Preface

In this book, the authors present current research in the study of the biology, geographical distribution and economic importance of dinoflagellates. Topics discussed in this compilation include the distribution, toxicity and impact on aquaculture dynamics of toxic dinoflagellates' blooms in the austral pacific region; an overview of the ecophysiology, molecular biology, and ecological impacts of the toxic bioluminescent dinoflagellate pyrodinium bahamense; and dinoflagellates of the Baikal Region.

Chapter I – In the southern Pacific region (Chile) covering about 3,000 km of coastline, the presence of important species of toxin-producing dinoflagellates has been described for many years and in which *Alexandrium catenella*, *Dinophysis acuminata* and *Dinophysis acuta* (Ehrenberg 1839) are the most identified species. Blooms associated with these dinoflagellates are delimited to spring-summer seasons (November-April), periods where the oscillation influence in the ocean affects both the general circulation of inland waters and the characteristics of the water column, which can favor or inhibit the blooms of these dinoflagellates. From the oceanic standpoint, fjords and channels from the south of Chile are considered a marine or estuarine transitional system, where the freshwater coming from the rivers and melting glaciers is mixed with rich in nutrients and increased salinity. This region has a long history of human poisoning caused by paralytic shellfish toxins (PSP-toxins) being the dinoflagellate *Alexandrium catenella* the primary poisoning source. Its current limit is located in the vicinities of the northern end of the Chiloé Island. *Alexandrium* blooms in the Magellan region are, generally, a mesoscale phenomenon (hundreds of kms) and the toxin tends to be distributed on an inland waters-ocean gradient, which suggests the existence of a climate mechanism associated with the behavior of coastal waters. Strains of *A. catenella* from the Magellan region have been studied for studies on toxins, life cycle, morphological and genetic taxonomic variations. Lipophilic toxins (PTX, YTX and DSP) have also been detected in the region (Chiloé and Magellan), associated with the dinoflagellate *Dinophysis acuminata*, *Dinophysis acuta* and *Protoceratium reticulatum*. Oceanographic dynamics in the austral fjords provide relevant factors that favor HAB (light, nutrients and temperature), strengthening the simultaneity of the blooms, which broadens the range of toxic species present in a bloom with a subsequent contribution of toxic compounds from dinoflagellates to the different species in the sea. Other relevant factors that negatively contribute to oceanographic dynamics and favor the bloom of toxic dinoflagellates (*Alexandrium sp.*, and *Dinophysis sp.*) correspond to the co-existing fish (salmon) farming centers which provide nutrients from food supplied to fishes and favor the occurrence of blooms in the fjords. Through this paper, the distribution of the toxic dinoflagellates species present in the fjords, dynamics of their blooms and toxic variability, as well as economic impact on local mussel culture and on endemic hydrobiological species in the southern Pacific region is explained.

Chapter II – Multiple species of dinoflagellates possess the capacity for rapid growth under environmental conditions favorable to their physiology, such as elevated nutrient levels. These events are often referred to as "harmful algal blooms," as many of the species produce toxic or noxious compounds, including several types of neurotoxins that are detrimental at various trophic levels throughout the ecosystem. These compounds interact with voltage-gated sodium, potassium and calcium channels and modulate the flux of ions into various cell types. The toxins bioaccumulate in filter-feeding fish and shellfish, resulting in several types of human illness via consumption of the contaminated seafood. *Pyrodinium bahamense* is a bioluminescent dinoflagellate that also possesses the ability to produce the potent neurotoxin saxitoxin. Saxitoxin and its analogues, collectively referred to as paralytic shellfish toxins (PSTs), are the causative agents of paralytic shellfish poisoning (PSP), the most widespread and potentially lethal of the diseases caused by HABs. In addition to human illness and death, PSP outbreaks result in aquaculture closures, impairment of tourism and recreational activities, ecosystem alterations, and death of marine mammals, fish, and seabirds. However, there also exist coastal lagoons, referred to as "bioluminescent bays," in which non-toxic blooms of *P. bahamense* serve as an eco-tourist attraction due to their bioluminescent capacity. This chapter reviews the geographical distribution, bloom dynamics, ecophysiology, and molecular biology of *P. bahamense*, with special consideration given to its bioluminescence and toxin production. The cumulative results of recent highthroughput sequencing experiments have identified saxitoxin biosynthesis genes in dinoflagellates, and these are discussed here. The impacts of *P. bahamense* blooms on both the ecosystem and socio-economic levels are also discussed.

Chapter III – Lake Baikal, situated in Eastern Siberia, is the oldest (more than 25 million years) and deepest (about 1640 m) lake on Earth. It contains 20% of the world total unfrozen surface fresh water. One of the world richest and unusual freshwater biota occupies this lake. Moreover, the whole Baikal region is very promising for biological studies. There are numerous small lakes of various origin, hot mineral springs and swamps, which are still insufficiently studied. First observations of Baikal dinoflagellates were made in 1930s and they were very incomplete, because of using low-resolution techniques. Nowadays more data about dinoflagellate distribution and ecological role were obtained, in particular, using molecular genetic methods. For example, DNA fragments of certain dinoflagellate families were found in Baikal sponges. Some of these dinoflagellates (e.g., those from the order Suessiales) may be regarded as potential symbionts of Baikal sponges. Other DNA sequences may represent residual fragments taken by sponges from the environment or originate from intact dinoflagellates that use sponges as a dwelling place. Planktonic dinoflagellate community from Lake Baikal is relatively small, but it plays an important role especially during spring under-ice season. Several species bloom under ice and even in the ice interstitial water. In some years their productivity is higher than productivity of diatoms. These dinoflagellates participate in forming of unusual cryophilic community, which includes both bacteria, algae and microzooplankton. Dominate planktonic dinoflagellates (*Gymnodinium baicalense*, *Peridinium baicalense*) seem to originate recently from brackish-water (such as glacier Arctic waters) ancestors. Though previously these species were regarded as endemic for Baikal, they were also found in a few other lakes from this region. Contrary, some cosmopolitan dinoflagellates (*Peridinium cinctum*, *Peridinium wierzejskii*, *Borghiella tenuissima, Peridinium bipes* and etc) which live in lakes near Baikal do not bloom in Baikal open waters. In future, more sampling in freshwaters of Eurasia should help to better understand the biogeography of Baikal dinoflagellates and to determine if they differentiated genetically.