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Environmental and social impacts of management approaches in Sevastopol Bay in a historic retrospective: a case study from the Black Sea

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Abstract

The article is aimed at discussion and comparison of ecosystems succession and landscapes transformation through influences of management approaches that were applied in the Sevastopol Bay Region (SBR), by several cultural traditions of different civilisations governing the territory in various times till present. These management consequences and possible solutions for the implementation of the sustainability principle in the development of the territory as civil and economically independent one, aimed at achieving non-destructive long-lasting anthropogenic transformations in coastal environments, were paid special attention. The article is focused on comparison of consequences of different models of management applied in SBR in various times. In this article is also a proposed list of helpful actions to be applied here. Also given is a description of an early industrial society management model with analysis of its difference from the late industrial society coastal zone management model, now commonly used all over the world as a method for obtaining sustainability in coastal zone. These societies have principally different structure of investments, sources of economical growth and social priorities not speaking about their public opinions. Principal differences in management models real for early and late periods of industrialisation are analysed taking into account that in general nature/environmental management could be effective only in democratic societies, but the set of management methods in these two cases must be principally different. The difference between these two options is mainly the difference in their social priorities and is treated as a key point for development of management strategies for certain regions/ecosystems to be effective and not only to declare some conservation/recovery efforts to perform. In other words coastal management is shown to be an extremely “socially sensitive” field of applied science, especially in developing societies. Creation and importance

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of special educational programmes/bodies for the implementation of management efforts and increasing of public and governmental awareness, is discussed. © 2000 Elsevier Science Ltd. All rights reserved.

1. Introduction

Coastal zone all over the world is the most favourable territory to settle for all peoples and cultures in all times suffers greatly from human activity performed in various directions. Fishery and agriculture destroying coastal ecosystems (terrestrial and aquatic); transport directly damaging most valuable components of ecosystems; defence causing huge land engineering projects; creation of “superpowers” with obligatorily constructed coastal megacities as their capitals could be mentioned among the most harmful ones. These last ones are already able to transform environments not only in their nearest territories but also — in entire countries, as they are the sources of imperial ambitions for humans and need all resources of the country to support imperial type of activity in these megacities. Decline of these imperial civilisations appears unavoidable as well as extensive decline of ecosystems after such management approach implementation as well. USA, USSR and Russia (in 18–19th centuries); ancient Egypt, Greece, Rome and Carthage; medieval Bisantium and Ottoman Porta are perfect examples of the imperial tradition of having global objectives and with the destruction of massive ecosystems and landscapes on the territories of their empires. Earlier this nature decline was the source of imperial decline visible as “bad luck” in some military campaign, but essentially being the loss of resource base for performance of former imperial politics. Now after huge energetic subsidy that technology may offer empires or may try to be more stable but nature destruction on such territories nevertheless is not less. To compare imperial and non imperial territories with late industrial societies theoretically capable of managing properly their environments, one may compare USA and Scandinavia to see the difference between nature conservation approaches and the results of their implementation being performed on these territories. Countries without imperial goals may invest necessary funds in nature conservation and recovery — as Scandinavian countries do; on the contrary, imperial late industrial society spends a lot in other fields with corresponding nature decline (both coasts of USA could be hardly called “parts of ecosystems”). Certainly “pre-industrial” and “early industrial” societies cannot be directly compared with “late industrial” in nature conservation/management from the point of view of public awareness, social priorities and economical resources available.

2. General considerations about various “management models” applied by different social structures and cultural traditions: importance of social priorities

All models of management applied by various peoples in various times had certain approaches to coastal environments conservation – more or less effective and based

on knowledge or beliefs. Anyway environmental changes in coastal zone caused by human activity in any times were always visible and were always analysed in certain degree. From our point of view cultural tradition is one of the *important factors* to influence nature conservation in general, to treat nature as a part of society or to look at it from outside as on “natural resource” to use. It is possible to suppose that not science can cause proper coastal zone management models application *in any society*, but on the contrary, cultural tradition and social priorities can cause certain scientific efforts to be brought into life.

This is the reason of our decision to figure out three main groups of models of management after their social origin and the system of social priorities bringing them into life (Fig. 1). These social priorities also could be mentioned among main reasons of ICZM-related conflict resolution methods choice in developed, developing and countries in transition economics [1]. Majorities of known classifications take into account mainly financial resources available in societies with various economical levels but *not their social priorities* and it seems after these classifications that all societies are looking for the same objectives. In reality it’s not a fact that all cultures/countries implementing them look for the same social/economical objectives, which rich country obligatory will invest enough in ICZM and, vice versa, that poor, developing country will do nothing in the field. Groups of models of management mentioned above were selected on the base of different social priorities in various societies, which were not only on different economical position, but also they had various cultural traditions. In other words, models of management depend on periods of modernisation of society.

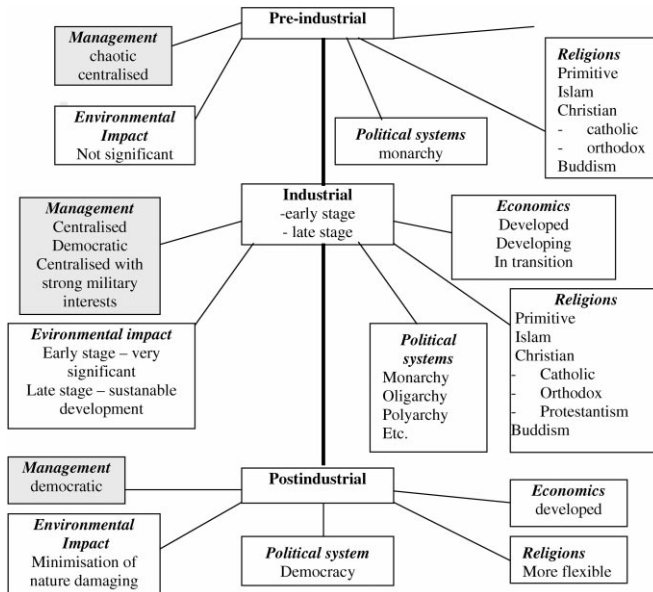


Fig. 1. Periods of modernisation in society and their characteristics.

The first stage of modernisation of society, pre-industrial, started about 10,000 BC in the time of Neolithic revolution, when people began to cultivate plants and domestic animals. This period was very prolonged in history and could be divided on several stages, the most interesting of them was the late stage of pre-industrial period. This stage characterised by primitive economics because Neolithic civilisation had a very limited technical base. About this time all main types of religion specifically Islam, Christian (catholic and orthodox) and Buddhism existed, primitive religion was also presented. The main type of political system was monarchy. Environmental impact of human activity in general and in coastal zone particularly due to low development of manufactures was not significant. Moreover, system of taboo and beliefs saved some places (i.e. parts of rivers, forests etc.) untouched. Management in general and management in coastal zones were *chaotic* or in some cases *centralised*. For example, the creating and work of fisheries communities on the north of Russia in Arkhangelsk region were spontaneous, but the founding of new cities was encouraged by the monarchy, for instance it was idea of Russian king Peter Great to found city on the Baltic Sea coast – Sankt Peterburg. Rear – by independent economical efforts – as Venice.

Second period of the modernisation of society was industrial. It is possible to divide it on two stages. The first stage is early industrialisation. This stage can be very prolonged in contrast second stage, late industrialisation, which can be very quick. Many modern countries are passing early stage now, for example China, Russia, Ukraine, Poland, India etc.; some countries, for instance France, USA, Sweden, Denmark, Germany etc., are on the late stage of industrialisation. Industrialisation started in the late 16th–early 17th century, after industrial revolution in England. It's interesting to notice that there is strong interaction between possibility of such revolution in Europe (not in China, for example, despite on higher level of development of manufactures in this country) and extension of Protestantism in this part of the world. According to the Max Weber [2] this branch of Christian religion broke down the distinction between the church and the world, between the monastery and the marketplace. "Protestantism and specially its puritan variety developed a particular type of character that frugality and hard work". People according to Protestantism supposed to have more individual responsibility. They became more independent from taboo, traditions and beliefs.

The industrial revolution provoked political revolutions in France and America in 18th century. As a result industrial society has different types of political systems, according to Cicin-Sain B. and Knecht R.W. it is possible to count about ten types of political systems in the world [1]. There are monarchy, old oligarchy, new oligarchy, socialist regime, communist regime, semi-competitive system, polyarchy, personalistic military regime, corporate military regime, and socialist military regime. All modern countries have different levels of development of economics because they are on different stages of industrialisation. According to these levels it is possible to determine developed, developing and countries in transitions economics. In this period of modernisation, especially on early stage of industrialisation, impact of human activity on environment could be very significant because of development of industry is on the high level. Negative environmental impact almost without any

attempts performed to estimate its consequences was recently presented in many developed countries, it is presented now in many developing and countries in transition economics. Therefore there is clear tendency in developed and some others countries to fix many problems occur in environment to save it for future generation, realise sustainability as a way of economical life. The words “sustainable development” become more and more popular in these countries. The present period of modernisation is characterised by several types of management in general and in coastal zone as well. They are tightly connected with types of political system, economical and social situation in a country. There are *democratic*, *centralised (totalitoral)*, and *centralised with strong military interests*. Almost all developed countries have democratic type of management, which is characterised by very strong public involvement. Former Soviet Union had totalitoral management. Japan now has centralised management. Developing countries have very interesting position concerning type of management. Most of these countries before comparatively recent time were colonised, many of them till now are under protection of former colonising countries. For this reason they have full or partial copy of type of management of former colonising countries. Moreover developing countries are stimulated by developed countries to do it by some sponsoring programmes aimed at on solving problem of management. According to countries in transition economics, they are just on the way to real democracy. They are trying to involve public in decision-making process, but mentality of people couldn't be changed so soon. People more prefer to be passive observers rather to participate in discussion about some virtual projects. There are several reasons of this. One of them is psychological: people couldn't change their behaviour so fast, especially, when long time before all decisions were made on the top of political power. Another reason is a large amount of financial problems, which are necessary to be solved for surviving. In other words, full democracy is goal for future in these countries.

Some sociologists, for instance Daniel Bell, figured out one more period of modernisation. This is post-industrial society. It seems to be premature to say that this period is started, but some countries, which are on the late industrial stage, came close to point of transition to post-industrialisation. As it is written above every new period of modernisation started after revolution and in our opinion the start point of the beginning of the transition to the new post-industrial period is Information Technology revolution, which is happened in the end of 20th century. Some attributes of post-industrial society are already presented in economics of developed countries. For example they have strong links between science and technology and moving to a service society by expansion of education, health care system, private and public welfare service. Religion over the world became more flexible and it also can be estimated like step to the post-industrialisation. Aim to save environment for future generation, to assess environmental impact of different project will minimise damage of nature that is one of typical mark of post-industrial society. Significant impact on transition to this high type of society extends fact of spreading of democracy among political systems and *democratic* type of management. As a result post-industrial society will have an opportunity to focus attempts at achieving

sustainability due to high level of public awareness and high level of free resources available. Objectives other than nature conservation and welfare increase will be also possible.

Crimea and SBR suffering consequences of imperial politics in full scale, may be perfect examples of deep landscapes/ecosystems artificial transformation with poor chances for recovery under previous and “modern” model of management applied here that could be called “management for myself”. The historic aspect is especially interesting for model of management of SBR elaboration because this aspect is the key-point of understanding reasons and consequences of various models applied here in different times. There was no certain cultural tradition to govern territory for a long time because they’ve changed each other often. This caused also management changes due to changes performed in agriculture and industry, religion and traditional relations with other peoples/states.

We may consider the history of juridical ideas/approaches in various peoples existing in practically equal technological and social environments, but at the same time developing principally different backgrounds for new societies that they have created. Not all societies have such tradition and not the level of incomes per capita is critically important to obtain “environmentally aware public opinion”. A lot of people are not troubled with environmental changes and in coastal zone as well, even if they earn enough. Hotel service level or gas prices, etc. more trouble many of them even if, for example, they are successful in oil export. It is easy to find numerous examples not only in poor developing but also in prosperous developed countries. Why are all these considerations important for SBR management? First of all because it needs to perform some steps to increase public awareness in the problem, to achieve some increase of public interest, political resonance, personal responsibility feeling etc. in order to try to stop destruction of coastal environments in SBR.

It is possible to conclude that ICZM implementation for SBR (as well as for all FSU territories) first of all is social task, then it is political and decision-making, and only finally it is purely scientific problem to perform coastal environment status essay and find proper measures to recover it. As we may suppose a 1000 years is between our social positions in the East and in the West. Any perfect scientific analysis of the region and possible models of management in current social status of society (some examples are discussed below) will be absolutely fruitless and may face social misunderstanding in better case and active rejection in worse (as last thing among social priorities). It is difficult to figure out, what are *sources of social priorities in certain society*. Are they defence objectives or increase of welfare? Obviously social facts of late stage of industrial society and consequent environment conservation/management attempts performed by them are absolutely not acceptable for pre-industrial and early stage of industrial society. It’s so not because of lack funds in these societies but because they generally think with other priorities. They constantly lack in funds because of having these other priorities. FSU countries now widely discussed in the Western media could be perfect examples of strange methods of foreign investments usage, strange export structure, strange privatisation, strange nature management as well.

Discussing models of management in Sevastopol Bay region in historical retrospective it is clear to see that the region have never been managed scientifically as it's common in late industrial stage: with high investments, proper engineering of lands and waters, high public awareness as basis of interest to its recovery. In all previous and modern times pre-industrial models of management or early industrial one were implemented here with various social priorities: from primitive economics to industrial and defence objectives prevailing. Preparing models of management for Sevastopol Bay Region it's reasonable to take into account that late industrial models of management are not acceptable for the region due to the absence of underlying social priorities and only early industrial models of management are acceptable with strong accent toward social aspects.

Models of management for this region have to be focused primarily on *social aspects of management*: as achieving of long term changes in public opinion and its preparation to acceptance of necessary measures to obtain sustainability in socio-economic development which absolutely is not a widely acceptable objective for now.

3. Comparison of the Sevastopol Bay Region coastal management models in various times

3.1. Ancient and medieval period: elemental sustainable development of coastal ecosystems in Crimea (Northern Black Sea coast) by various civilisations; chaotic management

The Black Sea was described in ancient times by Herodotus, 484 – 425 BC; Strabon, 63–19 BC; Ptolemy, 2nd century BC [3]. First Europeans to colonise it were ancient Greeks (around 5th century BC), who were pioneers in building cities (as Bisantium — ancestor of Constantinople; or Herones — at the territory of modern Sevastopol, etc.) and navigation. For centuries the Black Sea was the centre of European politics and economics because Great Silk Road ran across it. Rome and Bosphorus kingdom, Bisantium and Genoa had interests there. After the decline of Bisantium in 1453 and Columbus voyages to America, the entire region became more and more peripheral. New marine ways to India and China shifted the main transport lines outside the Black Sea. New times with the series of Russia–Turkey wars at the end of the 18th century became the turning point for the emerging of modern economical geography and political orientation of the region.

Middle Ages — the period of economic decline for the region without building of cities, roads, industry or serious military conflicts were very comfortable for Crimean ecosystems as a whole and SBR as well. Circumstances were positive for the sustainable development of coastal zone without over-exploitation and depletion of natural resources. In some way regional economic model based on trade and fishery was very effective and stable for thousand years even under constant “rotation” of people governing Crimea. Numerous coastal human civilisations inter-changing each other in Crimea were successful enough to realise the idea of sustainability during centuries with their “respect” toward slowly reanimating desert ecosystems and

landscapes. Even though all these civilisations/societies had a *chaotic* model of management they had a very clear social objective: to survive in Crimea without relying on import of food and raw materials from outside. It is difficult to say the same about civilisation of industrial type “managing” Crimea for the last two centuries.

3.2. Management of Russian monarchy period: ISCZMM — early industrial centralized model of management

Sevastopol was built at the mouth of the Sevastopol Bay as the main Russian Navy base in the region in 1783. Certainly it is difficult to discuss coastal management models applied by various state officials in every totalitarian Russian monarchy. The idea to defend the region from everybody by all available resources of Russia was the background for transformations. In general, the struggle for Crimea in last centuries was the struggle for some state superiority — not for economical benefits. Economical optimisation was not the background for some logical management here. In other words it means that management of all ecosystems in the region had been principally changed at the end of the 18th century from the previously primitive and civil to the “new” military way. Another aspect of this change was that now the regions’ development would not be based any more on inner resources but on huge import from the mainland. New strategy of “dependence” was the beginning of decline of regional ecosystems. It is hardly believable that a democratic regional society could emerge on the basis of this import as majority of the population has connected its success with the mainland — not with Crimea itself.

These changes have been started from practically intact condition of regional ecosystems. That was specially underlined by Russian Navy officers inspecting the territory with the aim to find a place for the main Navy base, who have seen crystal clear water, a lot of fish and even seals. Old pine trees abundance on the coasts around the Bay was among the main arguments to establish the base here (as a background for shipbuilding). All heavily armed, stone forts were built by Russians at the beginning of the 19th century. It was the time of rapid deforestation (forests on the territory of around 15 km² were lost) and heavy artificial succession of coastal ecosystems that greatly damaged marine ecosystems as well. It was one of the reasons for Crimean war of 1854–1855 during which local coastal ecosystems were critically damaged by the enormous concentration of military efforts in a very compact territory: best European armies were involved in action here on a very small territory during approximately a year. The reason for decline of local ecosystems could be also cultural because no scientifically based management could be applied in the 19th century — only a traditional one. Tradition of the north is to cut trees as they easily grow again, but the tradition of the south is to save them because trees in a very dry climate grow slowly. Old forests could not be recovered, as they were relicts of a wetter climate [4]. Correspondingly, marine coastal ecosystems could not be recovered under heavy annual flux of soil and mud from eroding shores. All these signs mark the process of ecosystem’s rapid decline that is not even realised by the

society now under deep new crisis leaving no time to discuss old forests and management approaches. Also nature conservation/coastal management was never among social priorities of the new social structure emerging in Crimea after WW2.

3.3. Venice–Sevastopol: influence of social strategy on landscape engineering and MM (model of management) choice

Any kind of human coastal activity may be characterised as dynamic and influenced by numerous factors able to disturb environments on the one hand and — to destroy artificial structures — on the other hand. Numerous ports/harbours have suffered deep successions due to changes in the water regime, breakwater construction, etc. To be successful coastal zone management must be flexible and be focused on the achievement of long-lasting results at the same time.

Speaking about SBR it is worth comparing the consequences of harbour engineering and corresponding management approaches implemented here with some other case to evaluate probable tendencies: if they are obligatorily negative for any port used for centuries or if there are examples of rather old coastal/shipping/defence industry which was sustainable enough in its environment to survive. Venice lagoon seems to be a perfect case for such comparison. It was intensively used for construction, shipping and defence approximately from the 6th century and its water regime was completely rearranged during centuries to avoid silting by several rivers discharging into the Lagoon. Venice was the first place to realise the idea of mass production of such huge constructions as ships and made it successfully for centuries putting into practice for the first time in the world the conveyer manufacturing at its Arsenal [5]. All this is worth mentioning because for 12 centuries with more or less intensity the Lagoon was very actively used for all possible works performed in harbours and this activity was successfully accompanied with heavy land and water engineering. Difficult to say which has established the basement for these rearrangements was more comprehensive than Soviet science in recent times. Then probably science does not determine the success of MMs applied for ICZM?

Venetian science was troubled with the idea of sustainability for Venice — in contrast with Russian fortification since the 19th century which was troubled only by defence objectives for the distant colony. As a result the last has succeeded in ecosystems destruction in SBR region. Basic differences between MMs applied in Venice and Sevastopol were cultural: Italians could look more widely and Russians could not. Italians were troubled by future threats that could not be felt either immediately, or in the nearest 100–200 yr (slow natural silting of the Lagoon) — approach impossible in the FSU territories even now as our main tradition is: use as much as is available and invest nothing if possible. It may be considered that all other factors in the process towards sustainable development and proper MM elaboration in 2 sites were in favour of SBR. Economical factors were obviously all in favour of SBR, nevertheless it was heavily destroyed in recent 200 yr. In Soviet times unlimited resources were available for SBR development and they were spent in an entirely wrong way, due to false priorities (as concrete breakwater construction in the mouth of the Bay, etc.).

Venetians have protected such an exotic resource as a water regime of entirely of coastal zone of Venice — together with rivers and nearby canals: the background of their economical success. It looks like PACKFISH strategy [6] avoiding tree cuts along rivers to protect not only the very endangered salmonid species but also the entire river ecosystem. PACKFISH looks very modern and Venice looks a little covered by water sometimes but the case really helps to compare new things with their very old analogies. It is worth saying that Venice at last made a mistake by cutting too many trees around in the mountains for the ships, but only creation of new transport routes (the same decline of the Great Silk Road that was also important for Crimea) has led to Venice's decline. It took 12 centuries instead of less than 2 for SBR case and one may perhaps conclude that MMs for the discussed cases have a quality difference of an order of magnitude.

4. Situation for today: environmental consequences of wrong management

4.1. Coastal uses in SBR

On the basis of existing social priorities SBR has or had in recent times the following principal coastal activities: tourism, fishing, shipping, mineral and oil exploitation, military establishments and operations, industrial plants, cables, pipelines and scientific research. SBR has also many upland activities affecting coastal activities such as agriculture, river diversions, construction of human settlements and roads.

Aquaculture is absent at present. Last oyster farm was closed by the end of the 19th century.

Nature conservation is not performed. SBR does not have MPA or other protected areas.

Tourism is dramatically declining. Annually Sevastopol has only around 15,000 foreign tourists. The degree of development of tourism industry could be estimated by this figure because practically only foreign visitors use tourist services in full scale. Now Crimea has not more than 15% of visitors compared to 1989 level [7] (Fig. 2) before the break of USSR. In the Summer of 1998 Crimea had 3.4 millions of

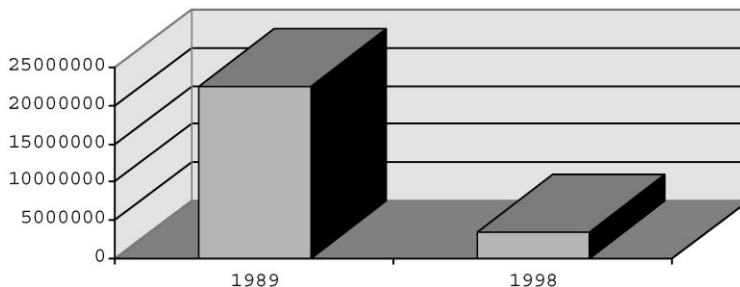


Fig. 2. Tourism: visitors numbers per season decline during the last 10 yr.

visitors, who have delivered around 20 million US dollars of taxes [8]. Sevastopol Bay has one legal and four illegal beaches with a system of relatively low quality service. Crimean coastal zone management problems are connected not only with nature conservation measures, but also with the creation of modern tourist infrastructure that would make recreational visits to Crimean coast profitable. Now a lot of people coming to have vacation underline that prices are very high and service is very low.

Fishing in SBR was based on fishery community activity. This activity was cancelled in 1997 due to financial reasons. Some citizens fish in Sevastopol Bay without any license. According to biological value Sevastopol Bay is still an important spawning site for some fish species. However traditional and industrial fishery that was background for regional economics has decreased. There are several reasons for this but the main reason was the orientation on fishery at Atlantic and Pacific oceans and absence of legal support for fishing in the Black Sea for local fishery community during Soviet times. The Black Sea was estimated as being too small for USSR trawlers. They were built too large and they could not fish in the Black Sea and be profitable. Now these large ocean ships are mainly out of operation as they are too expensive and could only operate under very low oil prices. Turkey had another strategy — supporting of small private fishery business. As a result of applying such a management model in fishery, while Ukraine has a decline of total catches from 1975 (129,000 ton) to 1995 (42,000 ton) Turkey had a huge increase for the same period: from 88,000 to 480,000 tons only in the Black Sea and without fish stocks depletion [9]. According to Zernoffs data [10] SBR had 40 fish species in 1913. In 1990 only 27 species were detected with most valuable species lost. Quality of fish catches has also decreased. According to Schevchenko data [11], a considerable decline of game fish quantity in SBR is observed (Table 1).

Shipping was focused on Navy component during the last 200 yr with recent increase of trawler fleet. Before 1991 Sevastopol Bay had heavy traffic because of Navy ships but present situation is better. Trade port in Sevastopol has several tourist vessels, municipal motorboats and ferries. Shore erosion, sewage discharges, oil spills, litter, etc. connected with Navy activity influence considerably other activities in SBR including fishing and tourism. Recycling plant of old Navy ships could be mentioned among most hazardous and at the same time — less “visible” enterprise in the coastal zone that determines water quality in the mouth of

Table 1

Total catch of game fish inside the Sevastopol Bay (kg) (source: Schevchenko [11])

Year	Mackerel	Mullet	Goat-fish	Flounder	Anchovy
1952	63,679	2186	23,222	86,638	40,483
1953	86,856	30,867	6477	54,306	12,007
1954	34,887	11,360	—	59,760	53,006
1988	1.8	—	1.2	—	—
1989	400	300	300	—	—
1990	50	—	400	—	0.5

Chjornaja river and in considerable part of the Bay. For decades dozens of old and often sunken ships are waiting for recycling polluting the Bay. No systematic observations are performed here. Often ships are processed just in the water — not in dry dock. All these activities are performed because there is no clearly defined property right on the Bay water. Coasts belong to certain owners (some terminals belong to Plants and Navy, etc.), but water inside the Bay belongs to nobody. Just recently — January 1999 — an accident with a ship wreck has lightened up the situation [12]. Cyprus ship “Xenoula” was damaged several metres from the mooring place by an Egyptian ship “Domat” due to the pilot error and had a hole large enough to sink. “Xenoula” had 207 ton of oil and was submerging. If oil penetrated into the Bay, the damage could have reached 66,000,000 \$ [13]. Because Sevastopol Port does not have State Traffic Service [14] and because water inside the Bay belongs to nobody, the accident in the first hours also did not have an “owner”. No service was found to fix it till the Russian Navy in urgent manner saved the ship and the Bay from the ecological disaster of an unprecedented scale. Trade port owns only 30 m of water along mooring lines and does not have such specialized services or equipment to perform necessary rescue operations (as underwater welding, etc.). This chaotic situation remains for now until the next accident.

Oil exploitation fortunately is connected only with transit — not with oil production itself. Nevertheless, SBR has several oil terminals and this increases the risk of accidental or illegal oil spills into the marine environment. Primarily they were constructed for Navy needs. Now the other way for their usage is development of such environmentally hazardous activities such as oil transport from Caucasus — an additional payload for our old railways (crude oil is carried to the city by railway) and the marine environment as well. This results in the death of seabirds due to constant oil spills and in the increase of crude oil hydrocarbon concentrations in seawater and in the bottom sediments that influence pelagic as well as the bottom fauna and fishing grounds.

Military establishments and operations are principal for SBR. Sevastopol is a base for Russian and Ukrainian Navy. Sevastopol was a restricted area till early 1990s, closed for foreigners. This was a problem for civilian traffic and tourism. At present Navy ships are the main sources of sewage, oil spills, litter, etc. in Sevastopol Bay. SBR bears heavy payload of military enterprises that still were not transformed into civil ones or closed: now Sevastopol has four military airfields, huge Navy shipyard, 19 km of mooring line, several military electronics enterprises, etc. They cannot operate as before since defence expenditures decreased several times and offer no possibility to sustain all old infrastructures. Also, they could not be used for civil industry needs in full scale.

Industrial plants are situated in the coastal zone, where they can easily gain access to harbour. It is a well-known fact that water quality, fauna and flora are affected in the vicinity of factories in the coastal zone. These plants discharge large amounts of polluted air and water into the coast. For instance, in 1993 cruise super-liner “United States” that was built in the 1950s with extensive use of asbestos as anti-inflammable matter was repaired on shipyard, one of plants on the coast of the Bay. Asbestos was removed manually without any new technologies applied. During this time very high

level of air pollution was observed. Another good example is oil power plant situated in the top of the Bay. Periodically this power plant discharges a large amount of warm water here that undoubtedly influences flora and fauna.

Cables and pipelines for telecommunications, electricity, water, oil and gas require space on the Sevastopol Bay bed. Cables and pipelines are often embedded in sediment to avoid conflict or damage.

Research performed in SBR is aimed at survey, analysis and monitoring of changes occurring in the environment and estimation of the effects of these changes. But it does not pay any attention to the socio-economic and cultural consequences of environmental changes. Several research institutes provide monitoring of SBR. The purpose of environmental monitoring is to follow fluctuations in the status of environment and human impacts. Environmental monitoring programmes cover the terrestrial and marine environment, seawater and toxic organic pollutants at some sites in the region.

4.2. Interactions among coastal uses in SBR

It is not easy to classify the relationships among coastal users: some of interactions could be harmful for interacting parties and environments, some of them are potentially harmful, mutually beneficial or harmful for one but beneficial for another [15]. SBR does not provide any examples of positive solutions for conflicts (relationships) in coastal zone (Fig. 9). All activity in the Bay was designed without the slightest attention to local ecosystems. Interactions cannot be well identified and we may only estimate some damaging effects: old or modern; more or less visible.

To illustrate the present-day situation, the case of anthropogenic succession in ecosystem of one of the main former centres of coastal defence system of SBR was specially investigated. A comparison of maps was made to detect coastline differences during the last 150 yr due to erosion process (Fig. 3). The site — Northern Suburb of Sevastopol (NSS) — was selected as one poorly covered with later constructions that enables us to discuss long-lasting consequences of native forests destruction. The site now is characterised by massive loss of soil and complete change of original floristic species composition of ecosystem. Former water regimen supplying old pine forests here with artesian water was destroyed by massive construction. Artesian layers were obviously damaged by fortification. Forest ecosystem consisting of mainly pines (*Pinus pallasiana*), now looks completely deserted with small spots of artificial park (*Spartium junceum* L., *Elaeagnus* sp., etc.). As a result, highlands now became very dry with no possibility of introducing *Pinus pallasiana* again. Sevastopol region coastal forest ecosystems, originating from a very dry climate, were traditionally exploited in the same way as the very wet climate of Russian north with a high self-recovery rate of forests.

Main Fort of NSS, which according to 19th-century maps, was situated in the centre of the coastal hill — is now situated practically on the coast (Fig. 4). Even relatively new concrete constructions around 50 yr old that were dug inside the nearby hills just before WW 2, now are naked by erosion in several places. The specifics here is that in the north, Sevastopol Bay is separated from the sea by

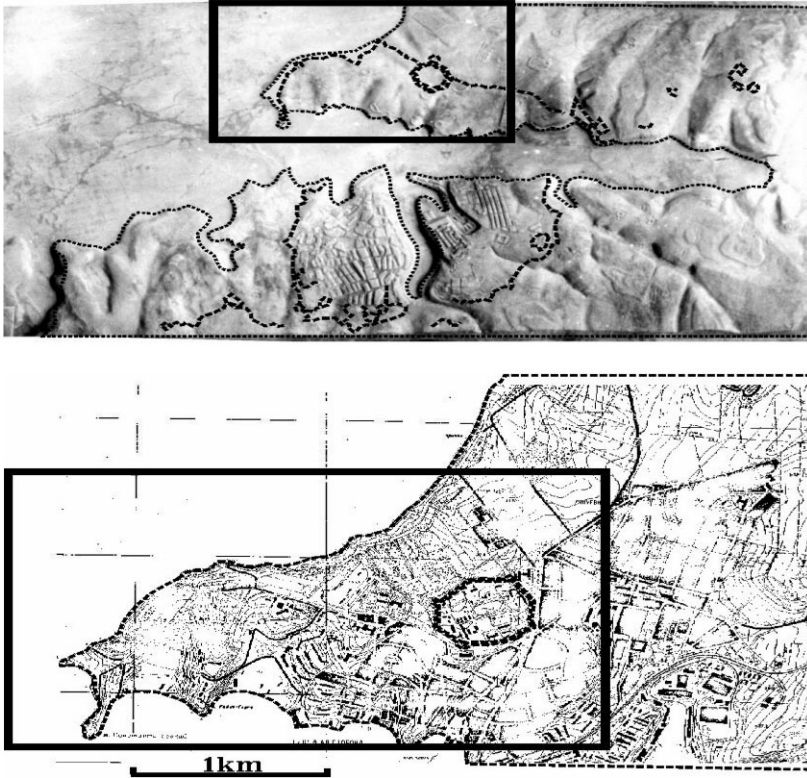


Fig. 3. Comparison of two maps that were issued in 1850 and in 1980; coastal zone erosion happened during last 150 yr in Northern Suburb of Sevastopol (NSS) is italicized. NSS fort is situated in the centre. In addition to central fort made of stone, long walls made of soil were also constructed. They had the length around 10 km, defended the town from the north as a whole defence stripe and their construction was most harmful for landscapes and ecosystems as they caused most massive soil removal/destruction. It's easy to imagine what huge amounts of soil were necessary to move to make these preparations.

relatively narrow land stripe consisting of soft soil hills. After deforestation of the early 19th century, the SBR outer shoreline facing open sea was changed significantly in comparison with its inner shoreline, as storm pressure is rather strong outside the Bay and naked shores were not able to withstand it. Main erosion is observed here. Shore and coastal ecosystems are practically not preserved or covered by special constructions.

Juridical defence is also weak. Landscape erosion is a problem for all Ukraine that loses approx. 30–200 ha of land in coastal zone annually. In SBR [16], Sevastopol coast land loss is approx. 0.3–0.8 m every year. The concept of development of Sevastopol does not have a paragraph about coastal erosion.

Urgent management measures are needed for optimisation of freshwater ecosystems and for creation of stable forests capable of supporting themselves

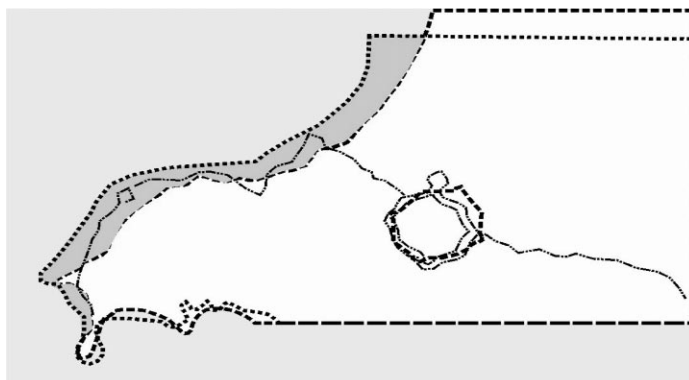


Fig. 4. Computer apposition of two maps that were issued in 1850 and in 1980. It's clearly seen that the fort at the entrance of the Bay (Konstantin Fort) was built on artificial island that's already is not visible now as manmade structure after around 150 yr during which changed water currents have moved unpredictable amounts of soil around this island and formed new shore line in most critical part of the Bay that principally influences water circulation and hence – water quality inside it. Now it already looks like natural peninsula as artificial dam of 19th century does not look straight enough due to erosion.

independently and — to be a basis for recovery of native forests. This would enable the protection of endangered species and biodiversity in coastal region and nearby national parks with low financial expenditures and create stable water supply.

Coastal erosion and landscapes destruction are not only a threat for local biodiversity, environmental and life quality and tourist industry potential, but also the reason for water supply disorders in most densely populated regions of Crimea, SBR not being an exception. Crimea and SBR have heavy annual droughts. In order to resolve the problem of freshwater in general, channels to carry the Dneper river water to Crimea were constructed. This water has high level of pollution (heavy metals and radioactive pollution as well) and the region must pay for it. At the same time, regional freshwater basins are not managed at all. During wet period of the year main water source of Sevastopol — river Chornaja and its water reservoir lose around 5–7 million cubic metres of excellent quality rain water per day [17]. Total volume of city water reservoir is 64.2 million m³ so daily loss of water in such days can reach a value of around 10% of its total amount. At the same time during cyclic droughts the reservoir loses all its water except “dead” volume (4815 million m³). In these times town has only 90,000 m³ per day that means 1 h per day of water supply.

Sevastopol's daily water expenditure in normal year is around 155–165,000 m³. The city obtains around 170,000 m³ including around 110,000 m³ of imported Dneper river water via Crimean Channel. It costs around 1 million local currency annually. Water leaking from rusty tubes is around one third of total supply. At the same time the city has more than 600 water artesian drills with a total annual production of around 8 million m³. This water is very pure and also much cheaper, but there are no funds to prepare all water drills for regular exploitation. Geological

investigations are not performed in full scale to predict and control the dynamics of water fluxes inside artesian layers. In general, water supply may be listed among the most complicated issues in regional economy. The situation in water supply is critical also because dozens of square km around the town are transformed into orchards with constant need of irrigation to support artificial ecosystems. Approximately 1–2 m³ of water per 10 m² is required to support them during the season. That is one of the main water spending types of activity in SBR and other urban regions of Crimea.

Sewage canalisation problem is not resolved till now because several regions of the city have their wastewater being illegally directed inside not holes or drills in the soil with the possibility to penetrate inside artesian layers. This makes it dangerous to use theoretically pure artesian waters now and for a long perspective. Every day more than 200,000 m³ of canalisation sewage is discharged into Bay [18]. Main polluters — as Russian Navy, are not responsible for loading sewage discharges, oil spills, litter in the Bay. Russia pays Ukraine for the pollution of Sevastopol Bay's water by agreement but Sevastopol municipal structures do not obtain this support. Sometimes to decrease expenditures on construction of communications water and canalisation tubes are placed together inside same trenches. This increases the risk of these waters mixing through rusty holes even under the soil where it is impossible to control mixing. Canalisation system was designed for a maximum of 200,000 population as it was 20 yr ago but not for the twice higher population now. Often wastewater is directed inside the Sevastopol Bay or to nearby shore line without any purification or antibacterial treatment. It is impossible to control these illegal leaks from separate houses or blocks of houses. This makes it problematic to have tourism as a profitable international industry. The region mainly suffers from wrong management ideology in the field of coastal management approaches based on the idea that a dry region must import water from a wet one. Indeed, it seems to be much easier to build one large water channel to bring in the Dneper river water than to take care of numerous little rivers, springs and artesian drills, to support them in operation and to have water self-sustainability and independence. But the last is the only opportunity for Crimea and Sevastopol to have future and stable development for human settlements in the region with the possibility of industrial and agricultural growth, with social and national stability and without painful conflicts in the beginning of the 3rd millennium.

In fact level of pollution is very high in the Sevastopol Bay, but water discharge not only the reason for it. Moreover it is necessary to remember that Sevastopol was for long time exploited like military base and has relatively big port and several oil terminals. In such situation high level of oil pollution exists. The problem with oil pollution became more actual after construction of a couple of new concrete breakwaters inside of the Bay shoreline in middle of 20th century (Fig. 5). Now the entrance to the Bay is more than 3 times narrower than it was two centuries ago. Real water exchange rate was decreased from 495 m³/s before the construction of seawalls to 245 m³/s in present time [19]. Sevastopol Bay bottom oil pollution amount is already estimated approximately to more than 20,000 ton [20] (Tables 2 and 3: Figs. 6–8) [21, 22].



Fig. 5. Konstantin Fort with northern breakwater.

Table 2

Crude oil derivatives concentration in benthic sediments of the Sevastopol Bay (g/100 g) (source: Mironov et al. [21])

1973	1976	1979	1982	1985
0.76 ± 0.16	0.99 ± 0.31	0.75 ± 0.21	1.50 ± 0.46	2.26 ± 0.15

Table 3

Organic matter total concentration in benthic sediments of the Sevastopol Bay (g/100 g) (source: Mironov et al. [21])

1982	1985
5.56 ± 3.39	7.37 ± 5.2

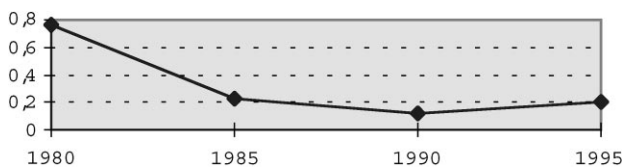


Fig. 6. Mean annual crude oil hydrocarbons concentration in Sevastopol Bay (mg/l): situation is going to be obviously better after early 1980s with decline of Navy activity [22].

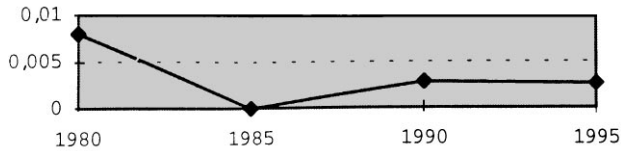


Fig. 7. Mean annual concentration of gamma-hexachlorocyclohexane in the Sevastopol Bay (ng/l): also became lower during the same period [22].

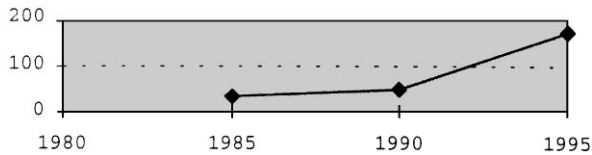


Fig. 8. Mean annual concentration of synthetic surface-active compounds in the Sevastopol Bay: considerable growth was mentioned according to the growth of population under poor water supply and destroyed waste water utilisation systems [22].

4.3. Social aspects

The Crimea and SBR could be ranked among the major disastrous regions of Ukraine. According to official medical statistics [23], Sevastopol has practically the highest cancer mortality in Ukraine. That region which has perfect climate and nice environments now has negative population growth (Fig. 10).

During the last 5 yr the number of people with consumption disease increased 5 times. At present 2000 children in Sevastopol have consumption diseases [24]. Number of people with enteric infection decreased relative to last year due to strong pollution in Sevastopol Bay (Table 4) [25].

The reasons are very low level of quality of life, unemployment, poverty, bad water quality, etc. All these indices indicate nothing if being analysed separately, but brought together they are clear signs of wrong management models applied here for a long time. Territory adapted for military purposes has no prospect for independent development without massive outer investments. Thus traditionally wrong management has also heavy social consequences.

Real nature conservation and recovery measures need serious investments. They are impossible under present total economic crisis. Situation in the entire Black Sea basin (especially, northern coast, Crimea) — zone of environmental disaster — seems a perfect example of absence of real nature conservation and coastal management efforts performed by regional governments because they are mainly busy with current economical problems. MMs used in all new post-Soviet countries is a logical consequence of rejection of centralised management that was shown to be “not effective” together with soviet system. The absence of management of natural resources is a social and economical consequence. That is why it is necessary to prove

Table 4

Quantity of enteric infection data during one week in 1998 and 1999

Data	Quantity of enteric infection case	Quantity of enteric infection case among children below 1 year of age
15.07.1998–22.07.1998	60	1
15.07.1999–22.07.1999	75	4

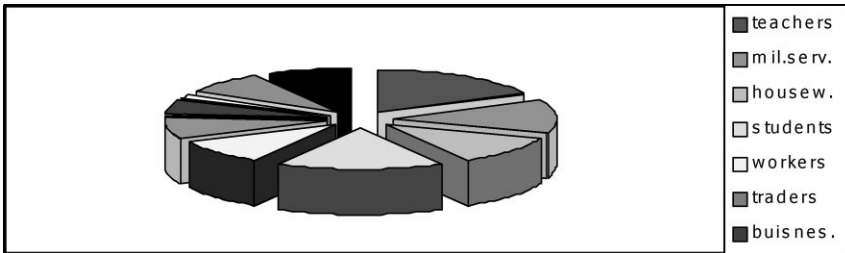


Fig. 11. Social investigation: represented by social groups.

to society that real scientific approach in management is required, i.e. social priorities need to be changed. Not only nature conservation, biodiversity or economical growth would be the objectives, but also tourism, employment and increase of quality of life in general. Society needs to have some background to understand that a modern management approach is the only way to obtain resources and to save money.

Conservation as a part of the economical process could be more effective and could find more support in the region. In 1998 *The Concept of the protection and rehabilitation of the environment of the Azov and the Black Seas* was adopted in Ukraine [26]. Integrated coastal zone management (ICZM) is mentioned in this document but mainly as some state budget initiative. There is no understanding of ICZM as a system of integrated measures performed by society itself — not by some ministries, governments, etc. So it is *necessary to perform broad and democratic educational initiatives with the aim to change public opinion about the problem* — the same changes have happened already in the economical life of new societies.

In the fall of 1998 special social investigation was fulfilled in Sevastopol with the aim to evaluate general level of understanding of coastal management problem. 100 citizens randomly chosen among all social groups of both sexes aged 22–47 were asked (Fig. 11) the following questions:

1. Do you know what is: (a) ecology; (b) biodiversity; (c) coastal zone management?
2. Do you think that our society needs to increase its knowledge in the mentioned fields?
3. What in your region must be the focus of activity of coastal management specialist?

4. Does Sevastopol have problems connected with coastal zone management? If so, then — which ones?

Not taking into account visible mass media activity in touching “ecological” problems of various origins (urgent necessity of nature protection in Ukraine, Chernobyl accident consequences, regional Crimean issues, etc.), 30% of respondents did not know what is ecology and biodiversity. 70% could suppose what is biodiversity only from the word’s construction. Only 1% had heard about ICZM. 100% of respondents were sure that the above-mentioned fields are necessary to be studied and introduced to public opinion as well. 20% did not know what must be the field of activity for coastal zone management person. 70% were sure that it must be only nature conservation issues. 10% thought that it is management and coordination inside city administration. 20% supposed that this person would be connected mainly with juridical aspects of activity in coastal zone.

All respondents were sure that there are some coastal management problems, but 40% could not tell which ones. 20% supposed that main problem was the lack of proper ecological education for children. Lack of juridical base was considered to be coastal management problem for 10%. Wrong natural resources use, environmental pollution as main problems were mentioned by 30%. Management components such as tourism, shipping, ports construction, fishery were missed by everybody, not taking into account that these fields are present in Ukraine and Sevastopol. The lack of coastal management knowledge in society is very logical because we do not have any specialised institutions where this speciality is taught. This field is new for Ukraine and all former USSR territories.

5. Discussion and recommendations

In countries in transition economics usually it’s difficult to focus attempts on conservation of separate endangered species due to lack of specialised institutions, state strategy in nature conservation in general and deep crisis in all spheres of life. Old mechanisms of nature protection were crushed and new ones could not be quickly created. In soviet times coastal zone has never been treated as integrated system to use it for industrial purpose and at the same time to protect it. It were two alternatives and there were no protected areas near or inside ports or harbours; especially in such military exploited area as SBR, where all human activities were determined by Navy base regimen. Under this tradition water pollution, coastal forests and soils decline were not treated as dangerous in comparison with “benefits” of achieving certain defence objectives. Heavy constructions performed in the region during last two centuries have badly damaged entire coastal ecosystem with no possibility to reanimate it, as it was relict of former climate. Close changes have occurred in all regions of Crimea after extensive forest cuts, introduction of new land property laws and water sources rearrangement for needs of water supply for growing urban population. All these measures performance were marks of wrong management ideology implementation in Crimea, where majority of nature

protection problems of present time are connected with transfer of “wet” type management to very “dry” region. Meanwhile it’s possible at least to stop rapidly declining landscapes from complete destruction, if to apply modern management models just now.

Usually industrial growth and environmental management (certain prohibitions or corresponding investments) are treated as not related objectives, but they could be reached more effectively in unity, under whole models of management than separately, as mutually conflicting ones (as it happens now). The lack of modern management in the region is the consequence of the cultural crisis of new societies emerging on the territories of the former USSR. These societies lack the possibility to trust scientific approaches applied to resolving of environmental and industrial challenges of new times and need effective measures in coastal zone ecosystems and endangered species conservation to be fulfilled. Conservation of coastal zone ecosystems instead of conservation of endangered sites and species could be successful methodology first of all for developing countries that usually does not have enough resources to spent if they are not invested in profitable business. One of the main methods to connect scientific knowledge and social demands are proper educational programmes to be established, as well as juridical base creation and proper investment politics. This complex of measures will be able to shift social priorities in the direction of acceptance of certain efforts for ICZM performance.

Unlike late industrial societies Ukraine does not have democratic element in resolution of problems connected with coastal zone management. Management projects are not discussed with community. Environmental impact assessment is almost absent before projects performance. Information is not inserted in local newspapers before decision of projects, but only after some period of projects fulfillment, when it’s not easy to stop or rearrange them. Now economic activity is generally treated as non-governmental, democratic field. Democracy and individual responsibility in business are already adopted as synonymous ideas. The same changes must occur in coastal management and all nature conservation approaches. To be effective in local circumstances models of management have to be more focused on regional needs (not metropolitan) and must be based on regional human and natural resources (not on massive import). For Crimean coastal zone it means development of tourism and fishery, transport and modern agriculture, service and small business as a basis of mass employment – not military heavy industry and urbanisation as earlier because these last ones mean *dependence* from some central structures. These “economical” components could be called by any models of management for destroyed coastal zone. For industrial society of post FSU new democratic country as Ukraine suffering long series of various crises economical growth is hardly reachable due to poor economical status. Significant corrections have to be made in “social” component of models of management. Probably they are not necessary in late industrial society, but we suppose it worth doing for SBR case. Following steps are proposed as necessary components for MM of SBR:

1. It is necessary to create of regional Committee on complex management of coastal zone.

2. Environmental Impact Assessment performance for ICZM related projects, industrial, agricultural, municipal activities in coastal zone. EIA is a fairly new tool in Ukrainian environmental policy and need special legislation to be adopted at national and regional levels.
3. Educational programmes for population with the aim to increase public awareness and create new social priorities with emphasis on life quality increase.
4. Focus groups creation.
5. Public opinion essays; creation of sociological institution focus on the work with public opinion in nature management field with the focus on coastal zone management. Public opinion increase toward ICZM problems.
6. Public discussion of new initiatives performed in coastal zone; creation of specialised municipal and NGO bodies and services.

Discussing former periods models of management it's difficult to figure out possible measures to fix at least most critical problems as there are too much ones and also because mainly these solutions are rather expensive to be brought into life. Obviously necessary measures focused on coastal construction to prevent erosion and regional water sources rearrangement, to obtain stable water supply, industrial modernisation and educational level increase. It is hardly believably in majority of population to be realised in nearest years as now society loses technology very rapidly here and hence there are no possibilities to find funds for development or innovations. Crimea practically does not have natural resources to sell instead of technology to obtain hard currency, but it seems that there are some steps that could be easily done at political level with very low expenditures and that are very promising from point of view of biodiversity conservation. Biodiversity is critically important to be saved as a basis for future ecosystems recovery and also for tourist industry growth. Crimea as an island type territory has very high level of flora/fauna endemism and it's necessary to start real nature conservation efforts just now. Among them such measures as recovery plans preparation for most critical species/populations, proper juridical base at regional and state levels elaboration, monitoring of coastal ecosystems and creation of new NGO structures with environmental management as their main field of activity could be pointed out among most urgent. The region and all Ukraine as well has rather high scientific potential to be used for resolving of these problems.

From our point of view in parallel with changing of state economic policy, most strict monetary methods must be applied to endangered Crimean ecosystems as a whole, coastal one not being an exception. It means that all lands, especially in coastal zone remaining in government or communal property must be the subject of international tender for management models aimed at creation of National Park or integrated management zones regimen on these territories to facilitate the legal money source for their management. Certainly the fields of financial activity must be outlined (not wild forestry or fishery as now, but piloted international ecotourism) and controlled by the central government (probably – some Board with annual coincidental rotation of 50% of its members) with appropriate set of laws – not by regional groups. Modern management methods and economical models use could

resolve the problem of Crimean (the Black Sea) coastal zone ecosystems integrated management implementation and conservation under the pressure of heavy crisis.

6. Conclusions

Sevastopol Bay is managed by local municipality and Navy without integrated approach and without involving public authority. Various societies traditionally have different attitude to science in general: from accepting science as a part of itself, to using it as a tool to support the state. Correspondingly, applications of scientific approaches are influenced culturally. Western society accepts ecological studies to be a subject and eastern society rejects technology because technology is associated with accidents. After the decline of communist system which was piloted technocratically and failed, the majority of people here do not accept scientific method in general because it was already used earlier and did not show itself effective. Now popular ideology is variously religious and this is understandable. So we need educational programmes to show that these scientific methods in coastal management could be and are effective and that they could be realised by new non-governmental structures in Crimea. New crisis of recent time in post-Soviet territories is called “the crisis of trust”. The same crisis is active in science because science has never shown itself to be useful to people here. If we hope to change the situation in understanding of ICZM as the only tool to create sustainable regime of development of human–nature interaction in Crimea, we must change public opinion in the direction of accepting scientifically based arguments for creation of friendly environment and acceptable life quality. The multi-system crisis of the Black Sea coastal zones is the crisis of trust and attitude toward scientific knowledge that is traditional to our society. Special independent educational programmes are urgently needed to help change the situation positively.

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