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# The Amateur Plankton Researcher's Practical Guide

How to Study  
Plankton  
at Home



Springer


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# Disclaimer of Responsibility

The information and activities provided in this book are intended for educational purposes to foster interest in plankton sampling and experimentation by amateur scientists. While every effort has been made to ensure that the methods outlined are safe and accurate, the author and publisher are not responsible for any accidents, injuries, or damages that may arise from following these instructions.

Sampling in or near bodies of water can carry inherent risks. **Adult supervision is strongly advised at all times**, especially for minors and inexperienced individuals. Always follow safety precautions and local regulations, and respect the environment when collecting samples or conducting experiments.

By using this book, you acknowledge that you assume full responsibility for your safety and the safety of others participating in any related activities. When in doubt, seek advice or guidance from qualified professionals.

# About the Guide

This practical guide is designed to help you study plankton at home, whether you are a student, educator, hobbyist, or citizen scientist. It will guide you through the entire process—from collecting samples in local water bodies to observing and documenting your findings, and even conducting basic experiments. While the guide introduces some concepts of plankton classification, and you can find representative images of the major plankton groups, it is not intended as a taxonomic reference.

Here is what you can expect:

- **A Brief Introduction to Plankton:** This chapter summarizes the essential knowledge, including the principal groups of plankton, their role in ecosystems, and the threats they face because of global changes. You will also gain insights into their seasonal variations and the environmental factors affecting their populations.
- **Getting Started:** Here, you will learn the essential equipment and materials needed to safely and effectively collect and study plankton.
- **Collecting Plankton Samples:** In this chapter, you will discover methods and tools for gathering and preserving samples for observation.
- **Observing Plankton:** Find out how to prepare samples, use a microscope, and identify common plankton groups.

- **Conducting Experiments:** Would you like to feel like a true scientist? This section will show you how to design and conduct simple experiments to explore plankton behavior and ecology, and how to analyze and interpret your data.
- **The Role of Molecular Techniques in Plankton Identification:** If you want to know about the latest technologies to study plankton, this chapter delves into more sophisticated methods, like DNA barcoding, environmental DNA, etc., for more detailed plankton studies.
- **Resources and Further Reading:** Here, you will access a list of books, online databases, and communities to deepen your understanding and connect with other plankton enthusiasts.
- **Glossary:** Use the glossary to familiarize yourself with key terms and refer to the appendices for useful tools like data sheets and identification images.
- **Practical Plankton Image Guide:** To complete the guide, you can find in this last section a library of pictures of the most abundant planktonic groups. The guide will be very useful to compare your organisms with a list of reference images. Also here, you will learn the anatomical and physiological characteristics of plankton that make each group unique.

By the end of this guide, I hope you will have the knowledge and skills to explore the captivating world of plankton and contribute to the understanding of these vital organisms.

# Contents

<b>1</b>	<b>A Brief Introduction to Plankton</b>	<b>1</b>
1.1	What Are Plankton?	1
1.2	Plankton's Roles in the Food Web	5
1.3	Seasonal and Spatial Variations in Plankton	6
1.4	Where Are Plankton When They Are Not There?	12
1.5	Environmental Factors Affecting Plankton	15
1.6	Importance of Studying Plankton	22
<b>2</b>	<b>Getting Started</b>	<b>27</b>
2.1	Equipment and Materials	27
2.2	Safety Precautions	36
<b>3</b>	<b>Collecting Plankton Samples</b>	<b>39</b>
3.1	Choosing Collection Sites	39
3.2	Time of the Day	43
<b>4</b>	<b>Observing Plankton</b>	<b>45</b>
4.1	Preparing Samples for Observation	45
4.2	Using a Microscope	48
4.3	Identifying Common Plankton Species	50



<b>5</b>	<b>Conducting Experiments</b>	<b>53</b>
5.1	Designing Simple Experiments at Home	53
5.2	Recording and Analyzing Data	64
5.3	Cultivating Plankton at Home	66
<b>6</b>	<b>The Role of Molecular Techniques in Plankton Identification</b>	<b>71</b>
6.1	DNA Barcoding: The Genetic Fingerprint of Plankton	71
6.2	Metagenomics: Unraveling the Complexity of Plankton Communities	72
6.3	Environmental DNA (eDNA) Analysis: A Non-Invasive Window into Plankton Diversity	73
6.4	The Future of Plankton Research: A Molecular Revolution?	74
<b>7</b>	<b>Resources and Further Reading</b>	<b>75</b>
7.1	Recommended Books	75
7.2	Online Databases and Identification Tools	76
7.3	Local and Online Communities for Plankton Enthusiasts	77
<b>8</b>	<b>Practical Plankton Image Guide</b>	<b>79</b>
8.1	Major Groups of Phytoplankton	80
8.2	Major Groups of Small Zooplankton (Protozoans and Small Metazoans)	88
8.3	Major Groups of Large Zooplankton (Metazoans)	116
	<b>Glossary</b>	<b>141</b>

## About the Author

**Albert Calbet** My passion for plankton began when I was just ten years old. It all changed for me on December 31st when I received a simple plastic microscope as a birthday present from my parents. I can still vividly recall observing my first protists—it remains one of my most enduring memories. The sample came from a flower jar on our dining table, where I noticed tiny dots moving around on the water's surface. Placing a drop of that water on a glass slide and looking through the microscope, I was astonished by the new world that unfolded before me. Creatures like *Euglena viridis* (a flagellated microalgae) and *Stylonychia mytilus* (a flat ciliate) dominated the scene. From that moment on, I could not resist exploring every pond, vessel, river, or lake I came across. I used to carry small containers in my pockets (and still do) to collect water samples for later observation.

My interest extended beyond plankton to other forms of life, leading me to study Biology at the University of Barcelona, my hometown. There, I had the privilege of learning from inspiring educators who fueled my drive to pursue this career. Although working as a bartender, cook, and waiter on weekends and summers slowed down my studies, I eventually completed my degree and began my PhD at the Marine Sciences Institute (CSIC, Barcelona). I shifted my focus to marine zooplankton, primarily copepods, despite never having been particularly drawn to marine

systems (probably due to my tendency to get seasick!). Yes, even marine biologists can struggle with seasickness. After four years of dedication, I successfully defended my PhD.

The next step in my journey was a postdoctoral position at the University of Hawaii, USA. I am not going to lie—I worked hard, but I also had an incredible experience. It was in Hawaii that I first became interested in marine microzooplankton, which has captivated me ever since, although I have not lost my enthusiasm for larger zooplankton.

Following my postdoc, I returned to Barcelona, spending a few years hopping from contract to contract before securing a permanent research position at the institution where I completed my PhD. Now, after more than three decades devoted to the study of plankton, I am passionate about sharing my knowledge with all kinds of audiences, especially the next generation of scientists. This is what motivated me to write this book, offering a practical and accessible guide to the fascinating world of plankton. I hope you enjoy it.



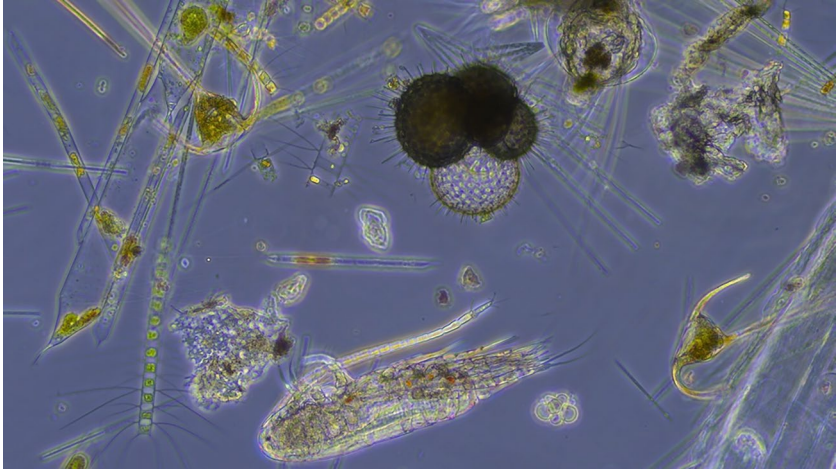
# 1

## A Brief Introduction to Plankton

### 1.1 What Are Plankton?

Plankton (Fig. 1.1) are diverse collections of organisms that live in marine and freshwaters and are unable (most of the time) to swim against the current. They are a crucial part of aquatic ecosystems, serving as the foundation of the food web. Plankton are typically divided into several main categories:

- **Bacterioplankton** and **virio plankton**: Bacterioplankton play a crucial role in the ocean's health. They feed on organic matter, breaking it down and recycling important nutrients. This process supports the entire marine food web, helping to keep coral reefs, seagrass beds, and fish populations healthy. But there is more to the story. The ocean is also home to an even smaller group: viruses. These tiny entities, though often invisible to the naked eye, have a big impact on marine life. Viruses infect not only bacteria but also other tiny plankton. They help control planktonic populations and play a key role in recycling nutrients. When viruses infect bacterioplankton or other organisms, they can cause them to burst. This releases organic material back into



**Fig. 1.1** Diverse plankton, including both phytoplankton and zooplankton

the water, which helps fuel new life and nutrient cycles. This process is essential for maintaining the balance of marine ecosystems.

- **Phytoplankton:** These are photosynthetic organisms, similar to terrestrial plants, and include groups like diatoms, cyanobacteria, and dinoflagellates, among others. They generate energy through photosynthesis, using sunlight to convert carbon dioxide ( $\text{CO}_2$ ) and water into oxygen ( $\text{O}_2$ ) and glucose. Phytoplankton are primary producers, forming the base of the aquatic food web. However, many of them are, at the same time, prey and predators. Akin to terrestrial carnivorous plants, we find a large array of mixotrophs within phytoplankton. This group will be referred to as mixoplankton.
- **Zooplankton:** These are heterotrophic organisms, meaning they feed on other plankton, including bacterioplankton, phytoplankton, other zooplankton, or detritus. Zooplankton include small crustaceans like copepods and cladocerans, jellyfish and other jelly organisms, fish larvae, and protozoans (unicellular), among others. They play a critical role in transferring energy up the food chain to larger predators, such as fish.

Plankton vary widely in size, from microscopic organisms that can only be seen under a microscope to larger species visible to the naked eye.



**Fig. 1.2** Marine copepod. *Labidocera wollastoni*

Within a few drops of water (1 milliliter), you will find tens of millions of viruses, millions of bacteria, and hundreds of thousands of flagellates. There are also thousands of microalgae, some ciliates, dinoflagellates, and even, occasionally, one tiny crustacean such as copepods (Fig. 1.2) or cladocerans. It is a bustling microcosm, teeming with life in numbers that stretch the limits of imagination.

Scientists also classify them according to size. At the smallest end of the scale, you have the **femtoplankton**, which are so small you would need a powerful electron microscope to see them. They are like the dust particles of the ocean, including mostly viruses. Next in size, we have the **picoplankton**—so tiny that they are invisible to the naked eye. These microscopic powerhouses, like certain bacteria and tiny algae, are usually less than 2 micrometers<sup>1</sup> across. Following up are the **nanoplankton**, still

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<sup>1</sup>A **micrometer** ( $\mu\text{m}$ ) is a unit of length that is incredibly small—there are 1000 micrometers in a single millimeter, and about 25,400 micrometers in an inch.