

# Part One

## Principles of Marine Science



# The Science of Marine Biology



A biologist weighs an Adélie penguin (*Pygoscelis adeliae*), one of many species losing habitat due to global climate change.

**M**arine biology is the scientific study of the organisms that live in the sea. The ocean is a vast realm, home to countless strange and wonderful creatures. It is often the beauty, mystery, and variety of life in the sea that attract students to a course in marine biology. Even professional marine biologists feel a sense of adventure and wonder in their studies.

There are also many practical reasons to study marine biology. Life on earth probably originated in the sea, so the study of marine organisms teaches us much about all life on earth, not just marine life. In the late nineteenth century, for example, the Russian scientist Ilya Metchnikof discovered cells of the animal immune system by studying sea anemones and the larvae of sea stars. His discovery underpins a great deal of modern medical research.

Marine life also represents a vast source of human wealth. It provides food, medicines, and raw materials; offers recreation to

millions; and supports tourism all over the world. Marine organisms can also cause problems. For example, some organisms harm humans directly by causing disease or attacking people. Others harm us indirectly by injuring or killing other marine organisms that we value for food or other purposes. Some marine organisms erode piers, walls, and other structures we build in the ocean, foul ship bottoms, and clog pipes.

At a much more fundamental level, marine life helps determine the very nature of our planet. Marine organisms produce around half of the oxygen we breathe and help regulate the earth's climate. Our shorelines are shaped and protected by marine life, at least in part, and some marine organisms even help create new land. In economic terms, it has been estimated that the ocean's living systems are worth more than \$20 *trillion* a year.

To make both full and wise use of the sea's living resources, to solve the problems marine organisms create, and to predict the effects of human activities on the life of the sea, we must learn all we can about marine life. In addition, marine organisms provide clues to the earth's past, the history of life, and even our own bodies that we must learn to understand. This is the challenge, the adventure, of marine biology.

## THE SCIENCE OF MARINE BIOLOGY

Marine biology is not really a separate science but, rather, the more general science of biology applied to the sea. Nearly all the disciplines of biology are represented in marine biology. There are marine biologists who study the basic chemistry of living things, for example. Others are interested in whole organisms: the way they behave, where they live and why, and so on. Other marine biologists adopt a global perspective and look at the way entire oceans function as systems. Marine biology is thus both part of a broader science and itself made up of many different disciplines, approaches, and viewpoints.

Marine biology is closely related to oceanography, the scientific study of the oceans. Like marine biology, oceanography has many branches. Geological oceanographers, or marine geologists, study the sea floor. Chemical oceanographers study ocean chemistry, and physical oceanographers study waves, tides, currents, and other physical aspects of the sea. Marine biology is most closely related to biological oceanography, so closely, in fact, that the two are difficult to separate. Sometimes they are distinguished on the basis that marine biologists tend to study organisms living

relatively close to shore, whereas biological oceanographers focus on life in the open ocean, far from land. Another common distinction is that marine biologists tend to study marine life from the perspective of the organisms (for example, studying how organisms produce organic matter), while biological oceanographers tend to take the perspective of the ocean (for example, studying how energy or organic matter cycles through the system). In practice there are so many exceptions to these distinctions that many marine scientists consider marine biology and biological oceanography to be the same.

A marine biologist's interests may also overlap broadly with those of biologists who study terrestrial organisms. Many of the basic ways in which living things make use of energy, for example, are similar whether an organism lives on land or in the sea. Nevertheless, marine biology does have a flavor all its own, partly because of its history.

## The History of Marine Biology

People probably started learning about marine life from the first time they saw the ocean. After all, the sea is full of good things to eat. Archaeologists have found piles of shells, the remains of ancient "clambakes," dating back to the Stone Age. Ancient harpoons and simple fishhooks of bone or shell have also been found. While they gathered food, people learned through experience which things were good to eat and which were bad-tasting or harmful. The tomb of an Egyptian pharaoh, for example, bears a warning against eating poisonous pufferfishes. Ancient people used marine organisms for more than food. Snail shells were used for necklaces at least 75,000 years ago, for example. In using marine resources, coastal peoples in virtually every culture developed a store of practical knowledge about marine life and the oceans.

Knowledge of the ocean and its organisms expanded as people gained skills in seamanship and navigation. Ancient Pacific Islanders had detailed knowledge of marine life, which their descendants still retain (Fig. 1.1). They were consummate mariners, using clues such as wind, wave, and current patterns to navigate over vast distances. The Phoenicians were the first accomplished Western navigators. By 2000 B.C. they were sailing around the Mediterranean Sea, Red Sea, eastern Atlantic Ocean, Black Sea, and Indian Ocean.

The ancient Greeks had considerable knowledge of nearshore organisms in the Mediterranean region (Fig. 1.2). The Greek philosopher Aristotle, who lived in the fourth century B.C., is considered by many to be the first marine biologist. He described many forms of marine life and recognized, among other things, that gills are the breathing apparatus of fish.

During the centuries known as the Dark Ages, scientific inquiry, including the study of marine life, came to a grinding halt in most of Europe. Much of the knowledge of the ancient Greeks was lost or distorted. Not all exploration of the ocean stopped, however. During the ninth and tenth centuries the Vikings continued to explore the northern Atlantic. In A.D. 995 a Viking party led by Leif Eriksson

**FIGURE 1.1** Micronesians like these Satawal Islanders from Yap Atoll in the Federated States of Micronesia navigated the Pacific for millennia in canoes much like this one.

