

# The Caspian Sea Region: Environmental Change

Ecosystems in the Caspian Sea region have been heavily modified by anthropogenic activities, mainly as a result of changes in the water flow and degradation of the water quality in the ecosystems. Changes in the regional environment have influenced regional economies, particularly obvious in the impacts on fish stocks. Using the methodology developed in the GIWA project, experts in the region carried out an assessment of the most important transboundary issues in shared waters in the region. This report focuses on the root causes for the most important drivers of environmental change in the region: habitat and community modification.

## INTRODUCTION

The aim of the study was to suggest mechanisms by which the impacts of habitat and community change can be mitigated in the future. The study identified 4 primary immediate causes, and their most important root causes, namely: *i*) pollution caused by old technology and infrastructure, primarily for the extraction and transportation of oil, and insufficient control of harmful pesticides; *ii*) poaching and unsustainable fishing practices due to lack of knowledge about quotas and other alternatives for regulating the catches as well as insufficient enforcement of existing legislation; *iii*) introduction of invasive species, mainly as a result of the absence of cleansing systems for tanks and hulls; and *iv*) stream flow regulation by dams on the discharging rivers, primarily due to insufficient control of the stream flow from the dams. The policy options recommended are of an integrated character, target all identified root causes, and can be grouped under 4 main headings: control functions; infrastructure development; economic instruments; and science and education.

A conventional “meet the requirements” approach to water resources allocation, where water-use strategies are formulated to accommodate projected population growth and economic development, with minimal consideration of ecological carrying capacity or water resource availability, often fails to achieve sustainability. There is a strong need to develop and implement integrated water resources management (IWRM) policies adjusted to the local natural and socioeconomic conditions. An IWRM policy can act as an efficient tool for ensuring a balance between the needs of water-related natural systems and the economic and social demands of society. Experience of internationally-led and locally executed environmental projects may play the role of a catalyst in development of sustainable regional water policies.

The Global International Waters Assessment (GIWA) aims to assess the transboundary water-related issues that are causing environmental change in subregions of the world, including both marine and freshwater systems. The project also assesses the root causes of environmental

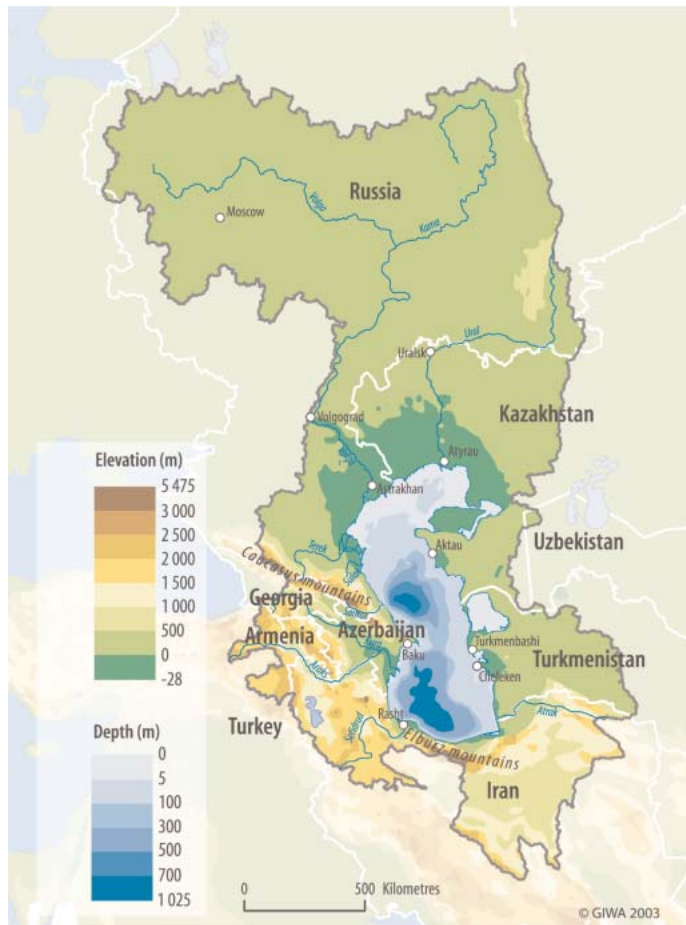


Figure 1. Map of the GIWA Caspian subregion (Drainage basin of the Caspian Sea) Source: GIWA Core Team, 2003.

change and suggests policy options to mitigate the problems (for a detailed description of the GIWA see Ref. 1). The present report focuses on the Caspian Sea, which is defined here as the sea itself and its catchment area (Fig 1). The majority of the drainage basin is occupied by the 5 littoral states: Russia, Azerbaijan, Iran, Kazakhstan, and Turkmenistan. The transboundary waters identified within the subregion are the Caspian Sea itself and the lower reaches of the Volga River. The Volga has a major hydrological impact on the Caspian Sea and other tributaries.

The GIWA methodology adopts a truly holistic approach, in line with state-of-art requirements of IWRM, and includes surface, underground and marine waters, particularly where there are clear transboundary implications of the impacts caused by human activities. GIWA's scientific and technical scope is focused primarily on the linkage between transboundary freshwater and marine systems (2). The present study concentrates on the Caspian Sea itself and its lower tributaries area (often referred to as the Caspian Economic Hinterland, CEH). CEH is the most biologically productive, biodiverse, and important transboundary part

of the subregion. Here, human activities cause the most significant and more or less well-documented impacts on the transboundary water environment. The population and economy are especially perceptible to disadvantageous modification of the water environment and, possibly, will be more receptive to the support of policy options directed to the maintenance of the Caspian Sea environment at a sustainable level (3).

## CHARACTERISTICS AND PRESSING ISSUES OF THE SUBREGION

The Caspian Sea is the largest continental waterbody on earth and controversy still exists whether this waterbody should be referred to as a sea or as a lake. This controversy leads to the whole problem of transboundary-waters management, which in the Caspian Sea basin is one of the most acute in world. The past history of the Caspian Sea reveals an environmental system that is highly stressed by natural factors and human activities (4). Natural resources of the region include oil and gas, exclusive fisheries in the form of the highly valuable sturgeon species, and a level of aquatic species endemism reaching 80%, thus rivalling even Lake Baikal (5). Socioeconomic features that complicate the management of transboundary environmental resources include legal controversy on the status of the waterbody and, therefore, on the form of cooperation and usage of the shelf, and underwater and coastal resources; a generally unstable economic situation of the newly emerged coastal states, and political tension.

The biodiversity of the Caspian and its coastal zone makes the region one of the most valuable ecosystems in the world (6). There are internationally significant protected areas in all the Caspian countries; these include coastal and marine areas, with different status, management regimes, and functions (Fig 2).

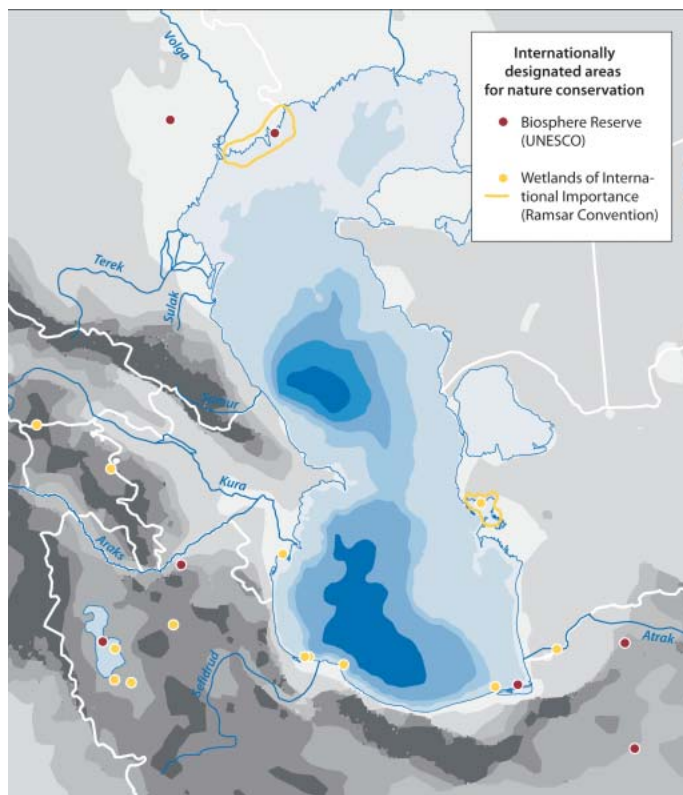


Figure 2. Internationally designated areas for nature conservation in the Caspian region. Source: (6).

Due to its long-term isolation from other waterbodies, the Caspian Sea is characterized by many endemic species. Among others, the Caspian Sea harbors 54 endemic fish, 53 endemic molluscs, and one endemic mammal, the Caspian seal (7). The existence of shallow areas, several deep depressions, and a wide range of salinities varying from 0.1–13‰ provide different ecological niches which gives rise to a high species diversity.

The coastal region is characterized by a wide range of habitats from vast river systems to extensive wetlands such as the deltas of the Volga, Ural, and Kura rivers, the hypersaline Kara Bogaz Gol, and extended wetland systems along the Iranian coast. The wetlands in the region also play a role as feeding and resting areas for migratory birds. The Caspian lies at the crossroads of migration routes and it has been estimated that up to 10 million birds stop over in the region each year in spring and autumn (3). The unique geographical position of the Caspian Sea at the meridian border of the subcontinents of Europe and Asia and sublatitudinal borders of natural zones of steppe, deserts, and subtropics of the temperate zone of the Eastern Hemisphere made provision for a large diversity of typical (zonal-subzonal) and ecotone (transitional) types of habitats both offshore and onshore (8). However, due to the varying water levels of the Caspian the coastal habitats are constantly changing.

The Caspian basin sustains an important fisheries sector. In the past, 500 000 to 600 000 tonnes (t) of fish, particularly valuable species such as beluga, sturgeon, and Caspian roach, were caught annually. This situation remained unchanged until the early 1950s, but since then, sprat fisheries have significantly intensified in the middle and southern Caspian in order to compensate for poor catches of the more valuable fish species. Between 1960 and 1980, the total volume of fish caught was largely maintained by the annual extraction of between 300 000 and 400 000 t of sprat (3). The Caspian Sea is famous for its population of sturgeon and, at its peak in the mid-1980s harbored some 85% of the world sturgeon population. There have been significant alterations in fish populations over the past 50 years as a result of human activities, particularly fisheries and habitat alteration (6).

The modern Caspian transgression during the last 2 decades has resulted in a sharp increase in sea level of approximately 2.5 m. This increase in sea level has displaced wetlands and other habitats located in shallow waters and along the coast, causing a concomitant decline in biodiversity and loss of ecosystem stability, particularly in the Cis-Caspian lowland (Kazakhstan, Russia), lowland deltas in Azerbaijan, and offshore shoals. A number of species, such as the rare Nut Lotus (*Nelumbo nucifera*), which has almost disappeared in the eastern part of the Volga delta, have lost their habitat, although, in the long term these habitats are likely to re-establish themselves along the new coast. In addition, the advance of the sea has caused progressive salinization of soils and a shift in the surge zone in the coastal area. Moreover, impacts associated with the inundation of coastal areas by rising sea levels have been exacerbated by the contamination of marine and wetland habitats with pesticides, herbicides, and oil products that were previously contained within coastal or inland areas (3).

The impacts of sea level rise have not all been negative. Despite the temporal loss of biodiversity, the inundation of coastal areas has also provided new habitats. In some areas, the rise has favorably influenced restoration of shallow

spawning grounds (carp, etc.), nesting locations for birds (flamingo, swan, etc.), diversity of flora and productivity and quality of feeding grounds (3).

A majority of international studies show that the major threats to biodiversity of the sea and its coastal zone in the Caspian basin are combinations of natural and anthropogenic factors (3, 5, 6, 8, 9). Most of the threats to biodiversity in the Caspian are transboundary in nature and require effective measures from all Caspian states (6).

## GIWA: METHODOLOGY

According to the assessment protocol, GIWA will focus on 5 major problem areas, including 23 specific environmental and socioeconomic problems (1). Causal Chain Analyses (CCA) will be carried out for the priority issues and concerns, specific in each subregion, selected by the subregional task team. CCA is an innovative interdisciplinary tool used to identify and better understand the links between perceived problems and their societal root causes. Causal Chain Analysis methodology is known to have been successfully applied to the problems of biodiversity loss (10, 11). CCA explores and helps an understanding of the root causes—the socioeconomic factors that drive humans to degrade the natural environment.

It has been shown, using the CCA analysis, that biodiversity loss is driven by a complex interplay of various forces operating at different scales (10). While any of the individual factors alone are sufficient to cause biodiversity loss, in reality, multiple factors are acting simultaneously to drive such loss. Scales, linkages and the hierarchy of individual root causes are studied in order to build conceptual models. The latter provide a descriptive picture of the chain of explanation of the phenomena; they are flexible, qualitative, and closely linked to the available data.

The aim of CCA is to identify the most important root causes of each concern, in order to target them, by appropriate policy measures, for remediation or mitigation. This last characteristic needs to be emphasized. The overall objective of GIWA and, thus, of GIWA's Causal Chain Analysis, is to develop a conceptual, strategic framework for the identification of priorities for remedial and mitigatory actions in international waters. For this reason, GIWA's Causal Chain Analysis is policy oriented (12).

The CCA approach requires that analyses consider factors across a range of scales, weigh their relative impact, and examine the linkages across scales. True interdisciplinary composition of the task team is also to be ensured, and access to local knowledge is essential (11).

## CASPIAN SUBREGION PRIORITIES FOR CCA AND POLICY OPTIONS ANALYSIS

The Caspian subregional task team consists of local policy-makers, academicians, environmental officers, and international experts (see 13).

*Undesirable habitat and community modification* (GIWA concern III) has been recommended for the causal chain and policy options analysis, in order to develop mechanisms by which the impacts of this concern can be mitigated in the future. This conclusion has been reached having assessed the

complex environmental and societal roots of each major GIWA concern within the Caspian Sea basin, and considering the Caspian Economic Hinterland as a discrete system with transboundary water-related problems.

The selected concern "habitat and community modification" has significant linkages with other GIWA concerns and issues such as stream flow modification, pollution, overfishing, and the introduction of exotic species that are responsible for the disadvantageous modification of habitats, community structure and species composition. By focusing on habitat and community modification it allows the inclusion of these concerns indirectly, also as targets of policy recommendations for the Caspian subregion.

*Habitat modification* is reported to be the primary cause of biodiversity loss worldwide. Habitat modification, essentially modifications of land cover and of aquatic habitats for human use, includes not only outright destruction or transformation but also reduction and fragmentation of habitats that in turn reduce the complexity of ecosystems (10). For the purpose of this study the following definition of habitat is used: *Habitat* = conditions and environment in which a plant or animal, population or species lives. Habitats of animals can consist of several grounds (for wintering, breeding, spending a night, feeding, etc.) (14).

## CAUSAL CHAIN ANALYSIS

The spatial scale of the analysis presented is the region under assessment, i.e. the Caspian Sea and its coastal zone. Eight immediate causes (immediate causes = physical, biological or chemical variables that have a direct impact on a GIWA issue/concern) have been identified for this geographical area: *i*) pollution; *ii*) poaching; *iii*) invasive species; *iv*) stream flow regulation; *v*) deforestation; *vi*) coastal erosion/dredging; *vii*) land use; *viii*) eutrophication.

Ranking procedure was used to identify the relative importance of the different immediate causes. Ranking has shown that although each Caspian country has its own priorities regarding relative importance of the immediate causes; pollution, poaching and unsustainable fishing practices, introduction of invasive species, and stream-flow regulation, can be defined as the most pressing ones for the subregion as a whole. General consensus was also achieved in understanding that the negative impacts of the most immediate causes are likely to accelerate in the future. The degree of severity of each immediate causes for the Caspian Sea itself, and for the freshwater basin were taken into account.

In the next stage of the analysis, a number of re-occurring drivers or root causes were identified (root causes = the key factors, trends, processes or institutions that influence a situation, issue, or decision, that propel the system forward, and determine a scenario's outcome). Many of the immediate causes are affected primarily by insufficient enforcement of national legislation, absence of regional regulations, inadequate expert advice, and both the overall economic situation in the region and low public participation and environmental awareness/transparency. Some of the root causes such as regional poverty and the economic recession will be difficult to change in the near future and are, to a large extent, dependent on international as well as national factors. Other root causes are more specific for the Caspian Economic Hinterland (CEH) and are hence within reach of

local and regional governance. The following root causes were identified as the most pressing for each immediate cause (Fig. 3):

- **Pollution:** Old technology and infrastructure for oil extraction and insufficient control of harmful pesticides.
- **Poaching and unsustainable fishing practices:** Inadequate expert advice on quotas.
- **Introduction of invasive species:** Absence of cleansing systems for tanks and hulls.
- **Flow stream regulation:** Insufficient control of stream flow regulations by dams.

pollution from point sources, and the legal consequences of exceeding pollution limits are generally very limited, the regional oil industry has few economic incentives to modernize its equipment. Improved local control of oil wells and pipelines and more effective taxes or fines on oil pollution constitute central strategies for the enforcement of the Polluter Pays Principle in the region. A parallel strategy is to stimulate the introduction of ‘green technologies’ and hence support for modernization of the Caspian oil industry. While the former measure is important, the general effectiveness is expected to be limited since pollution taxes or fines most likely will be lower than costly reconstructions. It is also unlikely that green technology stimulation will generate immediate effects, but the long-term benefits are expected to be significant.

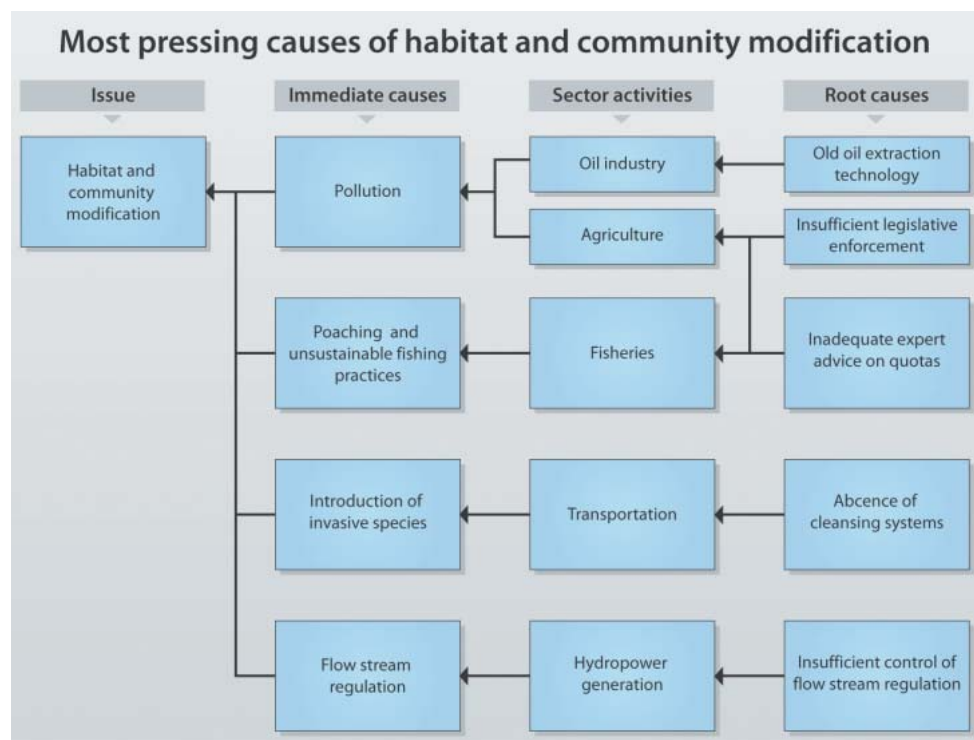


Figure 3. A summary of the main causal links for habitat and community modification in the Caspian Sea and its coastal zones. Source: (13).

## HARMFUL PESTICIDES

The use of environmentally harmful pesticides in small-scale farming along the Caspian coastline and river deltas has been identified as a serious threat to aquatic biodiversity in the region. In order to reduce the discharge of toxic and bioaccumulative substances into coastal waters, legislative enforcement must be strengthened. As suggested for causal chain analysis, the sale and use of DDT has been legally prohibited in the former Soviet states for 3 decades but the supply is still abundant throughout the CEH. To better enforce the ban on DDT, regional control functions need to be strengthened and local officials must be given the necessary resources to control local market supply and sale. The feasibility and effectiveness of improved legislative enforcement are expected to be

## INFRASTRUCTURE FOR OIL EXTRACTION

Old technical equipment used in the extraction and transport of oil is the most important root cause of oil pollution in Caspian waters. In Azerbaijan, the oil industry has long been by far the greatest culprit in the destruction of landscapes in the coastal zone, especially in the Absheron Peninsular area and the area south of Baku. Oil fields developed prior to the achievement of independence cover 20 000 ha of the peninsular, of which over 8000 ha are severely contaminated by oil and 2000 ha are occupied by artificial oil-water lakes and pits. These areas are classified as severely degraded semidesert landscapes. In addition, oil industry wastes have contaminated 165 natural lakes (6, 15, 16).

The existence of persistent and/or bio-accumulative toxic compounds in the environment, which have generally originated from the oil industry, jeopardizes offshore habitats and wetlands of Azerbaijan, Russia, and the northeastern coast of Kazakhstan. Much of the small but regular leakage from oil wells and pipelines could be effectively reduced if the infrastructure in use is reconstructed or replaced. However, since local authorities in most Caspian states fail to control

high since forbidden chemicals are easy enough to identify and confiscate. Responsibility for improved enforcement should be given to local and municipal authorities.

A recommended parallel measure is to provide local farmers with economically viable alternatives to DDT. This could be done by reducing import taxes on modern and less environmentally harmful pesticides. Modern pesticides are generally more expensive than DDT on the local markets in the CEH and, therefore, can not compete with traditional products. Tax reductions could reduce the prices of modern pesticides substantially, but it is unlikely that prices can drop enough to compete with the very cheap chemicals currently in use. The short-term effectiveness of a state-driven substitution of obsolete pesticides is hence expected to be fairly low. This measure is however still recommended as a long-term policy for all Caspian states.

Since the public awareness of the ecological consequences of the use of DDT is rather low in the region, educational efforts would complement the 2 topdown measures suggested above. Special training, lectures, and educational TV programs need to be developed and offered both to authorities and local communities in the region. A better public understanding

of the ecological vulnerability of the Caspian waters can in the long run increase local engagement in the regional environment. Educational policies are hence recommended on a broad scale in all 5 littoral countries.

## EXPERT ADVICE AND FISHING QUOTAS

Inadequate expert advice has been identified as the primary root cause of overfishing in the Caspian Sea. As suggested in the causal chain analysis the regional *Commission on Aquatic Bioresources* is providing scientific advice for the establishment of annual fishing quotas in the Sea. Since the scientists involved in this process are under pressure from the littoral governments and the fishing industry, the recommended quotas are often influenced by political and economic considerations. To make this Commission politically independent is thus an important first step towards more ecologically sustainable quotas. A second and perhaps even more important policy measure is to stimulate research in the Caspian Sea in order to improve the scientific understanding of the decreasing fish stocks. Currently, a range of factors such as overfishing, climatic, and hydrological changes and local population fluctuations are suggested as possible causes, but their relative importance is still highly uncertain.

Improved scientific advice is not the only key to effective fishing quotas in the Caspian Sea. Reduced fishing levels in the sea also require that quotas be respected. This problem also involves the dire economic situation of the small fishermen. Today, small- and large-scale poaching is a significant problem that must be better controlled by all littoral states. Although there is evidence that in some areas poaching is a local and seasonal issue (in the north and mid-Caspian), and will likely decline with the increase in catch per unit effort (CPUE) that accompanies overharvesting, (2) many studies still identify it as one of the major causes behind the decline in valuable species (17, 18). While local control organizations need to be reorganized and strengthened by better equipment and trained staff, in order to enforce fishing quotas, the effectiveness of control measures is expected to be relatively low. This is due to the widespread corruption in the region, and the high domestic and international market prices for sturgeon that make illegal trade a highly lucrative business.

## CLEANSING OF SHIP HULLS AND TANKS

As identified in the causal chain analysis invasive species are today accidentally introduced into the Caspian waters *via* ballast water of visiting ships and as hull fouling. Since all sea transport from outside the Caspian Sea is channelled through the Volga River, a facility for hull cleansing and control of ballast water is currently under construction in the strategically located port of Astrakhan. The Russian ministries of Ecology and Transport are responsible for the construction in cooperation with the local authorities in the Astrakhan oblast. While this initiative is expected to effectively reduce the number of exotic species in the Caspian Sea, the project is currently in need of additional funding.

A regional organization devoted to the control of invasive species is another more long-term measure that could reduce the habitat and community modification in the Caspian waters. Such an organization could strengthen the institutional framework necessary to control the currently unregulated aquaculture in the Sea, and support the control facility in

Astrakhan port. However, so far, strengthened local control in the 5 littoral states is expected to be more effective than cooperative efforts.

A more specific measure aimed to control the negative effects generated by the recent invader *Mnemiopsis leidi*, is the deliberate introduction of the comb jellyfish *Beroe ovata* feeding on *Mnemiopsis*. Since the consequences of this measure are not fully understood, scientific studies are currently being undertaken in Russia, Iran, and Azerbaijan. However, even these studies are under-funded and hence need support from the international community.

## STREAM FLOW REGULATION

The construction of dams on the Volga, Kura, and Atrek Rivers for the generation of hydroelectricity, which started in the 1930s, caused a decline in water flow and alterations of the natural water regimes and concomitant changes in the environmental conditions and structure of habitats in the deltas. In particular, a large part of the natural spawning grounds for sturgeon in the Volga, and semianadromous fish, such as Zander, Carp and Caspian Roach, in the Atrek, have been lost, resulting in declines in fish stocks in all littoral states (Table 1).

**Table 1. Spawning grounds of sturgeon. Source: (3)**

River	Area of spawning before river regulation (ha)	Area of remaining spawning grounds (ha)
Kura	n/a	160
Terek	n/a	130
Sulak	n/a	200
Ural	1700	1100
Volga	3390	372

There are 3 main groups of stakeholders affected by dam construction along the Caspian rivers. These include the power industry, farmers in need of irrigation, and fishermen. Since the interests of these 3 groups do not coincide, the stream flow regulation of dammed rivers requires careful management. Conflicts also arise because the regulation of rivers affects the size of stocks of commercial fish species in the entire subregion, but only those countries that have constructed dams benefit from the electricity and water for irrigation that these reservoirs yield. Under these circumstances, nations that do not benefit from the construction of these dams have no incentive to take measures to restore natural spawning grounds. Moreover, one of the primary principles outlined in the Agreement on the preservation and use of Caspian bioresources that states that the "distribution of aquatic bioresources depending on the input of Parties into their reproduction and preservation as well as bioproductivity of coastal waters" is not fully implemented within the region. As a consequence, the preservation of other natural habitats for sturgeon, such as feeding and wintering grounds, is not encouraged.

As suggested in the causal chain analysis the construction of large dams, particularly the Volgograd Dam on the Volga River and the Mingeaur Dam on the Kura River, has resulted in a 90% loss of spawning grounds for mature sturgeon and blocked important migration paths. To safeguard continued existence the sturgeon in the Caspian Sea the remaining spawning grounds need to be protected.

**Table 2. Integrated policy options for Caspian subregion.**

Immediate causes	Root causes	Recommended policy options Integrated to address all root causes
Pollution	Old technology and infrastructure for oil extraction  Insufficient control of harmful pesticides	<i>Control functions</i> Strengthen municipal control of forbidden chemicals Strengthen local control of oil wells and oil pipelines Strengthen local control of poaching
Poaching and unsustainable fishing practices	Inadequate expert advice on quotas  Insufficient enforcement of existing legislation	<i>Infrastructure</i> Modernisation of regional oil industry Facility for ballast water control and hull cleansing
Introduction of invasive species	Absence of cleansing systems for tanks and hulls	<i>Economic instruments</i> Tax reductions on less harmful pesticides Point taxes and fines on oil pollution State stimulation of green technologies Fines on damaging stream flow regulation
Flow stream regulation	Insufficient control of flow stream regulation by dams	<i>Science and education</i> Environmental training for the public Expert independence from authorities and fishery industry Scientific research on Caspian fish populations Increased public participation Institutional strengthening of key managerial institutions

*ii) Infrastructure*

Modernization of the equipment used by regional oil industry and to control transport vessels in the Astrakhan port are important but expensive measures. It is consequently important to enact the Polluter Pays Principle and hence make oil companies share implementation costs. When implemented, these measures can be very effective since they are expected to drastically reduce oil pollution and the number of invasive species in the Caspian Sea.

*iii) Economic instruments*

A range of economic instruments can be used to stimulate more sustainable production and consumption patterns in the region and hence reduce the ongoing habitat and community modification. While national and local authorities in the littoral states are responsible for developing suitable instruments, international advice will be important in this process.

Economic instruments such as fines and compensation could be introduced at the national and local level in order to internalize the external costs of damaged bioresources. Water prices that better reflect the ecological consequences of stream flow regulation are likely to stimulate a more sustainable water use in the region. Local and national authorities would be responsible for the implementation of these measures.

Finally, national regulations on dam construction and operation need to be substantially improved and better enforced in all 5 littoral states, in order to provide for the environmentally sound stream flow regulation of river influx into the Caspian Sea.

**RECOMMENDED POLICY OPTIONS**

The policy options recommended to reduce habitat and community modification in the Caspian Sea can be grouped under 4 main headings; *i)* control functions; *ii)* infrastructure; *iii)* economic instruments; and *iv)* science and education (Table 2). They will apply to the whole range of selected root causes and will have a synergism effect if implemented on the regional level.

*i) Control functions*

Improved local control of chemical use, oil extraction, and transport as well as poaching is central in order to reduce habitat and community modification in the Caspian waters. National and local authorities tend to share the cost and responsibility for legal enforcement in the former Soviet states. While strengthened local control is important, the effectiveness is impeded by the ongoing corruption among state officials in these countries.

*iv) Science and education*

To increase environmental awareness among the public in the Caspian region and to invest in further research are important long-term measures for reducing habitat and community modification in the Caspian Sea. While educational and research efforts will not generate direct effects, they may in time lead to more sustainable management of the aquatic resources in the region.

**CONCLUSION**

Possible policy measures for the environmental protection of the Caspian Sea and its coastal areas have been explored prior to the GIWA assessment by the Caspian Environment Programme (CEP) and in the Global Environmental Facilities (GEF) sponsored Transboundary Diagnostic Analysis (TDA). CEP Strategic Action Plan (not approved yet but finalized) highlights 4 areas of concern, namely: *i)* fisheries development; *ii)* biodiversity protection; *iii)* pollution monitoring and control; and *iv)* sustainable development of coastal areas. TDA policy options are comprehensively described in the TDA reports and provide a good basis for environmental management in the Caspian Economic Hinterland. Many of the policy recommendations in this report coincide with the previous studies. These include:

- To reduce oil pollution from offshore activities in the Caspian Sea.
- To ensure safe transportation for hydrocarbons and other raw materials.
- To achieve sustainable use of aquatic resources, with emphasis on fisheries.

- To establish a control system for the import and export of exotic species into and from the Caspian Sea.
- To prevent adverse human activity in sensitive areas (including deltas, reed beds, macrophyte habitats).
- Upgrade/renovate existing treatment plants for mechanical and biological treatment, but compatible with future upgrade to nutrient technology, if studies so suggest.
- Develop training and re-skilling programs taking into account similar efforts being implemented by other organizations and programs.
- To agree to a list of banned agrochemicals and a program to destroy stored banned products.

The present study aims to emphasize the importance of using already existing legal, institutional and public awareness resources under the local, national and international governance in order to enable a rehabilitation of the habitats and communities in the Caspian Sea.

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19. This paper is based on the result of GIWA assessment in the subregion 23 – Caspian Sea carried out by the international multidisciplinary expert team. For the list of experts and full text of assessment see GIWA website where the report will be published after peer review and Core Team approval. Authors also would like to acknowledge significant help in proof reading, language editing and illustration of the paper provided by the GIWA Core Team.

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