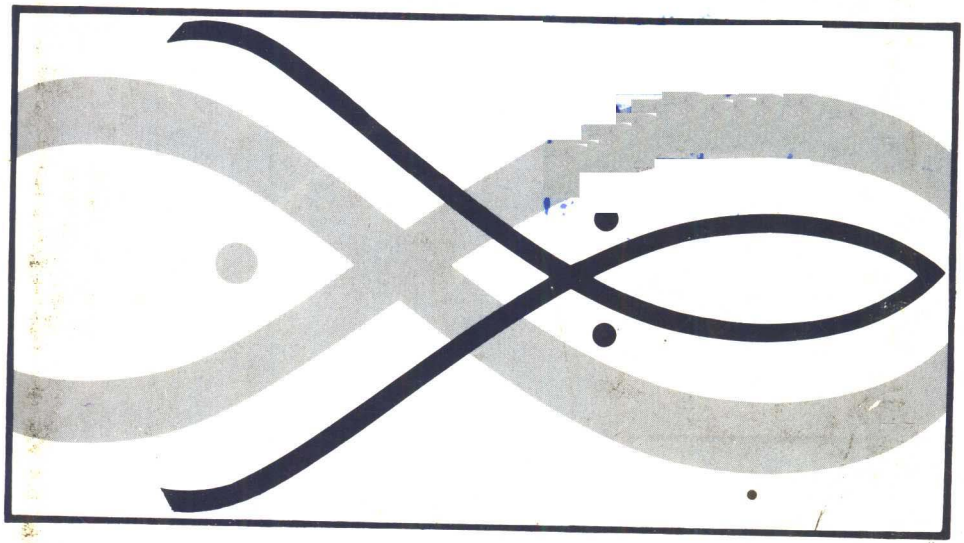
Edited by Howard E. Winn and Bori L. Olla

Behavior of Marine Animals

Current Perspectives in Research

Volume 3: Cetaceans



BEHAVIOR OF MARINE ANIMALS

Current Perspectives in Research

Volume 3: Cetaceans

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PREFACE

Four years ago we began soliciting articles for this volume from authors who were engaged in comprehensive research on whales. From the outset we decided not to limit the subject matter to behavior but to also include natural history. Much of what is known about the behavior of whales arose from studies whose principal aim was not behavior, much as it did for other animal groups before behavior was considered a distinct discipline. Thus in many of the articles behavior is closely intertwined with natural history and in others is completely overshadowed by a basic natural history approach.

Our aim was to have the articles contain a review of the literature and include research findings not previously published. For all intents and purposes this aim has been realized, albeit perhaps not in as balanced a fashion in terms of species or subject matter as was originally planned. Nevertheless, we believe the articles present a wide range of informative works with a myriad of approaches and techniques represented.

We are grateful to the contributors for their patience and understanding in awaiting publication, which has taken much longer than we originally expected. We are also grateful for the assistance of a number of people, especially Julie Fischer and Lois Winn for their editorial efforts, and Jill Grover, Carol Samet, and Lois Winn for their help in indexing.

Howard E. Winn
Bori L. Olla

INTRODUCTION

A decrease in the size of animal populations may be attributed to a number of factors, but the causes are often not easily assignable. In the case of certain species of whales at least, overexploitation is clearly the cause for reduced numbers. The efficiency of "man the hunter" as a predator has increased so rapidly that no vertebrate animal has developed a strategy to deal with it, least of all whales, which reproduce slowly. Therefore, preservation of these animals depends upon the predator establishing a strategy that will allow the prey to survive.

Implementation of conservation measures, to be of any value, must be based on a firm knowledge of the life history and habits of the animals. Unfortunately, as is true for most marine animals, too little is known to paint the total picture of whales' life habits. The degree of knowledge varies, running the gamut from anecdotal accounts in the natural environment to well documented behavioral patterns of smaller species observed in oceanaria.

Studying whales *in situ* presents special problems. Direct observation of animals that can move rapidly over long distances and in an environment that is often not easily accessible to human observers makes the acquisition of knowledge a painfully slow process, with information coming in small bits and pieces. Observations that seem trivial when considered within the context of other animals are oftentimes significant and of extreme value because the base of information for whales is so thin. As is the case with behavioral field studies in general, cause and effect relationships between physical parameters and particular habits depend almost entirely on correlations that may or may not be valid.

Indirect observations have been put to good use and much information has been gathered in this way. Acoustical monitoring has been one of the more important methods for observing whales indirectly, mainly because sound plays such an important role in their behavioral repertoire. But even with the voluminous amount of data gathered via acoustical monitoring, the meaning of most sounds is not yet well understood. One major reason for this is the difficulty involved in making direct behavioral observations synchronously with sonic recordings.

Much has been learned from studying those species that can be held within aquaria. However, one problem that arises from these studies is the difficulty of

extrapolating behavior patterns from the aquarium to the sea with confidence. Results from animals held in captivity under conditions that may modify habits in often immeasurable ways make it incumbent upon the researcher to interpret his findings with a view to those behaviors which may transcend the aquarium.

It is obvious that no matter where and how it is studied, the whale requires the application of a wide range of innovative methodologies and techniques to answer the most basic questions. New techniques such as individual recognition based on natural markings, radio tagging, and obtaining skin samples to determine sex, along with increased interest and support, can be expected to yield some exciting results in the near future. The papers presented in this volume represent the direction of future studies and are but a small measure of what must yet be learned before real progress in understanding these animals can be made.

Howard E. Winn
Bori L. Olla

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SOME RECENT USES AND POTENTIALS OF RADIOTELEMETRY IN FIELD STUDIES OF CETACEANS

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I. INTRODUCTION

In 1874, Charles M. Scammon, noted whaling captain/naturalist, observed:

> It is hardly necessary to say that any person taking up the study of marine mammals, particularly the cetaceans, enters a difficult field of research, since the opportunities for observing the habits of these animals under favorable conditions are but rare and brief. My own experience has proved that observation for months and even years may be required before a single new fact in regard to their habits can be obtained. This has been particularly the case with the dolphins, while many of the characteristic actions of the whales are so secretly performed that years of ordinary observation may be insufficient for their discovery.

In the more than 100 years since that statement, cetaceans have continued to be among the most elusive and difficult to study of all wild animals. They inhabit most of the world's major oceans and seas and even some freshwater rivers and lakes. Wherever they occur, they are visible to the confounded, air-bound

biologist primarily during the brief periods when they break the air–water interface to breathe and spend the rest of their lives, in some species greater than 95% of their time, below the surface and well out of view. Attempts to observe them from underwater (see Evans and Bastian, 1969; Norris *et al.*, 1974) and aircraft (e.g., Nishiwaki, 1962; Leatherwood, 1974*a*, 1975) have provided some new insights but still fail to get at some of the most important aspects of how the animals move in and exploit their three-dimensional environment.

This being the case, it is not surprising that the recent history of field studies of cetaceans includes a series of largely "show-and-tell" naturalistic approaches and attempts to modify old and develop new techniques for field studies.

Of the recent approaches used, perhaps none has shown more significant progress or offers more promise than radiotelemetry. This chapter reviews the most important recent developments in radiotelemetric technology as it applies to cetaceans, summarizes some of the most important recent applications, adds previously unpublished data to suggest some potential uses, and suggests directions in which we feel new research should progress.

As used in this chapter, radio tracking implies simply the attachment of a transmitter to an animal and subsequent determination of its position as a function of time. In a broader sense, radiotelemetry implies a greater variety of uses, including transmission of data about the animal's environment (e.g., water temperature, salinity, dissolved oxygen), behavior (e.g., diving depth, swimming speed, sound production), or physiological state (e.g., heart rate, body temperature) as a function of time and location.

A. Historical Background

During the last 25 years, radiotelemetry has come into prominence as a tool in biological studies in general (e.g., Mackay, 1970; Galler *et al*, 1972; Schevill, 1974). The importance and potential of radiotelemetric instrumentation and techniques in the study of animal behavior were recognized in print as early as 1963 (Slater, 1963). In particular, some potentials for the use of telemetry in studies of aquatic animal communication were identified and discussed (Evans and Sutherland, 1963). But before many of the then available and subsequently developed techniques could be applied to studies of marine mammals in their natural environment, a number of problems in packaging, frequency allocations, antenna and receiver design, and methods of attaching the instrument packages had to be overcome. In the past 15 years, with a rapid acceleration in the last five years, the state of the art in radiotelemetric instrumentation and techniques, as in other remote sensing technology applicable to the study of cetaceans (and other marine mammals), has increased several orders of magnitude. Some of the more visionary concepts underlying much of this development, including uses of multichannel instrument packages with environmental and acoustic sensors and