



The following was presented with visual and audio accompaniment by
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Sperm whales: the animals of superlatives!

- 1) A few decades ago, we, human beings, succeeded to leave the earth behind us and to travel in space; an environment which in its biggest part is completely unfriendly to our bodies and to life in general. The question I wanted to be the title of my presentation initially, was “Are we the only mammals who left the earth to explore completely new worlds?”. And the answer is negative.
- 2) There are some of our mammalian relatives who also left the earth, but a little bit earlier than we did. About 50 million years ago(!), these wolf-looking terrestrial mammals decided to explore the ocean; “another space” equivalently hostile for non adapted mammals. We used our brains and our technology in our explorations; they used their social and physiological adaptations since they had enough time, as well as their brains. These strange creatures, started by performing short dives very close to the coasts in order to catch fish and little by little... their anterior legs transformed into flippers, their posterior legs became smaller and then disappeared, their tail was replaced by a powerful pair of flukes, their fur gave its place to an extremely smooth and hydrodynamic skin and finally they became
- 3) the wonderful dolphins and whales which conquered all the seas and oceans of our planet.
- 4) Among the 85 cetacean species of the world, 9 and possibly some more live in Greece. I am going to present you only one of them, certainly the most amazing of all, since it's the one which went beyond all the limits among mammals. This is the sperm whale, on which our team has focused its research during the last 3 years.
- 5) Those who already visited the National Archeological Museum in Athens or the museums here in Santorini, are familiar with Greek frescos, urns, coins and other pieces of art 3.600 years old full of dolphins and whales. Especially dolphins were part of the Greek civilization since its very first steps. It is less known that cetology, the science that study them, was also born in Greece.
- 6) Not so far away from here in the north of the Aegean Sea, 2350 years ago, the great Greek philosopher Aristotle was the first one on earth to study and to scientifically publish works about cetaceans. He made very detailed descriptions of their morphology and behavior and this is why he is the one who put the bases and the criteria that we use even today, in order to classify the various cetacean species in toothed and baleen whales.

- 7) It is really surprising that Aristotle succeeded to estimate very accurately the life span of the common dolphin. He wrote that dolphins certainly live for 25 years and perhaps some of them reach 30 years or more. I think that it is even more interesting that, exactly like a good modern scientist would have done, Aristotle wrote also about the methodologies that he was using. In collaboration with fishermen, when a dolphin was accidentally caught in their nets and was still alive, before releasing it, they marked its dorsal fin in a way that it becomes unique and therefore identifiable. In this way, if the dolphin was resident in an area, they could follow it year by year and record how long it lives. The method of studying cetaceans by the nicks and scars on their fins is the most widely applied by cetologists today and it is called photo-identification.
- 8) Of course Aristotle was also aware of the presence of sperm whales in Greece so many years ago. Unfortunately, although the sea surrounds almost all our country, most of us modern Greeks do not know that these amazing marine animals live all year round, so close to our coasts.
- 9) Scientifically speaking, the sperm whale remains one of the most mysterious animals. Nevertheless, it is surnamed "the animal of superlatives" and there are many reasons for this:
- The sperm whale is the largest toothed organism on earth. The males often exceed 18 meters in length and 44 tons in weight.
 - Sperm whales exhibit the highest sexual dimorphism amongst all mammals, as the females are much smaller in size and do not exceed 12 meters in length. As a result, the mature males are three times heavier than the females.
- 10)
- Sperm whales are the best divers on Earth and despite the fact that they breathe fresh air with their lungs like we do, they are able to dive at depths of 2000 meters with just one breath, which they hold for at least 1 to 1½ hours!
 - Due to this fact, they still keep many more secrets from modern science than any other mammal. Imagine that leaving the surface after its last breath, within 10 minutes a diving sperm whale will be found in a kind of "space", a completely extreme environment. From light it passes to complete darkness. From almost 30 degrees Celsius (or even 40 out of the water) to close to zero. From a pressure of one atmosphere it passes to 100 and perhaps to 200 or more. From air to anaerobic conditions. And it is capable to repeat this travel to the big depths 20 times per day during its entire life!
- 11)
- Inside the sperm whale's head lies the largest sound-producing organ in the animal kingdom.
 - Sperm whales vocalize more than any other animal, spending almost 80% of the 70 years of their lives producing sounds.

- Last but not least, sperm whales have the largest brain that has ever existed on our planet.

- 12) We know relatively few things regarding sperm whales, but we know even less about their Mediterranean population. We are sure for only one thing: their numbers are decreasing. Additionally, because they are probably genetically isolated from the sperm whales of the Atlantic Ocean, they are very vulnerable, like any small and isolated population.

This is why we are running against time because we are afraid that these wonderful animals could disappear before we come to know about them. There are 3-4 good scientific teams in the Mediterranean struggling for the conservation of whales and dolphins. However, the problem is that they get very few (if any) support from their countries. Unfortunately the environment is still far from being a priority for our societies.

- 13) The steep underwater cliffs are the favorite habitat of sperm whales. In such environments, they perform long, deep feeding dives looking for their favorite food, the deep-living squids. These animals can exceed 1 meter in length and in the oceans they can reach 15 meters!
- 14) In Greece, the European continental shelf ends at what we call the Aegean arc, which runs all along the south of Greece, from Turkey to south of Rhodos Island, Karpathos Island, South Crete, South and West Peloponnese and finally the west coasts of the Ionian Islands. All along the arc, the depth increases steeply from 0 to 2 or 3.000 meters (and somewhere here close to the Peloponnese reaches the maximum depth of the Mediterranean Sea, which is 5.120 meters). All along the arc sperm whales seem to be present all year round.

The small red dots are mainly strandings and a few sightings of sperm whales recorded during the last decade. Santorini is just here, in the red circle. Important groups of sperm whales aggregate every fall also in the North Aegean Sea, but we didn't have enough funds to study them up to know. We hope that a preliminary expedition will become possible this year. We suppose that some vertical migration should occur for unknown reasons, this could be reproduction that we have not observed elsewhere in Greece (or in the rest of the Mediterranean) up to now. Our study area is here, in the SW Crete...

- 15) ...where at 2-3 miles from the coast, the depth is already more than 1000 meters. Therefore we are very lucky because in this area sperm whales are present very close to the coast, all year round. The sighting frequency we have recorded is the highest ever observed in the Mediterranean Sea. The 75% of the days we go out, we encounter the sperm whales.
- 16) It is even more exciting for us that here in Crete and perhaps in the rest of the Aegean arc, both solitary males and social groups are present all year round. This is something unique, since it has never been observed in any other place in the world. In both the Atlantic and Pacific Oceans, the social groups, which are the females with their offspring and young, immature males or females, live in the tropical or subtropical waters. Mature males live a solitary life at greater latitudes

than the social groups, and more they grow up, more they move towards the poles. They visit the social groups only once every couple of years in order to mate. This probably prevents a competition in food with the social groups, since the big males have huge appetites. They eat up to 1 ton of squids daily! Perhaps in the Aegean Arc they find so nice conditions that they have no reason to leave... Who knows? We hope to find the answer soon.

- 17) During the last two years we have photo-identified about 17 individuals. We recognize them by the nicks and the scars of their flukes and we assign names to them. Amazone, Zeus, Trypos etc. Our first impression is that we are dealing with a relatively small number of animals. We are still away from a valid scientific estimation, but this is something important we have to do, because there is no other way to monitor the status and general health of their population. This can be done only through birth and death rates.
- 18) And now I think it's time to pass to the most interesting part of my presentation, since I will speak about bioacoustics and we will hear some of the sperm whale vocalizations we have recorded in Greece. Cetologists are widely using bioacoustical methods because they find them to be an invaluable tool. For sperm whale research, they are even more important since we study an elusive animal which most of its time, is found at 1000 meters, very far away from the eyes of scientists. Fortunately, the sperm whale has to explore its environment and to navigate down there, and especially has to locate its prey. Its eyes cannot help it a lot in the complete darkness of these depths. This is why it uses its echolocation system, which is a biological sonar, much more evolved than our electronic ones.
- 19) The sperm whale emits sounds generated inside its huge head. These sounds reflect on the bottom, the cliffs or on the squids and return to the whale. Captured by special nerves found in the lower jaw of the whale, they are sent through the hearing nerves to its brain. The brain analyses them and produces a very precise image of the whale's environment. We can say, that in this way sperm whales as well as dolphins can see with their ears. The pulse sounds emitted by the sperm whale while exploring the big depths are called clicks and are quite monotonous.
- Let's hear some of them.
This sounds can be heard from 8 miles away (!) and allow us to locate the whale and to track it for several hours or even days. I will not go further into this, but I can tell you that from a couple of clicks like these there is enough information so that we can precisely estimate the total length of a sperm whale without seeing it, or we can possibly identify the individual, which is vocalizing.
 - Of course if more than one individual are simultaneously present in an area, we can hear or record sounds from more than one sperm whale. Since their clicks are not synchronous and also one is closer to the hydrophone and therefore louder than the other, I think that you can discern them easily in the following recording.
 - Things are becoming more complicated for us, when an entire social group performs feeding dives. Only our computers and a posteriori analyses can tell us how many whales are clicking.

- 20) Now what happens when the sperm whale locates a squid? As it is getting closer to it, the rate of click production increases because the reflected sound returns to the whale faster than before. The result is what we call a creak. We will hear two sperm whales; one of them passes from normal clicks to a creak, the second whale stops perhaps to listen what is happening, and after a pause while eating the squid, they both start clicking again.
- Something equivalent can happen when a sperm whale echolocate our boat or our bodies when we go into the water, and the produced sounds are called rapid clicks.
- 21) Sperm whales emit a lot of other sounds, but the most amazing of their vocalizations are those used for their communication. We all know that mathematics is a universal language, which exists all around the cosmos. However, most of us believe that we, humans, are the only creatures of our planet who understand and use mathematics. I will disappoint you once more. Let's listen to a coda. Codas are stereotype series of clicks, which are produced repeatedly from sperm whales, especially when they are found in social groups. The so-called 3+1 coda is the most common one in the Mediterranean and very rare if present in the oceans.
- There are dozens of other codas like the 4+1, 3+2, 8+2+1, or the "atypical 2+1" etc.
 - Things are becoming even more interesting when we have two or more sperm whales communicating by exchanging various codas that look very much like our Morse code.
- 22) I could talk to you for hours regarding these animals, but I think it would be better to conclude before showing a 3 minutes video of our work.

Therefore, I will just repeat the words of Roger Payne, who is one of the fathers of modern cetology and made a lot for the conservation of whales. Roger said: "There is a message coming from the ocean to us, from the whales directly. What this message says is: it is possible to own a brain as complex as our own without destroying our world. What we have to learn from this message is very simple. If what we do diminish the ability of our planet to support life then we don't have to do it! Or we have no future. Modern whales, for all their 20 million years, what is 19 million years more than us, have succeeded in living on our planet without destroying it. We could do just the same!