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NATURAL POTENTIAL OF MARITIME ECONOMY: ESSENTIAL FEATURES AND VALUATION

ПРИРОДНИЙ ПОТЕНЦІАЛ ЕКОНОМІКИ МОРЯ: СУТНІСТЬ ТА ВИМІРЮВАННЯ

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Abstract. The growth of unsatisfied needs and gradual decline of natural resources on the continents will inevitably lead the mankind to the coasts of the World Ocean with its natural potential being enormous up to the present day. That is why the author has systematized and described the essence of its key elements: natural conditions and natural resources. Consequences of the careful use of natural resources as part of the state policy are revealed. Favorable natural conditions for the development of the maritime economy in Ukraine are highlighted. Top-priority measures to be taken to achieve this goal are outlined. Furthermore, there is a detailed review of the approaches and methods for the valuation of the marine natural potential, namely, the cost method, successful efforts method, rental method, rates and norms method, and lost profit method. The paper also demonstrates the areas of their application and limitations to their use.

Keywords: maritime economy; natural potential; natural potential structure; natural conditions; natural resources; maritime country; natural potential of Ukraine; valuation of natural potential.

Аннотация. Рост неудовлетворённых потребностей и постепенное оскудевание ресурсов на континентах неизбежно приведёт человечество к побережью Мирового океана с его всё ещё огромным природным потенциалом. По этой причине систематизированы его ключевые элементы: природные условия и природные ресурсы. Раскрыта их сущность и последствия для стран, возведших рачительное использование природного потенциала в ранг государственной политики. Подчёркнуто наличие благоприятных природных условий для развития экономики моря в Украине. Намечены первоочередные меры, которые должны быть приняты в контексте достижения этой цели. Приведен детальный обзор подходов и методов стоимостной оценки морского природного потенциала: затратный, результативный, рентный, на базе такс и нормативов, оценки упущенной выгоды. Отмечены области их применения, достоинства и ограничения использования.

Ключевые слова: экономика моря; природный потенциал; структура природного потенциала; природные условия; природные ресурсы; морские державы; природный потенциал Украины; оценка природного потенциала.

Анотація. Зростання незадоволених потреб і поступове зубожіння ресурсів на континентах, неминуче приведе людство до узбережжя Світового океану з його все ще величезним природним потенціалом. З цієї причини систематизовані його ключові елементи: природні умови та природні ресурси. Розкрито їх сутність і наслідки для країн, які звели дбайливе використання природного потенціалу до рангу державної політики. Підкреслено наявність сприятливих природних умов для розвитку економіки моря в Україні. Окреслено першочергові заходи, які мають бути вжиті в контексті досягнення цієї мети. Наведено детальний огляд підходів і методів вартісної оцінки морського природного потенціалу: витратний, результативний, рентний, на базі такс і нормативів, оцінювання упущеної вигоди. Відзначено сфери їх застосування, переваги та обмеження щодо використання.

Ключові слова: економіка моря; природний потенціал; структура природного потенціалу; природні умови; природні ресурси; морські держави; природний потенціал України; оцінка природного потенціалу.

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Components of the natural potential

If follows from everything we know about the World Ocean that it is a vast and, most importantly, the last existing sound combination of the natural conditions and resources that affect the economic reality and are applied (or can be applied) in the production of material values that serve human needs. The indivisible integrity of natural conditions and natural resources forms the content of the notion of the natural potential of maritime economy (Fig. 1).

The first component is natural conditions. They include physical objects and natural forces which affect the maritime economic activity and therefore are crucial for consideration in the process of decision making by those involved in this activity. Favorable natural conditions facilitate economic development; conversely, the unfavorable ones hinder it. For example, the very availability of the World Ocean creates an objective prerequisite for the initiation of businesses which are otherwise basically impossible: marine tourism, fishing (industrial and recreational), offshore oil and gas extraction, shipbuilding and navigation, as well as mariculture. According to the National Oceanic and Atmospheric Administration (USA), the latter has maintained an annual growth rate of 5.8% since 2005, making it the world's fastest growing sector of food industry [1]. However, there are countries that have no sea coasts (for instance, Serbia, Slovakia, and many more).

At the same time, we should do justice to the ingenuity of the governments of some landlocked states. Say, Mongolia has been a newsmaker for a while. Less than two years ago, a liquefied gas carrier under the Mongolian flag was reported to arrive at the port of Kerch, disregarding the US and EU sanctions. As it turned out, the country of seeming cattle breeders established an international maritime register in 2003 and welcomed ships owners, who presently make up a list of 2500 and counting. The entrepreneurs find the annual contribution of 100-3000 dollars more than attractive [2].

It is noteworthy that the long coastline relatively reduces the price of imports and exports, as it moderates the share of marketing logistics in the cost of goods. There are numerous examples of a skillful use of this obvious advantage all over the world, particularly, in the European Union.

Namely, Hamburg, one of the EU's most famous cities that is located in the northern Germany, faithfully preserves and intensively develops the time-honoured maritime traditions that shape its identity and constitute the foundation of the local community's well-being. The port is a powerful driving force and the center of attraction of its revenues. And it cannot be any other way, since almost half of the Germany's exported and imported goods pass through the port. Yet, the business activity is not limited to this option. German developers of ocean and offshore equipment, seafarers, fishermen, and shipbuilders have faced the consequences of the aggravated competition in the world market: Japan, South Korea and China have taken a major share in shipyard backlogs of orders. Not that long ago, there was no doubt

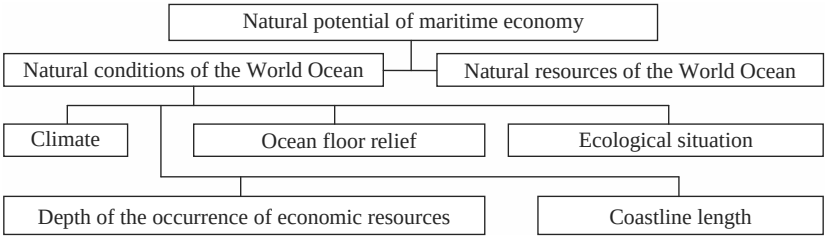

Fig. 1. Natural potential structure

that German specialists occupied a superior position in the segment of cruise liners, large luxury yachts, Ro-Ro ferries[1], container, product, gas, and chemical carriers, patrol, search, and research vessels, and tugs. However, they do not lose their typical self-control. Strengthening their positions in the well-developed segments of the market, Germans have found new niches in the production of offshore wind farms, environmental response vessels and production platforms, offering services for their repair and modernization as well.

The economy of Norway is closely related to the sea as well. Not surprisingly, the major type of cargo transport in this Scandinavian country is its vessels. More than 90% of the merchant fleet's tonnage is engaged in international transportation. Large gas deposits have been explored and are being developed in the North, Norwegian and Barents Seas. In the structure of exports, a substantial share is made up of shipyard products, oil extracted on the continental shelf, oil products, fish, and fish delicacies.

Maritime economy has long become a powerful engine for the development of the People's Republic of China. Coastal provinces, home to 40% of the country's population, occupy 14% of its territory. Numerous enterprises engaged in maritime economic activities employ 36 million people (34.2 million in 2011 [3]). The value of goods produced in 2016 exceeds 0.4 trillion U.S. dollars, which is 60% of the regional gross domestic product [4].

China possesses a huge sea transportation potential: two dozen ports equipped with advanced technology annually process 100 million tons of cargo; 90% of foreign trade is sea-based. Yet, there are new frontiers ahead. As reported by the Deputy Head of the PRC's State Oceanic Administration (now that is a scale!), the government plans to create 10-20 exemplary maritime economy development zones by 2020 [5].

In our opinion, even the above is enough to draw a conclusion that one has plenty of profit opportunities when it comes to sea access; if not, more examples can be provided from the maritime economic activity of Japan, Australia, the UK, South Korea, the Netherlands, and Vietnam. The latter is only a small Southeast Asian country, but it managed to rank fifth in the world by the gross tonnage of constructed ships, leaving even the Russian Federation behind. With that fact in mind, it sounds peculiar that hundreds of Vietnamese specialists were working for the former Kherson Shipbuilding Production Association not a long time ago; the experience they had accumulated turned out to be quite useful.

The factors that set up favorable natural conditions for the development of maritime economy in Ukraine include its extremely advantageous geographical location, sea border length, and water body area. There are about 100000 km2 of the Azov-Black Sea basin under the state's jurisdiction, of which 27000 km2 are internal waters. The economic activity conducted there makes a significant contribution to the economy of Ukraine. In the meantime, the territorial waters accommodate trunk lines connecting domestic and foreign commodity producers to world markets, since each line is a part of the global transport system.

The exclusive economic zone covers 72648 km². The Black and Azov Sea coast line is diverse and extensive; it stretches across 2782 km. By this indicator, Ukraine is inferior to the United States, China, and France, while outdoing Germany, Poland, and even more so the Netherlands (see Table 1).

Table 1. Coastline length (CLL) of some countries, km [6]

Countries	USA	China	France	Germany	Poland	Netherlands
CLL	19924	14500	4668	2389	491	451

Thus, it is fair to claim that "size does not matter"; it is reasonable judgement, knowledge, skills, and the aspiration to do good (instead of tirelessly complaining about issues and "catastrophes") that are truly important. Besides, there is a direct interrelation between the development of maritime economy and the country's well-being.

The second component of the natural potential of maritime economy is the natural resources of marine areas [7]. These are the physical objects and forces of nature which are involved in the material production and service provision at a given level of technological development. The cumulative productivity of natural resources is rendered through their use value in monetary or physical units of measurement (tons, cubic meters).

The great legacy of today's and future generations of Ukrainians is the abundance and biological diversity of the Black and Azov Seas. Their ecosystems are still characterized with a remarkable diversity of species, including commercial fish, invertebrates and algae. This is why maintenance of their well-being at a proper level and rational management of marine resources not only affect the residents of coastal areas (the Odessa, Mykolaiv, Kherson, Zaporizhzhia, and Donetsk regions, the

[1]The ferries are mainly intended for the transportation of wheeled vehicles capable of rolling onto and off the board along a loading ramp (in particular, cars and trucks, train cars, trailers, semi-trailers, special equipment). Surely, passengers are also allowed on board. This is quite convenient for the archipelago residents who need to travel to the continent or neighboring islands on business or personal matters.

Autonomous Republic of Crimea), but have also acquired a truly national scale[2].

Such a context makes a case for the relevancy of technical retrofitting of fish processing enterprises, which would be able to compete with numerous foreign fish product suppliers in the domestic market and then challenge them in international markets. For this to happen, it is crucial to focus on improving the product quality, making the product range more diverse, and increasing the production output. By the way, this is a problem to be shared by business and the state, which is bound to create favorable tax and credit conditions in order to encourage and increase respective investment.

Ukraine cannot apparently do without its own fishing fleet, and a balanced policy in this regard should include several aspects.

First, the fishing vessels in service (and they have been for a long time) are to be repaired and upgraded. These operations can be provided by the Yuzhnaya Shiprepairing Company, which is located in Mykolaiv. It has its own workshops, a machine park, advanced high-capacity and high-precision lifting and handling, plasma cutting, and welding equipment, test benches, as well as a large depository of shipboard equipment.

There is plenty of work for this company and the like, and it would take years to get through. According to the State Agency for Fisheries, the official Vessel Register of Ukraine as of the end of 2016 contains 5035 small-sized fishing vessels (6-12 m), of which 2063 are in the Azov and Black Seas, 110 low-tonnage vessels (12-45 m), and 236 large-tonnage fishing vessels (more than 45 m) [9].

The second aspect is the construction of new vessels, including high-speed watercrafts (boats and jet skis) for the fishery protection police. Here, public-private partnership could be quite useful, since shipyards have not received a single construction order since Ukraine became independent. Our fishermen have been short of money, and public officers at all levels settle for the fish ordered in restaurants.

There is a fine line between natural conditions and natural resources. At a closer look, seas and oceans are the condition for maritime transportation of goods and passengers and construction of offshore hydropower facilities. At the same time, seawater is the object of desalination for domestic, agricultural and industrial applications; it is also processed to extract dissolved minerals. For this reason, let us agree on mainly using the notion of "resources" in the further discussion.

[2]Given the stable reproduction and rational use of fish stocks in the Azov and Black Seas, it is possible to bring the annual fish and seafood capture in these bodies of water to 160000 tons [8, p. 99].

Characteristics of the elements of the natural resource potential are presented in appropriate cadastres, which are systematized records of economic, ecological, organizational and technical information. Collectively, they describe the quantity and quality of natural resources, as well as the types of their users. For example, the state water cadastre [10] contains information on the surface, underground, inland sea waters and the territorial sea, on the scope, condition, quality and use of the waters (water bodies), on water users, and on waterworks facilities. The latter provide for surface and ground water regulation and accumulation, collection and transportation, purification and use, as well as sewage treatment and discharge.

From time to time, the cadastres are updated, with information being added or defined more accurately based on the results of operation of the system developed for observation of a particular natural object. Table 2 sheds light on the cadastres which have been developed and are implemented in Ukraine.

Economic valuation of the natural potential

In the context of the country's resurgence, creation of new jobs in coastal areas and improvement of people's well-being, the natural potential of maritime economy may and will remain an undeveloped opportunity and a futile expectation if left without meaningful attention and reasonable care. They should be manifested at several levels:

1) establishment of the institutional regulation mechanisms that would streamline the activities of the Cabinet of Ministers, other executive bodies of nationwide and local authority, as well as business entities, encouraging social responsibility of the latter;

2) comprehensive planning, which encompasses the ecological, economic and social aspects of maritime economic activities and provides for implementation of business projects and processes that increase the wealth of the state and its citizens while preserving ecosystems;

3) intensification and enhancement of the effectiveness of fundamental and applied scientific research, implementation of the findings and recommendations in maritime economic technology, organization of production, transport infrastructure, and decision making, including that related to public support for innovation;

4) involvement of competent representatives and stakeholder groups of the civil society in the discussion on important issues of the revival of maritime economy.

Each level cannot do without economic valuation of the natural potential. It is basically the qualitative and quantitative description of natural conditions and resources which renders their value [12], significance, and utility for public entities (individuals, groups of individuals, local communities, whole country). Economic

Table 2. State cadastres of Ukraine

Name	Laws and regulations that govern the cadastre
Land cadastre	The Land Code of Ukraine, the Law of Ukraine "On the State Land Cadastre", the Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for Maintaining the State Land Cadastre", the Order of the Ministry of Agrarian Policy and Food of Ukraine "On Approval of the Procedure for Administering the State Land Cadastre"
Forest cadastre	The Forest Code of Ukraine, the Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for Maintaining the State Forest Cadastre and Forest Inventory", the Order of the State Forestry Committee of Ukraine "On Approval of the Instruction on the Procedure for Maintaining the State Forest Cadastre and Primary Forest Inventory"
Fauna cadastre. Cadastre of the territories and objects of the nature reserve fund. Cadastre of medical resources. Flora cadastre. Cadastre of the natural resort areas. Cadastre of mineral deposits and manifestations.	
Water cadastre	The Water Code of Ukraine, the Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for Maintaining the State Water Cadastre" [11]

valuation has several functions: accounting, comparative, and motivational.

The first function, accounting, provides a quantitative and qualitative description of the natural resources that are part of the national wealth of any country. Together with the accumulated production, non-production and human capital, the natural potential defines the prospects for the country's economy. Yet, it should be kept in mind that economic growth (indicated by gross national product, gross domestic product, and its share per capita) often entails environmental degradation [13]. In turn, implementation of the accounting function paves the way for controlling the gains and losses of natural conditions and resources, identifying the relationship between the intensity of maritime economic activities and the pressure they exert on the natural capital.

As shown by the analysis, there are two types of accounting estimates that have been put into practice. The first type is estimation of physical volumes, areas, and dimensions (water areas, mineral reserves, or marine habitats). The second is monetary estimation of the current and projected ecosystem services[3]. There are several groups of ecosystem services:

provision services. In this case, these regard the resources produced from the World Ocean (fish, mollusks, seaweed, and minerals) and the conditions used to obtain certain goods (for example, conversion of current and tidal energy into electricity). All of them have an appropriate market price, and their reserves can be more or less accurately estimated.

regulatory services. These are responsible for the fixation of atmospheric carbon dioxide, oxygen generation, creation of biota-friendly habitats (for example, coral reefs and mangrove forests), natural processing and neutralization of biological waste, ocean currents affecting the weather.

socio-cultural (intangible) services. These are provided to people observing the ocean's greatness and beauty, acquiring new knowledge through ocean research, or taking care of their health in the coastal recreational zones.

auxiliary (supporting) services. These cover everything enabling provision of the services mentioned above, ultimately, the primary productivity of the World Ocean (formation of biomass by phytoplankton through photosynthesis).

Experts estimate the annual total cost of the services rendered by marine and coastal ecosystems at 29.5 trillion dollars [14], which is one and a half times higher than the gross national product of the United States in 2017 (19.3 trillion dollars) [15].

The second function of economic valuation of the natural potential of the World Ocean is comparison of the results of the economic activity involving the use of components of the natural potential. It serves as a basis for choosing the best possible scenario of feasible application of the conditions and resources within a particular region or enterprise location. Like in the previous case, two groups of indicators are implemented.

Natural indicators render the volume of the components of the natural potential and describe their properties (tidal power of the ocean, speed of ocean currents, calorific value of the fuel, breeding performance of certain species of commercial fish, etc.).

Cost indicators develop under the influence of quantitative and (especially) qualitative parameters of marine conditions and resources. They supplement the system of economic estimates with a natural resource component.

The practice of valuation also includes scoring. For instance, the quality of deposits is evaluated with the help of special scales; the highest score of 100 points is assigned to the reference deposit for a particular mineral.

The third function of economic valuation of the natural potential is motivational. On the one hand, it forms the basis of compensation for the losses which the us-

[3]It is about the benefits people receive when using nature's gifts.

ers knowingly or unconsciously inflict on the nature with their activities. On the other hand, it prevents destructive behavior through raising people's awareness of the inescapable punishment for unlawful conduct.

Implementation of these functions of economic valuation of the natural potential of the World Ocean promotes solution of the following problems [16]:

estimation of the cost of natural resources and conditions with the purpose of optimizing the parameters of their use;

calculation of the effectiveness of capital investment in maritime economic activities and the losses stemming from irrational and fragmentary use of the natural potential;

indication of the natural potential in the structure of the national wealth;

calculation of the amount of compensation payments necessitated by the withdrawal or repurposing of natural resources;

calculation of the amount of rent payments for the use of natural resources and their collateral value, including the instances when an enterprise turns to loaning from financial institutions;

management of the use of the natural potential with the purpose of its preservation for future generations. In this context, especially noteworthy are the efforts being made by the international community to coordinate the environmental-economic accounting of natural resources, particularly water. The report "System of Environmental-Economic Accounting for Water Resources" compiled by The Statistics Division of the United Nations Department of Economic and Social Affairs highlights the following:

"Only by integrating information on the economy, hydrology, other natural resources and social aspects can integrated policies be designed in an informed and integrated manner. Policymakers effecting decisions on water need to be aware of the likely consequences of their decisions for the economy. Those determining the development of industries making extensive use of water resources, either as inputs in the production process or as sinks for the discharge of wastewater, need to be aware of the long-term consequences of their policies on water resources and the environment in general. [17]."

The economic theory offers several approaches to valuation of the natural potential [18, 19, 20]. They are systematized in Fig. 2 and rendered in detail further in the article.

The cost method. Natural resources are valuated through calculating the costs of implementing the state policy on maritime economic activity, as well as projects and programs aimed at:

developing and maintaining natural resource management sites and objects in a state when they can provide ecosystem services;

reproducing natural goods (for instance, rare and endangered marine animals or plants) when they become extinct or degraded.

Within this framework, the unit value of the natural resource ($B_{пр}$) is calculated as follows:

$$B_{пр} = B_{О–Э} : O_{пр}, \quad (1)$$

where $B_{О–Э}$ is the expenses for the development and subsequent exploitation of the resource, UAH; $O_{пр}$ is the volume of the resource that has been developed, tons, m^3, kg.

Now, all that remains is to choose the method for calculating the $B_{D–E}$ indicator. For instance, it can be done with the use of the reduced costs formula:

$$B_{О–Э} = C + I \times K_e, \quad (2)$$

where C is the current expenses for the development and exploitation of the natural resource, UAH; I stands for the sum of investments aimed at the development of the natural resource, UAH; K_e is the coefficient of investment efficiency. it is a quantity reciprocal to the return payback period (T). If $T = 5$ years, $K_e = 1 : 5 = 0.2$.

With regard to minerals, the investments will be required to solve the following problems: exploration of deposits, estimation of the amount of resources that it contains, preparation and introduction of the resources to economic activities, provision of environmental safety during extraction, development of an appropriate production infrastructure (capacities for the enrichment of primary raw materials and accumulation of transfer quantities, sanitary conditions for personnel).

In order to ensure the comparability of economic estimates, the indicator of the reduced final expenses ($B^1_{D–E}$)

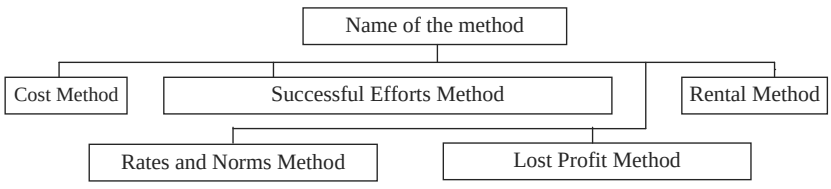

Fig. 2. Methods of economic valuation of the natural potential

is calculated using the following formula with account for the forwarding costs associated with the resource delivery to the location of its end use.

$$B^1_{D-E} = (C + I \times K_e) + B_T, \quad (3)$$

where B_T is the expenses for the resource transportation to the location of its end use, UAH.

Aggravation of environmental problems worldwide and in particular countries obliges to make efforts for the artificial reproduction of natural objects, principally those inhabited by rare and endangered plant and animal species and specially protected areas. Here, the need to estimate the expenses arises once again. The procedure is as follows.

First, one determines the natural level of renewable (for example, fish populations in the Black Sea) and non-renewable (underwater sand deposits at the bottom of coastal waters) resources. This level is regarded as the reference one. Any economic activity will be accompanied by restoration of renewable resources to the previous (reference) quantity, and non-renewable resources in a new quality (compensation without deterioration of the environment). An example of the latter is underwater sand mining by pumping sand-water slurry instead of employing dredges, which destroys the habitat of many species.

Afterwards, one calculates the resource cost as the sum of expenses for its restoration.

Below is the formula for estimating the expenses of restoration of an endangered species (C_r) [21, p. 82]:

$$C_r = (B_n + H_a + O_c) \times T \times (1 + H_n) \times (Ч_ф : Ч_n), \quad (4)$$

where B_n is the current expenses for livestock breeding, UAH; H_a is the fixed assets depreciation rate, UAH/UAH; O_c is the cost of the fixed assets being used, UAH; T is the time required for the livestock to reach its productive condition[4], years; H_n is the rate of return on invested capital, %; $Ч_ф$, $Ч_n$ are respectively the actual and threshold headcount of a species, pcs animals. The threshold headcount is the number of individuals that, having been reached, gives grounds to acknowledge that the species is no longer endangered within a certain range.

There are several cost methods which are referred to as indirect. Next, let us discuss them in detail.

The travel cost method is used to calculate the expenses for visiting a natural object (recreation and health care facilities, each of them being associated with an appropriate quality of the environment). It has been applied for the determination of recreational values of the natural potential. The essence of this method resides in estimation of the costs of visiting a resort region (say, the Dead or Azov Sea), city (Antalya, Hurghada, Lloret de Mar), or even individual zones of a particular natural landscape with a specific purpose (fishing, swimming, diving, water rides, boating, watching dolphins, sharks, whales, etc.). One just has to learn where the visitors come from (for example, using a questionnaire) and employ statistical methods to build a demand curve for the natural object[5]. It will reveal the price the visitors are willing to pay:

$$Ц_П = (T_Н \times Ц_Г) + Ц_Б + Ц_{УП}, \quad (5)$$

where $T_Н$ is the time spent in the hotel, days; $Ц_Г$ is the price of staying in the hotel for one day, UAH; $Ц_Б$ is the price of a two-way ticket, UAH; $Ц_{УП}$ is the price of services and products purchased at the resort, UAH.

The estimated result would indicate whether investments in the development of a certain area are attractive for business. If vacationers have paid a lot of money for the flight, accommodation, and a chance to observe the magnificent landscapes, they are unlikely to scrimp on restaurants, nightclubs, amusement parks and so on. This is the reason why such outlets pop up like mushrooms after a spring rain. The popularity of the recreational zone is growing along with its cost.

Another indirect cost method is the hedonic[6] pricing method. Ecosystem services are valuated on the basis of the analysis of residential property (apartments, houses) prices or rental rates in a particular recreational zone. It is a common knowledge that price (ЦН) is a function of several factors (variables):

$$Ц_Н = f(S_Н, Д_Н, P_Н, E_Н), \quad (6)$$

where $S_Н$ is the variable of property area; $Д_Н$ is the variable of property accessibility (distance from the airport, railway station, public transport stops, as well as open, underground, multi-storey parking lots); $P_Н$ is the variable of the district where the property is located; $E_Н$ is the environmental and emotional variable of the property. It can be a window / balcony view of a meditative seashore or a noisy motorway with heavy traffic, clean or polluted air, immediate proximity to the beach or a forced necessity to go there on foot, by taxi or by public transport, as well as the qualitative state of the shore.

[4]The commodity status is the (state) standard setting the fatness, state of health and appearance of the animals fit to be involved in economic activities

[5]When several types of recreational activities become the research object, individual demand functions and, accordingly, recreational values are established for each of them

[6]Hedonism is a school of thought that argues that pleasure and happiness (in contrast to pain and suffering) are the primary or most important intrinsic goods and the aim of human life. Hedonists insist that one should strive for pleasures, not postponing them for the future.

The advantage of the hedonic pricing method is that its users deal with the data on actual transactions concluded in the real estate market, although it might be difficult to get access to the necessary bits of information.

In all its forms, the approach under consideration is quite simple methodologically, apparent and comprehensible. Yet, there is a single substantial drawback. A natural resource with a location that is relatively more convenient to develop has a lower result of valuation even if its quality is rather high. This discrepancy can be illustrated by the example of oil and gas fields. Subject to treatment via the cost method, those that are closer to the sea surface appear to have a lower value than those located deep under the seafloor.

The Successful Efforts Method. Its proponents believe that value is ascribed only to those resources the use of which brings profit. Several types of this method are distinguished.

According to the first type, the value of the object of natural resource management is determined either by the gross extraction (capture) output obtained through the resource processing (selling), or by the cost of the reserves proven with geological exploration (research or industrial capture):

$$Д_Г = \sum_{i=1}^{n} Д_{Г_i} \times Ц_i, \quad (7)$$

where $Д_Г$ is annual sales revenue by extracted (captures) marine resources or the cost of mineral deposits, UAH; $Д_{Г_i}$ is the annual extraction (capture) output of the *i*-th marine resource or the amount of mineral deposits, tons, m^3; $Ц_i$ is the market unit price of the *i*-th marine resource or mineral, UAH; *n* is the number of types (species) of extracted (captured) resources or explored m inerals.

According to the second type of this method, the gross sales revenue is reduced by the amount of gross expenses. A positive result (the revenue being higher than the expenses) indicates profit. It is noteworthy that price fluctuations in world markets lead to a change in the resource cost as well. Let us consider the crude oil prices as an example (Fig. 3).

Thus, crude oil was four times cheaper in 2000 than in 2011. The landslide of prices in 2016 forced oil companies around the world to turn off investments in geological exploration and freeze projects, since oil production ceased to be cost-effective. As shown by numerous observations, such surges and recessions have a cyclical nature.

Valuation of natural resources (mainly biological) based on the rates (norms) accounts for the compensation for losses, harm, damage associated with violation of the natural resource management conditions, illegal resource withdrawal from the ecosystem, violation of environmental regulations, reduction in the number of stocks due to deterioration of the conditions of their life and reproduction. It is applied in order to estimate the amount of appropriate penalties.

Let us illustrate this method with estimation of the losses sustained by a fishery as a result of infringement of the rules of fishing and protection of aquatic living resources [23]. The estimation is performed if juridical and natural persons (entrepreneurs), including foreigners, cause damage to the Ukrainian maritime economy through the illegal capture or elimination of the stocks of aquatic living resources in the territorial, inland waters, on the continental shelf and in the exclusive (marine) economic zone of Ukraine.

Alas, the need for the estimation of losses is increasing because of a recently growing number of law violators and their ever advancing technical equipment. The latter includes night vision and satellite communication devices, sea navigators, echo sounders, electric fishing rods and the like. Annually, 10 000 kilometers of illegally installed fishing nets get removed in the Azov Sea. Using this thieves' tool, wrongdoers capture as much fish in the course of the year as all fishing enterprises do, which is about 200 000 tons [24].

The estimation follows the procedure shown in Fig. 4. Surveys, studies, laboratory analyses and examinations that accompany the administrative investigation of the deaths of aquatic bioresources and pollution of their habitat all serve as the input data sources; so are the ongoing monitoring and environmental control conduct-

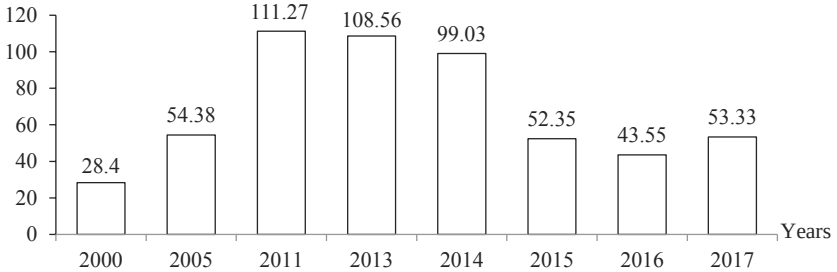

Fig. 3. Price of Brent crude oil, USD per barrel [22]

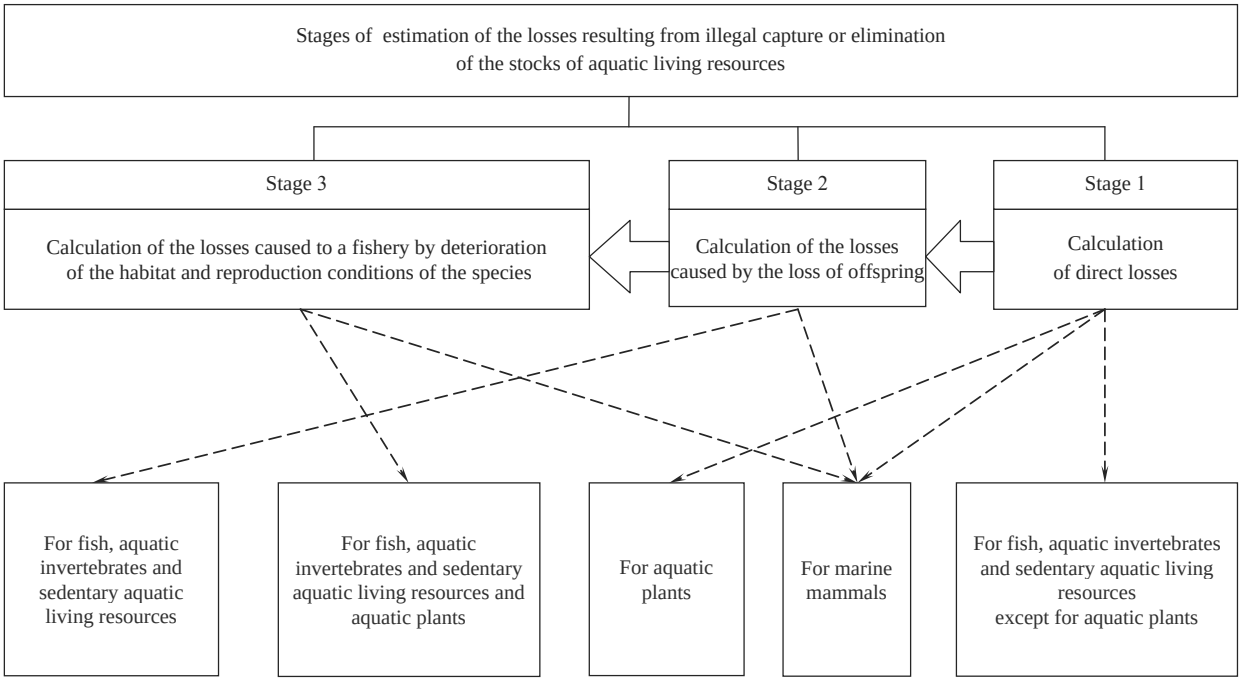

Fig. 4. Procedure of estimation of the damages sustained by maritime economy

ed by scientists and employees of relevant government agencies. Further on, let us discuss the methodological foundations of the procedure.

Thus, the first stage is calculation of direct losses.

1.1. For fish, aquatic invertebrates and sedentary aquatic living resources (except for aquatic plants) ($У_1^1$):

$$У_1^1 = С_п \times (П_к \times М_с \times \frac{П_л \times М_с \times К_1}{100} + \frac{З_і \times М_с \times К_2}{100}), \quad (8)$$

where $С_п$ is the price of goods produced by a single animal of an average commercial size, which follows the retail market prices of the region at the time of calculation of the damages incurred, UAH;

$П_к$ is the number of mature animal individuals which died because of an unlawful act or were illegally captured from the water body, pcs;

$М_с$ is the average weight of a mature animal individual, kg;

$П_л$ is the number of dead larvae, pcs;

$К_1$ is the coefficient of commercial return from larvae[7], %;

$З_1$ is the number of dead fish eggs, pcs;

$К_2$ is the coefficient of commercial return[8] from fish eggs, %.

In 2017, law enforcement officers of the Kinburn Spit detained an organized group of poachers with 42000 crabs and shrimp worth more than 5 million hryvnias. Instead of paying for a full package of permits, the poachers preferred to engage in illegal fishing [25].

1.2. For marine mammals ($З_2^1$):

$$З_2^1 = З_м \times С_п, \quad (9)$$

where $З_м$ is the number of dead of illegally captured mammals, pcs.

The criminal activities of poachers are particularly harmful for the Black Sea dolphins. Some of these gullible creatures get entangled in fishing nets, while some are killed by the propellers of high-speed boat motors used by the law breakers to take the sea.

1.3. For aquatic plants ($З_3^1$):

$$З_3^1 = З_р \times В_п, \quad (10)$$

where $З_р$ is the total weight of dead or illegally harvested plants, kg.

The next stage is calculation of the losses caused by the loss of offspring.

2.1. For fish, aquatic invertebrates and sedentary aquatic living resources, the losses ($З_1^2$) are estimated as follows:

$$З_1^2 = \frac{З_к \times П_{і(л)} \times К_{і(л)} \times М_с \times Д_с \times К_н}{10000} \times В_п, \quad (11)$$

where $З_к$ is the number of mature animal individuals killed or illegally captured in a water body, pcs;

$П_{і(л)}$ is the average fecundity, pcs eggs (larvae);

$К_{і(л)}$ is the coefficient of commercial return from fish eggs (larvae), %;

$М_с$ is the average weight of a mature animal individual, kg;

[7]It is calculated as the ratio of the number of fish in the commercial age to the number of fish at the initial stages of development (fish eggs, larvae, juveniles).

[8]It is identical to the coefficient of commercial return from larvae but taking into account fish eggs only.

$Д_c$ is the proportion of females in the herd (based on observations), %;

$K_н$ is the spawning frequency, times.

2.2. For marine mammals ($З_2^2$):

$$З_2^2 = K_c \times П_c \times K_{щ} \times B_n, \quad (12)$$

where K_c is the number of killed or illegally captured females, pcs;

$П_c$ is the average fecundity of females, pcs offspring;

$K_{щ}$ is the number of times a female of this species gives birth throughout her mature life;

B_n is the price of goods produced by a single mammal of an average commercial size, which follows the retail market prices of the region at the time of calculation of the damages incurred, UAH;

As follows from Fig. 4, the third stage is calculation of the losses caused to a fishery by deterioration of the habitat and reproduction conditions of the species (destruction of the spawning and overwintering locations).

3.1. For fish, aquatic invertebrates and sedentary aquatic living resources and aquatic plants ($З_1^3$):

$$З_1^3 = S_н (П_д \times П_{д1}) \times B_n, \quad (13)$$

where $S_н$ is the area affected by adverse factors, ha; $П_д$, $П_{д1}$ is the productivity of this site with regards to a particular species, before and after the onset of the adverse factor, respectively (kg/ha). If this site is of industrial importance, the productivity is calculated by dividing the captured amount of fish, invertebrates, sedentary aquatic living resources, and aquatic plants by the area of the site.

3.2. For marine mammals $З_2^3$:

where is the number of animal individuals before and after the onset of adverse factors, respectively, pcs; is the average fecundity of females, pcs offspring; is the proportion of females in the herd, %.

$$З_2^3 = B_n \times (K_1^o - K_2^o) + \frac{B_n \times П_c \times K_{щ} \times (K_1^o - K_2^o) \times Ч_c}{100}, \quad (14)$$

where K_1^0, K_2^0 is the number of animal individuals before and after the onset of adverse factors, respectively, pcs; $П_c$ is the average fecundity of females, pcs offspring; $Ч_c$ is the proportion of females in the herd, %.

The essence of **the rental method** is quite transparent: anyone who has set out to valuate natural resources must determine the amount of the differential rent received by their owners. In publication [26], we considered the topic of rent extensively. It is the price (charge or fee) paid for the right of productive use of limited natural resources.

Under such circumstances, there are several rent-forming factors. First, it is a continuously growing demand for marine natural resources, which is reflected in the level of their purchase by consumers. Second, it is the difference in the quality of marine natural resources. Other conditions (competence of the personnel, capacity of the production equipment, sophistication of the technologies applied) being equal, the resources of a higher quality allow achieving better economic results (income, profit) than the depleted resources. Finally, the third factor is location and logistics. For example, oil fields developed on the sea shelf and in the open sea are at a different distance from refining facilities, let alone the areas of consumption of oil products. Even if the quality is identical, extracting companies will receive differential rent in the first case only.

Apparently, individual production costs depend on the specific features of a particular kind of natural raw materials. Meanwhile, the value proposition and price of the products manufactured from these materials are the same. Under these circumstances, the actual amount of labor invested in products and services becomes problematic for the producer, who is forced to extract resources at the highest individual costs[9]. The latter are referred to as marginal costs.

It is the marginal costs that regulate the market price of goods at a balanced supply and demand. However, this is not always a case. For instance, when the production output is much higher than the level of demand, socially necessary (regulatory) costs, which determine the market price of goods, can be reduced to the level of individual costs in the areas located in acceptable and even most favorable natural conditions.

The annual amount of rent for the use of natural resources is estimated as the difference between the marginal and individual production costs (P_p):

$$P_p = \sum_{i=1}^{n} O_{n_i} \times (B_{eд_i}^з - B_{eд_i}^{iнд}), \quad (15)$$

where O_{n_i} is the production output for the product manufactured with the use of a particular natural resource, measured in appropriate units (tons, m^2);

$B_{eд_i}^з$ is the marginal costs of manufacturing a product unit with the use of a particular natural resource, UAH;

$B_{eд_i}^{iнд}$ is the individual costs of manufacturing a product unit with the use of a particular natural resource, UAH;

n is the quantity of products manufactured with the use of a particular natural resource.

If the amount of annual rent is known, one can estimate the value of the natural resource ($ПР_C$) according to the following formula:

[9] At best, the producer has to settle for a minimum profit. Now it becomes clear why capitalists tend to place their orders in the countries with a miserly cost of labor.

$$ПР_C = P_p : \frac{П}{100}, \quad (16)$$

where $П$ is the current bank interest rate, %

For instance, if $P_p = 10\,000$ UAH and $П = 10\,\%$, then the following is true:

$$ПР_C = 10000 : \frac{10}{100} = 10000 : 0{,}1 = 100000, \text{ UAH}$$

In this case, the value of the natural resource is definitely associated with the monetary capital (100 000 UAH). Being kept in a deposit account at a commercial bank at 10% per annum, the capital brings an annual income equal to the amount of rent (10 000 UAH).

To replenish the state's national wealth with the value of a natural resource, this value should be estimated for the entire period of use of the resource :

$$P_t = P_p \left(\frac{1}{1+Б_П} + \frac{1}{(1+Б_П)^2} + ... + \frac{1}{(1+Б_П)^t}\right), \quad (17)$$

where t is the period of use of the natural resources, years; $Б_П$ is the current bank interest rate, which serves as a discount factor in this case.

It should be recognized that numerous interpretations of the rent theory are extremely diverse, and the rent calculation methods applicable to marine resources are still a subject matter for scholarly disputes. For this reason, one may face certain problems when implementing the rental valuation of natural resources in practice.

The Lost Profit Method. Sometimes, none of the various business strategies for the use of particular resources of the World Ocean happens to come to life. Hence, the potential users have nothing else to do but estimate the income which has not been received. It may include the losses from the withdrawal of marine protected areas (marine reserves) from the sphere of economic activity. The largest reserves are listed in Table 3. The lost profit comprises the products that have not been realized (fish, seaweed, minerals), as well as other income lost (proceedings from selling coral reef fragments or providing excursion diving).

Table 3. The world's largest marine reserves[10] [27]

Country/location	Name	Type	Year of establishment	Square, thsd km²	
				Total	Sea area in particular
Republic of Kiribati	Phoenix Islands	Protected area	2006	410.5	410.5
Australia	Great Barrier Reef	Marine park	1979	344.4	344.4
USA	Papahanaumokuakaa	Marine national monument	2000	341.4	341.4
Commonwealth of the Northern Mariana Islands (USA)	Mariana Trenches	Marine national monument	2009	246.6	246.6
USA	Pacific Islands	Marine national monument	2009	225.0	225.0
Australia	Macquarie Island	Marine park	1999	162.0	162.0
The Galapagos Islands (Ecuador)	Galapagos	Marine conservation areas	1996	133.0	133.0
Greenland (Denmark)	Greenland	National park	1974	972.0	110.6
Colombia	Seaflower	Marine protected area	2005	65.1	65.0
Australian Antarctic Territories	Heard and McDonald Islands	Marine conservation areas	2002	64.6	64.2
Total	–	–	–	2964.6	2103.1

[10]In total, there are about 5000 marine reserves in the world. Together they cover an area of about 2.85 million km², which is 0.8% of the World Ocean.

CONCLUSIONS. 1. Ukraine is de facto a maritime state. Unfortunately, its officials and businessmen do not always demonstrate the ability to rationally employ the natural conditions at their disposal. The situation is not that hopeless, especially taking into account the conscientiousness of the citizens of large and small countries who care about preserving their state's maritime identity. To say the least, it would be nice to follow their example.

2. Economic valuation of the natural potential is of particular importance at a time when humanity has come close to large-scale activities aimed at development of the World Ocean. It is accompanied by interference in the environment, which entails almost inevitable losses of a part of natural resources and a local deterioration of the human range. Therefore, the valuation is not an unconditional criterion in making final decisions on certain projects. They should also be substantiated with considerations of rational natural resource management.

3. The maritime economic activity should be geoecologically balanced. It should combine reasonable consumption, careful protection, and cautious reproduction of biological, energy, recreational and other resources of the World Ocean. To recap, geoecology is a scientific discipline that studies the interaction of a person with the

environment, in the area of his/her dwelling and living in a geographical environment. Only under these conditions it is possible to reach a mutually beneficial co-evolution with the nature, when a person not only actively interferes with the biosphere, adapting it to their restless needs, but is itself transformed with account for the nature's requirements.

4. Interpretation of the economic value of marine resources substantially depends on their availability on land, while their extraction appears appropriate if the following condition is satisfied:

$$B_M^{ПП} \leq B_C^{ПП},$$

where $B_M^{ПП}$ is the costs of production for the specified goods at sea, UAH; $B_C^{ПП}$ is the costs of production for the specified goods on land, UAH.

However, with the growing shortage of essential raw materials on land, their industrial development beyond the coastline may prove expedient at relatively high costs as well. Even if the development of some resources is not currently economically feasible, the situation is likely to change over time.

5. Each of the described methods of economic valuation of the natural potential of the World Ocean has advantages and constraints with regard to its application. In the future, the range of methods is bound to be expanded with more constructive and pragmatic calculation techniques. They are necessary for the world that is too focused on money to realize: the environment is of a lasting, universal practical value, but it can be worthlessly perished. We should not ignore seemingly small-scale components of water areas and the species inhabiting them. There are no trifles in the nature!

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