



# Diving Physiology of Marine Mammals and Seabirds

PAUL J. PONGANIS

## **Diving Physiology of Marine Mammals and Seabirds**

Analyzing the physiological adaptations of marine mammals and seabirds, this book provides a comprehensive overview of what allows these species to overcome the challenges of diving to depth on a single breath of air. Through comparative reviews of texts on diving physiology and behavior from the last 75 years, Ponganis combines this research into one succinct volume.

Investigating the diving performance of marine mammals and seabirds, this book illustrates how physiological processes to extreme hypoxia and pressure are relevant to the advancement of our understanding of basic cellular processes and human pathologies. This book underscores the biomedical and ecological relevance of the anatomical, physiological, and molecular/biophysical adaptations of these animals to enable further research in this area.

An important resource for students and researchers, this text not only provides an essential overview of recent research in the field, but will also

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**YOUMARES 8 - Oceans Across Boundaries: Learning from each other** Simon Jungblut, Viola Liebich, Maya Bode, 2018-08-29 This open access book presents the proceedings volume of the YOUMARES 8 conference which took place in Kiel Germany in September 2017 supported by the German Association for Marine Sciences DGM The YOUMARES conference series is entirely bottom up organized by and for YOUNg MARine REsearchers Qualified early career scientists moderated the scientific sessions during the conference and provided literature reviews on aspects of their research field These reviews and the presenters conference abstracts are compiled here Thus this book discusses highly topical fields of marine research and aims to act as a source of knowledge and inspiration for further reading and research

*Oceanobs'19: An Ocean of Opportunity. Volume III* Tong Lee, Sabrina Speich, Laura Lorenzoni, Sanae Chiba, Frank E. Muller-Karger, Minhan Dai, Amos T. Kabo-Bah, John Siddorn, Justin Manley, Maria Snoussi, Fei Chai, 2020-12-31 This eBook is a collection of articles from a Frontiers Research Topic Frontiers Research Topics are very popular trademarks of the Frontiers Journals Series they are collections of at least ten articles all centered on a particular subject With their unique mix of varied contributions from Original Research to Review Articles Frontiers Research Topics unify the most influential researchers the latest key findings and historical advances in a hot research area Find out more on how to host your own Frontiers Research Topic or contribute to one as an author by contacting the Frontiers Editorial Office frontiersin.org/about/contact

**Bulletin of the Atomic Scientists**, 1970-12 The Bulletin of the Atomic Scientists is the premier public resource on scientific and technological developments that impact global security Founded by Manhattan Project Scientists the Bulletin's iconic Doomsday Clock stimulates solutions for a safer world

**Physiology of diving in marine mammals** G.L. KOOYMAN, M.A. CASTELLINI, R.W. DAVIS, 1981 The physiological consequences of breath-hold diving in marine mammals; the Scholander legacy Andreas Fahlman, Breath hold diving marine mammals are able to remain submerged for prolonged periods of time and dive to phenomenal depths while foraging A number of physiological biochemical and behavioral traits have been

suggested that enable this life style including the diving response lung collapse increased O<sub>2</sub> stores diving induced hypometabolism and stroke and glide behavior to reduce dive metabolic cost Since the initial studies by Scholander in the 1940 s when most of the physiological and biochemical traits were suggested few have received as much study as the diving response and O<sub>2</sub> management The calculated aerobic dive limit cADL was an important concept which allowed calculation of the aerobic dive duration and was defined as the total O<sub>2</sub> stores divided by the rate of O<sub>2</sub> consumption metabolic rate The total O<sub>2</sub> stores have been defined for several species and studies in both forced and freely diving animals have refined the metabolic cost of diving Currently there appears to be little consensus about whether marine mammals perform a significant proportion of dives exceeding the cADL or not and there may be large differences between species The diving response is a conserved physiological trait believed to arise from natural selection The response includes diving induced bradycardia peripheral vasoconstriction and altered blood flow distribution While the response results in reduced cardiac work it is not clear whether this is required to reduce the overall metabolic rate An alternate hypothesis is that the primary role of the diving bradycardia is to regulate the degree of hypoxia in skeletal muscle so that blood and muscle O<sub>2</sub> stores can be used more efficiently Scholander suggested that the respiratory anatomy of marine mammals resulted in alveolar collapse at shallow depths lung collapse thereby limiting gas exchange This trait would limit uptake of N<sub>2</sub> and thereby reduce the risk of inert gas bubble formation and decompression sickness In his initial treatise Scholander suggested that alveolar collapse probably made inert gas bubble formation unlikely during a single dive but that repeated dives could result in significant accumulation that could be risky Despite this lung collapse has been quoted as the main adaptation by which marine mammals reduce N<sub>2</sub> levels and inert gas bubble formation It was surprising therefore when recent necropsy reports from mass stranded whales indicated DCS like symptoms More recent studies have shown that live marine mammals appear to experience bubbles under certain circumstances These results raise some interesting questions For example are marine mammals ever at risk of DCS and if so could N<sub>2</sub> accumulation limit dive performance While an impressive number of studies have provided a theoretical framework that explains the mechanistic basis of the diving response and O<sub>2</sub> management many questions remain some widely accepted ideas actually lack sufficient experimental confirmation and a variety of marine mammal species potentially novel models for elucidating new diving adaptations are understudied The aim of this Frontiers Topic is to provide a synthesis of the current knowledge about the physiological responses of marine mammals that underlie their varied dive behavior We also include novel contributions that challenge current ideas and that probe new hypotheses utilize new experimental approaches and explore new model species We show that the field has recently entered a phase of renewed discovery that is not only unraveling more secrets of the natural diving response but will drive new applications to aid human exploration of the ocean depths We also welcome comparative analyses especially contributions that compare marine mammals with human divers

**Diving in Marine Mammals** Richard John Harrison, Gerald L. Kooyman, 1971

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**Marine Mammal Physiology** Michael A. Castellini,Jo-Ann Mellish,2015-11-18 Suppose you were designing a marine mammal What would you need to think about to allow it to live in the ocean How would you keep it warm What would you design to allow it to dive for very long periods to extreme depths Where would it find water to drink How would you minimize the cost of swimming and how would it find its prey in the deep an The Physiology of Diving in Man and Other Animals H. V. Hempleman,Antony Peter Murray Lockwood,1978 Physiology of Marine Mammals Michael Castellini,Jo-Ann Mellish,2023-07-05 Suppose you were designing a marine mammal What would they need to live in the ocean How would you keep them warm What design features would allow them to dive for very long periods to extreme depths Do they need water to drink How would they minimize the cost of swimming and how would they find their prey in the deep and dark These questions and more are examined in detail throughout Marine Mammal Physiology which explores how marine mammals live in the sea from a physiological point of view This undergraduate textbook considers the essential aspects of what makes a marine mammal different from terrestrial mammals beyond just their environment It focuses on the physiological and biochemical traits that have allowed this group of mammals to effectively exploit the marine environment that is so hostile to humans The content of this book is organised around common student questions taking the undergraduate s point of view as the starting point Each chapter provides a set of PowerPoint slides for instructors to use in teaching and students to use as study guides New Study Questions and Critical Thinking Points conclude each chapter which are each motivated by a Driving Question such as How do mammals stay warm in a cold ocean or How do mammals survive the crushing pressures of the deep sea Full colour images and comprehensive accessible content make this the definitive textbook for marine mammal

physiology     Marine Mammal Physiology ,2018-05 Marine Mammals deal with a subject in which both a great deal of interest and a great need for realistic information is essential Some marine mammals are significant renewable resources that can be harvested in a sustainable style others are important components of the ecosystems There are also species that are extremely few in number and very threatened Marine mammals are charming animals and in the international field they are important for the environment and conservation Similar to humans and other terrestrial mammals dolphins and seals must breathe air and maintain a stable core body temperature in order to survive Yet living in the ocean creates a paradox marine mammals must hold their breath to forage and their aquatic environment rapidly steals body heat Over evolutionary time marine mammals have acquired amazing physiological adaptations to endure these challenges This book brings together the contributions of eminent researchers and scientists as well as authors in the field focusing heavily on marine mammals It will explore the life history physiology and conservation of this fascinating group of mammals Marine mammals undergo important circulatory changes during diving In general the structure of the heart of cetaceans and pinnipeds closely resembles that of other mammals It covers the discussion of some of the possible structural and functional modifications of the lung which represent adaptations in mammals living in the sea Lung capacities of marine mammals seem to be larger than terrestrial mammals especially if they are compared on a lean weight basis This work also examines these other diving species as appropriate and reviews and relevant literature on these groups is included     Diving in Marine Mammals Richard John Harrison,G. L. Kooyman,1981     *Diverse Divers* Gerald L. Kooyman,2012-12-06 This book is not a conventional review of diving physiology The coverage of the literature has been selective rather than encompassing the emphasis has been on field studies rather than laboratory investigations and the dive responses described are often discussed from the perspective of some of the flaws or weaknesses in the conclusions Some of these points are of more historical interest to note how our concepts have evolved as we learn more about behavior and responses to natural diving in contrast to forced submersions in the laboratory As a result there is a degree of evaluation of some experiments on my part that may seem obvious or controversial to the specialist I have followed this plan at times in order to aid the reader who I hope is often an undergraduate or graduate student the nonspecialist and the layman in appreciating to some degree the level of dissatisfaction or skepticism about certain areas of research in diving physiology In view of historical boundaries in vertebrate biology the subject is of broad enough importance to catch the interest of a wide audience of readers if I have done my job well For example of the major epochal transitions or events there have been in vertebrate history three come immediately to mind 1 The transition from aquatic to aerial respiration which ultimately led to a broad occupation of terrestrial habitats 2 The development of endothermy     **Biochemical Adaptations for Diving in Marine Mammals** Michael Angelo Castellini,1981     **Diving in Marine Mammals** Richard John Harrison, Gerard L. Kooyman,1981     **Marine Mammals** Randall W. Davis,2019-11-14 This comprehensive book provides new insights into the morphological

metabolic thermoregulatory locomotory diving sensory feeding and sleep adaptations of Cetacea whales and dolphins Pinnipedia seals sea lions and walrus Sirenia manatees and dugongs and sea otters for an aquatic life Each chapter reviews the discoveries from previous studies and integrates recent research using new techniques and technology Readers will gain an understanding of the remarkable adaptations that enable marine mammals to spend all or most of their lives at sea often while hunting prey at depth      **Diving in Marine Mammals** Richard John Harrison, Gerald Lee Kooyman, 1971      Diving and Asphyxia Robert Elsner, Brett Gooden, 1983-07-21 This book concerns the comparative physiological adaptations of vertebrate animals especially mammals to cessation of breathing      *Physiology of Marine Mammals* Michael Angelo Castellini, Jo-Ann Mellish, 2024 This unique undergraduate textbook considers what makes a marine mammal different from terrestrial mammals focusing on the physiological and biochemical characteristics that have allowed this group of mammals to effectively exploit the hostile marine environment The contents are organised around common student questions such as How do mammals stay warm in a cold ocean while each chapter provides a set of PowerPoint slides for instructors to use in teaching Study Questions and Future Implications points conclude each chapter while full colour images and comprehensive accessible content make this the definitive textbook for marine mammal physiology      **Deep Diving in Mammals** Richard John Harrison, Sam H. Ridgway, 1976

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