

# **Advances in Polar Ecology**

Volume 5

**Series editor**

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### **Advances in Polar Ecology**

In recent years, the polar regions have received increased scientific and public interest. Both the Arctic and Antarctic have been recognized as key regions in the regulation of the global climate and polar ecosystems have been identified to be particularly susceptible to the ongoing environmental changes. Consequently, the international efforts in polar research have been enhanced considerably, and a wealth of new findings is being produced at a growing rate by the international community of polar researchers. The aim of the book series *Advances in Polar Ecology* is to foster the progress in the scientific knowledge about the polar and sub-polar regions of both hemispheres by contributing to the fast and wide-ranging dissemination of novel scientific information gained from recent studies of sea, freshwater and land biota among polar researchers, environmental managers and policy makers. *Advances in Polar Ecology's* broad ecology-oriented scope encompasses environmental and biological research of both recent and past ecosystems. The Series offers an outlet to publish contributions (monographs, edited works, conference proceedings, etc.) addressing scientific topics that need more comprehensive and in-depth analysis than the length of typical journal articles allow for. These include, but are not limited to, thorough accounts of the current status of active research areas of wide importance that outline promising perspectives for future research. An international editorial board oversees the rigorous peer review that all contributions will be subjected to.

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Yuri Mikhalev

# Whales of the Southern Ocean

Biology, Whaling and Perspectives  
of Population Recovery

 Springer

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# Annotation

This monograph examines the distribution and migration patterns of whales of the Southern Ocean. It defines distinct populations on the basis of phenes, as well as whale breeding zones, which are located in the adjacent to the Southern Ocean waters at lower latitudes. The book records the presence of a new species of killer whale in the Southern Ocean – *Orcinus nana*. Prenatal growth patterns, pregnancy and lactation duration, and mean sizes of newborn whales are determined. Methods for the graphic recording of registering structures are described, and an original method for their decoding is proposed to determine animal age. The age of sexual and physical maturity and life expectancy are determined. Earlier unknown “pair formations” on the lower jaw of baleen whales and sperm whales are described, together with their macro, histological, and electronic microscopic structure.

The impact of the extermination of whales on the Southern Ocean ecosystem is examined, recommendations for control of the current state of whale populations are given, and perspectives of whale population recovery are estimated. Regions that could be used as testing areas for whale registration method are defined.

The book is intended for biologist-cytologists, ecologists, and other specialists interested in cetaceans and for biology students.

# Marine Mammal Council

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Having examined *Whales of the Southern Hemisphere: Biology, Whaling and Perspectives of Population Recovery*, written by doctor of biology and professor of the Institute of Marine Biology of Ukrainian National Academy of Science (Odessa, Ukraine), Yuri Mikhalev, the Marine Mammal Council (Russia) concluded that the book is about a very important issue, contains high-level scientific research, and should be published.

Yuri Mikhalev is a member of the Council and has worked in the area of whale biology since 1964. He participated in six cruises of Soviet whaling fleets *Slava*, *Sovetskaya Ukraina*, *Yuri Dolgoruky*, and scientific-research boat “Bodry-25” as a member of a scientific team. Before starting his teaching career, he was a chief at the marine mammal laboratory at the Odessa branch of AzCherNIRO. Based on a huge amount of scientific data, he published more than 100 papers. His first thesis was about the biology of the Southern Ocean fin whale reproduction (Scientific Council of All-Union Institute of Sea Fishery and Oceanography, Moscow, 1972). He completed two doctorate theses concerning the biology of Southern Hemisphere

whales, focusing on “environmental protection and rational use of natural resources” (Scientific Council of the Institute of Ecology Problems and Evolution, Russian Academy of Science, Moscow, 1997) and “zoology” (Scientific Council of the Institute of Zoology, National Academy of Science of Ukraine, Kiev, 2005). He was awarded the “150 Years of Antarctica Discovery” Medal for his research on the Southern Ocean cetaceans.

Yuri Mikhalev actively opposed illegal whaling and the falsification of scientific data by whaling fleet authorities. He did much to save the true whaling data that the government tried to destroy and hide from the public.

Since 1994, he has been an independent expert of the Scientific Committee of International Whaling Commission (IWC).

This book is not a compilation of other scientists’ research. Rather, it includes only issues that the author himself studied. Nevertheless, partly as a result of discussions with other researchers, many aspects of whaling in the Southern Hemisphere, as well as whale distribution, growth, reproduction biology, and recovery capability, are carefully examined in this book. The book also analyzes the influence of whaling on the Southern Ocean ecology, and the author forecasts perspectives of whale population recovery. The book suggests recommendations for management and suggests regions of the world’s oceans that could be used as research areas for improving scientific methods of estimating abundance. The solutions proffered by Yuri Mikhalev on many issues are original, and they, as well as his hypotheses, will provoke discussion such that this book will be useful for both specialists and beginners. I believe it could be read with interest even by anyone who is interested in cetacean biology.

Chairman of the Council, Member-Correspondent of *Russian Academy of Science*.



A. V. Yablokov

# Acknowledgments

As a biologist, I am obliged to the chair of zoology of the Kishinev State University under the direction of highly skilled zoologists – the rector of the university and managing chair of zoology, Victor Sergeevich Chepurnov; the dean of biological faculty, Magda Sadykovich Burnashev; and the professor in charge of our course, Lyudmila Viktorovna Chepurnova. I am grateful to destiny that during my externship at AzCherNiRo (the Azovo-Black Sea Scientific Research Institute of Fishery Economics), she introduced me to Yury Petrovich Altukhov (subsequently the director of the USSR AS Institute of Genetics), in coauthorship with whom my first paper on jack mackerels of Black Sea was published.

I have warm memories of the director of L.S. Berg Museum of the Kishinev University, Alexandra Matveevna Didusenko. Like all other graduates of our chair, who went to the different corners of the Soviet Union, I considered it my duty to supply the museum with new exhibits. The cooperation with Aleksandra Matveevna lasted for many long years. I was extremely touched upon receiving the letter from her daughter with the sad news of Alexandra Matveevna's death, in which she informed me that some hours prior to her death she wrote to me that she saw me as the next director of the museum. It was Alexandra Matveevna who recommended me for work at the Odessa AzCherNiRo Laboratory (later transformed into the Odessa VNIRO branch on whaling and after that into the AzCherNiRo Branch). I am also sincerely grateful to the director of this laboratory, Arcady Vasilevich Krotov, who sent me to the whaling flotilla scientific group and after defending my master's thesis appointed me the head of the laboratory of marine mammals. Arcady Vasilevich was a quick-witted person with delicate humor and great life experience. Conversations with him on the chessboard have taught me a lot.

During the Odessa period of my life, I have had the good luck to form my views under the influence of great people and scientists including the head of zoology and chair of Odessa I.I. Mechnikov National University, Professor Ivan Ivanovich Puzanov (“the last encyclopedist of the twentieth century”) and the outstanding geneticist, Alexander Aleksandrovich Malinovsky; they both desperately struggled against “lysenkovschina,” the governmental biological ideology of that time.

I have greatly appreciated my conversations/consultations with most outstanding cytologists, Professor Avenir Grigor’evich Tomilin and Professor Vyacheslav Alekseevich Zemsky, and especially with a corresponding member of the Russian Academy of Sciences, Alexey Vladimirovich Yablokov – his criticism helped me not to make too many mistakes.

I would like to express special gratitude to my colleagues in the struggle for factual scientific material, to the former employees of the laboratory of marine mammals, and to the participants of scientific groups in the Southern Ocean voyages of the “Soviet Ukraine” whaling flotilla, Vladimir Pavlovich Savusin, Valery Leonidovich Zinchenko, and Sergey Genrihovich Bushuev, for their courage and scientific honesty.

With gratitude, I remember the kindness extended to me by the captain-director of the *Slava* whaling fleet, Anatoly Stepanovich Labunets; the captain of the scientific research whaling vessel “Bodry-25,” Anatoly Vasilevich Grebenshchikov; and sailors of the *Slava* and “the Soviet Ukraine,” Alexander Podymov, Yury Savelyev, Nikolay Nerezov, and many others, without whose help, it would have been impossible to work on deck and collect scientific material.

I can say without exaggeration that neither the two theses for my doctor’s degree nor this book could have been written without the help of my sons, Vladimir and Igor Mikhalyev, who created a special PC data processing program, translated my articles into English, and helped with international correspondence. *I devote this work to them!*

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Eisert (research scientist at the University of Canterbury in Christchurch, New Zealand) and Olga Suvorova-Stuart, who helped to maintain correspondence with foreign colleagues. I would like to thank limited companies “Utrish dolphinarium” and “Odessa dolphinarium” that have borne a part of the financial costs.

Very special thanks to Rosy Whelan. The English edition of the book would not have been possible without her great help.



# Introduction

Whales, baleen and toothed, being the top links in trophic chains, play a major role in the ecosystems of the world's oceans. Their huge size has always excited people's imagination: legends and myths were created. Whales became the heroes of literary works and the fine arts. At the same time, whales, with their huge weight, became a desired target for humans. From whales, food; medical, veterinary, and animal products; and sperm and baleen oil have been produced. Particular interest was paid to oil from the bones, from which high-quality lubricants for precision mechanisms and devices were prepared. Fresh and frozen meat from baleen whales has been consumed by humans, and second-grade edible products have been consumed by animals, e.g., on fur farms. Whale liver was used as an edible product and to manufacture medical preparations – primarily, vitamin A concentrate. Bone meal was added to animal fodder (Bodrov and Grigoriev 1963). More complete utilization of whale raw materials took place in Japan (Komatsu and Misaki 2005).

Together with whale catches, the study of whales took place. In the eighteenth to nineteenth centuries, special attention was given to cetacean anatomy, with research continuing into the twentieth century. Among morphological research, cetaceans were considered in V.E. Sokolova's monograph (1973, pp. 242–269) *Integument of Mammals*. Scientists of the department studying marine mammals at the I.I. Schmalhausen Institute of Zoology, under the direction of G.B. Agarkov, published the monographs *Morphology of Dolphins* (Agarkov et al. 1974) and *Functional Morphology of Cetaceans* (Agarkov et al. 1979). The physiology of respiration is considered in A.Z. Kolchinsky, N.N. Mankovsky, and A.G. Misjura's book *Breath and Oxygen Modes of the Dolphin Organism* (1980).

Detailed, general reports on the biology of whales began to appear in the twentieth century. The first monograph description of whales was that of F.E. Beddard, *A Book of Whales* (Beddard 1900). Detailed studies of large baleen whales were described by N.A. Mackintosh and J. F. Wheeler in the book *Sothorn Blue and Fin Whales* (Mackintosh and Wheeler 1929). Monographs describing first sperm whales

and then humpback whales were also published in *Discovery Reports* by L.H. Matthews (Matthews 1937, 1938).

The postwar period 1950s–1980s proved very fruitful. Among domestic works, the first that must be mentioned is M.M. Sleptsov’s monograph *Cetaceans of the Far East Seas* (Sleptsov 1955). As fundamental works, *Cetacea* (1957) and *Mammals of the USSR and Adjacent Countries* by A.G. Tomilin (1962) must be singled out. During the same period, E. Slijper’s book *Whales* (Slijper 1962) was published abroad. The collection *Whales, Dolphins, and Porpoises* under K.S. Norris’s editorship (Norris, 1966) and *Biology of Sea Mammals* under G.T. Andersen’s editorship (Andersen 1969) were published a little later. More attention is paid to cetaceans in handbooks, encyclopedias, and guides including “Cetaceans” in *Guide to the Mammals of the USSR* by N.A. Bobrinsky, B.A. Kuznetsov, and A.P. Kuz'yakin (1965, pp. 185–205), *Handbook of Marine Mammals* under P.A. Moiseyev’s editorship (Ivashin, Popov, Tsapko, 1972), and the short description of cetaceans in the book *Marine Mammals* by V.A. Arsenyev, V.A. Zemsky, and I.A. Studenetskaya (1973, 15–101). The suborder of toothed whales is described in detail in the second volume *Mammals of the Soviet Union: Pinnipeds and Toothed Whales* by V.G. Heptner, K.K. Chapsky, V.A. Arsenyev, and V.E. Sokolov (1976, pp. 413–660).

With some delay, *The Atlas of Marine Mammals of the USSR* was published in 1980 under V.A. Zemsky’s editorship; the work undertaken by prominent VNIRO experts began in the 1950s. The book *Baleen Whales* by V.E. Sokolov and A.A. Arsenyev was published in 1994. Several monograph descriptions of whales species have also been printed: S.E. Kleinenberg, A.V. Yablokov, V.M. Bel’kovich, and M.N. Tarasevich (1964) published *The White Whale*, A.A. Berzin (1971) published *The Sperm Whale*, and, abroad, D.V. Rice and A.A. Wolman (1971) published *The Life History and Ecology of the Gray Whale (Eschrichtius robustus)*. An overview of the results of whale research was provided in the book *Whales and Dolphins* (Yablokov et al. 1972).

Considerable attention was also given to the popularization of information on cetaceans. Among the books of this type, I will mention: *In the Country of Whales and Penguins* by V.A. Arsenyev and V.A. Zemsky (1954); *Whales of the Antarctic* by V.A. Zemsky (1962); *Our Friend the Dolphin* by V.M. Bel’kovich, S.E. Kleinenberg, and A.V. Yablokov (1967); the Russian translation of book *Whale* under L.H. Mathue editorship (1973); the Russian translation in 1962 of the 1851 novel by the American author, Herman Melville, *Moby Dick or The Whale*.

During that period, seminars of scientific groups from the whaling fleets were regularly held. All-union meetings on marine mammals, international conferences, the reports made at those meetings, and collections of articles were issued. After the disintegration of the Soviet Union, Russia restored those traditions: at 2-year intervals, international conferences on marine mammals of the Holarctic have been held, and the proceedings have been published.

More than a quarter of a century has passed since the commercial whaling in the world's oceans was all but stopped; the Russian whaling fleet has been utilized for other purposes or recycled. The future of whales, whose stocks were catastrophically reduced, continues to disturb mankind. It is necessary to comprehend, sum up, and define their prospects. First of all, the question is whether all species and their populations can ever be restored to their original numbers. There are strong grounds for anxiety, as the published facts of large-scale illegal whaling (Yablokov 1994; Zemsky et al. 1994a, 1995, 1996; Mikhalev 1997a, 1997b; Tormosov et al. 1998; Yablokov, etc., 1998; Kasuya 1999, 2002; etc.) became known to a wide range of experts and the public. Unfortunately, other countries, which conducted whaling for a considerably longer time than the Soviet Union and no less intensively, are not in a hurry to open their archives and publish the actual numbers of whales caught! At present, the only attempt I know of is the Japanese researcher, T. Kasuya (Kasuya 1999, 2002), who discovered illegalities in the catching of whales at onshore stations in Japan.

To begin working on the theory and practice of the restoration of whale populations and then to develop rational methods of exploitation (to conduct whale *management*), a full audit of all our information about the original size of whale populations is required. Primarily, it is necessary to ascertain the true numbers of whale catches and what damage was caused to populations by illegal catches.

For various economic and political reasons, solving this problem has not been easy. Successors of the old Soviet system, having this sin on their conscience, have concealed and destroyed archival materials.<sup>1</sup> “Specialists” of these departments are trying to mislead the public by means of speculative polemic.

These factors continue to dictate the necessity of returning to history, to the analysis of whaling methods, and the means of regulating the catch. In this book, the primary focus is on whales that were commercially caught in the Southern Ocean. Whales are feeding in this food-rich zone of the World Ocean during warm time of the year. At cold time, most of the whales with few exceptions leave the Southern Ocean and move to lower latitudes in breeding zones, which are located to the north of the ocean border – line of water convergence. Some species move even to the tropic waters and cross them. For example, pygmy blue whales, humpback whales, Bryde's whales, and some of sperm whales were noticed even in the Arabian Sea. It is not proved yet that the whales migrate over there from the Southern Ocean though. From this perspective, sperm whales are interesting. Their males are twice larger than females, and with few exceptions, they go to the feeding areas in the Southern Ocean, reaching very high latitudes. But small females and average size males stay

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<sup>1</sup>It is difficult to believe, but they literally destroyed records. It is authoritatively known that VNIRO's expert, M.V. Ivashin, in the early 1990s spent 2 days burning primary sources on whale catches in the institute courtyard.

for breeding and feeding in the lower latitudes. The females are frequently noticed to the north of convergence zone, but just few were recorded above 40 degrees south.

So whales of the Southern Ocean that are part of its ecosystem are closely linked to the ecosystems of waters in adjacent lower latitudes, and when necessary, the whales from the waters are described in the monograph. Sometimes, the comparison is made between whales of the Southern Ocean and the Northern Hemisphere including its polar zone.

## Research Materials Reported

- At conferences of Scientific Committee of the International Whaling Commission: Puerto Vallarta (Mexico), 1994; Galway (Ireland), 1995; Dublin (Ireland), 1995; Aberdeen (Scotland), 1996; Bournemouth (England), 1997; Muscat (Oman), 1998; Grenada (Republic of Grenada), 1999; Adelaide (Australia), 2000; London (England), 2001; Shimonoseki (Japan), 2002; Berlin, 2003; Sorrento (Italy), 2004; and Madera (Portugal), 2009.
- At all-union meetings on the study of marine mammals: Kaliningrad, 1969; Makhachkala, 1972; Kiev, 1975; Simferopol, 1978; Astrakhan, 1982; Arkhangelsk, 1986; and Svetlogorsk (Kaliningrad region), 1990.
- At the international conferences on the study and protection of marine mammals: Istanbul (Turkey), 1994, and Golitsyno (Russia), 1995. At the international scientific conferences on marine mammals of the Holarctic: Arkhangelsk (Russia), 2000; Listvyanka (the Irkutsk region, Russia), 2002; Koktebel (Crimea), 2004; St. Petersburg (Russia), 2006; Odessa (Ukraine), 2008; Istanbul (Turkey), 2009; Kaliningrad (Russia), 2010; Stralsund (Germany), 2010; Oakland (New Zealand), 2010; Suzdal (Russia), 2012; Saint Petersburg (Russia), 2014; Astrakhan (Russia) 2016; Copenhagen (Denmark), 2017; and Réunion Island, Saint Denis (France), 2017.
- At republic, regional, and university conferences: scientific conference of the Kishinev State University, 1965; conferences of young scientists of the Odessa State University, 1969; conferences of young biologists and physicians, Odessa, 1971; conferences of young scientific AzCherNIRO (nowadays YugNIRO), Kerch, 1973; at the conference “Wildlife Management and Rational Use of Natural Resources of the South of Ukraine,” Simferopol, 1977; at the inter-university conference on “The Protection of Fish Stocks and Increase in Efficiency of Reservoirs of the Southern Zone of the USSR,” Kishinev, 1969; at the accounting scientific conference of the Odessa Pedagogical University, Odessa, 1984; republican scientific-practical conferences, Odessa, 1989 and 1990; at the Anniversary scientific-practical conference devoted to the 130 anniversary of L.S. Berg, Bendery, 2006; etc.

## Data and Research Methods

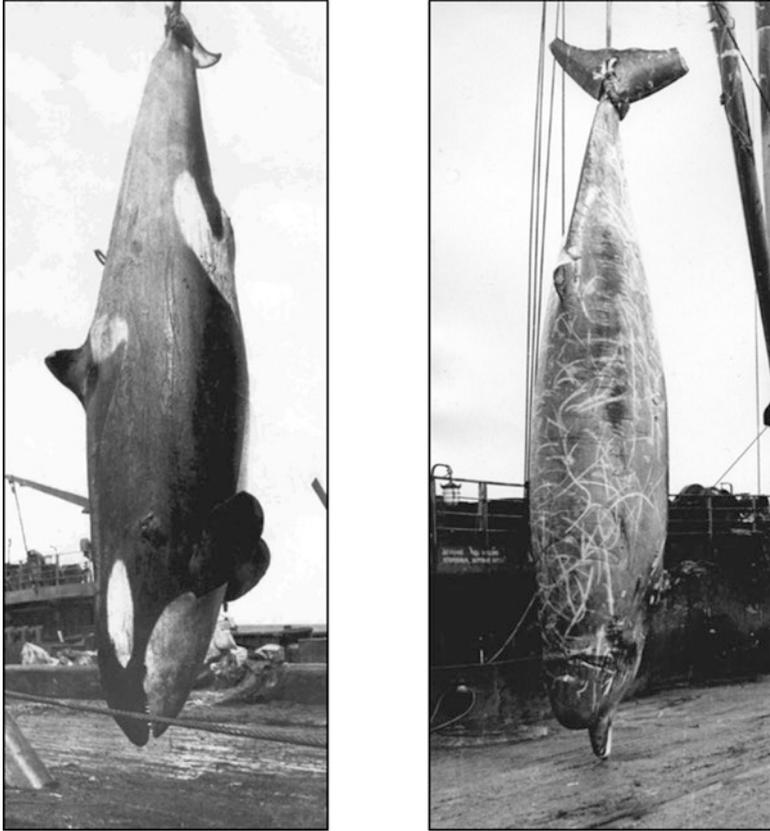
The basic area of research is the waters of the Southern Ocean up to the coast of Antarctica and also adjacent waters of the Atlantic and Indian Oceans to 30°N. The basic data for the research came from the commercial catches of whales in the Southern Ocean.

The data are materials collected by the author as a member of scientific groups on whaling fleet voyages, *Sovetskaya Ukraina* (1964–1965), *Slava* (1965–1966), and *Yuri Dolgoruky* (1966–1967 and 1968–1969), and on the scientific and research whaling vessel “Bodry-25” (1973–1974 and 1974–1975). The data collected for our program by scientific participants on the whaling fleets are also included.

Actual (true) data about the catch of whales are reported, which greatly differ from those reported to the International Whaling Commission (IWC) by the management of the fleets and the inspection service of the Ministry of Fisheries of the USSR. The data on marking of 21,456 whales and 759 return labels taken both from the IWC database and from whale logs collected by biologists on the whaling fleets have been corrected. Personally, I marked 97 whales, mainly in the Pacific sector of the Southern Ocean.

The results of weighing 1250 whales and 888 embryos are included. Weights were taken using spring dynamometers.

Prenatal growth curves of whales were developed on the basis of the sizes (zoological length) of 16,443 embryos from an early stage of development to prenatal fetuses. A series of numerous (standard) measurements of 655 embryos and 550 whales were taken. The characteristics of the variety of body shapes and colors were defined from 404 embryos. The age of 18,770 toothed and 12,800 baleen whales was determined. Using decalcified polished sections and polished sections of teeth from toothed whales, and earplugs of baleen whales, more than 2000 recording structure graphs were drawn. Whale distribution charts were compiled from the catch coordinates of more than 200,000 animals.



Weighting of killer whale (left) and bottlenose whale (right)

Using computing programs, biometric, approximate calculus, and visual analytic methods were employed (Rokitsky 1961, 1964; Plokhinsky 1961, 1978; Bailey 1970; Urbakht 1963; Pogorelov 1968; etc.). An estimation of the reliability of qualitative indicators was made following Wilcoxon (Urbakht 1963, 1964). The degree of distinctions of populations and local groups was estimated by the criteria of similarity and identity (Zhivotovsky 1979, 1982).

Decalcification of teeth by formic acid was made following Bow and Purday (Bow and Purday 1966). The calcium content in tooth sections was determined by an atomic-absorptive method (Dubin et al. 1982). The fat content of whale milk was determined using the *Butera* metric method. For the histological examination of teeth, earplugs, the pituitary gland, and “pair formations,” staining with silver nitrate, hematoxylin, and eosin was used. The equipment used for graphical records of the lamination of teeth and earplugs (recording structure graphs) included a domestic M-201 profilograph, an English Talyline-4 profilograph, an IFO-451 microphotometer, and plethysmographs with a special sensor/gauge of our own design.

For the convenience of describing and understanding the material presented, the techniques used are explained in more detail in the chapters in which they are applied. Data from the literature and the data provided by other researchers are stipulated in corresponding places.

The following species are examined in more detail:

- Cetacean group** – *Cetacea* Brisson, 1762  
**Suborder baleen whales** – *Mysticeti* Flower, 1864  
**Blue whale** – *Balaenoptera musculus* Linnaeus, 1758  
**Pygmy blue whale** – *Balaenoptera brevicaudis* Zemsky, 1972  
**Fin whale** – *Balaenoptera physalus* Linnaeus, 1758  
**Sei whale** – *Balaenoptera borealis* Lesson, 1828  
**Bryde's whale** – *Balaenoptera brydei* Olsen, 1913  
**Eden's whale** – *Balaenoptera edeni* Anderson, 1879  
**Minke whale** – *Balaenoptera acutorostrata* Lacépède, 1804  
**Humpback whale** – *Megaptera novaeangliae* Borowski, 1781  
**Southern right whale** – *Eubalaena glacialis* Muller, 1776  
**Pygmy right whale** – *Caperea marginata* Gray, 1846  
**Gray whale** – *Eschrichtius gibbosus* Erxleben, 1777  
**Suborder of toothed whales** – *Odontoceti* Flower, 1867  
**Sperm whale** – *Physeter macrocephalus* Linnaeus, 1758  
**Pygmy sperm whale** – *Kogia breviceps* de Blainville, 1838  
**Killer whale** – *Orcinus orca* Linnaeus, 1758  
**Short-bodied killer whale** – *Orcinus nana* Mikhalev, 1981  
**False killer whale** – *Pseudorca crassidens* Owen, 1846  
**Bottlenose whale** – *Hyperoodon ampullatus* Forster, 1770  
**Cuvier's beaked whale** – *Ziphius cavirostris* G. Cuvier, 1823  
**Pilot whale** – *Globicephala melaena* Traill, 1809  
**Beluga** – *Delphinapterus leucas* Pallas, 1776  
**Risso's dolphin** – *Grampus griseus* G. Cuvier, 1812  
**White-beaked dolphin** – *Lagenorhynchus albirostris* Gray, 1846  
**White-sided dolphin** – *Lagenorhynchus obliquidens* Gill, 1865  
**Vaquita** – *Phocoena sinus* Norris and McFarland, 1958  
**Finless porpoise** – *Neophocoena phocoenoides* G. Cuvier, 1829  
**Striped dolphin** – *Stenella coeruleoalba* Meyen, 1833

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## About the Author



Yuri Alekseyevich Mikhalev was graduated as biologist-zoologist from the Department of Biology at Kishinev State University in 1963, and was hired as Senior Scientist in the Sea Mammal Laboratory in Odessa branch of AzCherNIRO. He took part as a scientific group member in six cruises of Soviet whaling fleets “Slava” (1965–1966), “Sovetskaya Ukraina” (1964–1965), “Yuri Dolgorukiy” (1966–1967), and scientific-research vessel “Bodriy-25” (1973–1974 and 1974–1975).

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