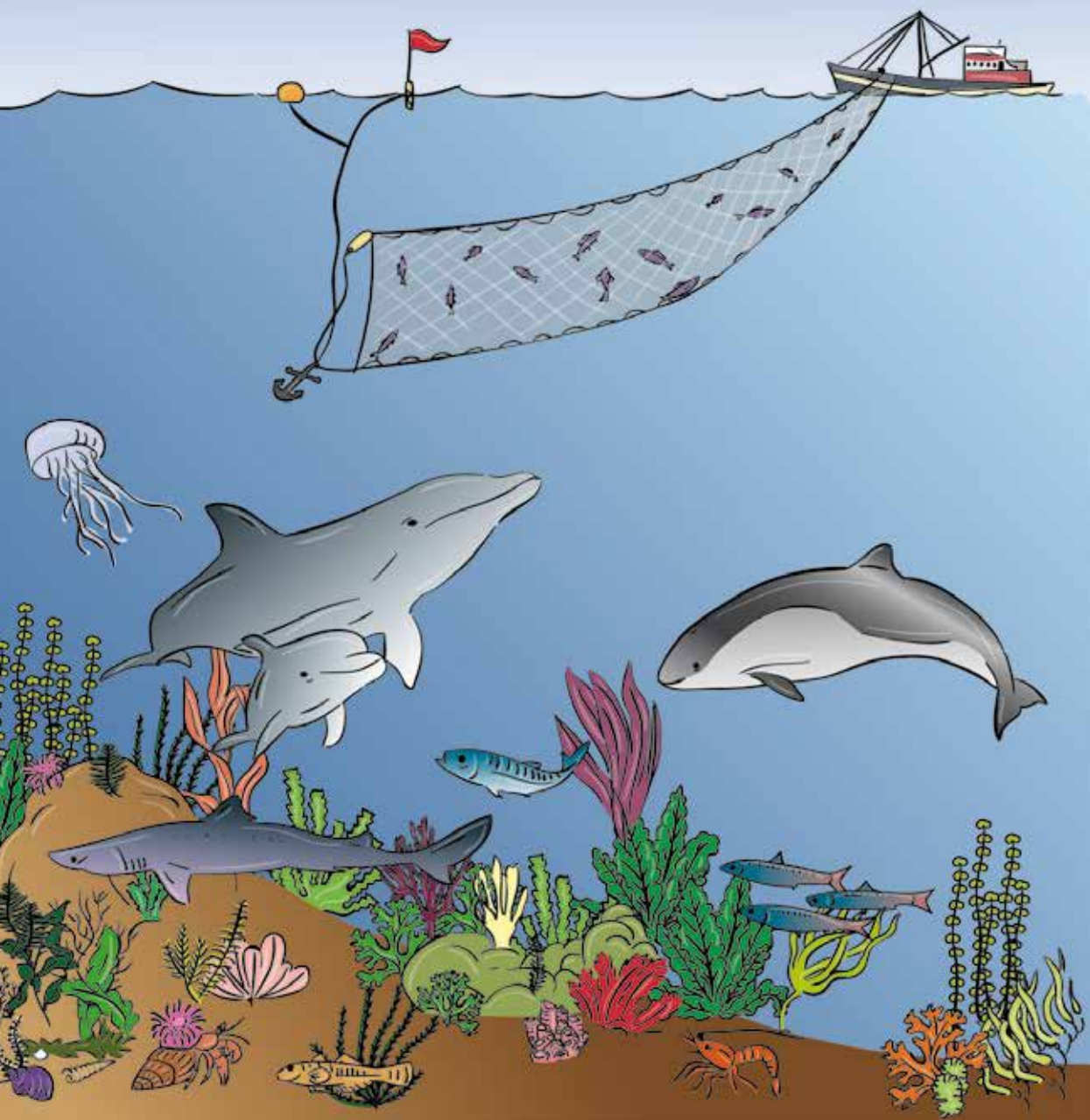


SEA, BIODIVERSITY, ECOLOGY

GALINA MESHKOVA, DIMITAR POPOV

DOLPHIN EXPEDITIONS ACROSS THE BLACK SEA

TEODORA ILIEVA



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Introduction

WE LIVE IN A SOCIETY ABSOLUTELY DEPENDENT ON SCIENCE AND TECHNOLOGY AND YET HAVE CLEVERLY ARRANGED THINGS SO THAT ALMOST NO ONE UNDERSTANDS SCIENCE AND TECHNOLOGY. THAT'S A CLEAR PRESCRIPTION FOR DISASTER.

CARL SAGAN

More than nine centuries ago, in his 'The Book of Healing' Avicenna defined natural philosophy or science, as we call it today, as the only weapon against mankind's many problems and the power to take it forward into the future. Indeed, science and technology have the potential and power to transform the world we live in, making the environmental footprint of our activities a hallmark of our era.

Without science we would not have had comfortable houses or transportation, we would not have had a telegraph, radio, cheap and generally available books and education, we would not have been able to rely on epidemic protection; culture and art would not have been accessible to everyone. There would also not have been machineries to free the workers from the heavy labor involved in the production of essential goods. Undoubtedly, the world we live in today we owe to science and technology. But science does not have to look distant, isolated and haughty. People need to understand what's going on behind the doors of laboratories and institutes. Society has the right to know that science works for it. That's why the information we provide in this book is not just a set of facts presented through the meagre and often incomprehensible definitions. It explains the facts that you have undoubtedly encountered elsewhere. They are presented in a format that is suitable for a wide range of readers. In other words, we took science out of the labs to make you sure it works for us humans.

The texts emphasize ecology and the fields it studies, because, being a relatively young science, it is often not completely understood, and scientists working in this field have to contend with, in addition to their daily professional problems, also with the attitudes of society.

The book is accompanied by original short stories, inspired by the expeditions carried out at sea, by dolphins and by the beauty of nature, with author Teodora Ilieva, who is our example of how nature gives birth to art.

The book is suitable for anyone who wants to learn more about the „magic“ of ecology and the sea. It is designed for people from all walks of life – fishermen and sailors, traders and entrepreneurs, salespeople and housewives, mothers and educators, journalists and even politicians. Anyone who can read at all. Of course, it can also be used by experts in the field for update, refresh of information or why not reason for refutation.

However, if there is unexplained stuff in the text, but still exciting for you, please see the section Short questions and answers at the end of the book. Or contact us at the contacts listed below:

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The Sea as Ecosystem

WE HAVE MAPPED THE ENTIRE GLOBE AND THERE ARE NO LONGER WHITE GAPS TO FILL WITH STRANGE MONSTERS AND FABULOUS CREATURES BORN OUT OF OUR IMAGINATION. BUT MAYBE WE SHOULDN'T STOP. BECAUSE LIFE ON THE PLANET IS FAR FROM COMPLETELY KNOWN TO US. JUST UNDER TWO MILLION ANIMAL SPECIES HAVE BEEN DESCRIBED BY SCIENCE TO DATE, BUT BIOLOGISTS ESTIMATE THAT THERE ARE A TOTAL OF ABOUT TEN MILLION MULTICELLULAR ORGANISMS IN THE WORLD. THE GREATEST DISCOVERIES STILL AWAIT US AT SEA.

MORTEN STROKSNES, SHARK DRUNK:

THE ART OF CATCHING A LARGE SHARK FROM A TINY RUBBER DINGHY IN A BIG OCEAN

What the Black Sea really is

The Black Sea is one of the relatively young seas in the world. Geological data show that about 8,000 years ago it was a freshwater lake – so called Pontic Lake – whose basin, along with that of today's Caspian Sea, collected the waters of the melting glaciers. There've been alternating periods of high water and periods of decline (when the glaciers receded). The hypothesis of the great flood is that of William Ryan and Walter Pitman, who in 1997 formed the assumption that in approximately 5600 BC, as the glaciers receded, the level of the Pontic Lake has fallen, and that of the oceans rose dramatically, which caused the tearing of the land strip separating the Pontic lake from the Mediterranean sea into today's Bosphorus. This resulted in 155,000 km² of land being flooded (by comparison, Bulgaria's territory is 110,994 km²) and altered the coastline, extending the waters mostly north and west, thus forming the Black Sea.

Of all the continental seas – such as the Aegean, Baltic and Mediterranean – the Black Sea is the most isolated of the Global Ocean. Due to this many large rivers flowing into the Black Sea maintain its relatively low salinity (about 17-18 ‰) on the surface layer. And exactly in this layer, extending down to about 100 m deep, almost the entire species composition is contained. For comparison, the salinity of the World Ocean is around 36 ‰ and most of its inhabitants do not tolerate salinity below 20 ‰, which is why the Black Sea ecosystem is relatively species-poor. However, the conditions in the deep sea layer, located from about 150 m depth to the bottom (~ 2 000 m), are fundamentally different, the difference being so drastic that they formed, figuratively speaking, two separate ecological universes. In the deep layer, the water is saltier, heavier and at a constant temperature – about 9°C. It almost does not mix with the water of the surface layer which prevents the penetration of oxygen in depth. That's the main reason for the lack of complex life forms there. However, there are many bacteria that decompose the sinking debris from the bodies of the pelagic² inhabitants, and release hydrogen sulfide³ as a by-product of their metabolism⁴, the accumulation of which makes the conditions at these depths even more hostile.

Yet there is life!

Despite differences in the conditions at different depths, the Black Sea is a whole ecosystem, and as such it functions in an extremely tight and strictly energy-defined way:

rivers flowing into the Black Sea (about 300 in number) deliver biogenic substances – salts of nitrogen, phosphorus and other essential minerals for plants; thanks to them, the algae and seagrasses are fed by sunlight to feed the herbivorous animals, and they themselves serve as food for predatory invertebrates and fish; the latter, in turn, become food for birds and dolphins.

In the Black Sea, there are approximately 1 520 species of animals, of which 164 species of fish and 4 species of mammals. There are also approximately 600 species of plants – algae and seagrass. Most animal species have reached the sea since its last connection to the Mediterranean. And about 140 species have lived since the time of the freshwater Pontic Lake (autochthonous, Sarmatian or Pontic relicts, or so-called Caspian species). They inhabit the brackish coastal stretches, lakes and estuaries, as well as some rivers – mainly the Danube and the Dnieper.

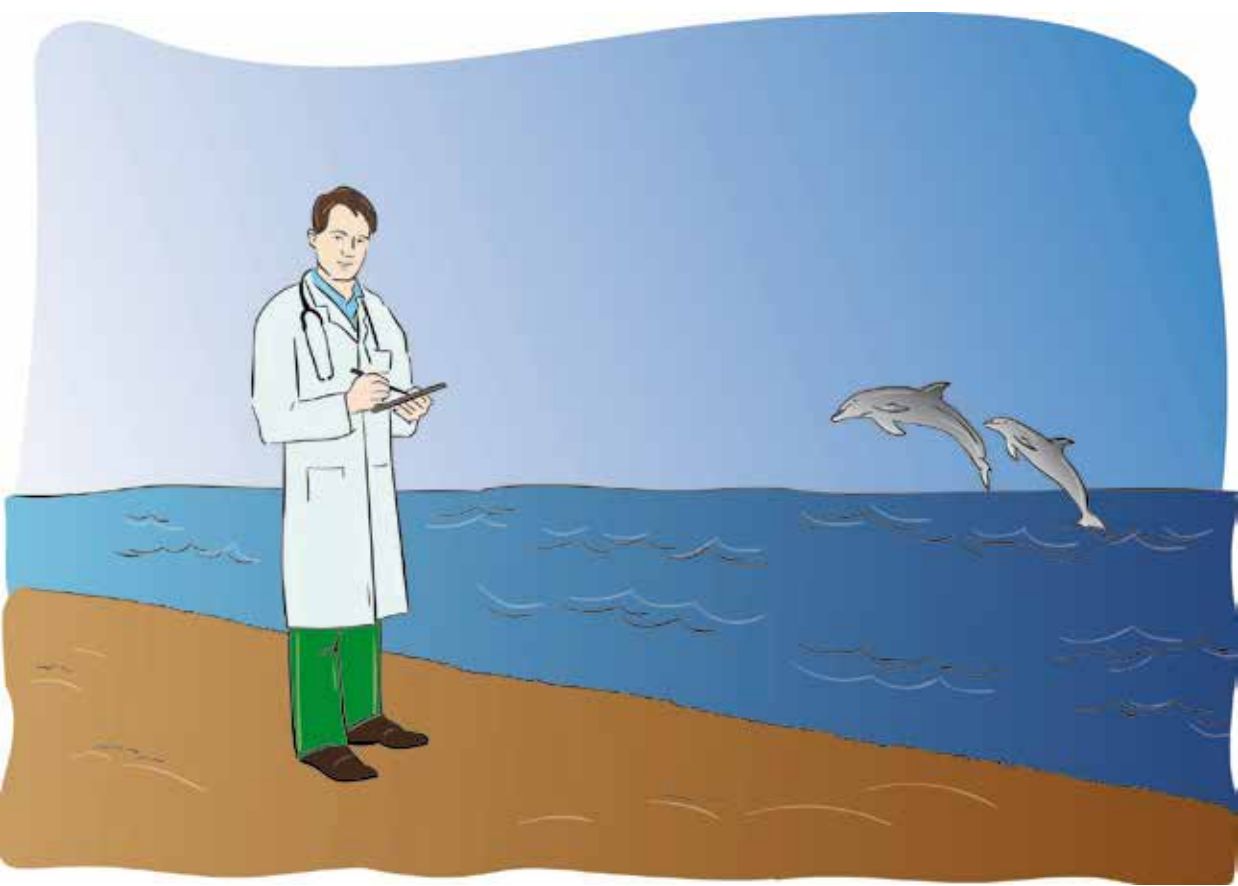
Most Black Sea fish breed and feed in the Black Sea. The stocks of pelagic fish undergo sharp fluctuations in number due to the different survival rates of the younger generation (due to the effects of overfishing⁵, bycatch⁶, poaching, disturbance in the growth sites). Newly hatched fish congregate in shallow coastal areas that are inaccessible to large predators, giving them shelter and the ability to survive long enough to reach breeding age. But, as you may guess, it is precisely these coastal and shallow stretches that are most anthropogenically impacted by diverse human activities – transport, tourism, fishing, sports. The role of the coastal shallow bays and lagoons is similar, for example Pomorie Lake, where fish enter through the channel connecting it to the sea. Once grown up, the fish return to the sea via this channel and the cycle is repeated annually. But quite often, even though it is a protected area for the above mentioned reasons, people enter the lake illegally - bathing or sporting, and they just fail to understand why there are such restrictions. The prohibition is perceived as something that is directed against the people and for the benefit of individual stakeholders or organizations. However, with a brief search on the Internet anyone could come to the conclusion that surfing and bathing in the waters of this unique ecosystem would have a devastating effect on its chemistry, which underpins its unique appearance associated with both its biodiversity and the so-called healing mud. As to the fishing, in combination with other impacts it influences the calmness and abundance of the fish populations that this ecosystem maintains and, accordingly, its importance to humans as a source of resources. That is, we should not wait for any information to be presented to us necessarily “cooked, chewed and digested”. It is thanks to technology in the 21st century that we have been given the invaluable opportunity to access a wealth of information. All we need is the will, the desire for awareness, and a little critical thinking.

A fundamental principle in ecology is the relationship between the diversity of an ecosystem (the number of species it consists of) and its resistance to destruction, or: more species=greater stability (*diverity-stability hypothesis*). This, combined with the conditions that determine poor species diversity, places the Black Sea at the forefront of the list of the world's most endangered seas by environmental disasters.

The conditions discussed above, as well as the species that have adapted to them, are the subject of the science called ecology. Ecology, in addition to the relationships between living organisms and the environment, also studies the impact of human economic activities and technologies, since these activities have a significant impact on the components of the ecosystem and thus cannot be considered separately.

All modern societies derive large amounts of their natural resources, whether we are talking about those that can be renewed (such as forest and fishery) or not (oil and metals). As a Black Sea country, fish and other marine products are an essential part of Bulgaria's wild (uncultivated) food sources. The economy of coastal communities is also somewhat dependent on them. These wild foods provide much of the protein we consume. And this consumption comes to us practically free of charge. Of course, if these resources are managed responsibly, the numbers of fish and other renewable resources will be stable and future generations will be able to rely on them too. Unfortunately, there is one well-known human problem here, called by Jared Diamond⁷ in his documentary bestseller "Collapse" ,the tragedy of the commons⁸. Or to put it another way, everyone rakes out bountiful of ecosystem resources, but prefers not to take care of it. We create liabilities that accumulate at the expense of future generations, but which are not here to vote today. The decisions imposing a variety of constraints to ensure resource renewability are made by politicians who, however, rarely think more than four-five years in advance (the duration of one term).

Not many people are aware of it, but the truth is that if we take care of our environment the way we look after our own bodies, it will be much cheaper for us, and it will also be more enjoyable. I doubt that anyone would question the fact that it is better to avoid diseases rather than treating them when we get sick. That is why we do the prophylactic examinations – on the basis of them, the doctor collects information about the state of all major organs and systems of your body and thanks to this information assesses whether and what is necessary to do. This is also the way we must approach the environment that secures our existence and is ultimately done by ecologists – exploring all components of the ecosystem, collecting data and analyzing it, using the results obtained to determine future actions and the measures we need to take to continue living in a healthy environment that provides all the resources we need for our existence. It is our duty to bequeath to future generations the resources that have been bequeathed to us and from which we ourselves have benefited generously.



Biodiversity

„AT LEAST 40% OF THE WORLD ECONOMY AND 80% OF THE NEEDS OF THE POOR ARE SECURED FROM BIOLOGICAL RESOURCES. MOREOVER, THE GREATER THE DIVERSITY OF LIFE, THE GREATER THE OPPORTUNITY FOR MEDICAL BREAKTHROUGHS, ECONOMIC DEVELOPMENT AND ADAPTIVE RESPONSES TO SUCH NEW CHALLENGES AS CLIMATE CHANGE.”

BIODIVERSITY CONVENTION

What is biodiversity?

Notice – the oxygen we breathe, the food we consume, the water we drink – it’s all a product of biodiversity and the way it functions in all its food chains, pyramids and stairs⁹, with all the dazzling entanglements of cycles and interdependencies.

But what exactly is biodiversity? The people in white aprons would answer that this is the number of species of plants, animals and microorganisms, the huge diversity of genes in these species, the different ecosystems of the planet – such as deserts, tropical forests and coral reefs – all of which make up the biodiverse planet Earth. This is the diversity of living matter, combined with all its forms and interactions. And if that sounds too complex and complicated for you, that’s probably because it is complex and complicated indeed. Biodiversity is the most complex feature on the planet. The future of humanity is entirely dependent on it. The term biodiversity was introduced in 1985. That is, our understanding of this so important and fragile characteristic of the planet we inhabit, the only one we have, is just newborn. Not to mention our knowledge of the mechanisms and ways in which our activities influence the processes that undergo and sustain this unimaginably large and complex set of organisms and relationships.

Conditionally and in order to better present and understand biodiversity, it can be viewed at several levels – genes, organisms, populations and entire ecosystems - in which wildlife interacts with non-living nature in strictly specific ways. It is these processes and interactions that have made the planet habitable for several billion years. In poetic language, biodiversity can be represented as the knowledge accumulated by species along the path of evolution over these billions of years about how to survive in extremely diverse and ever-changing environmental conditions. It is a kind of library of experience and skills acquired through geological eras, containing our history, volume after volume, chapter by chapter, written in the genome of every living creature that has ever inhabited and is inhabiting the planet today. Looking at it in that way, it seems that we humans are destroying this library of accumulated experience and knowledge so irresponsibly, similar to the fatal mistake we made with the burning of the Library of Alexandria¹⁰ and the loss of all the scientific discoveries and labors of hundreds of tireless scientists from antiquity. We are burning the library of life. Instead of continuing to study it and use this endless source of information to improve our quality of life. The vast amount of information that is stored there, recorded through the delightful language of genes, is presented to us and we only need to extract knowledge from it. But we don’t. To the best of our knowledge, each diploid cell¹¹ contains

1.5 GB of information, and the approximate amount of data stored in the human body is:

1.5 GB x 100 trillion of cells = 150 trillion GB или $150 \times 10^{12} \times 10^9$ bytes = 150 ZB (10^{21})

To get an idea of how large this amount is, imagine that if one 300 ml glass equals 1 GB, then by volume ratio, 1 ZB¹² would represent the Great Wall of China. And this is the information that is stored in a single human body.

Importance of biodiversity

For many people living in cities and rarely leaving them, wildlife is something that is only seen on television or on the Internet. They do not realize that the resources that sustain life in these metropolitan areas are a product of biodiversity, a consequence of the invisible and incomprehensible to most of us, looking as complex as a Goldberg machine¹³, series of interactions and processes flowing in amazing balance in wild ecosystems. Here are some examples of the benefits to which our society depends entirely on biodiversity.

Protection of water resources

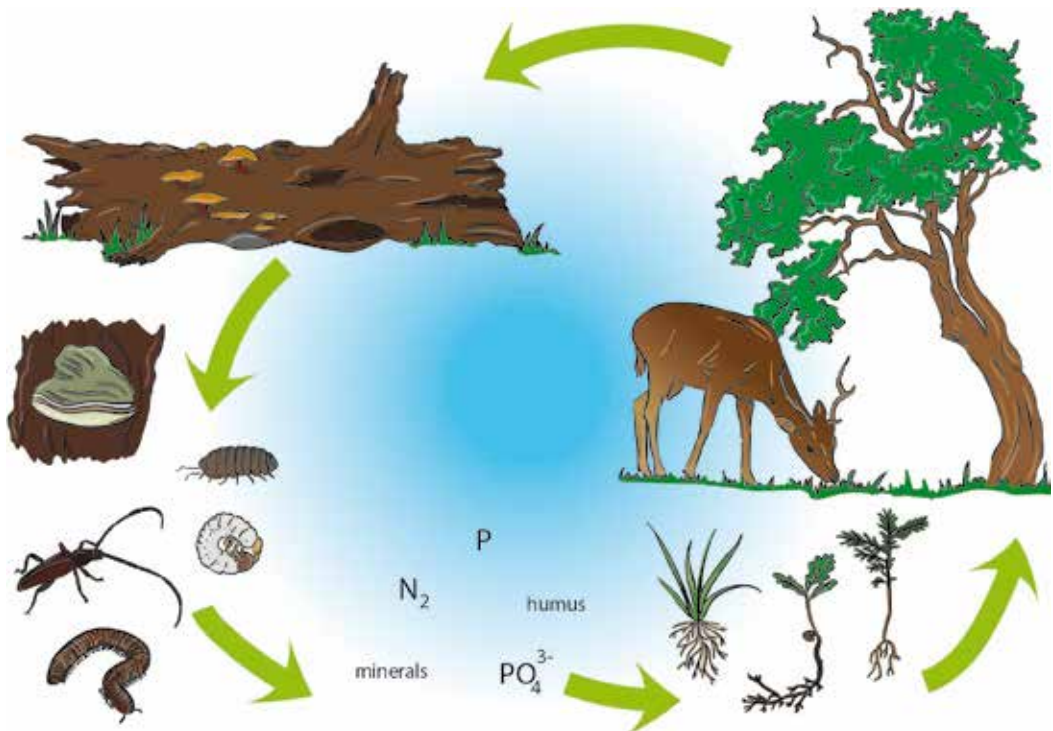
Natural vegetation cover in catchments helps maintain hydrological cycles¹⁴, regulates and stabilizes water runoff and acts as a buffer against extreme events such as floods and droughts. The removal of vegetation leads to the clogging of the catchments, loss of quantity and quality of water and, among other problems, degradation of aquatic habitats. Vegetation also helps to regulate groundwater, preventing soil salinization, which affects vast areas of agricultural land, and costs a great deal to society. Wetlands and forests act as water treatment systems, such as mangrove forests¹⁵ retaining silt, thus reducing the impact on marine ecosystems.



Source and recycling of nutrients

Over 95% of the species we know today do not have a spine. Only in the Staphylinidae¹⁶ family, for example, there are more species than all vertebrates combined – including mammals, fish, reptiles, amphibians, birds. But the smaller the species and the more unsightly the species, the less studied they are, which means we have scarce information on most of the planet's biodiversity. And invertebrates really play a huge role in nature, not only as pollinators, as is the most popular insect picture, but also as predators for various pests, as decomposers, but mostly as a base in most food chains while maintaining the specific energy budget that underpins all the biodiversity we benefit from in so many different ways. „If we damage the base, that is insects, the entire ecosystem will collapse“, said Professor Dave Gelson of the University of Sussex, UK. The energy accountancy of the ecosystems is uncompromising and leaves no uncertainty.

Many almost invisible species of fungi and microorganisms process dead organic matter, thus returning life-building elements to circulation and thus hold a key role in sustaining life on Earth. This remains hidden from our eyes and we are used to taking it for granted. But it is a vital, though invisible part of all biodiversity, inextricably linked to others in the complex energy economy of life.



Degradation and absorption of contamination

The burning of fossil fuels pollutes our planet's atmosphere. And while the contribution of human activities to global climate change is still under discussion, we can at least take responsibility for the conditions in urban areas whose microclimate is directly influenced by our activities. It is an indisputable fact that the natural solution to part of the problem is the photosynthetic species, which extract carbon dioxide from the atmosphere and fix it in organic matter during the photosynthesis process, thus releasing oxygen into the atmosphere. One of the wonders of nature, which for over 2 and a half billion years has maintained certain levels of oxygen and carbon dioxide in the atmosphere of the planet and thus made possible the existence of life as we know it. And if terrestrial life exists due to oxygen released from photosynthetic species (as well as the carbon dioxide they retain in their bodies), we can easily conclude what would be the effect of losing them.

The rich wood cover in cities also helps to filter out fine dust particles, regulates temperature and heat, acts as a barrier to traffic noise and other human activities.

In recent years many scientists have focused their attention on the use of microorganisms that literally consume various chemicals and transform heavy metals, or plants that capture and degrade organic pollutants, thereby neutralizing them. About 350 plant species that act as natural filters for heavy metals and organic pollutants have been studied so far. „By metabolizing the nutrients in the toxic constituents, these plants make them harmless, further stimulating the degradation of organic pollutants in the rhizosphere (the layer of soil located around the root systems) by releasing root exudates¹⁷”, explains Stephen Rock, an EPA¹⁸ engineer. Phytotechnology is still an underdeveloped area of knowledge, but with enormous potential in our fight against pollution. However, to do this, we must first preserve the diversity of organisms on which this promising science depends.

Contribution to climate stability

Plant species play a huge role here. But as we have already understood, everything in nature is interconnected, so when considering a group of species, we have to keep in mind that their existence depends on and/or determines that of all else.

The fossil records¹⁹ show that the first terrestrial plants appeared about 475 million years ago, during the Ordovician period. Again, thanks to geological and paleontological studies, we now know that the climate has changed dramatically during this period. At the beginning of Ordovician, about 485.4 million years ago, the climate was very hot due to the large amounts of carbon dioxide (4200 ppm²⁰) accumulated in the atmosphere during the long periods of volcanic activity. For comparison, the current concentrations of carbon dioxide in the atmosphere are in the range of 400 ppm. With the advent of plants, the climate gradually becomes cooler. This is what the data show. And about 460 million years ago the temperature of the oceans dropped to values close to modern ones. There have been also numerous increases in CO₂ concentrations since terrestrial plants have turned up, but these have always been associated with mass extinctions. How exactly the changes in the conditions and composition of this amazing and complete „organism“, such as our planet, follow and depend on each other, we do not yet fully understand. It is an extremely complex system that includes a huge number of variables whose exact prediction is impossible for science so far. That further obliges us to approach very cautiously²¹ and wisely when making decisions about the use of resources and impacting wild ecosystems.

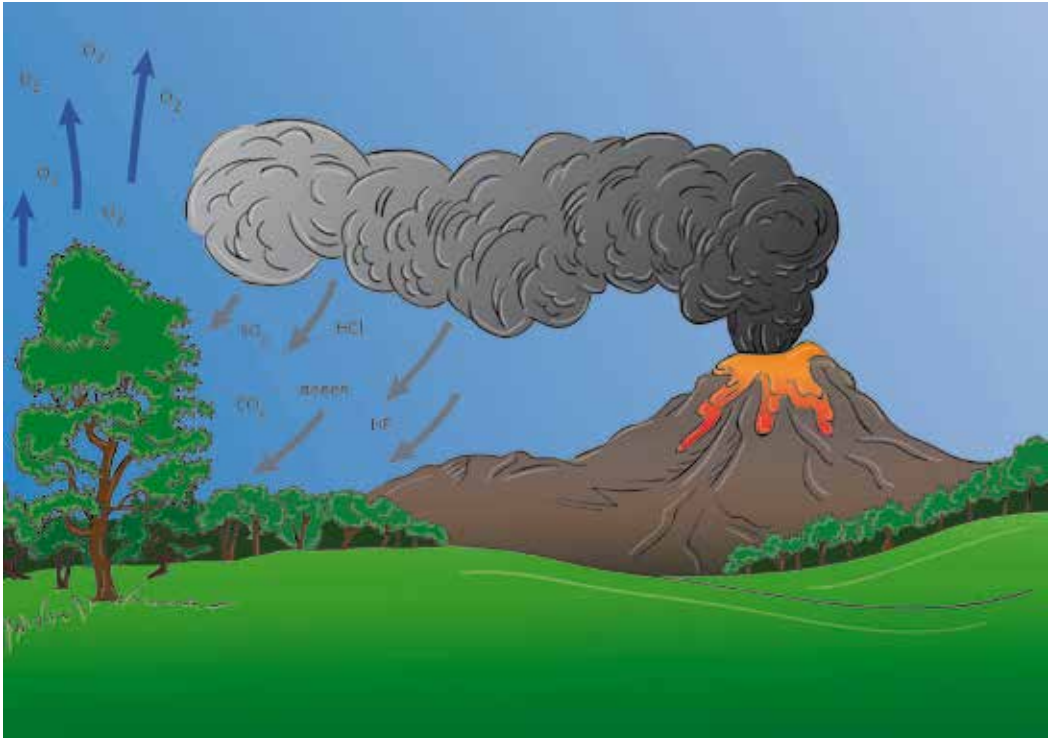
In regard to carbon dioxide absorption from the atmosphere we should not diminish the role of phytoplankton²² in the oceans, which according to some data is equivalent to that of tropical rain forests. However, it should be noted that perennial, long-lived species play a greater role in this regard, since carbon dioxide accumulated in tissues is released into the atmosphere after organism's death.

It is also worth asking ourselves – if the appearance of the vegetation cover on the planet had made such a dramatic change in its living conditions, even favoring the emergence of life on land, what would cause its disappearing? The answer to this question, we believe, is one everyone could give. But it is important to note the following: climate change on the planet is dating back to its very beginning, life history is a history of climate change and fluctuations in different conditions. They are the driving force behind speciation and diversity. Thanks to these changes we have all this natural richness and diversity. So speaking, it becomes clear that possible future climate change would have radically different implications for nature in general and humans in particular. For nature, for the planet they are something creative, or at least indifferent. But they would be detrimental to humans because we are a species that is adapted to the specific conditions of today and we are obliged to use all the knowledge and skills that we have acquired as a reasonable, thinking species to ensure these conditions for future generations. Which, as we have already stated, accumulates liabilities without voting rights.



Recovery of the Environment from natural disasters

Natural disasters today are, and have always been, a natural part of the planet's ongoing processes. Sometimes they do enormous damage, sweeping entire cities, islands, forests, populations. An example in this regard are the volcanoes, whose impact is always very dramatic, associated with huge damage, destroyed ecosystems, depopulated cities, even human casualties. Another example are the hurricanes and typhoons that destroy everything in their path. But there is something in common with the way the planet handles the consequences of all this – to clean up the poisonous gases emitted by volcanoes, as well as to restore soil and vegetation in hurricane-stricken territories, the biodiversity is needed. That balance between animate and inanimate nature, which in the process of evolution has learned to work in amazing synchrony to erase the effects of all the cataclysms that happened on Earth from the very beginning, but their traces remained invisible to us, precisely thanks to being successfully repaired. And as we already know, in order for this synchrony to work, all its components must be present and in working order.



Medicine and pharmaceuticals

Biology examines every living organism on the planet – from the simplest and smallest single-celled to the complexity of the human brain. For this reason, the discoveries in biology have a huge impact on our world. Biology has influenced everything in our daily lives – from agriculture to psychology. Including medicine and pharmacy.

The list of medicines that have been discovered and developed thanks to herbs containing active ingredients is enormous. Given that our knowledge of the planet's biodiversity is rather incomplete, we can imagine how many more such discoveries await its moment.

Thanks to advances in wildlife research we can today control the incorporation of viruses into the genome through antiviral drugs, combat genetic diseases by calculating the risk recorded in our genes, use as allies in the fight against severe and frequent deadly diseases such as cancer and diabetes undifferentiated (stem) cells. And many, many more. These discoveries are only a small part of all we can accomplish in this area if we can keep the library containing the information about it.



Cultural values

When the loss of biodiversity takes the form of disappearance of more unprepossessing and less intriguing creatures, one often hears reactions such as: „*Big deal! Are we going to think about humans or for some snails and frogs?*” However, this attitude misses something very important – the whole natural world consists of wild species that are not always interesting and good looking. But these species are linked in a surprisingly elegant way in a beautiful balance, built and established through the evolution for billions of years. Thanks to this balance we get free of charge a variety of services from nature, which would be very expensive if we had to perform/produce them ourselves. Not to mention that in most cases this is even impossible. The elimination of unattractive species often has detrimental effects and history has witnessed many such examples that we should learn from so that they do not recur.

Last but not least is our connection to all this, as a species that is ultimately a product of biodiversity, let us not forget that. Asked about their history most people would hardly go far back in time – most often human history comes down to great kings, battles, pyramids, kingdoms and empires. But human history is much more ancient and rich than that. Our history as a species is preceded by the existence and/or extinction of hundreds of other species that have left an imprint on this in our genome. Our genes have preserved the history of everything we went through, which we fought for and survived long before we became *Homo sapiens*. And this story is written in the genome of every species we share the planet with. We believe that it is a duty of our and future generations to keep this information protected, explored and invested in the well-being of our society.

The preservation of cultural and historical values is a national priority of great importance to society. But objectively speaking, historical and cultural monuments are not directly relevant to our physical survival. However, they are of great importance for our survival as individuals. Cultural and historical memory provide that spiritual nourishment that, to our knowledge, distinguishes man from other species. It would not even occur to anyone to ask why we needed culture and art since we can physically survive without them. But many are probably wondering why we conserve wildlife, since there are more important priorities like poverty, disease, war, corruption to deal with. And the same answer is valid here, too. We need it, in addition to all the other reasons listed above, because touching the beautiful, the unblemished, the pure, the wild satisfies the spiritual hunger for aesthetics and sublime, without which we can survive physically, but not spiritually. People have different needs and are looking for different ways to satisfy this hunger – historical monuments, art, music, architecture, landmarks and other beauties. These are different choices of different people, united by one thing – the right to fulfill this need and thus to survive mentally and spiritually as individuals. This is the right of all.

And in fact, the love of nature does not even need to be justified. It is one of the highest values of the civilized societies to which I believe we belong. And as part of human spirituality the worship of the nature's wonders needs no explanation. Because the morality that should come with sense cannot demand justifications for the love of life, beauty and aesthetics.

We must also not forget that the classics in art – great poets, artists, writers and composers – were inspired precisely by the beauty of nature. They contemplated, sought contact with, needed the aesthetics and harmony of the landscape undamaged, untouched by human

hand. In this sense, it can even be claimed that the classical art, though indirect, is a product of biodiversity.



These are just some of the ways that biodiversity impacts our lives. There are many more examples – a source of ornamental plants that have become an integral part of our daily lives and urban design, the huge role it plays in the development of education and science, as well as in tourism and recreation, without which we can not.

The Dolphins

„THE QUESTION IS, ARE WE HAPPY TO SUPPOSE THAT OUR GRANDCHILDREN MAY NEVER BE ABLE TO SEE AN ELEPHANT EXCEPT IN A PICTURE BOOK?“

DAVID ATTENBOROUGH

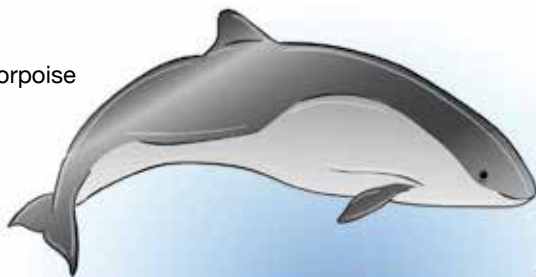
Species diversity

Now let's talk about the species that we, the team that created the book you are reading now, have been dealing with for over a decade. Species that are key to our sea biologically, ecologically, culturally and anthropologically.

Cetaceans are aquatic mammals that constitute infraorder *Cetacea* divided into two parvorder – Baleen (*Mysticeti*) and Toothed (*Odontoceti*) whales. These are whales, dolphins and harbour porpoises, which are globally classified into 14 families containing 39 genera, in which 88 species are distributed in total. That's all globally – 88 species. Of these 88 species only 3 occur in the Black Sea nominated as subspecies: two species of dolphins – the Bottlenose dolphin (*Tursiops truncatus ponticus*) and the Common dolphin (*Delphinus delphis ponticus*); and a Harbour porpoise (*Phocoena phocoena relicta*). That means our sea holds only about 3% of the world's species of Cetaceans. This, of course, is due to the limited general species diversity in it, as already discussed in previous chapters. It is important to note that these three Black Sea subspecies are endemic to our sea. This means that they are only found here. Millennia of survival in the closed system of Black Sea conditions have adapted and changed them to some extent from their relatives in the Mediterranean Sea, from which they originate - thousands of years ago, when the land barrier near the present-day Bosphorus was torn apart, the three species of marine mammals entered into the newly formed Black Sea along other species. The long isolation then modeled some of their genetic and morphological characteristics. Why and how this happened we can learn only as we continue to study them and collect data on their biology and social characteristics. A very interesting fact, however, is the absence of Harbour porpoise in the Mediterranean Sea. There is no precise record of when or why it disappeared there, but one thing is certain – this is the only possible route the species has reached the Black Sea. The closest relative to the Black Sea porpoise is its Atlantic cousin.

The numbers of the three cetacean species in the Black Sea are not fully understood, as far as the data available to scientists is incomplete. For various reasons in the past there have not been sufficient studies on the numbers and status of populations of these species in the Black Sea, much less their behavior. Actually in the past Black Sea cetaceans were the subject of commercial hunting, and the scarce data available for them were collected mainly during this period, rendering them unusable. However, we know from these data that only in the first half of the twentieth century about 4-5 million individuals were caught.

Harbour porpoise



Bottlenose dolphin



Common dolphin



A moratorium on dolphin hunting was imposed in 1966 first by the USSR, Bulgaria and Romania, and last in 1983 by Turkey. Currently, more than 35 years after the moratorium, the number of cetaceans in the Black Sea is estimated to be in the range of 200 to 400,000 in total for the three species. That is, there is no rapid population recovery. Why is that? Let's first focus on the main reason – slow reproduction rate.

Biological features

Cetaceans are mammals, just like us. As such, they give birth to their infants, lactate and take care for them. Males and females of different species reach sexual maturity at different ages, and it can be said, generally, that this is relatively late. Female Bottlenose dolphins, for example, reach maturity at age of about 4-5 years, while males – at 10-12. The situation with Common dolphins is similar. An exception is the Harbour porpoise as both male and female individuals reach maturity at age of about 3-4 years.

Why is this so? Mainly because of the social structure of the groups and the fact that most cetaceans are polygamous. As highly social species, they form groups with a specific and rigorous hierarchy in which male individuals compete for status, access to females, and resources. For this reason, mothers take care longer for male calves, who consequently mature later than females, giving them a better chance of fighting for higher status, reproduction and spreading their genes.

In addition to relatively late maturity, dolphins also give birth to only one calf, which they take a long time to care for. Depending on the species, these cares can last from two to more than five years, during which period the mother does not conceive. The record holder in the world of cetaceans in this regard is the Long-finned pilot whale (*Globicephala melas*), whose mothers take care of their calves over 10 years (the documented record is 14 years²³). All this, combined with the fact that the pregnancy lasts about 12 months, that

most of the young do not survive the first year, and a large percentage of the rest do not reach sexual maturity, shows us why the rate of recovery of populations of these delicate creatures are extremely low and explain why over 35 years after the total ban on dolphin hunting their numbers have never been able to reach the levels previously observed.

Quite often, the media make loud claims that dolphins in the Black Sea have doubled or tripled in a given year. But you already know why it's impossible. In fact, due to the presence of dolphin groups near fishing boats and vessels, for obvious reasons, often such a subjective and biased notion is reinforced in fishermen who are left with the wrong impression that what they observe near their vessels and boats should be valid for the entire sea.

Environmental role and importance

We also need to allocate a few lines to the important ecological role that cetaceans play in the Black Sea. They are predators at the top of the Black Sea food pyramid. And the ecosystems are controlled precisely from the top of the food pyramids. How exactly is this done? In terms of their survival strategy, the species are divided into several types, and for simplicity we will look at the old and simplified version: R-strategists are species that rely on rapid reproduction, multiple offspring and minimal care for it; K-strategists – species that reproduce slowly and invest in the cares for the offspring. The large predators at the top of the food pyramids belong to the second type. Their absence from the ecosystem has an avalanche-like detrimental effect that spreads down the pyramid in a strictly defined way. All ecosystems have a fixed energy budget dictated by the number of primary producers of organic matter – these are plants on land and photosynthetic organisms in the ocean. This energy budget cannot be exceeded and control comes always from above by the predators. In the absence of control from above, empty ecological niches in the food pyramid will be occupied by opportunistic, fast-reproducing (R-type) species that have the potential to overpopulate and deplete the environment and disrupt the ecological balance that is so important for proper functioning of the entire ecosystem. This is the so-called trophic cascade effect that is transmitted down the pyramid. There are many known examples in this regard, dating back to the geological past, caused by climatic or geological events and recorded in the rocks, as well as more recent, caused by humans – the sad story of the gray wolf in North America, the problem of the overpopulation of rabbits after the campaign on the extermination of birds of prey also there, as well as many others.

After this information, you probably already understand why it is ridiculous to say, for example, that dolphins have become more while at the same time the fish has decreased. To explain in more detail the relationships at the trophic level in an ecosystem, let's imagine a pyramid – a figure that is not randomly selected to symbolize this. A solid wide base and separate layers that flow smoothly into a sharp peak. Each layer symbolizes the energy reserve at the trophic level, making it clear that it is most at the basic – the most diverse at species and energy is the level with producers, which gradually decreases with each subsequent level until we reach the top and the predators, at which level there is usually one species. At the base are the plants and species from the low trophic levels, those that serve as food for the predators. And the base is wide and stable. What would happen if the base (fish) decreases and the top (dolphins) increases? Well, the whole structure would collapse. That is, it is impossible to happen. The relationships between the species from the different levels are such that the changes in the numbers of the species from the upper levels follow

immediately the changes in the numbers of the species from the lower levels. And these strict and rigorous rules, based on the immutable laws of thermodynamics (defining the flow and distribution of energy throughout the universe), strengthen the ecosystem from the dawn of life. It's just simple physics.



This is just another reason why it is important to keep our ecosystems in a state that provides human populations with access to long-term environmental resources. And this needs to be done by competent people (just as you entrust your healthcare to doctors, not lawyers, for example), without compromise (because those who act contrary to the recommendations of scientists in that specific field are harming society) and globally (because in nature – and in particular in the Black Sea – there are no borders).

The Man and the Sea

As mentioned above, as a coastal state, fishing in Bulgaria is an important economic, social and cultural activity. The Black Sea has maintained important fishing activities for the local community since ancient times. Decades of tradition in this regard have shaped the appearance of coastal cities and the livelihood of the local population. As such an important part of our daily lives, one would expect that along with traditions in fishing methods and scales, responsibility and concern of the local people for the environment has also evolved in time, enabling them to be what they are today. But it's not. Unfortunately, the reality shows that, in the Black Sea, similar to global trends, only the overfishing, consumption of seafood, especially fish and pollution of various kinds are increasing, the last possibly due to coastal overdevelopment and increased anthropogenic impact on the environment, as well as the exploitation of various non-living resources, such as oil and gas.

The sustainability of fisheries in the Black Sea is also greatly threatened by the effects of climate change, which also affect marine ecosystems. Like any other ecosystem to deal with this stressor it is important for the marine ecosystem to have all its components in good working order. The dramatic changes that have taken place over the last few decades are evidence of the need to take into account these diverse in nature impacts in the development of ecosystem-based fisheries management programs in the region.

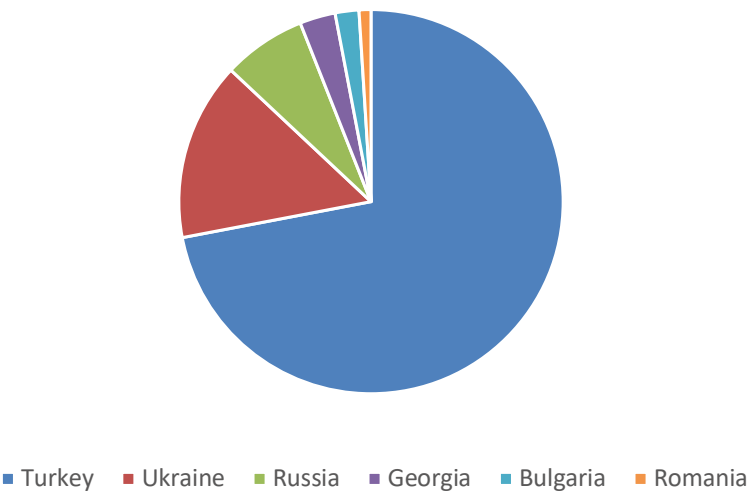
Today, there are industrial, semi-industrial and small-scale fisheries in the Black Sea region that use a variety of fishing gear. Unlike other large fisheries, the Black Sea fisheries use mainly benthic and pelagic fish stocks, including molluscs and crustaceans. In fact, despite its relatively low economic contribution compared to other activities (eg. tourism, oil and gas), the annual production of over 8,000 tonnes of fish in Bulgaria offers job opportunity for many people supplying marine products for consumption on the local markets and creates many other indirect benefits by maintaining the social structure of coastal communities and the cultural appearance of coastal settlements.

Along with the benefits to the community, however, fishing has a huge negative impact on the marine ecosystem. As you may guess, such removal of huge amount of organic matter (and respectively energy from the budget of the food pyramid) cannot but affect the final result and the overall state. It is impact that needs to be analyzed and evaluated on a regular basis, the data collected and systematized properly so that we can know at all times what is happening to the ecosystem, how its components work, what we need to do and how we should implement our activities, so as not to further deteriorate the conditions.

In the Black Sea for the period 2014-2016 the average reported catch amounts are totally 447 951²⁴ tonnes. Separately, the volume of discards is around 45,000 tonnes (about 10-15% of total catch). This makes approximately 500,000 tonnes of fish taken annually from the sea. We have to keep in mind that these are official statistics which, quite expectedly, do not include data from poaching and illegal fishing.

Of course, Turkey dominates in terms of catches (72%), followed by Ukraine (15%), Russia (7%), Georgia (3%), Bulgaria (2%) and Romania (1%).

Catch quantity per country



In any case, the analysis show that maintaining current levels of reduction (natural mortality plus fishing) of fish stocks could lead to a collapse of fishing in the foreseeable future.

There are several widespread fisheries in the Black Sea whose impacts of different magnitudes on the ecosystem are discussed below. One of the most discussed methods in terms of bottom habitats is bottom trawl fisheries, which have the highest share in economic value of catches and the second most important after pelagic fishing in terms of catch quantity. Beam trawls, in turn, are responsible for much of the discards (see below) wherever used. In this type of fishing gear the impact on the seabed and the benthos²⁵ is mainly due to the metal bars that support the vertical opening of the net. But overall the problems are mostly related to the weight of the entire structure, which is dragged along the bottom, thus raking and destroying it. It is important to know that the seabed is not just a pad. It is a complex ecosystem of organisms and conditions, the functioning of which supports other marine life. To get a clearer picture, imagine that you are ploughing and destroying a forest which is supposed to provide you with any resources – be it game or wood, herbs or mushrooms – all that it has provided a home for.

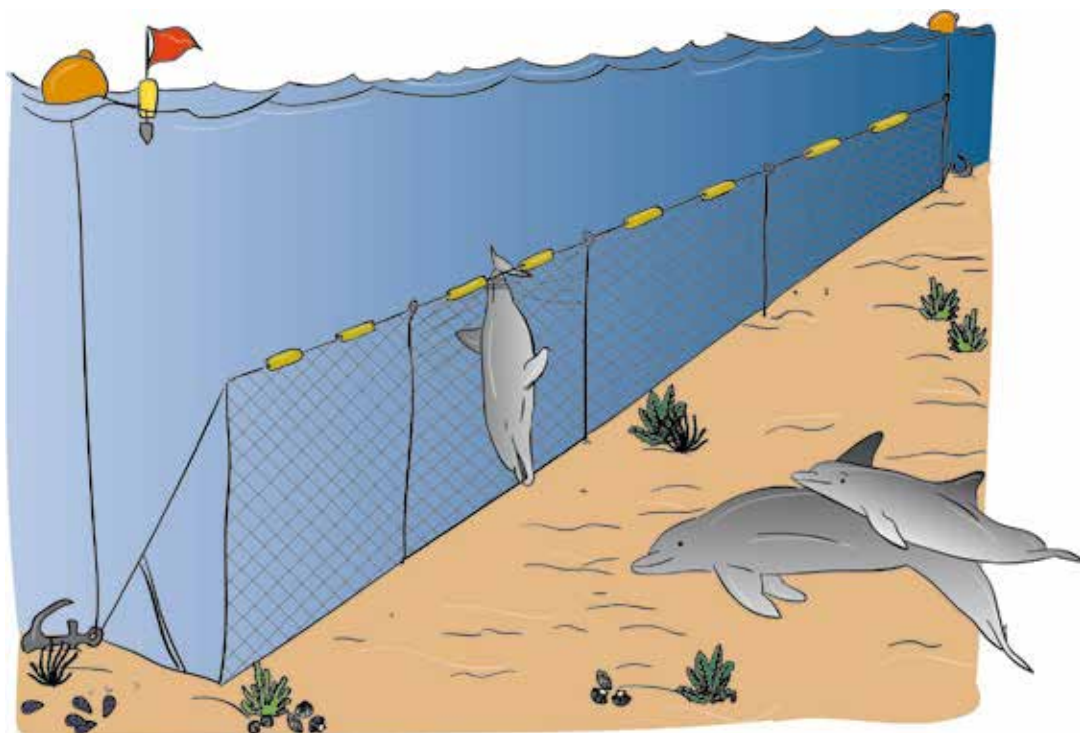


Actually the fact that for most people the seabed is just sand and mud is not surprising at all. Given the importance of the seas for us from ancient times, it is striking how little we know about the conditions in them. By the end of the 19th century everything that was known about the oceans in general was thanks to what the waves were washing on the shore or what the fishermen were taking with their nets. The rest were mostly anecdotes and myths, not facts. The British naturalist Edward Forbes, for example, who studied the Atlantic and Mediterranean bottoms in the 19th century, stated that there was no life in the seas at depth below 700 meters. Imagine how surprising it was when, in 1860, when one of the transatlantic telegraph cables, which was located at more than three kilometers deep, was pulled out, it turned out to have a huge layer of corals, mussels and other living organisms. Quite expectedly, the first organized exploration of the seas in 1872 by a joint expedition of the British Museum, the Royal Society and the British government duly followed.

But now, nearly 60 years after the expedition of Jacques Picard and Don Walsh to the bottom of the Mariana Trench, in 1960, this remains the only descent of a man at such depth. Why is that so? Well, for many politicians and senior executives on whom the approval and funding of such expeditions depend, underwater research is a waste of money. At that time, the countries were swallowed up by space race and the goal of sending a man to the Moon, making the deep sea exploration to seem unimportant and rather old-fashioned. You showed your strength to the world by sending people into the space, not into the sea. And although space exploration, and especially manned flights to the Moon and why not to neighboring planets in the near future, really capture the imagination and carry a wealth of information, it is unfortunate that the scientific community has never been able to motivate and persuade (and it is even more unfortunate that one has to be persuaded at all) the political stratum that exploration of the nature on Earth, especially in the seas and oceans, is not less exciting, not to mention that there is a much more direct benefit to society, as long as we still inhabit this planet and use resources from its ecosystems. In recent decades there has been a peculiar outflow of attention and effort invested in the exploration of still rich variety of species and conditions that Earth provides us with. A trend that we all hope is just temporary inattention.

As a result, what we know today about the seabed is extremely fragmentary and unclear. „If we look at the Moon with a standard home telescope, we will see huge craters – Fracastorius, Blancanus, Zach, Planck and many others familiar to any scientist who deals with the Moon – but they would not be familiar to him if they were on the bottom of the ocean. We have better maps of Mars than of seafloors”, notes Bill Bryson²⁶. And the few detailed bottom surveys conducted in the Black Sea are archaeological or bathymetric.

One very important sector in the Black Sea that we must pay attention to is turbot fishery with a total of 1 099 vessels operating (33 000 GT). This sector is using the so-called bottom gillnets. Bottom gillnets are interesting gear that are submerged at the bottom at a depth of usually about 50-100 meters and extend only in the Bulgarian stretch of the sea for tens, even hundreds of kilometers, blocking in the active fishing seasons most of our coast. Thus, they represent a barrier that obstructs the path of many species of fish, the target species being basically the turbot. The fish are literally entangled in the nets and then removed, in most cases alive. But not only they get entangled. Unfortunately, due to its fine structure and low density the mesh is a physical obstacle that cannot be effectively detected by the dolphin and porpoises's echolocators. The result is thousands of them, entangled and drowned at the bottom of the sea every year. And because active fishing for turbot usually coincides with the cetaceans' breeding season, the calves, which are still dependent on their mothers, subsequently also fall victims and subsequently die of starvation and lack of care. An estimate of global bycatch levels shows that over 300,000 marine mammals are drowned in fishing gear annually.



In the nets of diverse type, in addition to marine mammals and birds, also many other animals, usually non-target species are entangled. By the term bycatch we refer to that part of the catch that has accidentally been caught in fishing gear, in addition to the target species. It may consist of other commercial or non-commercial species (usually returned back to sea) as well as the occasional/incidental catch of vulnerable and threatened species.

A very important part of the bycatch is discards; this is the part of the catch that is of no interest and is thrown back into the sea (most organisms are dead). Discards may include both target species and any other species (commercial and non-commercial). According to the latest FAO²⁷ Global Catch and Discards Statement Report, 7.3 million tonnes of fish (usually dead or dying) are discarded annually from marine fisheries worldwide, which is about 8% of total catch. In the Black Sea discards are estimated at around 45,000 tonnes. However, these surveys cover only a small part of the fishing activity and there is a significant gap in up-to-date information.

Discards have huge negative impacts on the environment and ecosystems. Ethically, of course, this represents an irresponsible waste of a natural resource. From an environmental point of view it has a negative impact on marine ecosystems, causing changes in the overall structure of food webs and habitats, which ultimately puts the fishing sustainability at risk. Discarded catch increases the amount of dead organic matter, thereby affecting the relative abundance of carnivorous species and the spatial distribution of populations. In deep-sea environments where nutrients are scarce the introduction of organic matter from discards will artificially alter the proportion of benthic communities in individual areas, which in the long run may have more serious consequences for the ecosystem. In addition, species with low bycatch levels and corresponding mortality by discards, can increase their numbers in the areas with intensive fisheries and bycatch and this will completely change the structure of the ecosystem. Not to mention that most of the specimens caught and discarded, dead or dying, are usually young and sexually immature, leading to a decline in future stocks of breeding individuals and a reduction in the potential for resource recovery.

Fisheries have an impact not only on the target resources (fish, crustaceans and cephalopods), but also on many other species that are relevant to the functioning of the entire ecosystem, as well as directly (eg. discards, bycatch of vulnerable species, destruction of benthic communities, etc.) and indirectly (eg. species occupying higher trophic levels that rely on the target catch as prey). Fishing for small pelagic species (in particular anchovy, sprat, horse mackerel) dominates in the Black Sea. However, these species are not just a resource, but also play an extremely important role in the food web and are prey to many predators – bonito, bluefish, dolphins, etc. Observations on the biological resources of the Black Sea indicate that for the conservation of sprat, which is the main unit in the food chain, its total catch should not exceed 35 000 t/year. According to official information, in Turkey alone the catch of sprat is approximately 80 000 t per year, in Bulgaria – 4 500 t. And this is only official data. We can with a great confidence assume that illegal and unreported catch exceeds this data many times over.

As a whole, bycatch surveys are not conducted for all fishing gear, nor in all Black Sea countries and most of these surveys cover relatively short periods of time or cover small areas. This data gap underlines the need to extend research and standardize fishing methods to enable comparisons, testing of appropriate methods and finding mitigation solutions. Therefore, actions aimed at collecting more systematic data and more complete

statistics are crucial for analyzing the existing situation in the Black Sea, which would also contribute to closer cooperation between fisheries and scientific communities.

Here are some numbers for Bulgaria. According to official data from Executive Agency of Fisheries and Aquaculture (EAFA) for 2018, almost 1 680 tonnes of rapana whelk were extracted mainly through trawling in the Varna, Kavarna and Balchik regions. An additional 1,800 tonnes of rapana have been collected by divers along our coast. 600 tonnes of the so-called 'white mussel' (*Donax trunculus*, *Chamelea gallina*) were taken. It is documented as divers' extraction, but is known it is made with dredging equipment. Also extracted from the sea are 12 tons of wild black mussel (*Mytilus galloprovincialis*). 3 100 tonnes of sprats, 237 tonnes of bluefish, 167 tonnes of horse mackerel, 59 tonnes of red mullet, 15 tonnes of sand smelt were taken on board fishing vessels. An additional 82 tonnes of sprats, 55 tonnes of turbot, 30 tonnes of horse mackerel, 22 tonnes of bonito were caught in coastal dalianes and other stationary fishing nets. And this, of course, is the official harvest. It's scary, isn't it? We took all this from the sea. But what have we given it in return?

Today, the increasing exploitation of marine resources, habitat use and damage, and increasing pollution are serious threats to the future of the Black Sea ecosystem. Healthy and productive marine ecosystems are a constant prerequisite for maintaining maximum sustainable yield and resource status; fishing and other anthropogenic threats (such as pollution, tourism, shipping, climate change or the introduction of non-native species) are a boomerang that will sooner or later come back and strike on our well-being and that of our children. In order to maintain biodiversity and thus the state of resources, strict criteria must be adopted to minimize and mitigate the negative effects of anthropogenic impacts on marine biodiversity. And this must be done now before it is too late.

ECOLOGY

„MAN IS THE MEASURE OF ALL THINGS“

PROTAGORAS

What is Ecology

So far we have talked a lot about ecology, ecosystems, their conservation and everything to do with how it works. But what exactly is ecology? First, it is good to learn how to distinguish between ecology and conservation biology, and here we will try to explain both. It is important to learn to deal with concepts and terms correctly, because the order in human societies (and especially in science) rests on this. Imagine the chaos that would ensue if everyone started to put into words and concepts the meaning he personally likes.

Ecology is a science, the branch of biology that deals with the relations of organisms to one another and to their physical surroundings, at a population level.

This is the shortest possible definition of the ecology. That is, ecology is biology at population level. What does this mean? Different sciences work at different levels of living matter organization: at the cellular level – cytology; at the tissue level – histology, at the organ level – anatomy, physiology; at the organismal level – zoology, botany; and at the population level – ecology. That is, the subject of ecology are the groups of organisms – populations, communities, ecosystems and the types of interactions between them, just like the subject of cytology are cells.

Common mistakes

Often, ecology is identified with nature conservation or conservation biology. Although the two sciences are closely related (like most sciences, by the way), they still have radically different goals, objects and methods. This misconception about ecology is reinforced mostly by the mass media, which is often heard to say: „Ecologists protested against...“ An ecologist, in fact, is a person who has studied and graduated in this science, and who also practices this profession. Environmentalist, in turn, may be also a non-professional, or any person who carries out activities or is committed to the idea of nature conservation. And people who care for dogs, cats and other stray animals and protect their rights, is correct to call themselves animal rights defenders.

Conservation biology, on the other hand, is the scientific study of the Earth's biodiversity in order to conserve species, their ecosystems and natural habitats. The words underlined are not accidental, they must emphasize that conservation biology also has nothing to do with stray pets on the streets of cities and villages, with fine dust particles or the landfills. Conservation biology uses all the results and data collected from other biological sciences to preserve biodiversity. But even here, there is complete confusion in the media, especially when it comes to problems with polluted urban air and other problems in settlements that are subject to a completely different section of science and completely different methods, insofar as the difference between wild and urbanized systems is significant.

Society and ecologists

Very often regarding ecologists there are unusual over-expectations to deal with any environmental or conservational issue that may arise, or even one related to stray animals, illegal landfills, dirty air/water – anything that sounds like ,eco‘ at all. As specialists and professionals ecologists work with a specific group of organisms or ecosystems, research them, collect data and propose measures, all of which is focused on a specific area of biology that is subject of their interest and competence. Just like engineers, for example, specialize and work in a specific field of engineering science – there are research engineers, process engineers, civil engineers, computer engineers, rocket engineers, hydro engineers and many more. So, just as we cannot expect an aircraft engineer to be involved in, for example, a road construction problem and this to be considered as his engineering duty, so we cannot expect ecology specialists to solve any problem sounding as an ecological to us. If you have a problem with your computer, you bring it to a repair shop and you do not expect every computer professional in the country to engage with it just because it is a computer specialist with a degree, right?

As young sciences ecology and conservation biology have many social problems and obstacles to go through and to deal with. This, in addition to technical and financial problems, slows down and often completely hinders the work of professionals who, rather than doing their job, have to convince the public of the need to take care of the environment. Which, you should agree, is ridiculous in the 21st century. Often to ecologists automatically are transferred negatives by the actions of citizens, acting on the basis of their high emotions and demonstrating, for example, aversion to humanity as a whole or fighting for the rights of animals, people that are hostile to technological advances or other advances in civilization. These are generally examples of harmless emotional reactions, which, although extreme and unscientific, are dictated mainly by the way in which these people perceive nature, and are more a matter of personal choice that has nothing to do with ecology and scientific methods, which it follows. Just imagine what a breakdown in healthcare would occur if the work of all doctors and medicine in general were hampered because of the existing of charlatans trying to benefit from counterfeit drugs and treatments. At the other end of the spectrum are the utmost enemies of everything ecological. These are people for whom wildlife conservation is a completely unnecessary whim of the ,‘greens‘ and a waste of money. Of course, from what you have read so far you already know that this is not the case. Either way, these are the two extremes in a very popular issue that will become increasingly important to us as the human population grows, and let each of you decide for yourself which one of these extremes is more dangerous to society and why.

That's why the support of the society is crucial for science, so that together we can improve the knowledge and understanding of all people, and thus the quality of life of the entire society.

Short questions and answers

Who are OceanCare?

OceanCare is a Swiss organization for protection of the oceans through various activities such as study, campaigns, environmental education and active participation in a number of international activities. In 2011 it was awarded a Special Advisory Status on Maritime Affairs by the United Nations Economic and Social Council. The partnership with Green Balkans NGO has started in 2017 and thanks to the support by OceanCare five surveys on distribution and abundance of marine mammals in Bulgarian Black Sea territorial waters have been made.

Who are Green Balkans?

Green Balkans NGO is one of the oldest nature conservation organizations in Bulgaria. Established in 1988 by a group of biology students and their professors from the Faculty of Biology at the University of Plovdiv with an interest in biodiversity conservation. Among the main areas of work are activities on the conservation of species and habitats, environmental education, capacity building. The Conservation Program for the Black Sea Cetaceans started in 2006 and its main objective is to identify important areas for cetaceans in Bulgarian territorial waters. Since 2013 the association has the status of an official ACCOBAMS partner – Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area.

Why do we „count” dolphins?

Very often people are surprised to hear that a team of ecologists will count dolphins and even wonder if this is possible. How are dolphins counted? And rightly so. There is no clarity on the matter, little is written and explained. Why should someone count dolphins or any other animals? It seems as some people have no other job and because they enjoy watching dolphins, they started counting them.

I will again transfer responsibility for all this confusion and misunderstanding to the media. We often read or hear in a report that „a group of ecologists will count dolphins, birds, reptiles“, and such a misconception of ecologists as idlers, who, when not engaged in protests, being bored count different useless things. Responsibility for this misconception also lies with the state, which is often the one to commission surveys within which the species are „counted“, but does not engage itself to deliver the results in a non-specialist form, does not engage in publicity outside, no way to save it, the extremely sparse and poorly designed website the law obliges them to maintain. It lacks the will to explain to the society the science that was being applied, the reason for its application, and the results that have been achieved. This is done only on the websites of individual NGOs

engaged in public awareness and attitudes, but which websites even in our most optimistic expectations are hardly visited by people who are not directly interested in the topic.

So here we will try to explain in a few words why and how the species are counted, and in particular dolphins, in the hope that this booklet will be yet another attempt that information to reach wider audience.

First let's clarify that the right term, no matter what you are used to see in the mass media, is to **determine the population size or density of a species or group in a certain area.**

In very few areas of the ecology direct count of individuals in an area or sample is applied. This is usually done in botany, in microbiology, and generally where the objects of the study are not mobile. But even there no absolute values are used, but the results are extrapolation of the counted sample on the basis of optimal habitat²⁸, thereby obtaining the population size/density of the species in the entire studied ecosystem. Suppose you want to determine the microbial diversity in Antarctica, that is, how many species of bacteria the soil contains there. What you will do is not settle permanently in Antarctica and devote several lives to enumerating all the microorganisms there. Instead, you will examine the diversity of DNA in several samples to determine that it is about 10^4 different genomes. And based on that, you will estimate that the expected number of prokaryotic²⁹ species is approximately 10^4 to 10^9 .

People do not like bacteria and microorganisms at all. They are small, invisible and cannot be viewed and examined with naked eye. So let's give another example with a group far more familiar than germs – plants. Let's imagine that we are tasked with determining the abundance of wild strawberry (is there someone that never heard of wild strawberries) in a forest. And here, like the microbial diversity in Antarctica, we cannot count all the plants of the species in the forests around the town of Kotel. However, we can determine the numbers in several test sites, for example, meter by meter, in which this is actually achievable, and then extrapolate the obtained results based on the previously studied area of the habitat suitable for the species in the respective forest. Thus we will have the population density of the species in the region, but not the absolute value of the number of all individuals.

Something similar is the „counting“ of dolphins in the Black or any other sea. The team of specialists moves along predetermined routes/lines (transects), taking into account the number of individuals observed, after which specific software processes the collected data and presents the results with certain deviation limits: it is important to know that due to sampling, the result cannot be absolutely accurate. So far so good, but how sure are we that we don't repeat, that we don't „count“ some individuals several times? A serious issue that often bothers the people we talk to and that actually makes them doubt the reliability of our work. One of the most common world-wide methods for calculating population density is the so-called *distance sampling*. The method generally works with probabilities. It is based on the concept that the likelihood of meeting an animal of a species decreases with increasing distance from the observer. And vice versa. The same happens with this probability and if the population of a species is of low or high numbers and density, respectively – lower numbers/density leads to less frequent observations. This, of course, is figuratively speaking, and it does not at all exhaust the complexity of the calculations that lay in the development of the method. But we hope now it is clearer why it doesn't matter if the dolphins we see when we „count“ them repeat. The frequency with which they are registered, or more precisely the likelihood of this, is the important thing.

If, in spite of all this, the „counting“ of species still bothers you and sounds frivolous, you may want to refer to other closer fields of science – medicine, for example, which in similar way obtains information about the number of your blood cells or a component of your biochemistry. Methods for determining the abundance, biomass, biochemistry and other parameters of living ecosystems and organisms vary depending on the object and the purpose, but as a whole they have one common characteristic – the state of the whole object is analyzed on the basis of a relatively small sample.

Can dolphins eat all the fish in the sea?

In our work we have been confronted with all the amazing fears that people have expressed. One is the concern that dolphins can become so many that they will eat all the fish in the sea. Some go even further, fully convinced that dolphins are already too many and that's why there is not enough fish for us humans.

We have already examined above why it is impossible for a predator at the top of the food pyramid to multiply to such numbers and deplete the resources of its environment. We also noted the low numbers of the three species of marine mammals in the Black Sea, despite the measures adopted for their conservation and the reasons for that. You probably remember that marine mammals are extremely slow-breeding animals, and the rapid increase in numbers is impossible.

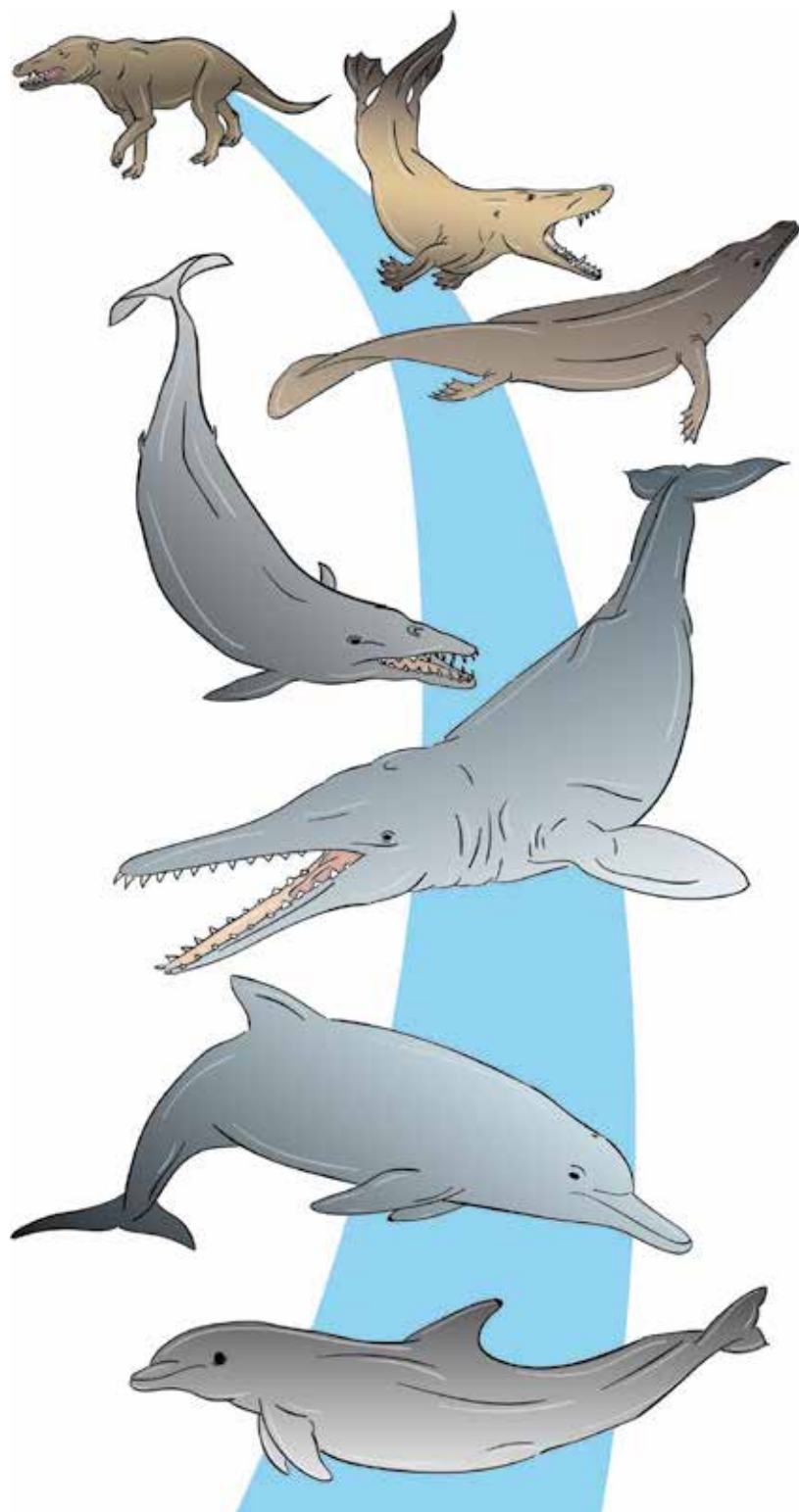
In addition to this, let us also look at the results of our studies over the last three years in the territorial waters of Bulgaria in the Black Sea, which cover an area of about 6,300 square kilometers. The first expedition took place in June 2017, with the largest number of cetacean sightings recorded: over 240, which translated into numbers for the three species shows about 9,300 harbour porpoises, 1,300 bottlenose dolphins and 2,700 common dolphins, or just over 13,000 individuals in total. However, in June 2018 survey the numbers were quite different – only 55 observations were recorded, of which calculations showed numbers for the three species were significantly lower than the previous year: 2,100 porpoises, about 360 bottlenose dolphins and 550 common dolphins. During the October 2018 survey – a season when fishing in our waters is in full swing, cetacean numbers do not show higher levels compared to June 2017, but there was still a slight increase compared to June same year for the two dolphin species: 1,500 bottlenose dolphins and nearly 4,400 common dolphins, while the porpoises retained in their lowest reported value for all studies conducted – about 1,300 individuals. And if you are not puzzled enough yet, here are the results of our last survey in May 2019 when we recorded a total of 168 sightings and the numbers of the three species, respectively, were: 10,300 porpoises, 1,000 bottlenose dolphins and 1,300 common dolphins. In short, all these data show us that the total abundance of cetacean mammals in our territorial waters ranges from 3,000 to 13,000, which is very far from the millions of dolphins spoken in some marine stories at the media.

However, apart from everything else we have looked at so far, there is a much more important reason why we have no reason to believe that fish in the seas could be eaten by dolphins if we, the people rescuers of the fish, did not intervene. And this reason is called history. Or in biological language – evolution. The origin of dolphins dates back to millions of years ago. In fact, some of the earliest ancestors of marine mammals that lived entirely in the water (not sure if you know, but dolphins originate from terrestrial animals secondary adapted to aquatic life) – the Basilosaurus – inhabited the oceans 40 to 34 million years ago during the Eocene period. Fossils of another ancestor of modern cetacean species, the Cetotherium,

which inhabited the waters of the prehistoric sea that flooded our latitudes 10-15 million years ago still can be found in strata along our northern coast, around Varna.

And what should all this show us? Dolphins have been inhabiting seas and oceans for millions of years. Long, long before us, humans. For these millions of years they fit in an extremely harmonious and elegant way into the balance of their ecosystem and the fact is that they have not eaten all the fish in all that time, even though we were not there to control and save it. But suddenly, almost a hundred years ago, industrial fishing came up, the effects of which we looked at above, and dolphins suddenly started to eat all the fish. Agree that it sounds frivolous. In fact, the modernization of fishing technologies and methods, as well as the globalization of trade, have led to catch of fish on an unprecedented scale in ecosystem history. Fish is simply not given a chance these days. Population growth (the so-called demographic explosion) is also something the world has never faced before. At the time of writing this book the number of people is estimated at just over 8 billion. All this, combined with the failure to comply with the recommendations of global environmental legislation aiming to regulate such a valuable resource in the long term, as well as poaching and unfair competition, is leading to a reduction in fish stocks. *„Anyone who believes that exponential growth can go on forever in a finite world is either a madman or an economist“*, says David Attenborough³⁰ with its inherent wit.

The long-term stable condition of the resources we all need is important to society. Keeping these resources in good condition is a duty of each of us to the extent that we all take advantage of them. And their source, as we have already learned, is ecosystem biodiversity. Of which we cannot only irresponsibly extract without care what will happen tomorrow or in a year or after 100 years. Today's actions can be tomorrow's assets or liabilities. It is up to us what our future holds. This is what we teach our children. And these actions cannot be tailored to one's preferences and whims, they can only be dictated by the scientific data that experts collect and analyze.



How each of us can help dolphin study and conservation in the Black Sea?

There are few studies of cetaceans in the marine area of Bulgaria and data on distribution, numbers, seasonal dynamics, migrations, preferred habitats are extremely scarce. Gathering all the information from the observations of these species and creating a national database is extremely important to fill the scientific void. This will be the basis for identifying and developing specific conservation measures for these marine mammals.

If you live along the Black Sea coast or your job involves regular sailing in the Black Sea, you can support our mission to study and conserve dolphins. Any help, though small, is welcome and helpful!

You can submit your dolphin sightings including dead and washed ashore dolphins using the BlackSeaWatch application freely available on the Internet (www.blackseawatch.org) or by e-mail to the Green Balkans NGO, providing the following data: species, photo, body length, exact location, date and time.

The best and easiest way to help protect dolphins directly is by volunteering for the Green Balkans Conservation Program for the Black Sea Cetaceans. Your participation will help gather information about these little-known marine life through the so-called Citizen science method – collecting observation data or regularly monitoring target species by non-professionals.

Anyone can become a volunteer. All you need is enthusiasm, binoculars and a little patience. If you live on the Black Sea coast or spend a lot of time there, or plan a visit, you can also spend some time watching, recording what you see or don't see. The second is also important because the basic rule in ecology is that lack of information is data, too. Thank you for taking time to read this book. We hope that we have contributed at least a little to a better and more complete understanding of the natural ecosystems, their functioning and the work of the people who care for them. We look forward to your feedback on the contacts above, to let us know what you liked or disliked in the text, what you would like a similar booklet to contain, and things that have remained unclear. We would be glad if you spread the book so it can reach more people. Give the book to a friend as a gift or to your child, show it at school, or discuss it with your professor. And the most important thing to remember is that **you cannot overdo it with nature care.**

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DOLPHIN EXPEDITIONS ACROSS THE BLACK SEA

Sea-scripts from Research Yacht Kaliakria

TEODORA ILIEVA

Cast:

Stoyan Georgiev (Captain Stoyan)

Mitko/Dimitar Popov (Mr. Popov)

Poli (as herself)

Toni (Annie Wild)

Teodora Ilieva (That's me – Teddy)

Galya and Galya (I'll explain later)

A few hundred dolphins (not going to name them)

Sailing yacht Lady Kaliakria (just Kaliakria for her friends)

***Any resemblance with actual people and events is NOT
coincidental.***

We exist and this really happened.

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Prologue

“Green Balkans” is a leading NGO in the field of nature conservation, established in 1988. Besides other things, cetaceans’ conservation is one of its priorities. Many experts and volunteers participate in projects, focused on marine mammals and inspired by the sea and the feeling of satisfaction, which is inevitable to experience when you have the chance to work with such amazing animals like the dolphins.

For more information about Cetaceans in the Black Sea, their status and populations, please contact Green Balkans. The following script doesn’t have educational purposes. Its aim is to shed some light on the lives and activities of the survey team, during three of the four cetaceans survey expeditions in Bulgarian territorial waters, conducted between 2016 and 2018. (And also, to entertain the aforementioned team.)

Life isn’t work only. There is fun, there are ups and downs, but most importantly – there is love. So, this is a story for love as well –love for nature, for the sea, the life, the universe and everything else.

The first expedition was with another yacht, in 2016, but we were in a hurry then (as much as you can hurry with a sailing yacht) and couldn’t completely explore the emotions I will tell you about in a while. So, make yourselves comfortable and let’s begin!

Cetaceans part 2: why the Black Sea is blue, are the dolphins easy to study and other useful questions?

JUNE 2017

We are preparing for the anxiously awaited marine scientific expedition (quotation marks not needed) for surveying the cetaceans' populations in Bulgarian territorial waters of the Black Sea. After few much similar survey-expeditions conducted in 2016, we feel like experienced sailors and dolphin observers (meaning – we have sailed, we have seen dolphins.)

Of course, the previous expeditions were somehow different. First of all, we didn't account for the weather (as much as we wanted to do so) and as a result we sailed through a thunder storm, watched an indescribable rainbow over the sea and enjoyed the sunset in the famous bay of Irakli, completley sober, because we couldn't reach the shore to obtain beer. But that's another story.

Now the participants are almost the same: me – an ecology student, searching for a purpose in life, Poli – soon-to-be an ecology graduate, a photographer, ornithologist in formation. Nikolay from Varna (whom neither me or Poli have met), the inspired dolphin observer and athlete from Stara Zagora Toni and of course – the leader of the project, the expedition and other things – Mitko/Dimitar Popov, who from now on will be respectfully called “Mr Popov”. We are doing serious work after all. Saying “Mitak, pass the rakia, would you?” is unofficial and discredits our endeavour.

So, with a little of experience, a lot of inspiration, couple of binoculous, a camera and eight bags of food (and beer, duh) we head east-north east, towards the town of Balchick, where the yacht is. (Temporarily – OUR yacht).

Departure

As we know very well by now, the weather at sea is difficult to predict, so we haven't decided on a specific day for departure. It's actually “tomorrow” whenever that happens to be. And it happens to be exactly on Poli's birthday. (She had better birthdays, I'm sure, but she won't easily forget this one). Poli wasn't particularly excited, but considering her day job boss (who didn't want her to go anywhere at all), her cat Orpheia (who was supposed to eat for the next week) and her apartment's keys (related to the cat's food), Poli didn't have much time for regrets.

So, she packed for roughly ten minutes (impossible for me) and we only had to load it and leave. We were one our late, because of me, for reasons even I, myself, couldn't fully comprehend.

After the initial excitement of the departure, the trip went normally boring. We arrived in Varna late at night, picked up Nikolay, and headed straight to Balchick – one of the nicest places at Bulgarian Black sea coast. (Probably because we have a yacht.) And the yacht herself, chartered in the last possible moment and almost accidentally, looks promising. We are going to get up

early tomorrow, so we bring the luggage to the yacht (four people, four loads each) stack the food in the fridge, our sleeping bags in the cabins, and ourselves in the sleeping bags and fall asleep, gently waggled by the sea. (We are at the marina, but let's not spoil the moment.)

At five am we meet The Captain and the owner of the yacht (capitalized on purpose), who made us coffee, then we went towards Cape Kaliakra. This is a particularly beautiful place, that appears magical looked from the sea side. I was so excited I took over 50 pictures, but it's the sensation I won't forget – the yacht, the calm sea, barely noticeable waves, the blue sky and the fresh morning air. Everything around us is moving fluidly, we ourselves are moving. But the cliffs – high and red –are solid and still as they have always been (or at least for a very long time).

When we sailed back the waves were bigger, violently crashing against the rocks; there were tiny boats, balancing disturbingly on the surface and the cliffs remained – huge and invincible even for the force of the sea.

We arrive in time for the first transect, and leave the romantic thoughts for later. Dolphin observation isn't an easy job, and we are determined to do it perfectly.

Captain Stoyan

No one knew anything about The Captain, because our plans changed few times during the past week (so did the weather, of course) and we chartered this yacht at the last moment (yesterday). But The Captain turned out to be a very interesting person – with an adequate, intelligent and extremely professional attitude, unflappable and unconcerned by the fact we did a tiny mess on his pretty yacht (we found out how exactly „tiny” the mess was after he managed to clean it, but I choose to believe it was inevitable). Besides, The Captian demonstrated incredible patience for our total lack of knowledge on the subject of sailing and kindly explained what is “a *spinnaker*”, “*heeling*” and what the sea has to do with knots. We learned that “*grog*” and “*grot*” are conceptually different things and where we can find the keel (for the more curious of us – what's its purpose).

The man turned out to be an experienced and knowledgeable sailor with the typical unperturbed attitude for the constantly rising little problems. With his delicate sense of humor and sincere interest in our endeavours he turned the expedition into a real adventure for which, I believe, we are all greatful.

Botany, ornithology, dolphins here and there

After the first day of observations, as scheduled, the weather worsened, so we are staying in Balchick. The weather worsened at sea, not in Balchick, though. Poli and I decided to visit the infamous Botanical garden of Balchick (after a short discussion is it worth the fee). It was worth the fee. At least because of its uncountable collection of succulents, including a cacti forest! Also, there were all kinds of trees, shrubs, flowers, meadows, alleys, arches and a spectacular view of the sea. A truly beautiful place. We were delighted. At the end we smelled all the roses, because there should be time for that, right? I had a nice memory with the smell of roses and sea.

In the afternoon, with the kind assistance of Mr Popov and his irreplaceable ornithology knowledge we traveled north, to research Cape Kaliakra from the coast side and try to observe wheatears, swifts, harriers, larks, gulls, a naked Romanian model with a bunch of photographers (unexpected) and harbor porpoises in the bay.

Afterwards we visited the nearby archeological reserve with the unpronounceable name “Yaylata” which had an unimpressive old ruins, but a very impressive view of the sea. Standing at the highest point, we watched a group of dolphins till it got dark (in scientific lingo – we studied their feeding habits).

Finally, we traveled back to Balchick during a thunderstorm, and our car broke, so we had to leave it in a garage outside the town. The cab arrived with half an hour delay, but this inconvenience was compensated by the conversation the driver and Mr. Popov had.

- “Where should I drop you?” the driver asks.
- “At the harbor... I mean the marina.” Mitko replies. Poli and me keep meaningful silence.
- “You are at a hotel there?” The driver gets curious.
- “No. A yacht.” Mitko says casually. The driver shuts up. We had a good laugh later. Dolphins are one thing, but there are so many other adventures, especially when we are that eager to learn.

Why the Black Sea is blue?

After the breathtaking landscapes of Cape Kaliakra, Krapets, Karadere, the sea and the sky, after two days of sailing following transects, dolphin sightings and staring at the horizon, the weather worsened again (as scheduled, of course). This time we are in Varna, comfortably moored at Port Varna, eating ice cream (I mean drinking beer) and discussing the future. In the meantime, I was surprised to learn that the magnificent bright blue color of the sea at this time of the year is not caused by the light, or by the polarization of my sunglasses (as I believed last year), neither by cyanobacteria. This is a normal event, caused by green algae called *Emiliania huxleyi*, which is globally spread. To reveal the mystery I had to go to the Institute for Oceanology, and they even let me see it under a microscope (not impressive at all, it's the quantity that counts).

In the evening we meet with the last member of the team, Toni. This is followed by a nice dinner, drinks and on the next day we turn south, for the last leg of the expedition, expecting only good weather.

Another dimension

Sailing is a tricky business. You have to understand the sea, the winds, the waves. Captain Stoyan is an experienced sailor, though, so no matter what kinds of surprises we encountered (and there are always surprises at sea) our adventures were mostly positive. Between the transects and the dolphins we circled around heavy black clouds, we watched a thunder storm over the shore (truly impressive sight) and followed the moving shadows of the clouds over the shiny blue water. When we were too hot, we just stopped, jumped from the boat in the middle of the sea, swam a bit and then continued (to be honest, it happened twice, but it was 80 meters deep). When there were winds, we put out the sails and that's when we realized how exciting sailing can be. Also, what is the meaning of the mysterious word “hiking”.

Performing various chores tilted at 45 degrees angle at all times, when you are moving ahead with 8-9 knots, and everything is shaking (not a scientific term) had a significant effect on my perception of sailing. It's difficult. But it's even more difficult not to acknowledge the beauty and the (almost) perfection, surrounding us – sea and sky, becoming one another at the horizon; blue, purple, green and white. Smooth and calm, or wavy, with that wind, blowing

my mind free of insignificant thoughts; with endless sunsets, the smell of adventures, and a hint of nostalgia. Because no matter how incredible the sea is, our home is the land. But the world isn't only land, two thirds of it is sea. Huge, incomprehensible, favourite blue. You only need a boat, a sail, some wind and courage. Long ago people have conquered the sea, we have sailed across all of these two thirds of the world. But that deep, mysterious, constantly changing sea will always remain hurtfully attractive – simply another dimension. That feeling, to have hundreds of meters of water underneath is humbling, but also inspiring. The land is home, but the sea is a different experience, a different dimension of reality, which changed forever my perspectives of life, the world and the Universe.

Cetaceans observation 101: Can they stay here?

A dolphin (cetacean) is a marine mammal, naturally living in the water. It doesn't go ashore and usually eats fish. Also, it surfaces occasionally, to breathe. And that's when we can observe it. So, a 13 meter long boat is moving through the waves, at 7 knots cruising speed. Direction isn't important, because the boat is following a precisely set linear transects (an almost straight line). The transects are set in zig zag patterns (north-west, south-east) and cover the 12-mile strip along the coast: Bulgarian territorial sea. Two people – dolphin observers (I'd like to call them researchers – Poli and me half of the time) – are sitting three meters from the bow, watching the sea. One takes starboard side the other – port side. This is happening under sun light, wind, occasional splatters from the waves and constant shaking, wagging, rolling, which has a certain rhythm, until it changes rapidly. It's mandatory to hold on to something, so you don't slide overboard, and few times we even wore life vests.

It may be hot, or cold. The sea changes by the hour. But there it is – a fin! I spot it in a second as something differing from the sea. Sighting! I take the binoculars. Is it going to surface again? Yes! I measure distance, mark the location with the GPS that is hanging on to something nearby. I check the sailing course and the glare. It's all recorded on paper forms. Did I mention the wind and the wave splashes? Oh, yeah – there are three species of cetaceans in the Black Sea. From the part that surfaces once or twice you have to determine the species; how many are there and where are they going to (most often on dolphin business). It's not easy, on the contrary – it's hard. It's hard to stare at the horizon for 12 hours a day, under the sun, and to have uneven tan stripes. It's hard and sometimes I get tired of the constant wagging. (I'm just about to sip my coffee and it all spills over me!) But I never get tired of seeing the incredible, amazing dolphins (cetaceans, to be scientifically correct). I never get tired of yelling "Where?!" when someone else spotted a fin, and I never get tired of watching them swimming, jumping, diving and jumping again 50 metres away. I never get tired of admiring these beautiful creatures and chanting in awe "Oh, they are so prettyyy" a hundred times a day.

And somewhere along the way I remind myself: the sea is their home. We are guests.

Cetaceans are among the most intriguing animals existing. They are marine animals, but they breathe like us. They are big, strong and a little daunting, but also intelligent, charming and curious, like us. They are part of our world, never mind they live in the sea, and just like us they are vulnerable and sensitive to the changes happening in their home.

The expedition is over, we came back home, but the dolphins remained in the sea. They were home already. The threats to their life and very existence also remained there – hidden under the surface at first glance, but obvious if you pay attention. The sea is still huge, blue and attractive with its breathtaking landscapes and awesome creatures and we, humans, need to remind ourselves more often that we are making the decisions – for the dolphins, for ourselves and for our home.

Cetaceans part 3: Expedition backwards

MOTTO OF THE EXPEDITION: "NO DOLPHIN TO REMAIN UNCOUNTED"

JUNE 2018

Emotional start

It's summer again and dolphins' expedition time is comming. Poli and me are traveling from Plovdiv to Tsarevo, where tomorrow we will board the yacht. We are inspired and decide to go and meet the sea. As usual it is so amazingly blue and infinite (but not warm enough for a swim). We take a walk on the beach, drink beer and do some romantic photos (shoes, feet, sand). On our way back, we unreasonably decide to take the road that goes along the shore. To clarify – the shore near Tsarevo is mostly high cliffs, and the road is more like a trail. Who knew it's ticks' mating season? At some unforgettable moment, I look down at my feet and they are covered in crawling ticks. Poli, having a particularly negative experience with ticks, panicked slightly (by slightly, I mean she ran towards the edge of the aforementioned cliffs, took all of her clothes off, and almost threw them into the sea). I didn't want to get a tick sucking on my blood, so I followed her example with the clothes. Anyway, we cleared the ticks, but how do we get back to Tsarevo now? We ran. We tried rock climbing first, but it was a bit dangerous and in my theory ticks are slow. Poli just wanted to get away from there and lost her sunglasses, but insisted it's a small price to pay for staying tickfree. We came back to Tsarevo tired, hungry and not in a good mood. But there is nothing two beers can't fix and there is a whole scientific expedition awaiting us. A bunch of ticks (hundreds, according to Poli) won't ruin it for us.

RY Kaliakria (RY is similar to RV)

The difference between a ship and yacht is its purpose. Research vessels, where people work, are usually ships, yachts are used for pleasure. Considering Kaliakria is both, she became Research yacht Kaliakria. So, Poli, me and our backpacks board RY Kaliakria and meet Galya and Galya. For them – later. The sea, we are certain, is excited to see us. As we are sailing, we enjoy the familiar landscapes with the specifically round shaped cliffs, different from those of the north coast, but equally impressive. We reach the port of Sozopol, where after a short walk around the town, logically, we end with beer. Obviously, Romans and other ancient people have inhabited the coast as there are many ruins, fortress, etc. that are not exactly uninteresting but just nothing special. Tomorrow, as scheduled, the weather should worsen but we can't do anything about that, therefore no one is worried.

Let me tell you about RY Kaliakria and her crew (us for the time being).

Captain Stoyan, of course, with his typical unperturbed style, patience and delicate sense of humor. He has new stories to tell and we can't wait.

Galya – Captain Stoyan’s captain, so to say, with an impressive wit, casual charm and adorably caring for everyone (“*Who is drinking water? Are you sick?*”). She got excited by our agenda, took out a selfie stick and decided to take some pictures with the dolphins. And she succeeded.

Mr Popov – leader of the project, main dolphin observer and the reason we are all here. (Thanks!)

Galya – Mr Popov’s captain. Besides dolphins, she is knowledgeable in ornithology and space research (“*One ticket to Mars, please? Yes, one way is fine*”). She has a very specific sense of humor that almost got me suffocating a few times.

Toni (aka Annie Wild abroad) – well informed about all kinds of dolphins and other marine mammals, motivated and inspired to make the world a better place. By the end of the expedition she managed to inspire us too.

Poli, you know her – an ecologist by education and a dolphin observer by chance; recently – a mother of vultures and a junior ornithologist.

And myself – as usual inspired to explore all the emotions of the sailing, the dolphins and the sea in general.

Kaliakria can fit up to 10 people, so we are comfortable. The food is almost enough and the beer never ends (we’ve learned from previous experience). It turns out we eat more than we drink, for Galya’s surprise, but cetacean observation is a difficult job, despite it doesn’t really seem such.

There aren’t many dolphins, though, which is discouraging and a little sad. (Fishermen usually claim otherwise, but this year there aren’t many of them as well, so we couldn’t hear their expert opinion.)

Along an azimuth

The lack of dolphins and the bad weather forecast aren’t a reason for despair. We leave port of Sozopol on sunrise and Poli is using the breaks to clean the deck (later she used the vacuum cleaner). No dolphins yet, but at least the weather forecast was correct – it’s raining. We managed to avoid the storm and sailed to Nessebar “along an azimuth”. I wondered what exactly “azimuth” means? Obviously, it’s something to do with navigation, I’ve heard it before. The scientific explanation contains a mindbending combination of angles, planes and horizons, which prevented me to understand the concept completely. Galya solved the problem: “It’s the shortest route, following a straight line”. After a while I finally got it. It’s just the direction of sailing, using a compass. Who needs all these angles and stuff? So, along an azimuth to Varna (and a few transects, but let’s keep it simple). Dolphins show up now and then but, in the end, they come next to us for a decent photo session.

Around Cape Emine a tiny bird comes aboard. It travels with us almost to Varna and doesn’t mind posing for pictures. Thanks to the internet we cause confusion and indignation in some famous bird experts, because our little hitch-hiker resembles three different bird species simultaneously. The fact we met it on a yacht, which apparently is not its natural habitat, didn’t help much. In the evening at Varna we made a decent dinner with fresh mussels from the pontoons. (I’m glad I don’t eat mussels). Poli and I did our traditional walk to the store for ice cream (I mean beer) and met with a colleague of mine and her friend.

The friend asks: “Why are you in Varna anyway?”

Me: “We are on a survey for dolphins. We just moored. With a yacht.”

Poli: “Say it more humbly, please.”

The friend (staring at me): “No, no. This can’t sound humbly.”

Then how am I supposed to explain that cetaceans’ surveying is actually pretty difficult?

Where are the dolphins?

Following the transects, we do everything else, except to encounter dolphin, which by day three becomes a bit annoying. Not that we are not observing carefully, on the contrary. There are just no dolphins. We speculate it’s connected to the lack of fish (which migrate during autumn and spring), but no one really knows. As real researches we try to be objective and accept the facts. There are no dolphins. Lack of data is also data, Mr Popov tries to convince us. The important part is to not give up. Meanwhile we discuss the life, the future, the World and the Universe. Toni, as more experienced sailor, tells stories, and Galya and Galya are so unbelievably funny I can’t stop laughing and at some point, I’m weeping. The Captain tells us a bit of adventurous stories and I start dreaming about sailing beyond the horizon.

While we enjoy the sailing, we contribute to the Bulgarian language, inventing few new words: “Facebooking” obviously meaning “staring at your phone and uploading pictures with the yacht, so everyone else can envy us” and “mermaiding”. Use your imagination, but consider that there are 5 (I mean five) ladies on board.

We arrive at Balchick by sunset, the sea is flat and the landscape is impressive, as usual. Kaliakria will undergo a bath and we plan to have a break tomorrow, so we stay late.

With Kaliakria to Kaliakra and why I do like Balchick

In the morning, after a short and confusing briefing (we had coffee and talked about the upcoming tasks) we split. I go to take a walk around town (I mean hills). In this town only the promenade is not hilly, but that’s what makes it special. The most impressive are the many fences, sidewalks and stairs made of the typical Balchick limestone, with fossils from all kinds of shellfish and other prehistoric creatures. All rocks in the area are of this type. This is possible because all the hills were sea bottom some million years ago. Logically, we can call the locals “sea people”. So, the aforementioned limestone fits perfectly with the modern architecture (interesting, right?) and in combination with the mountain-hilly terrain and the sea at your feet creates a specific vertical atmosphere I can’t compare with anything else I’ve seen. I notice that the asphalt is potholed here and there, but the limestone is intact, just like when it was at the bottom of the sea. Balchick is a strangely pleasant place. The stadium is on top of a hill (how do you actually call these?) and the beach is 30 meters long, more or less. I didn’t see any pedestrians, but walking down took me one fourth of the time for climbing uphill; the streets don’t follow any logical organization, as if they were aiming for the shortest route to the sea. The stones are interspersed with few flowers, weeds and all kinds of shrubs, which made my walk colourful and refreshing. And last but not least, on top of the highest hill, there is a large sign, reading “BALCHIK” in Cyrillic. Definitely a unique place.

I walk down to the sea and focus on dolphins. After a short transect we sail towards Cape Kaliakra. The most beautiful place on Bulgarian coast in my opinion (and I'm prepared to argue about it). The wind is with us (tailwind) and Galya discovered what "heel" means (according to her: the feeling that makes you scream when the boat tilts sideways due to the wind in the sails). Two beers later she gets used to it and I will always remember the sound of the wind, the speed and the movement itself, while Kaliakra closes on the cliffs of the cape. Then, we observe some cormorants, and drift around, fishing horse mackerel (I'm not fishing, because someone had to take photos). Long story made short: drifting means to let the waves waggle the boat around, which is slightly annoying, if you are doing something involving liquids. While the others are fishing (some trying to untangle the line from the poles and themselves from the line) I'm watching the sunset. No feeling like this one. The red cliffs bathing in the golden light, the constant movement of the waves, the unusual closeness of the sea and the contrast between the fluidity of the water and stillness of the rocks. It's a magical place that inspires me and not only me.

Fortunately, Galya and The Captain know how not to entangle their fishing poles and lines, otherwise we might have ended up with no dinner. We snack, enjoying the silence and discuss the lack of dolphins and the abundance of plastic trash in the Black Sea and in general.

It's an interesting experience to be anchored off shore or so we, as young sailors, believe. We have everything we might need – enough beer, water etc, but we can't get off. We are here – small boat full of people, surrounded by a huge sea. Inspiration continues.

Border

Last transects take us to the Romanian border and the coast guard becomes particularly interested in our coordinates (we didn't get why). Meanwhile we are mermaiding full power and the landscapes make me smile and sigh. The blue, infinite sea, low hanging clouds, the sky, fading towards the horizon, the green of the forest and the yellow of the beaches. All the important colors of the worlds and lots of them. We meet few boats, three Romanian dolphins and the wrecks of a sunken ship, probably a tourist site. I slowly realize it: borders exist on land. At sea, there are only waves and winds. Overall, the borders in nature have a slightly different meaning than those created by people.

The fact there are no dolphins doesn't ruin the experience. One of the new things we've learned is that the most important thing at sea is safety (not beer, as I was convinced during the previous expedition). We read "Sea stories" – short stories book that found Poli in a dusty bookstore and really wanted to come with us. We gave it to Kaliakra, to inspire other sea lovers. We promised ourselves more stories with main characters the dolphins and ourselves. We talked about how important is for the people to start acting smart.

We found out how accurate could the forecasts be (if you are using three different web sites and have a lifetime of experience in sailing across the Black Sea, I mean). We felt as explorers, sailors and most important – we felt as part of something bigger than ourselves, crowded on a small boat, dependent on the mercy of the sea, powerless before the eternal forces of nature, and yet striving for them. The world became partially fluid, concentrating life in the present moment, opening my mind and merging space and time. The horizon remains unreachable and the coast is only a rock, on a screen of shining huge blue.

Communicating with the sea and the dolphins in such a way caused me to experience a feeling of responsibility every person should experience towards all the other living beings we share the World with and towards the World itself.

Beyond the dolphins

Dolphins observation is not everything that is happening on the yacht. When you sail, the movement itself changes the perceptions. There is magic at sea, that turns dreams into memories and everything seems possible while your thoughts are travelling across the waves.

Life began in the oceans and when all my senses are full of sea, it seems easy to sink and give myself to the blue, to cross the border between the sky and the water and to become both. Then I remembered: people are somewhere at that border. We belong to the land, but are irresistibly attracted by the sea; we conquered the sea, but we didn't conquer its forces. And it changes me inside, like the waves change the land, and triggers something so deep, primal and permanent I'm barely able to realize it. But it stays with me and keeps me connected to the sea forever.

DOLPHIN EXPEDITIONS ACROSS THE BLACK SEA

Cetaceans part 2: At sea in October, or half an expedition

OCTOBER 2018

We, the explorers

Yes, as strange as it sounds, it's necessary to survey cetaceans' populations during autumn, too. Why? Because they live in the sea all year round and don't care about the weather. Main reason for their migrations (from the known reasons) is food.

So, with two jackets, a hat, a scarf and gloves I'm heading towards my favourite town – Balchick and RY Kaliakria. There are sea birds at sea and it's necessary to survey them, too. That's why Poli and Mr Popov are already there. Galya and Captain Stoyan also, only Galya is missing, because she is sick. We hope she will get better and we will pick her up when we reach Pomorie.

After three trains, a cab, a mini bus and a speed walk down the streets of Balchick (due to my heavy backpack) I find Kaliakria, drop the backpack and head for the beach, to take a walk and greet the sea. Despite we have seen each other recently, I missed the feeling that here ends the land and begins the other dimension of reality. Toni joins me and we wait for Mr Popov and Poli, then sail away. We don't see any dolphins on the first transect, but we enjoy the sea.

Each expedition is different, but I'm thinking how, when you do something few times it stops being so interesting. Until we reach Cape Kaliakra. No. It doesn't matter how many times I'll come here, or what's the weather, I will always want to take a hundred of pictures and to somehow capture in two dimensions everything I perceive with all my senses. That doesn't work, but the view is worth remembering. Then the dolphins come. They are having a snack, pretty little things, and we are trying to take photos of them. I'm inspired again: by the cliffs, by the dolphins, by the sea. I realize the same place can trigger many different emotions, but I will keep forever my first impression of the dolphins and Cape Kaliakra – humbled before the magnificence of nature.

After the photo session and an unsuccessful attempt to catch fish (Galya and The Captain mostly) we improvised our dinner. Because it's cold, we unanimously decided we need more wine in order to keep our body temperature at optimum. I'm not certain if it was because of the wine, or the weather, but I spent the evening in a T-shirt. Besides wine, there is rakia, traditionally, and beer (duh), and few other kinds of drinks. There is also food, but we eat a lot, so from now on I won't bother to mention it. We enjoy the evening and the company, talk about the past months and prepare for transects and dolphin observations.

Here they come!

After we reach the Romanian border during the night, we start the transects north to south. There are few dolphins and a bunch of harbor porpoises, but not many. And finally, we hear the usual "Dolphins! They are coming!" and few common dolphins swim towards us for

a bow ride. Of course, there is some running from starboard to port and back, excessive photo shooting, exclaiming usual “Oh, they are so prettyyy”. I’m never going to get bored of this. We record like 6000 videos and upload few immediately, to share our excitement.

Meanwhile we notice a lot of migrating birds – warblers, robins, wagtails. Some of them board the yacht for a break, or to look for food, or for who knows what reasons and we take advantage of it. Pictures of cute animals are never enough. Seagulls also take advantage of this. (Yellow-legged gull, to be scientifically correct) and hunt the birds mercilessly. Poli, as a young ornithologist is outraged and I oftenly hear her say “Fly, birdy, fly... oh...no....” but nature is cruel. Only the strongest survive (or those who never met a seagull). To be completely honest, I didn’t know seagulls hunt songbirds, but one never stops learning. Between the dolphins, the pictures, birds, sun and sea I, again, start feeling like part of something bigger than myself.

In the evening, we moor back in Balchick and I surprisingly learn that we are going to a bar.

There is another surprise, by Mr Popov and Galya who might not come at all, because the weather is worsening (not on schedule this time). We all receive individually made T-shirts, inspired by the dolphins, Douglas Adams (So long, and thanks for all the fish!) and ourselves.

There were for Galya and the Captain too, but they didn’t know yet. Just one thing clouded the positive emotions. The power supply on Kaliakria suddenly stopped. Whatever. We followed the Captain’s typical undisturbed patience and decided not to panic and just to tell him.

“Captain, um...the power at the yacht stopped suddenly”.

The captain (casually): “Who was in the right cabin?”

Me (guilty): “I was there.” wondering what I did.

The captain: “There is a red switch, you probably turned it off accidentally?”

Me, remembering my struggle with the new T-shirt: “Oh, yeah, probably.” But how should I know that was a switch?

Captain: “See? Everything has an explanation.”

So, I cut the power on Kaliakria. The same day the gas also finished, but that’s totally a coincidence.

Then we went to a bar, wearing the T-shirts. Kaliakria’s crew, yo-ho-ho and a bottle of rum! (two glasses in my case, because a bottle would be too much). We played pool. Everyone except Galya sucks at it, but strangely, we all won. Or so we choose to believe. Philosophically speaking, we won because we had fun. Really nice Friday night. Tomorrow we will finish the leg to Cape Emine.

Autumn sea

I thought I saw all the colours of the sea, all the shades of blue, grey, green, purple and white. I thought, although different, all the sunsets are alike. I was wrong. The sea in October is a little bit changed. The blue is more like grey and black, the sky fades and the sunsets become more purple and pinkish without losing their red, orange and golden. The sea has all the known colours and some unknown, I’m convinced. While sailing from Balchick to Cape Emine it feels like the water is sliding under us, and we are motionless in the fresh

air. Then, unnoticeably, the sky darkens, becomes black, the day becomes night and we are still there, all sails out, to be faster. We dine outside, where it's again unexpectedly warm. I look at the sky: bright, almost full moon is shining on the main sail. The only visible star is the orange Mars, everything else is black. It is so real; I get the feeling everything in the universe is this close; I only have to reach and take it. It doesn't get colder outside as we turn South from Cape Emine and anchor off shore. I go to bed with the thought that to be alive and feel all this is exceptionally awesome.

When the rigging screams

On the next day we will survey birds, so we have to sail for a few hours until we reach the starting point (GPS coordinates). But the weather worsens unexpectedly (big waves I mean) and around 3 am I wake up suddenly because of inhumane, extremely unstandable, screaming screaming of something close to me. I quickly realize that besides the screaming there is significant wagging in all directions, but mostly left to right – rolling. (Everything else is endurable). Ok. For a while I just think all this through. We are moving. There are waves. I don't hear the engine therefore we are entirely on sails. But this doesn't really help me, does it? I wonder how Poli is sleeping but it turns out she isn't. Around 4 am there is nothing much to talk about. I listen to some music, which doesn't mask the screaming (I got used to the wagging). I stop the music, trying to find a comfortable position for a nap. Doesn't work.

"Sleeping is so tough,

When the waves are rough.

My head is banging against the wall,

I'm desperately trying to stay in control,

when the rigging is screaming

and the wind outside is shrieking."

I try to rhyme, hoping to fall asleep.

And I get an insight: "That's why all the sailors from the books sleep in hammocks!" That also doesn't help me, though. At some point I fell asleep for about an hour. Not that there wasn't the same wagging before, but we never tried to sleep during it.

Around 6.30 I get up, because there is no point anyway. It turns out everyone else is also up, for the exact same reasons. The wagging causes a little inconvenience. First of all, if you don't hold on to something you will fall. If you somehow manage not to fall, you will get bruised. Second of all, if you want to eat something, or drink, or take something, you will fall, or spill it (ask Toni.) Or you will get bruised. Banging against the furniture is considered normal. Definitely a fun experience. At some point it becomes bearable. What is stranger – Poli and Mr Popov are actually observing birds all day long, with no breaks. That I call dedication (Congratulations to Poli!) I have an unavoidable desire to express my feelings towards the sea and I'm on my phone, writing. It's a good thing Galya brings us French breakfast. That's same as normal breakfast, but with wine. You should know that in October it's not so cold in the sea.

In the evening we manage to reach Sozopol. Galaya will go back to Balchick by a bus, and it turns out we need to take a break too. I'm going to cry. The weather will be bad for at least five more days and I can't come back for the Southern leg of the expedition. But that's life.

For a while my inner peace is disturbed, but a glass of wine later, things don't seem so bad. We take few pictures with our T-shirts, we do a gala dinner (or Galya dinner, because she cooked it) and we discuss the matters of life.

I get over my anxiety and share with everyone my feelings towards the sea I wrote earlier (I have to justify my T-shirt after all, there is a book and a pen on it). The night ends with warm feelings and positive emotions.

End of part one

On the next morning Galya and The Captain leave early, and for the rest of us is left to pack our backpacks, clean up Kaliakria and leave (I'm crying). I'm going to travel for three days to Montana (of course I'm exaggerating), so I'm not in a hurry, the bus Poli is supposed to take turns out not to exist, so we have a nice breakfast, take about 300 pictures with the T-shirts and the yacht (not enough pictures of me online), we drink some coffee, and start cleaning (mostly Poli and Toni).

Something funny smelling lives in the fridge, and we can't leave it to evolve, so Toni gets motivated and manages to clean it. Then, she also cleans up the hairs in the cargo compartment. We have never done such a complete clean up, Toni mostly. Finally, we say goodbye and take the bus to Burgas.

The expedition will continue next weekend, but I won't be here. I wouldn't say it was enough, though. I will never get enough sea. But sometimes the adventures continue in a different direction. Like now.

People and the Sea

We think we conquered the World; tamed nature and we control everything around us. Actually, we are what we are because of everything around us. As example – sea. For centuries it has inspired people. They were worshiping it, tried to tame it, to capture its forces. But it always remained what it is – unpredictable and incredible. Today we take for granted that because we know the sea, we know everything about it. But facts differ. The sea is the primary source of life. Great part of our food comes from it, the atmosphere, the climate, the season and even the rain exist because of the oceans. Everything else exists because of the oceans. And we are still unable to build an accurate model of all the connections in the global system. Why do we believe we conquered nature?

Watching the infinite blue, I'm having some thoughts about the beginning of life, the evolution, the actual size of the World. Because our Black Sea is so small, compared to the ocean, and so huge, when you are on a boat and don't see the coast. Then nothing else exists, but you, the sea and the sky. And you focus on the present moment, on what's happening around you and inside you. And the world shrinks into a single thought – how to be the best of yourself in this very moment.

Epilogue

When I first heard about “Cetaceans’ surveying” I had just finished my first year of a four-year course in ecology and environmental sciences. Back then I was convinced I will save the World (somehow) and I was anxious to do something with all this creative energy I had. When I first met Mitko Popov, I was certain that there is no way that I would board a yacht, sail and study cetaceans, but despite this I really wanted to do it. It’s been three years since then and I learned a valuable life lesson. Nothing is unachievable.

About saving the World, things didn’t go as expected (of course), but I learned something important here too: every day, every one of us, with the decisions we make affects everything around. So, let’s try to be better characters in our own adventures and maybe some day we will save the World!

I want to thank Mitko Popov, Stoyan Georgiev, Galya Meshkova, Galya Todorova, Poli Dimitriva and Annie Wild for the amazing memories, their patience, the funny moments and positive emotions we shared.

I want to thank the sea and its cetaceans and yacht Kaliakria for making my life more meaningful, and complete.

May we meet again and may the wind always be at your back!

Teddy, 23.10.2018

Notes

- 1 A per mille, also spelled per mil, per mill, permil, permill, or permille is a sign indicating parts per thousand. Per mil should not be confused with parts per million (ppm) which means parts per million.
- 2 A per mille, also spelled per mil, per mill, permil, permill, or permille is a sign indicating parts per thousand. Per mil should not be confused with parts per million (ppm) which means parts per million.
- 3 Hydrogen sulfide is the chemical compound with the formula H_2S . It is a colorless chalcogen hydride gas with the characteristic foul odor of rotten eggs. It is very poisonous, corrosive, and flammable.
- 4 Metabolism is the set of life-sustaining chemical reactions in organisms.
- 5 Overfishing is the removal of a species of fish from a body of water at a rate that the species cannot replenish in time, resulting in those species either becoming depleted or very underpopulated in that given area.
- 6 Bycatch, in the fishing industry, is a fish or other marine species that is caught unintentionally while catching certain target species and target sizes of fish, crabs etc.
- 7 Jared Mason Diamond is an American geographer, anthropologist, historian, and author best known for his popular science books *The Third Chimpanzee* (1991); *Guns, Germs, and Steel* (1997, awarded a Pulitzer Prize); *Collapse* (2005); and *The World Until Yesterday* (2012).
- 8 The tragedy of the commons is a situation in a shared-resource system where individual users, acting independently according to their own self-interest, behave contrary to the common good of all users, by depleting or spoiling that resource through their collective action. The theory originated in an essay written in 1833 by the British economist William Forster Lloyd and is cited in an article written by the American biologist and philosopher Garrett Hardin in 1968.
- 9 A food chain is a linear network of links in a food web starting from producer organisms (such as grass or trees which use radiation from the Sun to make their food) and ending at apex predator species (like grizzly bears or killer whales), detritivores (like earthworms or woodlice), or decomposer species (such as fungi or bacteria). A food chain also shows how the organisms are related with each other by the food they eat.
- 10 The Great Library of Alexandria in Alexandria, Egypt, was one of the largest and most significant libraries of the ancient world. Alexandria came to be regarded as the capital of knowledge and learning, in part because of the Great Library.
- 11 Diploid nuclei have pairs of homologous chromosomes. And haploid nuclei have one chromosome of each pair.
- 12 The zettabyte is a multiple of the unit byte for digital information. The prefix zetta indicates multiplication by the seventh power of 1000 or 10^{21} in the International System of Units (SI). A zettabyte is one sextillion (one long scale trillion) bytes. The unit symbol is ZB.
- 13 A Rube Goldberg machine is a machine intentionally designed to perform a simple task in an indirect and overcomplicated fashion. Often, these machines consist of a series of simple devices that are linked together to produce a domino effect, in which each device triggers the next one, and the original goal is achieved only after many steps.
- 14 The water cycle, also known as the hydrologic cycle or the hydrological cycle, describes the continuous movement of water on, above and below the surface of the Earth.

- 15 A mangrove is a shrub or small tree that grows in coastal saline or brackish water.
- 16 The rove beetles are a family (Staphylinidae) of beetles, primarily distinguished by their short elytra (wing covers) that typically leave more than half of their abdominal segments exposed.
- 17 Root exudates refer to a suite of substances in the rhizosphere that are secreted by the roots of living plants and microbially modified products of these substances.
- 18 The Environmental Protection Agency (EPA) is an independent agency of the United States federal government for environmental protection.
- 19 Fossil record - history of life as documented by fossils, the remains or imprints of the organisms from earlier geological periods preserved in sedimentary rock.
- 20 ppm - parts per million - commonly used as a unit of concentration.
- 21 The principle of prudence - an accounting principle that requires recording expenses and liabilities as soon as possible, but the revenues only when they are realized or assured. Also called conservatism principle.
- 22 Phytoplankton are the autotrophic (self-feeding) components of the plankton community and a key part of oceans, seas and freshwater basin ecosystems.
- 23 Marine mammals: biology and conservation/edited by Peter G.H. Evans and Juan Amonio Raga
- 24 According to the 2018 report of the GFCM (General Fisheries Commission for the Mediterranean) on the state of the Mediterranean and Black Sea fisheries.
- 25 Benthos is the community of organisms that live on, in, or near the seabed, river, lake, or stream bottom, also known as the benthic zone.
- 26 William McGuire Bryson is an American-British author. Bryson came to prominence in the United Kingdom with the publication of Notes from a Small Island (1995), an exploration of Britain, and its accompanying television series. He received widespread recognition again with the publication of A Short History of Nearly Everything (2003), a book widely acclaimed for its accessible communication of science.
- 27 Food and Agriculture Organization of the United Nations is a specialized agency of the United Nations that leads international efforts to defeat hunger.
- 28 During 20th century the majority of researchers interpreted ecological optimum as a certain combination of ambient factors which is optimal for growth, existence and reproduction of an organism.
- 29 A prokaryote is a unicellular organism that lacks a membrane-bound nucleus, mitochondria, or any other membrane-bound organelle.
- 30 Sir David Frederick Attenborough is an English zoologist, broadcaster and natural historian.

