion dollar industries, with potentially significant impacts are active within a region it is not uncommon to note correlations between their presence and environmental degradation which may not exist. (Kim, 2004). Nonetheless the attention that these claims draw create impressions of either a profound effort to hide the actual impacts or a lack of objective review of the evidence on behalf of those who have other interests at stake. (-----, September 9, 2004, Kim, 2004, Coleman, 2004, -----, January 28, 2007)

Recent events suggest that playing the environmental card can add to the strength of the countries hand in negotiations. Despite repeated assurances that the post Soviet oil activities in the region have been relatively benign for the Caspian waters from ministry officials, there has been a notable increase in environmental rhetoric as oil prices climb, and transportation options have expanded beyond those controlled only by Russia. (-----, February 3, 2006, -----, January 28, 2007) For example, once the governments of Azerbaijan and Kazakhstan took steps to formally agree to joint transport options, both Russia and Iranian officials voiced concerns over environmental issues. (Gorst, 2006, Roberts et al. 2006, Daly, 2007, -----, August 15, 2007).

Recently, there has been a 3 month halt on development of the Kashagan field ordered by the government of Kazakhstan on the grounds that environmental standards of the PSA between ENI and Kazakhstan are not being met. (Watkins, 2007) This halt seems to be in part due to delays in production which has frustrated all partners on the project and as a result is viewed as possibly being grounds for revisions of the existing PSA agreement as other global players come into the scene. (-----, April 18, 2007, Watkins, 2007, Gorst, 2007) Leveling charges of potential environmental neglect may result in consequential requirements of countries to more stringently enforce their existing environmental laws, which in the long term could be quite beneficial for the waters of the Caspian.

4.5.4 Industry Reaction to the Framework Convention

The legal status of the Caspian Sea continues to be a challenge facing the region. Bilateral agreements between countries have soothed some of the potential tensions, however there remains a cloud of uncertainty across the region, especially pertaining to status of various transboundary oil fields and the impacts of oil on regional waters. The development of the Tehran Convention was supported by the countries as a means to set the framework for management of the shared waters; however the regionally unresolved status of the basin continues to haunt petroleum development. International oil companies are leery of developing fields that are either contested or could be in the future, because of the potential to losing significant investments in negotiations, exploration and development. The industry historically carries a high degree of trepidation regarding regional agreements that will change the structure of the existing agreements they have with individual countries, as this can be prove costly when revising these agreements in line with new regional priorities.

The Caspian Environment Programme has supported development of a number of protocols to the Tehran Convention which will impact the petroleum industry

including: *The Protocol on Land-Based Sources of Pollution; The Protocol Concerning Regional Cooperation in Case of Emergency; The Protocol on EIA in a Transboundary Context, and The Protocol on Protection of the Caspian Biodiversity.* The Convention and its protocols set the stage for collaboration among all littoral countries, and have been greeted with muted interest by the international petroleum industry.

According to industry-based analysis of the conditions leading to the Convention, it is believed that "beneath the fine words of the various parties about the agreement lies an unspoken hope - that this pact will help push the five countries into reaching an over-arching deal on dividing up the sea."(-----, October 1, 2006) While they acknowledge that the ecological problems are significant, they site geopolitical positioning of the Caspian Countries as being a more significant driver for the development of the Convention, which is part of larger political maneuvering for control of contested oil fields. (ibid) Further, there is a guarded sense among those in the industry who are concerned about the potential for the Convention to be a catalyst for alternation and revision of the PSAs, including legal status of fields, or changes to agreed environmental standards.

4.5.5 Future Trends

The next several decades may see an array of petroleum related developments in the Caspian Sea, but the speed of development will depend on the prevailing economic and geopolitical conditions. The CEP I TDA forecast that "*oil pollution could be a problem, and in particular there is a risk of major, catastrophic oil spills. On-going cooperation among the littoral states, using the most up-to-date technology and observing environmental standards might actually lead to a better environment in the future."* (CEP I TDA V.2 p. 128) This early forecast has yet to be tested, both in terms of oil spills and in terms of the overall improvement in the conditions through adherence to international environmental standards. It also seems that although some significant advances in the cleanup of the pollution legacy have occurred, such as the rehabilitation of Baku Bay (----, January 9, 2003), there seems to be some degree of discrepancy between the enforcement of environmental regulations among the national oil companies in comparison to the international oil companies (-----, February 20, 2006). This may be an area where more improvements can emerge, with the support of national governments and the Tehran Convention.

The above review suggests that future trends in petroleum development in the Caspian region will be dependent on a wide number of variables. If demand for oil continues to climb, forcing prices up, the economic case for Caspian oil will strengthen. Strife in other oil rich regions will increase the development pace in the Caspian, but conservation concerns, for example climate change may slightly temper this. Current forecasts suggest that even with rising awareness of problems of burning fossil fuels, global demand for oil will continue to rise. The political gaming among international powers in the region is likely to continue, with China, the EU, US, Russia, and Iran continuing to sway development activities. Regardless of who ultimately wins the game, the oil development in the region will likely not reach the levels initially forecast even 5 years ago, and the development rates will be slower than expected. The potential impacts of the petroleum industry on the environment to be monitored closely and comprehensive biological and contaminate monitoring programmes need

to be established and executed by both the national authorities and the oil and gas companies.

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5. Governance / Institutional Analysis

5.1 Introduction

This section summarizes the National Briefs on Legislative and Institutional Frameworks for the Protection and Sustainable Management of the Caspian Sea Environment prepared by National Legal Experts of the five Contracting Parties to the Framework Convention for the Protection of the Marine Environment of the Caspian Sea.

The objectives of the section are:

- to review and provide an update on the status of the national legislative and institutional frameworks for the protection and sustainable management of the Caspian Sea environment, focusing on recent changes and developments in the context of the Convention process;
- to provide an analytical review of the possible legislative and institutional opportunities, challenges, and bottlenecks at the national level focusing on compliance and enforcement of the Tehran Convention and its draft protocols
- to develop recommendations for adjustments and modifications in national legislative and institutional frameworks necessary to meet the obligations of the Tehran Convention and its draft protocols, identifying priority areas within national legislation in need of strengthening and suggesting measures to increase regional coherence.

5.2 Regional Overview

The Caspian littoral states demonstrated their commitments to protect and restore the Caspian environment by signing and ratifying the "Framework Convention for the Protection of the Marine Environment of the Caspian Sea" (Tehran Convention) in November 2003 in Tehran, I.R. of Iran. Following its ratification by all five Caspian littoral states, the Convention entered into force on 12 August 2006. This was a major milestone in the development of governance mechanisms in the region, for all subsequent developments are now evaluated against the problems and prospective solutions that are specified in the Tehran Convention. In moving to implement the Convention, the countries also approved the Strategic Action Programme (SAP) and pursued the completion and endorsement of their National Caspian Action Plans (NCAPs). At the first meeting of the Signatories to the Tehran Convention (July 2004, Tehran, I.R. of Iran) the Caspian Government representatives agreed to initiate the development of the first draft protocols for priority areas of concern, namely: (1) the Protocol on Environmental Impact Assessment in Transboundary Context; (2) the Protocol on Pollution from Land-Based Sources; and (3) the Protocol on Biodiversity Conservation. The participants also agreed at that same meeting to finalize the ongoing negotiations on the draft Protocol Concerning Regional Cooperation in Cases of Emergency to the Governments, later renamed the Protocol Concerning Regional Preparedness, Response and Cooperation in Combating Oil Pollution Incidents. To date, all four draft protocols have been reviewed and discussed in the context of the regional meetings—it is anticipated that they will be agreed upon in the near future.

These new developments in the regional cooperation process put before the Caspian littoral states the task of ensuring the implementation of the Tehran Convention. In order to achieve this goal, the Contracting Parties must adjust, whenever needed, their national legislation and institutional arrangements. The same is needed in view of expected agreements on the four protocols that extend and further specify certain framework provisions of the Tehran Convention. The review of the national legislative and institutional frameworks undertaken herein will examine these arrangements, and in so doing will itself contribute to the Contracting Parties' compliance with Article 18 of the Convention, which states that the Contracting Parties shall cooperate in formulating, elaborating, and harmonizing rules, standards, recommended practices, and procedures consistent with this Convention and with the account of requirements commonly used in international practice in order to prevent, reduce, and control pollution of and to protect, preserve, and restore the marine environment of the Caspian Sea.

Within the first phase of the Caspian Environment Programme in 2003, the Caspian littoral states adopted a Strategic Action Programme that sets an agenda for enhanced regional cooperation among the littoral states over the next 15 years, in two distinct periods. To improve the environmental stewardship of Caspian ecosystems, the SAP outlines five regional Environmental Quality Objectives (EQOs) to be addressed and identifies environmental interventions to be taken in order to meet these EQOs at the national and regional levels. The SAP has been formulated on the basis of the priority environmental problems identified in the TDA, which comprise (1) the conservation and sustainable use of Caspian bioresources; (2) the conservation of Caspian biodiversity; (3) the improvement of the water quality of the Caspian; (4) the sustainable development of Caspian coastal zones; and (5) the strengthening of stakeholder participation in Caspian environmental stewardship. At the national level, the EQOs have been incorporated into the NCAP of each of the five littoral countries. The NCAPs thus represent a major mechanism through which these goals may be realized.

The EQOs above represent the stated goals of environmental governance in the region; they are thus the common threads throughout the legal arrangements. The remainder of this section is catagorised by the EQOs.

5.3 EQO 1: Conservation and Sustainable Use of Bioresources

Regional frameworks

The framework obligations to ensure sustainable use of marine bioresources by the Contracting Parties are encapsulated predominantly in Article 14 of the Tehran Convention. In summary they comprise an obligation to avoid over-exploitation of fish resources, and to take measures aimed at maintaining, restoring the potential and populations of marine species. The Convention does not specify which regional and national legal mechanisms, procedures, and institutional decisions need to be applied for implementing these obligations. However, the intentions of the Parties in this area may be found in the SAP that outlines that the countries should set up and adhere to a scientifically-based quota system for commercial fish resources, develop compliance, enforcement, and monitoring mechanisms for fisheries and reducing illegal trade in commercial fish resources, efficiently protect and manage natural fish spawning

grounds, and improve the management of hatcheries. The SAP also provides for addressing the social consequences of introducing restrictions in fish harvest and measures for fish protection, and stipulates that the countries shall improve livelihoods in coastal communities. The mechanism for this is not delineated at this time.

Article 14 also calls upon the development of the protocols on this question that would form the legal basis for regional common activities. In addition the SAP provides for reaching a regional intergovernmental agreement on the preservation and management of bioresources of the Caspian Sea (target under EQO I) that is not yet drafted. At the meeting of the State Signatories to the Tehran Convention held on 16 February 2006 in Almaty, Kazakhstan the Contracting Parties recommended that the Interim Secretariat develop an additional protocol on fisheries and explore mechanisms for data management and information collection. This decision clearly demonstrates the concern of the Contracting Parties for the problem of bioresources management and their interest in strengthening the legal basis for regional efforts to address it.

National frameworks

In **Azerbaijan**, legislation on the rational use of marine bioresources was adopted predominantly in late 90s and has been recently slightly changed. The changes were introduced by the Decree of the Cabinet of Ministers in 2005 that increased the charge for taking of sturgeon and other valuable fish of the Caspian Sea, the amount of administrative fines for illegal fishing, and also established fishing rules, including methods and tools of fishing, taking limits, and inspection and control procedures. In 2005 following the meeting of the CITES Standing Committee held on 19-22 June 2001 in Paris, the Cabinet of Ministers approved the "Rules for regulating the use and trade in sturgeon marine resources."

In addition to the legislation of the **I.R. of Iran** that regulates fishing, Article 14 of the 4th Development Plan highlights the importance of sustainable exploitation of aquatic resources and provides for organization of small fishing centers, improving the productivity of sustainable fishing and increasing the participation of the government. Fishing is still under strict control of the government and has exclusive right to sell and trade sturgeon fish and caviar. Private fishing and trade is prohibited and severely prosecuted. In 2005, the Environmental High Council doubled the amount of fines for illegal fishing.

Kazakhstan has introduced such new legal mechanism as establishment of annual limits for fish taking in fisheries (Governmental Regulation dated 25 January 2006). Such limits are determined in conformity with biological assessments for each fishery (Order of the Ministry of Fisheries dated 8 November 2004). Fisheries are to be granted for fishing on the basis of tenders (Governmental Regulation dated 4 February 2005). Also, certain species may be restricted or prohibited for taking, if necessary for their protection (Governmental Regulation dated 5 January 2005). For example, in 2001 and 2002, Kazakhstan imposed a moratorium on fishing for sturgeon, except for scientific purposes.

In **Russia**, aquatic bioresources management is regulated by a recently adopted federal law "On fishing and conservation of aquatic bioresources" (2004) that integrated and took into account the international obligation of Russia under global and regional instruments, including the Tehran Convention. It sets many new rules connected with the allocation of fishing rights and introduces quotas and permitting mechanisms. It also made the decision-making open and accessible for the public. In the interests of social protection of local communities, it provides for a special quota for local fishermen. And under the 2004 Governmental Decree concerning procedures for marine scientific research, permits for conducting such research may be cancelled or suspended if the work violates the requirements for bioresources protection.

In **Turkmenistan**, fishing is regulated by laws adopted in the early 90s that have not since been amended. The legislative provisions are developed in regulatory acts of the government. The Regulation on Protection of fish stocks and fishing in the territorial and internal waters (1998) has a special significance and provides for establishing the annual catch of commercial fish and a permitting mechanism for fishing.

Despite understanding of a regional character of marine bioresources management and need for concerted actions, the countries yet lack sufficient cooperation and common legal basis for concrete actions. The Tehran Convention contains only framework rules and may not be directly applied to regulating taking and protection of marine bioresources.

The Contracting Parties must explore the potential for the protocol on sustainable resources management. Due to the permanent trend on depletion of fisheries, the Contracting Parties should agree on common fishing rules. However, if the Contracting Parties committed themselves to developing necessary protocols (Article 14 of the Convention), this commitment should be implemented in the end. Such a protocol shall create a stable legal basis for coordinated decisions on annual catch, export quotas, various restrictions on fishing, monitoring and exchange of information.

5.4 EQO 2: Conservation of Biodiversity

Regional frameworks

The Tehran Convention is not explicit about specific measures needed for biodiversity conservation as additional to or separate from framework obligations of the Contracting Parties to protect, preserve, restore and use rationally the marine living resources expressed in Article 14 and proclaimed as an objective in Article 2. The only measures that are envisaged explicitly in terms of biodiversity conservation are to protect, preserve and restore endemic, rare and endangered species (Article 14(e)) and measures to be taken by the Parties to prevent introduction, control and combating of invasive alien species (Article 12).

This is despite the fact that SAP mentions threat to biodiversity as one of the priority regional environmental concern area and outlines a set of targets to be achieved by the Parties within 5-10 years. In addition to rare and alien species issues, the SAP provides for establishing regional biodiversity monitoring system, developing international scientific research, protecting habitat, in particular, through effective

management of protected coastal areas, assess priority coastal and marine habitat health and some others.

Implicitly these targets may be achieved though general obligation of the Contracting Parties to cooperate in monitoring, research and development, EIA, protection of the sea from pollution, and coastal zone management that are expressed in other articles of the Tehran Convention.

The gap is to be filled in by the draft Biodiversity Conservation Protocol that has been developed and is now negotiated under the general obligation of the Parties to cooperate in the development of protocols as per Articles 14.2 and 18. The SAP mentions the intention of the countries to develop the Biodiversity Protocol and the Protocol on introduction and invasion of non-native species.

National frameworks

The legislation of **Azerbaijan** that provides for biodiversity protection has not changed since 2001 and all the formerly established rules for wildlife and habitat protection continue to address in a traditional way the biodiversity conservation problem. It provides for keeping the Red Data Book of rare and endangered species, for fish propagation and establishing protected areas. The framework rules for biodiversity conservation are envisaged in the Law "On Environmental Protection."

The biodiversity legislation of the **I. R. of Iran** has not changed considerably for the past 5 years, although the available legislation provides for indirect measures that contribute to biodiversity conservation. The new approaches and requirements have been introduced by the 4th Development Plan. In particular, it provides for seashore area protection, protection of forests for the purpose of maintaining the ecological balance.

Kazakhstan has recently adopted several programs aimed at the conservation of biodiversity, including the "Program for conservation and rehabilitation of rare and threatened species for 2005-2007," the "Program for the protection, rehabilitation and rational use of forests for 2005-2007," and the "Program for the development of fisheries and increase in commercially valuable fish at fisheries in Kazakhstan for 2004-2006." Under the "Concept of environmental security," competent authorities now undertake inventories and assess the state of biodiversity. Such inventories have lengthened the list of rare species.

The legislation on biodiversity protection in **Russia** is mainly addressed in the Federal Laws "On Wildlife" (1995) and "On Protected Areas" (1995). Among the recent laws is the Forest Code adopted in 2006 that plays some role providing for the protection of forest ecosystems and the Federal Law "On fishing and Conservation of Aquatic Bioresources" adopted in 2004. The latter provides for the improvement of aquatic bioresources habitats, control of the water quality, and establishment of fish protective zones, including fish reserves.

The biodiversity protection legislation in **Turkmenistan** has not changed within the last 5 years; however, the existing legislation provides for most of biodiversity conservation requirements available in the Tehran Convention. In 1999, for example,

Turkmenistan published the 2nd edition of the Red Data Book and regulations on taking of rare and threatened species that generally conforms to CITES.

The legislation concerning biodiversity conservation within widely accepted traditional approaches is well-developed and generally covers principle issues as per the Tehran Convention. The missing components are those connected with control of introduction of alien and genetically modified species, access to technologies on biodiversity conservation, and protection of genetic resources. These gaps must be filled.

Much effort is needed regarding institutional strengthening, better enforcement, capacity-building of civil servants, raising awareness of the public and relevant stakeholder group involvement into decision-making pertaining to protection of biodiversity.

5.5 EQO 3: Improvement of Caspian Water Quality

The policy to address the water pollution of the Caspian in a regional framework is reflected in Article 7 of the Tehran Convention, which provides for obligations of the Contracting Parties to take all appropriate measures to prevent, reduce, and control pollution of the Caspian Sea from land-based sources without specifying such measures and referring to the future protocol on this issue that should prescribe additional protections. Articles 8-11 follow the same approach and provide for framework obligations of the Contracting Parties to take all appropriate measures for the protection of the Caspian Sea against pollution from seabed activities, vessels, dumping and other activities leaving regulation of specific measures to future protocols.

With no Protocols in force at the moment, formal implementation of the Convention in this part may not be either effectively enforced or controlled regionally, as the Convention leaves it to Contracting Parties to decide individually which measures shall be appropriate or sufficient.

In implementation of the above provisions, the Contracting Parties are in the process of negotiating the LBS Protocol. The Protocol specifies additional measures for the protection of the Caspian Sea from the pollution and goes beyond the recommended list of additional, both national and regional measures established by Article 7 of the Convention.

National frameworks

Pollution of the sea by wastewaters remains one of the priority problems in **Azerbaijan**. The legislative framework that was established in the 1990s remains as it is without considerable changes and is assessed as sufficient. In 2004, however, the Cabinet of Ministers adopted a decree in implementation of the Basel Convention that approved the State Strategy for Waste Management that regulates and restricts disposal of wastes in general and within coastal zones in particular.

To improve the situation with pollution of the sea from land-based sources, the **I. R. of Iran** has concentrated recently on control of waste management. The 2004 Waste Management Act provides for categorizing waste and for establishing restrictions on the transportation, disposal, and recycling of each of the 5 categories in conformity with environmental standards and regulations.

In **Kazakhstan**, the development and application of environmentally favorable technologies as a measure for environmental protection has been introduced into recently adopted legislation. In particular, the Law "On Oil" provides that facilities engaged in oil operation at sea should apply best environmental practice. Application of best environmental practice is also required for treatment of diffuse sources, including agriculture.

In **Russia**, several pieces of legislation have been adopted since 2001 that are aimed to control pollution of the marine environment from land-based sources. The Law "On Environmental Protection," for example, has a special article dealing with the oil and gas sector and requires that such installations have a buffer zone for the prevention of pollution.

The legislation in **Turkmenistan** makes use of various legal tools, including some of those envisaged by the Tehran Convention. There are several laws that regulate in this area with the Law "On Water" adopted in 2004 playing the key role. The law provides for an obligation of facilities to obtain a state permit for the discharge of wastewaters, and these must be obtained for each source individually.

The Caspian region would do well to emulate other regions such as the EU with regard to their use of Best Environmental Practices (BEPs) and Best Available Techniques (BATs). In particular, the quality standards and emission limit values are determined on the basis of methodologies that do not take into account the BAT and BEP, as it provided for by the Convention and draft protocol and no timetable for their implementation have been established. In addition, pollution from diffuse sources practically is not regulated and BEP is not applied.

5.6 EQO 4: Sustainable Development of the Coastal Zones

Regional frameworks

Article 15 of the Tehran Convention vests the Contracting Parties with a framework obligation to develop and implement national strategies and plans for management of the land affected by the proximity to the sea. The Convention does not have specific provisions concerning desertification; however, it may be inferred that this problem is to be addressed within planning and management of the coastal zone.

More specific measures for coastal zone management are outlined in the SAP, which provides for revising the national regulations on coastal area planning and management, strengthening legislation to combat desertification and deforestation, for setting up of the data centers, etc. The coastal lands and nature resources within them are to be used and managed on the basis of an integrated coastal zone management approach. For introducing this approach, pilot projects are to be undertaken in each Caspian state.

The draft LBS Protocol to the Tehran Convention (Article 11) provides for obligations of the Contracting Parties to introduce integrated coastal zone management and to take measures for reversing deforestation and land degradation. Draft Biodiversity Conservation Protocol includes into the list of general obligations of the Contracting Parties an obligation to apply integrated management approach to coastal areas taking into account sustainable use of biological resources and conservation of biological diversity.

National frameworks

Coastal zone management in **Azerbaijan** is regulated mostly by the Land Code amended in 2003 in relation to the coastal zone of the Caspian Sea. In particular, now the zone extends to 80-130 meters and the lands belong to the state. Such lands may not be sold or otherwise transferred to other persons in private ownership and may only be leased for public purposes.

In the **I. R. of Iran**, the 4th Development Plan in Art. 63 particularly points to an obligation of the government to prepare a comprehensive plan for integrated management of the seashore areas. At the moment, anyway, the Integrated Coastal Area Management and Planning Concept, although prepared, has not been put in practice and the country lacks the integrated approach in the management of the coastal and marine areas.

In **Kazakhstan**, the concept of integrated coastal zone management is incorporated in a general way alongside the concept of sustainable development; however, it is not well-specified. The water legislation provides for establishment of water protection zones, where such activities as forest cutting and economic activities are restricted.

The legal framework for coastal zone management in **Russia** is set by the 2006 amendments to the Land Code and by new Water Code of 2006. These laws weakened the protective regime of water protective zones by excluding them from the category of specially protected lands and by allowing construction of households and buildings. The Water Code also cut the width of zones from maximum 500 meters along rivers to 200 meters.

Issues connected with ensuring sustainable development of the coastal zone are hardly regulated in **Turkmenistan**, although the country actively participates in negotiating a Framework Convention for Environmental Protection for Sustainable Development in the Central Asia that deals with this regional environmental problem.

To ensure implementation of the Tehran Convention, the countries need to introduce the integrated coastal zone management approach into their legislation in conformity with the international experience. In particular, the legislation should provide for adopting land use plans, arranging for inventories of pollution sources, designating protected areas, and providing for reforestation and sustainable use of natural resources.

5.7 EQO 5: Strengthening of Stakeholder Participation in Caspian Environmental Stewardship

Regional frameworks

The Tehran Convention imposes on the Contracting Parties neither any obligation to involve the public in decision-making nor it provides for any rights of the public in connection with environmental protection or the use of natural resources of the Caspian Sea. Therefore, regulation of such generally recognized public rights, as the right to access to information, or the right to participate in decision-making falls entirely into the discretion of the Contracting Parties.

However, the draft Protocols are more specific in this area, and may open more legal opportunities for the public to influence the process of cooperation in environmental protection and development of natural resources of the Caspian Sea.

In a general form, the draft Protocols provide for obligations of the Parties to involve the public by providing the rights to:

- participate in decision-making relevant to implementation of the Protocols, and in particular, concerning activities that affect the marine and coastal environment of the Caspian Sea, including via the EIA procedure
- have access to information on the state of the environment and on decisions in relation to the activities that may affect the state of the environment of the Caspian Sea

The SAP provides more detail regarding which measures are to be implemented for ensuring public and other stakeholder participation in Caspian environmental stewardship. They comprise measures for facilitating access to information, training, promoting of partnerships among the local communities, governments and private sector, and partnership with the CEP.

National frameworks

The legislation that regulates public participation issues in **Azerbaijan** has not changed substantially since the 1990s. Still, the law "On obtaining information on the state of the environment" was enacted in 2002 and the Decree of the Cabinet of Minister from 2003 "On procedure for concluding agreements with persons wishing to obtain information on the state of the environment" establish procedures for getting access to information that was lacking before.

In the **I. R. of Iran**, Article 64 of the 4th Development Plan charges the Ministry of the Environment with preparing laws and regulations on issues regarding the execution of educational programs in collaboration with the state mass media. It is notable that such programs are to be implemented free of charge.

Over the recent years in **Russia**, the practical role of the public and the civil society, including mass media, in addressing environmental issues has grown generally; however, the local population still remains rather passive due to a lack of specific publicity on governmental policy and insufficiencies in awareness and education. The Federal Law "On Public Chamber" from 2005 is aimed at expanding the access of the public to decision-making and provides for creating a special forum for public communication and dialogue with the state authorities.

In **Kazakhstan**, the public actively participate in hearings that are arranged by operators of projects under EIA. Indeed, at the Civil Forum held in September 2005, the President of Kazakhstan specifically focused on the necessity to act together to protect the unique ecosystem of the Caspian Sea.

In **Turkmenistan**, the Law "On Public Associations" from 2003 expands the rights of the people to include disseminating information about government activities and cooperating with international organizations. Also, the Strategy and Action Plan for Biodiversity Conservation establishes the principle of partnership between the government and the public and creates practical mechanisms for providing information to the public.

The public under the national laws of the countries has sufficient rights for influencing the decision-making in relation to the Caspian Sea. At the same time, protection of the Caspian Sea with participation of the non-governmental organization of the Contacting Parties, is not only required under the Convention, but also is useful for establishing and sustaining the climate of cooperation.

The Contracting Parties should strive to provide favorable conditions for cooperation with NGOs and the private sector. On the part of NGOs, measures should be taken to establish good cooperative relations in order to respond quickly and efficiently to arising problems.

5.8 Conclusions and Recommendations

Since the 2002 CEP TDA significant progress has been made in the region with regards to the establishment and support of institutional mechanisms. Countries are bringing legislation into to line with the Tehran Convention. The process is not expected to be quickly accomplished. As countries take steps to bring the legislation into line with the Tehran Convention, and the emergent protocols, it would be advisable to work towards the standardization of the national level legal instruments where possible and appropriate. Overall, there are two distinct prescriptions to be discerned from the analysis above: (1) the need for increased standardization across the region; (2) the need to support increased public involvement mechanisms in the decision making process.

First, measures, methods, and legal standards must be harmonized across the region in order to increase the efficiency of governance institutions, for these are the concepts upon which they are built. While not every country will be able to achieve the same level of institutional development, the SAP, NCAPs, and The Tehran Convention and accompanying protocols delineate guidance for improved institutional governance mechanisms.

Second, public involvement may be satisfactorily permitted in that it is provided for legally, but the saliency of environmental issues must be addressed by raising public awareness if the public is to become actively engaged in the decision making process. This is important because ultimately it is the public who must assume responsibility for the goals spelled out in the EQOs if they are to be achieved. This is a challenge throughout the region, and globally, which will require involvement of groups,

working together and overcoming barriers that limit multisectoral inputs into governance of shared resources. Additionally, the challenges of successful implementation of the Tehran Convention and SAP are based in socioeconomic conditions throughout the region, and through the need to implement a sustainable, meaningful stakeholder involvement strategy within the region.

6. Socio-Economic and Development Setting

Social and economic changes within the Caspian Sea Basin impact the ecosystem and in turn are impacted by many of the environmental changes brought about during the last century. The ecosystem of the Caspian Sea has been heavily influenced by the shift from the Soviet economic system toward a free market economy in the Former Soviet States.

This section compares the socio-economic and development setting outlined in the 2002 CEP TDA to the current situation based on updated information. While the 2002 TDA section expertly outlined the situation and the importance of the specific variables used, this review will compare and contrast new information to more fully describe the changing socio-economic conditions in the Caspian region since that time.

6.1 Data and Information

The 2002 TDA Socio-economic section relied extensively on national level data in order to assess the conditions impacting and impacted by the Caspian environment. During the CEP II national level socio-economic reports were produced for Azerbaijan, IR of Iran, Kazakhstan, Russia and Turkmenistan, which significantly increase the level of data available for comparative analysis. While the units of measurement are the rayon or oblast, which are not uniform in geographic or demographic size, they provide more detail than was possible in the previous report. In many cases the data drawn from the national reports is not standardized and therefore comparable, so these reports were used to provide supplemental information where possible and appropriate.

Additionally, the 2002 CEP TDA includes a significant amount of input distinguishing between the *Caspian Economic Hinterland* (CEH) and *the Caspian Economic Zone* (CEZ). According to the CEP I TDA "CEH refers to the geographical area where social and economic activities have a *noticeable* impact on the environment of the Caspian Sea. The CEZ, on the other hand, refers to the geographic area where social and economic activities have a *substantial* impact on the Sea's environmental resources." For the purpose of this TDA revisit and examining changes in socio-economic trends, oblast/rayon level and national level data will be highlighted in an attempt to avoid additional confusion.

6.2 Human Development and Sustainable Livelihood

Demography
The CEP 2002 TDA estimates the population of the Caspian countries combined to have been 224.3 million people in 1999. The research conducted during the scope of CEP II demonstrates that the total Caspian coastal population was close to 16 million in 2004. This updated information focuses only on the administrative units contiguous to the Caspian Sea, but significantly shifts the perception of the size of the population of the region (see table 6.2.1.1). Iran has the largest population, though the Azerbaijan

capital Baku has the highest population density. Both Kazakhstan and Turkmenistan have populations of less than 1 million each in the Caspian coastal zone. Russia and Azerbaijan have coastal populations of just over 3 million within the administrative districts along the Caspian, while Iran has nearly 7 million within the three Caspian Sea districts.

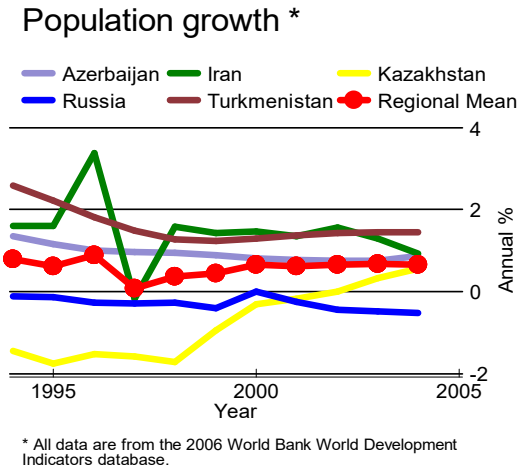
Table 6.2.1.1 Coastal population

Country	Coastal region/oblast	Population*
Azerbaijan	Astara	90,900
	Baku	1,855,300
	Devechi	486,000
	Khachmaz	152,800
	Khyzy	13,900
	Lankaran	197,900
	Masally	184,900
	Neftchala	75,500
	Salyan	117,400
	Siyazan	152,800
	Sumgayit	292,500
Total Azerbaijan	3,619,900	
Iran	Golestan	1,590,314
	Guilan	2,499,718
	Mazandaran	2,902,134
Total Iran	6,992,166	
Kazakhstan	Atyrau	443,700
	Manistau	336,000
Total Kazakhstan	779,700	
Russia	Astrakhan	1,005,280
	Dagestan	2,576,531
	Kalmykia	292,410
Total Russia	3,874,221	
Turkmenistan	Balkan Velayat	569,100
Total Turkmenistan	569,100	
Total Caspian Coastal Population	15,835,087	

*estimated of population 2002-2004 based on national socio-economic reports, and Russian Census 2002, 2004

In the CEP 2002 TDA the national level population growth rates were forecast to continue to rise in the southern and western regions of the Caspian, while declining in the north and east regions. The updated population growth trend data for the Caspian countries suggests that the overall population is increasing. Figure 6.2.1.1[1] illustrates the trend in annual percentage growth rate for the Caspian countries, plus a regional mean.

[1] Series: Population growth (annual %) Annual population growth rate. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship--except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of the country of origin.



While the 2002 CEP TDA focused on urbanization rates throughout the Caspian countries, the demographic trends across the Caspian coastal zones indicate that there is increasing population density in urban areas of Azerbaijan, and throughout Iran. As noted in the maps in Annex 6.1 from Socio Economic Data and Application Center, Columbia University, there is a much larger portion of the population on the west and southern coasts of the Caspian, while the population in the north and east coastal areas is quite sparse.

Figure 6.2.1.1

It is expected that the populations of Azerbaijan and Iran will continue to increase in the coastal areas, thus confirming the prediction of the 2002 CEP TDA. It is anticipated that the growth rate of Baku will continue well into the future reaching approximately 3.3 million by the year 2030[2]. This prediction is supported by the national socio-economic report for Azerbaijan, which goes on to say that the areas around Baku, including Sumgaiyait and Gobustan are also developing quickly as feeder communities to Baku.

The surge in annual growth rate in Iran may reflect the increase in census data from 1996, followed by a rebalancing the following year. The population increase in Kazakhstan shows a recovery that may be a result of a decline in migration. In some areas, specifically the coasts of Russia and Kazakhstan, the population around oil installations has a higher density, however overall trends are toward a decline in total population. In Turkmenistan populations along the Caspian coast remain low and are in decline according to national reports. The climate in the west and south is more hospitable year round, while conditions in the north and east are harsher in both summer and winter traditionally, partially accounting for the variation in settlement patterns.

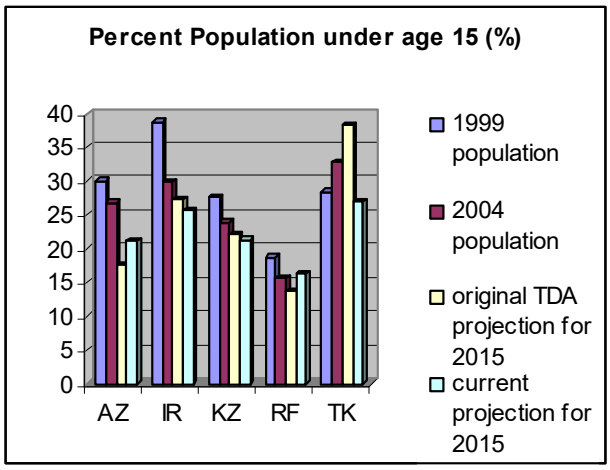


Figure 6.2.1.2

Another key factor for understanding population trends is the percentage of the population under the age of 15. This provides an idea of future trends in resource use as well as a sense of future population dynamics that will influence the degree of development within the region and demands on the environment. Figure 6.2.1.2 demonstrates the percentage of the

2 World Urbanization Prospects: The 2005 Revision Population Databasen http://esa.un.org/unup/p2k0data.asp

population under 15 years of age as of 1999; in 2004; forecast in the 2002 CEP TDA; and current adjusted projections for 2015, using data gathered from earlier TDA and current World Bank estimates. These show a gradual aging of the overall population, with the exception of Azerbaijan, where the population is increasing more quickly than earlier estimates. Overall there is an expected decline of pressures from a young regional population, which will reduce the earlier forecasted strains on social systems, government revenues and natural resources. The adjusted forecast population dynamic of Turkmenistan is in part due to migration in search of economic opportunities while children remain with other family members, yet even these revisions downgrade implied pressures significantly compared to earlier estimates.

Sustainable Livelihood

The health and well being of residents in the Caspian coastal area are critical measures for determining the overall environmental health as well as the impacts that human populations may be having on the Caspian ecology. Healthier communities tend to preserve environmental conditions more than less healthy communities because of the demands low public health places on government expenditures and the loss of economic earning potential. In the 2002 CEP TDA forecast that the health situation was likely to fall in the CIS countries, as subsidized health care became less prevalent.

Table 6.2.1.2

Country	Number of physicians/ 100,000		Health expenditures/cap per GDP/cap (PPP)			Percent Population under nourished (2003)
	2002	2006	Health exp.	GDP/Cap	Percent health exp /GDP	
AZ	360	355	140	$4153	3%	10
IR	85	45	498	$7525	7%	4
KZ	353	354	315	$7440	4%	8
RF	421	425	551	$9902	6%	3
TK	300	418	221	$4584	4%	8

*statistics compiled from the 2006 UN Human Development Report, and World Bank Social Indicators

While it seems that this predicted decline in expenditures may have been the case in some instances, it does not hold true across the board. The number of physicians for Kazakhstan, Russia and Turkmenistan has risen since 2002. The expenditures on health per capita (adjusted for Purchasing Power Parity) ranges between 3% in Azerbaijan to 7% in Iran, with the percent of population undernourished in 2003 ranging between 10 % in Azerbaijan and 3 % in Russia. It is presumed that the higher rate of undernourished populations in Azerbaijan is due to the large number of IDPs. Additionally, though not specified in these figures, it is possible that additional strains are being placed on social services in Iran by refugees fleeing conflict zones in Iraq and Afghanistan.

The 2002 CEP TDA also pointed to possible transmission of infectious diseases, specifically HIV/AIDS and tuberculosis, as potential problems because the incidence of these diseases was expected to increase rapidly. However, according to the UNDP

Human Development Report HIV infection rates remain at or below 0.2 percent of the population from 15-49 years of age for all Caspian countries except Russia, which has a rate of 1.1 percent. For tuberculosis, rates range between 35 cases per 100,000 people in Iran and 160 cases per 100,000 in Russia and Kazakhstan, placing the Caspian countries between 65th and 79th in global ranking of infection rate.

Infant mortality rates are often employed to gauge public health, especially the health of those who are most vulnerable to poor environmental conditions, including water and atmospheric pollutants, lack of sanitation, and increased exposure to ecosystem degradation. The 2002 CEP TDA stated that "During the mid-1990s, infant mortality rates in some regions soared to as high as four times the average in industrial countries." Updated information shows that across the Caspian countries infant mortality rates are dropping into the 2000's, with the exception of Turkmenistan and Kazakhstan. The individual country reports state there is a decline in the infant mortality rates in Kazakhstan and Turkmenistan due to an increase in medical care. (This discrepancy may be indicative of a variation in the measurement used). The country report for Turkmenistan suggests that there is a continued high level of infant mortality, significantly higher in rural areas, and another 40% higher in the rural areas near the Caspian. Despite this higher level, the country and sub-country level data shows that there is a decline in infant mortality rates in the region as a whole. This may bode well for the status of public health overall, especially as these rates drop; indicating an improvement in conditions. Conditions in Turkmenistan may warrant closer inspection to determine why there is a notably higher rate in areas contiguous to the Caspian. No clear indication was given within the report.

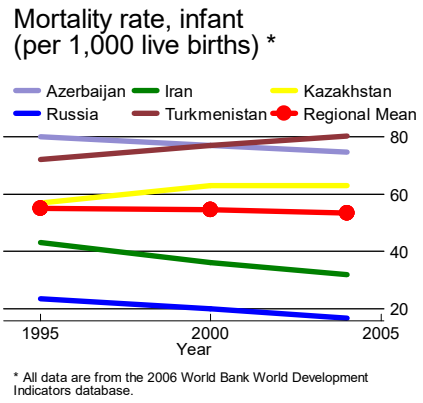
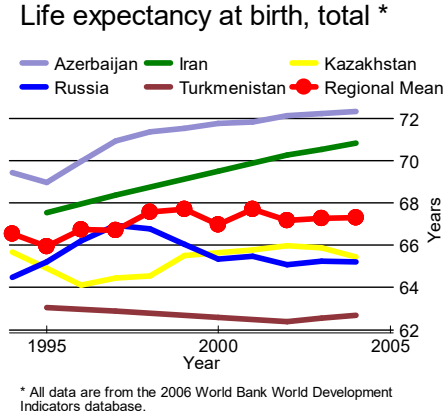


Figure 6.2.1.3[1]

The measure of life expectancy at birth is another indicator of public health. The time series data for life expectancy at birth in figure 6.2.1.3 indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life. This number varies based on a wide array of social indicators that combine economic status, health status indicators, access to nutrition and other basic needs data. The 2002 CEP TDA noted that the number fell slightly during the 1990's, although it generally remains high across the region, ranging from 64.1 in Kazakhstan to 68 in Iran in 1999. The TDA goes on to say that "towards the end of the 1990s, as the economy strengthened, infant mortality rates began to improve slightly and life expectancy began to rise in all Caspian countries. Iran stands as an exception in the region, as life expectancy has increased appreciably in recent years and access to healthcare has improved during the past decade." This trend has continued to expand. Iran continues to show significant improvements, as does



Azerbaijan. The national level data from Turkmenistan shows an improvement for rural and Caspian regions as well, though these remain lower than other areas. Again, there are inconsistencies among data, though it suggests that the coastal zone has a lower life expectancy than the general population, despite improvements being made.

The 2002 CEP TDA suggested that there would be a notable decline in literacy rates as economic strains and structural adjustments in the region take a toll on money available for social welfare programs. At the time, this seemed to be a valid forecast and may yet be verified. However, according to the UNDP Human Development Report 2006, the percentage of literacy rates remain in the high 90s throughout the FSU states, and upper 70s in Iran. This may be due to improving economic conditions, as well as the inherent recognition of the value of education due to such widespread exposure of populations during the Soviet era. On the other hand, it is possible that these rates will decline, but the impacts will not be readily apparent for another decade.

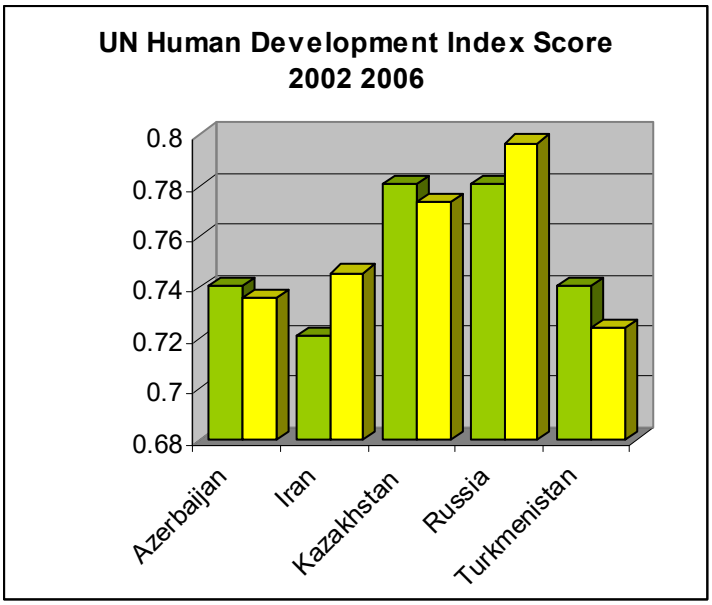


Figure 6.2.1.4

Overall, the Human Development Index employed by UNDP shows some small shifts in the overall conditions in the region in Figure 6.2.1.4 Conditions in Iran and Russia improved while conditions in Azerbaijan, Kazakhstan and Turkmenistan declined somewhat. While the 2002 CEP TDA focused on rankings, to do that in a comparative time series analysis could be misleading by overemphasizing changes. It should be noted that the rankings are at the national level, not specific to the Caspian coastal region. Nonetheless, as predicted there is a downward shift in the non-Russian FSU countries, likely due to realigning national budgets with the realities of political and economic independence. At the same time Iran continues to climb due to investments in education and health sectors after the Islamic Revolution.

6.3 Economy

The 2002 CEP TDA Socio-economic section economic analysis focused on broad spectrum measures for economic conditions, as well as more specific industry related issues expected to have an impact on the Caspian waters. The availability of comparable data leads to a focus on national level statistics, which is mainly the same in this report. However, the focus on the specific industry impacts on the Caspian and the factors contributing to those, specifically the impacts of the petroleum industry, and the fisheries impacts are now included in sections pertaining to those issues within Section 4 of this TDA. Issues of economic development trends, impacts on

water conditions and impacts of environmental conditions are addressed by specific sectors within this section.

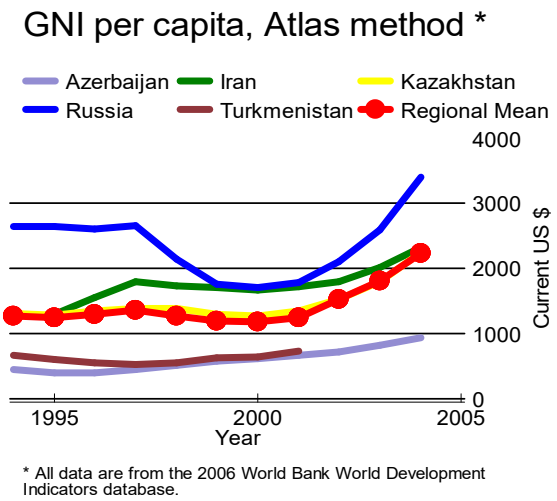


Figure 6.3.1

Recent economic data show that the economic development of the region is in part due to the population pressures, especially when there are dramatic variations from standard demographic trends, as is the case in Iran. However, the income rates also can reflect the economic health of a country. The graph in figure 6.3.1 depicting the Gross National Income [3] (GNI) per capita provides a standardized measure of economic strength of the region, as well as trends over time.

The measure of GNI per capita shows that the region overall has undergone a period of economic recovery since the initial 2002 CEP TDA.

The impacts of the 1998 downturn are evident, especially for Russia. However, the recovery there has been profound as well. This rise in GNI per capita in Russia while impressive, is potentially misleading, as the income distribution is highly concentrated within a small portion of the population. The near tripling of GNI per capita in Azerbaijan and doubling for Iran and Kazakhstan between 1995 and 2005 appears to be especially promising, assuming that this also results in available state revenues to address social and environmental needs. For all countries the 2006 GNI per capita continues to rise. Azerbaijan is $1,850, Iran is $3,000, Kazakhstan is $3,790, and Russia is $5,780. These increases, especially in Azerbaijan and Kazakhstan, are likely due to the increase in oil development compounded by the rising costs of oil, thus providing a double benefit. Data is not available for Turkmenistan currently.

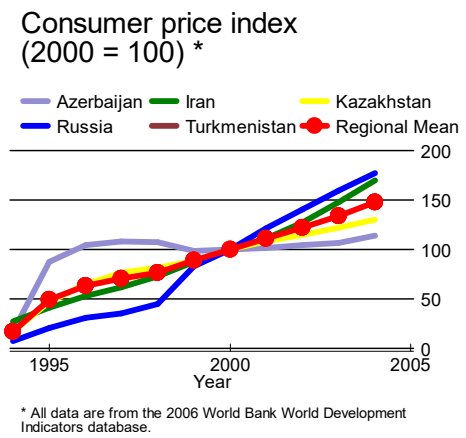
The optimism that could be signaled in the GNI per capita should be tempered with the reality of inflation measures across the region. Figure 6.3.2 illustrates the trends in inflation in the region through the consumer price index[4]. This similar trend was noted in the 2002 CEP TDA.

3 Series: GNI per capita, Atlas method (current US$)

GNI per capita (formerly GNP per capita) is the gross national income, converted to U.S. dollars using the World Bank Atlas method, divided by the midyear population. GNI is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad. GNI, calculated in national currency, is usually converted to U.S. dollars at official exchange rates for comparisons across economies, although an alternative rate is used when the official exchange rate is judged to diverge by an exceptionally large margin from the rate actually applied in international transactions. To smooth fluctuations in prices and exchange rates, a special Atlas method of conversion is used by the World Bank. This applies a conversion factor that averages the exchange rate for a given year and the two preceding years, adjusted for differences in rates of inflation between the country, and through 2000, the G-5 countries (France, Germany, Japan, the United Kingdom, and the United States). From 2001, these countries include the Euro Zone, Japan, the United Kingdom, and the United States.

4 Consumer price index (2000 = 100)

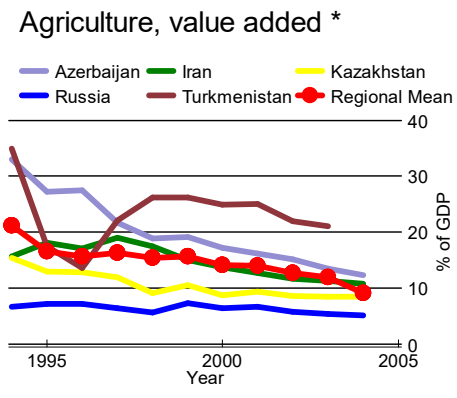
Figure 6.3.2



* All data are from the 2006 World Bank World Development Indicators database.

The consumer price index reflects changes in the cost to the average consumer of acquiring a fixed basket of goods and services that may be fixed or change yearly. Figure 6.3.2 demonstrates that there has been a steady increase in this index within the region, with the most serious inflation occurring in Russia and Iran, whereas in Azerbaijan the trend has slowed since 1995. It should be noted that anecdotal evidence suggests that the cost of household items continues to climb in Azerbaijan, as well as other countries in the past two years, which are not represented in this figure. This upward trend may imply that governments continue to benefit from increasing revenues.

There is an improvement in real economic earnings across the region, which suggests that as the countries become more affluent overall, more attention may be paid to environmental concern. While the 2002 CEP TDA focused on specific industries and the trends in development pertaining to the environment of the Caspian, those sections are now addressed in specific sectors pertaining to those issues in section 4, particularly sections on oil development and on water quality assessment of this report, while the broader economic trends broken down by sector are presented here. The sources of earnings also inform the type of impacts economic development has on the environment within the regions. As sectoral shifts occur the potential impacts on the environment also change, though those changes are not often swift or direct.



* All data are from the 2006 World Bank World Development Indicators database.

The 2002 CEP TDA stated that the agriculture sector in former Soviet countries provides many job opportunities, yet is technologically and managerially underdeveloped. In Iran, industrially-biased pricing systems and unsettled land tenure hamper agricultural development. This is supported by the sectoral trend data that examines growth in agriculture from 1994- 2004.

Figure 6.3.3

The agricultural sectors represented as percent of GDP[5] in figure 6.3.3 include forestry, hunting, and fishing, as well as cultivation of crops and livestock production.

Consumer price index reflects changes in the cost to the average consumer of acquiring a fixed basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used.

[5] Series: Agriculture, value added (% of GDP)
Agriculture corresponds to ISIC divisions 1-5 and includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion

The regional decline in the percentage of agriculture is largely is due to the increase in industrial production as a percentage of GDP, since there were notable increases in earnings as the oil industry ramped up production during this time. Also, the decline in agricultural production can be explained by the decline in state subsidies to farming activities which drove non-sustainable production during the Soviet era.

In comparison the industrial and service sectors show a positive trend. As these are percentages, the decline in one leads to a rise in the others. The 2002 CEP TDA states that "To various degrees, all littoral countries are burdened with heavily subsidized and otherwise non-viable industries. In the former Soviet countries, many of these industries are closed for lack of market and finance, adding thousands to the ranks of the unemployed. In Iran the relatively newer technologies, combined with direct and hidden subsidies, keep most industries functioning, although quite a few cannot be sustained in the long term." However, the increase in the industrial sector earnings also is reflected by additional income from mining activities which are incorporated in this data, and would include oil and gas development contributions to GDP.

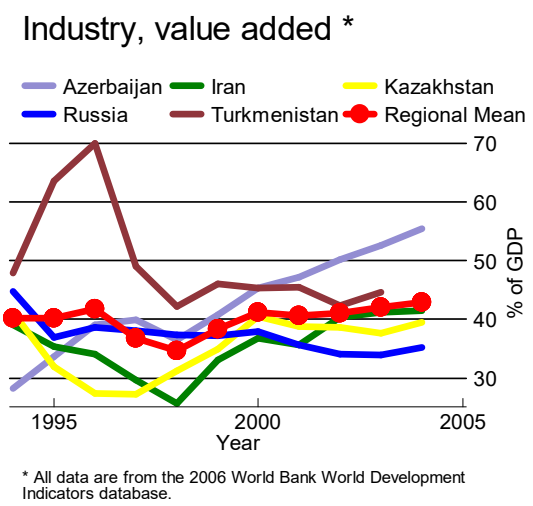
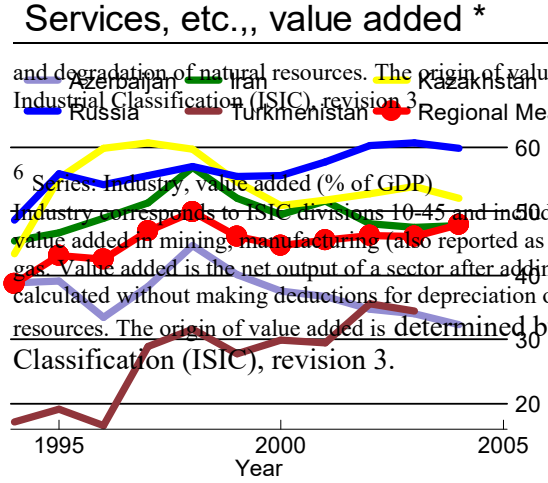


Figure 6.3.4

The shifts in industrial activities[6], especially pertaining to the oil industry, are reflected in figure 6.3.4. It comprises value added in mining, manufacturing (also reported as a separate subgroup), construction, electricity, water, and gas. The especially notable trends are in Azerbaijan and in Kazakhstan, which shows a steady upward trend in outputs. The shift in Turkmenistan is reflected in both agriculture and industry figures. This extreme variation in outputs is likely due to a change in calculation and reporting rather than in the actual outputs for Turkmenistan.

The 2002 CEP TDA predicted that the service sector appeared poised to be the major growth sector in most of the littoral countries, although the lines between underground and transparent economic activities in certain countries are murky. The 2002 CEP TDA also pointed out that the service industry in the former Soviet



and degradation of natural resources. The origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3.

[6] Series: Industry, value added (% of GDP)
Industry corresponds to ISIC divisions 10-45 and includes manufacturing (ISIC divisions 15-37). It comprises value added in mining, manufacturing (also reported as a separate subgroup), construction, electricity, water, and gas. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3.

countries depends heavily on foreign investment lured by oil and gas exploration. The data shows that there has also been an increase in earnings throughout the region for the services sector[7]. This includes value added in wholesale and retail trade (including hotels and restaurants), transport and government, financial, professional, and personal services such as education, health care, and real estate services. Also included are bank service charges, and import duties. These should be viewed concurrently with those for agriculture and industry, as they are percentages of total GDP. The increase in the service sector in Turkmenistan mirrors the other shifts, and the regional data now indicates a slow overall increase. As the service sector increases in national economies there is traditionally a decline in environmental impacts. However, as is the case here, the increase is probably less ecologically promising as the energy sector development increases significantly, with potential challenges for negative impacts on
Figure 6.3.5

the ecology of the Caspian. This will bear watching in the future, especially as there are increases in developments of the oil and gas sector, including challenges of extraction and transportation. This is addressed more thoroughly in Section 4 of this report.

The 2002 CEP TDA predicted that transportation and port structures would need to be improved significantly in the future for the transportation of people and goods across the Caspian waters. To date, there are multiple efforts underway to increase port capacity as well as affiliated land transportation infrastructure. The economic ramifications of increased port development, expansion and transportation are expected over to continue to increase in the next decade with benefits for local populations. Specifically, as the oil and gas sector continues to grow, transportation of petroleum resources, as well as associated extraction materials will increase significantly. The IMO forecasts that with the increased use of the Volga Don canal for movement of these items, there will be a growing demand for significant infrastructure improvements. This will include need for labor, materials, as well as primary and secondary labor to support the ports development, local infrastructure and land based transportation, as well as ongoing operation of these. Shipping fleets are being updated, and as port capacities increase with increased traffic in the Don Volga canal, the Caspian fleet is also expected to be improved. This should be monitored by CEP as much as possible in order avoid negatively impacting environmental conditions.

6.4 Summary

[7] Series: Services, etc., value added (% of GDP)
Services correspond to ISIC divisions 50-99 and they include value added in wholesale and retail trade (including hotels and restaurants), transport, and government, financial, professional, and personal services such as education, health care, and real estate services. Also included are imputed bank service charges, import duties, and any statistical discrepancies noted by national compilers as well as discrepancies arising from rescaling. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The industrial origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3.

The increase in populations in the coastal areas, especially in the western and southern coastal areas, suggests additional stresses will be put on the environment of the Caspian. The youth population will also continue to put pressure on environmental resources as well as government revenues. Economic conditions improve but must be tempered by potential inflation challenges, especially as more income is brought into the countries through resource development. The overall increase in petroleum production and transport in the region will increase potential stresses on the environment of the Caspian Sea. The increase in the services sector also indicates a shift in the economic makeup of the region which may be positive for the environment, though in this case it may also indicate an increase in support for the petroleum industry, which will also need to be monitored. The decline in agricultural production compared to other GDP factors may also indicate the increasing role in industrial and petroleum resource development in the region. Overall, human conditions are improving, as high literacy rates continue to remain high, life expectancy increases and infant mortality declines regionally. It is critical to note that these figures are more representative of the region however these trends over time should be followed and regularly updated in order to best understand how human socio-economic developments impact regional environmental conditions.

7. Caspian Public Participation Strategy and Stakeholder Analysis Revisit

7.1 Caspian Public Participation Strategy

To have a constructive dialogue between the CEP and public, two-way communications has been sought throughout the phase II of CEP. The CEP communication objectives include environmental awareness raising with emphasis on community-level understanding of the Caspian environment concerns; sensitising decision makers to the issues and to the need for adopting corrective and preventive policy measures and reinforcing additional support to the programme.

Towards these objectives the CEP began to identify major stakeholders as well as their perceptions of environmental issues and solutions at the beginning of the programme (phase I of CEP) by carrying out a comprehensive Ground- Truthing (GT) exercise which aimed to review and assess the status of the public participation around the Caspian including a review of regional, national and local institutional and legal structures, cultural characteristics, means of communication and access to information and justice on environmental issues. The exercise was carried out through questionnaires and face-to-face discussions in each Caspian countries by CEP advisors.

This was concurrent with the formulation of a regional Stakeholder Analysis Report to identify those who had a 'stake' and whose interests could have helped or hampered the programme in achieving its objectives. The Report provided insight into the ways stakeholders perceive issues and the policies that attempt to deal with them. It also provided recommendations on how to better inform stakeholders and engage them in a constructive dialogue to help improve the Caspian environment, and how to provide them with a better understanding of the issues at hand for the development of the Public Participation Strategy.

An institutional arrangement was made within the Programme to liaise with people at different regional, national and local levels. As a strategic approach towards communication objectives, CEP formulated a Public Participation Strategy (PPS) for the Caspian Sea to help enhance our communications and other objectives. The Caspian PPS was based on the GT survey and Stakeholder Analysis Report and through a consultative, participatory, transparent and inclusive process within the Caspian region.

The Caspian PPS serves as a flexible framework and addresses stakeholder participation in Caspian environmental initiatives through capacity building and strengthening the legal and institutional basis. It establishes new formal and informal institutions for public participation and facilitates a systematic and transparent information flow to raise public awareness. The desired outcome of PPS is to enhance and inform stakeholders and facilitate inter-sectoral participation in the management of the Caspian environment. The document divides CEP's target audiences into three groups at the regional, national and local levels and provides recommendations for actions expected to be taken by them.

The Caspian PPS was endorsed by the CEP Steering Committee Meeting in February 2006 and Operational Plans for activities at the various levels (local, national and

regional) were being developed, together with monitoring and evaluation indicators in each Caspian country based on the PPS and priority areas in each country.

The stakeholder involvement and public participation strategy for CEP is a critical part of the effectiveness of the organization within national and regional institutions. Because the health of the Caspian waters touch so many different groups, from oil companies to fishermen, to tourist to coastal residents, it is vital to have a link that will enable them to be involved in the project implementation and development where appropriate. The 2002 CEP TDA featured a very involved stakeholder analysis which provided insights into the concerns and priorities of stakeholder throughout the region. This was supplemented by the 2004 Caspian Regional Stakeholder Analysis Revisit (SAR), summarized here with recommendations included.

7.2 Stakeholder Analysis Revisit

The Caspian Regional Stakeholder Analysis Revisit (SAR) report was prepared in order to observe shifts in trends as they pertain to the current activities of the Caspian Environment Programme. Stakeholder opinion surveys were collected in Azerbaijan, Iran, Kazakhstan, Russia and Turkmenistan. As in the 2002 TDA CEP Stakeholder Analysis (SHA), the stakeholders were asked to prioritize these issues and respond to a series of statements pertaining to these issues. The statements used were identical to the initial SHA so that shifts in responses could be monitored. The respondents were asked self selected the stakeholder group with which they most closely identified, and while the stakeholders were not necessarily the same individuals as those who were surveyed in 2001, the responses were gauged by groups not individuals. Their attitudes and perceptions were averaged for each group, and the findings were analyzed and summarized graphically in Table 7.1 – *Stakeholder Prioritization of Issues.* The priority of each issue for each stakeholder group was ranked high, medium and low.

Overall the stakeholders ranked the issues as:

1- Reducing pollution in Caspian waters;
2- Preservation of biodiversity;
3- Improved Fisheries;
4- Sustainable economic development with environmental care;
5- Protection from invasive species;
6- Stronger civil society input into decision making.

The Caspian Stakeholder Groups (SHG) include representatives of: Environmental Ministry, Hydromet Officials, Foreign Affairs Ministry, Economic Ministry, Agriculture and Fisheries Ministry, Fisheries Commission, State Owned Fisheries Industry, Energy Ministry, Regional Government, District Water Management Official, Municipal Government, Ministry of Education, State Scientific Research Center, Private Scientific Research Center, National NGO, Nature Preserve Staff, Coastal Zone Resident, Public Healthcare Provider, Educator/Student, Farmer/Water User, Pastoralist/Animal Husbandry, National or Local NGO, Coastal Recreation Industry, Community Based Organization, Fishermen, Fisheries Enforcement/ Border Guards, Fishing Product Sales – National, Fisheries Consumer and Value added consumers, State Owned Industry, Private Industry, Oil Company Representatives, National Press, International Funding Institutions, International NGOs, Bilateral

Organizations, Experts Group from CEP SCM, and, attendees of the CEP Investment Forum.

7.2.1 Reducing pollution in Caspian waters:
Pollution in the Caspian is the highest priority issue for all stakeholder groups, especially those groups who are in closest contact with the Caspian waters. There is a wide perception that the waters of the Caspian are highly polluted despite recent studies which have reduced the level of concern among key stakeholder groups such as environmental ministries, and agriculture and fisheries ministries. Tensions between groups regarding pollution have become less pronounced than they were in the previous SHA. Tension remains between some groups regarding the cause and effects of pollution as well as the responsibility for the conditions of the Caspian. *Recommendations include:*

- Provide information summarizing recent scientific studies to broad stakeholder groups, in simplified and accessible formats, especially to groups dealing with water management issue in regional and municipal governments.
- Take steps towards empirically examining links between regional environmental conditions and the effects on human health.
- Improve dialogue opportunities for various stakeholder groups who are now in conflict over pollution causes.

7.2.3 Preservation of Biodiversity:
The protection of biodiversity is currently garnering broader support in the Caspian region than it was in 2002. This indicates that the regional population will be receptive to an informational campaign that focuses on the importance of biodiversity in the region as a part of sustainable development efforts. There are not expected to be strong tensions across stakeholder groups regarding preservation of biodiversity. *Recommendations include:*

- Provide a short training course for journalist on the importance of biodiversity in the region.
- Provide enforcement groups such as fisheries enforcement/border guards and nature reserve staff with support through information exchange forums, strategy workshops, and training with authorities from other regions who face similar challenges.
- Develop informational materials on the economic importance of protecting regional biodiversity for distribution through Interministerial Committees to related ministries.
- Design and establish a Caspian biodiversity status report to be published on a regular basis for the general public

7.2.4 Improved Fisheries:
This issue was the highest priority issue in the first SHA. There is decrease in the expected tensions between groups over fisheries compared to the 2002 study, but there is more internal division within more groups with regards to this. This may be due to the declining stocks, and lack of understanding for this decline among the broader population. *Recommendations include:*

- Continuation of public awareness building efforts focusing on the actual causes of decline such as over fishing and ecological changes brought by invasive species.
- Support consumer awareness campaigns in conjunction with regional, national and international organizations

7.2.5 Sustainable economic development with environmental care:
Sustainable development is a growing priority for stakeholders. The problems of using natural resources to meet current demand at the expense of future generations are increasing in the awareness of the stakeholders. During this study questions pertaining to coastal development and adaptive management were not included, as those issues were not salient initially and therefore not included in this survey. Groups who had previously taken extreme positions on this in the 2002 SHA appear to be recognizing the complexity of this issue. A topic of particular concern within this issue is the perception that the environment can recover regardless of what human activities. Tensions exist regarding the need to use economic resources in non-sustainable manner in order to meet current human needs. *Recommendations include:*

- Provide stakeholder groups with accessible models of sustainable development projects with concrete successes under comparable circumstances. Create an information campaign linking improved environmental conditions with economic development focusing on grass roots efforts to protect habitats.
- Provide workshops for regional, district and national level planning agencies, with CBOs, industries and NGOs, to train groups how to encourage sustainable development practices. Provide a basic ecology training workshops to targeted populations emphasising positive sum scenarios of sound environmental stewardship.
- Develop accessible materials demonstrating the linkages between low environmental conditions, poor human health and poor economic performance. In conjunction with other organizations develop a Caspian region environmental health atlas to pin point areas of environmentally linked human health problems.

7.2.6 Protection from invasive species:
Protection from invasive species remains a lower priority over all for stakeholders, as it was in the 2002 SHA. There is geographic variation and there are not strong tensions among or between stakeholder groups regarding the concerns over invasive species. *Recommendations include:*

- Create targeted awareness building campaigns for ministries involved in this issue, including: agriculture and fisheries ministries, economic ministries, transportation ministries, and environmental ministries, with support for and distribution through the Interministerial Committees.
- Develop an invasive species awareness campaign for stakeholders in the coastal area and who are active in the Caspian waters.

7.2.7 Stronger civil society input into decision making:
This issue is ranked as the lowest priority for all stakeholder groups in the region as it did in the 2002 SHA. There is ambivalence among most stakeholders regarding NGOs grassroots efforts in the region, and because most environmental information comes from media. Tensions may be more pronounced as groups attempt to assert

influence on the decision making process though this has not yet been tested empirically. *Recommendations includes:*

- Consider examining the claims of organizations who profess to represent broad stakeholder groups in order to determine if they are in fact working as grassroots activists, and if so in what capacity are they doing so.
- Conduct a wider investigation into sources of environmental information for more effective efforts to reach stakeholders.
- Identify specific means for stakeholder groups to be involved in decision making processes at local, national and regional levels.

7.3 Status of Civil Society/NGOs in the Caspian Basin

Additional surveys were made by the Public Participation Advisors in each Caspian country to review the changes in the status of Civil Societies/NGOs and other stakeholders comparing phase I of CEP.

Although there are some common trends, there are also significant differences between the countries, with different strengths and weaknesses in each. Therefore, although there is still a long way to go before the general public will have a significant impact on environmental policy and practices in the region, the positive green shoots of better information, more information and more active participation are there and growing.

In summary, the overall status of Civil Societies/NGOs has been evaluated as moderately significant in sense of being more educated and specialized. Distribution of grants had some impact on increased education and capacity building of NGOs, but there is still low environmental literacy. The number of environmental NGOs has been increased in most of the Caspian countries, though there have also been some declines as well.

The improvement in the areas of positive dialogue between government and NGOs, regarding access to information, NGO networking and strengthening the legal and institutional basis for participation of NGOs in environmental management, including decision making, around the Caspian Sea was evaluated as not significant. Financial and logistical constraints have also been considered as major threats which may cause decrease in NGOs activities.

General recommendations for overcoming or minimizing stakeholders and public conflicts are:

- Continuation on educational and awareness programmes for NGOs, stakeholders and decision makers to explain how their actions affect the environment and how changes can be made to reduce these impacts, and that focus on economic costs and benefits of sound environmental stewardship;
- Facilitate a systematic and transparent information flow, with the establishment of a Caspian information Centre;;
- Establish and strengthening the legal and institutional basis for better dialogue of public with government and local authorities and NGOs' participation;
- Simplifying the registration procedures for those NGOs wish to obtain the legal entity status;
- Support the establishment of NGO networking and a NGO forum.

Stakeholder group ranking high, medium, low	Fisheries	Biodiversity	Invasive Species	Pollution	Sustainable Development	Civil Society
All Stakeholders/ all respondents (# priority)	**# 3**	**# 2**	**# 5**	**# 1**	**# 4**	**# 6**
Environmental Ministry						
Hydromet Officials						
Foreign Affairs Ministry						
Economic Ministry						
Agriculture and Fisheries Ministry						
Fisheries Commission						
State Owned Fisheries Industry						
Energy Ministry						
Regional Government						
District Water Management Official						
Municipal Government						
Ministry of Education						
State Scientific Research Center						
Private Scientific Research Center						
National NGO						
Nature Preserve Staff						
Coastal Zone Resident						
Public Healthcare Provider						
Educator/ Student						
Farmer / Water User						
Pastoralist/Animal Husbandry						
National or Local NGO						
Coastal Recreation Industry						
Community Based Organization						
Fishermen						
Fisheries Enforcement/ Border Guards						
Fishing Product Sales - National						
Fisheries Consumer and Value added consumers						
State Owned Industry						
Private Industry						
Oil Company Representatives						
National Press						
International Funding Institutions						
International NGOs, Bilateral Organizations						
Experts Group from CEP SCM, Investment Forum						

8. Recommendations

The key recommendations from the from TDA revisit are listed below under the SAP priority regional environmental concerns are:

8.1 Threats to biodiversity, including those from invasive species

- To establish a regional integrated biodiversity monitoring programme based on an agreed M&E framework (with permanent consultation/training of experts within the region) to develop a baseline and identify trends, including changes in community structure.
- To develop a Ballast Waters Action Plan for the Caspian
- To create a reference collection under CEP umbrella – although there are limited reference collections in existence they are not available to many specialists in the region.
- To create a Caspian Red Book of endangered and threatened species.
- To undertake further ecotoxological studies on seals and sturgeon to determine the impact of persistent toxic substances on the higher trophic levels, in particular the long-lived species.
- To evaulate the economic importance of protecting regional biodiversity and communicate the results to the general public and Government decision makers.
- To develop informational materials for that emphasise the economic importance of biodiversity in the region, and list steps that can be taken by stakeholders to help reduce threats to the biodiversity in the region.

8.2 Pollution

- To establish a regional monitoring programme for an agreed core set of pollutants using harmonised protocols and underpinned by credible QA/QC procedures.
- To incorporate, into the regional aquatic pollution monitoring programme, measurements at the mouths of the major rivers in order to estimate pollutant fluxes into the Caspian Sea.
- To reassess national inventories of land-based sources of pollution, especially for the core set of pollutants, using a harmonised procedure.
- To investigate pollution profiles in the deltaic sediments of the major rivers in order to determine recent trends in contaminant inputs that can be used both to evaluate the efficacy of past environmental regulations and to serve as a benchmark against which to compare future change.
- To conduct a desktop study to assess the relative importance of diffuse sources, including atmospheric inputs, of key pollutants.
- To investigate the environmental mobility of pollutants currently retained in reservoirs behind damns in the major rivers, with a view to evaluating the environmental risk they pose for the Caspian Sea.
- To provide information summarizing recent scientific studies to broad stakeholder groups, in simplified and accessible formats, especially to groups dealing with water management issue in regional and municipal governments.
- To take steps towards empirically examining links between regional environmental conditions and the effects on human health.
- To improve dialogue opportunities for various stakeholder groups who are now in conflict over pollution causes.

8.3 Unsustainable use of bioresources

- To develop national fishery strategies and action plans under a single regional strategy
- To rehabilitate eroding fisheries stocks, including sturgeon through development of an Ecosystem Based Management approach and an itegrated information management system, incorporating fisheries, biological and oceanographic data and information.
- To protect and rehabilitate natural spawning grounds as well as fish river migratory routes including river de-siltation measures, fish ladders/lifts, public awareness campaigns, pilot Pollutants Reduction Management Plans
- To improve the efficiency of hatcheries and restocking programs including pan-culturing techniques and commercialization programes
- To establish tagging programmes to identify and track individuals and other programmes to identify separate fish stocks
- To investigate new and evaluate old stock assessment methodologies on the Caspian and provide increased technical support.
- To reduce of fishery pressure by extension of aquaculture, sturgeon farming and tourism as well as community oriented poverty alleviation/sustainable livelihood initiatives
- To Investigate ways to reduce the impact of *Mnemiopsis leiydyi* on Tulka fisheries
- To strengthen fisheries management to reduce over-fishing and minimize illegal fishing, including regional arrangements and capacity building measures for bioresources management e.g , improved legislation, enforcement and compliance
- To continue public awareness building efforts, focusing on the causes of the decline in fisheries such as over fishing and ecological changes brought by invasive specie

8.4 Unsustainable coastal area development

- To establish a set of agreed scenarios of water level fluctuations over a 25 year planning period, taking into account international and regional expert opinion regarding the impact of climate change.
- To undertake economic assessments of potential loss for each of the scenarios, including environmental and amenity losses, in key locations.
- To disseminate the results of the Anzali Lagoon and Port pilot project and based on the techniques and methodologies developed, establish conceptual models and management adaptation plans for five sites around the Caspian coast (a mixture of sites: industrial, environmental, residential).
- To design a model M&E framework for wetlands threatened by sea level rise linked to agreed scenarios.
- To establish national programmes for monitoring marine litter and establish control programmes in each country
- To deliver workshops for regional, district and national level planning agencies, with CBOs, industries and NGOs, to train groups how to encourage sustainable development practices. Provide a basic ecology training workshops to targeted

populations emphasising positive sum scenarios of sound environmental stewardship.

- To develop accessible materials demonstrating the linkages between low environmental conditions, poor human health and poor economic performance.

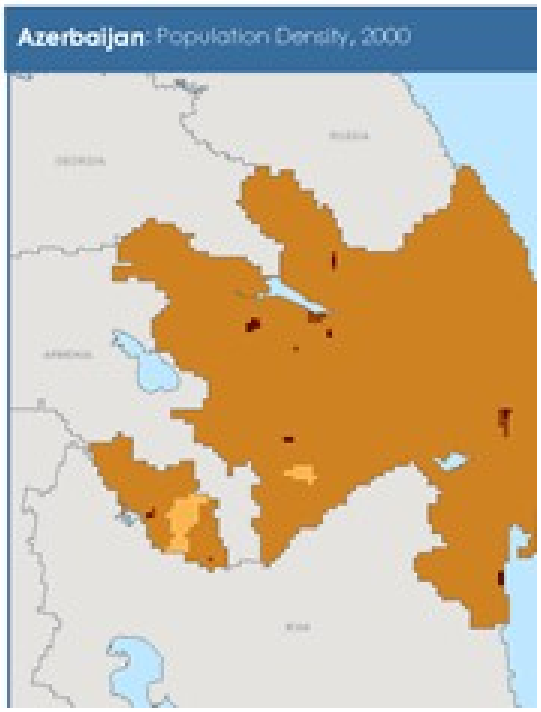
8.5 Strengthen stakeholder participation in Caspian Environmental stewardship (EQO V)

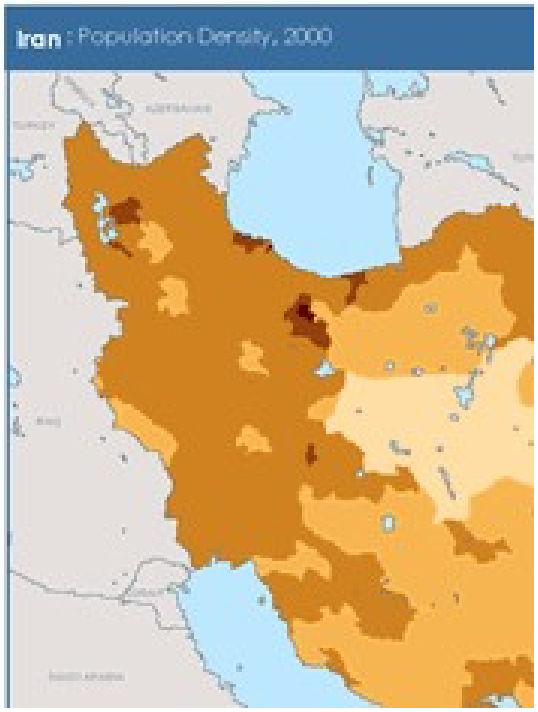
- To conduct a wider investigation into sources of environmental information for more effective efforts to reach stakeholders.
- To facilitate a more systematic and transparent information flow, with the establishment of an Caspian information Centre;
- To identify specific means for stakeholder groups to be involved in decision making processes at local, national and regional levels.
- To continue educational and awareness programmes for NGOs, stakeholders and decision makers to explain how their personnal and collective actions affect the environment and how changes can be made to reduce these impacts;
- Facilitate a systematic and transparent information flow;
- To help simplify the registration procedures for those NGOs wish to obtain the legal entity status;
- To support NGO networking and establishment of an NGO forum

Appendix 1 Chapter 6

ANNEX 6.1 – Socio Economic Data and Applications Center – Columbia University

http://sedac.ciesin.columbia.edu/






Turkmenistan: Population Density, 2000

Appendix 2
Transboundary Diagnostic Analysis for the Caspian Sea Revisit
Guide to Annex Files by Section

1. Introduction
3. Methodology

3. SAP and NCAPs Review
a. CEP SAP review[1]. Final: complete section for Programme Implementation Plan

4. Priority Transboundary Problems
4.1 Decline in Biodiversity
a. Monitoring Biodiversity Folder
1. Anzali Biodiversity Folder
i. Animal tables data Excell files- birds, fishes, macrophytes, mammals reptiles and amphibians, phytoplanktons, zeoplanktons
ii. Progress%20Report_2-1.doc: Anzali Lagoon Adaptive Management Pilot Initiative Project 2nd Progress Report, Nov. 2006
iii. Progress%20%20Report_3-2.doc: Anzali Pilot Project 3rd Progress Report (Primary Draft), Feb. 2007
2. 3-1-BMP-Rep-Az.doc: Caspian Coastal Sites Inventory Biodiversity Monitoring Programme Report- Azerbijan
3. 3-2-BMP-Rep-Ir.doc: Islamic Republic of Iran, General review on the fish resources exploitation in the Iranian part of the Caspian Sea in 2001-2005
4. 3-3-BMP-Rep_Kz.doc: Caspian Coastal Sites Inventory Biodiversity Monitoring Programme Report- Republic of Kazakhstan
5. 3-4-BMP-Rep-Ru.doc: Caspian Coastal Sites Inventory Biodiversity Monitoring Programme Report- Russian Federation
6. 3-5-BMP-Rep-Tm.doc: Caspian Coastal Sites Inventory Biodiversity Monitoring Programme Report- Turkmenistan
7. Draft TDA.zip: contains all Anzali Biodiversity files together

b. CCA biodiversity.doc: CCA- biodiversity in the Caspian, problem and causes

c. CISS_Agip_report_2006_Confident.pdf: Caspian International Seal Survey (CISS) report to Agip KCO on contracted Caspian seal population studies 2006, compiled by various Universities and Nature Conservatories in Kazakhstan, Russia, Estonia, Sweden and UK

d. CSCAP draft3_eng.doc: Caspian Seal Conservation Action Plan, 3rd Draft, Nov. 2006

e. Feeding to send.rar: 15 files included
1. Sturgeon Feeding_eng.doc: Significance of Fishes, Particularly Tulka, in Feeding of Sturgeons and Seals in the Caspian Sea
2. 14 PNG image graphs- Beluga Middle, Beluga North, Beluga South, Russian Middle-East, Russian Middle-West, Russian North-East, Russian North-West, Russian South-East-West, Seal North, Seal Whole Sea (tons), Sevruga Middle-East-West, Sevruga North-East, Sevruga North-West, Sevruga South-East-West

f. map-1.doc: map of Caspian Sea area (in Russian)

g. map-2.doc: map of Caspian Sea area with different focus (in Russian)

h. Mnemiopsis box.doc: Report on the presence of Mnemiopsis in the Caspian Sea from 1995-2005

i. Seal box.doc: Report on seals in the Caspian Sea and the effect of pollution and hunting

j. Seal_death_2007_rus[1].doc: same seal News Article as below, but Russian original

k. Seal_death_2007_translation[1].doc: News Article (unofficial translation)- First results of laboratory analyses show presence of seal distemper in the carcasses of dead seals on the Caspian, Aktau April 13, 2007, InterFax Kazakhstan

l. table- Excell table list (in Russian)

4.2 Changes in Environmental Quality

a. AECSI Final Report Caspian Sea: An Assessment of Marine Pollution in the Caspian Sea based on the CEP 2005 Contaminant Surveys, Dr. Stephen de Mora, Aromed Environmental Consulting Services Inc., Nov. 2006
b. Contaminant Summery_2006_reza.doc: Summary of findings in CEP Summer 2004 Contaminant Survey as well as HAB/ABB Investigation in Western Iranian Coastal Area in 2006
c. Kura_Contaminant Assessment_jan_07.doc: Contaminant Assessment of Kura River (Reza_January 2007)
d. Marine_Litter_in_Caspian_Sea._Drfat_Strategy_.II_Beb[1].doc: Caspian Marine Litter Situation Review and Framework Strategy Draft 2007, The Caspian Environment Programme
e. Report text[1].doc: Rapid Assessment of Point Sources Pollution in Iranian Part of the Caspian Sea Area, using GIWA Methodology, Caspian Environment Programme, by A. Larijani, April 2006, Tehran-IR-Iran
f. Annexes for Report text[1]: rar file with 8 Annexes (_A-_H), each Annex contains Excell spreadsheets used to support report contents
g. Report_Terek1k1.zip: UNDP/GEP Project “Implementation of Convention and Action Plan on Caspian Sea Environment Protection- Phase II,” UNOPS, SOI of Federal Service on Hydrometeorology and Monitoring of Environment (Roshydromet), Desk Study Project to determine the fluxes of major contaminants from the Terek River into Caspian Sea, Moscow 2007
h. Report_Terek1k2a.zip: continuation of above report- Chapter 2. Spatial Variability of Pollutants Concentration in the Terek Basin, SOI Expeditions 2002-2004
i. Report_Terek1k2b.zip: another continuation of report- 2.3.Water Pollution, 2.3.1.Petroleum Hydrocarbons, 2.3.2.Heavy Metals
j. TDA EQ Draft Ver 3_REZA_1.doc: Report draft (16 pages)- begins 1. Overall decline in environmental quality: strongly transboundary, finishes with undone Report on Soymonov Bay

4.3 Decline in Bioresources

a. 20 Oct report.doc: Fisheries Management in the Caspian Sea, October 2006
b. CCA tulka_Igor.doc: Caspian tulka fishing Causal Chain Analisis (CCA)
c. Fisheries Institutional paper.Pourkazemi.doc: same exact file as 20 Oct report.doc, just under different file name
d. Sturgeon and seal feeding in 2004-2005.doc: 2 pages of data for sturgeon and seal feeding in 2004-2005 for Russian sturgeon, Stellate, Beluga and Seal
e. Sturgeons.ppt: 4 Power Point slides on the Beluga, Russian Sturgeon, Stellate Sturgeon and Other Caspian Sturgeons
f. Total tulka 1995-2005.png: Office Picture Manager bar graph titled Total annual tulka catches in thousands tones Caspian Sea (1995-2005)
g. Tulka Total.png: line graph titled Total tulka catch in the Caspian Sea (1935-2005)
h. Tulka Total 1993-2005.png: line graph titled Total tulka catch by all countries in thousands tons (1993-2005)

4.4 Damage to Coastal Habitat and Infrastructure

a. Climate Change and Vulnerability Assessment Report Folder
    1. CC_Report-AZ_eng.doc: Vulnerability Evaluation of the Caspian Sea Basin to Climate Change
    2. CC_Report-AZ_rus.doc: Vulnerability Evaluation of the Caspian Sea Basin to Climate Change (in Russian)
    3. CC_Report-IR.doc: I.R. of Iran National Report- Climate Change and Vulnerability Assessment in the Southern Coast of Caspian Sea, produced by Atmospheric Science and Meteorological Research Center with Oceanic and Atmospheric Science Center, 2007
    4. CC_Report-KZ.doc: Climate Change and Vulnerability Assessment Report for Kazakhstan, by T. Kudekov 2006
    5. CC_Report-TK_eng.doc: Climate Change and Vulnerability Assessment Report for the Caspian Basin- Turkmenistan, by I. Atamundova
    6. CC_Report-TK_rus.doc: Climate Change and Vulnerability Assessment Report for the Caspian Basin- Turkmenistan, by I. Atamundova (in Russian)
    7. Report_Panin_TDA_CC_1.pdf: Transboundary Diagnostic Analysis- Climate Change and Vulnerability Assessment Report for the Caspian Basin, by Prof. Gennady N. Panin (Institute of Water Problems, RAS), Nov. 2006
    8. Report_Panin_TDA_CC_final.doc: Transboundary Diagnostic Analysis- Climate Change and Vulnerability Assessment Report for the Caspian Basin, by Prof. Gennady N. Panin (Institute of Water Problems, RAS), April 2007
b. KhazarClim_Final.doc: report on Caspian Sea Level Changes
c. Untitled.bmp- picture of report cover for I.R. of Iran National Report on Climate Change in South Coast of Caspian Sea
d. Article of Kazhydromet about Caspian Sea level fluctuations (2004)_quotation.doc: Operative system for forecast of sea level fluctuations in the Kazakhstan part of the Caspian Sea. //

Hydrometeorology and Ecolody. 2004. V-4. pp-35-43, Kudekov T.K., Shivareva N.I., Stroeva T.P.

e. CAP, 2007.doc: short background on the National Caspian Action Plan (NCAP) for the Republic of Azerbaijan and The Caspian Environmental Programme
f. CCA Water pollution_Regional_1.doc: CCA Diagram for overall decline in environmental quality with impacts of four factors (Risk for public health, Unsustainable coastal area development, Degradation of Caspian ecosystem, Decline in bioresources) on four sectors (Natural factors, Agriculture, Urban, Industry/Energy)
g. CMD07_Exploration_e_selected.pdf: 7 powerpoint slides, Capital Market Day Presentation titled "Exploration- 2007 and Beyond," by Lundin, Jan.30, 2007
h. wanzalilagoon1.zip: 6 files- Anzali water-level Excell spreadsheet, Average year profile.png, height increase_eng.jpg, Karimi district in country with road and pool_eng.jpg- map of area, Monthly average 1994-2004.png- graph titled Water level fluctuation of Caspian Sea near to Anzali port (monthly average)(1994-2004), Years average.png- graph titled Caspian Sea water-level fluctuation (Anzali port)
i. wanzalilagoon2.zip: 2 files- landuse ROOYAN_eng.jpg- picture of area (in Russian), lanuse height increase_eng- another picture of area (in Russian)
j. wanzalilagoon3.zip:
k. Water Level Fluctuations of the Caspian Sea.doc: Water Level Fluctuations of the Caspian Sea in the Hydrological Year 2005-2006, Jan. 2007, Ministry of Power, Water Research Institute, The National Research and Study Center of the Caspian Sea

4.5 Ecological Impacts of Oil Activities in the Caspian

a. OIL%20SPILL%20RESPONSE%20EQUIPMENT%20STOCKPILE.pdf: 2 pages of powerpoint slides that describe Combined Boom Skimmer, Offshore Boom, Sea Skimmer, Coastal Boom, Shoreline Barrier, Disc Skimmers, Storage Barges, Storage Tanks and 20m Response Vessel
b. OIL%20SPILL%20RESPONSE%20EQUIPMENT%20STOCKPILE-rus.pdf: the same powerpoint slides as above (in Russian)
c. Oil%20SPILL%20SCENARIO.pdf: 7 slides on report from Schleppo Port Control received September 21, 2006, titled SITREP1-7
d. Oil%20SPILL%20SCENARIO-rus.pdf: same slides as above (in Russian)
e. Action%20Against%20Oil%20Pollution.pdf: Action against Oil Pollution Brocure, A guide to the intergovernmental and industry organizations involved in the prevention and mitigation of oil pollution in the marine environment
f. Claims%20for%20Economic%20Losses%20in%20the%20Tourism%20Sector.pdf: 3 pages of slides, "Claims for Economic Losses in the Tourism Sector," Oil Pollution Claims and Compensation Workshop, Astana, Kazakhstan, September 20-21, 2006
g. Claims%20for%20Environmental%20Damage.pdf: 3 pages of slides, "Claims for Environmental Damage and Costs of Post-Spill Studies," Oil

Pollution Claims and Compensation Workshop, Astana, Kazakhstan, Sept. 20-21, 2006

h. Claims%20for%20Property%20Damage.pdf: 3 pages of slides, "Property Damage," Oil Pollution Claims and Compensation Workshop, Astana, Kazakhstan, Sept. 20-21, 2006
i. Claims%20in%20Fishery%20and%20Mariculture%20Sectors.pdf: 3 pages of slides, "Claims in the Fishery and Mariculture Sectors," Oil Pollution Claims and Compensation Workshop, Astana, Kazakhstan, Sept. 20-21, 2006
j. Explanatory%20note.pdf: The International Regime for Compensation for Oil Pollution Damage, Explanatory note prepared by the Secretariat of the International Oil Pollution Compensation Funds, May 2006
k. International%20Convention.pdf: Liability and Compensation for Oil Pollution Damage: Texts of the 1992 Conventions and the Supplementary Fund Protocol, 2005 Edition, International Oil Pollution Compensation Funds
l. IOPC%20Claims%20Manual.pdf: Claims Manual, International Oil Pollution Compensation Fund 1992, April 2005 Edition
m. IOPC%20Fund%20Annual%20Report.pdf: Annual Report 2005, International Oil Pollution Compensation Funds, Report on the Activities of the International Oil Pollution Compensation Funds in 2005
n. Liability%20and%20Compensation.pdf: 11 pages of slides, "The International Regime on Liability and Compensation for Oil Pollution Damage," IOPC Funds Claims Workshop, Astana, Kazakhstan, Sept. 19-20, 2006
o. Participants.pdf: Draft List of Participants, Regional Oil Spills Claims Workshop and the Emergency Response Regional Advisory Group Meeting: Astana, Septemeber 20-22, 2006, Caspian Environment Programme Coordination Unit
p. Course%20Programme.pdf: Emergency Response Regional Advisory Group (ERAG) Meeting, Astana, September 20, 2006, Caspian Environment Programme CEPSAP Project
q. Oil Conference Images Folder: Image1-Image13, all photos of the 2006 Conference
r. IPIECA Report Series Folder: 24 pdf files by the International Petroleum Industry Environmental Conservation Association (IPIECA)
    1. Vol1_BioImpacts.pdf: Guidelines on Biological Impacts of Oil Pollution, IPIECA Report Series Volume 1
    2. Vol1_BioImpacts_ru.pdf: same as above (in Russian)
    3. Vol2_ContPlanning.pdf: A Guide to Contingency Planning for Oil Spills on Water, IPIECA Report Series Volume 2, 2nd Edition, March 2000
    4. Vol2_ContPlanning_ru.pdf: same as above (in Russian)
    5. Vol3_Corals.pdf: Biological Impact of Oil Pollution: Coral Reefs, IPIECA Report Series Volume 3
    6. Vol4_Mangroves.pdf: Biological Impacts of Oil Pollution: Mangroves, IPIECA Report Series Volume 4
    7. Vol5_Dispersants.pdf: Dispersants and Their Role in Oil Spill Response, IPIECA Report Series Volume 5, 2nd Edition, November 2001

8. Vol5_Dispersants_ru.pdf: same as above (in Russian)
9. Vol6_Saltmarshes.pdf: Biological Impacts of Oil Pollution: Saltmarshes, IPIECA Report Series Volume 6
10. Vol6_Saltmarshes_ru.pdf: same as above (in Russian)
11. Vol7_RockyShores.pdf: Biological Impacts of Oil Pollution: Rocky Shores, IPIECA Report Series Volume 7
12. Vol7_RockyShores_ru.pdf: same as above (in Russian)
13. Vol8_Fisheries.pdf: Biological Impacts of Oil Pollution: Fisheries, IPIECA Report Series Volume 8
14. Vol8_Fisheries_ru.pdf: same as above (in Russian)
15. Vol9_SedimentaryShores.pdf: Biological Impacts of Oil Pollution: Sedimentary Shores, IPIECA Report Series Volume 9
16. Vol9_SedimentaryShores_ru.pdf: same as above (in Russian)
17. Vol10_NEBA.pdf: Choosing Spill Response Options to Minimize Damage- Net Environmental Benefit Analysis, IPIECA Report Series Volume 10
18. Vol10_NEBA_ru.pdf: same as above (in Russian)
19. Vol11_ResponderSafety.pdf: Oil Spill Responder Safety Guide, IPIECA Report Series Volume 11
20. Vol11_ResponderSafety_ru.pdf: same as above (in Russian)
21. Vol12_WasteManagement.pdf: Guidelines for Oil Spill Waste Minimization and Management, IPIECA Report Series Volume 12
22. Vol12_WasteManagement_ru.pdf: same as above (in Russian)
23. Vol13_OiledWildlife.pdf: A Guide to Oiled Wildlife Response Planning, IPIECA Report Series Volume 13
24. Vol13_OiledWildlife_ru.pdf: same as above (in Russian)

1. Compensation.pdf: Oil Spill Compensation- A Guide to International Conventions on Liability and Compensation for Oil Pollution Damage, A joint IPIECA/ITOPF Publication, February 2004
2. Compensation_ru.pdf: same as above (in Russian)
3. IMO_Vol1.pdf: Sensitivity Mapping for Oil Spill Response, IMO/IPIECA Report Series Volume 1
4. IMO_Vol1_ru.pdf: same as above (in Russian)
5. IMO_Vol2.pdf: A Guide to Oil Spill Exercise Planning, IMO/IPIECA Report Series Volume 2
6. IMO_Vol2_ru.pdf: same as above (in Russian)
7. Tier3.pdf: The Use of International Oil Industry Spill Response Resources: Tier 3 Centres, A joint IPIECA/ITOPF Briefing Paper, April 1999
8. Tier3_ru.pdf: same as above (in Russian)

s. OSPRI Folder: 4 pdf files

25. Briefing_paper_en.pdf: Briefing Paper- Oil Spill Preparedness Regional Initiative (Caspian Sea-Black Sea-Central Eurasia), OSPRI
26. Briefing_paper_rus.pdf: same as above (in Russian)
27. FAQs_en.pdf: Frequently Asked Questions (FAQs), Oil Spill Preparedness Regional Initiative (Caspian Sea-Black Sea-Central Eurasia), OSPRI
28. FAQs_ru.pdf: same as above (in Russian)

5. Governance / Institutional Analysis
    a. regional report.eng.2006.doc: Legislative and Institutional Frameworks for the Protection and Sustainable Management of The Caspian Sea Environment, Regional Report, 2006
    b. regional_report_eng_March_2007[1][1].doc: Legislative and Institutional Frameworks for the Protection and Sustainable Management of The Caspian Sea Environment, Regional Report, 2007

6. Socio-Economic and Development Setting
    a. Report_eng_Final.doc: Social and Economic conditions and environment of Caspian Sea
    b. S-E_Study-IR_eng.doc: An Analysis of Impact of Socio-Economic Development on Caspian Environment, in Iran (TDA Revisit)
    c. S-E_Study-KZ_eng.doc: Social-Economical Review, G.Temirbekova, Ministry of Environmental Protection of the Republic of Kazakhstan, Astana 2006
    d. S-E_Study-KZ_rus.doc: same report as above (in Russian)
    e. S-E_Study-TK_eng.doc: Socio-Economic Situation and Development of the Caspian Region
    f. S-E_Study-TK_rus.doc: same report as above (in Russian)
    g. Table 1-Coastal regions_eng.doc: data in tables of Coastal Regions of Azerbaijan Republic, Jan.1, 2005

7. Caspian Public Participation Strategy and Stakeholder Analysis Revisit
    a. CEP_Stakeholder_Analysis_Revist[13.12.04]: Caspian Environment Programme Stakeholder Analysis Revisit Autumn 2004, Mary M. Matthews, Ph.D., 5/5/2007
    b. Report draft for SHAG.2.doc: Meeting Report from the Kura-Aras Stakeholder Advisory Group, Gudauri, Georgia, Nov. 2006
    c. stakeholder&PPS report.doc: Stakeholders' Involvement and Public Participation Strategy, including the development process and summaries of the public involvement and Public Participation Strategy
    d. PPS-FINAL_Oct_2005-eng.doc: Public Participation Strategy for the Caspian Sea