

# Earthwatch Case Study #: Marine Science

## Spanish Dolphins Canaries in a Watery Coalmine

Common dolphins (*Delphinis delphis*) are now a rare sight in the Alboran Sea. Once, these waters, the only link between the Mediterranean and the network of the world's oceans, were filled with dolphins, attracted by an endless banquet of fish and squid. Now, it seems that common dolphins and many other species of cetaceans are disappearing, and scientists want to know why.

As marine ecosystems go, the Alboran Sea is unique. Scientists estimate that 20 percent of the world's ocean life passes through the waters between Spain and Morocco every year. This well traveled stretch of sea is also the place where cold Atlantic waters meet and mix with the warm, salty waters of the Mediterranean, creating upwellings of deep water filled with nutrients. These nutrients provide an ideal environment for plankton, the basis for all life in the oceans. Many species of fishes and other sea life prey on plankton, and they in turn attract bigger predators, such as dolphins. As a result, the Alboran Sea is one of the most diverse underwater communities on Earth.

Conservation efforts to protect dolphins are popular because of our fascination with these creatures. Dolphins amaze us with their intelligence, playfulness, and curiosity. Who would want to live in a world without dolphins? But in the Alboran Sea, common dolphins are also the canaries in a watery coalmine. As top predators, dolphins rely on stable populations of prey species, as well as waters free of pollutants. When the dolphins start to disappear, it is a signal that the whole ecosystem may be in danger.

One of the best ways to protect marine ecosystems is to establish Marine Protected Areas (MPAs). These are the ocean's equivalents of national parks, places where fishing is not allowed and the waters are kept clean. MPAs allow scientists to carefully monitor fish and marine mammal populations. When fish breed within the boundaries of MPAs, their young have ample time to grow to reproductive age. By providing safe places for young fish to mature and reproduce, MPAs can actually help the fishing industry become more sustainable as well as aid general conservation efforts. Establishing a network of MPAs in strategic places can make the difference in replenishing species that all predators, including dolphins and humans, rely on.

The dolphins seem to be telling us that the Alboran Sea would be a perfect place for a new Marine Protected Area. But we need to know more. In order for scientists to decide the best way to design a new MPA and the best place to establish its boundaries, they need information on the number of common dolphins left in the Alboran Sea, what their home ranges are, what species they feed on, and where their breeding grounds are. Using this information, scientists can work with local populations and governments to find a solution that will protect our marine resources in the Mediterranean for the dolphins, and for people for generations to come.

## **Taking A Dolphin Census**

How do you “do a Jane Goodall” with animals that spend their entire lives below the waves? Husband and wife team Ana Cañadas and Ricardo Saraminga van Buiten are in the business of doing just that. Aboard their restored turn of the century sailing vessel, the *Toftevaag*, they and Earthwatch volunteers are on a mission to uncover the mystery of the common dolphins of the Alboran Sea.

As they sail, the team takes soundings of the sea floor to determine its topography. They also collect samples of surface water, testing it for salinity and temperature. These data provide a background for understanding the habitat of the dolphins and the species they prey upon. An echosounder allows Cañadas and Saraminga to detect schools of fish. But when the lookout sights a pod of common dolphins, the fun really begins.

Ever since humans first began to build ships and sail the seas, they have seen dolphins swimming beside them, playing and leaping next to the bow. We now know that the bow-wake given off by a ship moving quickly gives the dolphins a lift and a push, similar to what a human feels while body surfing. What seems like great fun for the dolphins also provides the perfect opportunity for the team to capture them on film. Cañadas and Saraminga are even able to identify individuals they have seen before by using characteristic patterns of pigmentation and scars on the dolphins’ dorsal fins. Like fingerprints, these patterns are unique to each dolphin, and the team is thrilled when they see old friends.

If the dolphins seem willing, the team launches an inflatable Zodiac and motors close to the group. As a dolphin surfaces next to the bow, a volunteer will lightly swab its skin with a sponge on the end of an extendable pole, collecting a few skin cells. These cells contain DNA, which Cañadas and Saraminga can use to analyze the composition of the different dolphin pods they encounter, and how closely related they are to each other. This data is vital in determining the degree of inbreeding exists among common dolphins in the Alboran Sea.

After photography and skin swabbing, the *Toftevaag* sails after the dolphins at a distance for several hours, tracking their journey and learning about natural traveling behavior and migration routes.

## **A Noisy World**

The Spanish Dolphins project will help scientists understand the range and behavior of common dolphins in the Alboran Sea so that any future MPAs will be designed in such a way as to do them the most good. When the team has collected and analyzed all of their data, we will know much more about how many dolphins are left in the area, how big their groups are, what they feed on and how they migrate. But this expedition has discovered that common dolphins are facing even more challenges.

We've known for years that the Mediterranean has been the victim of overfishing and pollution. But one of the most interesting findings of the Spanish Dolphins Project has been how *acoustically* polluted this sea has become. With shipping traffic increasing, the Mediterranean is filled with a cacophony of engine noises and radio signals. It turns out that human technology uses sound frequencies in the same range that dolphins do. This interference makes it difficult to track dolphins using sound, but there may be a more important consequence. Dolphins, being highly intelligent and social animals, rely on sound to communicate with each other through the murky waters. Dolphins also echolocate, sending out high-pitched clicks toward their prey and listening for the echoes that bounce back to pinpoint their location. Are dolphin sounds being drowned out by all the noise? We don't yet understand just what effect the increase in technological sounds has had on dolphin behavior. For creatures that rely on sound as much as humans rely on sight, the noise may be having a critical impact.

The Spanish Dolphins team has also learned that not all fishing is the same in its impact on dolphin populations. Common dolphins in the Alboran Sea mainly feed on small pelagic fish such as sardines and anchovies. While humans also eat these fish, recently the biggest demand for them is to feed farm-raised tuna. Tuna are difficult to find and catch in the wild, being large predatory fish with huge migratory ranges. Raising them on farms has become more cost effective, but has increased the demand for smaller fish to feed the tuna. The human taste for tuna may now be starting to impact dolphin populations through competition for sardines and anchovies. We still don't know if the dolphins will be able to withstand this competition. Learning about the range of other species that common dolphins prey upon in their natural habitat can help us better manage our ability to raise fish in captivity.

### **Working Together to Protect the Mediterranean**

In 2000, the Universities of Valencia, Barcelona, and Madrid in consultation with the Spanish Ministry of the Environment launched a comprehensive program to determine the habitat requirements of cetaceans in the Spanish Mediterranean. The data that Cañadas, Saraminga and their team have been gathering for the past four years will provide the basis for the Ministry's recommendation on where a network of new MPAs should be located in the Alboran Sea.

But protecting our marine resources isn't as simple as putting a fence around a marine habitat. Our oceans provide homes for marine life, but they are also sources of natural resources, transportation corridors, and tourist playgrounds. Many individuals and organizations have a stake in the health of the Mediterranean. In order for future MPAs to succeed, the public, the fishing industry, and local governments must work together as partners in its management. Cañadas and Saraminga know that their mission consists of equal parts public relations and science.

Locals on the Andalusian coast can't help but notice when a century old wooden sailboat equipped to follow and study dolphins puts into port. The Spanish Dolphins Project team has used the charisma of their vessel and their subjects to increase awareness of the

decline of common dolphin populations in the Alboran Sea. These communities have historically depended on fishing for their livelihood, and it is very important that they lend their support to the project and the effort to establish MPAs in these waters. One of the most important missions of the project is to make local fishermen into partners. By agreeing to restrict fishing in a few key areas, fisherman will be making a long term investment that could pay off in increased catches elsewhere in the region and over the long term.

The Spanish Dolphins team is now working closely with the Andalusian fishermen they have gotten to know over the last fifteen years. They are getting out the message that Marine Protected Areas in the Alboran Sea are in everyone's best interests, and the time to start working together is now, before the dolphins disappear for good.

### **PI Background Sidebar**

Ana Cañadas has always loved dolphins and sailing. She studied biology at the University Autónoma of Madrid, and is currently the principal investigator on the Spanish Dolphins project. The data she has been collecting on dolphin populations in the Alboran Sea will form the basis of her doctoral dissertation. Cañadas is a pioneer in the use of methods of data collection that disturb cetaceans as little as possible.

Ricardo Saraminaga van Buiten is half Spanish and half Dutch and was also born in Madrid. He studied biology at the University of Neuchatel in Switzerland, and then later in his life he lived in Sweden, where he learned to restore old wooden sailing ships. He has loved the sea and sailing all his life, and has also been actively involved in marine conservation efforts through organizations such as Greenpeace. He is in charge of logistical operations for the Spanish Dolphins project, serving as the "skipper" of the *Toftevaag*.

Cañadas and Saraminaga met while working together on a Greenpeace conservation expedition. In 1989 they founded Alnitak, their research group dedicated to conserving cetaceans and their environment in the Mediterranean. That same year they found and restored the *Toftevaag* and have been watching and studying dolphins from her decks ever since.

### **Volunteer Sidebar**

#### **Fun Fact**

The *Toftevaag* was built in 1910 as a Norwegian fishing vessel. In 1989 she was refitted and given new life as a research ship. Today, she's equipped with a diesel engine and a full set of scientific equipment, but her history still shines through. She's even held together with wooden pins instead of nails!

## **Points of Departure: Middle School**

### Global food webs

1. How do dolphins fit into the food web in the Alboran Sea? How do humans fit into this web? Have things always been this way?
2. What might happen to the food web if all the dolphins disappeared?

Project: Find out what kinds of plants and animals live in the Alboran Sea and draw a food web that shows how they fit together. Describe what an MPA would do to change the balance of that food web.

### Competition for resources within an environment

1. What resources do humans use that can be found in the Mediterranean?
2. Do dolphins and humans use the same resources?

Project: Make a map showing the different kinds of resources that people use from the Mediterranean and where they are found. Explain how human use of the Mediterranean impacts the animals that live there.

### Relationships between organisms in an ecosystem

1. What other explanations could there be for the disappearance of the dolphins in the Alboran Sea? How would you test your hypothesis?
2. What kinds of nutrients do plankton need? Why does deep water have more of those nutrients? What causes deep water to come to the surface?

Project: Write a description of a study that would test an alternative hypothesis for the decline of dolphin populations in the Alboran Sea. Imagine you have an unlimited budget. How will you find out what you want to know?

## **Points of Departure: High School**

### Human influence on the world's ecosystems

1. Why don't we just ban fishing in the whole Mediterranean?
2. Why don't we farm all the fish we eat?

Project: Compare and contrast two different types of fishing: catching fish for human consumption or catching fish to feed farm-raised tuna. Which is more cost effective? Which uses more energy? How many sardines does a farm-raised tuna need to eat before it reaches an age where it can be sold to be eaten by humans?

### How ecosystems recover from damage

1. At what point is an ecosystem so damaged that it can't be saved?
2. How do we know how damaged a marine ecosystem really is?

Project: Stage a class debate about the fate of the Alboran Sea. One side should argue that the entire Mediterranean should be designated an MPA, and the other side should argue that all MPAs should be abolished. Articulate each extreme position, describe what is at stake, and work together to agree on an appropriate compromise.

## **Glossary**

Cetaceans: Animals that belong to the order *Cetacea*, which includes dolphins, whales, and porpoises. Cetaceans are mammals that spend their entire lives in water.

Echolocation: A sensory system dolphins use to navigate and locate food underwater. Dolphins produce high-pitched sounds and listen to the echoes produced when those sounds bounce off of objects or fish. Dolphins can use these echoes to determine the size, location, and even the density of an object.

Pelagic: Relating to or living in the open ocean.

Topography: The physical characteristics of the Earth's surface, including elevation.

Upwelling: A process by which cold, nutrient rich deep ocean water rises to the surface.

## **Resources**

Alnitak Website:

<http://www.geocities.com/tofte2000>

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Individual Recognition of Cetaceans: Use of Photo-Identification and Other Techniques to Estimate Population Parameters, P.S. Hammond, S.A. Mizroch and G.P. Donovan (Eds), Report of the International Whaling Commission. Special Issue 12, Cambridge 1990. ISBN: 0-906975-23-9

The Handbook of Marine Mammals. Ridgeway and Harrison (Eds.) Academic Press Ltd, 1994. ISBN: 0-12-588505-9

## **Keywords**

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